

MURPHY®

by **ENOVATION** CONTROLS



EMS PRO LITE

Engine Monitoring System Controller

Installation and Operations Manual

In order to consistently bring you the highest quality, full-featured products, we reserve the right to change our specifications and designs at any time.

Warranty - A limited warranty on materials and workmanship is given with this Murphy product. A copy of the warranty may be viewed or printed by going to www.fwmurphy.com/warranty.



Enovation Controls has made efforts to ensure the reliability of the **EMS PRO LITE** and to recommend safe use practices in system applications. Please note that in any application, operation and controller failures can occur. These failures might result in full control outputs or other outputs that might cause damage to or unsafe conditions in the equipment or process connected to the **EMS PRO LITE**.

To follow good engineering practices, electrical codes, and insurance regulations requires that you use independent external protective devices to prevent potentially dangerous or unsafe conditions. Assume that the **EMS PRO LITE** can fail with outputs full ON, outputs full OFF, or that other unexpected conditions can occur.

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT:

- This installation information is intended for all **EMS PRO LITE** Series models. A visual inspection of this product before installation for any damage during shipping is recommended.
- Disconnect all electrical power to the machine. Failure to disconnect all electrical power connections before welding can result in damage to the panel and/or its components.
- It is your responsibility to have a qualified technician install the unit and make sure installation conforms to local codes.
- Observe all Warnings and Cautions in each section of these instructions.
- The **EMS PRO LITE** is designed for use in industrial environments. There might be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbances.
- Please contact Enovation Controls immediately if you have any questions.

IMPORTANT! Improper use and operation of electronic products can be dangerous. It is required that point-of-operation guarding devices be installed and maintained. All such devices must meet OSHA and ANSI Machine safety standards. The manufacturer shall not accept any responsibility for installation, application, or safety of systems.

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Introduction

The **EMS PRO LITE** is a customizable pump-controller designed with dewatering and irrigation applications in mind.

EMS PRO LITE offers field-adjustable operating parameters without the need for a laptop computer. It can support both mechanical and J1939 electronic engines.

This unit offers selectable auto start/stop with auto-throttling options: Floats, and Transducer. A backlit operator-interface offers many easy-to-use performance-enhancing features. The display is readable day or night.

The **EMS PRO LITE** is ideal for use with a remote modem or in a SCADA system offering Modbus® RTU protocol on either the RS232 or RS485 port.

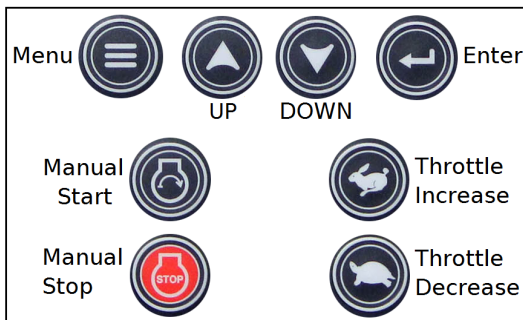
NOTE: Your **EMS PRO LITE** must be modified to use these ports – changes include additional wiring and enclosure modifications.









User Interface and Navigation

This section defines how to navigate through the EMS PRO LITE user interface. It explains the screens and keys used to modify settings and how each works.

Membrane Keypad

The membrane keypad is made up of eight buttons. All of the functions for the **EMS PRO LITE** can be set using these eight buttons.



ICON	Description
	START = In the “MAN” (manual) mode this initiates a start sequence.
	STOP = In the “MAN” (manual) mode this initiates a stop sequence.
	THROTTLE INCREASE = In the “MAN” (manual) mode this increases engine speed.
	THROTTLE DECREASE = In the “MAN” (manual) mode this decreases engine speed.
	MENU = Toggles between the front display and the password window, and allows user to exit menus.
	UP arrow = Use the arrow keys to scroll through information on the front display. Also, scroll through and increase values in the “S” & “P” numbers.
	DOWN arrow = Use the arrow keys to scroll through information on the front display. Also, scroll through and decrease values in the
	ENTER = Scroll to the entry code and press Enter to get into or out of the M , S or P numbers group, or an individually selected M , S or P number, to make changes. If changes were made, press Enter to exit, and your changes are saved.

Key Switch



The controller accepts inputs from a 3-position key switch. The three positions are **AUTO**, **OFF**, and **MAN**:

Input	Description
AUTO	Functions described in the “Auto Start/Stop Sequence” of this document.
OFF	Disconnects control power to prevent the engine from starting or continuing to run through the control panel. The OFF position provides an immediate shutdown whenever the key switch is placed in this position while the engine is running in either the automatic or manual modes.
MAN	Functions as described in the “MAN Start/Stop Sequence” in this document.

Stop Switch

The Stop Switch is the large red push button on the front face of the **EMS PRO LITE**. When it is pushed in, it latches closed. If the Stop Switch is pushed in, power to the controller is OFF. The Stop Switch must be pulled out to power the controller.

Screens Displayed

During normal operation, the controller allows you to scroll through a number of informative screen displays by using the   membrane keys. Below are several example screens.

0.0 ECU HRS	-1% LOAD
-0.1 GPH FUEL RATE	0 RPM ENGINE
NO ALARMS	

4-Up Screen

ENTRY ACTIVE ENTER CODE: 0
NO ALARMS

Entry Code

S1 SET MINUTES 10:45:57
NO ALARMS

S-Number Screen

P1 SUN SELECT YES
2 CHOICES
NO ALARMS

P-Number Screen

The **EMS PRO LITE** screens described below may appear in an order that is different from listed.

Screens Displayed	
Screen Name	Description
FW Murphy / Murphy / Enovation Controls	From the 4-Up screen default, depending where in the screen scroll you are, when you press the down arrow, the top line of the text page could be either FW MURPHY, MURPHY, or ENOVATION CONTROLS.
BUILD XXXXX	The current BUILD is usually a 5-digit number. Make note of the build number. You will need it if requesting technical assistance.
PROGRAM XXXXXXXX	The current PROGRAM is usually an 8-digit number. Make note of the program number. You will need it if requesting technical assistance.

Screens Displayed									
Screen Name	Description								
LEAD SPD XXXX RPM	If the controller is in AUTO mode, the internally generated lead/command speed is displayed in RPM. If the controller is in MANUAL, this does not display.								
SELECTOR XXXX	<p>This displays the position of the key: AUTO, or MAN. When a start signal is active, the display may include the following state or start options in place of the Auto or Manual states.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">START DELAY</td> <td style="width: 50%;">PRESSURE START</td> </tr> <tr> <td>STOP DELAY</td> <td>LEVEL START</td> </tr> <tr> <td>FLOAT START</td> <td>SCADA START</td> </tr> <tr> <td>CLOCK START</td> <td></td> </tr> </table>	START DELAY	PRESSURE START	STOP DELAY	LEVEL START	FLOAT START	SCADA START	CLOCK START	
START DELAY	PRESSURE START								
STOP DELAY	LEVEL START								
FLOAT START	SCADA START								
CLOCK START									
DAY OF THE WEEK	This line shows the present day of the week.								
DD MMM YYYY	This line displays the present date								
HH:MM:SS	This line shows the present time.								
STATE: XXXXXXXXXX	The following are the different states the controller can execute during operation:								
ST: (STATE XXXX)	<p>This text line displays states the controller can execute during operation:</p> <ul style="list-style-type: none"> • NOT READY occurs when the key switch is in the OFF position. This is seen briefly while the controller is powering ON. No sequence occurs in this state. • PANEL READY occurs when the key switch is in the AUTO position and no shutdowns have occurred. The controller is waiting for an auto start condition to occur. • START DELAY occurs when a start signal is active and the start delay is timing. The start signal must remain active throughout this delay before the auto sequence can continue. • PRESTART occurs after the start delay expires. During the Prestart state, the prestart output is turned ON. • WAIT FOR ECU occurs after the Prestart delay expires if "ECU" is selected in the engine type. During the WAIT state, the unit allows the ECU to warm-up prior to cranking. • CRANK ON occurs when cycle cranking begins. During the crank-on state, the crank output is turned ON. 								

Screens Displayed	
Screen Name	Description
ST: (STATE XXXX), continued	<ul style="list-style-type: none"> • CRANK OFF occurs when cycle cranking begins. During this state, the crank output is turned OFF. • RECRANK DELAY occurs if the engine speed drops below the “crank stop” set point before the “shutdown lockout delay” expires. • WARMUP occurs after the engine starts. During this state, the controller throttles the engine to the warm-up RPM until this delay expires. • AT LOAD occurs after the Warm-up delay expires. The low discharge pressure shutdown is armed when this delay expires. • FILL MODE occurs after the Warm-up delay expires. Auto throttling to the minimum RPM set point occurs during this state. • STOP DELAY occurs when a stop signal is active and the stop delay is timing. The stop signal must remain active throughout this delay before the auto sequence can continue. • COOLDOWN occurs after the Stop Delay has expired. During the Cool down state, the controller throttles the engine to an idle. • SHUTDOWN occurs if a shutdown condition is detected. Reasons for shutdown include low oil pressure, high engine temperature, overspeed, etc. During this state, the engine is signaled to shutdown and all start signals are ignored until the state is reset by moving the key switch to the OFF position and then back to AUTO or MAN.
FUEL XXX%	This displays the current fuel level as sensed from a sender.
SYS BAT XX.X VDC	This displays the current engine battery voltage.
SYS HRS or ECU HRS XXXX.X	This displays the current total engine run time. The prompt and data shown in this display is dependent on S#38 - ENGINE TYPE and S#39 - ECU HOUR SELECT.
ENG XXXX RPM	This displays the current engine RPM sensed either from a magnetic pickup or as broadcast from the ECU.
OIL PR XXX PSI	This displays the current engine oil pressure as sensed from an electric gauge sender, or as broadcasted from the ECU.

Screens Displayed	
Screen Name	Description
LEVEL XX.X (IF SELECTED)	This displays the current system level as sensed from a transducer.
LOCAL THROT (IF SELECTED)	This is only show if Local Throttle is selected in S-34.
SOOT LEVEL (IF SELECTED)	This shows the soot level percentage from SPN 3719. There are also 3 alarms associated with this Status sent from the ECU. The Alarms will be displayed on the Alarm line as "SOOT LEVEL LOW", "SOOT LEVEL MEDIUM", or "SOOT LEVEL HIGH".
UREA LEVEL (IF SELECTED)	This shows the urea level percentage from SPN 1761.
FIRST FOUR-UP SCREEN (DEFAULT SCREEN)	The first four-up screen should display Engine Oil Pressure, Engine Coolant Temp, Battery Voltage, & Engine RPM. This is the default screen when powering up the controller.
SECOND FOUR-UP ELECTRONIC ONLY SCREEN	The second four-up screen should display Run Hours, Fuel Consumption, Engine Load %, & Engine RPM. This screen can be viewed by pressing the arrow up key from the default screen.
SHUTDOWN SCREEN	This screen shows the last five shutdowns that have occurred. This screen can be accessed by pressing the arrow up key past the four-up screen(s).

Quick Set Up

This section gives information on setting up specific functions within the controller such as time, date, engine type, Tier 4 activity, and Unit display type (Metric or US Standard). Other menus, such as the **S**-menu, **P**-menu, and **M**-menu must also be setup before placing the unit in service.

NOTE: This section is a reference guide. We recommend you read this document completely, and ensure you understand it, before placing the controller in service.

Setting the Date/Time Clock

Setting up the clock is critical to many of the functions of the **EMS PRO LITE**. The clock includes the time (displayed in 24hr format), the date, and the day of the week. Use the following steps to set the Clock.

1. Access the **S** Menu by pressing **[Menu]**.
2. Use the **[Up or Down Arrow]** to increase or decrease the value to reach the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the Entry Code displays, press **[Enter]** to access the **S** menu.

NOTE: **S1** through **S6** are the S-Numbers used to set the clock. A complete guide to all S-Numbers is found in the **Menus** section, page 22.

1. Press **[Up or Down Arrow]** to scroll through the **S-Numbers** on the unit.
2. Press **[Enter]** when the setting you want to modify displays.
3. Use the **[Up or Down Arrow]** to scroll to increase or decrease the value.
4. Press **[Enter]** when you are finished.
5. Repeat steps 3 through 6 for each clock and date setting.
6. When setup is complete, exit the **S Menu** by pressing **[Menu]**.

NOTE: The user must be out of the **S** or **P** number Editing Mode to exit the menu.

EMS PRO LITE on electronically-governed Engine

The **EMS PRO LITE** factory defaults are set to run on an electronically governed engine. See the following section to use the controller on a mechanically governed engine.

EMS PRO LITE on mechanically-governed Engine

To use the controller on a mechanically governed engine, follow the steps below:

1. Access the S Menu by pressing **[Menu]**.
2. Use the **[Up or Down Arrow]** to scroll to the correct Entry Code (See the section, Entry Code Supplement for Entry Codes, page 48).
3. When the Entry Code displays, press **[Enter]** to access the S menu.
4. Press the **[Up Arrow]** until (S38) ENGINE TYPE is displayed and press **[Enter]**.
5. Press the **[Up Arrow]** until MECHANICAL is highlighted, then press **[Enter]**.
6. Press the **[Up Arrow]** until (S40) ENG THR TYPE displays and press **[Enter]**.
7. Press the **[Up Arrow]** until MECHANICAL is highlighted, then press **[Enter]**.
8. Press the **[Down Arrow]** until (S7) SPEED CALIB displays and press **[Enter]**.
9. Press the **[Up or Down Arrow]** to enter the number of pulses per revolution (PULSES/REV) the magnetic pickup supplies to the controller and press **[Enter]**.
10. Exit the S Menu by pressing **[Menu]**.

Start/Stop Settings

The auto/start/stop types are Transducer (pressure and level), Floats, and Clock Start.

Transducer Start/Stop Types

Existing Transducer choices include **None**, **Pressure Control**, and **Level Control**.

Use the following step-by-step instructions to set up the Pressure Start/Stop Type and the Level Start/Stop Type.

Pressure Start/Stop Type

The Pressure Start/Stop Type allows you to automatically start and stop the engine using a pressure transducer to measure low and high set points. Follow the steps below to set this start/stop feature.

1. Access the S Menu by pressing **[Menu]**.
2. Press the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement, page 48).
3. Press the **[Up or Down Arrow]** until (S35) SRT/STP SEL is displayed and press **[Enter]**.
4. Press the **[Up Arrow]** until TRANSDUCER is highlighted and press **[Enter]**.
5. Press the **[Up Arrow]** until (S37) XDUCER TYPE is displayed and press **[Enter]**.
6. Press the **[Up Arrow]** until PRESSURE CONTROL is highlighted and press **[Enter]**.
7. Review and modify the settings for S-numbers S45 through S56 for Pressure Start/Stop Type. To modify, press **[Enter]** while the setting is highlighted. When finished with the modification, press **[Enter]** again. Refer to the S-Number table in **Menus** for a description of the S-Numbers settings.
8. When finished with the S45 through S56 settings, press **[Menu]** to exit.

Level Start/Stop Type

The Level Start/Stop Type allows you to automatically start and stop the engine using a level transducer to measure low and high set points. Follow the steps below to set this start/stop feature.

1. Access the S Menu by pressing **[Menu]**.
2. Press the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until (S35) SRT/STP SEL is displayed and press **[Enter]**.
4. Press the **[Up Arrow]** until TRANSDUCER is highlighted and press **[Enter]**.
5. Press the **[Up Arrow]** until (S37) XDUCER TYPE displays and press **[Enter]**.
6. Press the **[Up Arrow]** until LEVEL CONTROL is highlighted and press **[Enter]**.

7. Review and modify the settings for S57 through S71 for Level Start/Stop Type. To modify a setting, press **[Enter]** when the setting is highlighted. When finished with the modification press **[Enter]** again. Refer to the S-Number table in **Menus** for a description of the S-Numbers settings.
8. When finished with the (S57-S71) settings, press **[Menu]** to exit.

2-Float Start/Stop Type

The 2-Float Start/Stop Type allows you to automatically start/stop the engine by using two float contacts (see page 21 for a description of Float Operation). Follow the steps below to set this start/stop feature.

1. Access the S Menu by pressing **[Menu]**.
2. Use the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until (S35) SRT/STP SEL is displayed and press **[Enter]**.
4. Press the **[Up Arrow]** until FLOATS is highlighted then press **[Enter]**.
5. Exit the S Menu by pressing **[Menu]**.

Clock Start/Stop Type

Using the internal real time clock, the user can select up to (3) different start times per day. The clock start/stop feature can be used in conjunction with other start/stop types.

Throttle Type

This section outlines several different throttling methods from which to choose and how to set these for operation in the controller.). Follow the steps below to set the type of throttling necessary for the application.

Throttle to Pressure

This type of throttling allows you to set a pressure you would like the controller to maintain when a transducer is used for discharge pressure.

1. Access the S Menu by pressing **[Menu]**.
2. Press the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).

3. Press the **[Up or Down Arrow]** until (S47) MAINTAIN PSI is displayed in the menu and press **[Enter]**.
4. Press the **[Up or Down Arrow]** until the desired pressure to maintain is highlighted and press **[Enter]**.
5. Press the **[Up or Down Arrow]** until (S48) DEADBAND PSI is shown in the menu and press **[Enter]**.
6. Press the **[Up or Down Arrow]** until the desired deadband range is highlighted and press **[Enter]**.
7. Press **[Menu]** to exit.

Throttle to Level

This type of throttling allows you to set a level you would like the controller to maintain when a transducer is used for Level.

1. Access the S Menu by pressing **[Menu]**.
2. Press the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until (S59) MAINTAIN LEVEL is displayed in the menu and press **[Enter]**.
4. Press the **[Up or Down Arrow]** until the desired pressure to maintain is highlighted and press **[Enter]**.
5. Press the **[Up or Down Arrow]** until (S60) DEADBAND LEVEL is shown in the menu and press **[Enter]**.
6. Press the **[Up or Down Arrow]** until the desired deadband range is highlighted and press **[Enter]**.
7. Press **[Menu]**.to exit.

Tier 4 Emissions*

*Murphy products are compliant with requirements for U.S. EPA Emission Standard – Tier 4 Interim and EU Emissions Standard – Stage IIIB for diesel engines. These engines, when fitted with a DPF (Diesel Particulate Filter), can self-clean the filter of particulates. The self-cleaning process is known as Regeneration. **EMS PRO LITE** offers two tier levels: Tier 3 and Tier 4. The following S-numbers are associated with emission control actions: S73 (Tier Rating), S74 (Tier State), and S75 (Request DPF Regen) and can be seen in the S-number table on page 22.

NOTICE: Enovation Controls does not control the Emissions ECU, please consult with your engine manufacturer for specific emissions operation.

If you are using the **EMS PRO LITE** on an Interim Tier 4 engine, please read and understand the information for the following S-numbers: S73, S74, and S75 in the S-number table, page 22. Also, read and understand the following information and steps to set up Tier 4 Emission options. The controller displays the SOOT level on the display when the engine has been de-rated and/or when regeneration (regen) is required to return to normal service. You must set S73 (Tier Rating) to **Tier 4** for these options to be available.

- If S74 (Tier State) is set to Auto DPF Regen, the ECU performs a regen automatically. This only occurs if the ECU conditions allow.
- If S75 (Request DPF Regen) is set to YES, the controller commands the ECU to perform a regen. This only occurs if ECU conditions allow.
- If S75 (Request DPF Regen) is set to NO, Inhibit Regen is active and no regen occurs.

To use the controller on a Tier 4 engine, follow the steps below:

1. Access the S Menu by pressing **[Menu]**.
2. Press the **[Up or Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until S73 (Tier Rating) is displayed in the menu and press **[Enter]**.
4. Press the **[Up or Down Arrow]** until TIER 4 is highlighted and press **[Enter]**.
5. Press the **[Up or Down Arrow]** until S74 (Tier State) is highlighted and press **[Enter]**. The default value is set to INHIBIT. To select **Auto DPF Regen** use the **[Up or Down Arrow]** to highlight the text and press **[Enter]**.

To use the Request DPF Regen feature, follow these steps (If all the conditions for a regen to occur are not met, this request could be ignored by the ECU):

1. Access the S Menu by pressing **[Menu]**
2. Press the **[Up or Down Arrow]** and scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until S75 (Request DPF Regen) is displayed in the menu and press **[Enter]**.
4. Press the **[Up Arrow]** until YES is highlighted and press **[Enter]**.

NOTE: Once the regen has started, allow this menu to display until the regen is complete and **NO** is displayed on the menu.

5. Press **[Menu]** to exit the S Menu.

Unit System – Metric or English

This setting allows you to change the default units from English units (PSI and °F) to Metric units (kPa & °C). Use the following steps to change the units:

1. Access the S Menu by pressing **[Menu]**
2. Press the **[Up or Down Arrow]** and scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up or Down Arrow]** until S72 (Unit System) is displayed in the menu and press **[Enter]**.
4. Press the **[Up or Down Arrow]** until METRIC is highlighted and press **[Enter]**.
5. Press **[Menu]** to exit the S Menu.

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Operating Instructions

AUTO Start/Stop Sequence

The following choices are available in the “Start/Stop type” S-Numbers:

- **Floats (2 contacts):** Both contacts close for start and both contacts re-open for stop.
- **Transducer:** Starting and stopping is controlled by S-Number set points. System pressure and level are available in the “transducer type” S Number.

NOTE: SCADA START.

If the engine is not already running, an auto start can be done through the Modbus start/stop register. This feature does not operate if the engine is already running via either a Floats or Transducer state (See Register 40012 on page 45).

Start Sequence

When the AUTO-OFF-MAN key switch is in the AUTO position (with no failures present), the **SELECTOR** text line shows **AUTO** and the **STATE** text line shows **PANEL READY**.

Important - When the key is in the AUTO position, and **ECU** is selected for engine type, the ECU enable output will turn ON for a period of 5 minutes. After a 5-minute period of inactivity, without a start signal or key press, the output will become inactive. This has no affect on the start sequence.

If **Mechanical** is selected for engine type, the following shutdown/alarm circuits are armed:

- **LOW FUEL ALARM** (If set point is above 0%).
- **LOW FUEL SHUTDOWN** (If set point is above 0%).

If the fuel/ECU output is not already on, the fuel/ECU enable output will be turned ON.

NOTE: NO SPEED SIGNAL

Shutdown occurs (when enabled) if the controller does not read a frequency within 3 seconds after cranking begins.

When a start condition occurs, the controller initiates an auto start sequence. The **SELECTOR** text line displays the **start type** while the **STATE** text line displays **START DELAY**.

- The start condition must remain active throughout the start delay, or the delay will reset to zero.
- When the “START DELAY” expires, the following will occur:
 - The STATE: text line will display “PRESTART DELAY”.
 - The “prestart delay” begins timing.
 - The prestart output turns ON.
- When the “PRESTART DELAY” expires, the following will occur:
 - The STATE: text line will display “CRANK ON/OFF”.
 - The following shutdown circuits are armed:
 - Low Coolant Level
 - High/Low Oil Level
 - High Discharge Pressure
 - Overspeed
 - Overcrank
 - Low Fuel Level (Self-clearing alarm only)
 - XDUCER OOR (Out of Range) HIGH (Only if float backup not selected)
 - XDUCER OOR (Out of Range) LOW (Only if float backup not selected)
 - High System Level (Self-clearing alarm or shutdown)
 - LO System Level (Self-clearing alarm or shutdown)
- The fuel/ECU enable output is turned ON.

NOTE the following:

WAIT FOR ECU: If ECU is selected in engine type, the controller will go through a fixed 10-second delay to allow the ECU to warm up prior to cranking.

A **NO SPEED SIGNAL** shutdown will occur (when enabled) if the controller does not read a frequency within 3 seconds after cranking begins.

- The Alt excite output is turned ON.
- The crank output is turned ON and cycle cranking begins at this point for all engine types.

NOTE: CYCLE CRANKING

If the engine does not start on the first crank, the controller will de-energize the starter output for the rest cycle.

NOTE: OVERCRANK

If the engine fails to start after the number of cranking attempts is exceeded, OVERCRANK will be indicated on the display. The auto start sequence will be stopped, requiring manual reset of the controller. The controller is reset by moving the panel key switch to the "OFF" position.

- When the engine speed rises above the crank stop set point, the following will occur:
 - The STATE: text line will display "WARMUP"
 - The "warm-up delay" begins timing
 - The crank output is turned OFF
 - The prestart output is turned OFF
 - The internal hourmeter begins recording engine run hours
 - The engine is throttled to the "WARMUP RPM" set point

NOTE: When you set the Engine Type, if you selected **Mechanical**, the throttle actuator will throttle the engine. If you set **Electronic**, the ECU throttling is determined by what you selected in the ECU **THROTTLE TYPE**.

- The "shutdown lockout" delay begins timing. When this delay expires, the following shutdowns are armed:
 - Low Oil Pressure
 - High Engine Temperature
 - Loss of Speed
 - ALT Fail/Low Bat

NOTES

If the engine speed drops below the "crank stop" set point before the "shutdown lockout" delay expires, the "re-crank" delay begins timing. When this delay expires, cycle cranking will resume.

If the engine speed drops below the "crank stop" set point after the "shutdown lockout" delay expires, the engine will be shutdown on LOSS OF SPEED.

NOTE: If **Electronic** is selected for **Engine Type**, the ECU will control and arm engine shutdowns. The exceptions are any shutdowns external to the ECU, in which case the controller will arm engine shutdowns.

- When the “warm-up delay” expires, the following will occur:
 - The STATE: Text line will display “FILL MODE”
 - The “fill mode” delay begins timing, and the engine is throttled to and remains at the “minimum RPM” set point
- When the “fill mode” delay expires the following will occur:
 - The engine is released to auto throttle determined by what is selected in the “system throttle type”
 - The STATE: text line will display “AT LOAD”
 - The “at load” delay begins timing
 - When the “at load” delay expires, the LOW DISCHARGE PRESSURE shutdown is armed (if selected)

Stop Sequence

- When a stop condition occurs, the controller initiates an auto stop sequence.
 - The STATE: text line will display “STOP DELAY”.
 - The stop condition must remain active throughout the stop delay, or the delay will reset to zero.
- When the “stop delay” expires, the following occurs:
 - The SELECTOR: text line will display “AUTO” and the STATE: text line will display “COOLDOWN”
 - The engine is throttled to the cooldown RPM set point
 - The “low discharge pressure” shutdown is ignored
- When the “cooldown delay” expires, the following will occur:
 - The SELECTOR: text line will display “AUTO” and the STATE: text line will display “PANEL READY”
 - The Fuel Output/ECU enable is turned OFF
 - The Alt excite output is turned OFF
 - The internal hour meter stops recording engine run hours
 - All shutdowns are ignored
 - Controller will “Go to Sleep” after 30 minutes of inactivity once engine has shutdown to conserve battery life. The controller will awake once any key is pressed or input is enabled (This is Standby Mode)
 - The controller is now waiting and ready for another start sequence to occur

Manual Start/Stop Sequence

There is only one start option in Manual Mode.

Start Sequence

- When you place the AUTO-OFF-MAN key switch in the **MAN** position (with no failures present) the SELECTOR text line will display **MAN**. The STATE text line will display **PANEL READY**.
- When the key is turned to the MAN position and ECU is selected for engine type, the ECU enable output turns ON for a period of 5 minutes. After a 5-minute period of inactivity without a start signal or key press, the output becomes inactive. This has no effect on the start sequence if **Mechanical** is selected as the engine type.
 - The following shutdown/alarm circuits are armed:
 1. **LOW FUEL ALARM** (if set point is above 0%).
 2. **LOW FUEL SHUTDOWN** (if set point is above 0%). (fuel level factory default on aux. 1 input)

NOTE: A **NO SPEED SIGNAL** shutdown will occur (when enabled) if the controller does not read a frequency within 3 seconds after cranking begins.

- To achieve a start condition, press the green start key. This will initiate the “prestart delay” after the start key is pressed, the following will occur:
 - The STATE: text line will display “PRESTART DELAY”
 - The “prestart delay” begins timing.
 - The prestart output turns ON.
- When the “PRESTART DELAY” expires, the following will occur:
 - The STATE: text line will display “CRANK ON/OFF”.
 - The following shutdown circuits are armed:
 - Low Coolant Level
 - High/Low Oil Level
 - High/Low Discharge Pressure
 - Overspeed
 - Overcrank
 - Low Fuel Level (Self-clearing alarm only)
 - Xducer OOR (Out of Range) High, (Only if float backup not selected)
 - Xducer OOR (Out of Range) Low, (Only if float backup not selected)
 - High System Level (Self-clearing alarm or shutdown)
 - Lo System Level (Self-clearing alarm or shutdown)
 - Auxiliary 1 (configurable)

- If the Fuel/ECU Enable output is not already ON, the Fuel/ECU Enable will be turned ON.

NOTES:

WAIT FOR ECU. If ECU is selected in engine type, the controller will go through a fixed 10-second delay to allow the ECU to warm up prior to cranking.

A **NO SPEED SIGNAL** shutdown occurs (when enabled) if the controller does not read a frequency within 3 seconds after cranking begins.

- The Alt excite output is turned ON.
- The crank output is turned ON and cycle cranking begins at this point for all engine types.

NOTES

CYCLE CRANKING - If the engine does not start on the first crank, the controller will de-energize the starter output for the rest cycle.

OVERCRANK - If the engine fails to start after the number of cranking attempts is exceeded, OVERCRANK will be indicated on the display. The auto start sequence will be stopped, requiring manual reset of the controller. The controller is reset by moving the panel key switch to the "OFF" position.

- After the crank cycle has finished, the following will occur:
 - The STATE text line displays "AT LOAD".
 - The "shutdown lockout" delay begins timing. When this delay expires, the following shutdowns/alarms are armed:
 - ALT FAIL/LOW BAT.

Stop Sequence

- When the red stop key is pressed, the following will occur:
 - The SELECTOR: text line will display "MAN" and the STATE: text line will display "COOLDOWN".
 - The engine is throttled to a cooldown RPM set point by the operator.

NOTE: If you do not manually throttle down the engine, it will not idle down in COOLDOWN before the engine is shut down.

- The "low discharge pressure" shutdown is ignored.

- When the “cooldown delay” expires, the following will occur:
The SELECTOR text line will display “AUTO” and the STATE text line will display “PANEL READY”.
 - The fuel/ECU enable is turned OFF.
 - The Alt excite output is turned OFF.
 - The internal hourmeter stops recording engine run hours.
 - All shutdowns are ignored.
 - When the engine is shutdown, the Controller will “Go to Sleep” after 30 minutes of inactivity to conserve battery life. The controller ‘wakes’ once any key is pressed or input is enabled. This is Standby Mode.
 - The controller is now waiting and ready for another start sequence to occur.

Special Features

Shutdown History

The Controller stores the last ten (10) shutdowns that have occurred due to system malfunctions. This record is found in the P-numbers with the date and time stamp of the shutdown. The Shutdown history screen also displays the last 5 shutdowns without date and time stamping.

Float Backup

- If the level transducer fails high or low, a shutdown occurs.
- If the float backup feature is enabled, a shutdown will not occur and the controller will start and stop on floats.
- If the engine is already running, it will remain running until a float stop occurs. During backup float operation, the engine is throttled to the maximum RPM set point.

NOTE: This feature remains in effect until the controller is reset, even if the transducer comes back into range. The start/stop and throttle types will have to be set back to TRANSDUCER to resume normal operation.

Standby Mode

Standby Mode will occur when the engine is not running and the controller has not seen any activity for 30 minutes. The standby mode will turn OFF the LCD backlight and heater while in this mode. Any activity will take the controller out of standby mode into active or ready state (e.g., Start condition becomes active or operator presses a key on the membrane).

Menus

The EMS PRO LITE has S-number, P-number, and M-number menus. This section contains a table for each number type that lists available numbers and a description of the function of each number. See the **Entry Code Supplement** for information on accessing the number menus.

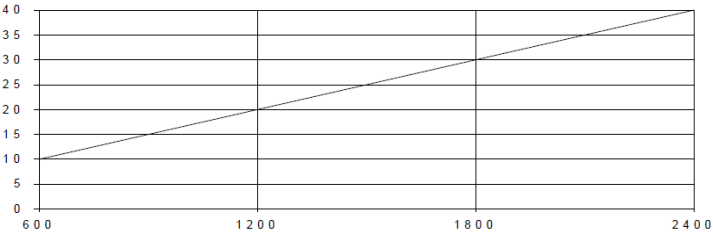
S-Number Description and Listing

The S-numbers are the adjustable variables used for customizing the controller to your specific application. You must set S-numbers before trying to use the controller.

The S-numbers shown on your controller depend on what is selected for numbers: S35, S36, S37, S38, S39, S40, and S73.

S-#	Description
S0	Manual 'EXIT' from the S-number setup mode. Press "menu to exit"
S1	Set Time Minutes To adjust the minute portion of the Real Time Clock.
S2	Set Time Hours: To adjust the hour portion of the Real Time Clock.
S3	Set Date Day: To adjust the day portion of the date display.
S4	Set Date Month: To adjust the month.
S5	Set Date Year: To adjust the year.
S6	Set Day of Week: Adjusts day of week Sunday through Saturday. Day advances with date.
S7	SPEED CALIB: (Note - S7 is only visible if S38 = Mechanical.) This setting is used to calibrate the speed signal so that the controller will display engine RPM. Simply enter the number of Pulses per revolution the magnetic pickup or alternator supplies to the controller. Another way to set this variable is to get the engine running at a known RPM and then change the number until the top line matches your known RPM. The resulting number is the pulses per revolution. Factory set to 120.

S-#	Description
S8	OVERSPEED: This setting allows you to enter the highest speed the engine can run before damage is caused. If the controller senses that the engine has exceeded this speed, it will signal the engine to shutdown. Factory set to 2000.
S9	LOCKOUT DELAY: This delay is used to ignore conditions such as low oil pressure when the engine first starts to allow the pressure time to reach its normal operating range (adjustable from 1 to 60 seconds). Factory set to 30.
S10	LOP @ LOW SPD: The EMS PRO LITE Controller gives you two oil-pressure shutdown-points. For engines that develop very little oil pressure at an idle, you put a lower shutdown setting in this set point. The controller automatically changes the shutdown point between the Low Speed Shutdown point and the High Speed Shutdown point. Factory set to 15.
S11	LOP @ HI SPD: This set point is the higher oil-pressure shutdown-point that is referred to in LOP @ LOW SPD (S10) above. This is the point at which you want the engine to shutdown during normal high-speed engine operation. By shutting down the engine at a higher oil pressure, you can avert damage that could be caused by waiting to shut down the engine at the lower set point needed to accommodate an idle. Factory set to 30.
S12	LOP LO SPEED: Set this to your engine idle speed. If the engine is running at this speed, an idle for example, and the oil pressure reaches the set point selected in S10, the controller will initiate an automatic shutdown. Factory set to 600.

S-#	Description
S13	<p>LOP HI SPEED: Set this to your engine maximum speed. If the engine is running at this speed, and the oil pressure reaches the set point selected in S11, the controller will initiate an automatic shutdown. Factory set to 1600.</p>  <p>The Graph above shows how the set point changes between your high-speed set point and low-speed set point. As the engine speed increases, the controller automatically raises the oil-pressure shutdown set point along a straight line between the two set points you entered.</p>
S14	<p>HI ENG TEMP: Adjust this setting to the engine-jacket water temperature you do not want to exceed. If the controller senses a temperature higher than this set point, it will initiate an automatic shutdown. Factory set to 220.</p>
S15	<p>LOW FUEL LEVEL: Enter in the fuel level that will cause a self-clearing alarm to occur. This alarm is disabled when set to 0%. Factory set to 0%. (see S76 and S77 for aux.1 input configuration)</p>
S16	<p>LOW FUEL SHUTDOWN: Enter the fuel level that will cause a shutdown to occur. This alarm is disabled when set to 0%. Factory set to 0%.(see S76 and S77 for aux.1 input configuration)</p>
S17	<p>ALT FAIL/LOW BAT: Enter in the alternator fail/low battery-voltage alarm value that will cause a self-clearing alarm to occur. When the alarm is active, it must increase 0.2 VDC above this set point to clear. Factory set to 13.0 VDC.</p>
S18	<p>WARMUP DLY: You can adjust this variable to the number of seconds you want your engine to warm-up before it engages the clutch and throttles up to an at load condition (adjustable from 1 to 9,999 seconds). Factory set to 180.</p>

S-#	Description
S19	COOLDOWN DLY: You can adjust this variable to the number of seconds you wish to cool down your engine before it shuts OFF after a stop signal is received (adjustable from 1 to 9,999 seconds). Factory set to 180.
S20	CRANK TIME: Set this delay to the desired amount of time you want each engine-cranking attempt to last. Consult your engine manual for recommended cranking and resting times (adjustable from 1 to 30 seconds). Factory set to 10.
S21	REST TIME: Set this delay to the desired amount of time you want each rest period between cranking attempts to last. Consult your engine manual for recommended resting and cranking times (adjustable from 1 to 30 seconds). Factory set to 10.
S22	RECRANK DELAY: This delay is used to adjust the amount of time the controller will wait for the engine to stop moving before attempting another crank if a false start occurs. During a false start, the engine starts but then dies before the LOCKOUT DELAY (S9) has expired (adjustable from 1 to 30 seconds). Factory set to 10.
S23	CRANK STOP RPM: This RPM set point is used to adjust where the controller releases the starter during cranking. Set this to the RPM the engine attains just as it starts. Set this way, the starter is not unnecessarily engaged after the engine starts. This is how the controller senses whether the engine is running or not. Factory set to 300.
S24	CRANK ATTEMPTS: Set the number of attempts you would like the controller to try an engine start. If the engine fails to start after the number of attempts you have selected, it will fail and display OVERCRANK on the front display. This shutdown requires a manual reset. Factory set to 6.
S25	WARMUP RPM: This is the engine RPM the controller will throttle the engine to during warm-up in auto mode. Consult the engine manual for the optimum warm-up speed. (adjustable from 1 to 9,999 seconds) Factory set to 600.
S26	COOLDOWN RPM: This is the engine RPM the controller will throttle the engine to during cooldown. Consult the engine manual for the optimum cooldown speed. Factory set to 600.
S27	MIN ENG RPM: When throttling in the AT LOAD state, the engine will not throttle below this set point. Factory set to 750.

S-#	Description
S28	MAX ENG RPM: When throttling in the AT LOAD state, the engine will not throttle above this set point. Factory set to 1600.
S29	RATE INC RPM: This set point is used to customize how fast or slow the controller will increase the engine RPM while throttling. Experiment with this number until the proper throttling is achieved. (All engines) Factory set to 10.
S30	RATE DEC RPM: This set point is used to customize how fast or slow the controller will decrease the engine RPM while throttling. Experiment with this number until the proper throttling is achieved. (All engines) Factory set to 10.
S31	THR MIN PULS: (S31 is only visible if S40 = Mechanical.) This set point is used to allow further customization of the way controller throttles the engine. Higher numbers will cause the throttling outputs to stay active for longer periods of time when the system is throttling either up or down. If the engine is hunting then lower the value. If the engine never reaches the set point then increase the value (Used with MECHANICAL engine throttle type S40). Factory set to 8400.
S32	THR FDBK DLY: This set point is used to adjust the amount of time the controller waits to sample the change made by the previous throttle pulse. If the system pressure, for example, takes a long time to change based on engine speed changes, this set point should be increased. However, if the system pressure responds quickly then set the variable to a smaller value. (Used with MECHANICAL engine throttle type S40) Factory set to 2.
S33	THR SENSITIVITY: (S33 is visible only if S40 = Mechanical.) This set point adjusts the throttle sensitivity when it closes in on the desired set point. Higher numbers cause it to make coarser signal adjustments when approaching a set point than lower numbers. This set point is used to keep the controller from overshooting or undershooting the set point. Lower the number if the controller is hunting. Raise the value if the controller does not achieve the desired set point. (Used with MECHANICAL engine throttle type S40) Factory set to 700.

S-#	Description
S34	SET ADJ DLY: This delay allows the controller to stop adjusting the engine RPM for this delay. It allows for a settling time after making a speed adjustment (adjustable from 1 to 9,999 seconds). (All engines) Factory set to 1.
S35	<p>STRT/STP SEL: Enter the type of auto start/stop required: FLOATS or TRANSDUCER. Factory set to FLOATS.</p> <p>When set to FLOATS:</p> <ul style="list-style-type: none"> • Empty: Wire one side of a N.O. low float to digital input 3. Wire one side of N.O. high float to digital 4. • Fill: Wire one side of N.C. low float to digital input 4. Wire one side of N.C. high float to digital input 3. The opposite side of the contacts should be wired to common ground.
S36	SYS THR TYPE: Enter the type of system auto throttling required, MAXIMUM RPM, TRANSDUCER, or LOCAL THROTTLE. Factory set to MAX RPM.
S37	XDUCER TYPE: (S37 is only visible if S35 = Transducer.) Enter the transducer type used: NONE, PRESSURE CONTROL, LEVEL CONTROL. Factory set to NONE.
S38	ENGINE TYPE: Enter "ECU-J1939" for diesels with ECU/J1939 communications. Enter "MECHANICAL" for engines that do not have an ECU-J1939. When "ECU-J1939" is selected, engine parameters are read from the ECU-J1939. Factory set to ECU.
S39	ECU HOUR SELECT: When set to "ECU-J1939" the hourmeter display will show data from SPN247. If set to "SYSTEM", the hourmeter display shows the Internal Hourmeter. Factory set to ECU-J1939. (Note: This display is only visible if "ENGINE TYPE" (S38) is set to ECU-J1939. If S38 is set to MECHANICAL, the hourmeter display will default to the internal hourmeter.)
S40	ENG THR TYPE: Enter MECHANICAL , ECU-J1939 , or ANALOG for the engine throttle type. MECHANICAL uses digital outputs for throttling with both ECU-J1939 and Mechanical engine types, while J1939 only works if you selected ECU-J1939 in S38. ANALOG is reserved for future enhancements. Factory Set to J1939. (Note: When using MECHANICAL THR Type, refer to S31-S33 for setup.)

S-#	Description
S41	SENDER TYPES: (S41 is only visible if S38=Mechanical.) This set point allows you to select between Murphy-resistive sending units or VDO-resistive sending units for Pressure and Temperature senders. Factory set to MURPHY.
S42	START DLY: Set this delay on engine start to the number of seconds that the start signal must be present before the controller accepts it and initiates an auto start sequence (adjustable from 1 to 9,999 seconds). Factory set to 1.
S43	PRESTART DLY: The time the prestart output is turned ON prior to cranking the engine (adjustable from 1 to 9,999 seconds). Factory set to 1.
S44	STOP DLY: Set this delay on engine stop to the number of seconds that the stop signal must be present before the controller accepts it and initiates a stop sequence (adjustable from 1 to 9,999 seconds). Factory set to 1.
S45	START PSI: (S45 is only visible if S35 = Transducer & S37 = Pressure.) When "pressure" is selected in the start / stop type, an auto start will occur when the discharge pressure drops to this set point. (adjustable from 0 to 1000 PSI) Factory set to 40.
S46	STOP PSI: (S46 is only visible if S35 = Transducer & S37 = Pressure.) When "pressure" is selected in the start / stop type, an auto stop will occur when the discharge pressure rises to this set point. (adjustable from 0 to 1000 PSI) Factory set to 60.
S47	MAINTAIN PSI: (S47 is only visible if S35 = Transducer & S37 = Pressure.) When "pressure" is selected in the throttle type, the engine will be throttled between the "minimum" and "maximum" rpm set points to maintain this pressure. (adjustable from 0 to 1000 PSI) Factory set to 50.
S48	DEADBAND PSI: (S45 is only visible if S35 = Transducer & S37 = Pressure.) When PRESSURE is selected in the throttle type, no throttling will occur while the pressure is in the deadband. This set point extends above and below the maintain set point (adjustable from 0 to 50 PSI). Factory set to 2.

S-#	Description
S49	HI DISCH PSI: (S45 is only visible if S35 = Transducer & S37 = Pressure.) When "pressure" is selected in either the start / stop or throttle type, an immediate shutdown will occur if the pressure rises to this set point. (adjustable from 0 to 1000 PSI) Factory set to 90. Entering "0" disables this function. When enabled, pressure is displayed on the front display regardless what is entered in S35 and S36.
S50	LOW DISCH PSI: (S45 is only visible if S35 = Transducer & S37 = Pressure.) When "pressure" is selected in either the start / stop or throttle type, an immediate shutdown will occur if the pressure drops to this set point (adjustable from 0 to 1000 PSI) Factory set to 25. Entering "0" disables this function. When enabled, pressure is displayed on the front display regardless what is entered in S35 and S36.
S51	AT LOAD DLY: (S45 is only visible if S35 = Transducer & S37 = Pressure.) This delay begins timing after the warm-up delay expires. The Low Discharge Pressure shutdown is armed when this delay expires (adjustable from 1 to 9,999 seconds). Factory set to 180.
S52	FILL MODE DLY: (S45 is only visible if S35 = Transducer & S37 = Pressure.) This delay begins timing after the warm-up delay expires. The engine is held at the minimum RPM set point until this delay expires (adjustable from 1 to 9,999 seconds). Factory set to 0.
S53	PRESSURE MAX: (S45 is only visible if S35 = Transducer & S37 = Pressure.) Set this to the maximum value of the pressure transducer. For example, if the transducer range is 0-100 PSI, enter 100. (adjustable from 0 to 5000 PSI) Factory set to 100 PSI.
S54	PRESSURE MIN: (S45 is only visible if S35 = Transducer & S37 = Pressure.) Set this to the minimum value of the pressure transducer. For example, if the transducer range is 0-100 PSI, enter 0. Factory set to 0.
S55	PSI XDUCER MAX CNT: (S45 is only visible if S35 = Transducer & S37 = Pressure.) With 5 VDC or 20mA applied to the analog channel, make the top line read the same value as the bottom line. Factory set to 904. (This is the setting for 4-20mA signal) If the transducer is 0-5 VDC, enter 1023 in this set point.

S-#	Description
S56	PSI XDUCER MIN CNT: (S45 is only visible if S35 = Transducer & S37 = Pressure.) With 1 VDC or 4mA applied to the analog channel, make the top line read the same value as the bottom line. Factory set to 181. (If transducer is 0-5 VDC, enter 0 in this set point)
S57	START LEVEL: (S57 is only visible if S35 = Transducer and S37 = Level.) When "level" is selected in the start / stop type, an auto start will occur when the system level reaches this set point. (adjustable from 0 to 100.0 FT) Factory set to 15.0 FT.
S58	STOP LEVEL: (S58 is only visible if S35 = Transducer and S37 = Level.) When "level" is selected in the start / stop type, an auto stop will occur when the system level reaches this set point. (adjustable from 0 to 100.0 FT) Factory set to 5.0 FT.
S59	MAINTAIN LEVEL: (S59 is only visible if S35 = Transducer and S37 = Level.) When "level" is selected in the throttle type, the engine will be throttled between the "minimum" and "maximum" rpm set points to maintain this level. (adjustable from 0 to 100.0 FT) Factory set to 10.0 FT.
S60	DEADBAND LEVEL: (S60 is only visible if S35 = Transducer and S37 = Level.) When "level" is selected in the throttle type, no throttling will occur while the level is in the deadband. This set point extends above and below the maintain set point. (adjustable from 0 to 100.0 FT) Factory set to 1.0 FT.
S61	LEVEL OFFSET: (S61 is only visible if S35 = Transducer and S37 = Level.) Enter in feet the distance from the bottom of the tank or sump to the transducer. This value is added to the actual level reading. Factory set to 0.0

S-#	Description
S62	<p>LEVEL TYPE: (S62 is only visible if S35 = Transducer and S37 = Level.) Enter type of level control required. The choices are “Empty”, “Fill”, or “Proportional”. Empty starts on high and stops on low. Fill starts on low and stops on high. S57 and S58 should be set accordingly. Proportional throttling is dedicated to EMPTY. The engine is throttled to the maximum rpm set point if the level is at or above the start level. As the level drops, the engine will be throttled down proportionally. When the level drops to the stop set point, the engine will be at the minimum rpm set point, and an auto stop will occur. Factory set to Empty.</p> <p>NOTE: This set point does not apply to FLOATS.</p>
S63	<p>HIGH LEVEL: (S63 is only visible if S35 = Transducer and S37 = Level.) When “empty” is selected in S62, a self-clearing alarm will occur if the level reaches this set point. A shutdown occurs with “fill” in S62. Factory set to 20.0 FT.</p>
S64	<p>LOW LEVEL: (S64 is only visible if S35 = Transducer and S37 = Level.) When “fill” is selected in S62, a self-clearing alarm will occur if the level reaches this set point. A shutdown occurs with “fill” in S62. Factory set to 1.0 FT.</p>
S65	<p>LEVEL MAX: (S65 is only visible if S35 = Transducer and S37 = Level.) Set this to the maximum value of the level transducer. For example, if the transducer range is 0-10.0 FT, enter 10.0. (adjustable from 0 to 100 FT) Factory set to 20 FT.</p>
S66	<p>LEVEL MIN: (S66 is only visible if S35 = Transducer and S37 = Level.) Set this to the minimum value of the level transducer. For example, if the transducer range is 0-10.0 FT, enter 0. (adjustable from 0 to 100 FT) Factory set to 0.</p>
S67	<p>LVL CNT MAX: (S67 is only visible if S35 = Transducer and S37 = Level.) With 5 VDC or 20mA applied to the analog channel, make the top line read the same value as the bottom line. Factory set to 904. (This is the setting for 4-20mA signal). If the transducer is 0-5 VDC, enter 1023 in this set point.</p>

S-#	Description
S68	LVL CNT MIN: (S68 is only visible if S35 = Transducer and S37 = Level.) With 1 VDC or 4mA applied to the analog channel, make the top line read the same value as the bottom line. Factory set to 181. (If transducer is 0-5 VDC, enter 0 in this set point)
S69	LVL XDCR OOR HI: (S69 is only visible if S35 = Transducer and S37 = Level.) When “level” is selected in the start / stop (S35) or throttle type (S36), and “No” is selected in the float backup enable (S71), a shutdown will occur if the transducer’s raw count reaches this set point. Factory set to 1000. This feature is not available if the transducer is 0-5 VDC.
S70	LVL XDCR OOR (out of range) LO: (S70 is only visible if S35 = Transducer and S37 = Level.) When “level” is selected in the start / stop (S35) or throttle type (S36), and “No” is selected in the float backup enable (S71), a shutdown will occur if the transducer’s raw count reaches this set point. Factory set to 100. This feature is not available if the transducer is 0-5 VDC.
S71	ENBL FLT BCKP: (Enable Float Backup) (S71 is only visible if S35 = Transducer and S37 = Level.) The choices are “YES” or “NO”: “YES” will cause the float switches to take control of the system if the transducer fails on OOR high or low. “NO” causes a shutdown if the transducer fails on OOR high or low. During float backup operation, the controller will remain on float operation until the controller is manually reset. Factory set to No.
S72	UNIT SYSTEM: Enter either Metric or English for displayed values. Factory set to English.
S73	TIER RATING: Set to either Tier3 or Tier4 for electronic engines. Factory set to Tier3.
S74	TIER4 STATE: This option is only available if S73 (Tier Rating) is set to Tier 4. Select the Regen option that best suits your application. The options to choose are AUTO DPF REGEN or INHIBIT DPF REGEN. Factory set to INHIBIT DPF REGEN.

S-#	Description
S75	<p>REQUEST DPF REGEN: This option is only available if: S73 (Tier Rating) is set to Tier 4 S38 (Engine Type) is set to ECU Engine RPM is above S23 (Crank Stop RPM) ECU output (Output 1) is ON. Selecting YES initiates a regen. After pushing YES, the display will go from NO to YES when the regen is complete. Allow the controller to return to NO before exiting the S-number. The controller will remain at this S number until the regen is complete. Factory set to NO.</p>
S76	<p>AUX. SWITCH 1: Enter either N.O. or N.C. for external switch type Factory set to N.O.</p>
S77	<p>AUX. CONFIG 1: Enter either FUEL LEVEL or AUX 1 Shutdown Factory set to FUEL LEVEL.</p>

P-Number Description and Listing

The **EMS PRO LITE** Controller has P-numbers in addition to the S-numbers previously configured. These are accessed in the same manner but using a different access code. See the Entry Code Supplement for this code number.

P-Number	Name	Description
P0	MENU	Press to exit.
P1	SUN SEL	Set this to YES if you want to start your engine on SUNDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P2	MON SEL	Set this to YES if you want to start your engine on MONDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P3	TUE SEL	Set this to YES if you want to start your engine on TUESDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.

P-Number	Name	Description
P4	WED SEL	Set this to YES if you want to start your engine on WEDNESDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P5	THR SEL	Set this to YES if you want to start your engine on THURSDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P6	FRI SEL	Set this to YES if you want to start your engine on FRIDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P7	SAT SEL	Set this to YES if you want to start your engine on SATURDAY. Set it to NO if you want to lock out the start time on this day. Factory set to NO.
P8	CLK A RUN TM	This set-point lets you set in the amount of time you would like your engine to run on your first start time. You have three available start times per day (A, B, and C). Factory set to 0.0.
P9	CLK A HR	This set-point lets you set the clock hour you would like to start in 24hr format. For example, if you want to start in the 3 o'clock in the afternoon hour, set it to 15. Factory set to 00.
P10	CLK A MIN	This set-point lets you set the clock minute you would like to start. For example, if you want to start at 8:30 in the morning, you would adjust this until it read 30 in the minute portion Factory set to 00.
P11	CLK B RUN TM	This set-point lets you set in the amount of time you would like your engine to run on your first start time. You have three available start times per day (A, B, and C). Factory set to 0.0.
P12	CLK B HR	This set-point lets you set the clock hour you would like to start in 24hr format. For example, if you want to start in the 3 o'clock in the afternoon hour, set it to 15. Factory set to 00.
P13	CLK B MIN	This set-point lets you set the clock minute you would like to start. For example, if you want to start at 8:30 in the morning, you would adjust this until it read 30 in the minute portion Factory set to 00.

P-Number	Name	Description
P14	CLK C RUN TM	This set-point lets you set in the amount of time you would like your engine to run on your first start time. You have three available start times per day (A, B, and C). Factory set to 0.0.
P15	CLK C HR	This set-point lets you set the clock hour you would like to start in 24hr format. For example, if you want to start in the 3 o'clock in the afternoon hour, set it to 15. Factory set to 00.
P16	CLK C MIN	This set-point lets you set the clock minute you would like to start. For example, if you want to start at 8:30 in the morning, you would adjust this until it read 30 in the minute portion Factory set to 00.
P17	DISCH PSI @ SHDN (IF SELECTED)	If Pressure Start/Stop is selected, this shows what the discharge pressure was when the controller initiated the last failure shutdown.
P18	LEVEL @ SHDN (IF SELECTED)	If Level Start/Stop is selected, this shows what the system level was when the controller initiated the last failure shutdown.
P19	OIL PSI @ SHDN	Shows what the engine oil pressure was when the controller Initiated the last failure shutdown.
P20	ENG TEMP @ SHDN	Shows what the engine-jacket water temperature was when the controller initiated the last failure shutdown.
P21	FUEL LVL @ SHDN	Shows what the engine fuel level was when the controller initiated the last failure shutdown.
P22	RPM @ SHDN	Shows what the engine speed was when the controller initiated the last failure shutdown.
P23	LAST SHUTDOWN	Shows what caused the last failure shutdown and the time (in running hours) that it occurred.
P23 to P32	##th SHUTDOWN	P23to P32 store the 2nd through the 10th cause of failure shutdown with the date and time the shutdown occurred.

M-Number Description and Listing

M-0	A Manual EXIT from the S-number setup mode. Press to exit	
M1	RS232 Slave	This is Modbus slave address for the RS232 port. Factory set to 1.
M2	RS485 Slave	This is Modbus slave address for the RS485 port. Factory set to 1.

M3	Hex View	For reading ram locations from 0000H to FFFFH. Factory set to 00H.
M4	Force Output	Using the down arrow to move the cursor under the correct output. From left to right, outputs are 1-7. Turn on the output using the up arrow button, and off by using the down arrow.
M5	Force LED	This allows the user to force the LEDs ON when they are not active. This action is to ensure the LEDs are working.
M6	An Out 1 Duty	The VDC on the analog out channel can be increased and decreased by changing the duty value. Factory set to 0.
M7	Factory Setups	Select YES to force factory settings into all of the applicable S, P, and M numbers. After pressing YES, the display will go from NO to YES. Allow the controller to return to NO before exiting the M number.
M8	SCADA ALARM	Selecting yes will enable the SCADA comm. alarm. Factory set to NO.
M9	SCADA AL DLY	This delay is only used if the SCADA alarm enable (M8) is set to YES. There is only one set point for both ports (232 and 485), but they each have their own timers. The delay starts timing on power up of the unit. The delay is restarted anytime a MODBUS packet is received on the associated port. If the delay times-out an alarm only message is displayed: SCADA FAILURE. This warning message ends as soon as MODBUS packets resume on the port.
M10	SYS V MAX	This number calibrates the controller to the incoming battery voltage. Improper readings may occur on sender inputs if this set point is not 30.5. Factory set to 30.5.
M11	Run HRS RST	This is the 1000 portion of the engine running hourmeter. This set point can be used reset the hourmeter to zero, or enter the correct running hours in 1000's. Factory set to 0.
M12	Tenth HR RST	This is the 100.0 portion of the engine running hourmeter. This set point can be used reset the hourmeter to zero, or enter the correct running hours in 100.0's. Factory set to 0.
M13	Oil P Lockout	This is a bubble timer to ignore fluctuations in the oil pressure reading and prevent false shutdowns. (adjustable from 1 to 4 seconds) Factory set to 1.
M14	Can 0 Address	This is the source address for can port 0. Factory set to 3.

M15	Can 0 Arbitrary	This is to allow the can 0 source address to be arbitrary, beginning at whatever is set in M14. Factory set to CAPABLE YES.
M16	CAN 0 TERM RES	This is one of the two CAN ports on the Controller. M20 is the other. Factory set to YES.
M17	Lost Can 0 DLY	If can data is not present throughout this delay, a J1939 com failure shutdown will occur (adjustable from 1 to 10 sec.). Factory set to 3.
M18	Can 1 Address	This is the source address for can port 1. Factory set to 234.
M19	Can 1 ARBITRA	This is to allow the can 1 source address to be arbitrary, beginning at whatever is set in M18. Factory set to CAPABLE YES.
M20	Can1 TERM RES	This is one of the two CAN ports on the Controller. M16 is the other. Factory set to YES.
M21	Lost Can 1 DLY	If can data is not present throughout this delay, a J1939 com failure shutdown will occur (adjustable from 1 to 10 sec.). Factory set to 3.
M22	TSC1 SCAN	This sets an auto scan feature for the controller to find the source address. The engine is set for TSC1 throttling.
M23	DROOP VALUE	This display shows the state of the droop factor. The state is calculated at-load, and has the following values: NO - this means that droop is not used on the ECU. YES -This means that droop is used on the ECU. UNKNOWN - This means the program was not able to determine the use of droop. (This value is set by the controller and is not adjustable.) Factory set to YES.
M24	DROOP VALUE	DROOP VALUE ENABLE: This is reserved for future disabling of auto droop calculations. Factory set to NO.
M25	Config Mode	Selecting YES allows the download and upload on RS232. Factory set to NO.
M26	No Speed SIG	Selecting yes enables the no speed signal shutdown. This shutdown occurs if a speed signal is not present in the first 3 seconds of the first crank attempt. Factory set to NO.
M27	THROT Dead	When throttling across the can bus, throttling will stop when the actual rpm is within this value from the target. Set point (adjustable from 1 to 100 rpm's). Factory set to 10.
M28	Backlight	Select NO to turn the backlight OFF . Factory set to Backlight ON .

M29	DSP Contrast	Lighten the text to a minimum of 8 or darken the text to a maximum of 35. Factory set to 25.
M30	Heater	The heater is regulated by the Controller that adjusts the heater depending on the ambient temperature. Turning this to ON could damage the Controller. Factory set to Heater OFF .
M31	Power ECU	Selecting yes allows ECU data to be shown on the front display. Selecting YES turns on the ECU enable output for 3 minutes. Factory set to YES.
The following are Raw Count displays. Display settings are not changeable.		
M32	Inputs 1-4	An X means the input is turned on. I1-8 0000 0000.
M33	Outputs 1-12	An X means the output is turned on. O1-12 0000 0000 0000.
M34	LED 1-2	An X means the LED is turned on. L1-2 00.
M35	Analog in 0	This displays the raw count value of analog 0. Range 0-1023.
M36	Analog in 1	This displays the raw count value of analog 1. Range 0-1023.
M37	Analog in 2	This displays the raw count value of analog 2. Range 0-1023.
M38	Analog in 5	This displays the raw count value of analog 5. Range 0-1023.
M39	Analog in 6	This displays the raw count value of analog 6. Range 0-1023.
M40	Analog in 7	This displays the raw count value of analog 7. Range 0-1023.
M41	Analog in 9	This displays the raw count value of analog 9. Range 0-1023.

Inputs and Outputs

When wiring to the **EMS PRO LITE** Controller, please refer to the schematic (included in the box with the controller) illustrating connector pin outs for the following list of dedicated Inputs & Outputs:

Digital Inputs

Digital Input	Description	Connector
1	Auto Position of Key Switch	
2	Man Position of Key Switch	
3	Float or Start Contact	Pin G 9 Pos. Conn.
4	Float or Start Contact	Pin B 9 Pos. Conn.

Analog Inputs

Analog Input	Description	Sending Unit Type	Connector
1	Engine Temperature Sender	Murphy ES2T or VDO Set in SENDER TYPES (S39) to Default to Murphy Senders.	Pin W, 21 Pos. Conn.
2	Engine Oil Pressure Sender	(Murphy ES2P or VDO). Set in SENDER TYPES (S39h) to Default to Murphy Senders.	Pin X, 21 Pos. Conn.
3	Reserved		
4	Reserved		
5	Auxiliary 1 configurable	Murphy ES2F (factory default)	Pin J, 9 Pos Conn
6	Discharge Pressure Transducer	4-20mA Sending Transducer	Pin 4, 9 Pos Conn. supplies transducer power & can be fused. Pin A, 9 Pos Conn. is transducer input.
7	Reserved		
8	Reserved		
9	System Level Transducer	4-20mA Sending Transducer	Pin D, 9 Pos. Conn. supplies transducer power. Pin H, 9 Pos. Conn. is the transducer input for level.
10	Reserved		
11	Reserved		
12	Reserved		

Digital Outputs

All Outputs are Pilot Duty. The first three outputs (DO 1-3) are B+ FET's rated 8-32VDC at 1Amp. The remaining nine (9) outputs (DO 4-12), are open collector transistor outputs that sink to ground when active, 100 mA, 32 V rated DO 10 drives an internal relay, R2. Consult the engine manufacturer to determine if the current draw is too large and a separate remote relay is needed.

Digital Output	Description	Connector
1	Fuel/Ignition/ECU Enable (B+)	Pin G, 21 Pos. Conn. from R1 relay
2	Reserved	
3	Alt Excite (B+)	
4	Throttle Decrease (Murphy Throttle Actuator AT-03069)	Pin R, 21 Pos. Conn
5	Throttle Increase ((Murphy Throttle Actuator AT-03069)	Pin S 21 Pos. Conn
6	Reserved	
7	Reserved	
8	Prestart (B-)	Pin E, 9 Pos Conn
9	Reserved	
10	Crank (B+)	Pin D, 21 Pos. Conn. from R2 relay
11	Reserved	
12	Reserved	

PCBA Shunts

Reference this section for default positions of the Shunt Jumpers on the PCBA's.

RS485 Terminating Resistor (LK3 Shunt):

This shunt allows a terminating resistor to be used on the RS485 port. (Default ON)

- ON – (Jumper Installed) allows the terminating resistor to be present.
- OFF – (Jumper Removed) removes terminating resistor from the RS485.

Sender Shunt (LK5 Shunt):

This shunt controls sender power (Default ON). This shunt must be installed to use senders. It can be removed when no senders are being used to reduce heat buildup inside the controller. This is only of interest in systems with battery voltage of 12VDC.

- ON – (Jumper Installed) allows sender resistor power for Mechanical engines using senders.
- OFF – (Jumper Removed) When the program is not using senders, this shunt can be removed.

General Information

LCD Contrast Adjustment on Startup

If the front display is not viewable upon power up, the contrast setting may be incorrectly adjusted. To correct this, follow the steps below:

1. Remove power on the unit.
2. Hold in the “Hare” button and apply power.
3. Continue to hold the “Hare” button for at least 2 seconds after power up, and then release it.
4. Look for a counting number in the mid to lower portion of the display. It may take up to 30 seconds for this number to become visible.
5. When the number becomes visible to an acceptable contrast level press the “Hare” button again to store the new setting.

General Wiring Precautions

There are steps that can be taken during initial installation that can increase the life of the unit. These steps may take a few extra minutes to do at the time of installation; but they can save time and expense in the future. Enovation Controls strongly recommends taking these precautionary actions.

Diodes

Place suppression diodes across all inductive loads. These loads typically include pilot relays, solenoid valves, starter solenoids, etc. This helps increase contact life and eliminates a source of electrical interference.

Wire power leads directly to battery post.

This helps minimize noise generated from battery chargers and alternators, and voltage drops during cranking.

Pilot excessive loads

Many of the outputs on the **EMS PRO LITE** Controller are rated for low current, control type loads. Do not run high current loads directly to the controller.

Use stranded wire for hookup

Solid wire transmits vibration and is more likely to crystallize and break when subjected to movement.

Separate AC and DC wiring

Never run AC and DC handling wiring together. AC signals can be coupled into the control circuits leading to erratic operation.

Wire standby battery charger directly to battery

Standby chargers must be wired directly to the battery. Failure to do this may result in erratic operation due to electronic "noise" coupled into the microprocessor.

Special precautions for spark ignition engines

Magnetos and ignition coils produce high voltage and cause high frequency interference. The **EMS PRO LITE** Controller is designed to filter out much of this interference; however, precautions must be taken to protect the controller. Sender and shutdown wiring must be routed away from the magneto and spark coil wiring. Resistor spark plugs and spark plug wires reduce electrical interference and may be required in especially "noisy" environments. An external relay piloted by the ECU/Fuel internal relay will be required if the ignition is to be controlled.

Use shielded cable on magnetic pickup

Shielded cable is recommended for connecting the magnetic pickup to the **EMS PRO LITE** Controller. This helps prevent signal loss and the possible coupling of electrical interference into the relatively sensitive speed sensing circuit. Ground the shield wire on the customer's end.

NOTE: Proper care during installation will help the **EMS PRO LITE** Controller live a long and trouble-free operating life. If for any reason a question arises during installation, feel free to call Enovation Controls Technical Support.

Fuses

There is one 10A fuse installed in the controller. It is on the faceplate and is used for the main power to the panel (Glass SAE type).

Communications

CAN

CAN port designated for J1939 communications.

RS-485

RS-485 port designated for Modbus RTU (slave) for SCADA. Modbus is available on this port using the Modbus map detailed in the Registers section on the following page.

NOTE: Modification to controller is required to use these ports – changes include additional wiring and enclosure modifications.

CPU PCB WIRING INTERFACE LIST (JP5) MOLEX 4 PIN CONNECTOR

EMS PRO LITE Pin Assignment	Hardware Assignment	Program Function Assignment
1	RS-485 +	SCADA
3	RS-485 -	SCADA
2	Ground	
4	Battery +	

RS-232

RS-232 port designated for Modbus RTU (slave) for SCADA and to upload the actual operating program.

NOTE: Modification to controller enclosure is required to use these ports.

CPU PCB Wiring Interface (J2) DB9 Connector

EMS PRO LITE Pin Assignment	Hardware Assignment	Program Function Assignment
2	RS-232 RX	SCADA
3	RS-232 TX	SCADA
5	Ground	
7	RS-232 RTS	
8	RS-232 CTS	

Description

The **EMS PRO LITE** implements a MODBUS RTU style communications protocol. The following describes the communications, and the register and coil implementation for the **EMS PRO LITE**.

Protocol

The **EMS PRO LITE** controller will reply to MODBUS RTU communications. This communications protocol uses RS232 or RS485 standards set to 9600-baud rate, no parity, eight (8) bits and one (1) stop bit.

- MODBUS® function code 03 - Read Holding Register Status: Reads the binary contents of the holding register in the **EMS PRO LITE** controller.
- MODBUS® function code 06 - Preset Single Register: Presets a value into a single holding register.
- MODBUS® function code 16 - Preset Multiple Registers: Presets values in a sequence of holding registers.

Registers

Registers are adjustable or varying data locations within the controller whose value is an integer value not just ON or OFF. They can represent the system analog input for flow or pressure. The registers could be an adjustable system parameter such as delay on start. The following is a list of the registers that can be accessed. The maximum number of registers that can be read at one time is 125. The starting address of the registers is 40001.

NOTE: If a query is made to the **EMS PRO LITE** controller beyond the published amount of registers, the **EMS PRO LITE** controller ignores the message as an invalid query.

REGISTER #	TYPE	DESCRIPTION
40001	Read Only	Running Hours, upper byte.
40002	Read Only	Running hours, lower byte.
40003	Read Only	Engine RPM
40004	Read Only	Battery Voltage. (12.5 will read 125)
40005	Read Only	Oil Pressure.
40006	Read Only	Engine Temperature.
40007	Read Only	System Status: Bits description follows:
		Bit 0 (LSB) Auto Ready: (1) yes, (0) no.
		Bit 1 Prestart Timing: (1) yes, (0) no.
		Bit 2 Start Delay Timing: (1) yes, (0) no.
		Bit 3 Warm-up Delay Timing: (1) yes, (0) no.
		Bit 4 Fill Mode: (1) yes, (0) no.
		Bit 5 At Load: (1) yes, (0) no.
		Bit 6 Stop Delay Timing: (1) yes, (0) no.
		Bit 7 Cooldown Delay Timing: (1) yes, (0) no.
		Bit 8 Common Failure: (1) yes, (0) no.
		Bit 9 Spare.
		Bit 10 Spare.
		Bit 11 Spare.
		Bit 12 Spare.
		Bit 13 Spare.
Bit 14 Spare.		
Bit 15 (MSB) Spare.		

REGISTER #	TYPE	DESCRIPTION
40008	Read Only	Shutdown Status: Bits description follows:
		Bit 0 (LSB) Low Oil Pressure: (1) yes, (0) no.
		Bit 1 High Engine Temperature: (1) yes, (0) no.
		Bit 2 Spare
		Bit 3 Spare
		Bit 4 Loss of Speed: (1) yes, (0) no.
		Bit 5 No Speed Signal: (1) yes, (0) no.
		Bit 6 Overspeed: (1) yes, (0) no.
		Bit 7 Overcrank: (1) yes, (0) no.
		Bit 8 High Discharge Pressure: (1) yes, (0) no.
		Bit 9 Low Discharge Pressure: (1) yes, (0) no.
		Bit 10 High System Level: (1) yes, (0) no.
		Bit 11 Low System Level: (1) yes, (0) no.
		Bit 12 Loss of Pressure Sender: (1) yes, (0) no.
		Bit 13 Spare
		Bit 14 Spare
Bit 15 Spare		
40009	Read Only	Shutdown Status: Bits description follows:
		Bit 0 Reserved
		Bit 1 Low Fuel Level Alarm: (1) yes, (0) no.
		Bit 2 Low Fuel Level Shutdown: (1) yes, (0) no.
		Bit 3 Spare.
		Bit 4 Spare.
		Bit 5 Spare.

REGISTER #	TYPE	DESCRIPTION
40009, cont.	Read only	Bit 6 Spare.
		Bit 7 Spare.
		Bit 8 Spare.
		Bit 9 Spare.
		Bit 10 Spare.
		Bit 11 Spare.
		Bit 12 Spare.
		Bit 13 Spare.
		Bit 14 Spare.
		Bit 15 (MSB) Spare.
40010	Read Only	Discharge Pressure. Current discharge pressure.
40011	Read Only	System Level. Current system level.
40012	Read / Write	Engine Start / Stop. (1) yes, (0) no.
40013	Read / Write	Maximum RPM Set Point.
40014 through 40037	Read Only	Reserved

Entry Code Supplement

WARNING

Knowledge of these codes allows you to set the operating parameters of the controller. You can customize the operation to fit your specific application. Keep this number unknown to anyone you do not want to have access to customization features.

P-NUMBERS

The P-numbers contain clock functions and the shutdown history. The code number is **61**.

S-NUMBERS

The S-numbers contain critical information and control functions. Be sure that only qualified personnel have access to this entry code. The code number is **64**.

M-Numbers

Please call Enovation Controls Technical Support to access this entry code.

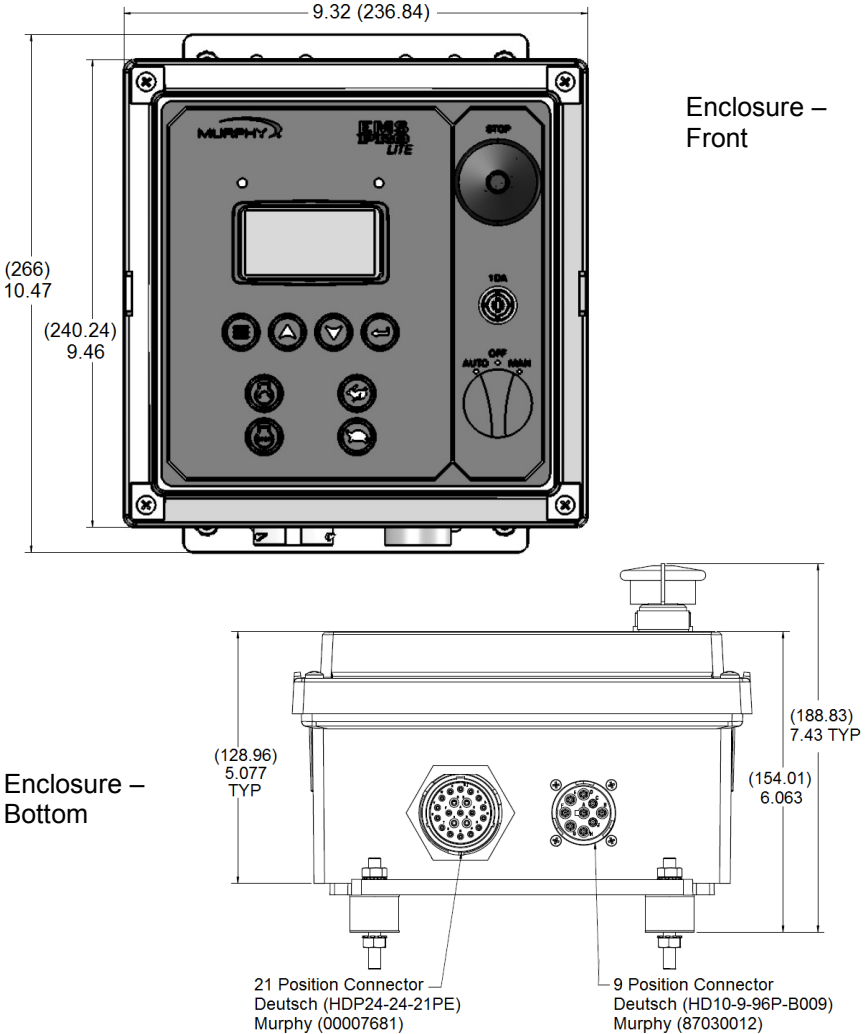
Loading a Program

If a new program is needed, always perform a factory setup after loading into the **EMS PRO LITE**.

Installation

EMS PRO LITE Dimensions












This section contains the EMS PRO LITE dimensions and connection schematics. Mount the **EMS PRO LITE** in a location that is accessible to the operator. Use connection harnesses to connect to the I/O and the engine.



EMS PRO LITE Wiring Diagram

Drawing Notes for the Wiring Diagram (00-02-0814) that is at the center of this manual.

NOTES:

1. ALL WIRE 18 GA WHITE UNLESS OTHERWISE NOTED.
2.  TWISTED WIRES OR SHIELDED, TWISTED WIRES. APPROXIMATELY ONE TWIST PER INCH.
3.  A PILOT RELAY MUST BE USED TO ENGAGE STARTER. RELAY COIL MUST DRAW LESS THAN 5 AMPS.
4.  INSTALL FLYBACK DIODES AS SHOWN TO REDUCE THE POTENTIAL OF VOLTAGE SPIKES DAMAGING SOLID STATE COMPONENTS.
6.  ALTERNATIVELY, FOR DIGITAL INPUTS 3 & 4, (DI3 & 4) THE GROUND (-) CONTACT ON THE N.O. SWITCH CAN BE REPLACED WITH BATTERY POSITIVE.
7.  NUMBERS & LETTERS IN [] REFER TO CONNECTOR POSITION.
8.  RECOMMENDED FW MURPHY TRANSDUCERS.
9.  CUSTOMER SUPPLIED 4-20MA LEVEL TRANSDUCER.
10.  IF ALTERNATOR DRAWS LESS THAN 1 AMP, USE DIODE RATED AT MINIMUM 1 AMP. IF ALTERNATOR DRAWS MORE THAN 1 AMP, A RELAY MUST BE USED.
11.  INSTALL APPROPRIATELY SIZED FUSE OR CIRCUIT BREAKER.
12.  CONNECT SHIELD OF MAGNETIC PICKUP WIRE TO GROUND.
13.  USE BALLAST RESISTOR OF 0.85 - 1.82 OHMS.
14. DO NOT RUN AC AND DC WIRES TOGETHER IN SAME BUNDLE.
15. N.O. = "NORMALLY OPEN".
16. N.C. = "NORMALLY CLOSED".

In addition, the wiring diagram can be found on the Enovation Controls Web site: <http://www.fwmurphy.com/>

Specifications

Operating Voltage: 8 VDC Minimum to 14.4 VDC Maximum (Designed to work on 12 VDC systems).

Operating Temperature: -40° to 80°C (-40 to 176°F)

Storage Temperature: -40° to 80°C (-40° to 176°F)

Environmental Sealing: IP65

Relative Humidity: 95%RH @ 60°F (140°C)

Standby Current: 140mA @ 12VDC for standby current. 600mA Max @ 12VDC when not in standby.

CAN Bus: SAE J1939 Compliant

Enclosure: Polycarbonate NEMA 4 (UL/cUL listed)

Analog Inputs: 6 Analog Inputs designated via program; sender/ground digital 4-20mA, 0-5 VDC.

Digital Inputs: 4 Digital Inputs high/low (Both Battery+ and ground are detected as active inputs. An inactive input floats at approximately 1/2 B+).

Frequency: 1 optically isolated input for speed reference, magnetic pick-up, (2VAC-50VAC RMS, 30-10kHz).

Fuel Sender Input: 33 Ohm full, 240 Ohm empty

Analog Output: 4-20mA or .4 to 4.2VDC (used for .4 – 4.2V throttling)

Digital Outputs: 6 Digital Outputs; 3 FET B+ (rated at 1A), 3 Open Collector sink-to-ground 100 mA (one of these is used to pilot a relay)

User Interface: 8-button keypad, Graphical display, back-lit.

Communications: RS485, RS232, CAN J1939, CAN 2.0B ports

Shipping Weight: 7 lb. (3.2 kg)

Shipping Dimensions: 12x12x10 (304.8x304.8x254 mm)

Real-time Clock: 24hr Format