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MiniCommand

Operation, Installation & Troubleshooting Manual

MM4000-I Rev D 11/27/07

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Preface

Important:

It is important to keep this manual in a safe place for future reference. The manual contains answers to questions that may arise during operation or installation of the ZF Marine Electronics MiniCommand Control System and its options.

Conventional Symbols Used in the Manual

Throughout this manual special attention should be paid to the following symbols.

| | |
|--|---|
| | <p>Warning: Personal Injury may result if these messages are not followed.</p> |
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| | |
|--|--|
| | <p>Caution: Damage to equipment may occur if these messages are not followed.</p> |
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| | |
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| | <p>Important: Contains essential information about a topic.</p> |
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| | <p>Note: Contains noteworthy information that may help to clarify a topic.</p> |
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How to Use the Manual

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| | <p>Warning: Personal Injury may result if this message is disregarded.</p> |
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This manual is written describing all possible options available for this processor. Your vessel may not require all of these options. Refer only to the sections that apply to your vessel. If you wish to use one of the available options listed, please contact a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, please see page 159.



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1. Introduction

The MiniCommand control system is a cost effective system to control twin screw vessels with electronic governors and solenoid activated clutches.

This manual is intended for use with the MiniCommand Processors in Table 1 below.

Table 1: MiniCommand Processor

| ZF Marine Electronics Processor Part No. | Number of Screws | ENGINE Electronic | CLUTCH Solenoid | Troll Solenoid | No. of Pluggable Stations (Max) |
|--|------------------|-----------------------------------|-----------------|----------------|---------------------------------|
| MI4002 | Twin | Analog (PWM, 0-5V, 4-20mA, Freq.) | Yes | Yes | 2 |
| MI4004 | Twin | CAN-VM Motori Engines | Yes | Yes | 2 |
| MI4007 | Twin | Analog (PWM, 0-5V, 4-20mA, Freq.) | Yes | No | 2 |
| MI4008 | Twin | CAN-VM Motori Engines | Yes | No | 2 |



1.1. Features

- Designed for pleasure craft applications.
- Diesel Engines Only.
- One or two Remote Station Pluggable Control Heads.
- Twin screw application built into one enclosure, but with two microprocessors for redundancy (one for each engine/gear).
- Single Lever control of transmission direction and engine speed.
- Proportional pause on direction changes (ahead to astern or vice versa).
- Configurable for either in-gear or neutral delay on direction changes.
- Electronic throttle output type selection:
 - ✓ Analog Throttle Output (PWM, 4-20mA, 0-5V, Frequency), or
 - ✓ CAN interface for VM Motori engines.
- Two on/off solenoid outputs per side for transmission control (ahead and astern clutches).
- Start interlock relay contacts for safe engine start.
- Optional solenoid outputs for open-loop troll operation (the MiniCommand Processor must be ordered with or without troll).
- Modes of operation are warm up, cruise, one lever and optional troll.
- Daylight viewable light emitting diodes (LEDs) for status indication.
- Audible tones for warnings and faults.
- Push-buttons and a display for ease of setup and troubleshooting.
- Open-loop synchronization of engine speed.
- The MiniCommand Processor can be used with the 400, 500, 700, MC2000 or 4000 series Control Heads.



1.2. System Overview

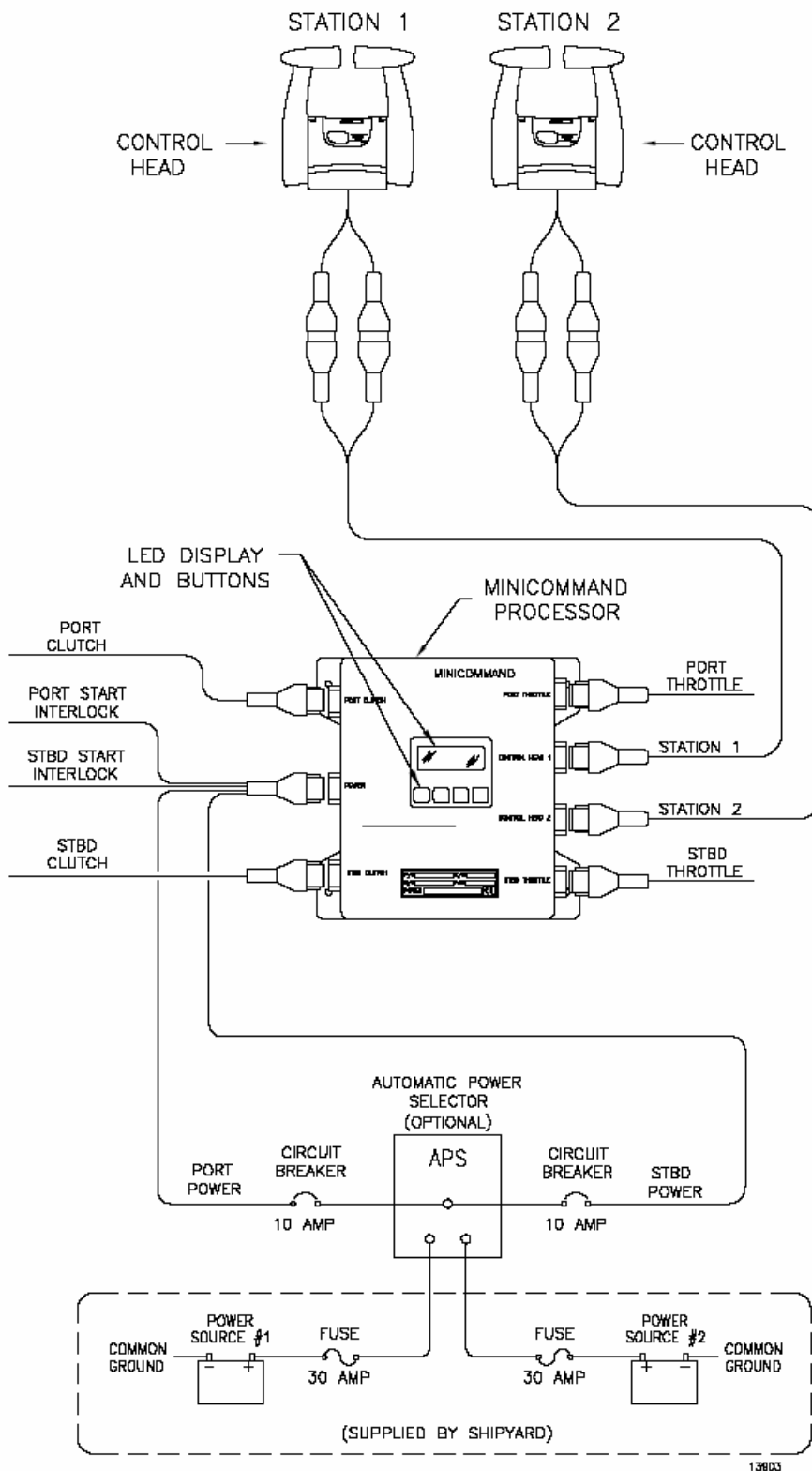


Figure 1: System Overview - Twin Screw with Two Remote Stations




1.3. Specifications

Table 2: General Specifications – Twin Screw Processor

| | |
|---|--|
| APPLICATION/MARKET | <p>MINICOMMAND IS INTENDED FOR THE PLEASURE CRAFT MARKET. IT IS NOT INTENDED FOR COMMERCIAL OR PASSENGER CARRYING APPLICATIONS.</p> <p>MINICOMMAND IS FOR TWIN SCREW DIESEL ENGINES ONLY.</p> |
| MAXIMUM CONTROL STATIONS | 2 |
| POWER REQUIREMENTS | TWO POWER SOURCES REQUIRED (PORT & STARBOARD) |
| NOMINAL VOLTAGE INPUT: | 12 OR 24 VDC |
| VOLTAGE RANGE: | 9.0 TO 31.2 VDC |
| CURRENT RATING | MAXIMUM 6A PER SCREW, TWO 10A CIRCUIT BREAKERS REQUIRED (ONE PER SCREW) |
| OUTPUTS | |
| <p>CLUTCH SOLENOID (4 OR 8 TOTAL OUTPUTS)</p> | <p>PORT:</p> <p>(2) ON/OFF TYPE FOR AHEAD & ASTERN. (1) OPTIONAL ON/OFF TYPE FOR TROLL ON/OFF. (1) OPTIONAL PROPORTIONAL/PWM TYPE FOR TROLL COMMAND.</p> <p>STARBOARD:</p> <p>(2) ON/OFF TYPE FOR AHEAD & ASTERN. (1) OPTIONAL ON/OFF TYPE FOR TROLL ON/OFF. (1) OPTIONAL PROPORTIONAL/PWM TYPE FOR TROLL COMMAND.</p> |
| <p>START INTERLOCK RELAY (2 TOTAL)</p> | (2) RELAY CONTACTS (PORT & STBD), 7A/30V MAXIMUM EACH |



| | | |
|---|--|--|
| THROTTLE OPTIONS (2 TOTAL OUTPUTS) | | (2) PWM, 8 TO 92% DUTY CYCLE. |
|  There are two different versions of MiniCommand with respect to the throttle outputs: Analog (PWM, 4-20mA, 0-5V, Frequency) and Can (VM Motori only); see Table 1: MiniCommand Processor on page #11. | | OR (2) 4 TO 20mA (PORT & STBD) |
| | | OR (2) 0.2 TO 4.9 VDC (PORT & STBD) |
| | | OR (2) FREQUENCY, 0/5 VDC, 120 TO 465 Hz (PORT & STBD). |
| | | OPTIONAL (2) CAN INTERFACE FOR VM MOTORI ENGINES (PORT & STBD) |
| ENVIRONMENTAL RATING | | IP55 (TEST PENDING) |
| OPERATING TEMPERATURE | | -25° C TO +70° C |
| STORAGE TEMPERATURE | | -40° C TO 85° C |
| EMC | | CE PER EN60945 |
| VIBRATION-RESONANT | | 2.0 Hz TO 13.2 Hz, ±1mm |
| | | 13.2 Hz TO 100 Hz, ±0.6g (6.9 m/SEC ²) |
| | | 20 Hz TO 2000 Hz, ±1.0g (9.8 m/SEC ²) |
| VIBRATION – RANDOM | | 20 Hz TO 2000 Hz, 7.5g |
| | | ACCELERATION CURVE: FLAT PER IEC 60068 (-2) – (+64) |
| | | 8 HOURS PER AXIS – EACH OF THREE AXES |
| WEIGHT | | 4.5 LB/[2.05kg] |

1.4. Optional Features


The optional features are:

- **Automatic Power Selector (APS).** For further information see section 15 - [Automatic Power Selector \(APS\) Part #13505](#) on page #151.
- **Troll.** When ordered with the troll option, MiniCommand is capable of open-loop trolling.




2. Operation

This Manual, as written, is intended for Twin Screw applications only.

| | |
|---|---|
|  | Warning: An Engine Stop Switch MUST BE installed at every remote operating station. Refer to CFR 46, Section 62.35-5 (US Coast Guard) and (ABYC) P-24.5.8 |
|---|---|

2.1. DC Power On

| | |
|---|--|
|  | Note: One Lever Operation may be used in Troll mode or in Non-Troll mode. |
|---|--|

When DC power is turned ON, on the processor:

- A short steady tone, followed by a slow repetitive tone, sounds at both Remote Stations indicating that no station has command.
- The Start Interlock relay contact remains open, preventing engine start.
- The electronic throttle signal is commanded to Idle.
- The Ahead and Astern shift solenoids are de-energized, commanding neutral.
- The solenoid for the trolling valve is off.

2.2. Taking Command

The operator uses the Control Head at the Remote Station to control the engine speed (idle to full) and the direction of the transmission (ahead or astern). On a twin screw vessel, the left Control Head Lever controls the port engine speed and transmission, and the right Control Head Lever controls the starboard engine speed and transmission.

The MiniCommand processor has (2) Remote Station connectors available for up to two pluggable Remote Station Control Heads.

To take command at any one of the Remote Stations:

- Ensure that both of the Control Head levers at that station are in the neutral detent.

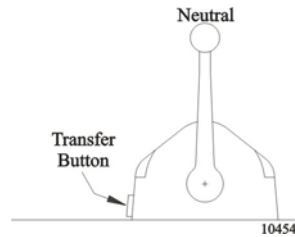


Figure 2: Station Taking Command with a 400 series Control Head

- Depress the *Control/Mode (Transfer)* button for ½ second.
- The red LED indicator lights turn on at the station's Control Head, which has taken command of the Control System.
- The slow repetitive tone stops at all stations.
- The operator is now in control of the vessel's propulsion system (engines, gears, propellers).



Warning: An Engine Stop Switch MUST BE installed at every remote operating station. Refer to CFR 46, Section 62.35-5 (US Coast Guard) and (ABYC) P-24.5.8



Note: If Start Interlock is used: Once a station is in command and the processor is commanding neutral, the Start Interlock relay contact closes, allowing the engine to start.

2.3. Basic Operation

2.3.1. Cruise Mode for Normal Operation

See Figure 3 and Figure 4 on page #19 and #20 respectively, for Control Head detent positions and Lever movement.

- a. The Control Head has three detents, Ahead, Astern and Neutral.
- b. With the Control Head lever positioned in the Neutral (middle) detent, the processor will command the transmission clutches to Neutral and the engine to idle speed.
- c. Movement of the Control Head's lever 15 degrees to the Ahead or Astern detent will command Ahead or Astern clutch, while the engine RPM remains at Idle.
- d. Further movement of the Control Head lever will increase the engine RPM in proportion to the Control Head's lever position.

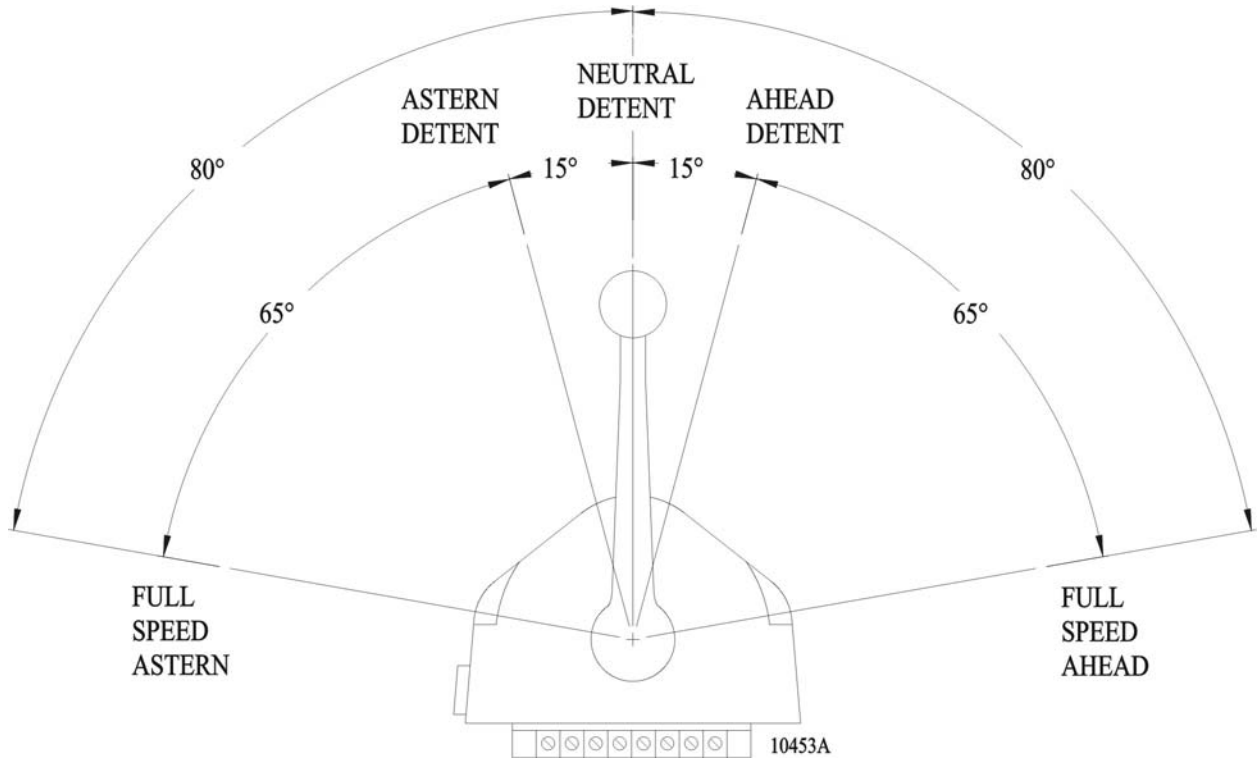


Figure 3: Detents and Lever Movement on the 400 and MC2000 Series Control Head

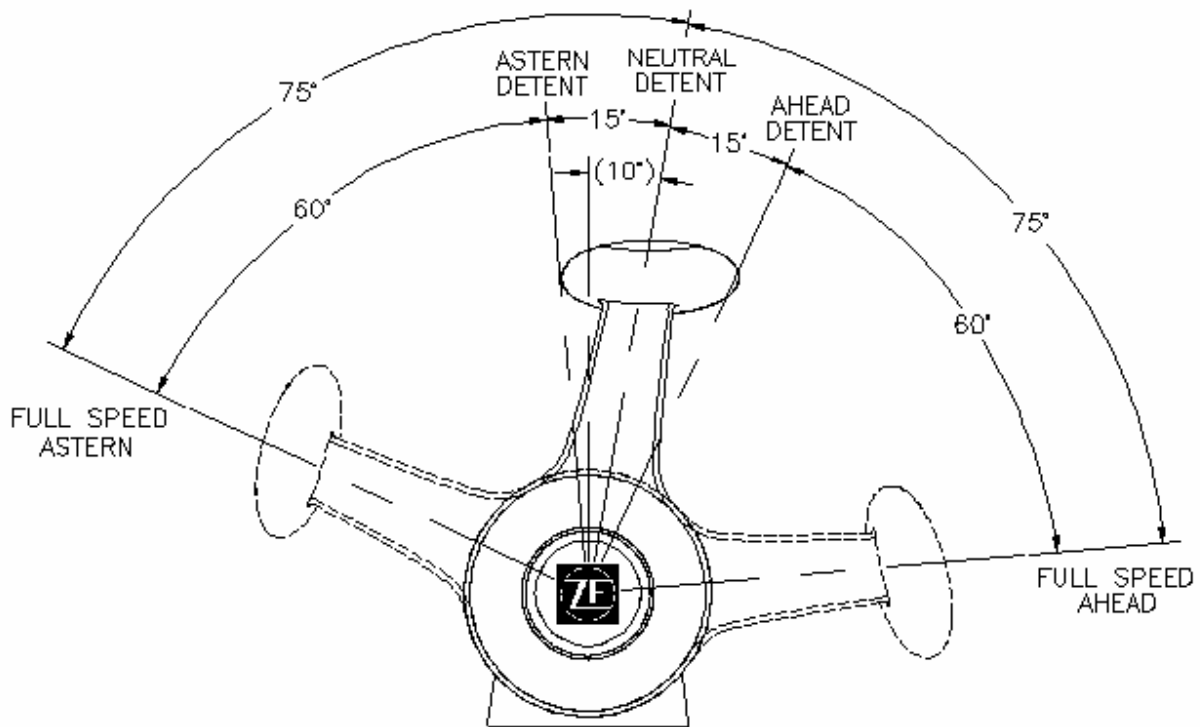



Figure 4: Detents and Lever Movement on the 4000 Series Control Head

2.3.2. Trolling Valve (Optional)

| | |
|---|---|
|  | <p>Warning: Personal Injury could occur if the following steps are not followed exactly.</p> |
|---|---|

For MiniCommand Processors equipped with the trolling option, the Control System is able to control electric trolling valves that utilize single or dual solenoids; one on/off solenoid (troll on/off) and one proportional solenoid (troll command).

This System has two modes of Operation when a Troll Valve Type of command is set up: *Troll* and *Cruise* (Troll Off).

The Troll mode option is selected during Setup. When Troll mode is setup, the Control system will initially power up in Cruise mode.



2.3.2.1. Operation in Cruise (Troll Off) Mode

In Cruise mode the solenoid outputs to the Trolling valve remain off and the system operates as described in section 2.3.1 - Cruise Mode for Normal Operation on page #18.

2.3.2.2. Operation in Troll Mode

2.3.2.2.1. Turn Troll On

- a. Place the Control Head lever(s) in the Neutral, Ahead, or Astern detent position.



Note: For Twin Screw systems ensure both levers are in the same detent.

- b. Press and *hold* the *Control/Mode (Transfer)* button for two (2) seconds. The two solid red indicator lights on the Control Head will begin blinking rapidly, indicating the system is now in *Troll* mode.

2.3.2.2.2. Operation

- a. Once in Troll mode, movement of the Control Head's lever(s) to the Ahead or Astern detent begins to rotate the propeller at approximately 30% of Idle lock-up RPM (depending on how the system is setup).
 - Transmission commanded to Ahead or Astern
 - Transmission trolling valve is activated
 - Throttle remains in Idle
 - Control Head LED is flashing red.
- b. Continued Control Head lever movement through the Troll Range:
 - Will increase the propeller RPM from 30% shaft RPM to approximately 70% shaft RPM.
 - Throttle remains at Idle (or can be adjusted to increase up to 20% of maximum throttle within this Troll Range).
 - Control Head LED becomes a steady red when the Control Head lever reaches the end of the Troll Range.



- c. The remaining movement of the Control Head lever beyond the Troll Range:
 - Transmission clutch locks up.
 - Engine speed increases, but can be limited depending on the troll range selected during setup.

2.3.2.2.3. Turn Troll Off

- a. Place the Station-in-Command Control Head levers in the Neutral, Ahead, or Astern detent.
- b. Press and hold the *Control/Mode (Transfer)* button until the red indicator lights on the Control Head stops blinking (approximately 2 seconds); then release the button.
- c. Troll mode is OFF and Cruise mode is ON.

2.4. Start Interlock (Highly Recommended!)

| | |
|--|---|
| | <p>Warning: Not using the Start Interlock Output could result in starting the engine with the transmission clutch engaged causing the vessel to surge ahead or astern. This could result in personal injury, death or damage to the vessel and the surrounding area.</p> |
|--|---|

The engine start signal is blocked unless *all* of the following are true:

- DC power is ON.
- A remote station is in command.
- The Control System is commanding Neutral.

2.5. Station Transfer From One Remote Control Head to Another

| | |
|--|---|
| | <p>Warning: Personal Injury could occur if the following steps are not followed exactly.</p> |
|--|---|

| | |
|--|--|
| | <p>Note: Only one station can have command at any given time.</p> |
|--|--|



Command can be transferred as follows:

- a. The Station-in-Command's lever(s) may be left in any position.
- b. Place the receiving station's Control Head lever(s) in the Neutral/Idle detent position.

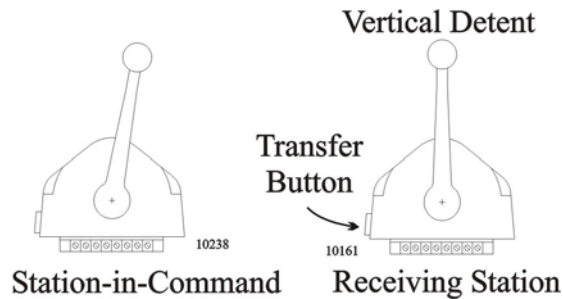


Figure 5: Original Station-in-Command for the 400 Series Control Head

- c. At the Receiving Station, depress and hold the *Control/Mode (Transfer)* button for ½ second.

Figure 6: Station No Longer in Command

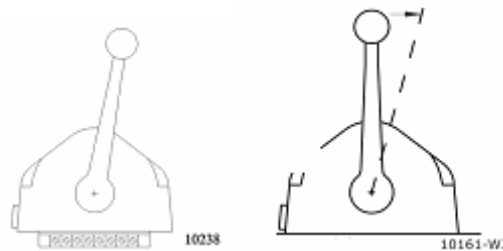



Figure 7: Station-in-Command

- The red LED indicator light at the receiving station's Control Head will illuminate, indicating that the station has taken command.
 - The red LED indicator light will go OFF at the original station's Control Head, indicating that that Station is no longer in command.
- d. The MiniCommand Throttle and Clutch outputs remain unchanged for one second after the red LED lights go on. This allows the operator time to move the Control Head's lever(s) to a position approximately matching the previous station in command, which allows the vessel to maintain present speed and direction.



2.6. Warm-up (Throttle Only) Mode

| | |
|---|---|
|  | <p>Warning: Personal Injury could occur if the following steps are not followed exactly.</p> |
|---|---|

This feature allows the operator to increase the engine's RPM, while the Clutch remains in Neutral. Warm-up mode is operational only when the Control Head lever is moved in the Ahead direction. It is not operational in the Astern direction.

2.6.1. Turning Warm-up On

- a. At the Station-in-Command, ensure that the Control Head's lever is in the Neutral detent position. Refer to graphic below.
- b. Depress and hold the *Control/Mode (Transfer)* button. After one second, move the Control Head's lever to the Ahead detent, while continuing to hold the *Control/Mode (Transfer)* button.
- c. Release the *Control/Mode (Transfer)* button. The red LED indicator light will blink slowly, indicating Warm-up mode is activated while the Clutch has remained at Neutral.

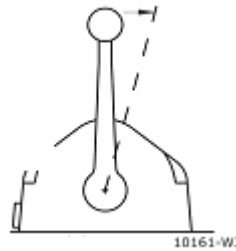


Figure 8: Control Head Warm-Up Mode (400 series Control Head)

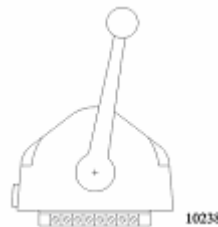



Figure 9: Control Head Normal Operating Mode




- d. The operator can now start the engine, if required, and increase the RPM through the entire throttle range by moving the Control Head's lever forward through its range of movement (Ahead direction only).

| | |
|---|---|
|  | <p>Note: If High Idle has been programmed (see section 2.7 - <u>High/Low Idle</u> on page #25), the processor will command the higher idle RPM when in warm-up mode.</p> |
|---|---|

2.6.2. **Turning Warm-up Off**

- a. When the Control Head's lever is returned to the Neutral detent, the red LED stops blinking and remains on. After one second in Neutral, the processor will automatically reset to normal operation with full control of the clutches and engine.
- b. The next movement of the Control Head's lever will engage the Ahead or Astern clutch (Normal Operation).

| | |
|---|---|
|  | <p>Note: If the lever is moved quickly from Ahead to Astern while in Warm-Up mode, the LED will continue to blink, but the Throttle command will remain at Idle.</p> |
|---|---|

2.7. High/Low Idle

The Control System provides the speed command input to the engine, so that it can run at the engine's default idle speed (Low Idle) or it can run at a second elevated idle speed (High Idle).


| | |
|---|---|
|  | <p>Note: High Idle is not available for CAN engines.</p> |
|---|---|

2.7.1. **Low Idle**

- The factory default setting is for low idle only
- When the system is initially powered-up, it will always command low idle, even when high idle is selected.


2.7.2. **High Idle**

- If high idle is desired, it may be programmed during Dock Trials.
- High idle is programmable up to a maximum setting of 20% of Full Throttle.

| | |
|---|---|
|  | <p>Caution: The transmission can be damaged if the clutches are engaged in Ahead or Astern with the engine speed too high. Refer to the Transmission Manual to determine the maximum engine speed at which the clutches can be safely engaged.</p> |
|---|---|



2.7.3. Selecting Between High and Low Idle

| | |
|---|---|
|  | <p>Warning: Personal Injury could occur if the following steps are not followed exactly.</p> |
|---|---|

Refer to Figure 10 below when selecting between Low and High Idle (or vice versa) at the Station-in-Command.

- a. The Control Head's lever(s) may be in the Neutral, Ahead or Astern detents when making a selection.

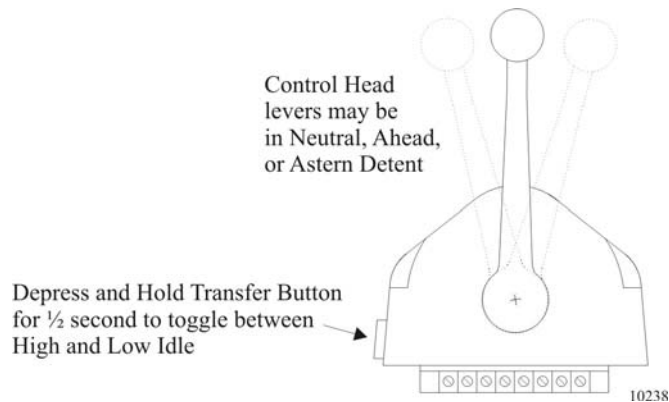



Figure 10: High/Low Idle Mode Selection on 400 Series Control Head

- b. Depress and hold the *Control/Mode (Transfer)* button for ½ second and then release. If the System was in Low Idle, it will toggle to High Idle, and vice versa.

| | |
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|  | <p>Note: The actual change occurs at the release of the <i>Control/Mode (Transfer)</i> button. Do not press and hold awaiting the Idle change.</p> |
|---|---|

- c. To return to the previous idle setting, depress and hold the *Control/Mode (Transfer)* button again for ½ second and then release.

2.8. Engine Synchronization (Twin Screw)

| | |
|---|--|
|  | <p>Note: The Control System offers one type of synchronization: Equal Throttle.</p> |
|---|--|

- The control system defaults as synchronization ON from the factory.
- You can set synchronization OFF or ON in setup.
- If synchronization is set as ON in setup, then you can turn it on or off at the control head.



- If synchronization is set as OFF in setup, it cannot be turned on at the control head.
- The Control system will always power-up with synchronization ON when selected in setup.
- If synchronization is turned OFF at the control head, it can be turned back ON at the control head. It will also turn back ON the next time you power up.
- In order for synchronization to become active (engines are at equal RPMs) the Synchronization criteria listed below must be met.

2.8.1. Synchronization Criteria

Synchronization criteria are met when all of the following are true:

- Both Control Heads must be commanding 5% or greater of the throttle range.
- The commanded throttles are within 10% of one another.
- Both Control Head levers are commanding Ahead clutch engagement. (Synchronization cannot be attained in astern.)

2.8.2. Synchronization Type

The following synchronization types use the same criteria, indications, and are turned ON and OFF as described in the following sections.

2.8.2.1. Equal Throttle Electronic Synchronization (Default)

Equal throttle synchronization has the processors send the same (equal) throttle command signal to each engine when all of the synchronization criteria, (as described in 2.8.1 - Synchronization Criteria on page #27) are met.



Caution: The Control System will remain synchronized as long as the control head levers are in close proximity to one another.

If one lever is moved to a point where the 10% throttle rule is exceeded, a 10% increase or decrease in engine RPM would occur in one engine, causing a sudden change in the vessel's direction.

2.8.3. Synchronization Indication

The green LED located on the Control Head indicates the synchronization status when:

- The green LED is on **steady**, the engines are synchronized.
- The green LED is **not on**, the engines are not synchronized and the Control System is not attempting to synchronize.

2.8.4. Turning Synchronization Off/ON When Criteria is Met

2.8.4.1. Turning OFF

When the criteria are met, synchronization is automatic and does not need to be turned ON. If the operator elects to turn OFF synchronization, follow the steps below:

- a. Ensure that the Control Head levers are positioned at a point where the synchronization criteria are met.
- b. At the Station-in-Command, press and hold the *Control/Mode (Transfer)* button until the green LED **blinks twice** and then goes out (approximately 2 seconds).
- c. Synchronization is now OFF.

2.8.4.2. Turning ON

Synchronization is automatic and does not need to be turned ON, unless previously turned OFF, as described in the previous section.

- a. Ensure that the Control Head levers are positioned to a point where the synchronization criteria are met.
- b. At the Station-in-Command, press and hold the *Control/Mode (Transfer)* button until the green LED turns on steady (approximately 2 seconds).
- c. The engines are synchronized again.



Note: If synch was previously turned Off and power to the Processor also turned Off, synch will be On when power is restored to the Processor.

2.9. One Lever Mode (Twin Screw)



Note: The Green LED will always be on steady in One Lever Operation, no matter which position the Master Control Head lever is in.

The system supports a mode of operation referred to as One Lever mode.

One Lever mode allows the operator to control both engines and transmissions with a single Control Head lever. Any of the Control Head levers at any Remote Station in control can be designated by the operator as the *Master lever*.


The designation of which lever is the Master Lever can be changed by the operator at any time. Most of the features (synchronization, troll, etc), which are available in normal operation are also available while operating in One Lever mode.


- The processor defaults to One Lever mode disabled/off.
- One Lever mode can be disabled or enabled in setup.
- When One Lever mode is enabled, the operation must be turned ON and OFF as described below.

2.9.1. Turning On One Lever Operation


- a. At the Station-in-Command, move all the Control Head levers to the Ahead detent.
- b. Depress and hold the *Control/Mode (Transfer)* button while moving one of the Control Head levers forward, out of the Ahead detent. Do Not release the *Control/Mode (Transfer)* button until the green LED turns ON, indicating One Lever Operation is now active.
- c. The Control Head lever which the operator chose to move out of the Ahead detent becomes the *Master Lever*.
- d. The Control Head lever which was left in the Ahead detent is now inactive.



| | |
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|  | <p>Note: The Control Head lever designated by the operator to be inactive in One Lever Operation, may be left in the Ahead detent or moved fully forward. Moving the lever fully forward is recommended, because it moves it out of the way and prevents accidental bumps while operating.</p> |
|---|---|


| | |
|---|--|
|  | <p>Warning: Whenever the inactive lever is moved to the Neutral detent, One Lever Operation is turned OFF. If the inactive lever is moved to neutral or astern, a sudden change in vessel direction will occur unless the <i>Master Lever</i> is also commanding neutral.</p> |
|---|--|

2.9.2. Turning OFF One Lever Operation

| | |
|---|---|
|  | <p>Warning: It is strongly recommended that the <i>Master Lever</i> and <i>Inactive</i> lever be returned to the Neutral/Idle position while simultaneously turning OFF One Lever Operation.</p> <ul style="list-style-type: none"> ➤ Do not attempt to transfer command from one Remote Station to another while in One Lever Operation. Always turn One Lever Operation OFF prior to transferring. ➤ Failure to observe these recommendations may result in a sudden change in the vessel's direction. |
|---|---|

- a. Place the *Master* and *Inactive* levers into the Neutral detent.
- b. One lever operation is now turned off.

2.10. Mode Stacking

| | |
|---|---|
|  | <p>Caution: Fully understand the various modes of operation, including enabling and disabling of the modes, prior to attempting Mode stacking.</p> |
|---|---|

The MiniCommand control system allows the operator to select two or more modes of operation at a given time. For instance, while in One Lever mode the operator may also select Trolling Mode or Warm-up mode. If desired, One Lever, Trolling and High Idle modes may be selected simultaneously.

While Mode Stacking, the rules for enabling and disabling the various modes of operation remain the same and may prevent some modes from operating with others. For instance, Trolling mode and Warm-up mode (in that order) can be



selected together. However, Warm-up mode actually bypasses trolling mode. They will not *work together.*



3. Installation

Refer to Section 9 – System Drawings starting on page #119 for an overview of the installation.



Note: When installing wire harnesses (cables), support the cables using clamps or straps not more than 18 inches (0.5m) apart, unless the wire harnesses are contained in a conduit or wireway. Install each cable so it is protected from physical damage. Refer to the ABYC standard E11, Section 11.16.4.1, 7/03.

3.1. Starting the Installation

The first step when installing a system is to carefully plan the installation. This includes finding proper mounting locations for the Processor and Control Heads. The decision is made based on where the power will be sourced and how the power will be routed to the Processor. Once the locations are decided upon, lengths of electrical wire harnesses can be determined. Refer to section 14.2 - MiniCommand Part Numbers on page #149.



Important: Start the actual installation only when the locations and lengths of wire harnesses are determined.

3.2. Installer Supplied Parts and Tools

3.2.1. Tools

- Tools as required to install individual control system components.
- Calibrated Digital Multimeter (Fluke 80 Series or equivalent).
- (Optional) Service Field Test Unit (P/N 13927), available through ZF Marine Electronics). Service Field Test Unit Pigtail – Clutch Adapter for MiniCommand required, (P/N 71127)
- (Optional) Field Test Control Head - Dual (P/N #14000) and a MiniCommand Field Test Control Head Adapter (P/N #71149).



3.2.2. Miscellaneous Parts

Processor mounting hardware: (4) ¼ inch or M6 fasteners, lock washers and washers.

3.2.3. Engine Stop Switch (Supplied by Others)

An engine STOP switch MUST be located at each Remote Station. Reference ABYC P-24, 24.5.8, 7/97

For VM Motori versions of the MiniCommand Processor, there is an option for connecting a Normal Engine Shutdown switch to the MiniCommand Processor. The actuation of this switch is communicated to the VM Motori engine using the CAN bus connection between the engine and Processor. This switch does NOT take the place of an emergency engine stop switch. There MUST be a means to shutdown the engine in the event the MiniCommand Processor fails.



Warning: An engine STOP switch MUST be installed at every remote operating station. Refer to section 3.7 - Engine Stop Switches on page #45



3.3. Processor

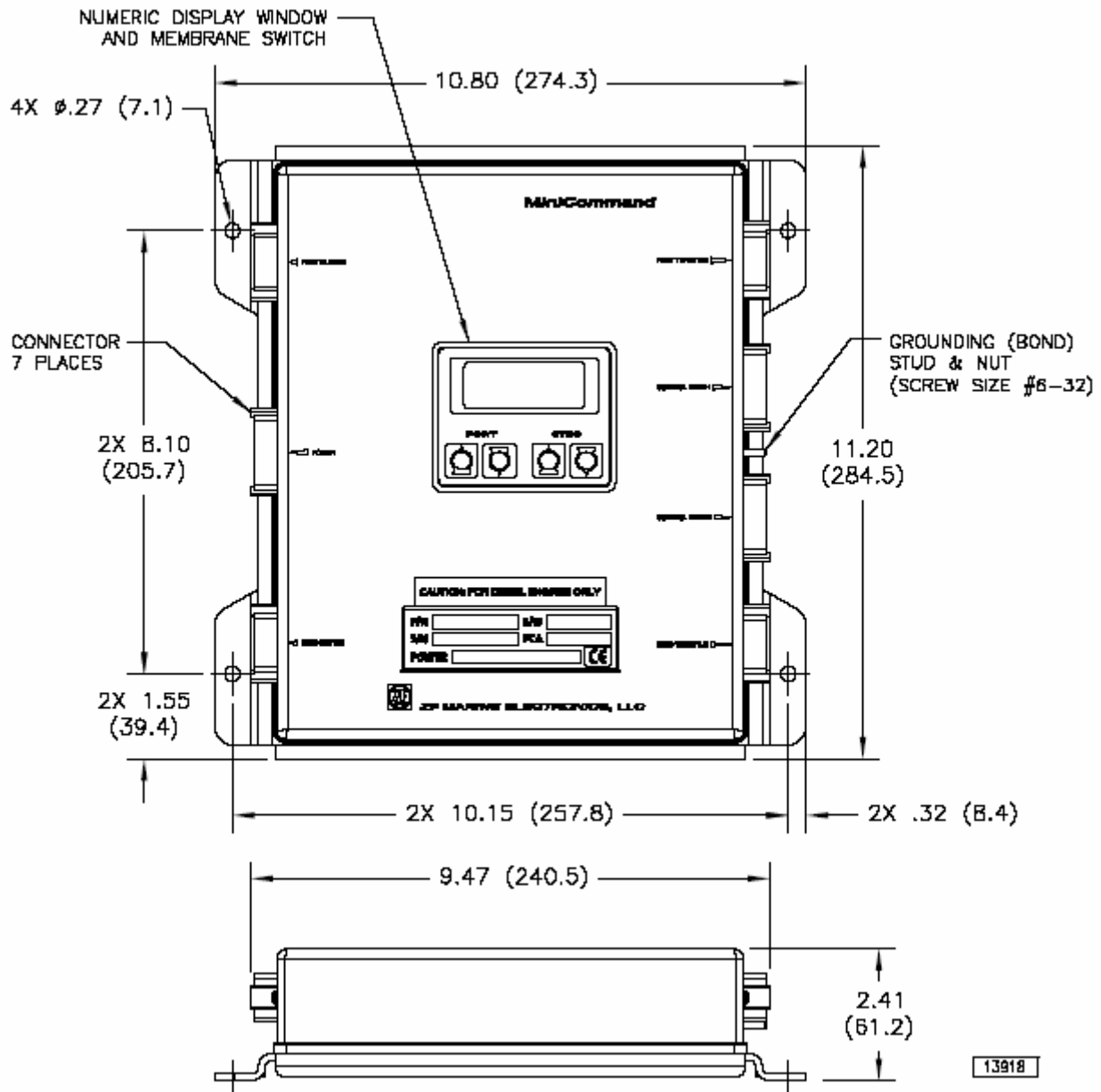


Figure 11: MiniCommand Processor Dimensions

3.3.1. General Information

- a. The MiniCommand twin screw processors are in a single enclosure.
- b. The mounting hardware is installer supplied.



3.3.2. Selecting the Location for the Processor

The following items must be taken into account when selecting the location for the Processor:

- The Processor is spray proof, but not water proof. Therefore, an area must be selected that typically stays dry.
- The engine room is the preferred location for mounting the Processor.
- If the engine room is too small, place the processor in any area where it is easily accessible, and all of the other criteria listed are met.
- Bulkhead mounting is the preferred method due to ease of access for wiring and adjustments. However, the Processor can be mounted in any position as long as the LED display and push-buttons are accessible.
- Do not mount the Processor on the engine, transmission, or any other location that is subject to excessive vibration.
- Do not mount the Processor to the transom when the vessel is equipped with a surface piercing drive system (due to vibration concerns).
- Locate the Processor away from sources of high heat, such as engine exhaust manifolds or turbochargers. Allow 4 feet (1,2m) of clearance or more.
- Do not mount the Processor in close proximity to ignition systems, alternators, generators or any equipment producing strong magnetic fields. Allow 4 feet (1,2m) or greater clearance.



Warning: Strong magnetic fields can influence the Processor's electronic circuits and **void your warranty**.

- System Grounding (Bonding) contributes to maximum electromagnetic compatibility (EMC) performance. A threaded male stud (size #6-32) is provided for connection to the vessel's grounding system. See Figure 52 - _Grounding on page #144.



Note: Connection to the vessel's ground/bond system is not required but is recommended.

3.3.3. Installing the Processor

- a. Place the Processor on the mounting surface and mark the four (4) screw holes. See Figure 11 - MiniCommand Processor Dimensions on page #35.
- b. Remove the Processor and drill the screw holes.
- c. Secure the Processor to the mounting surface with four 1/4 inch or M6 fasteners.



- d. Connect the Processor to the Hull or Grounding Bus by running a 14 AWG or larger conductor between the Processor's grounding threaded male stud (size #6-32) and the Grounding Bus or Hull (Grounding is optional).

3.4. Control Heads

3.4.1. General Information

Control Heads are available with pluggable pigtails. For information on the various Control Heads available and their dimensions, refer to Section 10 – Control Head Variations starting on page #121 in Appendix A.

- The Control Head can be mounted at any location on the vessel, as long as all criteria listed below are met.
- Maintain a minimum distance of 25cm from the compass.
- Retrofit applications may require an Adapter Pad to cover the old Control Head cutout. A variety of Adapters and Cover Pads are available. If an Adapter/Cover Pad is required, please contact a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, please start on page #159.
- The maximum Control Head Harness length is 50 feet (15,2m). Ensure that the location selected will allow the connection between the Control Head and Processor.
- Ensure that the clearance is sufficient for the Control Head's lever to reach full Ahead and full Astern.
- The Control Heads should be mounted in a forward facing position only!
- The 400, 500, and MC2000 series Control Heads are spray proof from the top, but must be protected from the weather on the underside.
- When a 400, 500, or MC2000 series Control Head is mounted in a location where the underside is exposed to the weather, consider using a Weather Mount Enclosure.
- The 4000 and 760 series Control Heads are sealed from underneath and therefore do not need a Weather Mount Enclosure. For additional information see section 11 – Weather Mount Enclosure on page #139.

3.4.2. Installing the 400, 500, 700, MC2000, 4000 and Handheld Series Control Heads

Refer to the appropriate Control Head Dimensions and Variations service sheets.



3.4.2.1. 400 Series Control Heads

Go to Appendix A, section 10.1 – 400 Series on page #121.

3.4.2.2. 521 - 522 Series Control Heads

For information on the 521 – 522 series Control Heads, ask your ZF Marine Representative for the MM15475 Control Head Assemblies Installation Manual.

3.4.2.3. 700 Series Control Heads

Go to Appendix A, section 10.2 – 700 Series Control Heads on page #125.

3.4.2.4. MC2000 Series Control Heads

Go to Appendix A, section 10.3 - MC2000 Series Control Heads on page #129.

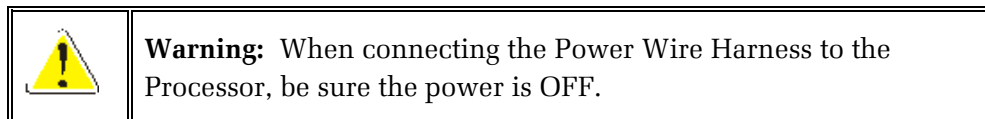
3.4.2.5. 4000 Series Control Heads

Go to Appendix A, section 10.4 - 4000 Series Control Heads on page #133.

3.4.2.6. Handheld Remote Controls

For information on the Handheld Remote Control Heads, ask your ZF Marine Representative for the MM12822 Handheld Installation manual.

3.5. DC Power Source



One of the most important (and often overlooked) items for proper operation of your control system is a clean, dedicated, and reliable source of DC Power.

The wiring used to supply power from the power source (battery) through the various components (fuses, distribution panel, relays, etc.) to the Processors must be sized for a voltage drop of 10% or less using 5 amps as the maximum current draw. Refer to **ABYC** Standard E-11, Table XI to determine the appropriate wire gauge for the necessary conductor length.

It is critical to design and wire the Control System in a manner which provides the cleanest power sources available. This can be accomplished by using an APS (Automatic Power Selector) which connect two separate power sources (batteries) to the Processor as shown on the system drawing in Section 9 - System Drawings on page #119. For additional information on the APS itself, refer to section 15 - Automatic Power Selector (APS) Part #13505 on page #151 in Appendix A.



The two APS power sources are protected by two 30 Ampere fast acting fuses. The power from the APS to the Processor is protected by two 10 Ampere trip-free thermal circuit breakers with manual On/Off actuation. In addition to the protection provided, the circuit breakers can be used to turn power On and Off to the Processor.

For installations where the processor's location exceeds 30 feet from the power source; Power Relays can be installed between the Power Source and the Processor. The Power Relays must be properly selected to avoid excessive voltage drop across the contacts. Relays with silver or gold contacts should be used.

3.5.1. DC Power Cable

3.5.1.1. Installation Without Power Relays

- a. Refer to Figure 55 - Drawing 11488F-3 Twin Screw Single APS Connection and Alternate Remote Switch on page #156.
- b. Within the Power Harness, run the cables labeled POWER to the port and starboard 10 Ampere Circuit Breakers.
- c. Terminate the red conductor at the Circuit Breaker and the black conductor to a DC Common (-).
- d. Run a conductor from each circuit breaker to the output of the APS.
- e. From the APS, run one conductor to the port power source and another to the starboard power source.
- f. Insert 30 Ampere in-line fuses in both the port and starboard (red) conductors.

3.5.1.2. Installation with Power Relays – Refer to Dwg #11488F

- a. Within the Power Harness, run the cables labeled POWER to the port and starboard Power Relays' *Normally Open (N.O.)* contact and terminate the red conductor. Terminate the Black conductor to a DC Common (-).
- b. From the opposite side of the *N.O.* contact, run a conductor to each of the 10 Ampere Circuit Breakers and terminate.
- c. Run conductors from the opposite side of the port and starboard Circuit Breakers to the output of the APS.
- d. From the APS, run one conductor to the port power source and another to the starboard power source.
- e. Insert 30 Ampere in-line fuses in both of the conductors.


3.6. Wire Harness Installation


3.6.1. General Information



For a twin screw MiniCommand Processor the following wire harness types are required. See Table 30 - MiniCommand Part Numbers on page #149:

- One Power/Start Interlock wire harness.
- Two Clutch wire harnesses.
- Two Throttle wire harnesses.
- One or two Control Head wire harnesses.

| | |
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|  | <p>Important: Typically each end of a wire harness has a different connector type. Before routing the wire harness through the vessel, ensure the correct connector is located at the appropriate start point such as the Processor.</p> |
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| | |
|---|---|
|  | <p>Warning: After installation every connector must have either a wire harness or plug connected to it in order to prevent damage or Processor failure. Do not leave any of the connector pins exposed to the environment.</p> |
|---|---|

When connecting (or disconnecting) wire harnesses to the Processor, ensure that the release button(s) on the plug connector are depressed and held until the plug is fully connected or disconnected.

Figure 12: Harness Plug Connectors (from left, picture 1 & 2)

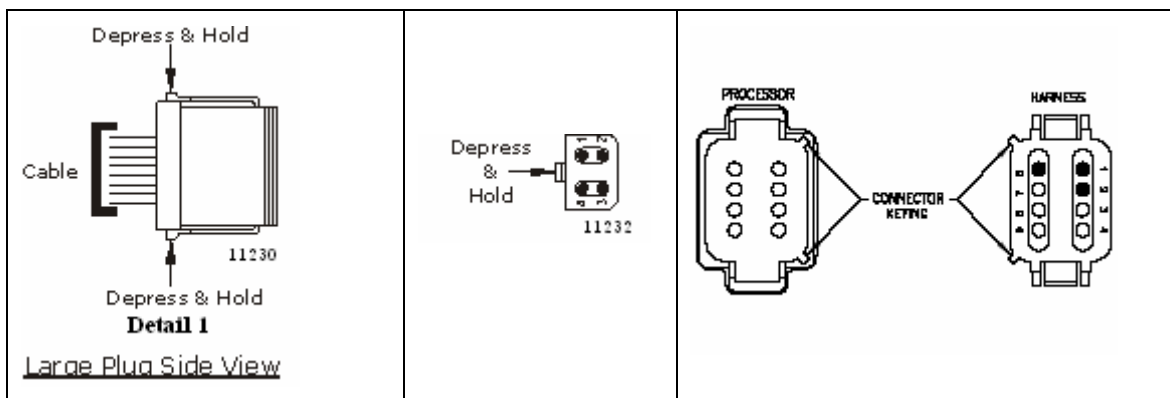



Figure 13: Processor Connector and Harness Plug Keying (from left, picture 3)

The plug connector on a wire harness is keyed and must be oriented correctly before connecting to the Processor.

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|  | <p>Caution: Connecting or disconnecting plugs without <i>depressing and holding</i> the release button(s) will damage the plug.</p> |
|---|--|

3.6.2. Wire Harness Plug Insertion and Extraction



Four different styles of plugs and connectors are used on the MiniCommand Processor but are inserted in an identical fashion as follows:

- Prior to inserting the wire harness plugs, pay close attention to the color, number of pins and the keying of the plug. The plug is designed to be inserted one way only into the connector, but can be incorrectly forced together in the opposite orientation.
- When connecting the plugs, ensure that the locking mechanisms are depressed and held until the plug is fully connected or disconnected. If this rule is not followed, damage to the plug could result.



Important: The distance of the Control Head from the Processor is limited to the length of an *uninterrupted* wire harness. This cable should NEVER be spliced.

3.6.3. Control Head Wire Harness

3.6.3.1. General Information

- The Control Head Wire Harnesses are available in various lengths from 10' to 50' (3,0 – 15,2m).
- The Wire Harness from **Control Head 1** on the Processor is routed to the Port and Starboard connections on *Control Head 1* (50' max).
- The Wire Harness from **Control Head 2** on the Processor is routed to the Port and Starboard connections on *Control Head 2* (50' max).

3.6.3.2. Installation

- a. At the Processor, insert the plug into the **Control Head 1** connector.
- b. Run the cable to the Control Head located at Station 1. Insert the wire harness plugs into the Control Head's appropriate Port and Starboard pigtails.
- c. Ensure that the wire harness has a Strain Relief close to the Control Head to relieve the strain on the connections.
- d. Repeat steps (a) through (c) on the opposite side (port or starboard).
- e. Repeat steps (a) through (d) for Station 2.

3.6.4. Power, Start Interlock Wire Harness for Twin Screw Processor

This Wire Harness has one plug, which is inserted in the Processor's *POWER* connector. The opposite end of the cables, have no connector and need to be terminated by the installer.



Caution: The most common source of trouble is loose wiring connections.

- Verify wiring connectors are properly crimped and cannot



| | |
|--|---|
| | <p>be pulled out.</p> <ul style="list-style-type: none"> ➤ Crimps and connections must be made to conductor wire, NOT to the wire insulation. ➤ Verify all wire connections are secure. |
|--|---|

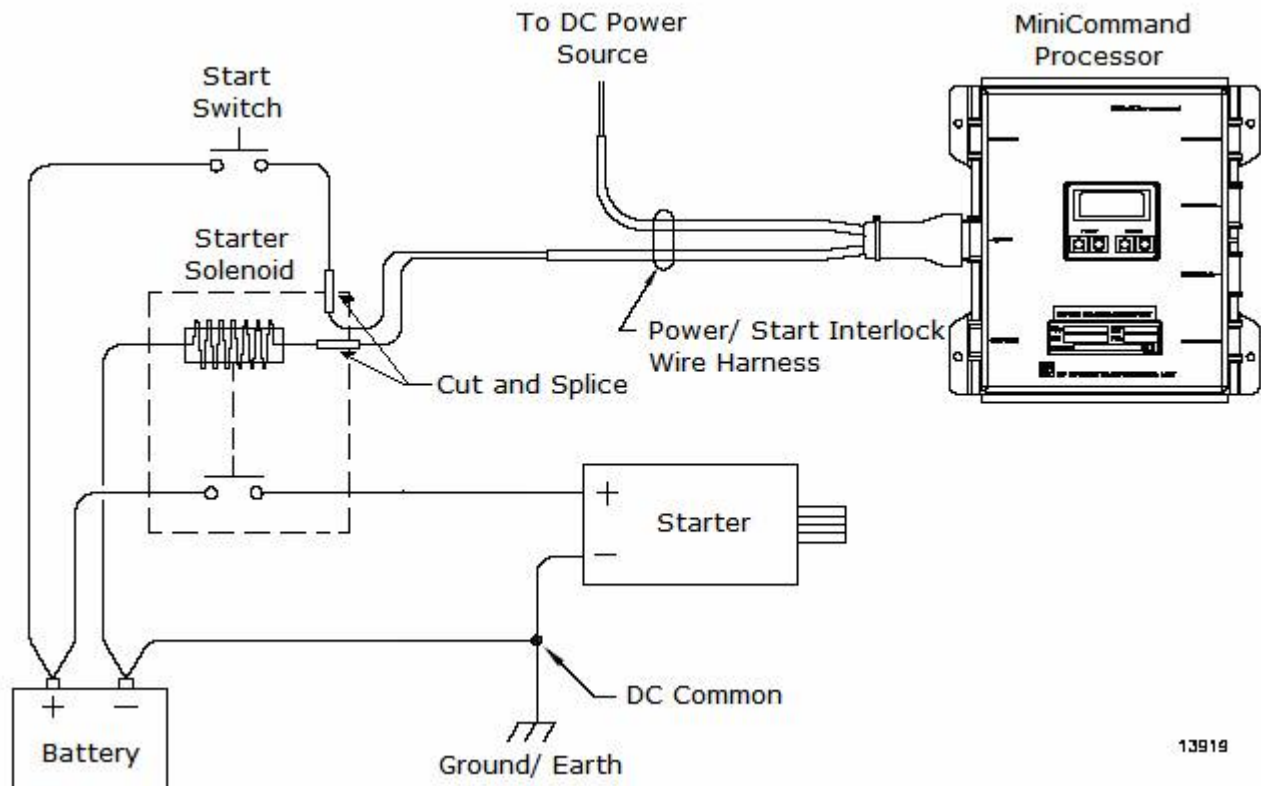
- The Power/Start Interlock Wire Harness has four cables: (2) DC Power and (2) Start Interlock (one each for Port and Starboard).
- All of the cables in the Wire Harness are the same length. Therefore, order a length that will reach all of the previously mentioned items
- The Wire Harness is available in lengths up to 30' (9,14m). ZF Marine Electronics' part numbers are P/N MI4402-10, P/N MI4402-20, and P/N MI4402-30 respectively.

3.6.4.1. Start Interlock Cable

| | |
|--|--|
| | <p>Warning: Not using the Start Interlock circuit could result in starting the engine with the transmission's clutch engaged, causing the vessel to surge ahead or astern unexpectedly. This could result in personal injury or death or damage to the vessel and surroundings.</p> |
|--|--|

| | |
|--|---|
| | <p>Note: The MiniCommand system's Start Interlock relay has a normally open contact. This contact only closes, allowing the engine to start, when a Control Station is in command and the Processor is commanding neutral.</p> |
|--|---|

| | |
|--|--|
| | <p>Caution: The Processor is designed for a maximum of 7 amperes, maximum 30 VDC start signal current. Greater current will damage the interlock circuit.</p> |
|--|--|



13919

Figure 14: Typical Start Interlock Connections

- Run the cable labeled *START INTERLOCK* to the Engine's Starter Solenoid (or other appropriate engine start circuit).
- Disconnect the Starter Switch wire from the Solenoid.
- Strip back the appropriate amount of PVC jacketing and conductor insulation.
- Connect one of the conductors to the Solenoid's Starter Switch terminal.
- Connect the second wire to the Starter Switch wire.

3.6.5. Clutch Wire Harness

3.6.5.1. General Information

The *Clutch* wire harness plugs into the Processor.

- Two wire harnesses are required: one each for the *Port Clutch* and *Stbd Clutch* connections on the Processor.
- Each Wire Harness has two, two-conductor cables for termination at the Ahead and Astern Clutch Solenoids.
- For processors equipped with optional troll, an additional (1) or (2) cables are included in the wire harness (*Troll On/Off* and/or *Troll Command*).



3.6.5.2. Installation

- a. Insert the *Port Clutch Wire Harness* into the *Port Clutch* connector on the Processor. (Example: Port to Port, etc.).
- b. Insert the *Starboard Clutch Wire Harness* into the *Starboard Clutch* connector on the Processor. (Example: Starboard to Starboard, etc.).
- c. Each wire harness has 2, 3 or 4 solenoid outputs and therefore 2, 3 or 4 two-conductor cables labeled Ahead, Astern, Troll On/Off, and/or Troll Command. Connect each two-conductor cable to the appropriate solenoid on the transmission

3.6.6. Throttle Wire Harness

3.6.6.1. General Information

- Two Wire Harnesses are required for the Processor: one each for the *Port Throttle* and *Starboard Throttle* connectors.
- There are 5 types of Throttle Wire Harnesses available: Voltage, Current, PWM (Pulse Width Modulation), Frequency, and CAN
- Most Throttle Wire Harnesses are plugged at the Processor end only. The other end is wired appropriately to the Engine ECM/ECU/etc. by the installer.
- Some Throttle wire harness types are available with plugs on both ends.

3.6.6.2. Installation



Important: Ensure all Processors are using the same kind of wire harness and that it matches the Engine Selection to be applied in Section 4 - Setup Procedure starting on page #47.

The Processor connects directly to the engine interface using a Throttle Wire Harness.

- a. Connect the plug end of the port Wire Harness into the *Port Throttle* connector at the Processor.
- b. Run the cable to the appropriate engine interface. (Example: Port to Port, etc.).
- c. Refer to the engine documentation for termination points at the engine interface.
- d. Repeat steps (a) thru (c) for the *Starboard Throttle* connection on the Processor.



3.7. Engine Stop Switches

An engine stop switch must be located at all Remote Stations and capable of stopping the engine at any RPM. This is a requirement for safety considerations in the event of a control system (or other) failure.

The Installer supplies the Stop Switches. Refer to the installation instructions supplied with the switch and the engine installation instructions for manufacturers' recommendations.

For VM Motori versions of the MiniCommand Processor, there is an option for connecting a Normal Engine Shutdown switch to the MiniCommand Processor. The actuation of this switch is communicated to the VM Motori engine using the CAN bus connection between the engine and Processor. This switch does NOT take the place of an emergency engine stop switch. There MUST be a means to shutdown the engine in the event the MiniCommand Processor fails.



Warning: An Engine Stop Switch at each remote Station is an absolute requirement for safety considerations. Refer to CFR 46, SEC. 62.35-5 and ABYC P-24.5.8.



4. Setup Procedure

The processor utilizes push-buttons in conjunction with LED displays to adjust and setup the various features. The push-buttons also allow you to access and display information to assist in troubleshooting the System.

The following paragraphs explain how to locate and use the push-buttons and LED display:

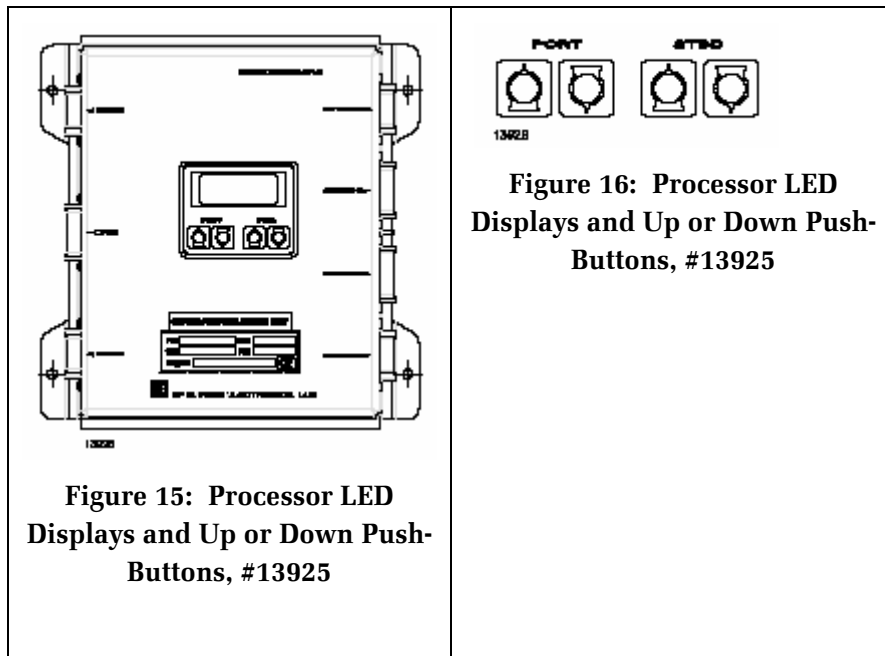
4.1. Processor Components Used in Setup

Each Processor has four LED Displays and four Up and Down Push-Buttons (two each for Port and Starboard) located on the front cover.

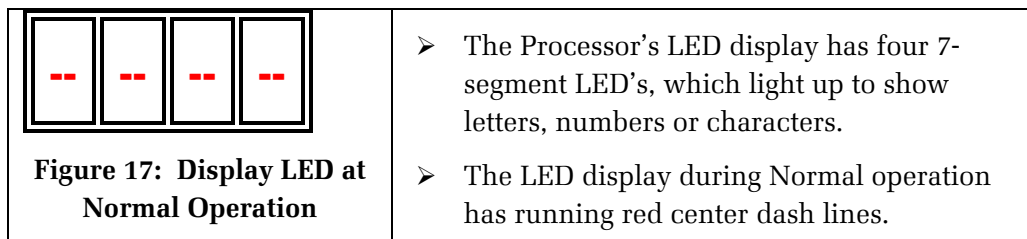
It is only possible to navigate between functions, using the Up and Down Push Buttons, when the function code is being displayed.

When viewing the value or extended value of a function code in “Display Mode”, the Up and Down buttons pushed by themselves will have no effect.

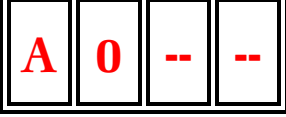
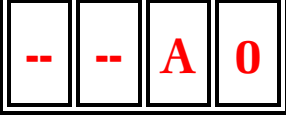
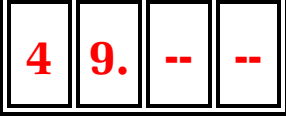
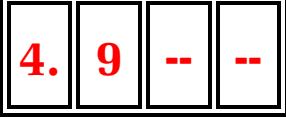
When changing from Edit Mode to Display Mode, the function code will be displayed first.



4.1.1. Processor LED Display





| | |
|--|---|
|  <p>Figure 18: Function Code for Port Side Engine</p> | <ul style="list-style-type: none"> ➤ The first two-digit LED displayed to the left are dedicated to the <i>Port</i> side engine. |
|  <p>Figure 19: Function Code for Starboard Side Engine</p> | <ul style="list-style-type: none"> ➤ The second two-digit LED displayed to the right are dedicated to the <i>Starboard</i> side engine. |
|  <p>Figure 20: H0 Value for Station #2</p> | <ul style="list-style-type: none"> ➤ For the H0 – Diagnostic values, when the decimal point is located to the right of the alphanumeric character on either LED display (port or starboard) indicates you are looking at station 2 values. |
|  <p>Figure 21: H0 Value for Station #1</p> | <ul style="list-style-type: none"> ➤ For the H0 – Diagnostic values, when the decimal point is located between the alphanumeric characters on either LED display; (port or starboard); this indicates you are diagnosing station 1. |

4.1.2. Push-Buttons

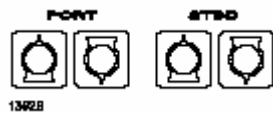


Figure 22: Up or Down Push-Buttons

There are four up or down push-buttons with arrows located below the LED display on the Processor cover, two for Port and two for Starboard. These buttons are used to scroll through, select, and store the Functions and Values. The direction of the push-buttons indicates "Up", and "Down".



4.1.2.1. Up and Down Push-Buttons

To display, edit, and save changes to the function code values and their extended values on the MiniCommand Processor (MCP), requires that you employ a combination of the following:

- Pressing and Holding the Up/Down arrow buttons for (2) seconds.
- Pressing and releasing the Up/Down arrow buttons.
- Pressing the Up or Down arrow buttons.

A typical example of how to deploy these actions would be as described below:

1. From Normal Operation mode (running red center dashes), click the Up or Down button arrow to display the function codes in Display mode.
2. Press the Up or Down arrow button until you come to the function code you want to change.
3. Simultaneously press and hold both the Up/Down arrow buttons for (2) seconds. You are now in Edit Mode and the Display is blinking.
4. Simultaneously press and release both the Up/Down arrow buttons to navigate from the function code to the value. Using the Up or Down arrow, select the applicable value.
5. If there is an extended value, press and release the Up/Down arrow buttons to navigate from the value to the extended value. Using the Up or Down arrow button, select the applicable extended value, if any.
6. To save the changes, simultaneously press and hold the Up/Down arrow buttons for (2) seconds. This returns you to the Function menu in Display mode.
7. If no action is taken by the user for 20 seconds, the system times out and no changes are saved.
8. If no action is taken by the user for 5 minutes, The MCP times out and goes from the Function mode to the Operations mode (running red center dashes).



Note: Refer to the *Error Numbers* in Table 29, on page #108 for the steps to be taken when encountering error messages.



4.1.2.2. Error Menu

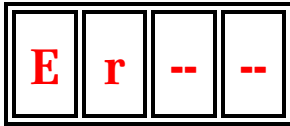


Figure 23: Error Function Code

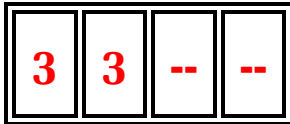


Figure 24: Error Value 33

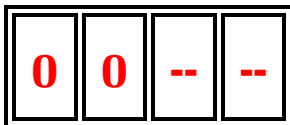


Figure 25: No Error Values - 00 Displays

1. When an error occurs, an (Er) appears on the Port or Starboard side of the Processor display.
2. If any errors have occurred, pressing the Up/Down buttons *simultaneously* has the following effect:
 - If an error value exists, the error value is displayed (Active errors blink, inactive do not).
 - If there are no error values, then **00** appears as the error value.

4.2. Activating Setup Mode

- a. The LED Display is in Normal operating mode with the running red center dashes.
- b. Depressing either the Up or Down push-button will *activate* the *Function Menu*.
- c. To *scroll* through the *Function Menu's Function Codes* one at a time, depress the Up or Down push-buttons.
- d. Once the desired Function Code is visible on the LED Display, press and *hold* the *Up* and *Down* push-buttons *simultaneously* for (2) seconds, until the Function Code begins to blink. This will activate Setup mode for the function code being displayed.

4.3. Storing Values to Memory

Once the desired Value has been reached in Setup Mode, the Value is stored to memory as follows:

- a. Depress and *hold* the *Up* and *Down* push-buttons simultaneously for (2) seconds until the Function Code stops blinking. The new Value is now programmed into memory. Setup Mode is exited.
- b. Depress the Up or Down Push-Button until the next required Function Code is reached.



- c. Once the desired Function Code is visible on the LED Display, press and *hold* the *Up* and *Down* push-buttons *simultaneously* for (2) seconds, until the Function Code begins to blink. This will activate Setup mode for the function code being displayed.



Exit Out of Function Code Menu to Normal Operating Mode

If no buttons are pressed for five (5) minutes, the *Selected Mode of Operation* is automatically exited, and the System returns to *Normal Operating Mode*.

Exit Out of Specific Function Code (Function Code Blinking/Now, Not Blinking)

If no push-buttons are pressed for (20) seconds while in *Setup Mode*, you will be exited *without* the changes stored to memory.



4.4. Function Codes and Values

The following tables list the *Function Codes*' Name, Default Value and Range or available Options. Each of the *Function Codes* is explained in further detail in the following sections.


| | |
|---|---|
|  | <p>Twin Screw Applications</p> <p>The (A1) function must be set FIRST, and the (A0) function must be set SECOND. The rest of the function values may be entered and stored in any order.</p> <p>Once these function codes are set, either cycle power to the processors or wait five (5) minutes, before continuing setup.</p> |
|---|---|

Table 3: Processor Function Codes

| Function Code | Function Name | Default Value | Value Range or Options |
|---------------|---------------------------------------|---------------|---|
| A1 | Number of Engines – Set First | 02 | 01, 02 |
| A0 | Processor Identification – Set Second | 00 | 01, 02 |
| A2 * | One Lever Operation | 01 | 00 – Disabled 01 – Enabled |
| A4 | Neutral Indication Tone | 00 | 00 – No Tone 01 – Tone sound when Control Head lever is moved to Neutral. 02 – Tone sound when Processor is commanding Neutral. |

Table 4: Electric Throttle Function Codes

| Function Code | Function Name | Default Value | Value Range or Options |
|---------------|-------------------------|-------------------------|---|
| E0 * | Engine Throttle Profile | 06 12 (if VM Motori) | 01 Caterpillar (PWM) (8 to 92%) |
| | | | 02 Cummins Centry (Voltage) (0.9 to 4.5 VDC) |
| | | | 03 Cummins Quantum (Voltage) (0.9 to 1.2- 4.0 VDC) |
| | | | 04 Detroit Diesel (Voltage) (0.64 to 4.65 VDC) |
| | | | 05 MTU or MAN (Current) (4.0 to 20.0 mA) |
| | | | 06 Scania (Voltage) (0.42 to 2.95 VDC) |
| | | | 07 John Deere (Voltage) (0.5 to 4.5 VDC) |
| | | | 08 Volvo (Voltage) (0.6 to 3.6 VDC) |
| | | | 09 Detroit Diesel 1800 (Frequency) (120.64 to 360.9 Hz) |




| Function Code | Function Name | Default Value | Value Range or Options | |
|---|--------------------------------|---------------|--|--|
| | | | 10 | Detroit Diesel 2399 (Frequency) (120.64 to 463.5 Hz) |
| | | | 11 | DO NOT USE. |
| | | | 12 | CAN Throttle Interface for VM Motori Engines |
| **DEFAULT BASED ON THROTTLE PROFILE SELECTED | | | | |
| E1 | Throttle in Neutral | 00.0 | 00.0% to 25.0% of Throttle Range (Throttle Range = Throttle Max (E3) - Throttle Min (E2)) | |
| E2 | Throttle Minimum | 8.2 | 1.0% to 97.0% Must be 3% or more below throttle maximum (E3) | |
| E3 | Throttle Maximum | 59.2 | 04.0% to 100.0% of Maximum Throttle Allowable. Must be 3% or more above Throttle Minimum (E2) | |
| E4 | Throttle Maximum Astern | 100.0 | 01.0 to 100.0% of Throttle | |
| E5 * | Throttle Pause Following Shift | 00.5 | 00.0 to 05.0 Seconds | |
| E6 | High Idle | 00.0 | 00.0 to 20.0% of Throttle Range (E2 - E3)  Note: Not available for CAN engines. | |
| E7 * | Synchronization | 01 | 00 | Disabled |
| | | | 01 | Enabled |

Table 5: Clutch Function Codes


| Function Code | Function Name | Default Value | Value Range or Options | |
|---------------|---|---------------|---|---|
| C2 * | Proportional (Reversal) Pause | 00 | 00 | In Gear |
| | | | 01 | Neutral |
| | | | 02 | Fixed Neutral Delay only (no proportional pause). |
| C3 * | Proportional (Reversal) Pause Time | 03 | 00 to 99 Seconds | |
| C4 * | Proportional (Reversal) Pause Ratio | 00 | 00 | 2:1 Ahead to Astern vs. Astern to Ahead |
| | | | 01 | 1:1 Ahead to Astern vs. Astern to Ahead |
| C8 | Fixed Neutral Delay with Proportional Pause | 0.0 | 0.0 to 4.0 seconds  Note: If C2 = 02, then C8 will not appear on the menu. | |



Table 6: Trolling Function Codes

| Function Code | Function Name | Default Value | Value Range or Options |
|---------------|---|---------------|--|
| L0 * | Troll Enable and Control Head Troll Lever Range | 00 | 00 No Troll |
| | | | 01 20 Degrees - Type 1 |
| | | | 02 35 Degrees - Type 2 |
| | | | 03 45 Degrees - Type 3 (Throttle limited to 75% of throttle range. |
| L1 * | Troll Valve Function | 00 | 00 Normal (No current when at lock-up) |
| | | | 01 Inverse (No current when at lockup) |
| | | | 02 Normal (Maximum Current when at lock-up) Preset for ZF220-550, 12 VDC systems. |
| | | | 03 Normal (No current when at lock-up) Preset for ZF220-550, 24VDC systems. |
| | | | 04 Normal (No current when at lock-up) Preset for ZF2000, 24 VDC systems. |
| | | | 05 Inverse (No current when at lock-up) Preset for ZF600, 1900 and 2500, 24 VDC systems. |
| L2 | Troll Minimum Pressure | 10.0 | 01.0 to 99.0%. Must be at least 1% more or less Troll Maximum (L3) (Depending on whether Normal or Inverse is selected) |
| L3 | Troll Maximum Pressure | 25.0 | 02.0% to 100.0%. Must be at least 1% more or less than Troll Minimum. (L2) (Depending on whether Normal or Inverse is selected). |
| L4 | Troll Throttle Limit | 00 | 00 to 20% of Troll Maximum (L3) |
| L5 | Troll Pulse Duration | 0.6 | 00.0 to 09.9 Seconds. |
| L6 | Troll Pulse Percentage | 25.0 | 00.0 to 100.0% |

Table 7: Troubleshooting Function Codes

| Function Code | Function Name | Default Value | Value Range or Options |
|---------------|---------------|---------------|--|
| H0 | Diagnostics | | Lever A/D, Stations 1, 2 |
| | | | Control/Mode (Transfer) button, Stations 1, 2 |
| | | | Software Revision Level <ul style="list-style-type: none"> ➤ SW70886-1.0 would appear 10 ➤ SW70886-2.0 would appear 20 ➤ SW70886-3.0 would appear 30 ➤ SW70886-4.0 would appear 40 |
| H1 | Erase EPROM | None | Return to Factory Defaults (For Authorized Personnel Only) |



| Function Code | Function Name | Default Value | Value Range or Options |
|---------------|---------------|-------------------|--|
| Er | Error Codes | 00 (No errors) | See Table 29: Error Numbers on page #108 |

* The selected value must be the same for both the port and starboard sides for this function code.



4.5. Field Service Test Unit (Break-Out Box) and Multimeter Use

Refer to the Service Field Test Unit on page #171 for the MM13927 Manual for more information on the use of the Field Service Test Unit. (Break-out Box).

To aid in adjusting the following list of Processor signals, ZF Marine Electronics recommends the use of a ZF Marine Electronics Field Service Test Unit (P/N 13927) (Break-out Box) and a calibrated Multimeter. For CAN throttle interface the Break-out Box and multimeter can not be used to test the CAN throttle output.

Note that the Field Service Test Unit cannot connect directly to the clutch connectors on the MiniCommand Processor. An adapter is required.

Table 8: Electric Throttle Functions Requiring Field Service Test Unit and Multimeter

| Code | Function Name | Code | Function Name |
|------|------------------|------|-------------------------|
| E1 | Throttle Neutral | E4 | Throttle Maximum Astern |
| E2 | Throttle Minimum | E6 | High Idle |
| E3 | Throttle Maximum | | |

4.6. System Adjustments



Note: For Twin Screw Applications, the (A1) function must be set FIRST, and the (A0) function must be set SECOND. The rest of the function values may be entered and stored in any order.



Note: Power must be turned ON to the processors when making any adjustments to the system.

4.6.1. Processor Functions

4.6.1.1. Function Code A1 – Number of Engines

The total number of engines (02-Twin Screw) must be entered into the memory of the Processors. The available values for this function are:

- 01 – One Engine
- 02 – Two (twin) Engines



Note: Twin screw applications require the Function Code (A1) value to be changed prior to changing the value of Function Code (A0).



To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

- a. Scroll to Function Code **A1**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory.
- e. Repeat for both sides of the processor.

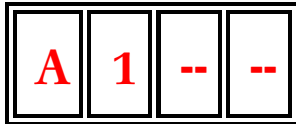


Figure 26: LED Display Function A1

4.6.1.2. Function Code A0 – Processor Identification



Note: In twin screw, the value of Function Code (A0) can be changed only AFTER the value in Function Code (A1) is changed to (02) on the processor.

In applications where there are two screws, the system must know which Processor is where. Each side of the processor must have its own unique identifying number. At NO time can both sides be identified by the same Processor Identification Number.

The available Values for this Function are:

- 00 (Default Value)
- 01
- 02



Note: The typical recommended values are (01) Port and (02) Starboard.

To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

- a. Scroll to Function Code A0.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired value.
- d. Store the value to memory.
- e. Repeat for both sides of the processor.

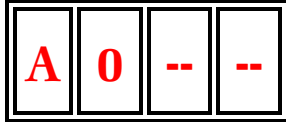


Figure 27: LED Display Function A0

4.6.1.3. Function Code A2 – One Lever Operation

In Twin Screw applications, the system has the ability to command both engines and transmissions to the same speed and direction with a single Control Head lever. This function allows this Feature to be enabled or disabled. (Refer to the Operation section on page #17).

The available Values for this function are:

- **00** Disabled
- **01** Enabled (Default Value)

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Scroll to Function Code A2.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory.

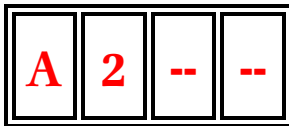


Figure 28: LED Display Function A2

4.6.1.4. Function Code A4 – Neutral Indication Tone

This function allows the installer to turn ON a ½ second, low frequency tone to indicate Neutral.

The available values for this function are:

- **00** Disabled (Default Value)
- **01** Tone sounds when the Control Head's lever reaches Neutral.
- **02** Tone sounds when the processor commands the transmission to Neutral.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Scroll to Function Code **A4**.
- b. Activate Setup Mode.



- c. Scroll Up or Down to the desired value.
- d. Store the value to memory.

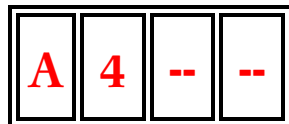


Figure 29: LED Display Function A4

4.6.2. Throttle Functions

The following throttle functions are set up in Section 5 - Dock Trials on page #65.

Table 9: Throttle Functions Performed During Dock Trials

| Code | Function Name | Code | Function Name |
|------|---------------------|------|--------------------------------|
| E1 | Throttle in Neutral | E4 | Throttle Maximum Astern |
| E2 | Throttle Minimum | E5 | Throttle Pause Following Shift |
| E3 | Throttle Maximum | E6 | High Idle |

4.6.2.1. Function Code E0 – Electric Engine Throttle Profile

This function, in combination with the Throttle Wire Harness type, configures the throttle output profile to meet the specifications of the engines and their values listed below.

- **01** - Caterpillar (PWM) (8 to 92%)
- **02** - Cummins Centry (Voltage) (0.9 to 4.5 VDC)
- **03** - Cummins Quantum (Voltage) (0.9 to 1.2 - 4.0 VDC)
- **04** - Detroit Diesel (Voltage) (0.64 to 4.65 VDC)
- **05** - MTU or MAN (Current) (4.0 to 20.0 mA)
- **06** - Scania (Voltage) (0.42 to 2.95 VDC)
- **07** - John Deere (Voltage) (0.5 to 4.5 VDC)
- **08** - Volvo (Voltage) (0.6 to 3.6 VDC)
- **09** - Detroit Diesel (Frequency) (120.64 to 360.9 Hz)
- **10** - Detroit Diesel (Frequency) (120.64 to 463.5 Hz)
- **11** - DO NOT USE.
- **12** - VM Motori engine CAN interface

The Default Value is set to **06**, Scania Profile for analog throttle versions of MiniCommand, and 11 - Do Not Use.

The default value is set to **12**, VM Motori Profile for CAN version of MiniCommand.



To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Scroll to Function Code **E0**.
- b. Activate Setup Mode.
- c. Scroll Up or Down until the desired value is displayed.
- d. Store the Value to memory.

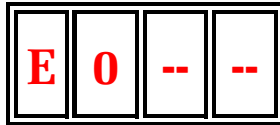


Figure 30: LED Display Function E0

4.6.2.2. Function Code E7 – Synchronization

This Function Code selects the type of Synchronization. The types are described in the Operation section on page #17.

The available values for this function are:

- **00** Disabled
- **01** Enabled (default)

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Scroll to Function Code E7.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory.

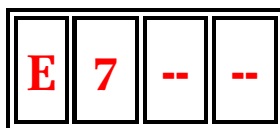


Figure 31: LED Display Function E7

4.6.3. Clutch Functions

The following Clutch Functions are set up prior to DOCK TRIALS and SEA TRIALS:

Table 10: Basic Clutch Functions Performed During Sea Trials

| Code | Function Name | Code | Function Name |
|------|-------------------------------|------|------------------------------------|
| C2 | Proportional (Reversal) Pause | C3 | Proportional (Reversal) Pause Time |



4.6.3.1. Function Code C4 – Proportional Pause Ratio

This function code selects whether the Proportional Pause time is the same in Ahead and Astern or whether the time in Ahead is twice that of Astern.

Standard vessels with a bow and a stern typically select a pause which is twice as much in Ahead compared to Astern. This is because much more speed is obtainable in Ahead, than in Astern. Consequently, more time is required to slow down from Ahead as compared to Astern.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.



Note: When the controls are installed on a vessel such as a double ended Ferry or the controls are being used to control a Thruster, the proportional pause should be the same in Ahead as Astern or Port and Starboard in the case of a Thruster.

The available Values for this Function are:

- **00** 2:1 Ahead to Astern vs. Astern to Ahead (Default Value)
- **01** 1:1 Ahead to Astern vs. Astern to Ahead

00 - 2:1 Ratio

- This is the default setting. This function determines how the value set during Sea Trials for **C3** - Proportional Pause Time, is applied.
- The number of seconds selected is for an Ahead to Astern maneuver only. An Astern to Ahead maneuver will be one-half ($\frac{1}{2}$) of the **C3** -Proportional Pause Time selected. This is the typical selection since most vessels do not reach the same speed in Astern as they would in Ahead.

Therefore, the time required to get to a sufficient water speed for a safe reversal is significantly less.

01- 1:1 Ratio

- When this setting is selected, the value set during Sea Trials for **C3** - Proportional Pause Time is the same for both Ahead to Astern, as with Astern to Ahead maneuvers.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Scroll to Function Code **C4**.
- b. Activate Setup Mode.



- c. Scroll Up or Down to the desired value.
- d. Store the Value to memory.

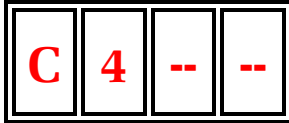


Figure 32: LED Display Function C4

4.6.4. Function Code L0 – Troll Enable and Control Head Lever Troll Range

There are three types which can be used to control any trolling valve. The available values are:

- **00** = No Trolling Valve (Normal Operating Mode) (Default)
- **01** = **Type 1** 20 degrees Troll Range
- **02** = **Type 2** 35 degrees Troll Range
- **03** = **Type 3** 45 degrees Troll Range



Note: When Troll Type 3 is selected, maximum throttle is limited to 75%.

To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

- a. Scroll to Function Code **L0**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory

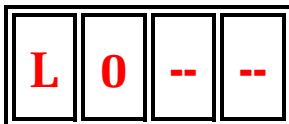


Figure 33: LED Display Function L0

4.6.5. Function Code L1 - Solenoid Troll Valve

Refer to - [Solenoid Trolling Valve Function L1 Type Selection](#) on page #63 to select the correct setup for the trolling valve used with this application.

The manner in which the current signal to the Proportional Valve behaves is determined with this function.

To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

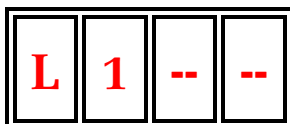
**Table 11: Solenoid Trolling Valve Function L1 Type Selection**

| Value | | Troll Valve | Description |
|-------|---------|--|--|
| 00 | Normal | Reintjes ZF 550 and lower | (Default) When selected, the current to the Proportional Valve increases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to 0. |
| 01 | Inverse | Twin Disc 6000 Series ZF 600 and higher | When selected, the current to the Proportional Valve increases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to 0. |
| 02 | Normal | ZF 220 – 550 12 VDC | When selected, the current to the Proportional Valve increases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to -0. Preset for ZF 220 -550 12 VDC Systems. |
| 03 | Normal | ZF 220 – 550 24 VDC | When selected, the current to the Proportional Valve increases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to -0. Preset for ZF 220 -550 24 VDC Systems. |
| 04 | Normal | ZF 2000 24 VDC | When selected, the current to the Proportional Valve decreases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to -0. Preset for ZF 2000 24 VDC Series Systems. |
| 05 | Inverse | ZF 600, 1900, 2500 24 VDC | When selected, the current to the Proportional Valve decreases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to -0. Preset for ZF 600, 1900, or 2500 24 VDC Series Systems. |

To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

The default value is **00**.

- a. Scroll to Function Code **L1**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the appropriate Value for the Trolling Valve.
- d. Store the Value to memory

**Figure 34: LED Display Function L1**

4.6.6. Troubleshooting Functions



4.6.6.1. Function Code H0 – Diagnostics

This Function is used during troubleshooting and is explained in detail in Section 8.3 –on page #105.

4.6.6.2. Function Code H1 – Return to Factory Defaults

This Function may be used during troubleshooting. Do not make any adjustments to this Function Code, unless directed to do so by a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, please see page 159.



5. Dock Trials



Warning: It is imperative that the information provided in the previous sections be *read* and *followed* precisely, *prior* to attempting a Dock Trial. If any of the following tests fail, consult section 8 – Troubleshooting on page #97, or consult a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, please see page 159.



Note: During the course of the Dock Trials and Sea Trials, fill out the Sea Trial Report on page #86.

5.1. Control Heads (Engines Stopped)



Warning: Do NOT START the Engines at this Time. Injuries Could Occur.

- a. Turn power ON to the Control system.
- b. Verify there is an intermittent tone (slow beeping) at each Control Head. You should hear a tone emitted from each side (port and starboard), even though the tones are being emitted simultaneously.
- c. Perform each of the following steps on all remote stations.
 1. Take command at a remote station by depressing the *Control/Mode (Transfer)* button, with the levers at the Neutral/ Idle detent. Both red LEDs (one for port and one for starboard) should illuminate. Also, the intermittent tone should stop at all Control Heads.
 2. Move the Control Head levers full Ahead and full Astern. Ensure that there are no obstructions to the movement, and that no tones are generated.
 3. Place the Control Head levers in the Neutral position.
 4. Depress and hold the Station's *Control/Mode (Transfer)* button while moving the Control Head levers to the Ahead detent. Release the button.
 - Both LEDs should blink slowly, indicating you have entered Warm-up Mode. Warm-up mode *only* operates in the Ahead direction.

If both red LEDs **blink**, continue with the testing. If either red LED **does not blink**, move the associated lever to the neutral position. Depress and hold the station *Control/Mode (Transfer)* button while moving the control head lever to the astern direction. If the LED now blinks slowly, the control head may be wired incorrectly.



Check with your local ZF Sales & Service Organization (SSO). For more information on an SSO in your area, please see page 159.

5.2. Start Interlock (Engines Stopped)

- a. Turn the Processor DC power OFF. Verify that the engines will not start.
- b. Turn Processor DC power On. Do *not* take command at a Remote Station. Verify that the engines will not start.
- c. Take command at a remote station. Place the Control Head levers to the Ahead detent. Verify that the engines will not start.
- d. Place the Control Head levers in the Neutral/Idle position. Take command at a Remote Station. Verify that the engines will start.

If any of the tests above fail, verify that the Start Interlock Cable connections are correctly connected. See section 3.6.4.1 on page #42.

| | |
|--|--|
| | Important: The following throttle signal tests must be performed on both the Port and Starboard throttle outputs. |
|--|--|

5.3. E1 – Throttle in Neutral (Cummins – Quantum Engines Only) (Engines Running)

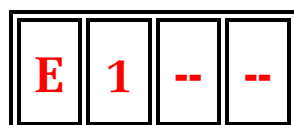
To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

| | |
|--|---|
| | Note: This function is used ONLY when the E0 Select Engine Throttle Profile is set for 03 – Cummins Quantum. |
|--|---|

The **Cummins-Quantum Engine** requires different throttle command signals in neutral than it does when in gear. These engines require a voltage throttle signal of 0.9 VDC when unloaded at Neutral. The throttle command signal increases to 1.2 VDC when the engine is placed under load by engaging the clutch.

The **E1 - Throttle in Neutral** function allows the installer the ability to adjust the throttle signal level at Neutral/Idle and also adjust a second throttle signal level when the clutch is engaged. The Neutral value may be adjusted anywhere from 1 to 20% of the maximum throttle output capability of the voltage circuit. For example:

If the circuit has the ability to drive 0 to 5.00 VDC and the value entered is 10, the output at Neutral would be 0.50 VDC (10% of 5.00 = 0.50 VDC).



- b. Connect the 8-Pin connector of the Service Field Test Unit to the processor throttle connector and



Figure 35: LED Display for Function E1

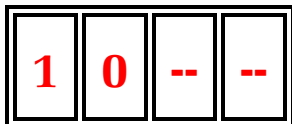


Figure 36: LED Display for Value 10 of Function E1

- a. Disconnect the throttle Wire Harness from the Processor.

Refer to the [Service Field Test Unit](#) manual on page #171.




- c. Turn power ON to the engine's ECM. Ensure Power is ON to the Processor.
- d. Scroll to Function Code **E1**.
- e. Activate Setup Mode.
- f. Scroll Up and Down to the desired Value.
- g. Store the Value to memory

5.4. Throttle Dock Settings (Engines Stopped)

5.4.1. E2 – Throttle Minimum Signal and E3 – Throttle Maximum Signal

Make note of the existing programmed values of **E2 – Throttle Minimum** and **E3 – Throttle Maximum** for both Port and Starboard, prior to adjusting them.

To change the value of a function code, review section 4.1.1 - [Processor LED Display](#) on page #47, section 4.1.2 - [Push-Buttons](#) on page #48, and section 4.1.2.1 - [Up and Down Push-Buttons](#) on page #49.

| | |
|---|--|
|  | Note: Adjustments may not be required! |
|  | Note: Synchronization is dependent on the Throttle Minimum and Maximum adjustments being equal on each Processor. |
|  | Note: Prior to adjustments, the correct Engine Signal Selection should be made during Setup. See section 4 - Setup Procedure on page #47. |

5.4.1.1. E2 – Throttle Minimum Signal

This function allows the installer the ability to adjust the Processor's Throttle signal at Idle, above and beyond the profile set in **E0 – Engine Throttle Profile**. This value is adjustable anywhere from 1% to 97% of the maximum throttle output capability of the driver. The **E2 -Throttle Minimum** value must be at least 3% less than **E3 – Throttle Maximum** setting.



For CAN versions of MiniCommand this parameter is adjustable between 0 and 97% but normally should not have to be changed from the default value of 0%.

5.4.1.2. E3 - Throttle Maximum Signal

This function allows the installer the ability to adjust the Processor's Throttle signal at full throttle, above and beyond the profile set in **E0 Engine Throttle Profile**. This value is adjustable anywhere from 4% to 100% of the maximum throttle output capability of the driver. The value must be at least 3% **greater** than the **E2 - Throttle Minimum** setting.

For CAN versions of MiniCommand this parameter is adjustable between 3 and 100% but normally should not have to be changed from the default value of 100%.

5.4.1.2.1. Processor Analog Throttle Signal Check




- a. Leave the Service Field Test Unit connected to the Processor. (If the Quantum profile wasn't selected, the Break-out Box will not be connected).
- b. Depending on the type of signal required, follow the appropriate column of - Analog Throttle Output Adjustments below:



Table 12: Analog Throttle Output Adjustments

| PWM (Duty Cycle) | VOLTAGE (VDC) | CURRENT (mA) | FREQUENCY (Hz) |
|--|---|--|--|
| 1. Set Multimeter to Duty Cycle Setting. <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;"> _____ % </div> | 1. Set Multimeter to the Voltage Setting. <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;"> _____ VDC </div> | 1. Set up the Multimeter to function as an Ammeter. <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;"> _____ mA </div> | 1. Set Multimeter to Frequency setting. <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;"> _____ Hz </div> |
| 2. On the Multimeter attach the black lead to COM and the red lead to V. | 2. On the Multimeter attach the black lead to the COM and the red lead to V. | 2. On the Multimeter attach the black lead to COM and the red lead to mA. | 2. On the Multimeter attach the black lead to COM and the red lead to V. |
| 3. Attach the Multimeter black lead to the negative (-) and red lead to the PWM. | 3. Attach the Multimeter black lead to the negative (-) and the red lead to the VDC. | 3. Attach the Multimeter black lead to the negative (-) and the red lead to the mA. The mA button must be depressed to measure the current output. | 3. Attach the Multimeter black lead to the negative (-) and the red lead to the Frequency. |

- c. Turn ON power to the Engine’s ECM, ECU, etc.
- d. Scroll to Function Code E2 – Throttle Minimum. The Multimeter reads the output signal for Throttle Minimum
- e. Position the control head levers of the station in command to full throttle position. The Multimeter reads the output signal for Throttle Maximum.
- f. At the station in command, return the control head levers to the neutral/idle position.

| | |
|---|--|
|  | Note: The actual minimum and maximum throttle signals required by the engine must be verified with the Engine Manufacturer. |
|  | Note: You must depress the mA push-button on the Service Field Test Unit to read Current. |
|  | Note: Synchronization is dependent on the Throttle Minimum and Maximum adjustments being equal on each Processor. |


5.4.1.2.2. Processor Throttle Signal Adjustment

If **E2** Throttle Minimum or **E3** Throttle Maximum require adjustment, perform the following on the Processor.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on



page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

| | |
|---|---|
|  | <p>Note:</p> <ol style="list-style-type: none"> 1. When in Setup Mode, a programmed value, such as 10.5, is displayed as a blinking 10. 2. In order to view the decimal value of this number, press and release the Up and Down buttons simultaneously. The value displays as a blinking 0.5. 3. You can now adjust the value in tenths of a percent using the Up or Down push-button. 4. To save the changes, simultaneously press and hold the Up/Down arrow buttons for (2) seconds. This saves the value and returns you to the Function menu in Display mode. |
|---|---|

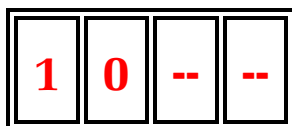


Figure 37: Port Side in Setup Mode for E2

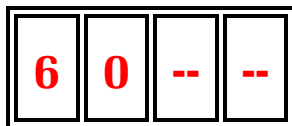



Figure 38: Port Side in Setup Mode for E3

- a. Leave the Service Field Test Unit connected to the Processor. Scroll to function code E2.
- b. Activate Setup Mode.
- c. Scroll either up or down to change the value of the function code E2 Throttle Minimum.
- d. Repeat steps (a) through (c) for E3 – Throttle Maximum.

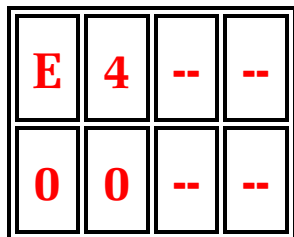
5.5. E4 – Throttle Maximum Astern (Engines Stopped)

This value determines the percentage of Throttle Maximum that is allowed in Astern. This is adjustable anywhere from 1% to 100%.

The default value is set to 100%. When set to 100, the same amount of throttle is available in Astern as is available in Ahead. Decreasing the value from 100 allows the installer to limit the amount of throttle available in Astern.

| | |
|---|---|
|  | <p>Note: To read current, the mA push-button on the Service Field Test Unit must be depressed.</p> |
|---|---|

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.



1. Leave the Service Field Test Unit connected to the Processor. Scroll to Function code E4.
2. Activate Setup Mode.
3. At the station in command, move the control head levers to full Astern. The Multimeter will read the output signal for Throttle Maximum Astern.
4. To decrease the throttle output while in Astern scroll down to the desired value.
5. Store the value to memory.
6. At the station in command, return the levers to the neutral/idle position.
7. Turn power off to the control system and the engine's electronics.
8. Remove the Service Field Test Unit and reinstall the throttle wire harness plug into the throttle socket.

5.6. Engine Stop Switches (Engines Running)

- a. At the first remote station, place the control head levers in the neutral/idle position.
- b. Press the *Control/Mode (Transfer)* button to take control.
- c. Start the engines.
- d. Verify that the engine Stop Switch (normally a push-button or key switch) stops the engines.
- e. Go to the second remote station, if installed, and repeat steps A-D.
- f. Refer to the information supplied by the engine or vessel manufacturer if the engine stop switch does not function correctly at either station.

| | |
|--|--|
| | Caution: An Engine Stop Switch at each station is an absolute requirement for safety considerations. Refer to CFR46, 62.35-5 and ABYC P-24.5.8. |
|--|--|

| | |
|--|--|
| | Warning: Do not attempt to continue tests until all Engine Stop Switches are functioning correctly! |
|--|--|

5.7. Throttle Check (Engines Running)

- a. Turn power ON to the controls.



- b. Verify there is an intermittent tone (slow beeping) at each Control Head. You should hear a tone emitted from each side (port and starboard), even though the tones are being emitted simultaneously.
- c. Initially the engine(s) should be stopped.
- d. Take command at a remote station by depressing the *Control/Mode (Transfer)* button, with the levers at the Neutral/ Idle detent. Both red LEDs (one for port and one for starboard) should illuminate. Also, the intermittent tone should stop at all Control Heads.
- e. Place the controls in Warm-up Mode: Depress and hold the Station's *Control/Mode (Transfer)* button while moving the Control Head levers to the Ahead detent. Release the button.
 - Both LEDs should blink slowly, indicating you have entered Warm-up Mode. Warm-up mode *only* operates in the Ahead direction.
 - If both red LEDs blink, continue with the testing. If either red LED does not blink, move the associated lever to the neutral position. Depress and hold the station *Control/Mode (Transfer)* button while moving the control head lever to the astern direction. If the LED now blinks slowly, the control head may be wired incorrectly. Check with your local ZF Sales & Service Organization (SSO). For more information on an SSO in your area, see page 159.
- f. With the controls in Warm-up Mode, start the engine(s).
- g. Check port engine throttle control by slowly moving the Port Control Head Lever from the ahead detent in the ahead direction. The port engine speed should increase above Idle speed. Move the Control Head Lever back to the ahead detent.
- h. Check starboard engine throttle control by slowly moving the Starboard Control Head Lever from the ahead detent in the ahead direction. The starboard engine speed should increase above Idle speed. Move the Control Head Lever back to the ahead detent.

5.8. Control Head Command Checks (Engines Running)

- a. Start engine(s) and let them run at Neutral/Idle.
- b. Place one Control Head lever at a time into the Ahead detent until thrust is felt and then return the lever to neutral.
- c. Confirm that the movement of the vessel is in the correct direction. If incorrect, reverse the electric cable connections at the shift solenoids.



- d. Place the same control head lever into the Astern detent until thrust is felt and then return the lever to neutral. If thrust is not felt, check your connection to the solenoid.
- e. While depressing the *control/mode (transfer)* button, move the same lever into the Ahead detent. Confirm that the transmission does not shift into Ahead, the red LED blinks slowly, and the engine speed can be increased above idle.
- f. Return the lever to the Neutral/Idle position, and verify that the red LED stops blinking (remains steady).
- g. Repeat steps (a) through (f) at the 2nd (other) Control Head lever.

5.9. E6 – High Idle (Engines Running)

This function allows the operator the option of having a second elevated Idle speed. This second elevated Idle can be adjusted from **0** to **20%** of full throttle. If **0** is selected, High Idle will be the same as normal or Low Idle, which is the default value.

When power is first applied to the system, low idle is commanded. In order to increase the RPM to the High Idle command, the *Control/Mode (Transfer)* button must be depressed for ½ second then released. This can be done with the Control Head lever in the Ahead, Neutral, or Astern Detent.

Additionally, when the system is placed in Warm Up mode, high idle is commanded.

- a. Take command at a remote station and leave the levers in a neutral/idle position. Start the engines.
- b. Place the Port and Starboard levers into Warm Up mode.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

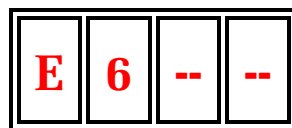


Figure 39: LED Display Function E6

- a. Scroll to Function Code **E6**.
- b. Activate Setup Mode.
- c. Scroll Up until the desired engine RPM for high idle is reached.
- d. Store the Value to memory.
- e. Move the control head levers to the neutral/idle position.
- f. Shut down the engines.



6. Sea Trials



Warning: It is imperative that the information provided in the previous Sections be **read** and **followed** precisely, **prior** to attempting a Sea Trial. If any of the following tests fail, discontinue the Sea Trial **immediately** and return to the Dock Trials. Consult section 8 – Troubleshooting on page #97, or consult a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, see page 159.



Note: In a Twin Screw Application, the following tests must be performed on all engines/transmissions. During the course of the Dock Trials and Sea Trials, fill out the Sea Trial Report starting on page #86.

6.1. E5 – Throttle Pause Following Shift (Engines Running)



Note: A Test Control Head and a stop-watch are recommended to determine the correct setting for the Throttle pause. If a Test Control Head is not available, a second person may be needed.

- a. Move the Station in command's lever to the Ahead detent, and at the same time start the Stop Watch.
- b. Monitor the Propeller Shaft. When the Shaft begins to rotate, stop the Stop-Watch.
- c. Record the time expired on the Stop Watch.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

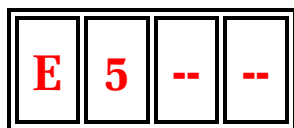


Figure 40: LED Display Function E5

- a. Scroll to Function Code **E5**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the time recorded on the Stop Watch.
- d. Store the Value to memory



6.2. Full Speed Setting

- a. Warm-up the engine(s) and transmission(s) and slowly move into open water.
- b. Gradually move the Control Head lever(s) to full speed.
- c. If synchronization is installed, disable synchronization as explained in section 2.8.4.1 - Turning OFF Synchronization on page #28.
 - Electric Throttle: If the engine RPM is *low*, refer to the Service Field Test Unit manual on page #171 on how to check the electric setting or increase the value of E3 until the desired RPM is reached..
 - If the engine RPM is *high*, decrease by using Function Code **E3** – Throttle Maximum, as explained in section 5 – Dock Trials on page #65.
- d. For twin screw applications, check that matching Idle, Mid-range and Full speed Control Head lever positions cause equal RPM in both engines.
 - Electric Throttle: If RPMs do not match, adjust Function Code **E3** – Throttle Maximum. Refer to section 5 – Dock Trials on page #65.

6.3. C2 – Proportional (Reversal) Pause

The proportional pause feature provides engine deceleration when making a direction change. The pause is variable and in proportion to:

- The Control Head's lever position prior to the reversal.
- How long the Control Head's lever has been in that position prior to the reversal.

The sequence of events, are as follows for the different Reversal Pause types:

6.3.1. In-Gear Delay (C200)

- a. The Throttle position drops to Idle.
- b. The Transmission remains engaged in Ahead or Astern.
- c. The Control System pauses at this position until the delay has timed out.
- d. The Transmission shifts to the opposite gear (astern or ahead).
- e. The Throttle position moves to the Control Head's present lever position.

6.3.2. Neutral Delay (C201)

- a. The Throttle position drops to Idle
- b. The Transmission shifts to Neutral.
- c. The Control System pauses at this position until the delay has timed out.
- d. The Transmission shifts to the opposite gear (Astern or Ahead).



- e. The Throttle position moves to the Control Head's present lever position.

6.3.3. Fixed Neutral Delay (C202)

- a. The throttle drops to idle.
- b. The transmission shifts to neutral.
- c. The control system pauses at this position until the delay has timed out.
- d. Transmission shifts to the opposite gear (astern or ahead).
- e. The throttle position moves to the control head's present lever position.

6.3.4. Store C2 – Proportional Pause Value

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

The applicable values for **C2** are:

- 1. In Gear
- 2. Neutral

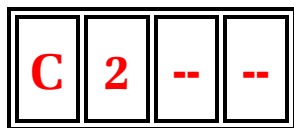


Figure 41: LED Display Function C2

- a. Scroll to Function Code **C2**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory.

6.4. C3 – Proportional (Reversal) Pause Time

The pause on a through Neutral shift is proportional to the speed commanded and the time at that speed. The Values listed for Function Code **C3** - Proportional (Reversal) Pause Time, are the maximum possible delays. When shifting from the Idle Ahead to Idle Astern or vice-versa the delay is zero. The time required to build up to the maximum pause is six times the Value selected.

In addition, in order to build up to the maximum delay Value, the System must be commanding Full Throttle. The Pause when shifting from Astern to Ahead is either half or the same as the Ahead to Astern delay depending on the Value selected for Function Code **C4** - Proportional (Reversal) Pause Ratio.

6.4.1. Determine C3 Pause Requirement



Note: A stop-watch is required to accurately program the Proportional (Reversal) Pause Time.

The amount of pause required is determined as follows:



- a. Place the Control Head lever(s) to the Full Ahead position.
- b. Leave the Control Head lever(s) at this position for whichever of the following two options is longer:
 - Sixty seconds
 - The vessel's speed through the water reaches maximum.
- c. Quickly move the Control Head lever(s) to Ahead Idle or Neutral, (depending on Function Code **C4** setting) while starting the stop-watch.
- d. When the engine(s) RPM reaches Idle and the vessel speed through the water is within two knots of the standard Idle Ahead speed, stop the stop-watch.
- e. Program Function Code **C3** to the time expired on the stop-watch.

6.4.2. Program Function Code C3

The available Values are **00** to **99** seconds. The default Value is **03** seconds.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

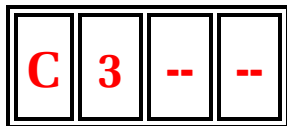


Figure 42: LED Display Function C3

- a. Scroll to Function Code **C3**.
- b. Activate Setup Mode.
- c. Scroll Up or Down to the desired Value.
- d. Store the Value to memory.


6.4.3. Testing Proportional (Reversal) Pause Time

| | |
|--|---|
| | <p>Caution: It is critical that the proportional (Reversal) Pause is tested as outlined below to ensure that it is properly programmed. Failure to do so could cause damage to the transmission.</p> |
|--|---|

- a. Position the boat in open water and slowly increase the Throttle to 25% of the speed range.
- b. Leave the Control Head lever(s) at this position for at least 60 seconds.
- c. Quickly move the Control Head lever(s) to Idle Astern.
 - The engines(s) RPM should drop to Idle.
 - The Clutch should stay engaged or shift to Neutral for 25% of the time selected with Function Code **C3** Proportional Pause Time.



- Once the time has expired, the Clutch should Shift to Astern.
 - The engine RPM will drop slightly when the astern load is placed on the engine, but not to the point where it comes close to stalling.
- d. Increase the Throttle slightly until the vessel starts moving in the opposite direction.
- If the engine stalled or came very close to stalling, increase the Value of Function Code **C3** by following the steps in the previous Section. Repeat steps (a) through (c).
 - If the engine does not stall or come close to stalling, proceed with the next step.
- e. Repeat steps (a) through (d) with the Throttle at 50%, 75%, and 100% of the speed range.
- If the engine stalls at any time, increase the Value of Function Code **C3** by one (1) second and repeat the steps (a) through (d) again.
- f. Once a Full Speed Reversal is successful without coming close to stalling, the Proportional Pause is properly adjusted.

| | |
|---|--|
|  | <p>Note: If a successful reversal cannot be made without stalling an engine, contact a technician from ZF Marine Electronics' Sales & Service Organization (SSO). For more information on an SSO in your area, please see page 159.</p> |
|---|--|

6.5. C8 - Fixed Neutral Delay with Proportional Pause

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

The function code **C8** is configurable from 0.0 to 4.0 seconds.

- a. Scroll to Function Code **C8**.
- b. Activate Setup Mode
- c. Scroll Up or Down to the desired Value, 0.0 to 0.4.
- d. Store the Value to memory
- e. Repeat for both sides of the processor.



- 6.5.1. **Fixed Neutral Delay with In-Gear Proportional Pause** Error! Bookmark not defined.

When the **C2** function is configured to **00** for Proportional In-Gear Delay and the throttle is moved from Ahead to Astern or vice-versa, the MiniCommand Processor (MCP) shall delay in gear for the time specified in **C3**, plus delaying in neutral idle for the time specified in **C8**.

- 6.5.2. **Fixed Neutral Delay with Neutral Proportional Pause**

When the **C2** function is configured to **01** for Proportional Neutral Delay and the throttle is moved from Ahead to Astern or vice-versa, the MCP shall delay in neutral idle for the time specified in **C3**, plus delaying in neutral idle for the time specified in **C8**.

- 6.5.3. **Fixed Neutral Delay with No Proportional Pause from C8**

When the **C2** function is configured to **02** for Fixed Neutral Delay and the throttle is moved from Ahead to Astern, the MCP shall delay for only the time specified in **C3**.

When **C2** is configured to **02**, then **C8** does not display and consequently is not configurable.

6.6. Synchronization Test

- 6.6.1. **Equal Throttle Synchronization**

- a. Move both Control Head levers side by side to approximately 25% of the Throttle range.
- b. If previously disabled, enable the synchronization by depressing the *Control/Mode (Transfer)* button for two seconds. The green LED on the Control Head should illuminate, indicating synchronization.
- c. Check the engine tachometers to see if they are within 1% of one another.
- d. Move both Control Head levers side by side to approximately 50% of the Throttle range.
- e. Check the engine tachometers to see if they are within 1% of one another.
- f. Move both Control Head levers side by side to approximately 75% of the Throttle range.



- g. Check the engine tachometers to see if they are within 1% of one another.
- h. Move both Control Head levers side by side to 100% of the Throttle range.
- i. Check the engine tachometers to see if they are within 1% of one another.

| | |
|--|--|
| | Important: Contact the ZF Marine Electronics Sales and Service Organization (SSO) if any of these tests fail. For more information on an SSO in your area, please see page 159. |
|--|--|

6.7. L2 – Trolling Minimum and L3 – Trolling Maximum Adjustments

| | |
|--|--|
| | Important: Do not attempt to operate in Troll mode or make any Troll adjustments until the transmission oil has reached normal operating temperature. |
|--|--|

6.7.1. Troll Minimum Pressure (L2)

The amount of current delivered to the Proportional Valve when Minimum Pressure is desired, is set with this function. This is adjustable between **01.0%** and **99.0%** of the total current output capability of the circuit. The value set must be at least 1% less or more (depending on whether non-inverted or inverted is selected) than Troll Maximum. The **Default Value** is **10.0%**.

6.7.2. Troll Maximum Pressure (L3)

The amount of current delivered to the Proportional Valve when Maximum Pressure is desired, is set with this function. This is adjustable between 02.0% to 100.0% of the total current output capability of the circuit. The value set must be at least 1% more or less (depending on whether non-inverted or inverted is selected) than Troll Minimum. The **Default Value** is **25.0%**

6.7.3. Transmission Reaches Operating Temperature

When the transmission has reached operating temperature, measure and record propeller shaft RPM at Idle Ahead into Table 13 below.

Table 13: Record Propeller Shaft RPM at Idle Ahead

| |
|--|
| Propeller Shaft RPM (when engines have reached operating temperature) |
| PORT |
| STARBOARD |



Use the Service Field Test Unit and a Multimeter: (Reference the section on the Service Field Test Unit on page #171.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

- a. Disconnect the Clutch/Troll Wire Harness from the Processor.
- b. Connect the 12-Pin connector of the Service Field Test Unit to the processor Clutch connector and to the Clutch/Troll Wire Harness.
- c. Set Multimeter to Current (mA) setting.
- d. On the Multimeter, attach the Black Lead to COM and the Red Lead to mA.
- e. Turn ON power to the Clutch Power Supply. Ensure Power is ON to the Processor.
- f. Position the Control Head lever to the Ahead Detent and turn Troll Mode ON.
- g. Activate the **Function Menu**.

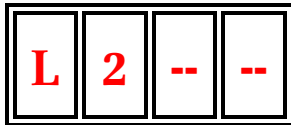


Figure 43: LED Display Function L2

- a. Scroll to Function Code.
- b. The Multimeter will read the output signal for Troll Minimum when the Troll Command Switch on the Test Unit is flipped away from "Troll Command".
- c. Activate Setup Mode.
- d. Scroll Up or Down to the desired Value.



Note: When the trolling valve is in the minimum oil pressure position, Propeller Shaft RPM should be 30% of the engaged RPM noted in Table 13 on page #81.

- e. Record Propeller Shaft RPM below.



Table 14: Record L2 - Minimum Trolling Pressure

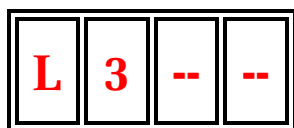
| TWIN SCREW | | | |
|---|------------------|---------------------|-------------------|
| Propeller Shaft RPM at minimum Trolling Pressure (Approx. 30-50% of Table 13 on page #81.): | | | |
| | Shaft RPM | Current (mA) | Function % |
| PORT | | | |
| STARBOARD | | | |

- f. Store the Value to Memory.


6.8. L3 – Troll Maximum Setup

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

Figure 44: LED Display Function L3



- a. Position the Control Head lever through the selected Troll Lever Range to the Troll Maximum position.
- b. Scroll to the function Code: The Multimeter will read the output signal for Troll Maximum when the Troll Command Switch on the Test Unit is flipped away from "Troll Command".

| | |
|---|---|
|  | <p>Note: It is difficult to use a slipping clutch to control shaft RPM between 70% and 100% of normal shaft RPM. However, it may be desirable to set the Maximum Trolling Pressure Position higher than the 70% RPM, so that added oil pressure is available when maneuvering.</p> |
|---|---|

- c. Activate Setup Mode.
- d. Scroll Up or Down to appropriate Value.
- e. Record Propeller Shaft RPM below.



Table 15: Record L3 Maximum Trolling Pressure

| TWIN SCREW | | | |
|---|------------------|---------------------|-------------------|
| Propeller Shaft RPM at maximum Trolling Pressure (Approx. 70% of Table 13 on page #81): | | | |
| | Shaft RPM | Current (mA) | Function % |
| PORT | | | |
| STARBOARD | | | |

- f. Store the Value to memory.
- g. Position the Control Head lever into the Neutral/Idle position.
- h. Remove the Service Field Test Unit and reconnect the Clutch/Troll Wire Harness to the Processor.

6.9. L4 – Troll Throttle Limit

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

| | |
|--|--|
| | <p>Caution: Consult the Trolling Valve’s Installation Manual prior to programming any increased throttle, above idle, while slipping the Clutch. Failure to adhere to the Transmission manufactures directive may permanently damage the Clutch Pack and void the warranty.</p> |
|--|--|

- The Value programmed for Function Code **L4** is a percentage of the throttle range. The Throttle Range is the difference between Throttle maximum (**E3**) and Throttle Minimum (**E2**).
- The maximum percentage of the Throttle Range which the Value can be set to is 20% of Full throttle.
- The adjustment of this Function Code is a matter of personal preference. There is no set procedure which determines when increased throttle should be used, and what percentage of the range it should be set to. But, never exceed the transmission manufacturer’s recommendation.
- The values of this Function are **00%** to **20%** of Throttle maximum. Default Value is set to **-00**.

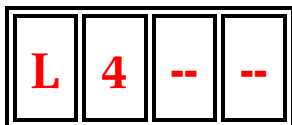


Figure 45: LED Display Function L4

- a. Disconnect the Throttle Wire Harness from the Processor.
- b. Connect the 8-pin connector of the Service Field Test Unit to the Processor throttle connector and to the throttle wire harness.
- c. Refer to the Service Field Test Unit on page #159. Turn ON power to the Engine's ECM. Ensure that power is ON to the Processor.
- d. Activate the Function Menu.
- e. Scroll to the Function Code. The Multimeter will read the Troll throttle Limit output signal.
- f. Activate Setup Mode.
- g. Change the Value of the Function.
- h. When the Value required is displayed, store the value.
- i. Remove the Service Field Test Unit and reconnect the throttle Wire Harness to the Processor.



Note: To read current, the Troll toggle switch on the Service Field Test Unit must be turned on.

6.10. L5 – Troll Pulse Duration

This function sets the time in seconds that the Proportional Valve will command **L6** – Troll Pulse Percentage. This function gives a pressure boost to the Clutch plate in order to get the Propeller Shaft rotating prior to dropping to the level programmed in **L2** – Troll Minimum.

The values of this Function are **0.0** to **9.9** seconds. **Default Value** is set at **0.6** seconds.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

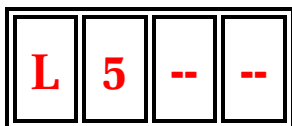


Figure 46: LED Display Function L5

- a. Activate the Function Menu.
- b. Scroll to the Function Code.
- c. Activate Setup Mode.
- d. Change the Value of the Function.
- e. When the Value required is displayed, store the value.



6.11. L6 – Troll Pulse Percentage

This function sets the percentage of **L3 – Troll Maximum**, which the Proportional Valve will be commanded when first entering Troll Mode. This function determines the amount of pressure boost to the Clutch plate in order to get the Propeller Shaft rotating prior to dropping to the level programmed in **L2 – Troll Minimum**.



The values of this Function are **0.0%** to **100.0%**. Default Value is set at **25%**.

To change the value of a function code, review section 4.1.1 - Processor LED Display on page #47, section 4.1.2 - Push-Buttons on page #48, and section 4.1.2.1 - Up and Down Push-Buttons on page #49.

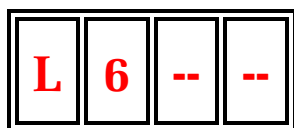


Figure 47: LED Display Function L6.

- a. Activate the Function Menu.
- b. Scroll to the Function Code.
- c. Activate Setup Mode.
- d. Change the Value of the Function.
- e. When the value required is displayed, store the value.

6.12. Sea Trial Report

The purpose of this Sea Trial Report is to provide a convenient checklist and record of installation, setup, dock trial, and sea trial performance of the ZF Marine Electronics Propulsion Control System. Please enter ALL of the information.

We recommend that this form remain aboard the vessel, and a copy be sent to ZF Marine Electronics', 12125 Harbour Reach Drive, Suite B., Mukilteo, WA 98275, along with the Warranty Registration which is located at the end of this manual.

**Table 16: Vessel Information**

| Vessel Information | | | |
|----------------------------------|---------------|-----------------|------------------|
| Vessel Name: | | Hull # | Trial Date |
| Vessel Type: | | Dwg No.: | |
| Installing Yard/Project Manager: | | Tel: | |
| Owner(s) Representative: | | Tel: | |
| Engine Data: | Make | Model: | HP(KW): RPM: |
| Propeller Data: | No. of Screws | Propeller Type: | Fixed: Other: |
| Gear Data: | Make: | Model: | Ratio: |
| No of Remote Stations: | Locations: | | |

6.12.1. Control System Checks

Make the following checks prior to applying power to the Processor.

Table 17: Processor

| Processor Serial Number: | PORT | STBD |
|---|--------|--------|
| Is the Processor subject to excessive heat? (Above 70 degrees C)? | YES NO | YES NO |
| At least 4 feet (1,2m) from strong magnetic fields? | YES NO | YES NO |
| Accessible for checkout, adjustments, and maintenance? | YES NO | YES NO |
| Are the Processors grounded? | YES NO | YES NO |
| Are all Electric Cables supported every 18 inches (45,72cm) | YES NO | YES NO |
| Are the electrical cable connections tight at the processors and control heads? | YES NO | YES NO |



| Processor Serial Number: | PORT | STBD |
|---|--------|--------|
| Is the Processor's Start Interlock Circuit being used? If NO, what type of start interlock is being utilized? | YES NO | YES NO |
| Is there an Engine Stop Switch installed at each Remote station? | YES NO | YES NO |
| Does Shift operate in the correct direction? | YES NO | YES NO |

Table 18: Wire Harness/Cable Lengths

| Processor Serial Number: | | PORT | STBD |
|---|-----------------|--------------|--------------|
| | | Length in Ft | Length in Ft |
| Control Head Wire Harness | Station # _____ | | |
| Control Head Wire Harness | Station # _____ | | |
| Clutch/Troll Wire Harness | | | |
| Power, Start Interlock, Clutch Pressure Switch, and Alarm Wire Harness. | | | |
| Throttle Wire Harness | | | |

Table 19: Power Supply

| Processor Serial Number: | | | |
|---|----------------------|----------------------|--------|
| | | PORT | STBD |
| What is the source of Processor power and how is it charged? | | | |
| Is there a backup power supply? APS or other? Explain. | | YES NO | YES NO |
| Are the power cables protected by 10 Ampere Circuit Breakers? | | | |
| If separate power supplies are used for each Processor, do they have a common ground? | | YES NO | YES NO |
| What is the Voltage when not being charged? | Battery _____ VDC | Battery _____ VDC | |



| Processor Serial Number: | | PORT | STBD |
|--|------------------------|------------------------|------|
| | Processor _____ VDC | Processor _____ VDC | |
| What is the Voltage when connected to Shore Power? | Battery _____ VDC | Battery _____ VDC | |
| | Processor _____ VDC | Processor _____ VDC | |
| What is the Voltage when the engines are running? | Battery _____ VDC | Battery _____ VDC | |
| | Processor _____ VDC | Processor _____ VDC | |

Table 20: Dock Trials

| Processor Serial Number: | | PORT | STBD |
|--|-----------|-----------|------|
| Does the engine start when the Control System is turned OFF? | YES NO | YES NO | |
| Does the engine Stop Switch function at all Stations, regardless of RPM? | YES NO | YES NO | |
| Can all Remote Stations take command? | YES NO | YES NO | |
| Does the Warm-up Indicator Light blink in Ahead? | YES NO | YES NO | |
| What is the Low Idle RPM? | RPM _____ | RPM _____ | |
| What is the High Idle RPM (optional) | RPM _____ | RPM _____ | |
| Does the vessel surge forward with Control Head lever in the Ahead Detent? | YES NO | YES NO | |

| | |
|--|--|
| | Warning: Do NOT START ENGINE to turn on engine electronics! |
|--|--|

Table 21: Record at Dock (Requires Use of Field Service Test Unit)

| Processor Serial Number: | | PORT | STBD |
|--|------------------------------------|------|------|
| Throttle in Neutral (Cummins Quantum only) | VDC, mA, Hz, or %Duty Cycle (PWM), | | |



| Processor Serial Number: | | PORT | STBD |
|--------------------------|--|------|------|
| | or %Throttle for CAN | | |
| Throttle Minimum, | VDC, mA, Hz, or %Duty Cycle (PWM), or %Throttle (CAN) | | |
| Throttle Maximum | VDC, mA, Hz, or %Duty Cycle (PWM) or %Throttle (CAN) | | |
| Troll Minimum (Signal) | mA | | |
| Troll Maximum (Signal) | mA | | |

Table 22: Sea Trials

| Processor Serial Number: | | PORT | STBD |
|--|------------------|------------------|------|
| Do the Dual Control Head levers match position and RPM throughout the speed range? | YES NO | YES NO | |
| The Full Speed Reversal Delay is set for how many seconds? | SECONDS _____ | SECONDS _____ | |
| Is Synchronization Operational? | YES NO | YES NO | |

Table 23: Record During Sea Trials (Requires Use of Field Service Test Unit)

| Processor Serial Number: | | PORT | STBD |
|--|--------------------|------|------|
| Engine Idle RPM | RPM: _____ | | |
| Shaft Idle RPM (Calculate the Shaft Idle RPM as follows: Engine Idle RPM/Gear Ratio) | RPM: _____ | | |
| Full Throttle RPM | RPM: _____ | | |
| Troll Minimum (Shaft RPM) (The desired Troll Minimum can be calculated as follows: Shaft Idle RPM x 0.3) | RPM (Actual) _____ | | |
| Troll Maximum (Shaft RPM) (The desired Troll Maximum can be calculated as follows: Shaft Idle RPM x 0.7) | RPM (Actual) _____ | | |



6.12.2. Record Function Codes

Record information onto the following Tables only after ALL information has been recorded in the previous Section **Control Checks**.

Table 24: Record Processor Function Codes

| CODE | FUNCTION NAME | PORT | STBD |
|------|--------------------------|------|------|
| A0 | Processor Identification | | |
| A1 | Number of Engines | | |
| A2 | One Lever Operation | | |
| A4 | Neutral Indication Tone | | |

Table 25: Record Throttle Functions

| CODE | FUNCTION NAME | PORT | STBD |
|------|---|------|------|
| E0 | Engine Throttle Profile | | |
| E1 | Throttle in Neutral (only available with Type 3 Throttle Profile) | | |
| E2 | Throttle Minimum | | |
| E3 | Throttle Maximum | | |
| E4 | Throttle Maximum Astern | | |
| E5 | Throttle Pause Following Shift | | |
| E6 | High Idle | | |
| E7 | Synchronization On/Off | | |

Table 26: Record Clutch Functions

| CODE | FUNCTION NAME | PORT | STBD |
|------|---|------|------|
| C2 | Proportional (Reversal) Pause | | |
| C3 | Proportional (Reversal) Pause Time | | |
| C4 | Proportional (Reversal) Pause Ratio | | |
| C8 | Fixed Neutral Delay with Proportional Pause | | |

**Table 27: Record Troll Functions**

| CODE | FUNCTION NAME | PORT | STBD |
|-------------|--|-------------|-------------|
| L0 | Troll Enable / Control Head Troll Lever Range | | |
| L1 | Troll Valve Function | | |
| L2 | Troll Minimum Pressure | | |
| L3 | Troll Maximum Pressure | | |
| L4 | Troll Throttle Limit | | |
| L5 | Troll Pulse Duration | | |



Comments (Please Use Additional Space as Needed)

General Installation Condition

Any Irregularities

Is the Installation and Troubleshooting Manual on board?

Is a copy of this completed Report placed in the Installation and Troubleshooting Manual on board?

INSPECTOR _____ DATE _____

MAIL A COMPLETED COPY TO:

ZF MARINE ELECTRONICS, LLC. 12125 HARBOUR REACH DRIVE, STE B, MUKILTEO, WA 98275

OR FAX TO: SERVICE DEPARTMENT 425-493-1569



7. Periodic Checks and Maintenance

The items listed below should be checked on an annual basis or more often, when advised.

7.1. Control Heads

Disconnect the Deutsch connector and check the pins and sockets for signs of moisture and corrosion.

7.2. Processor

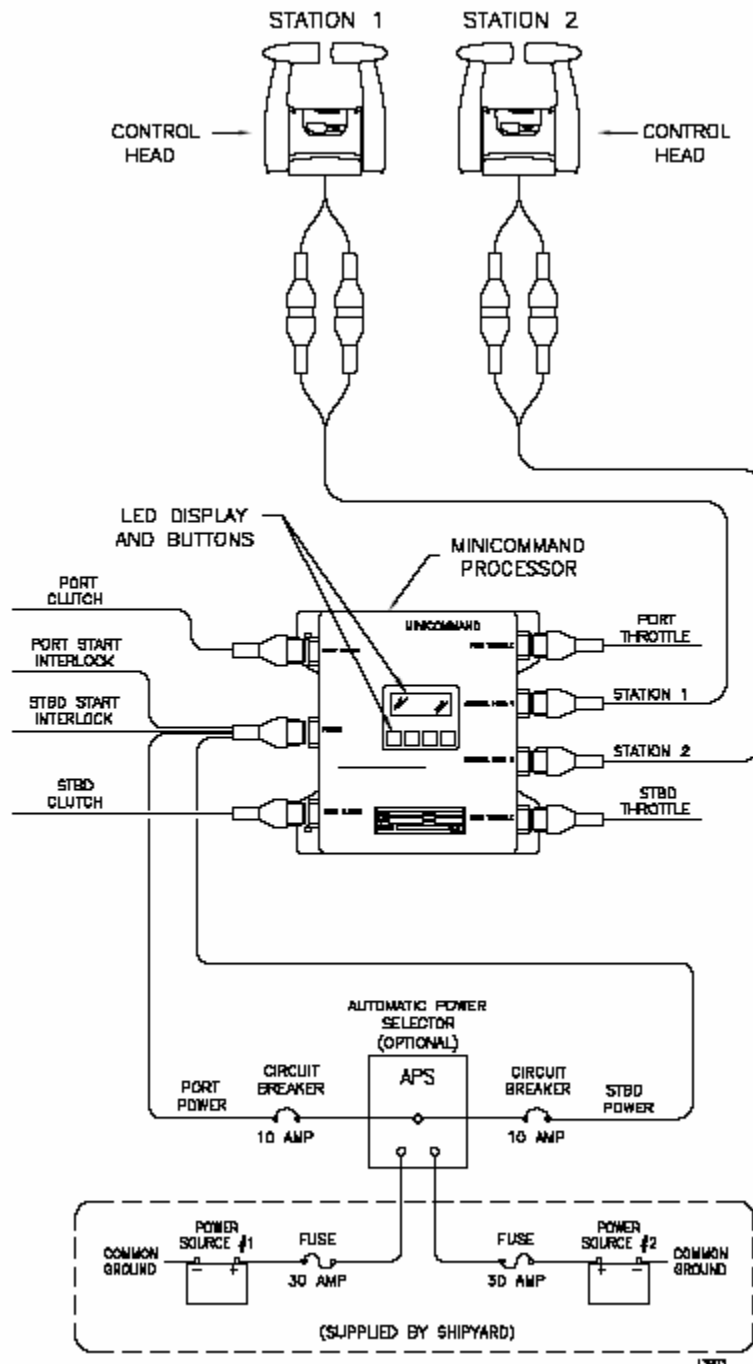
- Un-plug and inspect all Deutsch connectors and check the pins and sockets for signs of moisture or corrosion.



8. Troubleshooting

The ZF Marine Electronics' MiniCommand Control System (twin screw only) has two sets of electronics, one for each engine/transmission combination, in one enclosure, and is typically mounted in the engine room. The system can have a maximum of two Control Heads located at the vessel's remote stations.

In the event that a malfunction occurs, review the appropriate system diagram and become familiar with the various components, their functions and locations on the vessel.



If the control system detects a fault, audio tones (see section 8.1 - [Fault Tones](#) on page #99) are generated at the Control Head and “Er” is shown on the Processor LED Displays. If the control system is operating normally, scrolling dashes will be shown on the Processor LED Displays. Note that there are two LED Displays for port and two for starboard.



8.1. Fault Tones

There are various tones emitted from the Control Head if an error occurs.

8.1.1. Basic Control System Tones

These basic tones are as follows:

8.1.1.1. Slow Repetitive Tones



The Slow Repetitive tone, also referred to as the “Initialization Tone” is the tone you hear at all Remote Stations when power is initially applied to the control system. When this tone is heard, you know the following is true:

- Power is applied to the system.
- The Processor software is running normally.
- The Processor is commanding the throttle to idle.
- The Processor is commanding the clutch to Neutral.

This is a normal tone when power is initially applied to the Processor and a Control Head has not taken command.

However, if during normal operation the engine’s throttle drops to Idle, followed by the clutch to Neutral, the Control Head’s red LED goes out and a slow repetitive tone is heard at all remote stations, this would indicate a problem with the power supply connected to the Processor or with the Processor itself.

If there is a power supply problem, this situation will likely mean the voltage at the Processor has momentarily dropped below 8 VDC and then returned to a normal operational level. This could be due to:

- Loose battery power cable connection.
- Under charged or defective battery.
- Voltage drop due to current flow.

8.1.1.2. One Long – Three Short Tones



This tone indicates there is an invalid command signal at the Station-in-Command. The Processor expects a DC voltage, representative of the Control Head’s present lever position. This voltage is referred to as the “Command Signal”. In normally functioning Control Heads, the command signal changes with lever position from approximately 0.8 VDC at full astern to 4.10 VDC at full ahead. If the voltage were to exceed these limits (Out of Range) the following would occur:

- Throttle is commanded to Idle.



- Clutch is commanded to Neutral.
- Troll (if enabled) is commanded to Lock-up.
- One Long – Three Short tone pattern is emitted from all control stations.

The DC voltage of the command signal is converted to a digital representation by the Processor. This digital representation is referred to as an A to D (A/D) Count.

This A/D count can be viewed within the “H0” diagnostic display. The following table lists the processor’s response to the Control Head’s Command Signal:

Table 28: The Processor's Response to the Control Head's Command Signal

| Processor’s Response | Control Head Command Signals | |
|-----------------------------------|------------------------------|-----------------|
| | VDC * | A/D Count |
| Lever Out of Range (Astern) | <0.488 VDC | 100 A/D |
| Full Throttle (Astern) | 0.971 VDC | 162 A/D |
| Throttle Release (Astern) | 1.95 VDC | 398 A/D |
| Shift Engage – Disengage (Astern) | 2.21–2.26 VDC | 452–462 A/D |
| Neutral | 2.25–2.42–2.60 VDC | 462–495–532 A/D |
| Shift Engage –Disengage (Ahead) | 2.65–2.60 VDC | 542–532 A/D |
| Throttle Release (Ahead) | 2.92 VDC | 598 A/D |
| Full Throttle (Ahead) | 4.07 VDC | 832 A/D |
| Lever Out of Range (High) | >4.40 VDC | 900 A/D |

*DC voltages based on a 5.00 VDC reference.

The following faults will result in the Processor reporting on Out of Range Command Signal. These faults will also be accompanied by an Error Number

- An open or high resistance connection between the Control Head and Processors on the DC RTN (-) WIPER or VDC REF (+) conductors. This may be in the Control Head Wire Harness or Pigtail (4200 Series Only). Refer to Figure 48, Figure 49, and Figure 50.
 - ✓ An open connection of the DC RTN (-) conductor will result in a (High) Out of Range condition.
 - ✓ An open connection of the WIPER or VDC REF (+) conductor will result in a (Low) Out of Range condition.
- The Control Head is out of calibration.



- ✓ An out of calibration Control Head's A/D Count, as monitored within the "H0" diagnostic Menu, will be <480 A/D or >510 A/D Counts while the lever is in the Neutral/Idle position.
- ✓ Control Heads cannot be calibrated in the field and must be replaced.
 - A defective Control Head potentiometer.
 - ✓ Once a faulty connection has been ruled out, the Control Head must be replaced.

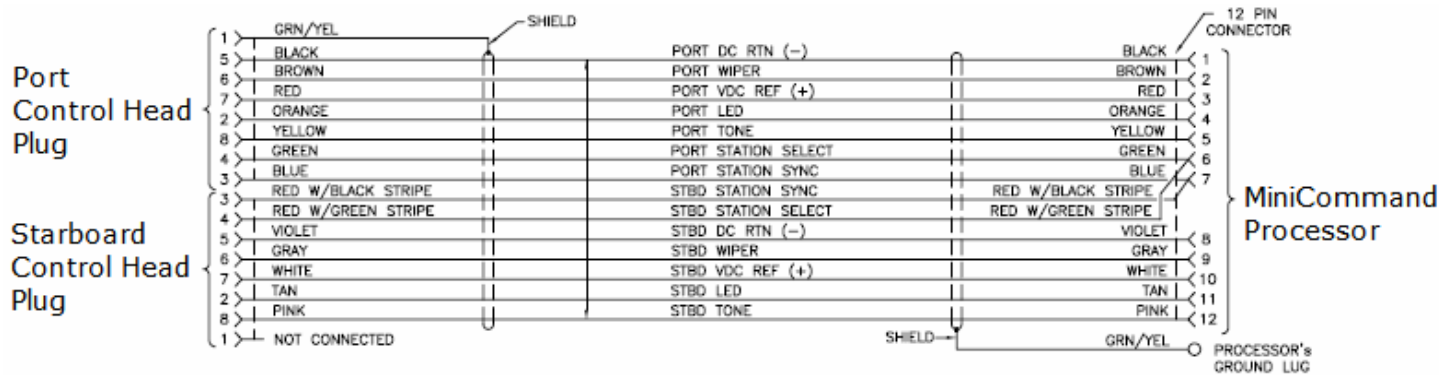


Figure 48: Control Head Wire Harness

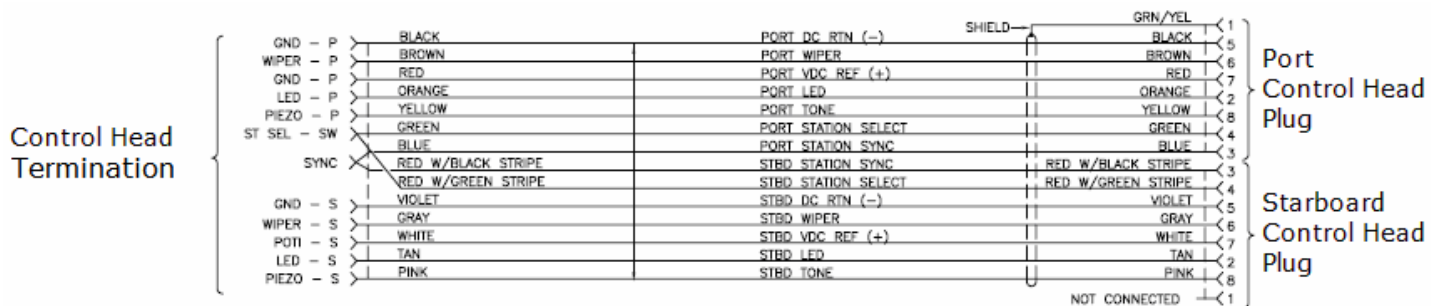


Figure 49: Control Head Pigtail (4200 Series)

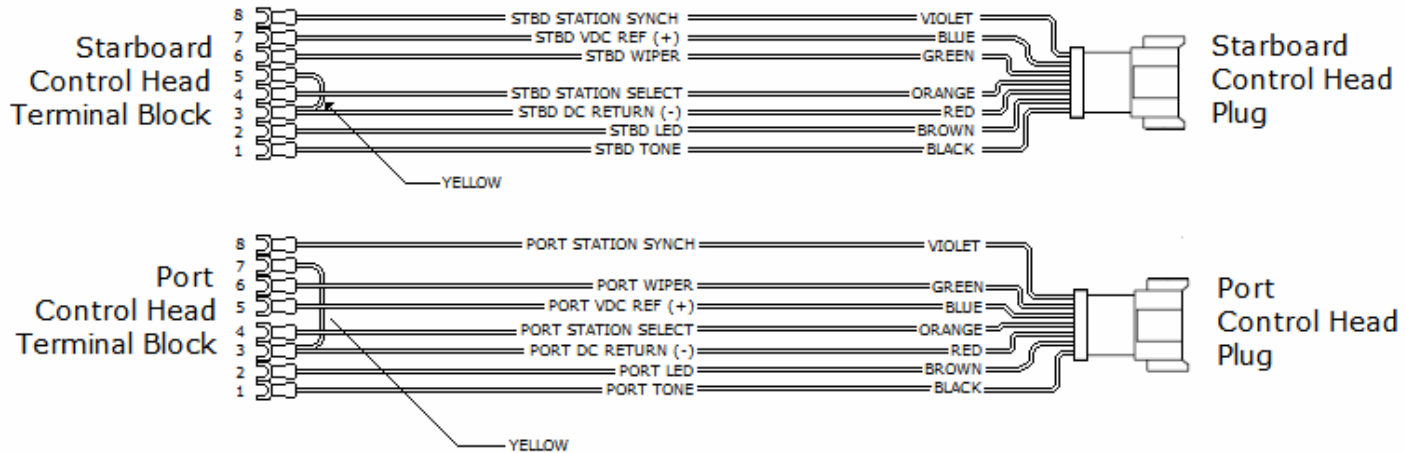


Figure 50: Control Head Pigtail (400, 500, 700 and MC2000 Series)

8.1.1.3. **Steady Tone**

The Steady tone is an indication to the operator that something has gone wrong within the Control System. The tone may be accompanied with an error number on the Processor’s port and/or starboard display to help diagnose. The tone may be caused by the following reasons:

- Processor Failure:
A Processor failure will typically not be accompanied by an error number at the Processor.
- Control/Mode (Transfer) Button is Shorted
 - ✓ If the Steady Tone is due to a shorted *Control/Mode (Transfer)* button, an error number will display on both the port and starboard displays.
 - ✓ If the error number is displayed on the port or starboard display and not both, there may be a wiring issue. Verify the connections of the (PORT STATION SELECT) and (STBD STATION SELECT) wires in the Control Head Wire Harness and Pigtails.

8.1.1.4. **Three Second Steady Tone**

A three second tone emitted at the Control Stations is an indication that there is a failure of the Serial Communication between the port and starboard sides of the Processor. This fault is typically accompanied by Error #50 (Communication Error Time-out System 1) or Error #51 (Communication Error Time-out System 2).



The fault may be due to the following causes:

- Loss of power to the port or starboard side of the Processor.
- Function Code A0 is set to the same value on both the port and starboard side of the Processor.
- A component failure within the port or starboard side of the Processor.

8.2. Taking Command

In order to take command at a Remote Station two items must occur:

- The Control Head's levers must be at the Neutral/Idle position.
- The *Control/Mode (Transfer)* button must be depressed.

If command cannot be taken at a Remote Station, one of the above items is not true, or the Processor thinks one of the items is not true.


8.2.1. Testing a Control Head's Output at Neutral/Idle

- a. Ensure that the Control Heads in question have both of their levers in the Neutral/Idle position.
- b. In Display mode, using the Up or Down push-buttons on the Port side of the MiniCommand Processor (MCP), scroll to the "H0" Function Code.
- c. Press the Up/Down buttons simultaneously for (2) seconds. This places the MCP in Setup mode and the **H0** begins to blink. When you release the buttons, the display changes to **00**.
- d. Press the Down push button to view the A/D value for Station #1 or 2. Then press the Down push button again to view the other station.
- e. The values should be between 49 and 50.
- f. If the decimal point is in the middle of the two numbers then you are viewing station #1.
- g. If the decimal point is to the right of the numbers, then you are viewing station #2.
- h. Repeat steps (a) through (g) for the Starboard side.
- i. If step (e) is incorrect on either side, replace the Control Head after the integrity of the Wire Harnesses are confirmed.



8.2.2. Testing the Control Head’s Control/Mode (Transfer) Push-Button

- a. In Display mode, using the Up or Down push-buttons on the Port side of the MiniCommand Processor (MCP), scroll to the “H0” Function Code.
- b. Press the Up/Down buttons simultaneously for (2) seconds. This places the MiniCommand Processor (MCP) in Setup mode and the **H0** begins to blink. When you release the buttons, the display changes to **00**.
- c. Have a second person depress and hold the Control Head’s *Control/Mode (Transfer)* button while you monitor the MCP display. The display should change to **01** if you are testing Station 1, or change to **10** if you are testing Station 2.
- d. Once the other person releases the *Control/Mode (Transfer)* button your display should return to **00**.
- e. Test the Port side of the MCP for both Control Heads 1 and 2.

| | |
|---|---|
|  | <p>Note: Either Error Code #29 (Station 1) or #30 (Station 2) will be displayed after the button is held closed for 12 or more seconds. Disregard these errors while performing these tests.</p> |
|---|---|


- f. Repeat steps (a) through (e) on the starboard side.
- g. If only the port side fails, check the integrity of the Wire Harness (steps a through f).
- h. If only the starboard side fails, ensure that both the port and starboard processor power supplies have a common ground (steps a through f).
- i. If the power supplies have a common ground, check the integrity of the Wire Harness.
- j. If both the port and starboard sides fail, replace the Control Head after the integrity of the Wire Harnesses are confirmed (steps a through d).

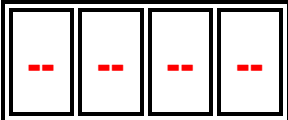
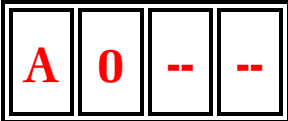
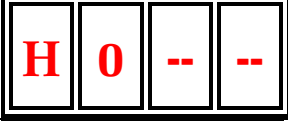
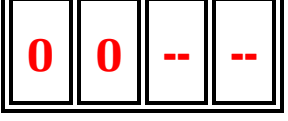
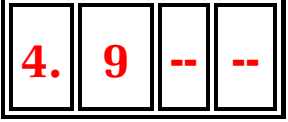
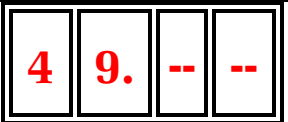
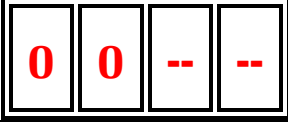
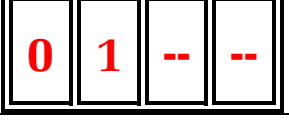


8.3. Function Code H0 - Diagnostic Menu

The Processor has built in diagnostics designed to assist the technician in determining the cause of a problem. These diagnostics allow the technician to view the input signals from the Remote Stations in addition to displaying the revision level of the installed software.

The diagnostic menu is accessed as follows:

| | |
|---|---|
|  | <p>Note: The following explanation and accompanying diagrams are shown for the port side of the Processor. The same information is true for the starboard side of the Processor.</p> |
|---|---|

| | |
|---|--|
|  | <p>a. Locate the port or starboard LED display on the Processor. The LED display will have a running dash pattern moving from left to right.</p> |
|  | <p>b. Depress the Up or Down Push-button to activate the Function Menu. The characters A0 will appear.</p> |
|  | <p>c. Depress the up Push-button three times until H0 is displayed.</p> |
|  | <p>d. Press and <u>hold</u> the Up and Down Push-buttons simultaneously until the H0 begins to blink. Release the Push-buttons. A blinking 00 will be displayed.</p> |
|  | <p>e. Pressing the Down Push-button once changes the display to the Station 1 A/D Count. Only the first two digits of the A/D Count are shown. (Decimal point in the middle indicates station #1.)</p> |
|  | <p>f. Press the Down Push-button again to change the display to the Station 2 A/D Count. (Decimal point to the right indicates station #2.)</p> |
|  | <p>g. Pressing the Down Push-button once again allows the monitoring of the Stations' <i>Control/Mode (Transfer)</i> button.</p> <p style="margin-left: 40px;">➤ 01 - Indicates a closure of Station 1's <i>Control/Mode (Transfer)</i> button.</p> |
|  | |



| | | | | | |
|--|---|----|----|----|--|
| <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">1</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">--</td> <td style="padding: 5px;">--</td> </tr> </table> | 1 | 0 | -- | -- | <ul style="list-style-type: none"> ➤ 10 - Indicates a closure of Station 2's <i>Control/Mode (Transfer)</i> button. |
| 1 | 0 | -- | -- | | |
| <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">3</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">--</td> <td style="padding: 5px;">--</td> </tr> </table> | 3 | 0 | -- | -- | <ul style="list-style-type: none"> h. Pressing the Down Push-button again displays the Processor's software revision level. |
| 3 | 0 | -- | -- | | |
| <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">H</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">--</td> <td style="padding: 5px;">--</td> </tr> </table> | H | 0 | -- | -- | <ul style="list-style-type: none"> i. To exit the Diagnostic Menu, depress the Up and Down Push-buttons simultaneously until H0 appears. You may now scroll through the Function Menu. |
| H | 0 | -- | -- | | |

8.4. Function Code Er - Error Display

The MiniCommand processor has four LED Displays: two for port and two for starboard. The MiniCommand system can detect certain faults and display a corresponding error number on the LED Display. The faults for port and starboard are displayed on their respective LED Displays. The error numbers are listed in Table 29 - Error Numbers, page #108.

| | | | |
|----|---------------|-------------------|--|
| Er | Error Display | 00 (No errors) | See Table 29: <u>Error Numbers</u> on page #108. |
|----|---------------|-------------------|--|

8.4.1. The "Er" Function Code

| | | | | | | | | | |
|---|---|----|----|----|---|---|----|----|---|
| <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">E</td> <td style="padding: 5px;">r</td> <td style="padding: 5px;">--</td> <td style="padding: 5px;">--</td> </tr> <tr> <td style="padding: 5px;">1</td> <td style="padding: 5px;">3</td> <td style="padding: 5px;">--</td> <td style="padding: 5px;">--</td> </tr> </table> | E | r | -- | -- | 1 | 3 | -- | -- | <ul style="list-style-type: none"> a. If a fault occurs during normal operation, and is active (device is currently experiencing the fault condition), "Er" will blink on the appropriate port or starboard side of the Processor's LED Display, followed by a blinking Error Number. These will alternate every couple of seconds. b. If a fault occurs but is inactive (device is currently <u>not</u> experiencing the fault condition), "Er" shows steady (not blinking) on the port or starboard side of the Processor's LED Display, followed by a steady Error Number. These will alternate every couple of seconds. |
| E | r | -- | -- | | | | | | |
| 1 | 3 | -- | -- | | | | | | |



| | | | | | | | | | |
|---|---|----|----|----|---|---|----|----|--|
| <table border="1"> <tr> <td style="text-align: center;">E</td> <td style="text-align: center;">r</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">9</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> </table> | E | r | -- | -- | 2 | 9 | -- | -- | <p>c. There may be multiple Error Numbers (active and/or inactive) stored in the Processors memory. To view these additional Error Numbers, press the Up or Down Push-button. “Er” and the next Error Number will alternate every couple of seconds.</p> <p>d. Repeat step (C) until the initial Error Number is again displayed.</p> <p>e. The Error Numbers and a brief description of each number are referenced in Table 29 - <u>Error Numbers</u> on page #108.</p> |
| E | r | -- | -- | | | | | | |
| 2 | 9 | -- | -- | | | | | | |

8.4.2. Clearing Inactive Errors

The cause of an error (both active and inactive) must be investigated. Once the cause of the error has been found and corrected, the error is no longer considered active. Inactive error numbers may be cleared as follow:

| | | | | | |
|--|---|----|----|----|--|
| <table border="1"> <tr> <td style="text-align: center;">E</td> <td style="text-align: center;">r</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> </table> | E | r | -- | -- | <p>a. If presently in a Menu other than the Error Menus, press the Up or Down Push-button until “Er” is displayed.</p> |
| E | r | -- | -- | | |
| <table border="1"> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> </table> | 0 | 0 | -- | -- | <p>b. Simultaneously press the Up and Down Push-buttons for approximately one second and release. If “00” is displayed, there are no longer any errors (active or inactive) stored in the Processor’s memory.</p> <p>c. If an Error Number is displayed and that Error Number is not blinking (inactive) clear from memory by pressing and holding the Up and Down Push-buttons for approximately one second.</p> <p>d. Return to the Function menu by pressing either the Up or Down Push-button.</p> |
| 0 | 0 | -- | -- | | |



Table 29: Error Numbers

| Error # | Title | Possible Causes | Possible Solutions |
|---------|----------------------------|--|---|
| 13 | Station No. 1 Faulted High | <ol style="list-style-type: none"> 1. Open ground connection between the Station No. 1 Control Head and the Processor. 2. Defective Station No. 1 Control Head. | <ol style="list-style-type: none"> 1. The DC RTN (-) conductor is not properly connected. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 2. Replace Control Head #1. |
| 14 | Station No. 2 Faulted High | <ol style="list-style-type: none"> 1. Open ground connection between the Station No. 2 Control Head and Processor. 2. Defective Station No. 2 Control Head. | <ol style="list-style-type: none"> 1. The DC RTN (-) conductor is not properly connected. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 2. Replace Control Head #2. |
| 23 | Station No. 1 Faulted Low | <ol style="list-style-type: none"> 1. Open VREF connection between Station No. 1 Control Head and Processor. 2. Open Command Signal connection between Station No.1 Control Head and the Processor. 3. Defective Station No. 1 Control Head | <ol style="list-style-type: none"> 1. The VDC REF (+) conductor is not properly connected. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 2. The Wiper conductor is not properly connected. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 3. Replace Control Head #1. |
| 24 | Station No. 2 Faulted Low | <ol style="list-style-type: none"> 1. Open VREF connection between Station No. 1 Control Head and Processor. | <ol style="list-style-type: none"> 1. The VDC REF (+) conductor is not properly connected. Refer to Figure 48 - <u>Control</u> |



| Error # | Title | Possible Causes | Possible Solutions |
|---------|---|---|---|
| | | <ol style="list-style-type: none"> 2. Open Wiper connection between Station No. 2 Control Head and the Processor. 3. Defective Station No. 2 Control Head. | <p><u>Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101.</p> <ol style="list-style-type: none"> 2. The Wiper conductor is not properly connected. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 3. Replace the Station No. 2 Control Head. |
| 33 | Station No. 1 <i>Control/Mode (Transfer)</i> button stuck closed. | <ol style="list-style-type: none"> 1. The Station No. 1 <i>Control/Mode (Transfer)</i> button depressed for 12 or more seconds. 2. Station No. 1 “Station Select” conductor is incorrectly wired. 3. Station #1 Control Head <i>Control/Mode (Transfer)</i> push-button defective. | <ol style="list-style-type: none"> 1. Remove finger from button and clear inactive error from memory. 2. Check the STATION SELECT conductor for proper terminations. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 3. Replace the Station No. 1 Control Head. |
| 34 | Station No. 2 <i>Control/Mode (Transfer)</i> button stuck closed. | <ol style="list-style-type: none"> 1. Station No. 2 <i>Control/Mode (Transfer)</i> button depressed for 12 or more seconds. 2. Station No. 2 “Station Select” conductor is incorrectly wired. 3. Station #2 Control Head <i>Control/Mode (Transfer)</i> push-button defective. | <ol style="list-style-type: none"> 1. Remove finger from button and clear inactive error from memory. 2. Check the STATION SELECT conductor for proper terminations. Refer to Figure 48 - <u>Control Head Wire Harness</u> on page #101 and Figure 49 - <u>Control Head Pigtail (4200 Series)</u> on page #101. 3. Replace the Station No. 2 Control Head. |
| 37 | CAN Communication | The Processor is defective. | Replace the faulty Processor. |



| Error # | Title | Possible Causes | Possible Solutions |
|---------|---------------------------------------|---|---|
| | Stuffing Error | | |
| 38 | CAN Communication Form Error | The Processor is defective. | Replace the faulty Processor. |
| 39 | CAN Communication Acknowledge Error | Loss of power to the Processor. | Restore power to the Processor. |
| 40 | CAN Communication Bit 1 Error | The Processor is defective. | Replace the faulty Processor. |
| 41 | CAN Communication Bit 0 Error | The Processor is defective. | Replace the faulty Processor. |
| 42 | CAN Communication CRC Error | The Processor is defective. | Replace the faulty Processor. |
| 43 | Reserved | Not Used | |
| 44 | Communication Error Time-out System 1 | <ol style="list-style-type: none"> 1. Port microprocessor not receiving data from starboard microprocessor. 2. Loss of power to processor ID No. 1. | <ol style="list-style-type: none"> 1. Replace unit. 2. Replace unit. |
| 45 | Communication Error Time-out System 2 | <ol style="list-style-type: none"> 1. Starboard microprocessor not receiving data from port microprocessor. 2. Loss of power to processor ID No. 2. | <ol style="list-style-type: none"> 1. Replace unit. 2. Replace unit. |
| 50 | Communication Error Time-out System 1 | <ol style="list-style-type: none"> 1. Loss of power to Processor ID 1. Typically the port side is designated 01. 2. Function Code A0 is set to the 02 on both the port and starboard side of the processor. Both sides will display error. 3. A component failure within the port side of the processor. Assuming port set to a value of 01. | <ol style="list-style-type: none"> 1. Reinstate power to the port side of the Processor. 2. Change the value of Function Code A0 to 01 on the port side. 3. Replace the Processor. |
| 51 | Communication Error Time-out System 2 | <ol style="list-style-type: none"> 1. Loss of power to Processor ID 2. Typically the starboard side is designated 02. | <ol style="list-style-type: none"> 1. Reinstate power to the starboard side of the Processor. |



| Error # | Title | Possible Causes | Possible Solutions |
|---------|--------------------------------|--|---|
| | | <ol style="list-style-type: none"> 2. Function Code A0 is set to the 01 on both the port and starboard side of the processor. Both sides will display the error. 3. A component failure within the starboard side of the processor. Assuming starboard set to a value of 01. | <ol style="list-style-type: none"> 2. Change the value of Function Code A0 to 02 on the starboard side. 3. Replace the processor. |
| 58 | Reset Due to Hardware Watchdog | <ol style="list-style-type: none"> 1. Lightening Strike in close proximity. 2. Defective Processor. | <ol style="list-style-type: none"> 1. Cycle power OFF and then ON to the Processor. If error persists, replace the Processor. 2. Replace the processor. |
| 59 | Oscillator Watchdog | An unexpected Software reset has occurred. | <ol style="list-style-type: none"> 1. Cycle power OFF and then ON to the Processor. If error persists, replace the Processor. 2. Replace the processor. |



8.5. MiniCommand Processor Connector Pin Functions for Analog Throttle Version

8.5.1. CONTROL HEAD 1 Connector

| | | |
|----------|---------|---|
| ➤ J15-1 | GNDC | DC Ground |
| ➤ J15-2 | WIPERP1 | Port Control Potentiometer Wiper 1 |
| ➤ J15-3 | PORT5V | Port VCC |
| ➤ J15-4 | LEDP1 | LED Port 1 |
| ➤ J15-5 | TONEP1 | Tone Port 1 |
| ➤ J15-6 | STSEL1 | Head Select Indicator |
| ➤ J15-7 | SYNC1 | Control Set Push-button |
| ➤ J15-8 | GNDC-2 | DC Ground |
| ➤ J15-9 | WIPERS1 | Starboard Control Potentiometer Wiper 1 |
| ➤ J15-10 | STRB5V | Starboard VCC-2 |
| ➤ J15-11 | LEDS1 | Starboard LED1 |
| ➤ J15-12 | TONES1 | Starboard Tone Port 1 |

8.5.2. CONTROL HEAD 2 Connector

| | | |
|----------|---------|---|
| ➤ J16-1 | GNDC | DC Ground |
| ➤ J16-2 | WIPERP2 | Port Control Potentiometer Wiper 2 |
| ➤ J16-3 | PORT5V | Port VCC |
| ➤ J16-4 | LEDP2 | LED Port 2 |
| ➤ J16-5 | TONEP2 | Tone Port 2 |
| ➤ J16-6 | STSEL2 | Head Select Indicator |
| ➤ J16-7 | SYNC2 | Control Set Push-Button |
| ➤ J16-8 | GNDC-2 | DC Ground |
| ➤ J16-9 | WIPERS2 | Starboard Control Potentiometer Wiper 2 |
| ➤ J16-10 | STRB5V | Starboard VCC-2 |
| ➤ J16-11 | LEDS2 | LED Starboard 2 |
| ➤ J16-12 | TONES2 | Tone Starboard 2 |

8.5.3. PORT THROTTLE Connector

| | | |
|---------|----------------|--|
| ➤ J12-1 | GNDC | DC Ground |
| ➤ J12-2 | THR_PWM_P | Throttle pulse width modulation port engine |
| ➤ J12-3 | THR_CUR_P | Throttle 4-20 mA. current source port engine |
| ➤ J12-4 | THR_VOLT_P | Throttle voltage source port engine |
| ➤ J12-5 | CAN_HP_ | CAN bus high port engine |
| ➤ J12-6 | CAN_LP | CAN bus low port engine |
| ➤ J12-7 | THR_FREQ_P | Throttle frequency control port engine |
| ➤ J12-8 | Chassis ground | |

8.5.4. STARBOARD THROTTLE Connector

| | | |
|---------|------|-----------|
| ➤ J13-1 | GNDC | DC Ground |
|---------|------|-----------|



- J13-2 THR_PWM_S Throttle Pulse Width Modulation Starboard Engine
- J13-3 THR_CUR_S Throttle 4-2-0mA Current Source Starboard Engine
- J13-4 THR_VOLT_S Throttle Voltage Source Starboard Engine
- J13-5 CAN_HP CAN bus high Starboard engine
- J13-6 CAN_LS CAN bus low Starboard engine
- J13-7 THR_FREQ_S Throttle Frequency Control Starboard Engine
- J13-8 Chassis ground

8.5.5. **PORT CLUTCH Connector**

- J2-1 HSDP4 Port Troll On/Off Command
- J2-2 GNDC DC Ground
- J2-3 HSDP1 Port Ahead Command
- J2-4 GNDC DC Ground
- J2-5 HSDP3 Port Troll Command
- J2-6 GNDC DC Ground
- J2-7 HSDP2 Port Astern Command
- J2-8 GNDC DC Ground

8.5.6. **STARBOARD CLUTCH Connector**

- J5-1 HSD4S Starboard Troll On/Off Command
- J5-2 GNDC DC Ground
- J5-3 HSD1S Starboard Ahead Command
- J5-4 GNDC DC Ground
- J5-5 HSD3S Starboard Troll Command
- J5-6 GNDC DC Ground
- J5-7 HSD2S Starboard Astern Command
- J5-8 GNDC - DC Ground

8.5.7. **POWER Connector**

- J14-1 VBAT1 Battery 1 - Port
- J14-2 GNDC1 DC Ground Battery 1 - Port
- J14-3 Fused Vsol,p *(Reserved-Do Not Use)*
- J14-4 Fused Vsol,s *(Reserved-Do Not Use)*
- J14-5 GNDC2 DC Ground Battery2 - Starboard
- J14-6 VBAT2 Battery 2 - Starboard
- J14-7 STIS+ Start Interlock Relay Contact, Starboard
- J14-8 STIS- Start Interlock Relay Contact, Starboard
- J14-9 Starboard voltage input *(Reserved-Do Not Use)*
- J14-10 Port voltage input *(Reserved-Do Not Use)*
- J14-11 STIP- Start Interlock Relay Contact, Port
- J14-12 STIP+ Start Interlock Relay Contact, Port



8.6. MiniCommand Processor Connector Pin Functions for CAN Throttle Output (VM Motori Engines only)

8.6.1. Signals between the Processor Module and the Port Engine

- J12-1 GNDE
- J12-2 No Connection
- J12-3 No Connection
- J12-4 No Connection
- J12-5 CAN_HP CAN bus high port engine
- J12-6 CAN_LP CAN bus low port engine
- J12-7 No Connection
- J12-8 Shield

8.6.2. Signals between the Processor Module and the Starboard Engine

- J13-1 GNDF
- J13-2 No Connection
- J13-3 No Connection
- J13-4 No Connection
- J13-5 CAN_HS CAN bus high starboard engine
- J13-6 CAN_LS CAN bus low starboard engine
- J13-7 No Connection
- J13-8 Shield

8.6.3. Signals between the Processor Module and the Transmission of the Port Engine

- J2-1 GNDF
- J2-2 GNDC Ground C
- J2-3 HSDP1 Port Ahead Command
- J2-4 GNDC Ground C
- J2-5 HSDP2 Port Astern Command
- J2-6 GNDC Ground C
- J2-7 HSDP3 Port Troll ON-OFF Command
- J2-8 GNDC Ground C

8.6.4. Signals between the Processor Module and the Transmission of the Starboard Engine

- J5-1 HSD4S Starboard Troll Command
- J5-2 GNDC Ground C
- J5-3 HSD1S Starboard Ahead Command
- J5-4 GNDC Ground C
- J5-5 HSD2S Starboard Astern Command
- J5-6 GNDC Ground C
- J5-7 HSD3S Starboard Troll ON-OFF Command



- J5-8 GNDC Ground C

8.6.5. **The Power Connection to the Processor Module is Described Below**

- J14-1 VBAT1 Battery 1 – Port
- J14-2 GNDC1 Ground Battery 1 - Port
- J14-3 VSW1 Switch Voltage Port for normal engine shutdown for VM Motori Engines only
- J14-4 VSW2 Switch Voltage Starboard for normal engine shutdown for VM Motori engines only
- J14-5 GNDC2 Ground Battery 2 - Starboard
- J14-6 VBAT2 Battery 2 – Starboard
- J14-7 STIS+ Start Interlock Starboard Engine
- J14-8 STIS- Start Interlock Starboard Engine Return
- J14-9 VMSTS Starboard normal engine shutdown switch input for VM Motori engines only.
- J14-10 VMSTP Port normal engine shutdown switch input for VM Motori engines only.
- J14-11 STIP- Start Interlock Port Engine Return
- J14-12 STIP+ Start Interlock Port Engine



Appendix A



9. System Drawings

- NOTES -

1. DO NOT MOUNT CONTROL SYSTEM COMPONENTS ON REDUCTION GEAR, ENGINE, OR IN ANY LOCATION SUBJECT TO EXCESSIVE VIBRATION.
2. DO NOT MOUNT CONTROL COMPONENTS NEAR SOURCES OF HIGH HEAT (EXHAUST DUCTS, ETC.), MAXIMUM ALLOWABLE AMBIENT TEMPERATURE IS 70°C.
3. DO NOT MOUNT CONTROL COMPONENTS NEAR SOURCES OF STRONG ELECTROMAGNETIC FIELDS (STARTERS, GENERATORS, ETC.).
4. MOUNT CONTROL COMPONENTS IN A LOCATION ACCESSIBLE FOR CHECKOUT, MONITORING AND MAINTENANCE.
5. ALL ELECTRICAL CABLES ARE TO BE SUITABLE FOR MARINE APPLICATION AND TO MEET ALL APPLICABLE REGULATORY REQUIREMENTS.

⚠ START INTERLOCK RELAY HAS NORMALLY OPEN CONTACTS. CONTACTS ARE CLOSED WHEN SYSTEM IS OPERATING AND COMMANDING NEUTRAL. MAXIMUM OF 5 AMP, MAXIMUM OF 30V.

⚠ THE CONTROL PROCESSOR WILL BE PROVIDED SHIP'S SUPPLY OF 12 OR 24 VDC, PROTECTED BY A 10 AMP RATED CIRCUIT BREAKER.

⚠ NOT USED

⚠ CAUTION:
THIS PART CONTAINS ELECTRONIC COMPONENTS WHICH CAN BE DESTROYED BY STATIC ELECTRICITY. PERSONNEL SHOULD GROUND THEMSELVES TO DISSIPATE ANY STATIC ELECTRICITY PRIOR TO WORKING INSIDE THE PART.

⚠ NOT USED

⚠ THE CONTROL PROCESSOR'S MOUNTING FEET MUST BE CONNECTED TO THE VESSEL'S GROUNDING SYSTEM.

⚠ NOT USED

⚠ NOT USED

⚠ REFER TO THE CONTROL SYSTEM MANUAL FOR ADDITIONAL INFORMATION.

⚠ CONTACT ZF MARINE ELECTRONICS OR REFER TO THE PROCESSOR'S INSTALLATION MANUAL FOR THE OPTIONS AVAILABLE FOR THIS ITEM.

⚠ ENSURE THAT THE YELLOW/GREEN SHIELD WIRE ATTACHED TO THE CONTROL HEAD CABLE IS CONNECTED TO THE GROUND STUD PROVIDED ON THE PROCESSOR CHASSIS.

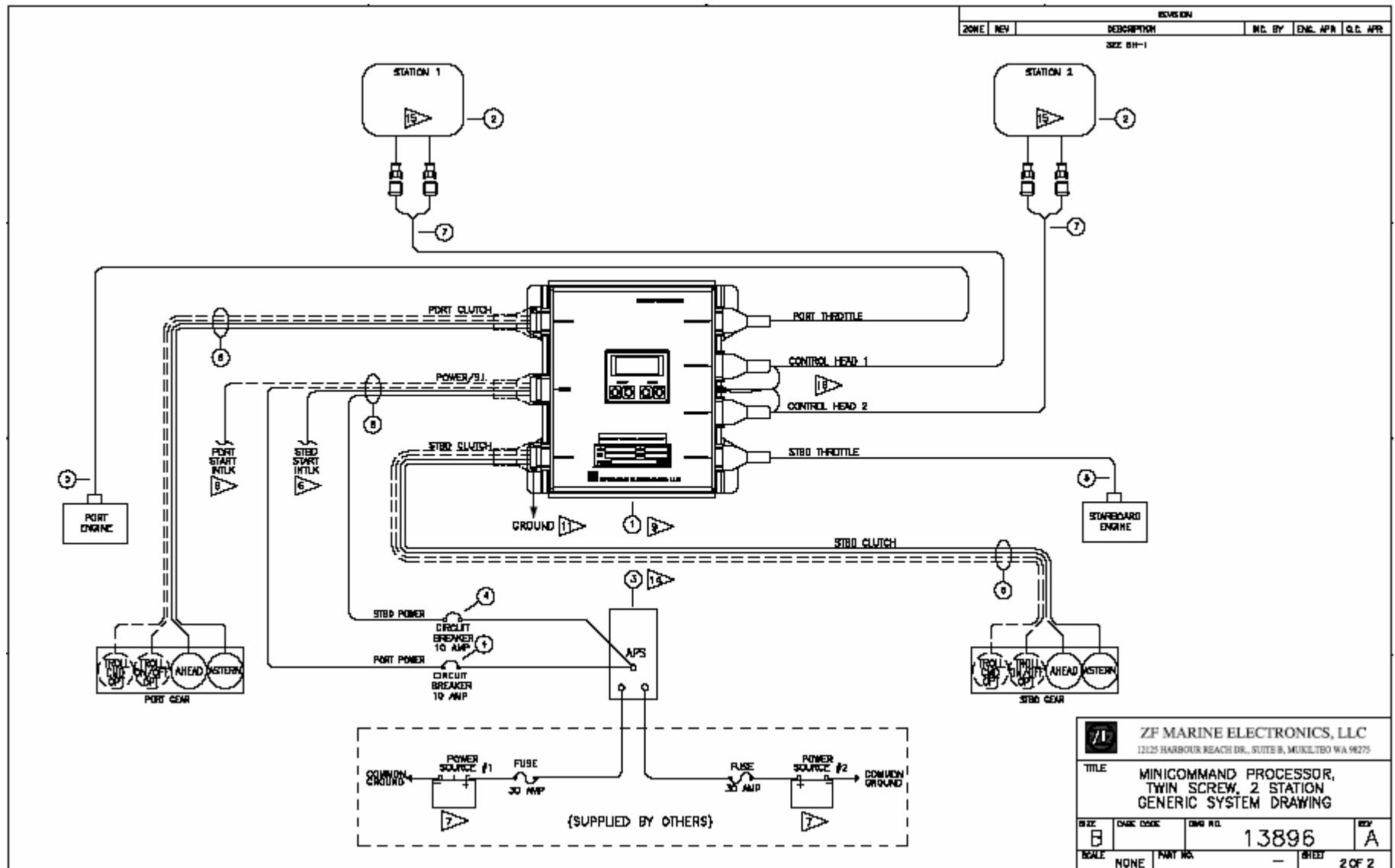
| MATERIAL LIST | | | | |
|---------------|------|-------|-------------|--|
| ✓ | ITEM | QTY | PART NUMBER | DESCRIPTION |
| | 1 | 1 | 13896 | MINICOMMAND PROCESSOR, TWIN SCREW |
| | 2 | MW. 2 | 13805 | CONTROL HEAD |
| | 3 | 1 | 13805 | AUTOMATIC POWER SELECTOR |
| | 4 | 2 | 81007A | CIRCUIT BREAKER, 10 AMP, UL1000 |
| | 5 | 2 | 13896 | WIRE HARNESS - THROTTLE, 3X FEET |
| | 6 | 2 | 13896 | WIRE HARNESS - MINICOMMAND, CLUTCH, 3X FEET |
| | 7 | MW. 2 | M4302-K1 | WIRE HARNESS - MINICOMMAND, CONTROL HEAD, TWIN SCREW, 3X FEET |
| | 8 | 1 | M4402-K1 | WIRE HARNESS - MINICOMMAND, POWER/SL, TWIN SCREW ANALOG, 3X FEET |

| INDEX | |
|-------|------------------------------|
| SHEET | DESCRIPTION |
| 1 | GENERAL NOTES, MATERIAL LIST |
| 2 | SYSTEM DIAGRAM |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--------------|--|----------------------------------|---------|------|-----------------|------|---------|----------|------|--|-----|----------|----------|-----|------------|----------|----|---|---|----|--------------|----------|-----|---|---|
| DR | A | SHEET 2 - SHIPPED DAMAGED AND BOLD LINES FOR STRO CLUTCH 1 DABLE | CLASHMAN | 3-17-07 | JED | 3-17-07 | RSH | 3-17-07 | | | | | | | | | | | | | | | | | | |
| DATE | REV | DESCRIPTION | DES. BY | CHK. BY | DATE | DATE | DATE | DATE | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">APPROVAL</td> <td style="width: 15%;">DATE</td> <td style="width: 70%; text-align: center;"> ZF MARINE ELECTRONICS, LLC 13125 HARBOUR BEACH DR., SUITE B, MEKELTOD WA 98025 </td> </tr> <tr> <td>DWH</td> <td>CLASHMAN</td> <td>04/24/07</td> </tr> <tr> <td>ENG</td> <td>J.DONWICKS</td> <td>04/24/07</td> </tr> <tr> <td>GM</td> <td>-</td> <td>-</td> </tr> <tr> <td>QC</td> <td>RH LUDERHARD</td> <td>04/28/07</td> </tr> <tr> <td>MFG</td> <td>-</td> <td>-</td> </tr> </table> | | | | | | | | | APPROVAL | DATE | ZF MARINE ELECTRONICS, LLC 13125 HARBOUR BEACH DR., SUITE B, MEKELTOD WA 98025 | DWH | CLASHMAN | 04/24/07 | ENG | J.DONWICKS | 04/24/07 | GM | - | - | QC | RH LUDERHARD | 04/28/07 | MFG | - | - |
| APPROVAL | DATE | ZF MARINE ELECTRONICS, LLC 13125 HARBOUR BEACH DR., SUITE B, MEKELTOD WA 98025 | | | | | | | | | | | | | | | | | | | | | | | | |
| DWH | CLASHMAN | 04/24/07 | | | | | | | | | | | | | | | | | | | | | | | | |
| ENG | J.DONWICKS | 04/24/07 | | | | | | | | | | | | | | | | | | | | | | | | |
| GM | - | - | | | | | | | | | | | | | | | | | | | | | | | | |
| QC | RH LUDERHARD | 04/28/07 | | | | | | | | | | | | | | | | | | | | | | | | |
| MFG | - | - | | | | | | | | | | | | | | | | | | | | | | | | |
| TITLE MINICOMMAND PROCESSOR, TWIN SCREW, 2 STATION GENERIC SYSTEM DRAWING | | | DOW DATE CODE 13896 | | | REV A | | | | | | | | | | | | | | | | | | | | |
| SCALE | | PART NO. | | SHEET | | 1 OF 2 | | | | | | | | | | | | | | | | | | | | |
| NONE | | | | | | | | | | | | | | | | | | | | | | | | | | |

THIS INFORMATION IS UNCLASSIFIED AND IS NOT TO BE REPRODUCED IN WHOLE OR IN PART OR USED FOR ANY PURPOSES EXCEPT THOSE AUTHORIZED BY ZF MARINE ELECTRONICS, LLC.

Figure 51: Twin Screw, Two Station

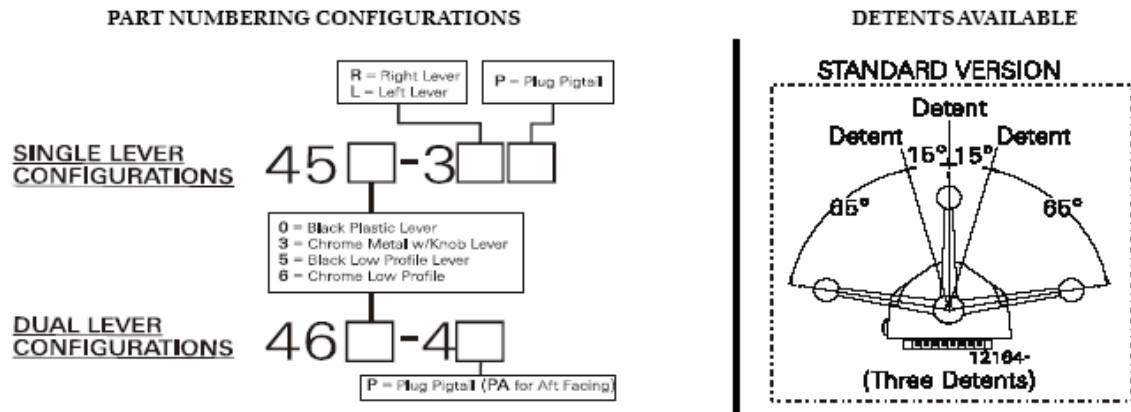




10. Control Head Variations

10.1. 400 Series Control Head

This Service Sheet reflects all current variations of the standard 3-detent ZF Marine Electronics 400 Series Control Heads.



REQUIREMENTS:

MicroCommander/ClearCommand: one (1) 8-Conductor Cable per Control Head lever.

Pluggable MicroCommander/ClearCommand: one (1) Control Head Harness per Control Head lever.

CruiseCommand: one (1) Control Head Harness per Control Head lever.

Included with the Control Head:

- Gasket
- Mounting screws and washers
- Terminals (For 8-Conductor or 1-Connector Harnesses)
- Watertight cable grip for the cable entrance on the Processor (For 8-Conductor)

When the Control Head is properly mounted on a console, it is spray proof from the top only. An adhesive gasket must be used to seal it to the mounting surface. However, below the mounting surface it needs protection from water or spray. Consider using a Weather Mount Enclosure, which is available from ZF Marine Electronics.

MOUNTING AND INSTALLATION:

- Select** the desired mounting locations and make cutouts per template. Refer to the Dimensions Diagram.
- Check** that the four mounting screws will start into the Control Head. Remove the Control Head from the cutout.
- Remove** the backing from the adhesive gasket and apply the gasket adhesive side to the console around the cutout.
- Run** cable/harnesses between Processor and Control Head. Label both ends with the Station ID. (EXAMPLE: Port, Center, or Starboard; Port Thrust, Port Throttle; etc.)

There are two types of Control Head connections available: Plug or Terminal Connected. Both types may be used with MicroCommander, ClearCommand, or CruiseCommand using the appropriate cable or harness. Follow the appropriate steps for the Control Head that has been supplied for your system.

TYPE 1 - PLUGGABLE

Plug Control Head cable into the pigtail at the Control Head. (Ensure the correct Processor Cable is being plugged into the corresponding Control Head lever pigtail).

When connecting the plugs, ensure that the release button or buttons are **depressed and held** until plug is fully connected or disconnected. Connecting or disconnecting plugs without **depressing and holding** the release button or buttons will damage the plug.

TYPE 2 - HARD-WIRED

- Strip** back the PVC cover on the shielded cable approximately 2-1/2" (63,5mm) at the Control Head.
- At the Control Head end of the cable **strip and cut off** the shielding and drain wire flush with the end of the PVC cover (the drain wire at the Control Head is **not** connected to ground).

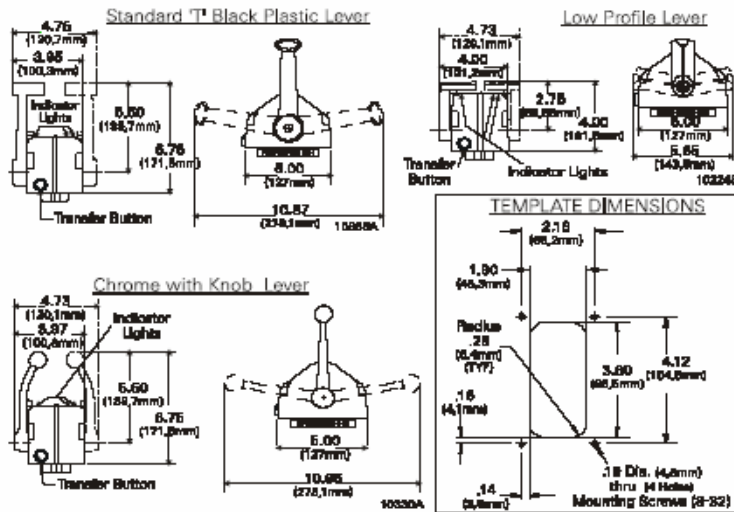
Control Head Variations

MMC-280 Rev.M 1/07



- C) Strip 3/8" (9,5mm) insulation off each wire.
- D) Twist the individual strands of the wires to minimize fraying.
- E) Crimp a locking fork terminal (included with each Control Head) to each of the conductors.
- F) Make connections to the Control Head as indicated in the following TERMINAL CONNECTIONS diagrams.

DIMENSIONS



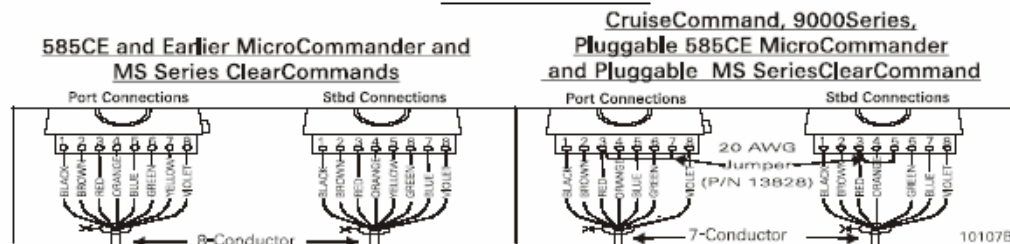
ALWAYS REFER TO THE MANUAL THAT IS SUPPLIED WITH THE CONTROL SYSTEM FOR ANY UNIQUE CONTROL HEAD CONNECTIONS FOR YOUR SYSTEM.

When cable connections are complete, MOUNT Control Head to the console using the four (4) mounting screws and washers supplied with the Control Head.

CABLE/HARNESS CONNECTIONS:

DUAL CONTROL HEAD CONNECTIONS

Terminal Connections



Cable/Jumper connections 5 and 7 at the Port and Starboard terminal block are direction sensitive.

MicroCommander/ClearCommand

| | |
|-------------------|-------------------|
| Port Lever: | Starboard Lever: |
| Terminal 3 Red | Terminal 3 Red |
| Terminal 5 Blue | Terminal 5 Yellow |
| Terminal 7 Yellow | Terminal 7 Blue |

CruiseCommand/9000 Series

| | |
|-------------------------|-------------------------|
| Port Lever: | Starboard Lever: |
| Terminal 3 Red & JUMPER | Terminal 3 Red & JUMPER |
| Terminal 5 Blue | Terminal 5 JUMPER |
| Terminal 7 JUMPER | Terminal 7 Blue |

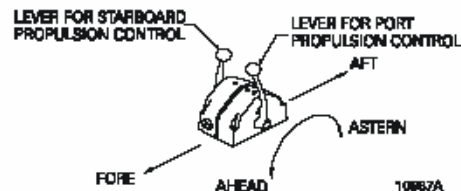
Pluggable Connections

Pluggable Control Heads are supplied with a harness pigtail for each lever. When disconnecting/connecting the plugs, ensure that the release button or buttons are depressed and held until plug is fully disconnected or connected. Disconnecting/connecting plugs without depressing and holding the release button or buttons **WILL** damage the plug.

AFT FACING CONTROL HEADS

For dual lever Control Head Stations that have the user facing aft: Reverse connections 5 and 7.

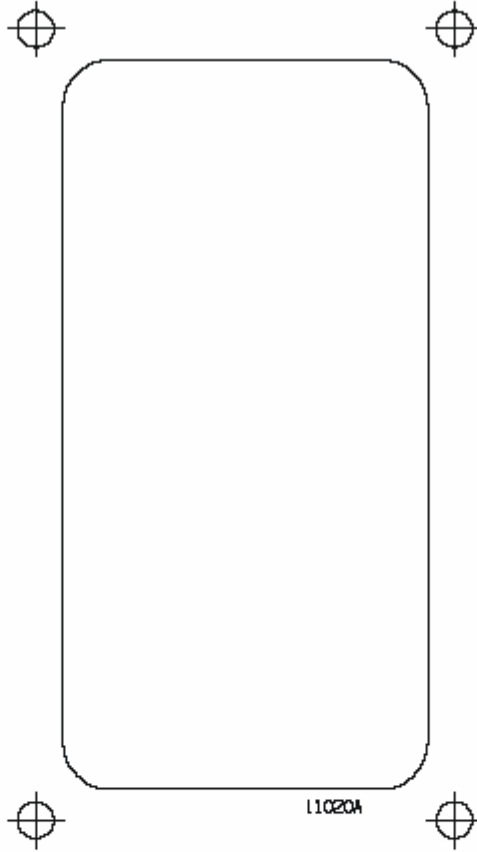
For single lever Control Head Stations that have the user facing aft and the one Control Head lever on the user's right, reverse connections 5 and 7.



Handheld Control is a Station option. Contact your ZF Marine Electronics Dealer for further information on Handheld requirements and options.



0.19 Diameter (4,8mm) through Holes
(4 holes)

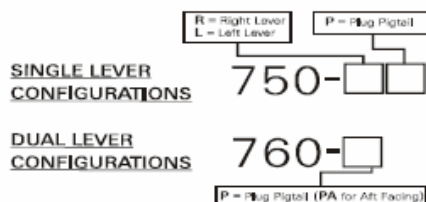




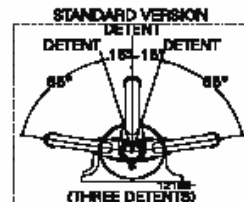
10.2. 700 Series Control Heads

This Service Sheet reflects all current variations of the standard 3-detent ZF Marine Electronics 700 Series Control Heads.

Part Numbering Configurations



Detents Available



REQUIREMENTS:

MicroCommander/ClearCommand: one (1) 8-Conductor Cable per Control Head lever.

Pluggable MicroCommander/ClearCommand: one (1) Control Head Harness per Control Head lever.

CruiseCommand: one (1) Control Head Harness per Control Head lever.

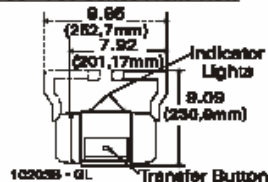
Included with the Control Head:

- (4) Flat-washer - Stainless Steel, 1/4 inch
- (4) Screw - Stainless Steel, Philip Pan Head, 1/4 inch-20 x 1-3/4 inch
- (4) Nut - Stainless Steel, 1/4 inch-20
- (14) Terminal - Flanged For, #6
- (2) Liquid Tight Connector (in addition to those installed at the factory)

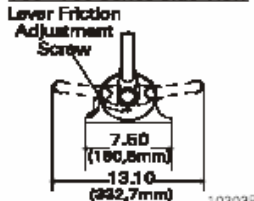
When the Control Head is properly mounted on a console, the Control Head is watertight.

Dimensions

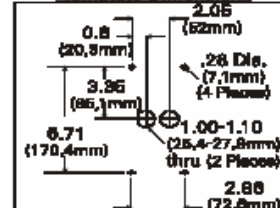
750 - 760 Series Front View



750 - 760 Series Side View



Template Dimensions



MOUNTING AND INSTALLATION:

Select the desired mounting locations and drill screw and cable holes as indicated on the template diagram. Refer to the Dimensions Diagram on the next page.

Run cable/harnesses between Processor and Control Head. Label both ends with the Station ID. (EXAMPLE: Port, Center, or Starboard; Port Thrust, Port Throttle; etc.)

There are two types of Control Head connections available: Plug or Terminal Connected. Both types may be used with MicroCommander, ClearCommand, or CruiseCommand using the appropriate cable or harness. Follow the appropriate steps for the Control Head that has been supplied for your system.

Standard Cable

- Remove the six screws holding the bottom cover of the Control Head housings and set aside.
- Insert cable through the correct cable grip in the bottom cover.
- Strip back the PVC cover on the shielded cable approximately 2-1/2" (63,5mm) at the Control Head.
- At the Control Head end of the cable strip and cut off the shielding and drain wire flush with the end of the PVC cover (the drain wire at the Control Head is not connected to ground).
- Strip 3/8" (9,5mm) insulation off each wire.
- Twist the individual strands of the wires to minimize fraying.
- Crimp a locking fork terminal (included with each Control Head) to each of the conductors.
- Make connections to the Control Head as indicated in the following TERMINAL CONNECTIONS diagrams.



Pluggable

- A) Plug Control Head cable into the pigtail at the Control Head. (Ensure the correct Processor Cable is being plugged into the corresponding Control Head lever pigtail).
- B) When connecting the plugs, ensure that the release button or buttons are depressed and held until plug is fully connected or disconnected. Connecting or disconnecting plugs without depressing and holding the release button or buttons will damage the plug.

ALWAYS REFER TO THE MANUAL THAT IS SUPPLIED WITH THE CONTROL SYSTEM FOR ANY UNIQUE CONTROL HEAD CONNECTIONS FOR YOUR SYSTEM.

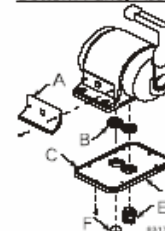
When cable connections are complete:

- A) Replace Control Head bottom cover using the six (6) mounting screws removed earlier. Ensure seal is in place.
- B) Tighten watertight cable grip(s).
- C) Remove front cover from the Control Head
- D) Mount Control Head with supplied hardware.
- E) Replace front cover when mounting is complete.

Bottom Panel Assembly Designations

| | |
|---|--|
| A | Front Cover |
| B | Cable Grip Nut |
| C | Seal |
| D | Bottom Cover |
| E | 750-R = Plug; 750-L & 760 = Watertight Cable Grip (Cable O.D. .275 - .393 [7mm - 10mm]) |
| F | 750-L = Plug; 750-R & 760 = Watertight Cable Grip (Cable O.D. .275 - .393 [7mm - 10mm]) |

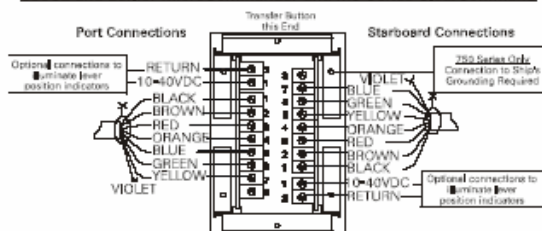
Bottom Panel Assembly



CABLE/HARNESS CONNECTIONS:

Dual Control Head Connections

585CE and Earlier MicroCommander and MS Series ClearCommand



TERMINAL CONNECTIONS

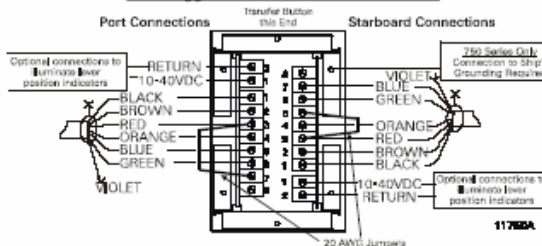
Cable/Jumper connections 5 and 7 at the Port and Starboard terminal block are direction sensitive.

585CE and Earlier MicroCommander and MS Series ClearCommand

- | | |
|--------------------------|--------------------------|
| Port Lever: | Starboard Lever: |
| <u>Terminal 3</u> Red | <u>Terminal 3</u> Red |
| <u>Terminal 5</u> Blue | <u>Terminal 5</u> Yellow |
| <u>Terminal 7</u> Yellow | <u>Terminal 7</u> Blue |

CruiseCommand, 9000 Series, Pluggable 585CE MicroCommander and Pluggable MS Series ClearCommand

CruiseCommand, 9000 Series, Pluggable 585CE MicroCommander and Pluggable MS Series ClearCommand



- | | |
|--------------------------------|--------------------------------|
| Port Lever: | Starboard Lever: |
| <u>Terminal 3</u> Red & JUMPER | <u>Terminal 3</u> Red & JUMPER |
| <u>Terminal 5</u> Blue | <u>Terminal 5</u> JUMPER |
| <u>Terminal 7</u> JUMPER | <u>Terminal 7</u> Blue |

PLUGGABLE CONNECTIONS

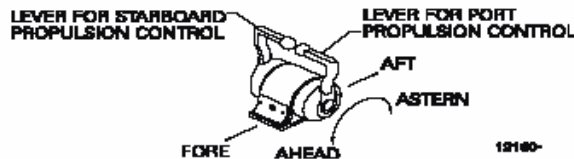
Pluggable Control Heads are supplied with a harness pigtail for each lever. When disconnecting/connecting the plugs, ensure that the release button or buttons are depressed and held until plug is fully disconnected or connected. Disconnecting/connecting plugs without depressing and holding the release button or buttons WILL damage the plug.

Aft Facing Control Head

For dual lever Control Head Stations that have the user facing aft: Reverse connections 5 and 7.

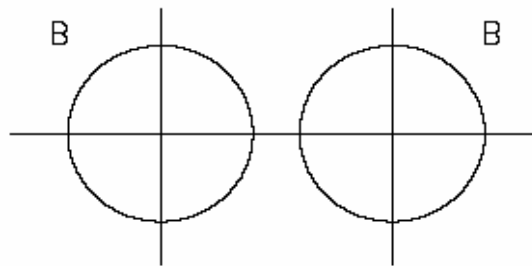
For single lever Control Head Stations that have the user facing aft and the one Control Head lever on the user's right, reverse connections 5 and 7.

Handheld Control is a Station option. Contact your ZF Marine Electronics Dealer for further information on Handheld requirements and options.





TEMPLATE



"A" HOLES \varnothing .28

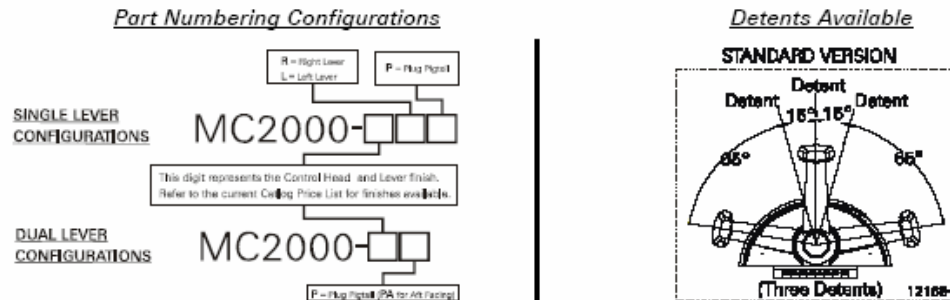
"B" HOLES \varnothing 1.00 - 1.10

11403-



10.3. MC2000 Series Control Heads

This Service Sheet reflects all current variations of the standard 3-detent ZF Marine Electronics MC2000 Series Control Heads



REQUIREMENTS:

- MicroCommander/ClearCommand: one (1) 8-Conductor Cable per Control Head lever.
- Pluggable MicroCommander/ClearCommand: one (1) Control Head Harness per Control Head lever.
- CruiseCommand: one (1) Control Head Harness per Control Head lever.

Included with the Control Head:

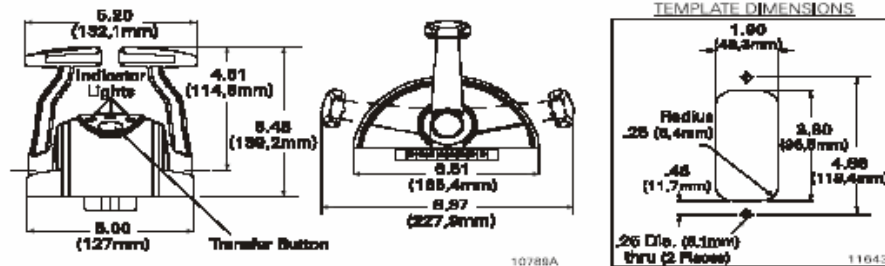
- Mounting screws
- Terminals (For 8-Conductor or 1-Connector Harnesses)
- Watertight cable grip for the cable entrance on the Processor (For 8-Conductor)

When the Control Head is properly mounted on a console, it is spray proof from the top only. An adhesive gasket is mounted on the bottom of the Control Head to seal it to the mounting surface. However, below the mounting surface it needs protection from water or spray. Consider using a Weather Mount Enclosure, which is available from ZF Marine Electronics.

MOUNTING AND INSTALLATION:

- A) Select the desired mounting locations and make cutouts per template. Refer to the Dimensions Diagram.
- B) Check that the two mounting screws will start into the Control Head. Remove Control Head from cutout.
- C) Run cable/harnesses between Processor and Control Head. Label both ends with the Station ID. (EXAMPLE: Port, Center, or Starboard; Port Thrust, Port Throttle; etc.)

Dimensions



There are two types of Control Head connections available: Plug or Terminal Connected. Both types may be used with MicroCommander, ClearCommand, or CruiseCommand using the appropriate cable or harness. Follow the appropriate steps for the Control Head that has been supplied for your system.

Pluggable

- A) Plug Control Head cable into the pigtail at the Control Head. (Ensure the correct Processor Cable is being plugged into the corresponding Control Head lever pigtail).
- B) When connecting the plugs, ensure that the release button or buttons are depressed and held until plug is fully connected or disconnected.
- C) Connecting or disconnecting plugs without depressing and holding the release button or buttons will damage the plug.



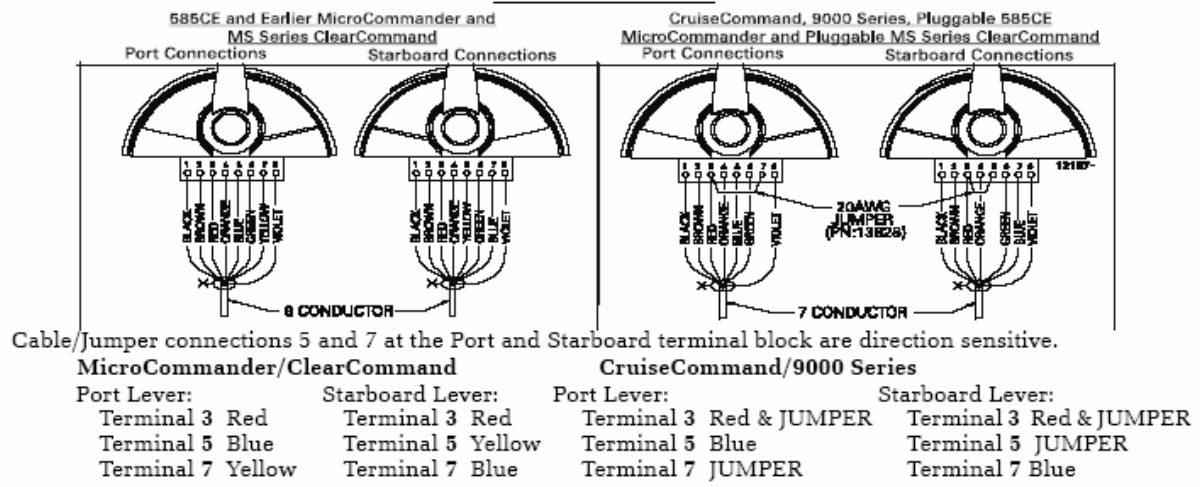
- A) Strip back the PVC cover on the shielded cable approximately 2-1/2" (63,5mm) at the Control Head.
- B) At the Control Head end of the cable strip and cut off the shielding and drain wire flush with the end of the PVC cover (the drain wire at the Control Head is not connected to ground).
- C) Strip 3/8" (9,5mm) insulation off each wire.
- D) Twist the individual strands of the wires to minimize fraying.
- E) Crimp a locking fork terminal (included with each Control Head) to each of the conductors.
- F) Make connections to the Control Head as indicated in the following TERMINAL CONNECTIONS diagrams.

ALWAYS REFER TO THE MANUAL THAT IS SUPPLIED WITH THE CONTROL SYSTEM FOR ANY UNIQUE CONTROL HEAD CONNECTIONS FOR YOUR SYSTEM.

When cable connections are complete, MOUNT Control Head to the console using the two (2) mounting screws and washers supplied with the Control Head.

CABLE/HARNESS CONNECTIONS:
Dual Control Head Connections

Terminal Connections

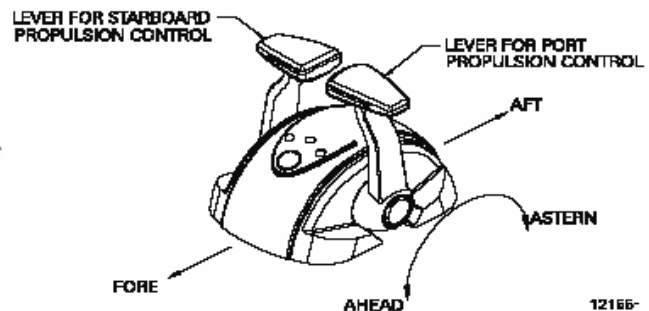


Pluggable Connections

Pluggable Control Heads are supplied with a harness pigtail for each lever. When disconnecting/connecting the plugs, ensure that the release button or buttons are depressed and held until plug is fully disconnected or connected. Disconnecting/connecting plugs without depressing and holding the release button or buttons **WILL** damage the plug.

Aft Facing Control Heads

For dual lever Control Head Stations that have the user facing aft: Reverse connections 5 and 7.
For single lever Control Head Stations that have the user facing aft and the one Control Head lever on the user's right, reverse connections 5 and 7.



Handheld Control is an option. Contact your ZF Marine Electronics Dealer for further information on Handheld requirements and options.



0.25 Diameter (6,1mm) through Holes
(2 Holes)



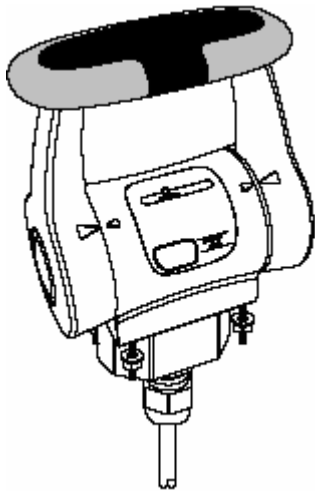


10.4. 4000 Series Control Heads

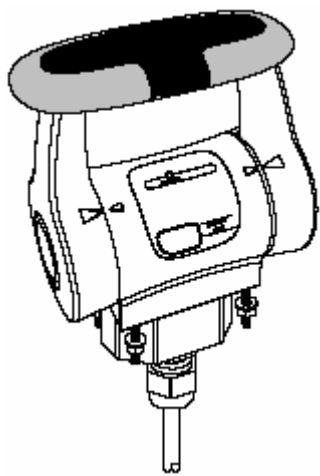
This Service Sheet reflects all current variations of the standard 3-detent ZF Marine Electronics 4000 Series Control Heads.

- Neutral
- Forward
- Reverse

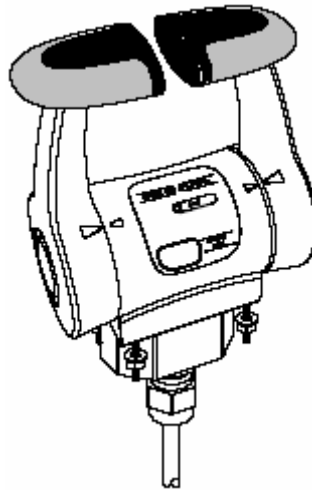
| Control Head # | Description |
|----------------|---|
| 4100 | Control Head, 4000 Series, Single Screw. This control head has a bridge between the levers to join them. |
| 4100LP | Control Head, 4000 Series, Single Screw, Low Profile. This control head has a bridge between the levers to join them. |
| 4200 | Control Head, 4000 Series, Twin Screw. |
| 4200LP | Control Head, 4000 Series, Twin Screw, Low Profile. |



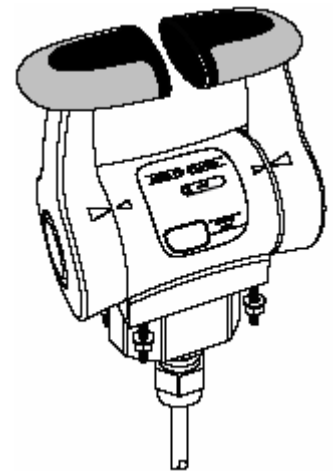
4100 Control Head
(13801C-1)



4100LP Control Head
(Low Profile) (13801C-1)



4200 Control Head
(13783C-1)



4200LP Control Head
(Low Profile)
(13783C-1)

REQUIREMENTS:

| Control System | Wire Harness Description |
|--|---|
| MicroCommander/ ClearCommand | (1) Control Head wire harness per lever |
| Pluggable Micro Commander/Clear Command | (1) Control Head wire harness per lever. |
| CruiseCommand | (1) Control Head wire harness per lever. |
| MiniCommand | (1) Control Head wire harness per Control Head. |



INCLUDED WITH THE CONTROL HEAD:

Mounting Studs with washer and nuts.

MOUNTING AND INSTALLATION:

1. Select the desired mounting location(s) and make cutout(s) per template. Refer to the Dimensions Diagram in the Cutout.
2. Check that the four mounting studs will start into the Control Head. Remove Control Head from cutout.
3. Run cable/wire harnesses between Processor and Control Head. Label both ends with the Station ID. (EXAMPLE: Port, Center, or Starboard; Port Thrust, Port Throttle, etc.).

Connections

There are two types of Control Head connections available:

- Pluggable on both ends
- Pluggable on one end and hardwired on the other.

The 4000 series Control Heads for the Cruise Command and MiniCommand processors are always pluggable at both ends. The control heads for the 9000 processors (MicroCommander / ClearCommand) can be pluggable at both ends or pluggable at the control head end and hardwired at the processor end.

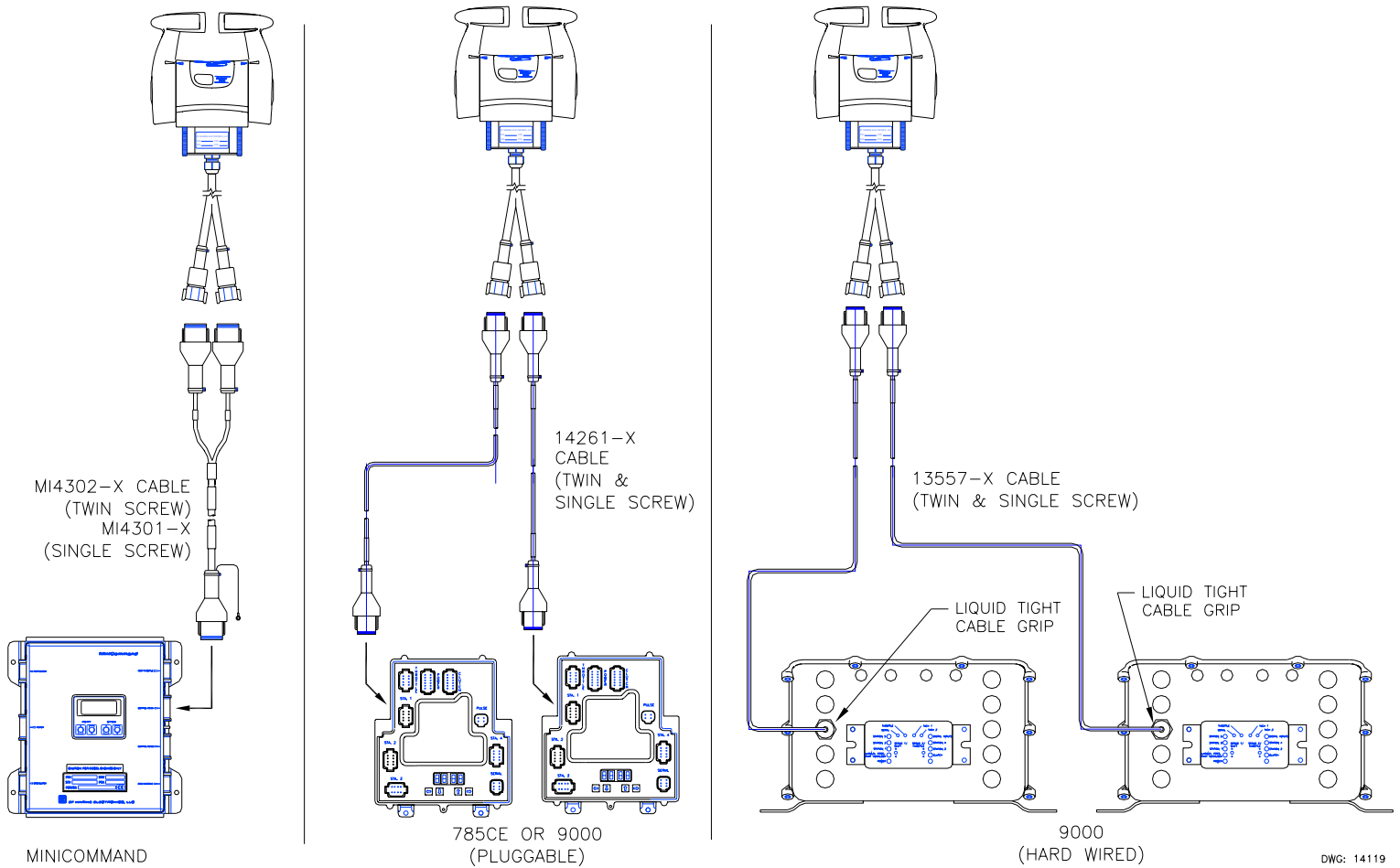
Pluggable

1. Plug Control Head cable/wire harness into the corresponding pigtail coming from the Processor. Ensure the correct Processor Cable is being plugged into the correct Control Head pigtail. (Example: Port to Port; Starboard to Starboard.)
2. When connecting the plugs, ensure that the release button or buttons are ***depressed and held*** until the plug is fully connected or disconnected.
3. Connecting or disconnecting plugs without ***depressing and holding*** the release button or buttons will damage the plug.



CABLE/HARNESS CONNECTIONS

Dual Control Head Connection

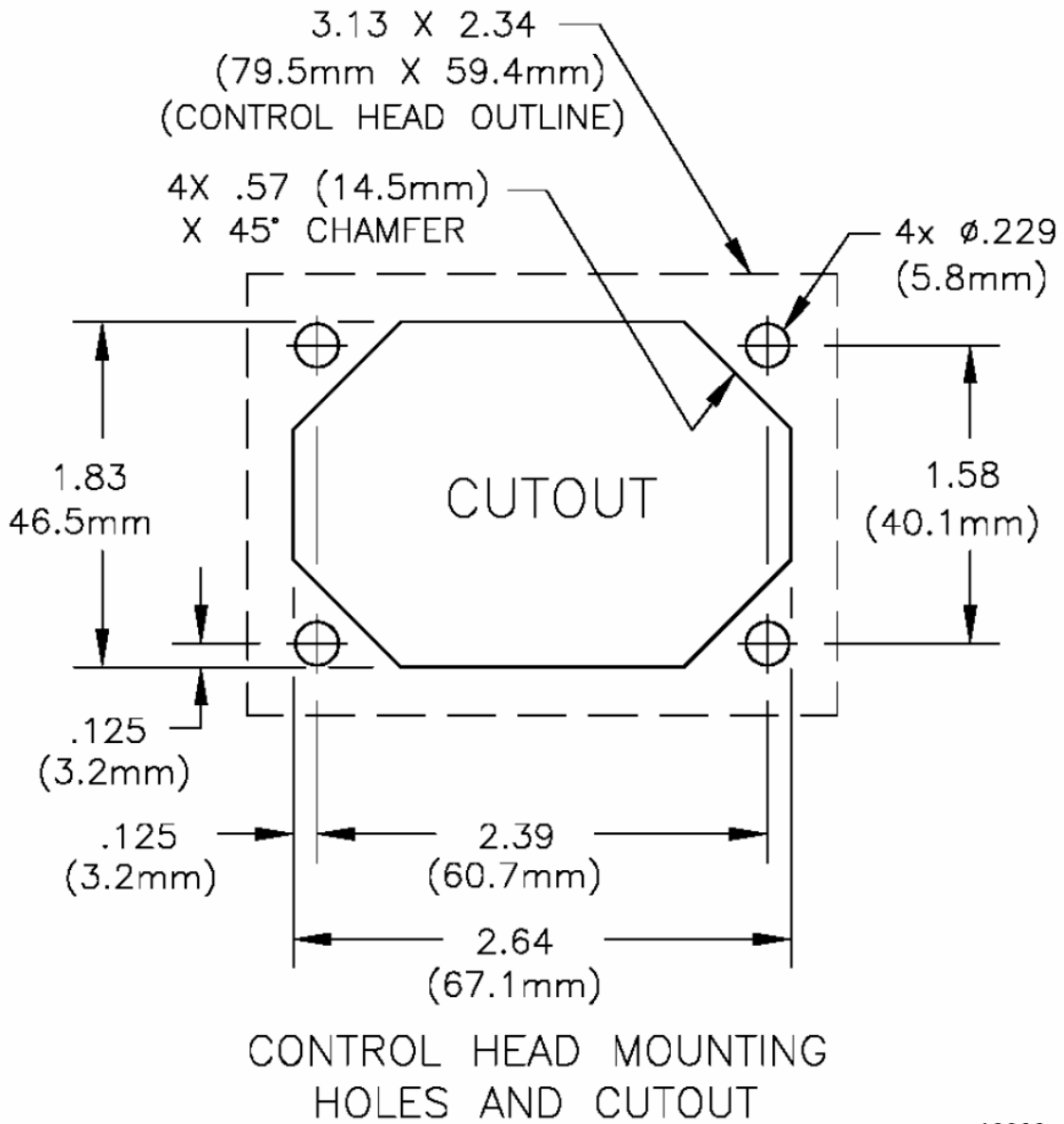


DWG: 14119

| | |
|--|--|
| | <p>WARNING: Pluggable Control Heads are supplied with a harness pigtail for each lever. When disconnecting/connecting the plugs, ensure that the release button or buttons are <u>depressed and held</u> until plug is fully disconnected or connected. Disconnecting/connecting the plugs without <u>depressing and holding</u> the release button or buttons WILL damage the plug.</p> |
|--|--|



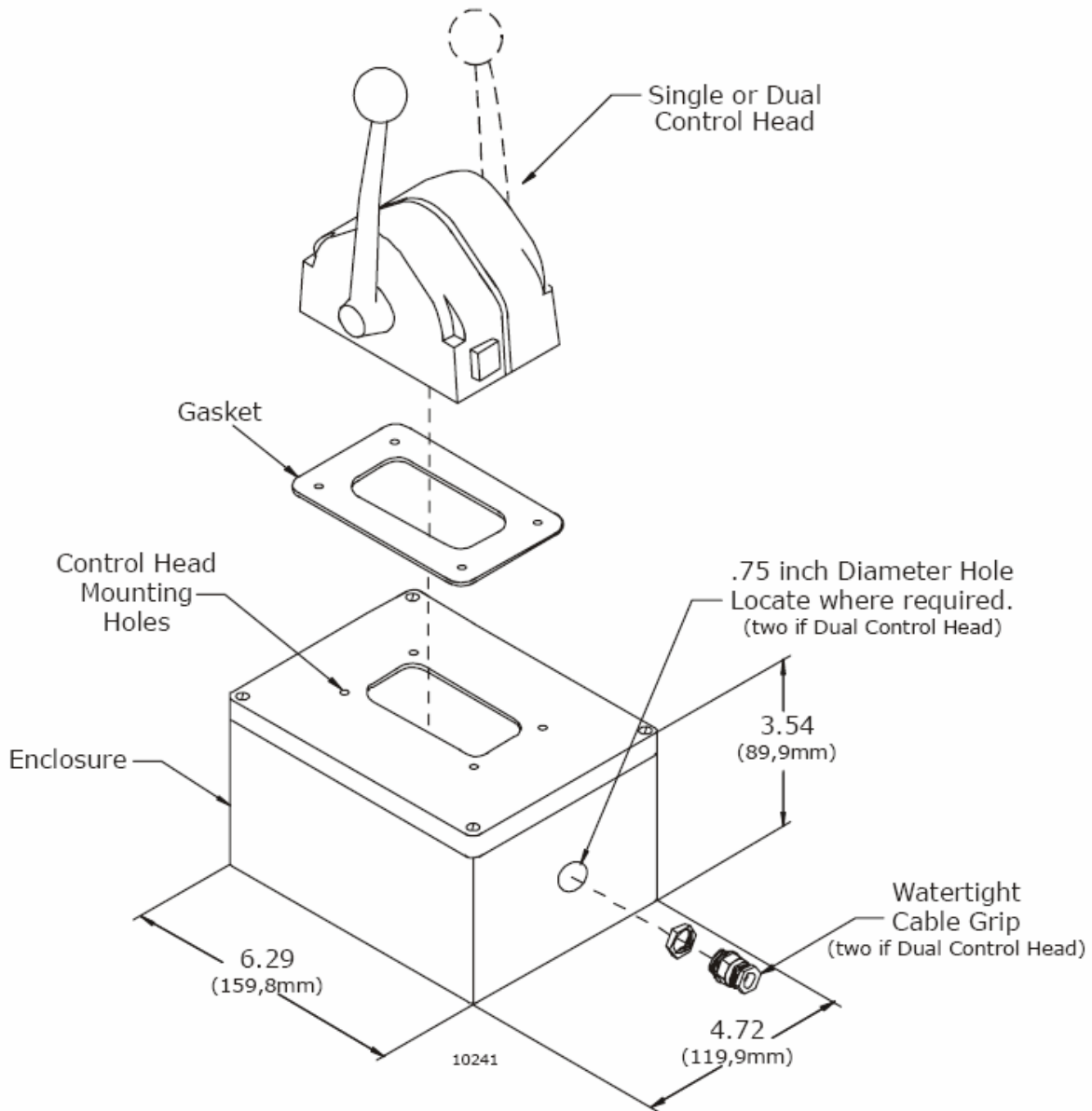
4000 Series Control Head Cutout



13293



11. Weather Mount Enclosure



Deck Mount or Exposed Mount

Ideal for Outside Mount

To prevent internal condensation and moisture build up, the mount is drilled to allow air circulation.

Part No. 12110



12. Deutsch Connector Assembly

12.1. DT Type

| Step 1: Contact Removal | | Step 2: Wire Stripping - Solid Contacts | | |
|---|---|---|--|------------------------------|
| | <ol style="list-style-type: none"> 1. Remove wedgelock using needlenose pliers or a hook shaped wire. Pull wedge straight out. 2. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver. 3. Hold the rear seal in place, as removing the contact may displace the seal | Contact Part Number | Wire Gauge Range | Strip Length (inches) |
| | | 0460-202-20141 0462-201-20141 | 20 AWG 20 AWG | .156-.218 .156-.218 |
| | | 0460-202-16141 0462-201-16141 | 16, 18 & 20 AWG 16, 18 & 20 AWG | .250-.312 .250-.312 |
| | | 0460-215-16141 0462-209-16141 | 14 AWG 14 AWG | .250-.312 .250-.312 |
| | | 0460-204-12141 0462-203-12141 | 12 & 14 AWG 12 & 14 AWG | .222-.284 .222-.284 |
| | | 0460-204-08141 0462-203-08141 | 8 & 10 AWG 8 & 10 AWG | .430-.492 .430-.492 |
| | | 0460-204-0490 0462-203-04141 | 6 AWG 6 AWG | .430-.492 .430-.492 |
| Step 3: Contact Crimping Use Crimp Tool #HDT48-00 | | Step 4: Contact Insertion | | |
| | <ol style="list-style-type: none"> 1. Strip insulation from wire. (See Step 2.) 2. Raise selector knob and rotate until arrow is aligned with wire size to be crimped. 3. Loosen locknut; turn adjusting screw in until it stops. 4. Insert contact with barrel up. Turn adjusting screw counter-clockwise until contact is flush with indenter cover. Tighten locknut. 5. Insert wire into contact. Contact must be centered between indicators. Close handles until crimp cycle is completed. 6. Release handles and remove crimped contact. 7. Inspect terminal to ensure that all strands are in crimp barrel. Note: Tool must be readjusted for each type/size of contact. Use HDT04-08 for size 8 and 4 contacts. | | <ol style="list-style-type: none"> 1. Grasp crimped contact approximately (25,2 mm) one inch behind the contact barrel. 2. Hold connector with rear grommet facing you. 3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that contact is properly locked in place. 4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. They may go in either way. Note: The receptacle is shown. Use the same procedure for the plug. | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | <p>Exclusive Authorized U.S. Distributor (800) 223-1236</p> | | |



13. Grounding (Bonding)

Grounding (Bonding) should be done according to ABYC Section E-11 and Code of Federal Regulations 46 CFR 111.05

Each grounding system must have only one point of connection to ground regardless of the number of power sources operating in parallel in the system.

A vessel's hull must not carry current as a conductor. A metallic hull, or the bonding and DC grounding systems, shall not be used as a return conductor.

There are some limited exceptions:

1. Impressed current cathodic protection systems.
2. Limited and locally grounded systems, such as a battery system for engine starting that has a one-wire system and the ground lead connected to the engine.
3. Insulation level monitoring devices if the circulation current does not exceed 30 mA under the most unfavorable conditions.
4. Welding systems with hull return except vessels subject to 46 CFR Subchapter D.

Grounding conductors should be green or green with a yellow stripe.

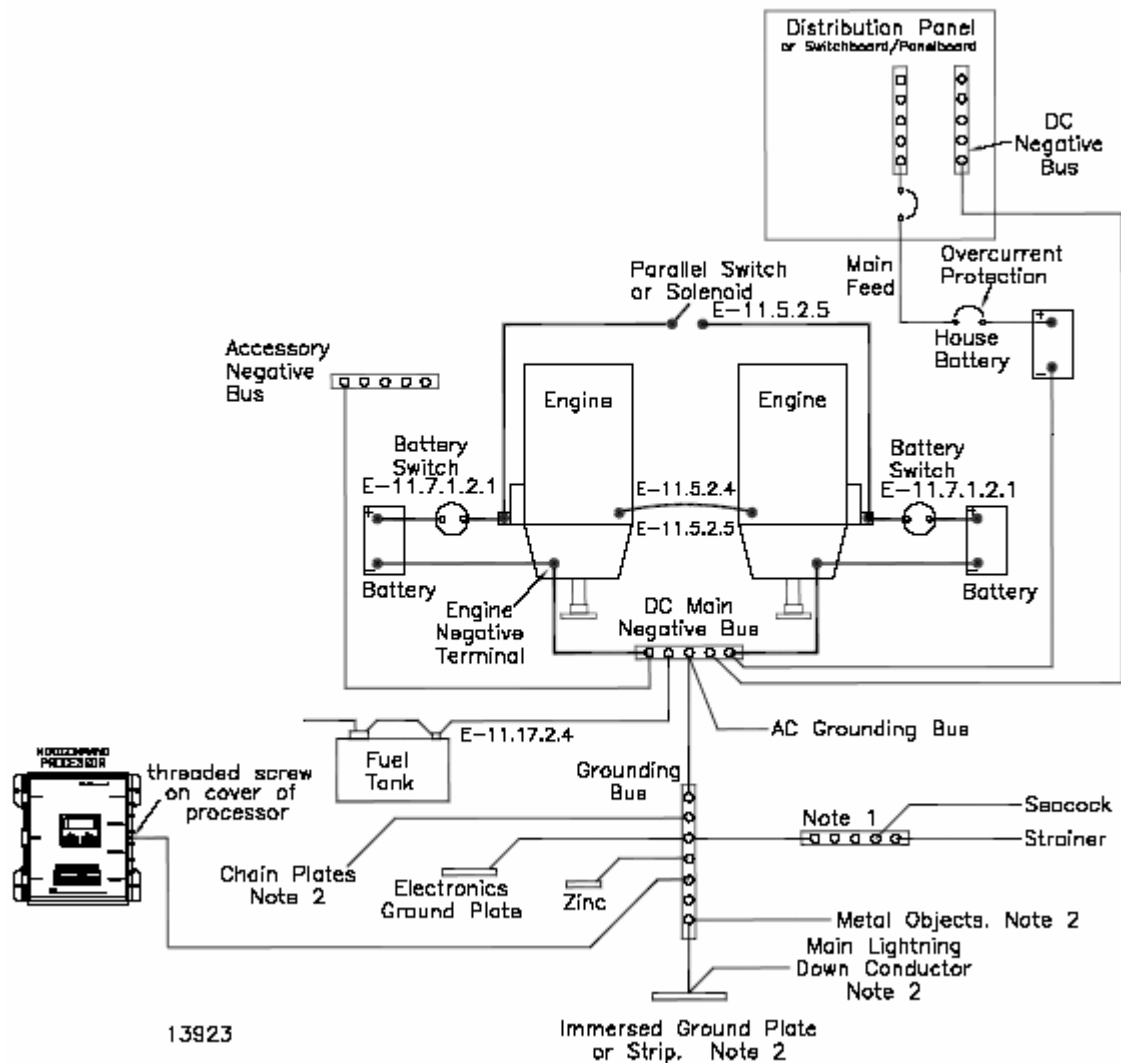
References:

- CFR Sec. 111.05-11, Sec. 111.05-13
- ABYC E-11; 11.4, 11.5.2.2, 11.18

See drawing on next page.



Figure 52: Grounding*



* Grounding is used courtesy of American Boat and Yacht Council
 All parts of figure except processor and processor connection © 2003 American Boat and Yacht Council



13.1. Metal Hull Vessels

The hull of a metal hull vessel may serve as the common grounding conductor. If it is desirable for the item being installed to be bonded to the vessel grounding system, and the installation or mounting method does not provide the desired path, a separate grounding conductor may be required.



14. References and Part Sources

14.1. References

- 14.1.1. **American Boat & Yacht Council (ABYC)**, 3069 Solomon's Island Road, Edgewater, MD 21037-1416, www.abycinc.org.

| | |
|----------|--|
| E-11.6.2 | Wiring Identification on Boats |
| E-11 | AC and DC Electrical Systems on Boats |
| H-2.6 | (Gasoline Engines) or H32.5.5 (Diesel Engines) Ambient Temp. 50 degree C |
| P-24 | Electric/Electronic Propulsion Controls |

- 14.1.2. **Code of Federal Regulations**

Obtain from the Superintendent of Documents, United States Information, POB 371 954, Pittsburgh, PA 15250-7954

- 33CFR 183 Subpart I – Electrical Systems
- 33CFR 183.410 Ignition Protection
- 33CFR 183.415 Grounding
- 33CFR 183.425 Conductors: General
- 33CFR 183.430 Conductors in Circuit of Less than 50 Volts
- 33CFR 183.445 Conductors: Protection
- 46CFR 111.01-5(b) Ambient Temp. Machinery Spaces 50 degrees C
- 46CFR 111.05-System Grounds

- 14.1.3. **Eng 119 Test Specification**

Revision M, AF Marine Electronics, Mukilteo, WA

- 14.1.4. **J1939 – Recommended Practice for a Serial Control and Communications Vehicle Network**

Revision: April 2005, SAE International, 400 Commonwealth Dr., Warrendale, PA 15096-0-001, USA

- 14.1.5. **Society of Automotive Engineers**

400 Commonwealth Drive, Warrendale, PA 15096, www.sae.org

- J1171 External Ignition Protection
- J1428 Marine Circuit Breakers
- J378 Marine Engine Wiring

- 14.1.6. **National Marine Manufacturers Association**

401 North Michigan Avenue, Chicago, IL 60611



- 14.1.7. **Quality Assurance Procedure, QAP-023**
Revision B, January 2003, ZF Marine Electronics, Mukilteo, WA
- 14.1.8. **Underwriters Laboratories, Marine Department**
POB 13995, 12 Laboratory Drive, Research Triangle Park, NC 27709,
www.ul.com



14.2. MiniCommand Part Numbers

Table 30: MiniCommand Part Numbers

| ASSIGNED P/N | DESCRIPTION |
|---|---|
| MI4002 | Twin Analog (PWM), 0-5V, 4-20mA, Freq. / No Troll |
| MI4004 | Twin CAN-VM Motori Engine w/Troll |
| MI4007 | Twin Analog (PWM), 0-5V, 4-20mA, Freq. / Yes Troll |
| MI008 | Twin CAN-VM Motori Engines w/o Troll |
| 4200 | Control Head – 4000 Series |
| 4200LP | Control Head – 4000 Series, Low Profile Levers |
| 460-4p | Control Head, “T” Lever, Pluggable |
| 463-4P | Control Head, Chrome Knob Lever, Pluggable |
| 465-4P | Control Head, Black Low Profile Lever, Pluggable |
| 466-4P | Control Head, Chrome Low Profile Lever, Pluggable |
| 522-4 | Control Head, Tournament Lever Style, Aluminum |
| 522-4B | Control Head, Tournament Lever Style, Aluminum w/Junction Box |
| 522-5 | Control Head, Tournament Lever Style, Chrome |
| 522-5B | Control Head, Tournament Lever Style, Chrome w/Junction Box |
| 760P | Control Head, Heavy Duty, Pluggable |
| MC2000-1P | Control Head, Black Body, Black Levers, Pluggable |
| MC2000-2P | Control Head, Chrome Body, Chrome Levers, Pluggable |
| MC2000-4P | Control Head, Black Body, Chrome Levers, Pluggable |
| The “#” sign following the dash (-) in the following part numbers represents the length, in feet, of the harness. | |
| 13432-# | Throttle, Voltage, 10 – 50’ (3,0 - 15,2m) |
| 13494-# | Throttle, Current, 10 – 50’ (3,0 - 15,2m) |
| 13533-# | Throttle, PWM, 10 – 70’ (3,0 – 21,3m) |
| 14363-# | Throttle, MAN, 5 – 65’ (1,5 – 19,8m) |
| 15027-# | Throttle, Frequency, 10 – 50’ (3,0 – 15,2m) |
| MI4501-# | Clutch, Ahead / Astern, MiniCommand, 10 – 30’ (3,0 – 9,1m) |
| MI4503-# | Clutch, Ahead / Astern, MiniCommand, 10 – 30’ |



| ASSIGNED P/N | DESCRIPTION |
|--------------|---|
| | (3,0 - 9,1m) |
| MI4505-# | Clutch, Ahead / Astern, Troll Command & On/Off, 10 - 30' (3,0 - 9,1m) |
| | |
| MI4402-# | Power, Start Interlock, Twin Screw, Analog, 10 - 30' (3,0 - 9,1m) |
| | |
| MI4302-# | Control Head, Twin Screw, MiniCommand, 10 - 50' (3,0 - 15,2m) |
| | |
| 13927 | Field Service Test Unit |
| 71127 | Service Field Test Unit Pigtail - Clutch Adapter for MiniCommand. |
| 14000 | Field Test Control Head |
| | |
| 13505 | APS |
| 13984 | Power Source Kit - Twin Screw |
| 1114H | Relay Kit - 12 VDC |
| 1122H | Relay Kit - 24 VDC |



15. Automatic Power Selector (APS) Part #13505

15.1. General Information

The APS (Automatic Power Selector), Part #13505, provides a simple, solid state solution to the need for routing redundant DC power sources for vital electronic equipment while maintaining isolation of the DC power sources.

Two independent batteries rated at the same nominal voltage are wired to separate terminals on the APS and internal diodes maintain total isolation between them. A single output terminal is wired to the ZF Marine Electronics' Propulsion Control System.


The APS is rated for loads of up to 70 Amps on 12-24 volt systems. The unit is ruggedly constructed with heavy-duty wiring studs and epoxy-potted components in an anodized aluminum case.

15.2. APS Specifications

| APS Specifications | Descriptions |
|------------------------------|---|
| Model | 13505 |
| Maximum Load Current | 70 amps |
| Operating Temperature | -40 degrees C to +80 degrees C; derate linearly from 100% @ 50 degrees C to 70% @ 80 degrees C. |
| Voltage Drop | 0.7 VDC @ 50% load; 0.9 VDC @full load. |
| Dimensions | 3.25" x 4.5" x 3.1" (8,3 x 11,4 x 7,9 cm) |

15.3. Materials Provided

The *single* APS is supplied with a hardware packet containing (6) hex nuts, (3) lock washers, (4) self-tapping mounting screws, (1) instruction diagram.

| | |
|---|---|
|  | <p>Note: Not all of the hardware is used in the installation; some spares are provided. Nut size is M-6.</p> |
|---|---|

The *Twin* APS is supplied with (2) *single* APS hardware packets.

15.4. Installation

Refer to the installation drawing #11488F on page #153.

1. Shut off all charging sources and disconnect the negative (ground) side of each battery which will be wired to the APS.
2. Mount the APS(s) in a suitable location which will keep wire runs to a minimum length, and is (preferably) ventilated, for cooler operation.

Automatic Power Selector (APS) Part: 13505

The case of the APS is electrically isolated from the internal diodes, so mounting on either a metal or non-metal surface is acceptable.

3. Complete the wiring as indicated on either drawing #11488D-1 on page #153 or 11488D-2 on page #155.
4. Reconnect the negative battery posts.



Important: Whenever the load is turned on, it can be drawing power from the batteries. Therefore, if the batteries are not simultaneously being recharged, or if charging will not be available for an extended period, it is recommended that the load be shut off to prevent complete discharge of batteries.



16. Drawings

NOTES:

1 WIRE SIZE (REF ABYC E 11.16.1.2.9, TABLE X 3%).

12VDC POWER SYSTEMS:

| | | | |
|---------|--------------|--------|------------------------|
| 0-15' | (0-4.6M) | 12 AWG | {#4 METRIC EQUIVALENT} |
| 15'-25' | (4.6-7.6M) | 10 AWG | {#6 " " "} |
| 25'-40' | (7.6-12.2M) | 8 AWG | {#10 " " "} |
| 40'-70' | (12.2-21.3M) | 6 AWG | {#16 " " "} |

24VDC POWER SYSTEMS:

| | | | |
|---------|--------------|--------|--------------------------|
| 0-20' | (0-6.1M) | 14 AWG | {#2.5 METRIC EQUIVALENT} |
| 20'-30' | (6.1-9.1M) | 12 AWG | {#4 " " "} |
| 30'-50' | (9.1-15.2M) | 10 AWG | {#6 " " "} |
| 50'-80' | (15.2-24.3M) | 8 AWG | {#10 " " "} |

2 WIRE SIZE (RECOMMENDED TWISTED PAIR)

12VDC POWER SYSTEMS:

| | | | |
|---------|------------|--------|--------------------------|
| 0-20' | (0-6.1M) | 14 AWG | {#2.5 METRIC EQUIVALENT} |
| 20'-30' | (6.1-9.1M) | 12 AWG | {#4 " " "} |

24VDC POWER SYSTEMS:

| | | | |
|---------|--------------|--------|--------------------------|
| 0-40' | (0-12.2M) | 14 AWG | {#2.5 METRIC EQUIVALENT} |
| 40'-65' | (12.2-19.8M) | 12 AWG | {#4 " " "} |

3. APS OUTPUT IS STRICTLY FOR ZF MARINE ELECTRONIC CONTROLS.
4. POWER SOURCES MAY BE 12 OR 24 VOLTS DC.
5. SINGLE SCREW KIT - PN: 13983.

| | |
|--------------------------------------|-------|
| PN: 13505 (AUTOMATIC POWER SELECTOR) | QTY 1 |
| PN: B10ETA (10 AMP CIRCUIT BREAKER) | QTY 1 |
| PN: AGC-30 (30 AMP FUSE) | QTY 2 |
| PN: HFB (FUSE HOLDER) | QTY 2 |

TWIN SCREW KIT - PN: 13984.

| | |
|--------------------------------------|-------|
| PN: 13505 (AUTOMATIC POWER SELECTOR) | QTY 1 |
| PN: B10ETA (10 AMP CIRCUIT BREAKER) | QTY 2 |
| PN: AGC-30 (30 AMP FUSE) | QTY 2 |
| PN: HFB (FUSE HOLDER) | QTY 2 |

6 MAXIMUM WIRE SIZE ALLOWED IN FUSEHOLDER IS 12 AWG. IF A LARGER WIRE SIZE IS REQUIRED FOR INSTALLATION, THE CUSTOMER SHALL PROVIDE AN APPROPRIATE FUSE AND FUSE HOLDER. (SUGGESTED MANUFACTURER BLUE SEA SYSTEMS, MAXI FUSE BLOCK SERIES).

7 IF THIS CONFIGURATION IS USED WITH AN ELECTRONIC ENGINE THE CIRCUIT BREAKER MUST BE TURNED ON PRIOR TO APPLYING POWER TO THE REMOTE SWITCH.

8 SEE FIGURE 1 BELOW FOR THE SUGGESTED HARDWARE STACK FOR SYSTEMS UTILIZING MULTIPLE OUTPUTS FROM THE PN: 13505 (AUTOMATIC POWER SELECTOR).

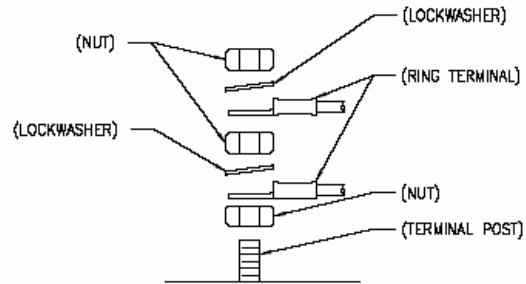
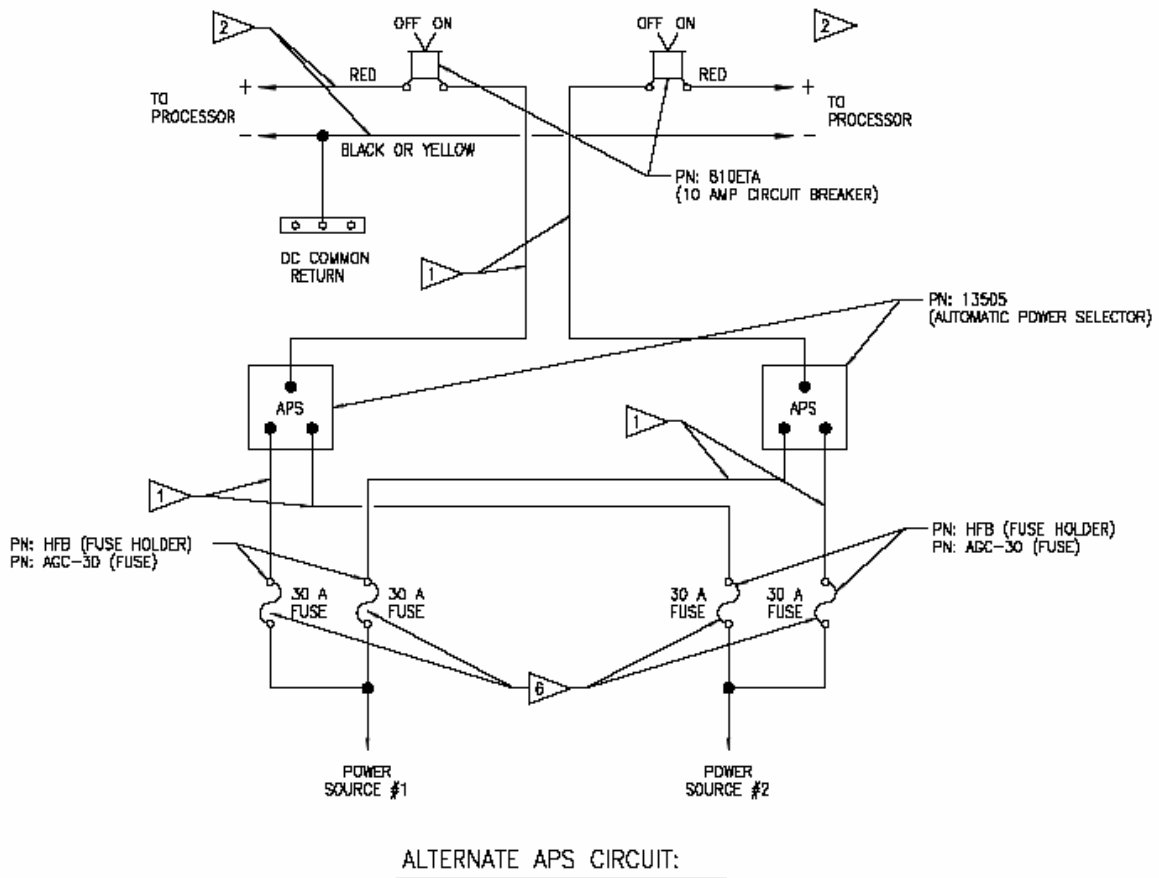


FIGURE 1

11488F-1

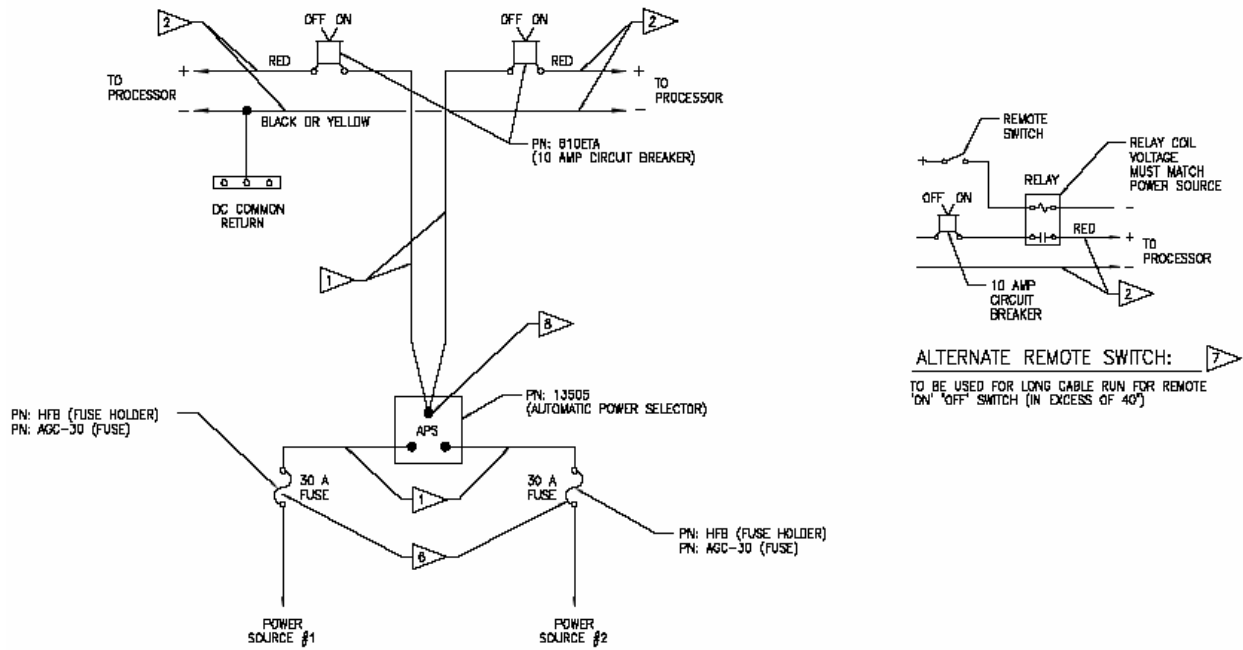
Figure 53: Drawing 11488F-1 Notes Page



TWIN SCREW DUAL APS CONNECTIONS

11488F-2

Figure 54: Drawing 11488F-2 Twin Screw Dual APS Connections



TWIN SCREW SINGLE APS CONNECTION AND ALTERNATE REMOTE SWITCH

1148BF-3

Figure 55: Drawing 11488F-3 Twin Screw Single APS Connection and Alternate Remote Switch



Appendix B



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18. Service Field Test Unit - Reference Manual - MM13927

Rev. D 10/03

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Revision List

| Rev | Date | Revision Description |
|-----|-------|--|
| A | 11/02 | Revised Section 1.0 Table 1 |
| B | 2/03 | Revised manual to current ZF Marine Electronics manual standards. Revised Section 3.0 |
| C | 4/03 | Deleted Section 2.1.6 |
| D | 10/03 | Revising to add 9000 Series and 2-Speed information |

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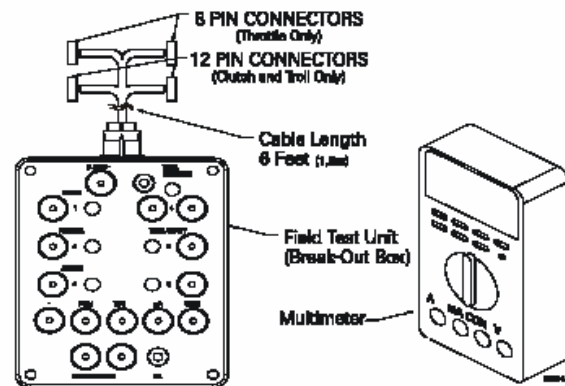
MM13927-1 INTRODUCTION

Refer to Bulletin 02-008 for Service Field Test Unit (Part No. 13927) recommendations. Refer to Figure MM13927-1: for an example of the Test Unit and a Multimeter.

The Service Field Test Unit, hereafter referred to as the “Break-out Box”, is recommended for use with all CruiseCommand Processors (Part No. 785CE) and with ClearCommand Processors (Part No. 9XXX Series) that have pluggable (Pigtail) Throttle, Clutch or Troll Connections.

The procedures for testing the various outputs of the ClearCommand and CruiseCommand Processors are similar, with the exception of where they connect to the respective Processor. Figure MM13927-2: indicates the location of the connectors on the CruiseCommand Processor and Figure MM13927-3: the typical pigtail plugs on a 9000 Series ClearCommand Processor.

Figure MM13927-1: Service Field Test Unit (Break-out Box)



NOTE: Not all ClearCommand Processors have all of the pigtails shown in Figure 3. Only the pigtails that are required for a specific application are installed in a ClearCommand Processor.

Figure MM13927-2: CruiseCommand Connector

Figure MM13927-3: Example of ClearCommand Pigtail

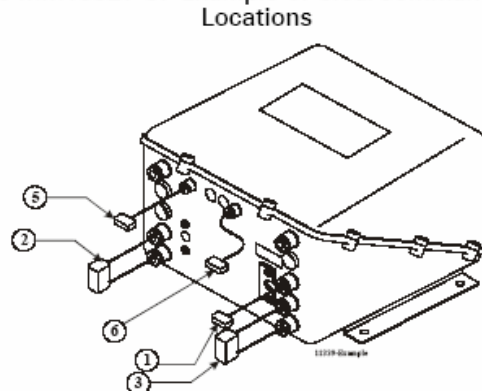
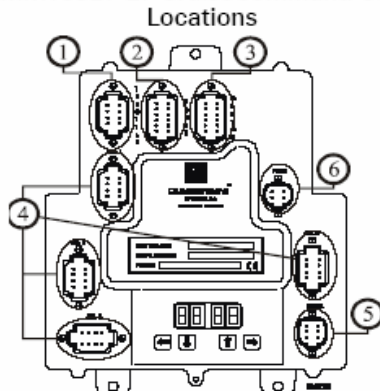


Table MM13927-1:

| Designation # | Description | Harness Type | Harness Use |
|---------------|--------------|---|--|
| 1 | Black 8 Pin | Throttle Connector/ Pigtail | The throttle signal is output from this connector/pigtail. The signal may be in the form of Pulse Width Modulation (PWM), Voltage, Current, or Frequency |
| 2 | Black 12 Pin | Power Connector/ Pigtail | This connector/pigtail contains the inputs and outputs for Main Processor Power, Start Interlock, Clutch Oil Pressure Interlock, and External Alarm Circuit. |
| 3 | Gray 12 Pin | Clutch Connector/ Pigtail | The external connections for Clutch Power, Ahead, Astern, and Neutral Solenoids, Troll On/ Off, and Proportional Solenoids are made at this connector/pigtail. |
| 4 | Gray 8 Pin | Control Head Connector | All the required connections for the Remote Control Stations are made at these connectors. |
| 5 | Gray 6 Pin | Serial Communication Connector/Pigtail | The Serial Communication connections between multiple Processors in applications with more than one Processor at this connector/pigtail |
| 6 | Gray 4 Pin | Tachometer Sensor Connector/Pigtail | The input signal from a Tachometer or Shaft Speed Sensor connects to this connector/pigtail. |

The actual procedures for using the Break-out Box are the same for CruiseCommand and ClearCommand Processors. However, the adjustment within the Processor to obtain the correct output may differ. The appropriate Installation Manual must be referred to when making the adjustments.



MM13927-2 PROCEDURE: THROTTLE SIGNAL TESTING

Depending on which Processor is being tested, it may have the capability of sourcing one or all of the following: DC Voltage, Current, PWM (Pulse Width Modulation) or Frequency.

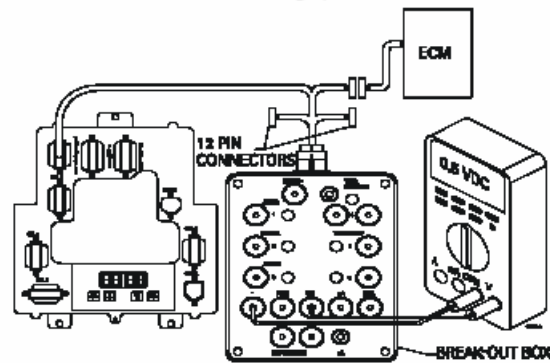


NOTE: The following procedures and drawings pertain to both the CruiseCommand and ClearCommand Processors.

MM13927-2.1 DC Voltage

- Ensure that power is removed from the Engine Electronics and the Processor.
- Disconnect the Throttle Harness from the number 1 Processor connector/pigtail.
- Insert the Break-out Box between the number 1 Processor connector/pigtail and the Throttle Harness as shown in Figure MM13927-4:
- Set up the Multimeter to measure DC Volts and plug the black lead into the Break-out Box black socket labeled "-" and the red lead into the socket labeled "VDC".
- Turn power 'On' to the Processor and take command at any Remote Station.
- The appropriate Idle Voltage for the application should be measured at this time.
- Move the Control Head lever to the Full Throttle position while depressing the Transfer Button (Throttle Only Mode).
- The appropriate Full Throttle Voltage for the application should be measured at this time.

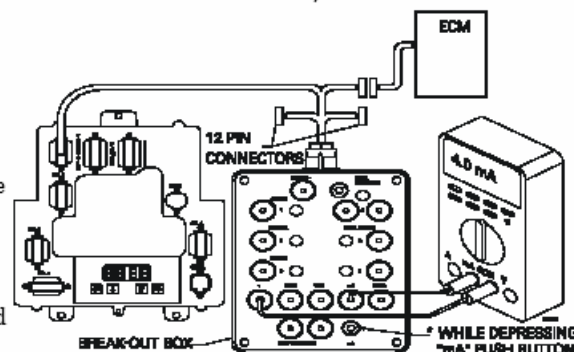
Figure MM13927-4: Throttle Connection (DC Voltage)



MM13927-2.2 Current (mA)

- Ensure power is removed from both the Engine Electronics and the Processor.
- Disconnect the Throttle Harness from the number 1 Processor connector/pigtail.
- Insert the Break-out Box between the number 1 Processor connector/pigtail and the Throttle Harness as shown in Figure MM13927-5:
- Set up the Multimeter to measure current (mA.) and plug the black lead into the Break-out Box black socket labeled "-" and the red lead into the socket labeled "mA".
- Turn power 'On' to the Processor and take command at any Remote Station.
- Depress and hold the Push-button Switch labeled "mA." The appropriate Current (mA.) for the application should be measured.
- Move the Control Head lever to the Full Throttle position while depressing the Transfer Button (Throttle Only Mode).
- Depress and hold the "mA." Push-button. The appropriate Full Throttle Current (mA.) for the application should be measured at this time.

Figure MM13927-5: Throttle Connection (Current mA)



MM13927-2.3 PWM (Pulse Width Modulation) with DC Voltmeter

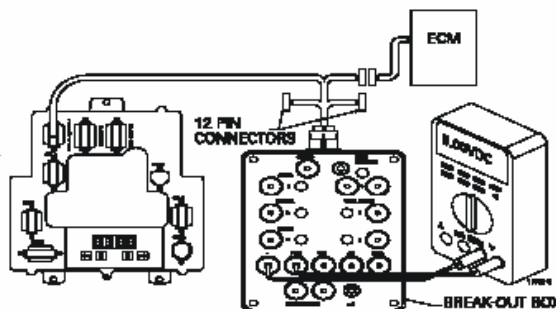
- Ensure power is removed from both the Engine Electronics and the Processor.
- Disconnect the Throttle Harness from the number 1 Processor connector/pigtail.
- Insert the Break-out Box between the number 1 Processor connector/pigtail and the Throttle Harness as shown in Figure MM13927-6: labeled "-" and the red lead into the socket labeled "PWM".
- Turn power 'On' to the Caterpillar ECM (Electronic Control Module) Only. Do Not apply power to the Processor at this time.



Service Field Test Unit

- E) Depending on the type of Caterpillar ECM (PEEC or ADEMS), the measurement should be approximately 5.00 or 12.00 VDC. Record the measurement as shown in Drawing Figure MM13927-6:.
- F) Set up the Multimeter to DC Volts and plug the black lead into the Break-out Box black socket Turn power 'On' to the Processor and take command at any Remote Station.
- G) Record the DC Voltage at this time. The measurement should be 7- 9% of the voltage measured in step F).
- H) Move the Control Head lever to the Full Throttle position while depressing the Transfer Button (Throttle Only Mode).
- I) The measurement should be 91- 93% of the voltage measured in step F) [e.g. Idle = 8% of 12 VDC reference or 0.96 VDC; Full Throttle = 92% of 12 VDC reference or 11.04 VDC.

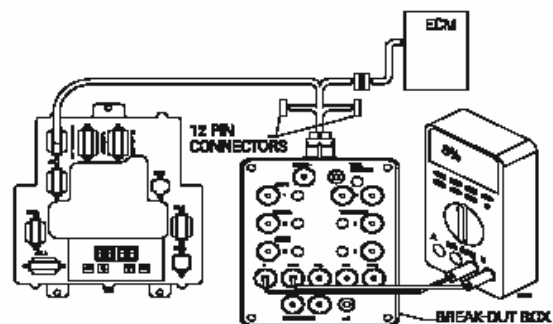
Figure MM13927-6: Throttle Connection (PWM with DC Voltmeter)



MM13927-2.4 PWM (Pulse Width Modulation) with Duty Cycle Meter

- A) Ensure power is removed from both the Engine electronics and the Processor.
- B) Disconnect the Throttle Harness from the number 1 Processor connector/pigtail.
- C) Insert the Break-out Box between the number 1 Processor connector/pigtail and the Throttle Harness as shown in Figure MM13927-7:
- D) Set up the Multimeter to measure Duty Cycle and plug the black lead into the Break-out Box black socket labeled "-" and the red lead into the socket labeled "PWM".
- E) Turn power 'On' to the Caterpillar ECM (Electronic Control Module) and to the Processor.
- F) The measurement should be approximately 8% duty Cycle.
- G) Move the Control Head lever to the Full Throttle position while depressing the Transfer Button (Throttle Only Mode).
- H) The measurement will increase from 8% to 91- 93%.

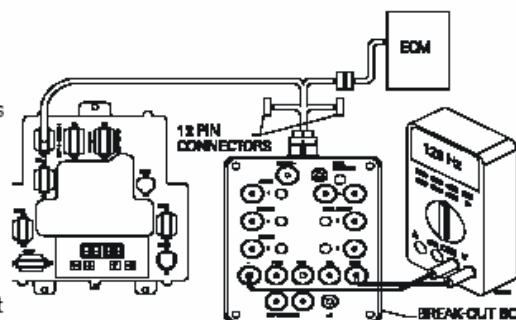
Figure MM13927-7: Throttle connection (PWM with Duty Cycle Meter)



MM13927-2.5 Frequency (Hz.)

- A) Ensure power is removed from both the Engine Electronics and the Processor.
- B) Disconnect the Throttle Harness from the number 1 Processor connector/pigtail.
- C) Insert the Break-out Box between the number 1 Processor connector/pigtail and the Throttle Harness as shown in Figure MM13927-8:
- D) Set up the Multimeter to measure Frequency and plug the black lead into the Break-out Box black socket labeled "-" and the red lead into the socket labeled "FREQ".
- E) Turn power 'On' to the Processor and take command at any Remote Station.
- F) The appropriate Idle Frequency for the application should be measured at this time.
- G) Move the Control Head lever to the Full Throttle position while depressing the Transfer Button (Throttle Only Mode).
- H) The appropriate Full Throttle Frequency for the application should be measured at this time.

Figure MM13927-8: Throttle Connection (Frequency Hz)



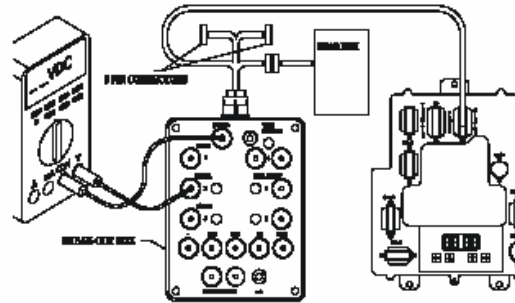


MM13927-3 PROCEDURE: CLUTCH TESTING

MM13927-3 .1 Neutral Solenoid Testing

- Ensure power is removed from both the Processor and the Clutch Power Supply.
- Disconnect the Clutch Harness from the number 3 Processor connector/pigtail.
- Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch Harness as shown in Figure MM13927-9.
- Turn power 'On' to the Processor and take command at any Remote Station with the Control Head lever in the Neutral/Idle position.
- The measurement on the Neutral Test Point should be 12 or 24 VDC, depending on the Solenoid's rating and the LED adjacent to the socket should be illuminated.
- Move the Control Head lever to the Ahead Detent position. The voltage should drop to 0 VDC in CruiseCommand systems and remain at 12 or 24 VDC in ClearCommand systems. The adjacent LED should go out in CruiseCommand systems and stay on in ClearCommand systems.

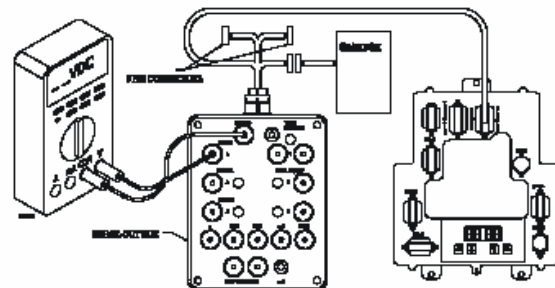
Figure MM13927-9: Clutch Connections Neutral Solenoid



MM13927-3 .2 Ahead Solenoid Testing

- Ensure power is removed from both the Processor and the Clutch Power Supply.
- Disconnect the Clutch Harness from the number 3 Processor connector/pigtail.
- Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch Harness as shown in Figure MM13927-10.
- Set up the Multimeter to measure DC Volts and plug the black lead into the Break-out Box socket labeled "CLUTCH -" and the red lead into the socket labeled "AHEAD".
- Turn power 'On' to the Processor and take command at any Remote Station with the lever in the Neutral/Idle position.
- The measurement should be 0 VDC and the adjacent LED should not be lit.
- Position the Control Head lever into the Ahead detent. The measurement should be 12 or 24 VDC depending on the Ahead Solenoid's rating. The LED adjacent to the Ahead plug on the Break-out Box should be lit.
- Return the Control Head lever to the Neutral/Idle position.

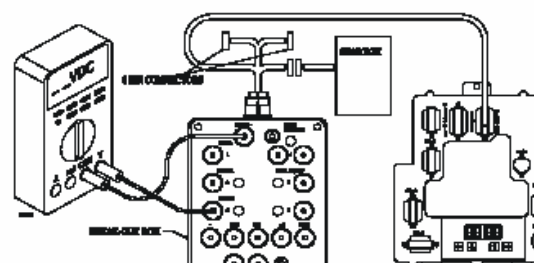
Figure MM13927-10: Clutch Connections Ahead Solenoid



MM13927-3 .3 Astern Solenoid Testing

- Ensure power is removed from both the Processor and the Clutch Supply Power.
- Disconnect the Clutch Harness from the number 3 Processor connector/pigtail.
- Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch Harness as shown in Figure MM13927-11.
- Set up the Multimeter to measure DC Volts and plug the black lead into the Break-out Box socket labeled "CLUTCH -" and the red lead into the socket labeled "ASTERN".
- Turn power 'On' to the Processor and take command at any Remote Station with the Control Head lever in the Neutral/Idle position.
- The measurement should be 0 VDC and the adjacent LED should not be lit.
- Position the Control Head lever into the Astern detent. The measurement should be 12 or 24 VDC depending on the Astern Solenoid's rating. The LED adjacent to the Astern plug on the Break-out Box should be lit. Return the Control Head lever to the Neutral/Idle position.

Figure MM13927-11: Clutch Connections Astern Solenoid



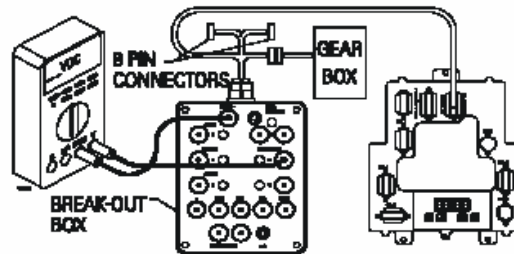


MM13927-4 PROCEDURES: TROLL TESTING

MM13927-4.1 Troll On/Off Solenoid

- Ensure power is removed from both the Processor and the Clutch Power Supply.
- Disconnect the Clutch Harness from the number 3 Processor connector/pigtail.
- Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch Harness as shown in Figure MM13927-12:.
- Set up the Multimeter to measure DC Volts and connect the black lead to the socket labeled "CLUTCH -" and the red lead to the socket labeled "TROLL ON/OFF" as shown in Figure MM13927-12:.
- Turn power 'On' to the Processor and the Clutch Power Supply and take command at a Remote Station with the Control Head lever in the Neutral/Idle position.
- Depress the Transfer Button again for approximately 2 seconds until the red LED begins blinking at a fast rate (Troll Mode Indication).
- The measurement should be 0 VDC.
- Position the Control Head lever to the Ahead detent. The measurement should now be 12 or 24 VDC, depending on the Solenoid's rating.
- Position the Control Head lever further forward while monitoring the DC Voltmeter. The measurement should go from 12 or 24 VDC to 0 VDC at the same time the red LED on the Control Head becomes lit solid.

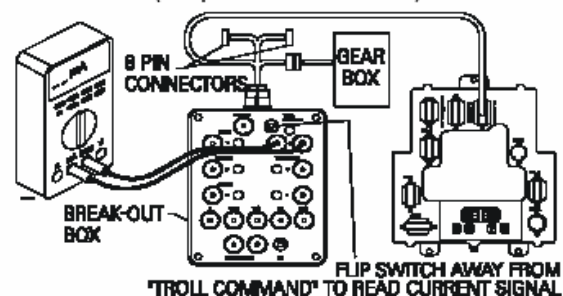
Figure MM13927-12: Troll Connections Troll On/Off Solenoid



MM13927-4.2 Troll Command (Proportional Solenoid) Testing with Amp Meter

- Ensure power is removed from both the Processor and the Clutch Power Supply.
- Disconnect the Clutch Harness from the number 3 Processor connector/pigtail.
- Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch Harness as shown in Figure MM13927-13:.
- Set up the Multimeter to measure (mA.) and connect the black lead to black socket and the red lead to the red socket labeled "TROLL COMMAND" as shown in Figure MM13927-13:.
- Turn power 'On' to the Processor and the Clutch Power Supply and take command at a Remote Station with the Control Head lever in the Neutral/Idle position.
- Depress the Transfer Button again for approximately 2 seconds until the red LED on the Control Head begins blinking at a fast rate (Troll Mode Indication).
- Flip switch away from "Troll Command" to read current through meter.
- Move the Control Head lever to the Ahead detent. The current measurement should be the correct value for minimum clutch pressure (shaft rotations). This value varies depending on the type of Marine Gear. Refer to the Literature provided with the Trolling Valve and the Processor for specifics.
- Slowly advance the Control Head lever while monitoring the current. The current should increase or decrease, depending on the Gear type, in proportion with the Control Head lever movement. Once again, refer to the Literature provided with the Trolling Valve and the Processor for specific values.
- Continue to move the Control Head lever forward until the red LED stops blinking (lit steady). The current should drop to 0 mA.

Figure MM13927-13: Troll Connections (Proportional Solenoid)



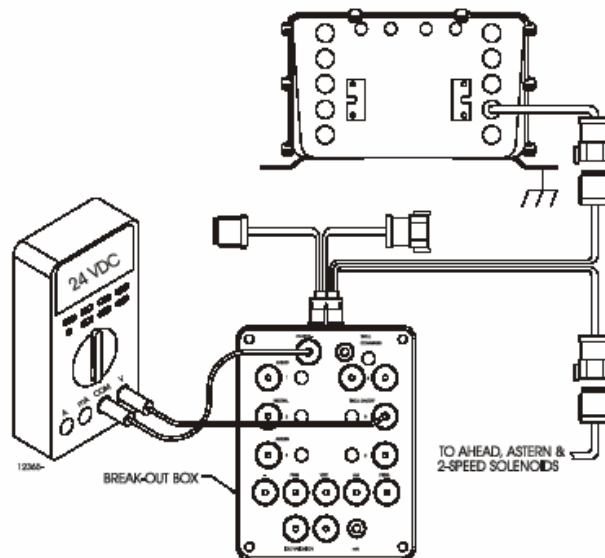


MM13927-5 PROCEDURE: 2-SPEED TESTING

MM13927-5.1 2nd Gear Disengaged

- A) Ensure power is removed from the Processor.
- B) Disconnect the Clutch/2-Speed Harness from the number 3 Processor connector/pigtail.
- C) Insert the Break-out Box between the number 3 Processor connector/pigtail and the Clutch/2-Speed Harness as shown in Figure MM13927-14:
- D) Set up the Multimeter to measure DC Volts and connect the black lead to the socket labeled "CLUTCH -" and the red lead to the socket labeled "TROLL ON/OFF" as shown in Figure MM13927-14:
- E) Turn power 'On' to the Processor and take command at any Remote Station.
- F) The voltage measurement should be approximate 0 VDC.

Figure MM13927-14: 2-Speed Connections



MM13927-5.2 2nd Gear Engaged

- A) Leave the Break-out Box and Multimeter in the same position as left in Section MM13927-5.1.
- B) Start the engine(s).
- C) Depress the Transfer Button while moving the lever(s) into the Ahead detent (red LED should be blinking, indicating Warm-up Mode).
- D) Continue to move both Control Head lever(s) forward until the RPM programmed for Function Code U1 has been reached.
- E) The voltage measurement at the Multimeter should now be 12 or 24 VDC, depending on the Solenoid's rating.
- F) Return the Control Head levers to the Neutral/Idle position and shut down the engines.
- G) Turn power Off to the Processor(s).
- H) Unplug the Break-out Box from the Pigtail and Harness plugs and reconnect the Harness to the Pigtail.

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MM13927-6 PARTS LIST

| ZF Marine Electronics Part No. | Part Name |
|--------------------------------|---|
| 13927 | Service Field Test unit (Break-out Box) |
| MM13927 | Technical Manual |
| | Multimeter |
| 14000 | Test Control Head - Dual |

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19. Glossary

| Glossary Word | Definition |
|------------------------|--|
| Active Control Station | The control head that is controlling the engine and transmission on the vessel. |
| Ahead Command | A command to the transmission to activate the forward gear. |
| Ampere (A) | The Ampere, often shortened to “amp”, is a unit of electric current, or amount of electric charge per second. |
| Analog Signal | A signal continuously variable in both time and amplitude. |
| Astern Command | A command to the transmission to activate the reverse gear. |
| Bulkhead | An upright partition (wall), ceiling, or floor separating compartments on a vessel. |
| CAN Bus | <p>Controller Area Network (CAN) is a broadcast, differential serial bus standard, originally developed in the 1980s by Robert Bosch GmbH for connecting electrical control units (ECUs).</p> <p>CAN was specifically designed to be robust in electromagnetically noisy environments and can utilize a differential balanced line like RS-485. It can be even more robust against noise if twisted pair wire is used.</p> |
| Clutch | A device typically comprised of one or more friction discs, which allow the engine’s output to be connected or disconnected from the transmission. |
| Command Signal | The signal which the Control Head outputs to the Processor, which in turn is converted to the appropriate outputs to the engine and transmission. |
| Configuration | Options in the MiniCommand controller to customize operation to a specific vessel. |
| Connector Designations | Name given to identify a specific connector. |
| Contact | Active component of electric switch or electrical connector. |
| Control Head | The device which the vessel’s operator uses to control the engine(s) and transmission(s). |
| Control Lever | The handle(s) on the port and starboard sides of the control head. |
| Control Station | The physical location of the Control Head |



| Glossary Word | Definition |
|-----------------------|--|
| Cruise | The typical operating mode of a vessel. |
| Current | Current is an electrical term which represents the flow of electrons through a conductor and is measured in amperes. |
| Detent | The mechanical stop (groove) on a control head (ahead, neutral and astern). |
| Digital Signal | A signal which is comprised of highs (1) and lows (0). |
| ECM | <i>See:</i> Electrical Control Unit. |
| Footprint | The physical size required to mount a device. |
| Function Code | A system of symbols which represent a configurable system parameter. |
| Gear | Referring to the marine transmission. |
| Governor | A device used on diesel engines to control the fuel and air mixture. |
| Hertz (Hz) | A unit of frequency equal to one cycle per second. |
| High Idle | An adjustable elevated Idle RPM. Extends from 0% to 20% above the idle throttle range. |
| Idle | Lowest operational RPM of the engine. |
| LED | <i>See:</i> Light Emitting Diodes |
| Lever | <i>See:</i> Control Lever |
| Light Emitting Diodes | Light emitting diodes are used throughout the system due to there low current requirements and visibility in the daylight. |
| Local Station | A Control Station located in the Engine Room. Also referred to as Engine Room Station. |
| Low Idle | This is the normal engine idle RPM. |
| MCP | MiniCommand Processor |
| Microprocessor | Electronic device used to control/manage operations of the controller. |
| Milliampere (mA) | 1/1000 th of an Ampere. |
| Mode | Mode of Operation (Cruise, Warm-up, Troll). |
| One Lever Mode | Where only one lever at a station is controlling the operation of the vessel. |



| Glossary Word | Definition |
|-----------------------------|---|
| Oscillating Tone Signal | Tone generated to alert operator of potential problem. |
| PIN | Personalized Identification Number. |
| Pin Assignments | Labels used to identify individual wires. |
| Pneumatic | The use of compressed air to move a piston in a cylinder and provide mechanical force or movement on the other side of the cylinder. |
| Port | While facing forward (front), the <i>Left</i> side of vessel. |
| Potentiometer Wiper Voltage | Control Head command voltage. |
| Power Connector | Connector that supplies power to the MiniCommand system. |
| Processor | The device which takes inputs from a Control Head and outputs the appropriate signals at the correct time to the engines and transmissions. |
| Proportional Solenoid | A solenoid which can be partially opened or closed by varying the amount of current applied. |
| Pulse Width Modulated (PWM) | The type of electronic signal used by Caterpillar engines for speed control. PWM is the ratio of On time to Total time. |
| PWM | <i>See:</i> Pulse Width Modulated |
| Redundancy | <p>Redundancy in general terms refers to the quality or state of being redundant, that is exceeding what is necessary or normal, or duplication.</p> <p>Specifically in Engineering, it means serving as a duplicate for preventing failure of the entire system.</p> |
| Remote Station | A Control Station (physical location of a Control Head) located anywhere other than the Engine Room. |
| Resistance | Resistance is an electrical term for measuring the opposition to the flow of current in a circuit. Resistance is measured in Ohms (Ω). |
| RPM | <i>See:</i> Revolutions Per Minute. |
| Revolutions Per Minute | Is a unit of frequency: The number of full rotations completed in one minute around a fixed axis. It is most commonly used as a measure of rotational speed or angular velocity of some mechanical component. |



| Glossary Word | Definition |
|----------------------------|---|
| Screw | Propeller |
| Seven Segment Display | The display unit on MiniCommand composed of seven segments. |
| Single Screw Configuration | When a system is programmed to control a single engine and transmission. |
| Soft Key | A push-button below, above, or to the side of a display window that allows the function of a button depression to be varied. An icon or text adjacent to the button designates the action performed when the button is depressed. |
| Solenoid | A device which takes an electrical input and converts that input to a mechanical output. Solenoids are used to engage the clutch in some marine transmissions. |
| Starboard | While facing forward (front), the right side of the vessel. |
| Start Interlock | A device which prevents the engine from being started. |
| Station Transfer | Moving control of the vessel's engine(s) and transmission(s) from one Control Station to another. |
| Station-in-Control | See: Active Control Station. |
| Synchronization | When referred to in Marine Propulsion Control systems, synchronization (or synch) is precisely matching the RPMs of two or more engines. |
| Throttle | The <i>Throttle</i> controls the speed of the engine. |
| Tone Signal | See: Oscillating Tone Signal |
| Transmission | The device which takes the engine's horsepower and torque and connects them to the propeller via the output shaft. |
| Transom | The material which forms the stern of a square ended boat. |
| Troll Command | The signal the Processor outputs to the Trolling Valve's Proportional Solenoid. |
| Troll On/Off Command | The signal the Processor outputs to the Trolling Valve's on/Off Solenoid. |
| Trolling Valve | A device used in some marine transmissions which allow the controlled slippage of the clutch that consequently permits slower vessel speeds. |
| Twin Screw | When a system is programmed to control two engines and |



| Glossary Word | Definition |
|------------------------------|---|
| Configuration | transmissions. |
| VDC | <i>See:</i> Voltage Direct Current |
| Voltage Direct Current (VDC) | A measure of electrical potential difference which has current flowing in one direction and is substantially constant in value. |
| Warm Up | Mode of Operation which allows the operator to increase the engine's RPM while the clutch remains in neutral. |



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Figure 42: LED Display Function C3 78

Figure 43: LED Display Function L2 82

Figure 44: LED Display Function L3 83

Figure 45: LED Display Function L4 85

Figure 46: LED Display Function L5 85

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23. Warranty

MiniCommand Propulsion Control Systems Limited Warranty

A. Limited Warranty: Your ZF Marine Electronics product has been designed and manufactured by experienced engineers and craftsmen. ZF Marine Electronics LLC warrants for the period indicated below, each product manufactured by ZF Marine Electronics LLC, to be free from defects in materials and workmanship. If during the applicable warranty period a product is determined by ZF Marine Electronics LLC to be in breach of this limited warranty, ZF Marine Electronics LLC, at its option will repair or replace the defective product.

B. Warranty Exclusions: This warranty covers only failures due to defects in materials or workmanship that occur during normal use. This warranty does not cover damage that occurs in shipment, failures that are caused by products not supplied by ZF Marine Electronics, failures that result from installation that is not in compliance with ZF Marine Electronics specifications, accident, misuse, abuse, neglect, water damage, mishandling, misapplication, set-up adjustments, improper maintenance, alteration, modification or service by anyone other than a ZF Marine Electronics Authorized Service Center, damage that is attributable to acts of God or other causes unrelated to defects in materials and workmanship.

The MiniCommand Propulsion System is designed specifically for installation on Pleasure Craft. This warranty does not cover failures when installed on a Commercial Craft. A Commercial Craft is defined as, any vessel used for any commercial purpose including but not limited to any use as a workboat, passenger vessel, charter or rental fleet.

C. Warranty Period: The warranty period is 36 months from the date of original shipment by ZF Marine Electronics or 24 months after the commissioning of the craft, whichever comes first.

Repair or replacement parts provided under this Warranty will be covered by the remainder of the unexpired warranty in effect on the complete unit.

D. No Coverage Under Warranty The exclusive remedy under this Warranty is the repair or replacement of the defective component and this warranty specifically does not provide coverage for:

- 1) Towing or transportation of the vessel, or travel to and from the job site or vessel.
- 2) Original installation charges or start-up costs.

E. To Obtain Warranty Service

Please go to www.zf-marine.com or Call 1-425-583-1900 or (U.S. only) 1-800-546-5455 for your nearest ZF Marine Electronics Factory Authorized Service Center.

- 1) The Service Center will contact ZF Marine Electronics Service Department for a Service Return Authorization (SRA) number. Return the product freight prepaid, marked clearly with the SRA number and a description of the malfunction.
- 2) If there are defects covered by this warranty, ZF Marine Electronics will, at its option, either repair or replace the defective part or product. If after inspection, ZF Marine Electronics determines that the product is not defective; ZF Marine Electronics will charge a testing fee and return the product to the sender, freight collect.
- 3) Repair or replacement during the warranty period will not extend the warranty period.
- 4) All SRA claims must be requested and submitted within 30 days from date of repair service.
- 5) Claims for over 3 hours labor must be pre-approved by the ZF Marine Electronics Service Department.

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ZF MARINE ELECTRONICS, L.L.C.

12125 Harbour Reach Drive, Suite B, Mukilteo, WA 98275
Telephone (425) 583-1900 Telefax (425) 493-1569

24. Warranty Registration

MiniCommand Warranty Registration

Processor, Serial # _____ Serial # _____

Number of Remote Stations _____

Purchase Date _____

Dealer's Name _____

Installer's Name _____

Phone Number () _____

Cell Number () _____

Fax Number () _____

E-Mail Address _____

Purchaser's Name _____

Street Address _____

City, State, Zip _____

Phone Number () _____

YOUR VESSEL:

Engine, Make & Model _____

Length _____

Manufacturer _____

ZF Marine Electronics, LLC. Product First Seen At:

Boat Show

Dealer

Magazine

Friend

ZF Marine Electronics, LLC.
12125 Harbour Reach Drive, Suite B
Mukilteo, WA 98275