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

NOTE: THESE INSTRUCTIONS COVER FIRMWARE VERSIONS 2.0 AND 2.1.

1.0 OVERVIEW

1.1 The Altronic CPU-2000 Digital Ignition system has been designed for application on large, natural gas fueled engines and integral compressors. This system is field-programmable and offers a variety of advanced control, emissions reduction, diagnostic, monitoring and engine protection features. The system consists of two main parts: a user interface Logic Module and an engine mounted Output Module.

1.2 This document provides instructions and descriptions to be used in the operation of the ignition system, and does not cover physical installation. Reference form CPU-2000 II for instructions regarding installation and mounting.

WARNING: THE IGNITION SYSTEM MUST BE CONFIGURED PRIOR TO USE ON AN ENGINE. REFER TO SECTION 9.7 TO VIEW THE CURRENT CONFIGURATION.

THESE INSTRUCTIONS COVER FIRMWARE VERSIONS 2.0 AND 2.1. REFERENCE FORM CPU-2000 PI FOR INSTRUCTIONS DESCRIBING HOW TO CONFIGURE THE IGNITION SYSTEM. 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 key-pad 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 ignition warning, or a diagnostic 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 ignition 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 unpowered. A typical application would be as a relay or solenoid coil driver.

- The FIRE-CONFIRM OUT switch is closed to signal that the ignition is running with no faults or ignition warnings. Warnings identified by the Diagnostic Module do not effect this output. Note: Switch is not opened for warnings with firmware version 2.1.
- The SHUTDOWN OUT switch is closed to signal that the ignition has detected no faults which would result in a self shutdown. Upon detecting a fault that would result in a self-shutdown of the ignition, this switch will open.
- The ALARM OUT switch is closed to signal that no un-acknowledged faults or warnings are present. Upon detection of a fault, ignition warning or a diagnostic warning, this switch will open. This output is designed to control an alarm indicator or sounding device.

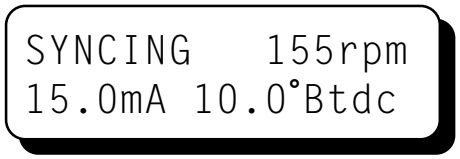
4.0 UNDERSTANDING THE HOME SCREEN

4.1 A series of "home" screens are used to describe the current status of the ignition system. The LCD display always reverts back 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 current loop (xx.x mA) in the lower left corner and the global ignition timing (xx.x˚BTDC or xx.x˚ATDC) in the lower right corner.

4.3 The READY message is displayed when the ignition is ready for the engine to crank for starting.

4.4 Once the engine begins turning, the SYNCING message is displayed while the ignition system verifies signals from the engine pickups.



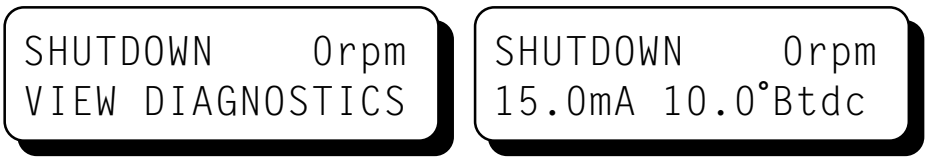
4.5 The FIRING message is displayed when the ignition begins firing. Additional data is provided on this screen to describe the selected mode of operation for the ignition. The energy mode (E1,E2,E3) and the single-strike / multi-strike type (S or M) are described in the middle of the upper line in small characters.

4.6 The STALLED message is displayed when a loss of rotation is detected after the ignition is firing and neither a SHUTDOWN or FAULT has occurred. This signifies that the engine has stopped without any detected cause from the ignition system.

4.7 The WARNING message will supersede all of the above home screens if an ignition warning or diagnostic warning condition is present. When any warning exists, a VIEW DIAGNOSTICS message will flash on the bottom line of the display. The ignition 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: Firmware version 2.0 and earlier also will open the Fire Confirm Out switch for ignition warnings. The various types of diagnostic warnings are described in section 10.0.

4.8 The FAULT message will supersede 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 ignition 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 Fire 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. The various types of diagnostic faults are described in section 10.0.

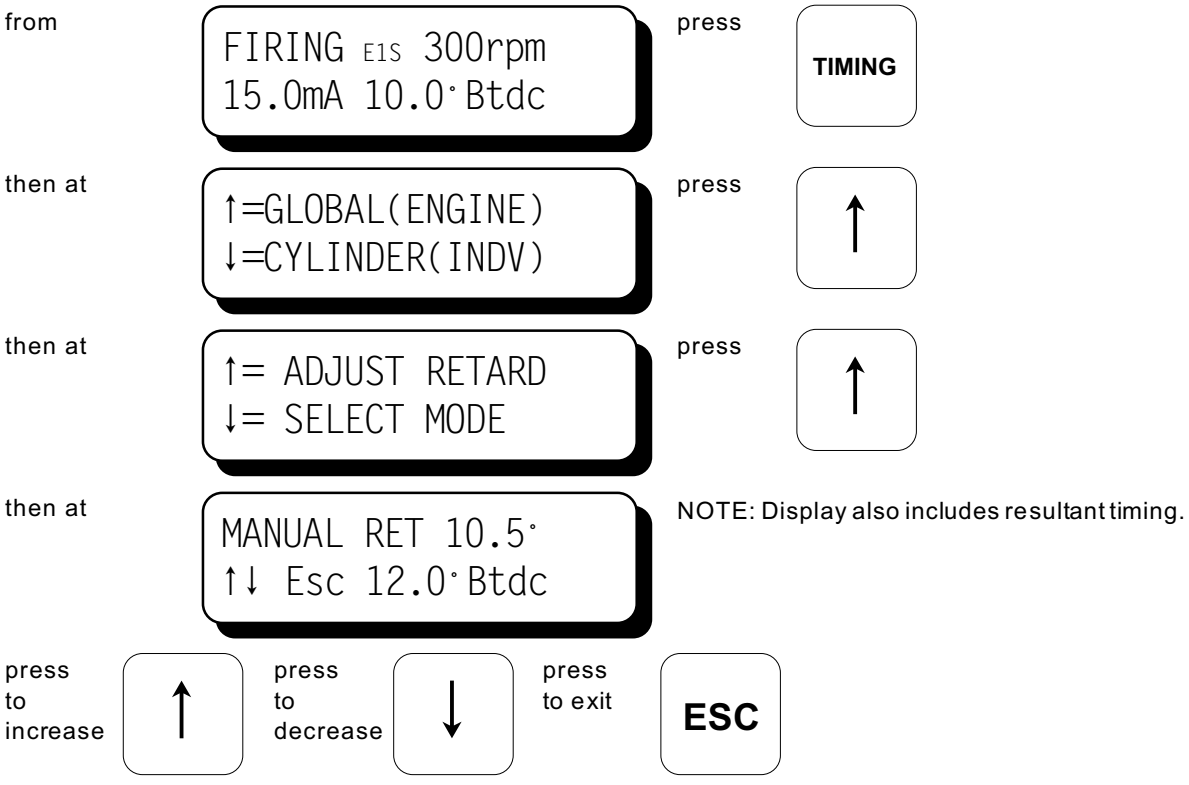
4.9 The SHUTDOWN screen will supersede all other home displays if the shutdown input is grounded or if the shutdown input was grounded and the engine has not stopped rotating. This screen indicates that the ignition is not firing because the shutdown input was activated to shutdown the engine. The Fire Confirm Out switch will change state (switch opens) and the other outputs will function as described above based on the existence of faults or warnings. If a fault or warning exists while the ignition is in shutdown, a VIEW DIAGNOSTICS message will flash on the bottom line of the display.



5.0 ADJUSTING GLOBAL RETARD

5.1 Global retard is an adjustment affecting the timing of all cylinders equally. This adjustment can be equated to the manual timing switch of the Altronic II-CPU system. Adjustments made as described below will be in effect until another adjustment is made.

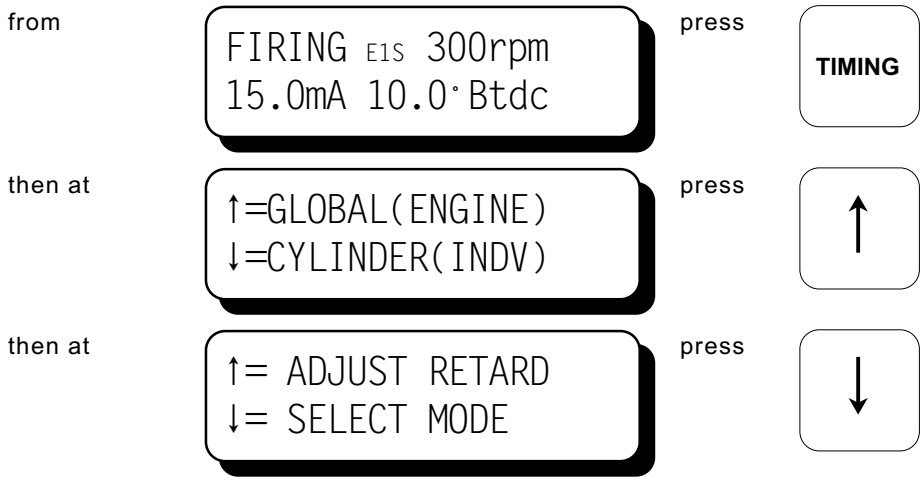
5.2 To adjust global retard:



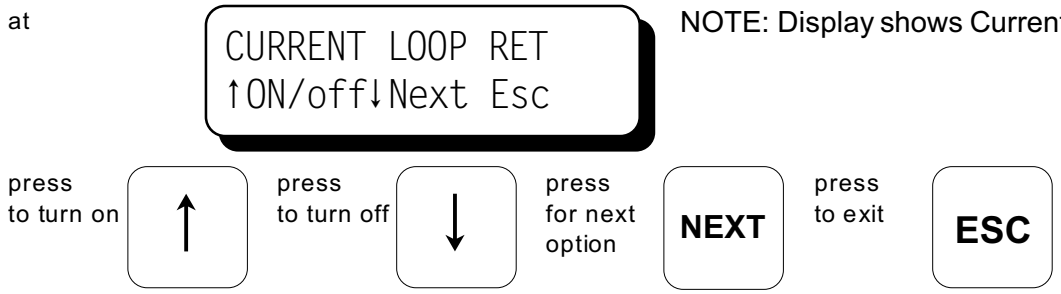
5.3 The increment of timing change is dependent on the number of holes or teeth being sensed. The minimum timing change is equal to "90/N" where N = no. of holes or teeth. EXAMPLE: For 360 holes, the minimum timing change increment is 90/360 = 0.25 degrees.

6.0 SELECTION OF GLOBAL TIMING MODES

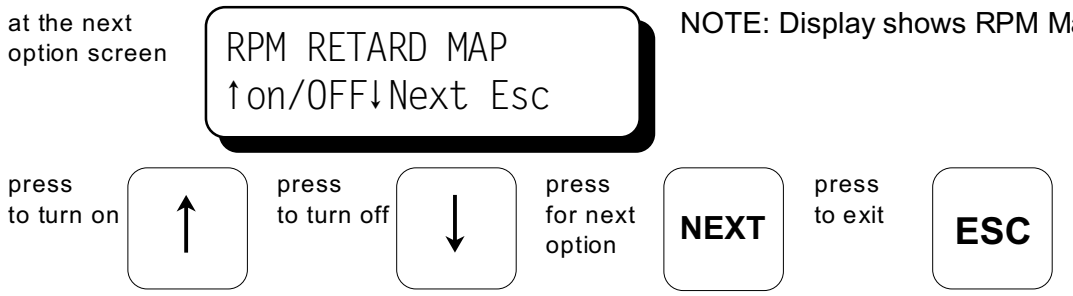
6.1 Several options exist with regard to global timing modes. Once the global timing mode menu is entered as described below, the status of each option can be viewed and changed.



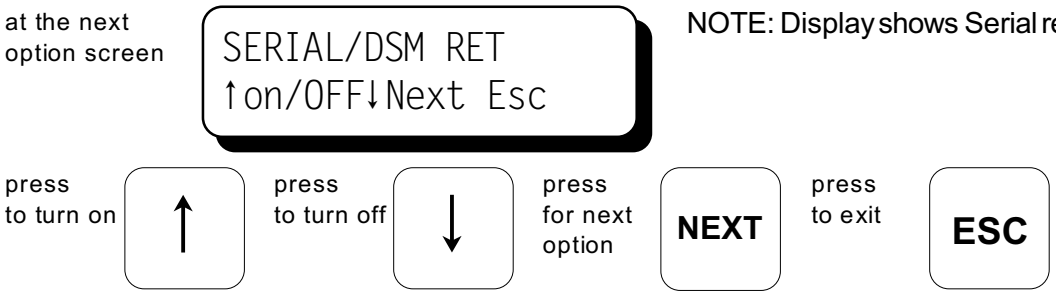
6.2 The first mode selection can enable or disable the pre-configured retard curve controlled by the 4-20 mA current loop input. The choices are ON and OFF, with the active selection displayed in capital letters. To configure the 4-20 mA curve, reference form CPU-2000 PI. When the current loop is on, the home screen displays the current loop value (xx.x mA). When the current loop is off, the display reads (xx.x ma).



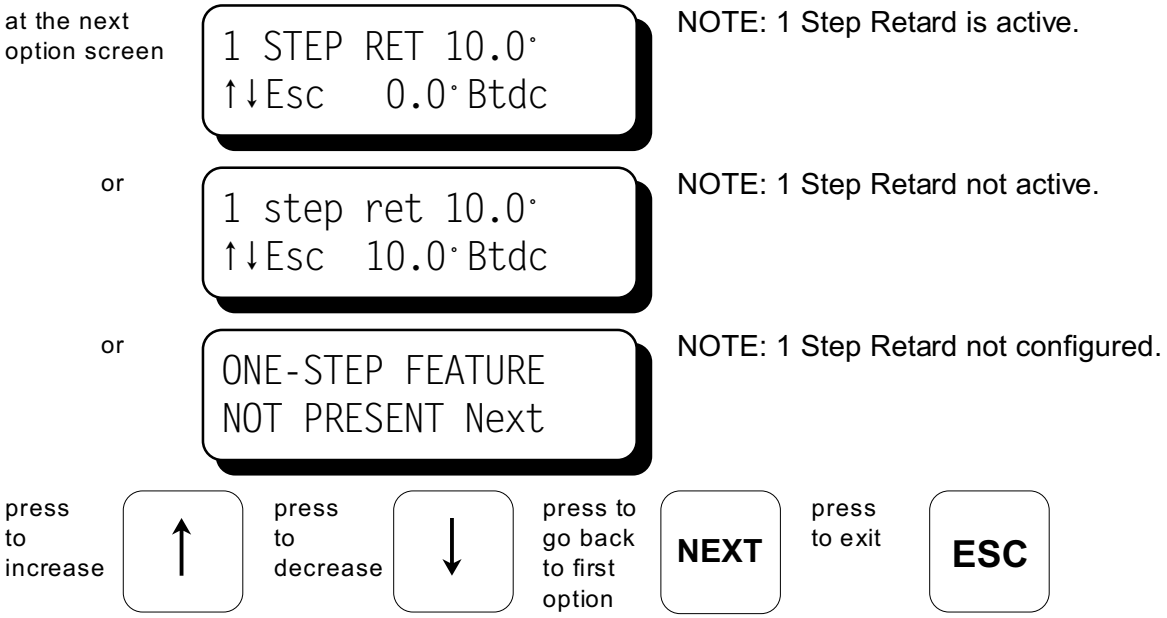
6.3 The Next mode selection can enable or disable the pre-configured retard curve controlled internally by engine RPM. To configure the RPM retard curve, reference form CPU-2000 PI.



6.4 The Next mode selection can enable or disable the additional retard value controlled by the serial port. To use this option reference form CPU-2000 PI.



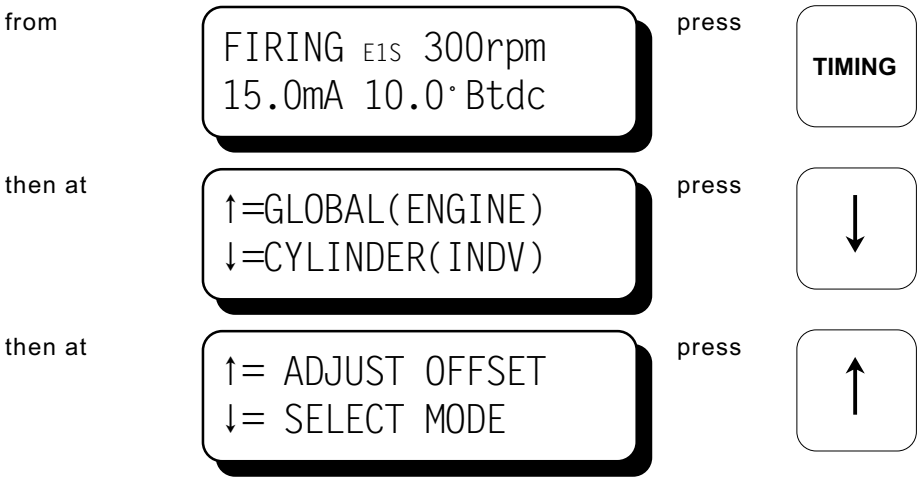
6.5 The Next mode selection can increase or decrease the one-step retard value. The first screen below is displayed when 1 step retard is both configured and is active. The second screen below is displayed when the 1 step retard is configured but not active. The default configuration selects one step retard to be controlled by the Misc Input terminal. The additional retard would be implemented when the input is grounded. The third screen below is displayed when the one-step retard feature is not configured. The actual engine timing is displayed on this screen so the effect of 1 step retard can be seen during adjustments (if the Misc Input terminal is grounded).



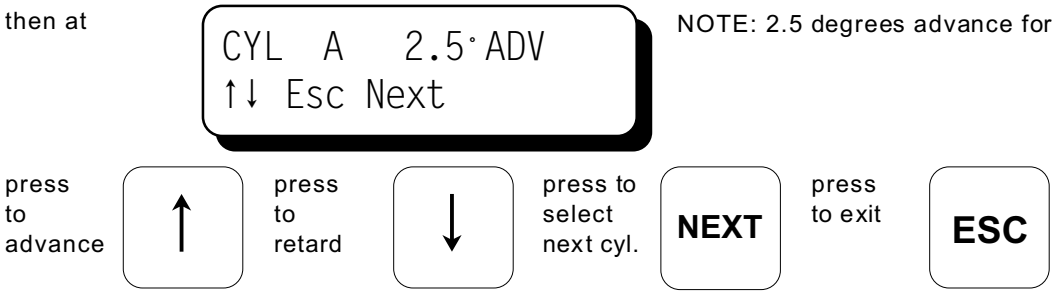
7.0 ADJUSTING INDIVIDUAL OFFSETS

7.1 The 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 ignition will revert back to the values saved in EEPROM memory on every start or power-up. To save temporary adjustments to EEPROM memory see section 8.0.

7.2 Enter the individual timing adjustment menu as described below.



7.3 The individual timing adjustment screen identifies the primary output(s) to be adjusted, and the degrees of offset in use for the output(s). In some cases, two outputs are controlled together.



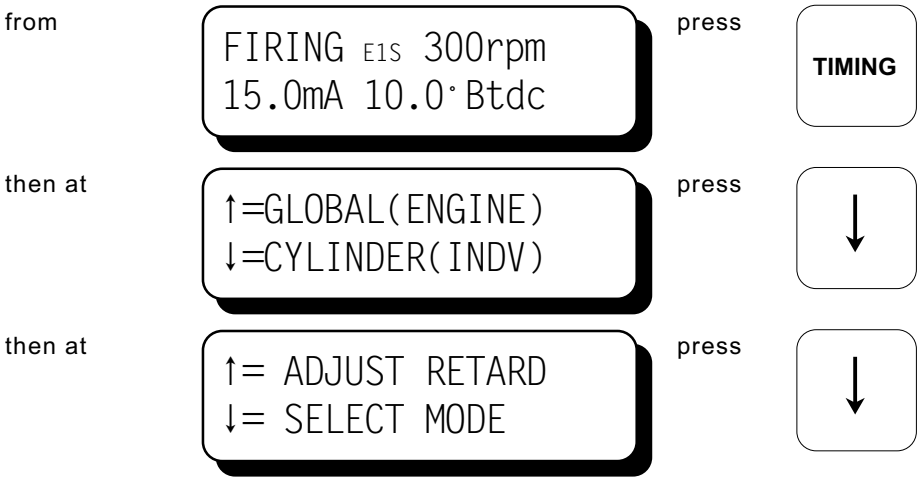
7.4 The output identification characters will be provided as follows:

A B C D for Output Module 291116-1 with 1 output per cylinder.
A,B C,D E,F G,H for Output Module 291116-1 with 2 outputs per cylinder.

A1 A2 B1 B2 for Output Module 291132-1 with 1 output per cylinder.
A12 B12 C12 D12 for Output Module 291132-1 with 2 outputs per cylinder.
A12 B12 C12 D12 for Output Module 291132-2 with 2 outputs per cylinder.

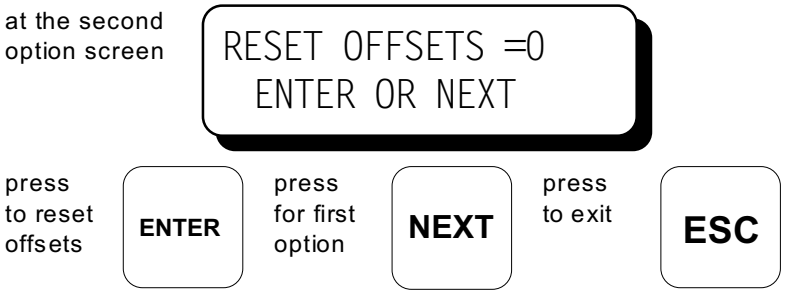
8.0 INDIVIDUAL CYLINDER OFFSET MODES

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



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

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



9.0 SETUP CONTROL OPTIONS

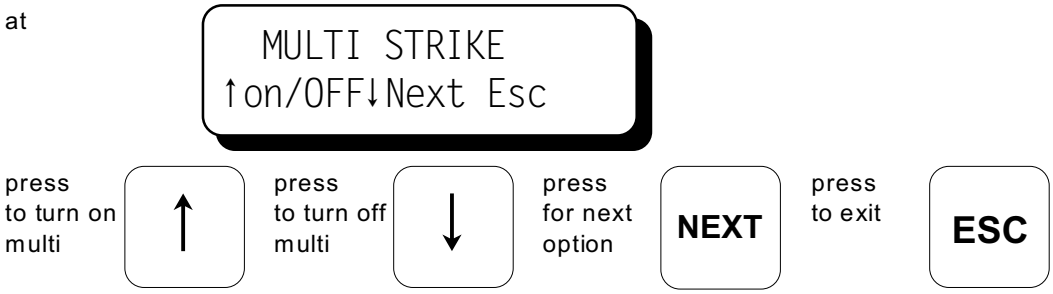
9.1 Additional control settings and display features can be accessed under the setup menu. Changes made under the Setup menu are stored in EEPROM and remain fixed until changed again. The Setup menu can be entered as described below.

9.2 The first setup screen permits the operator to enable or disable the Multi-Strike feature.

Note 1: One of two special features can be selected during configuration to force Multi-Strike to be active below 200 rpm, or when the Misc Input is grounded. This feature is not active in a standard configuration.

Note 2: The Multi-Strike feature is automatically turned off above 500 rpm. (750 rpm for firmware version 2.1)

Note 3: The use of Multi-Strike firings may tend to accelerate spark plug electrode erosion.



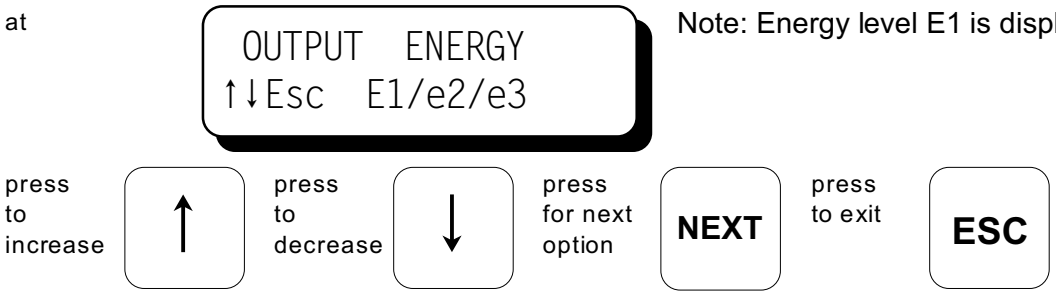
9.3 The next setup screen permits the operator to select from one of three ignition energy levels (E1,E2,E3). The energy levels are 125 millijoules (E1), 150 millijoules (E2), 185 millijoules (E3).

Note 1: One of two special features can be selected during configuration to use the maximum energy level below 200 rpm, or when the Misc Input is grounded. This feature is not active in a standard configuration.

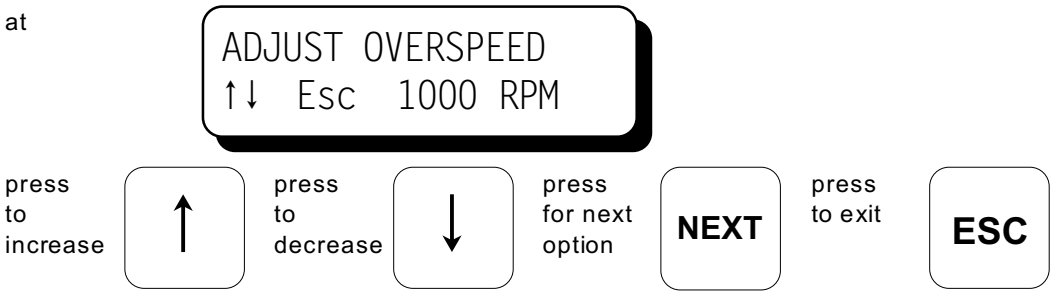
Note 2: The energy is automatically limited to E2 when Multi-Strike is active.

Note 3: The use of higher spark energy may tend to accelerate spark plug electrode erosion.

Note 4: Energy control features available with the optional Diagnostic Module may be configured to automatically select the energy level (to a level different than selected here) based on secondary spark data.

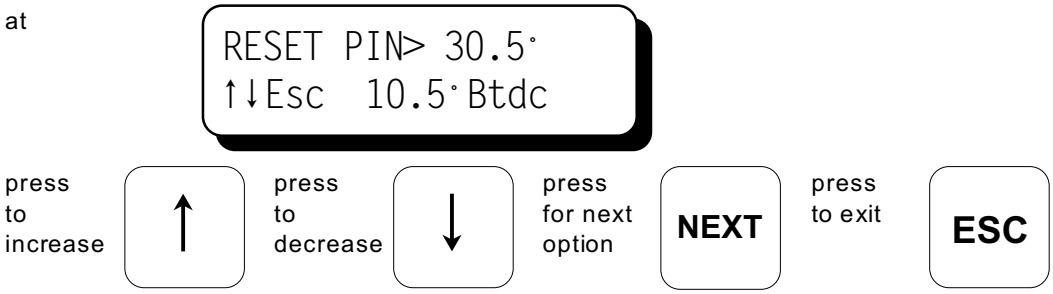


9.4 The next setup screen is used to adjust the engine overspeed setpoint. The setpoint can be adjusted in increments of 5 rpm to a maximum of 1275 rpm.

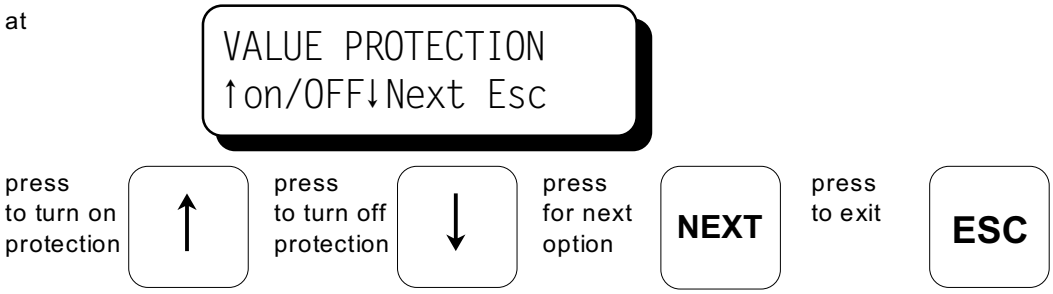


9.5 The next setup screen is used to specify the exact position of the reset pin. Both the reset position and the engine timing are displayed. Adjustments are made here to make the displayed timing match the actual spark timing as verified with a timing light. This adjustment effects the displayed timing but does NOT change the actual timing of the firings.

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

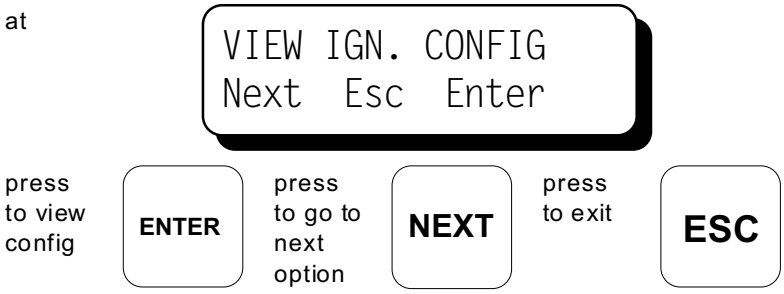


9.6 The next setup screen is used to enable or disable VALUE PROTECTION of all user values in the EEPROM memory. When protection is on, none of the EEPROM settings under the Setup or Timing menus can be changed. This feature can be used to provide limited protection from random changes by inexperienced operators.



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

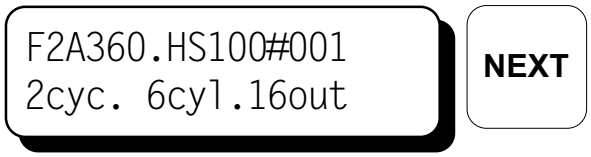
NOTE: Because EEPROMS can be reconfigured (using a PC and Altronic's configuration software), these comments should be viewed to identify and verify the configuration settings of the ignition prior to operation. Refer to form CPU-2000 PI for further information on configuration.



The configuration screens are shown starting on the next page.

The following types of screens can be viewed by pressing enter to start and next to advance.

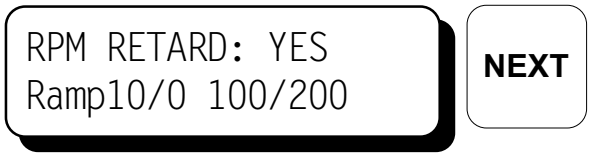
-Firing pattern code: (F2A360.HC100)
-Special Feature code: (#001) (1step default)
-Engine Type: (2cyc) (6cyl)
-Output Module Type: (16out)



-Date Configured: (01-01-95)
-Time Configured: (001)
-Configured By: (User Name)

-Current loop Curve Description
at 4 mA 0˚ retard
at 20 mA 24˚ retard
User specified description

-RPM Retard Curve Description
retard 10˚ below 100 rpm
ramp to 0˚ at 200 rpm
User specified description



-Location:
User specified description

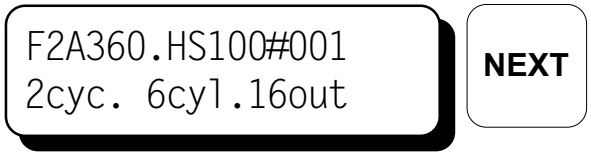
-Engine Number or Description
User specified description

-Special user comments area #1
User specified comments

-Special user comments area #2
User specified comments

-Rotation continues again through the 8 configuration comment screens.

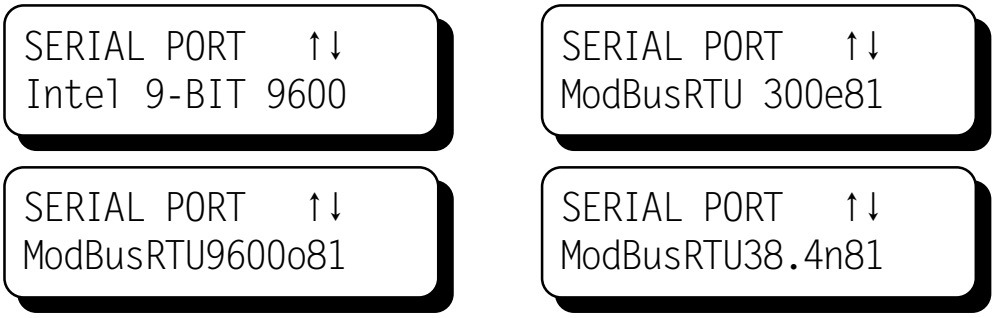
ESC. To exit to home screen.



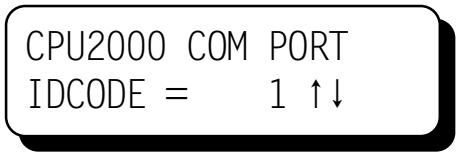
MEMORY PART NO. CODE: Example: F2A360.HS012#005

DESIGNATOR	DESCRIPTION
F	Letter in alphabet corresponding to no. of engine cylinders: C=3, D=4, E=5, F=6, G=7, H=8, I=9, J=10, L=12, N=14, P=16, R=18, T=20, X=24, Z=32
2	Engine stroke-cycle: 2 = 2-cycle 4 = 4-cycle 6 = 2-cycle with two outputs for each cylinder/2nd plug cutout feature 8 = 4-cycle with two outputs for each cylinder/2nd plug cutout feature
A	Altronic firing pattern code: A = even firing pattern, Other letters = odd firing pattern
360	No. of sensed teeth or holes: 360 = 360 holes or teeth
H	Memory series code: H = CPU-2000
S	Timing curve code: A = 48 degree retard for 4-20 mA input, 3 degrees retard default timing B = 36 degree retard for 4-20 mA input, 3 degrees retard default timing C = 24 degree retard for 4-20 mA input, 3 degrees retard default timing N = special range vs. 4-20 mA or RPM, non-factory programmed S = special range vs. 4-20 mA or RPM, factory programmed X = no timing curve programmed
012	Special timing curve version no. (only for types N and S) Note: This number must be selected and documented by the originator.
#005	Feature code (add numbers chosen; only one choice permitted per feature): 001 = 1-step retard when misc. input is grounded 016 = 1-step retard when rpm is less than 200 002 = Max. energy when misc. input is grounded 032 = Max. energy when rpm is less than 200 004 = Extended firing when misc. input is grounded 064 = Extended firing when rpm is less than 200 008 = Fire 2nd plug only when misc. input is grounded 128 = Fire 2nd plug only when rpm is less than 200 Example: 005 = feature 001 + feature 004.

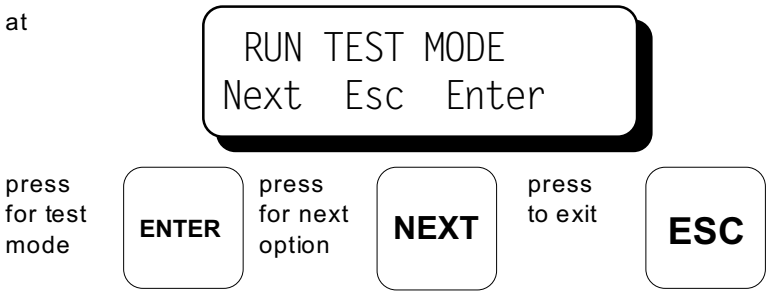
9.8 The CPU-2000 running firmware version 2.1 includes this screen which used to view and select 1 of 25 communications parameter options which include the standard Intel 9-bit programming protocol and 24 additional ModBus RTU modes. ModBus RTU configurations include 3 parity modes (even odd, none) and 8 baud rates (300, 600, 1200, 2400, 4800, 9600, 19200, 38400). Display screens are formatted as depicted below. Firmware versions 2.0 and earlier support only the Intel 9-BIT mode, which is used in all versions to program the system.



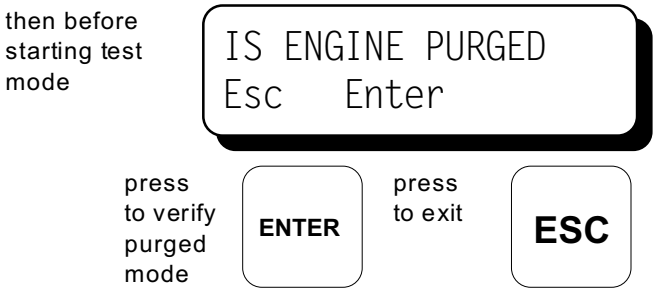
9.9 The Altronic CPU-2000 running firmware version 2.1 includes this screen used to view and select the communication ID-Code or Node-ID. The keypad can be used to select the ID-Code in the range of (0 to 255). Suitable ID-Codes for ModBus are (1 to 247), while suitable ID-Codes for the standard Intel 9-bit communication format are (1 to 254).



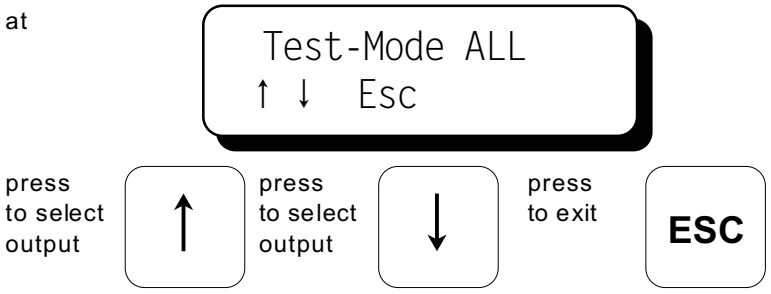
9.10 The next setup screen permits the operator to enter an ignition test mode. This test mode can fire all outputs in rotation, or individual outputs at a slow rate. This feature can be used to troubleshoot primary wiring and output module operation. Test mode will terminate if rotation of the engine is sensed.



WARNING: The operator MUST 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 the test mode screen indicates that the ignition is firing and permits the operator to select the output to be fired.



Test-Mode selection rotates as described below.

ALL,A,B,C,D,E,F,G,H,J,K,L,M,R,S,T,U,ALL,A,B,C,D..... for Output Module 291116-1

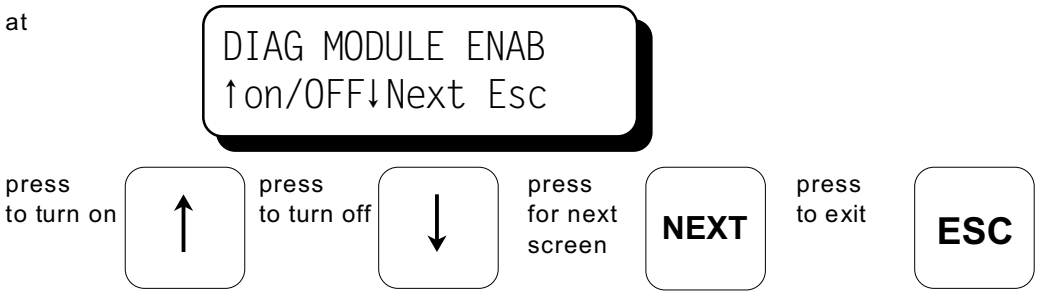
ALL,A1,A2,B1,B2,C1,C2,D1,D2,E1,E2,F1,F2,G1,G2..... for Output Modules 291132-1 and -2

9.11 The next setup screen is used to enable or disable the expanded secondary diagnostic features available with the optional CPU-2000 Diagnostic Module.

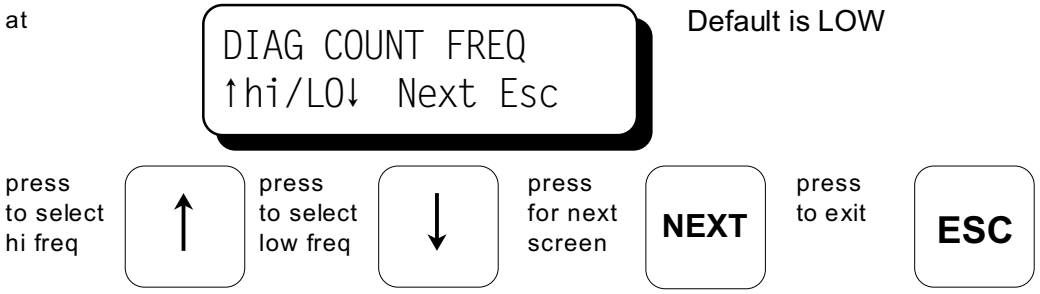
NOTE 1: hen "OFF" is selected this will be the last setup screen.

NOTE 2: When "ON" is selected and the Diagnostic Module is not connected, an ignition warning will be flagged.

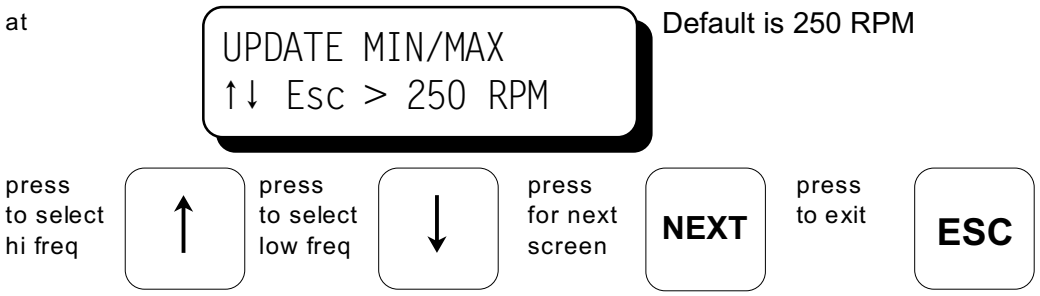
NOTE 3: Pressing the "RESET" key from this screen will re-initialize all Diagnostic Module settings to their default values (required upon installation).



9.12 WITH OPTIONAL DIAGNOSTIC MODULE ONLY: The next screen is used to select the counter frequency of the optional Diagnostic Module monitor circuit. Low frequency is the default setting which is recommended when one coil is connected to each output. The high frequency setting can be used to obtain more resolution in the diagnositic number when two coils in parallel are connected to each primary output. NOTE: The secondary diagnostic features are designed for use with AtIronic coils 291001 and 291001-S; do not use other types of coils.



9.13 WITH OPTIONAL DIAGNOSTIC MODULE ONLY: The next screen is used to select the RPM at which to permit the update of the MIN/MAX historical cylinder data array. This feature is provided to avoid the update of the MIN/MAX values when the engine is running below normal loaded conditions.



10.0 CPU-2000 DIAGNOSTICS

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

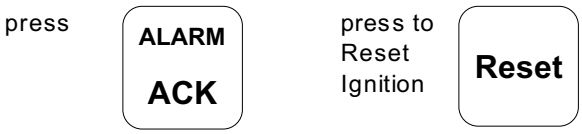
- The ignition will stop firing
- The Shutdown Out switch will open.
- The Fire Confirm Out switch will open.
- The Alarm Out switch will open.
- The Alarm LED on the front panel will turn on.
- The home status will read FAULT, and the bottom line will flash VIEW DIAGNOSTICS.

Diagnostic FAULTS will supersede diagnostic WARNINGS.

10.2 A warning represents the least severe classification of problems. The ignition will continue to fire in the presence of any warning. The list of warnings is expanded to include coil primary and secondary diagnostics when the Diagnostic Module is present. NOTE: These additional primary and secondary warnings do not operate the Fire Confirm Out Switch. 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 Fire Confirm Out switch will open (firmware versions 2.0 and earlier only).
- The home status will read WARNING, and the bottom line will flash 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 ignition system after the faults or warnings have been addressed.



Acknowledgement 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.

Resetting the system (Reset) returns all indicated fault and warning indicators and outputs to the normal condition, resets temporary timing offset values, and re-arms the ignition to begin firing if faults are no longer present.

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 are described below.

When zero gear-tooth pulses are seen between two reset pulses.

```
GT PICK-UP FAULT
MISSING   PULSES
```

When too many gear-tooth pulses are seen without a reset pulse.

```
RS PICK-UP FAULT
MISSING   PULSES
```

When there are no Hall-effect pickup pulses or when the pick-ups are not synchronized.

```
HE PICK-UP 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 overspeed setpoint.

Maximum observed speed is also displayed.

```
ENGINE OVERSPEED
  1023 RPM
```

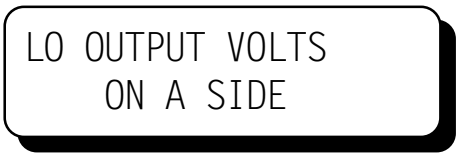
When the check-sum of microprocessor firmware cannot be verified.

Unit requires service.

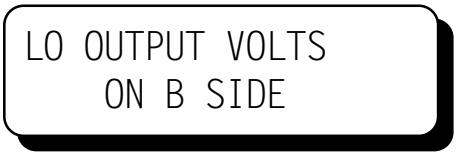
```
BOTTOM  BOARD uP
CHECKSUM  FAILED
```

10.6 The basic ignition diagnostic warning screens in order of display priority are described below.

This screen indicates that the A SIDE capacitor was not fully charged when a firing occurred. This affects outputs A,C,E,etc. (16-output) or A1,B1,C1,etc. (32-output).



This screen indicates that the B SIDE capacitor was not fully charged when a firing occurred. This affects outputs B,D,F,etc. (16-output) or A2,B2,C2,etc. (32-output).



This screen indicates that output pins "A" & "S" of connector 1 have primary faults. This would normally indicate faulty wiring or a bad coil, but may also indicate an Output Module problem.

This screen indicates that output pin "B" of primary connector 2 has a primary fault. Only 32-output Module 291132-1 has two connectors.

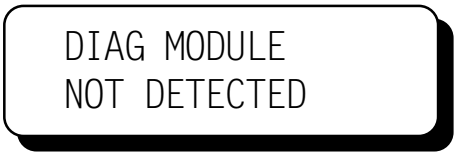
This screen indicates that the current-loop has deviated outside the limits of 2 mA and 22 mA. When this diagnostic is present, the current loop continues to follow the configured current loop curve which can be specified from 0 to 25 mA.

Note: Timing defaults to a programmable setting; see form CPU-2000 PI.
This diagnostic feature is not active when the current loop retard is turned off.

This screen indicates that 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.

This screen indicates that the firing pattern configuration data saved in EEPROM memory is incorrect or incomplete. The EEPROM memory must be reprogrammed or replaced.

This screen indicates that the ignition system is expecting but cannot detect the diagnostic module. If the diagnostic module is not connected, select diag module "off" from the appropriate setup screen.



11.0 DIAGNOSTIC WARNING SCREENS WITH OPTIONAL DIAGNOSTIC MODULE

11.1 The additional diagnostic warning screens provided by the Diagnostic Module are described below in the order of display priority. The second row of each display identifies which output has flagged the warning. The number "1" or "2" on the far right of upper row describes which connector caused the warning in the case of a 32-output unit 291132-1 or 291132-2. No number is shown for 16-output unit 291116-1.

This screen indicates that the Diagnostic Module has identified an open circuit on the primary output pin “C” of connector “1". This would normally indicate faulty wiring or a failed coil.

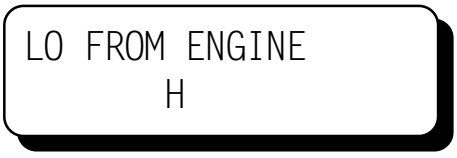
This screen indicates that the Diagnostic Module has identified a short circuit condition on the primary output pin “D”. This would normally indicate a mis-wired coil or a shorted primary.

This screen indicates that the Diagnostic Module has identifed a low spark demand condition on the plug at the “E” coil. This is often caused by a shorted spark plug or shorted secondary wire.

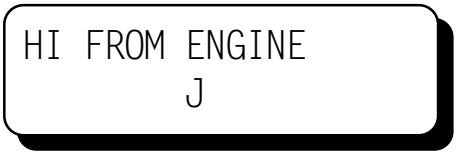
This screen indicates that the Diagnostic Module has identified a high spark demand condition on the spark plug at the “F” coil. This is often caused by worn spark plugs.

This screen indicates that the Diagnostic Module has identified a no spark condition on the plug at the “G” coil. No spark occurs when the sparkplug demand exceeds the output capability of the coil.

This screen indicates that the Diagnostic Module has detected that the average value of output “H” is significantly lower than the average of all the active outputs on the engine or connector group.



This screen indicates that the Diagnostic Module has detected that the average value of output “J” is significantly higher than average of all the active outputs on the engine or connector group.



This screen indicates that the Diagnostic Module has detected that output “K” of connector “2" is firing with significant cycle to cycle variation.

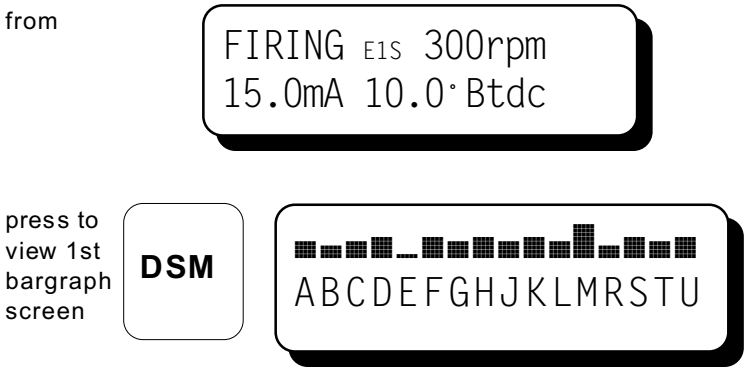
12.0 DATA DISPLAY SCREENS WITH OPTIONAL DIAGNOSTIC MODULE

12.1 Spark reference data display screens, bargraph screens and the offset adjustment screen are included with the optional Diagnostic Module. The "F1", "F2", "F3" and DSM keys are used to access and switch between these screens as described below.

NOTE: Bargraph screens ONLY exist in firmware version 2.1.

12.2 Three bargraph screens showing the relationship between the spark reference numbers of the ignition system on a global basis are available. These bargraphs provide a quick overview of each cylinder's respective value relative to the other cylinders.

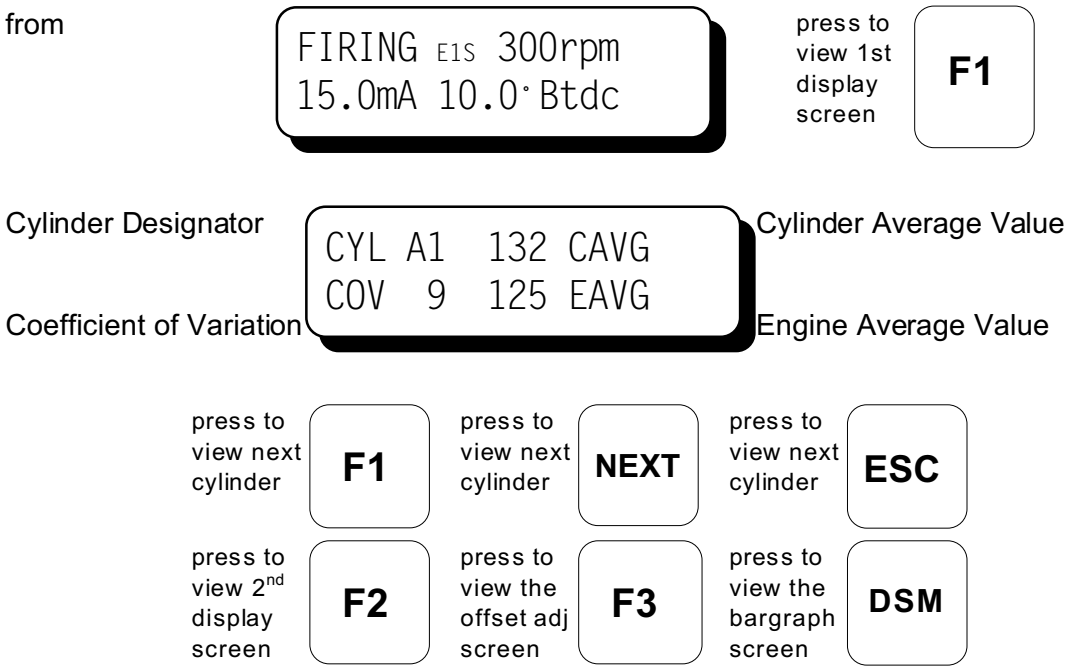
The first bargraph displays the spark reference number of each ignition output in terms of its relative magnitude. The spark reference number is scaled between the low and high alarm values. The cylinders represented by outputs with the tallest vertical bars have the highest voltage demand.



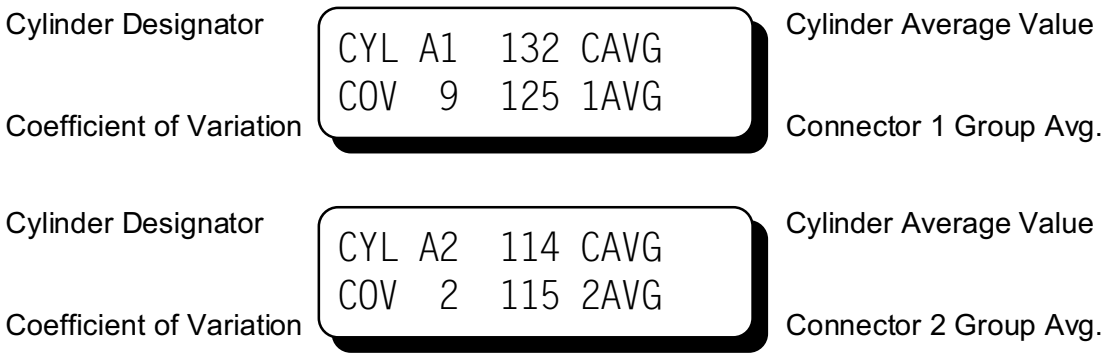
The second bargraph screen shows the difference between the spark reference number for each ignition output and the engine or group average. Scaling for this graph is determined by high and low from engine alarm values. The engine or group average is shown as a single narrow line across the middle of the character field. Bars extend up or down from narrow line to indicate relative deviation plus or minus of each cylinder from the engine or group average.

The third bargraph shows the relative magnitude of the Coefficient of Variation in voltage demand from cycle to cycle for each ignition output. The tallest vertical bars are the outputs with the greatest variation in voltage demand.

12.3 The first numeric display screen (F1) provides the cylinder average spark reference number "CAVG" which indicates the relative voltage demand of each cylinder. The average spark reference number for the entire engine "EAVG" is designed to make the comparison of a cylinder value to the overall engine value as convenient as possible. The "COV" number (coefficient of variation) is the result of a proprietary calculation which indicates the cycle-to-cycle variation of the reference numbers for each cylinder. This value increases as variation between firings of a given cylinder increases.

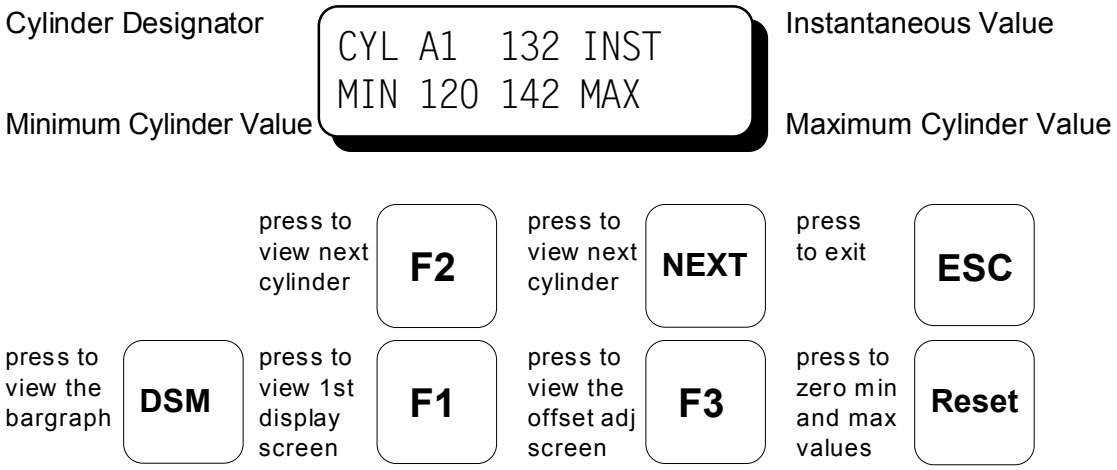


NOTE: Systems with firmware version 2.1 and a 32-output unit with memory engine cycle code “6" or “8" (2 individual outputs per cylinder) will have connector group averages displayed as shown below.

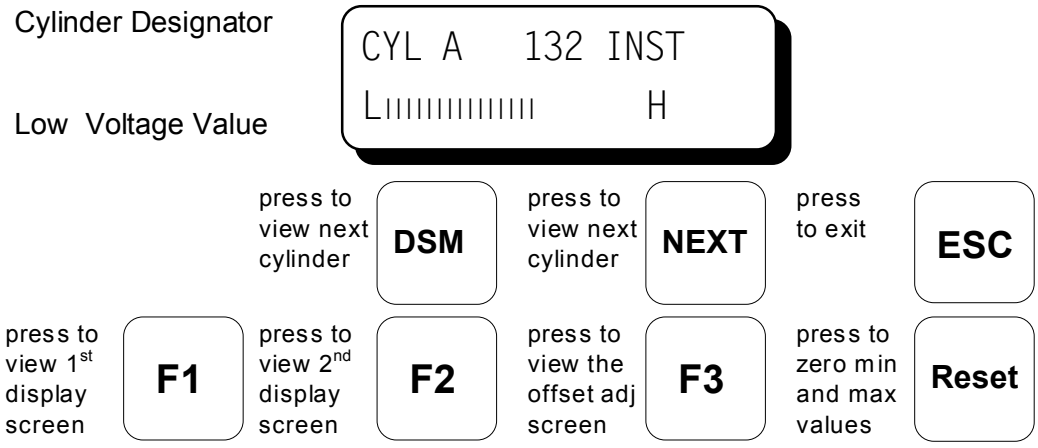


12.4 The second display screen (F2) provides the unfiltered, instantaneous spark reference number "INST". Also included is the historical range of the cylinder average displayed as "MIN" and "MAX". The MAX number is updated only when the CAVG number increases above the old MAX value. The MIN number is updated only when the CAVG number decreases below the old MIN value. Updates to MIN and MAX are restricted when the MIN/MAX rpm threshold is not satisfied. After initialization, the MIN and MAX values will display "###" until they are updated. Press "Reset" while at the second display screen to reinitialize the MIN and MAX values.

NOTE: This second display screen cannot be accessed directly from the home screen.

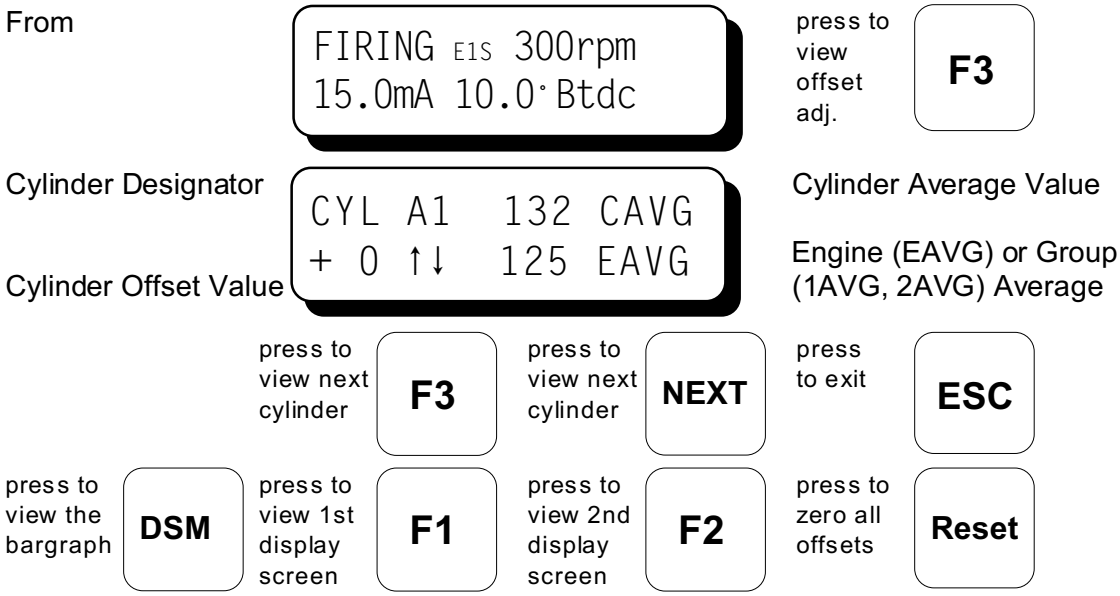


12.5 The spark reference number which shows the relative voltage demand of each cylinder can be viewed in a horizontal bargraph format. The bargraph is proportionately scaled between the low and high spark voltage alarm values. For example, the end of the bar will be halfway across the lower part of the display when the spark reference number is halfway between the low and high setpoints. This screen gives the user an overview of the current voltage demand of each cylinder relative to the low and high voltage alarm settings and a visualization of the stability of that voltage demand over time.



12.6 The offset adjustment screen (F3) permits the operator to use an offset adjustment to the spark reference number (+/- 15 counts) to compensate for minor variations in reference numbers between individual coils of the same type and voltage demand. To initialize all offset values to zero from this screen, press "Reset".

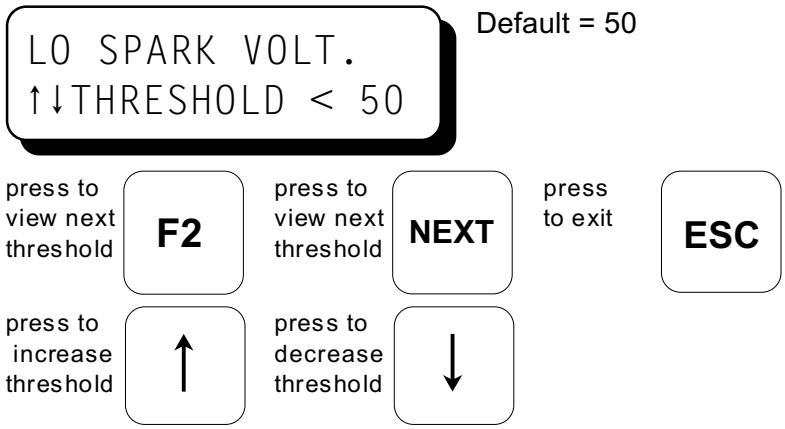
NOTE: Improper use of this feature may limit the effectiveness of the diagnostic system and result in spark reference numbers that mask, or create false, problems.



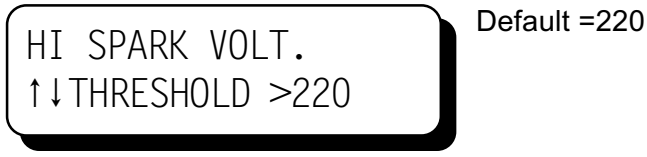
13.0 THRESHOLD ADJUSTMENT SCREENS WITH OPTIONAL DIAGNOSTIC MODULE

13.1 Ten threshold adjustment screens enable the operator to calibrate thresholds used to diagnose potential ignition problems and control ignition energy based on the spark reference numbers. All of the threshold screens have the same button functions as described with the first threshold screen.

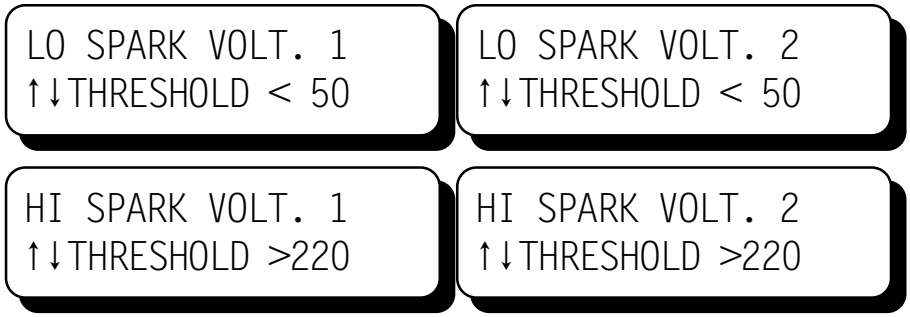
13.2 If the CAVG reference number of a cylinder is below the "LOW SPARK VOLTAGE" threshold, a diagnostic warning for that cylinder will occur. This test will identify a low voltage demand condition which may result from a shorted coil secondary lead or spark plug.



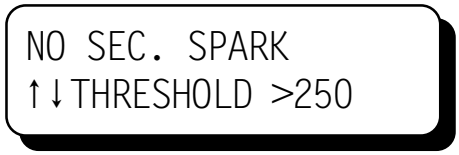
13.3 If the CAVG reference number of a cylinder is above the “HIGH SPARK VOLTAGE” threshold, a diagnostic warning for that cylinder will occur. When a high spark warning is present, the ignition energy will automatically be increased to at least E2. This test will identify a high voltage demand condition which may result, for example, from worn spark plugs or poor air-fuel ratio control.



NOTE: Applications using firmware version 2.1 and a 32-output unit with memory engine cycle code “6" or “8" will have a separate threshold for each connector group. Group threshold adjust screens will appear as below.

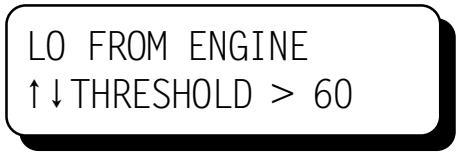


13.4 If the CAVG reference number of a cylinder is above the "NO SECONDARY SPARK" threshold, a diagnostic warning for that cylinder will occur. When a no secondary spark warning is present, the ignition energy will automatically be increased to E3 as long as the system is not in multi-strike mode. This test will identify cylinder firings that do not result in a spark - an open circuit condition at the secondary of the coil. This may result from a worn spark plug, or a disconnected or failed secondary wire.

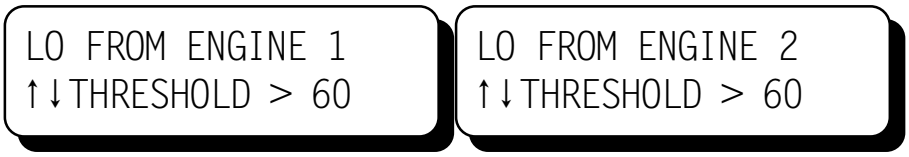


Default = 250

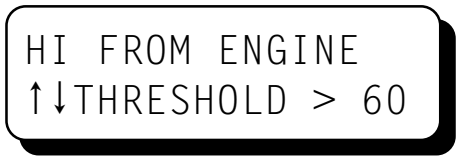
13.5 If the difference between EAVG and CAVG reference numbers is greater than the "LOW FROM ENGINE" or “LOW FROM GROUP 1 or 2" threshold, a diagnostic warning for that cylinder will occur. This test will identify a cylinder whose voltage demand is too far below the average engine or connector group voltage demand.



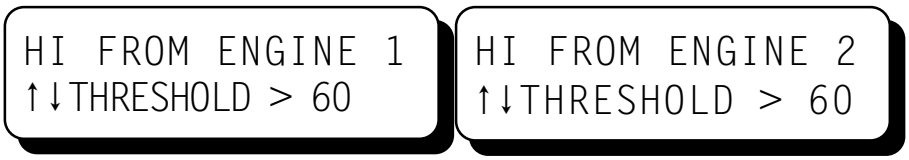
Default = 60



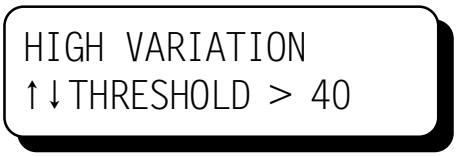
13.6 If the difference between CAVG and EAVG reference numbers is greater than the "HIGH FROM ENGINE" or “HIGH FROM GROUP 1 or 2" threshold, a diagnostic warning for that cylinder will occur. This test will identify a cylinder whose voltage demand is too far above the average engine voltage demand.



Default = 60

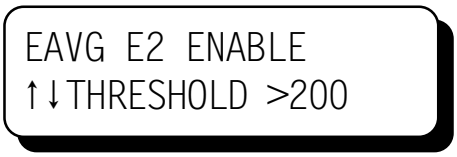


13.7 If the COV reference number is greater than the "HIGH VARIATION" threshold, a diagnostic warning for that cylinder will occur. This test will identify a cylinder whose cycle-to-cycle voltage demand has become erratic.



Default = 40

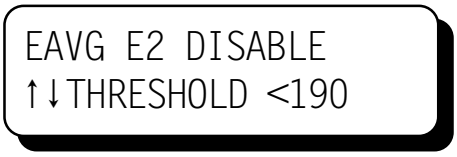
13.8 If the EAVG reference number is greater than the "EAVG E2 Enable" threshold, the energy will be increased to at least E2. This feature can be used to automatically increase the spark energy as the voltage demand of the engine increases.



Default = 200

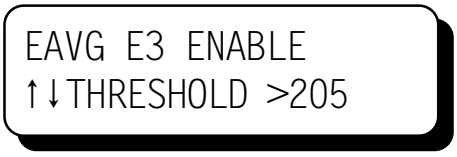
13.9 If the energy is at level E2 and if the base energy setting under the "Setup" key is E1, then the "EAVG E2 Disable" threshold setting can be used to automatically decrease the energy level to E1.

NOTE: The setting of this threshold must be at least 2 lower than the E2 Enable Threshold (section 13.8).



Default = 190

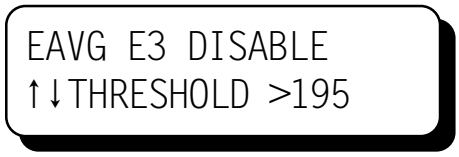
13.10 If the EAVG reference number is greater than the "EAVG E3 Enable" threshold, the energy will be increased to level E3 if multi-strike is not active. This feature can be used to further automatically increase the spark energy as the voltage demand of the engine increases.



Default = 205

13.11 If the energy is at E3 and if the base energy setting under the “Setup” key is not E3, then the "EAVG E3 Disable" threshold setting can be used to automatically decrease the energy level to E2.

NOTE: The setting of this threshold must be at least 2 lower than the E3 Enable Threshold (section 13.10).



Default = 195

NOTE: Applications using firmware version 2.1 and a 32-output unit with memory engine cycle code “6" or “8" will use the larger of the two group average values (1AVG or 2AVG) in place of EAVG when comparing to the energy thresholds.

14.0 UNDERSTANDING AND USING THE SECONDARY SPARK DIAGNOSTICS

14.1 The spark reference number is a unitless number which correlates with voltage demand at the spark plug and is calculated for every firing of each cylinder. As the voltage increases, the reference number also increases. The number is non-linear and will increase faster at higher voltages (above 20kV). The usefulness of the number lies not in its absolute value, but rather in how the number changes over time as the spark plugs erode. With a little experience, the engine operator will be able to tell when spark plugs require changing. Abnormal conditions in the ignition system, such as open or short circuits in the primary and secondary wiring, can also be detected.

14.2 The following spark reference numbers are available in the CPU-2000 system:

INSTANTANEOUS (INST): The numbers read back from the system in real time.
VARIATION (COV): The variation in values for the cylinder being viewed.
CYL. AVERAGE (CAVG): The average value for the cylinder being viewed.
MINIMUM VALUE (MIN): The minimum CAVG value since the last time reset.
MAXIMUM VALUE (MAX): The maximum CAVG value since the last time reset.

NOTE: The above values are available on a per cylinder (or per coil/spark plug) basis.

ENG. AVERAGE (EAVG): The average value for all cylinders of the engine.
or
GROUP AVERAGE (1AVG): The average value for all outputs of connector group 1.
GROUP AVERAGE (2AVG): The average value for all outputs of connector group 2.

NOTE: The (EAVG) average value indicates the average conditions of the entire engine. Applications using firmware version 2.1 and a 32-output unit with memory engine cycle code “6" or “8" will display the group average value corresponding to the connector number 1 or 2.

14.3 The spark reference number will have a characteristic range depending on the type of coil used. There are known differences between the various types of Altronic coils, and slight variations are normal between coils of the same type. In order to maximize the usefulness of the cylinder spark reference number, it is recommended that all coils be of the same type and vintage (production date). The typical ranges to be expected in normal operation with new spark plugs are:

COIL and NO. PER OUTPUT	RANGE	CONFIGURATION FREQUENCY (see section 9.10)
Current 291001 coil (1/output)	095 - 125	LO
Current 291001 coil (2/output)	135 - 175	HI
Current 291001-S coil (1/output)	100 - 130	LO
Current 291001-S coil (1/output)	140 - 185	HI
Current 591008 coil (1/output)	120 - 155	HI
Current 591008 coil (2/output)	085 - 110	HI

14.4 In addition to the diagnostic flags covered in section 13.0, the spark reference numbers can also be used for predictive purposes:

A. As the numbers increase toward the preset HI SPARK VOLTAGE threshold (see section 13.3), the operator knows that a change of spark plugs should be scheduled. With this information, spark plug replacement can be determined on an actual need basis rather than a predetermined schedule. Also, unexpected engine misfiring or shutdowns can be avoided by tracking the reference numbers on a routine basis.

B. The reference numbers can provide an early warning of a difference in operation in a given cylinder(s). A reading higher or lower than other cylinders (see sections 13.5 and 13.6) tells the operator of a potential problem. This allows further troubleshooting and evaluation to take place before an unexpected operational problem develops.

14.5 The spark energy setting has only a small effect on the spark reference number if the spark plug fires correctly. Therefore, the high and low voltage thresholds should hold across energy setting changes if the spark plugs continue to fire normally. On the other hand, a worn plug may not fire consistently on energy setting E1 but will on energy setting E2; in this case there will be a significant difference in the reference number when the energy setting is changed.

14.6 Operators may be able to increase spark plug life by using the automatic energy adjustment feature of the CPU-2000 system. In this mode, the system uses the spark reference numbers to establish the lowest required energy level to minimize spark plug erosion rates. To use this feature, the basic setup energy (section 9.3) should be set to E1. Then see sections 13.8 through 13.11 for setting the Enable and Disable thresholds for energy levels E2 and E3.

14.7 The secondary spark diagnostics will operate with either one or two coils connected to each system output lead. Optimum operation is obtained when only one coil is connected to each output lead; in this case, only one spark plug condition effects the spark reference number for that output. When two coils are wired in parallel to a common output lead, the spark reference number will tend to be an average of the condition at the two spark plugs. While deviations between cylinders will be somewhat harder to detect, most of the benefits of the spark reference number can still be realized.