

CruiseCommand 785CE Operator Manual

SW13867.0

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Revisions List

Rev	Date	Revision Description
-	4/01	Initial Release
A	5/10/01	Updated for initial production software release.
B	7/01	a) Main part of manual updated to reflect current terminology and production software release. b) Appendix A Parts List updated. c) Appendix A S-218 Set-up & Functions revised to A to reflect current terminology and production software release.
C	11/01	Revised Current Manual to ZF Mathers current Standards. Appendix A - SER-165 Contact List replaced with current revision.

1.0 INTRODUCTION

1.1 THIS MANUAL

The purpose of the CruiseCommand Operator Manual is:

- Operation (Section 2.0)
- ZF Mathers Sheets (Appendix A.1)
- General Troubleshooting Reference (Appendix B.1)

Keep this Manual on the vessel for future reference.

Throughout the manual special attention should be paid to the following boxes:

NOTE: Contains Helpful Information

CAUTION: Damage to equipment may occur if this message is disregarded.

WARNING: Personal Injury may result if this message is disregarded.

Appendix A.1 contains Sheets created by ZF Mathers regarding Parts and Warranty.

Appendix B.1 contains brief explanations on Trouble Shooting.

If you cannot find a solution within the Trouble Shooting, an in-depth Installation and Trouble Shooting Manual [MM14330] is available. Contact one of the companies listed on the ZF Mathers Contact list at the end of the Trouble Shooting Section.

The following Operator Manual is written with all options considered. Not all options are used on all Systems. Read ONLY the Sections that relate to the application used on this vessel.

1.2 CRUISECOMMAND SYSTEM

The CruiseCommand System is designed for:

- Engines that require either voltage, current (mA), or PWM speed command signal
- Transmissions equipped with solenoid clutch or solenoid clutch/troll

1.2.1 Features

- Sequencing of Clutch and Engine Speed
- Start Interlock
- Station-in-Command Indication
- Warm-up Mode
- High/Low Idle
- Engine Synchronization (Multi Screw)
- One Lever Operation (Multi Screw)
- Audible and Visual Indicators
- Electric Trolling Valve Control
- Key-Pad Set-up
- Plug-in Cable Connections
- Emergency Reversal Protection
- CruiseCommand Failure Alarm Contact (optional)
- Clutch Oil Pressure Interlock (optional)
- Built-in Diagnostics
- One to Four Remote Stations

2.0 OPERATION

2.1 DC POWER ON

When CruiseCommand control system DC power is turned ON:

- Processor will command Neutral/Idle.
- Intermittent tone will sound at all Stations indicating that no Station has command. (refer to Section 2.8)

2.2 TAKE COMMAND

To take command at a Station:

- Control Head lever(s) must be in the Neutral detent.
- Operator must depress the transfer button for 1/2 second.

The tone will stop at all Stations and the red LED indicator light on the Control Head will light, indicating the Station is in Command.

NOTE: Only one Station has command at a time.

2.3 BASIC OPERATION

The Control Head has three detents; Astern, Neutral, and Ahead. (Refer to Figure 1:) With the Control Head lever(s) positioned in the Neutral (vertical) detent, the System will command Neutral and Idle RPM. Control Head lever movement of 15 degrees to the Ahead or Astern detent will command Ahead or Astern clutch engagement while the engine remains at Idle RPM. Further movement of the Control Head lever will increase the engine RPM in proportion to the Control Head lever position.

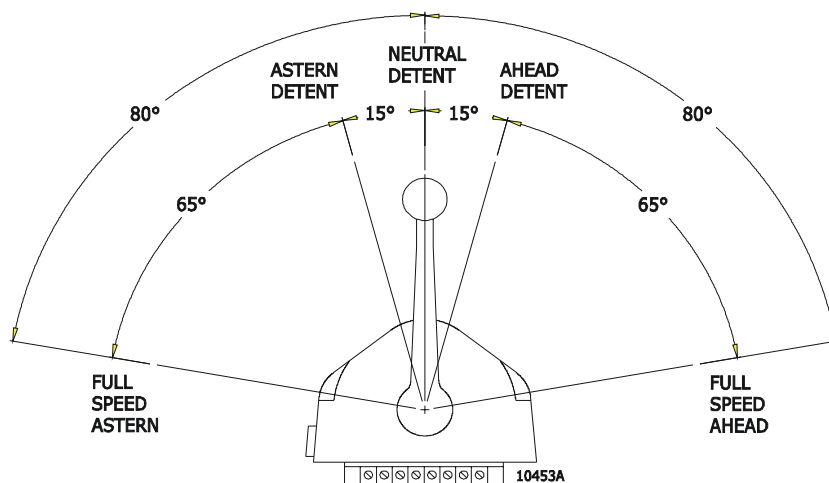


Figure 1: Control Head Detents

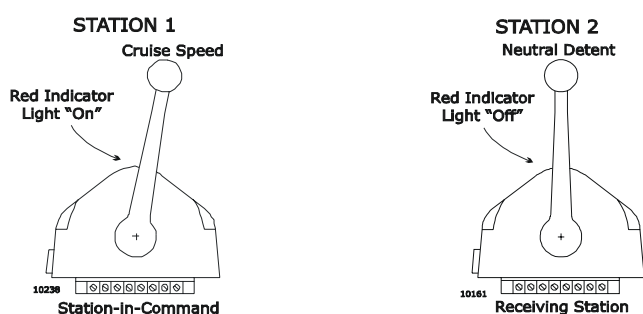
2.4 ENGINE START INTERLOCK

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

- DC power has been turned ON to the Control System.
- A Station has command.
- The Control System is commanding Neutral.

2.5 STATION TRANSFER

When transferring command from one Station to another:



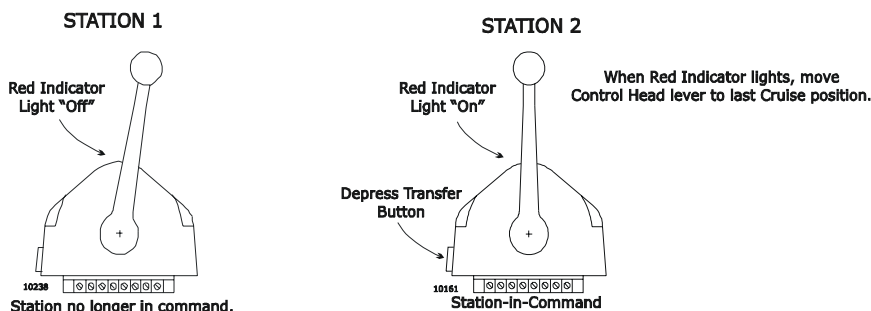
A) Leave the Control Head lever(s) of the Station-in-Command in any position.

B) Place the Control Head lever(s) of the receiving Station in the Neutral detent position. (refer to Figure 2:)

Figure 2: Remote Stations before Transfer of Command

C) At the Station taking command depress and hold the transfer button for 1/2 second. (Refer to Figure 3:)

- The red LED indicator will light at the receiving Station's Control Head, indicating the Station has taken command.



- The red LED indicator light will go Off at the transferring Station's Control Head, indicating the Station no longer has command.

Figure 3: Remote Station Transfer after Transfer of Command

D) The commanded positions of the Throttle and Clutch will remain unchanged for one second after the red indicator lights. This allows the operator time to move the Control Head lever(s) to a position approximately matching the last Station's, which will allow the vessel to maintain the current speed and direction.

2.6 WARM-UP MODE

This feature allows the operator to increase the engine's RPM while the Clutch remains in Neutral. Warm-up Mode is operational only in Ahead. The system is placed into Warm-up Mode as follows:

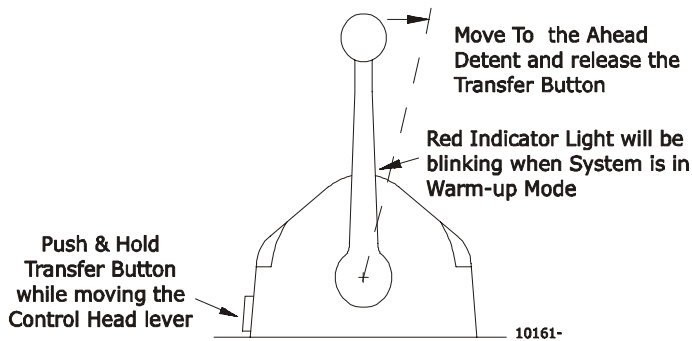


Figure 4: Control Head Warm-up Mode

A) At the Station-in-Command, ensure that the Control Head lever is in the Neutral detent position (refer to Figure 4):

B) Depress and hold the transfer button.

C) After one second move the Control Head lever to the Ahead detent position.

D) Now release the transfer button.

- The red indicator light will blink slowly indicating Warm-up Mode and the clutch has stayed in Neutral.

E) The operator can now start and warm-up the engine while moving the Control Head lever through the Ahead throttle ranges.

F) When the Control Head lever is returned to the Neutral detent, the red LED will discontinue blinking and the CruiseCommand will automatically reset to Normal Operating Mode after one second.

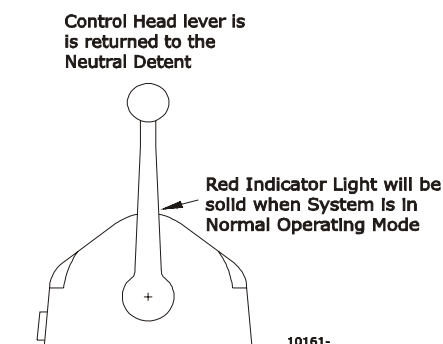


Figure 5: Control Head Normal Operating Mode

G) The next Control Head lever movement will shift the transmission.

2.7 HIGH / LOW IDLE MODES

The CruiseCommand Control System offers two options of engine IDLE RPM settings.

- Low Idle Mode (default setting)
- High Idle Mode. (an adjustable elevated Idle RPM)

2.7.1 Low Idle

Low Idle is the normal engine Idle RPM.

When the System is initially powered up, it will always command Low Idle.

2.7.2 High Idle

A **High Idle** RPM may be programmed during Set-up. The High Idle maximum setting is 20% of full throttle.

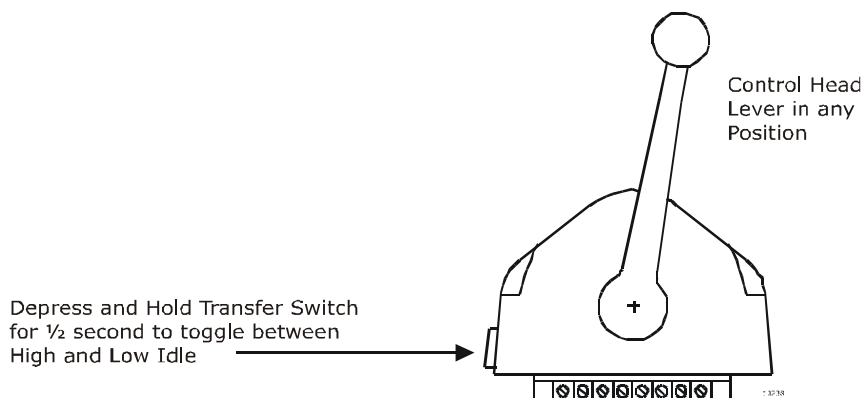


Figure 6: High/Low Idle Mode Selections

2.7.3 Selecting Between High / Low Idle

To select between Low and High Idle (or vice versa) at the Station-in-Command: (refer to Figure 6:)

- The Control Head levers may be in any position.
- Depress and hold the transfer button for 1/2 second and then release.
 - If the System was in Low Idle it will toggle to High Idle and vice versa.
- To return to the previous Idle setting, depress and hold the transfer button again for 1/2 second and then release.

2.8 SYNCHRONIZATION (MULTI SCREW)

The CruiseCommand System utilizes dual lever synchronization. Dual lever synchronization provides the security of both of the Control Head levers always being active.

Synchronization is automatic and only operates in Ahead; consequently it can be left ON full time. Cruise-Command will always power-up with synchronization Enabled.

In order for synchronization to become active and work toward synchronizing the engine's RPM's, the Control Head levers must be in the **synchronization range**.

Synchronization Range is:

- Both Control Head levers are in an Ahead position
- Greater than 5% percent of the throttle range is commanded
- Commanded throttles must be within 10% of one another.

The Processor's throttle signals are compared and then matched. The Processors then send the same signal to all engines. The engines are now synchronized.

A green LED indicator light located on the Control Head of the Station-in-Command indicates engine synchronization:

- When the green LED is NOT LIT, no synchronization.
- When the green LED is LIT, synchronization.

Synchronization can be turned OFF and ON:

To turn synchronization OFF:

1. Place the Control Head levers in the **synchronization range**.
2. Push the Transfer Button until the green LED blinks and goes out (approximately 2 seconds). Synchronization is now OFF.

To turn synchronization ON:

1. Place the Control Head levers in the **synchronization range**.
2. Push the Transfer Button until the green LED lights (approximately 2 seconds)
 - The green LED light will blink as the system is working to synchronize.
 - The green LED will become solid green when the engines are synchronized.

2.9 ONE LEVER OPERATION MODE (MULTI SCREW)

This System utilizes One Lever Operation Mode to allow one Control Head lever (Master) to command all engines and gears. The "Master" lever can be any lever. The advantage of this is that only one Control Head lever operates all engines and gears. Normal control sequencing and timing applies to all engines.

NOTE: The green LED will always be lit while in One Lever Operation, no matter what position the Master Control Head lever is in.

NOTE: The Control Head lever(s) that are in-active can now be placed out of the way in any position forward of the Ahead detent.

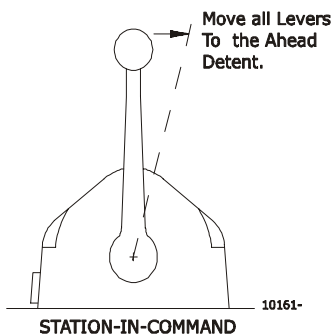


Figure 7: Step A One Lever Operation Mode

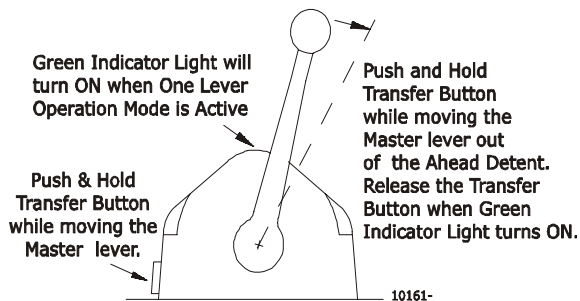


Figure 8: Step B One Lever Operation Mode

One Lever Operation Mode must be enabled.

To turn ON One Lever Operation:

- A) At the Station-in-Command, move all of the Control Head levers to the Ahead Detent
- B) Push and Hold the transfer button while moving the Master Control Head lever out of the Ahead detent. **DO NOT RELEASE TRANSFER BUTTON** until the green light turns On, indicating One Lever Operation Mode is now Active.

To turn OFF One Lever Operation:

- A) Place the Master Control Head lever into the Neutral Detent.
- B) Place the in-active Control Head lever(s) into the Neutral Detent.
- C) The green LED will turn Off, indicating control system is now in Normal Operating Mode.

CAUTION: It is strongly recommended that the Master Lever is returned to the Neutral/Idle position prior to disabling One Lever Operation. Failure to do so may result in a sudden change in vessel direction.

NOTE: One Lever Operation may be used in Troll Mode or in Non-Troll Mode.

2.10 TROLLING VALVE CONTROL (OPTIONAL)

The CruiseCommand System is able to control electric Trolling Valves that utilize single or dual solenoids.

The Troll Mode option is selected during Set-up.

2.10.1 Trolling Valve Command Operating Modes

This system has two Modes of Operation when a Troll Valve Type of command has been set up: **Troll** and **Non-Troll**. When the control system is initially powered up, the default Mode Of Operation is the Non-Troll Mode.

2.10.2 Operation in Non-Troll Mode

During Non-Troll Mode the Trolling Valve will remain locked up or at maximum oil pressure position and System will work in Normal Operating Mode.

2.10.3 Operation in Troll Mode

Troll Mode is a feature that must be turned On and Off at the Control Head.

- A) Place the Control Head lever in the Neutral, Ahead, or Astern Detent.
- B) Depress and hold the transfer button for two seconds.
 - The solid red indicator light on the Control Head will begin blinking rapidly, indicating the system is now in Troll Mode.

NOTE: If system is set for multiple screw operation, ensure all Control Head levers are in the Neutral/Idle (vertical) or Ahead detent.

- C) Once the system has been placed in Troll Mode and in the Ahead or Astern detent, the propeller will begin to rotate at approximately 30% of Idle lock-up RPM.
 - The throttle remains at Idle;
 - The transmission commands Ahead or Astern;
 - Control Head red LED flashing.

D) Continued Control Head lever movement through the Troll Range:

- Will increase the propeller RPM from 30 percent shaft RPM to approximately 70 percent shaft RPM;
- The throttle remains at Idle or can be adjusted to increase up to 20% of maximum throttle within this Troll Range.
- The Control Head red LED will become a steady light when the Control Head lever reaches the end of the Troll Range.

E) The remaining movement of the Control Head lever beyond the Troll Range:

- Clutch locks up.
- Will increase engine speed up to maximum throttle.

2.10.4 To turn Troll Mode On:

A) Place the Station-in-Command Control Head lever in the Neutral, Ahead, or Astern detent.

B) Depress and hold the Transfer Button until the red indicator light on the Control Head changes (approximately 2 seconds) then release the button:

- When the red indicator light is blinking rapidly, the control system has turned Troll Mode ON. The clutch is slipping.

2.10.5 To turn Troll Mode Off:

A) Place the Station-in-Command Control Head lever in the Neutral, Ahead, or Astern detent.

B) Depress and hold the Transfer Button until the red indicator light on the Control Head changes (approximately 2 seconds) then release the button:

- When the red indicator light is a steady red, the control system has Troll Mode OFF. The clutch is locked-up.

2.10.6 Types of Trolling Valve Command

- 00 = **No Trolling Valve** (Refer to Section 2.10.2 for operation)
- 01 = **Type 1 Trolling Valve Command** (20 degrees Troll Range) (Refer to Section 2.10.3 for operation)

OPERATION

- 02 = **Type 2** Trolling Valve Command (35 degrees Troll Range) (Refer to Section 2.10.3 for operation)
- 03 = **Type 3** Trolling Valve Command (45 degrees Troll Range) (Refer to Section 2.10.3 for operation)

NOTE: When Troll Type 3 is being used, maximum throttle is limited to 75%.

To turn Troll Mode **ON** (Troll Mode)/**OFF** (Non-Troll Mode) is the same for all Troll Types.

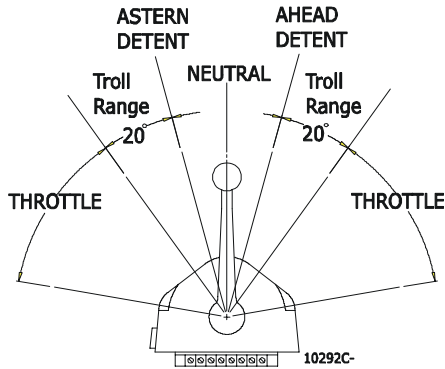


Figure 9: Control Head 20 Degree Troll Range - Type 1

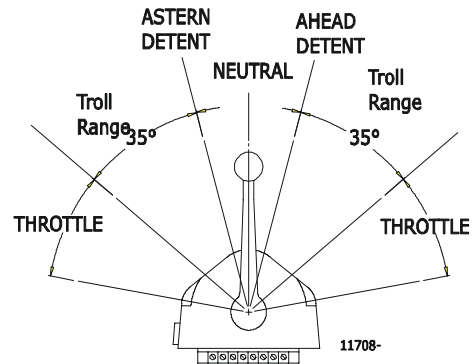


Figure 10: Control Head 35 Degree Troll Range - Type 2

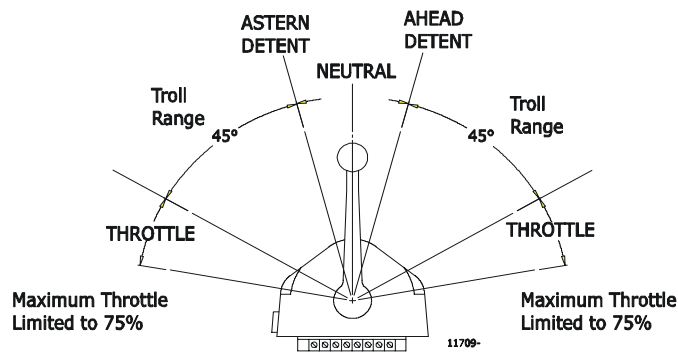


Figure 11: Control Head 45 Degree Troll Range - Type 3

APPENDIX A.1

PARTS LIST

PART NO.

DESCRIPTION

CONTROL HEADS

The following Control Heads are with Terminal connections. To order pluggable connections add a P onto the Part Number.
Example: 450-3LP or 460-4P

SINGLE SCREW

450-3L or 3R	Left or Right Control Head, 'T' Lever
453-3L or 3R	Left or Right Control Head, Chrome Knob Lever
455-3L or 3R	Left or Right Control Head, Black Low Profile Lever
456-3L or 3R	Left or Right Control Head, Chrome Low Profile Lever
750-L or -R	Left or Right Control Head, Heavy Duty
MC2000-1L or 1R	Left or Right Black Control Head, Black Lever
MC2000-2L or 2R	Left or Right Chrome Control Head, Chrome Lever
MC2000-4L or 4R	Left or Right Black Control Head, Chrome Lever
MC2000-5L or 5R	Left or Right Black Control Head, Gold Lever

TWIN SCREW (Synchronization Indication)

460-4	Control Head, 'T' Lever
463-4	Control Head, Chrome Knob Lever
464-4	Control Heads, Split, with Single Levers, Chrome Knobs (pair)
465-4	Control Head, Black Low Profile Lever
466-4	Control Head, Chrome Low Profile Lever
760	Control Head, Heavy Duty
MC2000-1	Black Head, Black Levers
MC2000-2	Chrome Head, Chrome Levers
MC2000-3	Gold Head, Gold Levers
MC2000-4	Black Head, Chrome Levers
MC2000-5	Black Head, Gold Levers

WIRE HARNESS (Plug)

Replace the # after the Part Number with the length of harness required. EXAMPLE: 13316-10;
13316-20; 13316-30

13432-#	Throttle, Voltage
13565-#	Throttle, Voltage (Cummins Plug)
14148-#	Throttle, Voltage (John Deere Plug)
13494-#	Throttle, Current
13533-#	Throttle, PWM
13322-#	Clutch – Ahead/Astern/Clutch Power
13324-#	Clutch – Ahead/Astern/Neutral/Clutch Power
13240-#	Clutch – Ahead/Astern/Troll ON-OFF/Troll Command/Clutch Power
14310-#	Clutch – Ahead/Astern/Troll Command/Clutch Power
13631-#	Power/Start Interlock/Clutch Pressure/Alarm Circuit
13552-#	Power/Start Interlock/Clutch Pressure
13756-#	Power/Start Interlock
13557-#	Control Head (Connector on One End)
14261-#	Control Head (Connector on Both Ends)
13316-#	Serial Communication (Twin Screw)
13408-#	Serial Communication (Multiple Screw)
13239-#	Magnetic Pickup or Pulse Transmitter

TEST UNIT

13927	Service Field Test Unit
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Set-up & Functions

CAUTION: Set-up Parameters are preset by the Builder for your specific vessel. ZF Mathers recommends adjustments be performed by or in consultation with a ZF Qualified Service Representative.

1. **Up and Down Arrow** - Depress Either Once.
 - Stops Display Normal Operating running center red dash lines and activates Function Menu.
 - When in the Function Menu, scrolls the Function Type one at a time.
 - When in Set-up, scrolls one Value's number one at a time.
 - When Error Code is displayed, scrolls through the error messages one at a time.

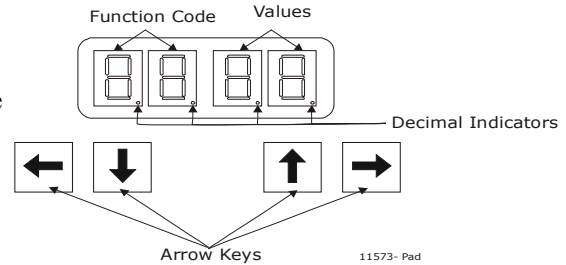


Figure 1: Display and Arrow Keys

2. **Left and Right Arrow** - Depress and Hold simultaneously.
 - Activates Set-up Mode. When Display Function Code begins to blink the Push Buttons may be released.
 - Saves Value and deactivates Set-up Mode. When the Display Function Code stops blinking the Push Buttons may be released. The system is now out of Set-up Mode and in the Function Menu.
3. **Left Arrow** - Depress Once.
 - Escapes from Set-up Mode without any change being stored. The Function Code will quit blinking and the previously saved values will be restored.
 - When in Function Menu, shows Error Codes, if any are presently stored.
4. **Right Arrow** - Depress and Hold.
 - Clears the Error Code from the Display, if the error had been resolved already. Must release and then depress again to clear multiple errors.
 - When in Set-up Mode, shows the values that have more than two digits. As long as the right arrow is depressed the complete value will be shown.

Activating Set-up Mode

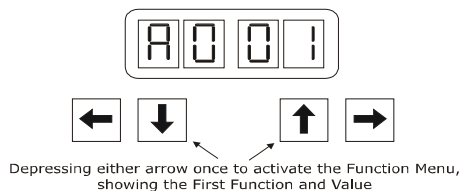


Figure 2: Display Function Menu Activated

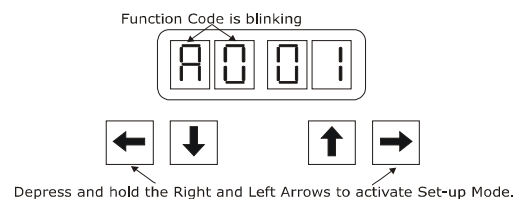


Figure 3: Display with Set-up Mode Activated

- A) **Depress once** either the **Up or Down Arrow** to **activate** the Function Menu. (refer to Figure 2:)
- B) **Depress** either the **Up or Down Arrow** to **scroll** through the Function Menu list, one Function at a time.
- C) When the Function Code that is to be adjusted is visible on the Display, **depress and hold** the **Left and Right Arrow** at the same time to **activate Set-up**.
 - The two Display Function Pads will begin to blink indicating that the value is ready to be changed. Refer to Figure 3:
- D) **Depress** either the **Up or Down Arrow** to **change the Value of the Function**.
 - Holding down either the Up or Down arrows will scroll quickly through the values.
- E) When the value required is shown, **depress and hold** the **Left and Right Arrow** at the same time until the **Display Function pads quit flashing**.
- F) **Depress** either the **Up or Down Arrow** to change to a **new Function Code**.

Table 1: Functions List

Function Code	Function Name	Default Value	Value Range or Options
PROCESSOR FUNCTIONS			
A0	Processor Identification	01	01 or 02 (Each Processor must have a unique ID number)
A1	Number of Engines	01	01 or 02
A2	One Lever Operation	00	00 - Disable; 01 - Enable
ENGINE FUNCTIONS *Throttle defaults are based on throttle profile selected.			
E0	Select Engine Throttle Profile	06	01 Caterpillar (PWM) (8 to 92%)
			02 Cummins Centry (Voltage) (0.9 to 4.5VDC)
			03 Cummins Quantum (Voltage) (0.9 to 1.2- 4.1VDC)
			04 Detroit Diesel (Voltage) (0.5 to 4.5VDC)
			05 MTU or MAN (Current) (4.0 to 20mA)
			06 Scania (Voltage) (0.4 to 3.0VDC)
			07 Volvo (Voltage) (0.5 to 4.5VDC)
E1	Throttle in Neutral (Only available with Type 03 - Throttle Profile)	*	01.0 to 25.0%
E2	Throttle Minimum	*	01.0 to 97.0%. Will always be 3% below Maximum.
E3	Throttle Maximum	*	04.0 to 100.0%. Will always be 3% above Minimum.
E4	Throttle Maximum Astern	100.0	1.0 to 100.0%
E5	Throttle Pause Following Shift	00.5	00.0 to 05.0 Seconds.
E6	High Idle	00.0	00.0 to 20.0% of Throttle Maximum
E7	Active Synchronization	00	00 - Disabled; 01 - Enabled
CLUTCH FUNCTIONS			
C0	Clutch Oil Interlock	00	00 - Not-Installed; 01 - Installed
C1	Clutch Oil Interlock Delay	05.0	00.5 to 10.0 Seconds.
C2	Reversal Pause	00	00 -In-Gear; 01 - Neutral
C3	Reversal Pause Time	03.0	00.0 to 16.0 Seconds.
C4	Reversal Pause Ratio	00	00 - 2:1 Ahd to Ast : Ast to Ahd 01 - 1:1 Ahd to Ast : Ast to Ahd
TROLL FUNCTIONS			
L0	Troll Lever Range	00	00 - No Troll 01 - 20 Degrees - Type 1 02 - 35 Degrees - Type 2 03 - 45 Degrees - Type 3
L1	Troll Valve Function	00	00 - Normal, No Current when Off 01 - Inverse, No Current when Off 02 - Inverse, Maximum Current when Off
L2	Troll Minimum Pressure	14.0	01.0- 99.0%. Will always be less/more (normal/inverted) than Troll Maximum by at least 1%.
L3	Troll Maximum Pressure	27.0	02.0- 100.0%. Will always be more/less (inverted/normal) than Troll Minimum by at least 1%.
L4	Troll Throttle Limit	00	00 - 20% of Maximum Throttle
L5	Troll Pulse Duration	00.6	00.0- 09.9 Seconds. Time that the Troll will be commanded to Troll Pulse Percentage every time Troll is engaged.
L6	Troll Pulse Percentage	27.0	00.0- 100.0%. Percentage of Troll command provided during Troll Pulse Duration.
TROUBLESHOOTING FUNCTIONS			
H0	Diagnostic	00	Input Voltage (+/- 0.5VDC)
			Tachometer Sensor Frequency
			Station 1 Lever A/D
			Station 2 Lever A/D
			Station 3 Lever A/D
			Station 4 Lever A/D
			Transfer Button, Stations 1, 2, 3 & 4
Software Revision Level			
H1	Erase EPROM	00	Store to Erase (For Authorized Personnel Only)
H2	High Side Driver Fault Detection Enable	00 - 63	Error Status Enable

A) PROCESSOR FUNCTIONS

A0 - Processor Identification

In applications where there is more than one screw, the system must have some way of determining which Processor is where. Every Processor must have its own identifying unique number. At no time can two Processors be identified by the same Processor Identification Number.

A1 - Number of Engines

The total number of screws must be entered into the memory of each of the Processors. This sets up the expectations of the serial communication between the various Processors. All Processors in an installation must have the same value entered.

A2 - One Lever Operation

This System utilizes One Lever Operation Mode to allow one Control Head lever to command all engines and gears at the same speed and direction. The advantage of this is that only one Control Head lever is active at all times, which eliminates the possibility of shifting when the engine RPM's are not at Idle.

B) ENGINE FUNCTIONS

NOTE: Throttle defaults are based on throttle profile selected.
--

E0 - Select Engine Throttle Profile

Various engine manufacturers use different electronic interfaces for commanding the engine's speed. In order to meet the diversity of these different engines, the engine type must be entered. This value, in combination with the Throttle Harness type, configures the throttle output profile to meet the specifications of these various engines.

E1 - Throttle in Neutral

NOTE: This Function is used ONLY when the E0 Select Engine Throttle Profile is set for 03 - Cummins Quantum.

The **Cummins- Quantum Engine** requires different throttle command signals in Neutral than In-Gear. These engines require a voltage throttle signal of 0.9 VDC when unloaded at Neutral. When a load is placed upon the engine by engaging the clutch, the throttle command signal increases to 1.2 VDC.

The Throttle in Neutral Function allows the installer the ability to adjust the throttle signal level at Neutral/Idle and also adjust a second throttle signal level for when the clutch is engaged. The Neutral value may be adjusted anywhere between 1 to 20% of the maximum throttle output capability of the voltage circuit.

For example; if the circuit has the ability to drive 0 to 5.00 VDC and the value entered is 10, the output at Neutral would be 0.50 VDC.

E2 - Throttle Minimum

This function allows the installer the ability to adjust the Throttle signal at Idle, above and beyond the profile set in Select Engine Throttle Profile. This value is adjustable anywhere between 1% to 97% of the maximum throttle output capability of the driver. The value must be at least 3% less than Throttle Maximum setting.

E3 - Throttle Maximum

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

E4 - Throttle Maximum Astern

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

E5 - Throttle Pause Following Shift

This value determines the amount of pause from the point where the clutch engagement signal is given, to the point where throttle is allowed to increase above Idle.

E6 - High Idle

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

When power is first applied to the system, the commanded throttle is low. In order to increase the RPM to the High Idle command, the Transfer Button must be depressed for ½ second then released. This can be done with the Control Head lever in any position.

E7 - Active Synchronization

The CruiseCommand default method of synchronization is an Equal Throttle Synchronization. With this type of synch the Processors ensure that the same or an equal Throttle Command Signals are applied to both Governors when the synchr criteria has been met. Through not true synch, in most cases this manner is very effective.

If a true synch is required or requested, Active Synchronization would need to be selected. Active Synch requires a Tachometer Signal representative of each engines' RPM's. The frequency of these signals are measured and changes to the Throttle Command Signal outputs of the Processors are made until the frequency of both engines are the same and both engines are running at the same RPM

C) CLUTCH FUNCTIONS

C0 - Clutch Oil Interlock (optional)

NOTE: This adjustment is to be set to Installed ONLY if the optional Clutch Oil Pressure Switch is being used with this application.

The function of this parameter is to let the Processor know if a Clutch Oil Pressure Switch is being used or not. The primary function of the switch is protection of the Clutch Pack. If for any reason full pressure is not reached or the pressure is lost when Ahead or Astern Gear is commanded, the throttle will be commanded to Idle. This feature will protect the Clutch Pack and prevent costly repairs.

C1 - Clutch Oil Interlock Delay (optional)

NOTE: This adjustment is to be used ONLY if the optional Clutch Oil Pressure Switch is being used with this application.

This function is used in conjunction with Clutch Oil Interlock (C0).

The value entered determines how quickly the system responds to a low gear oil pressure situation. The System will respond to the low pressure by reducing the Throttle Command Signal to Idle.

C2 - Reversal Pause

When doing a reversal in the vessels direction, a pause is introduced into the clutch command signal to allow time for the engines RPM's to drop to Idle and for the vessel's speed through the water to slow. Whether this pause occurs while the clutch is engaged or at Neutral is selectable with this function.

C3 Reversal Pause Time

The Reversal Pause Time feature provides engine deceleration, followed by a pause in throttling to the commanded speed in the new desired direction, upon a Full-Speed Reversal. This pause time is proportional to how much speed is being commanded and for how long. In order to build up to the pause value set, the vessel must be at full throttle and Ahead six times the pause set. The pause from Astern to Ahead is ½ the Reversal Pause value set.

The Throttle position drops to Idle and the transmission remains engaged; the pause that follows is in proportion to the prior Control Head lever position and how long the lever had been in that position before the reversal.

D) TROLL FUNCTIONS

L0 - Troll Lever Range

This Function selects the Troll Mode Type required for this applicaiton. For the Types of Troll Mode operation, refer to Section 2.10 of the MM13437 Operator Manual.

L1 - Troll Valve Function

Refer to Table 2: to select the correct set-up for the trolling valve used with this application.

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

Normal (Normal Off) (00)- (DEFAULT) When selected, the current to the Proportional Valve increases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to 0.

Inverse (Normal Off) (01)- When selected, the current to the Proportional Valve decreases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current drops to 0.

Inverse (Normal On) (02)- When selected, the current to the Proportional Valve decreases as Clutch pressure increases. When Lockup (Full Pressure) is selected, the current increases to maximum.

Table 2: Trolling Valve Type Selection

Troll Valve Normal (00)	Troll Valve Inverse (01)
Reintjes ZF 550 and lower (formerly HBW & HSW Series)	Twin Disc 6000 Series ZF 600 and higher (formerly IRM & BW Series)

L2 Trolling Minimum

This Function sets the amount of current delivered to the Proportional Valve when Minimum Pressure is desired. This is adjustable anywhere between 1 to 99% of the total current output capability of the circuit. The value set must be at least 1% less or more (depending on whether non-inverted or inverted is selected) than Troll Maximum.

L3 Trolling Maximum

This Function sets the amount of current delivered to the Proportional Valve when Maximum Pressure is desired. This is adjustable anywhere between 2 to 100% of the total current output capability of the circuit. The value set must be at least 1% more or less (depending on whether non-inverted or inverted is selected) than Troll Minimum.

L4 - Troll Throttle Limit

This Function sets the maximum amount of throttle command, which is applied to the engine while the Trolling Valve is actively slipping the clutch. This is adjustable from no increase in throttle above Idle, to an increase of 20% of full throttle.

L5 - Troll Pulse Duration

This function sets the time in seconds that the Proportional Valve will be commanded the current programmed in "Troll Pulse Percentage". This function gives a pressure boost to the Clutch plate in order to get the Propeller Shaft rotating prior to dropping to the level programmed in Troll Minimum.

L6 - Troll Pulse Percentage

This function sets the percentage of Troll Maximum that the Proportional Valve will be commanded when first entering Troll Mode. This function determines the amount of pressure boost to the Clutch plate in order to get the Propeller Shaft Rotating prior to dropping to the level programmed in Troll Minimum.

E) TROUBLESHOOTING FUNCTIONS

H0 - Diagnostic Menu

This Function provides the following diagnostic information regarding the CruiseCommand System:

- **Input Voltage**- The displayed value is in "real time" and provides a rough estimate of the DC voltage applied to the Processor. The reading is accurate to within 0.50 DC.
- **Tachometer Sensor Frequency**- The information displayed is the actual frequency outputted by the Tachometer Sender. This signal is utilized in Active Synchronization.
- **Station 1 Lever A/D** - This provides the Control Head potentiometer information (in A to D counts) for Station #1.
- **Station 2 Lever A/D** - This provides the Control Head potentiometer information (in A to D counts) for Station #2.
- **Station 3 Lever A/D** - This provides the Control Head potentiometer information (in A to D counts) for Station #3.
- **Station 4 Lever A/D** - This provides the Control Head potentiometer information (in A to D counts) for Station #4.
- **Transfer Button, Stations 1, 2, 3, & 4** - The status of the Transfer Button at all four Stations can be monitored. Is the Transfer Button Open or Closed (depressed).
- **Software Revision Version** - The version of the software currently installed in the Processor can be displayed.

H1 - Erase EEPROM

This function restores all of the parameters to the factory default values.

H2 - High Side Driver Fault Detection Enable

The five drivers used for controlling clutch and troll solenoids can be monitored. The presence of an open or shorted circuit can be detected.

The installer must program the system so that the fault detection software is enabled for the desired drivers.

The High Side Driver Fault Function is set at the factory for **00** with none of the Drivers Enabled.

NOTE: The "Value" should be entered that corresponds to the Solenoids that are in use and require monitoring

Table 3: Solenoid Error Status Enable

Ahead	Astern	Neutral	Troll Command	Troll On/Off	Value
1	1	0	0	0	03
0	0	1	0	0	04
1	0	1	0	0	05
0	1	1	0	0	06
1	1	1	0	0	07
0	0	0	1	0	08
1	0	0	1	0	09
0	1	0	1	0	10
1	1	0	1	0	11
0	0	1	1	0	12
1	0	1	1	0	13
0	1	1	1	0	14
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1	0	1	0	1	21
0	1	1	0	1	22
1	1	1	0	1	23
0	0	0	1	1	24
1	0	0	1	1	25
0	1	0	1	1	26
1	1	0	1	1	27
0	0	1	1	1	28
1	0	1	1	1	29
0	1	1	1	1	30
1	1	1	1	1	31



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MMC-165 Rev.C 10/00

Electronic Propulsion Control Systems Three **Year Limited Warranty**

Your ZF Mathers product has been designed and manufactured by experienced engineers and craftsmen. ZF Mathers LLC., warrants for the period indicated below, each product to be free from defect in material and workmanship. Repair or replacement, at ZF Mathers option, will be provided if the product, upon ZF Mathers inspection, is found to be properly installed and operated in accordance with ZF Mathers Manual. This warranty does not apply to malfunction caused by damage, unreasonable use, misuse, repair or service by unauthorized persons or normal wear and tear.

A) Coverage Under Warranty

Three years from the date of purchase by the original end user.

Year One

No charge for equipment repair, parts and labor. Up to three hours labor toward troubleshooting and replacement of defective equipment.

Year Two and Three

There is no charge for equipment repairs performed at the factory that are covered under warranty. No labor allowance for troubleshooting and replacement of defective equipment.

B) No Coverage Under Warranty

The following will not be covered under warranty.

1. Travel to and from the job site.
2. Adjustment or calibration of any ZF Mathers equipment.
3. Adjustment or calibration of any associated equipment which may include but not limited to push-pull cables, engine governor or carburetor, transmission or trolling valve.
4. Damage due to accidents, improper installation or handling and or improper storage.
5. Damage due to faulty repairs performed by an unauthorized service representative.
6. Damage due to conditions, modifications or installation contrary to published specifications or recommendations.
7. Original installation charges or start-up costs.
8. Battery service including labor charges related to battery service.
9. Rental of equipment during performance of warranty repairs.
10. Unauthorized repair shop labor, without prior approval from ZF Mathers Service Department.
11. Shop supplies such as connectors, wire, cable, etc.

C) Warranty Service

Call 1-800-546-5455 or 1-360-757-6265 for your nearest ZF Mathers Factory Authorized Dealer.

1. Prior to returning any product to the factory, you must contact ZF Mathers Service Department for a Material Return Authorization (MRA) number. Return the product freight prepaid, marked clearly with the MRA number and a description of the malfunction.
2. If there is a defect covered by warranty, ZF Mathers will, at its option, either repair or replace the defective part or product. If after inspection, ZF Mathers determines that the product is not defective, it will return the product to the sender, freight collect.
3. Repair or replacement during the warranty period will not extend the warranty period.

This Warranty is expressly in lieu of all other Warranties, express or implied. Except to the extent prohibited by applicable law, ZF Mathers hereby disclaims all other implied or express warranties of any kind, including warranties of merchantability and fitness for a particular purpose. Under no circumstances shall ZF Mathers be liable for any consequential damages sustained in connection with the product or its use, including any costs or damages which result from loss of use of the product or any engine or boat with which it is used. ZF Mathers does not authorize any representative or agent to assume for it any obligation or liability other than those expressly set forth above. Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. All implied warranties, if any, are limited to the duration of this express warranty. This warranty gives you legal rights, and you may have other rights which may vary from State to State.

APPENDIX B.1

1.0 TROUBLESHOOTING

1.1 INTRODUCTION

The CruiseCommand Control System consists of Control Heads located at the vessel's Stations, connected to Processor(s) located in the engine room area.

Before beginning troubleshooting, become familiar with the component configuration on your vessel.

Carefully inspect the following:

- DC Power Source
- Component Location
- Component Condition
- Interconnecting Wiring
- Wire Termination's

A key in troubleshooting the CruiseCommand System is identifying the problem as:

- DC Power Source
- Interconnection wiring or termination
- Component Calibration
- Component Failure

The CruiseCommand System has Station-in-Command indicator lights and audible tone indicators on each Control Head, as well as a Display on the Processor that will show Error Messages. These indicators will assist in troubleshooting and in control system status.

When contacting an authorized ZF Mathers, LLC. servicing dealer, or ZF Mathers, LLC. Service Department, please be ready with the Processor Part Number and Serial Number

NOTE: Always check the other Stations, to see if the symptom can be repeated.
--

1.2 GENERAL

The CruiseCommand Control System consists of one Processor per engine, typically mounted in the engine room, and one to four Control Heads located at the vessel's remote stations. The Processors are designed to precisely control electronic throttles and transmissions equipped with solenoid clutch or clutch/troll selection.

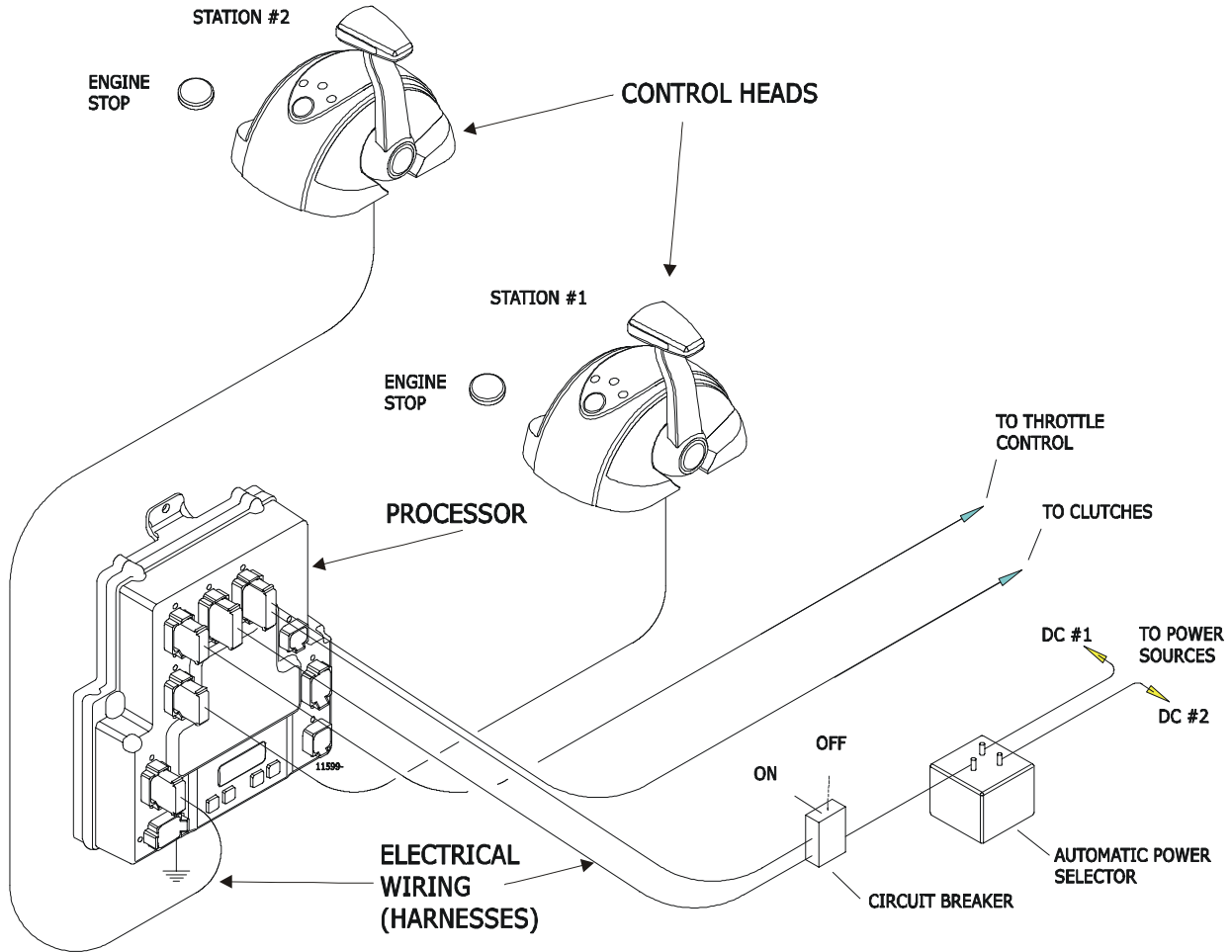


Figure 1:

Before you begin troubleshooting, review the CruiseCommand System Diagram above. Become familiar with the various components and their function within the control system. All CruiseCommand systems consist of at least four main components. These components are the Control Head(s), Processor(s), Electrical Wiring (Harnesses) and a Power Source.

1.3 TROUBLE SHOOTING QUESTIONS

A lot of problems can be resolved by answering these basic questions:

A) Is the system installed on a Single, Twin or Multiple Screw vessel?

- If the system is installed on a Single Screw vessel, this question does not have much value in narrowing down the possible causes of the fault.
- If the vessel has twin or more screws:
 1. Does the problem or symptoms occur on the Port, Starboard or both sides?
 2. If the problem or symptom only occurs on one side, you have effectively eliminated 50% of the possible causes. For example, if the symptom only occurs on the Port side, the Starboard Power Source, Harnesses, Processor and Control Heads have been eliminated as potential causes.
 3. If the problem occurs on both the Port and Starboard in Twin Screw vessels or two or more in Multiple Screw applications, you must ask yourself; **what do both sides have in common?** The most likely answer to your question would be the DC Power Source.

B) How many Remote Stations are there?

- If only one Remote Station is present, not much will be gained by asking this question.
- If more than one Remote Station is being used, command should be taken from one of the other Stations to see if the problem occurs from another Station.
- If the problem occurs from more than one Remote Station, the odds are that the Control Heads are not the cause of the trouble.
- If the problem only occurs at one Remote Station, there is a greater chance of the Control Head or the Control Head Harness of being the cause.

C) Are any tones generated when the problem occurs?

- The CruiseCommand system is capable of producing five different tones in order to alert the operator of a potential problem. Identifying these tones will dramatically narrow down the possible cause of the problem.
 1. **Slow Repetitive Rate Tone**, also referred to as the "Initialization Tone" is normal when DC power is first applied to the CruiseCommand System. This tone indicates:
 - Power has just been applied to the System
 - The Software Program is running normally
 - The Processor is commanding the throttle to Idle and the clutch to Neutral.
 2. **Repetitive Signal: One Long - Three Short** is used to indicate an invalid command signal at the Station-in-Command Control Head.
 3. **Steady Tone** is an indication that something has gone wrong within the Control System. Typically this tone will be accompanied by an Error Message on the Processor's Display.
 4. **Repetitive Signal: One Long - One Short** is used to indicate some type of malfunction with one or more of the Clutch or Neutral Solenoid Circuits. This tone will be accompanied by an Error Message on the Processor's Display. This tone is only available if the High Side Driver Fault is Enabled.
 5. **Three Second Steady Tone** is generated when a fault is detected with the Troll ON/OFF Solenoid or Troll Proportional Solenoid. Typically this tone will be accompanied by an Error Message on the Processor's Display. This tone is only available if the High Side Driver Fault is Enabled.
- Are any Error Messages shown on the Processor's Display? In addition to generating a tone, if at any time the system malfunctions or detects a fault, an error message will be displayed. Write down the Error Message Number and have available for the ZF Mathers Representative.

D) Are the Control Head(s) red LED's lit or not?

- The LED(s) will be in one of four states

1. **Lit Steady** - When the LED is Lit Steady, this indicates that the Station is in command and in the normal operative mode.
2. **Not Lit** - When the LED is Not Lit, that Station is not in command or is experiencing an error.
3. **Blinking Slowly** - A Slow Blinking LED indicates that the Control Head is in the "Warm-up Mode".
4. **Blinking Rapidly** - A LED which is Blinking Rapidly or strobing indicates that the system is in "Troll Mode".

E) Has anything changed on board the vessel?

- Items like adding additional electronic equipment to the vessel can obviously affect the load on the power supply and in turn effect the Control System.
- Re-powering of the vessel. EXAMPLE: Changing from a Caterpillar to a Cummins Electronic Engine would have a serious impact on delivering the correct signal from the Processor to the Governor.
- Any changes that, when initially considered, appear to have nothing to do with the Control System. EXAMPLE: This occurred on a vessel which had just been repainted. For some unknown reason, the painter took it upon himself to disconnect a Control Head and then reconnected it incorrectly.

Take the time to consider these questions. In the long run they will save a lot of time and money.

1.4 PROBLEM RESOLUTIONS

If a problem could not be resolved by asking the basic questions, a careful inspection of the Control System may be the next step. Carefully inspect the following:

A)DC Power Source

1. Ensure that the Processor(s) and Clutch power is connected to a properly charged 12 or 24 VDC battery through a 10 Ampere circuit breaker.
2. To ensure reliable power to the Processor(s) even with a failure of single battery, the APS (Automatic Power Selector) may be used as shown in Figure 2:.

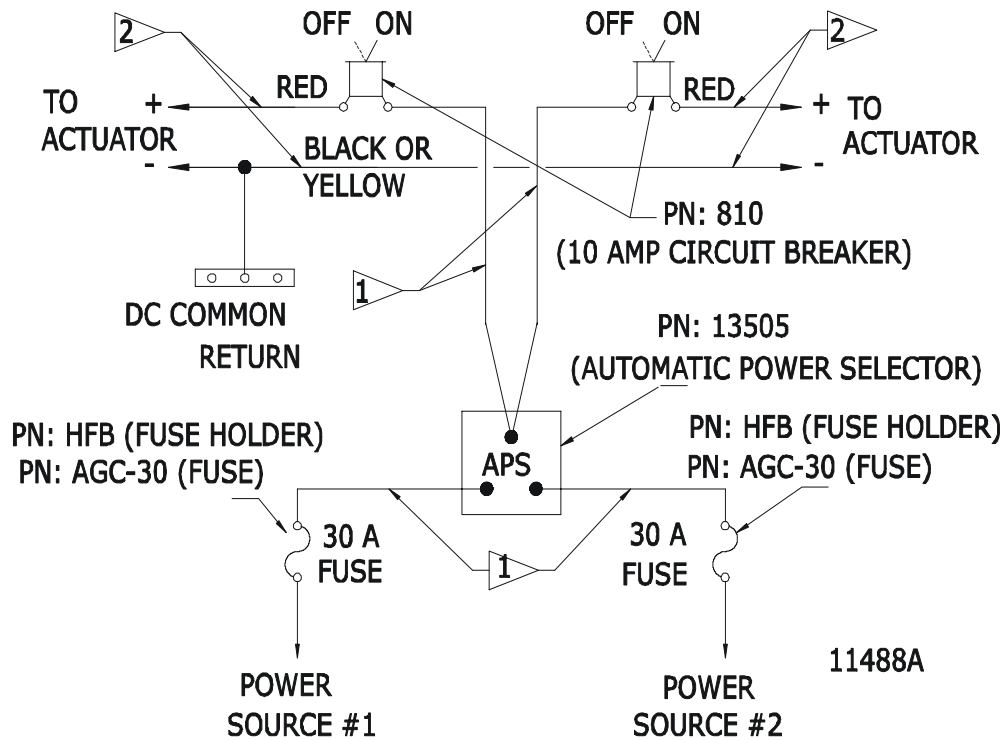


Figure 2: APS Power Connection

B)Component Locations

1. **Control Heads** - There are virtually no restrictions regarding the location of the 400 Series & MC2000 Series Style Control Heads, as long as the bottom is protected from the environment. In the case of the 700 Series Style Control Heads, this concern doesn't even exist.
2. **Processors** - The Processors are typically mounted anywhere in the Engine Room, while maintaining a minimum distance of four feet from sources of high heat and EMI or RFI energy.

C) Component Condition

1. **Control Heads** - Inspect for any signs of corrosion due to water incursion. Ensure that all fork connectors are properly secured to the terminal strip.
2. **Processors** - Inspect the Processors for any signs of physical damage.

D) Interconnecting Wiring

1. Inspect the Harness's Pins and Sockets for bent pins or any signs of corrosion.

The key to troubleshooting the CruiseCommand Control System is identifying which of the categories listed below is the cause of the problem:

- DC Power Source
- Interconnecting Wiring (Harnesses)
- Engine or Transmission
- Component Calibration
- Control Head Failure
- Processor Failure

There is no need to troubleshoot the system to any point further than one of the main components listed above. If the fault is found to be with a Control System component, that component is simply replaced.



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