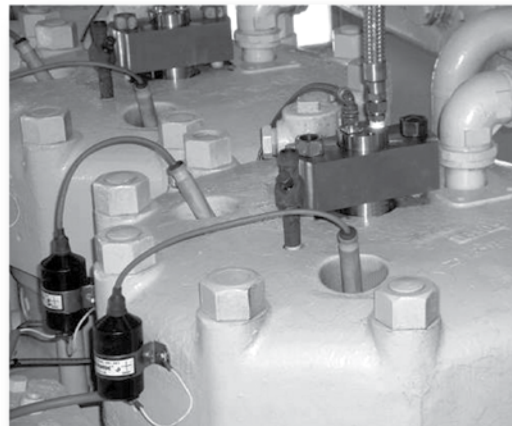
OPERATING INSTRUCTIONS

HYPERFUEL VALVE FUEL CONTROL SYSTEM

FORM HYPERFUEL OI 3-06

WARNING: DEVIATION FROM THESE INSTRUCTIONS MAY LEAD TO IMPROPER ENGINE OPERATION WHICH COULD CAUSE PERSONAL INJURY TO OPERATORS OR OTHER NEARBY PERSONNEL.

1.0 OVERVIEW

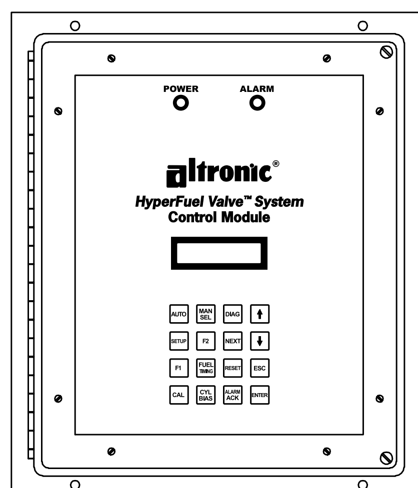


1.1 The Altronic HyperFuel Valve digital system has been designed for application on large, natural gas fueled engines and integral compressors. This system is field-programmable and provides fuel control and engine speed control as well as diagnostic features. The HyperFuel Valve system consists of three main parts: a user interface Logic Module, an engine-mounted Power Module and an engine-mounted Distributor Module.

1.2 This document provides instructions and descriptions to be used in the operation of the control system, and does not cover physical installation. Reference form **HYPERFUEL II** for instructions regarding installation and mounting.

WARNING: THE HYPERFUEL VALVE SYSTEM MUST BE CONFIGURED PRIOR TO USE ON AN ENGINE. REFER TO SECTION 9.5 TO VIEW THE CURRENT CONFIGURATION. VERIFY EEPROM PROGRAMMING PRIOR TO STARTING ENGINE.

2.0 THE LOGIC MODULE USER INTERFACE



2.1 An alphanumeric, 16 character x 2 line back-lit LCD display is used to provide output to the user. A sealed membrane keypad is used to accept user input. The LCD display and the keypad function together to provide an interactive user interface which prompts the user as different functions are selected.

2.2 Two LED indicators are also provided on the front panel. The Power (green) LED is illuminated when the logic module is powered and operating. The **ALARM** (yellow) **LED** is illuminated when a fault or warning is present. The **ALARM LED** flashes when an alarm condition has been acknowledged.

2.3 Inside the Logic Module, three additional red LED's are provided for troubleshooting.

3.0 DESCRIPTION OF OUTPUT SWITCHES

3.1 Three output switches provide a means of communicating the current control status to other systems. These switches have isolated outputs and share one common return path which is not referenced to engine or power ground. They will be in the open condition when the unit is not powered. A typical application would be as a relay or solenoid coil driver.

- **The FUEL-CONFIRM OUT switch is closed to signal that the fuel valves are being actuated.**
- **The SHUTDOWN OUT switch is closed to signal that the controller has detected no faults which would result in a self shutdown. Upon detecting a fault that would result in a self-shutdown of the controller, this switch will open.**
- **The ALARM OUT switch is closed to signal that no unacknowledged faults or warnings are present. Upon detection of a fault or warning, this switch will open. This output is designed to control an alarm indicator or sounding device.**

4.0 UNDERSTANDING THE HOME SCREEN

4.1 A series of “home” screens are used to describe the current status of the control system. The LCD display always reverts to one of the home screens after a keypad operation is completed or times out. The home screen is designed to display the most critical operating parameters on one screen.

4.2 All of the home screens provide a status word in the upper left corner, the engine speed (xxxx RPM) in the upper right corner, the governor command fuel pulse width (xx.xx mS) in the lower left corner and the global fuel timing (xxx.x°) Btdc in the lower right corner. Four modes are provided to control the governor setpoint target. The present control mode is indicated by one of five different characters located in the center of the top line of the display.

M = Manual mode via the keypad

W or R = automatic local settings for Warmup/Running (time delay transition)

L = automatic remote 4-20 mA current Loop

S = automatic remote Serial control over RS-485

4.3 **THE READY MESSAGE** is displayed when the controller is ready for the engine to crank for starting.

```
READY   W   0RPM
12.00mS   105.0°
```

4.4 **THE SYNCING MESSAGE** is displayed while the control system verifies signals from the engine pickups, once the engine begins turning.

```
SYNCING W  70RPM
12.00mS   105.0°
```

4.5 **THE STARTING MESSAGE** is displayed when the fuel valves begin actuating and the start up speed has not yet been met. While this screen is displayed the governor is disabled and the command pulse width will be at the start pulse width setting.

```
STRTING W  95RPM
12.00mS   105.0°
```

4.6 **THE FUELING MESSAGE** is displayed when the start RPM speed threshold has been met and the governor begins changing the command pulse width in order to obtain the target speed.

```
FUELING W 250RPM
11.00mS   105.0°
```

4.7 **THE GALLOP MESSAGE** is displayed when the governor pulse width command goes below the minimum pulse width setting. In this mode, valves will only be actuated if the logic has accumulated enough fuel to send the minimum pulse width. This will work to avoid lean misfire during warm-up or unloaded conditions by maintaining a rich enough mixture to fire a cylinder when more torque is needed, and by not fueling a cylinder when more torque is not required.

```
GALLOP  W 250RPM
 9.00mS   105.0°
```

4.8 THE MAX-PW MESSAGE is displayed when the governor pulse width command is larger than the maximum pulse width setting. In this condition the displayed and delivered pulse width is limited to the max pulse width limit. The pulse width limit is designed to provide a max torque limit beyond which the cylinders will not be fueled. If this condition persists for 5 seconds, a warning condition will be flagged.

```
MAX-PW  W 250RPM
19.99mS   105.0°
```

4.9 THE STALLED MESSAGE is displayed when a loss of rotation is detected after the controller has been fueling and neither a **SHUTDOWN** or **FAULT** has occurred. This signifies that the engine has stopped without any detected cause from the control system.

```
STALLED W   0RPM
12.00mS   105.0°
```

4.10 THE WARNING MESSAGE supersedes all of the above home screens if a warning condition is present. When any warning exists, a **VIEW DIAGNOSTICS** message will flash on the bottom line of the display. The control system will continue to operate under a warning condition, while alerting the operator of a potential problem in several ways: by turning on the front panel **ALARM LED**, by changing the state of the **ALARM OUT** switch (switch opens), and by displaying the **WARNING MESSAGE**.

NOTE: The various types of diagnostic warnings are described in section 10.0.

```
WARNING W 250RPM
15.00mS   105.0°
```

```
WARNING W 250RPM
VIEW  DIAGNOSTICS
```

4.11 THE FAULT MESSAGE supersedes all of the above home screens if a diagnostic fault condition is present. When a diagnostic fault exists, a **VIEW DIAGNOSTICS** message will flash on the bottom line of the display. The control system will stop operating under a fault condition, and will alert the operator to the problem in five ways: by turning on the front panel **ALARM LED**, by changing the state of the **FUEL CONFIRM OUT** switch (switch opens), by changing the state of the **ALARM OUT** switch (switch opens), by changing the state of the **SHUTDOWN OUT** switch (switch opens), and by displaying the **FAULT MESSAGE**.

NOTE: The various types of diagnostic faults are described in section 10.0.

```
FAULT   W   0RPM
VIEW DIAGNOSTICS
```

```
FAULT   W   0RPM
12.00mS   105.0°
```

NOTE: An engine that was previously stopped by grounding the Shutdown input, will continue to display the shutdown message even when the shutdown input is no longer grounded providing an indicator of what stopped the engine. In this case, the action of attempting a restart will automatically transition to ready and begin the start sequence.

4.12 **THE SHUTDOWN SCREEN** supersedes all other home displays if the shutdown input is grounded or if the shutdown input was grounded and the engine has not stopped rotating. This message indicates that the control system is not fueling because the shutdown input is now activated or when the engine was previously stopped due to an activated shutdown input or a fault condition. The **FIRE CONFIRM OUT** switch will change state (switch opens) and the other outputs will function as described based on the existence of faults or warnings. If a fault or warning exists while the controller displays shutdown, a **VIEW DIAGNOSTICS** message will flash on the bottom line of the display.

```
SHUTDOWN     0RPM
12.00mS    105.0°
```

INDICATES THAT THE SHUTDOWN INPUT CAUSED THE SHUTDOWN

```
SHUTDOWN     0RPM
VIEW  DIAGNOSTICS
```

IF A WARNING OR FAULT IS PRESENT, BOTTOM LINE WILL FLASH TO VIEW

5.0 ADJUSTING GLOBAL RETARD

5.1 Global retard is an adjustment affecting the fuel delivery angle of all cylinders equally. This is similar to the adjustment of global spark timing of an ignition system; however, fuel delivery is typically timed to begin 140° to 90° Btdc. Adjustments made as described below will be in effect as changes are made and will remain in effect until another adjustment is made.

5.2 To adjust global retard:

FROM

```
FUELING W 250RPM
11.00mS    105.0°
```

PRESS **TIMING**

THEN AT

```
↑=GLOBAL(ENGINE)
↓=CYLINDER(INDV)
```

PRESS **↑**

THEN AT

```
↑= ADJUST RETARD
↓= SELECT MODE
```

PRESS **↓**

THEN AT

```
MAN DELAY  10.5°
↑↓Esc 105.0°Btdc
```

PRESS TO INCREASE **↑** PRESS TO DECREASE **↓** PRESS TO EXIT **ESC**

NOTE: Display also includes resultant timing.

5.3 The increment of timing change is dependent on the number of holes or teeth being sensed. The minimum timing change is equal to "90/N" where N = no. of holes or teeth.

EXAMPLE: For 360 holes, the minimum timing change increment is 90/360 = 0.25 degrees.

6.0 SELECTION OF GLOBAL TIMING MODES

6.1 Several options exist with regard to global timing modes. Once the global timing mode menu is entered as described below, the status of each option can be viewed and changed.

FROM

```
FUELING W 250RPM
11.00mS    105.0°
```

PRESS **TIMING**

THEN AT

```
↑=GLOBAL(ENGINE)
↓=CYLINDER(INDV)
```

PRESS **↑**

THEN AT

```
↑= ADJUST RETARD
↓= SELECT MODE
```

PRESS **↓**

6.2 ENABLE OR DISABLE PRE-CONFIGURED FUEL RETARD CURVE
The first mode selection can enable or disable the pre-configured fuel retard curve versus engine RPM. To configure the RPM retard curve, reference form **HYPERFUEL PI**.

NOTE: Display shows RPM Map OFF.

AT THE NEXT OPTION SCREEN

```
RPM RETARD MAP
↑on/OFF↓Next Esc
```

PRESS TO TURN ON **↑**

PRESS TO TURN OFF **↓**

PRESS FOR NEXT OPTION **NEXT**

PRESS TO ESCAPE **ESC**

6.3 ONE-STEP RETARD FEATURE

The next mode selection describes the one-step retard feature. When the one-step feature has been configured, the screens provide a means to view the current timing on the bottom line and to view and adjust the retard offset on the top line. The default configuration selects one-step retard to be controlled by the Misc Input terminal. The additional retard would be implemented when the input is grounded. The third screen indicates that one-step retard feature is not configured.

NEXT MODE, 1 STEP ACTIVE

```
1 STEP RET 10.0°
↑↓Esc    0.0°Btdc
```

OR 1 STEP INACTIVE

```
1 step ret 10.0°
↑↓Esc    0.0°Btdc
```

PRESS TO INCREASE ↑

PRESS TO DECREASE ↓

PRESS FOR NEXT OPTION NEXT

PRESS TO ESCAPE ESC

OR 1 STEP NOT CONFIGURED

```
ONE-STEP FEATURE
NOT PRESENT Next
```

7.0 ADJUSTING INDIVIDUAL OFFSETS

7.1 The fuel timing of individual cylinders can be offset by up to 3 degrees of advance or retard. Adjustments made as described below should be considered temporary. The control will revert to the values saved in the EEPROM on every start or power-up. To save temporary adjustments to the EEPROM. **SEE SECTION 8.0.**

7.2 Enter the individual timing adjustment menu as described below.

FROM

```
FUELING R 300RPM
15.00mS    105.0°
```

PRESS **TIMING**

THEN AT

```
↑=GLOBAL(ENGINE)
↓=CYLINDER(INDV)
```

PRESS ↓

THEN AT

```
↑= ADJUST OFFSET
↓= SELECT MODE
```

PRESS ↑

7.3 The individual fuel timing adjustment screen identifies the valve output(s) to be adjusted, and the degrees of offset in use for the output(s).

NOTE: 2.5 degrees advance for output A.

THEN AT

```
CYL  A   2.5°ADV
↑↓ Esc Next
```

PRESS TO ADVANCE ↑

PRESS TO RETARD ↓

PRESS TO SELECT NEXT CYL. **NEXT**

PRESS TO EXIT **ESC**

7.4 The output identification characters will be provided as follows:

A1 A2 B1 B2 C1 C2 etc.

8.0 INDIVIDUAL CYLINDER OFFSET MODES

8.1 Two additional functions with regard to individual cylinder fuel timing offsets are provided. These functions can be accessed from the individual timing mode menu which can be entered as described below.

FROM

```
FUELING R 300RPM
15.00mS    105.0°
```

PRESS TIMING

THEN AT

```
↑=GLOBAL(ENGINE)
↓=CYLINDER(INDV)
```

PRESS ↓

THEN AT

```
↑= ADJUST RETARD
↓= SELECT MODE
```

PRESS ↓

8.2 **SAVE CURRENT OFFSETS**

The first function can be used to save the current (temporary) individual offsets to the EEPROM. When this is done, the controller will load these new offset settings every time the engine starts.

AT THE FIRST OPTION SCREEN

```
SAVE CYL OFFSETS
 ENTER OR NEXT
```

PRESS TO SAVE OFFSETS ENTER

PRESS FOR NEXT OPTION NEXT

PRESS TO EXIT ESC

8.3 **RESET ALL OFFSETS**

The **NEXT** mode function can be used to reset all cylinder timing offset values to zero (both temporary memory and EEPROM).

AT THE SECOND OPTION SCREEN

```
RESET OFFSETS =0
 ENTER OR NEXT
```

PRESS TO RESET OFFSETS ENTER

PRESS FOR FIRST OPTION NEXT

PRESS TO EXIT ESC

9.0 SETUP CONTROL OPTIONS

9.1 Additional control settings and display features can be accessed under the **SETUP** menu. Changes made under the **SETUP** menu are stored in EEPROM and remain fixed until changed. The **SETUP** menu can be entered as described below.

FROM

```
FUELING R 300RPM
15.00mS    105.0°
```

PRESS **SETUP**

9.2 ADJUST THE ENGINE OVERSPEED SETPOINT

The first **SETUP** screen is used to adjust the engine overspeed setpoint. The setpoint can be adjusted in increments of 5 RPM to a maximum of 1275 RPM.

AT

```
ADJUST OVERSPEED
↑↓ Esc   330 RPM
```

PRESS TO INCREASE ↑ **PRESS TO DECREASE** ↓

PRESS FOR NEXT OPTION **NEXT** **PRESS TO EXIT** **ESC**

9.3 SPECIFY THE RESET PIN POSITION

The next **SETUP** screen is used to specify the exact position of the reset pin. Both the reset position and the engine timing are displayed. Adjustments are made to make the displayed timing match the actual fuel timing as verified with a timing light on valve drive output. Adjustments affect the displayed timing but do NOT change the actual timing of the fueling.

> ***NOTE: Adjustment of this parameter should be done while individual cylinder offsets are all at zero.***

AT

```
RESET AT> 130.5°
↑↓Esc 105.0°Btdc
```

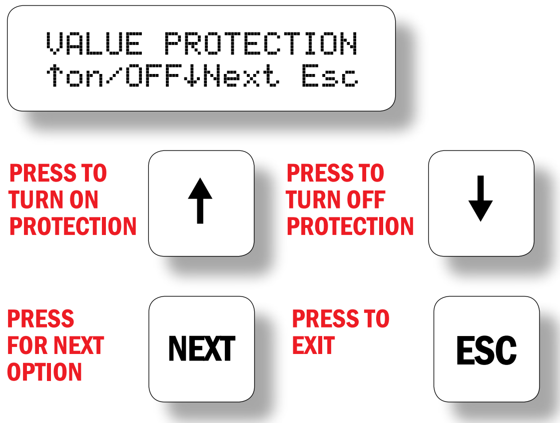
PRESS TO INCREASE ↑ **PRESS TO DECREASE** ↓

PRESS FOR NEXT OPTION **NEXT** **PRESS TO EXIT** **ESC**

9.4 ENABLE OR DISABLE VALUE PROTECTION

The next **SETUP** screen is used to enable or disable **VALUE PROTECTION** of all user values in the EEPROM. When protection is on, none of the EEPROM settings under the **SETUP, CAL, CYL BIAS** or **TIMING** menus can be changed. This feature can be used to provide limited protection from random changes by inexperienced operators.

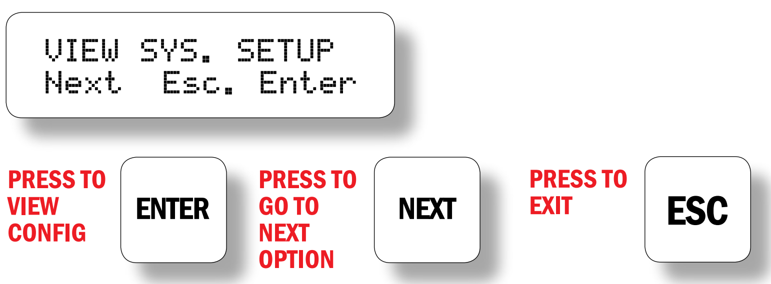
AT



9.5 VIEW THE CONFIGURATION COMMENTS

The next setup screen can be used to view the configuration comments which describe the configuration of the control system. There are 8 screens which can be rotated to the display using the **NEXT** key.

AT



NOTE: Because EEPROMS can be reconfigured (using a PC and Altronic's configuration software), these comments should be viewed to identify and verify the configuration settings of the unit prior to operation. Refer to form HYPERFUEL PI for further information on configuration.

The following types of screens can be viewed by pressing **ENTER** to start and **NEXT** to advance.

Description		Screen	Key
Firing Pattern code: **Special Feature code:** **Engine Type:** **Output Connector Configuration:**	**(F2A360.HS100)** **(#001) (1 step default)** **(2cyc) (6cyl)** **(32out)**	F2A360.HS100#001 2cyc. 6cyl.32out	**NEXT**
Date Configured: **Time Configured:** **Configured By:**	**(07-01-02)** **(12:00)** **(User Name)**	07-01-02 12:00 By:Gary K.	**NEXT**
Screen currently not defined in HyperFuel system			**NEXT**
RPM Retard Curve Description **(not typically active)**		RPM RETRARD: NO	**NEXT**
Location:	**(User specified)**	LOCATION: ALT. GIRARD OHIO USA	**NEXT**
Engine Number or Description:	**(User specified)**	ENGINE: TLA6 Number 4 USA-GAS	**NEXT**
Special User Comments Area #1:	**(User specified)**	USER COMMENTS #1	**NEXT**
Special User Comments Area #2:	**(User specified)**	USER COMMENTS #2	**NEXT**
Rotation continues through the 8 **Configuration Comment Screens**		F2A360.HS100#001 2cyc. 6cyl.32out	**NEXT**
ESC to exit to Home Screen			**ESC**

BREAKDOWN OF FIRING PATTERN CODE:

F represents the number of outputs used, in this case 6 (G = 7, L = 12, etc.)

2 represents the cycle type of the engine
2 = standard two-cycle
4 = standard four-cycle

A represents the Altronic pattern code (see Altronic II-CPU Application List)

360 represents the number of gear teeth to be sensed on the crankshaft

H represents a designator for HYPERFUEL or CPU-2000 Logic Module

S S = non-standard speed curve vs. current, factory programmed
N = non-standard speed curve vs. current, non-factory programmed
X = no current loop retard control of fuel timing

100 represents the special version number (only exists for types N and S)

#001 represents the special feature code
(total sum of all selected options; 001=default)
016 = use 1 step retard when RPM is less than 200
001 = use 1 step retard when Misc Input is grounded

Note: Special Version number must be selected and properly documented by the originator.

9.6 ENTER THE CONTROLLER TEST MODE

This test mode can actuate all the fuel valve outputs in rotation, or individual outputs at a slow rate. This feature can be used to troubleshoot valve wiring and power module operation. Test mode will terminate if rotation of the engine is sensed.

AT

```
RUN TEST MODE
Next  Esc  Enter
```

PRESS FOR TEST MODE **ENTER** PRESS FOR NEXT OPTION **NEXT** PRESS TO EXIT **ESC**

WARNING: THE OPERATOR MUST BLOW DOWN THE FUEL SYSTEM AND FULLY PURGE THE ENGINE OF COMBUSTIBLE MIXTURES PRIOR TO SELECTING THE TEST MODE OPERATION. PRESSING THE ENTER KEY AGAIN IS A CONFIRMATION OF THIS ACTION.

THEN, BEFORE STARTING TEST MODE

```
IS FUEL DISABLED
  Esc    Enter
```

PRESS TO VERIFY PURGED MODE **ENTER** PRESS TO EXIT **ESC**

Then the test mode screen indicates that the controller is actuating fuel valves and permits the operator to select the output to be fired.

AT

```
Test-Mode ALL
 ↑ ↓  Esc
```

PRESS TO SELECT OUTPUT **↑** PRESS TO SELECT OUTPUT **↓** PRESS TO EXIT **ESC**

Test-Mode selection rotates as described below.

ALL,A1,A2,B1,B2,C1,C2,D1,D2,E1,E2,F1,F2...

9.7 **COMMUNICATIONS OPTIONS**

The HyperFuel Valve controller supports 25 communication options, which include the standard 9-bit programming protocol and 24 ModBus RTU modes. These configurations (all having 8 data bits, and 1 stop bit) include 3 parity modes (even, odd, none) and 8 baud rates (300,600,1200,2400,4800,9600,19200,38400). Display screens are formatted as depicted below. Use the arrow keys to select the communication mode.

```
SERIAL PORT   ↑↓
Intel 9-BIT 9600
```

```
SERIAL PORT   ↑↓
ModBusRTU 300e81
```

```
SERIAL PORT   ↑↓
ModBusRTU9600o81
```

```
SERIAL PORT   ↑↓
ModBusRTU38.4n81
```

9.8 From the next setup screen the communication ID-Code or Node-ID can be viewed or modified. Suitable ID-Codes for ModBus are (1 to 247), while suitable ID-Codes for the standard Intel 9-bit communication format are (1 to 254). Use the arrow keys to select the Node-ID.

```
HYPERFUEL  COM
IDCODE =    1 ↑↓
```

9.9 The next screen is used to enable or disable the **HYPERBALANCE SUPPORT FUNCTION**.

```
HYPR BAL Support
↑ON/off↓ NextEsc
```

10.0 HYPERFUEL VALVE CONTROLLER DIAGNOSTICS

10.1 A diagnostic fault represents the most severe classification of problems. The presence of a diagnostic fault will inhibit the controller from fueling. When a fault is detected several things will occur:

- **THE CONTROLLER WILL STOP FUELING.**
- **THE SHUTDOWN OUT SWITCH WILL OPEN.**
- **THE FIRE CONFIRM OUT SWITCH WILL OPEN.**
- **THE ALARM OUT SWITCH WILL OPEN.**
- **THE ALARM LED ON THE FRONT PANEL WILL TURN ON.**
- **THE HOME STATUS WILL READ FAULT, AND THE BOTTOM LINE WILL FLASH VIEW DIAGNOSTICS.**

Diagnostic **FAULTS** will supersede diagnostic **WARNINGS**.

```
FAULT         0RPM
VIEW DIAGNOSTICS
```

10.2 A warning represents the least severe classification of problems. The controller will continue to fuel the engine in the presence of any warning. When a warning is detected, several things will occur:

- **THE ALARM OUT SWITCH WILL OPEN.**
- **THE ALARM LED ON THE FRONT PANEL WILL TURN ON.**
- **THE HOME STATUS WILL READ WARNING, AND THE BOTTOM LINE WILL FLASH VIEW DIAGNOSTICS.**

```
WARNING   300RPM
VIEW DIAGNOSTICS
```

10.3 If the **ALARM OUT** switch is being used to turn on an audible alarm or flasher, the user can acknowledge the alarm to silence the alarm. After viewing faults or warnings, the user would then reset and re-arm the control system after the faults or warnings have been addressed.

PRESS [**ALARM ACK**] **PRESS TO RESET CONTROLLER** [**Reset**]

Acknowledgment of alarms (**ALARM ACK**) causes the **ALARM OUT** switch to return to its closed position; the **ALARM LED** will flash as a visual reminder that the alarm had occurred.

The **RESET** function clears all latched fault and warning conditions and returns indicators and outputs to normal conditions when warning and fault conditions are no longer present. This function also resets temporary individual fuel timing offset values, and will restore the **READY MESSAGE** if the shutdown input is not currently active.

10.4 When a warning or fault is present, the operator can display the actual cause of the diagnostic as depicted below.

FROM THE HOME SCREEN

```
FAULT          0RPM
VIEW DIAGNOSTICS
```

PRESS TO VIEW DIAGS. **DIAG**

Then from the diagnostic description screens use the following keys:

PRESS TO VIEW NEXT DIAG. **DIAG** **OR PRESS TO VIEW NEXT DIAG.** **NEXT** **PRESS TO EXIT** **ESC**

10.5 **DIAGNOSTIC FAULT SCREENS** in order of display priority :

When zero gear-tooth pulses are seen between two reset pulses.	GT Pickup FAULT MISSING PULSES
When too many gear-tooth pulses are seen without a reset pulse.	RS Pickup FAULT MISSING PULSES
When there are no Hall-effect pickup pulses or when the pickups are not synchronized.	HE Pickup FAULT MISSING//NO-SYNC
When too many or too few gear-tooth pulses are seen between reset pulses. The received number of pulses is displayed.	RING-GEAR FAULT 352 TEETH READ
When the engine speed exceeds the over-speed setpoint. The maximum observed speed is also displayed.	ENGINE OVERSPEED 1023 RPM
When the logic unit does not properly communicate with the power module.	NO COMMUNICATION TO HYPR OUTPUT
When the check-sum of microprocessor firmware cannot be verified. Unit requires service.	BOTTOM BOARD uP CHECKSUM FAILED

10.6 CONTROLLER DIAGNOSTIC WARNING SCREENS in order of display priority:

An A SIDE output circuit was detected as an open circuit.

```
VALVE WIRE FAULT
   ON A SIDE
```

A B SIDE output circuit was detected as an open circuit.

```
VALVE WIRE FAULT
   ON B SIDE
```

The current-loop has deviated outside the limits od 2 mA and 22 mA. The current loop target is limited under all conditions to the 4 mA or 20 mA setting.

```
  CURRENT LOOP
  OUT OF RANGE
```

The govenor command pulse width was limited to the max pulse width to protect against engine overload for more than 5 consecutive seconds.

```
Fuel Pulse Width
was at MAX  5sec
```

The firing pattern configuration data saved in EEPROM memory is incorrect or incomplete. The EEPROM memory must be reprogrammed or replaced.

```
 EEPROM  MEMORY
CHECKSUM  FAILED
```

At some point the display board of the Logic Module was not running correctly. Temporary values for cylinder offsets would be lost if this message appeared; the values from EEPROM would be used.

```
DISPLAY BOARD
WAS NOT RUNNING
```

11.0 HYPERFUEL VALVE CONTROLLER CALIBRATION SETTINGS

11.1 Calibration values for the governor system can be accessed with the **CAL** key. Changes made under the **CAL** menu are stored in EE-PROM and remain fixed until readjusted. Changes are not permitted while protection is activated. The **CAL** menu can be entered as described below.

FROM

```
FUELING R 300RPM
15.00mS   105.0°
```

PRESS **CAL**

11.2 VIEW AND ADJUST ENGINE SPEED TARGET FOR MANUAL MODE
The first **CAL** screen. An **"M"** in the home screen indicates that this setting is in force for the governor target.

SEE SECTION 12.0 FOR SWITCHING MODES.

AT

```
MANUAL MODE SPD
↑↓TARGET= 300RPM
```

PRESS **ESC**

PRESS TO INCREASE **↑**

PRESS TO DECREASE **↓**

PRESS FOR NEXT OPTION **NEXT**

PRESS TO LOAD CAL DEFAULTS **RESET**

11.3 VIEW AND ADJUST ENGINE SPEED TARGET FOR WARMUP MODE
The next **CAL** screen is used to view and adjust the engine speed target for the automatic local **WARMUP**/run mode. A **"W"** for **WARMUP** in the home screen indicates that this value is the active target speed.

```
AUTO WARMUP SPD
↑↓TARGET= 250RPM
```

11.4 VIEW AND ADJUST ENGINE SPEED TARGET FOR RUN MODE
The next **CAL** screen is used to view and adjust the engine speed target for the automatic local warmup/**RUN** mode. An **"R"** for run in the home screen indicates that this value is the active RPM target. Control automatically goes from **WARMUP** to **RUN** after the delay time.

```
AUTO RUN     SPD
↑↓TARGET= 300RPM
```

11.5 VIEW AND ADJUST WARMUP DELAY TIME

This timer begins counting down when in automatic local **WARMUP**/run mode. When the timer expires the control target will change from the **WARMUP** value to the **RUN** value.

```
AUTO WARMUP TIME
↑↓DELAY   300sec
```

Note: This value also provides a MINIMUM limit for the target speed when controlled by serial data in the AUTOMATIC REMOTE SERIAL mode.

11.6 VIEW AND ADJUST ENGINE SPEED TARGET FOR AUTOMATIC REMOTE 4-20 AND SERIAL CONTROL MODES

This value defines the governor target speed for 4 mA on the current **LOOP** input when in automatic remote **LOOP** mode indicated by **"L"**.

```
4-20 &SERIAL MAX
↑↓ 4mA =  200RPM
```

Note: This value also provides a MAXIMUM limit for the target speed when controlled by serial data in the AUTOMATIC REMOTE SERIAL mode.

11.7 VIEW AND ADJUST ENGINE SPEED TARGET FOR AUTOMATIC REMOTE 4-20 AND SERIAL CONTROL MODES

This value represents the governor target speed for a 20 mA current **LOOP** input when in **AUTOMATIC REMOTE LOOP** mode. The min and max 4-20 cal values define the straight line relationship of the current loop to RPM target.

```
4-20 &SERIAL MAX
↑↓20mA =  300RPM
```

11.8 VIEW AND ADJUST BRAKE SPEED RPM

This setting defines the speed at which the governor shall become aggressive to avoid an engine overspeed event. This setting is normally set 5 RPM above the full load speed and at least 10 RPM below the engine overspeed setpoint.

```
BRAKE SPEED
↑↓SETPNT  305RPM
```

11.9 VIEW AND ADJUST START UP SPEED

Defines the speed at which the governor will begin to adjust fuel pulse width to regulate the engine speed.

```
START UP SPEED
↑↓SETPNT 150RPM
```

11.10 VIEW AND ADJUST START-UP PULSE WIDTH

This setting defines the fuel pulse width to be used below the start-up speed setpoint RPM.

```
START UP FUEL PW
↑↓SETPNT 12.00mS
```

11.11 VIEW AND ADJUST MIN PULSE WIDTH

This setting defines the smallest fuel pulse width to be permitted. When the displayed governor command pulse width is below this value, then **GALLOP** mode will be entered. In **GALLOP** mode, fuel pulses equal to the **MIN PULSE WIDTH** are delivered when enough command fuel is accumulated. When the accumulated command fuel is less than the **MIN PULSE WIDTH** no fuel is delivered, which results in a deliberate misfire of the cylinder. **GALLOP** mode produces suitable torque and speed control while maintaining air/fuel ratios still rich enough for good combustion.

```
MIN PULSE WIDTH
↑↓SETPNT 10.00mS
```

11.12 VIEW AND ADJUST MAX PULSE WIDTH

The calculated governor command pulse width will be limited to this maximum value to provide an overload or torque limit. If this condition persists more than 5 seconds, a warning event is flagged. This feature provides a means to detect an overload condition which may result from a misfiring cylinder or a problem with the compressor or some other failure. This value should be set ~10% above the observed pulse width for the properly running engine at full load.

```
MAX PULSE WIDTH
↑↓SETPNT 19.99mS
```

11.13 VIEW AND ADJUST INTEGRAL ATTACK CONSTANT (KI)

This value controls the speed at which the control algorithm will be permitted to change the integrated portion of the command pulse width. This calibration determines the authority of the governor in its primary task of maintaining the proper acceleration required to reach and remain at the speed target. Changing this value will not necessarily change the rate at which the governor will acquire the speed target but rather its ability to control the rate of change of the speed. Adjustment of this value should be considered to compensate for new fuel valve sizing or fuel BTU changes. Higher numbers will produce more governor action.

```
KI INT. ATTACK
↑↓CONSTANT   40
```

DEFAULT = 40
RECOMMENDED RANGE 20-80

11.14 VIEW AND ADJUST APPROACH RATE CONSTANT (KD)

This value determines the desired engine acceleration/deceleration rate the governor will use to bring the engine to the target speed. Higher values cause the governor to seek the target RPM at a faster rate. Because the primary goal of running these engines is stability, a default value of 40 results in a slow smooth action of controlling the speed through load transients accepting slight RPM droop as a normal by-product of adding load. The default value of 40 equates to an approach rate of ~7 RPM/sec for |RPM error| > 80; and ramps to 0 RPM/sec as the RPM error decreases.

```
KD APPROACH RATE
↑↓CONSTANT   40
```

DEFAULT = 40
RECOMMENDED RANGE 20-60

11.15 VIEW AND ADJUST PROPORTIONAL DEPART CONSTANT (KP)

This control setting determines the proportional response of the governor while the engine speed is departing from the speed setpoint. The proportional governor action can be tuned to increase stability of operating near the target speed. Higher numbers produce greater governor action.

```
KP PROP DEPART
↑↓CONSTANT    5
```

DEFAULT = 5
RECOMMENDED RANGE 3-10

11.16 VIEW AND ADJUST PROPORTIONAL APPROACH CONSTANT (KS)

This control setting determines the proportional response of the governor while the engine speed is approaching the speed setpoint. The proportional governor action can be tuned to increase stability of operation near the target speed. Higher numbers produce greater governor action. **KS** should be less than **KP**.

```
KS PROP APROACH
↑↓CONSTANT    3
```

DEFAULT = 3
RECOMMENDED RANGE 1-8

11.17 VIEW AND ADJUST PROPORTIONAL BRAKING CONSTANT (KB)

This control function determines the proportional response of the governor during acceleration when the speed is at or above the **BRAKE SPEED RPM** **DESCRIBED IN 11.8**. This condition of acceleration beyond the max desired speed is typical of a load reduction and can result in an engine overspeed. If this situation occurs the governor imposes a large fuel reduction action to reduce the torque (apply the brakes). This value may be tuned to address (HP/Inertia/Friction) characteristics of the machine. Higher values result in larger fuel reductions (harder braking).

```
KB PROP BRAKE
↑↓CONSTANT  100
```

DEFAULT = 100
RECOMMENDED RANGE 60-200

12.0 SELECTION OF THE TARGET GOVERNOR SPEED

12.1 **MANUAL** mode is the simplest means of determining the governor speed setpoint. When in manual mode the target speed can be adjusted by the operator via the key pad and it will remain at that speed until it is readjusted or until the mode of control is changed. To view, adjust, or select the manual speed control mode press the **MAN** key.

There are three different **AUTOMATIC** governor setpoint modes. These include the local warmup/run control mode, the remote 4-20 current loop mode and the remote serial control mode. Press the **AUTO** key to view the current auto mode, to change from manual mode, or to change from the current auto mode.

All changes of the control mode must be confirmed by pressing the **ENTER** key while viewing the screen describing the "from" and "to" modes as well as the "from" and "to" target speeds.

Note: The MANUAL mode setting can be adjusted in two places, here and under the CAL SETTINGS menu.

12.2 Press **MAN** to view or adjust the manual speed setpoint if already in manual mode.

FROM MANUAL MODE HOME SCREEN

```
FUELING M 300RPM
14.56mS    105.0°
```

PRESS **MAN**

MANUAL VIEW OR ADJUST SCREEN — MANUAL ACTIVE

```
MANUAL     LOCAL
MODE   ↑↓   = 300
```

PRESS TO INCREASE ↑ **PRESS TO DECREASE** ↓

12.3 Press **MAN** to select the **MANUAL** mode if NOT already in **MANUAL** mode.

FROM LOOP MODE HOME SCREEN

```
FUELING L 249RPM
13.14mS    105.0°
```

PRESS **MAN**

MANUAL SELECT OR ADJUST SCREEN — LOOP STILL ACTIVE

```
from A-LOOP= 250
ENT? MAN ↑↓= 300
```

PRESS TO CONFIRM MANUAL **ENTER**

PRESS TO EXIT **ESC**

MANUAL VIEW OR ADJUST SCREEN — MANUAL ACTIVE

```
MANUAL     LOCAL
MODE   ↑↓ =  300
```

PRESS TO INCREASE MANUAL **↑**

PRESS TO DECREASE MANUAL **↓**

12.4 From the **MANUAL MODE** home screen press the **AUTO** key to select or view the previous or any other automatic mode. The first "from" "to" screen will display the last selected automatic mode. From there, pressing **ENTER** will enable that auto mode, or pressing **ARROWS** permits the selection of a new auto mode prior to switching from manual to auto mode.

FROM MANUAL MODE HOME SCREEN

```
FUELING M 295RPM
14.56mS    105.0°
```

PRESS **AUTO**

AUTO LOOP SELECT SCREEN — MANUAL ACTIVE

```
from MANUAL= 295
ENT? A-RUN = 300
```

PRESS FOR AUTO=SERIAL ↓

AUTO LOOP SELECT SCREEN — STILL MANUAL

```
from a-run = 290
ENT? a-ser = 200
```

PRESS AUTO= WARM/RUN MODE ↑

AUTO LOOP SELECT SCREEN — STILL MANUAL

```
from a-run = 290
ENT? a-loop= 200
```

PRESS CONFIRM AUTO=SERIAL **ENTER**

AUTO LOOP SELECT SCREEN — STILL MANUAL

```
from MANUAL= 295
ENT? A-LOOP= 300
```

PRESS CONFIRM A-LOOP **ENTER**

AUTO LOOP SELECT SCREEN — NOW LOOP

```
AUTOMATIC REMOTE
LOOP 20.0ma= 300
```

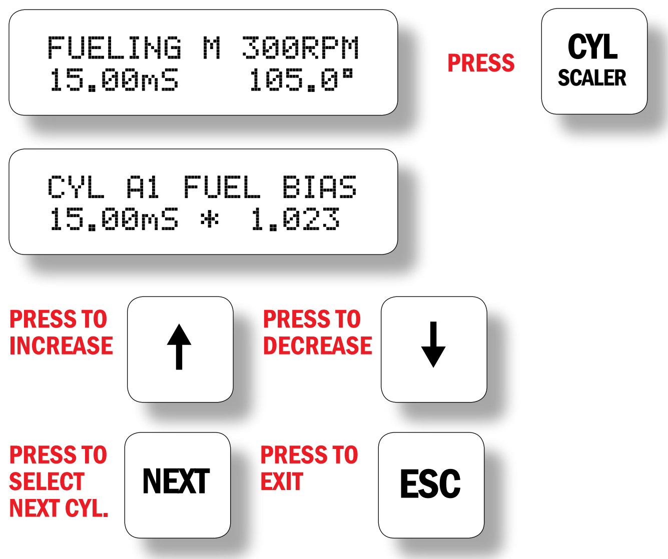
13.0 CYLINDER BALANCE USING FUEL BIAS FUNCTION:

13.1 The cylinder bias function provides a means to adjust the torque balance of the various cylinders of the engine. Each cylinder has it own assigned bias factor which can be adjusted between 0.5 and 1.5. Changes are not permitted while protection is activated.

13.2 The individual cylinder bias is applied to the governor command pulse width after it has been manipulated by the minimum and maximum pulse width limits. Therefore, the actual maximum fuel pulse delivered to cylinder A1 with a bias factor of 1.5 would be 1.5 * **MAX-PW**. The minimum fuel pulse delivered to cylinder A2 with a bias factor of 0.5 would be 0.5 * **MIN-PW**.

13.3 The cylinder bias factor as well as the resulting fuel pulse width being delivered can be viewed, as well as adjusted as described below.

FROM ANY HOME SCREEN



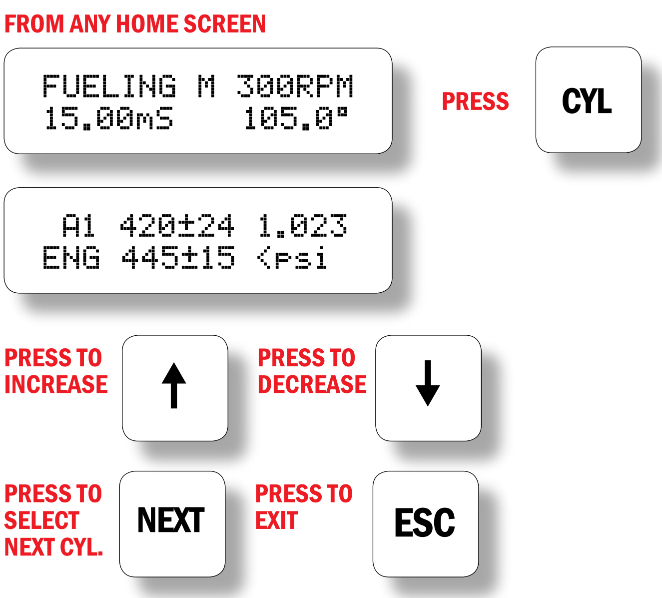
14.0 HYPERBALANCE MODULE SUPPORT FEATURES:

14.1 The HyperFuel Valve controller has been designed to interface with a **HYPERBALANCE** module. This interface permits an add-on module to adjust the individual cylinder fuel bias factors as well as to utilize basic display features to provide a user interface. The support features are accessible to the add-on device through the RS-485 serial port. The **HYPERBALANCE** module must be the MODBUS Master to the HyperFuel Valve controller, which is the slave.

Generic support for a "**REMOTE BALANCE**" function permits remote adjustment of the cylinder bias factors over the MODBUS RS-485 serial port.

This section describes the interface screens which relate to the **HYPERBALANCE** module. Additional information should be obtained from the **HYPERBALANCE** supplier.

14.2 The presence of a **HYPERBALANCE** module is signaled by a specific MODBUS write to a dedicated display array within the HyperFuel Valve controller. When data is written to this array, the cylinder bias screen **DESCRIBED IN 13.3** is enhanced to provide engine average and cylinder-specific average peak pressure and pressure deviation. In the example screen below, cylinder A1 is running with a fuel bias factor of 1.023 and is firing with an average pressure of 420 psi with typical variation of 24 psi. This cylinder-specific data can be compared to the engine average data which is depicted on the bottom line of the screen.



14.3 Various status screens relating to the **HYPERBALANCE** module are accessible from the HyperFuel Valve controller.

FROM ANY HOME SCREEN

```
FUELING M 300RPM
15.00mS    105.0°
```

PRESS **F1**

When a HYPERBALANCE module is present, this will be the most typical status screen.

```
READY TO BALANCE
 ENTER TO BEGIN
```

If the HYPERBALANCE module detects an out of balance condition, it can recommend that the user re-balance the engine.

```
BALANCE REQUIRED
 ENTER TO BEGIN
```

The balance request has been made, but cylinder bias factors are not yet being remotely adjusted.

```
  PREPARING TO
 BALANCE ENGINE
```

HYPERBALANCE is currently performing a re-balance of the engine.

```
 BALANCING NOW
 ENTER TO ABORT
```

Current conditions as determined by the HYPERBALANCE module are restricting the initiation of the balance function.

```
  NOT READY TO
    BALANCE
```

HYPERBALANCE is detected, but the support feature is turned off within the HyperFuel Valve controller.

```
 REMOTE BALANCE
SUPPORT DISABLED
```

HYPERBALANCE is not sending data to the HyperFuel Valve controller.

```
 BALANCE MODULE
  NOT  DETECTED
```

14.4 Provisions for a **HYPERBALANCE** module to report diagnostic messages are also included. A warning condition relating to any of these messages also turns on the alarm indicator and output similar to HyperFuel Valve warnings in **SECTION 10.2**.

FROM ANY HOME SCREEN

```
FUELING M 300RPM
15.00mS    105.0°
```

PRESS **F1**

Then from the diagnostic description screens use the following keys.

PRESS TO VIEW NEXT DIAG. **DIAG** **OR PRESS TO VIEW NEXT DIAG.** **NEXT** **PRESS TO EXIT** **ESC**

HYPERBALANCE module can report a problem with its magnetic pickup input signal.

```
*BALANCE MODULE*
 MAG PICKUP ERR
```

HYPERBALANCE module can report a problem relating to the pressure sensor gain calibrations.

```
*BALANCE MODULE*
 SENSOR GAIN ERR
```

HYPERBALANCE module can report a detected problem relating to combustion stability.

```
*BALANCE MODULE*
UNSTABLE COMBUST
```

HYPERBALANCE module can report a detected problem relating to engine balance conditions.

```
*BALANCE MODULE*
POOR ENG BALANCE
```