Electronic Engine Controls by Glendinning

Installation & Operation Manual v8.0A

(software version 8)

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A word about the Symbols used in the Manual

When driving from one destination to another, road signs prove to be invaluable. Road signs are an important source of information. For example, road signs can warn you about potential problems ahead to help divert certain disaster or they can let you know where to turn off for a rest or a meal.

In an effort to help you navigate your way through this manual we will from time to time use the following symbols:

Throughout the manual the NOTES symbol will appear to support what has been mentioned in the text. A note can be used where further explanation is needed or where something needs highlighting. BE CAREFUL to read all NOTES.

Sometimes it is helpful to take a break and really absorb what you just read. The WARNING symbol will alert the reader to information that needs to be completely understood before you continue on in the reading of the manual. ALWAYS STOP and READ these points.

The TIP symbol will be used when something mentioned in the text need more “light” shed on it. The tip could explain or be a list of do’s and don’ts. Whatever the TIP is, you do not want to miss out on the information it contains.

MANUAL REVISIONS

REVISION	PAGE #	DESCRIPTION	DATE of CHANGE
8.0	--	Initial start-up of document	AUGUST 2005
8.0a	68	Corrected configuration steps for TROLL.	NOVEMBER 2006

1.0 System Description & Capabilities

The Electronic Engine Control System (EEC) has been designed by Glendinning Marine Products as an alternative to other means of controlling a marine propulsion system, such as mechanical, hydraulic, or pneumatic controls. By means of sophisticated, state of the art electronics and digital computer programming, the boat owner can now have the ability to control his engines and reverse gear with more precision and less effort than ever before. In addition, a number of features not offered with any other type of control system are now available.

The Glendinning Electronic Engine Control incorporates the following significant features:

• **Convenient "single-lever" electronic control** — Electronic control permits the use of single lever operation-combined clutch and throttle in one handle-from up to 6 stations, without the "stiffness" normally encountered with mechanical or hydraulic controls.

• **Mechanical Backup —** Mechanical control for use in the event of system failure, such as loss of DC power. This mechanical backup system utilizes a separate control head, or in some cases the same head used to control the boat electronically.

• **Sophisticated Power Management** — Power system designed to receive power from two independent power sources.

• **Extremely Accurate Synchronization** — Synchronization capability similar to that of the Glendinning mechanical Automatic Synchronizer (accurate to about 5 RPM differential throughout the RPM range).

• **Solid Construction** — Rugged, robust construction, comparable to other products manufactured by Glendinning Marine Products. All system components are completely sealed from the environment.

• **Complete Electrical Shielding** — The system is completely shielded to eliminate problems caused by electromagnetic interference, complying with the latest and strictest standards in the industry.

In its most general form, the Electronic Engine Control system consists of four separate components:

Control Head — The Control Head is the means by which the boat operator commands the EEC system. .

Engine Processor — The Engine Processor is the heart of the system and controls operation of all the other components.

Actuators — The actuators move the governor/throttle lever, gearbox lever, and /or troll valve control levers and are controlled by the Engine Processor

Mechanical Backup (optional) — One Control Head is connected to the Actuators via mechanical push-pull cables. In the event that DC power is lost or if the system were to fail, these cables allow the boat operator to bypass the entire EEC system and control the engine throttle and gearbox directly.

1.1 Control Head

The Glendinning EEC Control Head is a "single lever" control system, this means that each handle on the Control Head is able to operate the engine throttle and reverse gear position (ahead / neutral / reverse) for a single engine. When the Control Head handles are placed in the center of their travel (perpendicular to the mounting surface of the Control Head), the transmission will be in neutral and the engine throttles will be in idle. Moving the Control Head handles forward will first engage the forward gear, followed by an increase in engine RPM. Moving the Control Head handle toward in the aft direction, will put the gear into reverse, followed by an increase in engine RPM.

Old style EEC-1000 Control Head

In addition to the engine control handles in each Control Head, the Control Head cover also includes lights which are used to control the "operating mode" of the EEC system. These switches include the following:

New style EEC-2001 Control Head

TAKE — Take control. This switch is used to transfer control from one station to another. The station transfer system allows the boat operator to "pre-position" the control handles at the station that will take control so that station transfer may be done smoothly, without changing engine RPM. The station transfer system also requires a "two button press" — the TAKE button must be pressed twice to transfer control, eliminating the possibility of control transfer if the TAKE button is inadvertently pressed.

SYNC — Automatic Synchronization. When both engines are in ahead gear, and at least 100 RPM above idle, the automatic synchronization function can be engaged by depressing the SYNC switch. This function will automatically control the speed of the port engine to be the same as the starboard engine speed (within 5 RPM accuracy). Once in synchronization mode, the speed of both engines can be controlled by adjusting the speed of the starboard engine. Synchronization mode can be turned off, and full manual control restored, by aligning the port control handle to an approximate position that corresponds to the starboard control handle and depressing the SYNC switch a second time.

WARM — Warm up mode. (Gear Lockout) This mode can be activated when both engines are in neu-

tral. Once activated, by depressing the WARM button, the control lever handle can be advanced into the ahead throttle position in order to accelerate the engine speed while leaving the gear in neutral. The system will remain in the warm up mode until the handle is returned to Neutral and the WARM button is depressed a second time.

TROLL — Troll mode. This switch can be used to operate the trolling valves for boats so equipped. While in Troll Mode, the boat operator is able to control the gear position (Ahead, Reverse, and Neutral) and the trolling valve position (Full slip to no slip). To prevent transmission damage, the engine throttle will remain in idle at any time that the troll valve is not in the Full Lockup - no slip - position. (While in normal Cruise Mode, the trolling valve actuator is always in the Full Lockup - no slip - position). Troll Mode is activated from Neutral by depressing the TROLL button on the keypad once.

For boats that are equipped with troll valves, the troll valve operating mode may be selected in one of three ways: redesignate the "Slow" mode switch to activate "Troll" mode, use a combination of the "Take", and "Slow" buttons pressed at the same time, or use a button / indicator light separate from the control head.

SLOW — Slow mode. The "slow" mode changes the range of handle movement from 0 - 100% engine speed to approximately 0 - 50%. (That is, full handle travel will only give you about one-half of WOT engine speed). This will provide the boat owner with a much greater control of engine RPM at slow cruise speeds and in close quarters maneuvers such as docking. Slow Mode is activated by depressing the TAKE and TROLL buttons simultaneously.

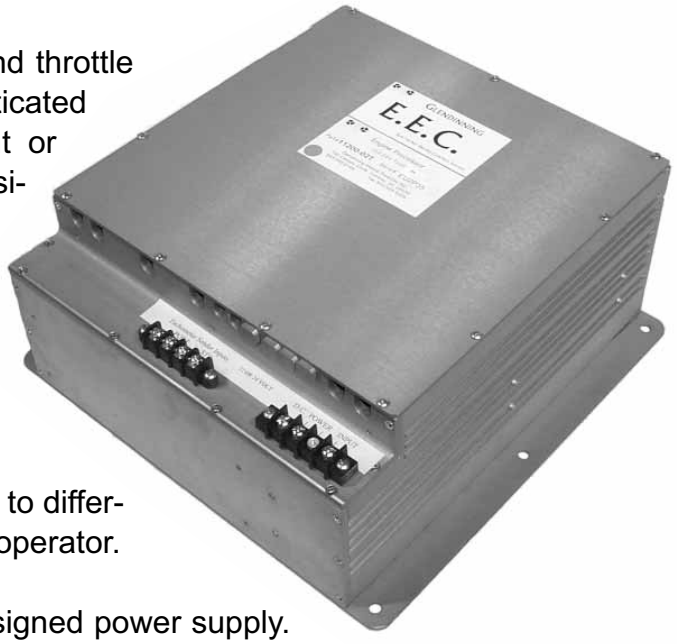
Indicator lights clearly signal the boat operator of the status of the control system and what operating mode the EEC system is in. A buzzer is also installed to signal system problems, such as low battery input voltage.

The Control Head is sealed from the external environment and is normally mounted on top of a flat surface. A single station communication cable, which exits from the bottom of the control head assembly, connects the control handle to the Engine Processor. The connector cable is factory terminated with a waterproof, electrically shielded end connector. The Control Head is approximately the same size as other control heads available in the industry. In addition to the "topmount" control head that is shown in the photograph (opposite page), a "sidemount" control head is also available for boats equipped with "Palm Beach" style controls. When a sidemount control is used, the operating mode control switches are mounted in a control keypad assembly which may be located remotely, anywhere at the helm station.

1.2 Engine Processor (EP)

The engine processor is the hub of the EEC system and could be considered its "brain" (central processing unit). The Engine Processor performs the following functions:

- The primary function of the engine processor is to receive commands from the control



station that is "active" and position the gear and throttle actuators to the commanded position. Sophisticated computer logic will prevent gear engagement or disengagement unless the engine throttle position is at idle. An adjustable gear shift delay can be set to the operators disgression.

- Where trolling valves are installed, the Engine Processor will control the operation of the trolling valve actuator

- Coordinate and control the transfer of control to different helm stations when requested by the boat operator.

- Provide system power through a custom designed power supply. This power supply will automatically draw power from 2 independent power sources (such as the port and starboard engine batteries). Power taken from each battery input will be proportional to the battery voltage available; that is, more power will be drawn from the battery with higher voltage and less power drawn from the battery with lower voltage. Isolation between the batteries is continuously maintained. The power supply can operate the EEC system down to about 80 % of nominal voltage (about 9.5 volts on 12 VDC nominal system). The Engine Processor can operate over an input voltage range of 10 to 30 volts DC.

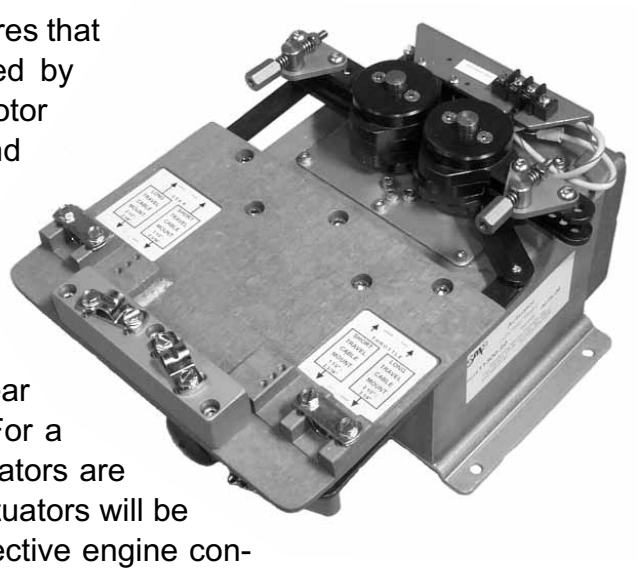
- Monitors battery supply voltage and signals the operator when input voltage drops below 9.0 volts (low voltage alarm).

- Performs a variety of other diagnostic tests during system startup as well as during system operation. Some examples of these diagnostic tests include: actuator motor current, external battery supply voltages, and internal control voltages. In the event that the tests identify an out of tolerance condition, an alarm will indicate this condition to the operator and control will be automatically transferred to the mechanical backup system (if equipped).

- A simple calibration system has been designed into the Engine Processor, which allows the installer to easily adjust the stroke of each actuator for each specific Boat installation. This need for tedious potentiometer adjustments is eliminated installation is greatly simplified.

1.3 Actuator

The electromechanical actuators convert the electronic commands that are generated by the Engine Processor into specific positions at the engine gear, throttle and trolling valve lever. The actuators are



housed in rugged, corrosion resistant, aluminum enclosures that are sealed to eliminate problems which may be caused by exposure to the marine environment. The actuator motor drive assembly uses precision ground steel gears and components that are manufactured to very precise tolerances. Combined with a high-frequency pulse width modulation (PWM) input, the actuator is able to resolve a linear position of less than 0.005 inch very smoothly with no "steps".
Each actuator is capable of two functions, such as the gear and throttle for a single engine, or two trolling valves. For a typical two-engine boat, without trolling valves, two actuators are required. Trolling valves are installed, a total of three actuators will be required. The actuators will be connected to their respective engine control levers (governor or clutch) via Type 33 series push-pull cables.

IF YOUR SYSTEM IS EQUIPPED WITH THE MECHANICAL BACKUP FEATURE — READ ON (if not proceed to Section 1.6 - Tach Senders, pg. 7):

In addition to the control cables and linkages that are used to control the engine electronically, each actuator includes a "coupler" assembly for the purpose of installing a mechanical backup cable. This coupler assembly transfers control between the normal electronic operation and the mechanical backup system as follows:

- When the EEC system is turned off, the coupler assembly couples the mechanical backup control to the engine governor and gear control levers. Any movement of the control head equipped with the mechanical backup system, will move the engine governor and / or gear.

- When the EEC system is energized, prior to engine startup, a solenoid on the actuator will be energized causing the electromechanical actuator to be coupled to the governor and gear controls. During normal operation, the actuator will be controlled by the Engine Processor to specific gear and engine throttle settings, as selected by the boat operator.

- In the event of failure of the electronic system (for example, loss of DC power), the actuator solenoid will deenergize the coupler assembly on top of the actuator, and engine / gear control will automatically be transferred from the electronic system back to the mechanical backup control.

1.4 Integrated Mechanical Backup Assembly

As described in the Actuator section, the Glendinning EEC system is designed to incorporate a

mechanical (push-pull cable) backup control system that will control the propulsion system in the event of failure of the electronic system. This system can utilize a control head and Type 33C cables available through Glendinning. The backup mechanical head can be located anywhere on the vessel, although it should be located in a place which allows the boat operator to continue to control the boat in a safe manner.

A separate control head for mechanical backup may be used, however, a key feature that the Glendinning EEC system offers is an integrated mechanical backup system. With this system, one of the Control Heads which is normally used to control the system electronically can also function as a mechanical control head. In order to do this, a mechanical backup assembly is installed underneath one of the control heads. The purpose of this assembly is to convert the movement of the single lever control handle (combined clutch / throttle) into separate clutch and throttle movements. A total of four control cables will connect the mechanical backup assembly with the two Actuators located in the engine room.
The Integrated Mechanical Backup assembly functions as follows:

- In normal electronic operation, the control station equipped with the mechanical backup assembly will control the system electronically. Due to the connection of the backup control cables, there may be a slight increase in the amount of force necessary to move the control handle as compared with a station capable only of electronic operation.

- In the event of power failure or other loss of electronic control, the electro-mechanical actuators located in the engine room will automatically revert to the mechanical backup mode. If the control station equipped with the mechanical backup control is in operation when this occurs, the boat operator wifl immediately be in mechanical control at this instant. If the boat is being controlled from another control station, the boat operator can gain mechanical control of the engine and clutch by going to the control station equipped for mechanical control and moving the control head handles to approximately match the position of clutch and throttle when the electronic control failure occurred. This will automatically engage the mechanical backup control system. If an alternative control head is used other than Glendinning's Integrated Mechanical Backup Control Head, the boat operator must go to the control station that has been designated and equipped for mechanical backup control.

1.5 Station Processor

*(ONLY used with old style EEC-1000 Control Heads [PN 11404], Integrated Mechanical Backup Control Head [PN 11424], and the **hard-wired** Sidemount Keypad Assembly [PN 11430, 11432])*

The Station Processor is located within a few feet of the Control Head, and is electrically connected to the Engine Processor. The function of the station processor is to interface between the Control Head and the Engine Processor. In brief, the station processor will analyze the position of the Control Head handles and the operating mode buttons and sends this information to the engine processor via a custom designed digital communications link.

1.6 Tachometer Senders

In order to accurately synchronize the engines to a 5 RPM maximum difierential, the Engine Processor requires very accurate engine RPM information. This information is supplied to the Engine Processor using tachometer senders. One tach sender must be mounted on each engine, typically using the mechanical tachometer outlet provided on the engine. Where a mechanical tachometer outlet connection is not available on the engine, mechanical drive adapters can be installed to provide this connection. The tach senders can also be used to provide RPM information to the digital tachometer heads or other compatible tachometer indicators.

2.0 Operating the EEC System

Section 2.9 describes the indications of control system failure and the emergency procedures that are to be followed if the EEC System becomes inoperative. This section (2.9) of the manual must be read and understood by all vessel operators prior to startup of the EEC system.

2.1 General Information

In order to properly understand the operation of the Glendinning Electronic Engine Control system, there are certain key concepts or product components that one should have a clear understanding of. These key concepts include the following:

- o Operational Modes
- o Active Station vs. Inactive Station
- o Control Buttons
- o Indicating lights

• Operational Modes

The Glendinning EEC system has 5 different “Operational Modes”. It is important to understand the function of each of these modes and to keep in mind the specific Operational Mode that one is in. These Operational Modes include:

Cruise mode — This is the normal mode that the system is in while the system is operating. While in the Cruise Mode, the system operates exactly the same as any other single lever control system (mechanical, pneumatic, or electronic control)

Sync mode — This is the mode that the system is in when automatic synchronization is activated.

Warm up mode — This mode causes the gear actuator to be locked in neutral so throttles can be operated independantly. This mode would typically be used while tied up to the dock, warming up the engines.

Slow mode — This mode is similar to “Cruise mode”. While in Slow Mode however, the engine throttle is limited to about 50% of its normal speed range. (Full movement of the control handle will only get about 1/2 normal full throttle engine RPM). This mode is typically used when operating in close quarters or during maneuvering.

Troll mode — If installed, this is the mode that the system is in when troll is activated.

• Active Station vs. Inactive Station

When the EEC system is Operational, ***only one control station (Control Head) may be in control at any one time.*** The control station that is operating the EEC system is called the “Active Station”. All of the other installed control stations are called “Inactive Stations”. System control may be trans-

ferred from the “Active Station” to any of the “Inactive Stations” by following the procedures described below in Station Transfer (Section 2.8). The “Active Station” TAKE light will always be ON (not flashing) at the Active Station - this tells the boat operator that the station is in control. Also, the TAKE light will only be ON at the Active Station - only one station can be the Active Station - in control of the boat - at any time.

• Control Buttons

The Operational Mode that the EEC system is in is controlled by means of (4) buttons, which are located on the top of the control head body. When each button is ***pressed and released***, the Operational Mode, or function, associated with that button is activated. Pressing and releasing the button a second time will deactivate the operational mode. (NOTE: The button must be released in order for the button function to be activated or deactivated. Pressing the button alone - without releasing it - will have no effect.)

Each control head includes a keypad with four (4) control buttons. The function of each control button is described here briefly - see the referenced manual section for additional information:

CONTROL BUTTON	DESCRIPTION	REFERENCED SECTION
TAKE	This button is used to “take control” when control is transferred from one station to another (Station Transfer).	2.8
SYNC	This button is used to put the EEC system into the SYNC Mode. When this operational mode is activated, the EEC system will automatically control the speed of the port engine so that it exactly matches the speed of the starboard engine. (NOTE: On vessels equipped with Caterpillar engines with Electronic Engine Governors, the Synchronization function is accomplished by the engine governor and NOT by the Glendinning EEC system. In these installations, the Control Head does NOT have a button for engine synchronization.	2.4
WARM	This button will cause the system to lock the gear in neutral position. Moving the control handle in the throttle range will operate the engine throttle only, while the gear is locked in the neutral position.	2.5
SLOW	This button reduces the speed which will be achieved by full deflection of the control head handle. (NOTE: On boats equipped with troll valve actuators (for controlling the reduction gear trolling valve), the rightmost button will activate and deactivate the trolling valve actuator. In this situation, SLOW Mode can be obtained by pressing and releasing the TAKE and TROLL buttons *simultaneously*.	2.6
TROLL	On boats equipped with Trolling valves, one of the Control Head control buttons will be used to activate or deactivate the trolling valve actuator.	2.7

• Indicating Lights

Four (4) lights are incorporated into the Control Head that corresponds with the each of the control buttons. The purpose of these lights are to inform the operator about the current EEC Operational Mode. At the Active Station, when the light is ON, the mode associated with that button is activated. When the light is OFF, its associated mode is deactivated.

“Heartbeat”

As described above, the Control Head indicating lights are fully lit at the “Active Station” to indicate the Operational Mode. At the Inactive Station, the indicating lights will blink very briefly (1 flash every 2 seconds) while the EEC system is operational. The Indicating lights which blink will correspond to those which are ON at the “Active Station”. That is, while the EEC system is in the normal “Cruise Mode”, only the TAKE light will blink. While the EEC system is in “Slow Mode”, both the TAKE and SLOW lights will blink (1 flash every 2 seconds).

In addition to ON and OFF, the lights can indicate two other facts:

Slow blink — In general, the light will begin to slow blink (1 blink per second) after receiving input from the operator, for example, to acknowledge that a control button has been pressed. While the light continues to blink slowly, the EEC system is indicating that the operators' request is being processed. In most functions, this will mean that the EEC system is verifying that required conditions exist prior to accomplishing the requested function. If the light continues to blink for an excessively long period of time (more than 2-3 seconds), the operator will then know that one or more prerequisite conditions do not exist. (Two examples are 1) During station transfer, the station that wants to take control must have their control handles aligned with the station that is in control at that moment. If the control handles are not aligned, the “TAKE” indicator light will continue to slow blink and 2) During startup, if the control handles are not in neutral, the “TAKE” indicator light will continue to slow blink until the control handles are put into neutral.

Fast blink — After the EEC system has verified that the prerequisite conditions exist, the light will begin to blink rapidly (5 flashes per second). This tells the operator that the system is ready to proceed with the next step *as soon as the button is pressed a second time* by the vessel operator. For example, the light will fast blink during the station transfer procedure, waiting for the operator to press the button the second time, after the control handles have been moved to an appropriate position for transfer.

The purpose of the “Heartbeat” is to inform a person at the “Inactive Station” in two ways: 1) the EEC system is operational and 2) which operational mode the system is in.

Control Head Keypad styles

There are four (4) styles of control head keypads. Any style of keypad can be used in any installation configuration, however, jumper settings in the Station Processor must be changed to match the Station

Processor operation to the keypad configuration.

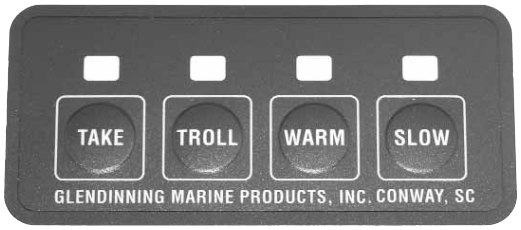
STANDARD KEYPAD (Control Head part # has a -SH or -SS suffix)

The STANDARD keypad is provided on boats not equipped with troll valves, and with non-electronically controlled diesels. Troll valve operation is NOT AVAILABLE with the STANDARD keypad.

TROLL KEYPAD (Control Head part # has a -TH or -TS suffix)

The TROLL keypad is provided on boats equipped with troll valves, and with non-electronically controlled diesels. SLOW mode operation is activated with a “2-button” press (TAKE & TROLL buttons pressed simultaneously).

CAT KEYPAD (Control Head part # has a -CH or -CS suffix)



The CAT keypad is provided on boats equipped with electronically controlled diesels. Troll valve operation is activated by pressing the second button from the left (TROLL).

NEW CONTROL HEAD KEYPAD

The NEW Control Head keypad is available on the re-designed EEC control head. You will find the above referenced keypads on an earlier style Remote (Electric only) Control Station or the Mechanical Backup Control Head station only.

2.2 Control System Startup

When starting the controls the EEC system immediately goes into the Warm Mode. The boat operator can be assured that the engine transmission is in Neutral at engine start, and will remain in Neutral, until the system is placed in normal run / cruise mode by pressing the WARM button on the control head keypad.

The following procedure will activate the EEC system and bring it to the Cruise mode.

1. Verify that the Main Station Control head levers and the mechanical backup control head levers are in the Neutral position.

2. Turn on the “EEC Power Switch” or the circuit breakers which control power to the engine control system. The “EEC Power Switch” is normally located at the helm station that is equipped with the main station control head.

3. Immediately after the EEC Power Switch is turned on, the EEC system will begin initialization procedures, including a transfer of control from mechanical backup to electronic. This process will take approximately 5 seconds. While the process is underway, the Control Head Indicator lights will “scroll” to indicate that power has been applied to the EEC system.

4. After approximately 5 seconds, the “TAKE” indicator light will remain ON (no blinking) and the WARM indicator light will remain ON (no blinking). The EEC system is now fully operational in the Warm up mode.

1. One of these diagnostics that the EP does during the startup process is to verify that the Main Station Control Head (mechanical backup) control levers are in the "Neutral" detent position. ***If both Control Levers are not in the Neutral position****, the Control Head Indicator lights will not “scroll”. Rather, the TAKE / WARM / SLOW lights will slowly blink - pressing and releasing the TAKE button will have no effect. To continue the System Startup process, reposition the control levers into the Neutral detent and the startup process will continue automatically.*

2. Step 4 of the above procedure applies to EEC Systems equipped with EP Software version 4 and later. (This software began shipping in February, 1999). For EEC systems equipped with earlier versions of software, a “2 button” press will be required to activate the Engine Control system, as follows:

a. Approximately 5 seconds after turning on the EEC Power Switch, the “TAKE” indicator light at the “main station” will begin to blink slowly. Press and release the TAKE button 1 time.

b The “TAKE” indicator light at the “main station” will begin to blink quickly. Press and release the TAKE button a second time.

c The “TAKE” indicator light at the “main station” will remain ON. The EEC system is now fully operational in the Cruise mode.

REMOTE STATION CALIBRATION

After the EEC system startup, each remote station Control Head must be placed in the neutral detent position for at least 5 sections for diagnostic testing. The completion of this testing will be indicated by the TAKE light blinking once every two seconds (the “heartbeat”).

It is NOT NECESSARY that the remote station (electronic control only) Control Head levers be in the Neutral position during startup. However, it is necessary that the Station Processor recalibrate the control head electronic position prior to transferring control to the remote station. This automatic calibration process is done by returning the control levers to the Neutral position after the EEC system has been started for approximately 4 seconds. After the Control Head calibration is completed, the TAKE light will begin to blink (“heartbeat”) indicating that the remote station is fully operational and that the remote station is an Inactive Station. Control transfer may be done at any time. If the remote station control head handles are in the Neutral position at the time of system startup, this calibration process will be accomplished simultaneously with the main station calibration.

Prior to the automatic calibration process described above, the Control Head TAKE and SLOW Indicator lights will be ON - as if the remote station was in Slow Mode. This will alert the operator to the fact that the remote handle has not yet been calibrated. Once the handles are placed in the Neutral position, the SYNC / TROLL and WARM Indicator lights will be lit, showing that the automatic calibration process is in progress.

2.3 Cruise Mode

• General Description

While the EEC system is in the Cruise Mode of operation, the system will respond as a normal “single lever” control system. At the mid-point of the control lever position, the gear will be in the Neutral position. This will be felt on the control head by a detent position. Pushing the control lever forward one detent will engage the ahead gear, at idle RPM. Pushing the control lever still farther forward will throttle up the engine, still while in the ahead gear.

Pulling the control lever aft out of the Neutral detent position will cause the gear to go into reverse gear. Pulling the control lever farther aft will also throttle up the engine with the gear in reverse.

There are 5 possible control handle positions while in the Cruise Mode:

- o Ahead gear - with throttle
- o Ahead gear - engine idle
- o Neutral gear - engine idle
- o Astern gear - engine idle
- o Astern gear - with throttle

• Gear Sequence

The EEC system will automatically sequence the gears when the handle is moved from the ***'ahead with throttle'*** position to the ***'astern with throttle***' position. This means that the EEC system will only allow the gear to change position (ahead - neutral - astern) when the engine is at idle. And the engine throttle will only be advanced when the gear position is fully engaged with either ahead or astern.

A) Throttle Delay (only applicable for EEC software version 4 and later)

On some boats, it is possible that a prolonged period of time (up to 3 or 4 seconds) will transpire between the time that the transmission control lever is moved into gear and the time that the propeller shaft actually begins to turn. (By comparison, it only takes the EEC system Actuator approximately _ half a second to move the transmission control lever from Neutral into Ahead or Astern gear). The actual time delay that exists in any transmission will depend on various factors and adjustments inside the transmission. During this period of time, it is possible that the boat operator will be able to speed up the engine RPM above idle. If the internal transmission delay is excessive, it is possible that gear damage may occur if the gear engagement occurs at a significant engine speed.

To prevent this possible damage to the gear, the EEC system can be calibrated to include an optional time delay between the moment that the transmission control lever reaches the Ahead or Astern position, and the moment that the engine is allowed to be accelerated above idle. The selected delay may be set as 0 seconds (no delay), 0.5 seconds, 0.8 seconds or 1.0 second.

The following example will illustrate the operation of the throttle delay:

1. Control Handle is moved from Neutral to Ahead gear position and 50% engine throttle.
2. Gear Actuator moves transmission control lever into Ahead position, immediately after movement of Control Head handle.
3. Selected time delay is inserted (0.5 sec, 0.8 sec, 1.0 sec).
4. After time delay, Throttle Actuator will move engine throttle / governor to selected engine speed position.

B) Gear Delay (only applicable for EEC software version 5 and later)

The EEC system can also be calibrated to include a second type of delay, called “gear delay”. Gear delay will insert a time delay in the movement of the Gear Actuator when the control handle is moved from ahead or astern throttle position back to neutral or into the opposite gear. The purpose of Gear delay is prevent damage to the transmission if the gear is disengaged while the engine is at a significant speed above idle. Gear delay will allow the engine to slow down to idle (or to a speed close to idle) before the transmission is moved out of the gear position into neutral (see Section 8.1 — Custom Calibration Options).

The actual amount of gear delay is determined by two things:

1. Gear delay setting in Engine Processor DIP switches. This setting can be changed at any time that the EEC system is off. The gear delay has 8 possible settings, from 0 seconds (no delay) to 12 seconds.

2. The amount of time that the engine has been operated at the set speed. This delay is proportional to the amount of time that the engine has been operated at any particular speed. The following guidelines are used to determine the proportion:
— the amount of delay time begins to build as the engine throttle is set above 1000 RPM.
— The maximum delay time - that is, the delay time that is set by the DIP switch setting is reached when the engine has been operating at full throttle for 5 times the DIP switch setting.
— If the engine is operated at a high speed (90% of full throttle) and then slowed down to lower speed (30% of full throttle) for a short period of time, the gear delay will also be reduced in proportion to the slower engine speed.

Examples

1. If a 3 second gear delay is set on the EP DIP switches, the full 3 second gear delay will only be reached when the engine has been operated at full throttle for 15 seconds (5 x 3 second gear delay). If the engine is operated at a slower speed (less than full throttle), or for a shorter time that 15 seconds, the time delay will be correspondingly less than 3 seconds.

2. If a 9 second gear delay is set on the EP DIP switches, the full 9 second gear delay will only be reached when the engine has been operated at full throttle for 45 seconds (5 x 9 second gear delay). If the engine speed is reduced to 50% throttle for approximately 15 seconds, the time delay will be approximately 4.5 seconds, reflecting the slower engine operating speed.

The following example will illustrate the operation of the gear delay:

1. Boat is operating at cruise speed - ahead gear with throttle at 2000 RPM.
2. Control Handle is rapidly moved to neutral gear position (engine idle).
3. Throttle Actuator moves engine governor to idle position; engine RPM begins to descrease to idle, although this decrease is delayed due to natural engine inertia and the “windmilling” action of the propeller as the boat moves through the water.
4. After Throttle Actuator has moved engine governor to idle, Gear Actuator maintains transmission lever in ahead gear until predetermined time delay occurs (from 0 to 12 seconds).
5. After completion of time delay “wait time”, the Gear Actuator will move tranmission to neutral.

C) Bump mode (only applicable for EEC software version 5 and later)

The Electronic Engine Control system includes a special “bump” mode which allows the boat operator to control their engine speed with extreme precision. The bump mode allows the Throttle Actuator position (and therefore the engine governor / throttle) to be changed in very small increments, or

bumps, by pressing and releasing the WARM (to increase engine speed) or SLOW / TROLL (to decrease engine speed). This feature is available at any time when the engine is being operated at any speed above idle - in normal “cruise” (“run”) mode, or in “warm” mode or in “sync” mode.

1. Each bump will increase or decrease engine RPM approximately 15-20 RPM, although this value will from one installation to another.

2. The bump mode adds or subtracts small amounts from the Control Head handle position (although the handle does not move). If the Control Head is moved by the boat operator, the bump amount that has been added or subtracted is reset to zero, and the engine speed will be determined by the position of the Control Head handle.

2.4 SYNC (Synchronization) Mode

• General Description

The purpose of the EEC Sync Mode is to automatically match the speed of one engine (the port engine) with the speed of the other engine (starboard engine) while cruising. By maintaining the engines at virtually the same speed, noise and vibration caused by engines operating “out of sync” is eliminated. While the Sync Mode is operational, the difference between the port and starboard engine will normally not exceed 5 RPM.

On boats equipped with Caterpillar ECM engines, the Glendinning EEC system Sync function is normally not used. These engines are synchronized using the Caterpillar ECM system. Consult the Caterpillar engine Operation Manual for details.

• SYNC Mode Activation Procedure:

1. In order to activate the Synchronization Mode, the following must be true:
   1) the gears are in the ahead position
   2) engine speed is above 950 RPM
   (Note: This speed will vary from boat to boat depending on various factors related to system calibration, engine governor cable connection geometry, and engine governor dynamics. If synchronization does not engage at 950 RPM, try advancing the engines to a higher speed - perhaps 1500 RPM - and retry)
   3) engines speeds are within 250 RPM of each other for approximately 4 seconds

2. Whenever the engine RPMs meet the conditions stated above, press and release the SYNC button one time. The SYNC indicator light will go on. The EEC system will automatically adjust the speed of the Port engine to exactly agree with the speed of the Starboard engine.

3. While in Synchronization mode, the starboard engine speed can be changed. As the starboard engine RPM changes, the speed of the port engine will be automatically adjusted to match the new speed of the starboard engine. While in Sync mode, the port engine control lever will have no effect on the port engine - the EEC system is controlling the port engine for you. However, to make it easier to deactivate the Synchronization mode, it is good practice to keep the port engine control lever at approximately the same handle position as the starboard engine.

4. While in Synchronization mode, the engine RPM can be operated at any speed between idle and full throttle. At idle speed, or at full throttle, the Synchronization mode may enter the "limit" mode - see Note 3 below.

• SYNC Mode Deactivation Procedure:

1. Align the port Control Head handle with the starboard engine control handle.

2. Press and release the SYNC button one time. Sync mode will be deactivated and the EEC system will be returned to the normal Cruise Mode (Section 3.3).

1. Normally, when deactivating the Synchronization mode, the port Control Head handle should be pre-aligned with the starboard handle. If it is not, the engine control system will enter a special mode called "transition Sync". Rather than have the port engine RPM change drastically to the RPM corresponding to the Control Head port handle position (which may be in any throttle position), the port engine will operate at approximately the same RPM as the starboard engine. This will continue until the port Control Head handle is aligned with the starboard handle, at which point the port engine will return to normal, non-synchronized, "Cruise mode" operation.

2. If both engine control levers (port and starboard) are brought back to the neutral position, the Synchronization mode will automatically deactivate without any action by the boat operator.

3. "Limit mode" (also called "psuedo-sync") - If the engines are operated at or near idle speed or near full throttle, it is possible that the Engine Control system will not have sufficient range of movement on the Port Engine governor to make the speed adjustments necessary for synchronization. If this occurs, the Engine Processor will automatically enter a "psuedo-sync" mode. In this mode, the Port engine speed will be approximately the same (probably within 40 RPM) as the Starboard engine, but the Port engine will not be "synchronized". This condition will be indicated to the boat operator by the Control head TAKE and SYNC lights flashing in tandem.
If this occurs, nothing should be done. The lights are blinking so that the boat operator knows that the EEC system is not actively synchronizing engine speed. When the starboard engine is moved away from idle or full throttle a small amount, the EEC system will restart the active synchronization mode and the TAKE and SYNC lights will return to their normal "full on" (non-blinking) condition.

2.5 WARM Mode

• General Description

The purpose of the Warm Mode is to allow the engine to be throttled up while the gear is locked in the Neutral position. The Warm Mode is normally used during startup or while the vessel is at the dock, although it may be activated at any time.

• WARM Mode Activation Procedure:

1. Move the Control Head levers to the Neutral position. Warm Mode may only be activated while the gear is in the Neutral position.

2. Press and release the WARM button one time. The WARM indicator light will turn ON indicating that the EEC system is in Warm Mode.

3. While the WARM light is ON, moving the control handle into the 'Ahead' detent will have no effect - the gear actuator will be locked in the Neutral position. Advancing the throttle past the 'Ahead' gear detent will cause the engine to increase in RPM. (The engine will only accelerate if the handle is moved into the throttle range position. Moving it into the Astern position will have no effect.)

• WARM Mode Deactivation Procedure:

1. Move the Control Head levers to the Neutral position. Warm Mode may only be deactivated while the gear is in neutral.

2. Press and release the WARM button one time. The WARM indicator light will go OUT. The system is back in normal Cruise Mode (Section 2.3).

On EEC systems with software prior to version 4, Station Transfer is not possible while the Active Station is in Warm Mode.

Station Transfer is possible while the Active Station is in Warm Mode on EEC systems with software version 4 or later.

2.6 SLOW Mode

• General Description

Slow Mode is essentially the same as Cruise Mode, with one difference: the maximum RPM that may be obtained is approximately 50% of WOT (wide-open throttle). The purpose of slow mode is to give the vessel operator approximately twice the precision compared with normal Cruise Mode. This is important while the vessel is being operated at slow speeds, such as during maneuvering or docking.

• SLOW Mode Activation Procedure:

1. Move the Control Head levers to the Neutral or Ahead / Astern idle detent position. Slow Mode may only be activated while the control handle is in one of the three detent positions.

2. Press and release the SLOW button one time. The SLOW indicator light will go ON, indicating that the EEC System is in Slow Mode.

For boats equipped with troll valves, it may be necessary for two buttons - TAKE and TROLL - to be pressed simultaneously. See Control Head styles - section 2.1 for more information.

3. While in the Slow Mode, operation of the propulsion system is essentially the same as in normal Cruise Mode. The only differences are that engine throttle response will be slower and more precise, and maximum RPM obtainable will be approximately 50% of maximum.

• SLOW Mode Deactivation Procedure:

1. Move the Control Head levers to the Neutral or Ahead / Astern idle detent position. Slow Mode may only be deactivated while the control handle is in one of the three detent positions.

2. Press and release the SLOW button one time. The SLOW indicator light will go OUT. The system is back in normal Cruise Mode (Section 3.3).

2.7 TROLL Mode

• General Description

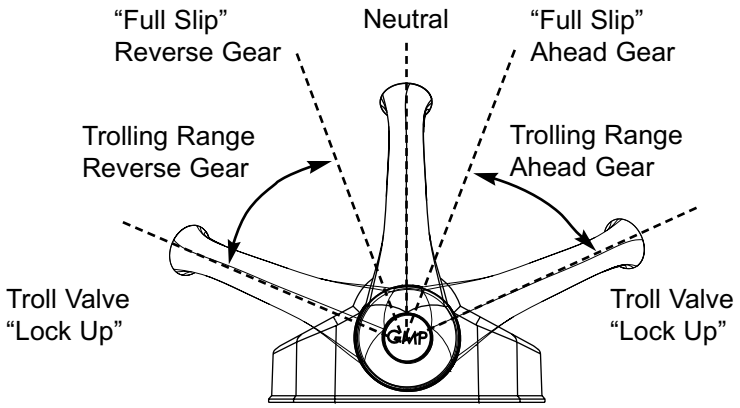
Troll Mode is used on boats that are equipped with trolling valve actuators to allow a boat speed slower than that typically obtained with normal engine idle. This is done by moving a lever on the engine transmission - called the “trolling valve” - which adjusts the gear oil pressure and allows the transmission to slip. The amount of slippage is adjusted by the position of the trolling valve.

While in Troll Mode, the boat operator is able to control the gear position (Ahead, Reverse, and Neutral) and the trolling valve position (Full slip to no slip). To prevent transmission damage, the engine throttle will remain in idle at any time that the troll valve is not in the Full Lockup - no slip - position. (While in normal Cruise Mode, the trolling valve actuator is always in the Full Lockup - no slip - position.)

Two methods of troll operation are available. These are described in the following diagrams. The specific method of troll operation that is in use is determined during control system calibration (See Operations Manual, Section 5.0 - Calibration)

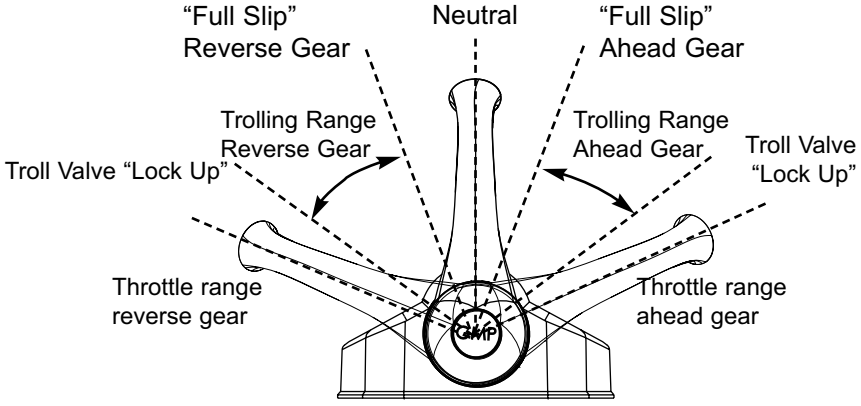
Method 1
“Troll only - no throttle”

This troll valve operation method permits only troll valve operation - engine throttle is locked at idle.



Method 2
“Throttle at top end of troll”

This troll valve operation method controls troll valve through first 2/3 of handle travel - throttle is locked in idle. Last 1/3 of handle travel allows approximately 50% of engine throttle - troll valve is positioned in Full Lockup - no slip - while throttle is operated.



• TROLL Mode Activation Procedure:

1. Move the Control Head levers to the Neutral position. Troll Mode may only be activat-

ed while the control handle is in Neutral.

2. Press and release the TROLL button one time. In the engine compartment, the Trolling Valve Actuator will move the transmission trolling valve to the “full slip” position. The TROLL indicator light will go ON indicating that the EEC system is in Troll Mode.

3. While in the Troll Mode, moving the Control Head lever out of neutral into the Ahead or Reverse gear position will have no effect on the propeller shaft - the trolling valve is in “full slip” and there will be no propeller shaft movement.

4. As the Control Head lever is pushed past the Ahead / Reverse position into the normal position for engine throttle, the Troll Valve Actuator will move the trolling valve away from “full slip” toward the “full lockup” position, and the propeller shaft will begin to rotate. Propeller speed can be adjusted by moving the Control Head lever.

HIGH IDLE WHILE IN TROLL MODE

While in TROLL Mode it may be desirable to set your engine’s idle to a higher setting. Some boat operators have found that setting the engine idle higher while in TROLL Mode improves the performance of the trolling valves. Changes in engine idle will only take effect while the system is in TROLL Mode. Once in TROLL Mode (as outlined above) follow the following steps:

A) Make sure you are in TROLL Mode and handles are in the Neutral posiiton.

B) Press and Release the TAKE & SYNC buttons simultaneously to “bump up” engine idle setting (this “bump” size and amount, is a configurable setting described in Sec. 8.1, pg. 117).

C) OR Press and Release the WARM & TROLL / SLOW buttons simultaneously to “bump down” engine idle setting.

D) Once desired setting is achieved Press & Release TAKE & WARM buttons simultaneously to store your setting in memory. Again — the memorized engine idle setting only affects engine idle while in TROLL Mode.

E) To return engine idle setting to default — While in TROLL Mode Press & Release the WARM button (handles must be in Neutral position).

REFER TO YOUR MANUFACTURERS RECOMMENDATION FOR MAXIMUM RPMs IN TROLL MODE TO PREVENT TRANSMISSION DAMAGE.

• TROLL Mode DeActivation Procedure:

1. Move the Control Head levers to the Neutral position. Troll Mode may only be deactivated while the control handle is Neutral.

2. Press and release the TROLL button one time. In the engine compartment, the Trolling Valve Actuator will move the transmission trolling valve to the “full lockup” position. The TROLL indicator light will go OUT, indicating that the system is back in normal Cruise Mode (Section 2.3).

2.8 Station Transfer

• General Description

The purpose of the Station Transfer function is to allow the vessel operator to transfer control from one station to another. (This could also be described as changing the control station which is the “Active Station” - the “Active Station” is always that station that is in control of the EEC system.)

In order to understand the proper procedure for station transfer, two concepts must be kept in mind:

1. Control can be transferred FROM one station (the “Active Station”) TO any other “Inactive station” at any time. The propulsion plant may be in any position during the transfer process - ahead, astern, neutral, idle, or full throttle. If stations are transferred while the gears are in neutral, the “Inactive” (receiving) Station control levers must also be in the neutral gear position. If stations are transferred while the engines are in gear, the “Inactive” (receiving) Station control levers must be: 1) in neutral, or, in the same gear as the “Active Station” (i.e., ahead / astern) and 2) at or below the throttle position of the “Active Station”. (That is, the Inactive Station control lever must be at or below the throttle position of the Active Station).

This is only true for Engine Controls that include Version 4 software or higher.

For systems equipped with older software, station transfer can only occur while the system is in Cruise, Sync, or Slow mode only. (Station transfer is not allowed while the system is in Warm or Troll mode).

2. Control transfer is a two step process. The first step involves signaling the EEC system that a control transfer is desired. This is done by pressing the TAKE button one time at the “Inactive Station” where you desire to take control. The EEC system will analyze the system status and determine whether control can be transferred. (This primarily checks to see if the “Inactive Station” control levers are in a position that is appropriate for station transfer). If the EEC confirms that station transfer is permissible, this will be signaled by a quick flashing TAKE light at

the “Inactive Station”. If some parameter prevents taking control (such as the Inactive (Receiving) Station control lever being in Reverse while the Active (In-control) Station is in Ahead) the TAKE light will 'slow blink'. It will continue to 'slow blink' until the parameter is changed or until a “time-out” is reached - approximately 12 seconds after first pressing the TAKE button.

Remember, Station transfer is only possible when:

Both Inactive Station control levers are in Neutral Gear
OR
Both Inactive Station control levers are in the same gear as Active Station (ahead/ astern), and at the same or lower throttle setting than Active Station.

• Station Transfer Procedure:

1. At the Inactive Station where you desire to take control, press and release the TAKE button 1 time. The Inactive Station control levers can be in any position when the button is pressed.

2. If Inactive Station control levers are in a position that is allowable for control transfer (see above), the TAKE light will begin to 'quick blink' and the control head will beep quickly.

3. If Inactive Station control levers are not in an appropriate position, TAKE light will 'slow blink'. The Inactive Station control levers should be moved to an appropriate transfer position, as described above. Doing this will cause TAKE light to 'quick blink'.

The EEC system only allows a 12-second time period to make adjustments to the position of the Inactive Station control levers. If the control levers are not in an appropriate transfer position by the end of 12 seconds, the EEC system will revert back to a normal Cruise,Sync, or Slow Mode.

4. When TAKE light is 'quick blinking', press and release the TAKE button again (1 time). Control will immediately be transferred to the Inactive Station. This control station now becomes the Active Station and has full control of the EEC system.

A good method of transferring stations while underway (ahead, with throttle) is to do the following:
1) Press and release the TAKE button one time at the Inactive Station
2) Advance the control handles to the full throttle ahead position. (The engine speed will not change since the control station is still Inactive). The TAKE light will blink slowly, indicating that the control handles are beyond the allowable position for station transfer.
3) Pull the control handles back slowly to the point where the TAKE light begins to blink quickly. At this point the control handles are aligned with the current engine speed.
4) Press and release the TAKE button again (one time). Control will be transferred immediately and the engine RPM will be virtually unchanged.

2.9 Alarm Mode / Mechanical Backup Operation

• Alarm Mode Sequence

During normal operation, the Engine Processor continually monitors the operation of the entire control system to ensure that the system is functioning properly. In the event that a problem is discovered during these routine and continuous diagnostic checks, the EEC system will enter an “alarm mode”. The following will occur when the “alarm mode” is entered:

1) The system actuators will remain at their “last- commanded” position; that is, the engine throttle and gear will remain in the same position they were in when the system entered the alarm mode.

2) The actuator solenoids will release, allowing the system to transfer automatically to mechanical backup operation (if equipped).

3) All four (4) LED's on the control head will begin to blink in unison at all helm stations. The Control Head beeper will also begin to beep simultaneously.

4) The error code associated with the specific alarm condition will be indicated on the Engine Processor LED's.

5) The error code is stored in the system memory as an aid to troubleshooting the problem later.

• Mechanical Backup Procedure

When the EEC system enters “alarm mode” as indicated by the (4) Control Head LEDs blinking simultaneously, the vessel operator should immediately accomplish the following:

1) ***If the vessel is being controlled at the Main control station***, the one equipped with the integrated mechanical backup, the control system will revert to mechanical operation immediately.

If the vessel is being operated in the troll mode when the system enters alarm mode, the troll valves must be manually closed. There is no automatic mechanical backup system for the troll valve actuator. Do not increase engine throttle above the speed allowed by the transmission manufacturer while the troll valve is open. DAMAGE CAN OCCUR!

2) ***If the vessel is being controlled at one of the remote control stations (electronic control only)***, the vessel operator should move to the mechanical backup station and regain mechanical control. This is done by moving the Main control station (equipped

with the mechanical backup system) to the same approximate position (i.e., Ahead with 60% throttle) as the remote control station when the system entered the alarm mode.

In some cases, it may be necessary to "jiggle" the control handle a small amount in one direction or the other in order to regain mechanical backup control. Whether or not this small amount of control handle movement is necessary depends upon a number of factors, including: control handle position, length of mechanical backup cables, cable adjustment during installation, etc.

3) Investigating for the cause of the system failure can begin immediately or may be delayed until the vessel reaches its final destination:

a) **Immediate investigation** — Leave EEC system ON in alarm mode with Control Head LEDs blinking and beeper sounding. DO NOT turn off the EEC Power Switch. Remove the EP Access and identify the LED's which are lit brightly. Once this information is recorded, the power to the Engine Processor may be turned off by pressing and releasing the EP circuit breakers. This will cause the Control Head LED's and beeper to cease blinking / beeping. Switch OFF the EEC power switch at the main panel.

Immediate investigation should only be made if the vessel is tied up at the dock. If the vessel is underway, investigation of the alarm should be delayed until the vessel returns to the dock (see Delayed Investigation - next paragraph).

b) **Delayed investigation** — Turn OFF the EEC system by switching the EEC power switch at the Main helm station to the OFF position. The Control Head LED's and beeper will cease. When the vessel has been tied up, follow the procedures under Section 5.1 "Troubleshoot Mode" to read the stored LED information.

4) Call GMP personnel with a description of the problem and LED error code information. (See Section 5)

If electronic control is lost and then regained using the mechanical backup system, it is possible to attempt to restart the EEC while the vessel is underway. This may be done by placing the gear in the Neutral position, and proceeding with the System Startup procedures described in Section 2.2. The alarm codes that were stored during the original system failure will remain stored in system memory.

• System Failure — No Alarm

There are 3 conditions where the EEC system may fail without entering the Alarm Mode:

1) **DC power failure** — Although dual battery inputs make the possibility of this occurring remote, a sudden and continuous loss of DC power input to the Engine Processor

would make the EEC system stop “dead in its tracks” (NOTE: A slow loss of DC battery voltage [i.e., battery charger failure] would be indicated by the system entering “alarm mode” due to low input voltage. This alarm code would be stored in system memory.).

2) **Power Switch power failure** — A failure to supply power to the Power Switch at the Main station will have the same effect as a DC power failure.

3) **Internal diagnostic failure** — The diagnostic system fails to detect a system failure, or the diagnostic system has an internal failure causing it to cease operation.

If the system were to fail from one of the 3 causes listed above, the vessel operator would detect this failure in one of three ways:

1) The TAKE light, which is always fully ON (illuminated) at the Active Station, will go out.

2) If the vessel is being controlled from the mechanical backup helm station, the control handles may be much harder to move.

3) If the vessel were being controlled from a remote, electronic-only, station, movement of the control handles would result in no change of engine throttle and gear position. In this situation, mechanical control should be immediately regained at the mechanical backup station.

The EEC system may be shifted to Mechanical backup operation at any time. This is done by simply turning OFF the EEC power switch at the mechanical backup helm station. The EEC system will be immediately de-energized and control may be regained using the mechanical backup system.

• Mechanical Backup System (detailed description)

General

A separate mechanical Control Head by another manufacturer may be used with the Glendinning Mechanical Backup feature, however, the mechanical backup feature WILL NOT be integrated with the separate Control Head. When using another manufacturers Control Head, it will be necessary for the boat operator to take mechanical control over the vessel from this dedicated station.

One of the key features of the Glendinning Electronic Engine Control system is the integrated mechanical backup system. In essence, the EEC system is really two control systems that operate in parallel to one another:

1) A computer controlled electro-mechanical system that permits control of gear and throttle from up to six different locations and . . .

2) A mechanical control that permits control of the gear and throttle from one helm station. While the system is in operation, the specific system that is controlling the engine throttle and gear is determined by a custom designed coupler mechanism on the top of the actuator which is located in the engine room. In the electronic operation, the coupler mechanism connects the electro-mechanical actuator output to the engine throttle and gear; the position and movement of the mechanical control system is ignored. In mechanical backup operation, the coupler mechanism connects the control cable from the mechanical backup station to the engine throttle and gear; the position and movement of the electro-mechanical actuator is ignored.

Control Changeover — Electronic / Mechanical

In order to understand the method of transfer between the electronic and mechanical control systems, the concept of alignment must be understood. Control may only be transferred between the two parallel control systems when they are both in the same position. For example, if the vessel is being operated in the ahead gear at 2000 RPM in electronic control, the mechanical control system must be moved to a position that corresponds to “Ahead/ 2000 RPM” in order to regain mechanical control. (This alignment must only be approximate for transfer to occur).

When the vessel is being controlled electronically ***from the mechanical backup station***, the electronic control system and the mechanical control are generally aligned. That is, when the system enters “alarm mode” when the system is being controlled electronically at the Main helm station, control will be transferred immediately from electronic to mechanical.
:

In some cases, it may be necessary to “jiggle” the control handle a small amount in one direction or the other for this transfer to occur. Whether or not control will be immediate depends upon a number of factors, including: control handle position, length of mechanical backup cables, cable adjustment during installation, etc.

When the vessel is being controlled electronically ***from a remote, electronic-only, control station***, it will be necessary to “align” the mechanical handles up with the current position of the engine throttle and gear in order to regain control. This may be done very simply by pushing the control lever in the direction of vessel movement (ahead or astern) and continuing to push the lever until a change is observed in the engine speed (RPM). At the moment that the mechanical control system is aligned with the electronic system, the engine will either increase or decrease slightly in RPM. The engines may now be controlled mechanically.

Control transfer ***from mechanical operation to electronic*** is accomplished every time that the EEC system is turned on. During system startup, the electronic control system automatically aligns itself up with the mechanical control. This is the reason why the main control station handles must be in the Neutral position prior to turning on the EEC power switch. (see section 4.2).

3.0 Installing the EEC System

Before beginning the installation of the Glendinning Electronic Engine Control (EEC), proper consideration and pre-planning should be given to several very important parts of the EEC system. Proper planning of the installation will help to insure that the EEC system will operate correctly and within specification. Failing to properly plan will decrease the reliability of the EEC system and possibly disable some of the product's inherent safety features.

3.1 Pre-Installation Planning

The two most critical parts of the EEC system installation are the following:

Component Location — In order for the integrated mechanical backup system to work properly, and to maximize the overall reliability of the EEC system, the proper location of the Actuators, Engine Processor, and Mechanical backup control head is extremely important.

EEC system power supply — The EEC system includes a reliability feature called “dual battery inputs”. One of the most critical factors in determining the reliability of any electrical equipment is providing a solid source of electrical power. In order to increase the probability that the Electronic Engine Control will be able to receive a solid source of electrical power, the EEC system has been designed for power inputs from two (2) independent batteries. *Failing to properly provide power from (2) independent battery sources will disable this important safety feature!!*

• Component Locations

The most important pre-installation decisions which must be made are the proper locations for several of the EEC components, specifically the Actuators, Mechanical Backup Control Head, and Engine Processor. Properly installed, the EEC system will work according to specifications. Improperly installed, overall reliability of the EEC system will be reduced and some system features, such as mechanical backup operation, will be degraded.

Actuator Location

It cannot be emphasized strongly enough: ***the location of the EEC system actuators is the most important factor in the satisfactory operation of the integrated mechanical backup system*** (If no mechanical backup system is used, or if the system is "non-integrated", actuator location is less important). This is because the location of the Actuators has a direct impact on the routing of the control cables. In general, and almost without exception, there is a direct connection between good routing of the control cables and the operation of the mechanical backup system - good control cable routing will result in good mechanical backup operation, bad control cable routing will result in bad mechanical backup operation. Some factors which contribute to good Actuator location are the following:

— **Straight cable runs with the minimum number of bends** - The most efficient cable configuration is a straight cable run with no bends. Although this will yield maximum cable efficiency, it is not practical in a typical installation. Therefore, to maximize cable efficiency, the Actuator locations should be chosen which will reduce or eliminate the total number of bends in the control cables. (This includes the control cables which connect the Actuator to the engine / gear as well as the mechanical backup cables).

— **Cable bends should have a large radius** - The claims of the control cable manufacturers notwithstanding, control cables are far more efficient with larger diameter bends rather than smaller diameter. Where possible, large, sweeping turns should be used rather than smaller, tighter turns.

As an aid in determining the best location for the EEC system actuators, several drawings have been prepared which depict some typical installations. Please review these drawings, which are located at the end of this section, to see if any of these layouts would be applicable to your specific installation.

As part of its service to its customers, Glendinning Marine Products, Inc. offers, at no charge to the customer, a plan review service for EEC system installations. In order to take advantage of this free service, fax or mail a sketch of the proposed installation to our EEC Application Manager. Although this sketch can be very simple, it should show the general arrangement of the engine and gearbox, points of attachment for the control cables, location for mechanical backup cable entry into the engine room, and proposed location of EEC system components.

A WORD REGARDING CONTROL CABLES. . .

To ensure good operation of the Engine Control mechanical backup system it is important that good quality control cables be used. Although the EEC system components - Actuators and Mechanical backup control head - are designed to accommodate any standard Type 33 control cable, there are many grades and qualities of control cables available on the market. Like the position of the Actuators described above, the quality of the control cables will have a direct impact on the function of the mechanical backup after the installation is completed. In general, the use of standard quality “Morse Red Jaket” cables (or Teleflex equivalent) is not recommended. Some installers have had acceptable result using “Morse Supreme” cables (or Teleflex equivalent). Our recommendation, based on decades of experience with control cables, is to use Type 95 control cables manufactured by Glendinning Marine Products, Inc. Our testing has found these cables to have consistently the highest efficiency, smoothest operation, and greatest flexibility of any control cable on the market. NW Control cables by Glendinning are available from Glendinning Marine Products, Lewis Marine Supply, or other marine distributors.
On aftermarket installations, it is generally not recommended to reuse the existing control cables for the mechanical backup system.

Mechanical Backup Control Head

Determining a good location for the mechanical backup control head is important, although the location of this component is frequently pre-determined by the boat owner or yacht designer. Two issues must be considered in the installation of the mechanical backup cables:

— **Clearance for mechanical backup levers** - Several levers are mounted below and on the

side of the mechanical backup control head. In some cases, there is insufficient clearance below the control head to allow for unimpeded movement of these levers or for their installation or servicing.

— **Control cable routing** - The issues discussed above regarding control cable routing to the actuators also apply here. Large sweeping bends should be used rather than tight turns. Lay cables out straight prior to installation. Cycle test cable during installation to determine if any compound bends have created noticable drag in cable operation.

Engine Processor

The following considerations should be kept in mind when identifying a good location for the Engine Processor:

— **Environmental conditions** - The Engine Processor should be mounted in an area that is relatively dry and cool. Although the Engine Processor electronic components are reasonably well-sealed from moisture, the product enclosure is not designed for constant direct contact with water. Since the longevity of electronic components is reduced in high temperature environments, it is best to find an area of the engine compartment that is not exposed to temperature extremes. Although the Engine Processor has been designed for installation in the engine compartment, the design of the product does allow it to be installed external to the engine compartment, as long as the wire length from the Actuators is 20' or less. The Engine Processor should be installed where there is some air movement or ventilation. DO NOT MOUNT ON ENGINE!

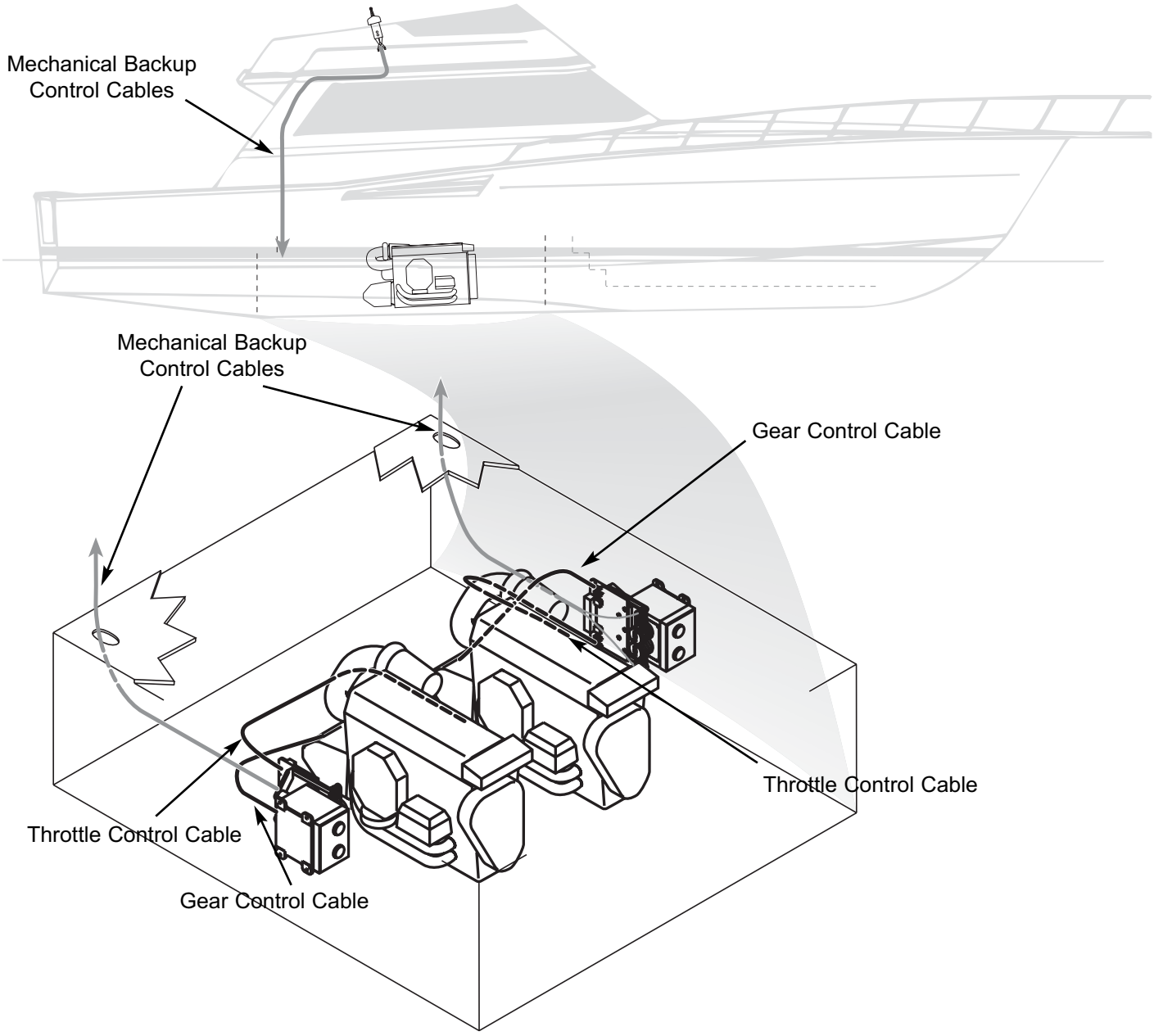
— **Accessible** - During system calibration or troubleshooting, it will be necessary for the installer or repair technician to have access to the internal connections of the Engine Processor. In view of this, the Engine Processor should be mounted in a relatively accessible area.

— **The Engine Processor can be mounted in any orientation** - on the overhead or deck, or on the bulkhead.

• Example Installation Diagrams

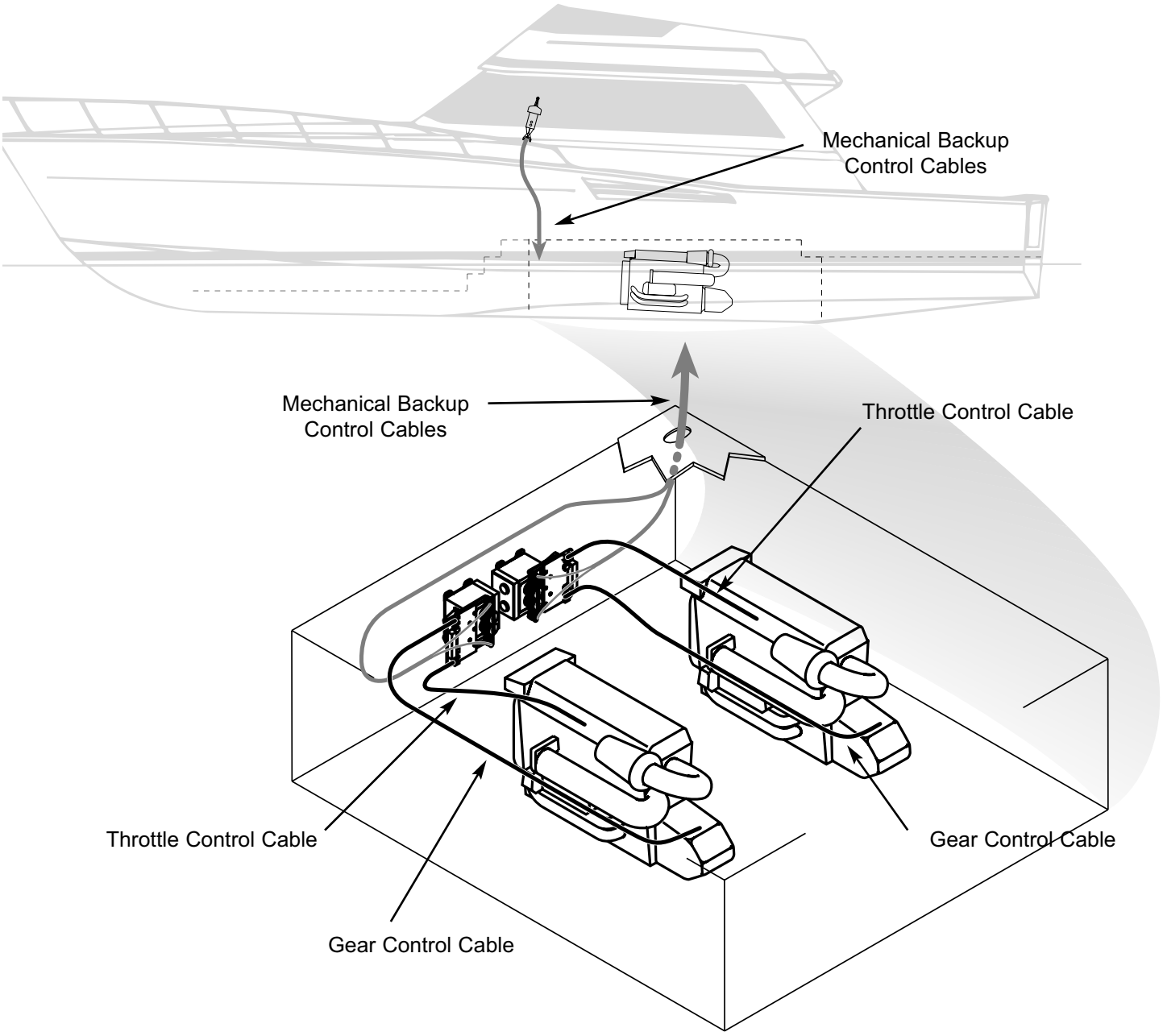
The following drawing illustrates a typical location for the Actuators where the mechanical backup cables enter the engine compartment at the aft rear corners. The Actuators are mounted on the outboard hull, with the Actuator control cable mounting plate oriented toward the aft end of the boat. The control cables to the engine and gear make a “rear entry” and are connected to the Actuators through a single 180 degree bend.

Aft - Starboard and Port Entry Points



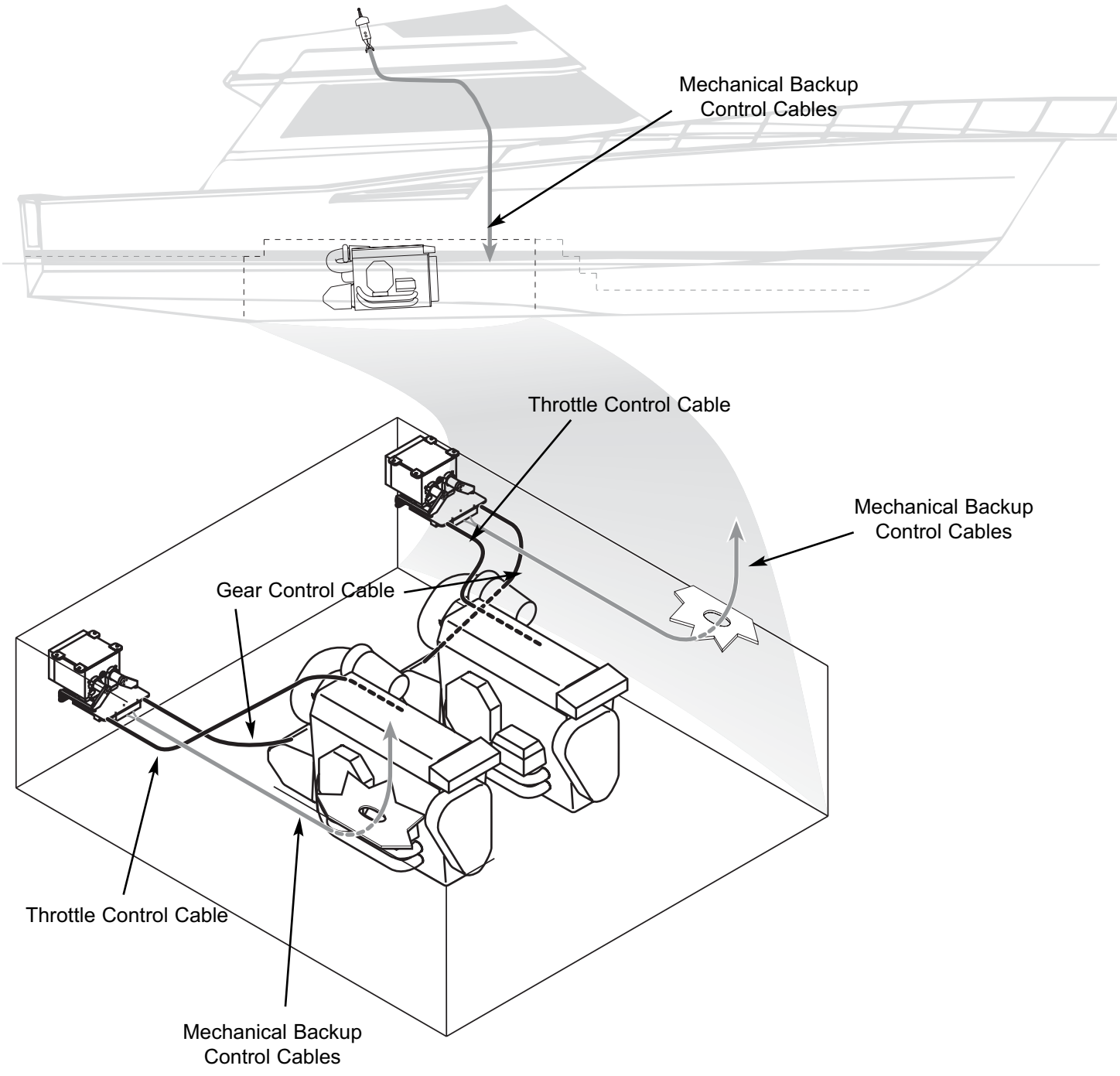
The following drawing illustrates a typical location for the Actuators where the mechanical backup cables enter the engine compartment at one of the forward corners. The Actuators are mounted on the forward bulkhead, with the Actuator control cable mounting plate oriented toward the side of the engine compartment where the cables enter. The control cables to the engine and gear make a “front entry” to the engine governor and are connected to the Actuators through a one or two 90 degree bends.

Forward - Starboard Entry Points



The following drawing illustrates a typical location for the Actuators where the mechanical backup cables enter the engine compartment at the forward corners. The Actuators are mounted on the overhead of the engine compartment at each rear corner, with the Actuator control cable mounting plate oriented toward the forward end of the engine compartment where the cables enter. The control cables to the engine and gear make a “rear entry” to the engine governor and are connected to the Actuators through a one or two 90 degree bends.

Mid - Starboard and Port Entry Points

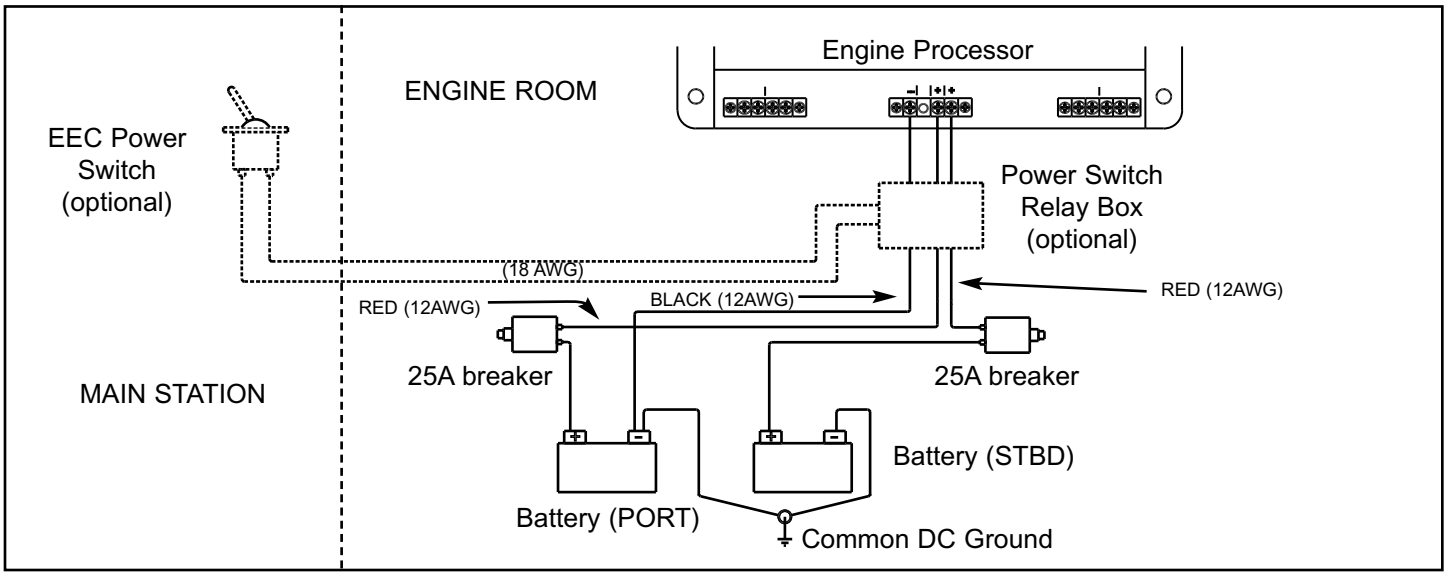


• Power Supply

In the installation of any electronic device, the source of power is one of the most important factors to consider during the installation. The Glendinning Electronic Engine Control has a unique and very reliable power supply system which, if the system is properly installed, greatly improves the overall reliability of the engine control system.

One of the significant features of the power supply system the “dual battery input” - that is, the Engine Control provides for the connection of two independent sources of DC power. During normal operation, the Engine Control system will draw power from both power sources. In the event one of those power sources fail - due to battery failure, battery charger failure, or some other electrical distribution failure - the Engine Control is designed to run off a single DC power source, switching over automatically to the power source that is supplying the higher voltage. Of course, both power sources are completely isolated from the other. We believe that this concept of “dual battery inputs” provides a very important backup to a very critical part of the EEC system.

In its most simple form, the dual battery schematic is as follows:



Some points which should be considered in the installation of the EEC power supply system are the following:

Battery power should be drawn from 2 independent sources — In a typical boat, the DC power distribution system is designed to take power from a single battery source and then distribute it to the various equipment that require power. Although the battery source can usually be selected from one of several batteries, the DC distribution panel is not able to provide for the supply of power from 2 independent sources to any single device. Therefore, providing power to the EEC system from the DC distribution is usually not a good idea.

In other boats, several batteries are arranged in parallel. Obviously, these batteries are not

independent - that is, the voltage observed at one battery terminal will be the same at the other battery terminal. It is important that each battery source be completely independent of the other.

Draw power from the battery as close to the battery positive terminal as possible — It cannot be overemphasized that providing a secure, uninterrupted source of power to the EEC system is vitally important to the reliable operation of the control system. For this reason, it is best that the EEC power be drawn as close as possible to the battery positive terminal, without having various components which may interrupt the flow of current to the control system

Circuit protection — Per the ABYC guidelines, some type of current protection - circuit breaker or fuse - must be installed within 7 inches (17 cm) of the connection to the source of power. It is very important to understand that circuit protection is installed for the protection of the wire, not the EEC system. The EEC system has its own internal current protection and does not need any external fuse. However, the wire which connects the EEC to the boat power must be protected in case of chafing or other damage. In order to not limit power to the EEC system during normal operation, a minimum 25 Amp fuse or circuit breaker must be installed. (If a 30 Amp fuse or circuit breaker is used, then it is necessary that 10 AWG wire - or larger - is used to connect the EEC system to its power source).

In order to follow the two recommendations above - draw power close to battery positive terminal, and provide circuit protection for the interconnecting wiring - it is normal that the current protection - fuse or circuit breaker - will be physically located in the engine compartment. However, it is inconvenient to require the boat owner to have to go to the engine compartment to start up the Engine Control system each time that he / she wishes to use the boat. For this reason, Glendinning Marine Products has an optional "Power Switch Relay Unit" (PSRU) which allows the boat owner to remotely turn on or turn off the engine control system from the helm station. When the PSRU is used, the EEC circuit protection is typically left in the "ON" position. The PSRU only requires that a small (2 conductor, 18 gauge) wire be run from the engine compartment to the helm station. For more details, see Section 2.5-E of the manual.

Battery ground — The dual battery system requires that the battery positive terminals be at roughly the same voltage. In order for the battery positive terminals to be at the same voltage, it is necessary that the negative terminals of the batteries be connected at some common point. This is normal marine electrical practice and is specified in the ABYC voluntary guidelines. Prior to the final electrical hookup of the EEC system, the installer should verify that the battery ground terminals are connected at some common point.

3.2 Cable Connections

Prior to installation of the Electronic Engine Control (EEC) system, it is vital to determine the actual direction of travel of the control cables that connect to the engine governor and transmission control levers. Check the following items and write them in the space provided - this information will be needed later for EEC system calibration and for the connection of the mechanical backup cables.

Failure to obtain and enter this information correctly may result in incorrect system calibration, incorrect connection of the mechanical backup cables, and extra (unnecessary) work in redoing the control cable connections at the end of the installation!!!

• **Direction of transmission gear lever movement** — Does mechanical cable PULL or PUSH on transmission gear control lever to obtain ahead gear?

PORT ENGINE		STARBOARD ENGINE	
To Engage Ahead Gear:	Cable will pull or push lever?	To Engage Ahead Gear:	Cable will pull or push lever?

• **Direction of engine governor lever movement** — Does mechanical cable PULL or PUSH on engine governor / throttle lever to increase engine speed?

PORT ENGINE		STARBOARD ENGINE	
To Increase Engine Speed:	Cable will pull or push lever?	To Increase Engine Speed:	Cable will pull or push lever?

• **Direction of transmission troll lever movement** — (If installed) Does mechanical cable PULL or PUSH on transmission troll valve control lever for full (100%) lock-up?

PORT ENGINE		STARBOARD ENGINE	
For Full Lockup:	Cable will pull or push lever?	For Full Lockup:	Cable will pull or push lever?

3.3 Engine Room Components Installation

• Actuator Installation

The proper location of the Gear / Throttle Actuators is the most critical decision that must be made during the installation process. Failure to properly locate the actuators may cause degradation in system performance, premature failure of the actuator, or difficulty with the operation of mechanical backup system. Therefore, great care must be taken to ensure that the actuators are located in the best location possible.

A. The **primary factor in choosing a location for the actuators** is finding a location that results in the shortest, most direct path for the push-pull cable that connects each actuator to the control head and transmission and engine governor. In general, for engines where the control cable travels aft from

the engine governor / throttle lever, the actuator will be mounted in the aft section of the engine room. Conversely, for engines where the control cable heads forward from the engine governor lever, the actuator will be mounted toward the forward end of the engine room. In general, the length of the control cable from each actuator to the transmission and engine governor should not be greater than 10 feet and 180 total degrees of bend. (Longer lengths may be used after review and approval of the physical layout of the product installation by Glendinning Marine Products).

One reason why a short cable to the engine governor is critical has to do with engine synchronization. In order to accurately synchronize one engine to the other, it is necessary to position the governor with an accuracy of less than five thousandths (0.005") of an inch. Any unnecessary bend in the control cable to the governor lever, or using a cable that is longer than necessary, will result in lost motion between the actuator and engine, causing a reduction in synchronization accuracy. This greater length will also increase the difficulty in controlling the engine governor using the mechanical backup system.

Push-Pull control cables must be run straight for 9 - 12" from the mounting clamp point before making any bends.

B. A second important factor which should be considered in correctly positioning the actuators is the routing of the mechanical backup cables. The shortest and most direct routing of the mechanical backup cables is important for smooth and easy operation of the mechanical backup system.

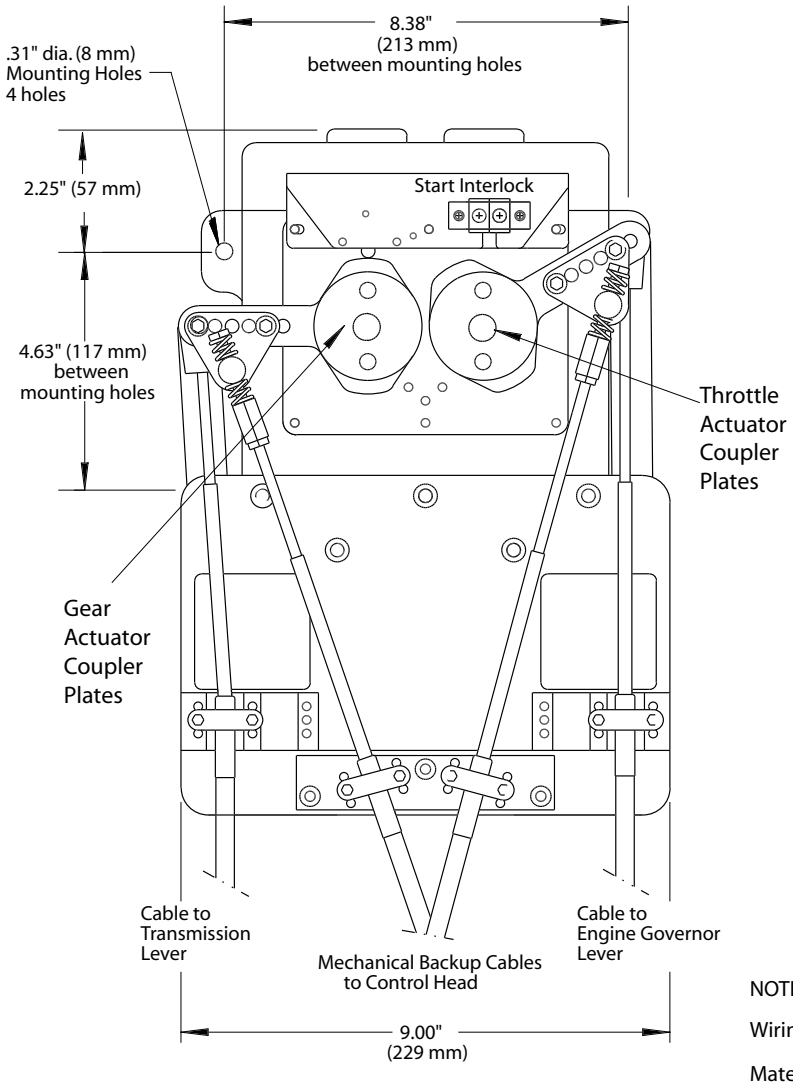
C. Other factors which should be considered are:

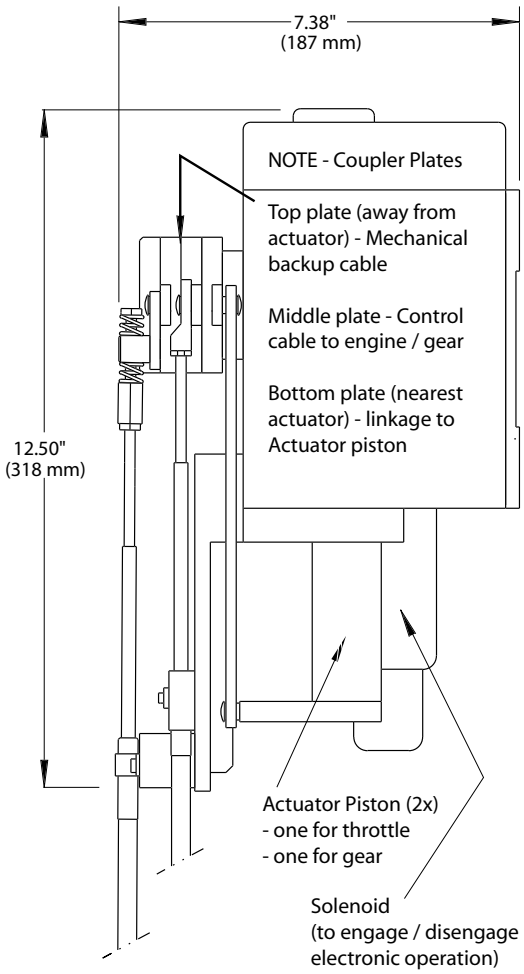
- **The actuators can be mounted in any orientation** — on the bulkhead, overhead, or deck. The actuators should NOT be mounted on the engine.

- **Control cable length** — The push-pull cables between Actuator and Engine Throttle or Gear control lever should be no longer than 10 feet (unless installation layout is approved by Glendinning Marine Products).

- **The actuators should be protected from direct exposure to water or excessive heat.** The Glendinning EEC actuator has been carefully designed to withstand exposure to saltwater normally encountered in an engine room and resist the effects of marine corrosion. However, installing the actuator in a location that subjects it to excessive saltwater exposure will cause premature wear and increase the possibility of system failure. Care should be taken to not locate the actuator near engine room vents, stern tube packing glands or other sources of saltwater spray. Shielding the actuator from sources of excessive heat, such as the engine exhaust manifolds, should also be taken into account.

- **Maintainability** — The actuator should be located in a position that is accessible for control cable adjustments.





NOTE:

Wiring Harness to EP:
20' long (6 meters)
Material : Aluminum Gold Anodized
& Stainless Steel
Weight : 28 lbs. (13 kg)

MOUNTING THE ACTUATORS

A. The actuators should be securely attached to the boat structure, using (4) 1/4" (7mm) machine bolts or lag screws. If using lag screws, screw length should be no less than 1" through 1-1/2" (40mm). If using machine bolts, lockwashers or locknuts must be used.

• Control Cable Installation - Actuator to throttle / gear / troll lever

This section describes the installation and connection of the control cables to the engine governor and gear control lever. This connection must be properly made before control cables are connected to the EEC system Actuators.

A. Using standard Type 33 cable clamps and shims, mount the throttle / gear / troll lever control cables in their respective locations on the engine and transmission. Mount cables using cable clamps only

— **DO NOT CONNECT THE CABLE ENDS TO THE CONTROL LEVERS AT THIS TIME.**
NOTE: we recommend premium grade, Type 33 control cables as the best cable choice.

B. Install terminal eyes on the end of each control cable, ensuring that the tip of the cable protrudes from the threaded portion of the metal terminal eye or that you have at least 1/2" (13 mm) of thread engagement. Do not tighten the terminal eye locknuts yet.

C. Compare the travel of each control cable to its associated lever at the transmission and engine. Ensure that each control cable has "over-travel" or that the cable is able to travel farther than the lever that it will be attached to. Check this for both ends of travel. If the control cable will not "over-travel" in both directions, adjustments will have to be made:

- If 1/4" or less adjustment is required, the terminal eye on the end of the cable may be screwed on or off the cable end. **Terminal eye thread engagement on the control cable end must never be less than 1/4".**

- If more than 1/4" inch adjustment is necessary to achieve correct over-travel, the cable clamp position on the engine or transmission will have to be moved.

In some cases, sufficient over-travel will not be able to be obtained even with adjustment of the cable clamp holder. This is caused by the connection point on the engine or transmission lever (normally called the pivot pin) being too far away from the shaft that the lever is connected to. In these cases, the pivot pin will have to be moved closer to the shaft (the "fulcrum point") in order to shorten the pivot pin travel. This will give you the correct over-travel required. The recommended length of travel of the control lever pivot pin should be approximately 2 1/2" to 2-3/4".

Once correct control cable over-travel is verified, connect the terminal eye of each control cable to the engine governor / throttle and transmission lever and install the pivot pin cotter pins or clips. **Tighten the control cable terminal eye jam nuts lightly, do not overtighten.**

D. After the control cable terminal eyes are attached to the control levers on the engine governor and transmission, measure the amount of travel for each control cable. (This is the distance that the cable will travel when the engine or transmission control lever is moved from one mechanical stop to the other. Record the information below - this information is needed in order to determine the correct cable connection on the Actuator coupler plates.

PORT ENGINE		STARBOARD ENGINE	
CONTROL CABLE	LENGTH OF TRAVEL	CONTROL CABLE	LENGTH OF TRAVEL
Throttle		Throttle	
Gear		Gear	
Troll Valve		Troll Valve	

E. Once the control cables are properly attached to the engine governor / throttle and transmission control levers as described above in paragraphs A, B, and C, they may be connected to the Actuator levers as described below in paragraphs F, G, H and I. The following summarizes this process:

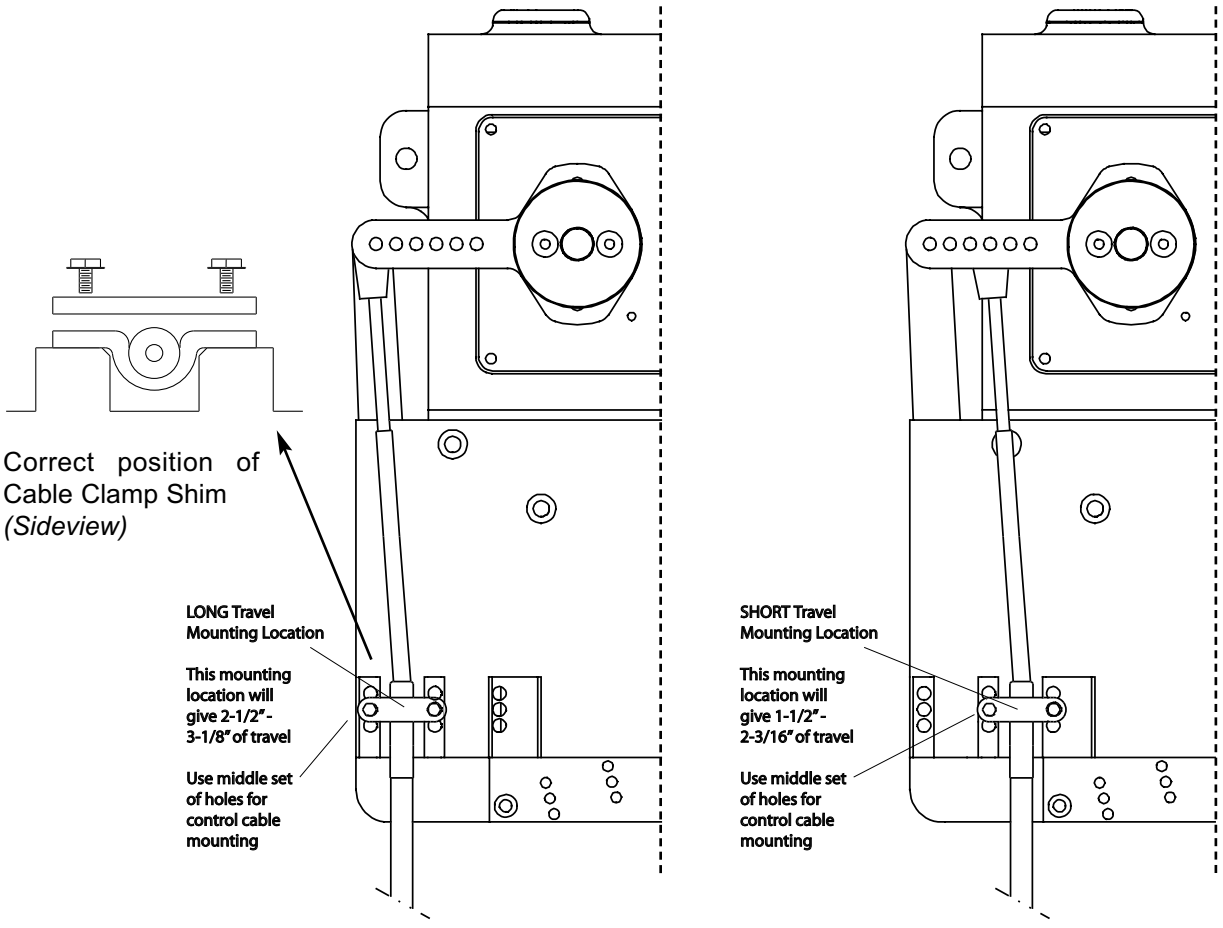
Paragraph F — Select the correct control cable mounting location on the Actuator, depending on the length of control lever / control cable travel.

Paragraph G — Move top "coupler plate" on Actuator out of the way to access middle "coupler plate".

Paragraph H — Select the correct coupler plate connection hole to be used, depending on length of control cable travel.

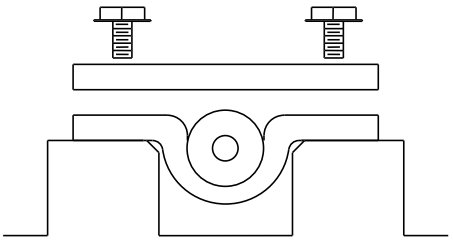
Paragraph I — Adjust control cable terminal prior to attaching to Actuator coupler plate

F. Mount the engine / transmission control cables to the proper control cable mounting location on the actuator. There are two possible mounting locations on the actuator for the control cables depending on the length of control cable travel - the distance measured in paragraph D. above. For control cable travel between 1-1/2” and 2-3/16”, mount the control cable in the SHORT Travel Mounting location. For control cable travel between 2-1/4” and 3-1/8”, mount the control cable in the LONG Travel Mounting location. (See the following drawing for clarification). Use the middle set of holes in each mounting location slot to mount the cable.



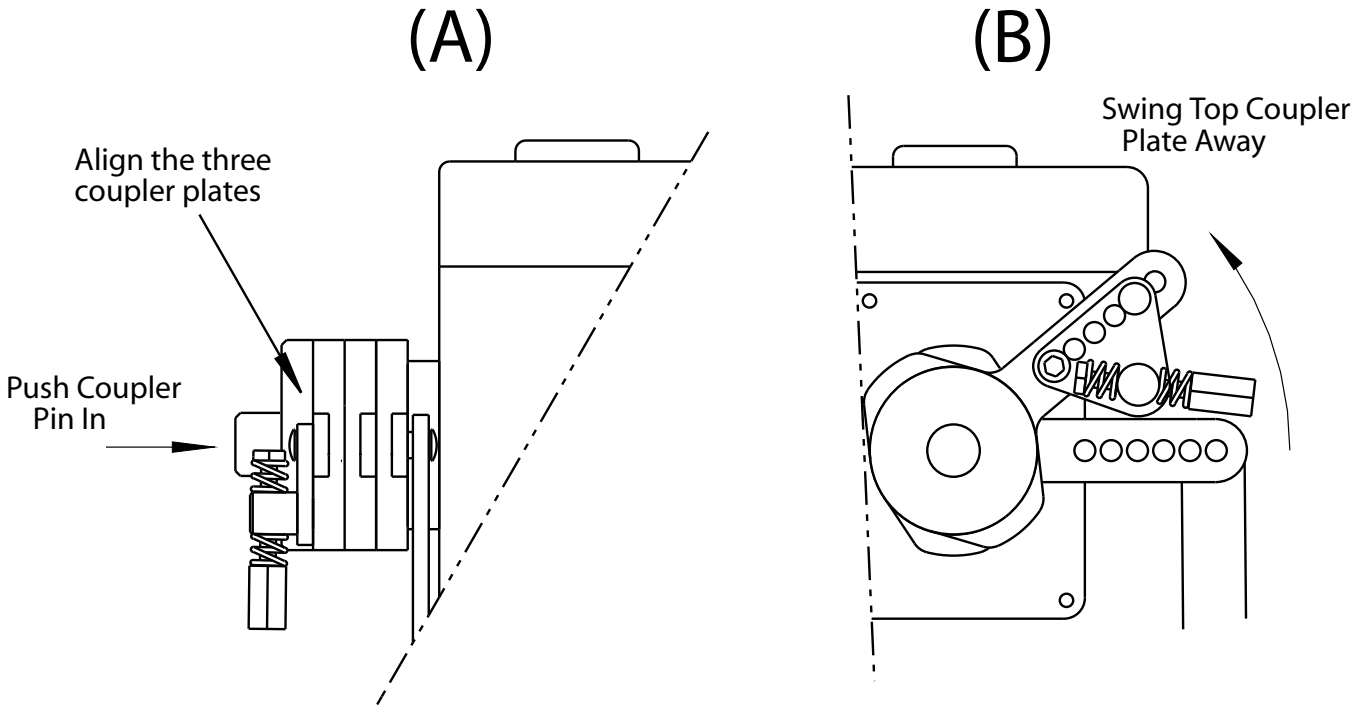
G. Swing top coupler plate out of way to expose middle coupler plate.

Mount the cables using the cable clamp, cable shim and screws provided. ***The cable clamp must be mounted underneath the control cable and then the flat shim is placed on top.*** *The cable clamps (33c or 43c) will fit in the slots on the actuator.*



Once the cables are mounted on the Actuator in the correct mounting location and the clamp screws are tightened, attach the control cables to the actuator coupler plates. For the engine / transmission control cables, use the middle set of plates on the actuator coupler assembly. To gain access to the middle plates, line up all three (3) plates (drawing A below) and then push in on the 1/2" round coupler pin in the middle of the coupler assembly. This will release the top plate, which can be then be swung out of the way (drawing B). (This top coupler plate is for the mechanical backup cables, which will be used later on in the installation).

H. Select correct mounting hole for control cable terminal eye.



For each mounting position (long travel or short travel) there are three different terminal eye mounting holes that can be used. The diagram on the next page shows each hole (marked A - F) and the corresponding control cable travel that it will give you. (The control cable travel is the distance that the engine / transmission control cable will move after it is connected to the engine / transmission control lever; this distance was measured in step D above). Use the mounting hole that will give you slightly more than the amount of travel recorded in step D.

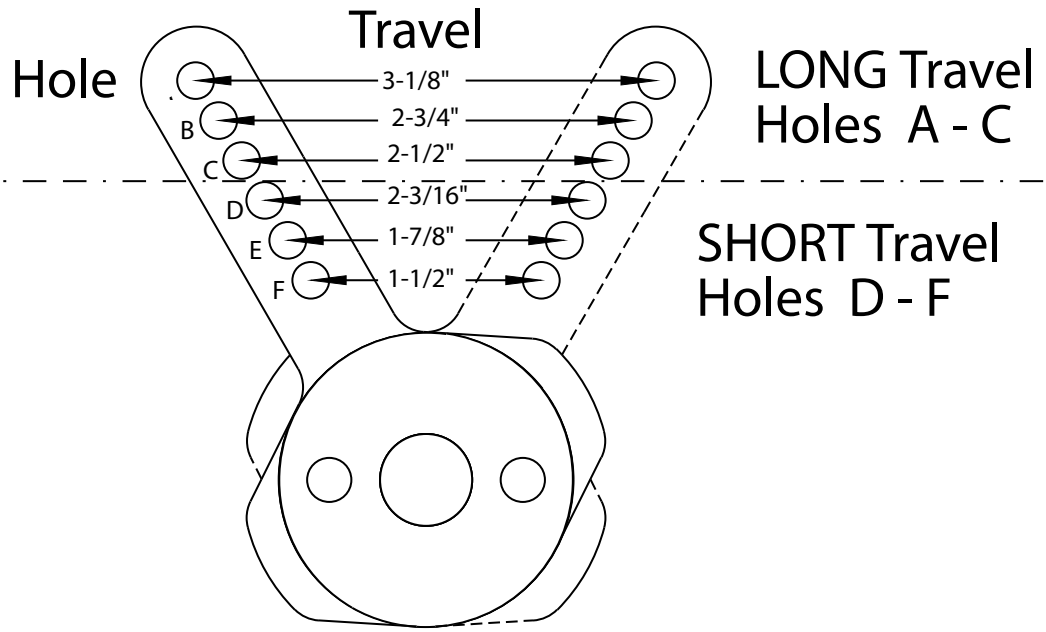
Example: You measured the travel of the control cable at the actuator end and found it

Do not connect the control cable to the Actuator coupler plate in this step - see Step I for instructions regarding terminal eye adjustment first. This paragraph describes how to determine the correct mounting hole for the control cable mounting hole.

to be **2 5/8"**. The cable must be mounted in the **Long Travel Mounting Location** and the cable terminal eye would be **attached to Hole B**. *Control cable mounting location must correspond with selected coupler plate travel hole.*

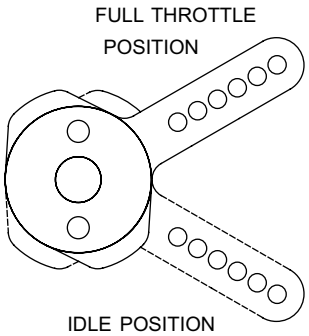
I. Adjust Control Cable Terminal Eye and connect to middle coupler plate.

The actuators are shipped from the factory in a set position for the adjustments to be done below. The



shipped positions are:

GEAR ACTUATOR:	NEUTRAL GEAR POSITION.
THROTTLE ACTUATOR:	IDLE POSITION FOR A PULL TO OPEN GOVERNOR. FULL THROTTLE POSITION FOR A PUSH TO OPEN GOVERNOR. IDLE POSITION FOR ACTUATOR EQUIPPED WITH CAT TPS MOUNTING PLATE.
TROLL ACTUATOR:	LOCK-UP POSITION FOR PULL TO LOCKUP CONFIGURATION. FULL SLIP POSITION FOR PUSH TO LOCKUP CONFIGURATION.



TRANSMISSION CONTROL LEVER - CONTROL CABLE TERMINAL EYE ADJUSTMENTS:

The following definitions are commonly used in the marine industry to define control cable movement. Control cable movement is defined by observing the control cable connection at the engine or transmission and determining what is done to the engine or transmission control lever, as follows:

Pull to Open - Control cable "pulls" on the engine governor / throttle to increase RPM.
Push to Open - Control cable "pushes" on the engine governor / throttle to increase RPM.
Pull to Ahead- Control cable "pulls" on the transmission control lever to place transmission in Ahead position.
Push to Ahead - Control cable "pushes" on the transmission control lever to place transmission in Ahead position.
Pull to "Lockup" - Control cable "pulls" on the transmission troll valve control lever to close troll valve ("Full Lockup" - no slip - position).
Push to "Lockup" - Control cable "pushes" on the transmission troll valve control lever to close troll valve ("Full Lockup" - no slip - position).

1) After the control cable is clamped in its proper mounting location on the Actuator (paragraph F) and the proper coupler plate hole position is determined (paragraph H), move the transmission control cable so that the transmission control lever is in the neutral position.

2) Adjust the terminal eye so that when the cable travel is in the middle of its backlash, the hole in the terminal eye lines up with the proper hole location on the coupler plate.

3) Once adjusted, use the special shoulder bolts provided to mount the cable to the actuator lever. (Use a little grease on the shoulder of the screw. This will help with the feel of the mechanical backup system.)

GOVERNOR CABLE TERMINAL EYE ADJUSTMENTS:

Terminal eye thread engagement on the cable must be at least _" . If a large adjustment is necessary in the terminal eye position (more than 1/4"), move the control cable clamp to a different set of holes in its mounting location.

1) Once the cable is mounted and the proper hole position is determined, move the control cable to either:

A) Idle for Pull to Open installations, or
B) Full Open for Push to Open installations.

2) Adjust the terminal eye so that the control cable lost motion is eliminated. In other words, when the actuator begins moving, it will not have to take up the backlash in the cable before it moves the engine governor.

-On a pull-to-open configuration, pull the control cable terminal away from the engine (in the direction that will increase engine RPM)

3) Once adjusted, use the special shoulder bolts provided to mount the cable to the actuator lever. (Use a little grease on the shoulder of the screw. This will help with the feel of the mechanical backup system.)

TROLL VALVE CABLE TERMINAL EYE ADJUSTMENTS:

Terminal eye thread engagement on the cable must be at least 1/4". If a large adjustment is necessary in the terminal eye position (more than 1/4"), move the control cable clamp to a different set of holes in its mounting location

1) Once the cable is mounted and the proper hole position is determined, move the control cable to either:

C) "Lock up" for Pull to Lockup installations, or
D) "Full slip" for Push to Lockup installations.

2) Adjust the terminal eye so that the control cable lost motion is eliminated. In other words, when the actuator begins moving, it will not have to take up the backlash in the cable before it moves the engine governor.

-On a pull-to-open configuration, pull the control cable terminal away from the transmission (in the direction that will move the troll valve toward the "lockup position)

3) Once adjusted, use the special shoulder bolts provided to mount the cable to the actuator lever. (Use a little grease on the shoulder of the screw. This will help with the feel of the mechanical backup system.)

I. After completion of all the control cable mounting and connections, tighten all control cable jam nuts,

Terminal eye thread engagement on the cable must be at least 1/4". If a large adjustment is necessary in the terminal eye position (more than 1/4"), move the control cable clamp to a different set of holes in its mounting location

mounting screws, and shoulder screws. Also, split all cotter pins on engine and transmission control levers.

J. Do not connect mechanical backup cables to Actuator at this time. The best time to make this connection at the completion of system calibration (See Section 4.0)

• Mounting the Engine Processor

The Engine Processor is essentially a digital computer, similar to those used in offices or at home. Although the system has been carefully designed to operate in conditions that are common in recreational yachts. Reliability of the system will be enhanced if the engine processor can be mounted in an area external to the engine room, where operating temperatures will be somewhat cooler.

A. Mounting Location — The engine processor can be mounted anywhere in the engine room, or outside the engine room, as long as the 20' connection cable to each actuator will be able to reach the Engine Processor. (The 20' actuator connection cable cannot be extended). The engine processor should be reasonably accessible so that changes in DIP switch settings and inspection of the internal indicator lights (LED's) may be performed. As with the actuator location, the engine processor should not be installed in adverse locations subject to saltwater exposure or excessive heat.

B. The engine processor should be mounted using 1/4" (7mm) machine bolts or lag screws. If using lag screws, screw length should be no less than 1” (25mm). If using machine bolts, lockwashers or locknuts must be used.

• Tachometer Senders / Mechanical Drive Adapters

This end connects to engine’s tach outlet

The purpose of the tachometer sender is to provide RPM information to the EEC system. This information is used by the System during engine synchronization. Installation of the tachometer senders is relatively straightforward. The following points should be considered:

A. Only tachometer senders that are supplied by GMP are to be used with the EEC system.

B. On engines equipped with mechanical tachometer outlets, such as Detroit Diesel, Caterpillar 3208, MAN, etc. the tach senders may be directly connected to the tachometer outlet on the engine. The tach senders that are supplied by GMP are “in-line” senders; that is, they may be installed between the engine tachometer connection and any other tachometer senders or tachometer drive cables that are attached to that tachometer connection.

C. On engines that are not equipped with a tach sender outlet, such as Volvo Diesel or any gasoline engine, a mechanical tachometer adapter will have to be used. See the back of the Installation Manual

(Section 6.2) for a list of applicable drive adapters and drive adapter installation instructions.

D. The tach senders must be driven at a speed that corresponds to 1/2 engine speed. This is normal on most engines that have mechanical tachometer outlets or that use a mechanical drive adapter. On some engines, it may be possible to drive the tach sender at 1:1 or even twice engine speed. If this is done, the Engine Processor will be damaged due to excessive voltage output from the tach sender. To check for excessive tach sender speed, set your meter on frequency or hertz, verify that at full open the frequency is no larger than 5000 hz. (If you cannot check frequency , check the voltage from the tach sender while the engine is running at full speed. No more than 18 VAC should be present at the tachometer sender terminals.)

3.4 Engine Room Electrical Connections

After all of the EEC system mechanical components are correctly installed, the following electrical connections should be made.

• Actuator Harness

1) Each actuator is provided with a 20' harness, which electrically connects the Actuator to the Engine Processor (EP). Route each harness, from the port and starboard Actuators, to enter the Engine Processor at the front bottom. Route the harness alongside other cable or piping runs, avoiding sources of excessive heat. Securely fasten the harness using tie-wraps or cable clamps - DO NOT COIL EXCESS HARNESS LENGTH.

2) Remove the tape from the connectors and wire terminals.

3) Attach the wire terminals to their respective terminal strips. Observe that wires are correctly connected to each screw connection following the color coding on the Engine Processor label. Securely tighten all of the barrier strip screws.

Make sure that the actuator power and feed back wires are installed in the correct location for the port and starboard Actuator.

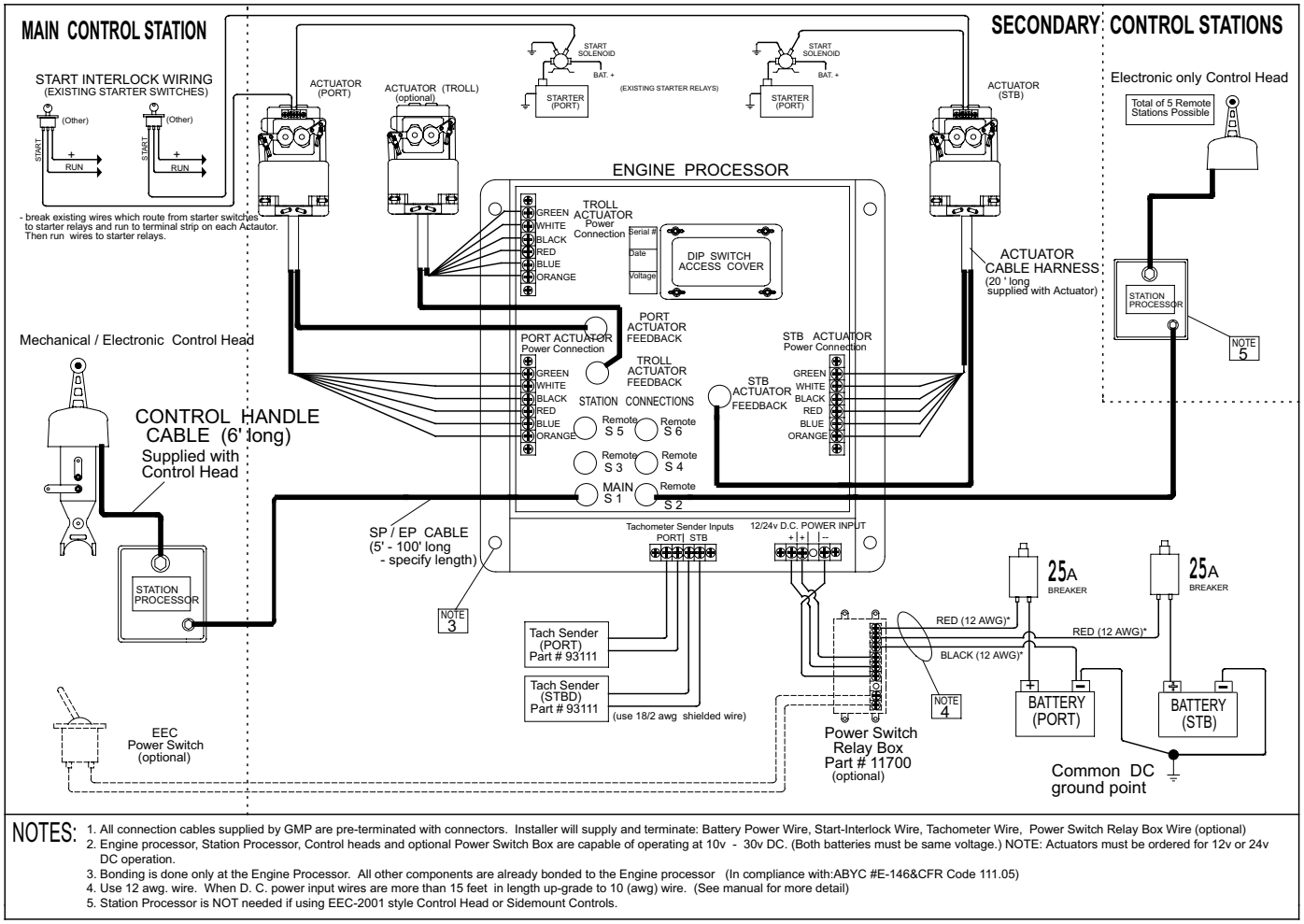
4) Plug in each actuator plug to its appropriate connection point. Once the connector is fully engaged, rotate the connector nut clockwise until a “detent” is felt. This will lock the connector in place.

DO NOT FORCE CONNECTOR INTO RECEPTACLE - BE CERTAIN THAT THE CONNECTOR IS PROPERLY ALIGNED PRIOR TO PLUGGING IT IN! If the connector is properly aligned with its receptacle, only a small amount of physical force will be necessary to insert connector into Engine Processor. Failure to properly align the connector may damage it and cause the EEC system to fail.

5) Secure the actuator harness in the proper strain relief slot. The port actuator power and feedback

wires go into the 1/2” slot on the left hand side of the EP and likewise the starboard actuator power and feedback wires go into the _” slot on the right hand side of the EP. The middle 3/8” slots are for the SP/EP connection cables. Install tie wraps around each wire and use the tie strap holder provided. NOTE: A LARGER WIRING DIAGRAM IS ENCLOSED IN THE BACK OF THIS MANUAL (PG. 102).

Engine Processor 12/24v DC Troll Capable WIRING DIAGRAM Part # 11200-02T



NOTES:
1. All connection cables supplied by GMP are pre-terminated with connectors. Installer will supply and terminate: Battery Power Wire, Start-Interlock Wire, Tachometer Wire, Power Switch Relay Box Wire (optional)
2. Engine processor, Station Processor, Control heads and optional Power Switch Box are capable of operating at 10v - 30v DC. (Both batteries must be same voltage.) NOTE: Actuators must be ordered for 12v or 24v DC operation.
3. Bonding is done only at the Engine Processor. All other components are already bonded to the Engine processor (In compliance with:ABYC #E-146&CFR Code 111.05)
4. Use 12 awg. wire. When D. C. power input wires are more than 15 feet in length up-grade to 10 (awg) wire. (See manual for more detail)
5. Station Processor is NOT needed if using EEC-2001 style Control Head or Sidemount Controls.

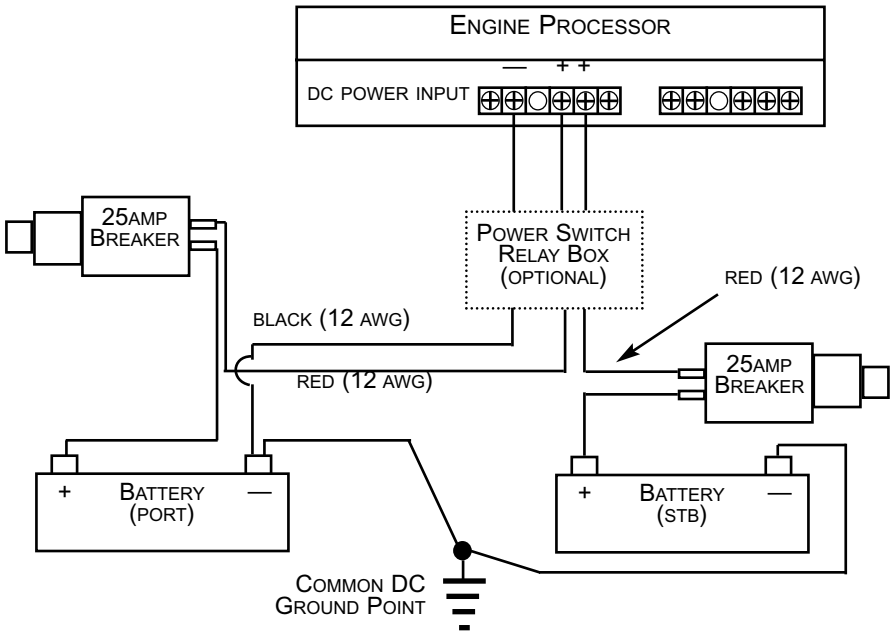
• Engine Processor (EP) Power Supply & Bonding Wire

The Glendinning EEC system is equipped with a sophisticated power management system that allows it to receive power from 2 independent batteries (normally the port and starboard engine start batteries). In normal operation, the EEC will receive power from both battery sources, taking power from each battery proportionate to the voltage level available. In the event of loss of power voltage from one battery source, such as during engine start, the EEC system will continue to function normally by receiving power from the other battery with normal voltage.

1. Run #12 gage wire from two independent battery sources, normally the port and starboard engine start batteries, to the EP. On the positive side of these two runs, install a 25amp circuit breaker near each battery or power source. (Follow ABYC standards which requires a circuit protection device with-

in 7” of the wire connection to the power source) Note: If the total wire run is longer than 15' from the battery to the EP, use #10 AWG wire rather than #12 AWG.

2. Connect the two power wires and one negative wire to the EP at the terminal strip on the EP. Make sure the breakers are in the “off” position before doing this.
It is strongly recommended that a Power Switch Relay Unit be used to control input power to the Engine Processor - see paragraph 2.5-E for more information.



The EEC system should be connected to one and only one battery negative. Proper battery installation procedures require that all of the vessel battery negatives be connected at a location, and only 1 location, somewhere in the boat. This battery negative connection location must not be the Engine Processor. Proper connection of battery negatives should be verified by inspection.

3. Run a bonding wire (#12 AWG, green jacket) from the Engine Processor mounting bolt to the central ground strip or bonding strip in the boat .

• Start Interlock Wiring

The EEC system includes a “start interlock” safety feature as part of each Actuator. This feature verifies that the transmission control lever is in Neutral prior to starting the engines. In order to utilize this product feature, the signal wire from the helm station start switch to the engine starter solenoid must be intercepted and run through the control switches that are mounted on each Actuator.

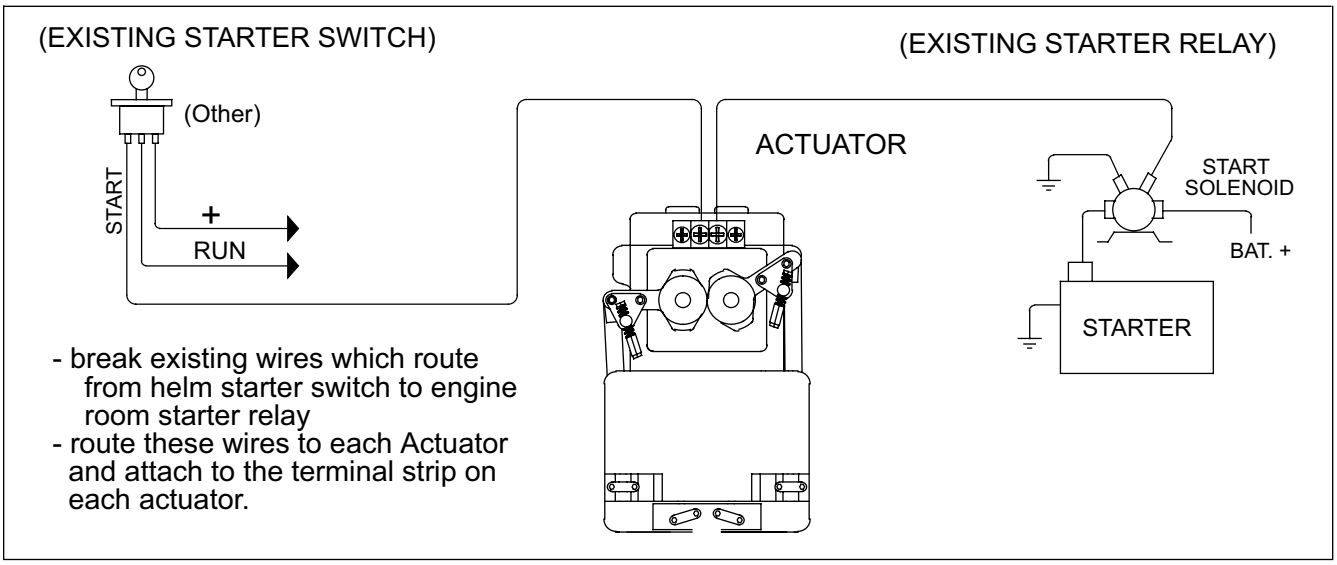
The maximum current that can be run through the standard start interlock system is 10 amps. Where a larger start signal is used (i.e., no remote start relays), special high current start interlock switches need to be specified when the EEC system is ordered from GMP.

Install the start interlock system as follows:

1. Identify the signal wire from the key switch to the starter solenoid of each engine. This

is normally a wire that is yellow or yellow w/ red stripe.

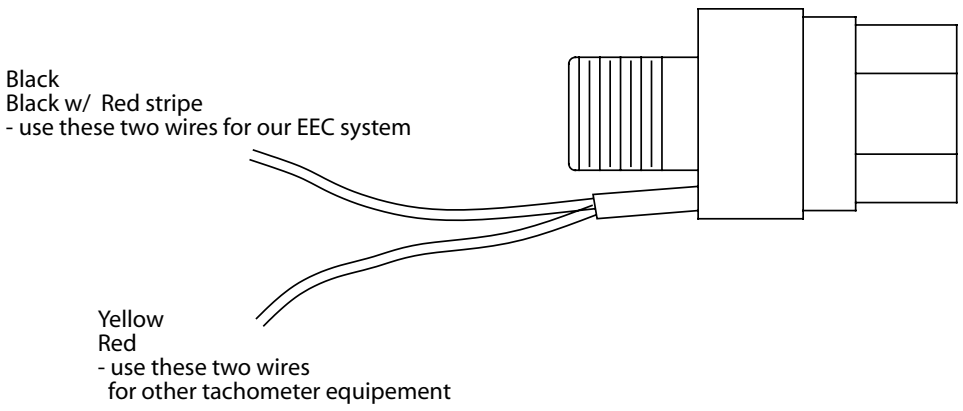
2. On each engine, cut this wire near the starter relay and connect both ends of a #12 AWG, 2 conductor wire to these two wires. Run this wire to the Actuator that corresponds with each engine - for example, connect the starter relay signal wire for the starboard engine with the Actuator start interlock switch that is mounted on the starboard Actuator.



• Tachometer Sender Wiring

1. Connect one end of an #18 AWG) / 2 conductor shielded wire to each tachometer sender . Use the Black and Black w/ red stripe wires. Run this wire to the EP. (The other wires, yellow and red, may be used to drive other tachometers.)

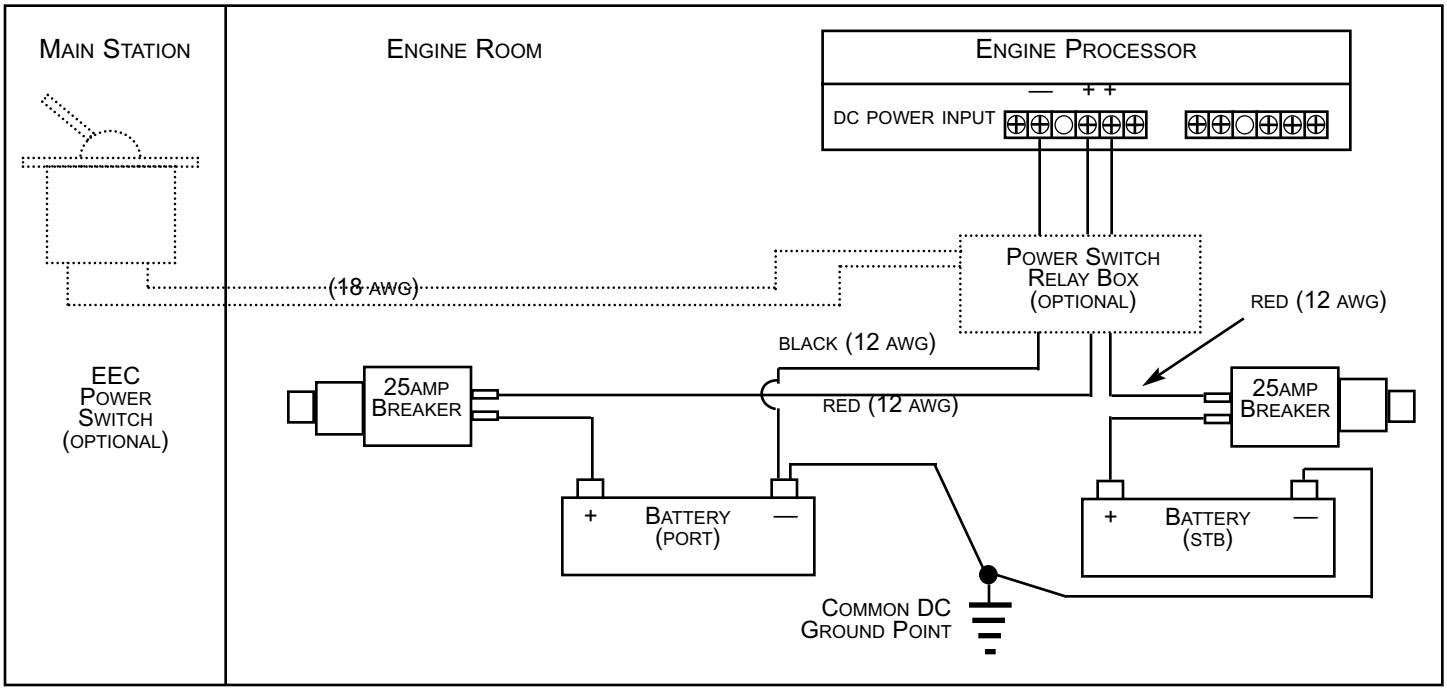
Do not connect anything else to the Black and Black with Red stripe wires other than the EEC control system.



2. Connect the other end of each wire to the EP tachometer terminal strip. Make sure that the port wire is attached to the port side of the EP terminal strip and the starboard is attached to the stbd. side of the terminal strip. These wires are non-polarized, either wire can be hooked to either terminal strip position, as long as the pair of wires are connected to the appropriate terminal strip positions for each engine.

• Remote Power Switch (option)

While the boat is tied up at the dock and not in use, it is recommended that the EEC system be turned off. Since power is normally supplied directly to the Engine Processor from power sources in the engine room, turning power on and off in the engine power may be difficult to do each time the system is started up. For this reason, a remote “power switch box” is available for use with the EEC control system. This power switch box allows a remote “On / OFF” switch be located at the Main station - the station which is normally equipped with the mechanical backup control handles.



The EEC System Power Switch is installed as follows:

A) Make sure the circuit breakers that control the power to the EP are turned off before starting this installation.
B) Install a Single Pole, Single Throw (SPST) switch in the instrument panel. A water resistant rocker switch or toggle switch is available from GMP.
C) Install the Power Switch Box next to the EP.
D) Run #18 /2 wire from the Main Station where the switch is mounted to the Power Switch Box in the engine room. Terminate each end of the wire at the switch and the Power Switch Box.

E) Attach the battery input power (2 positive wires / 1 negative wire) to the input side of the Power switch Box.
F) Connect the output terminals of the Power switch Box - (2) positive and (1) negative connection - to the power input terminals of the Engine Processor.

3.5 Topside Component Installation

• General Overview

A. The most important factor in selecting control head locations will obviously be the ability to control the vessel from the control station. In addition, the following factors should also be kept in mind:

1) Allowance for the full movement of the control head handles should be considered. Due to interference from other equipment mounted on the helm station control panel, it is possible that the normal movement of the control head is prevented at either end of travel. **THIS MUST NOT BE ALLOWED!**

2) Although the control heads are sealed to prevent moisture from getting inside them, they are not designed to be submerged or allowed to remain in standing water for prolonged periods. The area around the control head should have proper drainage.

B. In addition to the factors identified above for control head location, other factors should be considered in selecting a location for the mechanical backup control head:

1) A mechanical backup interface assembly is mounted to the bottom of the mechanical backup control head. A minimum amount of space as shown below is required for this interface assembly.

2) The control cables that are connected to the mechanical backup interface will extend downward from the assembly and should be routed with a minimum bend radius of 9 inches.

3) The mechanical backup station should be located such that it is possible to maneuver and dock the boat from this station.

The following instructions describe the installation of the standard "Top Mount" Control Head. See Section 6.1 of this Installation Manual for information about the "Side Mount" control head.

• Remote Station Control Head

The Remote Station Control Heads are the electric only heads. Follow the procedure below when installing each control handle.

1) The surface that the control head is mounted on should be flat and reasonably strong enough to support the control head securely.

2) Mark the location for the control head, a **full size template is provided in the last section of this manual.**

3) Mount the control head and tighten all screws. The holes that were cut should be sealed using the gaskets supplied.

Installing Topside Control Head through hole cut in console *(notice position of mounting gasket)*

• Main Station Control Head - with mechanical backup

The Main Station Control head is the control head with the mechanical backup mechanism attached to it. To mount this assembly, the following procedure should be followed:

1) The surface that the control head is mounted on should be flat and reasonably strong enough to support the control handle securely.

2) Mark the location for the control head, the location of the mounting screw holes and center cutout for the connection wire and mechanical backup mechanism. **A full size template is provided in the**

last section of this manual.

3) Mount the control head and tighten all screws. The holes that were cut should be sealed using the gaskets supplied.

See next section for instructions on mounting control cable hardware and control levers to the mechanical backup mechanism.

Glendinning's Mechanical
Backup Control Head Assembly

The instructions above and below are for the installation of the *Glendinning* Mechanical Backup Control Head.

It is possible to use another manufacturers mechanical control head in the place of the *Glendinning* Mechanical Backup control Head in a NON-INTEGRATED format.

IF USING ANOTHER MANUFACTURERS PRODUCT, PLEASE FOLLOW THE MANUFACTURERS INSTRUCTIONS FOR INSTALLATION OF THE MECHANICAL BACKUP CONTROL HEAD.

• Mechanical Backup Cable Installation

One of the key features of the Glendinning EEC system is that a mechanical backup system has been incorporated allowing the boat owner to continue to control the boat propulsion system in the event of electrical power failure or other problem.

A. The relative movement of engine throttle and gearshift control (i.e., pull to open) was determined and recorded in Section 1.0. Verify that this information is correct and record it here as well.

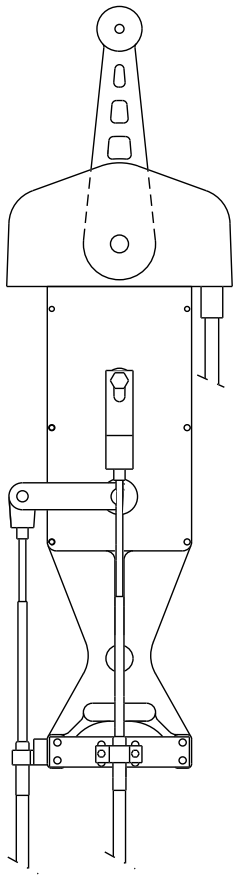
DIRECTION OF TRANSMISSION GEAR LEVER MOVEMENT

PORT ENGINE		STARBOARD ENGINE	
To Engage Ahead Gear:	Cable will pull or push lever?	To Engage Ahead Gear:	Cable will pull or push lever?

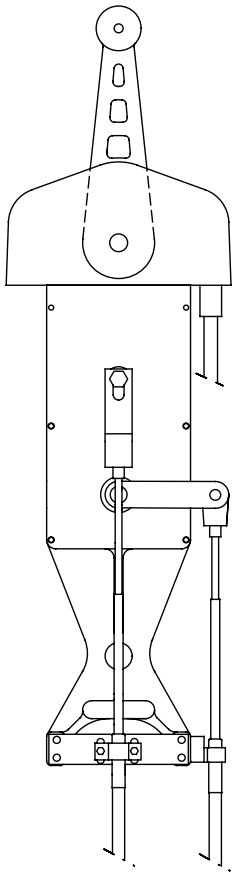
DIRECTION OF TRANSMISSION GEAR LEVER MOVEMENT

PORT ENGINE		STARBOARD ENGINE	
To Increase Engine Speed:	Cable will pull or push lever?	To Increase Engine Speed:	Cable will pull or push lever?

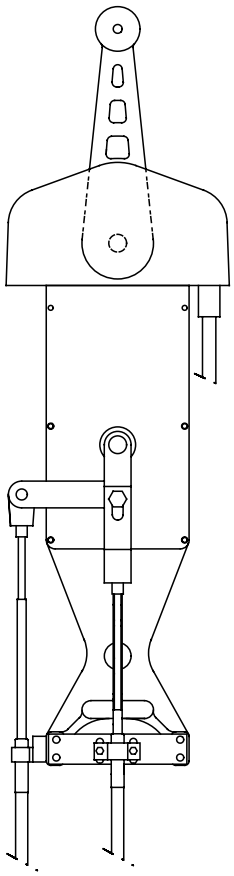
B. Depending on the information contained above, reassemble the mechanical backup interface as shown in the following drawings (NOTE: remember the control head mechanism (levers) work opposite to the direction in which the actuators are to be calibrated).



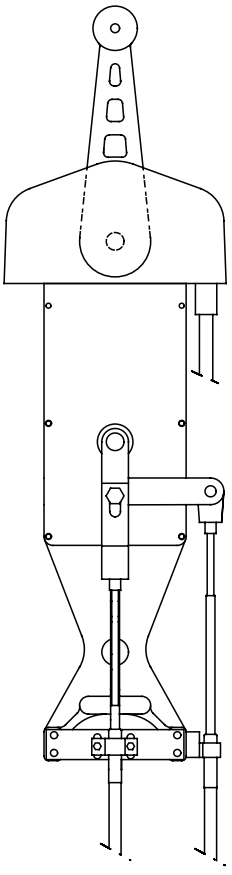
Pull to Open Throttle
Push to Ahead Gear



Pull to Open Throttle
Pull to Ahead Gear



Push to Open Throttle
Push to Ahead Gear



Push to Open Throttle
Pull to Ahead Gear

Be sure to connect the mechanical backup linkage exactly as directed in the preceeding drawings, using the electrical connection cable as a reference. Although it may seem that these connections are "backwards" from normal convention (i.e., on the left hand drawing throttle is set for "pull to open" although it would appear to be "push to open"), this arrangement is necessary due to parallel connection of cables at Actuator coupler plates.

C. Mount the throttle and gear control cables to the mechanical backup interface as shown above. Use the middle set of holes provided at the bottom of the mechanical backup assembly for mounting the control cable clamps. Verify that the slot on the end fitting of the control cable is mated correctly to the control cable clamp.

D. Screw the terminal eyes on the end of each control cable, ensuring that the terminal eye has 1/2" of thread engagement. Attach the terminal eyes to the mechanical backup interface control levers using the shoulder screws provided. Use grease on the shoulder of the screws to make the mechanical backup easier to move.

E. Route the control cables to each actuator in the engine room. Take note on port and starboard and which side of the actuator is the gear side and which side is the throttle side.

F. Mount the control cable to the actuator as shown in the drawing on page 41. Use the middle set of holes provided.

G. Screw the cable end spring mechanism onto the end of the control cable, obtaining at least 1/4" of thread engagement (7 turns).

H. Adjust the gear control backup cable as follows:

1) Verify the following:
- transmission control lever is in the Neutral detent.
- mechanical backup control head is in the Neutral detent.

2) Compare the relative position of the top coupler plate with the position of the middle and bottom plate. They should all line up at neutral. If not adjust the hex nut.

3) If hex nut does not have at least 1/4" of thread engagement then remount cable in the other set of mounting holes.

I. Attach the throttle control backup cable as follows:

1) Verify the following:
- governor or throttle is at idle for pull to open and at full open for push to open.
- mechanical backup control head is in the Neutral detent.

2) Compare the relative position of the top coupler plate with the position of the middle and bottom plate. They should all line up at idle.

3) If hex nut does not have at least 1/4” of thread engagement then remount cable in the other set of mounting holes.

J. After installation of the mechanical backup cables is completed, verify the following on both engines:

- With the Control head at Neutral Detent, the transmission control lever is at the Neutral detent position.

- Move the Control head to the Ahead Idle detent, the transmission control lever should move in the appropriate direction (toward ahead). The engine governor should be at the idle (mechanical stop) position.

It may be easier to do the preceeding steps (paragraphs F - J, mechanical backup cable connection to the Actuator coupler plates) at the conclusion of system calibration rather than at this point of the installation. If so, it may be necessary to “tie-wrap” all three coupler plates in alignment so that the coupler pins will retract smoothly during the Calibration process.

• Station Processor Installation

The Station Processor is to be used with the Old style EEC-1000 Control Head, the Integrated Mechanical Backup Control Head, or the hard-wired Sidemount Keypad Assembly ONLY.

A. The Station Processor should be mounted in the area below the control handle. The location chosen for the Station Processor should be relatively dry, preferably on the overhead or bulkhead of the compartment. A 6 foot connection cable is provided with each control handle for connection to the station processor and the station processor should be located within this distance from the control head.

B. The station processor should be mounted using #10 (5 mm diameter) machine bolts or screws. If using screws, screw length should be no less than 1-1/2” (40mm). If using machine bolts, lockwashers / locknuts must be used.

C. After mounting the Station Processor, connect the Control Head cable plug to the large connector on the Station processor. Make sure the pins are properly lined up when installing. Once the connector is fully engaged, thread the connector nut clockwise until it is tight.

DO NOT FORCE CONNECTOR INTO RECEPTACLE - BE CERTAIN THAT THE CONNECTOR IS PROPERLY ALIGNED PRIOR TO PLUGGING IT IN! If the connector is properly aligned with its receptacle, only a small amount of physical force will be necessary to insert connector into Engine Processor. Failure to properly align the connector may damage it and cause the EEC system to fail.

• Control Station to Engine Processor Connection Cables

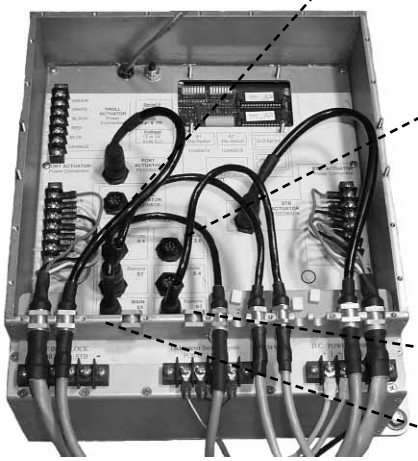
Each Control Station (or Station Processor, if equipped with Glendinning Mechanical Backup Control Head) is connected to the Engine Processor using pre-terminated connection cables. These wires are available in lengths of 10 to 100 feet in 10' increments and have pre-terminated ends for connection to the Control Station and Engine Processors.

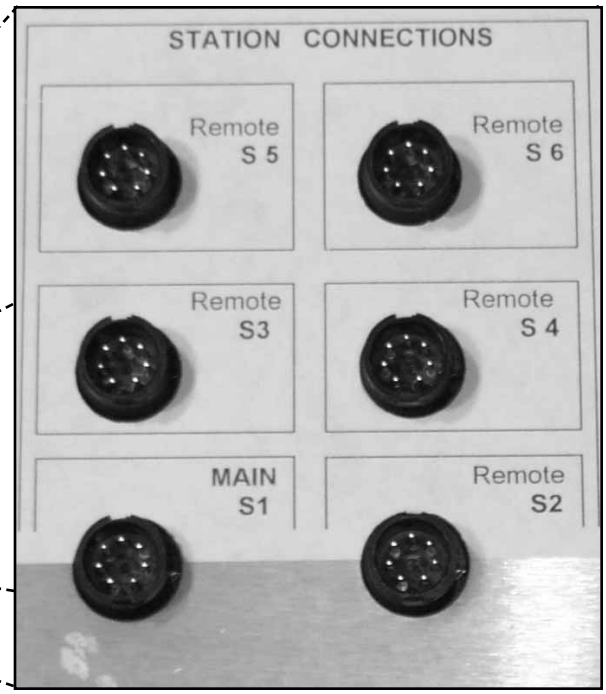
A. Route the cables between the Engine and Control Station. The cables should be free of bends or kinks in the wire. The Metal Connector on the SP / EP Connection Cable is connected to the Control Station and the plastic connector is connected to the receptacle in the Engine Processor.

B. Connect the metal connector to the smaller connector plug on the Control Station. Once the connector is fully engaged, tighten the connector nut. Make sure the pins line up when installing.

DO NOT FORCE CONNECTOR INTO RECEPTACLE - BE CERTAIN THAT THE CONNECTOR IS PROPERLY ALIGNED PRIOR TO PLUGGING IT IN! If the connector is properly aligned with its receptacle, only a small amount of physical force will be necessary to insert connector into Engine Processor. Failure to properly align the connector may damage it and cause the EEC system to fail.

C. Connect the other end of the Connection cable to one of the station connections on the Engine Processor (S1 - S6). The “main station”, which is the control station normally located with the EEC system power switch and mechanical backup, should be connected to the S1 position at the EP. All other stations should be connected to Engine Processor in ascending order (S2, S3, S4, S5,





S6). (Do not skip stations! - the Engine Processor will not “look” for a station connected to a higher station connection point once it detects an empty connection receptacle). Once the cable connector is fully engaged in its plug, rotate the connector nut clockwise until a “detent” is felt. This will lock the connector in place. Make sure to line up the pins before inserting into the connector.

DO NOT FORCE CONNECTOR INTO RECEPTACLE - BE CERTAIN THAT THE CONNECTOR IS PROPERLY ALIGNED PRIOR TO PLUGGING IT IN! If the connector is properly aligned with its receptacle, only a small amount of physical force will be necessary to insert connector into Engine Processor. Failure to properly align the connector may damage it and cause the EEC system to fail.

D. Mount the SP connection cables in smaller slots on the EP. Use the installed tie wrap holders to provide proper strain relief to the connection cables. Fill up the extra slots with the plugs provided.

4.0 Maintenance

If any welding is performed on the boat at any time, it is essential that the power input terminals and bonding system connection to the Engine Control System (EEC) must be disconnected from the Engine Processor. This is necessary to protect the system from any stray currents which may be created during the process of welding. Failure to do this may cause damage to the EEC components. This failure will not be covered by warranty!!!

4.1 Routine Maintenance

The EEC system has been designed to require as little maintenance as possible. In general, routine maintenance consists of inspecting the system components for mechanical tightness and for indications of external corrosion. This inspection should be done 2-3 times per season, perhaps at the beginning, middle, and end of each boating season.

System Component	Description
Actuator	a) Inspect external surfaces for corrosion, including actuator output shafts. Use “Corrosion Block” or equivalent to keep all Actuator surfaces free of corrosion. b) Verify that all control cable connections are tight. This includes: —control cable clamps, which hold control cables onto Actuator —terminal eye jam nuts - small nuts on control cable rod end which lock terminal eye in place —“shoulder bolts” - bolts which attach control cables to Actuator coupler plates
Engine Processor	a) Inspect external surfaces for corrosion b) Inspect wire connections for corrosion
Station Processor (if equipped)	a) Inspect external surfaces for corrosion and free from moisture b) Verify that connectors are tight.
Control Head	a) Inspect for visible moisture in control panel windows.

4.2 System Calibration Check

When the EEC system is initially installed in a boat, the system is calibrated to the limits of travel for engine governor and transmission control levers. As long as nothing is disturbed with the control cables in the engine room, no re-calibration is necessary. However, during any routine work on the

engine governor or transmission, it is possible that these settings may be disturbed. If there is any possibility that these control levers have been disturbed, the system calibration should be checked.

Failure to have gear actuator properly calibrated may lead to transmission failure. Always verify that gear calibration is correct if any work is done on engine or transmission.

Recheck the system calibration using the following procedure:

1) Turn ON the EEC system (normal startup procedure - see Section 3.2).

2) Disconnect the control cable at the affected control lever - engine governor or transmission. (DO NOT disconnect the control cables at the EEC system actuators).

3) To check the transmission control cable calibration:

a) Place the Control Head in the Neutral detent position, and move the associated transmission control lever to it's Neutral detent. Verify that the control cable terminal eye is aligned with the control lever pivot pin.

b) Perform the same check with the Control head and transmission in the Ahead and Astern gear positions.

4) To check the engine governor control cable calibration:

a) With the Control Head in the Ahead idle detent position, and with the associated engine governor lever at the idle mechanical stop, verify that the control cable terminal eye is aligned with the governor lever pivot pin.

b) Perform the same check with the Control head and engine governor in the Full Throttle positions.

If the terminal eyes **DO NOT** line up with the control lever pivot pins, the system must be re-calibrated. (See Section 6.0 - System Calibration)

4.3 Actuator Control Cable Replacement

To replace the control cables which connect the EEC Actuator to the engine / transmission control levers, do the following:

1) Prior to removal of the existing control cable(s), verify that terminal eye locknuts are securely fastened.

2) Disconnect the control terminal eyes from the actuator coupler plate and governor / transmission control levers. Remove the existing control cable from the actuator and control lever.

3) Loosen and unscrew the terminal eyes off the old control cable, counting the number of turns. Install the terminal eyes on the new control cable, screwing them on the same number of turns.

4) Mount the new control cable in the engine / transmission cable mounts. Mount the other end of the new control cable in the actuator mounting blocks. Ensure that the control cable slots fit tightly on the cable clamps at both mounting positions.

5) Connect the terminal eyes to actuator coupler plate. Tighten the terminal eye locknuts. Secure the terminal eyes on the coupler plate pivots with cotter pins.

6) Verify that the terminal eyes have been correctly installed by verifying the system calibration (Paragraph 4.2). If the new control cable terminal eyes do not line up with engine / transmission control levers, adjust the terminal eye position (screw on / off).

7) When the control cable terminal eyes are lined up, tighten the terminal eye locknut, and secure the terminal eye on the engine / transmission control lever.

5.0 System Calibration

• Introduction

The purpose of EEC system calibration is to adjust the EEC system actuator movement (length of travel) so that it matches the movement of the engine governor lever, transmission gear selector lever, and / or trolling valve control lever.

The EEC system must be calibrated after the system is installed, **prior to initial operation**. In addition, the EEC system must be re-calibrated whenever any change is made in the control levers of the engine governor, reduction gear, or trolling valve. Re-calibration will be also be required if any changes are made to the push-pull control cables that connect each actuator to the engine governor and / or gear box.

Failure to recalibrate the EEC system after changes are made to engine and / or reduction gear control levers, or the interconnecting push-pull cables, could cause failure of one or more system components.

• Calibration Procedure Overview

Calibration of the Electronic Engine Control system consists of manually controlling each actuator through the complete range of travel of the associated engine or gear control lever . At each endpoint of travel — engine throttle idle position, engine throttle full speed position, ahead gear position, astern gear position, etc. — the EEC system will “memorize” the location of this position and will use this position as a reference during operation. For example, during normal operation, when the vessel operator moves the control head lever to the "idle, neutral" position, the EEC system will move the engine throttle and gear control levers to the *idle engine speed position* and *neutral gear position* that were set during the calibration procedure. Obviously, if this position is not correctly set during calibration, the EEC system will not be able to move the control levers to the correct position.

Manual calibration consists of 6 steps:

5.1	System preparation	5.4	Handle calibration
5.2	Entering Calibration Mode	5.5	Exiting Calibration Mode
5.3	Actuator positioning	5.6	Calibration verification

5.1 System Preparation

Prior to beginning manual calibration, the EEC system must be prepared as follows:

1) BEFORE calibration, connect all push-pull control cables to the EEC actuators. AFTER calibration you may connect the other ends of the push-pull cables to the engine, transmission, and trolling valves.

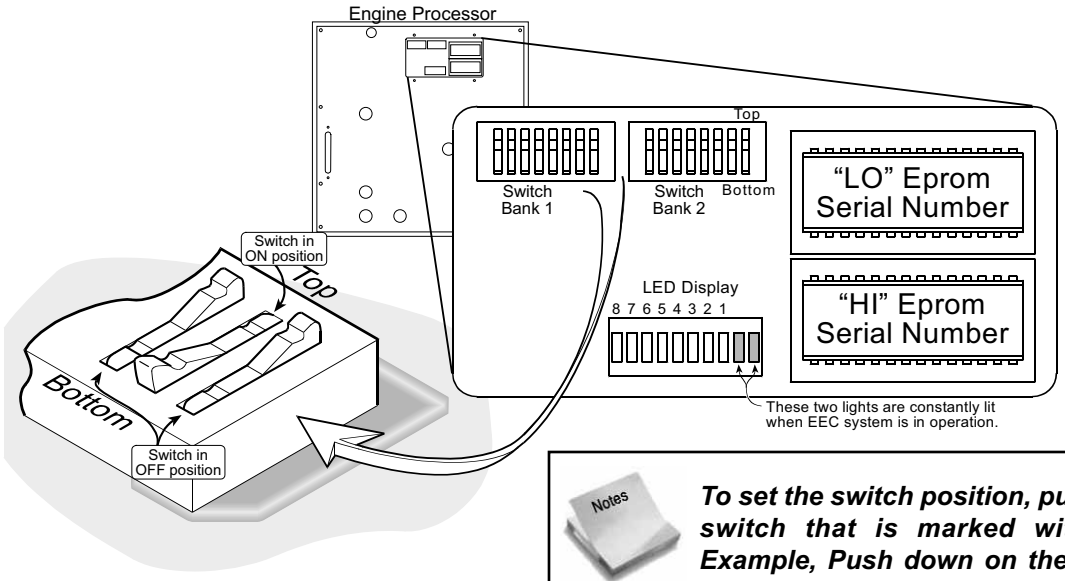
Once calibration is completed, any changes that are made to the control cables or the engine / transmission control levers will make re-calibration of the EEC system necessary.

> Notes
>
> ***Although the mechanical backup control cables may be hooked up (the cables which connect the EEC actuators to the mechanical backup control head), it may be easier to go through the calibration process with these cables disconnected at the actuator. These control cables can be safely hooked up after the calibration process is completed. This only applies to initial calibrations, before the mechanical backup cables have been adjusted. During subsequent calibrations, the mechanical backup cables may be left connected to the actuator.***

2) Verify that the Main station control handles are in the neutral position. The Main Station is the control station that is connected to the "S1" connection in the Engine Processor. Normally, the Main station is also equipped with the mechanical backup cables.

3) Turn OFF all power to the EEC system.

4) Open the Engine Processor (EP) access plate to expose the DIP Switches and LED indicator light assembly (see illustration below).



> Notes
>
> ***To set the switch position, push down on the side of the switch that is marked with your desired setting. Example, Push down on the OFF side if you want the switch to be in the OFF position (see diagram above).***

There are 2 separate calibration steps:

1) ***System Configuration*** — This sets the number of control stations, the direction of actuator travel for throttle, gear and troll (if equipped).

2) ***Actuator Endpoint Positioning*** — This sets the position of the actuator endpoints.

• System Configuration

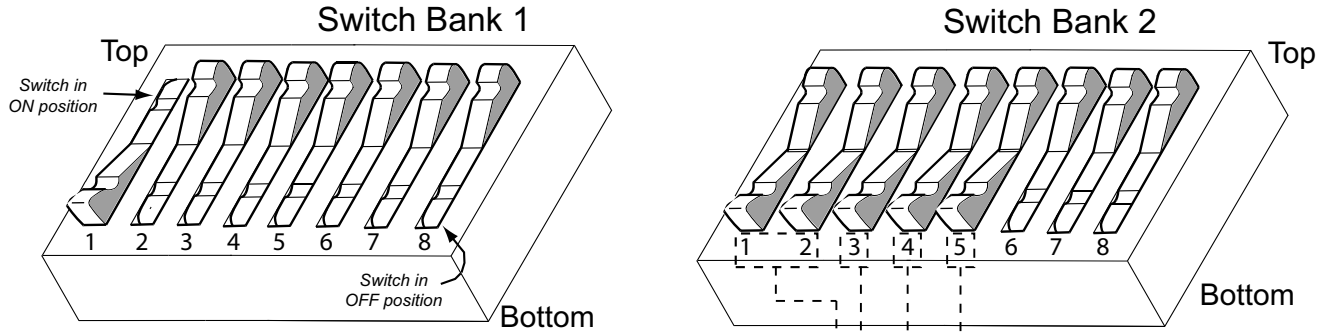
To set System Configurations you will be following the 4 steps outlined below for each System

Configuration Option. **For a complete list of CUSTOM OPTIONS refer to page 115**:

1) Make sure control system is turned OFF.
2) Set Switch Bank 1 Switches to the appropriate positions.
3) Set Switch Bank 2 Switches to appropriate positions.
4) Turn System ON — with power ON turn Switch Bank 2, Switch 8 to ON to memorize configuration settings. Remember to return Switch Bank 2, Switch 8 to OFF before turning power to Control System OFF.

QUICK CONFIGURATION

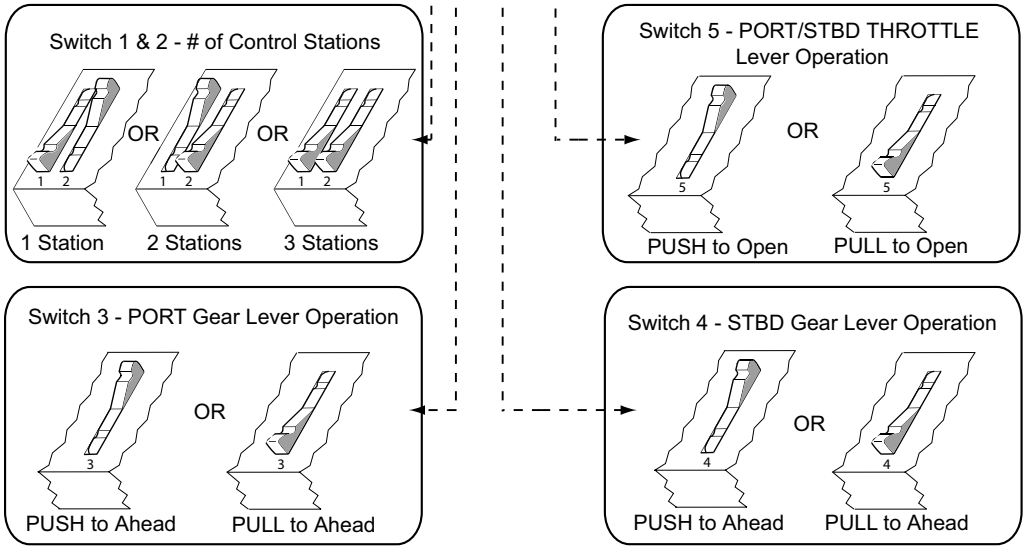
Quick Configuration settings allow you to configure the EEC system for the basic operation of your propulsion system. To utilize the custom configuration options - see Section 8.1. For quick configuration, set the DIP switches as follows



STEP 1 — Set Switch Bank 1 DIP swtiches as depicted in the illustration (see above left).

STEP 2 — Set Switch Bank 2 DIP switches as indicated.

STEP 3 — Position the DIP switches to match your boat's specifications. See diagram for Switches 1 through 5.



(see next page for an explanation of "push" or "pull to ahead" and "push or pull to open" cable directions)

STEP 4 — After desired settings are completed, **Turn System ON** — With Power ON turn **Switch Bank 2, Switch 8** to **ON** to memorize configuration settings. Return Switch 8 to OFF before turning OFF Control System Power.

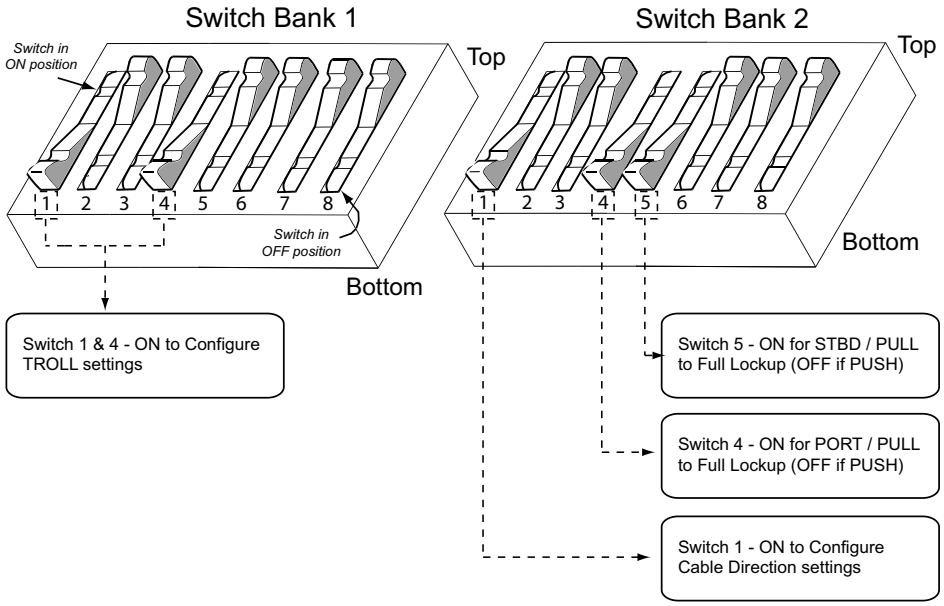
If your boat is **NOT EQUIPPED WITH TROLLING VALVES** proceed to Section 5.2 - Calibrating Actuator Endpoints.

If your boat is equipped **with TROLLING VALVES** — you must also configure the system for operation of the trolling valves with the EEC:

STEP 1 — Set Switch Bank 1 DIP switches 1 and 4 to ON and set **Switch Bank 2** DIP Switch 4 only to the ON position (all other switches OFF).

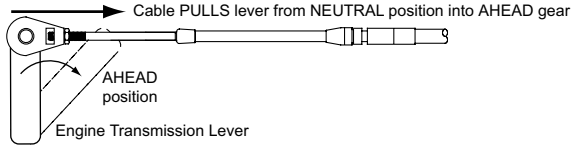
STEP 2 — After settings are completed, **TURN System ON —** with power ON, **turn switch Bank 2, Switch 8 to ON** to memorize settings. Return Switch 8 to OFF before turning power to system OFF.

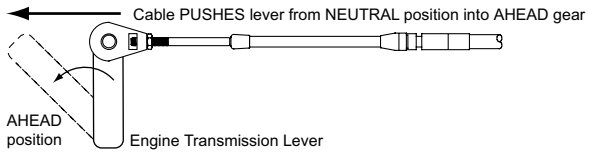
STEP 3 — Set Switch Bank 1 & Switch Bank 2 DIP Switches to the position indicated in the illustration at the right.



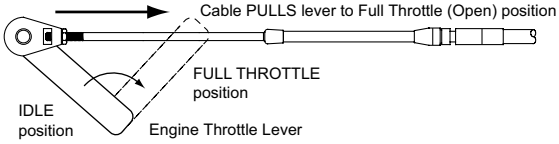
STEP 4 — After settings are completed, **TURN System ON —** with power ON, **turn switch Bank 2, Switch 8 to ON** to memorize settings. Return Switch 8 to OFF before turning power to system OFF.

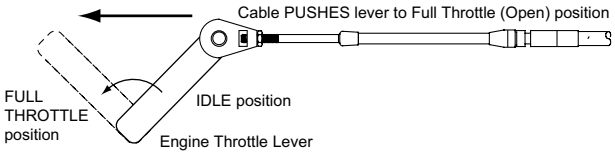
NOTE: WHAT DOES "PULL TO AHEAD" AND "PUSH TO AHEAD" MEAN?



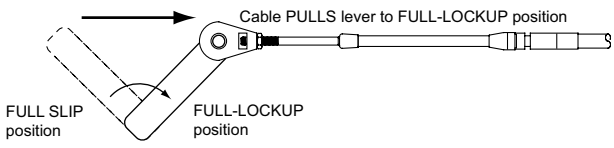


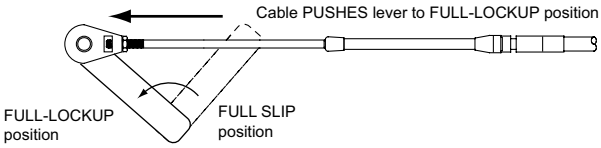
NOTE: WHAT DOES "PULL TO OPEN" AND "PUSH TO OPEN" MEAN?





NOTE: WHAT DOES "PULL TO LOCKUP" AND "PUSH TO LOCKUP" MEAN?



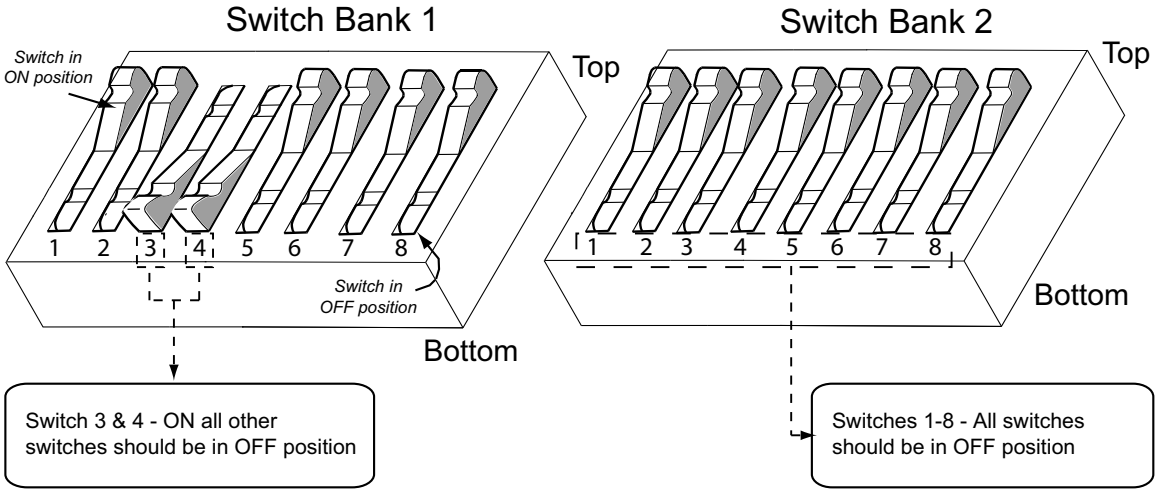


FULL-Lockup position = Trolling Valve CLOSED

5.2 Calibration Mode for Actuator Endpoint Positioning

To enter calibration mode for Actuator Endpoint Positioning, follow the steps below:

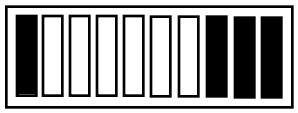
1) Make sure system is OFF.



2) Set the DIP switches as outlined below:

3) Remove the Manual Calibration Box (MCB) from the EP enclosure.

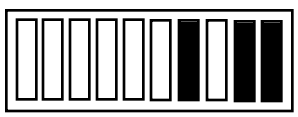
8 7 6 5 4 3 2 1



4) Turn the EP "ON". The system will go through its startup sequence and the actuator solenoids will be energized locking the actuator coupler pins down. The LED's on the Engine Processor will then change to the sequence indicated at the right (BLACK box indicates LED is illuminated).

If the coupler plates on each Actuator are not lined up (these are the plates which are connected to the push-pull control cables), the system will not be able to enter the calibration mode. If the coupler plates are not lined up, the system will try for three times to start up and then will go in to alarm mode. If this happens, turn the system "OFF", line up the actuator coupler plates, and then turn the system "ON" again. In some cases, the actuator coupler plates may be kept in line by connecting all three coupler plates together with a electrical wire tie ('tie wrap'). This may be likely to happen if the mechanical backup control cables are not hooked up as recommended in Section 4.1.

8 7 6 5 4 3 2 1



5) The actual calibration procedure can be started by pressing the "Accept" button one time on the Manual Calibration Box (MCB). The EP LED lights will change to the sequence indicated at the right .

This light sequence indicates that the system is now ready to begin to calibrate the Actuator "end-point" positions. Calibration will begin with the Starboard throttle actuator.

1) The actuators that are calibrated ***MUST BE DONE IN A SPECIFIC ORDER:***

STBD Throttle / STBD Gear / PORT Throttle / PORT Gear / STBD Troll Valve / PORT Troll Valve

2) The order of the actuator endpoint that is calibrated is NOT IMPORTANT; that is, full throttle may be calibrated BEFORE or AFTER idle, astern gear calibrated BEFORE or AFTER the ahead gear position.

5.3 Actuator Positioning

The actuators are calibrated by moving each actuator to each endpoint position and then "memorizing" that position by pressing the MCB "Accept" button. For a typical twin-engine boat without trolling valves, there will be eight positions to identify:

1) Starboard throttle idle
2) Starboard throttle full throttle
3) Starboard gear ahead
4) Starboard gear astern
5) Port throttle idle
6) Port throttle full throttle
7) Port gear ahead
8) Port gear astern

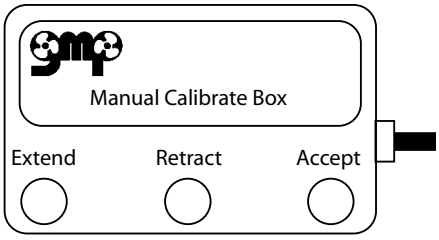
For a boat that is equipped with a trolling valve, there will be a total of twelve positions to identify, the eight positions listed above as well as the following additional positions:

9) Starboard troll valve closed (lockup)
10) Starboard troll valve open
11) Port troll valve closed (lockup)
12) Port troll valve open

Each actuator is calibrated by the following procedure:

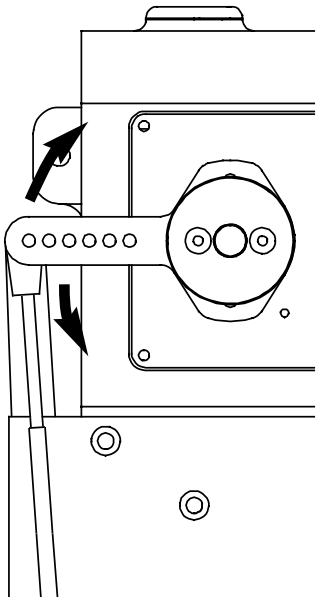
1) Move the actuator by depressing the extend or retract button to move the actuator toward the endpoint of travel of it's associated control lever. The actuator will move steadily if the button is held down. The actuator will only move a small amount if the button is quickly pressed and released.

2) The actuator should be moved to a position where the associated engine / reduction gear control lever has reached its mechanical stop position. This can be done by observing the push-pull cable connection to the control lever and stopping the actuator when the connection visibly tightens. Move the actuator in the opposite direction if the connection appears excessively tight. Make sure that the cable is not



Pushing the 'Extend" button on the MCB will extend the actuator arm to its endpoint position. Press "Accept" when achieved.

Pushing the "Retract" button on the MCB will retract the actuator arm to its endpoint position. Press "Accept" when achieved.



binding. It is important to find the proper balance between the control cable position being "too loose" and not reaching its endpoint position (and therefore the engine not achieving idle speed or full throttle), and the cable being set up "too tight" and constantly operating in a compressed or stretched condition when moving to its endpoint of travel. Continue adjusting the actuator position until a good position has been achieved.

3) When the control lever endpoint is properly achieved, the position can be “memorized” by pressing the MCB “Accept” button (1 time).

4) Move the actuator in the opposite direction to calibrate the other endpoint of the control lever. Again, observe the push-pull cable connection and move the actuator to the point where the lever is hard against its mechanical stop, but not binding.

5) When the control lever endpoint is properly achieved, the position should be “memorized” by pressing the MCB “Accept” button.

6) After both endpoints have been calibrated, press the “Accept” button one additional time to calibrate the next actuator calibration position - see the order of calibration specified on the opposite page.

7) Once both endpoints of the final actuator have been "memorized" - either the port gear actuator or the port troll valve actuator - the "Accept" button must be pressed one additional time. This will confirm that all Actuators have been successfully calibrated, all of the endpoint positions (engine idle, engine full throttle, etc.) have been stored in memory, and you are now ready to move to Handle Calibration.

It is important to note that the Actuators will move to the "mid-stroke" position when calibration is complete. If the Actuators do not move, it is possible that an error has been made during the calibration process:

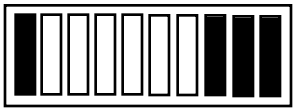
- The "Accept" button was not pressed one additional time, as described in Paragraph 7 above.

- Troll Valve Operation is set, but no Troll Valve actuators are installed.

LED Light Sequence

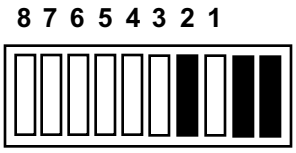
As an aid to the technician, the LEDs located in the EP access port will light up indicating the specific Actuator that is currently being calibrated, and whether both endpoints have been calibrated. The LEDs will light up according to the following sequence:

8 7 6 5 4 3 2 1

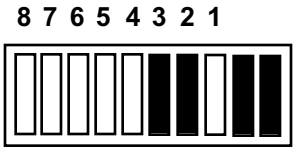


After system startup / prior to beginning calibration
LED 1 and 8 are ON (rightmost (2) LEDs are always ON when EEC system is operational).

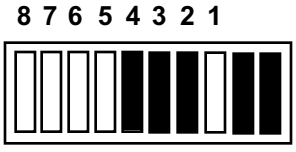
(see more LED light sequences on next page)



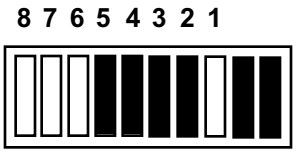
Starboard throttle calibration
LED 2 is ON.



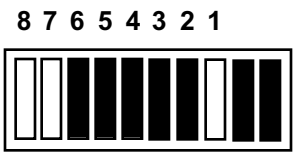
Starboard Gear calibration
LED 2 and 3 are ON.



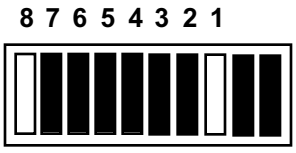
Port throttle calibration
LED 2, 3, and 4 are ON.



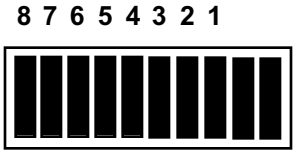
Port Gear calibration
LED 2, 3, 4, and 5 are ON.



Starboard Troll Valve calibration (if boat is equipped with troll valves)
LED 2, 3, 4, 5, and 6 are ON.
(NOTE: If boat is not equipped with troll valves, this light indication will signal calibration complete).



Port Troll Valve calibration (if boat is equipped with troll valves)
LED 2, 3, 4, 5, 6, and 7 are ON.



Actuator calibration complete (If troll valve actuators are installed)
ALL LEDs are ON.

CALIBRATION NOTES

1) The above sequence of events should be carefully followed anytime that the EEC system is being installed or if several of the Actuator positions must be re-calibrated (such as after an engine replacement).

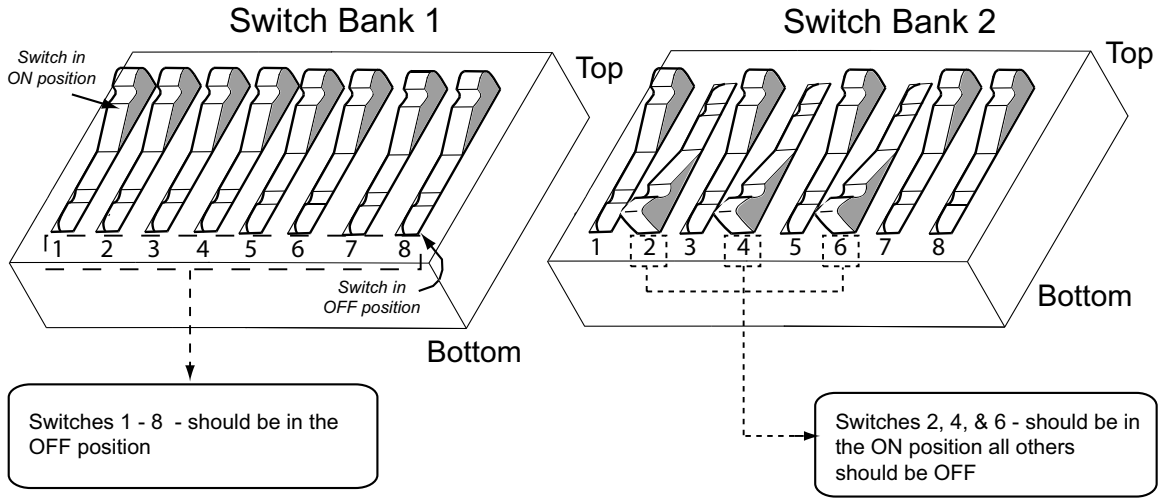
If only one Actuator position must be re-calibrated it is not necessary to recalibrate every Actuator position. In this case, follow the chart on the opposite page for setting the Switch Bank switches for the Actuator that needs to be recalibrated. You can identify which Actuator is in the process of being calibrated by looking at the LED indicators shown in the previous diagrams, or you can skip over in normal calibration mode.

5.4 Exiting Calibration Mode

After all the actuators are calibrated, restore the EEC system to normal operation by the following steps:

1) Turn the EEC system OFF.

2) Reset the DIP switches to their “Run Mode” position, as indicated in the following chart.



5.5 Calibration Verification

Upon completion of the Calibration procedure, it is advisable that the operation of the EEC system be inspected to verify that each engine throttle and transmission lever is being properly moved in the correct direction and through the full range of travel.

It is extremely important that the Calibration be verified after the Calibration Procedure is completed. Failure to do this can cause gear / transmission failure if the gear control lever is not moved into it's correct position resulting in loss of control of vessel!!

A suggested verification procedure follows:

1. Take control at any station that is convenient for good communication between the engine room and helm station.

The following points should be kept in mind when verifying actuator position and operation:
Direction of travel - The location of engine idle and full throttle, gear ahead and astern, and troll valve lockup / slip should be considered to ensure that the EEC actuator is moving the engine and gear controls in the appropriate direction.
Actuator endpoint - The actuator should move its associated control lever to the mechanical stop without placing undue strain on the control cable or control lever.
Control lever detent position - When position the gear lever or trolling valve lever, it may be helpful to disconnect the push-pull cable from the lever and move the control lever independently from the EEC system.

2. With the station control levers (port and starboard) in the **neutral position**, verify the following for both engines and transmissions:
   Engine governor - Idle position (mechanical stop)
   Gear control lever - Neutral position
   Trolling valve - Lockup position (troll valve closed) (if installed)

3. Move the station control levers (port and starboard) to the **ahead detent** position. Verify that both gear control levers have moved to the ahead position ***and that the control cable is not binding.***

4. Move the station control lever (port and starboard) to the **astern detent** position. Verify that both transmission levers have moved to the astern position ***and that the control cable is not binding.***

5. Move the station control lever (port and starboard) to the **full astern position.** Verify that both engine governors are at the full throttle (mechanical stop) position ***and that the control cable is not binding.***

6. Move the station control lever (port and starboard) to the **neutral position**. Verify that both engine governors are at the idle (mechanical stop) position ***and that the control cable is not binding.***

7. (Troll valve equipped boats only) - Move the station control lever (port and starboard) to the **neutral position**. Press and release the troll switch on the control. Troll switch light will illuminate indicating that troll mode is energized. Verify that both troll actuators have moved to troll valve open position ***and that the control cable is not binding.***

8. (Troll valve equipped boats only) - Move the station control lever (port and starboard) to the **full throttle position**. Verify that both troll actuators have moved toward lockup position, but have not moved into the detented lock-up position ***and that the control cable is not binding.***

9. (Troll valve equipped boats only) - Move the station control lever (port and starboard) to the **neutral position**. Press and release the troll switch on the control. Troll switch light will go out indicating that troll mode is off and that normal gear / throttle operation is available.. Verify that both troll actuators have returned to the lockup position ***and***

that the control cable is not binding.

After performing the Calibration Verification check, if you find that one actuator position needs to be changed, go back to the beginning of the Calibration section and follow the instructions. You can skip over actuator positions just by pressing the “Accept” button. When skipping, watch the LED's. This will let you know which actuator position you are at.

This completes the calibration procedure. The electronic engine control system is now fully operational and ready for use.

6.0 System Test & Checkout

• General Overview

System Inspection / Checkout consists of 2 steps:

a) Component Installation Checks - verify that the components are correctly mounted and installed.
b) Operational Tests.

6.1 Component Installation Checks

1. Engine Processor (Internal)

1.1	Before closing DIP Switch Access cover, verify that DIPswitches are correctly set for: —Correct synchronizer gain setting (Bank 1, Switches 5-8) —Selected gear delay (Bank 2, Switches 1-3) —Selected throttle delay (Bank 2, Switches 5 - 6) —EP is in Run mode (Bank 2, Switch 4 and Switch 8 = OFF) After switch settings are verified to be correct, close DIP Switch Access cover and tighten (4) wing nuts.
1.2	Inside wire connection “cavity”, verify that all actuator power wires are properly connected to correct barrier strip terminal - verify jacket insulation color - and are tight. Verify that actuator feedback plugs are fully inserted and plug nuts are securely tightened (fully clockwise). Feel for click, do not overtighten.
1.3	Verify that all connection wires bushings are fitted into correct groove in Engine Processor. All wires should be secured with tie-wraps.
1.4	Close Engine Processor cover.

2. Engine Processor (External)

2.1	Verify Engine Processor is securely fastened to boat structure.
2.2	Verify electrical power connections: Battery negatives — Negatives from both batteries should be connected (not at Engine Processor). It is vital that there be zero voltage potential between battery negative terminals. Battery negative terminals should be connected to Bonding system also. Negative leads — Negative wire from EEC system is connected to single battery negative. Positive leads — Power should be connected from Battery positive terminal or Disconnect switch (battery side of switch) to EP via 25 amp fuse / circuit breaker. Check that all battery connections are tight and proper crimps are made.
2.3	Inspect connection of tach sender input wire (if installed). Verify that tach wires for PORT and STBD engines are connected to appropriate terminal. Inspect installation of mechanical drive adapter (if installed).
2.4	Bonding wire should be connected between Engine Processor and Engine Room bonding system. Verify that Battery negative is also connected to Engine Room bonding system.

3. Actuators

3.1	Verify Actuators are securely fastened to boat structure.
3.2	Verify tightness of terminal eye shoulder bolts, cable clamps, control cable jam nuts.
3.3	Verify that terminal eyes have at least 1/4” thread engagement (at least 6 threads).
3.4	Verify that start interlock wiring is connected to correct engine.

4. Control Heads

4.1	Verify that all control heads are securely fastened to boat structure.
4.2	Mechanical backup control head — verify tightness of terminal eye bolts, cable clamps, control cable jam nuts.
4.3	Verify that terminal eyes have at least 1/4” thread engagement (at least 6 threads).

5. Station Processor

5.1	Verify that SP / EP cable and Control Head cable metal plug nuts are securely tightened (fully clockwise).

6.2 Operational Checks

1	Prior to startup, verify that system has been calibrated (system must be calibrated prior to running).
2	If system has been calibrated, do the following: —Verify EEC power switch at main helm station is OFF. —Turn ON engine room circuit breakers to EEC system. —Power up EEC system as per normal procedure.
3	Perform calibration verification: a) Move both control head handles into ahead idle detent. Verify that both gear levers (at gearbox) move to end of travel, but are not binding against end stops. Verify that engine throttle levers are at idle position. b) Move both control head handles to full throttle. Verify that both engine throttle levers move to end of travel, but are not binding against end stops. c) Move both control head handles to astern idle detent. Verify that both gear levers (at gearbox) move to end of travel, but are not binding against end stops. Verify that engine throttle levers are at idle position. d) Move both control head handles to neutral detent. Verify that both gear levers are in the neutral detent position.
4	Verify the following at each control station: —Normal run mode (full ahead — full astern — full ahead) —Warm up mode —Slow mode
5	Move STBD Control handle out of neutral position. Attempt to start engine: —Engine should not start; if it does, start interlock has not been hooked up correctily. —Move STBD control handle back to neutral position. —Perform same for PORT engine.

6.3 System Inspection / Checkout

The Electronic Engine Control is a relatively complex system that has components located throughout the boat. Although efforts have been made to make the system reasonably easy to install, it is vital that the control system be thoroughly checked out prior to initial operation in order to verify that the

system has been correctly installed and to make final adjustments to the system components. Due to the system complexity, it is very important that system checkout be done carefully and methodically. The following procedure and checklist is provided as a guide for this inspection.

• Overview

In general, the system inspection and startup procedure involves the following five (5) steps:

1. ***Component Installation Verification*** — This is done before calibration of the EEC system, verifying that each EEC system component has been installed correctly.

2. ***Calibration (Section 5.0)*** — Prior to initial operation of the EEC system, it is necessary to calibrate the length of travel for each actuator to match the actual conditions. See Section 5.0 for instructions on EEC system calibration.

3. ***Mechanical backup final hookup (Section 3.3, paragraph H - J)*** — It is recommended that the final hookup of the mechanical backup cables to each actuator not be completed until after the system has been electronically calibrated. See Installation Manual Section 3.3, paragraph H - J for instructions on how to connect and adjust the mechanical backup cables at the gear and throttle actuators. (Per the Installation Manual Section 3.3, paragraph B, the mechanical backup cables should be connected below the mechanical backup control head.)

4. ***Sea Trial preparation checks*** — Prior to the initial operation of the EEC system underway, some final checks and adjustments should be made to ensure that the system is ready for operation.

5. ***Sea Trial Operational checks*** — During sea trials, the engine control system should be methodically tested, using the procedure

By carefully doing the above tests and adjustments in the exact order described above, the installer may be sure that the Engine Control system is operating properly and according to specifications.

• Component Installation Verification (pre-calibration)

Verify the correct installation of all EEC components prior to system calibration

A. Control Heads

A.1	Verify that all control heads are securely fastened to boat structure.

(CHART CONTINUES ON NEXT PAGE)

A.2	Mechanical backup control head only — verify tightness of all mechanical calbe attachments: —Control levers (connected to mechanical backup control head) —Terminal eye shoulder bolts (attach control cable terminal eyes to control levers) —Control cable jam nuts (located below cable end terminal eyes) —Cable clamps (these hold body of control cable to mounting block) —Verify that terminal eyes have less than 1/2” of threads visible below jam nut.
A.3	Mechanical control head only — ensure that all mechanical backup cables are free to move through complete range of cable movement (from full throttle ahead to full throttle astern).

B. Station Processor

B.1	Verify that the station processor is securely fastened to boat structure.
B.2	Verify that cable plugs have O-rings seals in place. Connect SP / EP cable and control head cable metal plug nuts to station processor and securely tighten (fully clockwise).

C. Actuators

C.1	Verify that Actuators are securely fastened to boat structure.
C.2	Verify that control cable to engine throttle and gear control lever are correctly located in the appropriate mounting location based on cable travel — see section 3.0, paragraph F on page 41.
C.3	Verify tightness of all mechanical cable attachments: —Terminal eye shoulder bolts (attach control cable terminal eyes to control levers) —Control cable jam nuts (located below terminal eyes). —Cable clamps (these hold body of control cable to mounting block). —Verify that terminal eyes have less than 1/2” of threads visible below jam nut. NOTE: It is recommended that the mechanical backup cables not be connected to the actuator coupler plates at this point. They will be completed after the EEC system is calibrated.

D. Control Cable connections to engine and gear

D.1	Verify tightness of all mechanical cable attachments: —Terminal eyes or ball joint connections are fully seated with securing cotter pins split rings in place. —Control cable jam nuts (located below terminal eyes) are tight. —Verify that terminal eyes have less than 1/2” of threads visible below jam nut. —Cable clamps (these hold body of control cable to mounting block).
D.2	Warning tags, reminding boat owner that control system must be recalibrated if changes are made to control lever settings, should be installed on control cables (warning tags are provided with installation manual package).

E. Engine Processor

E.1	Verify Engine Processor is securely fastened to boat structure.
E.2	Verify proper connection of electrical power supply: —Positive Leads - Power should be connected form battery positive terminals or battery disconnect switches (battery side of switch) to engine processor via 25 amp fuse / circuit breaker. —Negative Lead - Negative wire from EEC system is connected to single battery negative. —Battery Negatives - Negatives from both batteries should be connected in some way (see Fig. 2.1). It is vital that there is zero voltage potential between battery negative terminals. Battery negative terminals should be connected to bonding system also as per ABYC guidelines. —Connection tightness - Check that all battery connections are tight.
E.3	Measure voltage - Measure the voltage at the input terminals of the Engine Processor (or power switch relay box, if installed). Verify the supplied voltage is appropriate for rated voltage of actuators (12 or 24 VDC).
E.4	Verify correct connection of PORT / STBD start interlock (if installed).
E.5	Inspect connection of tach sender input wire (if installed). —Verify that tach wires for PORT and STBD engines are connected to appropriate terminal (ie. PORT to PORT, STBD to STBD). —Inspect installation of mechanical drive adapter (if installed).
E.6	Inside the Engine Processor, verify the following: —All actuator power wires are connected to correct barrier strip terminal and are tight. —Verify that actuator feedback plugs are fully inserted and plug nuts are securely tightened (fully clockwise). —Verify that the bushings for all the connection wires (actuator power wire, actuator feedback wire, and station wires) are fitted into correct groove in engine processor.

E.7	Bonding wire should be connected between engine processor and engine room bonding system. Verify that battery negative is also connected to engine room bonding system.

• Sea Trial Preparation Checks

Prior to sea trials, the system should be properly calibrated as per Section 5.0 and the mechanical backup control cables connected and adjusted as per Section 3.3

A. Engine Processor

A.1	Verify that DIP switches are correctly set: —Correct number of control stations (Bank 2, Switches 1-3), see Section 5.1, page 65 for details. —Correct synchronizer gain setting (Bank 2, Switches 5-8), see Section 6.0 for details. —EP is in Run Mode (Bank 2, Switch 4 and Switch 8 = OFF). After settings are checked and found to be correct, close DIP Switch Access cover and tighten (4) wing nuts.
A.2	Coil manual calibration control box into EP cavity. Close Engine Processor cover.

B. Mechanical backup operational test

B.1	With engine OFF, test operate engine control system in manual mode. Ensure that, while in mechanical control, engine control handle can be moved from Neutral to Ahead gear / full throttle to Astern gear / full throttle to Neutral.
B.2	Test transfer of control from electronic to manual using the following procedure: a) Turn ON EEC system and operate electronically. b) Take control at the station equipped for mechanical backup, and advance control handle to the Ahead gear / full throttle position. c) Turn OFF the EEC system. Verify that mechanical operation is regained. d) Repeat steps (a) through (c), for the Reverse gear / full throttle position. e) If the boat is equipped with a second electronic control station (remote station), turn ON the EEC system and take control at the remote station and advance the engine control to the Ahead gear / full throttle position. f) Turn OFF the EEC system. At the station equipped with mechanical backup, move the control handles to the ahead gear / full throttle position. Verify that mechanical operation is regained at the mechanical backup control station. g) Repeat steps (e) through (f), for the Reverse gear / full throttle position.

C. Calibration Validation

C.1	Verify that EEC Calibration has been correctly completed: a) Turn ON EEC system and take control as per normal procedure. b) Move both control handles into Ahead / Idle detent. Verify that both gear control levers (at gearbox) move to end of travel, but are not binding against end stops. Verify that engine throttle levers are at Idle position. c) Move both control head handles to Full Throttle. Verify that both engine throttle levers move to end of travel, but are not binding against end stops. d)Move both control head handles to Astern / Idle detent. Verify that both engine control levers (at gearbox) move to end of travel, but are not binding against end stops. Verify that engine throttle levers are at Idle position. e) Move both control head handles to Neutral detent. Verify that both gear control levers are in the Neutral detent position.

• Sea Trial Operational Checks

A.1	Dockside Tests — Before engine start: —Turn ON EEC system and take control as per normal procedure. —Verify the following at each control station: a) Normal Run Mode - (full ahead / full astern / full ahead). b) Warm Up Mode - Gear should remain locked in Neutral. c) Slow Mode - Throttle should be 1/2 the normal output when control handles placed in WOT.
A.2	During sea trials, verify the following: —Engine Synchronization (if system is equipped for this feature). During normal operation, EEC system should synchronize engines within 5-6 rpm (nominal). —Mechanical backup operation, according to the following procedure: While in open waters, and at any speed setting, turn OFF EEC system. Recover control as per section 2.9,

7.0 Troubleshooting

If difficulty is encountered during system operation, the following steps should be followed to determine the cause and / or fix the problem:

1. If the vessel is underway, immediately regain mechanical backup control. All troubleshooting steps should be postponed until positive control over the vessel's engine and gear is regained.

2. If the difficulty occurs during system startup, follow the “EEC System Startup Sequence” flowchart depicted on the next page. Almost always, system startup problems are caused by Control Heads not being positioned in the Neutral position prior to startup, or by adjustment problems caused by mechanical backup misalignment / misadjustment.

3. Perform the steps listed under “Troubleshooting Mode (Recover Alarm Codes) described in Section 7.1. Obtain the following information:

— Number of alarm code that was most recently stored in memory
— Alarm code LED sequence for each alarm in memory.

4. With the alarm code information gathered in Step #3 above, and with the Engine Processor serial number (located on the front cover of the Engine Processor), contact the product service personnel at Glendinning Marine Products, as follows:

Office phone: 800-500-2380
Office fax: 843-399-5005
Hours: 8:00 a.m. - 5:30 p.m. Monday - Friday
(On many days, there are people at the factory either earlier or later than these hours)

Beeper: 843-477-6630

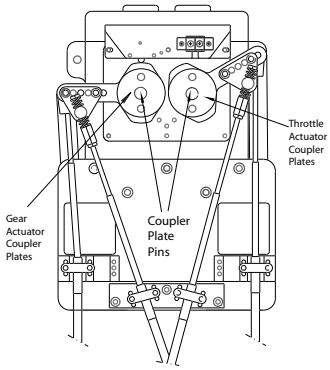
When you hear the “three beeps”, please key in the phone number where you would like to be contacted at. We will try to call you back as soon as possible. Please understand that this is a special beeper which is dedicated to responding to urgent calls regarding the EEC product ONLY and is not to be used for calls relating to our other products.

• EEC System Startup Sequence

During the startup process, the EEC performs various diagnostic tests. In addition, the EEC system must changeover from mechanical backup operation (the failsafe mode that the system is in when powered OFF) to electronic operation.

Normally, mechanical backup can be aligned with the electronic control by adjusting the mechanical backup control head prior to system startup. If difficulty is encountered during startup, verify alignment of coupler plates on actuators in engine compartment.

Prior to startup, gear and throttle coupler plates on both gear / throttle actuators must be aligned (3 coupler plates / function).



Prior to EEC system startup, verify that Main Control Station is in Neutral position.

If the Main Control Station is not also the mechanical backup station, verify that the mechanical backup controls are also in the Neutral position.

Turn EEC system ON.

Is the Main Station Control Head in neutral position?

NO

Move Main Station Control Head handles to neutral position.

TAKE light will flash slowly accompanied by a slow beep

YES

TAKE light will flash slowly.

Actuator solenoids will attempt to engage.

Are Actuator solenoids engaged?

(Actuator solenoid engagement is indicated by coupler plate center pin being fully retracted)

PORT Actuator solenoid will attempt to retract coupler pins first; STBD Actuator solenoids will be energized only if PORT Actuator coupler pin engagement is successful.

NO

Actuators will move small amounts to align coupler plates.

Does Actuator movement allow coupler plate center pins to fully retract?

YES

NO

System will go into ALARM mode (indicated by all 4 lights blinking in unison). Mechanical backup mis-alignment is excessive.

1) Turn OFF EEC system.
2) Adjust mechanical backup control head position.
3) Restart EEC system.

YES

Control Head — TAKE & WARM light ON.

System is ready for operation.

7.1 Troubleshoot Mode (Recover Alarm History)

This section is contained here for general information only. Troubleshoot Mode should only be accomplished when directed by Glendinning Marine Products or by a technician who has been trained by Glendinning Marine Products. Please contact Glendinning Marine Products for additional information.

As described above under Section 2.9, whenever the EEC system goes into the “Alarm Mode”, a code is stored in the system memory which indicates the diagnostic alarm that was encountered. This error code may be retrieved from the system at any time, even if the system has been turned off or even if the system has experienced multiple, or cascading, failures.

The general procedure that is used to recover the Alarm error codes is as follows:

1) Identify the number of the last alarm code stored in memory
2) Read each alarm code that is stored
3) Clear the alarm code memory.

The following procedure is used to retrieve the Alarm Mode error codes:

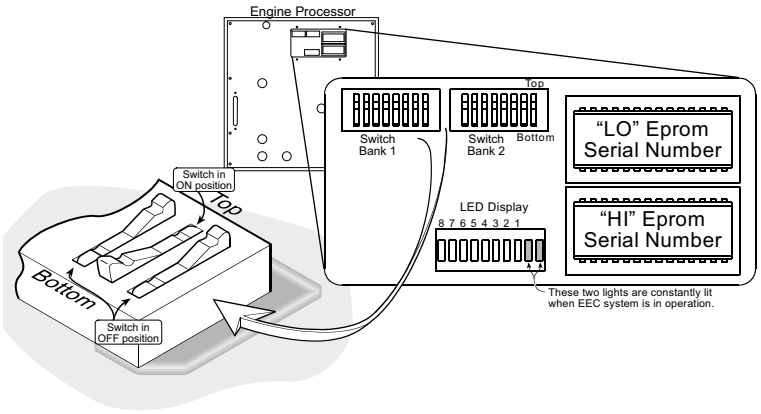
IDENTIFY NUMBER OF STORED ALARM CODES

1. Turn “OFF” the EEC system. Open EP access panel to expose the LEDs and DIP switches.

2. Verify or record the positions (ON/OFF) of each of the EP DIP switches with the “DIP switch position table" that is kept in the front pocket of this manual. If they are not already recorded, write them in the chart below:

DIP SWITCH	#1	#2	#3	#4	#5	#6	#7	#8
Bank 1								
Bank 2								

NOTE: Bank #2, Switches 1 - 6 are the only switch positions that need to be recorded. Do not change the position of any other switches.

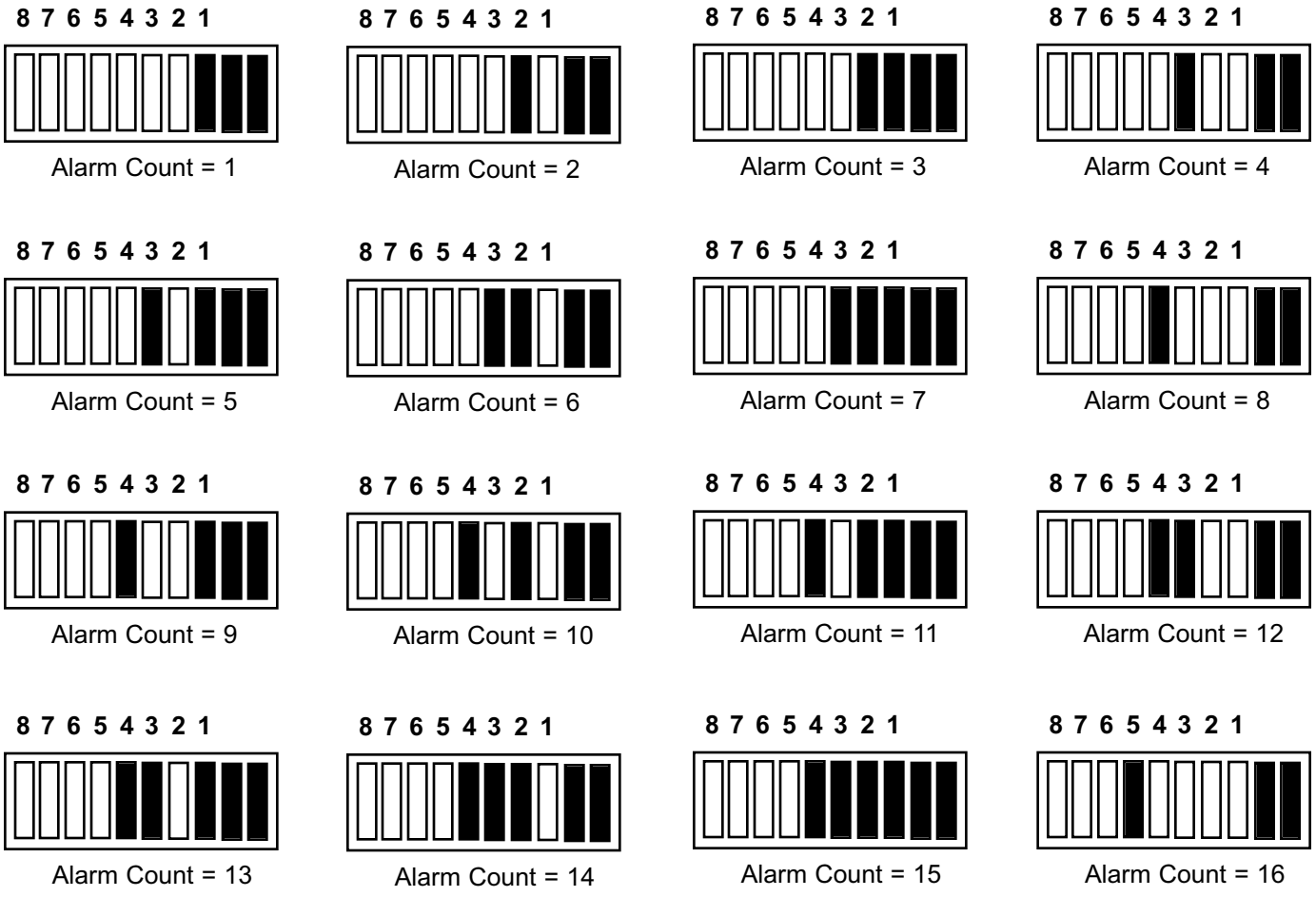


3. Position the DIP Switches as indicated below:

SWITCH BANK #1	SWITCH BANK #2
Switch #4 — ON all others OFF	ALL Switches — OFF

4. Turn ON the EEC system (use same switch at main helm station that is used to turn on the EEC system during normal operation).

5. The alarm count will be displayed on the EP LED.



If no lights are visible, there are no alarm codes stored in memory. Proceed to Step 9 .

RECOVER STORED ALARM CODES

6. Change Bank #2, Switch #1 to the ON position. The most recent alarm code will be displayed in the LEDs. Record Alarm Code.

7. Read all (16) Alarm code memory locations by toggling ON and OFF DIP Switch Bank #2 Switch 2 to display the next most recent alarm code.

CLEAR ALARM CODE MEMORY

8. Once all of the alarm codes have been retrieved, the alarm code memory may be cleared by positioning Dip Switch Bank #2, Switches #7 and Switch #8 to the ON position. When the Alarm Codes have been cleared, all 8 LEDs will be lit.

Once the alarm codes have been recorded, it is good practice to clear them in order to prevent confusion if any additional alarm error codes are written to memory during future operations. However, there is no requirement to clear the memory once the codes have been retrieved. Any future alarm mode error codes will be written to the next available alarm memory location.

9. Turn OFF the EEC system. Restore the EEC system to normal operation by resetting the DIP Switches to their normal operational position, as follows:

Bank #1 — All switches OFF.

Bank #2 — Restore all switch positions to the recorded positions in Step 2.

10. Replace the EP Access Panel. The EEC system is now ready for normal operation.

7.2 Alarm Code Recovery from the Control Head

When the EEC enter “Alarm Mode” (Section 2.9), the specific diagnostic alarm which caused the Alarm Mode can be review from the main station Control Head. Follow the steps below:

1 - Enter Handle Troubleshoot Mode

To review the stored EEC alarm codes you must first enter “Handle Troubleshoot Mode.” To do this you must use the main station control head and follow the 4 simple steps below:

1

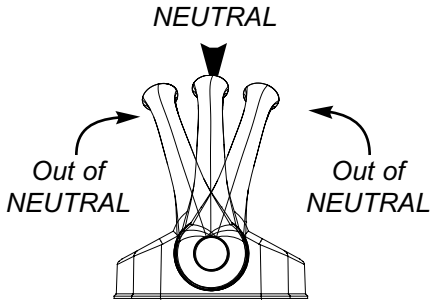
Turn system OFF

LEDs <u>not</u> illuminated

Check to see that the control head keypad LEDs are NOT illuminated. This is a visual indication that the system has been turned OFF.

2

Move handles out of NEUTRAL



You may move the handles out of Neutral in either direction (Ahead or Astern).

3

Turn system ON

When the system has been turned ON the TAKE LED will blink slowly and a buzzer will be beeping.

4

Press the 2 outer buttons on keypad

Take & Troll / Slow buttons

After pressing the two buttons, the keypad's 4 LEDs will now begin to alternate between **slow blinking** and **fast blinking** every 4 seconds.

2 - Retrieve alarm count & alarm codes

The control head keypad LEDs will alternate between **slow blinking** and **fast blinking**, every 4 seconds, to indicate the alarm count and the alarm codes. The system stores in memory the 16 most recent alarm codes beginning with the latest.

1

Record Alarm Count

All LEDs slow blinking

All LEDs fast blinking

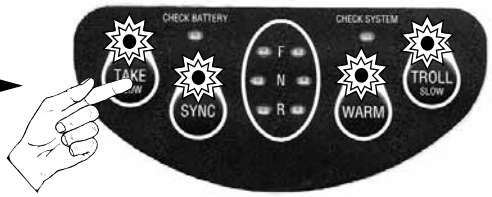
LEDs alternate between slow & fast blinking every 4 seconds

Record the sequence of blinking LEDs in the space provided on page 4. Determine the number of counts from the chart.

2

Press TAKE to view Alarm Codes

LEDs alternating every 4 seconds



Pressing the TAKE button will allow you to cycle through the 16 most recent alarm codes. Record the sequence of blinking LEDs on page 5. Determine the alarm code by using the chart on pages 6-7 and fill in the appropriate space on the chart.

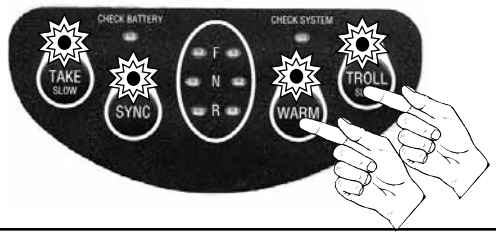
3 - Deleting Alarm Codes and Resetting Alarm Count to Zero

While in Handle Troubleshoot Mode you can delete the 16 most recent alarm codes and reset the alarm count to zero. Deleting alarm codes and resetting alarm count will minimize confusion for future troubleshooting. Follow the step below:

1

Press WARM & TROLL

All LEDs flashing



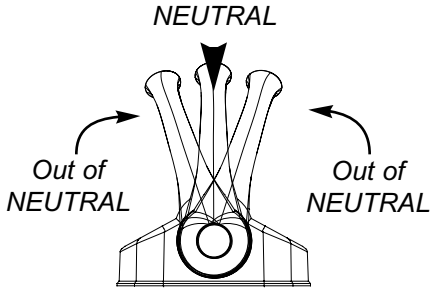
Press WARM & TROLL buttons anytime after entering Handle Troubleshoot Mode to delete alarm codes & reset alarm count to zero.

4 - Exiting Handle Troubleshoot Mode

Once alarm codes have been reviewed and / or deleted, simply turn the system OFF and return the main station control handles to NEUTRAL before restarting system.

1

Power OFF & Move handles into NEUTRAL



To Exit Handle Troubleshoot Mode:

1—Power system OFF
2—Move handles back to NEUTRAL.
3—Restart system.

EXAMPLE

The following describes an actual problem that occurred on a boat which will illustrate the use of our troubleshooting mode.

When John turned his system on he noticed that all 4 LEDs on the keypad were flashing and the control head was beeping. He knew this was not normal and wanted to troubleshoot what was wrong.

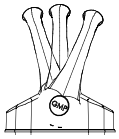
All LEDs flashing

Beeping sound emitted

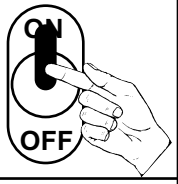
*John entered the system into "Handle Troubleshoot Mode" by **turning the system OFF**, moving the handles of the main station control **out of NEUTRAL**, and **turning the system back ON**. Now John can easily troubleshoot the problem.*

Turn system OFF

Move handles OUT of NEUTRAL



Turn system ON



*John next noticed that the keypad LEDs began to alternate every 4 seconds between **slow blinking** and **fast blinking**. He recorded the LEDs that were blinking slow and the LEDs that were blinking fast on the chart (see pg. 91). The sequence below showed the system went into alarm a total of 3 times.*

Slow blinking

Fast blinking

*John **pressed the TAKE button** to reveal the first alarm code. He recorded the sequence of blinking LEDs (pg. 92) and using the alarm code description chart (pgs. 93-94), John determined that the battery voltage at startup was below 9.6 volts. By pressing the TAKE button a second time John was able to retrieve the next alarm code, and repeated this process for the last alarm code.*

Slow blinking

Fast blinking

Now that John discovered that the reason for the EEC system alarm code was low battery input voltage, he was able to focus on discovering the reason for this low battery voltage. After further investigation, he found two problems with his battery supply to the control system. The first problem is that only one battery power sources was connected to the EEC system, rather than two battery sources (see pg. 35 for more information).

Secondly, the battery source that was connected (generator battery) was very low in voltage due to a failed battery charger. John fixed the problem with the generator battery charger, which charged the generator battery, and the EEC system immediately began to operate. Later, John had his marine electrician install a wire and circuit breaker to his house (domestic) battery source to provide a second battery source for the EEC system.

Alarm Count Chart

LEDs SLOW BLINKING				LEDs FAST BLINKING				= alarm count _____
TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL	

COUNT	LEDs SLOW BLINKING				LEDs FAST BLINKING			
	TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL
1	✸							
2		✸						
3	✸	✸						
4			✸					
5	✸		✸					
6		✸	✸					
7	✸	✸	✸					
8				✸				
9	✸			✸				
10		✸		✸				
11	✸	✸		✸				
12			✸	✸				
13	✸		✸	✸				
14		✸	✸	✸				
15	✸	✸	✸	✸				
16					✸			
17	✸				✸			
18		✸			✸			
19	✸	✸			✸			
20			✸		✸			
21	✸		✸		✸			
22		✸	✸		✸			
23	✸	✸	✸		✸			
24				✸	✸			
25	✸			✸	✸			
26		✸		✸	✸			
27	✸	✸		✸	✸			
28			✸	✸	✸			
29	✸		✸	✸	✸			
30		✸	✸	✸	✸			
31	✸	✸	✸	✸	✸			
32						✸		

COUNT	LEDs SLOW BLINKING				LEDs FAST BLINKING			
	TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL
33	✸					✸		
34		✸				✸		
35	✸	✸				✸		
36			✸			✸		
37	✸		✸			✸		
38		✸	✸			✸		
39	✸	✸	✸			✸		
40				✸		✸		
41	✸			✸		✸		
42		✸		✸		✸		
43	✸	✸		✸		✸		
44			✸	✸		✸		
45	✸		✸	✸		✸		
46		✸	✸	✸		✸		
47	✸	✸	✸	✸		✸		
48					✸	✸		
49	✸				✸	✸		
50		✸			✸	✸		
51	✸	✸			✸	✸		
52			✸		✸	✸		
53	✸		✸		✸	✸		
54		✸	✸		✸	✸		
55	✸	✸	✸		✸	✸		
56				✸	✸	✸		
57	✸			✸	✸	✸		
58		✸		✸	✸	✸		
59	✸	✸		✸	✸	✸		
60			✸	✸	✸	✸		
61	✸		✸	✸	✸	✸		
62		✸	✸	✸	✸	✸		
63	✸	✸	✸	✸	✸	✸		
64							✸	

Record alarm codes

Pressing the TAKE button will advance from the alarm count to alarm codes 1 - 16. Record each alarm code by placing an “X” in the appropriate space on the chart (below). After recording each alarm code press TAKE to cycle through each code.

#	LEDs SLOW BLINKING				LEDs FAST BLINKING				ALARM CODE DESCRIPTION
	TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Once all alarm codes have been recorded, look up the alarm code in the table (on the following pages) and record the alarm code description in the space provided next to each alarm code above.

Alarm Codes Description chart

Check alarm code values that you recorded on the opposite page with the list of alarm code descriptions below. Enter the description in the appropriate column on the chart.

LEDs SLOW BLINKING				LEDs FAST BLINKING				ALARM CODE DESCRIPTION
TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL	
☼								No handle connected to CP at startup.
	☼							Master handle moved out of neutral during engagement of the solenoids.
☼	☼							Reference supply too low (<4.655V for 3 seconds).
		☼						Reference supply too high (>5.355V for 3 seconds).
☼		☼						Nine volt power supply too low (<8.33V for 3 seconds).
	☼	☼						Nine volt power supply too high (<12.139V for 3 seconds).
☼	☼	☼						Relay power supply too low (<9.5V engage/startup or <6.0V run).
			☼					Relay power supply too high (>12.6V for 3 seconds).
☼			☼					Battery below 9.6V (12V) or 20.7V (24V) for 3 seconds.
	☼		☼					Battery above 15.6V (12V) or 30.0V (24V) for 3 seconds.
☼	☼		☼					Battery below 9.6V at startup.
		☼	☼					Battery above 15.6V but below 20.7V at startup.
☼		☼	☼					Battery above 30.0V at startup.
	☼	☼	☼					Port throttle actuator high current, above 10 amps, for 4.8 seconds.
☼	☼	☼	☼					Stbd throttle actuator high current, above 10 amps, for 4.8 seconds.
				☼				Port gear actuator high current, above 10 amps, for 4.8 seconds.
☼				☼				Stbd gear actuator high current, above 10 amps, for 4.8 seconds.
	☼			☼				Port troll actuator high current, above 10 amps, for 4.8 seconds.
☼	☼			☼				Stbd troll actuator high current, above 10 amps, for 4.8 seconds.
		☼		☼				Port throttle actuator high current, above 8 amps, for 10 seconds.
☼		☼		☼				Stbd throttle actuator high current, above 8 amps, for 10 seconds.
	☼	☼		☼				Port gear actuator high current, above 8 amps, for 10 seconds.
☼	☼	☼		☼				Stbd gear actuator high current, above 8 amps, for 10 seconds.
			☼	☼				Port troll actuator high current, above 8 amps, for 10 seconds.
☼			☼	☼				Stbd troll actuator high current, above 8 amps, for 10 seconds.
	☼		☼	☼				Port th actuator problem. Error between command and feedback too large.
☼	☼		☼	☼				Port gr actuator problem. Error between command and feedback too large.
		☼	☼	☼				Port tv actuator problem. Error between command and feedback too large.
☼		☼	☼	☼				Stbd th actuator problem. Error between command and feedback too large.
	☼	☼	☼	☼				Stbd gr actuator problem. Error between command and feedback too large.
☼	☼	☼	☼	☼				Stbd tv actuator problem. Error between command and feedback too large.

LEDs SLOW BLINKING				LEDs FAST BLINKING				ALARM CODE DESCRIPTION
TAKE	SYNC	WARM	TROLL	TAKE	SYNC	WARM	TROLL	
					☼			Port throttle pot feedback is <44 millivolts or >4.956V.
☼					☼			Port gear pot feedback is <44 millivolts or >4.956V.
	☼				☼			Stbd throttle pot feedback is <44 millivolts or >4.956V.
☼	☼				☼			Stbd gear pot feedback is <44 millivolts or >4.956V.
		☼			☼			Port troll pot feedback is <44 millivolts or >4.956V.
☼		☼			☼			Stbd troll pot feedback is <44 millivolts or >4.956V.
	☼	☼			☼			Port and Stbd solenoid micro swithces are off for 1.2 seconds.
☼	☼	☼			☼			Port solenoid micro swtich is off for 1.2 seconds.
			☼		☼			Stbd solenoid micro switch is off for 1.2 seconds.
☼			☼		☼			Values read from EEPROM are corrupted. Recalibrate system.
	☼		☼		☼			Failed to engage solenoid on port actuator.
☼	☼		☼		☼			Failed to engage solenoid on stbd actuator.
		☼			☼	☼		CS1 handle disconnected from SP during operation.
☼		☼			☼	☼		CS2 handle disconnected from SP during operation.
	☼	☼			☼	☼		CS3 handle disconnected from SP during operation.
☼	☼	☼			☼	☼		CS4 handle disconnected from SP during operation.
			☼		☼	☼		CS5 handle disconnected from SP during operation.
☼			☼		☼	☼		CS6 handle disconnected from SP during operation.
	☼		☼		☼	☼		CS1 Port Pot below 15mV or above 4.985V.
☼	☼		☼		☼	☼		CS2 Port Pot below 15mV or above 4.985V.
		☼	☼		☼	☼		CS3 Port Pot below 15mV or above 4.985V.
☼		☼	☼		☼	☼		CS4 Port Pot below 15mV or above 4.985V.
	☼	☼	☼		☼	☼		CS5 Port Pot below 15mV or above 4.985V.
☼	☼	☼	☼		☼	☼		CS6 Port Pot below 15mV or above 4.985V.
				☼	☼	☼		CS1 Stbd Pot below 15mV or above 4.985V.
☼				☼	☼	☼		CS2 Stbd Pot below 15mV or above 4.985V.
	☼			☼	☼	☼		CS3 Stbd Pot below 15mV or above 4.985V.
☼	☼			☼	☼	☼		CS4 Stbd Pot below 15mV or above 4.985V.
		☼		☼	☼	☼		CS5 Stbd Pot below 15mV or above 4.985V.
☼		☼		☼	☼	☼		CS6 Stbd Pot below 15mV or above 4.985V.
	☼	☼		☼	☼	☼		CS1 lost serial communications with the EP.
☼	☼	☼		☼	☼	☼		CS2 lost serial communications with the EP.
			☼	☼	☼	☼		CS3 lost serial communications with the EP.
☼			☼	☼	☼	☼		CS4 lost serial communications with the EP.
	☼		☼	☼	☼	☼		CS5 lost serial communications with the EP.
☼	☼		☼	☼	☼	☼		CS6 lost serial communications with the EP.

7.3 Troubleshooting Chart

1) The following problems may be encountered during system startup:

PROBLEM / SYMPTON	POSSIBLE FAILURE	RECOMMENDATION
After turning ON power switch or circuit breakers, EEC system will not turn ON.	No input power to Engine Processor	A) Verify that at least one source of 12 or 24 VDC is available at EP power supply input barrier strip. B) Verify that EP circuit breakers are ON.
	Power switch relay box defective	A) Verify 12 or 24 VDC across input terminals of Power switch relay box. If no voltage is observed, power supply from vessel batteries is problem. B) If voltage is present at input terminals, turn on power switch at helm station. Verify that 12 or 24 VDC is present at power switch relay box output terminal strip. If no voltage is observed, then power switch relay box is probably defective.
	EEC internal failure	Open Dip switch access cover. While assistant turns ON power switch, observe EP LEDs and record pattern of lights which turn on. Call GMP for technical help.
After turning ON power switch “TAKE” light slowly blinks but system will not start up.	Main station Control head handles are not in Neutral detent position.	Leave power switch ON. Move handles to Neutral detent position. EEC system will automatically begin intinialization and startup procedures.
	“Neutral detent” potentiometer in Control Head defective.	A) Cycle control handles several times (Full ahead—Full Reverse—Full Ahead) and then repeat startup process. B) For boats equipped with 2 or more stations, change SP connections at EP to place a different station in S#1 position. Repeat startup process. C) Replace control head.
5-6 seconds after turning on Power switch, all four lights blink simultaneously, along with Control Head buzzer sounding & Check System light is blinking.	EEC system was unable to engage electronic control (All lights blinking simultaneously indicates that system has entered “Alarm Mode” — Light code 3, 7, “No EEC”).	Mechanical backup control cables are incorrectly adjusted.
	Low battery voltage — System has enough voltage to start up Engine Processor, but not enough voltage for solenoid “pull up” current.	A) Check voltage at EP input terminals during startup process. If battery voltage is low, charge batteries. B) Verify alignment of coupler plates on Actuator prior to system startup. Try pushing in coupler pins during system startup.

2) The following problems may be encountered during normal operation:

PROBLEM / SYMPTON	POSSIBLE FAILURE	RECOMMENDATION
While operating control system, all (4) control head LEDs blink simultaneously, along with control head buzzer sounding & Check System light blinking.	EEC system is in Alarm Mode.	A) Immediately regain mechanical control of engine throttle and gear.. B) Try resetting control system: —return engine/gear to neutral/idle position. —turn EEC system power switch OFF and then ON. —Wait 5 seconds for EEC system to restart. —When TAKE light is ON (no blinking), system is now ready for electronic operation. C) After returning to port, accomplish troubleshooting procedure to determine cause of failure.
Synchronization Mode is inoperative. When SYNC switch is pressed, Control Head beeper is heard.	Required conditions for entering SYNC Mode do not exist.	A) No (or incorrect) tach sender input to EP—see next failure mode. B) Sync Mode may only be entered when both engines are above 950 RPM. *(NOTE: This value will vary from one boat to another and is affected by several factors, including: EEC system software version, throttle cable geometry, calibration adjustments, etc.)* —During initial sea trials, always test synchronization function above 1600 RPM to ensure that low engine RPM is not preventing Synchronication function. C) Control handles must be reasonably well matched—no more than 1/2” misalignment. D) Engine RPMs must be within 250 RPM of each other. *NOTE: If this maximum engine RPM differential cannot be obtained with handles matched (see B above), then throttle cable geometry at engine is mismatched between engine. Correct cable connection and retest.* E) Engine RPM difference must be less than 250 RPM for at least 4 seconds. Wait 4-5 seconds for engine RPM to stabilize before pressing SYNC button.
	No tachometer input to Engine Processor.	A) Verify both tachometer senders connection wires are securely attached to tachometer sender and to EP barrier strip. B) Verify that proper wires from each tachometer sender (black and black-red) are connected to correct input terminals: Port to Port terminals, Starboard to Starboard terminals. C) *BEST METHOD:* measure frequency input to EP terminals: 1000 RPM = 66 Hz, 1800 RPM = 120 Hz. D) Alternative method: measure voltage input to EP terminals: 1000 RPM = 3-4 VAC; 1800 RPM = 6-7 VAC.

PROBLEM / SYMPTON	POSSIBLE FAILURE	RECOMMENDATION
In Troll Mode, with full handle deflection, no propeller shaft movement.	Troll actuator endpoint positions not correctly calibrated.	Recalibrate troll actuator endpoint positions.
In Troll Mode, propeller shaft does not move until 40% or more control handle movement.	Too much deadband on transmission troll lever	Recalibrate troll actuator endpoint positions. Call GMP
While in electronic mode, control handles are moved but engine / gear does not respond.	Electronic engine control has failed.	A) Immediately regain mechanical control of engine throttle and gear. B) Check control head indicator lights to see if they are blinking—if so, EEC system is in Alarm Mode.

8.0 Appendix / Reference

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8.1 Custom Configuration Options

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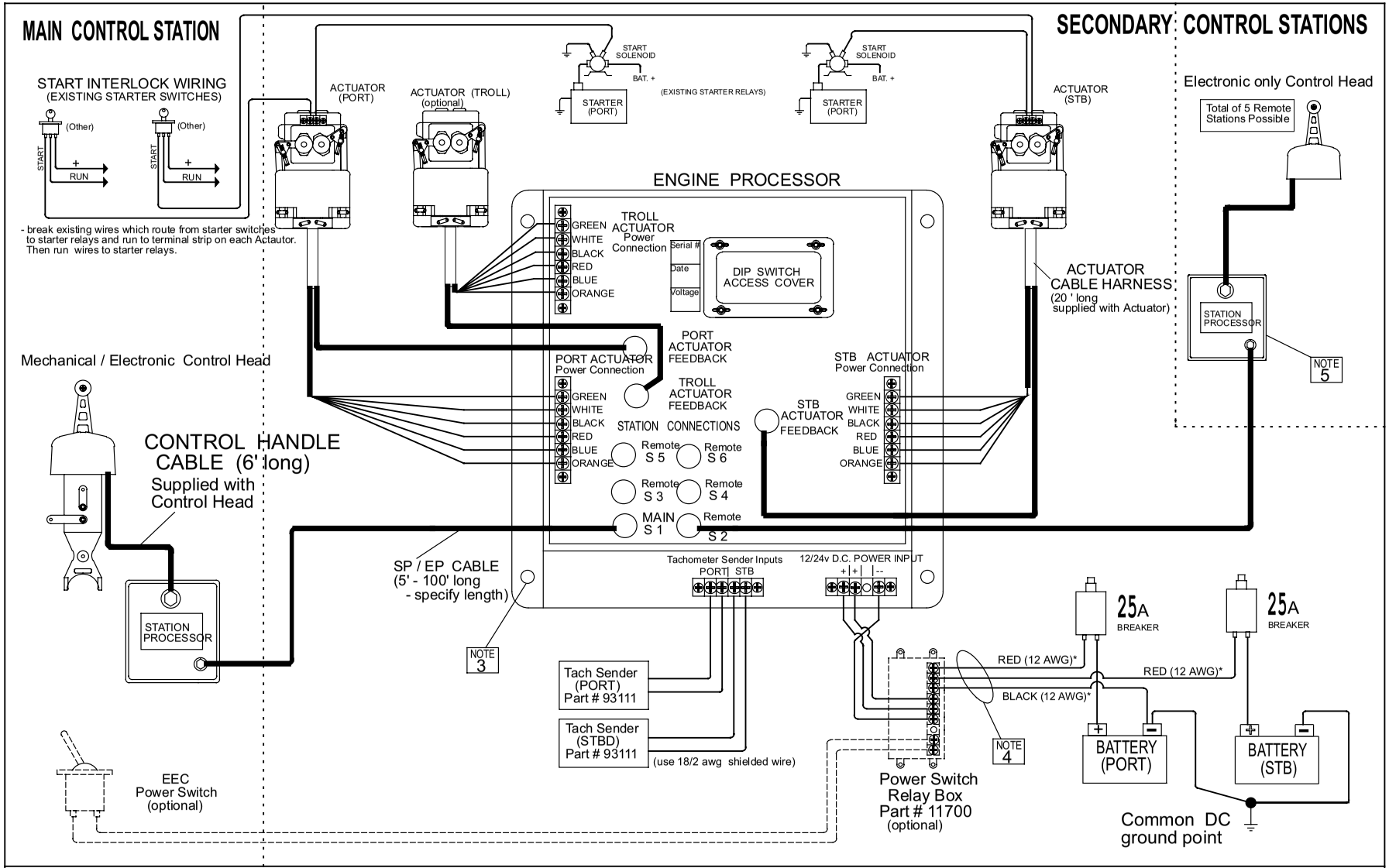
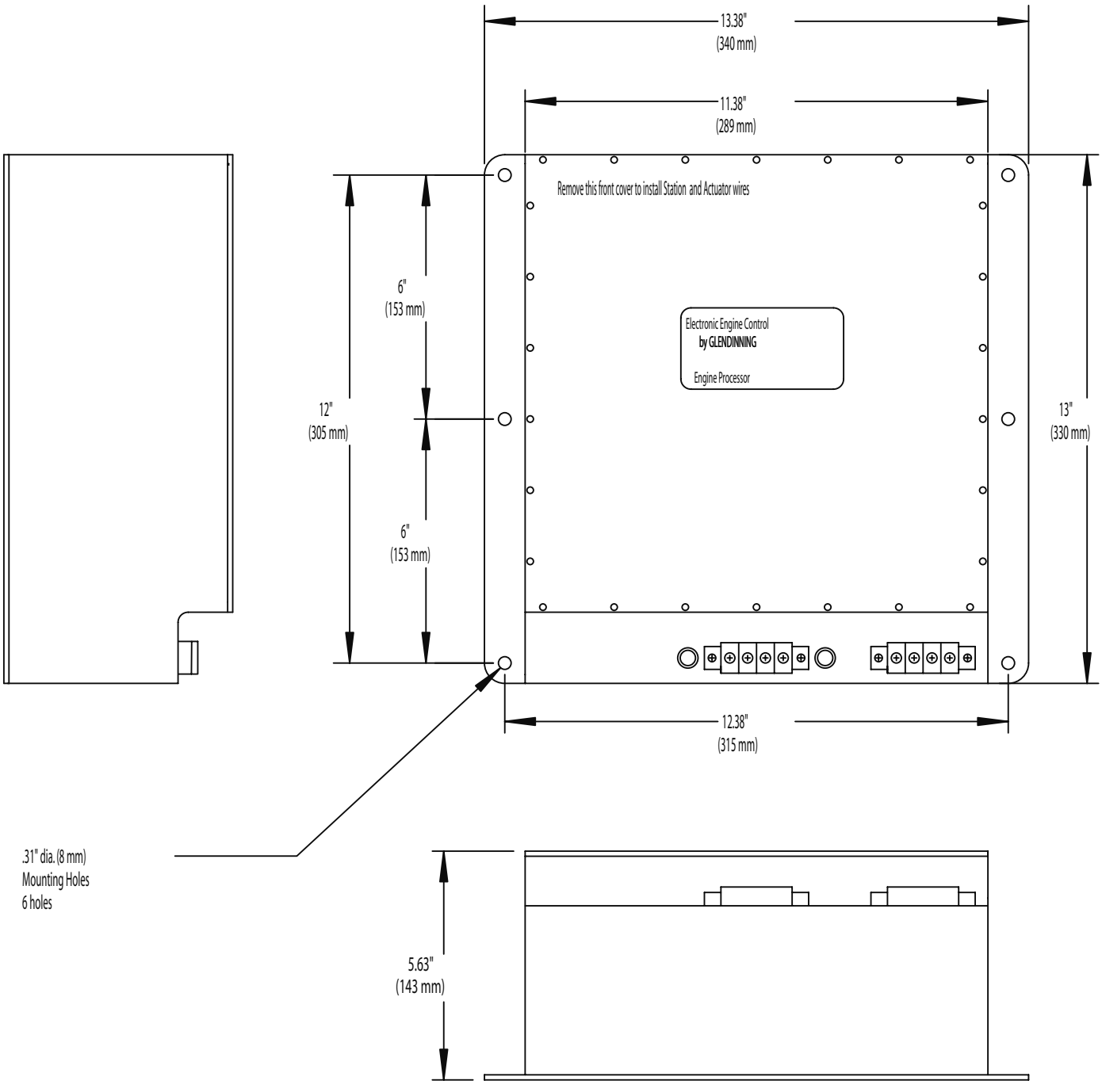
Engine Processor 12/24v DC Troll Capable WIRING DIAGRAM Part # 11200-02T

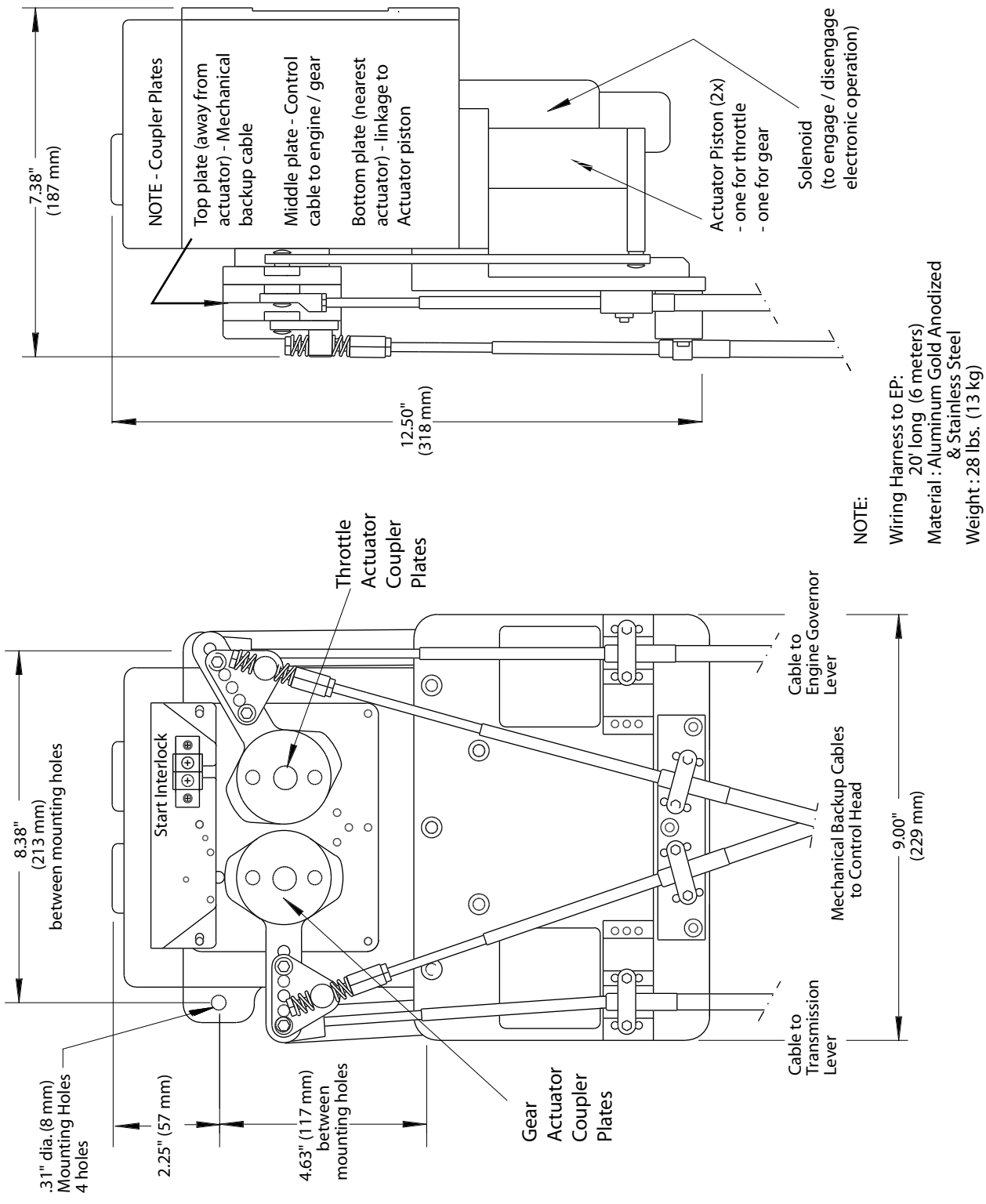


NOTES:
1. All connection cables supplied by GMP are pre-terminated with connectors. Installer will supply and terminate: Battery Power Wire, Start-Interlock Wire, Tachometer Wire, Power Switch Relay Box Wire (optional)
2. Engine processor, Station Processor, Control heads and optional Power Switch Box are capable of operating at 10v - 30v DC. (Both batteries must be same voltage.) NOTE: Actuators must be ordered for 12v or 24v DC operation.
3. Bonding is done only at the Engine Processor. All other components are already bonded to the Engine processor (In compliance with:ABYC #E-146&CFR Code 111.05)
4. Use 12 awg. wire. When D. C. power input wires are more than 15 feet in length up-grade to 10 (awg) wire. (See manual for more detail)
5. Station Processor is NOT needed if using EEC-2001 style Control Head or Sidemount Controls.

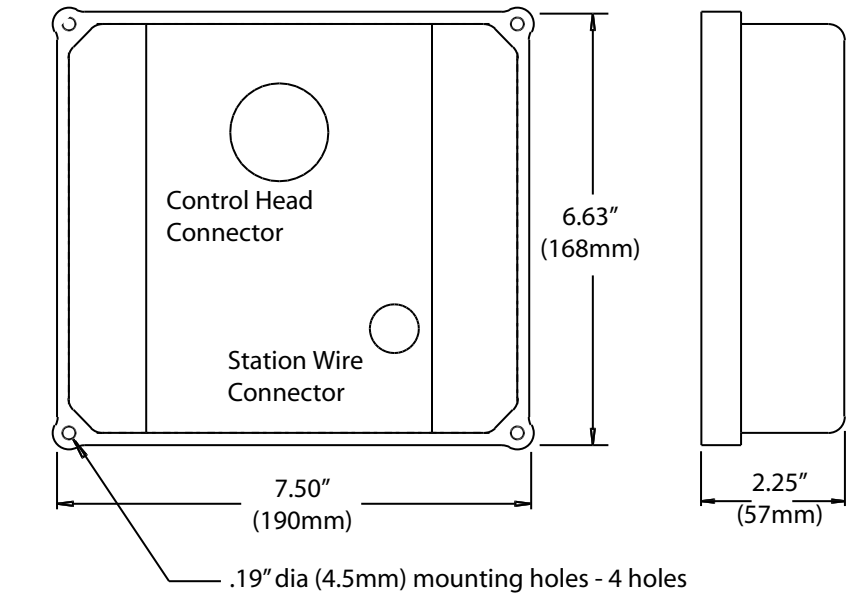
Engine Processor (EP) Dimensions

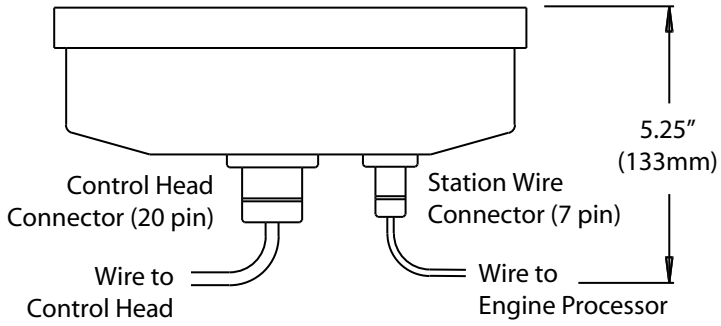


Actuator Dimensions

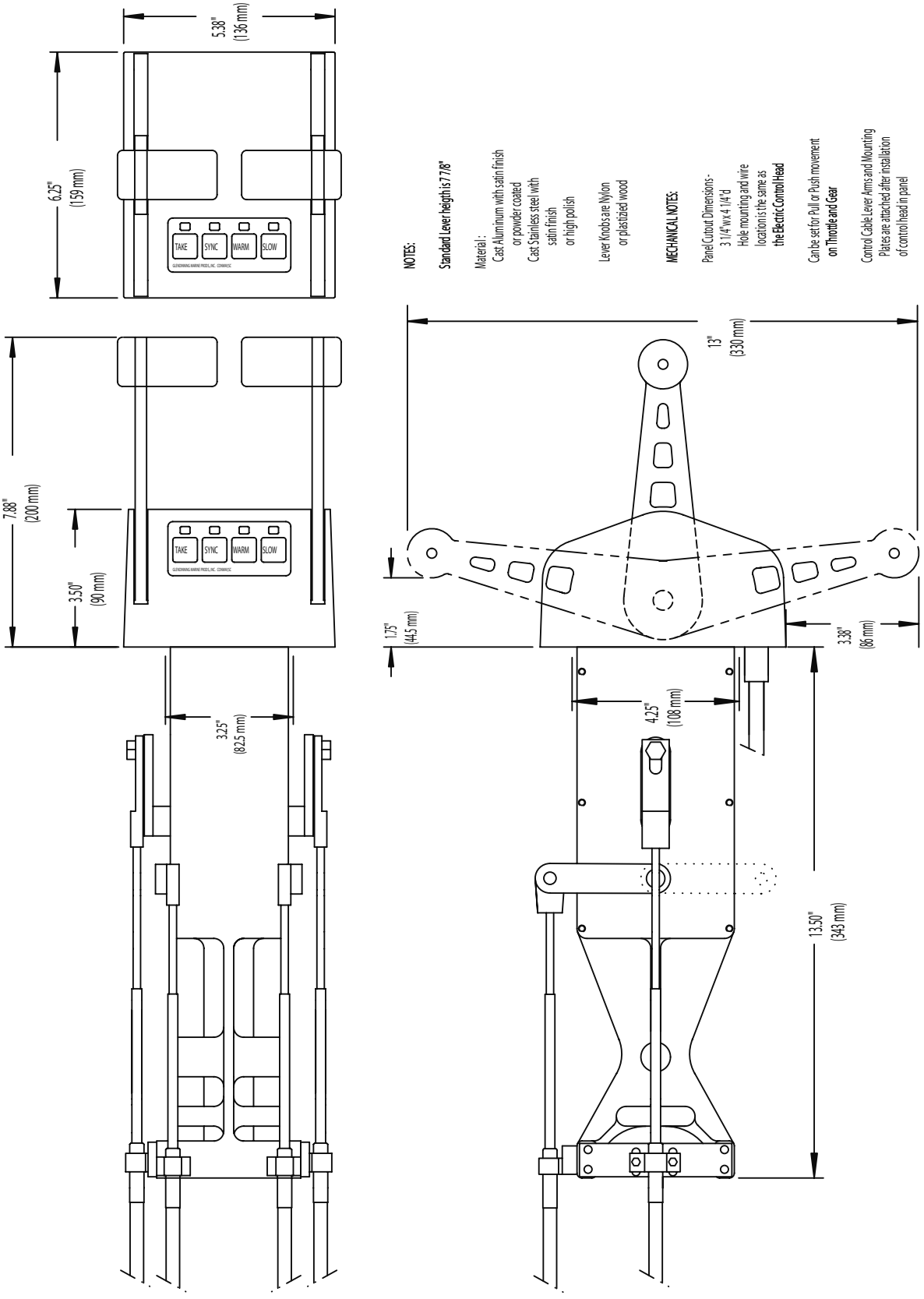


Station Processor Dimensions

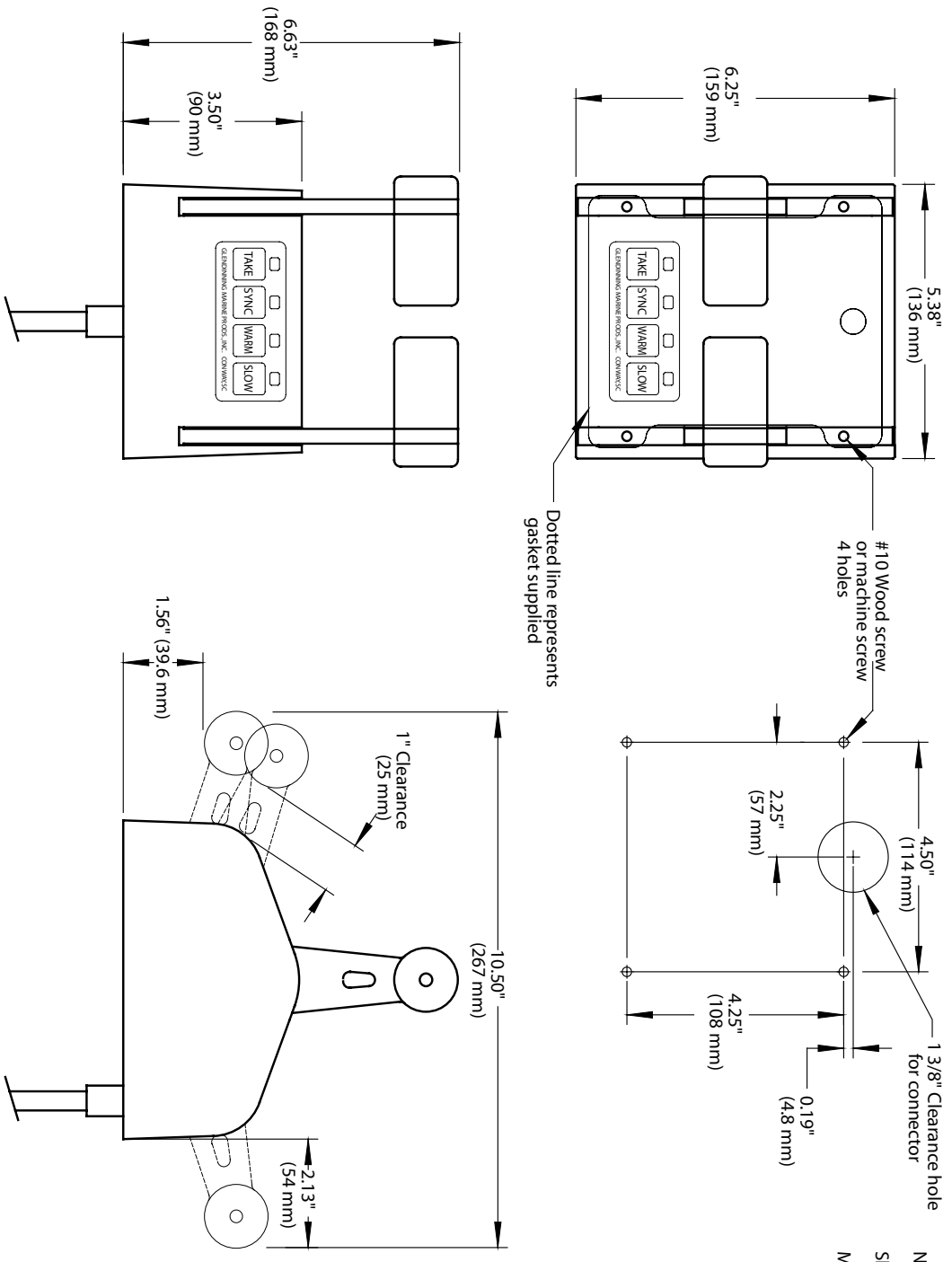




Control Head - Mechanical Backup Dimensions



Control Head - Remote (Electric only) Dimensions



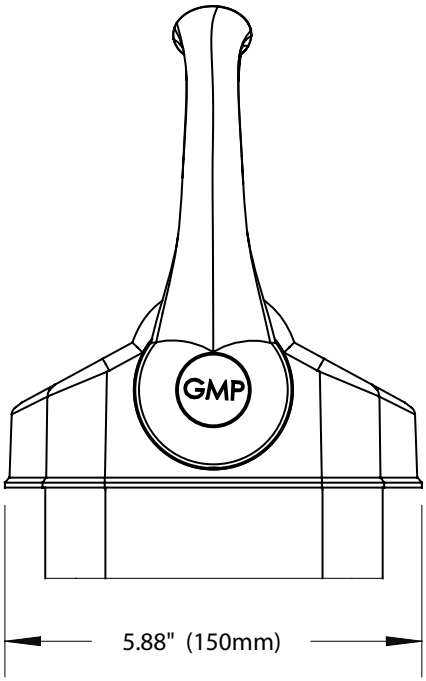
NOTES:

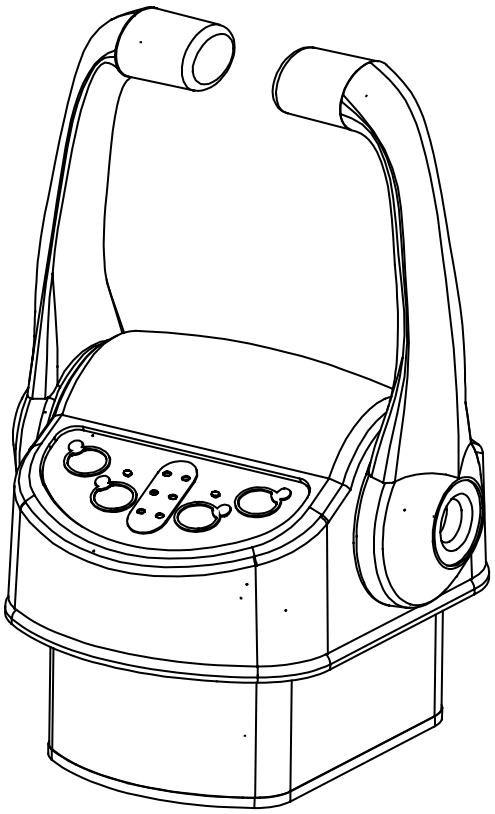
Short version Lever heigth is 6 5/8""

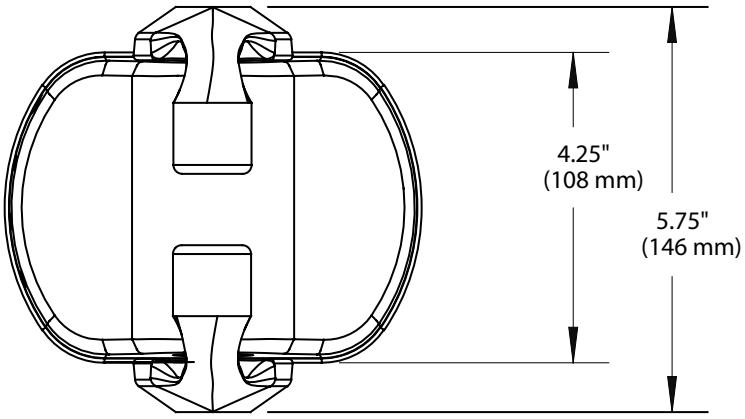
Material :
Cast Stainless steel with satin finish
or high polish

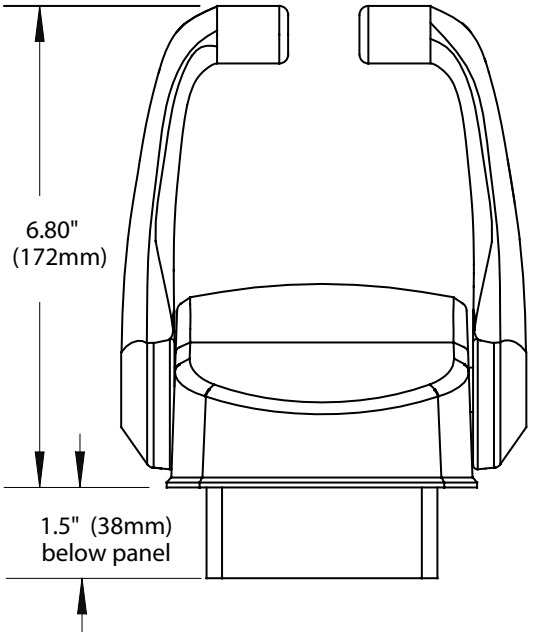
Lever Knobs are Nylon
or plastizied wood

Control Head - New Style Dimensions





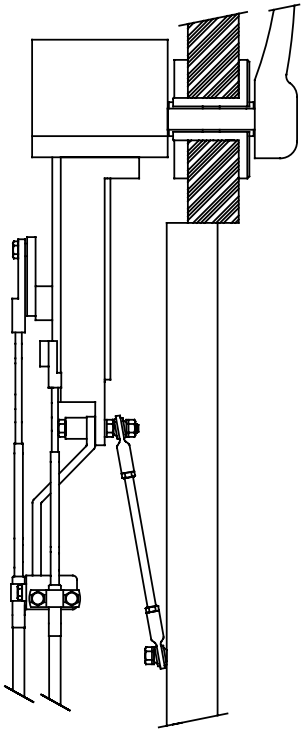




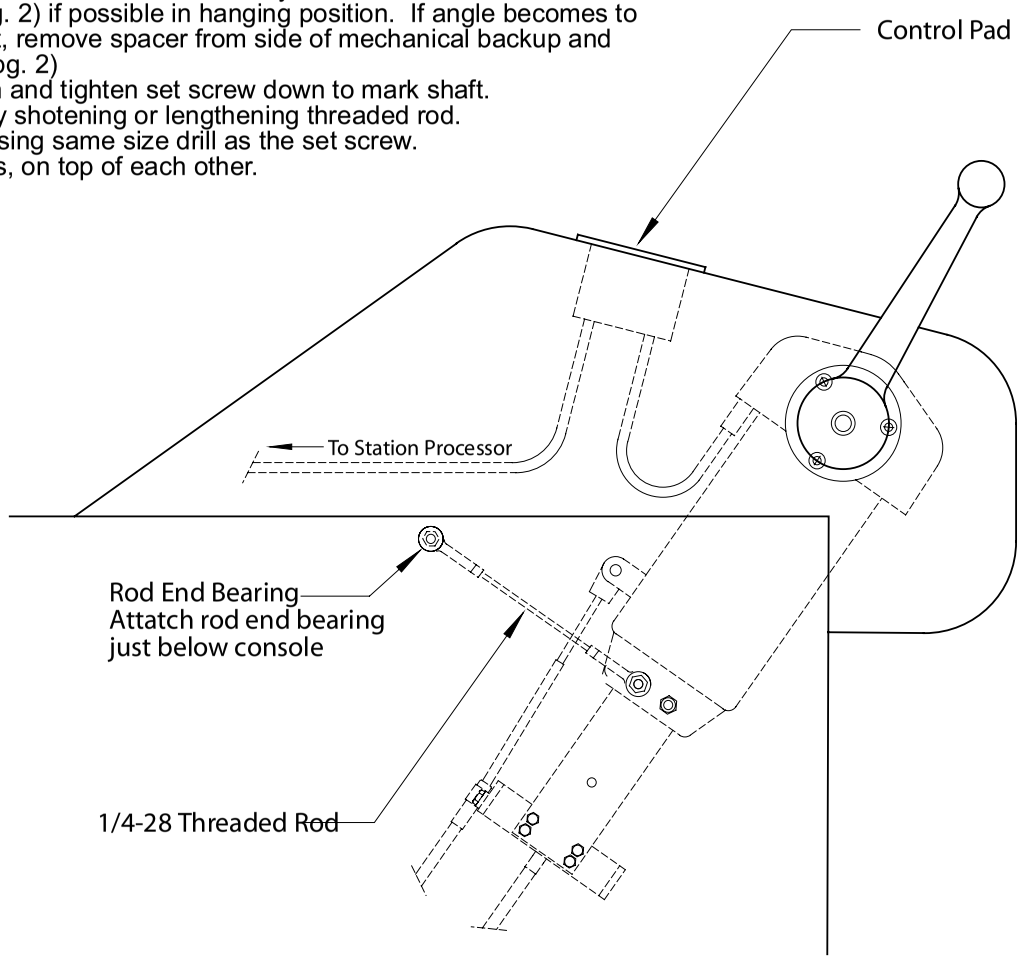
Sidemount Control Head Installation

INSTALLATION

1) Drill 1 1/4" dia. hole in proper location; also drill (3) 17/64 dia. holes for Outside Flange mounting
2) Attach Inside Flange to console using (3) 1/4-20 oval head machine screws
3) Once Outside Flange and Inside Flange are mounted, install (3) #10 flat head wood screws through Inside Flange. This will hold the Inside Flange in place in case of removal in the future.
   Note: Wood screws should not be longer than the thickness of the console.
4) Install the Control Head mechanism in flange (Note: The control heads are marked Port and Stb.; also the wire that exits the control head should be coming out out of the forward part of the control head.)
5) Establish the desired Control Head angle and attach the tie rod assembly as shown.
   Tie rod should be 90° to control head (see Fig. 2) if possible in hanging position. If angle becomes to great when attaching tie rod to side of cabinet, remove spacer from side of mechanical backup and place on the opposite side. (see Fig. 4&5 on pg. 2)
6) Install Control Handle and key in proper location and tighten set screw down to mark shaft.
   Fine alignment of handles may be adjusted by shotening or lengthening threaded rod.
7) Remove set screw and handle and divot shaft using same size drill as the set screw.
8) Reinstall Control Handle and use two set screws, on top of each other.

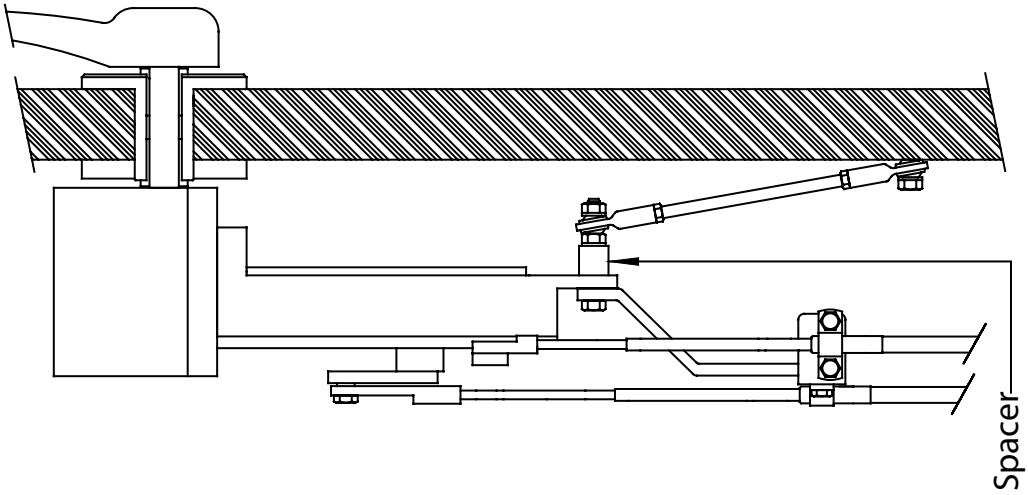


(Fig. 1)

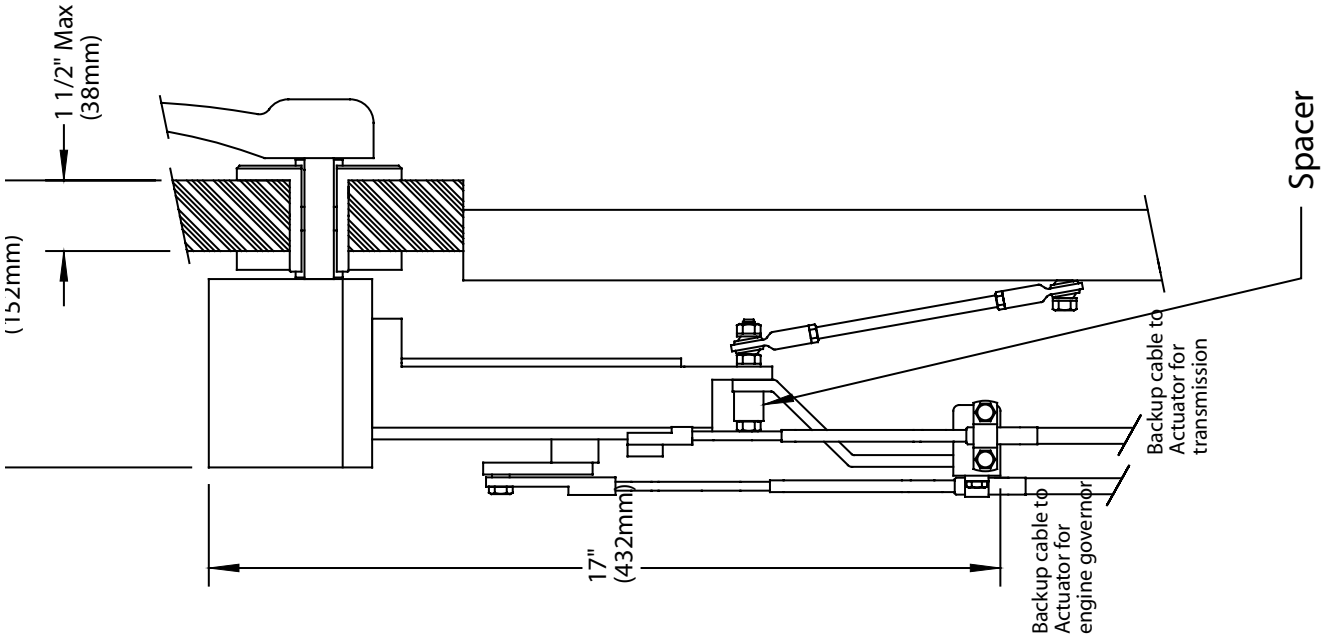


(Fig. 2)

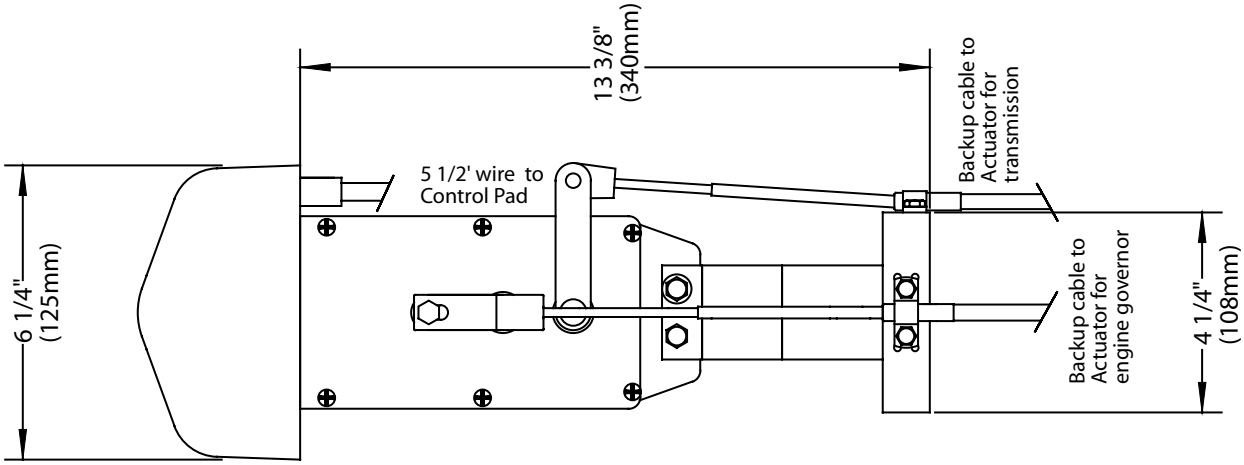
Sidemount Control Head Installation



(Fig. 5)

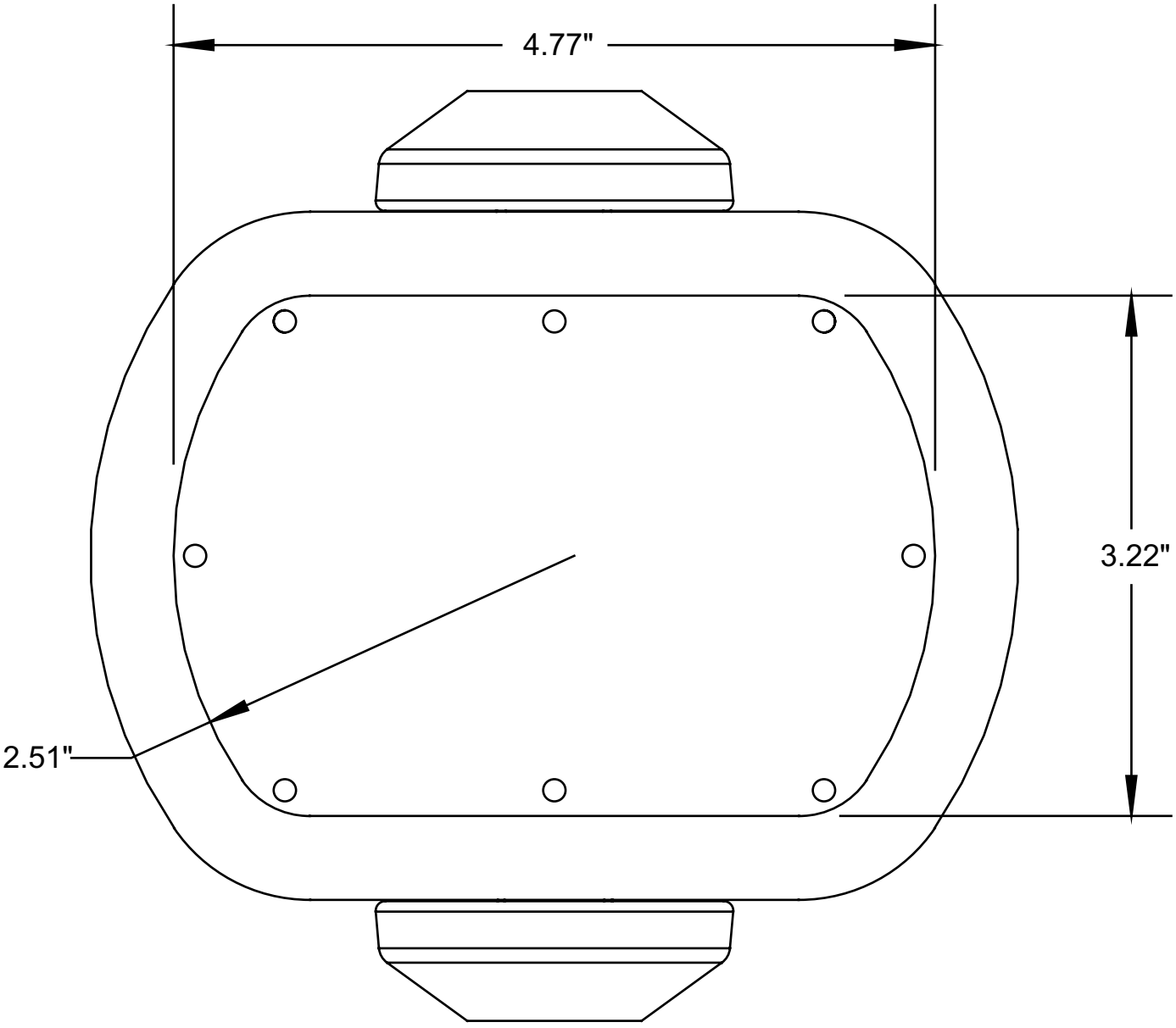


(Fig. 4)

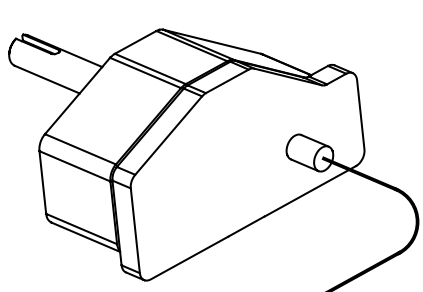


(Fig. 3)

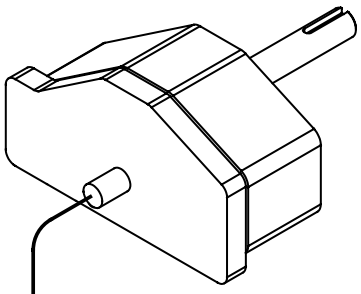
Control Head Template - New Style



Sidemount Wiring Diagram

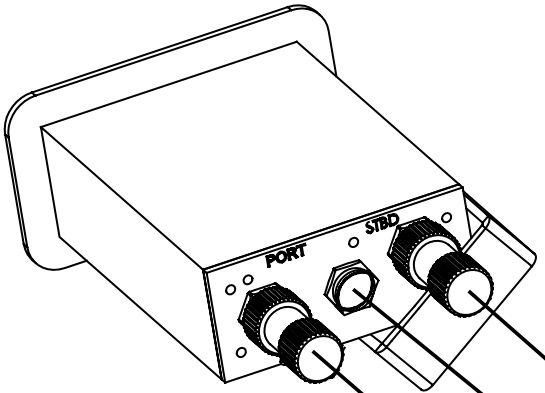


PORT Sidemount Control Station Assembly



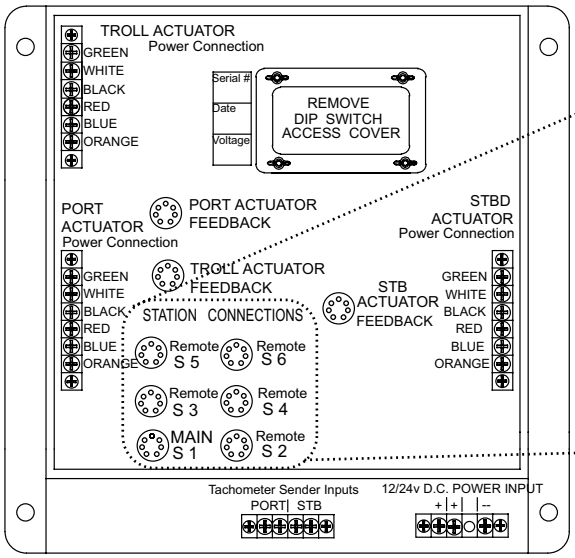
STBD Sidemount Control Station Assembly

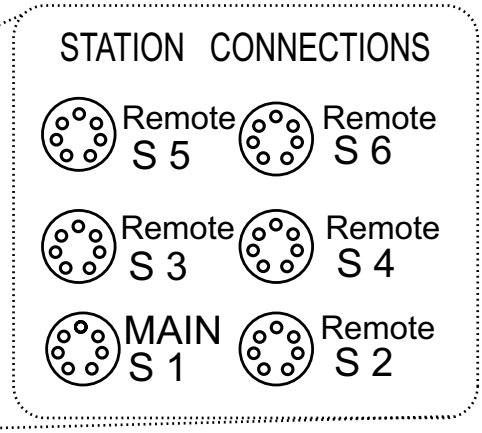
Sidemount Keypad Assembly



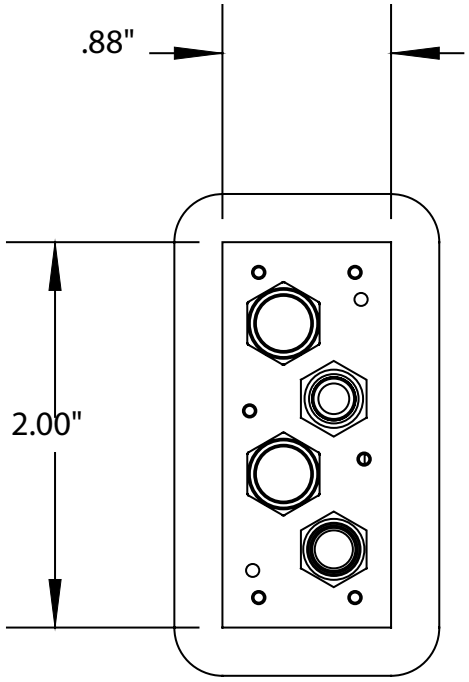
Connects to Station Connection MAIN S1 on Engine Processor (see below)

ENGINE PROCESSOR





Sidemount Keypad Assembly Template



8.1 Custom Configuration Options

Besides the Quick Configuration Option mentioned on page 67, it may be necessary (depending on your boat's equipment and operator preference) to set Custom Configuration Options for the EEC Control System.

The Custom Calibration Options charts are divided into 5 sections:

A) Control Station Custom Options
B) Gear Custom Options
C) Throttle Custom Options
D) Troll Custom Options
E) Other Custom Options

Prior to changing the DIP switch settings for Custom Configuration Options, the EEC system must be prepared as follows:

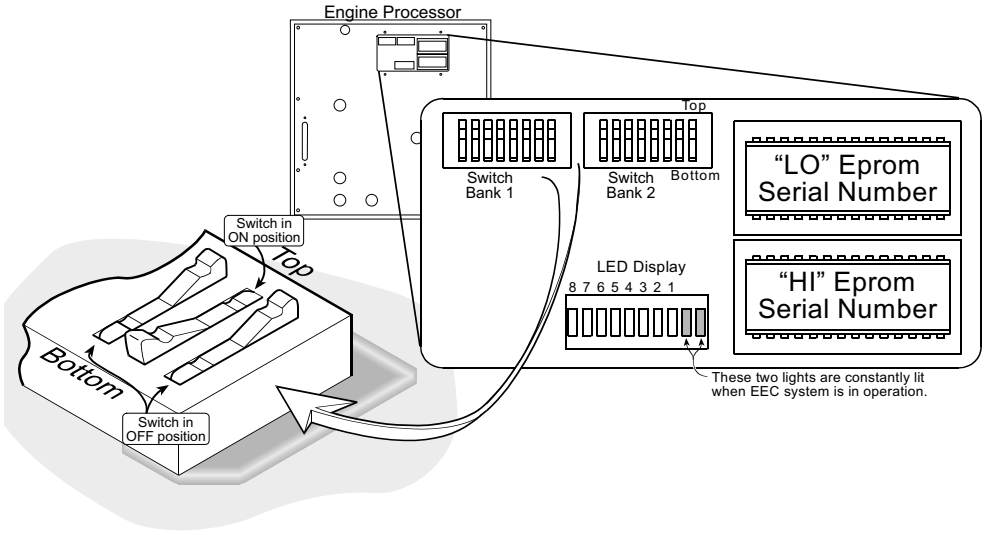
1) Once calibration is completed, any custom calibration options that are chosen may require recalibration for that particular function.

2) Verify that the Main station control handles are in the neutral position. The Main Station is the control station that is connected to the "S1" connection in the Engine Processor. The Main station may also be the control station that is equipped with the mechanical backup cables.

3) Turn OFF all power to the EEC system.

4) Open the Engine Processor (EP) access plate to expose the DIP Switches and LED indicator light assembly (see illustration below).

To set the Custom Configuration Options follow the 8 steps outlined on the next page for each Configuration Option:



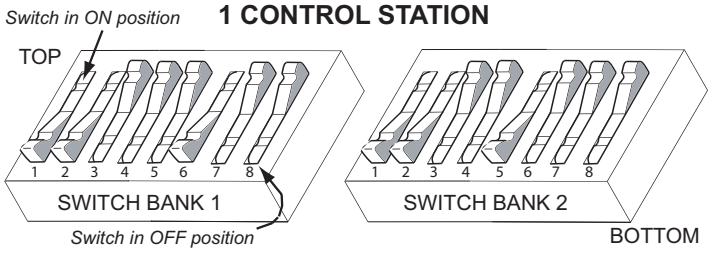
To set the switch position, push down on the side of the switch that is marked with your desired setting. Example, Push down on the OFF side if you want the switch to be in the OFF position (see left).

1) **Make sure power to Control System is OFF** (LEDs should NOT be illuminated).
2) **Write down** the positions of the switches (ON or OFF) for Switch Bank 1 & Switch Bank 2.
3) **Set Switch Bank 1 & Switch Bank 2 switches** to their appropriate positions (see charts on the following pages for switch settings).
4) **Turn ON** Control System (LEDs will turn ON and will indicate the position of the Switch Bank 2 switch settings).
5) **Turn ON Switch Bank 2, Switch 8** to memorize configuration settings (all LEDs will illuminate).
6) **Turn OFF Switch Bank 2, Switch 8** before turning power to System OFF.
7) **Return** Switch Bank 1 & Switch Bank 2 switches to the positions recorded in step 2.
8) **Turn ON** System and operate controls with the custom options you configured.

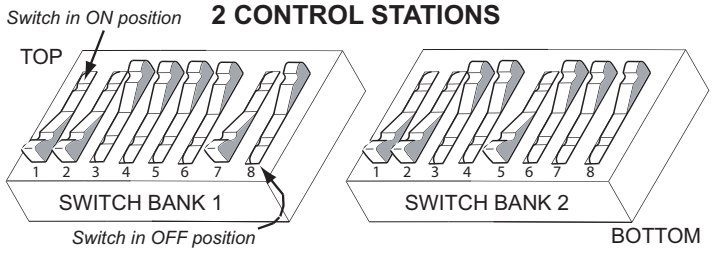
A) CONTROL STATION CUSTOM OPTIONS

To change the number of control stations that will communicate with the EEC system, set the Switch Bank DIP Switch settings for the proper NUMBER OF STATIONS.

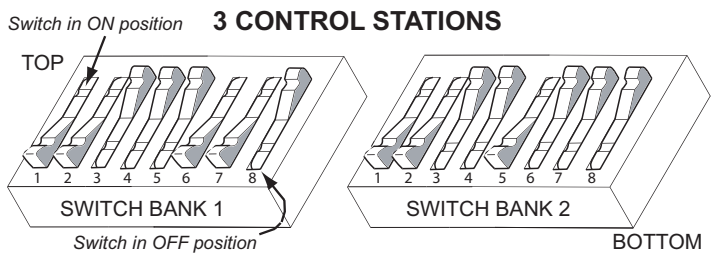
1 CONTROL STATION



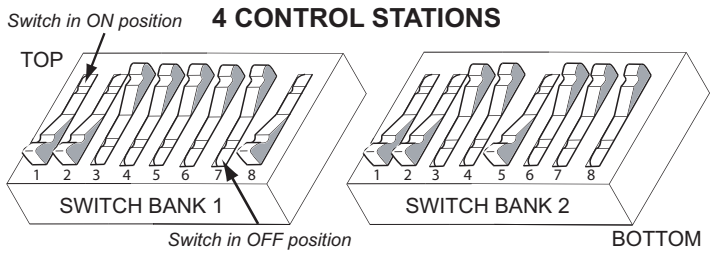
2 CONTROL STATIONS



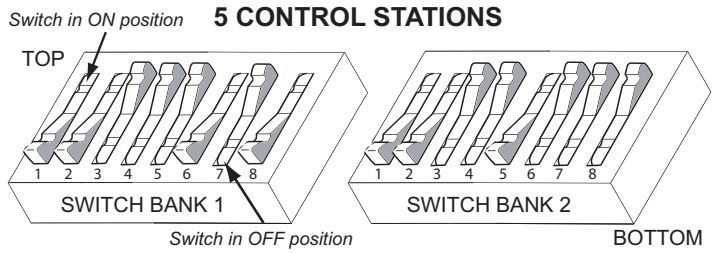
3 CONTROL STATIONS



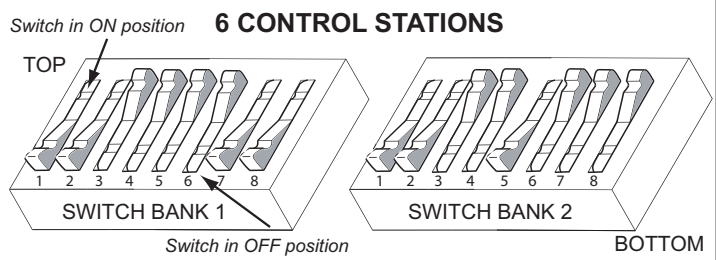
4 CONTROL STATIONS



5 CONTROL STATIONS



6 CONTROL STATIONS

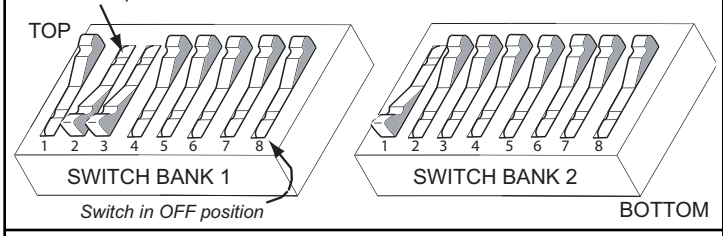


You may continue to change other custom options or . . . ***Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM by making sure all control heads perform properly.***

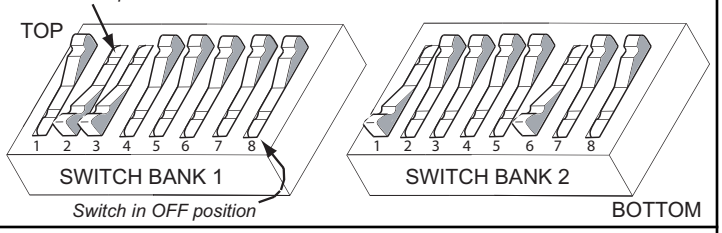
B) GEAR CUSTOM OPTIONS

To change the time allowed (delay) when the transmission shifts into gear once handles are moved into the proper detent, set the Switch Bank DIP Switch settings for the desired GEAR DELAY.

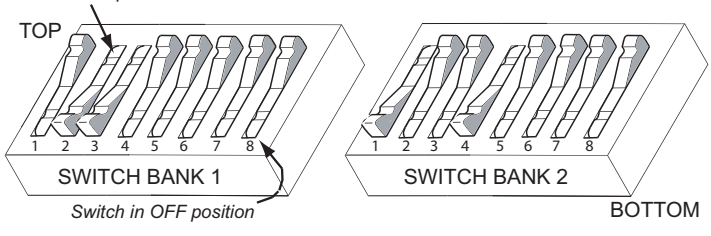
NO GEAR DELAY



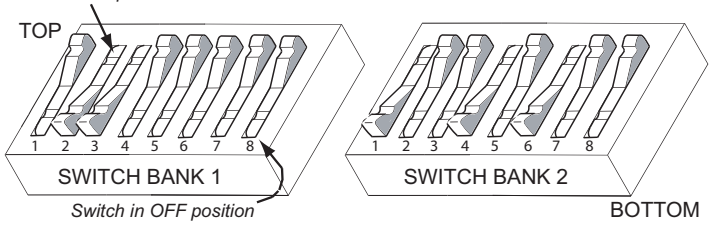
4.0 SECOND GEAR DELAY



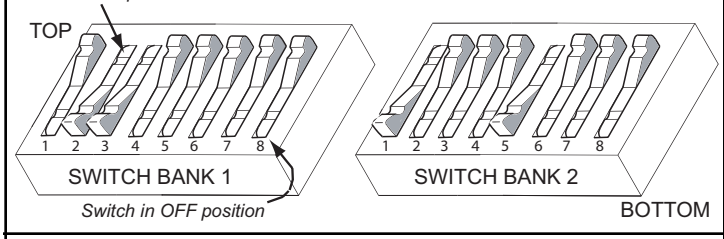
1.0 SECOND GEAR DELAY



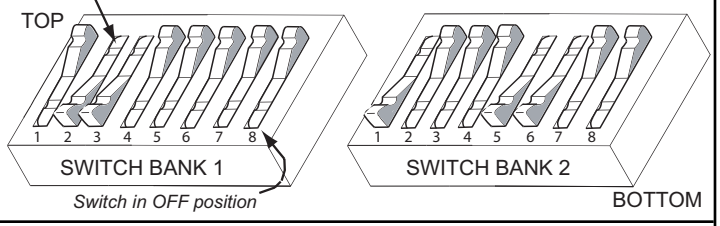
6.0 SECOND GEAR DELAY



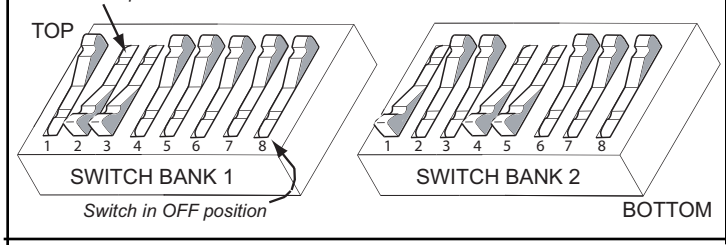
2.0 SECOND GEAR DELAY



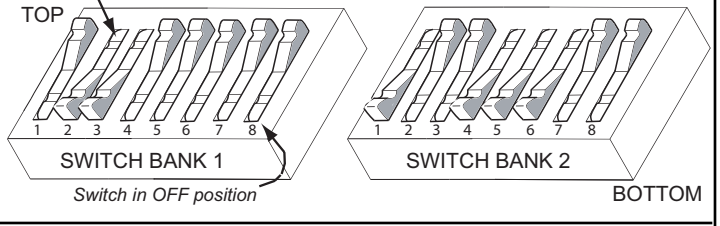
8.0 SECOND GEAR DELAY



3.0 SECOND GEAR DELAY



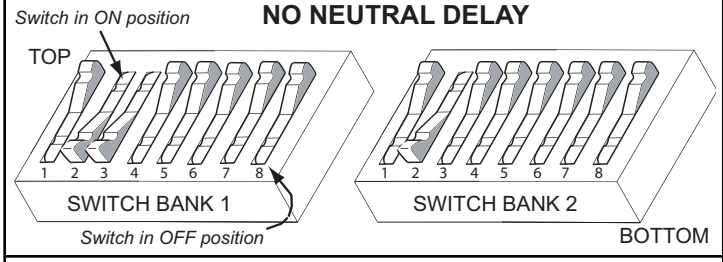
10.0 SECOND GEAR DELAY



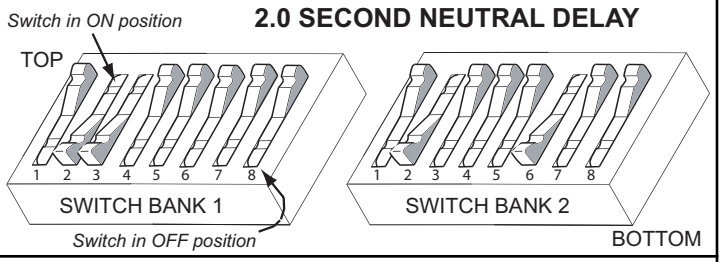
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change the time allowed (delay) when the transmission shifts into neutral once handles are moved into the neutral detent, set the Switch Bank DIP Switch settings for desired GEAR DELAY.

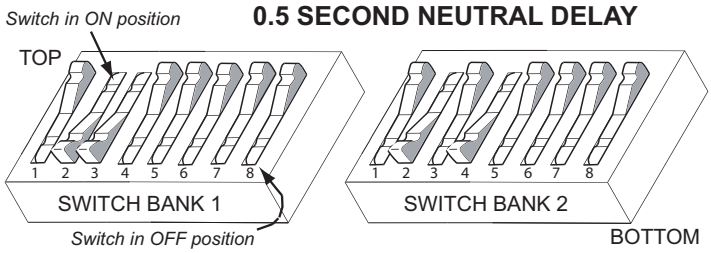
NO NEUTRAL DELAY



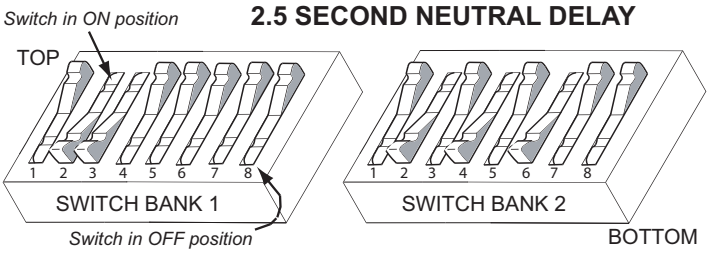
2.0 SECOND NEUTRAL DELAY



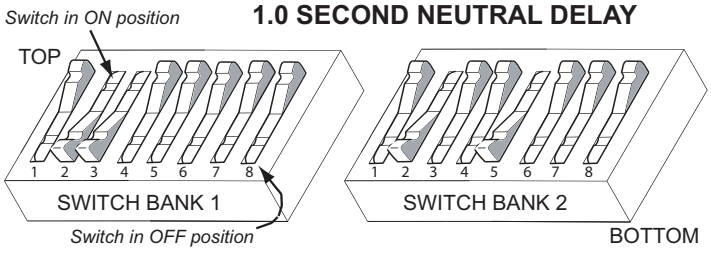
0.5 SECOND NEUTRAL DELAY



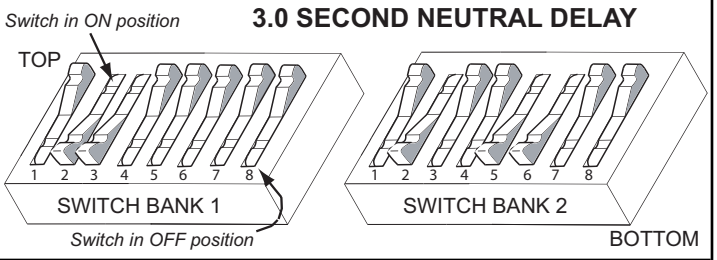
2.5 SECOND NEUTRAL DELAY



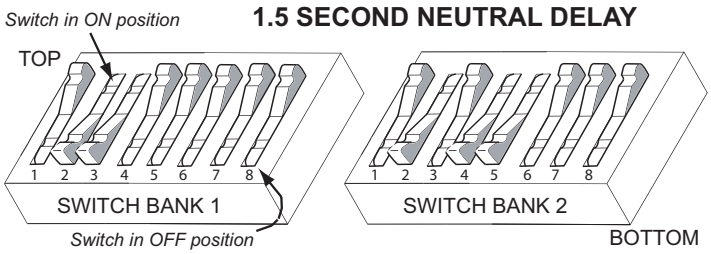
1.0 SECOND NEUTRAL DELAY



3.0 SECOND NEUTRAL DELAY



1.5 SECOND NEUTRAL DELAY



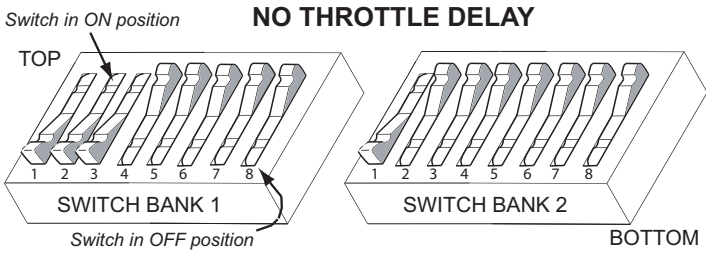
You may continue to change other custom options or . . .

Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

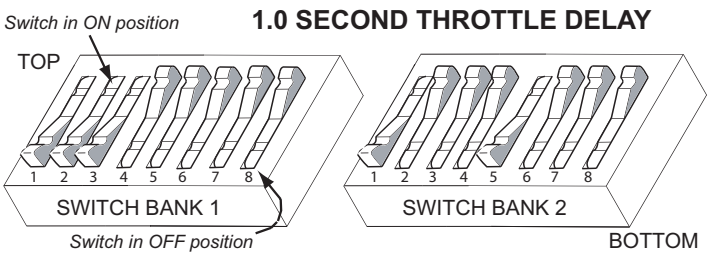
C) THROTTLE CUSTOM OPTIONS

To change the time allowed (delay) when the engines RPMs increase or decrease once handles are moved into the throttle range, set the Switch Bank DIP Switch settings for desired THROTTLE DELAY.

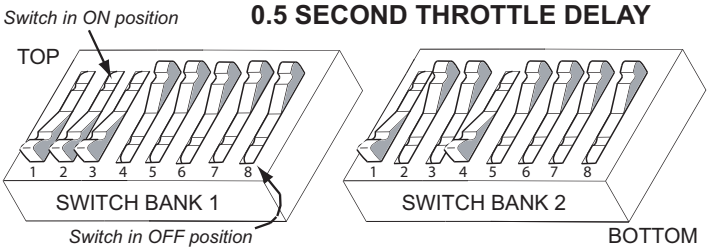
NO THROTTLE DELAY



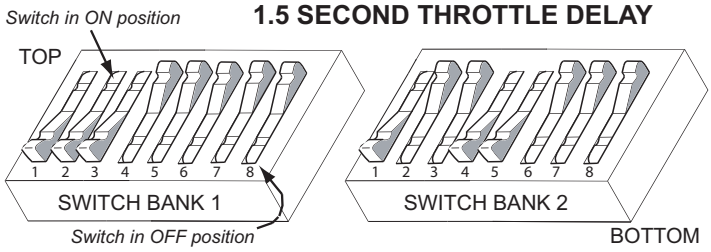
1.0 SECOND THROTTLE DELAY



0.5 SECOND THROTTLE DELAY



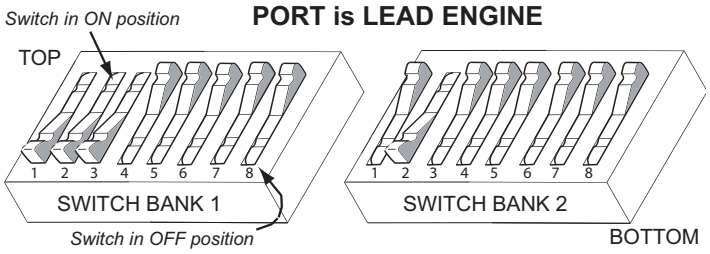
1.5 SECOND THROTTLE DELAY



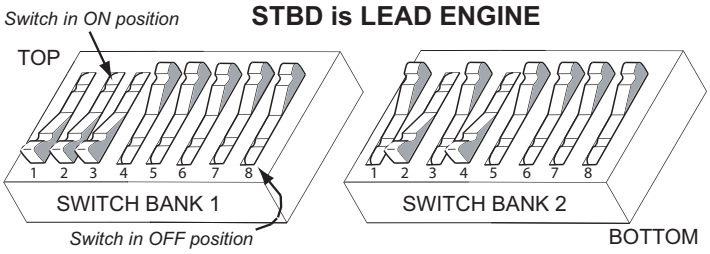
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change which engine is the LEAD engine for the SYNC Mode, set the Switch Bank DIP Switch settings for PORT or STBD.

PORT is LEAD ENGINE



STBD is LEAD ENGINE

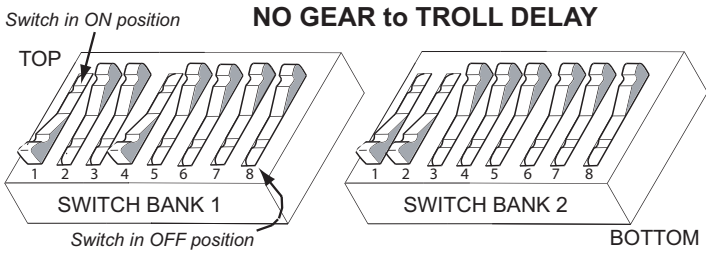


You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

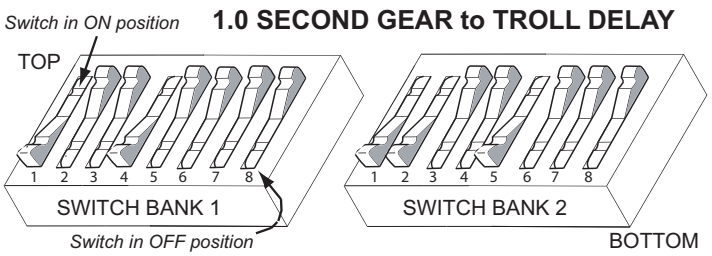
D) TROLL CUSTOM OPTIONS

To change the amount of time allowed (delay) when the system goes from gear shift to troll modulation, set the Switch Bank DIP Switch settings for the desired GEAR TO TROLL DELAY.

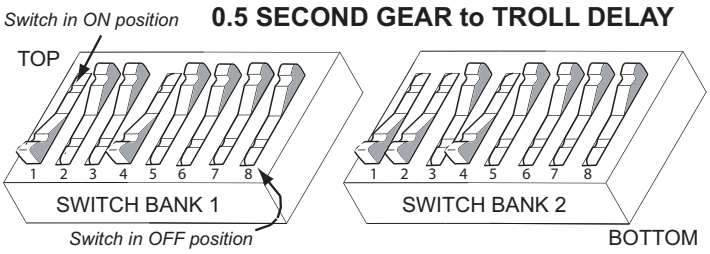
NO GEAR to TROLL DELAY



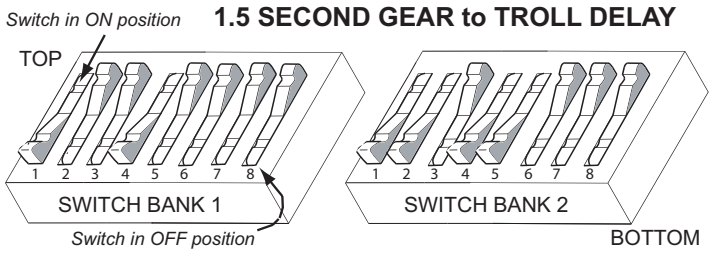
1.0 SECOND GEAR to TROLL DELAY



0.5 SECOND GEAR to TROLL DELAY



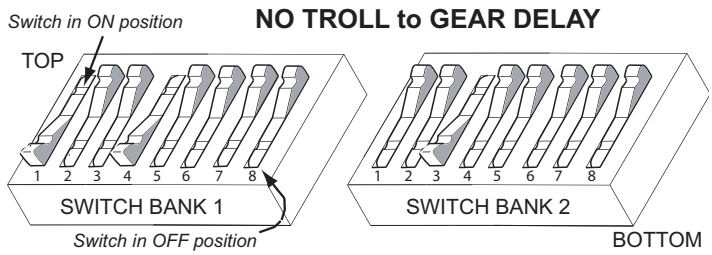
1.5 SECOND GEAR to TROLL DELAY



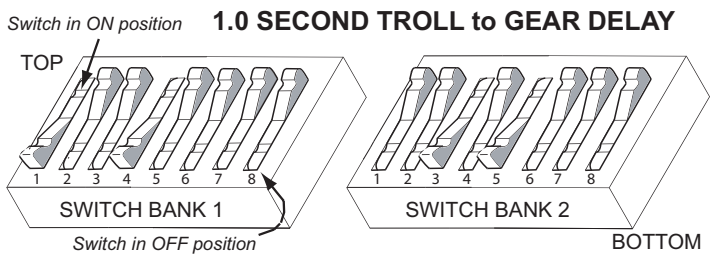
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change the amount of time allowed (delay) when the system goes from troll modulation to gear shift, set the Switch Bank DIP Switch settings for the desired TROLL TO GEAR DELAY.

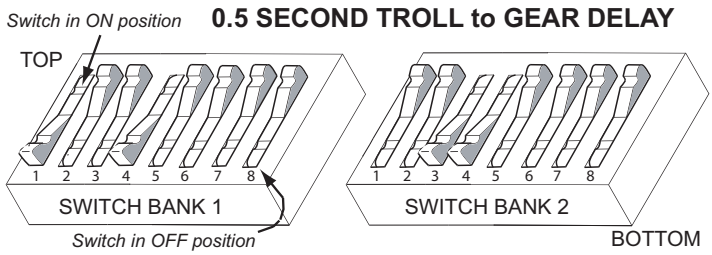
NO TROLL to GEAR DELAY



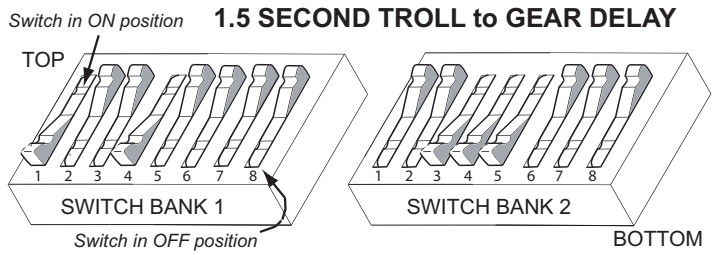
1.0 SECOND TROLL to GEAR DELAY



0.5 SECOND TROLL to GEAR DELAY



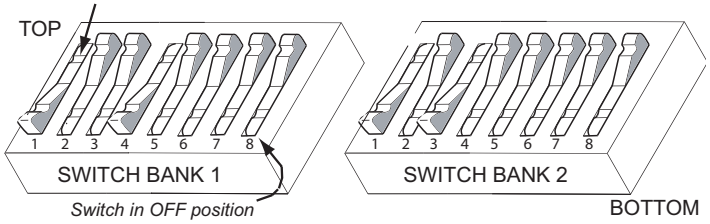
1.5 SECOND TROLL to GEAR DELAY



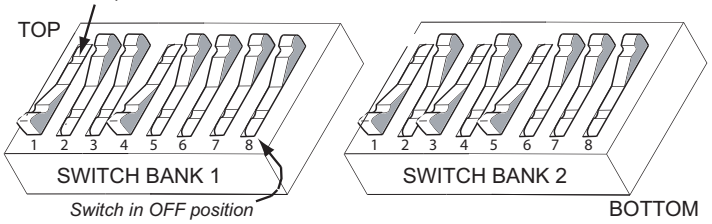
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change the amount of time allowed (delay) when the system goes from troll modulation to throttle output, set the Switch Bank DIP Switch settings for the desired TROLL TO THROTTLE DELAY.

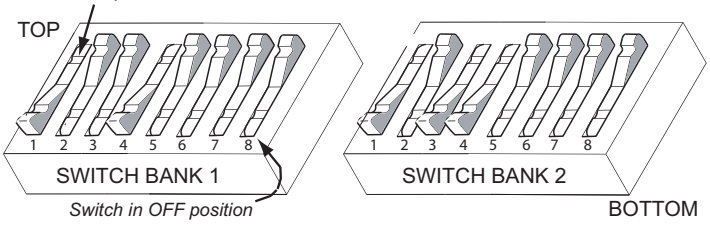
NO TROLL to THROTTLE DELAY



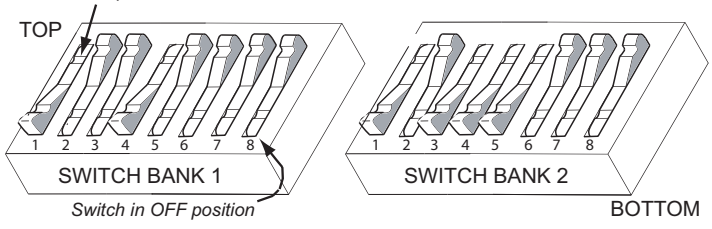
1.0 SECOND TROLL to THROTTLE DELAY



0.5 SECOND TROLL to THROTTLE DELAY



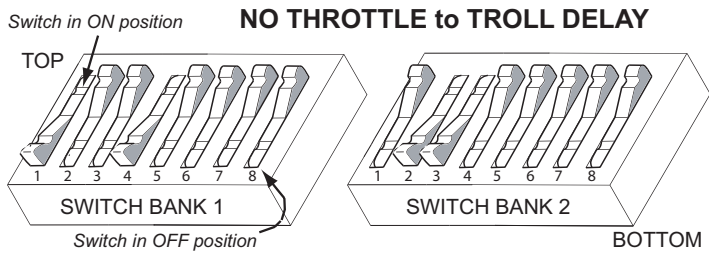
1.5 SECOND TROLL to THROTTLE DELAY



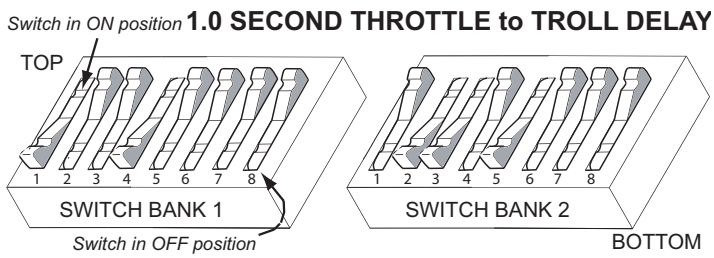
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change the amount of time allowed (delay) when the system goes from throttle output to troll modulation, set the Switch Bank DIP Switch settings for the desired THROTTLE TO TROLL DELAY.

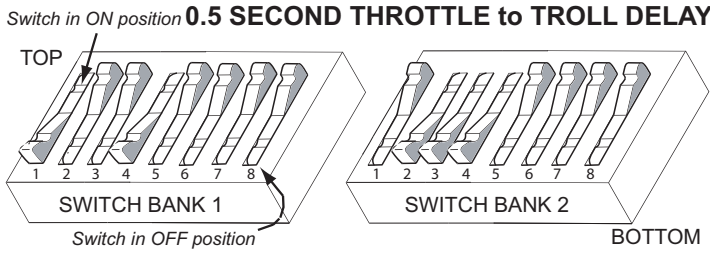
NO THROTTLE to TROLL DELAY



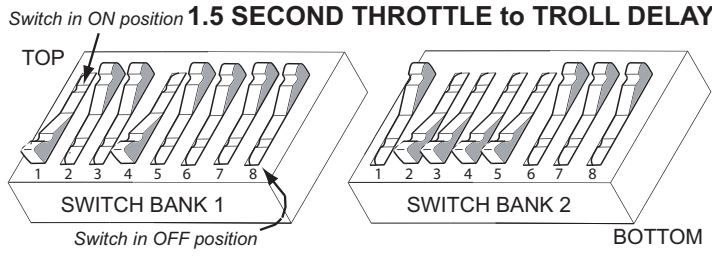
1.0 SECOND THROTTLE to TROLL DELAY



0.5 SECOND THROTTLE to TROLL DELAY



1.5 SECOND THROTTLE to TROLL DELAY

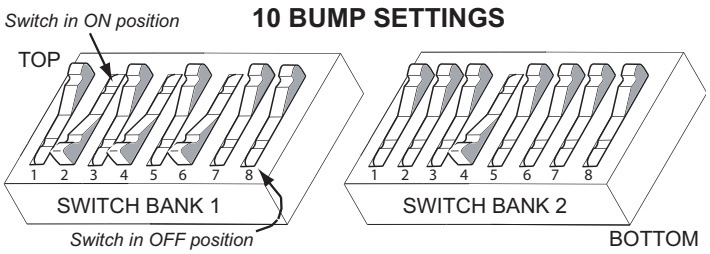


You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

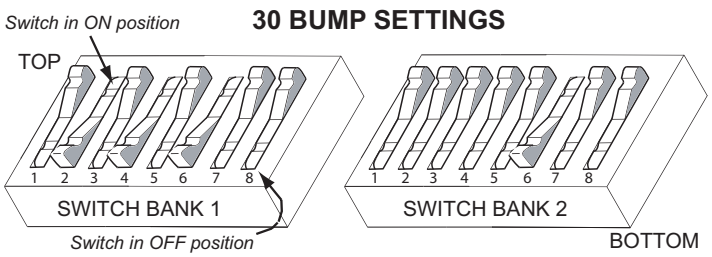
E) OTHER CUSTOM OPTIONS

To change the number of BUMP settings available to the system,
set the Switch Bank DIP Switch settings for the desired BUMP NUMBER SETTING.

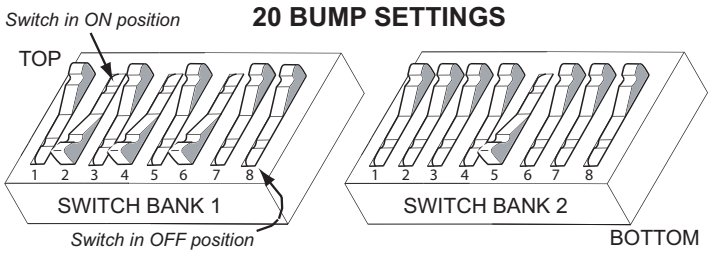
10 BUMP SETTINGS



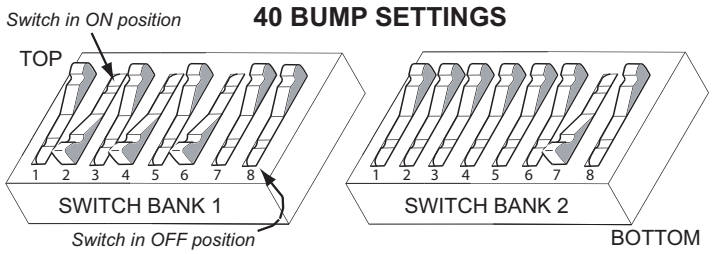
30 BUMP SETTINGS



20 BUMP SETTINGS



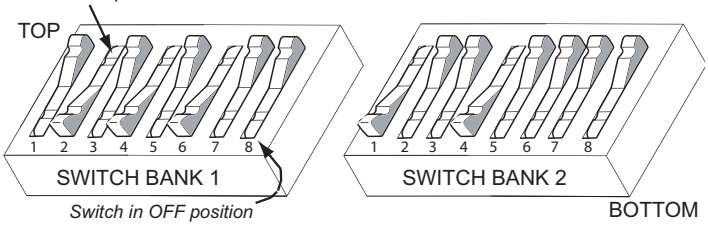
40 BUMP SETTINGS



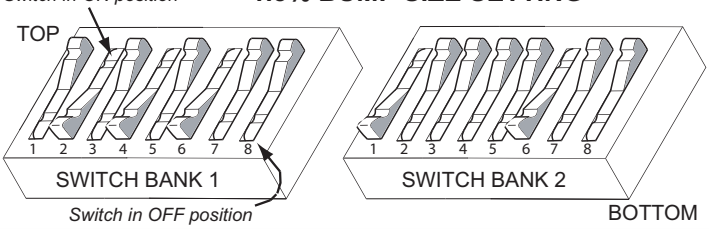
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change the size of each BUMP setting,
set the Switch Bank DIP Switch settings for the desired BUMP SIZE SETTING.

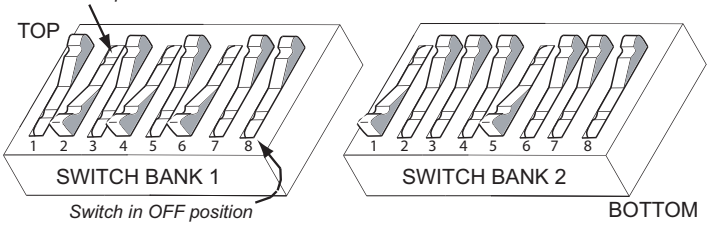
.5% BUMP SIZE SETTING



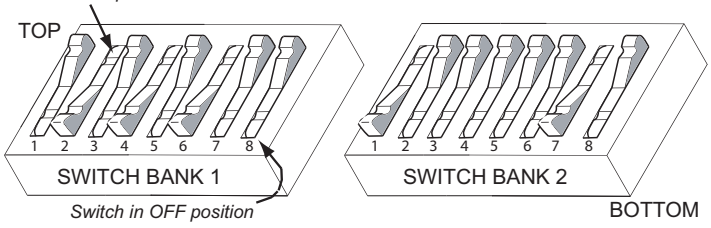
1.5% BUMP SIZE SETTING



1.0% BUMP SIZE SETTING



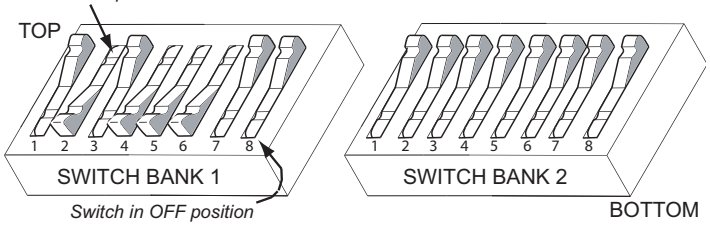
2.0% BUMP SIZE SETTING



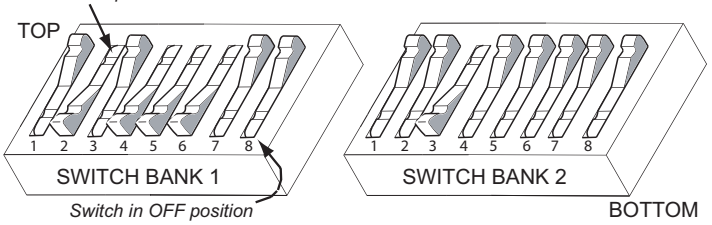
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To modify individual or all HI IDLE Steps,
set the Switch Bank DIP Switch settings for the desired MODIFY HI IDLE SETTING.

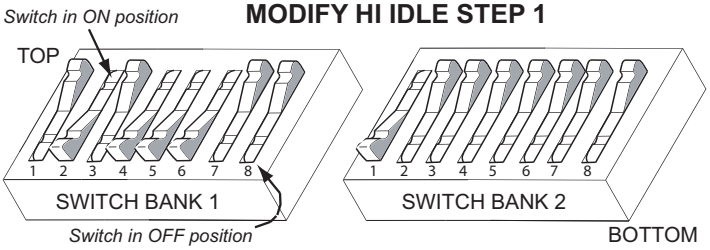
MODIFY ALL 7 HI IDLE STEPS



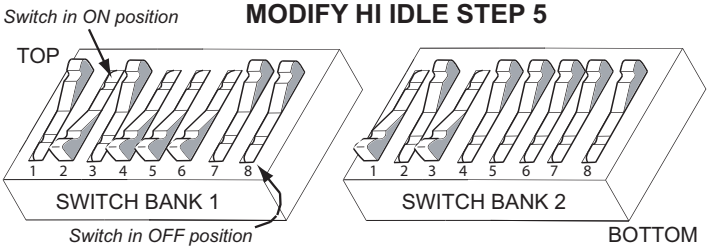
MODIFY HI IDLE STEP 4



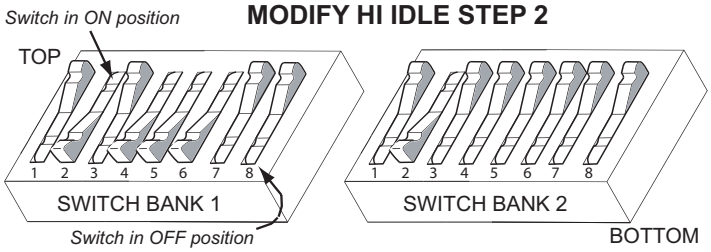
MODIFY HI IDLE STEP 1



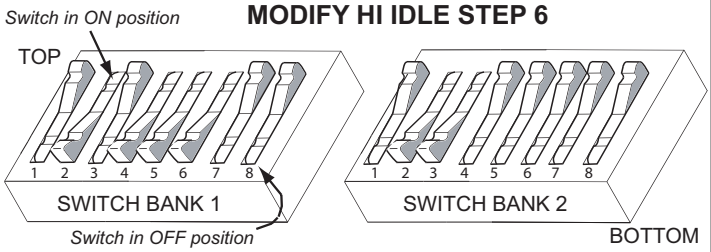
MODIFY HI IDLE STEP 5



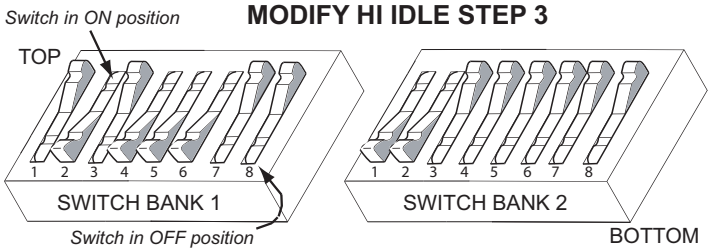
MODIFY HI IDLE STEP 2



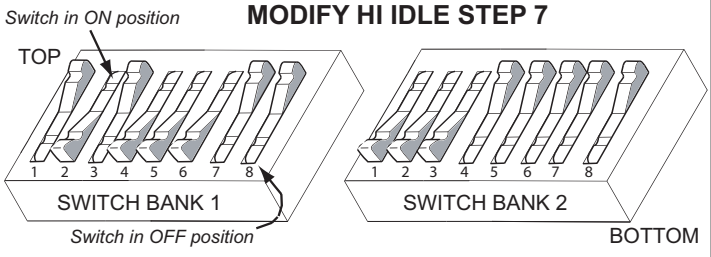
MODIFY HI IDLE STEP 6



MODIFY HI IDLE STEP 3



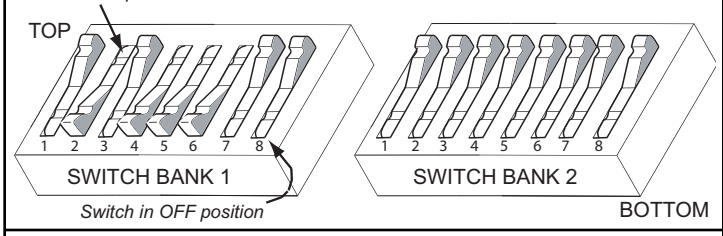
MODIFY HI IDLE STEP 7



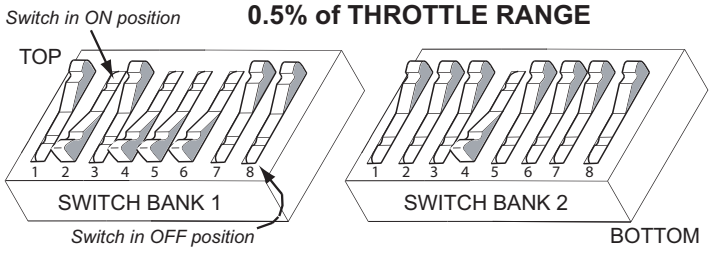
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To modify the size of each HI IDLE Step,
set the Switch Bank DIP Switch settings for the desired SIZE OF HI IDLE SETTING.

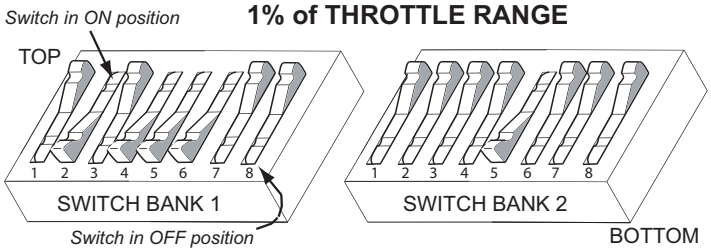
0% of THROTTLE RANGE



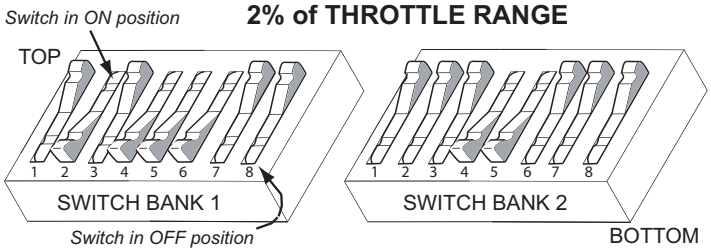
0.5% of THROTTLE RANGE



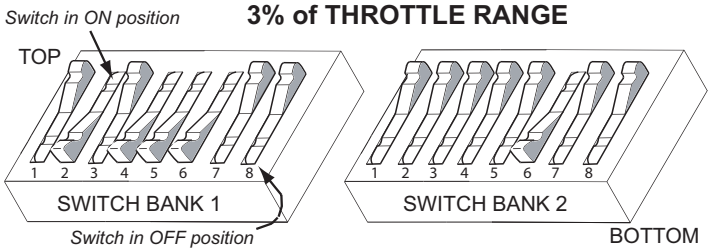
1% of THROTTLE RANGE



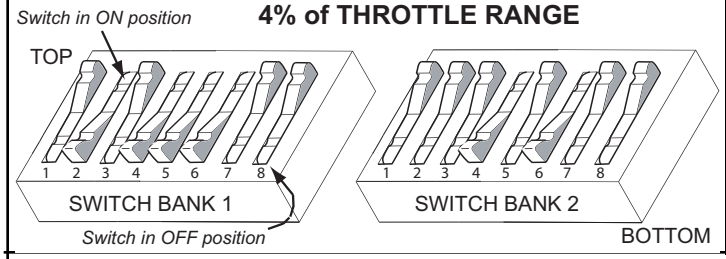
2% of THROTTLE RANGE



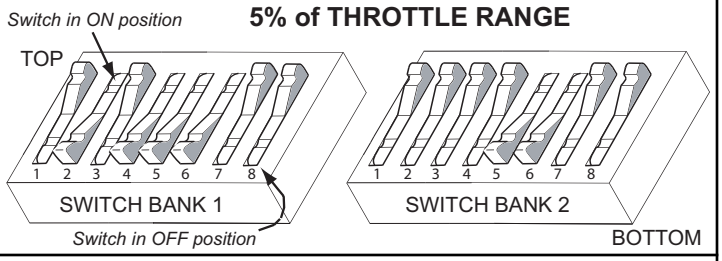
3% of THROTTLE RANGE



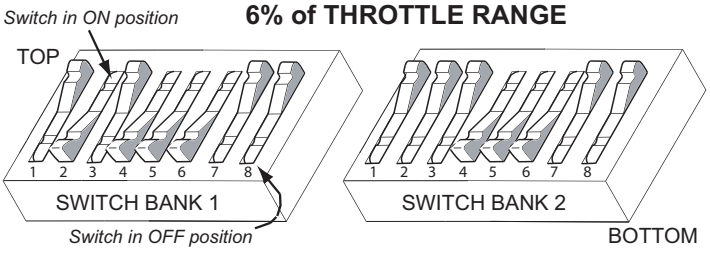
4% of THROTTLE RANGE



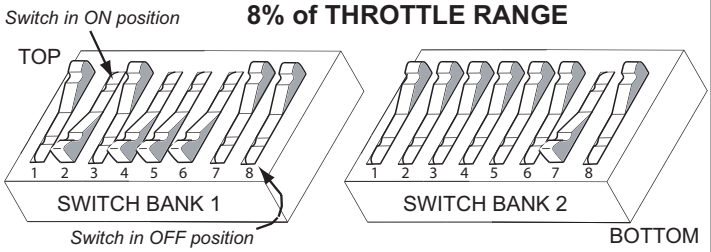
5% of THROTTLE RANGE



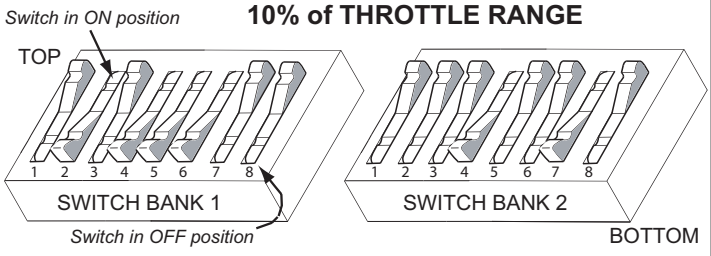
6% of THROTTLE RANGE



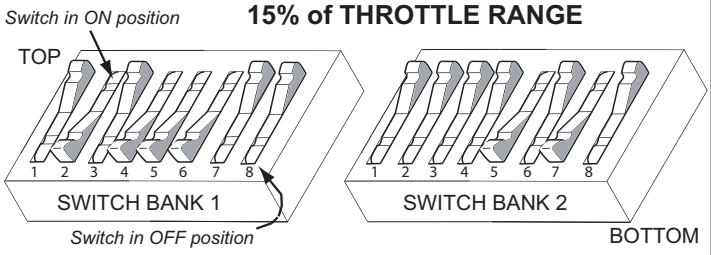
8% of THROTTLE RANGE



10% of THROTTLE RANGE



15% of THROTTLE RANGE



20% of THROTTLE RANGE

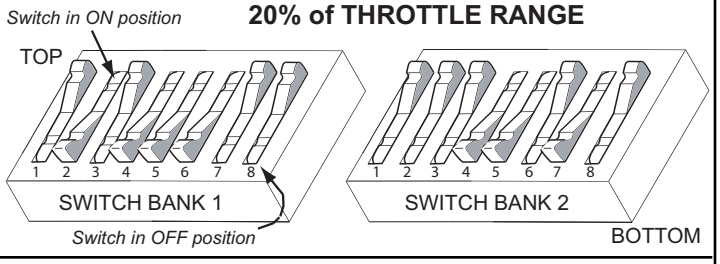
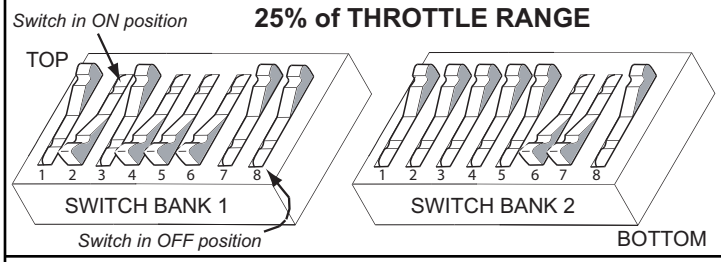


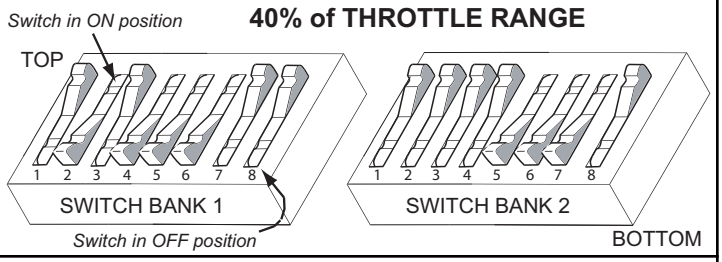
CHART CONTINUED ON NEXT PAGE . . .

To modify the size of each HI IDLE Step,
set the Switch Bank DIP Switch settings for the desired SIZE OF HI IDLE SETTING.

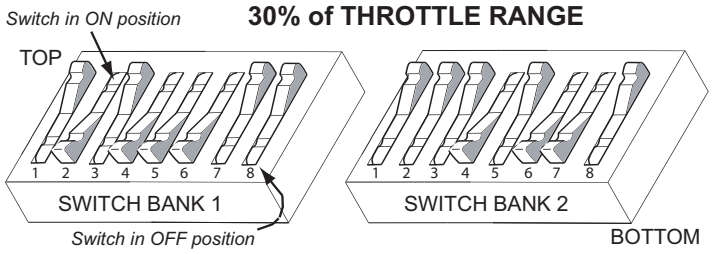
25% of THROTTLE RANGE



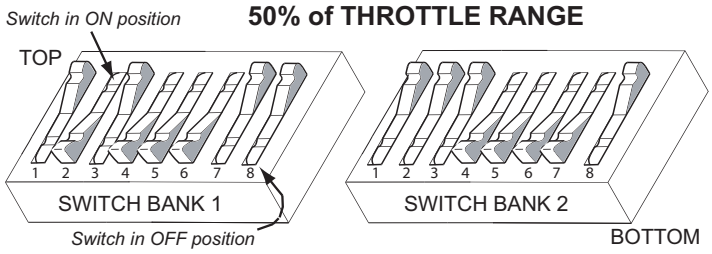
40% of THROTTLE RANGE



30% of THROTTLE RANGE



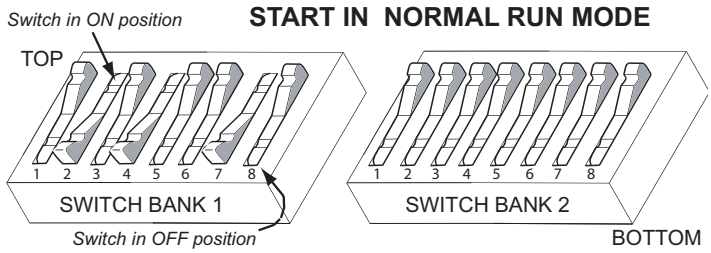
50% of THROTTLE RANGE



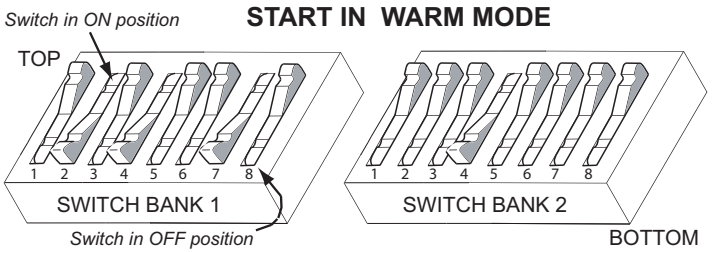
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

To change which operating mode the EEC system starts up in,
set the Switch Bank DIP Switch settings for NORMAL RUN Mode or WARM Mode.

START IN NORMAL RUN MODE



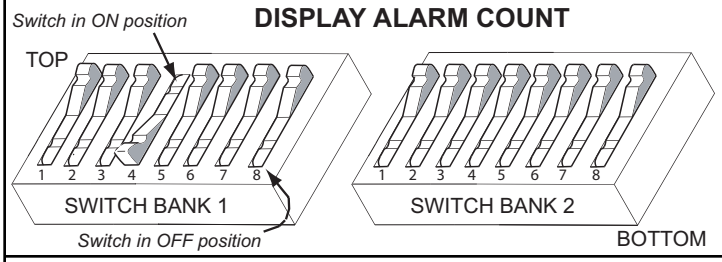
START IN WARM MODE



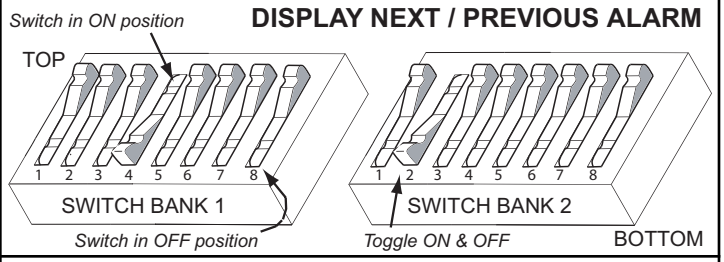
You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.

For display or delete Alarm Codes or Alarm Code Counts,
set the Switch Bank DIP Switch settings for the desired TROUBLESHOOTING OPTION.

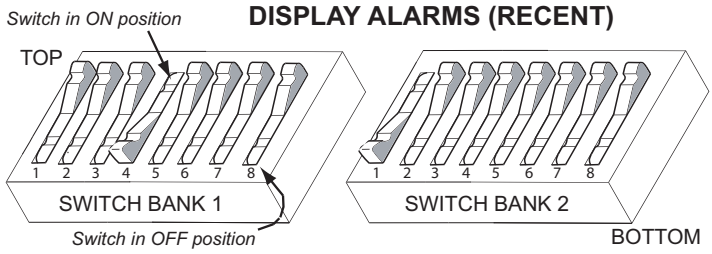
DISPLAY ALARM COUNT



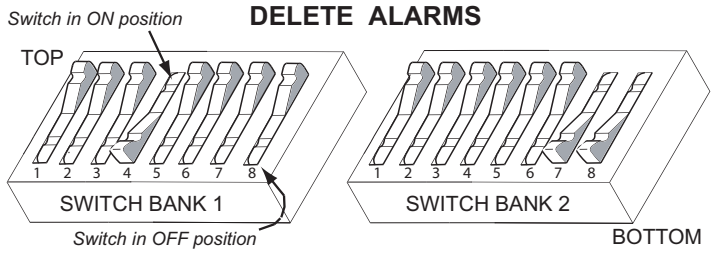
DISPLAY NEXT / PREVIOUS ALARM



DISPLAY ALARMS (RECENT)



DELETE ALARMS



NOTE: LEDs will scroll after ALL the alarms have been deleted.

You may continue to change other custom options or . . .
Replace the Engine Processor DIP Switch Access Plate and TEST SYSTEM.