CPU-95 ADVANCED DIGITAL IGNITION SYSTEM FOR INDUSTRIAL ENGINES

- **Microprocessor-based, crankshaft–referenced digital ignition system for medium-sized natural gas-fueled engines**
- **Optimizes engine combustion and performance, as well as fuel efficiency and spark plug service life**
- **Delivers full-time system, primary discharge, and secondary discharge diagnostics (patented)**
- **Enhanced, user-friendly Display Module insures a convenient means of adjusting system settings and access to critical ignition operating information, including all diagnostic messages along with datalogs, USB connectivity, and the ability to upload the ignition programming code to the CPU-95 Ignition Module**
- **Special CPU-95 variants for SI controller-equipped Caterpillar 3500 engines and for low BMEP, slow speed integral compressor engines (VariSpark™)**
- **Simple and cost-effective retrofit option for CPU-90, III-CPU, and even Altronic III operators**
- **Class I, Division 2, Group C and D certified by the Canadian Standards Association (CSA)**

The Altronic CPU-95 is a 24 Vdc-powered, microprocessor-based digital ignition system designed for application to medium-range industrial gas engines. Advantages include a full-featured user display and interface, spark characteristic control, advanced timing adjustment options, serial communications, and state-of-the-art diagnostics.

Full access to all CPU-95 operating data and control functionality is available through an advanced, user-friendly Display Module as well as via a PC operating the provided CPU-95 Terminal Program. Both options display essential engine and ignition data such as RPM, timing angle, spark energy level, and diagnostic messages, along with global and individual cylinder timing adjustments, spark energy level control, overspeed setpoint and double strike/extended spark (VariSpark™ variant) selectability. Additionally, the Enhacend Display Module features extensive spark reference number graphing and trending.

Patented CPU-95 diagnostics and prognostics (predictive diagnostics) supervise all ignition system-related functions. The secondary analysis capabilities detect shorted spark plugs and leads, as well as spark plugs that exhibit high voltage demand or are not firing at all. A display of the relative voltage demand of each spark plug is provided, allowing spark plug changes to be predicted and scheduled. Module and pickup operation, timing input, and primary output functions are also monitored for operation within preset limits.

The CPU-95 system is shop or field configurable. Using the standard Terminal Program and the Enhanced CPU-95 Display Module, the user has the added flexibility and convenience associated with a USB-based connection to the system for programming. Operation of the Enhanced Display Module also enables the user to download and retain the ignition operating parameters (firing code, number of monitored gear teeth, 4-20mA or RPM control loop, etc.) from the connected Ignition Module. Should the ignition module ever require replacement, the Enhanced Display Module can then simply upload the correct ignition operating parameters into the new unit without need for a laptop, the Terminal Program, or the services of an instrumentation technician.

New Backward-Compatible Enhanced CPU-95 Display Now Available

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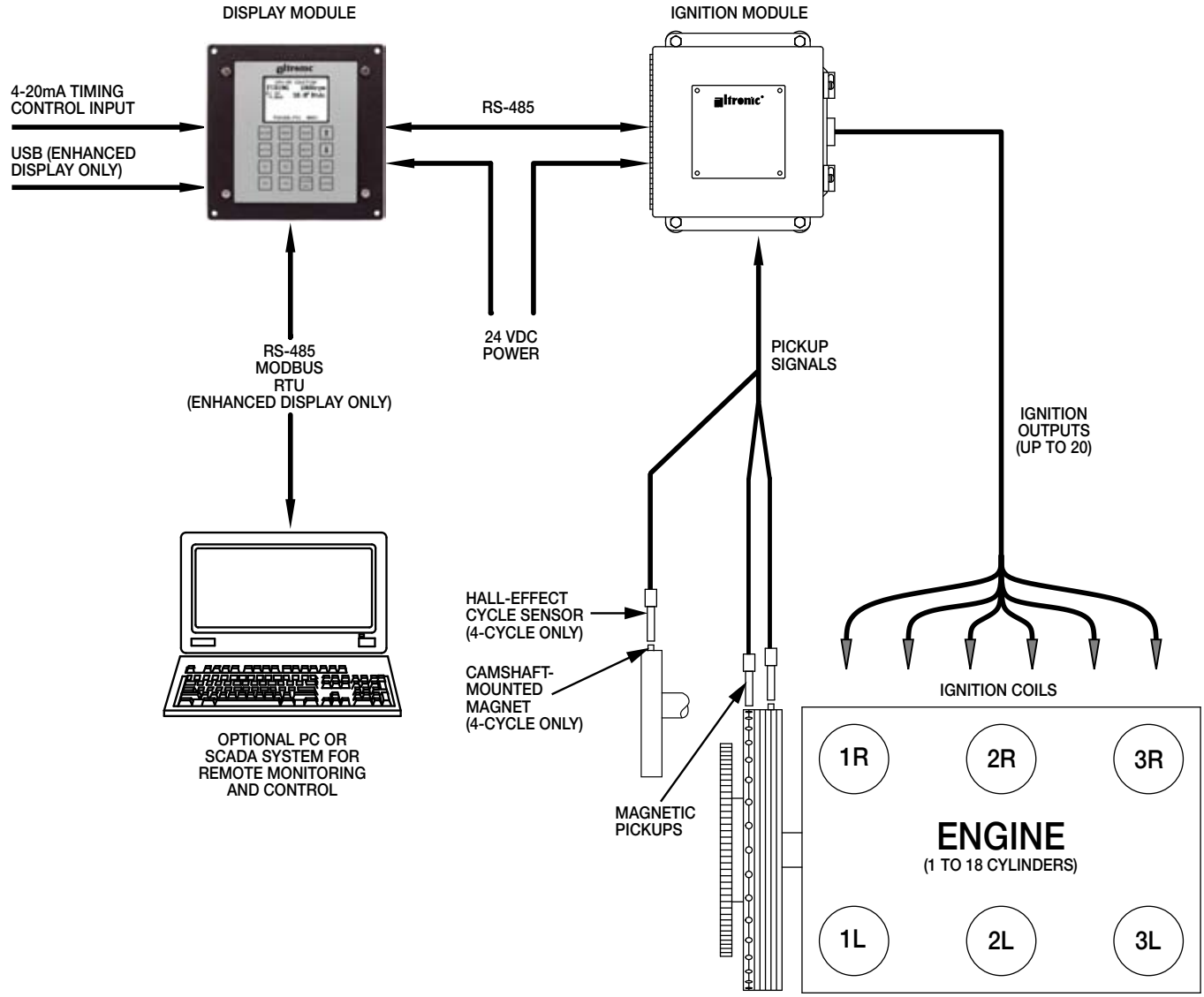
CLASS I, DIVISION 2, GROUPS C and D

System Overview



System Components

Each CPU-95 system is composed of the Ignition Module, two magnetic pickups and cables, a primary wiring harness, and an ignition coil for each spark plug. A system Display Module, typically used (but not required), is also available. A Hall-effect pickup and cable, as well as a magnet turning at camshaft-speed are utilized on 4-cycle applications only.

System Operation

The diagram above illustrates how these components are integrated into an operating system. To insure that the spark is delivered at precisely the right moment for each engine cylinder on each revolution, the CPU-95 determines the position of the engine crankshaft through the use of a magnetic pickup sensing starting ring gear teeth or holes drilled into the flywheel allowing precise determination of crankshaft angular position in real time. Matching that to a pre-programmed system memory, the CPU-95 system can achieve extremely high ignition timing accuracy. A second, flywheel-based magnetic pickup, is used to generate a once per crankshaft revolution reset pulse. Four-cycle applications also utilize a Hall-effect pickup sensing a magnet turning at camshaft speed to determine the compression cycle of the engine.

The CPU-95 Ignition Module is typically mounted on or near the engine. This 24-VDC-powered module accepts and processes the input data derived from the engine-based pickups and any control data being brought into the system through the CPU-95 Display Module, Terminal Program, or engine management system (see review to left). This control information, including timing adjustments, spark energy control, and multi-strike or extended duration (VariSpark™) directly influences both the moment at which the spark is delivered and the important characteristics of that spark. A 4-20mA timing control input from a supervisory control system or an instrument monitoring a specific operating parameter (such as fuel manifold pressure or air manifold temperature) is also available as an additional means of optimizing performance.

System Features

Comprehensive Display Capability

Two-line, alphanumeric, backlit display indicates the following operating parameters:

- System status and mode
- Ignition energy level, mode and number of strikes
- Global timing (in degrees BTDC)
- Individual cylinder timing
- Value of timing control signal (4-20mA)
- Relative spark plug voltage indication by cylinder
- Engine speed (in RPM)
- Engine overspeed setpoint
- Diagnostic messages

Spark Characteristic Control

For improved engine performance and combustion stability, ignition of lean mixtures for emissions reduction or improved starting and loading characteristics:

- Double-striking mode (selectable ON/OFF)
- VariSpark™ mode (selectable ON/OFF – VariSpark™ model only)
- Manual or automatic ignition energy level control (3 levels)

Ignition Timing Control Modes

Local and remote control of ignition timing (global or individual cylinder) allows engine starting and running performance to be optimized.

- One-step timing change vs. input signal or RPM
- Keypad control via display module
- Terminal program control via serial port
- Analog 4 to 20 mA control
- Timing control vs. RPM

Serial Communications to PC or Engine Management System

All system features, display data, and configuration inputs are accessible via an integral RS-485 serial port. A new, dual port display module enables simultaneous use of both the system display, and a supervisory control system utilizing ModBus RTU.

System Configuration

Engine-specific configuration parameters are contained in a plug-in memory (EEPROM) which can be moved to a spare unit if necessary. The memory can be configured in the shop or on location using a personal computer connected to the serial port.

- Engine firing pattern
- Number of gear teeth or flywheel holes sensed
- Timing control vs. 4-20mA and RPM

Diagnostics, Testing, Shutdown Capabilities

Advanced and patented diagnostics, self-test, and alarm/shutdown capabilities are included with each CPU-95 system:

- Primary and secondary discharge faults identified as to cylinder (see inset at right)
- Status of system pickups
- Verification of number of teeth/holes
- Test firing of selected cylinder(s) (optional)
- Overspeed condition
- Alarm and shutdown outputs

Retrofit Existing Altronic III, III-CPU, CPU-90 Systems

Retaining many system components makes conversion to the CPU-95 simple and cost-effective.

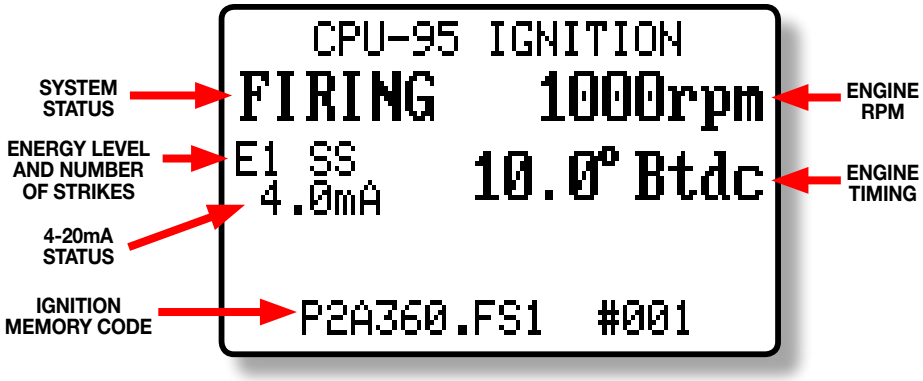
Display Options

The CPU-95 Ignition Module is designed to operate in conjunction with a variety of display/control options through its integral RS-485 communication port. This facilitates the application of CPU-95 systems to gas engines operating at varying stages of automation and sophistication.

Display Module

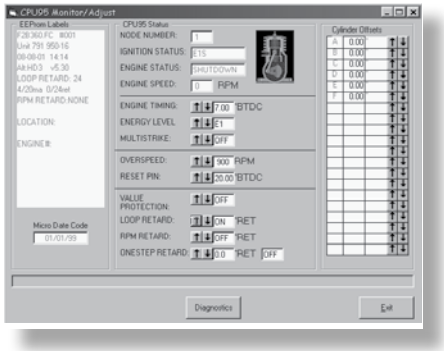
The CPU-95 Display Module, typically mounted in an engine control panel or other enclosure off the engine, offers users comprehensive display and control functionality. It features an alphanumeric display, in conjunction with a front-accessible, sealed membrane keypad and gives users access to critical operating, setup, and diagnostic information. Enhanced Display Module is optional (see discussion at right).

A typical running message:



Terminal Program

The CPU-95 Terminal Programs can be operated via the Ignition Module's serial port or through the second serial port located on the enhanced CPU-95 Display Module. This Windows™-based software package duplicates the display and control capabilities of the Display Module on a compatible Personal Computer. The Terminal Program also enables a user to reconfigure the engine specific data (firing pattern, number of holes or teeth, and timing control curves) in the field, as well as to simultaneously monitor all primary and secondary discharge diagnostics for each engine power cylinder.



Engine Management System

For OEM or highly-automated applications, the CPU-95 Ignition Module's RS-485 port can be directly connected to an engine management system or other high-level control system for direct control of all ignition system functions and access to all diagnostics.

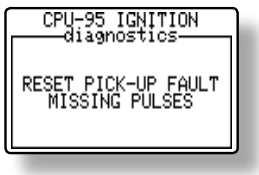
CPU-95 System Diagnostics

To assist operators of gas engines in properly locating and diagnosing the source of ignition-related problems, a suite of comprehensive, easy-to-use, troubleshooting diagnostics have been developed and imbedded into the CPU-95 system. The goal of these diagnostics is simple: reduce engine downtime and all of the costs associated with it.

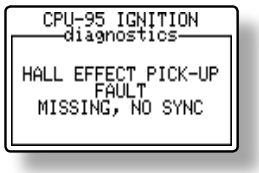
CPU-95 diagnostics are split into two separate groups. System diagnostics are those that relate primarily to the operation of the ignition system itself or to the inputs into the system (pickups, control inputs, etc.). The second group encompasses **Altronic's patented primary and secondary discharge diagnostics** (U.S. Patent No. 5,623,209). These powerful, non-intrusive diagnostics are unique in the industry for their reliability and the fact that they do not require a special ignition coil, any add-on probes or clamps, or any other special equipment. Instead, Altronic primary and secondary diagnostics utilize standard ignition coils (typically the same ignition coil that is on the engine during a retrofit) in assessing secondary voltage demand. This valuable capability assists users in determining the proper point at which to change their spark plugs, in troubleshooting problematic primary and secondary connections, and in detecting combustion anomalies in the cylinder (such as air/fuel ratio or imbalance conditions). The secondary diagnostic functions also assist the user selecting the appropriate point at which to manually or automatically adjust the delivered spark energy (there are three levels available) to assure maximum spark plug life and reliable combustion.

Typical System Diagnostics

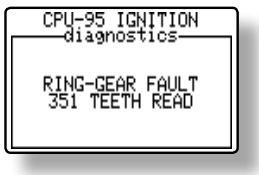
Zero gear-tooth pulses are seen between two reset pulses.



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

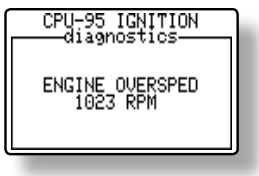


There are no Hall-effect pickup pulses or the pickups are not synchronized.



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

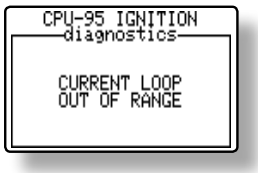
The received number of pulses is displayed.



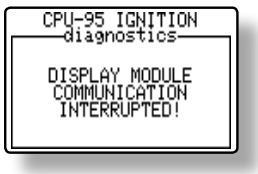
When the engine speed exceeds the overspeed setpoint.

Maximum observed speed is also displayed.

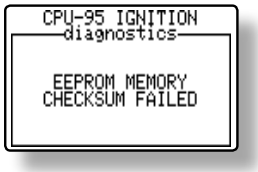
Patented Primary and Secondary Discharge Diagnostics



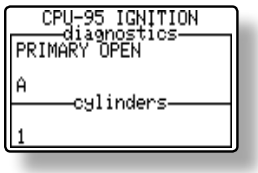
The current loop has deviated outside the limits of 2 mA and 22 mA. The current loop follows the configured curve which is specified from 0-25 mA. Active only if the current loop retard is on.



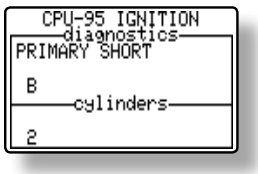
At some point, no loop data was received from the Display Module. In this condition, the timing for 0 mA is used. Active only if the current loop retard is on.



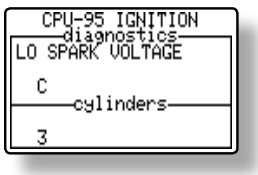
The firing pattern configuration data saved in EEPROM memory is incorrect or incomplete. The EEPROM memory must be reprogrammed or replaced.



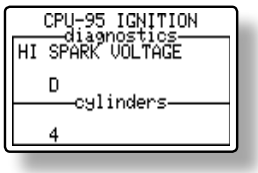
An open circuit on the primary output pin A of cylinder 1. Normally indicates faulty wiring or a failed coil.



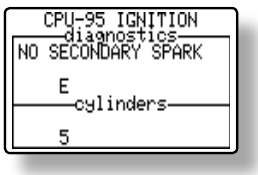
A short circuit condition on the primary output pin B of cylinder 2. This would normally indicate a coil is miswired, or the primary wire is shorted.



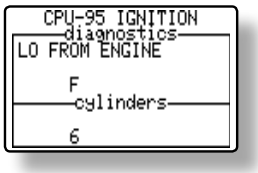
A low spark demand condition on the plug at the C coil of cylinder 3. Often caused by a shorted spark plug or shorted secondary wire.



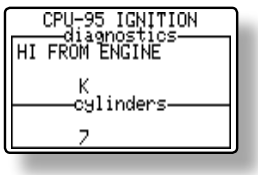
A high spark demand condition on the spark plug at the D coil of cylinder 4 has been identified. Often caused by worn spark plugs.



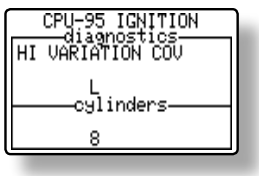
No spark condition on the plug at the E coil of cylinder 5. No spark occurred since the demand was greater than the output capability of the coil.



Condition detected where the average value of output F of cylinder 6 is significantly lower than the average of all the active outputs on the engine.



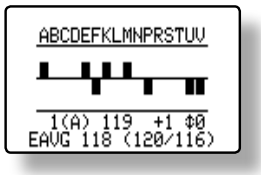
Condition detected where the average value of output K of cylinder 7 is significantly higher than the average of all the active outputs on the engine.

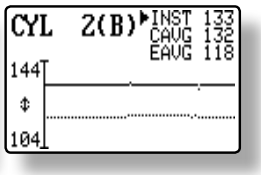


The Diagnostic Module has detected that output L of cylinder 8 is firing with significant cycle-to-cycle variation.

Enhanced CPU-95 Display Module (791909-1)

- **Larger display for greater single-screen access to operating, diagnostic, and setup data**
- **Features an integral graphing and data-logging capability for convenient spark reference number analysis**
- **Allows for display mapping of individual outputs (Output A = Cylinder 1L, Output B = Cylinder 1 R, etc.)**
- **Incorporates a unique upload-download capability to assist users in configuring a new or replacement CPU-95 Ignition Module without need of a laptop**
- **On-board USB connectivity and a Modbus RTU-capable serial port are included for simple connection to a PC for continuous monitoring and/or automation system integration**
- **Password protection of key operating characteristics including overspeed setpoint, spark configuration, and diagnostic thresholds**





Enhanced Display Module allows the user to monitor all spark reference numbers individually and simultaneously.

For users seeking an expanded level of capability or intending on integrating their CPU-95 system into an existing or planned supervisory control or remote monitoring system, Altronic offers its Enhanced Display Module (791909-1).

In addition to incorporating a Modbus RTU-enabled serial port for communication with a remote monitoring system or local controller, the Enhanced CPU-95 Display Module also supports USB connectivity to a PC and the associated CPU-95 Terminal Program. An innovative ignition memory "cloning" system allows this advanced Module to upload the ignition system configuration file (number of cylinders, firing pattern, number of monitored gear teeth, 4-20mA or RPM curve, etc.) from a connected Ignition Module, retain it indefinitely in its own memory, and - without need of a laptop - to download that memory information to a new Ignition Module in the event that the existing module is damaged or requires replacement.

The larger system display allows for the simultaneous display of large amounts of information, and the ability to "map" the CPU-95 Ignition Outputs to the appropriate cylinder designation. Thus, the user retains indication of the appropriate CPU-95 output (A, B, C, etc.) while also getting diagnostic indications in terms of the on-engine cylinder reference (5L, 3R, #6, etc.).

Advanced spark reference number graphing is also made possible by the incorporation of the larger display (see sample displays above). "Live" and datalog-based XY graphing of the monitored Spark Reference Number for a given cylinder and "at-a-glance" indication of the relative value of the Spark Reference Number across all cylinders gives the user unparalleled access and convenience in ignition system troubleshooting and monitoring.

Added capabilities also include an on-board datalogging function which retains up to one-hundred (100) date and time-stamped records of the Spark Reference Number for each output which have been recorded at user-adjustable intervals. These records are stored in a rolling "first in-first out" fashion and are accessible for download via the Enhanced Display Module for offline trending and analysis.

Special CPU-95 Systems

VariSpark™ Option

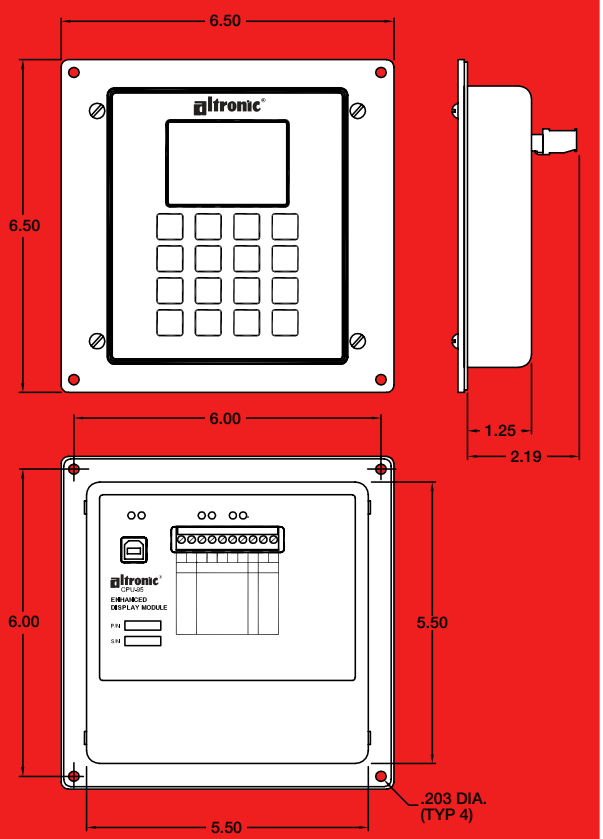
VariSpark™ (patent pending) provides the user with a switchable option to choose between an ultra-long spark duration mode to overcome poor in-cylinder mixing conditions, and a conventional shorter duration spark for maximum spark plug life. The new VariSpark™ combines the fast rise time and high available voltage (up to 47kV) characteristic of capacitive discharge ignition systems, with the ultra-long spark duration previously found only in inductive ignition systems. This allows the CPU-95 with VariSpark™ to improve combustion and stability in engines with poor air/fuel mixtures, such as large slow-speed, low BMEP engines, or high speed engines operating at "off-load" or idle conditions, while still maximizing spark plug life by firing partially-fouled plugs and wide spark plug gaps.

CPU-95 System for SI-Controller-equipped Caterpillar 3500-Series Engines

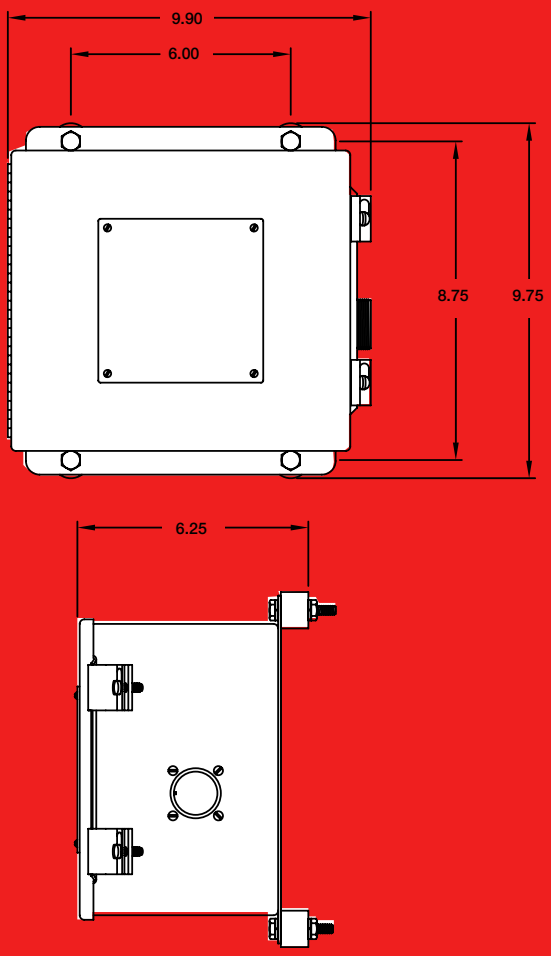
This custom CPU-95 is designed to replace the Altronic III and AIB Interface Box used on SI-Controller-equipped Caterpillar 3508, 3512, and 3516 gas engines. It eliminates all ignition-related moving parts (and the maintenance associated with them) and offers users access to all the diagnostics and spark characteristic control functionality resident in standard CPU-95 systems.

Dimensions

Display Module



Ignition Module



Specifications

Input Signals:
Magnetic pickups (2)
1 - ring gear teeth or drilled holes
1 - reset (1/engine revolution)

Hall-effect pickup for compression stroke reference (4-cycle applications only)

Control Inputs (ground to activate):
Shutdown
Feature control (timing, energy, double-strike, VariSpark™)

Timing Control Inputs:
Manual (display module keypad)
Analog (4-20mA control signal)
Digital (RS-485 serial data)

Ignition Output:
47kV maximum output voltage
300–600 microseconds duration (791950/952/955)
1000–2000 microseconds duration with VariSpark™ option (791958)

Control Outputs (solid state, N.C. switches):
Normal fire confirm
Alarm fault
Shutdown fault

Communications:
RS-485 serial
USB, Modbus RTU (Enhanced Display Only)

Display:
Alphanumeric, backlit

Power Requirements:
24VDC, 1–8 amps typ. (varies by application)
NOTE: On many applications, power can be supplied by engine-driven Altronic 24 Vdc alternator; see form ALT.

Temperature
-40° F. to +158° F. / -40° C. to +70° C.

Ordering Information

CPU-95 IGNITION MODULE – 1 per system

791950-8	Ignition Module, 8 outputs, standard
791950-16	Ignition Module, 16 outputs, standard
791950-18	Ignition Module, 18 outputs, standard
791952-18	Ignition Module, 18 outputs, dual capacitor
791955-16	Ignition Module, 16 outputs, Caterpillar G3500 low emissions engines
791958-16	Ignition Module, 16 outputs, VariSpark™ extended spark duration

CPU-95 DISPLAY MODULE – 1 per system

PART NO.	DESCRIPTION	USE WITH IGNITION MODULE	
		791950-xx 791952-18 791958-16	791955-16
791902-1	Display Module, standard	X	
791902-1S	Display Module, no test	X	
791902-2	Display Module, Cat G3500		X
791908-1	Display Module, dual port*	X	
791909-1	Display Module, enhanced	X	

*Not recommended for new installations.

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