621 CHAPALA STREET
SANTA BARBARA, CALIFORNIA 93101
T 805.963.0651 F 805.963.2074

June 10, 2024 13397

Ms. Agnieszka Letts
Air Quality Engineer II
Santa Barbara County Air Pollution Control District
260 North San Antonio Road, Suite A
Santa Barbara, CA 93110

Subject: *Request for Modification to Authority to Construct 16000*
FID: 10436
SSID: 11146

Dear Ms. Letts

Dudek, on behalf of Space Exploration Technologies, Inc. (SpaceX), submits to the Santa Barbara County Air Pollution Control District (District) the enclosed request for modification to authority to construct (ATC) 16000.

Requests for Modification

The project is to modify ATC 16000 to allow the primary and support tugboats to travel within the Santa Barbara Channel. The load factor for the primary and support tugboats propulsion engines was increased to 100% for all jurisdictions. The number of trips is not changing from the 36 currently permitted, but the daily limit is being increased to 24 hours per day. The annual limit it also being changed from 36 trips to an hourly equivalent.

Enclosed with this letter are the following attachments:

- Attachment A: Emission Calculations (Electronic)
- Attachment B: Marine Vessel Monitoring and Reporting Plan
- Attachment C: APCD Form – 01

Please contact me, Adam Poll, at (805) 308-8516, or Mr. Keegan O'Day at (310) 970-5138 should you have questions or comments regarding this requested modification.

Sincerely,

Adam Poll, QEP, LEED AP BD+C
Senior Air Quality Specialist

cc: Keegan O'Day, SpaceX

Print Form

air pollution control district
SANTA BARBARA COUNTY

General Permit Application Form -01

Santa Barbara County Air Pollution Control District
260 N. San Antonio Road, Suite A
Santa Barbara, CA 93110-1315

1. APPLICATION TYPE (check all that apply)**:**

- ☐ Authority to Construct (ATC)
- ☐ Permit to Operate (PTO)
- ☒ ATC Modification
- ☐ PTO Modification
- ☐ Other (Specify)
- ☐ Transfer of Owner/Operator (use Form -01T)
- ☐ Emission Reduction Credits
- ☐ Increase in Production Rate or Throughput
- ☐ Decrease in Production Rate or Throughput

Previous ATC/PTO Number (if known) 16000

○ Yes ◉ No Are Title 5 Minor Modification Forms Attached? (this applies to Title 5 sources only and applies to all application types except ATCs and Emission Reduction Credits). Complete Title 5 Form -1302 A1/A2, B, and M. Complete Title 5 Form -1302 C1/C2, D1/D2, E1/E2, F1/F2, G1/G2 as appropriate. http://www.ourair.org/wp-content/uploads/t5-forms.pdf

Mail or email the completed application to the APCD's Engineering Division at the address listed above or permits@sbcapcd.org.

2. FILING FEE:

A $491 application filing fee must be included with each application. The application filing fee is COLA-adjusted every July 1st. Please ensure you are remitting the correct current fee (the current fee schedule is available on the APCD's webpage at: http://www.ourair.org/district-fees). This filing fee will not be refunded or applied to any subsequent application. Payment may also be made by credit card by submitting the Credit Card Authorization Form found here https://www.ourair.org/wp-content/uploads/apcd-01c.pdf via mail or calling 805-979-8050 to pay via phone.

Do not submit the Credit Card Authorization Form via email.

3. IS YOUR PROJECT'S PROPERTY BOUNDARY LOCATED OR PROPOSED TO BE LOCATED WITHIN 1,000 FEET FROM THE OUTER BOUNDARY OF A SCHOOL? If yes, and the project results in an emissions increase, submit a completed Form -03 (*School Summary Form*) http://www.ourair.org/wp-content/uploads/apcd-03.pdf ○ Yes ◉ No

If yes, provide the name of school(s)

Address of school(s)

City Zip Code

4. DOES YOUR APPLICATION CONTAIN CONFIDENTIAL INFORMATION? ○ Yes ◉ No

If yes, please submit with a redacted duplicate application which shall be a public document. In order to be protected from disclosure to the public, all information claimed as confidential shall be submitted in accordance with APCD Policy & Procedure 6100-020 (*Handling of Confidential Information*): http://www.ourair.org/wp-content/uploads/6100-020.pdf, and meet the criteria of CA Govt Code Sec 6254.7. Failure to follow required procedures for submitting confidential information, or to declare it as confidential at the time of application, shall be deemed a waiver by the applicant of the right to protect such information from public disclosure. *Note: Part 70 permit applications may contain confidential information in accordance with the above procedures, however, the content of the permit documents must be public (no redactions).*

FOR APCD USE ONLY				DATE STAMP
FID	10436	Permit No.	ATC Mod 16223-01	Rec'vd 6/10/2024
Project Name	Space Exploration Technologies			
Filing Fee	$491		202.E? YES / NO	

Billed Space Exploration Technologies 530000/205516

5. COMPANY/CONTACT INFORMATION:

Owner Info	(•) Yes ( ) No	Use as Billing Contact?			
Company Name	Space Exploration Technologies				
Doing Business As	SpaceX				
Contact Name	Keegan O'Day	Position/Title	Manager, Environmental Health & Safety		
Mailing Address	PO Box 568				
City	Lompoc	State	CA	Zip Code	93438
Telephone	310-970-3699	Cell	3233766556	Email	keegan.o'day@spacex.com

Operator Info	(•) Yes ( ) No	Use as Billing Contact?			
Company Name	Space Exploration Technologies				
Doing Business As	SpaceX				
Contact Name	Keegan O'Day	Position/Title	Manager, Environmental Health & Safety		
Mailing Address	PO Box 568				
City	Lompoc	State	CA	Zip Code	93438
Telephone	310-970-3699	Cell	(323) 376-6556	Email	keegan.o'day@spacex.com

Authorized Agent Info*	( ) Yes ( ) No	Use as Billing Contact?			
Company Name					
Doing Business As					
Contact Name		Position/Title			
Mailing Address					
City		State		Zip Code	
Telephone		Cell		Email	

*Use this section if the application is not submitted by the owner/operator. Complete APCD Form -01A (http://www.ourair.org/wp-content/uploads/apcd-01a.pdf). Owner/Operator information above is still required.

SEND PERMITTING CORRESPONDENCE TO *(check all that apply)*:

- [x] Owner
- [ ] Operator
- [ ] Authorized Agent
- [ ] Other (attach mailing information)

6. GENERAL NATURE OF BUSINESS OR AGENCY:

Space X designs, manufacturers, and launches advanced rockets and spacecraft. SpaceX operates it Falcon 9 and Falcon Heavy Launch Vehicle Programs from Space Launch Complex (SLC)-4 on Vandenberg Space Force Base (VSFB), California. Falcon 9 and Falcon Heavy vehicles are launched from SLC-4E and in many instances are flown back and land at SLC-4W.

7. EQUIPMENT LOCATION (Address):

Specify the street address of the proposed or actual equipment location. If the location does not have a designated address, please specify the location by cross streets, or lease name, UTM coordinates, or township, range, and section.

Equipment Address	VSFB Harbor and Space Launch Complex (SLC)-4				
City	Vandenberg Space Force Base	State	CA	Zip Code	
Work Site Phone					

○ Incorporated (within city limits) ◉ Unincorporated (outside city limits) ○ Used at Various Locations

Assessors Parcel No(s):

8. PROJECT DESCRIPTION:

(Describe the equipment to be constructed, modified and/or operated or the desired change in the existing permit. Attach a separate page if needed):

SpaceX is changing the route the marine vessels may operate as well as the daily limits. The details of the requested changes are included in the attached cover letter.

9. DO YOU REQUIRE A LAND USE PERMIT OR OTHER LEAD AGENCY PERMIT FOR THE PROJECT DESCRIBED IN THIS APPLICATION?: ○ Yes ◉ No

A. If **yes,** please provide the following information

Agency Name	Permit #	Phone #	Permit Date

* The lead agency is the public agency that has the principal discretionary authority to approve a project. The lead agency is responsible for determining whether the project will have a significant effect on the environment and determines what environmental review and environmental document will be necessary. The lead agency will normally be a city or county planning agency or similar, rather than the Air Pollution Control District.

B. If **yes,** has the lead agency permit application been deemed complete and is a copy of their completeness letter attached?

○ Yes ○ No

Please note that the APCD will not deem your application complete until the lead agency application is deemed complete.

C. If the lead agency permit application has not been deemed complete, please explain.

D. A copy of the final lead agency permit or other discretionary approval by the lead agency may be requested by the APCD as part of our completeness review process.

10. PROJECT STATUS:

A. Date of Equipment Installation: Pending permit modification appr

B. Have you been issued a Notice of Violation (NOV) for not obtaining a permit for this equipment/modification *and/or* have you installed this equipment without the required APCD permit(s)? If yes, the application filing is double per Rule 210. ○ Yes ◉ No

C. Is this application being submitted due to the loss of a Rule 202 exemption? ○ Yes ◉ No

D. Will this project be constructed in multiple phases? If yes, attach a separate description of the nature and extent of each project phase, including the associated timing, equipment and emissions. ○ Yes ◉ No

E. Is this application also for a change of owner/operator? If yes, please also include a completed APCD Form -01T. ○ Yes ◉ No

11. APPLICANT/PREPARER STATEMENT:

The person who prepares the application also must sign the permit application. The preparer may be an employee of the owner/operator or an authorized agent (contractor/consultant) working on behalf of the owner/operator (an *Authorized Agent Form -01A* is required).

I certify pursuant to H&SC Section 42303.5 that all information contained herein and information submitted with this application is true and correct.

Keegan ODay	Jun 9, 2024
Signature of application preparer	Date
Keegan O'Day	SpaceX
Print name of application preparer	Employer name

12. APPLICATION CHECKLIST (*check all that apply*)

☒ Application Filing Fee (Fee = $491. The application filing fee is COLA adjusted every July 1st. Please ensure you are remitting the current fee.) As a convenience to applicants, the APCD will accept credit card payments. If you wish to use this payment option, please complete a *Credit Card Form-01C* https://www.ourair.org/wp-content/uploads/apcd-01c.pdf and submit it via mail or call 805-979-8050 to pay over the phone. **Do not submit the *Credit Card Form-01C* via email**.

☒ Existing permitted sources may request that the filing fee be deducted from their current reimbursable deposits by checking this box. Please deduct the filing fee from my existing reimbursement account.

☐ Form -01T (*Transfer of Owner/Operator*) attached if this application also addresses a change in owner and/or operator status from what is listed on the current permit. http://www.ourair.org/wp-content/uploads/apcd-01t.pdf

☐ Form -03 (*School Summary Form*) attached if the project's property boundary is within 1,000 feet of the outer boundary of a school (k-12) and the project results in an emissions increase. http://www.ourair.org/wp-content/uploads/apcd-03.pdf

☒ Information required by the APCD for processing the application as identified in APCD Rule 204 (*Applications*), the APCD's *General APCD Information Requirements List* (https://www.ourair.org/wp-content/uploads/gen-info.pdf), and any of the APCD's Process/Equipment Summary Forms (http://www.ourair.org/permit-applications) that apply to the project.

☐ Form -01A (*Authorized Agent Form*) attached if this application was prepared by and/or if correspondence is requested to be sent to an Authorized Agent (e.g., contractor or consultant). This form must accompany each application. http://www.ourair.org/wp-content/uploads/apcd-01a.pdf

☐ Confidential Information submitted according to APCD Policy & Procedure 6100-020. (*Failure to follow Policy and Procedure 6100-020 is a waiver of right to claim information as confidential.*)

13. NOTICE OF CERTIFICATION:

All applicants must complete the following Notice of Certification. This certification must be signed by the Authorized Company Representative representing the owner/operator. Signatures by Authorized Agents will not be accepted.

NOTICE of CERTIFICATION

I, Keegan O'Day , am employed by or represent

Type or Print Name of Authorized Company Representative

SpaceX

Type or Print Name of Business, Corporation, Company, Individual, or Agency

(hereinafter referred to as the applicant), and certify pursuant to H&SC Section 42303.5 that all information contained herein and information submitted with this application is true and correct and the equipment listed herein complies or can be expected to comply with said rules and regulations when operated in the manner and under the circumstances proposed. If the project fees are required to be funded by the cost reimbursement basis, as the responsible person, I agree that I will pay the Santa Barbara County Air Pollution Control District the actual recorded cost, plus administrative cost, incurred by the APCD in the processing of the application within 30 days of the billing date. If I withdraw my application, I further understand that I shall inform the APCD in writing and I will be charged for all costs incurred through closure of the APCD files on the project.

For applications submitted for Authority to Construct, modifications to existing Authority to Construct, and Authority to Construct/Permit to Operate permits, I hereby certify that all major stationary sources in the state and all stationary sources in the air basin which are owned or operated by the applicant, or by an entity controlling, controlled by, or under common control with the applicant, are in compliance, or are on approved schedule for compliance with all applicable emission limitations and standards under the Clean Air Act (42 USC 7401 *et seq.*) and all applicable emission limitations and standards which are part of the State Implementation Plan approved by the Environmental Protection Agency.

Completed By: Keegan O'Day Title: Manager, Environmental Health & Safety

Date: Jun 9, 2024 Phone: 310-970-3699

Signature of Authorized Company Representative Keegan O'Day

PLEASE NOTE THAT FAILURE TO COMPLETELY PROVIDE ALL REQUIRED INFORMATION OR FEES WILL RESULT IN YOUR APPLICATION BEING RETURNED OR DEEMED INCOMPLETE.

air pollution control district
SANTA BARBARA COUNTY

EMISSION REDUCTION CREDITS - AUTHORIZATION OF ERC USE
APPLICATION FORM -05U

The owner of an ERC Certificate that is registered in the APCD's Source Register must completely fill in this form and submit it to the APCD each time the ERC Certificate is "used". Please be specific as to the amount and type of ERCs "used" and which specific "emission elements" are the source of the ERCs being used. This form must be filled in for each ERC Certificate subject to use. An application filing fee per Rule 210 (Schedule F.1) is required.

1. SUMMARY INFORMATION

Certificate No: 0655-0429 Expiration Date: April 3rd, 2029

Certificate Owner Name(s): Space Exploration Technologies (SpaceX), Keegan O'Day

Company and Project Authorized to Use the ERCs: Space Exploration Technologies (SpaceX)
ATC 16293

Total ERCs Authorized for Use (tons/yr):				
	NO_x:	0.556	SO_x:	
	ROC:	0.056	PM_{10}:	
	CO:	0.588	PM:	

Company Official Authorized to Release the ERCs: Keegan O'Day
Please Print Name

Signature

(323) 376 - 6556
Phone and Fax Numbers

2. USE INFORMATION

☐ Yes ☒ No Will the ERC Certificate be used in whole?

☒ Yes ☐ No If partial use of the ERC Certificate is occurring, will the remaining ERCs belong to the original ERC Certificate owner? If No, then an ERC Certificate Transfer application must first be submitted and then an ERCs may be used by the new owner.

Specify the ERC Certificate Emission Elements (by name and number), the pollutants and the amounts that comprise the authorized "use". (*if no response is provided, the APCD will select for you*):

0.031 TPY of NOx

3. COST INFORMATION

(a) Transaction Type[1]: ☐ Purchase ☒ Use on Company Owned Project

☐ Barter ☐ Subsidiary

(b) ERC Costs:

Pollutant	ERCs Used (tpy)	Total Cost ($)	Unit Cost ($/ton)
NO_x	0.031	Not Applicable	
ROC			
CO			
SO_x			
PM_{10}			
PM			

(c) ☐ Yes ☒ No Are the total cost values stated above one time payments? If No, please explain in detail the nature of the payments:

(d) ☐ Yes ☒ No Are there any other payment provisions or "in-kind" costs associated with this transaction? If Yes, please detail:

4. ERC ATTACHED

☒ Yes ☐ No Is the ERC Certificate included with this application? *(The district cannot process this application until the ERC has been submitted.)*

[1] If barter was involved and/or no money was exchanged for the ERCs, please calculate an equivalent dollar per ton value for the credit transaction. Barters can include one company placing controls on another company to generate ERCs. The price should reflect the total cost to install the equipment and any additional fees paid as part of the agreement between both companies. The price paid should reflect the value of the ERC at the time of the transaction.

Attachment A: Emission Calculations (Electronic)

Attachment B: Marine Vessel Monitoring and Reporting Plan

Marine Vessel Monitoring and Reporting Plan
SpaceX Tugboat and Barge Operations
Authority to Construct 16223

Prepared for:

Space Exploration Technologies, Inc.

PO Box 568
Lompoc, CA 93438
Contact: Keegan O'Day

Prepared by:

DUDEK
3760 State Street, Suite 101
Santa Barbara, California 93105
Contact: Adam Poll

JULY 2024

Printed on 30% post-consumer recycled material.

Table of Contents

FIGURES

TABLES

1 Project Overview

1.1 Project Purpose

Space Exploration Technologies (SpaceX) is submitting this marine vessel monitoring and reporting plan (plan) to operate two tugboats and a barge in the Vandenberg Space Force Base (VSFB) Harbor for transport of a rocket booster. SpaceX is expanding its launch capability at Space Launch Complex 4 (SLC-4) to be able to launch, recover, refurbish, and re-fly a Falcon 9 launch vehicle every three days. To accommodate this increased cadence, SpaceX must expedite the processing of a Falcon 9 vehicles. The success of this expedited Falcon 9 vehicle processing is dependent on SpaceX having the capability to transport boosters to SLC-4 through the Harbor.

1.2 General Process Description

This marine vessel monitoring and reporting plan describes the operation of two tugboats and a barge to deliver rocket boosters and fairings mounted on a transporter to VSFB Harbor. The primary tugboat and barge will depart the Port of Long Beach (POLB) or the Port of Los Angeles (POLA) (depending on shipping traffic) and travel up the coast through state and federal waters to the VSFB Harbor. The support tugboat will depart the POLB, POLA, Port of Hueneme (POH), or Port of Ventura (POV) and travel up the coast through state waters to the VSFB Harbor. The support tugboat will assist the barge and primary tugboat during maneuvering into and out of the VSFB Harbor. The rockets will be transported from the VSFB Harbor to SLC-4 and the transporter will return to the barge from SLC-4 to VSFB Harbor. The barge and transporter will then depart VSFB Harbor with the assistance of the primary tugboat and support tugboat to return to the POLB or POLA. The support tugboat will return to the POLB, POLA, POH, or POV. Each trip will occur between three to eight days.

SpaceX has identified Curtin Maritime (Curtin) as a marine solutions company to provide the tugboat and barge services. All engines aboard the primary tugboat are certified to Tier 4 Marine emission standards and the support tugboat's engines are certified to Tier 3 Marine emission standards. The primary tugboat is powered by two 1,300 horsepower Cummins QSK38-M2 Tier 4 diesel engines. In addition, the primary tugboat utilizes two 99 horsepower John Deere 4045AFM85 Tier 3 diesel engines for auxiliary power. The support tugboat is powered by two 500 horsepower John Deere 6135 Tier 3 diesel engines and the auxiliary power is provided by one 99 horsepower John Deere 4045AFM85 Tier 3 diesel engine. Per Curtin, the typical transit speed for this type of operation, under normal seas, would be at 7.5 knots (not to exceed 10 knots). To the extent possible, each approach to the dock at the Harbor would be made with the rising tide. The barge would utilize a 49 horsepower Tier 4 Final diesel generator to power auxiliary loads and to provide accessory power to the tug while it is offline and docked.

1.3 Associated Permits

SpaceX currently operates equipment at the SLC-4 on VSFB under Permit to Operate 15999, SSID: 11146, and FID: 10436. This plan is associated with Permit to Operate 16223 (and subsequent permit reevaluations).

1.4 Equipment Being Used

The equipment to be used in the project is shown below in Table 1.

Table 1. Project Equipment

Equipment	Specifications
Primary Tugboat 1 (Elizabeth C)	Port Main Engine Make: Cummins Model: QSK38-M2 Tier 4 Engine #: 33234272 Serial #: 14501-1 Horsepower: 1,300 EPA Family: PCEXN38.0AAC IMO Family: M32QTA04 Starboard Main Engine: Make: Cummins Model: QSK38-M2 Tier 4 Engine #: 33234273 Serial #: 14501-2 Horsepower: 1,300 EPA Family: PCEXN38.0AAC IMO Family: M32QTA04 Port Auxiliary Engine: Make: John Deere Model: 4045AFM85 Serial #: PE4045N003989 Tier 3 Horsepower: 99 EPA Family: HJDXN04.5146 Starboard Auxiliary Engine: Make: John Deere Model: 4045AFM85 Serial #: PE4045N003988 Tier 3 Horsepower: 99 EPA Family: HJDXN04.5146
Primary Tugboat 2 (Kelly C)	Port Main Engine Make: Cummins Model: QSK38-M1 Tier 3 Serial #: 33227367 Horsepower: 1,000 bhp (electronically derated from 1,300 bhp) EPA Family: MCEXN19.0AAA IMO Family: M32QTA01 Starboard Main Engine: Make: Cummins Model: QSK38-M1 Tier 3 Serial #: 33227441 Horsepower: 1,000 bhp (electronically derated from 1,300 bhp) EPA Family: MCEXN19.0AAA

Table 1. Project Equipment

Equipment	Specifications
	IMO Family: M32QTA01 FWD Auxiliary Engine: Make: John Deere Model: 4045TFM85 Serial #: PE4045N030337 Tier 3 Horsepower: 99 EPA Family: MJDXN04.5165 AFT Auxiliary Engine: Make: John Deere Model: 4045TFM85 Serial #: PE4045N030044 Tier 3 Horsepower: 99 EPA Family: MJDXN04.5165
Support tugboat (currently approved tugboat – Bernadine C)	Port Main Engine Make: John Deere Model: 6135 Tier 3 Serial #: RG6135L031149 Horsepower: 500 EPA Family: FJDXN13.5158 IMO Family: R552504 Starboard Main Engine: Make: John Deere Model: 6135 Tier 3 Serial #: RG6135L031150 Horsepower: 500 EPA Family: FJDXN13.5158 IMO Family: R552504 Auxiliary Engine: Make: John Deere Model: 4045AFM85A Serial #: PE4045L983330 Tier 3 Horsepower: 99 EPA Family: FJDXN04.5146
Support tugboat 2 (Mackenzie C)	Port Main Engine Make: John Deere Model: 6135 Tier 3 Serial #: RG6135L039079 Horsepower: 425 EPA Family: FJDXN13.5158 IMO Family: R552504 Starboard Main Engine: Make: John Deere

Table 1. Project Equipment

Equipment	Specifications
	Model: 6135 Tier 3 Serial #: RG6135L039076 Horsepower: 425 EPA Family: FJDXN13.5158 IMO Family: R552504
Support tugboat 3 (Marley C)	Port Main Engine Make: John Deere Model: 6135 Tier 3 Serial #: EG6135L039094 Horsepower: 475 EPA Family: FJDXN13.5158 IMO Family: R552504 Starboard Main Engine: Make: John Deere Model: 6135 Tier 3 Serial #: RG6135L039090 Horsepower: 475 EPA Family: FJDXN13.5158 IMO Family: R552504
Barge	Generator: Make: TBD Model: TBD Tier IV Final Horsepower: 49 EPA Family: TBD CARB Certification: TBD

1.5 Planned Route

The proposed travel area for the primary and support tugboats and barge is shown in Figure 1 below. The primary and support tugboats and barge shall not travel through the Channel Islands National Marine Sanctuary as shown around the Channel Islands National Park. The red lines indicate the SBCAPCD jurisdictional waters and the purple line represents the Ventura County Air Pollution Control District (VCAPCD) outer boundary. Depending on environmental conditions, the primary and support tugboats and barge may travel up the Santa Barbara channel or around the Channel Islands National Park.

Figure 1 – Planned Route

In general, each trip will occur over a three- to eight-day period if the full contingency hours are utilized. The proposed schedule is provided in detail below for each trip.

The primary tugboat, barge and support tugboat departs the POLB or POLA and travels within the SCAQMD jurisdiction for up to 10.7 hours. The primary tugboat and barge and support tugboat travels within the VCAPCD jurisdiction for up to 24 hours and within the SBCAPCD jurisdiction for up to 24 hours to the VSFB harbor.

Alternatively, the primary tugboat and barge would depart the POLB or POLA and travel within the SCAQMD jurisdiction for up to 10.7 hours. The primary tugboat and barge travel within the VCAPCD jurisdiction for up to 24 hours and within the SBCAPCD jurisdiction for up to 24 hours. The primary tugboat and barge travel within Federal waters up to 24 hours and then within the SBCAPCD jurisdiction for up to 24 hours to the VSFB harbor.

Contingency

If conditions are not amenable to executing the operation under applicable restrictions, the landing attempt will be abandoned, the primary tugboat and barge will remain in SBCAPCD waters and hotel in order to attempt the offloading event the next calendar day. This contingency scenario will be attempted up to three calendar days in a row per trip until conditions are acceptable.

1.6 Jurisdictions of Waters Being Travelled

As shown in Figure 1, the primary tugboat and barge may operate within the SCAQMD, VCAPCD, SBCAPCD, and Federal jurisdictions. The support tugboat would operate within the SCAQMD, VCAPCD, and SBCAPCD jurisdictions. The California Coast Waters adjacent to the SCAQMD jurisdiction begin from the south at 33°23'12.6834"N, 117°35'46.4131"W, southwest 72 nautical miles to 32°29'59.9886"N, 118°30'0.0147"W, northwest 59 nautical miles to 32°59'59.9891"N, 119°30'0.0011"W, and northeast 69 nautical miles to 34°02'42.3726"W, 118°56'41.1999"N. The California Coast Waters adjacent to the VCAPCD jurisdiction begin at 34°02'42.3726"W, 118°56'41.1999"N and go southwest 69 nautical miles to 32°59'59.9891"N, 119°30'0.0011"W, then north 83 nautical miles to 34°22'24"N, 119°28'33"W. The California Coast Waters adjacent to the SBCAPCD jurisdiction begin at 34°22'24"N, 119°28'33"W then south 83 nautical miles to 32°59'59.9891"N, 119°30'0.0011"W, then northwest 155 nautical miles to 34°58'19.1603"W, 121°28'15.7747"W, then east 41 nautical miles to 34°58'29"N, 120°38'53"W. Federal waters are defined as waters beyond California Coastal Waters.

For each round trip, the primary tugboat and barge are expected to travel up to 100 nautical miles within the SCAQMD jurisdiction, 60 nautical miles within the VCAPCD jurisdiction, 200 nautical miles within the SBCAPCD jurisdiction, and 106 nautical miles within federal jurisdiction.

For each round trip, the support tugboat is expected to travel up to 100 nautical miles within the SCAQMD jurisdiction, 60 nautical miles within the VCAPCD jurisdiction, and 200 nautical miles within the SBCAPCD jurisdiction.

2 Operational Restrictions

2.1 Hours of Operation

The project will operate under the following hourly limits within each jurisdiction it will operate per trip.

The primary tugboat and support tugboat travels for up to 10.7 hours within the SCAQMD jurisdiction. The primary and support tugboat will travel up to 24 hours in the VCAPCD jurisdiction. The primary and support tugboat will travel up to 24 hours in the SBCAPCD jurisdiction. The primary tugboat may travel up to 24 hours in the federal jurisdiction.

Annually, the primary tugboat and barge are expected to spend up to 770.4 hours within the SCAQMD jurisdiction; 1,728 hours within the VCAPCD jurisdiction; 2,568 hours within the SBCAPCD jurisdiction; and 1,728 hours within the federal jurisdiction. Annually, the support tugboat is expected to spend up to 770.4 hours within the SCAQMD jurisdiction; 1,728 hours within the VCAPCD jurisdiction; and 1,728 hours within the SBCAPCD jurisdiction.

2.2 Overnight and Hoteling Use

The project will operate overnight during periods of transit. The support tugboat will hotel at VSFB Harbor when it is not maneuvering the barge or in transit. During hoteling, the support tugboat may operate on its auxiliary engine only. When the primary tugboat and barge are docked at VSFB, the engines on the tugboat will be shutdown and the Tier IV generator on the barge will be operated to provide any auxiliary power needed for the barge and tugboat. These conditions will be followed unless emergency safety precautions must be taken to ensure crew and vessel safety.

2.3 Schedule of Operation

Refer to Section 1.5 for a detailed schedule of operation for the project.

2.4 Operating Restrictions

The following operational restrictions apply to the project in accordance with Authority to Constrict 16223 (and subsequent PTOs and permit reevaluations):

- SpaceX will maintain a manifest that documents the departure and arrival times from POLB and POLA to VSFB Harbor, as well the operational hours in air district and federal waters on Calendar Day cross-over transits, operational hours in SCAQMD, VCAPCD, SBCAPCD, and federal waters for the in-bound and out-bound transits. GPS timestamp data and fuel usage will be provided as supporting documentation.
- The barge and tugboats would travel at no greater than 10 knots at any time while in transit.
- Vessels will enter the harbor, to the extent possible, only when the tide is too high for pinnipeds to haul-out on the rocks. The vessel will reduce speed to 1.5 to 2 knots (1.5-2.0 nm/hr; 2.8-3.7 km/hr) once the vessel

is within 3 mi (4.83 km) of the harbor. The vessel will enter the harbor stern first, approaching the wharf and mooring dolphins at less than 0.75 knots (1.4 km/hr).

- Vessels using the harbor will follow a predetermined route that limits crossing kelp beds.
- No vessels will anchor within kelp beds or hard-bottom habitat outside of the dredge footprint, and no vessel anchors within the dredge footprint will be placed in kelp or hard bottom habitat.
- If nighttime activities are to occur at any time from dusk to dawn, the required lighting will be turned on before dusk and left on the entire night. Lights will not be turned on or off between dusk and dawn.
- Activities that could result in the startling of wildlife in the vicinity of the harbor will be allowed so long as they are initiated before dusk and not interrupted by long periods of quiet (in excess of 30 minutes). If such activities cease temporarily during the night, they will not be reinitiated until dawn.
- Starting-up of activities (either initially or if activities have ceased for more than 30 minutes) will include a gradual increase in noise levels if pinnipeds are in the area.
- The restrictions on access to the intertidal area will be included in the personnel orientations provided at project startup and for new employees.
- The tug vessels and barge will be periodically cleaned as necessary to avoid impacts related to the transfer of non-native invasive pests and vegetation to VSFB Harbor.
- SpaceX and its contractors will implement best management practices to prepare for and respond to a spill. These practices include fueling equipment at least 100 feet from the water, fueling only in areas designed to capture runoff or spilled fuel, and maintaining spill response kits.
- SpaceX will prepare and submit a health and safety plan to VSFB and will appoint a trained individual as safety officer.
- Fuel use limits for each engine for operating days as defined in Section 2.5.
- Hours of operation limits for operating days as defined in Section 2.1.
- R99 diesel will be the only fuel combusted in the marine vessel engines while in California Coastal Waters.
- No visible emissions per SBCAPCD Rule 302.
- The primary and support tugboats will only use one auxiliary engine at a time.
- The support tugboat will hotel at VSFB harbor while the primary tugboat is traveling to and from the VSFB out to Point Conception for travel into and out of the VSFB harbor. The support tugboat will only operate with the primary tugboat within the VSFB harbor for maneuvering of the barge.

2.5 Engine and Fuel Use Limits

Only CARB R99 diesel fuel with a maximum sulfur content of 0.0015 weight percent (15 ppmw) or less shall be used in the engines on the tugboat and barge generator.

In accordance with the operating schedule presented in section 2.3, the project will be limited to the following daily fuel heat input limits within each jurisdiction. The heat input limits were estimated based on a higher heating value of 137,000 British thermal units per gallon (Btu/gal) for R99 diesel and a brake specific fuel consumption of 7,420 Btu per brake-horsepower-hour (bhp-hr). The Elizabeth C is assumed to operate up to 100% of the annual trips with the Kelly C used as backup for up to 25% of the annual trips.

Elizabeth C

The following represents the daily fuel consumption limits for the project's marine vessels assuming use of the Elizabeth C as the primary tugboat.

Within the SCAQMD jurisdiction, each primary tugboat propulsion engine shall be limited to 753.37 gallons and auxiliary engine usage is limited to 17.83 gallons per day. Within VCAPCD, each primary tugboat propulsion engine shall be limited to 1,689.81 gallons and auxiliary engine usage is limited to 39.99 gallons per day. Within SBCAPCD, each primary tugboat propulsion engine shall be limited to 1,689.81 gallons and auxiliary engine usage is limited to 39.99 gallons per day. Within Federal waters, each primary tugboat propulsion engine shall be limited to 1,689.81 gallons and auxiliary engine usage is limited to 39.99 gallons per day.

Within the SCAQMD jurisdiction, each support tugboat propulsion engine shall be limited to 289.76 gallons and auxiliary engine usage is limited to 17.83 gallons per day. Within the VCAPCD jurisdiction, each support tugboat propulsion engine shall be limited to 649.93 gallons and the auxiliary engine is limited to 39.99 gallons. Within the SBCAPCD jurisdiction, each support tugboat propulsion engine shall be limited to 649.93 gallons and the auxiliary engine is limited to 39.99 gallons.

Annually, the Elizabeth C is limited to 54,242.91 gallons for each propulsion engine and auxiliary engine usage is limited to 1,283.58 gallons per year within the SCAQMD jurisdiction; 121,666.34 gallons for each propulsion engine and 2,879.05 gallons for auxiliary engine usage within the VCAPCD jurisdiction; 180,809.69 gallons for each propulsion engine and 4,278.59 gallons for auxiliary engine usage within the SBCAPCD jurisdiction; and 121,666.34 gallons for each propulsion engine and 2,879.05 gallons for auxiliary engine usage within federal jurisdiction per year.

Annually, the support tugboat is limited to 20,862.66 gallons for each propulsion engine and auxiliary engine usage is limited to 1,283.58 gallons per year within the SCAQMD jurisdiction; 46,794.74 gallons for each propulsion engine and 2,879.05 gallons for the auxiliary engine within the VCAPCD jurisdiction; and 69,542.19 gallons for each propulsion engine and 4,278.59 gallons for the auxiliary engine within the SBCAPCD jurisdiction per year.

Kelly C

The following represents the daily fuel consumption limits for the project's marine vessels assuming use of the Kelly C as the primary tugboat.

Within the SCAQMD jurisdiction, each primary tugboat propulsion engine shall be limited to 579.52 gallons and auxiliary engine usage is limited to 17.83 gallons per day. Within VCAPCD, each primary tugboat propulsion engine shall be limited to 1,299.85 gallons and auxiliary engine usage is limited to 39.99 gallons per day. Within SBCAPCD, each primary tugboat propulsion engine shall be limited to 1,299.85 gallons and auxiliary engine usage is limited to 39.99 gallons per day. Within Federal waters, each primary tugboat propulsion engine shall be limited to 1,299.85 gallons and auxiliary engine usage is limited to 39.99 gallons per day.

Annually, the Kelly C is limited to 10,431.33 gallons for each propulsion engine and auxiliary engine usage is limited to 320.89 gallons per year within the SCAQMD jurisdiction; 23,397.37 gallons for each propulsion engine and 719.76 gallons for auxiliary engine usage within the VCAPCD jurisdiction; 34,771.09 gallons for each propulsion engine and 1,069.65 gallons for auxiliary engine usage within the SBCAPCD jurisdiction; and 23,397.37 gallons for each propulsion engine and 719.76 gallons for auxiliary engine usage within federal jurisdiction per year.

2.6 Harbor Operation Restrictions

The following discusses the operation and how it will maintain compliance in accordance with the operating restrictions for lighting and noise during nighttime activities within the VSFB Harbor as outline in Section 2.4.

VSFB Approach: The support tuboat will arrive 1 hour before the primary tugboat at the VSFB harbor. The primary tugboat will arrive at the VSFB harbor. If the primary and support tugboat approaches the VSFB harbor near or after dusk, area lighting will be turned on prior to dusk and the lighting will remain on the remainder of the night. Once the support tugboat is docked the main engine will be shutoff and transferred onto auxiliary power. Once the primary tugboat is docked the main and auxiliary engines will be shutoff and use of the Tier 4 engine on the barge will be utilized. The crane will approach the VSFB harbor and turn off its engines before dusk. If offloading is to occur during nighttime, the crane will remain on with lighting on until the KMAG is offloaded. The crane will place the ramps in position between the barge and the dock and then shutdown. The KMAG will roll-off and transport the booster to SLC-4E. The tugs lights will remain on until sunrise and then shutoff. The barge generator will remain on during approach to the harbor as well as while docked at the harbor. After sunrise, the lighting on the primary and support tugboat will be turned off.

VSFB Departure: If during daylight, the primary and support tugboat will maneuver the barge out of the VSFB harbor and return to the POLB or POLA with lighting off. If during nighttime, the lighting on the primary and support tugboat will remain on until after sunrise when it can be turned off. The crane will turn on prior to dusk and remain on until the barge has left the harbor. If during daytime, the crane will only operate as-needed with its lights off. The crane will return to SLC-4E.

If for any reason the lighting on the tugs is not sufficient for the operation, auxiliary light carts will be utilized that use a combination of solar panels and batteries to operate.

2.7 Communication Protocol

SpaceX has implemented a communication protocol with Curtin. Curtin shall notify SpaceX immediately prior to commencement of an operation when sea or wind conditions are such that the conditions set forth within ATC 16223 and this marine vessel monitoring and reporting plan cannot be achieved. SpaceX will work with Curtin to

determine the next acceptable operating window within which the operation can operate within the constraints of ATC 16223 and this marine vessel monitoring and reporting plan.

2.8 Hull Coating and Cleaning

The primary tug and barge hulls will be coated with Intersleek 1100SR or an equivalent anti-fouling coating once every 5 years according to the manufacturer's recommendation. The primary tug and barge hulls will be cleaned every 6 months to remove biofouling. Every 2.5 years, the vessels will be cleaned while dry-docked.

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3 Monitoring

3.1 GPS

3.1.1 Make and Model

The primary tugboat and support tugboat have two GPS models installed on each vessel, the Furuno GP33 GPS and Furuno SC-70 Satellite Compass. The FURUNO GP33 is the perfect GPS navigator for a wide range of vessels. This advanced unit provides accurate and reliable position fixing, thanks to a super sensitive, 12-channel GPS receiver combined with integrated WAAS technology. Its waterproof display is built to stand up to tough marine conditions. The durable casing houses an impressive memory, capable of storing up to 3,000 points of ship's track, 10,000 points for marks and waypoints, and 100 routes of up to 30 waypoints each. Vital navigation data is presented on a 4.3" color LCD. The SC70 is the latest satellite compasses built on FURUNO's commercial-grade technology platform. These satellite compasses prove their value by increasing the accuracy of other devices, such as Radar, ARPA, Scanning Sonar, Current Indicator, Chart Plotter, ECDIS and Autopilots. They provide a highly accurate heading input to these other technologies by utilizing the very latest GNSS (Global Navigation Satellite System). This satellite system is comprised of GPS, Galileo and GLONASS to ensure the highest precision and a continuous coverage. The GPS are managed by a Rose Point electronic charting and navigation software. Rose Point ECS improves operational efficiency, situational awareness, and decision making with straightforward, uncluttered displays and controls that provide instant access to the information professional mariners and fleet operators need to navigate safely.

3.1.2 Calibration Frequency and Procedure

According to Rose Point and Furuno, there is no calibration required. The GPS are satellite and internet enabled and calibrate or update in accordance with the manufacturers recommendations as updates are available. Manufacturer literature on the GPS units for the primary tugboat are included in Appendix A.

3.1.3 Operation

The GPS will be operated in accordance with the user manuals provided in Appendix A. The GPS units are on anytime auxiliary power is provided to the primary tugboat or support tugboat. The GPS units data are logged using the voyage data recorder and has the capability to store the vessel location and time stamp during each arrival and departure within each jurisdiction. Data is collected during each trip and will be printed out from the logbook at the conclusion of the trip for the purpose of record keeping and reporting. The location and time stamp data is encrypted and cannot be altered by the crew. The Rose Point system will be programmed to continuously record the primary tugboat and support tugboat position every 15 minutes between these latitudes. Each position will be date and time stamped to the nearest minute using Pacific Standard Time. Continuous recording of the primary tugboat support tugboat position will also include the time the vessel is docked.

3.1.4 Examples of Printouts

Examples of GPS printouts are provided in Appendix A.

3.1.5 Hours of Operation in Jurisdictional Waters

The hours of operation of the propulsion and auxiliary engines will be tracked using the onboard GPS system along with the hour meter and fuel use meter (as applicable) for each engine on the tugboat. The onboard tracking system will allocate the time of start and stop within each of the SCAQMD, VCAPCD, SBCAPCD, and federal jurisdictions for engine use tracking.

3.2 Engine Fuel Use

3.2.1 Make and Model

Tugboat fuel use from the primary tugboat and support tugboat (for all engines) is monitored by manufacturer's electronic integrated Engine Control Modules (ECMs), which continuously meter fuel use by engine. ECMs are read daily, as required, to determine fuel use in California Coastal Waters adjacent to Santa Barbara County. ECM readings for each engine category will be logged on the vessel fuel log/reporting form for each of the following events:

- At the entry and exit of waters of Santa Barbara within the same day.
- If over multiple days, the fuel use will be recorded at the end of the day.

Fuel use will be tracked within each jurisdiction (SCAQMD, VCAPCD, SBCAPCD, and federal) using the onboard data management system and fuel use tracking log (Appendix C). This management system links the engines hourly and fuel meters to the onboard GPS system. Total daily fuel use for each engine category will be compared to subject APCD permit (main and auxiliary) fuel heat input limits to ensure ongoing compliance.

Generator fuel use from the barge is monitored by manufacturer's electronic integrated Engine Control Modules (ECMs), which continuously meter fuel use of the engine. ECMs are read daily, as required, to determine fuel use in California Coastal Waters adjacent to Santa Barbara County. The fuel use will be recorded on the fuel log/reporting form daily.

3.2.2 Calibration Frequency and Procedure

The non-resettable fuel use meters on each propulsion and auxiliary engine do not require regular calibration in accordance with the manufacturer's specifications as provided in Appendix B.

4 Recordkeeping

4.1 GPS Data and Printouts

The GPS location/time data for each trip to VSFB will be recorded within each jurisdiction at intervals of no greater than 15 minutes, consisting of a chart upon which the vessel's position has been plotted for each transport trip from the POLB or POLA to VSFB harbor and the hard copy printouts from the vessel's GPS system.

A hardcopy record of each arrival and departure of the primary tugboat and support tugboat will be maintained in the SpaceX SLC-4 environmental offices as required by Authority to Constrict 16223 (and subsequent PTOs and permit reevaluations) CONDITION 4. This record will be the data collected by the Electronic Chart Display (ECD) system as described in Section 3.0 of this plan.

An example of the Rose Point GPS data output format is shown in Appendix A. The hardcopy data stored for each trip will be maintained for three years. Additionally, printouts of electronic charts showing the primary tugboat and support tugboat routes to and from the VSFB harbor will be kept on file. The route of the primary tugboat and support tugboat will be automatically recorded and plotted on an electronically created graphic version of the navigational chart by the Rose Point system.

4.2 Hours in Jurisdictional Waters

A log will be maintained documenting the hours of operation within each jurisdiction. An example log is provided in Appendix C.

4.3 Engine Heat Input Limits

Fuel use will be recorded daily on the attached Monthly Boat Logging/Reporting Form (Attachment C). Daily fuel use for the tugboat and barge will be summarized on a monthly basis. The fuel use will be converted to daily and annual heat input (based on the default value from CARB or from billing vouchers) and using a brake specific fuel consumption of 7,420 Btu/bhp-hr. This information is then included with the total project related fuel use and air emissions and provided to the SBCAPCD in the annual emissions report. The log will also document the start time and end time of operation for each engine.

Documentation and billing vouchers documenting the diesel fuel sulfur content and higher heating value (HHV) for fuel loaded into the marine vessel will be maintained. The documentation will clearly denote the ASTM methods used for analysis and shall be clear that the fuel purchased matches the fuel noted in the billing voucher.

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5 Reporting

5.1 GPS Data and Printouts

The GPS location/time data for each trip to from the POLB or POLA to VSFB will be recorded within each jurisdiction (SCAQMD, VCAPCD, SBCAPCD, and federal); consisting of a chart upon which the vessel's position has been plotted for each transport trip to VSFB harbor and the hard copy printouts from the vessel's GPS system. The data will be logged and reported to the SBCAPCD within 45 days of trip completion. An example of the GPS data and printouts is included in Appendix A.

5.2 Hours in Jurisdictional Waters

The hours operated within each jurisdictional waters will be recorded and reported in accordance with applicable permit conditions and included in the trip report to the SBCAPCD within 45 days of trip completion.

5.3 Engine Fuel Use

The fuel use per engine will be recorded within each jurisdiction using the onboard fuel and hour meters. This information will be logged on the Monthly Boat Logging/Reporting Form and the fuel use will be converted to heat input to compare to applicable permit limits within Authority to Constrict 16223 (and subsequent PTOs and permit reevaluations). This information will be reported to the SBCAPCD on each trip report within 45 days of trip completion.

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Appendix A

GPS Specifications

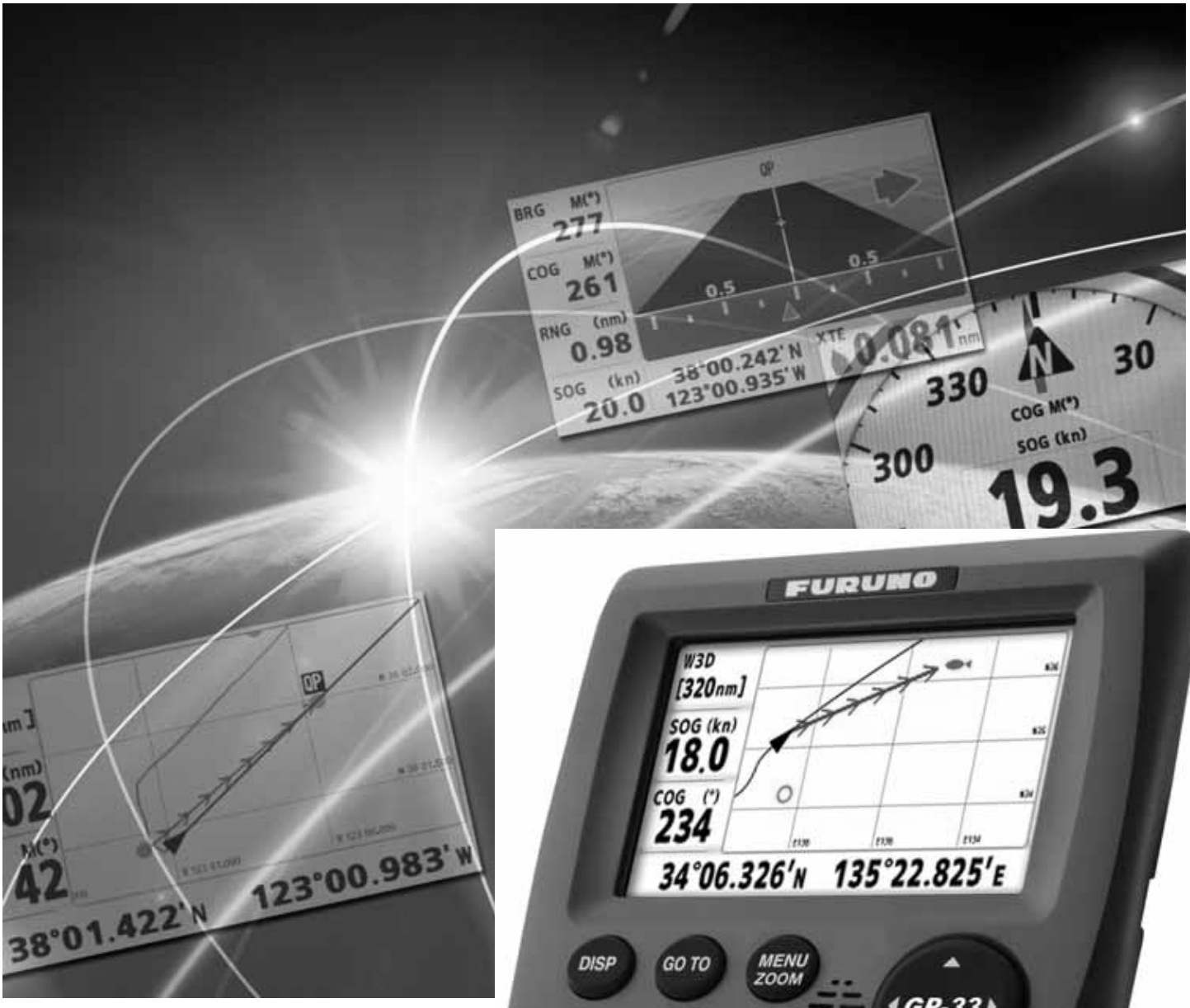
Table of Contents

NAVnet 3D Connect

FURUNO

GP-33

GPS NAVIGATOR



Enhanced Sunlight Viewable

CAN bus

www.furuno.com

A smart navigation solution that fits perfect into your console

Compact in size, yet big on features and performance, the FURUNO GP-33 is the perfect GPS navigator for a wide range of vessels. This advanced unit provides accurate and reliable position fixing, thanks to a super sensitive, 12-channel GPS receiver combined with integrated SBAS (WAAS/EGNOS/MSAS) technology.

The GP-33 has a waterproof display and is built to stand up to tough marine conditions. The durable casing houses an impressive memory, capable of storing up to 3,000 points of ship's track, 10,000 points for marks and waypoints, and 100 routes of up to 30 waypoints each. Vital navigation data is presented on a 4.3" color LCD.

The GP-33 features FURUNO's CAN bus interface system for feeding highly accurate navigation data to your NavNet 3D, radar, chart plotter, autopilot, fish finder or other navigation equipment. The unit offers easy plug-and-play installation with CAN bus network connectivity. NMEA0183 protocol versions are also supported.

- ►4.3" "Sunlight Viewable" color LCD (Brightness: 700 cd)
- ►Enhanced data legibility thanks to large characters and high resolution visual aid
- ►Stores up to 10,000 marks/waypoints, 100 routes and 3,000 track points
- ►7 display modes available, including 2 user-customized modes
- ►Supports both NMEA0183 and CAN bus interface
- ►Contact closure capability available on the 10P connector
- ►SBAS capable for better measurement

SBAS is a general term for a GPS navigation system with differential correction by means of geostationary satellites. In the US, it is called WAAS (Wide Area Augmentation System), whereas in Europe and Japan, it is called EGNOS (European Geostationary Navigation Overlay System) and MSAS (MSAT Satellite-based Augmentation System), respectively.

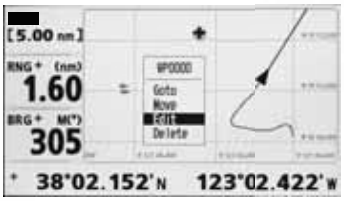
What is CAN bus?

CAN bus is a communication protocol that shares multiple data and signals through a single backbone cable. You can simply connect any CAN bus devices onto the backbone cable to expand your network onboard. With CAN bus, IDs are assigned to all the devices, and the status of each sensor in the network can be detected. All the CAN bus devices can be incorporated into the NMEA2000 network.

CAN bus

Easy Operation

Innovative digital graphic displays and intuitive on-screen menu structure provide simple operation and easy access to the features you use most frequently.



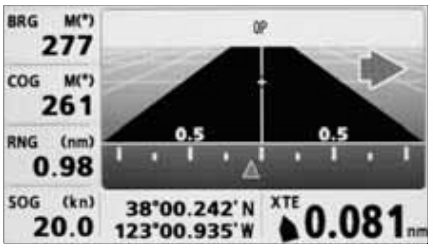
Various Displays

The GP-33 provides navigation data and displays them in a wide variety of numerical and graphical formats. You may freely select which data you want displayed with easy to use controls. The combination of a high resolution screen and large data fields makes the screen easy to read in almost any condition.

NAV data

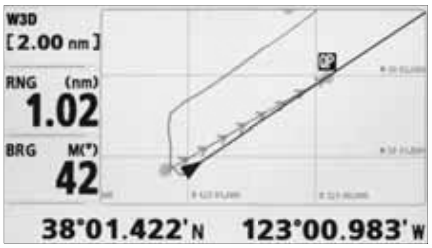
The nav data display shows receiver status, position in latitude and longitude (or TDs), course over ground, speed over ground, date and time.

Highway



3-D view of own ship's progress toward destination (waypoint). This mode is best used for navigation when a straight line course can be followed.

Plotter



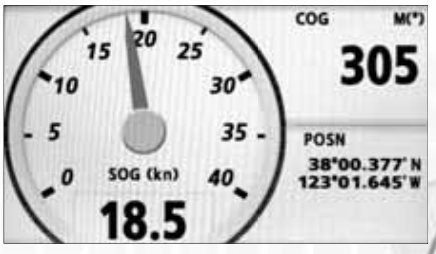
The plotter display traces own ship's track and shows position on a 2-D map*. This mode presents various data and information with graphic symbols and icons, rather than text. The Auto Waypoint Entry function plots ship's track as "WAYPOINTS". The user may define waypoint entry by time interval, tack angle, etc.

*The unit does not include charts.

COG

Easy to read digital compass heading display that greatly assists you in maintaining a desired course.

User Display



You choose what data is displayed in the User Display Mode.

SPECIFICATIONS OF GP-33

DISPLAY

Screen Size	4.3" color LCD
Effective Display Area	95.04 (W) x 53.85 (H) mm
Pixel Number	480 (V) x 272 (H) pixels

Display Mode
Plotter, Highway, Steering, Nav Data, Satellite, User Display1, User Display2

Memory Capacity
3,000 ship's track points
10,000 marks and waypoints with comments
100 routes, 30 waypoints/route

Alarm
Arrival, Anchor watch, XTE, Speed, WAAS (SBAS), Time, Trip, Odometer

GPS/SBAS (WAAS/EGNOS/MSAS)

Receiver Type
GPS: Twelve discrete channels, C/A code, all-in-view
SBAS receiver: Standard fitted in display unit

Receive Frequency	L1 (1575.42 MHz)
Time to First Fix	Less than 90 seconds (Cold start)
Tracking Velocity	999.9 knots
Geodetic Systems	WGS-84 (and others)

ACCURACY

GPS: Better than 10 m (2drms)
WAAS: Better than 3 m (2drms)

INTERFACE

Ports
CAN bus: 1 port
NMEA0183: 2 ports

Output
NMEA0183
AAM, APB, BOD, BWC, BWR, DTM, GGA, GLL, GSA, GSV, RMB, RMC, VTG, XTE, ZDA
CAN bus
059392, 060928, 061184, 126208, 126464, 126720-1, 126720-2, 126992, 126996, 127258, 129026, 129029, 129033, 129044, 129283, 129284, 129285, 129538, 129539, 129540, 130822, 130823

Input
CAN bus
059904, 060928, 061184, 065286, 126208, 126720

POWER SUPPLY

15 VDC : LEN7 (CAN bus)
12-24 VDC : 0.24-0.12 A (Non CAN bus)

ENVIRONMENT

Temperature	Receiver unit: -15°C to +55°C Antenna unit: -25°C to +70°C
Waterproofing	Receiver unit: IP56 Antenna unit: IPX6

EQUIPMENT LIST

Standard
1. Receiver unit GP-33 with drop cable 6 m 1 unit
2. Antenna unit GPA-017 with cable 10 m 1 unit
3. Standard spare parts and installation materials

Option

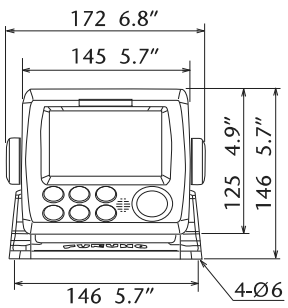
1. Junction box	FI-5002	
2. Cable assembly	KON-004-02M (NMEA0183)	2 m

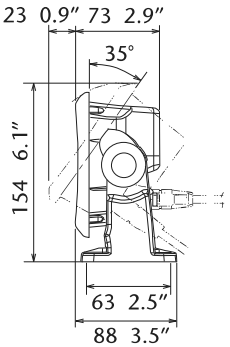
OFFICIAL NAME OF THE EQUIPMENT

GPS Navigator GP-33

Display Unit GP-33

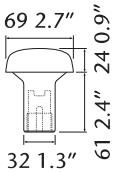
0.72 kg 1.58 lb



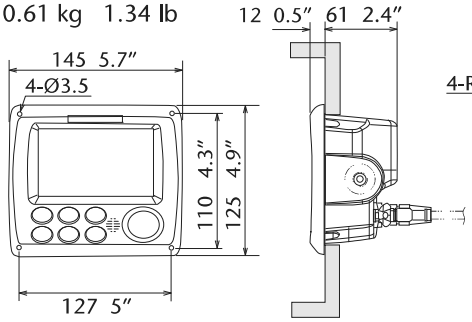


GPS Antenna GPA-017

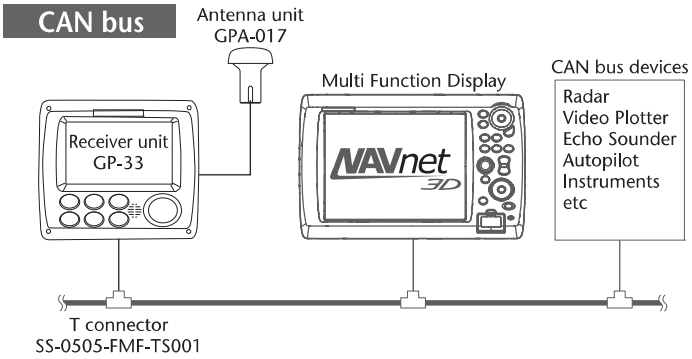
0.6 kg 1.3 lb

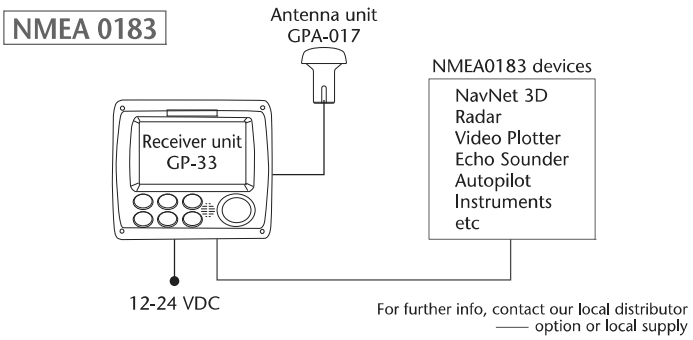


Flush mount
0.61 kg 1.34 lb



INTERCONNECTION DIAGRAM





SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FURUNO ELECTRIC CO., LTD.
Nishinomiya, Hyogo, Japan
www.furuno.com

FURUNO U.S.A., INC.
Camas, Washington, U.S.A.
www.furunousa.com

FURUNO (UK) LIMITED
Havant, Hampshire, U.K.
www.furuno.co.uk

FURUNO FRANCE S.A.S.
Bordeaux-Mérignac, France
www.furuno.fr

FURUNO ITALIA S.R.L.
Gatteo Mare, Italy
www.furuno.it

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1601PDF
Catalogue No. N-871c

FURUNO

English

GPS NAVIGATOR

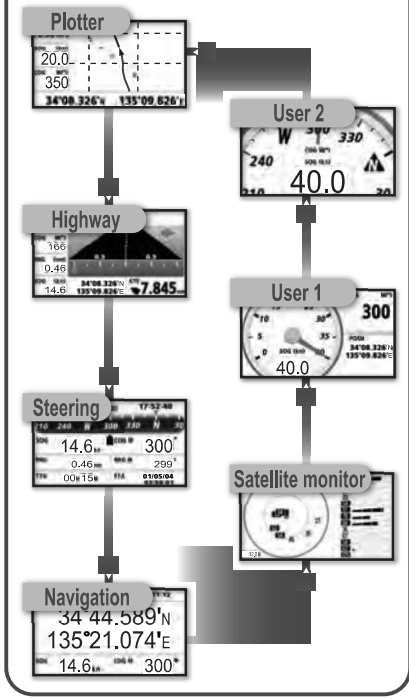
GP-33 Operator's Guide

The purpose of this guide is to provide the basic operation for this equipment. For more detailed information, see the Operator's Manual.

How to select a display

DISP

There are seven displays.



How to set the cursor position as destination

(Plotter display only)

GP-33 → GO TO

Move the cursor (+) to the position to be set.

Range/bearing and the shortest course from own boat appear.

To cancel the destination

GP-33 → ENT → GP-33 → ENT → GP-33 → ENT

Place the cursor on the destination.

Select "Cancel Goto".

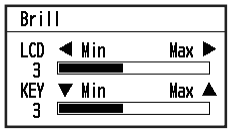
Select "Yes".

How to adjust brilliance/panel dimmer

BRILL

Short press

(Long press: Turn the power off.)

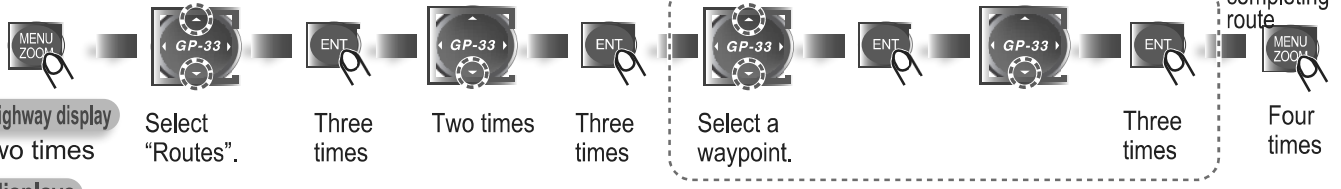


LCD Brilliance → GP-33

Panel Dimmer → GP-33

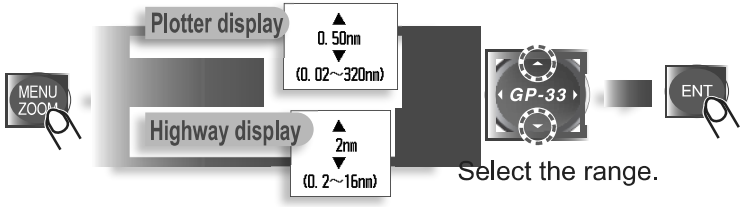
ENT

How to create a route



How to zoom in/out the range

(Plotter and Highway displays only)

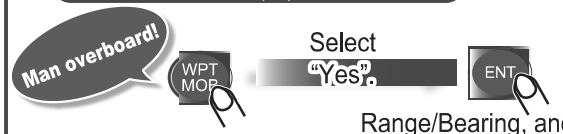


How to set own boat position as waypoint

(Plotter display only)

Short press

How to set MOB (M) as destination



How to register the cursor position as waypoint

(Plotter display only)

Move own boat mark (△) to center

(Plotter display only)

Long press

FURUNO NAVIGATEUR GPS

Français

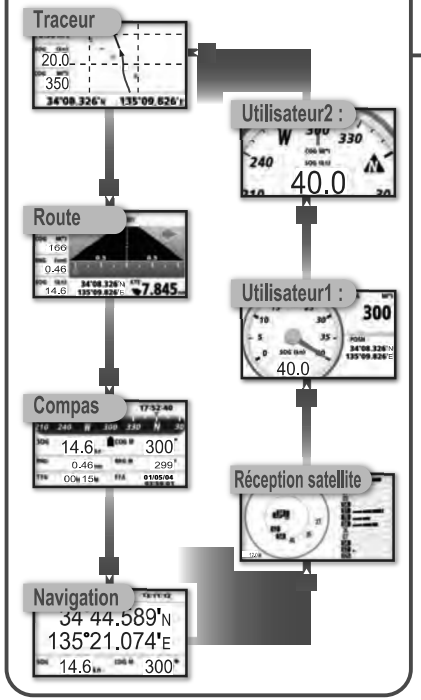
GP-33 Guide d'utilisation

Ce guide décrit les procédures d'utilisation de base de cet équipement. Pour plus d'informations, reportez-vous au Manuel d'utilisation.

Comment sélectionner un affichage

DISP

Il y a 7 affichages.



Comment définir la position du curseur comme destination

(Affichage Traceur uniqt)

Déplacez le curseur (✚) sur la position à définir.

La distance/le relèvement et la route la plus courte depuis votre bateau s'affichent.

Pour annuler la destination

Placez le curseur sur la destination.

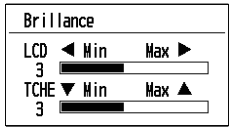
Sélectionnez "Annuler Goto".

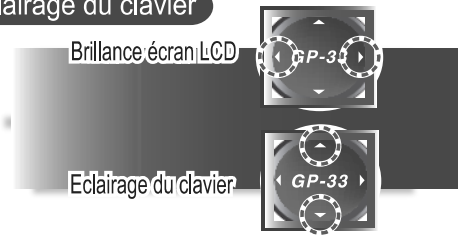
Sélectionnez "Oui".

Comment ajuster la brillance/l'éclairage du clavier

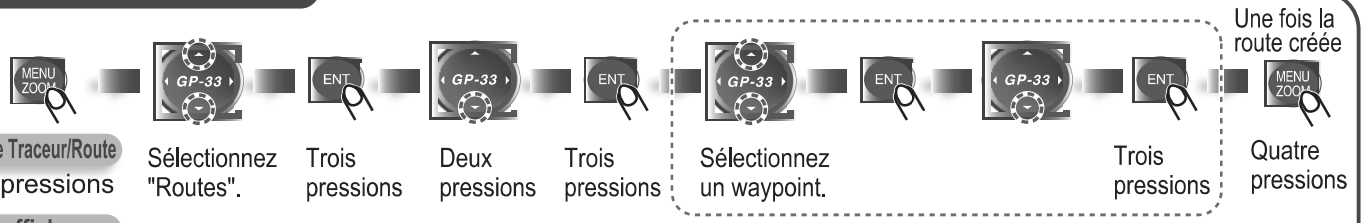
Pression rapide

(Pression longue : éteint l'appareil.)



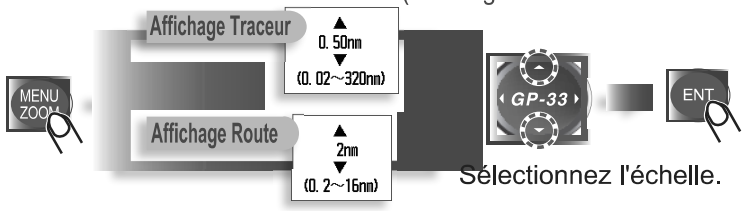


Comment créer une route



Comment effectuer un zoom vers l'avant ou vers l'arrière

(Affichages Traceur et Route uniqt)



Comment définir la position de votre bateau comme waypoint

(Affichage Traceur uniqt)

Pression rapide

Comment définir la position MOB ( ) comme destination

Pression longue

La distance/le relèvement et la route la plus courte depuis votre bateau s'affichent.

Comment enregistrer la position du curseur comme waypoint

(Affichage Traceur uniqt)

Déplacez le curseur sur la position à enregistrer.

Pression rapide

Déplacer la marque du bateau (△) au centre

(Affichage Traceur uniqt)

Pression longue

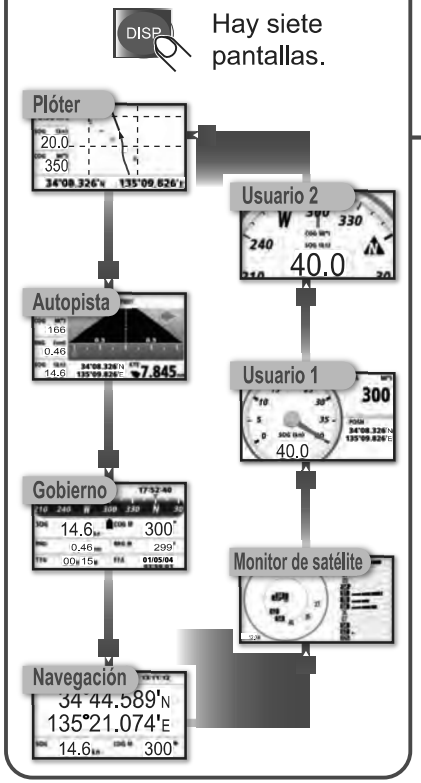
FURUNO NAVEGADOR GPS

Español

GP-33 Guía del operador

El propósito de esta guía es explicar la utilización básica de este equipo. Para obtener información más detallada, consulte el Manual del operador.

Cómo seleccionar una pantalla



Cómo establecer la posición del cursor como destino

(Sólo en la pantalla de plóter)

Mueva el cursor (✚) a la posición que desee establecer.

Aparecerán la distancia/demora y el curso más corto desde el propio barco.

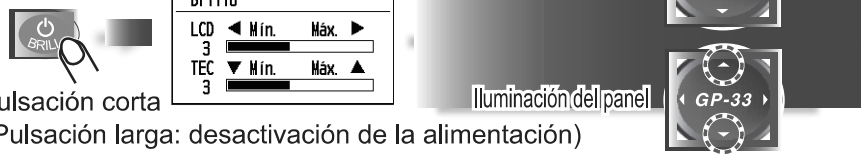
Para cancelar el destino

Sitúe el cursor sobre el destino.

Seleccione "Cancelar Ir a".

Seleccione "Sí".

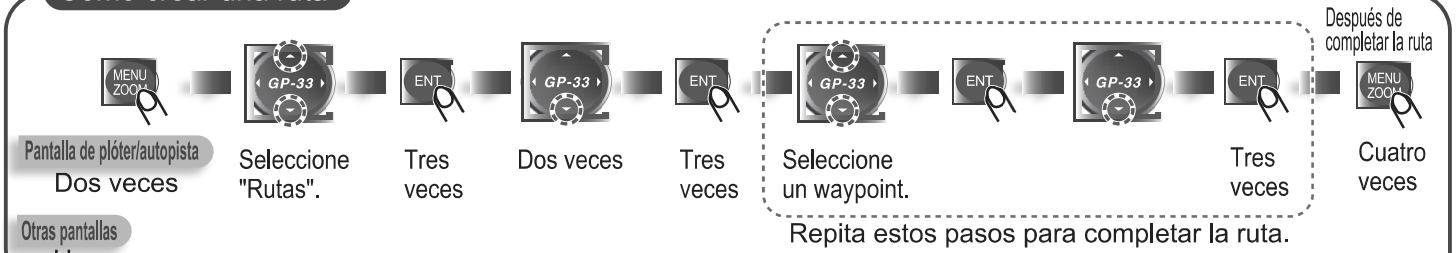
Cómo ajustar el brillo y la iluminación del panel



Pulsación corta

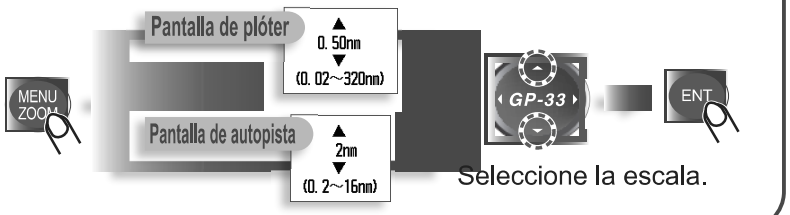
(Pulsación larga: desactivación de la alimentación)

Cómo crear una ruta



Cómo ampliar o reducir la escala

(Sólo en las pantallas de plóter y autopista)



Cómo establecer la posición del barco como waypoint

(Sólo en la pantalla de plóter)

Cómo establecer MOB (M) como destino

Cómo registrar la posición del cursor como waypoint

(Sólo en la pantalla de plóter)

Mueva la marca del barco propio (△) al centro.

(Sólo en la pantalla de plóter)

FURUNO

OPERATOR'S MANUAL

GPS Navigator

Model GP-33

FURUNO ELECTRIC CO., LTD.

www.furuno.com

ECF
(Elemental Chlorine Free)
The paper used in this manual is elemental chlorine free.

FURUNO ELECTRIC CO., LTD.

9-52, Ashihara-cho,
Nishinomiya, 662-8580, JAPAN

・FURUNO Authorized Distributor/Dealer

 Printed in Japan

A: JAN. 2010
H2: APR. 22, 2020

Pub. No. OME-44580-H2
(ETMI) GP-33

00017317717

IMPORTANT NOTICE

General

- This manual has been authored with simplified grammar, to meet the needs of international users.
- The operator of this equipment must read and follow the descriptions in this manual. Wrong operation or maintenance can cancel the warranty or cause injury.
- Do not copy any part of this manual without written permission from FURUNO.
- If this manual is lost or worn, contact your dealer about replacement.
- The contents of this manual and equipment specifications can change without notice.
- The example screens (or illustrations) shown in this manual can be different from the screens you see on your display. The screens you see depend on your system configuration and equipment settings.
- Save this manual for future reference.
- Any modification of the equipment (including software) by persons not authorized by FURUNO will cancel the warranty.
- The following concern acts as our importer in Europe, as defined in DECISION No 768/2008/EC.
  - Name: FURUNO EUROPE B.V.
  - Address: Ridderhaven 19B, 2984 BT Ridderkerk, The Netherlands
- All brand and product names are trademarks, registered trademarks or service marks of their respective holders.

How to discard this product

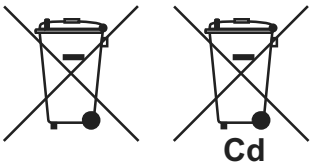
Discard this product according to local regulations for the disposal of industrial waste. For disposal in the USA, see the homepage of the Electronics Industries Alliance (http://www.eiae.org/) for the correct method of disposal.

How to discard a used battery

Some FURUNO products have a battery(ies). To see if your product has a battery, see the chapter on Maintenance. Follow the instructions below if a battery is used. Tape the + and - terminals of battery before disposal to prevent fire, heat generation caused by short circuit.

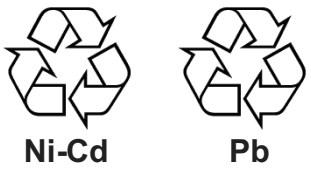
In the European Union

The crossed-out trash can symbol indicates that all types of batteries must not be discarded in standard trash, or at a trash site. Take the used batteries to a battery collection site according to your national legislation and the Batteries Directive 2006/66/EU.



In the USA

The Mobius loop symbol (three chasing arrows) indicates that Ni-Cd and lead-acid rechargeable batteries must be recycled. Take the used batteries to a battery collection site according to local laws.



In the other countries

There are no international standards for the battery recycle symbol. The number of symbols can increase when the other countries make their own recycle symbols in the future.

SAFETY INSTRUCTIONS

WARNING	Indicates a condition that can cause death or serious injury if not avoided.
CAUTION	Indicates a condition that can cause minor or moderate injury if not avoided.

Safety Instructions for the Operator

WARNING

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can occur.

Turn off the power immediately if water leaks into the equipment or smoke or fire is coming from the equipment.

Failure to turn off the equipment can cause fire or electrical shock. Contact a FURUNO agent for service.

CAUTION

The glass of an LCD panel breaks easily. Handle the LCD carefully.

Injury can result if the glass breaks.

No single navigation aid (including this unit) should ever be relied upon as the exclusive means for navigating your vessel.

The navigator is responsible for checking all aids available to confirm his position. Electronic aids are intended to assist, not replace, the navigator.

Safety Instructions for the Installer

WARNING

Turn off the power at the switchboard before you install the equipment.

Fire or electrical shock can occur if the power is left on.

Be sure that the power supply is compatible with the voltage rating of the equipment.

Connection of an incorrect power supply can cause fire or equipment damage. The voltage rating of the equipment appears on the label above the power connector.

CAUTION

Ground the equipment to prevent mutual interference.

Observe the following compass safe distances to prevent interference to a magnetic compass:

Model	Standard compass	Steering compass
GP-33	0.65 m	0.45 m

TABLE OF CONTENTS

FOREWORD

A Word to the Owner of the GP-33

Congratulations on your choice of the GP-33 GPS Navigator.

Since 1948, FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics is furthered by our extensive global network of agents and dealers.

Your navigator is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless installed, operated and maintained properly. Please carefully read and follow the recommended procedures for installation, operation and maintenance.

We would appreciate feedback from you, the end-user, about where we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

Features

The main features of the GP-33 are as shown below.

- High-resolution color LCD
- A DGPS beacon receiver can be connected to the GP-33 to add DGPS capability.
- WAAS capability
- Storage for 10,000 waypoints, 100 routes and 3,000 track points
- Alarms: Arrival/Anchor, XTE (Cross-track Error), Trip, Odometer, Time, WAAS/DGPS and Speed
- Man overboard feature records position at time of man overboard and provides continuous updates of range and bearing when navigating to the MOB position.
- Unique Highway display provides a graphic presentation of boat's progress toward a waypoint.
- User-programmable nav data displays provide analog and digital navigation data.
- Navigation data output to the autopilot when connecting.
- Waypoint and route data can be uploaded from a PC and downloaded to a PC.

Program No.

Name	No.	Ver.
CPU MAIN	2051530-02.**	March, 2013
CPU Boot	2051531-01.**	January, 2010
CPU CAN LD	2051532-01.**	January, 2010
GPS	48502640-**	January, 2010

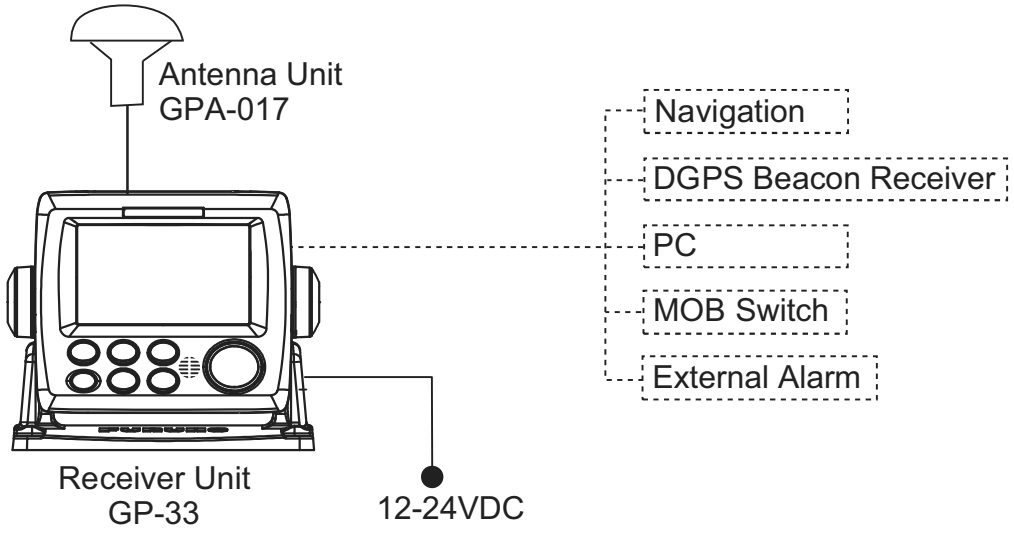
**: Minor change

CE declaration

With regards to CE declarations, please refer to our website (www.furuno.com), for further information on RoHS conformity declarations.

SYSTEM CONFIGURATION

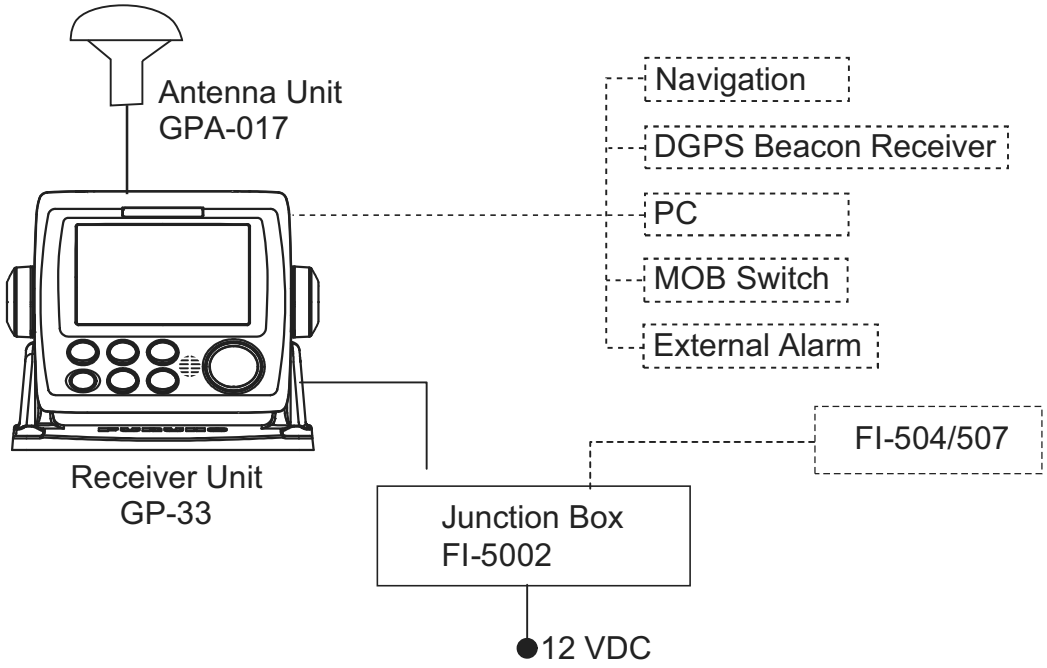
Standalone system



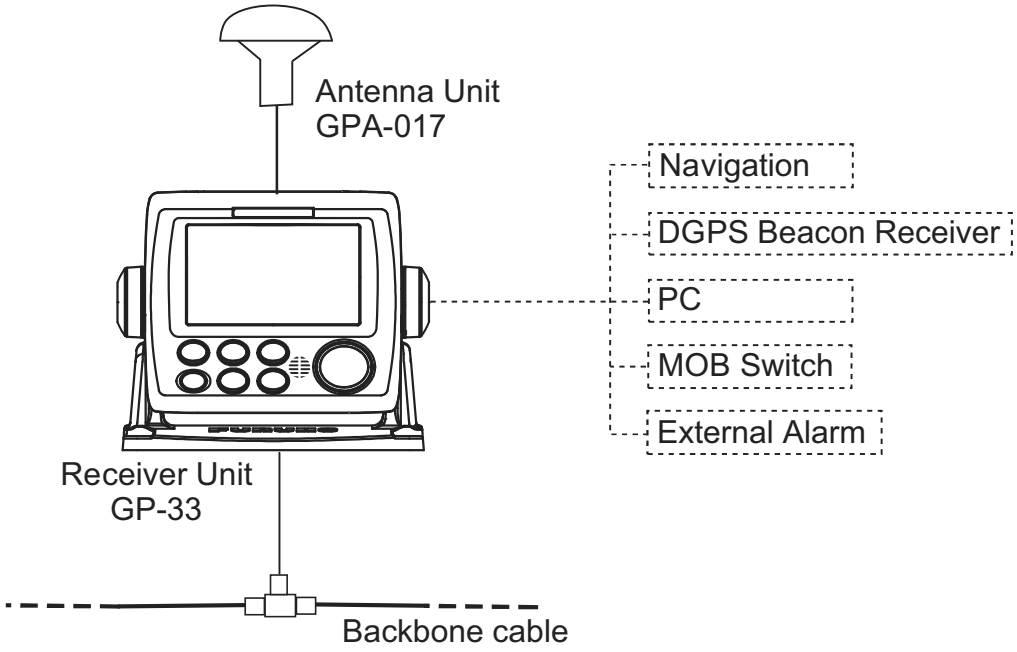
Standard configuration is shown with solid line.

CAN bus network

When optional junction box FI-5002 is connected



When no FI-5002 is connected



Category of Units

Units	Category
Antenna Unit GPA-017	Exposed to weather
Receiver Unit GP-33	Protected from weather
Junction Box FI-5002 (Option)	

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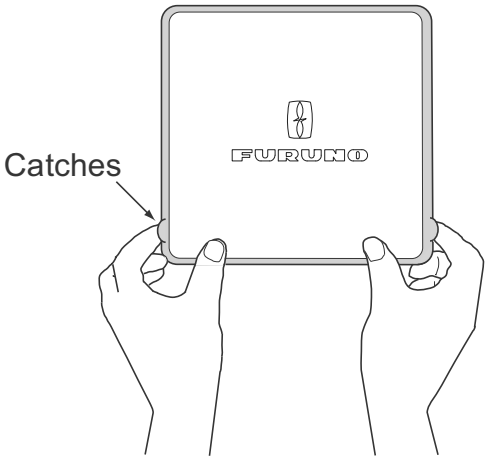
1. OPERATIONAL OVERVIEW

1.1 Controls

Key	Description
DISP	Selects display mode.
GO TO	Sets destination.
MENU ZOOM	-Opens the Menu. (plotter and highway displays: twice, others: once) -Shows the zoom window (plotter and highway displays only).
GP-33 (Cursorpad)	-Shifts the cursor. -Selects item on menus.
BRILL	-Long press: Turns power off. -Momentary press: Turns power on./Shows Brill window.
WPT MOB	-Long press: Inscribes MOB mark. -Momentary press: Registers own boat position as waypoint.
ENT	-Long press: Returns own boat position to center (plotter display only). -Momentary press: Confirms selection on menus.

How to detach the hard cover from the unit

Put your thumbs on the front and forefingers on the catches at the sides of the cover, and pull it toward you.



1.2 How to Turn Power On/Off

1. Press the ⏻**/BRILL** key to turn on the power. The unit beeps and then starts up with the last-used display mode. Your equipment takes about 90 seconds to find its position. The equipment shows receiver status indication at the top left-hand corner in most display modes. The table below shows these indications and their meanings.

Status indications

Indication	Meaning
2D	2D GPS position fixed
3D	3D GPS position fixed
D2D	2D DGPS position fixed
D3D	3D DGPS position fixed
W2D	2D WAAS position fixed
W3D	3D WAAS position fixed
DOP*	2D: HDOP larger than 4 3D: PDOP larger than 6
SIM	Simulation mode
- - -	Not fixed

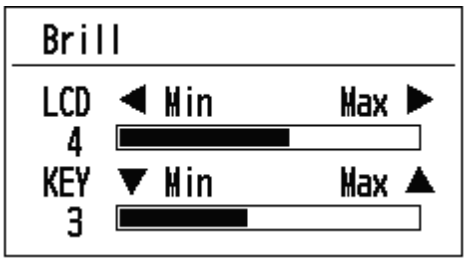
*: DOP (Dilution of Precision) is the index of position accuracy, and it is the distribution pattern of satellites used in position fixing. Generally, the smaller the figure the better the position accuracy. (HDOP: Horizontal DOP, PDOP: Position DOP)

2. To turn off the power, press and hold down the ⏻**/BRILL** key for three seconds. The time remaining until the power is turned off is counted down on the display.

Note: The screen refreshes slower in low ambient temperature.

1.3 How to Adjust LCD and Key Panel Brilliance

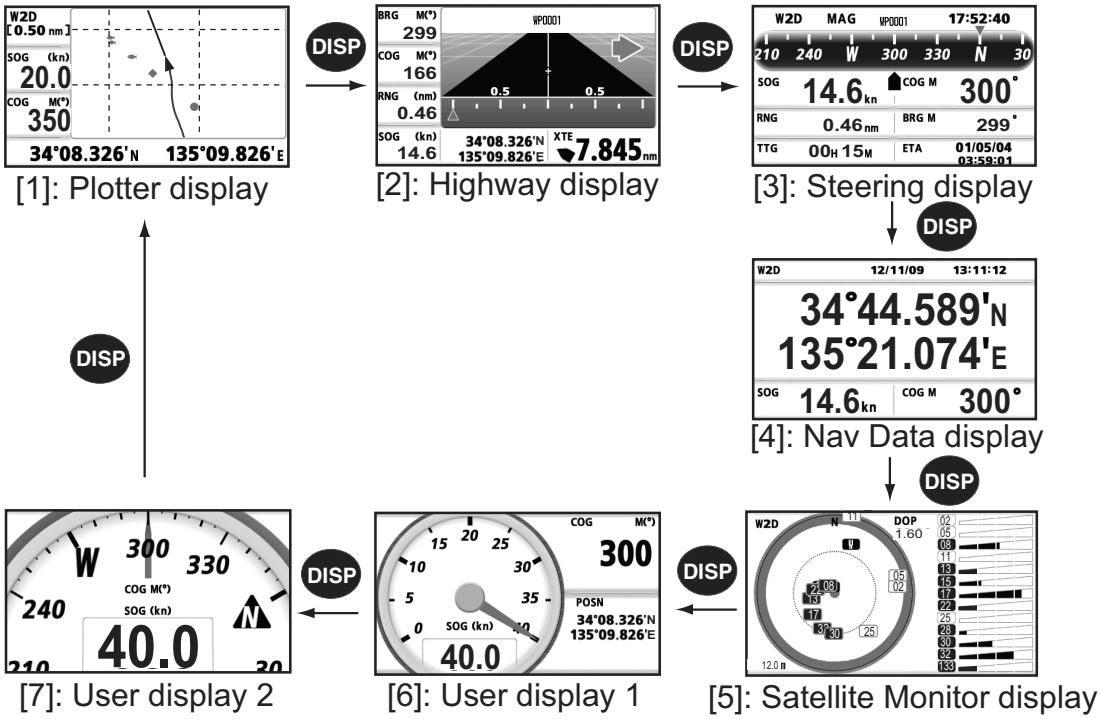
1. Press the ⏻ **/BRILL** key to show the following window.



2. To adjust the LCD brilliance, press ⏻ **/BRILL** key.
   The setting changes "0→1→…→7→6…0→1…" continuously. Maximum setting is 7. You can use also the cursorpad (◀, ▶) to adjust the brilliance.
3. To adjust the panel brilliance, press the cursorpad (▲, ▼, max: 7).
4. Press **ENT** or **MENU/ZOOM** key.

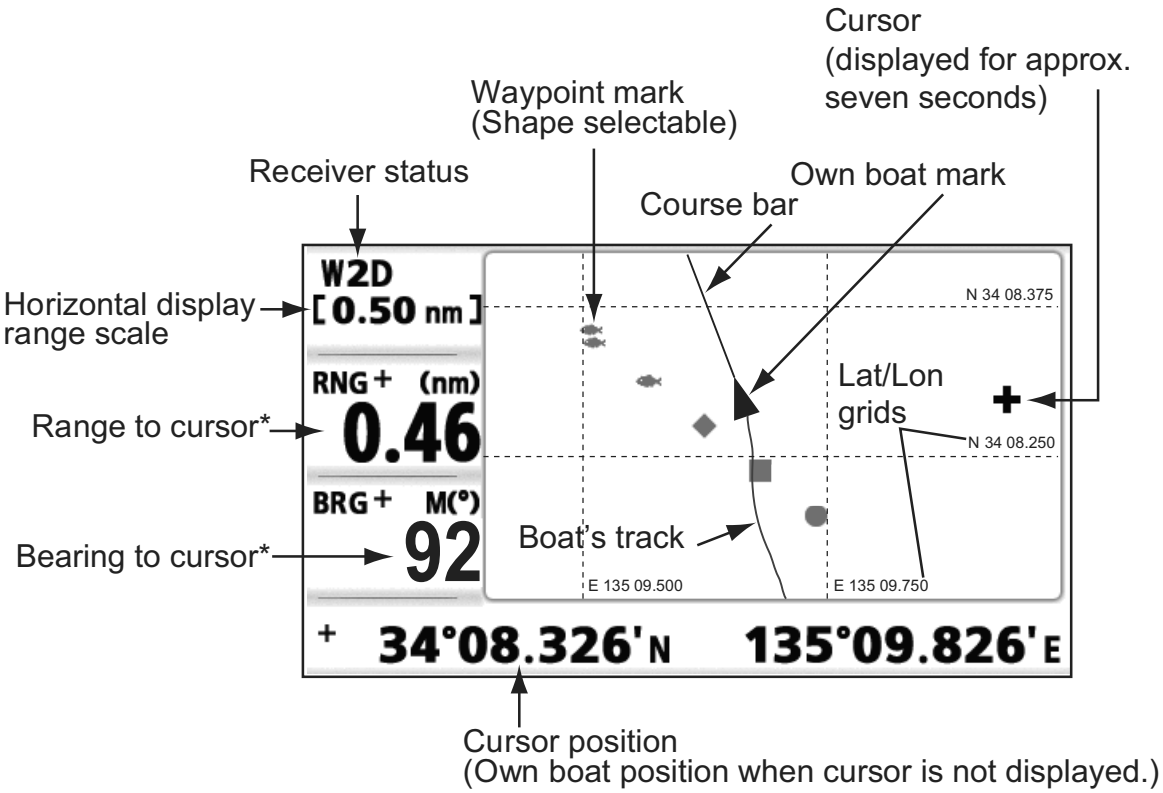
1.4 Display Modes

Your unit has seven display modes: Plotter Display, Highway Display, Steering Display, Nav Data Display, Satellite Monitor Display and User Display 1/2. Press the **DISP** key to select a display mode. Each time the key is pressed, the display mode changes in the sequence shown below. To step through the displays in reverse order, press the **DISP** key more than three seconds.



Plotter Display

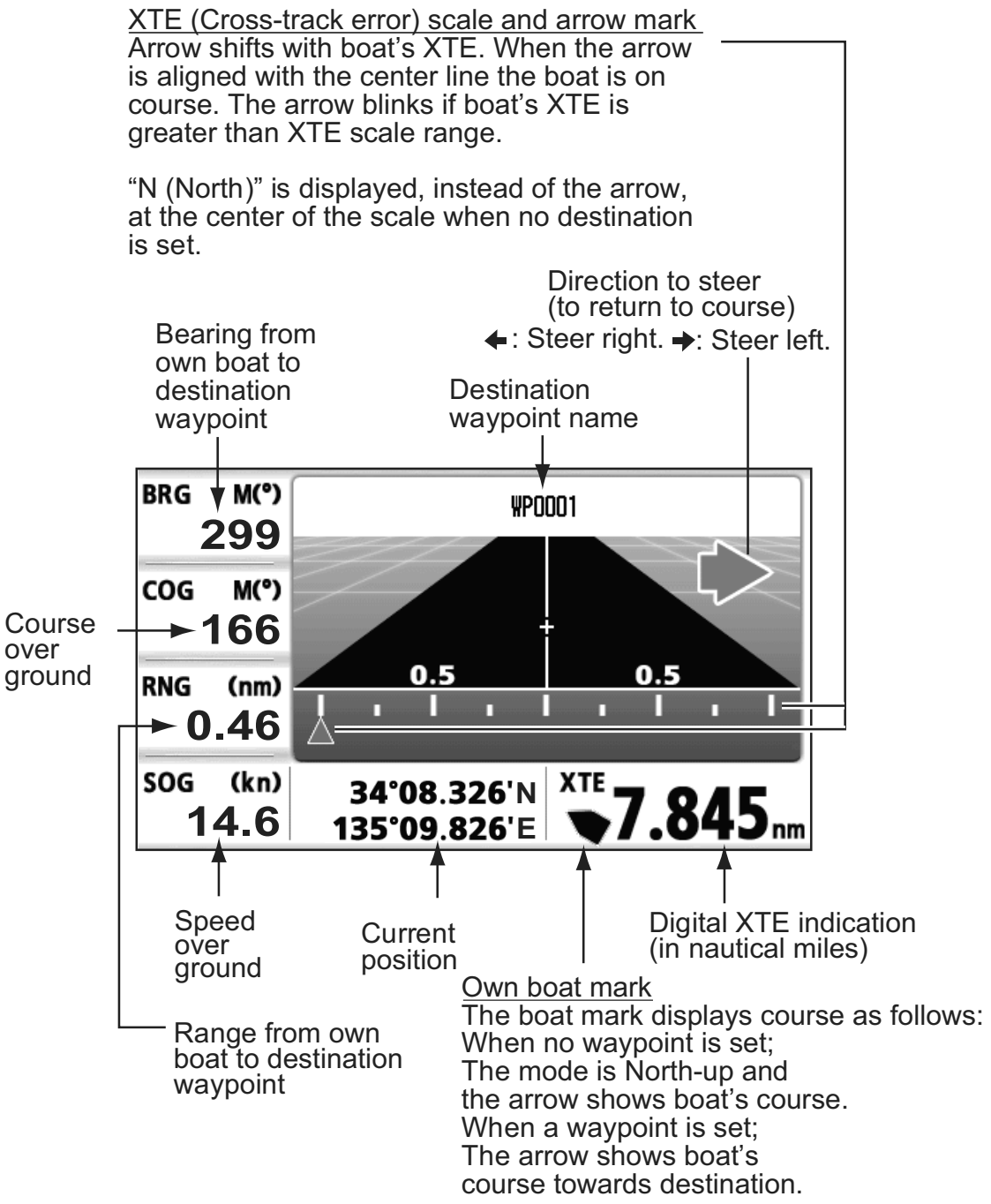
The plotter display traces own boat's track.



*:COG and SOG replace bearing to cursor and range to cursor when the cursor is not displayed.

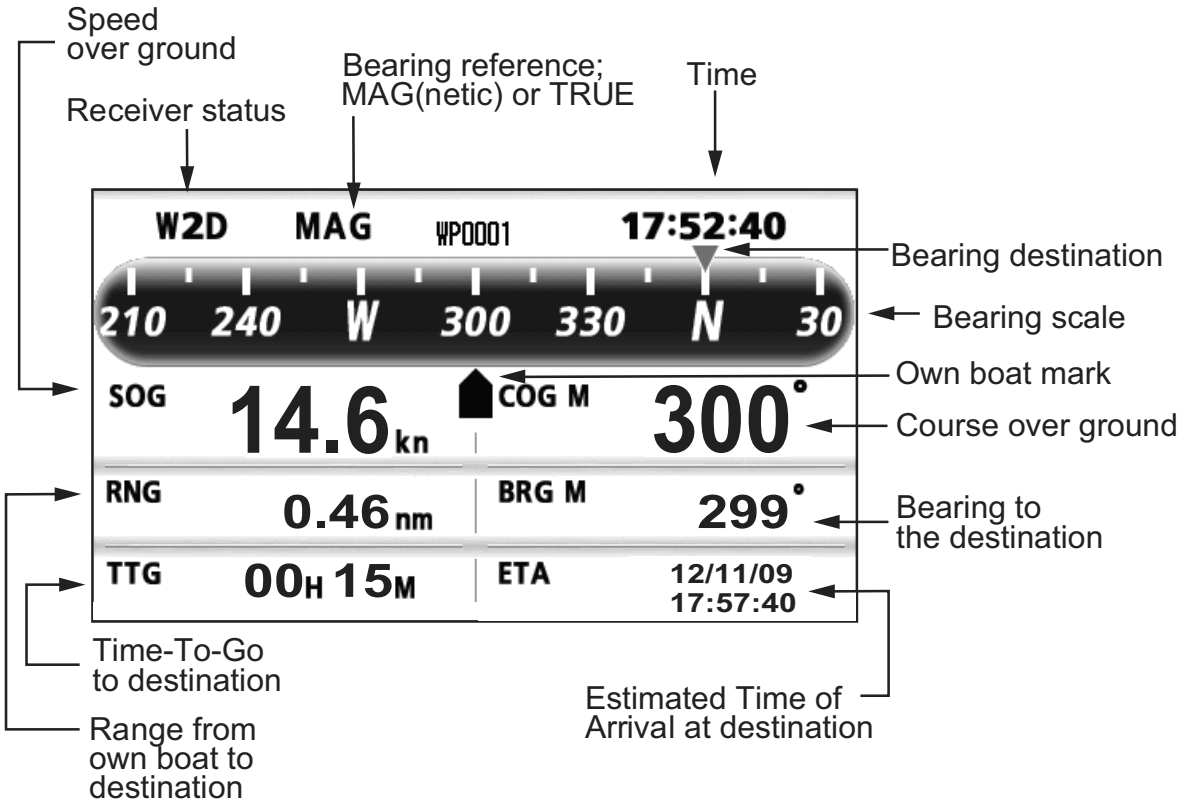
Highway Display

The highway display provides a 3-D view of own boat's progress toward destination.

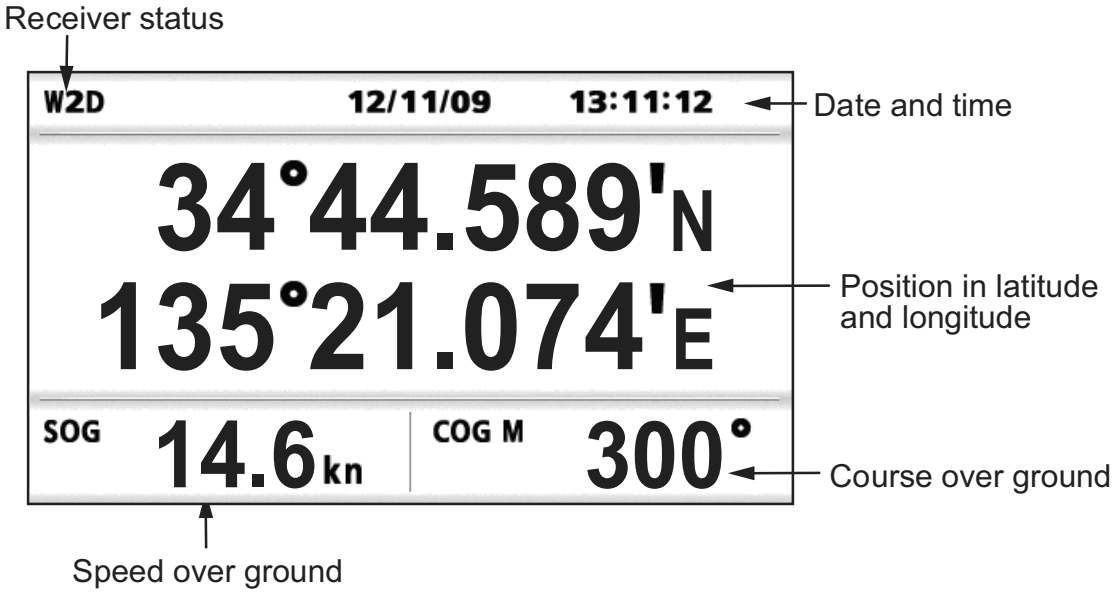


Steering Display

The steering display provides steering information.

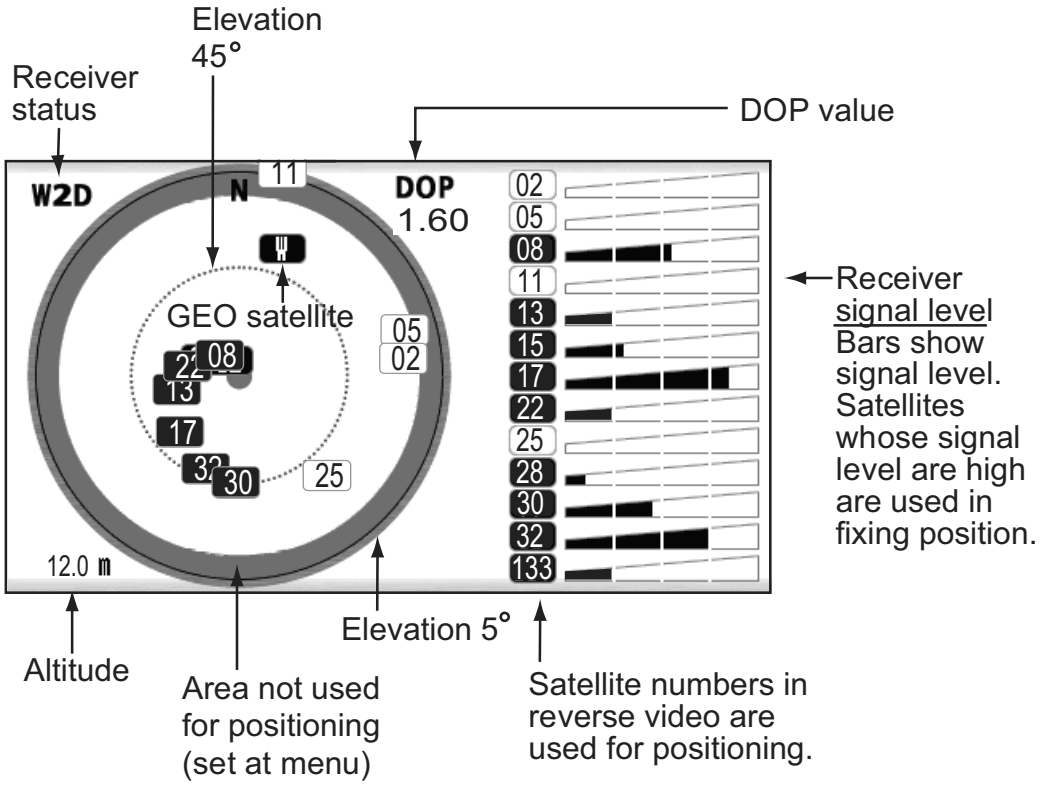


Nav Data Display



Satellite Monitor Display

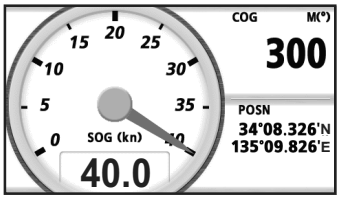
The satellite monitor display shows the condition of GPS and GEO (WAAS) satellites. Number, bearing and elevation angle of all GPS and GEO satellites (if applicable) in view of your receiver appear.



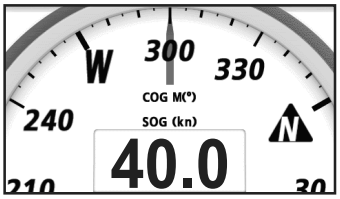
User Display 1, User Display 2

- Digital display
  The digital display shows digital navigation data. You can select what data to display in one to four cells. The choices of data are time, date, speed over ground, cross-track-error, odometer distance, position, course over ground, time-to-go to destination, trip distance, power source voltage, range and bearing to waypoint and estimated time of arrival at destination.
- Speedometer display
  The speedometer display provides both digital and analog displays of speed over ground.
- COG display
  The COG display shows both analog course over ground, and digital speed over ground.

Digital display (four cells)



Speedometer display
(default: User display 1)



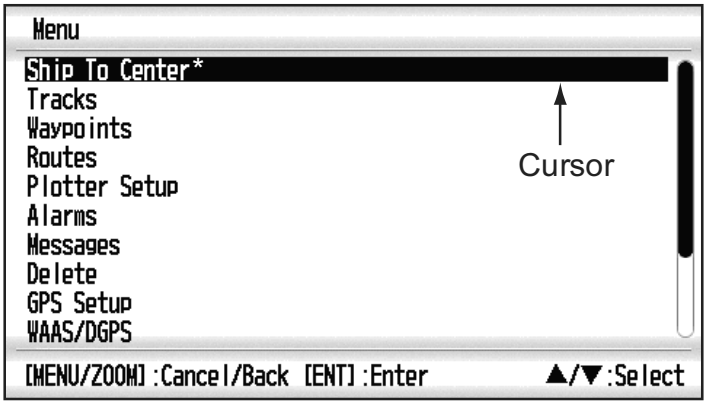
COG display
(default: User display 2)

1.5 Menu Overview

Most operations of your unit are done through the menu. Below is a quick introduction to how to select a menu and change menu settings. If you get lost in operation, press the **MENU/ZOOM** key to return to the main menu.

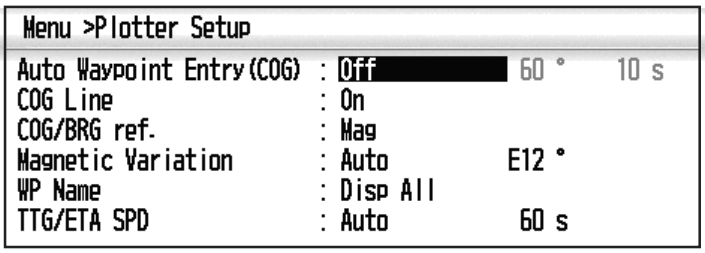
1. Press the **MENU/ZOOM** key once or twice to display the main menu.
   Press once: Steering display, nav data display, satellite monitor display, user display 1/2.
   Press twice: Plotter display, highway display

   Note: Following explanation takes the menus for the plotter display as an example.



*: Shown only when the MENU/ZOOM key is pressed at the plotter display.

2. Press ▲ or ▼ to select an item, and press the **ENT** key.
3. Press **ENT** (or ▶) key.
   For example, select [Plotter Setup] and press the **ENT** key.

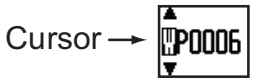


4. Press ▲ or ▼ to select option desired.
   For example, select [COG/BRG ref.]
5. Press the **ENT** key (or ▶).
   A window shows the options for the item selected.

6. Press ▲ or ▼ to select option desired.
7. Press the **ENT** key (or ▶).
8. Press the **MENU/ZOOM** key (or ◀) twice to close the menu.

How to enter alphanumeric data

Some menu operations require you to enter alphanumeric data (A to Z, 0 to 9) and symbols (&, _, #,' , -, > and space). The procedure which follows shows how to enter alphanumeric data. For example, to change the waypoint name "WP0006" to "KOBE", do the follows:

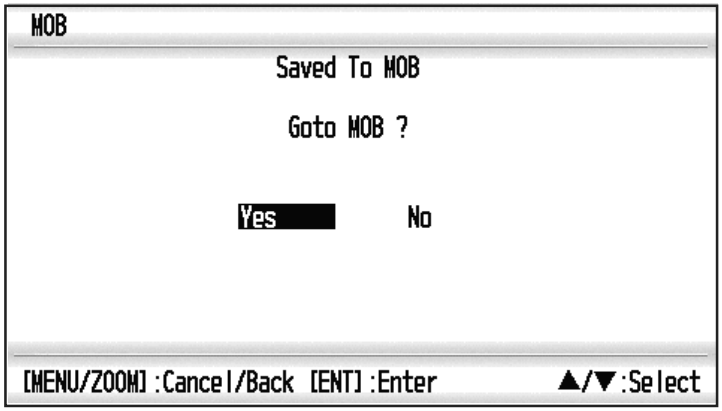


1) Press ▲ or ▼ to select "K".
2) Press ▶, and press ▲ or ▼ to select "O".
3) Press ▶, and press ▲ or ▼ to select "B".
4) Press ▶, and press ▲ or ▼ to select "E".
5) Press ▶, and press ▲ or ▼ to select " "(space).
6) Press ▶, and press ▲ or ▼ to select " " (space).
7) Press the **ENT** key.

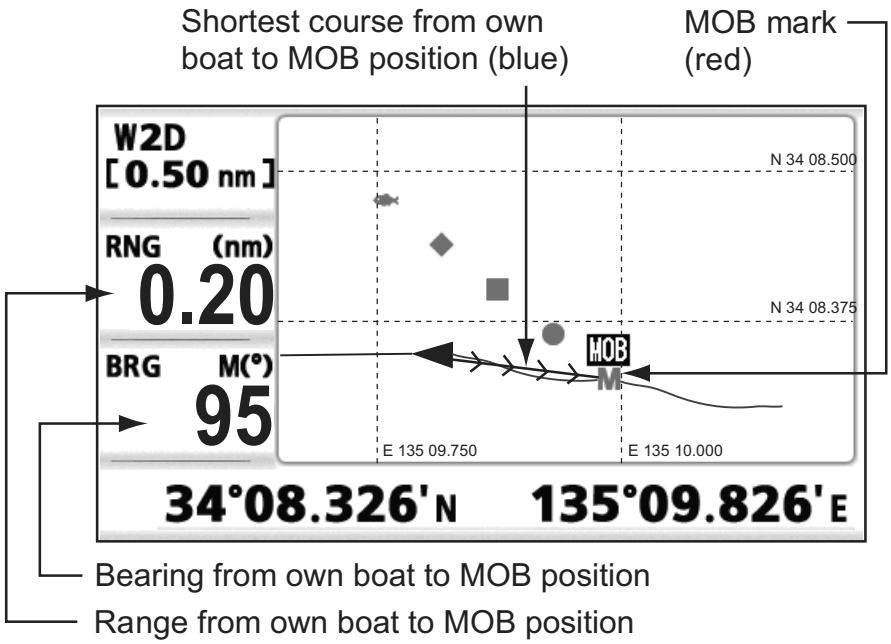
1.6 How to Enter the MOB Mark

The MOB mark denotes man overboard position. Only one MOB mark is displayed. Each time the MOB mark is entered the previous MOB mark and its position data are overwritten.

1. Press and hold the **WPT/MOB** key down to show the following message.



2. To set MOB position as destination, confirm that [Yes] is chosen and press the **ENT** key. MOB mark ("M") appears and a blue line is drawn between own boat mark and the MOB mark. This line shows the shortest course to go to the MOB position, and arrows on the line show the direction to the MOB position.

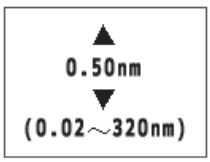

Shortest course from own boat to MOB position (blue)
MOB mark (red)
W2D
[0.50 nm]
RNG (nm)
0.20
BRG M(°)
95
N 34 08.500
N 34 08.375
E 135 09.750
E 135 10.000
MOB
34°08.326'N 135°09.826'E
Bearing from own boat to MOB position
Range from own boat to MOB position

2. PLOTTER DISPLAY OVERVIEW

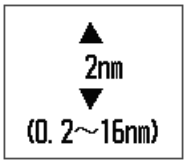
2.1 How to Select the Display Range

You can change the display range on the plotter and highway displays. The horizontal range in the plotter display is available among 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 40, 80, 160 and 320 nautical miles. The horizontal range in the highway display is available among 0.2, 0.4, 0.8, 1, 2, 4, 8 and 16 nautical miles.

1. Press the **MENU/ZOOM** key on the plotter or highway display.
   The following window appears.



(Plotter display)



(Highway display)

2. Press ▲ or ▼ to select range you want.
3. Press the **ENT** key.

2.2 How to Shift the Cursor

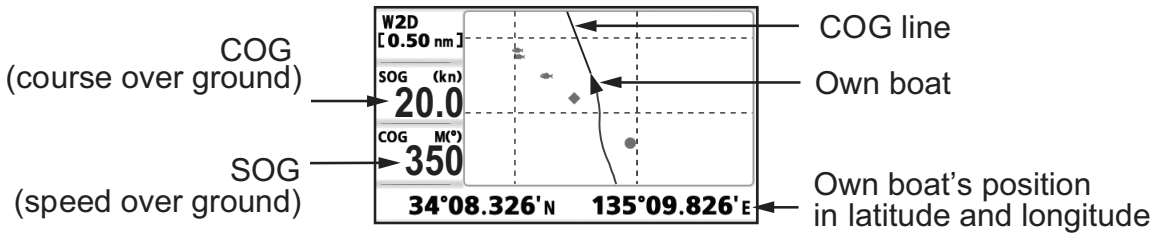
Use the cursorpad to shift the cursor. The cursor moves in the direction of the arrow or diagonal.

Cursor state and position indication

The position indication, shown at bottom of the plotter display, changes according to cursor state.

Cursor at rest

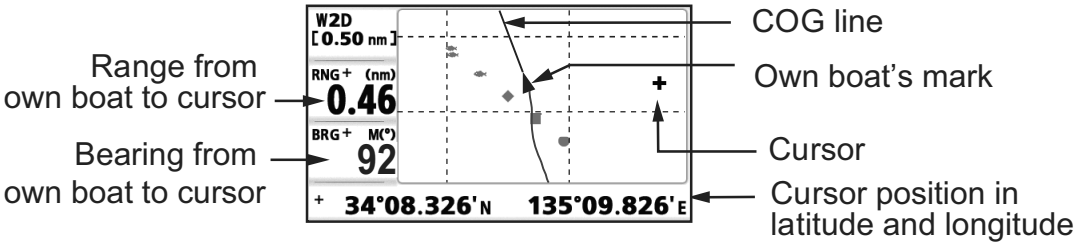
When the cursor is not shown, boat's position in longitude and latitude or TDs (depending on the menu setting) appears at the bottom of the display.



Cursor state and position indication

Cursor position is displayed in latitude and longitude or TDs at the bottom of the plotter display when the cursor is shown.

If there is no operation for about seven seconds, the cursor disappears.



2.3 How to Shift the Display

The display can be shifted on the plotter display.

1. Press the cursorpad to show the cursor.
2. Press and hold down an arrow on the cursorpad.
   When the cursor is placed at an edge of the screen, the display shifts in the direction opposite to cursorpad operation.

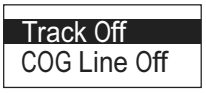
Centering own boat's position

When own boat tracks off the plotter display, the own boat mark is automatically returned to the screen center. You can also return it manually by pressing and holding the **ENT** key for more than three seconds.

2.4 How to Display/Hide Track and COG Line

The own boat's track and COG line can be displayed or hidden separately on the plotter display.

1. Press the cursorpad to show the cursor.
2. Operate the cursorpad to place the cursor on the own boat mark.
3. Press the **ENT** key to show the pop-up window.
   The default setting is On for Track and COG Line, so the following pop-up window for Off setting appears.

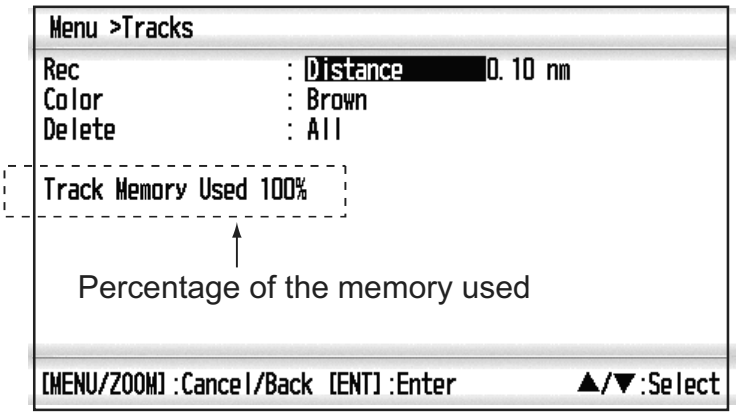


4. Select [Track Off] or [COG Line Off] to hide the track or COG line, and press the **ENT** key. To display the track or COG line, select [Track On] or [COG Line On] and press the **ENT** key.

2.5 How to Change Track Plotting Interval, Stop Recording

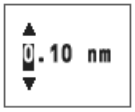
To trace the boat's track, the boat's position is stored into the memory at an interval of distance or according to display range. For distance, a shorter interval provides better reconstruction of the track, but the storage time of the track is shorten. When the track memory becomes full, the oldest track is erased to make room for the latest. The current percentage of the memory used can be confirmed by choosing [Tracks] on the menu.

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Tracks], and press the **ENT** key.



3. Confirm that the [Rec] is selected, and press the **ENT** key.

4. Select [Off], [Distance] or [Auto], and press the **ENT** key.
   Off: Track is not recorded. This setting is useful when you do not need to record track.
   Distance: Track is recorded and plotted at the distance interval set.
   Auto: Plotting and recording interval changes with display range selected.
5. For [Off] or [Auto], go to step 6. For [Distance], enter the recording interval as follows:
   1) Press ▶.
   2) Press **ENT** key.



   3) Use the cursorpad to enter the interval, and press the **ENT** key.
      For entering the numeric data, see page 1-9.
6. Press the **MENU/ZOOM** key twice to close the menu.

2.6 How to Change Track Color

You can select the color for the tracks among red, yellow, green, blue, purple, black and brown. It is useful to change the color to distinguish tracks at different times of a day, for example.

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Tracks], and press the **ENT** key.
3. Select [Color], and press the **ENT** key.

4. Select the color to use for the track, and press the **ENT** key.
5. Press the **MENU/ZOOM** key twice to close the menu.

2.7 How to Erase Track

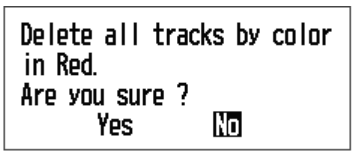
The tracks can be erased collectively or by color. The tracks cannot be restored once erased, therefore be absolutely sure you want to erase the tracks.

2.7.1 How to erase track by color

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Tracks], and press the **ENT** key.
3. Select [Delete], and press the **ENT** key.

4. Select [By Color], and press the **ENT** key.

5. Select the track color to erase, and press the **ENT** key.
   The window shown below appears.



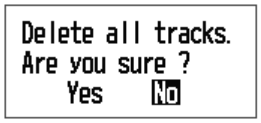
6. Press ◀ to select [Yes], and press the **ENT** key.
   The tracks with the color chosen at step 5 are erased.

Note: To cancel, select [No] at this step.

7. Press the **MENU/ZOOM** key twice to close the menu.

2.7.2 How to erase all tracks

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Tracks], and press the **ENT** key.
3. Select [Delete], and press the **ENT** key.
4. Select [All], and press the **ENT** key.



5. Press ◀ to select [Yes], and press the **ENT** key to erase all tracks. [Track Memory Used] on the Tracks menu shows “0%”.
6. Press the **MENU/ZOOM** key twice to close the menu.

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3. WAYPOINTS

3.1 How to Enter Waypoints

In navigation terminology a waypoint is a particular location on a voyage, whether it be a starting, intermediate or destination waypoint. Your unit can store 10,000 waypoints. Waypoints can be entered on the plotter display: at cursor position, at own boat's position, through the waypoints list and at the MOB position. Also, waypoints can be entered automatically when your boat changes course prominently.

3.1.1 How to enter a waypoint with the cursor

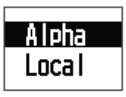
1. Use the cursorpad to place the cursor on the location desired for a waypoint.
2. Press the **ENT** key to enter the waypoint mark (default shape: green solid circle). This waypoint is named with the youngest unused waypoint number, and saved to the waypoint list.

3.1.2 How to enter a waypoint at own boat position

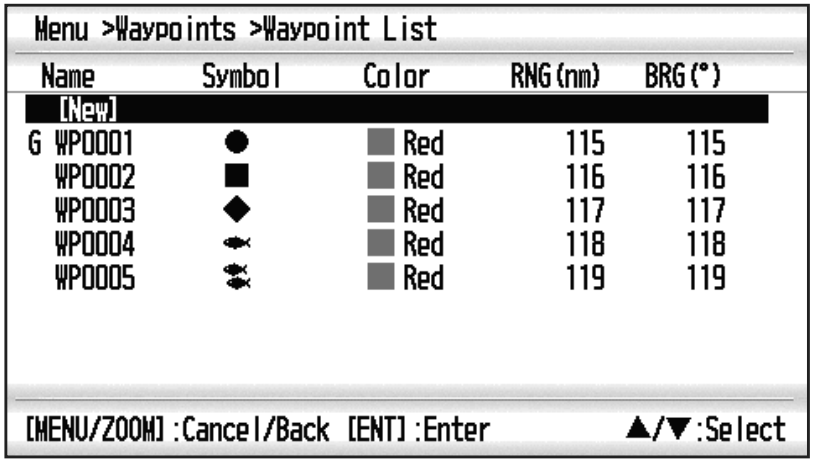
Press the **WPT/MOB** key to enter the waypoint mark (default shape: green solid circle). This waypoint is named with the youngest unused waypoint number, and saved to the waypoint list.

3.1.3 How to enter a waypoint through the list

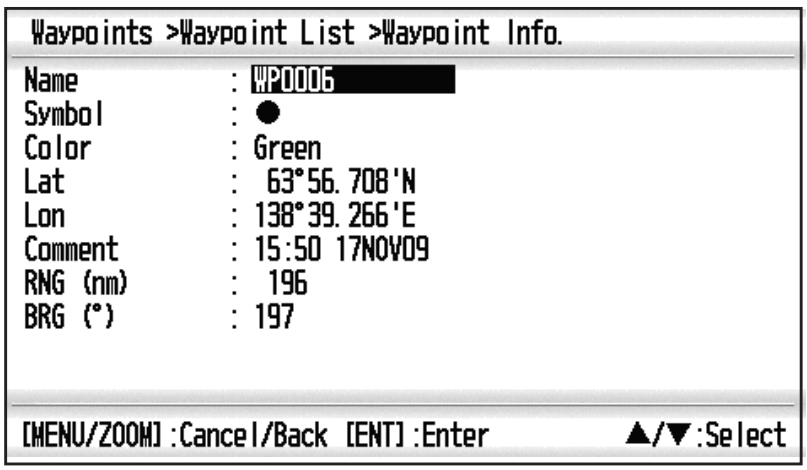
1. Press the **MENU/ZOOM** key to show the main menu.
2. Select [Waypoints], and press the **ENT** key.



3. Press the **ENT** key to show the waypoint list.

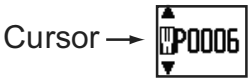


4. Confirm that [New] is chosen, and press the **ENT** key.



The default name, Lat/Lon and Comment are as follows:
Name: The youngest unused waypoint number.
Lat, Lon: Current own boat position
Comment: Current date/time

5. To change the waypoint name, press the **ENT** key.



6. Operate the cursorpad to change the waypoint name (max. 8 characters).
7. To change the mark shape, select [Symbol] and press the **ENT** key.

8. Select a mark desired, and press the **ENT** key.
9. To change the mark color, select [Color], and press the **ENT** key.

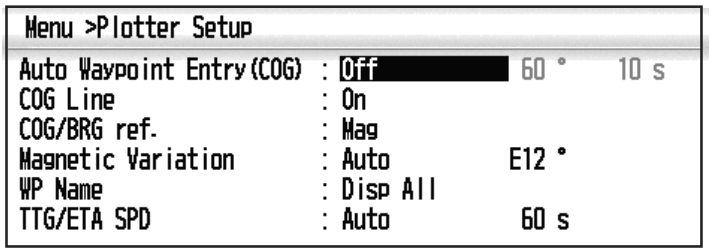
10. Select a color desired, and press the **ENT** key.
11. To change the position, do as follows:
    1) Select [Lat], and press the **ENT** key.
    2) Enter latitude, and press the **ENT** key.
    3) Press ▼ to select [Lon], and press the **ENT** key.
    4) Enter longitude, and press the **ENT** key.

12. To change the comment, select [Comment] and press the **ENT** key.
13. Enter the comment, and press the **ENT** key.
14. Press the **MENU/ZOOM** key to register the new waypoint into the list.
15. To register other waypoints, repeat steps 4 through 14.
16. Press the **MENU/ZOOM** key several times to close the menu.

3.1.4 How to enter waypoints automatically

Waypoints can be entered automatically when your course changes by a specified degree. This function is useful for reversely following the waypoints recorded on an outward voyage when you return home. To set the criteria for automatic entering of waypoints, do the following:

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Plotter Setup], and press the **ENT** key.

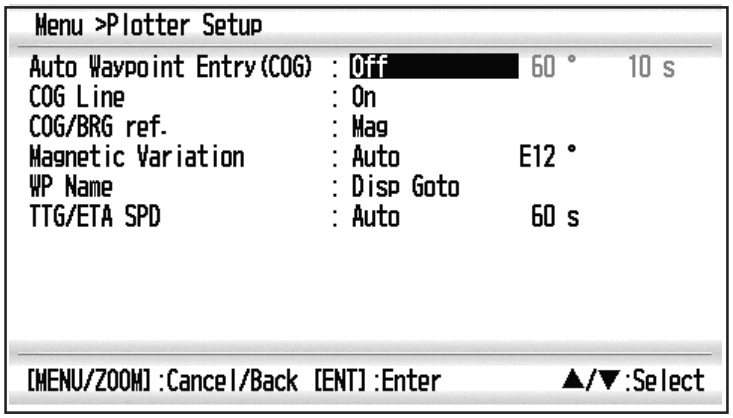


3. Select [Auto Waypoint Entry (COG)], and press the **ENT** key.
4. Select [On], and press the **ENT** key.
5. Press ▶ to select the degree setting, and press the **ENT** key.
6. Enter the degree, and press the **ENT** key (setting range: 15 to 150°).
7. Press ▶ to select the seconds setting, and press the **ENT** key.
8. Enter the seconds, and press the **ENT** key (setting range: 1 to 60 seconds).
9. Press the **MENU/ZOOM** key twice to close the menu.

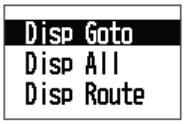
3.2 How to Display Waypoint Name

You can display waypoint names as follows:

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Plotter Setup], and press the **ENT** key.



3. Select [WP Name], and press the **ENT** key.



4. Select [Disp Goto], [Disp All] or [Disp Route], and press the **ENT** key.
   Disp Goto: Displays only the destination waypoint name.
   Disp All: Displays all waypoint names.
   Disp Route: Displays all waypoint names in the route when it is set as destination.
5. Press the **MENU/ZOOM** key twice to close the menu.

3.3 How to Edit Waypoints

Waypoint position, name, mark shape and comment can be edited on the plotter display or through the waypoint list.

Note: When the waypoint chosen is set as the destination, the message "Change The Waypoint. Are you sure?" appears.

3.3.1 How to edit waypoints on the plotter display

1. Operate the cursorpad to place the cursor on the waypoint to edit.
2. Press the **ENT** key to show the pop-up window.

3. Select [Edit], and press the **ENT** key to show the waypoint information.
4. Edit the waypoint (see the paragraph 3.1.3).
5. Press the **MENU/ZOOM** key to return to the plotter display.

3.3.2 How to edit waypoints through the list

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Waypoints], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key.
   Alpha: The list shows waypoints in alphabetical order.
   Local: The list shows waypoints from the nearest to the furthest.
4. Select the waypoint to edit, and press the **ENT** key to show the pop-up window.

5. Select [Edit], and press the **ENT** key to show the waypoint information.
6. Edit the waypoint data (see the paragraph 3.1.3).
7. Press the **MENU/ZOOM** key several times to close the menu.

3.4 How to Move Waypoints

You can move waypoints to any position on the plotter display.

1. Operate the cursorpad to place the cursor on the waypoint to move.
2. Press the **ENT** key to show the pop-up window.

3. Select [Move], and press the **ENT** key to show the waypoint information.
4. Operate the cursorpad to move the cursor to the new position.
5. Press the **ENT** key.

3.5 How to Erase Waypoints

You can erase each or all waypoint(s).

Note: You cannot erase the waypoint used as the current destination. (See paragraphs paragraph 3.5.1, paragraph 3.5.2.)

3.5.1 How to erase a waypoint on the plotter display

1. Operate the cursorpad to place the cursor on the waypoint to erase.
2. Press the **ENT** key to show the pop-up window.

3. Select [Delete], and press the **ENT** key.

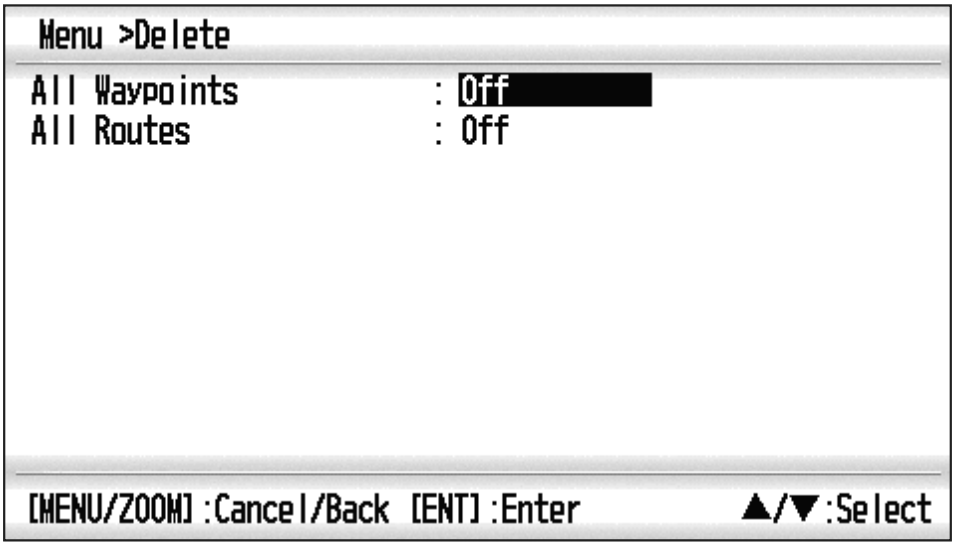
3.5.2 How to erase a waypoint through the waypoint list

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Waypoints], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key.
4. Select the waypoint to erase, and press the **ENT** key.

5. Select [Delete], and press the **ENT** key.
6. Press the **MENU/ZOOM** key several times to close the menu.

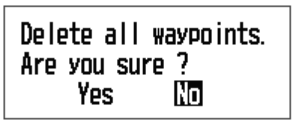
3.5.3 How to erase all waypoints

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Delete], and press the **ENT** key.

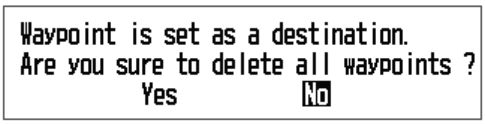


3. Confirm that [All Waypoints] is chosen, and press the **ENT** key.

4. Select [Delete], and press the **ENT** key.



When no waypoint is set as destination



When a waypoint is set as destination

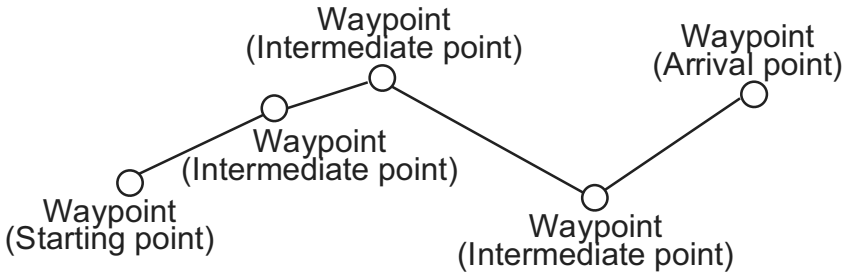
5. Select [Yes], and press the **ENT** key to erase all waypoints.
   Note: To cancel, select [No].
6. Press the **MENU/ZOOM** key twice to close the menu.

4. ROUTES

In many cases a trip from one place to another involves several course changes, requiring a series of waypoints which you navigate to, one after another. The sequence of waypoints leading to the ultimate destination is called a route. Your unit can automatically advance to the next waypoint on a route, so you do not have to change the destination waypoint repeatedly.

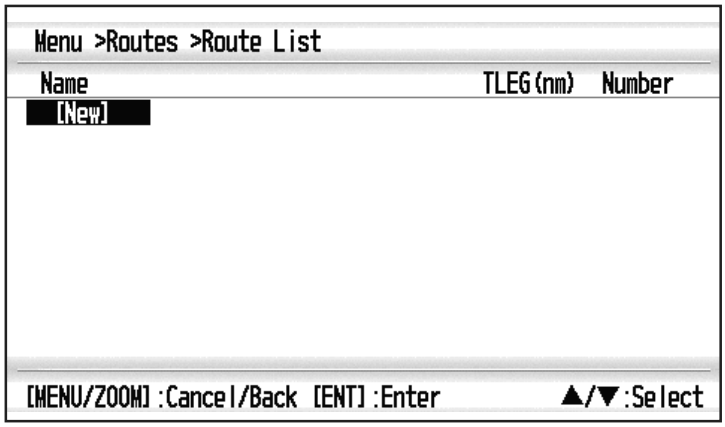
4.1 How to Create Routes

You can store up to 100 routes, and a route can have 30 waypoints. A route is constructed with the waypoints you have entered.

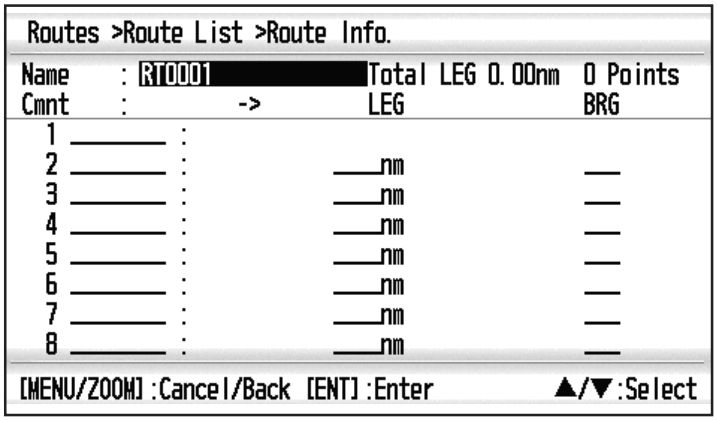


Sample route

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Press the **ENT** key to show the route list.

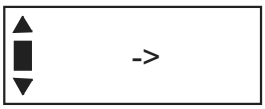


4. Confirm that [New] is chosen, and press the **ENT** key to show the route information.

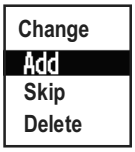


5. Press the **ENT** key to change the route name.

6. Operate the cursorpad to enter the route name, and press the **ENT** key (maximum: six characters).
7. Press ▼ then **ENT** key.



8. Operate the cursorpad to enter the comment (maximum: 18 characters).
9. Press ▼ to move the cursor to [1], and press the **ENT** key.



10. Confirm that [Add] is chosen, and press the **ENT** key.
11. Select [Alpha] or [Local], and press the **ENT** key to show the waypoint list.
12. Select the waypoint to add to the route, and press the **ENT** key.
    The chosen waypoint (as the starting point) is registered to [1].
13. Press ▼ to select [2], and press the **ENT** key.
14. Repeat steps 10 through 13 to complete the route.
15. Press the **MENU/ZOOM** key several times to close the menu.

4.2 How to Edit Routes

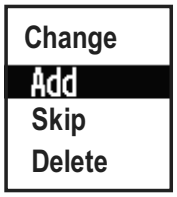
You can edit the route created.

Note: When the route chosen is set as route navigation, the message "Route is set as a destination. Are you sure?" appears.

4.2.1 How to replace a waypoint in a route

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to show the route list.
4. Select the route to edit, and press the **ENT** key.

5. Select [Edit], and press the **ENT** key to show the route list.
6. Select the waypoint to replace, and press the **ENT** key.



7. Select [Change], and press the **ENT** key.
8. Select [Alpha] or [Local], and press the **ENT** key to show the waypoint list.
9. Select the new waypoint, and press the **ENT** key.
10. Press the **MENU/ZOOM** key several times to close the menu.

4.2.2 How to delete a waypoint from a route

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to show the route list.
4. Select the route to edit, and press the **ENT** key.
5. Select [Edit], and press the **ENT** key to show the route information.
6. Select the waypoint to delete from the route, and press the **ENT** key.
7. Select [Delete], and press the **ENT** key.
8. Press the **MENU/ZOOM** key several times to close the menu.

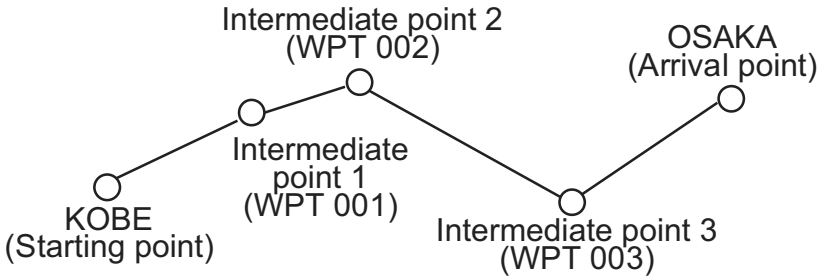
4.2.3 How to insert a waypoint in a route

To insert a waypoint in a route, do the following:

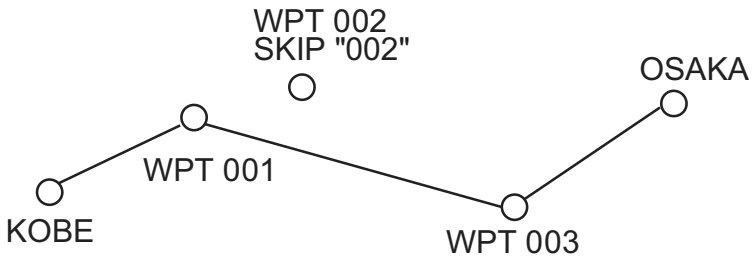
1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to show the route list.
4. Select the route to edit, and press the **ENT** key.
5. Select [Edit], and press the **ENT** key to show the route list.
6. Select the waypoint which will come after the waypoint to be inserted, and press the **ENT** key.
7. Select [Add], and press the **ENT** key.
8. Select [Alpha] or [Local], and press the **ENT** key to show the waypoint list.
9. Select the waypoint, and press the **ENT** key.
10. Press the **MENU/ZOOM** key several times to close the menu.

4.2.4 How to temporarily deselect a waypoint in a route

You can temporarily deselect an unnecessary waypoint from a route. Using the route created in the illustration shown below as an example, deselect the second intermediate waypoint.



If you reconstruct the route without the second intermediate point it would look like the illustration below.



1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to select the route list.
4. Select the route to edit, and press the **ENT** key.
5. Select [Edit], and press the **ENT** key to show the route information.
6. Select the waypoint to skip, and press the **ENT** key.
7. Select [Skip], and press the **ENT** key to show “X” next to the waypoint chosen at step 6.

8. Press the **MENU/ZOOM** key several times to close the menu.

Note: To restore waypoint to a route, select [Skip Off] at step 7, and press the **ENT** key.

4.3 How to Erase a Route

You can erase routes individually or collectively.

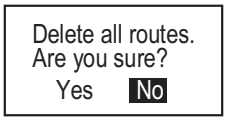
4.3.1 How to erase a route through the route list

Note: The route used as route navigation can not be erased.

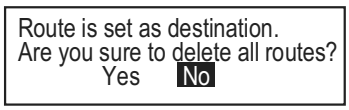
1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Routes], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to show the route list.
4. Select the route to erase, and press the **ENT** key.
5. Select [Delete], and press the **ENT** key to erase the route chosen at step 4.
6. Press the **MENU/ZOOM** key several times to close the menu.

4.3.2 How to erase all routes

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Delete], and press the **ENT** key.
3. Select [All Routes], and press the **ENT** key.
4. Select [Delete], and press the **ENT** key to show the following message.



When no route is set as destination



When a route is set as destination

5. Select [Yes], and press the **ENT** key to erase all routes.
   Note: To cancel, select [No].
6. Press the **MENU/ZOOM** key twice to close the menu.

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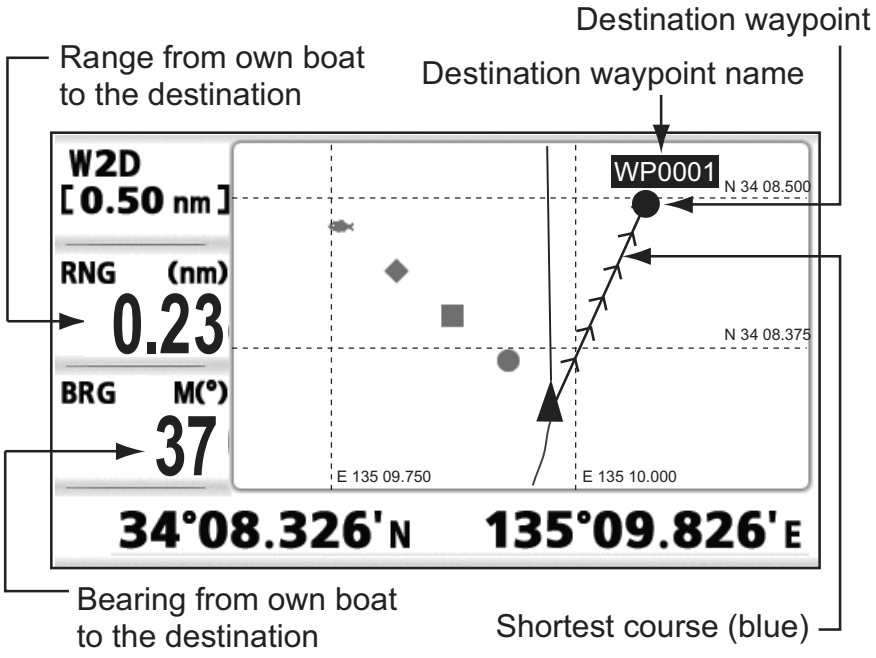
5. DESTINATION

Destination can be set four ways: by cursor, by waypoint, by route and by MOB position. Previous destination is cancelled whenever a new destination is set. The setting by MOB position is described in chapter 1. When setting a destination, a blue line is shown between own boat and the destination selected. Also, the range and bearing from own boat to the destination are shown at the left-hand side of the screen.



5.1 How to Set Destination by Cursor Position

You can set a destination at the position with no waypoint. This destination is called “Quick Point”.

1. On the plotter display, operate the cursorpad to place the cursor on the location desired for destination.
2. Press the **GO TO** key to enter the waypoint as the quick point.
   The quick waypoint is shown with a green solid circle, and named as "QP". This point is saved in the waypoint list automatically.
3. Cancel the destination, referring to section 5.4, when arriving at the waypoint.

Note: The quick point set is erased when a new one is entered.

5.2 How to Set Destination by Waypoint

You can set a waypoint as destination by using the cursor or the waypoints list.

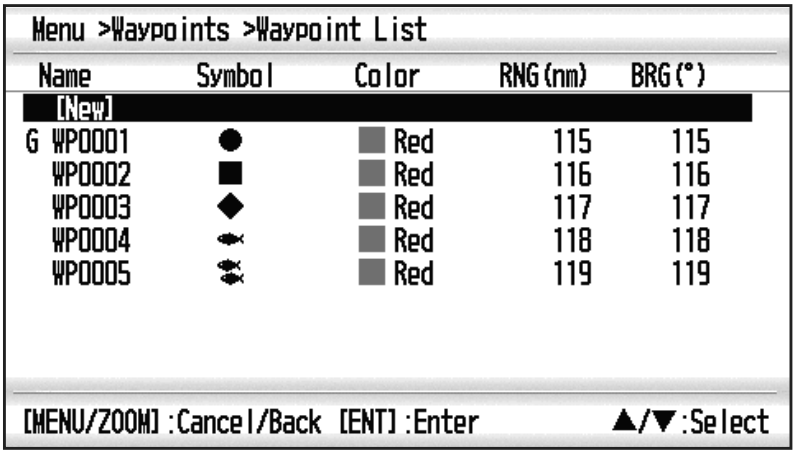
5.2.1 How to set a destination waypoint with the cursor

1. On the plotter display, operate the cursorpad to place the cursor on the waypoint which you want to set as the destination.
2. Press the **ENT** key.

3. Select [Goto], and press the **ENT** key.
4. Cancel the destination referring to section 5.4 when arriving at the waypoint.

5.2.2 How to set a destination waypoint through the list

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Waypoints], and press the **ENT** key.
3. Select [Alpha] or [Local], and press the **ENT** key to show the waypoint list.



4. Select the waypoint to set as a destination, and press the **ENT** key.

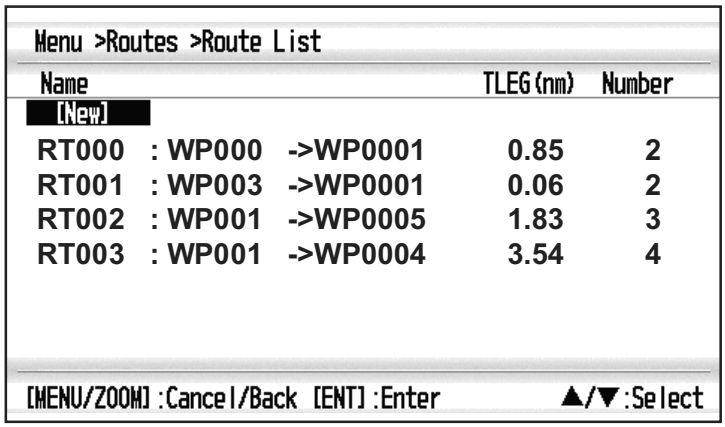
5. Select [Goto], and press the **ENT** key to show the plotter display.
6. Cancel the destination referring to section 5.4 when arriving at the waypoint.

5.3 How to Set Route as Destination

You can set a route as destination through the list.

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Route], and press the **ENT** key.

3. Select [Alpha] or [Local], and press the **ENT** key.

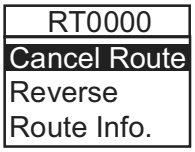


4. Select the route to set as a destination, and press the **ENT** key.

5. Select [Goto], and press the **ENT** key.
6. Select [Forward] or [Reverse].
   Forward: Follows waypoints in order registered (1→2→3…)
   Reverse: Follows waypoints in reverse order registered (30 (when maximum entered) →29→28…→1)
7. Press the **ENT** key to show the plotter display. The destination route is shown with waypoints connected with legs.
8. Cancel the destination referring to section 5.4 when arriving at the waypoint.

How to change the following direction after you set a route as destination

After you start doing the route destination, you can change the following direction, [Forward]→[Reverse] or vice versa. Place the cursor on a leg of the route, and press the **ENT** key to show the following pop-up window. Select [Reverse] (or [Forward]). Then, select [Yes] and press the **ENT** key.



Note: If your boat has not yet arrived at the first waypoint in the route, the current route destination is cancelled if you select [Reverse] (or [Forward]). Set the route destination again.

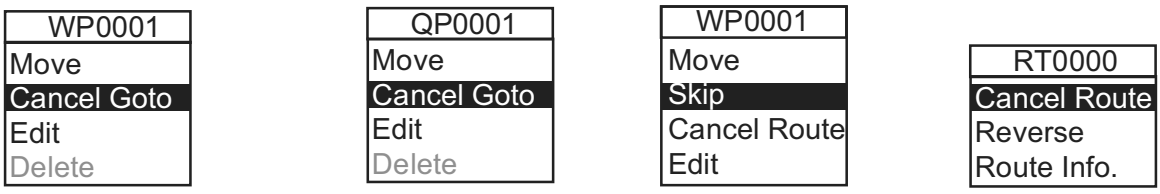
5.4 How to Cancel Destination

You can cancel destination by using the cursor, or through the list.

5.4.1 How to cancel destination with the cursor

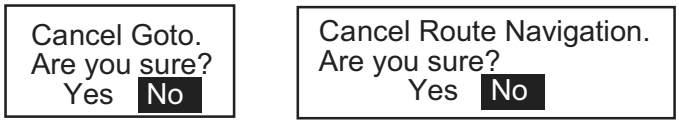
1. On the plotter display, operate the cursorpad to place the cursor on the waypoint (route) set as the current destination.

2. Press the **ENT** key.



(for waypoint destination) (for QP destination) (for route navigation) (for route leg)

3. Select [Cancel Goto (Route)], and press the **ENT** key.

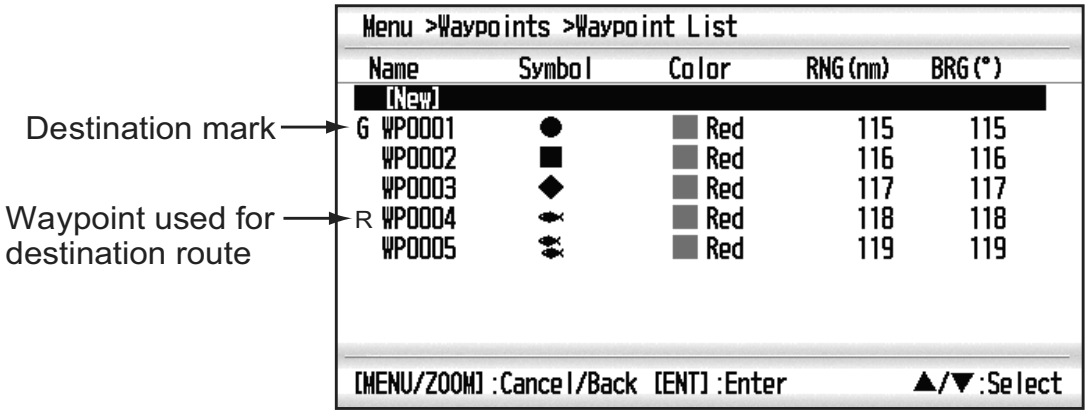


(for waypoint destination) (for route navigation)

4. Chose [Yes], and press the **ENT** key.
   To cancel, select [No].

5.4.2 How to cancel destination through the list

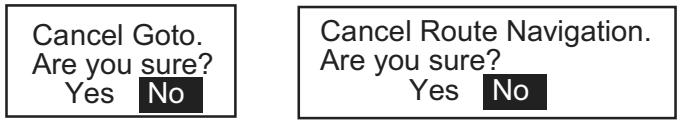
1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Waypoints] (or [Routes]), and press the **ENT** key twice.
3. Select the waypoint (route) set as the current destination.



4. Press the **ENT** key.

(for waypoint destination) (for route navigation)

5. Select [Cancel Goto (Route)], and press the **ENT** key.



(for waypoint destination) (for route navigation)

6. Select [Yes], and press the **ENT** key.
   To cancel, select [No].
7. Press the **MENU/ZOOM** key several times to close the menu.

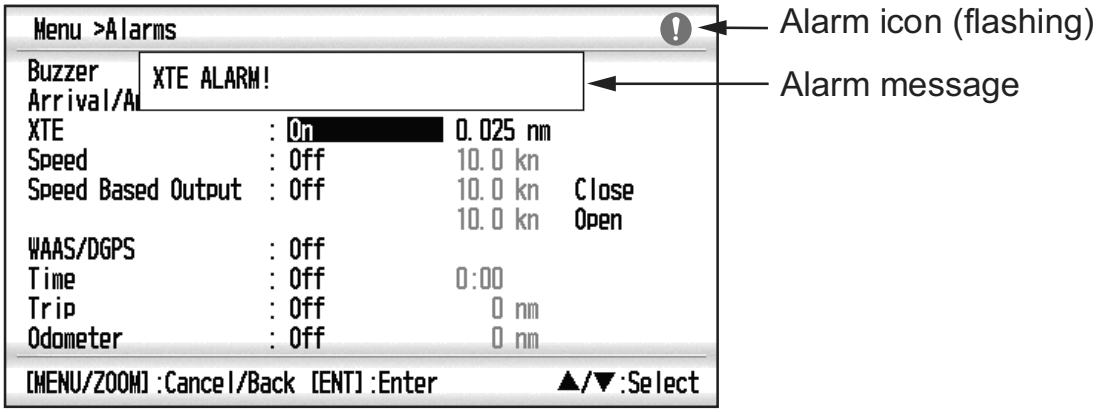
6. ALARMS

6.1 Overview

There are nine alarm conditions which generate both audio and visual alarms: Arrival alarm, Anchor watch alarm, XTE (Cross-Track Error) alarm, Speed alarm, Speed Based Output alarm, WAAS/DGPS alarm, Time alarm, Trip alarm and Odometer alarm.

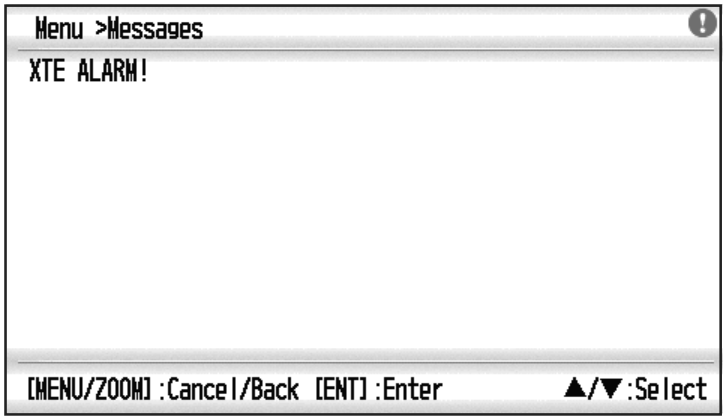
When an alarm setting is violated, the buzzer sounds and the name of the offending alarm and the alarm icon appear on the display (alarms other than Speed Based Output).

You can silence the buzzer and remove the alarm name indication by pressing any key. The alarm icon remains on the screen until the reason for the alarm is cleared.



To know which alarm has been violated, do the following procedure.

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Messages], and press the **ENT** key.



Example alarm message

The display shows the names of offending alarms. When there are no alarms, the message "No Message! " appears.

Message and meanings

Message	Meaning
XTE ALARM!	The boat is off its intended course by the range set.
TIME ALARM!	The time set has come.
SPEED ALARM!	The boat's speed is higher than the range set.
ARRIVAL ALARM!	The boat is approaching the arrival area.
TRIP ALARM!	The boat has traveled further than the preset trip distance.
ODOMETER ALARM!	The boat has traveled the total distance set.
ANCHOR WATCH!	The boat has moved a certain distance (when it should be at rest).
NO WAAS SIGNAL!	WAAS signal cannot be found.
NO DGPS SIGNAL!	DGPS signal cannot be found.
NO WAAS/DGPS SIGNAL!	WAAS and DGPS signal cannot be found.

Note: The message screen also shows equipment trouble. See section 8.3.

6.2 Buzzer Type Selection

The buzzer sounds whenever an alarm setting is violated. You can select the type of buzzer as follows:

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [Alarms], and press the **ENT** key.
3. Select [Buzzer], and press the **ENT** key.

4. Select buzzer type, and press the **ENT** key.
   Short: A short beep sounds.
   Long: Three long beeps sound.
   Continuous: Continuous long beeps sound until a key is pressed.
5. Press the **MENU/ZOOM** key twice to close the menu.

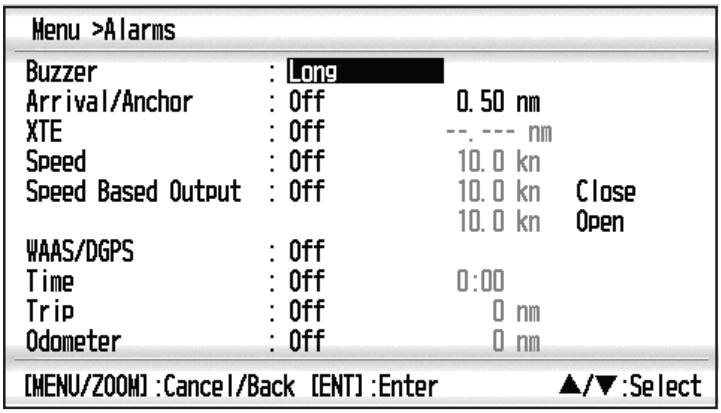
6.3 How to Set an Alarm

Set alarms as below:

Note: For the Anchor alarm, press the **WPT/MOB** key to enter the waypoint at own boat's position, and set it as destination referring to paragraph 5.2.1.

1. Press the **MENU/ZOOM** key twice to show the main menu.

2. Select [Alarms], and press the **ENT** key.



3. Select an alarm item, and press the **ENT** key.
4. Do one of the following:
   (Arrival/Anchor)
   1) Select [Arrival] or [Anchor], and press the **ENT** key.
   2) Press ▶ and **ENT** key.
   3) Enter the alarm area, and press the **ENT** key.

   (XTE, Speed, Trip and Odometer)
   1) Select [On], and press the **ENT** key.
   2) Press ▶ and **ENT** key.
   3) Enter the value, and press the **ENT** key.

   (WAAS/DGPS)
   Select [On], and press the **ENT** key.
   (Time)
   1) Select [On], and press the **ENT** key.
   2) Press ▶ and **ENT** key in order.
   3) Enter the time, and press the **ENT** key.
   4) For 12-hour clock, press ▶ and **ENT** key.
   5) Select [AM] or [PM], and press the **ENT** key.

   (Speed Based Output)
   1) Select [On], and press the **ENT** key.
   2) Press ▶ and **ENT** key.
   3) Enter the speed at which to close the contact signal, and press the **ENT** key.
   4) Press ▼ and **ENT** key.
   5) Enter the speed to open the contact signal, and press the **ENT** key.
5. Press the **MENU/ZOOM** key twice to close the menu.

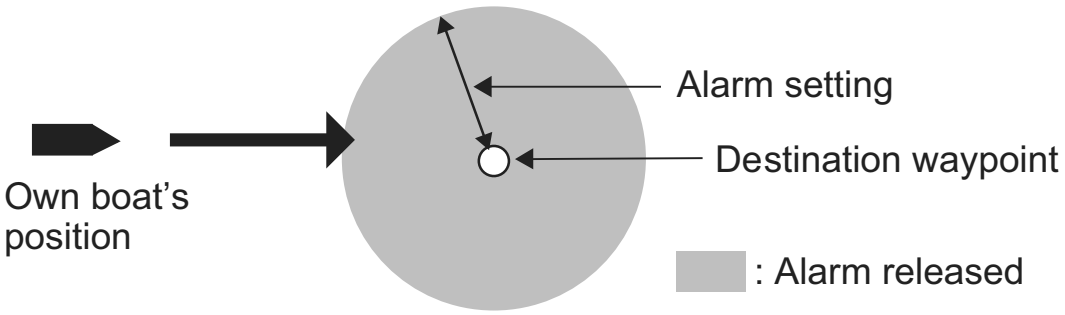
Note 1: To cancel an alarm, select [Off] at 1) on step 4.

Note 2: You can activate the arrival alarm or the anchor watch alarm; they cannot be activated together.

6.4 Alarm Descriptions

Arrival alarm

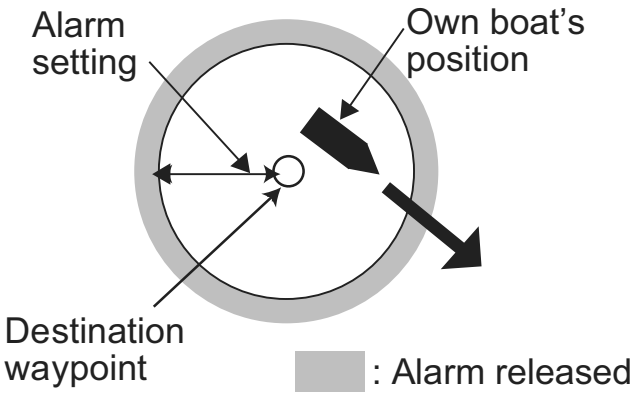
The arrival alarm informs you that own boat is approaching a destination waypoint. The area that defines an arrival zone is that of a circle which you approach from the outside of the circle. The alarm will activate if your boat enters the circle.



How the arrival alarm works

Anchor watch alarm

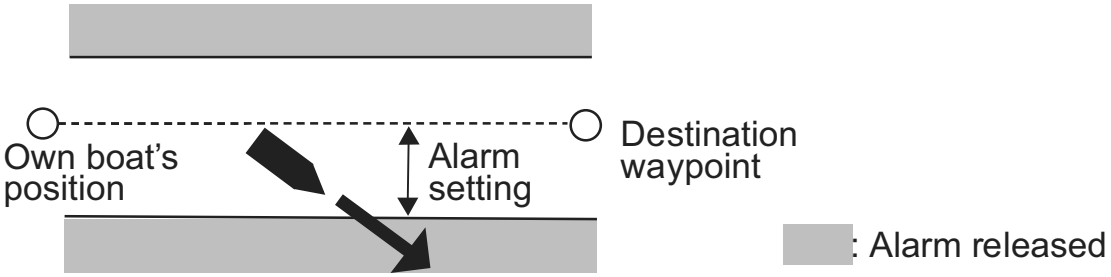
The anchor watch alarm sounds to warn you that your boat is moving when it should be at rest. Before setting the anchor watch alarm, set current position as destination waypoint.



How the anchor watch alarm works

XTE (Cross-Track Error) alarm

The XTE alarm warns you when own boat is off its intended course.



How the XTE alarm works

Speed alarm

The speed alarm alerts you when the boat's speed is higher than the alarm range set.

WAAS/DGPS alarm

This alarm alerts you when the WAAS or DGPS signal is lost (status indication except W2D/W3D/D2D/D3D). Note that On cannot be chosen if [Mode] in Menu>WAAS/DGPS is set to GPS.

Time alarm

The time alarm works like an alarm clock, releasing audio and visual alarms when the time entered has come.

Trip alarm

The trip alarm tells you when your boat has traveled further than the preset trip distance.

Odometer alarm

This alarm alerts you when your boat has traveled the total distance you set.

Speed Based Output

This alarm is for a boat that has a control system that applies the boat's speed. The contact signal is normal open. When your boat's speed is faster than the [Close] setting, the contact signal is closed. When your boat's speed is less than the [Open] setting, the contact signal is opened.

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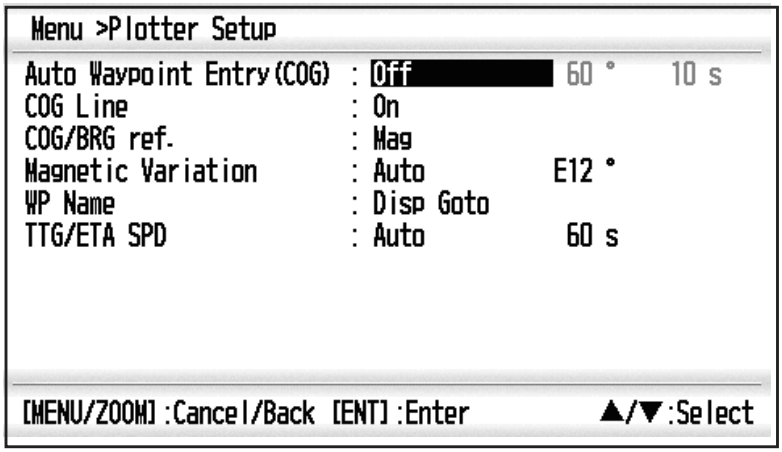
7. OTHER FUNCTIONS

This chapter describes menu items not carried in other chapters.

7.1 Plotter Setup Menu



COG Line

You can show or hide the COG line on the plotter display.

COG/BRG ref.

Boat's course and bearing to a waypoint are displayed in true or magnetic bearing. Magnetic bearing is true bearing plus (or minus) earth's magnetic variation. Select the bearing reference in according to the compass installed: magnetic for magnetic compass, true for gyrocompass or satellite compass using true bearing.

Magnetic Variation

The location of the magnetic north pole is different from the geographical north pole. This causes a difference between the true and magnetic north direction. The difference is called magnetic variation, and varies with respect to the observation point on earth. Your unit is pre-programmed with all the earth's magnetic variation. However, you may wish to enter variation manually to refine accuracy using the latest chart. Set [COG/BRG ref.] on the Plotter Setup menu to [Mag] to use magnetic variation.

To enter magnetic variation manually, do the following:

1) If necessary, change coordinate from east to west or vice versa.
2) Enter the value referring to a recent nautical chart.
3) Press the **ENT** key.

TTG/ETA SPD

To calculate time to go and estimated time of arrival, enter your speed as below.

-Auto (GPS calculated speed)

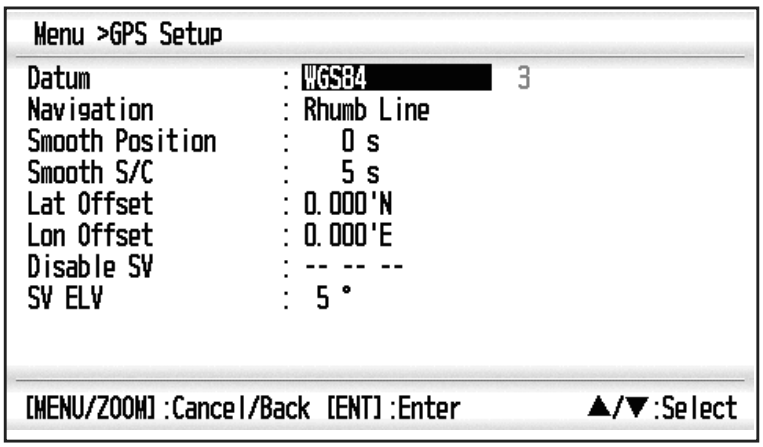
1. Press ▶ and **ENT** in order.
2. Enter the speed average (1 to 999 sec.) to use, and press the **ENT** key.

-Manual (Speed calculated manually)

1. Press ▶ and **ENT** in order.
2. Enter speed (1 to 999 knot), and press the **ENT** key.

7.2 GPS Setup Menu

The GPS Setup menu smooths position and course, averages speed, applies position offset, and deactivates unhealthy satellites.



Datum

Your unit is programmed to recognize most of the major chart systems of the world. Although the WGS-84 system, the GPS standard, is now widely used other categories of charts still exist. Select the same datum which is used in your nautical charts. Select WGS84 (default setting), WGS72 or Other (required the datum number entering).

Navigation

When you set a destination, the equipment displays the range, bearing and course to that destination. Range and bearing are calculated by the Great Circle or Rhumb Line method. Route total distance is also calculated. Cross-track error is only calculated in the Rhumb Line method.

Rhumb line: This method calculates the range and bearing between two points drawn on a nautical chart. Since the bearing is kept constant it is ideal for short-range navigation.

Great circle: This course line is the shortest course between two points on the surface of the earth, like stretching a piece of string between two points on earth. Frequent bearing changes are required to navigate by this method. For long-range navigation, divide the Great Circle route into several routes, and navigate each route by Rhumb Line.

Smooth Position

When the receiving condition is unfavorable, the GPS fix may change randomly, even if the boat is dead in water. This change can be reduced by smoothing the raw GPS fixes. The setting range is from 0 (no smoothing) to 999 seconds. The higher the setting the more smoothed the raw data, however too high a setting slows response time to change in latitude and longitude. This is especially noticeable at high boat speeds. “3” is the normal setting; increase the setting if the GPS fix changes randomly.

Smooth S/C (speed/course)

During position fixing, your boat’s velocity (speed and course) is directly measured by receiving GPS satellite signals. The raw velocity data may change randomly depending on receiving conditions and other factors. You can reduce this random variation by increasing the smoothing. Like with latitude and longitude smoothing, the higher the speed and course smoothing the more smoothed the raw data. If the setting is too high, however, the response to speed and course change slows. The setting range is from 0 (no smoothing) to 9999 seconds.

Lat Offset, Lon Offset

If there is the error between the positions shown on your equipment and chart when docking at a pier, you may apply an offset to latitude and longitude position. Mark own boat’s position on the chart to calculate the error with latitude and longitude, and enter the values.

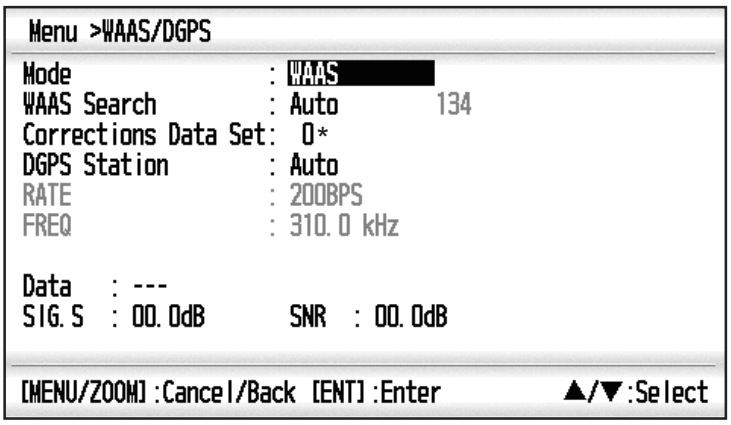
Disable SV (satellite)

Every GPS satellite is broadcasting abnormal satellite number(s) in its Almanac, which contains general orbital data about all GPS satellites. Using this information, the GPS receiver automatically eliminates any malfunctioning satellite from the GPS satellite schedule. However, the Almanac sometimes may not contain this information. You can disable an inoperative satellite manually. Enter satellite numbers (max. three satellites) in two digits.

SV ELV (satellite elevation)

Set the minimum elevation of satellites to use to fix position.

7.3 WAAS/DGPS Menu



*Use “0” (as default setting).

Mode

You can select [WAAS], [GPS] or [DGPS] for the position fixing mode. When selecting [Auto], the mode automatically switches to WAAS with no DGPS signal. When selecting [WAAS], [DGPS] or [Auto], the mode automatically switches to GPS with no WAAS or DGPS signal.

Note: A DGPS beacon receiver required to add DGPS capability.

WAAS Search

For WAAS setting, the GEO satellite is searched automatically or manually. For GEO satellite number, see page AP-3.

Auto: The system automatically searches for the optimum GEO satellite from your current position. (All satellites are searched.)

Manual: Enter a GEO satellite number manually.

Correction Data Set

Use [0] as default setting.

DGPS Station

The DGPS station is searched automatically or manually.

Auto: The system automatically searches for the DGPS station.

Manual: Set the rate and frequency for the DGPS station manually.

RATE

When selecting [Manual] in the [DGPS Station] menu, select the bit rate for the DGPS station from [50BPS], [100BPS] or [200BPS].

FREQ

When selecting [Manual] in the [DGPS Station] menu, set the frequency for the DGPS station (setting range: 283.5 to 325.0 kHz; 0.5 kHz step).

Data

The current communication status for the beacon receiver is displayed.

- When [Mode] is set to [DGPS] or [Auto]:
  - [OK] is displayed if the data can be received from the beacon receiver.
  - [NG] is displayed if the data can not be received from the beacon receiver for 60 seconds or above.
- When [Mode] is set to [GPS] or [WAAS], "– – –" is displayed.

SIG.S

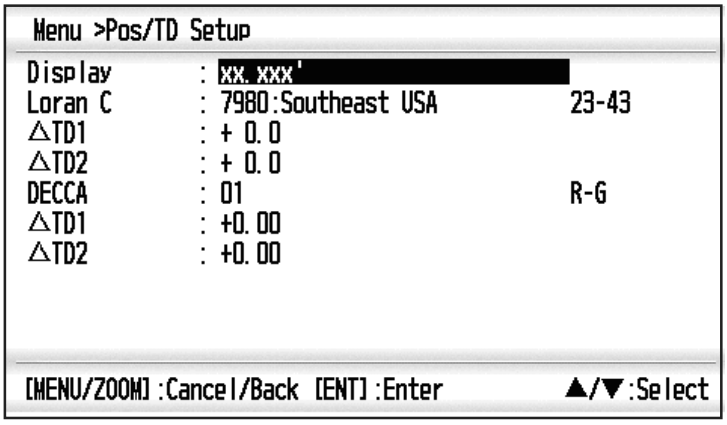
The signal intensity from the DGPS station is displayed. "00.0dB" is displayed except [Mode] is set to [DGPS] or [Auto].

SNR

The signal-to-noise ratio from the DGPS station is displayed. "00.0dB" is displayed except [Mode] is set to [DGPS] or [Auto].

7.4 Position Display Format

Position can be shown in latitude and longitude or TDs (Loran C). Loran C chain data is programmed into the equipment.



Display

Select the position format.

- xx.xxx': Shows L/L position with no seconds.
- xx'xx.x": Displays L/L position with seconds.
- LC TD: Loran C TDs
- DE TD: DECCA TDs

Loran C

When choosing LC TD at Display, do the following:

1) Press the **ENT** key.
2) Select the GRI code, and press the **ENT** key.
3) Press ▶ and **ENT** key.

4) Select the pair of slave station, and press the **ENT** key.

△TD1, △TD2

Enter TD offsets to refine Loran C position accuracy.

DECCA

When choosing DE TD at Display, do the following:

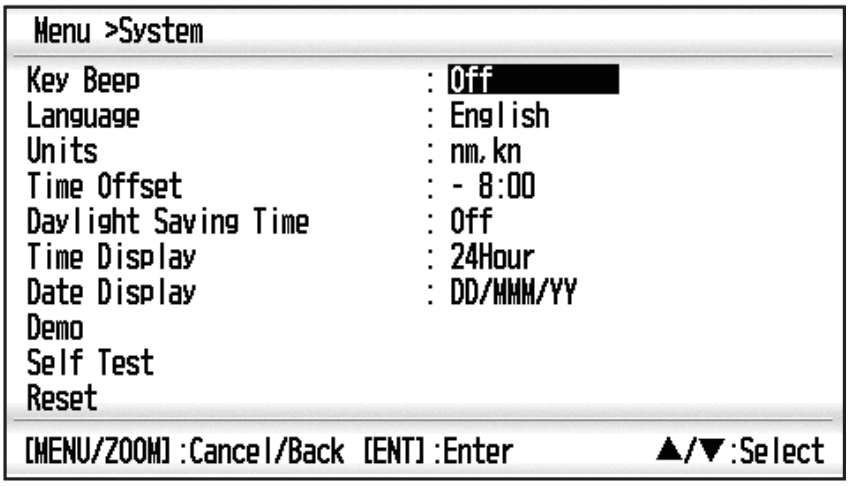
1) Press the **ENT** key.
2) Select the decca chain no., and press the **ENT** key.
3) Press ▶ and **ENT** key.
4) Select the pair of slave station, and press the **ENT** key.

△TD1, △TD2

Enter TD offsets to refine Decca position accuracy.

7.5 System Menu

In the System menu, you can customize various display settings, for example, time and date formats, etc.

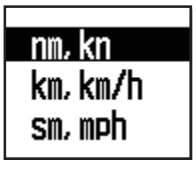


Key Beep

This item turns the key beep on or off.

Units

The Units item lets you select the unit of measurement for range, speed and distance, from the units shown below.



Time Offset

GPS uses UTC time. If you would rather use local time, enter the time difference (range: -14:00 to +14:00, 15 minutes step) between it and UTC time.

Daylight Saving Time

For countries that use daylight savings time, select On to enable daylight savings time.

Time Display

You can display the time in 12 or 24 hour format.

Date Display

Select the date display, DD/MMM/YY or MM/DD/YY.

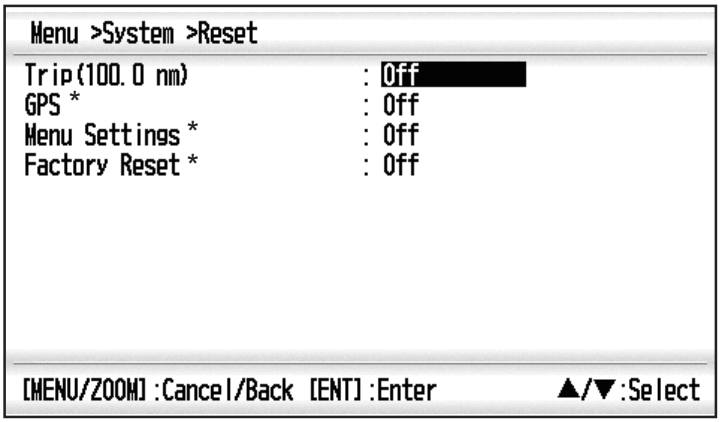
Demo

The demonstration display provides simulated operation of this unit. You may set the speed manually and course manually or automatically. All controls are operative - you may enter marks, set destination, etc.

- **Mode:** Select [On]. The indication SIM appears at the top left-hand side to inform you that the simulation mode in use. To cancel, select [Off].
- **Speed:** Enter the speed (two digits) to use for the demonstration mode.
- **Course:** Select Auto or Manual. For manual entry of course, enter course in three digits. The Auto course tracks a circular course.
- **Lat, Lon:** Enter latitude and longitude of the position to start the demonstration.

Reset (Trip)

You can reset the trip meter to zero. Select [On] at [Trip] on System>Reset menu.

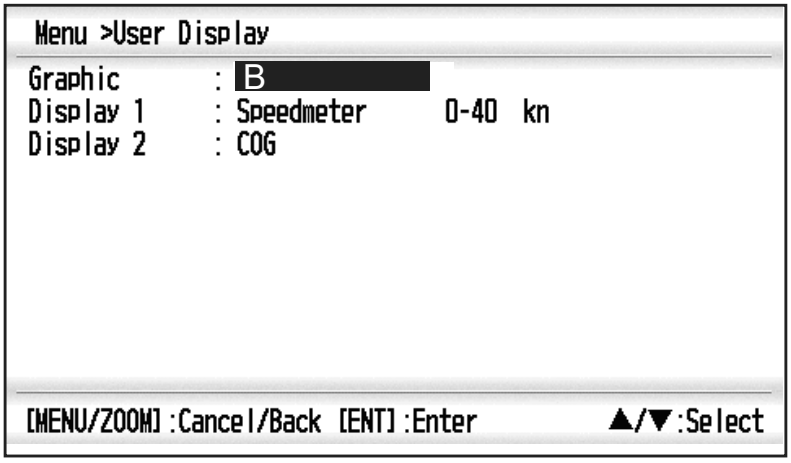


*: Items to be cleared (See section 8.5.)

7.6 User Display Menu

To customize user displays, which are [6] and [7] appeared when the **DISP** key is pressed (see section 1.4), use the User Display menu.

	DISP key is pressed	Item name on User Display menu
User display 1	Display [6]	Display 1
User display 2	Display [7]	Display 2

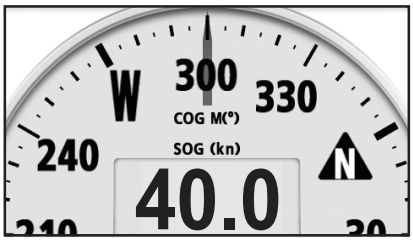


Note: You can show the User Display menu by pressing the **ENT** key more than three seconds at the User display 1 (display [6]) and 2 ([7]).

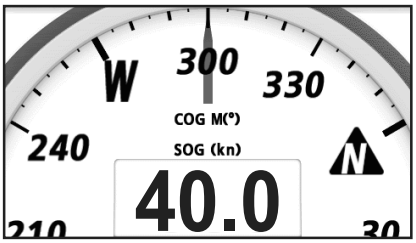
Graphic

You can select the graphic type for the analog COG and speedometer displays from two patterns (A and B) which have different character font and scale steps. Note that the graphic selected here can affect minor changes to other displays.

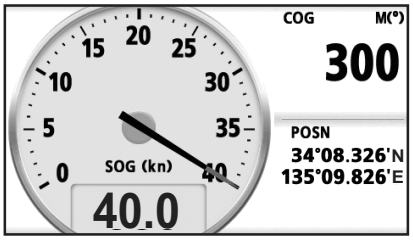
Graphic: A

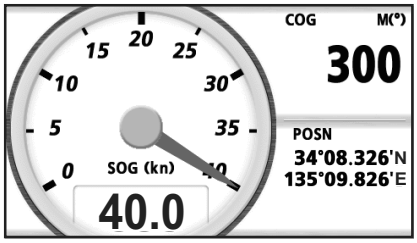


Graphic: B



COG display

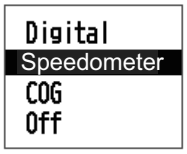




Speedometer display

Display 1, Display 2

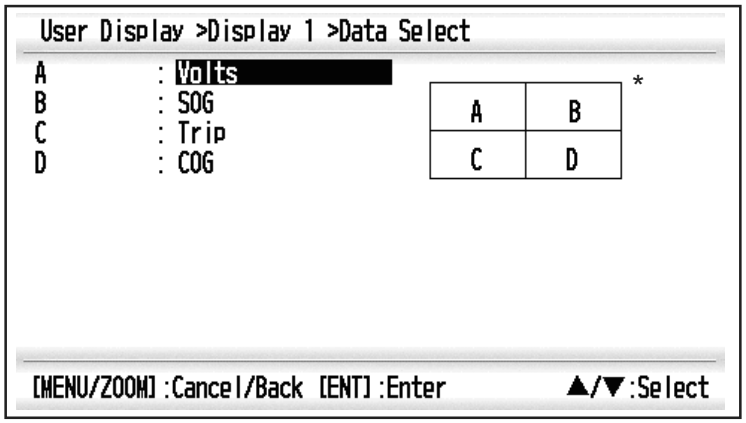
You can select items to show on the User display 1 (display [6]) and 2 ([7]), from among digital data, speedometer and COG (see page 1-7). When choosing [Off] for Display 2, for example, the display [7] is not shown.



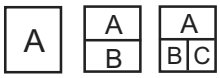
For [Digital], you can display one to four items of digital navigation data on the user display.

1. Press ▶ and **ENT** key in order to show the following window.

2. Select the screen division, which is the number of data to display, and press the **ENT** key.
   The display now looks something like the one shown below, showing data choices and screen division selected.

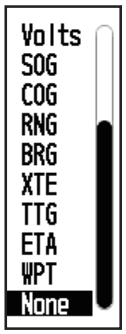


*: Depending on the selection at step 2.



3. Select [A], [B], [C] or [D], and press the **ENT** key.

Page 1



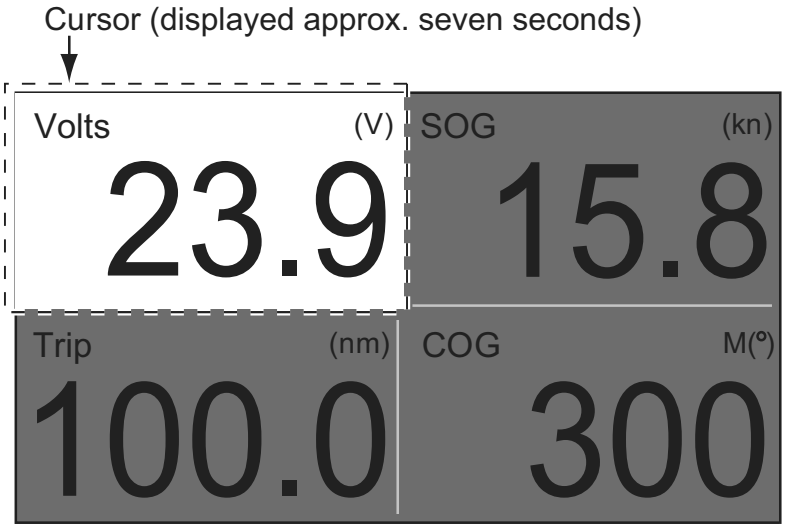
Page 2

ODO: Odometer distance
Trip: Trip distance
Time: Time
Date: Date
POSN: Position
Volts: Power voltage
SOG: Speed over ground
COG: Course over ground
RNG: Range
BRG: Bearing
XTE: Cross-track error
TTG: Time to go (to destination)
ETA: Estimated time to arrival (to destination)
WPT: Range and bearing to waypoint
None: No display

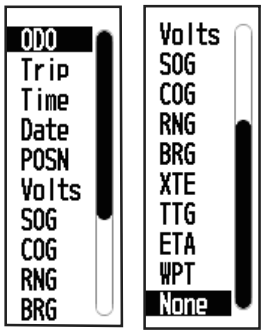
4. Select data desired, and press the **ENT** key.
5. Repeat steps 3 and 4 to set other data.

You can select digital data also from the User display 1 (display [6]) and 2 ([7]) directly.

1. Press the **DISP** key several times to show User display 1 or 2 desired, and press the **ENT** key to show the cursor.



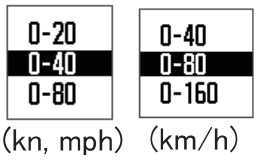
2. Operate the cursorpad to select the column to select data, and press the **ENT** key.



ODO: Odometer distance
Trip: Trip distance
Time: Time
Date: Date
POSN: Position
Volts: Power voltage
SOG: Speed over ground
COG: Course over ground
RNG: Range
BRG: Bearing
XTE: Cross-track error
TTG: Time to go (to destination)
ETA: Estimated time to arrival (to destination)
WPT: Range and bearing to waypoint
None: No display

3. Select the item to show, and press the **ENT** key.
4. Repeat steps 2 and 3 for other displays if necessary.

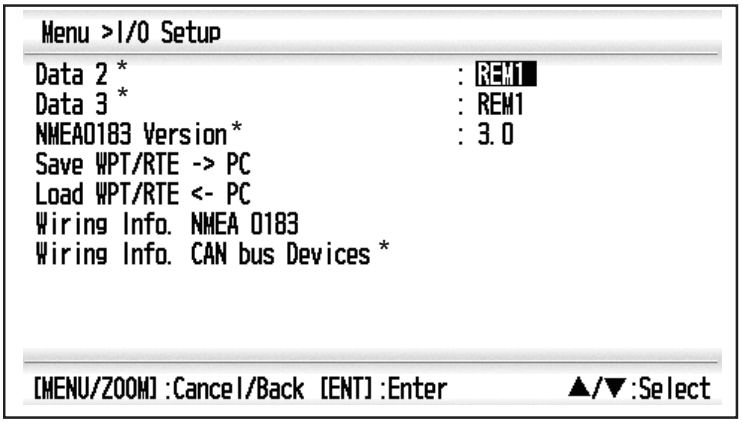
Speedometer
When choosing [speedometer], you can select the range for the speedometer to show on the User display 1 or 2.



7.7 I/O Setup Menu

Waypoint and route data can be uploaded from your unit to a PC, or downloaded from a PC to your unit.

There are two kinds of data for route data: route data and route comment data.



*: See chapter 9.

Note: No position fix is available during uploading or downloading.

Setting for communication software on PC

Baud Rate	• Navigation data output: 4800 bps • Waypoint/route information upload/download: 38400 bps
Character Length	8 bit
Parity	None
Stop Bit	1 bit
Flow Control	XON/OFF

Waypoint data format

$PFEC, GPwpl, llll.ll, a, yyyyy.yy, a, c—c, c, c—c, a, hhmmss, xx, xx, xxxx <CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12

1: Waypoint latitude
2: N/S
3: Waypoint longitude
4: E/W
5: Waypoint name (1 to 8 characters)
6: Waypoint color
(NULL/0: black, 1: red, 2: yellow, 3: green, 4: brown, 5: purple, 6: blue)
7: Waypoint mark and waypoint comment ("@_ (see below.)" + 0 to 13 characters)
-Following characters can be used for comments:
_ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789&()+-/=?> (space)
-Following marks are waypoint marks:
●: @q, ■: @r, ◆: @s, : @t, : @u,
: @v, : @w, : @x, : @y, : @z
8: Flag marking waypoint (A: displayed, V: Not displayed)
9: UTC (Always NULL)
10: Day (Always NULL)
11: Month (Always NULL)
12: Year (Always NULL)

Route data format

$GPRTE, x.x, x.x, a, c--c, c--c, ... , c--c <CR><LF>
1 2 3 4 5 12

1: Number of sentences required for one
complete route data (1 to 6) See note.
2: Number of sentences currently used (1 to 6)
3: Message mode (Always set to "C".)
4: Route No. (1 to 100)
5 to 12: Waypoint name (1 to 8 characters, length of each
waypoint name is fixed to 7 byte)
1st byte: "-" (hyphen)= skip ON, " " (space)= skip OFF
After 2nd byte: Waypoint name (1 to 8 characters)

Note: A route can contain max.30 waypoints and GPRTE sentence for one route data may exceed 80 byte limitation. In this case, route data is divided into several GPRTE sentences (max. 4 sentences). This value shows the number of sentences route data has been divided.

Route comment data format

```
$PFEC, GPrtc, x, c--c, c--c <CR><LF>
              1  2     3
```

1: Route No. (1 to 100)

2: Route comment (Max. 18 characters, variable length)

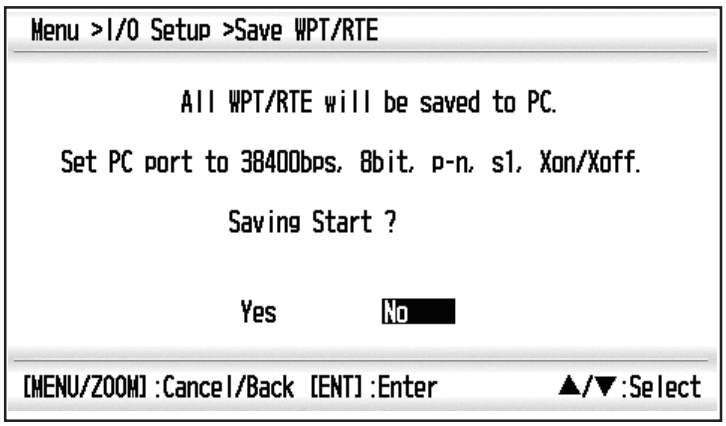
3: Route name (Max. 6 characters, variable length)

End of sentence

```
$PFEC, GPxfr, CTL, E <CR><LF>
```

7.7.1 Uploading data to a PC

1. Connect a PC to your GP-33, referring to the interconnection diagram at the back of this manual.
2. Press the **MENU/ZOOM** key twice to show the main menu.
3. Select[I/O Setup], and press the **ENT** key.
4. Select [Save WPT/RTE -> PC], and press the **ENT** key.



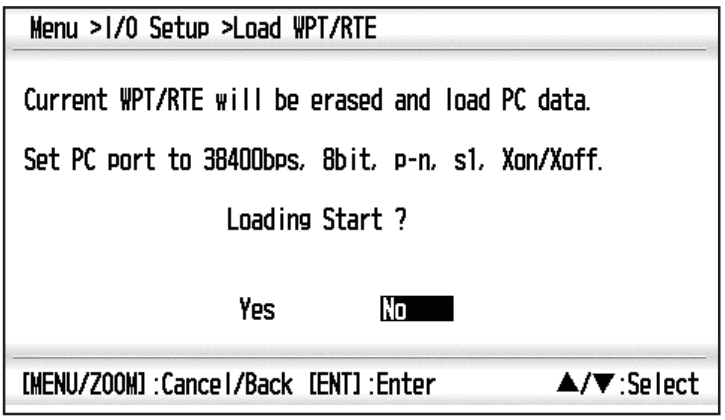
5. Press ◀ to select [Yes], and press the **ENT** key to start the uploading.
6. When the completion message appears, press any key to finish.

7.7.2 Downloading data from PC

Note that all waypoint and route data stored in the GP-33 will be deleted when data is downloaded from PC.

1. Connect a PC to your GP-33, referring to the interconnection diagram at the back of this manual.
2. Press the **MENU/ZOOM** key twice to show the main menu.
3. Select [I/O Setup], and press the **ENT** key.

4. Select [Load WPT/RTE <- PC], and press the **ENT** key.



5. Press ◀ to select [Yes], and press the **ENT** key to start the downloading.
6. After the completion message appears, press any key to finish.

8. MAINTENANCE, TROUBLE-SHOOTING

NOTICE

Do not apply paint, anti-corrosive sealant or contact spray to plastic parts or equipment coating.

Those items contain products that can damage plastic parts and equipment coating.

8.1 Maintenance

Regular maintenance is important to maintain performance. Check the following points to help maintain performance.

- Check that connectors on the rear panel are firmly tightened and free of rust.
- Check that the ground system is free of rust and the ground wire is tightly fastened.
- Check that battery terminals are clean and free of rust.
- Dust or dirt may be removed from the cabinet with soft cloth. Water-diluted mild detergent may be used if desired. DO NOT use chemical cleaners to clean the display unit; they may remove paint and markings.
- Wipe the LCD carefully to prevent scratching, using tissue paper and an LCD cleaner. To remove dirt or salt deposits, use an LCD cleaner, wiping slowly with tissue paper so as to dissolve the dirt or salt. Change paper frequently so the salt or dirt will not scratch the LCD. Do not use solvents such as thinner, acetone or benzene for cleaning. Also, do not use degreaser or antifog solution, as they can strip the coating from the LCD.

Life of LCD

The life of the LCD is approximately 50,000 hours. The actual number of hours depends on ambient temperature and humidity. When the brilliance cannot be raised sufficiently, ask your dealer about replacement.

8.2 Troubleshooting

This section provides simple troubleshooting procedures which the user can follow to restore normal operation. If you cannot restore normal operation, do not attempt to check inside the unit. Any trouble should be referred to a qualified technician.

Symptom	Remedy
You cannot turn on the power.	Check that power cable is firmly fastened.
	Check for damaged power cable and connector.
	Check battery for proper voltage output.
No picture appears.	Press the ⏻ **/BRILL** key several times to adjust the brilliance.
There is no response when a key is pressed.	Turn off and on the power. If no change, ask your dealer.
Position is not fixed within 90 seconds.	Check that antenna connector is firmly fastened.
	Check the number of satellites on Satellite Monitor display. If there are two or less, check for obstructions between antenna unit and satellites.
Position is wrong.	Check that the correct geodetic chart system is selected on the GPS Setting screen.
	Enter position offset on the GPS Setting screen.
Loran C/Decca TDs do not appear.	Check Loran C/Decca chain data on the Pos/TD Setup screen.
Loran C/Decca TDs are wrong.	Enter TD offset on the Pos/TD Setup screen.
Bearing is wrong.	Check Magnetic Variation on the Plotter Setup screen.

8.3 Displaying the Message Board

When an error occurs, a message and an alarm icon appear on the screen. The message board displays the error messages (see page 6-2) shown in table below.

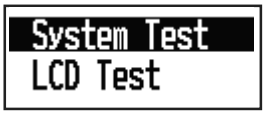
Messages and meanings

Message	Meaning, remedy
GPS ERROR!	Request service.
GPS NO FIX!	No GPS signal. Check antenna cable.
RAM ERROR!	Request service.
ROM ERROR!	Request service.
BACKUP ERROR!	RAM data corrupted. Try to clear backup data.

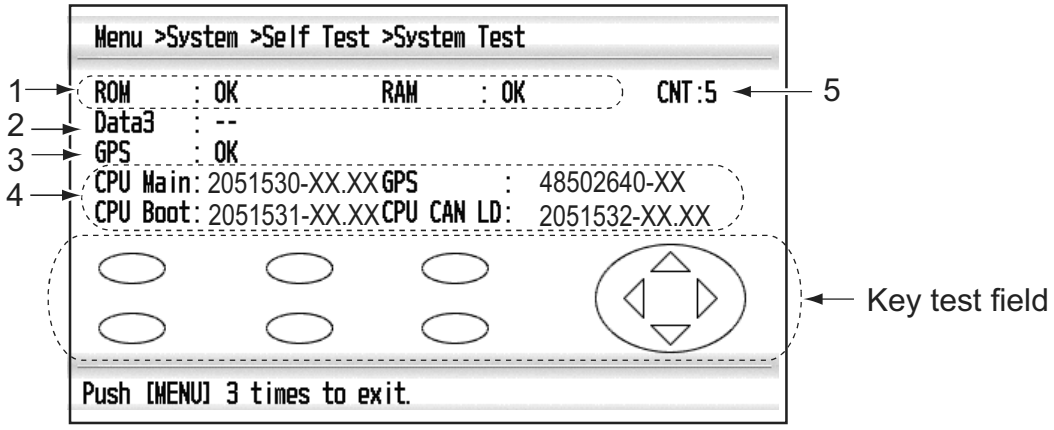
8.4 Diagnostics

The diagnostic test checks the ROM, RAM, input data, GPS core, keyboard and LCD performance. The user can do the tests to help the service technician in troubleshooting.

1. Press the **MENU/ZOOM** key twice to show the menu.
2. Select [System], and press the **ENT** key.
3. Select [Self Test], and press the **ENT** key.



4. Select [System Test], and press the **ENT** key to start the test.
   The results are individually displayed as OK or NG (No Good). If NG appears, try the test again. If NG re-appears, contact your dealer for advice.



XX: Program version No.

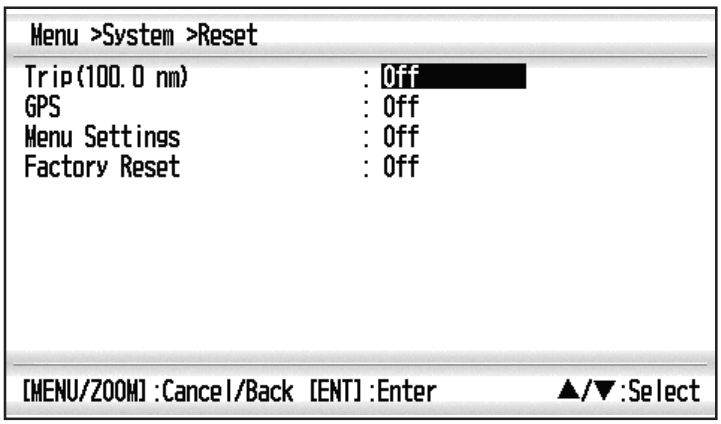
No.	Test Items	Description
1	ROM, RAM test	Correct: “OK”, Wrong: “NG”
2	Data3 test	“-” (This test is used at factory only.)
3	GPS test	Correct: “OK”, Wrong: “NG”
4	Program version No.	The program version No. which is currently used appears.
5	CNT	Number of test repetition.

5. Press each key one by one.
   The corresponded mark on the display turns red if the key is functioning properly.
6. Press the **MENU/ZOOM** key three times to close the test screen.
7. Select [LCD Test], and press the **ENT** key.
   Each press of this key changes the LCD pattern in the sequence shown below.
   Red→Green→Blue→Red (gradation)→Green (gradation)→Blue (gradation)→White→Black→White/Black (gradation)→return to System screen.
   Note: To cancel the test, press the **MENU/ZOOM** key.
8. Press the **MENU/ZOOM** key twice to close the menu.

8.5 Clearing Data

You can clear GPS data, menu settings* and all backup data* to start afresh (*other than Language, Units and TD).

1. Press the **MENU/ZOOM** key twice to show the menu.
2. Select [System], and press the **ENT** key.
3. Select [Reset], and press the **ENT** key.



4. Select [GPS], [Menu Settings] or [Factory Reset], and press the **ENT** key.
5. Select [On], and press the **ENT** key.
6. Press ◀ to select [Yes], and press the **ENT** key.
   [Menu Settings], [Factory Reset]: Go to Initial Setting screen. Select the language, then press **ENT** and **MENU/ZOOM** key in order.

9. INSTALLATION

9.1 Equipment Lists

Standard Supply

Name	Type	Code No.	Qty	Remarks
Receiver unit	GP-33	-	1	
Antenna Unit	GPA-017	-	1	w/10 m cable
Installation Materials	CP20-03300	-	1 set	-M12-05BM+05BF-060 -CP20-03310
Accessories	FP20-01200	-	1 set	See the packing list at the back of this manual.

Optional Supply

Name	Type	Qty	Remarks
Junction Box	FI-5002	000-010-765	
Cable Assy.	FRU-10BFFM-02M	001-112-970-10	
Right Angle Antenna Base	NO.13-QA330	001-111-910-10	For mounting the antenna unit, select one.(See the installation procedure at the back of this manual.)
L-type Antenna Base	NO.13-QA310	001-111-900-10	
Handrail Antenna Base	NO.13-RC5160	001-111-920-10	
Mast Mounting Kit	CP20-01111	004-365-780	
NMEA Connector	SS-050505-FMF-TS001	000-168-603-10	CAN bus distributor, micro style
	NC-050505FMF-TS001	000-160-507-10	CAN bus distributor, mini style
Cover-Up Bezel	OP20-38	001-156-750	Kit for upgrading GP-32 to GP-33

9.2 Installation of Receiver Unit

9.2.1 Installation consideration

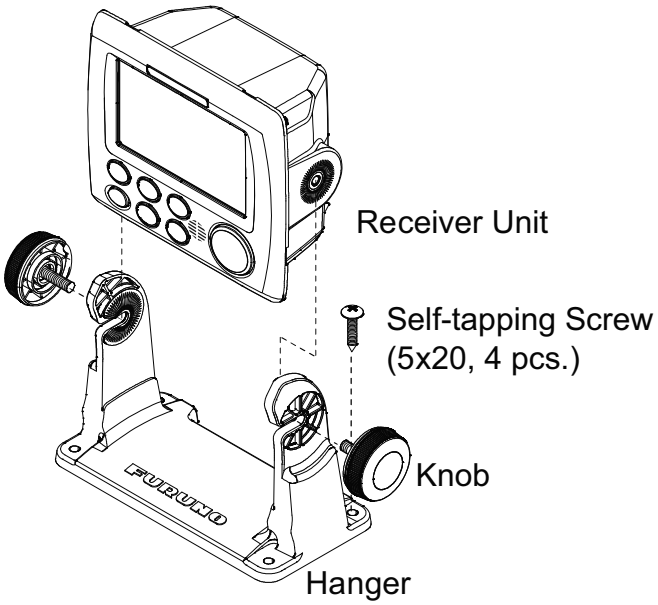
The receiver unit can be installed on a desktop, underside of table or in a panel. Refer to the outline drawings at the end of this manual for installation instructions. When selecting a mounting location, keep in mind the following points:

- Locate the unit away from exhaust pipes and vents.

- The mounting location should be well ventilated.
- Mount the unit where shock and vibration are minimal.
- Locate the unit away from equipment which generates electromagnetic fields such as a motor or generator.
- Allow sufficient maintenance space at the sides and rear of the unit and leave sufficient slack in cables, to facilitate maintenance and servicing.
- Observe compass safe distances noted on page ii to prevent interference to a magnetic compass.
- Locate the unit away from direct sunlight. An LCD may black out if it is exposed to direct sunlight for a long time.
- The optimal viewing distance is 0.6 m. Select a suitable mounting location considering the distance.

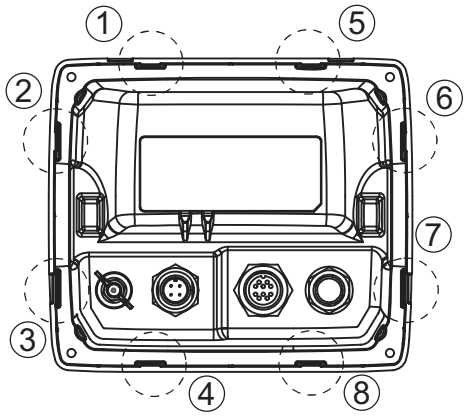
9.2.2 Desktop and underside of table mount

1. Unscrew knobs to dismount the receiver unit from the hanger.
2. Prepare four pilot holes (for 5x20 self-tapping screws) at the mounting location.
3. Fix the hanger to the mounting location with four self-tapping screws (5x20, supplied).
4. Attach cables to the back of the receiver unit (see section 9.4).
5. Set the receiver unit to the hanger, and fasten knobs to fix it.

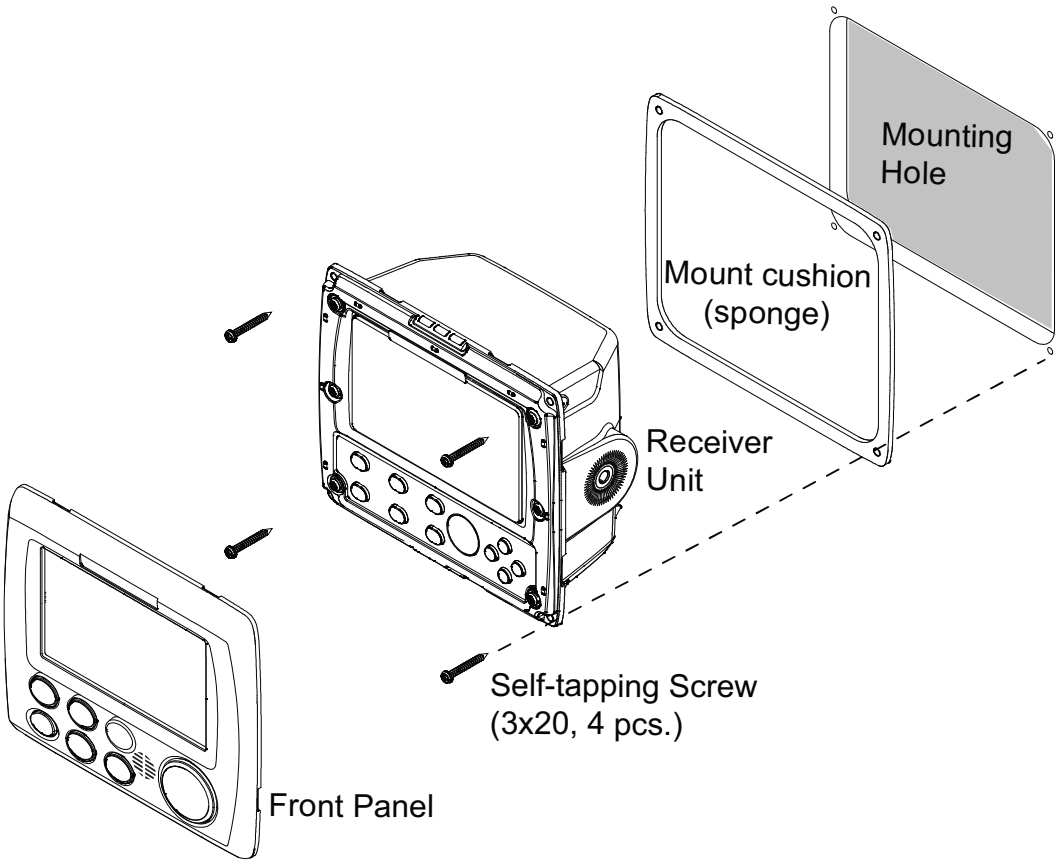


9.2.3 Flush mount

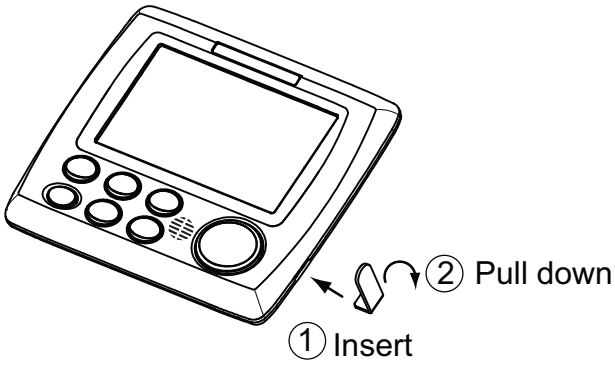
1. Using the template (supplied), cut out a hole in the mounting location.
2. Prepare four pilot holes (for 3x20 self-tapping screws) at the mounting location.
3. Unscrew knobs to dismount the receiver unit from the hanger.
   This hanger can be discarded.
4. Remove the front panel from the receiver unit by unfastening the catches at the rear of the panel by hands, in the order shown in the figure below.



5. Attach the mount cushion (sponge) to the hole made at step 1, or receiver unit.
6. Connect cables to the back of the receiver unit (see section 9.4).
7. Use four self-tapping screws (3x20, supplied) to fasten the receiver unit to the mounting location, and re-attach the front panel.



Note: When removing the equipment from the flush mounted location, use the remover (supplied) to remove the panel as shown below.



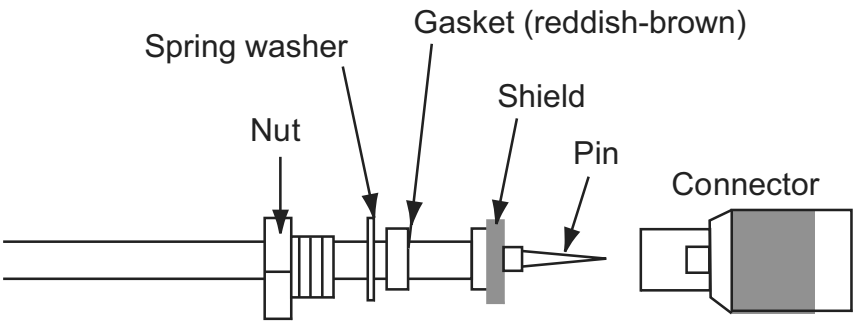
9.3 Installation of Antenna Unit

Install the antenna unit referring to the antenna installation diagram at the back of this manual. When choosing a mounting location for the antenna unit, keep in mind the following points:

- Select a location out of the radar beam. The radar beam will obstruct or prevent reception of the GPS signal.
- The location should be well away from a VHF/UHF antenna. A GPS receiver is interfered by a harmonic wave of a VHF/UHF antenna.
- There should be no interfering object within the line-of-sight to the satellites. An object within line-of-sight to satellites, for example, a mast, may block reception or prolong acquisition time.
- Mount the antenna unit as high as possible to keep it free from interfering objects and water spray. Freezing water can interrupt reception of the GPS satellite signal.

Note 1: Do not shorten the antenna cable.

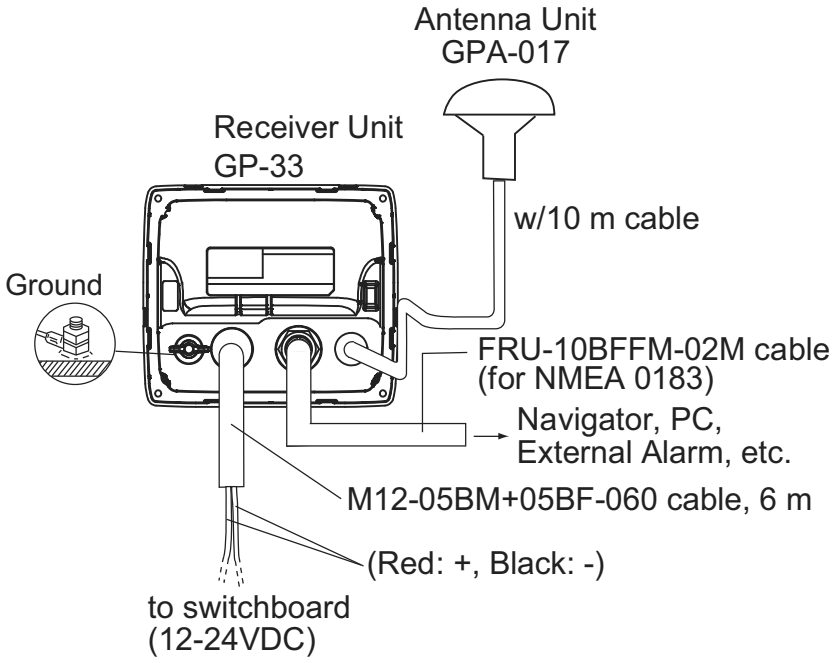
Note 2: If the antenna cable is to be passed through a hole which is not large enough to pass the connector, unfasten the connector with a needle nose pliers and 3/8-inch open-end wrench. Refasten it as shown below, after running the cable through the hole.



9.4 Wiring

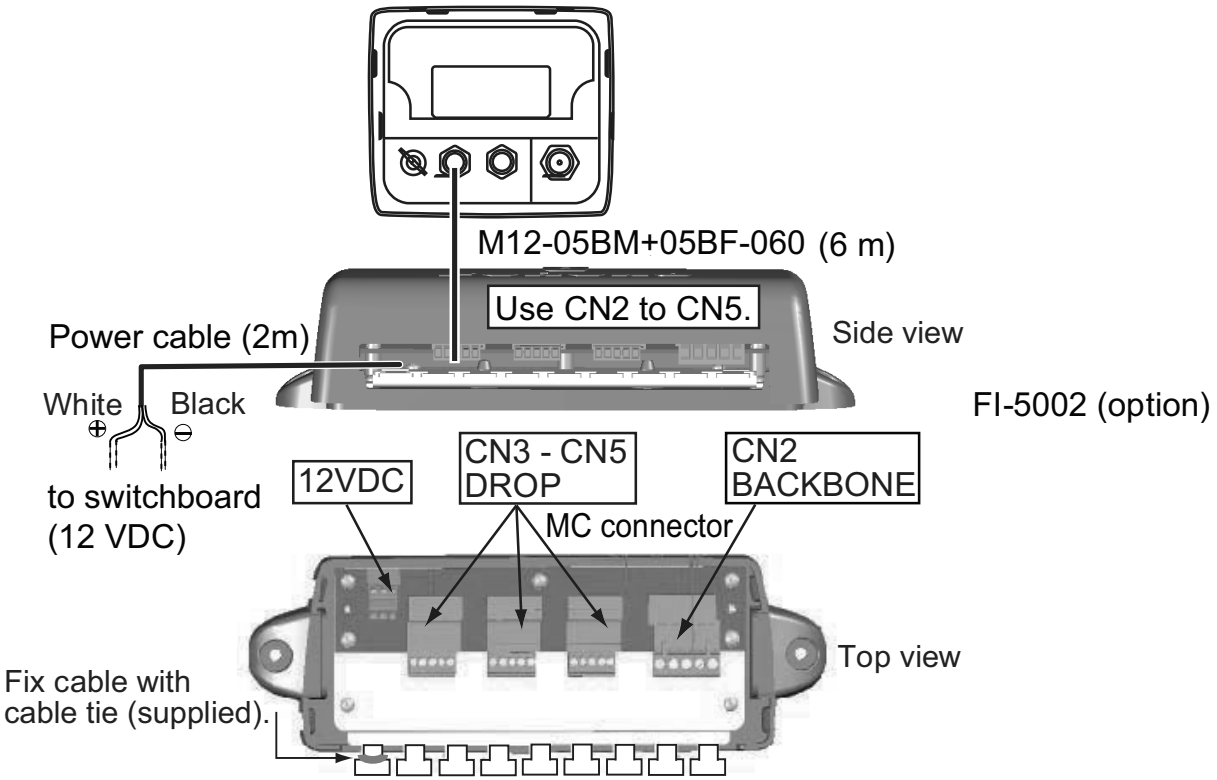
When no CAN bus equipment is connected

When connecting no CAN bus equipment, use the red and black-colored cores of M12-05BM+05BF-060 cable to connect to the 12-24 VDC switch board. (For other cores, cut them and tape individually.)

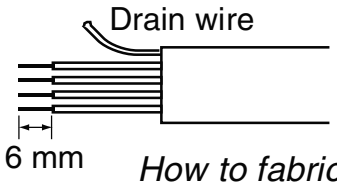


Connection with the optional junction box FI-5002

Detailed information for the service technician about CAN bus wiring is in the document titled “Furuno CAN bus Network Design Guide (TIE-00170-*)” separately.

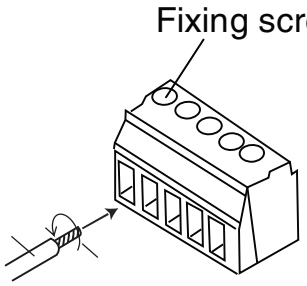


- Fabrication of M12-05BM+05BF-060 cable and MC connector



How to fabricate cable

Drain	#1
Red	#2
Black	#3
White	#4
Blue	#5

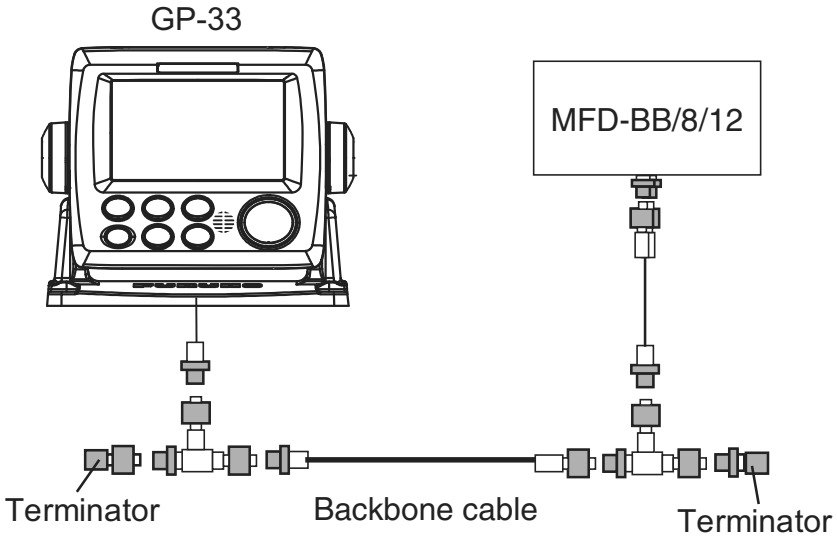


1. Twist wires.
2. Loosen fixing screw in plug.
3. Insert wire into hole.
4. Tighten fixing screw.
5. Pull wire to confirm the connection.

How to insert wire

Terminator

- When connecting to backbone cable



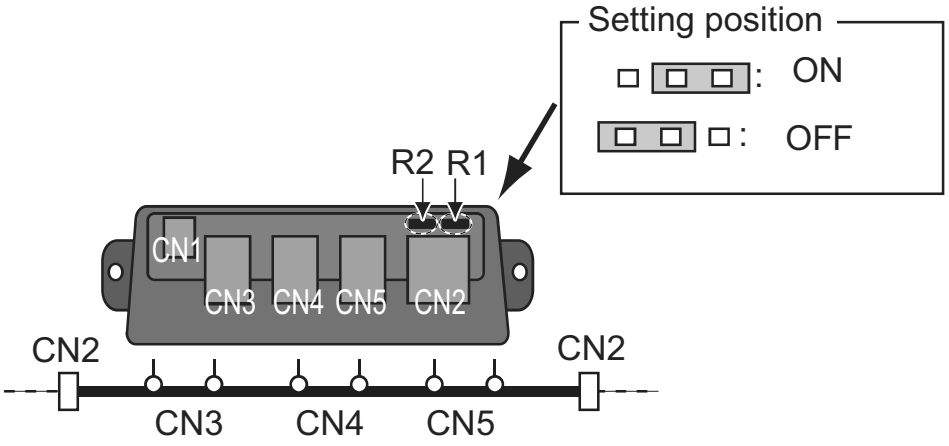
Attach the following terminators to both ends of the backbone cable.

Name	Type	Code No.	Remarks
Terminator (male)	LTWMN-05AMMT-SL8001	000-160-508-10	Mini connector
Terminator (female)	LTWMN-05AFFT-SL8001	000-160-509-10	Mini connector
Terminator (male)	LTWMC-05BMMT-SL8001	000-168-604-10	Micro connector
Terminator (female)	LTWMC-05BFFT-SL8001	000-168-605-10	Micro connector

When connecting to the optional junction box FI-5002

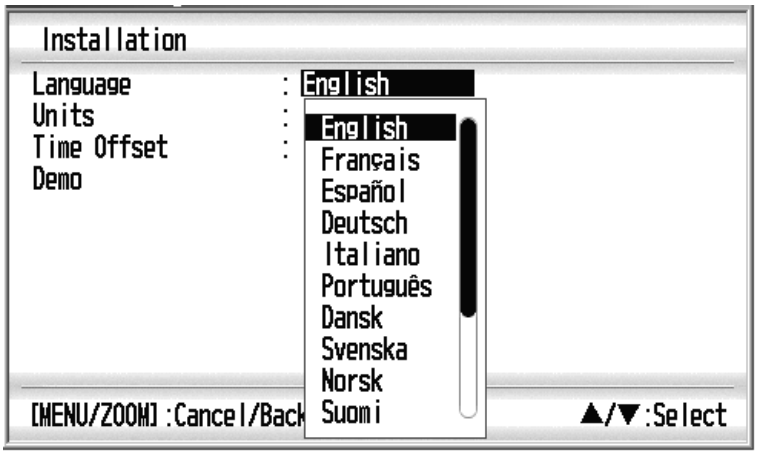
There are two terminal resistors (R1 and R2) inside the FI-5002.

- No backbone cable is connected: Set both R1 and R2 to “ON”.
- Backbone cable is connected: Set a resister to “ON”.
- Two backbone cables are connected: Set both R1 and R2 to “OFF”.



9.5 Language Setting

When you first turn the power on after installation, you are asked the language to use on the equipment. Press ▲ or ▼ to select the language, and press the **ENT** key.



9.6 Input/Output Data

This equipment inputs/outputs NMEA0183 or CAN bus data shown below. Note that NMEA 0183 version (2.0 or 3.0) can be a selected from the I/O setup screen.

Data 1: CAN bus port (input)

PGN	Description	Remark
059904	ISO Request	
060928	ISO Address Claim	
061184 #4=0	Self Test Group Function	
065286	Proprietary; Boot State Request	
126208	Request Group Function	
	Command Group Function	
126720 #4=1	Memory Clear Group Function	
126720 #4=2	Reset Group Function	

Data 1: CAN bus port (output)

PGN	Description	Output cycle
059392	ISO Acknowledgement	N/A
060928	ISO Address Claim	N/A
061184	Self Test Group Function	N/A
126208	NMEA-Acknowledge group function	N/A
126464	PGN List Transmit and Received PGNs Group Function	N/A
126720-1	Memory Clear Group Function	N/A
126720-2	Reset Group Function	N/A
126992	System Time	1000
126996	Product Information	N/A
127258	Magnetic Variation	1000
129026	COG & SOG, Rapid Update	1000
129029	GNSS Position Data	1000
129033	Time & Date	1000
129044	Datum	10000
129283	Cross Track Error	1000
129284	Navigation Data	1000
129285	Navigation -Route/WP information	N/A
129538	GNSS Control Status	N/A
129539	GNSS DOPs	1000
129540	GNSS Sats in View	1000
130822	Unit Division Code	N/A
130823	Browser Control Status	N/A

Data 2/Data 3: NMEA Output Sentence

Format**	REM1	REM2	AP	GPS
AAM*			ON	
APB*			ON	
BOD*			ON	
BWC*		ON	ON	
BWR*		ON	ON	
DTM	ON	ON		
GGA	ON	ON		ON
GLL	ON		ON	
GSA				ON
GSV				ON
RMB*	ON	ON		
RMC	ON	ON		
VTG	ON	ON	ON	ON
XTE			ON	
ZDA	ON	ON	ON	
RTE	For PC only. (See Chapter 7.)			

REM1/REM2: Radar, echo sounder, etc.

AP: Autopilot

*: Not output when no waypoint is set.
**: Talker; GP

Output setting

1. Press the **MENU/ZOOM** key twice to show the main menu.
2. Select [I/O Setup], then press the **ENT** key.
3. Select [Data 2], [Data 3] or [NMEA0183 Version] depending on the equipment connected.
4. Press the **ENT** key. One of the following screens appears depending on the item selected at step 3.

"Data2/Data3*"

"NMEA0183 Version"

*: When selecting [DGPS] or [Auto] in the [WAAS/DGPS] - [Mode] menu, [Beacon] is grayed out in the [Data3] menu.

5. Press ▲ or ▼ to select the option.
   REM1, 2: Output data to radar, echo sounder.
   AP: Output data to an autopilot.
   GPS: Output GPS data (used for the service)
   2.0, 3.0: select the NMEA version of external equipment. If you are unsure of the version number, try both and select the one which successfully outputs data.
6. Press the **ENT** key.
7. Press the **MENU/ZOOM** key twice to close the menu.

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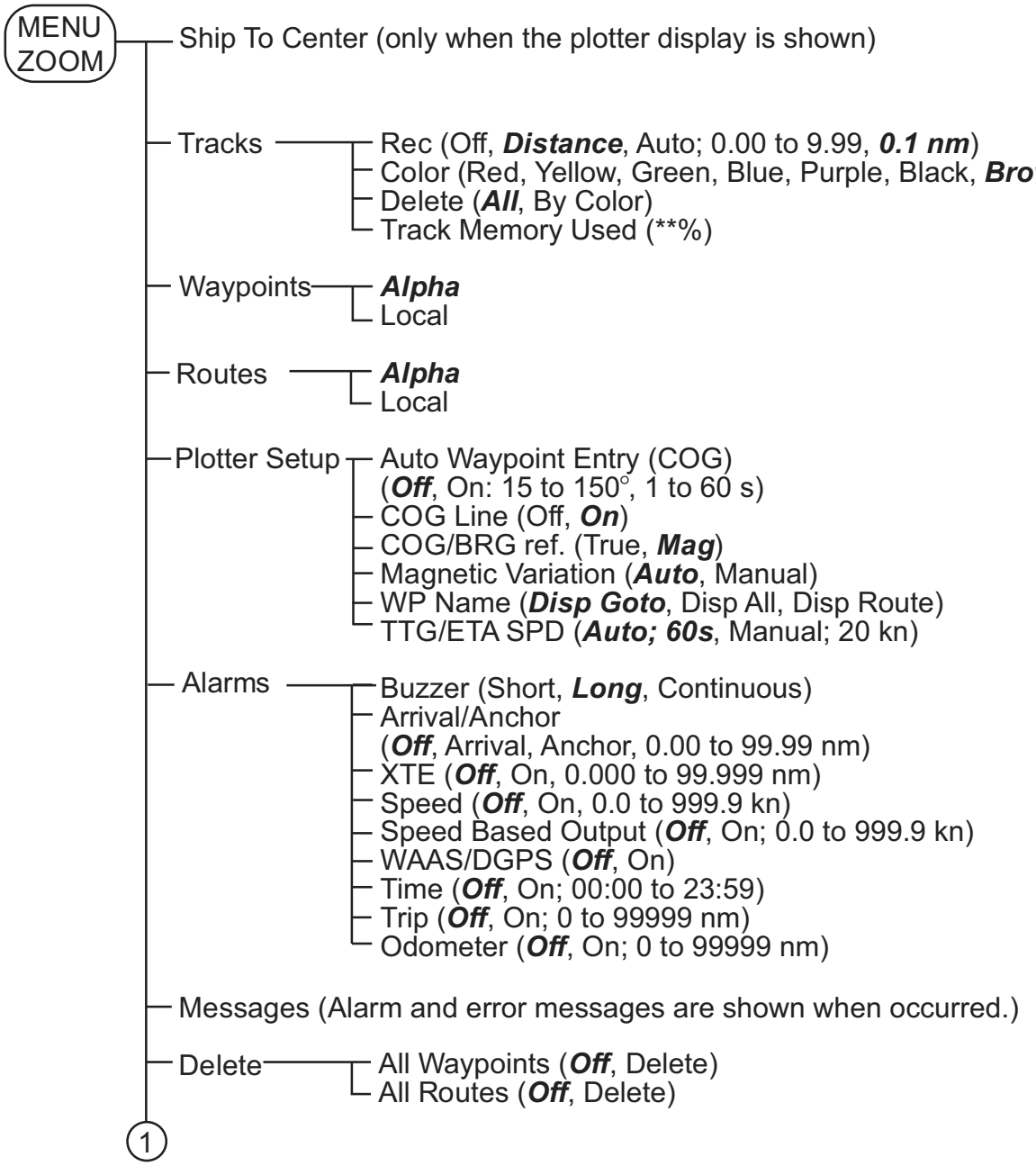
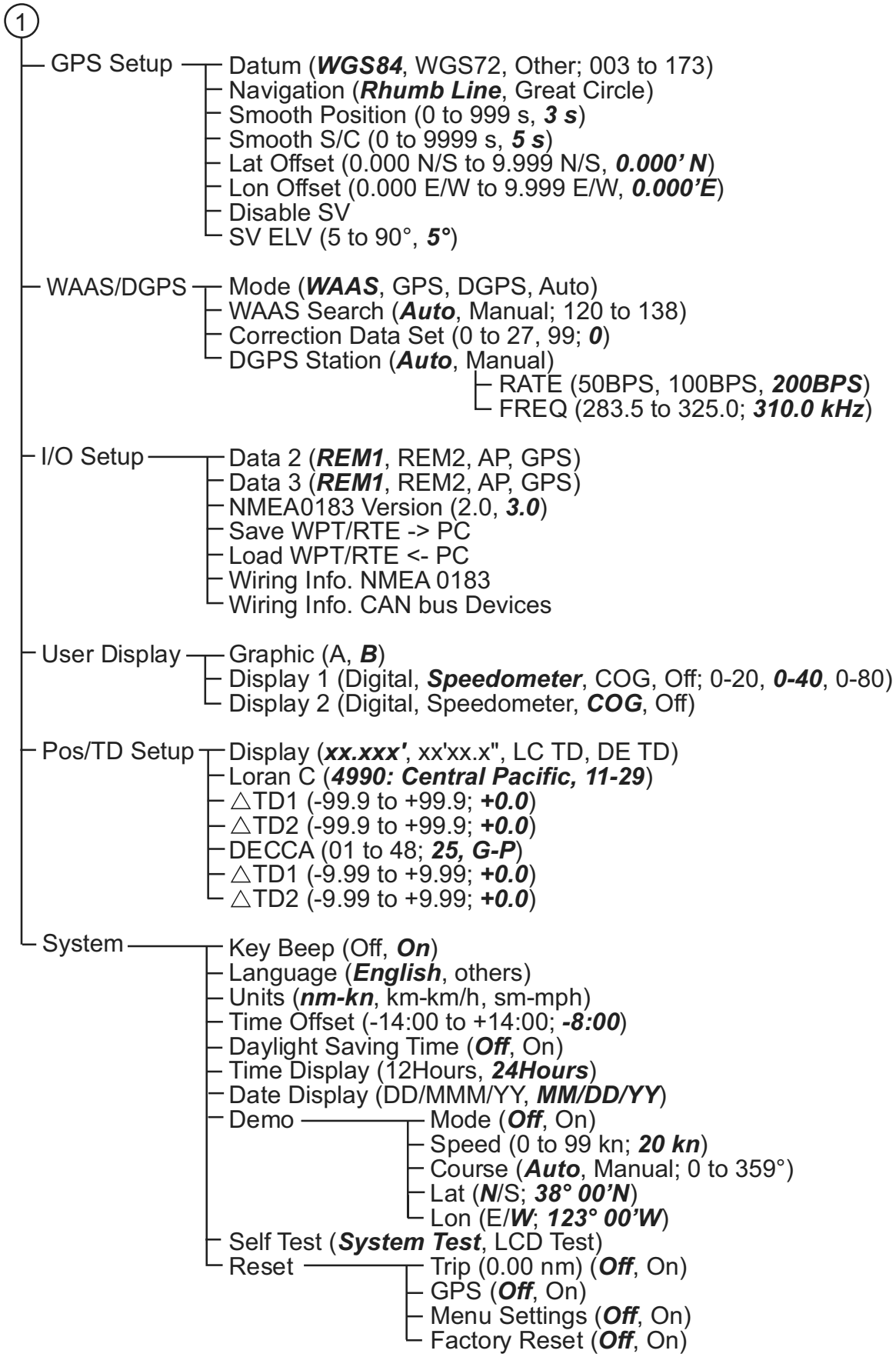
APPENDIX 1 MENU TREE

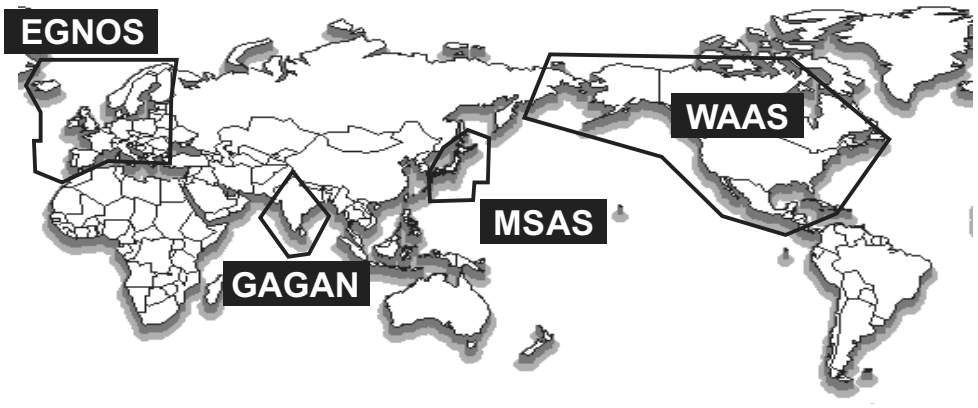


Bold: Default setting


1
GPS Setup
Datum (WGS84, WGS72, Other; 003 to 173)
Navigation (Rhumb Line, Great Circle)
Smooth Position (0 to 999 s, 3 s)
Smooth S/C (0 to 9999 s, 5 s)
Lat Offset (0.000 N/S to 9.999 N/S, 0.000' N)
Lon Offset (0.000 E/W to 9.999 E/W, 0.000'E)
Disable SV
SV ELV (5 to 90°, 5°)
WAAS/DGPS
Mode (WAAS, GPS, DGPS, Auto)
WAAS Search (Auto, Manual; 120 to 138)
Correction Data Set (0 to 27, 99; 0)
DGPS Station (Auto, Manual)
RATE (50BPS, 100BPS, 200BPS)
FREQ (283.5 to 325.0; 310.0 kHz)
I/O Setup
Data 2 (REM1, REM2, AP, GPS)
Data 3 (REM1, REM2, AP, GPS)
NMEA0183 Version (2.0, 3.0)
Save WPT/RTE -> PC
Load WPT/RTE <- PC
Wiring Info. NMEA 0183
Wiring Info. CAN bus Devices
User Display
Graphic (A, B)
Display 1 (Digital, Speedometer, COG, Off; 0-20, 0-40, 0-80)
Display 2 (Digital, Speedometer, COG, Off)
Pos/TD Setup
Display (xx.xxx', xx'xx.x", LC TD, DE TD)
Loran C (4990: Central Pacific, 11-29)
△TD1 (-99.9 to +99.9; +0.0)
△TD2 (-99.9 to +99.9; +0.0)
DECCA (01 to 48; 25, G-P)
△TD1 (-9.99 to +9.99; +0.0)
△TD2 (-9.99 to +9.99; +0.0)
System
Key Beep (Off, On)
Language (English, others)
Units (nm-kn, km-km/h, sm-mph)
Time Offset (-14:00 to +14:00; -8:00)
Daylight Saving Time (Off, On)
Time Display (12Hours, 24Hours)
Date Display (DD/MMM/YY, MM/DD/YY)
Demo
Mode (Off, On)
Speed (0 to 99 kn; 20 kn)
Course (Auto, Manual; 0 to 359°)
Lat (N/S; 38° 00'N)
Lon (E/W; 123° 00'W)
Self Test (System Test, LCD Test)
Reset
Trip (0.00 nm) (Off, On)
GPS (Off, On)
Menu Settings (Off, On)
Factory Reset (Off, On)

APPENDIX 2 WHAT IS WAAS?

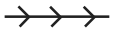
WAAS, available in North America, is a provider in the worldwide SBAS (Satellite Based Augmentation System) navigation system. CBAS provides GPS signal corrections to SBAS users, for even better position accuracy, typically better than three meters. There are three more SBAS providers, MSAS (Multi-Functional Satellite Augmentation System) for Japan, EGNOS (Euro Geostationary Navigation Overlay Service) for Europe and GAGAN (GPS And GEO Augmented Navigation) for India. The illustration below shows the coverage area. (Accuracy may be affected when using a GEO satellite not within your current location.) This manual uses “WAAS” for these three providers generically.



Provider	Satellite type	Longitude	Satellite No.
WAAS	Intelsat Galaxy XV	133°W	135
	TeleSat Anik F1R	107.3°W	138
	Inmarsat-4-F3	98°W	133
EGNOS	Inmarsat-3-F2/AOR-E	15.5°W	120
	Artemis	21.5°E	124
	Inmarsat-4-F2	25°E	126
MSAS	MTSAT-1R	140°E	129
	MTSAT-2	145°E	137
GAGAN	Inmarsat-4-F1	64°E	127

APPENDIX 3 LIST OF TERMS

The following table shows the terms used in GP-33.

Terms/Symbols	Meaning	Terms/Symbols	Meaning
	Waypoints	Lat	Latitude
	Own Boat	Lon	Longitude
"**M**"	Man Overboard	LC	Loran-C
	Shortest course to the destination	M, Mag	Magnetic
+	Cursor	MAR	March
%	Percentage	MAY	May
2D, 3D	2D/3D GPS position fix	MM (MMM)	Month
D2D, D3D	2D/3D DGPS position fix	mph	mile per hour
W2D, W3D	2D/3D WAAS position fix	N	North
AP	Autopilot	nm	Nautical Mile
APR	April	NMEA	National Marine Electronics Association
AUG	August	NOV	November
Auto	Automatic	OCT	October
Brill	Brilliance	ODO	Odometer
BRG	Bearing	PDOP	Position Dilution Of Precision
Cmnt	Comment	Pos	Position
COG	Course Over Ground	ref.	Reference
DD	Day	QP	Quick Point
DE	Decca	REM	Remote
DEC	December	RNG	Range
Demo, SIM	Demonstration Mode	RTE, RT	Route
Disp	Display	S	South
DOP	Dilution Of Precision	s	seconds
E	East	S/C	Speed/Course
ELV	Elevation	SEP	September
ENT	Enter	sm	Statute Mile
ETA	Estimated Time of Arrival	SOG	Speed Over Ground
FEB	February	SPD	Speed
G	Go to	T	True
GPS	Global Positioning System	TD	Time Difference
I/O	Input/Output	TTG	Time To Go
HDOP	Horizontal Dilution Of Precision	Volt	Voltage
JAN	January	W	West
JUL	July	WAAS	Wide Area Augmentation System
JUN	June	WPT, WP	Waypoint
km	kilometer	XTE	Cross Track Error
kn	knot	YY	Year

APPENDIX 4 GEODETIC CHART LIST

001: WGS84
002: WGS72
003: TOKYO : Mean Value (Japan, Korea & Okinawa)
004: NORTH AMERICAN 1927 : Mean Value (CONUS)
005: EUROPEAN 1950 : Mean Value
006: AUSTRALIAN GEODETIC 1984 : Australia & Tasmania
007: ADINDAN : Mean Value (Ethiopia & Sudan)
008: ADINDAN : Ethiopia
009: ADINDAN : Mali
010: ADINDAN : Senegal
011: ADINDAN : Sudan
012: AFG : Somalia
013: AIN EL ABD 1970 : Bahrain Is.
014: ANNA 1 ASTRO 1965 : Cocos Is.
015: ARC 1950 : Mean Value
016: ARC 1950 : Botswana
017: ARC 1950 : Lesotho
018: ARC 1950 : Malawi
019: ARC 1950 : Swaziland
020: ARC 1950 : Zaire
021: ARC 1950 : Zambia
022: ARC 1950 : Zimbabwe
023: ARC 1960 : Mean Value (Kenya & Tanzania)
024: ARC 1960 : Kenya
025: ARC 1960 : Tanzania
026: ASCENSION IS. 1958 : Ascension Is.
027: ASTRO BEACON "E" : Iwo Jima Is.
028: ASTRO B4 SOR. ATOLL : Tern Is.
029: ASTRO POS 71/4 : St. Helena Is.
030: ASTRONOMIC STATION 1952 : Marcus Is.
031: AUSTRALIAN GEODETIC 1966 : Australia & Tasmania
032: BELLEVUE (IGN) : Efate & Erromango Is.
033: BERMUDA 1957 : Bermuda Is.
034: BOGOTA OBSERVATORY : Columbia
035: CAMPO INCHAUSPE : Argentina
036: CANTON IS. 1966 : Phoenix Is.
037: CAPE : South Africa
038: CAPE CANAVERAL : Mean Value (Florida & Bahama Is.)
039: CARTHAGE : Tunisia
040: CHATHAM 1971 : Chatham Is. (New Zealand)
041: CHUA ASTRO : Paraguay
042: CORREGO ALEGRE : Brazil
043: DJAKARTA (BATAVIA) : Sumatra Is. (Indonesia)
044: DOS 1968 : Gizo Is. (New Georgia Is.)
045: EASTER IS. 1967 : Easter Is.
046: EUROPEAN 1950 (Cont'd) : Western Europe
047: EUROPEAN 1950 (Cont'd) : Cyprus
048: EUROPEAN 1950 (Cont'd) : Egypt
049: EUROPEAN 1950 (Cont'd) : England, Scotland, Channel & Shetland Is.
050: EUROPEAN 1950 (Cont'd) : England, Ireland, Scotland & Shetland Is.
051: EUROPEAN 1950 (Cont'd) : Greece
052 EUROPEAN 1950 (Cont'd) : Iran
053: EUROPEAN 1950 (Cont'd) : Italy, Sardinia
054: EUROPEAN 1950 (Cont'd) : Italy, Sicily
055: EUROPEAN 1950 (Cont'd) : Norway & Finland
056: EUROPEAN 1950 (Cont'd) : Portugal & Spain
057: EUROPEAN 1979 : Mean Value
058: GANDAJIKA BASE : Republic of Maldives
059: GEODETIC DATUM 1949 : New Zealand
060: GUAM 1963 : Guam Is.
061: GUX 1 ASTRO : Guadalcanal Is.
062: HJORSEY 1955 : Iceland
063: HONG KONG 1963 : Hong Kong
064: INDIAN : Thailand & Vietnam
065: INDIAN : Bangladesh, India & Nepal
066: IRELAND 1965 : Ireland
067: ISTS 073 ASTRO 1969 : Diego Garcia
068: JOHNSTON IS. 1961 : Johnston Is.
069: KANDAWALA : Sri Lanka
070: KERGUELEN IS. : Kerguelen Is.
071: KERTAU 1948 : West Malaysia & Singapore
072: LA REUNION : Mascarene Is.
073: L. C. 5 ASTRO : Cayman Brac Is.
074: LIBERIA 1964 : Liberia
075: LUZON : Philippines (excl. Mindanao Is.)
076: LUZON : Mindanao Is.
077: MAHE 1971 : Mahe Is.
078: MARCO ASTRO : Salvage Islands
079: MASSAWA : Eritrea (Ethiopia)
080: MERCHICH : Morocco
081: MIDWAY ASTRO 1961 : Midway Is.
082: MINNA : Nigeria
083: NAHRWAN : Masirah Is. (Oman)
084: NAHRWAN : United Arab Emirates
085: NAHRWAN : Saudi Arabia
086: NAMIBIA : Namibia
087: MAPARIMA, BWI : Trinidad & Tobago
088: NORTH AMERICAN 1927 : Western United States
089: NORTH AMERICAN 1927 : Eastern United States
090: NORTH AMERICAN 1927 : Alaska
091: NORTH AMERICAN 1927 : Bahamas (excl. San Salvador Is.)
092: NORTH AMERICAN 1927 : Bahamas, San Salvador Is.
093: NORTH AMERICAN 1927 (Cont'd): Canada (incl. Newfoundland Is.)
094: NORTH AMERICAN 1927 (Cont'd): Alberta & British Columbia
095: NORTH AMERICAN 1927 (Cont'd): East Canada
096: NORTH AMERICAN 1927 (Cont'd): Manitoba & Ontario
097: NORTH AMERICAN 1927 (Cont'd): Northwest Territories & Saskatchewan
098: NORTH AMERICAN 1927 (Cont'd): Yukon
099: NORTH AMERICAN 1927 (Cont'd): Canal Zone
100: NORTH AMERICAN 1927 (Cont'd): Caribbean
101: NORTH AMERICAN 1927 (Cont'd): Central America
102: NORTH AMERICAN 1927 (Cont'd): Cuba
103: NORTH AMERICAN 1927 (Cont'd): Greenland
104: NORTH AMERICAN 1927 (Cont'd): Mexico
105: NORTH AMERICAN 1983 : Alaska
106: NORTH AMERICAN 1983 : Canada
107: NORTH AMERICAN 1983 : CONUS
108: NORTH AMERICAN 1983 : Mexico, Central America
109: OBSERVATORIO 1966 : Corvo & Flores Is. (Azores)
110: OLD EGYPTIAN 1930 : Egypt
111: OLD HAWAIIAN : Mean Value
112: OLD HAWAIIAN : Hawaii
113: OLD HAWAIIAN : Kauai
114: OLD HAWAIIAN : Maui
115: OLD HAWAIIAN : Oahu
116: OMAN : Oman
117: ORDNANCE SURVEY OF GREAT BRITAIN 1936: Mean Value
118: ORDNANCE SURVEY OF GREAT BRITAIN 1936: England
119: ORDNANCE SURVEY OF GREAT BRITAIN 1936: England, Isle of Man & Wales
120: ORDNANCE SURVEY OF GREAT BRITAIN 1936: Scotland & Shetland Is.
121: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : Wales
122: PICO DE LAS NIVIES : Canary Is.
123: PITCAIRN ASTRO 1967 : Pitcairn Is.
124: PROVISIONAL SOUTH CHILEAN 1963: South Chile (near 53°S)
125: PROVISIONAL SOUTH AMERICAN 1956: Mean Value
126: PROVISIONAL SOUTH AMERICAN 1956: Bolivia
127: PROVISIONAL SOUTH AMERICAN 1956: Chile-Northern Chile (near 19°S)
128: PROVISIONAL SOUTH AMERICAN 1956: Chile-Southern Chile (near 43°S)
129: PROVISIONAL SOUTH AMERICAN 1956: Columbia
130: PROVISIONAL SOUTH AMERICAN 1956: Ecuador
131: PROVISIONAL SOUTH AMERICAN 1956: Guyana
132: PROVISIONAL SOUTH AMERICAN 1956: Peru
133: PROVISIONAL SOUTH AMERICAN 1956: Venezuela
134: PUERTO RICO : Puerto Rico & Virgin Is.
135: QATAR NATIONAL : Qatar
136: QORNOQ : South Greenland
137: ROME 1940 : Sardinia Is.
138: SANTA BRAZ : Sao Miguel, Santa Maria Is. (Azores)
139: SANTO (DOS) : Espirito Santo Is.
140: SAPPER HILL 1943 : East Falkland Is.
141: SOUTH AMERICAN 1969 : Mean Value
142: SOUTH AMERICAN 1969 : Argentina
143: SOUTH AMERICAN 1969 : Bolivia
144: SOUTH AMERICAN 1969 : Brazil
145: SOUTH AMERICAN 1969 : Chile
146: SOUTH AMERICAN 1969 : Columbia
147: SOUTH AMERICAN 1969 : Ecuador
148: SOUTH AMERICAN 1969 : Guyana
149: SOUTH AMERICAN 1969 : Paraguay
150: SOUTH AMERICAN 1969 : Peru
151: SOUTH AMERICAN 1969 : Trinidad & Tobago
152: SOUTH AMERICAN 1969 : Venezuela
153: SOUTH ASIA : Singapore
154: SOUTHEAST BASE : Porto Santo & Madeira Is.
155: SOUTHWEST BASE : Faial, Graciosa, Pico, Sao Jorge & Terceria Is.
156: TIMBALAI 1948 : Brunei & East Malaysia (Sarawak & Sabah)
157: TOKYO : Japan
158: TOKYO : Korea
159: TOKYO : Okinawa
160: TRISTAN ASTRO 1968 : Tristan da Cunha
161: VITI LEVU 1916 : Viti Levu Is. (Fiji Is.)
162: WAKE-ENIWETOK 1960 : Marshall Is.
163: ZANDERIJ : Surinam
164: BUKIT RIMPAH : Bangka & Belitung Is. (Indonesia)
165: CAMP AREA ASTRO : Camp Mcmurdo Area, Antarctica
166: G. SEGARA : Kalimantan Is. (Indonesia)
167: HERAT NORTH : Afghanistan
168: HU-TZU-SHAN : Taiwan
169: TANANARIVE OBSERVATORY 1925 : Madagascar
170: YACARE : Uruguay
171: RT-90 : Sweden
172: PULKOVO 1942 : Russia
173: FINNISH KKJ : Finland

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SPECIFICATIONS OF GPS NAVIGATOR
GP-33

1 GENERAL

1.1	Display system	4.3-inch color LCD
1.2	Effective area	95.04 x 53.85 mm, 480 x 272 dots (WQVGA)
1.3	Projection	Mercator
1.4	Display mode	Plotter, Highway, Steering, NAV data, Satellite monitor, User
1.5	Memory capacity	Track: 3,000 pts, Waypoint: 10,000 pts w/ comment (13 character)
1.6	Storage capacity	100 routes w/ 30 waypoint each
1.7	Alarms	Arrival and anchor watch, Cross track error, Odometer alarm, Ship's speed, Timer, Trip, WAAS
1.8	Display scale	
	Plotter display	0.02/0.05/0.1/0.2/0.5/1/2/5/10/20/40/80/160/320 NM
	Highway display	0.2/0.4/0.8/1/2/4/8/16 NM

2 GPS RECEIVER

2.1	Receiving channels	
	GPS	12 channels parallel, 12 satellites tracking
	WAAS	2 channel
2.2	Rx frequency	1575.42 MHz
2.3	Rx code	C/A code, WAAS
2.4	Position accuracy (95% of the time, 2drms)	
	GPS	10 m approx.
	DGPS	5 m approx. (external data required)
	WAAS	3 m approx.
	MSAS	7 m approx.
2.5	Tracking velocity	999.9 kn
2.6	Position fixing time	Within 90 s (cold start)
2.7	Position update interval	1 s

3 INTERFACE

3.1	Number of port	CAN bus: 1 port, NMEA0183: 2 ports
3.2	Serial output	NMEA0183 Ver2.0/3.0 (current loop and RS-232C)
	Data sentences	AAM, APB, BOD, BWC, BWR, DTM, GGA, GLL, GSA, GSV, RMB, RMC, RTE, VTG, XTE, ZDA
3.3	DGPS data input	RTCM SC-104 Ver2.1
3.4	CAN bus PGN (NMEA2000)	
	Input	059904, 060928, 061184, 065286, 126208/720
	Output	059392, 060928, 061184, 126208/464/720/992/996, 127258, 129026/029/033/044/283/284/285/538/539/540, 130822/823
3.5	Contact signal	Event switch (MOB input), Speed alarm (output)

4 POWER SUPPLY

15 VDC (9-16 V): LEN7 (CAN bus)
12-24 VDC (10.8-31.2 V): 0.24-0.12 A (Non CAN bus)

5 ENVIRONMENTAL CONDITION

5.1	Ambient temperature	
	Antenna unit	-25°C to +70°C
	Receiver unit	-15°C to +55°C
5.2	Relative humidity	93% at 40°C
5.3	Degree of protection	IP56
5.4	Vibration	IEC 60945

6 UNIT COLOR

6.1	Antenna unit	N9.5
6.2	Receiver unit	N2.5

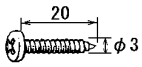
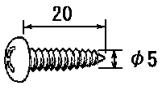
FURUNO

CODE NO.	001-087-240-00 **	20BE-X-9401 -1
TYPE	CP20-03310	1/1

工事材料表

INSTALLATION MATERIALS

GP-33/RD-33

番 号 NO.	名 称 NAME	略 図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	+ナベタッピンネジ 1シュ SELF-TAPPING SCREW		3X20 SUS304 CODE NO. 000-163-884-10	4	
2	+トラスタッピンネジ 1シュ SELF-TAPPING SCREW		5X20 SUS304 CODE NO. 000-162-608-10	4	

C4458-M01-B

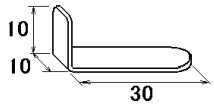
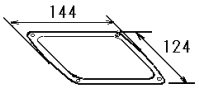
FURUNO

CODE NO.	001-087-250-00 **	20BE-X-9501 -2
TYPE	FP20-01200	1/1

付属品表

ACCESSORIES

GP-33/RD-33

番 号 NO.	名 称 NAME	略 図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	パネルリムーバー PANEL REMOVER		19-028-3124-1 CODE NO. 100-340-471-10	1	
2	F_MOUNT CUSHION F_MOUNT CUSHION		20-032-1064-1 CODE NO. 100-357-181-10	1	

C4458-F01-C

ｺｰﾄﾞ番号末尾の[**]は、選択品の代表ｺｰﾄﾞを表します。
CODE NUMBER ENDING WITH "**" INDICATES THE CODE NUMBER OF REPRESENTATIVE MATERIAL.

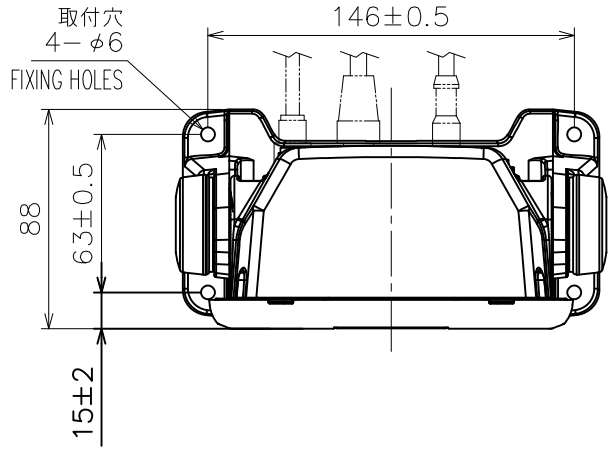
型式/ｺｰﾄﾞ番号が２段の場合、下段より上段に代わる過渡期品であり、どちらかが入っています。 なお、品質は変わりません。

TWO TYPES AND CODES MAY BE LISTED FOR AN ITEM. THE LOWER PRODUCT MAY BE SHIPPED IN PLACE OF THE UPPER PRODUCT. QUALITY IS THE SAME.

（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO ELECTRIC CO ., LTD.

FURUNO



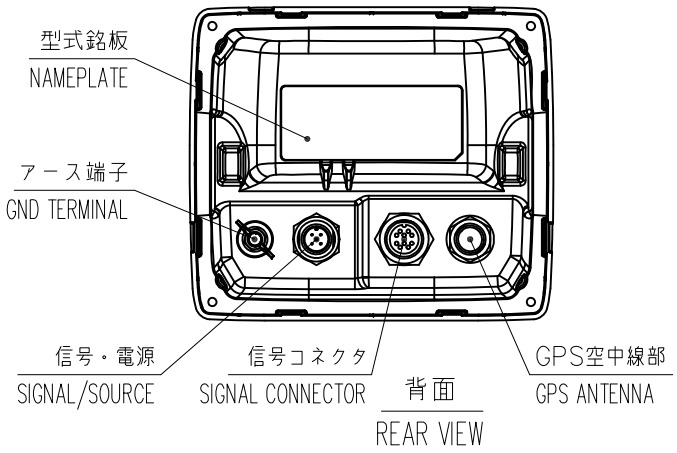
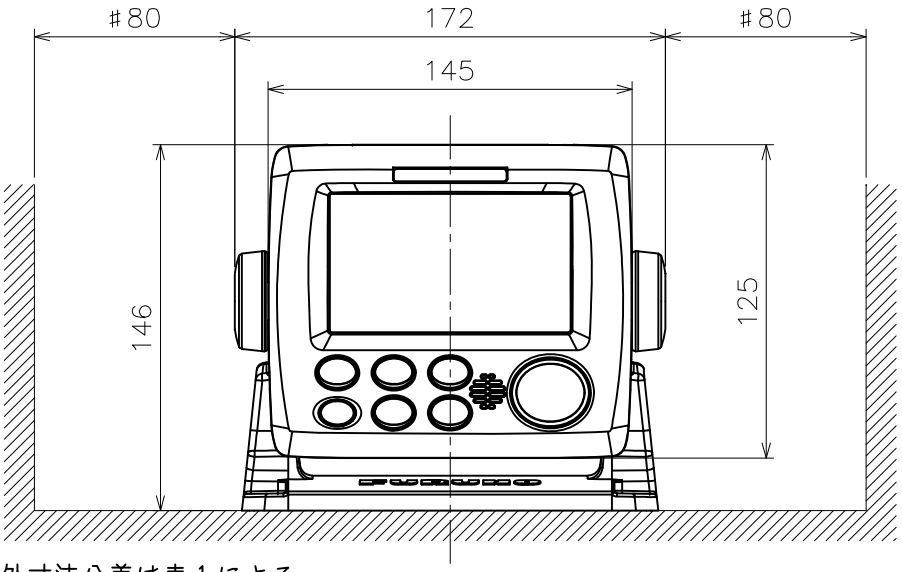
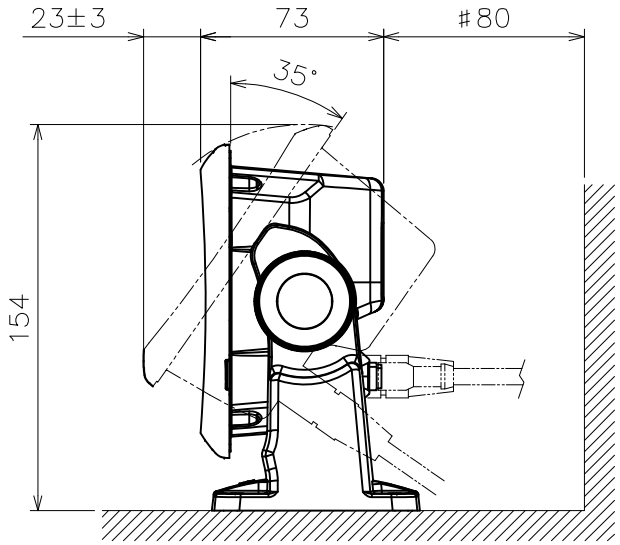


表１ TABLE 1

寸法区分（ｍｍ） DIMENSION	公差（ｍｍ） TOLERANCE
Ｌ≦５０	±１．５
５０<Ｌ≦１００	±２．５
１００<Ｌ≦５００	±３





注 記

１） 指定外寸法公差は表１による。

２） ＃印寸法は、最小サービス空間寸法とする。

３） 取付にはトラスタッピンネジ呼び径５×２０を使用のこと。

NOTE

1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS ø5x20 FOR FIXING THE UNIT.

DRAWN 18/Oct/2010 T.YAMASAKI		TITLE	GP-33
CHECKED 19/Oct/2010 T.TAKAHASHI		名称	受信演算部（卓上装備）
APPROVED 19/Oct/2010 Y. NISHIYAMA			外寸図
SCALE	MASS 0.72 ±10% kg 質量はケーブルを含まず MASS W/O CABLE	NAME	RECEIVER UNIT (TABLETOP MOUNT)
DWG.No. C4458-G01- B	REF.No. 20-032-100G-3		OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO

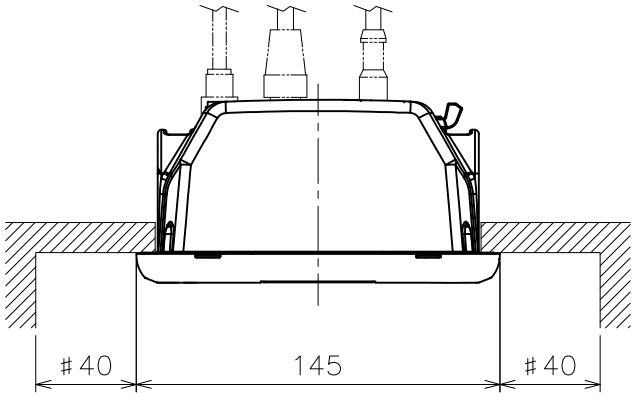
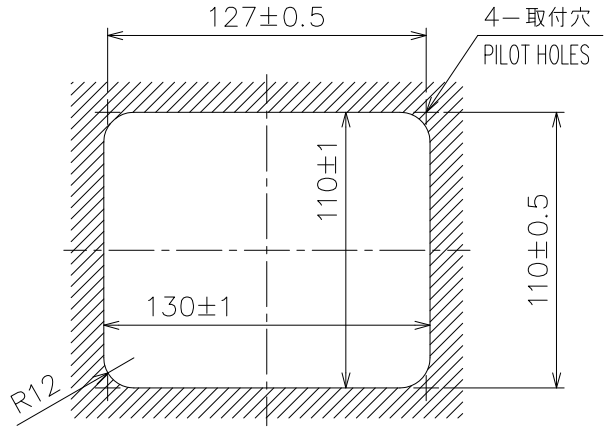
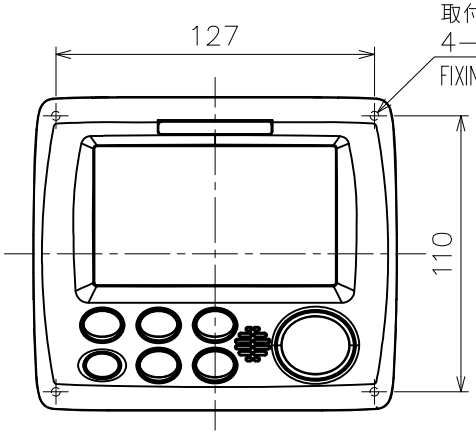


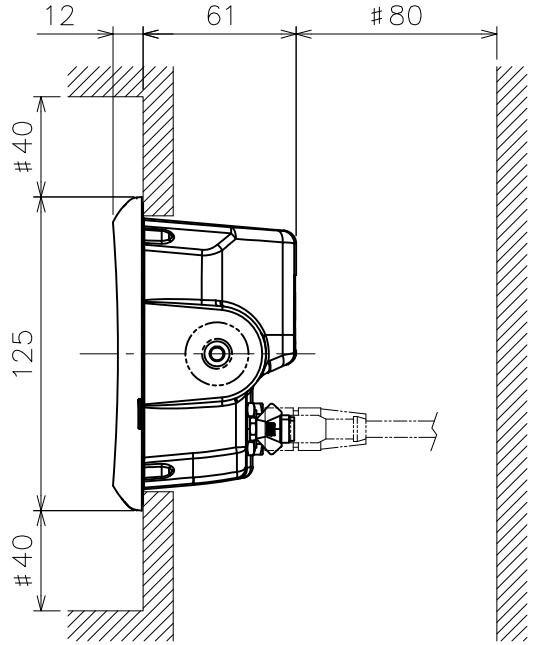
表1 TABLE 1

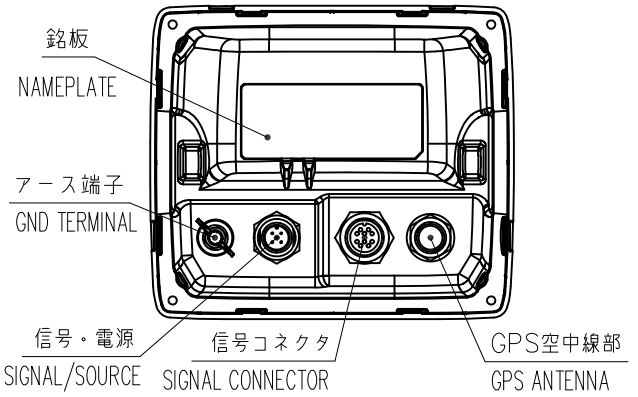
寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3



取付穴寸法図
CUTOUT DIMENSIONS







注　記
1）　指定外寸法公差は表1による。
2）　#印寸法は、最小サービス空間寸法とする。
3）　取付にはナベタッピンネジ呼び径3×20を使用のこと。

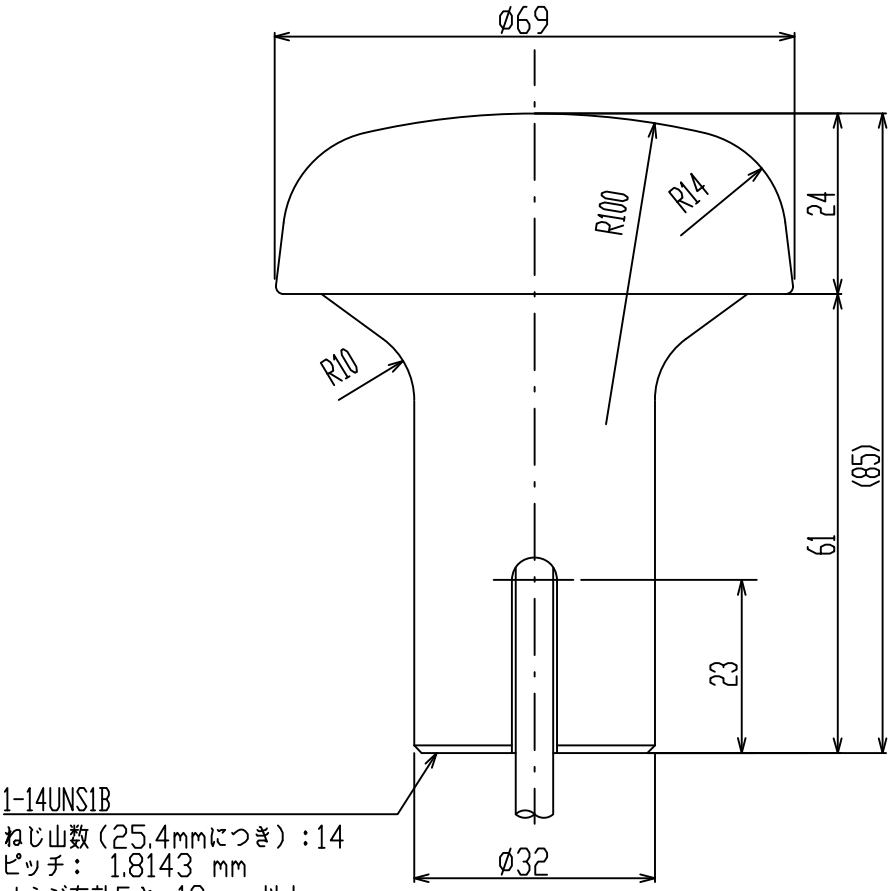
NOTE
1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS ø3x20 FOR FIXING THE UNIT.

DRAWN 18/Oct/2010 T.YAMASAKI		TITLE	GP-33
CHECKED 19/Oct/2010 T.TAKAHASHI		名称	受信演算部（埋込装備）
APPROVED 19/Oct/2010 Y. NISHIYAMA			外寸図
SCALE	MASS 0.61 ±10% kg 質量はケーブルを含まず MASS W/O CABLE	NAME	RECEIVER UNIT (FLUSH MOUNT)
DWG.No. C4458-G02- B	REF.No. 20-032-1106-3		OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

表1 TABLE 1

寸法区分(mm) DIMENSION	公差(mm) TOLERANCE
L ≦ 50	±1.5
50 < L ≦ 100	±2.5
100 < L ≦ 500	±3



1-14UNS1B
ねじ山数（25.4mmにつき）：14
ピッチ： 1.8143 mm
オネジ有効長さ：19 mm以上
オネジ有効径：24.17mm

THREAD PER 25.4mm (1 INCH): 14
PITCH: 1.8143 mm
THREAD LENGTH: 19 mm OR MORE
PITCH DIAMETER: 24.17mm

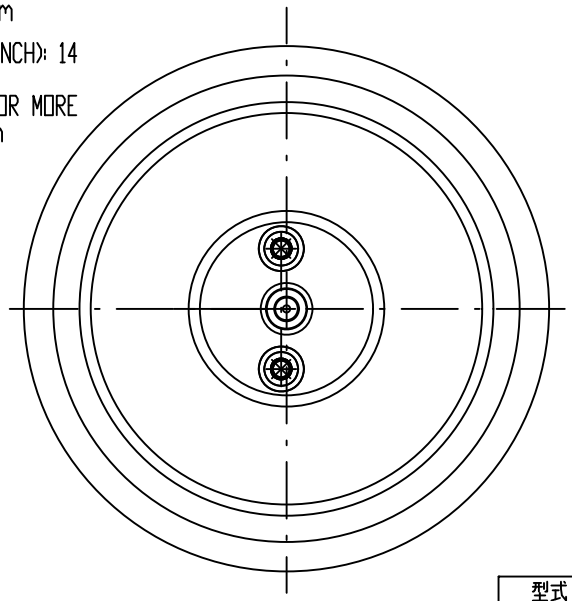


表2 TABLE 2

型式 TYPE	ケーブル長(m) CABLE LENGTH	プラグ PLAG	質量(kg±10%) MASS
GPA-017	10	TNC-P-3	0.6
GPA-017S	0.2	TNC-J-3	0.15

注記
指定外の寸法公差は表1による。

NOTE
TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.

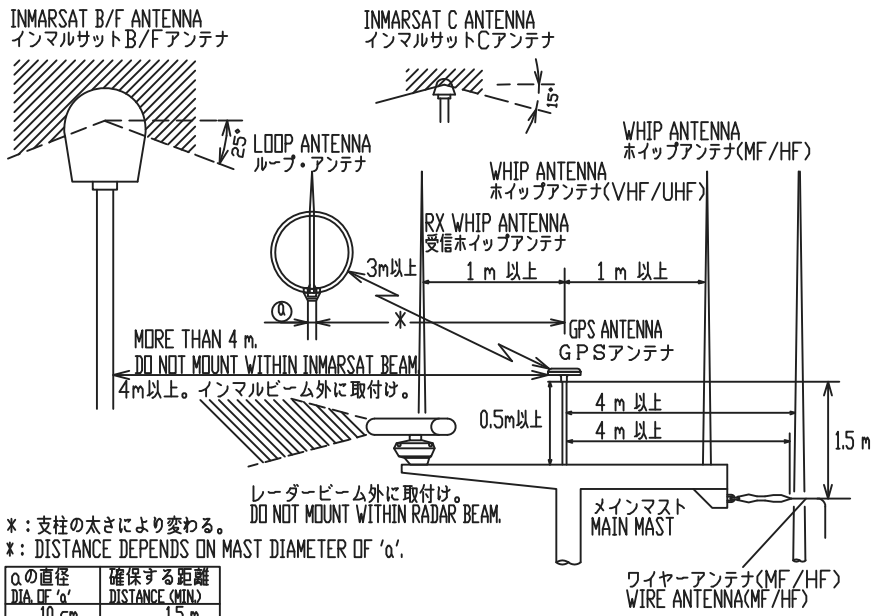
DRAWN Mar. 27 '07 T.YAMASAKI		TITLE	GPA-017/017S
CHECKED Mar. 27 '07 T.TAKENO		名称	空中線部
APPROVED Mar. 27' 07 R. Esumi			外寸図
SCALE 1/1 MASS TABLE 2 表2参照		NAME	ANTENNA UNIT
DWG.No. C4384-G04- L			OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO

取付位置
MOUNTING LOCATION

他の機器のアンテナから下の図の距離以上離す。
THIS FIGURE SHOWS THE SEPARATION DISTANCES FROM OTHER ANTENNAS TO AVOID MUTUAL INTERFERENCE.

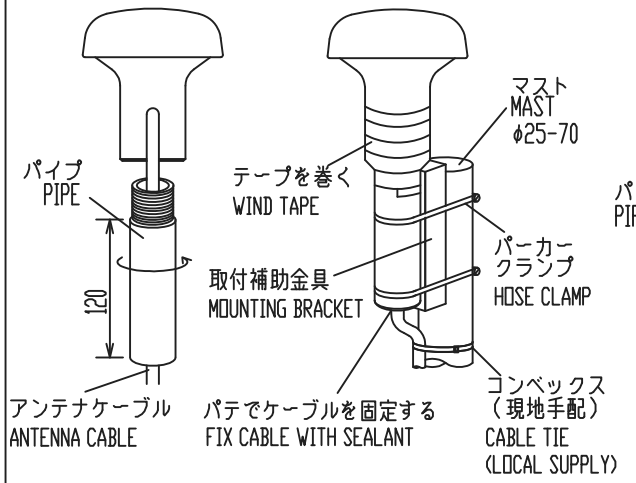


*：支柱の太さにより変わる。
*: DISTANCE DEPENDS ON MAST DIAMETER OF 'a'.

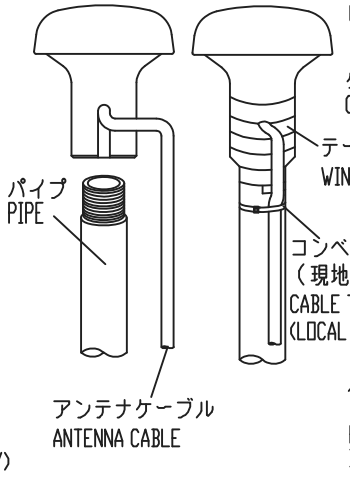
aの直径 DIA. OF 'a'	確保する距離 DISTANCE (MIN)
10 cm	1.5 m
30 cm	3 m

A）マストへの取付け　MAST MOUNTING

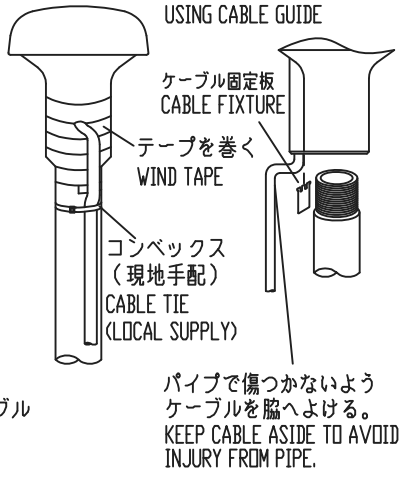
a)マスト取付金具CP20-01111(工事材料)でマストに固定する。
USE MAST MOUNTING KIT CP20-01111.



b)パイプのみを使うとき
USE A PIPE ONLY.



ケーブル溝のある場合
USING CABLE GUIDE

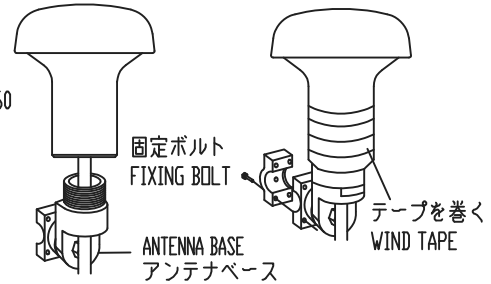


B）スタンションやパルピットにつけるとき

レール用アンテナベース No.13-RC5160
（取付可能レール直径：ø19~ø32）
（コード番号：000-806-114）

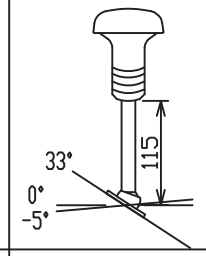
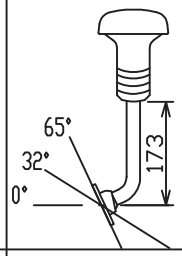
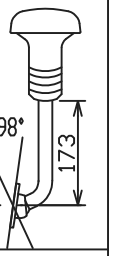
HANDRAIL MOUNTING

USE HANDRAIL MOUNTING BASE No.13-RC5160 (CODE No.000-806-114, OPTION).
THE DIAMETER OF THE HANDRAIL MAY BE FROM ø19mm TO ø32mm.

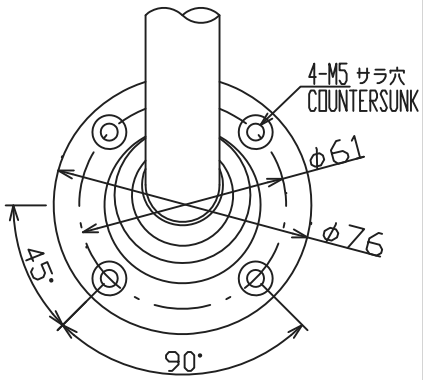


C）取付ける場所が傾斜しているとき　ANTENNA BASE MOUNTING

オプションのアンテナベースを使う。
USE OPTIONAL ANTENNA BASE.

傾斜 INCLINATION	-5° - 33°	32° - 65°	65° - 98°
装備方法 MOUNTING METHOD			
アンテナベース型式 ANT. BASE TYPE コード番号 CODE No.	直型アンテナベース RIGHT ANGLE ANTENNA BASE No.13-QA330 000-803-239	L型アンテナベース L-TYPE ANTENNA BASE No.13-QA310 000-803-240	

アンテナベース基部
MOUNTING DIMENSIONS OF ANTENNA BASE.



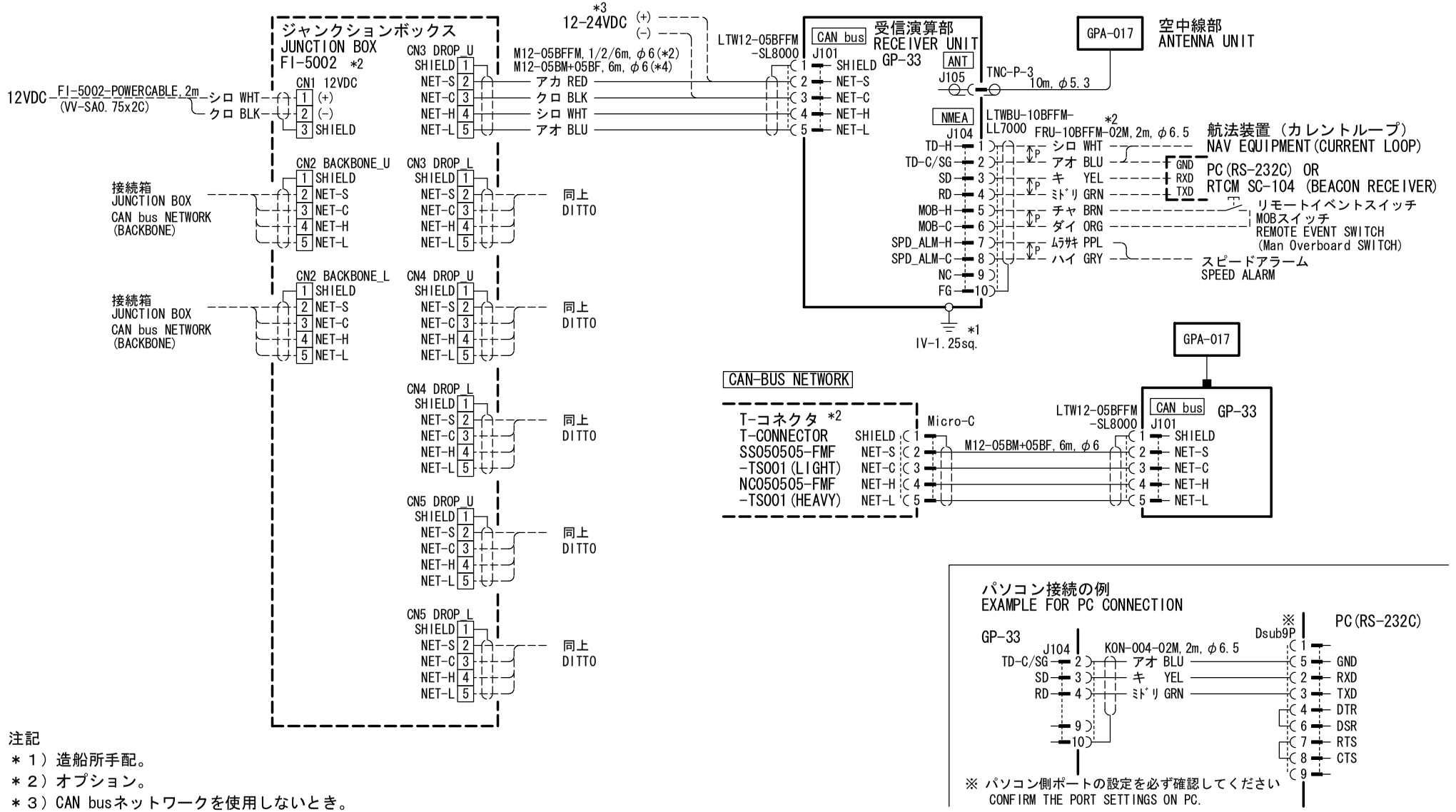
注記 1）パイプやアンテナベースはアンテナユニットにねじ込んだ後に固定する。
2）アンテナを固定するときはパイプ（アンテナベース）をアンテナにねじ込むこと。
アンテナ側をねじるとコネクタ部やケーブルに無理がかかり、故障の原因となる。

NOTE 1. FASTEN PIPE(ANTENNA BASE) TO ANTENNA UNIT FIRST THEN FIX THEM TO MAST OR HANDRAIL.
2. WHEN FIXING ANTENNA, TURN PIPE OR ANTENNA BASE; NOT THE ANTENNA.
TURNING THE ANTENNA MAY TWIST THE CABLE AND PLACE STRESS ON CONNECTOR.

DRAWN 14/MAY/2014 T.YAMASAKI		TITLE	GPA series
CHECKED 14/MAY/2014 H.MAKI		名称	空中線部
APPROVED 15/May/2014 H. MAKI			装備要領図
SCALE / MASS		NAME	ANTENNA UNIT
DWG.No. C4384-Y01- F			INSTALLATION PROCEDURE

FURUNO ELECTRIC CO., LTD.

FURUNO



注記
＊１）造船所手配。
＊２）オプション。
＊３）CAN busネットワークを使用しないとき。
＊４）コネクタプラグを切断して接続のこと。

NOTE
*1: SHIPYARD SUPPLY.
*2: OPTION.
*3: WHEN CAN bus NETWORK IS NOT USED.
*4: CONNECT WIRES AFTER CONNECTOR PLUG REMOVED.

DRAWN 17/Jan/2013 T.YAMASAKI		TITLE	GP-33
CHECKED 17/Jan/2013 H.MAKI		名 称	GPS航法装置
APPROVED 18/Jan/2013 Y.NISHIYAMA			相互結線図
SCALE / MASS kg		NAME	GPS NAVIGATOR
DWG. No. C4458-C01- G	REF. No. 20-032-5001-1		INTERCONNECTION DIAGRAM

FURUNO ELECTRIC CO., LTD.

INDEX

T

U

W

X

FURUNO Worldwide Warranty for Pleasure Boats (Except North America)

This warranty is valid for products manufactured by Furuno Electric Co. (hereafter FURUNO) and installed on a pleasure boat. Any web based purchases that are imported into other countries by anyone other than a FURUNO certified dealer may not comply with local standards. FURUNO strongly recommends against importing these products from international websites as the imported product may not work correctly and may interfere with other electronic devices. The imported product may also be in breach of the local laws and mandated technical requirements. Products imported into other countries as described previously shall not be eligible for local warranty service.

For products purchased outside of your country please contact the national distributor of Furuno products in the country where purchased.

This warranty is in addition to the customer´s statutory legal rights.

1. Terms and Conditions of Warranty

FURUNO guarantees that each new FURUNO product is the result of quality materials and workmanship. The warranty is valid for a period of 2 years (24 months) from the date of the invoice, or the date of commissioning of the product by the installing certified dealer.

2. FURUNO Standard Warranty

The FURUNO standard warranty covers spare parts and labour costs associated with a warranty claim, provided that the product is returned to a FURUNO national distributor by prepaid carrier.

The FURUNO standard warranty includes:

- Repair at a FURUNO national distributor
- All spare parts for the repair
- Cost for economical shipment to customer

3. FURUNO Onboard Warranty

If the product was installed/commissioned and registered by a certified FURUNO dealer, the customer has the right to the onboard warranty.

The FURUNO onboard warranty includes

- Free shipping of the necessary parts
- Labour: Normal working hours only
- Travel time: Up to a maximum of two (2) hours
- Travel distance: Up to a maximum of one hundred and sixty (160) KM by car for the complete journey

4. Warranty Registration

For the Standard Warranty - presentation of product with serial number (8 digits serial number, 1234-5678) is sufficient. Otherwise, the invoice with serial number, name and stamp of the dealer and date of purchase is shown.

For the Onboard Warranty your FURUNO certified dealer will take care of all registrations.

5. Warranty Claims

For the Standard Warranty - simply send the defective product together with the invoice to a FURUNO national distributor.
For the Onboard Warranty – contact a FURUNO national distributor or a certified dealer. Give the product´s serial number and describe the problem as accurately as possible.

Warranty repairs carried out by companies/persons other than a FURUNO national distributor or a certified dealer is not covered by this warranty.

6. Warranty Limitations

When a claim is made, FURUNO has a right to choose whether to repair the product or replace it.

The FURUNO warranty is only valid if the product was correctly installed and used. Therefore, it is necessary for the customer to comply with the instructions in the handbook. Problems which result from not complying with the instruction manual are not covered by the warranty.

FURUNO is not liable for any damage caused to the vessel by using a FURUNO product.

The following are excluded from this warranty:

a. Second-hand product

b. Underwater unit such as transducer and hull unit

c. Routine maintenance, alignment and calibration services.

d. Replacement of consumable parts such as fuses, lamps, recording papers, drive belts, cables, protective covers and batteries.

e. Magnetron and MIC with more than 1000 transmitting hours or older than 12 months, whichever comes first.

f. Costs associated with the replacement of a transducer (e.g. Crane, docking or diver etc.).

g. Sea trial, test and evaluation or other demonstrations.

h. Products repaired or altered by anyone other than the FURUNO national distributor or an authorized dealer.

i. Products on which the serial number is altered, defaced or removed.

j. Problems resulting from an accident, negligence, misuse, improper installation, vandalism or water penetration.

k. Damage resulting from a force majeure or other natural catastrophe or calamity.

l. Damage from shipping or transit.

m. Software updates, except when deemed necessary and warrantable by FURUNO.

n. Overtime, extra labour outside of normal hours such as weekend/holiday, and travel costs above the 160 KM allowance

o. Operator familiarization and orientation.

FURUNO Electric Company, March 1, 2011

FURUNO Warranty for North America

FURUNO U.S.A., Limited Warranty provides a twenty-four (24) months LABOR and twenty-four (24) months PARTS warranty on products from the date of installation or purchase by the original owner. Products or components that are represented as being waterproof are guaranteed to be waterproof only for, and within the limits, of the warranty period stated above. The warranty start date may not exceed eighteen (18) months from the original date of purchase by dealer from Furuno USA and applies to new equipment installed and operated in accordance with Furuno USA's published instructions.

Magnetrons and Microwave devices will be warranted for a period of 12 months from date of original equipment installation.

Furuno U.S.A., Inc. warrants each new product to be of sound material and workmanship and through its authorized dealer will exchange any parts proven to be defective in material or workmanship under normal use at no charge for a period of 24 months from the date of installation or purchase.

Furuno U.S.A., Inc., through an authorized Furuno dealer will provide labor at no cost to replace defective parts, exclusive of routine maintenance or normal adjustments, for a period of 24 months from installation date provided the work is done by Furuno U.S.A., Inc. or an AUTHORIZED Furuno dealer during normal shop hours and within a radius of 50 miles of the shop location.

A suitable proof of purchase showing date of purchase, or installation certification must be available to Furuno U.S.A., Inc., or its authorized dealer at the time of request for warranty service.

This warranty is valid for installation of products manufactured by Furuno Electric Co. (hereafter FURUNO). Any purchases from brick and mortar or web-based resellers that are imported into other countries by anyone other than a FURUNO certified dealer, agent or subsidiary may not comply with local standards. FURUNO strongly recommends against importing these products from international websites or other resellers, as the imported product may not work correctly and may interfere with other electronic devices. The imported product may also be in breach of the local laws and mandated technical requirements. Products imported into other countries, as described previously, shall not be eligible for local warranty service.

For products purchased outside of your country please contact the national distributor of Furuno products in the country where purchased.

WARRANTY REGISTRATION AND INFORMATION

To register your product for warranty, as well as see the complete warranty guidelines and limitations, please visit www.furunousa.com and click on "Support". In order to expedite repairs, warranty service on Furuno equipment is provided through its authorized dealer network. If this is not possible or practical, please contact Furuno U.S.A., Inc. to arrange warranty service.

FURUNO U.S.A., INC.
Attention: Service Coordinator
4400 N.W. Pacific Rim Boulevard
Camas, WA 98607-9408
Telephone: (360) 834-9300
FAX: (360) 834-9400

Furuno U.S.A., Inc. is proud to supply you with the highest quality in Marine Electronics. We know you had several choices when making your selection of equipment, and from everyone at Furuno we thank you. Furuno takes great pride in customer service.

Declaration of Conformity

[GP-33]

Bulgarian (BG)	С настоящото Furuno Electric Co., Ltd. декларира, че гореспоменат тип радиосъоръжение е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес:
Spanish (ES)	Por la presente, Furuno Electric Co., Ltd. declara que el tipo de equipo radioeléctrico arriba mencionado es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente:
Czech (CS)	Tímto Furuno Electric Co., Ltd. prohlašuje, že výše zmíněné typ rádiového zařízení je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese:
Danish (DA)	Hermed erklærer Furuno Electric Co., Ltd., at ovennævnte radioudstyr er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse:
German (DE)	Hiermit erklärt die Furuno Electric Co., Ltd., dass der oben genannte Funkanlagentyp der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar:
Estonian (ET)	Käesolevaga deklareerib Furuno Electric Co., Ltd., et ülalmainitud raadioseadme tüüp vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil:
Greek (EL)	Με την παρούσα η Furuno Electric Co., Ltd., δηλώνει ότι ο προαναφερθέντας ραδιοεξοπλισμός πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο:
English (EN)	Hereby, Furuno Electric Co., Ltd. declares that the above-mentioned radio equipment type is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address:
French (FR)	Le soussigné, Furuno Electric Co., Ltd., déclare que l'équipement radioélectrique du type mentionné ci-dessusest conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante:
Croatian (HR)	Furuno Electric Co., Ltd. ovime izjavljuje da je gore rečeno radijska oprema tipa u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi:
Italian (IT)	Il fabbricante, Furuno Electric Co., Ltd., dichiara che il tipo di apparecchiatura radio menzionato sopra è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet:
Latvian (LV)	Ar šo Furuno Electric Co., Ltd. deklarē, ka augstāk minēts radioiekārta atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē:

Lithuanian (LT)	Aš, Furuno Electric Co., Ltd., patvirtinu, kad pirmiau minėta radijo įrenginių tipas atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu:
Hungarian (HU)	Furuno Electric Co., Ltd. igazolja, hogy fent említett típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen:
Maltese (MT)	B'dan, Furuno Electric Co., Ltd., niddikjara li msemmija hawn fuq-tip ta' tagħmir tar-radju huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej:
Dutch (NL)	Hierbij verklaar ik, Furuno Electric Co., Ltd., dat het hierboven genoemde type radioapparatuur conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres:
Polish (PL)	Furuno Electric Co., Ltd. niniejszym oświadcza, że wyżej wymieniony typ urządzenia radiowego jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym:
Portuguese (PT)	O(a) abaixo assinado(a) Furuno Electric Co., Ltd. declara que o mencionado acima tipo de equipamento de rádio está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet:
Romanian (RO)	Prin prezenta, Furuno Electric Co., Ltd. declară că menționat mai sus tipul de echipamente radio este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet:
Slovak (SK)	Furuno Electric Co., Ltd. týmto vyhlasuje, že vyššie spomínané rádiové zariadenie typu je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese:
Slovenian (SL)	Furuno Electric Co., Ltd. potrjuje, da je zgoraj omenjeno tip radijske opreme skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu:
Finnish (FI)	Furuno Electric Co., Ltd. vakuuttaa, että yllä mainittu radiolaitetyyppi on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa:
Swedish (SV)	Härmed försäkrar Furuno Electric Co., Ltd. att ovan nämnda typ av radioutrustning överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress:

Online Resource

http://www.furuno.com/en/support/red_doc

SPECIFICATIONS

GENERAL

Receiving frequency	1575.42 MHz (GPS/Galileo), 1602.5625 MHz (GLONASS), E1B (Galileo), 1OF (GLONASS)
Tracking code	C/A code (GPS), E1B (Galileo), 1OF (GLONASS)
Positional accuracy (dependent on ionospheric activity and multipath)	GPS 10 m approx. (2DRMS, HDOP<4) DGPS 5 m approx. (2DRMS, HDOP<4) WAAS 3 m approx. (2DRMS, HDOP<4) MSAS 7 m approx. (2DRMS, HDOP<4)
Ship's speed accuracy (SOG)	0.02 kn RMS (tracking satellites 5 or more)
Ship's speed accuracy (VBW, SOG)	0.2% of ship's speed or 0.02 kn whichever is the greater (tracking satellites 5 or more, at antenna position)
Course accuracy	SC-130 0.25° RMS, SC-70 0.4° RMS
Course resolution	0.1°,0.01°,0.001° (select from menu)
Attitude resolution	0.1°,0.01°,0.001° (select from menu)
Rate of turn	0.1°/s, 0.01°/s or 0.001°/s (select from menu)
Tracking bearing	40°/s
Position fixing time	90 s approx. (typical)
Attitude accuracy	Pitch/ Roll: 0.4° RMS

DISPLAY UNIT

Screen	4.3-inch color LCD, 95.04 mm (W) x 87.12 mm (H)
Resolution	480 x 272 dots (WQVGA)
Brilliance	600 cd/m² typical
Contrast	17 levels
Display mode	Heading, Nav data, Rate of turn and Speed modes (Non-IMO types only)

INTERFACE (JUNCTION BOX)

Number of ports (junction box)		
IEC61162-2:		1 port (IN: 1, OUT: 1)
IEC61162-1:		8 ports (IN: 4, OUT: 8)
External beacon input (DATA5 port):		RTCM SC-104 V2.3 (RS-485), ITU-R M823
CANbus:		1 port
AD-10:		4 ports, for heading output
RS-485:		1 port, for display unit connection
LAN (IEC61162-450):		Ethernet, 100Base-TX, RJ45 connecter
Data sentences		
DATA ports	Input	ACK, ACM, ACN, HBT, HDT*1, MSK, MSS, THS, VBW*2, VDR*2
	Output	ALC, ALF, ALR, ARC, DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG*2, HDM*2, HDT*1, HRM*2, MSK, POS, RMC, ROT, THS,VBW*2, VDR*2, VHW*2, VLW*2, VTG, XDR*2, ZDA
NETWORK ports	Input	ACK, ACM, ACN, HBT
	Output	ALC, ALF, ALR, ARC, DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG, HDM, HDT*1, HRM*2, POS, RMC, ROT, THS, VBW*2, VDR*2, VHW*2, VLW*2, VTG, XDR*2, ZDA
Output proprietary sentences		PFEC: GPatt, GPhve, GPimu, Ilalr, pidat
PGN	Input	059392/904, 060928, 061184, 126208/720/996
	Output	059392/904, 060928, 061184, 065280, 126208/464/720/992/996, 127250/251/252/257/258, 129025/026/029/033/044/291/539/540/545/547, 130310/312/314/316/577/578/822/823/842/843/845/846
IEC61162-450 transmission group		
	Input	MISC, SATD, NAVD, PROP
	Ouput	Arbitrary (default: SATD)
Other network function		NTP, HTTP

*1: Not used for new SOLAS vessels.
*2: for Non-IMO types only.

POWER SUPPLY

Junction box	12-24 VDC: 2.1-1.1 A (included Antenna Unit and Display Unit)

ENVIRONMENTAL CONDITIONS

Ambient temperature	Antenna unit: -25°C to +55°C (storage: -25°C to +70°C) Display unit/ Junction box: -15°C to +55°C
Relative humidity	95% or less at +40°C
Degree of protection	Antenna unit IP56 Display unit IP22 (IP35: option) Junction box IP20 (IP22: bulkhead mount)
Vibration	IEC 60945 Ed.4

EQUIPMENT LIST

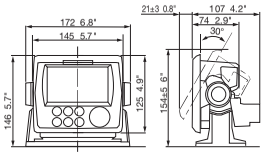
Standard

1	Antenna Unit	SC-703 x 1 SC-1303 x 1
2	Display Unit	SC-702 x 1
3	Junction Box	SC-701 x 1
4	Installation Materials	

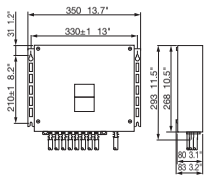
Optional supply

1	AC/DC Power Supply Unit	PR-240
2	Alarm Monitoring	IF-2503
3	Interface Unit	IF-NMEA SC
4	Remote Display	RD-50
5	Connector (waterproof)	FRU-RJ-PLUG-ASSY
6	Modular Connector	MPS588-C
7	LAN_CNV Kit	OP20-47/48
8	Cable Assembly	M12-05BFFM-010/020/060
9	Connector (NMEA)	LTWMC-05BFFT-SL8001 x 1 LTWMC-05BMMT-SL8001 x 1 SS-050505-FMF-TS001 x 1

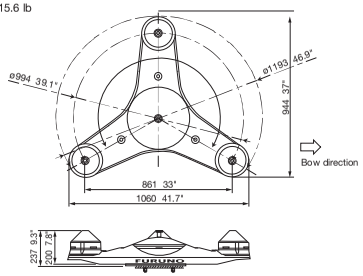
DISPLAY UNIT (HANGER)
SC-702 0.7 kg, 1.5 lb



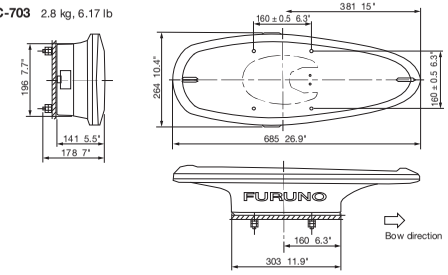
JUNCTION BOX
SC-701 2.9 kg, 6.39 lb



ANTENNA UNIT
SC-1303 7.1 kg, 15.6 lb



SC-703 2.8 kg, 6.17 lb



Satellite Compass is a trademark of FURUNO ELECTRIC CO.,LTD

Beware of similar products

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FURUNO ELECTRIC CO., LTD.
Nishinomiya, Hyogo, Japan
www.furuno.com

FURUNO U.S.A., INC.
Camas, Washington, U.S.A.
www.furunousa.com

FURUNO (UK) LIMITED
Havant, Hampshire, U.K.
www.furuno.co.uk

FURUNO FRANCE S.A.S.
Bordeaux-Mérignac, France
www.furuno.fr

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Limassol, Cyprus
www.furuno.com.cy

FURUNO CHINA CO., LTD.
Hong Kong
www.furuno.com/cn

FURUNO SHANGHAI CO., LTD.
Shanghai, China
www.furuno.com/cn

1-A-17043SK Printed in Japan
Catalogue No. CA000001102

FURUNO

SATELLITE COMPASS

Model **SC-70/130**

NAVnet Connect | CAN bus | Multi-GNSS

www.furuno.com

High precision and accurate heading of 0.25° (SC-130)
Perfect for Radar, ECDIS, AIS, Sonar and Autopilot

Standard High contrast 4.3" Color LCD
(on the screen, the THD mode)
SC-702

SATELLITE COMPASS

Model **SC-70/130**

The SC-70 and SC-130 are the latest satellite compasses, built on FURUNO's commercial-grade technology platform.

These satellite compasses prove their value by increasing the accuracy of other devices, such as Radar, ARPA, Scanning Sonar, Current Indicator, Chart Plotter, ECDIS and Autopilot.

They provide a highly accurate heading input to these other technologies by utilizing the very latest GNSS (Global Navigation Satellite System). This satellite system is comprised of GPS, Galileo and GLONASS to ensure the highest precision and a continuous coverage.

The SC-70 and SC-130 provide a variety of data, including GPS Positioning, SOG (Speed Over Ground), COG (Course Over Ground), ROT (Rate Of Turn) and 3-axis speed (bow, stern and longitudinal).

All of these data assist with critical maneuvers, such as berthing.

These compasses are maintenance free and are a great asset for any vessel.

Features

SC-130 features a Tri-sensor antenna that provides a high system accuracy for the heading of your vessel

Provides highly accurate heading data for Autopilot, Radar, ARPA, Scanning Sonar, Current Indicator, Chart Plotter, ECDIS and Autopilot.

- **0.25° (with SC-130)**
  Ideal for medium to large vessels navigating in crowded ports and making precise maneuvers, such as berthing.
- **0.4° (with SC-70)**
  Ideal for small to medium boats requiring highly accurate heading.

Utilizes GNSS such as GPS, Galileo and GLONASS for high Precision

- SBAS compatible (EGNOS,WAAS,MSAS)
- Provide precise data for SOG, COG, ROT and L/L
- Eliminating the problem of not having enough satellites at hand by using multiple types of satellites

Speed on 3 axis (bow, stern and longitudinal) for safe navigating and berthing

IMO Type-approved as THD, GPS and ROTI. Complying with the IEC, ISO requirements

Easily integrated into the existing shipboard network via Ethernet

Rapid follow-up rate 40°/s (twice the IMO high speed craft requirement, 20°/s)

Maintenance free and no recurring cost as there are no mechanical parts

Super short starting time - 90 seconds

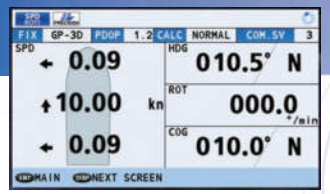
- Once the power is on, it takes about 90 seconds to start (the starting time will slightly differ depending on the equipment location)

Easy to retrofit by using existing antenna cabling

- For SC-50/55/60/110/120 (The LAN_CNV option kit is necessary)

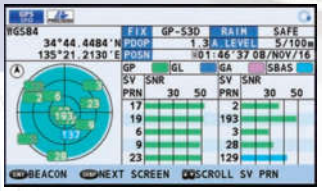
Precision Pitch/Roll data in Analog and Digital formats for Vessel Stabilization, SONAR, etc.

Display modes



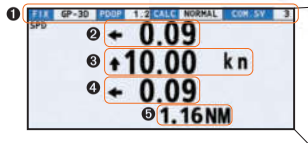
Navigational data screen

- 3-axis speed, as well as the Heading, Rate Of Turn and Course Over Ground can be grasped at a glance. (non-IMO type only)

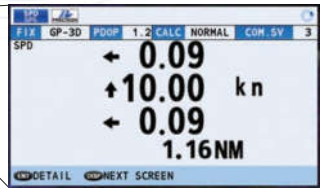


GPS integrity mode

- GPS satellites signal reception including signal strength and signal to noise Ratio
- SBAS signal status

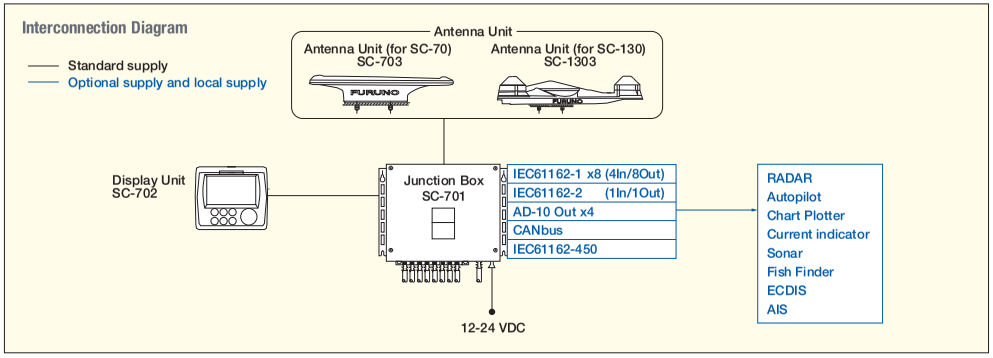


❶Current selected mode (SPD or THD), integrity status and common satellite number
❷Transverse speed at bow position
❸Longitudinal speed
❹Transverse speed at stern position
❺Distance travelled



Speed mode

- 3-axis speed of the ship : bow, stern and longitudinal (non-IMO type only)



FURUNO

OPERATOR'S MANUAL

SATELLITE COMPASS

Model **SC-70**
SC-130

FURUNO ELECTRIC CO., LTD.

www.furuno.com

ECF
(Elemental Chlorine Free)
The paper used in this manual
is elemental chlorine free.

FURUNO ELECTRIC CO., LTD.

9-52 Ashihara-cho,
Nishinomiya, 662-8580, JAPAN

・FURUNO Authorized Distributor/Dealer

 Printed in Japan

A : JAN. 2017
K2 : JAN. 06, 2021

Pub. No. OME-72820-K2

(GREG) SC-70/SC-130

0001924071 9

IMPORTANT NOTICES

General

- This manual has been authored with simplified grammar, to meet the needs of international users.
- The operator of this equipment must read and follow the instructions in this manual. Wrong operation or maintenance can void the warranty or cause injury.
- Do not copy any part of this manual without written permission from FURUNO.
- If this manual is lost or worn, contact your dealer about replacement.
- The contents of this manual and the equipment specifications can change without notice.
- The example screens (or illustrations) shown in this manual can be different from the screens you see on your display. The screens you see depend on your system configuration and equipment settings.
- Save this manual for future reference.
- Any modification of the equipment (including software) by persons not authorized by FURUNO will void the warranty.
- The following concern acts as our importer in Europe, as defined in DECISION No 768/2008/EC.
  - Name: FURUNO EUROPE B.V.
  - Address: Ridderhaven 19B, 2984 BT Ridderkerk, The Netherlands
- All brand, product names, trademarks, registered trademarks, and service marks belong to their respective holders.

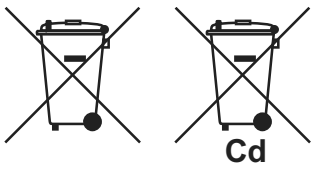
How to discard this product

Discard this product according to local regulations for the disposal of industrial waste. For disposal in the USA, see the homepage of the Electronics Industries Alliance (http://www.eiae.org/) for the correct method of disposal.

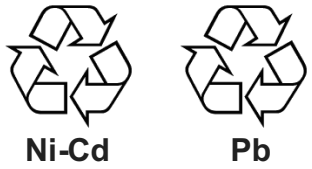
How to discard a used battery

Some FURUNO products have a battery(ies). To see if your product has a battery, see the chapter on Maintenance. If a battery is used, tape the + and - terminals of the battery before disposal to prevent fire, heat generation caused by short circuit.

In the European Union
The crossed-out trash can symbol indicates that all types of batteries must not be discarded in standard trash, or at a trash site. Take the used batteries to a battery collection site according to your national legislation and the Batteries Directive 2006/66/EU.



In the USA
The Mobius loop symbol (three chasing arrows) indicates that Ni-Cd and lead-acid rechargeable batteries must be recycled. Take the used batteries to a battery collection site according to local laws.



In the other countries
There are no international standards for the battery recycle symbol. The number of symbols can increase when the other countries make their own recycle symbols in the future.

SAFETY INSTRUCTIONS

The operator and installer must read the applicable safety instructions before attempting to operate or install the equipment. Failure to comply with these safety instruction may cause injury, loss of life or damage to the equipment.

DANGER	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

Warning, Caution Prohibitive Action Mandatory Action

Safety instructions for the installer

WARNING

Turn off the power at the mains switchboard before beginning the installation.

Fire, electrical shock or serious injury can result if the power is left on or is applied while the equipment is being installed.

ELECTRICAL SHOCK HAZARD
Do not open the equipment unless totally familiar with electrical circuits and service manual.

Only qualified personnel should work inside the equipment.

Use the specified power cable.

Fire can result if an incorrect cable is used.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can occur.

Do not install the equipment where it may get wet from rain or water splash.

Water in the equipment can cause fire, electrical shock or damage to the equipment.

CAUTION

Ground the equipment to prevent electrical shock and mutual interference.

Observe the following safe compass distances to prevent interference to a magnetic compass:

	Standard compass	Steering compass
Display Unit SC-702	0.50 m	0.30 m
Junction Box SC-701	1.35 m	0.85 m
Antenna Unit SC-703	0.40 m	0.30 m
Antenna Unit SC-1303	0.30 m	0.30 m
Remote Display Unit RD-50	0.45 m	0.30 m
Remote Display Unit RD-20	1.25 m	0.80 m

Safety instructions for the operator

⚠ WARNING

ELECTRICAL SHOCK HAZARD
Do not open the equipment unless totally familiar with electrical circuits and service manual.

Only qualified personnel should work inside the equipment.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can occur.

Turn off the power immediately if water leaks into the equipment or smoke or fire is coming from the equipment.

Failure to turn off the equipment can cause fire or electrical shock.
Contact a FURUNO agent for service.

Use the correct fuse.

A wrong fuse can cause fire or serious damage to the equipment.

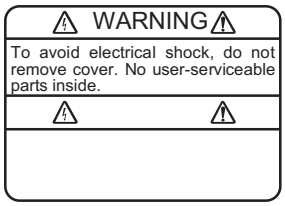
CAUTION

No single navigation aid (including this unit) should ever be relied upon as the exclusive means for navigating your vessel.

The navigator is responsible for checking all aids available to confirm his position. Electronic aids are intended to assist, not replace, the navigator.

WARNING LABEL

A warning label is attached to the Junction Box (SC-701). Do not remove the label.
If the label is missing or damaged, contact a FURUNO agent or dealer about replacement.



Unit: Junction Box (SC701)
Name: Warning Label (1)
Type: 86-003-1011-3
CodeNo.: 100-263-233-10

About the TFT LCD

The TFT LCD is constructed using the latest LCD techniques, and displays 99.99% of its pixels. The remaining 0.01% of the pixels may drop out or blink, however this is not an indication of malfunction.

TABLE OF CONTENTS

FOREWORD

A Word to the Owner of the SC-70/SC-130

FURUNO Electric Company thanks you for purchasing the FURUNO SC-70 or SC-130 Satellite Compass™. We are confident you will discover why the FURUNO name has become synonymous with quality and reliability.

Since 1948, FURUNO Electric Company has enjoyed an enviable reputation for quality and reliability throughout the world. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your equipment is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly operated and maintained. Please carefully read and follow the operation and maintenance procedures in this manual.

We would appreciate feedback from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO.

Features

The SC-70/SC-130 is a new Satellite Compass™ designed with FURUNO advanced GPS kinematic technology. This compass has a wide range of applications for both land and sea vessels.

The main features are:

- Meets the requirement for the following regulations: IMO MSC. 116(73), ISO 22090 Ed 2.0, IMO A. 694(17), IEC 60945, ISO 22090 Ed 2.0, IEC 61108-1 Ed 2.0, ISO 20672 Ed 1.0, IEC 61924-2 Ed 1.0, IEC 61162-1 Ed 4.0, IEC 61162-2 Ed 1.0, IEC 61162-450 Ed 1.0, IEC 62288 Ed 2.0, IEC 61924-2 Ed 1.0 RESOLUTION MSC. 302(87).
- Can output speed for any set location, allowing monitoring of bow and stern berthing speeds without the use of optional equipment.
- Perfect for use as a heading sensor for RADAR/ARPA, AIS, ECDIS and scanning SONARs.
- There are no mechanical parts such as gimbals or a rotating motor, thus the compass is free from routine maintenance.
- Geomagnetism does not affect the compass performance, making it usable on any vessel.
- No need for speed correction, unlike a gyrocompass.
- Short setting time
- Easily integrated into existing ship-board network via Ethernet.
- Remote Maintenance Service (RMS) ready, allowing hassle-free assistance when in port.
- Can be connected using existing antenna cabling (SC-50/60/110/120 only) by adding the optional conversion kit. Note that existing antennas units must be replaced. (Non-IMO type only)
- Uses multiple satellite types, eliminating the problem of not having enough satellites visible. (Non-IMO type only.)

Software used in this product

This product includes software to be licensed under the GNU General Public License (GPL) version 2.0, GNU Lesser General Public Software License (LGPL) version 2.0, Apache, BSD and others. The program(s) is/are free software(s), and you can copy it and/or redistribute it and/or modify it under the terms of the GPL version 2.0 or LGPL version 2.0 as published by the Free Software Foundation. Please access to the following URL if you need source codes:

https://www.furuno.co.jp/en/contact/cnt_oss_e01.html

CE declaration

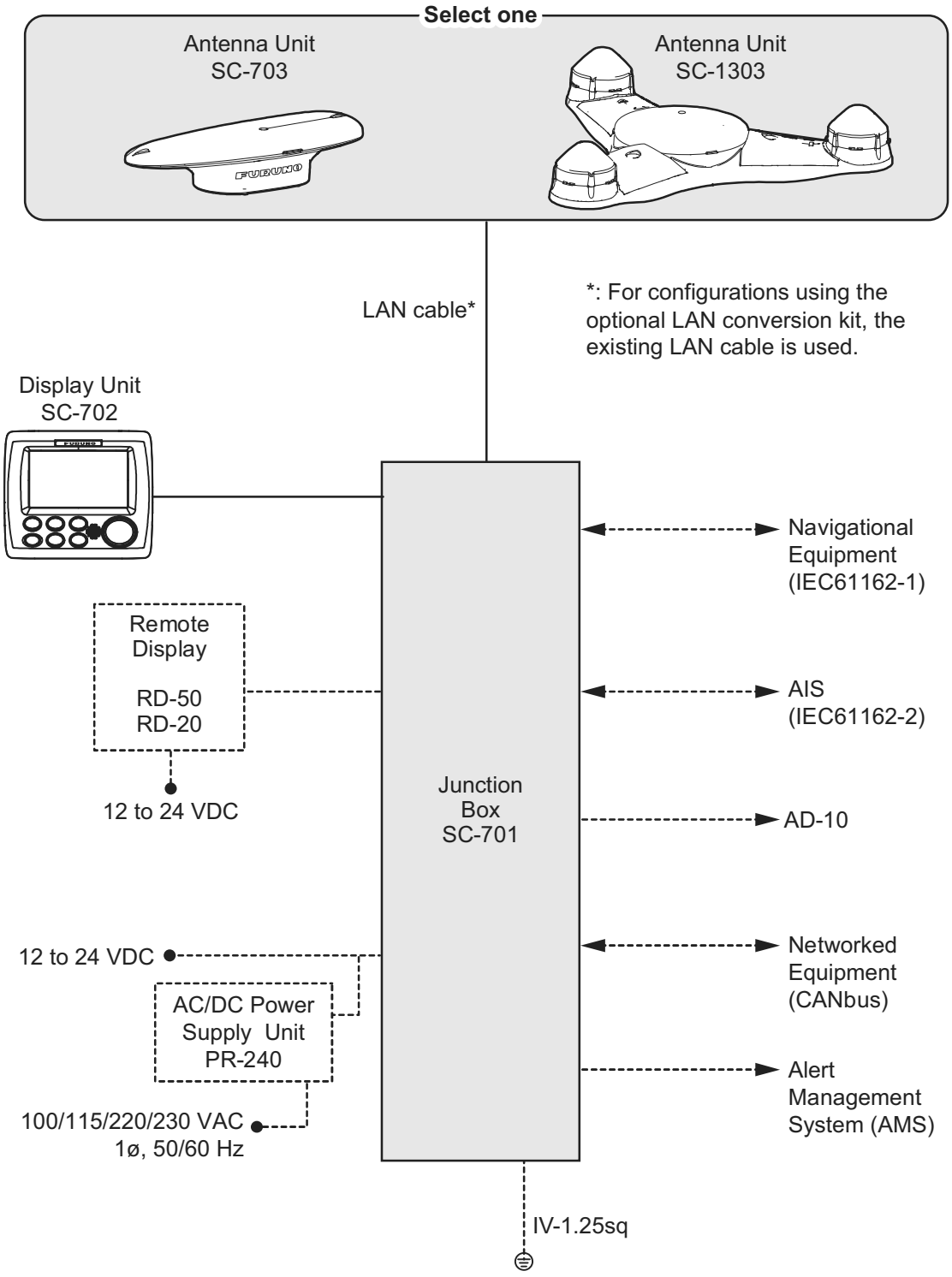
With regards to CE declarations, please refer to our website (www.furuno.com), for further information about RoHS conformity declarations.

Program numbers

Unit & PC Board	PCB/Application	Program No.*
Antenna Unit	MAIN	2051570-01.xx
	GNSS	48505230xx
Junction box	MAIN	2051562-01.xx
Display Unit	MAIN	2051566-01.xx
Remote Display Unit RD-50	Starter	2651006-01.xx
	Booter	2651007-01.xx
	Main	2651008-01.xx
Remote Display Unit RD-20	Starter	2651003-01.xx
	Booter	2651004-01.xx
	Main	2651005-01.xx

*: “xx” denotes version number.

SYSTEM CONFIGURATION



Environmental categories:

Antenna units:	Exposed to the weather.
Other units:	Protected from the weather.

———: Standard supply
- - - - - - - - - - : Optional/local supply

EQUIPMENT LIST

Standard supply

Name	Type	Code No.	Qty.	Remarks
Antenna unit	SC-703	-	Select one	-
	SC-703-L			Contains LAN-Coax conversion kit.
	SC-1303			
	SC-1303-L			Contains LAN-Coax conversion kit.
Display Unit	SC-702	-	1	-
Junction Box	SC-701	-	Select one	-
	SC-701-L	-		Contains LAN-Coax conversion kit.
Installation materials	CP20-04300	000-033-318	Select one	LAN cable (30 m) for SC-701 to Antenna Unit connection.
	CP20-04310	000-033-319		LAN cable (40 m) for SC-701 to Antenna Unit connection.
	CP20-04320	000-033-320		LAN cable (50 m) for SC-701 to Antenna Unit connection.
	CP20-04340	000-033-322		LAN cable (30 m) for SC-701 to Antenna Unit connection. No armor, with connector attached.
	CP20-04360	000-033-324		LAN cable (30 m) for SC-701 to Antenna Unit connection. No armor, with separate connector.
	CP20-04370	000-035-430		LAN cable (10 m) for SC-701 to Antenna Unit connection, with separate connector.
	CP20-04380	000-035-431		LAN cable (15 m) for SC-701 to Antenna Unit connection, with separate connector.
	CP20-04500	000-035-432		LAN cable (10 m) for SC-701 to Antenna Unit connection, with connector attached.
	CP20-04510	000-035-433		LAN cable (15 m) for SC-701 to Antenna Unit connection, with connector attached.
	CP20-04520	000-035-508		LAN cable (10 m) for SC-701 to Antenna Unit connection, No armor, with separate connector.
	CP20-04530	000-035-509		LAN cable (15 m) for SC-701 to Antenna Unit connection, No armor, with separate connector.
	CP20-04540	000-035-510		LAN cable (10 m) for SC-701 to Antenna Unit connection, No armor, with connector attached.
	CP20-04550	000-035-511		LAN cable (15 m) for SC-701 to Antenna Unit connection, No armor, with connector attached.
	CP20-04201	001-514-460	1	For SC-703.
	CP20-04202	001-514-570	1	For SC-1303.
	CP20-04001	001-514-470	1	For SC-701.

Name	Type	Code No.	Qty.	Remarks
Installation materials	CP20-04101	001-521-480	1	For SC-702.
	CP20-04100	000-035-376	Select one	For SC-702-E-1. 10 m cable.
	CP20-04110	000-035-377		For SC-702-E-3. 30 m cable.
Spare parts	SP20-01801	001-516-680	1	For SC-701. (Fuses × 2)
Accessories	FP19-01201	001-517-360	1	For SC-702. Front panel remover. (19-028-3124-1. Code: 100-340-471-10)

Optional supply

Name	Type	Code No.	Remarks
Interface Unit	IF-2503	000-010-101	-
	IF-NMEA SC	000-011-469	For analog output.
AC/DC Power Supply Unit	PR-240	000-013-632	100 VAC to 115 VAC, 200 VAC to 230 VAC
Remote Display Unit	RD-50	-	-
	RD-20	-	-
Cable Assembly (For NMEA2000)	M12-05BFFM-010	001-105-780-10	For NMEA2000 equipment connection.
	M12-05BFFM-020	001-105-790-10	
	M12-05BFFM-060	001-105-800-10	
LAN cable (For AMS or dual configurations)	FR-FTPC-CY *10M*	001-240-510	For AMS connection.
	FR-FTPC-CY *20M*	001-240-520	
	FR-FTPC-CY *30M*	001-240-530	
3 Pair Cable	Z-#26X2P+0.3SQX1PL30	000-192-277-10	For SC-702, 30 m
	Z-#26X2P+0.3SQX1PL10	000-192-276-10	For SC-702, 10 m
Connector (waterproof)	FRU-RJ-PLUG-ASSY	000-192-316-10	For connection between SC-701 and SC-703/SC-1303.
Bird Repellent Fixture	OP20-37	004-380-840	Single.
	OP20-36	004-380-830	Four pieces.
	OP20-49	001-482-870	Seven pieces.
Front Fixing Panel	OP24-35	001-247-240	For SC-702.
Water Proof Kit	OP05-139	001-426-500	For SC-702.
F_Mount Cushion Kit	OP05-141	001-436-880	For SC-702.
LAN_CNV kit	OP20-47	001-516-110	For SC-701.
	OP20-48	001-516-120	For SC-703/SC-1303.
Snow Cover Kit	OP20-51	001-525-960	For SC-703
Modular Connector	MPS588-C	001-459-840	For LAN cable.
Micro T-Connector	SS-050505-FMF-TS001	000-168-603-10	
Termination Resistor (Micro)	LTWMC-05BFFT-SL8001	000-168-605-10	
	LTWMC-05BMMT-SL8001	000-168-604-10	

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1. INSTALLATION

This chapter covers the installation procedure and initial set up procedures and settings for the SC-70 and SC-130 systems.

Note: The settings and procedures outlined in this chapter are for technical personnel and should not be adjusted or changed by the user. If you require a change to any of these settings, contact your dealer.

NOTICE

Do not apply paint, anti-corrosive sealant or contact spray to coating or plastic parts of the equipment.

Those items contain organic solvents that can damage coating and plastic parts, especially plastic connectors.

1.1 How to Install the Antenna Units

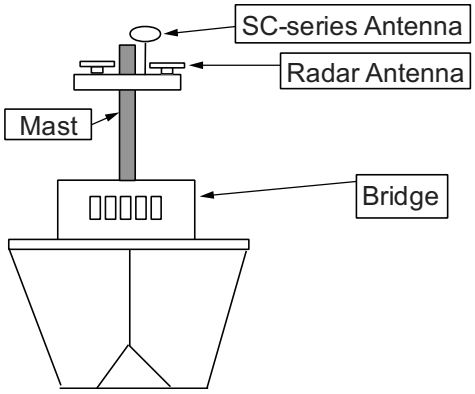
General considerations

- Keep the length of the antenna cable in mind when selecting a mounting location.
- Select a location with minimal or no vibration.
- The sensor should be separated more than three meters from Inmarsat F/FB antennas. Select a location outside this transmission area.
- Do not loop the antenna cable or bundle the antenna cable with radio equipment cables. When these noise reductions are insufficient, adjust the squelch on the radio equipment.
- Select a location with obstructions to the radio waves.
- Select a location more than a meter from the floor/deck etc.
- Select a location with no local vibration or impact (including sympathetic vibrations due to engine or mast) for the GPS sensor in the antenna unit.

Installing the antenna above superstructures

It is recommended that the antenna is installed above all other superstructures on the vessel. The antenna can obtain an unobstructed view of the available satellites, regardless of the vessel heading. Failure to install the antenna above all other superstructures can cause shadows and multipath reflection problems.

The following figure shows an example of the antenna installed above all other superstructures.



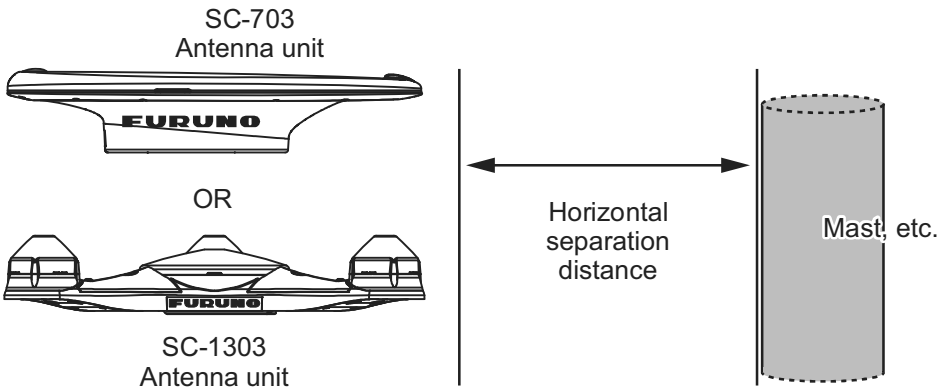
Installing the antenna below superstructures

Where the antenna is installed below superstructures on the vessel, shadows and multipath problems may occur on at least one heading, and possibly more. To avoid these problems where possible, follow the guidelines in this section.

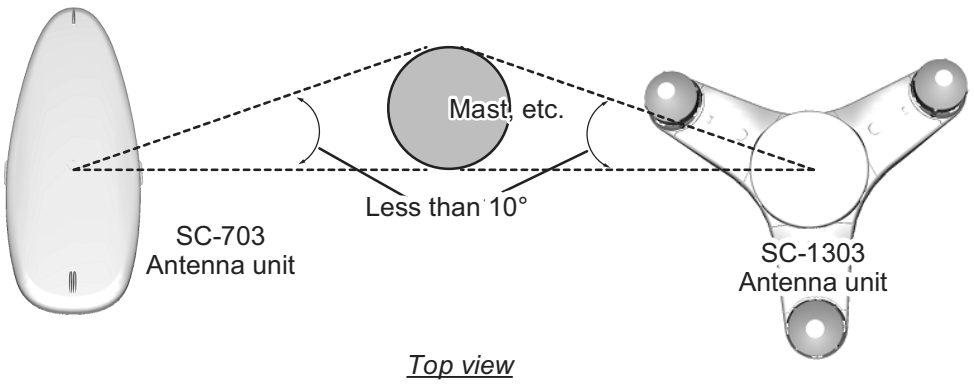
Note: If the antenna is installed below any superstructure, the installation must be done over a two-day period, following the procedure in the service manual.
At least 12 hours are required to capture tracking data to measure multipath indexes and locate areas of shading.

- The horizontal separation between the antenna and masts must be as shown in the table below and the figure on the following page:

Mast diameter	Minimum separation distance
10 cm	1.5 m
30 cm	3 m

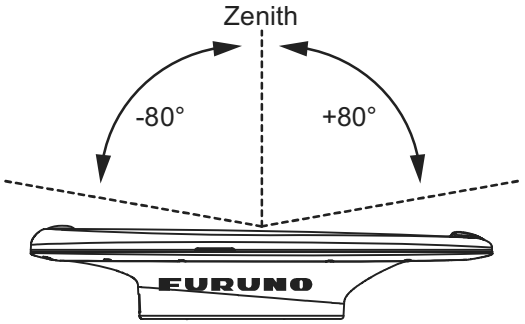


Side view

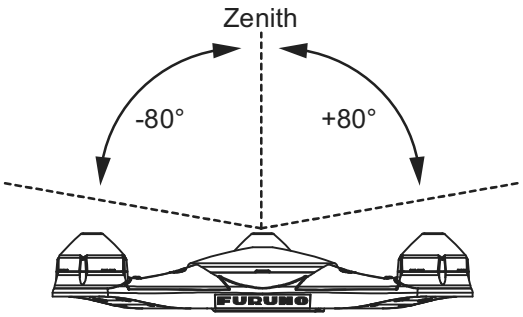


Top view

- The field of view above the antenna should be as shown in the figure below, ±80° against the zenith. To avoid reflections from masts and other obstacles, locate the antenna well away from shadows of the radar mast, etc.

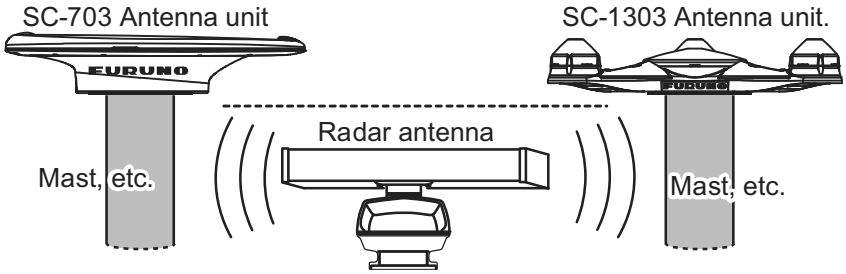


SC-703 Antenna field of view



SC-1303 field of view.

- Locate the antenna unit above the radar, out of the radar beam.



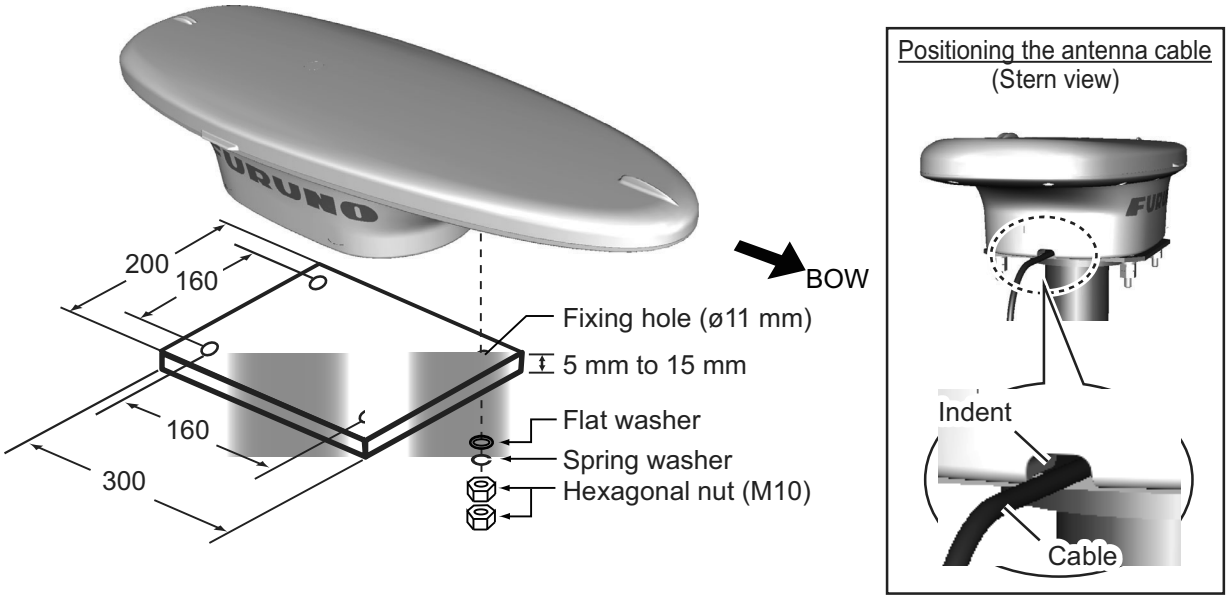
SC series antenna installed away from radar beam

1.1.1 How to install the SC-703 Antenna Unit

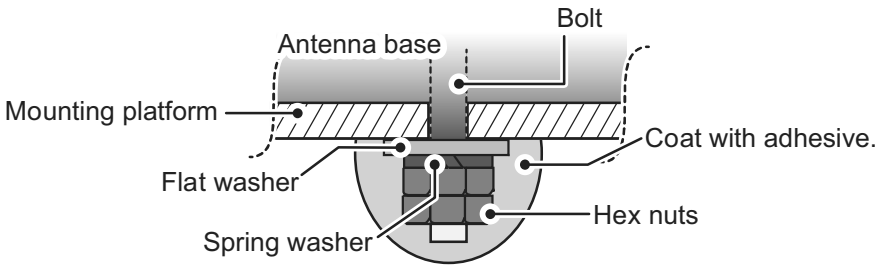
Note 1: Where the installation location is inconvenient for cable connection, connect the cabling (see step 6) before securing the antenna unit to the mounting location.

Note 2: The bird deterrents can be attached to the antenna cover to prevent birds from landing on the cover. If it is more convenient to attach the bird deterrents before securing the antenna unit to the mounting location, do step 6 of the procedure below before fixing the antenna unit.

1. Prepare a mounting platform in accordance with the outline drawing at the back of this manual. If corrosive material is used, take necessary anti-corrosion measures.
   Note: Holes drilled into the mounting platform must be parallel with the fore-aft line of the vessel.
2. Orient the antenna unit to face the bow, referring to the figure below. The antenna should be installed within ±2.5° of the bowline.
   Note: The antenna cable must be routed via the indent at the rear of the base (see the following figure).



3. Secure the unit to the platform with four sets of M10 hex. nuts, spring washers and flat washers (all included as installation materials) with 20 ±2 Nm torque.
   Note 1: Take care not to crush the cabling when mounting the antenna to the platform.
   Note 2: Take care not to cover the breathing hole on the antenna.
4. Coat the exposed parts of the nuts, bolts and washers with the Adhesive TB5211 (included) to prevent corrosion.



5. Connect the SC-703 cable to the cable from the SC-701, then waterproof the connection (see section 1.5.2 for the waterproofing procedure).
6. Remove the double-sided tape from the bird deterrents, then attach to the antenna cover. Coat around the bird deterrents with the Adhesive TB5211 (included).

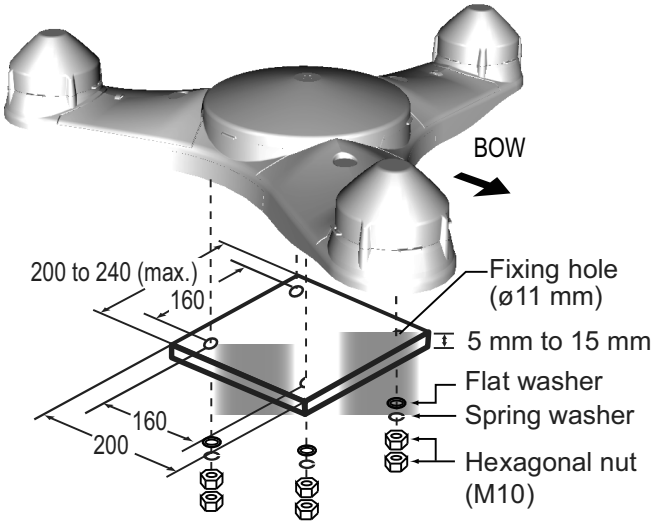
7. Secure the cables to the mast (or superstructure) with cable ties, at regular intervals.

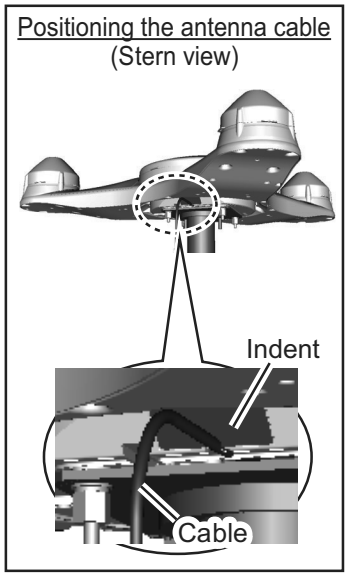
1.1.2 How to install the SC-1303 Antenna Unit

Note 1: Where the installation location is inconvenient for cable connection, connect the cabling (see step 6) before securing the antenna unit to the mounting location.

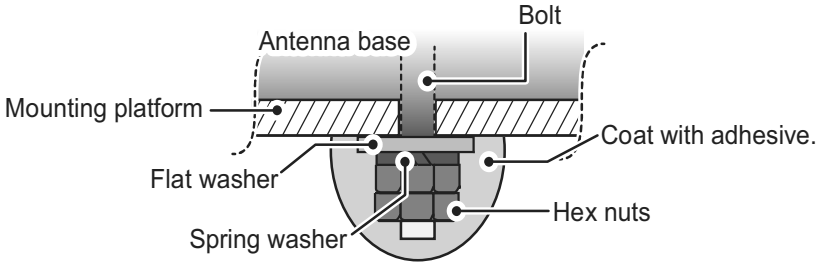
Note 2: The bird deterrents can be attached to the antenna cover to prevent birds from landing on the cover. If it is more convenient to attach the bird deterrents before securing the antenna unit to the mounting location, do step 7 before fixing the antenna unit.

1. Prepare a mounting platform in accordance with the outline drawing at the back of this manual. If corrosive material is used, take necessary anti-corrosion measures.
   Note: Holes drilled into the mounting platform must be parallel with the fore-aft line of the vessel.
2. Orient the antenna unit to face the bow, referring to the figure below. The antenna should be installed within ±2.5° of the bowline.
   Note: The antenna cable must be routed via the indent at the rear of the base (see figure on the following page).



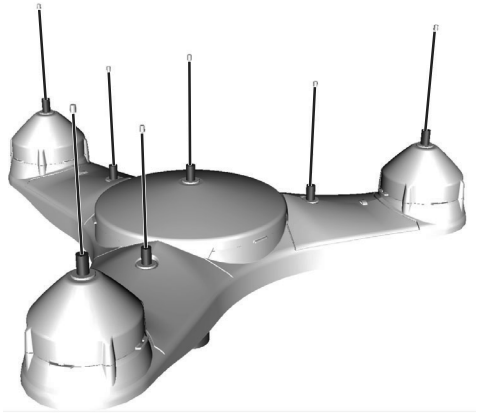


3. Coat the thread of the hex. bolts with silicone grease.
4. Fasten the unit to the platform with four sets of M10 hex. bolts, spring washers and flat washers with 20 ±2 Nm torque.
   Note: Take care not to crush the cabling when mounting the antenna to the platform.
5. Coat the exposed parts of the nuts, bolts and washers with the Adhesive TB5211 (included) to prevent corrosion.



6. Connect the SC-1303 cable to the cable from the SC-701, then waterproof the connection (see section 1.5.2 for the waterproofing procedure).

7. Remove the double-sided tape from the bird deterrents, then attach to the antenna cover. Coat around the bird deterrents with the Adhesive TB5211 (included).

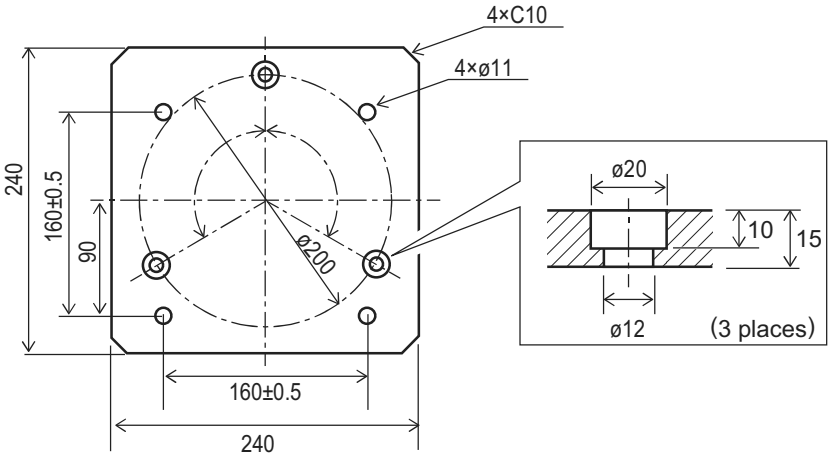


8. Secure the cables to the mast (or superstructure) with cable ties, at regular intervals.

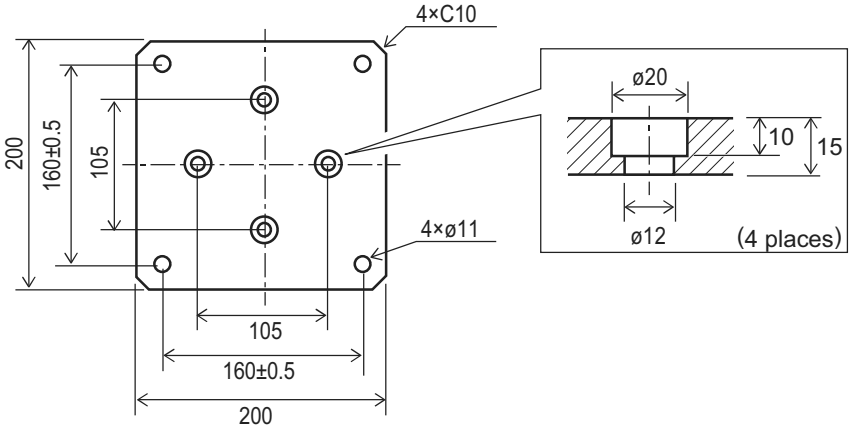
1.1.3 How to retrofit from SC-603/SC-1203

For retrofits from the SC-603 or SC-1203, the following attachments must be fabricated and attached to the mounting platform.

For SC-603 retrofits



For SC-1203 retrofits



1.2 How to Install the Junction Box (SC-701)

The junction box can be mounted on the floor, bulkhead, on a desk/console or on the underside of a desk.

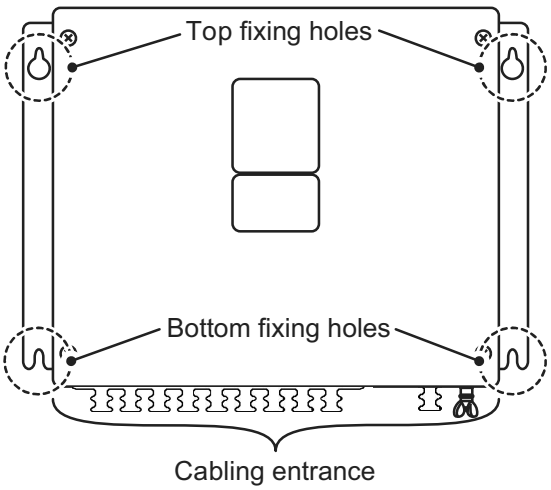
Mounting considerations

Select a mounting location, keeping the following points in mind:

- Locate the SC-701 away from heat sources. Heat can build up inside the unit, causing damage to electrical parts.
- Locate the SC-701 away from areas prone to vibrations. The mounting location should have minimal vibrations.
- Locate the SC-701 away from areas prone to water splash and rain.
- Make sure to connect the unit's ground to the ship's ground.
- Leave sufficient space around the unit to allow access for maintenance. See the outline drawings at the back of this manual for the recommended maintenance space.
- A magnetic compass will be affected if the junction box is placed too close to the magnetic compass. Refer to the compass safe distances at the front of this manual when selecting a mounting location.
- The power switch has a small light which lights up when the unit is turned on.

Note 1: For wall/bulkhead mounted junction boxes, the cabling entrance indicated in the figure below must be oriented to face downwards, to avoid water entering the unit.

Note 2: For floor/desk mounted (top or bottom) junction boxes, select a location where water will not reach the cabling entrance indicated in the figure below.



1. Referring to the outline drawing at the back of this manual, drill four pilot holes for the fixing screws.
2. Fasten two self-tapping screws (ϕ20, supplied) at the location for the top fixing holes. Leave approximately 5 mm of thread exposed.
3. Hang the SC-701 on the two screws using the two top fixing holes.
4. Fasten two self-tapping screws (ϕ20, supplied) to the bottom fixing holes.
5. Fasten all screws to secure the SC-701 in place.

1.3 How to Install the Display Unit (SC-702)

The display unit can be installed on a desktop, overhead (bulkhead) or flush mounted in a panel. Install the SC-702 on the chart table or near the helm, referring to the outline drawing at the back of this manual.

Mounting considerations

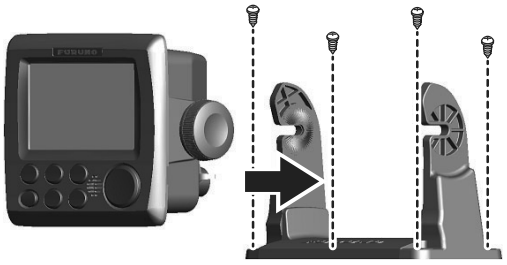
When selecting a mounting location for the display unit, keep the following in mind:

- Keep the unit out of direct sunlight.
- The temperature and humidity should be moderate and stable. (See the specifications at the back of this manual for operating temperatures.)
- Locate the unit away from heat sources, such as exhaust pipes and vents.
- The mounting location should be well ventilated.
- Keep the unit away from areas subject to rain or water splash.
- Install a ship-board earth to the grounding terminal at the rear of the unit.
- Mount the unit where shock and vibration are minimal.
- Keep the unit away from electromagnetic field generating equipment, such as motors and generators.
- Referring to the outline drawings at the back of this manual, leave sufficient space around the unit to allow access for maintenance.
- A magnetic compass will be affected if the unit is placed too close to it. Observe the compass safe distances listed on page ii to prevent magnetic disturbance.
- Leave enough slack in the unit's cabling to allow for maintenance and service.
- **For flush mount installations,** make sure the mounting location is flat.
- To avoid damage to the cabling when mounting the SC-702, make sure the cabling is not excessively bent.

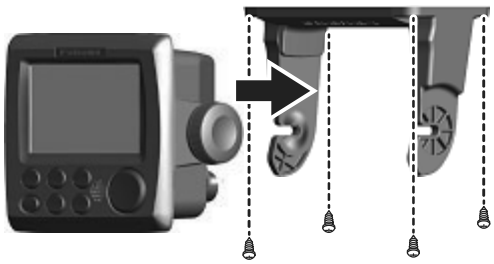
1.3.1 How to install the SC-702 on a desktop or overhead

The display unit is shipped with the hanger, and must removed from the hanger in order to be installed correctly.

1. Place the SC-702 on a firm, flat surface, then unfasten the two knobs on either side of the display unit to remove the unit.
2. Drill four holes for the self-tapping screws (ϕ5x20) at the installation location.
3. Secure the hanger to the desktop or overhead bulkhead with four self-tapping screws (ϕ5×20, included). The hanger should be oriented with the insertion slots facing forwards. For mounting dimensions and required clearance, see the outline drawing at the back of this manual.



Desktop mounted



Roof (bulkhead) mounted

4. Referring to section 1.5.6, connect the cabling to the SC-702.
5. Fit the SC-702 to the hanger and tighten the bolts on either side evenly. Adjust the angle of the SC-702 so the screen can be viewed clearly.

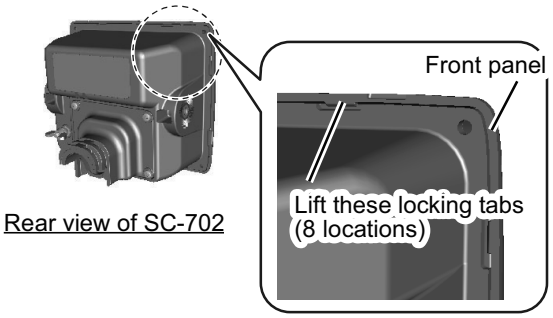
1.3.2 How to flush mount the SC-702

There are two methods for flush mounting the SC-702. You can mount the unit directly onto the mounting area, or use the optional front fixing panel kit.

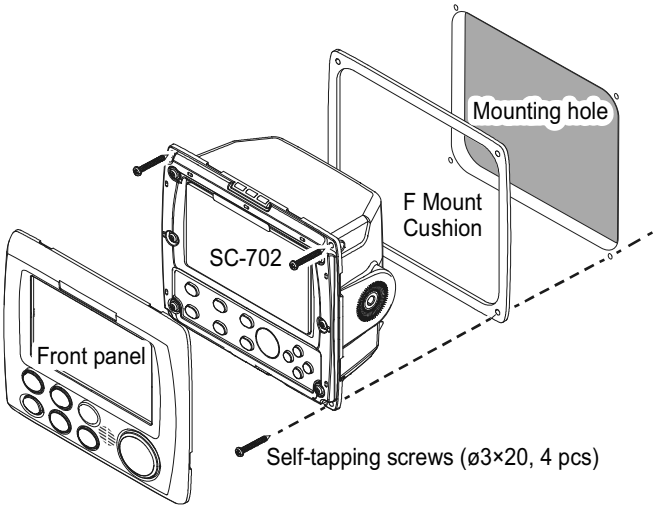
For both flush mount installation methods, the hanger and knobs are not required. remove the unit from the hanger and discard the hanger and knobs.

Flush mounting the SC-702 (unit only)

1. Cut a hole in the mounting location, using the template at the back of this manual.
2. Drill four holes for the self-tapping screws (ϕ5x20) at the installation location.
3. Place the SC-702 on a firm, flat surface, then unfasten the two knobs on either side of the display unit to remove the unit. The hanger can be disposed.
4. Gently lift the locking tabs at the rear of the front panel, then remove the front panel. Take care not to damage the locking tabs or the front panel.

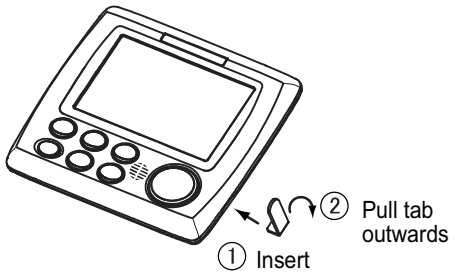


5. Fit the F Mount Cushion Kit (code: 20-032-106, included) to the rear of the SC-702 or to the mounting hole.
6. Run the cabling through the cutout, then, referring to section 1.5.6, connect the necessary cabling to the SC-702.
7. Referring to the figure below, fit the SC-702 to the cutout, then use the supplied self-tapping screws (ϕ3×20) to secure the SC-702 to the flush mount panel.



8. Re-fit the front panel that was removed at step 4.

Note: To remove the SC-702 from the mounting location, use the panel remover (FP19-01201, included).



Flush mounting the SC-702 (with optional F Mount Panel)

Use the optional kit (OP24-35), referring to the outline drawings at the back of this manual and the installation instructions (C42-01310) included with the optional kit.

1.4 How to Install the Remote Display Unit (option)

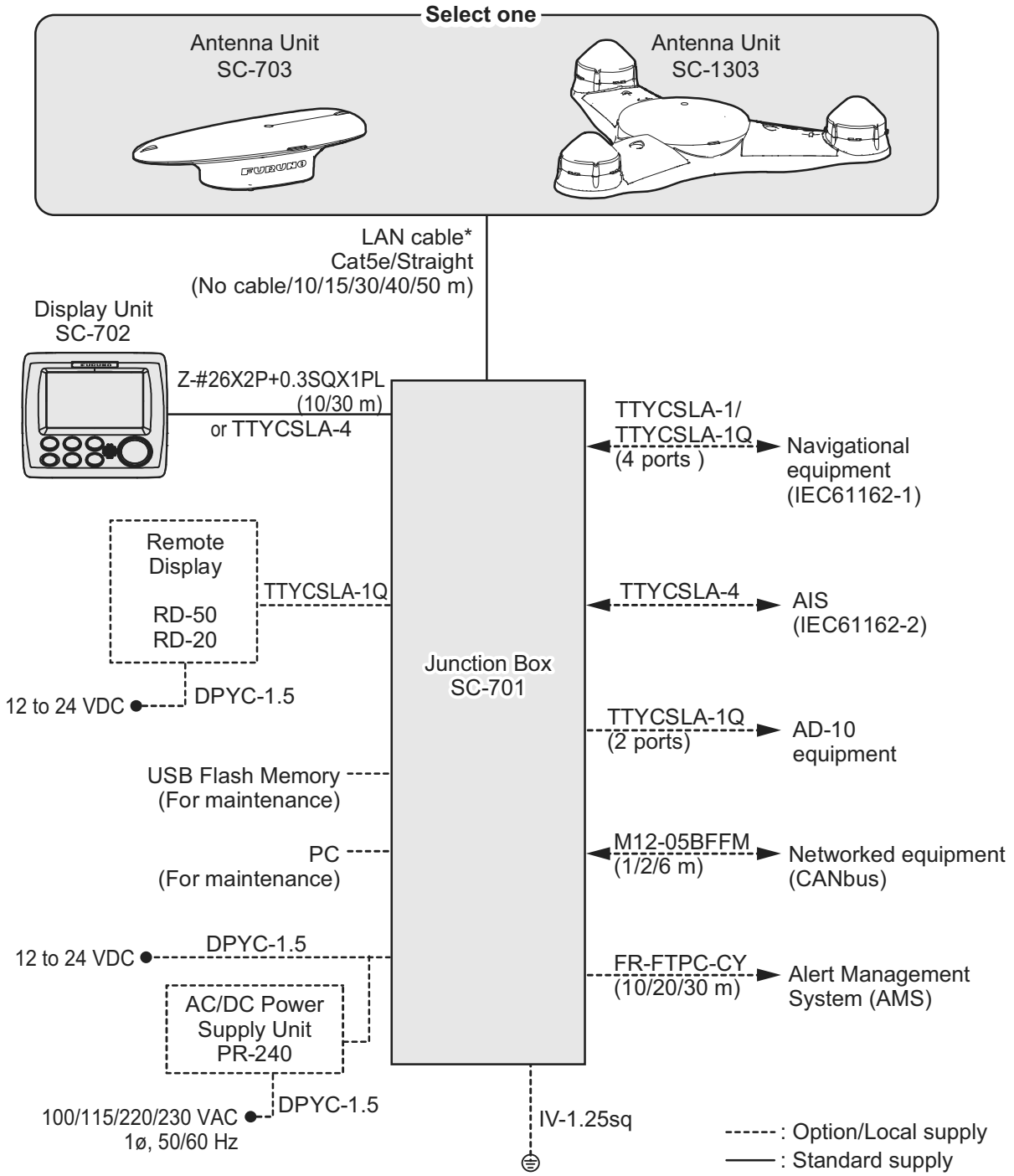
The RD-50/RD-20 can be connected as a ROTI (Rate Of Turn Indicator) display unit.

For installation instructions regarding the RD-50 or RD-20, see the appropriate operator's manual (RD-50: OME-44530-x, RD20: OME-44540-x; x denotes the manual version), included with your Remote Display.

Note: If your vessel is required to be ROTI type-test compliant, use the RD-50.

1.5 Wiring

This section covers general wiring. For further details see the interconnection diagram at the back of this manual.



*: Attach **the supplied modular connector** to **the supplied LAN cable**. Do not use a commercial STP cable (LAN cable) or connector due to their low durability. See "Mounting considerations" on page 1-8 for how to attach the modular plug. Also, when using the optional LAN CONV KIT, use the existing cables.

1.5.1 How to fabricate the cables

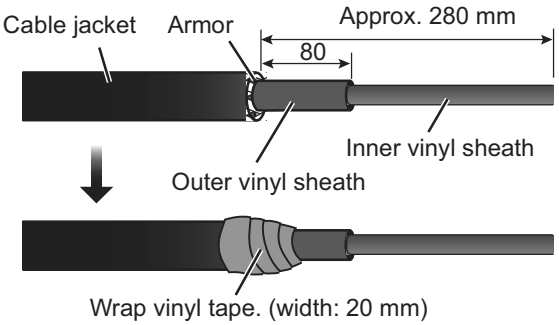
LAN cable

Note 1: When fabricating the LAN cable for connection to the antenna unit, remove the locking nut on the antenna base, then pass **the supplied LAN cable** through the cable entrance before fitting **the supplied modular plug** on the both ends.

- Modular plug for the junction box: MPS588-C
- Modular plug for the antenna unit: FRU-RJ-PLUG-ASSY

Secure to attach the shield (folded area) of the LAN cable to the chassis of the modular plug (see the following step 6). Then fit the locking nut on the LAN cable.

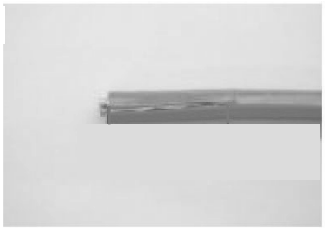
Note 2: This equipment only uses straight cables.



Expose the inner and outer sheaths as shown to the left.

Cover the cable jacket at the cut as shown to the left.

1

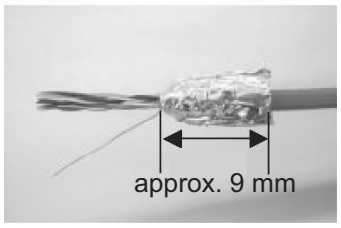


Expose inner vinyl sheath.

2

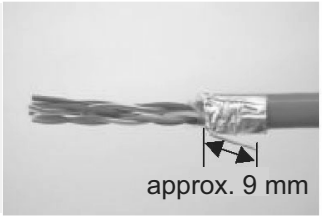
Remove the inner vinyl sheath by approx. 25 mm. Be careful not to damage inner shield and cores.

3



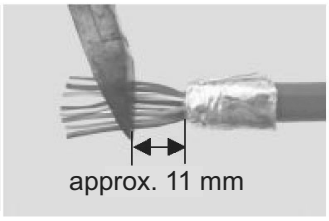
Fold back the shield, wrap it onto the inner vinyl sheath and cut it, leaving approx. 9 mm.

4



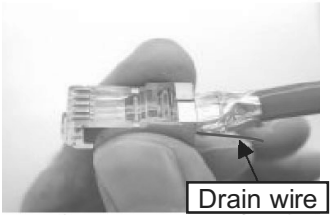
Fold back drain wire and cut it, leaving approx. 9 mm.

5



Straighten and flatten the cores in colored order and cut them, leaving approx. 11 mm.

6

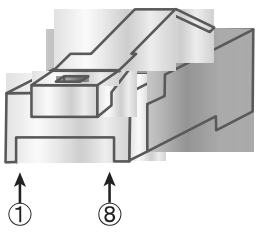


Insert the cable into the modular plug so that the folded part of the shield enters into the plug housing. The drain wire should be located on the tab side of the jack.

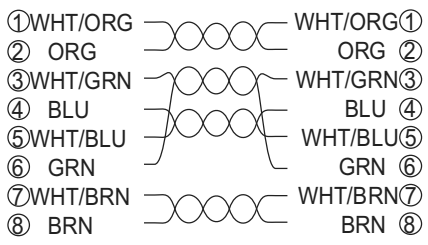
7

Using special crimping tool MPT5-8AS (PANDUIT CORP.), crimp the modular plug. Finally, check the plug visually.

Modular plug

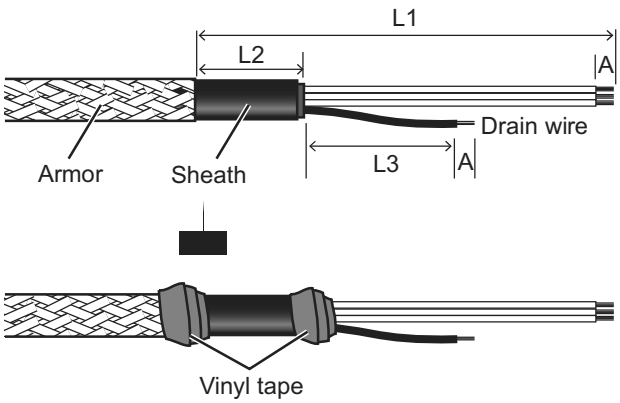


[Straight cable]



Z-#26X2P+0.3SQX1PL10/30, TTYCSLA-1/1Q/4

The supplied cable (Z-#26X2P+0.3SQX1PL10/30) does not have the armor.



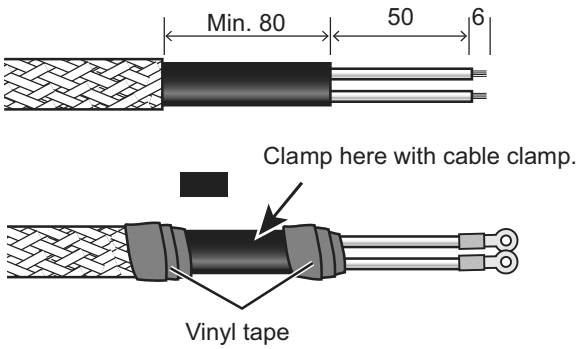
Measurements are displayed in mm

Unit	L1	L2	L3	A
Junction Box	*	80	80	6
Display Unit	130	80	50	6

*: Length depends on installation configuration. When fabricating this cable, ensure enough slack is left to allow easy access for maintenance and service.

Note: L2 lengths displayed in the table above are the minimum recommended length. Adjust the length according to the installation configuration.

Power cable DPYC-1.5



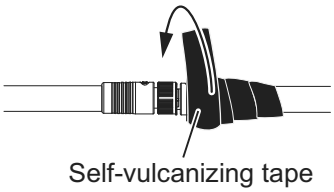
1.5.2 How to secure and waterproof the cable connections

All cable connections not inside the equipment, whether exposed to weather or otherwise, should be waterproofed and secured after making the connection.

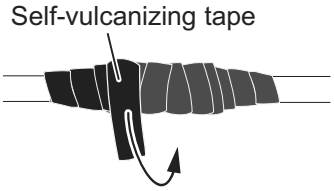
To waterproof and secure each connection, refer to the procedure outlined below.

Securing and waterproofing connections

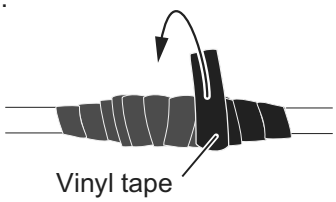
1) Wrap the connection with self-vulcanizing tape.



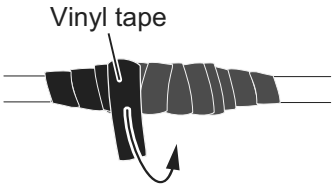
2) Wrap a second layer of self-vulcanizing tape in the opposite direction.



3) Wrap vinyl tape over the self-vulcanizing tape.

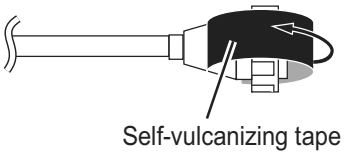


4) Wrap a second layer of vinyl tape in the opposite direction.

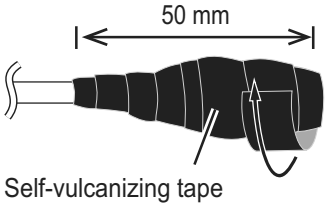


Securing and protecting unused cable connectors

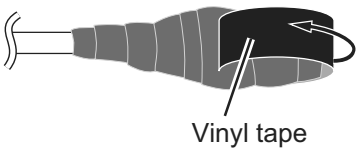
1) Cover the loose end of the cable connector with self-vulcanizing tape.



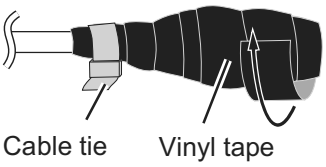
2) Wrap the connector with a layer of vulcanizing tape, covering approx. 50 mm of the connected cable. Confirm that the connector is covered.



3) Wrap vinyl tape over the self-vulcanizing tape.

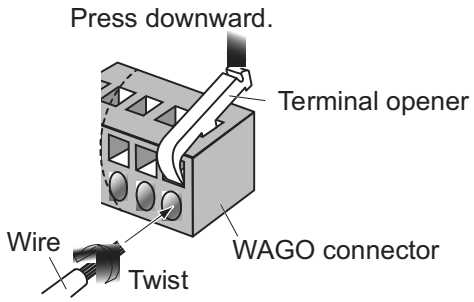


4) Wrap the connector with a layer of vinyl tape. Bind the tape end with a cable tie to prevent the tape from unraveling.



1.5.3 How to fabricate the WAGO connectors

Follow the procedure outlined below to fabricate the WAGO terminal connections.



Procedure
1. Twist the cores.
2. Press the terminal opener downward.
3. Insert the wire to hole.
4. Remove the terminal opener.
5. Pull the wire to confirm that it is secure.

Note: Two terminal openers are included inside the SC-701. Check that the size of the opener is correct before use.

- Small opener (labeled as “DISP”): For use on connectors for cabling between the SC-702 and SC-701.
- Large opener: For use on the connectors inside the SC-701.

1.5.4 How to connect the Antenna Unit (SC-703/SC-1303)

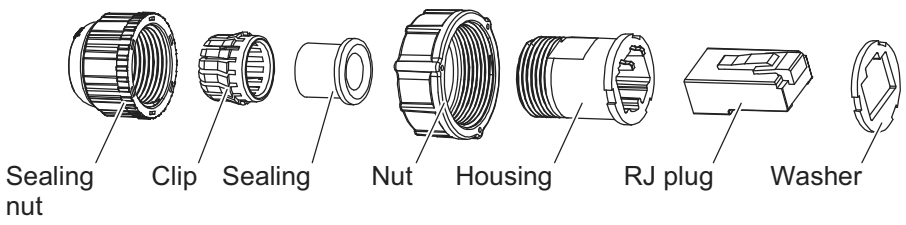
Connect the LAN cable (included as installation materials; see table below) from the antenna LAN port to the J3 terminal inside the SC-701.

Installation materials type	LAN cable		Installation materials type	LAN cable	
	Length	Armor		Length	Armor
CP20-04300*	30 m	Yes	CP20-04500	10 m	Yes
CP20-04310*	40 m	Yes	CP20-04510	15 m	Yes
CP20-04320*	50 m	Yes	CP20-04520*	10 m	No
CP20-04340	30 m	No	CP20-04530*	15 m	No
CP20-04360*	30 m	No	CP20-04540	10 m	No
CP20-04370*	10 m	Yes	CP20-04550	15 m	No
CP20-04380*	15 m	Yes	—		

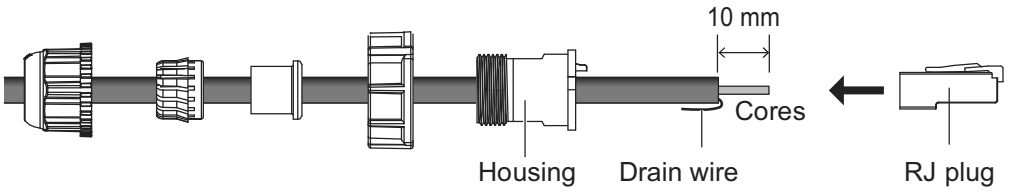
How to fit the waterproof connector

Follow the procedure below to fit the waterproof connector (included in installation materials marked with “*” in the above table).

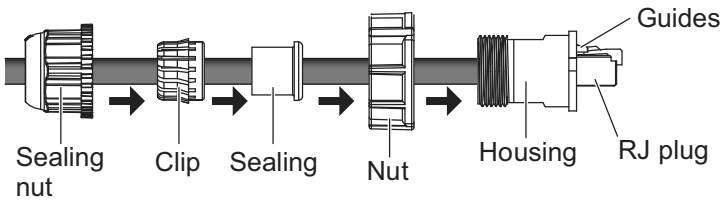
Waterproof connector components



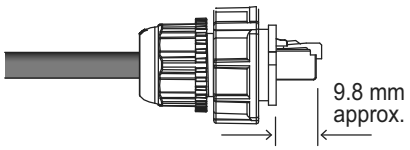
1. Referring to the figure below, fit the connector components to the LAN cable. Strip approximately 10 mm of the outer sheath to expose the cores, then fold the drain wire back, along the cable.



2. Insert the cable cores into the RJ plug, then secure the cores using a crimping tool (MPT5-8AS, or equivalent, local supply). Make sure the RJ plug is in contact with the drain wire.
3. Push the RJ plug into the housing. Make sure the RJ plug is aligned with the housing guides, then fit the nut, sealing, clip and sealing nut, in order.



4. Fasten the sealing nut until the thread on the housing is not visible. Fastening torque: 0.72 to 0.98 N•m.



5. Fit the washer to the RJ connector, making sure that the indents on the washer match the indents on the connector.

6. Connect the assembled waterproof connector to the LAN cable on the antenna.
7. Use self-vulcanizing tape and vinyl tape to additionally waterproof the connection. For details on waterproofing cable connections, see section 1.5.2.

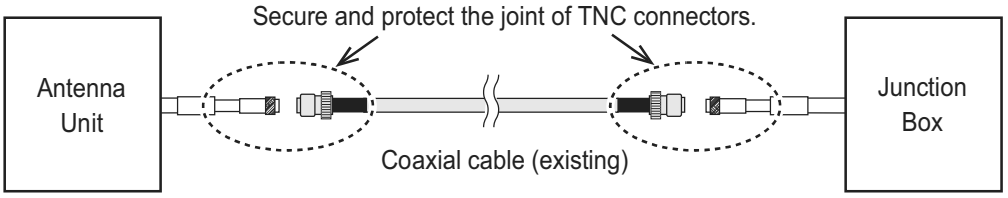
Retrofits - Coaxial cable connection

You can use the existing coaxial cable for connection. In this case, the optional LAN_CNV kits (OP20-47 and OP20-48) are required.

Cable connection:

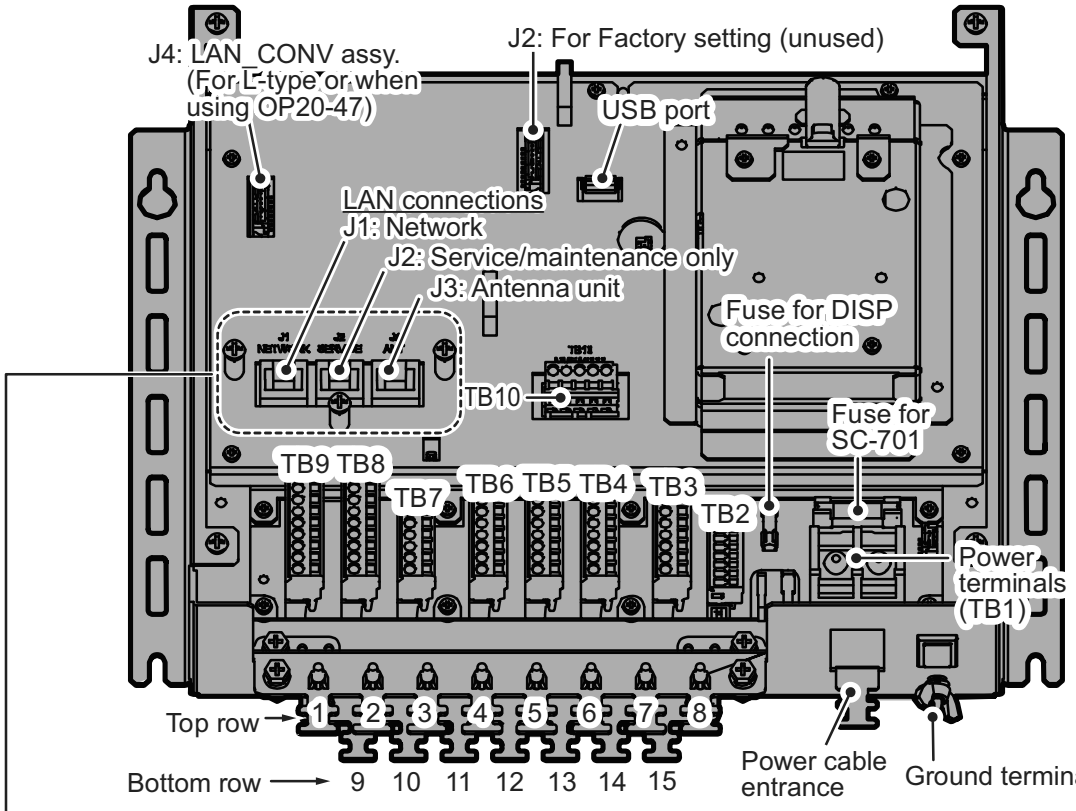
For cable connection, use one of the three existing coaxial cables. Connect both ends of the cable, one end to the antenna unit, the other end to the junction box. Secure and protect the connection points of the coaxial cables, referring to subsection 1.5.2.

For unused existing coaxial cables, secure and protect both ends of the coaxial cables, referring to subsection 1.5.2.



1.5.5 How to connect the Junction Box (SC-701)

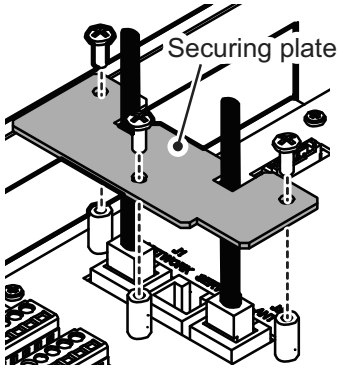
The Junction Box (SC-701) has two rows of cable entrances for connection. The following figure and table show the internal connection points for the SC-701 and the recommended cable entrance for each connection (based on a configuration which uses all connections). The tables on the following pages show the pin connections for each WAGO connector.



How to secure the LAN connectors

The securing plate is preattached to the LAN port. Detach the securing plate to connect the LAN cables, then reattach the plate after connecting the LAN cables.

The securing plate prevents communication error between the Junction Box and the Antenna Unit that is caused by the vibration. Be sure to attach the securing plate after connecting the LAN cables.



Note 1: LAN cable recommended entrances should be used to prevent undue stress to the LAN cables. The power and DISP cable must be passed through their recommended entrance to prevent damaged to the cabling.

Note 2: Cable entrances 1 though 8 are protected from foreign materials with a small plastic spacer. To use one these cable entrances, remove the spacer, then pass the cable through.

The following table indicates the recommended cable entrance, connector number and the cable type required for connections to the SC-701.

External connection	Recommended entrance	Connector No.	Cable type
Power	Power cable entrance only	TB1	(JIS) DPYC-1.5
Shipboard network (AMS, etc.) (IEC61162-450)	1, 2 or 9	J1	(JIS) FR-FTPC-CY
Antenna unit (SC-703 or SC-1303)	9	J3	LAN
	10 or 11	LAN-Coaxial conversion kit	Existing coaxial.
AD-10 format data output	3 or 10	TB8 or TB9	(JIS) TTYCSLA-1Q
NMEA0183 (IEC61162-2)	3 or 10	TB7	(JIS) TTYCSLA-4
NMEA0183 (IEC61161-1)	4, 5, 6, 7 or 11, 12, 13, 14	TB3 to TB6	(JIS) TTYCSLA-1 or TTYCSLA-1Q
Display unit (SC-702)	15 only	TB2	(JIS) TTYCSLA-4
CANbus	4, 5, 6, 7 or 11, 12, 13, 14	TB10	M12-05BFFM** (“**” indicates length)
USB Flash Memory*	-	USB port	-

*: To remove the USB Flash Memory, see "How to remove the USB Flash Memory" on page 3-4.

Note: For (JIS) cable equivalents, see the JIS cable guide at the back of this manual.

TB2 WAGO connector (9-pin, TTYCSLA-4)

Pin no.	Connection (signal)	Description	Remarks
1	P12V	Power	-
2	GND	Grounding.	-
3			-
4			-
5	TD6_A	TX data	Fixed at 115200 bps.
6	TD6_B	TX data	
7	RD6_A	RX data	
8	RD6_B	RX data	
9	GND	Drain wire	Connect to drain wire.

TB3 to TB6 WAGO connectors (7-pin, TTYCSLA-1/TTYCSLA-1Q)

Pin no.	Connection (signal)	Description	Remarks
1	TDx_1A	TX data	NMEA(Ver1.5/2.0/3.0/4.0), IEC61162-1

Pin no.	Connection (signal)	Description	Remarks
2	TDx_1B	TX data	"x" denotes the connection to terminals as shown below.
3	TDx_2A	TX data	
4	TDx_2B	TX data	
5	RDx_H	RX data (Hot)	
6	RDx_C	RX data (Cold)	
7	GND	Drain wire	

Signal	Terminal
TR/RD5	TB3
TR/RD4	TB4
TR/RD3	TB5
TR/RD2	TB6

TB7 WAGO connector (6-pin, TTYCSLA-4)

Pin no.	Connection (signal)	Description	Remarks
1	TD1_A	TX data	NMEA(Ver1.5/2.0/3.0/4.0) IEC61162-2
2	TD1_B	TX data	
3	RD1_A	RX data	
4	RD1_B	RX data	
5	ISO_GND	Isolating ground	
6	GND	Drain wire	

TB8 WAGO connector (9-pin, TTYCSLA-1Q)

Pin no.	Connection (signal)	Description	Remarks
1	DATA_3A	RS-485	Data output in AD-10 format.
2	DATA_3B		
3	SHIFT_3A		Shift output in AD-10 format.
4	SHIFT_3B		
5	DATA_4A		Data output in AD-10 format.
6	DATA_4B		
7	SHIFT_4A		Shift output in AD-10 format.
8	SHIFT_4B		
9	GND		

TB9 WAGO connector (9-pin, TTYCSLA-1Q)

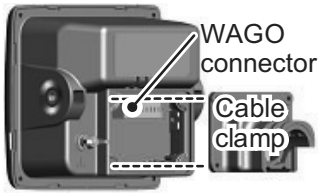
Pin no.	Connection (signal)	Description	Remarks
1	DATA_1A	RS-485	Data output in AD-10 format.
2	DATA_1B		
3	SHIFT_1A		Shift output in AD-10 format.
4	SHIFT_1B		
5	DATA_2A		Data output in AD-10 format.
6	DATA_2B		
7	SHIFT_2A		Shift output in AD-10 format.
8	SHIFT_2B		
9	GND		

TB10 WAGO connector (5-pin, M12-05BFFM-010/020/060)

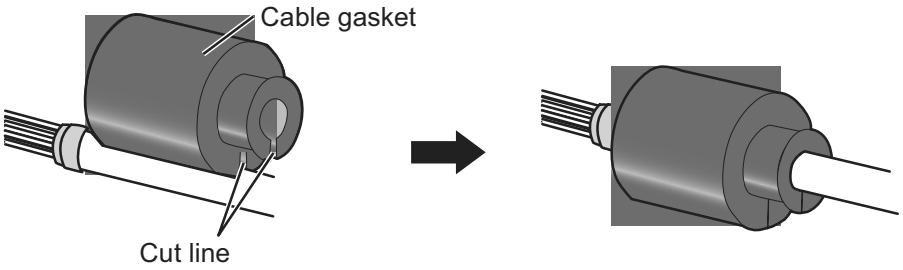
Pin no.	Connection (signal)	Description	Remarks
1	Shield	CAN_Shield	
2	NET_S	Power input	+9 V DC to +16 V DC
3	NET_C	CAN_GND	
4	NET_H	CANbus	Data I/O (Hot)
5	NET_L	CANbus	Data I/O (Cold)

1.5.6 How to connect the Display unit (SC-702)

The display unit is connected to the Junction Box using a 9-pin WAGO connector. Referring to section 1.5.3 and the table below, fabricate the WAGO connector. Note that the WAGO connector is included inside the SC-702 and must first be removed from the unit.



1. Unfasten the four screws on the rear cable clamp of the SC-702, then remove the cable clamp to reveal the WAGO connector.
2. Unplug the WAGO connector from the SC-702.
3. Pass the cable through the cable clamp.
   For the supplied cable (Z-#26X2P+0.3SQX1PL)
   When the supplied cable is used, the supplied cable gasket (Type: 20-037-2104-0) must be attached. Open the cut line of the cable gasket then attach the cable gasket to the cable.
   Note: To prevent water intrusion, the cut line of the cable gasket must face downward.



4. Referring to the following table and the interconnection diagram at the back of this manual, connect the cable to the WAGO connector.

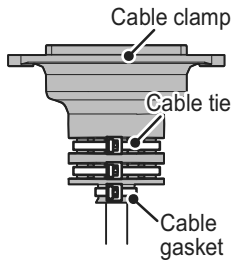
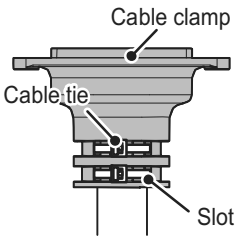
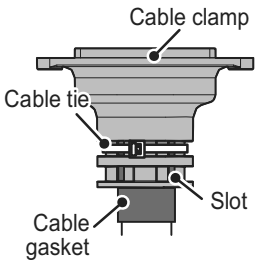
Display unit (SC-702) internal J301 WAGO connector (9-pin, TTYCSLA-4)

Pin no.	Connection (signal)	Description	Remarks
1	P12V	Power	-
2	GND	Grounding. Connect to SC-701.	-
3			-
4			-
5	TD_A	TX data	Fixed at 115200 bps.
6	TD_B	TX data	
7	RD_A	RX data	
8	RD_B	RX data	
9	GND	Drain wire	Connect to drain wire.

5. Connect the cabling to the SC-702.
6. Slide the clamp along the cable towards the SC-702, then fasten the four screws which were removed at step 1.

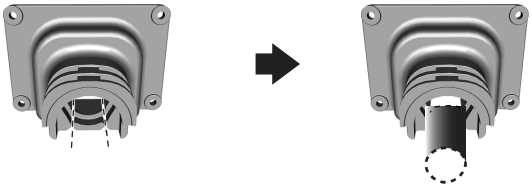
7. Secure the cable to the cable clamp, referring to the figure below.

Top view of cable clamp

Supplied cable (Z-#26X2P+0.3SQX1PL)	Equivalent cable for JIS cable (TTYCSLA-4)	
	Without Water Proof Kit	With Water Proof Kit
With three cable ties	With two cable ties	With a single cable tie
		
Secure the cable gasket also with a cable tie.	Wind cable ties through the slots.	Wind a cable tie outside of the cable clamp.

Note: In cases where the WAGO connector is connected to the cable before the cable is passed through the cable clamp, the cable clamp can be adjusted to allow connection. Adjusting the cable clamp as outlined in the figure below voids the IPx5 waterproof rating of the clamp and the unit.

Cut along “V”-shaped indent using a wire cutter or similar tool.



Slide the clamp over the cable.

To keep the IPx5 rating, remove the WAGO connector, then repeat the procedure above.

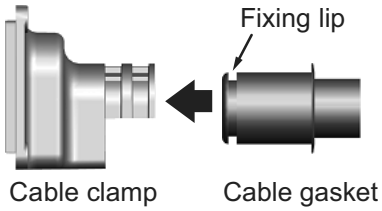
How to fit the optional waterproofing kit (OP05-139)

The optional waterproofing kit must be fitted at the same time as the cabling is connected to the SC-702.

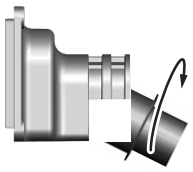
Note: To satisfy the requirements for IPX5 waterproof rating, the cable used must have a diameter of 14.4 mm (±0.4 mm).

1. Unfasten the four screws on the rear cable clamp, then remove the cable clamp to reveal the WAGO connector.
2. Fit the cable gasket to the cable clamp, referring to the figure below.

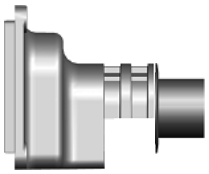
1. Fit the cable gasket to the cable clamp, passing the fixing lip partially through the cable clamp.



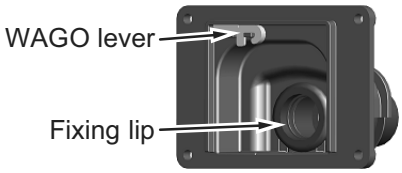
2. To pass the fixing lip completely through the cable gasket, twist the cable gasket gently.



3. Check that the cable gasket is flush against the cable clamp, as shown below.



4. Check that the cable gasket's fixing lip is flush against the inside of the cable clamp.



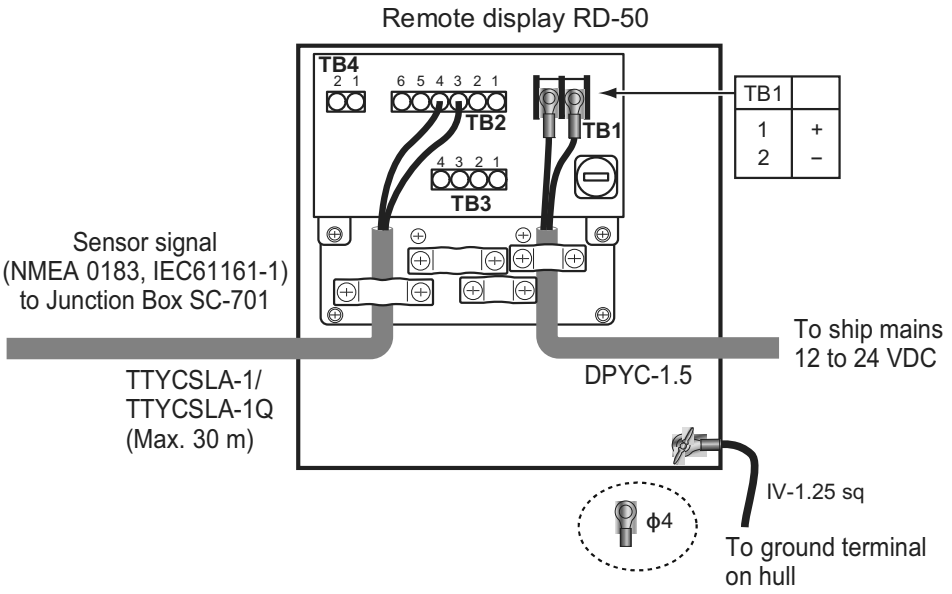
3. Pass the cabling through the cable gasket and cable clamp.
4. Fit the cover gasket (rubber seal) to the rear of the SC-702. Make sure the rubber seal is placed inside the groove indicated in the figure below.

5. Connect the cabling to the SC-702, referring to section 1.5.6.
6. Slide the cable clamp along the cable until the clamp is flush against the rear of the SC-702.
   Note: The cable clamp must be oriented with the dome facing upwards in order to retain it's waterproofing rating.
7. Fasten the four screws removed at step 1.
8. Secure the cables to the cable clamp with cable ties.

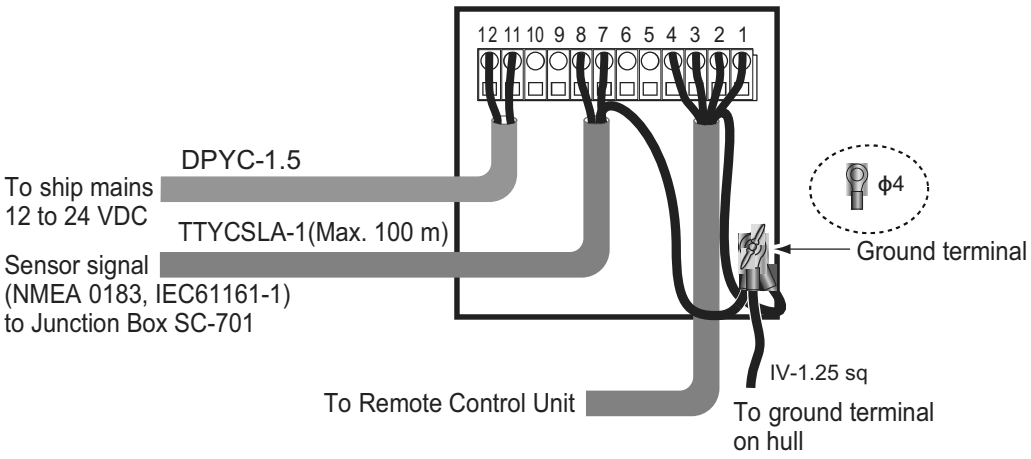
1.5.7 How to connect the Remote Display Unit (option)

Connect the RD-50 to the SC-70/SC-130 referring to the connection diagram below.

RD-50 connection
(For details, see the RD-50 Operator's Manual OME-44530)



RD-20 Connection
(For details, see the RD-20 Operator's Manual OME-44540)



1.6 Initial Settings

The initial setup for your SC-70/SC-130 requires the system to be powered. Referring to the instructions at section 2.2, turn the power on.

For the sake of brevity, the following terminology is used.

Terminology	Meaning
"Select"	Example: "Select [SENSOR], then press the **ENT** key." Use the Cursorpad to select the menu item.
"Open the [MENU]."	Press the **MENU ESC** key; this opens the [MENU].
"Close the [MENU]."	• Press the **MENU ESC** key; this closes the [MENU] and returns to the last used display screen or sub-screen. • Press the **DISP** key; this closes the [MENU] and returns to the main screen.
IMO type	SC-70 or SC-130 systems which have been assigned as [MERCHANT] at installation and installed on vessels which meet the applicable IMO standards.
Non-IMO type	SC-70 or SC-130 systems which have been assigned as [FISHING] at installation and installed on vessels which do not meet the applicable IMO standards.

When the unit is powered for the first time, it is in a “cold start” state. There is no satellite data (almanac data) stored. In this state, the unit searches for, and stores, satellites to find its heading. This process takes approximately 90 seconds. If the heading is not found within 30 minutes, the antenna installation location may not be suitable. A lack of visible satellites (less than five) can also prevent the unit from finding a heading. Resolve the problem, then re-check the tracking status.

If the heading error is between 5° and 10°, adjust the antenna unit orientation while monitoring the heading indication on the SC-702.

Once a heading has been found, the following items may need setting or adjustment:

- Vessel dimensions.
- Antenna location.
- Offset heading, roll, pitch, heave, etc.
- Main device mode.
- Password (as necessary).
- Alert mode.
- Legacy sentence input.
- I/O menu settings as appropriate. (See section 1.8.)

Note: Some settings are set at installation and are non-selectable (gray in color) from the menu. These settings require password input. Password input is not covered in the setting procedures for these items. To adjust these settings, contact your dealer.

1.6.1 Main menu

How to access the menu

The menu is locked with a password. Press the **MENU ESC** key to show the password input window (shown below-right).

If this is the first time the unit has been turned on, the password is not set at default. Press the **ENT** key to access the menu. It is recommended to set a new password in this case.

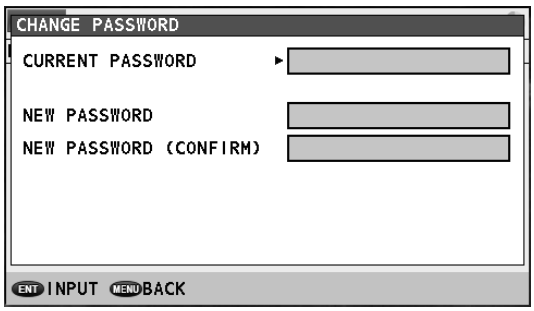
If the unit has a previously set password, input the password, then press the **ENT** key to access the menu.

Note 1: Password input is required to access the menu each time the unit is turned off, then on again.

Note 2: The menu closes automatically if no keys are pressed within one minute.

How to change/set the password

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [PASSWORD], then press the **ENT** key.
4. Select [CHANGE], then press the **ENT** key. An input window appears. The currently selected input box is indicated with a small arrow to the left-side of the input box, as shown in the figure to the right.
   To set the password for the first time, press the **ENT** key to select the [NEW PASSWORD] input box, then skip to step 6.



5. Enter the current user password. If the password is incorrect, the input window is reset to blank. If the password is correct, the arrow indication moves to the [NEW PASSWORD] input box.
6. Enter a new password, then press the **ENT** key. The arrow indication moves to the [NEW PASSWORD (CONFIRM)] input box.
7. Enter the new password again, then press the **ENT** key. If the passwords match, the [CHANGE PASSWORD] input window disappears.
   If the passwords do not match, the input boxes for [NEW PASSWORD] and [NEW PASSWORD (CONFIRM)] are reset and the arrow indication returns to the [NEW PASSWORD] box. Repeat the procedure from step 6.
8. Close the [MENU].

How to disable access to the menu

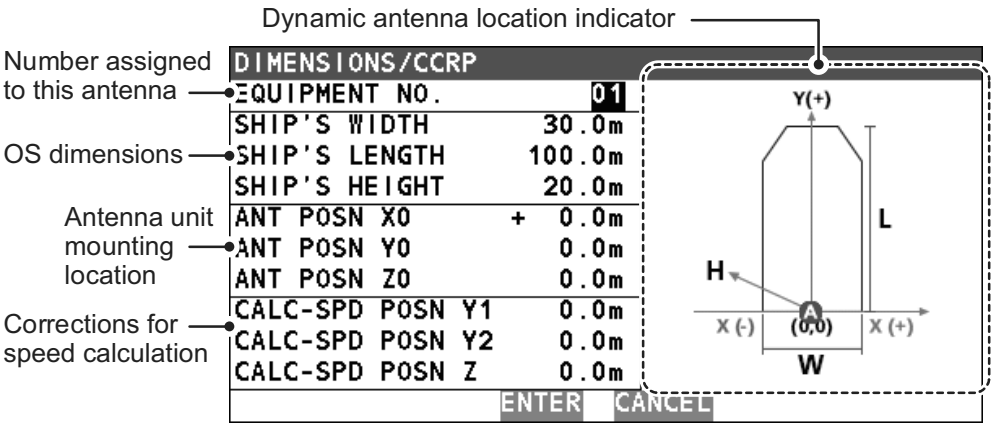
Where necessary, you can disable menu access by doing the following:

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [PASSWORD], then press the **ENT** key.
4. Select [LOGOUT], then press the **ENT** key. The menu closes.

1.6.2 How to set vessel dimensions, antenna location and CCRP

Note: Access to the [OFFSET] menu requires the [SERVICE] menu to be unlocked. To unlock the service menu, consult your local dealer.

1. Open the [MENU].
2. Select [SENSOR], then press the **ENT** key.
3. Select [OFFSET], press the **ENT** key.
4. Select [DIMENSIONS/CCRP], then press the **ENT** key. The settings window appears. The figure below is an example of the settings window.



5. Select [EQUIPMENT NO.], then press the **ENT** key. The [INPUT EQUIPMENT NO.] pop up window appears.
6. Set the antenna number you wish to set the location for.
7. Select [ENTER], at the bottom of the pop up window, then press the **ENT** key. The antenna selected here is used to output the POS sentence to external equipment.
8. Select [SHIP'S WIDTH], then press the **ENT** key. A numerical pop up window appears. Referring to the figure above, set the dimensions of the vessel.
9. Set [SHIP'S LENGTH] and [SHIP'S HEIGHT] in a similar manner.
   Note: [SHIP'S HEIGHT] is from the keel to the mast top.
10. Referring to the table below, set the antenna mounting position (CCRP) and the speed calculation adjustments.
    Note: These settings require CCRP and ship dimensions. Do step 5 and step 6 before changing these settings.

Indication	Description	Setting range
[ANT POSN X0]	Port-starboard location of antenna unit. Enter a negative value for port-side, positive value for starboard-side. The center of the vessel is [0 m].	- ([SHIP'S WIDTH]/2) to + ([SHIP'S WIDTH]/2). For example, if the [SHIP'S WIDTH] is set to [100 m], the range is [-50 m] to [+50 m].
[ANT POSN Y0]	Bow-stern location of the antenna unit. Calculated from the center of the stern.	[0.0 m] to [SHIP'S LENGTH]. For example, if [SHIP'S LENGTH] is set to [45 m], the maximum range for this setting is also [45 m].
[ANT POSN Z0]	Height of antenna unit location, from the bottom of the ship.	[0.0 m] to [99.9 m]
[CALC-SPD POSN Y1]*	Ship's speed can be measured at two locations in addition to the antenna position. Enter the forward distance, calculated from the CCRP, to the location where you want to measure the ship's speed.	[0.0 m] to [SHIP'S LENGTH]. For example, if [SHIP'S LENGTH] is set to [45 m], the maximum range for this setting is also [45 m].
[CALC-SPD POSN Y2]*		[0.0 m] to [SHIP'S LENGTH]. For example, if [SHIP'S LENGTH] is set to [45 m], the maximum range for this setting is also [45 m].
[CALC-SPD POSN Z]*	Enter 0 to calculate the height from the bottom the ship. Enter the draught amount to calculate the height from the draught.	[0.0 m] to [ANT POS Z0].

*: These settings are required in order to display correct data on the SPD display. See section 2.10.

11. To apply the settings, select [ENTER], then press the **ENT** key.
    To discard the changes and start again, select [CANCEL], then press the **ENT** key.
12. Close the [MENU].

1.6.3 How to apply offsets for heading/pitch/heave/roll/position

Note: Access to the [OFFSET] menu requires the [SERVICE] menu to be unlocked. To unlock the service menu, consult your local dealer.

1. Open the [MENU].
2. Select [SENSOR], then press the **ENT** key.
3. Select [OFFSET], then press the **ENT** key.
4. Referring to the table below, select the appropriate item to offset, then press the **ENT** key.

Menu item	Description	Offset range
HDG OFFSET	Offset the heading.	-180° to +180°
PITCH OFFSET	Offset to compensate for pitch.	-10°000 to +10°000
ROLL OFFSET	Offset to compensate for roll.	

Menu item	Description	Offset range
POSITION OFFSET	Offset the Own Ship position.	North/South: 00.0000' to 59.9999' East/West: 00.0000' to 59.9999'
DIMENSIONS/CCRP	Set the ship size, location of the antenna and CCRP.	See section 1.6.2.
SOG OFFSET	Offset the SOG.	-12.5% to +12.5%
ATM OFFSET	Offset atmospheric pressure.	-99.9 hPa to +99.9 hPa
TEMP OFFSET	Offset the temperature. **Note:** The displayed temperature appears lower than the actual temperature immediately after the power is turned on. It takes approximately one hour for the equipment to display the correct temperature in a stable manner.	-99.9°C to +99.9°C

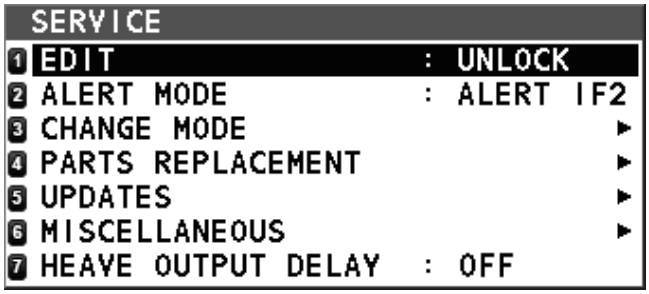
5. Use the arrows key to set the offset, then press the **ENT** key.
6. Close the [MENU].

1.6.4 How to set the heave output delay

To use the heaving compensation on external equipment, the SC-70/SC-130 must output the heave data to the external equipment. Do as follows to output heave data.

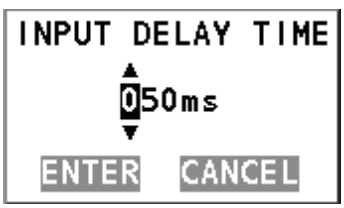
Note: Access to the [HEAVE OUTPUT DELAY] menu requires the [SERVICE] menu to be unlocked. To unlock the service menu, consult your local dealer.

1. Open the [MENU].
2. Select [SERVICE], then press the **ENT** key.



3. Select [HEAVE OUTPUT DELAY], then press the **ENT** key.
4. Select [ON] or [OFF] as appropriate, then press the **ENT** key.
   To output the heave data to the external equipment, select [ON].

5. When [ON] is selected, confirm that the delay time setting is "050 ms", then select [ENTER]. When [OFF] is selected, go to the next step.
   Keep the default delay time setting (50 ms).



When you change the setting for [HEAVE OUTPUT DELAY], the following confirmation message appears.

6. Select [YES], then press the **ENT** key.
   The following message appears and the system is restarted automatically.

1.7 How to Access and Use the [SERVICE] Menu

Menu items which require service level access are shown in gray. A password, obtained from FURUNO, is required to access the [SERVICE] menu. Several initial settings must be done from this menu to complete the setup of your SC-70 or SC-130. To adjust or change any of these settings, consult your local dealer.

1.8 I/O Menu Settings

To set which data to output to external equipment from the SC-70/ SC-130, see section 2.15.

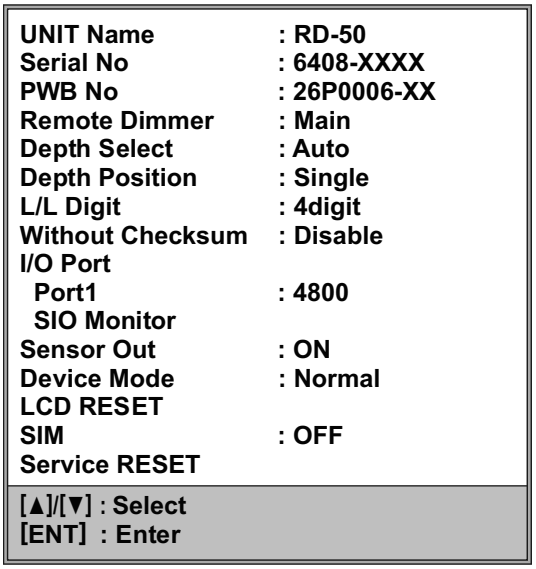
1.9 Initial Settings for the Remote Display

After wiring is complete for all units in the configuration, setup the [ROTI Display] as follows. The RD-50 requires menu setup.

For detailed operational guidance for either Remote Display unit, see the appropriate Operator's Manual (RD-50: OME-44530-x, RD:20: OME-44540-x: "x" denotes version).

How to setup the RD-50 for ROTI display.

1. Open the [SERVICE] menu for the RD-50.



XXXX: Serial number
XX: Program version number

2. Select [Device Mode], then press the **ENT** key.
   Note: Do not change the settings for any other items in the [SYSTEM] menu for the RD-50.
3. Select [ROTI], then press the **ENT** key.
4. Press the **PWR** key to close the menu and turn off the power. When the power is next turned on, your RD-50 shows the [ROTI Display] from the SC-70/SC-130.

How to setup the RD-20 for ROTI display

Press the **DISP** key on the RD-20 to show the ROTI display.

2. OPERATION

2.1 Controls Overview

No.	Key	Description
1	**BRILL**	• Opens the [BRILL SETTING] window. • With the BRILL SETTING window open, adjusts the screen brilliance.
2	**DISP**	• With the menu open: Close the menu and return to the last used display mode's main screen. • Without the menu open: Change the display mode.
3	**MENU ESC**	• Open the main menu. • Close the menu and return to the last used screen. • Close settings pop up window and return to the last used menu.
4	**ACK**	• Acknowledge an individual alert and close the alert pop up message.
5	**LIST**	• Show the [LIST] display. • Cycle through the [LIST] display.
6	**ENT**	• Open a menu item. • Confirm selected setting in pop up window. • Switch between graphic and main display for the current device mode. • From the SPD main screen: Long press to reset track (for non-IMO types only).
7	Cursorpad	• Navigate menus. ◀ button: Go back one layer in the menu. ▶ button: Open the selected menu item. ▲ button: Move selection cursor to the item above the current selection. ▼ button: Move selection cursor to the item below the current selection. • Adjust settings. ◀ button: Move cursor to the left. ▶ button: Move cursor to the right. ▲ button: Increase the value of the selected item. ▼ button: Decrease the value of the selected item. • With [INTEGRITY] screen shown: scroll through the displayed data when more than one screen is available.

2.2 How to Turn the Power On/Off

The power is turned on or off from the Junction Box (SC-701). Turn the SC-701 on/off to turn the SC-702 on/off.

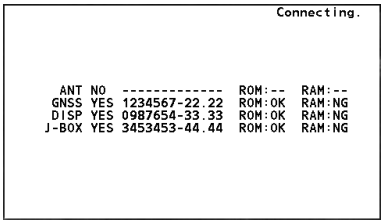
The startup screen appears for five seconds, then the system starts a diagnostic test. The diagnostic test takes approximately 30 seconds to complete. After the diagnostic test is complete, the main screen appears. You can also bypass the diagnostic test and show the main screen at any time during the test, my pressing any key.

Note 1: If the startup process has one or more errors, the message "COMMUNICATION ERROR" appears at the bottom of the diagnostic test screen.

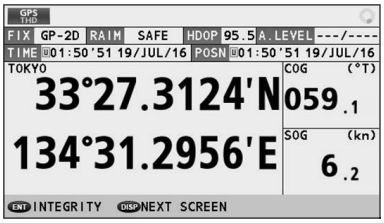
Note 2: The display may appear “sluggish” if the ambient temperature is low.

Note 3: Viewable angles may vary between daylight and nighttime.

Startup/initialize screen.
Shown for approximately five seconds.



Self-test screen.
Shown for approximately 30 seconds.



Main screen.

For IMO type vessels: The preset [DEVICE MODE]* screen appears.
For non-IMO vessels: The last used screen appears.

*: The [DEVICE MODE] is set at installation. To change this setting, consult your local dealer.

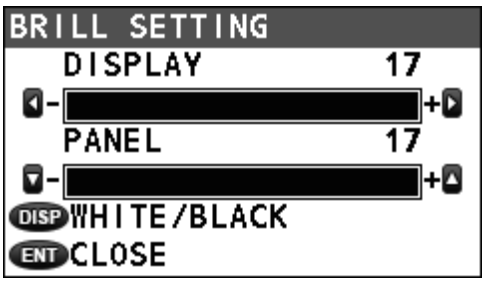
2.3 How to Adjust the Brilliance, Change the Background Color

The display unit (SC-702) has brilliance (brightness) controls for the screen and the key panel.

2.3.1 How to adjust the screen and key panel brilliance

To change the brilliance, do the following:

1. Press the **BRILL** key. The brilliance pop up window appears.



Note: The pop up window automatically disappears if there is no operation detected.

2. Press ◀ to reduce, or ▶ to increase, the display brilliance.
3. Press ▼ to reduce, or ▲ to increase, the key panel brilliance.
4. Press the **ENT** key to close the pop up window.

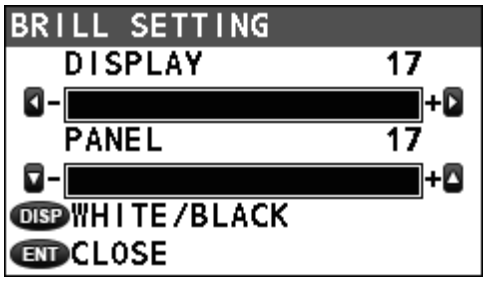
The factory default settings and setting range for brilliance are listed in the table below.

Display	Panel
Setting range: [1] to [17]	Setting Range: [0] to [17]
White background default: [14]	White background default: [10]
Black background default: [6]	Black background default: [10]

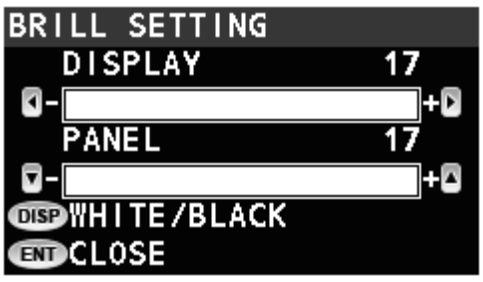
Note: The brilliance default setting for RD-50/RD-20 is [9], and the setting range is [0] to [9]. See the operator's manual (RD-50: OME-44530-x, RD:20: OME-44540-x; "x" denotes version) for details.

2.3.2 How to change the background and text color

1. Press the **BRILL** key to show the brilliance pop up window.
2. Press the **DISP** key to alternate background/text color.



White background



Black background

3. Press the **ENT** key to close the pop up window.

The background color can also be changed from the menu, see section 2.13.1.

2.4 Menu Overview

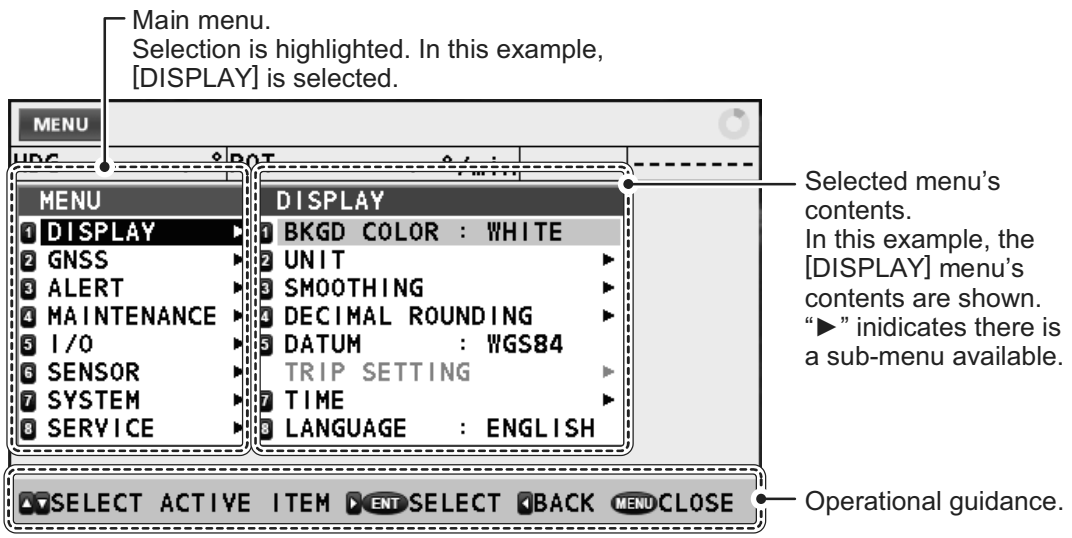
The main menu can be password protected. For information on how to access and operate the main menu, see section 1.6.1.

For the sake of brevity, the following terminology is used in this manual:

Terminology	Meaning
"Select"	Example: "Select [SENSOR], then press the **ENT** key." Use the Cursorpad to select the menu item.
"Open the [MENU]."	Press the **MENU ESC** key; this opens the [MENU].
"Close the [MENU]."	• Press the **MENU ESC** key; this closes the [MENU] and returns to the last used display screen or sub-screen. • Press the **DISP** key; this closes the [MENU] and returns to the main screen.
IMO type	SC-70 or SC-130 systems which have been assigned as [MERCHANT] at installation and installed on vessels which meet the applicable IMO standards.
Non-IMO type	SC-70 or SC-130 systems which have been assigned as [FISHING] at installation and installed on vessels which do not meet the applicable IMO standards.

Note: The default operation mode for the SC-70/SC-130 is [MERCHANT] (IMO compliant). [FISHING] is not compliant with the IMO regulations and must not be used for vessels which are required to be IMO compliant. To change the operation mode, consult your local dealer.

1. Press the **MENU ESC** key to open the menu.



2. Press ▲ or ▼ to select a menu item, then press the **ENT** key.
   "▶" next to a menu item indicates that there is a sub-menu available.
3. Press the **MENU ESC** key to close the menu.

2.5 LIST Screens Overview

LIST display mode shows the [ACTIVE ALERT] list, [ALERT LOG] and [DEVICE LIST] in cyclic order with the display mode currently in use.

Press the **LIST** key to cycle through the lists in the order shown below. Press and hold the **LIST** key to cycle through the lists in reverse order.

Main screen ➡ [ALERT LIST] ➡ [ALERT LOG] ➡ [DEVICE LIST]

2.6 Display Modes Overview

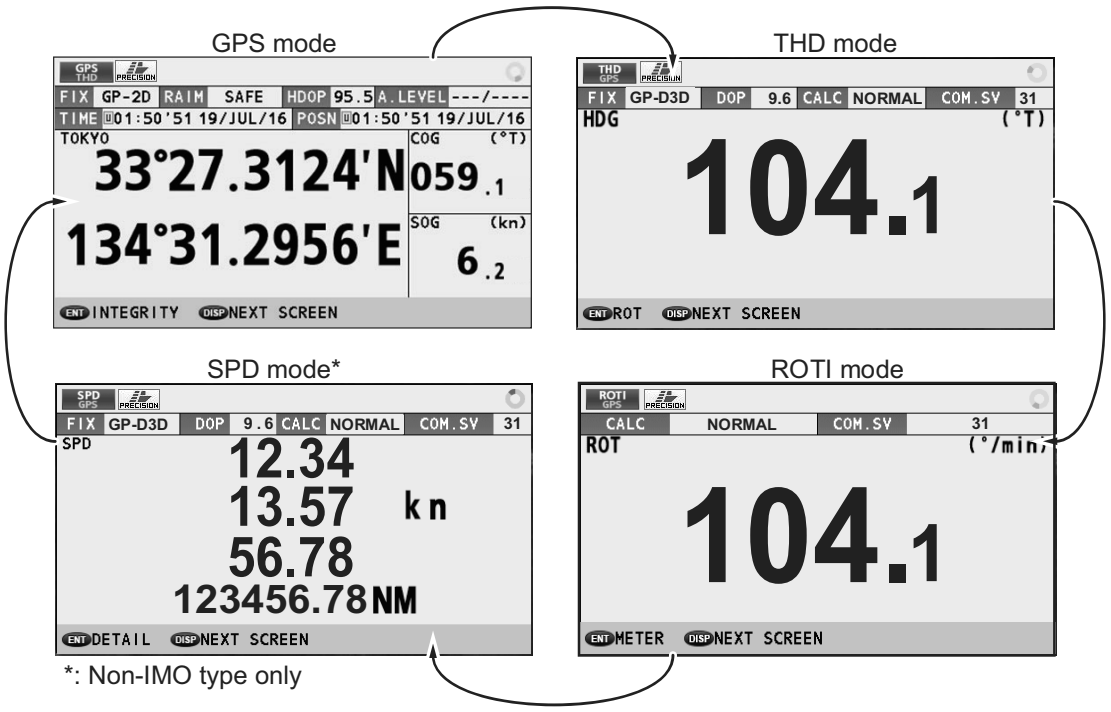
The available display modes are GPS, THD, ROTI and SPD.

Note: The SPD display mode is available only for non-IMO compliant vessels. If the device mode is changed to [MERCHANT] and the SPD display mode is in use, it is automatically changed to the THD display mode. Consult your local dealer for details.

How to change the display mode

Press the **DISP** key to cycle through the display modes. The order in which the display modes are shown is: GPS → THD → ROTI → SPD → GPS...

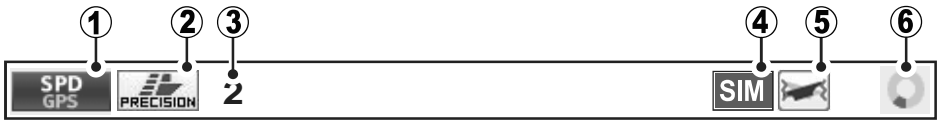
Note: Some display modes may not be available, depending on vessel configuration. The figures below shows all four available display modes.



*: Non-IMO type only

2.6.1 Icons and indications

The top section of all device modes displays various icons and the operational status icon is always displayed. The example figure below shows all icons, along with a brief description.



No.	Description
1	Indicates the displayed screen. Display mode icon: (Two-tier)  Current display mode / Preset [DEVICE MODE] (Startup screen) Display mode icon: (Single-tier)  Indication appears on one line when the currently selected screen matches the preset [DEVICE MODE]. LIST screen:  MENU screen: 
2	Precision indicator - displayed when five or more satellites are available for position fixing.
3	GNSS core number - shown for non IMO-types only. Shown only when GNSS core 1 is faulty; the substituted core number is shown here.
4	Simulation mode indicator. Shown only when the system is in simulation mode.
5	Excessive vibration icon - displayed when the antenna location is subjected to excessive vibration.
6	Operational status indicator - rotates in a clockwise direction when the system is operating normally. If this indicator does not move for more than 30 seconds, restart the equipment. For Non IMO-types, this icon is displayed in a light-blue color. For IMO-types, this icon is displayed in a dark blue color.

Alerts and operational guidance

The bottom section of the screen for all device display modes shows operational guidance and alerts.

Alerts take priority over guidance and must be acknowledged before normal operational guidance can be displayed again.

Operational guidance

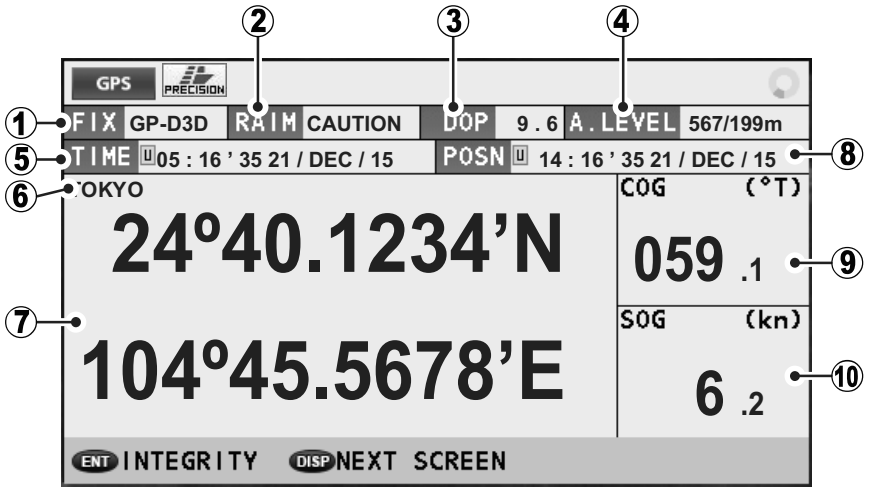
Alert message (flashing)

2.7 GPS Display Mode

The GPS display mode has three display screens. Press the **ENT** key to cycle through the screens in the following order: Main screen → INTERGITY → BEACON/TYPE 16 MESSAGE → main screen...

2.7.1 GPS coordinates screen (main screen)

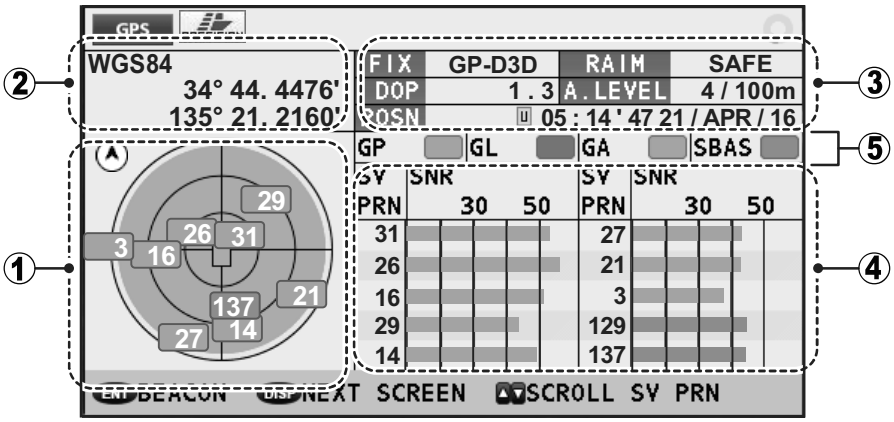
The GPS main screen shows own position, COG, SOG and other important GPS information.



No.	Indication	Description
1	[FIX]	Current position fixing method (GP-3D, GP-D3D, etc.)
2	[RAIM]	Current RAIM status. • SAFE: GPS signal is normal, positioning accuracy satisfies the setting value. • CAUTION: RAIM accuracy cannot be calculated. (Signals from more than five GPS satellites are necessary.) The positioning accuracy does not satisfy the setting value. • UNSAFE: GPS signal is abnormal, therefore the positioning accuracy is not reliable. • OFF: RAIM is disabled.
3	[PDOP], [HDOP]	Current DOP (Dilution Of Precision). Displayed as PDOP for positional dilution, HDOP for horizontal dilution.
4	[A. LEVEL]	Accuracy offset for RAIM.
5	[TIME]	Time and date. Displayed with the prefix "L" for local time, "U" for UTC.
6	Datum	Current Datum in use.
7	Location	Own ship latitude and longitude (coordinates).
8	[POSN]	Time and date of last position calculation. Displayed in a orange color when the unit is restarted. When connection is established and positioning can be calculated, the indication changes to the opposite color of the setting selected from the [DISPLAY] → [BKGD COLOR] menu.
9	[COG]	Course Over Ground.
10	[SOG]	Speed Over Ground.

2.7.2 GPS integrity screen

The GPS integrity display shows satellite status and various integrity-related data, as shown in the figure and table below.



No.	Name	Description
1	Satellite positions	Shows the available satellites and their elevation. • Light blue shaded circle: Indicates area where multipath can be used. • White numerals: Indicates satellites used for position fix. • Own ship is shown at the center of the circle. Press ▶ to alternate between North-Up and Head-Up orientations.
2	Own ship position/positioning reference	Shows OS coordinates and positioning reference.
3	Text data box	See section 2.7.1.
4	RX level	Shows the strength of the signal received from the satellite code. • [SV PRN]: Satellite number. • [SNR]: Signal to Noise Ratio. When more than 10 satellites are in use, press ▲ or ▼ to scroll though the list.
5	Satellite color codes	Shows the color code for the satellites currently in use. The displayed indications are abbreviated as follows: • [GP]: GPS. • [GL]: GLONASS. • [GA]: Galileo • [SBAS]: SBAS

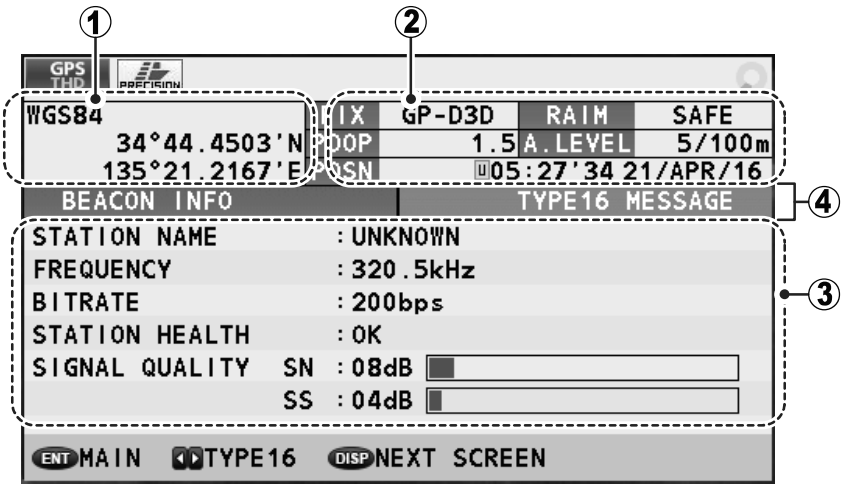
2.7.3 BEACON INFO/TYPE 16 MESSAGE screen

The beacon information display screen has two information tabs, the [BEACON INFO] tab and the [TYPE16 MESSAGE] tab.

The GPS [BEACON INFO] tab displays important information about the selected GPS beacon.

The [TYPE16 MESSAGE] tab displays all received TYPE16 messages received from beacons.

To switch tabs, press either the ◀ or the ▶ arrow key.



No.	Name	Description
1	Own ship position/positioning reference	Shows OS coordinates and positioning reference
2	Text data box	See section 2.7.1.
3	Information/message box	**BEACON INFO tab**: • STATION NAME: Always shown as "UNKNOWN". • FREQUENCY: Beacon/station's frequency • STATION HEALTH: Always shown as "Not Available". • SIGNAL QUALITY: SN = Signal to noise ratio (range: 00 dB to 99 dB); SS = Signal strength (range: 00 dB to 99 dB). **Note:** Where the value for SN or SS exceeds the maximum displayable value, the indicated value appears as bars ("99dB").
4	[BEACON INFO] / [TYPE16 MESSAGE] tabs	Displays beacon information ([BEACON INFO] tab), or displays received [TYPE16 MESSAGE] messages.

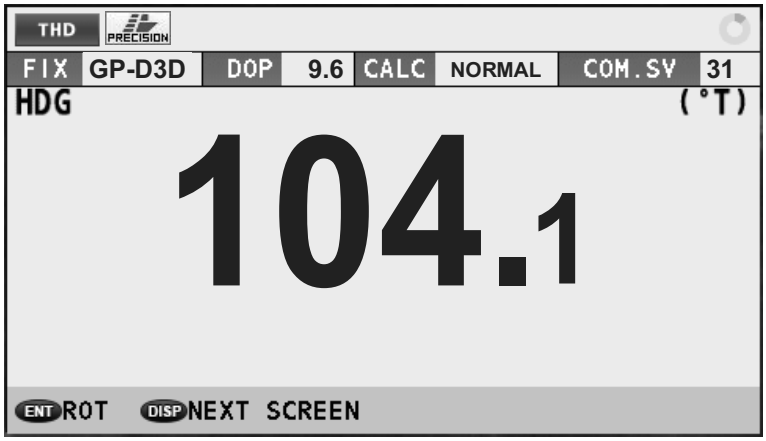
2.8 THD Display Mode

THD (Transmitting Heading Device) display mode outputs heading data to external equipment. This display mode has three sub display screens. The default screen is the HDG (heading) data screen. The sub screens, in displayed order, are: ROT (Rate Of Turn) screen → HDG/ROT split screen → THD integrity screen.

Press the **ENT** key to cycle through the display screens.

2.8.1 HDG data screen

The HDG data screen shows your current heading and any offset applied to the heading data.

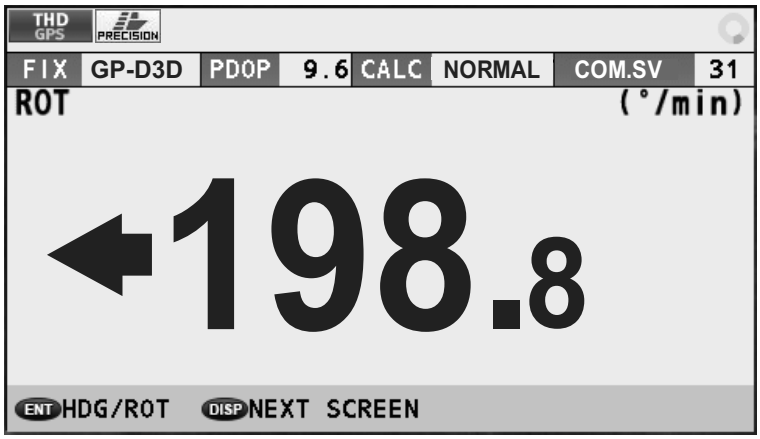


How to interpret the THD data display screen

Indication	Description
FIX	Current position fixing method (GP-3D, GP-D3D, etc.)
PDOP	Current DOP (Dilution Of Precision). Displayed as PDOP for positional dilution, HDOP for horizontal dilution.
CALC	Calculation status. • [NORMAL]: HDG and ROT are calculated normally. • [DR]: HDG and ROT are calculated using Dead Reckoning. • [STOPPED]: HDG calculation stopped. • [SYS FAULT]: System fault.
COM. SV	Commonly used satellite's number.

2.8.2 ROT data screen

The ROT data screen shows your vessel's current rate of turn.

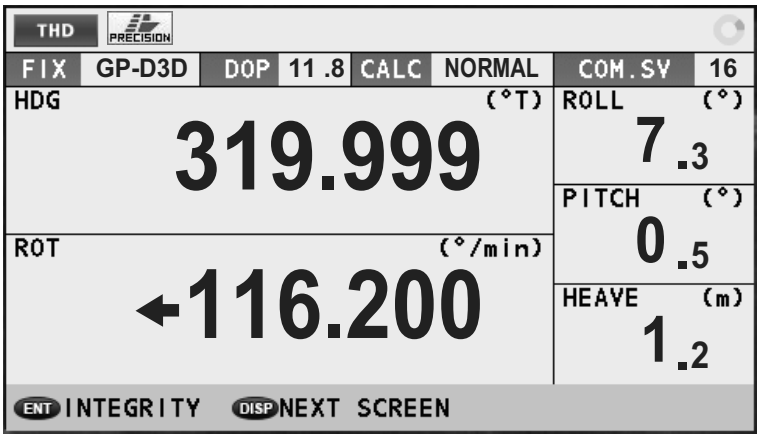


How to interpret the ROT data screen

Indication	Description
FIX	Current position fixing method (GP-3D, GP-D3D, etc.)
PDOP	Current DOP (Dilution Of Precision). Displayed as PDOP for positional dilution, HDOP for horizontal dilution.
CALC	Calculation status. • [NORMAL]: HDG and ROT are calculated normally. • [DR]: HDG and ROT are calculated using Dead Reckoning. • [STOPPED]: HDG calculation stopped. • [SYS FAULT]: System fault.
COM. SAT	Commonly used satellite's number.

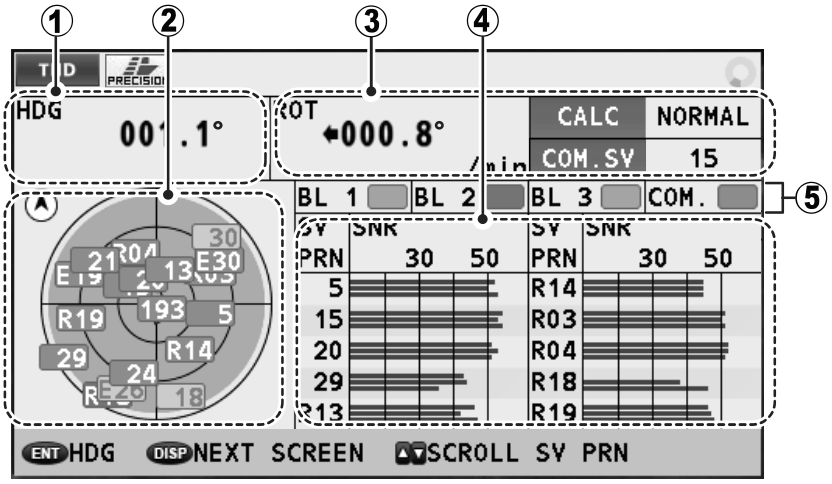
2.8.3 HDG/ROT split screen

The HDG/ROT split screen shows heading and rate of turn data with roll/pitch/heave.



2.8.4 THD integrity screen

The THD integrity display shows satellite status and various integrity-related data, as shown in the figure and table below.



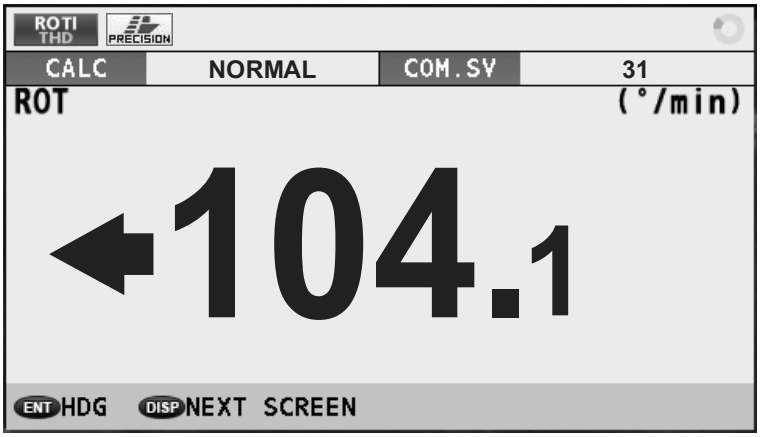
No.	Indication	Description
1	HDG	Current heading.
2	Available satellites	Shows the available satellites and their elevation. Press ▶ to alternate between North-Up and Head-Up orientations.
3	• ROT • CALC • COM. SAT	• Current Rate Of Turn. • Calculation status. (See the table in "HDG data screen" on page 2-10 for details.) • Commonly used satellite's number.
4	Satellite details	Shows the strength of the signal received from the satellites. More than one bar indicates that more than one antenna is using that satellite. • [SV PRN]: Satellite number. • [SNR]: Signal to Noise Ratio. When more than 10 satellites are in use, press ▲ or ▼ to scroll though the list.
5	Antenna baseline color codes	Shows the color for each antenna baseline in use. The displayed indications are abbreviated as follows: • [BL 1] - Antenna No. 1 + Antenna No. 2 • [BL 2]* - Antenna No. 2 + Antenna No. 3 • [BL 3]* - Antenna No. 3 + Antenna No. 1 • COM - Common *: Shown only when a SC-1303 is connected.

2.9 ROTI Display Mode

The ROTI display mode is essentially the same as the THD display mode, in terms of displayed data. However, the following items are displayed in a different manner:

- [DOP] and [FIX] are not shown.
- The indications for [ROT] and [HDG] in the split-screen are reversed.

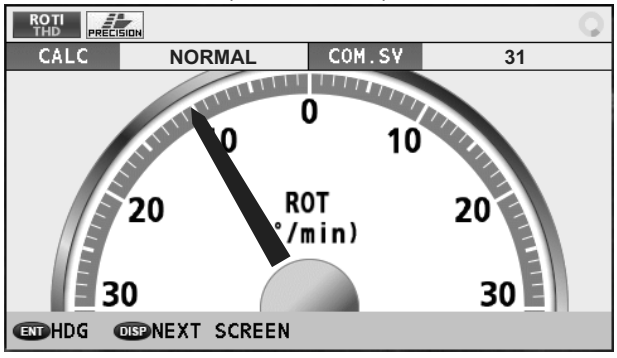
This display mode has three sub display screens. The default screen is the ROT (Rate Of Turn) data screen. The sub screens, in displayed order, are: ROT analog meter screen → HDG (Heading) screen → ROT/HDG split screen → THD integrity screen.



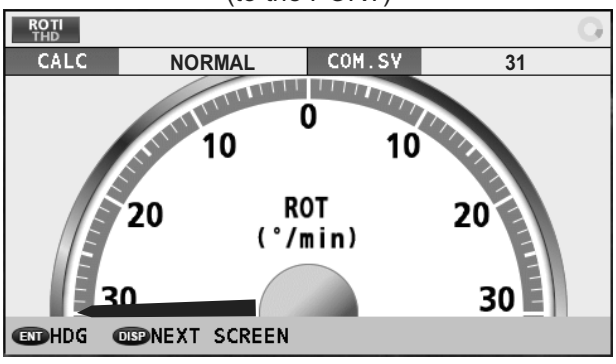
2.9.1 ROTI analog meter screen

In the ROT analog meter screen, the ROT data is displayed in an analog meter format. When the ROT value exceeds 30° (degrees), the meter needle will be as the illustration on right side.

When ROT value is 10 degrees (to the PORT)



When ROT value exceeds the 30 degrees (to the PORT)



2.9.2 ROTI Display for RD-50/RD-20 (option)

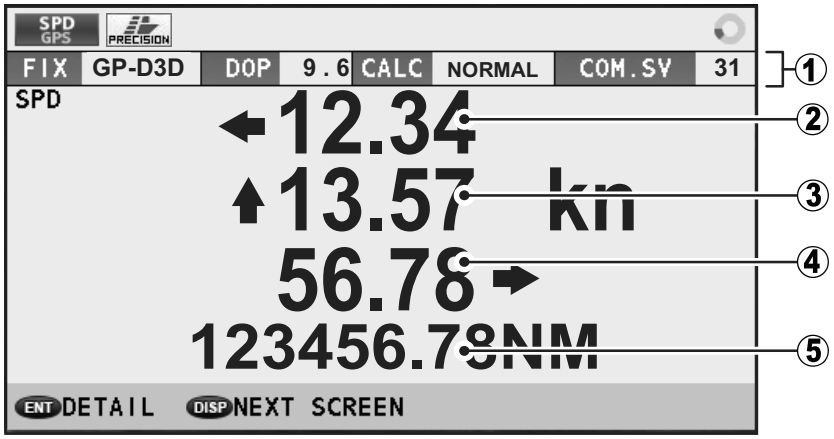
For vessels with the optional RD-50/RD-20 installed as part of the SC system configuration, you can show the ROTI data on the RD-50/RD-20 display. See the appropriate operator's manual for details (RD-50: OME-44530-x; RD-20: OME-44540-x; "x" denotes the manual version).

Note: For IMO-type vessels, the RD-50 remote display is compatible with IMO regulations. If you use the RD-20 remote display, your vessels no longer meets the IMO requirements.

2.10 SPD Display Mode (Non-IMO types only)

The speed and distance data display screen is the default. The sub screen shows navigational data. This display mode is only available for non-IMO types.

2.10.1 Speed and distance display screen

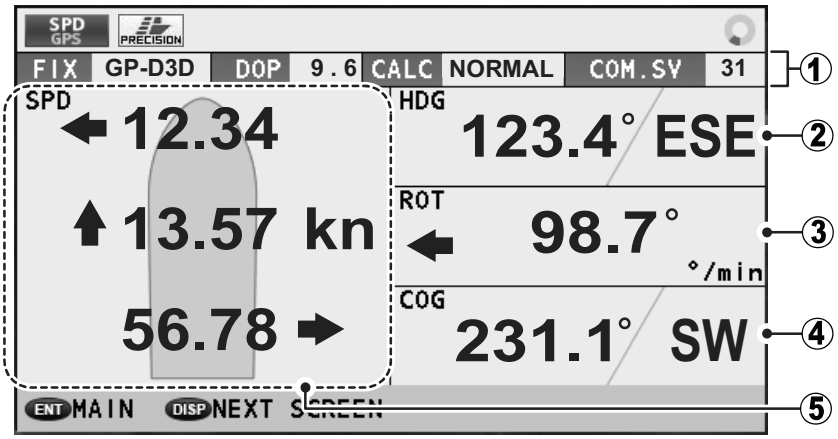


How to interpret the speed and distance display screen

No.	Indication	Description
1	[FIX], [DOP], [CALC], [COM. SV]	See section 2.8.1.
2	Lateral bow speed*	Shows the calculated speed at the bow of your vessel. The arrow indicates tendency to port or starboard.
3	Bow to stern speed*	Shows the calculated speed of your vessel. The arrow indicates forward or reverse motion.
4	Lateral stern speed*	Shows the calculated speed at the stern of your vessel. The arrow indicates tendency to port or starboard.
5	Distance traveled	Shows the distance traveled for this trip.

*: CALC-SPD values must be set at installation to show these speeds. See section 1.6.2 for details.

2.10.2 Navigational data screen



How to interpret the navigational data

No.	Indication	Description
1	FIX	See section 2.8.1.
2	HDG	Current heading
3	ROT	Rate of turn.
4	COG	Course Over Ground.
5	Speed data	Top line: Lateral bow speed. Middle line: Bow to stern speed. Bottom line: Lateral stern speed.

2.11 Alerts

When an alert is triggered, a flashing indication appears at the bottom of the screen and an alert sound is released. The indication shows the alert name, alert code and alert icon.

[Warning] level alerts are shown in yellow-orange color, [Caution] level alerts are shown in yellow color.

Example alert message (flashing)

The SC-70/SC-130 tracks active (acknowledged but not rectified, or unacknowledged) alerts in the [ALERT LIST] (see section 2.11.3). Alerts which are acknowledged and rectified are saved in the [ALERT LOG] (see section 2.11.4).

For a full list of possible alerts, along with their details such as alert codes and remedies or action required, see "ALERT LIST" on page AP-4.

2.11.1 How to acknowledge alerts

There are two methods by which you can acknowledge an alert.

How to acknowledge an alert from the display unit (All alert modes)

Press the **ACK** key to acknowledge the alert.

How to acknowledge an alert remotely (LEGACY alert mode only)

The [REMOTE ACK I/F] setting sets the behavior of external equipment which can acknowledge alerts. To use this function, the [ALERT MODE] must be set to [LEGACY] at installation. (Consult your dealer to change this setting.)

To set remote acknowledge, do the following:

1. Open the [MENU].
2. Select [ALERT], then press the **ENT** key.
3. Select [REMOTE ACK I/F], then press the **ENT** key.
4. Select the appropriate setting, then press the **ENT** key.

Setting	Description
[ACK]	External equipment can acknowledge alerts.
[BUZZER STOP]	External equipment can stop aural alerts, but cannot acknowledge alerts.

5. Close the [MENU].

Refer to the operator's manual for the external equipment for alert acknowledgment procedures.

2.11.2 How to enable/disable the aural alert (Non-IMO type only)

This setting is only available for non-IMO types.

1. Open the [MENU].
2. Select [ALERT], then press the **ENT** key.
3. Select [SOUND], then press the **ENT** key. An options pop up window appears.
4. Select the appropriate option, then press the **ENT** key.

Option	Description
[OFF]	Disable aural alerts.
[SHORT]	Release two short beeps when an alert is triggered.
[LONG]	Release three long beeps when an alert is triggered.
[CONTINUOUS]	Release a continuous beep when an alert is triggered.

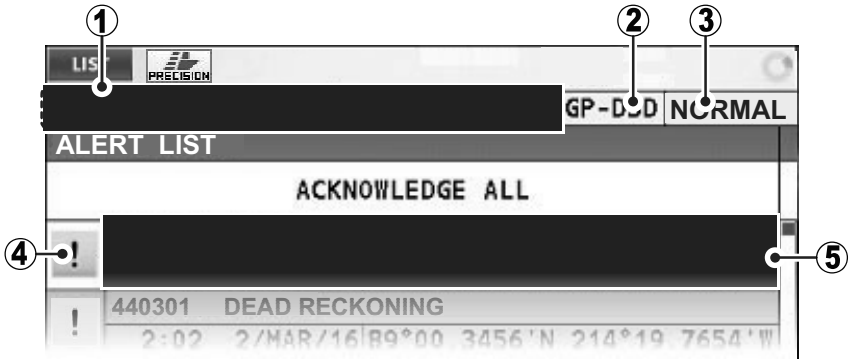
5. Close the [MENU].

2.11.3 How to access the alert list

The alert list shows all currently violated alerts and state of acknowledgment.

All unacknowledged alerts are shown, even those whose reason for the alert has bee rectified or passed (except for cautions). To access the alert list, do the following:

1. Open the [MENU].
2. Select [ALERT], then press the **ENT** key.
3. Select [ALERT LIST], then press the **ENT** key. The list of active alerts appears.



4. Press ▲ or ▼ to scroll up or down through the alert log.
5. Press the **DISP** key to close the [ALERT LIST].

Note: You can also access the [ALERT LIST] from the [LIST] display. Press the **LIST** key to cycle through the lists.

How to interpret the alert list

No.	Indication name	Description
1	DATUM/OS coordinates or [HDG]/[ROT]	Where the device mode is [THD] or [ROTI]: • [HDG]: OS heading, oriented to North. If the heading data is received from an external device, the device name and external input talker are shown. • [ROT]: Rate of turn with arrow indicating turn direction to port or starboard. Where the device mode is [SPD] or [GPS]: Datum and OS coordinates are displayed.
2	FIX	Current position fixing method (GP-3D, GP-D3D, etc.)
3	CALC	Calculation status. • [NORMAL]: Data is calculated normally. • [DR]: Data is calculated using Dead Reckoning. • [STOPPED]: Data calculation stopped. • [SYS FAULT]: System fault.
4	Alert icon	Shows alert status. See page AP-9 for details.
5	Alert details	Top line: alert code, alert message Bottom line: time of alert, coordinates at time of alert. **Note:** A full list of alert codes, meaning and measure is included at "ALERT LIST" on page AP-4.

2.11.4 How to access the alert log

The alert log shows the latest 50 alerts. When the log becomes full, the oldest entry is erased to make room for current alerts. To access the alert log, do the following:

1. Open the [MENU].
2. Select [ALERT], then press the **ENT** key.
3. Select [ALERT LOG], then press the **ENT** key.

4. Press ▲ or ▼ to scroll up or down through the alert log.
5. Press the **DISP** key to close the [ALERT LOG].

Note: The [ALERT LOG] can also be accessed from the [LIST] display. Press the **LIST** key to cycle through the lists.

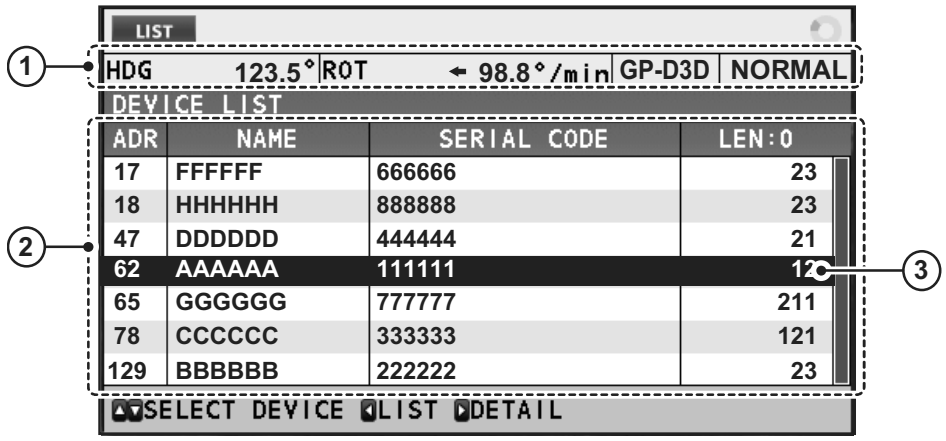
How to interpret the alert log

No.	Indication name	Description
1	DATUM, OS coordinates, Calculation status, [HDG], [ROT]	See section 2.11.3.
2	Alert code and message	Alert code appears in six digit format. **Note:** A full list of alert codes, meaning and measure is included at "ALERT LIST" on page AP-4.
3	Alert number	Number assigned to the selected alert by the alert log. Up to 50 alerts are stored. **Note:** This is not an alert code.
4	[ACK]	Time and date the alert was acknowledged.
5	Alert priority	The priority level assigned to the selected alert. Displayed as "WARNING" or "CAUTION".
6	Alert time / coordinates	Time of alert, coordinates at time of alert.
7	[RECT]	Time and date alert was rectified.

2.12 How to View the Connected Devices

The [DEVICE LIST] shows up to 51 devices connected to the same CANbus network. You can also view details for each displayed device.

To view the [DEVICE LIST], press the **LIST** button to cycle through the [LIST] screens.



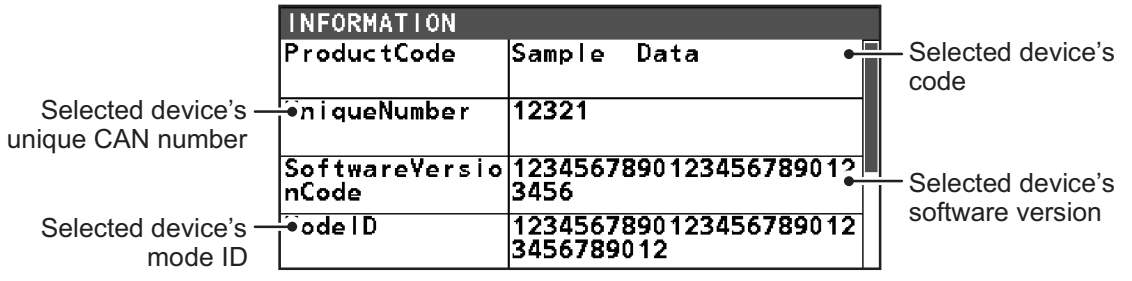
Note: The [DEVICE LIST] is updated each time it is accessed. If a device is added to the network while the [DEVICE LIST] is open, close, then re-open the [DEVICE LIST] to show the newly added device.

How to interpret the device list

No.	Indication name	Description
1	DATUM, OS coordinates, Calculation status, [HDG], [ROT]	See section 2.11.3.
2	[ADR]	CANbus network address (0 to 255). Devices are listed in numerical order.
	[NAME]	CAN Device name.
	[SERIAL CODE]	CAN device's address claim.
	[LEN]	CAN device's LEN (Load Equivalency Number).
3	Selected item (highlighted)	Press ▼ or ▲ to scroll through the device list.

How to interpret device details

Select the device whose details you want to view, then press ▶. the device details appears at the center of the screen.



2.13 DISPLAY Menu

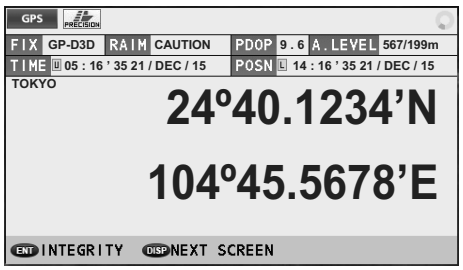
You can customize the manner in which most items are displayed on your screen, from the [DISPLAY] menu.

Press the **MENU ESC** key, select [DISPLAY], then press the **ENT** key to show the [DISPLAY] menu.

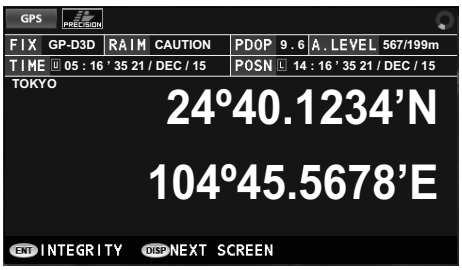
2.13.1 How To Change the Display Color

You can change the background and text color for better visibility. There are two options, White background and Black background.

White background



Black background



The color change can be made using of the two following methods:

How to change the color from the menu

1. Open the [DISPLAY] menu.
2. Select [BKGD COLOR], then press the **ENT** key.
3. Select [BLACK] or [WHITE] as appropriate, then press the **ENT** key.
4. Close the [MENU].

How to change the color from the controls

See section 2.3.2 for details.

2.13.2 How to Change the Units of Measurement

To change the unit of measurement for distance, follow the procedure below.

1. Open the [DISPLAY] menu.
2. Select [UNIT], then press the **ENT** key.
3. [DISTANCE] is selected, press the **ENT** key.
4. Select the appropriate distance unit, then press the **ENT** key.
   Note: The unit of measurement for speed is also changed, as shown below
   - [NM]: Nautical Miles - speed shown as [kn].
   - [KM]: Kilometers - speed shown as [km/h].
   - [SM]: Statute Miles - speed shown as [mph].
5. Close the [MENU].

2.13.3 How To Use The Smoothing Menu

Data received from external sensors can be smoothed. This helps to reduce variations caused by unfavorable receiving conditions or other factors.

1. Open the [DISPLAY] menu.
2. Select [SMOOTHING], then press the **ENT** key.
3. Select the appropriate item to smooth, then press the **ENT** key.

Menu item	Description	Setting range
VTG	Course over ground, ground speed	0000 s to 9999 s
6DoF	Six Degrees of Freedom - Roll/Pitch	0000 s to 9999 s
OS SPEED (X,Y)	Dual water/ground speed	0000 s to 9999 s **Note:** Available for non-IMO types only.
ROT	Rate of turn	00 s to 30 s

4. Close the [MENU].

To disable smoothing for any of the above menu items, repeat the above procedure, then set the smoothing value to [0] (zero).

2.13.4 How to set the number of digits after a decimal point

To change the number of digits displayed after a decimal point, follow the procedure below. Up to three digits can be set.

1. Open the [DISPLAY] menu.
2. Select [DECIMAL ROUNDING], then press the **ENT** key.
3. Select the appropriate item, then press the **ENT** key.

Item	Affected indications
[VTG]	Speed indications which use the VTG sentence for data input.
[VBW]	Speed indications which use the VBW sentence for data input.
[HDG]	All heading indications. ([ROT] is also affected, see section 2.8.2.)
[ROLL, PITCH]	All roll/pitch indications. ([HEAVE] is also affected, see section 2.8.3.)

4. Select [1], [2] or [3] as appropriate, then press the **ENT** key.
   - [1]: Values are displayed with one digit after the decimal point. The values are also rounded up or down as appropriate.
   - [2]: Values are displayed with two digits after the decimal point. The values are also rounded up or down as appropriate.
   - [3]: Values are displayed with three digits after the decimal point. The values are also rounded up or down as appropriate.

   Note: This setting also affects serial output data, sent to other equipment.
5. Close the [MENU].

2.13.5 How to Set Geodetic Data

The SC-70/SC-130 uses the WGS84 datum as the default geodetic datum. To change the datum used, follow the procedure below.

1. Open the [DISPLAY] menu.
2. Select [DATUM], then press the **ENT** key.
3. Select the appropriate datum, then press the **ENT** key. The available selections are: [WGS84], [WGS72], [PZ90], [CK42], [CK95] and [OTHERS].
   If the datum you wish to use is not displayed, select [OTHERS].
4. If you selected [OTHERS], proceed to step 5. For all other selections, close the menu.
5. Input the chart number, referring to the geodetic chart list at the back of this manual, then press the **ENT** key.
6. Close the [MENU].

2.13.6 How to Reset the Trip Meter

The trip meter calculates the distance your vessel has traveled and can be restarted at any time. This menu is not available for IMO types.

To reset the trip meter, do the following:

1. Open the [DISPLAY] menu.
2. Select [TRIP SETTING], then press the **ENT** key.
3. [CLEAR] is already selected. Press the **ENT** key to reset the meter.
4. Close the [MENU].

2.13.7 How to Adjust the Date and Time

The SC-70/SC-130 can display the date and time in UTC format or as the local (geographical) time. You can also set for summer time. To adjust time settings, refer to the appropriate topic below.

How to change the time display format

1. Open the [DISPLAY] menu.
2. Select [TIME], then press the **ENT** key.
3. Select [LOCAL TIME], then press the **ENT** key.
4. Select [UTC] or [LOCAL] as appropriate, then press the **ENT** key.

Setting	Remarks
[UTC]	UTC (Coordinated Universal Time) time is calculated automatically.
[LOCAL]	Manually input the time offset (based on UTC time).

5. Close the [MENU].

How to enable/disable summer time

You can manually adjust the time to reflect summer (daylight saving) time.

1. Open the [DISPLAY] menu.
2. Select [TIME], then press the **ENT** key.
3. Select [SUMMER TIME], then press the **ENT** key.
4. Select [ON] to enable summer time, [OFF] to disable summer time.
5. Close the [MENU].

2.13.8 How to Set the Display Language

The SC-70/SC-130 can display menus and data in English or Japanese. If the display language has been changed to Japanese, do the following to change the language back to English.

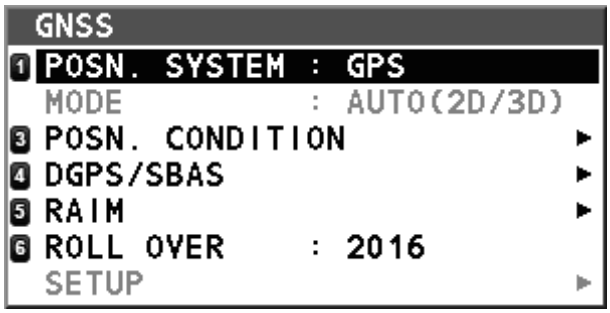
Note: This procedure uses the menu item numbers which are displayed at the left-side of each menu.

1. Open the [MENU].
2. Select [1], then press the **ENT** key.
3. Select [8], then press the **ENT** key.
4. Select [ENGLISH], then press the **ENT** key.
5. Close the [MENU].

2.14 GNSS Menu

You can adjust various GNSS-related settings from the [GNSS] menu.

Press the **MENU ESC** key, select [GNSS], then press the **ENT** key to show the [GNSS] menu.

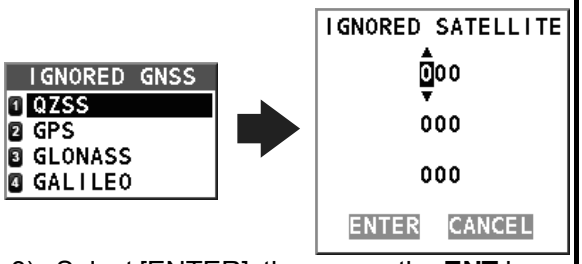


2.14.1 How to select the positioning system to use

1. Open the [GNSS] menu.
2. Select [POSN. SYSTEM], then press the **ENT** key.
3. Select the appropriate positioning system, then press the **ENT** key.
   Note: At the time of printing, only [GPS] is available for selection. Other positioning system may be added at a later date.
4. Close the [MENU].

2.14.2 How to set the positioning conditions

1. Open the [GNSS] menu.
2. Select [POSN. CONDITION], then press the **ENT** key.
3. Referring to the table below, set the conditions for position fixing, then press the **ENT** key.

Menu item	Options	Remarks
QZSS	• [OFF] • [ON] (default)	Enable/disable the use of the QZSS system.
ELEVATION MASK	For technical personnel only. Not changeable.	
IGNORED GNSS	[000] to [999]	The system uses the on-board almanac to ignore satellites which are known to provide incorrect data. However, some of these satellites may not be registered in the almanac. You can add satellites to be ignored using this function. 1) Select the satellite network to which the satellite you want to ignore is registered. The [IGNORED SATELLITE] window appears. 2) Enter the satellite number to be ignored. You can enter up to 3 satellites per network. Press ▲ to increase the value, ▼ to decrease the value and press ▶ or ◀ to move the input cursor.  3) Select [ENTER], then press the **ENT** key.

4. Close the [MENU].

2.14.3 How to Set Up DGPS/SBAS

The SC-70/SC-130 can connect to DGPS beacons or SBAS (Satellite Based Augmentation Systems) to refine position fixing.

How to select the mode of refinement

1) Open the [GNSS] menu.
2) Select [DGPS/SBAS], then press the **ENT** key.
3) Select [DIFFERENTIAL], then press the **ENT** key.
4) Referring to the list below, select the appropriate mode, then press the **ENT** key.
   - [GNSS]: No position refinement used.
   - [GNSS+SBAS]: Use SBAS to refine position fixing.
   - [GNSS+EXTERNAL]: Use beacons to refine position fixing.
     Note: The [MODE] setting for [DATA5] in the [I/O] menu must be set to [RTCM] to enable this mode.
   - [AUTO]: The SC-70/SC-130 automatically switches modes as required.
     The priority is: [EXTERNAL] > [SBAS] > [GNSS].
5) Close the [MENU].

How to search for available SBAS

1) Open the [GNSS] menu.
2) Select [DGPS/SBAS], then press the **ENT** key.
3) Select [SBAS SEARCH], then press the **ENT** key.
4) Select [AUTO] or [MANUAL] as appropriate, then press the **ENT** key.
   - [AUTO] selects the highest elevated satellite available.
   - [MANUAL] requires the manual input of the three-digit satellite number.
5) Close the [MENU].

How to ignore SBAS satellites

1) Open the [GNSS] menu.
2) Select [DGPS/SBAS], then press the **ENT** key.
3) Select [IGNORED SBAS], then press the **ENT** key.
4) Enter the satellite number to be ignored. You can enter up to 3 satellites per network. Press ▲ to increase the value, ▼ to decrease the value and press ▶ or ◀ to move the input cursor.
5) Close the [MENU].

How to select the DGPS beacon

1) Open the [GNSS] menu.
2) Select [DGPS/SBAS], then press the **ENT** key.
3) Select [BEACON SETUP], then press the **ENT** key.
4) Select [AUTO] or [MANUAL], then press the **ENT** key.
   - [AUTO]: The SC-70/SC-130 automatically select the beacon to use.
   - [MANUAL]: Manually input the beacon frequency and bit rate.
5) Close the [MENU].

2.14.4 How to Set Up RAIM

RAIM (Receiver Autonomous Integrity Monitoring) is a diagnostic feature which tests the integrity (accuracy) of the position fixing signal.

The receiver estimates position confidence using range value and detected satellite error, and displays (provided the RAIM function is active) the results as one of three levels of position confidence in the text data box of the GPS display mode only. The three levels are as follows:

- [SAFE]: GPS signal is normal. The positioning accuracy satisfies the setting value.
- [CAUTION]: RAIM accuracy cannot be calculated. (Signals from five or more GPS satellites are necessary for calculation.) The positioning accuracy does not satisfy the setting value.
- [UNSAFE]: GPS signal is abnormal, therefore the positioning accuracy is not reliable.

To use the RAIM feature, do the following:

1. Open the [GNSS] menu.
2. Select [RAIM], then press the **ENT** key.
3. Select [RAIM FOR GPS], then press the **ENT** key.
4. Select [SETTING], then press the **ENT** key. An options pop up window appears.
5. Select [ON] to enable the RAIM feature, select [OFF] to disable the RAIM feature.
6. Select [ACCURACY LEVEL], then press the **ENT** key. A numerical input pop up window appears.
7. Set the compensation for RAIM accuracy.
8. Select [ENTER], then press the **ENT** key to apply the RAIM settings, or select [CANCEL] then press the **ENT** key ignore the settings changes.
9. Close the [MENU].

2.14.5 How to set the rollover timing

The SC-70/SC-130 uses the positioning system to calculated date and time. Date and time data sent via satellite signal is reset once every few years, which can cause problems in date/time display. The rollover is used to prevent this from occurring. By setting the correct year on your SC-70/SC-130, the satellites and your system become synchronized.

1. Open the [GNSS] menu.
2. Select [RAIM], then press the **ENT** key.
3. Select [ROLL OVER], then press the **ENT** key. The [INPUT ROLL OVER] window appears.
4. Enter the current year.
   Press ▲ to increase the value, ▼ to decrease the value and press ▶ or ◀ to move the input cursor.
5. Select [ENTER] to apply the new setting, select [CANCEL] to keep the current setting.
   If you select [ENTER], a confirmation window appears. Select [YES] to confirm and restart the system with the new setting.

2.15 How to Set Up the I/O Menu

Besides its fundamental function of displaying position, the SC-70/SC-130 can also output various data to external equipment. Before outputting data to external equipment, first determine what data the external equipment requires. Only the necessary data should be output, to ensure that the data will be output correctly.

All data transmitted by marine electronics equipment are prefixed with a two character code, known as a “talker”. The same talker must be shared by the transmitting and receiving equipment to transmit and receive data successfully.

2.15.1 How to set up serial data output

The SC-70/SC-130 has five serial data ports which can be set up for data output.

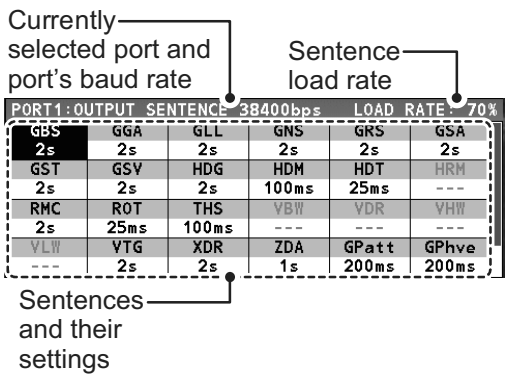
To set up more than one port, repeat the procedure below as necessary.

1. Open the [MENU].
2. Select [I/O], then press the **ENT** key.
3. Select [DATA 1], or the appropriate data port, then press the **ENT** key.
4. Select [DATA OUTPUT], then press the **ENT** key. An options pop up window appears.
5. Select [IEC/NMEA] or [RTCM] as appropriate, then press the **ENT** key.
   [IEC/NMEA]: Output data in NMEA format.
   [RTCM]: Output data in binary format.
   Note: [RTCM] can only be selected as the mode of output at [DATA 5], all other ports display [RTCM] in gray color and [RTCM] is not selectable.
6. For non-IMO vessels only, select [OUTPUT FORMAT], then press the **ENT** key. An options pop up window appears.
   For IMO type vessels, go to step 12. [OUTPUT FORMAT] and [BAUD RATE] are fixed for IMO type vessels.
7. Select the appropriate port output format, then press the **ENT** key. The available options are: [IEC61162-1ED.4], [IEC61162-1ED.3], [NMEA V2.0], [NMEA V1.5].
8. Select [TALKER], then press the **ENT** key. An options pop up window appears.
9. Select the appropriate talker, then press the **ENT** key. The available options are listed in the table below with a brief description.

Talker	Description	Talker	Description
GN	Mixed GPS and GLONASS	GP	GPS
HE	Heading - North seeking gyrocompass	GL	GLONASS
HN	Heading - Non-north seeking gyrocompass	GA	Galileo
HC	Heading - Magnetic compass		

   Note: For IMO-types, the talkers are fixed as follows.
   - THD, ROTI device mode: Fixed at [HE].
   - GPS device mode: Fixed at [GP].
10. Select [BAUD RATE], then press the **ENT** key. An options pop up window appears.
11. Select the appropriate baud rate for data transfer, then press the **ENT** key.

12. Select [SENTENCES], then press the **ENT** key. The sentence setup window appears.
13. Press the arrow keys to move the selection cursor and highlight the sentence to set up, then press the **ENT** key. The cycle section of the sentence is now highlighted.
14. Press ◀ or ▶ to adjust the sentence output cycle, then press the **ENT** key.



15. To set up other sentences, repeat step 13 and step 14 as necessary.
    Note: The sentence load rate indicates the workload required to process the sentences. When setting sentences, observe the load rate carefully and ensure it does not reach or exceed 100%.
16. To apply the changes, select [ENTER], at the bottom of the sentence list, then press the **ENT** key.
    To cancel any changes to the sentences, select [CANCEL], then press the **ENT** key.
17. Close the [MENU].

2.15.2 How to set up LAN data output

When connecting the SC-70/SC-130 to a shipboard LAN network, perform the following procedure to set up data output.

1. Open the [MENU].
2. Select [I/O], then press the **ENT** key.
3. Select [NETWORK], then press the **ENT** key.
4. For non-IMO vessels, select [TALKER], then press the **ENT** key.
   An options pop up window appears.
   For IMO-type vessels, go to step 6.
5. Select the appropriate talker, then press the **ENT** key. The available options are listed in the table at step 9 of section 2.15.1.
   Note: For IMO-types, the talkers are fixed as follows.
   - THD, ROTI device mode: Fixed at [HE].
   - GPS device mode: Fixed at [GP].
6. Referring to steps 12 through 15 of section 2.15.1, set up the sentences as appropriate.
7. Select [IP ADDRESS/PORT], then press the **ENT** key. A numerical pop up window appears.
   Use the following IP Address and Port combinations to show the log data in the [ETHERNET] log:

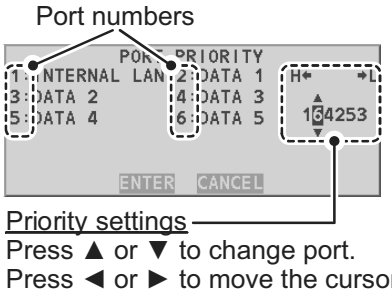
IP Address	Port	IP Address	Port
239.192.000.001	60001	239.192.000.004	60004
239.192.000.003	60003	239.192.000.008	60008

8. Set the IP address and port as appropriate, select [ENTER], then press the **ENT** key.

9. Close the [MENU].

2.15.3 How to set up data sources (data input)

1. Open the [MENU].
2. Select [I/O], then press the **ENT** key.
3. Select [DATA SOURCE], then press the **ENT** key.
4. Select [HDG] (Heading) or [EXT. STW] (External Speed Thru Water), then press the **ENT** key. An options pop up window appears.
5. Referring to the table below, set the appropriate data source for [HDG] or [EXT. STW].

Menu option	Description
[INTERNAL LAN]*	Use the SC-70/SC-130 antenna as the data source. This is the default setting.
[DATA 1] to [DATA 5]	Select the serial port for position data input from an external source.
[USER PRIORITY]	Set the priority for serial ports. If the signal from a port is interrupted, the SC-70/SC-130 automatically switches to the next available port (sensor), in priority order. The port numbers are listed on the left-side of the window. The priority settings, at the right-side of the window, show the highest priority sensor to the left, and the lowest priority sensor to the right. In the example figure, the priority order is set as follows: 1→6→4→2→5→3.  **Note:** [1: INTERNAL LAN] is fixed as the highest priority data source.

*: The [INTERNAL LAN] menu option is not available for [EXT. STW].

6. Close the [MENU].

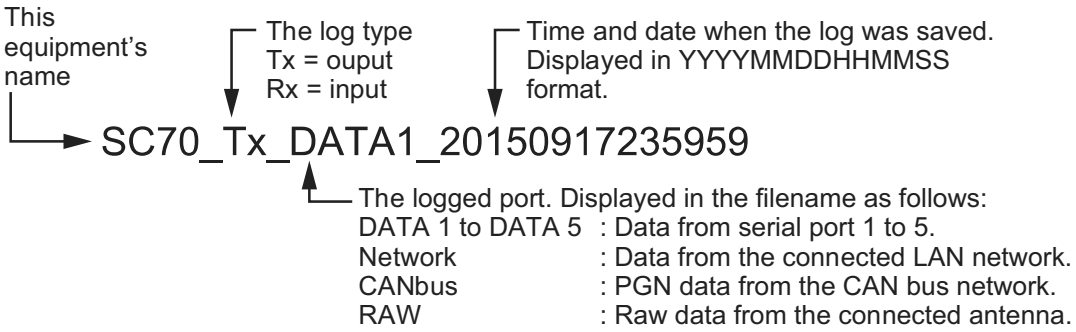
2.15.4 How to use the input/output logs

The [I/O LOGS] display logged data for input/output information for serial ports and LAN connections. You can export the logged data to an external flash memory.

The following keys have specific functions when a log screen appears.

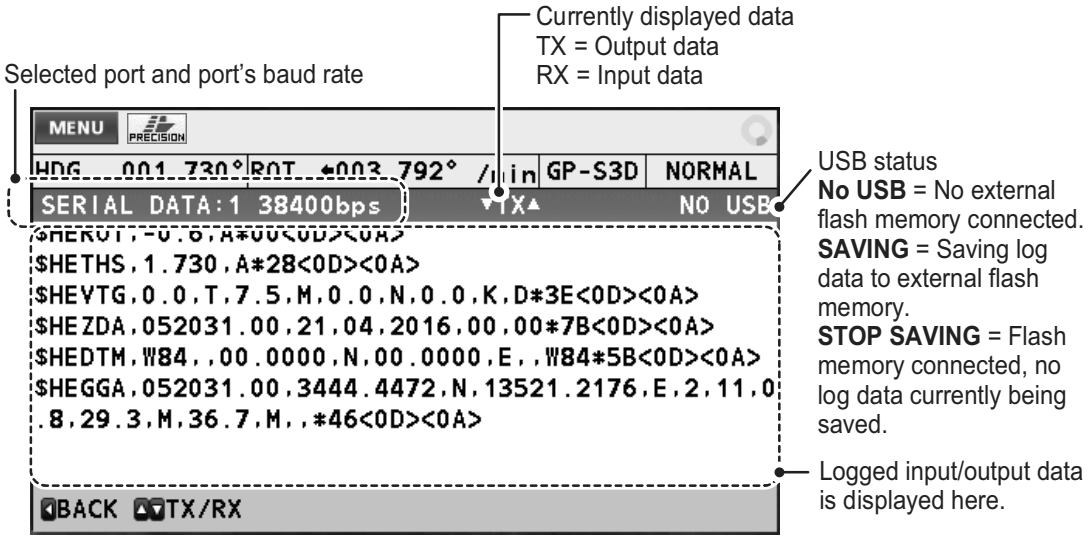
Key	Function
◀	Close the log and return to the [I/O] menu.
▲ or ▼	Toggle input and output log displays.
ENT	Press with external flash memory connected: start/pause saving the log.
MENU ESC	Close the logs and the [I/O] menu.

Saved log files are automatically named in the following format:



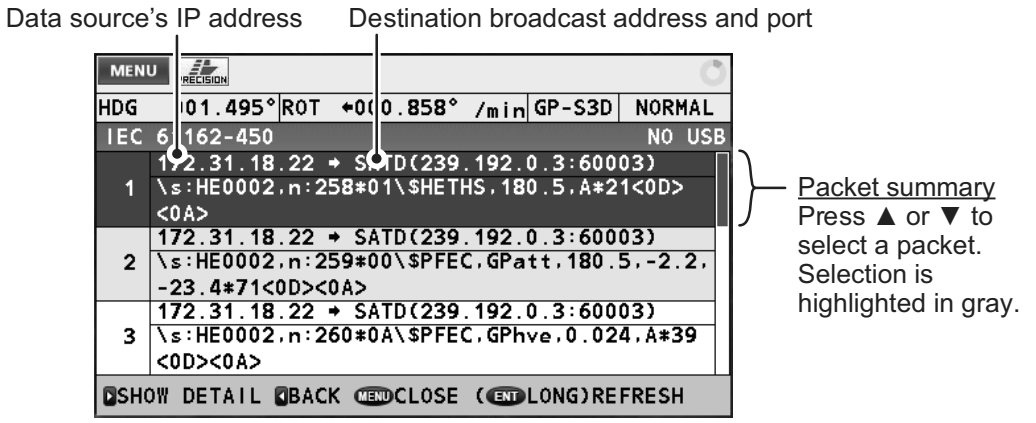
The log data which can be saved depends on the monitor type selected.

[DATA1] to [DATA5] - Serial data

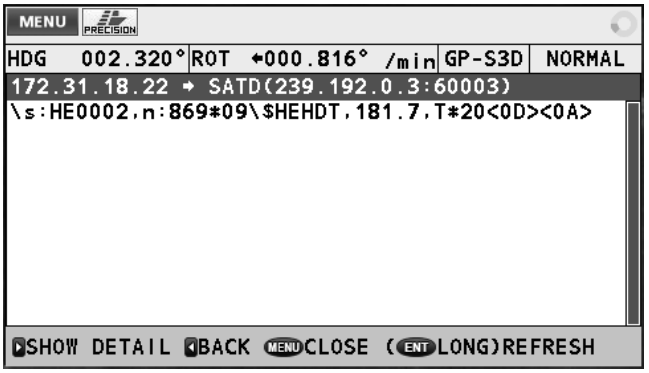


[ETHERNET] - LAN data

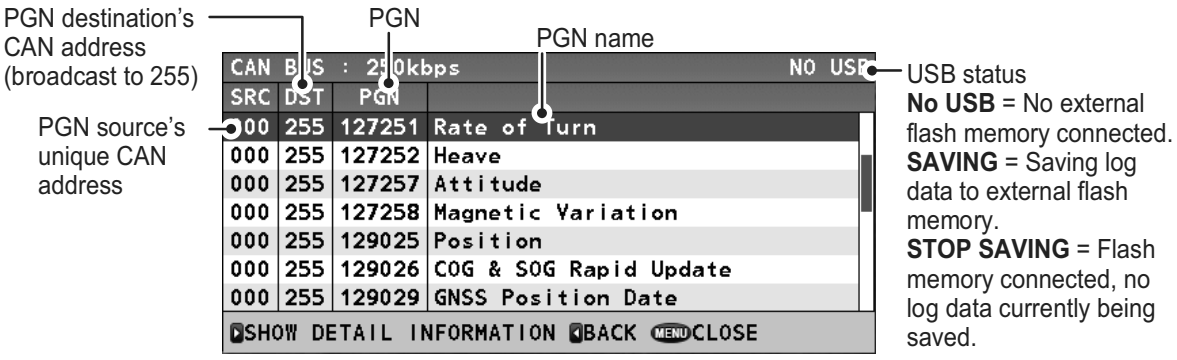
Note: If the IP address & port combination is not a recognized combination (see section 2.15.2), the [ETHERNET] log screen appears blank.



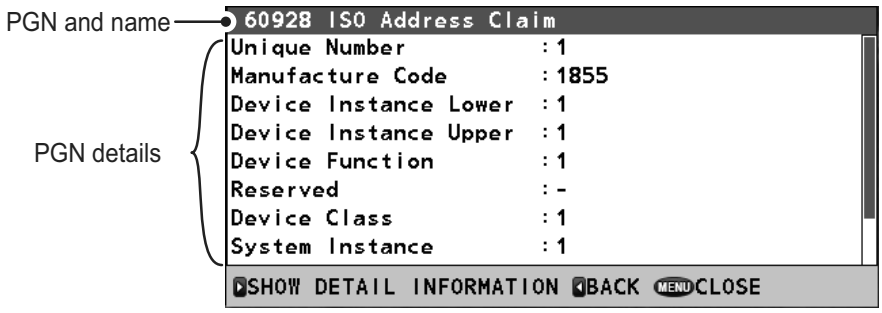
Select a packet, then press ▶ to view the packet details.



[CAN] - CAN Bus network data



Select a PGN, then press ▶ to view the PGN details.



[LAN ERROR LOG]

The [LAN ERROR LOG] counts LAN errors, filing the errors in one of six error groups. The table below shows the error groups along with possible causes for their errors.

LAN ERROR COUNTER		
1	INCORRECT SENTENCE	0
2	TAG BLOCK FRAMING ERROR	0
3	TAG SYNTAX ERROR	0
4	TAG BLOCK CHECKSUM ERROR	0
5	INCORRECT TAG BLOCK	0
6	INVALID HEADER	0

Error	Possible cause(s)
[INCORRECT SENTENCE]	• Sentence in TAG block has an error. • CHECKSUM error. • Sentence does not meet NMEA0183 standards.
[TAG BLOCK FRAMING ERROR]	Unexpected transmission start/stop in TAG block.
[TAG SYNTAX ERROR]	• One or more errors in TAG block. • Data length is too long or too short. • Delimiter is in use. • Use of incorrect characters.
[TAG BLOCK CHECKSUM ERROR]	TAG block has one or more CHECKSUM errors.
[INCORRECT TAG BLOCK]	One or more instances of the following: • Incorrect talker used. • Incorrect SFI used. • Incorrect parameters (g, s, p, n, t) used.
[INVALID HEADER]	One or more instances where the following are not included: • UdPbC • RaUdP • RrUdP

Press and hold the **ENT** key to clear the [LAN ERROR LOG].

2.15.5 How to restart heading output

In cases where the heading signal is lost or interrupted, the SC-70/SC-130 can restart signal output. There are two methods, [AUTO] and [MANUAL].

1. Open the [MENU].
2. Select [I/O], then press the **ENT** key.
3. Select [MISCELLANEOUS], then press the **ENT** key.
4. Select [HDG OUTPUT RESTART], then press the **ENT** key. An options pop up window appears.
5. Select [AUTO] or [MANUAL] as appropriate, then press the **ENT** key.
   [AUTO] : Automatically restart heading output when the signal is restored.
   [MANUAL] : When the heading signal is lost, an alert message and audible alert are released. If the heading signal output is restored, the message "HDG DATA OUTPUT HAS BEEN RESTARTED." is shown. Press the **ENT** key to resume the signal output.

   Note: The default setting is [AUTO]. Select [MANUAL] depending on connected equipment.
6. Close the [MENU].

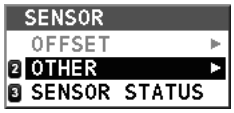
2.15.6 How to change the speed reference (Non-IMO types only)

The speed reference is used in the VHW sentence for speed data output to external equipment.

1. Open the [MENU].
2. Select [I/O], then press the **ENT** key.
3. Select [MISCELLANEOUS], then press the **ENT** key.
4. Select [STW] (Speed Through Water), then press the **ENT** key. An options pop up window appears.
5. Select [VECTOR] or [SCALAR] as appropriate, then press the **ENT** key.
   [VECTOR] : Speed is calculated based on own ship vector.
   [SCALAR] : Speed is calculated based on SOG (Speed Over Ground).
6. Close the [MENU].

2.16 SENSOR Menu

The [SENSOR] menu contains settings for the connected sensors. Some settings in this menu require service level access and are not changeable by the user.

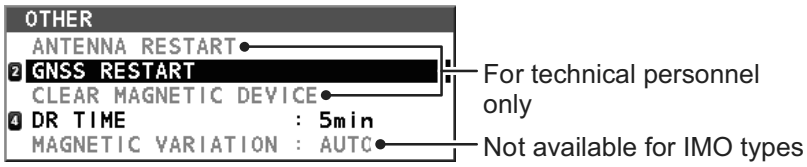


To access this menu, open the [MENU], then select [SENSOR].

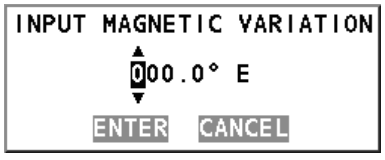
Note: The [OFFSET] menu is reserved for technical personnel only.

2.16.1 OTHER menu

1. Open the [MENU].
2. Select [SENSOR], then press the **ENT** key.
3. Select [OTHER], then press the **ENT** key.



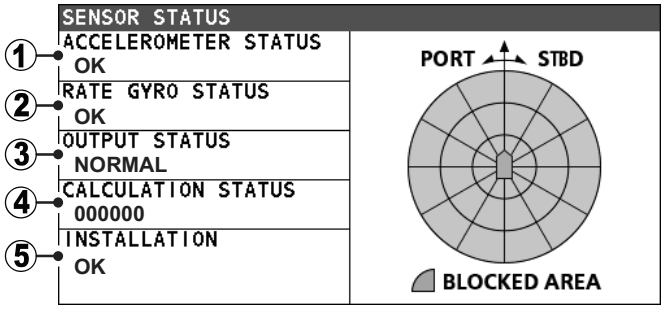
4. Select the appropriate menu item, then press the **ENT** key.
   - [GNSS RESTART]: Restarts the GNSS cores. A confirmation message appears; select [YES] to reset the GNSS cores or select [NO] to cancel the reset.
   - [DR TIME]: Set the Dead Reckoning time. Available options are [1 min], [2 min], [3 min], [4 min] and [5 min] (default setting). Select the required time, then press the **ENT** key.
   - [MAGNETIC VARIATION]: Select whether to adjust for magnetic variation automatically ([AUTO]) or manually ([MANUAL]). If you selected [MANUAL], the [INPUT MAGNETIC VARIATION] pop up window appears. Enter the variation amount, select [ENTER], then press the **ENT** key.

     Note: The [MAGNETIC VARIATION] menu item is not available for IMO types.
5. Close the [MENU].

2.16.2 SENSOR STATUS menu

You can check the status of your sensors from this menu. Select [SENSOR STATUS] from the [SENSOR] menu to show the window below.

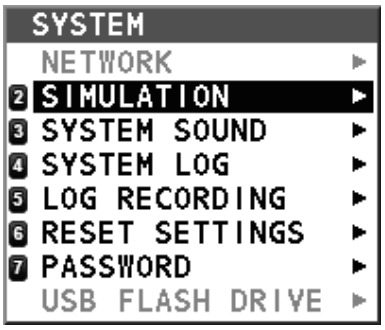


Possible statuses for each item are listed in the table below.

No.	Possible status
1	• "OK": Sensor is functioning normally. • "NG (axis)": The sensor is not functioning normally on the axis shown. For example, "NG X,Y" means the X and Y axis are not functioning normally.
2	• "OK": Sensor is functioning normally. • "NG (axis)": The sensor is not functioning normally on the axis shown. For example, "NG X,Y" means the X and Y axis are not functioning normally.
3	• "NORMAL": Sensor is functioning normally. • "DR": Dead Reckoning in use. • "OUTPUT STOPPED": Sensor output has stopped. • "NOT EXPECTED": An unexpected error has occurred.
4	Hexadecimal code is displayed.
5	• "OK": Sensor is functioning normally. • "BLOCKED": One or more sensors' line of view is blocked. • "VIBRATED": One or more sensors are in a location which is subject to excessive vibrations.

2.17 SYSTEM Menu

The SYSTEM menu contains settings for your SC-70/ SC-130 system. To access this menu, open the [MENU] then select [SYSTEM].



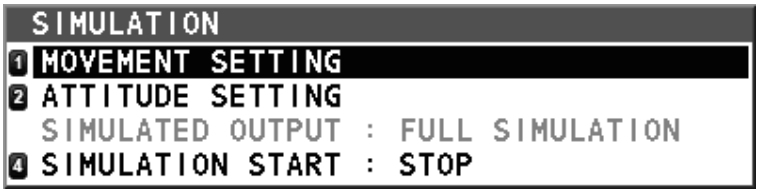
Note 1: The [USB FLASH DRIVE] menu item is selectable only when a USB Flash Memory is connected to the Junction Box.

Note 2: The [NETWORK] menu item is reserved for technical personnel only and require password level access from the [SERVICE] menu.

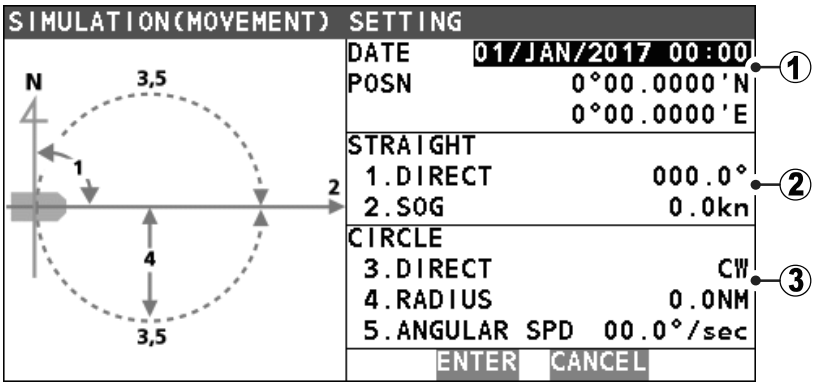
2.17.1 Simulation mode

Simulation mode uses data from the internal memory to provide a simulation of the systems functions. To use the simulation mode, several settings are required, as listed in the procedure below.

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [SIMULATION], then press the **ENT** key.



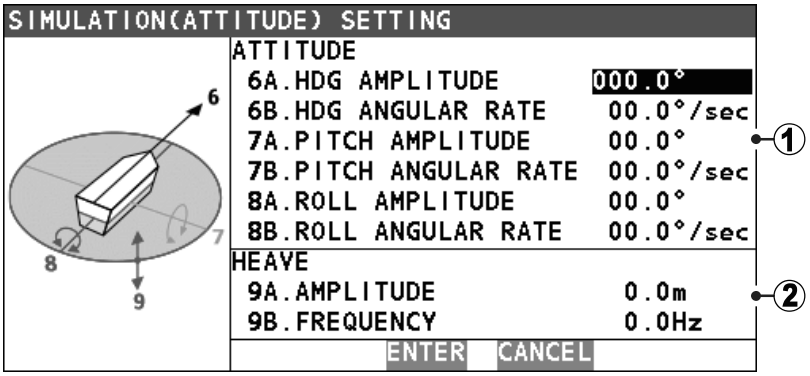
4. Select [MOVEMENT SETTING], then press the **ENT** key. The [SIMULATION(MOVEMENT) SETTING] window appears.



No.	Menu item	Description
1	• [DATE] • [POSN]	• Sets the date for the simulation. • Sets the position (coordinates) for the simulation.
2	[STRAIGHT] • [DIRECT] • [SOG]	Sets a simulated course in a straight line. • Sets the heading for the simulation. • Sets the SOG (Speed Over Ground) for the simulation.
3	[CIRCLE] • [DIRECT] • [RADIUS] • [ANGULAR SPD]	Sets a simulated course in a circle. • Sets the direction of the circle. ([CW]: Clockwise; [CCW]:Counter-clockwise) • Sets the radius of the circle, in Nautical Miles. • Sets the speed at which to turn during the simulation.

5. Referring to the figure and table above, select a parameter to set for the simulation, then press the **ENT** key. A settings pop up window appears.
6. Press the CursorPad to move the cursor and adjust the settings for the selected parameter. When the settings for the selected parameter are complete, select **ENTER**, at the bottom of the window, then press the **ENT** key. The [SIMULATION(MOVEMENT) SETTING] window appears.
7. When all parameter settings are complete, select **ENTER**, at the bottom of the [SIMULATION(MOVEMENT) SETTING] window, then press the **ENT** key. The [SIMULATION] menu appears.

8. Select [ATTITUDE SETTING], then press the **ENT** key. The [SIMULATION(ATTITUDE) SETTING] window appears.



No.	Menu item	Description
1	[ATTITUDE] • [HDG AMPLITUDE] • [HDG ANGULAR RATE] • [PITCH AMPLITUDE] • [PITCH ANGULAR RATE] • [ROLL AMPLITUDE] • [ROLL ANGULAR RATE]	Attitude settings for heading, pitch and roll. • Sets the heading angle. • Sets the rate at which the heading changes. • Sets the pitch angle. • Sets the rate at which the pitch changes. • Sets the roll angle. • Sets the rate at which the roll changes.
2	[HEAVE] • [AMPLITUDE] • [FREQUENCY]	Settings for heave. • Sets the distance for heave. • Sets the frequency (Hz) for heave.

9. Referring to the figure and table above, select a parameter to set for the simulation, then press the **ENT** key. A settings pop up window appears.
10. Press the CursorPad to move the cursor and adjust the settings for the selected parameter. When the settings for the selected parameter are complete, select **ENTER**, at the bottom of the window, then press the **ENT** key. The [SIMULATION(ATTITUDE) SETTING] window appears.
11. When all parameter settings are complete, select **ENTER**, at the bottom of the [SIMULATION(ATTITUDE) SETTING] window, then press the **ENT** key. The [SIMULATION] menu appears.
12. Select [SIMULATION], then press the **ENT** key. The start/stop options window appears.
13. Select [START]. A confirmation window appears. Select [YES] to start the simulation, or select [NO] to cancel.
    If you select [YES], the system restarts. When the restart is completed, the system operates in simulation mode and the simulation indicator is shown at the top-right of the display.

How to stop the simulation

You can stop the simulation at any time from the menu.

1) Referring to the steps 1 to 3 of the above procedure, open the [SIMULATION] menu.
2) Select [SIMULATION], then press the **ENT** key. The start/stop options window appears.
3) Select [STOP]. A confirmation window appears. Select [YES] to start the simulation, or select [NO] to cancel.
   If you select [YES], the system restarts. When the restart is completed, the system operates in normal mode and the simulation indicator is not shown at the top-right of the display.

2.17.2 SYSTEM SOUND menu

When a key is pressed the system releases a “key beep”. You can turn the key beeps on or off, to suit your preference.

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [SYSTEM SOUND], then press the **ENT** key. The [SYSTEM SOUND] menu appears.

4. [KEY BEEP] is already selected, press the **ENT** key. The settings options window appears.
   Note: The [NOTIFICATION SOUND] menu item is reserved for technical personnel and is not selectable.
5. Select [ON] or [OFF] as appropriate, then press the **ENT** key.
6. Close the [MENU].

2.17.3 SYSTEM LOG menu

If a USB Flash Memory is connected to the Junction Box, you can save a system log file to the USB. To save a log file, do the following:

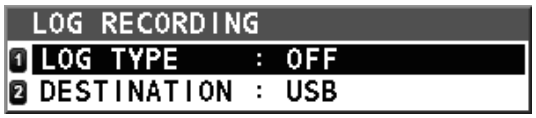
1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [SYSTEM LOG], then press the **ENT** key. The [SYSTEM LOG] menu appears.

4. [RECORDING] is already selected, press the **ENT** key. The settings options window appears.
   Note: The [LOG LEVEL] menu item is reserved for technical personnel and is not selectable.
5. Select [ON] or [OFF] as appropriate, then press the **ENT** key.
6. Close the [MENU].

2.17.4 How to save a sensor log

You can save a log file for your GNSS, sensor or offline (both GNSS and sensor) data.

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [LOG RECORDING], then press the **ENT** key. The [LOG RECORDING] menu appears.
4. Select [LOG TYPE], then press the **ENT** key. An options pop up window appears.
5. Select the appropriate option, then press the **ENT** key.
   - [OFF]: No log data is saved.
   - [GNSS ONLY]: Only GNSS core log data is saved.
   - [SENSOR ONLY]: Only sensor log data is saved.
   - [OFFLINE DATA]: Both GNSS and sensor log data is saved as offline data.
6. Select [DESTINATION], then press the **ENT** key. An options pop up window appears.
7. Select the appropriate option, then press the **ENT** key.
   - [USB]: Log data is saved to the USB Flash Memory.
   - [MP]: Log data is saved to the device connected via the Remote Maintenance port.
8. Close the [MENU].



2.17.5 How to clear display settings and GPS memory

You can reset the display settings and clear the GNSS (GPS) memory.

1. Open the [MENU].
2. Select [SYSTEM], then press the **ENT** key.
3. Select [RESET SETTING], then press the **ENT** key. The [RESET SETTINGS] menu appears.
4. Select the appropriate option, then press the **ENT** key. A confirmation window appears.
   Note: The [FACTORY DEFAULT] menu item is reserved for technical personnel and is not selectable.
5. Select [YES] to reset the settings, or [NO] to cancel.

2.18 ROTI Display Operations (RD-50/RD-20, option)

The optional RD-50/RD-20 Remote Display Unit is available as a remote display for ROTI data only. Operations and settings for the RD-50 are outlined in the RD-50 operator's manual (OME-44530-x; x denotes the manual version), supplied with the RD-50.

3. MAINTENANCE, TROUBLE-SHOOTING

3.1 Preventative Maintenance

Regular maintenance is necessary to maintain performance. A monthly maintenance program should be established and should at least include the items listed in the table below.

Item	Check point
Connectors	Check that all connectors on the rear panel of the Junction Box and display unit are firmly connected.
Cabling	Check cabling for damage. Replace if damaged.
Ground terminal	Check the ground terminal on the display unit and Junction Box for rust. Clean if necessary.
Ground wire	Check that the ground wire on the display unit and Junction Box is firmly fastened.
Display unit, Junction Box.	Dirt and dust should be removed from units with a soft, dry cloth. For the LCD, wipe it carefully to prevent scratching, using tissue paper and an LCD cleaner. To remove dirt or salt deposits, use an LCD cleaner, wiping slowly with tissue paper so as to dissolve the dirt or salt. Change paper frequently so the salt or dirt will not scratch the LCD. Do not use solvents such as thinner, acetone or benzene for cleaning any unit; they can remove paint and marks and deform the equipment.
Exposed nuts and bolts and sealant compound on cable gland of antenna unit (every three or six months)	• Check for corroded or loosened nuts and bolts. If necessary, clean and repaint them thickly. Replace them if heavily corroded. • Check for cracks and peeling in sealing compound on cable gland. • Sealing compound can be used instead of paint. Apply a small amount of grease between nuts and bolts for easy removal in future. • Apply sealing compound to minor cracks or peeling. If the problem is severe, completely remove sealant then reapply.

3.2 Replacement of Fuse

The Junction Box (SC-701) contains fuses which protects the equipment from overvoltage, reverse polarity and equipment fault. If power cannot be turned on, check if the fuse has blown.

⚠ WARNING

Use the proper fuse.
Use of a wrong fuse can damage the equipment or cause fire.

Only a qualified technician should change the fuse, contact your dealer and quote the fuse details listed below.

Used for	Fuse type	Code No.
SC-701	FBGO-A 125V 3A PBF	000-155-850-10
SC-702	FGMB 125V 0.3A PBF	000-176-821-10

3.3 Basic Troubleshooting

This section provides basic troubleshooting which the user may follow to restore normal operation. If the problem is not rectified, contact your dealer for advice.

Symptom	Possible cause and remedy
Cannot turn the power on.	Power cables may be damaged or corroded. Check the cables for corrosion or damage; replace as necessary.
	Power cable may be loose or disconnected. Check the cable connections are fastened firmly.
	Blown fuse. Check the fuses. If blown, contact your dealer for replacement.
	Ship battery may have low voltage. Check that the battery voltage is within rating.
Display screen is blank.	Brilliance level may be too low. Press the **BRILL** key to adjust the brilliance.
No position fix.	Antenna cable may be loose or disconnected. Check the antenna cable is fastened firmly.
	Unable to see more than two satellites. Check that there are no large obstructions preventing a clear view to the sky.
	GPS needs to be restarted. From the main menu, select [SYSTEM]→[RESET SETTINGS]→[CLEAR GNSS]→[YES].
Large error between actual and indicated location.	Positioning system may be incorrect or sensor is faulty. From the main menu, select [GNSS]. Confirm that the settings for [POSN. SYSTEM] and [MODE] are correct.
Heading indication changes randomly when the vessel is anchored or does not change when the vessel is moving.	Antenna may be poorly located or unable to obtain a positioning fix. 1) Check that the antenna has a clear view to the sky. 2) Check that the installation location is not subjected to excessive vibrations. 3) Check that there the antenna is not subject to interference from nearby equipment
	Sensor may be faulty. 1) Check the sensor status from the [SENSOR] menu. 2) Run a [DIAGNOSTIC TEST] from the [MAINTENANCE] menu. If one or more sensors are faulty, contact your dealer for advice.
Data output from the SC-70/SC-130 does not appear on external equipment.	Connection between the SC-70/SC-130 and external equipment is loose or damaged. Check connection, replace or reconnect/refasten as necessary.
	Output settings are incorrect. From the main menu, select [I/O], then select the output port. Confirm that the settings are correct.
	Sensor may be faulty. 1) Check the sensor status from the [SENSOR] menu. 2) Run a [DIAGNOSTIC TEST] from the [MAINTENANCE] menu. If one or more sensors are faulty, contact your dealer for advice.
	External equipment not set correctly. 1) Check the external equipment data input settings. 2) Output data and input data connection should set as follows: SC70/SC-130=TD-A ←connection→ external equipment=RD-A SC70/SC-130=TD-B ←connection→ external equipment=RD-B
The external equipment can not received CANbus (NMEA2000) data from SC-70/SC-130.	Turn on the CANbus network (NMEA2000) before the SC-70/SC-130. If the SC-70/SC-130 is turned on before the CANbus network (NMEA2000), reboot the SC-70/SC-130.

3.4 Maintenance Menu

The [MAINTENANCE] menu contains items such as diagnostic tests, unit information and other maintenance-specific menus. You can also save or load your user settings from this menu.

To access the [MAINTENANCE] menu, open the [MENU], then select [MAINTENANCE]. The [MAINTENANCE] menu appears.

3.4.1 How to find unit information

You can view your equipment's details from the [INFORMATION] menu. The displayed details include handy information such as program numbers and serial numbers.

1. From the [MAINTENANCE] menu, select [INFORMATION], then press the **ENT** key.
2. Select the unit whose information you want to view, then press the **ENT** key.
3. Select the part of the unit whose information you want to view, then press the **ENT** key.
   Items shown in gray are either not selectable, or have no information to view.
   Press ▲ or ▼ to scroll through the displayed information.

3.4.2 How to Backup User Settings

If a USB Flash Memory is connected at installation (see section 1.5.5), the SC-70/SC-130 can import or export user settings via external USB flash memory. This allows you to apply the same settings to multiple units, or recover settings if they are accidentally changed.

Note: The menu is inoperable while importing or exporting settings. Also, the import/export procedure cannot be stopped once it starts. For safety, conduct these operations while moored safely.

To import or export settings, do the following:

1. Open the [MENU].
2. Select [MAINTENANCE], then press the **ENT** key.
3. Select [IMPORT/EXPORT], then press the **ENT** key.
4. Select [IMPORT USER SETTINGS] or [EXPORT USER SETTINGS] as appropriate, then press the **ENT** key. A confirmation pop up window appears.
5. Select [YES] to import/export the user settings, [NO] to cancel the import/export. If [YES] is selected, a progress widow appears, showing the overall progress of the import/export.
   If an error occurs during the import/export, an error message appears. Referring to the table on the following page, take the appropriate action.

Error message	Meaning	Recommended action
"NO USB!"	No USB flash memory is connected to this unit.	Press the **MENU ESC** key to close the pop up. Check the connection. If a flash memory is connected, the USB connector/cable may be damaged, contact your dealer.
"ERROR DETECTED IN SETTINGS TRANSFER! RESTORING PREVIOUS SETTINGS."	Data transfer to/from the USB flash memory was interrupted/ stopped. This unit will restore the settings used prior to import.	Press the **ACK** key to close the pop up and start restoring the settings.
"NOT ENOUGH SPACE ON USB."	USB flash memory does not have enough space to save the settings.	Delete unnecessary files from the USB or use a USB with sufficient memory.
"NO FILE FOUND ON USB."	There is no settings file saved on the connected USB.	Connect the correct USB.
"OTHER BACKUP PROCESS IS RUNNING."	Import/export was attempted while a separate backup (or log) is in progress.	Wait for the other backup/log to complete, then try again.

6. When the import/export is complete the progress window is replaced with a pop up window displaying the message "IMPORT COMPLETE" or "EXPORT COMPLETE".
7. Press the **ENT** key. The last used display screen appears.
8. Open the [MENU].
9. Select [SYSTEM], then press the **ENT** key.
10. Select [USB FLASH DRIVE], then press the **ENT** key.
11. Select [UNMOUNT], then press the **ENT** key.
12. Close the [MENU].

How to remove the USB Flash Memory

To remove the USB Flash Memory, open the MENU, then select [SYSTEM] → [USB FLASH DRIVE] → [UNMOUNT]. When the process is completed, the message "YOU CAN REMOVE THE USB SAFELY" appears. Remove the USB Flash Memory.

3.5 Diagnostic Tests

The [DIAGNOSTICS] menu has several diagnostic tests which may help find the cause of a problem. To access the [DIAGNOSTICS] menu, do the following:

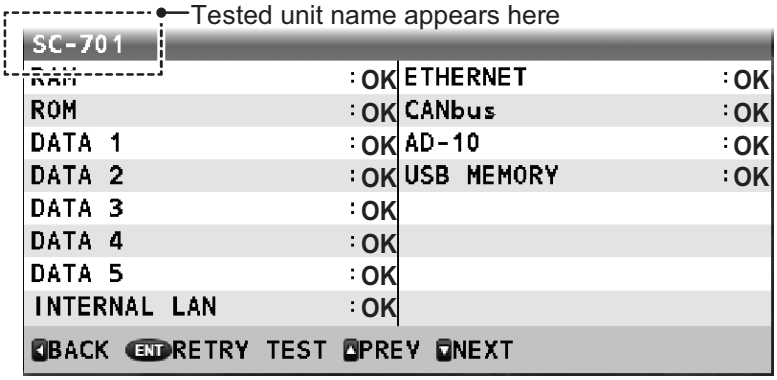
1. Press the **MENU ESC** key to access the menu.
2. Select [MAINTENANCE], then press the **ENT** key.
3. Select [DIAGNOSTICS], then press the **ENT** key.
   The following tests are available:

[MEMORY] TEST	: See section 3.5.1.
[KEY TEST]	: See section 3.5.2.
[LCD TEST]	: See section 3.5.3.
[AUTOMATIC TEST]	: See section 3.5.4.
[MANUAL TEST]	: For technical personnel only.
[SOUND TEST]	: See section 3.5.5.

4. Select the appropriate test, then press the **ENT** key.
5. Close the [MENU].

3.5.1 Memory test

The [MEMORY] test checks RAM, ROM, USB, LAN ports and data ports for the Junction Box (SC-701), the display unit (SC-702) and the antenna unit (SC-703/SC-1303).

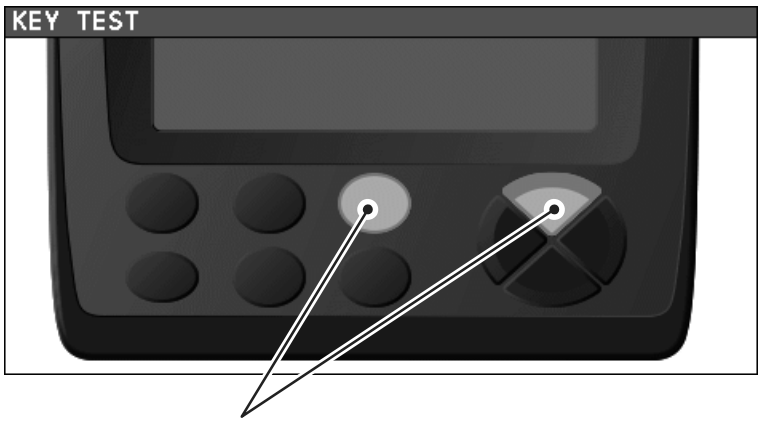


Press the ▲ or ▼ to cycle through the test result for each tested unit.

Press the **MENU ESC** key to close the results screen and return to the [SELF TEST] menu, or press the **ENT** key to repeat the test.

3.5.2 Keyboard test

The [KEYBOARD] test checks that the keys are functioning correctly.



Keys are highlighted when the corresponding key is pressed. Press the key again and the highlight is removed.

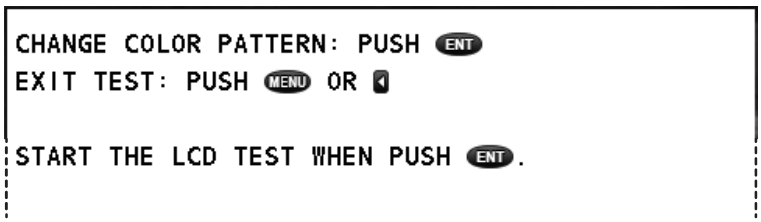
If a key is malfunctioning, contact your dealer.

To close this test screen, press the **MENU ESC** key three times.

3.5.3 LCD test

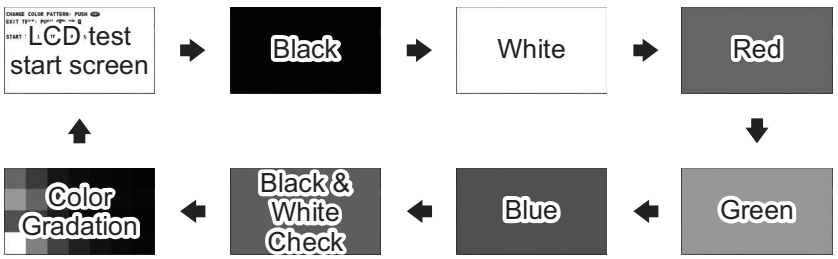
The [TEST PATTERN] test checks the LCD display colors and patterns. This test changes the display color and shows patterns.

The test start screen shows operational guidance for the LCD test, as shown in the figure below.



Press the **ENT** key to continue the test, or press the **MENU ESC** key to abort the test.

The colors and patterns appear in the order shown below.



If the colors are not displayed correctly, or show signs of LCD damage, contact your dealer.

3.5.4 Automatic Test

The [AUTOMATIC TEST] conducts a brief test on the LCD, keyboard (SC-702) and memory (SC-701, SC-702 and SC-703).

This saves you the time it takes to conduct each test individually. If an error is detected during any of the automatic tests, the test stops. Check the item in question and consult your dealer if necessary.

The [AUTOMATIC TEST] does the following in numerical order:

1. Displays the PC board version numbers and program version numbers for the display unit, junction box and the connected antenna. Results are displayed for approximately five seconds, then section 2 is initiated.
2. Tests RAM/ROM and data input/output. (See section 3.5.1.) Results are displayed for approximately five seconds, then step 3 is initiated.
3. Tests the SC-702 keys. (See section 3.5.2.) Proceeds to step 4 if no key is pressed within five seconds.
4. Tests the LCD. (See section 3.5.3.) Displayed test screens changes after two seconds until the “checkered flag” screen appears. Proceeds to step 5 if no key is pressed within five seconds.
5. Tests screen brilliance. Press the **BRILL** key to cycle through the brilliance settings in the following order:

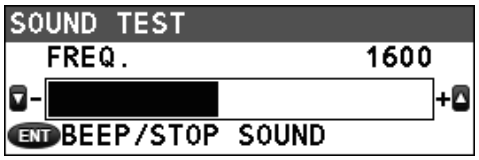
   Maximum brilliance → Medium brilliance → Minimum brilliance

   Repeats the tests from step 1 if no key is pressed within five seconds.
   To exit this test, press the **MENU ESC** key.

Note: The SC-70/SC-130 continues data output while this test is active.

3.5.5 Sound test

Use the sound test to check the buzzer. Press ▲ or ▼ to change the buzzer’s sound frequency.



The frequency range is 1400 (Hz) to 1850 (Hz).

Note: The settings used for the sound test are not saved.

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APPENDIX 1 MENU TREE

Main menu
- 1 DISPLAY
- 2 GNSS
- 3 ALERT
- 4 MAINTENANCE
- 5 I/O
- 6 SENSOR
- 7 SYSTEM
- 8 SERVICE*

Bold Italic: Default

***: Requires password access. For technical personnel only.**

1 DISPLAY
- 1 BKGD COLOR (***WHITE***, BLACK)
- 2 UNIT
  - 1 DISTANCE (***NM***, KM, SM)
- 3 SMOOTHING
  - 1 VTG (***0000s*** to 9999s)
  - 2 6DoF (***0000s*** to 9999s)
  - 3 OS SPEED(X,Y)***6** (***0000s*** to 9999s)
  - 4 ROT (00s to 30s, default: ***04s***)
- 4 DECIMAL ROUNDING
  - 1 VTG (***1***, 2, 3)
  - 2 VBW***6** (***1***, 2, 3)
  - 3 HDG (***1***, 2, 3)
  - 4 ROLL, PITCH (***1***, 2, 3)
- 5 DATUM (***WGS84***, WGS72, PZ90, CK42, CK95, OTHERS)
- 6 TRIP SETTING***6**
  - 1 CLEAR
- 7 TIME
  - 1 LOCAL TIME (***UTC***, LOCAL)
  - 2 SUMMER TIME (*ON*, ***OFF***)
- 8 LANGUAGE
  - **1 ENGLISH**
  - 2 日本語 (Japanese)

***6: Non-IMO only, fixed for IMO**

2 GNSS
- 1 POSN. SYSTEM
  - 1 GPS
- 2 MODE (***AUTO(2D/3D)***, 2D) (For technical personnel only. Do not use.)
- 3 POSN. CONDITION
  - 1 QZSS (***ON***, OFF)
  - 2 ELEVATION MASK (***5º*** to 90º) (For technical personnel only. Do not use.)
  - 3 IGNORED GNSS
    - 1 QZSS
    - 2 GPS
    - 3 GLONASS
    - 4 GALILEO
- 4 DGPS/SBAS
  - 1 DIFFERENTIAL (GNSS, GNSS+SBAS, GNSS+EXTERNAL, ***AUTO***)
  - 2 SBAS SEARCH (***AUTO***, MANUAL)
  - 3 IGNORED SBAS
  - 4 BEACON SETUP (***AUTO***, MANUAL)
- 5 RAIM
  - 1 RAIM FOR GPS
    - 1 SETTING (***ON***, OFF)
    - 2 ACCURACY LEVEL (001m to 999m, default: ***100m***)
- 6 ROLL OVER (2000 to 2099, default: ***2016***)
- 7 SETUP***1**

***1: Requires password access. For service personnel only.**

Continued on page AP-2

Continued from page AP-1

3 ALERT
- 1 ALERT LIST
- 2 REMOTE ACK I/F (***ACK***, BUZZER STOP)***7**
- 3 SOUND (OFF, SHORT, ***LONG***, CONTINUOUS)***5**
- 4 ALERT LOG

***5: Non-IMO types only. Fixed for IMO types.**

***7: Available on when Alert Mode is set to Legacy.**

4 MAINTENANCE
- 1 INFORMATION
  - 1 DISPLAY UNIT
    - 1 MAIN PCB
    - 2 LCD
  - 2 ANTENNA UNIT
    - 1 MAIN PCB
    - 2 SUB IMU (Not available where there is no SUB_IMU board)
    - 3 LAN_CNV PCB
    - 4 GNSS_LNA 1
    - 5 GNSS_LNA 2
    - 6 GNSS_LNA 3 (Available only for SC-130 systems)
  - 3 JUNCTION BOX
    - 1 MAIN PCB
    - 2 LAN_CNV PCB
    - 3 TB_PWR PCB
- 2 DIAGNOSTICS
  - 1 MEMORY TEST
  - 2 KEY TEST
  - 3 LCD TEST
  - 4 AUTOMATIC TEST
  - 5 MANUAL TEST (For technical personnel only. Do not use.)
  - 6 SOUND TEST
- 3 IMPORT/EXPORT
  - IMPORT USER SETTING
  - EXPORT USER SETTING

5 I/O
- 1 DATA 1
  - 1 DATA OUTPUT (***IEC/NMEA***, RTCM***2**)
  - 2 OUTPUT FORMAT ***(IEC61162-1 ED.4***, IEC61162-1 ED.3, NMEA0183 V2.0, NMEA0183 V1.5)
  - 3 TALKER***3** (GP, GL, GA, GN, ***HE***, HN, HC) ***3: Non-IMO only, fixed for IMO**
  - 4 BAUD RATE (4800bps, 9600bps, 19200bps, ***38400bps***) ***3 *4**
  - 5 SENTENCES

***2: Selectable for DATA5 only**

***4: Default for IEC61162-2 is 38400bps**
- 2 DATA 2
  - 1 DATA OUTPUT (***IEC/NMEA***, RTCM***2**)
  - 2 OUTPUT FORMAT ***(IEC61162-1 ED.4***, IEC61162-1 ED.3, NMEA0183 V2.0, NMEA0183 V1.5)
  - 3 TALKER (GP, GL, GA, GN, ***HE***, HN, HC)
  - 4 BAUD RATE (***4800bps***, 9600bps, 19200bps, 38400bps)
  - 5 SENTENCES
- 3 DATA 3 (Same as DATA 2)
- 4 DATA 4 (Same as DATA 2)
- 5 DATA 5 (Same as DATA 2)
- 6 NETWORK
  - 1 TALKER***6** (GP, GL, GA, GN, ***HE***, HN, HC)
  - 2 SENTENCES
  - 3 IP ADDRESS/PORT

***6: Non-IMO only, fixed for IMO**
- 7 DATA SOURCE
  - 1 HDG ***(INTERNAL LAN***, DATA 1, DATA 2, DATA 3, DATA 4, DATA 5, USER PRIORITY)
  - 2 EXT. STW***6** (DATA 1, DATA 2, DATA 3, DATA 4, DATA 5, ***USER PRIORITY***)
- 8 I/O LOGS
  - 1 DATA 1(Shows TX/RX log)
  - 2 DATA 2(Shows TX/RX log)
  - 3 DATA 3(Shows TX/RX log)
  - 4 DATA 4(Shows TX/RX log)
  - 5 DATA 5(Shows TX/RX log)
  - 6 ETHERNET
  - 7 CANbus
  - 8 LAN ERROR LOG
- 9 MISCELLANEOUS
  - 1 HDG OUTPUT RESTART (***AUTO***, MANUAL)
  - 2 STW***6** (***VECTOR***, SCALAR)

Continued on page AP-3

Continued from page AP-2

6 SENSOR
- 1 OFFSET (For technical personnel only. Do not use.)
  - 1 HDG OFFSET (-180º000' to +180º000', default: ***+0.000º***)
  - 2 PITCH OFFSET (-10º000' to +10º000', default: ***+0.000º***)
  - 3 ROLL OFFSET (-10º000' to +10º000', default: ***+0.000º***)
  - 4 POSITION OFFSET
  - 5 DIMENSIONS/CCRP
  - 6 SOG OFFSET -12.5% to +12.5%, default: ***+00.0%***)
  - 7 ATM OFFSET (-99.9hPa to +99.9hPa, default: ***00.0hPa***)
  - 8 TEMP OFFSET (-99.9ºC to +99.9ºC, default: ***+00.0ºC***)
- 2 OTHER
  - 1 ANTENNA RESTART (For technical personnel only. Do not use.)
  - 2 GNSS RESTART
  - 3 CLEAR MAGNETIC DEVICE(For technical personnel only. Do not use.)
  - 4 DR TIME (1min, 2min, 3min, 4min, ***5min***)
  - 5 MAGNETIC VARIATION***6** (***AUTO***, MANUAL)
- 3 SENSOR STATUS

***6: Non-IMO only, fixed for IMO**

7 SYSTEM
- 1 NETWORK (For technical personnel only. Do not use.)
  - 1 ETHERNET
  - 2 EQUIPMENT ID (001 to 999, default: ***1***)
  - 3 MP PORT (***ENABLE***, DISABLE)
  - 4 MP IP ADDRESS/PORT
  - 5 SFI
- 2 SIMULATION
  - 1 MOVEMENT SETTING
  - 2 ATTITUDE SETTING
  - 3 SIMULATED OUTPUT (***FULL SIMULATION***, FIX, DIFFERENTIAL FIX, ESTIMATION (DR), MANUAL INPUT, NO FIX) (For technical personnel only. Do not use.)
  - 4 SIMULATION START (START, ***STOP***)
- 3 SYSTEM SOUND
  - 1 KEY BEEP (***ON***, OFF)
  - 2 NOTIFICATION SOUND (OFF, ***ON***, CONTINUOUS) (For technical personnel only. Do not use.)
- 4 SYSTEM LOG
  - RECORDING (ON, ***OFF***)
  - LOG LEVEL (For technical personnel only. Do not use.)
- 5 LOG RECORDING
  - 1 LOG TYPE (***OFF***, GNSS ONLY, SENSOR ONLY, OFFLINE DATA)
  - 2 DESTINATION (***USB***, MP)
- 6 RESET SETTINGS
  - 1 CLEAR DISPLAY SETTINGS
  - 2 CLEAR GNSS
  - 3 FACTORY DEFAULT (For service personnel only. Do not use.)
- 7 PASSWORD
  - 1 LOGOUT
  - 2 CHANGE
- 8 USB FLASH DRIVE (**UNMOUNT**) ***7**

***7: Shown only if a USB device is connected.**

8 SERVICE — EDIT (***LOCK***, UNLOCK) (Password protected. For technical personnel only.)

APPENDIX 2 ALERT LIST

The table below shows the alert no., alert name, text, priority, meaning and remedy for each alert. The alerts table is grouped by device mode. Alerts are not shared between device modes.

Note 1: “Inst.” in the following tables denotes “Instance number” for the alert.

Note 2: "GNSS CORE(4) FAULT" appears only if SC-1303 is connected to the system.

No.	Inst.	Alert name	Text	Priority/ Category	Meaning
GPS mode alerts					
210	1	HDOP EXCEEDED	HDOP EXCEEDED	Caution/B	The value of HDOP (Horizontal Dilution of Precision) is 4 or above.
Remedy: If the same state continues for five minutes, contact your dealer.					
212	1	LOSS OF POSITION	GNSS CORE(1) FAULT	Warning/ B	GNSS module may be faulty.
	5		TOO FEW TRACKING SATELLITES		Not enough satellites available to fix position.
	6		ANTENNA UNIT CONNECTION LOST		Data connection to the antenna has been interrupted or the physical connection is disconnected.
Remedy: If the same state continues for five minutes, contact your dealer.					
THD mode alerts					
440301	1	DEAD RECKONING	DEAD-RECKONING	Caution/B	The heading is calculated using ROT, not GPS position.
Remedy: If this alert occurs frequently, contact your dealer.					
440302	2	OUTPUT STOPPED (HDG)	GNSS CORE(2) FAULT	Warning/ B	GNSS module may be faulty.
	3		GNSS CORE(3) FAULT		GNSS module may be faulty.
	4		GNSS CORE(4) FAULT		GNSS module may be faulty. **Note:** Shown only for system configuration with SC-1303 included.
	5		TOO FEW TRACKING SATELLITES		Not enough satellites available to fix position.
	6		ANTENNA UNIT CONNECTION LOST		Data connection to the antenna has been interrupted or the physical connection is disconnected.
	7		RATE GYRO BROKEN DOWN		Rate gyro may be faulty.
	8		ACCELEROMETER BROKEN DOWN		Accelerometer may be faulty.
	10		NO EXTERNAL HDG		External heading data is not received for five seconds.
	18		INTERNAL HDG ERROR		Abnormal internal heading data is detected.
Remedy: If the same state continues for five minutes, contact your dealer.					

No.	Inst.	Alert name	Text	Priority/ Category	Meaning
ROTI mode alerts					
440303	2	OUTPUT STOPPED (ROT)	GNSS CORE(2) FAULT	Warning/ B	GNSS module may be faulty.
	3		GNSS CORE(3) FAULT		GNSS module may be faulty.
	4		GNSS CORE(4) FAULT		GNSS module may be faulty. **Note:** Shown only for system configuration with SC-1303 included.
	5		TOO FEW TRACKING SATELLITES		Not enough satellites available to fix position.
	6		ANTENNA UNIT CONNECTION LOST		Data connection to the antenna has been interrupted or the physical connection is disconnected.
	7		RATE GYRO BROKEN DOWN		Rate gyro may be faulty.
	8		ACCELEROMETER BROKEN DOWN		Accelerometer may be faulty
	10		NO EXTERNAL ROT		External ROT data is not received for five seconds.
	18		INTERNAL ROT ERROR		Abnormal internal ROT data is detected.
Remedy: If the same state continues for five minutes, contact your dealer.					
SPD mode alerts					
440311	2	OUTPUT STOPPED (SPD)	GNSS CORE(2) FAULT	Warning/ B	GNSS module may be faulty.
	3		GNSS CORE(3) FAULT		GNSS module may be faulty.
	4		GNSS CORE(4) FAULT		GNSS module may be faulty.
	5		TOO FEW TRACKING SATELLITES		Not enough satellites available to fix position.
	6		ANTENNA UNIT CONNECTION LOST		Data connection to the antenna has been interrupted or the physical connection is disconnected.

No.	Inst.	Alert name	Text	Priority/ Category	Meaning
440311	7	OUTPUT STOPPED (SPD)	RATE GYRO BROKEN DOWN	Warning/ B	Rate gyro may be faulty.
	8		ACCELEROM-ETER BROKEN DOWN		Accelerometer may be faulty
Remedy: If the same state continues for five minutes, contact your dealer.					
LEGACY mode alerts (when IF-250x is connected)					
210	—	HDOP exceeded	HDOP EXCEEDED	Caution/ B	The value of HDOP (Horizontal Dilution of Precision) is 4 or above.
212	—	Loss of position	LOSS OF POSITION	Warning/ B	Position data connection is interrupted or physically disconnected.
301	—	Dead-Reckoning	DEAD-RECKONING	Caution/ B	The heading is calculated using ROT, not GPS position.
302	—	Output stopped (HDG)	OUTPUT STOPPED (HDG)	Warning/ B	Heading data connection is interrupted or physically disconnected.
303	—	Output stopped (ROT)	OUTPUT STOPPED (ROT)	Warning/ B	ROT data is connection is interrupted or physically disconnected.
311	—	Output stopped (SPD)	OUTPUT STOPPED (SPD)	Warning/ B	Speed data is connection is interrupted or physically disconnected.
Remedy: If the same state continues for five minutes, contact your dealer.					

APPENDIX 3 ABBREVIATIONS AND UNITS

Term	Meaning	Term	Meaning
Numerical:			
2D	Two Dimensional Positioning	3D	Three Dimensional Positioning
A:			
ACK	Acknowledge	APR	April
ADR	Address	ARPA	Automatic Radar Plotting Aid
AIS	Automatic Identification System	ATM	Atmospheric Pressure
ALARM	Alarm	AUG	August
ANT	Antenna	Auto	Automatic
B:			
BAM(S)	Bridge Alert Management (System)	BRG	Bearing
BKGD	Background	BRILL	Brilliance
BL	BaseLine	bps	Bits Per Second
C:			
CAN	Controlled Area Network	CNV	Converter
CALC	GPS baseline calculation	COM.	Common
CCRP	Consistent Common Reference Point	COG	Course Over Ground
CLR	Clear	CPU	Central Processing Unit
D:			
DEC	December	DR	Dead Reckoning
deg	Degree(s)	DST	Destination
deg/min	Degree(s) per minute	D2D	Differential + 2D
DISP	Display	D3D	Differential + 3D
DGPS	Differenetial GPS		
E:			
E	East	ENT	Enter
ECDIS	Electronic Chart Display and Information System	EXT.	External
EGNOS	European Geostationary Navigational Overlay System		
F:			
FEB	February	FREQ	Frequency
FIX	Fix		
G:			
GLONASS	Global Opening Navigation Satellite System	GNSS	Global Navigation Satellite System
GND	Ground	GPS	Global Positioning System
GP-3D	GPS used for position fix.	GP-D3D	GPS differential used for position fix.
H:			
HDG	Heading	hPa	Hectopascal
HDOP	Horizontal Dilution of Position		
I:			
ID	Identification	INFO	Information
I/F	Interface	INIT	Initial
IEC	International Electrotechnical Commission	I/O	Input/Output
IMO	International Maritime Organization	IP	Internet Protocol
IMU	Inertial Measurement Unit		
J:			
JAN	January	JUN	June
JUL	July		
L:			
L	Local (time)	L/L	Latitude/Longitude
LAN	Local Area Network	LOC	Location
LEN	Load Equivalency Number	LOG	Log
LCD	Liquid Crystal Display		

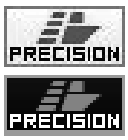
M:			
MAR	March	MP	Management Profile
MAY	May	MSAS	Multi-Functional Satellite Augmentation System
MENU	Menu		
N:			
N	North	NMEA	National Marine Electronics Association
N/A	Not Available	NOV	November
NG	Not Good	NO.	Number
O:			
OCT	October	ON	On
OFFSET	Offset	OS	Own Ship
P:			
PC	Printed Circuit	PGN	Parameter Group Number
PCB	Printed Circuit Board	PORT	Port
PDOP	Positional Dilution Of Precision	PRN	Pseudo-Random Noise
POSN	Position		
Q:			
QZSS	Quasi-Zenith Satellite System		
R:			
RAM	Random Access Memory	ROM	Read Only Memory
RAIM	Receiver Autonomous Intergrity Monitoring	ROT	Rate Of Turn
RECT	Rectified	ROTI	Rate Of Turn Indicator
RMS	Root Mean Square	RTCM	Radio Technical Commission for Marine Service
RNG	Range	RX	Receive
S:			
S	South	SOG	Speed Over Ground
SAT	Satellite	SPD	Speed
SBAS	Satellite Base Argument System	SRC	Source
SC	Satellite Compass	SS	Signal Sensitivity
SEP	September	STBD	Starboard
SET	Set (i.e. set and drift, or setting a value)	STW	Speed Though the Water
SFI	System Function ID	SV	Space Vehicle
SIM	Simulation	SYS	System
SN	Signal to Noise	S2D	SBAS + 2D
SNR	Signal to Noise Ratio	S3D	SBAS + 3D
T:			
T	TRUE	THD	Transmitting Heading Device
TEST	Test	TIME	Time
TEMP	Temperature	TX	Transmit
U:			
U/UTC	Universal Time, Coordinated	USB	Universal Serial Bus
W:			
W	West	WGS	World Geodetic System
WAAS	Wide Area Augmentation System	WGS84	World Geodetic System 84

Units of measurement

Unit	Meaning	Unit	Meaning
º	Degree(s)	m/s	Meter(s) per second
º/min	Degree(s) per minute	ms	Milisecond(s)
dB	Decibel(s)	NM	Nautical Mile(s)
kHz	Kilohertz	Ω	Ohm(s)
KM	Kilometer(s)	s	Second(s)
m	Meter(s)	SM	Statue Mile(s)
min or '	Minute(s)		

APPENDIX 4 ICONS AND SYMBOLS

Standard icons and their meanings

Icon	Meaning		Icon	Meaning
 See note below.	Excessive vibrations detected at the antenna installation location. Check the antenna installation location and change if necessary.		 Shown in light blue for IMO types, dark-blue for non-IMO types.	Blue indication rotates in a clock-wise direction, indicating that the equipment is functioning correctly. If this indication is not moving, the system may be frozen. Restart the system. If the problem recurs, contact your dealer.
 See note below.	Indicates that five or more satellites are under use for calculating velocity and own ship's movement.			Simulation icon. The system is currently operating in simulation mode.

Note: Icon background color changes according to the SC-702 background color.

Alert icons and their meanings

Icons	Meaning		Icons	Meaning
	Active, unacknowledged warning			Active, responsibility transferred warning
	Silenced warning			Active, acknowledged warning
	Rectified, unacknowledged warning			Caution

APPENDIX 5 GEODETIC CHART CODES

001: WGS84
002: WGS72
003: TOKYO : Mean Value (Japan, Korea & Okinawa)
004: NORTH AMERICAN 1927 : Mean Value (CONUS)
005: EUROPEAN 1950 : Mean Value
006: AUSTRALIAN GEODETIC 1984 : Australia & Tasmania
007: ADINDAN : Mean Value (Ethiopia & Sudan)
008: ADINDAN : Ethiopia
009: ADINDAN : Mali
010: ADINDAN : Senegal
011: ADINDAN : Sudan
012: AFG : Somalia
013: AIN EL ABD 1970 : Bahrain Is.
014: ANNA 1 ASTRO 1965 : Cocos Is.
015: ARC 1950 : Mean Value
016: ARC 1950 : Botswana
017: ARC 1950 : Lesotho
018: ARC 1950 : Malawi
019: ARC 1950 : Swaziland
020: ARC 1950 : Zaire
021: ARC 1950 : Zambia
022: ARC 1950 : Zimbabwe
023: ARC 1960 : Mean Value (Kenya & Tanzania)
024: ARC 1960 : Kenya
025: ARC 1960 : Tanzania
026: ASCENSION IS. 1958 : Ascension Is.
027: ASTRO BEACON "E" : Iwo Jima Is.
028: ASTRO B4 SOR. ATOLL : Tern Is.
029: ASTRO POS 71/4 : St. Helena Is.
030: ASTRONOMIC STATION 1952 : Marcus Is.
031: AUSTRALIAN GEODETIC 1966 : Australia & Tasmania
032: BELLEVUE (IGN) : Efate & Erromango Is.
033: BERMUDA 1957 : Bermuda Is.
034: BOGOTA OBSERVATORY : Columbia
035: CAMPO INCHAUSPE : Argentina
036: CANTON IS. 1966 : Phoenix Is.
037: CAPE : South Africa
038: CAPE CANAVERAL : Mean Value (Florida & Bahama Is.)
039: CARTHAGE : Tunisia
040: CHATHAM 1971 : Chatham Is. (New Zealand)
041: CHUA ASTRO : Paraguay
042: CORREGO ALEGRE : Brazil
043: DJAKARTA (BATAVIA) : Sumatra Is. (Indonesia)
044: DOS 1968 : Gizo Is. (New Georgia Is.)
045: EASTER IS. 1967 : Easter Is.
046: EUROPEAN 1950 (Cont'd) : Western Europe
047: EUROPEAN 1950 (Cont'd) : Cyprus
048: EUROPEAN 1950 (Cont'd) : Egypt
049: EUROPEAN 1950 (Cont'd) : England, Scotland, Channel & Shetland Is.
050: EUROPEAN 1950 (Cont'd) : England, Ireland, Scotland & Shetland Is.
051: EUROPEAN 1950 (Cont'd) : Greece
052 EUROPEAN 1950 (Cont'd) : Iran
053: EUROPEAN 1950 (Cont'd) : Italy, Sardinia
054: EUROPEAN 1950 (Cont'd) : Italy, Sicily
055: EUROPEAN 1950 (Cont'd) : Norway & Finland
056: EUROPEAN 1950 (Cont'd) : Portugal & Spain
057: EUROPEAN 1979 : Mean Value
058: GANDAJIKA BASE : Republic of Maldives
059: GEODETIC DATUM 1949 : New Zealand
060: GUAM 1963 : Guam Is.
061: GUX 1 ASTRO : Guadalcanal Is.
062: HJORSEY 1955 : Iceland
063: HONG KONG 1963 : Hong Kong
064: INDIAN : Thailand & Vietnam
065: INDIAN : Bangladesh, India & Nepal
066: IRELAND 1965 : Ireland
067: ISTS 073 ASTRO 1969 : Diego Garcia
068: JOHNSTON IS. 1961 : Johnston Is.
069: KANDAWALA : Sri Lanka
070: KERGUELEN IS. : Kerguelen Is.
071: KERTAU 1948 : West Malaysia & Singapore
072: LA REUNION : Mascarene Is.
073: L. C. 5 ASTRO : Cayman Brac Is.
074: LIBERIA 1964 : Liberia
075: LUZON : Philippines (excl. Mindanao Is.)
076: LUZON : Mindanao Is.
077: MAHE 1971 : Mahe Is.
078: MARCO ASTRO : Salvage Islands
079: MASSAWA : Eritrea (Ethiopia)
080: MERCHICH : Morocco
081: MIDWAY ASTRO 1961 : Midway Is.
082: MINNA : Nigeria
083: NAHRWAN : Masirah Is. (Oman)
084: NAHRWAN : United Arab Emirates
085: NAHRWAN : Saudi Arabia
086: NAMIBIA : Namibia
087: MAPARIMA, BWI : Trinidad & Tobago
088: NORTH AMERICAN 1927 : Western United States
089: NORTH AMERICAN 1927 : Eastern United States
090: NORTH AMERICAN 1927 : Alaska
091: NORTH AMERICAN 1927 : Bahamas (excl. San Salvador Is.)
092: NORTH AMERICAN 1927 : Bahamas, San Salvador Is.
093: NORTH AMERICAN 1927 (Cont'd): Canada (incl. Newfoundland Is.)
094: NORTH AMERICAN 1927 (Cont'd): Alberta & British Columbia
095: NORTH AMERICAN 1927 (Cont'd): East Canada
096: NORTH AMERICAN 1927 (Cont'd): Manitoba & Ontario
097: NORTH AMERICAN 1927 (Cont'd): Northwest Territories & Saskatchewan
098: NORTH AMERICAN 1927 (Cont'd): Yukon
099: NORTH AMERICAN 1927 (Cont'd): Canal Zone
100: NORTH AMERICAN 1927 (Cont'd): Caribbean
101: NORTH AMERICAN 1927 (Cont'd): Central America
102: NORTH AMERICAN 1927 (Cont'd): Cuba
103: NORTH AMERICAN 1927 (Cont'd): Greenland
104: NORTH AMERICAN 1927 (Cont'd): Mexico
105: NORTH AMERICAN 1983 : Alaska
106: NORTH AMERICAN 1983 : Canada
107: NORTH AMERICAN 1983 : CONUS
108: NORTH AMERICAN 1983 : Mexico, Central America
109: OBSERVATORIO 1966 : Corvo & Flores Is. (Azores)
110: OLD EGYPTIAN 1930 : Egypt
111: OLD HAWAIIAN : Mean Value
112: OLD HAWAIIAN : Hawaii
113: OLD HAWAIIAN : Kauai
114: OLD HAWAIIAN : Maui
115: OLD HAWAIIAN : Oahu
116: OMAN : Oman
117: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : Mean Value
118: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : England
119: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : England, Isle of Man & Wales
120: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : Scotland & Shetland Is.
121: ORDNANCE SURVEY OF GREAT BRITAIN 1936 : Wales
122: PICO DE LAS NIVIES : Canary Is.
123: PITCAIRN ASTRO 1967 : Pitcairn Is.
124: PROVISIONAL SOUTH CHILEAN 1963: South Chile (near 53°S)
125: PROVISIONAL SOUTH AMERICAN 1956: Mean Value
126: PROVISIONAL SOUTH AMERICAN 1956: Bolivia
127: PROVISIONAL SOUTH AMERICAN 1956: Chile-Northern Chile (near 19°S)
128: PROVISIONAL SOUTH AMERICAN 1956: Chile-Southern Chile (near 43°S)
129: PROVISIONAL SOUTH AMERICAN 1956: Columbia
130: PROVISIONAL SOUTH AMERICAN 1956: Ecuador
131: PROVISIONAL SOUTH AMERICAN 1956: Guyana
132: PROVISIONAL SOUTH AMERICAN 1956: Peru
133: PROVISIONAL SOUTH AMERICAN 1956: Venezuela
134: PUERTO RICO : Puerto Rico & Virgin Is.
135: QATAR NATIONAL : Qatar
136: QORNOQ : South Greenland
137: ROME 1940 : Sardinia Is.
138: SANTA BRAZ : Sao Miguel, Santa Maria Is. (Azores)
139: SANTO (DOS) : Espirito Santo Is.
140: SAPPER HILL 1943 : East Falkland Is.
141: SOUTH AMERICAN 1969 : Mean Value
142: SOUTH AMERICAN 1969 : Argentina
143: SOUTH AMERICAN 1969 : Bolivia
144: SOUTH AMERICAN 1969 : Brazil
145: SOUTH AMERICAN 1969 : Chile
146: SOUTH AMERICAN 1969 : Columbia
147: SOUTH AMERICAN 1969 : Ecuador
148: SOUTH AMERICAN 1969 : Guyana
149: SOUTH AMERICAN 1969 : Paraguay
150: SOUTH AMERICAN 1969 : Peru
151: SOUTH AMERICAN 1969 : Trinidad & Tobago
152: SOUTH AMERICAN 1969 : Venezuela
153: SOUTH ASIA : Singapore
154: SOUTHEAST BASE : Porto Santo & Madeira Is.
155: SOUTHWEST BASE : Faial, Graciosa, Pico, Sao Jorge & Terceria Is.
156: TIMBALAI 1948 : Brunei & East Malaysia (Sarawak & Sabah)
157: TOKYO : Japan
158: TOKYO : Korea
159: TOKYO : Okinawa
160: TRISTAN ASTRO 1968 : Tristan da Cunha
161: VITI LEVU 1916 : Viti Levu Is. (Fiji Is.)
162: WAKE-ENIWETOK 1960 : Marshall Is.
163: ZANDERIJ : Surinam
164: BUKIT RIMPAH : Bangka & Belitung Is. (Indonesia)
165: CAMP AREA ASTRO : Camp Mcmurdo Area, Antarctica
166: G. SEGARA : Kalimantan Is. (Indonesia)
167: HERAT NORTH : Afghanistan
168: HU-TZU-SHAN : Taiwan
169: TANANARIVE OBSERVATORY 1925 : Madagascar
170: YACARE : Uruguay
171: RT-90 : Sweden
172: CK42 (PULKOVO 1942) : Russia
173: FINNISH KKJ : Finland
174: PZ90 : Russia
175: CK95 : Russia

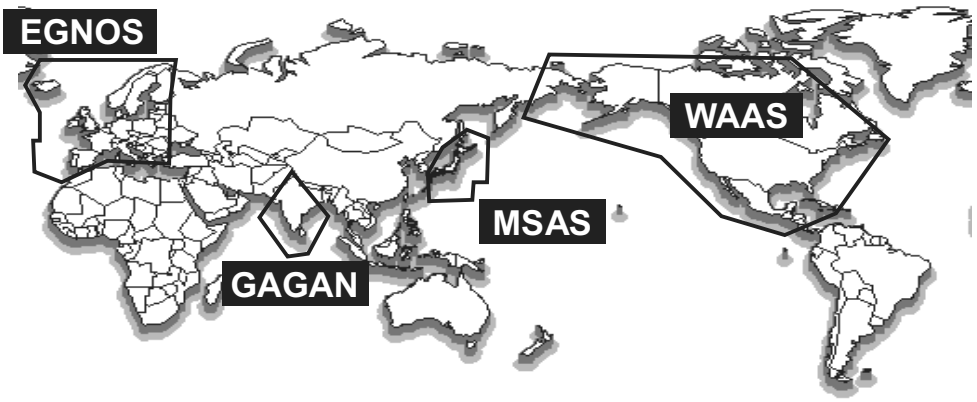
APPENDIX 6 WHAT IS SBAS?

A satellite based augmentation system, or SBAS (Satellite Based Augmentation System), is an augmentation system that uses additional messages from satellite broadcasts to support regional and wide area augmentation. SBAS provides GPS signal corrections to SBAS users, for even better position accuracy, through the GPS error corrections that are widely broadcast from the geostationary satellite.

SBAS is used in America, Europe, Japan and India.

- America: WAAS (Wide Area Augmentation System)
- Europe: EGNOS (Euro Geostationary Navigation Overlay Service)
- Japan: MSAS (Multi-Functional Satellite Augmentation System)
- India: GAGAN (GPS And GEO Augmented Navigation)

These four systems have interoperability. The illustration below shows the coverage area for each provider. This manual uses "SBAS" for these four providers generically.



Provider	Satellite type	Longitude	Satellite No.
WAAS	Intelsat Galaxy XV	133°W	135
	TeleSat Anik F1R	107.3°W	138
	Inmarsat-4-F3	98°W	133
EGNOS	Inmarsat-3-F2/AOR-E	15.5°W	120
	Inmarsat-4-F2	25°E	126
	SES-5	5°E	136
MSAS	MTSAT-1R	140°E	129
	MTSAT-2	145°E	137
GAGAN	GSAT-8	55°E	127
	GSAT-10	83°E	128

As of March 6th, 2014

APPENDIX 7 DIGITAL INTERFACE (IEC 61162-1 EDITION 4(2010-11))

Serial data sentences

Input: ACK, ACN (ACM), HBT, HDT*[1], MSK, MSS, THS, VBW*[2], VDR*[2]

Output: ALC, ALF, ALR, ARC, DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG*[2], HDM*[2], HDT*[1], HRM*[2], MSK, POS, RMC, ROT, THS, VBW*[2], VDR*[2], VHW*[2], VLW*[2], VTG, XDR*[2], ZDA

Ethernet sentences

Input: ACK, ACN (ACM), HBT

Output: ALC, ALF, ALR, ARC, DTM, GBS, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG, HDM, HDT*[1], HRM*[2], POS, RMC, ROT, THS, VBW*[2], VDR*[2], VHW*[2], VLW*[2], VTG, XDR*[2], ZDA

*[1]: Not used for new SOLAS vessels.
*[2]: For Non-IMO types only.

Transmission Interval

Sentence	Available intervals
DTM*/GBS/GGA/GLL/GNS/GRS/GSA/GST/GSV/RMC/ VBW/VDR/VHW/VLW/VTG/XDR/ZDA	0s, 1s, 2s
HDT/ROT/THS/HDG/HDM/HRM	20ms, 25ms, 100ms, 200ms, 1s, 2s
ALC/ALF/ALR/ARC/MSK	Fixed (Not changeable).

*: Fixed for IMO type vessels.

Load requirements as listener

Isolation: Photo coupler
Input impedance: 470 ohms
Max. voltage: ±15 V
Threshold: 3 mA (in case of connection with FURUNO device talker)

Data transmission

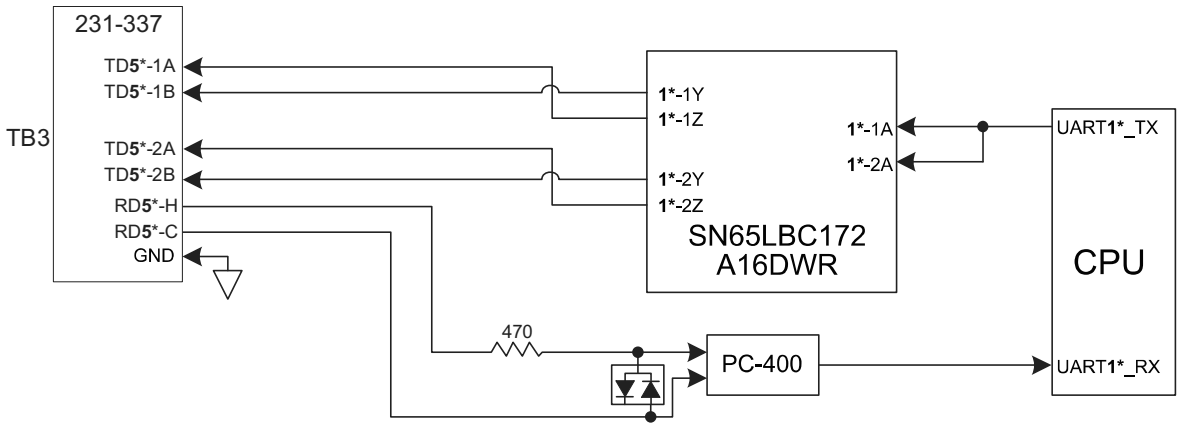
Data is transmitted in serial asynchronous form in accordance with the standard referenced in IEC 61162-1 and IEC 61162-2. The first bit is a start bit and is followed by data bits.

The following parameters are used:

Baud rate: 4800 for IEC 61162-1, 38400 for IEC 61162-2
Data bits: 8, parity = none
Stop bits: 1

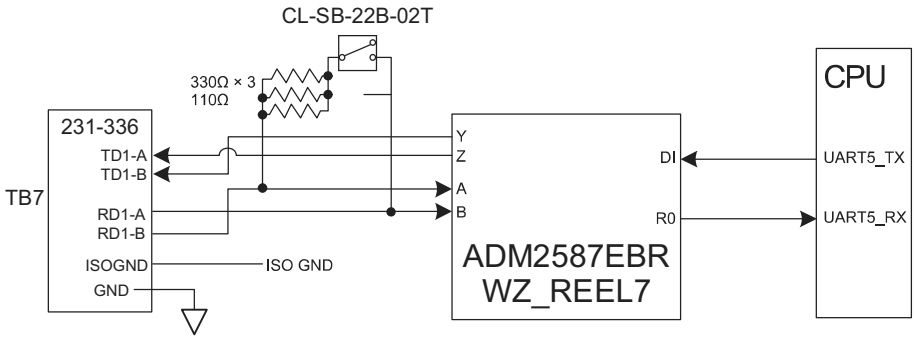
Schematic diagrams

Data ports 2 through 5



*: Numerals in bold change as follows, with their respective terminal blocks.
TB4: **4**; TB5: **3**; TB6: **2**

Data port 1



Sentence description (Input)

- ACK: Acknowledge Alarm

$**ACK,xxx,*hh<CR><LF>
1

1. Local alarm number (identifier) (000 to 999)

- ACN (ACM): Alert Command

$**ACN,hhmmss.ss,aaa,x.x,x.x,c,a*hh<CR><LF>
1 2 3 4 5 6

1. Time (UTC,unused)
2. Manufacturer mnemonic code (3 digits)
3. Alert Identifier (000 - 999999)
4. Alert Instance (1 - 999999,unused)
5. Alert command (A,Q,O,S)
   A=acknowledge
   Q=request/repeat information
   O=responsibility transfer
   S=silence
6. Sentence status flag(C) (fixed)

- HBT: Heartbeat Supervision Sentence

$**HBT,x.x,A,x*hh<CR><LF>
1 2 3
1. Configured repeat interval (1 to 999(s))
2. Equipment status (A=Normal V=System fail)
3. Sequential sentence identifier (0 to 9)

- HDT: Heading, true

$**HDT,xxx.x,T*hh<CR><LF>
1 2
1. Heading, degrees (0.0 to 360.0)
2. True (T)

- MSK: Receiver Interface Command

$**MSK,x.x,a,x.x,a,x.x,x,a *hh<CR><LF>
1 2 3 4 5 6 7
1. Beacon frequency, kHz (283.45 to 325.04)
2. Auto/Manual frequency (See note 2) (A=Auto, M=Manual)
3. Beacon bit rate, bits/s (25, 50, 100, 150, 200)
4. Auto/Manual beacon bit rate (See note 2) (A=Auto, M=Manual)
5. Interval for sending $**MSS (status) in seconds (See note 1) (1 to 99, null))
6. Channel number (See note 3) (Fixed at 1)
7. Sentence status flag (See note 4) (R, C) (R=Sentence status is a report of current settings (use for a reply to a query, C=Sentence is a configuration command to change settings. A sentence without “C” is not a command.)

Notes:
1) When status data is not to be transmitted this field is "null".
2) If Auto is specified the previous field value is ignored.
3) Set equal to “1” or null for single channel receiver.
4) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.

- MSS: MSK Receiver Signal Status

$**MSS,x.x,x.x,x.x,x.x,x *hh<CR><LF>
1 2 3 4 5
1. Signal strength (SS), dB/(1μV/m) (0.0 to 999.94)
2. Signal-to-noise ratio (SN), dB (0.0 to 999.94)
3. Beacon frequency, kHz (283.5 to 325.04)
4. Beacon bit rate, bits/s (25, 50, 100, 200)
5. Channel number (1,null)(Set to “1” or “null” for single channel receivers.)

- THS: True Heading And Status

$**THS,x.x,a*hh<CR><LF>
1 2
1. Heading, degrees True (0.0 to 360.0)
2. Mode indicator (A=Autonomous, S=Simulator)

- VBW: Dual Ground/water Speed

$**VBW,x.x,x.x,a,x.x,x.x,a,x.x,a,x.x,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. Longitudinal water speed, knots (-999.994 to 999.994, null)
2. Transverse water speed, knots (-999.994 to 999.994, null)
3. Status: water speed (A=Data valid)
4. Longitudinal ground speed, knots (unused)
5. Transverse ground speed, knots (unused)
6. Status: ground speed, (A=Data valid, V=Data invalid)
7. Stern transverse water speed, knots (-999.994 to 999.994, null)
8. Status: stern water speed (A=Data valid)
9. Stern transverse ground speed, knots (unused)
10. Status: stern ground speed, (A=Data valid, V=Data invalid)

- VDR: Set and Drift

$**VDR,x.x,T,x.x,M,x.x,N*hh <CR><LF>
1 2 3 4 5 6

1. Direction, degrees True (0.0 to 360.0,null)
2. T=True (fixed)
3. Direction, degrees Magnetic (0.0 to 360.0,null)
4. M=Magnetic (fixed)
5. Current speed (0 to 99.99)
6. N=Knots (fixed)

- Proprietary sentences: GPatt, GPhve, Ilals, pireq.

Sentence description (Output)

- ALC: Cyclic Alert List

$**ALC,xx,xx,xx,x.x, aaa,x.x,x.x,x.x,’’’’’*hh<CR><LF>
1 2 3 4 5 6 7 8 9

1. Total number of sentences this message (01 to 99)
2. Sentence number (01 to 99)
3. Sequential message identifier (00 to 99)
4. Number of alert entries (0 to 2)
5. Manufacturer mnemonic code (FEC, null)
6. Alert identifier (000 to 999999)
7. Alert instance (1 to 999999)
8. Revision counter (1 to 99)
9. Additional alert entries (same as 5 to 8)

- ALF: Alert Sentence

$**ALF,x,x,x,hhmmss.ss,a,a,a,aaa,x.x,x.x,x.x,x,c--c*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

1. Total number of ALF sentences this message (1, 2)
2. Sentence number (1, 2)
3. Sequential message identifier (0 to 9)
4. Time of last change (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99), null
5. Alert category (B=Alert category B,), null when #2 is 2.
6. Alert priority (W=Warning, C=Caution), null when #2 is 2.
7. Alert state (V=Not ACKed, S=Silence, A=ACked, O/U=Resolved, Not ACKed, N=Normal state), null when #2 is 2.
8. Manufacturer mnemonic code (FEC, null)
9. Alert identifier (000 to 999999)
10. Alert instance (1 to 999999)
11. Revision counter (1 to 99)
12. Escalation counter (0 to 9)
13. Alert text (when #2 =1: max. 16 characters; when #2=2: max. characters according to regulation)

- ALR: Set Alarm State

$**ALR,Hhmmss.ss,xxx,A,A,c—c*hh<CR><LF>
1 2 3 4 5

1. Time of alarm condition change, UTC (000000.00 to 235959.99), null
2. Unique alarm number (identifier) at alarm source (000 to 999),null
3. Alarm condition (A=threshold exceeded, V=threshold not exceeded)
4. Alarm acknowledge state (A=acknowledged, V=not acknowledged)
5. Alarm description text (alphanumeric), null

- ARC: Alert Command Refused

$**ARC,hhmmss.ss,aaa,x.x,x.x,c*hh<CR><LF>
1 2 3 4 5

1. Release time of the Alert Command Refused (UTC)
2. Used for proprietary alerts, defined by the manufacturer (FEC,null)
3. The alert identifier (000 to 999999)
4. The alert instance (1 to 999999)
5. Refused Alert Command(A, Q, O, S)
   A=acknowledge
   Q=request/repeat information
   O=responsibility transfer
   S=silence

- DTM: Datum Reference

$**DTM,ccc,a,x.x,a,x.x,a,x.x,ccc*hh<CR><LF>
1 2 3 4 5 6 7 8

1. Local datum (W84:WGS84; W72:WGS72; P90:PZ90; User defined:999, IHO datum code)
2. Local datum subdivision code (null or one character)
3. Lat offset, minutes (0 to 59.9999)
4. N/S
5. Lon offset, min (0 to 59.9999)
6. E/W
7. Altitude offset, meters (null)
8. Reference datum (W84:WGS84; W72:WGS72; P90:PZ90)

- GBS: GNSS Satellite Fault Detection

$**GBS, hhmmss.ss, x.x, x.x, x.x, xx, x.x, x.x, x.x, h, h *hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. UTC time of GGA or GNS fix associated with this sentence (000000.00 to 235959
2. Expected error in latitude (0.00 to 999.99),null
3. Expected error in longitude (0.00 to 999.99),null
4. Expected error in altitude (0.00 to 999.99),null
5. ID number of most likely failed satellite (1 to 255),null
6. Probability of missed detection for most likely failed satellite (0.00 to 100.00),null
7. Estimate of bias in meters on most likely failed satellite (-999.99 to 999.99),null
8. Standard deviation of bias estimate (0.00 to 999.99), null
9. GNSS system ID (1 to F)
10. GNSS signal ID (0 to F)

- GGA - Global Positioning System Fix Data

$**GGA,hhmmss.ss,llll.lll,a,yyyyy.yyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. UTC of position (000000.00 to 235959.99)
2. Latitude (0000.0000 to 9000.00000)
3. N/S
4. Longitude (0000.0000 to 18000.00000)
5. E/W
6. GPS quality indicator (0 to 8)
7. Number of satllite in use (00 to 99)
8. Horizontal dilution of precision (0.0 to 99.9)
9. Antenna altitude above/below mean sea level (-9999 to 9999)
10. Unit, (Fixed at m)
11. Geoidal separation (-9999 to 9999)
12. Unit, (Fixed at m)
13. Age of differential GPS data (0 to 299) ,null
14. Differential reference station ID (0000 to 1023),null

- GLL: Geographic Position - Latitude/Longitude

$**GLL,llll.lll,a,yyyyy.yyy,a,hhmmss.ss,a,x*hh<CR><LF>
1 2 3 4 5 6 7

1. Latitude (0000.0000 to 9000.0000)
2. N/S
3. Longitude (0000.0000 to 18000.0000)
4. E/W
5. UTC of position (000000.00 to 235959.99)
6. Status (A=data valid V=data invalid)
7. Mode indicator (A=Autonomous, D=Differential, E=Estimated (dead reckoning), M=Manual input, S=Simulator, N=Data not valid)

- GNS: GNSS Fix Data

$**GNS,hhmmss.ss,llll.lll,a,IIIII.III,a,c--c,xx,x.x,x.x,x.x,x.x,x.x,x.x,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of position (000000.00 to 235959.99)
2. Latitude (0000.0000 to 9000.0000)
3. N/S
4. Longitude (0000.0000 to 18000.0000)
5. E/W
6. Mode indicator
   N=No fix A=Autonomous D=Differential P=Precise R=Real Time Kinematic
   F=Float RTK E=Estimated Mode M=Manual Input Mode S=Simulator Mode
7. Total number of satellites in use (00 to 99)
8. HDOP (0.0 to 50.0)
9. Antenna altitude, meters (-9999 to 9999)
10. Geoidal separation (-9999 to 9999)
11. Age of differential data (0 to 99)
12. Differential reference station ID (0000 to 1023)
13. Naivgational status indicator
    S=Safe C=Caution U=Unsafe V=Navigational status not valid

- GRS: GNSS Range Residual

$**GRS,hhmmss.ss,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,h,h*hh<CR><LF>

1 2 3 to 14 15 16

1. UTC time of GGA/GNS fix
2. Mode: 0=Residuals were used to calculate the position given in the matching GGA or GNS sentence; 1=Residuals were recomputed after the GGA or GNS position was computed
3. Range residuals in meters for satellites used in the navigation solution (-99 to 99, null) See notes 1&2.

4 to 14. Same as #3.

15. GNSS System ID (1 to F; 1=GP, 2=GL, 3=GA, 4 to F=RESERVED)
16. Signal ID (0 to F)

Notes:

1) If the range residual exceeds +99.9 meters, then the decimal part is dropped, resulting in an integer (-13.7 becomes -13). The maximum value for this field is +99.
2) The sense or sign of the range residual is determined by the order of parameters used in the calculation.
   The expected order is as follows: range residual = calculated range - measured range.
3) When multiple GRS sentences are being sent then their order of transmission must match the order of corresponding GSA sentences.
   Listeners shall keep track of pairs of GSA and GRS sentences and discard data if pairs are incomplete.
4) Signal ID indentifies the actual ranging signal according to the Table below.
5) System ID according to Table below.

GRS Table

System	System ID	Satellite ID	Signal ID	Signal Channel
GPS	1 (GP)	1 to 99 1 to 32 is reserved for GPS 33 to 64 is reserved for SBAS 65 to 99 is undefined	0 1 2 3 4 5 6 7 8 9 to F	All Signals L1 C/A L1 P(Y) L1 M L2 P(Y) L2C-M L2C-L L5-I L5-Q Reserved
GLONASS	2 (GL)	1 to 99 1 to 32 is undefined 33 to 64 is reserved for SBAS 65 to 99 is reserved for GLONASS	0 1 2 3 4 5 to F	All Signals G1 C/A G1 P G2 C/A GLONASS (M) G2 P Reserved
GALILEO	3 (GA)	1 to 99 1 to 36 is reserved for Galileo SVs 37 to 64 is reserved for Galileo SBAS 65 to 99 is undefined	0 1 2 3 4 5 6 7 8 to F	All Signals E5a E5b E5 a+b E6-A E6-BC L1-A L1-BC Reserved
Reserved	4 to F			

- GSA: GNSS DOP and Active Satellites

$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,h *hh<CR><LF>
1 2 3 4 5 6 7

1. Mode (M=manual, forced to operate in 2=2D 3=3D mode
   A=automatic, allowed to automatically switch 2D/3D)
2. Mode (1=fix not available 2=2D 3=3D)
3. ID number of satellites used in solution (01 to 96, null)
4. PDOP (0.0 to 50.0),null
5. HDOP (0.0 to 50.0),null
6. VDOP (0.0 to 50.0),null
7. GNSS System ID (See GRS table:System ID)

- GST: GNSS Pseudorange Error Statistics

$**GST,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x *hh<CR><LF>
1 2 3 4 5 6 7 8

1. UTC time fo the GGA or GNS fix. (000000.00 to 235959.99)
2. RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges & DGNSS corrections. (1 to 999, null)
3. Standard deviation of semi-major axis of error ellipse (meters) (0 to 655.34, null)
4. Standard deviation of semi-minor axis of error ellipse (meters) (0 to 655.34, null)
5. Orientation of semi-major axis of error ellipse (degrees from true north) (0 to 180, null)
6. Standard deviation of latitude error (meters) (0 to 999.9, null)
7. Standard deviation of longitude error (meters) (0 to 999.9, null)
8. Standard deviation of altitude error (meters) (0 to 999.9, null)

- GSV: GNSS Satellites in View

$**GSV,x,x,xx,xx,xx,xxx,xx._____,xx,xx,xxx,xx, h *hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. Total number of messages (1 to 4)
2. Message number (1 to 4)
3. Total number of satellites in view (00 to 14)
4. Satellite ID number (01 to 96),null
5. Elevation, degrees (00 to 90),null
6. Azimuth, degrees true (000 to 359),null
7. SNR(C/No) (00 to 99(dB-Hz), null when not tracking)
8. Second and third SVs
9. Fourth SV
10. Signal ID (See GRS table:Signal ID)

- HBT - Heartbeat Supervision Sentence

$**HBT,x.x,A,x*hh<CR><LF>
1 2 3

1. Configured repeat interval (50.0(s))(+1)
2. Equipment status (A=Normal)
3. Sequential sentence identifier (0 to 9)

- HDG: Heading, Deviation and Variation

$**HDG,x.x,x.x,a,x.x,a*hh<CR><LF>
1 2 3 4 5

1. Magnetic sensor heading, degrees (0.0 to 359.9)
2. Magnetic deviation, degrees (0.0 to 180.0)
3. E/W
4. Magnetic variation, degrees (0.0 to 180.00)
5. E/W

- HDM: Heading, Magnetic

$**HDM,x.x,M*hh<CR><LF>
1 2
1. Heading, degrees (0.0 to 359.9)
2. Magnetic (M)

- HDT: Heading, True

$**HDT,xxx.x,T*hh<CR><LF>
1 2
1. Heading, degrees (0.0 to 359.9)
2. True (T)

- HRM: Heel Angle, Roll Period and Roll Amplitude Measurement Device

$**HRM,hhmmss.ss,x.x,x.x,x.x,A,x.x,x.x,hhmmss.ss,x.x,x.x *hh<CR><LF>
1 2 3 4 5 6 7 8 9 10
1. Actual heel angle, degrees (-89.999 to 89.999, null)
2. Roll period, seconds (0 to 99.9, null)
3. Roll amplitude, port side, degrees (0 to 89.999, null)
4. Roll amplitude, starboard side, degrees (0 to 89.999, null)
5. Status (A/V) A=Data valid, V=Data invalid
6. Roll peak hold value, port side, degrees (null)
7. Roll peak hold value, starboard side, degrees (null)
8. Peak hold value reset time (fixed at null)
9. Peak hold value reset day (fixed at null)
10. Peak hold value reset month (fixed at null)

- MSK: Receiver Interface Command

$**MSK,x.x,a,x.x,a,x.x,x,a *hh<CR><LF>
1 2 3 4 5 6 7
1. Beacon frequency, kHz (283.5 to 325.0, null)
2. Auto/Manual frequency (See note 2) (A=Auto, M=Manual)
3. Beacon bit rate, bits/s (25, 50, 100, 150, 200, null)
4. Auto/Manual beacon bit rate (See note 2) (A=Auto, M=Manual)
5. Interval for sending $**MSS (status) in seconds (See note 1) (Fixed at 5)
6. Channel number (See note 3) (Fixed at 1)
7. Sentence status flag (See note 4) (C - Sentence is a configuration command to change settings. A sentence without “C” is not a command.)

Notes:
1) When status data is not to be transmitted this field is "null".
2) If Auto is specified the previous field value is ignored.
3) Set equal to “1” or null for single channel receiver.
4) This field is used to indicate a sentence that is a status report of current settings or a configuration command changing settings. This field should not be null.

- POS: Device Position and Ship Dimensions Report or Confirmation Command

$**POS,cc,xx,a,x.x,x.x,x.x,a,x.x,x.x,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. Equipment ID (GP, GL, GA, GN, HE, HN, HC)
2. Equipment number (01 to 99)
3. Position validity flag (A=Valid V=Invalid)
4. Position X-coordinate (-999.9 to 999.9)
5. Position Y-coordinate (0 to 999.9)
6. Position Z-coordinate (0 to 999.9)
7. Ship's width and length (A=Valid)
8. Ship's width (000.0 to 999.9)
9. Ship's length (000.0 to 999.9)
10. Sentence status flag (R=Sentence is status report of current settings)

- RMC: Recommended Minimum Specific GNSS Data

$**RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,ddmmyy,x.x,a,a,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 1213

1. UTC of position fix (000000.00 to 235959.99)
2. Status (A=data valid, V=navigation receiver warning)
3. Latitude (0000.0000 to 9000.0000)
4. N/S
5. Longitude (0000.0000 to 18000.0000)
6. E/W
7. Speed over ground, knots (0.000 to 9999.999)
8. Course over ground, degrees true (0.0 to 359.9)
9. Date (010100 to 311299)
10. Magnetic variation, degrees (0.0 to 180.0,null)
11. E/W (E/W,null)
12. Mode indicator (A= Autonomous mode, D= Differential mode, E=Estimated (DR), S= Simulator, M=Manual, N=Data not valid, P=Precise)
13. Navigational status indication (S=Safe C=Caution U=Unsafe V=Navigational status not valid)

- ROT: Rate of Turn

$**ROT,x.x,A *hh<CR><LF>
1 2

1. Rate of turn, deg/min, "-"=bow turns to port (-9999.9 - 9999.9,null)
2. Status (A=data valid, V=data invalid)

- THS: True Heading & Status

$**THS,x.x,a*hh<CR><LF>
1 2

1. Heading, degrees True (0.0 to 359.9 null)
2. Mode indicator (A=Autonomous, E=Estimated, M=Manual input, S=Simulator V=Data not valid)

- VBW: Dual Ground/Water Speed

$**VBW,x.x,x.x,a,x.x,x.x,a,x.x,a,x.x,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. Longitudinal water speed, knots (-999.999 to 999.999),null
2. Transverse water speed, knots (-999.999 to 999.999),null
3. Status: water speed, A=Data valid V=Data invalid
4. Longitudinal ground speed, knots (-999.999 to 999.999),null
5. Transverse ground speed, knots (-999.999 to 999.999),null
6. Status: ground speed, A=Data valid V=Data invalid
7. Stern transverse water speed, knots (-999.999 to 999.999),null
8. Status: stern water speed, A=Data valid V=Data invalid
9. Stern transverse ground speed, knots (-999.999 to 999.999),null
10. Status: stern ground speed, A=Data valid V=Data invalid

- VDR: Set and Drift

$**VDR,x.x,T,x.x,M,x.x,N*hh <CR><LF>
1 2 3 4 5 6

1. Direction, degrees (0.0 to 359.9),null
2. T=True (fixed)
3. Direction, degrees (0.0 to 359.9),null
4. M=Magnetic (fixed)
5. Current speed (0 to 99.99),null
6. N=Knots (fixed)

- VHW: Water Speed and Heading

$**VHW,x.x,T,x.x,M,x.x,N,x.x,K,*hh <CR><LF>
1 2 3 4 5 6 7 8

1. Heading, degrees (0.000 to 359.999, null)
2. T=True (fixed)
3. Heading, degrees (0.000 to 359.999, null)
4. M=Magnetic (fixed)
5. Speed, knots (-999.999 to 999.999, null)
6. N=Knots (fixed)
7. Speed, km/hr (-999.999 to 999.999, null)
8. K=km/hr (fixed)

- VLW: Dual Ground/Water Distance

$**VLW,x.x,N,x.x,N,x.x,N,x.x,N*hh<CR><LF>
1 2 3 4 5 6 7 8

1. Total cumulative water distance (null)
2. N=Nautical miles
3. Water distance since reset (null)
4. N=Nautical miles
5. Total cumulative ground distance (null)
6. N=Nautical miles
7. Ground distance since reset (0.00 to 999999.99)
8. N=Nautical miles

- VTG: Course Over Ground and Ground Speed

$**VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh <CR><LF>
1 2 3 4 5 6 7 8 9

1. Course over ground, degrees (0.0 to 359.9),null
2. T=True (fixed)
3. Course over ground, degrees (0.0 to 359.9),null
4. M=Magnetic (fixed)
5. Speed over ground, knots (0.0 to 999.9),null
6. N=Knots (fixed)
7. Speed over ground (0.0 to 999.9),null
8. K=km/h (fixed)
9. Mode indicator (A=Autonomous, D=Differential, E=Estimated (dead reckoning), M=Manual input, S=Simulator, N=Data not valid, P=Precise)

- XDR: Transducer Measurements

$**XDR, a, x.x, a, c--c, a, x.x, a, c--c *hh<CR><LF>
1 2 3 4 5 6 7 8

1. Transducer type, transducer no. 1 (C=Celcius, fixed)
2. Measurement data, transducer no. 1 (-50.00 to 99.99)
3. Units of measure (C=Celcuis, fixed)
4. Transducer no.1 ID (AIRT, fixed)
5. Transducer type, transducer no. 2 (P=Pressure, fixed)
6. Measurement data, transducer no. 2 (0.00 to 120000.00)
7. Units of measure (P=Pascal, fixed)
8. Transducer no.2 ID (AIRP, fixed)

- ZDA: Time and date

$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx,*hh<CR><LF>
1 2 3 4 5 6

1. UTC (000000 to 235959)
2. Day (01 to 31, UTC)
3. Month (01 to 12, UTC)
4. Year (0000 to 9999, UTC)
5. Local zone, hours (-13 to ±13)
6. Local zone, minutes (00 to ±59)

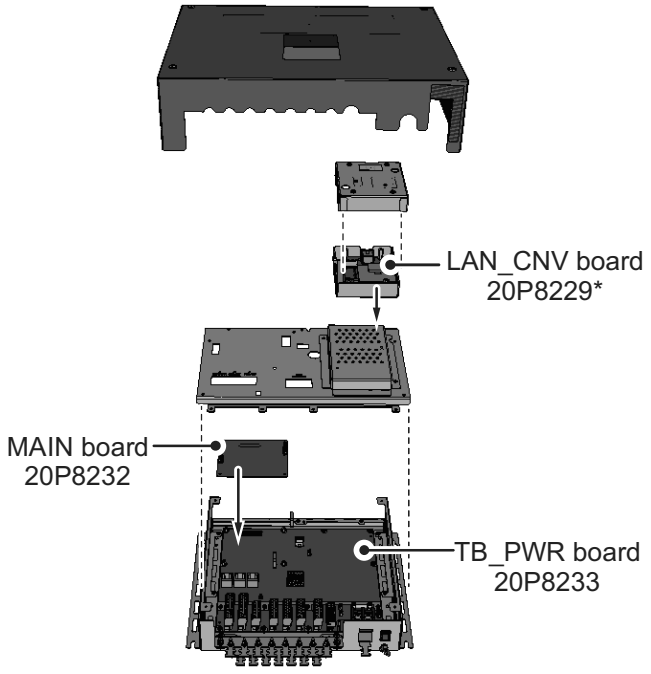
APPENDIX 8 PARTS LIST/LOCATION

Parts List

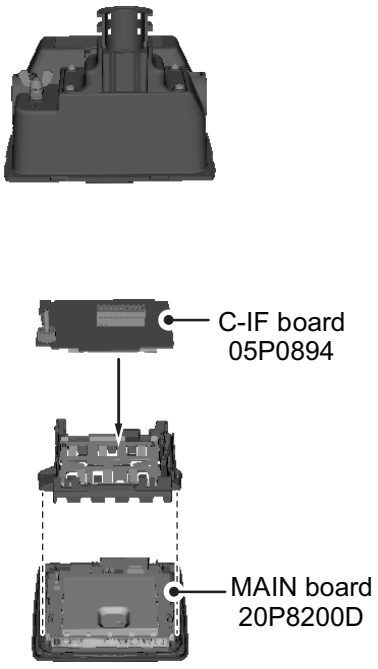
This equipment contains complex modules in which fault diagnosis and repair down to component level are not practical (IMO A.694(17)/8.3.1). Only some discrete components are used. FURUNO Electric Co., Ltd. believes identifying these components is of no value for shipboard maintenance; therefore, they are not listed in the manual. Major modules can be located on the parts location figures below.

F U R U N O ELECTRICAL PARTS LIST	Model	SC-70/SC-130
	Unit	DISPLAY UNIT, JUNCTION BOX,
TYPE, NAME	LOCATION	
PRINTED CIRCUIT BOARD		
20P8200E, MAIN	DISPLAY UNIT SC-702	
05P0894A, C-IF	DISPLAY UNIT SC-702	
20P8232, MAIN	JUNCTION BOX SC-701	
20P8233, TB_PWR	JUNCTION BOX SC-701	
20P8229A, LAN_CNV	JUNCTION BOX SC-701	

PCB locations for SC-701



PCB locations for SC-702

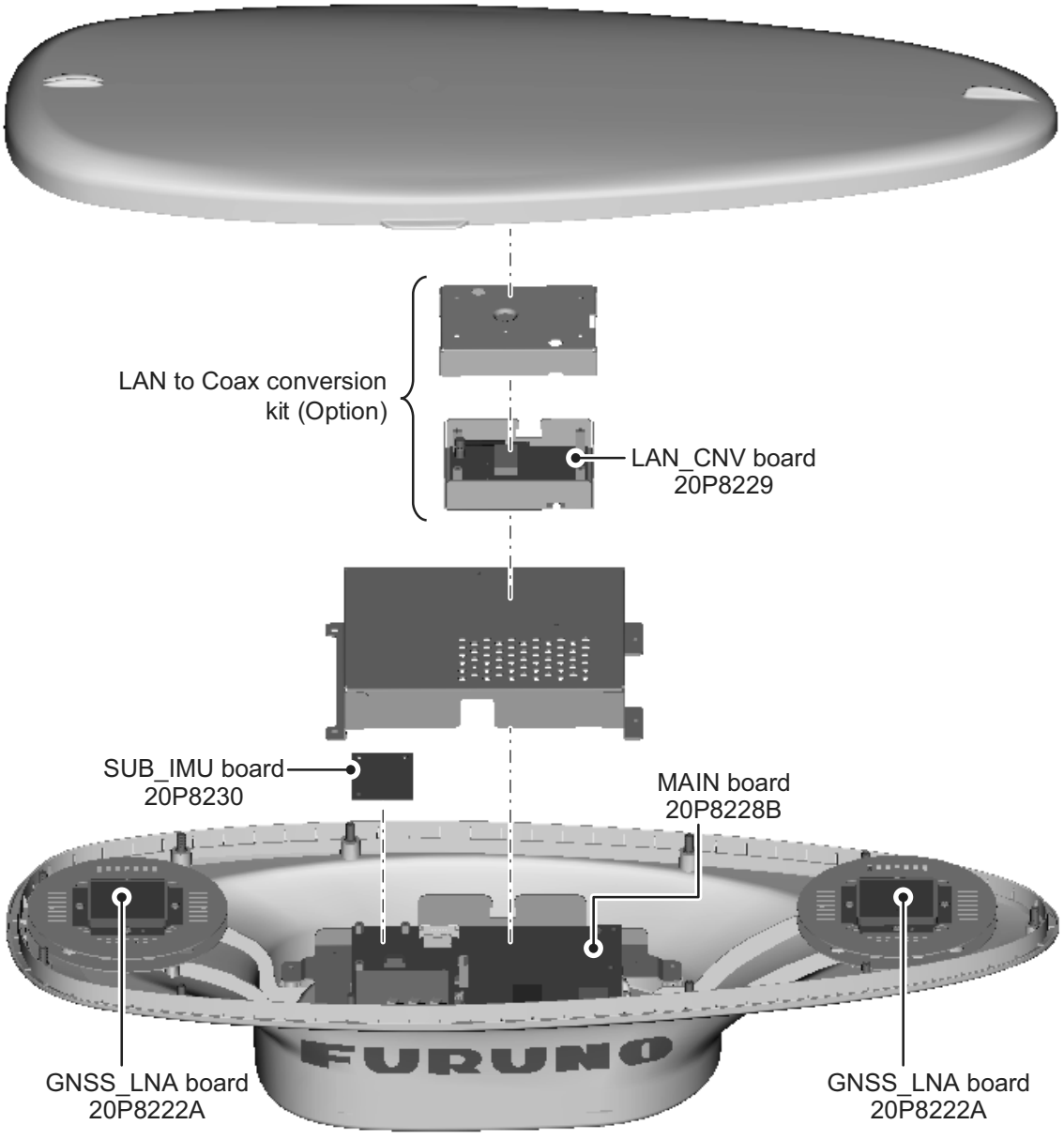


*: Optional LAN to Coax conversion kit.

Note: SC-701 and SC-702 are not shown to scale in this figure.

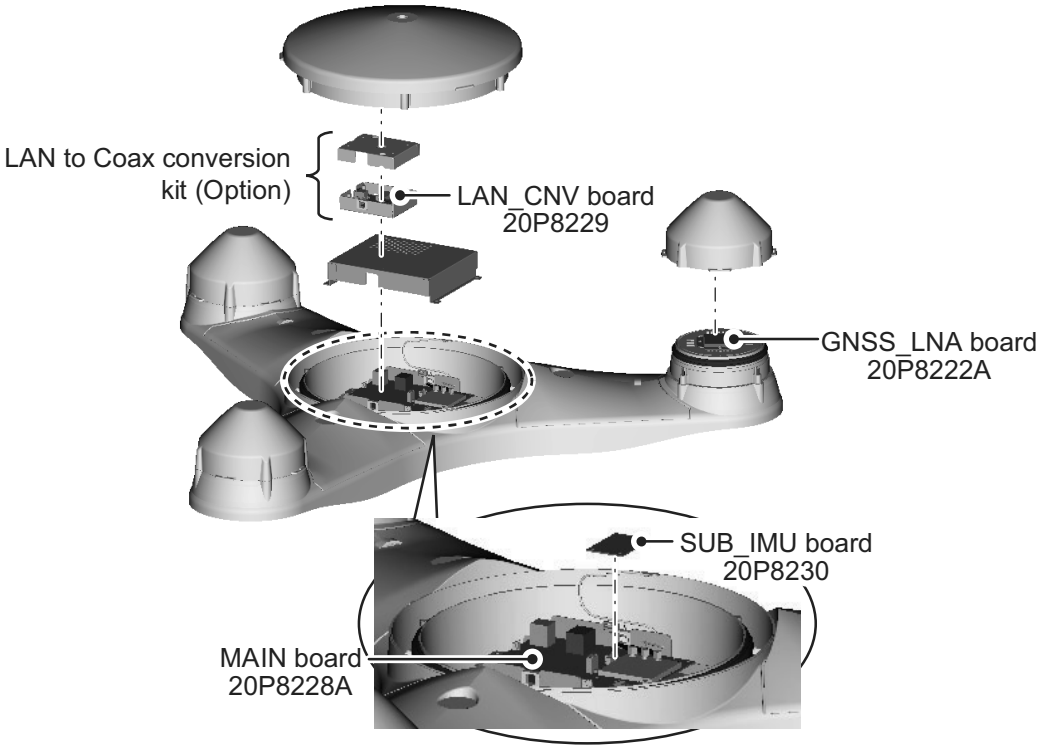
F U R U N O ELECTRICAL PARTS LIST	Model	SC-703
	Unit	ANTENNA UNIT
TYPE, NAME	LOCATION	
PRINTED CIRCUIT BOARD		
20P8228A, MAIN	ANTENNA UNIT SC-703	
20P8222A, GNSS_LNA	ANTENNA UNIT SC-703	
20P8229B, LAN_CNV	ANTENNA UNIT SC-703	
20P8230, SUB_IMU	ANTENNA UNIT SC-703	

PCB locations for SC-703



F U R U N O ELECTRICAL PARTS LIST	Model	SC-1303
	Unit	ANTENNA UNIT
TYPE, NAME	LOCATION	
PRINTED CIRCUIT BOARD		
20P8228B, MAIN	ANTENNA UNIT SC-1303	
20P8222A, GNSS_LNA	ANTENNA UNIT SC-1303	
20P8229B, LAN_CNV	ANTENNA UNIT SC-1303	
20P8230, SUB_IMU	ANTENNA UNIT SC-1303	

PCB locations for SC-1303



APPENDIX 9 JIS CABLE GUIDE

Cables listed in the manual are usually shown as Japanese Industrial Standard (JIS). Use the following guide to locate an equivalent cable locally.

JIS cable names may have up to 6 alphabetical characters, followed by a dash and a numerical value (example: DPYC-2.5).
For core types D and T, the numerical designation indicates the *cross-sectional Area (mm^2)* of the core wire(s) in the cable.
For core types M and TT, the numerical designation indicates the *number of core wires* in the cable.

1. Core Type

D: Double core power line
T: Triple core power line
M: Multi core
TT: Twisted pair communications (1Q=quad cable)

2. Insulation Type

P: Ethylene Propylene Rubber

3. Sheath Type

Y: PVC (Vinyl)

4. Armor Type

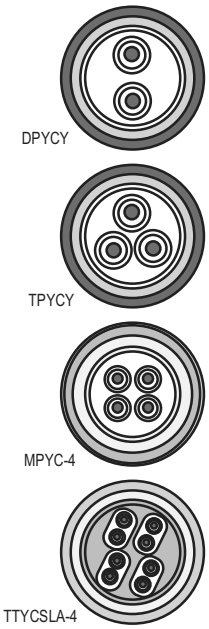
C: Steel

5. Sheath Type

Y: Anticorrosive vinyl sheath

6. Shielding Type

SLA: All cores in one shield, plastic tape w/aluminum tape
-SLA: Individually shielded cores, plastic tape w/aluminum tape



1 2 3 4 5 6
EX: TTYCYSLA - 4
Designation type — # of twisted pairs

1 2 3 4
MPYC - 4
Designation type — # of cores

The following reference table lists gives the measurements of JIS cables commonly used with Furuno products:

Type	Core Area	Core Diameter	Cable Diameter	Type	Core Area	Core Diameter	Cable Diameter
DPYC-1.5	1.5mm²	1.56mm	11.7mm	TTYCSLA-1	0.75mm²	1.11mm	9.4mm
DPYC-2.5	2.5mm²	2.01mm	12.8mm	TTYCSLA-1T	0.75mm²	1.11mm	10.1mm
DPYC-4	4.0mm²	2.55mm	13.9mm	TTYCSLA-1Q	0.75mm²	1.11mm	10.8mm
DPYC-6	6.0mm²	3.12mm	15.2mm	TTYCSLA-4	0.75mm²	1.11mm	15.7mm
DPYC-10	10.0mm²	4.05mm	17.1mm	TTYCY-1	0.75mm²	1.11mm	11.0mm
DPYCY-1.5	1.5mm²	1.56mm	13.7mm	TTYCY-1T	0.75mm²	1.11mm	11.7mm
DPYCY-2.5	2.5mm²	2.01mm	14.8mm	TTYCY-1Q	0.75mm²	1.11mm	12.6mm
DPYCY-4	4.0mm²	2.55mm	15.9mm	TTYCY-4	0.75mm²	1.11mm	17.7mm
MPYC-2	1.0mm²	1.29mm	10.0mm	TTYCY-4SLA	0.75mm²	1.11mm	19.5mm
MPYC-4	1.0mm²	1.29mm	11.2mm	TTYCYSLA-1	0.75mm²	1.11mm	11.2mm
MPYC-7	1.0mm²	1.29mm	13.2mm	TTYCYSLA-4	0.75mm²	1.11mm	17.9mm
MPYC-12	1.0mm²	1.29mm	16.8mm				
TPYC-1.5	1.5mm²	1.56mm	12.5mm				
TPYC-2.5	2.5mm²	2.01mm	13.5mm				
TPYC-4	4.0mm²	2.55mm	14.7mm				
TPYCY-1.5	1.5mm²	1.56mm	14.5mm				
TPYCY-2.5	2.5mm²	2.01mm	15.5mm				
TPYCY-4	4.0mm²	2.55mm	16.9mm				

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SPECIFICATIONS OF SATELLITE COMPASS
SC-70/130

1 GENERAL

1.1	Receiving frequency	1575.42 MHz (GPS/GALILEO), 1602.5625 MHz (GLONASS)
1.2	Tracking code	C/A code (GPS), E1B (GALILEO), L1OF (GLONASS)
1.3	Positional accuracy (dependent on ionospheric activity and multipath)	
	GPS	10 m approx. (2drms, HDOP<4)
	DGPS	5 m approx. (2drms, HDOP<4)
	WAAS	3 m approx. (2drms, HDOP<4)
	MSAS	7 m approx. (2drms, HDOP<4)
1.4	Ship's speed accuracy (SOG)	
		0.2 kn rms (tracking satellites 3 or 4)
		0.02 kn rms (tracking satellites 5 or more)
1.5	Ship's speed accuracy (VBW, speed on ground)	
		2.0% of ship's speed or 0.2 kn whichever is the greater (tracking satellites 3 or 4)
		0.2% of ship's speed or 0.02 kn whichever is the greater (tracking satellites 5 or more, at antenna position)
		0.2% of ship's speed or 0.08 kn rms (tracking satellites 5 or more, at another position)
1.6	Course accuracy	
	SC-70	0.4° RMS
	SC-130	0.25° RMS
1.7	Course resolution	0.1°, 0.01° or 0.001° (select from menu)
1.8	Attitude resolution	0.1°, 0.01° or 0.001° (select from menu)
1.9	Rate of turn	0.1°/s, 0.01°/s or 0.001°/s (select from menu)
1.10	Tracking bearing	45°/s
1.11	Position fixing time	90 s approx. (typical)
1.12	Attitude accuracy	Pitch/ Roll: 0.4° RMS
1.13	Heave accuracy	5 cm (1σ)

2 DISPLAY UNIT

2.1	Screen	4.3-inch color LCD, 95.04 mm (W) x 87.12 mm (H)
2.2	Resolution	480 x 272 dots (WQVGA)
2.3	Brilliance	600 cd/m^2 typical
2.4	Contrast	17 levels
2.5	Display mode	Heading, Nav data, Rate of turn and Speed (Non-IMO mode only)
2.6	Visible distance	0.65 m nominal

3 INTERFACE (JUNCTION BOX)

3.1	Number of ports (junction box)	
	IEC61162 (NMEA0183)	IEC61162-2: 1 port, IEC61162-1: 8 ports (I/O: 4, O: 4) External beacon input (DATA5 port): RTCM SC-104 V2.3 (RS-485), ITU-R M823
	CANbus	1 port
	AD-10	4 ports, for heading output
	RS-485	1 port, for display unit connection

	LAN	2 ports, Ethernet, 100Base-TX, RJ45 connecter (for IEC61162-450 and maintenance)
	USB	1 port for maintenance
3.2	Data sentences	
	DATA ports	
	Input	ACK, ACM, ACN, HBT, HDT, MSK, MSS, THS, VBW*2, VDR*2
	Output	ALC, ALF, ALR, ARC, DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG*2, HDM*2, HDT*1, HRM*2, MSK, POS, RMC, ROT, THS, VBW*2, VDR*2, VHW*2, VLW*2, VTG, XDR*2, ZDA
	NETWORK port	
	Input	ACK, ACM, ACN, HBT
	Output	ALC, ALF, ALR, ARC, DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, HBT, HDG, HDM, HDT*1, HRM*2, POS, RMC, ROT, THS, VBW*2, VDR*2, VHW*2, VLW*2, VTG, XDR*2, ZDA
		*1: Not used for new SOLAS vessels.
		*2: for Non-IMO types only.
3.3	Output proprietary sentences	
	PFEC	GPatt, GPhve, GPimu, pidat, pireq
3.4	PGN	
	Input	059392/904, 060928, 061184, 126208/720/996
	Output	059392/904, 060928, 061184, 065280, 126208/464/720/992/996, 127250/251/252/257/258, 129025/026/029/033/044/291/539/540/545/547, 130310/312/314/316/577/578/822/823/842/843/845/846
3.5	IEC61162-450 transmission group	
	Input	MISC, SATD, NAVD, PROP
	Output	Arbitrary (default: SATD)
3.6	Other network function excepted IEC61162-450	
		NTP, HTTP

4 POWER SUPPLY

4.1	Junction box	12-24 VDC: 2.1-1.1 A (included antenna unit and display unit)
4.2	Rectifier (PR-240, option)	100-115/220-230 VAC, 1 phase, 50/60Hz and 24VDC

5 ENVIRONMENTAL CONDITIONS

5.1	Ambient temperature	
	Antenna unit	-25°C to +55°C (storage: -25°C to +70°C)
	Display unit/ Junction box	-15°C to +55°C
5.2	Relative humidity	95% or less at +40°C
5.3	Degree of protection	
	Antenna unit	IP56
	Display unit	IP22 (IP35: option)
	Junction box	IP20 (IP22: bulkhead mount)
5.4	Vibration	IEC 60945 Ed.4

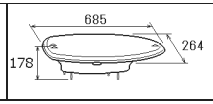
6 UNIT COLOR

6.1	Antenna unit	N9.5
6.2	Display unit/ Junction box	N2.5

P A C K I N G　L I S T

SC-703-A-＊, SC-703-A-＊-HK

A-1

N A M E	O U T L I N E	DESCRIPTION/CODE No.	Q'TY
ユニット　UNIT			
空中線部 ANTENNA UNIT		SC-703-A-＊ 000-037-295-00 ＊＊	1
工事材料　INSTALLATION MATERIALS			
工事材料 INSTALLATION MATERIALS		CP20-04201 001-459-750-00 ＊＊	1

ｺｰﾄﾞ番号末尾の[＊＊]は、選択品の代表ｺｰﾄﾞを表します。
CODE NUMBER ENDING WITH "＊＊" INDICATES THE CODE NUMBER OF REPRESENTATIVE MATERIAL.

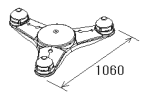
略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

C7282-Z07-D

P A C K I N G　L I S T

SC-1303-A-＊, SC-1303-A-＊-HK

A-2

N A M E	O U T L I N E	DESCRIPTION/CODE No.	Q'TY
ユニット　UNIT			
空中線部 ANTENNA UNIT		SC-1303-A-＊ 000-037-299-00 ＊＊	1
工事材料　INSTALLATION MATERIALS			
工事材料 INSTALLATION MATERIALS		CP20-04202 001-459-760-00 ＊＊	1

ｺｰﾄﾞ番号末尾の[＊＊]は、選択品の代表ｺｰﾄﾞを表します。
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略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

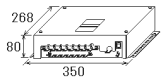
C7283-Z01-C

P A C K I N G L I S T

20BI-X-9851 -2 1/1

SC-701-A-*, SC-701-A-*-HK-*

A-3

N A M E	O U T L I N E	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT			
接続箱 JUNCTION BOX		SC-701-A-* 000-037-210-00 **	1
予備品 SPARE PARTS			
予備品 SPARE PARTS		SP20-01801 001-474-090-00 **	1
工事材料 INSTALLATION MATERIALS			
工事材料 INSTALLATION MATERIALS		CP20-04001 001-459-600-00 **	1

ｺｰﾄﾞ番号末尾の[**]は、選択品の代表ｺｰﾄﾞを表します。
CODE NUMBER ENDING WITH "**" INDICATES THE CODE NUMBER OF REPRESENTATIVE MATERIAL.

略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

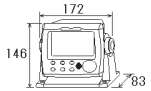
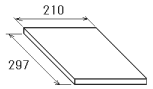
C7282-Z01-C

P A C K I N G L I S T

20BI-X-9863 -3 1/1

SC-702-A-*, SC-702-A-*-HK

A-4

N A M E	O U T L I N E	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT			
表示部 DISPLAY UNIT		SC-702-A-* 000-037-269-00 **	1
付属品 ACCESSORIES			
付属品 ACCESSORIES		FP19-01201 001-033-760-00 **	1
工事材料 INSTALLATION MATERIALS			
工事材料 INSTALLATION MATERIALS		CP20-04101 001-521-370-00 **	1
図書 DOCUMENT			
取扱説明書 OPERATOR'S MANUAL		OM*-72820-* 000-192-405-1* **	1

ｺｰﾄﾞ番号末尾の[**]は、選択品の代表ｺｰﾄﾞを表します。
CODE NUMBER ENDING WITH "**" INDICATES THE CODE NUMBER OF REPRESENTATIVE MATERIAL.

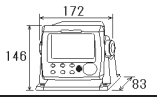
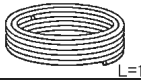
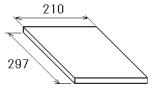
略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

C7282-Z11-D

PACKING LIST

SC-702-A-*-1/3 , SC-702-A-*-1/3-HK

A-5

NAME	OUTLINE	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT			
表示部 DISPLAY UNIT		SC-702-A-*-1/3 000-037-273-00 **	1
付属品 ACCESSORIES			
付属品 ACCESSORIES		FP19-01201 001-033-760-00 **	1
工事材料 INSTALLATION MATERIALS			
ｹｰﾌﾞﾙ組品 CABLE ASSEMBLY		Z-#26X2P+0.3SQX1PL10 000-192-276-10	1 (*)
ｹｰﾌﾞﾙ組品 CABLE ASSEMBLY		Z-#26X2P+0.3SQX1PL30 000-192-277-10	1 (*)
工事材料 INSTALLATION MATERIALS		CP20-04101 001-521-370-00 **	1
図書 DOCUMENT			
取扱説明書 OPERATOR'S MANUAL		OM*-72820-* 000-192-405-1* **	1

1.ｺｰﾄﾞ番号末尾の[**]は、選択品の代表ｺｰﾄﾞを表します。
CODE NUMBER ENDING WITH "**" INDICATES THE CODE NUMBER OF REPRESENTATIVE MATERIAL.

2.(*)は、それぞれ仕様選択品を表します。
(*)INDICATE SPECIFICATION SELECTIVE ITEM.

略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

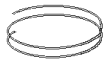
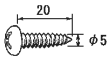
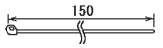
A-6

FURUNO

CODE NO.	001-514-470-00	20BI-X-9410 -0
TYPE	CP20-04001	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｲﾗｯｸｽﾁｭｰﾌﾞA INSULATION TUBE		3.0X0.3 YEL *50CM* CODE NO. 000-162-841-10	3	
2	+ﾄﾗｽﾀｯﾋﾟﾝﾈｼﾞ 1ｼｭ SELF-TAPPING SCREW		5X20 SUS304 CODE NO. 000-162-608-10	4	
3	ｺﾝﾍﾞｯｸｽ CABLE TIE		CV-150N CODE NO. 000-162-186-10	32	

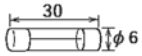
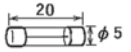
(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

FURUNO ELECTRIC CO., LTD.

FURUNO

CODE NO.	001-516-680-00	20BI-X-9303-0 1/1
TYPE	SP20-01801	BOX NO. P

SHIP NO.	SPARE PARTS LIST FOR	U S E	SETS PER VESSEL

ITEM NO.	NAME OF PART	OUTLINE	DWG. NO. OR TYPE NO.	QUANTITY WORKING PER SET	QUANTITY WORKING PER VES	QUANTITY SPARE	REMARKS/CODE NO.
1	ﾋｭｰｽﾞ GLASS TUBE FUSE		FGBO-A 125V 3A PBF	1	1	3	000-155-850-10
2	ﾋｭｰｽﾞ GLASS TUBE FUSE		FGMB 125V 0.3A PBF	1	1	3	000-176-821-10

MFR'S NAME	FURUNO ELECTRIC CO.,LTD.	DWG NO.	C7282-P02-A CN	1/1

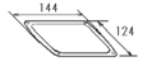
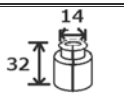
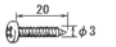
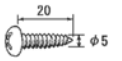
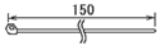
（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO

CODE NO.	001-521-480-00	20BI-X-9414 -0
TYPE	CP20-04101	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	F_MOUNT CUSHION F_MOUNT CUSHION		20-032-1064-1 CODE NO. 100-357-181-10	1	
2	ｹｰﾌﾞﾙﾊﾟｯｷﾝ CABLE GASKET		20-037-2104-0 CODE NO. 100-419-500-10	1	
3	+ﾅﾍﾞﾀｯﾋﾟﾝﾈｼﾞ 1ｼｭ SELF-TAPPING SCREW		3X20 SUS304 CODE NO. 000-163-884-10	4	
4	+ﾄﾗｽﾀｯﾋﾟﾝﾈｼﾞ 1ｼｭ SELF-TAPPING SCREW		5X20 SUS304 CODE NO. 000-162-608-10	4	
5	ｺﾝﾍﾞｯｸｽ CABLE TIE		CV-150B CODE NO. 000-167-183-10	3	

（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO ELECTRIC CO ., LTD. CN

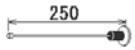
C7282-M13-A

FURUNO

CODE NO.	001-514-460-00	20BI-X-9411 -1
TYPE	CP20-04201	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	鳥除け BIRD DETERRENT		20-024-3101-3 ROHS CODE NO. 100-315-303-10	4	
2	六角ﾅｯﾄ 1ｼｭ HEX.NUT		M10 SUS304 CODE NO. 000-166-475-10	8	
3	ﾊﾞﾈ座金 SPRING WASHER		M10 SUS304 CODE NO. 000-167-233-10	4	
4	平座金 FLAT WASHER		M10 SUS316L CODE NO. 000-167-416-10	4	
5	接着剤袋詰 ADHESIVE		TB5211 50G CODE NO. 001-517-370-00	1	

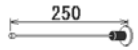
（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO

CODE NO.	001-514-570-00	20BI-X-9412 -1
TYPE	CP20-04202	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	鳥除け BIRD DETERRENT		20-024-3101-3 ROHS CODE NO. 100-315-303-10	7	
2	六角ﾅｯﾄ 1ｼｭ HEX.NUT		M10 SUS304 CODE NO. 000-166-475-10	8	
3	ﾊﾞﾈ座金 SPRING WASHER		M10 SUS304 CODE NO. 000-167-233-10	4	
4	平座金 FLAT WASHER		M10 SUS316L CODE NO. 000-167-416-10	4	
5	接着剤袋詰 ADHESIVE		TB5211 50G CODE NO. 001-517-370-00	1	

（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO

CODE NO.	000-033-318-00	20BI-X-9405 -0
TYPE	CP20-04300	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLABVCV30T CODE NO. 001-470-930-00	1	

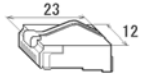
（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO

CODE NO.	000-033-319-00	20BI-X-9406 -0
TYPE	CP20-04310	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLABVCV40T CODE NO. 001-470-940-00	1	

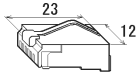
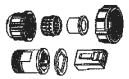
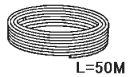
（略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.）

FURUNO

CODE NO.	000-033-320-00	20BI-X-9407 -0
TYPE	CP20-04320	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLABVCV50T CODE NO. 001-470-950-00	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

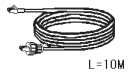
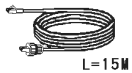
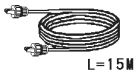
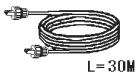
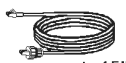
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.		20BI-X-9404 -3
TYPE		1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLAVCV10CT CODE NO. 001-521-000-00	1	選択 TO BE SELECTED
2	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLAVCV15CT CODE NO. 001-521-010-00	1	選択 TO BE SELECTED
3	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		EDTIC5E350SLAW8.815T CODE NO. 001-470-960-00	1	選択 TO BE SELECTED
4	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		EDTIC5E350SLAW8.830T CODE NO. 001-470-970-00	1	選択 TO BE SELECTED
5	ｹｰﾌﾞﾙ(ｸﾐﾋﾝ) CABLE ASSEMBLY		S-17209-L10 CODE NO. 001-524-090-00	1	選択 TO BE SELECTED
6	ｹｰﾌﾞﾙ(ｸﾐﾋﾝ) CABLE ASSEMBLY		S-17209-L15 CODE NO. 001-524-100-00	1	選択 TO BE SELECTED

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

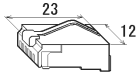
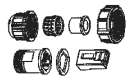
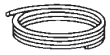
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.	000-033-324-00	20BI-X-9409 -0
TYPE	CP20-04360	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY	 L=30M	EDTIC5E350SLAW8.830T CODE NO. 001-470-990-00	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

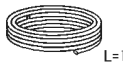
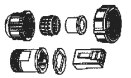
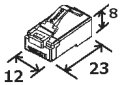
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.	000-035-430-00	20BI-X-9417 -1
TYPE	CP20-04370	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY	 L=10M	DTIC5E350SLABVCV10T CODE NO. 000-195-119-11	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

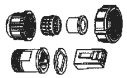
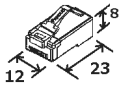
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.	000-035-431-00	20BI-X-9418 -1
TYPE	CP20-04380	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	LANｹｰﾌﾞﾙ(CAT5E) CABLE ASSEMBLY		DTIC5E350SLABVCV15T CODE NO. 000-195-120-11	1	
2	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	
3	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

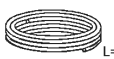
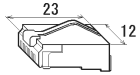
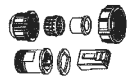
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.	000-035-508-00	20BI-X-9419 -0
TYPE	CP20-04520	1/1

工事材料表

INSTALLATION MATERIALS

番号 NO.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	ｹｰﾌﾞﾙ(ｸﾐﾋﾝ) CABLE ASSEMBLY		S-17210-L10 CODE NO. 000-195-269-10	1	
2	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C CODE NO. 000-166-044-10	1	
3	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY CODE NO. 000-192-316-10	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

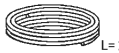
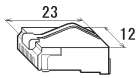
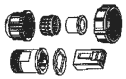
FURUNO ELECTRIC CO ., LTD.

FURUNO

CODE NO.	000-035-509-00	20BI-X-9420 -1
TYPE	CP20-04530	1/1

工事材料表

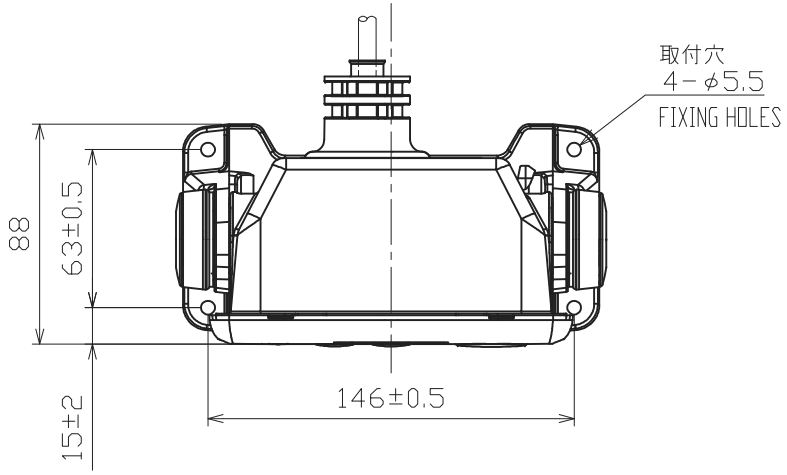
INSTALLATION MATERIALS

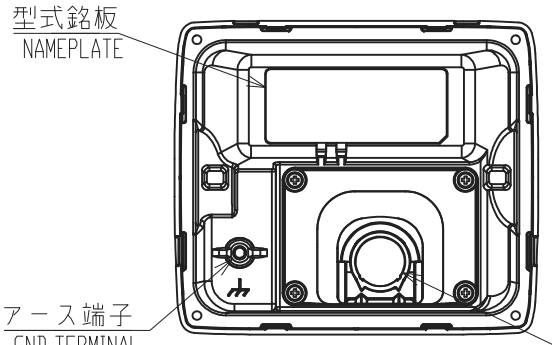
番 号 NO.	名 称 NAME	略 図 OUTLINE	型名／規格 DESCRIPTIONS		数量 Q'TY	用途／備考 REMARKS
1	ｹｰﾌﾞﾙ(ｸﾐﾋﾝ) CABLE ASSEMBLY		S-17210-L15		1	
			CODE NO.	000-195-270-10		
2	ｺﾈｸﾀ(ﾓｼﾞｭﾗｰ) MODULAR CONNCTOR		MPS588-C		1	
			CODE NO.	000-166-044-10		
3	ｺﾈｸﾀ(ﾎﾞｳｽｲｶﾞﾀ) CONNECTOR		FRU-RJ-PLUG-ASSY		1	
			CODE NO.	000-192-316-10		

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

FURUNO ELECTRIC CO ., LTD.

FURUNO

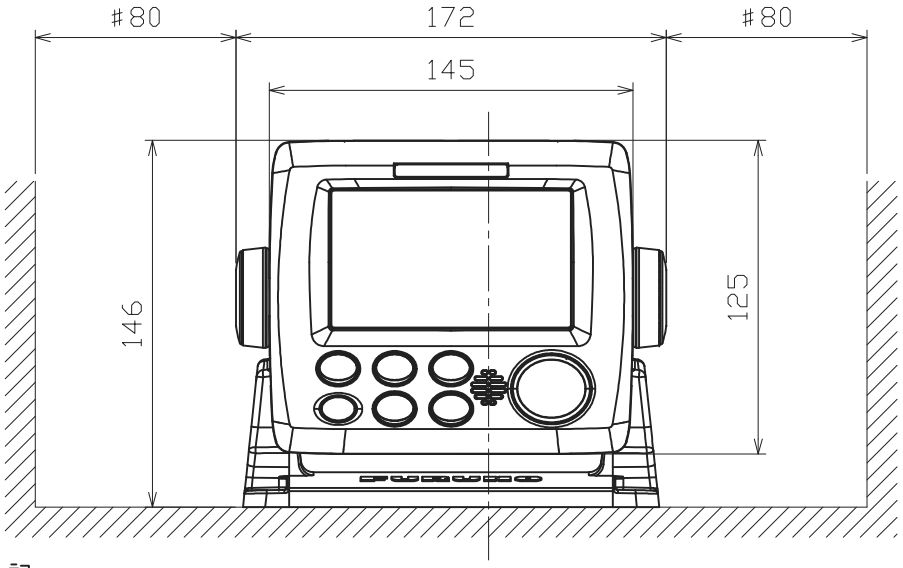


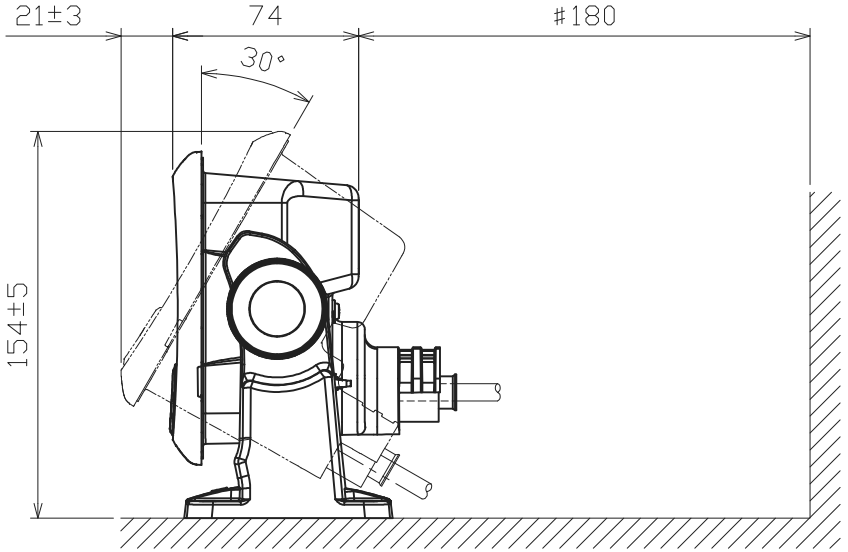


背面
REAR VIEW

表1 TABLE 1

寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3





注　記

1）指定外寸法公差は表１による。

2）＃印寸法は、最小サービス空間寸法とする。

3）取付用ネジはトラスタッピンネジ呼び径５×２０を使用のこと。

NOTE

1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS ø5x20 FOR FIXING THE UNIT.

DRAWN 26/Dec/2017 T.YAMASAKI		TITLE	SC-702
CHECKED 26/Dec/2017 H.MAKI		名称	表示部（卓上装備）
APPROVED 27/Dec/2017 H.MAKI	SC-70/130		外寸図
SCALE 1/3 MASS 0.70 ±10% kg	質量はケーブルを含まず。 MASS DOES NOT INCLUDE CABLE.	NAME	DISPLAY UNIT (TABLETOP MOUNT)
DWG.No. C7282-G01- B	REF.No. 20-037-200G-3		OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO

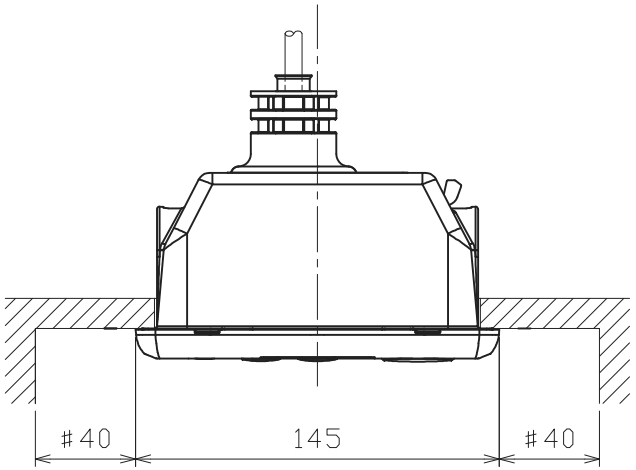
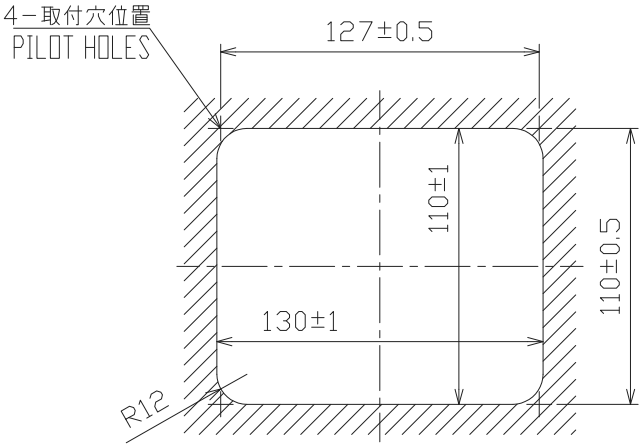
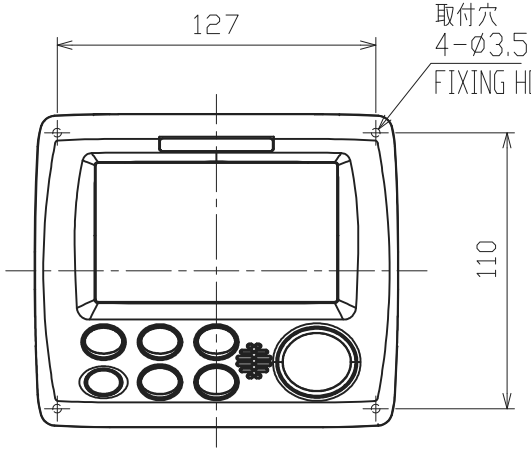
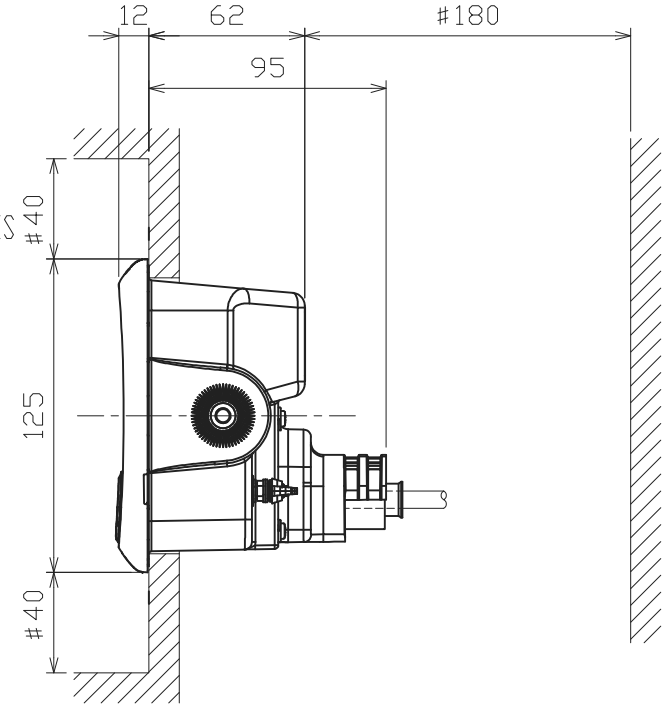


表1 TABLE 1

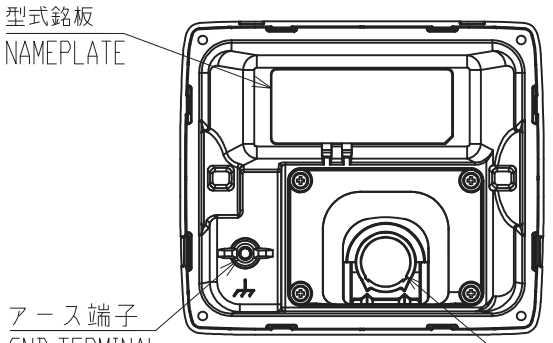
寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3







取付穴寸法
CUTOUT DIMENSIONS



注　記

１）　指定外寸法公差は表１による。

２）　＃印寸法は、最小サービス空間寸法とする。

３）　取付用ネジはナベタッピンネジ呼び径３×２０を使用のこと。

NOTE

1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE PAN-HEAD TAPPING SCREWS ø3x20 FOR FIXING THE UNIT.

DRAWN 26/Dec/2017 T.YAMASAKI			TITLE SC-702
CHECKED 26/Dec/2017 H.MAKI			名称 表示部（埋込装備）
APPROVED 27/Dec/2017 H.MAKI		SC-70/130	外寸図
SCALE 1/3	MASS 0.60 ±10% kg	質量はケーブルを含まず。 MASS DOES NOT INCLUDE CABLE.	NAME DISPLAY UNIT (FLUSH MOUNT)
DWG.No. C7282-G02- B		REF.No. 20-037-201G-3	OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO

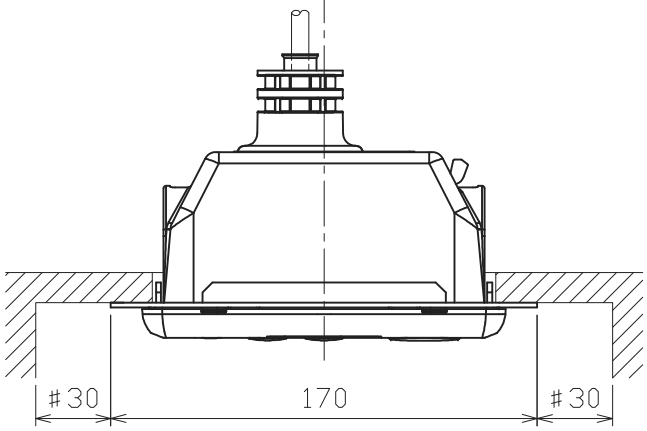
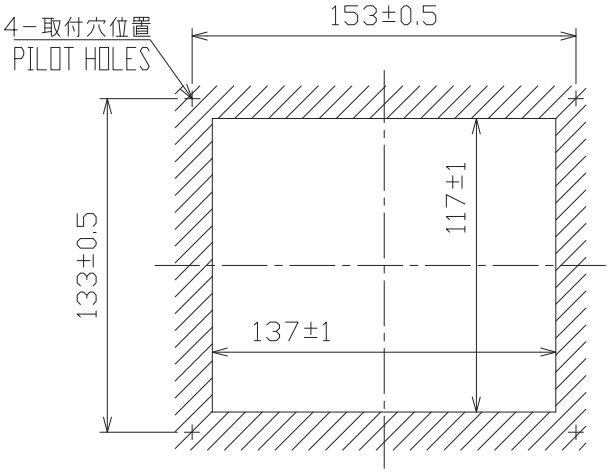
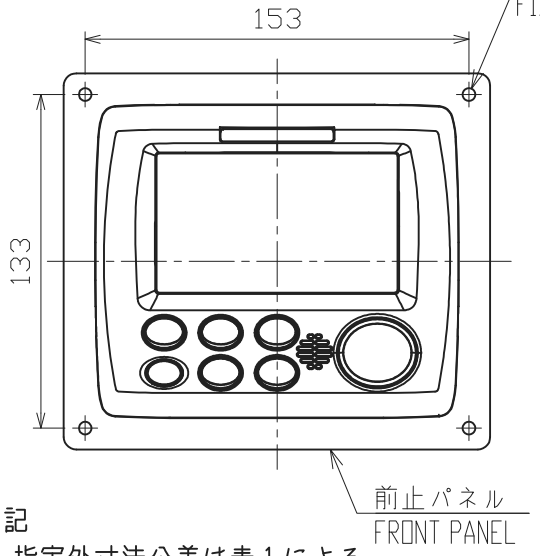


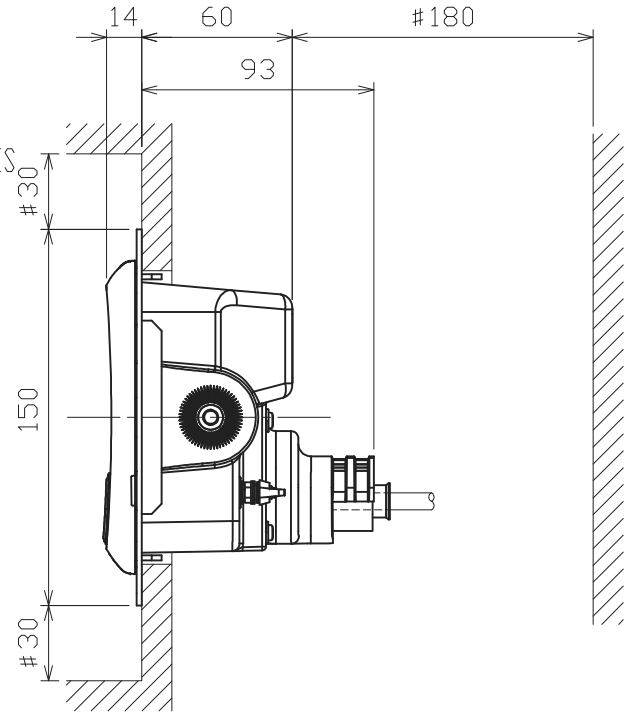
表1 TABLE 1

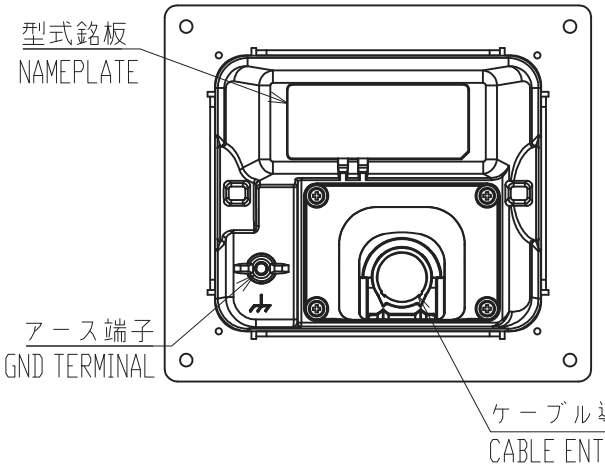
寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3



取付穴寸法図
CUTOUT DIMENSIONS







注　記

1）指定外寸法公差は表1による。

2）#印寸法は、最小サービス空間寸法とする。

3）取付用ネジはトラスタッピンネジ呼び径4×16を使用のこと。

NOTE

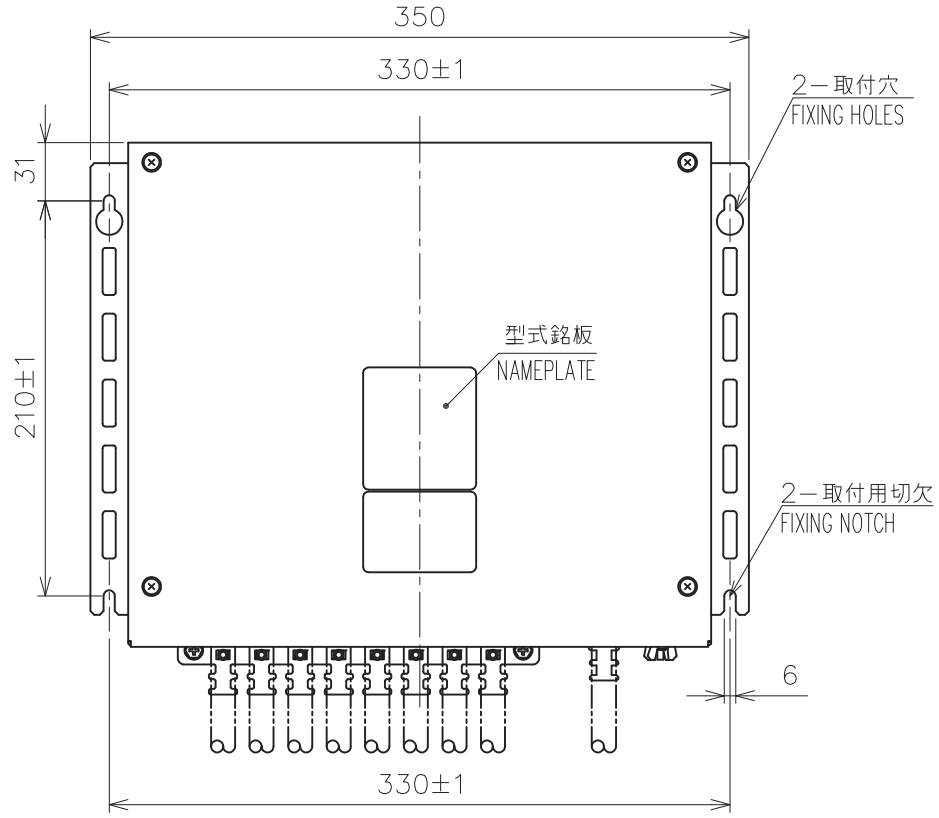
1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS ø4x16 FOR FIXING THE UNIT.

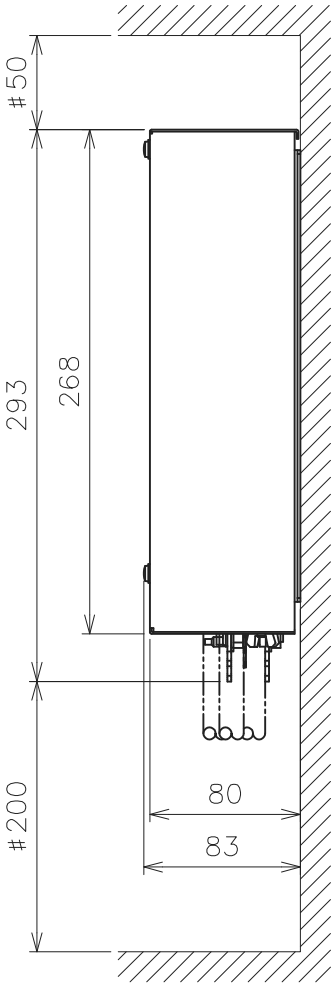
DRAWN 26/Dec/2017 T.YAMASAKI		TITLE	SC-702
CHECKED 26/Dec/2017 H.MAKI		名称	表示部（パネル装備）
APPROVED 27/Dec/2017 H.MAKI	SC-70/130		外寸図
SCALE 1/3 MASS 0.65 ±10% kg	質量はケーブルを含まず。 MASS DOES NOT INCLUDE CABLE.	NAME	DISPLAY UNIT (PANEL MOUNT)
DWG.No. C7282-G03- B	REF.No. 20-037-202G-3		OUTLINE DRAWING

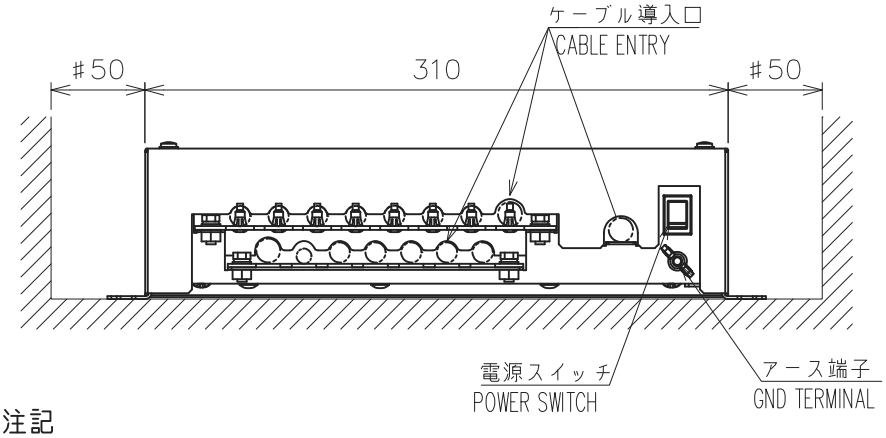
FURUNO ELECTRIC CO., LTD.

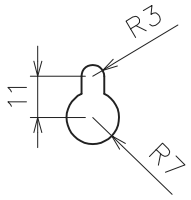
表1 TABLE 1

寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3









取付穴詳細（尺度：１／２）
DETAIL FOR FIXING (SCALE: 1/2)

注記
１）指定外の寸法公差は表１による。
２）＃印寸法は最小サービス空間寸法とする。
３）取付用ネジはタッピンネジＭ５×２０、またはＭ５ボルトを使用のこと。

NOTE
1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #: MINIMUM SERVICE CLEARANCE.
3. USE M5 BOLTS OR TAPPING SCREWS M5x20 FOR FIXING THE UNIT.

表2 TABLE 2

変換基板 LAN-CNV	質量（kg±10%） MASS
なし －	2.9
あり YES	3.1

DRAWN 17/Jan/2017 T.YAMASAKI		TITLE	SC-701
CHECKED 17/Jan/2017 H.MAKI		名称	接続箱
APPROVED 17/Jan/2017 H.MAKI	SC-70/130		外寸図
SCALE 1/4 MASS 表２参照 SEE TABLE 2		NAME	JUNCTION BOX
DWG. No. C7282-G04- C	REF. No. 20-037-100G-3		OUTLINE DRAWING

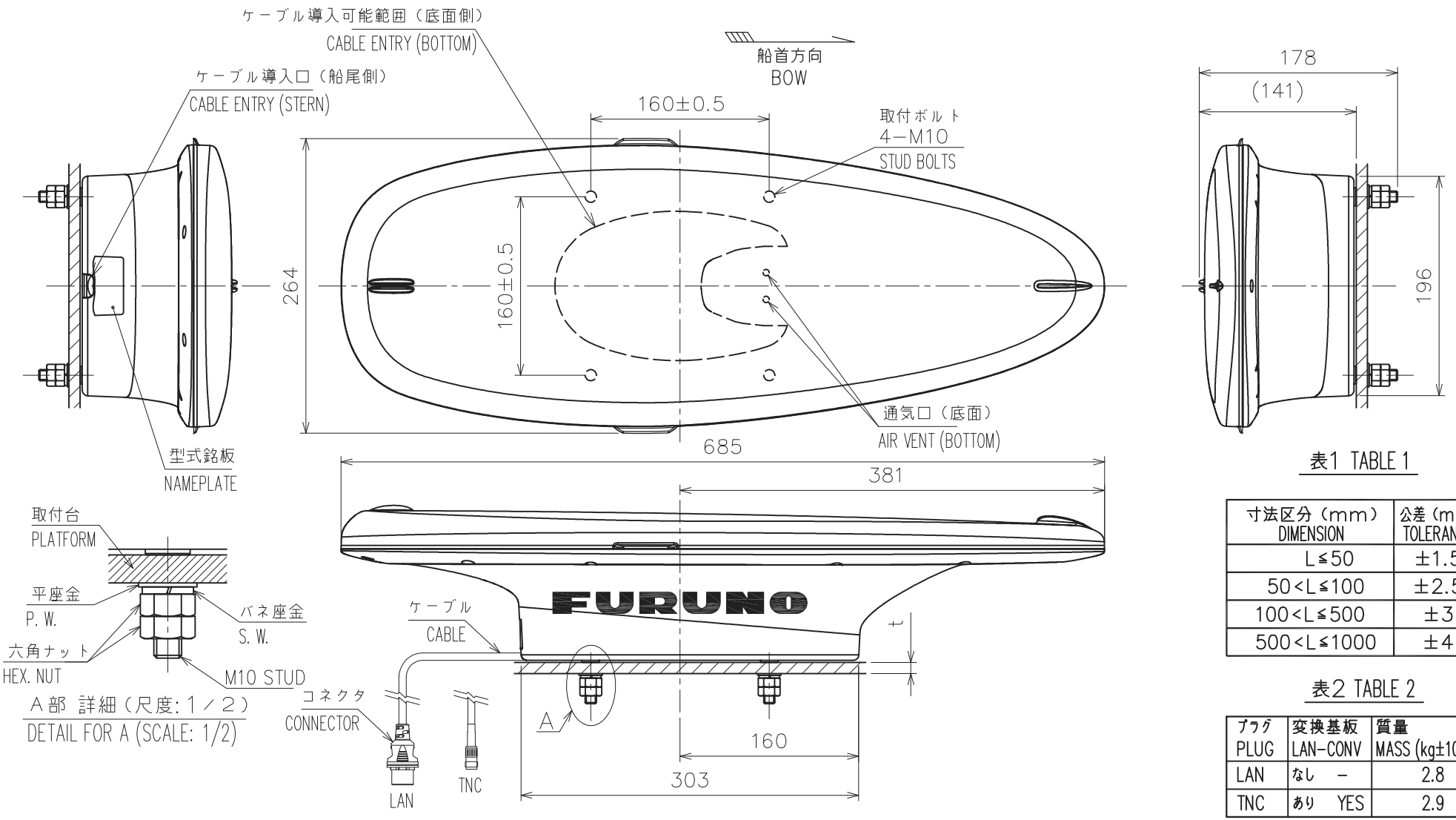


表1 TABLE 1

寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3
500<L≦1000	±4

表2 TABLE 2

プラグ PLUG	変換基板 LAN-CONV	質量 MASS (kg±10%)
LAN	なし −	2.8
TNC	あり YES	2.9

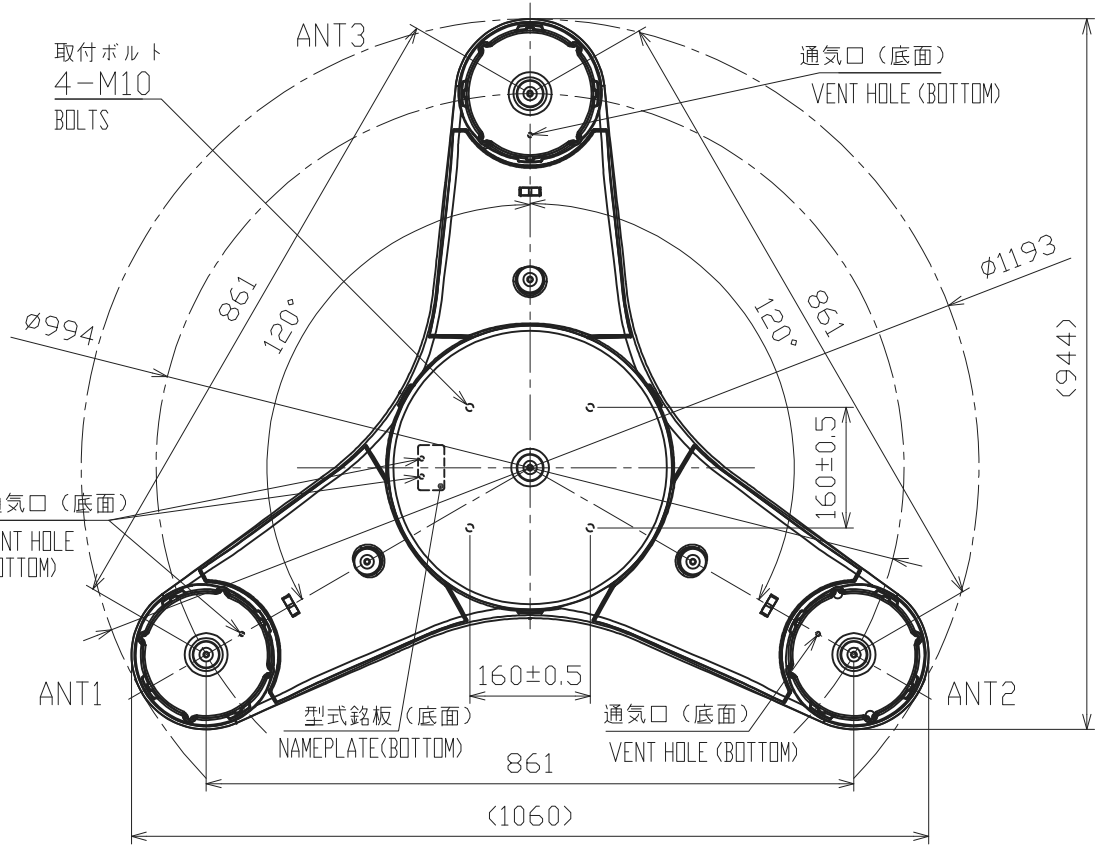
注　記　1）指定外の寸法公差は表1による。
　　2）取付台の厚さ（t）は、5以上15以下とする。

NOTE　1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
　　2. THICKNESS OF PLATFORM (t): 5≦t≦15.

DRAWN 25/Jan/2018 T.YAMASAKI		TITLE	SC-703
CHECKED 25/Jan/2018 H.MAKI		名称	空中線部
APPROVED 25/Jan/2018 H.MAKI	SC-70		外寸図
SCALE 1/5 MASS 表2 TABLE 2	質量はケーブル（0.5m）を含む。 MASS INCLUDES 0.5m CABLE.	NAME	ANTENNA UNIT
DWG.No. C7282-G05- C	REF.No. 20-037-300G-3		OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO



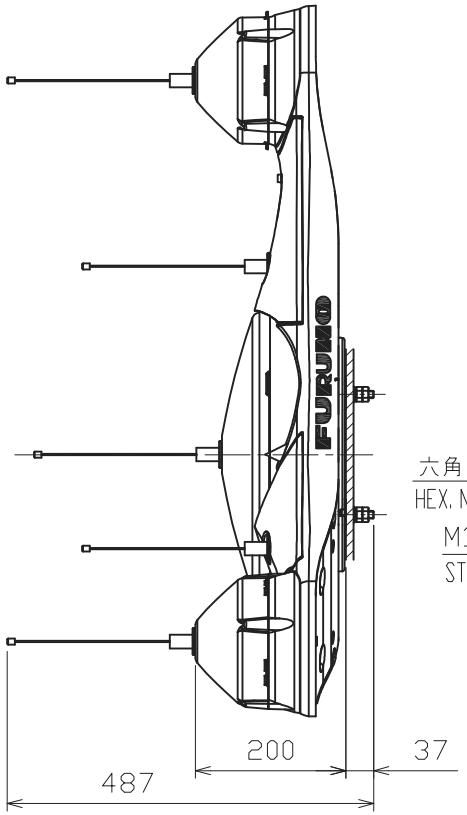
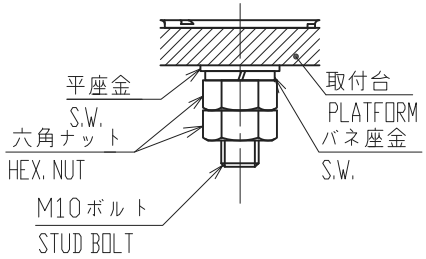


表1　TABLE 1

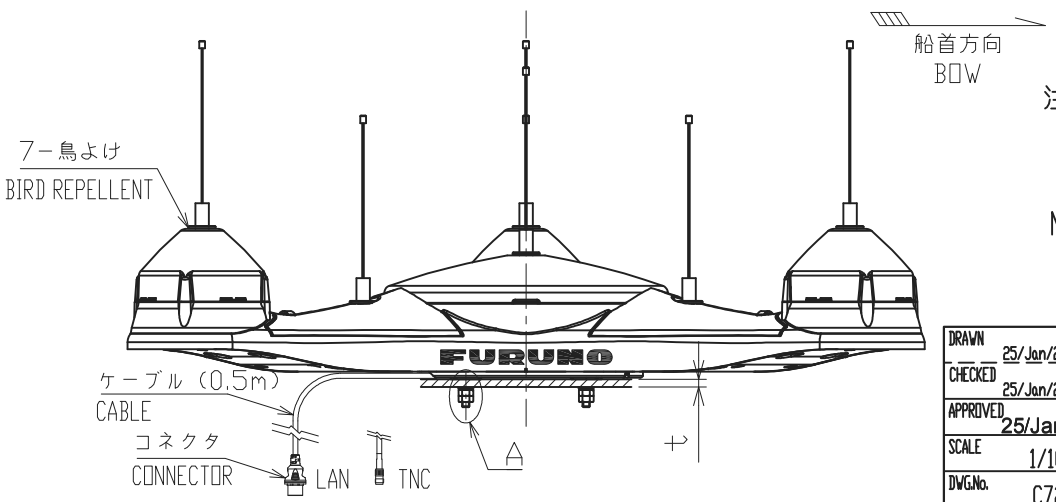
寸法区分（mm） DIMENSION	公差（mm） TOLERANCE
L≦50	±1.5
50<L≦100	±2.5
100<L≦500	±3
500<L≦1000	±4
1000<L≦2000	±5



A部 詳細　（尺度 1:2）
DETAIL OF A (SCALE: 1/2)

表2 TABLE 2

プラグ PLUG	変換基板 LAN-CONV	質量 MASS (kg±10%)
LAN	なし　－	7.1
TNC	あり　YES	7.2



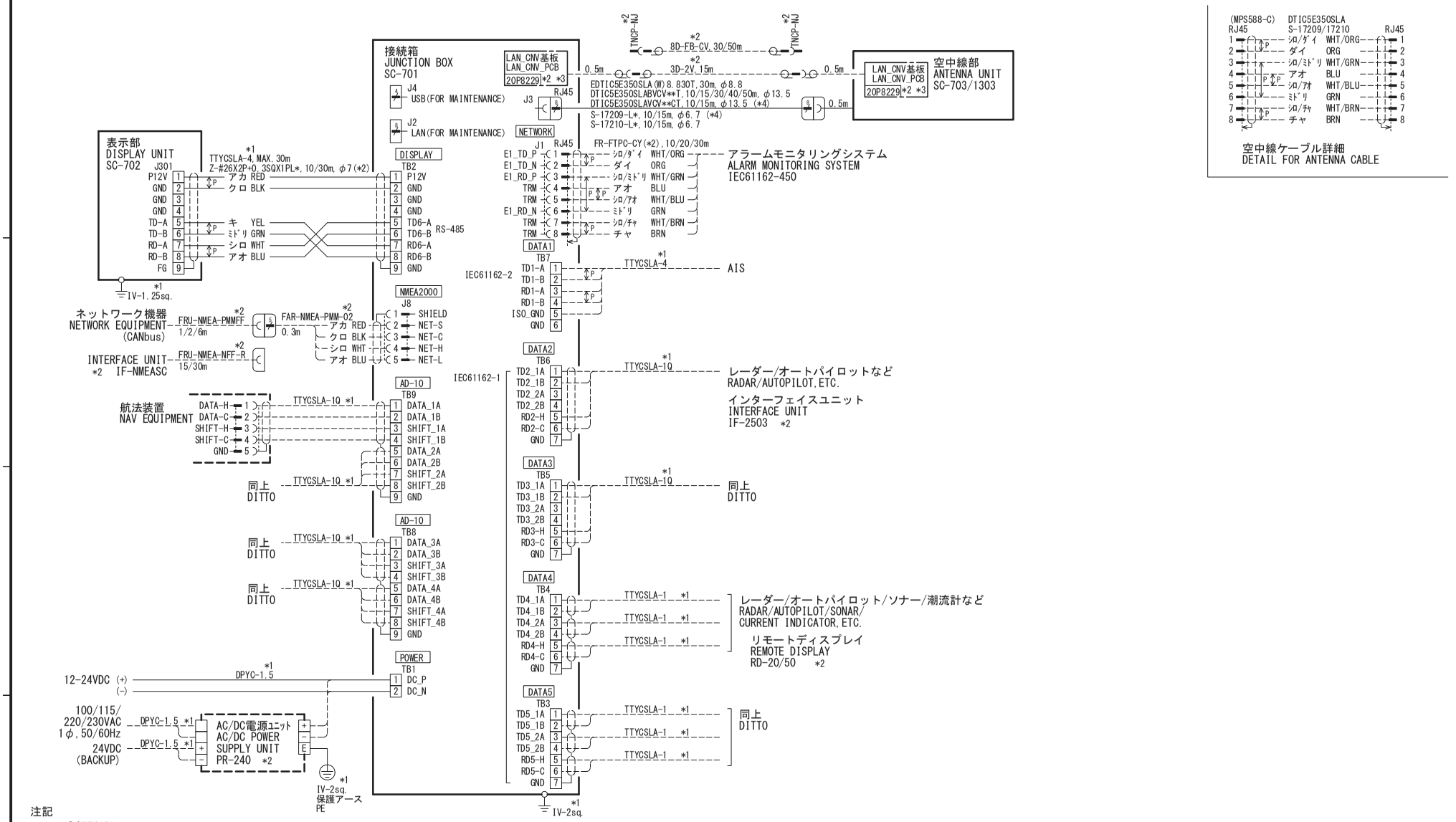
注　記　1）　指定外の寸法公差は表１による。
　　2）　取付台の厚さ（ｔ）は、５以上１５以下とする。
　　3）　取付面は平坦であること。

NOTE　1.　TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
　　2.　THICKNESS OF PLATFORM (t): 5≦t≦ 15.
　　3.　PLATFORM SHOULD BE FLAT.

DRAWN 25/Jan/2018 T.YAMASAKI			TITLE SC-1303
CHECKED 25/Jan/2018 H.MAKI			名称 空中線部
APPROVED 25/Jan/2018 H.MAKI		SC-130	外寸図
SCALE 1/10	MASS 表2 TABLE 2	質量は座金・ナットを含まず。 MASS DOES NOT INCLUDE WASHER/NUT.	NAME ANTENNA UNIT
DWG.No. C7283-G01- D		REF.No. 20-037-350G-3	OUTLINE DRAWING

FURUNO ELECTRIC CO., LTD.

FURUNO



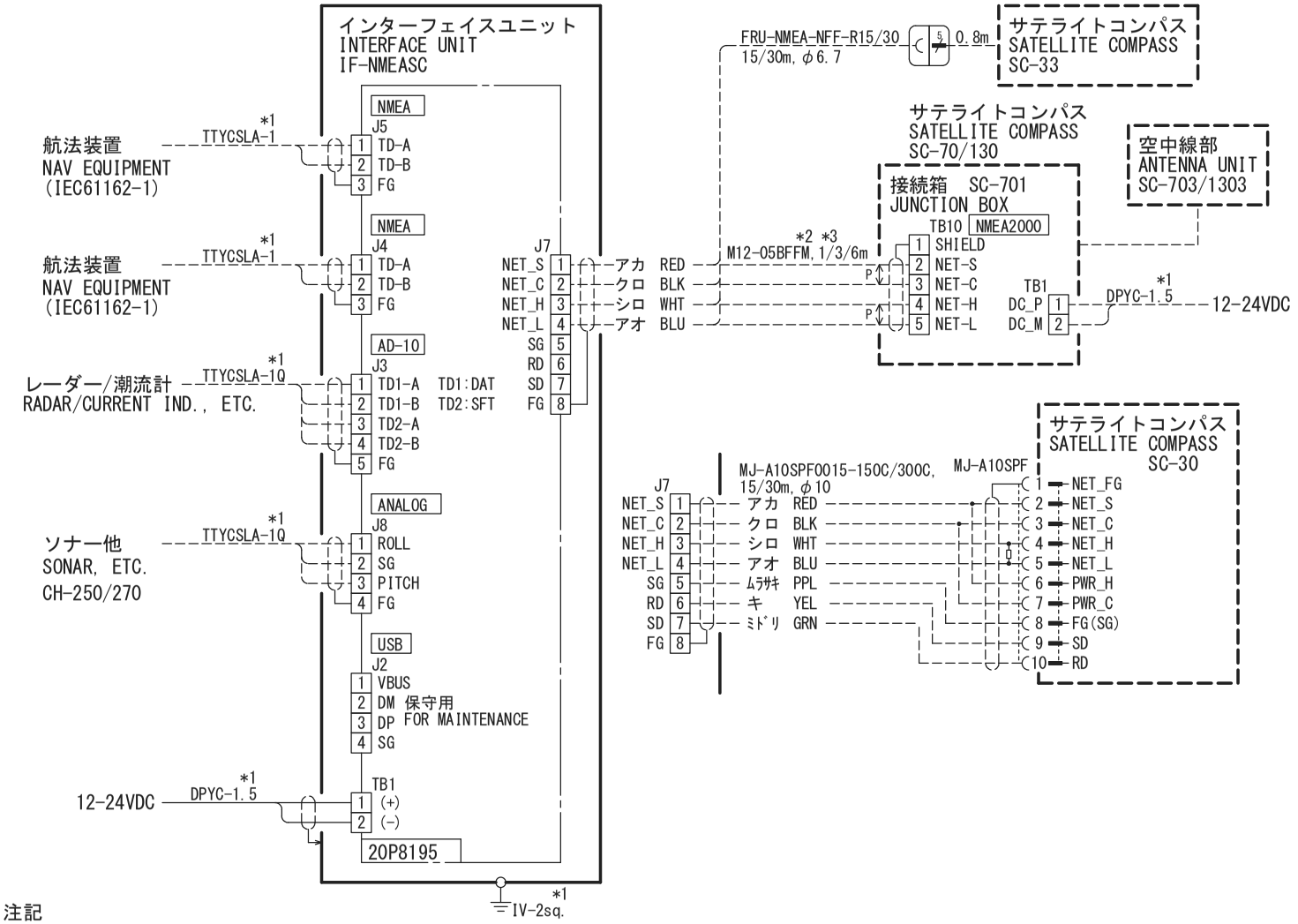
注記
＊1）造船所手配。
＊2）オプション。
＊3）換装時のみ。
＊4）両端コネクタ付。

NOTE
*1: SHIPYARD SUPPLY.
*2: OPTION.
*3: FOR REPLACEMENT ONLY.
*4: CONNECTORS ARE ATTACHED AT BOTH SIDE.

DRAWN 14/Jul/2020 T.YAMASAKI		TITLE	SC-70/130
CHECKED 14/Jul/2020 H.MAKI		名称	サテライトコンパス
APPROVED 17/Dec/2020 H.MAKI			相互結線図
SCALE / MASS kg		NAME	SATELLITE COMPASS
DWG No. C7282-C01- L	REF. No. 20-037-5001-3		INTERCONNECTION DIAGRAM

FURUNO ELECTRIC CO., LTD.

FURUNO



注記
＊1）造船所手配。
＊2）オプション。
＊3）コネクタを取り外して接続する。

NOTE
*1: SHIPYARD SUPPLY.
*2: OPTION.
*3: REMOVE THE PLUG FOR FABRICATION.

DRAWN 25/Oct/2017 T.YAMASAKI			TITLE IF-NMEASC
CHECKED 25/Oct/2017 H.MAKI			名称 インターフェイスユニット
APPROVED 27/Oct/2017 H.MAKI			相互結線図
SCALE	MASS kg		NAME INTERFACE UNIT
DWG. No. C7265-C02- B		REF. No.	INTERCONNECTION DIAGRAM

FURUNO ELECTRIC CO., LTD.

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FURUNO

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www.furuno.com

Publication No. DOCQA1377

Declaration of Conformity

0560

We FURUNO ELECTRIC CO., LTD.

(Manufacturer)

9-52 Ashihara-Cho, Nishinomiya City, 662-8580, Hyogo, Japan

(Address)

declare under our sole responsibility that the product

SATELLITE COMPASS SC-70 and SC-130
(Serial No. 1000-56xx/88xx-xxxx)

(Model name, type number)

to which this declaration relates conforms to the following standard(s) or normative document(s)

IMO Resolution A.526(13)
IMO Resolution A.694(17)
IMO Resolution MSC.112(73)
IMO Resolution MSC.116(73)
IMO Resolution MSC.191(79)
IMO Resolution MSC.302(87)
2000 HSC Code 13
ISO 20672 Ed.1.0: 2007
ISO 22090-3 Ed.2.0: 2014
IEC 60945 Ed.4.0: 2002
IEC 61108-1 Ed.2.0: 2003
IEC 61162-1 Ed.5.0: 2016
IEC 61162-2 Ed.1.0: 1998
IEC 61162-450 Ed.1.0: 2011
IEC 62288 Ed.2.0: 2014

(title and/or number and date of issue of the standard(s) or other normative document(s))

For assessment, see

- EC type examination (Module B) certificate No. MEDB00001BW (GPS), MEDB00001BX (ROTI) and MEDB00001BY (THD) issued by DNV GL AS (0575), Norway.
- Product Quality System (Module D) certificate No. P 112 (Issue 46) issued by Telefication, The Netherlands.

This declaration is issued according to the Directive 2014/90/EU of the European Parliament and of the Council on marine equipment, and the Implementing Regulation (EU) 2020/1170.

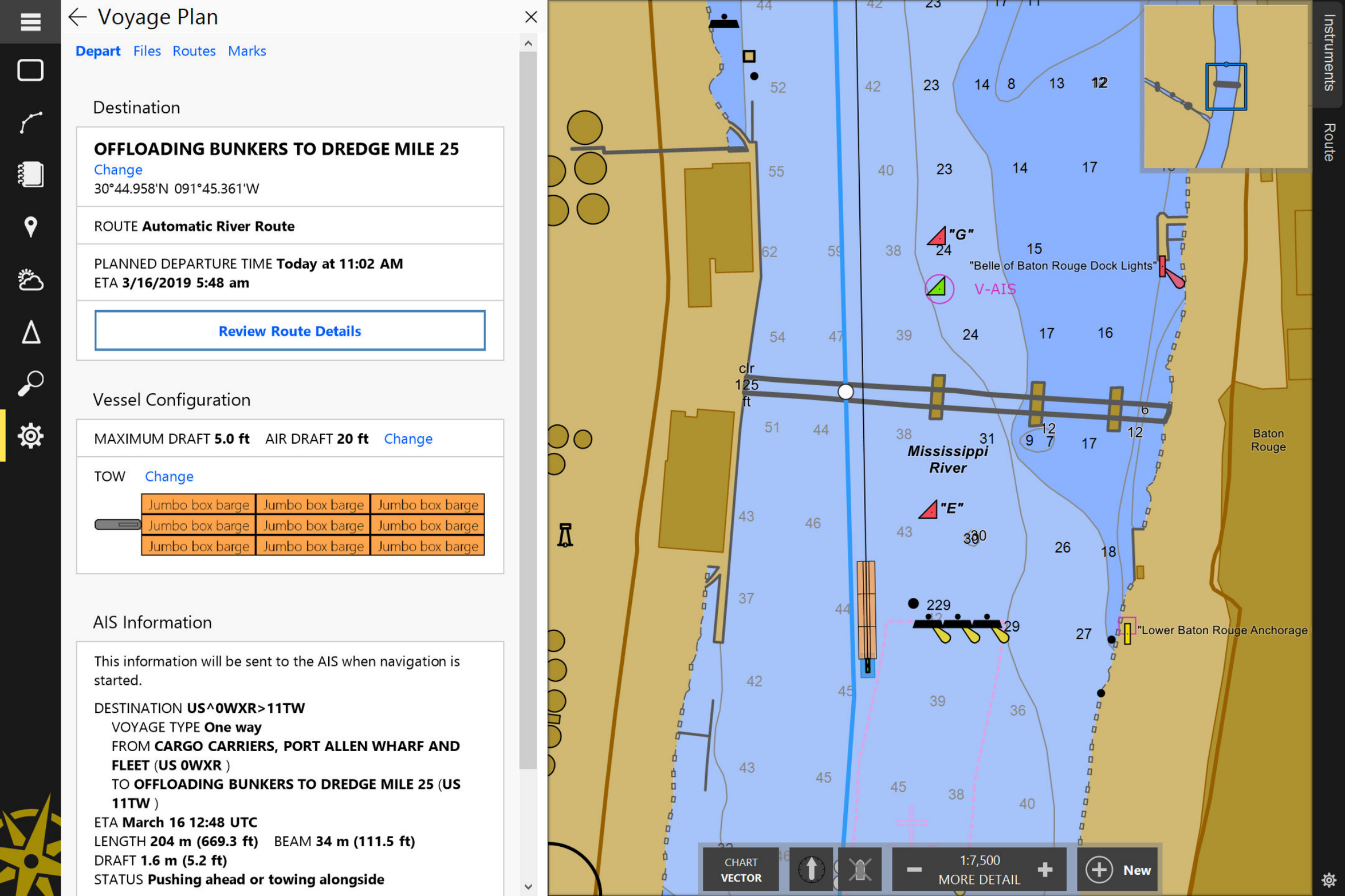
On behalf of Furuno Electric Co., Ltd.

Nishinomiya City, Japan
October 30, 2020

(Place and date of issue)

Akihiko Kanechika
Department General Manager
Quality Assurance Department A. Kanechika

(name and signature or equivalent marking of authorized person)


Voyage Plan
Depart
Files
Routes
Marks
Destination
OFFLOADING BUNKERS TO DREDGE MILE 25
Change
30°44.958'N 091°45.361'W
ROUTE Automatic River Route
PLANNED DEPARTURE TIME Today at 11:02 AM
ETA 3/16/2019 5:48 am
Review Route Details
Vessel Configuration
MAXIMUM DRAFT 5.0 ft
AIR DRAFT 20 ft
Change
TOW
Change
Jumbo box barge
AIS Information
This information will be sent to the AIS when navigation is started.
DESTINATION US^0WXR>11TW
VOYAGE TYPE One way
FROM CARGO CARRIERS, PORT ALLEN WHARF AND FLEET (US 0WXR)
TO OFFLOADING BUNKERS TO DREDGE MILE 25 (US 11TW)
ETA March 16 12:48 UTC
LENGTH 204 m (669.3 ft)
BEAM 34 m (111.5 ft)
DRAFT 1.6 m (5.2 ft)
STATUS Pushing ahead or towing alongside
"G"
"Belle of Baton Rouge Dock Lights"
V-AIS
clr 125 ft
Mississippi River
"E"
Baton Rouge
"Lower Baton Rouge Anchorage
CHART VECTOR
1:7,500
MORE DETAIL
New
Instruments
Route

Ship's Log

Tracks Events **Voyage Recordings**

Own-Ship

AUGUST 2021
Aug 13 19:00 - 23:59
Aug 14 00:00 - 23:59
Aug 15 00:00 - 23:59
Aug 16 00:00 - 23:59
Aug 17 00:00 - 23:59
Aug 18 00:00 - 23:59
Aug 19 00:00 - 23:59
Aug 20 00:00 - 23:59
Aug 21 00:00 - 23:59
Aug 22 00:00 - 23:59
Aug 23 00:00 - 23:59
Aug 24 00:00 - 23:59
Aug 25 00:00 - 23:59
Aug 26 00:00 - 23:59
Aug 27 00:00 - 23:59
Aug 28 00:00 - 23:59
Aug 29 00:00 - 23:59
Aug 30 00:00 - 23:59
Aug 31 00:00 - 23:59
SEPTEMBER 2021
Sep 1 00:00 - 23:59

Boundary Crossed

RESERVED VESSEL TYPE 38

ELIZABETH C (WDJ6855)

DESTINATION **LONG BEACH**

SOG **4.70 kn** Pushing ahead or towing alongside

BRG **000°T** RNG **0 ft**

VIA **AIS** MMSI **368000890** just now

Browser **Keep Active**

37°45.697'N 122°21.703'W +MARK

37°46.354'N 122°22.694'W 1.02 NM 310°T

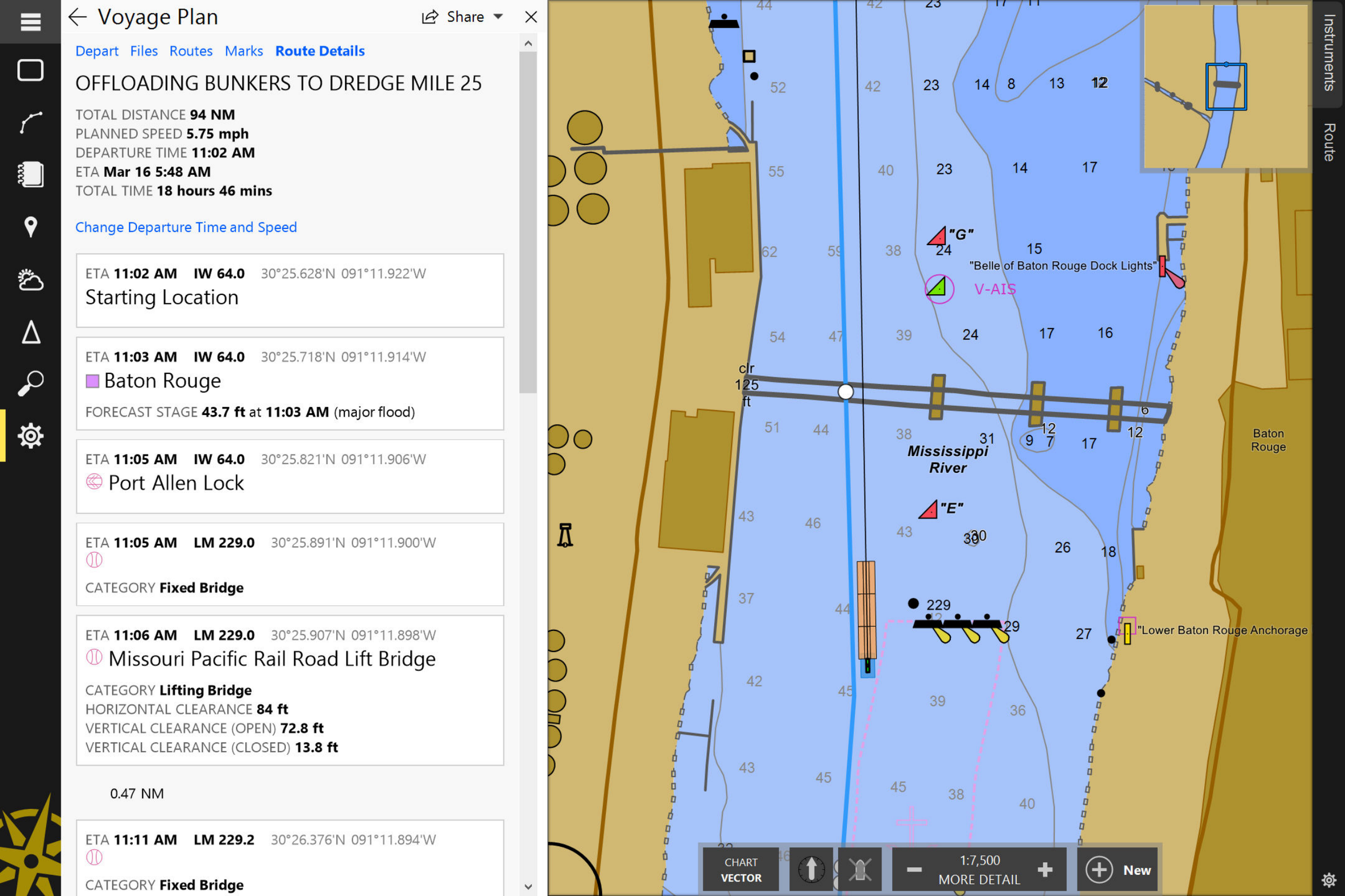
CHART BOTH | 1:20,000 RCDS MODE | New

Replay at 1x Speed

2021-Aug-26
00:16:14

0000 0005 0010 0015 0020 0025 0030 0035 0040 0045 0050 0055 0100

INSTRUMENTS Instruments 3


Voyage Plan
Share
Depart Files Routes Marks Route Details
OFFLOADING BUNKERS TO DREDGE MILE 25
TOTAL DISTANCE 94 NM
PLANNED SPEED 5.75 mph
DEPARTURE TIME 11:02 AM
ETA Mar 16 5:48 AM
TOTAL TIME 18 hours 46 mins
Change Departure Time and Speed
ETA 11:02 AM IW 64.0 30°25.628'N 091°11.922'W
Starting Location
ETA 11:03 AM IW 64.0 30°25.718'N 091°11.914'W
Baton Rouge
FORECAST STAGE 43.7 ft at 11:03 AM (major flood)
ETA 11:05 AM IW 64.0 30°25.821'N 091°11.906'W
Port Allen Lock
ETA 11:05 AM LM 229.0 30°25.891'N 091°11.900'W
CATEGORY Fixed Bridge
ETA 11:06 AM LM 229.0 30°25.907'N 091°11.898'W
Missouri Pacific Rail Road Lift Bridge
CATEGORY Lifting Bridge
HORIZONTAL CLEARANCE 84 ft
VERTICAL CLEARANCE (OPEN) 72.8 ft
VERTICAL CLEARANCE (CLOSED) 13.8 ft
0.47 NM
ETA 11:11 AM LM 229.2 30°26.376'N 091°11.894'W
CATEGORY Fixed Bridge
"G"
"Belle of Baton Rouge Dock Lights"
V-AIS
clr 125 ft
Mississippi River
"E"
229
"Lower Baton Rouge Anchorage
Baton Rouge
CHART VECTOR
1:7,500
MORE DETAIL
New
Instruments
Route

Tow Configuration

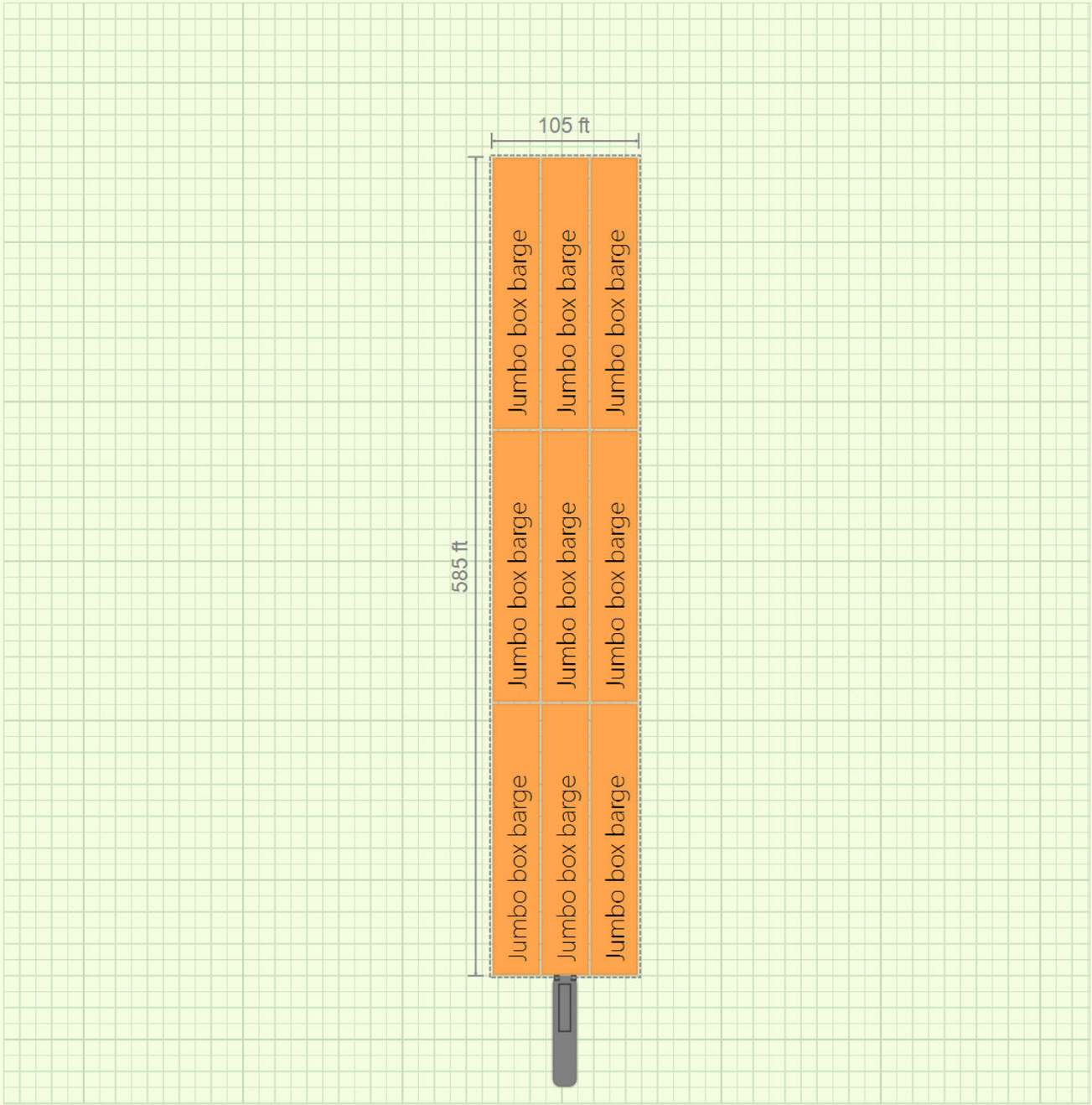
Other Tows

Today's Tow

Print...

Drag barges from this list to the plan on the right.

- **Add a new barge...**
- **Jumbo box barge (195.00 ft x 35.00 ft)**
  195 ft x 35 ft
- **Jumbo box barge (196.00 ft x 35.00 ft)**
  196 ft x 35 ft
- **Jumbo box barge (197.00 ft x 35.00 ft)**
  197 ft x 35 ft
- **Jumbo box barge (198.00 ft x 35.00 ft)**
  198 ft x 35 ft
- **Jumbo box barge (199.00 ft x 35.00 ft)**
  199 ft x 35 ft
- **Jumbo box barge (200.00 ft x 35.00 ft)**
  200 ft x 35 ft
- **Large Deck barge (148.00 ft x 27.00 ft)**
  148 ft x 27 ft
- **Small Deck barge (135.00 ft x 27.00 ft)**
  135 ft x 27 ft
- **Standard box barge (175.00 ft x 26.00 ft)**
  175 ft x 26 ft
- **Standard rake barge (Both) (175.00 ft x 26.0(**
  175 ft x 26 ft
- **Standard rake barge (Bow) (175.00 ft x 26.00**
  175 ft x 26 ft
- **Standard rake barge (Stern) (175.00 ft x 26.0**
  175 ft x 26 ft
- **Stumbo barge (195.00 ft x 26.00 ft)**
  195 ft x 26 ft

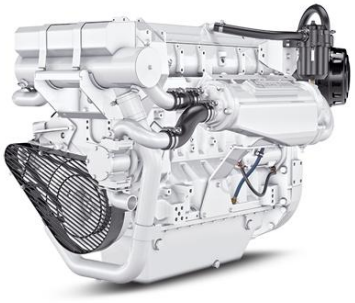


Appendix B

Boat Engine Specifications and Manuals

PowerTech ™
6135SFM85 Diesel Engine

Marine Propulsion Engine Specifications



6135SFM85 shown

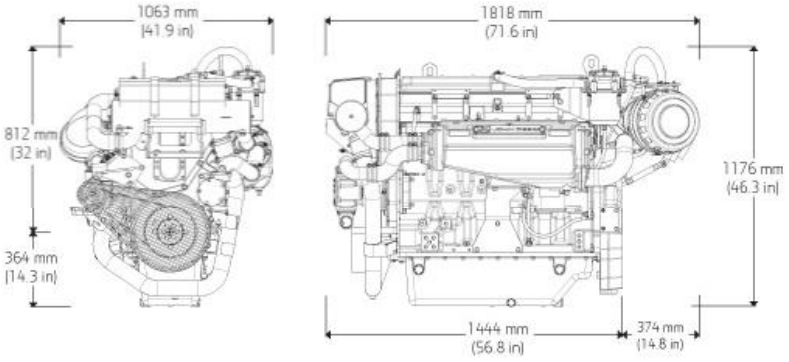
Emissions

EPA Commercial Marine Tier 3

IMO MARPOL Annex VI Tier II Compliant

NRMM (97/68/EC) as amended

Dimensions



Dimensions shown in mm (in) may vary according to options selected. Contact your distributor for more information.

General Data (Based on Standard Option Configuration)

Model	6135SFM85	Length maximum - mm (in)	1819 (71.6)
Number of cylinders	6	Height - mm (in)	1266 (49.8)
Displacement - L (cu in)	13.5 (824)	Height, crankshaft centerline to top - mm (in)	902 (35.5)
Bore and Stroke-- mm (in)	132 x 165 (5.20 x 6.50)	Height, crankshaft centerline to bottom - mm (in)	364 (14.3)
Engine Type	In-line, 4- Cycle	Weight, dry - kg (lb)	1426 (3144)
Aspiration	Air-to-sea water		

Classification Societies

ABS,BV,DNV-GL,LR,PRS

*SOLAS and other accessories available. Contact your distributor for details.

Engine Specifications

Performance ratings	Power kW (bhp)	Rated Speed (rpm)	Rated fuel consumption L/hr (gal/hr)
M1	317 (425)	1800	79.5 (21.0)
M2	373 (500)	1900	94.4 (24.9)
M3	429 (575)	2000	110.9 (29.3)
M4	485 (650)	2100	124.7 (32.9)
M5	559 (750)	2200	145.9 (38.5)

Metric hp = Brake hp x 1.01387

M rating	M1	M2	M3	M4	M5
Typical load factor	> 65%	< =65%	< =50%	< =40%	< =35%
Typical annual usage (hr)	Unrestricted	3,000-5,000 hr	2,000-4,000 hr	1,000-3,000 hr	300-1,000 hr
Typical full-power operation (hr)	Uninterrupted	16 of each 24 hr	4 of each 16 hr	1 of each 12 hr	0.5 of each 8 hr

Ratings are based on ISO 8655 standard power rating and the SAE J1 228 crankshaft power rating.
Flexibility of installation due to range of options.
See your John Deere Power Systems engine distributor or marine dealer for more detailed performance information.

Features and Benefits

High Torque and Low Rated RPM

- High torque provides excellent vessel control and maneuverability. Lower rated propulsion RPM reduces vibration and noise for improved crew comfort.

4-Valve Cylinder Head

- Excellent airflow through 4-valve cylinder head delivers greater low-speed torque and better transient response time.

Electronic Unit Injectors (EUI)

- The EUI fuel system provides higher injection pressures. It also controls fuel injection timing and provides precise control for start, duration, and end of injection.

Water-cooled Exhaust Manifold

- Integrated components eliminate external hoses and fittings that can leak or break. Wet exhaust manifold creates a cooler and quieter environment for passengers and crew.

Turbocharged with Air-to-Seawater Aftercooling

- Cooler turbocharger operation enables higher ratings and efficiencies for applications tha t require high power or speed.

Replaceable Cylinder Liners

- Replaceable wet-type cylinder liners are precision-machined and hardened for long life. Allows engine to be rebuilt to original specifications.

Electronic Engine Control Unit (ECU)

- Advanced fault code diagnostics and customizable engine protections ensure reliability and uptime. Provides highly customizable features and trim to integrate your vessel.

Heat Exchanger

- High-capacity heat exchanger provides reliable operation in adverse conditions.

Multiple Service Options

- Either-side oil fill/dipstick combinations and remote oil and fuel filter options are available for easier service access.

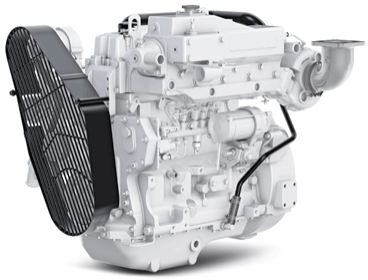
John Deere Power Systems
3801 W. Ridgeway Ave. PO Box 5100
Waterloo, IA 50704-5100
Phone: 1-800-533-6446
Fax: 319.292.5075

John Deere Power Systems
Orléans-Saran Unit
1, rue John Deere – B.P. 11013
45401 Fleury les Aubrais Cedex
France
Phone: 33.2.38.82.61.19
Fax: 33.2.38.84.62.66

All values at rated speed and power with standard options unless otherwise noted. Specifications and design subject to change without notice.

PowerTech ™ 4045TFM85 Diesel Engine

Marine Generator Drive Engine Specifications



4045TFM85 shown

Emissions

EPA Commercial Marine Tier 3 @ 1800 rpm / 60Hz

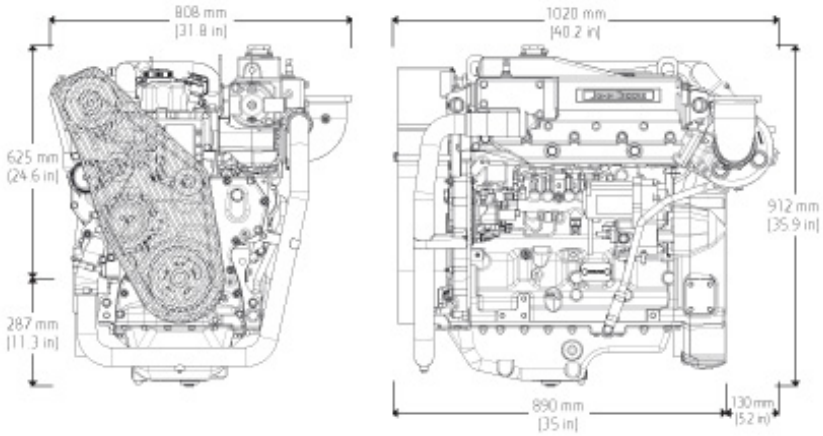
IMO MARPOL Annex VI Tier II Compliant

Marine China Stage I †

EU Inland Waterway Stage V *

† Available on 61 kW (82 hp) generator drive
* Available on 61 kW (82 hp) prime generator

Dimensions



Dimensions shown in mm (in) may vary according to options selected. Contact your distributor for more information.

General Data (Based on Standard Option Configuration)

Model	4045TFM85
Number of cylinders	4
Displacement - L (cu in)	4.5 (275)
Bore and Stroke-- mm (in)	106 x 127 (4.17 x 5.00)
Engine Type	In-line, 4-Cycle
Aspiration	Turbocharged

Length maximum - mm (in)	1032 (40.6)
Height - mm (in)	908 (35.7)
Height, crankshaft centerline to top - mm (in)	621 (24.4)
Height, crankshaft centerline to bottom - mm (in)	287 (11.3)
Weight, dry - kg (lb)	507 (1118)

Classification Societies

ABS,BV,CCS,DNV-GL,LR

*SOLAS and other accessories available. Contact your distributor for details.

Features and Benefits

Optional Low RPM Operation

- A lower speed option provides the user the ability to start the engine without going to the gen-set rated speed and allows the user to clutch in an accessory that may be driven by the engine.

High-pressure Common-rail (HPCR)

- The HPCR fuel system provides variable common-rail pressure, multiple injections, and higher injection pressures. It also controls fuel injection timing and provides precise control for the start, duration, and end of injection. Electronic transfer pump is self-priming for ease of maintenance. Provides high performance, excellent fuel economy, and low emissions.

Water-cooled Exhaust Manifold

- Integrated components eliminate external hoses and fittings that can leak or break. Wet exhaust manifold creates a cooler and quieter environment for passengers and crew.

Replaceable Cylinder Liners

- Replaceable wet-type cylinder liners are precision-machined and hardene d for long life. Allows engine to be rebuilt to original specifications.

Electronic Engine Control Unit (ECU)

- Advanced fault code diagnostics and customizable engine protections ensure reliability and uptime. Provides highly customizable features and trim to integrate your vessel.

Keel-cooled or Heat Exchanger

- Closed cooling system in keel-cooled engine option eliminates the need for a sea strainer, seawater pump, or anodes. Heat exchanger option offers a lighter, more compact, and simpler engine installation.

Internal Balancers

- Internal balancers reduce engine noise and vibration for crew comfort. NOTE: John Deere 4045 engines only.

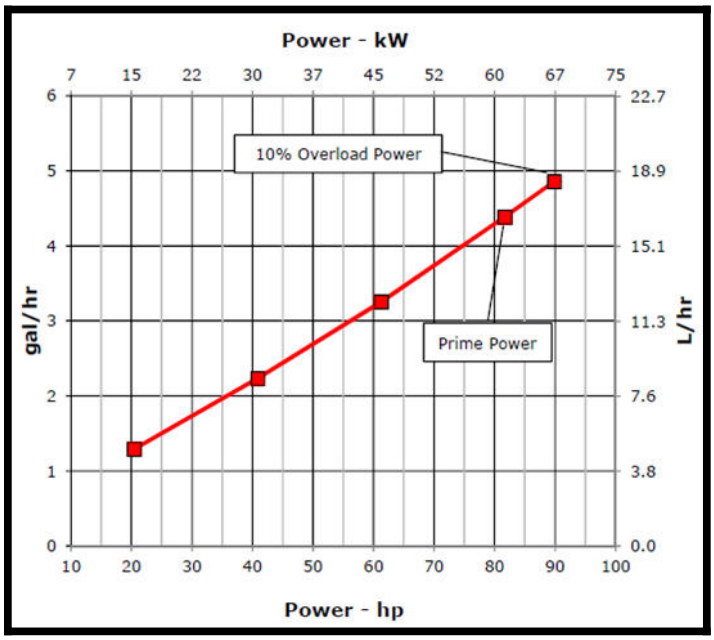
Multiple Service Options

- Either-side oil fill/dipstick combinations and remote oil and fuel filter options are available for easier service access.

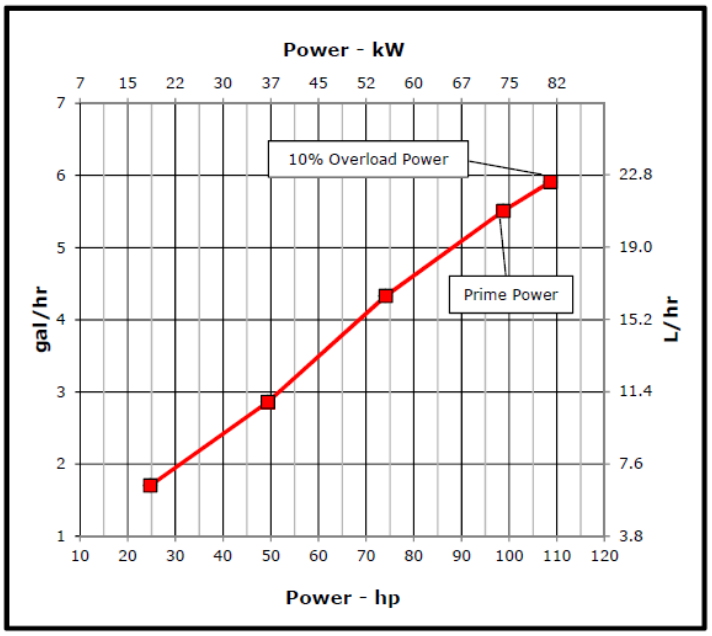
Photographs may show non-standard equipment.

Performance Curves

50Hz (1500 rpm)



60Hz (1800 rpm)



Performance data points shown at 25%, 50%, 75%, 100% (prime), and 110% (overload) power.

Calculated Generator-Set Rating

Rated speed Hz (rpm)	Generator efficiency %	Engine power		Power factor	Calculated generator set rating	
		Prime*			Prime*	
		kW	hp		kWe	kVA
50 (1500)	88-92	61	82	0.8	54-56	68-70
60 (1800)	88-92	74	99	0.8	65-68	81-85

*Prime power is the normal power an engine is capable of delivering with a variable load for an unlimited number of hours per year. This rating conforms to ISO 3046 and SAE J1995. This rating incorporates a 10 percent overload capability, and conforms to ISO 8528 prime power.

See your John Deere Power Systems engine distributor or marine dealer for more detailed performance information.

John Deere Power Systems
3801 W. Ridgeway Ave. PO
Box 5100
Waterloo, IA 50704-5100
Phone: 1-800-533-6446
Fax: 319.292.5075

John Deere Power Systems
Orléans-Saran Unit
1, rue John Deere – B.P. 11013
45401 Fleury les Aubrais Cedex
France
Phone: 33.2.38.82.61.19
Fax: 33.2.38.84.62.66

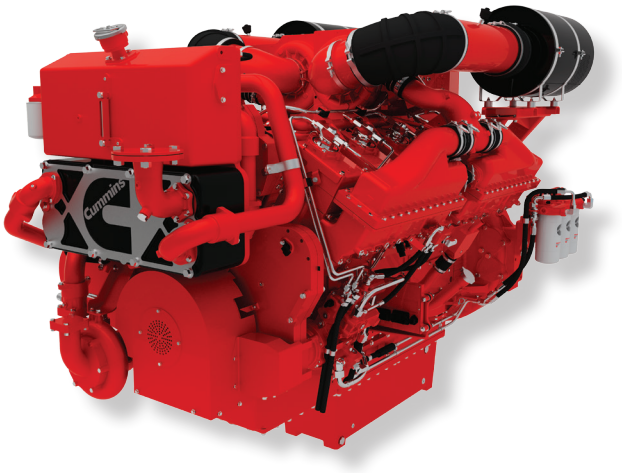
All values at rated speed and power with standard options unless otherwise noted. Specifications and design subject to change without notice.

QSK38

Marine Propulsion and Auxiliary Engines for Commercial and Recreational Applications

General Specifications

Configuration	V-12 cylinder, 4-stroke diesel
Aspiration	Turbocharged / Aftercooled
Displacement	38 L (2300 in^3)
Bore & Stroke	159 X 159 mm (6.25 X 6.25 in)
Rotation	Counterclockwise facing flywheel
Fuel System	High Pressure Common Rail



Product Dimensions and Weight

Overall Length	mm (in)	2282.4	(89.86)
Length of Block	mm (in)	1546.9	(60.90)
Overall Width	mm (in)	1573.4	(61.95)
Overall Height	mm (in)	2241.8	(88.26)
Weight	kg (lb)	4850	(10,692)

Dimensions and weight may vary based on selected engine configuration.

Power Ratings

Engine Model	Output Power kW	MHP	BHP	Engine Speed RPM	Rating Definition	Fuel Consumption Rated Speed L/hr (gal/hr)	ISO* L/hr (gal/hr)	Emissions IMO	EPA	EU	RCD
Variable Speed											
QSK38-M1	746	1014	1000	1800	Continuous	191.7 (50.6)	143.9 (38.0)	2	3	—	—
QSK38-M1	746	1014	1000	1800	Continuous	185.6 (49.0)	136.6 (36.1)	2	—	3a	—
QSK38-M1	969	1318	1300	1600	Continuous	247.4 (65.3)	183.6 (48.5)	2	3	—	—
QSK38-M1	969	1318	1300	1600	Continuous	235.8 (62.3)	169.9 (44.9)	2	—	3a	—
QSK38-M1	969	1318	1300	1800	Continuous	247.6 (65.4)	182.8 (48.3)	2	3	—	—
QSK38-M1	969	1318	1300	1800	Continuous	248.4 (65.6)	170.8 (45.1)	2	—	3a	—
QSK38-M1	1044	1420	1400	1600	Heavy Duty	251.3 (66.4)	181.3 (47.9)	2	—	3a	—
QSK38-M1	1044	1420	1400	1800	Heavy Duty	271.4 (71.7)	194.4 (51.4)	2	3	—	—
QSK38-M1	1044	1420	1400	1800	Heavy Duty	261.2 (69.0)	182.3 (48.2)	2	—	3a	—
QSK38-M1	1044	1420	1400	1900	Heavy Duty	265.4 (70.1)	194.4 (51.4)	2	3	—	—
QSK38-M1	1044	1420	1400	1900	Heavy Duty	257.5 (68.0)	183.5 (48.5)	2	—	3a	—
Fixed Speed											
QSK38-DM1	984	1338	1320	1500 (50 Hz)	Prime Power	234.3 (61.9)	124.6 (32.9)	2	—	3a	—
QSK38-DM1	1044	1420	1400	1800 (60 Hz)	Prime Power	262.6 (69.4)	144.2 (38.1)	2	3	—	—
QSK38-DM1	1044	1420	1400	1800 (60 Hz)	Prime Power	252.5 (66.7)	135.8 (35.9)	2	—	3a	—

* Average fuel consumption based on ISO 8178 E3 Standard Test Cycle (variable speed models) and ISO 8178 D2 Standard Test Cycle (fixed speed models)

QSK38

Marine Propulsion and Auxiliary Engines
for Commercial and Recreational Applications

Features and Benefits

Engine Design – Reliable base engine uses common components from the proven K19, K38 and K50 engines. A new cast-iron, ductile single-piece piston with nitride-coated rings and hardened cylinder liner provides excellent durability and long life

Fuel System – Modular Common Rail Fuel System features a simplified design which provides constant high injection pressure regardless of engine speed or load condition. Benefits include low noise and vibration for quiet operation, idle stability and low-end torque

Cooling System – Two-pump, two-loop, low temperature aftercooling maximizes efficiency and improves performance. Engine-mounted titanium plate heat exchanger provides superior durability with minimal maintenance requirements

Exhaust System – Dry-shielded exhaust manifold and turbocharger. Vertical or horizontal exhaust connections available for installation flexibility

Air System – Turbocharger optimized for vessel operating conditions and safety. Mounted or remote marine grade air cleaner with replaceable canister reduces maintenance cost

Lubrication System – Standard capacity 151 L (40 gal) and high capacity 204 L (54 gal) marine grade oil pan. Handed Cummins spin-on oil filters available for easy accessibility and servicing

Electronics – 24v Quantum System electronics feature an ECM to monitor operating parameters, while providing diagnostics, prognostics and complete engine protection. Simplified electrical customer interface box for all vessel connections to reduce installation complexity

Certifications – Complies with IMO Tier II, EPA Tier 3 and EU Stage IIIa emissions regulations. Designed to meet the International Association of Classification Societies (IACS) and SOLAS requirements. Consult your local Cummins professional for a complete listing of available class approvals

Optional Equipment

- C Command panels
- ELIMINATOR™ oil filtration system
- Premium coolant hose connections
- Duplex lube oil and fuel filtration
- SAE A or B (keel cooled only) accessory drives
- Front PTO adaptor
- CENTINEL oil management system
- Pre-Lube with QuickEvac
- Air or electric starter
- Rigid or flexible mounting arrangements

Cummins Inc.
4500 Leeds Avenue – Suite 301
Charleston, SC 29405-8539
U.S.A.

Internet: marine.cummins.com

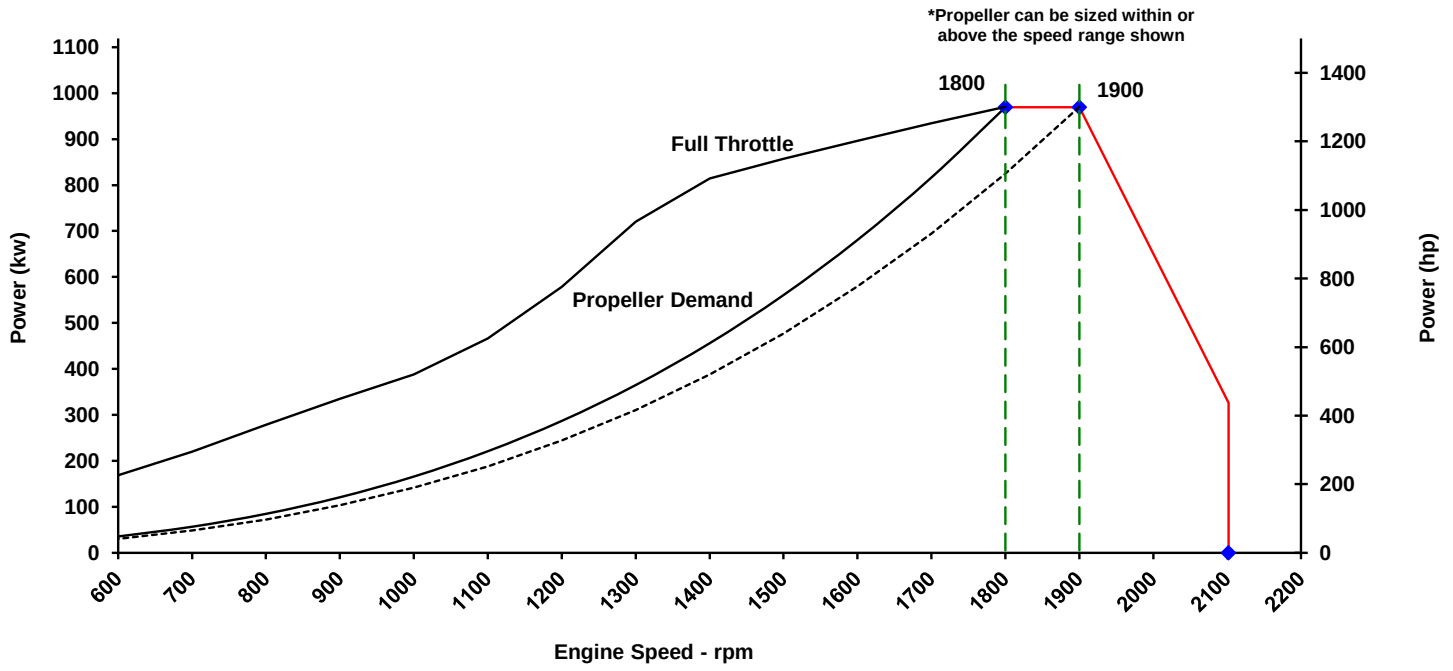
Bulletin 4986141 11/15

CUMMINS INC.	Basic Engine Model	Curve Number:	
Charleston, SC 29405	QSK38-M1	M-60071	
Marine Performance Curves	Engine Configuration	CPL Code:	Date:
marine.cummins.com	D233046MX03	3819	21-May-14

Displacement: **37.7 liter [2301 in³]**
Bore: **159 mm [6.25 in]**
Stroke: **159 mm [6.25 in]**
Cylinders: **12**
Fuel System: **Modular Common Rail (MCRS) with C3.0 Injectors**

Rated Power: **969 kw [1300 bhp]**
Rated Speed: **1800 rpm**
Rating Type: **Continuous Duty**
Aspiration: **Turbocharged / Low Temp. Aftercooled**

CERTIFIED: This diesel engine complies with or is certified to the following agencies requirements:
EPA Tier 3 - Model year requirements of the EPA marine regulation (40CFR1042)
IMO Tier II (Two) NOx requirements of International Maritime Organization (IMO), MARPOL 73/78 Annex VI, Regulation 13



Speed	Full Throttle				Propeller Demand					
	Power		Torque		Power		Torque		Fuel Consumption	
rpm	kw	(hp)	N·m	(ft-lb)	kw	(hp)	N·m	(ft-lb)	L/hr	(gal/hr)
1900	969	(1300)	4872	(3593)						
1800	969	(1300)	5143	(3793)	969	(1300)	5143	(3793)	247.6	(65.4)
1700	934	(1252)	5246	(3869)	817	(1095)	4587	(3383)	220.2	(58.2)
1600	896	(1202)	5349	(3945)	681	(913)	4063	(2997)	185.7	(49.1)
1500	856	(1148)	5452	(4021)	561	(752)	3571	(2634)	156.9	(41.5)
1400	814	(1092)	5553	(4096)	456	(612)	3111	(2295)	124.0	(32.8)
1300	720	(965)	5288	(3900)	365	(490)	2682	(1979)	100.0	(26.4)
1200	578	(775)	4600	(3393)	287	(385)	2286	(1686)	82.2	(21.7)
1100	467	(626)	4050	(2987)	221	(297)	1921	(1417)	62.7	(16.6)
1000	387	(520)	3700	(2729)	166	(223)	1587	(1171)	47.7	(12.6)
900	335	(449)	3549	(2618)	121	(163)	1286	(948)	36.1	(9.5)
800	279	(373)	3324	(2452)	85	(114)	1016	(749)	26.5	(7.0)
700	220	(295)	3002	(2215)	57	(76)	778	(574)	19.5	(5.2)
600	168	(226)	2680	(1977)	36	(48)	571	(421)	13.9	(3.7)

*** Cummins Full Throttle Requirements:**

- Engine achieves or exceeds rated rpm at full throttle under any steady operating condition
- Engines in variable displacement boats (such as pushboats, tugboats, net draggers, etc.) achieve no less than 100 rpm below rated speed at full throttle during a dead push or bollard pull
- Engine achieves or exceeds rated rpm when accelerating from idle to full throttle

Rated Conditions: Ratings are based upon ISO 15550 reference conditions; air pressure of 100 kPa [29.612 in Hg], air temperature 25deg. C [77 deg. F] and 30% relative humidy. Member NMMA. Unless otherwise specified, tolerance on all values is +/-5%. Values from engine control modules and displayed on instrument panels are not absolute. Tolerance varies, but is generally less than +/-5% when operating within 30% of rated power.

Full Throttle curve represents power at the crankshaft for mature gross engine performance corrected in accordance with ISO 15550, ISO 3046-1:2002. Propeller Curve represents approximate power demand from a typical propeller. Propeller Shaft Power is approximately 3% less than rated crankshaft power after typical reverse/reduction gear losses and may vary depending on the type of gear or propulsion system used.

Fuel Consumption is based on fuel of 35 deg. API gravity at 16 deg C [60 deg. F] having LHV of 42,780 kj/kg [18390 Btu/lb] and weighing 838.9 g/liter [7.001 lb/U.S. gal].

Continuous Rating (CON): Intended for continuous use in applications requiring uninterrupted service at full power. This rating is an ISO 15550 standard power rating.

TECHNICAL DATA DEPT. **CHIEF ENGINEER**

Propulsion Marine Engine Performance Data

Curve No.	**M-60071**
DS :	**D23-MX-2**
CPL :	**3819**
DATE:	**21-May-14**

General Engine Data			
Engine Model			QSK38-M1
Rating Type			Continuous Duty
Rated Engine Power		kW [hp]	969 [1300]
Rated Engine Speed		rpm	1800
Rated Power Production Tolerance		±%	3
Rated Engine Torque		N·m [lb·ft]	5143 [3793]
Peak Engine Torque @ 1400 rpm		N·m [lb·ft]	5553 [4096]
Brake Mean Effective Pressure		kPa [psi]	1714 [249]
Maximum Allowable Engine Speed		rpm	2375
Maximum Torque Capacity from Front of Crank Specifications			
Maximum Torque Capacity from Front of Crank²	Refer to MAB 0.16.05-10/09/2007		
Maximum Continuous Torque Capacity from Front of Crank with SAE #0 Flywheel²		N·m [lb·ft]	2929 [2160]
Maximum Continuous Torque Capacity from Front of Crank with SAE #00 Flywheel²		N·m [lb·ft]	2689 [1983]
Maximum Intermittent (<500 hrs/Year) Torque Capacity from Front of Crank²		N·m [lb·ft]	5143 [3793]
Compression Ratio			15:1
Piston Speed		m/sec [ft/min]	9.5 [1875]
Firing Order			2-11-10-3-6-7-12-1-4-9-8-5
Weight (Dry) - Engine Only - Average		kg [lb]	4850 [10692]
Weight (Dry) - Engine With Heat Exchanger System - Average		kg [lb]	5060 [11155]
Weight Tolerance (Dry) Engine Only		3xStd Dev(±%)	8.4
Governor Settings			
Default Droop Value	Refer to MAB 2.04.00-03/23/2006		16%
Maximum Droop Allowed			16%
High Speed Governor Break Point		rpm	1900
Minimum Idle Speed Setting		rpm	550
Normal Idle Speed Variation		±rpm	10
High Idle Speed Range Minimum		rpm	1900
Maximum		rpm	2102
Noise and Vibration			
Average Noise Level - Top	(Idle)	dBA @ 1m	81
	(Rated)	dBA @ 1m	102
Average Noise Level - Right Side	(Idle)	dBA @ 1m	85
	(Rated)	dBA @ 1m	99
Average Noise Level - Left Side	(Idle)	dBA @ 1m	85
	(Rated)	dBA @ 1m	99
Average Noise Level - Front	(Idle)	dBA @ 1m	81
	(Rated)	dBA @ 1m	102
Fuel System¹			
Avg. Fuel Consumption - ISO 8178 E3 Standard Test Cycle		l/hr [gal/hr]	182.8 [48.3]
Fuel Consumption at Rated Speed		l/hr [gal/hr]	247.6 [65.4]
Approximate Fuel Flow to Pump		l/hr [gal/hr]	560.2 [148.0]
Maximum Allowable Fuel Supply to Pump Temperature		°C [°F]	60.0 [140]
Approximate Fuel Flow Return to Tank		l/hr [gal/hr]	312.6 [82.6]
Approximate Fuel Return to Tank Temperature		°C [°F]	63.3 [146]
Fuel Pressure - Pump Out/Rail INSITE Reading		kPa [psi]	119227 [17,292]

TBD= To Be Determined **N/A = Not Applicable** **N.A. = Not Available**

1 **Unless otherwise specified, all data is at rated power conditions and can vary ± 5%.**
2 **No rear loads can be applied when the FPTO is fully loaded. Max PTO torque is contingent on torsional analysis results for the specific drive system. Consult Installation Direction Booklet for Limitations.**
3 **Heat rejection to coolant values are based on 50% water/50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.**
4 **Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.**

CUMMINS INC.

COLUMBUS, INDIANA

All Data is Subject to Change Without Notice - Consult the following Cummins website for most recent data: http://marine.cummins.com

Propulsion Marine Engine Performance Data

Curve No.	**M-60071**
DS :	**D23-MX-2**
CPL :	**3819**
DATE:	**21-May-14**

Air System[1]			
Intake Manifold Pressure		kPa [in Hg]	212 [63]
Intake Air Flow		l/sec [cfm]	1571 [3329]
Heat Rejection to Ambient		kW [Btu/min]	47 [2678]
Exhaust System[1]			
Exhaust Gas Flow		l/sec [cfm]	3651 [7737]
Exhaust Gas Temperature (Turbine Out)		°C [°F]	458 [855]
Exhaust Gas Temperature (Manifold)		°C [°F]	605 [1120]
Emissions (in accordance with ISO 8178 Cycle E3)			
NOx (Oxides of Nitrogen)		g/kw·hr [g/hp·hr]	5.09 [3.80]
HC (Hydrocarbons)		g/kw·hr [g/hp·hr]	0.12 [0.09]
CO (Carbon Monoxide)		g/kw·hr [g/hp·hr]	1.48 [1.10]
PM (Particulate Matter)		g/kw·hr [g/hp·hr]	0.07 [0.05]
Cooling System[1]			
Sea Water Pump Specifications		Refer to MAB 0.08.17-07/16/2001	
Pressure Cap Rating		kPa [psi]	103 [15]
Max. Pressure Drop Across Any External Cooling System Circuit		kPa [psi]	34 [5]
Engines with Low Temperature Aftercooling (LTA)			
Two Loop LTA (For both 1 & 2 pump systems)			
Main Engine Circuit			
Coolant Flow to Main Cooler (with blocked open thermostat)		l/min [gal/min]	1102 [291]
Standard Thermostat Operating Range	Start to open	°C [°F]	82 [180]
	Full open	°C [°F]	95 [202]
Heat Rejection to Engine Coolant[3]		kW [Btu/min]	354 [20137]
Aftercooler (LTA) Circuit			
Coolant Flow to LTA Cooler (with blocked open thermostat)		l/min [gal/min]	560 [148]
LTA Thermostat Operating Range	Start to open	°C [°F]	46 [115]
	Full open	°C [°F]	57 [135]
Heat Rejection to Engine Coolant[3]		kW [Btu/min]	251 [14274]
Maximum Coolant Inlet Temperature from LTA Cooler		°C [°F]	49 [120]

TBD= To Be Determined **N/A = Not Applicable** **N.A. = Not Available**

1 **Unless otherwise specified, all data is at rated power conditions and can vary ± 5%.**
2 **No rear loads can be applied when the FPTO is fully loaded. Max PTO torque is contingent on torsional analysis results for the specific drive system. Consult Installation Direction Booklet for Limitations.**
3 **Heat rejection to coolant values are based on 50% water/50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.**
4 **Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.**

CUMMINS INC.

COLUMBUS, INDIANA

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C Command

Engine monitoring that puts you in control

TECHNOLOGY
THAT TRANSFORMS

Engine information at your fingertips

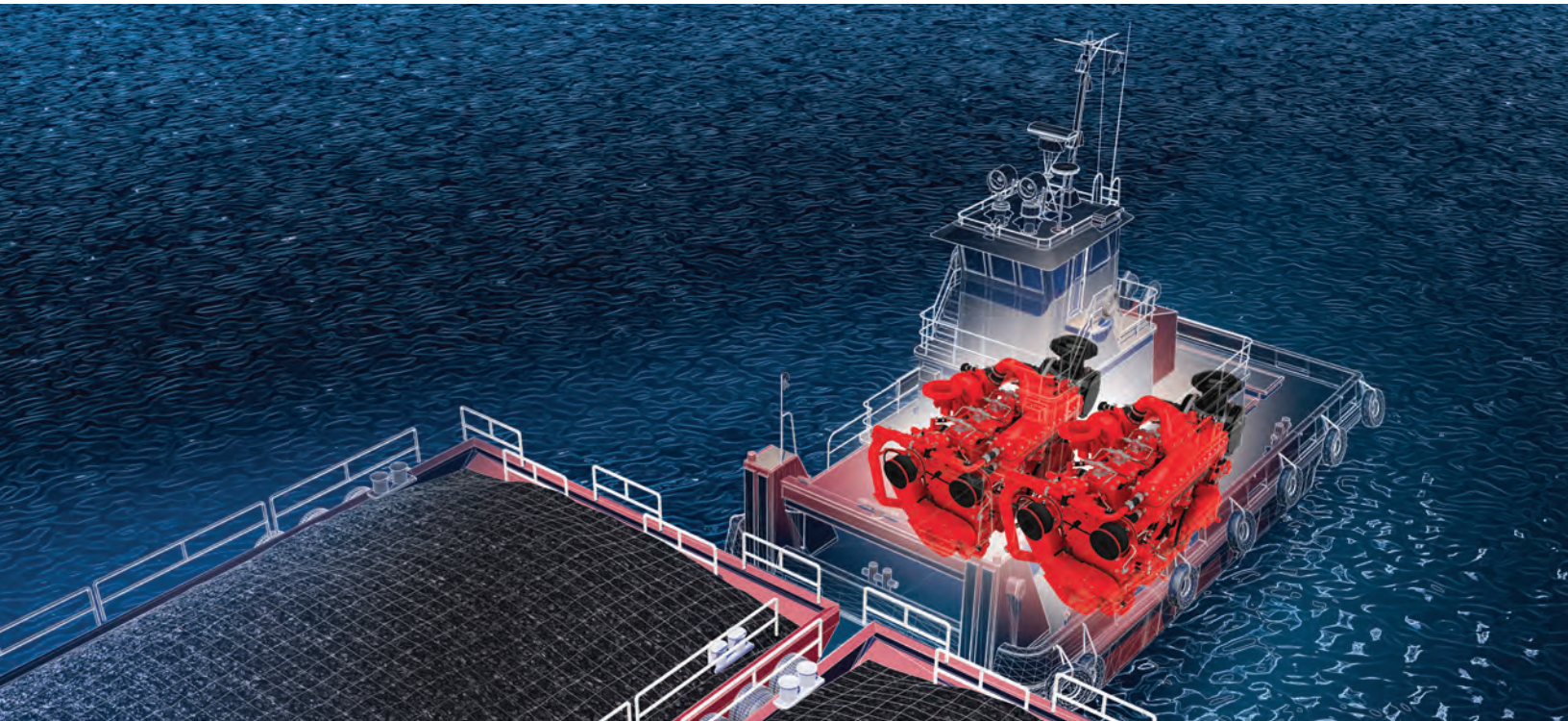
Cummins offers a modular panel system with a selection of display options designed to help marine operators protect and enhance engine performance and manage costs.

All components of the C Command system are designed for rugged marine environments. This means enclosures are built to combat vessel vibration, humidity and ambient conditions in both the pilot house and engine room. Each display is easily configured and allows for flexible data presentation. During development, focus was placed on designing quality displays that are readable in variable lighting conditions.

The information displayed by the panels provides insight into engine operating conditions such as percent load, fuel consumption*, running hours and temperatures, which can be used to locate the most efficient operating point.

Additionally, premium digital displays provide instantaneous access to fault code descriptions, troubleshooting tips and maintenance advice. This information is invaluable to any operator who wants to maximize profits by operating at the best possible efficiency.

*The values of displayed parameters for fuel consumption and load (or power) are not absolute. Tolerance varies, but is generally less than +/- 5% when operating within 30% of rated power.



Cost-effective monitoring for Quantum Series engines 19 to 60 liters

Simplified installation with a single interface

All connections on Cummins Quantum System engines are centralized in a customer interface box, which helps simplify vessel installation. The CIB contains all ECM connections, start/stop logic, emergency stop button and OEM connections. From the customer interface box, engine data can be viewed on the C Command panel system or sent to a centralized vessel management system via J1939 datalink or Modbus (Elite and Elite Plus systems only). Additionally, each component is designed for complete integration with the engine and ease of installation with “plug and play” capability.

C Command

The C Command basic system offers the flexibility to function with or without an engine room panel and features a variety of display options to ensure engine data is easily accessible.

Customer Interface Box Features

- Customer interface for all wiring
- Emergency stop button
- Main circuit breakers
- Start/stop functionality
- IP66-rated box designed for operation in harsh engine room environments

Engine Room Panel Features

- ED-3 reads all engine data from the ECM and displays information in text and graphics. Includes fault code logging with text description
- Soft buttons control start/stop as well as alarm indication and acknowledgement
- Enclosed in an IP44-rated box designed for operation in harsh engine room environments

Remote Options

- ED-3 display to monitor critical operating parameters and fault codes
- Gauge instrument panel provides fault code readout through a digital display on the tachometer
- Soft button control panel for start/stop and alarm acknowledgement
- Switch panel available to engage electronic features, including alternate idle, engine protection override and intermediate speed control

Advanced monitoring for Quantum Series engines 19 to 95 liters

C Command Elite

C Command Elite offers additional functionality and monitoring over the C Command system with the added benefit of easy-to-read, customer configured, color displays.

The Elite system can include up to three remote panels and may be complemented by an ED-3 display in areas where only basic monitoring is required.

Customer Interface Box Features

- Includes integrated control panel
- Full color text and graphics in menu format
- Multiple languages and configurations may be saved to accommodate multinational crews
- Stores a comprehensive history of alarms and faults for more efficient troubleshooting and service scheduling, easily downloaded via Ethernet connection
- Capable of supporting customer-supplied temperature, pressure and switch inputs

Remote Panel Features

- Large, configurable touch screen features superior visibility even in direct sunlight
- Can simultaneously monitor and control up to eight engines

C Command Elite Plus

C Command Elite Plus utilizes the same displays for both main station and remote monitoring as the Elite system, but also includes most Classification Society-mandated sensors, alarms and shutdowns. The result is a globally supported, fully classed engine and safety & alarm system that protects against the substantial risk of non-compliance. The Elite Plus system is fully approved by ABS, BV, DNV-GL, KR, LR and RINA.

C Command Elite Plus is now available on the QSK95. In addition to the above functionality, the CIB is larger to accommodate higher power capability and meets additional class requirements for this engine size. There is additional I/O available for vessel integration and customization. At launch, the system will be approved by ABS, with additional society approvals under review.

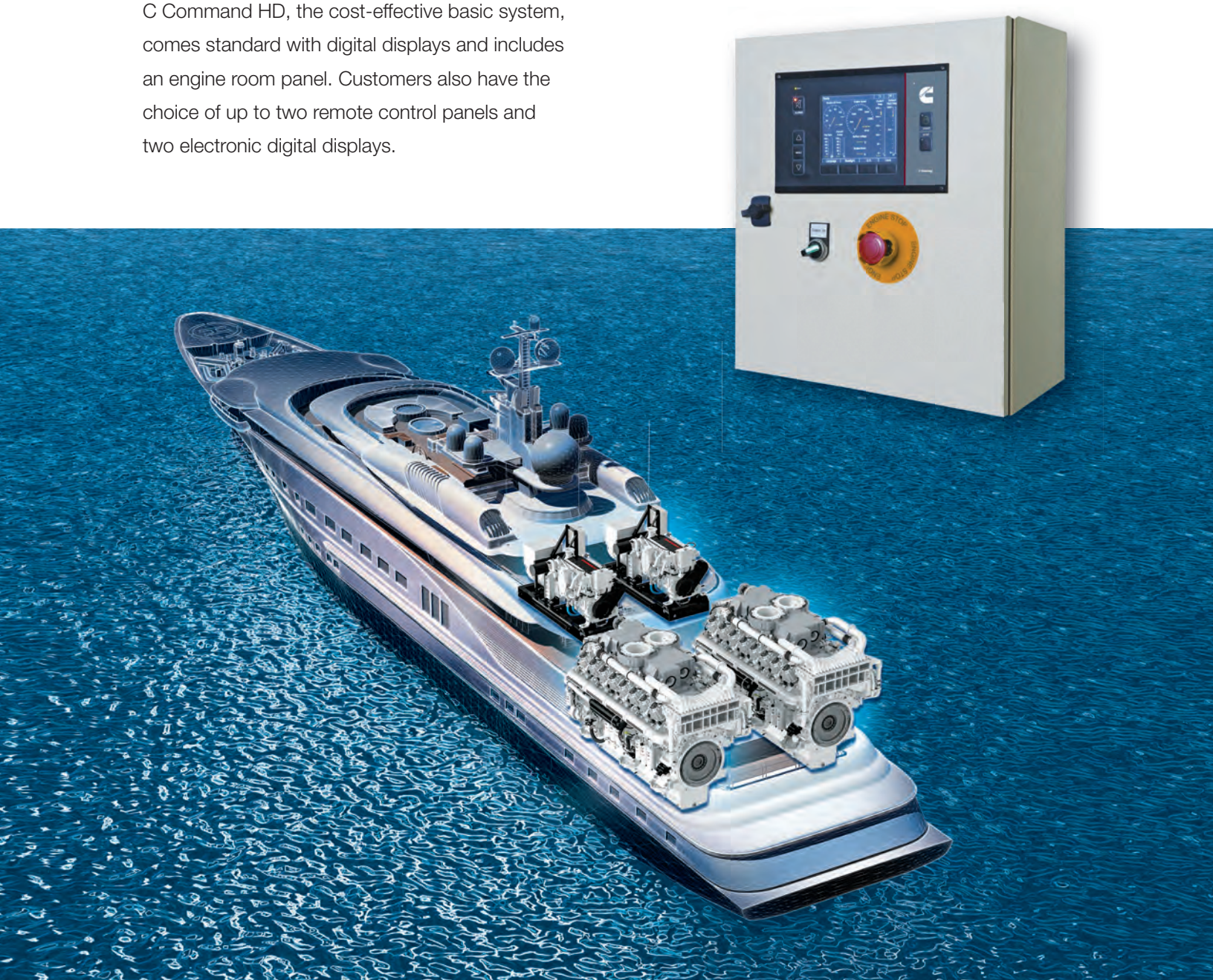
C Command monitoring for Quantum Series 6.7 and 11 liter engines

C Command HD

C Command HD and HD Elite Plus are available for the QSB7 auxiliary and the QSM11 propulsion and auxiliary engines. Both systems offer simplified installation and include local and remote control options.

C Command HD, the cost-effective basic system, comes standard with digital displays and includes an engine room panel. Customers also have the choice of up to two remote control panels and two electronic digital displays.

C Command HD Elite Plus, the type-approved system, includes Classification Society-mandated sensors, alarms and shutdowns. Easily integrated to vessel networks, this system comes standard with full color displays and optional remote control panels.



C Command monitoring for K Series engines 19 to 50 liters

C Command PT

Operators can have all the benefits of modern engine monitoring on mechanical and Centry-controlled products with Cummins C Command PT panels. Based on C Command architecture, this modular panel system includes a selection of display options designed to enhance K Series engine performance and manage costs.

C Command PT Elite Plus includes Classification Society-mandated sensors, alarms and shutdowns. The result is a globally supported, fully classed engine and safety & alarm system that protects against the substantial risk of non-compliance. Certification is available from ABS, BV, DNV-GL and LR.

Available exclusively with C Command PT Elite Plus, Cummins Fuel Consumption Monitor enables accurate, reliable monitoring within +/- 3% while providing trip, total and instantaneous measurements on digital remote datalink.

Remote Options

- Control Panel (CP)
- Electronic Digital Display (ED-3)
- Remote Control Panel (RP)

Available Upgrades

- Switch panel
- Gear oil pressure

C Command for Quantum Series propulsion engines 6.7 to 11 liters

C Command Connect

C Command Connect leverages existing engine capabilities and throttle shift systems, including third party systems, making it easy to upfit existing boat designs. C Command Connect utilizes J1939 protocol to allow full access to engine data and fault information. The system supports J1939 and N2K data interfaces to allow operators the flexibility of using the Cummins ED-4 display panel or third party gauges and displays for remote monitoring. Operators can simultaneously monitor multiple engines at multiple display locations.

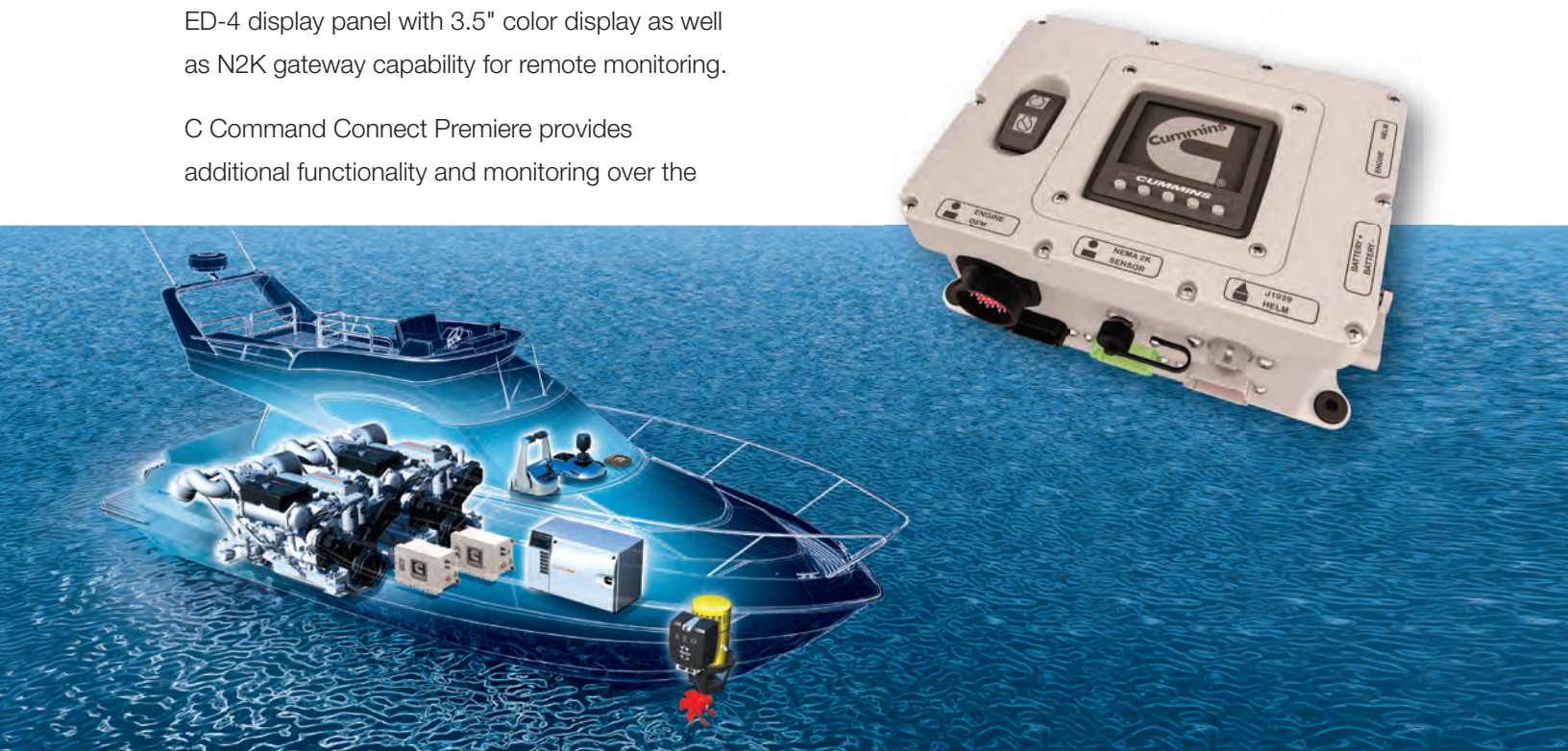
Like the original C Command system designed for Cummins QSK19, QSK38, QSK50 and QSK60 engines, the C Command Connect systems utilize a customer interface box (CIB) to centralize vessel connections. The basic and Premiere applications include all harnessing, user interfaces and optional ED-4 display panel with 3.5" color display as well as N2K gateway capability for remote monitoring.

C Command Connect Premiere provides additional functionality and monitoring over the basic system. It includes a CIB with integrated ED-4 display panel, N2K output and alarm indication to the helm. Vessel sensor capability allows operators to monitor fuel level, gear oil pressure and temperature, and rudder angle.

Tested and Supported

Cummins delivers quality into all products, not just the engine. Like every component on our marine engines, the electronics and panels are subject to extensive lab and field testing to ensure best in class reliability and durability.

All C Command panels are fully supported by the Cummins global service network. Plus, all are covered by a standard comprehensive one year warranty that is both transferable and valid at any Cummins authorized marine outlet worldwide.



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Bulletin 4082006 Printed in US Rev. 08/16

4.5 L and 6.8 L Marine Diesel Engines (Tier 3/Stage III A Platform)

OPERATOR'S MANUAL

4.5 L and 6.8 L Marine Diesel Engines (Tier 3/Stage III A Platform)

OMRG39400 ISSUE 16JUN17 (ENGLISH)

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

If this product contains a gasoline engine:

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

The State of California requires the above two warnings.

Additional Proposition 65 Warnings can be found in this manual.

John Deere Power Systems **TP-6889 06/17**

Worldwide Edition

PRINTED IN U.S.A.

OEM Engine and Drivetrain Warranty Registration

RG24614 —UN—21OCT13

Scan this code to register your OEM engine online. You can also visit us directly at JohnDeere.com/warranty.

Why registering your OEM engine or drivetrain product is a really smart idea:

- **Get faster service.** Registering your engine or drivetrain product gives us the information we need to meet your service needs promptly and completely.
- **Protect your investment.** You'll be kept up-to-date on engine or drivetrain product updates.
- **Extend your warranty.** You'll be given the option to extend your coverage before your standard warranty term expires.
- **Stay informed.** Be the first to know about new products and money-saving offers from John Deere.

You're Covered

When you buy a John Deere engine or drivetrain product you aren't just buying pistons and crankshafts and gear drives. You're buying the ability to get work done. Without downtime, without worries, and without hassles. And you're buying the assurance that if you do need help, a strong support network will be there — ready to step in.

Confidence. That's what John Deere engines, John Deere drivetrains, and John Deere Warranties are all about.

Long durations. Warranties designed to give you confidence in your engine or drivetrain product.

Worldwide support. Get service when and where you need it. John Deere has 4,000+ service locations worldwide.

Genuine John Deere parts and service. Authorized service outlets will use only new or remanufactured parts or components furnished by John Deere.

Warranty Duration

Equipment operators can't afford downtime or unexpected repairs. That's why we offer a 2-year/2,000-hour warranty, with unlimited hours in the first year, on our OEM industrial and marine engines. This warranty takes effect the date that the engine is delivered to the first retail purchaser. In addition, extended warranties are available under certain conditions. John Deere offers a variety of purchased warranties to extend the warranty period for your engine. You'll be given the option to extend your coverage before your standard warranty term expires. Be sure to register your engine or drivetrain product and take full advantage of the John Deere service and support network.

Obtaining Warranty Service

Warranty service must be requested through an authorized John Deere service outlet before the expiration of the warranty. Evidence of the engine's or drivetrain product's delivery date to the first retail purchaser must be presented when requesting warranty service. Authorized service outlets include:

- John Deere distributor
- John Deere OEM service dealer
- John Deere equipment dealer
- John Deere marine dealer

Worldwide Support Network

Visit JohnDeere.com/dealer to find the authorized engine or drivetrain service location nearest you. For complete warranty details visit JohnDeere.com/warrantystatements to view, download, or print the warranty statement for your engine or drivetrain product.

ZE59858,000025E -19-31MAY17-1/1

Foreword

READ THIS MANUAL carefully to learn how to operate and service your engine correctly. Failure to do so could result in personal injury or equipment damage.

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your engine and should remain with the engine when you sell it.

MEASUREMENTS IN THIS MANUAL are given in both metric and customary U.S. unit equivalents. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

RIGHT-HAND AND LEFT-HAND sides are determined by standing at the drive or flywheel end (rear) of the engine and facing toward the front of the engine.

WRITE ENGINE SERIAL NUMBERS and option codes in the spaces indicated in the Record Keeping Section. Accurately record all the numbers. Your dealer also needs these numbers when you order parts. File the identification numbers in a secure place off the engine.

SETTING FUEL DELIVERY beyond published factory specifications or otherwise overpowering will result in loss of warranty protection for this engine.

CERTAIN ENGINE ACCESSORIES such as air cleaner, and instruments are optional equipment on John Deere Marine Engines. These accessories may be provided by the equipment manufacturer instead of John Deere. This operator's manual applies only to the engine and those options available through the John Deere distribution network.

ZE59858,00001AA -19-15OCT13-1/1

Engine Owner

John Deere Engine Owner:

It is important for you to register your new engine for factory warranty. Registering your engine will allow your Service Dealer to verify that your warranty status should a repair be needed. The easiest way to register your engine is via the internet. To register your engine for warranty via the internet, please use the following URL: http://www.johndeere.com/enginewarranty

Your John Deere Engine Distributor or local John Deere Service Dealer will also be happy to provide this service. Engine service can be done by all Ag, C&FD, and JDPS branded dealers. To view the John Deere Service Dealer network or locate your nearest Dealer, use the following URL: http://www.johndeere.com/dealer

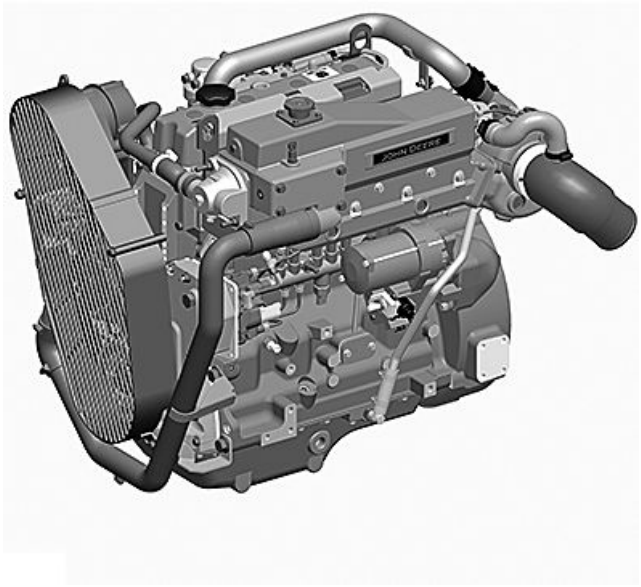
JR74534,000026F -19-21JUN12-1/1

Identification Views

NOTE: Heat exchanged engine models shown, keel cooled engines are similar.

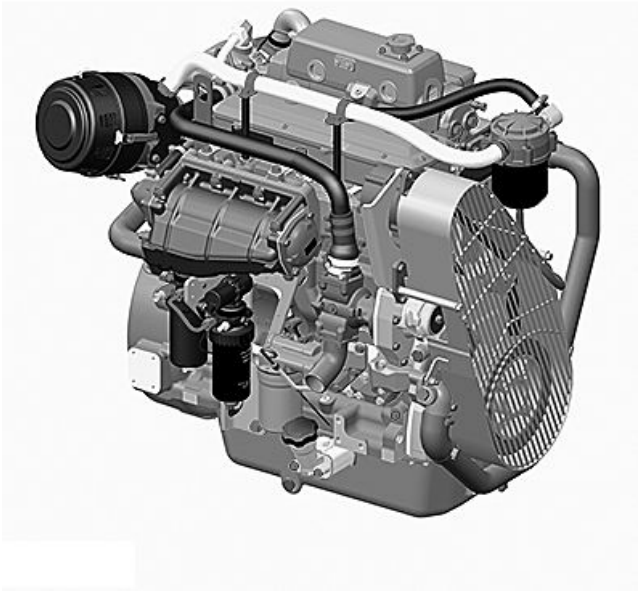
RG24329 —UN—06SEP13

4045TFM85 Engine



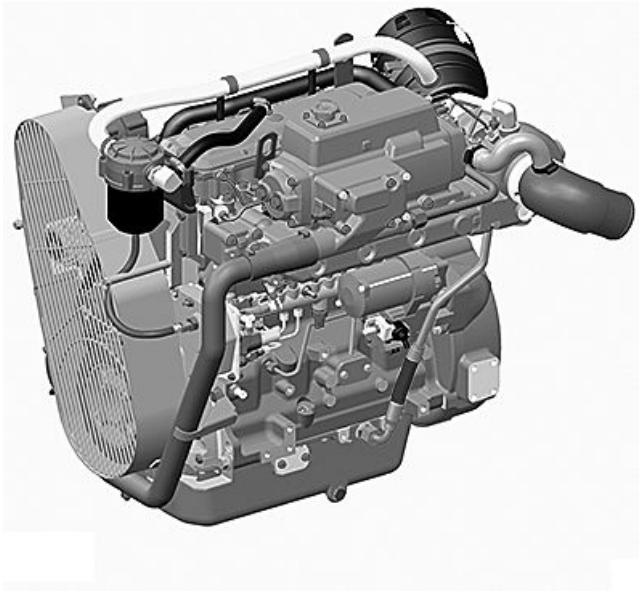
RG24330 —UN—06SEP13

4045TFM85 Engine



RG24331 —UN—06SEP13

4045AFM85 Engine



RG24332 —UN—06SEP13

4045AFM85 Engine

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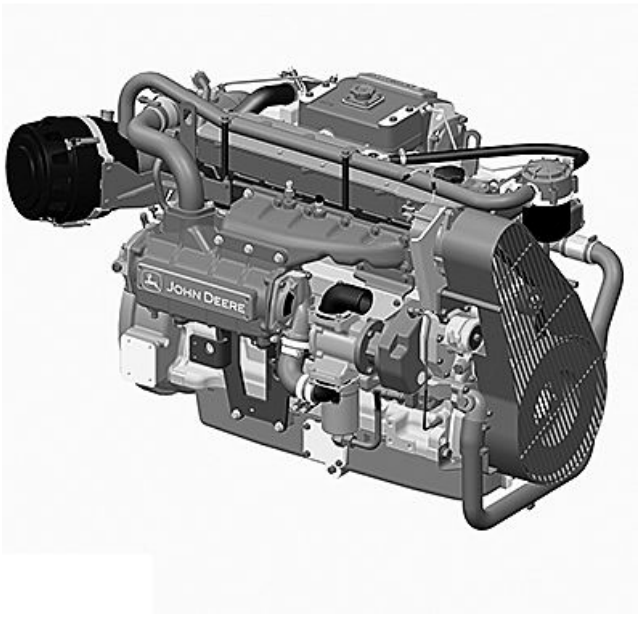
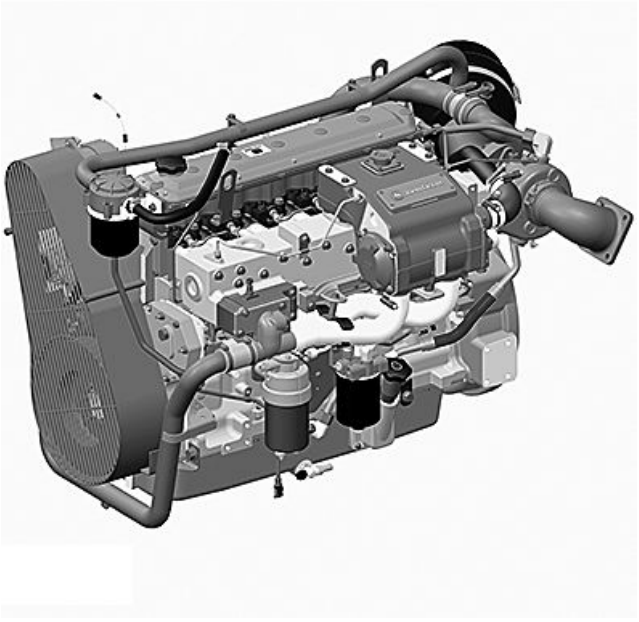


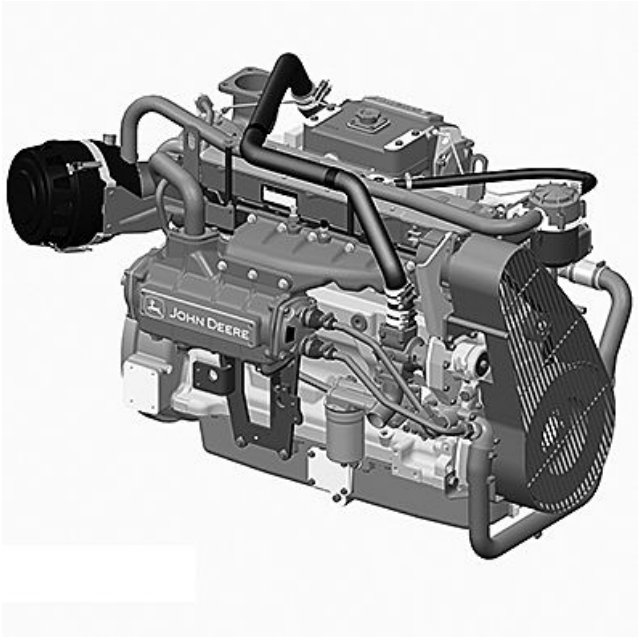
RG24333 —UN—06SEP13

6068SFM85 Engine



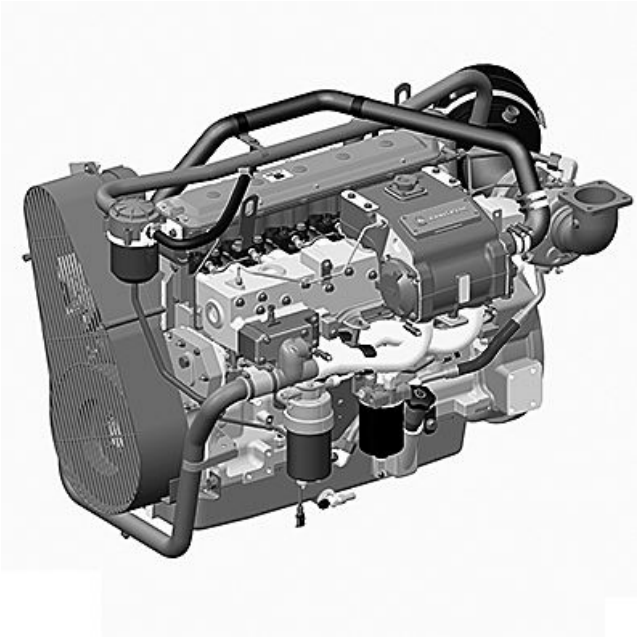
RG24334 —UN—06SEP13

6068SFM85 Engine



RG24335 —UN—06SEP13

6068AFM85 Engine



RG24336 —UN—06SEP13

6068AFM85 Engine

RG19661,00003B9 -19-29OCT13-2/2

Trademarks

Trademarks	
AdBlue®	AdBlue is a trademark of VDA, the German Association of the Automotive Industry.
AMP®	AMP is a trademark of Tyco Electronics
BIO-GREASE-GARD™	BIO-GREASE-GARD is a trademark of Deere & Company
Bio Hy-Gard™	Bio Hy-Gard is a trademark of Deere & Company
Bluetooth®	Bluetooth is a trademark of Bluetooth SIG
Break-In™ Plus	Break-In is a trademark of Deere & Company
CINCH™	CINCH is a trademark of Cinch Inc.
COOL-GARD™ PLUS	COOL-GARD is a trademark of Deere & Company
CoolScan™	CoolScan is a trademark of Deere & Company
COOLSCAN™ PLUS	COOLSCAN is a trademark of Deere & Company
Custom Performance™	Custom Performance is a trademark of Deere & Company
Deere™	Deere is a trademark of Deere & Company
DENSO®	DENSO is a trademark of DENSO Corporation
DEUTSCH®	DEUTSCH is a trademark of Deutsch Co.
DieselScan™	DieselScan is a trademark of Deere & Company
DuPont®	DuPont is a trademark of E.I. DuPont de Nemours and Company
EXTREME-GARD™	EXTREME-GARD is a trademark of Deere & Company
FleetGard™	FleetGard is a trademark of Deere & Company
Fuelscan™	Fuelscan is a trademark of Deere & Company
Funk™	Funk is a trademark of Deere & Company
GREASE-GARD™	GREASE-GARD is a trademark of Deere & Company
Hy-Gard™	Hy-Gard is a trademark of Deere & Company
JDLink™	JDLink is a trademark of Deere & Company
JDParts™	JDParts is a trademark of Deere & Company
John Deere™	John Deere is a trademark of Deere & Company
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OILSCAN PLUS™	OILSCAN PLUS is a trademark of Deere & Company
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ZE59858,0000006 -19-09MAR16-2/2

Contents

Continued on next page

Original Instructions. All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

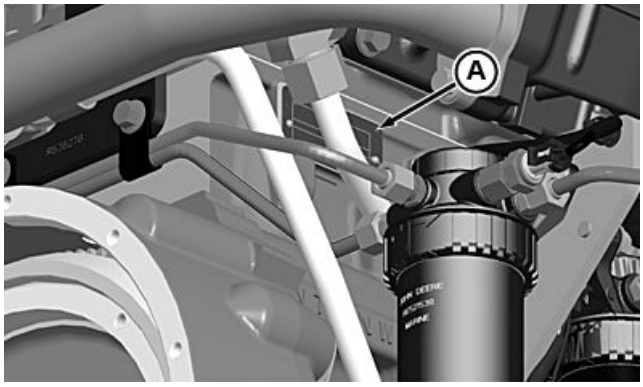
Continued on next page

Engine Serial Number Plate

Each engine has a 13-digit John Deere engine serial number. The first two digits identify the factory that produced the engine:

- "CD" indicates the engine was built in Saran, France
- "PE" indicates the engine was built in Torreon, Mexico

Your engine's serial number plate (A) is located on the right-hand side of cylinder block behind the fuel filter.



RG22321 —UN—11JAN13

Engine Serial Number Plate

RG19661,00003B7 -19-11JAN13-1/1

Record Engine Serial Number

Record all of the numbers and letters found on your engine serial number plate in the spaces provided below.

This information is very important for repair parts or warranty information.

Engine Serial Number (A)_____

Engine Model Number (B)_____

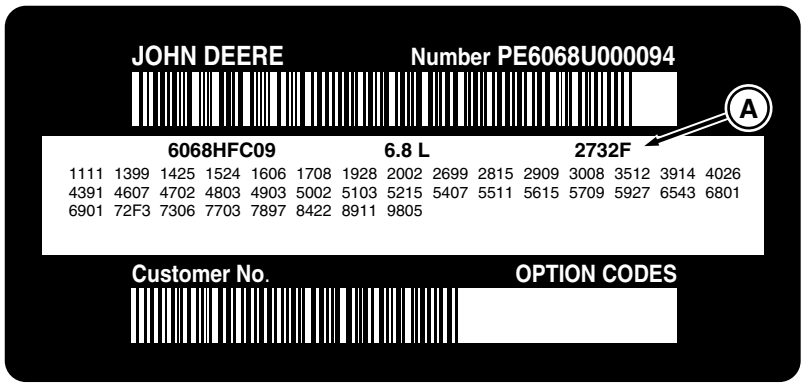
A—Engine Serial Number **B—Engine Model Number**

RG24323 —UN—05SEP13

Serial Number Plate

RG19661,00003B8 -19-05SEP13-1/1

Engine Option Codes



RG24026 —UN—05AUG13

Option Code Label Example

A—Engine Base Code (example)

OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

The engine option code label includes an engine base code (A). This base code must also be recorded along with the option codes. At times it will be necessary to furnish this base code to differentiate two identical option codes for the same engine model.

The first two digits of each code identify a specific group, such as alternators. The last two digits of each code identify one specific option provided on your engine, such as a 24 volt, 120 amp alternator.

If an engine is ordered without a particular component, the last two digits of that functional group option code will be 99, 00, or XX. The following list shows only the first two digits of the code numbers. For future reference such as ordering repair parts, it is important to have these code numbers available. To ensure this availability, enter the third and fourth digits shown on your engine option code label in the spaces provided on the following page.

An additional option code label may also be delivered (in a plastic bag attached to the engine or inserted in the machine documentation). It is recommended to place this label either on this page of the operators manual or in the Engine Owner's Warranty booklet under Option Codes.

The machine manufacturer may have placed the label in a specific accessible area (inside the enclosure or close to a maintenance area).

Your engine option code label may not contain all option codes if an option has been added after the engine left the producing factory.

If option code label is lost or destroyed, consult your servicing dealer or engine distributor selling the engine for a replacement.

Record your engine Base Code (A) in the spaces provided below for easy reference.

Engine Base Code (A):

_____

Option Codes	Description	Option Codes	Description
10_____	Paint Protection	56_____	Paint
11_____	Rocker Arm Cover	57_____	Water Pump Inlet
12_____	Oil Filler	58_____	Power Take Off
13_____	Crankshaft Pulley	59_____	Oil Cooler/Oil Filter
14_____	Flywheel Housing	60_____	Add-On Fan Drive Pulley
15_____	Flywheel	61_____	After Treatment Device/Muffler
16_____	Fuel Injection System	62_____	Alternator Mounting
17_____	Air Inlet	63_____	Low-Pressure Fuel Lines
18_____	Air Cleaner	64_____	Exhaust Elbow
19_____	Oil Pan	65_____	Turbocharger
20_____	Water Pump	66_____	Temperature Switch
21_____	Thermostat Cover	67_____	Engine Sensors
22_____	Thermostat	68_____	Damper
23_____	Fan Drive	69_____	Engine Serial Number Plate
24_____	Fan Belt	70_____	Decomposition Tube (OEM)

Continued on next page

RG,RG34710,5004 -19-12JUN17-1/2

Option Codes	Description	Option Codes	Description
25	Fan	71	SCR (OEM)
26	Block Heater	72	Performance Software and Labels
27	Radiator/Heat Exchanger	7A	Performance Software and Labels
28	Exhaust Manifold	73	After Treatment Dosing System
29	Ventilator System	74	Air Conditioning
30	Starting Motor	75	Restriction Indicator
31	Alternator	76	Oil Pressure Switch
32	DEF Lines, Pressure (OEM)	77	Timing Gear Cover (S450/S650
33	DEF Lines, Supply/Return to Tank (OEM)	78	Air Compressor
34	DEF Tank and Header (OEM)	79	Certification
35	Final Fuel Filter	80	Sea Water Pump (Marine)
36	Front Plate and Idler Shafts	81	Primary Fuel Filter/Water Separator
37	Fuel Transfer Pump	82	Ignition System (Natural Gas)
38	Operator Manual	83	Vehicle Performance Software
39	Thermostat Housing	84	Wiring Harness
40	Dipstick and Tube	85	Fuel System (Natural Gas)
41	Belt Driven Auxiliary Drive (Add-On Crank Pulley)	86	Fan Pulley
42	DEF Line, Supply Module to Injector (OEM)	87	Belt Tensioner
43	Starting Aid	88	Oil Filter
44	Timing Gear Cover (S350)	89	EGR System
44	Tachometer Drive Sensors (S450/S650)	90	Trim Software (OEM)
45	Secondary Balancers	91	Engine Installation Kit (S350)
46	Cylinder Block with Camshaft	92	Engine Test Certificate/Engine Accessories (S350)
47	Crankshaft/Main Bearings	92	Engine Installation Kit (S450)
48	Connecting Rods/Pistons/Liners	93	Emission Label
49	Valve Actuating Mechanism	94	Custom Software
50	Oil Pump	95	Parts Installed at Factory
51	Cylinder Head with Valves	96	Engine Installation Kit/Ship With (S450/S650)
52	Gear Driven Auxiliary Drive	96	ECU Wiring Harness (6125/6135)
53	Fuel Heater	97	Field Installed Items
54	Turbo Air Intake	98	Engine Lift Strap
55	Shipping Stand	99	Service Only Parts

NOTE: This is a complete option code list based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice. Your engine will not contain all option codes listed.

RG,RG34710,5004 -19-12JUN17-2/2

Record High-Pressure Fuel Pump Model Number

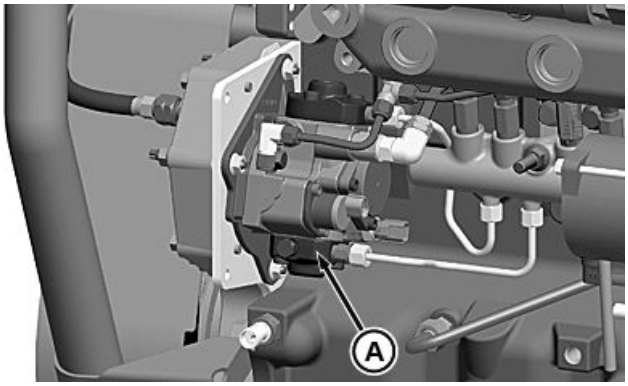
Record the fuel injection pump model and serial information found on the serial number plate (A).

Model No._____

Manufacturer's No._____

Serial No._____

A—Serial Number Plate



RG22161 —UN—06DEC12

High Pressure Fuel Pump

RG19661,00003FC -19-28FEB13-1/1

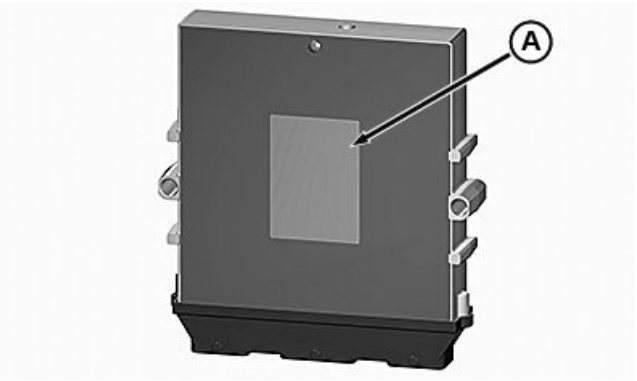
Record Engine Control Unit (ECU) Serial Number

Record the part number and serial number information found on the serial number label (A) on the Engine Control Unit (ECU) mounted on or near the engine.

Part No._____

Serial No._____

A—Serial Number Label



RG24314 —UN—05SEP13

Record Engine Control Unit (ECU) Serial Number

ZE59858,0000186 -19-05SEP13-1/1

Understand Signal Words

TS187 —19—30SEP88

DANGER; The signal word DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING; The signal word WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION; The signal word CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION may also be used to alert against unsafe practices associated with events which could lead to personal injury.

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards. DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

DX,SIGNAL -19-05OCT16-1/1

Recognize Safety Information

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

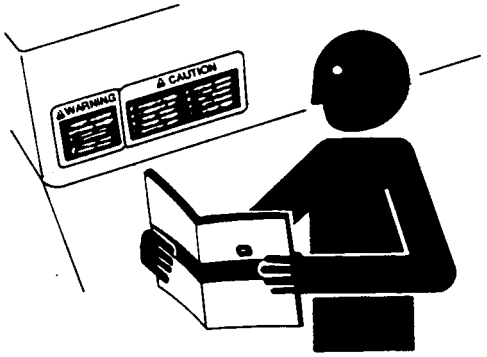
T81389 —UN—28JUN13

DX,ALERT -19-29SEP98-1/1

Replace Safety Signs

Replace missing or damaged safety signs. Use this operator's manual for correct safety sign placement.

There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator's manual.



TS201 —UN—15APR13

DX,SIGNS -19-18AUG09-1/1

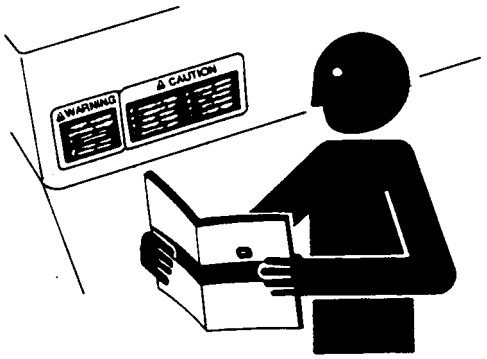
Follow Safety Instructions

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator's manual.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.



TS201 —UN—15APR13

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.

DX,READ -19-16JUN09-1/1

California Proposition 65 Warning

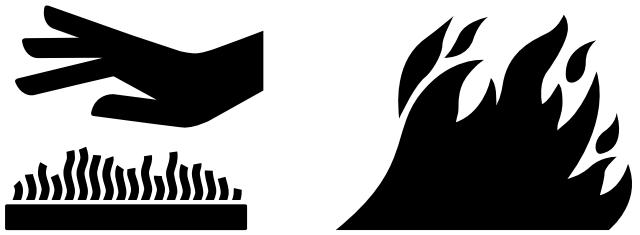
Diesel engine exhaust, some of its constituents, along with certain machine components contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. In addition, certain fluids contained in the machine and certain products of component wear contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

RG41061,000001F -19-12JAN10-1/1

Avoid Hot Exhaust

Servicing machine or attachments with engine running can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

Exhaust parts and streams become very hot during operation. Exhaust gases and components reach temperatures hot enough to burn people, ignite, or melt common materials.



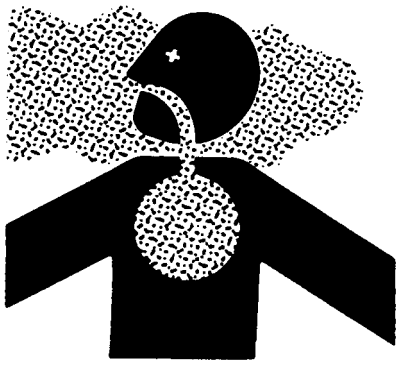
RG17488 —UN—21AUG09

DX,EXHAUST -19-20AUG09-1/1

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.



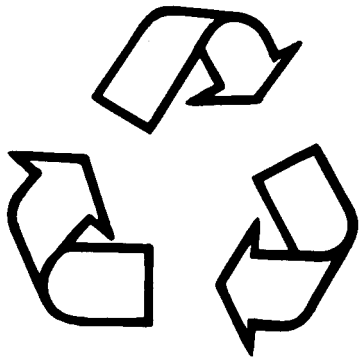
TS220 —UN—15APR13

DX,AIR -19-17FEB99-1/1

Decommissioning — Proper Recycling and Disposal of Fluids and Components

Safety and environmental stewardship measures must be taken into account when decommissioning a machine and/or component. These measures include the following:

- Use appropriate tools and personal protective equipment such as clothing, gloves, face shields or glasses, during the removal or handling of objects and materials.
- Follow instructions for specialized components.
- Release stored energy by lowering suspended machine elements, relaxing springs, disconnecting the battery or other electrical power, and releasing pressure in hydraulic components, accumulators, and other similar systems.
- Minimize exposure to components which may have residue from agricultural chemicals, such as fertilizers and pesticides. Handle and dispose of these components appropriately.
- Carefully drain engines, fuel tanks, radiators, hydraulic cylinders, reservoirs, and lines before recycling components. Use leak-proof containers when draining fluids. Do not use food or beverage containers.
- Do not pour waste fluids onto the ground, down a drain, or into any water source.
- Observe all national, state, and local laws, regulations, or ordinances governing the handling or disposal of waste fluids (example: oil, fuel, coolant, brake fluid);



TS1133 —UN—15APR13

filters; batteries; and, other substances or parts. Burning of flammable fluids or components in other than specially designed incinerators may be prohibited by law and could result in exposure to harmful fumes or ashes.

- Service and dispose of air conditioning systems appropriately. Government regulations may require a certified service center to recover and recycle air conditioning refrigerants which could damage the atmosphere if allowed to escape.
- Evaluate recycling options for tires, metal, plastic, glass, rubber, and electronic components which may be recyclable, in part or completely.
- Contact your local environmental or recycling center, or your John Deere dealer for information on the proper way to recycle or dispose of waste.

DX,DRAIN -19-01JUN15-1/1

Prevent Machine Runaway

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.

TS177 —UN—11JAN89

DX,BYPAS1 -19-29SEP98-1/1

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet, and clothing away from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

Falling while cleaning or working at height can cause serious injury. Use a ladder or platform to easily reach each location. Use sturdy and secure footholds and handholds.

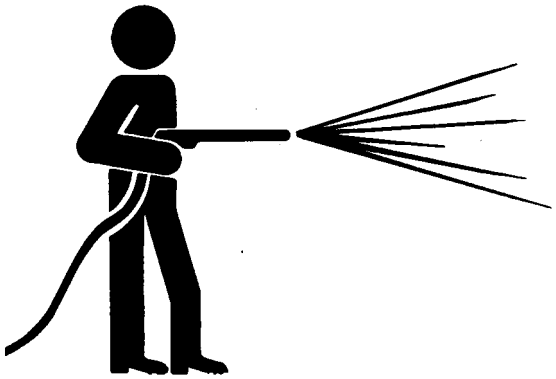
TS218 —UN—23AUG88

DX,SERV -19-28FEB17-1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



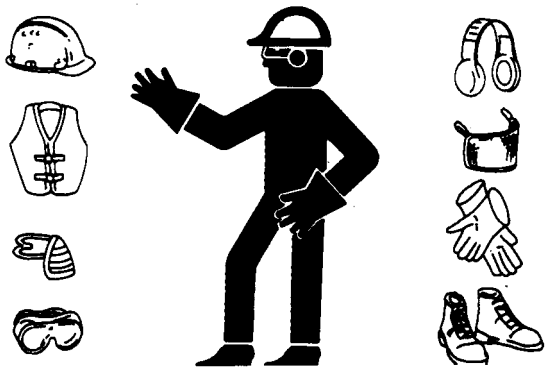
T6642EJ —UN—18OCT88

DX,CLEAN -19-04JUN90-1/1

Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



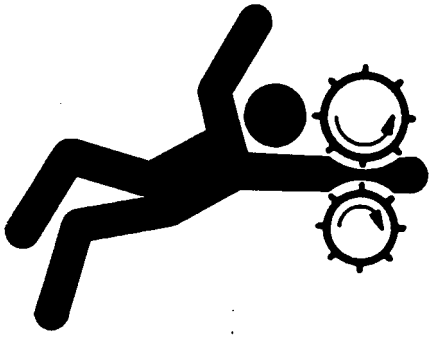
TS206 —UN—15APR13

DX,WEAR2 -19-03MAR93-1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 —UN—23AUG88

DX,LOOSE -19-04JUN90-1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.

TS779 —UN—08NOV89

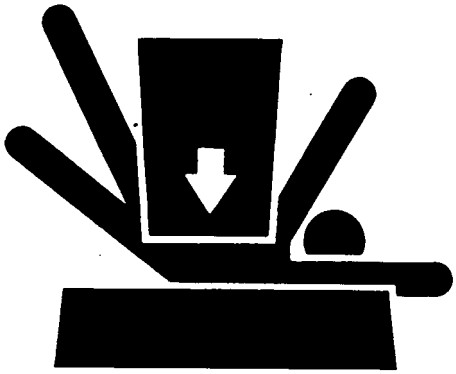
DX,REPAIR -19-17FEB99-1/1

Support Machine Properly

Always lower the attachment or implement to the ground before you work on the machine. If the work requires that the machine or attachment be lifted, provide secure support for them. If left in a raised position, hydraulically supported devices can settle or leak down.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

When implements or attachments are used with a machine, always follow safety precautions listed in the implement or attachment operator's manual.



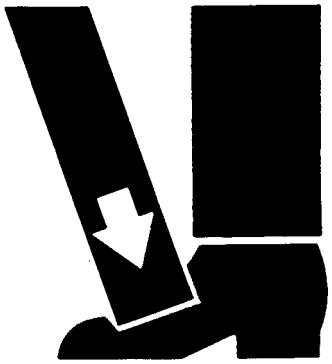
TS229 —UN—23AUG88

DX,LOWER -19-24FEB00-1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



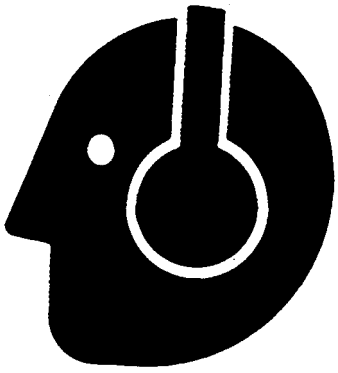
TS226 —UN—23AUG88

DX,LIFT -19-04JUN90-1/1

Protect Against Noise

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

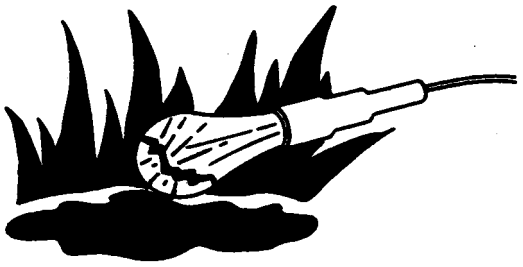


TS207 —UN—23AUG88

DX,NOISE -19-03MAR93-1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



TS223 —UN—23AUG88

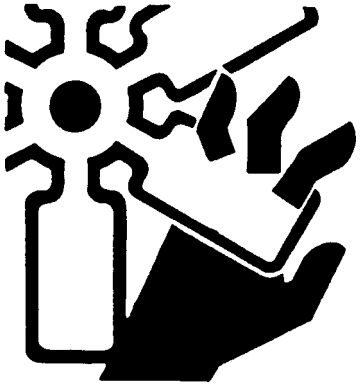
DX,LIGHT -19-04JUN90-1/1

Install All Guards

Rotating cooling system fans, belts, pulleys, and drives can cause serious injury.

Keep all guards in place at all times during engine operation.

Wear close-fitting clothes. Stop the engine and be sure fans, belts, pulleys, and drives are stopped before making adjustments, connections, or cleaning near fans and their drive components.



TS677 —UN—21SEP89

DX,GUARDS -19-18AUG09-1/1

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep all shields in place at all times. Make sure rotating shields turn freely.

Wear close-fitting clothing. Stop the engine and be sure that all rotating parts and drivelines are stopped before making adjustments, connections, or performing any type of service on engine or machine driven equipment.

TS1644 —UN—22AUG95

DX,ROTATING -19-18AUG09-1/1

Protect Against High Pressure Spray

Spray from high pressure nozzles can penetrate the skin and cause serious injury. Keep spray from contacting hands or body.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

TS1343 —UN—18MAR92

DX,SPRAY -19-16APR92-1/1

Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

TS281 —UN—15APR13

DX,RCAP -19-04JUN90-1/1

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 100 mm (4 in.) from area to be affected by heating. If paint cannot be removed, wear an approved respirator before heating or welding.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.

TS220 —UN—15APR13

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT -19-24JUL02-1/1

Do Not Open High-Pressure Fuel System

High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail (HPCR) fuel system.

Only technicians familiar with this type of system can perform repairs. (See your John Deere dealer.)

TS1343 —UN—18MAR92

DX,WW,HPCR1 -19-07JAN03-1/1

Avoid High-Pressure Fluids

Inspect hydraulic hoses periodically – at least once per year – for leakage, kinking, cuts, cracks, abrasion, blisters, corrosion, exposed wire braid or any other signs of wear or damage.

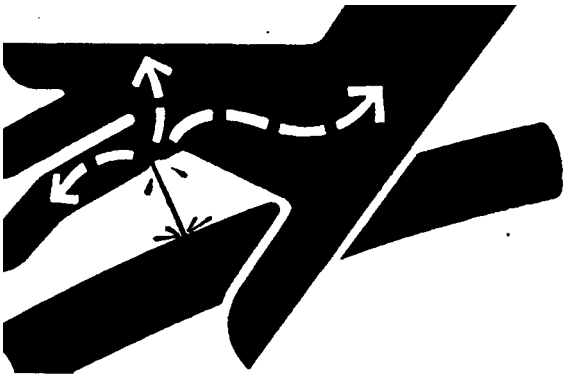
Replace worn or damaged hose assemblies immediately with John Deere approved replacement parts.

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available in English from Deere & Company Medical Department in Moline, Illinois, U.S.A., by calling 1-800-822-8262 or +1 309-748-5636.



X9811 —UN—23AUG88

DX,FLUID -19-12OCT11-1/1

Avoid Heating Near Pressurized Fluid Lines

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when heat goes beyond the immediate flame area.

TS953 —UN—15MAY90

DX,TORCH -19-10DEC04-1/1

Avoid Static Electricity Risk When Refueling

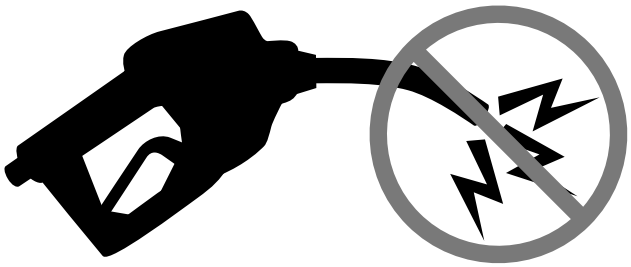
The removal of sulfur and other compounds in Ultra-Low Sulfur Diesel (ULSD) fuel decreases its conductivity and increases its ability to store a static charge.

Refineries may have treated the fuel with a static dissipating additive. However, there are many factors that can reduce the effectiveness of the additive over time.

Static charges can build up in ULSD fuel while it is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion.

Therefore, it is important to ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

RG22142 —UN—17MAR14



RG21992 —UN—21AUG13

DX,FUEL,STATIC,ELEC -19-12JUL13-1/1

Handle Fuel Safely—Avoid Fires

Handle fuel with care: it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.

Use only an approved fuel container for transporting flammable liquids.

Never fill fuel container in pickup truck with plastic bed liner. Always place fuel container on ground before refueling. Touch fuel container with fuel dispenser nozzle before removing can lid. Keep fuel dispenser nozzle in contact with fuel container inlet when filling.

TS202 —UN—23AUG88

Do not store fuel container where there is an open flame, spark, or pilot light such as within a water heater or other appliance.

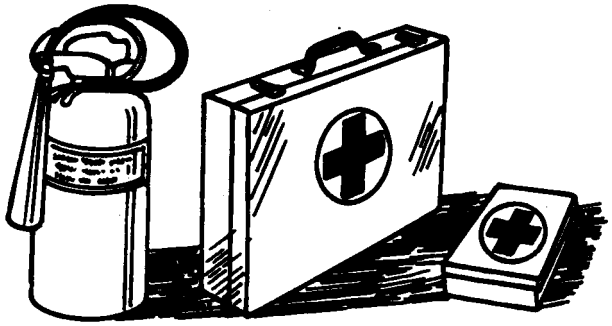
DX,FIRE1 -19-12OCT11-1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 —UN—15APR13

DX,FIRE2 -19-03MAR93-1/1

Handle Starting Fluid Safely

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.

Do not use starting fluid on an engine equipped with glow plugs or an air intake heater.

TS1356 —UN—18MAR92

DX,FIRE3 -19-14MAR14-1/1

Handling Batteries Safely

Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace grounded clamp last.

Sulfuric acid in battery electrolyte is poisonous and strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid hazards by:

- Filling batteries in a well-ventilated area
- Wearing eye protection and rubber gloves
- Avoiding use of air pressure to clean batteries
- Avoiding breathing fumes when electrolyte is added
- Avoiding spilling or dripping electrolyte
- Using correct battery booster or charger procedure.

If acid is spilled on skin or in eyes:

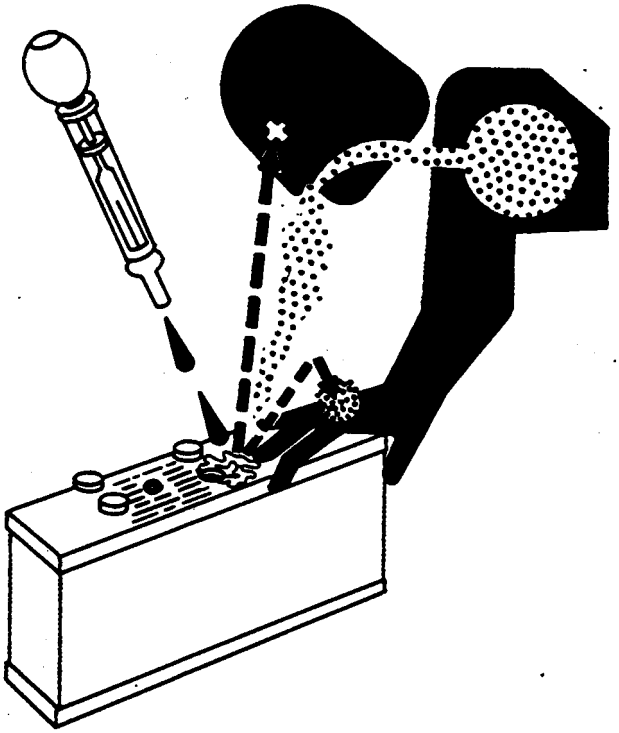
1. Flush skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).
3. Get medical attention immediately.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

TS204 —UN—15APR13



TS203 —UN—23AUG88

DX,WW,BATTERIES -19-02DEC10-1/1

Prevent Acid Burns

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

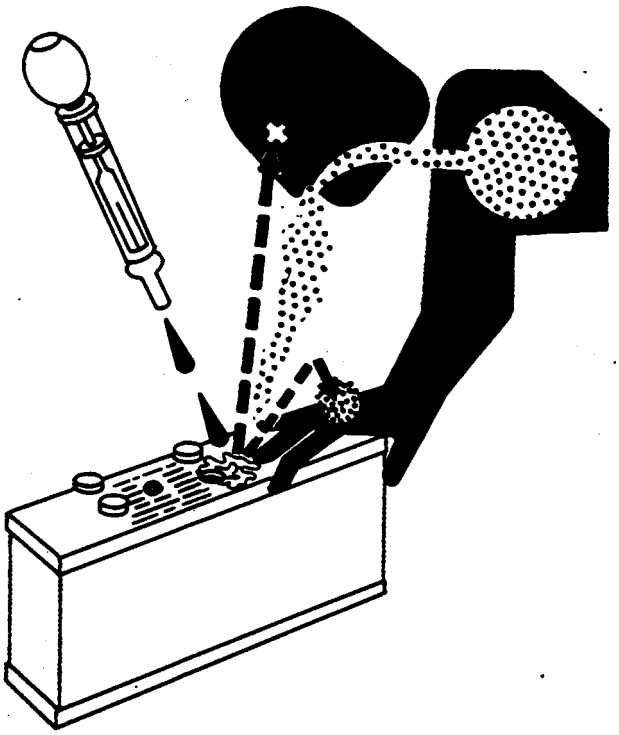
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



TS203 —UN—23AUG88

DX,POISON -19-21APR93-1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

TS204 —UN—15APR13

DX,SPARKS -19-03MAR93-1/1

Live With Safety

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231 —19—07OCT88

DX,LIVE -19-25SEP92-1/1

Diesel Fuel

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended. Renewable diesel fuel produced by hydrotreating animal fats and vegetable oils is basically identical to petroleum diesel fuel. Renewable diesel that meets EN 590, ASTM D975, or EN 15940 is acceptable for use at all percentage mixture levels.

Required Fuel Properties

In all cases, the fuel shall meet the following properties:

Cetane number of 40 minimum. Cetane number greater than 47 is preferred, especially for temperatures below –20 °C (–4 °F) or elevations above 1675 m (5500 ft.).

Cold Filter Plugging Point (CFPP) should be at least 5 °C (9 °F) below the expected lowest temperature or **Cloud Point** below the expected lowest ambient temperature.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

Diesel fuel quality and sulfur content must comply with all existing emissions regulations for the area in which the engine operates. DO NOT use diesel fuel with sulfur content greater than 10 000 mg/kg (10 000 ppm).

E-Diesel fuel

DO NOT use E-Diesel (Diesel fuel and ethanol blend). Use of E-Diesel fuel in any John Deere machine may void the machine warranty.

CAUTION: Avoid severe injury or death due to the fire and explosion risk from using E-Diesel fuel.

Sulfur content for Interim Tier 4, Final Tier 4, Stage III B, and Stage IV Engines

- Use ONLY ultra low sulfur diesel (ULSD) fuel with a maximum of 15 mg/kg (15 ppm) sulfur content.

Sulfur Content for Tier 3 and Stage III A Engines

- Use of diesel fuel with sulfur content less than 1000 mg/kg (1000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 1000—2000 mg/kg (1000—2000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 2000 mg/kg (2000 ppm), contact your John Deere dealer.

Sulfur Content for Tier 2 and Stage II Engines

- Use of diesel fuel with sulfur content less than 2000 mg/kg (2000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 2000—5000 mg/kg (2000—5000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm), contact your John Deere dealer.

Sulfur Content for Other Engines

- Use of diesel fuel with sulfur content less than 5000 mg/kg (5000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm) REDUCES the oil and filter change interval.

IMPORTANT: Do not mix used diesel engine oil or any other type of lubricating oil with diesel fuel.

Improper fuel additive usage may cause damage on fuel injection equipment of diesel engines.

DX,FUEL1 -19-13JAN16-1/1

Supplemental Diesel Fuel Additives

Diesel fuel can be the source of performance or other operational problems for many reasons. Some causes include poor lubricity, contaminants, low cetane number, and a variety of properties that cause fuel system deposits. These and others are referenced in other sections of this Operator's Manual.

To optimize engine performance and reliability, closely follow recommendations on fuel quality, storage, and handling, which are found elsewhere in this Operator's Manual.

To further aid in maintaining performance and reliability of the engine's fuel system, John Deere has developed a family of fuel additive products for most global markets. The primary products include Fuel-Protect Diesel Fuel Conditioner (full feature conditioner in winter and summer formulas) and Fuel-Protect Keep Clean (fuel injector deposit removal and prevention). Availability of these and other products varies by market. See your local John Deere dealer for availability and additional information about fuel additives that might be right for your needs.

DX,FUEL13 -19-07FEB14-1/1

Lubricity of Diesel Fuel

Most diesel fuels manufactured in the United States, Canada, and the European Union have adequate lubricity to ensure proper operation and durability of fuel injection system components. However, diesel fuels manufactured in some areas of the world may lack the necessary lubricity.

IMPORTANT: Make sure the diesel fuel used in your machine demonstrates good lubricity characteristics.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

If fuel of low or unknown lubricity is used, add John Deere Fuel-Protect Diesel Fuel Conditioner (or equivalent) at the specified concentration.

Lubricity of BioDiesel Fuel

Fuel lubricity can improve significantly with BioDiesel blends up to B20 (20% BioDiesel). Further increase in lubricity is limited for BioDiesel blends greater than B20.

DX,FUEL5 -19-07FEB14-1/1

Handling and Storing Diesel Fuel

CAUTION: Reduce the risk of fire. Handle fuel carefully. DO NOT fill the fuel tank when engine is running. DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

Keep all storage tanks as full as practical to minimize condensation.

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering. Monitor water content of the fuel regularly.

When using biodiesel fuel, the fuel filter may require more frequent replacement due to premature plugging.

Check engine oil level daily prior to starting engine. A rising oil level may indicate fuel dilution of the engine oil.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier or John Deere dealer for recommendations.

DX,FUEL4 -19-15FEB13-1/1

BioDiesel Fuel

BioDiesel fuel is comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. BioDiesel blends are BioDiesel mixed with petroleum diesel fuel on a volume basis.

Before using fuel containing BioDiesel, review the BioDiesel Use Requirements and Recommendations in this Operator's Manual.

Environmental laws and regulations can encourage or prohibit the use of biofuels. Operators should consult with appropriate governmental authorities prior to using biofuels.

All John Deere Engines with Exhaust Filter (Released 2011 and After)

While 5% blends (B5) are preferred, BioDiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. BioDiesel blends up to B20 can be used ONLY if the BioDiesel (100% BioDiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

BioDiesel concentrations above B20 can harm the engine's emission control systems and should not be used. Risks include, but are not limited to, more frequent stationary regeneration, soot accumulation, and increased intervals for ash removal.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using BioDiesel blends from B10—B20, and are recommended when using lower BioDiesel blends.

All John Deere Engines Excluding Exhaust Filter (Primarily Released Prior to 2012)

While 5% blends (B5) are preferred, BioDiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. BioDiesel blends up to B20 can be used ONLY if the BioDiesel (100% BioDiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

These John Deere engines can operate on BioDiesel blends above B20 (up to 100% BioDiesel). Operate at levels above B20 ONLY if the BioDiesel is permitted by law and meets the EN 14214 specification (primarily available in Europe). Engines operating on BioDiesel blends above B20 might not fully comply with or be permitted by all applicable emissions regulations. Expect up to a 12% reduction in power and an 18% reduction in fuel economy when using 100% BioDiesel.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using BioDiesel blends from B10—B20, and are recommended when using lower BioDiesel blends.

BioDiesel Use Requirements and Recommendations

The petroleum diesel portion of all BioDiesel blends must meet the requirements of ASTM D975 (US) or EN 590 (EU) commercial standard.

BioDiesel users in the U.S. are strongly encouraged to purchase BioDiesel blends from a BQ-9000 Certified Marketer and sourced from a BQ-9000 Accredited Producer (as certified by the National BioDiesel Board). Certified Marketers and Accredited Producers can be found at the following website: http://www.bq9000.org.

BioDiesel contains residual ash. Ash levels exceeding the maximums allowed in either ASTM D6751 or EN14214 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present).

The fuel filter can require more frequent replacement, when using BioDiesel fuel, particularly if switching from diesel. Check engine oil level daily prior to starting engine. A rising oil level can indicate fuel dilution of the engine oil. BioDiesel blends up to B20 must be used within 90 days of the date of BioDiesel manufacture. BioDiesel blends above B20 must be used within 45 days from the date of BioDiesel manufacture.

When using BioDiesel blends up to B20, the following must be considered:

- Cold-weather flow degradation
- Stability and storage issues (moisture absorption, microbial growth)
- Possible filter restriction and plugging (usually a problem when first switching to BioDiesel on used engines)
- Possible fuel leakage through seals and hoses (primarily an issue with older engines)
- Possible reduction of service life of engine components

Request a certificate of analysis from your fuel distributor to ensure that the fuel is compliant with the specifications provided in this Operator's Manual.

Consult your John Deere dealer for approved fuel conditioners to improve storage and performance with BioDiesel fuels.

The following must also be considered if using BioDiesel blends above B20:

- Possible coking or blocked injector nozzles, resulting in power loss and engine misfire if John Deere approved fuel conditioners are not used
- Possible crankcase oil dilution (requiring more frequent oil changes)
- Possible lacquering or seizure of internal components
- Possible formation of sludge and sediments
- Possible thermal oxidation of fuel at elevated temperatures
- Possible compatibility issues with other materials (including copper, lead, zinc, tin, brass, and bronze) used in fuel handling equipment

Continued on next page

DX,FUEL7 -19-15MAY13-1/2

- Possible reduction in water separator efficiency
- Possible damage to paint if exposed to BioDiesel
- Possible corrosion of fuel injection equipment
- Possible elastomeric seal and gasket material degradation (primarily an issue with older engines)
- Possible high acid levels within fuel system
- Because BioDiesel blends above B20 contain more ash, using blends above B20 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present)

IMPORTANT: Raw pressed vegetable oils are NOT acceptable for use as fuel in any concentration in John Deere engines. Their use could cause engine failure.

DX,FUEL7 -19-15MAY13-2/2

Testing Diesel Fuel

A fuel analysis program can help to monitor the quality of diesel fuel. The fuel analysis can provide critical data such as cetane number, fuel type, sulfur content, water content, appearance, suitability for cold weather operations, bacteria, cloud point, acid number, particulate contamination, and whether the fuel meets specification.

Contact your John Deere dealer for more information on diesel fuel analysis.

DX,FUEL6 -19-14APR11-1/1

Fuel Filters

The importance of fuel filtration cannot be overemphasized with modern fuel systems. The combination of increasingly restrictive emission regulations and more efficient engines requires fuel system to operate at much higher pressures. Higher pressures can only be achieved using fuel injection components with very close tolerances. These close manufacturing tolerances have significantly reduced capacities for debris and water.

John Deere brand fuel filters have been designed and produced specifically for John Deere engines.

To protect the engine from debris and water, always change engine fuel filters as specified in this manual.

DX,FILT2 -19-14APR11-1/1

Minimizing the Effect of Cold Weather on Diesel Engines

John Deere diesel engines are designed to operate effectively in cold weather.

However, for effective starting and cold-weather operation, a little extra care is necessary. The following information outlines steps that can minimize the effect that cold weather may have on starting and operation of your engine. See your John Deere dealer for additional information and local availability of cold-weather aids.

Use Winter Grade Fuel

When temperatures fall below 0 °C (32 °F), winter grade fuel (No. 1-D in North America) is best suited for cold-weather operation. Winter grade fuel has a lower cloud point and a lower pour point.

Cloud point is the temperature at which wax begins to form in the fuel. This wax causes fuel filters to plug. **Pour point** is the lowest temperature at which movement of the fuel is observed.

NOTE: On average, winter grade diesel fuel has a lower Btu (heat content) rating. Using winter grade fuel may reduce power and fuel efficiency, but should not cause any other engine performance effects. Check the grade of fuel being used before troubleshooting for low-power complaints in cold-weather operation.

Air Intake Heater

An air intake heater is an available option for some engines to aid cold weather starting.

Ether

An ether port on the intake is available to aid cold weather starting.

CAUTION: Ether is highly flammable. Do not use ether when starting an engine equipped with glow plugs or an air intake heater.

Coolant Heater

An engine block heater (coolant heater) is an available option to aid cold weather starting.

Seasonal Viscosity Oil and Proper Coolant Concentration

Use seasonal grade viscosity engine oil based on the expected air temperature range between oil changes and a proper concentration of low silicate antifreeze as recommended. (See DIESEL ENGINE OIL and ENGINE COOLANT requirements in this section.)

Diesel Fuel Flow Additive

Use John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula), which contains anti-gel chemistry, or equivalent fuel conditioner to treat non-winter grade fuel (No. 2-D in North America) during the cold-weather season. This generally extends operability to about 10 °C (18 °F) below the fuel cloud point. For operability at even lower temperatures, use winter grade fuel.

IMPORTANT: Treat fuel when outside temperature drops below 0 °C (32 °F). For best results, use with untreated fuel. Follow all recommended instructions on label.

BioDiesel

When operating with BioDiesel blends, wax formation can occur at warmer temperatures. Begin using John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula) at 5 °C (41 °F) to treat BioDiesel fuels during the cold-weather season. Use B5 or lower blends at temperatures below 0 °C (32 °F). Use only winter grade petroleum diesel fuel at temperatures below -10 °C (14 °F).

Winterfronts

Use of fabric, cardboard, or solid winterfronts is not recommended with any John Deere engine. Their use can result in excessive engine coolant, oil, and charge air temperatures. This can lead to reduced engine life, loss of power and poor fuel economy. Winterfronts may also put abnormal stress on fan and fan drive components potentially causing premature failures.

If winterfronts are used, they should never totally close off the grill frontal area. Approximately 25% area in the center of the grill should remain open at all times. At no time should the air blockage device be applied directly to the radiator core.

Radiator Shutters

If equipped with a thermostatically controlled radiator shutter system, this system should be regulated in such a way that the shutters are completely open by the time the coolant reaches 93 °C (200 °F) to prevent excessive intake manifold temperatures. Manually controlled systems are not recommended.

If air-to-air aftercooling is used, the shutters must be completely open by the time the intake manifold air temperature reaches the maximum allowable temperature out of the charge air cooler.

For more information, see your John Deere dealer.

DX,FUEL10 -19-15MAY13-1/1

Diesel Engine Break-In Oil — Non-Emissions Certified and Certified Tier 1, Tier 2, Tier 3, Stage I, Stage II, and Stage III

New engines are filled at the factory with either John Deere Break-In™ or John Deere Break-In Plus™ Engine Oil. During the break-in period, add John Deere Break-In™ or Break-In Plus™ Engine Oil, respectively, as needed to maintain the specified oil level.

Operate the engine under various conditions, particularly heavy loads with minimal idling, to help seat engine components properly.

If John Deere Break-In™ Engine Oil is used during the initial operation of a new or rebuilt engine, change the oil and filter at a maximum of 100 hours.

If John Deere Break-In Plus™ Engine Oil is used, change the oil and filter at a minimum of 100 hours and a maximum equal to the interval specified for John Deere Plus-50™ II or Plus-50™ oil.

After engine overhaul, fill the engine with either John Deere Break-In™ or Break-In Plus™ Engine Oil.

If John Deere Break-In™ or Break-In Plus™ Engine Oil is not available, use an SAE 10W-30 viscosity grade diesel engine oil meeting one of the following and change the oil and filter at a maximum of 100 hours of operation:

- API Service Classification CE
- API Service Classification CD
- API Service Classification CC
- ACEA Oil Sequence E2
- ACEA Oil Sequence E1

IMPORTANT: Do not use Plus-50™ II, Plus-50™, or engine oils meeting any of the following for the initial break-in of a new or rebuilt engine:

API CK-4	**ACEA E9**
API CJ-4	**ACEA E7**
API CI-4 PLUS	**ACEA E6**
API CI-4	**ACEA E5**
API CH-4	**ACEA E4**
API CG-4	**ACEA E3**
API CF-4	
API CF-2	
API CF	

These oils do not allow the engine to break in properly.

John Deere Break-In Plus™ Engine Oil can be used for all John Deere diesel engines at all emission certification levels.

After the break-in period, use John Deere Plus-50™ II, John Deere Plus-50™, or other diesel engine oil as recommended in this manual.

Break-In is a trademark of Deere & Company.
Break-In Plus is a trademark of Deere & Company
Plus-50 is a trademark of Deere & Company.

DX,ENOIL4 -19-02NOV16-1/1

Diesel Engine Oil — Marine Engines

Failure to follow applicable oil standards and drain intervals can result in severe engine damage that might not be covered under warranty. Warranties, including the emissions warranty, are not conditioned on the use of John Deere oils, parts, or service.

Use oil viscosity based on the expected air temperature range during the period between oil changes.

John Deere Plus-50™ II oil is preferred.

John Deere Torq-Gard™ is also allowed.

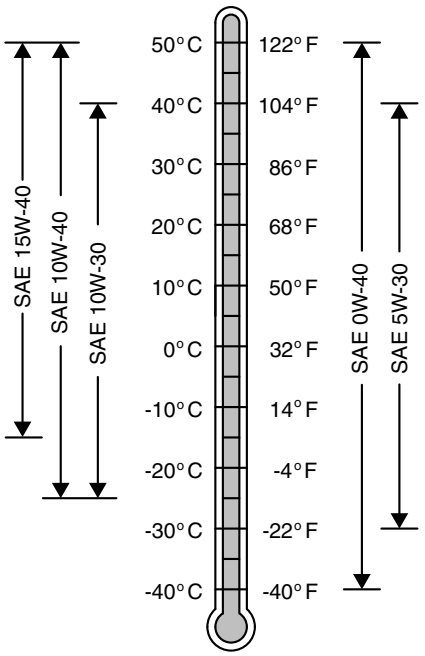
Other oils may be used if they meet one or more of the following standards:

- API Service Category CK-4
- API Service Category CJ-4
- API Service Category CI-4 PLUS
- API Service Category CI-4
- ACEA Oil Sequence E9
- ACEA Oil Sequence E7
- ACEA Oil Sequence E6
- ACEA Oil Sequence E5
- ACEA Oil Sequence E4

Multi-viscosity diesel engine oils are preferred.

Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.

Plus-50 is a trademark of Deere & Company
Torq-Gard is a trademark of Deere & Company



Oil Viscosities for Air Temperature Ranges

DO NOT use diesel fuel with sulfur content greater than 10000 mg/kg (10000 ppm).

AK08008,000004A -19-17APR17-1/1

Engine Oil and Filter Service Intervals — Tier 3 and Stage IIIA — Marine Engines

Recommended oil and filter service intervals are based on a combination of oil pan capacity, type of engine oil and filter used, and sulfur content of the diesel fuel. Actual service intervals also depend on operation and maintenance practices.

Use oil analysis to evaluate the condition of the oil and to aid in selection of the proper oil and filter service interval. Contact your John Deere dealer or other qualified service provider for more information on engine oil analysis.

Change the oil and oil filter at least once every 12 months even if the hours of operation are fewer than the otherwise recommended service interval.

Diesel fuel sulfur content affects engine oil and filter service intervals.

- Use of diesel fuel with sulfur content less than 1000 mg/kg (1000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 1000—2000 mg/kg (1000—2000 ppm) REDUCES the oil and filter change interval.
- BEFORE using diesel fuel with sulfur content greater than 2000 mg/kg (2000 ppm), contact your John Deere dealer or qualified service provider.
- DO NOT use diesel fuel with sulfur content greater than 10000 mg/kg (10000 ppm).

IMPORTANT: To avoid engine damage:

- **Reduce oil and filter service intervals by 50% when using BioDiesel blends greater than B20. Oil analysis may allow longer service intervals.**
- **Use only approved oil types.**

Approved Oil Types:

- “Plus-50 Oils” include John Deere Plus-50™ II and John Deere Plus-50™ or “Other Oils” with approved oil analysis.
- “Other Oils” include John Deere Torq-Gard™ and oils meeting the following standards: API CK-4, API CJ-4, API CI-4 PLUS, API CI-4, ACEA E9, ACEA E7, ACEA E6, ACEA E5, and ACEA E4.

Engine Oil and Filter Service Intervals		
Fuel Sulfur	Less than 500 mg/kg (500 ppm)	
Engine Type	Generator	Propulsion
Plus-50 Oil and JD Filters*	500 hours	375 hours
Fuel Sulfur	Less than 1000 mg/kg (1000 ppm)	
Plus-50 Oils*	375 hours	
Other Oils	250 hours	
Fuel Sulfur	1000—2000 mg/kg (1000—2000 ppm)	
Plus-50 Oils*	300 hours	
Other Oils	200 hours	
Fuel Sulfur	2000—10000 mg/kg (2000—10000 ppm)	
Plus-50 Oils*	Contact John Deere dealer or qualified service provider	
Other Oils	Contact John Deere dealer or qualified service provider	
Fuel Sulfur	Greater than 10000 mg/kg (Greater than 10000 ppm)	
Plus-50 Oils*	Do not use	
Other Oils	Do not use	

*Or “Other Oils” with approved oil analysis
Oil analysis may extend the service interval of “Other Oils” to a maximum not to exceed the interval of Plus-50 II oils. Oil analysis means taking a series of oil samples at 50-hour increments beyond the normal service internal until either the data indicates the end of useful oil life or the maximum service interval of John Deere Plus-50 II oils is reached.

Plus-50 is a trademark of Deere & Company
Torq-Gard is a trademark of Deere & Company

AK08008,000004C -19-17APR17-1/1

Mixing of Lubricants

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

DX,LUBMIX -19-18MAR96-1/1

Alternative and Synthetic Lubricants

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual.

Some John Deere brand coolants and lubricants may not be available in your location.

Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic lubricants.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

DX,ALTER -19-11APR11-1/1

Lubricant Storage

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST -19-11APR11-1/1

Oil Filters

Filtration of oils is critically important for proper operation and lubrication. John Deere brand oil filters have been designed and produced specifically for John Deere applications.

John Deere filters adhere to engineering specifications for quality of the filter media, filter efficiency rating, strength of the bond between the filter media and the element end cap, fatigue life of the canister (if applicable), and pressure capability of the filter seal. Non-John Deere branded oil filters might not meet these key John Deere specifications.

Always change oil filters regularly as specified in this manual.

DX,FILT1 -19-11APR11-1/1

Diesel Engine Coolant (engine with wet sleeve cylinder liners)

Preferred Coolants

The following pre-mix engine coolants are preferred:

- **John Deere COOL-GARD™II**
- **John Deere COOL-GARD II PG**

COOL-GARD II pre-mix coolant is available in several concentrations with different freeze protection limits as shown in the following table.

COOL-GARD II pre-mix	Freeze Protection Limit
COOL-GARD II 20/80	-9 °C (16 °F)
COOL-GARD II 30/70	-16 °C (3 °F)
COOL-GARD II 50/50	-37 °C (-34 °F)
COOL-GARD II 55/45	-45 °C (-49 °F)
COOL-GARD II PG 60/40	-49 °C (-56 °F)
COOL-GARD II 60/40	-52 °C (-62 °F)

Not all COOL-GARD II pre-mix products are available in all countries.

Use COOL-GARD II PG when a non-toxic coolant formulation is required.

Additional Recommended Coolants

The following engine coolant is also recommended:

- John Deere COOL-GARD II Concentrate in a 40—60% mixture of concentrate with quality water.

IMPORTANT: When mixing coolant concentrate with water, do not use less than 40% or greater than 60% concentration of coolant. Less than 40% gives inadequate additives for corrosion protection. Greater than 60% can result in coolant gelation and cooling system problems.

Other Coolants

Other ethylene glycol or propylene glycol base coolants may be used if they meet the following specification:

- Pre-mix coolant meeting ASTM D6210 requirements
- Coolant concentrate meeting ASTM D6210 requirements in a 40—60% mixture of concentrate with quality water

If coolant meeting one of these specifications is unavailable, use a coolant concentrate or pre-mix coolant that has a minimum of the following chemical and physical properties:

- Provides cylinder liner cavitation protection according to either the John Deere Cavitation Test Method or a fleet study run at or above 60% load capacity
- Is formulated with a nitrite-free additive package
- Protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion

Water Quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

Coolant Drain Intervals

Drain and flush the cooling system and refill with fresh coolant at the indicated interval, which varies with the coolant used.

When COOL-GARD II or COOL-GARD II PG is used, the drain interval is 6 years or 6000 hours of operation.

If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to 2 years or 2000 hours of operation.

IMPORTANT: Do not use cooling system sealing additives or antifreeze that contains sealing additives.

Do not mix ethylene glycol and propylene glycol base coolants.

Do not use coolants that contain nitrites.

COOL-GARD is a trademark of Deere & Company

DX,COOL3 -19-15MAY13-1/1

Water Quality for Mixing with Coolant Concentrate

Engine coolants are a combination of three chemical components: ethylene glycol (EG) or propylene glycol (PG) antifreeze, inhibiting coolant additives, and quality water.

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

All water used in the cooling system should meet the following minimum specifications for quality:

Chlorides	<40 mg/L
Sulfates	<100 mg/L
Total solids	<340 mg/L
Total dissolved I hardness	<170 mg/L
pH	5.5—9.0

IMPORTANT: Do not use bottled drinking water because it often contains higher concentrations of total dissolved solids.

Freeze Protection

The relative concentrations of glycol and water in the engine coolant determine its freeze protection limit.

Ethylene Glycol	Freeze Protection Limit
40%	-24 °C (-12 °F)
50%	-37 °C (-34 °F)
60%	-52 °C (-62 °F)
Propylene Glycol	**Freeze Protection Limit**
40%	-21 °C (-6 °F)
50%	-33 °C (-27 °F)
60%	-49 °C (-56 °F)

DO NOT use a coolant-water mixture greater than 60% ethylene glycol or 60% propylene glycol.

DX,COOL19 -19-15MAY13-1/1

Operating in Warm Temperature Climates

John Deere engines are designed to operate using recommended engine coolants.

Always use a recommended engine coolant, even when operating in geographical areas where freeze protection is not required.

IMPORTANT: Water may be used as coolant *in emergency situations only.*

Foaming, hot surface aluminum and iron corrosion, scaling, and cavitation occur when water is used as the coolant, even when coolant conditioners are added.

Drain cooling system and refill with recommended engine coolant as soon as possible.

DX,COOL6 -19-15MAY13-1/1

Testing Coolant Freeze Point

The use of a handheld coolant refractometer is the quickest, easiest, and most accurate method to determine coolant freeze point. This method is more accurate than a test strip or a float-type hydrometer which can produce poor results.

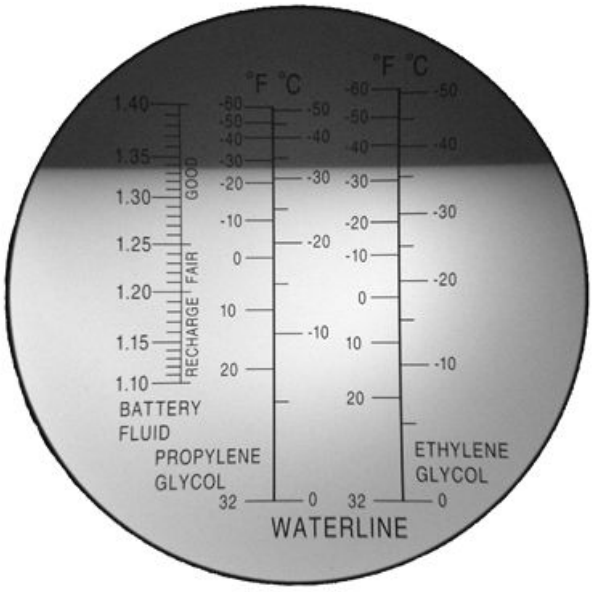
A coolant refractometer is available through your John Deere dealer under the SERVICEGARD™ tool program. Part number 75240 provides an economical solution to accurate freeze point determination in the field.

To use this tool:

1. Allow cooling system to cool to ambient temperatures.
2. Open radiator cap to expose coolant.
3. With the included dropper, collect a small coolant sample.
4. Open the lid of the refractometer, place one drop of coolant on the window and close the lid.
5. Look through the eyepiece and focus as necessary.
6. Record the listed freeze point for the type of coolant (ethylene glycol coolant or propylene glycol) being tested.

TS1732 —UN—04SEP13

SERVICEGARD™ Part Number 75240



TS1733 —UN—04SEP13

Image with a Drop of 50/50 Coolant Placed on the Refractometer Window

SERVICEGARD is a trademark of Deere & Company

DX,COOL,TEST -19-13JUN13-1/1

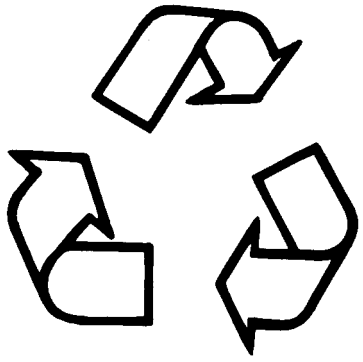
Disposing of Coolant

Improperly disposing of engine coolant can threaten the environment and ecology.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere engine distributor or servicing dealer.



TS1133 —UN—15APR13

Recycle Waste

RG,RG34710,7543 -19-09JAN07-1/1

Sea Trials for Performance and Warranty

NOTE: John Deere Marine Engines are not eligible for an extended warranty until proper installation and performance is found to be consistent with John Deere's Application Guidelines; verified by a sea trial. Once a sea trial has been completed, your John Deere dealer / distributor will provide the results to John Deere for analysis. If the engine installation meets all guidelines it will then be eligible for extended warranty.

Following any John Deere marine engine installation a John Deere Marine dealer should conduct a sea trial in order to validate proper installation. In order to maximize the performance of each vessel, it is very important to have each installation checked mechanically and electronically before it is put into regular service. The testing and investigation conducted during sea trials can proactively identify issues before they potentially result in performance problems. Sea trials also provide valuable insight to optimize engine performance, improve long-term durability, and provide a useful reference for future updates.

Two important requirements examined in a sea trial are exhaust backpressure and rated engine speed. Exceeding the recommended backpressure could result in extensive engine damage or failure. The rated engine speed is checked to verify the vessel is not over-propped (propeller is too big) or under-propped (propeller is too small). Either of these conditions will reduce engine life expectancy, increase repair costs and negatively impact fuel consumption. The John Deere Marine dealer should also verify that the additional requirements set forth in the John Deere Marine Application Guidelines were met during engine installation.

RG17228 —UN—12JUN09

The overall benefit of the sea trial is to verify the engines are installed correctly and are properly matched to the vessel. This provides for the best possible performance in the unpredictable conditions you may operate in on the open water.

NOTICE: ANY ENGINE DAMAGE RESULTING FROM OVER-PROPPING, EXCESSIVE EXHAUST BACK-PRESSURE OR OTHER INSTALLATION / RIGGING ISSUES ARE NOT COVERED UNDER WARRANTY.

NOTE: The specifications section in the back of this manual lists the rated speed for each of the different available power ratings.

JR74534,0000294 -19-23AUG11-1/1

John Deere Instrument (Gauge) Panel (Electronically Controlled Engines)

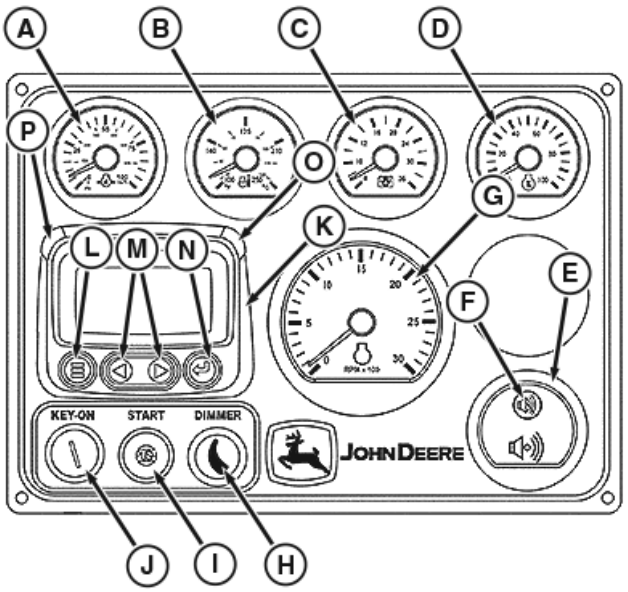
Tier 3 John Deere ***POWERTECH***™ Marine Engines have an electronic control system, which has the following controls and gauges as shown. The following information applies only to those controls and gauges supplied by John Deere for electronically controlled engines. Refer to your engine application manual or boat builder for specific guidelines if John Deere-sourced controls and instrumentation are not used.

NOTE: The standard main station (wheel house) instrument panel is shown. An optional fly-bridge panel is also available that includes the same gauges as the standard panel, but has a stop button in place of the key start switch.

NOTE: On generator-set engines, the gauges are supplied by the gen-set manufacturer. Minimum gauges required are: hour meter, oil pressure gauge and coolant temperature gauge as well as safety shutdown devices.

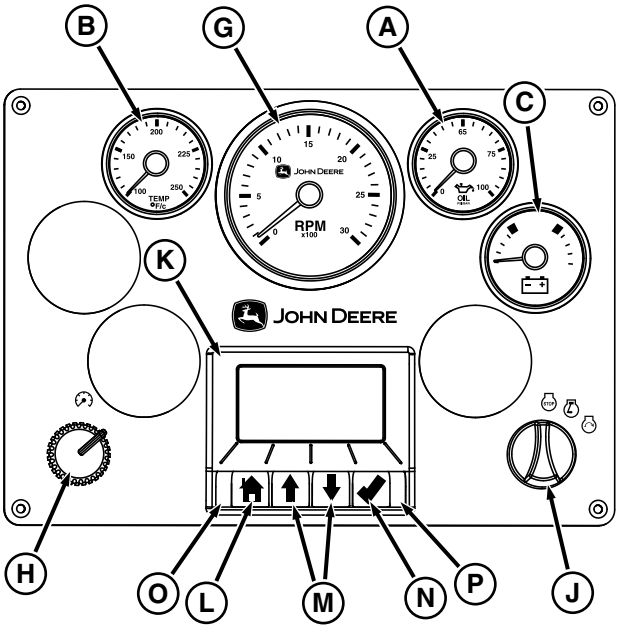
IMPORTANT: Whenever an electronic gauge or sensor does not register a correct reading, replace it with a new one. DO NOT attempt to repair it. Wiring diagrams are located in the TROUBLESHOOTING Section later in this manual.

Following is a brief description of the available optional electronic controls and gauges found on John Deere provided instrument panels. Refer to manufacturer's literature for information on controls not provided by Deere.



RG29337 —UN—01MAR17

Instrument Panel (Option A)



RG29336 —UN—01MAR17

Instrument Panel (Option B)

A—Oil Pressure Gauge
B—Coolant Temperature Gauge
C—Voltmeter
D—Percent Load Gauge (if equipped)
E—Audible Alarm
F—Audible Alarm Override Button (if equipped)
G—Tachometer
H—Dimmer Switch
I— Start Button (if equipped)
J—Key Switch
K—Diagnostic Gauge
L—Menu Key
M—Arrow Keys
N—Enter Key
O—Red "STOP ENGINE" Indicator Light
P—Amber "WARNING" Indicator Light

A—Engine Oil Pressure Gauge

The oil pressure gauge (A) indicates engine oil pressure. An audible alarm warns the operator if engine oil pressure falls below a safe operating pressure.

B—Engine Coolant Temperature Gauge

The engine coolant temperature gauge (B) indicates engine coolant temperature. An audible alarm warns the operator if coolant temperature rises above the preset safe operating temperature.

C—Voltmeter

The voltmeter (C) indicates system battery voltage. The amber "Warning" light (P) illuminates when battery voltage is too low for proper operation of the fuel injection system.

D—Percent Load Gauge

If equipped, the percent load gauge shows percent of available engine power being used by the vessel.

E—Audible Alarm

The audible alarm (E) sounds whenever low oil pressure, high coolant temperature, or water-in-fuel conditions exist. This includes all signals that light up the amber "warning" indicator (intermittent alarm) or the red "stop engine" indicator (steady alarm).

NOTE: Audible alarm is mounted behind the panel on option B.

Continued on next page

RG19661,00003B4 -19-01MAR17-1/2

F—Audible Alarm Override Button (Option A only)

The audible alarm has an override button (F) that silences the audible alarm for approximately two minutes when pressed.

G—Tachometer

The tachometer (G) indicates engine speed in hundreds of revolutions per minute (rpm).

H—Dimmer Switch

The dimmer switch (H) allows the operator to dim or brighten the illumination of the instrument panel. The diagnostic gauge (K) also has a backlight adjustment function.

I—Start Button

If equipped, the start button (I), when pressed and held in, operates the starting motor to start the engine. The engine will only start with key switch (J) in the “ON” position.

RG19661,00003B4 -19-01MAR17-2/2

John Deere Instrument (Gauge) Panel (Electronically Controlled Engines) (Continued)

J—Key Switch (Option A)

The main station instrument panel has a two-position (OFF/ON) key switch (J) which controls the engine electrical system, starts and stops the engine. When the switch is in the “ON” position, the engine may be started by pressing the start button (I).

The remote station instrument panel has a start/stop rocker in place of the key switch. With the key switch on the main station instrument panel in the ON position, the engine can be started and stopped from the remote station instrument panel.

J—Key Switch (Option B)

The main station instrument panel has a three-position (OFF/ON/CRANK) key switch (J) which controls the engine electrical system, starts and stops the engine.

The remote station instrument panel has a stop button in place of the key switch. With the key switch on the main station instrument panel in the ON position, the engine can be started and stopped from the remote station instrument panel.

K—Diagnostic Gauge/Hour Meter

The diagnostic gauge (K) displays diagnostic trouble codes (DTCs) as they are accessed. Other information on the engine can be accessed using the touch keys (L, M, and N). The hour meter feature shows the operating hours of the engine and should be used as a guide for scheduling periodic maintenance. If the diagnostic gauge receives a trouble code from an engine control unit, the current display switches to a warning or shutdown (depending on the severity of the code) screen that will display the trouble code number, the description of the code and the corrective action needed. (Refer to the following pages for use of the diagnostic gauge or OEM Diagnostic Gauges Operator’s Manual OMDZ109098.)

L—Menu Key

The menu key is pressed to either enter or exit the menu screens.

M—Arrow Keys

Use the touch keys (M) to change the display on the window of the diagnostic gauge and to access engine performance data.

Pressing the left arrow to scroll to the left or upward or the right arrow to scroll to the right or downward. This will allow you to view various engine parameters and any diagnostic trouble codes that occur.

Refer to the following story for accessing engine information on the diagnostic gauge using the touch keys.

N—Enter Key

The enter key is pressed to select the parameter that is highlighted on the screen.

O—Red “STOP ENGINE” Indicator Light

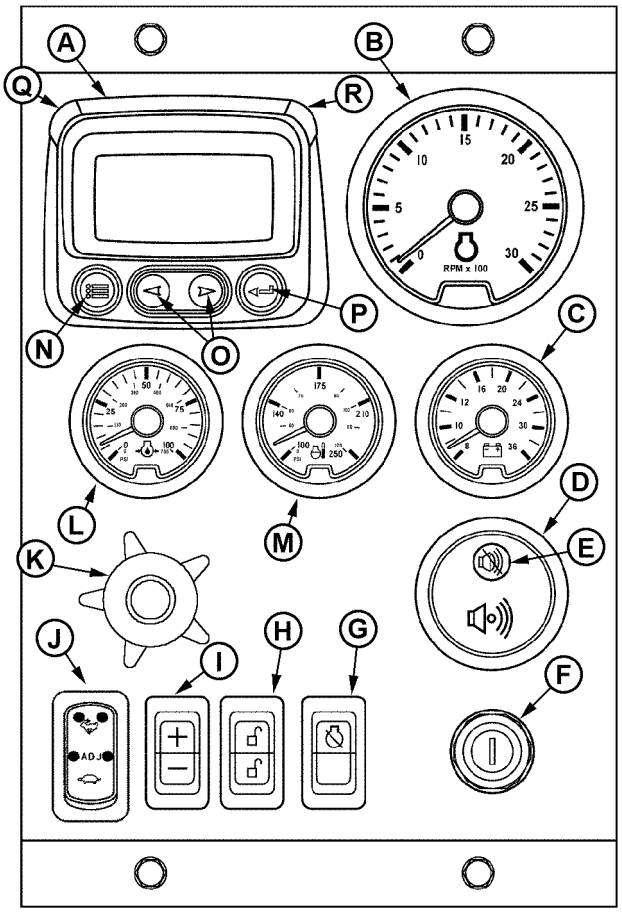
When light comes on, stop engine immediately or as soon as safely possible to prevent engine damage. Correct problem before restarting.

P—Amber “WARNING” Indicator Light

When light comes on, an abnormal condition exists. It is not necessary to shutdown engine immediately, but problem should be corrected as soon as possible.

OURGP12,0000218 -19-07MAR17-1/1

PV101 Instrument Panels



RG13276 —UN—28OCT03

Full-Featured Instrument Panel

A—Diagnostic Gauge/Hour Meter
B—Tachometer
C—Voltmeter (Optional)
D—Audible Alarm (Optional)
E—Audible Alarm Override Button
F—Key Switch
G—Override Shutdown Rocker Switch
H—Bump Enable Rocker Switch
I— Speed Select Rocker Switch
J—High-Low Speed Select Rocker Switch
K—Analog Throttle Control (Optional)
L—Oil Pressure Gauge
M—Coolant Temperature Gauge
N—Menu Key
O—Arrow Keys
P—Enter Key
Q—Amber "WARNING" Indicator Light
R—Red "STOP ENGINE" Indicator Light

Interim tier 4 / Stage III B John Deere PowerTech™ OEM Engines have an electronic control system, which has the following controls and gauges as shown. The following information applies only to those controls and gauges supplied by John Deere. Refer to your engine application manual for specific guidelines if John Deere-sourced controls and instrumentation are not used.

NOTE: This manual only covers operation of engine with a John Deere control system.

Following is a brief description of the available optional electronic controls and gauges found on John Deere provided instrument panels. Refer to manufacturer's literature for information on controls not provided by Deere.

Instrument Panels (Continued)

A—Diagnostic Gauge/Hour Meter

The diagnostic gauge (A) displays diagnostic trouble codes (DTCs) as they are accessed. Other information on the engine can be accessed using the touch keys (N, O and P). The hour meter feature shows the operating hours of the engine and should be used as a guide for scheduling periodic maintenance. If the diagnostic gauge receives a trouble code from an engine control unit, the current display will switch to a warning or shutdown (depending on the severity of the code) screen that will display the trouble code number, the description of the code and the corrective action needed.

B—Tachometer

The tachometer (B) indicates engine speed in hundreds of revolutions per minute (rpm).

C—Voltmeter (Optional)

Continued on next page

The voltmeter (C) indicates system battery voltage. The amber “Warning” light (Q) will illuminate when battery voltage is too low for proper operation of the fuel injection system.

D—Audible Alarm (Optional)

The audible alarm (D) will sound whenever low oil pressure, high coolant temperature, or water-in-fuel conditions exist. This includes all signals that light up the amber “warning” indicator (intermittent alarm) or the red “stop engine” indicator (steady alarm).

E—Audible Alarm Override Button

The optional audible alarm has an override button (E) that silences the audible alarm for approximately two minutes when pressed.

F—Key Start Switch

The three-position key start switch (F) controls the engine electrical system. When the key switch is turned clockwise to “START”, the engine will crank. When the engine starts, the key is released and returns to the “ON” (RUN) position.

G—Override Shutdown Rocker Switch

Switch will be present, but may not be active, depending on engine control unit (ECU) options originally selected. If switch is active, pressing the upper half of the override shutdown switch (G) will override an engine shutdown signal. The switch must be pressed within 30 seconds to prevent undesired shutdown of engine. Pressing this switch will override the engine shutdown for 30 seconds at a time to move vehicle to a safe location.

H—Bump Speed Enable Rocker Switch

This is a three-position switch (H) with the center position as “OFF” (locked). With this switch in the “OFF” position, the speed select switch (I) is also locked, to prevent accidental changes in operating speed. Pressing upper or lower half of switch (H) will unlock or enable the bump speed switch to take effect using speed select switch (I).

I—Speed Select Rocker Switch

The speed select switch (I) is used to bump engine speed up (+) or down (-) in small increments during operation. This switch must be used with the bump speed enable switch (H) in the unlocked position (top or bottom half of button depressed).

J—High-Low Speed Select Rocker Switch

The high-low speed select switch (J) is used to set the engine operating speeds at slow (turtle) or fast (rabbit). Factory preset idle speeds can also be adjusted using bump speed enable switch (H) with speed select switch (I).

The basic instrument panel will have the high-low speed select switch only. Press and hold up (+) or down (-) to adjust engine speed as desired. The engine speed selected will not be held in the memory. To adjust engine speeds, See Changing Engine Speeds in Section 20.

How To Select Preset Operating Speeds (Bump Speeds)

First select Turtle (Slow) or Adj by pressing speed select switch (J) to “Turtle” (slow) or “Adj”(center). Then you can press either the upper or lower portion of the bump speed enable switch (H) to unlock the setting. The bump speed enable must be held down as the speed select switch (J) is used to change the setting by pressing (+) to increase speed or (-) to decrease speed.

Once the slow idle speed has been set, the bump speed enable **switch must be pressed and released three times within two seconds to commit the new operating speed to memory.** If not done, the engine's new speed will only be effective until the key switch is shut off. Then the speed will revert back to the previous setting.

The fast idle speed is not adjustable. It will always go back to the factory preset fast idle speed.

K—Analog Throttle Control (Optional)

The throttle control (K) is used to control engine speed. This control is available only on engines with analog throttle.

L—Engine Oil Pressure Gauge

The oil pressure gauge (L) indicates engine oil pressure. An audible alarm (D) warns the operator if engine oil pressure falls below a safe operating pressure.

M—Engine Coolant Temperature Gauge

The engine coolant temperature gauge (M) indicates engine coolant temperature. An audible alarm (D) warns the operator if coolant temperature rises above the preset safe operating temperature.

N—Menu Key

The menu key is pressed to either enter or exit the menu screens on the diagnostic gauge.

O—Arrow Keys

Use the arrow keys (O) to change the display on the window of the diagnostic gauge and to access engine performance data.

Pressing the left arrow to scroll to the left or upward or the right arrow to scroll to the right or downward. This will allow you to view various engine parameters and any diagnostic trouble codes that occur.

Refer to the following story for accessing engine information on the diagnostic gauge using the touch keys.

P—Enter Key

The enter key is pressed to select the parameter that is highlighted on the screen.

Q—Amber “WARNING” Indicator Light

Continued on next page

When light comes on, an abnormal condition exists. It is not necessary to shut down the engine immediately, but the problem should be corrected as soon as possible.

When light comes on, stop engine immediately or as soon as safely possible to prevent engine damage. Correct problem before restarting.

R—Red “STOP ENGINE” Indicator Light

PowerTech is a trademark of Deere & Company

JR74534,00002C7 -19-05APR16-3/3

PV101 Diagnostic Gauge — Using

The diagnostic gauge (A) allows the operator to monitor engine functions, view diagnostic trouble codes (DTC’s), and perform preliminary diagnostics. The gauge is linked to the electronic control system and sensors.

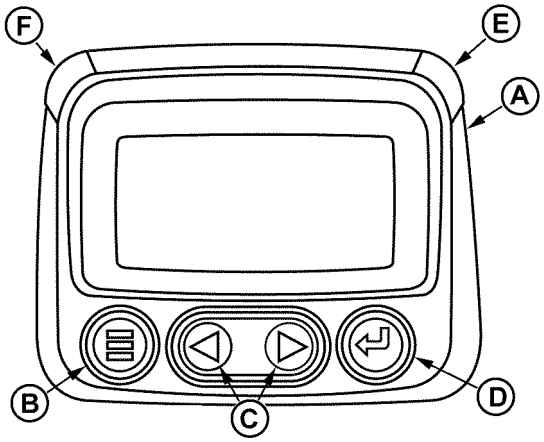
The menu key (B) allows the operator to access the main menu of the diagnostic gauge. For more information see PV101 Diagnostic Gauge — Main Menu. This key also allows the operator to cancel an option and go back to the previous menu or home menu.

The arrow keys (C) allows the operator to scroll between menu items. The arrow keys automatically change from up and down, to left and right depending on the menu item to be selected.

The select key (D) allows the operator to access menu items selected by the arrow keys (C) and confirm changes made by the operator.

The red “STOP ENGINE” indicator light (E) allows the operator to visually see when a condition exists which requires immediate operator action and service.

The amber “WARNING” indicator light (E) allows the operator to visually see when a condition exists which requires operator action.



RG13132 —UN—09SEP03

Diagnostic Gauge

A—Diagnostic Gauge
B—Menu Key
C—Arrow Keys
D—Select Key
E—Red “STOP ENGINE” Indicator Light
F—Amber “WARNING” Indicator Light

BL90236,000002A -19-23MAR16-1/1

PV101 Diagnostic Gauge — Main Menu

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

The main menu is the starting point in accessing engine information and configuring the diagnostic gauge. Press the menu key (B) to access the main menu.

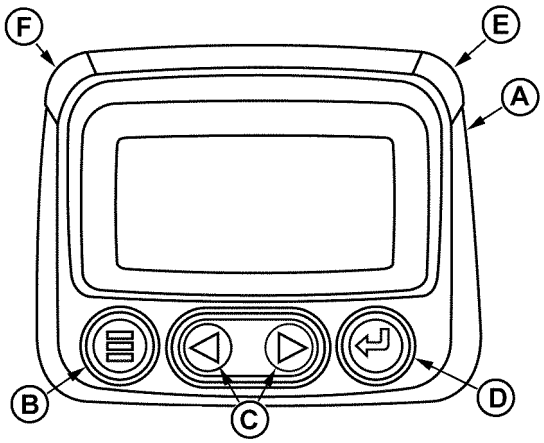
Use the arrow keys (C) and select key (D) to view menu items displayed:

- Go to 4-up dislpay
- Exhaust filter
- Engine speed control
- Languages
- Stored codes
- Engine configuration
- Setup 1-up display
- Setup 4-up display
- Select units
- Adjust backlight
- Adjust contrast
- Utilities

Listed are examples of features available in main menu items.

In Utilities:

- Gauge data
- Remove all gauges
- Software version
- Modbus setup
- Fault conversion



RG13132 —UN—09SEP03

Diagnostic Gauge

A—Diagnostic Gauge
B—Menu Key
C—Arrow Keys
D—Select Key
E—Red "STOP ENGINE" Indicator Light
F—Amber "WARNING" Indicator Light

- Select engine ECU
- Clear machine hours
- Performance data
- Interactive tests
- Reset trip
- Set function instance
- ECU software update

JR74534,00002C8 -19-02JUN16-1/1

PV101 Diagnostic Gauge — Essential Menus

Automatic Exhaust Filter Cleaning

To enable auto exhaust filter cleaning mode:
1. Press menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to EXHAUST FILTER
3. Press select key
4. Press arrow keys to scroll up or down to AUTO EXH FLT CLEAN
5. Press select key to enable auto exhaust filter cleaning

Manual/Parked Exhaust Filter Cleaning

To request a manual/parked exhaust filter cleaning:
1. Reduce engine speed to slow idle
2. Press menu key
3. Press arrow keys to scroll up or down to EXHAUST FILTER
4. Press select key
5. Press arrow keys to scroll up or down to REQUEST EXH FLT CLEAN
6. Press select key to request a manual/parked exhaust filter cleaning
7. Follow directions on display and ensure all conditions are met
8. Press select key to CONFIRM all conditions are met

Disable Exhaust Filter Cleaning

To disable the auto exhaust filter cleaning mode:
1. Press menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to EXHAUST FILTER
3. Press select key
4. Press arrow keys to scroll up or down to DISABLE EXH FLT CLEAN
5. Press select key to disable exhaust filter cleaning

Fault Codes — Active

To view active fault code information:
1. Press menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FAULTS
3. Press select key
4. Press arrow keys to scroll up or down to ACTIVE FAULTS
5. Press select key
6. Press arrow keys to scroll through available faults

Fault Codes — Stored

To view stored fault code information:
1. Press menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FAULTS
3. Press select key
4. Press arrow keys to scroll up or down to STORED FAULTS
5. Press select key
6. Press arrow keys to scroll up or down to VIEW
7. Press select key
8. Press arrow keys to scroll through available faults

BL90236,0000025 -19-02JUN16-1/1

DG14 Diagnostic Gauge — Using

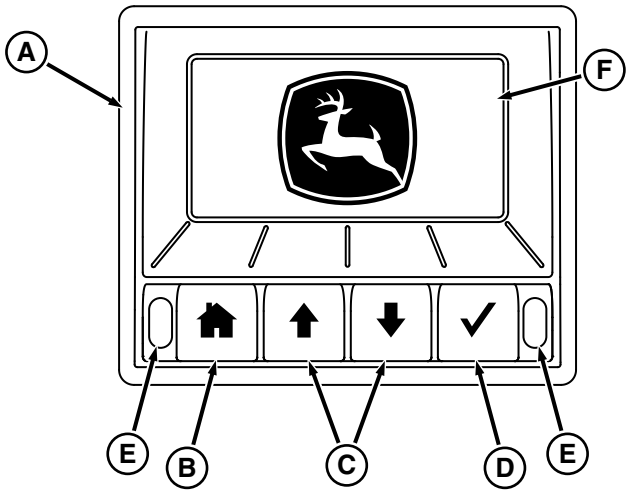
The diagnostic gauge (A) allows the operator to monitor engine functions, view diagnostic trouble codes (DTC's), and perform preliminary diagnostics. The gauge is linked to the electronic control system and sensors.

The (home) menu key (B) allows the operator to access the main menu of the diagnostic gauge. For more information see DG14 Diagnostic Gauge — Main Menu. This key also allows the operator to cancel an option and go back to the previous menu or home menu.

The arrow keys (C) allows the operator to scroll between menu items. The arrow keys automatically change from up and down, to left and right depending on the menu item to be selected.

The (check mark) select key (D) allows the operator to access menu items selected by the arrow keys (C) and confirm changes made by the operator.

The indicator lights (E) allows the operator to visually see the presence of an active trouble code.



Diagnostic Gauge

A—Diagnostic Gauge
B—(Home) Menu Key
C—Arrow Keys
D—(Check Mark) Select Key
E—Indicator Light
F—Display

BL90236,0000028 -19-02JUN16-1/1

DG14 Diagnostic Gauge — Main Menu

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

The main menu is the starting point in accessing engine information and configuring the diagnostic gauge. Press the menu key (B) to access the main menu.

Use the arrow keys (C) and select key (D) to view menu items displayed:
- Function
- Display
- Utility
- Setup

Listed are examples of features available in main menu items.

In Function:

- View fault code
- Reset trip (FT4 Only)
- Exhaust regeneration (IT4 & FT4 Only)
- Emission system override (if equipped)
- ECU software updates

In Display:

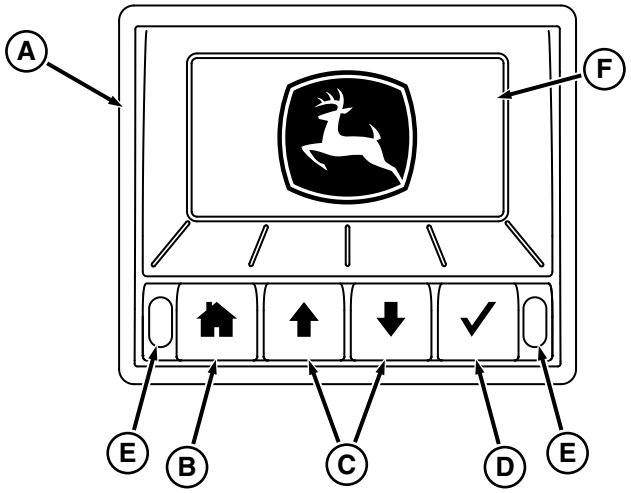
- Adjust backlight
- Adjust indicator brightness
- Display option setup

In Utility:

- Full parameter list
- Software data
- Select units
- Select language

In Setup:

- Select analog input
- Select digital input
- Select digital output



RG27904 —UN—25FEB16

Diagnostic Gauge

A—Diagnostic Gauge
B—(Home) Menu Key
C—Arrow Keys
D—(Check Mark) Select Key
E—Indicator Light
F—Display

- Alarm functionality
- Add J1939 gage
- Set RS485 messaging
- Set engine source address
- Set function instance
- Harness diagnostics
- TSC control (password protected)

Key Code for Password Protected Screens

Numeric values are assigned to keys on diagnostic gauge as identified below:

- 1 — (Home) Menu Key
- 2 — (Up) Arrow Key
- 3 — (Down) Arrow Key
- 4 — (Check Mark) Select Key

BL90236,0000029 -19-02JUN16-1/1

DG14 Diagnostic Gauge — Essential Menus

Automatic Exhaust Filter Cleaning

To enable auto exhaust filter cleaning mode:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press arrow keys to scroll up or down to EXHAUST REGENERATION
5. Press (check mark) select key
6. Press arrow keys to scroll up or down to AUTOMATIC
7. Press (check Mark) select key to enable auto exhaust filter cleaning

Manual/Parked Exhaust Filter Cleaning

To request a manual/parked exhaust filter cleaning:
1. Reduce engine speed to slow idle
2. Press (home) menu key on diagnostic gauge
3. Press arrow keys to scroll up or down to FUNCTION
4. Press (check mark) select key
5. Press arrow keys to scroll up or down to EXHAUST REGENERATION
6. Press (check mark) select key
7. Press arrow keys to scroll up or down to FORCED
8. Press (check mark) select key to request a manual/parked exhaust filter cleaning
9. Follow directions on display and ensure all conditions are met
10. Press (check mark) select key to CONFIRM all conditions are met

Disable Exhaust Filter Cleaning

To disable the auto exhaust filter cleaning mode:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press arrow keys to scroll up or down to EXHAUST REGENERATION
5. Press (check mark) select key
6. Press arrow keys to scroll up or down to INHIBIT
7. Press (check mark) select key to disable exhaust filter cleaning
8. Press (check mark) select key to continue after the warning has been acknowledged

Emission System Override — Activate

To activate an override during a derate:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press Arrow keys to scroll up or down to EMERGENCY OVERRIDE
5. Press (check mark) select key
6. Press (check mark) select key to continue after the warning has been acknowledged
7. Press (check mark) select key
8. Using the keypad, input the PASSCODE: 3 – 2 – 1 – 4. The sequence is (down arrow key – up arrow key – (home) menu key – (check mark) select key
9. Press the (check mark) select key to “ACTIVATE” an emergency override

Emission System Override — Pause

To pause an override during a derate:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press Arrow keys to scroll up or down to EMERGENCY OVERRIDE
5. Press (check mark) select key
6. Press the up arrow key to PAUSE an emergency override

Emission System Override — Resume

To resume an override during a derate:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press Arrow keys to scroll up or down to EMERGENCY OVERRIDE
5. Press (check mark) select key
6. Press the up arrow key to RESUME an emergency override

Fault Codes — Active

To view active fault code information:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press Arrow keys to scroll up or down to VIEW FAULT CODES
5. Press (check mark) select key
6. Press arrow keys to scroll up or down to ACTIVATE
7. Press (check mark) select key
8. Press Arrow keys to scroll through available faults

Fault Codes — Stored

To view stored fault code information:
1. Press (home) menu key on diagnostic gauge
2. Press arrow keys to scroll up or down to FUNCTION
3. Press (check mark) select key
4. Press Arrow keys to scroll up or down to VIEW FAULT CODES
5. Press (check mark) select key
6. Press arrow keys to scroll up or down to STORED
7. Press (check mark) select key
8. Press Arrow keys to scroll through available faults

BL90236,0000026 -19-22SEP16-1/1

PV480 Instrument Panel

John Deere PowerTech™ OEM engines have an electronic control system, which has controls and gauges as shown. The following information applies only to those controls and gauges supplied by John Deere. Refer to your engine application manual for specific guidelines if John Deere-sourced controls and instrumentation are not used.

The following is a brief description of the available optional electronic controls and gauges found on John Deere provided instrument panels. Refer to manufacturer's literature for information on controls not provided by John Deere.

Instrument Panel

A — Diagnostic Gauge

The diagnostic gauge (A) allows the operator to view fuel level, DEF level, engine parameters, diagnostic trouble codes (DTCs), and other engine functions. The gauge is linked to the electronic control system and its sensors. This allows the operator to monitor engine functions and to troubleshoot the engine systems when needed.

B — Arrow Keys

The arrow keys (B) allows the operator to select menu items

C — Menu Key

The menu key (C) allow the operator to access the main menu of the diagnostic gauge.

D — Select Key

The select key (D) allows the operator to access menu items selected by the arrow keys (B) and confirm changes made by the operator.

E — Exit Key

The exit key (E) allows the operator to cancel an option and to go back to the previous menu.

F — Key Start Switch

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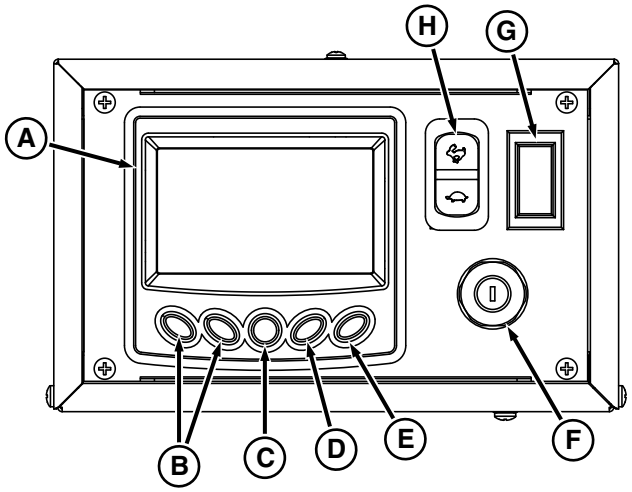


Instrument Panel

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Key Switch
G—Cover
H—Speed Select Rocker Switch

The three-position key start switch (F) controls the engine electrical system. When the key switch is turned clockwise to "START", the engine will crank. When the engine starts, the key is released and returns to the "ON" (RUN) position.

G — Cover

The cover (G) hides an expansion slot for an additional switch.

H — Speed Select Rocker Switch

The speed select switch (H) is used to bump engine speed up (+) or down (-) in small increments during operation.

BL90236,0000003 -19-25APR16-1/1

PV480 Diagnostic Gauge — Using

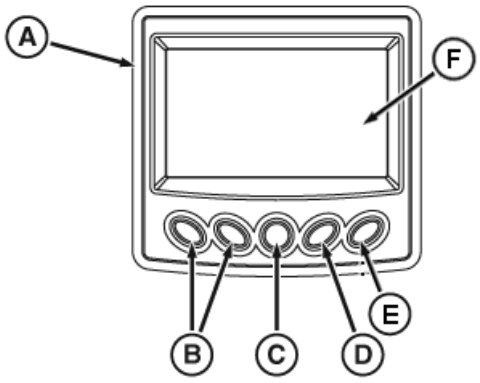
The diagnostic gauge (A) allows the operator to monitor engine functions, view diagnostic trouble codes (DTC's), and perform preliminary diagnostics. The gauge is linked to the electronic control system and sensors.

The arrow keys (B) allows the operator to scroll between menu items. The arrow keys automatically change from up and down, to left and right depending on the menu item to be selected.

The menu key (C) allows the operator to access the main menu of the diagnostic gauge. For more information see PV480 Diagnostic Gauge — Main Menu.

The select key (D) allows the operator to access menu items selected by the arrow keys (B) and confirm changes made by the operator.

The exit key (E) allows the operator to cancel an option and to go back to the previous menu.



RG23474 —UN—06JUN13

Diagnostic Gauge

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Display

BL90236,0000006 -19-27MAY16-1/1

PV480 Diagnostic Gauge — Main Menu

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

The main menu is the starting point in accessing engine information and configuring the diagnostic gauge. Press the menu key (C) to access the main menu.

Use the arrow keys (B) and select key (D) to view menu items displayed:
- User Settings
- Faults
- Exhaust Filter
- Start Options
- Service
- Utilities

Listed are examples of features available in main menu items.

In User Settings:

- Date
- Time
- Language
- Units
- Brightness
- Ambient Light

In Check Faults:

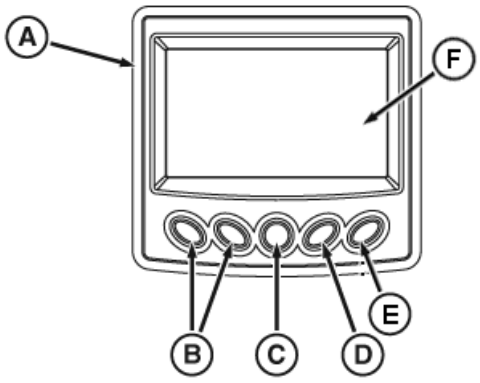
- Active fault codes
- Stored fault codes

In Exhaust Filter:

- Status
- Auto exhaust filter clean
- Disable exhaust filter clean
- Request exhaust filter clean

In Start Options:

- Auto features



RG23474 —UN—06JUN13

Diagnostic Gauge

A—Diagnostic Gauge
B—Arrow Keys
C—Menu Key
D—Select Key
E—Exit Key
F—Display

- Manual features
- Clock start
- Temperature start

In Service:

- Data list screens
- Engine hours
- Data logger
- Service reminders
- Harness diagnostics
- Component identification
- Emission system override (if equipped)

In Utilities:

- System settings
- Pressure governing
- ECU software update
- Advanced settings (password protected)

BL90236,0000001 -19-02JUN16-1/1

PV480 Diagnostic Gauge — Essential Menus

Automatic Exhaust Filter Cleaning

To enable auto exhaust filter cleaning mode:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to EXHAUST FILTER
3. Press Select key
4. Press Arrow keys to scroll up or down to AUTO EXH FLT CLEAN
5. Press Select key to enable auto exhaust filter cleaning

Manual/Parked Exhaust Filter Cleaning

To request a manual/parked exhaust filter cleaning:
1. Reduce engine speed to slow idle
2. Press Menu key
3. Press Arrow keys to scroll up or down to EXHAUST FILTER
4. Press Select key
5. Press Arrow keys to scroll up or down to REQUEST EXH FLT CLEAN
6. Press Select key to request a manual/parked exhaust filter cleaning
7. Follow directions on display and ensure all conditions are met
8. Press Select key to CONFIRM all conditions are met

Disable Exhaust Filter Cleaning

To disable the auto exhaust filter cleaning mode:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to EXHAUST FILTER
3. Press Select key
4. Press Arrow keys to scroll up or down to DISABLE EXH FLT CLEAN
5. Press Select key to disable exhaust filter cleaning

Emission System Override — Activate

To activate an override during a derate:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to SERVICE
3. Press Select key
4. Press Arrow keys to scroll up or down to DATA LIST
5. Press and hold the Menu key for 5 seconds
6. Press Select key
7. Press Arrow keys to scroll up or down to STATUS
8. Press Select key on the STATUS option
9. Press Arrow keys to ACTIVATE an emergency override
10. Press the Select key to CONFIRM selection
11. Follow directions on display and ensure all conditions have been acknowledged

Emission System Override — Pause

To pause an override during a derate:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to SERVICE
3. Press Select key
4. Press Arrow keys to scroll up or down to DATA LIST
5. Press and hold Menu key for 5 seconds
6. Press Arrow keys to scroll up or down to EMERGENCY OVERRIDE
7. Press Select key
8. Press Select key on STATUS option
9. Press Arrow keys to PAUSE emergency override
10. Follow directions on display and ensure all conditions have been acknowledged

Emission System Override — Resume

To resume an override during a derate:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to SERVICE
3. Press Select key
4. Press Arrow keys to scroll up or down to DATA LIST
5. Press and hold Menu key for 5 seconds
6. Press Arrow keys to scroll up or down to EMERGENCY OVERRIDE
7. Press Select key
8. Press Select key on STATUS option
9. Press Arrow keys to RESUME emergency override
10. Follow directions on display and ensure all conditions have been acknowledged

Fault Codes — Active

To view active fault code information:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to FAULTS
3. Press Select key
4. Press Arrow keys to scroll up or down to ACTIVE FAULTS
5. Press Select key
6. Press Arrow keys to scroll through available faults

Fault Codes — Stored

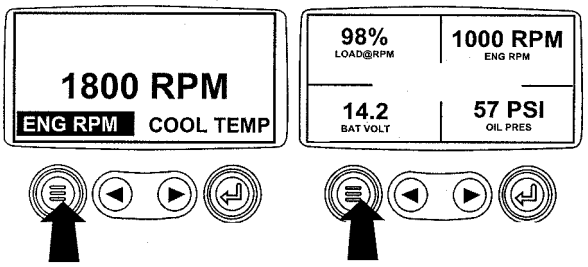
To view stored fault code information:
1. Press Menu key on diagnostic gauge
2. Press Arrow keys to scroll up or down to FAULTS
3. Press Select key
4. Press Arrow keys to scroll up or down to STORED FAULTS
5. Press Select key
6. Press Arrow keys to scroll up or down to VIEW
7. Press Select key
8. Press Arrow keys to scroll through available faults

BL90236,0000024 -19-02JUN16-1/1

Main Menu Navigation

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, See Starting the Engine in the Engine Operation Section. All of the engine values illustrated on the diagnostic gauge indicate the engine is running.

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display, press the "Menu" key.

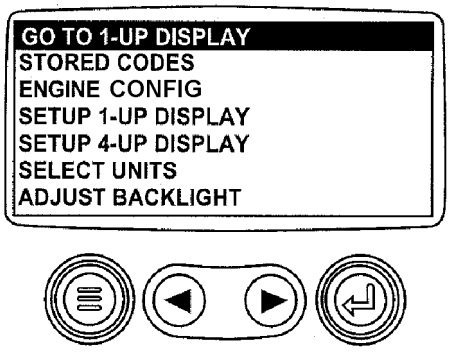


RG13159 —UN—26SEP03

Menu Key

OURGP11,00000A9 -19-20SEP13-1/5

2. The first seven items of the "Main Menu" will be displayed.

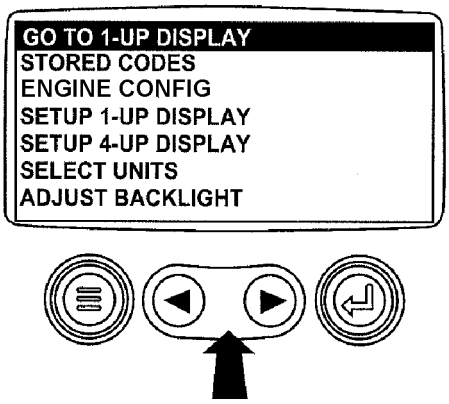


RG13160 —UN—02OCT03

Menu Display

OURGP11,00000A9 -19-20SEP13-2/5

3. Pressing the "Arrow" keys will scroll through the menu selections.



RG13161 —UN—02OCT03

Main Menu Items

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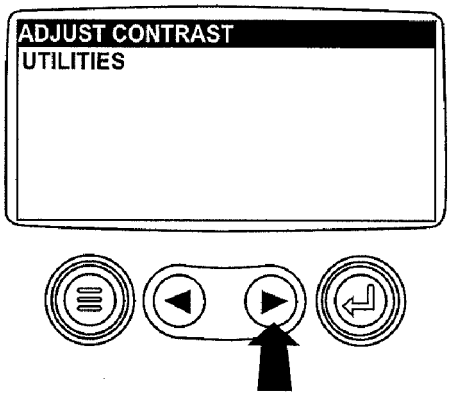
OURGP11,00000A9 -19-20SEP13-3/5

4. Pressing the right arrow key will scroll down to reveal the last items of "Main Menu" screen, highlighting the next item down.

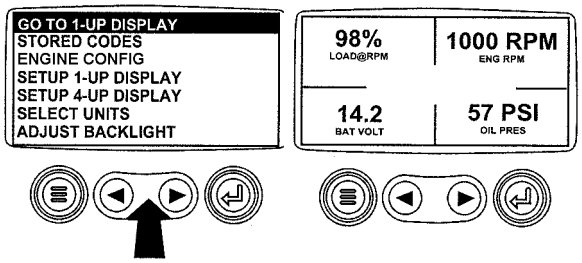


RG13162 —UN—26SEP03

Last Items On Main Menu

OURGP11,00000A9 -19-20SEP13-4/5

5. Use the arrow keys to scroll to the desired menu item or press the "Menu Button" to exit the main menu and return to the engine parameter display.



RG13163 —UN—02OCT03

Use Arrow Buttons To Scroll / Quadrant Display

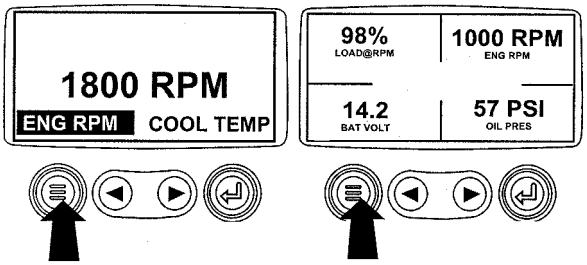
OURGP11,00000A9 -19-20SEP13-5/5

Engine Configuration Data

NOTE: The engine configuration data is a read only function.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, see Starting the Engine in the Engine Operation Section. All of the engine values illustrated on the diagnostic gauge indicate the engine is running.

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display, press the "Menu" key.



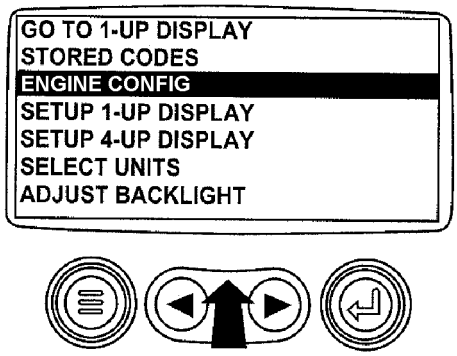
RG13159 —UN—26SEP03

Menu Key

Continued on next page

OURGP11,00000AB -19-08NOV13-1/6

2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Engine Config" is highlighted.

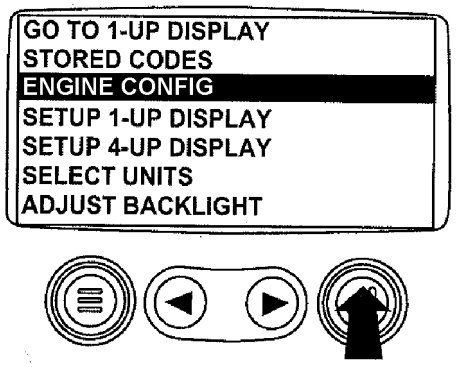


RG13164 —UN—07OCT03

Select Engine Configuration

OURGP11,00000AB -19-08NOV13-2/6

3. Once "Engine Config" menu item has been highlighted, press the "Enter" key to view the engine configuration data.

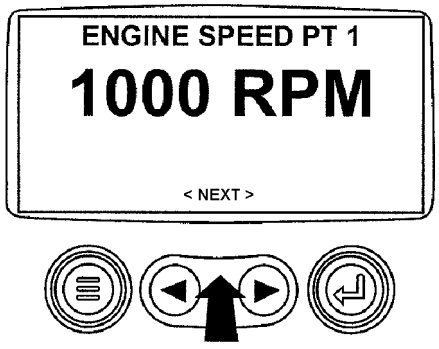


RG13165 —UN—02OCT03

Enter Key

OURGP11,00000AB -19-08NOV13-3/6

4. Use the "Arrow" keys to scroll through the engine configuration data.



RG13166 —UN—29SEP03

Use Arrow Keys To Scroll

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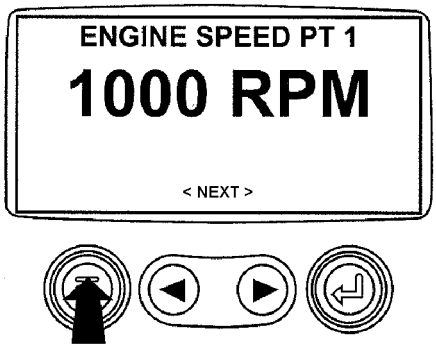
OURGP11,00000AB -19-08NOV13-4/6

5. Press the "Menu" key to return to the main menu.

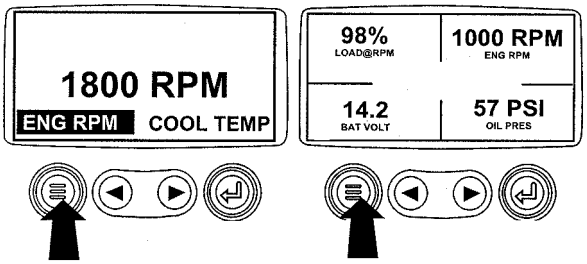


RG13167 —UN—29SEP03

Return To Main Menu

OURGP11,00000AB -19-08NOV13-5/6

6. Press the "Menu" key to exit the main menu and return to the engine parameter display.



RG13159 —UN—26SEP03

Exit Main Menu

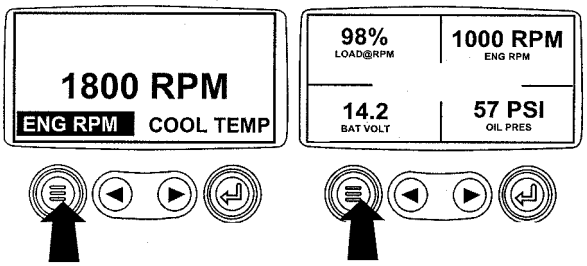
OURGP11,00000AB -19-08NOV13-6/6

Accessing Stored Diagnostic Trouble Codes

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, see Starting The Engine in the Engine Operation Section. All of the engine values illustrated on the diagnostic gauge indicate the engine is running.

For description of diagnostic trouble codes, see Diagnostic Trouble Codes (DTCs) — Listing in the Troubleshooting Section.

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display, press the "Menu" key.



RG13159 —UN—26SEP03

Menu Key

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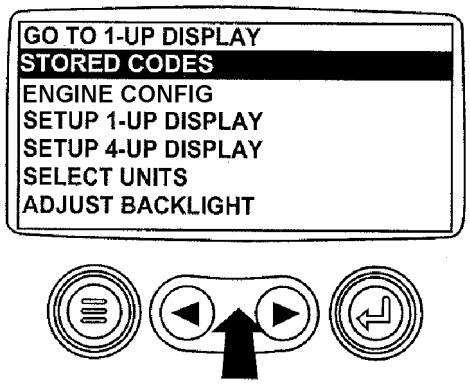
ZE59858,0000235 -19-13NOV13-1/6

2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Stored Codes" is highlighted.

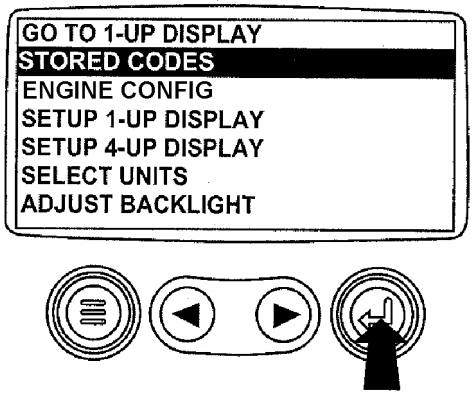


RG13168 —UN—02OCT03

Select Stored Codes

ZE59858,0000235 -19-13NOV13-2/6

3. Once the "Stored Codes" menu item has been highlighted press the "Enter" key to view the stored codes.

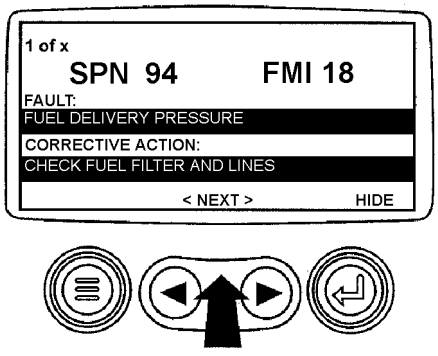


RG13169 —UN—02OCT03

Enter Key

ZE59858,0000235 -19-13NOV13-3/6

4. If the word "Next" appears above the "Arrow" keys, there are more stored codes that may be viewed. Use the "Arrow" key to scroll to the next stored code.



RG13245 —UN—02OCT03

Use Arrow Keys To Scroll

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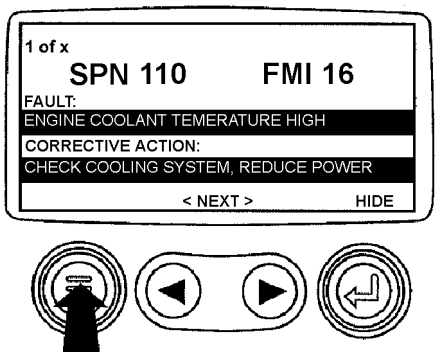
ZE59858,0000235 -19-13NOV13-4/6

5. Press the "Menu" key to return to the main menu.

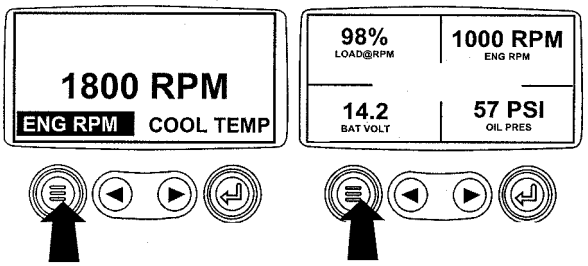


RG13246 —UN—02OCT03

Return To Main Menu

ZE59858,0000235 -19-13NOV13-5/6

6. Press the "Menu" key to exit the main menu and return to the engine parameter display.



RG13159 —UN—26SEP03

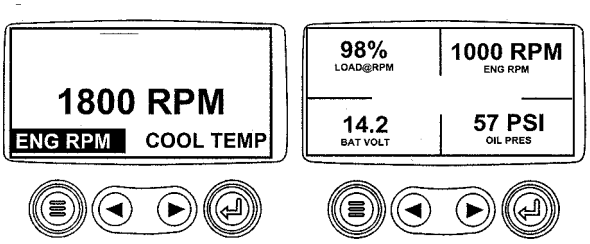
Exit Main Menu

ZE59858,0000235 -19-13NOV13-6/6

Accessing Active Diagnostic Trouble Codes

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, see Starting the Engine in the Engine Operation Section. All of the engine values illustrated on the diagnostic gauge indicate the engine is running.

For description of diagnostic trouble codes, see Diagnostic Trouble Codes (DTCs) — Listing in the Troubleshooting Section.



RG13172 —UN—26SEP03

Normal Operation

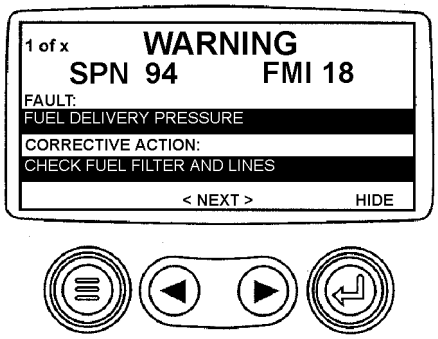
1. During normal operation the single or four parameter screen will be displayed.

Continued on next page

ZE59858,0000236 -19-13NOV13-1/7

2. When the diagnostic gauge receives a diagnostic trouble code from an engine control unit, the single or four parameter screen will be replaced with the "Warning" message. The SPN and FMI number will be displayed along with a description of the problem and the corrective action needed.

IMPORTANT: Ignoring active diagnostic trouble codes can result in severe engine damage.

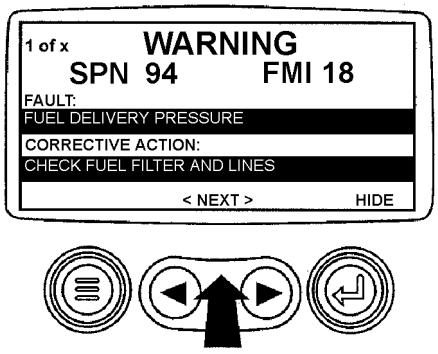


RG13240 —UN—30SEP03

Active Diagnostic Trouble Codes Displayed

ZE59858,0000236 -19-13NOV13-2/7

3. If the word "Next" appears above the arrow keys, there are more diagnostic trouble codes that can be viewed by using the arrow keys to scroll to the next diagnostic trouble code.



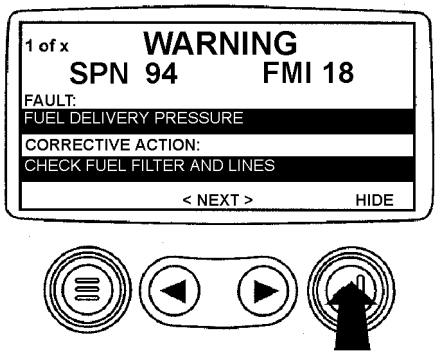
RG13241 —UN—30SEP03

Use Arrow Keys To Scroll

ZE59858,0000236 -19-13NOV13-3/7

IMPORTANT: Ignoring active diagnostic trouble codes can result in severe engine damage.

4. To acknowledge and hide the code and return to the single or four parameter display, press the "Enter" Key.

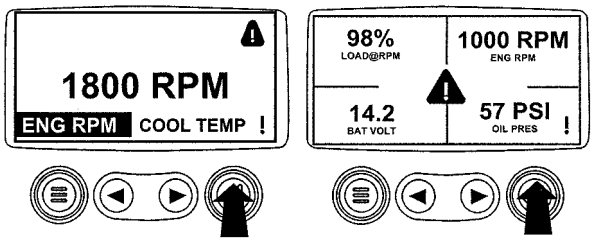


RG13242 —UN—30SEP03

Hide Diagnostic Trouble Codes

ZE59858,0000236 -19-13NOV13-4/7

5. The display will return to the single or four parameter display, but the display will contain the warning icon. Pressing the "Enter" key will redisplay the hidden diagnostic trouble code.



RG13176 —UN—26SEP03

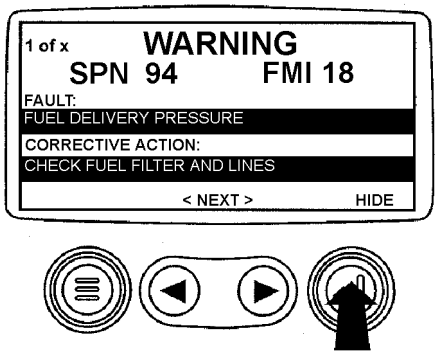
Active Diagnostic Trouble Code Icon

Continued on next page

ZE59858,0000236 -19-13NOV13-5/7

IMPORTANT: Ignoring active diagnostic trouble codes can result in severe engine damage.

6. Pressing the "Enter" key once again will hide the diagnostic trouble code and return the screen to the single or four parameter display.

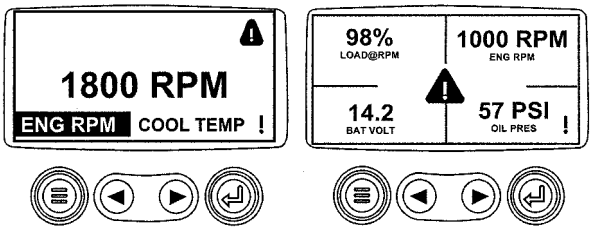


RG13242 —UN—30SEP03

Enter Key

ZE59858,0000236 -19-13NOV13-6/7

7. The single or four parameter screen will display the warning icon until the diagnostic trouble code condition is corrected.



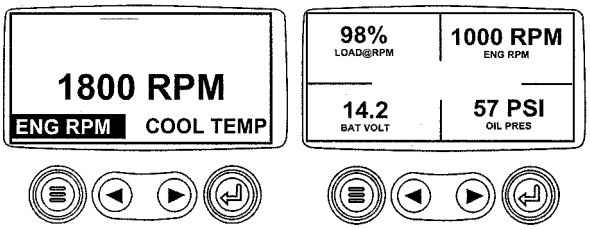
RG13243 —UN—01OCT03

Active Diagnostic Trouble Code Condition

ZE59858,0000236 -19-13NOV13-7/7

Engine Shutdown Diagnostic Trouble Codes

1. During normal operation the single or four parameter screen will be displayed.



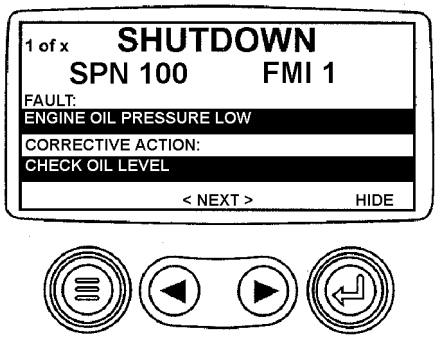
RG13172 —UN—26SEP03

Normal Operation

OURGP11,00000AE -19-29OCT13-1/6

2. When the diagnostic gauge receives a severe diagnostic trouble code from an engine control unit, the single or four parameter screen will be replaced with the "Shutdown" message. The SPN and FMI number will be displayed along with a description of the problem and the corrective action needed.

   If the word "Next" appears above the arrow keys, there are more diagnostic trouble codes that can be viewed by using the arrow keys to scroll to the next diagnostic trouble code.



RG13238 —UN—29SEP03

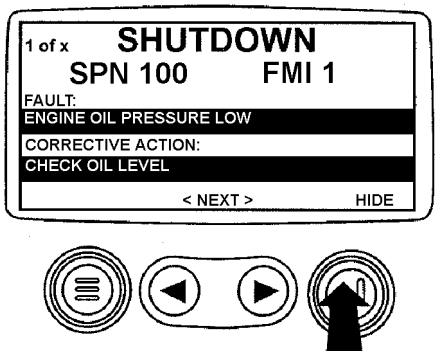
Shutdown Message

Continued on next page

OURGP11,00000AE -19-29OCT13-2/6

3. To acknowledge and hide the diagnostic trouble code and return to the single or four parameter display, press the "Enter" key".

IMPORTANT: Ignoring the shutdown message can result in severe engine damage.



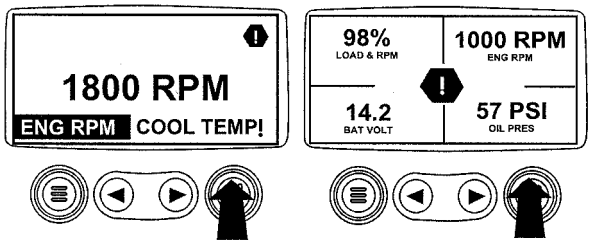
RG13239 —UN—29SEP03

Hide Diagnostic Trouble Code

OURGP11,00000AE -19-29OCT13-3/6

4. The display will return to the single or four parameter display, but the display will contain the "Shutdown" icon. Pressing the "Enter" key will redisplay the hidden diagnostic trouble code.

IMPORTANT: Ignoring the shutdown message can result in severe engine damage.

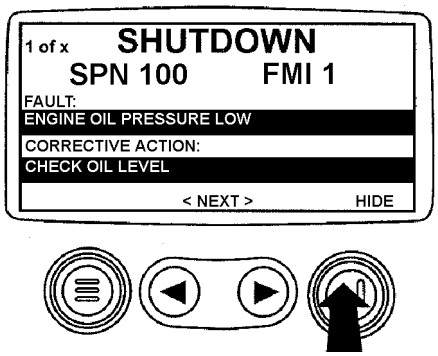


RG13179 —UN—26SEP03

Flashing Shutdown Icon

OURGP11,00000AE -19-29OCT13-4/6

5. Pressing the "Enter" key once again will hide the diagnostic trouble code and return the screen to the single or four parameter display.



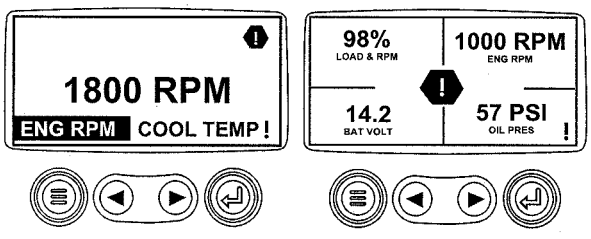
RG13239 —UN—29SEP03

Redisplay Diagnostic Trouble Code

OURGP11,00000AE -19-29OCT13-5/6

6. The single or four parameter screen will display the shutdown icon until the diagnostic trouble code condition is corrected.

IMPORTANT: Ignoring the shutdown message can result in severe engine damage.



RG13180 —UN—26SEP03

Shutdown Icon

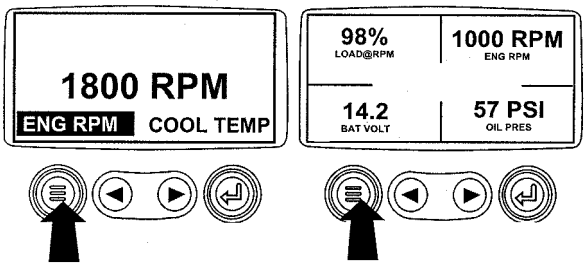
OURGP11,00000AE -19-29OCT13-6/6

Adjusting Backlighting

NOTE: The backlight control on the instrument panel may also be used to adjust backlighting. This control will override any adjustment made on the diagnostic gauge.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens. If engine start up is desired, see Starting the Engine in the Engine Operation Section. All of the engine values illustrated on the diagnostic gauge indicate the engine is running.

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display, press the "Menu" key.

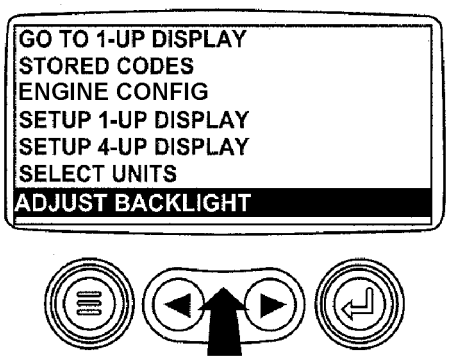


Menu Key

RG13159 —UN—26SEP03

ZE59858,0000237 -19-20SEP13-1/6

2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Adjust Backlight" is highlighted.

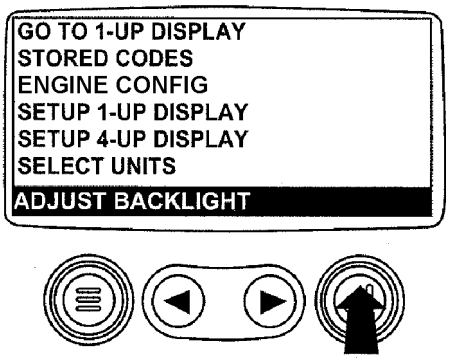


Select Adjust Backlight

RG13181 —UN—02OCT03

ZE59858,0000237 -19-20SEP13-2/6

3. Once the "Adjust Backlight" menu item has been highlighted, press the "Enter" key to activate the "Adjust Backlight" function.



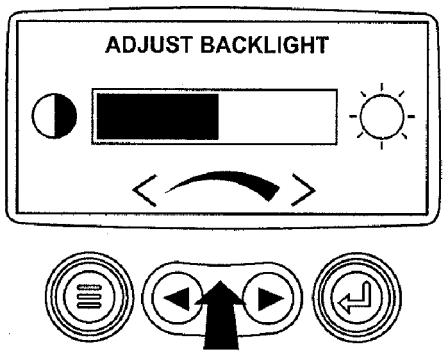
Press Enter Key

RG13182 —UN—02OCT03

Continued on next page

ZE59858,0000237 -19-20SEP13-3/6

4. Use the "Arrow" keys to select the desired backlight intensity.

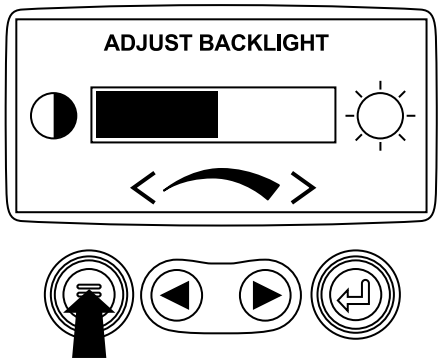


RG13183 —UN—29SEP03

Adjust Backlight Intensity

ZE59858,0000237 -19-20SEP13-4/6

5. Press the "Menu" key to return to the main menu.

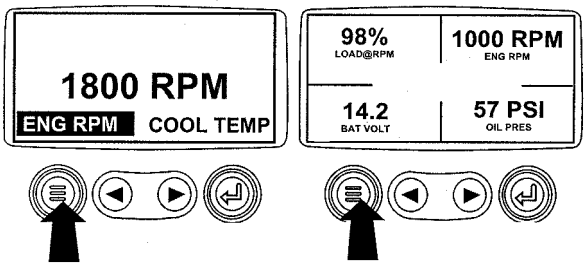


RG19048 —UN—23AUG10

Return To Main Menu

ZE59858,0000237 -19-20SEP13-5/6

6. Press the "Menu" key to exit the main menu and return to the engine parameter display.



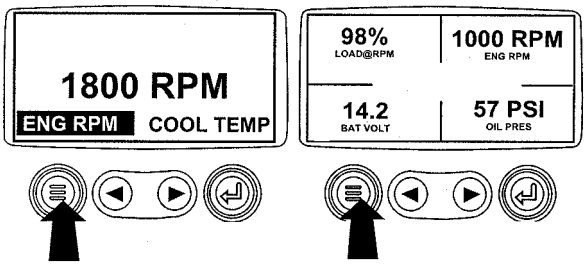
RG13159 —UN—26SEP03

Exit Main Menu

ZE59858,0000237 -19-20SEP13-6/6

Adjusting Contrast

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display press the "Menu" key.



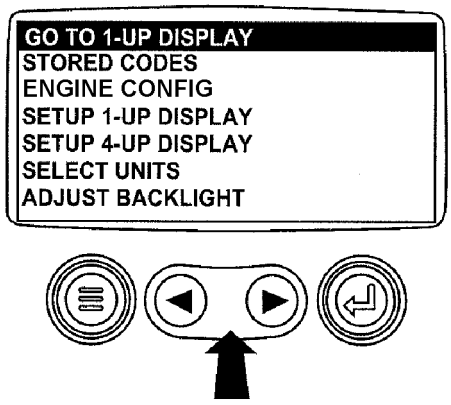
RG13159 —UN—26SEP03

Menu Key

Continued on next page

OURGP11,00000AF -19-13NOV13-1/6

2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Adjust Contrast" is highlighted.

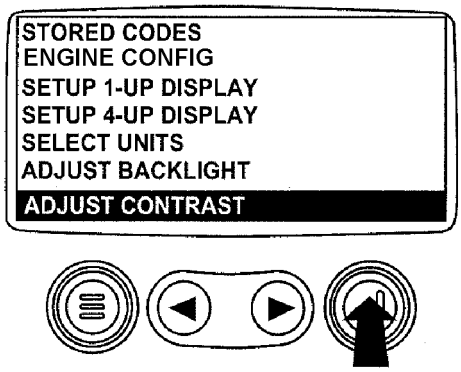


RG13161 —UN—02OCT03

Select Adjust Contrast

OURGP11,00000AF -19-13NOV13-2/6

3. Once the "Adjust Contrast" menu item has been highlighted, press the "Enter" key to activate the "Adjust Contrast" function.

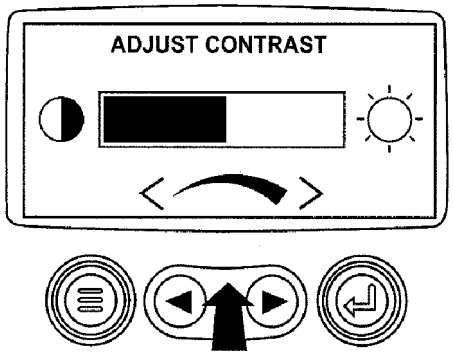


RG13185 —UN—02OCT03

Press Enter Key

OURGP11,00000AF -19-13NOV13-3/6

4. Use the "Arrow" keys to select the desired contrast intensity.



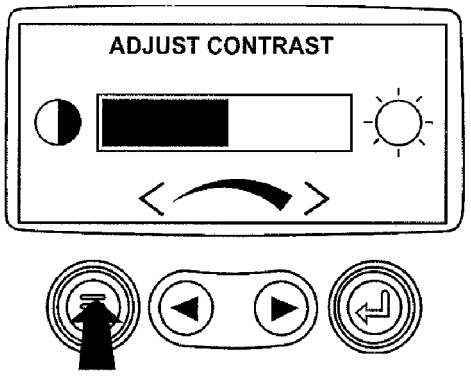
RG13186 —UN—29SEP03

Adjust Contrast Intensity

Continued on next page

OURGP11,00000AF -19-13NOV13-4/6

5. Press the "Menu" key to return to the main menu.

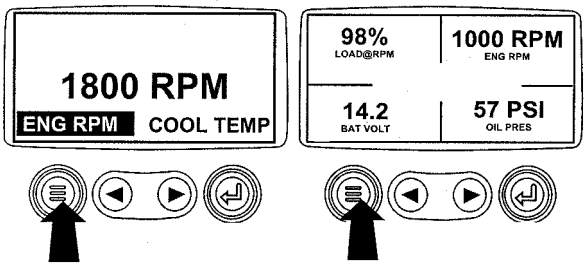


RG13187 —UN—26SEP03

Return To Main Menu

OURGP11,00000AF -19-13NOV13-5/6

6. Press the "Menu" key to exit the main menu and return to the engine parameter display.



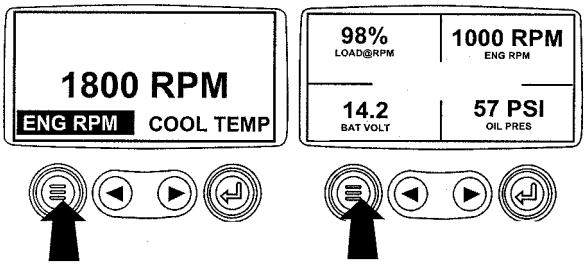
RG13159 —UN—26SEP03

Exit Main Menu

OURGP11,00000AF -19-13NOV13-6/6

Selecting Units Of Measurement

1. Turn the key switch to the ON position. Starting at the single or four engine parameter display, press the "Menu" key.

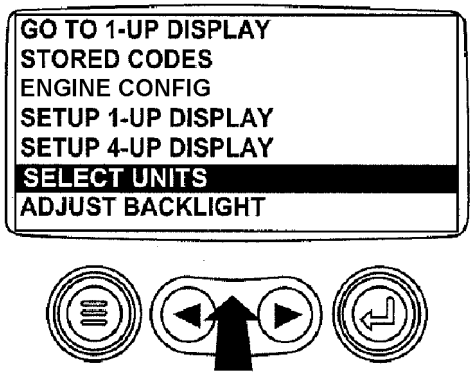


RG13159 —UN—26SEP03

Menu Key

OURGP11,00000B0 -19-13NOV13-1/7

2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Select Units" is highlighted.



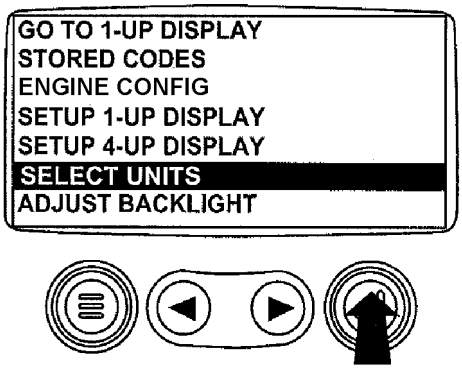
RG13188 —UN—02OCT03

Select Units

Continued on next page

OURGP11,00000B0 -19-13NOV13-2/7

3. Once the "Select Units" menu item has been highlighted press the "Enter" key to access the "Select Units" function.



RG13189 —UN—02OCT03

Press Enter Key

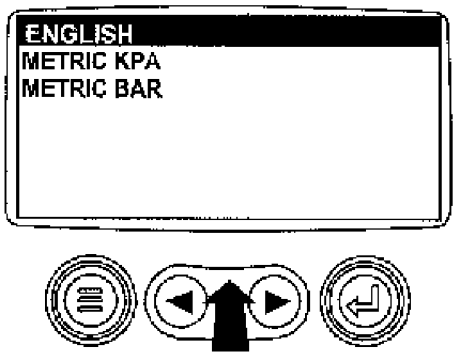
OURGP11,00000B0 -19-13NOV13-3/7

4. There are three choices for units of measurement, English, Metric kPa or Metric Bar.

   English is for Imperial units, with pressures displayed in PSI and temperatures in °F.

   Metric kPa and Metric bar are for IS units, with pressures displayed in kPa and bar respectively, and temperatures in °C.

   Use the "Arrow" keys to highlight the desired units of measurement.

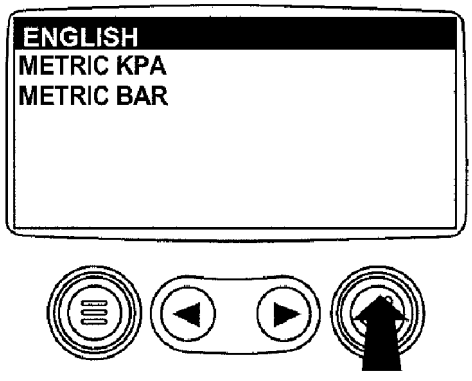


RG13190 —UN—26SEP03

Select Desired Units

OURGP11,00000B0 -19-13NOV13-4/7

5. Press the "Enter" key to select the highlighted units.



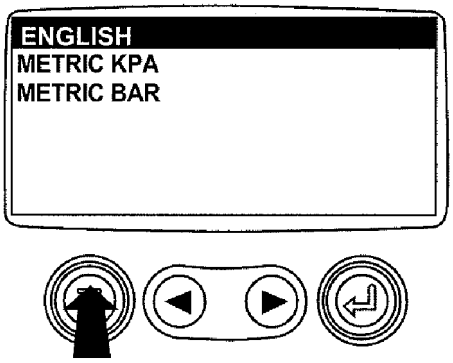
RG13191 —UN—30SEP03

Press Enter Key to Select

Continued on next page

OURGP11,00000B0 -19-13NOV13-5/7

6. Press the "Menu" key to return to the main menu.

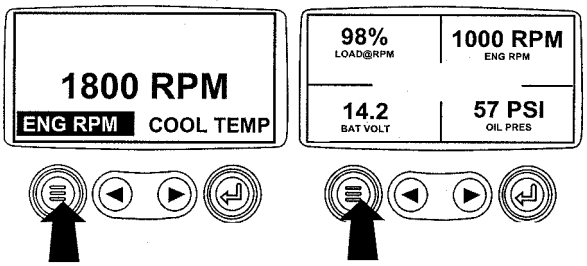


RG13192 —UN—26SEP03

Return To Main Menu

OURGP11,00000B0 -19-13NOV13-6/7

7. Press the "Menu" key to return to the engine parameter display.



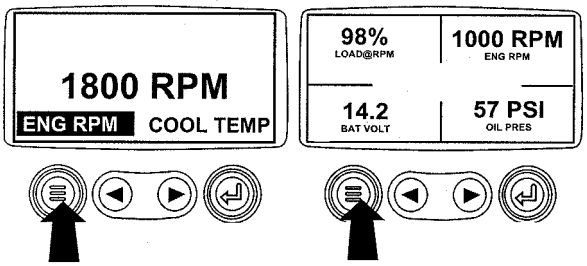
RG13159 —UN—26SEP03

Press Menu Key

OURGP11,00000B0 -19-13NOV13-7/7

Setup 1-Up Display

1. Turn the key switch to the ON position. Starting at the single engine parameter display, press the "Menu" key.

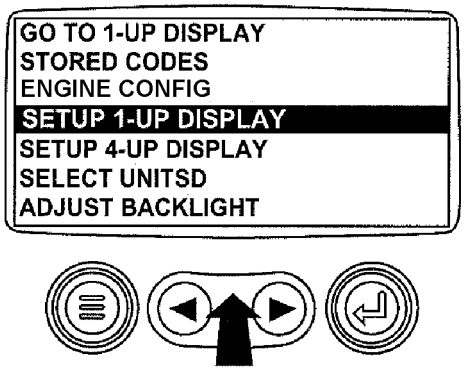


RG13159 —UN—26SEP03

Menu Key

OURGP11,00000B1 -19-13NOV13-1/18

2. Use the "Arrow" keys to scroll through the menu until "Setup 1-Up Display" is highlighted.



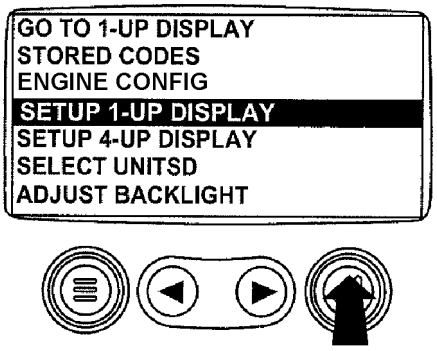
RG13193 —UN—02OCT03

Setup 1-Up Display

Continued on next page

OURGP11,00000B1 -19-13NOV13-2/18

3. Once "Setup 1-Up Display" menu item has been highlighted press the "Enter" key to access the "Setup 1-Up Display" function.

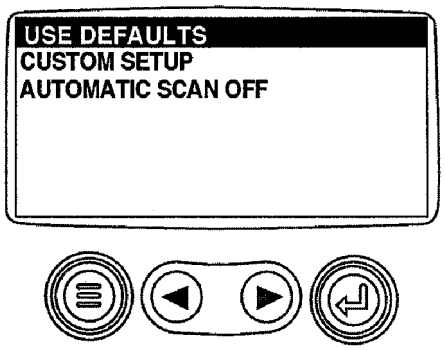


RG13194 —UN—02OCT03

Press Enter Key

OURGP11,00000B1 -19-13NOV13-3/18

4. Three options are available for modification of the 1-Up Display.
   a. **Use Defaults** – This option contains the following engine parameters for display: Engine Hours, Engine Speed, Battery Voltage, % Load, Coolant Temperature and Oil Pressure.
   b. **Custom Setup** – This option contains a list of engine parameters. Engine parameters from this list can be selected to replace any or all of the default parameters. This option can be used to add parameters available for scrolling in the 1-Up Display.
   c. **Automatic Scan** – Selecting the scan function will allow the 1-Up Display to scroll through the selected set of parameters one at a time, momentarily pausing at each.

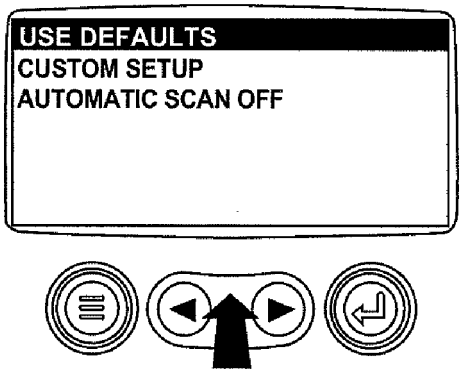


RG13196 —UN—26SEP03

1-Up Display Options

OURGP11,00000B1 -19-13NOV13-4/18

5. **Use Defaults** - To select "Use Defaults" use the Arrow keys to scroll to and highlight "Use Defaults" in the menu display.



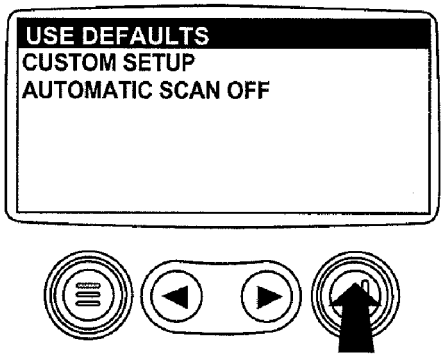
RG13195 —UN—26SEP03

Select Defaults

Continued on next page

OURGP11,00000B1 -19-13NOV13-5/18

6. Press the "Enter" key to activate the "Use Defaults" function.

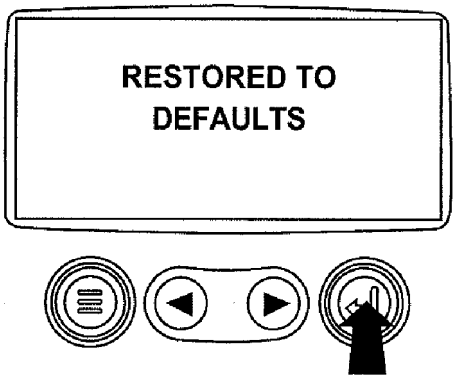


RG13197 —UN—29SEP03

Defaults Selected

OURGP11,00000B1 -19-13NOV13-6/18

7. The display parameters are reset to the factory defaults, then the display will return to the "Setup 1-Up Display" menu.

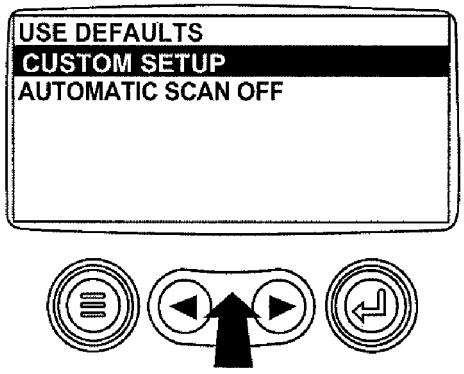


RG13149 —UN—24SEP03

Restored To Defaults

OURGP11,00000B1 -19-13NOV13-7/18

8. **Custom Setup** - To perform a custom setup of the 1-Up Display, use the arrow buttons to scroll to and highlight "Custom Setup" on the display.



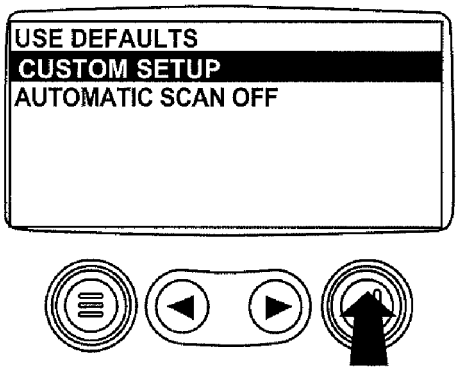
RG13198 —UN—26SEP03

Select Custom Setup

Continued on next page

OURGP11,00000B1 -19-13NOV13-8/18

9. Press the "Enter" key to display a list of engine parameters.

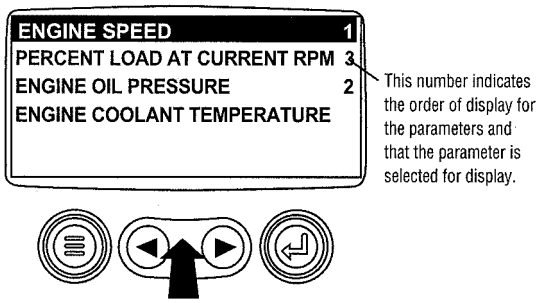


RG13199 —UN—26SEP03

Engine Parameters

OURGP11,00000B1 -19-13NOV13-9/18

10. Use the "Arrow" keys to scroll to and highlight a selected parameter (parameter with a number to right of it).

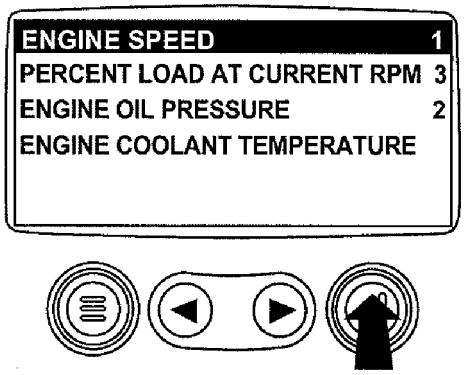


RG13150 —UN—24SEP03

Select Parameters

OURGP11,00000B1 -19-13NOV13-10/18

11. Press the "Enter" key to deselect the selected parameter, removing it from the list of parameters being displayed on the 1-Up Display.



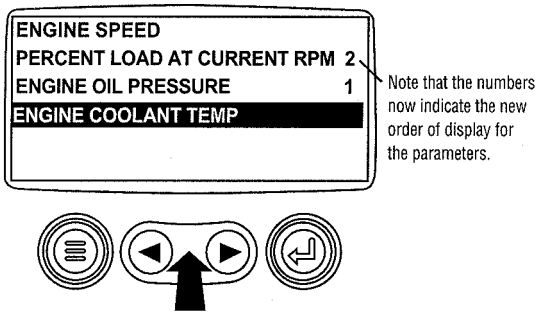
RG13219 —UN—26SEP03

Deselect Parameters

Continued on next page

OURGP11,00000B1 -19-13NOV13-11/18

12. Use the "Arrow" keys to scroll and highlight the desired parameter that has not been selected for display (parameter without a number to right of it).

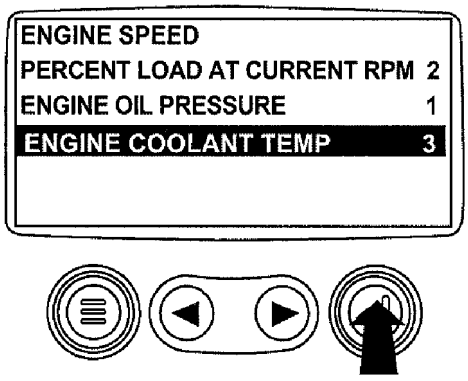


RG13151 —UN—24SEP03

Select Desired Parameters

OURGP11,00000B1 -19-13NOV13-12/18

13. Press the "Enter" key to select the parameter for inclusion in the Single Engine Parameter Display.
14. Continue to scroll through and select additional parameters for the custom 1-Up Display. Press the "Menu" key at any time to return to the "Custom Setup" menu.

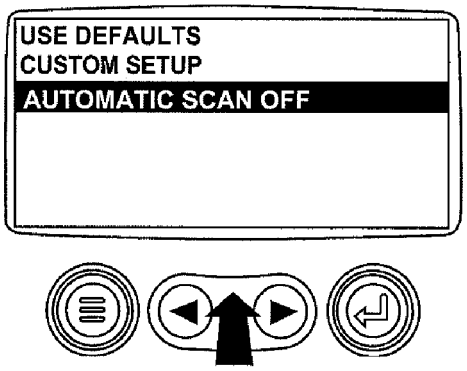


RG13220 —UN—26SEP03

Select Parameters For Display

OURGP11,00000B1 -19-13NOV13-13/18

15. **Automatic Scan** - Selecting the scan function will allow the 1- Up Display to scroll through the selected set of parameters one at a time. Use the "Arrow" keys to scroll to the "Automatic Scan" function.



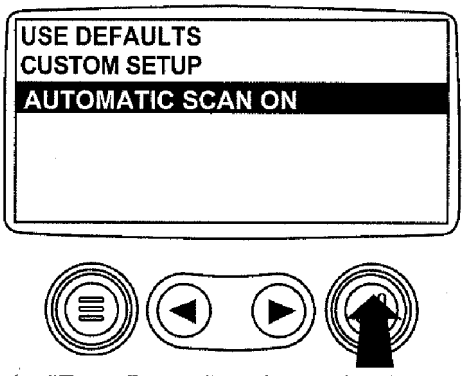
RG13221 —UN—26SEP03

Automatic Scan Off

Continued on next page

OURGP11,00000B1 -19-13NOV13-14/18

16. Press the "Enter" key to toggle the "Automatic Scan" function on.

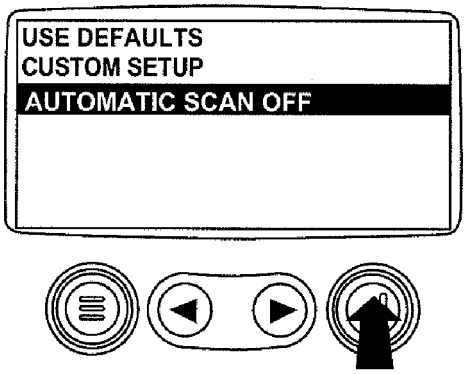


RG13222 —UN—26SEP03

Automatic Scan On

OURGP11,00000B1 -19-13NOV13-15/18

17. Press the "Enter" key again to toggle the "Automatic Scan" function off.

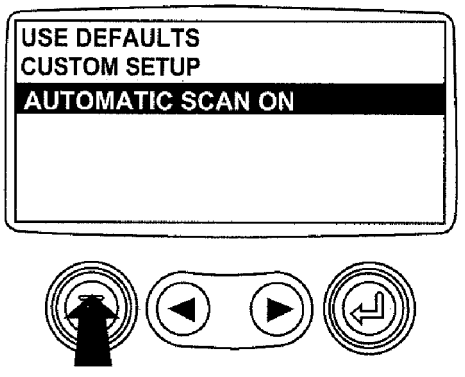


RG13223 —UN—26SEP03

Automatic Scan Off

OURGP11,00000B1 -19-13NOV13-16/18

18. Once the "Use Defaults", "Custom Setup" and "Automatic Scan" functions have been set, press the "Menu" key to return to the main menu.



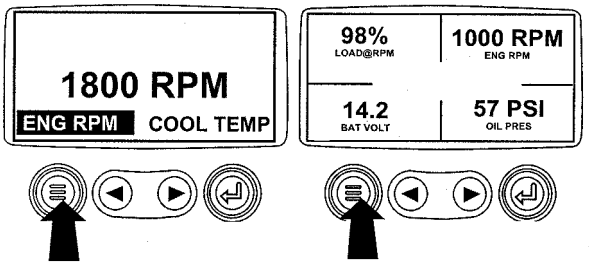
RG13224 —UN—26SEP03

Menu Key

Continued on next page

OURGP11,00000B1 -19-13NOV13-17/18

19. Press the "Menu" key to exit the main menu and return to the engine parameter display.

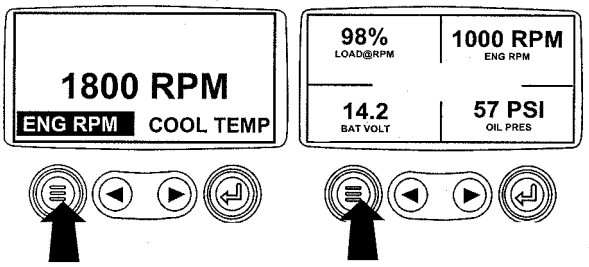


Exit Main Menu

OURGP11,00000B1 -19-13NOV13-18/18

Setup 4-Up Display

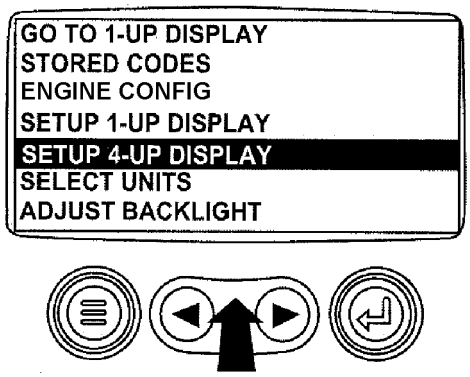
1. Turn the key switch to the ON position. From the single or four engine parameter display, press the "Menu" key.



Menu Key

OURGP11,00000B2 -19-13NOV13-1/14

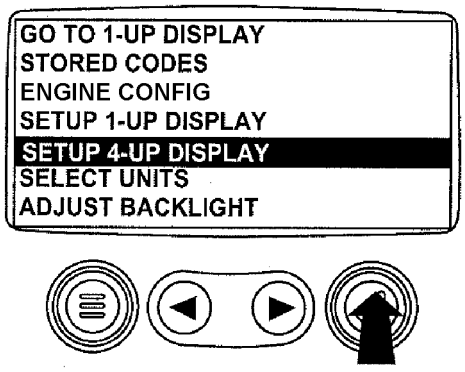
2. The main menu will be displayed. Use the "Arrow" keys to scroll through the menu until "Setup 4-Up Display" is highlighted.



Select Setup 4-Up Display

OURGP11,00000B2 -19-13NOV13-2/14

3. Once the "Setup 4-Up Display" menu item has been highlighted, press the "Enter" key to activate the "Setup 4-Up Display" menu.



Press Enter Key

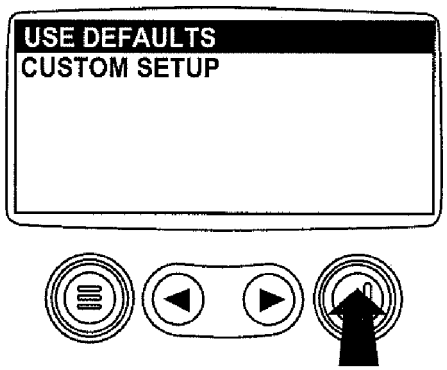
Continued on next page

OURGP11,00000B2 -19-13NOV13-3/14

4. Two options are available for the 4-Up Display.

   a. **Use Defaults** – This option contains the following engine parameters for display: Engine Speed, Battery Voltage, Coolant Temperature and Oil Pressure.

   b. **Custom Setup** – This option contains a list of engine parameters. Engine parameters from this list can be selected to replace any or all of the default parameters.

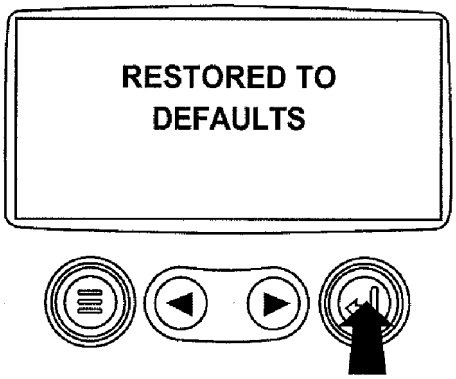


RG13244 —UN—02OCT03

Select Factory Defaults

OURGP11,00000B2 -19-13NOV13-4/14

5. To reset the display parameters to the factory defaults, scroll to and highlight "Use Defaults". Press the "Enter" key to activate the "Use Defaults" function. A message indicating the display parameters are reset to the factory defaults will be displayed, then the display will return to the "Setup 4-Up Display" menu.

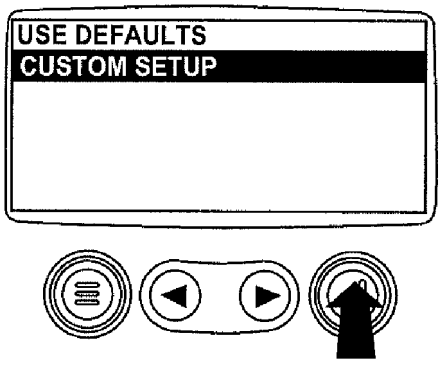


RG13149 —UN—24SEP03

Restored To Defaults

OURGP11,00000B2 -19-13NOV13-5/14

6. **Custom Setup** - To perform a custom setup of the 4-Up Display, use the arrow buttons to scroll to and highlight "Custom Setup" on the display.



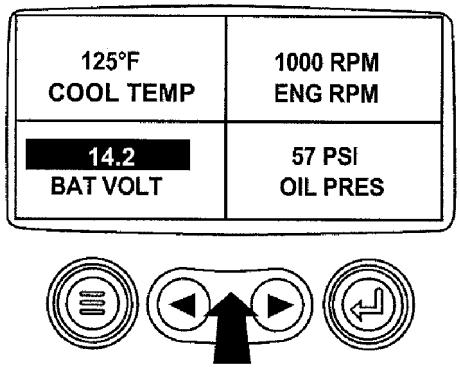
RG13227 —UN—26SEP03

Custom Setup

Continued on next page

OURGP11,00000B2 -19-13NOV13-6/14

7. The quadrant with the highlighted parameter value is the current selected parameter. Use the "Arrow" keys to highlight the value in the quadrant you wish to change to a new parameter.

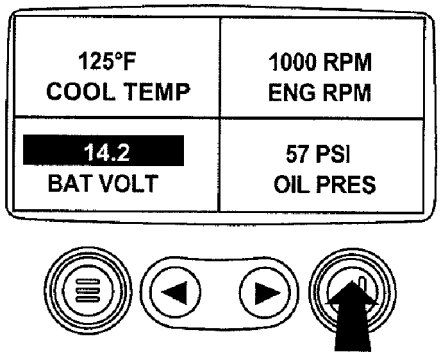


RG13228 —UN—26SEP03

Select Parameters

OURGP11,00000B2 -19-13NOV13-7/14

8. Press the "Enter" key and a list of engine parameters will be displayed.

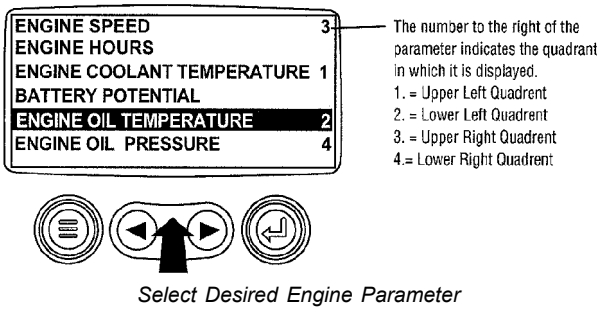


RG13229 —UN—26SEP03

List Of Engine Parameters

OURGP11,00000B2 -19-13NOV13-8/14

9. The parameter that is highlighted is the selected parameter for the screen. Use the "arrow" keys to highlight the new parameter to be placed in the "4-Up Display".



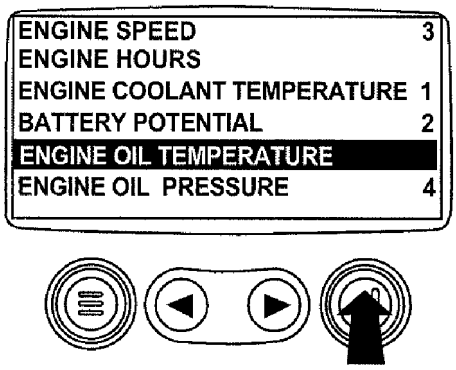
RG13230 —UN—26SEP03

Select Desired Engine Parameter

Continued on next page

OURGP11,00000B2 -19-13NOV13-9/14

10. Press the "Enter" key to change the selected parameter in the quadrant to the new parameter.

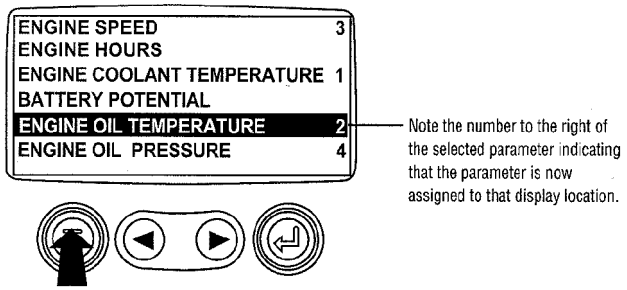


RG13231 —UN—26SEP03

Enter Selected Parameter

OURGP11,00000B2 -19-13NOV13-10/14

11. Use the "Menu" keys to return to the "4-Up Custom Setup" screen.

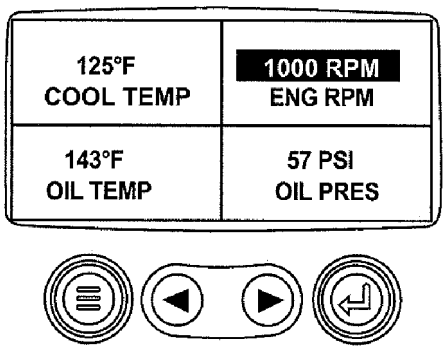


RG13232 —UN—26SEP03

Return To 4-Up Custom Setup

OURGP11,00000B2 -19-13NOV13-11/14

12. The selected quadrant has now changed to the new selected parameter.



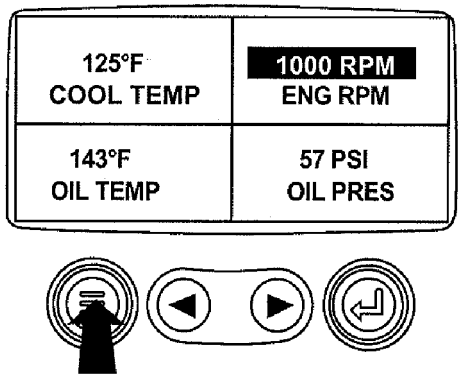
RG13153 —UN—24SEP03

4-Up Display

Continued on next page

OURGP11,00000B2 -19-13NOV13-12/14

13. Repeat the parameter selection process until all spaces are as desired.
14. Press the "Menu" key to return to the main menu.

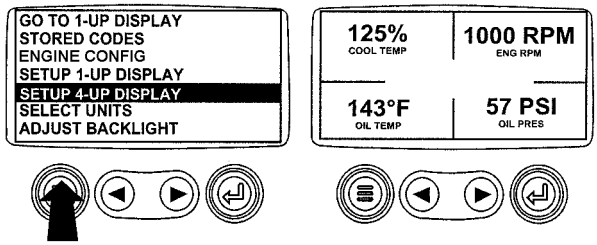


RG13154 —UN—24SEP03

Return To Main Menu

OURGP11,00000B2 -19-13NOV13-13/14

15. Press the "Menu" key to exit the main menu and return to the engine parameter display.



RG13155 —UN—07OCT03

Select Remaining Parameters

OURGP11,00000B2 -19-13NOV13-14/14

John Deere PowerSight

John Deere PowerSight is a web based service that allows remote access to machine data. John Deere PowerSight is accessible from a laptop, desktop or mobile device.

John Deere PowerSight works by combining a controller that includes cellular communication and GPS antennas. Machine data is collected by the controller and wirelessly transferred to a data server, where it is made available on a website.

John Deere PowerSight allows you to:

- Stay informed on machine location and hours
- Protect assets with Geofence and Curfew alerts
- Keep assets running with maintenance tracking and preventive maintenance plans
- Track and analyze machine and fuel usage
- Conduct remote machine diagnostics and programming

For more information and availability, contact an authorized John Deere dealer or servicing dealer.

BL90236,0000031 -19-13FEB14-1/1

Normal Engine Operation

Observe engine coolant temperature and engine oil pressure. Temperatures and pressures will vary between engines and with changing operating conditions, temperatures, and loads. See General Marine Engine Specifications — 4.5L or General Marine Engine Specifications — 6.8L in the Specifications Section near end of manual for temperature and pressure specifications for your engine.

If coolant temperature rises above the maximum coolant temperature reduce load on engine. Unless temperature drops quickly, stop engine and determine cause before resuming operation.

Operate the engine under a lighter load and at slower than normal speed for first 15 minutes after start-up. DO NOT run engine at slow idle unless necessary for maneuvering out of dock and harbor.

Stop engine immediately if there are any signs of part failure. Symptoms that may be early signs of engine problems are:

- Sudden drop in oil pressure
- Abnormal coolant temperatures
- High marine gear oil temperature
- Unusual noise or vibration
- Sudden loss of power
- Excessive black exhaust
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

ZE59858,0000238 -19-30OCT13-1/1

Marine Break-In Service

A proper break-in procedure is critical with John Deere marine diesel engines. A proper break-in will ensure optimal engine life. A proper break-in for John Deere marine engines is expected to take approximately 100 hours if performed correctly.

During this process, it is recommended that the vessel is operated in open water sufficient for safe extended operation.

Initial Run-In Procedure

NOTE: The sea trial procedure should not be replaced by the initial run-in procedure.

Ideally, the initial run-in procedure is accomplished during the sea trial process with a qualified John Deere marine engine technician onboard, following a successful completion of all basic functional testing.

1. Engine speeds and loads should be increased at 100 rpm intervals while simultaneously monitoring engine vitals. Engine operation should be maintained at each 100 rpm interval for a minimum of 5—10 minutes or until engine temperature stabilizes.
2. Speed and load should be increased until rated speed is achieved. If rated speed cannot be achieved abort process and review installation and application guidelines. As with the previous speed and load intervals, rated speed should be maintained for a minimum of 5—10 minutes or until engine temperature stabilizes. If a diagnostic trouble code occurs, abort this process and review installation and application guidelines.
3. Following stabilization at rated speed, proceed to test 100% throttle operation. At 100% throttle the engine should increase above rated speed to operate on the governor. As with the previous speed and load intervals, 100% throttle speed should be maintained for a minimum of 5—10 minutes or until engine temperature stabilizes. If a diagnostic trouble code occurs, abort this process and review installation and application guidelines.

NOTE: The engine speed achieved above rated speed at 100% throttle is dependent on propeller or impeller matching and will vary accordingly.

Exceptions

Bollard pull applications such as working tugs and push boats. Due to the high power to weight ratio and hull designs, it may not be practical to achieve rated speed without bollard operation. For bollard pull applications, perform speed steps and loads as defined previously in a bollard operation with an immovable object. In bollard pull applications only, it is acceptable if 100% throttle results in an engine speed of no more than 100 rpm less than rated speed (rated speed - 100 rpm = GOOD; rated speed - 101 rpm = REVIEW). If under full bollard pull operation with an immovable object and a minimum engine speed of 100 rpm less than rated speed is not achieved, abort process and review installation and application guidelines.

Constant speed engine operation such as generators. A similar process should be followed, except instead of changing speed, the engine load should be increased until the point of maximum engine fueling (100% load or maximum generator output). These 10% steps in engine percent load should be performed for a minimum of 5—10 minutes each or until engine temperature stabilizes while monitoring all engine criticals. If a fault code should occur, abort process and review application and installation guidelines.

Break-In Oil

The engine is factory filled with John Deere Diesel Engine Break-In Oil. This is a special formulation of oil that is designated to aid with the proper break-in of engine components. If performed correctly, it is expected the break-in process will take 100 hours. During this process some make-up oil may be required. As it is not unusual for some oil consumption during the break-in process; it is critical that the oil level be frequently monitored during this process. If make up oil is required use only John Deere Diesel Engine Break-In Oil.

Following the 100 hour break-in process it is recommended that change of oil and filter should occur. If the break-in procedure has been followed and sufficient extended loading of the engine has occurred it is acceptable to proceed with normal oil changes as advised in this operator's manual. However, if during the first 100 hours of operation the engine has operated at periods of light loading and/or idle it is recommended that the oil should be drained and replaced with John Deere Diesel Engine Break-In Oil, and the oil filter should be changed and replaced with a new John Deere oil filter. Following this, the break-in procedure should continue for an additional 100 hours.

IMPORTANT: DO NOT fill above the top of the crosshatch pattern or the FULL mark, whichever is present. Marine engines installed at an angle will have an alternate pattern as identified by the dipstick remarking process to compensate for installation angle. Oil levels anywhere within crosshatch are considered in the acceptable operating range. John Deere Break-In engine oil should be used to make up any oil consumed during the break-in period.

IMPORTANT: DO NOT use Plus-50 or Plus-50 II engine oil during the break-in period of a new engine or engine that has had a major overhaul. Plus-50 or Plus-50 II engine oil will not allow a new or overhauled engine to properly seat in during this break-in period.

IMPORTANT: If John Deere Break-In or Break-In Plus engine oils are not available, use a SAE 10W-30 viscosity grade diesel engine oil meeting one of the following:

Continued on next page

API Service Classification CE
API Service Classification CD
API Service Classification CC
ACEA Oil Sequence E2
ACEA Oil Sequence E1

IMPORTANT: Do not use Plus-50 II, Plus-50, or engine oils meeting any of the following for the initial break-in of a new or rebuilt engine:

API CJ-4	ACEA E9
API CI-4 PLUS	ACEA E7
API CI-4	ACEA E6
API CH-4	ACEA E5
API CG-4	ACEA E4
API CF-4	ACEA E3
API CF-2	
API CF	

These oils do not allow the engine to break-in properly.

Break-In Procedure

During the 100 hour break-in period it is important to adequately work the engine to properly seat the engine components. Extended idle and light load operation should be minimized. Extended idle and/or light load operation intervals should not exceed 30 minutes during the break-in process. Minimum operating engine loads should be sufficient to result in coolant temperatures at or above the thermostat opening temperature.

IMPORTANT: It is critically important to properly break in the engine within the first 100 hours. Attempting a break-in at higher hour intervals may be unsuccessful. To correctly perform the break-in, extra effort is required to ensure that engine is heavily exercised and may include running the engine harder than normal usage. This is especially true with M1-M3 ratings and lightly loaded applications such as trawlers and oversized generator sets.

[1]Load factor – is the actual fuel burned over a period of time divided by the full-power fuel consumption for the same period of time. For example, if an engine burns 160 L of fuel during an eight-hour run, and the full-power fuel consumption is 60 L per hour, the load factor is 160 L / (60 L per hour x 8 hours) = 33.3%.

M1, M2, and M3 Propulsion Applications — Engine load factors[1] during the break-in period should be greater than 40%. Underway, it is recommended that the vessel is operated at a minimum engine speed of approximately 200—300 rpm below rated speed greater than 50% of the time to provide the minimum sufficient loading.

M4 and M5 Propulsion Applications — Engine load factors[1] during the break-in period should be greater than 25%. Underway, it is recommended that the vessel is operated at a minimum engine speed of approximately 400—500 rpm below rated speed greater than 50% of the time to provide the minimum sufficient loading.

Constant Speed Applications — Minimum engine load factors[1] during the break-in period should be greater than 30%. It is recommended that the engine operate between 50% and 90% load greater than 50% of the time during the break-in period.

IMPORTANT: Lightly Loaded Applications Post Break-In: Engine break-in will not compensate for the observable conditions of a lightly loaded engine such as black fuel oil residue in the exhaust system. These conditions can be common among trawler propulsion engines, oversized generator sets, applications that spend long intervals at idle, and will occur on any lightly loaded diesel engine. John Deere marine diesel engines are designed to operate at loaded conditions. To prevent exhaust system contamination in a lightly loaded application, regularly exercise the engine by periodically increasing the load.

For example, in a trawler propulsion application underway increase the throttle to achieve an engine speed of the break-in speeds defined above for a minimum of 10 minutes every 3 hours. For a generator application, increase the load to 50% load for a minimum of 10 minutes every 3 hours.

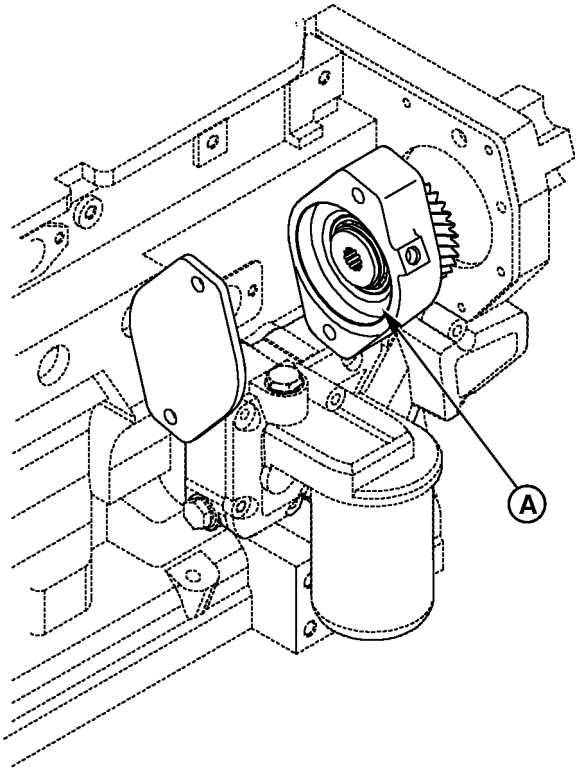
RG19661,00003BC -19-10FEB14-2/2

Auxiliary Gear Drive Limitations

IMPORTANT: When attaching a sea water pump or other accessory to be driven by the auxiliary gear drive (A) (engine timing gear train at front of engine), power requirements of the accessory must be limited to values listed below:

- 30 kW (40 hp) Continuous Operation
- 37 kW (50 hp) Intermittent Operation

A—Auxiliary Gear Drive



RG7634A —UN—22JAN99

Auxiliary Gear Drive

RG,RG34710,5555 -19-03JAN02-1/1

Generator Set Power Units

To assure that your engine will deliver efficient generator operation when needed, start engine and run at rated speed (with 50%—70% load) for 30 minutes every 2 weeks. DO NOT allow engine to run extended period of time with no load.

RG,RG34710,5556 -19-20MAY96-1/1

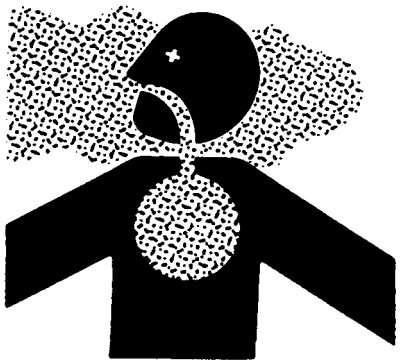
Starting the Engine

The following instructions apply to the optional controls and instruments available through the John Deere Parts Distribution Network. The controls and instruments for your engine may be different from those shown here; always follow manufacturer's instructions.

⚠ CAUTION: Before starting engine in a confined engine room, install proper outlet exhaust ventilation equipment. Always use safety approved fuel storage and piping.

NOTE: If temperature is below 0 °C (32 °F), it may be necessary to use cold weather starting aids. See Cold Weather Operation in the Engine Operation Section.

1. Perform all prestarting checks. See Daily Prestarting Checks in the Lubrication & Maintenance — Daily Section.
2. Open the fuel supply shutoff valve.
3. If equipped, open fuel return shutoff valve. Verify that all fuel return lines are open and free of restrictions.
4. Set marine gear control lever in the “NEUTRAL” position on propulsion units.



TS220 —UN—15APR13

Use Proper Ventilation

5. Move the throttle control lever approximately 1/3 of the way off the idle position.
6. Turn the key switch to the ON position. The "Wait To Start Preheating" message will be displayed when ambient temperatures require preheating (for engines with preheating options). The timer will display minutes and seconds, counting down to zero. Once the timer has reached 0:00 and the "Wait to Start" message is no longer displayed, you may start the engine.

Continued on next page

ZE59858,000027E -19-10MAR17-1/2

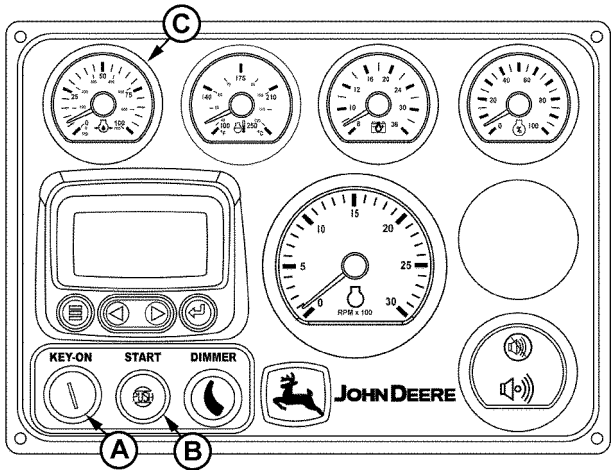
IMPORTANT: Do not operate the starter for more than 30 seconds at a time. To do so may overheat the starter. If the engine does not start the first time, wait at least 2 minutes before trying again. If engine does not start after four attempts, see Engine Troubleshooting in the Troubleshooting Section.

If the start switch button is released before the engine starts, wait until the starter and the engine stop turning before trying again. This will prevent possible damage to the starter and/or flywheel.

NOTE: Key switch (A) on main (standard) instrument panel must be in "ON" position to start engine using fly bridge (optional) instrument panel.

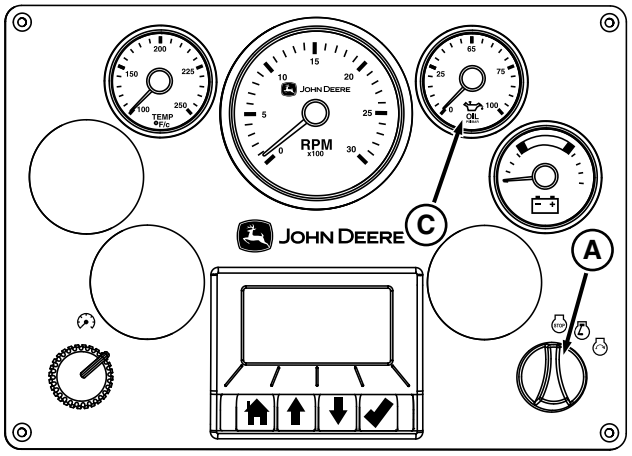
7. Press start button or turn key switch to crank the engine. When the engine starts, release the button or switch.
8. After the engine starts, observe the oil pressure gauge (C) until it reads at least the slow idle pressure. See General Marine Engine Specifications — 4.5L or General Marine Engine Specifications — 6.8L in the Specifications Section.
9. Warm up the engine at or below 1200 rpm with no load for 1-2 minutes. See following guidelines.
10. Check all gauges for normal engine operation. If operation is not normal, stop the engine and determine the cause.
11. Check sea water outlet for water flow. Check exhaust pipe for water flow on engines with wet exhaust systems.

    If sea water does not flow within one minute after engine starts, stop engine and check sea cock, sea water strainer, and sea water pump for restrictions.



RG13134 —UN—07OCT03

Start Engine (Option A)



RG29320 —UN—23FEB17

Start Engine (Option B)

A—Key Switch
B—Start Button
C—Oil Pressure Gauge

ZE59858,000027E -19-10MAR17-2/2

Warming Engine

IMPORTANT: To assure proper lubrication, operate engine at or below 1200 rpm with no load for 1–2 minutes. Extend this period 2–4 minutes when operating at temperatures below freezing.

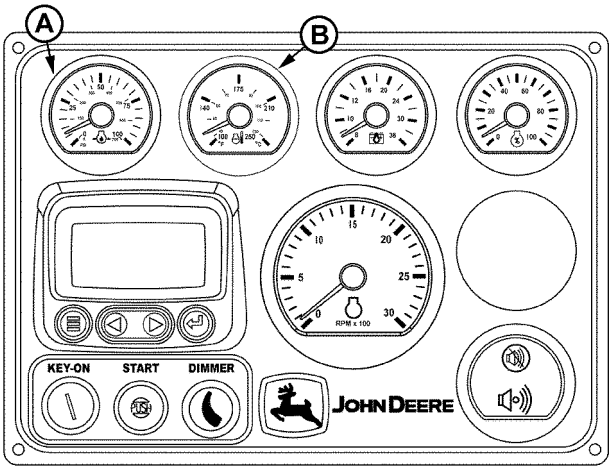
Engines used in generator set applications where the governor is locked at a specified speed may not have a low idle function. Operate these engines at high idle for 1 to 2 minutes before applying the load. This procedure does not apply to standby generator sets where the engine is loaded immediately upon reaching rated speed.

1. Check oil pressure gauge (A) as soon as engine starts. If gauge needle does not rise above minimum oil pressure specification within 5 seconds, stop the engine and determine the cause. See General Marine Engine Specifications and Engine Power And Speed Specifications in the Specifications Section for all oil pressure, engine speed, and coolant temperature specifications.

NOTE: On certain engines, the oil pressure and coolant temperature gauges are replaced by indicator warning lights. The lights must be "OFF" when engine is running.

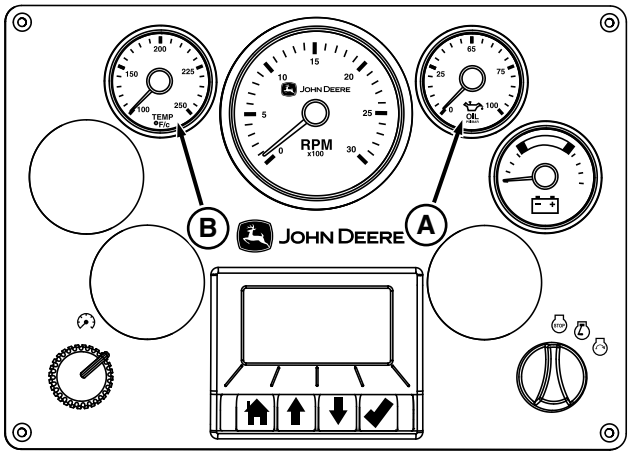
2. Watch coolant temperature gauge (B). Do not place engine under full load until it is properly warmed up. See General Marine Engine Specifications in the Specifications Section for the normal engine coolant temperature range specification.

NOTE: It is a good practice to operate the engine under a lighter load and at lower speeds than normal for the first few minutes after start-up.



RG13135 —UN—07OCT03

Oil Pressure And Coolant Temperature Gauges (Option A)



RG29321 —UN—23FEB17

Oil Pressure And Coolant Temperature Gauges (Option B)

A—Oil Pressure Gauge

B—Coolant Temperature Gauge

OUOD006,0000091 -19-01MAR17-1/1

Idling Engine

Avoid excessive engine idling. Prolonged idling may cause the engine coolant temperature to fall below its normal range. This, in turn, causes crankcase oil dilution, due to incomplete fuel combustion, and permits formation of gummy deposits on valves, pistons, and piston rings. It also promotes rapid accumulation of engine sludge and unburned fuel in the exhaust system.

Once an engine is warmed to normal operating temperatures, engine should be idled at slow idle speed.

Slow idle speed for this engine is set at the factory. See Engine Power And Speed Specifications in the Specifications Section near end of manual for slow idle speed for your engine. If an engine will be idling for more than 5 minutes, stop and restart later.

NOTE: Generator set applications where the governor is locked at a specified speed may not have a slow idle function. These engines will idle at no load governed speed (high idle).

OUOD006,0000092 -19-08NOV13-1/1

Cold Weather Operation

Engines may be equipped with coolant heaters as cold weather starting aids.

Engine coolant heaters should be used when temperatures are at or below 0 °C (32 °F).

Switch on the engine coolant heater for a minimum of 2 hours before starting the engine. Additional information on cold weather operation is available from your engine distributor or authorized servicing dealer. Follow steps listed in Starting the Engine in the Engine Operation Section.

Synthetic oils improve flow at low temperatures, especially in arctic conditions.

Starting Fluid is Flammable

TS1356 —UN—18MAR92

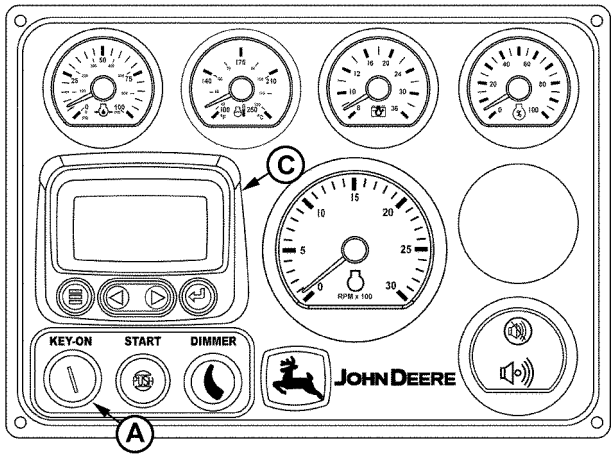
ZE59858,00002A8 -19-02DEC13-1/1

Stopping the Engine

IMPORTANT: Before stopping an engine that has been operating at working load, idle engine at least 5 minutes at 1000–1200 rpm to cool hot engine parts.

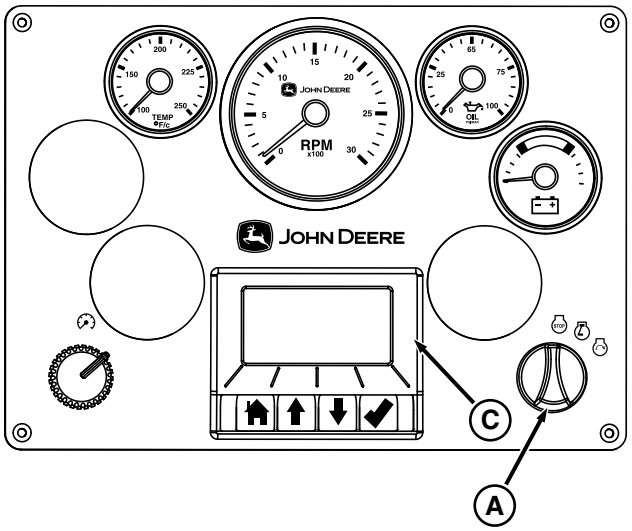
Engines in generator set applications where the engine control unit (ECU) is locked at a specified speed and no low idle function is available, run engine for at least 5 minutes at high idle and no load.

1. Remove load from engine or shift marine gear to “NEUTRAL” and run engine for at least 5 minutes at 1000–1200 rpm to allow coolant and oil to carry heat away from the combustion chamber, turbocharger, pistons, and bearings.
2. Turn key switch (A) to “OFF” position and remove key from ignition.
3. If vessel will not be used for several days, close fuel valves and sea cock.
4. Turn main electrical power switch to “OFF”, if equipped.
5. Fill the fuel tank to minimize possible water condensation problems. Filling tanks at end of day drives out moisture-laden air.
6. **For Heat Exchanger Engines:** If the engine will be subjected to temperatures at or below 0°C (32°F), open the sea water pump end cover to drain the sea water from the system to prevent freezing. The sea water pump will require priming before starting the engine.
7. Observe the hour meter reading on diagnostic gauge/hour meter (C) to determine if periodic maintenance is necessary. Make appropriate entries in maintenance logs in the Lubrication and Maintenance Records Section.
8. Perform required periodic maintenance on all other equipment, as recommended by the equipment manufacturers.



RG13290 —UN—06NOV03

Electronically Controlled Engines (Option A)



RG29318 —UN—23FEB17

Electronically Controlled Engines (Option B)

A—Key Switch

C—Diagnostic Gauge/Hour Meter

RG19661,00003BE -19-10MAR17-1/1

Using a Booster Battery or Charger

A 12 volt booster battery can be connected in parallel (B) with battery(ies) on the unit to aid in cold weather starting. ALWAYS use heavy-duty jumper cables.

Series:

- Amps = Same as single battery
- Volts = Twice as a single battery

Parallel:

- Amps = Twice as a single battery
- Volts = Same as a single battery

CAUTION: Gas given off by battery is explosive. Keep sparks and flames away from battery. Before connecting or disconnecting a battery charger, turn charger off. Make last connection and first disconnection at a point away from battery. Always connect NEGATIVE (–) cable last and disconnect this cable first.

IMPORTANT: Be sure that polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive to positive and negative to ground. Always use 12 volt booster battery for 12 volt electrical systems and 24 volt booster battery(ies) for 24 volt electrical systems.

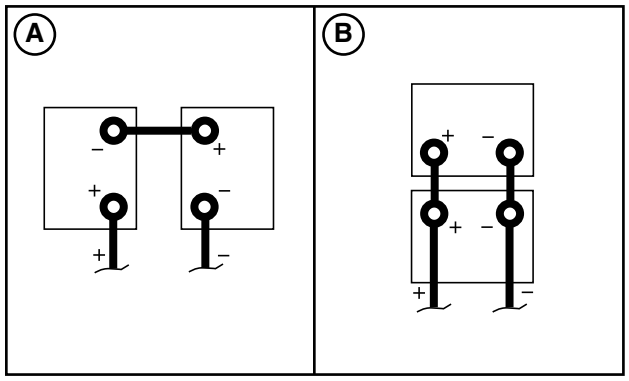
1. Connect booster battery or batteries to produce the required system voltage for your engine application.

NOTE: To avoid sparks, DO NOT allow the free ends of jumper cables to touch the engine.

2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.
3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.
4. Connect one end of the other jumper cable to the NEGATIVE (–) post of the booster battery.

TS204 —UN—15APR13

Exploding Battery



RG24885 —UN—17DEC13

A—Series **B—Parallel**

5. ALWAYS complete the hookup by making the last connection of the NEGATIVE (–) cable to a good ground on the engine frame and away from the battery(ies).
6. Start the engine. Disconnect jumper cables immediately after engine starts. Disconnect NEGATIVE (–) cable first.

RG,RG34710,5564 -19-17DEC13-1/1

Welding Near Electronic Control Units

IMPORTANT: Do not jump-start engines with arc welding equipment. Currents and voltages are too high and may cause permanent damage.

1. Disconnect the negative (-) battery cable(s).
2. Disconnect the positive (+) battery cable(s).
3. Connect the positive and negative cables together. Do not attach to vehicle frame.
4. Clear or move any wiring harness sections away from welding area.
5. Connect welder ground close to welding point and away from control units.

TS953 —UN—15MAY90

6. After welding, reverse Steps 1—5.

DX,WW,ECU02 -19-14AUG09-1/1

Keep Electronic Control Unit Connectors Clean

IMPORTANT: Do not open control unit and do not clean with a high-pressure spray. Moisture, dirt, and other contaminants may cause permanent damage.

1. Keep terminals clean and free of foreign debris. Moisture, dirt, and other contaminants may cause the terminals to erode over time and not make a good electrical connection.
2. If a connector is not in use, put on the proper dust cap or an appropriate seal to protect it from foreign debris and moisture.
3. Control units are not repairable.
4. Since control units are the components LEAST likely to fail, isolate failure before replacing by completing a diagnostic procedure. (See your John Deere dealer.)
5. The wiring harness terminals and connectors for electronic control units are repairable.

DX,WW,ECU04 -19-11JUN09-1/1

Required Emission-Related Information

Service Provider

A qualified repair shop or person of the owner's choosing may maintain, replace, or repair emission control devices and systems with original or equivalent replacement parts. However, warranty, recall, and all other services paid for by John Deere must be performed at an authorized John Deere service center.

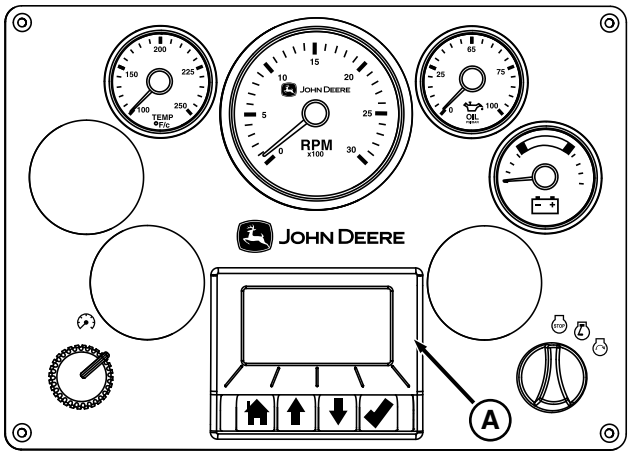
DX,EMISSIONS,REQINFO -19-12JUN15-1/1

Observe Service Intervals

In an emergency, where an authorized John Deere service location is not available, repairs may be performed at any available service establishment, or by the owner, using any replacement part, provided such parts are warranted by their manufacturer to be the equivalent of John Deere parts in performance and durability and the failure does not arise from the owner's failure to perform required maintenance.

Using hour meter (A) as a guide, perform all services at the hourly intervals indicated on following pages. At each scheduled maintenance interval, perform all previous maintenance operations in addition to the ones specified. Keep a record of hourly intervals and services performed, using charts provided in Lubrication and Maintenance Records section.

IMPORTANT: Recommended service intervals are for normal operating conditions. Perform maintenance at interval which occurs first, for example, either at 500 hours of operation or every 12 months. Service more often if engine operated under adverse conditions. Neglecting maintenance can result in failures or permanent damage to the engine.



RG29319 —UN—23FEB17

Hour Meter On Instrument Panel

A—Hour Meter

Perform all services at the hourly intervals. Record the services performed in the Lubrication and Maintenance Records Section. When scheduled service at any hourly level is performed, also perform all subordinate hourly level services.

Main Service	Subordinate Services			
	250 Hours	500 Hours	2000 Hours	6000 Hours
250 Hours	X			
500 Hours	X	X		
2000 Hours	X	X	X	
6000 Hours	X	X	X	X

ZE59858,00002F3 -19-03MAR17-1/1

Use Correct Fuels, Lubricants, and Coolant

IMPORTANT: Use only fuels, lubricants, and coolants meeting specifications outlined in Fuels, Lubricants, and Coolant Section when servicing your John Deere Engine.

Consult your John Deere engine distributor, servicing dealer or your nearest John Deere Parts Network for recommended fuels, lubricants, and coolant. Also available are necessary additives for use when operating engines in tropical arctic, or any other adverse conditions.

TS100 —UN—23AUG88

Parts Network

DPSG,OUOE003,20 -19-19JUN07-1/1

Lubrication and Maintenance Service Interval Chart

Item	Daily/Before Every Startup	250 Hours or 6 Months	500 Hours or 12 Months	2000 Hours or 24 Months	6000 Hours or 72 Months	Service As Required
Operate Engine at Rated Speed and 50%—70% Load for a Minimum of 30 Minutes. Perform every 2 weeks. (Generator Sets Only)						
Check Engine Oil Level and Coolant Level	•					
Check Sea Water Pump and Strainer (If Equipped)	•					
Check Accessory Drive Belts	•					
Drain Water from Fuel Filters	•					
Inspect Wiring Harness and Fuses	•					
Check Aftercooler Condensate Drain (If Equipped)	•					
Check Air Cleaner Dust Unloader Valve and Air Filter Restriction Indicator [a]	•					
Check Air Intake System	•					
Visual Walkaround Inspection	•					
Change Engine Oil And Replace Oil Filter [b]		•				
Service Fire Extinguisher		•				
Service Battery		•				
Check Engine Mounts		•				
Inspect and Replace Zinc Plugs (If Equipped)		•				
Replace Crankcase Ventilation Filter			•			
Check Air Intake System			•			
Replace Fuel Filter Elements and Clean Water Separator [c]			•			
Check Automatic Belt Tensioner and Belt Wear			•			
Check Cooling System			•			
Pressure Test Cooling System			•			
Inspect and Clean Heat Exchanger Core (If Equipped)			•			
Inspect and Clean Seawater Aftercooler Core (If Equipped)			•			
Check and Adjust Engine Speeds			•			
Check Engine Electrical Ground Connections			•			
Replace Sea Water Pump Impeller (If Equipped)			•			
Check and Adjust Engine Valve Clearance				•		
Check Crankshaft Vibration Damper (If Equipped) [d]				•		
Inspect and Repair Sea Water Pump				•		
Flush And Refill Cooling System					•	
Test Thermostats					•	
Drain Water From Fuel Filters						•
Add Coolant						•
Service Air Cleaner Element						•
Replace Air Cleaner Element						•
Replace Alternator Belt						•
Check Fuses						•

[a] Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (52 in) H2O, or when reset button has popped up.
[b] Change the oil for the first time before 100 hours maximum of (break-in) operation.
[c] Replace fuel filter element when audible alarm sounds and trouble codes indicate plugged fuel filter (low fuel pressure). If no alarm sounds during a 12 month interval, replace element at that time, or after every 500 hours of operation.
[d] Replace elastomeric crankshaft vibration damper every 4500 hours or 60 months, whichever occurs first.

ZE59858,0000180 -19-02NOV15-1/1

Daily Prestarting Checks

Check the following items BEFORE STARTING THE ENGINE for the first time each day:

- Operate Engine at Rated Speed and 50%—70% Load for a Minimum of 30 Minutes. Perform every 2 weeks. (Generator Sets Only)
- Check engine oil level on dipstick. Fill cap/dipstick may be located on left or right side, depending on application. Add as required, using seasonal viscosity grade oil. See Diesel Engine Oil — Tier 3 and Stage IIIA Marine Engines in the Fuels, Lubricants, and Coolants Section for oil specifications.

  NOTE: Wipe all fittings, caps, and plugs before performing any maintenance to reduce the chance of system contamination.

- Check the coolant level when engine is cold. Fill radiator or surge tank with proper coolant if level is low. See Adding Coolant in the Service As Required Section. Check overall cooling system for leaks.
- Check the sea water strainer for trash buildup and rinse to clean, if equipped.
- Check the sea water pump for coolant leaks, if equipped.

  NOTE: It is normal for a small amount of coolant to weep from the engine weep hole, especially as the engine cools down and parts contract. If enough coolant weeps from the engine where coolant drips from the engine, this may indicate the need to replace the coolant pump seal. Contact your engine distributor or servicing dealer for repairs.

- Check accessory drive belts for cracks, breaks, or other damage.
- Loosen water drain valve on each fuel filter all the way so that the valve opens to drain water and debris as needed. Retighten valves securely.

  NOTE: Any water in fuel is drained into the bottom of the fuel filters. The operator is signaled by an amber indicator on the instrument panel. To service, see Draining Water From Fuel Filter in the Service As Required Section.

- Inspect seawater aftercooler condensate drain for leaks (if equipped).
- Inspect wiring harness and fuses for frayed wires, damages, or blown fuses.
- Squeeze the automatic dust unloader valve (if equipped) on air cleaner assembly to clear away any dust buildup.
- Check air intake restriction indicator gauge and service air cleaner as required (if equipped).
- Check air intake system hoses and connections for cracks and loose clamps.
- Inspect the engine compartment. Look for fluid leaks, worn fan and accessory drive belts, loose connections, and trash buildup. Remove trash buildup and have repairs made as needed.

ZE59858,00001F9 -19-14NOV13-1/1

Changing Engine Oil and Replacing Oil Filter

See Engine Oil and Filter Service Intervals — Tier 3 and Stage IIIA — Marine Engines in the Fuels, Lubricants, and Coolant Section for service intervals.

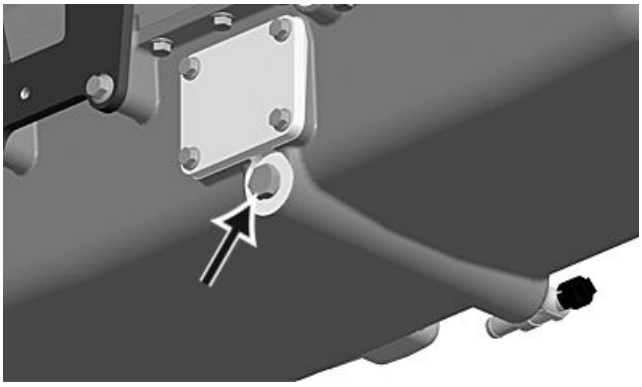
IMPORTANT: If using BIODIESEL blends greater than B20, shorten oil change interval to half the recommended service interval or monitor engine oil using OILSCAN to ensure that fuel dilution does not exceed 5%.

NOTE: Change engine oil and filter for the first time before 100 hours maximum of operation.

OILSCAN™ or OILSCAN PLUS™ is a John Deere sampling program to help you monitor machine performance and identify potential problems before they cause serious damage. OILSCAN™ or OILSCAN PLUS™ kits are available from your John Deere dealer. Oil samples should be taken prior to the oil change. Refer to instructions provided with kit.

To change engine oil and oil filter:

1. Run engine approximately 5 minutes to warm up oil. Shut engine off.



RG22041 —UN—07JAN13

Oil Pan Drain Plug

2. Remove oil pan drain plug (arrow).
3. Drain crankcase oil from engine while warm.

NOTE: Drain plug location may vary, depending on the application.

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OILSCAN PLUS is a trademark of Deere & Company.

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RG19661,00003D4 -19-26MAY15-1/3

4. Turn filter element (A) using a suitable filter wrench to remove. Discard oil filter element.

NOTE: Depending on engine application, oil filter may be located on either side of the engine in a high- or low-mount location.

IMPORTANT: Filtration of oils is critical to proper lubrication. Always change filter regularly. Use filter meeting John Deere performance specifications.

5. Apply clean engine oil to the new filter at the inner (B) and outer (C) seals and to filter threads.

6. Wipe both sealing surfaces of the header (D, E) with a clean rag. Ensure that the notches in dust seal (F) are properly installed in the slots of the housing. Replace if damaged.

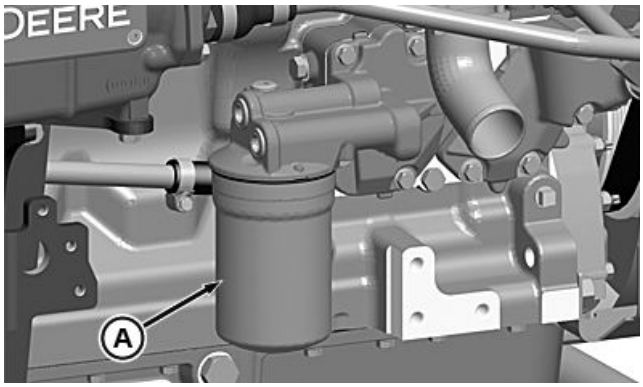
IMPORTANT: When installing filter element, HAND TIGHTEN only. A filter wrench may be used for REMOVAL ONLY.

7. Install and tighten oil filter by hand until firmly against dust seal (F). DO NOT apply an extra 3/4 to 1-1/4 turn after gasket contact as done with standard filters.

8. Tighten drain plug to specifications.

Specification	
Oil Pan Drain Plug With Copper Washer—Torque	70 N·m (52 lb.-ft.)
Oil Pan Drain Plug With O-Ring—Torque	50 N·m (37 lb.-ft.)

A—Oil Filter Element
B—Inner Seal
C—Outer Seal
D—Sealing Surface On Header
E—Sealing Surface On Header
F—Dust Seal

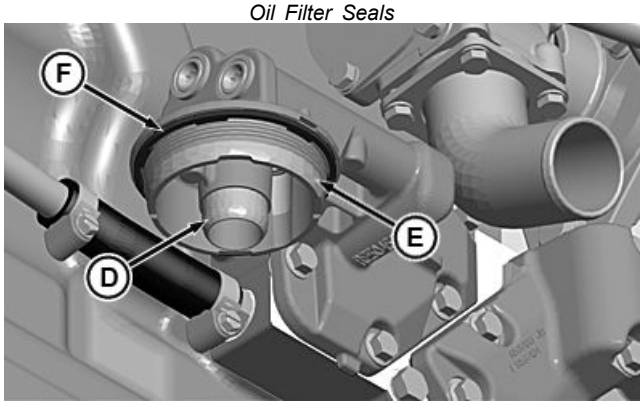


RG22045 —UN—29NOV12

Oil Filter

RG11617 —UN—24OCT01

Oil Filter Seals



RG22046 —UN—29NOV12

Oil Filter Mounting Header

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RG19661,00003D4 -19-26MAY15-2/3

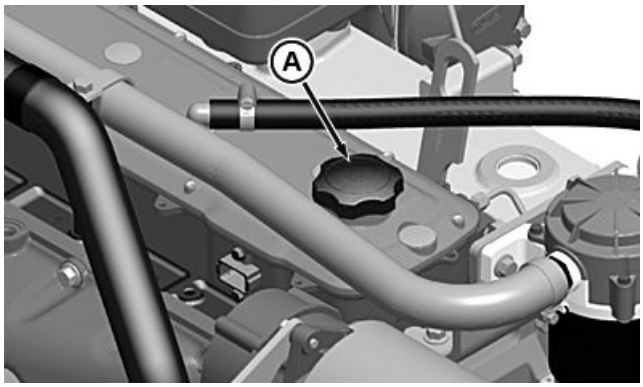
9. Fill engine crankcase with correct John Deere engine oil through rocker arm cover opening (A) or through oil fill cam on side of engine. See Diesel Engine Oil — Tier 3 and Stage IIIA Marine Engines in the Fuels, Lubricants, and Coolant Section for determining correct engine oil.

   To determine the correct oil fill quantity for your engine, see Engine Crankcase Oil Fill Quantities in the Specifications Section.

IMPORTANT: Immediately after completing any oil change, crank engine for 30 seconds without permitting engine to start. This will help insure adequate lubrication to engine components before engine starts.

NOTE: Crankcase oil capacity may vary slightly. ALWAYS fill crankcase within crosshatch marks on dipstick. DO NOT overfill.

10. Start engine and run to check for possible leaks.



RG22047 —UN—29NOV12

Rocker Arm Cover Oil Filler Opening

A—Rocker Arm Cover Oil Filler Opening

11. Stop engine and check oil level after 10 minutes. Oil level reading should be within crosshatch on dipstick.

RG19661,00003D4 -19-26MAY15-3/3

Servicing Fire Extinguisher

A fire extinguisher (A) is available from your authorized servicing dealer or engine distributor.

Read and follow the instructions which are packaged with it. The extinguisher should be inspected at least every 250 hours of engine operation or every 6 months. Once extinguisher is operated, no matter how long, it must be recharged. Keep record of inspections on the tag which comes with the extinguisher instruction booklet.

RW4918 —UN—15DEC88

Fire Extinguisher

OURGP11,000015D -19-07NOV13-1/1

Servicing Battery

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded NEGATIVE (–) battery clamp first and replace it last.

TS204 —UN—15APR13

Exploding Battery

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

1. On regular batteries, check electrolyte level. Fill each cell to bottom of filler neck with distilled water.

NOTE: Low-maintenance or maintenance-free batteries should require little additional service. However, electrolyte level can be checked by cutting the center section of decal on dash-line, and removing cell plugs. If necessary, add clean, soft water to bring level to bottom of filler neck.

2. Keep batteries clean by wiping them with a damp cloth. Keep all connections clean and tight. Remove any corrosion, and wash terminals with a solution of 1 part baking soda and 4 parts water. Tighten all connections securely.

NOTE: Coat battery terminals and connectors with a mixture of petroleum jelly and baking soda to retard corrosion.

3. Keep battery fully charged, especially during cold weather. If a battery charger is used, turn off charger before connecting charger to battery(ies). Attach POSITIVE (+) battery charger lead to POSITIVE (+) battery post. Then attach NEGATIVE (–) battery charger lead to a good ground.

Continued on next page

RG,RG34710,5568 -19-08NOV13-1/2

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Use proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 10–15 minutes. Get medical attention immediately.**

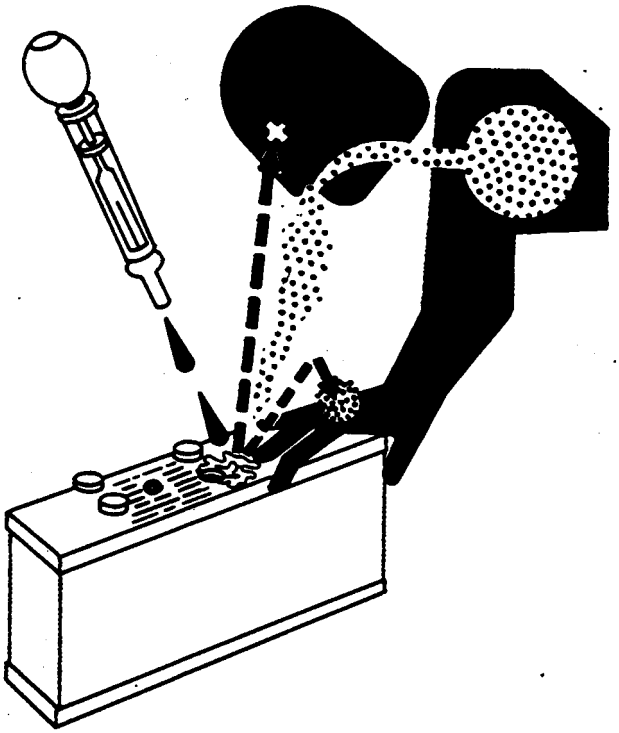
If acid is swallowed:

1. **Drink large amounts of water or milk.**
2. **Then drink milk of magnesia, beaten eggs, or vegetable oil.**
3. **Get medical attention immediately.**

In freezing weather, run engine at least 30 minutes to assure thorough mixing after adding water to battery.

If necessary to replace battery(ies), replacements must meet or exceed the following recommended capacities at -18 °C (0 °F):

Specification	
12 Volt System—Cold Cranking Amps	800
Reserve Capacity (Minutes)	350
24 Volt System—Cold Cranking Amps	570
Reserve Capacity (Minutes)	275



TS203 —UN—23AUG88

Sulfuric Acid

RG,RG34710,5568 -19-08NOV13-2/2

Checking Engine Mounts

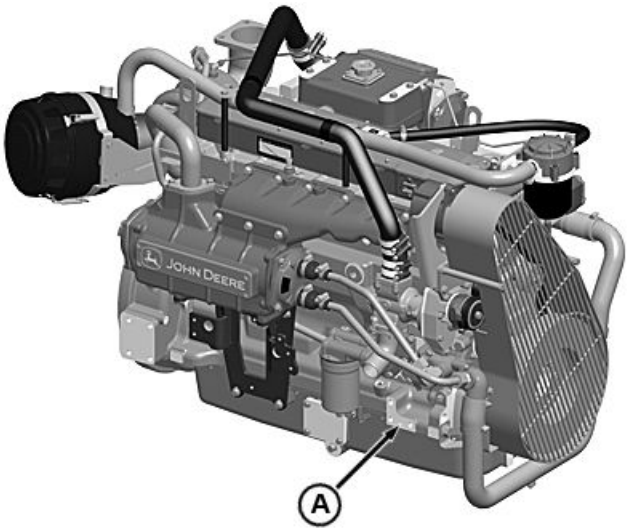
Engine mounting is the responsibility of the vessel or generator manufacturer. Follow manufacturer's guidelines for mounting specifications. Front engine mounts (A) only are available from John Deere.

IMPORTANT: Use only SAE Grade 8 or higher grade of hardware for engine mounting.

1. Check the engine mounting bolts on support frame and engine block for tightness. Tighten as necessary.

2. Inspect overall condition of vibration isolators, if equipped. Replace isolators, as necessary, if rubber has deteriorated or mounts have collapsed.

A—Engine Mounting Holes



RG22051 —UN—29NOV12

Check Mounting Holes

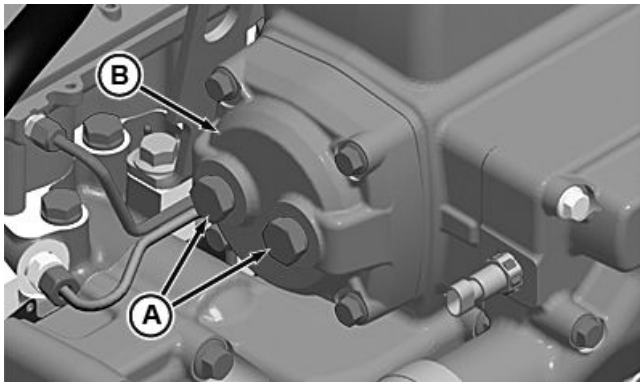
RG19661,00003D7 -19-29JAN13-1/1

Inspecting and Replacing Zinc Plugs (If Equipped)

Zinc plugs (A) are installed in the sea water cooling system to help reduce the corrosive action of salt in the sea water. The reaction of the zinc to sea water causes the plugs to deteriorate, instead of the more critical cooling system parts. Therefore, the zinc plugs MUST BE inspected every 250 Hours.

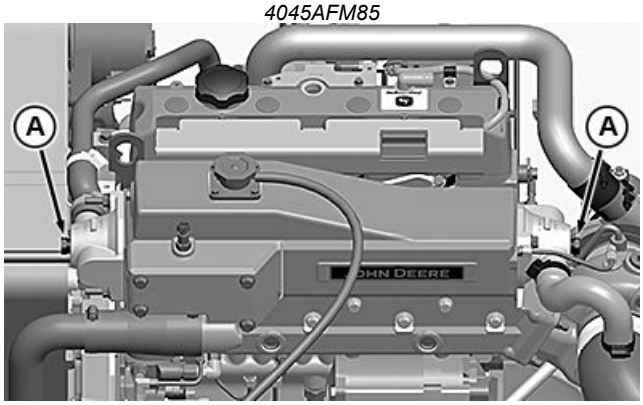
1. Remove zinc rod from each end cap (B) and observe condition of each.

A—Zinc Plugs **B—End Cap**



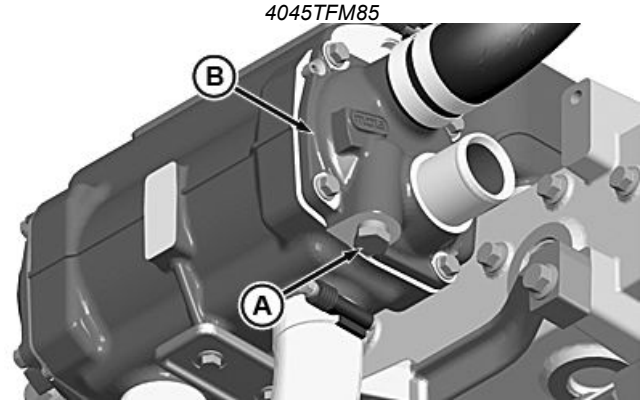
RG22137 —UN—06DEC12

4045AFM85



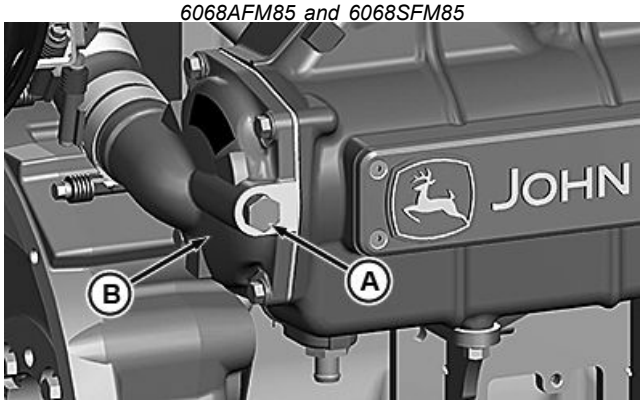
RG24320 —UN—05SEP13

4045TFM85



RG22048 —UN—29NOV12

6068AFM85 and 6068SFM85



RG24315 —UN—05SEP13

6068SFM85

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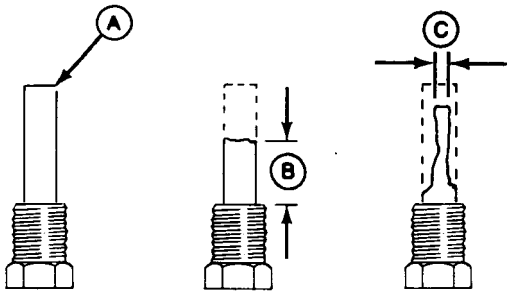
RG19661,00003D5 -19-11NOV13-1/2

2. Measure zinc plugs (A) to determine the amount of erosion on length (B) and outer diameter (C).
3. Tap the zinc rods lightly with a hammer. If rod flakes apart when tapped, install a new zinc plug.

   NOTE: Zinc plug new part dimensions are 31.8 mm (1.25 in.) long and 9.5 mm (0.38 in.) outer diameter.

4. If length is less than 15.9 mm (0.63 in.) or outer diameter is less than 4.8 mm (0.19 in.) on either plug, replace all zinc plugs.
5. Install zinc plug and tighten to specifications.

Specification	
Zinc Plug—Torque	40 Nm (30 lb-ft)



RG6007 —UN—27JAN92

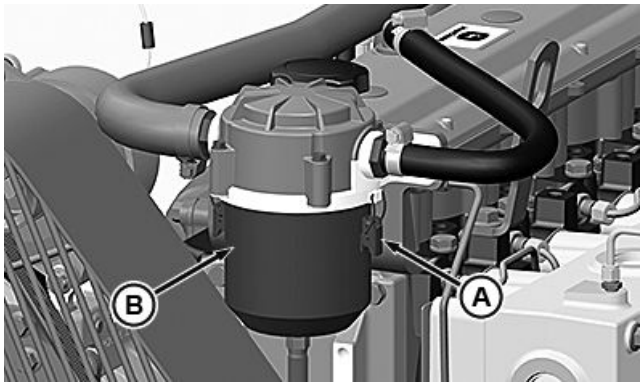
Zinc Plug Erosion

A—Measure Zinc Plugs
B—Measure Length
C—Measure Diameter

RG19661,00003D5 -19-11NOV13-2/2

Replacing Crankcase Vent Filter

1. Remove clamps (A) and remove the crankcase vent housing (B).
2. Remove old filter and discard.
3. Install new filter into crankcase vent housing and snap into place.
4. Install housing and secure clamps.
5. Inspect crankcase fitting for damage and make sure that it is not plugged.
6. Verify that the crankcase vent system bypass port is not plugged.
7. Inspect hoses and oil drain line for kinks, blockage, or other damage.



RG24339 —UN—06SEP13

Replace Crankcase Vent Filter

A—Clamps **B—Housing**

RG19661,00003D8 -19-08NOV13-1/1

Checking Air Intake System

IMPORTANT: The air intake system must not leak. Any leak, no matter how small, may result in engine failure due to abrasive dirt and dust entering the intake system.

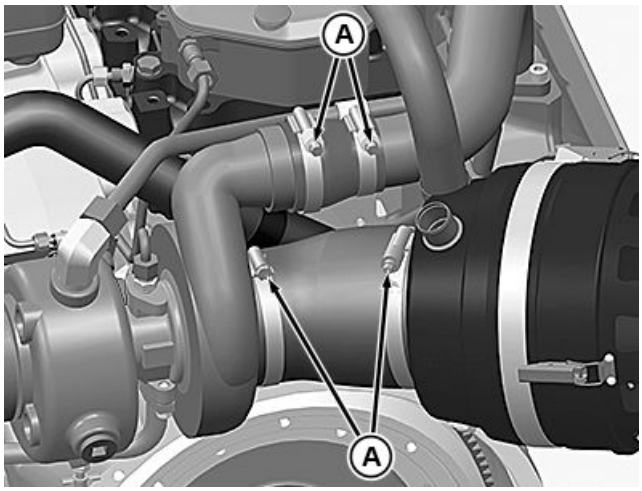
1. Inspect all intake hoses (piping) for cracks. Replace as necessary.
2. Check clamps (A) on piping which connects the air cleaner, engine and, if present, turbocharger. Tighten clamps as necessary. This will help prevent dirt from entering the air intake system through loose connections causing internal engine damage.

IMPORTANT: ALWAYS REPLACE primary air cleaner element when air filter restriction indicator gauge shows vacuum of 625 mm (25 in.) H_2O, or when reset button has popped up (if equipped). Also replace element if it is torn, or visibly dirty.

3. Test air filter restriction indicator (B) for proper operation. Replace indicator as necessary.

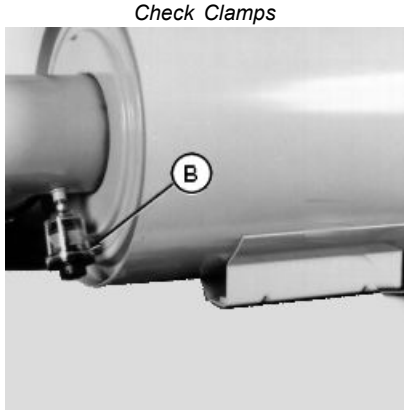
IMPORTANT: If not equipped with air filter restriction indicator, replace air cleaner elements at 500 hours or 12 months, whichever occurs first.

4. Replace air cleaner element if restriction indicator gauge shows vacuum of 625 mm (25 in.) H_20, or when reset button has popped up, if equipped. Also replace element if it is torn, or visibly dirty. Service as necessary. See Replacing Air Cleaner Filter Element in the Service As Required Section.



RG24319 —UN—05SEP13

Check Clamps



RG9875 —UN—12FEB99

Air Restriction Indicator

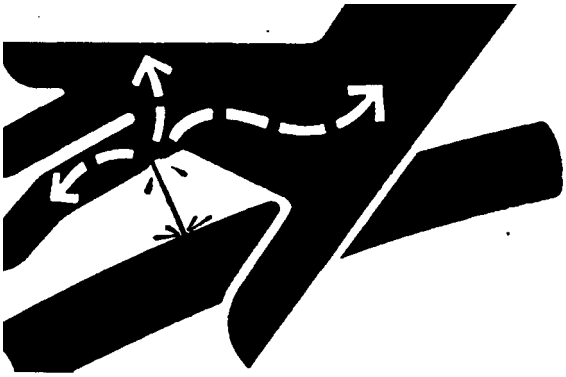
A—Clamps **B—Air Restriction Indicator**

RG19661,00003DA -19-30OCT13-1/1

Replacing Fuel Filters/Cleaning Water Separator

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.



X9811 —UN—23AUG88

High Pressure Fluids

Continued on next page

RG19661,00003E5 -19-08NOV13-1/2

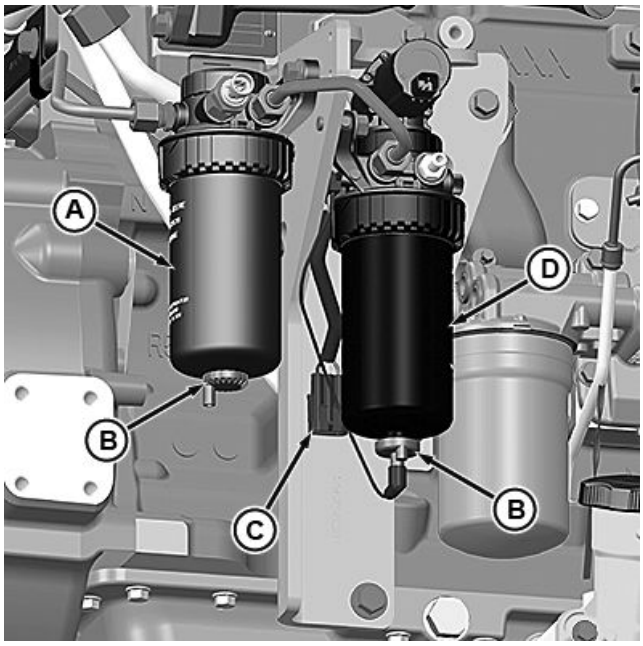
CAUTION: If engine has been running, engine and fuel filter housing may be hot.

IMPORTANT: Primary fuel filter and secondary fuel filter must both be replaced whenever audible alarm sounds and diagnostic trouble code indicates a plugged filter (fuel supply pressure moderately/extremely low).

1. Close fuel shutoff valve (if equipped).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Disconnect water-in-fuel connector (C).
4. Open drain valve (B) and drain fuel from water separator into a suitable container.
5. Remove primary fuel filter (D) by hand or using suitable filter wrench.
6. Remove water separator bowl, if equipped, from primary fuel filter by hand or using a suitable strap wrench.
7. Clean separator bowl and dry it.
8. Lubricate new water separator bowl seal with thin film of clean fuel, and hand tighten to primary fuel filter.

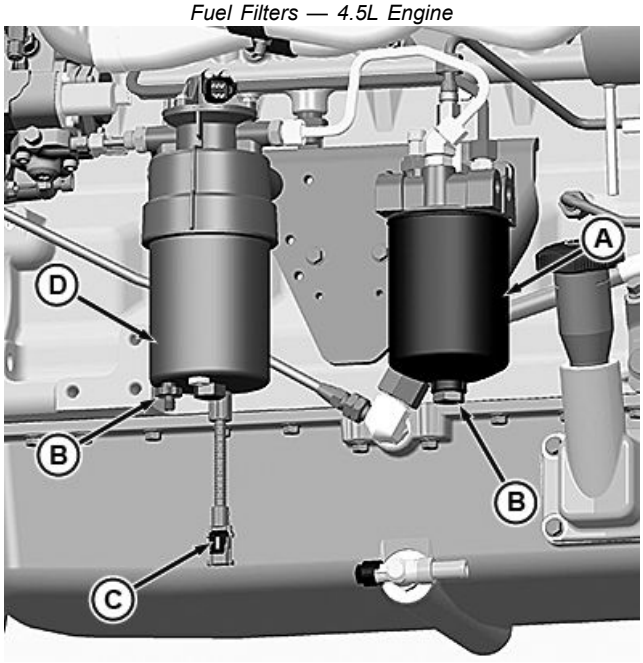
   NOTE: Raised locators on fuel filter canisters must be indexed properly with slots in mounting base for correct installation.

9. Lubricate new primary fuel filter seal with thin film of clean fuel.
10. Screw primary fuel filter into header until the seal contacts the fuel filter header.
11. When seal contacts the fuel filter header, tighten until a “click” is heard.
12. Connect water-in-fuel sensor connector (C).
13. Remove secondary fuel filter (A) using a suitable filter wrench.
14. Lubricate new secondary fuel filter seal with a thin film of clean fuel, and screw filter into fuel filter header until the seal contacts the fuel filter header.
15. When the seal contacts the header, tighten until a “click” is heard.
16. Open fuel supply shutoff valve (if equipped).
17. Turn ignition key to the ON position for 120 seconds to allow the fuel system to prime itself.
18. Start engine and allow to run for a minimum of 5 minutes.



RG24753 —UN—08NOV13

Fuel Filters — 4.5L Engine



RG24752 —UN—08NOV13

Fuel Filters — 6.8L Engine

A—Secondary Fuel Filter
B—Drain
C—Water-In-Fuel Connector
D—Primary Fuel Filter

RG19661,00003E5 -19-08NOV13-2/2

Checking Belt Tensioner Spring Tension and Belt Wear

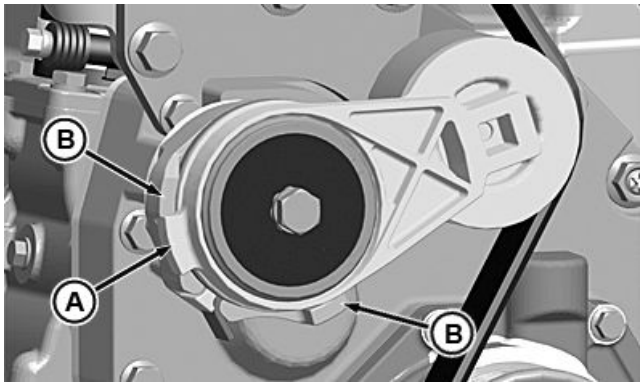
Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.

Checking Belt Wear

The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops (A and B) when correct belt length and geometry are used.

Visually inspect cast stops (A and B) on belt tensioner assembly.

If the tensioner cast stop (A) on swing arm is hitting either fixed cast stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see Replacing Alternator Belt in the Service As Required Section).



RG22080 —UN—03DEC12

Cast Stops - Tensioner Arm

A— Tensioner Cast Stops **B— Fixed Cast Stops**

Continued on next page

RG19661,00003E6 -19-20SEP13-1/2

Checking Tensioner Spring Tension

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below.

1. Release tension on belt using a long handled 1/2 inch drive tool in square hole in tensioner arm. (Earlier tensioner arms have bolt in place of square hole, and require breaker bar with socket.) Remove belt from pulleys.

NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

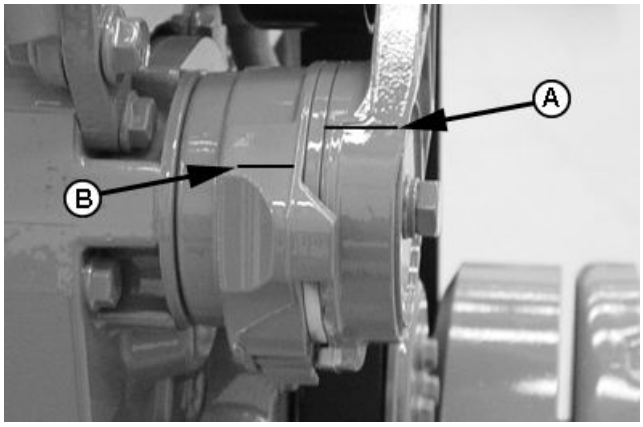
2. Release tension on tension arm and remove drive tool.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from (A) and put a mark (B) on tensioner mounting base.
5. Install torque wrench (C) so that it is aligned with centers of pulley and tensioner. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Specification

Spring Tension—Torque..... 18—22 N·m (13—16 lb.-ft.)

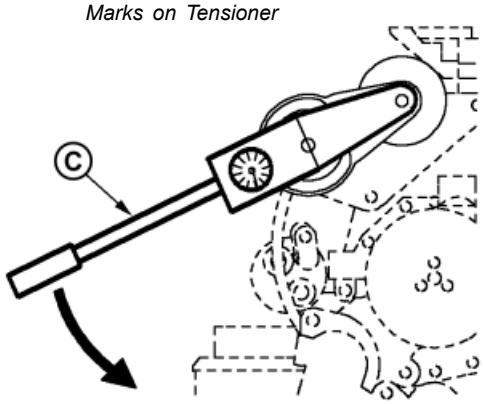
NOTE: Threads on belt tensioner roller cap screw are LEFT-HAND threads

A—Mark On Swing Arm
B—Mark On Tensioner Mounting Base
C—Torque Wrench



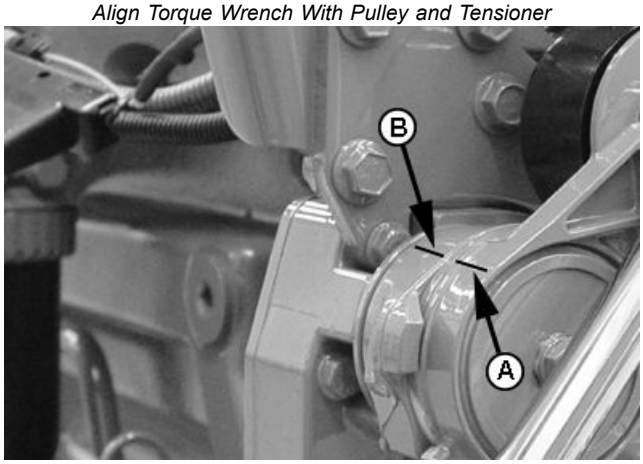
RG13745 —UN—11NOV04

Marks on Tensioner



RG12065 —UN—28JAN02

Align Torque Wrench With Pulley and Tensioner



RG13746 —UN—11NOV04

Align Marks

RG19661,00003E6 -19-20SEP13-2/2

Checking Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

IMPORTANT: Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting at rear of cylinder head or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.

1. Check entire cooling system for leaks. Tighten all clamps securely.

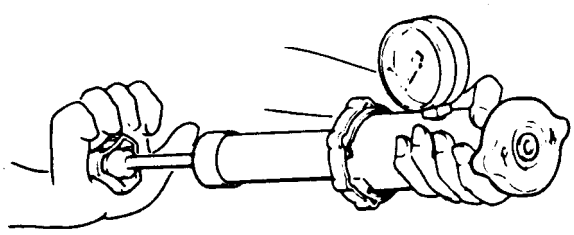
TS281 —UN—15APR13

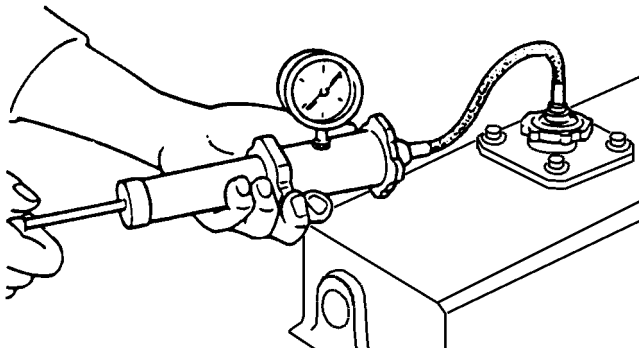
High-Pressure Fluids

2. Thoroughly inspect all cooling system hoses. Replace hoses when hard, flimsy, or cracked.

RG,RG34710,5580 -19-07NOV13-1/1

Pressure Testing Cooling System





RG6557 —UN—20JAN93

RG9850 —UN—06JAN99

⚠ CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Test Coolant Filler Cap

1. Remove coolant filler cap and attach to an appropriate tester as shown.
2. Pressurize cap to specifications. Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

   If gauge does not hold pressure, replace pressure cap.

Specification

Radiator Cap — 4045TFM85—Pressure..... 69 kPa (0.69 bar) (10 psi)

Specification

Radiator Cap —Pressure.....110 kPa (1.1 bar) (16 psi)

3. Remove the cap from gauge, turn it 180°, and retest cap. This will verify that the first measurement was accurate.

Test Cooling System

NOTE: Engine should be warmed up to test overall cooling system.

1. Allow engine to cool, then carefully remove coolant filler cap.
2. Fill tank with coolant to the normal operating level.

IMPORTANT: DO NOT apply excessive pressure to cooling system, doing so may damage coolant tank and hoses.

3. Connect gauge and adapter to filler neck. Pressurize cooling system to specifications.

Specification

Cooling System — 4045TFM85—Pressure..... 69 kPa (0.69 bar) (10 psi)

Specification

Cooling System —Pressure.....110 kPa (1.1 bar) (16 psi)

4. With pressure applied, check all cooling system hose connections, coolant tank, and overall engine for leaks.

   If leakage is detected, correct as necessary and pressure test system again.

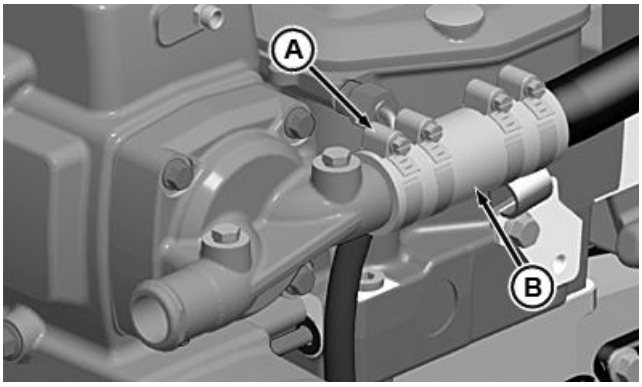
   If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket. Have your servicing dealer or distributor correct this problem immediately.

RG19661,0000409 -19-04SEP13-1/1

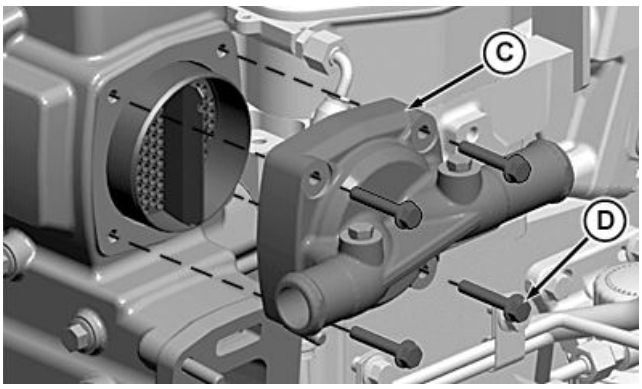
Removing, Inspecting, and Cleaning Engine Heat Exchanger Core (4.5 L)

1. Close sea cocks and drain the sea water system.
2. Open drain valve on cylinder block and drain engine coolant into a clean container. Close drain valve.
3. Loosen hose clamps (A) and disconnect sea water tube (B).
4. Remove cap screws (D) and remove rear end cap (C). Identify end cap so it can be installed in the same position as removed.
5. Remove cap screws (F) and remove front end cap (E). Identify end cap so it can be installed in the same position as removed.
6. Thoroughly inspect condition of end cap sealing O-rings. Sealing O-rings may be reused if not excessively worn or damaged during disassembly. Replace sealing rings as necessary.

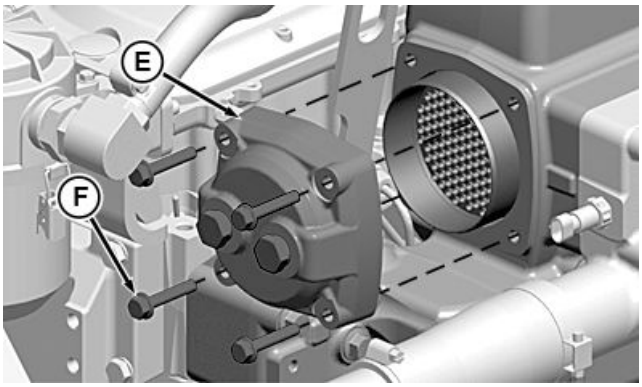
A—Hose Clamp
B—Tube
C—Rear End Cap
D—Cap Screws
E—Front End Cap
F—Cap Screws



RG22138 —UN—06DEC12



RG22139 —UN—06DEC12



RG22140 —UN—06SEP13

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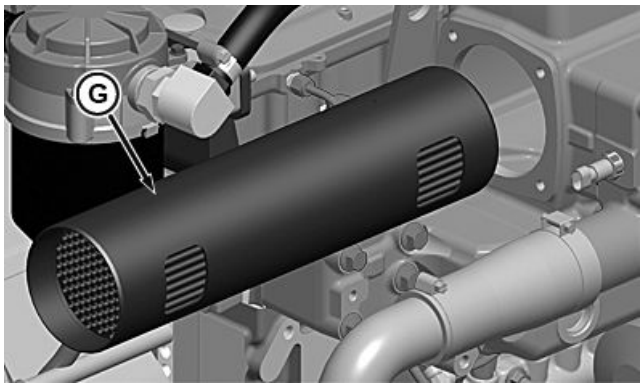
RG19661,000040B -19-30OCT13-1/2

7. Remove heat exchanger core (G) through rear side of housing.
8. Remove remaining end cap from water manifold/heat exchanger housing. Remove end cap from heat exchanger core.
9. Thoroughly clean all buildup from both end caps and inspect zinc plug in each. Replace plugs as needed. See Inspecting and Replacing Zinc Plugs (If Equipped) in the 250 Hours/6 Months Section.)
10. Use a brass rod to clean out any buildup in each heat exchanger tube. Run the rod the entire length of each tube to push out debris.
11. Flush the heat exchanger tubes with clean water, making sure that all tubes are cleared of debris. Clean (with brass rod) and flush heat exchanger again if necessary to remove any remaining debris from tubes. If you suspect that your heat exchanger core is defective, have your authorized servicing dealer or engine distributor pressure test for leaks. Replace heat exchanger core as required.
12. Remove and thoroughly clean water manifold/heat exchanger housing if needed.



RG22141 —UN—06SEP13

G—Heat Exchanger Core

RG6066 —UN—23JAN92

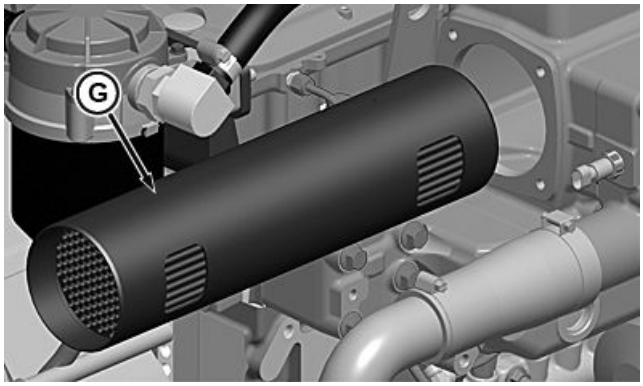
Clean Heat Exchanger

RG19661,000040B -19-30OCT13-2/2

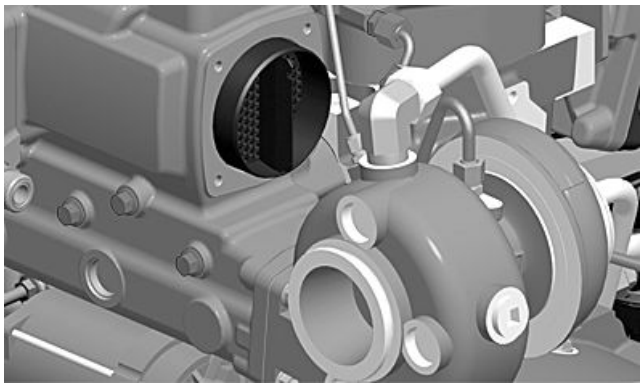
Installing Heat Exchanger Core (4.5 L)

1. Install heat exchanger core (G) through rear side of housing.
2. Be sure that heat exchanger core divider is oriented in the vertical position.

G—Heat Exchanger Core



RG22141 —UN—06SEP13



RG22708 —UN—09APR13

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RG19661,000040F -19-09SEP13-1/2

3. Thoroughly inspect condition of end cap sealing O-rings. Sealing O-rings may be reused if not excessively worn or damaged during disassembly. Replace sealing rings as necessary.
4. Install rear end cap (C) and install cap screws (D). Index end cap in same position as removed.
5. Tighten cap screws (D) to specifications depending on your application.

Specification

Cap Screws (D) —
4045AFM85—Torque..... 35 N·m (26 lb.-ft.)
Cap Screws (D) —
4045TFM85—Torque..... 50 N·m (37 lb.-ft.)

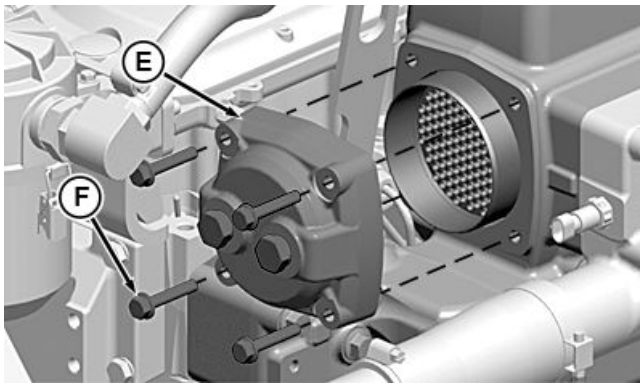
6. Install front end cap (E) and install cap screws (F). Index end cap in same position as removed.
7. Tighten cap screws (F) to specifications depending on your application.

Specification

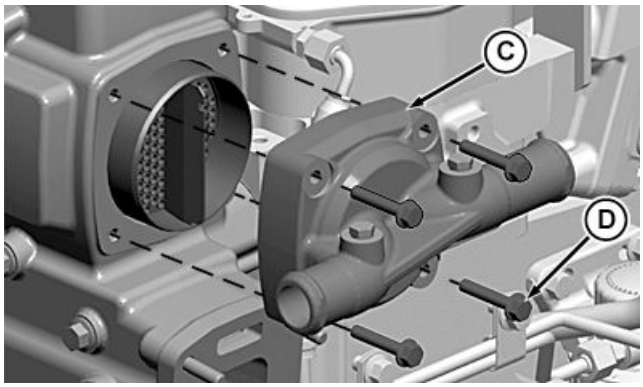
Cap Screws (F) —
4045AFM85—Torque..... 35 N·m (26 lb.-ft.)
Cap Screws (F) —
4045TFM85—Torque..... 50 N·m (37 lb.-ft.)

8. Connect sea water tube (B) and tighten hose clamps (A) securely. Fill cooling system with the proper amount and concentration of ethylene glycol base antifreeze.
9. Open sea cock, start engine, and check for leaks.

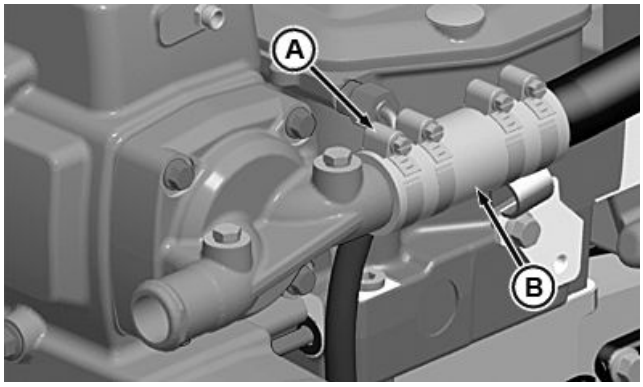
A—Hose Clamp
B—Tube
C—Rear End Cap
D—Cap Screws
E—Front End Cap
F—Cap Screws



RG22140 —UN—06SEP13



RG22139 —UN—06DEC12



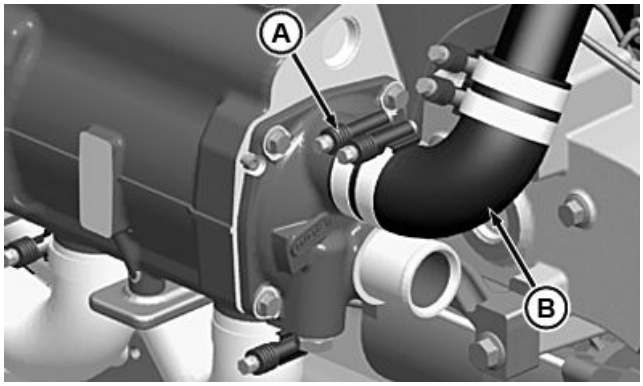
RG22138 —UN—06DEC12

RG19661,000040F -19-09SEP13-2/2

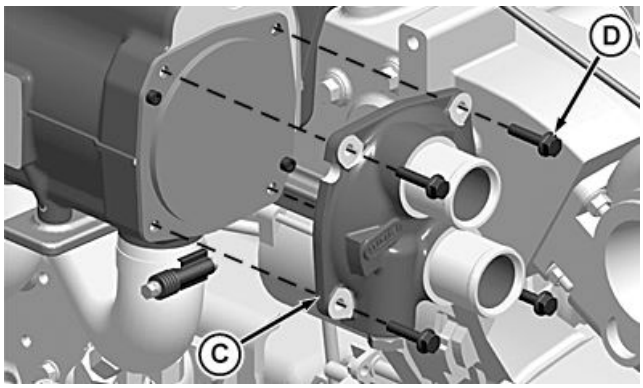
Removing, Inspecting, and Cleaning Engine Heat Exchanger Core (6.8 L)

1. Close sea cocks and drain the sea water system.
2. Open drain valve on cylinder block and drain engine coolant into a clean container. Close drain valve.
3. Loosen hose clamps (A) and disconnect sea water tube (B).
4. Remove cap screws (D) and remove rear end cap (C). Identify end cap so it can be installed in the same position as removed.
5. Remove socket head cap screws (E).
6. Remove cap screws (G) and remove front end cap (F) . Identify end cap so it can be installed in the same position as removed.
7. Thoroughly inspect condition of end cap sealing O-rings. Sealing O-rings may be reused if not excessively worn or damaged during disassembly. Replace sealing rings as necessary.

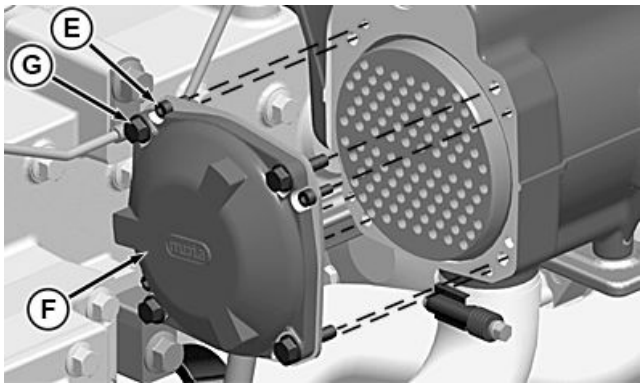
A—Hose Clamp
B—Tube
C—Rear End Cap
D—Cap Screws
E—Socket Head Cap Screws
F—Front End Cap
G—Cap Screws



RG22133 —UN—06DEC12



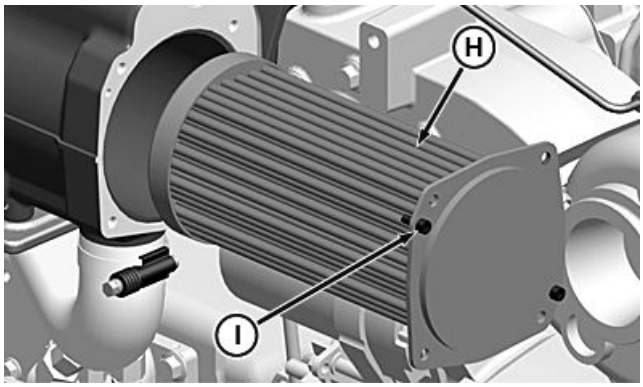
RG22134 —UN—06DEC12



RG22135 —UN—06SEP13

Continued on next page
ZE59858,000018A -19-30OCT13-1/2

8. Remove socket head cap screws (I).
9. Remove heat exchanger core (H) through rear side of housing.
10. Remove remaining end cap from water manifold/heat exchanger housing. Remove end cap from heat exchanger core.
11. Thoroughly clean all buildup from both end caps and inspect zinc plug in each. Replace plugs as needed. See Inspecting and Replacing Zinc Plugs (If Equipped) in 250 Hours/6 Months Section.
12. Use a brass rod to clean out any buildup in each heat exchanger tube. Run the rod the entire length of each tube to push out debris.
13. Flush the heat exchanger tubes with clean water, making sure that all tubes are cleared of debris. Clean (with brass rod) and flush heat exchanger again if necessary to remove any remaining debris from tubes. If you suspect that your heat exchanger core is defective, have your authorized servicing dealer or engine distributor pressure test for leaks. Replace heat exchanger core as required.
14. Remove and thoroughly clean water manifold/heat exchanger housing if needed.



RG22136 —UN—06SEP13

H—Heat Exchanger Core **I— Socket Head Cap Screws**

RG6066 —UN—23JAN92

Clean Heat Exchanger

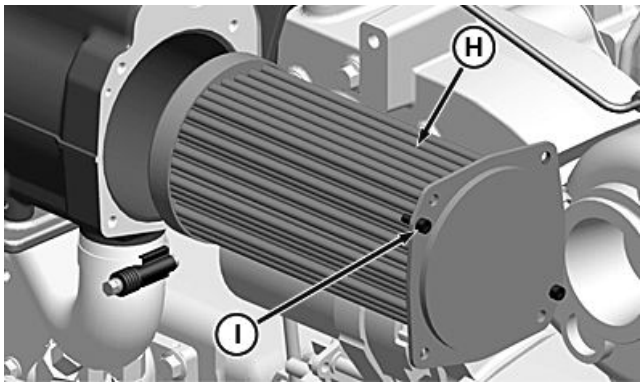
ZE59858,000018A -19-30OCT13-2/2

Installing Heat Exchanger Core (6.8 L)

1. Install heat exchanger core (H) through rear side of housing.
2. Install socket head cap screws (I). Tighten socket head cap screws to specifications.

Specification	
Socket Head Cap Screws—Torque	11 N·m (97 lb.-in.)

H—Heat Exchanger Core **I— Socket Head Cap Screws**



RG22136 —UN—06SEP13

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ZE59858,000018B -19-23OCT13-1/2

3. Thoroughly inspect condition of end cap sealing O-rings. Sealing O-rings may be reused if not excessively worn or damaged during disassembly. Replace sealing rings as necessary.
4. Install front end cap (F) and install cap screws (G). Index end cap in same position as removed.
5. Tighten cap screws (F) to specifications.

Specification

Cap Screws (G)—Torque ..... 26 N·m (230 lb.-in.)

6. Install socket head cap screws (E). Tighten socket head cap screws to specifications.

Specification

Socket Head Cap Screws—Torque ..... 11 N·m (97 lb.-in.)

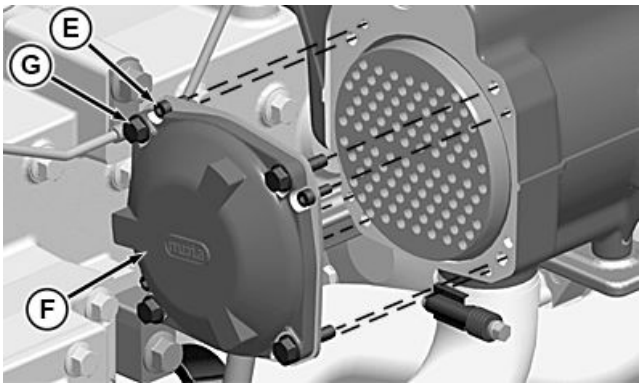
7. Install rear end cap (C) and install cap screws (D). Index end cap in same position as removed.
8. Tighten cap screws (D) to specifications.

Specification

Cap Screws (D) —Torque ..... 26 N·m (230 lb.-in.)

9. Connect sea water tube (B) and tighten hose clamps (A) securely. Fill cooling system with the proper amount and concentration of ethylene glycol base antifreeze.
10. Open sea cock, start engine, and check for leaks.

A—Hose Clamp
B—Tube
C—Rear End Cap
D—Cap Screws
E—Socket Head Cap Screws
F—Front End Cap
G—Cap Screws



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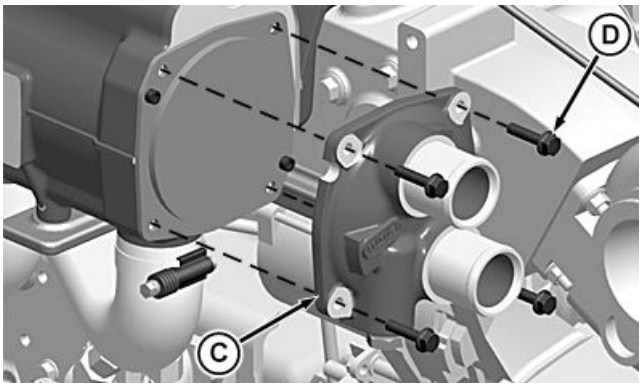

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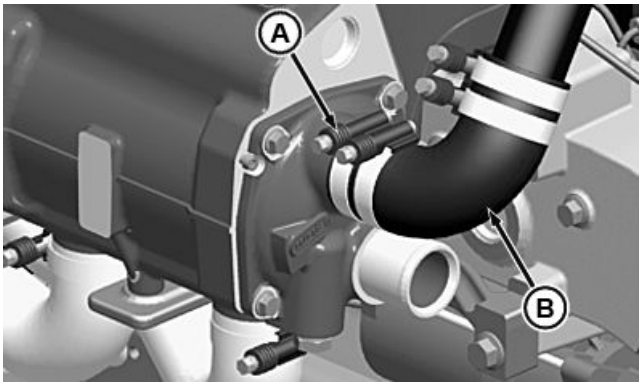

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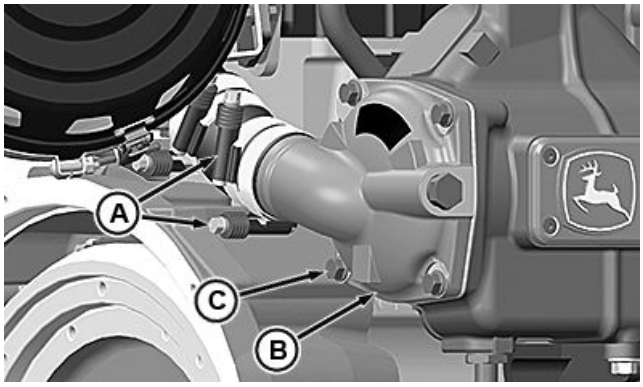
ZE59858,000018B -19-23OCT13-2/2

Removing, Inspecting, and Cleaning Engine Aftercooler Core (6068SFM85)

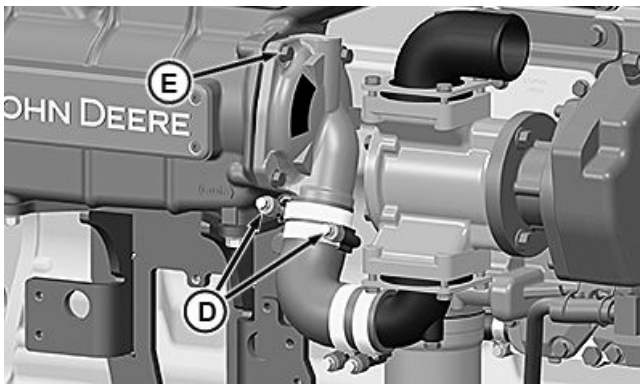
IMPORTANT: Ensure that Service Kit is readily available before removing aftercooler core. Air side seals will be destroyed during core removal, and service kit includes required replacement seals, as well as end cap O-rings.

1. Close sea cocks and drain the sea water or coolant system.
2. Remove air filter.
3. Loosen clamps (A) and remove sea water hose from rear end cap.
4. Remove cap screws (C) and rear end cap (B). Identify end cap so it can be installed in the same position as removed.
5. Loosen clamps (D) and remove lines from front end cap.
6. Remove cap screws (E) and rear end cap. Identify end cap so it can be installed in the same position as removed.
7. Remove aftercooler core (F) through rear side of housing.

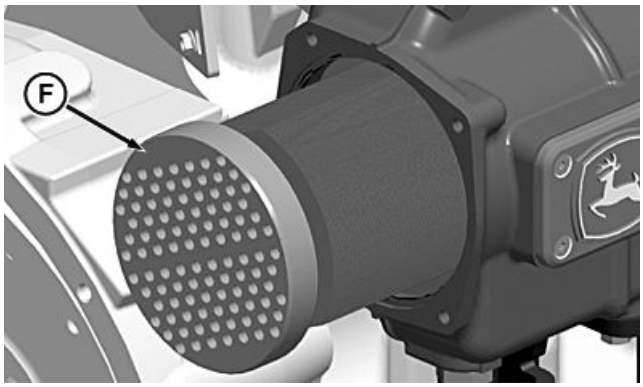
A—Clamps
B—Rear End Cap
C—Cap Screws
D—Clamps
E—Cap Screws
F—Aftercooler Core



RG22151A —UN—04NOV13



RG22152A —UN—04NOV13



RG22153 —UN—06SEP13

ZE59858,000018C -19-04NOV13-1/2

8. Thoroughly clean all buildup from both end caps.
9. Use a brass rod to clean out any buildup in each tube. Run the rod the entire length of each tube to push out debris.
10. Flush the tubes with clean water, making sure that all tubes are cleared of debris. Clean (with brass rod) and flush aftercooler core again if necessary to remove any remaining debris from tubes.
    If you suspect that your aftercooler core is defective, have your authorized servicing dealer or engine distributor pressure test for leaks. Replace aftercooler core as required.


RG12181 —UN—25FEB02

Clean Aftercooler Core

ZE59858,000018C -19-04NOV13-2/2

Installing Aftercooler Core (6068SFM85)

1. Install O-rings on front and rear end caps. Lubricate front and rear end cap O-rings with clean multi-purpose grease.
2. Install aftercooler core (G) through rear side of housing.
3. Install front end cap in same position as removed. Evenly tighten cap screws (E) to specifications.

Specification

Cap Screws—Torque..... 26 N·m (230 lb.-in.)

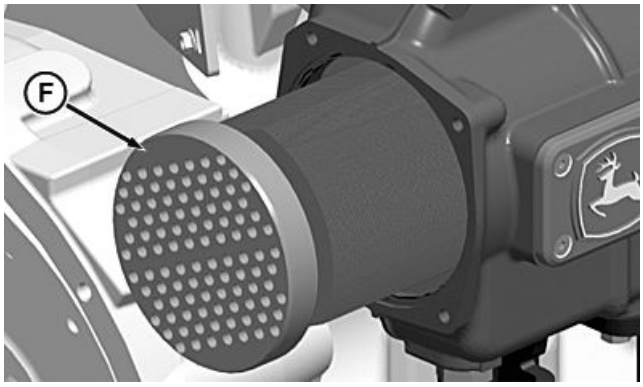
4. Install lines and clamps (D).
5. Install rear end cap (B) in same position as removed. Evenly tighten cap screws (C) to specifications.

Specification

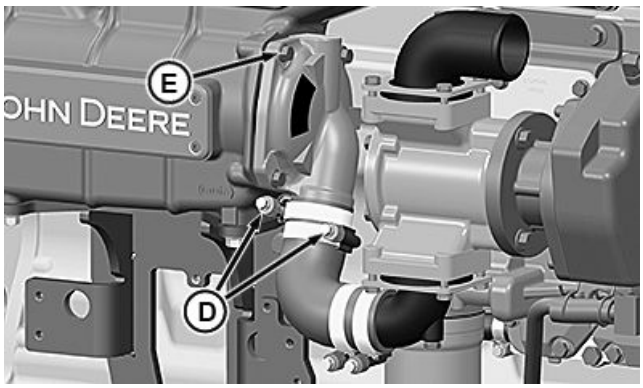
Cap Screws—Torque..... 26 N·m (230 lb.-in.)

6. Install sea water hose and clamps (A) to rear end cap.
7. Open sea cocks.
8. Install air cleaner.

A—Clamps
B—Rear End Cap
C—Cap Screws
D—Clamps
E—Cap Screws
F—Aftercooler Core



RG22153 —UN—06SEP13



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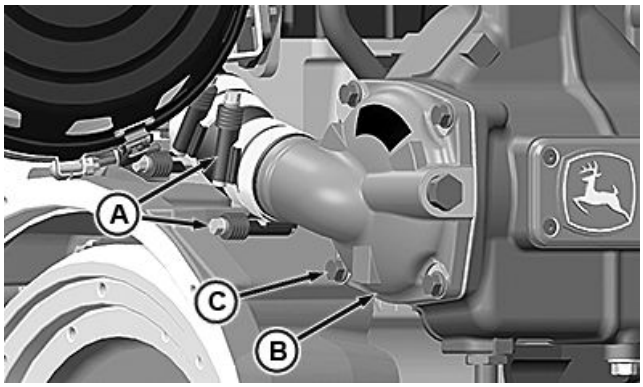
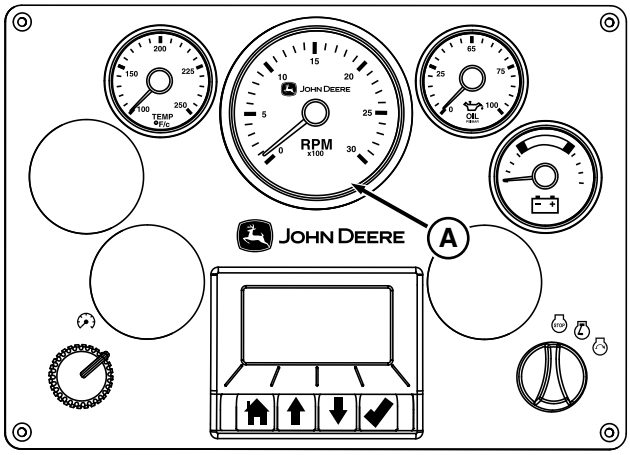


RG22151A —UN—04NOV13

ZE59858,000018D -19-04NOV13-1/1

Checking and Adjusting Engine Speeds

Observe tachometer reading (A) on the instrument panel to verify engine speeds. See Engine Power and Speed Ratings in the Specifications Section.



RG29322 —UN—23FEB17

Observe Tachometer Reading

ZE59858,000023A -19-03MAR17-1/1

Checking Engine Electrical Ground Connections

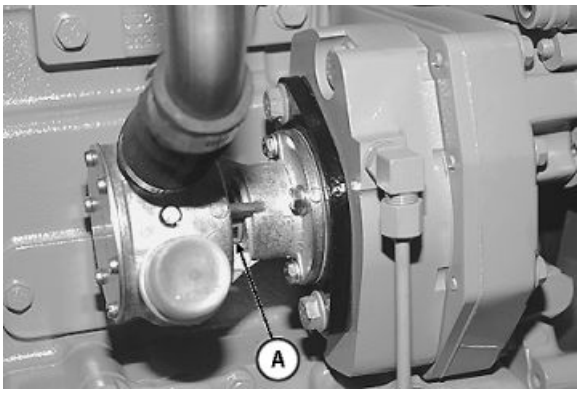
Keep all engine ground connections clean and tight to prevent electrical arcing which can damage electronic components.

Also see precautions in Troubleshooting Section when welding on engine or machine.

OUOD002,0000169 -19-23NOV01-1/1

Replacing Sea Water Pump Impeller (4045TFM85)

1. Inspect the sea water pump housing weep hole (A), if equipped, for evidence of water or oil indicating seal leakage.
   If water leakage is evident, order an Impeller Repair Kit and replace impeller and front housing/shaft seal.
   If oil leakage is evident, order a Major Repair Kit and replace all internal components except shaft. An arbor press and drivers are needed to install this kit. Have an experienced technician install this kit.



RG9852 —UN—05JAN99

Inspect Sea Water Pump

A—Weep Hole

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RG19661,0000401 -19-06SEP13-1/2

2. Close sea cock and drain sea water system if not previously done.
3. Remove six cover plate cap screws with washers and remove cover plate (A) with O-ring. Remove impeller end cap from end of impeller bore.

   NOTE: Normally the impeller can be removed by using two pair of pliers to grip impeller vanes on opposite sides of impeller. Rotating the pump shaft by hand may help free the impeller. Petroleum based lubricants can cause the impeller to swell, and are not recommended to free a stuck impeller.

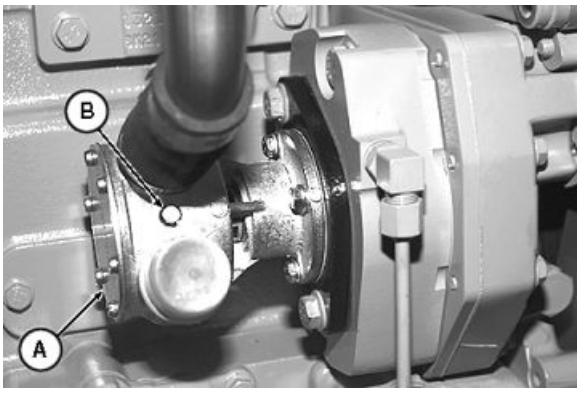
4. Carefully remove impeller with cam plate. Be careful not to damage impeller if it is in reusable condition. Remove key from shaft keyway.
   The impeller must be installed in the same direction as removed. Mark the impeller to ensure installation in proper direction of rotation if impeller is reused.
5. Inspect impeller for damages such as tears, stress cracks, excess abrasions on vane ends, or chunks of material missing. Impellers that are run dry will overheat and fail the impeller blades at the root. Impellers that swell and stick, fail the impeller in the middle of the blade. If impeller replacement is necessary, order an impeller repair kit.

   IMPORTANT: If impeller has chunks of material missing, the heat exchanger, gear oil cooler, and any other circuit that are cooled by raw water should be thoroughly cleaned and flushed.

6. Remove cam screw (B) holding cam plate to impeller housing bore.
7. Thoroughly clean impeller housing bore and cam plate (if cam plate is reused).
8. Apply LOCTITE® 242 to curved side of cam plate near threaded hole and install cam plate into impeller housing bore, be sure holes in cam plate and housing are aligned. Apply LOCTITE® 242 to cam screw (B), install, and tighten.
   The cam plate should be inspected to insure that none of the cam fingers are protruding which could cause impeller damage. The cam screw should also be inspected to insure that it does not protrude below the cam plate. Replace cam plate and cam screw or grind screw flush as needed.

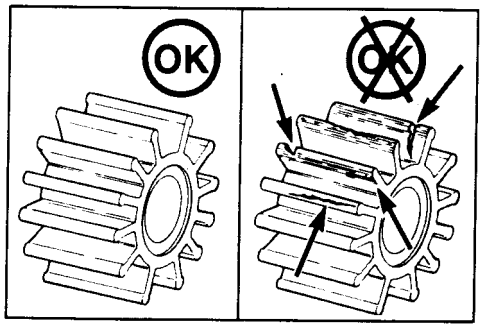
   IMPORTANT: Petroleum based lubricants can cause the impeller to swell, and are not recommended to lubricate the impeller before installation.

9. Lubricate impeller blades with a non-petroleum based lubricant such as silicone or soapy water. Install impeller using a twisting motion and be sure that the impeller blades are bent in the same direction as they were upon removal.
   Be sure that impeller is installed in same direction as removed if reusing existing impeller.
10. Rotate impeller to align keyway and slide the key in place. Install impeller end cap in end of impeller bore.
11. Using a new O-ring, install cover plate (A) onto impeller housing. Install six cap screws with washers and tighten screws evenly.
12. Reconnect all water piping, if disconnected.
13. Open sea cock and prime sea water pump with water. Start engine and check for leaks.



RG9853 —UN—05JAN99

Remove Cover Plate



RG6243 —UN—23MAR92

Inspect Sea Water Pump Impeller

A—Cover Plate **B—Cam Screw**

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RG19661,0000401 -19-06SEP13-2/2

Replacing Sea Water Pump Impeller (4045AFM85/6068AFM85)

NOTE: Sea water pump with shaft key is illustrated. Sea water pumps with a splined shaft follow the same procedure

1. Close sea cocks and drain sea water system.
2. Remove cap screws and cover plate (A) from sea water pump.

NOTE: Special impeller puller tool is provided with minor and major sea water pump rebuild kits. If tool is not available, the impeller can normally be removed by using two pair of pliers to grip impeller vanes on opposite sides of impeller. Rotating the pump shaft by hand may help free the impeller. Petroleum based lubricants can cause the impeller to swell, and are not recommended to free a stuck impeller.

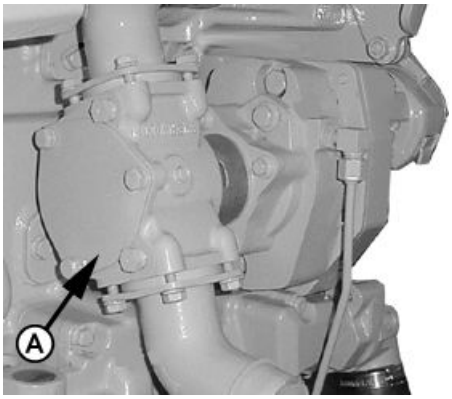
3. Remove impeller (B) and shaft key (C) (if equipped) from pump housing.
4. Remove O-ring (D).
5. Inspect cam plate (E) for evidence of heavy pitting or wear. Replace as needed.
6. Inspect impeller for damages such as tears, stress cracks, excess abrasions on vane ends, or chunks of material missing. Impellers that are run dry will overheat and fail the impeller blades at the root. Impellers that swell and stick, fail the impeller in the middle of the blade. If impeller replacement is necessary, order an impeller repair kit.

IMPORTANT: If impeller has chunks of material missing, the heat exchanger, aftercooler, marine gear oil cooler, and any other circuit that are cooled by raw water should be thoroughly cleaned and flushed.

7. Install shaft key (C) (if equipped) on shaft.

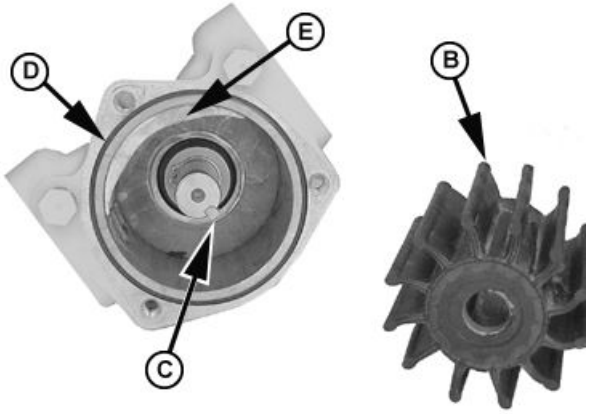
IMPORTANT: Petroleum based lubricants can cause the impeller to swell, and are not recommended to lubricate the impeller before installation.

8. Lubricate new impeller blades with a non-petroleum based lubricant such as silicone or soapy water. Install impeller using a twisting motion and be sure that the impeller blades are bent in the same direction as they were upon removal to prevent damage at startup. Rotate impeller on shaft to align keyways and spines and slide the impeller onto the shaft.
9. Using a new O-ring (D), install cover plate and cap screws with washers and tighten to specifications.



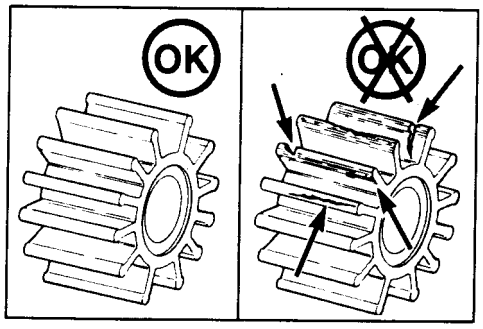
RG14949 —UN—20JUN07

Remove Cover Plate



RG12189 —UN—25FEB02

Remove and Inspect Components



RG6243 —UN—23MAR92

Inspect Sea Water Pump Impeller

A—Cover Plate
B—Impeller
C—Shaft Key
D—O-Ring
E—Cam Plate

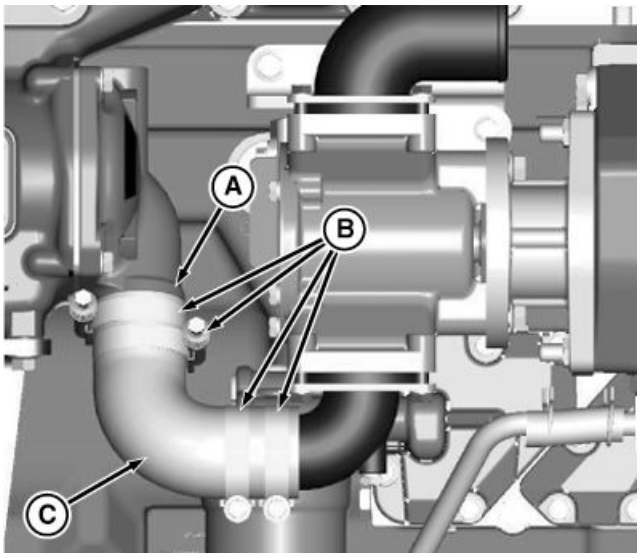
Specification

Cap Screws—Torque..... 35 N·m (26 lb.-ft.)

10. Open sea cocks, start engine, and check pump operation.

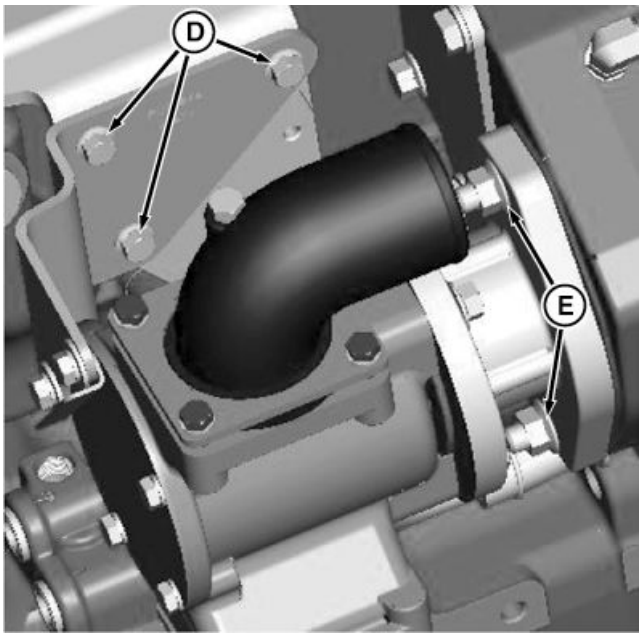
RG19661,0000402 -19-06SEP13-1/1

Replacing Sea Water Pump Impeller (6068SFM85)



RG22485 —UN—04MAR13

Remove and Install Sea Water Pump



RG22484 —UN—07MAR13

NOTE: The 6068SFM85 sea water pump must be removed to gain access to the pump impeller.

1. Close sea cock and drain sea water system.
2. Remove sea water pump inlet connection. Loosen constant tension clamps (B) on formed hose (C) that is attached to the aftercooler inlet (A).
3. Remove sea water pump bracket cap screws (D). Remove pump mounting nuts (E) and remove sea water pump (H).
4. Clean sealing surfaces and inspect for defects. Replace O-ring (G) if necessary.
5. Install sea water pump impeller.
6. Install sea water pump with O-ring on studs (F). Install nuts (E) finger tight evenly on both studs and tighten to specifications.

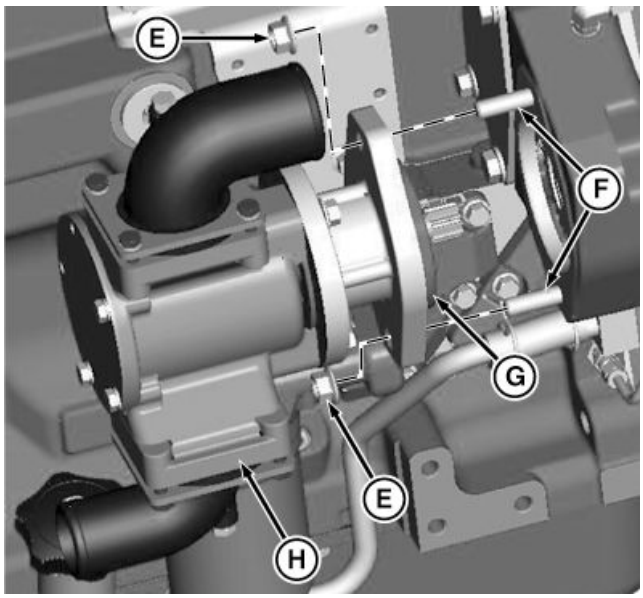
Specification	
Nuts—Torque	60 N·m (44 lb.-ft.)

7. Install bracket cap screws (D) and tighten to specifications.

Specification	
Cap Screws—Torque	35 N·m (26 lb.-ft.)

8. Install formed hose (C) and tighten constant tension clamps (B) to.

Specification	
Clamps—Torque	12 N·m (106 lb.-in.)



RG22483 —UN—07MAR13

A—Aftercooler Inlet
B—Constant Tension Clamps
C—Formed Hose
D—Cap Screws
E—Nuts
F—Studs
G—O-ring
H—Sea Water Pump

9. Connect sea water pump inlet.
10. Open sea cock, start engine, and check for leaks.

ZE59858,0000185 -19-13NOV13-1/1

Checking and Adjusting Engine Valve Clearance

CAUTION: To prevent accidental starting of engine while performing valve adjustments, always disconnect NEGATIVE (—) battery terminal.

IMPORTANT: Valve clearance MUST BE checked and adjusted with engine COLD.

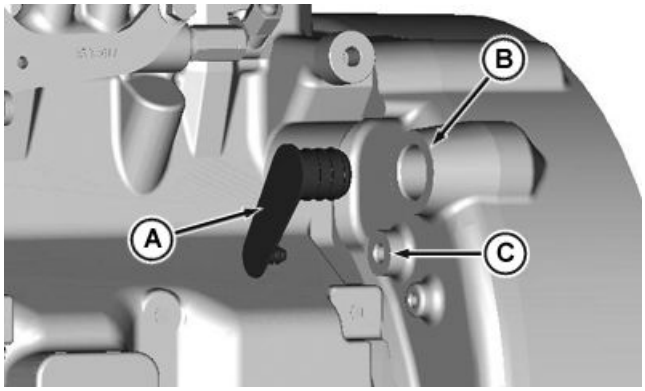
1. Disconnect wiring harness as required.
2. Disconnect crankcase ventilation tube and remove rocker arm cover.

IMPORTANT: Visually inspect contact surfaces of valve tips, bridges, and rocker arm wear pads. Check all parts for excessive wear, breakage, or cracks. Replace parts that show visible damage.

Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.

3. Remove plastic plug (A) from flywheel housing bores and install appropriate flywheel turning tool (JDG820, JDG10576, or JDE83) and JDG1571 locking pin.

NOTE: Some engines are equipped with flywheel housings which do not allow use of an engine flywheel rotation tool. These engines with straight nose crankshafts may be rotated from front nose of engine, using JDG966 Crankshaft Front/Rear Rotation Adapter.



RG20536 —UN—03JUN11

Bores to Insert Flywheel Turning Tool and Locking Pin

A—Plastic Plug
B—Flywheel Turning Tool Bore
C—Locking Pin Bore

4. Rotate engine with the flywheel turning tool until locking pin engages timing hole in flywheel.

NOTE: If the rocker arms for No. 1 (front) cylinder are loose, the engine is at No. 1 top dead center compression.

NOTE: If the rocker arms for No. 4 (rear) cylinder are loose, the engine is at No. 4 top dead center. Rotate the engine one full revolution (360°) to No. 1 top dead center compression.

ZE59858,00002B0 -19-05DEC13-1/4

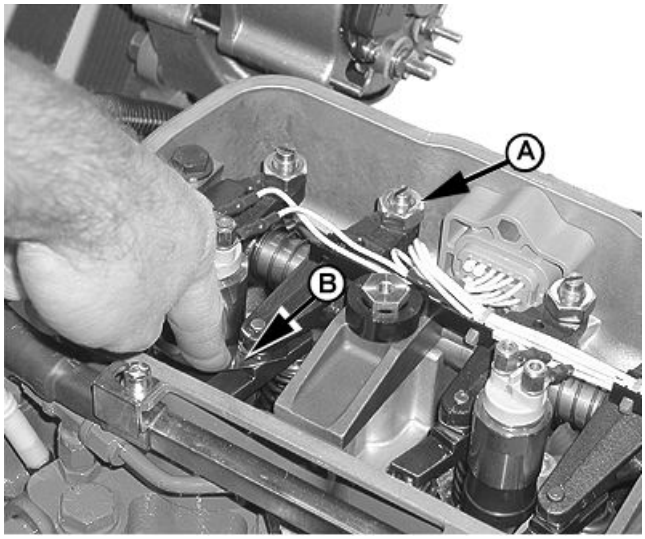
5. Loosen the nut (A) on rocker arm adjusting screw. Turn adjusting screw until feeler gauge (B) slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten nut to specifications. Recheck clearance again after tightening nut. Readjust clearance as necessary.

Specification	
Intake Valve Clearance Adjustment (Engine Cold)—Clearance	0.36 mm (0.014 in.)
Exhaust Valve Clearance Adjustment (Engine Cold)—Clearance	0.46 mm (0.018 in.)
Rocker Arm Adjusting Screw Jam Nut—Torque	27 N·m (20 lb.-ft.)

6. Install rocker arm cover with new gasket. Tighten cap screws to specification starting in the middle, working outward.

Specification	
Cap Screws—Torque	11 N·m (97 lb.-ft.)

7. Install crankcase ventilation tube.
8. Reconnect battery terminal.



RG13809 —UN—07DEC04

Adjusting Valves

A—Adjusting Screw Jam Nut
B—Feeler Gauge

Continued on next page

ZE59858,00002B0 -19-05DEC13-2/4

4-Cylinder Engine

NOTE: Firing order is 1-3-4-2.

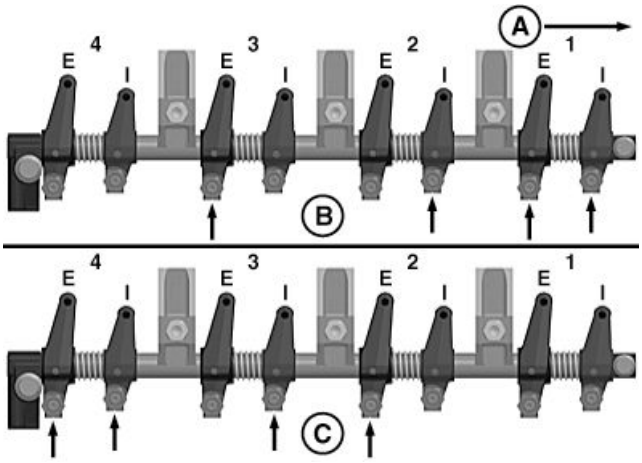
Lock No. 1 piston at TDC compression stroke (B).

Adjust valve clearance on No. 1 and 3 exhaust valves and No. 1 and 2 intake valves.

Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).

Adjust valve clearance on No. 2 and 4 exhaust valves and No. 3 and 4 intake valves.

A—Front of Engine
B—No. 1 Piston at TDC Compression Stroke
C—No. 4 Piston at TDC Compression Stroke
E—Exhaust Valve
I— Intake Valve



RG22378 —UN—28JAN13

4-Cylinder Engine Valve Adjustment

ZE59858,00002B0 -19-05DEC13-3/4

6-Cylinder Engine:

NOTE: Firing order is 1-5-3-6-2-4.

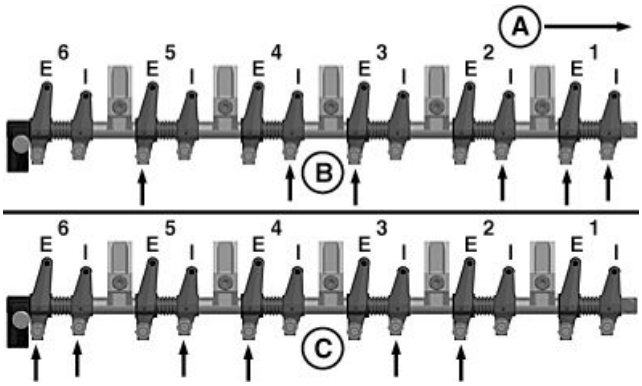
Lock No. 1 piston at TDC compression stroke (B).

Adjust valve clearance on No. 1, 3 and 5 exhaust valves and No. 1, 2, and 4 intake valves.

Turn crankshaft 360°. Lock No. 6 piston at TDC compression stroke (C).

Adjust valve clearance on No. 2, 4 and 6 exhaust valves and No. 3, 5, and 6 intake valves.

A—Front of Engine
B—No. 1 Piston TDC Compression
C—No. 6 Piston TDC Compression
E—Exhaust Valve
I— Intake Valve



RG22377 —UN—28JAN13

6-cylinder Engine Valve Adjustment

ZE59858,00002B0 -19-05DEC13-4/4

Checking Crankshaft Vibration Damper (If Equipped)

IMPORTANT: Crankshaft vibration damper is not repairable. For engines equipped with elastomeric crankshaft vibration damper replace every 4500 hours or 60 months, whichever comes first. For engines equipped with viscous crankshaft vibration damper replace at major engine overhaul. Also replace viscous crankshaft vibration damper when short block, complete block, or remanufactured basic engine is installed.

NOTE: Checking procedure only applies to elastomeric crankshaft vibration damper.

1. Remove belts (shown removed).
2. If elastomeric material is separated, partially missing, or has any visible inconsistency, replace crankshaft vibration damper.
3. Check crankshaft vibration damper radial runout (concentricity) by positioning dial indicator so probe contacts crankshaft vibration damper outer diameter.
4. With engine at operating temperature, rotate crankshaft using JDE83 or JDE81-1 flywheel turning tool.
5. Note dial indicator reading. If runout (concentricity) exceeds specification, replace crankshaft vibration damper.

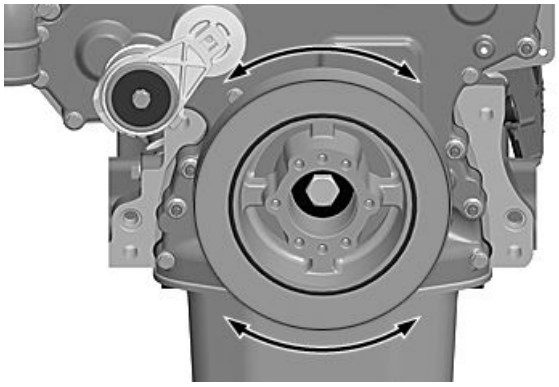
Specification

Crankshaft Vibration Damper—Maximum Radial Runout ..... 1.50 mm (0.060 in)

6. Check crankshaft vibration damper end play by positioning dial indicator so probe contacts front of crankshaft vibration damper. Compare with specification. Replace as necessary.

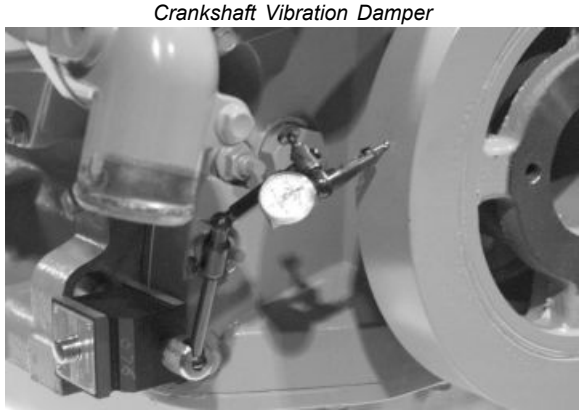
Specification

Crankshaft Vibration Damper—End Play ..... 0.03—0.36 mm (0.001—0.014 in)



RG19046 —UN—23AUG10

Crankshaft Vibration Damper



RG7508 —UN—23NOV97

Check Runout

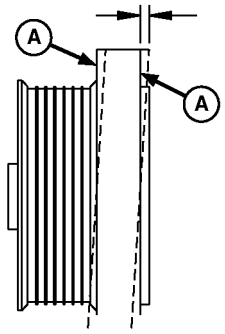
ZE59858,0000182 -19-02NOV15-1/2

7. Check crankshaft vibration damper axial runout using dial indicator. Measure axial runout at the outer edges of crankshaft vibration damper face (A).
8. Rotate crankshaft one complete revolution using JDE83 or JDE81-1 flywheel turning tool and note total dial indicator movement. Compare with specification.

Specification

Crankshaft Vibration Damper Pulley Outer Ring—Wobble (Maximum) ..... 0.76 mm (0.030 in)

A—Crankshaft Vibration Damper Wobble



RG9053 —UN—16MAR98

ZE59858,0000182 -19-02NOV15-2/2

Inspecting and Repairing Sea Water Pump (4045TFM85)

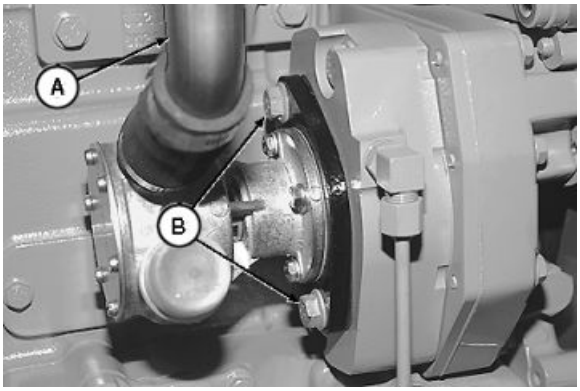
NOTE: Sea water pump may have two more mounting cap screws than illustrated. Removal and installation procedures are unchanged.

1. Close sea cock and drain sea water system, if not previously done.
2. Remove water inlet tube (shown removed) and outlet tube (A) from sea water pump.
3. Remove cap screws (B) attaching sea water pump to gear housing. Withdraw pump from housing until splined shaft (C) is free from splined drive gear ID (D).
4. Clean all gasket material from both mating surfaces.
5. Install pump overhaul kit.
6. Position a new gasket on water pump mounting flange. Install splined pump shaft in splined ID of drive gear.
7. Align mounting holes in water pump flange and gasket with threaded holes in gear housing. Install cap screws with washers and tighten cap screws to specifications.

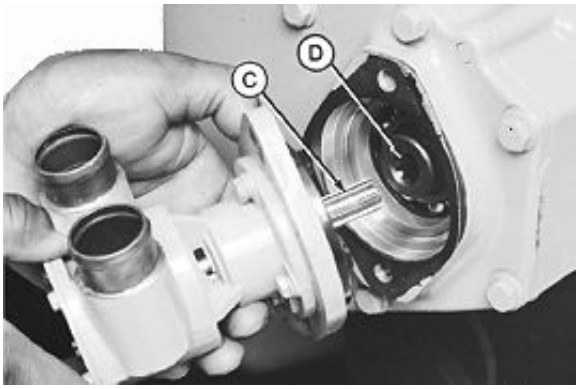
Specification

Cap Screws—Torque..... 47 N·m (35 lb.-ft.)

8. Connect water piping and tighten clamps.
9. Open sea cock, start engine, and check for leaks.



RG9861 —UN—06JAN99



RG9864 —UN—06JAN99

A—Outlet Tube
B—Mounting Screws
C—Splined Shaft
D—Drive Gear Splined ID

RG19661,00003FE -19-08NOV13-1/1

Inspecting and Repairing Sea Water Pump (4045AFM85/6068AFM85)

1. Close sea cock and drain sea water system.
2. Remove sea water outlet connection (A), remove sea water pump cap screws (B) and remove pump.
3. Clean all gasket material from both mating surfaces.
4. Inspect gear teeth for damage. Install new gear (D) by aligning key (C) to the pump shaft keyway.
5. Install pump overhaul kit.
6. Install lock washer (E) and hex nut (F) finger tight and insure key is properly in place.
7. Tighten hex nut to specifications.

Specification

Hex Nut—Torque..... 68 N·m (50 lb.-ft.)

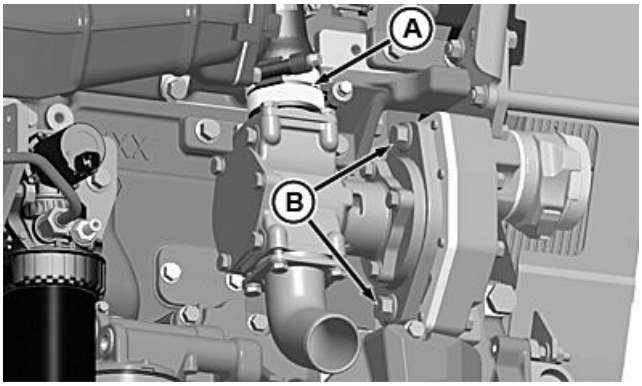
8. Install sea water pump with new gasket to front plate and tighten cap screws (B) to specifications.

Specification

Cap Screws—Torque..... 140 N·m (103 lb.-ft.)

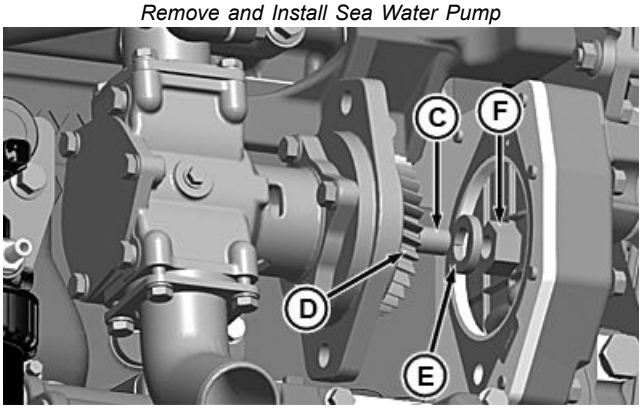
9. Connect sea water inlet and outlet.
10. Open sea cock, start engine, and check for leaks.

A—Sea Water Outlet
B—Cap Screws
C—Key
D—Gear
E—Lock Washer
F—Hex Nut



RG22172 —UN—10DEC12

Remove and Install Sea Water Pump

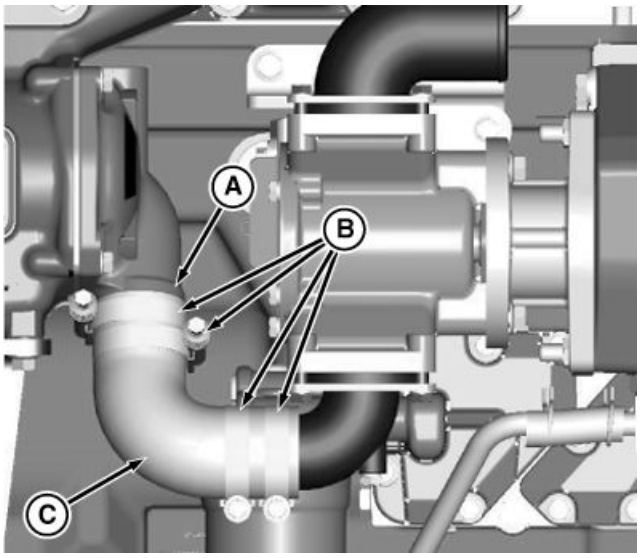


RG22173 —UN—10DEC12

Sea Water Pump Drive Gear

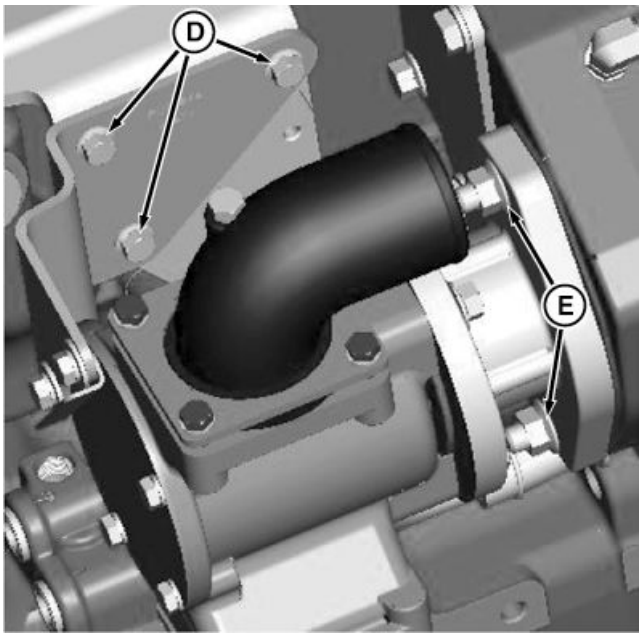
RG19661,00003FF -19-08NOV13-1/1

Inspecting and Repairing Sea Water Pump (6068SFM85)



RG22485 —UN—04MAR13

Remove and Install Sea Water Pump



RG22484 —UN—07MAR13

1. Close sea cock and drain sea water system.
2. Remove sea water pump inlet connection. Loosen constant tension clamps (B) on formed hose (C) that is attached to the aftercooler inlet (A).
3. Remove sea water pump bracket cap screws (D). Remove pump mounting nuts (E) and remove sea water pump (H).
4. Clean sealing surfaces and inspect for defects. Replace O-ring (G) if necessary.
5. Install pump overhaul kit.
6. Install sea water pump with O-ring on studs (F). Install nuts (E) finger tight evenly on both studs and tighten to specifications.

Specification

Nuts—Torque..... 60 N·m (44 lb.-ft.)

7. Install bracket cap screws (D) and tighten to specifications.

Specification

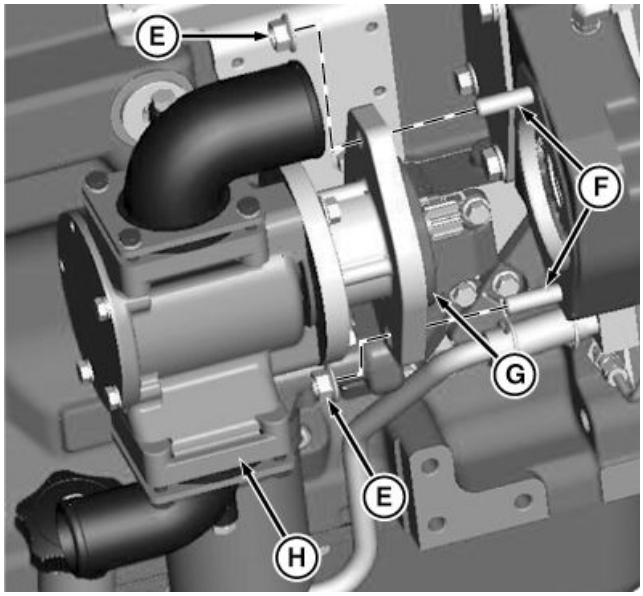
Cap Screws—Torque..... 35 N·m (26 lb.-ft.)

8. Install formed hose (C) and tighten constant tension clamps (B) to.

Specification

Clamps—Torque..... 12 N·m (106 lb.-in.)

9. Connect sea water pump inlet.



RG22483 —UN—07MAR13

A—Aftercooler Inlet
B—Constant Tension Clamps
C—Formed Hose
D—Cap Screws
E—Nuts
F—Studs
G—O-ring
H—Sea Water Pump

10. Open sea cock, start engine, and check for leaks.

RG19661,0000404 -19-13NOV13-1/1

Flushing And Refilling Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

NOTE: If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to 2 years or 2000 hours of operation.

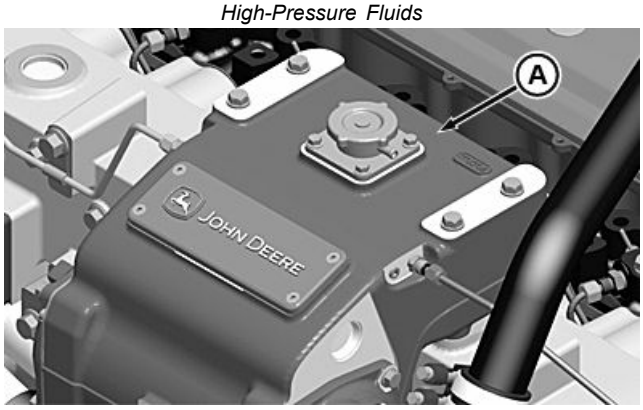
Drain old coolant, flush the entire cooling system, test thermostats, and fill with recommended clean coolant using the following procedure.

1. Pressure test entire cooling system and pressure cap if not previously done. See Pressure Testing Cooling System in the Lubrication & Maintenance — 500 Hours/12 Months Section.
2. Slowly open the cap on the top tank (A and B) or heat exchanger to relieve pressure and allow coolant to drain faster.

A—Top Tank Cap

High-Pressure Fluids

TS281 —UN—15APR13



Engine Top Tank

RG22040 —UN—28NOV12

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ZE59858,0000250 -19-11NOV13-1/2

3. Open engine block drain valve (A) on left side of engine. Drain all coolant from engine block.
4. Open heat exchanger or top tank drain valve. Drain all coolant from heat exchanger or top tank.
5. Remove thermostats at this time, if not previously done. Install cover (without thermostats) using old gasket and tighten cap screws to specifications. See Removing and Installing Thermostats in the Lubrication & Maintenance — 6000 Hours/72 Months Section.
6. Test thermostat opening temperature. See Testing Thermostats in the Lubrication & Maintenance — 6000 Hours/72 Months.
7. Close all drain valves after coolant has drained.

CAUTION: Do not run engine longer than 10 minutes. Doing so may cause engine to overheat, causing burns when cooling system is draining.

8. Fill the cooling system with clean water. Run the engine about 10 minutes to stir up possible rust or sediment.
9. Stop engine, pull off lower cooling system hose and remove heat exchanger or top tank cap. Immediately drain the water from system before rust and sediment settle.
10. After draining water, close drain valves. Reinstall cap, lower cooling system hose, and clamp. Fill the cooling system with clean water and a heavy duty cooling system cleaner such as Fleetguard® RESTORE™ and RESTORE PLUS™.
11. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run the engine about 10 minutes, remove heat exchanger or top tank cap and pull off lower cooling system hose to drain out flushing water.
12. Close all drain valves. Reinstall hoses and tighten clamps securely. Install thermostats using a new gasket. See Removing and Installing Thermostats in the Lubrication & Maintenance — 6000 Hours/72 Months Section.

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RESTORE is a trademark of Fleetguard.
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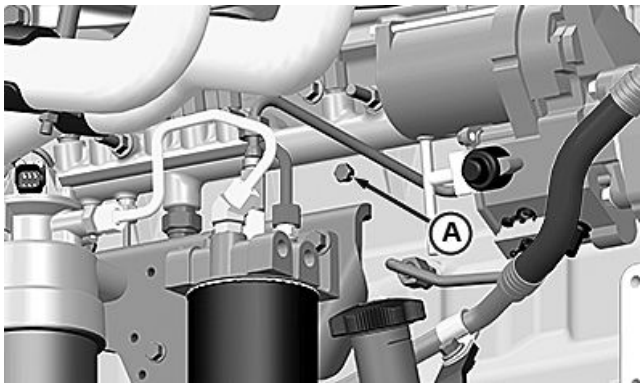
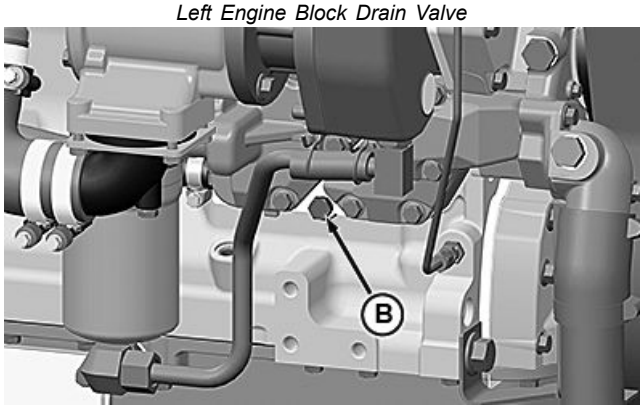


RG24317 —UN—05SEP13

Left Engine Block Drain Valve



RG24318 —UN—05SEP13

Right Engine Block Drain Valve

A—Engine Block Drain Valve

13. Refill with fresh coolant until coolant touches bottom of filler neck. See Adding Coolant in the Service As Required Section. Install heat exchanger or top tank cap.
14. Run engine until it reaches operating temperature. This mixes the solution uniformly and circulates it through the entire system. See the Specifications section for engine coolant operating range.
15. After running engine, check coolant level and entire cooling system for leaks.

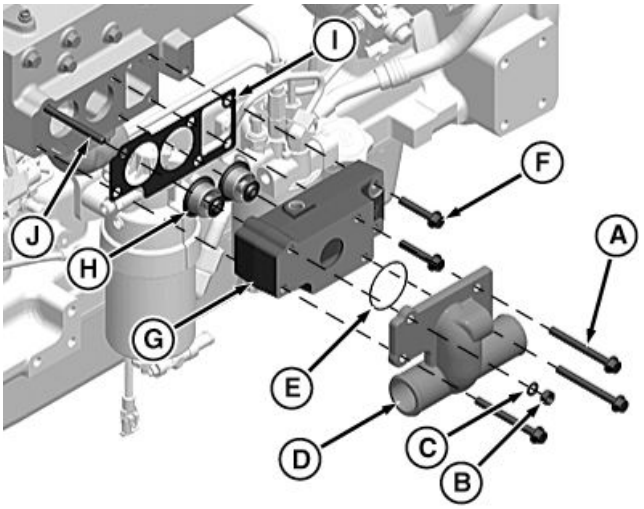
ZE59858,0000250 -19-11NOV13-2/2

Removing and Installing Thermostats

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely. DO NOT drain coolant until it has reached ambient temperature.

1. Visually inspect area around thermostat housing and cover for leaks.
2. Remove coolant tank pressure cap and partially drain coolant system.
3. Remove cap screws (A), nut (B) and washer (C) attaching coolant cover (D) with sealing O-ring (E) to the thermostat housing (G) and exhaust manifold.
4. Remove cap screws (F) attaching thermostat housing to the exhaust manifold.
5. Remove thermostat housing with gasket (I). Remove and discard all gasket material. Clean all sealing surfaces.
6. Inspect and test thermostats for proper opening temperature.
7. Install thermostats with a new gasket and pilot housing on stud (J). Install thermostat housing cap screws finger tight.
8. Inspect thermostat cover sealing O-ring and replace if necessary. Install thermostat cover with O-ring, cap screws, washer, and nut. Tighten nut and all cap screws to specifications.



RG22482 —UN—04MAR13

Remove and Install Thermostats

A—Cap Screws (Thermostat Cover)
B—Nut
C—Washer
D—Thermostat Cover
E—O-ring
F—Cap Screws (Thermostat Housing)
G—Thermostat Housing
H—Thermostats
I— Gasket
J— Stud

Specification

Cap Screws—Torque..... 35 N·m (25 lb.-ft.)

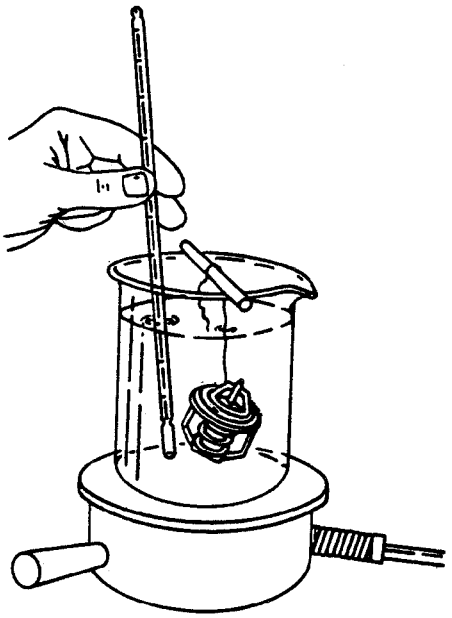
ZE59858,0000251 -19-21OCT13-1/1

Testing Thermostats

1. Remove thermostats. See Removing and Installing Thermostats in the Lubrication & Maintenance — 6000 Hours/72 Months Section.
2. Visually inspect thermostats for corrosion or damage. Replace thermostats as a matched set as necessary.
3. Inspect thermostat with wiggle wire in vent notch. If wire movement is restricted, replace thermostat if cleaning does not free movement.

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

4. Suspend thermostats and a thermometer in a container of water.
5. Stir the water as it heats. Observe opening action of thermostat and compare temperatures with specifications. See General Marine Engine Specifications in the Specification Section.
6. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.



RG5971 —UN—23NOV97

Thermostat And Thermometer In Water

7. If any one thermostat is defective, replace both thermostats.

ZE59858,0000252 -19-30OCT13-1/1

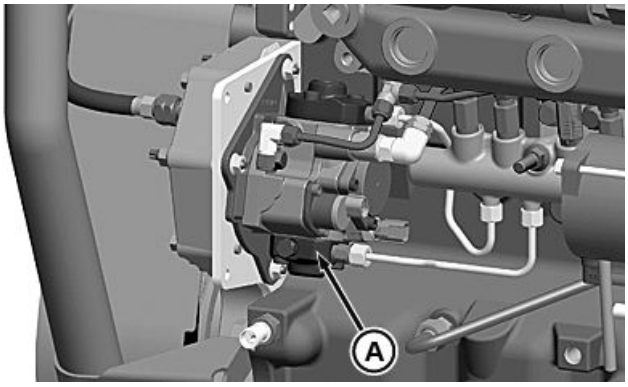
Do Not Modify Fuel System

IMPORTANT: Modification or alteration of the high-pressure fuel pump, the injection pump timing, or the fuel injectors in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

In addition, tampering with fuel system which alters emission-related equipment on engines may result in fines or other penalties, per EPA regulations or other local emission laws.

Do not attempt to service high-pressure fuel pump or fuel injectors yourself. Special training and special tools are required. See your authorized servicing dealer or engine distributor.

IMPORTANT: Never steam clean or pour cold water on a high-pressure fuel pump while it is still warm. To do so may cause seizure of pump parts.



RG22161 —UN—06DEC12

A—High-Pressure Fuel Pump

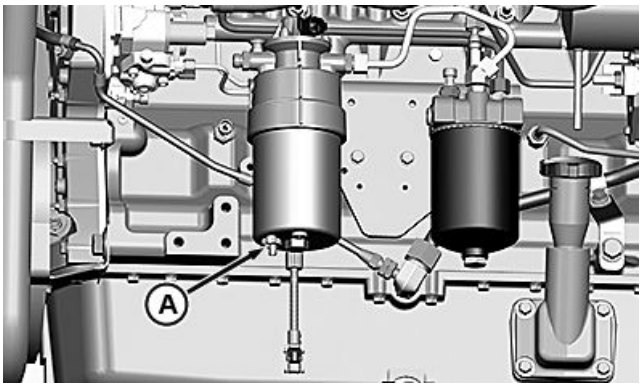
RG19661,00003C1 -19-08NOV13-1/1

Draining Water From Fuel Filters

IMPORTANT: When using BIODIESEL blends, monitor water quantity more closely in the fuel filter element. Water in the filter separator may need to be drained more frequently.

If instrument panel provides a water in fuel warning, drain water or debris from filter using the following steps.

1. Loosen thumb screw (A) and drain water and debris into a suitable container. Tighten thumb screw.
2. Dispose of water and debris in an environmentally safe manner.



RG24313 —UN—05SEP13

Drain Fuel Filter

A—Thumb Screw

ZE59858,0000187 -19-20SEP13-1/1

Adding Coolant

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

IMPORTANT: Never pour cold liquid into a hot engine, as it may crack cylinder head or block. DO NOT operate engine without coolant for even a few minutes.

John Deere Cooling System Sealer may be added to the cooling system to stop leaks. DO NOT use any other stop-leak additives in the cooling system.

Air must be expelled from cooling system when coolant is added.

1. Loosen temperature sending unit fitting at rear of cylinder head or plug in side of thermostat housing to allow air to escape when filling system.

IMPORTANT: When adding coolant to the system, use the appropriate coolant solution. See Diesel Engine Coolant (engine with wet sleeve cylinder liners) in the Fuels, Lubricants, and Coolant Section for mixing of coolant ingredients before adding to cooling system.

TS281 —UN—15APR13

High-Pressure Fluids

Do not overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of coolant tank.

2. Fill until coolant level touches bottom of coolant tank filler neck.
3. Tighten plugs and fittings when air has been expelled from system.

RG,RG34710,5593 -19-29OCT13-1/1

Pre-Start Cleaning Guide

IMPORTANT: Before cleaning machine, allow ample time for hot surfaces to cool.

IMPORTANT: Do not direct high-pressure spray from hose output directly at or close to electrical connections and sensors.

Rigorous cleaning as needed is recommended. Clean more frequently during heavy machine use, and when weather conditions are dry.

- Check enclosed areas daily. Clean the engine and other enclosed areas of equipment to remove debris and any buildup of oil and grease. Keep the engine and engine compartment free of combustible material.
- Check for debris buildup daily on and around intake systems, exhaust systems, and intercooler piping systems. Verify that there are no holes or leaks in intake or exhaust systems. Do not allow debris to build up near hot exhaust components. Verify that hot exhaust components are cleaned as often as environmental conditions require.
- Inspect cooling system daily to determine whether cooling system needs cleaning. Visible buildup of residue that blocks airflow may degrade machine performance and requires more frequent cleaning depending on environmental conditions.
- Inspect difficult to observe areas daily as conditions may require additional cleaning care to remove debris.
- Check for oil and fuel leaks daily. Replace or repair any sources of leaks, including gaskets, seals, breather tubes, fittings, and fluid lines.

Maintenance and Service Reminders

- Keep surfaces free of grease and oil.
- Clean up after hydraulic and other fluid leaks.
- Fuel Lines — Check for leaks, cracks, and kinks that require service before use.
- Fuel Pumps — Check fittings, especially compression ring couplings, for cracks and leaks.
- Fuel Injectors — Check pressure and return lines for signs of leaks.
- When servicing fuel filter or draining water separator, avoid fuel spills. Immediately clean up any fuel spill.
- Handle transmission and power steering fluids with care. Immediately clean up any spills, especially around fill points.
- Check for transmission case venting system seepage, transmission case leakage, power steering cylinder leakage, or power steering line leakage.
- Check for loose electrical connectors, damaged wiring, corrosion, and poor connections.

ZE59858,0000009 -19-20MAY13-1/1

Servicing Air Cleaner Filter Element

IMPORTANT: Always service primary air cleaner element when air filter restriction indicator shows a vacuum of 625 mm (25 in.) H_2O, or when reset button has popped up. Also replace element if it is torn, or visibly dirty.

NOTE: This procedure applies to John Deere air cleaner kits. Refer to manufacturers' instructions for servicing air cleaners not supplied by John Deere.

1. Loosen clamp and remove filter element.

IMPORTANT: Replace filter element after 10 cleanings.

2. Tap end of filter GENTLY on hard surface to dislodge loose dirt.
3. Brush dirt side of filter GENTLY with soft bristle brush.

IMPORTANT: DO NOT clean element with gasoline, solvents, parts cleaners, strong detergents, or caustic cleaning solutions. DO NOT steam clean or use high-pressure washers to clean element. These processes will damage filter media and/or rubber base or end cap.

4. Spray air filter cleaner liberally onto entire element. Let soak into filter media for 10 minutes.
5. Rinse filter with low-pressure water, flushing opposite the direction of air flow (from clean side to dirty side).

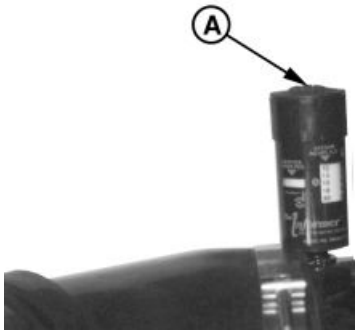
IMPORTANT: Let element dry at room temperature. Compressed air will damage filter media. Heat will shrink filter media and may damage rubber base or end cap.

6. Shake off excess water and let the element dry at room temperature.

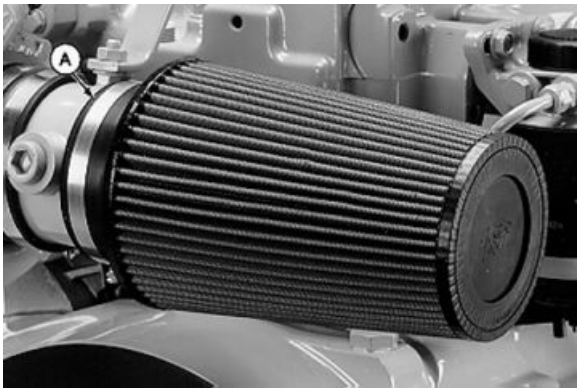
IMPORTANT: Never put filter in service without oiling it. The filter will not function properly without being oiled with oil provided in kit.

Do not use automatic transmission fluid, motor oil, diesel fuel, or any type light-weight spray lubricant. These products will damage filter or degrade its performance.

NOTE: Red dye is added to oil to show areas of oil application.



RG9927 —UN—18NOV99



RG9926 —UN—18NOV99

Remove Filter Element

A—Air Filter Restriction Indicator Button

7. Spray air filter oil from squeeze bottle in kit from distance of 25 cm (10 in.) onto a group of pleats until the pleats become reddish in color. Respray any areas that are still white 10 minutes after initial application.
8. Install filter and tighten clamp.

IMPORTANT: Whenever the air cleaner has been serviced, ALWAYS fully depress the air filter restriction indicator reset button (if equipped) to assure accurate readings.

9. If equipped, fully depress air filter restriction indicator reset button (A) and release to reset indicator.

ZE59858,0000183 -19-11NOV13-1/1

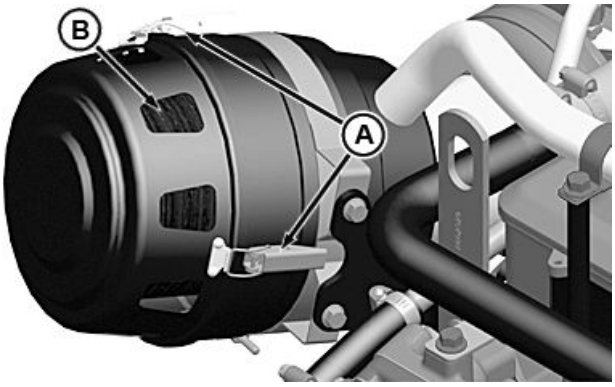
Replacing Air Cleaner Filter Element

IMPORTANT: ALWAYS REPLACE primary air cleaner element when air filter restriction indicator (A) shows vacuum of 625 mm (25 in.) H_2O, or when reset button has popped up (if equipped). Also replace element if it is torn, or visibly dirty.

1. Release air filter assembly clamps (A) and remove cover.

IMPORTANT: Insure all air intake connections are secure to prevent ingestion of abrasive dirt and dust into the system, causing possible engine damage.

2. Install new air filter element (B), install cover and engage clamps.



RG22155 —UN—21FEB13

Replace Air Filter Element

A—Air Filter Assembly Clamps B—Air Filter Element

RG19661,00003F5 -19-08NOV13-1/1

Replacing Alternator Belt

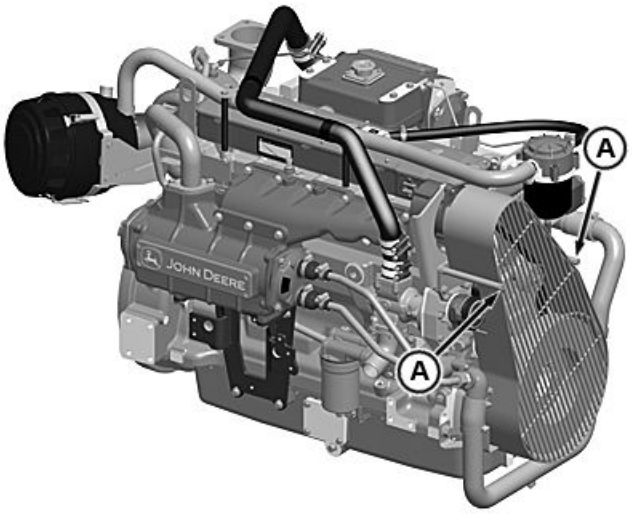
See Checking Belt Tensioner Spring Tension and Belt Wear in Lubrication & Maintenance — 500 Hours/12 Months Section for additional information on the belt tensioner.

CAUTION: Belt guard should be in place at all times when engine is running.

NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

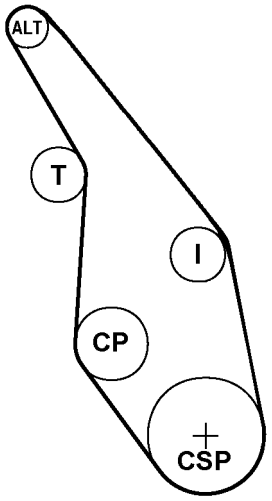
1. Remove cap screws (A) and carefully remove belt guard from engine.
2. Release tension on belt using a breaker bar and socket on tension arm and remove poly-vee belt from pulleys.
3. Inspect belts for cracks, fraying, or stretched out areas. Replace if necessary.
4. Install new belt, making sure that belt is correctly seated in all pulley grooves. Refer to belt routing at right.
5. Apply tension to belt with tensioner. Remove socket.
6. Start engine and check belt alignment.

A—Cap Screws
ALT— Alternator
CSP—Crankshaft Pulley
I— Idler Pulley
T—Tensioner
CP—Coolant Pump



RG22162 —UN—06DEC12

Remove Belt Guard



RG12077 —UN—26FEB02

Belt Routing

RG19661,00003F4 -19-20SEP13-1/1

Checking Fuses

Check the following fuses located in the control panel wiring harness. Replace defective fuses.

- Control Panel fuse — 30 amp
- ECU Power fuse — 20 amp
- Low-Pressure Fuel Pump fuse — 15 amp

See Electronically Controlled Engine Electrical System Layouts in the Troubleshooting Section.

ZE59858,000028D -19-08NOV13-1/1

Bleeding Fuel System

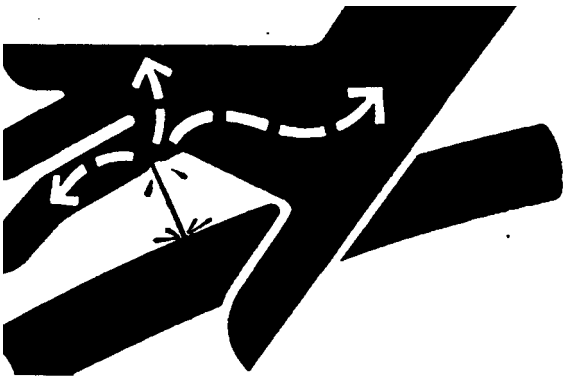
CAUTION: High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High-Pressure Common-Rail (HPCR) fuel system. Only technicians familiar with this type of system can perform repairs. (See your John Deere dealer.)

Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid hazards by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

IMPORTANT: Four-valve cylinder head engines are especially sensitive to fuel contamination. Do not crack any fuel lines to bleed the fuel system.

Bleed the fuel system anytime the system has been opened. This includes:



X9811 —UN—23AUG88

High-Pressure Fluids

- After fuel filter changes.
- Anytime fuel lines have been disconnected.
- After engine has run out of fuel.
- After pump or nozzle replacement.

Bleeding Fuel System — 4045AFM85, 6068AFM85, and 6068SFM85

4045AFM85, 6068AFM85, and 6068SFM85 engines have an electric fuel pump

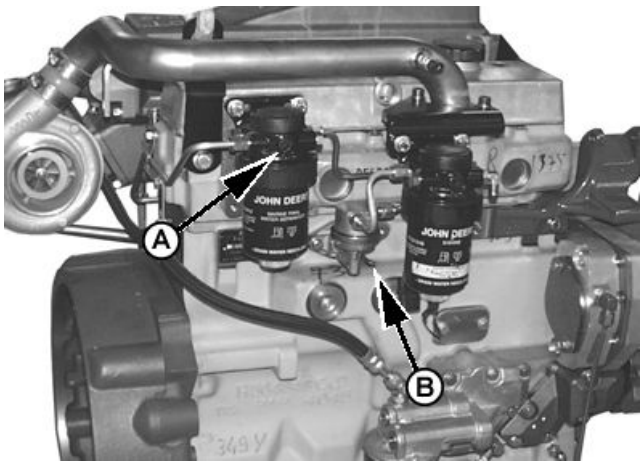
If engine will not start after filter changes, turn ignition key ON for 60 seconds to prime the fuel system. It may be necessary to turn the key off and on again to reprime the system before starting.

RG19661,00003FD -19-13DEC13-1/2

Bleeding Fuel System — 4045TFM85

1. Turn ignition key ON.
2. Loosen the air bleed vent screw (A) two full turns by hand on fuel filter base.
3. Operate supply pump primer lever (B) until fuel flow is free from air bubbles.
4. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Leave hand primer in the up position, away from the cylinder block.
5. Start engine and check for leaks.

A—Bleed Vent Screw **B—Primer Lever**



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Bleed Fuel System At Filter

RG19661,00003FD -19-13DEC13-2/2

General Troubleshooting Information

Troubleshooting engine problems can be difficult. Engine wiring diagrams are provided in this section to help isolate electrical problems on engines using John Deere wiring harness and instrument (gauge) panel.

Later in this section is a list of possible engine problems that may be encountered, accompanied by possible causes and corrections. The illustrated diagrams and troubleshooting information are of a general nature; final design of the overall system for your engine application may be different. See your engine distributor or servicing dealer if you are in doubt.

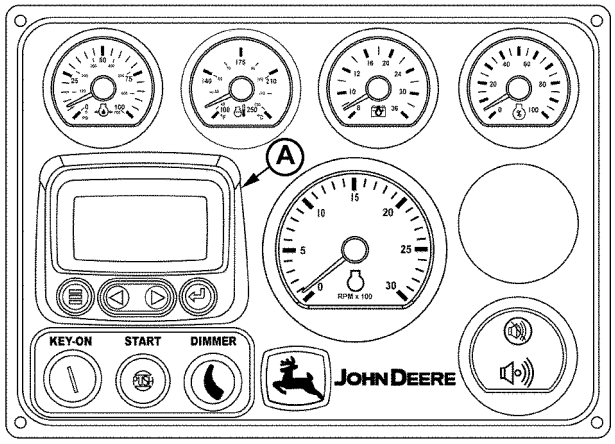
For Electronically Controlled Engines: The Engine Control Unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any of the sensor input voltages are too high or too low, if the camshaft and crankshaft position sensor inputs are valid, and if the unit injector solenoids are responding properly.

If the ECU detects a problem with the electronic control system a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU's memory.

There are two types of DTCs:
- Active
- Inactive (Stored)

Active DTCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures. They can be accessed on the diagnostic gauge (A) on the instrument panel.

Inactive or stored DTCs indicate that a failure has occurred in the past, but is not currently occurring. This type of "stored" DTC can be caused by an "intermittent" failure.



RG13140 —UN—07OCT03

Diagnostic Gauge

A—Diagnostic Gauge - Electronically Controlled Engine

These could be problems such as a bad connection or a wire intermittently shorting to ground.

To access DTC's with the diagnostic gauge (A), see section 15 of this manual.

If a sensor or wiring fails and a DTC is active for the sensor, the ECU will use a substitute "limp home" value in its calculations to continue engine operation.

A list of DTCs is given later in this section with a description of each. Contact your engine servicing dealer to correct any DTCs which are displayed on the instrument panel.

OUOD006,00000F8 -19-25SEP07-1/1

Precautions for Welding

Remove paint before welding or heating (see Safety Section in this manual for more information on paint removal and high-pressure lines).

CAUTION: Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. If you sand or grind paint, avoid breathing the dust by wearing an approved respirator. If you use solvent or paint stripper, remove with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area before welding. Allow fumes to disperse at least 15 minutes before welding or heating.

IMPORTANT: Welding on the engine is NOT ALLOWED. If welding must be performed on the machine, follow these precautions.

IMPORTANT: High currents or electrostatic discharge into electronic components from welding may cause permanent damage.

1. Remove paint from the area to be welded and ground cable clamp location.
2. Disconnect the negative (-) battery cable(s) or open battery (-) switch if equipped.

TS953 —UN—15MAY90

3. Disconnect the positive (+) battery cable(s) or open battery (+) switch if equipped.
4. Clear or move any wiring harness sections away from the welding area.
5. Welding on engine components is not allowed.
6. Never connect the welder ground to any engine component or engine driven components that may be connected to the engine.
7. After welding, reverse steps 2—3.

DX,WELDING,PRECAUTIONS -19-06DEC10-1/1

Precautions For Welding On Vessels Equipped With Electronic Engine Control Unit (ECU)

IMPORTANT: ALWAYS disconnect Electronic Control Unit (ECU) connectors and engine control system-to-vessel ground before welding. High currents or electro-static discharge in electronic components from welding may cause permanent damage.

1. Remove the ground connection for the engine control system-to-vessel frame.
2. Disconnect the connectors from the ECU.
3. Connect the welder ground close to the welding point and be sure ECU or other electronic components are not in the ground path.

TS953 —UN—15MAY90

Welding Precautions

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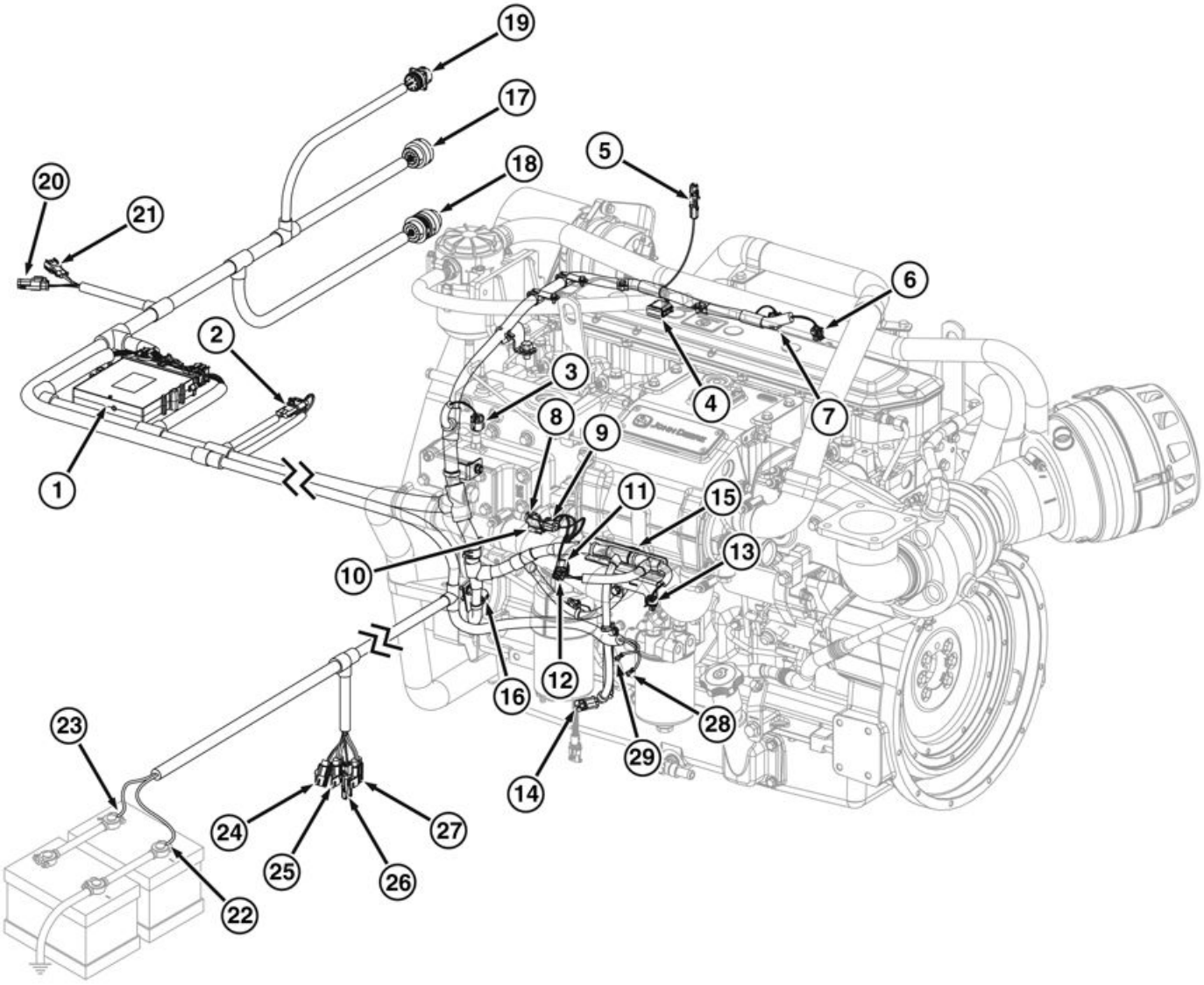
Electronically Controlled Engine Electrical System Layout — 6068AFM85 and 6068SFM85



RG22346 —UN—05FEB13

1— Engine Control Unit (ECU)
2— Auxiliary Power Connector
3— Coolant Temperature Sensor Connector
4— Fuel Injection Harness Connector
5— Alternator Connector
6— Manifold Air Pressure Sensor Connector
7— Manifold Air Temperature Sensor Connector
8— Suction Control Valve Sensor Connector
9— Fuel Temperature Sensor Connector
10— Camshaft Position Sensor Connector
11— Low-Pressure Fuel Pump Connector
12— Oil Pressure Sensor Connector
13 — Fuel Pressure Sensor Connector
14— Water-in-Fuel Sensor Connector
15— Fuel Rail Pressure Sensor Connector
16— Crankshaft Position Sensor Connector
17— Control Panel Connector
18— Auxiliary Connector
19— Diagnostic Connector
20— CAN Terminator Connector
21— Remote On/Off Connector
22— Unterminated Ground (Battery)
23— Unterminated Power (Battery)
24— Low-Pressure Fuel Pump Fuse (15 Amp)
25— ECU Fuse (20 Amp)
26— Transient Voltage Protection Connector
27— System Fuse (30 Amp)
28— Starter Relay Coil Connector (Power)
29— Starter Relay Coil Connector (Ground)

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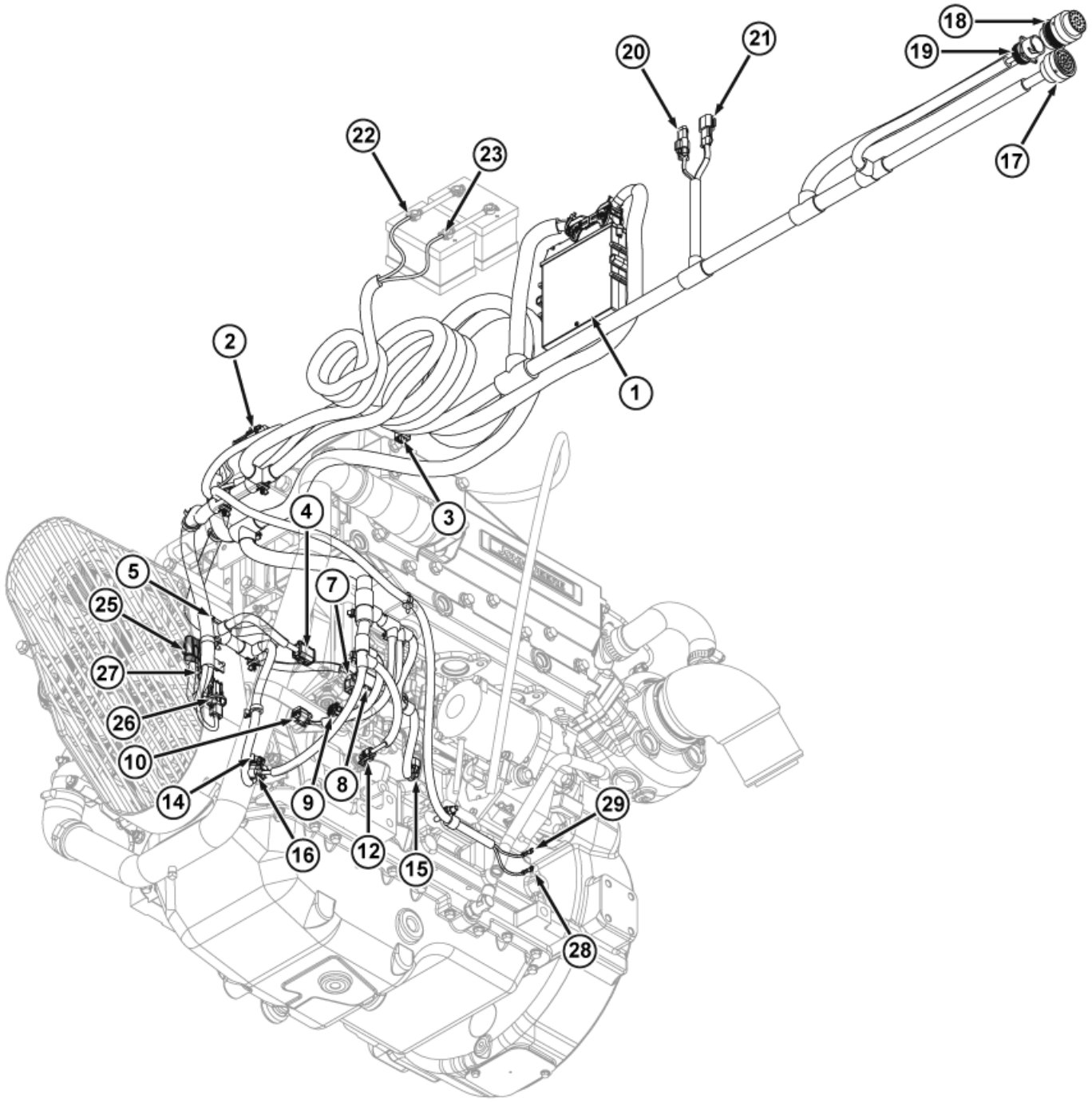
Electronically Controlled Engine Electrical System Layout — 4045TFM85

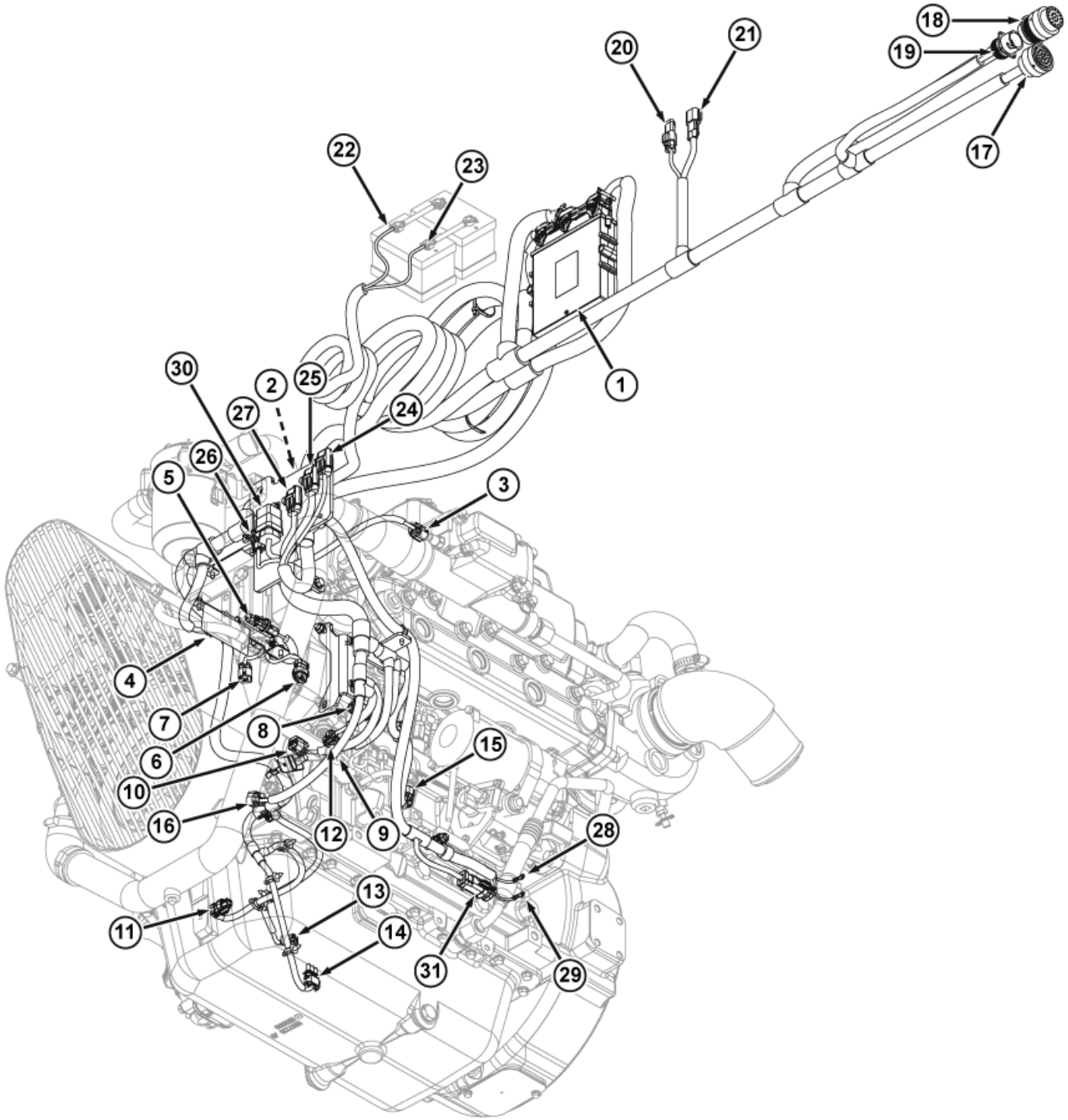


RG22975 —UN—01MAY13

1— Engine Control Unit (ECU)
2— Auxiliary Power Connector
3— Coolant Temperature Sensor Connector
4— Fuel Injection Harness Connector
5— Alternator Connector
7— Manifold Air Temperature Sensor Connector
8— Suction Control Valve Sensor Connector
9— Fuel Temperature Sensor Connector
10— Camshaft Position Sensor Connector
12— Oil Pressure Sensor Connector
14— Water-in-Fuel Sensor Connector
15— Fuel Rail Pressure Sensor Connector
16— Crankshaft Position Sensor Connector
17— Control Panel Connector
18— Auxiliary Connector
19— Diagnostic Connector
20— CAN Terminator Connector
21— Remote On/Off Connector
22— Unterminated Ground (Battery)
23— Unterminated Power (Battery)
25— ECU Fuse (20 Amp)
26— Transient Voltage Protection Connector
27— System Fuse (30 Amp)
28— Starter Relay Coil Connector (Power)
29— Starter Relay Coil Connector (Ground)

ZE59858,000017C -19-29AUG13-1/1

Electronically Controlled Engine Electrical System Layout — 4045AFM85



RG22969 —UN—30APR13

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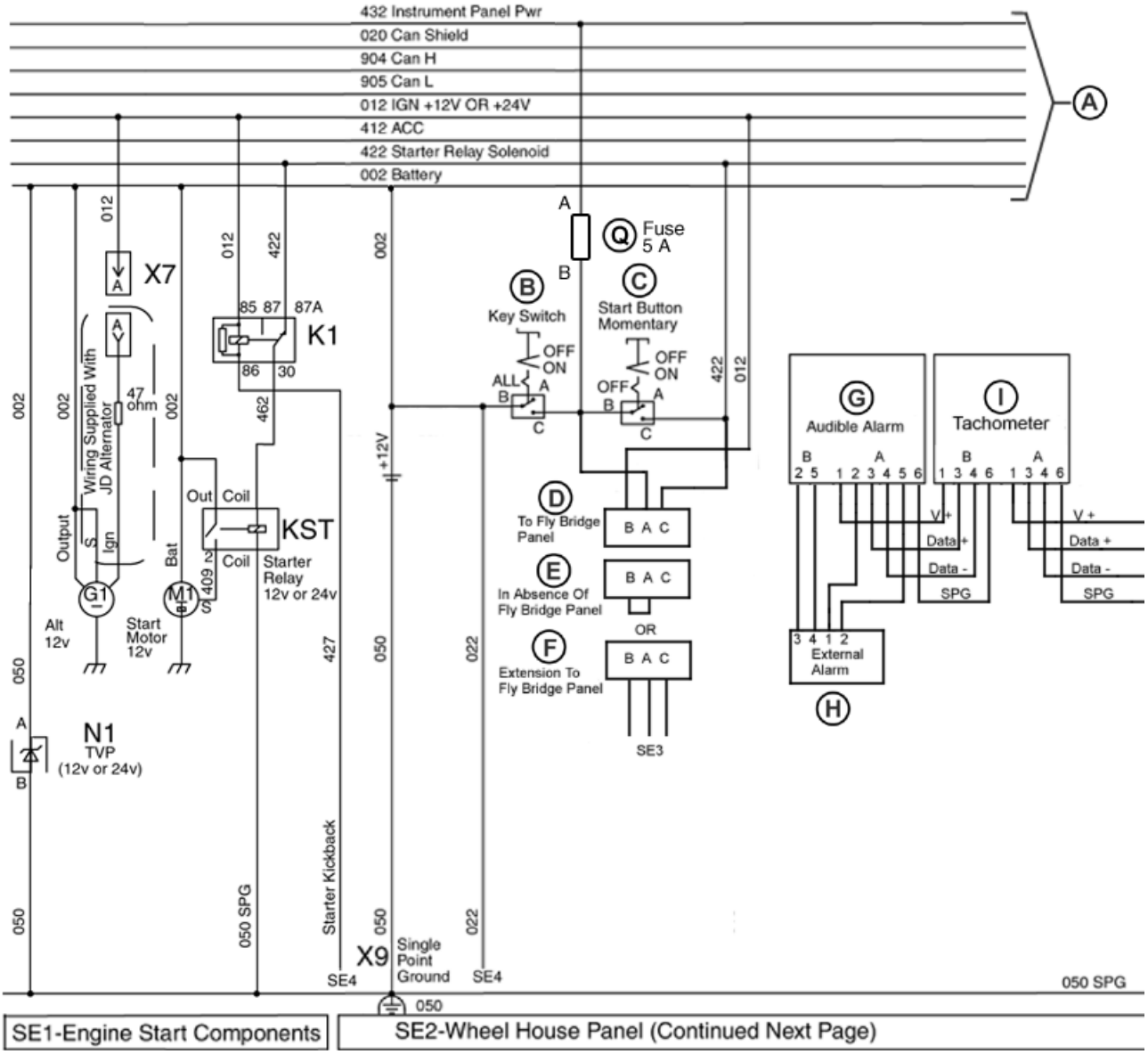
ZE59858,000017D -19-29AUG13-1/2

1— Engine Control Unit (ECU)
2— Auxiliary Power Connector
3— Coolant Temperature Sensor Connector
4— Fuel Injection Harness Connector
5— Alternator Connector
6— Manifold Air Pressure Sensor Connector
7— Manifold Air Temperature Sensor Connector
8— Suction Control Valve Sensor Connector
9— Fuel Temperature Sensor Connector
10— Camshaft Position Sensor Connector
11— Low-Pressure Fuel Pump Connector
12— Oil Pressure Sensor Connector
13— Fuel Pressure Sensor Connector
14— Water-in-Fuel Sensor Connector
15— Fuel Rail Pressure Sensor Connector
16— Crankshaft Position Sensor Connector
17— Control Panel Connector
18— Auxiliary Connector
19— Diagnostic Connector
20— CAN Terminator Connector
21— Remote On/Off Connector
22— Unterminated Ground (Battery)
23— Unterminated Power (Battery)
24— Low-Pressure Fuel Pump Fuse (15 Amp)
25— ECU Fuse (20 Amp)
26— Transient Voltage Protection Connector
27— System Fuse (30 Amp)
28— Starter Relay Coil Connector (Power)
29— Starter Relay Coil Connector (Ground)
30— Fuel Transfer Pump Relay (24V)
31— Transmission Sensors

ZE59858,000017D -19-29AUG13-2/2

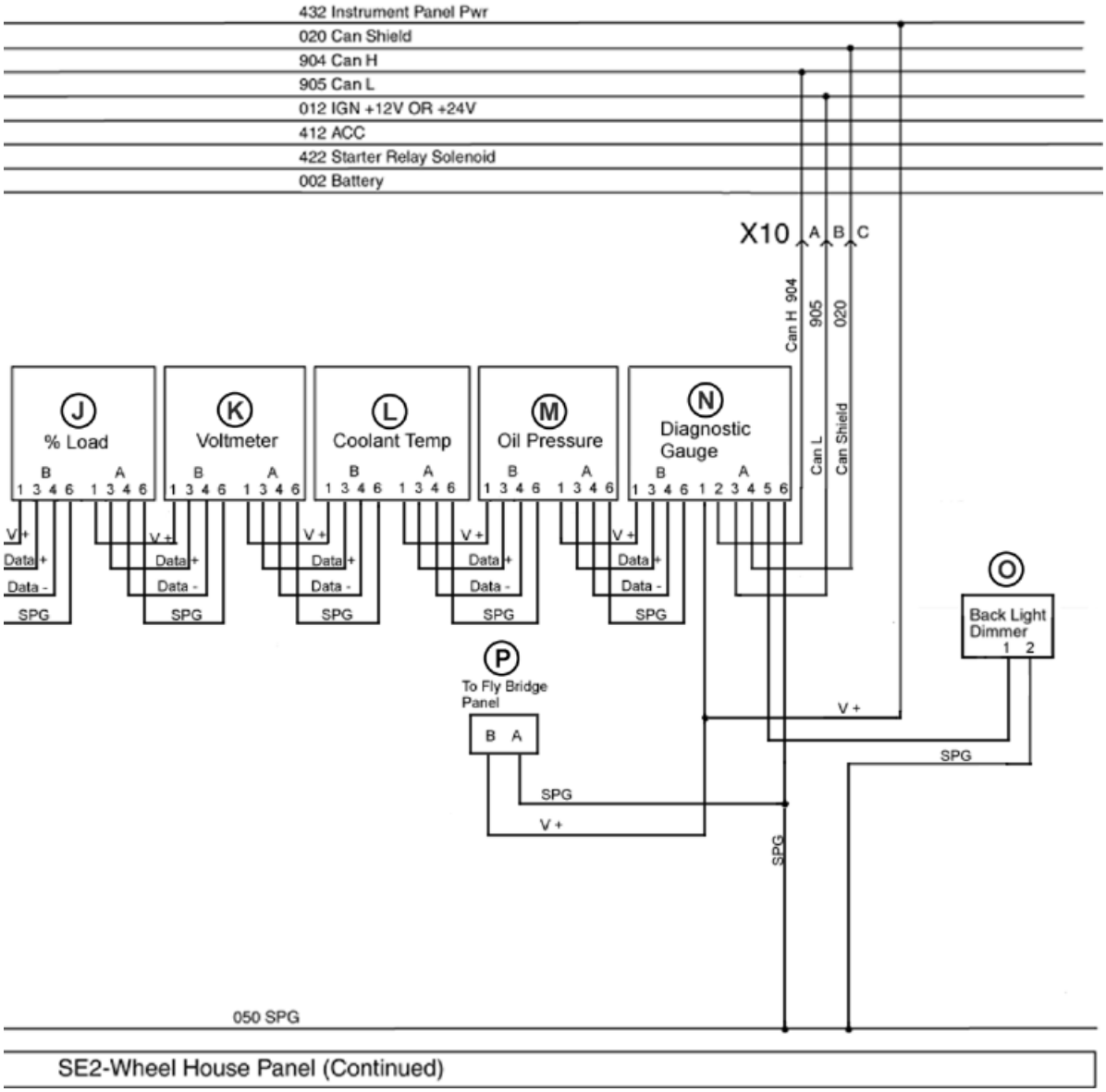
Wiring Diagram for John Deere Main Station (Wheel House) Instrument Panel - Electronically Controlled Engine



A—Vehicle Harness Connector
B—Key Switch
C—Start Button- Momentary
D—To Fly Bridge Panel
E—In Absence of Fly Bridge Panel
F—Extension to Fly Bridge Panel
G—Audible Alarm
G1—Alternator
H—External Alarm
I— Tachometer
J—% Load
K—Voltmeter
KST—Starter Relay
L—Coolant Temp
M—Oil Pressure
M1—Start Motor
N—Diagnostic Gauge
N1—Transient Voltage Protection
O—Back Light Dimmer
P—To Fly Bridge Panel
Q—Fuse 5 A
X7—Alternator Harness Connector
X9—Single Point Ground
X10— CAN Terminator
002— Battery
012— IGN +12V or +24V
020— CAN Shield
412— ACC
422— Starter Relay Solenoid
432— Instrument Panel Power
904— Can H
905— Can L

OUOD006,00000BC -19-11OCT13-1/1

Wiring Diagram for John Deere Main Station (Wheel House) Instrument Panel - Electronically Controlled Engine - Cont'd



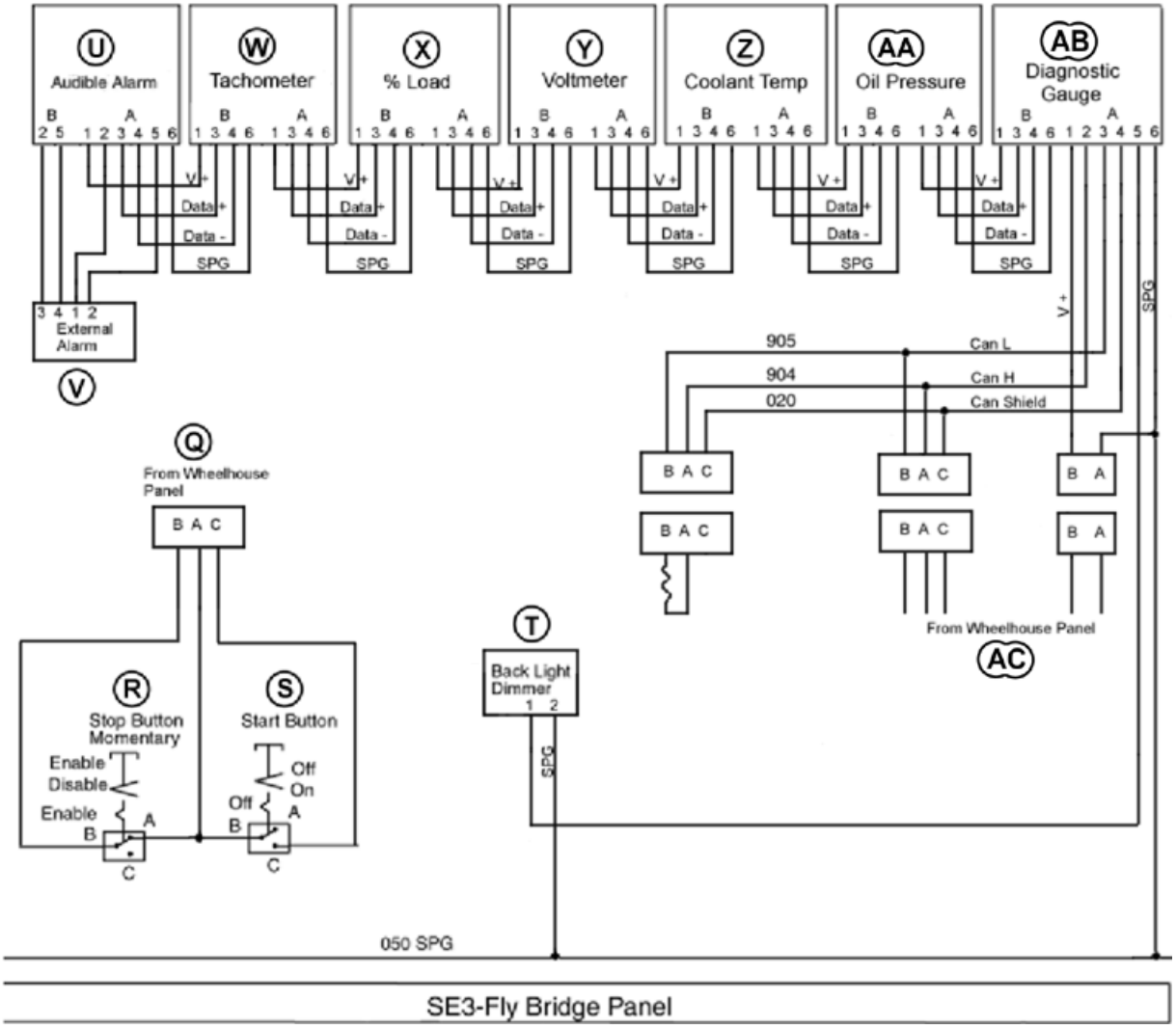
RG15470 —UN—04SEP07

A—Vehicle Harness Connector
B—Key Switch
C—Start Button- Momentary
D—To Fly Bridge Panel
E—In Absence of Fly Bridge Panel
F—Extension to Fly Bridge Panel
G—Audible Alarm
G1—Alternator
H—External Alarm
I— Tachometer
J—% Load
K—Voltmeter
KST—Starter Relay
L—Coolant Temp
M—Oil Pressure
M1—Start Motor
N—Diagnostic Gauge
N1—Transient Voltage Protection
O—Back Light Dimmer
P—To Fly Bridge Panel
X7—Alternator Harness Connector
X9—Single Point Ground
X10— CAN Terminator
002— Battery
012— IGN +12V or +24V
020— CAN Shield
412— ACC
422— Starter Relay Solenoid
432— Instrument Panel Power
904— Can H
905— Can L

OUOD006,00000BD -19-27SEP07-1/1

Wiring Diagram for John Deere Optional Fly Bridge Instrument Panel - Electronically Controlled Engine

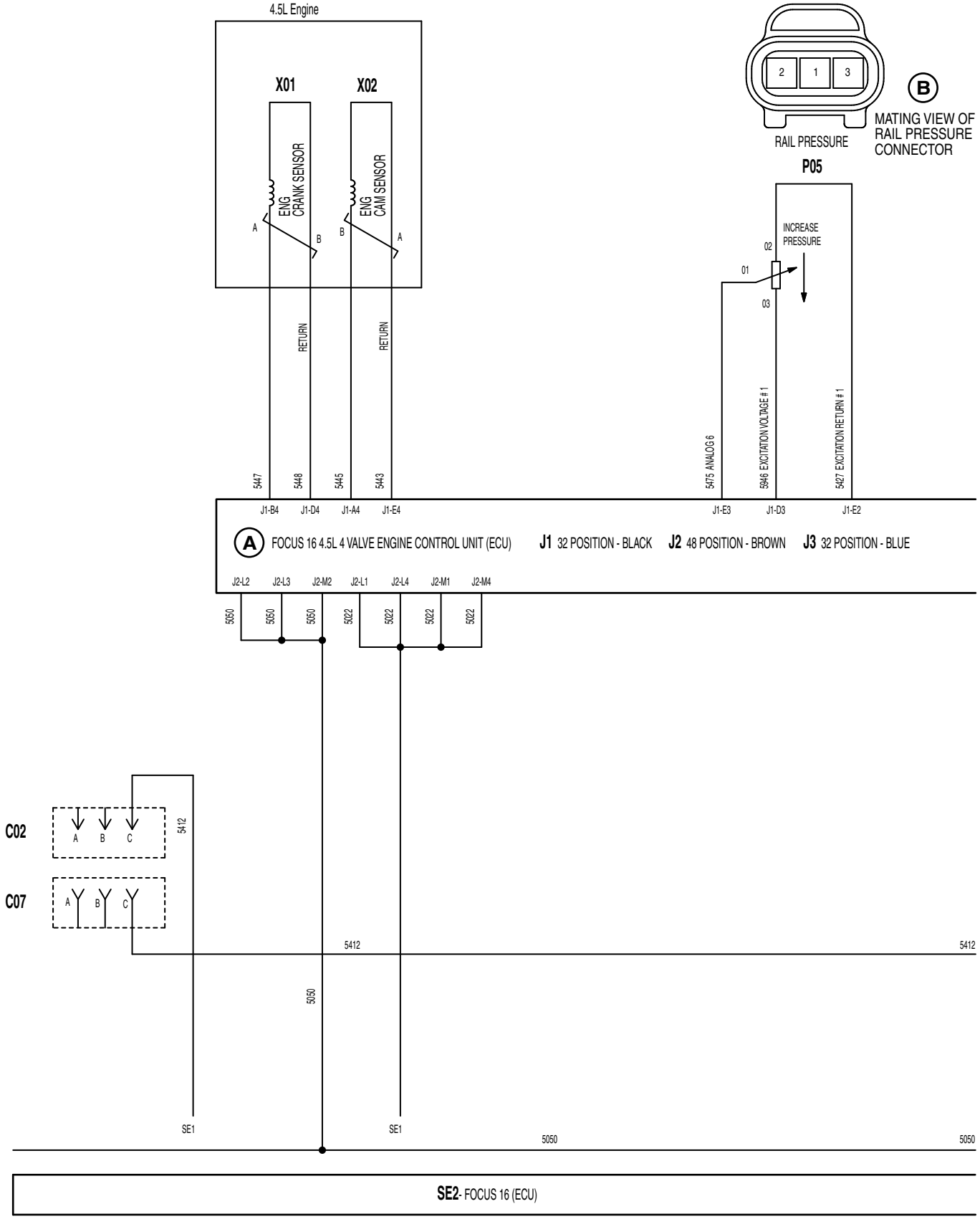
432 Instrument Panel Pwr
020 CAN Shield
904 CAN H
905 CAN L
012 Ign +12v or +24v
412 ACC
422 Starter Relay Solenoid
002 Battery



Q—From Wheelhouse Panel
R—Stop Button- Momentary
S—Start Button- Momentary
T—Back Light Dimmer
U—Audible Alarm
V—External Alarm
W—Tachometer
X—% Load
Y—Voltmeter
Z—Coolant Temp
AA—Oil Pressure
AB—Diagnostic Gauge
AC—From Wheelhouse Panel
002— Battery
012— IGN +12V or +24V
020— CAN Shield
412— ACC
422— Starter Relay Solenoid
432— Instrument Panel Power
904— Can H
905— Can L

OUOD006,00000BE -19-25JUL07-1/1

4045TFM85 Marine Electronic Control System Wiring Diagram



RG22434 —UN—15FEB13

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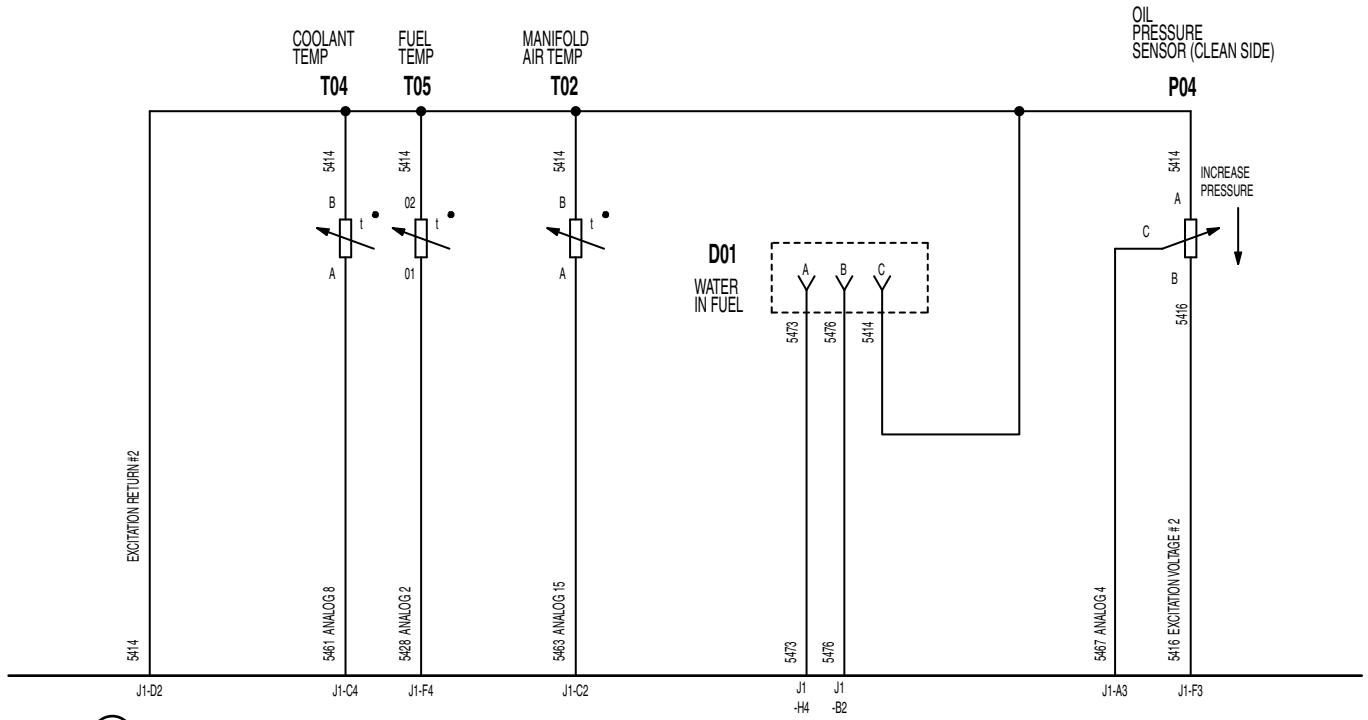
RG19661,00003EA -19-21FEB13-1/2

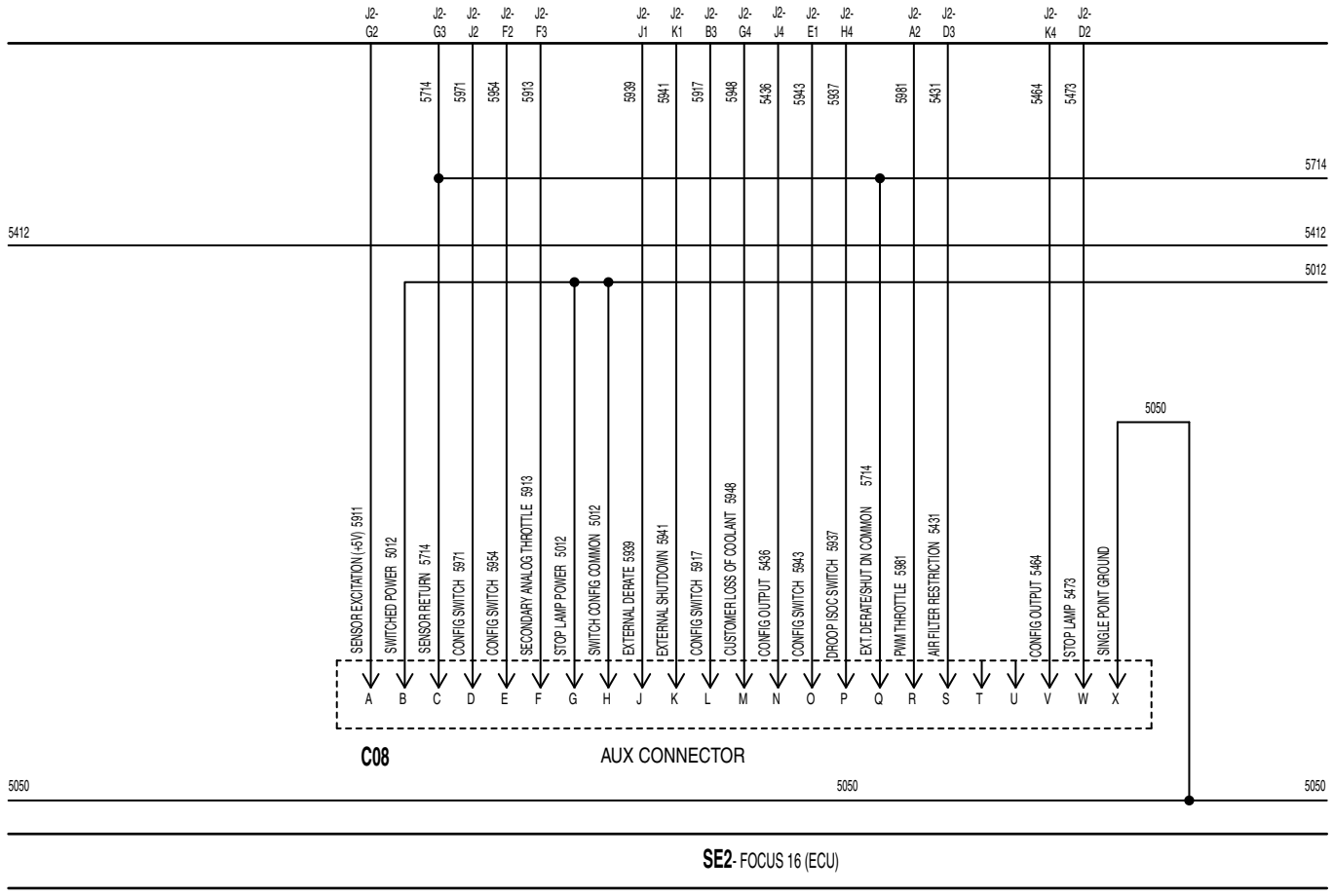
A— Focus 16, 4.5 L, 4 Valve, Engine Control Unit (ECU)
B— Mating View of Rail Pressure Connector
J1— 32 Position - Black
J1-D3— Excitation Voltage #1
J1-D4— Return
J1-E2— Excitation Return #1
J1-E3— Analog 6
J1-E4— Return
J2— 48 Position - Brown
J3— 32 Position - Blue
P05— Fuel Rail Pressure Sensor
SE2— Focus 16 (ECU)
X01— Crankshaft Position Sensor
X02— Camshaft Position Sensor

RG19661,00003EA -19-21FEB13-2/2

4045TFM85 Marine Electronic Control System Wiring Diagram - Cont-d



A FOCUS 16 4.5L 4 VALVE ENGINE CONTROL UNIT (ECU) **J1** 32 POSITION - BLACK **J2** 48 POSITION - BROWN **J3** 32 POSITION - BLUE



RG22435 —UN—15FEB13

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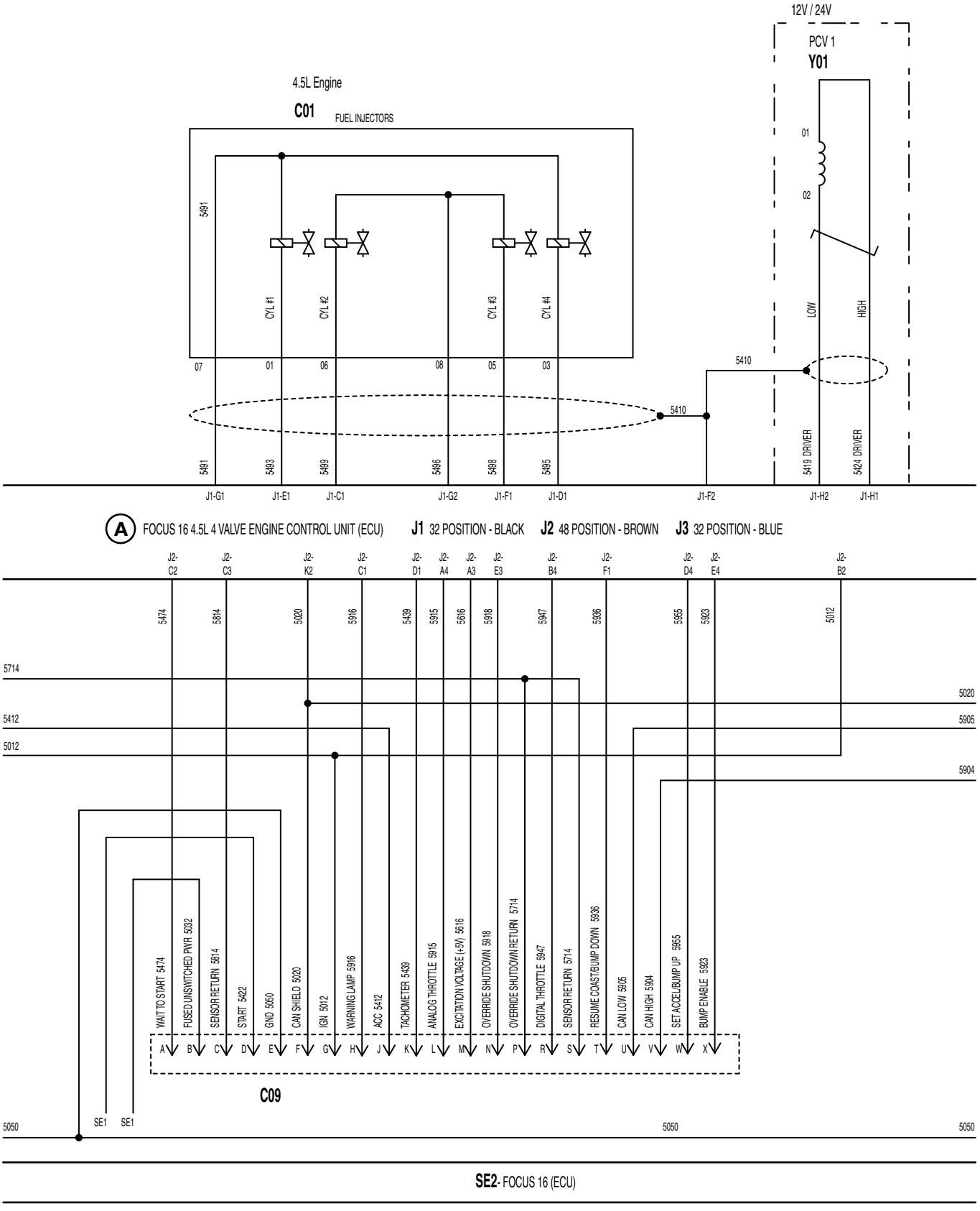
RG19661,00003EC -19-21FEB13-1/2

A— Focus 16, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C08— Auxiliary Connector
C08-A— Sensor Excitation (+5 V)
C08-B— Switched Power
C08-C— Sensor Return
C08-D— Configurable Switch
C08-E— Configurable Switch
C08-F— Secondary Analog Throttle
C08-G— Stop Lamp Power
C08-H— Common Configurable Switch
C08-J— External Derate
C08-K— External Shutdown
C08-L— Configurable Switch
C08-M— Customer Loss of Coolant
C08-N— Configurable Output
C08-O— Configurable Switch
C08-P— Droop Isochronous Switch
C08-Q— External Derate/Shutdown Common
C08-R— PWM Throttle
C08-S— Air Filter Restriction
C08-V— Configurable Output
C08-W— Stop Lamp
C08-X— Single Point Ground
D01— Water-In-Fuel Sensor
J1— 32 Position - Black
J1-A3— Analog 4
J1-C2— Analog 15
J1-C4— Analog 8
J1-D2— Excitation Return #2
J1-F3— Excitation Voltage #2
J1-F4— Analog 2
J2— 48 Position - Brown
J3— 32 Position - Blue
P04— Engine Oil Pressure Sensor (Clean Side)
SE2— Focus 16 (ECU)
T02— Manifold Air Temperature Sensor
T04— Engine Coolant Temperature Sensor
T05— Fuel Temperature Sensor

RG19661,00003EC -19-21FEB13-2/2

4045TFM85 Marine Electronic Control System Wiring Diagram - Cont-d



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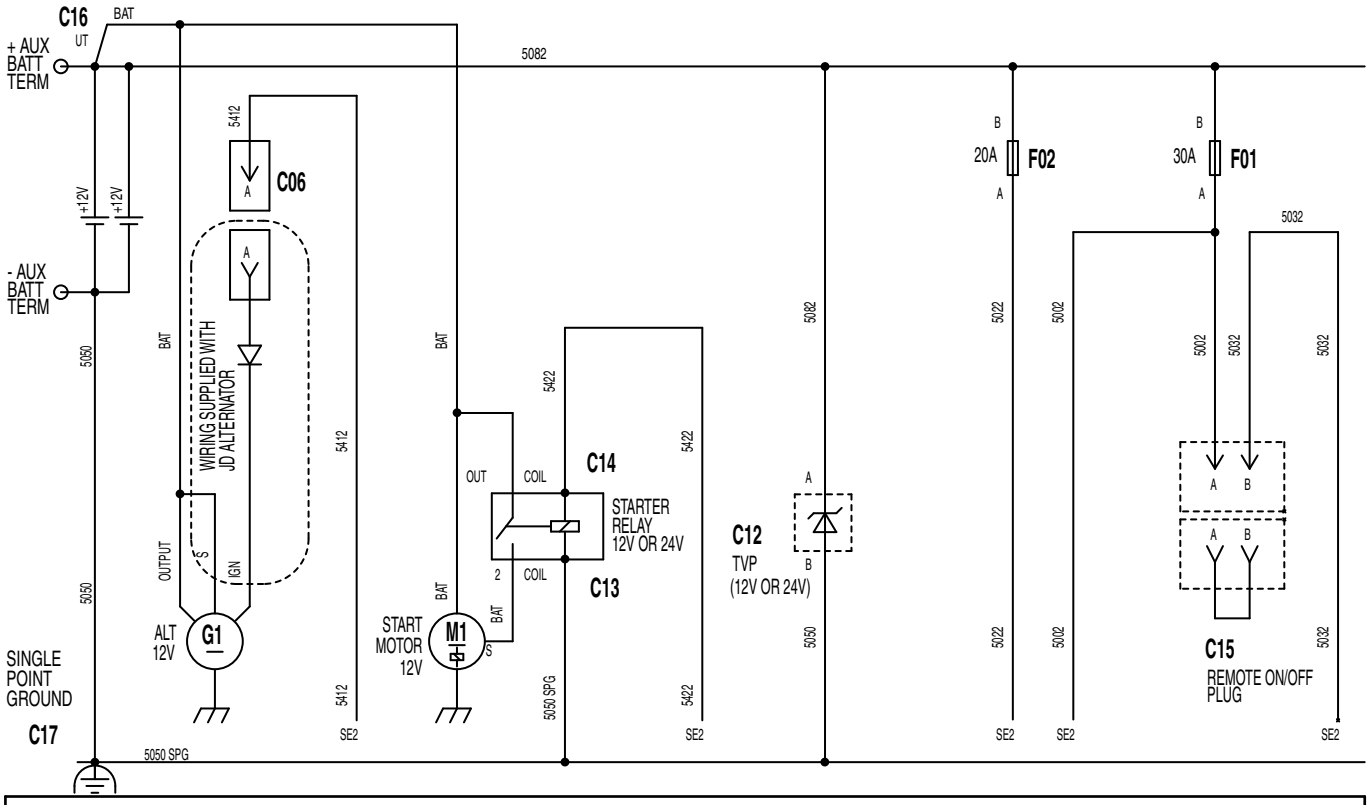
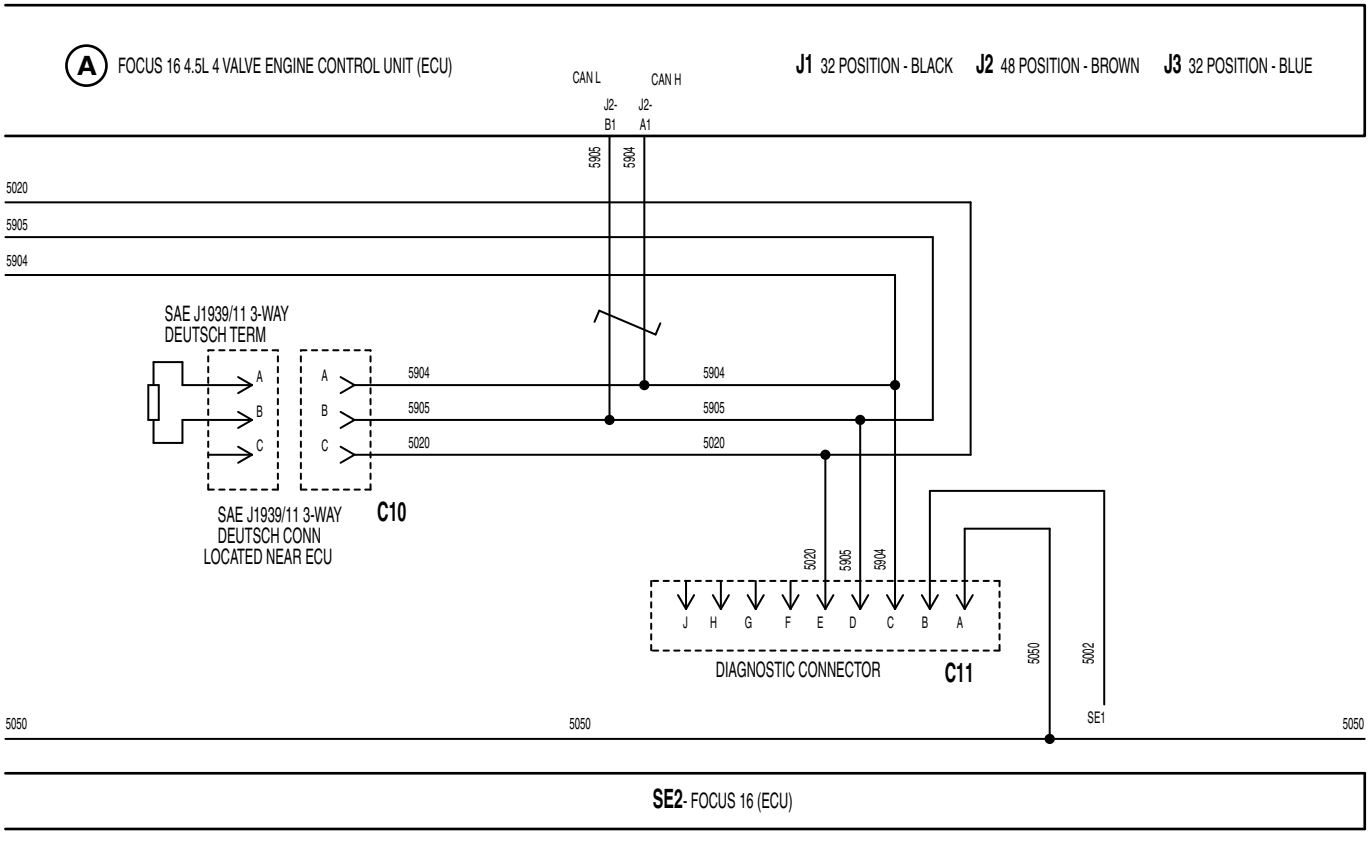
RG19661,00003ED -19-21FEB13-1/2

A— Focus 16, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C01— Fuel Injectors
C09-A— Wait To Start
C09-B— Fused Unswitched Power
C09-C— Sensor Return
C09-D— Start
C09-E— Ground
C09-F— CAN Shield
C09-G— Ignition
C09-H— Warning Lamp
C09-J— Accessory
C09-K— Tachometer
C09-L— Analog Throttle
C09-M— Excitation Voltage (+5 V)
C09-N— Override Shutdown
C09-P— Override Shutdown Return
C09-R— Digital Throttle
C09-S— Sensor Return
C09-T— Resume Coast/Bump Down
C09-U— CAN Low
C09-V— CAN High
C09-W— Set Accelerator/Bump Up
C09-X— Bump Enable
J1— 32 Position - Black
J1-C1— Cylinder 2
J1-D1— Cylinder 4
J1-E1— Cylinder 1
J1-F1— Cylinder 3
J1-H1— High Driver
J1-H2— Low Driver
J2— 48 Position - Brown
J3— 32 Position - Blue
SE2— Focus 16 (ECU)
Y01— Pressure Control Valve 1 (12 V/ 24 V)

RG19661,00003ED -19-21FEB13-2/2

4045TFM85 Marine Electronic Control System Wiring Diagram - Cont-d





RG22437 —UN—21FEB13

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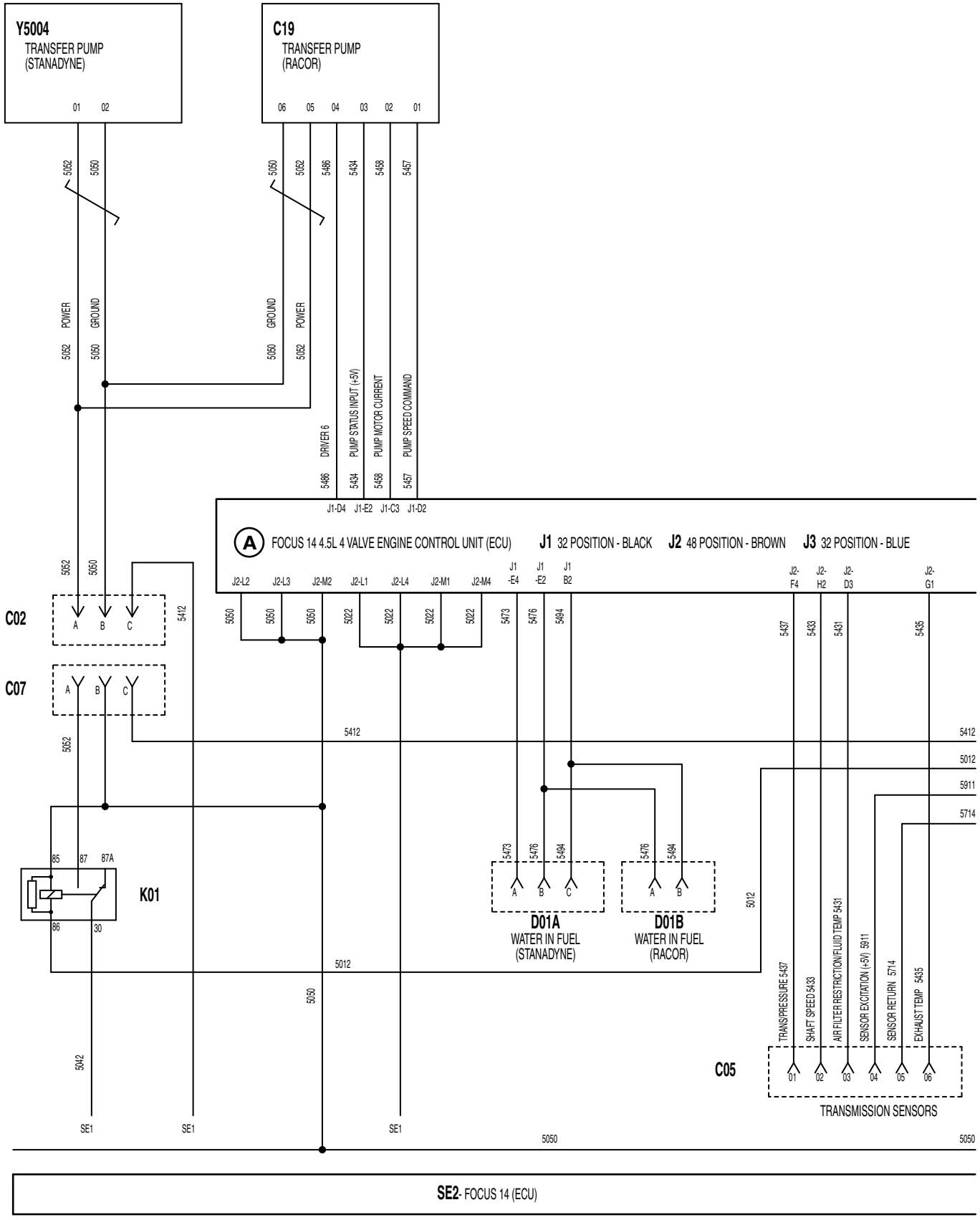
RG19661,00003EE -19-25FEB13-1/2

A— Focus 16, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C06— Wiring Supplied With JD Alternator
C10— SAE J1939/ 11 Way Deutsch Connector, Located Near ECU
C11— Diagnostic Connector
C12— Transient Voltage Protection (12 V or 24 V)
C13— Starter Relay Coil Ground
C14— Starter Relay Coil Power
C15— Remote On/Off
C16— Battery
C17— Single Point Ground
G1— Alternator 12 V
J1— 32 Position - Black
J2— 48 Position - Brown
J3— 32 Position - Blue
J2-A1— CAN High
J2-B1— CAN Low
J3— 32 Position - Blue
M1— Start Motor 12 V
SE1— Engine Start Components
SE2— Focus 16 (ECU)

RG19661,00003EE -19-25FEB13-2/2

4045AFM85 Marine Electronic Control System Wiring Diagram



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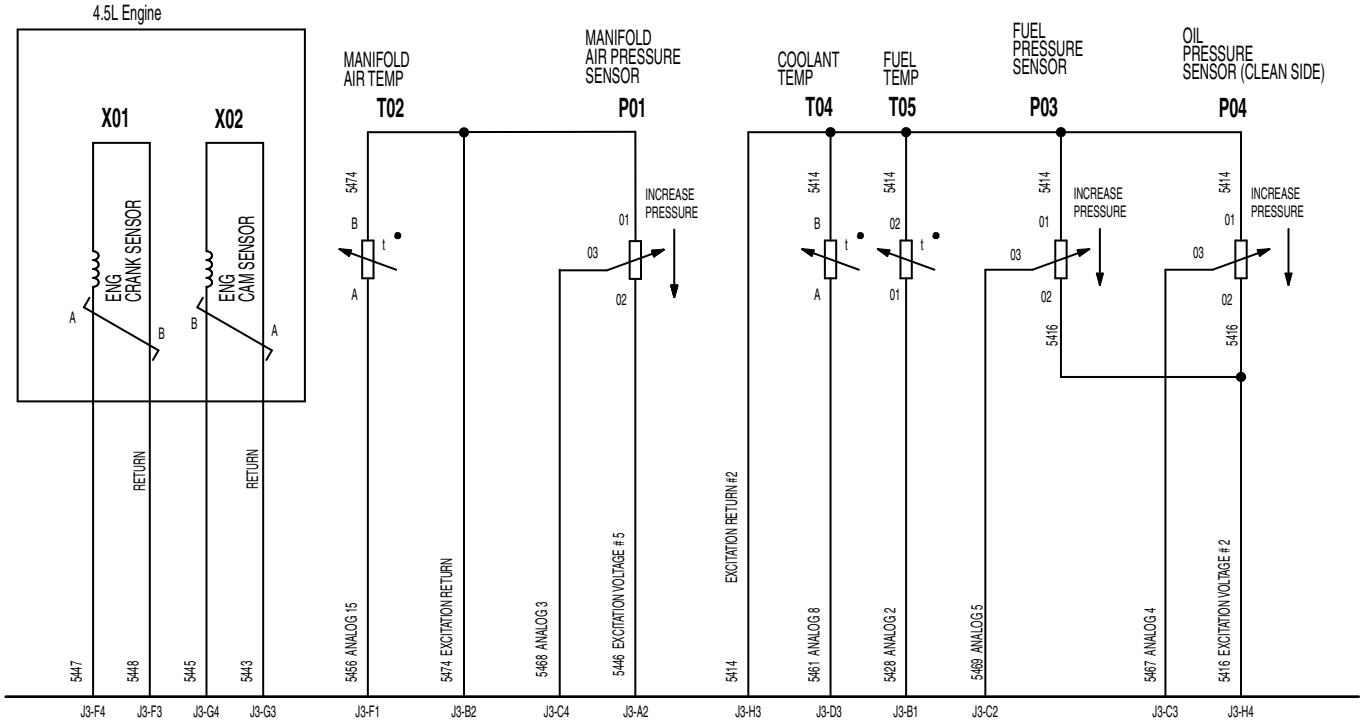
RG19661,00003EB -19-11OCT13-1/2

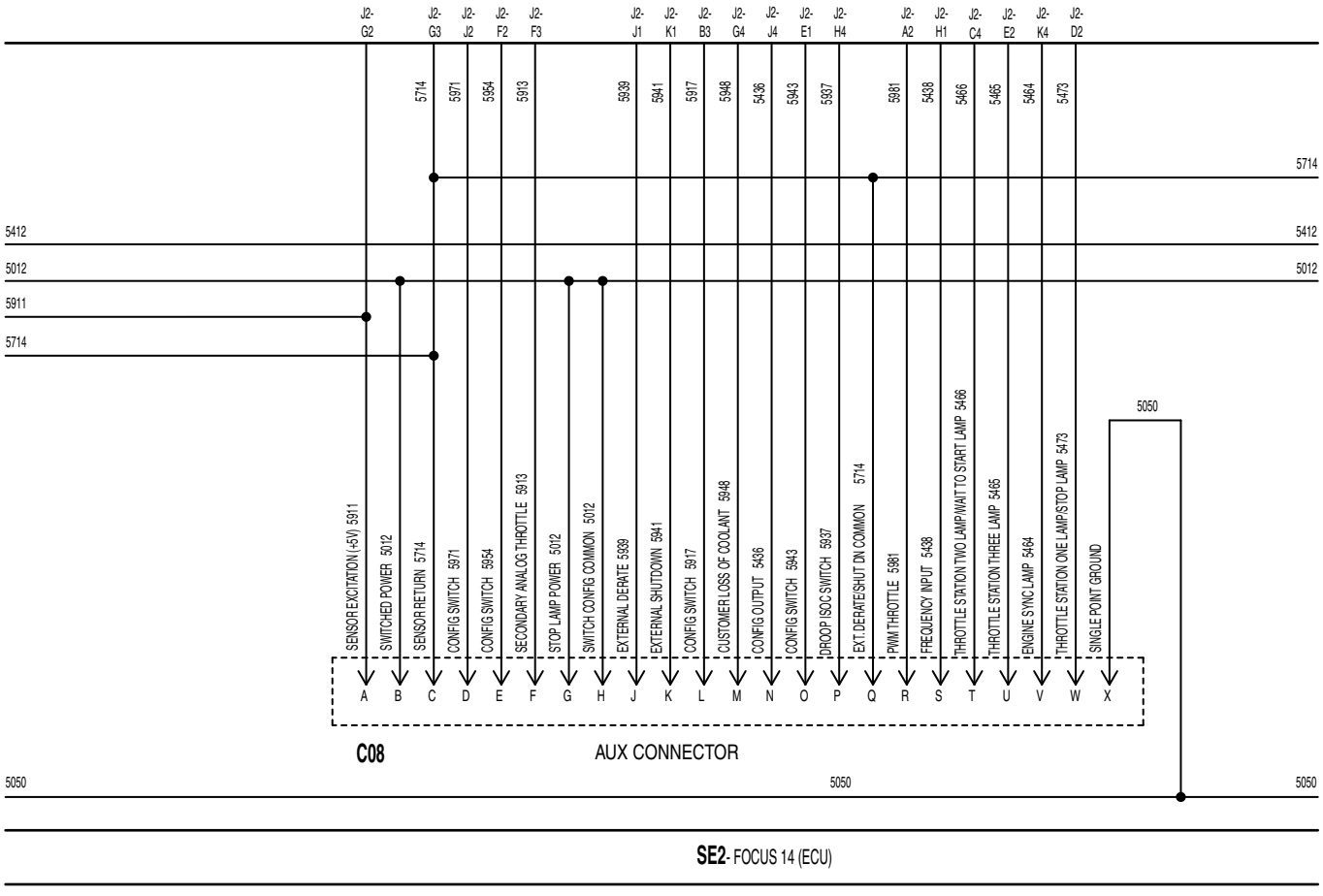
A— Focus 14, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C02-A— Power
C02-B— Ground
C05— Transmission Sensors
C05-01— Transmission Pressure
C05-02— Shaft Speed
C05-03— Air Filter Restriction Fluid Temperature
C05-04— Sensor Excitation (+5 V)
C05-05— Sensor Return
C05-06— Exhaust Temperature
C19— Low-Pressure Fuel Pump (Racor)
D01A— Water-In-Fuel Sensor (Stanadyne)
D01B— Water-In-Fuel Sensor (Racor)
J1-C3— Pump Motor Current
J1-D2— Pump Speed Command
J1-D4— Driver 6
J1-E2— Pump Status Input (+5 V)
K01— Fuel Transfer Pump Relay (24 V)
SE2— Focus 14 (ECU)
Y5004— Low-Pressure Fuel Pump (Stanadyne)

RG19661,00003EB -19-11OCT13-2/2

4045AFM85 Marine Electronic Control System Wiring Diagram - Cont'd



A FOCUS 14 4.5L 4 VALVE ENGINE CONTROL UNIT (ECU) **J1** 32 POSITION - BLACK **J2** 48 POSITION - BROWN **J3** 32 POSITION - BLUE



RG22430A —UN—11OCT13

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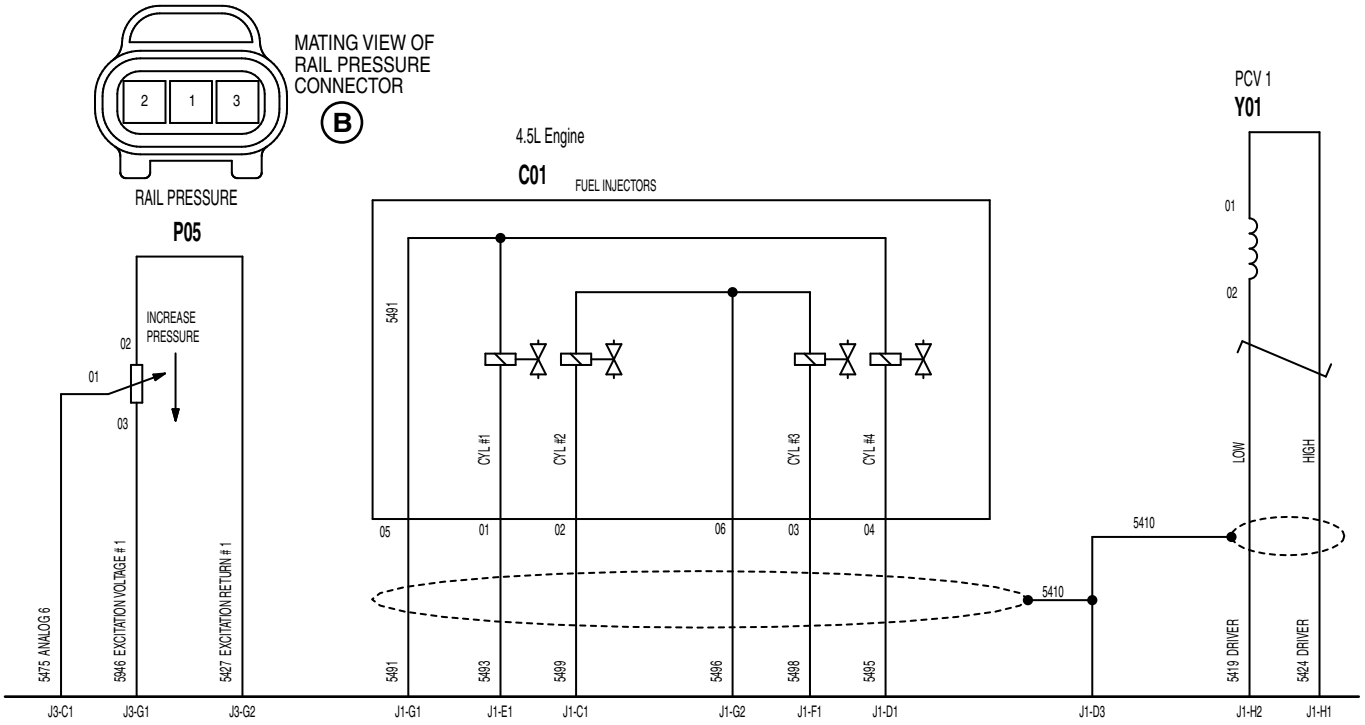
RG19661,00003EF -19-11OCT13-1/2

A— Focus 14, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C08— Auxiliary Connector
C08-A— Sensor Excitation (+5 V)
C08-B— Switched Power
C08-C— Sensor Return
C08-D— Configurable Switch
C08-E— Configurable Switch
C08-F— Secondary Analog Throttle
C08-G— Stop Lamp Power
C08-H— Common Configurable Switch
C08-J— External Derate
C08-K— External Shutdown
C08-L— Configurable Switch
C08-M— Customer Loss of Coolant
C08-N— Configurable Output
C08-O— Configurable Switch
C08-P— Droop Isochronous Switch
C08-Q— External Derate/Shut-down Common
C08-R— PWM Throttle
C08-S— Frequency Input
C08-T— Throttle Station Two Lamp/Wait To Start Lamp
C08-U— Throttle Station Three Lamp
C08-V— Engine Sync Lamp
C08-W— Throttle Station Two Lamp/Stop Lamp
C08-X— Single Point Ground
J1— 32 Position - Black
J2— 48 Position - Brown
J3— 32 Position - Blue
J3-A2— Excitation Voltage #5
J3-B1— Analog 2
J3-B2— Excitation Return
J3-C2— Analog 5
J3-C3— Analog 4
J3-C4— Analog 3
J3-D3— Analog 8
J3-F1— Analog 15
J3-F3— Return
J3-G3— Return
J3-H3— Excitation Return #2
J3-H4— Excitation Voltage #2
P01— Manifold Air Pressure Sensor
P03— Fuel Rail Pressure Sensor
P04— Engine Oil Pressure Sensor (Clean Side)
SE2— Focus 16 (ECU)
T02— Manifold Air Temperature Sensor
T04— Engine Coolant Temperature Sensor
T05— Fuel Temperature Sensor
X01— Crankshaft Position Sensor
X02— Camshaft Position Sensor

RG19661,00003EF -19-11OCT13-2/2

4045AFM85 Marine Electronic Control System Wiring Diagram - Cont'd



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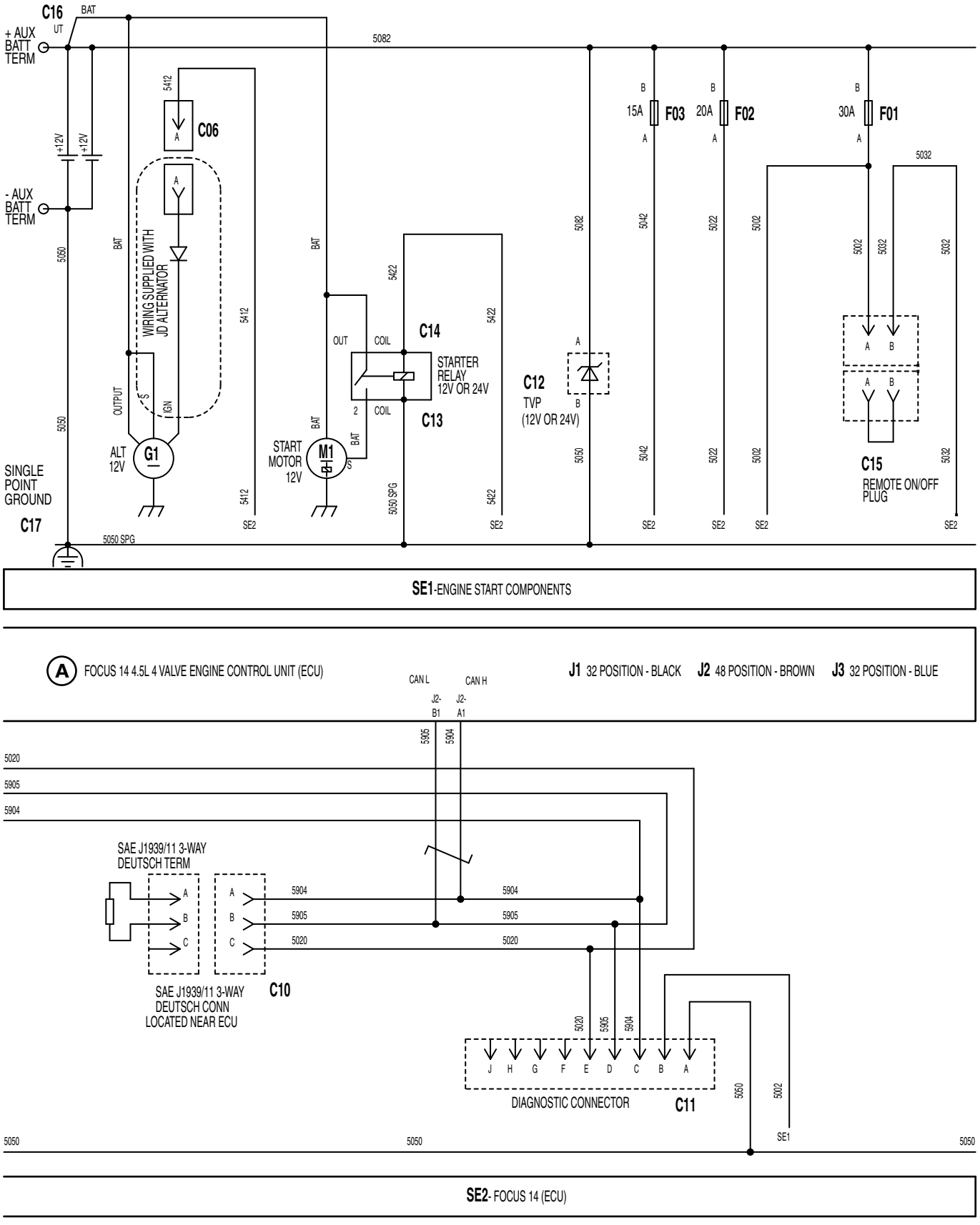
RG19661,00003F0 -19-11OCT13-1/2

A— Focus 14, 4.5 L, 4 Valve, Engine Control Unit (ECU)
B— Mating View of Rail Pressure Connector
C01— Fuel Injectors
C09-A— Wait To Start
C09-B— Fused Unswitched Power
C09-C— Sensor Return
C09-D— Start
C09-E— Ground
C09-F— CAN Shield
C09-G— Ignition
C09-H— Warning Lamp/Configurable Output/Kick Back Start
C09-J— Accessory
C09-K— Tachometer
C09-L— Throttle Station 1
C09-M— Excitation Voltage (+5 V)
C09-N— Override Shutdown
C09-P— Override Shutdown Return
C09-R— Digital Throttle
C09-S— Sensor Return
C09-T— Resume Coast/Bump Down
C09-U— CAN Low
C09-V— CAN High
C09-W— Set Accelerator/Bump Up
C09-X— Bump Enable
J1— 32 Position - Black
J1-C1— Cylinder 2
J1-D1— Cylinder 4
J1-E1— Cylinder 1
J1-F1— Cylinder 3
J1-H1— High Driver
J1-H2— Low Driver
J2— 48 Position - Brown
J3— 32 Position - Blue
J3-C1— Analog 6
J3-G1— Excitation Voltage #1
J3-G2— Excitation Return #1
P05— Fuel Rail Pressure Sensor
SE2— Focus 14 (ECU)
Y01— Pressure Control Valve 1

RG19661,00003F0 -19-11OCT13-2/2

4045AFM85 Marine Electronic Control System Wiring Diagram - Cont'd



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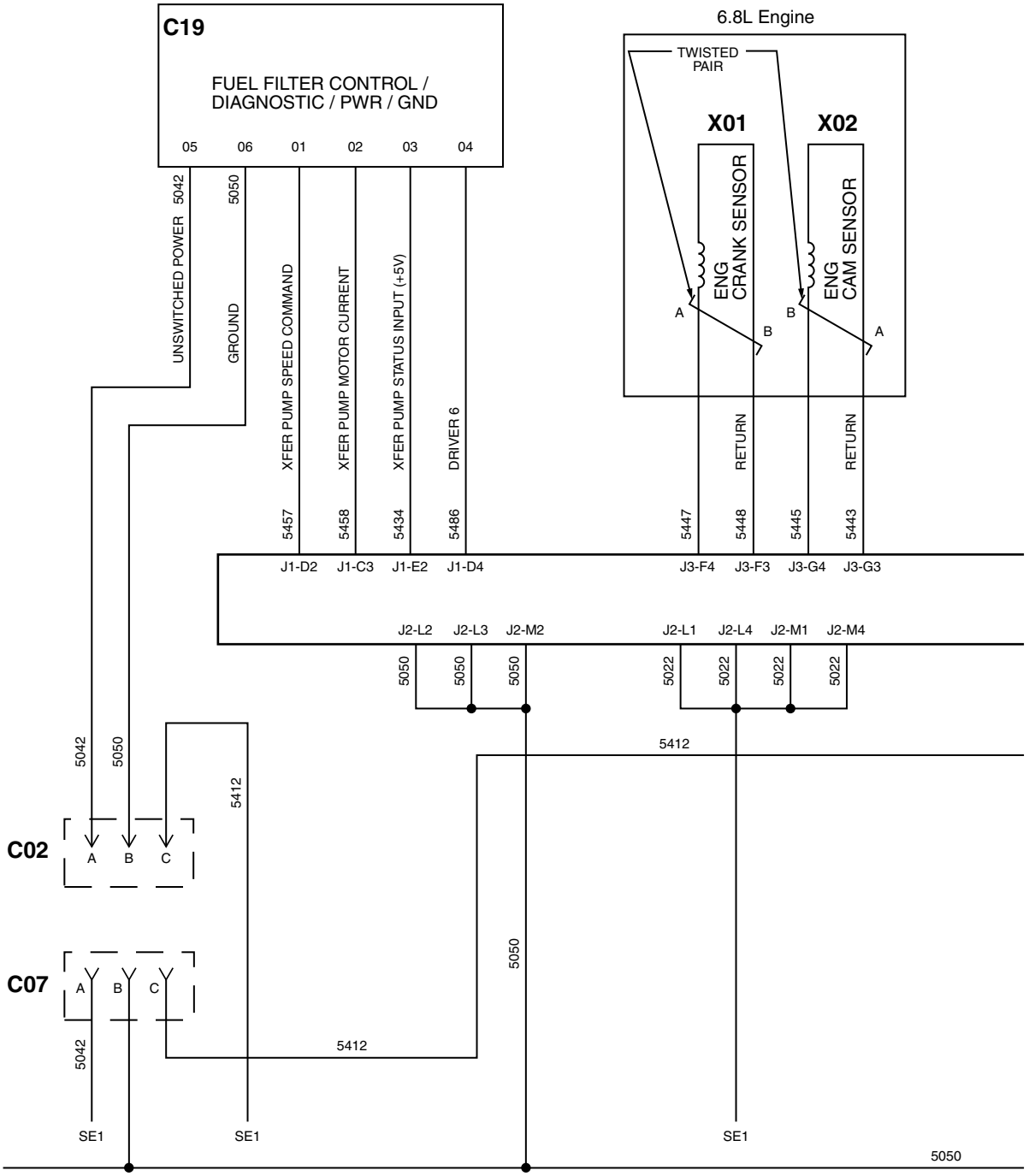
RG19661,00003F1 -19-25FEB13-1/2

A— Focus 14, 4.5 L, 4 Valve, Engine Control Unit (ECU)
C06— Wiring Supplied With JD Alternator
C10— SAE J1939/ 11 Way Deutsch Connector, Located Near ECU
C11— Diagnostic Connector
C12— Transient Voltage Protection (12 V or 24 V)
C13— Starter Relay Coil Ground
C14— Starter Relay Coil Power
C15— Remote On/Off
C16— Battery
C17— Single Point Ground
G1— Alternator 12 V
J1— 32 Position - Black
J2— 48 Position - Brown
J3— 32 Position - Blue
J2-A1— CAN High
J2-B1— CAN Low
J3— 32 Position - Blue
M1— Start Motor 12 V
SE1— Engine Start Components
SE2— Focus 14 (ECU)

RG19661,00003F1 -19-25FEB13-2/2

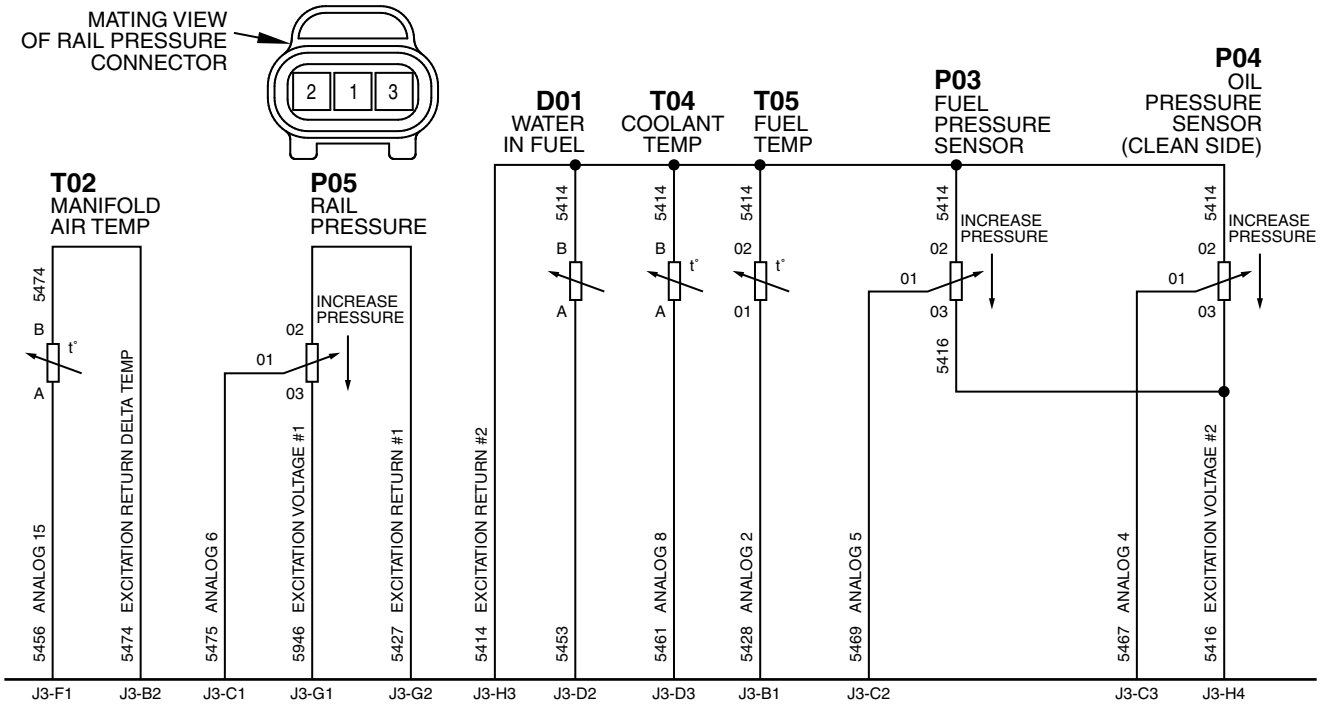
6068SFM85 / AFM85 Marine Electronic Control System Wiring Diagram



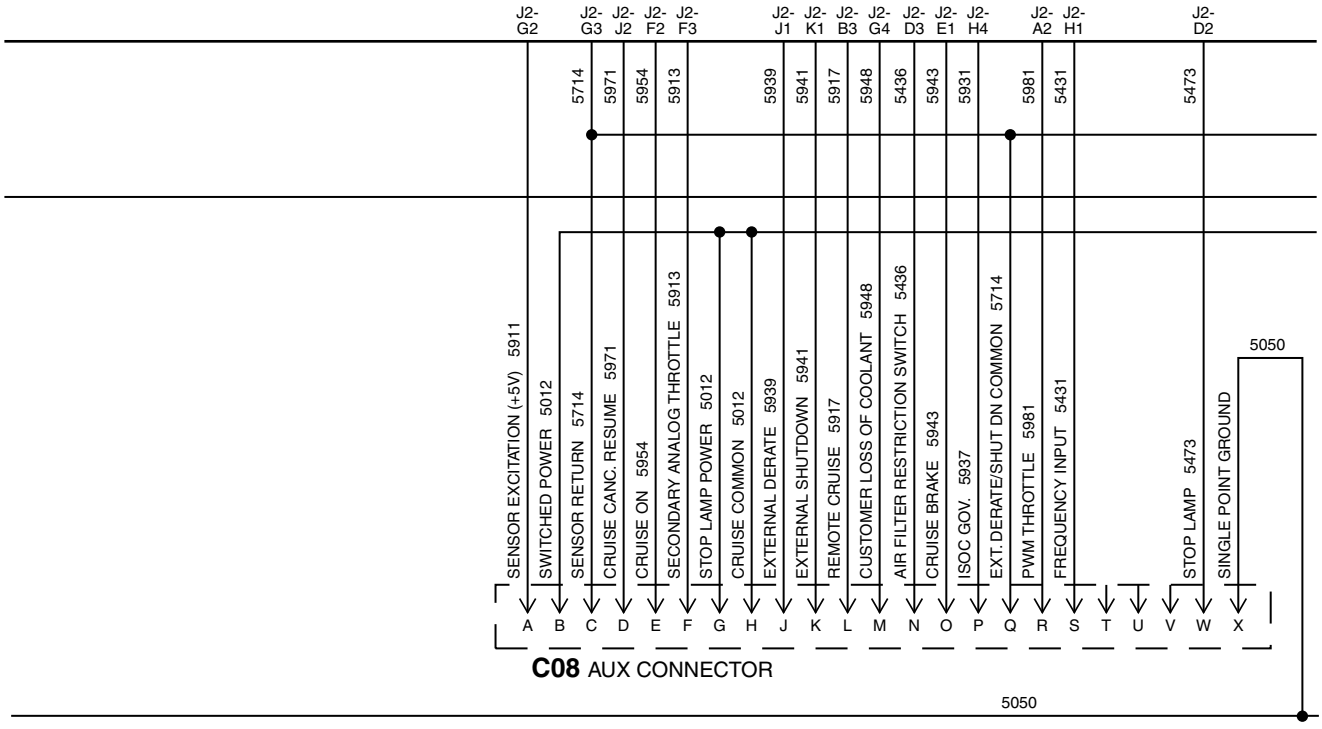
C19— Fuel Filter Control/ Diagnostic/Pwr/Gnd
X01— Engine Crank Sensor
X02— Engine Cam Sensor
5042— Unswitched Power
5050— Ground
5434— Xfer Pump Status Input (+5V)
5443— Return
5448— Return
5457— Xfer Pump Speed Command
5458— Xfer Pump Motor Current
5486— Driver 6

RG19661,00003DF -19-15FEB13-1/1

6068SFM85 / AFM85 Marine Electronic Control System Wiring Diagram - Continued



FOCUS 14 6.8L 4 VALVE ENGINE CONTROL UNIT (ECU)



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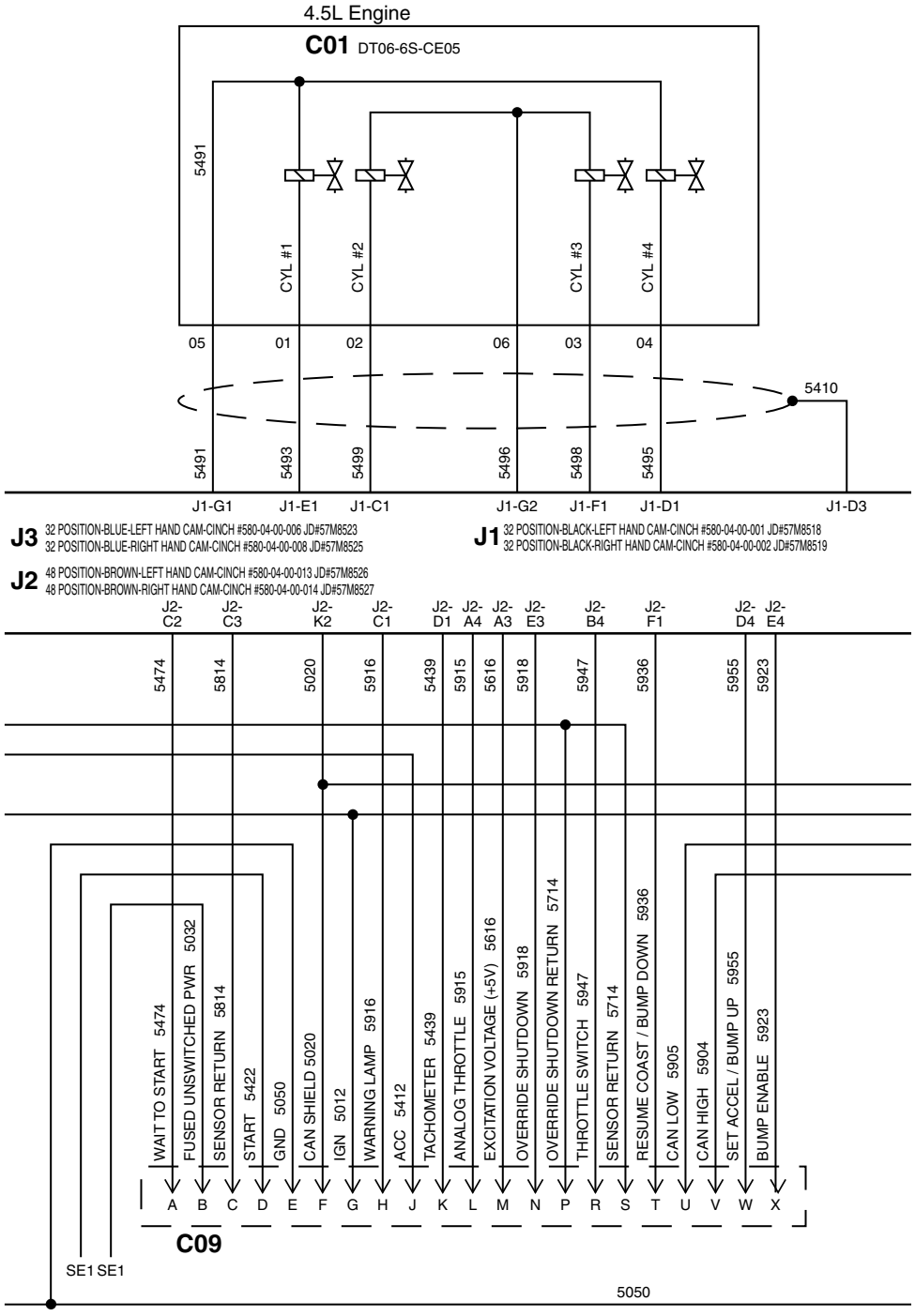
RG19661,00003E0 -19-15FEB13-1/2

C08— Aux Connector
D01— Water in Fuel
P03— Fuel Pressure Sensor
P04— Oil Pressure Sensor (Clean Side)
P05— Rail Pressure
T02— Manifold Air Temp
T04— Coolant Temp
T05— Fuel Temp
5012— Switched Power/Stop Lamp Power/Cruise Common
5050— Single Point Ground
5414— Excitation Return #2
5416— Excitation Voltage #2
5427— Excitation Return #1
5428— Analog 2
5431— Frequency Input
5436— Air Filter Restriction Switch
5456— Analog 15
5461— Analog 8
5467— Analog 4
5469— Analog 5
5473— Stop Lamp
5474— Excitation Return Delta Temp
5475— Analog 6
5714— Sensor Return/Ext. Derate/Shut Dn Common
5911— Sensor Excitation (+5V)
5913— Secondary Analog Throttle
5917— Remote Cruise
5937— Isoc. Gov
5939— External Derate
5941— External Shutdown
5943— Cruise Brake
5946— Excitation Voltage #1
5948— Customer Loss of Coolant
5954— Cruise On
5971— Cruise Canc. Resume
5981— Pwr Throttle

RG19661,00003E0 -19-15FEB13-2/2

6068SFM85 / AFM85 Marine Electronic Control System Wiring Diagram - Continued



5012— IGN
5020— CAN Shield
5032— Fused Unswitched Power
5050— Ground
5412— ACC
5422— Start
5439— Tachometer
5474— Wait to Start
5616— Excitation Voltage (+5V)
5714— Sensor Return/Override Shutdown Return
5814— Sensor Return
5904— CAN High
5905— CAN Low
5915— Analog Throttle
5916— Warning Lamp
5918— Override Shutdown
5923— Bump Enable
5936— Resume Coast/Bump Down
5947— Throttle Switch
5955— Set Accel/Bump Up

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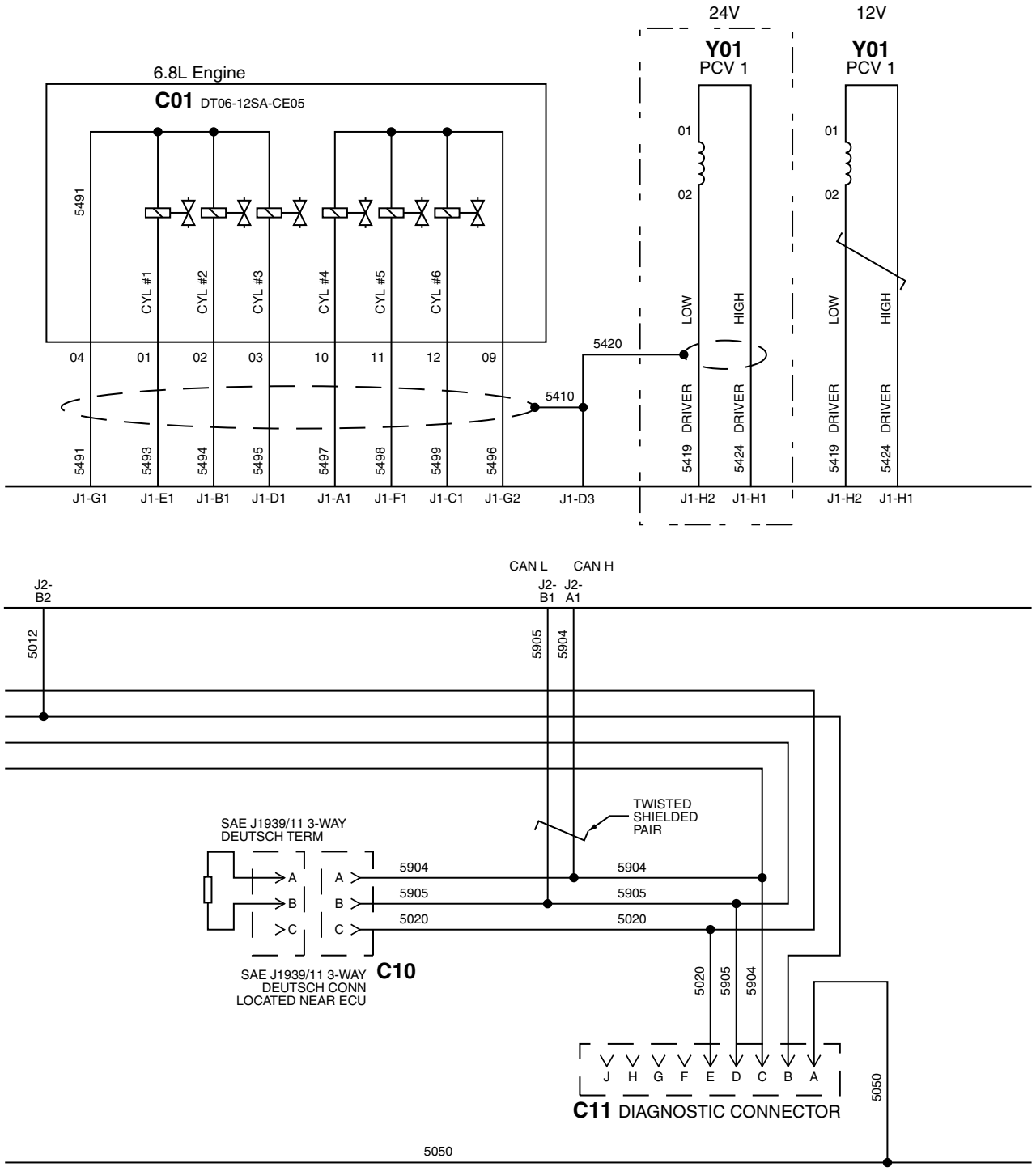


C10— Deutsch Conn. Located Near ECU

C11— Diagnostic Connector

5419— Driver Low

5424— Driver High

RG19661,00003E1 -19-11FEB13-2/2

Engine Troubleshooting

NOTE: If using BIODIESEL blends above B20, the possibility of some of the symptoms listed below, such as power loss, could increase.

NOTE: Before troubleshooting the engine, first retrieve any fault codes on the diagnostic gauge display and perform the corrective actions. (See information later in this section.) If any problems remain, use the following charts to solve engine problems.

Symptom	Problem	Solution
Engine cranks but will not start	Incorrect starting procedure.	Verify correct starting procedure.
	No fuel.	Check fuel in tank and manual shut-off valve.
	Exhaust restricted.	Check and correct exhaust restriction.
	Fuel filter plugged or full of water.	Replace fuel filter or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Check fuel flow at supply pump or bleed fuel system.
	Faulty injection pump or nozzles.	Consult authorized diesel repair station for repair or replacement.
Engine hard to start or will not start	Engine starting under load.	Disengage PTO (if equipped).
	Improper starting procedure.	Review starting procedure.
	No fuel.	Check fuel tank.
	Air in fuel line.	Bleed fuel line.
	Cold weather.	Use cold weather starting aids.
	Slow starter speed.	See “Starter Cranks Slowly”.
	Crankcase oil too heavy.	Use oil of proper viscosity.
	Improper type of fuel.	Consult fuel supplier; use proper type fuel for operating conditions.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed system.
	Clogged fuel filter.	Replace filter element.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Electronic fuel system problem	See your authorized servicing dealer
	Injection pump shut-off not reset.	Turn key switch to “OFF” then to “ON”.
Engine knocks	Low engine oil level.	Add oil to engine crankcase.

Continued on next page

Symptom	Problem	Solution
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Low coolant temperature.	Remove and check thermostat.
	Engine overheating.	See “Engine Overheats”.
Engine runs irregularly or stalls frequently	Low coolant temperature.	Remove and check thermostat.
	Clogged fuel filter.	Replace fuel filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed system.
	Poor quality fuel.	Change to better quality fuel.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Electronic fuel system problem	See your authorized servicing dealer
Below normal engine temperature	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check gauge, sender, and connections.
Lack of power	Engine overloaded.	Reduce load.
	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace filter elements.
	Improper type of fuel.	Use proper fuel.
	Overheated engine.	See “Engine Overheats”.
	Below normal engine temperature.	Remove and check thermostat.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Injector tip deposits	Use John Deere approved biodiesel fuel conditioners containing detergents.
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning. (Turbocharger engines only.)	See your authorized servicing dealer or engine distributor.

Continued on next page

Symptom	Problem	Solution
	Leaking exhaust manifold gasket.	See your authorized servicing dealer or engine distributor.
	Defective aneroid control line.	See your authorized servicing dealer or engine distributor.
	Restricted fuel hose.	Clean or replace fuel hose.
	Low fast idle speed.	See your authorized servicing dealer or engine distributor.
	Damaged propeller	Have propeller checked.
	Marine growth	Clean hull.
Low oil pressure	Low oil level.	Add oil.
	Improper type of oil.	Drain, fill crankcase with oil of proper viscosity and quality.
High oil consumption	Crankcase oil too light.	Use proper viscosity oil.
	Oil leaks.	Check for leaks in lines, gaskets, and drain plug.
	Restricted crankcase vent tube.	Clean vent tube.
	Defective turbocharger (if equipped).	See your authorized servicing dealer or engine distributor.
Engine emits white smoke	Improper type of fuel.	Use proper fuel.
	Low engine temperature.	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
	Defective injection nozzles.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
Engine emits black or gray exhaust smoke	Improper type of fuel.	Use proper fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load.

Continued on next page

Symptom	Problem	Solution
	Fuel injectors dirty.	Use John Deere approved biodiesel or diesel fuel conditioners containing detergents. If no improvement is seen, see your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
	Electronic fuel system problem	See your authorized servicing dealer
Engine overheats	Engine overloaded.	Reduce load.
	Low coolant level.	Fill coolant tank to proper level, check coolant tank and hoses for loose connections or leaks.
	Faulty coolant tank cap.	Have serviceman check.
	Stretched poly-vee belt or defective belt tensioner.	Check automatic belt tensioner and check belts for stretching. Replace as required.
	Faulty sea (raw) water pump.	Check/replace impeller/pump.
	Low engine oil level.	Check oil level. Add oil as required.
	Cooling system needs flushing.	Flush cooling system.
	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check water temperature with thermometer and replace, if necessary.
	Electronic fuel system problem	See your authorized servicing dealer
	Incorrect grade of fuel.	Use correct grade of fuel.
	Plugged heat exchanger.	Clean heat exchanger and core.
	Plugged keel cooler.	Flush and clean keel cooler. Check for marine growth on O.D. of keel cooler tubes.
	Trash or debris in engine compartment.	Clean engine compartment.
High fuel consumption	Improper type of fuel.	Use proper type of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.

Continued on next page

Symptom	Problem	Solution
	Engine overloaded.	Reduce load.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Injector tip deposits	Use John Deere approved biodiesel fuel conditioners containing detergents.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
	Low engine temperature.	Check thermostat.

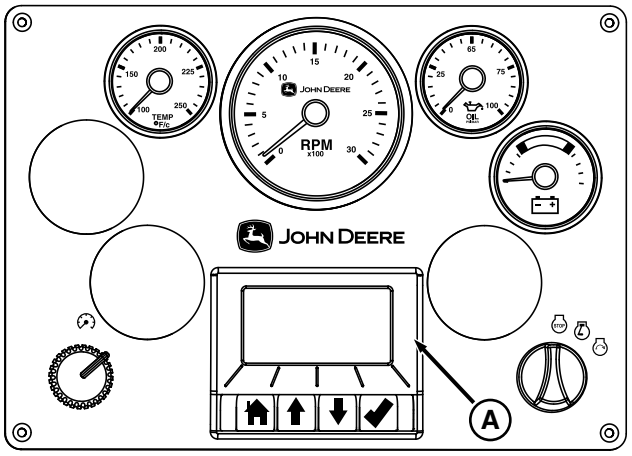
OUOD006,0000113 -19-13NOV13-5/5

Instrument Panel Method for Retrieving Diagnostic Trouble Codes

IMPORTANT: Care should be used during diagnostic procedures to avoid damaging the terminals of connectors, sensors, and actuators. Probes should not be poked into or around the terminals or damage will result. Probes should only be touched against the terminals to make measurements.

Diagnosis of the electronic control system should be performed according to the following procedure:

1. Make sure all engine mechanical and other systems not related to the electronic control system are operating properly.
2. Read and record diagnostic trouble codes (DTCs) displayed on the diagnostic gauge (A). To access trouble codes on diagnostic gauge (A), see Section 15 of this manual.
3. Go to the LISTING OF DIAGNOSTIC TROUBLE CODES (DTCs) later in this section, to interpret the DTCs present.



Diagnostic Gauge

A—Diagnostic Gauge

4. Contact your nearest engine distributor or servicing dealer with a list of DTC codes that are displayed so necessary repairs can be made.

OURGP11,00000BB -19-01MAR17-1/1

Diagnostic Trouble Codes (DTCs) — Operation

SPN/FMI CODES

Stored and active diagnostic trouble codes are output on the diagnostic gauge on the Deere electronic instrument panel according to the J1939 standard as a two-part code as shown on the tables on the following pages.

The first part is a Suspect Parameter Number (SPN) followed by a Failure Mode Identifier (FMI) code. In order to determine the exact failure, both parts (SPN and FMI) of the code are needed.

The SPN identifies the system or the component that has the failure; for example SPN 000110 indicates a failure in the engine coolant temperature circuit.

The FMI identifies the type of failure that has occurred; for example FMI 03 indicates value above normal. Combining SPN 000110 with FMI 03 yields a fault code “engine coolant temperature input voltage too high”. A corrective action will also be displayed, “check sensor and wiring”. If this check does not solve the engine fault, contact your servicing dealer.

Always contact your servicing dealer for help in correcting unsolved diagnostic trouble codes which are displayed for your engine.

RK80614,000004A -19-26AUG13-1/1

Diagnostic Trouble Codes (DTCs) — Listing

NOTE: Not all of these codes are used in all engine applications.

NOTE: Not all DTCs are listed below. See your application technical manual for more information.

There are several possible combinations of SPN and FMI codes. To use the table below, first write down the SPN and FMI codes you received from the engine diagnostic gauge. Locate each SPN and its associated definition. In the same way, locate the FMI and its associated definition.

FMI Code	FMI Name
0	Extremely High
1	Extremely Low
2	Invalid
3	Out of Range High
4	Out of Range Low
5	High Resistance
6	Low Resistance
7	Mismatch
8	Signal Missing
9	Loss of Communication
10	Change Abnormal
11	Activated
12	Error
13	Fault
14	Incorrect Message
15	Slightly High
16	Moderately High
17	Slightly Low
18	Moderately Low
19	Communication Error
31	Condition Exists

SPN Code	SPN Name
000028	Digital Throttle
000029	Secondary Analog Throttle
000084	Vehicle Speed
000091	Primary Analog Throttle
000094	Low Pressure Fuel Pressure Signal
000097	Water-in-fuel Signal
000100	Engine Oil Pressure Signal
000102	Manifold Air Pressure Signal
000105	Manifold Air Temperature Signal
000107	Air Filter Restriction Switch
000108	Barometric Pressure Signal
000110	Engine Coolant Temperature Signal
000111	Engine Coolant Level Alarm Switch
000157	Fuel Rail Pressure Signal
000158	ECU Power Down
000160	Vehicle Speed Signal
000171	Ambient Air Temperature
000174	Fuel Temperature Signal
000189	Engine Speed Derate
000190	Engine Speed
000611	Injector Drive #1
000627	Injector Power Supply
000629	ECU EEPROM
000636	Camshaft Position Signal
000637	Crankshaft Position Signal
000640	External Derate Commanded
000644	Speed Input
000651	Injector #1
000652	Injector #2

Continued on next page

SPN Code	SPN Name
000653	Injector #3
000654	Injector #4
000655	Injector #5
000656	Injector #6
000676	Cold Start Aid
000695	Unapproved Engine Speed Request
000898	Vehicle Speed or Torque
000970	External Shutdown Switch
000971	External Fuel Derate Switch
001075	Low Pressure Fuel Pump Data
001109	Engine Protection Shutdown Warning
001110	Engine Protection Shutdown
001136	ECU Temperature Signal
001172	Intake Air Temperature
001180	Calculated VGT Turbine Inlet Temp
001321	Engine Starter Control Circuit
001347	Suction Control Valve
001349	Fuel Rail Pressure
001569	Engine in Derate Condition
002000	Security Violation
002002-002253	Source Address 2-253
002790	Fixed Turbocharger Compressor Outlet Temp
002795	VGT Calibration Version
003509	Sensor Supply #1 Voltage
003510	Sensor Supply #2 Voltage
003511	Sensor Supply #3 Voltage
003512	Sensor Supply #4 Voltage
003513	Sensor Supply #5 Voltage
516598	Engine Overload Condition
524225	Engine Start Protection

NOTE: Diagnostic gauge on instrument panel may also display text for communication faults, such as “CAN Bus FAILURE”. Contact your servicing dealer.

ZE59858,0000192 -19-24OCT13-2/2

Intermittent Fault Diagnostics

Intermittent faults are problems that periodically “go away”. A problem such as a terminal that intermittently doesn't make contact can cause an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors, since a high percentage of intermittent problems originates here. Check for loose, dirty, or disconnected connectors. Inspect the wiring routing, looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity, looking for wires that have pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged splices and terminals. Look for broken wires, damaged splices, and wire-to-wire shorts. Use good judgment if component replacement is thought to be required.

NOTE: The engine control unit (ECU) is the component LEAST likely to fail.

Suggestions for diagnosing intermittent faults:

- If diagnostic charts on preceding pages indicate that the problem is intermittent, try to reproduce the operating conditions that were present when the diagnostic trouble code (DTC) set.
- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DTCs, then check the connection or wire by wiggling it while watching the diagnostic gauge to see if the fault resets.

Possible causes of intermittent faults:

- Faulty connection between sensor or actuator harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc., can cause faulty signals to be sent to the ECU.

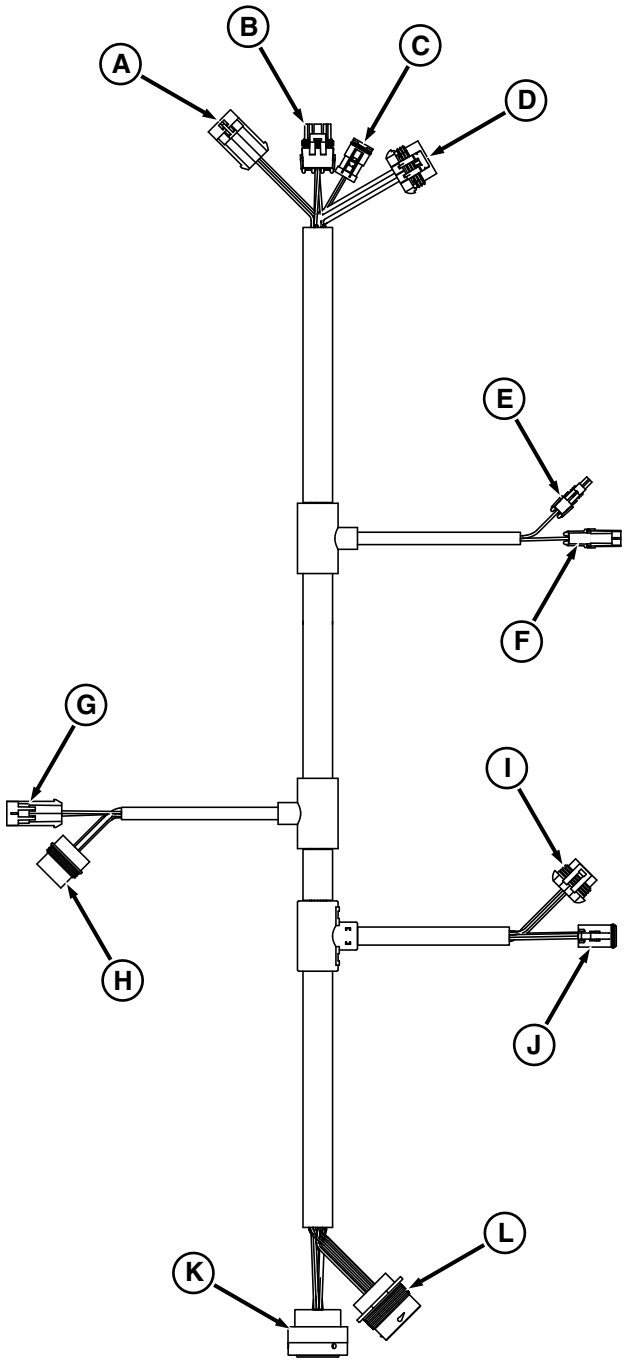
NOTE: Refer to wiring diagrams later in this section as a guide to connections and wiring.

RK80614,000004C -19-26AUG13-1/1

Transition Harness

The marine transition harness connects the engine wiring harness and the main instrument panel. The engine end of the transition harness contains connections for the 21- and 23-pin connectors, the starter cutout relay, an external shutdown connection, station select and an auxiliary analog throttle input. The instrument panel end of the harness contains connectors for station select/engine sync, engine sync in and out, power and starting circuit wiring for the instrument panel, wheelhouse analog throttle and CAN bus connection.

A— Wheelhouse Station Select Input
B— Wheelhouse Throttle Input
C— CAN Connector (to marine instrument panel)
D— Battery (+), Ground (—)
E— Engine Sync Input
F— Engine Sync Output
G— External Shutdown Conector
H— Starter Cutout Relay
I— Auxiliary Throttle Input
J— Auxiliary Station Select Input
K— 23-Pin Connector (engine wiring harness)
L— 21-Pin Connector (engine wiring harness)



Transition Harness

RG19661,00003DD -19-13SEP13-1/1

Engine Storage Guidelines

IMPORTANT: Special considerations should be taken prior to storage when using BioDiesel. See BioDiesel Fuel in the Fuels, Lubricants, and Coolant Section.

1. John Deere engines can be stored outside for up to three months with no long-term preparation if covered by a waterproof covering. No outside storage is recommended without a waterproof covering.
2. John Deere engines can be stored in a standard overseas shipping container for up to three months with no long-term preparation.
3. John Deere engines can be stored inside for up to six months with no long-term preparation.
4. John Deere engines expected to be stored more than six months **must** have long-term storage preparation. See Preparing Engine for Long-Term Storage in the Storage Section.

OUOD006,0000114 -19-04FEB15-1/1

Preparing Engine for Long-Term Storage

IMPORTANT: Any time the engine is not used for over six months, the following recommendations for storing it and removing it from storage helps to minimize corrosion and deterioration.

IMPORTANT: Long-term storage is not advised when using BioDiesel. For storage longer than one year, use straight hydrocarbon fuel.

If BioDiesel must be used it is recommended the blend not exceed B7 and a high-quality fuel stabilizer be used. Storage should not exceed one year.

For more information see BioDiesel Fuel in the Fuels, Lubricants, and Coolants Section.

NOTE: The following storage preparations are used for long-term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

1. Change engine oil and replace filter. Used oil does not give adequate protection. Add 30 mL of rust preventive oil to the engine crankcase for every 1 L of engine oil, or 1 oz. of rust preventative oil per 1 qt. of engine oil. This rust preventive oil should be an SAE 10W oil with 1%-4% morpholine or equivalent vapor corrosion inhibitor, such as NOX RUST VCI-10 OIL from Daubert Chemical Company, Inc.
2. Replace air cleaner.
3. Draining and flushing of cooling system is not necessary if the engine is only stored for less than one year. However, for extended storage periods of a year or longer, it is recommended that the cooling system be drained, flushed, and refilled. Refill with appropriate coolant. See Diesel Engine Coolant (engine with wet sleeve cylinder liners) in the Fuels, Lubricants, and Coolants Section.
4. Prepare a solution of diesel fuel and rust preventive oil in a temporary container, add 78 mL of rust preventive oil per 1 L of diesel fuel, 10 oz. of rust preventive oil per 1 gal. of diesel fuel.
5. Remove existing lines and plugs as required. Run a temporary line from the temporary container to the engine fuel intake before the fuel filters, and another temporary line from the fuel return to the temporary container, so rust preventive oil solution is circulated through the injection system during cranking.

IMPORTANT: Do not operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

6. Crank the engine several revolutions with starter. Do not allow the engine to start. This allows rust preventive oil solution to circulate.

   See your authorized dealer for the proper procedure for your application.
7. Remove temporary lines installed in Step 5 and replace any lines or plugs previously removed.
8. Loosen (or remove) and store fan and alternator poly-vee belt.
9. Remove and clean batteries. Store them in a cool, dry place and keep them fully charged.
10. Disengage the clutch for any driveline.
11. Clean the exterior of the engine with salt-free water and touch up any scratched or chipped painted surfaces with a good quality paint.
12. Coat all exposed bare metal surfaces with grease or corrosion inhibitor if not feasible to paint.
13. Seal all openings on engine with plastic bags and tape.
14. Store the engine in a dry protected place. If engine must be stored outside, cover it with a waterproof canvas or other suitable protective material and use a strong waterproof tape.

OUOD006,00000FC -19-28APR16-1/1

Removing Engine from Long-Term Storage

NOTE: The following storage removal procedure is used for long-term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

Refer to the appropriate section for detailed services listed below or have an authorized servicing dealer or engine distributor perform unfamiliar services.

1. Remove all protective coverings from engine. Unseal all openings in engine and remove covering from electrical systems.
2. Remove grease from all exposed metal surfaces.
3. Remove the batteries from storage. Install batteries (fully charged) and connect the terminals.
4. Install fan and alternator poly-vee belt, if removed.
5. Fill fuel tank.
6. Perform all appropriate prestarting checks. See Daily Prestarting Checks in the Lubrication & Maintenance — Daily Section for more information.
7. Open sea water valve and prime the sea water system.

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

8. Crank engine for 20 seconds with starter. Do not allow the engine to start. Wait 2 minutes and crank engine an additional 20 seconds to assure bearing surfaces are adequately lubricated.

   See your authorized dealer for the proper procedure for your application.
9. Start engine and run at low idle and no load for 15 minutes.
10. Shut engine off. Change engine oil and replace filter.
11. Warm up engine and check all gauges before placing engine under load.
12. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

NOTE: If using BioDiesel blends after long-term storage, frequency of fuel filter plugging can increase initially.

OUOD006,0000115 -19-24OCT13-1/1

General Marine Engine Specifications — 4.5L

ITEM	UNIT OF MEASURE	ENGINE MODEL 4045TFM85	ENGINE MODEL 4045AFM85
General Data			
Engine Type		In-line, 4 cycle diesel	In-line, 4 cycle diesel
Aspiration		Turbocharged	Turbocharged and coolant aftercooled
Number of Cylinders		4	4
Bore	mm (in.)	107 (4.21)	107 (4.21)
Stroke	mm (in.)	127 (5.00)	127 (5.00)
Displacement	L (cu in.)	4.5 (273)	4.5 (273)
Compression Ratio		16.0:1	16.7:1
Physical Dimensions			
Width	mm (in.)	715 (28.1)	770 (30.3)
Height	mm (in.)	912 (35.9)	964 (37.9)
Length	mm (in.)	1007 (39.6)	1105 (43.5)
Weight (approximate)[a]	kg (lb)	507 (1117)	578 (1274)
Performance Data			
See Engine Power and Speed Ratings in the Specifications Section.			
Lubrication System (Propulsion Applications)			
Oil Pressure at Rated rpm (±35%)	kPa (psi)	—	436 (63)
Oil Pressure at Low Idle (800 rpm)	kPa (psi)	—	213 (31)
Lubrication System (Generator Applications)			
Oil Pressure at Rated rpm (±35%)	kPa (psi)	290 (42)	378 (55)
Cooling System			
Recommended Pressure Cap	kPa (psi)	110 (16)	110 (16)
Coolant Temperature Operating Range	°C (°F)	82-95 (180-203)	71-83 (160-182)
Coolant Temperature (Maximum)	°C (°F)	110 (230)	110 (230)
Coolant Capacity (Including Heat Exchanger)	L (qt)	14 (15)	17 (18)
Fuel System			
ECU Level		L16	L14
Fuel Injection Type		HPCR	HPCR
Primary Fuel Filter		10 micron	10 micron
Secondary Fuel Filter		2 micron	2 micron
Electrical System			
Battery Capacity (Minimum)- 12 Volt System	CCA	640	640
Battery Capacity (Minimum)- 24 Volt System	CCA	570	570
Air System			
Maximum Air Intake Restriction	(kPa) (Bar) (psi)	6.25 (0.0625) (1.0)	6.25 (0.0625) (1.0)
Maximum Exhaust Back Pressure	(kPa) (Bar) (psi)	7.5 (0.075) (1.09)	7.5 (0.075) (1.09)

[a] *Includes engine oil. Excludes engine coolant.*

RG19661,00003E8 -19-03DEC13-1/1

General Marine Engine Specifications — 6.8L

ITEM	UNIT OF MEASURE	ENGINE MODEL 6068SFM85	ENGINE MODEL 6068AFM85
General Data			
Engine Type		In-line, 4 cycle diesel	In-line, 4 cycle diesel
Aspiration		Turbocharged and seawater after cooled	Turbocharged and coolant after cooled
Number of Cylinders		6	6
Bore	mm (in.)	106 (4.17)	106 (4.17)
Stroke	mm (in.)	127 (5.00)	127 (5.00)
Displacement	L (cu in.)	6.8 (415)	6.8 (415)
Compression Ratio		16.3:1	16.7:1
Physical Dimensions:			
Width	mm (in.)	872 (34.3)	854 (33.6)
Height	mm (in.)	938 (36.9)	912 (38.7)
Length	mm (in.)	1317 (51.9)	1333 (52.5)
Basic Dry Weight	kg (lb)	764 (1684)	787 (1735)
Performance Data			
Engine Power and Speed Ratings		See Engine Power and Speed Ratings in the Specifications Section.	
Lubrication System (Propulsion Applications)			
Oil Pressure at Rated rpm (±35%)	kPa (psi)	415 (60)	310 (45)
Oil Pressure at Low Idle	kPa (psi)	180 (26)	150 (22)
Engine Oil Capacity		See Engine Crankcase Oil Fill Quantities in the Specifications Section.	
Lubrication System (Generator Applications)			
Oil Pressure at Rated rpm (±35%)	kPa (psi)	341 (49)	299 (43)
Engine Oil Capacity		See Engine Crankcase Oil Fill Quantities in the Specifications Section.	
Cooling System			
Recommended Pressure Cap	kPa (psi)	110 (16)	110 (16)
Coolant Temperature Operating Range	°C (°F)	82-94 (180-202)	81-95 (178-203)
Coolant Temperature (Maximum)	°C (°F)	110 (230)	110 (230)
Coolant Capacity (Including Heat Exchanger)	L (qt)	31.5 (33.5)	34 (36)
Fuel System			
ECU Level		L14	L14
Fuel Injection Type		HPCR	HPCR
Primary Fuel Filter		10 micron	10 micron
Secondary Fuel Filter		2 micron	2 micron
Electrical System			
Battery Capacity (Minimum)- 12 Volt System	CCA	925	925
Battery Capacity (Minimum)- 24 Volt System	CCA	625	625
Air System			
Maximum Air Intake Restriction	(kPa) (Bar) (psi)	6.25 (0.0625) (1.0)	6.25 (0.0625) (1.0)
Maximum Exhaust Back Pressure	(kPa) (Bar) (psi)	7.5 (0.075) (1.09)	7.5 (0.075) (1.09)

RG19661,00003E9 -19-25JAN16-1/1

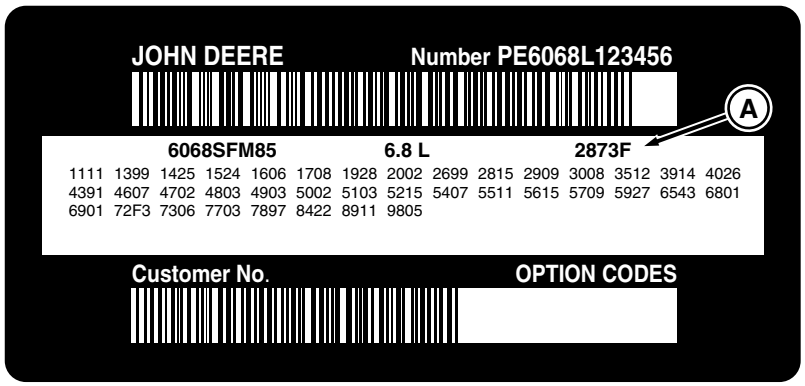
Engine Power And Speed Ratings

Engine Model	Application Rating	Power Rating @ Rated Speed Without Fan kW (hp)[a]	Rated Speed[b] (rpm)	Slow Idle (rpm)	Peak Torque (rpm)
4045TFM85	M1	75 (100)	2400	600	1500
	M2	93 (125)	2500	600	1800
	Gen-Set 60 Hz	74 (99)	1800	1800	—
	Gen-Set 50 Hz	61 (82)	1500	1500	—
4045AFM85	M1	119 (160)	2300	600	1800
	M2	134 (180)	2400	600	2000
	M3	149 (200)	2500	600	2000
	M4	168 (225)	2600	600	2100
	Gen-Set 60 Hz	110 (148)	1800	1800	—
	Gen-Set 50 Hz	89 (120)	1500	1500	—
6068AFM85	M1	172 (230)	2300	600	1700
	M2	198 (265)	2400	600	1800
	M3	224 (300)	2500	600	1900
	M4	246 (330)	2600	600	1900
	Gen-Set 60 Hz	166 (223)	1800	1800	—
	Gen-Set 50 Hz	139 (186)	1500	1500	—
6068SFM85	M1	186 (249)	2400	600	1700
	M2	209 (280)	2500	600	1800
	M3	239 (321)	2600	600	1900
	M4	265 (355)	2700	600	2000
	M5	298 (400)	2800	600	2200
	Gen-Set 60 Hz	195 (262)	1800	1800	—
	Gen-Set 50 Hz	168 (226)	1500	1500	—

[a]Engine speeds listed are preset to factory specification. Slow idle speed may be reset depending upon specific boat application requirements. Refer to your boat operator's manual for engine speeds that are different from those preset at the factory.
[b]Generator set engines (3-5% governor) usually run at 1500 rpm (50 Hz) or 1800 (60 Hz) when operating under load depending on cycles of AC current.

RG19661,00003FB -19-09JAN15-1/1

Engine Crankcase Oil Fill Quantities



RG24322 —UN—05SEP13

Option Code Label

A—Engine Base Code

Each engine has a 13-digit John Deere engine serial number. The first two digits identify the factory that produced the engine:

"CD" indicates that the engine was built in Saran, France and "PE" indicates Torreon, Mexico.

In addition to the serial number plate, Marine engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

The engine option code label includes an engine base code (A). At times it will be necessary to furnish this base code to differentiate two identical option codes for the same engine model.

To determine the option code for the oil fill quantity of your engine, refer to the engine option code label affixed to the rocker arm cover. The first two digits of the code (40) identify the dipstick tube group. The last two digits of each code identify the specific dipstick and tube assembly on your engine.

Listed below are engine crankcase oil fill quantities:

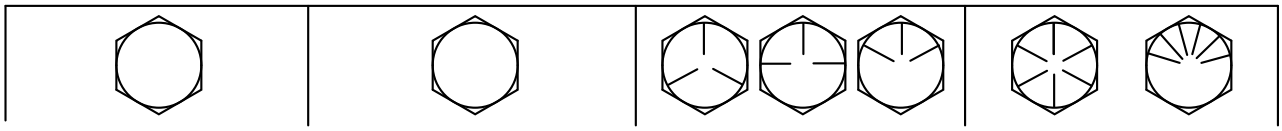
Engine Model	Oil Pan Option Code (s)	Crankcase Oil Capacity
4045TFM85	1954	13.0 L (14 qt.)
	19AG	15.0 L (16 qt.)
4045AFM85	19CZ	18.0 L (19 qt.)
6068SFM85	19BP	19.0 L (20 qt.)
6068AFM85	19BP	19.0 L (20 qt,)

NOTE: Crankcase oil capacity may vary slightly from amount shown. ALWAYS fill crankcase to full mark or between arrows on dipstick, whichever is present. DO NOT overfill.

RG19661,00003CD -19-06SEP13-1/1

Unified Inch Bolt and Screw Torque Values

TS1671 —UN—01MAY03



Bolt or Screw Size	SAE Grade 1				SAE Grade 2[a]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
	Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]	
	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N·m	lb.-ft.	N·m	lb.-ft.
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N·m	lb.-ft.	N·m	lb.-ft.				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N·m	lb.-ft.														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a]Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

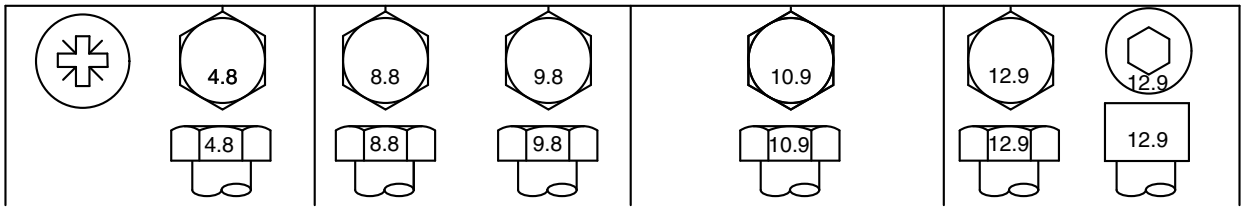
[b]"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.

[c]"Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B, F13E or F13H zinc flake coating.

DX,TORQ1 -19-12JAN11-1/1

Metric Bolt and Screw Torque Values

TS1670 —UN—01MAY03



Bolt or Screw Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]	
	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.	N·m	lb.-in.
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N·m	lb.-ft.	N·m	lb.-ft.	N·m	lb.-ft.								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N·m	lb.-ft.														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a] *"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C, F13F or F13J zinc flake coating.*

[b] *"Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B, F13E or F13H zinc flake coating.*

DX,TORQ2 -19-12JAN11-1/1

Lubrication and Maintenance Records

Using Lubrication and Maintenance Records

Refer to specific Lubrication and Maintenance Section for detailed service procedures.

1. Keep a record of the number of hours you operate your engine by regular observation of hour meter.
2. Check your record regularly to learn when your engine needs service.
3. DO ALL the services within an interval section. Write the number of hours (from your service records) and the date in the spaces provided. For a complete listing of all items to be performed and the service intervals required, refer to the quick-reference chart near the front of the Lubrication and Maintenance Section.

IMPORTANT: The service recommendations covered in this manual are for the accessories that are provided by John Deere. Follow manufacturer's service recommendations for servicing engine driven equipment not supplied by Deere.

OURGP11,0000159 -19-28JAN04-1/1

Daily (Prestarting) Service

- Operate engine at rated speed and 50%—70% Load for a Minimum of 30 Minutes. Perform every 2 weeks. (Generator Sets Only)
- Check engine oil level.
- Check coolant level.
- Check sea water pump and strainer, if equipped.
- Check accessory drive belts.
- Drain water from fuel filters.
- Inspect wiring harness and fuses.
- Check aftercooler condensate drain, if equipped.
- Check air cleaner dust unloader valve and air filter restriction indicator, if equipped.
- Check air intake system.
- Visual walkaround inspection.

RG,RG34710,5621 -19-08NOV13-1/1

250 Hours/6 Months Service

- Change engine oil and replace oil filter.
- Service fire extinguisher.
- Service battery.
- Check engine mounts.
- Inspect and replace zinc plugs.

Hours									
Date									
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500 Hours/12 Months Service

- Replace crankcase vent filter.
- Check air intake system.
- Replace fuel filter element and clean water separator bowl.
- Check automatic belt tensioner and belt wear.
- Check cooling system.
- Inspect and clean heat exchanger core.
- Inspect and clean aftercooler core.
- Pressure test cooling system.
- Check and adjust engine speeds.
- Check engine electrical ground connections.
- Replace sea water pump impeller.

Hours									
Date									
Hours									
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2000 Hours/24 Months Service

- Check and adjust engine valve clearance.
- Check crankshaft vibration damper.
- Inspect and repair sea water pump.

Hours									
Date									
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6000 Hours/72 Months Service

- Flush and refill cooling system.
- Test thermostats.

Hours									
Date									
Hours									
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Service As Required

- Drain water from fuel filters.
- Add coolant.
- Service air cleaner element.
- Replace air cleaner element.
- Replace alternator drive belt
- Check fuses.

Hours									
Date									
Hours									
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John Deere Warranty in OEM Applications

Overview

This section focuses on John Deere engines marketed in products manufactured by companies other than John Deere or its affiliates, and on John Deere repower engines in all applications. Herein appears the original warranty applicable to the engine as delivered to the retail purchaser on or after 1 May 2010. The following is information about the warranty and warranty service.

NOTE: "John Deere" means John Deere Power Systems with respect to users in the United States, John Deere Limited with respect to users in Canada, and Deere & Company or its subsidiary responsible for making John Deere equipment in other countries where the user is located.

Promptly register your engine online at https://www.johndeere.com/enginewarranty

When Warranty Service Is Needed

The nearest dealer stands ready with genuine parts and trained and equipped personnel should the need arise. If following the Operator's Manual delivered with the engine/machine are not adequate to correct an engine problem, contact the nearest John Deere service dealer for assistance. Authorized engine service dealers can be found at: https://www.johndeere.com/ (click on "Dealer Locator").

NOTE: When requesting warranty service, the purchaser must be prepared to provide proof that the engine is within the warranty period.

The following information is always required: Engine serial number, date of delivery, engine owner, name and location of dealer and specific person contacted, date of contact, nature of engine problem, and outcome of the service dealer contact.

Given that normally it is the dealer contacted who in the end will provide the service required, maintaining a purchaser-dealer relationship of mutual respect from the beginning is always helpful.

Privacy Notice

At John Deere your privacy is important to us. We collect, use, and disclose your personal information in accordance with the John Deere privacy statement. For instance, we collect, use, and disclose your personal information to provide you with the products and services that you request; to communicate with you as our customer (examples include warranty and product improvement programs) and to meet safety and legal requirements; and for marketing and promotional purposes. Sometimes, we may ask our John Deere affiliates, dealers, or business partners to do work for us which involves your information. For complete details on your privacy rights and to obtain a copy of the John Deere Privacy Statement, please visit our website at https://www.johndeere.com/.

Warranty Duration

Unless otherwise provided in writing by John Deere, John Deere makes the following warranty to the first retail purchaser and each subsequent purchaser (if purchase is made prior to the expiration of applicable warranty) of each John Deere new off-highway engine marketed as part of a product manufactured by a company other than John Deere or its affiliates and on each John Deere engine used in an off-highway repower application:

- 12 months, unlimited hours of use, or
- 24 months and before the accumulation of 2000 hours of use.

NOTE: In the absence of a functional hourmeter, hours of use will be determined on the basis of 12 hours of use per calendar day.

Warranty Coverage

This warranty applies to the engine and to integral components and accessories sold by John Deere, and delivered to the first retail purchaser on or after 1 May 2010.

All John Deere-warranted parts and components of John Deere engines which, as delivered to the purchaser, are defective in materials and/or workmanship will be repaired or replaced, as John Deere elects. Warrantable repairs will be made without charge for parts or engine repair labor, including reasonable labor costs to remove and reinstall non-engine parts or components of the equipment in which the engine is installed. If required, reasonable labor costs for engine removal and reinstallation will also be included. All coverage is based on the defect appearing within the warranty period as measured from the date of delivery to the first retail purchaser.

Obtaining Warranty Service

Warranty service must be requested of the nearest authorized John Deere engine service outlet before the expiration of the warranty. An *authorized* service outlet is a John Deere engine distributor, a John Deere engine service dealer, or a John Deere equipment dealer selling and servicing equipment with an engine of the type covered by this warranty. (See When Warranty Service is Needed above.)

Authorized service outlets will use only new or remanufactured parts or components furnished or approved by John Deere.

NOTE: Authorized engine service locations are listed on the Internet at https://www.johndeere.com/ (Click on "Dealer Locator".)

At the time of requesting warranty service, the purchaser must be prepared to present evidence of the date of delivery of the engine.

Continued on next page

John Deere reimburses authorized service outlets for limited travel expenses incurred in making warranty service repairs in non-John Deere applications when travel is actually performed. The limit, as of the date of publication of this booklet, is US$400.00 (US$500.00 if engine is marine) or equivalent. **If distances and travel times are greater than reimbursed by John Deere, the service outlet will charge the purchaser for the difference.**

Warranty Exclusions

John Deere's obligations will not apply to components and accessories which are not furnished or installed by John Deere, nor to failures caused by such items, except as required by law.

Purchaser's Responsibilities

The cost of normal maintenance and depreciation.

Periodic cleaning of the diesel particulate filter (DPF).

Consequences of negligence, misuse, or accident involving the product, or improper application, installation, or storage.

Consequences of service performed by someone other than an authorized John Deere engine service outlet.

Consequences of any product modification or alteration not approved by John Deere, including, but not limited to, tampering with engine fuel and air delivery systems.

Consequences of failure of non-product components.

Consequences of fuels, lubricants, or coolants that fail to meet the specifications and requirements listed in the Operator's Manual.

The effects of cooling system neglect as manifested in cylinder liner or cylinder block cavitation ("pitting, "erosion", "electrolysis").

Any premium for overtime labor requested by the purchaser.

Costs of transporting the product or the equipment in which it is installed to and from the location at which the warranty service is performed, if such costs are in excess of the travel reimbursement payable to the dealer had the warranty service been performed at the product's location.

Costs incurred in gaining access; for example, overcoming physical barriers such as walls, fences, floors, decks, or similar structures impeding access to the product, rental of cranes or similar, or construction of ramps or lifts or protective structures for product removal and reinstallation.

Incidental travel costs including meals, lodging, and similar, and any travel time or mileage costs in excess of the maximum allowance.

Service outlet costs incurred in solving or attempting to solve non-warrantable problems.

Services performed by a party other than an authorized John Deere service dealer.

Charges by dealers for initial start-up and inspection deemed unnecessary by John Deere when an Operator's Manual is supplied with the product are followed.

Costs related to interpretation or translation services.

No Representations or Implied Warranty

Where permitted by law, neither John Deere nor any company affiliated with it makes any guaranties, warranties, conditions, representations or promises, express or implied, oral or written, as to the nonoccurrence of any defect or the quality of performance of its engines other than those set forth in this booklet, and DOES NOT MAKE ANY IMPLIED WARRANTY OR CONDITIONS OF MERCHANTABILITY OR FITNESS otherwise provided for in the Uniform Commercial Code or required by any Sale of Goods Act or any other statute. This exclusion includes fundamental terms. In no event will a John Deere engine distributor or engine service dealer, John Deere equipment dealer, or John Deere or any company affiliated with John Deere be liable for incidental or consequential damages or injuries including, but not limited to, loss of profits, loss of crops, rental of substitute equipment or other commercial loss, damage to the equipment in which the engine is installed or for damage suffered by purchaser as a result of fundamental breaches of contract or breach of fundamental terms, unless such damages or injuries are caused by the gross negligence or intentional acts of the foregoing parties.

Remedy Limitation

The remedies set forth in this warranty are the purchaser's exclusive remedies in connection with the performance of, or any breach of guaranty, condition, or warranty in respect of new John Deere engines. In the event the above warranty fails to correct purchaser's performance problems caused by defects in workmanship and/or materials, purchaser's exclusive remedy shall be limited to payment by John Deere of actual damages in an amount not to exceed the cost of the engine.

No Seller's Warranty

No person or entity, other than John Deere, who sells the engine or product in which the engine has been installed makes any guaranty or warranty of its own on any engine warranted by John Deere unless it delivers to the purchaser a separate written guaranty certificate specifically guaranteeing the engine, in which case John Deere shall have no obligation to the purchaser. Neither original equipment manufacturers, engine or equipment distributors, engine or equipment dealers, nor any other person or entity, has any authority to make any representation or promise on behalf of John Deere or to modify the terms or limitations of this warranty in any way.

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Replacement Parts Warranty

John Deere and John Deere Reman parts and components (excluding replacement engines) installed during engine warranty service are warranted for the remaining warranty period of the engine or the applicable warranty term for the installed service part, whichever is greater. A new or remanufactured engine replacing a failed engine under warranty is warranted for 90 days or the remaining warranty period of the original engine, whichever is greater.

Warranty Transfer

The remainder of the original engine warranty and the emissions control-related warranty may be transferred to a subsequent owner of the engine. The Engine Warranty Transfer card should be used to report the transfer to John Deere. If a card is not available, contact your Dealer or simply send the following Information to JDPS Warranty Administration at Diesel-US@JohnDeere.com.

1. The complete 13-character engine serial number.
2. The name and mailing address of the original purchaser.
3. Delivery date to the original purchaser.
4. Hours at the time of transfer.
5. Date of transfer to the new owner.
6. Name and mailing address of the new owner.
7. How the engine/drivetrain being used, i.e., what equipment it powers, by manufacturer and model.
8. Equipment it powers, by manufacturer and model.

Purchased Extended Warranty

Extended warranty may be purchased on most engines in many areas of the world. John Deere engine distributors and equipment dealers, and dealers of manufacturers using John Deere engines in their products, have details. John Deere may also be contacted at U.S.A. fax number 1-309-749-0816, or in Europe fax number 33.2.38.84.62.66.

Emissions Warranties

Emissions warranties appear in the Operator's Manual furnished with the engine/machine. **(Warning: Statutes providing severe penalties for tampering with emissions controls may apply at the user's location.)** John Deere may also be contacted at U.S.A. fax number 1-309-749-0816; or in Europe fax number 33.2.38.84.62.66.

Local Warranty Requirements

Warranties required by local statutes will be furnished by the seller.

Option Codes (Engine Manufacturing Configuration)

When in need of engine replacement parts, your authorized John Deere service dealer will need to know the corresponding "Option Codes" for your engine. The option code label on the engine rocker arm cover may become damaged over time. By recording the four-digit codes when the engine is new, and storing this manual where it can be found when parts are needed, fast, accurate parts ordering and service will be assured. (See Engine Option Codes in the Record Keeping Section).

Should there be a question about an engine option code, note the engine serial number and call 1-800-JDENGINE from the U.S.A. or Canada, or fax U.S.A. number 1-309-749-0816; or E-mail at diesel-us@johndeere.com, Attention: Warranty Administration; or in Europe fax number 33.2.38.84.62.66, or E-mail at saranservice@johndeere.com.

Registering The Engine For Warranty

Completion and submission of the John Deere Engine Warranty Registration form (cut out sheet found in this manual) is very important. John Deere will not deny warranty service on an engine within its warranty period if the engine has not been registered. However, registering your engine will assure your servicing dealer that the engine is within the warranty period.

The easiest way to register your engine is via the Internet. Go to website https://www.johndeere.com/enginewarranty You can use the sheet in this manual to gather the information needed to register the warranty.

NOTE: Information provided on the form must be legible!

Typing is preferred, but legible handwritten reports are acceptable. "Block" numbers and Roman alphabet letters should be used. For example: 1,2,3,4 and A, B, C, D.

All requested information should be given. Much of it contributes to reports, including those required by governments.

The purchaser's telephone number or E-mail address allows John Deere to make contact should there be questions concerning the registration. The purchaser should sign and date the form.

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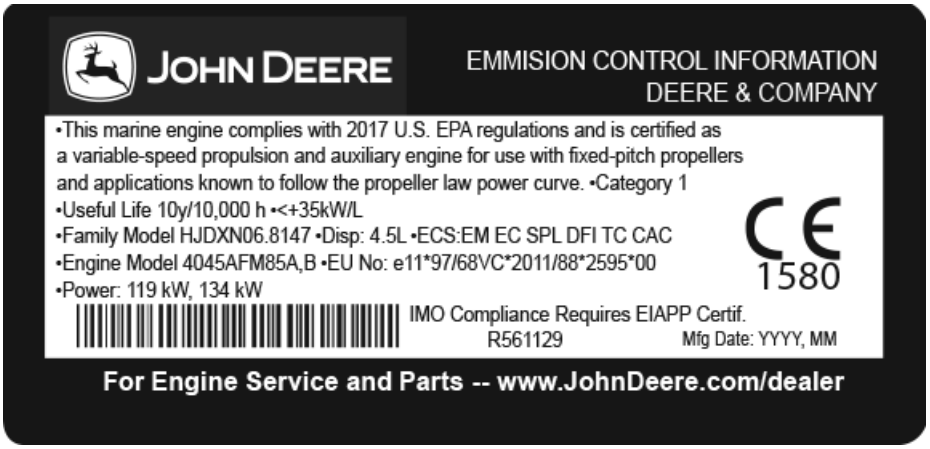
Emissions Control System Certification Label

CAUTION: Statutes providing severe penalties for tampering with emissions controls may apply to the user or dealer.



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Emission Label

The emissions warranty applies to those engines marketed by John Deere that have been certified by the United States Environmental Protection Agency (EPA) and/or California Air Resources Board (CARB); and used in the United States and Canada in Non-road equipment (excluding marine engines for Canada). The presence of an emissions label like the one shown signifies that the engine has been certified with the EPA and/or CARB. The EPA and CARB warranties only apply to new engines having the certification label affixed to the engine and sold as stated above in the geographic areas. The EPA and/or CARB emissions warranties do not apply to the EU countries.

Emission Control System(s) Laws

The U.S. EPA and CARB prohibit the removal or rendering inoperative of any device or element of design installed on or in engines/equipment in compliance with applicable emission regulations prior to or after the sale and delivery of the engines/equipment to the ultimate purchaser.

AK08008,0000040 -19-07MAR17-1/1

European Union (EU) Declaration of Emissions Conformity

The presence of an EU number on the label signifies that the Marine Diesel Engine has been certified with the European Union countries per Directives 97/68/EC as amended by Directive 2004/26/EC, under the transitional provision of (EU) 2016/1628 article 58. The EU engine family is listed on the Emissions Label. When installed in accordance with the manufacturer's instructions, John Deere marine diesel propulsion engines without integral exhaust certified under Directive 97/68/EC as amended by Directive 2004/26/EC produce exhaust emissions of carbon monoxide, hydrocarbons, nitrogen oxides and particle emissions which comply with the requirements of the Recreational Craft Directive 2003/44/EC.

The presence of a CE mark signifies the propulsion engine complies with Exhaust Emission requirements of Recreational Craft Directive 2 (2013/53/EU).

AK08008,0000041 -19-07MAR17-1/1

U.S. Marine Compression-Ignition Engine Emission Control Warranty Statement

DXLOGOV1 —UN—28APR09

JOHN DEERE

U.S. MARINE COMPRESSION-IGNITION ENGINE EMISSION CONTROL WARRANTY STATEMENT

YOUR WARRANTY RIGHTS AND OBLIGATIONS
To determine if the John Deere engine qualifies for the additional warranties set forth below, look for the “Emission Control Information” label located on the engine and verify that it states the engine conforms to U.S. EPA regulations for Recreational or commercial marine compression-ignition engines.

Warranties stated on this certificate refer only to emissions-related parts and components of your engine. The complete engine warranty, less emissions-related parts and components, is provided separately. The U.S. EPA Emissions Warranty only applies to engines in vessels that are registered and operated in the USA. Engines that are not covered by the U.S. EPA Emissions regulations are not covered by the EPA Emissions Warranty. If you have any questions about your warranty rights and responsibilities, you should contact John Deere at 1-319-292-5400.

JOHN DEERE’S WARRANTY RESPONSIBILITY:
John Deere warrants to the ultimate purchaser and each subsequent purchaser that this marine diesel engine including all parts of its emission control system was designed, built and equipped so as to conform at the time of sale with applicable regulations under section 213 of the Clean Air Act and is free from defects in materials and workmanship which would cause the engine to fail to conform with applicable US EPA regulations for the following periods:

Recreational Category 1 Marine Engine	Five years or 500 hours, whichever comes first *
Commercial Category 1 Marine Engine	Five years or 5,000 hours, whichever comes first *

Where a warrantable condition exists, John Deere will repair or replace, as it elects, any part or component with a defect in materials or workmanship that would increase the engine’s emissions of any pollutant within the stated warranty period at no cost to you, including expenses related to diagnosing and repairing or replacing emission-related parts. Warranty coverage is subject to the limitations and exclusions set forth herein.

EMISSION WARRANTY EXCLUSIONS:
John Deere may deny warranty claims for malfunctions or failures caused by:
- Non-performance of maintenance requirements listed in the Operator’s Manual.
- The use of the engine / equipment in a manner for which it was not designed.
- Abuse, neglect, improper maintenance or unapproved modifications or alterations.
- Accidents for which it does not have responsibility or by acts of God.

The marine engine is designed to operate on diesel fuel as specified in the Fuels, Lubricants and Coolants section in the Operators Manual. Use of any other fuel can harm the emission control system of the engine / equipment and is not approved for use.

To the extent permitted by law, John Deere is not liable for damage to other engine components caused by a failure of an emission-related part, unless otherwise covered by standard warranty.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. REMEDIES UNDER THIS WARRANTY ARE LIMITED TO THE PROVISIONS OF MATERIAL AND SERVICES AS SPECIFIED HEREIN. WHERE PERMITTED BY LAW, NEITHER JOHN DEERE NOR ANY AUTHORIZED JOHN DEERE ENGINE DISTRIBUTOR, DEALER, OR REPAIR FACILITY OR ANY COMPANY AFFILIATED WITH JOHN DEERE WILL BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

* The emissions-related warranty shall not be shorter than any published warranty Deere offers without charge to the customer.

Emission_Marine_EPA(13Mar10)

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Appendix C

Recordkeeping Log Examples

Trip Summary # Report Date:

Support Tug											**Jurisdiction**
Trip #											
Leg	Date	Start Time	End Time	Engine	Prior Hours	Add Hours	Total Hours	Start FOB	Fuel Burn	End FOB	
PH-SB Waters				SME							VCAPCD
PH-SB Waters				PME							
SB Waters-VAND				SME							SBCAPCD
SB Waters-VAND				PME							
SB Waters-VAND				GEN							
STBY											
VAND ASSIST				SME							SBCAPCD
VAND ASSIST				PME							
VAND ASSIST				GEN							
VAND ASSIST				SME							SBCAPCD
VAND ASSIST				PME							
VAND ASSIST				GEN							
STBY											
VAND-SB Waters				SME							SBCAPCD
VAND-SB Waters				PME							
VAND-SB Waters				GEN							
SB Waters-PH				SME							VCAPCD
SB Waters-PH				PME							
					Hours Prior	Add Hours	Hours End	FOB START			
				SME							
				PME							
				GEN							
								Total Fuel Burn			
									FOB END		

Primary Tug											
Trip #											
Leg	Date	Start Time	End Time	Engine	Prior Hours	Add Hours	Total Hours	Start FOB	Fuel Burn	End FOB	
POLB-WP1				SME							SCAQMD
POLB-WP1				PME							
POLB-WP1				FWD GEN							
POLB-WP1				AFT GEN							
WP1-WP2				SME							SCAQMD
WP1-WP2				PME							
WP1-WP2				FWD GEN							
WP1-WP2				AFT GEN							
WP2-WP3				SME							VCAPCD
WP2-WP3				PME							
WP2-WP3				FWD GEN							
WP2-WP3				AFT GEN							
WP3-WP4				SME							SBCAPCD
WP3-WP4				PME							
WP3-WP4				FWD GEN							
WP3-WP4				AFT GEN							
WP4-WP5				SME							Federal
WP4-WP5				PME							
WP4-WP5				FWD GEN							
WP4-WP5				AFT GEN							
WP5-WP6				SME							Federal
WP5-WP6				PME							
WP5-WP6				FWD GEN							
WP5-WP6				AFT GEN							
WP5-WP6				SME							Federal
WP5-WP6				PME							
WP5-WP6				FWD GEN							
WP5-WP6				AFT GEN							
WP6-WP7				SME							SBCAPCD
WP6-WP7				PME							
WP6-WP7				FWD GEN							
WP6-WP7				AFT GEN							
Manuvering				SME							SBCAPCD
				PME							
				FWD GEN							
				AFT GEN							
Stand by				SME							SBCAPCD
				PME							
				FWD GEN							
				AFT GEN							
Manuvering				SME							SBCAPCD
				PME							
				FWD GEN							
				AFT GEN							
Stand by				SME							SBCAPCD
				PME							
				FWD GEN							
				AFT GEN							
Manuvering				SME							SBCAPCD
				PME							
				FWD GEN							
				AFT GEN							
WP7-WP6				SME							SBCAPCD
WP7-WP6				PME							
WP7-WP6				FWD GEN							
WP7-WP6				AFT GEN							
WP6-WP5				SME							Federal

WP6-WP5		PME							
WP6-WP5		FWD GEN							
WP6-WP5		AFT GEN							
WP6-WP5		SME							Federal
WP6-WP5		PME							
WP6-WP5		FWD GEN							
WP6-WP5		AFT GEN							
WP5-WP4		SME							Federal
WP5-WP4		PME							
WP5-WP4		FWD GEN							
WP5-WP4		AFT GEN							
WP4-WP3		SME							SBCAPCD
WP4-WP3		PME							
WP4-WP3		FWD GEN							
WP4-WP3		AFT GEN							
WP3-WP2		SME							VCAPCD
WP3-WP2		PME							
WP3-WP2		FWD GEN							
WP3-WP2		AFT GEN							
WP2-WP1		SME							SCAQMD
WP2-WP1		PME							
WP2-WP1		FWD GEN							
WP2-WP1		AFT GEN							
WP1-POLB		SME							SCAQMD
WP1-POLB		PME							
WP1-POLB		FWD GEN							
WP1-POLB		AFT GEN							
			Hours Prior	Add Hours	Hours End	FOB START			
		SME							
		PME							
		FWD GEN							
		AFT GEN							
						Total Fuel Burn			
							FOB END		