OPERATING INSTRUCTIONS

CPU-95 DIGITAL IGNITION SYSTEM

MODELS 791950-8/16/18, 791952-18, 791958-16

FORM CPU-95 OI 4-08

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 **CPU-95** Digital Ignition system has been designed for application on natural gas fueled engines. This system is field-programmable and offers a variety of advanced control, emissions reduction, primary and spark diagnostics, self diagnostics, serial communications and engine protection features. The system consists of two main parts: an engine mounted Ignition Module **(791950-8/16/18, 791952-18 OR 791958-16)** and an optional user interface Display Module **(791902-1 OR 791908-1**).

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 the installation instructions, form **CPU-95 II**, for instructions regarding installation and mounting.

NOTE: These instructions pertain to CPU-95 systems equipped with firmware release 4.0, dated 01/01/99 and later. The firmware dates can be displayed from the home screen by pressing "DIAG" and then "ENTER". The date of the installed firmware is viewed:

- ***Top line (LOGIC) applies to the output module firmware date.***
- ***Lower line (DISPLAY) applies to the display module firmware date.***

WARNING: THE IGNITION SYSTEM MUST BE CONFIGURED PRIOR TO USE ON AN ENGINE. REFER TO SECTION 9.7 TO VIEW THE CURRENT CONFIGURATION. REFERENCE FORM CPU-95 PI FOR INSTRUCTIONS DESCRIBING HOW TO CONFIGURE THE IGNITION SYSTEM. VERIFY EEPROM PROGRAMMING PRIOR TO STARTING ENGINE.

2.0 IGNITION MODULE OUTPUT SWITCHES, LED INDICATORS AND CONTROL INPUT

2.1 Three output switches in the Ignition Module 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.

FIRE-CONFIRM OUT switch: closed when the ignition is firing or trying to fire. Could be used as a signal to the control system to turn fuel on.

FAULT OUT switch: closed to signal that the ignition has no diagnostic 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. Could be used as a signal to the control system to turn fuel off.

ALARM OUT switch: closed to signal that no unacknowledged faults or warnings are present. Upon detection of a diagnostic fault or warning, this switch will open. This output is designed to control an alarm indicator or sounding device.

2.2 Four red LED indicators are provided inside the ignition unit for troubleshooting purposes:

POWER LED: on to indicate that the unit has power and the microprocessor is running. The Power LED flashes to indicate that the unit has power but is not operating correctly. The Power LED is off to indicate that the unit has no power.

TX LED: flashes to indicate that the ignition unit is transmitting on the RS-485 serial link.

RX LED: flashes to indicate that the ignition unit is receiving on the RS-485 serial link.

ALARM LED: turns on to indicate that a warning or fault is present. The ALARM LED flashes when an acknowledged warning is present.

2.3 One **RS-485** serial communications port is provided within the Ignition Module. This port is normally used for communication to the optional Display Module. A PC (personal computer) or a PLC (programmable logic controller) can be connected to the **RS-485** port to perform remote monitoring or control functions. The Ignition Module can be operated in a stand-alone mode, but diagnostic and control features would not be accessible. This port is also used to configure the ignition system for its application using a PC and the **CPU-95** PC terminal software.

2.4 One digital input is provided inside the ignition system **(MISC. INPUT)**. This logic level input is active when shorted to ground, and is used to control any combination of the following features: one-step retard, spark energy level or multi-strike option. These features are enabled based on the special features configuration settings as described in the programming instructions, **FORM CPU-95 PI**.

NOTE: If possible, keep the original shipping container. If future transportation or storage is necessary, this container will provide the optimum protection.

3.0 DISPLAY MODULE USER INTERFACE AND INPUTS

3.1 **DISPLAY MODULE:** serves as the user interface for the **CPU-95** ignition system. An **RS-485** two wire serial communications format is used to connect the Display Module to the Ignition Module. This link communicates between the modules using a proprietary protocol.

3.2 **LCD DISPLAY:** 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. **SEE FIGURE 1** for a description of the keypad.

3.3 All actions and adjustments are immediate and are performed on an incremental basis using up and down arrow keys. All keypad adjustments, except individual offset timing adjustments are performed directly in non-volatile EEPROM memory. This EEPROM memory retains previous settings even after an engine shutdown, or an ignition power down.

3.4 Capital letters are used on the LCD display screen to designate an active selection while lower case letters are used to indicate other possible options.

3.5 The Display Module includes an isolated current loop input which can be configured to control spark timing. Reference the programming instructions, **FORM CPU-95 PI**.

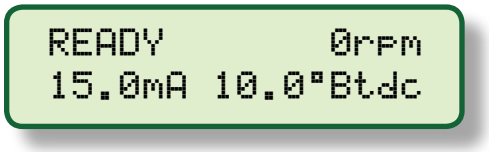
3.6 One logic level digital input **(MISC. INPUT)** is available at the Display Module which can be used in the same fashion as the input of the Ignition Module. If either input is shorted to ground, then the **MISC. INPUT** functions are active.

4.0 UNDERSTANDING THE HOME SCREEN

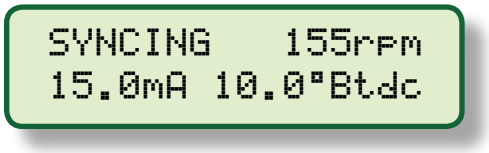
4.1 A series of **HOME** screens are used to describe the current status of the ignition system. The LCD display always reverts back to one of the home screens after a keypad operation is completed or times out. The **HOME** screen is designed to display the most critical operating parameters on one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

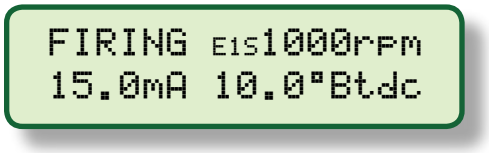
4.3 The **READY** message is displayed when the ignition is ready for the engine to crank for starting.



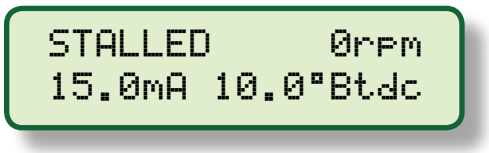
4.4 Once the engine begins turning, the **SYNCING** message is displayed while the ignition system verifies signals from the engine pickups.



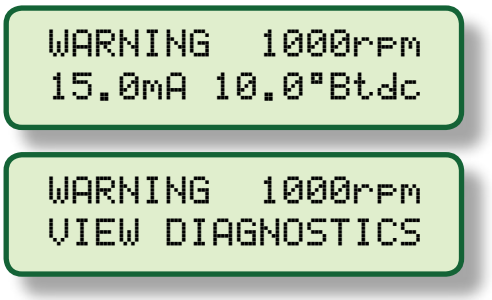
4.5 The **FIRING** message is displayed when the ignition begins firing. Additional data is provided on this screen to describe the selected mode of operation for the ignition. The energy mode (**E1,E2,E3**) and the single-strike/multi-strike type **(S or M)** are described in the middle of the upper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



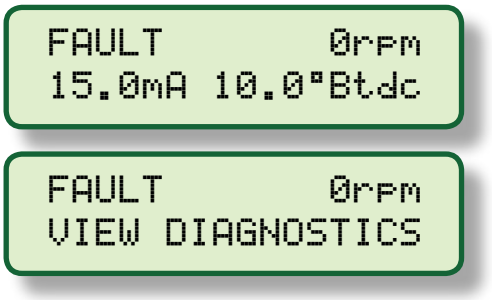
4.6 The **STALLED** message is displayed when a loss of rotation is detected after the ignition is firing and neither a **SHUTDOWN** or **FAULT** has occurred. This signifies that the engine has stopped without any detected cause from the ignition system.



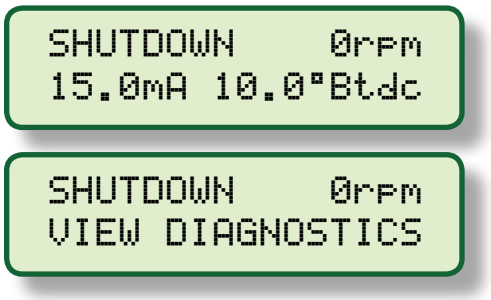
4.7 The **WARNING** message will supersede all of the above home screens if a diagnostic warning condition is present. When a diagnostic warning exists, a **VIEW DIAGNOSTICS** message will flash on the bottom line of the display. The Ignition Module will continue to operate under a warning condition while alerting the operator of a potential problem in several ways: by turning on the Alarm LED in the Ignition Module and by changing the state of the Alarm Out switch (switch opens). The Display Module will display the Warning message. 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 several ways: by changing the state of the Fire Confirm Out switch (switch opens), by turning on the alarm LED inside the Ignition Module, by changing the state of the Alarm Out switch (switch opens), by changing the state of the Fault Out switch (switch opens), and by displaying the Fault message. The various types of diagnostic faults are described in SECTION 10.0.



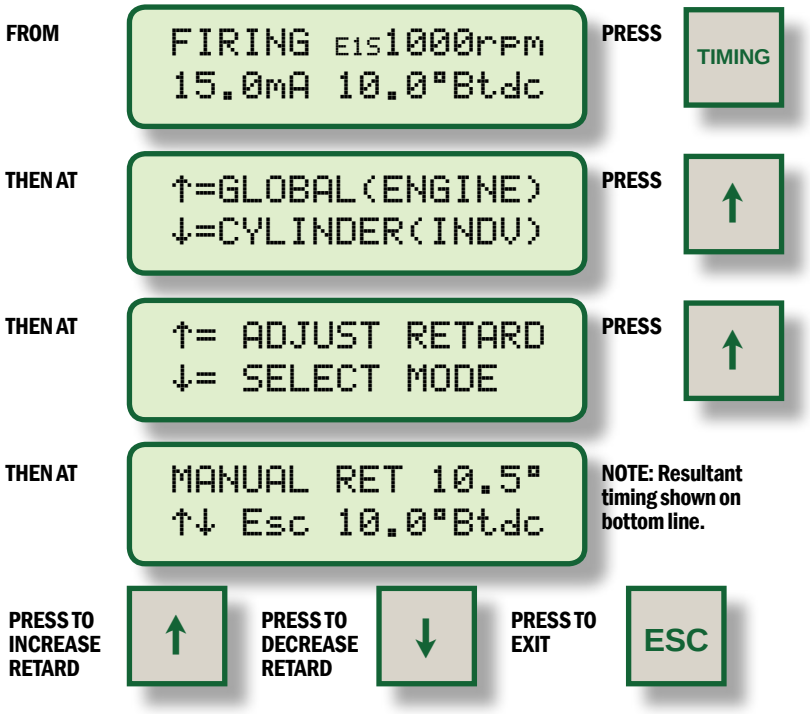
4.9 The **SHUTDOWN** screen will supersede all other home displays if the logic level shutdown input of the Ignition Module or the G-Lead of the output primary connector is grounded or was previously grounded and the engine has not stopped rotating. This screen indicates that the ignition is not firing because a shutdown input was triggered to shutdown the engine. If a diagnostic fault or warning exists while the ignition is in shutdown, a **VIEW DIAGNOSTICS** message will flash on the bottom line of the display. 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.



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 CPU-90 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 defined as follows.

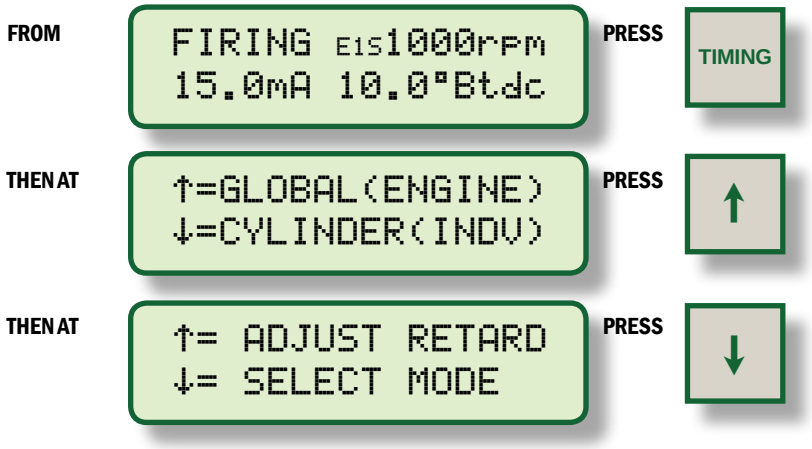
If N < 270, then Increment = "45/N" degrees

If N ≥ 270, then timing increment is "90/N" degrees, where N = no. of holes or teeth.

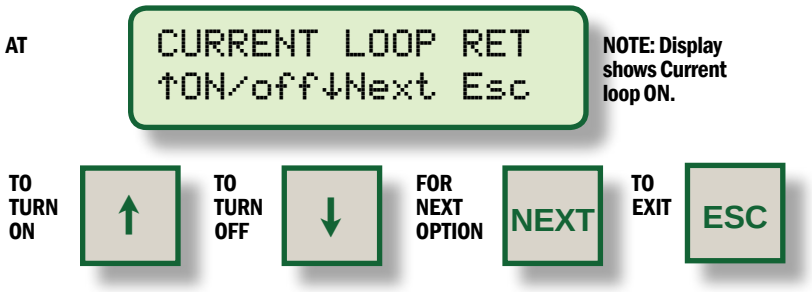
5.4 Global spark timing is determined based on the sum of several spark retard components which include manual retard, current loop retard, rpm retard, and one step retard. The range of total retard is limited to **255 X TIMING INCREMENT**. When the sum of all retard components reaches **255 X TIMING INCREMENT**, the actual timing will be at the retard limit.

6.0 SELECTION OF GLOBAL TIMING MODES

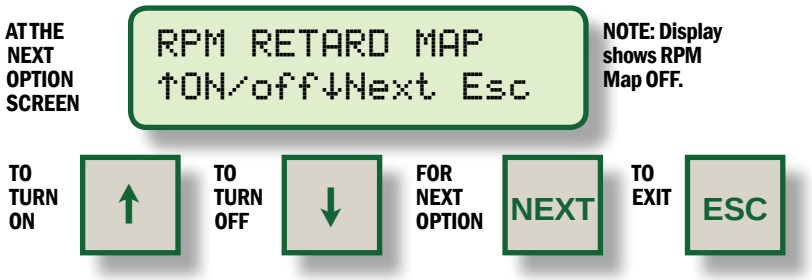
6.1 Several options exist with regard to global timing modes. Once the global timing mode menu is entered as described below, the status of each option can be viewed and changed.



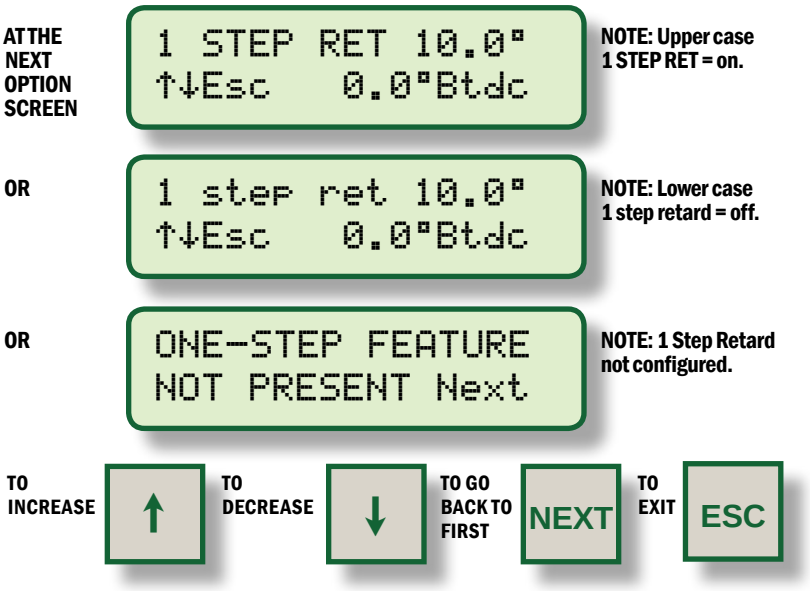
6.2 The first mode selection can enable or disable the pre-configured retard curve controlled by the **4-20 mA** current loop input. The choices are **ON** or **OFF**, with the active selection displayed in capital letters. A PC is required to configure the **4-20 mA** curve; reference the programming instructions, form **CPU-95 PI**. When the current loop is on, the current loop value is displayed **(xx.x mA)** with the "**A**" capitalized. When the current loop is off, the value is displayed **(xx.x ma)** with the lower case "**a**".



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-95 PI**.



6.4 The **NEXT** mode selection can increase or decrease the one-step retard value. The first screen below is displayed when one-step retard is both configured and is active. The second screen below is displayed when the one-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 from the global timing of the engine. Adjustments made as described below should be considered temporary. The ignition will revert back to the values saved in EEPROM memory on every reset, start or power-up. To save temporary adjustments to EEPROM memory **SEE SECTION 8.0.**

NOTE: In applications with narrow firing angles, the adjustment range may be limited.

7.2 Enter the individual timing adjustment menu as described below.

FROM

```
FIRING Eis1000rpm
15.0mA 10.0°Btdc
```

PRESS TIMING

THEN AT

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

PRESS ↓

THEN AT

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

PRESS ↑

7.3 The individual timing adjustment screen identifies the primary output to be adjusted, and the degrees of offset in use for the output.

THEN AT

```
CYL  A   2.5°ADV
↑↓ Esc Next
```

NOTE: 2.5 degrees advance for output A.

TO ADVANCE ↑ **TO RETARD** ↓ **TO SELECT NEXT CYL.** NEXT **TO EXIT** ESC

7.4 The output identification characters will be provided as follows:

IGNITION MODULE 791950-8/16 OR 791958-16:

A	B	C	D	E	F	K	L	M	N	P	R	S	T	U	V

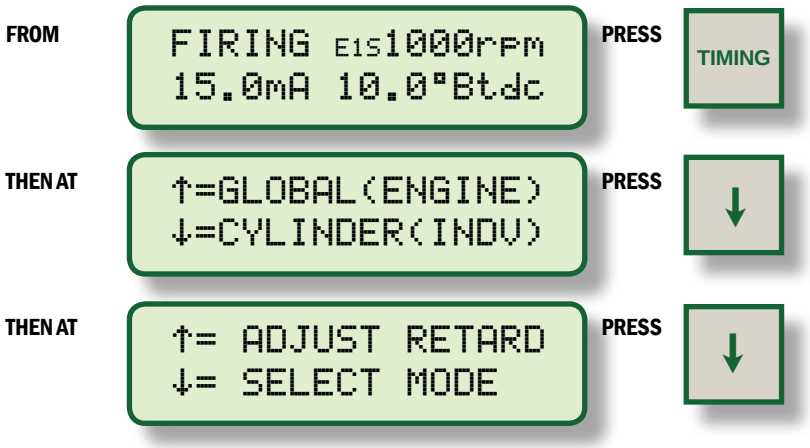
IGNITION MODULE 791950-18 OR 791952-18:

A	B	C	D	E	F	G	H	K		G	R	P		1
L	M	N	P	R	S	T	U	V		G	R	P		2

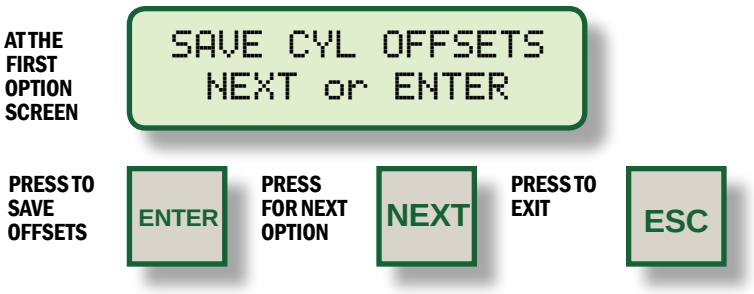
This identification is the **CPU-95** output harness identification; match-up to the engine firing order to determine the engine cylinder number.

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 is used to save the current (temporary) individual offsets to EEPROM memory. When this is done, the ignition will load these offset settings every time the engine starts or reset is pressed. **REFERENCE SECTION 7.0** to adjust individual (temporary) offsets.

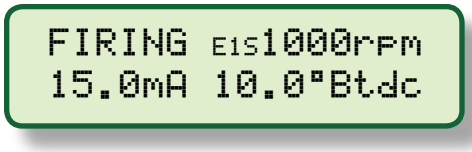


8.3 The **NEXT** mode function can be used to reset all cylinder offset values back to zero (both temporary memory and EEPROM memory).

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.

FROM



PRESS [SETUP]

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

Note 1: A special feature can be selected during configuration to force Multi-Strike to be active below 250 rpm, or when the Misc. Input is grounded. This feature is not active in a standard configuration.

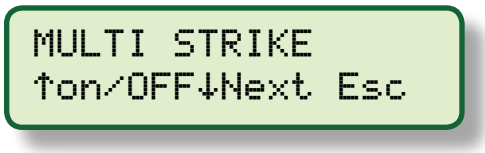
Note 2: The Multi-Strike feature is automatically turned off above 1050 rpm.

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

Note 4: The Multi-Strike feature fires the spark plug 2 times per event (~1100usec apart).

Note 5: ON 791958-16 UNIT ONLY: The Multi-Strike feature is replaced by the VariSpark long duration (~2000 usec) spark.

AT



TO TURN ON MULTI [↑] TO TURN OFF MULTI [↓] FOR NEXT OPTION [NEXT] TO EXIT [ESC]

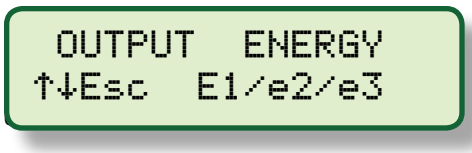
9.3 The next setup screen permits the operator to select one of three ignition energy levels **(E1,E2,E3)**. The energy levels are **75 millijoules (E1), 100 millijoules (E2), 125 millijoules (E3)**.

Note 1: A special feature can be selected during configuration to use the maximum energy level below 250 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.

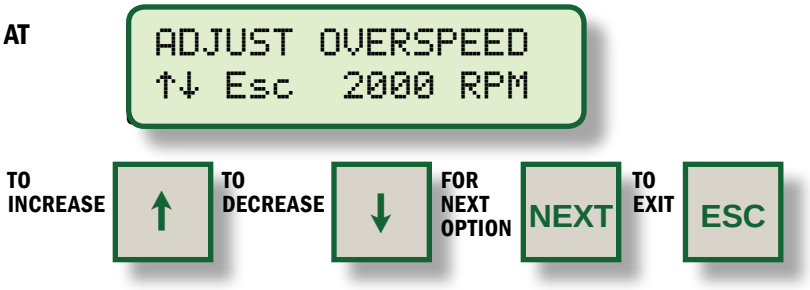
AT



NOTE: Energy level E1 is displayed.

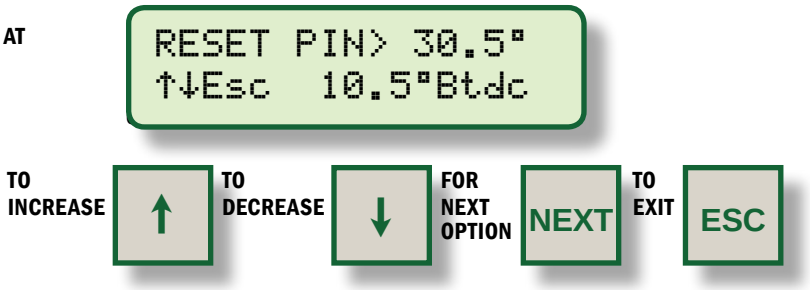
TO INCREASE [↑] TO DECREASE [↓] FOR NEXT OPTION [NEXT] TO EXIT [ESC]

9.4 The next setup screen is used to adjust the engine overspeed setpoint. The setpoint can be adjusted in increments of **10 rpm** to a maximum of **2550 rpm**.

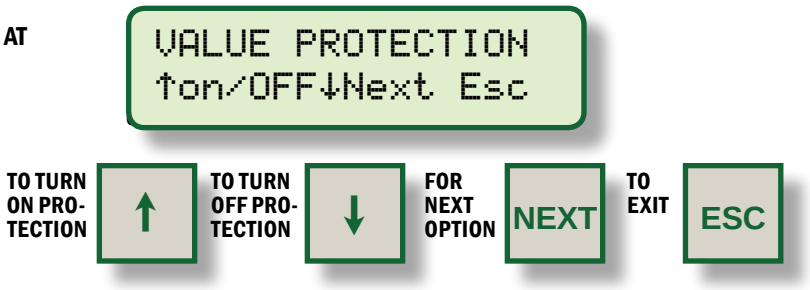


9.5 The next setup screen is used to specify the exact position of the reset pin. Both the reset position and the engine timing are displayed. Adjustments are made here to make the displayed timing match the actual spark timing as verified with a timing light. This adjustment effects the displayed timing 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.



FOR DISPLAY MODULE P/N 791908-1 ONLY: The **VALUE PROTECTION** can be **PASSWORD** protected. The password **PROTECTION LOCK** is enabled when programming options from the **791908-1** PC terminal program. See the Programming Instructions, **FORM CPU-95 PI** for details. When password protection is enabled the following menu appears instead of the **VALUE PROTECTION** menu.

To enter the password press, use the function keys **F1, F2, F3, F4** where **F1=1, F2=2, F3=3, F4=4** where the number entered is equal to the user assigned five digit password. After the last digit of the proper password is entered, the **VALUE PROTECTION** menu shown above will appear. If the password is not known, press the **ESC** key to exit or the **NEXT** key to go on to the **VIEW IGNITION SETUP** menu.

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.

AT

PRESS TO VIEW CONFIG — ENTER

PRESS TO GO TO NEXT — NEXT

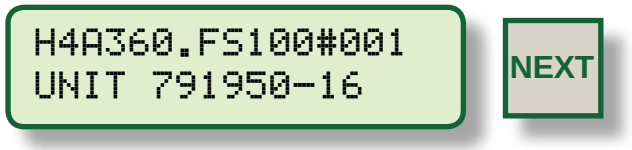
PRESS TO EXIT — ESC

The configuration screens are shown starting on the next page.

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 the programming instructions, form CPU-95 PI, for further information on configuration.

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

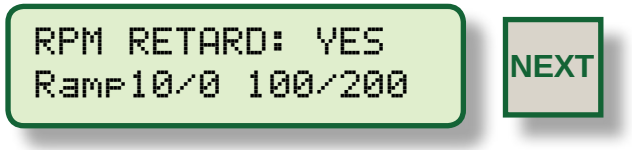
FIRING PATTERN CODE: (H4A360.FS100)
SPECIAL FEATURE CODE: (#001) (1STEP DEFAULT)
IGNITION MODULE TYPE: (PART NUMBER)



DATE CONFIGURED: (01-22-07)
TIME CONFIGURED: (12:00)
CONFIGURED BY: (USER NAME)
TERMINAL VERSION #: (V1.00)

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



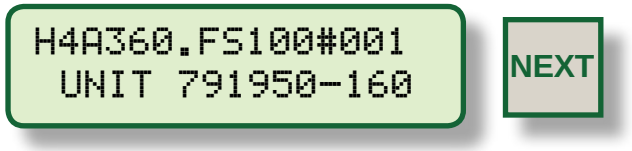
LOCATION:
USER SPECIFIED DESCRIPTION

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.

BREAKDOWN OF FIRING PATTERN CODE:

H REPRESENTS THE NUMBER OF OUTPUTS USED, IN THIS CASE 8 (F =6, L = 12, ETC.)

4 REPRESENTS THE CYCLE TYPE OF THE ENGINE

- 2 = TWO-CYCLE
- 4 = FOUR-CYCLE

A REPRESENTS THE ALTRONIC PATTERN CODE (SEE FORM CPU-95 AL)

360 REPRESENTS THE NUMBER OF GEAR TEETH OR HOLES TO BE SENSED

F REPRESENTS A DESIGNATOR FOR CPU-95 VERSION 1

S REPRESENTS THE CURRENT LOOP RETARD CURVE TYPE

- A = 0° AT 4MA / 48° AT 20MA
- B = 0° AT 4MA / 36° AT 20MA
- C = 0° AT 4MA / 24° AT 20MA
- D = 0° AT 4MA / 16° AT 20MA
- E = 0° AT 4MA / 8° AT 20MA
- N = SPECIAL NON-STANDARD TIMING CURVE VS. CURRENT OR RPM, NON-FACTORY PROGRAMMED
- S = SPECIAL NON-STANDARD TIMING CURVE VS. CURRENT OR RPM, FACTORY PROGRAMMED
- X = NO CURRENT LOOP CURVE

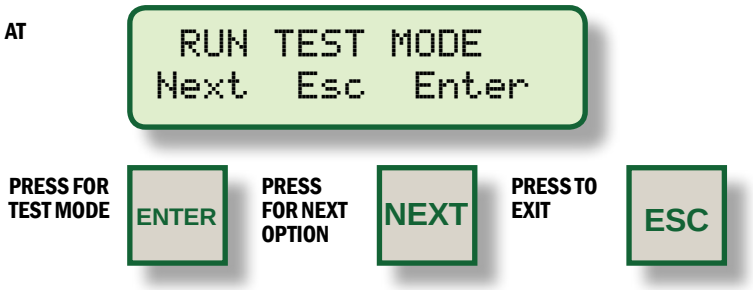
NOTE: This number must be selected and properly documented by the originator.

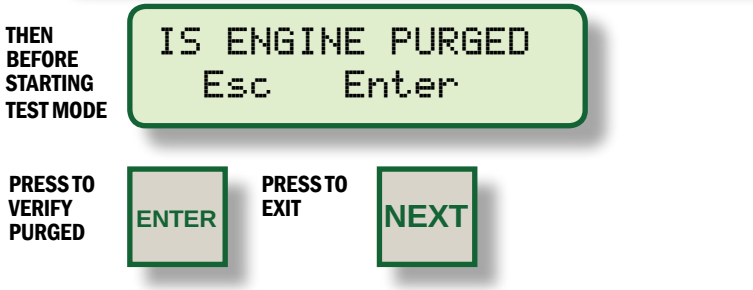
100 REPRESENTS THE SPECIAL VERSION NUMBER (ONLY EXISTS FOR TYPES N AND S)

#001 REPRESENTS THE SPECIAL FEATURE CODE
(TOTAL SUM OF ALL SELECTED OPTIONS; 001=DEFAULT)

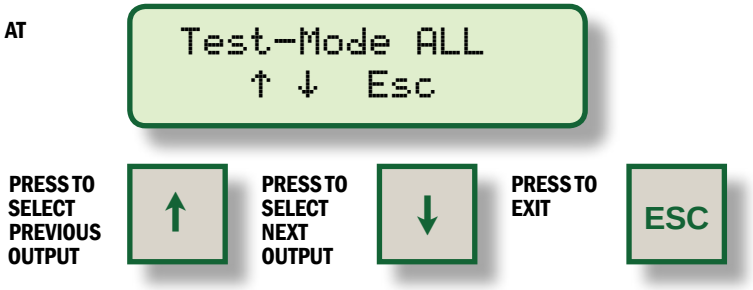
- 064 = FORCE MULTI-STRIKE WHEN RPM IS LESS THAN 250
- 032 = FORCE MAX ENERGY WHEN RPM IS LESS THAN 250
- 016 = USE 1 STEP RETARD WHEN RPM IS LESS THAN 250
- 004 = FORCE MULTI-STRIKE WHEN MISC INPUT IS GROUNDED
- 002 = FORCE MAX ENERGY WHEN MISC INPUT IS GROUNDED
- 001 = USE 1 STEP RETARD WHEN MISC INPUT IS GROUNDED

9.8 The last 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. Diagnostic features do not function while in test mode.





Then the test mode screen indicates that the ignition is firing and permits the operator to select the output to be fired.



NOTE: 791908-1 Display Module only: The Test-Mode is enabled by the user during initial setup of display module from PC terminal program. See form CPU-95 PI for details.

Test-Mode selection rotates as described below.

MODEL #	ROTATION SEQUENCE
791950-8:	ALL, A, B, C, D, E, F, K, L
791950-16, 791958-16:	ALL, A, B, C, D, E, F, K, L, M, N, P, R, S, T, U, V, ALL
791950-18:	ALL, A, B, C, D, E, F, G, H, K, L, M, N, P, R, S, T, U, V, ALL
791952-18:	ALL (Individual output test mode not available.)

10.0 CPU-95 DIAGNOSTICS

10.1 A diagnostic fault represents 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:

- **Ignition will stop firing.**
- **Fire Confirm Out switch will open.**
- **Fault Out switch will open.**
- **Alarm Out switch will open.**
- **Alarm LED in the ignition unit will turn on.**
- **Home status will read FAULT, and the bottom line will flash VIEW DIAGNOSTICS.**

NOTE: Diagnostic FAULTS will supersede diagnostic WARNINGS.

10.2 A diagnostic warning represents the least severe classification of problems. The ignition will continue to fire in the presence of a diagnostic warning. When a warning is detected, several things will occur:

- **Alarm Out switch will open.**
- **Alarm LED in the ignition unit will turn on.**
- **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 as described below.

PRESS 

Acknowledgment of the alarm results in the following until a reset is commanded or until another fault or warning may occur.

- **Alarm Out switch will return to its closed position.**
- **Alarm LED will flash to indicate that an alarm is present but acknowledged.**

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

FROM THE HOME SCREEN

PRESS

Then from the diagnostic description screens use the following keys.

PRESS TO VIEW NEXT

OR PRESS TO VIEW NEXT

PRESS TO EXIT

10.5 Diagnostic Fault screens, in order of display priority:

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

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

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

When too many or too few gear-tooth pulses are seen between reset pulses.

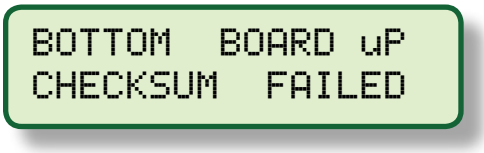
The received number of pulses is displayed.

When the engine speed exceeds the overspeed setpoint.

Maximum observed speed is also displayed.

When the check-sum of micro-processor firmware cannot be verified.

Unit requires service.

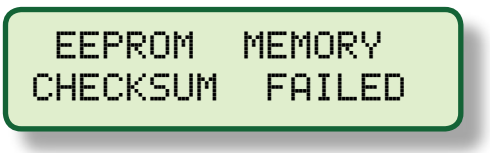


10.6 Diagnostic Warning screens, in order of display priority:

This screen indicates that the current-loop has deviated out-side the limits of 2 mA and 22 mA. The current loop follows the configured curve which is specified from 0-25 mA. This diagnostic is active only if the current loop retard is on.

This screen indicates that at some point no loop data was received from the Display Module. In this condition, the timing for 0 mA is used. This test is active only if the current loop retard is on.

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 diagnostics have identified an open circuit on the primary output pin "A". Normally indicates faulty wiring or a failed coil.

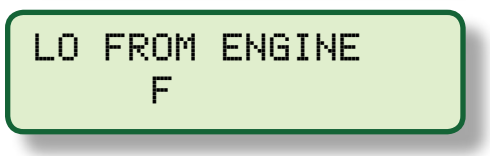
This screen indicates that diagnostics have identified a short circuit condition on the primary output pin "B". This would normally indicate a coil is miswired, or the primary wire is shorted.

This screen indicates that the diagnostics have identified a low spark demand condition on the plug at the "C" coil. This is often caused by a shorted spark plug or shorted secondary wire.

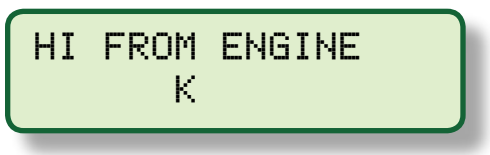
This screen indicates that the diagnostics have identified a high spark demand condition on the spark plug at the "D" coil. This is often caused by worn spark plugs.

This screen indicates that the diagnostics have identified a no spark condition on the plug at the "E" coil. No spark occurred since the demand was greater than the output capability of the coil.

This screen indicates that the diagnostics have detected a condition where the average value of output "F" is significantly lower than the average of all the active outputs on the engine.



This screen indicates that the diagnostics have detected a condition where the average value of output "K" is significantly higher than the average of all the active outputs on the engine.



10.7 After all of the diagnostics have been read, the user can reset the warnings and faults by pressing the reset key as pictured below.

Pressing the reset key performs all of the following actions:

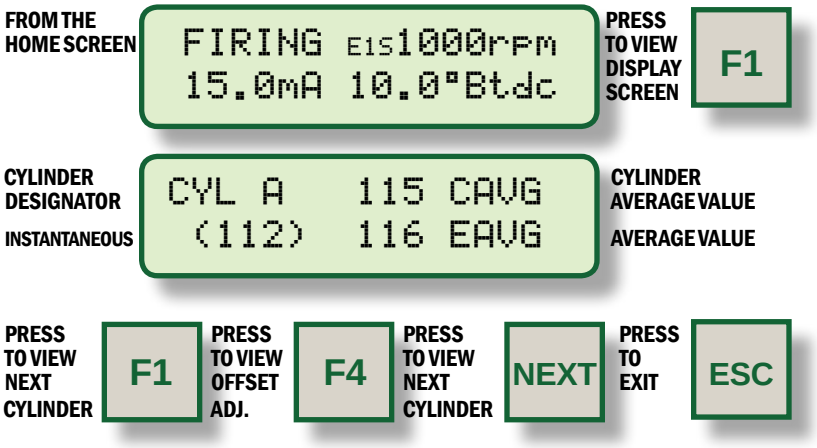
- **Clears all diagnostic warnings from memory.**
- **Clears all diagnostic faults from memory.**
- **Clears a latched shutdown condition when the input is no longer grounded.**
- **Causes temporary cylinder timing offsets to be overwritten from EEPROM memory**

11.0 UNDERSTANDING AND USING THE SECONDARY SPARK DIAGNOSTICS

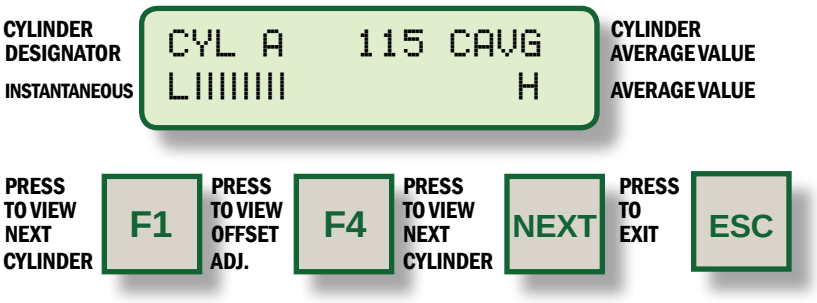
11.1. The spark reference number is a unitless number which correlates with voltage demand at the spark plug and is calculated for every firing of each cylinder. As the voltage increases, the reference number also increases. The number is non-linear and will increase faster at higher voltages **(above 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.

11.2 The reference "cylinder spark data" number can be viewed separately for each ignition output (cylinder) in two ways, and compared to the average of the entire engine:

- **INSTANTANEOUS value: shown in ( )**
- **CYLINDER AVERAGE value: CAVG**

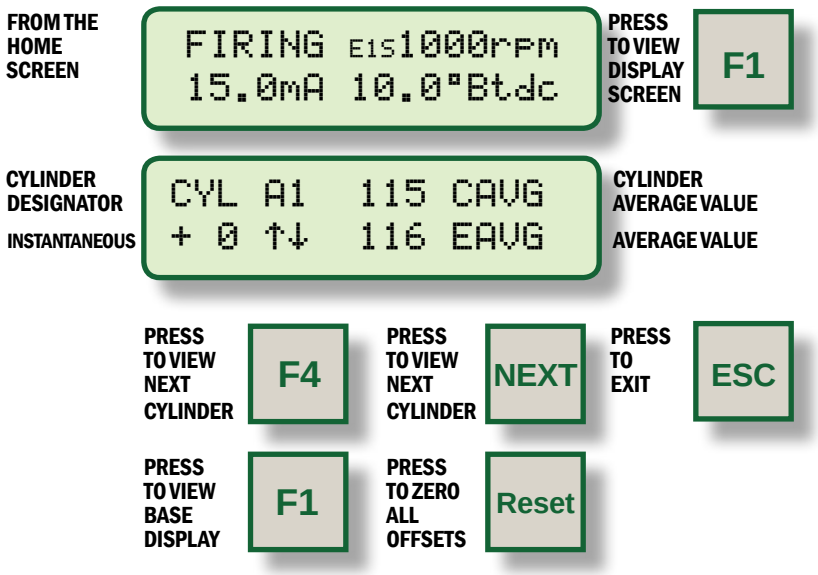


ON THE 791908-1 DISPLAY MODULE ONLY: Press **F2** for Bar Graph display of Spark number.



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

11.3 The offset adjustment screen (**F4**) permits the operator to adjust an offset 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**.



11.4 The spark reference number is used in conjunction with comparative thresholds to set diagnostic codes for several different ignition system and spark plug conditions. When a threshold is violated twice in a row, the corresponding diagnostic flag is set for the appropriate cylinder. The diagnostic flags are latching and will exist until the unit is restarted or until a reset or power-down occurs.

Open Primary	**CAVG < 1**
Shorted Primary	**CAVG < 50**
Low Spark Voltage	**CAVG < user programmable threshold (typ. 100)**
High Spark Voltage	**CAVG > user programmable threshold (typ. 180), also Forces E2**
No Secondary Spark	**CAVG > user programmable threshold (typ. 250), also Forces E3**
Low From Engine	**(EAVG - CAVG) > user programmable threshold (typ. 20)**
High From Engine	**(CAVG - EAVG) > user programmable threshold (typ. 20)**

11.5 The spark reference number is also used to automatically change spark energy for different ignition system conditions. The minimum energy setting is selected under the **Setup Menu** **(SEE SECTION 9.3)**. Energy will automatically be adjusted in response to the engine average spark reference number **(EAVG)** based on four individual thresholds listed below. Additionally, spark energy will automatically be increased when a High Spark Voltage or No Secondary Spark warning exists for any cylinder.

Auto Enable E2	**EAVG > user programmable threshold (typical 200)**
Auto Disable E2	**EAVG < user programmable threshold (typical 190)**
Auto Enable E3	**EAVG > user programmable threshold (typical 205)**
Auto Disable E3	**EAVG < user programmable threshold (typical 195)**

11.6 The above user programmable thresholds need to be adjusted based on the type of coil being used and on the operating characteristics (specifically, voltage demand) of the engine. There are known differences between 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)**. This will aid greatly in detecting variations in one cylinder vs. the general trend in the engine. The typical ranges to be expected in normal operation with new spark plugs are:

Older 501061 (blue) coils:	**70 to 90**
Current 501061 (blue) coils:	**90 to 120**
Current 591010 (red) coils:	**120 to 140**
Current 501061-S (shielded blue) coils:	**110 to 130**
Current 591007 / 591011A / 591011B coils:	**70 to 90**

11.7 The indicated thresholds were designed to be adjustable so that the user can customize these diagnostics to fit the specific needs of each engine. It will take some testing and adjustment to obtain thresholds that optimize the use of these features. For maximum benefit, the spark reference number for each cylinder should be recorded at normal operating load with new spark plugs installed and then monitored over a period of time for changes. The **HI SPARK VOLTAGE** alarm level should be set (typically) at 180 initially and can be adjusted as experience dictates. A gradual increase in the spark reference number is expected over time as the spark plug electrodes erode.

11.8 In addition to energy control and the diagnostic flags, the reference numbers can also be used for predictive purposes:

A. As the numbers increase toward the preset **HI SPARK VOLTAGE** threshold **(SEE SECTION 12.3)**, the operator knows that a change of spark plugs should be scheduled. With this information, this function 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 the other cylinders, when such a difference is not normally present, tells the operator of a potential problem; this allows further troubleshooting and evaluation to take place before an unexpected operational problem develops. **(SEE SECTION 12.5, 12.6.)**

11.9 Other Information regarding the spark reference number:

NOTE: See Section 11.5 for automatic system adjustment of ignition energy.

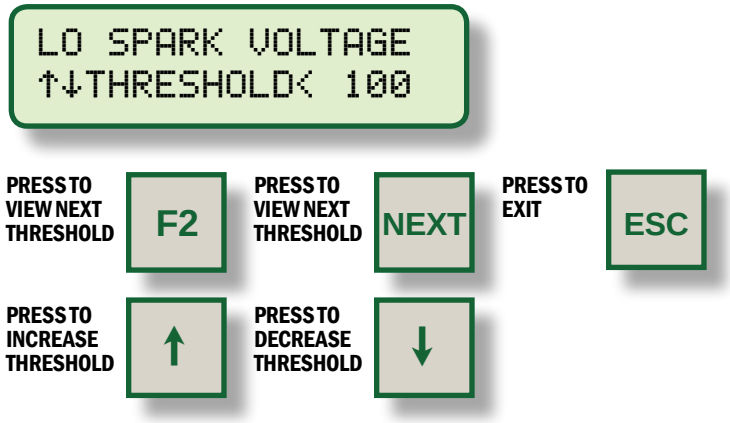
A. The spark energy setting has only a small effect on the reference number if the spark plug fires correctly. Therefore, the high and low voltage thresholds should hold across the energy settings if the spark plugs continue to fire correctly. On the other hand, a worn plug may not fire consistently 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. Operators may be able to increase spark plug life by operating initially with new spark plugs on **E1** energy setting and use the **HI SPARK VOLTAGE** alarm as an indicator to manually increase the energy progressively to **E3**.

B. The spark reference number is designed to work with one coil per output. Where two coils are connected to the same primary lead, the number will tend to be an average of the conditions at the two spark plugs. While some of the benefits of the spark reference number can still be realized, the usefulness of the number in detecting deviations between cylinders (alarm levels) will be reduced.

12.0 THRESHOLD ADJUSTMENT SCREENS

12.1 Nine 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. All thresholds are accessed under the **F2** key.

12.2 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. To disable diagnostic, set value to zero.



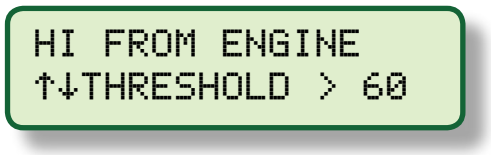
12.3 If the **CAVG** reference number of a cylinder is above the **HIGH SPARK VOLTAGE** threshold, a diagnostic warning for that cylinder will occur. When a high spark warning is present, the ignition energy will automatically be increased to at least **E2**. This test will identify a high voltage demand condition which may result, for example, from worn spark plugs or poor air-fuel ratio control. To disable, set to **255**.

12.4 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 resulting from a worn spark plug, or a disconnected or failed secondary wire. To disable, set to **255**.

12.5 If the difference between **EAVG** and **CAVG** reference numbers is greater than the **LOW FROM ENGINE** 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 voltage demand.

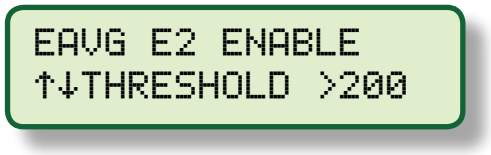
Default = 60

12.6 If the difference between **CAVG** and **EAVG** reference numbers is greater than the **HIGH FROM ENGINE** 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.



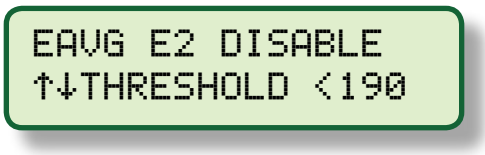
Default = 60

12.7 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

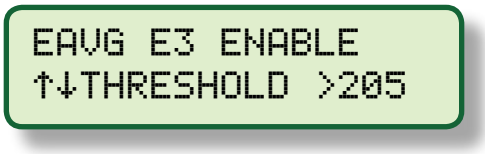
12.8 If the energy is at level **E2** and if the base energy setting under the **SETUP** key is **E1**, then the **EAVG E2 DISABLE** threshold setting is used to automatically decrease the energy from **E2**.



Default = 190

NOTE: This threshold must be at least 2 counts below the enable threshold. See section 12.7.

12.9 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 automatically increase to the maximum energy to attempt to keep the engine running until worn plugs can be serviced.



Default = 205

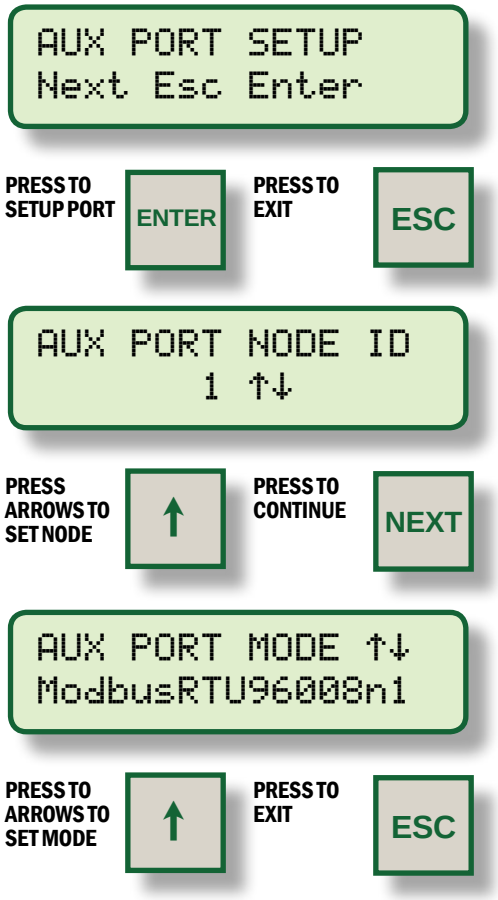
12.10 If the energy is at **E3** and if the base energy setting under the **SETUP** key is not **E3**, then the **EAVG E3 DISABLE** threshold setting is used to automatically decrease the energy from **E3**. **NOTE:** This threshold must be at least **2** counts below the enable threshold **(SECTION 12.9)**.

Default = 195

13.0 SPECIAL INSTRUCTIONS FOR 791908-1 DISPLAY MODULE ONLY

13.1 The **791908-1** Display Module incorporates data logging and a half duplex **RS-485** port which is Modbus RTU slave compliant. The protocol used follows the Modicon Modbus RTU standard. A complete listing of the Modbus register addresses is included on the **CPU-95** terminal program CD, along with a PC based Modbus compatible monitoring program which can be used to access the ignition data remotely.

13.2 The auxiliary communications port configuration must be set to match the values expected by the Modbus master. This is done in the **791908-1** Display Module via the **AUX PORT SETUP** menu which appears immediately after the **RUN TEST MODE** menu under the **SETUP** menu. **(SEE SECTION 9.8)**.



Supported baud rates are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.

Supported parity selections are n (none), o(odd), e(even).

Supported data bit format is 8 with 1 stop bit.

In order to simplify troubleshooting of the Modbus connection, an **AUX PORT** diagnostic menu is provided. To access this menu, press the **DIAG** key when viewing any of the **AUX PORT** setup screens above.

PRESS TO VIEW DIAGS. DIAG

MODBUS ERROR
NONE

PRESS TO RETURN TO PREVIOUS MENU NEXT

ERROR LIST:		
	"CRC"	Checksum on incoming data invalid
	"INVALID ADDRESS"	Received data contained invalid address
	"INVALID DATA LEN"	Received data was the wrong length
	"REC BUF OVF"	Incoming data greater than 256 bytes
	"UKN FN"	Unknown function called
	"NONE"	No errors since last reset

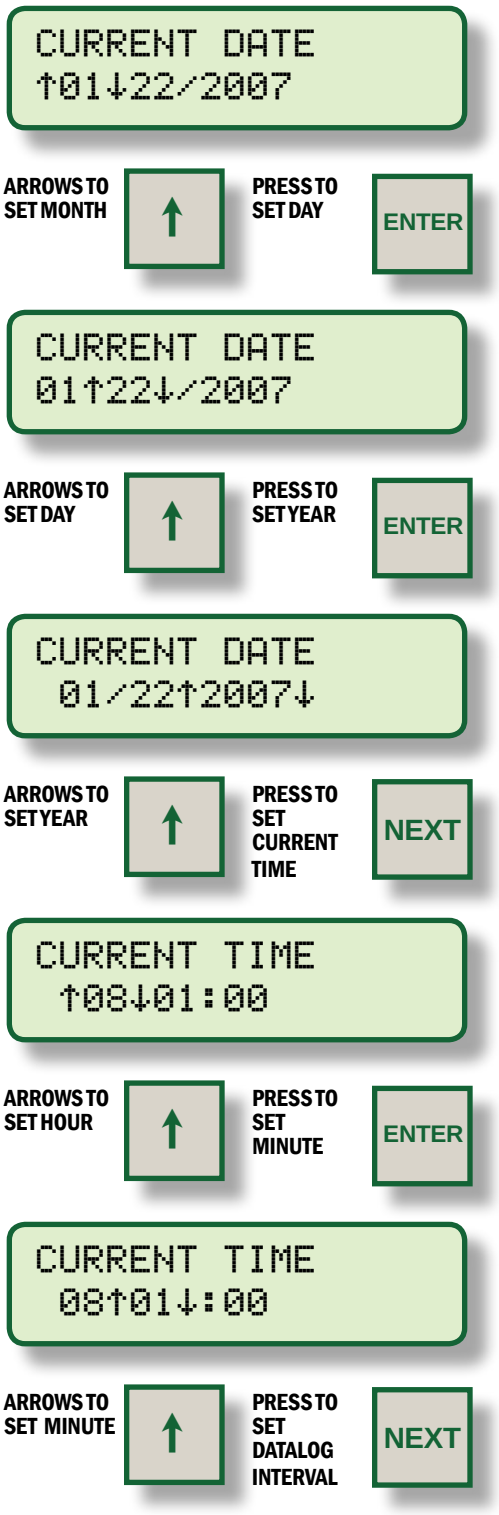
PRESS TO CLEAR ERROR Reset PRESS TO EXIT ESC

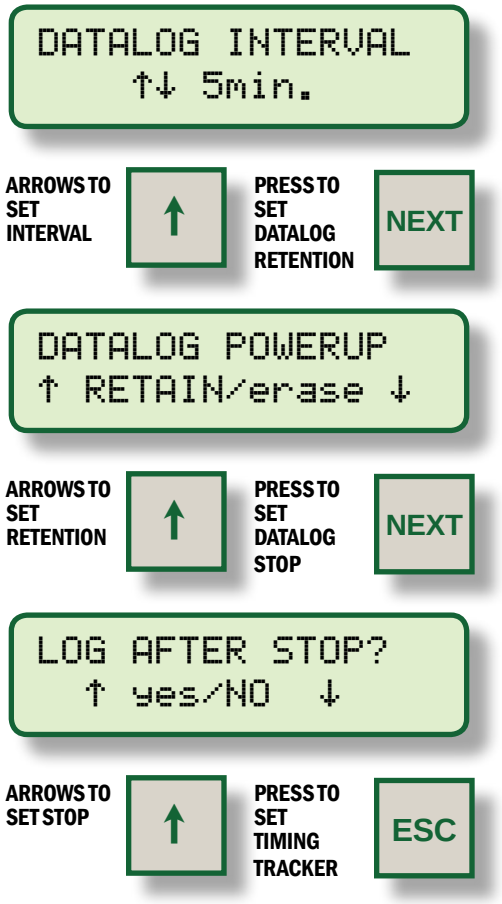
13.3 The **791908-1** Display Module supports data logging of the information normally available from the display of the **CPU-95**. The unit retains **100** datalogs which are stored in a **FIFO** (first in, first out) manner. When **100** logs are stored, the oldest log is purged and the newest added. The oldest data is stored as **LOG NO. 100** and the newest as **NO. 1**; there is also a copy of the current values available as **DATALOG 0**. The datalogs can be accessed by the special PC terminal program supplied with the unit or by a special Modbus command sent by the User supplied PLC or computer system. More detailed information is provided on the terminal CD.

The **DATALOG SETUP** menu appears after the **AUX PORT SETUP** menu. If datalogs are not being used, press the **NEXT** key to proceed to the **BARGRAPH SETUP** menu.

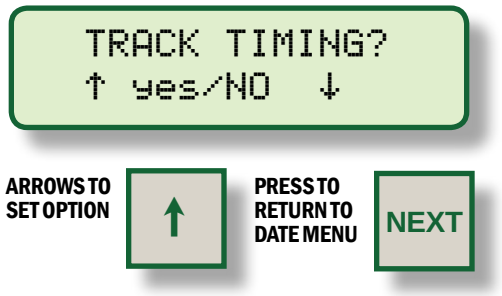
DATALOG SETUP
Next Esc Enter

PRESS TO SET CURRENT MONTH ENTER PRESS TO SEE BARGRAPH SETUP NEXT

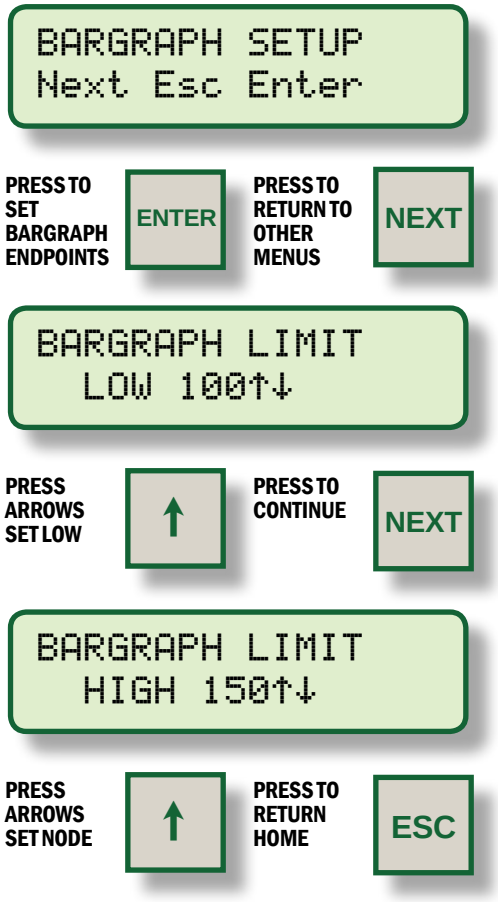

CURRENT DATE
↑01↓22/2007
ARROWS TO SET MONTH
PRESS TO SET DAY
ENTER
CURRENT DATE
01↑22↓/2007
ARROWS TO SET DAY
PRESS TO SET YEAR
ENTER
CURRENT DATE
01/22↑2007↓
ARROWS TO SET YEAR
PRESS TO SET CURRENT TIME
NEXT
CURRENT TIME
↑08↓01:00
ARROWS TO SET HOUR
PRESS TO SET MINUTE
ENTER
CURRENT TIME
08↑01↓:00
ARROWS TO SET MINUTE
PRESS TO SET DATALOG INTERVAL
NEXT



It is possible to setup the system so that any change to the ignition timing will trigger a datalog event (an exception report). Exception reports are automatically generated for alarms or shutdowns.



13.4 The Bargraph display SEE SECTION 11.2 of the spark reference number on Display Module **791908-1** can be scaled by changing the **LOW** and **HIGH** endpoints of the bargraph. A smaller range between endpoints increases the resolution of the Bargraph.



The Bargraph **LOW LIMIT** is adjustable from 0 to the value set for the **LOW SPARK** threshold alarm SEE SECTION 12.2 for details. The Bargraph **HIGH LIMIT** is adjustable from the value set for the **HIGH SPARK** threshold to **255** SEE SECTION 12.3 for details.

SPECIFICATIONS

POWER: 24 VDC @ 150 mA NOMINAL, 32 VDC @ 250mA MAX.

ENCLOSURE: WEATHERPROOF, POWDER COATED ALUMINUM

FIELD CONNECTIONS: PLUG-IN TERMINAL STRIPS ON BACK

CONTROL INPUTS:

1. RS485 SERIAL COMMUNICATIONS PORT
2. MISCELLANEOUS INPUT - ONE STEP RETARD (DEFAULT), ALSO MULTI-STRIKE, MAX. ENERGY LEVEL (CONFIGURED THROUGH P.C.)
3. 4-20 mA CURRENT LOOP INPUT