Operating Manual

GTI Bi-Fuel®

IN-LINE ENGINE CONTROL SYSTEM

Form GPN1000 with VSM+ OM 9-15

altronic
HOERBIGER Engine Solutions

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1.0 OVERVIEW

1.1 This manual applies to GPN1000 and GPN1000-12 panels S/N 1346 and up.

1.2 The control system panel GPN1000 consists of three main parts packaged in an industrial enclosure: Display Module DE-1510, Power/Terminal Module 691142-2, and VSM+. Interconnecting cable 693115-1 connects Module DE-1510 to Module 691142-2. The GPN1000 is for 24V systems, and the GPN1000-12 is for 12V systems.

1.3 The Altronic DE-1510 controller system is a dedicated electronic microprocessor-based system designed to sense specific analog and digital input points to control and monitor the GTI Bi-Fuel® natural gas fumigation system for diesel engines. The system is configurable for various applications using a PC (personal computer) and the supplied DE-1510 terminal program and contains a non-volatile memory to store the setup. Serial communications provide an interface to PC's, PLC's, modems and satellite uplinks for remote communication if desired. A backlit 4x20 LCD character display shows system status, programmed controller parameters and channel labels. A front mounted keypad serves as the user interface. The DE-1510 provides for the natural gas fueling off/on control function and for an optional closed loop automatic control function to optimize the amount of natural gas substitution of diesel fuel under varying modes of operation. Additionally, the DE-1510 provides for remote data acquisition and supervisory control in a compact, low cost package dedicated to natural gas fuel substitution on industrial diesel engine applications.

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

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

2.0 DE-1510 DISPLAY MODULE

2.1 The Display Module serves as the user interface for the DE-1510 system. Packaged in a 6.5" x 6.5" panel mounted enclosure, it consists of an alphanumeric 20-character x 4-line backlit LCD display, a 16-key front-mounted keypad, DB-25 D-Sub and DB-9 D-Sub connectors and three pairs of serial port indicators.

2.2 The keypad is a sealed membrane unit containing the STOP and RESET keys and other keys used to navigate through channel status, description, view screens, and to edit the setpoints.

2.3 The LCD has a home screen that displays a status line, BI-FUEL OFF or ON, gas supply pressure (GSP), manifold air pressure (MAP1) and manifold air temperature (MAT1). Pressing the VIEW CHANNEL key displays the channel number, its timer status, analog value (if applicable) and the user label.

2.4 The keypad, along with the LCD display, are used to navigate through channel status and descriptions, view screens, and to view or edit the system's configuration. The ↑UNITS or ↓UNITS or the →TENS or ←TENS keys are used to access channels by increasing or decreasing the channel numbers by one or by ten with each key press. Pressing the NEXT key advances the display to the next screen or item. All menu adjustments are saved in non-volatile EEPROM memory by pressing the ENTER key. The EEPROM memory retains the current configuration during normal operation, after engine shutdown and at system power-down.

2.5 Three pairs of LED's are provided on the back of the Display Module for troubleshooting purposes, one Receive (RX) and one Transmit (TX) LED for each port. The TX LED will flash when the Display Module is transmitting serial communications on the labeled port. The RX LED will flash when the Display Module is receiving serial communications on the labeled port.

3.0 POWER/TERMINAL MODULE

3.1 The Power/Terminal Module is the interface to the DE-1510 Display Module and to other systems. It is also the point of interface between the field sensor wiring terminal strip and the DE-1510 control system. A removable dual terminal strip is used for the connection of the system. The equipment mounted discrete sensors may consist of up to 4 normally-open or normally-closed switches as well as 8 analog transducers. The 4 discrete sensor inputs are numbered 10-13. The 8 analog inputs are numbered 20-27.

3.2 The Power/Terminal Module has six solid state output switches. The output switches provide a means of using the DE-1510 controller system status to operate relays and the fuel solenoid valve. The output switches will be in the open (de-energized) condition when the unit is unpowered. If 12 or24 Vdc is lost to the DE-1510 system, the output switches will go to an open state. Output switches 3 and 4 function as normally-closed contacts to permit the Bi-Fuel solenoid valve to turn on.

3.3 The input power for the DE-1510 system is applied to the power supply terminals marked (+) and (–) PWR on the terminal board (factory wired). A 6.3 amp, replaceable slow-blow fuse protects the system from over currents, and a power LED lights when power is applied to the system.

4.0 MOUNTING THE PANEL (FIG. 1)

4.1 Mount the control panel(s) to a post or to a suitable flat surface so that the display is at a convenient viewing height.

5.0 WIRING (SEE WIRING DIAGRAMS: FIGS. 6, 7 & 8)

5.1 SYSTEM COMPONENT WIRING

Four individual wiring harnesses are offered with the Bi-Fuel system. The Engine Harness, Fuel Harness, Power Harness, and Vibration Harness are required with all systems.. Each wiring harness, or bundle, consists of functionally-grouped connections to sensors or actuators, which would normally be located in the same general area. Each bundle is marked as Engine Harness, Fuel Harness, or Power Harness, with exception to the Vibration Harness. The wiring is protected by a flexible plastic tubing. Each wiring bundle is provided with a bulkhead fitting installed. Mount the bulkhead fittings into the holes provided in the bottom of the panel. When routing the wiring, it is essential that the following practices be adhered to:

NOTE: All furnished drawings and instructions assume (–) ground DC system. In the case of a floating ground, or (+) ground DC system, please contact Altronic Factory for support.

- Never run sensor wires in the same conduit with high energy wiring such as the AC line power.
- Keep high voltage wiring at least eight inches (200mm) away from sensor and sensor wiring.
- If it becomes necessary to check sensor to panel wiring with an ohmmeter or other powered means, first DISCONNECT the plug-in terminal strips from the Terminal Module. Applying voltage to the DE-1510 system through the sensor leads may damage the device.

5.2 ENGINE (ORANGE) HARNESS WIRING (FIG. 6)

NOTE: Do not expose the pressure transducer to temperatures above 221°F. (105°C).

A. Mount the necessary pressure sensors to the engine in a manifold or tube from the engine. Plug in the mating connectors; VAC1 is the air cleaner vacuum and MAP1 is the MANIFOLD AIR PRESSURE.

B. Mount the thermocouples to the engine, routing the thermocouple wires as required. To accommodate the differences in location of the sensors, remove the individual wires from the plastic tubing, as required, and tape the tubing closed after proper length to reach the sensor location is known. MAT1 is the MANIFOLD AIR TEMPERATURE and EGT1 is the EXHAUST GAS TEMPERATURE.

C. At the panel end, adjust the length of the bundle, if required, and mount the bulkhead fitting through either of the far left holes, viewing the panel from the front. Terminate the wires to the customer connection terminal strip. Each wire is marked with the same identifier as the terminal strip; connect these to match.

5.3 FUEL (BLUE) HARNESS WIRING (FIGS. 6 & 7)

The FUEL HARNESS contains the wiring to the fuel supply and pressure regulator and is not to be routed to the engine.

A. After mounting the FUEL GAS SOLENOID VALVE, connect the SOL+ and SOL- wires to the solenoid coil.

B. Connect the ROP wires to the REGULATOR OUTPUT PRESSURE switch terminals. Do not connect the shield wire, as it is terminated at the panel end only.

C. Mount the GAS SUPPLY pressure transducer GSP and plug in the connector.

D. At the panel end, adjust the length of the bundle, if required, and mount the bulkhead fitting through either of the far right holes viewing the panel from the front. Terminate the wires to the customer connection terminal strip. Each wire is marked with the same identifier as the terminal strip; connect these to match.

5.4 POWER (RED) HARNESS WIRING (FIG. 7)

The POWER HARNESS contains the power wiring for the panel.

A. **GPN1000** — Connect the supply power wires to the 24 Vdc input power terminals on the power supply, plus to terminal (+) and minus to terminal (–); power requirement is 24 Vdc, 120 watts max. The DC– terminal will be connected to the panel ground which must be the same as engine chassis ground.

GPN1000-12 — Connect the supply power wires to the 12 Vdc input power terminals on the power supply, plus to terminal (+) and minus to terminal (–); power requirement is 12 Vdc, 180 watts max. The DC– terminal will be connected to the panel ground which must be the same as engine chassis ground.

B. At the panel end adjust the length of the bundle, if required, and mount the bulkhead fitting through the other open hole on the right side viewing the panel from the front. Terminate the wires to the customer connection terminal strip. Each wire is marked with the same identifier as the terminal strip; connect these to match.

NOTE: This is the return path for normally-open sensors and must be connected to the engine block or chassis ground for proper operation.

5.5 VSM+ HARNESS WIRING (FIG. 8)

The VSM+ HARNESS contains the sensor wiring for the panel. This harness is to be built. The harness consists of flexible plastic tubing and desired cable assembly. At the panel end adjust the length of the bundle, if required, and mount the bulkhead fitting through the remaining hole on the left side hole viewing the panel from the front. Terminate the wires to the customer connection terminal strip on the VSM+.

DESCRIPTION	PART NUMBER
Vibration Sensor	615107
Cable Assembly, 10'	693134-1
Cable Assembly, 20'	693134-2
Cable Assembly, 30'	693134-3
Cable Assembly, 40'	693134-4
Cable Assembly, 50'	693134-5
Cable Assembly, 100'	693134-6
VSM+ Conduit w/Connectors, 30'	662031-1
VSM+ Conduit w/Connectors, 50’	662031-2
VSM+ Conduit w/Connectors, 100’	662031-3

6.0 KEYPAD DESCRIPTION

6.1 The DE-1510 controller Display Module contains a 16-key sealed membrane keypad which is used to adjust, stop and reset the system.

6.2 STOP
Used for a manual stop condition. By pressing the STOP key, the controller activates the configured outputs.

6.3 RESET
Clears all past faulted points and resets all input and output timers to their preset values. This can also be accomplished remotely by interrupting the DC power to the panel for 5 seconds.

6.4 CANCEL TIMERS
Cancels all timers.

6.5 VIEW CHAN
Allows the user to view the status of any input channel and its user defined label.

6.6 NEXT
Shows optional settings.

6.7 ENTER
Used to accept a selection and to save a new value in memory.

6.8 ESC
Enables the user to exit any view channels, information or menu screens at any time and return to the previous screen without changing programmed values.

6.9 MENU
Allows the user to enter the edit menu. Control setpoints may be viewed and adjusted using the MENU key.

6.10 UNITS/TENS
Increase or decrease values by one. The →TENS/←TENS keys increase or decrease values by ten. These keys are used to increase or decrease channel numbers, timers and to move the pointer in the menu screen.

6.11 F1
From Home screen, function key F1 displays the hourmeter. From control screen F1 switches between auto and manual modes.

6.12 F2
Displays the time and date of the first fault.

7.0 UNDERSTANDING THE HOME SCREENS

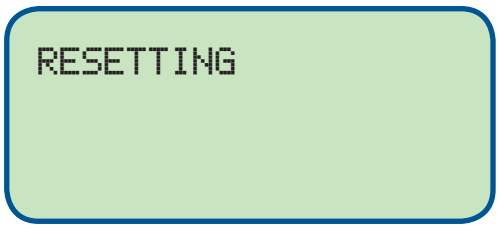
7.1 The “home screens” are described as a series of screens used to display several of the most critical operating parameters on one screen. All of the home screens provide a status word on the upper line.

The status line will read one of the following:

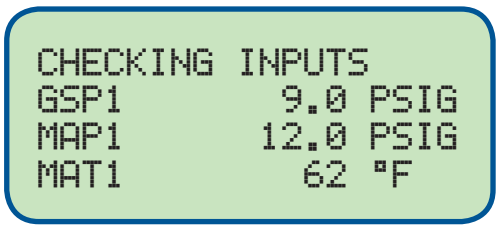
BI-FUEL ON
BI-FUEL OFF
BI-FUEL INHIB
TIMERS ACTIVE
CHECKING INPUTS
FAULT AL1
MANUAL STOP

The LCD display always reverts to one of the home screens after a keypad operation is completed or the operation times out.

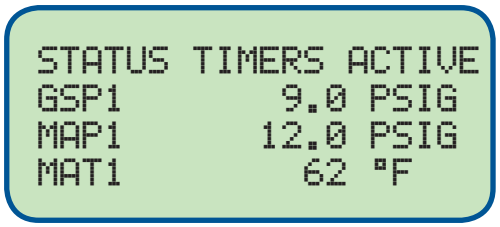
7.2 To activate the Bi-Fuel system, turn on the power; the unit automatically resets. If no system faults are detected during the CHECKING INPUTS scan, the home screen will display the TIMERS ACTIVE message until the programmed fuel delay timer expires. After the time delay is completed, the home screen will display either the BI-FUEL ON or BI-FUEL OFF status according to the current conditions and the programmed control values. The RESETTING message will be displayed momentarily followed by TIMERS ACTIVE, and the home screen will then re-appear.



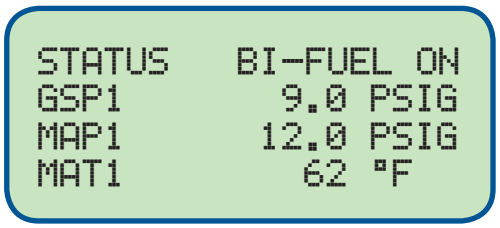
APPEARS IMMEDIATELY AFTER POWER-UP OR A USER RESET COMMAND FOR ABOUT 1 SECOND



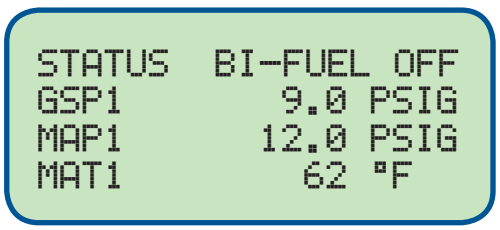
APPEARS AFTER RESET AS UNIT SCANS INPUTS FOR PRE-EXISTING FAULT CONDITIONS



APPEARS AFTER RESET OR BI-FUEL OFF CONDITION WHEN NO FAULTS ARE DETECTED AND THE BI-FUEL DELAY TIMER IS ACTIVE

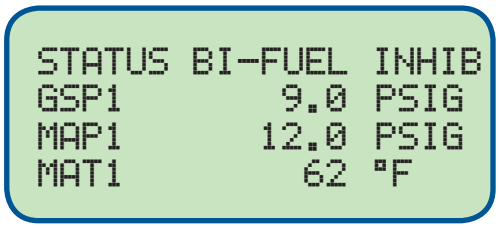


APPEARS WHEN ALL TIMERS ARE EXPIRED, ALL FAULTS ARE CLEAR AND ALL CONTROL SETTINGS ARE PERMITTING THE BI-FUEL GAS VALVE TO BE ON



APPEARS WHEN ALL TIMERS ARE EXPIRED, ALL FAULTS ARE CLEAR AND ONE OR MORE CONTROL SETTINGS IS KEEPING THE BI-FUEL GAS GAS VALVE IN THE OFF POSITION UNTIL CONDITIONS CHANGE

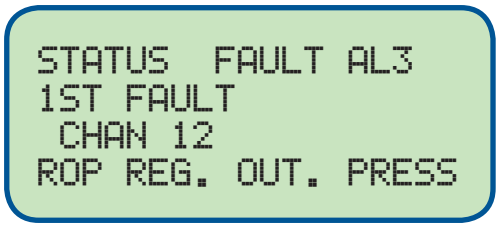
7.3 The DE-1510 controller continuously monitors the system for two different levels of setpoints. The first group are called control setpoints and, when violated, they cause the Bi-Fuel function to be temporarily suspended (engine reverts to 100% diesel operation) until conditions change. The violation of these setpoints may occur readily in normal operation of the engine and the system does not require any USER intervention to begin re-supplying natural gas when these clear, after the bi-fuel delay expires.



APPEARS WHEN CHANNEL 13 HAS BEEN ACTUATED

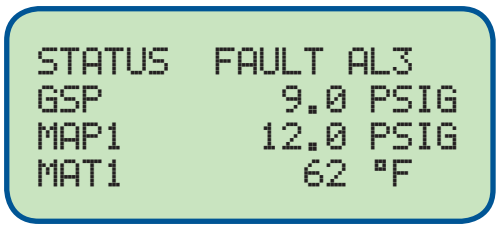
A temporary Bi-Fuel Inhibit can be implemented when desired, by opening the jumper connection between the terminals for input 13. This input prevents output #4 from turning on, which prevents Bi-Fuel operation. Bi-Fuel operation may begin after input 13 is no longer actuated.

7.4 The safety shutdowns are the second level of monitored setpoints. When any of these setpoints are violated even momentarily, the Bi-Fuel will stop supplying natural gas (engine reverts to 100% diesel operation) and will NOT begin re-supplying gas, until a USER initiated RESET is received. When one of the safety shutdown setpoints has been violated, the gas solenoid valve is closed, and the FAULT message for the first faulted channel will appear on the display and will remain until it is acknowledged by a RESET. The number 1, after AL (alarm), shows the output switch that is faulted. If all of the faulted sensors have been cleared and the RESET key is pressed, the class B and output timers will reset and the display will repeat the sequence of section 7.2.



RETURNS TO FAULT HOME SCREEN

ESC



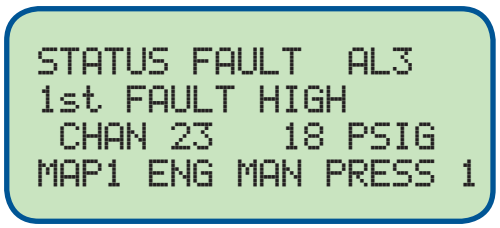
PRESS TO RETURN TO 1ST FAULT SCREEN

VIEW CHAN

TO CLEAR FAULTS, RESET TIMERS & OUTPUTS

RESET

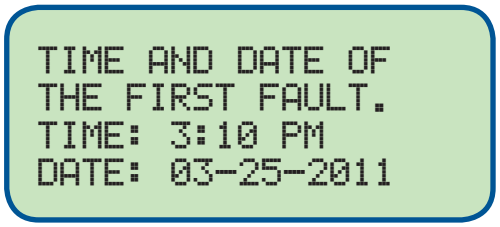
When a fault occurs on analog channel,20-27, a HIGH or LOW indication will also be displayed as to whether the point faulted on a high or low setpoint.



A HIGH SETPOINT FAULTED ON AN ANALOG INPUT. THE CURRENT ANALOG VALUE AND HIGH ARE DISPLAYED

The DE-1510 controller system “stamps” the time and date of the first fault. To view the time and date of the first fault, press the F2 key after a fault occurs

but before reset is initiated. If no key is pressed for 10 seconds, the display will revert to the first fault screen.



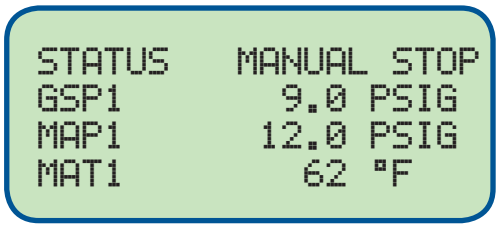
VIEW TIME AND DATE OF FIRST FAULT

F2

7.5 From the home screen, any control fault condition can be viewed by pressing the NEXT key once. The screen holds a host of information for optional equipment, but also has the ability to scroll through any outstanding channels with a CONTROL set point violated. As long as the first line is holding the Gas Valve in AUTO mode, the second line will contain the violated channels, scrolled one at a time. If the Gas Valve is in MANUAL mode, or there are no control set points violated, then the second line will contain the HOLD POSITION value.

To alternate between MANUAL and AUTO mode press the F1 key.

7.6 The MANUAL STOP message will supersede all of the above home screens if the STOP key is pressed. The fuel solenoid valve will close and remain closed until RESET.



PRESS TO STOP

STOP

8.0 VIEW CHANNEL STATUS SCREENS

8.1 Use the VIEW CHAN key to enter the view channels screens. Once in the VIEW CHAN mode, the user can view any channel's details. The UNITS and TENS keys allow the user to quickly navigate through the controller channels. Use the ↑ UNITS or ↓ UNITS keys to increase or decrease the viewed channel by one. Use the → TENS or ← TENS keys to increase or decrease the viewed channel by ten. To exit the VIEW CHAN mode, press the ESC key. After two minutes with no keypad activity, the display will revert to the current home screen.

9.0 VIEWING OR EDITING THE SETPOINT VALUES USING THE MENU MODE

9.1 The menu screens can be accessed from any home screen by pressing the MENU key. The menu screens allow the user to view or edit values and the time and date. The controller must be initially configured using the terminal program running on a PC connected to the RS-232 port on the back of the controller. Reference the programming instructions section 13.0 for details on how to configure the controller system for a specific application. The menu screens are intended to view or edit the already programmed values in the field. Changes made in the menu are stored in permanent memory and remain fixed until changed again.

NOTE: To edit any value, the password combination must be entered from first level menu. Press the F2 key followed by the F1 key. Upon pressing this sequence, changes can be made to the configuration.

9.2 To view the controller configuration, from the home screen press the MENU key. Use the NEXT key to select the group to be viewed and press ENTER. To edit the controller configuration, the controller system requires a password key sequence.

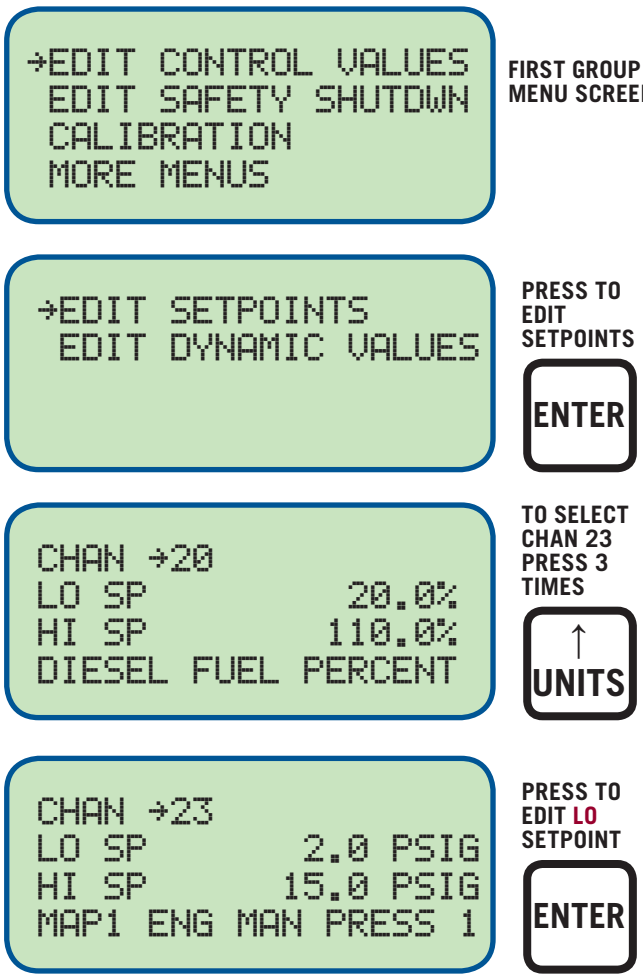
The password procedure is: From the home screen, press the MENU key. Then press the F2 key followed by the F1 key. Upon pressing this sequence, changes can be made to the configuration.

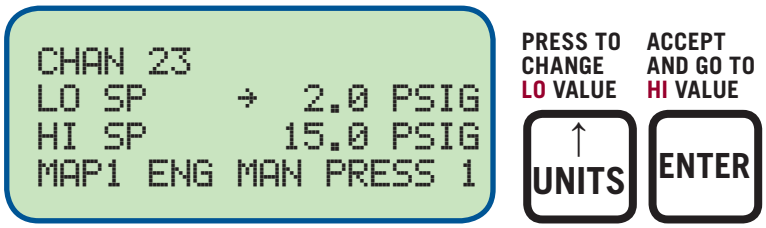
9.3 The menu screens have two levels. The first level lists the headings of the items to be viewed or edited. Upon selecting one of the headings, the second level is displayed. Press the MENU key to enter the first level of the menu screens. The arrow points to the first selection to be viewed or edited. Three keys can be used to navigate the first level of menu selections: NEXT or ↑ UNITS or ↓ UNITS keys. The NEXT key will move the arrow down one selection. The ↑ UNITS or ↓ UNITS keys will move the selector arrow up or down one selection.

Once the arrow is pointing to the selection group to be edited, press the ENTER key. The display will advance to the second level to view or allow changes to the values.

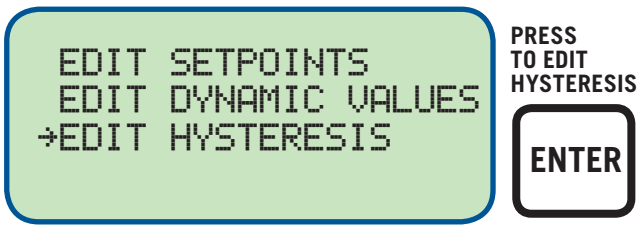
9.4 To edit the setpoint values, point to EDIT CONTROL VALUES and press the ENTER key. The edit control values menu is shown. The arrow points to the EDIT SETPOINTS. The example shows how to change the LO setpoint of CHAN 23. Use arrow keys as shown to select desired channels. Use ENTER key as shown to select LO or HI setpoint.

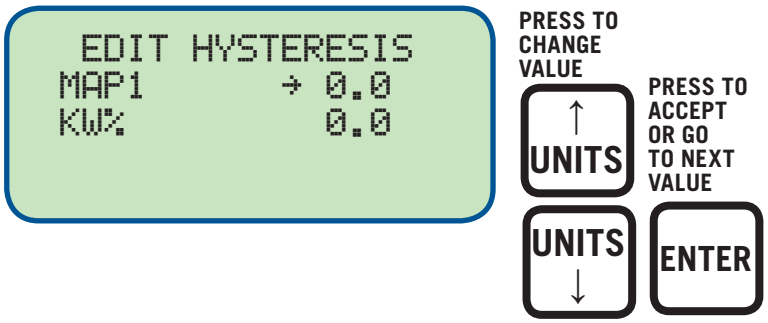
9.5 To edit the setpoint values, point to EDIT CONTROL VALUES and press the ENTER key. The edit control values menu is shown. The arrow points to the EDIT SETPOINTS. The following example shows how to change the LO setpoint of Chan 23a. Use arrow keys to select desired channels. Use ENTER key to select LO or HI setpoint.





9.6 To edit hysteresis values, select EDIT HYSTERESIS and press the ENTER key.

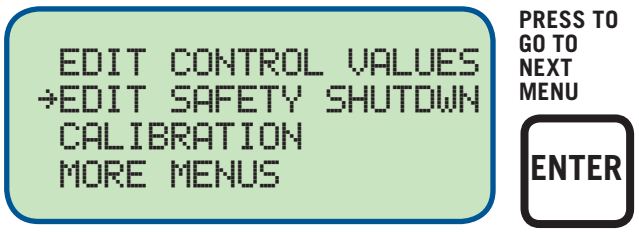




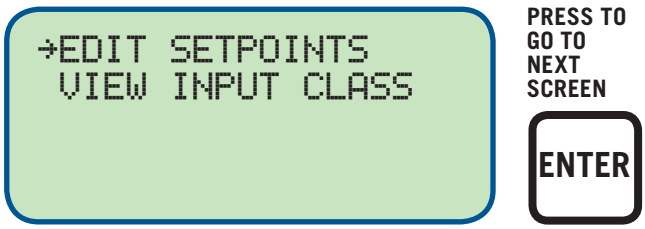
There is a programmable hysteresis value for both the MAP1 and the KW% sensor which prevents the gas from turning on and off as these channels dither around the high and low control setpoints.

9.7 To view or edit safety shutdown values, choose EDIT SAFETY SHUTDWN from the main menu. To edit or view setpoints, choose EDIT SETPOINTS.

FIRST GROUP OF MENU SCREENS



SECOND GROUP OF MENU SCREENS



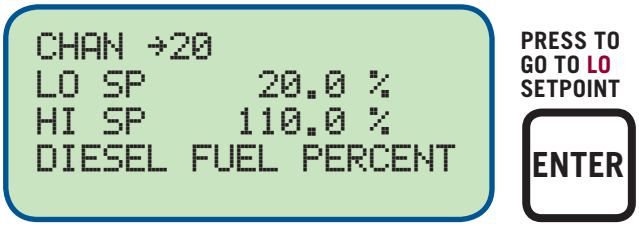
EXAMPLE FOR MAP1 HYSTERESIS

MAP1 Setpoint
Control High: **25psig**
Control Low: **16.7psig**
MAP1 HYSTERESIS: **.3psig**

Control High:
If MAP1 surpasses 25psig with MAP1 Hysteresis setpoint of .3, then bi-fuel will turn off at 25psig and will NOT turn back on until MAP1 drops below 24.7psig. (25psig – .3psig = 24.7psig.)

Control Low:
If MAP1 low set point is 16.7psig with MAP1 Hysteresis setpoint of .3, bi-fuel will NOT turn on until MAP1 exceeds the low setpoint (16.7psig + .3psig = 17psig) but will not turn back off until MAP1 low setpoint of 16.7psig is reached.

Take care when setting Hysteresis so that gas will not be ON in an area in which data was not recorded.

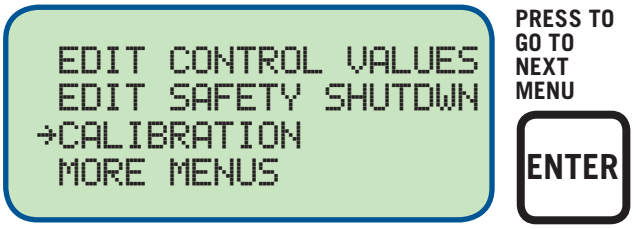


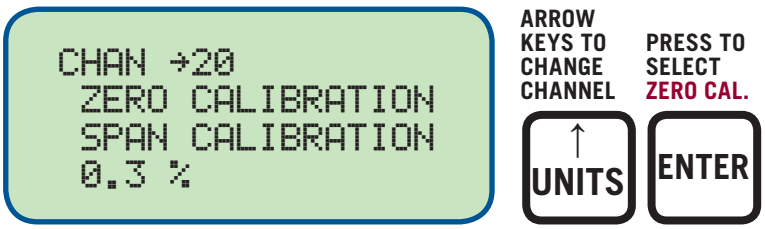
9.8 To view or edit the sensor calibration, select CALIBRATION from the main menu. Use the arrow keys to select the desired channel for calibration. Use the enter key to select either zero or span calibration for the selected channel. Watching the bottom line of the display use the arrow keys to display the desired value. For example, in order to calibrate the zero value of the transducer, apply the zero value to the input and follow the steps below. If the full scale value also requires calibration apply the full scale input to the channel and adjust the span to obtain the desired reading on the bottom line of the display as shown.

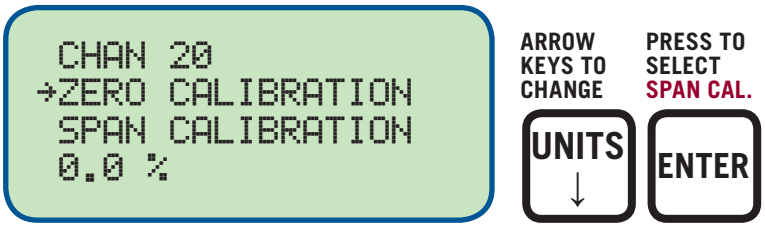
NOTE: Sensors should be calibrated through the proper terminal program.

NOTE: Thermocouple channels are calibrated at the factory and do not require field calibration.

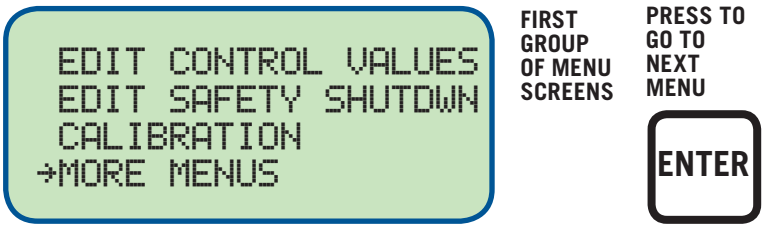
FIRST GROUP OF MENU SCREENS



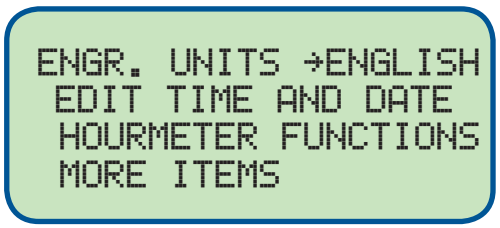




9.9 Select MORE MENUS from menu.



9.10 The display shows the current Engineering units selection English or Metric. Use the up arrow key to change and then press Enter to accept the new selection and move to Edit Time and Date.



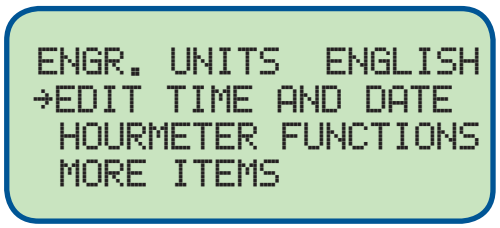
PRESS TO CHANGE UNITS

↑ UNITS

PRESS TO ACCEPT

ENTER

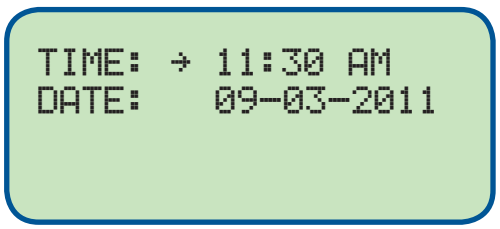
Selection arrow now points to time and date.



PRESS TO GO TO NEXT SCREEN

ENTER

The time and date will be displayed with the selection arrow pointing to the time. The hours and minutes can be edited separately; AM and PM follow the hours. With the selection arrow pointing to the hours, use the ↑ UNITS or ↓ UNITS keys to increase or decrease the hours. Press ENTER to save the new hour setting; the selection arrow will point to the minutes. Use the same procedure to edit the minutes. Use the NEXT key to move through the time and date screen without making a permanent change in memory.



PRESS TO CHANGE VALUE

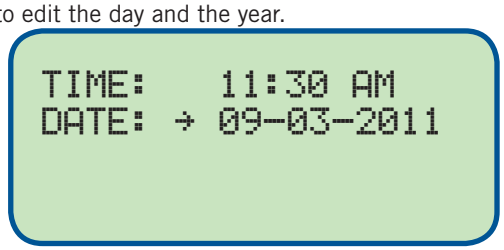
↑ UNITS

PRESS TO ACCEPT

ENTER

NOTE: Verify correct time and date to ensure the fault log accurately records the correct time and date.

The date is shown as month-day-year. The month, day and year can be edited separately. With the selection arrow pointing to the month, use the ↑ UNITS or ↓ UNITS keys to increase or decrease the month. Press ENTER to save the new month setting; the selection arrow will point to the day. Use the same procedure to edit the day and the year.



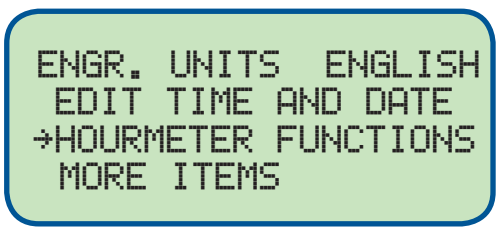
PRESS TO CHANGE VALUE

↑ UNITS

PRESS TO ACCEPT

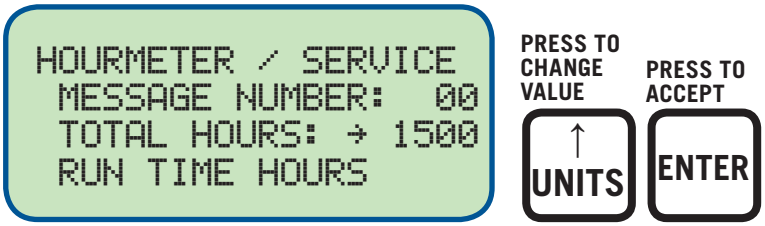
ENTER

9.11 To view the Hourmeter message, select HOURMETER FUNCTIONS from the main menu and press ENTER.

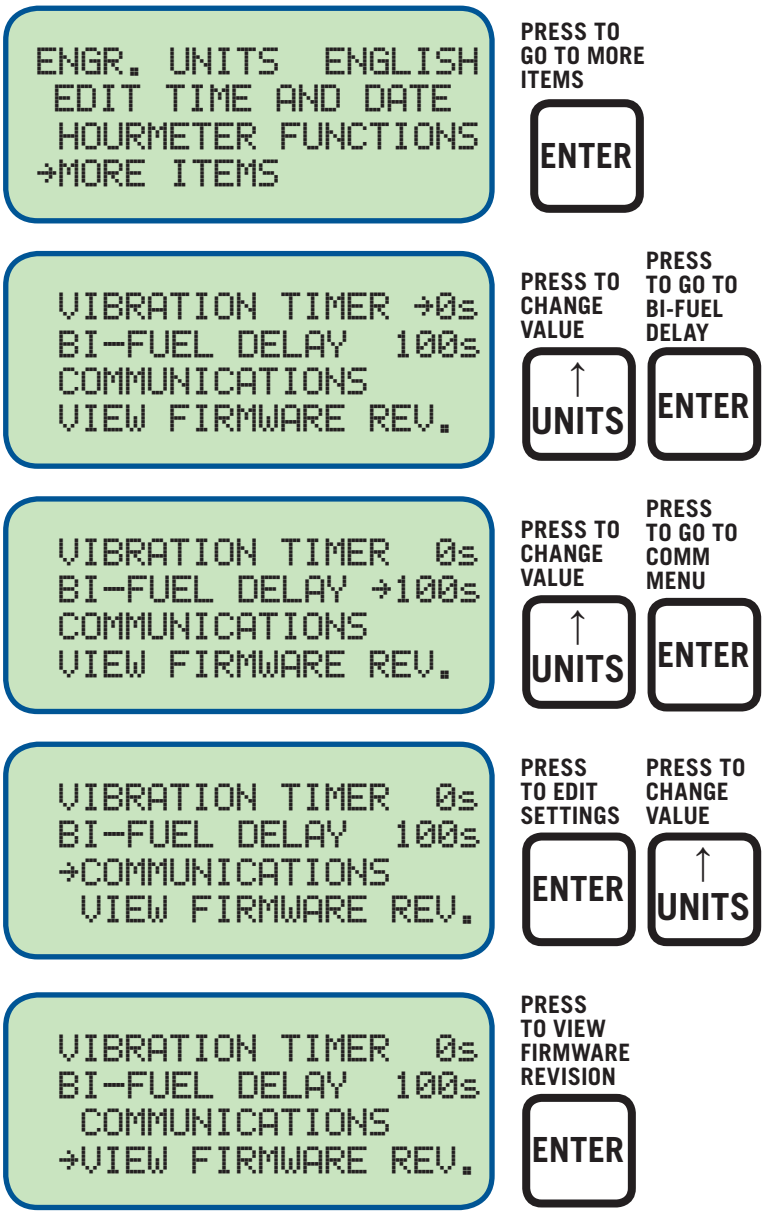


PRESS TO GO TO SET HOURMETER

ENTER



9.12 To view or edit the values for VIBRATION TIMER, BI-FUEL DELAY TIMER, COMMUNICATION SETTINGS and to view the FIRMWARE REVISION level, select MORE ITEMS. The Vibration Timer is the length of time in seconds that a vibration level must be detected for to cause a fault. The Bi-Fuel Delay Timer is the amount of time in seconds before Bi-fuel will be allowed to turn on after a power loss, reset, or controlled off condition, if no faults exist.



10.0 DATA LOGGING AND COMMUNICATION OPTIONS

10.1 The DE-1510 controller system contains a data logging feature. Data logging collects information from the system and keeps track of, or logs, that information over a period of time. That data is then available through a PC or PLC at port 1 (the RS-232 port) or port 3 (the RS-485 port).

NOTE: Consult VSM+ IOM for a complete list of VSM+ Modbus registers.

10.2 NODE NUMBER
The node number is the address of the controller being contacted. This number is programmed by the terminal program and can be viewed or edited in the menu screen. A two digit number from 01 to 99 can be used.

10.3 COMMUNICATIONS PARAMETERS
The following must be set in the PC or PLC to communicate with the controller system:

Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None

10.4 The data logging memory can retain a total of 100 records before writing over the oldest information. The most current data is always record number one; the next most current is number two, etc. The oldest information, record 100, is lost when a new record is written. The logging period is set for 1 minute.

A new record is also written when a first fault occurs. If the first fault occurs between the logging period, the first fault record will be record number one and the next scheduled record will be number two.

10.5 The following document describes the spacing for the fields of the DE-1510 data logging command.

This command is functional from the RS-232 and the RS-485 data logging port. The communications settings are 9600, 8, N and 1. The node number must be correct for the DE-1510 to respond on the RS-485 port. The node number field is ignored on the RS-232 port and responds accordingly.

10.6 The command to access a particular record is as follows:

>(XX DL YYY)

COMMAND HEADER “>” (0) - ASCII value 3Eh.

BEGIN TEXT “(” (1) - ASCII value 28h.

DE-1510 NODE NUMBER (2-3) - This field consists of the node number associated with the particular DE-1510. The range is from 01 to 99.

SPACE (4), (7) - ASCII value 20h.

COMMAND (5, 6) - The letters “D” and “L”, which stand for “data log”.

REQUESTED RECORD NUMBER (8-10) -

TABLE I:
This value will be between 001 and 100 and represents the requested record number. Record number 001 will always contain the most recent data log event. Record number 002 contains the second most recent data log event and so on. Requesting record number 999 gives a response which occurred due to a first fault condition. If there is no faults and 999 is requested, the “NO DATA AVAILABLE” message occurs. Requesting record number 000 transmits current status information.

TABLE II:
Table II shows the structure of data log command 998. This is for the Hourmeter.

END TEXT “)” (11) - ASCII value 29h.

10.7 **TABLE I**

The following is the response:

FIELD DESCRIPTION	EXAMPLES OFLOGGED DATA	AMT OF CHARACTERS	CHARACTER LOCATION
SITE LOCATION	GTI Bi-Fuel GPN1000	30.00	0-29
CR, LF		2	30, 31
REC NUM / HOURS	022 12345 HRS	14.00	32 - 45
CR, LF		2.00	46, 47
TIME AND DATE	06-16-2003 12:02 PM	20.00	48 - 67
CR, LF		2.00	68, 69
STATUS DISPLAY	STATUS BI-FUEL ON	20.00	70 - 89
CR, LF		2.00	90, 91
HOME LINE 2	ACT 57.7 %	20.00	92 - 111
CR, LF		2.00	112, 113
HOME LINE 3	GSP 12.3 PSIG	20.00	114 - 133
CR, LF		2.00	134, 135
HOME LINE 4	MAP1 12.5 PSIG	20.00	136 - 155
CR, LF		2.00	156, 157
VIEW scn #1, L1 LINE1	VAC1 67.9 PSIG	20.00	158 - 177
CR, LF		2.00	178, 179
VIEW scn #1, L2 LINE2	MAT1 145 F	20.00	180 - 199
CR, LF		2.00	200, 201
VIEW scn #1, L3 LINE3	EGT1 1022 F	20.00	202 - 221
CR, LF		2.00	222, 223
VIEW scn #1, L4 LINE4	VIB1 0.20 IPS 40 20.2 BAR	20.00	224 - 243
CR, LF		2.00	244, 245
VIEW scn #2, L1 LINE1	VIB2 0.22 IPS	20.00	246 - 265
CR, LF		2.00	266, 267
VIEW scn #2, L2 LINE2		20.00	268 - 287
CR, LF		2.00	288, 289
VIEW scn #2, L3 LINE3		20.00	290 - 309
CR, LF		2.00	310, 311
VIEW scn #2, L4 LINE4		20.00	312 - 331
CR, LF		2.00	332, 333
L12		20.00	334 - 353
CR, LF		2.00	354, 355
L13		20.00	356 - 375
CR, LF		2.00	376, 377
L14		20.00	378 - 397
CR, LF		2.00	398, 399
L15		20.00	400 - 419
CR, LF		2.00	420, 421
POSS. 1ST FAULT	1ST FAULT	20.00	422 - 441
CR, LF		2.00	442, 443

POSS. FAULT CH	CHAN 23	20.00	444 - 463
CR, LF		2.00	464, 465
FAULT LABEL	MAP1 ENG MAN PRESS 1	20.00	466 - 485
CR, LF		2.00	486, 487
1ST FAULT TIME	06-06-2003 11:07AM	20	488, 507
CR, LF		2.00	508, 509
CR, LF		2.00	510, 511
TOTAL CHARACTERS		512.00	

The following will be displayed when there is no information in the data log.
"NO DATA AVAILABLE
(CR, LF)
(CR, LF)"

Note that the spacing for the analog labels and values on the 20 character line is as follows:

Location 1-? occupy the label associated with that channel.
(? dependent upon label name)
Location 12-16 occupy the analog value. (100.4)
Location 17 contains a space.
Location 18-20 contain the units of measure. (PSI)

10.8 **TABLE II**

FIELD DESCRIPTION	EXAMPLES OF LOGGED DATA	AMT OF CHAR.	CHARACTER LOCATION	HOUR LOCATION
SITE LOCATION	GTI Bi-Fuel GPN1000	30.00	0-29	
CR, LF		2	30, 31	
REC NUM/HOURS	998 12345 HRS	14.00	32 - 45	
CR, LF		2.00	46, 47	
TIME AND DATE	06-16-2003 12:02 PM	20.00	48 - 67	
CR, LF		2.00	68, 69	
HOURMETER	RUN-TIME HOURS 12345	26.00	70 - 95	91-95
CR, LF		2.00	96, 97	
CR, LF		2.00	98, 99	
LABEL MESSAGE	SERVICE HOURS LEFT:	19.00	100-118	
CR, LF		2.00	119, 120	
SERV. MSG. 1	NOT USED	26	121-146	142-146
CR, LF		2.00	147, 148	
SERV. MSG. 2	NOT USED	26.00	149-174	170-174
CR, LF		2.00	175, 176	
SERV. MSG. 3	NOT USED	26.00	177-202	198-202
CR, LF		2.00	203, 204	
SERV. MSG. 4	NOT USED	26.00	205-230	226-230
CR, LF		2.00	231, 232	
SERV. MSG. 5	NOT USED	26.00	233-258	254-258
CR, LF		2.00	259, 260	
SERV. MSG. 6	NOT USED	26.00	261-286	282-286
CR, LF		2.00	287, 288	

FIELD DESCRIPTION	EXAMPLES OF LOGGED DATA	AMT OF CHAR.	CHARACTER LOCATION	HOUR LOCATION
SERV. MSG. 7	NOT USED	26.00	289-314	310-314
CR, LF		2.00	315, 316	
SERV. MSG. 8	NOT USED	26.00	317-342	338-342
CR, LF		2.00	343, 344	
SERV. MSG. 9	NOT USED	26.00	345-370	366-370
CR, LF		2.00	371, 372	
SERV. MSG.10 10	NOT USED	26.00	373-398	394-398
CR, LF		2.00	399, 400	
SERV. MSG.11 11	NOT USED	26.00	401-426	422-426
CR, LF		2.00	427, 428	
RESERVED		26.00	429-454	
CR, LF		2.00	455, 456	
RESERVED		26.00	457-482	
CR, LF		2.00	483, 484	
RESERVED		25.00	485-509	
CR,LF		2.00	510, 511	

The CHARACTER LOCATION for the service messages consists of 20 characters which were previously programmed into the DE-2510. The HOUR LOCATION describes the position of the hours associated with the service message or with the hour meter function. If a service message is “NOT USED”, then there will be “-----” in the HOUR LOCATION field. Values less than 10000 hours are right justified with spaces in locations to the left. For example, the hour value of 12345 will be displayed as “12345” and an hour value of 477 will be shown as “477”.

10.9 COMMUNICATIONS PARAMETERS:
All communications are at 9600 baud, 8 Data bits, No Parity, 1 Stop bits. (9600 8N1)

10.10 COMMUNICATION OVERVIEW:
The DE-1510 is compliant to the Modicon Modbus RTU standard. The DE-1510 supports DE-1510 Display Modbus Communications

Register reads and data is duplicated for the 30000’s & 40000’s address range. Maximum number of registers that can be read at one time has been limited to 32.

10.11 MODBUS REGISTERS:

Register	Description
40002.00	Hour meter; range from 0-65535
40003.00	Null, will always read 0
40004.00	Status (11, 12, 20-27) Bi-fuel shutdown on that channel. 50 = Bi-fuel ON. 51=Bi-fuel OFF. 60=STOP.
40005.00	Reserved
40006.00	Reserved
40007.00	Reserved
40008.00	Reserved
40009.00	Bit 0 = Low fault shutdown. Bit 1 = High fault shutdown. Only applicable when fault exists.

40100.00	Analog Channel 20; range from -9999 to 9999
40101.00	Analog Channel 21; range from -9999 to 9999
40102.00	Analog Channel 22; range from -9999 to 9999
40103.00	Analog Channel 23; range from -9999 to 9999
40104.00	Analog Channel 24; range from -9999 to 9999
40105.00	Analog Channel 25; range from -9999 to 9999
40106.00	Analog Channel 26; range from -9999 to 9999
40107.00	Analog Channel 27; range from -9999 to 9999
40115.00	Decimal point location for Analog Channel 20; range from 0-3. 0 = no decimal place, 1 = 1 decimal place etc.
40116.00	Decimal point location for Analog Channel 21; range from 0-3
40117.00	Decimal point location for Analog Channel 22; range from 0-3
40118.00	Decimal point location for Analog Channel 23; range from 0-3
40119.00	Decimal point location for Analog Channel 24; range from 0-3
40120.00	Decimal point location for Analog Channel 25; range from 0-3
40121.00	Decimal point location for Analog Channel 26; range from 0-3
40122.00	Decimal point location for Analog Channel 27; range from 0-3

10.12 IDENTIFICATION:
In addition to the above, the DE-1510 will respond to function code 17 with an identification string as follows:

Query: NN 17 CRC CRC
NN = node number, 17 = ID function code, CRC CRC = two byte Modbus RTU CRC.

Response: NN 17 07 D E - 1 5 1 0 CRC CRC
NN = node number, 17 = ID function code, 07 = number of bytes to follow, DE-2500 (seven byte ASCII ID string), CRC CRC = two byte Modbus RTU CRC

10.13 STOP/RESET:
Register 40999 can be written to remotely trigger the STOP & RESET functions. It will only respond to a single write (function code 06). The stop Command is 0xAC53. The reset command is 0xBE41.

10.14 REMOTE KEYPAD EMULATION:
The DE has a feature called the "Remote Keypad Emulation" that can be accessed through function code 20 as follows:

Query: NN 20 KP CRC CRC
NN = node number, 20 = KP function code, KP is the single byte "Key Press" from the table below, CRC CRC = two byte Modbus RTU CRC.

"Key Press" Table
00 = NONE (no keypress, returns current display)
01 = CANCEL TIMERS
02 = TEST
03 = RESET
04 = STOP
05 = VIEW
06 = NEXT
07 = UP/UNITS
08 = VIEW CHAN
09 = F1
10 = RIGHT/TENS
11 = ENTER
12 = LEFT/TENS
13 = F2

14 = MENU
15 = DOWN/UNITS
16 = ESC

Response: NN 20 88 (20bytes 1st line of display) CR LF (20 bytes 2nd line) CR LF (20bytes 3rd line) CR LF (20bytes 4th line) CR LF CRC CRC

NN = node number, 20 = KP function code, 88 = number of bytes to follow, CR = Carriage Return, LF = Linefeed, 4 20 byte ASCII blocks that is the display, CRC CRC = two byte Modbus RTU CRC

11.0 VSM+ GENERAL

11.1 The VSM+ senses shock and vibration from remote mounted sensors and outputs a velocity amplitude number in the range of 0 to 1023. The velocity amplitude number is unit-less and is referred to as the vibration reference number or VIB.

The VSM+ vibration sensor is an automotive type accelerometer. It generates a low voltage signal proportional to vibration intensity. The sensor inputs to the VSM+ are differential and are not referenced to ground.

Each of the eight (8) channels can be configured with its own unique control and safety shutdown set point, startup delay timer, sensor gain, and trip delay value.

The VSM+ utilizes two output switches. Switch 1 is used for "Control" shutdown and switch two is used for "Safety" shutdown.

The VSM+ can communicate to other instruments, PC's, or PLCs via the Ethernet communications port. Use data grade Category 5E Shielded Twisted Pair (STP) or Unshielded Twisted-Pair (UTP) cable that has a 100Ω characteristic impedance that meets the EIA/TIA Category Five (CAT-5) wire specifications. Maximum wire length is 100 meters (325 feet).

NOTE: The use of Category 5E STP (Shielded Twisted Pair) cable with shielded RJ45 plug connectors is strongly recommended for installation in harsh industrial environments and/or in the presence of strong electrical fields.

NOTE: To use the embedded web server, "Internet Protocol Version 4 (TCP/IPv4) Properties" will have to be changed. Please consult your IT department on how to configure your computer properly.

Select "Use the following IP address". For "IP address:" enter "10.1.100.XXX" XXX must be something other than 100 or another used identifier. For "Subnet mask:" enter "255.255.255.0"

11.2 **POWER** – The VSM+ requires 10-32Vdc, .20Amps. When powered, the green "POWER" LED will be on.

STATUS – The status indicator is multi-purpose. It contains several "blink" patterns.

EtherNet/IP communications mode – one long, one short blink at ¼-second rate

Modbus/TCP communications mode – short blinks at ¼-second rate

"wink" mode – steady short blinks at ⅛-second for the selected time

ETHERNET – The Ethernet port contains two LEDs that are built into the RJ45 connector. The green LINK LED will be on solid if the Ethernet port has successfully established a connection. The yellow RX/TX LED signals network activity.

OUTPUT SWITCH – Each of the built-in switches (SW1 and SW2) have an LED indicator. The led turns on when the switch is activated. When faulted, the GPN1000 display will read Bi-Fuel Inhibit.

EDS File (Electronic Data Sheet) – The EDS file is used for Monitor configuration. This will be utilized if remote monitoring is required. Please reference VSM+ IOM for further detail.

Embedded Web Server – The VSM+ has a built in web server that must be used for VSM+ configuration. The embedded web server can also be used to view and set the network and protocol settings.

Once connected and powered, open your web browser and type the IP address assigned to the monitor. The default address is "http://10.1.100.100"

11.3 OUTPUT SWITCH 1 is designed to be used as CONTROL HIGH. The switch is activated when a control set point value is violated for any monitored sensor. Each sensor can be configured with a CONTROL HIGH set point.

Switch 1 can be configured as normally open (N/O) or normally closed (N/C). Switch 1 should be configured N/O “FAILSAFE” to allow for normal bi-fuel operation.

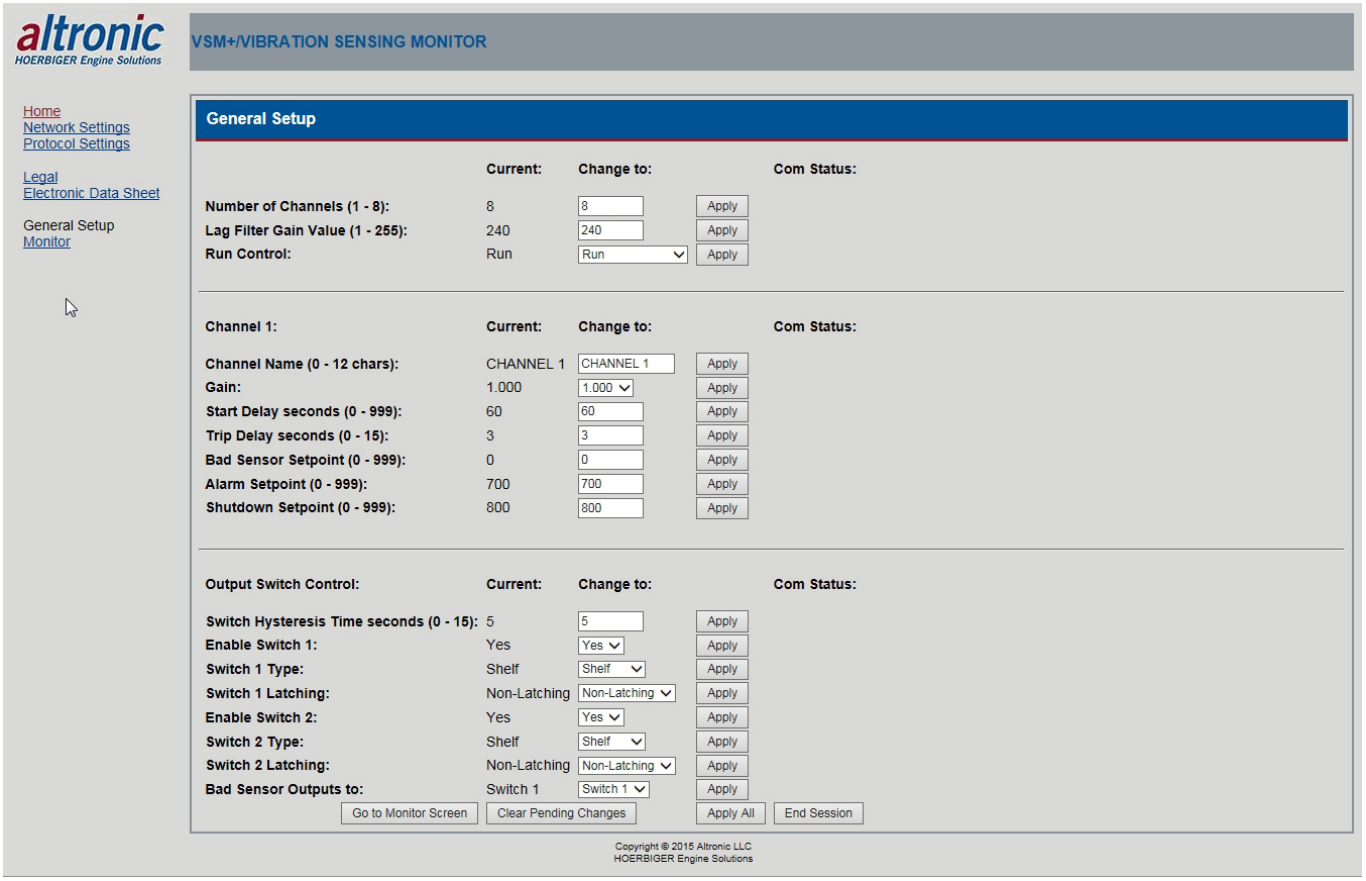
OUTPUT SWITCH 2 is designed to be used as SAFETY HIGH. The switch is activated when a safety set point value is violated for any monitored sensor. Each sensor can be configured with a SAFETY HIGH set point.

Switch 2 can be configured as normally open (N/O) or normally closed (N/C). Switch 2 should be configured N/O “SHELF” to allow for normal bi-fuel operation.
Switches 1 and 2 can be configured as Latching or Non-Latching. To configure channels to be use as a CONTROL HIGH set point, NON-LATCHING should be selected. To configure channels to be used as a SAFETY HIGH set point, LATCHING should be selected.

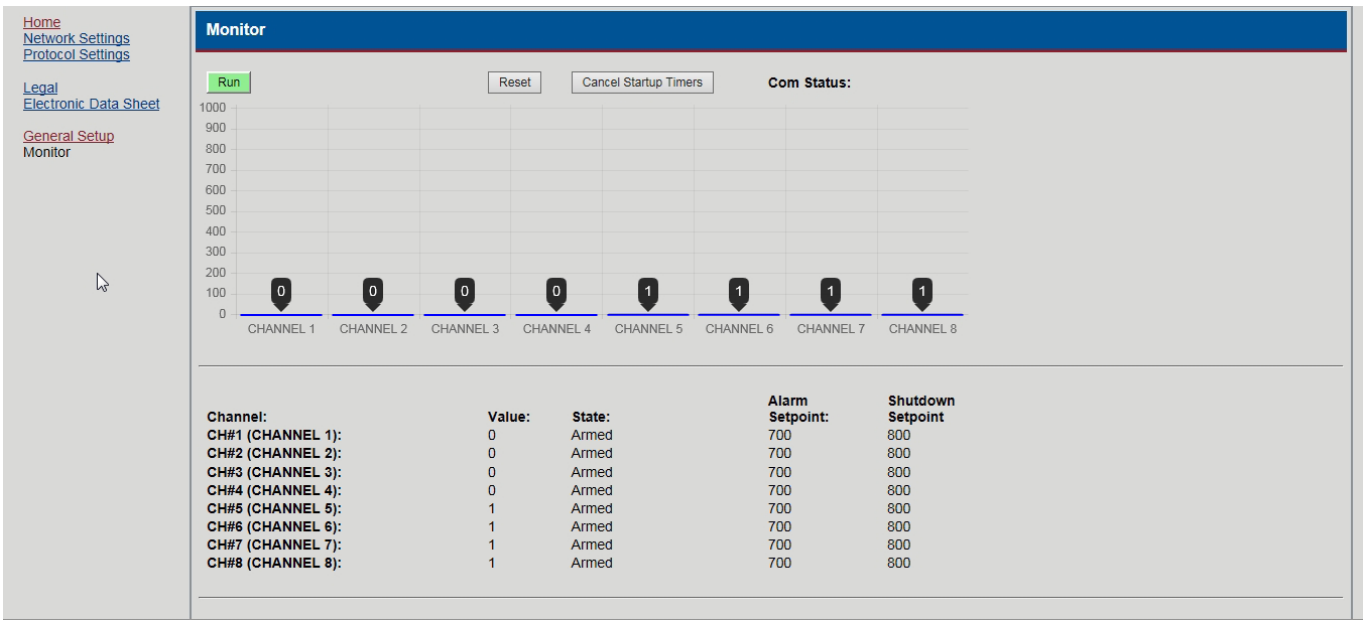
NOTE: Nomenclature translation on the embedded VSM+ configuration page.
Alarm and Non-latch is Control
Shutdown and Latch is Safety
CH1 Shelf is N/C
CH1 Failsafe is N/O
CH2 Shelf is N/O
CH2 Failsafe is N/C

11.4 To configure the VSM+, connect to the embedded web server as describe in the note above. Select “General Setup” which is located in the menu bar on the left hand side of the screen. The General Setup screen will display on the computer. This screen is used to configure the VSM+ for the specific engine application.

- Number of Channels (1-8) – allows the user to select between 1 and 8 vibration inputs.
- Lag Filter Gain Value (1-255) – should not be changed (default value is 240)
- Run Control – should be in the Run position. This tells the VSM+ to act or ignore exceeded set points.
- Channel Name (0-12 chars) – allows the user to name each individual channel up to 12 characters
- Gain – allows the user to bring the sensor value into a desired range. A starting value of .296 is recommended
- Start Delay seconds (0-999) – allows the user to delay when the VSM+ starts looking for values above the programmed set point. A starting value of 0 is recommended.
- Trip Delay seconds (0-15) – allows vibration values to exceed the programmed set point for a specified amount of time before an output switch is tripped. It is recommended that this value be 3 seconds or less.
- Bad Sensor Setpoint (0-999) – is a value that is programmed to notify the user of a broken, bad, or disconnected sensor. A recommended starting value is 50.
- Alarm Setpoint (0-999) – allows the user to set a Control Off set point
- Shutdown Setpoint (0-999) – allows the user to set a Safety Shutdown setpoint



11.5 To view the VSM+ readings through computer select “Monitor” which is located in the menu bar on the left hand side of the screen. The Monitor screen will display on the computer. This screen is used to view the inputs to the VSM+.



For information on Network Settings and Protocol Settings, please consult the VSM+ IOM.

12.0 CONTRAST RATIO ADJUSTMENT

12.1 The LCD contrast ratio is adjusted for optimum contrast over a large temperature range at the factory. It may be necessary to make slight adjustments to the LCD contrast ratio because of aging and or extreme temperature changes. The contrast ratio potentiometer (TP1) is located on the back of the Display Module. Use an adjusting tool and turn the potentiometer clockwise to lighten the contrast ratio or counterclockwise to darken the contrast ratio.

To set the potentiometer back to the factory setting: with the Display Module at an ambient temperature of approximately 65°F to 77°F (18°C to 25°C), turn the potentiometer clockwise until the display contrast ratio is almost too light to read. Turn the potentiometer counterclockwise 3 to 3-½ turns. The display should then be at a desirable contrast ratio.

13.0 PROGRAMMING THE DE-1510

13.1 The DE-1510 terminal program operates from a standard PC and permits the operator to configure the system. There is a monitor mode that the operator can use to monitor an existing installation and access system data. This data can be accessed locally or remotely via a modem.

The following user-supplied hardware is required:

Computer: IBM-compatible PC, Windows 95/98/ME/XP/7/8/10, hard drive (10 MB of free disk space required) and SVGA graphics (800X600 or greater preferred) with color monitor.

Serial Port: RS-232 port for programming.

Modem: 9600 baud (or greater) modem required.

13.2 A minimum of 10MB of free disk space is required. Additional disk space will be required if the remote data log database function is used. The space required will be dependent on the size of the working database.

Download the proper terminal program from the GTI website following the link instructions. Select the autorun selection under the downloaded folder. The install program will prompt you for a destination folder where the program will be installed. After the install completes, you can run the program from the Windows Start button, Programs Menu, Altronic DE-1510 system. Select the DE-1510 menu selection.

13.3 Connect the computer cable from the computer to the DB9 connector Port #1 on the back of the DE-1510 display.

13.4 CONFIGURE KEY
The DE-1510 needs to be initially programmed using the DE-1510 Terminal program. Select the items for download which best fit the intended application.

13.5 EDIT SETPOINTS KEY
The setpoints of the DE-1510 may be changed from the computer by selecting this key.

13.6 MONITOR KEY
This feature allows the user to retrieve data logged messages which are typically used for PC monitoring or SCADA/PLC systems. The connections can use either a modem or connected directly into the comm. Port. Data logs may be retrieved into a standard EXCEL file format.

The following keys are applicable during the monitor function:

CONNECT KEY
This feature selects how the PC is going to connect to the DE-1510. Select either a comm port or a telephone number for a modem.

HANGUP KEY
This disconnects the PC from the port or the modem.

DATALOGS KEY
This feature allows for retrieval of data logged messages in the PC. Data logs may be retrieved into a standard EXCEL file format.

AUTO START KEY
This feature allows for serial communications to STOP Bi-Fuel operation or RESET Bi-Fuel operation.

VIEW DATABASE / CHART DATABASE KEY
These powerful tools allow users to display and chart the data logged information.

13.7 CALIBRATE KEY
This allows the user to calibrate analog sensor channels. Press this button and select the channel to be calibrated. The sensor selection box will show the default values or the last values calibrated. The CURRENT DATA box shows the value being displayed by the DE-1510. On the terminals of the channel being calibrated, connect a voltmeter between the input (+ and –) to measure the output voltage of the transducer. Apply the desired minimum pressure, temperature, vibration, position or KW input to the transducer being calibrated. Now measure the voltage using the voltmeter on the terminal strip. Enter this voltage into the LOW SENSOR VOLTAGE box on the PC screen. Click the ACCEPT button to make this the new calibration value. The CURRENT DATA box will now read the desired minimum value. If the span is to be adjusted, increase the input to the transducer to the desired high value. Measure the voltage at the terminal strip using the voltmeter and enter the measured voltage in the HIGH SENSOR VOLTAGE box and hit the ACCEPT button. The calibration of the channel is now complete.

13.8 EXIT KEY
Exits the DE-1510 PC Terminal program.

DE-1510 CHANNEL DESCRIPTION CHART:

CHANNEL	DESCRIPTION	DISPLAYED UNITS (Default: English)	DISPLAYED UNITS (Metric)	DEFAULT CONTROL SETPOINTS		DEFAULT SAFETY SETPOINTS	
				LOW	HIGH	LOW	HIGH
11	GAS DETECTION (optional)	—	—	—	—	—	—
12*	ROP REG. OUT. PRESS.	—	—	—	—	—	—
13	BI-FUEL INHIB.	—	—	—	—	—	—
20	DIESEL FUEL PERCENT	%	%	– 25	125	– 25	125
21	GSP GAS SUPPLY PRESS	PSIG	Kpa	– 12.5	62.5	– 12.5	62.5
22	VAC1 AIR FILTER 1	PSIG	Kpa	– 12.5	62.5	– 12.5	62.5
23	MAP1 ENG MAN PRESS 1	PSIG	Kpa	20	62.5	20	62.5
24	MAT1 ENG MAN TEMP1	°F	°C	0	1472	0	1472
25	EGT1 ENG EXH TEMP 1	°F	°C	0	1472	0	1472
26	VIB1 ENG VIBRATION 1	IPS	MPS	– 0.5	2.50	– 0.5	2.50
27	KW PERCENT	%	%	– 25	125	– 25	125

DE Terminal Program Configuration Defaults
Device/Units: DE-1510 Controller/English

HARNESS GUIDE

ENGINE HARNESS	PART NO.	693128-1	693140-1
	LENGTH (FT)	20	10
	CONNECTIONS	MAP1	MAP1
		VAC1	VAC1
		EGT1	EGT1
		MAT1	MAT1
		VIB1L	VIB+, VIB1
		KW	KW
FUEL HARNESS ASSEMBLY	**PART NO.**	**693126-1**	**693139-1**
	LENGTH (FT)	20	10
	CONNECTIONS	GSP	GSP
		ROP	ROP
		SOL+, SOL–	SOL+, SOL–
POWER HARNESS ASSEMBLY	**PART NO.**	**693127-1**	**693138-1**
	LENGTH (FT)	20	10
	CONNECTIONS	+, –, GND	+, –, GND
VSM+ CONDUIT W/CONNECTORS	**PART NO.**	**662031-1**	
	LENGTH (FT)	30 (TRIM TO SIZE)	
	CONNECTIONS	CONDUIT	
VSM+ SENSOR HARNESS	**PART NO.**	**693134-2**	**693134-1**
	LENGTH (FT)	20	10
	CONNECTIONS	2 PIN CONNECTOR	2 PIN CONNECTOR

SENSOR GUIDE

NAME	PART NO.	FUNCTION
GAS SUPPLY PRESSURE SENSOR	691201-15	GSP
MANIFOLD AIR PRESSURE SENSOR	691201-50	MAP
VACUUM PRESSURE SENSOR	691206-50	VAC
VSM+ VIBRATION SENSOR	615107	VIB
FILTER TRANSDUCER ADAPTER	610879	FILTER SENSOR CONNECTION
1/4” FILTER TRANSDUCER ADAPTER GASKET	610880	FILTER SENSOR CONNECTION
BUSHING, STRAIN RELIEF	610756	ROP HARNESS-SWITCH CONNECTION

FIG. 1 MOUNTING DIMENSIONS — GPN1000/GPN1000-12

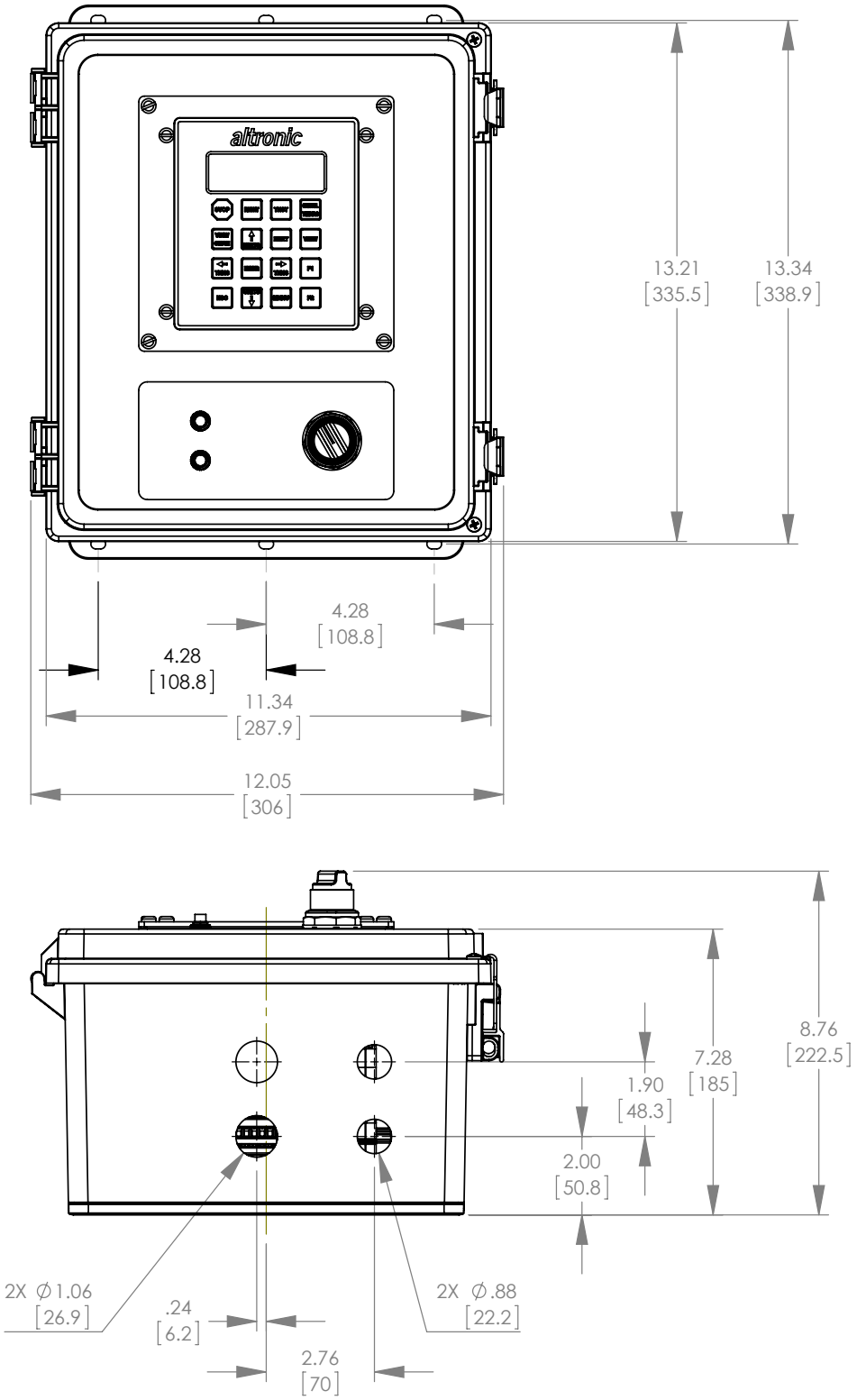
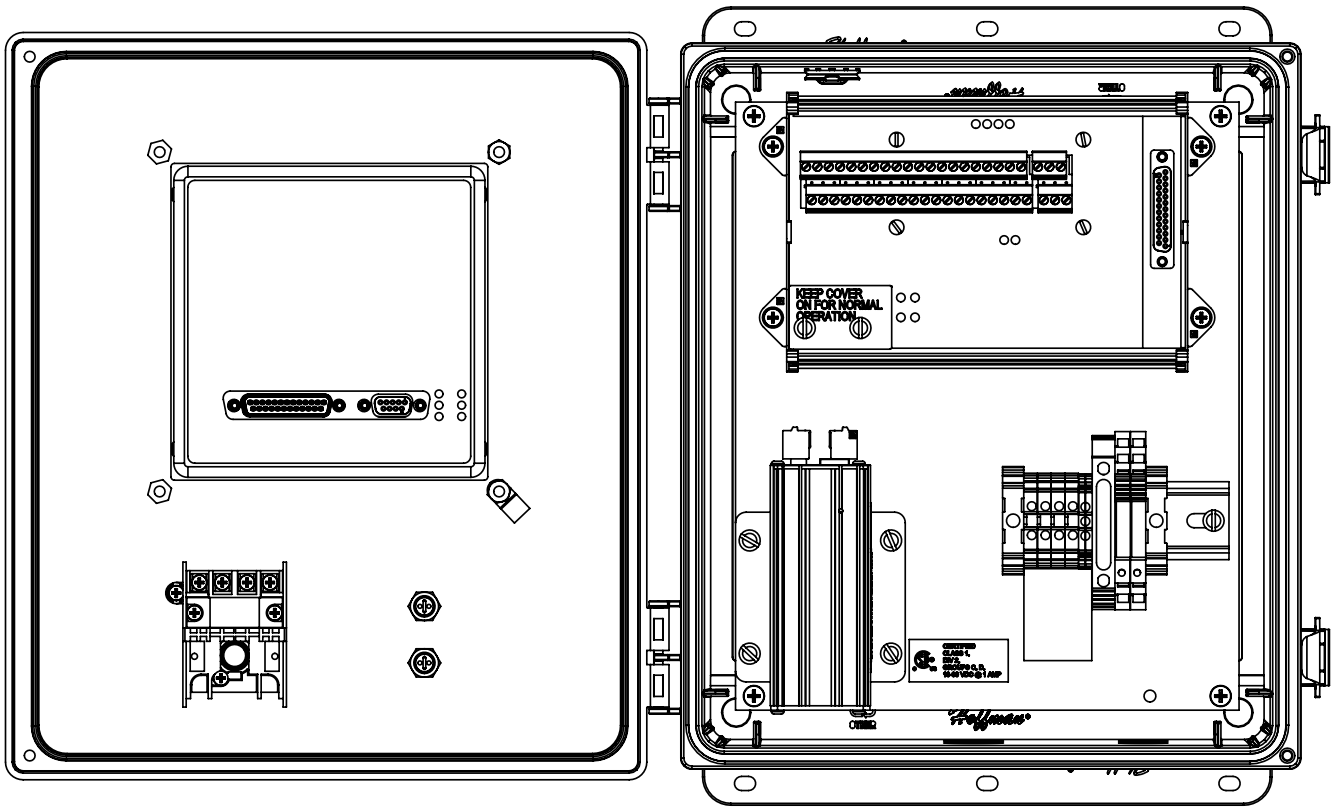


FIG. 2 WIRING HARNESS/PANEL LAYOUT — GPN1000 WITH VSM+



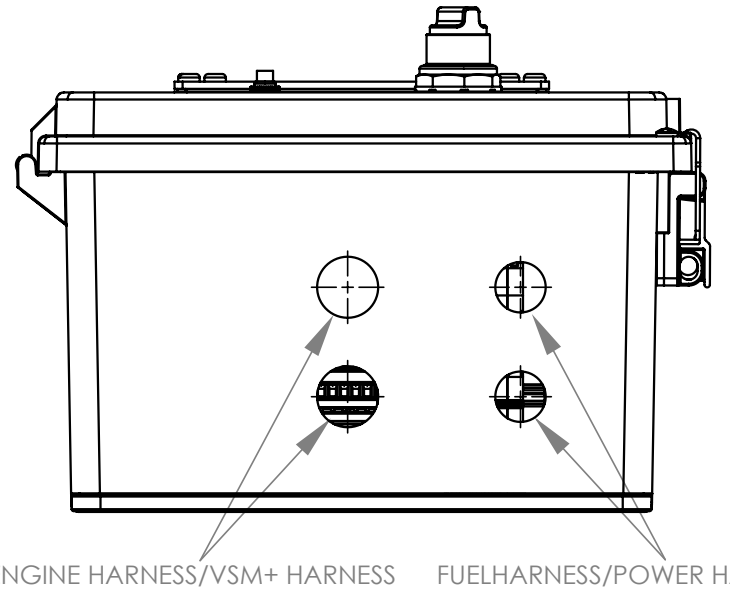
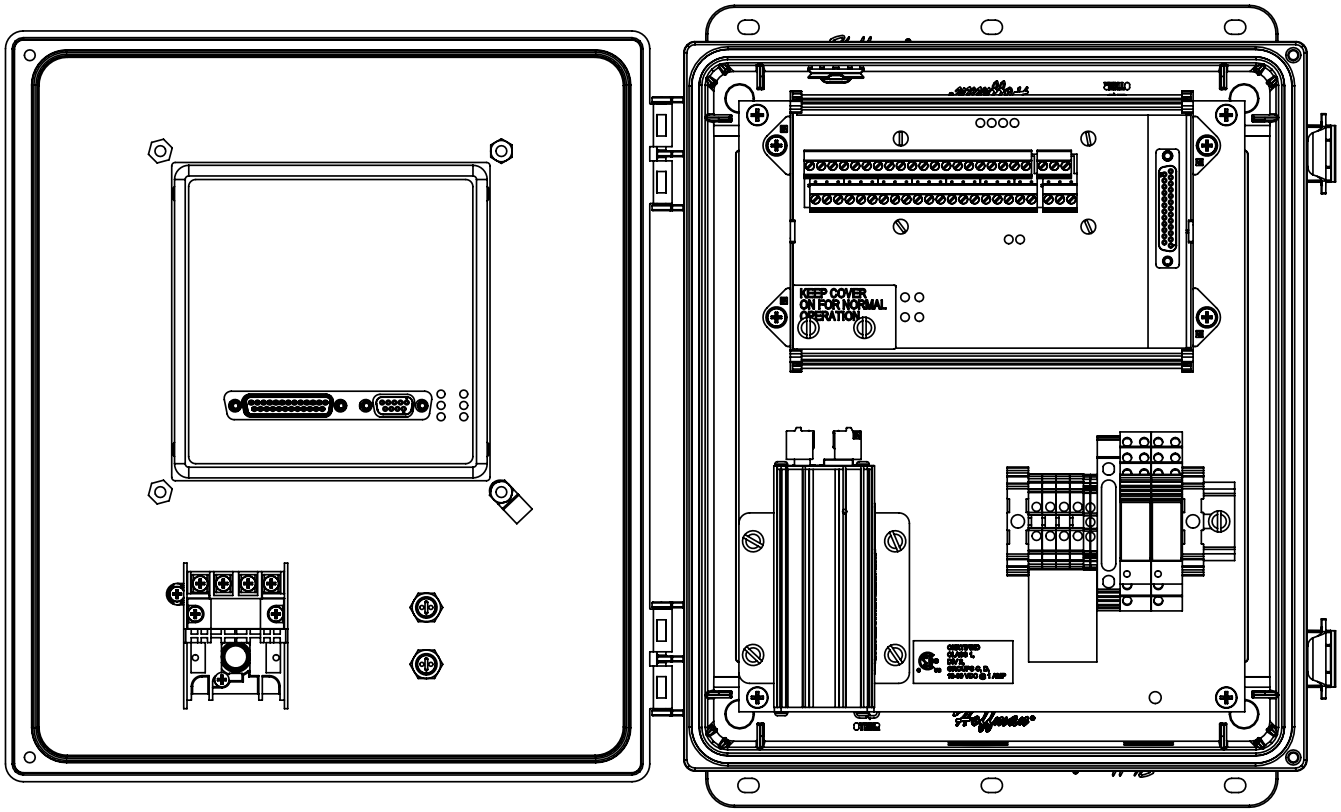


FIG. 3 WIRING HARNESS/PANEL LAYOUT — GPN1000-12 WITH VSM+



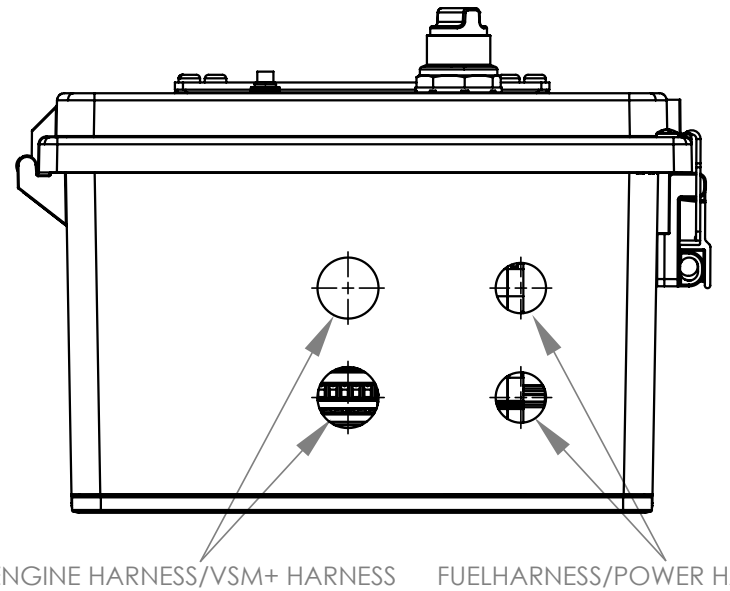


FIG. 4 WIRING DIAGRAM — GPN1000 WITH VSM+

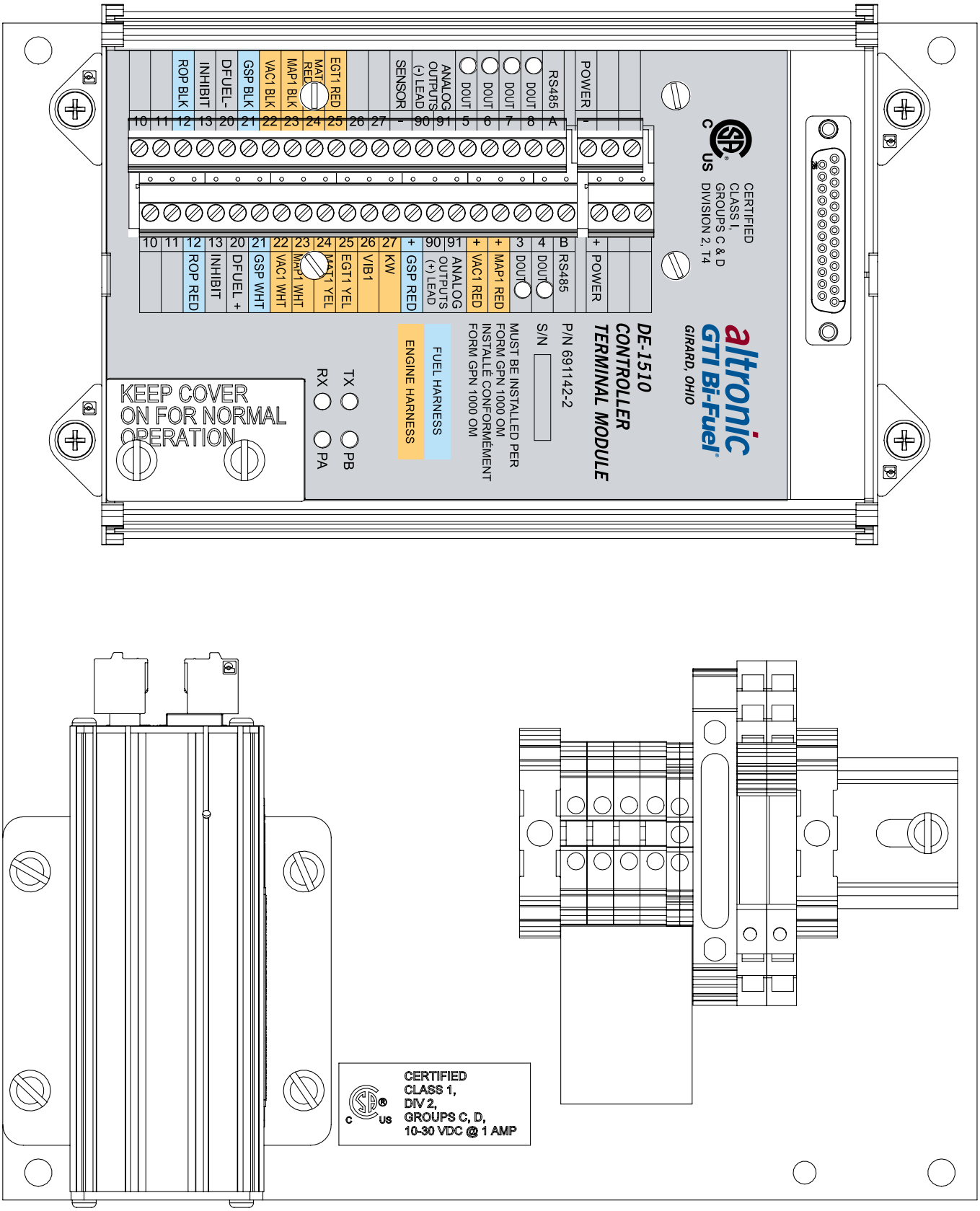


FIG. 5 WIRING DIAGRAM — GPN1000-12 WITH VSM+

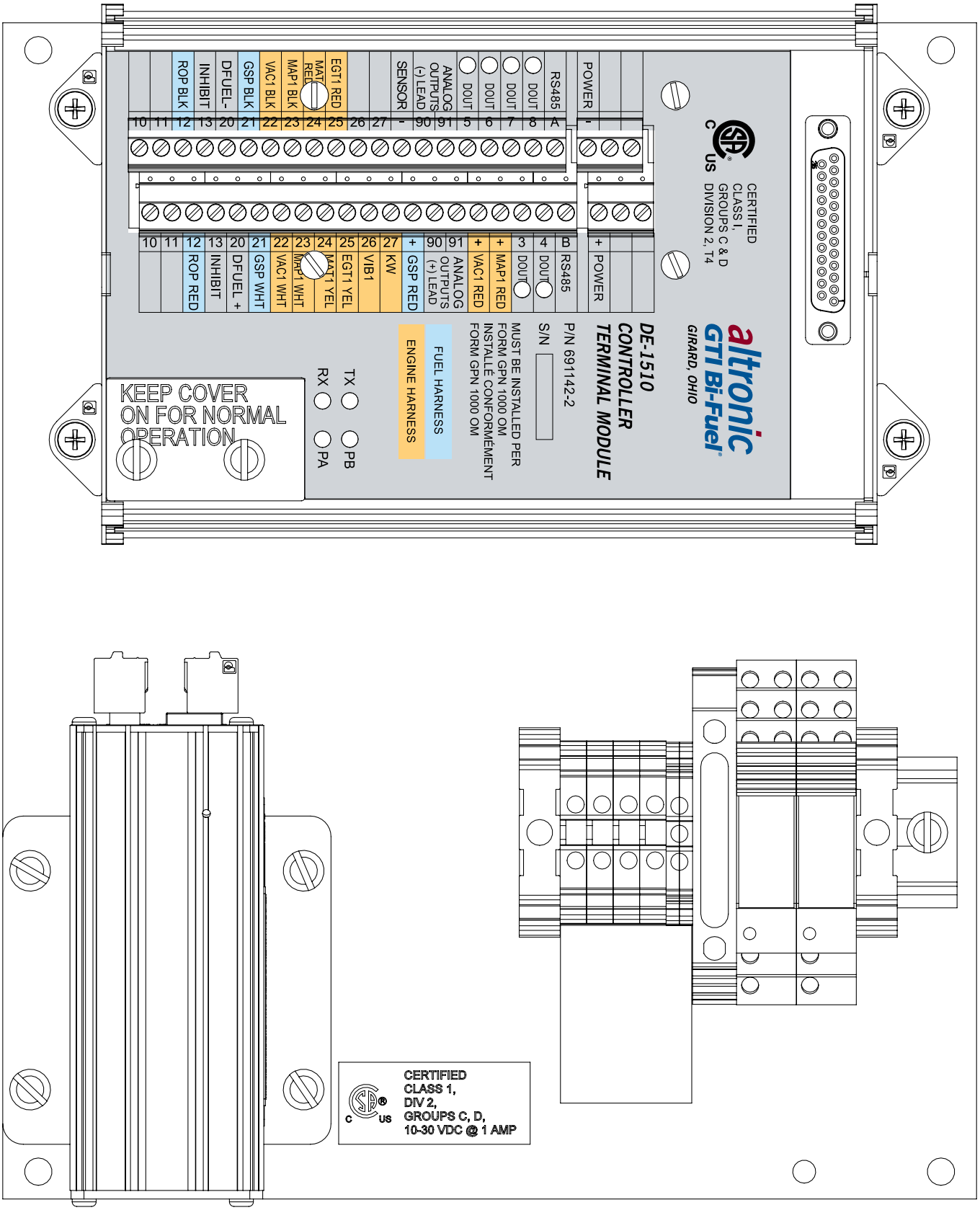


FIG. 6 WIRING DIAGRAM — CUSTOMER CONNECTIONS — GPN1000/GPN1000-12

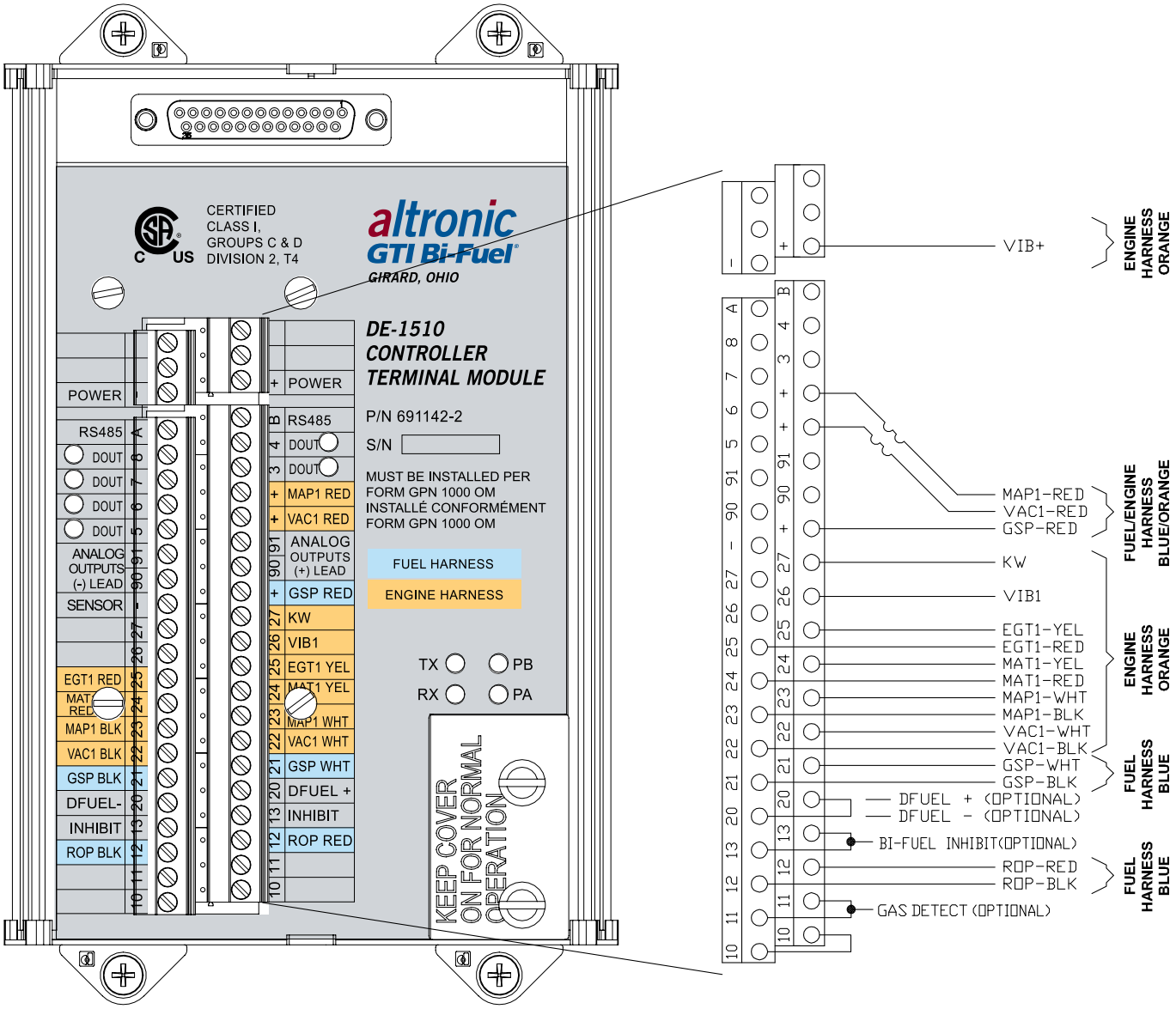


FIG. 7 WIRING DIAGRAM — CUSTOMER CONNECTIONS — GPN1000/GPN1000-12

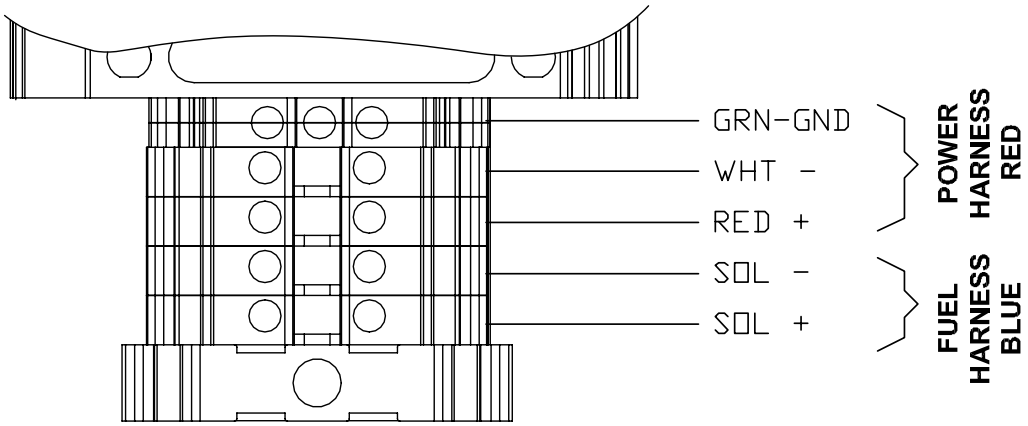


FIG. 8 CUSTOMER WIRING, VSM+

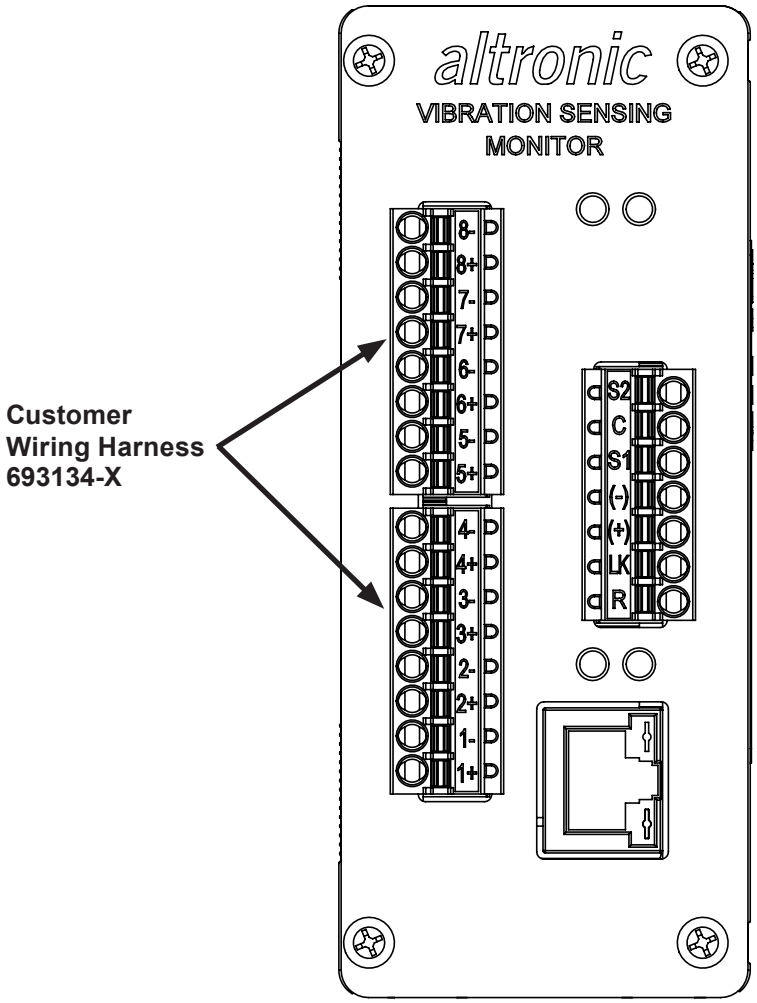
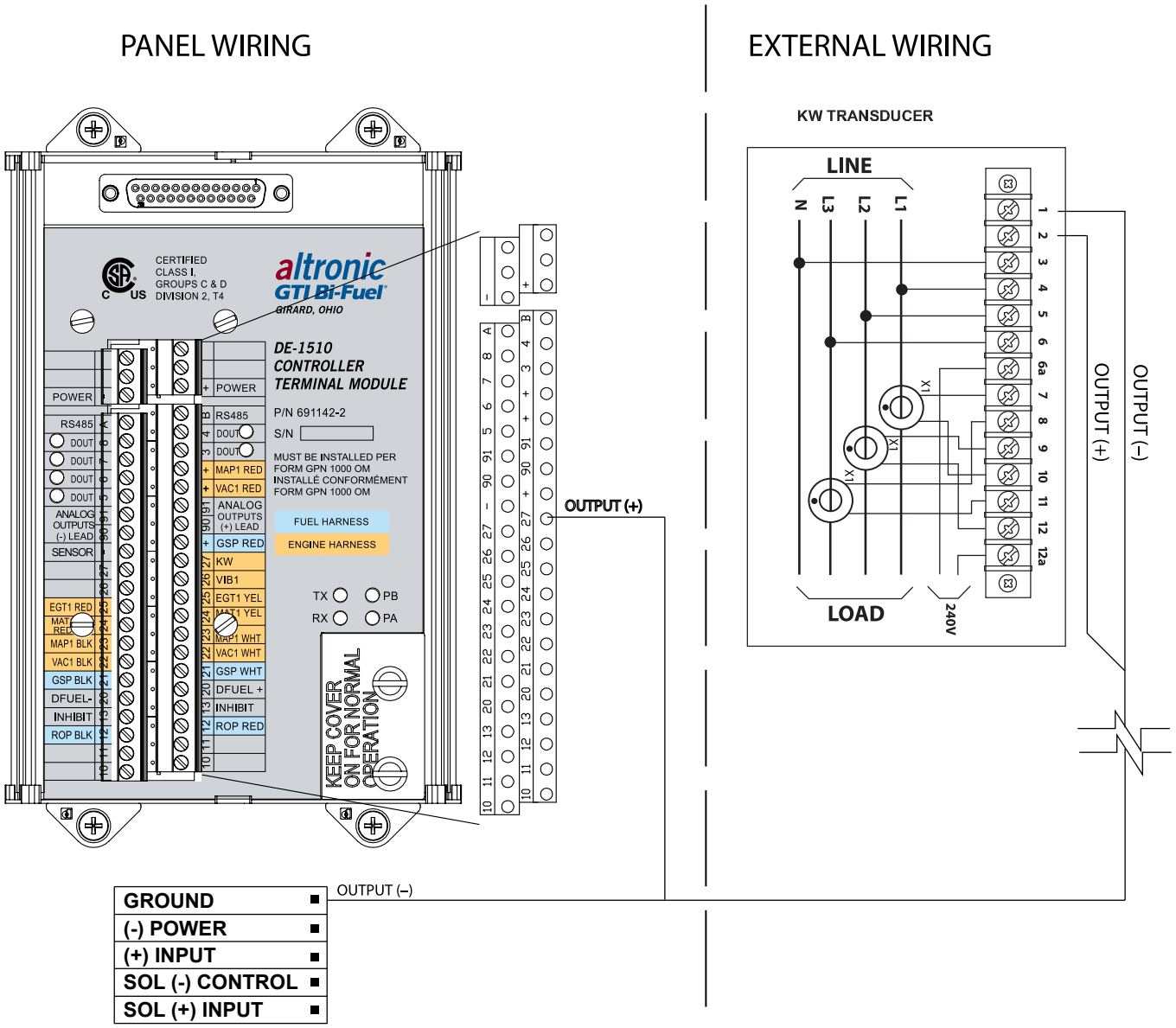


FIG. 9 3-PHASE, 3-WIRE AND 3-PHASE, 4-WIRE WIRING SCHEMATIC



NOTE: KW Terminal Strip Specs.
Wire Strip Length: .38" [9.652]
Recommended Torque: 8 in-lbs.

NOTE: All furnished drawings and instructions assume (–) ground DC system. In the case of a floating ground, or (+) ground DC system, please contact Altronic Factory for support.

FIG. 10 PT WIRING SCHEMATIC

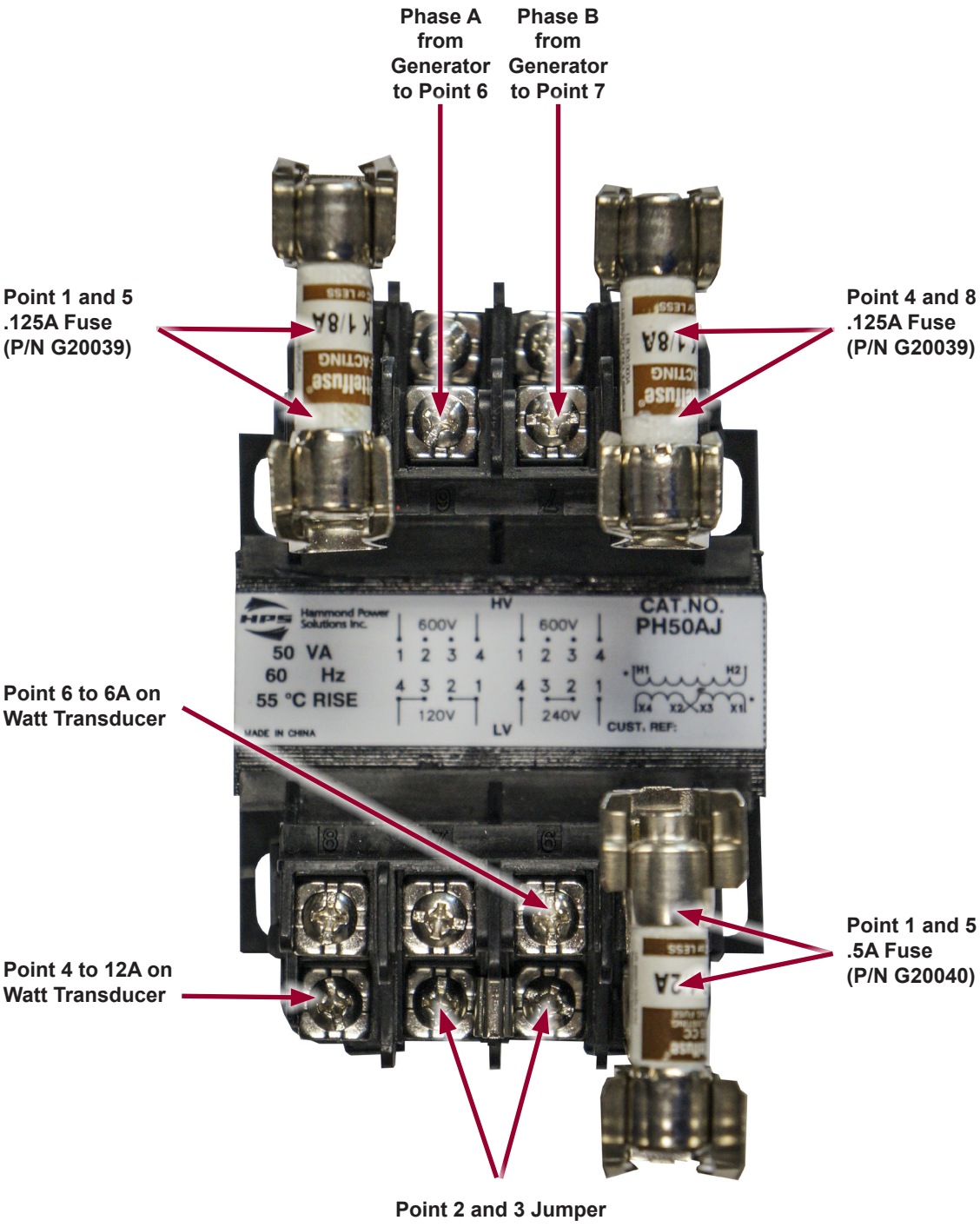
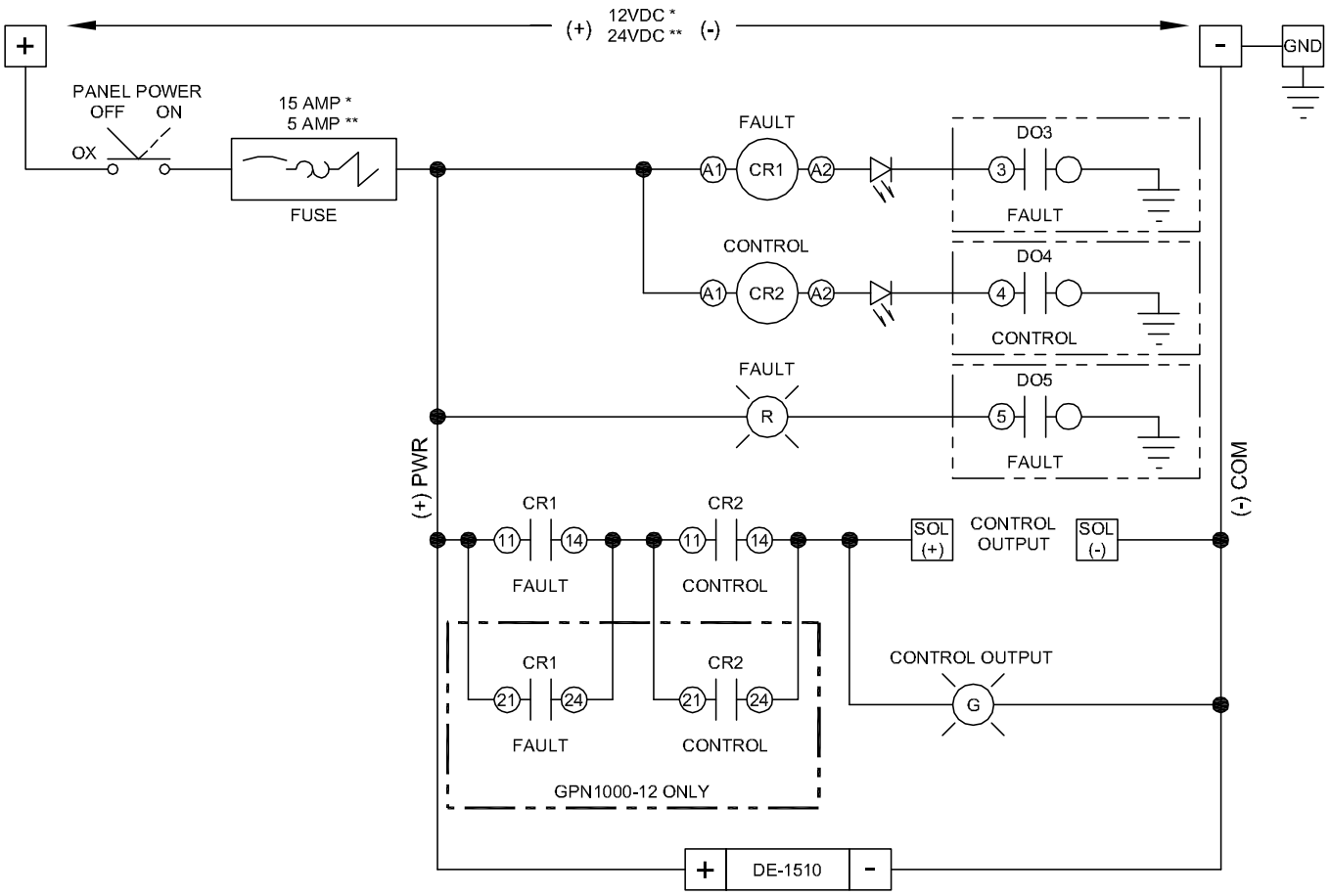


FIG. 11 WIRING DIAGRAM — LADDER LOGIC — GPN1000/GPN1000-12



* GPN1000-12
** GPN1000