APPLICATION AND INSTALLATION GUIDE

MARINE ENGINE ELECTRONIC DISPLAYS INSTALLATION GUIDE

CATERPILLAR®

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SPECIFICATIONS

1 SAFETY

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

CAUTION: Improper operation, lubrication, maintenance, or repair of this product can be dangerous and could result in injury or death.

DO NOT operate or perform any lubrication, maintenance, or repair on this product, until you have read and understood the operation, lubrication, maintenance, and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

1.1 WARNING LABELS

The hazards are identified by the Safety Alert Symbol and followed by a Signal Word such as DANGER, WARNING, or CAUTION. The Safety Alert WARNING label is shown below.

The meaning of this safety alert symbol is as follows:

- Attention!
- Become Alert!
- Your Safety Is Involved!

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE or CAUTION labels on the product and in this publication. Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all-inclusive.

1.2 PRACTICES

If a tool, procedure, work method, or operating technique that is not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance, or repair procedures that you choose.

The information, specifications, and figures in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, Figures, Tables, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job.

Caterpillar dealers have the most current information available.

1.3 REPLACEMENT PARTS

⚠ WARNING

When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength, and material.

CAUTION: Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

NOTES:

2 INFORMATION

This manual provides the information that is necessary for the installation of electronic displays for Caterpillar® marine engines and describes the installation of the following displays:

Engine Monitoring System (EMS)

Engine Vision Display

Global Positioning System (GPS)

Marine Analog Power Display (MAPD)

Marine Power Display (MPD)

Messenger

The installation requires the use of a Caterpillar Electronic Service Tool. The Caterpillar electronic service tool must be equipped with the proper software for the particular engine.

Use of the appropriate Troubleshooting Guide and the appropriate drawings is recommended. This will aid the Original Equipment Manufacturer (OEM) in the installation of the electronic components and systems.

Caterpillar electronic service tools are designed to help the service technician with the diagnosis and repair of electronic engines. Several tools are available to assist the service technician.

NOTE: Should a marine application require the Multi-Station Control System, refer to the following publication: LEGM2735 — Marine Multi-Station Control System Installation Guide.

2.1 REQUIRED SERVICE TOOLS

Table 2-1 Required Service Tools

REQUIRED SERVICE TOOLS	
Part Number	**Description**
N/A	4 mm Allen Wrench
1U-5804	Crimp Tool (12 AWGTO18AWG)
140-2266 or 7X-1715	Cable As (70-PIN BREAKOUT) Adapter Cable As (40-PIN BREAKOUT)
7X-6370	Adapter Cable As (3-PIN BREAKOUT)
7X-1710	Multimeter Probe
257-0140 or 146-4080	Digital Multimeter Digital Multimeter Gp (RS232)
175-3700	Connector Repair Kit

2.2 JUMPER WIRES

Two short jumper wires are needed to check the continuity of some wiring harness circuits by shorting two adjacent terminals together in a connector. A long extension wire may also be needed to check the continuity of some wiring harness circuits.

Table 2-2 Jumper Wires

JUMPER WIRES		
No. of Wires	**Wire Size**	**Length of Wire**
2(1)	16 AWG	203mm (8 inch)
2(1)	16 AWG	1.2 m (4 ft)
(1) Use the 1U-5804 Crimp Tool (12 AWG TO 18 AWG) to crimp pins on one wire and sockets on the other wire.		

2.3 CATERPILLAR® ELECTRONIC TECHNICIAN (ET)

The Caterpillar Electronic Technician (Cat ET) can display the following information:

- Parameters
- Event codes
- Diagnostic codes
- Engine configuration

Caterpillar ET can be used by the technician to perform the following functions:

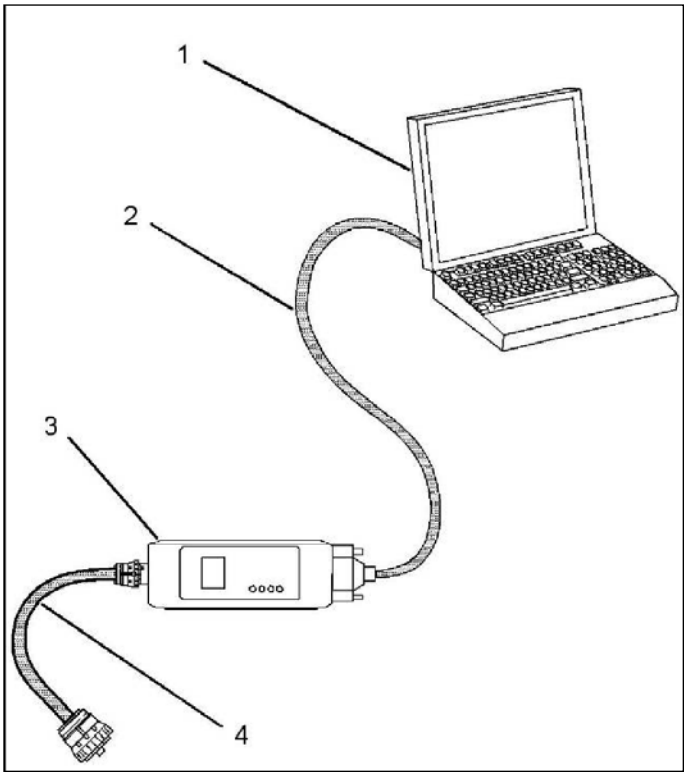
- Diagnostic tests
- Sensor calibrations
- Flash programming
- Set parameters

COMPONENTS REQUIRED TO USE CATERPILLAR ET

The following components are required to use Caterpillar ET to service the engine.

Table 2-3 Required Components for The Use of Cat ET

Part Number	Description
JERD2124	Electronic Technician Program (Cat® ET)
JERD2129	Data Subscription for All Engines and Machines
275-5120(1)	Communication Adapter Gp
237-7547(2)	Adapter Cable As
(1) The 7X-1700 Communication Adapter Gp may also be used. The Communication Adapter Gp is not necessary for communication with the PL1000T. (2) The 237-7547 Adapter Cable As is required to connect to the USB port on computers that are not equipped with a RS232 serial port.	



Caterpillar ET

(1) Personal computer (PC)

(2) 196-0055 Adapter Cable As

(3) 275-5121 Communication Adapter As

(4) 207-6845 Adapter Cable As (Data Link)

NOTE: Items (2), (3), and (4) are part of the 275-5120 Communication Adapter GP.

Figure 2-1 Cat® ET and Communications Adapter

COMPONENTS REQUIRED TO USE CATERPILLAR ET

Use the following procedure to connect Cat ET and the 275-5120 Communication Adapter GP:

1. Turn the key switch to the OFF/RESET position. If the key switch is not placed in the OFF/RESET position, the engine may start.
2. Connect cable (2) between the COMPUTER end of communication adapter (3) and the RS232 serial port of PC (1).

NOTE: The 237-7547 Adapter Cable As is required to connect to the USB port on computers that are not equipped with a RS232 serial port.

3. Connect cable (4) between the DATA LINK end of communication adapter (3) and the service tool connector.
4. Turn the key switch to the ON position. If Cat ET and the communication adapter does not communicate with the ECM, refer to The Cat ET Troubleshooting Guide — Electronic Service Tool Will Not Communicate with ECM.

2.4 OPTIONAL SERVICE TOOLS

The Caterpillar Electronic Technician (Cat ET) can display the following information:

Table 2-4 Optional Service Tools

OPTIONAL SERVICE TOOLS	
Part Number	**Description**
4C-4075	Crimp Tool (4 AWG TO 10 AWG)
4C-4911[1]	Battery(-) Load Tester
5P-7277	Voltage Tester
8T-5319	Connector Tool Group
[1] Refer to Special Instructions, SEHS9249, Use of the 4C-4911 "Battery Load Tester for 6, 8, and 12 Volt Lead Acid Batteries" and Special Instructions, SEHS7633, "Battery Test Procedure".	

2.5 PUBLICATIONS

Table 2-5 Publications That Are Needed During Installation

PUBLICATIONS THAT WILL BE NEEDED IN THE INSTALLATION	
Description	**Form Number**
Engine Vision Operators Guide	LEKM8504
Engine Vision Version Update	LERM8401
EMS Operators Guide	LEKM7488
Marine Multi-Station Control System	RENR7651
Marine Multi-Station Control System Installation Guide	LEGM2735
Marine Power Display Operator's Manual and Software	LEBM0189
Color Marine Power Display Basic Operations Manual and Software	EEBR1000
Marine Multi-Station Control System Electrical System - Typical Single Engine Installation	RENR7893
Marine Multi-Station Control System Electrical System - Typical Dual Engine Installation	RENR7929
PL1000T Communication ECM	RENR7945
Installation Guide for the 256-7511 PL1000T Communications ECM	REHS2125

3 ELECTRICAL CONNECTORS

Many of the procedures in this manual will direct you to a specific electrical connector. All of these connectors utilize a locking feature that will hold the terminals in place. There is also a locking feature that secures the two halves of the connector after joining. The connectors are repairable without cutting the wires.

CAUTION: During Repairs, Never Solder Terminals to the Wires. Terminals Should Always Be Crimped onto the Wires as Shown in Figure 3-1.

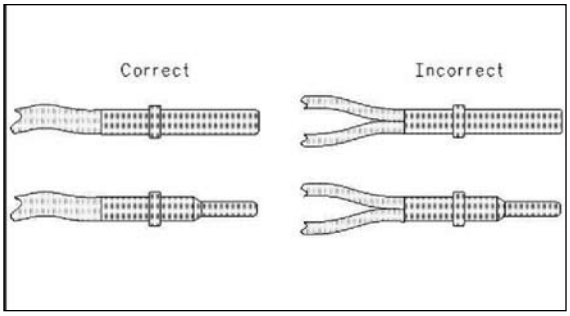


Figure 3-1 Terminal Connections

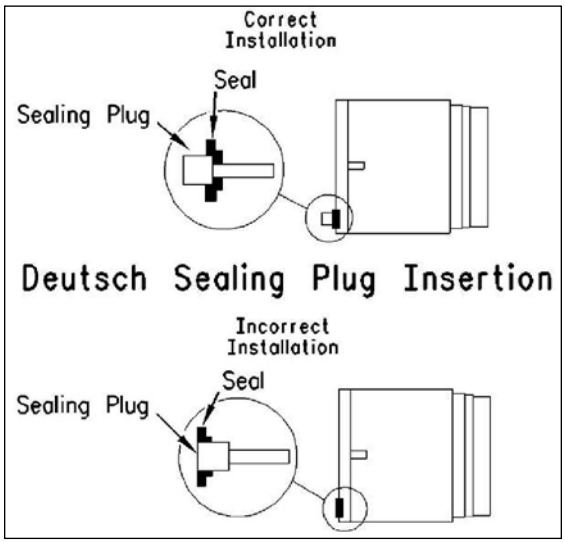


Figure 3-2 Installation of Seal Plugs

Use the 1U-5804 Crimp Tool to crimp the terminals to the wires.

The 8T-8729 Connector Pin and the 8T-8730 Connector Socket is designed to accept only one 16 AWG or 18 AWG wire as shown in Figure 3-1.

DO NOT insert multiple wires of a smaller wire size into a single terminal.

The 9W-0852 Connector Pin and the 9W-0844 Connector Socket are also designed to accept only one 14 AWG wire.

Never insert multiple wires of a smaller wire size into a single terminal.

3.1 INSTALLATION OF SEAL PLUGS

The seal plug is used to fill unused terminal locations. A 8T-8737 Seal Plug must be installed in all unused slots of the connector socket.

The proper insertion of the seal plug will provide a seal that is water tight. Figure 3-2 demonstrates the correct insertion of the seal plug into the terminal location. The cap of the seal plug is designed to seal against the face of the sealing band for the connector's terminal location.

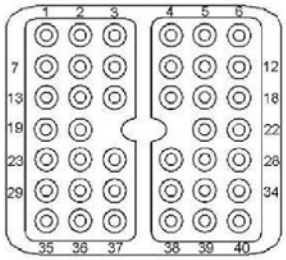
DO NOT force the cap of the sealing plug past the lip of the sealing band.

3.2 CUSTOMER CONNECTORS

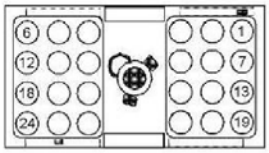
Figure 3-3 Customer Connectors

P2 Customer Connector
(40 Pin Terminal Side)

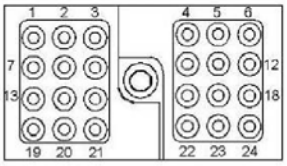
P2 Customer Connector
(40 Pin Wire Side)



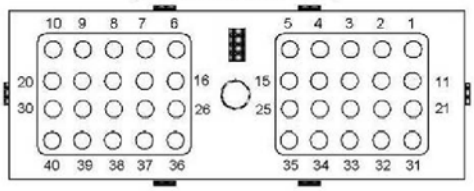
P31 Customer Connector
(24 Pin Terminal Side)



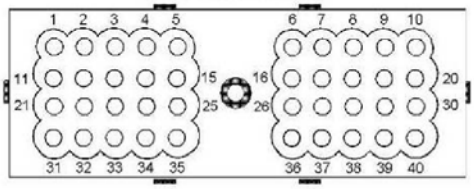
P31 Customer Connector
(24 Pin Wire Side)



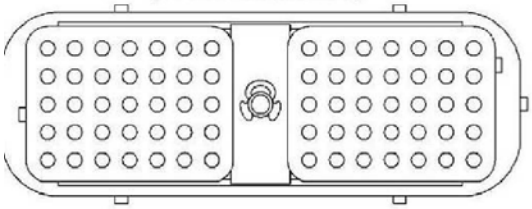
P3 or P61 Customer Connector
(40 Pin Terminal Side)



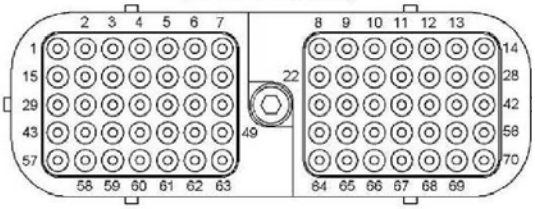
P3 or P61 Customer Connector
(40 Pin Wire Side)



P3 or P61 Customer Connector
(70 Pin Terminal Side)



P3 or P61 Customer Connector
(70 Pin Wire Side)



P3 or P61 Customer Connector
(85 Pin Terminal Side)

P3 or P61 Customer Connector
(85 Pin Wire Side)

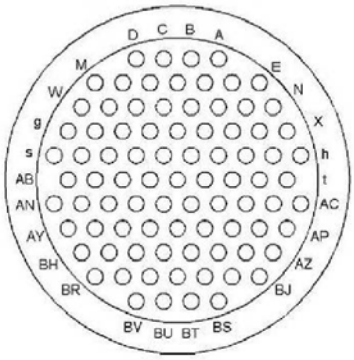


Table 3-1 Customer Connectors

CUSTOMER CONNECTORS	
Part Number	**Description**
233-9217	Connector (85 pin customer connector)
9X-4391	Connector Plug As (70 pin customer connector)
8T-9834	Connector Plug As (40 pin customer connector)
7X-6222	Connector Plug As (24 pin customer connector)
8T-8732	Receptacle (40 pin customer connector)
143-5018	Electrical Cable(1)
8T-8737	Seal Plug
1U-5805	Wire Removal Tool
151-6320	Wire Removal Tool
(1) The Data Link cable must be fabricated to the correct length.	

- Ensure that the allen head screw for the customer connector is properly tightened. For the correct torque value, see SENR5002 Troubleshooting Guide.
- Perform the 45 N (10 lb) pull test on each socket, each pin, and each wire. Each socket, each pin, and each wire should easily withstand the pull test. All components should remain in the connector body.

This test ensures that the wire was properly crimped to the terminal and that the terminals are properly inserted in the connector.

The acceptable range for the outside diameter of the wire is 2.54 to 3.43 mm (0.100 to 0.135 inch) for the customer connectors.

HD-10 CONNECTORS

The acceptable range for the outside diameter of the wire is 2.50 to 3.75 mm (0.100 to 0.150 inch).

1. Ensure that the plug and the receptacle are aligned with the index marking.
2. Rotate the plug until the plug slips into the receptacle.
3. Rotate the coupling to a quarter turn. A click will be heard.
4. Ensure that the two halves cannot be pulled apart.

DT CONNECTORS

The acceptable range for the outside diameter of the wire is 2.20 to 3.68 mm (0.088 to 0.145 inch). The DT connectors use a locking wedge to secure the terminals into the connector.

1. Check the locking wedge for wear and/or damage. Replace the wedge if necessary.
2. Check that the seals are in place and check that the seals are properly seating.
3. Check the terminals for damage before joining the connectors.
4. Verify proper alignment and locations of terminals in each connector.
5. Check the locking tab of the connector for damage. Replace the connector if the locking tab is damaged.
6. After joining the connectors, ensure that the locking tab is properly latched. An audible click will be heard as the locking tab snaps into the locking slot.
7. Ensure that the two mating connectors cannot be pulled apart.

NOTES:

4 SWITCHES

4.1 ELECTRICAL SPECIFICATIONS

Voltage that is applied to the switches by the Electronic Control Module (ECM) will not exceed 13 VDC under normal conditions.

NOTE: Gold plated contacts are recommended. The plating on the contacts must not be allowed to corrode or oxidize.

Current draw through the switches must not exceed 5.0 mA.

Contact chatter, the momentary opening and closing of the contact points, should not exceed 100 milliseconds in duration.

Vibration or shock, normally found in the marine environment, should not actuate switches.

When a switch contact is opened or the harness has an open circuit, the ECM and the internal pull-up resistors of the display module force the respective input(s) to an internal pull up voltage.

Closure Of Switches: Switches installed by the Original Equipment Manufacturer (OEM), must complete the circuit to the negative Battery(-) bus bar.

Switches that control the power for the engine vision display should be rated at the following specifications:

• 28 V, 30 Amp, starting surge

• 10 Amp steady state

4.2 VOLTAGE THRESHOLDS

INPUTS FOR LOW VOLTAGE

When any of the switch contacts are closed, the voltage drop through the switch circuit must be less than 0.9 VDC. This measurement should be taken with respect to the control input and the Battery(-) input at the ECM. This measurement includes the following values:

• Ground potential differences

• Voltage drop across the switch

• Voltage drop across the wiring harness

INPUTS FOR HIGH VOLTAGE

When any of the switch contacts are open, the resistance between the respective control input and the Battery(-) input at the ECM should not be less than 5,000 Ohms.

Potential paths for leakage may exist within the following components:

• Connectors

• Harnesses

• Switches

CAUTION: OEM installed switches must be connected to the Battery(-).

4.3 CUSTOMER INSTALLED SWITCHES

Table 4-1 Customer Installed Switches

CUSTOMER INSTALLED SWITCHES		
Switch	**Required Actuator**	**Type**
3E-8766	155-2706	Rocker Actuator (1)
3E-8768	155-2706	Rocker Actuator (2)
3E-8772	155-2705	Rocker Actuator (3)

(1) Single Pole Single Throw (SPST)
(2) SPST momentary Drawing for 3E-8766 Switch and 3E-8768 Switch
(3) Double Pole Double Throw (DPDT) momentary

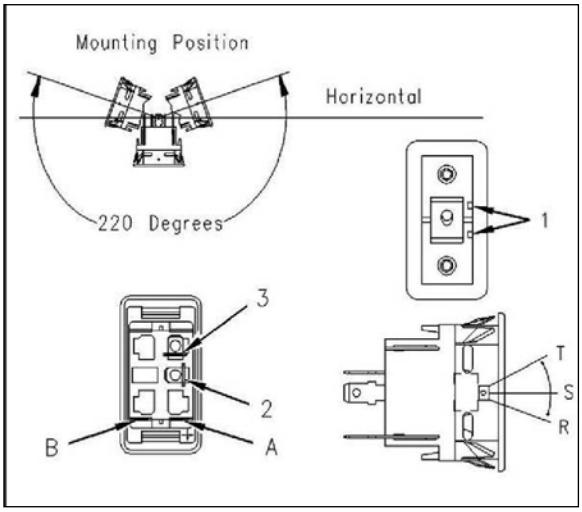


Figure 4-1
E-8766 & 3E-8768 Switch

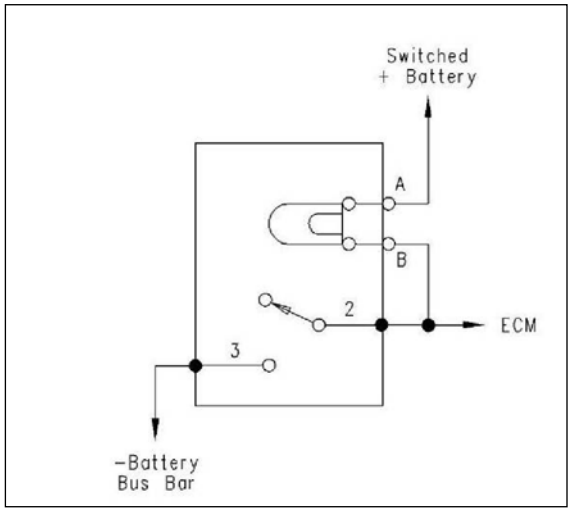


Figure 4-2
Drawing 3E-8766 & 3E-8768 Switch

(R) ON (top or left) (T) OFF (bottom or right)

(S) NONE (center) (1) Locating tabs

When contacts 2 and 3 of the switch are closed, the backlight that is connected to switch terminals A and B illuminates.

NOTES:

5 WIRING

5.1 DATA LINK COMMUNICATIONS

The Data Link is available to share data between the Electronic Control Module (ECM), electronic display modules, electronic service tools, and other modules.

The SAE J1939 Data Link is used to communicate engine information from the ECM to display modules on the J1939 Data Link, such as the Marine Power Display or the Marine Analog Power Display.

The ATA SAE J1587 and SAE J1708 Data Link (American Trucking Association) is used in some applications to communicate with electronic service tools. Use 143-5018 Electrical Cable for all connections to the ATA Data Link.

The Cat Data Link is a proprietary communication medium that is available on all electronic marine engines that are produced by Caterpillar. It is used for communications between the engine and other electronic display modules (microprocessor based) created by Caterpillar.

5.2 WIRING THE CAT DATA LINK (CDL)

The Cat Data Link must be wired properly for proper display operation.

CAUTION: Improper wiring of the Cat Data Link can result in electronic display modules that do not function properly. Avoid splicing or soldering wire connections.

Table 5-1 Cat Data Link Required Parts

CAT DATA LINK REQUIRED PARTS		
Part Number	**Description**	**Quantity**
8T-8730	Connector Socket	4
143-5018	Electrical Cable	N/A

1. Use the 143-5018 Electrical Cable and the terminal strips that are dedicated for all connections to the Cat Data Link.
2. Install the terminal strips in a location that will minimize the overall cable length for the Cat Data Link.
3. The total length of the Data Link wires must not exceed 30 m (100 ft).
4. There can be only one cable for the Cat Data Link that runs from the engine room to the electronic displays.
5. If another operator station uses a Cat Data Link, then the Data Link cable should be run from the terminal strip in the engine room to the operator station.
6. The cable should then run from the first station to the second station.
7. All connections must be terminated at the terminal strips.
8. Terminal strip connections will help in order to ensure the reliability of the engine.

These connections will ensure the reliability of the communications. Refer to the Table 5-2 for the proper terminal locations for a particular engine.

Table 5-2 Terminal Locations for Customer Connector

CAT DATA LINK TERMINAL LOCATIONS FOR CUSTOMER CONNECTOR		
Engine	**Cat Data Link+**	**Cat Data Link**
3408C, 3412C	18	24
3176B	9	3
3126B, 3176C, 3196, 3406E, 3412E, C7, C9, C12, C15, C18, C30, C32	7	6
3500B	22	14
3500B Series II	h	g

5.3 CONNECTIONS IN THE ENGINE ROOM

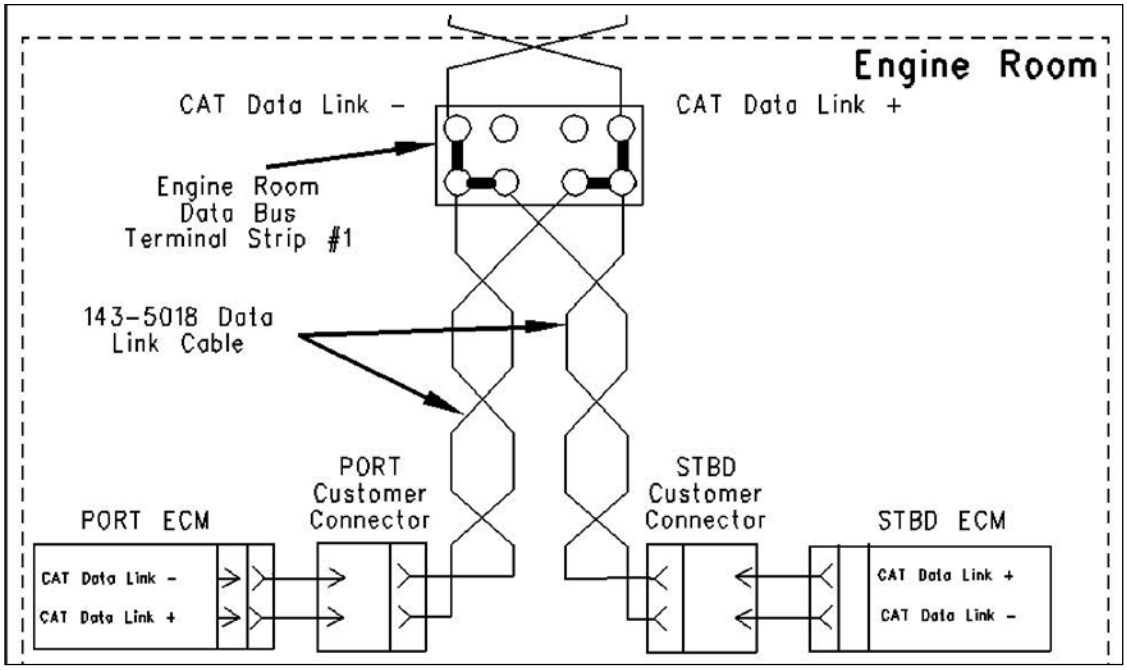


Figure 5-1 Connections in the Engine Room

DATA LINK TERMINAL STRIP

- The terminal strip for the Data Link (in the engine room) should be located as close as possible to the customer connector. This will help to minimize the length of the Data Link cable.
- Ensure that there is a terminal strip for the Data Link in the engine room.
- A terminal strip should be located at the operator station that is on the bridge.

MULTIPLE OPERATOR STATIONS

- For multiple operator stations, route the Data Link cable from the bridge to the second operator station.
- Connect the wires for the STBD Cat Data Link and the wires for the PORT Cat Data Link to the terminal strip that is in the engine room. Use the 143-5018 Electrical Cable to make this connection.

5.4 CONNECTIONS FROM THE ENGINE ROOM TO THE BRIDGE

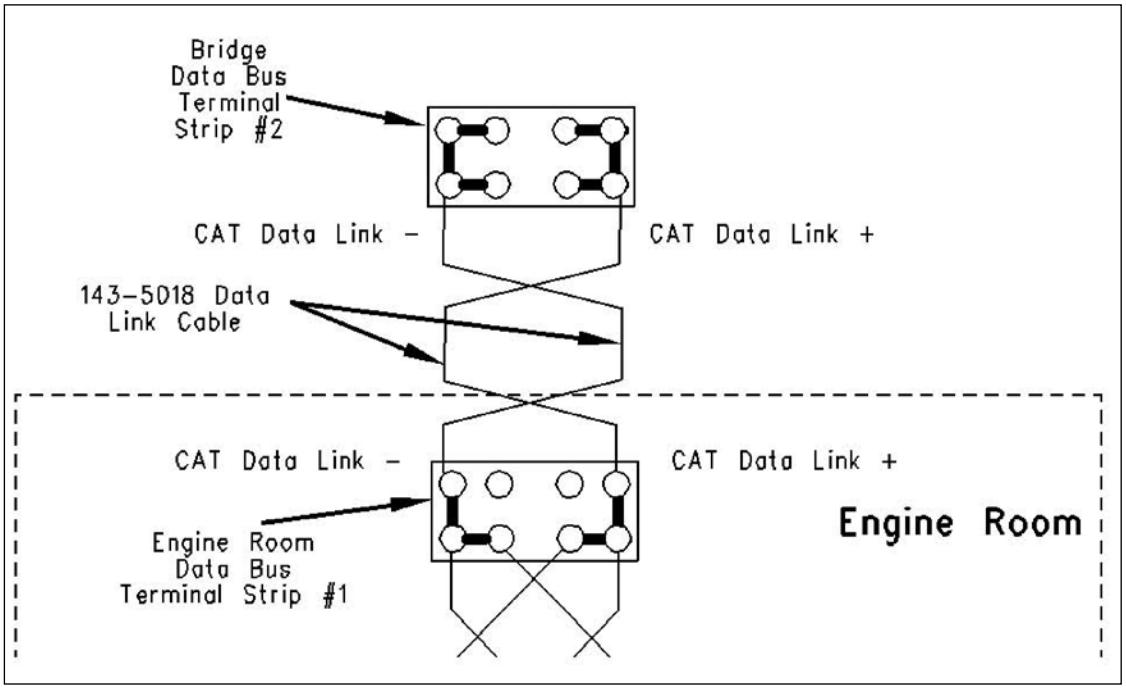


Figure 5-2 Connections from the Engine Room to the Bridge

1. Connect the Cat Data Link from the terminal strip that is in the engine room to the terminal strip that is on the bridge. Use the 143-5018 Electrical Cable to make this connection.
2. Correct wiring of the Cat Data Link is essential for proper display operation.
3. The Cat Data Link requires the use of the 143-5018 Electrical Cable.
4. The installation is required to have a terminal strip that is dedicated to the connections for the Cat Data Link.

   This terminal strip must be placed at a location that will minimize the length of the wire that is required for the Cat Data Link.

NOTE: Use only one set of twisted wire when wiring to the displays on the bridge.

SECOND OPERATOR STATION

If a second operator station requires a display, perform the following procedure:

1. Begin the data wires at the terminal strip in the engine room.
2. Continue the wires to the first station.
3. Wiring will then continue from the first station to the second station.

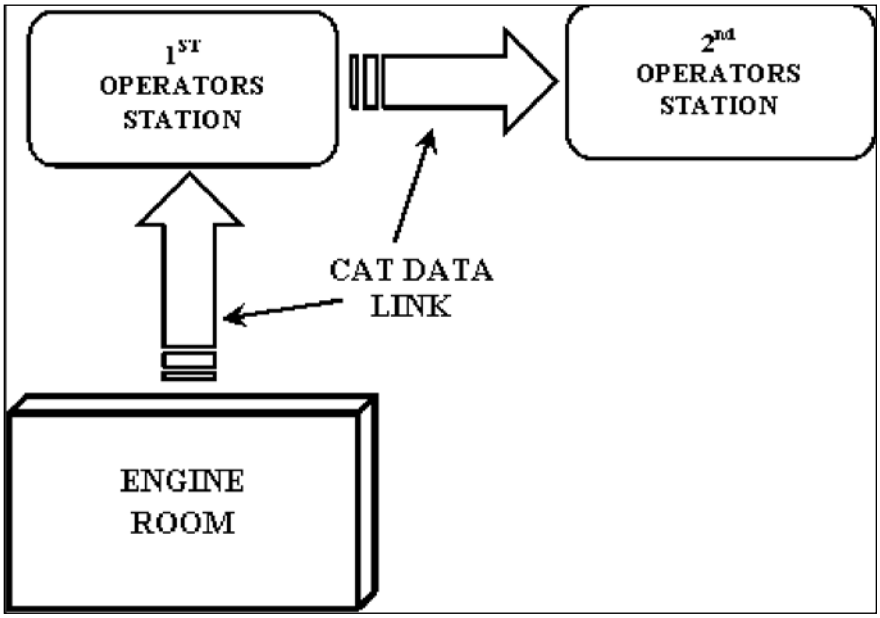


Figure 5-3 Second Operator Station

5.5 J1939 DATA LINK WIRING

The SAE J1939 Data Link is used in order to communicate the engine information to a J1939 display.

NOTE: If a marine application requires the Multi-Station Control System, refer to LEGM2735, Marine Multi-Station Control System Installation Guide for installation of the J1939 Data Link.

5.6 CONNECTING THE J1939 DATA LINK

Figure 5-4 shows the connection of modules to the J1939 Data Link. The following requirements must be met for installation of modules on the J1939 Data Link:

153-2707 Electrical Cable must be used for all J1939 Data Link wiring. This is twisted pair wiring.

NOTE: If the Caterpillar recommended cable is not used, the cable must meet J1939 standards.

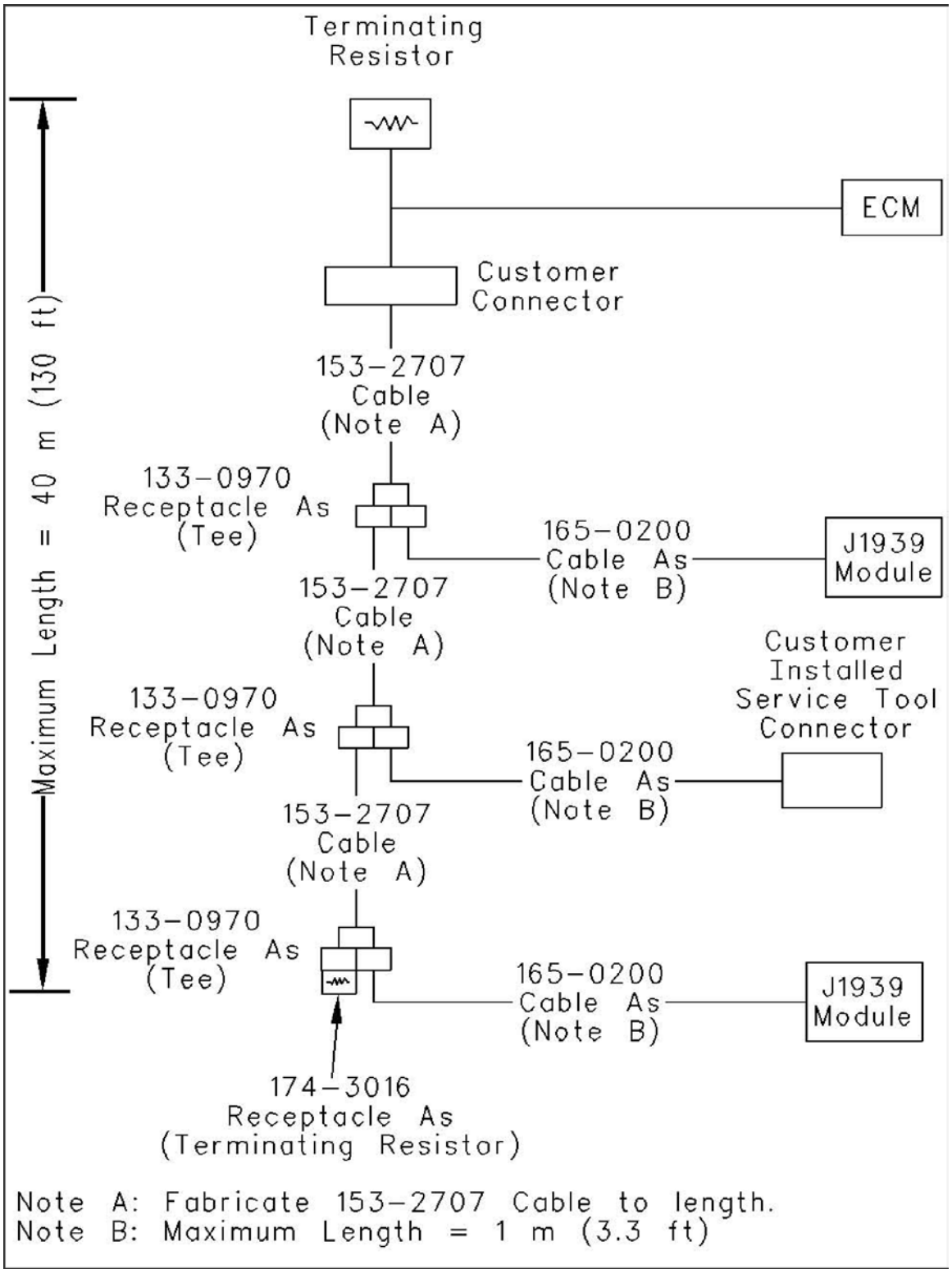


Figure 5-4 Module Connections to the J1939 Data Link

5.7 J1939 CABLE SPECIFICATIONS

CABLE LENGTH

The total length of the Data Link must not exceed 40 m (130 ft).

All splices into the Data Link require a 133-0970 Receptacle As.

A 174-3016 Plug As must be installed at the end of the Data Link in order to ensure proper operation. These termination resistors are necessary for the proper operation of the network.

Table 5-3 J1939 Specifications for Conductors

J1939 SPECIFICATIONS FOR CONDUCTORS			
Conductor	**Minimum**	**Nominal**	**Maximum**
Impedance (ohm)	108	120	132
Capacitance between conductors (pF/m)	0	40	75
Capacitance between the conductors and the shield (pF/m)	0	70	110

TERMINATION RESISTORS

One termination resistor for the J1939 Data Link is included in the Caterpillar supplied wiring harness to the customer connector.

One additional termination resistor must be installed at the end of the Data Link by the customer.

5.8 J1939 CONNECTING MODULES — REQUIRED PARTS

Table 5-4 Required Parts Single Module Installation

REQUIRED PARTS: SINGLE MODULE INSTALLATION		
Part Number	**Description**	**Qty**
5P-6001	Tube	6cm (2.4 inch)
125-7876	Heat-shrink Tube	15 cm (6.0 inch)
133-0969	Socket Connector	2
133-0970	Receptacle As	1
174-3016	Plug As	1
153-2707	Electrical Cable	(1)
165-0200	Cable As	2
8T-8736(2)	Connector Receptacle	1
174-0503	Connecting Plug Kit (3)	1
186-3736	Connector Socket	4

(1) Fabricated to length
(2) The 8T-8736 Connector Receptacle for the service tool connector should only be used if one was not previously installed
(3) Use the blue wedge

Table 5-5 Required Parts Additional Module

REQUIRED PARTS: ADDITIONAL MODULE INSTALLATION		
Part Number	**Description**	**Qty**
5P-6001	Tube	6cm (2.4 inch)
125-7876	Heat-shrink Tube	15 cm (6.0 inch)
133-0969	Socket Connector	2
133-0970	Receptacle As	1
153-2707	Electrical Cable	(1)
165-0200	Cable As	1
174-0503	Connecting Plug Kit (2)	2
186-3736	Connector Socket	4
	(1) Fabricated to length	
	(2) Use the blue wedge	

5.9 J1939 MODULE CONNECTION PROCEDURE:

STEPS 1 – 5

Use the following procedure to connect modules to the J1939 Data Link:

STEP 1: J1939 DATA LINK CUSTOMER CONNECTOR TO A MODULE

NOTE: The end of the Data Link must be within approximately 1 m (3.3 ft) of the module.

CAUTION: The total length of the Data Link must not exceed 40 m (130 ft).

1. Run 153-2707 Electrical Cable from the customer connector to the location of the first module. Cut the cable to length.

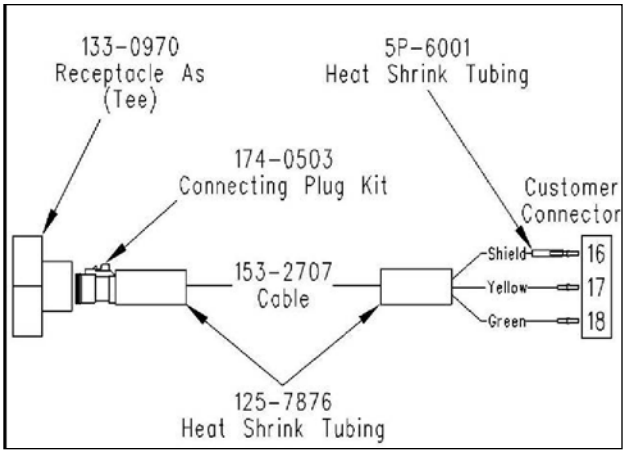


Figure 5-5 Connecting Customer Connection to Tee

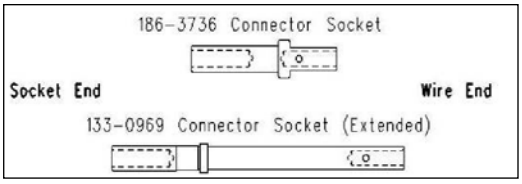


Figure 5-6 Connector Sockets

2. Remove 25 mm (1.0 inch) of insulation from both ends of the cable.
3. Remove 7 mm (0.3 inch) of insulation from each end of the green wire and the yellow wire.
4. Crimp a 186-3736 Connector Socket on each end of the green wire and the yellow wire with a 1U-5804 Crimp Tool.

5. Crimp a 133-0969 Socket Connector on each end of the shield with a 1U-5804 Crimp Tool.
6. Cut two 30 mm (1.2 inch) pieces of 5P-6001 Tube.
7. Slide a piece of the heat-shrink tube over the shield at each end of the cable.
8. Position the heat-shrink tube so that 1 cm (0.4 inch) of the socket is covered and the remaining tubing is covering the shield.
9. Apply heat until a complete seal is formed around the shield and the socket.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

10. Cut two 50 mm (2.0 inch) pieces of 125-7876 heat-shrink tube. Slide a piece of the heat-shrink tube over each end of the cable.
11. Insert the wires from one end of the Data Link into the customer connector, Table 5-6.

Table 5-6 Terminal Locations in the Customer Connector

TERMINAL LOCATIONS IN THE CUSTOMER CONNECTOR	
Wire Color	**Location**
Shield	16
Yellow	17
Green	18

12. Position the 125-7876 Heat-Shrink Tube so that 20 mm (0.8 inch) of the exposed wires are covered and the remainder of the heat-shrink tube is over the cable.
13. Apply heat until a complete seal is formed.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

14. Insert the sockets at the opposite end of the J1939 Data Link into a 174-0503 Connecting Plug Kit. Refer to Table 5-7.

Table 5-7 Terminal Locations in the Plug

TERMINAL LOCATIONS IN THE PLUG	
Wire Color	**Location in the Plug**
Shield	C
Yellow	A
Green	B

15. Insert the blue wedge into the connector to secure the terminals in place.
16. Position the 125-7876 Heat-Shrink Tube so that 10 mm (0.4 inch) of the plug is covered and the rest of the heat-shrink tube is over the cable.
17. Apply heat until a complete seal is formed around both the plug and the cable.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

18. Plug the end of the Data Link into the single end of a 133-0970 Receptacle As.

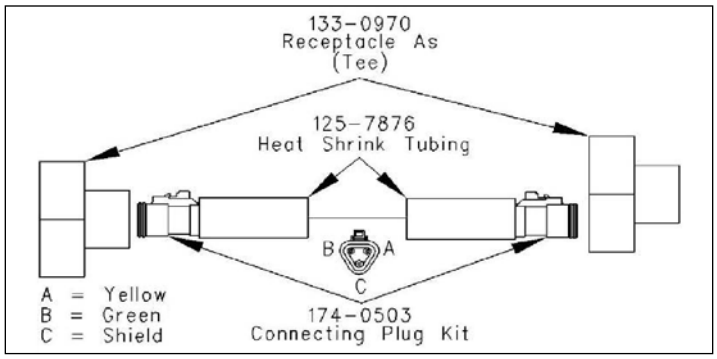


Figure 5-7 Connecting One Tee to Another Tee

STEP 2: ADDITIONAL MODULE DATA LINK WIRING TEE TO TEE

NOTE: For the installation of a single module, proceed to Step 3.

CAUTION: The end of the Data Link must be within approximately 150 mm (6.0 inch) of the module. The total length of the Data Link must not exceed 40 m (130 ft).

1. Run 153-2707 Electrical Cable from the tee to the location of the next module. Cut the cable to length.
2. Remove 25 mm (1.0 inch) of insulation from both ends of the cable.
3. Remove 7 mm (0.3 inch) of insulation from each end of the green wire and the yellow wire.
4. Crimp a 186-3736 Connector Socket on each end of the green wire and the yellow wire with a 1U-5804 Crimp Tool.
5. Crimp a 133-0969 Socket Connector (Extended) on each end of the shield with a 1U-5804 Crimp Tool.
6. Cut two 30 mm (1.2 inch) pieces of 5P-6001 Tube.
7. Slide a piece of the heat-shrink tube over the shield at each end of the cable.
8. Position the heat shrink tube so that 10 mm (0.4 inch) of the socket is covered and the remaining tubing is covering the shield.
9. Apply heat until a complete seal is formed around the shield and the socket.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

10. Cut two 50 mm (2.0 inch) pieces of 125-7876 Heat-Shrink Tube and slide a piece of the heat-shrink tube over each end of the cable.

Install a 174-0503 Connecting Plug Kit on each end of the cable.

11. Table 5-8. Insert the blue wedge into the connector in order to secure the terminals in place.

Table 5-8 Terminal Locations in the Plug

TERMINAL LOCATIONS IN THE PLUG	
Wire Color	**Location in Plug**
Shield	C
Yellow	A
Green	B

12. Position the 125-7876 Heat-shrink Tube so that 10 mm (0.4 inch) of the plug is covered and the rest of the heat-shrink tube is over the cable.
13. Apply heat until a complete seal is formed around both the plug and the cable.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

14. Perform this process on both ends of the cable.
15. Plug one end of the new cable into one of the openings in the existing tee. Plug the other end of the new cable into the single end of a 133-0970 Receptacle As for the additional module.

NOTE: If you are installing additional modules, repeat Step 2 for each module.

STEP 3: CONNECT RECEIVING MODULE TO THE TEE

1. Plug a 165-0200 Cable As into the 133-0970 Receptacle As (Tee).

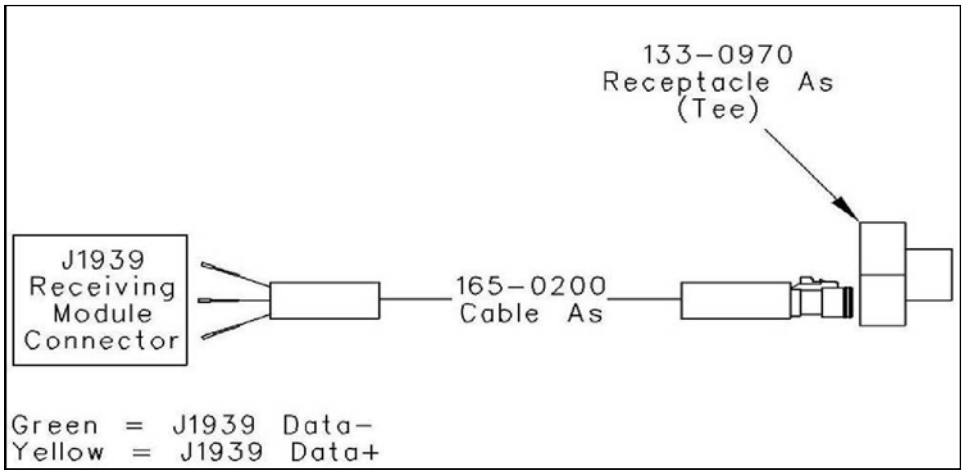


Figure 5-8 Connecting a J1939 Module

2. Cut a 50 mm (2.0 inch) piece of 125-7876 Heat-shrink Tube. Slide the heat-shrink tube over the display connector of the cable assembly.
3. Connect the three wires from the end of the cable assembly to the appropriate terminals on the plug for the module.

NOTE: Refer to the appropriate topic for the display that is being installed for more information on connecting the display module.

Repeat Step 3 for each module.

STEP 4: CONNECT SERVICE TOOL CONNECTOR

NOTE: If a customer supplied service tool connector is already installed, connect the J1939 Data Link to the existing connector.

1. Run the 153-2707 Electrical Cable from the last 133-0970 Receptacle As to the service tool connector. Cut the cable to length.

CAUTION: The total length from the 133-0970 Receptacle As to the Communications Adapter must be no more than 1.0 m (3.25 ft)

2. Remove 25 mm (1.0 inch) of insulation from both ends of the cable.
3. Remove 7 mm (0.3 inch) of insulation from each end of the green wire and the yellow wire.
4. Crimp a 186-3736 Connector Socket on each end of the green wire and the yellow wire with a 1U-5804 Crimp Tool.
5. Crimp a 133-0969 Socket Connector on each end of the shield with a 1U-5804 Crimp Tool.

6. Cut two 30 mm (1.2 inch) pieces of 5P-6001 Tube.
7. Slide a piece of the Heat-Shrink Tube over the shield at each end of the cable.
8. Position the Heat-Shrink Tube so that 1 cm (0.4 inch) of the socket is covered and the remaining tubing is covering the shield.
9. Apply heat until a complete seal is formed around the shield and the socket.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

10. Cut two 50 mm (2.0 inch) pieces of 125-7876 Heat-Shrink Tube and slide a piece of the heat-shrink tube over each end of the cable.
11. Insert the wires from one end of the Data Link into the service tool connector, Table 5-9.

Table 5-9 Terminal Locations in the Service Tool Connector

TERMINAL LOCATIONS IN THE SERVICE TOOL CONNECTOR	
Wire Color	**Location**
Shield	C
Yellow	G
Green	F

12. Position the 125-7876 Heat-shrink Tube so that 20 mm (0.8 inch) of the exposed wires are covered and the rest of the heat-shrink tube is over the cable. Apply heat until a complete seal is formed.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

13. Insert the sockets at the opposite end of the J1939 Data Link in to a 174-0503 Connecting Plug Kit, Table 5-10. Insert the green wedge into the connector in order to secure the terminals in place.

Table 5-10 Terminal Locations in the Plug

TERMINAL LOCATIONS IN THE PLUG	
Wire Color	**Location in the Plug**
Shield	C
Yellow	A
Green	B

14. Position the 125-7876 Heat-shrink Tube so that 10 mm (0.4 inch) of the plug is covered and the rest of the heat-shrink tube is over the cable. Apply heat until a complete seal is formed around both the plug and the cable.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat-shrink tube.

15. Plug the 174-0503 Connecting Plug Kit into the double end of a 133-0970 Receptacle As.

STEP 5: TERMINATION RESISTOR CONNECTION TO TEE AT END OF DATA LINK

1. Connect a 174-3016 Plug As to the 133-0970 Receptacle As.

NOTES:

SYSTEMS OPERATION SECTION

6 ANALOG POWER DISPLAY INSTALLATION

The Marine Analog Power Display (MAPD) receives information from J1939 Data Link. This information is broadcast to the Data Link by an Electronic Control Module (ECM).

The J1939 Data Link is utilized to send status information for the engine to the control module for the MAPD.

The control module supplies a signal to display operating information on the analog gauges.

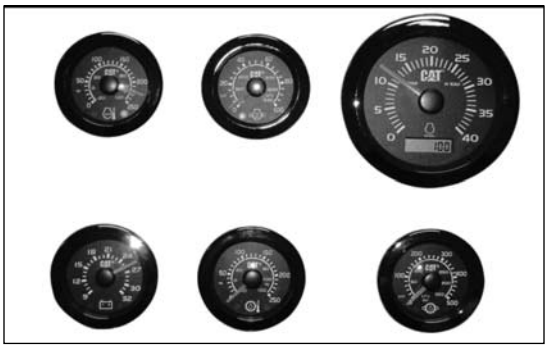


Figure 6-1 Marine Analog Power Display (MAPD)

Two LED indicators on each gauge can be illuminated in order to alert the operator of problems with the engine and/or Data Link communications.

A liquid crystal display on the tachometer gauge can display hours and diagnostic codes.

A maximum of 12 gauges can be connected to the control module for the MAPD.

Refer to Table 6-1 for a list of available gauges.

Table 6-1 Available Gauges and Harnesses

AVAILABLE GAUGES AND HARNESSES			
PART #	**DESCRIPTION**	**RANGE**	**SIZE**
210-4309	Gauge Control Gp		
222-9889	Auxiliary Pressure Gauge Gp	0to3450kPa (0 to 500psi)	51 mm (2 inch)
222-9893	Auxiliary Temperature Gauge	40 to 50 °C (40 to 120 °F)	51 mm (2 inch)
222-9895	Manifold Pressure Gauge Gp	0to350 kPa (0 to 50 psi)	76 mm (3 inch)
211-0740	Manifold Pressure Gauge Gp	0to350 kPa(0to50 psi)	51 mm (2 inch)
222-9899	Coolant Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	76 mm (3 inch)
207-2823	Coolant Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	51 mm (2 inch)
222-9900	Pyrometer Gp	120 to 870 °C (250 to 1600 °F)	51 mm (2 inch)
211-0744	Fuel Level Gauge Gp	0to4/4	51 mm (2 inch)
222-9901	Fuel Pressure Gauge Gp	700 kPa (100 psi)	76 mm (3 inch)
211-0745	Fuel Pressure Gauge Gp	700 kPa (100 psi)	51 mm (2 inch)
222-9902	Fuel Consumption Rate Gauge Gp	190 L/h (50 gph)	51 mm (2 inch)
211-0746	Fuel Consumption Rate Gauge Gp	0to300 L/h(0to80gph)	51 mm (2 inch)
222-9904	Fuel Consumption Rate Gauge Gp	760 L/h (200 gph)	76 mm (3 inch)
222-9903	Fuel Consumption Rate Gauge Gp	760 L/h (200 gph)	51 mm (2 inch)
222-9905	Fuel Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	76 mm (3 inch)
211-0747	Fuel Temperature Gauge Gp	0to120 °C (0 to 250 °F)	51 mm (2 inch)
222-9906	Manifold Air Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	76 mm (3 inch)
211-0748	Manifold Air Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	51 mm (2 inch)
222-9907	Engine Oil Pressure Gauge Gp	0to 690 kPa (0to100 psi)	76 mm (3 inch)
207-2824	Engine Oil Pressure Gauge Gp	0to 690 kPa (0to100 psi)	51 mm (2 inch)
222-9908	Engine Oil Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	76 mm (3 inch)
211-0741	Engine Oil Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	51 mm (2 inch)

AVAILABLE GAUGES AND HARNESSES (CONTINUED)			
PART #	**DESCRIPTION**	**RANGE**	**SIZE**
222-9909	Engine Percent Load Gauge Gp	0to100%	76 mm (3 inch)
211-0749	Engine Percent Load Gauge Gp	0to100%	51 mm (2 inch)
222-9910	Speedometer Gp	0to60 knots	76 mm (3 inch)
207-2825	Tachometer Gp	0to 4000rpm	76 mm (3 inch)
211-0743	Tachometer/Service Gauge Gp	0to 3600rpm	76 mm (3 inch)
211-0742	Tachometer/Service Gauge Gp	0to 3000rpm	76 mm (3 inch)
222-9915	Gear Oil Pressure Gauge Group (TRANSMISSION)	0to3450kPa (0 to 500psi)	76 mm (3 inch)
207-2826	Gear Oil Pressure Gauge Group	0to3450kPa (0 to 500psi)	51 mm (2 inch)
222-9916	Oil Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	76 mm (3 inch)
207-2827	Oil Temperature Gauge Gp	0 to 120 °C (0 to 250 °F)	51 mm (2 inch)
222-9917	Voltmeter Gp	0 to32VDC	76 mm (3 inch)
207-2822	Voltmeter Gp	0 to32VDC	51 mm (2 inch)
211-0707	Voltmeter Gp	0 to16VDC	51 mm (2 inch)
Available Harnesses			
212-8258 or 212-8257 or 212-8256	Harness		0.9 m (3 ft) 1.5 m (5 ft) 9m(30ft)
212-8255	Harness T-harness cable		
212-8259	Harness Termination	Pin to socket terminals	
221-0777	Wiring Harness Termination	Sockets to Sockets	
174-3016	Plug As Termination	120 Ohms	

CAUTION: No additional connections are allowed to any wires that are detailed and described in this publication without the approval of Caterpillar.

6.1 MOUNTING THE MARINE ANALOG POWER DISPLAY

1. Mount the control module in a location that is protected from direct exposure to moisture.
2. The control module should be mounted away from vibration.
3. If the control module must be mounted in a location that is exposed to vibration, use rubber grommets in order to reduce the effects of the vibration.
4. The control module may be mounted alone or the control module may be mounted to the back of a three inch gauge.
5. If you plan to mount the gauge onto the engine, first install the gauge into the panel.
6. Be sure to install the assembly with rubber grommets in order to reduce vibration.

MOUNTING THE CONTROL MODULE ALONE

1. Determine the location for the mounting of the control module.
2. Allow extra space for the routing of the harnesses.
3. Drill two 4.5 mm (0.18 inch) in diameter holes in the mounting surface at the specified spacing. The type of fastener used determines the hole size needed to mount the control module. Refer to Figure 6-2 for proper spacing of the holes.
4. Mount the control module with the appropriate fasteners.

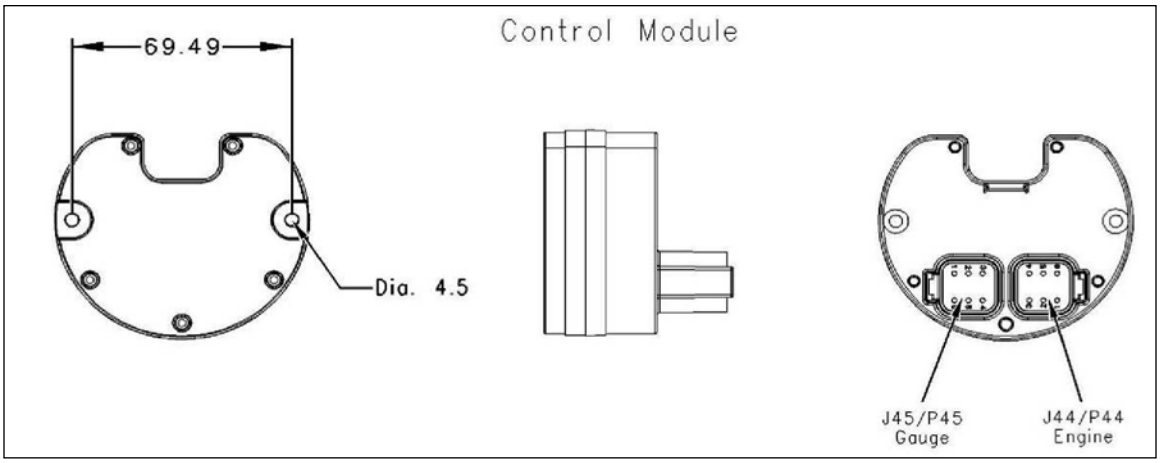


Figure 6-2 Mounting Dimensions (mm) Control Module

MOUNTING THE CONTROL MODULE TO A THREE-INCH GAUGE

5. Attach the control module to the back of the three-inch gauge. The control module will be held in place by the studs on the back of the gauge. Align the notch in the control module with the connector on the three inch gauge.
6. Use two nuts to fasten the control module to the gauge.
7. Determine the desired number and the desired size of gauges for your application.
8. Determine the location of each gauge on the panel. Mark the location for each gauge on the panel.

NOTE: The thickness of the panel must be between 3.18 mm (0.125 inch) and 12.7 mm (0.50 inch).

9. Cut out the hole and the keyway for each gauge. Refer to Figure 6-3 and Figure 6-4 for the proper hole size.
10. Remove the mounting nut from the back of the analog gauge.
11. Place the seal on the mounting surface.
12. Place the gauge in the cutout that is in the panel. Align the key on the gauge with the keyway in the cutout.
13. Screw the mounting nut to the back of the gauge or attach the mounting bracket to the studs on the back of the gauge.

GAUGE MOUNTING DIMENSIONS

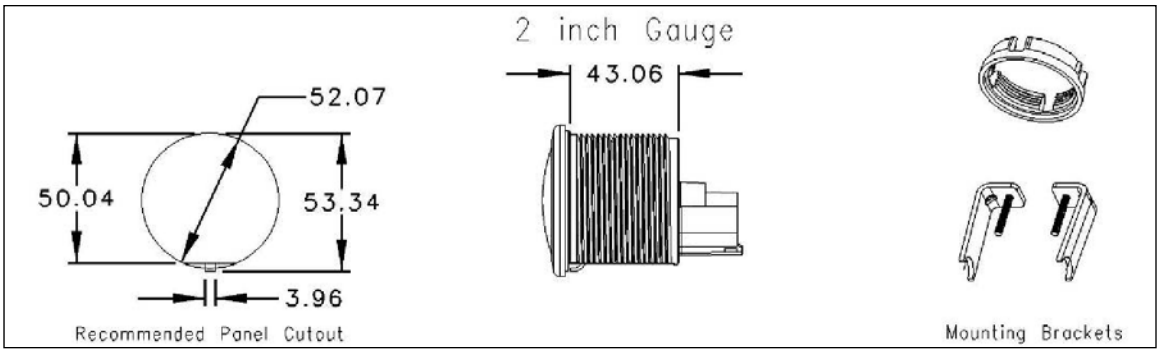


Figure 6-3 Mounting Dimensions for 51 mm (2.0 Inch) Gauges

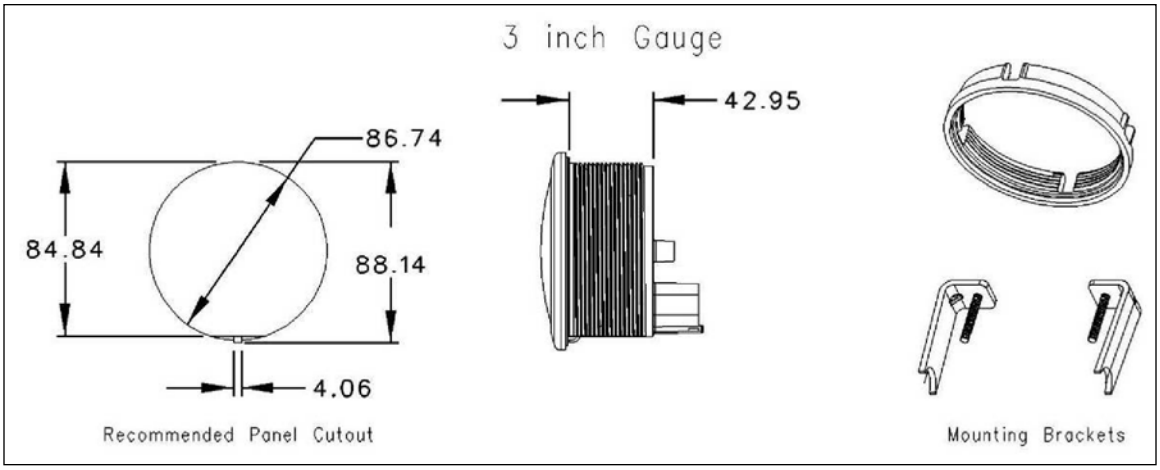


Figure 6-4 Mounting Dimensions for 76 mm (3.0 Inch) Gauges

6.2 CONNECTING TO THE J1939 DATA LINK

Table 6-2 Required Parts

REQUIRED PARTS		
Part #	**Description**	**Qty**
186-3736	Connector Socket	1
N/A	Momentary Switch	1
N/A	16 AWG Wire	(1)
	(1) Fabricated to length	

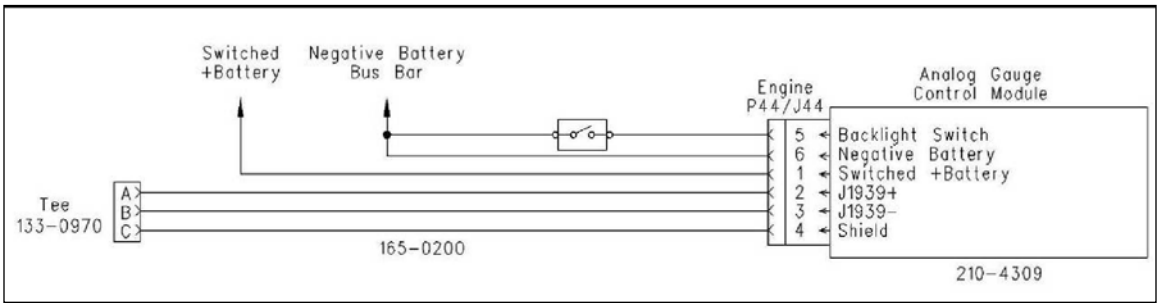


Figure 6-5 Drawing for Connecting the Analog Gauges to the J1939 Data Link

1. Turn the key switch to the OFF position.
2. Connect the 3-pin connector of the 165-0200 Cable As to a 133-0970 Receptacle As.

NOTE: Refer to Specifications, SENR5002, Wiring (J1939 Data Link) for more information that is related to the installation of the J1939 Data Link.

3. Connect the other end of the 165-0200 Cable As to the P44 engine connector for the 210-4309 Gauge Control Gp. Refer to Figure 6-5.

NOTE: The total length of the cable between the 133-0970 Receptacle As and the control module should not exceed 1 m (3.3 ft).

4. Connect the J1939 + to P44-2 of the control module.
5. Connect the J1939 -to P44-3 of the control module.
6. Connect the J1939 cable shield to P44-4 of the control module.
7. Connect the vessel's key switch circuit to P44-1 of the control module.

NOTE: The input voltage for the control module must be 9 to 32 V DC.

8. Connect the bus bar for the negative Battery(-) to P44-6 of the control module.
9. Use a switched Battery(-) circuit for backlighting P44-6. Refer to Table 6-2 Required Parts.

OPTIONAL MOMENTARY SWITCH FOR BACKLIGHTING

1. An optional switch may be installed in order to control the backlighting. The momentary switch allows the operator to adjust the backlighting intensity.
2. Cycling the switch will increase the backlighting intensity by one level.
3. There are 10 levels of backlighting intensity.
4. The default intensity is level 5. Once the maximum intensity is reached, the intensity will return to level 1.

INSTALLING OPTIONAL SWITCH

1. Determine the location for the switch. A momentary switch that is normally open should be used.
2. Fabricate a piece of 16 AWG wire to reach from the control module to the switch.
3. Crimp a 186-3736 Connector Socket to one end of the wire.
4. Connect the wire to P44-5 of the control module. Connect the other end of the wire to the switch.
5. Fabricate a wire to reach from the switch to the negative Battery(-) bus bar.
6. Connect the switch to the negative Battery(-) bus bar.

6.3 CONNECTING GAUGES TO CONTROL MODULE

CONNECTING WITHOUT AN EXTENSION HARNESS

Use this procedure for connecting the gauges to the control module without an extension harness. Refer to Figure 6-6 for connecting the gauges to the control module without an external harness.

NOTE: An extension harness should only be used when the control module can not be placed close to the gauges.

1. Connect a 212-8255 Harness to the J45 gauge connector on the 210-4309 Gauge Control Gp.
2. Connect a 212-8259 Harness that is for the termination resistor to the 212-8255 Harness that is connected to the control module.
3. Connect a 174-3016 Plug As (termination resistor) to the 212-8259 Harness.
4. Connect another 212-8255 Harness to the first 212-8255 Harness.

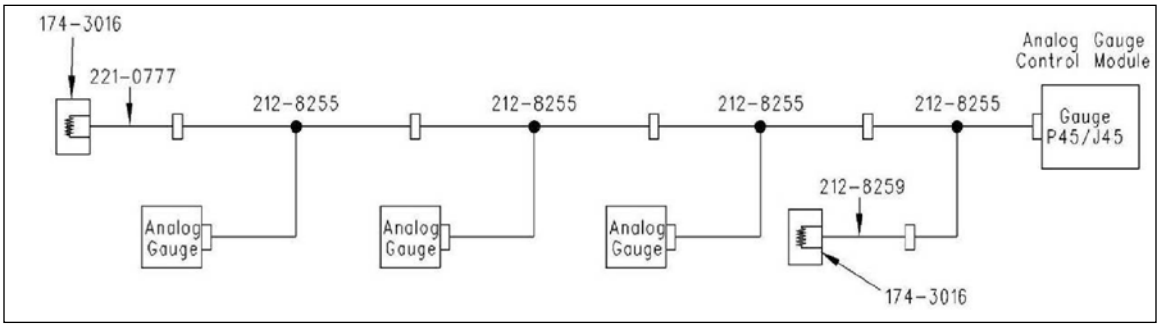


Figure 6-6 Diagram for Analog Gauges

5. Continue to connect additional 212-8255 Harness until the desired number of gauges are connected to the control module.

NOTE: A maximum of 12 gauges can be connected to a control module. To determine the number of harnesses that are needed, add one to the number of gauges that are desired in the application.

6. Connect the 212-8255 Harness to the back of each analog gauge.
7. Connect a 221-0777 Wiring Harness to the 212-8255 Harness that is at the end of the Data Link.
8. Connect a 174-3016 Plug As (termination resistor) to the 221-0777 Wiring Harness.

CONNECTING WITH AN EXTENSION HARNESS

1. Use this procedure for connecting the gauges to the control module with an extension harness.
2. Refer to Figure 6-7 for connecting the gauges to the control module with an external harness.

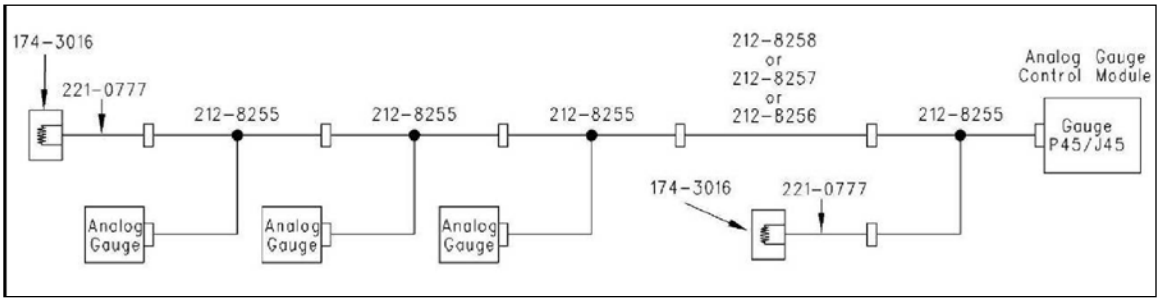


Figure 6-7 Diagram for Analog Gauges w/Harness

NOTE: An extension harness should only be used when the control module can not be placed close to the gauges.

3. Connect a 212-8255 Harness to the J45 gauge connector for the 210-4309 Gauge Control Gp.
4. Connect a 212-8259 Harness to the 212-8255 Harness that is connected to the control module.
5. Connect a 174-3016 Plug As (termination resistor) to the 212-8259 Harness.
6. Connect an extension harness to the other connector on the 212-8255 Harness.

NOTE: The length of the extension harness depends on the application. The following harnesses are available from Caterpillar, Table 6-3 Extension Harnesses.

Table 6-3 Extension Harnesses

EXTENSION HARNESSES	
Part Number	**Length**
212-8258	0.9 m (3 ft)
212-8257	1.5 m (5 ft)
212-8256	9m(30ft)

NOTE: A maximum of 12 gauges can be connected to a control module. Add one to the number of gauges (being installed), this is the number of harness assemblies needed.

7. Connect the 212-8255 Harness to the back of each analog gauge.
8. Connect a 221-0777 Wiring Harness to a 212-8255 Harness at the end of the Data Link.
9. Connect a 174-3016 Plug As (termination resistor) to the 221-0777 Wiring Harness.
10. Connect a 212-8255 Harness to the extension harness.
11. Continue to connect additional 212-8255 Harness(es) until the desired number of gauges is connected to the control module.

NOTES:

7 ENGINE MONITORING SYSTEM

The Engine Monitoring System (EMS) displays a variety of parameters for the engine and the transmission. Additional EMS display modules can be installed in multiple locations on the vessel. This will allow a vessel to have multiple operator stations.

The engine's Electronic Control Module (ECM) monitors the following engine information which is processed by the engine ECM:

- Operating parameters
- Diagnostic information

The information is then transmitted over the network to the EMS display module via the Cat Data Link. The display module receives the information from the Cat Data Link and then displays the information.

The network for the Cat Data Link consists of twisted pair wiring. All of the operating parameters and the diagnostics information for the engine are communicated over the network.

The EMS can also display information from a GPS receiver over the network. The GPS Interface Module will provide the EMS with information that relates to the speed and to the position of the vessel. This information can then be displayed in the EMS display. Refer to the section on the GPS Interface Module for more information.

7.1 EMS DISPLAY MODULE

The EMS incorporates three individual gauge displays. One Main EMS Gauge Unit is required for each operator station. The Tachometer Module and Quad Gauge Modules are optional. These gauges will not operate without a connection to a Main EMS Gauge Unit, Figure 7-1 EMS Gauge Set.

QUAD GAUGE MODULE **TACHOMETER MODULE** **EMS DISPLAY MODULE**

Figure 7-1 EMS Gauge Set

The Quad Gauge Module, Figure 7-2, has warning zones that are on a scale and displays the following functions in an analog format:

- Engine Oil Pressure
- Engine Coolant Temperature
- Marine Gear Oil Pressure
- Marine Gear Oil Temperature

Figure 7-2 Quad Gauge Module

The Tachometer Module, Figure 7-3, displays engine speed on a analog type gauge. The following functions are displayed on a digital LCD readout.

- Vessel Speed
- Engine Synchronization
- Trolling Mode

Figure 7-3 Tachometer Gauge Module

The EMS Display Module, Figure 7-4, has ten indicators (two rows of five) which display diagnostics that are related to the system. A digital LCD display shows the parameters for the engine and the parameters for the transmission that are monitored.

- Engine Speed
- Engine Oil Pressure
- Engine Coolant Temperature
- Transmission Oil Pressure
- Transmission Oil Temperature
- Fuel Rate
- Engine Hours
- Engine Load (Percent Load)
- Engine Location

Figure 7-4 EMS Display Module

EMS provides excellent visibility in various conditions of lighting and also supports the connections for the backlights.

NOTE: The vessel speed digital LCD display requires a Global Positioning System Interface Module (GPSIM) or a PL1000T Communication ECM to be installed.

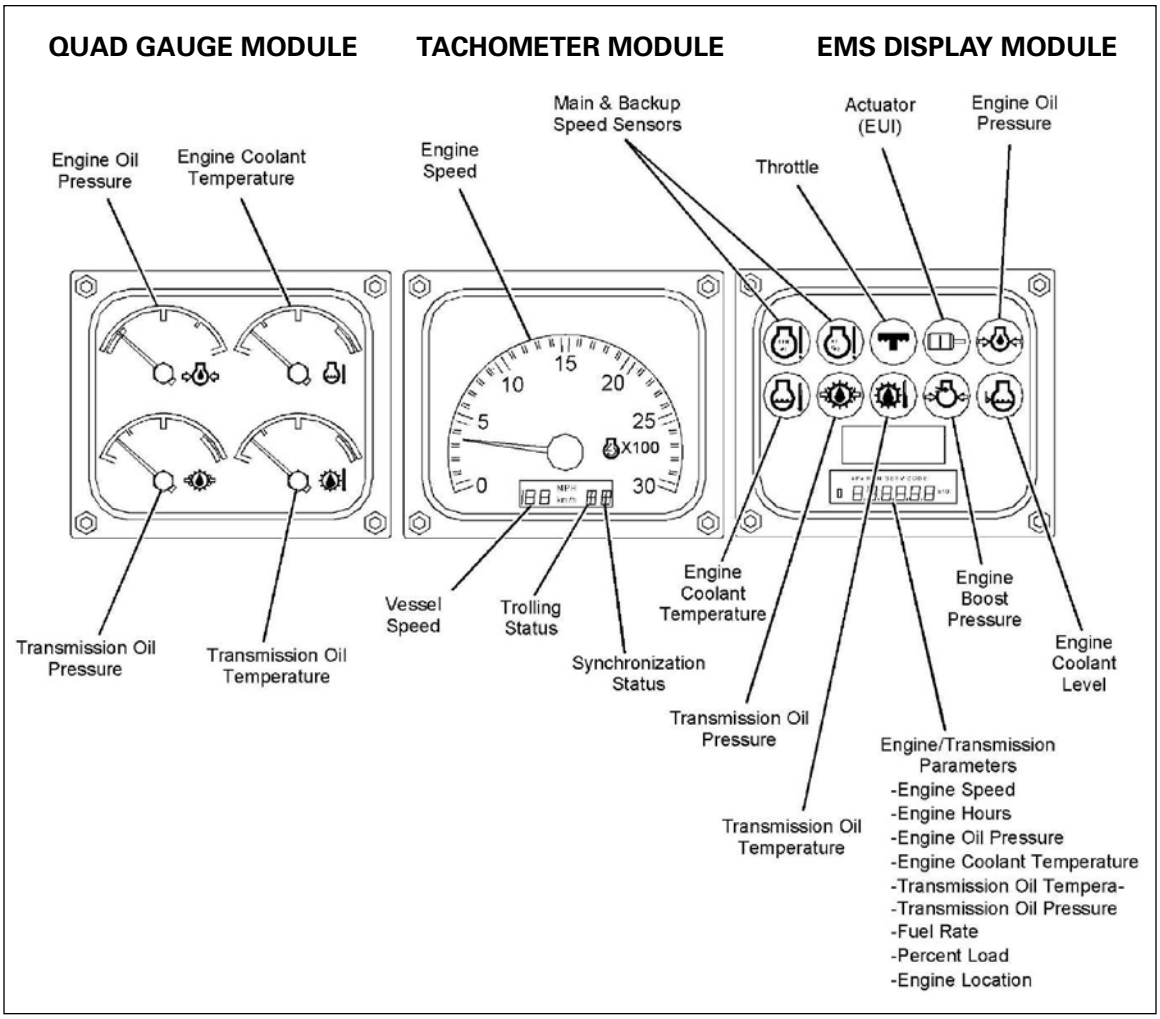


Figure 7-5 Display for the Engine Monitoring System

7.2 ENGINE MONITORING SYSTEM (EMS) INSTALLATION

Use Table 7-1 to determine the required parts to install the EMS.

Table 7-1 Required Parts for Display Module

REQUIRED PARTS FOR DISPLAY MODULE
MAIN STATION WITH 121-4017 WIRING HARNESS

Gauge Modules

Part #	Description	Qty
198-9749	Monitor Electronic Control Module	1
115-7580	Film	1
190-3484	Speedometer and Tachometer Module Gp	1
166-6941	Quad Gauge Module Gp	1
117-6601	Bezel	3
7Y-7388	Screw	12
8T-3992	Screw	9
143-5018	Electrical Cable	N/A
Hardware For The 121-4017 Wiring Harness		
186-3736	Connector Socket	13
121-4017	Wiring Harness	1
155-2255	Connecting Plug Kit (12 PIN)	1
3E-5177	Plug Lock Wedge	1
118-5075	Lamp	4
3E-8775	Switch	1
165-5674	LED Lamp	3
155-2705	Rocker Actuator	1
2N-2371	Indicator Lamp	1
7N-5876	Lamp	1
3E-8766	Switch	1
155-2706	Rocker Actuator	1
(1)	Rocker Actuator	1
123-9694	Horn	1
OR		
9G-9813	Alarm Gp	1
Remote Station		
190-3484	Speedometer and Tachometer Module Gp	1
OR		
166-6941	Quad Gauge Module Gp	1

(1) OEM supplied 75 Ohm 10 watt
(2) Fabricate cable to length

And

Part #	Description	Qty
117-6601	Bezel	1
7Y-7388	Screw	4
8T-3992	Screw	3
155-2274	Connecting Plug Kit	1
3E-5177	Plug Lock Wedge	1
(2)	16 AWG wire	N/A
155-2265	Connecting Plug Kit	1
155-2259	Plug Lock Wedge	1
186-3736	Connector Socket	7
Main Station Without 121-4017 Wiring Harness		
8T-9834	Connector Plug As	1
186-3736	Connector Socket	24
155-2274	Connecting Plug Kit	2
3E-5177	Plug Lock Wedge	2
186-3735	Connector Pin	19
102-8801	Receptacle Kit	1
3E-5180	Receptacle Lock Wedge	1
118-5075	Lamp	10
113-5184	Terminal	12
118-5077	Socket (Lamp)	6
102-8806	Receptacle Kit	1
3E-3389	Receptacle Lock Wedge	1
(2)	16 AWG wire	N/A
155-2255	Connecting Plug Kit	1
3E-5177	Plug Lock Wedge	1
3E-8775	Switch	1
155-2705	Rocker Actuator	1
2N-2371	Indicator Lamp	1
7N-5876	Lamp	1
3E-8766	Switch	1
155-2706	Rocker Actuator	1
(1)	Dimmer Potentiometer	1
123-9694	Horn	1
OR		
9G-9813	Alarm	1

CAUTION: No additional connections are allowed to any wires that are detailed and described in this publication without the approval of Caterpillar.

7.3 EMS POWER REQUIREMENTS

The EMS display requires 24 VDC. A converter capable of supplying 5 Amps at 24 VDC can be used and must have circuit protection of at least 5 Amps, Figure 7-6.

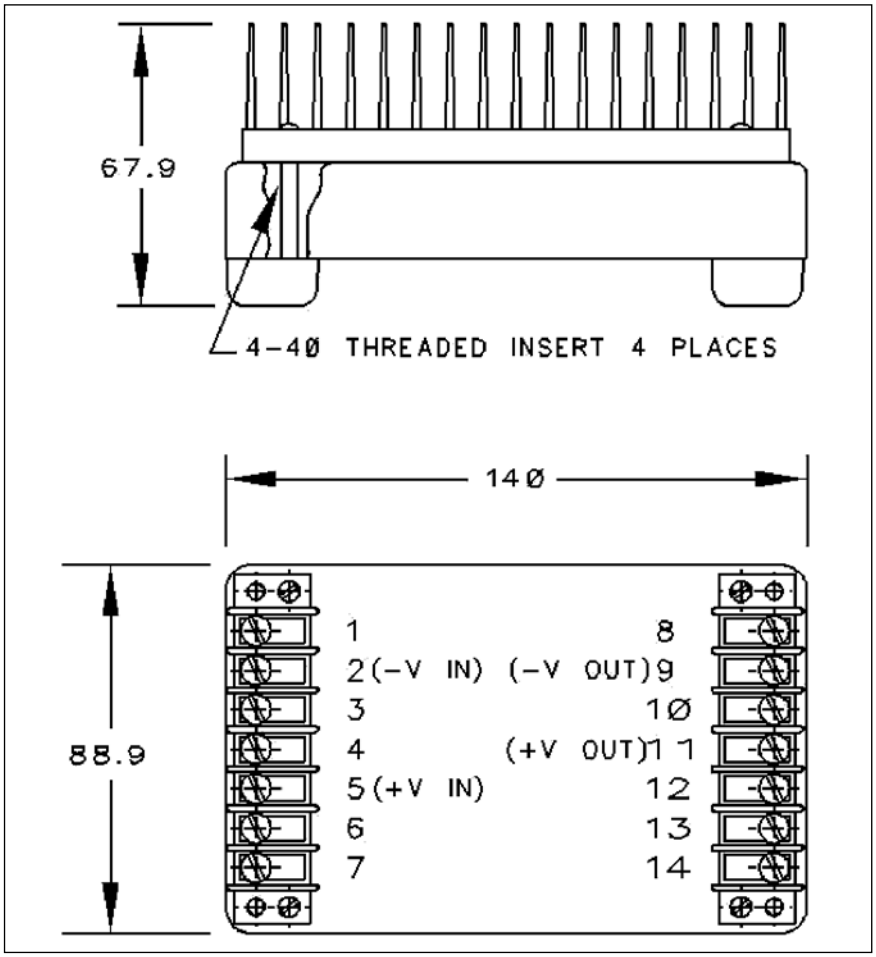


Figure 7-6 Electrical Converter Gp 127-8853

CAUTION: If an electrical system uses 12 VDC, the display will require 127-8853 Electrical Converter Gp, Figure 7-6.

NOTE: Avoid splicing or soldering wire connections. All connections should be terminated at terminal strips. This will help in order to ensure the reliability of the engine and communications devices.

7.4 EMS GAUGE MODULES

All modules have identical dimensions (141.6 mm X 119.3 mm) or (5.58 in x 4.70 in). Refer to Figure 7-7 for complete dimensions and mounting bracket.

Each module has:

- 5 mm tapped hole in each corner (four holes)
- 4 mm clearance hole in each corner
- four 6 mm tapped holes in the back of the housing
- front or rear mounting

FRONT MOUNT

The front mount applications do not require mounting brackets.

- Bezels must be installed over the front of the module.
- Install 7Y-7388 Screws in the four corners of the bezel, through the dash panel, and into the tapped holes in the gauge module.

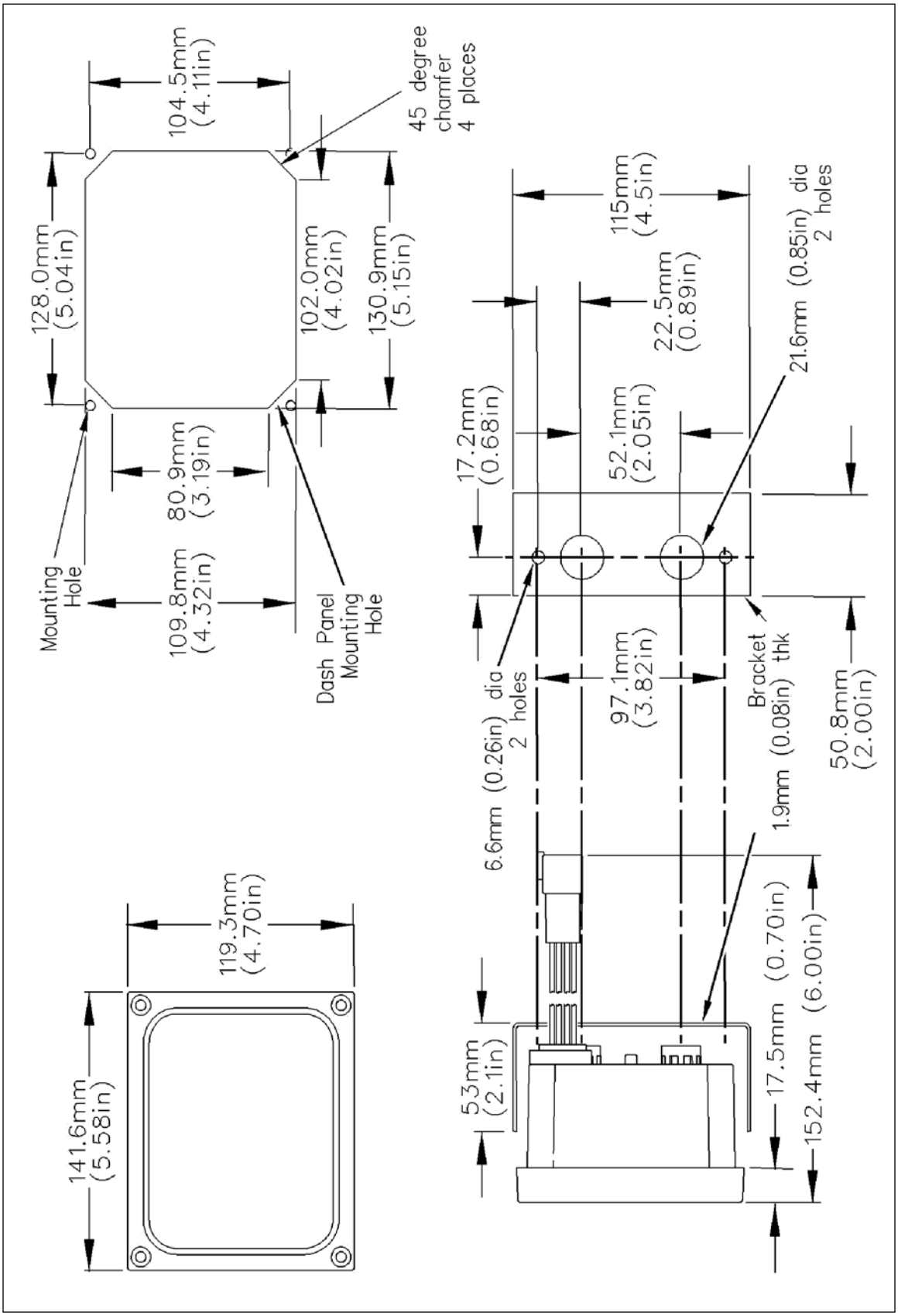
REAR MOUNT

Rear mounted applications require a U-shaped bracket.

1. Measure the legs of the bracket
2. Cut the legs to the correct length to fit your dash panel.
3. The bracket should push up against the inside of the dash panel
4. Pull the module tightly against the outside of the dash panel
5. Use 8T-3992 Screws to attach the bracket to the holes in the rear of the module.
6. The bezel can be attached to the gauge module with 7Y-7388 Screws.
7. Install the screws through the bezel and into the tapped holes in the flange of the module.

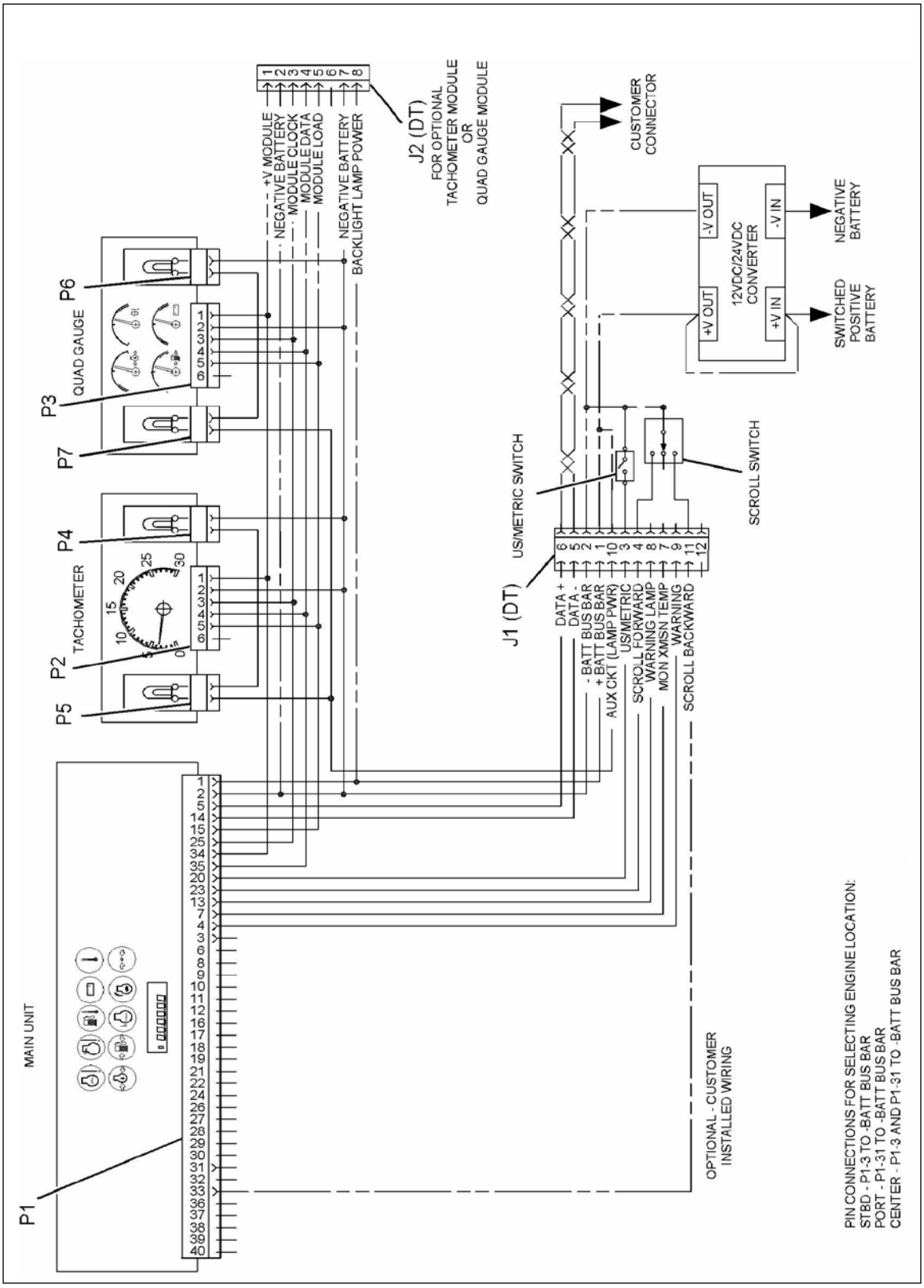
NOTE: The bezel screws must not exceed 12 mm (0.5 inch) in length. If a longer screw is used, the screw will protrude through the module and into the dash panel.

Figure 7-7 Dimensions for the Gauge Module



7.5 CONNECTING THE EMS DISPLAY MODULES

Figure 7-8 EMS Drawing



CONNECTING THE HARNESS

Table 7-2 Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
160-1050	Instrument Panel Harness As	1

1. Connect the P1 connector to the main EMS module.
2. Torque the allen head screw to 2.25 ± 0.25 N·m (20 ± 2 lb-in).
3. Plug the tachometer into the P2 harness connector.
4. Plug the quad gauge into the P3 harness connector.

BATTERY CONNECTIONS FOR 12 VOLT SYSTEMS

Table 7-3 Required Parts 12 Volt Systems

REQUIRED PARTS		
Part Number	**Description**	**Qty**
127-8853	Electrical Converter Gp	1
186-3736	Connector Socket	2
N/A	16 AWG Wire	(1)
(1) Fabricated to length		

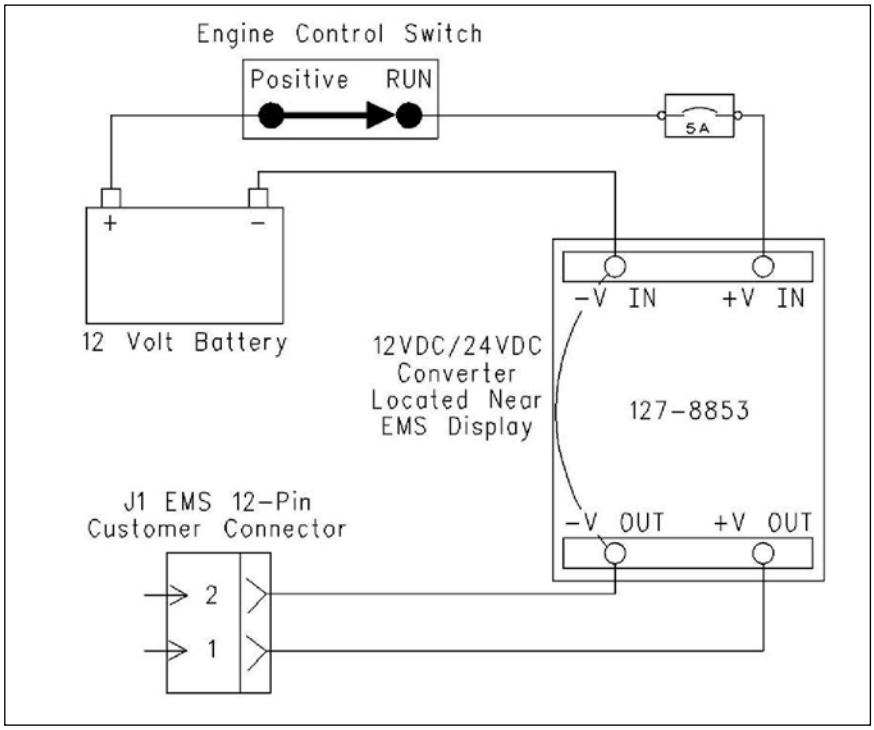


Figure 7-9 12 Volt Battery Connections w/Converter

1. Run a wire from the RUN terminal of the Engine Control Switch (ECS) to the +V IN terminal of the electrical converter group, Figure 7-9 12 Volt Battery Connections w/ Converter
2. Run a wire from the negative Battery(-) to the V IN terminal of the electrical converter group.
3. Run a wire from the +V OUT terminal of the electrical converter group to terminal 1 of the J1 EMS customer connector.
4. Install a jumper wire between the V IN and the V OUT terminals on the electrical converter group.
5. Run a wire from the -V OUT terminal of the electrical converter group to terminal 2 of the J1 EMS customer connector.

BATTERY CONNECTIONS FOR 24 VOLT SYSTEMS

Figure 7-10 Required Parts 24 Volt Systems

REQUIRED PARTS		
Part Number	**Description**	**Qty**
186-3736	Connector Socket	2
N/A	16 AWG Wire	(1)
(1) Fabricated to length		

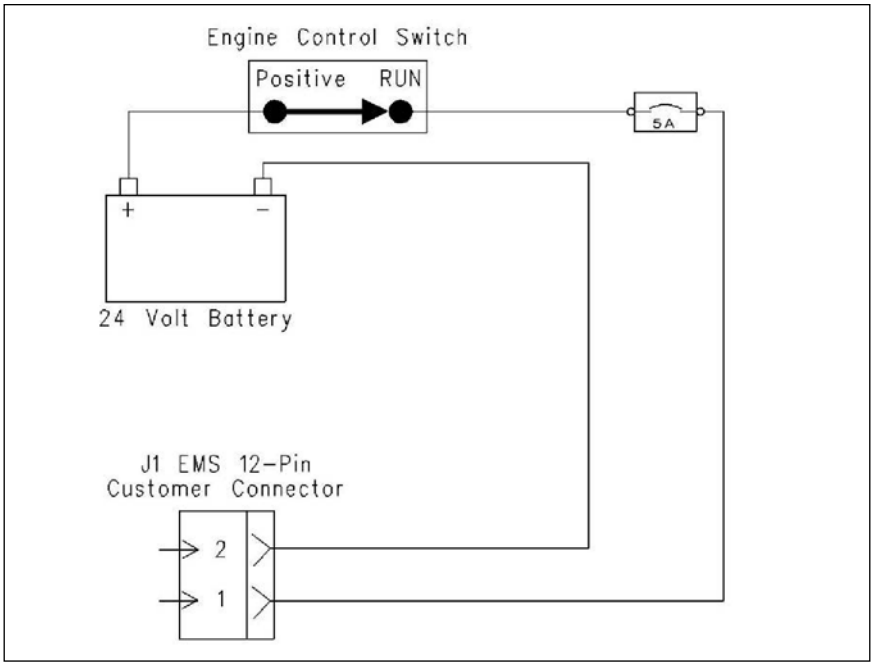


Figure 7-11 24 Volt Battery Connections

1. Run a wire from the RUN terminal of the ECS to terminal 1 of the J1 EMS customer connector, Figure 7-11 24 Volt Battery Connections.
2. Run a wire from the negative Battery(-) to terminal 2 of the J1 EMS customer connector.
3. Run a wire from the RUN terminal of the Engine Control Switch (ECS) to the +V IN terminal of the electrical converter group.

NOTES:

7.6 CONNECTING TO THE CAT DATA LINK

NOTE: Refer to Table 7-4 for the proper terminal locations for your engine.

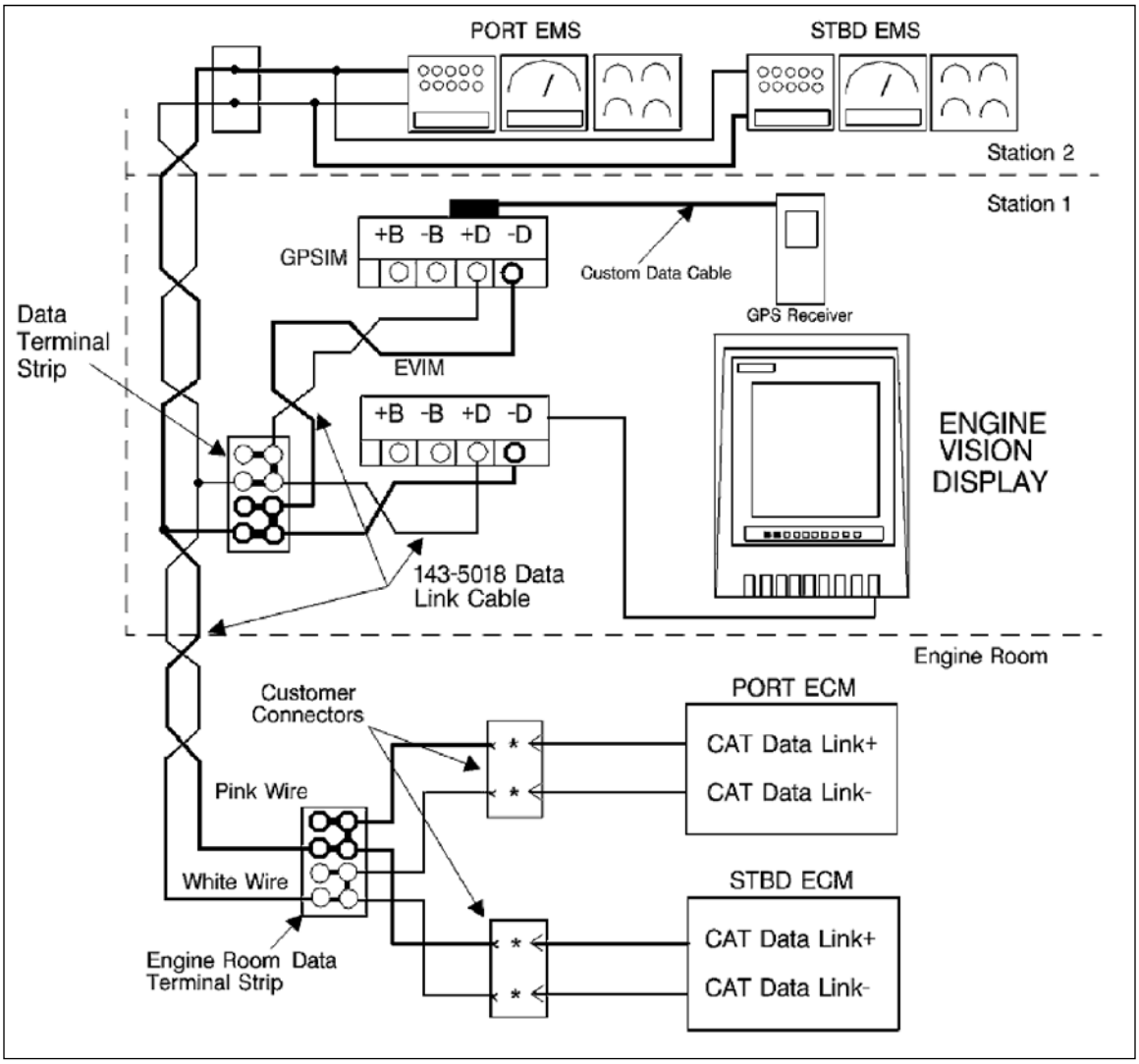


Figure 7-12 Connecting the Cat Data Link

Table 7-4 Customer Connector Terminal Locations

CUSTOMER CONNECTOR TERMINAL LOCATIONS AT FOR CAT DATA LINK		
Engine	**Cat Data Link+**	**Cat Data Link**
3408C, 3412C	18	24
3176B	9	3
3126B, 3176C, 3196, 3406E, 3412E, C7, C9, C12, C15, C18, C30, C32	7	6
3500B	22	14
3500B Series II	h	g

NOTE: Use a 143-5018 Electrical Cable for connections of the Cat Data Link. This wire is twisted pair wiring.

Table 7-5 Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
186-3736	Connector Socket	2
143-5018	Electrical Cable	(1)
(1) Fabricated to length		

1. Connect the terminal for the Cat Data Link + of the customer connector for the PORT ECM to the terminal for the Cat Data Link + on the terminal strip in the engine room. Make the same connection for the STBD ECM, Figure 7-12 Connecting the Cat Data Link.
2. Connect the terminal for the Cat Data Link of the customer connector for the PORT ECM to the terminal for the Cat Data Link on the terminal strip in the engine room. Make the same connection for the STBD ECM.
3. Connect the terminal for the Cat Data Link + on the terminal strip in the engine room to the terminal for the Cat Data Link + on the terminal strip in the bridge.
4. Connect the terminal for the Cat Data Link on the terminal strip in the engine room to the terminal for the Cat Data Link on the terminal strip in the bridge.
5. Connect the terminal for the Cat Data Link + of the bridge to terminal 6 of the J1 PORT EMS 12 pin customer connector. Make the same connection for the STBD connector.
6. Connect the terminal for the Cat Data Link of the bridge to terminal 5 of the J1 PORT EMS 12 pin customer connector. Make the same connection for the STBD connector.

CAUTION: The total length of the cable should not exceed 30 m (100 ft).

7.7 SELECTING ENGINE LOCATIONS

Connect the negative Battery(-) bus bar to the input on the 8T-9834 Connector Plug As, use Table 7-6.

Table 7-6 Engine Terminal Locations

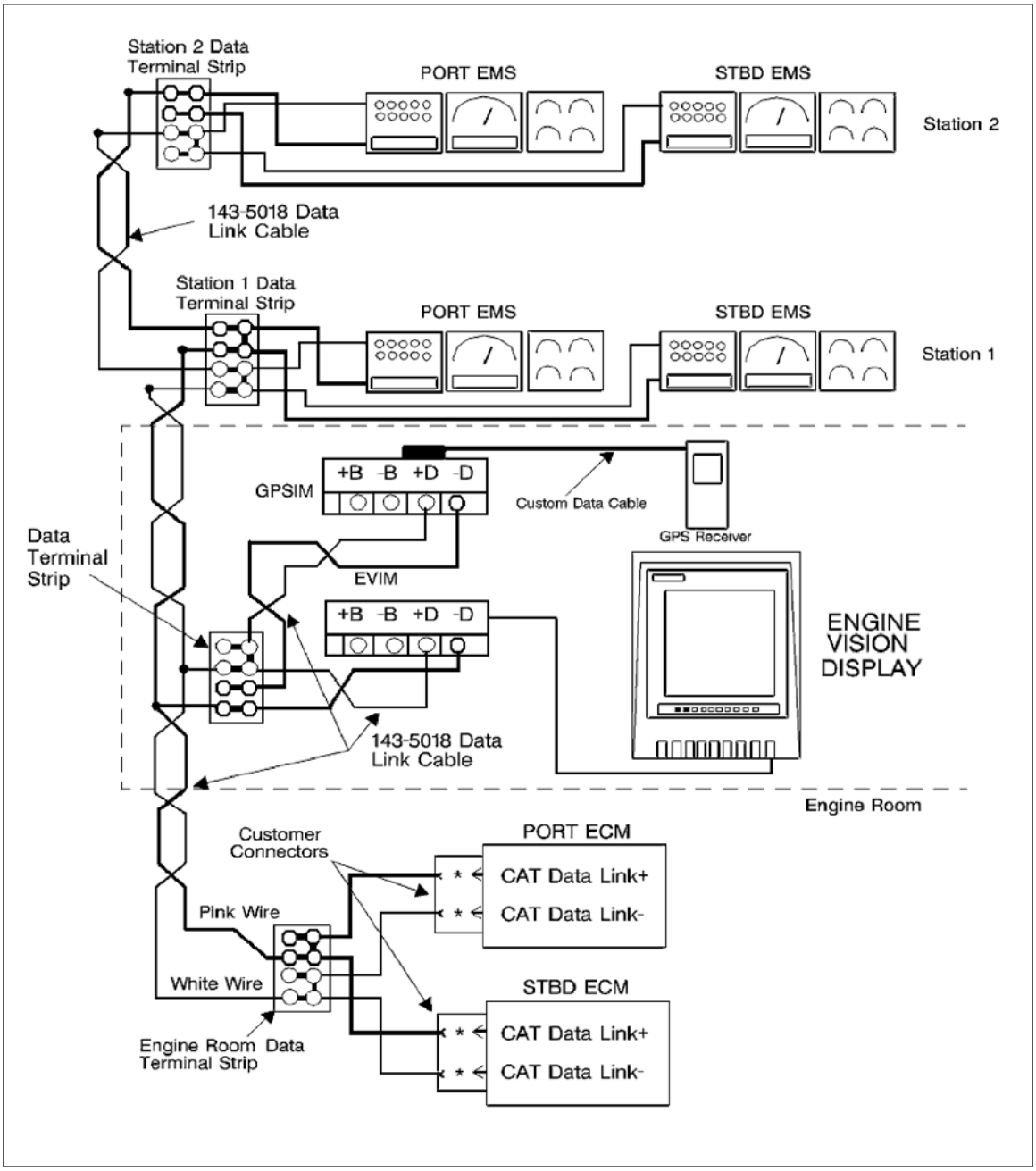
ENGINE LOCATIONS		
Port	**Starboard**	**Center**
Terminal 31	Terminal 3	Terminal 3 And Terminal 31

7.8 CONNECTING MULTIPLE EMS DISPLAYS

Additional EMS display modules can be installed for a multiple module system. Refer to Table 7-4 for proper connections of the EMS display module for each station. For additional stations, make multiple connections to the Cat Data Link. The total combined cable length should be kept as short as possible. The preferred method for all circuit connections is through terminal strips.

CAUTION: Use 143-5018 Electrical Cable for all connections to the Cat Data Link. This wire is a twisted pair. The total length of the cable should not exceed 30 m (100 ft).

Figure 7-13 Multiple EMS Display Connections



7.9 OPTIONAL SWITCHES, LAMPS, AND ALARMS

When the scroll switch is actuated, the display on the EMS module will scroll through the parameters. Refer to Figure 7-14 in order to connect the switch.

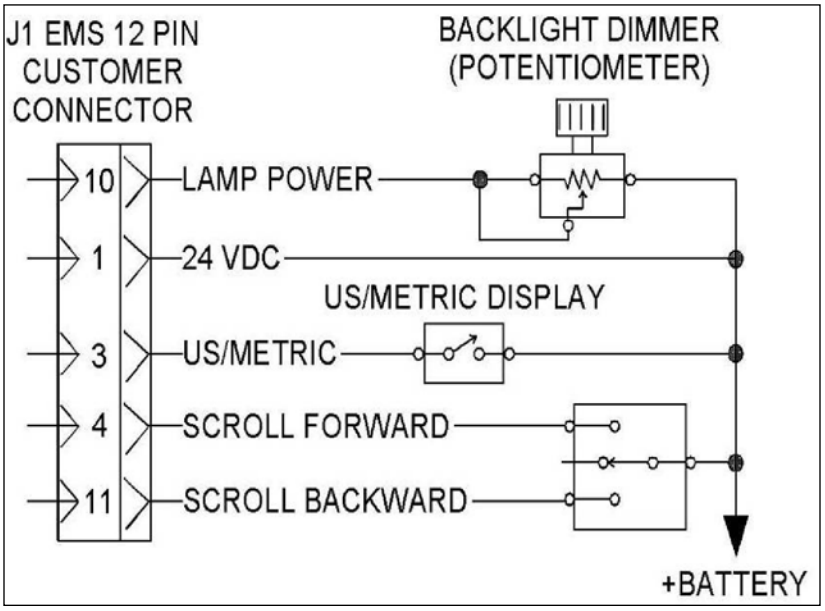


Figure 7-14 Scroll Switch

Table 7-7 Scroll Switch Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
N/A	Switch SPDT Momentary for the scrolling feature	1
3E-7996	Connector Plug	1
065-7187	Terminal	(1)
186-3736	Connector Socket	(1)
N/A	16 AWG Wire	(2)
	(1) The application determines the quantity	
	(2) Fabricated to length	

7.10 U.S./METRIC DISPLAY SWITCH

The default setting for the EMS display is metric units (SI). If metric units (SI) are desired, no connection is needed. If U.S. is desired, a connection from terminal 3 of the J1 EMS customer connector to the Battery(+) is necessary. If both U.S. units and metric units are desired, install a 3E-8768 Switch for the mode selector as shown in Figure 7-14.

Table 7-8 U.S./Metric Display Switch Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
3E-8768	Switch: SPST Switch for US or Metric display	1
155-2706	Rocker Actuator: Actuator for the US/Metric display switch	1
3E-7996	Connector Plug: Connector for the US/Metric display switch	1
065-7187	Terminal: Terminals for the US/Metric Display Switch	(1)
186-3736	Connector Socket	(1)
N/A	16 AWG Wire	(2)
	(1) The application determines the quantity	
	(2) Fabricated to length	

7.11 OPTIONAL OUTPUT FOR THE WARNING LAMP

The diagnostic outputs may be used to warn the operator of any engine diagnostics and/or engine warnings that are present. An additional switch may be installed to enable or disable an alarm.

Diagnostic outputs are provided at the J1 EMS customer connector which could be used to drive a relay, an audible alarm, or an alarm lamp.

CAUTION: The maximum current draw on the outputs is 0.3 Amp.

1. Connect a wire from terminal 8 (warning lamp) of the J1 EMS customer connector to one of the terminals on the lamp, Figure 7-15.
2. Connect the other terminal of the lamp to Battery(-).

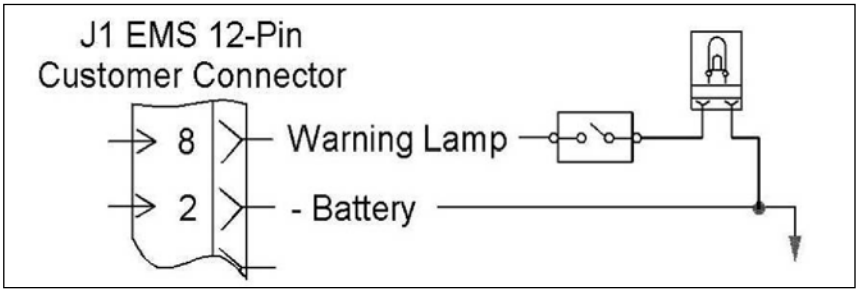


Figure 7-15 Warning Lamp

Table 7-9 Warning Lamp Required Parts

WARNING LAMP REQUIRED PARTS		
Part Number	**Description**	**Qty**
2N-2371	Indicator Lamp	1
7N-5876	Lamp	1
2L-8074	Terminal	2
186-3736	Connector Socket	1
N/A	16 AWG Wire	(1)
	(1) Fabricated to length	

7.12 WARNING ALARM

1. Connect a wire from terminal 9 (warning alarm) of the J1 EMS customer connector to the positive terminal on the alarm, Figure 7-16.
2. Connect the negative terminal on the alarm to the Battery(-).

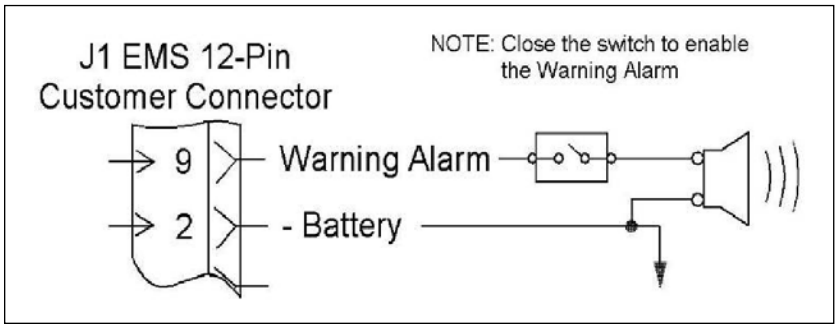


Figure 7-16 Warning Alarm

Table 7-10 Warning Alarm Required Parts

WARNING ALARM REQUIRED PARTS		
Part Number	**Description**	**Qty**
9G-9813 or 123-9694	Alarm Gp Horn	1
2L-8074	Terminal	2
186-3736	Connector Socket	1
N/A	16 AWG Wire	(1)
	(1) Fabricated to length	

7.13 OPTIONAL ALARM ENABLE/DISABLE SWITCH

Connect the SPST switch between the Battery(-) and the negative terminal on the alarm.

Table 7-11 Alarm Enable/Disable Switch

REQUIRED PARTS		
Part Number	**Description**	**Qty**
3E-8768	Switch SPST switch	1
155-2706	Rocker Actuator	1
3E-7996	Connector Plug	1
065-7187	Terminal	(1)
N/A	16 AWG Wire	(2)
	(1) The application determines the quantity (2) Fabricated to length	

7.14 TRANSMISSION MONITORING FUNCTION — DISABLE

NOTE: Installations for 3408C, 3412C, 3176B, 3176C, 3196 and 3406E engines.

1. Connect the negative Battery(-) bus bar to terminal 7 (monitor trans) of the J1 12-pin customer connector.

CAUTION: When terminal 7 is connected to the negative Battery(-) bus bar, the display for the transmission temperature and the display for the transmission pressure are disabled. This option can be used in installations that do not require monitoring of the transmission.

7.15 INSTALLATIONS FOR OTHER ENGINES

TRANSMISSION SENSORS

The transmission oil pressure sensor and the transmission oil temperature sensor can be programmed to Not Installed on the Caterpillar Electronic Technician (ET). This will disable the diagnostics for the transmission oil pressure and the diagnostics for the transmission oil temperature.

CONNECTING BACKLIGHT FOR DISPLAY

1. Install a 118-5075 Lamp in each of the P4, P5, P6, and P7 lamp sockets.
2. Connect P4 and P5 to the tachometer module.

Table 7-12 Backlighting Required Parts

BACKLIGHTING REQUIRED PARTS		
Part Number	**Description**	**Qty**
118-5075	Lamp	4
186-3736	Connector Socket	1
N/A	16 AWG Wire	(1)
(1) Fabricated to length		

3. Connect P6 And P7 To The Quad Gauge Module.
4. If a dimmer for the display backlight is being installed, proceed to Installing a Dimmer for the Display Backlight (Potentiometer). Otherwise, connect terminal 10 (lamp power) of the J1 EMS customer connector to the switch circuit that is +24 VDC.

INSTALLING DIMMER FOR BACKLIGHT DISPLAY (POTENTIOMETER)

1. Connect the wiper (output) of the potentiometer to terminal 10 (lamp power) of the J1 EMS customer connector, Figure 7-17.
2. Connect the terminal for +V IN of the potentiometer to the switch circuit that is +24 VDC.
3. Connect the remaining terminal of the potentiometer back into the wiper.

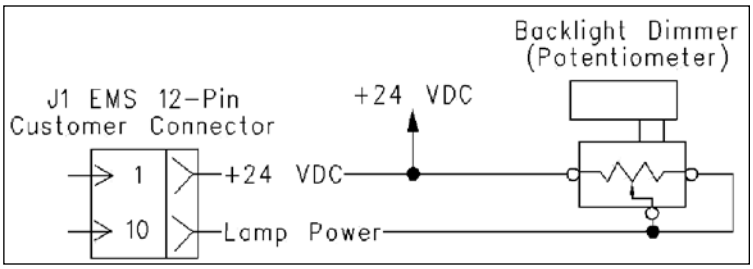


Figure 7-17 Drawing For the Potentiometer

Table 7-13 Potentiometer Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
N/A	Rheostat (1)	1
186-3736	Connector Socket	1
N/A	16 AWG Wire	(2)
	(1) 75 Ohm, 10 Watt dimmer for the backlight	
	(2) Fabricated to length	

OPTIONAL REMOTE MODULE

Table 7-14 Optional Remote Module Required Parts

REQUIRED PARTS		
Part Number	**Description**	**Qty**
(1) Remote Tachometer Module		
153-8059	Speedometer and Tachometer Module Gp	1
117-6601	Bezel	1
7Y-7388	Screw	4
8T-3992	Screw	3
155-2274	Connecting Plug Kit	1
186-3736	Connector Socket	12
113-5183	Lamp Socket	2
113-5184	Terminal	4
118-5075	Lamp	2
N/A	16 AWG Wire	(2)
(1) Remote Quad Gauge Module		
166-6936	Quad Gauge Module Gp	1
117-6601	Bezel	1
7Y-7388	Screw	4
8T-3992	Screw	4
155-2265	Connecting Plug Kit	1
186-3736	Connector Socket	12
113-5183	Lamp Socket	2
113-5184	Terminal	4
118-5075	Lamp	2
N/A	16 AWG Wire	(2)
(1) Only one remote gauge may be installed. This remote gauge can be a tachometer or the remote gauge can be a quad gauge. Both gauge modules are optional (2) Fabricated to length		

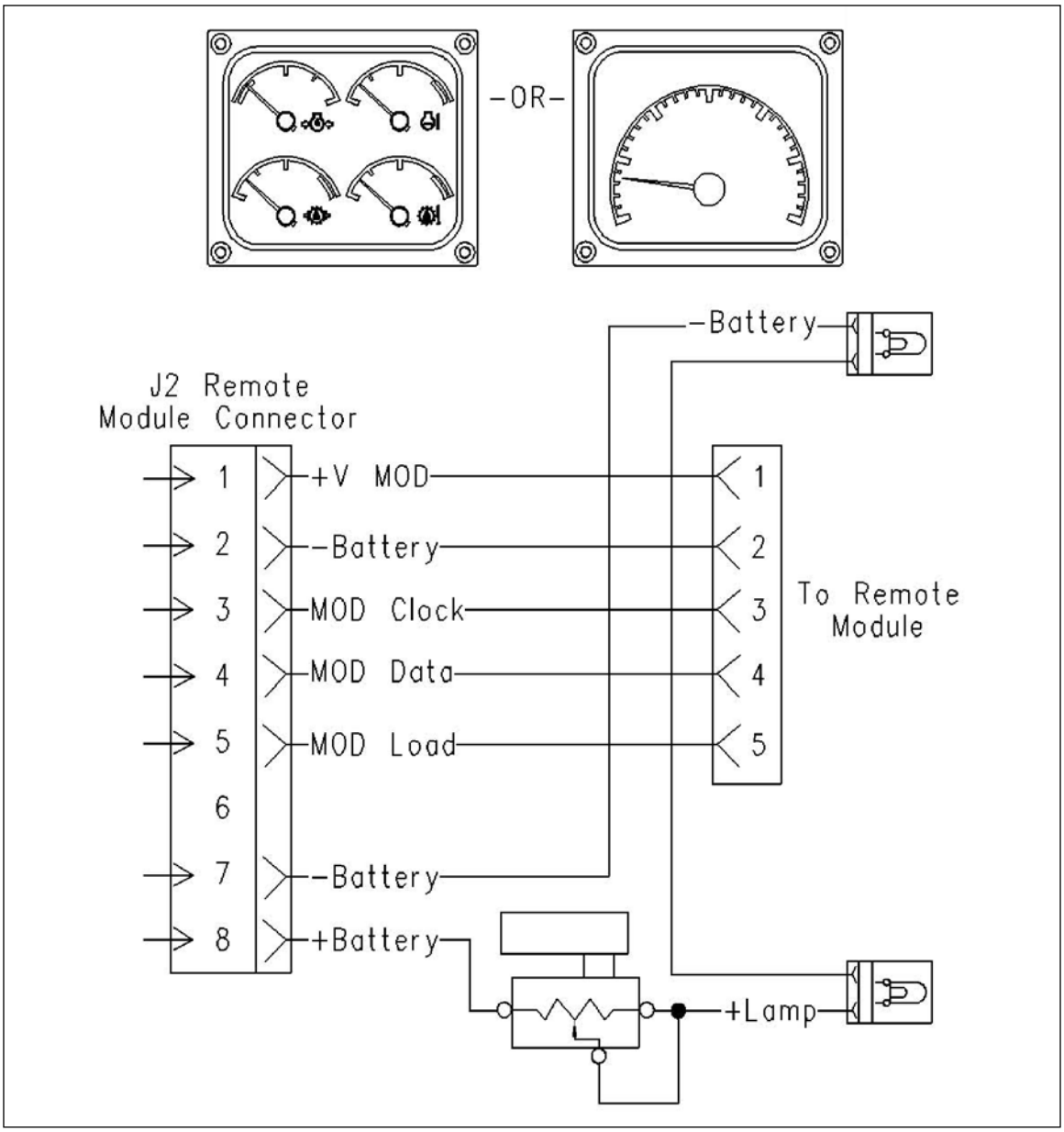


Figure 7-18 Drawing For a Remote Module

1. Mount the remote module (tachometer or quad gauge).

NOTE: The length of the wires between the J2 remote module connector and the remote module should not exceed 6 m (20 ft).

2. Remove the sealing plugs from the J2 remote module connector.
3. Connect a wire from terminal 1 of the J2 remote module connector to terminal 1 of the 155-2274 Connecting Plug Kit (6 PIN) or terminal 1 of the 155-2265 Connecting Plug Kit (8 PIN).
4. Continue connecting wires between the two connectors at terminals 2, 3, 4, and 5.
5. Refer to Figure 7-17 for connections of the circuit for the backlight.
6. Install the sealing plugs that were removed in Step 1 into any open cavities in the J2 remote module connector and the connector at the remote module.
7. Connect the remote module to the harness.

NOTES:

8 ENGINE VISION

Engine Vision is a computerized monitoring system that is used to display engine information. This system offers the best performance and flexibility to the owners of marine vessels. The microprocessor-based device is powered by the vessel's battery. The Engine Vision display is case hardened in order to withstand the harsh environment that is often found in marine applications.

The Engine Vision communicates with the Electronic Control Module (ECM) via the Cat Data Link and is used to display engine information to the operator.

Engine Vision displays current information for temperatures, for pressures, and for fluid levels. The touch-screen display and/or the user mode buttons can be used to access the following screens:

- Gauges
- Diagnostic Information
- Maintenance Information
- Configuration
- Navigation

These screens can be easily accessed by using a set of function keys that are provided below the display screen. The color monitor provides excellent visibility in various light conditions. The backlighting for the display can be dimmed for visibility at night.

The Engine Vision display can monitor three engines at one time. Information is transferred from the ECM to the display module through the Cat Data Link.

Figure 8-1 Engine Vision Console

Support for Engine Vision display is provided in the software for the engine ECM. The following table represents the earliest engine software that supports Engine Vision display for the various engine models.

Table 8-1 Support for Engine Vision Display

SUPPORT FOR ENGINE VISION DISPLAY			
Engine	**Rating**	**Requirement For Earliest Personality Module Part Number**	**Flash File**
3176B	E D C	143-6745 143-6742 143-6739	143-6743 143-6740 143-6737
3408C High Performance	E D C	143-7590 143-7588 143-7586	
3412C High Performance	Ehp E D C	143-3262 143-3271 143-3269 143-3267	
3412C High Performance Side Access	Ehp E D C	143-3265 143-3278 143-3275 143-3273	
3126B, 3176C, 3196, 3406E, 3412E 3500B 3500B Series II C7, C9, C12, C18, C15, C30, C32	All Ratings	Supported from First Production	

8.1 ENGINE VISION DISPLAY AND FUNCTION KEYS

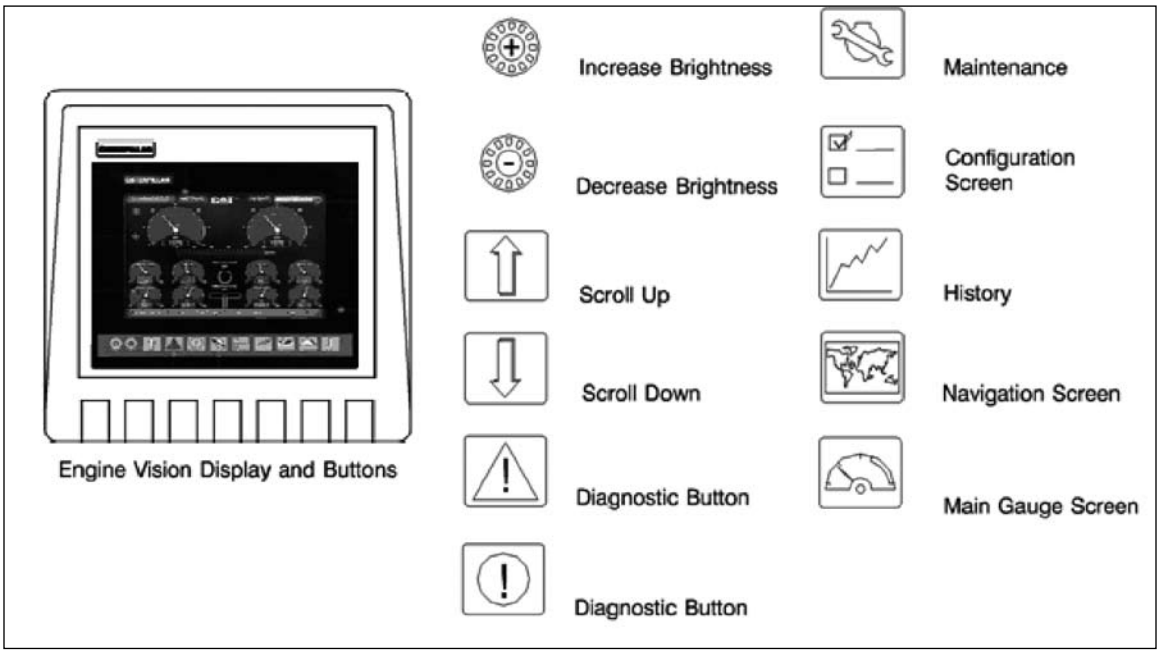


Figure 8-2 Controls for the Engine Vision

8.2 PROGRAMMING THE ECM FOR ENGINE LOCATION

Use the Caterpillar Electronic Technician (ET) in order to program the ECM to one of the following engine locations.

- PORT
- STBD
- CENTER

The Engine Vision display will show a red ERROR message under the tachometer and gauges if the engine location is not selected.

Use Cat ET in order to access the screen for Configuration.

Scroll down the screen to the Engine/Gear Parameters (see Figure 8-3).

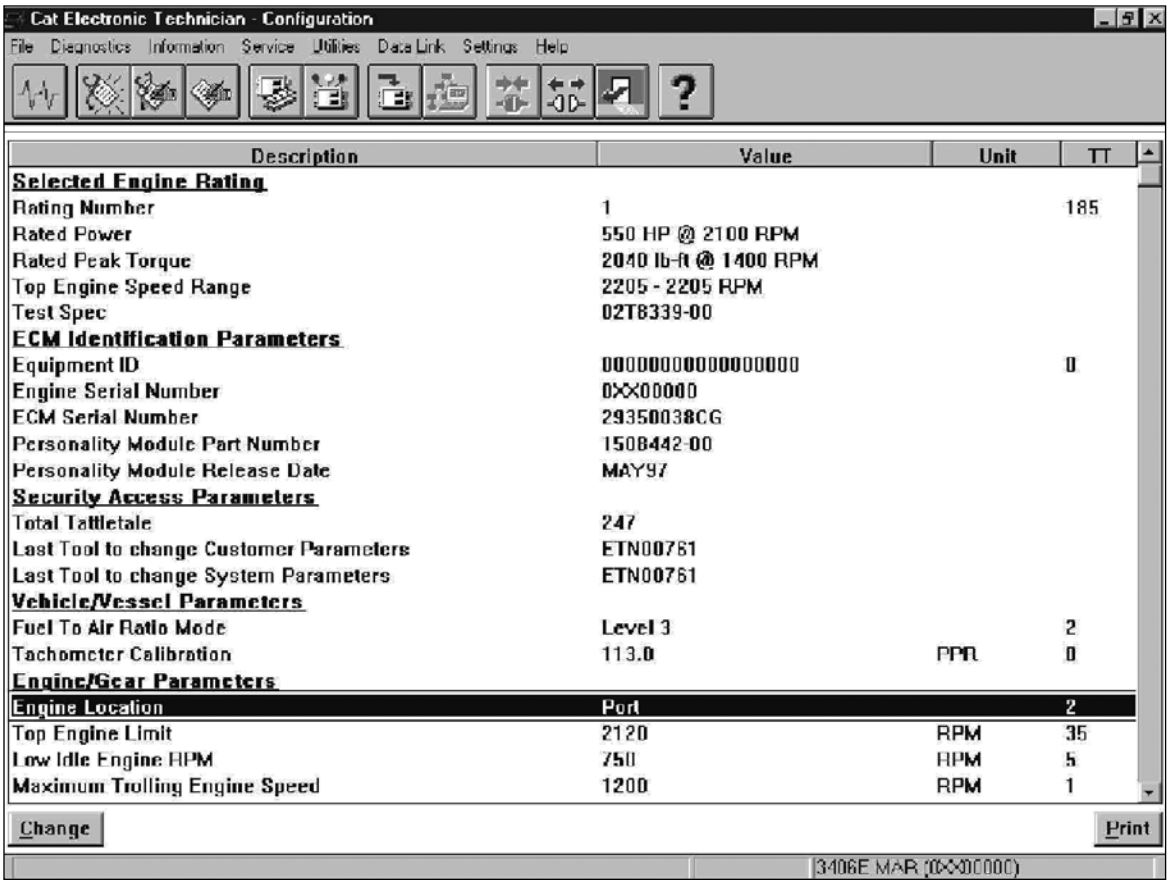


Figure 8-3 Selecting Engine Location

8.3 ENGINE CONFIGURATION

The ONE_TIME_CONFIGURATION screen will be displayed when the Engine Vision display is powered up for the first time. This menu is used to select the appropriate engine family for the installation. Once the engine family is selected and confirmed, the Engine Vision display will prompt the user to cycle power to the system.

To cycle power to the system:

• Turn the key switch to the OFF position.

• Then turn the key switch to the ON position.

The display will then power up with the configuration that was chosen (see Figure 8-4).

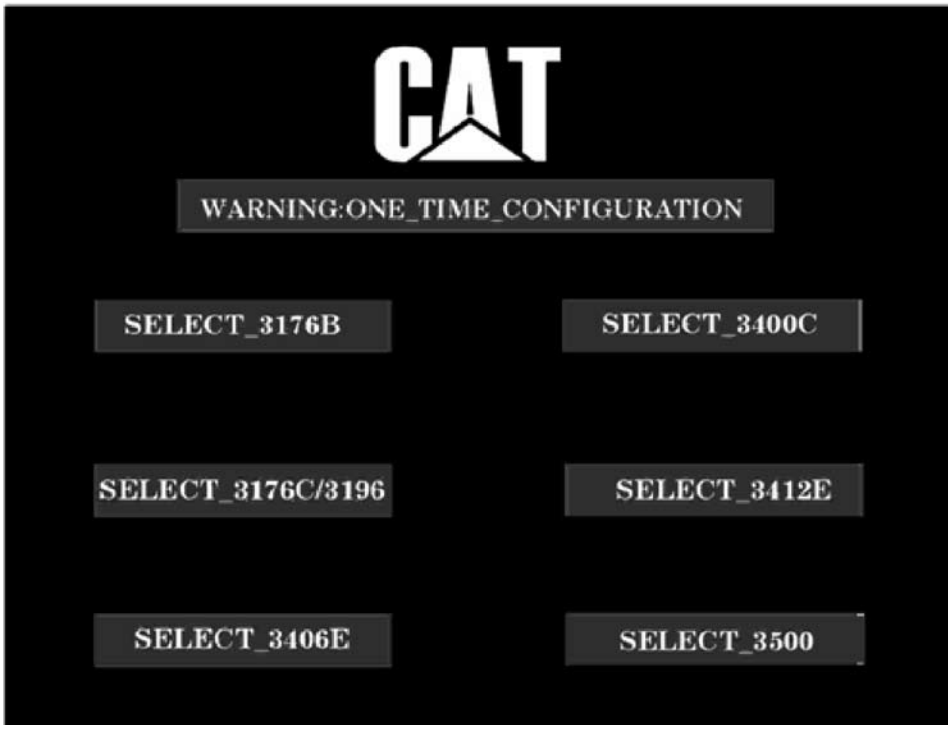


Figure 8-4 The ONE_TIME_CONFIGURATION Screen (Typical Example)

8.4 ENGINE VISION — INSTALLATION

REQUIRED PARTS

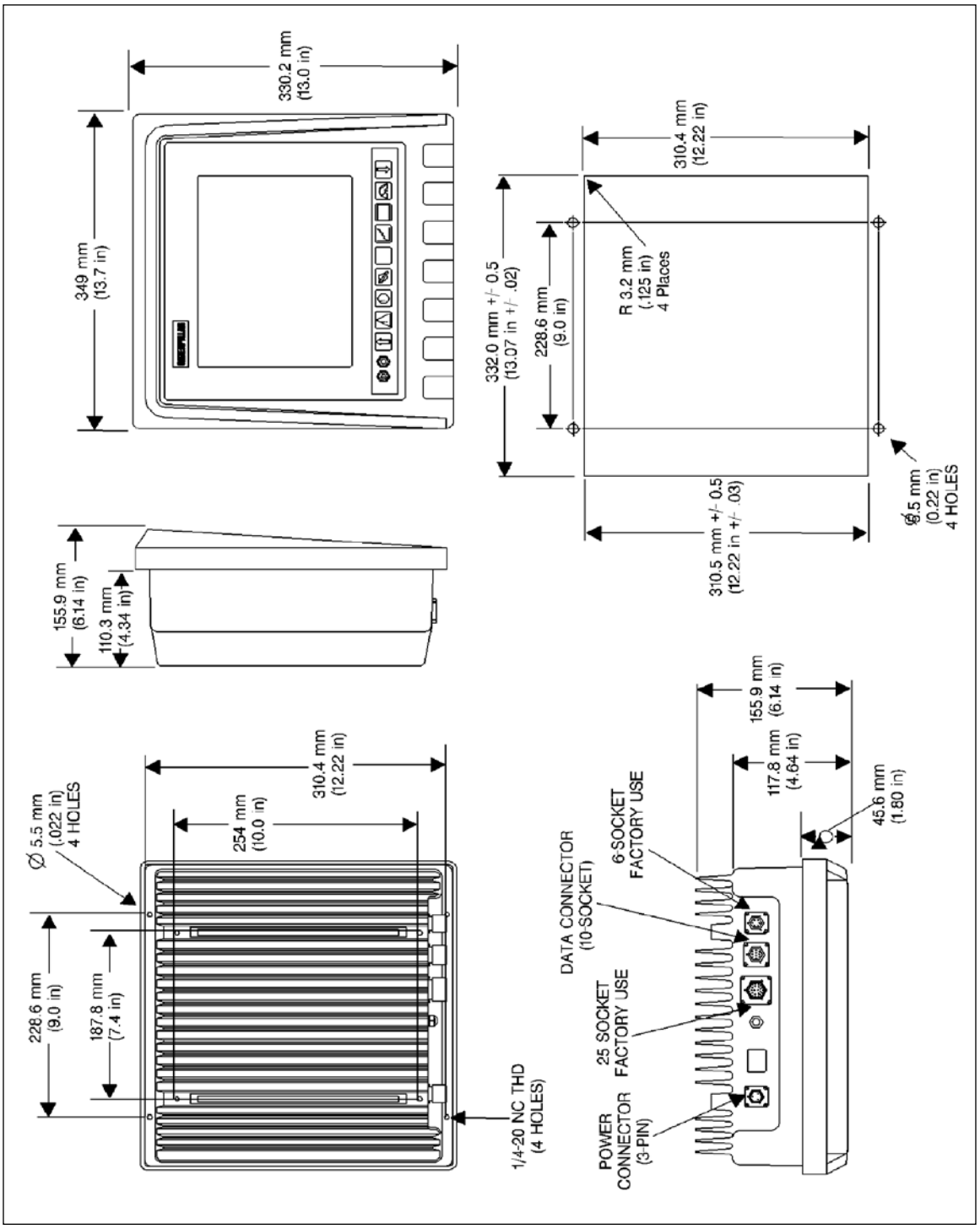
The following Table 8-2 is used in order to obtain the parts that are required for the installation of the Engine Vision display. Refer to the individual topics for the specific parts and the quantities that are required for each particular installation. The items and the quantities will vary due to the options that are chosen.

Table 8-2 Required Parts for the Engine Vision Display

ENGINE VISION REQUIRED PARTS		
Part Number	**Description**	**Qty**
212-7481	Engine Vision display includes the following items:	1
	Monitor Electronic Control Module (ENGINE VISION)	
	163-3972 Mounting Kit	
	163-3974 Power Cable	
	163-3973 Data Link Cable	
225-0774 or 256-7511	System Communication Module Gp Communication Electronic Control Module	1
7C-2668	Diode	1
5P-3059	Terminal	4
(1)	SPST Switch (25 Amp at 28 VDC)	1
127-8853(2)	Electrical Converter Gp	1
(1)	16 AWG Wire(3)	N/A
143-5018	Electrical Cable(3)	N/A
	(1) OEM supplied (2) The converter is required for the 12 VDC Electrical Systems (3) Fabricate the wires to the desired length	

8.5 MOUNTING THE ENGINE VISION DISPLAY

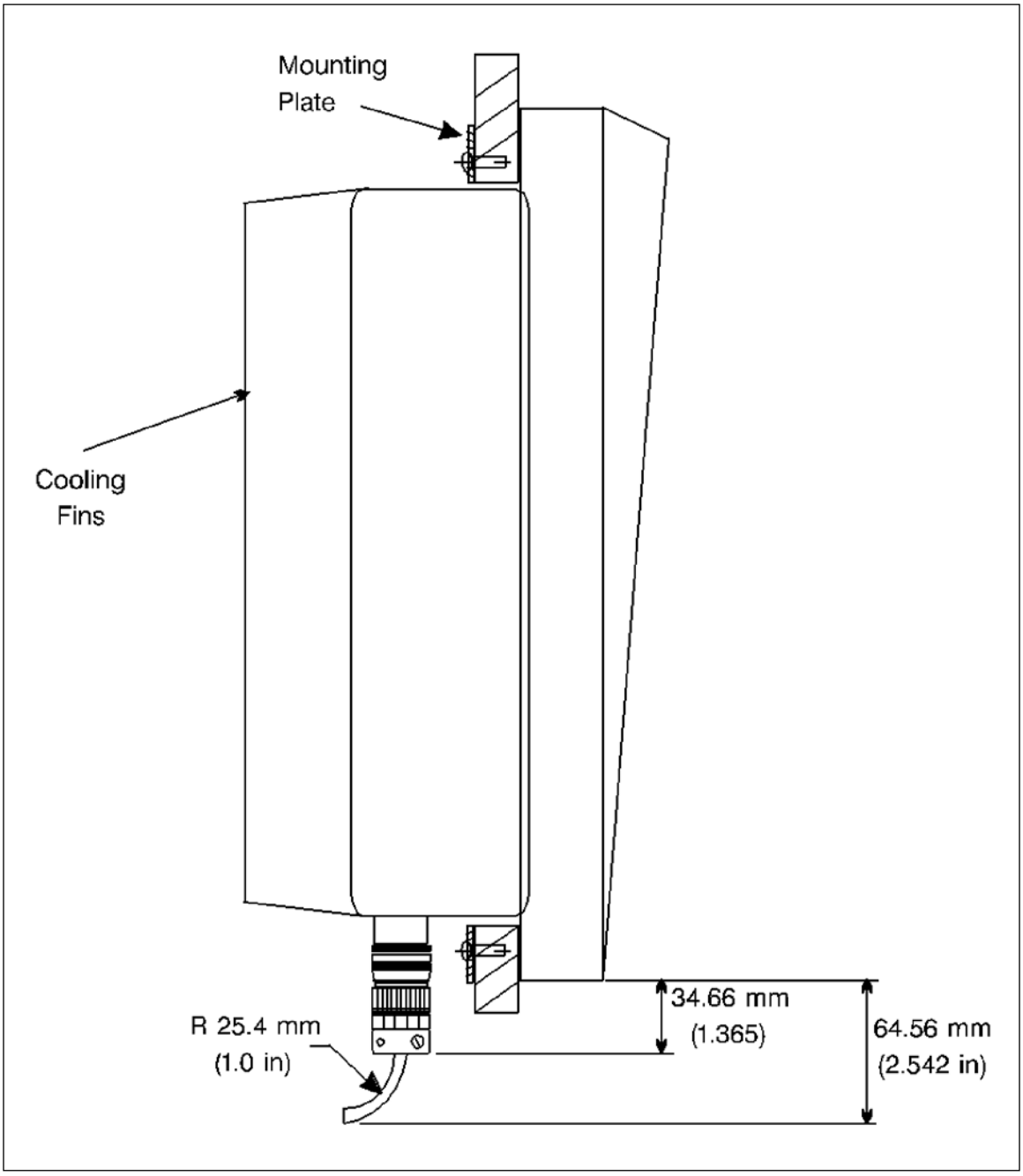
Figure 8-5 Dimensions for the Engine Vision Display



MOUNTING CONSIDERATIONS

The installation can be customized in order to fit the surroundings of the vessel. However, the package cannot be modified in any fashion. Do not form a tight enclosure around the back of the Engine Vision display. The display module must have proper air flow in order to ensure adequate heat dissipation.

Figure 8-6 Clearance Dimensions for the Engine Vision Display



MOUNTING THE ENGINE VISION DISPLAY

1. The display module is most easily viewed from a perpendicular position.
2. The thickness of the console that is recommended should not exceed 19.05 mm (0.750 inch).
3. Four holes for clearance for the 10-32 screws are provided in the flange on the housing for the display.
4. Four 1/4-20 threaded mounting holes are provided on the rear of the display module.
5. A 163-3972 Mounting Kit is provided. This kit contains a mounting plate with four 10-32 tapped holes in order to secure the display to the console.
6. A 64.5 mm (2.54 inch) clearance is needed at the bottom of the display.
7. Wiring between the EVIM and display must be no greater than 1.8 m (6.00 ft). Mount the EVIM in a location that is protected from exposure to moisture.

8.6 ENVIRONMENTAL SPECIFICATIONS

The Original Equipment Manufacturer (OEM) must provide adequate cooling in order to produce a 50°C (122°F) maximum air temperature at the display's cooling fins. Forced cooling is required for installations with a mounting angle that is less than 30 degrees from the horizontal. The specifications in Table 8-3 must be met under all anticipated ambient conditions.

Table 8-3 Cooling Specifications

COOLING SPECIFICATIONS	
Specification	**Value**
Operating Temperature Range	0to50°C (32to122 °F)
Storage Temperature Range	25to70°C(13to158°F)
Humidity	0 to 100 percent
Voltage	9VDC to 32 VDC
Steady State Current (12 VDC)	10 Amps
Steady State Current (24 VDC)	7Amps
Circuit Protection	30 Amps

8.7 MOUNTING THE ENGINE VISION

Position the mounting bracket on the console in the pilot house at the location of installation for the Engine Vision display, Figure 8-7.

One side of the bracket has a sticker that reads This Side Up. This side must be positioned in the UP position so that the sticker is visible.

The mounting bracket must be positioned at least 114.3 mm (4.50 inch) from the front vertical panel or 114.3 mm (4.50 inch) from the rear vertical panel of the console, to provide adequate clearance.

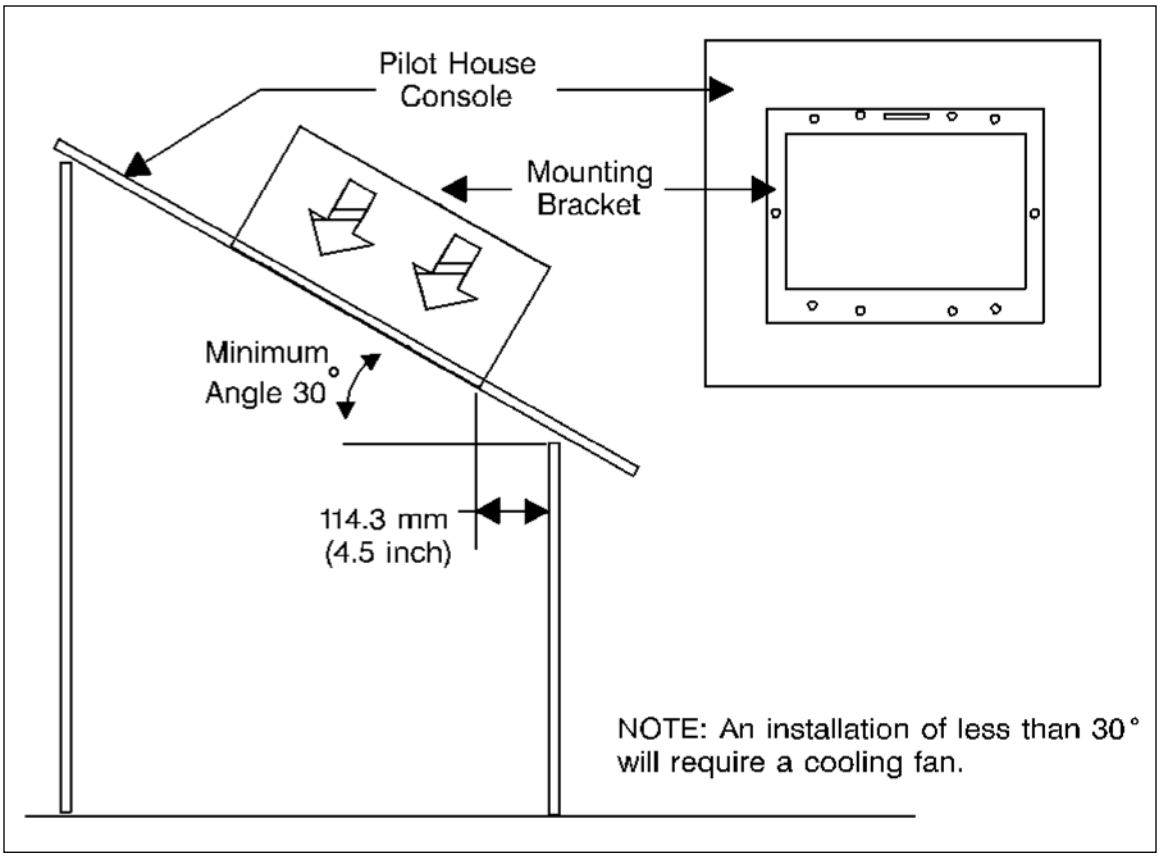


Figure 8-7 Mounting Location

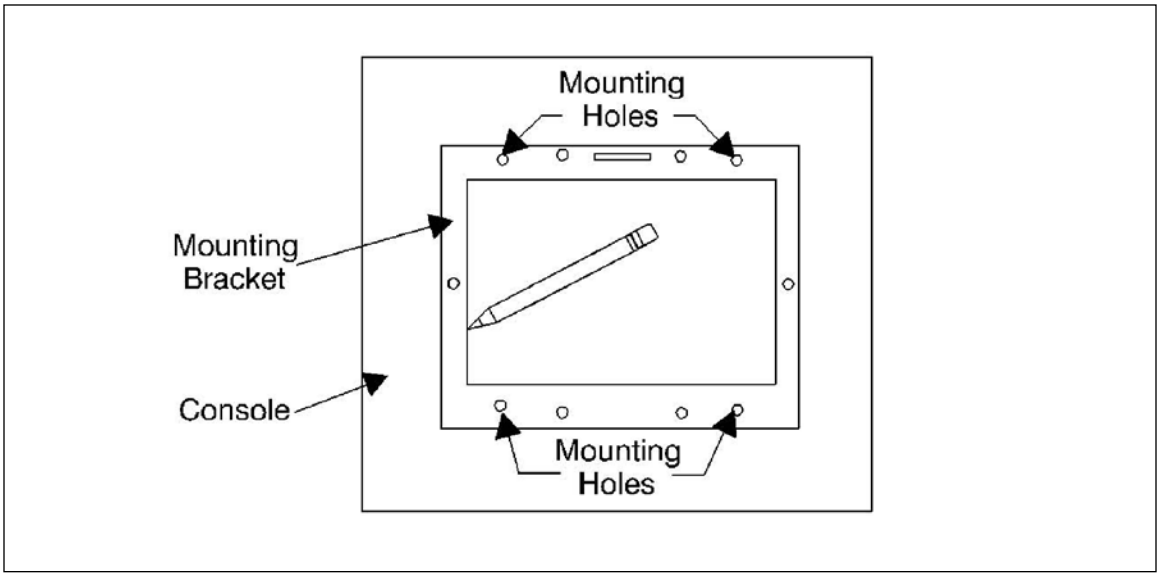


Figure 8-8 Trace the Mounting Bracket

Trace the inside of the mounting bracket with a pencil in order to identify the portion of the console that must be removed, Figure 8-8.

Trace the edge of the bracket as closely as possible. Also mark the four mounting holes in the bracket with the pencil.

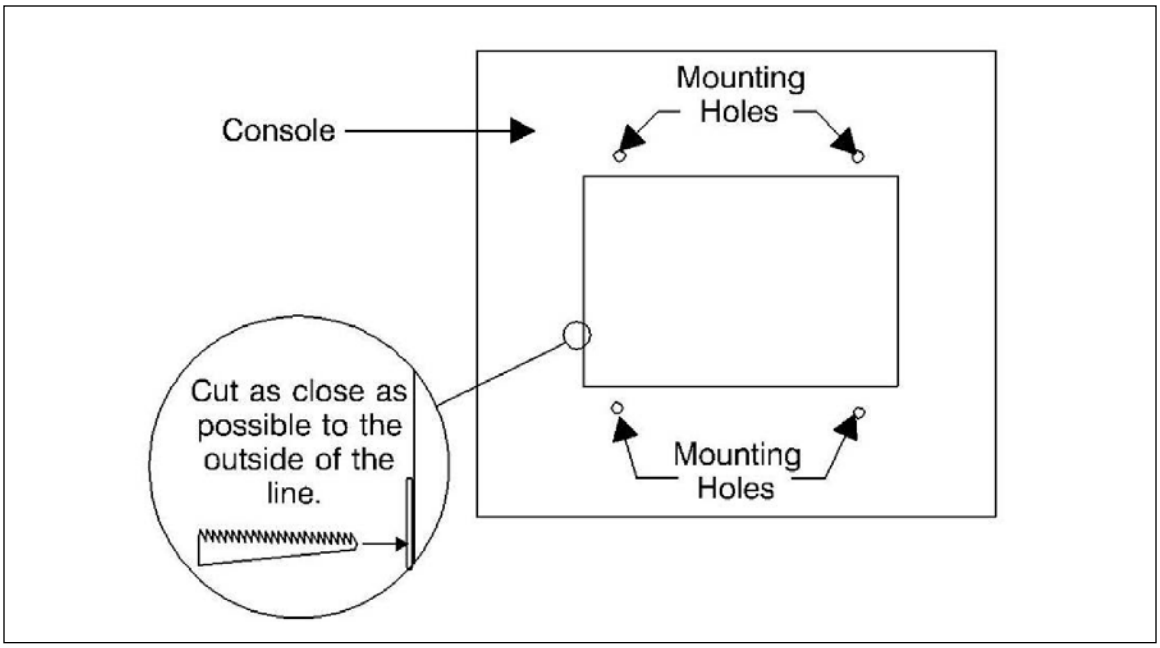


Figure 8-9 Cut the Console

Drill four mounting holes in the console that are 6.4 mm (0.25 inch) in diameter.

Cut the hole for the Engine Vision display in the console. Follow the outside of the line that is traced, Figure 8-9.

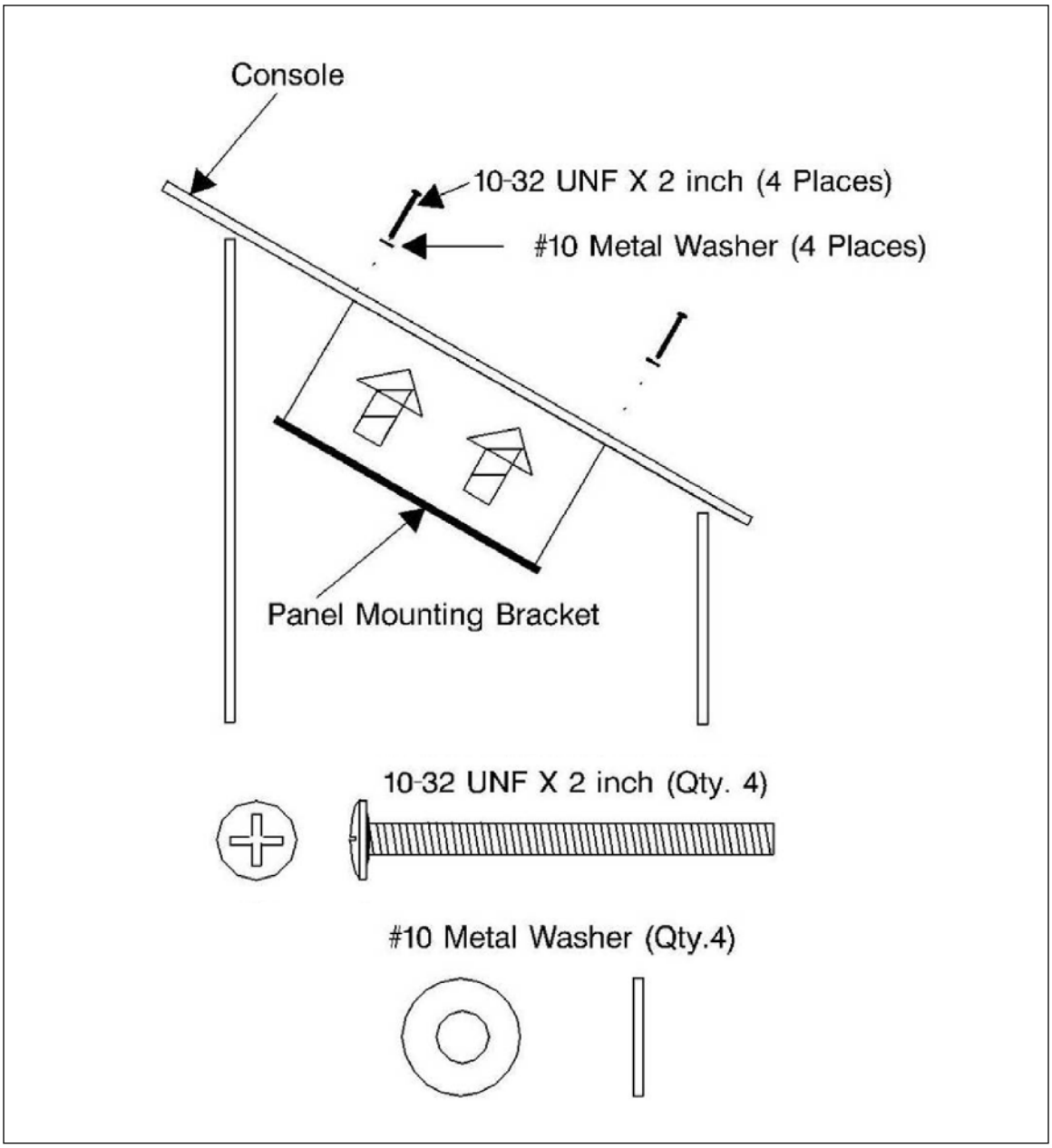


Figure 8-10 Install the Mounting Bracket

Place the mounting bracket on the underside of the console.

Align the bracket with the hole that has been cut for the Engine Vision display and the four mounting holes.

Attach the mounting bracket to the console with the four machine screws (10-32 UNF x 2 inch). Insert the screws from the top side of the console, Figure 8-10.

NOTE: After the bracket has been attached, the bracket must be visible. If a section of the bracket is not visible, cut the console so that the edges of the bracket are visible.

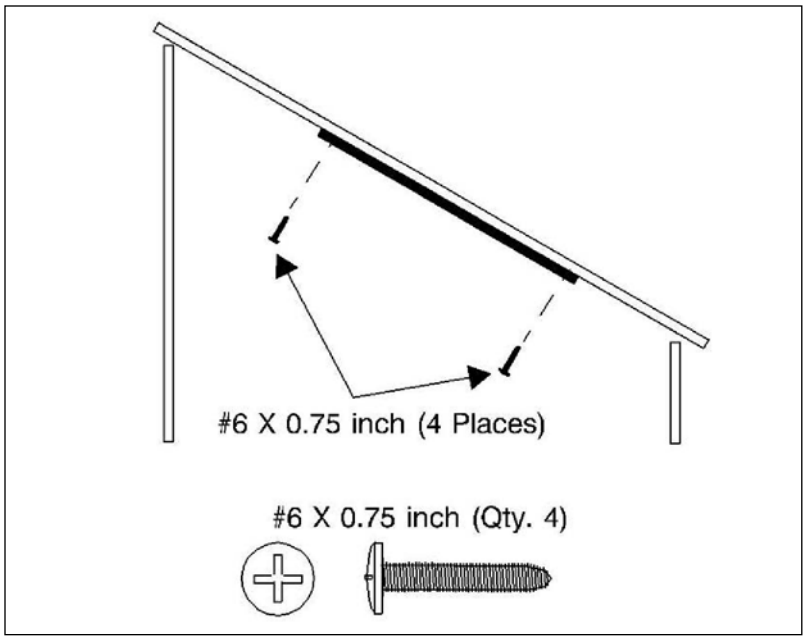


Figure 8-11 Secure the Mounting Bracket

Attach the mounting bracket with four 6 x 0.75 inch sheet metal screws, Figure 8-11.

Insert the screws from the underside of the console.

Remove the four machine screws (10-32 UNF x 2 inch) from the top side of the console.

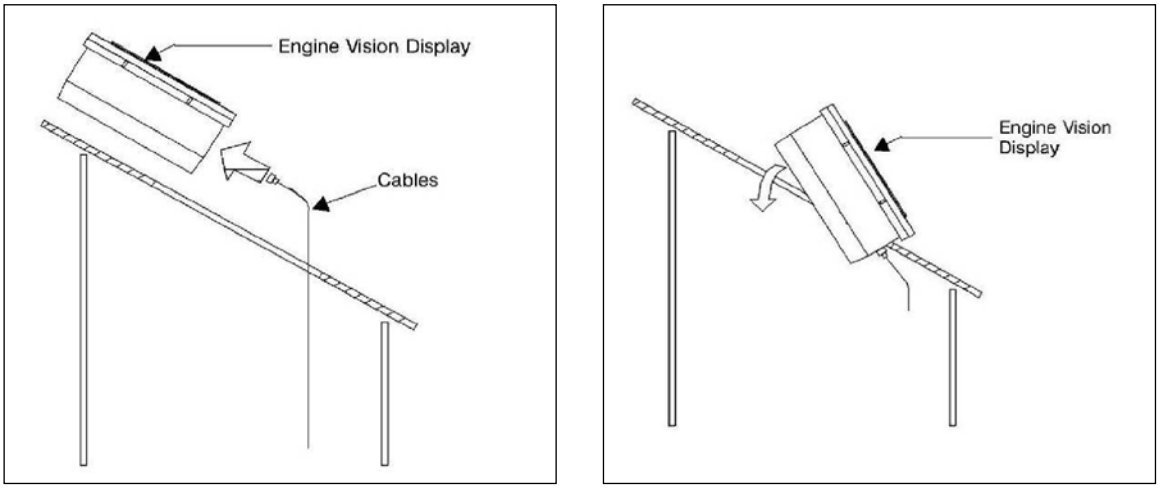


Figure 8-12 Install the Engine Vision Display

Bring the cables through the hole in the console for the Engine Vision display, Figure 8-12.

Make all of the required connections to the Engine Vision display.

Insert the side of the Engine Vision display that has the connectors into the hole first and then slide the balance of the display into the hole.

NOTE: If the console is thicker than 12.7 mm (0.50 inch), the cables must be connected after the Engine Vision display has been inserted into the hole.

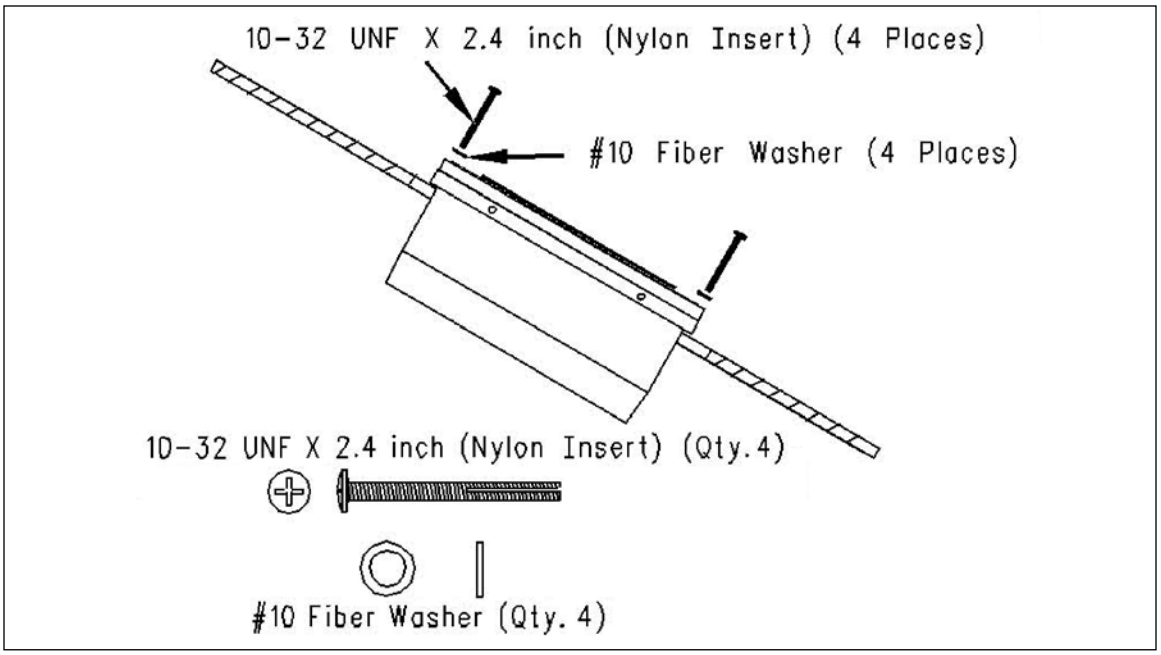


Figure 8-13 Secure the Engine Vision Display

Use the four 10-32 UNF x 2.4 inch locking machine screws and the four fiber washers in order to attach the Engine Vision display to the mounting bracket, Figure 8-13.

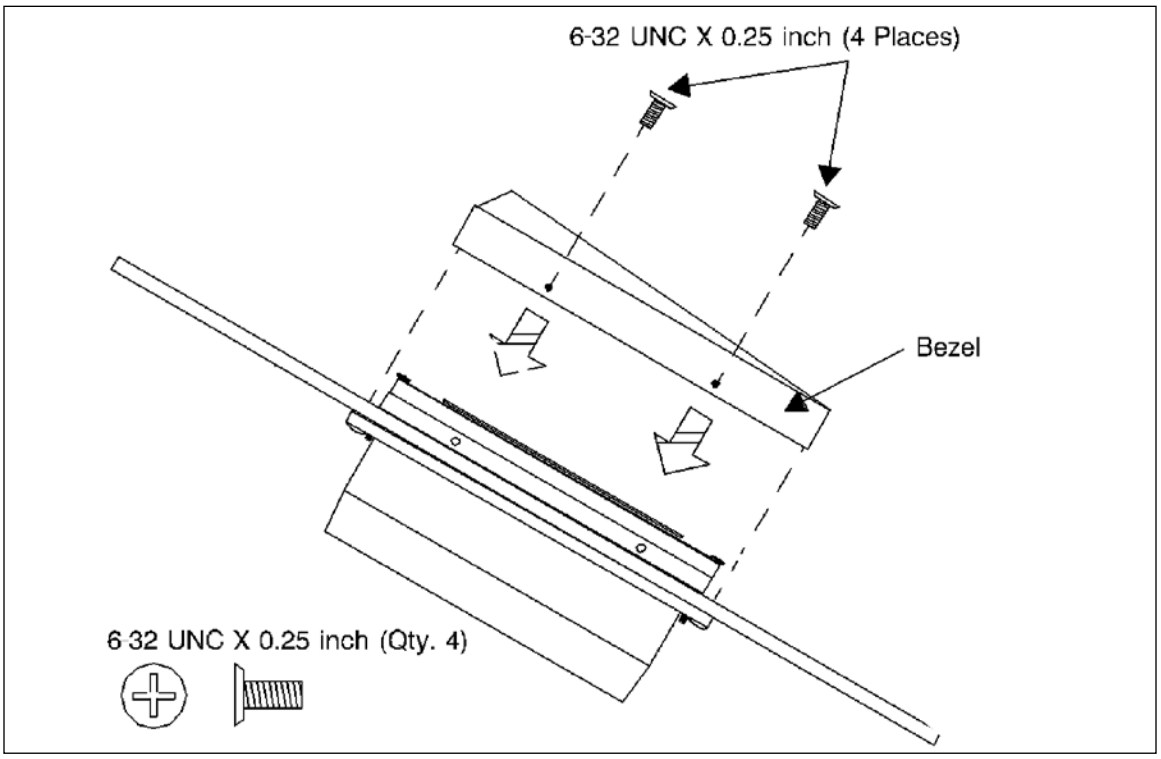
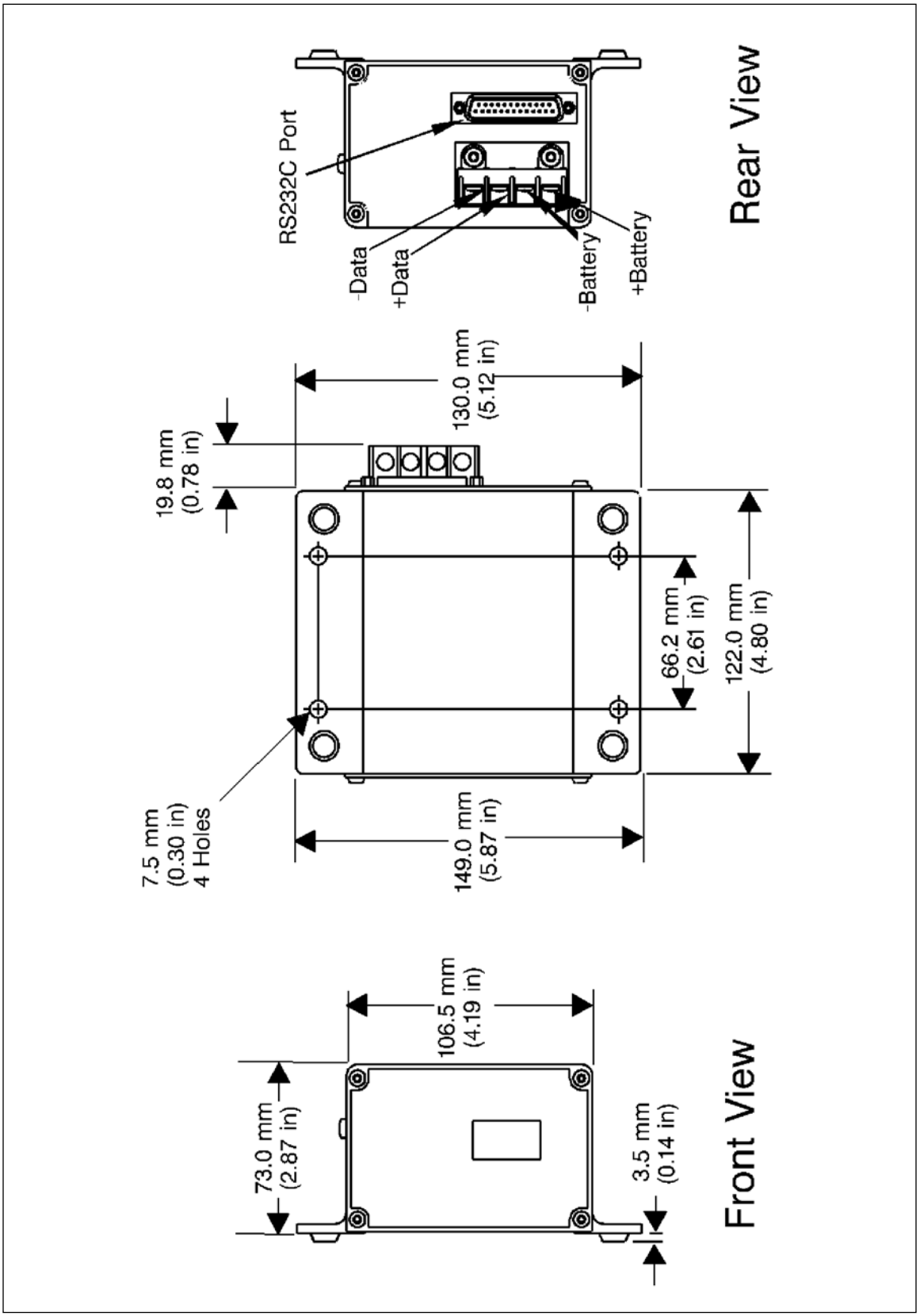


Figure 8-14 Attach the Engine Vision Display

Attach the plastic bezel over the Engine Vision display and attach the bezel with the four small screws (6-32 UNC x 0.25 inch), Figure 8-14.

8.8 ENGINE VISION INTERFACE MODULE (EVIM) DIMENSIONS

Figure 8-15 Dimensions for the Engine Vision Interface Module



8.9 POWER CONSIDERATIONS FOR THE EVIM

The EVIM requires a supply voltage of 24 VDC.

If the vessel has an electrical system that is 12 VDC, the installation of the EVIM will require the installation of a voltage converter.

The power requirement for the DC/DC converter must provide a minimum of 24 VDC at 25 watts.

8.10 ENVIRONMENTAL CONSIDERATIONS

Mount the EVIM in a location that is protected from direct exposure to moisture. The following specifications in Table 8-4 must be met.

Table 8-4 EVIM Environmental Considerations

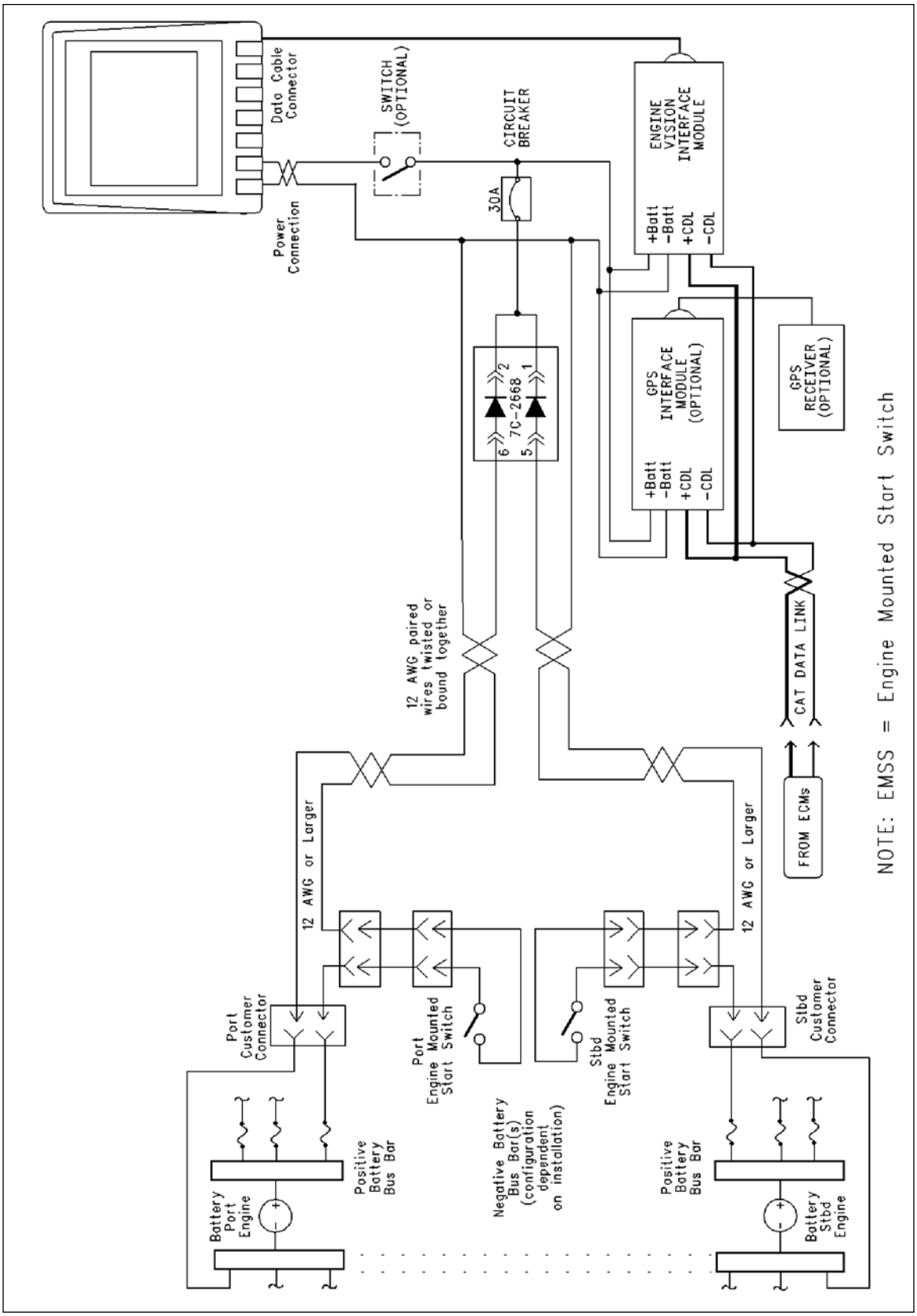
EVIM ENVIRONMENTAL CONSIDERATIONS	
Specification	**Value**
Operating Temperature Range	0 to 50°C (32 to 122°F)
Storage Temperature Range	25 to 70°C (13 to 158°F)
Humidity	0 to 100 percent
Circuit Protection	1Amp

8.11 BATTERY(-) CONNECTIONS

CAUTION: Avoid splicing or soldering wire connections. All connections should be terminated at terminal strips in order to ensure electrical system reliability.

1. Connect the power switch for the PORT engine to terminal 6 of the 7C-2668 Diode.
2. Connect the power switch for the STBD engine to terminal 5 of the 7C-2668 Diode.
3. Connect terminal 1 and terminal 2 of the 7C-2668 Diode to the +V input on the EVIM. Also, connect pin 1 and pin 2 to the +V input on the Engine Vision display.
4. Connect the negative terminal of the Battery(-) bus bar to the Battery(-) on the EVIM and the Engine Vision display.

Figure 8-16 Battery Connections



8.12 CONNECTIONS TO THE CAT DATA LINK

CAUTION: Avoid splicing or soldering wire connections. All connections should be terminated at terminal strips in order to ensure electrical system reliability.

Table 8-5 Connections to the Cat Data Link

CONNECTIONS TO THE CAT DATA LINK - PARTS REQUIRED		
Part Number	**Description**	**Qty**
186-3736	Connector Socket	4
143-5018	Electrical Cable	N/A

See Table 8-6 for the proper terminal positions for your engine.

Table 8-6 Terminal Locations for Cat Data Link

CUSTOMER CONNECTOR TERMINAL LOCATIONS		
Engine	**Cat Data Link+**	**Cat Data Link**
3408C, 3412C	18	24
3176B	9	3
3126B, 3176C, 3196, 3406E, 3412E, C7, C9, C12, C15, C18, C30, C32	7	6
3500B	22	14
3500B Series II	h	g

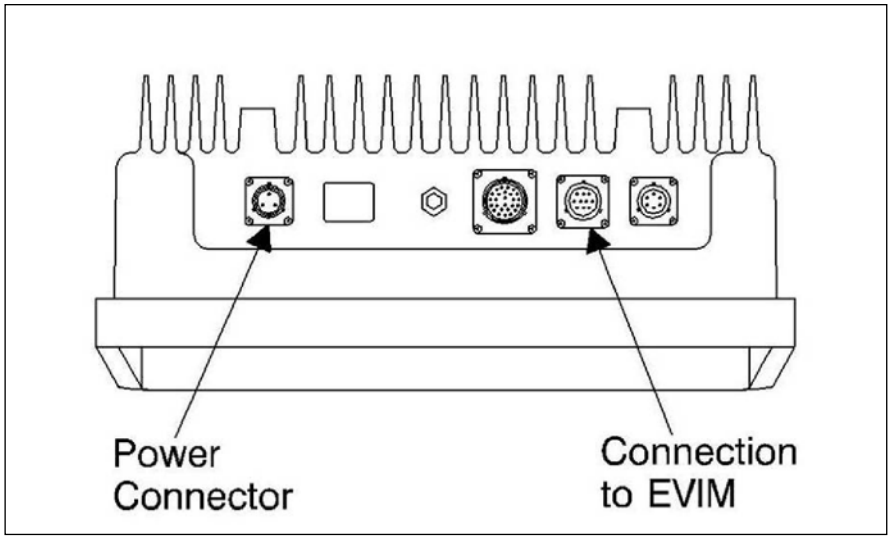


Figure 8-17 Connections for the Engine Vision Display

1. Connect the terminal for the Cat Data Link + of the PORT customer connector to the terminal for the Cat Data Link - on the terminal strip connection for the engine room data.
2. Connect the terminal for the Cat Data Link - of the PORT customer connector to the terminal for the Cat Data Link on the terminal strip connection for the engine room data.

3. Connect the terminal for the Cat Data Link + of the STBD customer connector to the terminal for the Cat Data Link + on the terminal strip connection for the engine room data.
4. Connect the terminal for the Cat Data Link - on the STBD customer connector to the terminal for the Cat Data Link - on the terminal strip connection for the engine room data.
5. Connect the terminal for the Cat Data Link + on the terminal strip connection for the engine room data to the +D terminal of the EVIM.
6. Connect the terminal for the Cat Data Link - on the terminal strip connection for the engine room data to the -D terminal of the EVIM.
7. Connect the 163-3973 Cable As from terminal 25 of the EVIM connector to terminal 10 of the connector for the Engine Vision display.

10.13 MULTIPLE EMS DISPLAYS

For multiple EMC connections to the Cat Data Link see Figure 8-18 EVD Connections to Cat Data Link.

For multiple Operator Station connections to the Cat Data Link see Figure 8-18 EVD Connections to Cat Data Link.

NOTE: Refer to Table 8-6 Terminal Locations For Cat Data Link for correct terminal locations.

The following components are required for each Engine Vision Display:

• Engine Vision Interface Module — EVIM

• Diode Block

• Display Data Link

The EVIM data and the Engine Vision Display data communicate over Display Data Link.

The diode block isolates engine power (battery systems), ensuring that accurate data is received from each engine. The diode block is also necessary for each Battery system or power supply.

Each vessel requires only one Global Positioning System Interface Module (GPSIM). It is located between GPS receiver and the engine ECM.

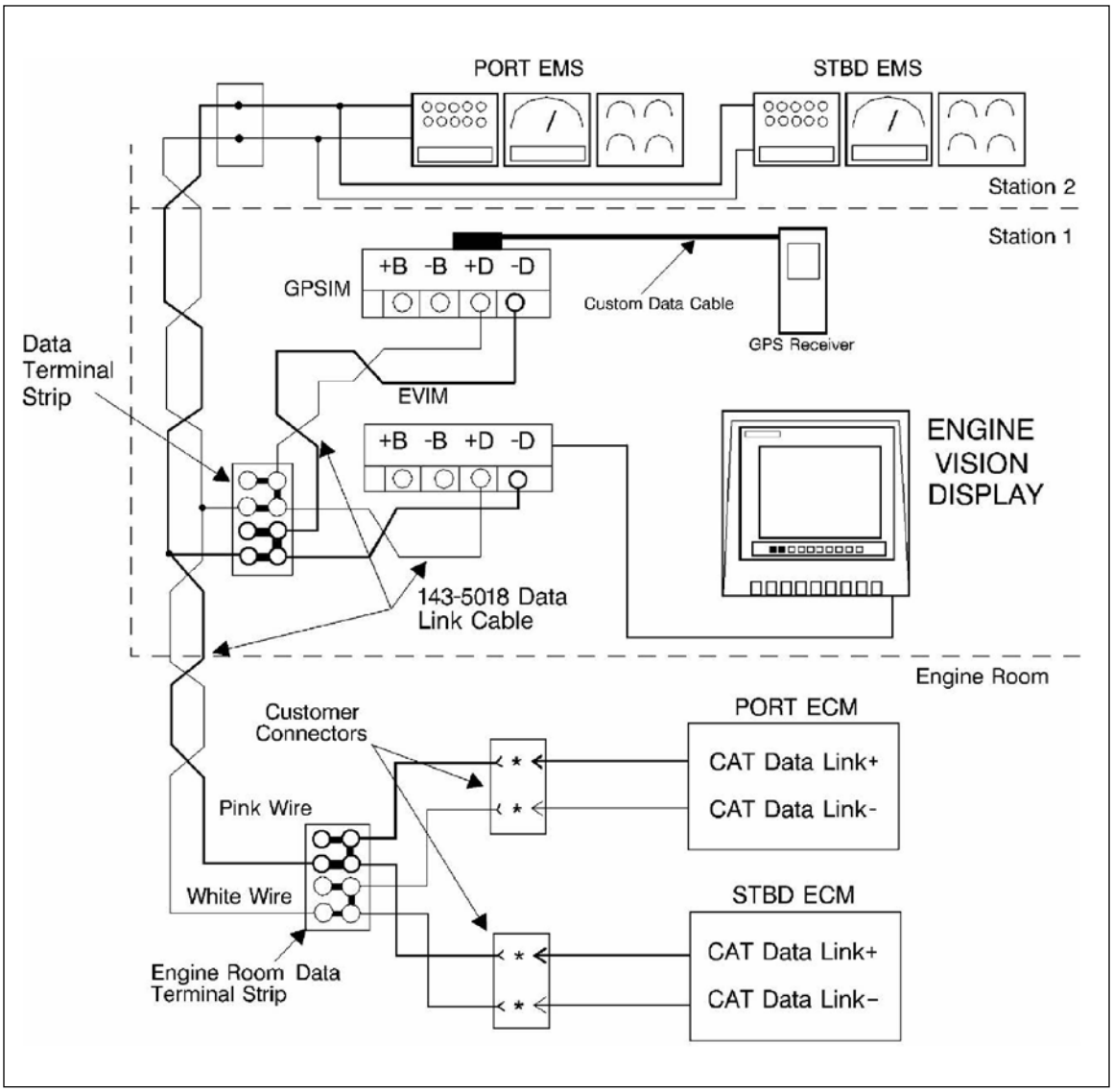


Figure 8-18 EVD Connections to Cat Data Link

8.14 ADDITIONAL DISPLAYS

Additional displays that utilize the Cat Data Link may be installed in order to allow the installation of additional operator stations (see Figure 8-18).

When additional stations are needed, terminal strips should be used to make multiple connections to the Cat Data Link + and Cat Data Link -.

Be sure to use 143-5018 Electrical Cable to connect the stations to the Cat Data Link.

The total length of cable in the circuit should NOT exceed 30 m (100 ft).

9 GLOBAL POSITIONING SYSTEM

9.1 INSTALLATION

Refer to Table 9-1 for the parts that are required to install the GPSIM.

Table 9-1 Installation of the GPSIM

REQUIRED PARTS		
Part #	**Description**	**Qty**
130-6191 or 256-7511	System Communication Module Gp Communication Electronic Control Module	1
7C-2668	Diode (1)	1
5P-2321	Terminal	4
127-8853 (2)	Electrical Converter Gp (3)	1
(4)	16 AWG Wire	(5)
143-5018	Data Link Cable	1

(1) Use this part if a diode assembly is not already installed
(2) The GPSIM can be connected to the DC/DC Converter that is used to power the EVIM
(3) The DC/DC converter is required for vessels that use electrical systems that are 12 VDC.
(4) OEM Supplied
(5) Fabricate cable to length

The wiring instructions and optional features of the Original Equipment Manufacturer (OEM) are recommended.

CAUTION: No additional connections are allowed to any wires that are detailed and described in this publication without the approval of Caterpillar.

9.2 GPSIM DIMENSIONS

The installation can be customized to fit the surroundings of the vessel.

- Do NOT modify the GPSIM in any fashion.
- Four mounting holes are provided on the flange.
- Mount the GPSIM in a location that is protected from exposure to moisture.

CAUTION: The environmental specifications must be maintained (see Table 9-2).

Table 9-2 GPSIM Environmental Specifications

GPSIM ENVIRONMENTAL SPECIFICATIONS	
Specification	**Value**
Operating Temperature Range	0to50°C (32 to 122°F)
Storage Temperature	25to70°C(13to158°F)
Humidity	0 to 100 percent
Nominal Voltage	24 VDC
Circuit Protection	1Amp

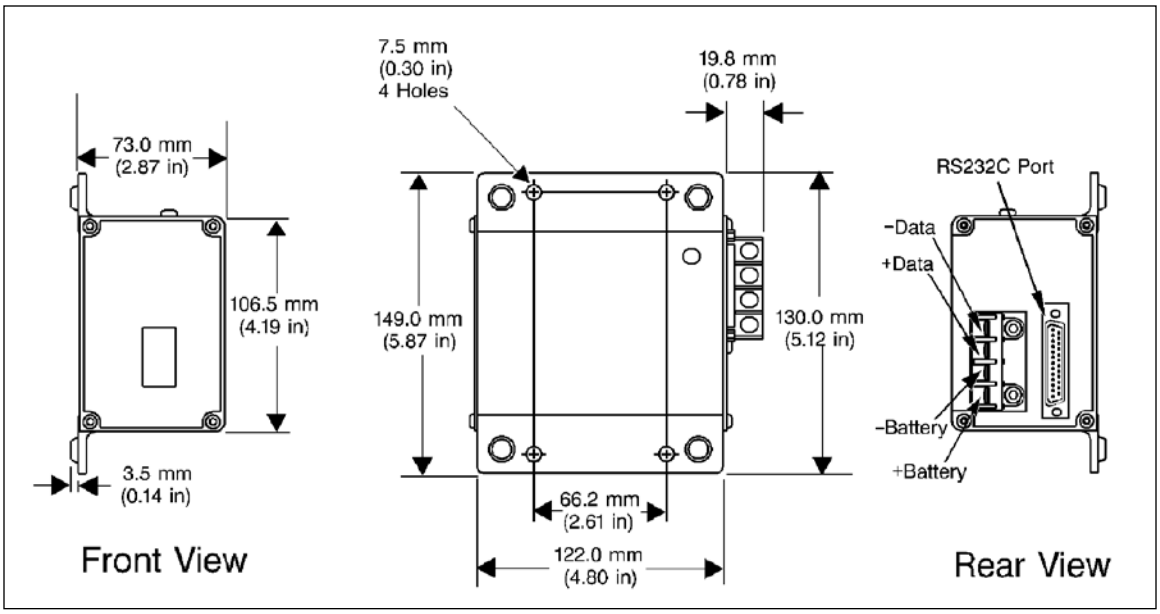


Figure 9-1 GPSIM Mounting Considerations

9.3 BATTERY CONNECTIONS

The GPSIM requires a power supply that is 24 VDC. If an electrical system that is 12 VDC is used, the GPSIM will require a 12/24 volt converter.

CAUTION: Use a 1A circuit protection in the supply circuit (24 VDC) for the GPSIM.

If a 12 volt to 24 volt converter is used, place the converter in the circuit between the diode block and the GPSIM, Figure 9-2.

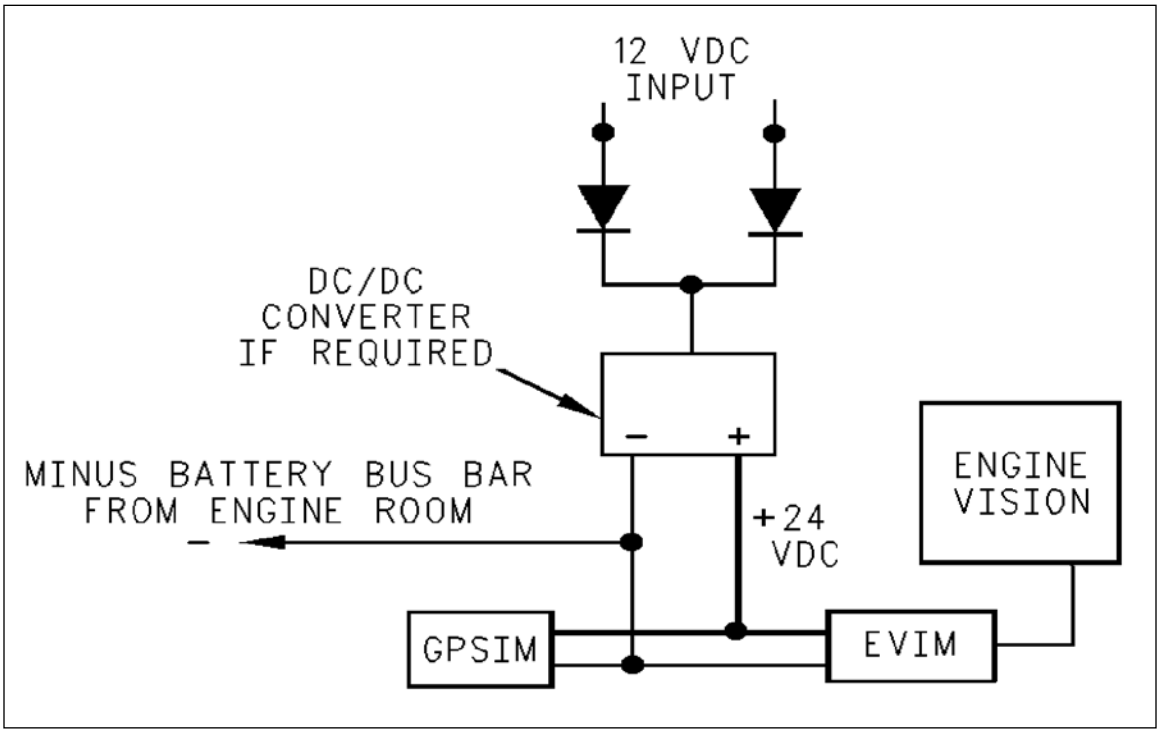


Figure 9-2 GPSIM Diode Block

9.4 GPSIM POWER CONNECTIONS

1. Connect the PORT engine power switch to terminal 6 of the 7C-2668 Diode.
2. Connect the STARBOARD engine power switch to terminal 5 of the 7C-2668 Diode.
3. Connect terminal 1 and terminal 2 of the 7C-2668 Diode to the Battery(+) terminal of the GPSIM.
4. Connect the negative Battery(-) bus bar to the Battery(-) terminal of the GPSIM.

9.5 CONNECTING THE GPSIM TO THE CAT DATA LINK

NOTE: Use a 143-5018 Electrical Cable to make the connections to the Cat Data Link.

This cable is twisted pair wiring.

The total cable length should NOT exceed 30 m (100 ft).

Refer to Table 9-3 for the proper terminal locations for your engine.

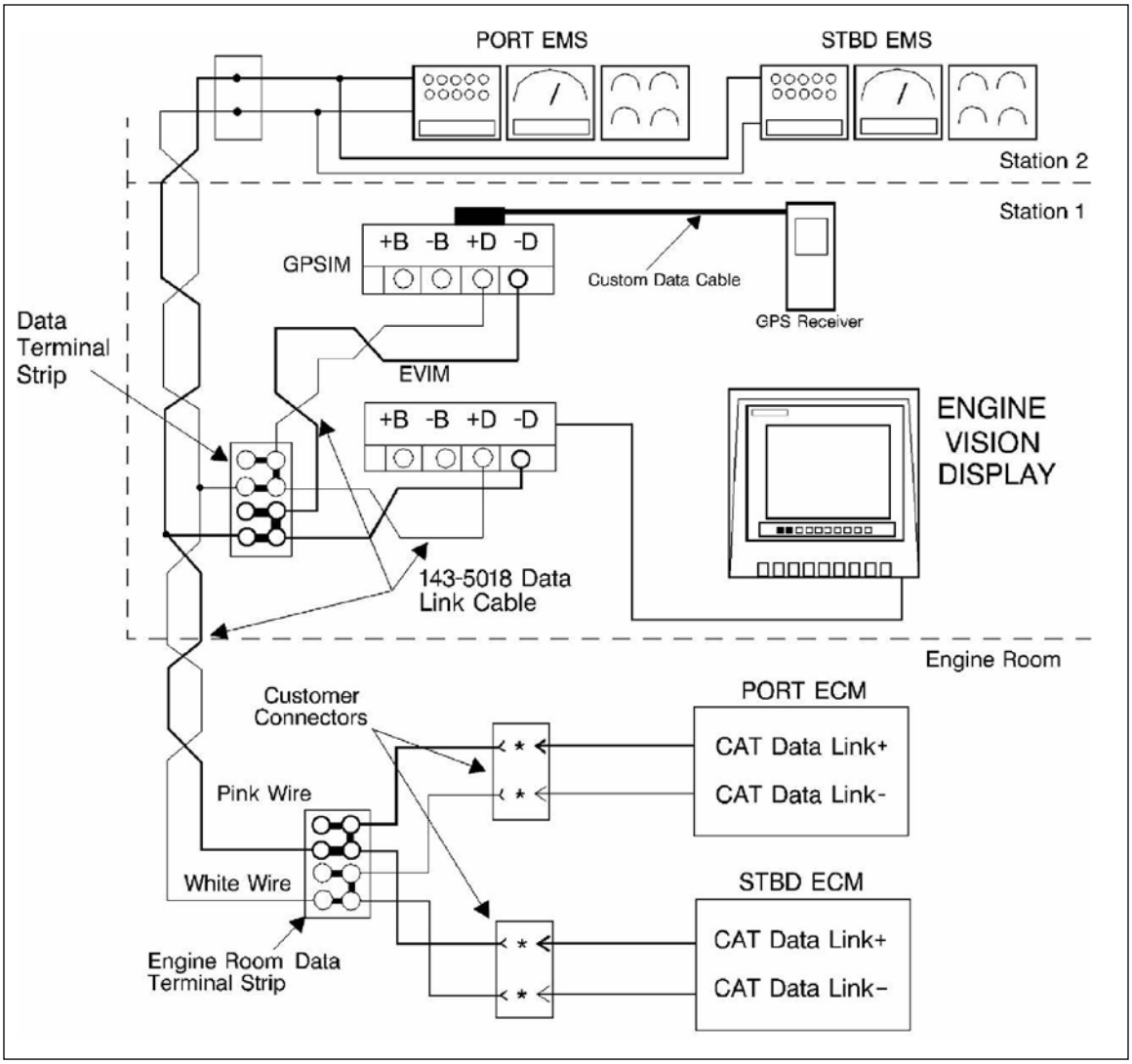


Figure 9-3 Connections for the Cat Data Link

Table 9-3 Terminal Locations for Cat Data Link

TERMINAL LOCATIONS AT CUSTOMER CONNECTOR FOR CAT DATA LINK		
Engine	**Cat Data Link +**	**Cat Data Link**
3408C, 3412C	18	24
3176B	9	3
3126B, 3176C, 3196, 3406E, 3412E, C7, C9, C12, C15, C18, C30, C32	7	6
3500B	22	14
3500B Series II	h	g

1. Connect the terminal for the Cat Data Link + of the PORT customer connector to the terminal for the Cat Data Link + on the terminal strip connection for the engine room data, Figure 9-3 Connections for the Cat Data Link.
2. Connect the terminal for the Cat Data Link - of the PORT customer connector to the terminal for the Cat Data Link - on the terminal strip connection for the engine room data.
3. Connect the terminal for the Cat Data Link + of the STBD customer connector to the terminal for the Cat Data Link + on the terminal strip connection for the engine room data.
4. Connect the terminal for the Cat Data Link - on the STBD customer connector to the terminal for the Cat Data Link - on the terminal strip connection for the engine room data.
5. Connect the terminal for the Cat Data Link + on the terminal strip connection for the engine room data to the terminal for the Cat Data Link + of the GPSIM.
6. Connect the terminal for the Cat Data Link - on the terminal strip connection for the engine room data to the terminal for the Cat Data Link - of the GPSIM.

9.6 GPS RECEIVER CONNECTS TO GPS INTERFACE MODULE

1. Connect the data output for the GPS Receiver to terminal 3 of the DB-25 connector for the GPSIM, Figure 9-4.
2. Connect the ground terminal of the GPS Receiver to terminal 7 of the DB-25 connector for the GPSIM.
3. Place a jumper wire between terminal 8 and terminal 20 on the DB-25 connector for the GPSIM.

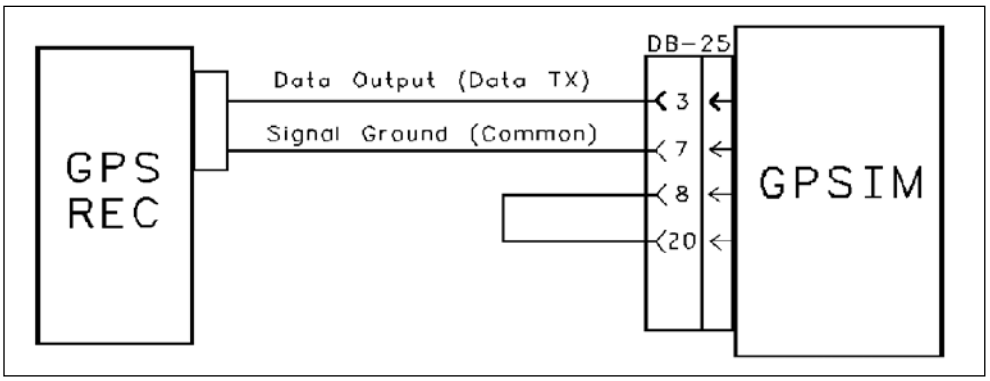


Figure 9-4 GPS to GPSIM Drawing

Table 9-4 GPS to GPSIM Required Parts

GPS TO GPSIM REQUIRED PARTS		
Part Number	**Description**	**Qty**
143-5018	Data Link Cable	1
130-6191	GPS Interface Module	1

9.7 SETTING THE GPS RECEIVER

The NMEA 0183 Standard is used in order to make the proper settings for the GPS Receiver.

Use the following settings:

- 4800 baud
- No parity
- 8 data bits
- 1 stop bit

Set the GPS to the following settings:

- GLL — This setting will allow the position to be displayed.
- VTG — This setting will allow vessel speed to be displayed.
- RMC — This setting will allow the vessel speed and the position to be displayed.

NOTES:

10 MARINE DISPLAYS

10.1 DISPLAY DESCRIPTIONS

The Marine Displays come in three different models:

- MPD — Marine Power Display
- Mini MPD — Mini Marine Power Display
- Color MPD — Color Marine Power Display

Figure 10-1 Legacy MPD

LEGACY AND MINI MPD

The legacy MPD and the newer Mini MPD share all the same functionality, screens and software. In this document, an MPD reference includes the Mini MPD.

Figure 10-2 Mini MPD

COLOR MPD

The Color MPD has all of the functionality descriptions of the MPD with many enhancements such as on-screen editing, dual engine support, and video camera inputs.

Figure 10-3 Color MPD (CMPD)

10.2 MPD/MMPD LANGUAGE SELECTION

The MPD and Mini MPD have multiple flash files for language selection. The units ship with English/Spanish language installed. If another language will be used, then a Cat dealer must flash the unit. See Table 10-1 for file selection.

After the language flash file has been installed, the operator can select between English and the selected language by using the System Information Menu Screen.

Table 10-1 MPD/MMPD Languages

LANGUAGE FLASH FILES			
Language	**Flash File**	**Language**	**Flash File**
English/Spanish	306-3061-00	English/German	306-9469-00
English/Italian	306-9467-00	English/Portuguese	306-9470-00
English/ French	306-9468-00	English/Dutch	306-9471-00

10.3 COLOR MPD LANGUAGE SELECTION

The Color MPD has all languages installed. The operator can select the desired language by using the System Configuration Menu Screen.

10.4 COMMUNICATIONS

The Marine displays transmit and receive information over the J1939 Data Link. This information is transferred to and from the Engine Control Module (ECM) and the Powertrain Control Processor (PCP).

10.5 DISPLAY SYMBOLS

When the display language is set to English, the displayed parameters will be defined with the name of the parameter that is being measured. When the display language is set to one of the other available languages, the displayed parameters will be defined by one of the following symbols (see Table 10-2 Display Matrix Definitions).

Figure 10-4 Display Symbols – Matrix

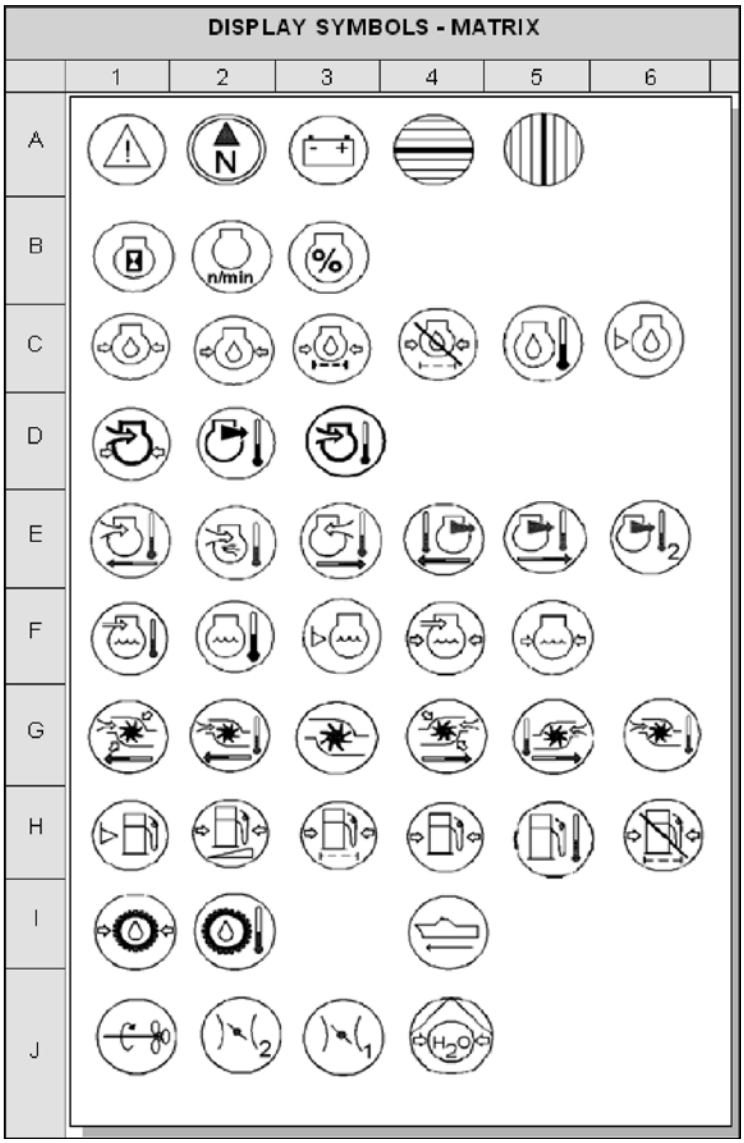


Table 10-2 Display Matrix Definitions

SYMBOL TABLE			
Matrix	**Symbol Name**	**Matrix**	**Symbol Name**
A1	Diagnostics	G1	Left Turbocharger Compressor Inlet Pressure
A2	Heading	G2	Left Turbocharger Compressor Inlet Temperature
A3	Battery(-) Voltage	G3	Boost Pressure
A4	Latitude Position	G4	Right Turbocharger Compressor Inlet Pressure
A5	Longitude Position	G5	Right Turbocharger Compressor Inlet Temperature
		G6	Turbocharger Compressor Inlet Temperature
B1	Engine Hours		
B2	Engine Speed	H1	Fuel Level
B3	Engine Load	H2	Fuel Rate
		H3	Fuel Filter Differential Pressure
C1	Crankcase Pressure	H4	Fuel Pressure
C2	Oil Pressure	H5	Fuel Temperature
C3	Oil Filter Differential Pressure	H6	Unfiltered Fuel Pressure
C4	Unfiltered Oil Pressure		
C5	Oil Temperature	I1	Transmission Pressure
C6	Oil Level	I2	Transmission Temperature
D1	Air Inlet pressure	I4	Vessel Speed
D2	Stack Exhaust Temperature		
D3	Air Inlet Temperature	J1	Shaft Speed
		J2	Secondary Throttle Position
E1	Left Air Inlet Temperature	J3	Primary Throttle Position
E2	Inlet Manifold Temperature	J4	See Water Pump Outlet Pressure
E3	Right Air Inlet Restriction		
E4	Left Exhaust Temperature		
E5	Right Exhaust Temperature		
E6	Intake Manifold Temperature (2)		
F1	Aftercooler Coolant Temperature		
F2	Coolant Temperature		
F3	Coolant Level		
F4	Aftercooler Coolant Pressure		
F5	Coolant Pressure		

10.6 DIAGNOSTIC CODES AND EVENT CODES

Table 10-3 includes a complete listing of the Diagnostic Codes and the Event Codes that may be displayed by the MPD.

NOTE: Refer to the Marine Display Troubleshooting document for information on troubleshooting, diagnostics, and repairs.

Table 10-3 Diagnostic Codes and Event Codes

DIAGNOSTIC CODES AND EVENT CODES	
Code	**Description Of The Code**
E048	Backup ECM Took Control
E881	Multiple Master Control Stations
CID 253-FMI 2	Check Customer or System Parameters
CID 254-FMI 12	ECM Fault
CID 268-FMI 2	System Parameters
CID 337-FMI 2	Incorrect Remote E-Stop Switch Inputs
CID 338-FMI 5	Pre-Lube Relay Open Circuit
CID 338-FMI 6	Pre-Lube Relay Short to Ground
CID 369-FMI 7	Gear Not Qualified
CID 579-FMI 5	Heartbeat Signal Open Circuit
CID 579-FMI 6	Heartbeat Signal Short to Ground
CID 650-FMI 2	Harness Code Unknown
CID 700-FMI 2	Gear Signal Abnormal
CID 718-FMI 2	Xmsn Not Responding
CID 1326-FMI 9	ECM Not Responding
CID 1440-FMI 3	Throttle Open/Short to Battery(+)
CID 1440-FMI 4	Throttle Short to Ground
CID 1440-FMI 7	Throttle Not Qualified
CID 1440-FMI 8	Throttle Signal Abnormal
CID 1815-FMI 4	Control System Low Voltage
CID 1815-FMI 11	Backup System Active
CID 1815-FMI 12	PCP Fault
CID 1815-FMI 13	PCP Calibration Error
CID 1816-FMI 9	Active Control Station Communications Loss
CID 1817-FMI 9	Troll Communications Loss
CID 1821-FMI 9	Master Control Station Data Link Failure
CID 1822-FMI 9	Control Station Data Link Failure
SPN 29-FMI 8	Invalid Secondary Throttle Signal
SPN 29-FMI 13	Secondary Throttle Sensor Calibration
SPN 52-FMI 0	High Aftercooler Temperature Shutdown
SPN 52-FMI 3	Aftercooler Temp Open/Short to Battery(+)
SPN 52-FMI 4	Aftercooler Temp Short to Ground
SPN 52-FMI 15	High Aftercooler Temperature Warning
SPN 52-FMI 16	High Aftercooler Temperature Derate
SPN 91-FMI 8	Invalid Throttle Signal
SPN 91-FMI 10	Throttle Sensor Rate of Change
SPN 91-FMI 13	Throttle Sensor Calibration
SPN 94-FMI 1	Low Fuel Pressure Shutdown
SPN 94-FMI 3	Fuel Pressure Signal Open/Short to Battery(+)
SPN 94-FMI 4	Fuel Pressure Signal Short to Battery(-)

SPN 94-FMI 7	Fuel Pressure Miss-installed
SPN 94-FMI 13	Fuel Pressure Signal Calibration Required
SPN 94-FMI 15	High Fuel Pressure Warning
SPN 94-FMI 17	Low Fuel Pressure Warning
SPN 94-FMI 18	Low Fuel Pressure Derate
SPN 95-FMI 15	Fuel Filter Restriction Warning
SPN 96-FMI 11	Fuel Level Sensor Fault
SPN 98-FMI 1	Low Engine Oil Level Shutdown
SPN 98-FMI 17	Low Engine Oil Level Warning
SPN 98-FMI 18	Low Engine Oil Level Derate
SPN 99-FMI 0	Engine Oil Filter Restriction Shutdown
SPN 99-FMI 15	Engine Oil Filter Restriction Warning
SPN 99-FMI 16	Engine Oil Filter Restriction Derate
SPN 100-FMI 1	Low Engine Oil Pressure Shutdown
SPN 100-FMI 3	Oil Pressure Sensor Open Circuit
SPN 100-FMI 4	Oil Pressure Sensor Short Circuit
SPN 100-FMI 10	Oil Pressure Rate of Change or Engine Oil Pressure Out of Range
SPN 100-FMI 11	Very Low Oil Pressure Warning
SPN 100-FMI 13	Engine Oil Pressure Calibration Required
SPN 100-FMI 17	Low Oil Pressure Warning
SPN 100-FMI 18	Low Oil Pressure Derate
SPN 101-FMI 0	High Crankcase Pressure Shutdown
SPN 101-FMI 3	Crankcase Pressure Sensor Open/Short to Battery(+)
SPN 101-FMI 4	Crankcase Pressure Sensor Short Circuit
SPN 101-FMI 13	Crankcase Pressure Calibration Required
SPN 101-FMI 15	High Crankcase Pressure Warning
SPN 101-FMI 16	High Crankcase Pressure Derate
SPN 102-FMI 1	Boost Reading Stuck Low
SPN 102-FMI 3	Boost Sensor Open Circuit or Turbo Compressor Outlet Pressure Open
SPN 102-FMI 4	Boost Sensor Short Circuit or Turbo Compressor Outlet Pressure Short
SPN 102-FMI 13	Boost Sensor Calibration or Turbo Outlet Pressure Calibration Required
SPN 102-FMI 15	Boost Reading Stuck High or Turbo Compressor Outlet Pressure High
SPN 102-FMI 16	Very High Boost Pressure Warning
SPN 105-FMI 3	Inlet Air Manifold Temperature Open Circuit
SPN 105-FMI 4	Inlet Air Manifold Temperature Short Circuit
SPN 105-FMI 11	Very High Inlet Air Manifold Temp Warning
SPN 105-FMI 15	High Inlet Air Manifold Temp Warning
SPN 105-FMI 16	High Inlet Air Manifold Temp Derate
SPN 107-FMI 1	Inlet Air Restriction Shutdown
SPN 107-FMI 17	Inlet Air Restriction Warning
SPN 107-FMI 18	Inlet Air Restriction Derate
SPN 108-FMI 3	Atmospheric Pressure Sensor Open Circuit or Atmospheric Pressure Signal Open
SPN 108-FMI 4	Atmospheric Pressure Sensor Short Circuit or Atmospheric Pressure Signal Short to Battery(-)
SPN 108-FMI 13	Atmospheric Pressure Calibration Required
SPN 109-FMI 1	Low Coolant Pressure Shutdown
SPN 109-FMI 16	Low Engine Coolant Pressure Derate
SPN 109-FMI 17	Low Coolant Pressure Warning
SPN 109-FMI 18	Low Coolant Pressure Derate

SPN 110-FMI 0	High Engine Coolant Temperature Shutdown
SPN 110-FMI 1	Low Engine Coolant Temperature Shutdown
SPN 110-FMI 3	Coolant Temp Sensor Open Circuit
SPN 110-FMI 4	Coolant Temp Sensor Short Circuit
SPN 110-FMI 11	Very High Coolant Temperature Warning
SPN 110-FMI 15	High Coolant Temperature Warning
SPN 110-FMI 16	High Coolant Temperature Derate
SPN 110-FMI 17	Low Coolant Temperature Warning
SPN 110-FMI 18	Low Coolant Engine Temperature Derate
SPN 111-FMI 1	Low Engine Coolant Level Shutdown
SPN 111-FMI 2	Coolant Level Intermittent
SPN 111-FMI 11	Very Low Coolant Level Warning
SPN 111-FMI 17	Low Coolant Level Warning
SPN 111-FMI 18	Low Coolant Level Derate
SPN 127-FMI 3	Trans Oil Pressure Sensor Open Circuit
SPN 127-FMI 4	Trans Oil Pressure Sensor Short Circuit
SPN 127-FMI 10	Trans Oil Pressure Sensor Rate Change
SPN 127-FMI 15	High Trans Oil Pressure Warning
SPN 127-FMI 17	Low Transmission Oil Pressure Warning
SPN 158-FMI 1	Low System Voltage Shutdown
SPN 158-FMI 17	Low System Voltage Warning
SPN 158-FMI 18	Low System Voltage Derate
SPN 164-FMI 2	Injection Actuation Pressure Intermittent
SPN 164-FMI 3	Injection Actuation Pressure Open
SPN 164-FMI 4	Injection Actuation Pressure Short
SPN 164-FMI 11	Injection Actuation Pressure Fault
SPN 164-FMI 15	Injection Actuation Pressure High Reading
SPN 168-FMI 0	Battery(-) Voltage Above Normal
SPN 168-FMI 1	Battery(-) Voltage Below Normal
SPN 168-FMI 2	Battery(-) Voltage Intermittent
SPN 172-FMI 0	High Inlet Air Temperature Shutdown
SPN 172-FMI 1	Low Inlet Air Temperature Shutdown
SPN 172-FMI 3	Intake Manifold Air Temperature Open Circuit
SPN 172-FMI 4	Intake Manifold Air Temperature Short Circuit
SPN 172-FMI 15	High Inlet Air Temperature Warning
SPN 172-FMI 16	High Inlet Air Temperature Derate
SPN 172-FMI 17	Low Inlet Air Temperature Warning
SPN 172-FMI 18	Low Inlet Air Temperature Derate
SPN 173-FMI 0	High Exhaust Temperature Shutdown
SPN 173-FMI 8	Exhaust Stack Temp Signal Abnormal
SPN 173-FMI 15	High Exhaust Temperature Warning
SPN 173-FMI 16	High Exhaust Temperature Derate
SPN 174-FMI 0	High Fuel Temperature Shutdown
SPN 174-FMI 1	Low Fuel Temperature Shutdown
SPN 174-FMI 3	Fuel Temperature Sensor Open Circuit
SPN 174-FMI 4	Fuel Temperature Sensor Short Circuit
SPN 174-FMI 15	High Fuel Temperature Warning
SPN 174-FMI 16	High Fuel Temperature Derate
SPN 174-FMI 17	Low Fuel Temperature Warning

SPN 174-FMI 18	Low Fuel Temperature Derate
SPN 175-FMI 0	High Engine Oil Temperature Shutdown
SPN 175-FMI 3	Engine Oil Temperature Signal Open/Short to Battery(+)
SPN 175-FMI 4	Engine Oil Temperature Signal Short to Battery(-)
SPN 175-FMI 15	High Engine Oil Temperature Warning
SPN 175-FMI 16	High Engine Oil Temperature Derate
SPN 177-FMI 0	High Transmission Oil Temperature Shutdown
SPN 177-FMI 3	Trans Oil Temp Sensor Open Circuit
SPN 177-FMI 4	Trans Oil Temp Sensor Short Circuit
SPN 177-FMI 15	High Trans Oil Temp Warning
SPN 177-FMI 16	High Trans Oil Temp Derate
SPN 190-FMI 0	Engine Overspeed Shutdown
SPN 190-FMI2	Loss of Engine RPM Signal
SPN 190-FMI 3	Primary Speed Signal Open/Short to Battery(+)
SPN 190-FMI 7	Primary Speed/Timing Sensor Miss-installed
SPN 190-FMI 8	Primary Speed/Timing Signal Abnormal
SPN 190-FMI 10	Engine Speed Rate of Change or Engine Speed Out of Range
SPN 190-FMI 11	Primary Speed/Timing Sensor Fault
SPN 190-FMI 15	Engine Overspeed Warning
SPN 228-FMI 13	Speed/Timing Sensor Calibration
SPN 234-FMI 2	Incorrect Engine Software
SPN 234-FMI 11	Personality Module Fault
SPN 580-FMI 16	High Altitude Derate
SPN 608-FMI 2	ATA Data Communications Loss
SPN 620-FMI 3	+5 VDC Supply Above Normal or 5 Volt Open Circuit or Analog Sensor Supply Short to Battery(+)
SPN 620-FMI 4	+5 VDC Supply Below Normal or 5 Volt Short Circuit or Analog Sensor Supply Short to Battery(-)
SPN 632-FMI 5	Shutoff Solenoid Open Circuit
SPN 632-FMI 6	Shutoff Solenoid Short Circuit
SPN 638-FMI 5	Rack BTM Open Circuit
SPN 638-FMI 6	Rack BTM Short Circuit
SPN 638-FMI 11	Rack System Fault
SPN 639-FMI 2	J1939 Data Communications Loss
SPN 651-FMI 5	Cylinder 1 Open
SPN 651-FMI 6	Cylinder 1 Short
SPN 651-FMI 11	Cylinder 1 Fault
SPN 652-FMI 5	Cylinder 2 Open
SPN 652-FMI 6	Cylinder 2 Short
SPN 652-FMI 11	Cylinder 2 Fault
SPN 653-FMI 5	Cylinder 3 Open
SPN 653-FMI 6	Cylinder 3 Short
SPN 653-FMI 11	Cylinder 3 Fault
SPN 654-FMI 5	Cylinder 4 Open
SPN 654-FMI 6	Cylinder 4 Short
SPN 654-FMI 11	Cylinder 4 Fault
SPN 655-FMI 5	Cylinder 5 Open
SPN 655-FMI 6	Cylinder 5 Short
SPN 655-FMI 11	Cylinder 5 Fault

SPN 656-FMI 5	Cylinder 6 Open
SPN 656-FMI 6	Cylinder 6 Short
SPN 656-FMI 11	Cylinder 6 Fault
SPN 657-FMI 5	Cylinder 7 Open
SPN 657-FMI 6	Cylinder 7 Short
SPN 657-FMI 11	Cylinder 7 Fault
SPN 658-FMI 5	Cylinder 8 Open
SPN 658-FMI 6	Cylinder 8 Short
SPN 658-FMI 11	Cylinder 8 Fault
SPN 659-FMI 5	Cylinder 9 Open
SPN 659-FMI 6	Cylinder 9 Short
SPN 659-FMI 11	Cylinder 9 Fault
SPN 660-FMI 5	Cylinder 10 Open
SPN 660-FMI 6	Cylinder 10 Short
SPN 660-FMI 11	Cylinder 10 Fault
SPN 661-FMI 5	Cylinder 11 Open
SPN 661-FMI 6	Cylinder 11 Short
SPN 661-FMI 11	Cylinder 11 Fault
SPN 662-FMI 5	Cylinder 12 Open
SPN 662-FMI 6	Cylinder 12 Short
SPN 662-FMI 11	Cylinder 12 Fault
SPN 663-FMI 5	Cylinder 13 Open
SPN 663-FMI 6	Cylinder 13 Short
SPN 663-FMI 11	Cylinder 13 Fault
SPN 664-FMI 5	Cylinder 14 Open
SPN 664-FMI 6	Cylinder 14 Short
SPN 664-FMI 11	Cylinder 14 Fault
SPN 665-FMI 5	Cylinder 15 Open
SPN 665-FMI 6	Cylinder 15 Short
SPN 665-FMI 11	Cylinder 15 Fault
SPN 666-FMI 5	Cylinder 16 Open
SPN 666-FMI 6	Cylinder 16 Short
SPN 666-FMI 11	Cylinder 16 Fault
SPN 677-FMI 5	8 Volt Supply Above Normal or 8 Volt Open Circuit or Digital Sensor Supply Short to Battery(+)
SPN 677-FMI 6	8 Volt Supply Below Normal
SPN 678-FMI 3	8 Volt Short Circuit
SPN 678-FMI 4	Digital Sensor Supply Short to Battery(-)
SPN 679-FMI 5	Injection Actuation Pressure Valve Open
SPN 679-FMI 6	Injection Actuation Pressure Valve Short
SPN 679-FMI 11	Injection Actuation Pressure Valve Fault
SPN 723-FMI 2	Loss of Secondary Speed/Timing Signal
SPN 723-FMI 3	Secondary Speed/Timing Signal Open Circuit
SPN 723-FMI 7	Secondary Speed/Timing Sensor Miss-installed
SPN 723-FMI 8	Secondary Speed/Timing Signal Abnormal
SPN 723-FMI 11	Secondary Speed/Timing Sensor Fault
SPN 729-FMI 5	Inlet Air Heater Relay Open Circuit
SPN 729-FMI 6	Inlet Air Header Relay Short Circuit
SPN 733-FMI 5	Rack Sensor Open Circuit

SPN 733-FMI 6	Rack Sensor Short Circuit
SPN 733-FMI 10	Rack Sensor Rate of Change
SPN 970-FMI 2	Auxiliary Engine Shutdown (E-Stop) Switch Fault
SPN 971-FMI 31	Engine Derate Overridden
SPN 1111-FMI 2	Protection System ECM Not Found
SPN 1176-FMI 3	Left Turbo Inlet Pressure Open/Short to Battery(+)
SPN 1176-FMI 4	Left Turbo Inlet Pressure Short to Ground
SPN 1176-FMI 13	Left Turbo Inlet Pressure Calibration Required
SPN 1177-FMI 3	Right Turbo Inlet Pressure Open/Short to Battery(+)
SPN 1177-FMI 4	Right Turbo Inlet Pressure Short to Ground
SPN 1177-FMI 13	Right Turbo Inlet Pressure Calibration Required
SPN 1208-FMI 3	Unfiltered Oil Pressure Open/Short to Battery(+)
SPN 1208-FMI 4	Unfiltered Oil Pressure Short to Ground
SPN 1208-FMI 11	Unfiltered Engine Oil Pressure Miss-installed
SPN1208-FMI13	Unfiltered Oil Pressure Calibration Required
SPN 1237-FMI 31	Engine Shutdown Overridden
SPN 1239-FMI 31	High Pressure Fuel Line Broken Warning
SPN 1247-FMI 31	Excessive Engine Power
SPN 1318-FMI 15	High Exhaust Differential Temp
SPN 1382-FMI 3	Unfiltered Fuel Pressure Open/Short to Battery(+)
SPN 1382-FMI 4	Unfiltered Fuel Pressure Short to Ground
SPN 1382-FMI 11	Unfiltered Fuel Pressure Miss-installed
SPN 1382-FMI 13	Unfiltered Fuel Pres Calibration Required
SPN 1383-FMI 11	Unexpected Engine Shutdown
SPN 1542-FMI 3	12 Volt Supply Above Normal
SPN 1542-FMI 4	12 Volt Supply Below Normal
SPN 1656-FMI 2	Incorrect ESC Switch Inputs
SPN 2431-FMI 31	High Pressure Oil Line Broken Warning
SPN 2433-FMI 0	High Right Exhaust Temperature Shutdown
SPN 2433-FMI 3	Right Exhaust Temp Open/Short to Battery(+)
SPN 2433-FMI 4	Right Exhaust Temp Short to Ground
SPN 2433-FMI 8	Right Exhaust Temp Signal Abnormal
SPN 2433-FMI 15	High Right Exhaust Temperature Warning
SPN 2433-FMI 16	High Right Exhaust Temperature Derate
SPN 2434-FMI 0	High Left Exhaust Temperature Shutdown
SPN 2434-FMI 3	Left Exhaust Temp Open/Short to Battery(+)
SPN 2434-FMI 4	Left Exhaust Temp Short to Ground
SPN 2434-FMI 8	Left Exhaust Temp Signal Abnormal
SPN 2434-FMI 15	High Left Exhaust Temperature Warning
SPN 2434-FMI 16	High Left Exhaust Temperature Derate
SPN 2435-FMI 1	Low Seawater Outlet Pressure Shutdown
SPN 2435-FMI 17	Low Seawater Outlet Pressure Warning
SPN 2435-FMI 18	Low Seawater Outlet Pressure Derate
SPN 2813-FMI 3	Air Shutoff Relay Open
SPN 2813-FMI 4	Air Shutoff Relay Short

10.7 INSTALLATION & MOUNTING THE MPD

DIMENSIONS

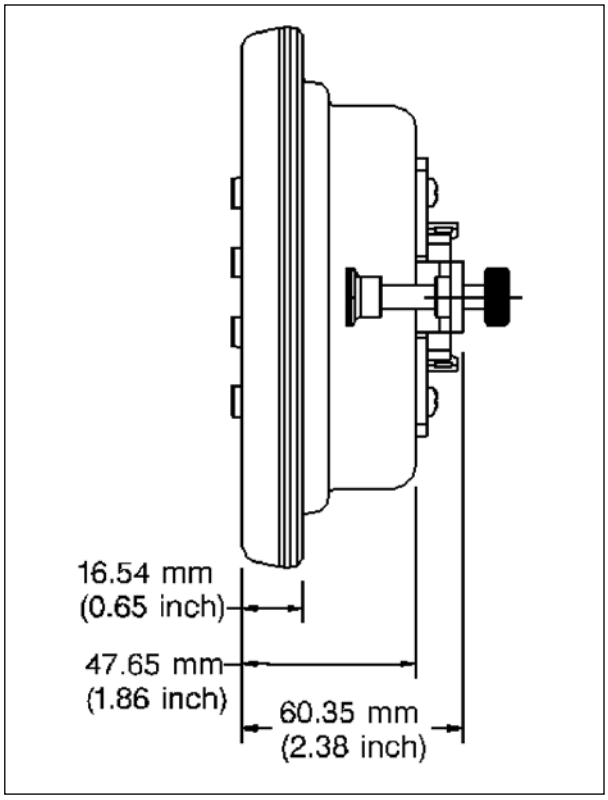


Figure 10-5 MPD (side view)

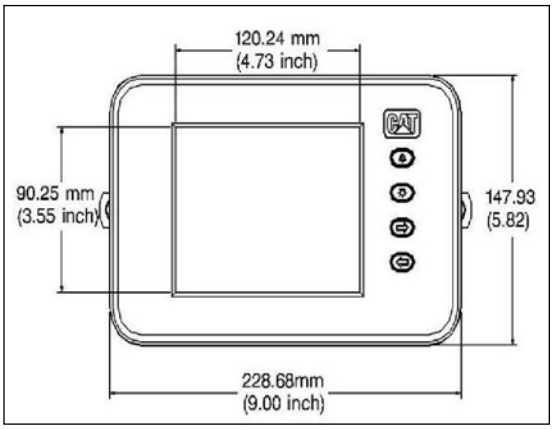
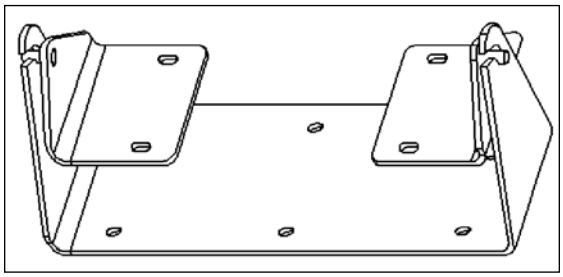


Figure 10-6 MPD (front view)



215.9 mm (8.50 inch) high by
279.4 mm (11.00 inch) wide

Figure 10-7 208-0590 Mounting Bracket Gp

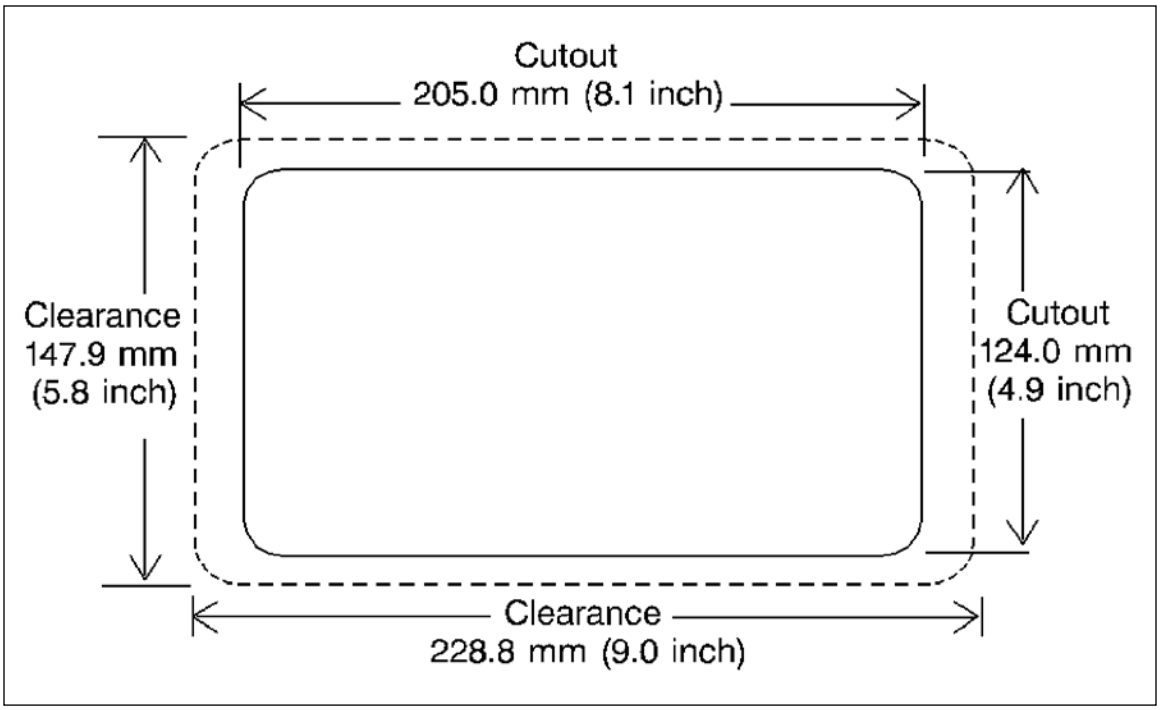


Figure 10-8 Marine Power Display (Cutout not to scale)

10.8 INSTALLATION & MOUNTING THE MINI MPD

DIMENSIONS

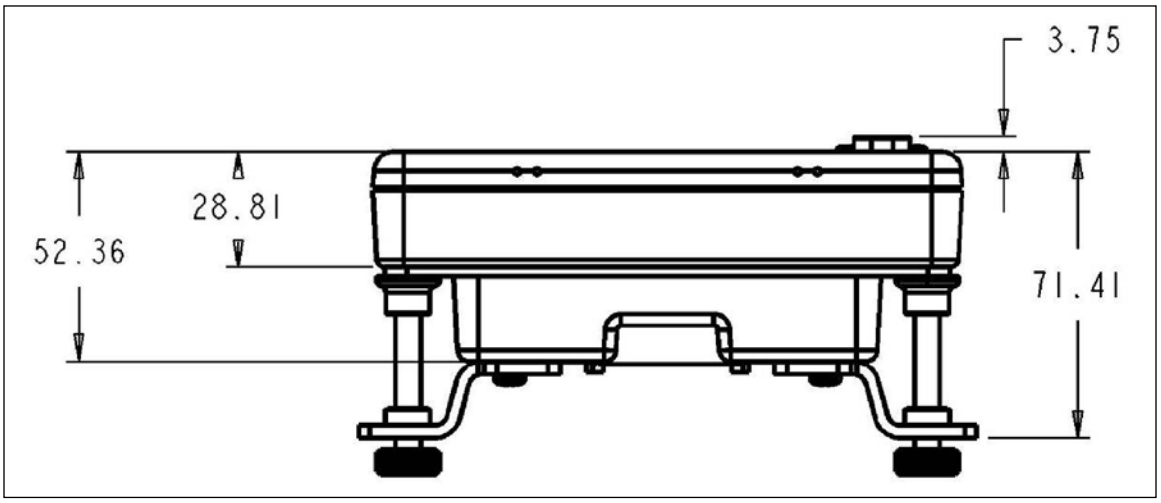


Figure 10-9 Mini MPD (side view)

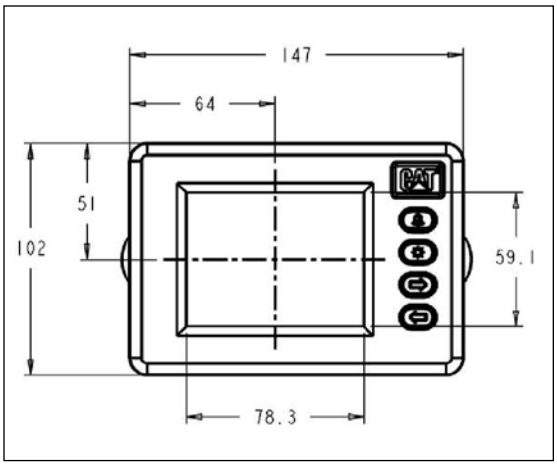


Figure 10-10
Mini MPD (front view)

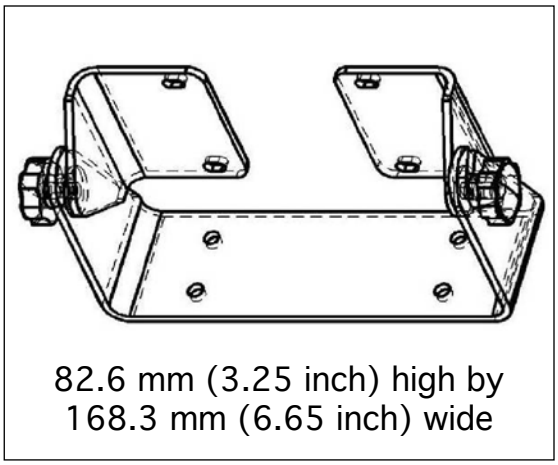


Figure 10-11
208-1508 Mounting Bracket Gp

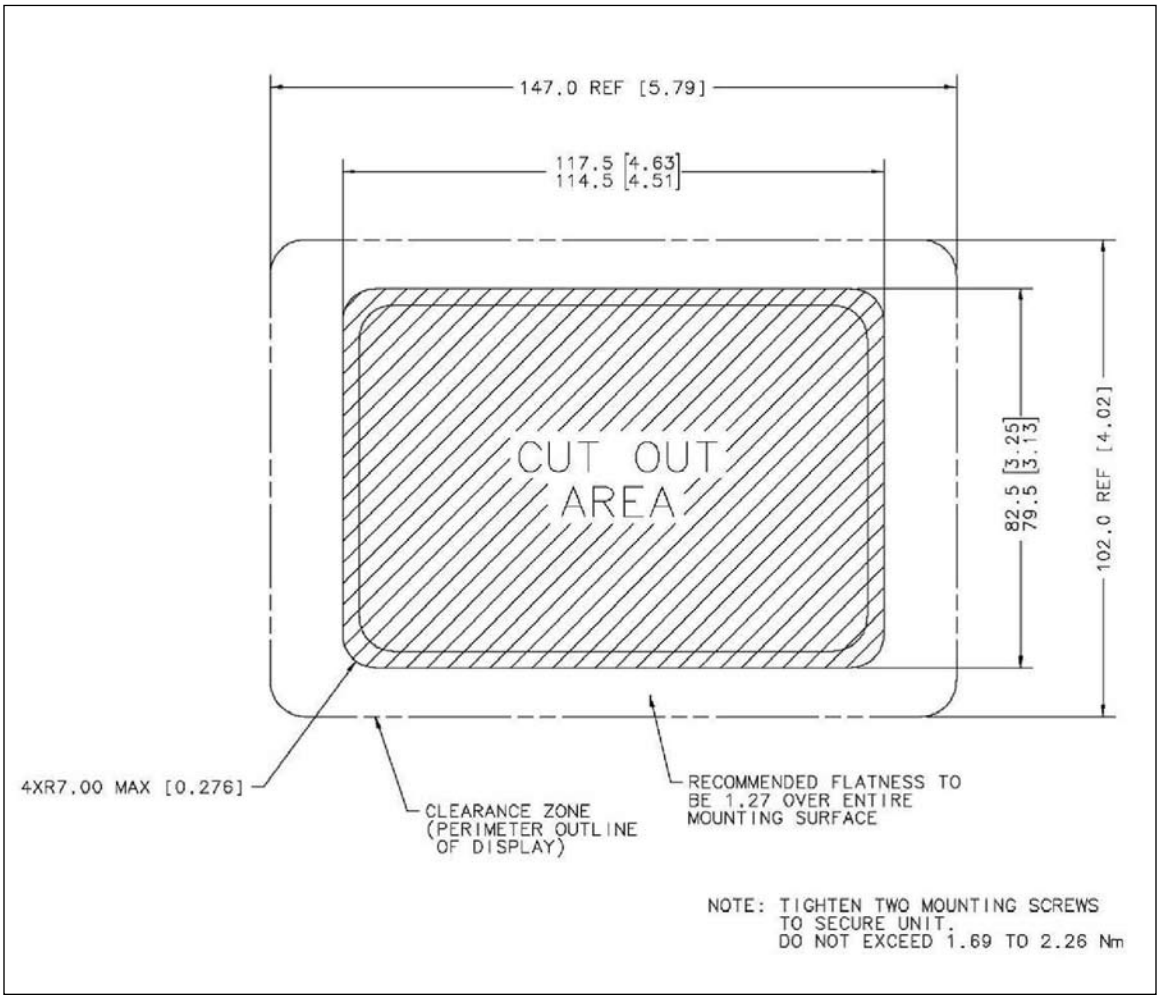


Figure 10-12 Mini MPD (Cutout not to scale)

12.9 INSTALLATION & MOUNTING THE COLOR MPD

DIMENSIONS

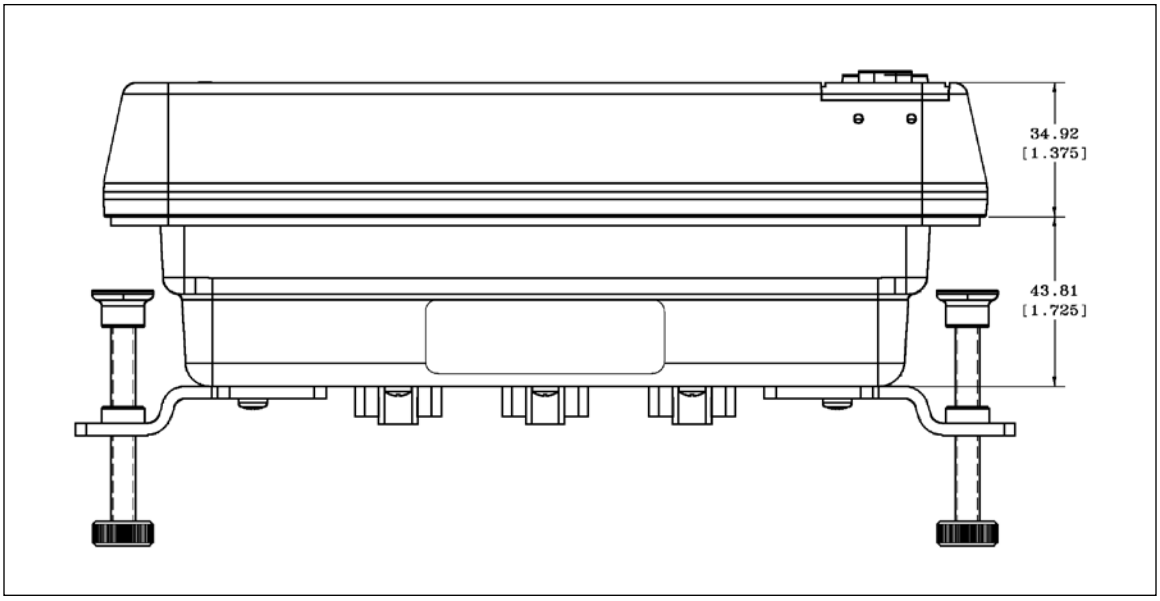


Figure 10-13 Color MPD (side view)

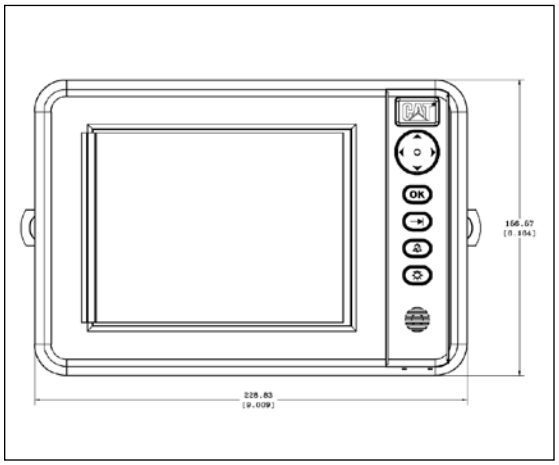


Figure 10-14
Color MPD (front view)

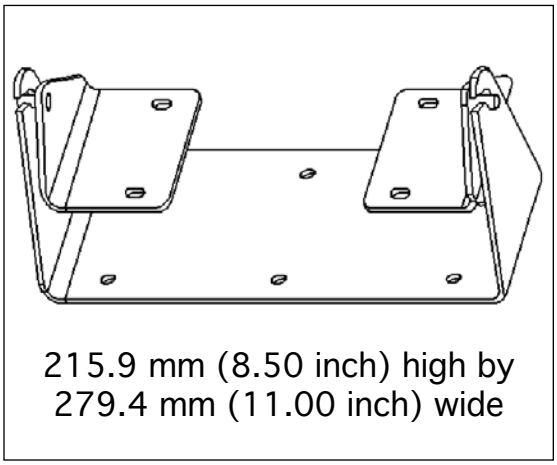


Figure 10-15
208-0590 Mounting Bracket Gp

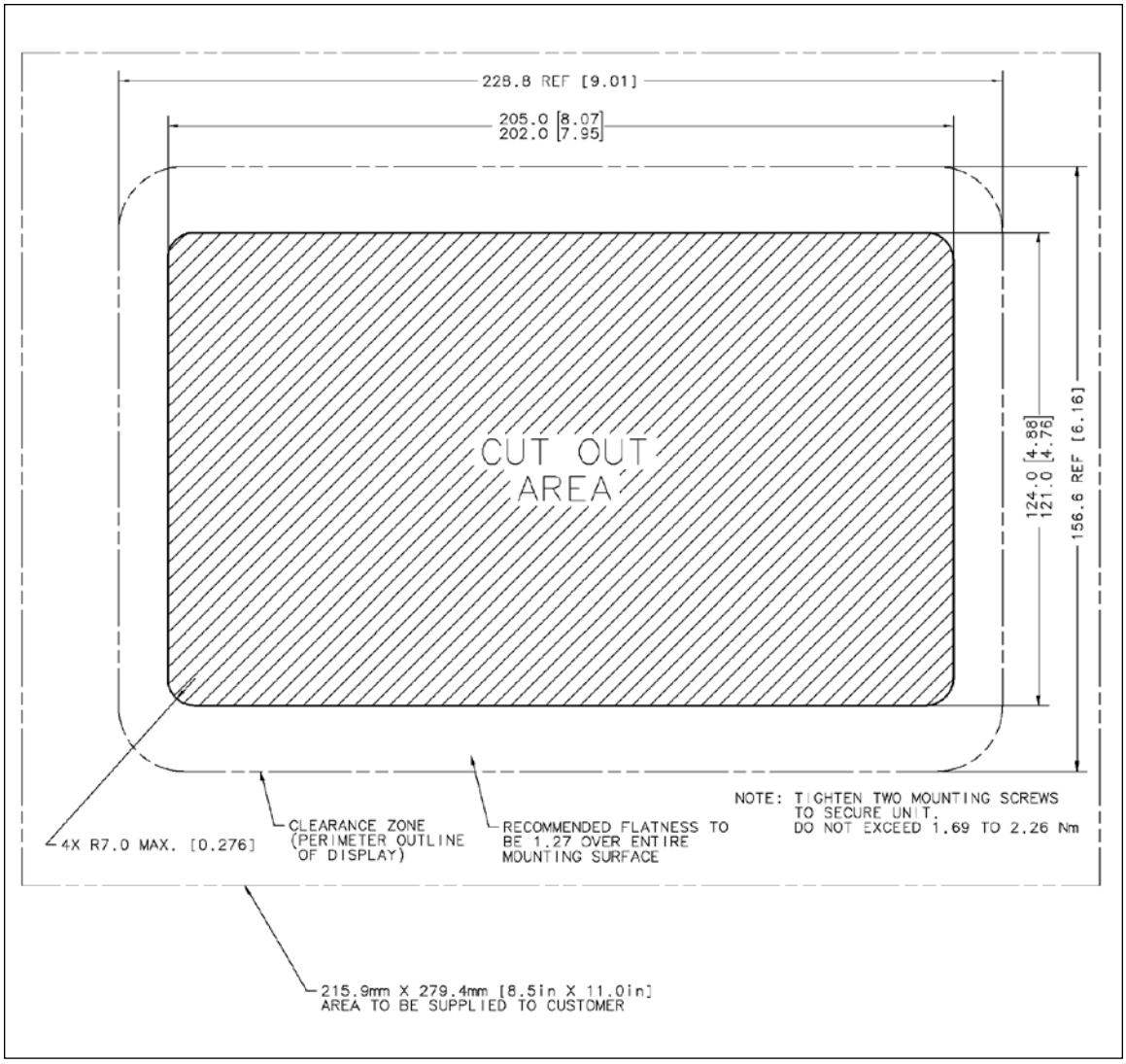


Figure 10-16 Color MPD (Cutout not to scale)

MOUNTING CONSIDERATIONS

The Marine Displays can be mounted into a console with a maximum thickness of 22 mm (0.9 inch).

Two mounting brackets are installed on the back of the display.

Tighten the mounting screws in order to secure the display.

Tighten the screws to a torque of 1.69 to 2.26 N•m (15 to 20 lb in).

NOTE: The MPD has a polarized lens. If the person that is viewing the MPD is wearing polarized sunglasses, the screen will appear to have black spots on the display screen. This is a normal condition.

ENVIRONMENTAL SPECIFICATIONS

The Original Equipment Manufacturer (OEM) must provide adequate cooling in order to produce a 70°C (126°F) maximum air temperature for the display. Forced cooling may be required for installations with extreme temperatures. The specifications in Table 10-4 must be met under all anticipated ambient conditions.

Table 10-4 Ambient Conditions

AMBIENT CONDITIONS	
Specification	**Value**
Operating Temperature Range	20 to 70 °C (4to 126 °F)
Storage Temperature Range	20 to 75 °C (4° ± 135°F)
Humidity	0 to 100 percent
Operating Voltage	9to32VDC
Circuit Protection	5Amps

10.10 CONNECTING THE MPD

1. The MPD must be configured for operation. The configuration for the display is provided in the display's software.
2. Three terminal locations at the display connector are reserved for the delivery of an enable signal to the display.
3. Terminal 1 and terminal 2 are the terminals that are used for the configuration. Terminal 3 is the return for the signal.
4. To configure the MPD, jumper either terminal 1 or terminal 2 on the display connector to terminal 3 (the return).
5. Jumper wire
6. Fabricate a jumper wire that is long enough to connect terminal 1 and terminal 3.
7. Crimp a 186-3736 Connector Socket to each end of the wire.
8. Insert the jumper into a 155-2256 Connecting Plug Kit from terminal 1 to terminal 3, or from terminal 2 to terminal 3.

10.11 CONNECTING THE MPD TO THE J1939 DATA LINK

1. Turn the key switch to the OFF position.
2. Connect the 3-pin connector of the 165-0200 Cable Assembly to a 133-0970 Receptacle Assembly.

NOTE: Refer to Specifications SENR5002 Wiring (J1939 Data Link) for more information that is related to the installation of the J1939 Data Link.

3. Connect the other end of the 165-0200 Cable As to the 12-pin connector for the MPD. Refer to
4. Figure 10-17 and Figure 10-18.

CAUTION: The total length of the cable between the 133-0970 Receptacle Assembly and the control module should not exceed 1 m (3.3 ft).

5. Connect the J1939 + to terminal 7 of the 12-pin connector.
6. Connect the J1939 - to terminal 8 of the 12-pin connector.
7. Connect the J1939 cable shield to terminal 9 of the 12-pin connector for the MPD.
8. Connect the vessel's key switch circuit to terminal 10 of the 12-pin connector.
9. Connect the vessel's Battery(+) to terminal 11 of the 12-pin connector.
10. Connect the vessel's negative Battery(-) bus bar to terminal 12 of the 12-pin connector.
11. Connect the 12-pin connector to the MPD.

10.12 CONNECTING THE MPD EXTERNAL ALARM

The MPD can be connected to an external alarm. This alarm (100 mA or less) can be used to alert the operator of problems with the vessel.

NOTE: An alarm relay is required for alarms that over 100 mA of current. See Figure 10-17. For alarms circuits 100 Ma and under, see Figure 10-18.

Table 10-5 MPD External Alarm Connections

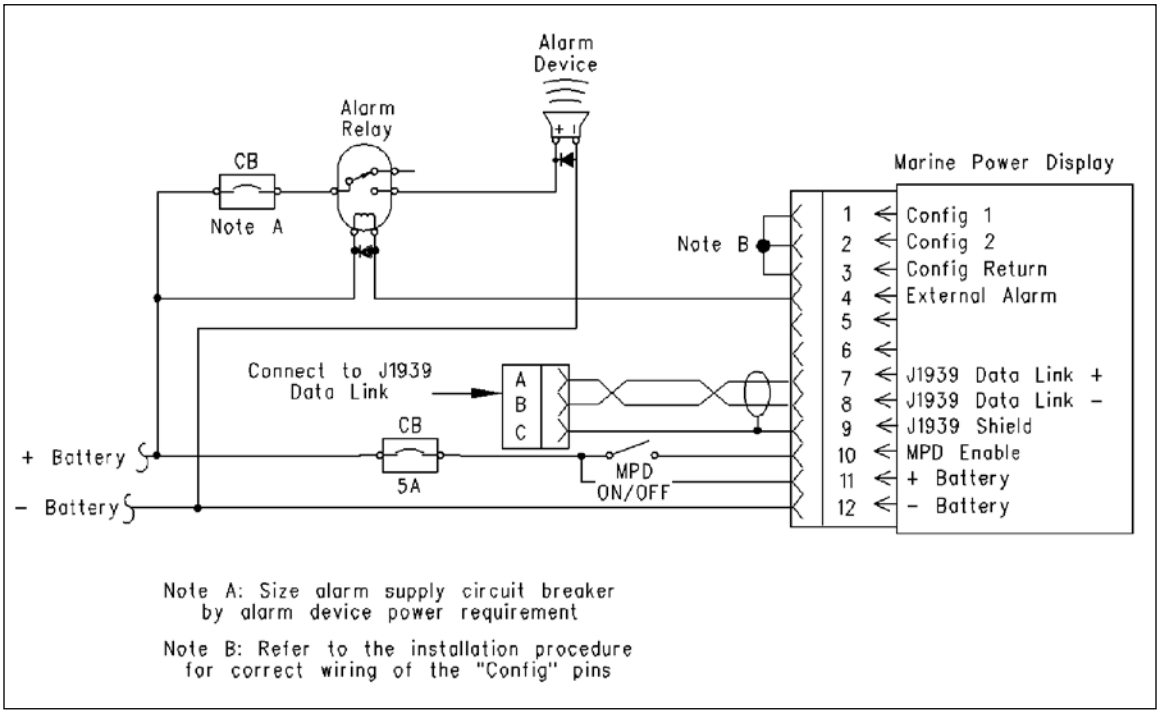
CONNECTION TO THE 12-PIN CONNECTOR	
Circuit	**Terminal Location**
Configuration (jumper wire)	1 to 3 or 2 to 3
External Alarm	4
J1939 + (yellow wire)	7
J1939 (green wire)	8
Shield (bare wire)	9
Switched Battery(+)	10
Unswitched Battery(+)	11
Battery	12

USE THIS PROCEDURE FOR AN ALARM THAT REQUIRES MORE THAN 100 MA OF CURRENT:

1. Fabricate a jumper wire of 16 AWG wire that is long enough to reach from the 12-pin connector for the MPD to the alarm relay.
2. Crimp a 186-3736 Connector Socket to one end of the wire.
3. Insert the wire into terminal 4 of the 12-pin connector for the MPD.
4. Connect the other end of the wire to the negative side of the relay control.
5. Connect the remaining terminal of the relay control to the positive Battery(-) bus bar.
6. Connect one terminal of the relay load to Battery(+). Circuit protection should be placed in the circuit between the Battery(+) and the relay load. Size the circuit protection to the requirements of the alarm.

7. Connect the other terminal of the relay load to the positive terminal on the alarm.
8. Connect the negative terminal on the alarm to the vessel's negative Battery(-) bus bar.

Figure 10-17 MPD with Alarms Greater Than 100 mA Current.



USE THIS PROCEDURE FOR AN ALARM THAT REQUIRES 100 MA OF CURRENT OR LESS:

1. Fabricate a jumper wire of 16 AWG wire that is long enough to reach from the 12-pin connector for the MPD to the alarm.
2. Crimp a 186-3736 Connector Socket to one end of the wire.
3. Insert the wire into terminal 4 of the 12-pin connector for the MPD.
4. Connect the other end of the wire to the negative terminal on the alarm.
5. Fabricate a jumper wire from 16 AWG wire to reach from the alarm to the Battery(+).
6. Connect one end of the wire to the positive terminal on the alarm.
7. Connect the other end of the wire to Battery(+).

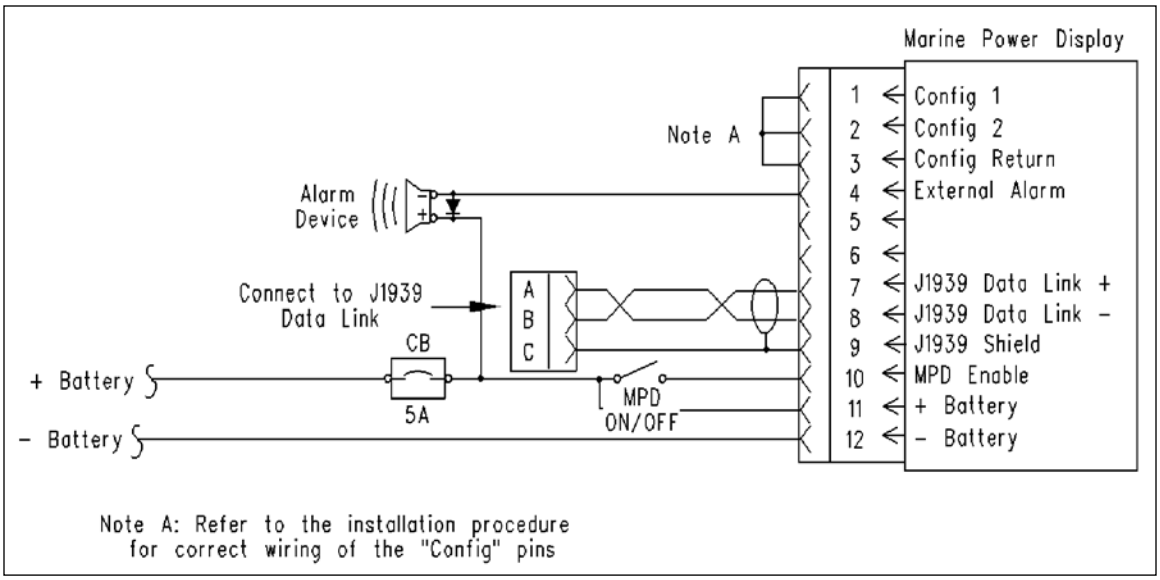


Figure 10-18 MPD with Alarms 100 mA Current or Less

10.13 CONNECTING THE COLOR MPD

CONNECTING THE COLOR MPD POWER CONNECTOR

Table 10-6 Power Connector

12-PIN CONNECTOR POWER CONNECTOR			
PIN	**Description**	**PIN**	**Description**
1	External Alarm 2	7	CAN 1 High
2	Lamp On	8	CAN 1 Low
3	CAN 2 Shield	9	CAN 1 Shield
4	External Alarm 1	10	Keyswitch
5	CAN 2 Low	11	Batt (+)
6	CAN 2 High	12	Batt (-)

External Alarm 2
This is an output which provides positive battery (B+) if there is an alarm condition. The output shall be capable of sourcing 300 mA continuously.

Lamp On
This is an input which shall allow the LCD backlight and button backlights to be turned on and off externally under software control. Connecting this pin to positive battery (B+) shall cause the LCD backlight and the button backlights to turn on.

External Alarm 1
This is an output which provides a contact connection to ground if there is an alarm condition. The contact shall be capable of sinking 300 mA continuously.

CAN 1 High, CAN 1 Low, and CAN 1 Shield
These pins provide bidirectional communication. These pins shall be compliant with the physical requirements specified in SAE J1939/11 DEC94. The baud rate of this port shall be 250 Kbits/s.

CAN 2 High, CAN 2 Low, and CAN 2 Shield
These pins provide bidirectional communication. These pins shall be compliant with the physical requirements specified in SAE J1939/11 DEC94. The baud rate of this port shall be 250 Kbits/s.

Keyswitch
This is an input which shall turn the CMPD on or off. Connecting this pin to positive battery (B+) shall cause the CMPD to turn on. Disconnecting this pin from battery (B+) shall cause the software to perform a controlled shutdown and turn the CMPD off.

Batt (+)
This is an input which provides positive battery (B+) to the CMPD. The CMPD shall be capable of operating between 9-32 VDC continuously. The CMPD shall draw no more than 3 amps at 12 VDC.

Batt (–)
This is an input which provides negative battery (B-) to the CMPD. The CMPD shall require that the negative side of the battery banks be tied together for the system to operate properly if multiple battery banks are used in the equipment in which the CMPD is installed.

The Color MPD can be connected to a sinking and/or sourcing external alarm. This alarm (300 mA or less) can be used to alert the operator of problems with the vessel.

NOTE: For alarms circuits over 300 mA, a custom circuit using a relay must be used. See Figure 10-19 and Figure 10-20.

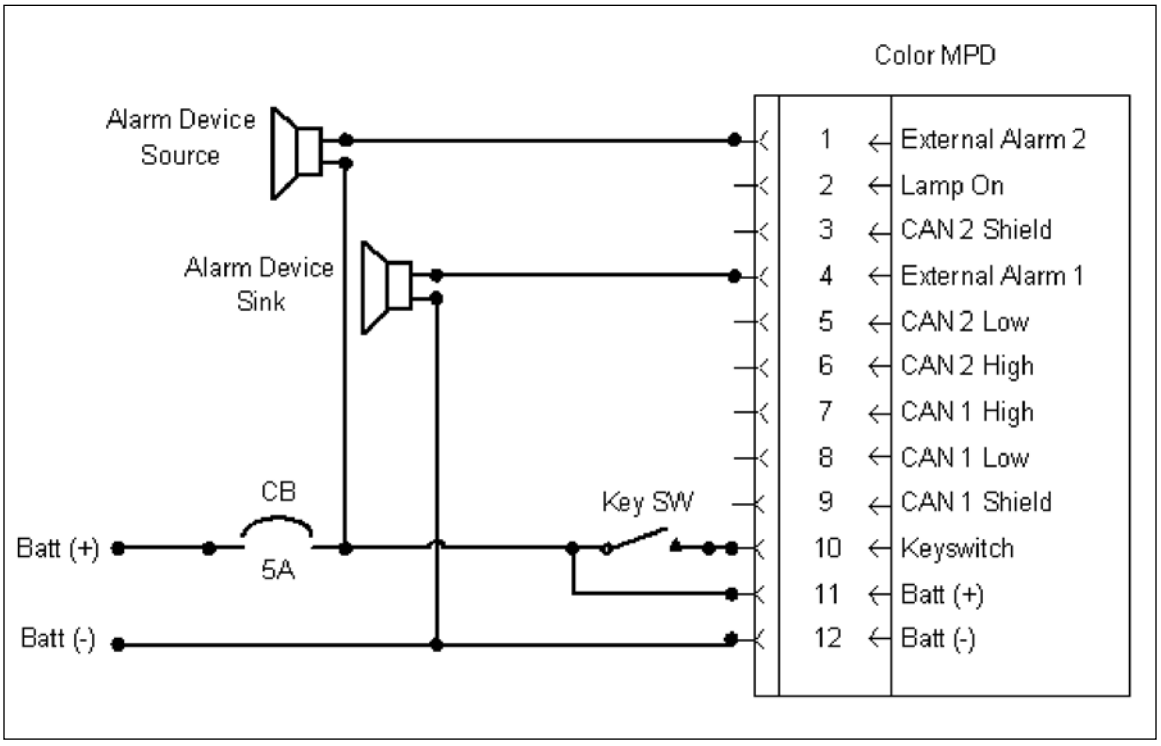


Figure 10-19 Color MPD with Alarms 300 mA Current or Less

The Color MPD can be used for single or dual marine engine modes. For single engine mode, the standard J1939 cable (226-6112) can be connected directly into the Power Connector. For dual engine mode, a Y-Harness (323-5180) will plug into the Power Connector and two standard J1939 cables (226-6112) can be connected into the Y-Harness, see Figure 10-20.

NOTE: Single/Dual engine mode is selected in the System Configuration Menu screen.

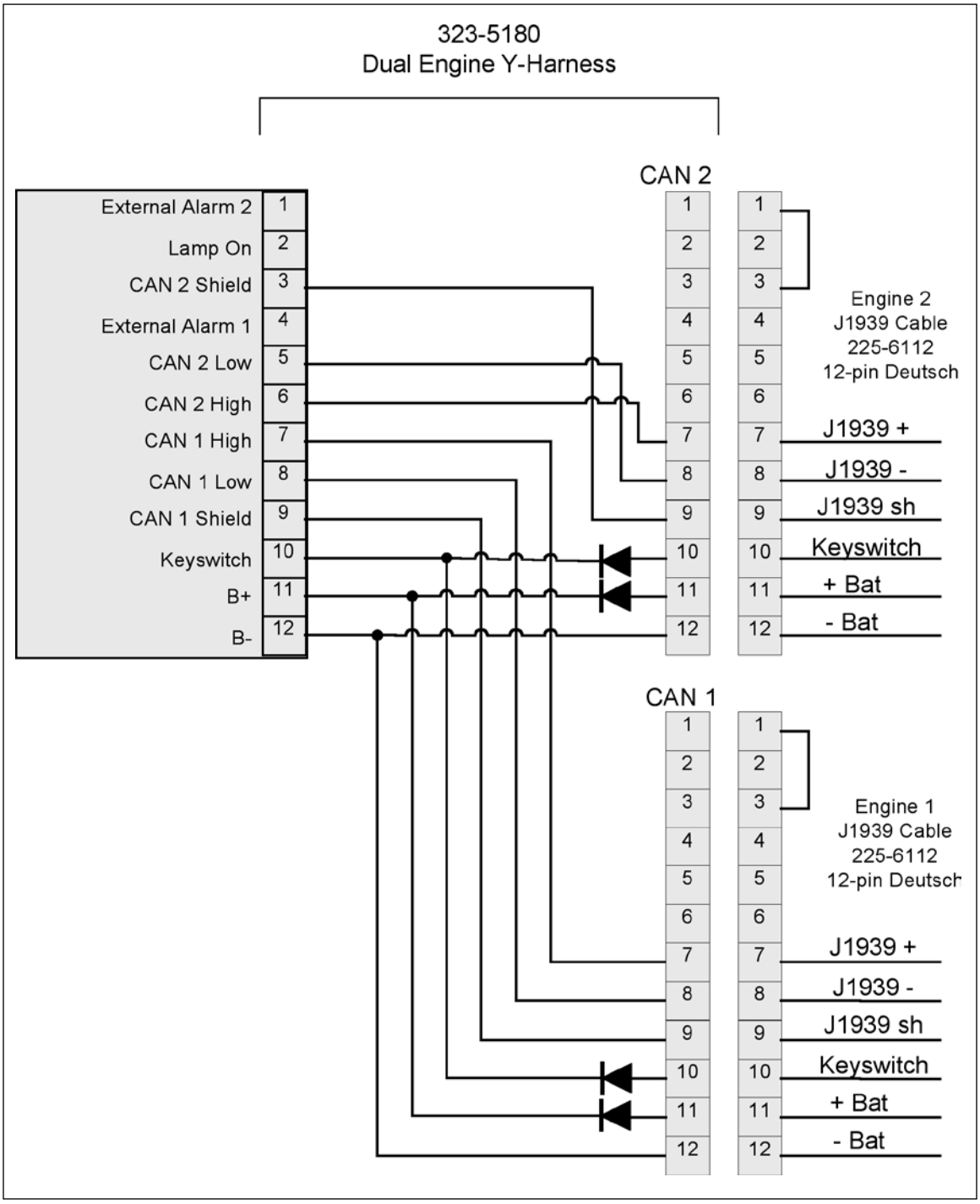


Figure 10-20 Color MPD Y-Harness for Dual Engines

CONNECTING THE COLOR MPD VIDEO CONNECTOR

Table 10-7 Video Connector

12-PIN CONNECTOR VIDEO CONNECTOR			
PIN	Description	PIN	Description
1	Channel 1 Signal	7	V- Camera
2	Channel 1 Return	8	Camera Return
3	Channel 1 Signal	9	Channel 1 Signal
4	Channel 1 Return	10	Channel 1 Return
5	Camera Return	11	Channel 1 Signal
6	V+ Camera	12	Channel 1 Return

Channel X Signal, Channel X Return
This is an input which provides the external video signal to the CMPD. The video shall be either NTSC or PAL format. The input format will be automatically detected and there shall be no operator intervention to switch between the formats.

+V Camera, Camera RTN
This is an output which provides power for the cameras. The output will provide battery voltage minus the drop in protective circuitry to the cameras. The output will have protection to prevent damage to the CMPD in the event of a short circuit.

Table 10-8 Video Cables

VIDEO CAMERAS AND CABLES			
Description	Part Number	Description	Part Number
1 Camera Harness	319-6827	Camera Wide Angle 115 deg.	286-4271
2 Cameras Harness	319-6828	Camera 78 deg.	296-0603
3 Cameras Harness	319-6829	Drop Harness Variable Length	319-6831
4 Cameras Harness	319-6830		

CONNECTING THE COLOR MPD USB CONNECTOR

Table 10-9 USB Connector

12-PIN CONNECTOR POWER CONNECTOR			
PIN	Description	PIN	Description
1	USB1 VBus (not used)	7	CDL ATA DL+ (not used)
2	USB1 Host D+ (not used)	8	CDL ATA DL- (not used)
3	USB1 Host D- (not used)	9	USB2 GND
4	USB1 GND (not used)	10	USB2 Host D-
5	RS-232 TXD (not used)	11	USB2 Host D+
6	RS-232 RXD (not used)	12	USB2 VBus

USB2 VBUS, USB2 Device D+, USB2 Device D+, USB2 GND
These pins provide bidirectional communication. The data link shall be compliant to the USB 2.0 specification for full speed (12 Mbs) operation. This data link shall be configured as a device.

NOTES:

11 MESSENGER

This display allows the operator to monitor the engine information while the engine is being operated. The Messenger display (Figure 11-1) can provide information on various engine operating parameters.

Figure 11-1 Messenger

Engine diagnostic codes can also be displayed on the Messenger display. Messenger will automatically display diagnostic codes when the diagnostic code becomes active. This allows the operator to take appropriate action when a diagnostic code becomes active.

The Messenger display also provides information to the operator from the engine Electronic Control Module (ECM) messenger through the J1939 Data Link.

11.1 CONSOLE MOUNTING THE MESSENGER DISPLAY

Tools that are required (Table 11-1):

Table 11-1 Messenger Required Tools

MESSENGER REQUIRED TOOLS	
Part #	**Description**
151-0968	Cordless Drill Gp
257-9140	Digital Multimeter
3S-2093	Cable Strap
6V-6193	Diagonal Cutter
6V-6194	Needle Nose Pliers
6V-7934	Screwdriver
6V-7935	Screwdriver
140-9944	Terminal Repair Kit

MOUNTING CONSIDERATIONS

Cutout dimensions are necessary to install the Messenger display, Figure 11-5.

Determine and mark the location for the Messenger display.

NOTE: If the dash is more than 6 mm (0.3 inch) thick, the brackets may be carefully trimmed, Figure 11-2.

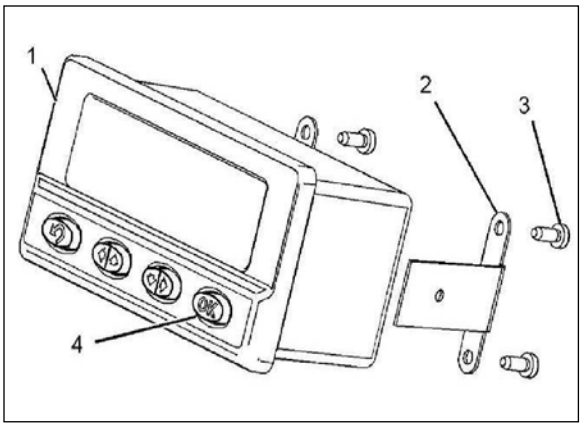


Figure 11-2
Messenger Display Overview

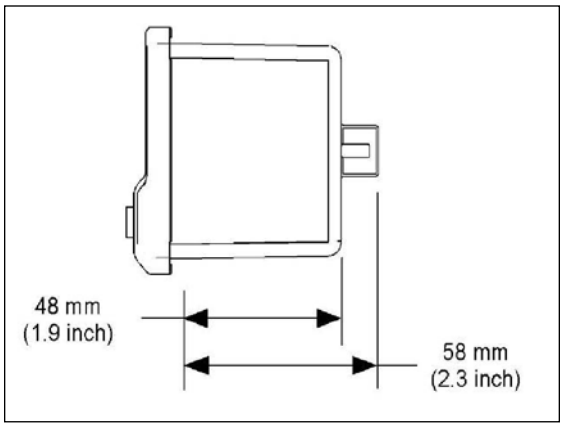


Figure 11-3
Messenger Display Side View

(1) Messenger display
(2) Mounting bracket
(3) Mounting screws
(4) Keypad

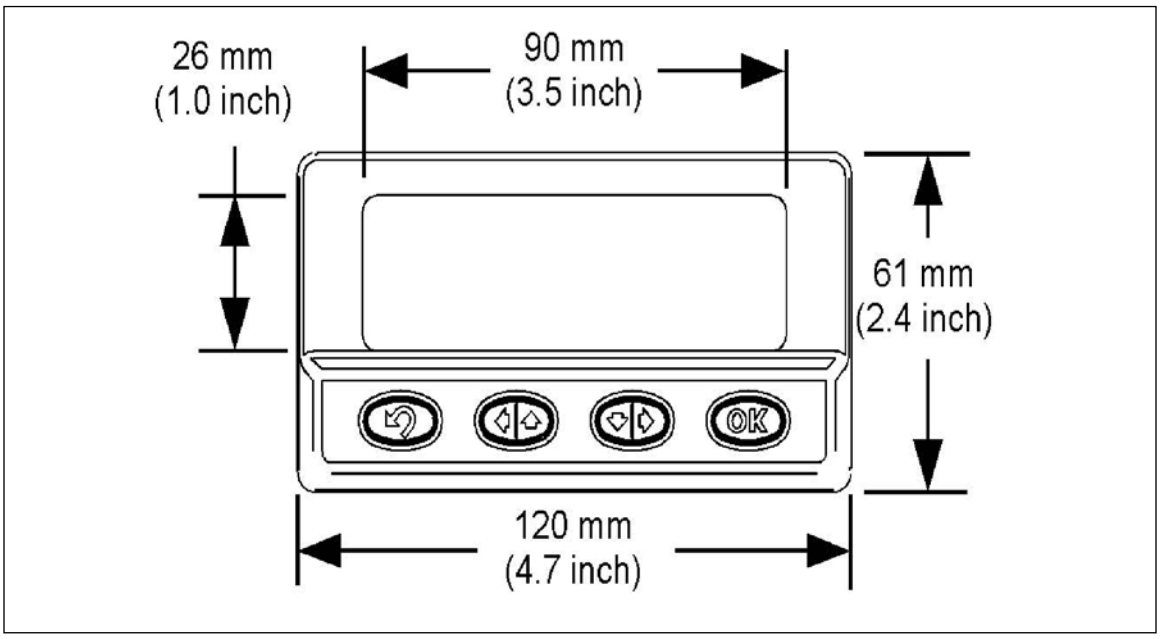


Figure 11-4 Messenger Display Front View

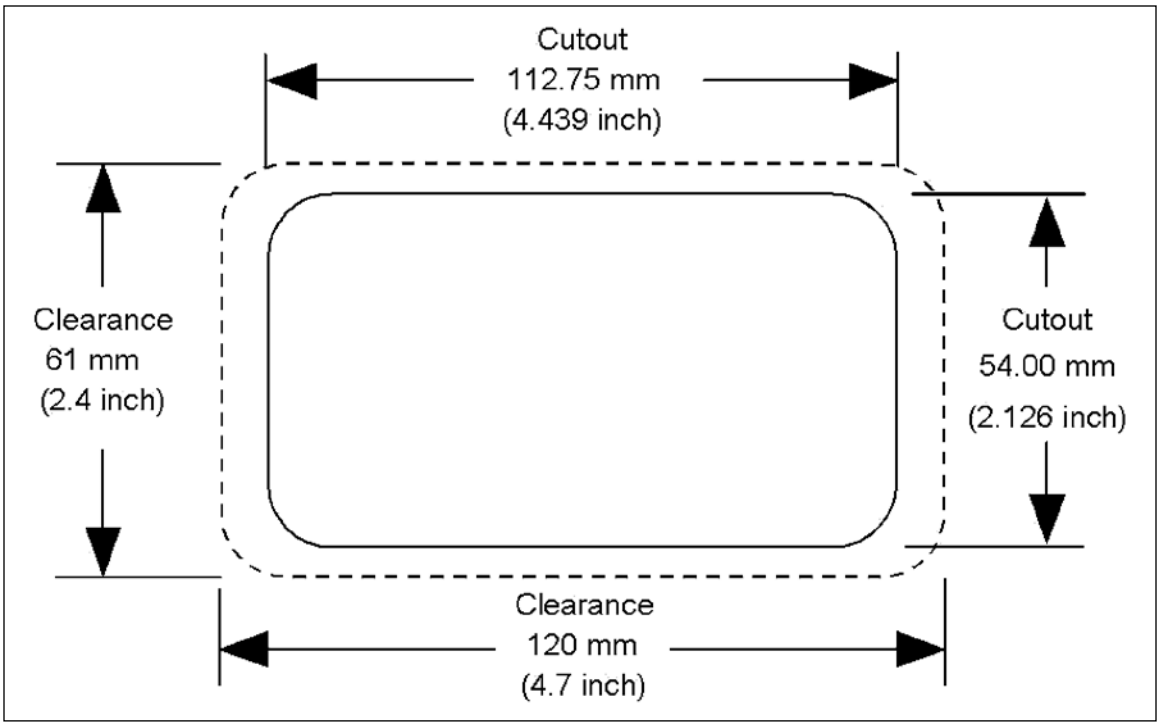


Figure 11-5 Messenger Display Cutout

11.2 WIRING THE MESSENGER DISPLAY

1. Disconnect the batteries.
2. Connect the wiring to the Messenger display. See Table 11-2 and Figure 11-6 for information that is related to wiring the Messenger display.

Table 11-2 Messenger Pin-Out Specification

MESSENGER PIN OUT SPECIFICATION	
Terminal	**Function**
1	Battery(+)
2	Battery(-)
3	Key switch
7	J1939+
8	J1939

3. Connect the 3-pin connector of the 165-0200 Cable Assembly to a 133-0970 Receptacle Assembly.

NOTE: Refer to the section Specifications, Wiring (J1939 Data Link), for more information on the wiring of the J1939 Data Link.

4. Cut a 50 mm (2 inch) piece of 125-7876 Heat Shrink Tube. Slide the heat shrink tube over the 165-0200 Cable As.
5. Connect the remaining end of the 165-0200 Cable As to the display connector.

CAUTION: The total length between the 133-0970 Receptacle Assembly and the display should not exceed 1 m (3.3 ft).

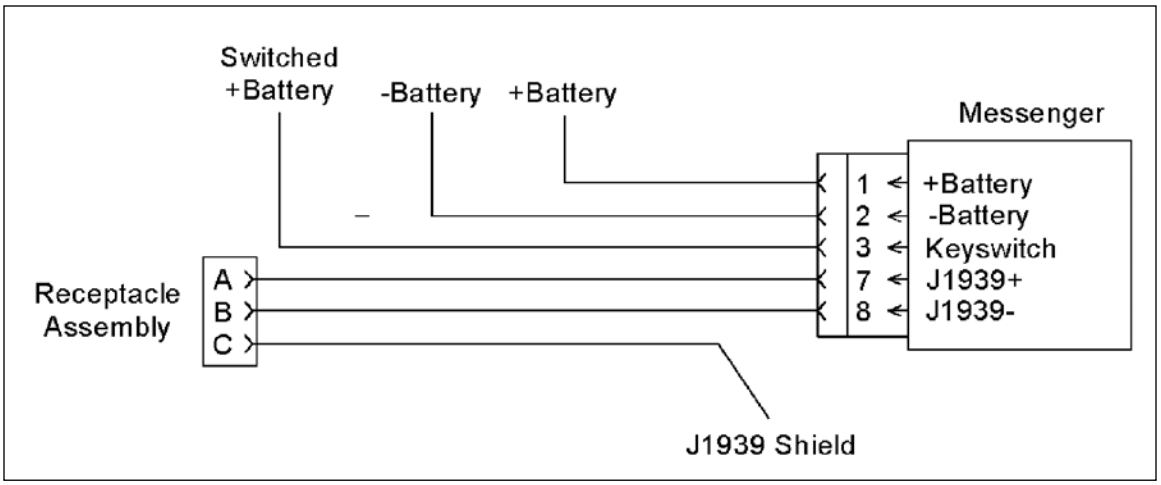


Figure 11-6 Messenger Wiring Diagram

6. Connect the wire for the J1939 + to terminal 7 on the connector for the display.
7. Connect the wire for the J1939 -to terminal 8 on the connector for the display.
8. Connect terminal 1 on the connector for the display to an Unswitched Battery(+) source.
9. Connect terminal 2 on the connector for the display to a Battery(-) source.
10. Connect terminal 3 on the connector for the display to a switched Battery(+) source.
11. Trim the shield (bare wire) back to the existing heat shrink tube on the cable assembly.
12. Position the 125-7876 Heat Shrink Tube so that the shield is completely insulated and a proper seal can be obtained.
13. Apply heat until a complete seal is formed.

CAUTION: Be careful to avoid skin contact with any hot glue that may seep from the heat shrink tube.

14. Reconnect the batteries.
15. Verify the supply voltage at the display unit.
16. Use a Multimeter to measure the voltage.
17. Measure the voltage between the Battery(+) (terminal 1) and the Battery(-) (terminal 2) with the key switch in the ON position.
18. The voltage should be 11V to 13.5V DC for 12 volt systems, and 23V to 27V DC for 24 volt systems.

NOTE: The Messenger display's supply voltage to can range from 9V to 32V DC.

19. Use a Multimeter to measure the voltage.
20. Measure the voltage between the switched Battery(+) (terminal 3) and the Battery(-) (terminal 2) with the key switch in the ON position.

21. The voltage should be 11V to 13.5V DC for 12 volt systems, and 23V to 27V DC for 24 volt systems.
22. Turn the key switch to the OFF position.
23. Measure the voltage between the Battery(+) (terminal 1) and the Battery(-) (terminal 2).
24. The voltage should be 11V to 13.5V DC for 12 volt systems, and 23V to 27V DC for 24 volt systems when the key switch is in the OFF position.
25. Turn the key switch to the OFF position.
26. Measure the voltage between the switched Battery(+) (terminal 3) and the Battery(-) (terminal 2).
27. The voltage should be 0V DC when the key switch is in the OFF position.

11.3 CONSOLE INSTALLATION

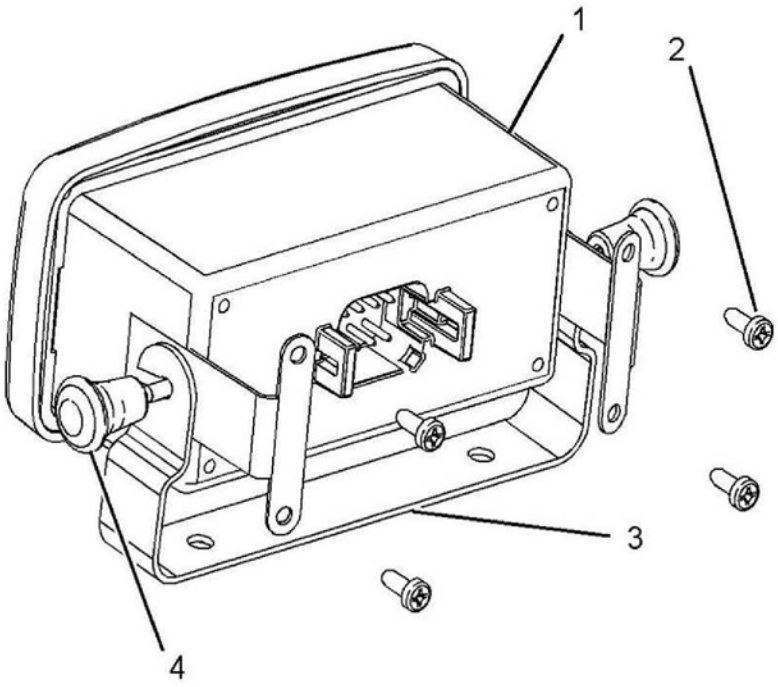
1. Place the gasket around the cutout on the front of the console.
2. Mount the Messenger display into the console.
3. Insert the display into the cutout from the front of the console.
4. Install the rear brackets and loosely tighten the four pan-head screws that hold the brackets in place.
5. Ensure that the face of the Messenger display is straight and positioned correctly in the opening.
6. Fully tighten the four screws that hold the brackets in place.
7. Connect the 8-pin connector to the back of the display.
8. Secure the Messenger display wiring with tie straps in order to avoid wiring abrasion and interference with the operator.

11.4 GIMBAL INSTALLATION

Tools that are required, see Table 11-3 and Figure 11-7:

Table 11-3 Tools Required for the Gimbal Mounting

TOOLS REQUIRED	
Part #	**Description**
151-0968	Cordless Drill Gp
3S-2093	Cable Strap
6V-6193	Diagonal Cutter
6V-7934	Screwdriver



(1) Messenger display (2) Mounting screws (3) Gimbal mounting bracket (4) Thumb screws

Figure 11-7 Messenger Display Rear View

For additional components required, see Table 11-4:

Table 11-4 Additional Required Components

ADDITIONAL REQUIRED COMPONENTS	
Quantity	**Description**
4	6-20 Pan head screws[1]
2	6 mm (0.3 inch) Mounting screws[2] [3]

[1] Supplied with the Messenger display
[2] Provided by the customer
[3] Double faced tape may also be used to fasten the mounting bracket.

GIMBAL INSTALLATION PROCEDURE

1. Determine the location for the Messenger display.
2. Do not place the Messenger display in a location that would interfere with the safe operation of the engine or of the vessel.
3. The Messenger display is approximately 120 mm (4.7 in) wide by 61 mm (2.4 in) in height. The depth is approximately 58 mm (2.3 in).

NOTE: The location of the Messenger display must be within 1 m (3.3 ft) of the J1939 Data Link.

4. Complete Steps 1 to 4 from Wiring the Messenger Display.
5. Place the Gimbal mounting bracket into the location that has been selected.
6. Mark the locations for the holes.
7. When mounting with machine screws, drill the holes for the Gimbal mounting bracket. The length of the machine screws is determined by the thickness of the dash. The required fasteners for this procedure are not supplied with the Messenger display.
8. When mounting with double-faced tape, cut and place the tape onto the bottom part of the bracket. Press the bracket onto the mounting surface.
9. Fasten the Messenger display to the Gimbal mounting bracket.
10. Insert the Messenger display into the Gimbal mounting bracket.
11. Secure the Messenger display with two thumb screws. Do not tighten the thumb screws fully.
12. Tilt the Messenger display to the desired angle and fully tighten the thumb screws.
13. Connect the 8-pin connector to the back of the display.
14. Secure the Messenger display wiring with tie straps in order to avoid wiring abrasion and interference to the operator.

NOTES:

12 PL1000T COMMUNICATION ECM

The PL1000T Communication Electronic Control Module (ECM) provides the following features:

- Sea Water Module Interface (SWMI)
- Engine Vision Interface Module (EVIM)
- Global Positioning System Interface Module (GPSIM)
- J1939 Bridge
- Controller Area Network (CAN) Extension Bridge
- Cat Data Link (CDL) Tunnel
- Cat Data Link (CDL) Boost
- Embedded Communications Adapter (ECA)

Table 12-1 PL1000T Communication Features specifies the combinations of features that are capable of being enabled simultaneously for the PL1000T Communication ECM. Each group indicates a unique set of features that can be performed simultaneously with a single PL1000T Communication ECM.

Using the RS-232 ports that are available, the PL1000T can provide the functionality of the SWMI, the EVIM, and the GPSIM in the combinations that are shown in Table 12-1. By using the CAN port that is available, the PL1000T can be used to provide a J1939 bridge or a CAN extension bridge.

Table 12-1 PL1000T Communication Features

SIMULTANEOUS FEATURES - PL1000T COMMUNICATION ECM							
Feature	**Group A**	**Group B**	**Group C**	**Group D**	**Group E**	**Group F**	**Group G**
SWMI	RS-232 #1	RS-232 #1			RS-232 #1	RS-232 #1	
EVIM		RS-232 #2	RS-232 #1		RS-232 #2		RS-232 #1
GPSIM	RS-232 #2		RS-232 #2	RS-232 #1		RS-232 #2	RS-232 #2
J1939 Bridge	CAN Port	CAN Port	CAN Port				
CAN Extension Bridge				CAN Port			
CDL Tunnel					CDL Port	CDL Port	CDL Port
CDL Boost	CDL Port	CDL Port	CDL Port	CDL Port	CDL Port	CDL Port	CDL Port
ECA	RS-232 #3	RS-232 #3	RS-232 #3	RS-232 #3	RS-232 #3	RS-232 #3	RS-232 #3

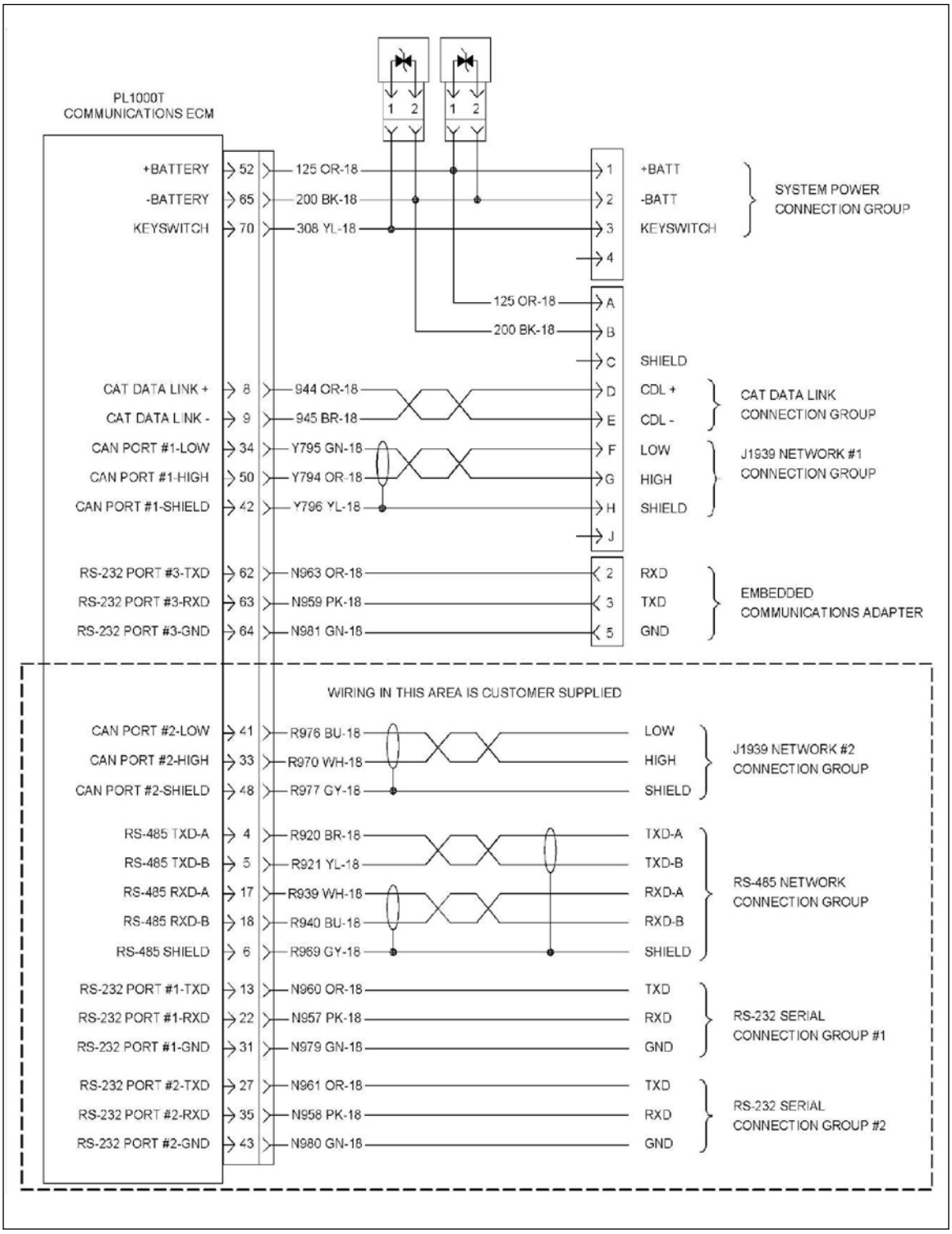
12.1 CONFIGURING THE PL1000T COMMUNICATION ECM

The information that follows provides the description, the connections, and the configuration of the PL1000T Communication ECM for each of these features.

Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

Refer to Special Instruction REHS2125, Installation Guide for the 256-7511 PL1000T Communication ECM for general information that is related to the installation of the PL1000T Communication ECM.

Figure 12-1 ECM Electrical Diagram



12.2 SEA WATER MODULE INTERFACE (SWMI)

The PL1000T Communication ECM provides the functionality of an interface module for sensing devices that measure the temperature and the depth of the water. The sensing devices must be compliant with standards that are approved by the National Marine Electronics Association (NMEA). These devices must comply with the NMEA-183 standard.

The PL1000T receives the signal that communicates the temperature and the depth of the water from the sensing module. This information is then transmitted over the Cat Data Link or over the J1939 Data Link to the display module.

CONNECTIONS

The RS-232 ports provide for a connection between the PL1000T Communication ECM and other devices that comply with NMEA-183. The communication protocol for the port conforms to EIA RS-232 standards. This port is compatible with any NMEA devices that also conform to EIA RS-232 standards. Table 12-2 shows the requirements for connections to the NMEA devices. Figure 12-2 shows the connections that are necessary to provide the functionality for the sea water module interface.

Table 12-2 Requirements for Connections to the NMEA Devices

NMEA PORT CHARACTERISTICS	
Parameter	**Value**
Maximum Cable Length	30.5 m (100 ft)
Maximum Conductor to Conductor Cable Capacitance (1)	0.002 µF
Maximum Resistance of the Cable for a Single Conductor (2)	25 Ω

(1) To measure the capacitance of the cable, disconnect all of the devices from the network at the connection to the device. The network wires must be open between the two conductors. Measure the capacitance between the two wires.

(2) To measure the cable resistance, disconnect all devices from the network at the device connection. The network wires must be open between the two conductors. Short the wires at the device connection for the PL1000T Communication ECM. Measure the resistance between the two wires at all other device connections. For the maximum resistance that is measured, divide the resistance measurement by two. Compare the result to the value that is shown.

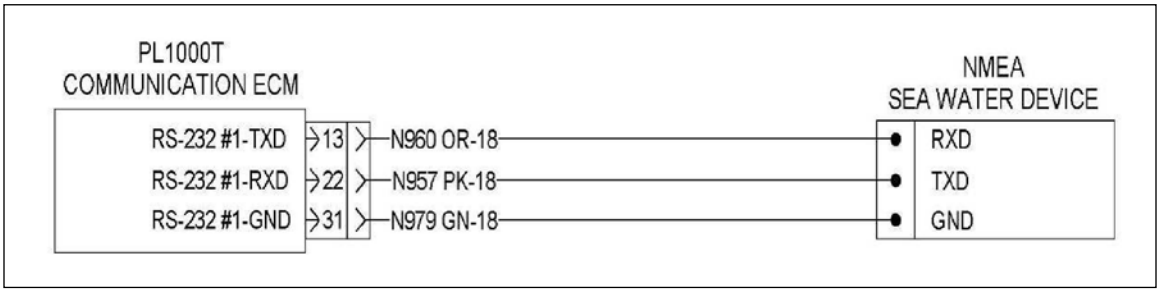


Figure 12-2 RS232 PL1000T Connections To NMEA Sea Water Device

Review these additional considerations for connecting NMEA devices:

1. Use good wire routing and wire securing practices in order to avoid damage to the cable.
2. Use 18 AWG wire for networks that connect to the RS-232 serial ports.
3. Route the network cable away from sources of high power and of high frequency in order to avoid introducing electrical noise into the network.
4. Wire each NMEA device so that the power connection to the Battery(-) is common.

CONNECTIONS FOR THE SEA WATER MODULE INTERFACE

A custom harness must be constructed in order to connect the sea water sensing devices to the PL1000T Communication ECM.

1. Use the 153-2707 Electrical Cable to fabricate a harness that is long enough to connect the GPS module to the communication ECM.
2. Crimp a connector socket to one end of each of the wires.
3. Remove the power from the communication ECM.
4. Disconnect the 70-pin connector from the communication ECM.

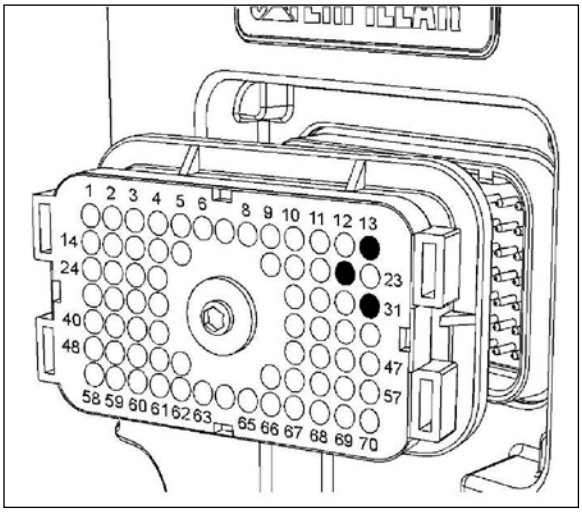


Figure 12-3 70-Pin Connector — Communication ECM

PORT #1
Table 12-3 ECM Input Connections

Signal Input	Terminal Location
TXD	13
RXD	22
Ground	31

5. Prior to wiring the 70-pin connector, remove the plug seals from the appropriate terminal locations, Figure 12-3.
6. Install the wires for the RS-232 Port #1 into the 70-pin connector's terminal locations, see Table 12-3:
7. Reconnect the 70-pin connector to the communication ECM.
8. Prior to restoring the power to the communication ECM, ensure that the connections at the NMEA device have been installed correctly.

CONFIGURATION AS A SEA WATER MODULE INTERFACE

Configure the PL1000T Communication ECM as a sea water module interface. Refer to Service Manual, RENR7945, Electronic Control Module (ECM). Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Connect the Caterpillar Electronic Technician (ET) to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the Sea Water Data Interface Function Port Selection as the parameter that will be changed.
4. Change the parameter to the value of Serial Port #1.

The PL1000T Communication ECM is now configured to receive data from NMEA sea water sensing devices.

12.3 ENGINE VISION INTERFACE MODULE (EVIM)

The PL1000T Communication ECM has the capability of providing the functionality of the EVIM. It is capable of communicating the data requests and data responses between the engine ECM and the Engine Vision display.

NOTE: Refer to Systems Operation SENR5002, Engine Vision for information that is related to the operation of the engine vision display.

CONNECTIONS

The RS-232 ports can be used to connect an Engine Vision display to the PL1000T Communication ECM. The connection conforms to EIA RS-232 standards. The ports will work with any NMEA device that also conforms to EIA RS-232 standards.

Figure 12-4 shows the connections that are necessary to provide the functionality for the EVIM.

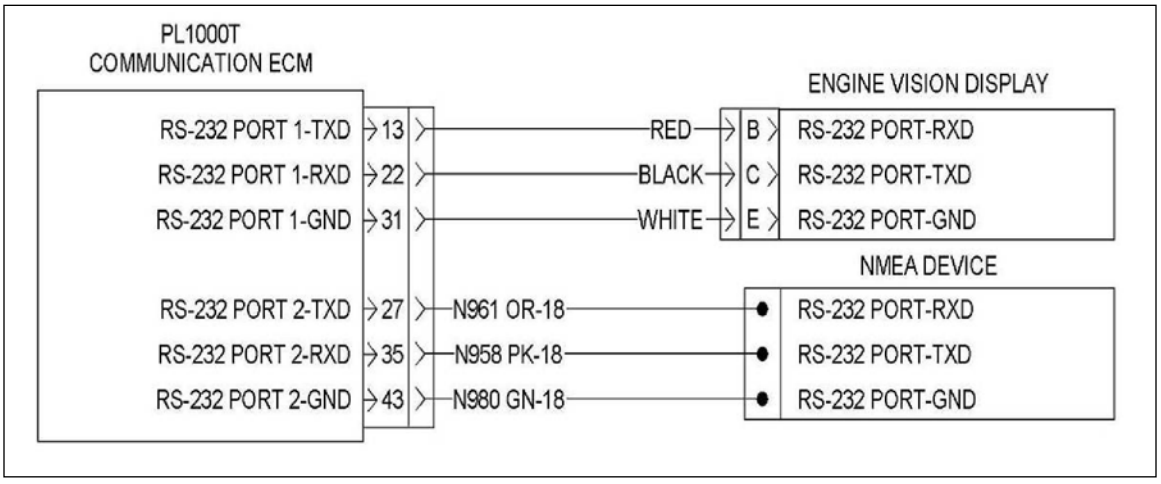


Figure 12-4 RS-232 to Engine Vision

The Engine Vision display may be connected to either the RS-232 port #1 or the RS-232 port #2. The port connection for the Engine Vision display is dependent on other devices that will be connected to the PL1000T Communication ECM. Refer to Table 12-1 for a summary of the simultaneous features that are allowed for the PL1000T Communication ECM.

CONNECTIONS FOR THE ENGINE VISION DISPLAY

A 163-3973 Cable As is available as a generic harness for the connection of the Engine Vision display to an interface module.

NOTE: This cable must be modified prior to the connection of the Engine Vision display to the PL1000T Communication ECM. Refer to the drawing in Figure 12-5 for more information.

Use the following procedure to connect the 163-3973 Cable As to the connector of the PL1000T Communication ECM:

1. Remove the 25-pin DB style connector from the 163-3973 Cable Assembly.
2. Crimp a connector socket to the end of the following wires:

- Black (RXD)
- Red (TXD)
- White (Ground)

Refer to the drawing in Figure 14-5 for information.

3. Remove the electrical power from the communication ECM.
4. Disconnect the 70-pin connector from the communication ECM.

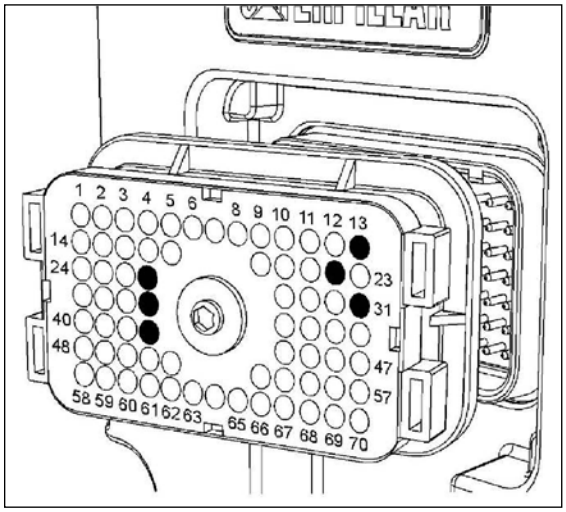


Figure 12-5
70-pin Connector for the ECM

Table 12-4
RS-232 Port #1 & Port #2

ECM INPUT	TERMINAL LOCATION
Pin#	**RS-232 Port #1**
13	TXD input
22	RXD input
31	Ground connection
Pin#	**RS-232 Port #2**
27	TXD input
35	RXD input
43	Ground connection

5. Prior to wiring the 70-pin connector, remove the plug seals from the terminal locations of the connector.
6. Install the wires for the appropriate RS-232 port into the 70-pin connector's terminal locations:
7. Reconnect the 70-pin connector to the communication ECM.
8. Prior to restoring the power to the communication ECM, ensure that the connections at the display module are installed correctly.

CONFIGURATION AS AN EVIM

1. Configure the PL1000T Communication ECM as an EVIM. Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.
2. Connect Cat ET to the PL1000T Communication ECM.
3. Access the Configuration screen that is found under the Service menu.
4. Select the parameter for Engine Vision Interface Function Port Selection.
5. Change the parameter to Serial Port #1 or to Serial Port #2. This parameter depends on the connections that were made in the previous section.
6. Select the parameter for Engine Vision Interface Serial Port Baud Rate.
7. Change the parameter to match the baud rate setting of the Engine Vision display.

The PL1000T Communication ECM is now configured to communicate with the Engine Vision display.

12.4 GLOBAL POSITIONING SYSTEM INTERFACE MODULE (GPSIM)

The PL1000T Communication ECM has the capability of providing for the functionality of the GPSIM. The PL1000T Communication ECM receives information from the sensing module (NMEA-183) for the Global Positioning System (GPS). This information is then transmitted over the Cat Data Link or over the J1939 Data Link.

NOTE: Refer to Systems Operation SENR5002, Global Positioning System for information that is related to the operation of the GPS.

CONNECTIONS

The RS-232 ports provide for a connection between the PL1000T Communication ECM and other NMEA compliant devices. The communication protocol for the port conforms to EIA RS-232 standards. This port is compatible with any NMEA devices that also conform to EIA RS-232 standards. Table 12-2 shows the requirements for connecting to NMEA device connections.

Figure 12-6 shows the connections that are necessary to provide the functionality for the GPSIM.

The sensing module for the GPS may be connected to either the RS-232 port #1 or the RS-232 port #2. The correct connection for the GPS module is dependent on other NMEA devices that will be connected to the PL1000T Communication ECM.

Refer to Table 12-1 for a summary of the simultaneous features that are allowed for the PL1000T Communication ECM.

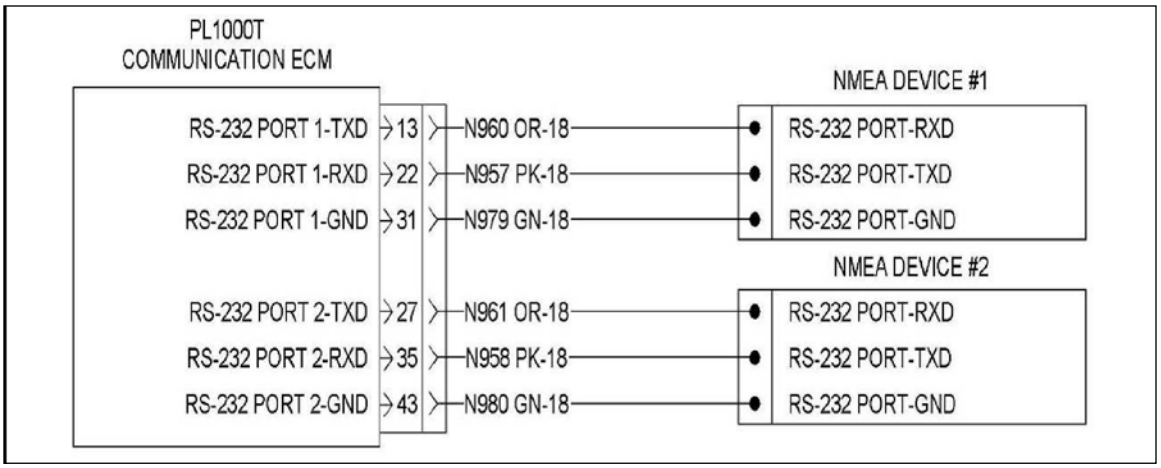


Figure 12-6 70-Pin Connector for the Communication ECM

Custom Harness

A custom harness must be constructed in order to connect the sensing module for the GPS to the PL1000T Communication ECM.

1. Use the 153-2707 Electrical Cable to fabricate a harness that is long enough to connect the GPS module to the communication ECM.
2. Crimp a connector socket to one end of each of the wires.
3. Remove the electrical power from the communication ECM.
4. Disconnect the 70-pin connector from the communication ECM.
5. Prior to wiring the 70-pin connector, remove the plug seals from the appropriate terminal locations.
6. Install the wires for the appropriate RS-232 port into the 70-pin connector's terminal locations, Table 12-5 and Table 12-6:

Table 12-5 RS-232 Port #1

RS-232 PORT #1	
Signal Input	**Terminal Location**
TXD	13
RXD	22
Ground	31

Table 12-6 RS-232 Port #2

RS-232 PORT #1	
Signal Input	**Terminal Location**
TXD	13
RXD	22
Ground	31

7. Reconnect the 70-pin connector to the communication ECM.
6. Prior to restoring the power to the communication ECM, ensure that the connections at the GPS module have been installed correctly.

CONFIGURATION AS A GPS INTERFACE MODULE

Configure the PL1000T Communication ECM as a global positioning system interface module. Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Connect Cat ET to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the parameter for Global Positioning System Interface Function Port Selection.
4. Change the parameter to Serial Port #1 or to Serial Port #2. This parameter depends on the connections that were made in the previous section.

The PL1000T Communication ECM is now configured to communicate with the GPS.

12.5 J1939 BRIDGE SYSTEM

The PL1000T Communication ECM can be configured to join two J1939 Data Link networks into a single J1939 Data Link network. In this configuration, the PL1000T Communication ECM functions as a repeater between the two networks. All messages that are transmitted by a device that is part of the first network are transmitted by the communication ECM to the second network. The opposite is also true.

The PL1000T Communication ECM forwards the incoming data from one J1939 Data Link network to the other J1939 Data Link network.

CONNECTIONS

The J1939 network connection groups provide a standard CAN bus connection that operates at 250K baud.

J1939 BRIDGE

Two J1939 network connection groups must be connected in order to implement the J1939 Bridge feature or the CAN Extension Bridge feature.

If both of the J1939 network connection groups are connected to form a J1939 bridge, the Embedded Communications Adapter feature must be configured for communications with the service tool. The embedded communications adapter will allow for communications between the devices that are on the network and standard Caterpillar service tools, such as Cat ET. Refer to Special Instruction REHS2125, Installation Guide for the 256-7511 PL1000T Communication ECM for specific wiring requirements.

Figure 12-7 shows the connections that are necessary to provide the functionality for the J1939 bridge.

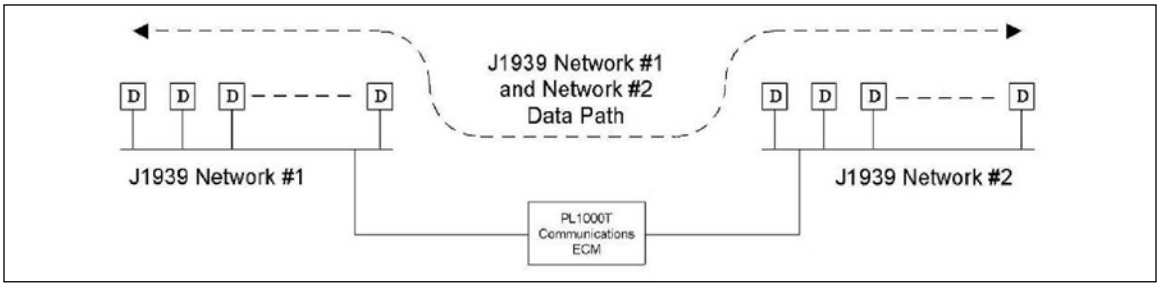


Figure 12-7 PL1000T Communication ECM — J1939 Bridge

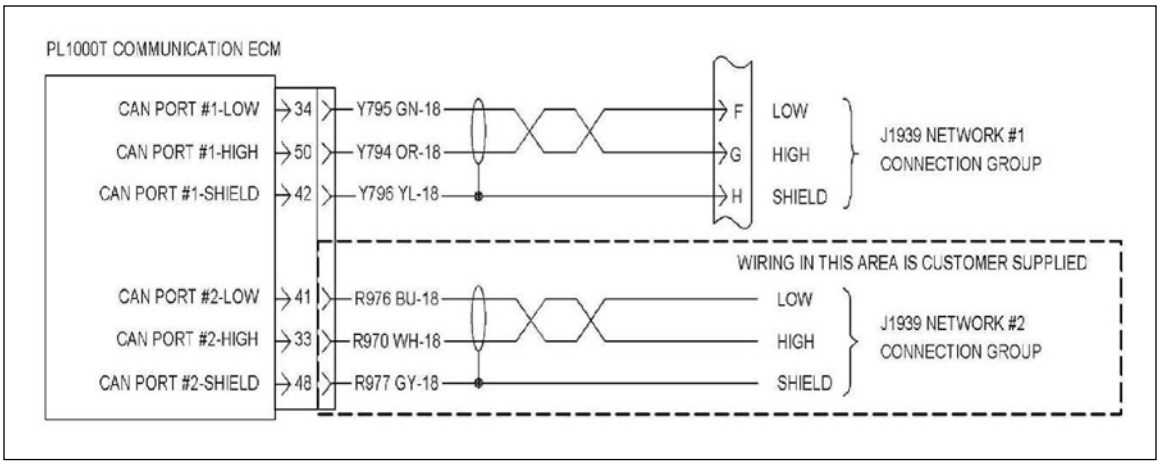


Figure 12-8 J1939 Bridge Diagram

CONNECTIONS FOR THE J1939 BRIDGE

Custom Harness

A custom harness must be constructed for the connection of one of the J1939 network connection groups to the PL1000T Communication ECM. The remaining J1939 network connection group will be connected to the communication ECM through the 9-pin connector.

1. Use 16 AWG or 18 AWG twisted pair wiring (shielded) for connecting the J1939 network. The twisted pair wiring must have one full twist per inch.
2. Fabricate a harness that is long enough to connect one of the network connection groups to the 9-pin connector for the communication ECM. When possible, use the wire identifications that are shown in Figure 12-8.
3. Crimp a 9X-3401 Connector Pin to one end of each of the wires.
4. Remove the electrical power from the communication ECM.
5. Disconnect the 9-pin connector.
6. Prior to wiring the 9-pin connector, remove the plug seals from the appropriate terminal locations.
7. Install the wires for the J1939 network connection group into the 9-pin connector's terminal locations, Figure 12-9 and Table 12-7:
8. Reconnect the 9-pin connector.

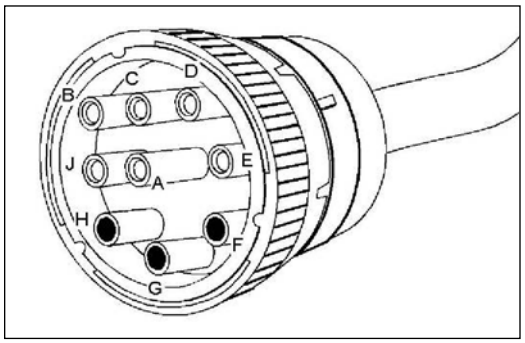


Figure 12-9 CAN Port #1

Table 12-7 CAN Port #1 Inputs

SIGNAL INPUT	TERMINAL LOCATION
High	G
Low	F
Shield	H

9. Use 16 AWG or 18 AWG twisted pair wiring (shielded) for connecting the J1939 network. The twisted pair wiring must have one full twist per inch.
10. Fabricate a harness that is long enough to connect one of the network connection groups to the 70-pin connector for the communication ECM. When possible, use the wire identifications that are shown in Figure 12-10.
11. Crimp a 9X-3402 Connector Socket to one end of each of the wires.

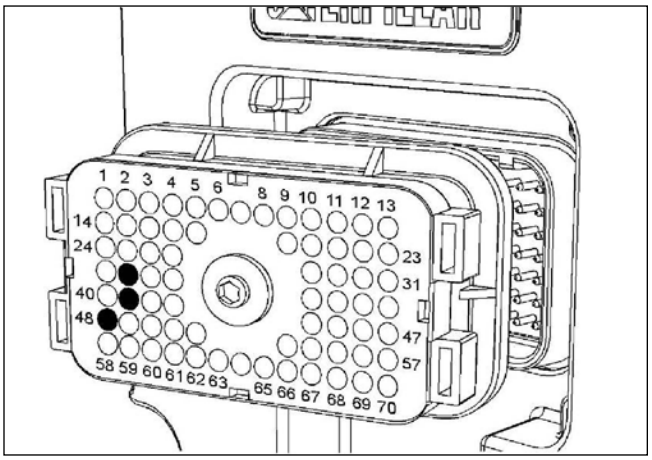


Figure 12-10 CAN #2: 70-Pin Connector

Table 12-8 CAN Port #2 Inputs

SIGNAL INPUT	TERMINAL LOCATION
High	33
Low	41
Shield	48

12. Disconnect the 70-pin connector.
13. Prior to wiring the 70-pin connector, remove the plug seals from the appropriate terminal locations.
14. Install the wires for the appropriate J1939 network connection group into the 70-pin connector's terminal locations, Table 12-8:
15. Reconnect the 70-pin connector to the communication ECM.
16. Prior to restoring the electrical power to the communication ECM, ensure that the connections at each J1939 network have been installed correctly.

CONFIGURATION AS A J1939 BRIDGE

Configure the PL1000T Communication ECM as a J1939 bridge. Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Connect Cat ET to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the parameter for J1939 Bridge Function Enable Status.
4. Change the parameter to Enabled.

When this feature is enabled, the PL1000T Communication ECM will bridge communications between the J1939 networks that are connected to CAN port #1 and to CAN port #2.

NOTE: The operation of the J1939 bridge and CAN extension bridge features are mutually exclusive. If the functionality for the J1939 bridge is enabled, the functionality for the CAN extension bridge will be automatically disabled. The opposite is also true. Refer to Systems Operation, RENR7945 for information that is related to the compatibility of these features.

12.6 CAN EXTENSION BRIDGE

Two CAN Data Link networks will be joined into a single network when the PL1000T Communication ECM is configured as the CAN Extension Bridge function.

The CAN Extension Bridge feature provides the ability to communicate over much longer networks when the RS-485 network protocol is enabled.

NOTE: This configuration requires the installation of an additional PL1000T Communication ECM. Both of the PL1000T Communication ECMs will multiplex the data for each pair of J1939 networks. The data is then sent over the RS-485 network.

Up to two pairs of J1939 Data Link networks can be connected through the CAN extension bridge, Figure 12-11.

CAN EXTENSION BRIDGE CONNECTIONS

Two PL1000T Communication ECMs must be installed in order to implement the CAN Extension Bridge feature. Refer to Systems Operation, RENR7945, PL1000T Communication ECM, and Special Instruction, REHS2125, Installation Guide for the 256-7511 PL1000T Communication ECM for specific details and wiring requirements for the network, Figure 12-11.

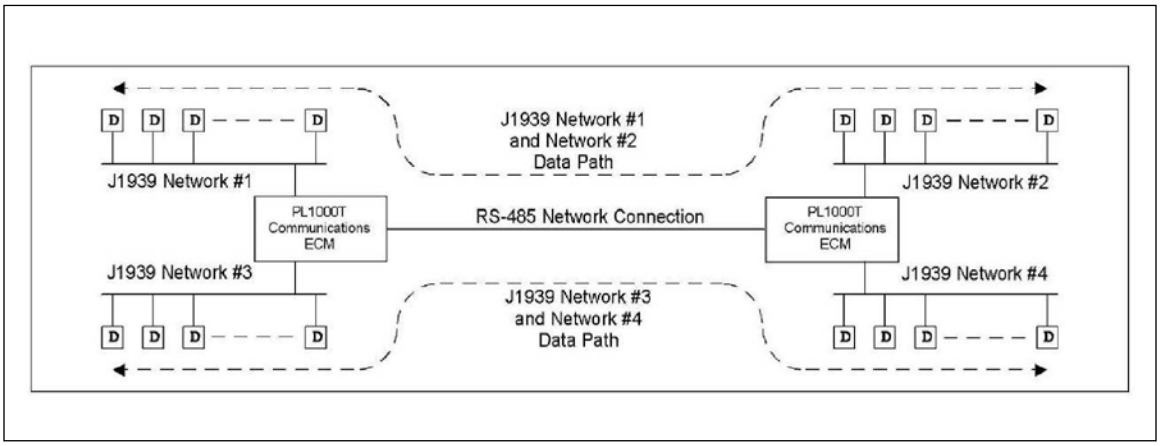


Figure 12-11 PL1000T Configured for the CAN Extension Bridge Network

Figure 12-12 shows the connections that are necessary to provide the functionality for the CAN extension bridge.

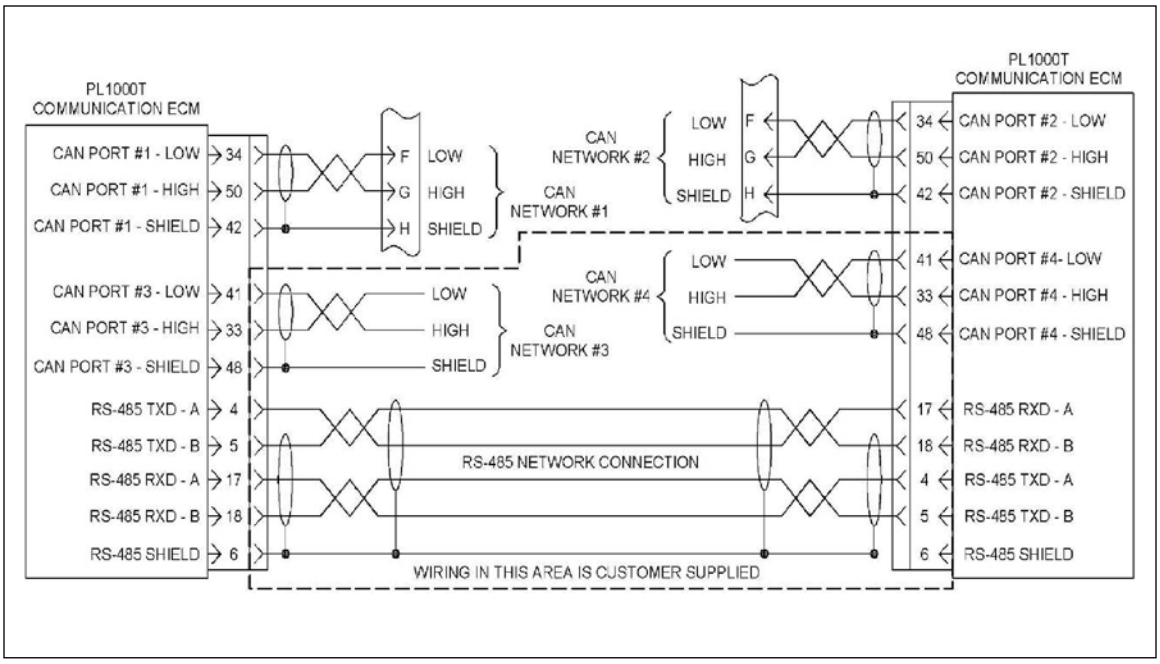


Figure 12-12 PL1000T Communication ECM Configured As a CAN Extension Bridge Network

CONNECTIONS FOR THE CAN EXTENSION BRIDGE

Custom Harness

A custom harness must be constructed when connecting the CAN extension bridge network to the two PL1000T Communication ECMs, Figure 12-13.

1. Use 16 AWG or 18 AWG twisted pair wiring (shielded) for each of the CAN extension bridge networks that are created. The twisted pair wiring must have one full twist per inch.
2. Fabricate a harness that is long enough to connect the two PL1000T Communication ECMs that are to be used. When possible, use the wire identifications that are shown in Table 14-9 RS-485 A Network.
3. Crimp a 9X-3402 Connector Socket to both ends of each of the wires.
4. Remove the electrical power from the communication ECM.
5. Disconnect the 70-pin connector.
6. Prior to wiring the 70-pin connector, remove the plug seals from the appropriate terminal locations.
7. Install the wires for the RS-485 networks into these 70-pin connector's terminal locations:

NOTE: If you are using the CAN extension bridge to connect only one pair of J1939 networks, use the connections for the RS-485 A network.

8. Reconnect the 70-pin connector to the communication ECM.
9. Prior to restoring the power to the communication ECM, ensure that the connections for each of the J1939 networks are installed correctly.

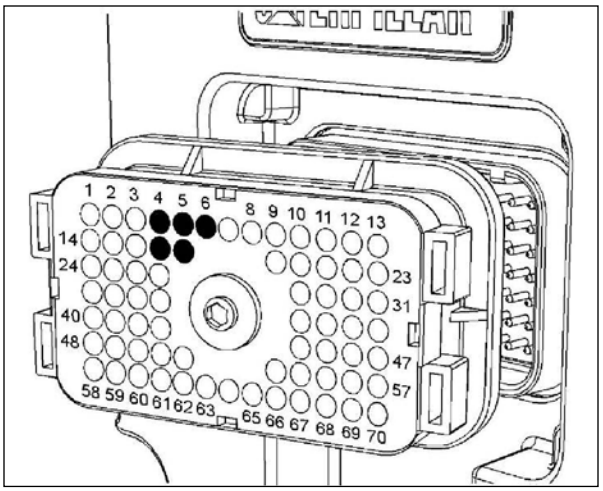


Figure 12-13 70-pin ECM Connector

Table 12-9 RS-485 A Network

ECM #1		ECM #2	
Signal Input	Terminal Location	Signal Input	Terminal Location
TXD	4	RXD	17
RXD	17	TXD	4
TXD	5	RXD	18
RXD	18	TXD	5
Shield to terminal location 43 for one ECM only			

4 RS-485 A TXD
5 RS-485 B TXD
6 RS-485 Shield
17 RS-485 A RXD
18 RS-485 B RXD

CONFIGURATION AS A CAN EXTENSION BRIDGE

Configure the PL1000T Communication ECM as a CAN extension bridge. Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Connect the Cat ET to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the parameter for Can Extension Bridge Function Enable Status.
4. Change the parameter to Enabled.
5. When this feature is enabled, the PL1000T Communication ECM will bridge communications between the J1939 networks that are connected to CAN port #1 and CAN port #2.
6. Communications between the J1939 networks that are connected to CAN port #3 and CAN port #4 will also be bridged.

NOTE: The operation of the J1939 bridge and of the CAN extension bridge features is mutually exclusive. If the J1939 bridge functionality is enabled, the CAN extension bridge functionality will be automatically disabled. The opposite is also true. Refer to Systems Operation, RENR7945 for information that is related to the compatibility of these features.

12.7 CDL TUNNELING

The PL1000T Communication ECM can be configured to transmit the full content of one protocol inside the envelope of a different protocol.

All messages on the Cat Data Link are received by the PL1000T Communication ECM. These messages are formatted as a tunneling message. The tunneling message is then transmitted over the J1939 network.

This is a specialized feature that is used to integrate multiple 3500B Series II and 3500C Caterpillar Engines. The feature allows for the communications from multiple engines to be sent to a single display device that is on the Cat Data Link. Refer to the Application and Installation Guide for information that is related to the application and the installation of the engine.

NOTE: Each engine will require an individual PL1000T Communication ECM for translating the tunneling messages to the Cat Data Link. No more than three PL1000T Communication ECMs can be connected to the same Cat Data Link network

.

CDL TUNNELING CONNECTIONS

The CDL tunneling feature utilizes Cat Data Link networks and a J1939 network. These networks must be connected to the PL1000T Communication ECM. Refer to the appropriate section for information that is related to wiring the networks.

CONFIGURATION FOR CDL TUNNELING FUNCTIONALITY

Configure the PL1000T Communication ECM for the CDL tunneling functionality. Refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Connect the Cat ET to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the parameter for Cat Data Link Over J1939 Tunnel Function Enable Status.
4. Change the parameter to Enabled.

When this feature is enabled, the PL1000T Communication ECM will broadcast messages from the Cat Data Link over the J1939 network.

12.8 CAT DATA LINK BOOST

The PL1000T Communication ECM contains circuitry that can provide a Boost function for the Cat Data Link. When this boost function is enabled, the length limitation for the CAT Data Link wiring harness is extended.

CONNECTIONS CAT DATA LINK BOOST

The CDL tunneling feature utilizes a Cat Data Link network that is connected to the PL1000T Communication ECM.

1. Use 16 AWG or 18 AWG twisted pair wiring for the connection to the Cat Data Link network. The twisted pair wiring must have one full twist per inch.
2. Fabricate a harness that is long enough to connect the network to the 9-pin connector for the communication ECM. When possible, use the wire identifications that are shown in Figure 12-14 and Table 12-10.
3. Crimp a 9X-3401 Connector Pin to one end of each of the wires.
4. Remove the electrical power from the communication ECM.

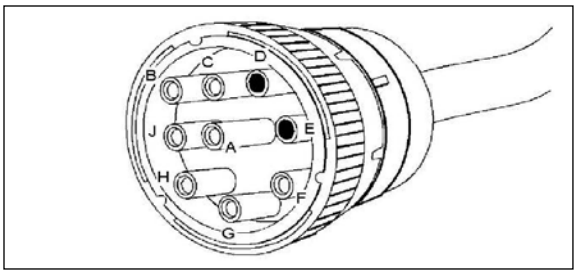


Figure 12-14 9-Pin Connector

Table 12-10 CAN Port #1

SIGNAL INPUT	TERMINAL LOCATION
Cat Data Link+	D
Cat Data Link	E

5. Disconnect the 9-pin connector.
6. Prior to wiring the 9-pin connector, remove the plug seals from the appropriate terminal locations.
7. Install the wires for the Cat Data Link into the 9-pin connector's terminal locations:
8. Connect the 9-pin connector.
9. Prior to restoring the power to the communication ECM, ensure that the connections at the Cat Data Link network have been installed correctly.

CDL BOOST FUNCTION CONFIGURATION

With the CDL boost function enabled, the maximum wiring harness length for the Cat Data Link network is extended to 305 m (1000 ft). With the CDL boost function disabled, the maximum wiring harness length for the Cat Data Link network is 30 m (100 ft).

NOTE: Enabling the CDL boost function when the wiring harness for the Cat Data Link network is less than 100 feet can cause communication errors. Enable the boost function only when the harness length for the network is greater than 30 m (100 ft). When multiple PL1000T Communication ECMs are connected to the same Cat Data Link, enable the CDL boost on only one device. If the CDL boost is enabled on multiple PL1000T Communication ECMs, normal communications on the network may be corrupted.

1. Connect Cat ET to the PL1000T Communication ECM.
2. Access the Configuration screen that is found under the Service menu.
3. Select the parameter for Cat Data Link Boost Function Enable Status.
4. Change the parameter to Enabled.

When this feature is enabled, the PL1000T Communication ECM will communicate using the Cat Data Link Boost feature.

12.9 EMBEDDED COMMUNICATIONS ADAPTER

The PL1000T Communication ECM provides the functionality of an Embedded Communication Adapter. This feature facilitates communications with any standard Caterpillar service tool. Once the communication adapter is enabled, the PL1000T Communication ECM eliminates the need for the traditional external communication adapters. The Embedded Communication Adapter provides all of the same functionality as the external communication adapter.

The connection for the Embedded Communication Adapter provides a standard RS-232 serial interface that can operate anywhere in the range of 9600 baud through 115,000 baud.

EMBEDDED COMMUNICATION ADAPTER CONNECTIONS

When using the Embedded Communication Adapter, the RS-232 port #3 provides for a connection between the PL1000T Communication ECM and the Caterpillar Service Tool, Figure 12-15.

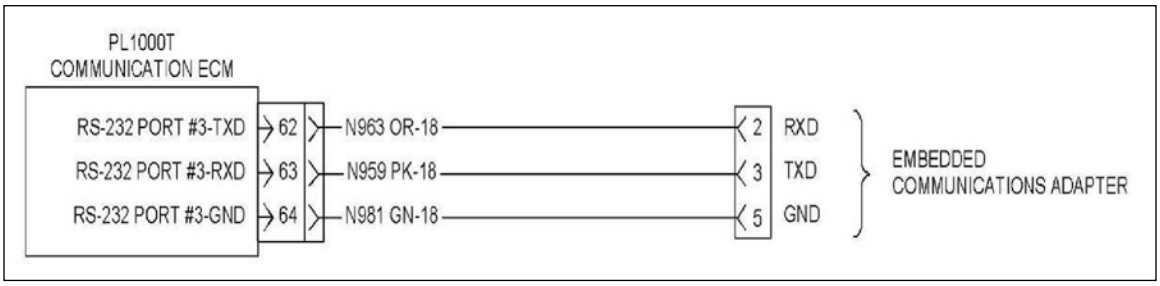


Figure 12-15 Connections for Embedded Communications Adapter

A communication cable that is suitable for a standard PC interface can be used to connect to the PL1000T Communication ECM.

The cable must be compliant with RS-232 requirements and must be equipped with a 9-pin DE connector for connection to the harness assembly that is supplied for the PL1000T Communication ECM.

1. Remove the power from the communication ECM and the PC.
2. Plug one end of the communication cable into the correct COM port on the back of the PC.
3. Plug the other end of the communication cable into the 9-pin DE connector that is on the harness of the communication ECM.
4. Restore the electrical power to the communication ECM and the service tool.

EMBEDDED COMMUNICATION ADAPTER CONFIGURATION

For the PL1000T Communication ECM, this feature is always enabled and assigned to Serial Port #3. If a problem is encountered, refer to Service Manual RENR7945, Electronic Control Module (ECM) — Configure for extensive information that is related to the configuration of the PL1000T Communication ECM.

1. Configure the PL1000T Communication ECM for the embedded communications adapter feature.
2. Start the service tool. Select Preferences from the Utilities pull-down menu.
3. On the Preferences screen, select the radio button for the COM port that you will be using. Select the Caterpillar Embedded Communication Adapter from the selection menu.
4. Select the Advanced button on the right side of the dialog box. On the resulting Advanced Communication Settings screen, select the appropriate baud rate from the list and select OK.
5. Return to the Preferences screen and select the OK button to save your changes.

Figure 12-16 PL1000T CAN Bridge Example

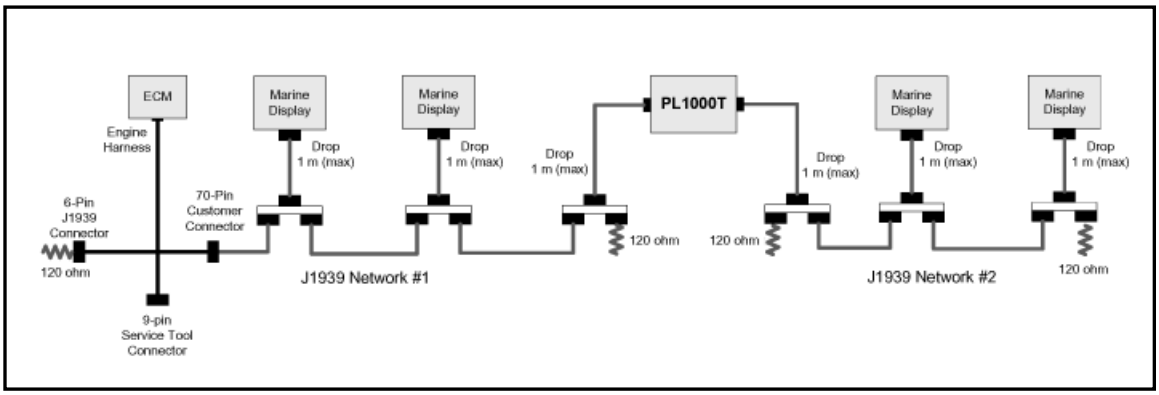
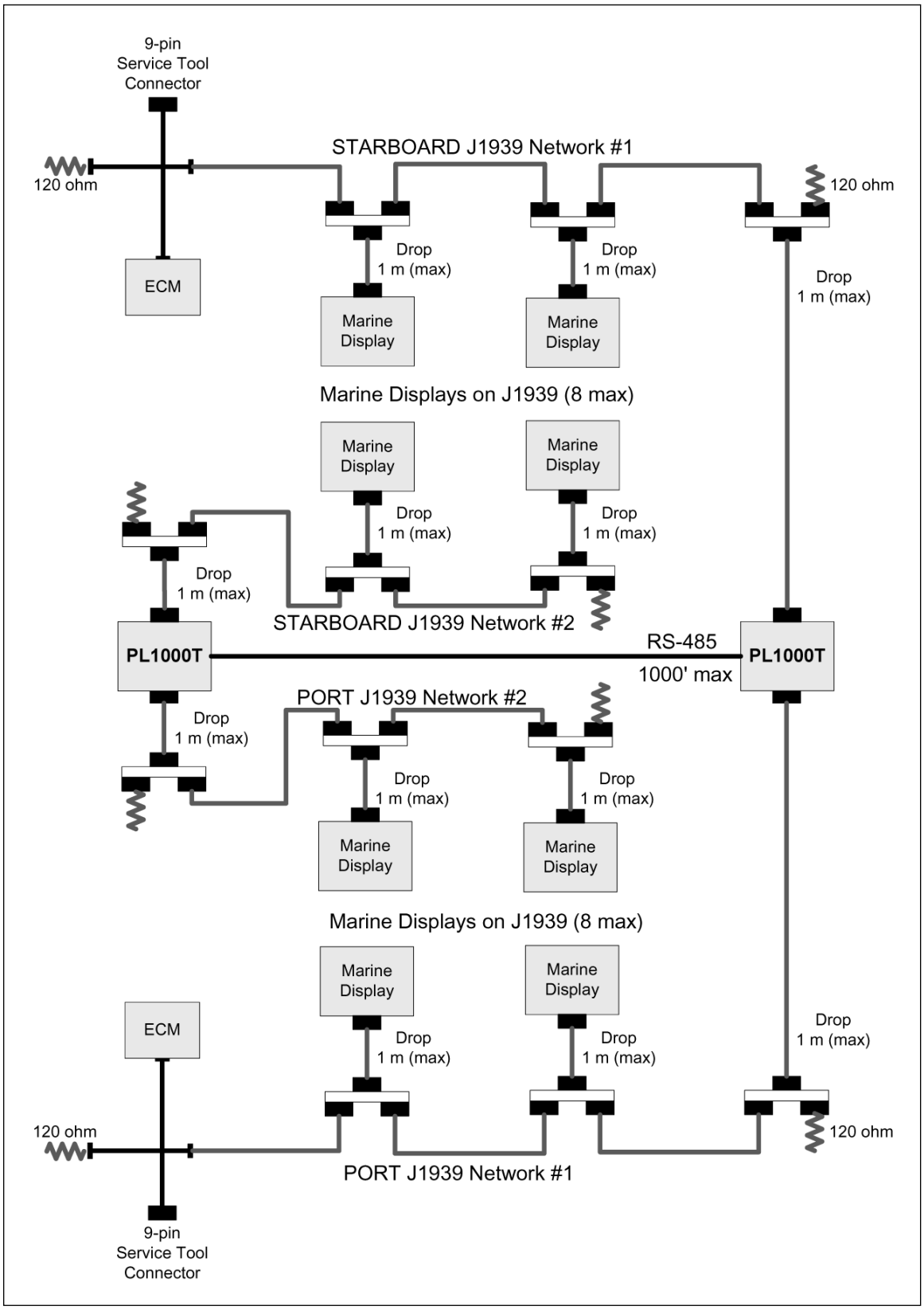


Figure 12-17 PL1000T CAN Extension Example



NOTES:

NOTES:

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