Operating Instructions

CPU-XL VariSpark Digital Ignition System with Enhanced Display

Form CPU-XL VariSpark IOM 07-21

altronic

1.0 OVERVIEW

1.1 The Altronic CPU-XL VariSpark Digital Ignition with enhanced display is a DC-powered, microprocessor-based, capacitor discharge system applicable to slow and medium speed, stationary, natural gas-fueled engines. It features crankshaft-triggered timing accuracy and the capability to vary timing electronically by several means, including an external 4-20mA control signal. This system is field-programmable and offers a variety of advanced control, emissions reduction, primary and spark diagnostic, self-diagnostic, serial communications and engine protection features.

WARNING: Deviation from these instructions may lead to improper engine operation which could cause personal injury to operators or other nearby personnel.

The ignition system must be configured prior to use on an engine. Refer to section 19.9 To view the current configuration. Reference form CPU-XL VariSpark PI for instructions describing how to configure the ignition system. Verify eeprom programming prior to starting engine.

2.0 COMPONENTS

2.1 The system consists of a Logic/Display Module, a Junction/Diagnostic Module, up to two Output Modules, up to four EZRails, two magnetic pickups and cables, a Hall-effect pickup and trigger magnet (4-cycle engines only), appropriate cables and harnesses, and an ignition coil for each spark plug. For a total system overview, refer to Figure 1.

2.2 Logic/Display Module (291400-1) – Typically mounted in the engine control panel, the Logic/Display Module has a graphical, color, backlight LCD display showing the operating status, engine RPM, energy level, spark profile in use, current loop input value and ignition timing. Additional display screens show set-up and diagnostic information. Its menu structure is similar to those of the CPU-2000 and CPU-95 systems.

2.3 Output Module(s) (291410-1)– Connected by harness to the Junction/Diagnostic Module, an Output Module is installed on each bank of the engine. This device generates the high voltage DC power and distributes this energy to the ignition coil rails. Two modules are required to run V-type engines with one module generating firings for each bank. Each Output Module can drive 10 separate outputs and each output can be used to drive one coil or two coils for engines having two spark plugs per cylinder.

2.4 Junction/Diagnostic Module (291405-2) – The Junction/Diagnostic Module replaces the traditional on-engine junction box and serves several purposes. The Junction/Diagnostic Module wiring is used to determine which cylinder is fired for each output event of the Logic/Display Module. The CPU-XL ignition fires in the same order as all other Altronic digital ignition systems. The first firing event is the one following the reset. The firing events are brought out in order of occurrence (1, 2, 3, 4…) on the 20-position terminal strip inside the Junction/Diagnostic Module.

NOTE: All new installations must use the 291405-2 Junction/Diagnostic Module and the 791401-2 Coil. The -1 versions of these parts are for replacement application only.

2.5 Ignition Coil/EZRail Module(s) – The CPU-XL VariSpark ignition coils and primary wiring are integrated into a series of engine-specific EZRail modules. These coil/rail modules are connected by harness to the Output Module and deliver a factory-certified and tested mounting and on-engine wiring solution. Primary cables and associated connectors are eliminated in the high current portion of the system, thereby enhancing reliability.

2.6 Harnesses (all connectors sealed with epoxy potting)

Logic/Display Module to Junction/Diagnostic Module – 293030-L, one straight 17-pin connector.

Junction/Diagnostic Module to Output Module – 793101-L, one straight and one right-angle 19-pin connector or 793102-L, two right-angle 19-pin connectors.

Output Module to EZRail Assembly – 793102-L, two right-angle 19-pin connectors (max. 48").

2.7 To allow for a simple and economical upgrade of existing Altronic CPU-2000 installations, the CPU-XL utilizes existing CPU-2000 magnetic pickups, Hall-effect pickup and trigger magnet, pickup cables, and inter-module wiring harnesses.

2.8 Power requirement is 24Vdc, 30 amperes.

3.0 MOUNTING THE LOGIC/DISPLAY MODULE

3.1 The CPU-XL Logic/Display Module is preferably panel-mounted off the engine in such a manner as to minimize exposure to vibration. Refer to Figure 2 for dimensions.

3.2 The Logic/Display Module should be mounted within 50 feet (15m) of the Junction/Diagnostic Module.

3.3 Operating temperature range is -40°F to 158°F (-40°C to 70°C). Humidity specification is 0-95%, non-condensing. Housed in a NEMA 4 enclosure, the CPU-XL Logic/Display Module is splash resistant; however, the mounting site should provide as much protection from inclement weather as is practical. Avoid mounting the LCD display and keypad in direct sunlight.

4.0 MOUNTING THE OUTPUT MODULES

4.1 Refer to Figure 3 for physical dimension details. Select a mounting location meeting the following requirements:

- On the engine, within 50 ft. (15m) of the Logic/Display Module.
- Within 15 ft. (4.5m) of the Junction/Diagnostic Module.
- Within 6 ft. (1.8m) of the ignition rails.
- The maximum ambient temperature must not exceed 158°F (70°C).

4.2 The Output Module enclosure should be fastened securely to a rigid engine bracket using the shock mounts provided.

5.0 MOUNTING THE JUNCTION/DIAGNOSTIC MODULE

5.1 Refer to Figure 4 for physical dimension details. Select a mounting location meeting the following requirements:

- Within 20 ft. (6m) of the Output Modules.
- The front panel door of the Junction/Diagnostic Module should be easily accessible and free to swing open.
- The maximum ambient temperature must not exceed 158°F (70°C).

5.2 The Junction/Diagnostic Module enclosure should be fastened securely to a rigid engine bracket using the shock mounts provided.

6.0 MOUNTING FLYWHEEL GEAR/DRILLING FLYWHEEL HOLES

6.1 The Altronic CPU-XL system requires a source of angular position pulses from the engine crankshaft. This can be a flywheel ring gear, a separately provided gear or specially drilled holes in the flywheel. The source of position pulses must meet the following requirements:

- Must be ferrous material, diameter of 18" or greater.
- No. of teeth or holes must be 180 or greater.
- Maximum run-out referenced to the pickup of .007". Refer to Figures 5 and 6 for further details.

7.0 MOUNTING THE MAGNETIC PICKUPS

7.1 The system requires two magnetic pickup signals: the angular position pulses from the gear or drilled holes and a reset pulse near the most advanced firing position desired for no. 1 cylinder. The pickups must be mounted to rigid brackets to maintain an air gap of .015" ± .005" with respect to the rotating gear or flywheel. It is also important for maximum signal efficiency that the centerline of the rotating part pass through the center of the pickup. See Figure 5.

8.0 MOUNTING THE FLYWHEEL RESET PIN

8.1 Set the engine with no. 1 cylinder six (6) degrees ahead of the most advanced firing point. Mark a point on the flywheel directly opposite the pole piece of the reset magnetic pickup; then rotate the engine to a position convenient for drilling and tapping the flywheel at the point marked above. The reset pin should be made from a steel (magnetic) 1/4"-20 bolt or stud. See Figure 5.

8.2 Rotate the engine to the original set point and adjust the air gap between the end of the reset pin and the magnetic pickup at .010" using a feeler gauge.

9.0 MOUNTING THE CYCLE TRIGGER (4-cycle engine only)

9.1 The trigger magnet (260604, 260605 or 720002) must be mounted on the engine camshaft or other accessory drive operating at camshaft speed. An M8 (8mm) tapped hole, 0.5 inches (13mm) deep is required. See Figures 7, 8 or 9 for details. The magnet MUST rotate on a diameter NOT EXCEEDING:

- 6 inches (152mm) for magnet 720002, or
- 15 inches (381mm) for magnet 260604 or 260605.
- Maximum run-out referenced to the pickup of .007”

9.2 Set the engine on the COMPRESSION stroke of no. 1 cylinder with the reset pin DIRECTLY OPPOSITE the reset pickup. The Hall-effect pickup (591014-x) must be mounted DIRECTLY OPPOSITE the trigger magnet coincident with the reset pickup and pin being lined-up.

NOTE: The Hall-effect signal and the reset pickup signal must occur at the same time for the system to function.
The Hall-effect pickup dimensions are shown in Figure 10. The air gap between the Hall-effect pickup and trigger magnet must not exceed .040" (1.0mm).

10.0 LOGIC/DISPLAY MODULE ELECTRICAL HOOK-UP

10.1 The power connections to the CPU-XL must be in accordance with the National Electrical Code or other applicable country code. The CPU-XL is suitable for installation in Class I, Division 2, Group D locations.

10.2 The Logic/Display Module must have its own 24Vdc power connection. Although the device has internal protective fuses (3 amp), an external fuse near the power source is recommended.

10.3 Power wiring and signal wiring must be in separate conduits and conduit entries into the Logic/Display Module to avoid undesired electrical interaction. All conduit entries are sized for a 1/2"-14 NPT male conduit fittin g. Separate as follows (refer to Figure 11):

- RIGHT CONDUIT ENTRY Power wiring and cable 293030–xx to Diagnostic Module
- CENTER CONDUIT ENTRY Magnetic pickups and Hall-effect pickup
- LEFT CONDUIT ENTRY Control inputs, serial communications, and alarm outputs

10.4 RIGHT ENTRY: Input power supply wires (16 AWG minimum) should enter the right conduit entry and connect to the 24Vdc supply terminals of the terminal block. The interface cable 293030-xx, connecting the Logic/Display Module with the Junction/Diagnostic Module, also enters through the right conduit entry. Refer to Figures 11 and 12 for connection details.

10.5 CENTER ENTRY: Run a separate conduit for the two (2) magnetic pickup cable assemblies. These should enter through the center entry in the Logic/Display Module box and terminate as shown in Figure 11.

4-CYCLE ENGINE ONLY: The cable from the Hall-effect pickup also enters through the center entry and connects as shown.

10.6 LEFT ENTRY: A separate conduit must be used to the left-hand entry for all connections to the user interface terminal strips in the Logic/Display Module. Use 24 AWG, UL style 1015 wire or shielded cable for these connections; the 24 AWG wire is available from Altronic under part no. 603102 (black) or 603103 (white).

A. SHUTDOWN INPUT (terminal 4): Use to stop the ignition for engine shutdown. This input is open for normal operation of the system and is connected to engine ground to inhibit ignition firings. NOTE: This is a 5-volt low level signal.

B. ALARM OUT (terminal 5), SHUTDOWN OUT (terminal 6), FIRE CONFIRM OUT (terminal 7): Three output switches are available for monitoring ignition system status. Each output consists of a solid state switch normally closed to a single common rail COMMON OUT (terminal 8). The switches are rated 75mA @ 100Vdc. These output switches are electrically isolated from all other terminals. The recommended hook-up is shown in Figure 11.

C. 4-20mA TIMING CONTROL INPUT: The 4-20mA timing control loop connects to terminals 9(+) and 10(–). This input is electrically isolated from all other terminals; refer to Figures 11 and 15.

D. MISC INPUT (terminal 11): Provides for control of various user-selected features. This input is normally open; connect to engine ground to activate the selected feature (see Figure 11). NOTE: This is a 5-volt low-level signal.

E: 4-20mA SPARK NUMBER CONTROL INPUT: The 4-20mA spark number control loop connects to terminals 3(-) and 4(+) of the 2nd (rear) terminal strip. This input is electrically isolated from all other terminals.

F: SPARK NUMBER OVERRIDE (rear terminal 1): Provides a user-configurable override of the current selected spark profile number. This input is normally open; connect to engine ground to activate the selected feature. NOTE: This is a 5-volt low-level signal.

G: RS-485: The terminals: 5(GND), 6(–), and 7(+) provide an RS-485 port for external control VIA PC or PLC.

11.0 OUTPUT MODULE ELECTRICAL HOOK-UP

11.1 All required connections to the CPU-XL Output Module are made through harnesses using multi-pin, threaded connectors.

11.2 BOTTOM 19-PIN CONNECTOR: The bottom 19-pin of the Output Module connects to the Junction/Diag Module by means of harness series 793101-L or 793102-L. Insert the connector into the bottom Output Module receptacle and hand-tighten; then carefully tighten an additional one-sixth turn with a wrench.

11.3 SIDE 19-PIN CONNECTORS: The 19-pin connectors “A on left” and “B on right” are output connections to the EZRails by means of harness series 793102-L.

11.4 7-PIN CONNECTOR: The 7-pin connector is reserved for future development and is not presently utilized. A sealed connector cap should be in place over this connector.

12.0 JUNCTION/DIAGNOSTIC MODULE ELECTRICAL HOOK-UP

12.1 All required external connections to the CPU-XL Junction/Diagnostic Module are made via harnesses using multi-pin, threaded connectors.

12.2 17-PIN CONNECTOR: Connection to the 17-Pin receptacle of the Junction/Diagnostic Module is made using harness 293030-L, which has been properly terminated inside the Logic/Display Module as described in section 10.0

12.3 19-PIN CONNECTORS: The 19-Pin connectors of the Junction/Diagnostic Module mate to harnesses 793101-L or 793102-L coming from the Output Modules. Take care that the harnesses route the proper signals to the appropriate bank (Output Module) according to the application diagram developed for the installation on your engine. Insert the connector into the receptacle and hand-tighten, then carefully tighten an additional one-sixth turn with a wrench.

12.4 The firing order of the engine, as well as the cylinder identification (1, 2, 3…or 1L, 1R, 2L…or other), should be recorded on the chart in Figure 1.

12.5 After the correct firing order is identified by cylinder, and the cylinders have been labeled, the specific ignition rail, which will be used to fire the coils for each cylinder, can be identified. Each rail connects to one connector of an Output Module using the harness provided.

12.6 The Junction/Diagnostic Module wiring is is used to determine which cylinder is fired for each output event of the Logic/Display Module. The CPU-XL ignition always fires in the same order as all other Altronic digital systems. The first firing event is the one following the reset. The firing events are brought out in order of occurrence (1, 2, 3, 4…) on the 20-position terminal strip inside the Junction/Diagnostic Module. With the Junction/Diagnostic Module mounted with the 20-position terminal strip horizontal, and above the two vertical 10-position output strips and connectors, the firing events are in order from left to right, going from the first to the twentieth firing.

12.7 Wiring the Junction/Diagnostic Module internal jumpers to match the specific firing order of the engine. As with a traditional ignition system such as the CPU-2000, the igniton outputs must be matched to the proper cylinders according to the firing order of the engine. This is done inside the Junction/Diagnostic Module using logic level 20AWG, 503128 jumper wires connected between the pluggable terminal blocks.

12.8 Inside the Junction/Diagnostic Module, two vertical, 10-position, terminal strips are used to connect to the Output Modules via the 79310x-L cables. Each 10-position vertical strip is used to connect to one Output Module, which, in turn, connects to the two ignition rails on a single bank of the engine. The upper five terminals go to one rail through one connector of the Output Module and the lower five terminals go to the other rail mounted on the same bank and connected to the other connector of the same Output Module. This is more easily understood if the entire ignition system is viewed as four separate systems, each of which can fire 1 to 5 cylinders with single or dual coils. Each Output Module contains two separate, five-cylinder ignitions, and each one of these connects to a single rail. Single spark plug per cylinder engine applications use engine rails having a maximum of five coils per rail. Dual spark plug applications can have a maximum of ten coils per rail. All applications service a maximum of five cylinders per rail.

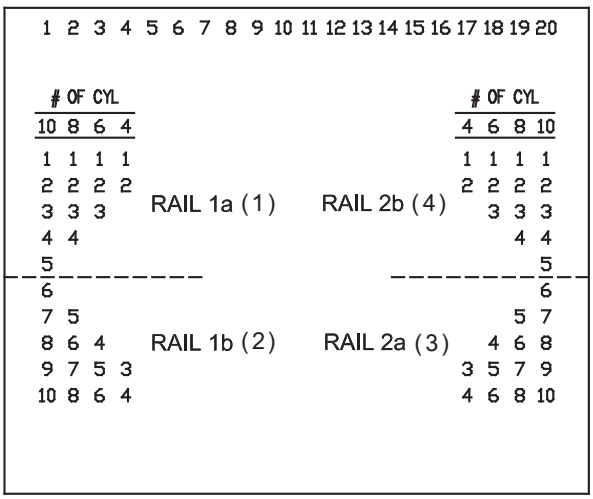
Point-to-point connections of the system.

Junction Terminal ID on Label inside Junction/Diagnostic Module	Cable to Output Module	Output Module Harness to EZRail Connector Pin	Cyl. Position, counting from end away from 19-pin connector	Rail Designator
Rail 1 Terminal 1	Out 1 Pin A	Connector a Pin A	1 Far end of engine	
Rail 1 Terminal 2	Out 1 Pin B	Connector a Pin B	2	
Rail 1 Terminal 3	Out 1 Pin C	Connector a Pin C	3	
Rail 1 Terminal 4	Out 1 Pin D	Connector a Pin D	4	
Rail 1 Terminal 5	Out 1 Pin E	Connector a Pin E	5	

Junction Terminal ID on Label	Cable to Output Module Wire	Output Module Harness to EZRail Connector Pin	Rail Position, counting from end away from 19-pin connector	Rail Designator
Rail 2 Terminal 6	Out 1 Pin F	Connector b Pin E	5	
Rail 2 Terminal 7	Out 1 Pin G	Connector b Pin D	4	
Rail 2 Terminal 8	Out 1 Pin H	Connector b Pin C	3	
Rail 2 Terminal 9	Out 1 Pin J	Connector b Pin B	2	
Rail 2 Terminal 10	Out 1 Pin K	Connector b Pin A	1 Far end of engine	

Junction Terminal ID on Label	Cable to Output Module Wire	Output Module Harness to EZRail Connector Pin	Rail Position, counting from end away from 19-pin connector	Rail Designator
Rail 4 Terminal 1	Out 2 Pin K	Connector b Pin A	1 Far end of engine	
Rail 4 Terminal 2	Out 2 Pin J	Connector b Pin B	2	
Rail 4 Terminal 3	Out 2 Pin H	Connector b Pin C	3	
Rail 4 Terminal 4	Out 2 Pin G	Connector b Pin D	4	
Rail 4 Terminal 5	Out 2 Pin F	Connector b Pin E	5	

Junction Terminal ID on Label	Cable to Output Module Wire	Output Module Harness to EZRail Connector Pin	Rail Position, counting from end away from 19-pin connector	Rail Designator
Rail 3 Terminal 6	Out 2 Pin E	Connector a Pin E	5	
Rail 3 Terminal 7	Out 2 Pin D	Connector a Pin D	4	
Rail 3 Terminal 8	Out 2 Pin C	Connector a Pin C	3	
Rail 3 Terminal 9	Out 2 Pin B	Connector a Pin B	2	
Rail 3 Terminal 10	Out 2 Pin A	Connector a Pin A	1 Far end of engine	



13.0 DC POWER HOOKUP: 293030-XX CABLE

13.1 The power connections to the CPU-XL must be in accordance with the National Electrical Code or other applicable country code. The CPU-XL is suitable for installation in Class I, Division 2, Group D locations.

13.2 It is necessary to split the control cable and power leads of the 293030 cable in an engine-mounted Junction/Diagnostic Module or conduit tee. This box should be separate from the main Junction/Diagnostic Module used to terminate the output harness(es) to the ignition coils. Refer to Figure 12.

13.3 The CPU-XL system can be powered in one of the following ways:

A. 24 volt battery with charger.

B. DC power supply capable of furnishing 24-28Vdc at currents up to 30 amperes.

IMPORTANT: For proper operation of the CPU-XL system, voltage and current supplied must be sufficient during all selected modes of operation. Figure 14 provides these details regarding the DC power hook-up:

1. CURRENT DRAW PER SYSTEM – formula varies depending on number of outputs used, engine cycle and RPM, and spark number used.

2. MINIMUM WIRE GAUGE REQUIREMENTS – Chart 1 of Figure 16 gives the requirement vs. the length of run between the power source and the CPU-XL Junction/Diagnostic Module.

3. MULTIPLE ENGINE INSTALLATIONS – It is recommended that each engine be supplied by a dedicated power supply capable of up to 30 amperes of 24 volt DC power. If a large, uninterruptible, bussed supply is available it can be used for multiple engines, but each igniton should be wired back to the supply main independently of the other ignitions.

NOTE: The negative (-) of the 24Vdc supply MUST BE COMMON WITH ENGINE GROUND. Engines using positive ground DC accessories or starter motors will require a separate dedicated power supply.

WARNING: Although the device has internal protective fuses (3 AMP in the Logic/Display Module, and 15 AMP in the Junction/Diagnostic Module), two external 20 amp fuses near the power source are recommended for the protection of engine and building wiring. This will reduce the possibility of a fire occurring in the event of a short circuit in the wiring. See Figure 16.

14.0 PRIMARY WIRING

14.1 There is no traditional primary wiring required for the use of the CPU-XL ignition system. All of the necessary primary wiring is supplied pre-configured inside the flexible conduit harnesses and the ignition rails.

15.0 SECONDARY WIRING

15.1 Mount the ignition rails as close as possible to the engine spark plugs consistent with a secure mounting and avoidance of temperatures in excess of 185°F (85°C).

15.2 The spark plug leads should be fabricated from silicone insulated 7mm cable with suitable terminals and silicone spark plug boots. The use of leads with resistor spark plug boots (Altronic series 59320x-xx) is recommended to minimize interference from emitted RFI on the operation of other nearby electronic equipment. Another option is the use of suppression ignition cables. It is also essential to keep spark plug leads as short as possible and in all cases not longer than 24 inches (600mm). Spark plug leads should be kept at least 2 inches (50mm) away from any grounded engine part. In deep spark plug wells, use rigid insulated extenders projecting out of the well.

15.3 The use of a clear, silicone grease (such as Dow Corning DC-4, G.E. G-623 or GC Electronics ZS) is recommended for all high-tension connections and boots. This material helps seal out moisture and prevent corrosion from atmospheric sources.

16.0 INPUT/OUTPUT WIRING

16.1 To shut-off the DC-powered CPU-XL system, a special input (SHUTDOWN INPUT terminal 4) in the Logic/Display Module is provided. This input is open for normal operation and is connected to engine ground to initiate an ignition shutdown. Use a switch rated 24Vdc, 0.5 amps. Refer to section 10.6 A, and Figure 11 for details.

16.2 The Logic/Display Module includes two isolated current loop inputs. The first can be configured to control spark timing. Reference the programming instructions, form CPU-XL VariSpark PI. See Figure 11 for Terminal Block ID.

16.3 The second current loop input can be configured to control the spark number. Reference the programming instructions, form CPU-XL VariSpark PI. See Figure 11 for Terminal Block ID.

16.4 Two digital inputs are provided inside the ignition system. These logic-level inputs are active when shorted to ground. The first, MISC. INPUT, controls one-step retard, and the second, SPK OVERRIDE, controls the spark override number. See Figure 11 for Terminal Block ID.

17.0 COMMUNICATIONS

17.1 The Logic/Display Module incorporates a half-duplex RS-485 port which is Modbus RTU slave compliant. The protocol used follows the Modicon Modbus RTU standard. 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. This port is also used to configure the ignition system for its application using a PC and the CPU-XL VariSpark PC terminal software. For a complete list of the Modbus register addresses, see section 32.0. The CPU-XL VariSpark terminal program CD contains a PC-based Modbus compatible monitoring program which can be used to access the ignition data remotely.

17.2 Logic/Display Module: serves as the user interface for the CPU-XL VariSpark ignition system. A proprietary CANBUS communications format is used to connect the Logic/Display Module to the Junction/Diagnostic Module.

17.3 An internal USB port can also be configured as another Modbus RTU interface.

18.0 DISPLAYS AND INDICATORS

18.1 A graphical, color-changing, back-lit, LCD display provides output to the user. A sealed-membrane keypad accepts user input. The LCD display and the keypad function together to provide an interactive user interface that prompts the user as different functions are selected. The screen background color indicates status: green indicates normal condition, yellow indicates a warning and remains until a key is pressed, and red indicates a fault and remains until a key is pressed. Pressing any key results in a white background which remains for 30 seconds.

18.2 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.

18.3 Green LED indicators are provided inside the ignition unit for troubleshooting:

POWER LED: on to indicate that the unit has power and the microprocessor is running. 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.

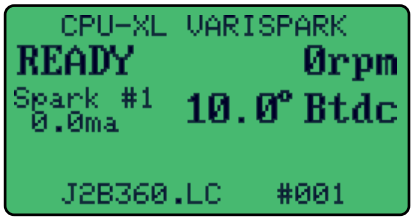
RX LED: flashes to indicate that the ignition unit is receiving on the RS-485 serial link.

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

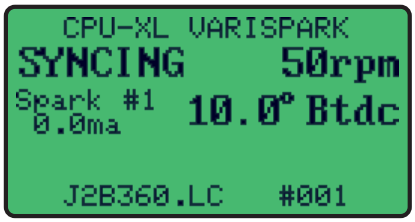
19.0 UNDERSTANDING THE HOME SCREEN

19.1 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.

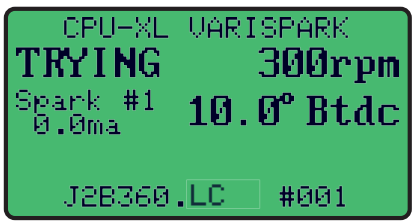
19.2 The **READY** message is displayed when the ignition is ready for the engine to crank for starting.



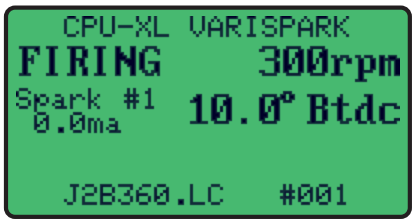
19.3 Once the engine begins turning, the **SYNCING** message is displayed while the ignition system verifies signals from the engine pickups.



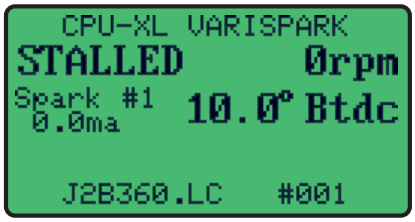
After the ignition system has synchronized with the engine, the system displays TRYING. This message means that the system has begun firing.



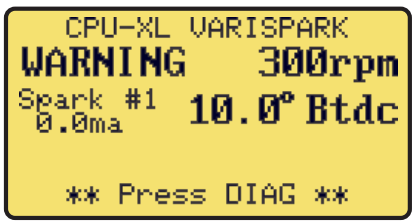
19.4 The **FIRING** message is displayed after one channel of each Output Module has fired at least once. When this is displayed, the fire-confirm signal is also closed. Additional data is provided on this screen to describe the selected mode of operation for the ignition. The spark mode (#1-8) is described beneath the status.



19.5 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.

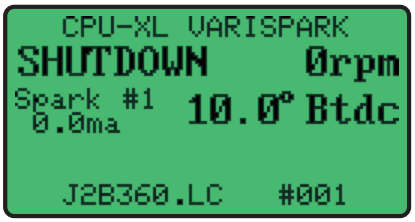


19.6 The **WARNING** message will supersede all of the above home screens if a diagnostic warning condition is present. When a diagnostic warning exists, a ** **Press DIAG** ** message will appear on the display. The Ignition Module will continue to operate under a warning condition while alerting the operator of a potential problem in several ways: by turning on the Alarm LED in the Ignition and by changing the state of the Alarm Out switch (switch opens), and changing the screen background color to yellow. The Logic/Display Module will display the **WARNING** message. The various types of diagnostic warnings are described in section 25.6.



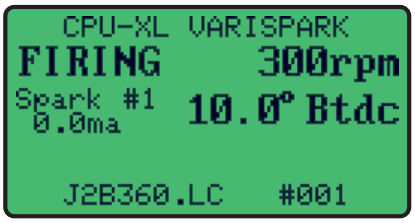
19.7 The **FAULT** message will supersede all of the above home screens if a diagnostic fault condition is present. When a diagnostic fault exists, a ** **Press DIAG** ** message will appear on the display. The ignition system will stop operating under a fault condition and will alert the operator to the problem in several ways: by changing the state of the Fire Confirm Out switch (switch opens), by turning on the alarm LED on the Logic/Display Module, by changing the state of the Alarm Out switch (switch opens), and by displaying the Fault message and changing the screen background color to red. The various types of diagnostic faults are described in section 25.5.

19.8 The **SHUTDOWN** screen will supersede all other home displays if the logic level shutdown input of the Ignition Module. 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 ** **Press DIAG** ** message will appear on 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.



19.9 From the **HOME SCREEN**, pressing the NEXT key allows you to cycle through the configuration comments which describe the configuration of the ignition system.

AT



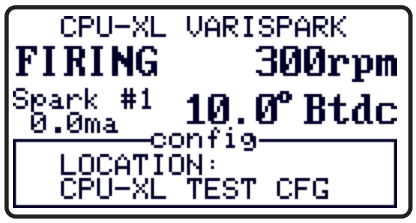
PRESS TO GO TO NEXT

The configuration screens are shown starting on the next page.

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

FIRING PATTERN CODE: (J²B³⁶⁰.HC)
SPECIAL FEATURE CODE: (#⁰⁰¹)
(¹ STEP DEFAULT)
IGNITION MODULE TYPE: (P A R T

NEXT

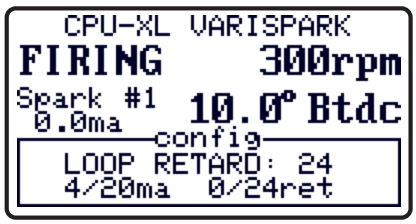


LOCATION:
USER SPECIFIED DESCRIPTION

NEXT

DATE CONFIGURED: (05_16_12)
TIME CONFIGURED: (10:07)
CONFIGURED BY: (HD³)
TERMINAL VERSION #: (v¹.⁰⁰)

NEXT



CURRENT LOOP CURVE DESCRIPTION
AT ⁴mA ⁰° RETARD
AT ²⁰mA ²⁴° RETARD
USER SPECIFIED DESCRIPTION

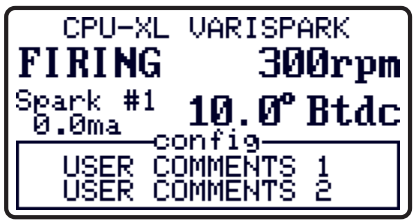
NEXT

RPM RETARD CURVE DESCRIPTION
YES/NO Status
RPM RANGE Retard Range
⁰/₁₂₇₅ ¹⁰% ret

NEXT

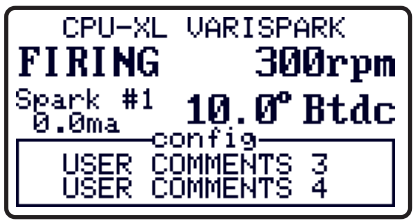
ENGINE NUMBER OR DESCRIPTION
USER SPECIFIED DESCRIPTION

NEXT



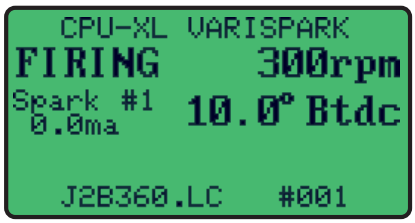
SPECIAL USER COMMENTS AREA #1
USER SPECIFIED COMMENTS

NEXT



SPECIAL USER COMMENTS AREA #2
USER SPECIFIED COMMENTS

NEXT



PRESS NEXT TO RETURN TO HOME

NEXT

PRESS ESC. FROM ANY SCREEN TO RETURN TO HOME SCREEN

ESC

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-XL VariSpark PI, for further information on configuration.

BREAKDOWN OF FIRING PATTERN CODE: J²B³⁶⁰.LC#⁰⁰¹

J REPRESENTS THE NUMBER OF OUTPUTS USED, IN THIS CASE ¹⁰
(F =⁶, L = ¹², ETC.)

² REPRESENTS THE CYCLE TYPE OF THE ENGINE

² = TWO–CYCLE

⁴ = FOUR–CYCLE

B REPRESENTS THE ALTRONIC PATTERN CODE (SEE FORM CPU–XL VA–RISPARK AL)

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

L REPRESENTS A DESIGNATOR FOR CPU–XL VARISPARK VERSION ¹

C 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

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

⁰¹⁶ = USE ¹ STEP RETARD WHEN RPM IS LESS THAN ²⁵⁰

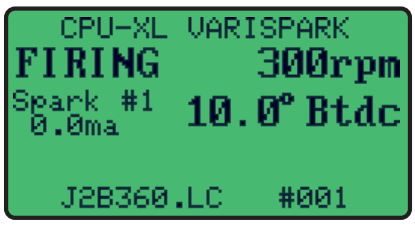
⁰⁰¹ = USE ¹ STEP RETARD WHEN MISC INPUT IS GROUNDED

20.0 ADJUSTING GLOBAL RETARD

20.1 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-XL VariSpark system. Adjustments made as described below will be in effect until another adjustment is made.

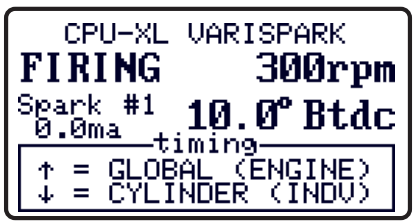
20.2 To adjust global retard:

FROM



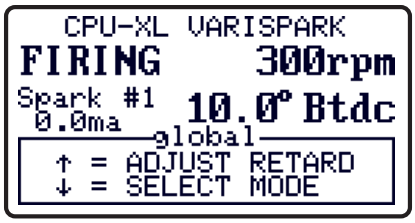
PRESS TIMING

THEN AT



PRESS ↑

THEN AT



PRESS ↓

THEN AT

NOTE: RESULTANT TIMING SHOWN ON BOTTOM LINE.

PRESS TO INCREASE RETARD ↑

PRESS TO DECREASE RETARD ↓

PRESS TO EXIT ESC

20.3 The increment of timing change is dependent on the number of holes or teeth being sensed. The minimum timing change is defined as follows.

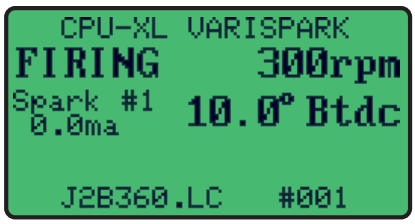
The timing increment is "90/N" degrees, where N = no. of holes or teeth.
Example: 90/360 = 0.25° min. timing increment.

20.4 Global spark timing is determined based on the sum of several spark retard components which include manual retard, current loop retard, RPM retard, and 1 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.

21.0 SELECTION OF GLOBAL TIMING MODES

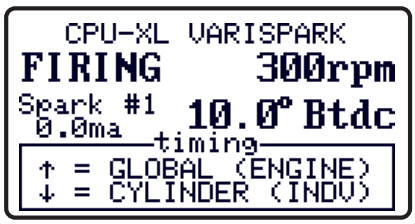
21.1 Several options exist with regard to global timing modes. Once the global timing mode menu is entered as described below, the status of each option can be viewed and changed.

FROM



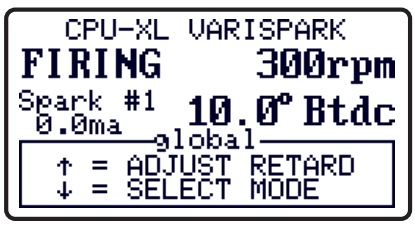
PRESS TIMING

THEN AT



PRESS ↑

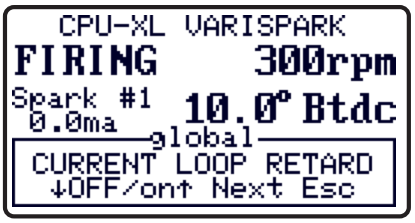
THEN AT



PRESS ↓

21.2 The first mode selection can enable or disable the pre-configured retard curve controlled by the 4-20mA current loop input. The choices are ON or OFF, with the active selection displayed in capital letters. A PC is required to configure the 4-20mA curve; reference the programming instructions, form CPU-XL VariSpark 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".

AT



NOTE: DISPLAY SHOWS CURRENT LOOP ON.

TO TURN ON ↑ **TO TURN OFF** ↓ **FOR NEXT OPTION** NEXT **TO EXIT** ESC

21.3 The next mode selection can enable or disable the pre-configured retard curve controlled internally by engine RPM. To configure the RPM retard curve, refer to the Programming Instructions, Form CPU-XL VariSpark PI.

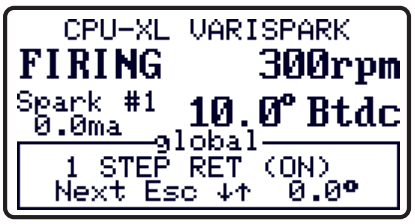
AT THE NEXT OPTION SCREEN

NOTE: DISPLAY SHOWS RPM MAP OFF.

TO TURN ON ↑ **TO TURN OFF** ↓ **FOR NEXT OPTION** NEXT **TO EXIT** ESC

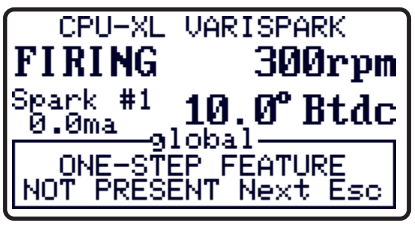
21.4 The next mode selection can increase or decrease the 1 step retard value. The first screen below is displayed when 1 step retard is both configured and is active. The second screen below is displayed when the 1 step retard is configured but not active. The default configuration selects 1 step retard 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 1 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).

AT THE NEXT OPTION SCREEN



OR

OR



NOTE: 1 STEP RETARD NOT CONFIGURED.

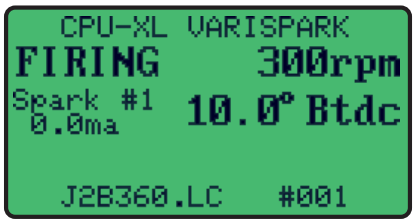
TO INCREASE ↑ **TO DECREASE** ↓ **TO GO BACK TO FIRST** NEXT **TO EXIT** ESC

22.0 ADJUSTING INDIVIDUAL OFFSETS

22.1 The timing of individual cylinders can be offset by up to 3 degrees of advance or retard from the global timing of the engine. The values are not saved in EEPROM memory. See section 23.2.

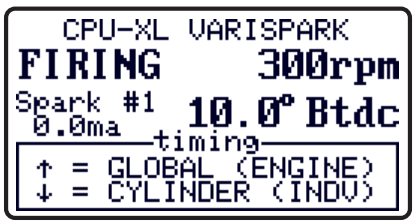
22.2 Enter the individual timing adjustment menu as described below.

FROM



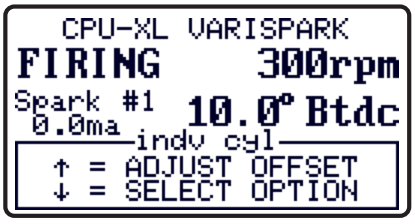
PRESS TIMING

THEN AT



PRESS ↓

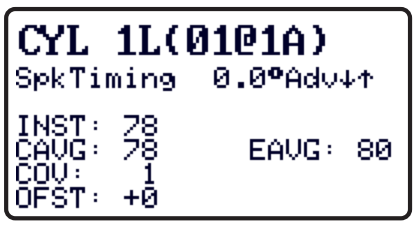
THEN AT



PRESS ↑

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

THEN AT



NOTE: 0.0 degrees advance for output A.

TO ADJUST INDIVIDUAL CYL TIMING OFFSET ↑ ↓

TO SELECT NEXT CYLINDER NEXT

TO SELECT PREVIOUS CYLINDER SETUP

TO VIEW CURRENT CYLINDER GRAPH F3

TO GO TO CYLINDER SELECT F1

TO GO TO DIAGNOSTIC OFFSET F4

TO RETURN TO HOME SCREEN ESC

IADVANCE TO THE NEXT CYLINDER IN THE FIRING ORDER TIMING

TO RESET THE CYLINDER TIMING TO EEPROM STORED VALUE RESET

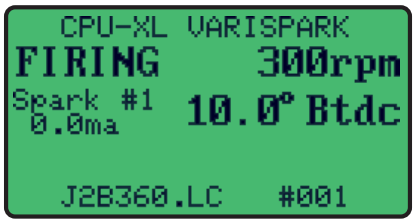
NOTE: In applications with narrow firing angles, the adjustment range may be limited.

NOTE: Cylinder identification information describes:
1L = Cylinder Label
01 = Firing Order
1A = Rail/Coil Position.

23.0 INDIVIDUAL CYLINDER OFFSET MODES

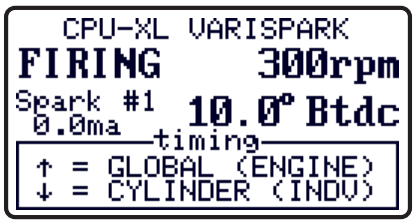
23.1 Two additional functions with regard to individual cylinder timing offsets are provided. These functions can be accessed from the individual timing mode menu which can be entered as described below.

FROM



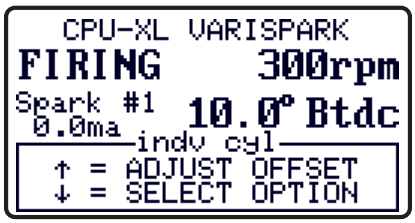
PRESS TIMING

THEN AT



PRESS ↓

THEN AT



PRESS ↓

23.2 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 22.3 to adjust individual offsets.

AT THE FIRST OPTION SCREEN

PRESS TO SAVE OFFSETS ENTER

PRESS FOR NEXT OPTION NEXT

PRESS TO EXIT ESC

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

> ***NOTE: This does not affect default settings. To zero default settings, perform this action, then perform SAVE CYL OFFSETS action (Section 23.2).***

AT THE NEXT OPTION SCREEN

PRESS TO RESET OFFSETS — ENTER

PRESS FOR NEXT OPTION — NEXT

PRESS TO EXIT — ESC

23.4 The next screen allows all temporary cylinder timing to be reloaded from the EEPROM.

PRESS TO RELOAD OFFSETS — ENTER

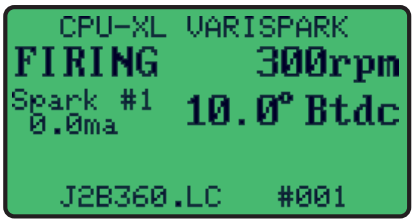
PRESS FOR NEXT SCREEN — NEXT

TO RETURN TO THE HOME SCREEN — ESC

24.0 SETUP CONTROL OPTIONS

24.1 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**

24.2 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.

AT

TO INCREASE ↑ TO DECREASE ↓ FOR NEXT OPTION **NEXT** TO EXIT **ESC**

24.3 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: Reset position must be selected and properly documented by the originator.

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

AT

TO INCREASE ↑ TO DECREASE ↓ FOR NEXT OPTION **NEXT** TO EXIT **ESC**

24.4 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 critical operating EEPROM settings can be changed. This feature can be used to provide limited protection from random changes by inexperienced operators.

AT

TO TURN ON PROTECTION ↑ **TO TURN OFF PROTECTION** ↓ **FOR NEXT OPTION** **NEXT** **TO EXIT** **ESC**

24.5 The **VALUE PROTECTION** can be password protected. The password **PROTECTION LOCK** is enabled under the programming options from the PC terminal program. See the Programming Instructions, form CPU-XL VariSpark PI for details. When password protection is enabled the following menu appears instead of the **VALUE PROTECTION** menu.

24.6 To enter the password, use the function keys (F1, F2, F3, F4 where F1=1, F2=2, F3=3, F4=4). 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 next setup menu.

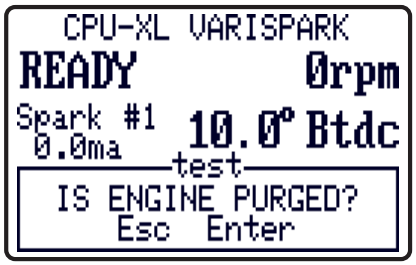
24.7 The next setup screen permits the operator to enter an ignition Test Mode. This test mode can fire all outputs in rotation, or individual outputs at a slow rate. This feature can be used to troubleshoot primary wiring and Output Module operation. Test Mode will terminate if rotation of the engine is sensed. Diagnostic features do not function while in Test Mode.

NOTE: The Test Mode is enabled by the user during initial setup of Logic/ Display Module from PC terminal program. See form CPU–XL VariSpark PI for details.

AT

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

THEN BEFORE STARTING TEST MODE



PRESS TO VERIFY PURGED ENTER **PRESS TO EXIT** NEXT

WARNING: The operator MUST fully purge the engine of combustible mix–tures 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.

AT

PRESS TO SELECT PREVIOUS OUTPUT ↑ **PRESS TO SELECT THE NEXT OUTPUT** ↓ **PRESS TO EXIT** ESC

Test Mode selection is described below:

ALL – Rotate through all cylinders in the fire order

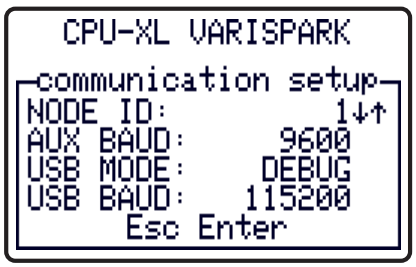
[1]–N –Fire individual cylinder; the cylinder's label and connection will be displayed. If the firing is detected at a different location or not detected at all, an asterisk '*' will be displayed next to the location.

24.8 The **COMMUNICATION SETUP MENU** allows the adjustment of various aspects of the Logic/Display Module's two user ports.

AT

PRESS TO ACCESS THE MENU ENTER **PRESS TO GO TO THE NEXT MENU** NEXT **PRESS TO EXIT** ESC

AT



PRESS TO MODIFY THE VALUE ↑ ↓

PRESS TO ADVANCE TO THE NEXT SELECTION ENTER **PRESS TO GO TO THE NEXT MENU** NEXT **PRESS TO EXIT** ESC

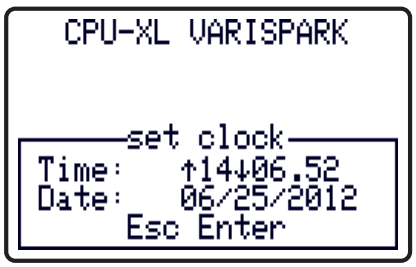
Node ID can be set anywhere from 1 to 254. The auxiliary RS-485 (Modbus RTU) port can have the following baud rates 9600, 19200, 38400, 57600, 115200. Always no parity, 8 data bits, and 1 stop bit (N81). The USB port has the following modes: **TERMINAL**, **MODBUS RTU**, and **DEBUG**. The **TERMINAL** mode is for future use only. The **MODBUS RTU** mode follows the node ID, and the USB baud rate. This mode uses the virtual com port driver that is a part of the USB driver on the CDROM. The USB port virtual com port baud rate can be set to the following: 9600, 19200, 38400, 57600, 115200. The **DEBUG** mode is used by the factory for testing purposes.

24.9 The **CLOCK SETUP** menu is used to set the desired calendar date and time used by the datalog feature of the Logic/Display Module.

AT

PRESS TO ACCESS THE MENU [ENTER] PRESS TO GO TO THE NEXT MENU [NEXT] PRESS TO EXIT [ESC]

AT



PRESS TO MODIFY THE VALUE [↑] [↓]

PRESS TO ADVANCE TO THE NEXT SELECTION [ENTER] PRESS TO GO TO THE NEXT MENU [NEXT] PRESS TO EXIT [ESC]

NOTE: The Logic/Display Module's real time clock does not automatically adjust for daylight savings time.

24.10 The CPU-XL contains three different data logging sets. Each log is stored in a FIFO (first in, first out) manner with the oldest logs being purged when new data is available. Data logs can be accessed via special Modbus commands, and/or through the CPU-XL Terminal Program.

The first set contains real-time engine information of the last 773 engine cycles. This data is used to generate the real-time graphs and can be accessed through the CPU-XL VariSpark Terminal Program to be used in case of failure. This log set requires no configuration and is always active when the engine is firing. The real-time spark logs can be requested by the rotation number (0-65535, but not more than 773 from the current rotation number).

The second log set contains 512 snapshots of the system configuration and the average ignition values. This log set is accessed with an index of 0-511, with 0 being the most recent snapshot. Snapshots are taken at regular intervals (optionally, only when the engine is running), and after the following major events:

- **The running ignition program is updated.**
- **An alarm is triggered or cleared.**
- **Optionally, when the global timing changes.**

The third log set contains the history of engine RPM speed over the last 5 minutes organized as 512 individually time stamped logs 0-511, with 0 being the most recent, along with a maximum and minimum observed over this time frame. This log also requires no user configuration and is active whenever the engine is rotating. When the engine stops rotating, a single log entry is made noting the time that the engine has stopped.

The **DATALOG SETUP** menu appears after the **COMMUNICATION SETUP** menu. If datalogs are not being used, press the NEXT key to proceed to the **CYLINDER LABELS** menu.

AT

PRESS TO ENTER THE DATALOG MENU — ENTER

PRESS TO GO TO THE NEXT MENU — NEXT

PRESS TO EXIT — ESC

AT

PRESS TO MODIFY THE VALUE — ↑ ↓

PRESS TO ADVANCE TO THE NEXT SELECTION — ENTER

PRESS TO GO TO THE NEXT MENU — NEXT

PRESS TO EXIT — ESC

NOTE: 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.

24.11 The **CYLINDER LABELS** menu allows the user to associate two alphanumeric cylinder designators with the output lead on the CPU-XL VariSpark.

AT

PRESS TO ACCESS THE MENU — ENTER

PRESS TO GO TO THE NEXT MENU — NEXT

PRESS TO EXIT — ESC

AT

PRESS TO MODIFY THE VALUE ↑ ↓

PRESS TO ADVANCE TO THE NEXT SELECTION ENTER

PRESS TO GO TO THE NEXT MENU NEXT

PRESS TO EXIT ESC

24.12 The **FIRE ORDER** menu allows the user to configure the CPU-XL to correctly associate physical cylinders with the correct connected EZRail location. The system uses a simple identification of rails (1-4) and coils (A-E). Rails 1 and 2 are the upper and lower rail of the first (left) Output Module. Rails 3 and 4 correspond to the lower and upper rails of the second (right) Output Module. This is required in order to be able to correlate cylinder diagnostic information with the actual physical cylinder and has no bearing on the actual fired cylinder.

AT

PRESS TO ACCESS THE MENU ENTER

PRESS TO GO TO THE NEXT MENU NEXT

PRESS TO EXIT ESC

AT

PRESS TO MOVE BETWEEN CYLINDER, RAIL, COIL AND SLAVE ENTER

PRESS TO MODIFY THE VALUE ↑ ↓

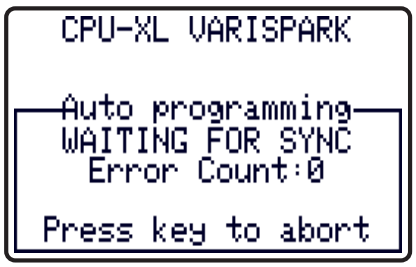
PRESS TO GO TO THE NEXT MENU NEXT

PRESS TO EXIT ESC

PRESS TO LOAD A HARD–CODED DEFAULT THAT ENABLES ALL THE CYLINDERS AND COILS RESET

PRESS TO ATTEMPT TO VERIFY THE PROGRAMMED ORDER (MUST BE DONE ON A RUNNING ENGINE – SEE BELOW) DIAG

AT



PRESS TO ATTEMPT TO AUTOMATICALLY DETECT THE PROGRAMMED ORDER (MUST BE DONE ON A RUNNING ENGINE – SEE BELOW)

AUTO

AT

PRESS TO CONTINUE

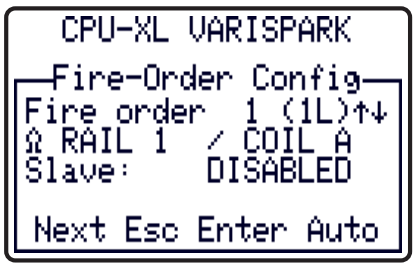
ENTER

PRESS TO RETURN TO PREVIOUS SCREEN

ESC

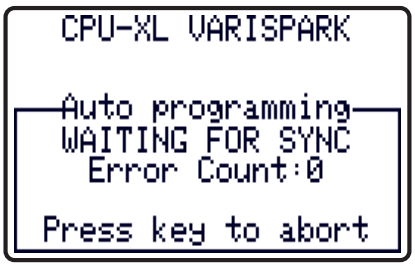
The system has the ability to attempt to automatically detect and/or verify the connections while the engine is running. **This has no effect on the engine operation.** To verify the firing order:

FROM



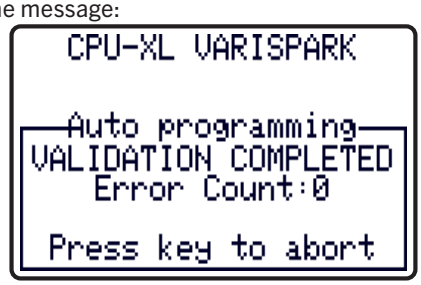
PRESS

DIAG



The system will verify the fire order:

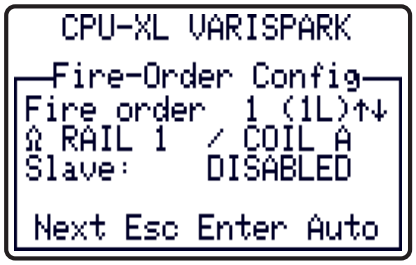
And pop-up the message:



OR

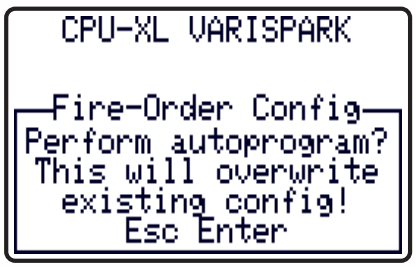
The system can also automatically detect the fire order:

FROM



PRESS

AUTO



PRESS TO CONTINUE

ENTER

It will then detect and verify the fire order:

If the detection fails, it will display the following message:

And reset the fire order to the hard-coded default.

25.0 CPU-XL VARISPARK DIAGNOSTICS

25.1 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 read PRESS DIAG.
- LCD backlight turns red.

25.2 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 read PRESS DIAG.
- LCD backlight turns yellow.

25.3 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.

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.

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

FROM THE HOME SCREEN

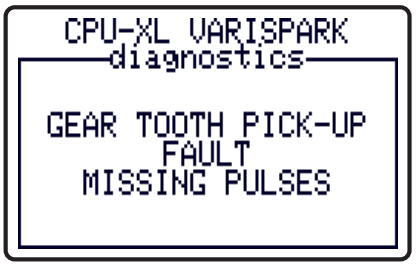
PRESS DIAG

Then from the diagnostic description screens use the following keys.

PRESS TO VIEW NEXT NEXT **PRESS TO EXIT** ESC

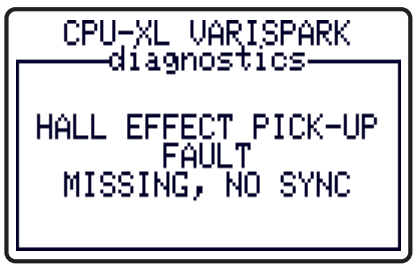
25.5 Diagnostic Fault screens, in order of display priority:

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



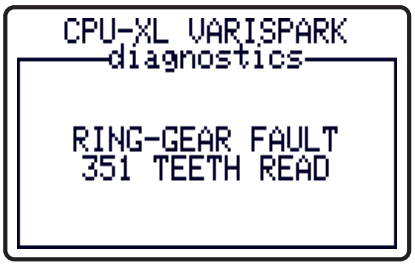
When too many gear-tooth pulses are seen without a reset pulse.

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.

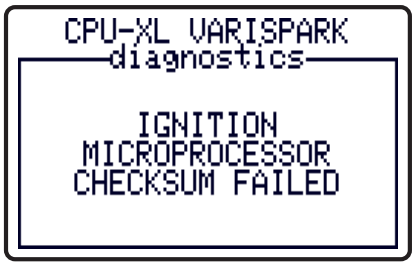


When the engine speed exceeds the overspeed setpoint.

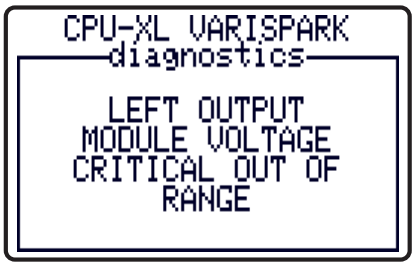
Maximum observed speed is also displayed.

When the configuration and firing data stored in EEPROM memory is corrupted. This indicates that the EEPROM memory must be replaced.

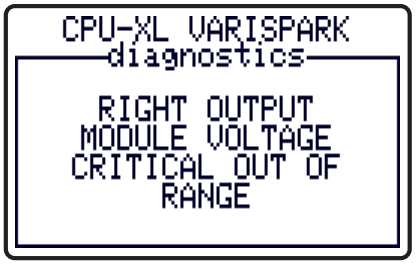
When the programming stored in the Ignition processor is corrupted. This indicates that the Ignition processor must be replaced.



When the voltage supplied to the left Output Module (rails 1 and 2) has gone critically too high or too low. This indicates either a bad power supply, or a blown fuse (located in the Junction/Diagnostic Module).



When the voltage supplied to the right Output Module (rails 3 and 4) has gone critically too high or too low. This indicates either a bad power supply, or a blown fuse (located in the Junction/Diagnostic Module).

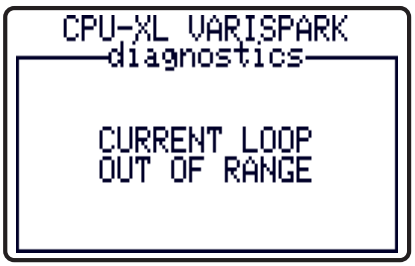


This indicates a short or open circuit on the CAN communications lines between the Logic/Display Module and the Junction/Diagnostic Module.

25.6 Diagnostic Warning screens, in order of display priority:

NOTE: Diagnostic FAULTS will supersede diagnostic WARNINGS.

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



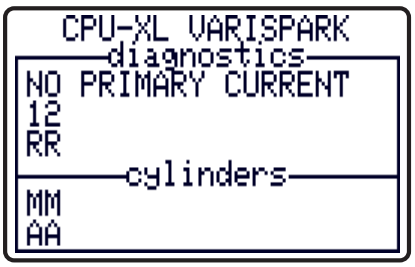
This screen indicates that the firing pattern configuration data saved in EEPROM memory is incorrect or incomplete. The EEPROM memory must be reprogrammed.

This screen indicates that the ignition processor detected a communication interruption between itself and the display processor in the Junction/Diagnostic Module.

This could indicate a wiring fault or a failure inside the Logic/Display Module.

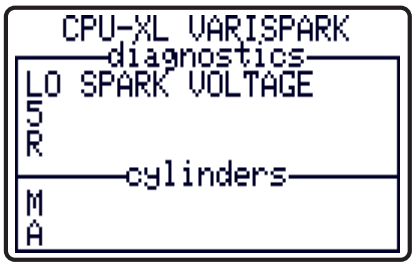
This screen indicates that the diagnostics have identified no current draw on the master coil primary of cylinders 1R and 2R.

This normally indicates faulty wiring or a failed coil.



This screen indicates that there is a low spark demand condition on the master coil of cylinder 5R.

This is often caused by low compression or insufficient spark plug gap.

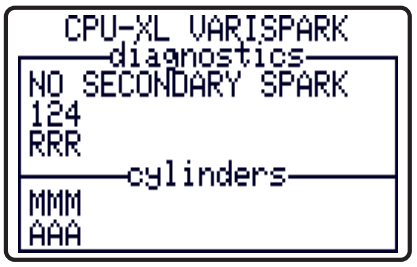


This screen indicates that there is a high spark demand condition on the master coils of cylinders 1R, 2R, 4L, 4R, and 5L.

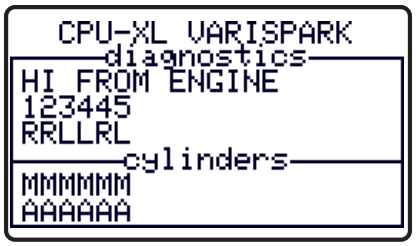
Often caused by worn spark plugs.

This screen indicates that there is a no secondary spark demand condition on the master coils of cylinders 1R, 2R, and 4R.

This can be caused by a shorted spark plug, faulty coil, or opened spark plug lead.

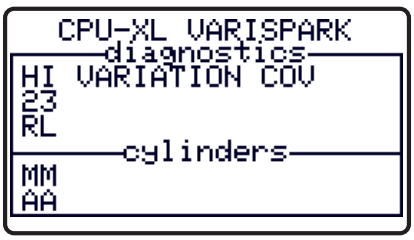


This screen indicates that diagnostics have detected a condition where the output of the master coils of cylinders 1R, 2R, 3L, 4L, 4R, and 5L are significantly higher than the average of all the active outputs on the engine.



This screen indicates that diagnostics have detected a condition where the output of the master coils of cylinders 2L and 2R are significantly lower than the average of all the active outputs on the engine.

This screen indicates that diagnostics have detected that the output of the master coils of cylinders 2R and 3L are firing with significant cycle-to-cycle variation.



This screen indicates that the Logic/Display Module has detected an interruption in the internal communication between the display processor and ignition processor. This could indicate a wiring fault or failure inside the Logic/Display Module.

This screen indicates that the Logic/Display Module has lost communication with the Junction/Diagnostic Module. This could indicate a wiring fault between the Logic/Display Module and the Junction/Diagnostic Module or a faulty diagnostic processor inside the Junction/Diagnostic Module.

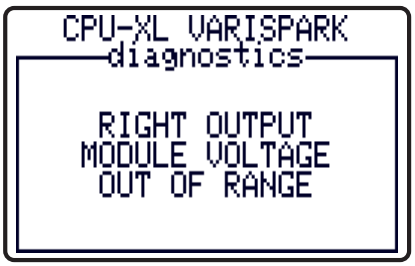
This screen indicates that the auxiliary current loop (spark number control) has deviated outside the limits of 2mA and 22mA. The current loop follows the configured curve which is specified from 4-20mA. This diagnostic is active only if the 4-20mA spark select map is on.

This screen indicates that the voltage detected at the junction module is not within the acceptable range for the requested spark number. This could indicate loose wiring between the Logic/Display Module and Junction/Diagnostic Module or a faulty connector.

This indicates that the mapping between the spark diagnostics and the actual engine firing order is incorrect and needs to be updated.

This indicates that the voltage supplied to the left Output Module (rails 1 and 2) has deviated outside of the normal operating range. This can result from poor wiring, an inadequate power supply, or a discharged/weak supply battery.

This indicates that the voltage supplied to the right Output Module (rails 3 and 4) has deviated outside of the normal operating range. This can result from poor wiring, an inadequate power supply, or a discharged/weak supply battery.



This screen indicates a problem with the diagnostic detection circuit on rails 1 and 3.

25.7 After all of the diagnostics have been read, the user can reset the warnings and faults by pressing the reset key from the **HOME SCREEN** as pictured below.

Pressing the reset key performs all of the following actions:

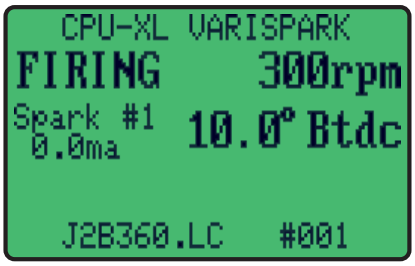
- Clears all diagnostic warnings from memory.
- Clears all diagnostic faults from memory.
- Clears a latched shutdown condition when the input is no longer grounded.
- Causes temporary cylinder timing offsets to be overwritten from EEPROM memory.
- Resets internal communication statistics.

26.0 SYSTEM LEVEL INFORMATION

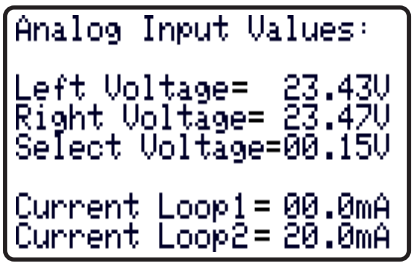
26.1 In addition to engine diagnostics, the CPU-XL VariSpark has the ability to display internal system level information. This can be used as an aid to troubleshoot a malfunctioning unit or verify proper configuration and operation.

26.2 “Analog Data” screen.

FROM



PRESS DIAG THEN F1 OR ENTER



This screen displays the actual voltage values read from the Junction/Diagnostic Module as well as the current loops in both the RPM retard current loop, and spark select current loop.

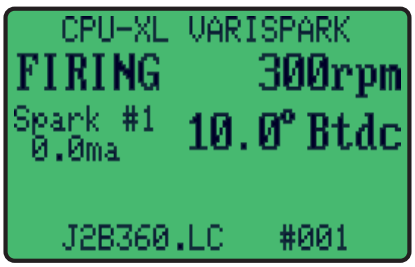
PRESS TO RETURN TO HOME SCREEN ESC

PRESS TO RETURN DIAGNOSTIC SCREEN DIAG

26.3 Additional information is accessible by authorized technicians. This information is protected by a hard-coded password. This prevents unauthorized access to various parts of the system:

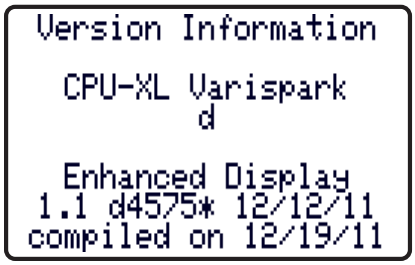
26.4 “Version Information” screen.

FROM



PRESS **DIAG**

THEN **ENTER**



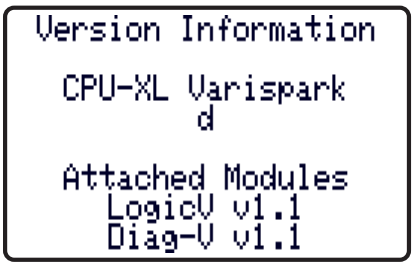
This screen displays the software build information including build number, and software version. The first screen shows the information for the display unit.

PRESS TO GO TO “ATTACHED MODULES” SCREEN **ENTER**

PRESS TO GO TO HOME SCREEN **ESC**

26.5 “Attached Modules” screen.

This screen displays the software version and name for the Junction/Diagnostic Module and Logic/Display Module.



PRESS TO GO TO “VERSION INFORMATION” SCREEN **ENTER**

PRESS TO GO TO HOME SCREEN **ESC**

27.0 UNDERSTANDING AND USING THE SECONDARY SPARK DIAGNOSTICS

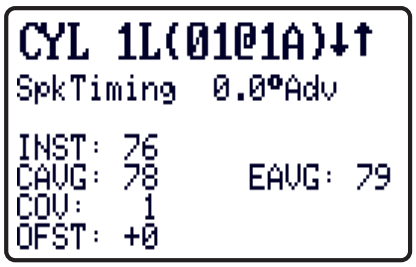
27.1. The spark reference number represents 100 volts, or 0.1Kv, per count of voltage demand at the spark plug and is calculated for every firing of each cylinder. With a little experience, the engine operator will be able to tell when spark plugs require changing. Abnormal conditions in the ignition system, such as open or short circuits in the primary and secondary wiring, can also be detected.

27.2 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: INST**
- **Cylinder average value: CAVG**

FROM THE HOME SCREEN

PRESS TO VIEW DISPLAY SCREEN **F1**



NOTE: A spark number of 76 represents a voltage demand of 7.6Kv.

TO GO UP IN FIRING ORDER **↑**

TO GO DOWN IN FIRING ORDER **↓**

TO SELECT NEXT CYL. **NEXT**

TO SELECT PREVIOUS CYLINDER **SETUP**

TO VIEW CURRENT CYLINDER GRAPH **F3**

TO GO TO DIAGNOSTIC OFFSET **F4**

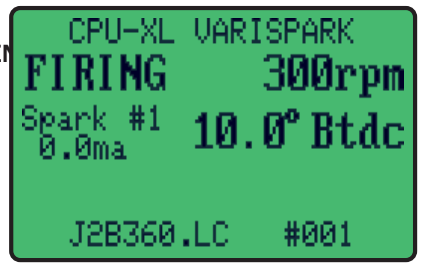
TO GO TO CYLINDER TIMING **TIMING**

TO EXIT **ESC**

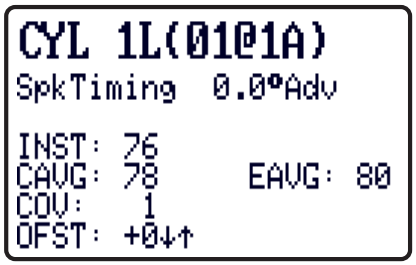
TO GO TO NEXT CYL IN FIRING ORDER **F1**

27.3 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.

FROM THE HOME SCREEN



PRESS TO VIEW DISPLAY SCREEN **F4**



TO ADJUST INDIVIDUAL COIL DIAGNOSTIC OFFSET **↑** **↓**

TO SELECT NEXT CYLINDER **NEXT**

TO SELECT PREVIOUS CYLINDER **SETUP**

TO VIEW CURRENT CYLINDER GRAPH **F3**

TO GO TO CYLINDER SELECT **F1**

TO GO TO CYLINDER TIMING **TIMING**

TO RETURN TO HOME SCREEN **ESC**

IF SLAVE COIL EXISTS, TO TOGGLE BETWEEN DIAGNOSTIC OFFSET FOR THE MASTER AND SLAVE COIL, OTHERWISE, ADVANCE TO NEXT CYLINDER IN FIRING ORDER **F4**

TO RESET THE DIAGNOSTIC OFFSET FOR THE COIL TO ZERO **RESET**

27.4 All thresholds are user-configurable through menus (section 28.0) or through Modbus registers and the PC Terminal Program.

High Spark Voltage	CAVG > user programmable threshold (Typ. 235)
Low Spark Voltage	CAVG < user programmable threshold (Typ. 35)
High From Engine	(CAVG – EAVG) > user programmable threshold (Typ. 15)
Low From Engine	(EAVG – CAVG) > user programmable threshold (Typ. 15)
High Variation COV	COV > User programmable threshold (Typ. 30)

NOTE: By default all threshold diagnostics are disabled. They can be enabled using the menu (Section 28.0) or through the use of the CPU-XL Terminal Programming Instructions, Form CPU-XL VariSpark PI.

27.5 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. 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.

27.6 The High Spark Voltage Threshold, Low Spark Voltage Threshold, High From Engine Threshold, Low From Engine Threshold, and Hi COV Threshold should be adjusted as experience dictates. 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 255 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.

27.7 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, 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.

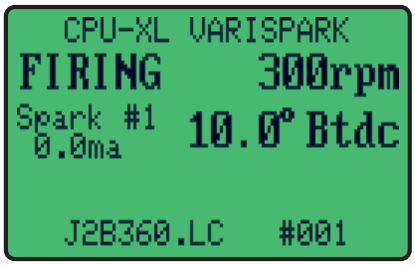
27.8 Other Information regarding the spark reference number: The spark number setting has only a small effect on the reference number if the spark plug fires correctly. Therefore, the high and low voltage thresholds should hold across the different profiles if the spark plugs continue to fire correctly. On the other hand, a worn plug may not fire consistently on one given spark number, but will fire consistently on another; in this case there will be a significant difference in the reference number when the setting is changed. Operators may be able to increase spark plug life by operating initially with new spark plugs on spark number 1 and using the HI SPARK VOLTAGE alarm as an indicator to change the spark number.

28.0 THRESHOLD ADJUSTMENT SCREENS

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.

28.1 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.

FROM



PRESS TO VIEW FIRST THRESHOLD SCREEN **F2**

28.2 If the CAVG reference number of a cylinder is below the **LO 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.

PRESS TO VIEW NEXT CYLINDER **F2**

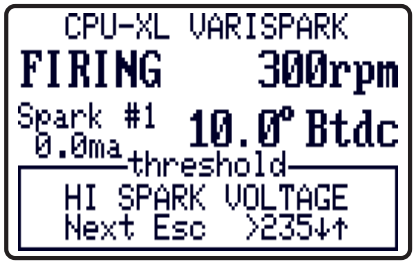
TO VIEW GRAPH OF CURRENT CYLINDER **NEXT**

PRESS TO ADJUST SPARK OFFSET **ESC**

PRESS TO INCREASE THRESHOLD **↑**

PRESS TO DECREASE THRESHOLD **↓**

28.3 If the CAVG reference number of a cylinder is above the **HI SPARK VOLTAGE** threshold, a diagnostic warning for that cylinder will occur. 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.



28.4 If the difference between EAVG and CAVG reference numbers is greater than the **LO 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 = **15**

28.5 If the difference between CAVG and EAVG reference numbers is greater than the **HI 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 = **15**

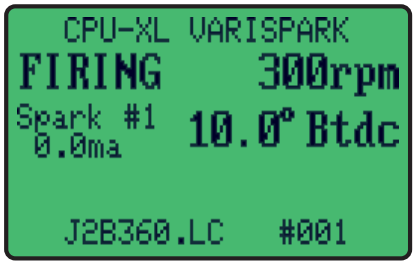
28.6 If the COV reference number is greater than the **HI VARIATION COV** threshold, a diagnostic warning for that cylinder will occur. This test will identify a cylinder whose cycle-to-cycle voltage demand has become erratic.

Default = **30**

29.0 GRAPHING

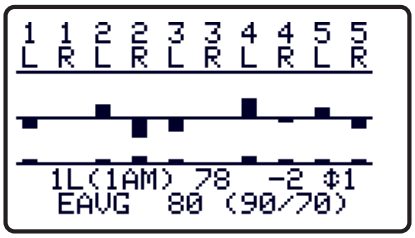
29.1 The Logic/Display Module has two graphs of the spark diagnostic data.

FROM



PRESS F3

29.2 The first graph shows all cylinders CAVG (cylinder average) and COV spark diagnostic numbers in relation to the EAVG (engine average).



PRESS TO TOGGLE BETWEEN OUTPUT LEAD AND CYLINDER LABEL — MAN

PRESS TO INCREASE/ DECREASE THE ZOOM — ↑ ↓

PRESS TO INCREMENT THE COIL BEING VIEWED — NEXT

PRESS TO ACCESS THE CURRENT SELECTED CYLINDER GRAPH — F3

PRESS TO DECREMENT THE COIL BEING VIEWED — SETUP

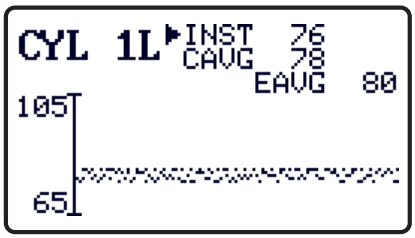
PRESS TO VIEW THE CURRENT SELECTED CYLINDER — F1

PRESS TO ADJUST THE CURRENT SELECTED CYLINDER SPARK OFFSET — F4

PRESS TO ADJUST THE CURRENT SELECTED CYLINDER TIMING OFFSET — TIMING

PRESS TO EXIT — ESC

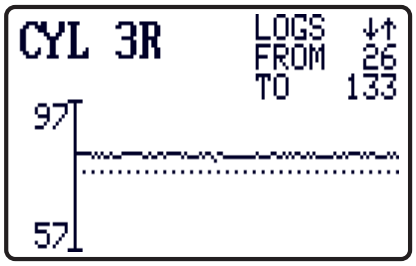
29.3 The second graph shows each individual cylinder. The solid line is the cylinder data while the dashed line is the engine average. In this picture, 105 corresponds to the spark number that is top of the graph and 65 is the bottom.



PRESS TO TOGGLE BETWEEN GRAPHING INST AND CAVG	DIAG	PRESS TO CHANGE THE LAYOUT OF THE GRAPH	ENTER
PRESS TO VIEW THE DATALOG GRAPH	AUTO	PRESS TO TOGGLE BETWEEN LABEL, FIRING ORDER, AND OUTPUT RAIL/COIL POSITION	MAN
PRESS TO GO TO PREVIOUS CYLINDER	SETUP	PRESS TO ADVANCE TO THE NEXT CYLINDER	NEXT
PRESS TO ACCESS THE GRAPH IN SECTION 29.2	F3	PRESS TO VIEW THE CURRENT SELECTED CYLINDER	F1
PRESS TO ADJUST THE CURRENT SELECTED CYLINDER SPARK OFFSET	F4	PRESS TO ADJUST THE CURRENT SELECTED CYLINDER TIMING OFFSET	TIMING
PRESS TO CLEAR ERROR COUNTS	RESET	PRESS TO EXIT	ESC

Pressing ENTER the first time will display ↑↓ and allows the user to move the graphed lines up and down using the arrow keys. This changes the spark number used for the top and bottom limits of the graph. Pressing ENTER the second time will display the ↕ and allows the user to change the zoom level using the arrow keys. Pressing ENTER a third time exits the adjustments.

29.4 The datalog graph allows the user to view the history of a given cylinder.



PRESS TO VIEW THE SHORT TERM GRAPH — AUTO

PRESS TO TOGGLE BETWEEN LABEL, FIRING ORDER, AND OUTPUT RAIL/COIL POSITION — MAN

PRESS TO GO TO PREVIOUS CYLINDER — SETUP

PRESS TO ADVANCE TO THE NEXT CYLINDER — NEXT

PRESS TO ACCESS THE GRAPH IN SECTION 29.2 — F3

PRESS TO VIEW THE CURRENT SELECTED CYLINDER — F1

PRESS TO ADJUST THE CURRENT SELECTED CYLINDER SPARK OFFSET — F4

PRESS TO ADJUST THE CURRENT SELECTED CYLINDER TIMING OFFSET — TIMING

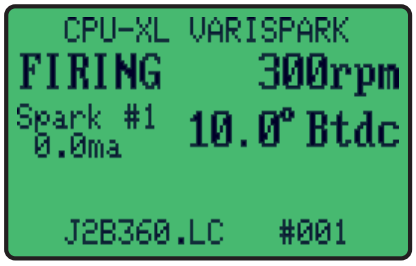
PRESS TO CLEAR ERROR COUNTS — RESET

PRESS TO EXIT — ESC

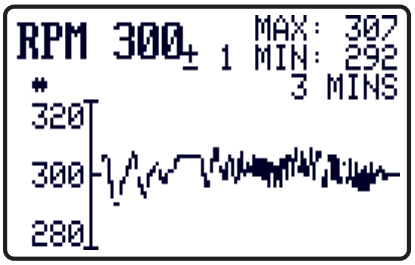
PRESS TO CHANGE THE LAYOUT OF THE GRAPH — ENTER

29.5 In addition to short and long term spark demand graphs, the system has a set of short and long term RPM graphs. The short term graph shows the RPM over the last 1-5 minutes to allow the operator to monitor engine speed and stability. This RPM data is what is recorded by the ignition system and should not be used in place of a tachometer or other high precision device. The RPM data is updated every 640ms during normal engine operation.

FROM



PRESS — ENTER



PRESS TO VIEW THE LONG TERM RPM GRAPH **AUTO**

PRESS TO ADJUST THE DISPLAY PARAMETERS ↑ ↓

PRESS TO CHANGE THE LAYOUT OF THE GRAPH **ENTER**

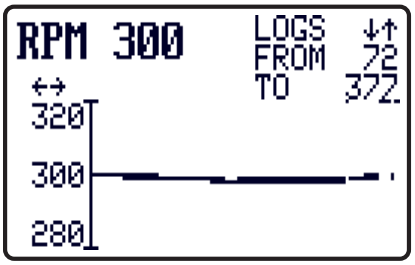
PRESS TO EXIT **ESC**

This screen shows the current running RPM as reported by the ignition system and the minimum and maximum RPM as observed over the last 5 minutes of operation. In this case, a minimum of 292 and maximum of 307 RPM were observed. It also shows the level of variation (error) that may exist between the ignition RPM and the actual RPM; in this case 1RPM. Lastly, the screen shows the timeframe being observed (1-5 minutes of operation – in this case, 3 minutes).

Pressing **ENTER** will toggle the arrows in the upper left-hand corner of the graph and change the role of the up and down arrow keys.

- When the arrows are ⇔ (left/right), using the ↓↑ (up/down) arrow keys will shift the time period being displayed (to view data earlier/later than what is currently being graphed).
- When the arrows are ⇠⇢ (left and right) using the ↓↑ (up/down) arrow keys will adjust the scale of the graph in the X direction (Time). This will cause the graph to change the length of time displayed (from 1–5 minutes).
- When the arrows are ⇳ (up/down), using the ↓↑ (up/down) arrow keys will adjust the center of the graph in the Y direction (RPM). This change is stored in EEPROM memory.
- When the arrows are ⇣⇡ (up and down), using the ↓↑ (up/down) arrow keys will adjust the scale of the graph in the Y direction (RPM). This change is stored in EEPROM memory.

29.6: The long-term graph shows the RPM range observed over a datalog interval.



PRESS TO VIEW THE SHORT TERM RPM GRAPH — AUTO

PRESS TO ADJUST THE DISPLAY PARAMETERS — ↑ ↓

PRESS TO CHANGE THE LAYOUT OF THE GRAPH — ENTER

PRESS TO EXIT — ESC

This screen shows the current running RPM as reported by the ignition system. It also shows the log range being shown. The up and down arrows to the right of "LOGS" indicates whether or not there are more valid logs before (up) or after (down) the current range.

Pressing ENTER will toggle the arrows in the upper left-hand corner of the graph and change the role of the up and down arrow keys.

- When the arrows are ↔ (left/right), using the ↓↑ (up/down) arrow keys will shift the time period being displayed (to view data earlier/later than what is currently being graphed).
- When the arrows are ↔ (left and right) using the ↓↑ (up/down) arrow keys will adjust the scale of the graph in the X direction (Time). This will cause the graph to change the length of time displayed (To – From increases).
- When the arrows are ↕ (up/down), using the ↓↑ (up/down) arrow keys will adjust the center of the graph in the Y direction (RPM). This change is stored in EEPROM memory.
- When the arrows are ↓↑ (up and down), using the ↓↑ (up/down) arrow keys will adjust the scale of the graph in the Y direction (RPM). This change is stored in EEPROM memory.

30.0 IGNITION CLONING

30.1 Backing up the CPU-XL VariSpark

The CPU-XL has a redundant storage system internally. The entire configuration including ignition program is stored on both the Display board, and the Logic board inside the Logic/Display Module. Using the backup and program functions, the configuration of one component can be backed up, and restored from the other in the event that one becomes corrupted.

WARNING: THE CPU–XL VariSpark MUST BE PROGRAMMED PRIOR TO USE. REFER TO PROGRAMMING INSTRUCTIONS CPU–XL VariSpark PI.

FROM

PRESS AUTO

PRESS TO SELECT PROGRAM OPTION ↑ **PRESS TO BEGIN THE SELECTED OPTION** ENTER **PRESS TO EXIT** ESC

If a previous ignition backup has been stored in the display, an overwrite confirmation is displayed

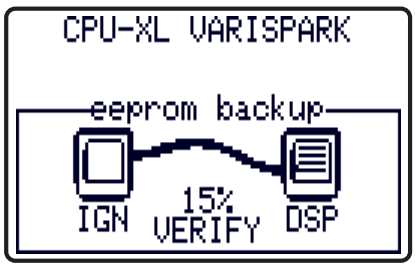
PRESS TO CONTINUE WITH THE BACKUP ENTER **PRESS TO EXIT** ESC

The first phase of the backup is to read the ignition eeprom contents.

PRESS TO ABORT

ESC

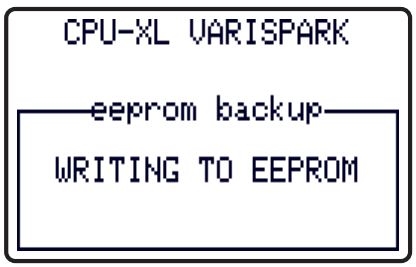
The second phase is to read the ignition again for verification.



PRESS TO ABORT

ESC

After reading and verifying, the contents are written to the eeprom of the Logic/ Display Module.



Done.

PRESS TO EXIT

ESC

30.2 Programming the CPU-XL VariSpark EEPROM

Program the CPU-XL VariSpark system through the enhanced display on the Logic/Display Module, P/N 291400-1, via RS-485 or via USB from a computer without a RS-485 card. Refer to programming instructions CPU-XL VariSpark PI. The user must first confirm the program option.

WARNING: THE CPU–XL VariSpark MUST BE PROGRAMMED PRIOR TO USE. REFER TO PROGRAMMING INSTRUCTIONS CPU–XL VariSpark PI.

WARNING: THE IGNITION MUST BE SHUT DOWN IN ORDER TO PROGRAM THE IGNITION EEPROM.

FROM

PRESS AUTO

THEN ↑

THEN ENTER

PRESS TO CONTINUE PROGRAMMING ENTER **PRESS TO EXIT** ESC

The Logic/Display Module now writes the eeprom contents of the CPU-XL VariSpark ignition.

Next, the Logic/Display Module will read back what was written for verification.

With verification complete, the ignition is reset.

Done.

PRESS TO EXIT **ESC**

30.3 Backing up the CPU-XL Configuration

The CPU-XL has a redundant storage system internally. The entire configuration including ignition program is stored on both the Display board, and the Logic board inside the Logic/Display Module. Using the backup and program functions, the configuration of one component can be backed up, and restored from the other in the event that one becomes corrupted.

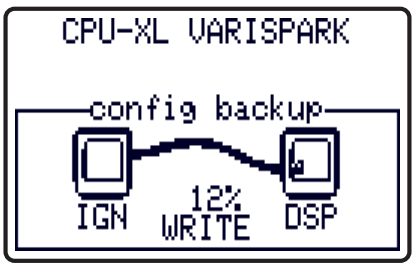
NOTE: The running configuration is stored separately from the ignition program image and can be backed up and restored form the ignition image.

FROM

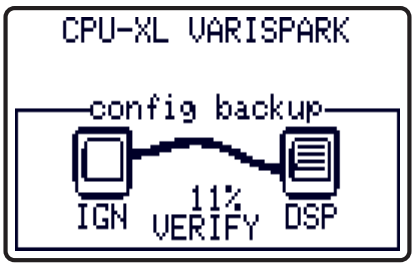
PRESS NEXT

THEN ENTER

The Logic/Display Module will write the configuration to the ignition EEPROM.



Next, the Logic/Display Module will read back what was written in order to verify that it is correct.



With verification complete, the ignition will be reset.

Done.

PRESS TO EXIT **ESC**

30.4 Restoring the CPU-XL Configuration from the ignition image.

FROM

PRESS **NEXT**

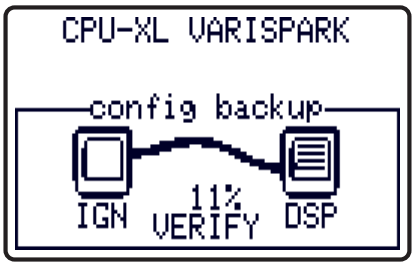
THEN **UP**

THEN **ENTER**

NOTE: After the CPU–XL ignition image has been programmed (section 30.2) the configuration must be restored from the ignition image.

The Logic/Display Module will read the configuration from the ignition EEPROM.

Next, the Logic/Display Module will read back what was written to verify that it is correct.



With verification complete, the configuration will be updated.

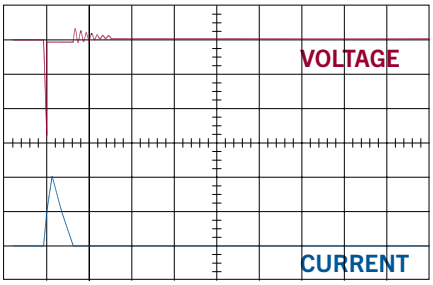
Done.

PRESS TO EXIT **ESC**

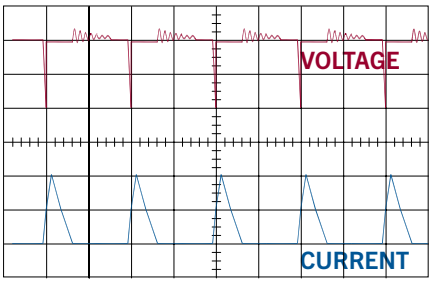
31.0 DIRECTED ENERGY SPARK PROFILES

Eight pre-configured spark profiles are embedded within the standard CPU-XL Varispark system. While other profiles can be achieved, these eight have been selected as representative of those that have proven effective on the range of CPU-XL applications. Individual performance testing of each during the commissioning process will be required to determine which of these profiles deliver the most benefit to operation. All are configured to provide enhanced combustion assurance.

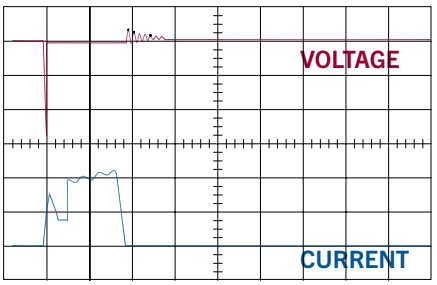
31.1 **SPARK #1:** An enhanced, capacitive-discharge (CD) style spark profile.



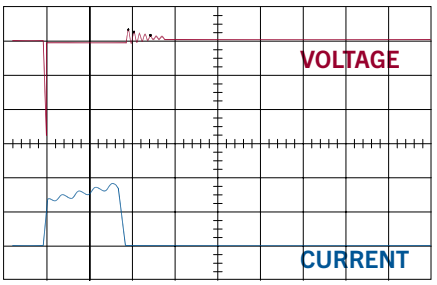
31.2 **SPARK #2:** A rapid, multi-strike spark event consisting of five (5) distinct, CD-style spark discharges. This profile optimizes the advantages of a multi-strike approach as it maintains the desired peak pressure angle after top dead center (TDC). Doing so ensures optimum engine performance and has proven particularly beneficial on pre-combustion chamber-equipped engines.



31.3 **SPARK #3:** An expanded current spark profile. Unachievable with any other ignition system, this unique, specially-designed spark current profile features a high breakdown capability and the ability to enable movement of the spark along the spark plug ground electrode. The effect is minimized spark plug wear and improved performance, particularly on low emissions engines and on those 2- and 4-stroke cycle engines modified for enhanced combustion.

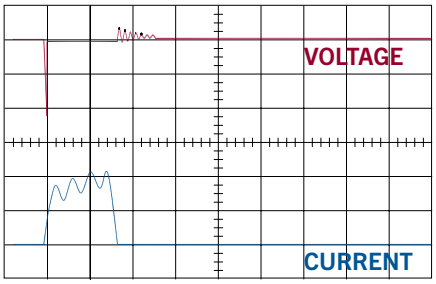


31.4 **SPARK #4:** A long duration spark event featuring increasing current.

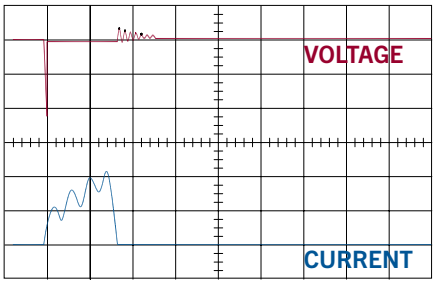


NOTE: Waveforms shown are for illustrative purposes only.

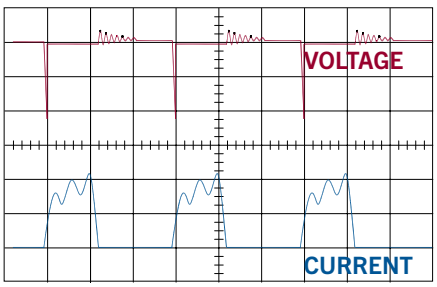
31.5 **SPARK #5:** Similar in construction to the spark profile shown in section 31.4, but incorporating lower duration.



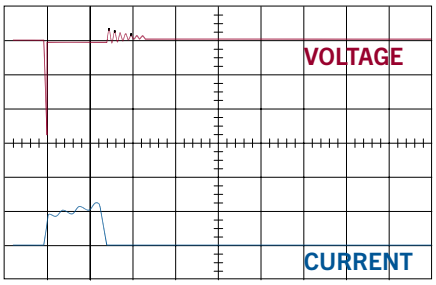
31.6 **SPARK #6:** Profile features many of the same characteristics of the spark profile shown in section 31.5, but with lower applied energy.



31.7 **SPARK #7:** A multi-strike profile incorporating three (3) independent spark discharges with each featuring longer duration and increasing current.



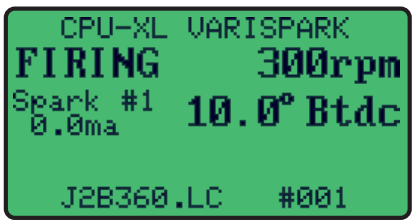
31.8 **SPARK #8:** A long duration, lower-current spark profile that also offers maximized spark plug life.



NOTE: Waveforms shown are for illustrative purposes only.

31.9 The BASE SPARK NUMBER defines the spark number which will be used when no overriding conditions are active. The selectable range for the base spark number is 1 to 8.

FROM



PRESS MAN

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.10 The MISC-IN SPARK NUMBER defines the spark selection number to be utilized when the Aux. Misc. Input is activated (connected to ground). The selectable range for Misc-in Spk Number is 0-8. When set to zero, this feature is disabled and will not override the active spark number.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

NOTE: Spark number selection criteria in order of priority:

1. *Misc-In*
2. *High EAVG*
3. *High single cylinder COV*
4. *4-20mA Current Loop*
5. *Base Spark Number*

NOTE: If the spark number used is changed through a Modbus key command message, that spark will be used until another condition changes (ex: EAVG was active, and no longer is, or the 4-20mA current loop changes).

31.11 The EAVG E2 ENABLE setting determines the engine average spark diagnostic enable threshold at which the HI EAVG SPARK NUMBER selection will be asserted.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.12 The EAVG E2 DISABLE setting determines the engine average spark diagnostic disable threshold at which the HI EAVG SPARK NUMBER selection will be de-asserted. The Enable and Disable thresholds create a hysteresis pair to add stability to the HI EAVG SPARK request function.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.13 The HI EAVG SPK NMBR E2 defines the desired spark number to be asserted when the HI EAVG spark number is asserted. The range of this configuration value is 0-8 where zero disables the function entirely and 1-8 would be the desired spark selection for the special condition of high engine average diagnostic values.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.14 The HI COV COV2 EN setting determines the high variation spark diagnostic enable threshold at which the HI COV SPARK NUMBER selection will be asserted. The coil with the highest COV is compared against this threshold.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.15 The HI COV COV2 DIS setting determines the high variation spark diagnostic disable threshold below which the latched HI COV SPARK NUMBER selection will be disabled. The coil with the highest COV is compared against this threshold. The Enable and Disable thresholds create a hysteresis pair to add stability to the HI COV SPARK request function.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.16 The HI COV SPK NMBR COV2 defines the desired spark number selection to be asserted when the HI COV spark number is asserted. The range of this configuration value is 0-8 where zero disables the function entirely and 1-8 would be the desired spark selection for the special condition of high COV average diagnostic values.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

31.17 The 4-20ma SPARK MAP configuration setting enables or disables the ability to remotely control the spark number via the auxiliary 4-20mA input. When turned on, the valid 4-20mA range is limited to 2-22mA, so even when this feature turned on, the assertion of a spark number based on the 4-20mA signal will only be active if the 4-20mA signal is within the limit range of 2-22mA. If the current is outside of the range, a warning is asserted.

TO ADJUST THE VALUE ↑ ↓ TO ADVANCE TO THE NEXT MENU NEXT TO GO BACK TO THE HOME SCREEN ESC

4-20mA Current Loop to Spark Map

- ***Current*** > ***2mA and*** <***6mA: Spark #1***
- ***Current*** >= ***6mA and*** <***8mA: Spark #2***
- ***Current*** >= ***8mA and*** <***10mA: Spark #3***
- ***Current*** >= ***10mA and*** <***12mA: Spark #4***
- ***Current*** >= ***12mA and*** <***14mA: Spark #5***
- ***Current*** >= ***14mA and*** <***16mA: Spark #6***
- ***Current*** >= ***16mA and*** <***18mA: Spark #7***
- ***Current*** >= ***18mA and*** <***22mA: Spark #8***

Any values outside of those listed will produce a diagnostic warning and the current loop will have no effect on the spark number.

32.0 CPU-XL VARISPARK MODBUS REGISTER LIST

The CPU-XL VariSpark is compliant with the Modicon Modbus RTU standard. The CPU-XL VariSpark Terminal program CD contains a PC-based Modbus-compatible monitoring program. Maximum number of registers that can be read at one time is limited to 127. The default configuration is 9600 baud, 8 Data bits, No Parity, 1 Stop bit (9600 8N1). The MODBUS address list is on the following pages.

The 10xxx registers are read-only binary and support Modbus standard function 2. These registers are read in multiples of 8 (1 byte) addressed at each 8 bit boundary (10001-10008, etc.). A single Boolean read from registers 10001 to 10064 can be made which will return all 64 values as a group of 8 bytes. These registers also support an Altronic custom function 102 which will return a descriptive label for each specific register. The custom label function can be used to reduce the need for the Modbus master to maintain a current listing of all of the register labels for each unit

Enhanced Display Modbus Register 10000

Register	Label
REG10001	FIRE CONFIRM OUTPUT 1 = FIRING
REG10002	SHUTDOWN OUTPUT 0 = SHUTDOWN
REG10003	ALARM OUTPUT 0 = ALARM
REG10004	Alarm LED
REG10005	2K ROM MAP ENABLED
REG10006	SKIP CONTROL (internal)
REG10007	CMDPAGE2 (internal)
REG10008	TWO CYCLE
REG10009	IGN SHUTDOWN FLAG
REG10010	IGN WARNING FLAG
REG10011	IGN FAULT FLAG
REG10012	IGN FIRED FLAG
REG10013	IGN ALARM OUTPUT ACTIVATED
REG10014	IGN FIRING FLAG
REG10015	IGN PICKUPS OK
REG10016	IGN ENGINE ROTATING
REG10017	PROTECTION ENABLED EEPROM
REG10018	SERIAL RETARD ENABLED EEPROM
REG10019	RPM RETARD MAP ENABLED EEPROM
REG10020	4-20ma RET MAP ENABLED EEPROM
REG10021 THROUGH REG10024	spare
REG10025	TRANSCODER 1=4X 0=8X
REG10056	spare
REG10057	spare
REG10028	CHKPAGE2 (interal)
REG10029	MISC INPUT
REG10030	TEST DENY (internal)

Register	Label
REG10031	TEST ACT (internal)
REG10032	TEST REQ (internal)
REG10033	MISC. 0=USE ONESTEP
REG10034	MISC. 0=FIRE MAXENERGY
REG10035	MISC. 0=FIRE MULTISTRIKE
REG10036	MISC. 0=FIRE ALL
REG10037	RPM < 200 USE ONESTEP
REG10038	RPM < 200 FIRE MAX ENERGY
REG10039	RPM < 200 FIRE MULTI
REG10040	RPM < 200 FIRE ALL
REG10041	LOGICAL SHUTDOWN 1=OPEN 0=GND
REG10042	spare
REG10043	MISC INPUT NOW
REG10044	ONE STEP ACTIVE NOW
REG10045 THROUGH REG10048	spare
REG10049	FAULT NO GEAR TOOTH SIGNAL
REG10050	FAULT NO MAGNETIC RESET SIGNAL
REG10051	FAULT NO CYCLE RESET SIGNAL
REG10052	FAULT WRONG NUMBER OF TEETH
REG10053	FAULT OVERSPEED SHUTDOWN
REG10054	spare
REG10055	spare
REG10056	FAULT FIRMWARE CHECKSUM ERR
REG10057 THROUGH REG10060	spare
REG10061	WARN 4-20 LOOP OUT OF RANGE
REG10062	spare

Register	Label
REG10063	WARN EEPROM CHECKSUM FAIL
REG10064	WARN FAIL DETECT DISP BOARD
REG10065	RESET PULSE READ STATE
REG10066	spare
REG10067	FIRST APPLICATION FAULT
REG10068	NEW SPIN-UP AFTER 4S
REG10069	DIAGNOSTIC HOLDOFF (internal)
REG10070	RPM READ STATE
REG10071	SHUTDOWN GROUNDED
REG10072	CAM PULSE READ STATE
REG10073	NO PRIMARY CURRENT ANY
REG10074	spare ANY
REG10075	LOW VOLTAGE ANY
REG10076	HIGH VOLTAGE ANY
REG10077	NO SECONDARY SPARK ANY
REG10078	HIGH FROM ENGINE AVG ANY
REG10079	LOW FROM ENGINE AVG ANY
REG10080	HIGH COV ANY
REG10081	WARN FAIL DETECT LOGIC BOARD
REG10082	WARN FAIL DETECT DIAG BOARD
REG10083	WARN 4-20 SPK LOOP OOR
REG10084	WARN SELECT VOLTAGE OOR
REG10085	WARN SPARK MAP INCORRECT
REG10086	WARN LEFT OUTPUT VOLTAGE
REG10087	WARN RIGHT OUTPUT VOLTAGE
REG10088	WARN RAIL BAD ADDRESS
REG10089	FAULT LEFT OUTPUT VOLTAGE
REG10090	FAULT RIGHT OUTPUT VOLTAGE
REG10091	FAULT CAN FAILURE
REG10092 THROUGH REG10096	spare
REG10097	NO PRIMARY CURRENT 1M
REG10098	spare 1M
REG10099	LOW VOLTAGE 1M
REG10100	HIGH VOLTAGE 1M
REG10101	NO SECONDARY SPARK 1M
REG10102	HIGH FROM ENGINE AVG 1M
REG10103	LOW FROM ENGINE AVG 1M
REG10104	HIGH COV 1M
REG10105	PRIMARY OPEN 1S
REG10106	Spare 1S
REG10107	LOW VOLTAGE 1S

Register	Label
REG10108	HIGH VOLTAGE 1S
REG10109	NO SECONDARY SPARK 1S
REG10110	HIGH FROM ENGINE AVG 1S
REG10111	LOW FROM ENGINE AVG 1S
REG10112	HIGH COV 1S
REG10113	NO PRIMARY CURRENT 2M
REG10114	spare 2M
REG10115	LOW VOLTAGE 2M
REG10116	HIGH VOLTAGE 2M
REG10117	NO SECONDARY SPARK 2M
REG10118	HIGH FROM ENGINE AVG 2M
REG10119	LOW FROM ENGINE AVG 2M
REG10120	HIGH COV 2M
REG10121	NO PRIMARY CURRENT 2S
REG10122	spare 2S
REG10123	LOW VOLTAGE 2S
REG10124	HIGH VOLTAGE 2S
REG10125	NO SECONDARY SPARK 2S
REG10126	HIGH FROM ENGINE AVG 2S
REG10127	LOW FROM ENGINE AVG 2S
REG10128	HIGH COV 2S
REG10129	NO PRIMARY CURRENT 3M
REG10130	spare 3M
REG10131	LOW VOLTAGE 3M
REG10132	HIGH VOLTAGE 3M
REG10133	NO SECONDARY SPARK 3M
REG10134	HIGH FROM ENGINE AVG 3M
REG10135	LOW FROM ENGINE AVG 3M
REG10136	HIGH COV 3M
REG10137	NO PRIMARY CURRENT 3S
REG10138	spare 3S
REG10139	LOW VOLTAGE 3S
REG10140	HIGH VOLTAGE 3S
REG10141	NO SECONDARY SPARK 3S
REG10142	HIGH FROM ENGINE AVG 3S
REG10143	LOW FROM ENGINE AVG 3S
REG10144	HIGH COV 3S
REG10145	NO PRIMARY CURRENT 4M
REG10146	spare 4M
REG10147	LOW VOLTAGE 4M
REG10148	HIGH VOLTAGE 4M
REG10149	NO SECONDARY SPARK 4M
REG10150	HIGH FROM ENGINE AVG 4M

Register	Label
REG10151	LOW FROM ENGINE AVG 4M
REG10152	HIGH COV 4M
REG10153	NO PRIMARY CURRENT 4S
REG10154	spare 4S
REG10155	LOW VOLTAGE 4S
REG10156	HIGH VOLTAGE 4S
REG10157	NO SECONDARY SPARK 4S
REG10158	HIGH FROM ENGINE AVG 4S
REG10159	LOW FROM ENGINE AVG 4S
REG10160	HIGH COV 4S
REG10161	NO PRIMARY CURRENT 5M
REG10162	spare 5M
REG10163	LOW VOLTAGE 5M
REG10164	HIGH VOLTAGE 5M
REG10165	NO SECONDARY SPARK 5M
REG10166	HIGH FROM ENGINE AVG 5M
REG10167	LOW FROM ENGINE AVG 5M
REG10168	HIGH COV 5M
REG10169	NO PRIMARY CURRENT 5S
REG10170	spare 5S
REG10171	LOW VOLTAGE 5S
REG10172	HIGH VOLTAGE 5S
REG10173	NO SECONDARY SPARK 5S
REG10174	HIGH FROM ENGINE AVG 5S
REG10175	LOW FROM ENGINE AVG 5S
REG10176	HIGH COV 5S
REG10177	NO PRIMARY CURRENT 6M
REG10178	spare 6M
REG10179	LOW VOLTAGE 6M
REG10180	HIGH VOLTAGE 6M
REG10181	NO SECONDARY SPARK 6M
REG10182	HIGH FROM ENGINE AVG 6M
REG10183	LOW FROM ENGINE AVG 6M
REG10184	HIGH COV 6M
REG10185	NO PRIMARY CURRENT 6S
REG10186	spare 6S
REG10187	LOW VOLTAGE 6S
REG10188	HIGH VOLTAGE 6S
REG10189	NO SECONDARY SPARK 6S
REG10190	HIGH FROM ENGINE AVG 6S
REG10191	LOW FROM ENGINE AVG 6S
REG10192	HIGH COV 6S
REG10193	NO PRIMARY CURRENT 7M

Register	Label
REG10194	spare 7M
REG10195	LOW VOLTAGE 7M
REG10196	HIGH VOLTAGE 7M
REG10197	NO SECONDARY SPARK 7M
REG10198	HIGH FROM ENGINE AVG 7M
REG10199	LOW FROM ENGINE AVG 7M
REG10200	HIGH COV 7M
REG10201	NO PRIMARY CURRENT 7S
REG10202	spare 7S
REG10203	LOW VOLTAGE 7S
REG10204	HIGH VOLTAGE 7S
REG10205	NO SECONDARY SPARK 7S
REG10206	HIGH FROM ENGINE AVG 7S
REG10207	LOW FROM ENGINE AVG 7S
REG10208	HIGH COV 7S
REG10209	NO PRIMARY CURRENT 8M
REG10210	spare 8M
REG10211	LOW VOLTAGE 8M
REG10212	HIGH VOLTAGE 8M
REG10213	NO SECONDARY SPARK 8M
REG10214	HIGH FROM ENGINE AVG 8M
REG10215	LOW FROM ENGINE AVG 8M
REG10216	HIGH COV 8M
REG10217	NO PRIMARY CURRENT 8S
REG10218	spare 8S
REG10219	LOW VOLTAGE 8S
REG10220	HIGH VOLTAGE 8S
REG10221	NO SECONDARY SPARK 8S
REG10222	HIGH FROM ENGINE AVG 8S
REG10223	LOW FROM ENGINE AVG 8S
REG10224	HIGH COV 8S
REG10225	NO PRIMARY CURRENT 9M
REG10226	spare 9M
REG10227	LOW VOLTAGE 9M
REG10228	HIGH VOLTAGE 9M
REG10229	NO SECONDARY SPARK 9M
REG10230	HIGH FROM ENGINE AVG 9M
REG10231	LOW FROM ENGINE AVG 9M
REG10232	HIGH COV 9M
REG10233	NO PRIMARY CURRENT 9S
REG10234	spare 9S
REG10235	LOW VOLTAGE 9S
REG10236	HIGH VOLTAGE 9S

Register	Label
REG10237	NO SECONDARY SPARK 9S
REG10238	HIGH FROM ENGINE AVG 9S
REG10239	LOW FROM ENGINE AVG 9S
REG10240	HIGH COV 9S
REG10241	NO PRIMARY CURRENT 10M
REG10242	spare 10M
REG10243	LOW VOLTAGE 10M
REG10244	HIGH VOLTAGE 10M
REG10245	NO SECONDARY SPARK 10M
REG10246	HIGH FROM ENGINE AVG 10M
REG10247	LOW FROM ENGINE AVG 10M
REG10248	HIGH COV 10M
REG10249	NO PRIMARY CURRENT 10S
REG10250	spare 10S
REG10251	LOW VOLTAGE 10S
REG10252	HIGH VOLTAGE 10S
REG10253	NO SECONDARY SPARK 10S
REG10254	HIGH FROM ENGINE AVG 10S
REG10255	LOW FROM ENGINE AVG 10S
REG10256	HIGH COV 10S
REG10257	NO PRIMARY CURRENT 11M
REG10258	spare 11M
REG10259	LOW VOLTAGE 11M
REG10260	HIGH VOLTAGE 11M
REG10261	NO SECONDARY SPARK 11M
REG10262	HIGH FROM ENGINE AVG 11M
REG10263	LOW FROM ENGINE AVG 11M
REG10264	HIGH COV 11M
REG10265	NO PRIMARY CURRENT 11S
REG10266	spare 11S
REG10267	LOW VOLTAGE 11S
REG10268	HIGH VOLTAGE 11S
REG10269	NO SECONDARY SPARK 11S
REG10270	HIGH FROM ENGINE AVG 11S
REG10271	LOW FROM ENGINE AVG 11S
REG10272	HIGH COV 11S
REG10273	NO PRIMARY CURRENT 12M
REG10274	spare 12M
REG10275	LOW VOLTAGE 12M
REG10276	HIGH VOLTAGE 12M
REG10277	NO SECONDARY SPARK 12M
REG10278	HIGH FROM ENGINE AVG 12M
REG10279	LOW FROM ENGINE AVG 12M

Register	Label
REG10280	HIGH COV 12M
REG10281	NO PRIMARY CURRENT 12S
REG10282	spare 12S
REG10283	LOW VOLTAGE 12S
REG10284	HIGH VOLTAGE 12S
REG10285	NO SECONDARY SPARK 12S
REG10286	HIGH FROM ENGINE AVG 12S
REG10287	LOW FROM ENGINE AVG 12S
REG10288	HIGH COV 12S
REG10289	NO PRIMARY CURRENT 13M
REG10290	spare 13M
REG10291	LOW VOLTAGE 13M
REG10292	HIGH VOLTAGE 13M
REG10293	NO SECONDARY SPARK 13M
REG10294	HIGH FROM ENGINE AVG 13M
REG10295	LOW FROM ENGINE AVG 13M
REG10296	HIGH COV 13M
REG10297	NO PRIMARY CURRENT 13S
REG10298	spare 13S
REG10299	LOW VOLTAGE 13S
REG10300	HIGH VOLTAGE 13S
REG10301	NO SECONDARY SPARK 13S
REG10302	HIGH FROM ENGINE AVG 13S
REG10303	LOW FROM ENGINE AVG 13S
REG10304	HIGH COV 13S
REG10305	NO PRIMARY CURRENT 14M
REG10306	spare 14M
REG10307	LOW VOLTAGE 14M
REG10308	HIGH VOLTAGE 14M
REG10309	NO SECONDARY SPARK 14M
REG10310	HIGH FROM ENGINE AVG 14M
REG10311	LOW FROM ENGINE AVG 14M
REG10312	HIGH COV 14M
REG10313	NO PRIMARY CURRENT 14S
REG10314	spare 14S
REG10315	LOW VOLTAGE 14S
REG10316	HIGH VOLTAGE 14S
REG10317	NO SECONDARY SPARK 14S
REG10318	HIGH FROM ENGINE AVG 14S
REG10319	LOW FROM ENGINE AVG 14S
REG10320	HIGH COV 14S
REG10321	NO PRIMARY CURRENT 15M
REG10322	spare 15M

Register	Label
REG10323	LOW VOLTAGE 15M
REG10324	HIGH VOLTAGE 15M
REG10325	NO SECONDARY SPARK 15M
REG10326	HIGH FROM ENGINE AVG 15M
REG10327	LOW FROM ENGINE AVG 15M
REG10328	HIGH COV 15M
REG10329	NO PRIMARY CURRENT 15S
REG10330	spare 15S
REG10331	LOW VOLTAGE 15S
REG10332	HIGH VOLTAGE 15S
REG10333	NO SECONDARY SPARK 15S
REG10334	HIGH FROM ENGINE AVG 15S
REG10335	LOW FROM ENGINE AVG 15S
REG10336	HIGH COV 15S
REG10337	NO PRIMARY CURRENT 16M
REG10338	spare 16M
REG10339	LOW VOLTAGE 16M
REG10340	HIGH VOLTAGE 16M
REG10341	NO SECONDARY SPARK 16M
REG10342	HIGH FROM ENGINE AVG 16M
REG10343	LOW FROM ENGINE AVG 16M
REG10344	HIGH COV 16M
REG10345	NO PRIMARY CURRENT 16S
REG10346	spare 16S
REG10347	LOW VOLTAGE 16S
REG10348	HIGH VOLTAGE 16S
REG10349	NO SECONDARY SPARK 16S
REG10350	HIGH FROM ENGINE AVG 16S
REG10351	LOW FROM ENGINE AVG 16S
REG10352	HIGH COV 16S
REG10353	NO PRIMARY CURRENT 17M
REG10354	spare 17M
REG10355	LOW VOLTAGE 17M
REG10356	HIGH VOLTAGE 17M
REG10357	NO SECONDARY SPARK 17M
REG10358	HIGH FROM ENGINE AVG 17M
REG10359	LOW FROM ENGINE AVG 17M
REG10360	HIGH COV 17M
REG10361	NO PRIMARY CURRENT 17S
REG10362	spare 17S
REG10363	LOW VOLTAGE 17S
REG10364	HIGH VOLTAGE 17S
REG10365	NO SECONDARY SPARK 17S

Register	Label
REG10366	HIGH FROM ENGINE AVG 17S
REG10367	LOW FROM ENGINE AVG 17S
REG10368	HIGH COV 17S
REG10369	NO PRIMARY CURRENT 18M
REG10370	spare 18M
REG10371	LOW VOLTAGE 18M
REG10372	HIGH VOLTAGE 18M
REG10373	NO SECONDARY SPARK 18M
REG10374	HIGH FROM ENGINE AVG 18M
REG10375	LOW FROM ENGINE AVG 18M
REG10376	HIGH COV 18M
REG10377	NO PRIMARY CURRENT 18S
REG10378	spare 18S
REG10379	LOW VOLTAGE 18S
REG10380	HIGH VOLTAGE 18S
REG10381	NO SECONDARY SPARK 18S
REG10382	HIGH FROM ENGINE AVG 18S
REG10383	LOW FROM ENGINE AVG 18S
REG10384	HIGH COV 18S
REG10385	NO PRIMARY CURRENT 19M
REG10386	spare 19M
REG10387	LOW VOLTAGE 19M
REG10388	HIGH VOLTAGE 19M
REG10389	NO SECONDARY SPARK 19M
REG10390	HIGH FROM ENGINE AVG 19M
REG10391	LOW FROM ENGINE AVG 19M
REG10392	HIGH COV 19M
REG10393	NO PRIMARY CURRENT 19S
REG10394	spare 19S
REG10395	LOW VOLTAGE 19S
REG10396	HIGH VOLTAGE 19S
REG10397	NO SECONDARY SPARK 19S
REG10398	HIGH FROM ENGINE AVG 19S
REG10399	LOW FROM ENGINE AVG 19S
REG10400	HIGH COV 19S
REG10401	NO PRIMARY CURRENT 20M
REG10402	spare 20M
REG10403	LOW VOLTAGE 20M
REG10404	HIGH VOLTAGE 20M
REG10405	NO SECONDARY SPARK 20M
REG10406	HIGH FROM ENGINE AVG 20M
REG10407	LOW FROM ENGINE AVG 20M
REG10408	HIGH COV 20M

Register	Label
REG10409	NO PRIMARY CURRENT 20S
REG10410	spare 20S
REG10411	LOW VOLTAGE 20S
REG10412	HIGH VOLTAGE 20S
REG10413	NO SECONDARY SPARK 20S
REG10414	HIGH FROM ENGINE AVG 20S
REG10415	LOW FROM ENGINE AVG 20S
REG10416	HIGH COV 20S
REG10417	spare
REG10418	spare
REG10419	spare
REG10420	KEYCOMMAND SPARK REQUESTED
REG10421	EAVG SPK ENABLED
REG10422	HI MAX COV SPK ENABLED
REG10423	MISC-IN SPK ENABLED
REG10424	MISC-IN LOCAL STATUS
REG10425	DATALOG SYNC
REG10426	DIAGNOSTIC MODULE ACTIVE
REG10427	LOGIC MODULE ACTIVE
REG10428	DATALOG VOLTAGE SYNC
REG10429	DATALOG FIRE MISSING OCCURRED
REG10430	ALARM OUTPUT DISPLAY 1 = ALARM
REG10431	Alarm LED Display
REG10432	ALL RAILS SEEN FIRING
REG10433	FAULT NO GEAR TOOTH ACK'D
REG10434	FAULT NO MAGNETIC RESET ACK'D
REG10435	FAULT NO CYCLE RESET ACK'D
REG10436	FAULT WRONG NUM OF TEETH ACK'D
REG10437	FAULT OVERSPEED SHUTDOWN ACK'D
REG10438	spare ACK'D
REG10439	spare ACK'D
REG10440	FAULT FIRMWARE CHECKSUM ACK'D
REG10441	LEFT OUTPUT VOLTAGE ACK'D
REG10442	RIGHT OUTPUT VOLTAGE ACK'D
REG10443	CAN FAILURE ACK'D
REG10444 THROUGH REG10452	spare ACK'D
REG10453	4-20 LOOP OUT OF RANGE ACK'D
REG10454	spare ACK'D
REG10455	EEPROM CHECKSUM FAIL ACK'D
REG10456	FAIL DETECT DISP BOARD ACK'D
REG10457	PRIMARY OPEN ACK'D

Register	Label
REG10458	spare ACK'D
REG10459	LOW VOLTAGE ACK'D
REG10460	HIGH VOLTAGE ACK'D
REG10461	NO SECONDARY SPARK ACK'D
REG10462	HIGH FROM ENGINE AVG ACK'D
REG10463	LOW FROM ENGINE AVG ACK'D
REG10464	HIGH COV ACK'D
REG10465	FAIL DETECT LOGIC BOARD ACK'D
REG10466	DETECT JUNCTION BOARD ACK'D
REG10467	4-20 SPK LOOP OOR ACK'D
REG10468	SELECT VOLTAGE OOR ACK'D
REG10469	SPARK MAP INCORRECT ACK'D
REG10470	WARN LEFT OUTPUT ACK'D
REG10471	WARN RIGHT OUTPUT ACK'D
REG10472	WARN RAIL BAD ADDRESS ACK'D
REG10473	SECONDARY COIL CURRENT M1
REG10474	SECONDARY COIL CURRENT M2
REG10475	SECONDARY COIL CURRENT M3
REG10476	SECONDARY COIL CURRENT M4
REG10477	SECONDARY COIL CURRENT M5
REG10478	SECONDARY COIL CURRENT M6
REG10479	SECONDARY COIL CURRENT M7
REG10480	SECONDARY COIL CURRENT M8
REG10481	SECONDARY COIL CURRENT M9
REG10482	SECONDARY COIL CURRENT M10
REG10483	SECONDARY COIL CURRENT M11
REG10484	SECONDARY COIL CURRENT M12
REG10485	SECONDARY COIL CURRENT M13
REG10486	SECONDARY COIL CURRENT M14
REG10487	SECONDARY COIL CURRENT M15
REG10488	SECONDARY COIL CURRENT M16
REG10489	SECONDARY COIL CURRENT M17
REG10490	SECONDARY COIL CURRENT M18
REG10491	SECONDARY COIL CURRENT M19
REG10492	SECONDARY COIL CURRENT M20
REG10493	SECONDARY COIL CURRENT S1
REG10494	SECONDARY COIL CURRENT S2
REG10495	SECONDARY COIL CURRENT S3
REG10496	SECONDARY COIL CURRENT S4
REG10497	SECONDARY COIL CURRENT S5
REG10498	SECONDARY COIL CURRENT S6
REG10499	SECONDARY COIL CURRENT S7
REG10500	SECONDARY COIL CURRENT S8

Register	Label
REG10501	SECONDARY COIL CURRENT S9
REG10502	SECONDARY COIL CURRENT S10
REG10503	SECONDARY COIL CURRENT S11
REG10504	SECONDARY COIL CURRENT S12
REG10505	SECONDARY COIL CURRENT S13
REG10506	SECONDARY COIL CURRENT S14
REG10507	SECONDARY COIL CURRENT S15
REG10508	SECONDARY COIL CURRENT S16
REG10509	SECONDARY COIL CURRENT S17
REG10510	SECONDARY COIL CURRENT S18
REG10511	SECONDARY COIL CURRENT S19
REG10512	SECONDARY COIL CURRENT S20
REG10513	PRIMARY COIL CURRENT 1
REG10514	PRIMARY COIL CURRENT 2
REG10515	PRIMARY COIL CURRENT 3
REG10516	PRIMARY COIL CURRENT 4
REG10517	PRIMARY COIL CURRENT 5
REG10518	PRIMARY COIL CURRENT 6
REG10519	PRIMARY COIL CURRENT 7
REG10520	PRIMARY COIL CURRENT 8
REG10521	PRIMARY COIL CURRENT 9
REG10522	PRIMARY COIL CURRENT 10
REG10523	PRIMARY COIL CURRENT 11
REG10524	PRIMARY COIL CURRENT 12
REG10525	PRIMARY COIL CURRENT 13
REG10526	PRIMARY COIL CURRENT 14
REG10527	PRIMARY COIL CURRENT 15
REG10528	PRIMARY COIL CURRENT 16
REG10529	PRIMARY COIL CURRENT 17
REG10530	PRIMARY COIL CURRENT 18
REG10531	PRIMARY COIL CURRENT 19
REG10532	PRIMARY COIL CURRENT 20
REG10533	BAD ADDRESS RAIL 1
REG10534	BAD ADDRESS RAIL 2
REG10535	BAD ADDRESS RAIL 3
REG10536	BAD ADDRESS RAIL 4
REG10537 THROUGH REG10560	spare

The 30xxx registers are read-only 16-bit integers and support Modbus standard function 4. These registers also support an Altronic custom function 104 which will return a descriptive label for each specific register. The custom label function can be used to reduce the need for the Modbus master to maintain a current listing of all of the register labels for each unit.

Enhanced Display Modbus Register 30000

Register	Label
REG30001	ENGINE AVERAGE DIAG
REG30002	NUMBER OF FIRINGS
REG30003	TEST TYPE
REG30004	ENGINE RPM 1RPM/BIT
REG30005	MAX SEEN RPM
REG30006	ACTUAL GEAR TEETH
REG30007	EEDIAG0
REG30008	NUMBER OF COILS
REG30009	FAULT GEAR TEETH COUNTS
REG30010	4-20 ANALOG INPUT 0.098ma/bit
REG30011	COUNTS TO DEGREES SCALER
REG30012	REFERENCE ANGLE OF RESET PIN
REG30013	GLOBAL TIMING DISPLAY VALUE
REG30014	GLOBAL RETARD SETTING
REG30015	MANUAL RETARD SETTING
REG30016	ONESTEP RETARD SETTING
REG30017	ANALOG RETARD FROM TABLE
REG30018	RPM RETARD FROM TABLE
REG30019	SERIAL RETARD FROM REMOTE
REG30020	MAX INDIVIDUAL OFFSET
REG30021	STANDARD INDIVIDUAL OFFSET
REG30022	RESET COUNTER
REG30023	FAULT GEAR TEETH ACTUAL
REG30024	4-20 ANALOG INPUT ma*10
REG30025	MANUAL RETARD SETTING deg*10
REG30026	ONESTEP RETARD SETTING deg*10
REG30027	GLOBAL TIMING DISPLAY deg*10
REG30028	GLOBAL RETARD SETTING deg*10
REG30029	ANALOG RETARD FROM TBL deg*10
REG30030	RPM RETARD FROM TBL deg*10
REG30031	SERIAL RETARD deg*10
REG30032	REF. ANGLE OF RESET PIN deg*10
REG30033	MAX INDIVIDUAL OFFSET deg*10
REG30034	STD INDIVIDUAL OFFSET deg*10
REG30035	COIL AVG 1M
REG30036	COIL AVG 1S
REG30037	COIL AVG 2M

Register	Label
REG30038	COIL AVG 2S
REG30039	COIL AVG 3M
REG30040	COIL AVG 3S
REG30041	COIL AVG 4M
REG30042	COIL AVG 4S
REG30043	COIL AVG 5M
REG30044	COIL AVG 5S
REG30045	COIL AVG 6M
REG30046	COIL AVG 6S
REG30047	COIL AVG 7M
REG30048	COIL AVG 7S
REG30049	COIL AVG 8M
REG30050	COIL AVG 8S
REG30051	COIL AVG 9M
REG30052	COIL AVG 9S
REG30053	COIL AVG 10M
REG30054	COIL AVG 10S
REG30055	COIL AVG 11M
REG30056	COIL AVG 11S
REG30057	COIL AVG 12M
REG30058	COIL AVG 12S
REG30059	COIL AVG 13M
REG30060	COIL AVG 13S
REG30061	COIL AVG 14M
REG30062	COIL AVG 14S
REG30063	COIL AVG 15M
REG30064	COIL AVG 15S
REG30065	COIL AVG 16M
REG30066	COIL AVG 16S
REG30067	COIL AVG 17M
REG30068	COIL AVG 17S
REG30069	COIL AVG 18M
REG30070	COIL AVG 18S
REG30071	COIL AVG 19M
REG30072	COIL AVG 19S
REG30073	COIL AVG 20M
REG30074	COIL AVG 20S
REG30075	COV 1M
REG30076	COV 1S
REG30077	COV 2M
REG30078	COV 2S
REG30079	COV 3M
REG30080	COV 3S

Register	Label
REG30081	COV 4M
REG30082	COV 4S
REG30083	COV 5M
REG30084	COV 5S
REG30085	COV 6M
REG30086	COV 6S
REG30087	COV 7M
REG30088	COV 7S
REG30089	COV 8M
REG30090	COV 8S
REG30091	COV 9M
REG30092	COV 9S
REG30093	COV 10M
REG30094	COV 10S
REG30095	COV 11M
REG30096	COV 11S
REG30097	COV 12M
REG30098	COV 12S
REG30099	COV 13M
REG30100	COV 13S
REG30101	COV 14M
REG30102	COV 14S
REG30103	COV 15M
REG30104	COV 15S
REG30105	COV 16M
REG30106	COV 16S
REG30107	COV 17M
REG30108	COV 17S
REG30109	COV 18M
REG30110	COV 18S
REG30111	COV 19M
REG30112	COV 19S
REG30113	COV 20M
REG30114	COV 20S
REG30115	FIRE DELAY COIL 1M
REG30116	FIRE DELAY COIL 1S
REG30117	FIRE DELAY COIL 2M
REG30118	FIRE DELAY COIL 2S
REG30119	FIRE DELAY COIL 3M
REG30120	FIRE DELAY COIL 3S
REG30121	FIRE DELAY COIL 4M
REG30122	FIRE DELAY COIL 4S
REG30123	FIRE DELAY COIL 5M

Register	Label
REG30125	FIRE DELAY COIL 6M
REG30126	FIRE DELAY COIL 6S
REG30127	FIRE DELAY COIL 7M
REG30128	FIRE DELAY COIL 7S
REG30129	FIRE DELAY COIL 8M
REG30130	FIRE DELAY COIL 8S
REG30131	FIRE DELAY COIL 9M
REG30132	FIRE DELAY COIL 9S
REG30133	FIRE DELAY COIL 10M
REG30134	FIRE DELAY COIL 10S
REG30135	FIRE DELAY COIL 11M
REG30136	FIRE DELAY COIL 11S
REG30137	FIRE DELAY COIL 12M
REG30138	FIRE DELAY COIL 12S
REG30139	FIRE DELAY COIL 13M
REG30140	FIRE DELAY COIL 13S
REG30141	FIRE DELAY COIL 14M
REG30142	FIRE DELAY COIL 14S
REG30143	FIRE DELAY COIL 15M
REG30144	FIRE DELAY COIL 15S
REG30145	FIRE DELAY COIL 16M
REG30146	FIRE DELAY COIL 16S
REG30147	FIRE DELAY COIL 17M
REG30148	FIRE DELAY COIL 17S
REG30149	FIRE DELAY COIL 18M
REG30150	FIRE DELAY COIL 18S
REG30151	FIRE DELAY COIL 19M
REG30152	FIRE DELAY COIL 19S
REG30153	FIRE DELAY COIL 20M
REG30154	FIRE DELAY COIL 20S
REG30155	MINIMUM SEEN COIL 1M
REG30156	MINIMUM SEEN COIL 1S
REG30157	MINIMUM SEEN COIL 2M
REG30158	MINIMUM SEEN COIL 2S
REG30159	MINIMUM SEEN COIL 3M
REG30160	MINIMUM SEEN COIL 3S
REG30161	MINIMUM SEEN COIL 4M
REG30162	MINIMUM SEEN COIL 4S
REG30163	MINIMUM SEEN COIL 5M
REG30164	MINIMUM SEEN COIL 5S
REG30165	MINIMUM SEEN COIL 6M
REG30166	MINIMUM SEEN COIL 6S
REG30167	MINIMUM SEEN COIL 7M

Register	Label
REG30168	MINIMUM SEEN COIL 7S
REG30169	MINIMUM SEEN COIL 8M
REG30170	MINIMUM SEEN COIL 8S
REG30171	MINIMUM SEEN COIL 9M
REG30172	MINIMUM SEEN COIL 9S
REG30173	MINIMUM SEEN COIL 10M
REG30174	MINIMUM SEEN COIL 10S
REG30175	MINIMUM SEEN COIL 11M
REG30176	MINIMUM SEEN COIL 11S
REG30177	MINIMUM SEEN COIL 12M
REG30178	MINIMUM SEEN COIL 12S
REG30179	MINIMUM SEEN COIL 13M
REG30180	MINIMUM SEEN COIL 13S
REG30181	MINIMUM SEEN COIL 14M
REG30182	MINIMUM SEEN COIL 14S
REG30183	MINIMUM SEEN COIL 15M
REG30184	MINIMUM SEEN COIL 15S
REG30185	MINIMUM SEEN COIL 16M
REG30186	MINIMUM SEEN COIL 16S
REG30187	MINIMUM SEEN COIL 17M
REG30188	MINIMUM SEEN COIL 17S
REG30189	MINIMUM SEEN COIL 18M
REG30190	MINIMUM SEEN COIL 18S
REG30191	MINIMUM SEEN COIL 19M
REG30192	MINIMUM SEEN COIL 19S
REG30193	MINIMUM SEEN COIL 20M
REG30194	MINIMUM SEEN COIL 20S
REG30195	MAXIMUM SEEN COIL 1M
REG30196	MAXIMUM SEEN COIL 1S
REG30197	MAXIMUM SEEN COIL 2M
REG30198	MAXIMUM SEEN COIL 2S
REG30199	MAXIMUM SEEN COIL 3M
REG30200	MAXIMUM SEEN COIL 3S
REG30201	MAXIMUM SEEN COIL 4M
REG30202	MAXIMUM SEEN COIL 4S
REG30203	MAXIMUM SEEN COIL 5M
REG30204	MAXIMUM SEEN COIL 5S
REG30205	MAXIMUM SEEN COIL 6M
REG30206	MAXIMUM SEEN COIL 6S
REG30207	MAXIMUM SEEN COIL 7M
REG30208	MAXIMUM SEEN COIL 7S
REG30209	MAXIMUM SEEN COIL 8M
REG30210	MAXIMUM SEEN COIL 8S

Register	Label
REG30211	MAXIMUM SEEN COIL 9M
REG30212	MAXIMUM SEEN COIL 9S
REG30213	MAXIMUM SEEN COIL 10M
REG30214	MAXIMUM SEEN COIL 10S
REG30215	MAXIMUM SEEN COIL 11M
REG30216	MAXIMUM SEEN COIL 11S
REG30217	MAXIMUM SEEN COIL 12M
REG30218	MAXIMUM SEEN COIL 12S
REG30219	MAXIMUM SEEN COIL 13M
REG30220	MAXIMUM SEEN COIL 13S
REG30221	MAXIMUM SEEN COIL 14M
REG30222	MAXIMUM SEEN COIL 14S
REG30223	MAXIMUM SEEN COIL 15M
REG30224	MAXIMUM SEEN COIL 15S
REG30225	MAXIMUM SEEN COIL 16M
REG30226	MAXIMUM SEEN COIL 16S
REG30227	MAXIMUM SEEN COIL 17M
REG30228	MAXIMUM SEEN COIL 17S
REG30229	MAXIMUM SEEN COIL 18M
REG30230	MAXIMUM SEEN COIL 18S
REG30231	MAXIMUM SEEN COIL 19M
REG30232	MAXIMUM SEEN COIL 19S
REG30233	MAXIMUM SEEN COIL 20M
REG30234	MAXIMUM SEEN COIL 20S
REG30235	SPARK SELECT VOLTAGE A-D COUNT
REG30236	SPARK SELECT VOLTAGE * 100
REG30237	LEFT VOLTAGE A-D COUNT
REG30238	LEFT VOLTAGE * 100
REG30239	RIGHT VOLTAGE A-D COUNT
REG30240	RIGHT VOLTAGE *100
REG30241	InStat 001-016
REG30242	InStat 017-032
REG30243	InStat 033-048
REG30244	InStat 049-064
REG30245	InStat 065-080
REG30246	InStat 081-096
REG30247	InStat 097-112
REG30248	InStat 113-128
REG30249	InStat 129-144
REG30250	InStat 145-160
REG30251	InStat 161-176
REG30252	InStat 177-192
REG30253	InStat 193-208

Register	Label
REG30254	InStat 209-224
REG30255	InStat 225-240
REG30256	InStat 241-256
REG30257	InStat 257-272
REG30258	InStat 273-288
REG30259	InStat 298-304
REG30260	InStat 305-320
REG30261	InStat 321-336
REG30262	InStat 337-352
REG30263	InStat 352-368
REG30264	InStat 369-384
REG30265	InStat 385-400
REG30266	InStat 401-416
REG30267	InStat 417-432
REG30268	InStat 433-448
REG30269	InStat 449-464
REG30270	InStat 465-480
REG30271	InStat 481-496
REG30272	InStat 497-512
REG30273	InStat 513-528
REG30274	InStat 529-544
REG30275	InStat 545-560
REG30276	spare
REG30277	spare
REG30278	Packet not in rotation
REG30279	Fire count (global) mismatch
REG30280	Per-cyl fire count mismatch
REG30281	Cylinder out-of order
REG30282	Fire data missing
REG30283	Voltage message error count
REG30284	CAN RX Errors
REG30285	SPARK REQUESTED
REG30286	ACTIVE SPARK NUMBER
REG30287	Datalog Last Rotation Number
REG30288	4-20 ANALOG INPUT(LOCAL) ma*10
REG30289	Label01
REG30290	Label02
REG30291	Label03
REG30292	Label04
REG30293	Label05
REG30294	Label06
REG30295	Label07
REG30296	Label08

Register	Label
REG30297	Label09
REG30298	Label10
REG30299	Label11
REG30300	Label12
REG30301	Label13
REG30302	Label14
REG30303	Label15
REG30304	Label16
REG30305	Label17
REG30306	Label18
REG30307	Label19
REG30308	Label20
REG30309	Label21
REG30310	Label22
REG30311	Label23
REG30312	Label24
REG30313	Label25
REG30314	Label26
REG30315	Label27
REG30316	Label28
REG30317	Label29
REG30318	Label30
REG30319	Label31
REG30320	Label32
REG30321	Label33
REG30322	Label34
REG30323	Label35
REG30324	Label36
REG30325	Label37
REG30326	Label38
REG30327	Label39
REG30328	Label40
REG30329	Label41
REG30330	Label42
REG30331	Label43
REG30332	Label44
REG30333	Label45
REG30334	Label46
REG30335	Label47
REG30336	Label48
REG30337	Label49
REG30338	Label50
REG30339	Label51

Register	Label
REG30340	Label52
REG30341	Label53
REG30342	Label54
REG30343	Label55
REG30344	Label56
REG30345	Label57
REG30346	Label58
REG30347	Label59
REG30348	Label60
REG30349	Label61
REG30350	Label62
REG30351	Label63
REG30352	Label64
REG30353	Label65
REG30354	Label66
REG30355	Label67
REG30356	Label68
REG30357	Label69
REG30358	Label70
REG30359	Label71
REG30360	Label72
REG30361	Label73
REG30362	Label74
REG30363	Label75
REG30364	Label76
REG30365	Label77
REG30366	Label78
REG30367	Label79
REG30368	Label80
REG30369	Label81
REG30370	Label82
REG30371	Label83
REG30372	Label84
REG30373	Label85
REG30374	Label86
REG30375	Label87
REG30376	Label88
REG30377	Label89
REG30378	Label90
REG30379	Label91
REG30380	Label92
REG30381	Label93
REG30382	Label94

Register	Label
REG30383	Label95
REG30384	Label96
REG30385	Label97
REG30386	Label98
REG30387	Label99
REG30388	Label100
REG30389	Label101
REG30390	Label102
REG30391	Label103
REG30392	Label104
REG30393	Label105
REG30394	Label106
REG30395	Label107
REG30396	Label108
REG30397	Label109
REG30398	Label110
REG30399	Label111
REG30400	Label112
REG30401	Label113
REG30402	Label114
REG30403	Label115
REG30404	Label116
REG30405	Label117
REG30406	Label118
REG30407	Label119
REG30408	Label120
REG30409	Label121
REG30410	Label122
REG30411	Label123
REG30412	Label124
REG30413	Label125
REG30414	Label126
REG30415	Label127
REG30416	Label128
REG30408	Label120
REG30409	Label121
REG30410	Label122
REG30411	Label123
REG30412	Label124
REG30413	Label125
REG30414	Label126
REG30415	Label127
REG30416	Label128

The 00xxx registers are read/write binary registers. These registers are read using Modbus standard function 1, and can be written using function 5 (individual), or function 15 (multiple). When read or written to in groups, these registers are accessed in multiples of 8 (1 byte) addressed at each 8 bit boundary (10001-10008, etc.). A single Boolean read from registers 00001 to 00064 can be made which will return all 64 values as a group of 8 bytes. These registers also support an Altronic custom function 101 which will return a descriptive label for each specific register. The custom label function can be used to reduce the need for the Modbus master to maintain a current listing of all of the register labels for each unit.

Enhanced Display Modbus Register 00000

Register	Label	Default
REG00001	CYL 1M ENABLED	1
REG00002	CYL 2M ENABLED	1
REG00003	CYL 3M ENABLED	1
REG00004	CYL 4M ENABLED	1
REG00005	CYL 5M ENABLED	1
REG00006	CYL 6M ENABLED	1
REG00007	CYL 7M ENABLED	1
REG00008	CYL 8M ENABLED	1
REG00009	CYL 9M ENABLED	1
REG00010	CYL 10M ENABLED	1
REG00011	CYL 11M ENABLED	1
REG00012	CYL 12M ENABLED	1
REG00013	CYL 13M ENABLED	1
REG00014	CYL 14M ENABLED	1
REG00015	CYL 15M ENABLED	1
REG00016	CYL 16M ENABLED	1
REG00017	CYL 17M ENABLED	1
REG00018	CYL 18M ENABLED	1
REG00019	CYL 19M ENABLED	1
REG00020	CYL 20M ENABLED	1
REG00021	CYL 1S ENABLED	1
REG00022	CYL 2S ENABLED	1
REG00023	CYL 3S ENABLED	1
REG00024	CYL 4S ENABLED	1
REG00025	CYL 5S ENABLED	1
REG00026	CYL 6S ENABLED	1
REG00027	CYL 7S ENABLED	1
REG00028	CYL 8S ENABLED	1
REG00029	CYL 9S ENABLED	1
REG00030	CYL 10S ENABLED	1
REG00031	CYL 11S ENABLED	1
REG00032	CYL 12S ENABLED	1
REG00033	CYL 13S ENABLED	1

Register	Label	Default
REG00034	CYL 14S ENABLED	1
REG00035	CYL 15S ENABLED	1
REG00036	CYL 16S ENABLED	1
REG00037	CYL 17S ENABLED	1
REG00038	CYL 18S ENABLED	1
REG00039	CYL 19S ENABLED	1
REG00040	CYL 20S ENABLED	1
REG00041	CYL 1 INDEP	0
REG00042	CYL 2 INDEP	0
REG00043	CYL 3 INDEP	0
REG00044	CYL 4 INDEP	0
REG00045	CYL 5 INDEP	0
REG00046	CYL 6 INDEP	0
REG00047	CYL 7 INDEP	0
REG00048	CYL 8 INDEP	0
REG00049	CYL 9 INDEP	0
REG00050	CYL 10 INDEP	0
REG00051	CYL 11 INDEP	0
REG00052	CYL 12 INDEP	0
REG00053	CYL 13 INDEP	0
REG00054	CYL 14 INDEP	0
REG00055	CYL 15 INDEP	0
REG00056	CYL 16 INDEP	0
REG00057	CYL 17 INDEP	0
REG00058	CYL 18 INDEP	0
REG00059	CYL 19 INDEP	0
REG00060	CYL 20 INDEP	0
REG00061 THROUGH REG00064	spare	0
REG00065 THROUGH REG00122	RESERVED	0
REG00123	Datalog Power On Erase	0
REG00124	Datalog Continue Log At Stop	0
REG00125	Datalog Track Timing Change	0
REG00126	SLI Password Protect	0
REG00127	4-20MA SPK MAP EN	1
REG00128	ALARM	0

The 40xxx registers are read/write 16-bit integers. These registers are read using Modbus standard function 3, and can be written using function 6 (individual), or function 16 (multiple). These registers also support an Altronic custom function 103 which will return a descriptive label for each specific register. The custom label function can be used to reduce the need for the Modbus master to maintain a current listing of all of the register labels for each unit.

Enhanced Display Modbus Register 40000

Register	Label	Min	Max	Default
REG40001	MANUAL RETARD SETTING deg*10	0	65535	0
REG40002	OVERSPEED SETTING	0	65535	350
REG40003	RESET POSITION	0	65535	0
REG40004	CYL TIM. OFF. 1 deg*10	0	65535	0
REG40005	CYL TIM. OFF. 2 deg*10	0	65535	0
REG40006	CYL TIM. OFF. 3 deg*10	0	65535	0
REG40007	CYL TIM. OFF. 4 deg*10	0	65535	0
REG40008	CYL TIM. OFF. 5 deg*10	0	65535	0
REG40009	CYL TIM. OFF. 6 deg*10	0	65535	0
REG40010	CYL TIM. OFF. 7 deg*10	0	65535	0
REG40011	CYL TIM. OFF. 8 deg*10	0	65535	0
REG40012	CYL TIM. OFF. 9 deg*10	0	65535	0
REG40013	CYL TIM. OFF. 10 deg*10	0	65535	0
REG40014	CYL TIM. OFF. 11 deg*10	0	65535	0
REG40015	CYL TIM. OFF. 12 deg*10	0	65535	0
REG40016	CYL TIM. OFF. 13 deg*10	0	65535	0
REG40017	CYL TIM. OFF. 14 deg*10	0	65535	0
REG40018	CYL TIM. OFF. 15 deg*10	0	65535	0
REG40019	CYL TIM. OFF. 16 deg*10	0	65535	0
REG40020	CYL TIM. OFF. 17 deg*10	0	65535	0
REG40021	CYL TIM. OFF. 18 deg*10	0	65535	0
REG40022	CYL TIM. OFF. 19 deg*10	0	65535	0
REG40023	CYL TIM. OFF. 20 deg*10	0	65535	0
REG40024	CYL DEF. OFF. 1 deg*10	0	65535	0
REG40025	CYL DEF. OFF. 2 deg*10	0	65535	0
REG40026	CYL DEF. OFF. 3 deg*10	0	65535	0
REG40027	CYL DEF. OFF. 4 deg*10	0	65535	0
REG40028	CYL DEF. OFF. 5 deg*10	0	65535	0
REG40029	CYL DEF. OFF. 6 deg*10	0	65535	0
REG40030	CYL DEF. OFF. 7 deg*10	0	65535	0
REG40031	CYL DEF. OFF. 8 deg*10	0	65535	0
REG40032	CYL DEF. OFF. 9 deg*10	0	65535	0
REG40033	CYL DEF. OFF. 10 deg*10	0	65535	0
REG40034	CYL DEF. OFF. 11 deg*10	0	65535	0
REG40035	CYL DEF. OFF. 12 deg*10	0	65535	0
REG40036	CYL DEF. OFF. 13 deg*10	0	65535	0
REG40037	CYL DEF. OFF. 14 deg*10	0	65535	0

Register	Label	Min	Max	Default
REG40038	CYL DEF. OFF. 15 deg*10	0	65535	0
REG40039	CYL DEF. OFF. 16 deg*10	0	65535	0
REG40040	CYL DEF. OFF. 17 deg*10	0	65535	0
REG40041	CYL DEF. OFF. 18 deg*10	0	65535	0
REG40042	CYL DEF. OFF. 19 deg*10	0	65535	0
REG40043	CYL DEF. OFF. 20 deg*10	0	65535	0
REG40044 THROUGH REG40048	RESERVED	0	65535	0
REG40049	COIL DIAG. OFF. 1M deg*10	0	30	15
REG40050	COIL DIAG. OFF. 1S deg*10	0	30	15
REG40051	COIL DIAG. OFF. 2M deg*10	0	30	15
REG40052	COIL DIAG. OFF. 2S deg*10	0	30	15
REG40053	COIL DIAG. OFF. 3M deg*10	0	30	15
REG40054	COIL DIAG. OFF. 3S deg*10	0	30	15
REG40055	COIL DIAG. OFF. 4M deg*10	0	30	15
REG40056	COIL DIAG. OFF. 4S deg*10	0	30	15
REG40057	COIL DIAG. OFF. 5M deg*10	0	30	15
REG40058	COIL DIAG. OFF. 5S deg*10	0	30	15
REG40059	COIL DIAG. OFF. 6M deg*10	0	30	15
REG40060	COIL DIAG. OFF. 6S deg*10	0	30	15
REG40061	COIL DIAG. OFF. 7M deg*10	0	30	15
REG40062	COIL DIAG. OFF. 7S deg*10	0	30	15
REG40063	COIL DIAG. OFF. 8M deg*10	0	30	15
REG40064	COIL DIAG. OFF. 8S deg*10	0	30	15
REG40065	COIL DIAG. OFF. 9M deg*10	0	30	15
REG40066	COIL DIAG. OFF. 9S deg*10	0	30	15
REG40067	COIL DIAG. OFF. 10M deg*10	0	30	15
REG40068	COIL DIAG. OFF. 10S deg*10	0	30	15
REG40069	COIL DIAG. OFF. 11M deg*10	0	30	15
REG40070	COIL DIAG. OFF. 11S deg*10	0	30	15
REG40071	COIL DIAG. OFF. 12M deg*10	0	30	15
REG40072	COIL DIAG. OFF. 12S deg*10	0	30	15
REG40073	COIL DIAG. OFF. 13M deg*10	0	30	15
REG40074	COIL DIAG. OFF. 13S deg*10	0	30	15
REG40075	COIL DIAG. OFF. 14M deg*10	0	30	15
REG40076	COIL DIAG. OFF. 14S deg*10	0	30	15
REG40077	COIL DIAG. OFF. 15M deg*10	0	30	15
REG40078	COIL DIAG. OFF. 15S deg*10	0	30	15
REG40079	COIL DIAG. OFF. 16M deg*10	0	30	15
REG40080	COIL DIAG. OFF. 16S deg*10	0	30	15
REG40081	COIL DIAG. OFF. 17M deg*10	0	30	15
REG40082	COIL DIAG. OFF. 17S deg*10	0	30	15

Register	Label	Min	Max	Default
REG40083	COIL DIAG. OFF. 18M deg*10	0	30	15
REG40084	COIL DIAG. OFF. 18S deg*10	0	30	15
REG40085	COIL DIAG. OFF. 19M deg*10	0	30	15
REG40086	COIL DIAG. OFF. 19S deg*10	0	30	15
REG40087	COIL DIAG. OFF. 20M deg*10	0	30	15
REG40088	COIL DIAG. OFF. 20S deg*10	0	30	15
REG40089	CYL LABEL 1	0	65535	12620
REG40090	CYL LABEL 2	0	65535	12626
REG40091	CYL LABEL 3	0	65535	12876
REG40092	CYL LABEL 4	0	65535	12882
REG40093	CYL LABEL 5	0	65535	13132
REG40094	CYL LABEL 6	0	65535	13138
REG40095	CYL LABEL 7	0	65535	13388
REG40096	CYL LABEL 8	0	65535	13394
REG40097	CYL LABEL 9	0	65535	13644
REG40098	CYL LABEL 10	0	65535	13650
REG40099	CYL LABEL 11	0	65535	13900
REG40100	CYL LABEL 12	0	65535	13906
REG40101	CYL LABEL 13	0	65535	1406
REG40102	CYL LABEL 14	0	65535	14162
REG40103	CYL LABEL 15	0	65535	14412
REG40104	CYL LABEL 16	0	65535	14418
REG40105	CYL LABEL 17	0	65535	14668
REG40106	CYL LABEL 18	0	65535	14674
REG40107	CYL LABEL 19	0	65535	32844
REG40108	CYL LABEL 20	0	65535	32850
REG40109	CYL POSITION MAP TO FIRE 1	0	45	11
REG40110	CYL POSITION MAP TO FIRE 2	0	45	21
REG40111	CYL POSITION MAP TO FIRE 3	0	45	31
REG40112	CYL POSITION MAP TO FIRE 4	0	45	41
REG40113	CYL POSITION MAP TO FIRE 5	0	45	12
REG40114	CYL POSITION MAP TO FIRE 6	0	45	22
REG40115	CYL POSITION MAP TO FIRE 7	0	45	32
REG40116	CYL POSITION MAP TO FIRE 8	0	45	42
REG40117	CYL POSITION MAP TO FIRE 9	0	45	13
REG40118	CYL POSITION MAP TO FIRE 10	0	45	23
REG40119	CYL POSITION MAP TO FIRE 11	0	45	33
REG40120	CYL POSITION MAP TO FIRE 12	0	45	43
REG40121	CYL POSITION MAP TO FIRE 13	0	45	14
REG40122	CYL POSITION MAP TO FIRE 14	0	45	24
REG40123	CYL POSITION MAP TO FIRE 15	0	45	34
REG40124	CYL POSITION MAP TO FIRE 16	0	45	44
REG40125	CYL POSITION MAP TO FIRE 17	0	45	15

Register	Label	Min	Max	Default
REG40126	CYL POSITION MAP TO FIRE 18	0	45	25
REG40127	CYL POSITION MAP TO FIRE 19	0	45	35
REG40128	CYL POSITION MAP TO FIRE 20	0	45	45
REG40129	BASE SPARK NUMBER	1	8	1
REG40130	HI EAVG SPARK NUMBER	0	8	2
REG40131	EAVG ENABLE THRESHOLD	0	255	200
REG40132	EAVG DISABLE HYSTERESIS	0	255	70
REG40133	HI COV SPARK NUMBER	0	8	4
REG40134	COV ENABLE THRESHOLD	0	255	15
REG40135	COV DISABLE HYSTERESIS	0	255	5
REG40136	SPARK NUMBER OVERRIDE	0	8	8
REG40137	HI COV VARIATION	0	255	255
REG40138	HI FROM ENGINE THRESHOLD	0	255	255
REG40139	LO FROM ENGINE THRESHOLD	0	255	255
REG40140	LO SPARK DIAG THRESHOLD	0	255	0
REG40141	HI SPARK DIAG THRESHOLD	0	255	255
REG40142	RPM Graph Center	35	1800	300
REG40143	RPM Graph Counts Per Point	1	10	2
REG40144	Spk Select Cal low AD	0	65535	0
REG40145	Spk Select Cal low volt	0	65535	0
REG40146	Spk Select Cal hi AD	0	65535	16368
REG40147	Spk Select Cal hi volt	0	65535	250
REG40148	Low Output Module Thresh*100	0	65535	1500
REG40149	Hi Output Module Thresh*100	0	65535	3200
REG40150	Crit Low Voltage Thresh*100	0	65535	1000
REG40151	Crit Hi Voltage Thresh*100	0	65535	3500
REG40152	LCD Backlight Timeout (s)	0	65535	30
REG40153	Voltage Calibration low AD	0	65535	0
REG40154	Voltage Calibration low	0	65535	70
REG40155	Voltage Calibration hi AD	0	65535	16368
REG40156	Voltage Calibration hi	0	65535	5845
REG40157	Modbus RTU Node ID (1-254)	1	254	1
REG40158	Auxiliary Port Baud Rate (0-4)	0	4	0
REG40159	USB Port Mode 0=T,1=M,2=D	0	2	2
REG40160	USB Port Baud Rate (0-4)	0	4	4
REG40161	Datalog Interval	0	11	2
REG40162	COV Bar Graph Spread	1	17	1
REG40163	Test Mode Availability	0	2	2
REG40164	Value Protect Password (Keys)	0	65535	0
REG40165	Value Protect Password (Keys)	0	65535	0
REG40166	Value Protect Password (Keys)	0	65535	0
REG40167	Value Protect Password (Keys)	0	65535	0
REG40168	Value Protect Password (Keys)	0	65535	0

Register	Label	Min	Max	Default
REG40169	Cylinder Bar Graph Center	20	235	85
REG40170	Cyl Bar Graph Counts Per Point	1	5	1
REG40171	EAVG Bar Graph Spread	1	255	30
REG40172 THROUGH REG40191	RESERVED	0	65535	0
REG40192	Coil 001-016	0	65535	65535
REG40193	Coil 017-032	0	65535	65535
REG40194	Coil 033-048	0	65535	255
REG40195	Coil 049-064	0	65535	0
REG40196	Coil 065-080	0	65535	0
REG40197	Coil 081-096	0	65535	0
REG40198	Coil 097-112	0	65535	0
REG40199	Coil 113-128	0	65535	16384
REG40200 THROUGH REG40249	RESERVED	0	65535	0
REG40250	RTC Year	2007	2099	2012
REG40251	RTC Date msb=month,lsb=day	101	1231	101
REG40252	RTC Time msb=hour,lsb=minutes	0	2359	1200
REG40253	RTC Seconds	0	59	0
REG40254	Key Command Data	0	65535	0
REG40255	Key Commands	0	65535	0
REG40256	RESERVED	0	65535	0

32.1 Modbus Exception Codes

The CPU-XL Modbus implementation will return these Modbus error codes to requests made that are incorrect based on the error encountered.

STATUS CODE	MEANING	DESCRIPTION
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the slave. This may also occur if coils or discrete inputs are not read on an octal boundary (eg, 1, 9, 17, etc) and / or not in quantities that are a multiple of 8.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the slave. This may also be the result when the number of bytes sent in a request does not match the expected number of bytes for the request (eg, too few bytes written in a function 16 request).
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the slave was attempting to perform the requested action. This may occur when a request must be relayed directly to the ignition module and the ignition module rejects it).
06	SLAVE DEVICE BUSY	The slave is engaged in processing a long–duration program command. The master should retransmit the message later when the slave is free. This may occur if the display module has lost communication with the ignition module.
09	OVERFLOW	The master has sent an otherwise valid request, but the request length exceeded the size of the internal request buffer. The maximum request length supported is 270 bytes.

FIGURES SECTION

FIGURE 1: CPU-XL VARISPARK SYSTEM OVERVIEW

FIGURE 2: CPU-XL VARISPARK LOGIC/DISPLAY MODULE MOUNTING DIMENSIONS

FIGURE 3: CPU-XL VARISPARK OUTPUT MODULE MOUNTING DIMENSIONS

FIGURE 4: CPU-XL VARISPARK JUNCTION/DIAGNOSTIC MODULE MOUNTING DIMENSIONS

FIGURE 5: PICKUP MOUNTING DETAIL

FIGURE 6: FLYWHEEL HOLE DRILLING

FIGURE 7: MAGNET ASSEMBLY

FIGURE 8: MAGNET ASSEMBLY

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FIGURE 11: WIRING DIAGRAM – CPU-XL VARISPARK LOGIC/DISPLAY MODULE

FIGURE 12: SHIELDED HARNESS (293030)

FIGURE 13: SHIELDED HARNESS (793101)

FIGURE 14: SHIELDED HARNESS (793102)

FIGURE 15: TIMING CURVE, 4–20mA

FIGURE 16: DC POWER HOOKUP

FIGURE 1: CPU-XL VARISPARK SYSTEM OVERVIEW
EXAMPLE IS A COOPER GMV-10

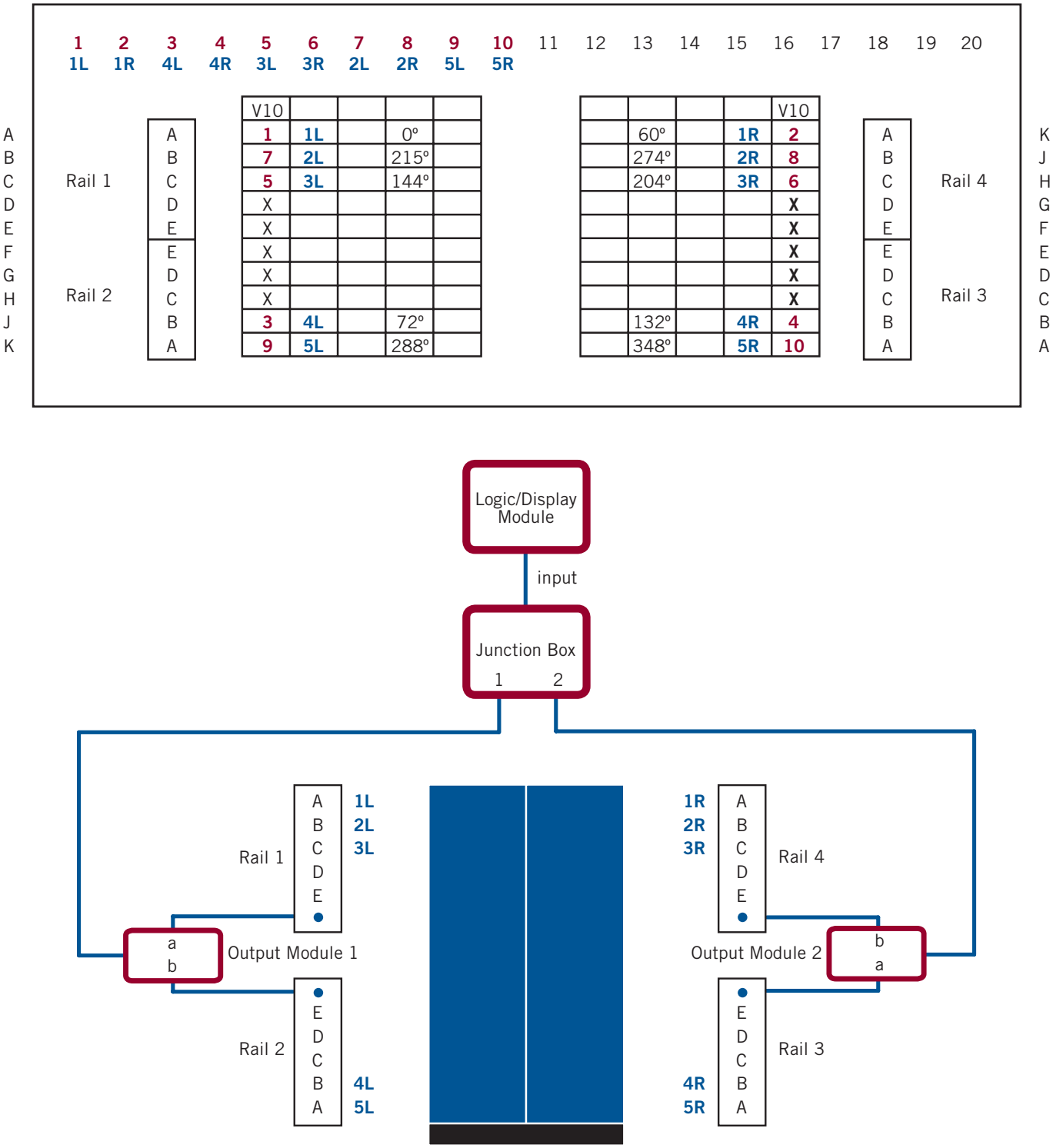
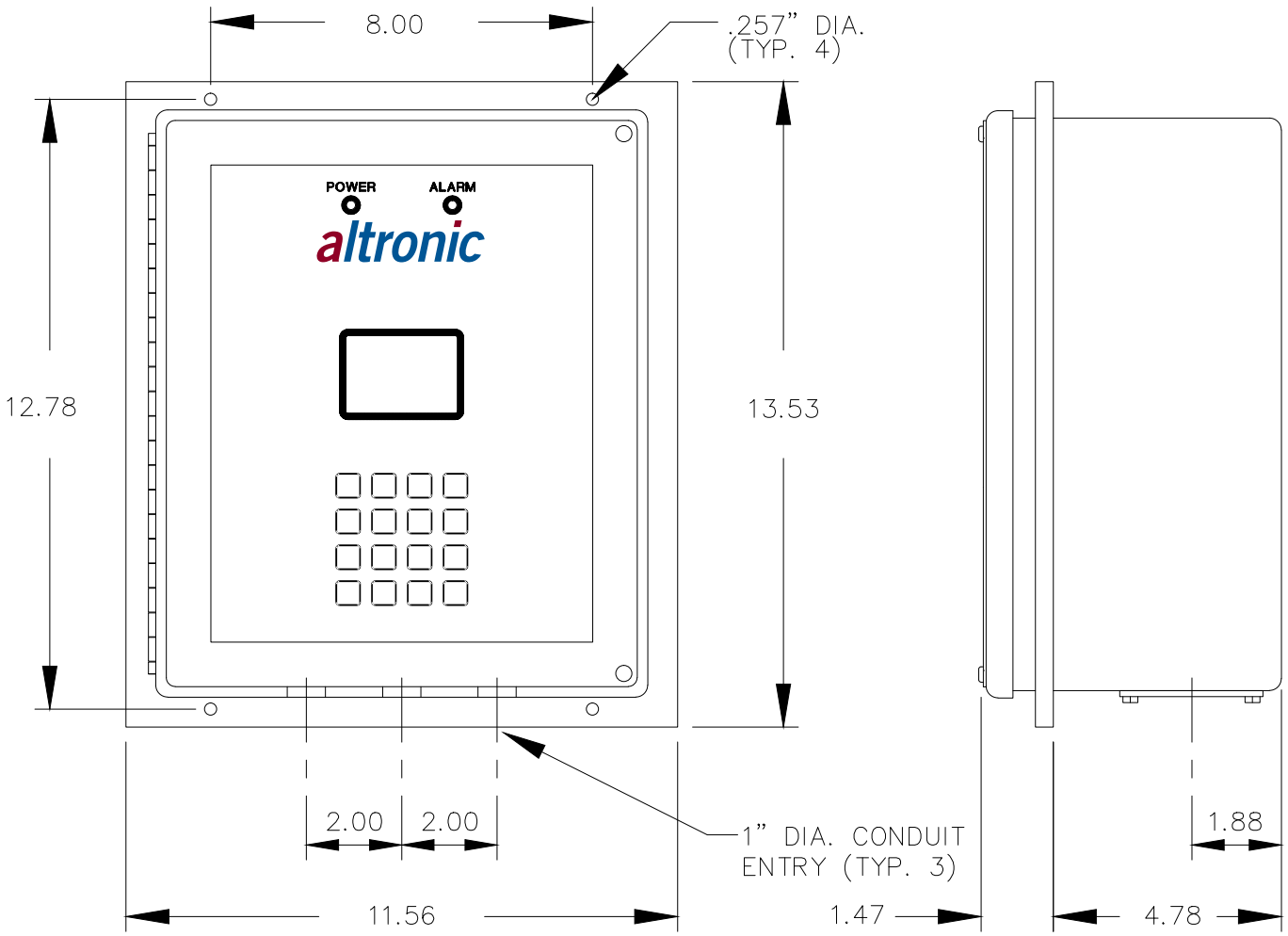


FIGURE 2: CPU-XL VARISPARK Logic/Display Module MOUNTING DIMENSIONS



NOTE: PANEL CUT-OUT IS 10.12" X 12.12"
ALL DIMENSIONS ARE IN INCHES.

FIGURE 3: CPU-XL VARISPARK OUTPUT MODULE MOUNTING DIMENSIONS

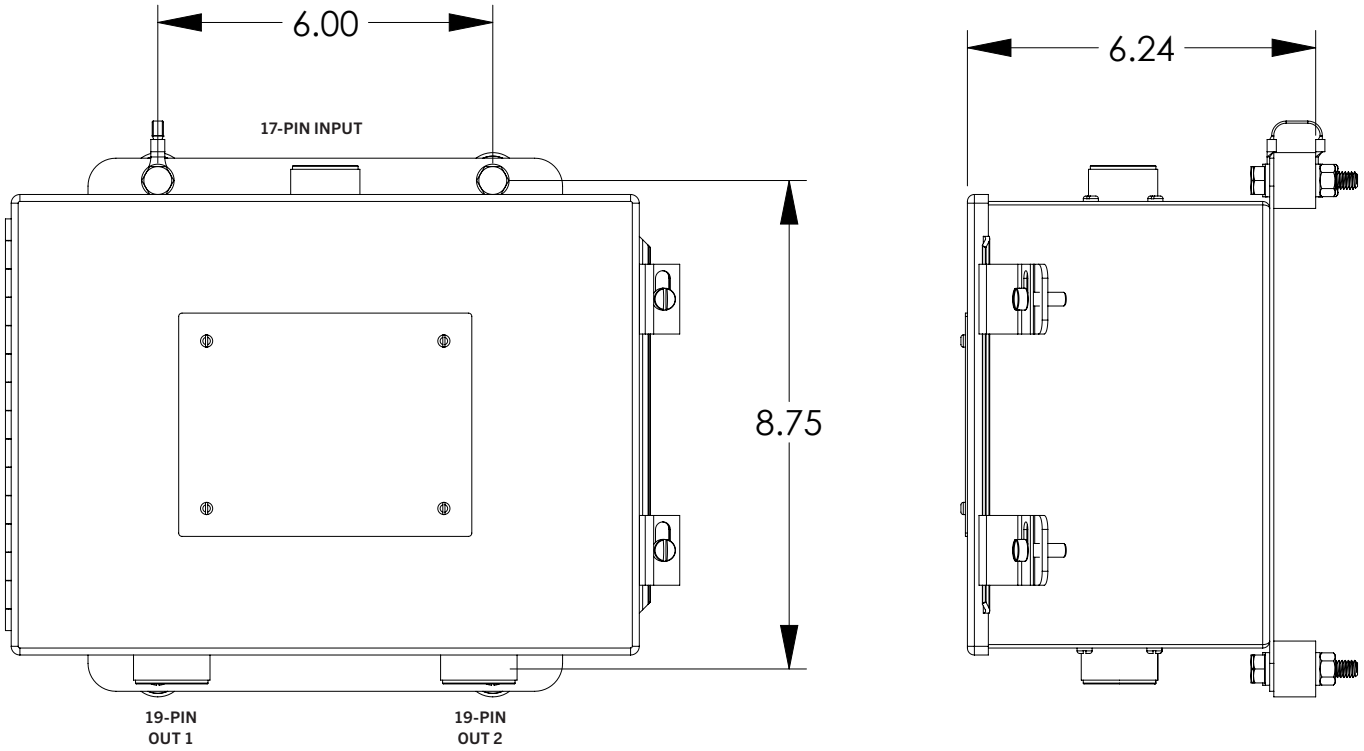


FIGURE 4: CPU-XL VARISPARK JUNCTION/DIAGNOSTIC MODULE MOUNTING DIMENSIONS

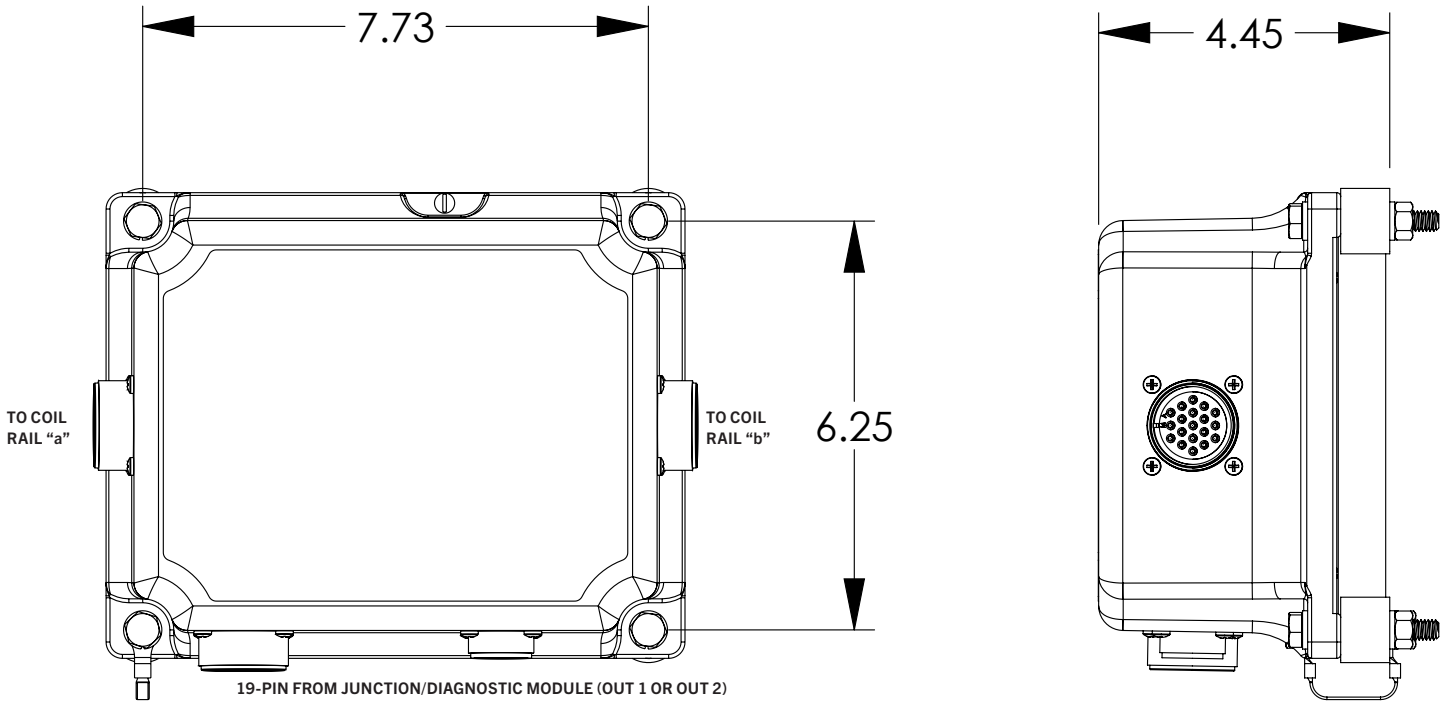
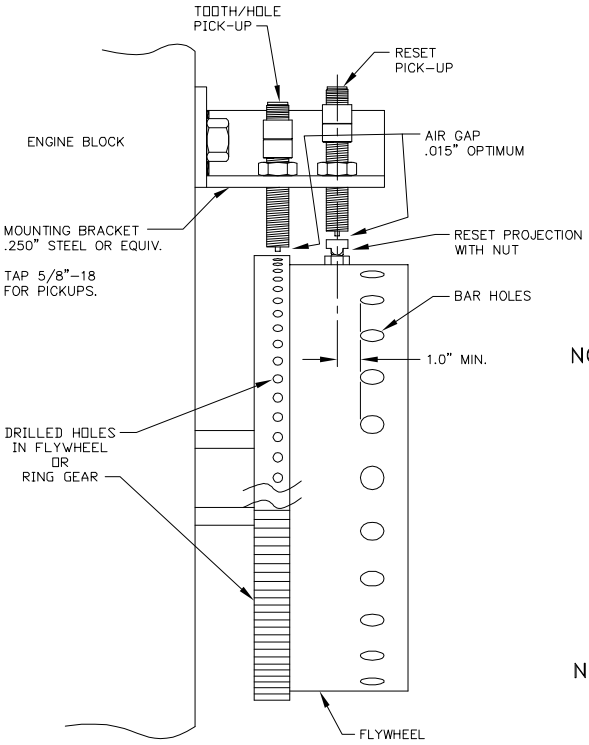


FIGURE 5: PICKUP MOUNTING DETAIL

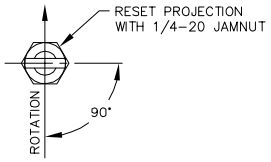


NOTE:

1. FLYWHEEL GUARD NOT SHOWN FOR CLARITY.

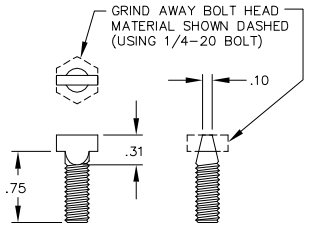
NOTE:

VISUAL PROPORTION OF THIS ILLUSTRATION WILL CHANGE WITH VARIATIONS IN GEAR AND FLYWHEEL SIZE AND RELATIONSHIP.



PATH OF ROTATION IS PERPENDICULAR TO FLAT OF STUD

EDGE VIEW



RESET PROJECTION

FIGURE 6: FLYWHEEL HOLE DRILLING

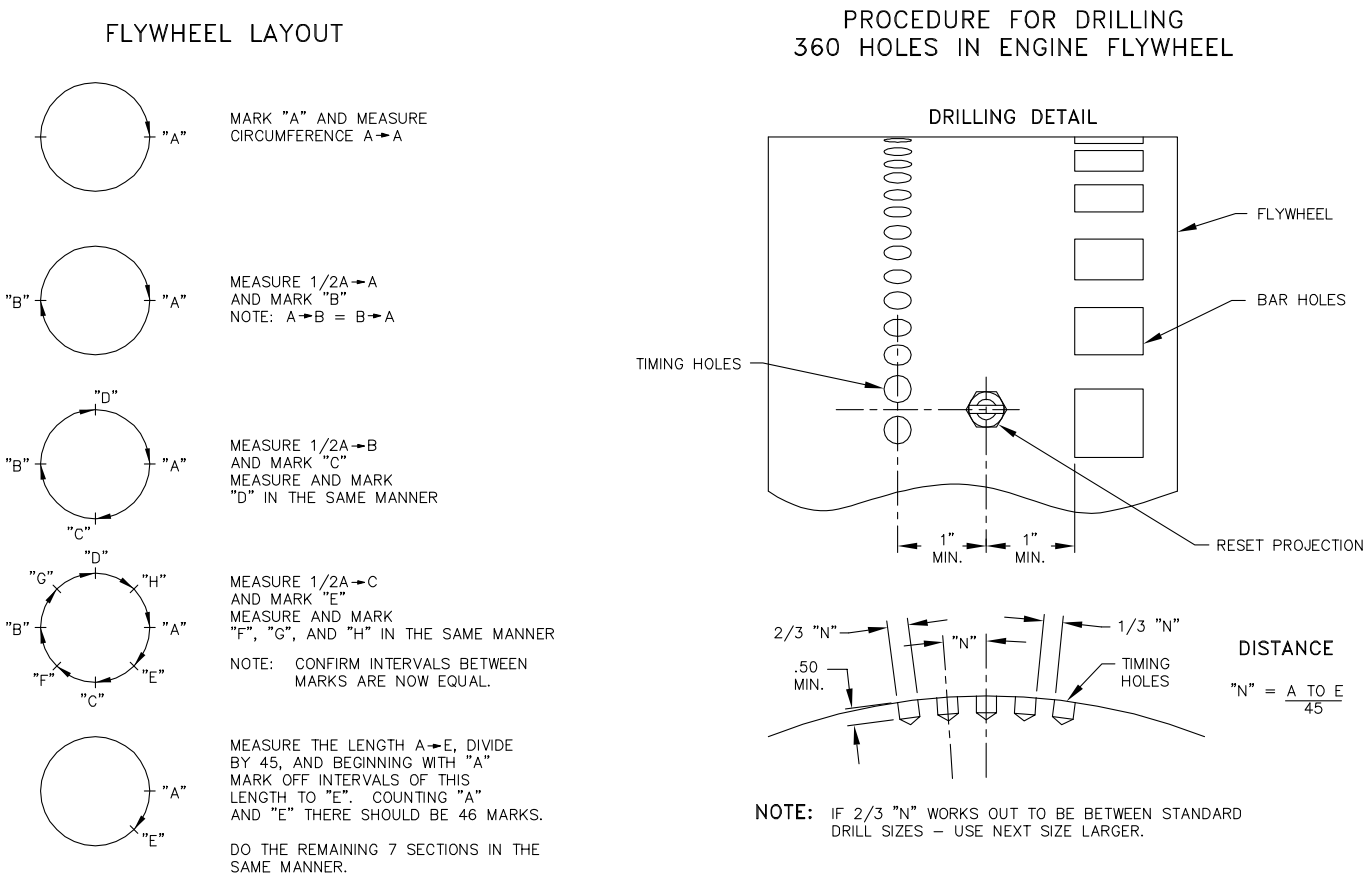


FIGURE 7: MAGNET ASSEMBLY

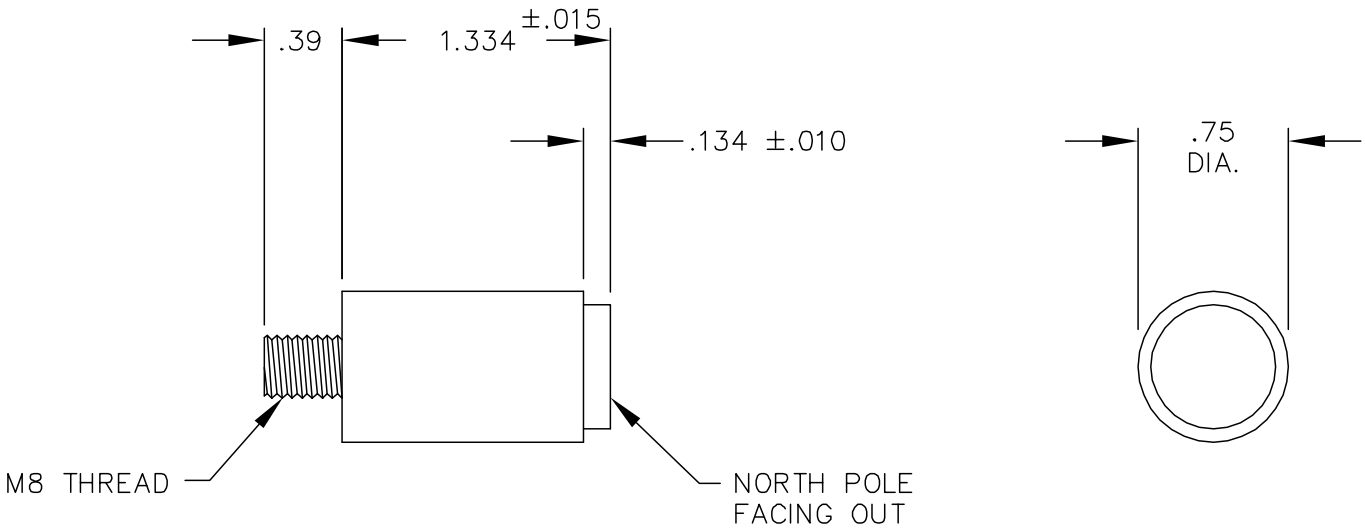


FIGURE 8: MAGNET ASSEMBLY

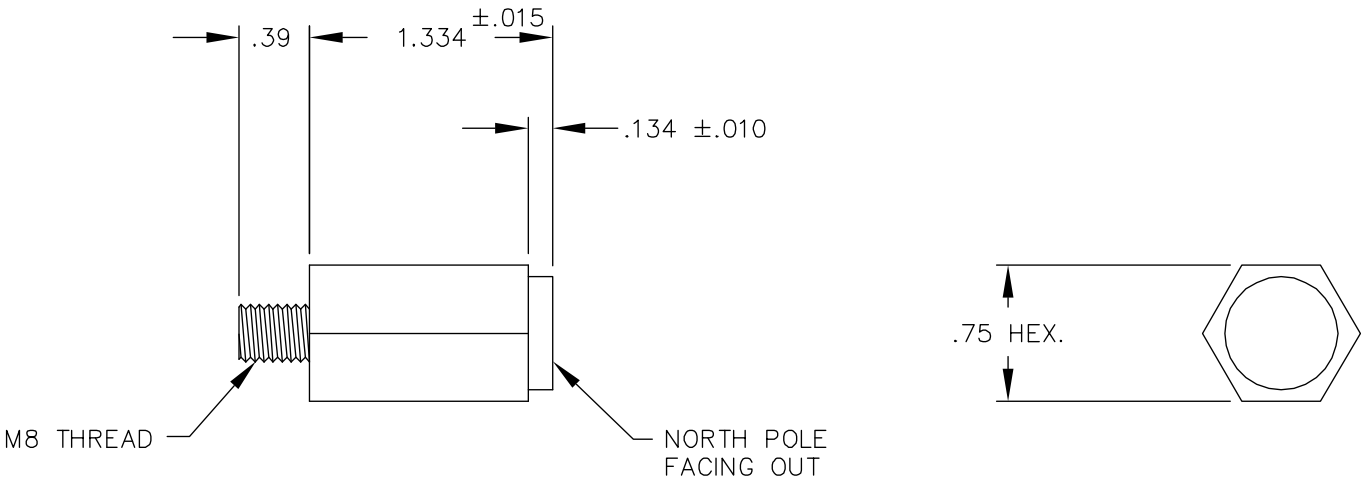


FIGURE 9: MAGNET ASSEMBLY

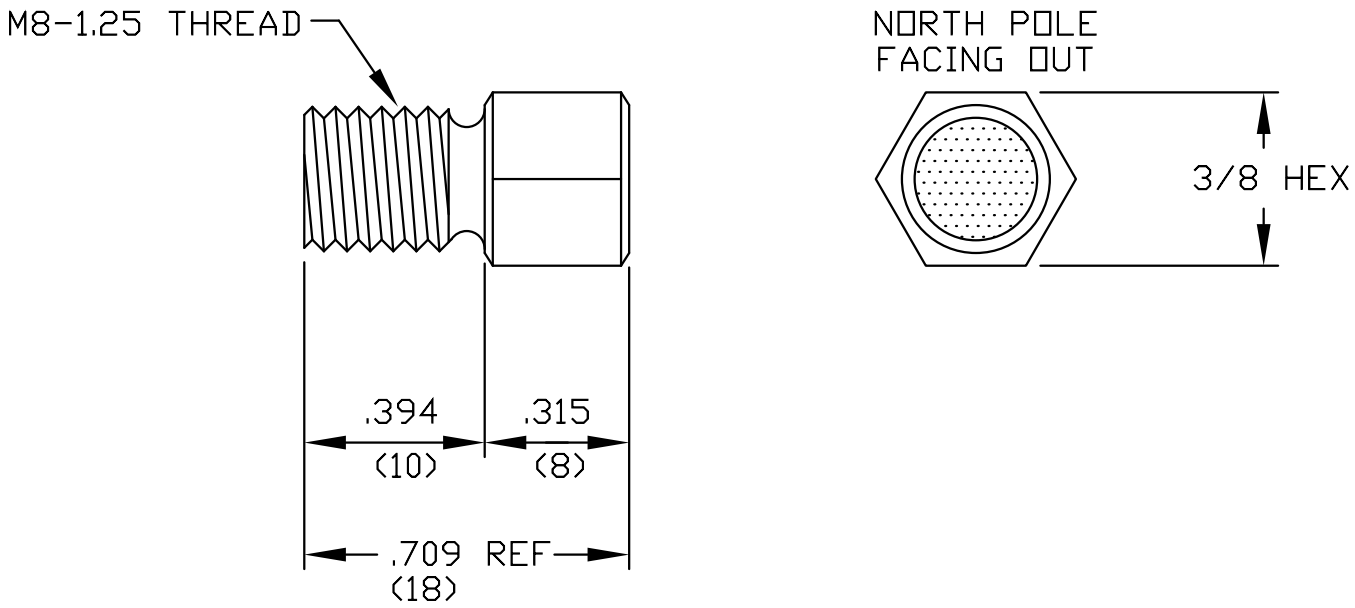


FIGURE 10: HALL-EFFECT PICKUP

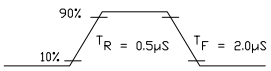
SPECIFICATIONS:

SUPPLY VOLTAGE:	5 TO 8 VOLTS D.C.
SUPPLY CURRENT:	50 mA. MAX.
OUTPUT VOLTAGE @ 5 ma.:	SUPPLY VOLTAGE MINUS 1.0 VOLT MAX.
OUTPUT CURRENT SOURCING:	10 mA. MAX.
STORAGE AND OPERATING TEMP.:	-40°C TO +125°C -40°F TO +257°F

ENCAPSULATED IN GLASS-FILLED EPOXY SUITABLE FOR ENGINE OIL OR OTHER NON-CONDUCTIVE MEDIA ONLY.

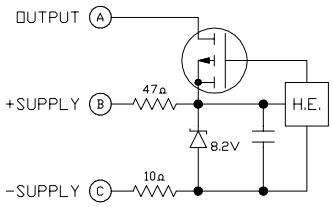
MAXIMUM OPERATING PRESSURE: 50 psi DIFFERENTIAL

TYPICAL OUTPUT WAVEFORM

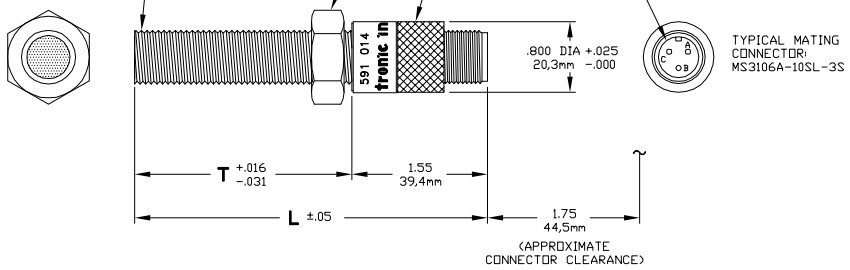


TRIGGERED BY THE NORTH POLE OF MAGNET 5 VOLT SUPPLY 1KΩ LOAD

SCHEMATIC



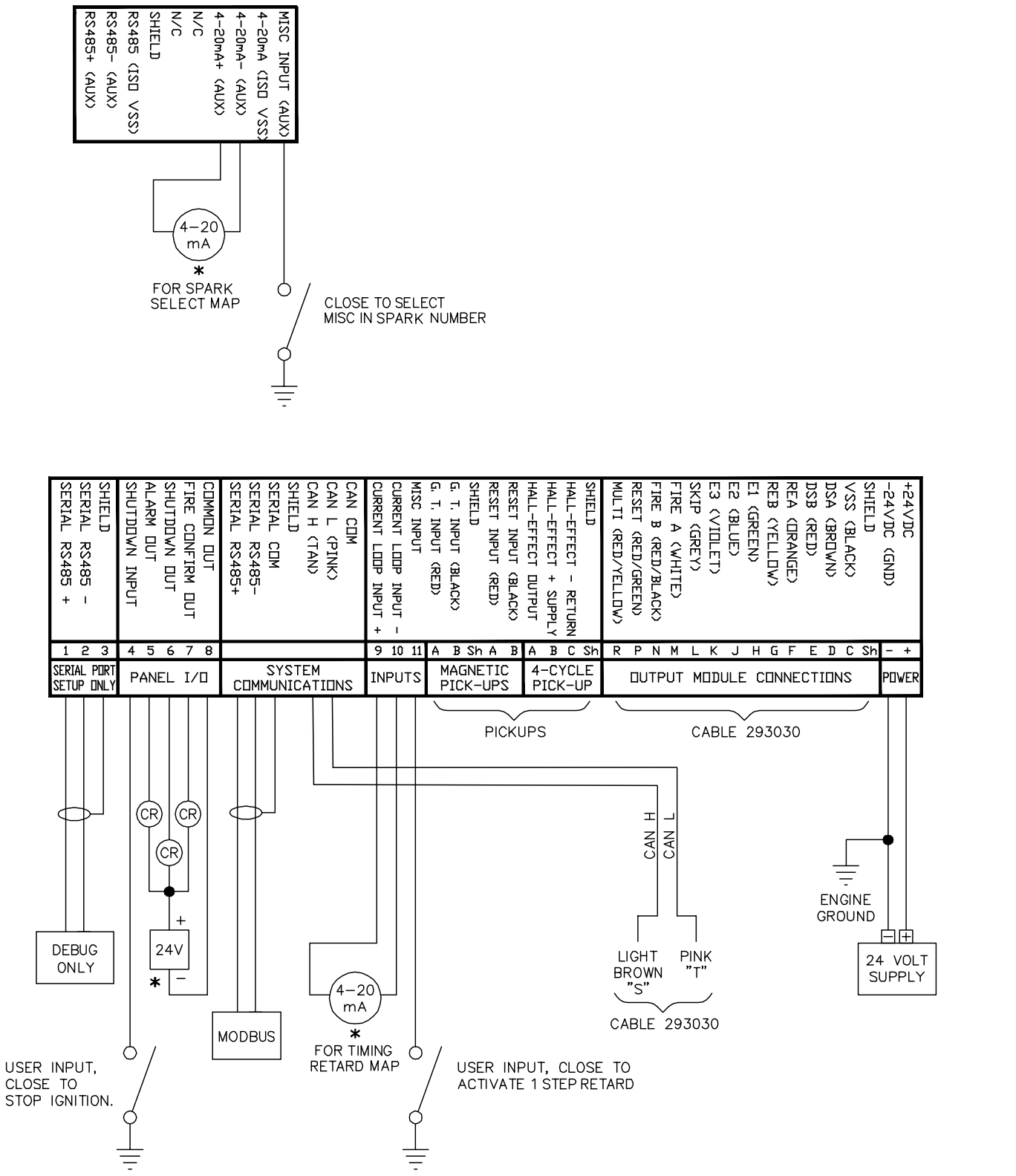
ALTRONIC P/N	T	L
591014-2	2.50"/63,5mm	4.05"/102,8mm
591014-4	4.50"/114,3mm	6.05"/153,7mm



NOTE:

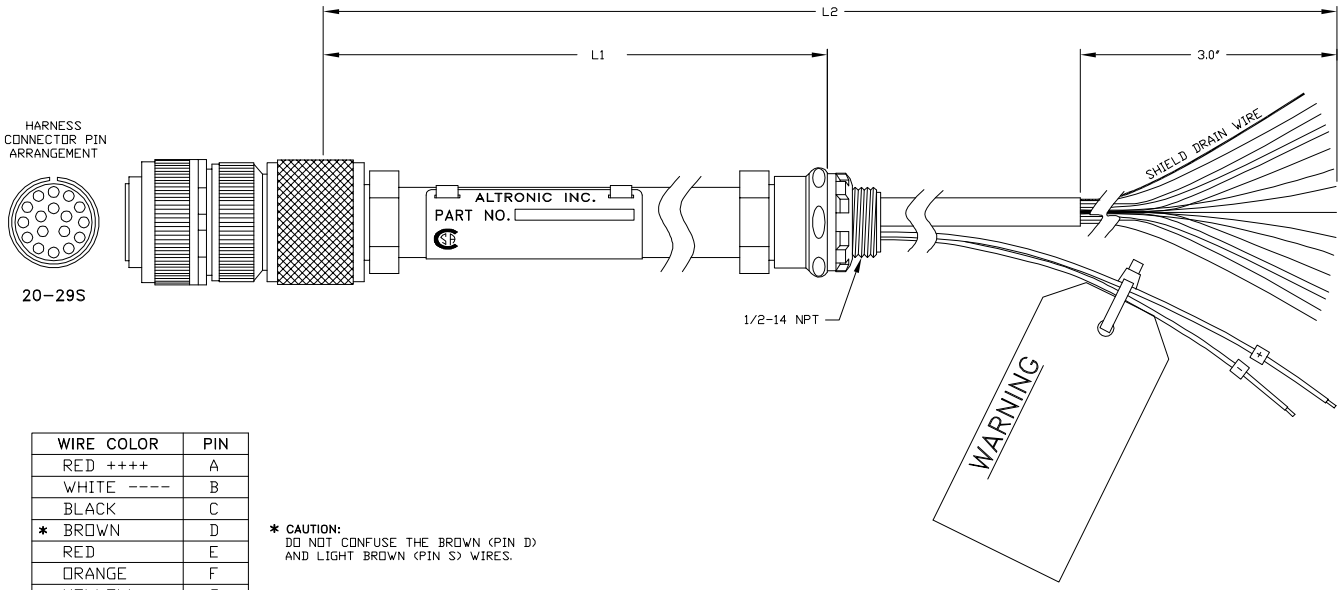
1. NORTH POLE OF MAGNET MUST FACE SENSING END WITH AIR GAP OF .030/.040 (,76/1,0).
2. CENTERLINE OF MAGNET'S ROTATION MUST RUN THROUGH CENTERLINE OF PICKUP.

FIGURE 11: WIRING DIAGRAM – CPU-XL VARISPARK LOGIC/DISPLAY MODULE



* NOTE:
ISOLATED TERMINALS WHICH ARE NOT CONNECTED TO GROUND OR ±24 VOLT SUPPLY. THESE TERMINALS CAN BE REFERENCED TO AN EXTERNAL ISOLATED SUPPLY IF REQUIRED.

FIGURE 12: SHIELDED HARNESS (293030)



WIRE COLOR	PIN
RED ++++	A
WHITE ----	B
BLACK	C
* BROWN	D
RED	E
ORANGE	F
YELLOW	G
GREEN	H
BLUE	J
VIOLET	K
GRAY	L
WHITE	M
RED/BLK	N
RED/GRN	P
RED/YEL	R
* LT BRN	S
PINK	T

* CAUTION:
DO NOT CONFUSE THE BROWN (PIN D) AND LIGHT BROWN (PIN S) WIRES.

PART NO.	L1 LENGTH	L2 LENGTH
293030-25	72"	25'
293030-50	72"	50'
293030-75	72"	75'
293030-100	72"	100'

FIGURE 13: SHIELDED HARNESS (793101)

CONNECTOR WIRING

IT.2	IT.3
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
J	J
K	K
L	L
M	M
N	N
P	P
R	R
S	S
T	T
U	U
V	V

GROUP #	L1	L2	PART NO.	PART NO.
24	24"	30"	793101-24	793101-24A
36	36"	41"	793101-36	793101-36A
48	48"	52"	793101-48	793101-48A
60	60"	64"	793101-60	793101-60A
72	72"	76"	793101-72	793101-72A
96	96"	100"	793101-96	793101-96A
120	120"	124"	793101-120	793101-120A
144	144"	148"	793101-144	793101-144A
180	180"	184"	793101-180	793101-180A

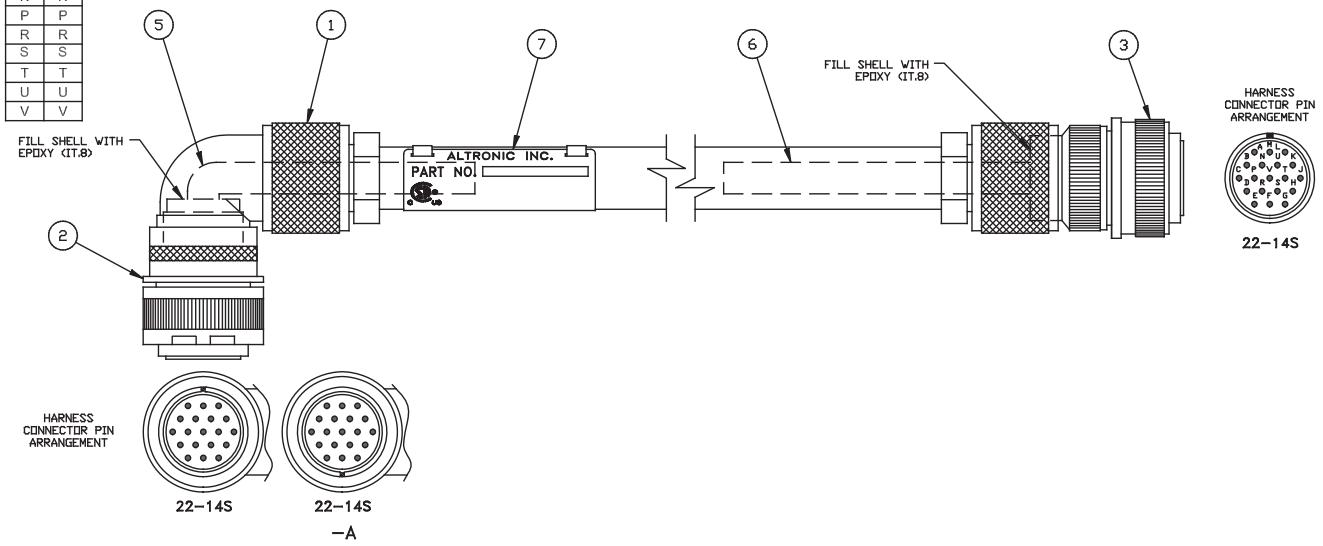


FIGURE 14: SHIELDED HARNESS (793102)

CONNECTOR WIRING

CONNECTOR PIN	PINS IN IT.2
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
J	J
K	K
L	L
M	M
N	N
P	P
R	R
S	S
T	T
U	U
V	V

NOTE: STRAIGHT WIRING BETWEEN CONNECTORS. EX: A-A, B-B, C-C…

GROUP #	L1	L2	PART NO.
24	24"	30"	793102-24
36	36"	41"	793102-36
48	48"	52"	793102-48
60	60"	64"	793102-60
72	72"	76"	793102-72
96	96"	100"	793102-96
120	120"	124"	793102-120
144	144"	148"	793102-144
180	180"	184"	793102-180
240	240"	244"	793102-240

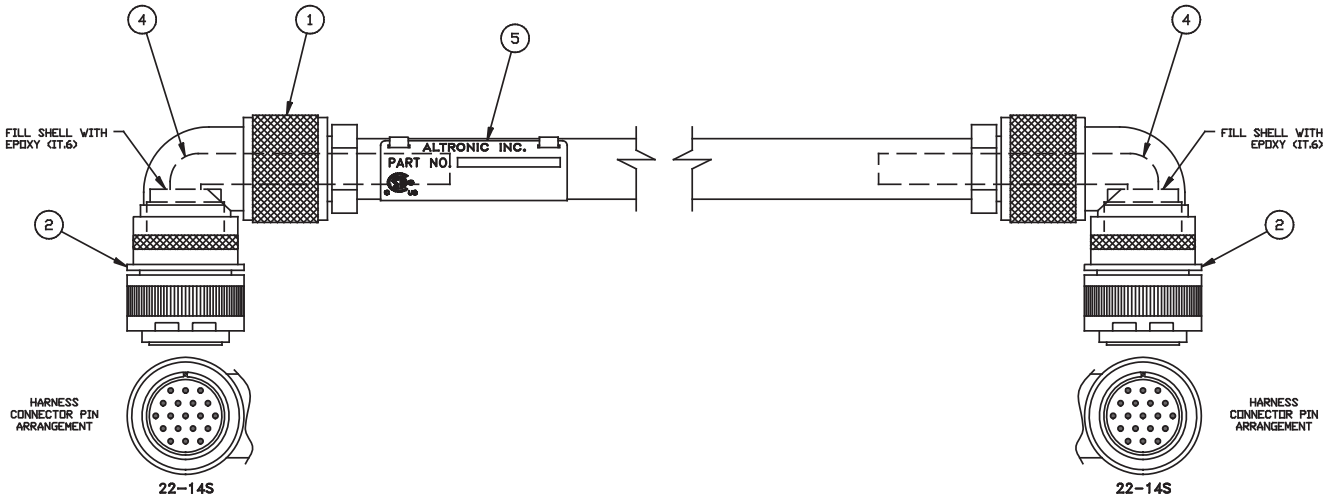
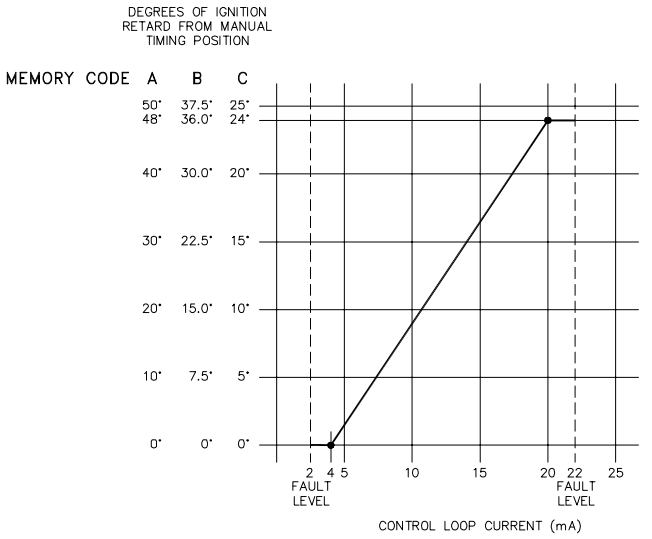
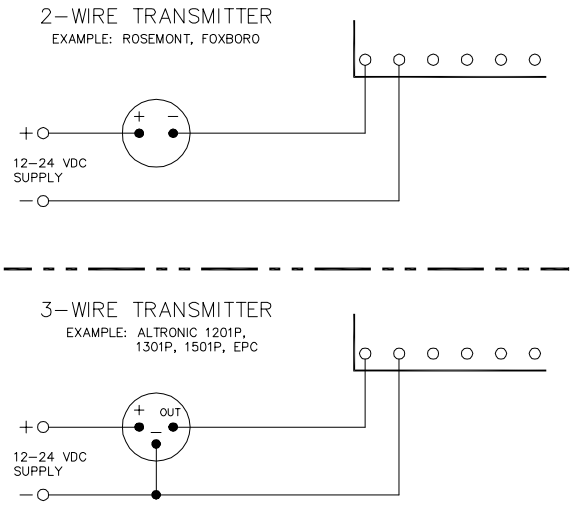


FIGURE 15: TIMING CURVE, 4–20mA



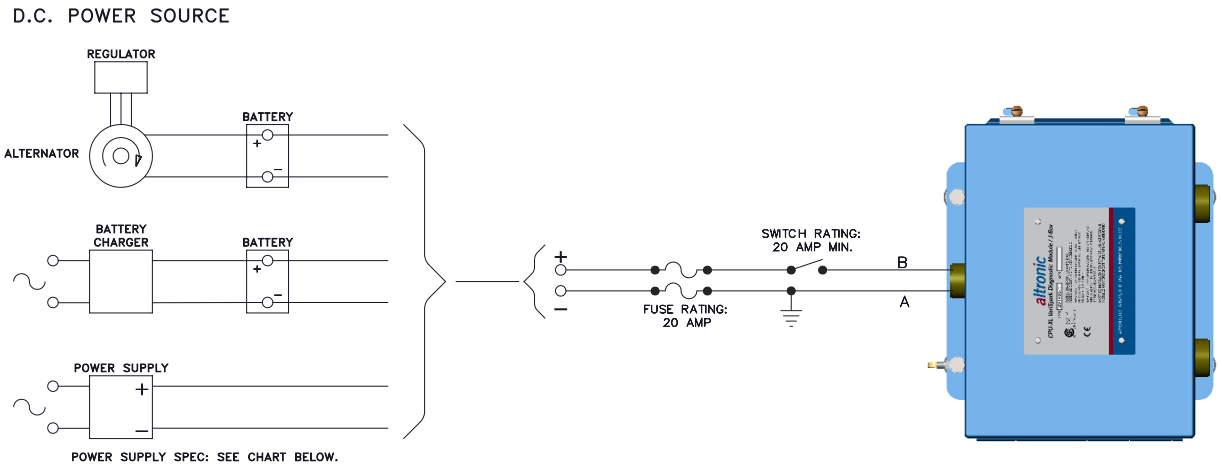
IF CURRENT LOOP PASSES THROUGH EITHER FAULT LEVEL, DIAGNOSTICS ARE ACTIVATED.
- FOR STANDARD MEMORY CHIPS (.HA, .HB, .HC), TIMING GOES TO A VALUE 3 DEGREES RETARDED FROM MAXIMUM ADVANCE.
- THE DEFAULT VALUE CAN BE SPECIFIED DIFFERENTLY IN A SPECIAL MEMORY CHIP (.HSxxx) OR CHANGED VIA THE SERIAL PORT USING A PC.



NOTE:

1. LOOP INPUT IMPEDANCE: 250 OHMS ±1%.
2. FIELD WIRING MUST BE 24 AWG UL STYLE 1015 TYPE WIRE IN SEPARATE CONDUIT AWAY FROM ALL OTHER WIRING.

FIGURE 16: DC POWER HOOKUP



1. IT IS RECOMMENDED THAT EACH SYSTEM BE CONNECTED SEPARATELY BACK TO THE POWER SOURCE. USE CHART 1 TO DETERMINE THE WIRE SIZE (GAUGE) REQUIRED.

2. MULTIPLE ENGINE INSTALLATIONS – IT IS RECOMMENDED THAT EACH ENGINE BE SUPPLIED BY A DEDICATED POWER SUPPLY CAPABLE OF UP TO 30 AMPERES OF 24 VOLT DC POWER. IF A LARGE UNINTERRUPTIBLE, BUSSED SUPPLY IS AVAILABLE IT CAN BE USED FOR MULTIPLE ENGINES, BUT EACH IGNITION SHOULD BE WIRED BACK TO THE SUPPLY MAIN INDEPENDENTLY OF THE OTHER IGNITIONS.

	4–CYCLE	2–CYCLE
TYPICAL CURRENT DRAW	N X RPM / 1,800	N X RPM / 900

N = NUMBER OF OUTPUTS USED.
MULTIPLY BY NUMBER OF ENGINES FOR TOTAL REQUIREMENT.

OPERATING VOLTAGE REQUIREMENT:

STARTING:	20 VDC MIN.
RUNNING:	24–28 VDC

DISTANCE IN FEET	MINIMUM WIRE GAUGE
UP TO 25	12 AWG
26–40	12 AWG
41–65	10 AWG
66–100	8 AWG
101–160	6 AWG

CHART 1

NO. OF SYSTEMS X DISTANCE IN FEET	MINIMUM WIRE GAUGE
26–40	12 AWG
41–65	10 AWG
66–100	8 AWG
101–160	6 AWG
161–250	4 AWG
251–400	4 AWG

CHART 2

NOTE: ABOVE 400, USE MULTIPLE PAIRS OF WIRES FROM THE POWER SOURCE TO THE ENGINE ROOM.