MURPHY®

by ENOVATION CONTROLS

EMS PRO

Engine Monitoring System Controller

Installation and Operations Manual

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Section 40

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 http://www.fwmurphy.com/warranty.

ENOVATION CONTROLS has made efforts to ensure the reliability of the EMS PRO 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.

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

Please read the following information before installing.

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT:

- This installation information is intended for all EMS PRO 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 confirms with local codes.
- Observe all Warnings and Cautions in each section of these instructions.
- The EMS PRO 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! False or improper use and operation of electronic products could 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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NOTES

Introduction

This document is designed to support a user in getting familiar with the EMS PRO and how to navigate the interface, modify the settings and install and operate the controller. The Quick Set Up guide assists with establishing the different functions in the EMS PRO System Controller. Before attempting to set up the controller, be sure to read and understand this manual in its entirety.

Product Description

The EMS PRO is a flexible, all-in-one customizable unit that meets the needs of engine-driven pumping equipment applications. The EMS PRO is a dedicated microprocessor-based, single-engine controller. It offers field-adjustable operating parameters that can be changed without the need for a laptop computer. It is able to support both mechanical and J1939 electronic engines.

The EMS PRO has a selectable auto start/stop with many auto throttling options. The auto start/stop options (Single Contact, Floats, Momentary, and Transducer) are available at the touch of a button. In addition, there are many performance-enhancing features, all of which are available via a back-lit operator interface that's easy to learn and use. The display is readable day or night.

The EMS PRO is designed for use with a SCADA system, offering Modbus® RTU protocol on either the RS232 or RS485 port. See the Modbus portion of this manual for details.

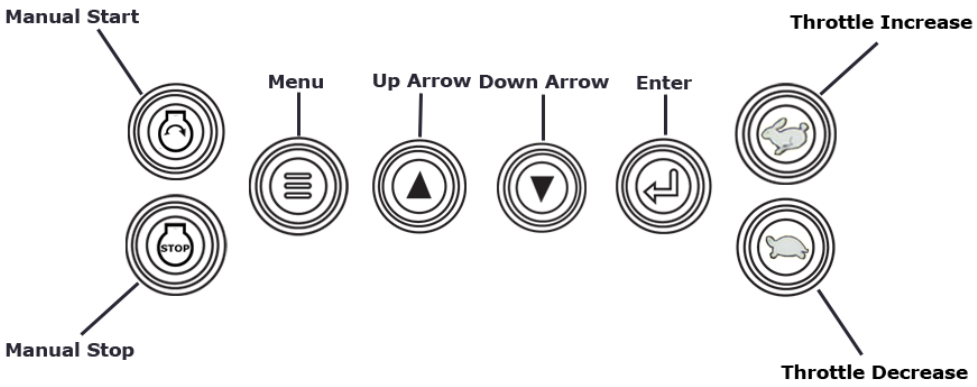
> **NOTE:** Harness kit 40000536 is available to "bring out" the (2) wire RS485 to the bottom of the enclosure. The RS232 is accessed via a DB9 connector located on the display/CPU board. Customer modification to the enclosure is required to use either port.

User Interface and Navigation

This section defines how to navigate through the EMS PRO user interface. It will assist the user in understanding 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 can be set using these eight buttons.



ICON	Description
	"START" = In the "MAN" (manual) mode this will initiate a start sequence. Can be used for local auto start if "Local Pushbutton" is selected in start/stop type, S35.
	"STOP" = In the "MAN" (manual) mode this will initiate a stop sequence. Can be used for local auto stop if "Local Pushbutton" is selected in start/stop type, S35.
	"THROTTLE INCREASE" = In the "MAN" (manual) mode this will increase engine speed.
	"THROTTLE DECREASE" = In the "MAN" (manual) mode this will decrease engine speed.
	"MENU" = Toggles between the front display and the password window and allows user to exit menus.
	"UP" arrow = Scrolling on the front display, scrolling through and increasing values in the "S" & "P" numbers.
	"DOWN" arrow = Scrolling on the front display, scrolling through and decreasing values in the "S" & "P" numbers.
	"ENTER" = Getting into the "S" or "P" numbers group after the correct entry code is entered, getting into an actual "S" or "P" number selected to make changes.

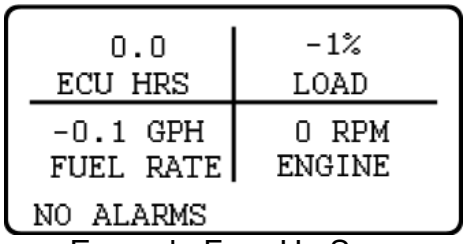
Key Switch

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

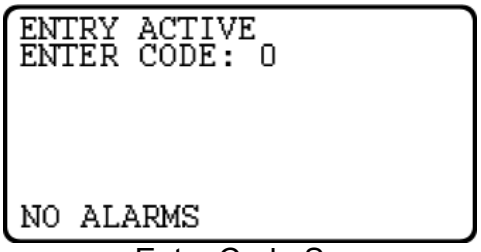
Input	Description
AUTO	Functions described in the "Auto Start/Stop Sequence" of this document.
OFF	Disconnects control power to prevent the engine from starting or continuing to run through the control panel. The OFF position provides an immediate shutdown whenever the key switch is placed in this position 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.

Screens Displayed

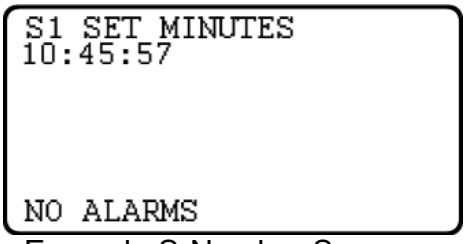
During normal operation, the controller allows you to scroll through a number of informative front screen displays by using the  membrane keys. Below are several example screens.



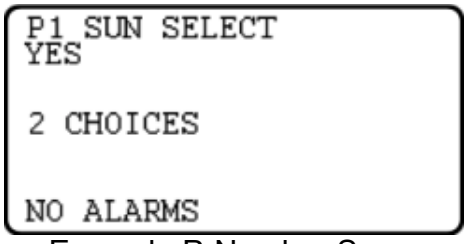
Example Four-Up Screen



Entry Code Screen



Example S-Number Screen



Example P-Number Screen

The screens displayed by the EMS PRO are listed and described below:

Screens Displayed	
Screen Name	**Description**
FW MURPHY or MURPHY or ENOVATION CONTROLS	This is the last line of the text page when pressing the **down** arrow key from the default screen.
BUILD xxxxxx	Refer to the program and build number when requesting technical assistance.
PROGRAM 50333178	Refer to the program and build number when requesting technical assistance.

Screens Displayed	
Screen Name	**Description**
SELECTOR XXXX	There are three positions displayed on this line: AUTO and MAN. When a start signal is active, the display will change to show the start option being used in place of Auto or MAN: "SINGLE CONTACT START", "FLOAT START", "MOMENTARY START", "PRESSURE START", "LEVEL START", "TEMP START", "CLOCK START", "SCADA 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 will execute during the auto sequence:

Screens Displayed	
Screen Name	**Description**
STATE:	This text line displays any of the following states the controller will execute during the auto sequence: • **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 start sequence can continue. • **PRESTART** occurs after the start delay expires. During this state, the prestart output is turned ON. This output remains on until the engine actually starts. • **WAIT FOR ECU** occurs after the Prestart delay expires, if "ECU" is selected in the engine type. During this state, the unit allows the ECU to initialize prior to cranking. A "J1939 COMM FAIL" will occur if the PRO is not receiving CAN data when this delay expires. • **CRANK ON** occurs when cycle cranking begins. During this state, the crank output is turned ON. • **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. Cycle cranking continues when this delay expires. • **WARMUP** occurs after the engine starts. During this state, the engine is throttled 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. During this state, the engine is throttled to minimum rpm and held there until this delay expires. • **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 stop sequence can continue. • **COOLDOWN** occurs after the Stop Delay has expired. During this state, the engine is throttled to the cooldown rpm. • **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 S38 "ENGINE TYPE" and S39 "ECU HOUR SELECT". S39 will not appear when S38 is set to "MECHANICAL".
LEAD SPD XXXX RPM	This displays the internally generated lead/command speed.

Screens Displayed	
Screen Name	**Description**
ENG XXXX RPM	This displays the current engine RPM sensed from either a magnetic pickup or as broadcasted 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.
ENG TEMP XXX °F	This displays the current engine jacket water temperature as sensed from an electric gauge sender, or as broadcasted from the ECU.
DISCH PR XXX PSI (IF SELECTED)	This displays the current discharge pressure as sensed from a transducer.
LEVEL XX.X (IF SELECTED)	This displays the current system level as sensed from a transducer.
AMB TEMP XXX °F (IF SELECTED)	This displays the current ambient temperature as sensed from a Murphy Model 12 transducer.
LOCAL THROT (IF SELECTED)	This is only show if Local Throttle is selected in S36.
SOOT LEVEL (IF SELECTED)	This shows the soot level percentage. There are also 3 alarms associated with this Status sent from the ECU. The Alarms will be displayed on the Alarm line as “REGEN NEEDED LOW”, “REGEN NEEDED MEDIUM”, or “REGEN NEEDED HIGH”.
UREA LEVEL (IF SELECTED)	This shows the urea level percentage as broadcasted over CAN 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 ECU 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. This screen will also display (3) Tier 4 icons by temporarily writing over ECU run hours, LOAD%, and FUEL RATE.
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 is to help in setting portions of the program in which cover the primary uses of this controller. The steps below will only cover how to change certain portions of the program to better suit your application. There are other parameters to be setup in the menus before the unit is placed in service.

> **NOTE:** This section is used as a reference guide and this entire document should be completely read and understood before ever placing the controller into service.

Setting the Time/Date Clock

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

1. Access the S numbers menu by pressing **[Menu].**
2. Use the **[Up Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the correct Entry Code is displayed, press **[Enter]** to access the S numbers menu.

> **NOTE:** If the incorrect code is entered, “PASSWORD FAILURE” will appear on the display. Press **[Enter]** and try again.

> **NOTE:** (S1 - S6) are the S-Numbers used to set the clock. See the S number section of this manual for details.

4. Press **[Up Arrow]** and **[Down Arrow]** to scroll through the S-Numbers.
5. Press **[Enter]** when displaying the correct S number to highlight the current setting.
6. Use the **[Up Arrow]** and **[Down Arrow]** to enter the correct setting in the S number.
7. Press **[Enter]** to un-highlight the value and to move to another S number.
8. Repeat steps 4 through 7 for each clock and date setting.
9. When setup is complete, exit the S Menu by pressing **[Menu]**.

> **NOTE:** The user must be out of the S or P number (un-highlighted) to exit the menu.

> **NOTE:** Accessing the S or P numbers to change any set point is done in the same manner as above.

10. Verify the clock is set to the current time, date and day of the week.

Setting for Mechanical Engines

The EMS PRO Controller factory defaults are set to run on an ECU equipped engine. In order to set the controller to work on a mechanical engine, follow the steps below:

1. Access the S numbers menu by pressing **[Menu].**
2. Use the **[Up Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the correct Entry Code is displayed, press **[Enter]** to access the S numbers menu.

> **NOTE:** If the incorrect code is entered, “PASSWORD FAILURE” will appear on the display. Press **[Enter]** and try again.

> **NOTE:** (S7, 38 & 40) are the S-Numbers used to set the controller for a mechanical engine. See the S number section of this manual for details.

4. Press the **[Up Arrow]** and **[Down Arrow]** until (S38) ENGINE TYPE is displayed, press **[Enter]** to highlight the current setting.
5. Press the **[Up Arrow]** and **[Down Arrow]** until MECHANICAL is displayed, press **[Enter]** to un-highlight the new setting.
6. Press the **[Up Arrow]** and **[Down Arrow]** until (S40) ENG THR TYPE is displayed, press **[Enter]** to highlight the current setting.
7. Press the **[Up Arrow]** and **[Down Arrow]** until MECHANICAL is highlighted then press **[Enter]** to un-highlight the new setting.
8. Press the **[Up Arrow]** and **[Down Arrow]** until (S7) SPEED CALIB is displayed, press **[Enter]** to highlight the current setting.
9. Press the **[Up Arrow]** and **[Down Arrow]** to enter the number of teeth on the engine's flywheel ring gear and press **[Enter]** to un-highlight the new setting.
10. Exit the S Menu by pressing **[Menu]**.

> **NOTE:** For mechanical engine throttling, see the PCBA SHUNTS section of this manual for details.

Start/Stop Settings

There are five start/stop types in S35: SINGLE CONTACT, FLOATS, MOMENTARY, TRANSDUCER, LOCAL PB (GREEN AND RED PUSHBUTTONS).

Single Contact Start/Stop:

The Single Contact Start/Stop is when a remote contact closes and remains closed for auto start, and re-opens for auto stop.

(2) Float Start/Stop:

The (2) Float Start/Stop is when both float contacts are closed for auto start, and both float contacts are open for auto stop.

Momentary Start/Stop:

The Momentary Start/Stop is when a contact closes momentarily for auto start, and a second contact closes momentarily for auto stop.

Transducer Start/Stop:

A transducer is used for auto throttling. There are set points, allowing the operator to enter the appropriate values.

Local Pushbutton Start/Stop:

The Local Pushbutton Start/Stop is when the local panel mounted green and red pushbuttons are used for auto start/stop.

Use the following steps to select the correct start/stop:

1. Access the S numbers menu by pressing **[Menu].**
2. Use the **[Up Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the correct Entry Code is displayed, press **[Enter]** to access the S numbers menu.

> **NOTE:** If the incorrect code is entered, “PASSWORD FAILURE” will appear on the display. Press **[Enter]** and try again.

> **NOTE:** S35 is the S-Number used for the start/stop type. See the S number section of this manual for details.

4. Press the **[Up Arrow]** and **[Down Arrow]** until (S35) START/STOP SELECT is displayed, press **[Enter]** to highlight the current setting.
5. Press the **[Up Arrow]** and **[Down Arrow]** until the desired selection is displayed, press **[Enter]** to un-highlight the new setting.
6. Exit the S Menu by pressing **[Menu]**.

System Throttling Types

There are (3) throttling types in S37: MAX. RPM, TRANSDUCER, LOCAL THROTTLE.

Max. RPM:

The Engine is throttled to the max. rpm set point.

Transducer:

A transducer is used for auto throttling. There are set points, allowing the operator to enter the appropriate values.

Local Throttle:

An external 0-5 vdc potentiometer is used for auto throttling. There are set points, allowing the operator to enter the appropriate values.

Use the following steps to select the correct transducer type:

1. Access the S numbers menu by pressing **[Menu].**
2. Use the **[Up Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the correct Entry Code is displayed, press **[Enter]** to access the S numbers menu.

> **NOTE:** If the incorrect code is entered, “PASSWORD FAILURE” will appear on the display. Press **[Enter]** and try again.

> **NOTE:** S36 is the S-Number used for the transducer type. See the S number section of this manual for details.

4. Press the **[Up Arrow]** and **[Down Arrow]** until (S36) SYSTEM THROTTLE TYPE is displayed, press **[Enter]** to highlight the current setting.
5. Press the **[Up Arrow]** and **[Down Arrow]** until the desired selection is displayed, press **[Enter]** to un-highlight the new setting.
6. Exit the S Menu by pressing **[Menu]**.

Transducer Types

There are (10) transducer types in S37: NONE -- PRESSURE CONTROL -- LEVEL CONTROL -- TEMPERATURE CONTROL -- PRESSURE CONTROL / LEVEL DISPLAY -- LEVEL CONTROL / PRESSURE DISPLAY -- PRESSURE DISPLAY -- LEVEL DISPLAY --PRESSURE CONTROL / FLOW STOP -- PRESSURE CONTROL / FLOW STOP & THROTTLE. Below are the step-by-step instructions to set up these options.

None:
There is no transducer wired to the controller.

Pressure Control:
Pressure start/stop and throttling.

Level Control:
Level start/stop and throttling.

Temperature Control:
Temperature start/stop. Throttling to the maximum rpm set point will occur.

Pressure Control / Level Display:
Pressure start/stop, throttling, and level displayed with high and low alarms.

Level Control / Pressure Display:
Level start/stop, throttling, and pressure displayed with high and low shutdowns.

Pressure Display:
Pressure is displayed with high and low shutdowns.

Level Display:
Level is displayed with high and low alarm.

Pressure Control / Flow Stop:
Pressure start, throttling, and flow stop.

Pressure Control / Flow Stop & Throttle:
Pressure start, flow stop, and flow throttling.

Use the following steps to select the correct transducer type:

1. Access the S numbers menu by pressing **[Menu].**
2. Use the **[Up Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. When the correct Entry Code is displayed, press **[Enter]** to access the S numbers menu.

> **NOTE:** If the incorrect code is entered, “PASSWORD FAILURE” will appear on the display. Press **[Enter]** and try again.

> **NOTE:** S37 is the S-Number used for the transducer type. See the S number section of this manual for details.

4. Press the **[Up Arrow]** and **[Down Arrow]** until (S37) XDUCER TYPE is displayed, press **[Enter]** to highlight the current setting.
5. Press the **[Up Arrow]** and **[Down Arrow]** until the desired selection is displayed, press **[Enter]** to un-highlight the new setting.
6. Exit the S Menu by pressing **[Menu]**.

Tier 4 Emissions

The Tier 4 Emissions set up allows users of the EMS PRO to use it on an Interim Tier 4 engine. The controller displays the SOOT level when the engine has been de-rated and/or when regeneration (regen) is required to return to normal service on the front display.

> **NOTE:** Please read and understand S84 (Request DPF Regen) found in the S-number table.

- If the regen is selected, the ECU will perform a regen automatically.
- If a regen is requested, the controller will command the ECU to perform a regen. This feature will only occur if ECU conditions allow.
- If Inhibit Regen is selected, 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 Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up Arrow]** and **[Down Arrow]** until (S82) TIER RATING is displayed in the menu and press **[Enter]**.
4. Press the **[Up Arrow]** and **[Down Arrow]** until TIER 4 is highlighted and press **[Enter]**.
5. Press the **[Up Arrow]** and **[Down Arrow]** until (S83) TIER4 STATE and press **[Enter]**.button. The default value is set to AUTO. If you want the engine state to be in INHIBIT DPF REGEN use the **[Up Arrow]** and **[Down Arrow]** to highlight the text and press **[Enter]**.
6. To set the Diesel Particulate Filter (DPF) Regeneration follow the steps below:

> **NOTE:** If all conditions for a regen to occur are *not* met, this request could be ignored by the ECU.

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

c. Press the **[Up Arrow]** and **[Down Arrow]** until (S84) AUTO DPF REGEN is displayed in the menu and press **[Enter]**.
d. Press the **[Up Arrow]** until YES is highlighted and press **[Enter]**.

> **NOTE**: S84 is only available if S83"TIER 4 RATING" is set to 4, S38 "ENGINE TYPE" is set to ECU, the engine RPM is above S23 "CRANK STOP RPM", and the ECU output (Output 1) is on.
>
> **NOTE:** Once the regen has started, this menu must continue to be displayed until the regen is complete and NO is displayed on the menu.

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

7. The following TIER 4 alarms will appear on the alarm line. Icons are displayed on the ECU 4 up temporarily replacing ECU running hours, Load% and Fuel rate:

   a. REGEN NEEDED LOW. (Status message based on Particulate Filter spn 3701)
   b. REGEN NEEDED MEDIUM. (Status message based on Particulate Filter spn 3701)
   c. REGEN NEEDED HIGH. (Status message based on Particulate Filter spn 3701)
   d. REGEN NEEDED (Status message based on Particulate Filter spn 3697 with steady and flashing ICON).
   e. EXHAUST HIGH TEMP. (Based on spn 3698 with steady ICON).
   f. REGEN INHIBIT (Status message based on spn 3703 with Steady ICON).

Unit System – Metric or English

This setting allows the user 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 Arrow]** and **[Down Arrow]** to scroll to the correct Entry Code (See Entry Code Supplement for Entry Codes).
3. Press the **[Up Arrow]** and **[Down Arrow]** until (S81) UNIT SYSTEM is displayed in the menu and press **[Enter]**.
4. Press the **[Up Arrow]** and **[Down Arrow]** until METRIC is highlighted and press **[Enter]**.
5. Press **[Menu]** to exit the S Menu.

Operational Directions

AUTO Start/Stop Sequence

The following choices are available in the "start/stop type" S Number:

- **Single Contact**: A remote contact closes to start and re-opens to stop.
- **Floats (2 contacts)**: Both contacts close for start and both contacts re-open for stop.
- **Momentary (2 contacts)**: One contact momentarily closes for start; one contact momentarily closes for stop.

- **Transducer**: Starting and stopping is controlled by S Number set points. System pressure, level, and temperature are available in the "transducer type" S Number.
- **Local PB:** Auto start with front interface green button. Stop sequence with front interface red button, run countdown timer, or external flow switch.

> **NOTE: SCADA START**. If the engine is not already running, an auto start can be accomplished through the Modbus start/stop register. This feature does not function if the engine is already running from one of the above conditions. If the engine is running, and the actual start condition is not present, an auto stop will occur if the start/stop register is "toggled" to "1" then back to "0".

Start Sequence

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

> **NOTE:** When the key is turned to the AUTO position, and ECU is selected for engine type, the ECU enable output will turn ON for a period of 30 minutes prior to the engine starting. After this 30 minute period of inactivity, the output will become inactive. This delay will not prevent an auto start sequence from occurring. The following shutdown/alarm circuits are armed:
>
> 1. **LOW FUEL ALARM** Self-clearing alarm if set point is above 0%.

- When a start condition occurs, the controller initiates an auto start sequence. The SELECTOR: text line will display start type while the STATE: text line will display "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 following shutdown circuits are armed:

    - LOW COOLANT LEVEL.
    - HIGH / LOW OIL LEVEL.
    - HIGH DISCHARGE PRESSURE.
    - OVERSPEED.
    - OVERCRANK.
    - PUMP LOW OIL LEVEL.
    - PUMP HIGH OIL TEMPERATURE.
    - PUMP HIGH HOUSING TEMPERATURE. (N.C. opens for fault)
    - 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)
    - Auxiliary 2 (configurable)
    - Auxiliary 3 (configurable)

- The ECU output is turned on.

> **NOTE:** WAIT FOR ECU is displayed if ECU is selected in engine type. This is a fixed 10 second delay to allow the ECU to warm up prior to cranking.

- When the “WAIT FOR ECU” delay expires, the following will occur:

  - The STATE: text line will display “CRANK ON/OFF”.

> **NOTE:** 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:** If “mechanical” is selected as the engine type, the AT03069 throttle actuator will throttle the engine. If “electronic” is selected, the ECU throttling is determined by what is selected in the in the “ECU THROTTLE TYPE”.

  - The “shutdown lockout” delay begins timing. When this delay expires, the following shutdown/alarms are armed:

    - LOW OIL PRESSURE.
    - HIGH ENGINE TEMPERATURE.
    - LOSS OF SPEED.
    - ALT FAIL/LOW BAT. Self-clearing alarm.

> **NOTE:** 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.

NOTE: 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 the shutdowns. The exceptions are any shutdowns external to the ECU, in which case the controller will arm and shutdown as necessary.

- When the “warm-up delay” expires, the following will occur:
    - The clutch output is turned ON when the engine speed reaches the “clutch engage” RPM set point.
    - 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.
    - The “at load” delay begins timing.
- 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”.
- When the “at load” delay expires the following will occur:
    - The LOW DISCHARGE PRESSURE shutdown is armed (if selected).

Stop Sequence

- When a stop condition occurs, the controller will initiate 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 will occur:
    - 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 clutch output is turned OFF when the engine speed drops to the “clutch disengage” 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 the manual mode.

Start Sequence

- When the user places the AUTO - OFF- MAN key switch in the “MAN" position, with no failures present, the SELECTOR: text line will display “MAN”. The text line STATE: 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 30 minutes prior to the engine starting. After this 30 minute period of inactivity, the output becomes inactive. This has no affect on the start sequence if Mechanical is selected as the engine type.

    A. The following shutdown/alarm circuits are armed:
        1. **LOW FUEL ALARM** Self-clearing alarm if set point is above 0%.

- 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 following shutdown circuits are armed:

        - LOW COOLANT LEVEL.
        - HIGH / LOW OIL LEVEL.
        - HIGH DISCHARGE PRESSURE.
        - OVERSPEED.
        - OVERCRANK.
        - PUMP LOW OIL LEVEL.
        - PUMP HIGH OIL TEMPERATURE.
        - PUMP HIGH HOUSING TEMPERATURE. (N.C. opens for fault)
        - 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)
        - Auxiliary 2 (configurable)
        - Auxiliary 3 (configurable)

    - The ECU output is turned on.

> **NOTE:** WAIT FOR ECU is displayed if ECU is selected in engine type. This is a fixed 10 second delay to allow the ECU to warm up prior to cranking.

- When the “WAIT FOR ECU” delay expires, the following will occur:

  - The STATE: text line will display “CRANK ON/OFF”.

    > **NOTE:** 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 “AT LOAD”.
  - The “shutdown lockout” delay begins timing. When this delay expires, the following shutdowns/alarms are armed:

    - LOW OIL PRESSURE.
    - HIGH ENGINE TEMPERATURE.
    - LOSS OF SPEED.
    - ALT FAIL / LOW BAT. Self-clearing alarm.

  - The “at load” delay begins timing. When this delay expires, the following shutdowns/alarms are armed:

    - LOW DISCHARGE PRESSURE.
  - Throttling is done using the panel mounted hare and tortoise buttons.

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 the user does not manually throttle down the engine, it will not idle down in COOLDOWN before the engine is shut down.

  - The clutch output is turned OFF when the engine speed drops to the “clutch disengage” 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/ECU enable is turned OFF.
  - The Alt excite output is turned OFF.
  - The internal hourmeter 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.

Special Features

Shutdown History

The Controller stores the last ten (10) shutdowns that have occurred due to system malfunctions. This record can be found in the P-numbers with the date and time stamp of the shutdown. The Shutdown history screen will also display the last 5 shutdowns.

Float Backup

- If the level transducer fails high or low, a shutdown will occur.
- 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.

Clock Start

Regardless of the start/stop type selected, the controller will also start by selecting days and start / run times in the P numbers. If the engine is already running from another condition, and the clock time occurs, the clock start time is ignored.

Overspeed Shutdown

If an overspeed shutdown occurs, output 9 turns ON for 15 seconds to actuate the air damper.

Auxiliary I/O

The three auxiliary inputs control the three auxiliary outputs (1 to 1, 2 to 2, and 3 to 3). These are configurable in the S numbers.

Standby Mode

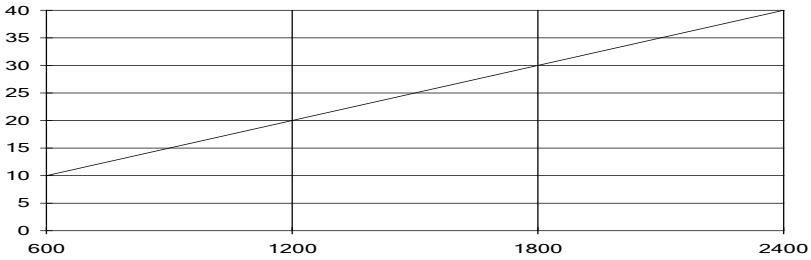
Standby Mode will occur when the engine is not running and the controller has not seen any activity for 30 minutes. The standby mode will turn OFF the LCD backlight and heater while in this mode. Any activity will take the controller out of standby mode into active or ready state (e.g. Start switch becomes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

Menus

S-Number Description and Listing

The S-numbers are used for customizing the controller to your specific application. Included in the S-numbers are the adjustable variables for the system. These S-Numbers must be set before trying to use the controller. Following is a list of available S-Numbers and a short description of the function of each. See Secret Code Supplement for the entry code number.

S-Number	Description
S0	Manual 'EXIT' from the S-number setup mode. Press "menu to exit"
S1	**Set Time Minutes**. To adjust the minutes portion of the Real Time Clock.
S2	**Set Time Hours**. To adjust the hours 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**: 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**.
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**.

S-Number	Description
S10	**LOP @ LOW SPD**: The EMS PRO 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 that 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**.
S13	**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**.  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.
S14	**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.**
S15	**LOW FUEL LEVEL ALARM:** 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%.**
S16	**LOW FUEL LEVEL SHUTDOWN:** Enter in the fuel level that will cause a shutdown alarm to occur. This shutdown is disabled when set to 0%.**Factory set to 0%.**
S17	**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 10.0 VDC.**
S18	**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.**
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.**

S-Number	Description
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. A false start is when 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. This way, the starter is not engaged unnecessarily 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. **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.**
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:** This set point is used to further customize the way controller will throttle 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.**

S-Number	Description
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:** 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 and undershooting the set point. Lower the number if the controller is hunting. Raise the value if the controller doesn't achieve the desired set point. (Used with MECHANICAL engine throttle type S40) **Factory set to 700.**
S34	**SET ADJ DLY:** This delay allows the controller to stop making adjustments to the engine RPM for this delay. It allows for a settling time after making a speed adjustment (adjustable from 1 to 999 seconds). (All engines) **Factory set to 1.**
S35	**STRT/STP SEL:** Enter the type of auto start/stop required: SINGLE CONTACT, FLOATS, MOMENTARY, TRANSDUCER, LOCAL PB. **Factory set to SINGLE CONTACT.** When set to **FLOATS:** • **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. Note: If the XDUCER TYPE set point is set to TEMPERATURE CONTROL, the system throttle type will default to MAX RPM. **Factory set to MAX RPM.**
S37	**XDUCER TYPE:** Enter the type of transducer being used. NONE, PRESSURE CONTROL, LEVEL CONTROL, PRESSURE CONTROL/LEVEL DISPLAY, LEVEL CONTROL/PRESSURE DISPLAY, TEMP CONTROL, PRESSURE DISPLAY, LEVEL DISPLAY, PRESSURE CONTROL/ FLOW STOP, PRESSURE CONTROL/FLOW STOP & THROTTLE. **Factory set to NONE.**
S38	**ENGINE TYPE:** Enter ECU (electronic diesels), ECU/SENDER (electronic diesels that don't broadcast oil pressure), MECHANICAL (non ecu engines). **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 will show the internal hourmeter. **Factory set to ECU-J1939.** (Note: This display is only visible if "ENGINE TYPE" (S38) is set to ECU. If S38 is set to MECHANICAL the hourmeter display will default to the internal hourmeter.)

S-Number	Description
S40	**ENG THR TYPE:** Enter “MECHANICAL”, “J1939 (TSC1)” or “ANALOG” for the engine throttle type. “MECHANICAL” uses digital outputs for throttling with both ECU and MECHANICAL engine types while “J1939” only works if “ECU” is selected in S38. ANALOG is reserved for future use. **Factory Set to J1939.** (Note: When using MECHANICAL THR Type, refer to S29-S34 for setup.) **(JOHN DEERE ECU’S, IT IS RECOMMENDED TO TURN OFF ALL OTHER THROTTLING OPTIONS WHEN USING TSC1 FOR SPEED CONTROL)**
S41	**SENDER TYPES:** 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 SENDER.**
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:** 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 -500 to 5000 PSI) **Factory set to 40.**
S46	**STOP PSI:** 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 -500 to 5000 PSI) **Factory set to 60.**
S47	**MAINTAIN PSI:** 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 -500 to 5000 PSI) **Factory set to 50.**
S48	**DEADBAND PSI:** 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.**
S49	**HI DISCH PSI:** 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 -500 to 5000 PSI) **Factory set to 90.**
S50	**LOW DISCH PSI:** 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 -500 to 5000 PSI) **Factory set to 25.**
S51	**AT LOAD DLY:** This delay begins timing after the warm-up delay expires. The Low Discharge Pressure shutdown is armed when this delay expires. (adjustable from 0 to 9,999 seconds). **Factory set to 180.**
S52	**FILL MODE DLY:** 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 0 to 9,999 seconds). **Factory set to 0.**

S-Number	Description
S53	**PRESSURE MAX:** Set this to the maximum value of the pressure transducer. For example, if the transducer range is 0-100 PSI, enter 100. (adjustable from -500 to 5000 PSI) **Factory set to 100 PSI**
S54	**PRESSURE MIN:** Set this to the minimum value of the pressure transducer. For example, if the transducer range is 0-100 PSI, enter 0. (adjustable from -500 to 5000 PSI) **Factory set to 0.**
S55	**PSI XDUCER MAX CNT:** 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.** (If transducer is 0-5 VDC, enter 1023 in this set point)
S56	**PSI XDUCER MIN CNT:** 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:** 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:** 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:** 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:** 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:** 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**
S62	**LEVEL TYPE**: 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. The engine is throttled to the maximum rpm setpoint 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 setpoint, the engine will be at the minimum rpm setpoint, and an auto stop will occur. **Factory set to Empty**. **NOTE:** This setpoint does not apply to FLOATS.
S63	**HIGH LEVEL:** A self-clearing alarm will occur if the level reaches this setpoint. **Factory set to 20.0 FT.**
S64	**LOW LEVEL:** A self-clearing alarm will occur if the level reaches this setpoint. **Factory set to 1.0 FT.**
S65	**LEVEL MAX:** 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.**
S66	**LEVEL MIN:** 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.**

S-Number	Description
S67	**LVL CNT MAX:** 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.** (If transducer is 0-5 VDC, enter 1023 in this set point)
S68	**LVL CNT MIN:** 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:** When "level" is selected in the start / stop or throttle type, and "No" is selected in the float backup enable, 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 LO:** When "level" is selected in the start / stop or throttle type, and "No" is selected in the float backup enable, 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	**START TEMP**: When transducer is selected in the start/stop type and "temp control" is selected in transducer type, an auto start will occur when the system temperature falls to this set point (adjustable from 0 to 115°F). **Factory set to 34°F**.
S72	**STOP TEMP**: When transducer is selected in the start/stop type and "temp control" is selected in transducer type, an auto stop will occur when the system temperature rises to this set point (adjustable from 0 to 115°F). **Factory set to 38°F**.
S73	**ENBL FLT BCKP**: (Enable Float Backup) 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**.
S74	**ENBL PVA20-A:** Enter Yes if this oil pressure gauge will be on the RS485 port. **Factory set to NO.**
S75	**ENBL PVA20-B:** Enter Yes if this water temperature gauge will be on the RS485 port. **Factory set to NO.**
S76	**ENBL PVA20-C-12:** Enter Yes if this voltmeter (12vdc) will be on the RS485 port. **Factory set to NO.**
S77	**ENBL PVA20-C-24:** Enter Yes if this voltmeter (24vdc) will be on the RS485 port. **Factory set to NO.**
S78	**ENABLE PVA20-T:** Enter Yes if this tachometer will be on the RS485 port. **Factory set to NO.**
S79	**CLTCH ENG RPM:** When the engine speed reaches this set point after the warm-up delay has expired, the clutch output is turned ON. **Factory set to 600.**
S80	**CLTCH DIS-ENG RPM:** When the engine speed reaches this set point during the cooldown delay, the clutch output is turned OFF. **Factory set to 600.**

S-Number	Description
S81	**UNIT SYSTEM:** Enter either Metric or English for displayed values. **Factory set to English.**
S82	**TIER RATING**: Enter either Tier3 or Tier4 for electronic engines. **Factory set to Tier3**.
S83	**TIER4 STATE:** Select the Regen option that best suits the application. The options to choose are AUTO DPF REGEN **or** INHIBIT DPF REGEN. **Factory set to INHIBIT DPF REGEN.** **NOTE:** This option only available if TIER RATING (S82) is set to Tier4.
S84	**REQUEST DPF REGEN:** Selecting YES will initiate a regen. After pushing the "yes" button, 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. **NOTE**: This display is only available if S82"TIER 4 RATING" is set to 4, S38 "ENGINE TYPE" is set to ECU, the engine RPM is above S23 "CRANK STOP RPM", and the ECU output (Output 1) is on.
S85	**AUX 1 TYPE CONFIG**: Enter N.C or N.O. for auxiliary switch 1. **Factory set to N.O.**
S86	**AUX 2 TYPE CONFIG:** Enter N.C or N.O. for auxiliary switch 2. **Factory set to N.O.**
S87	**AUX 3 TYPE CONFIG:** Enter N.C or N.O. for auxiliary switch 3. **Factory set to N.O.**
S88	**AUX 1 DELAY:** Auxiliary 1 switch must remain active throughout this delay for auxiliary 1 output to turn ON. The delay will reset if the input is removed before the delay expires. (Adjustable from 1 to 9,999 seconds) **Factory set to 1**.
S89	**AUX 2 DELAY:** The Auxiliary 2 switch must remain active throughout this delay for Auxiliary 2 output to turn ON. The delay will reset if the input is removed before the delay expires. (Adjustable from 1 to 9,999 seconds) **Factory set to 1.**
S90	**AUX 3 DELAY**: The Auxiliary 3 switch must remain active throughout this delay for Auxiliary 3 output to turn ON. The delay will reset if the input is removed before the delay expires. (Adjustable from 1 to 999,999 seconds) **Factory set to 1**.
S91	**S81 FUEL METRIC CONFIG.** Enter "Liter/hr." or "Imperial Gallon/hr. **Factory set to Liter/hr.**
S92	**S81 OIL PSI METRIC CONFIG.** Enter "KPA" or "BAR **Factory set to KPA.**
S93	**STOP FLOW:** When "flow" is selected in S37, an auto stop will occur when the flow drops to this set point. (adjustable from -500 to 10,000 GPM) **Factory set to 1000 GPM.**
S94	**MAINTAIN FLOW:** When "flow" is selected in S37, the engine will be throttled between the "minimum" and "maximum" rpm set points to maintain this flow. (adjustable from -500 to 10,000 GPM) **Factory set to 5000 GPM.**

S-Number	Description
S95	**DEADBAND FLOW:** When "flow" is selected in S37, no throttling will occur while the flow is in the deadband. This set point extends above and below the maintain set point. (adjustable from -500 to 10,000 GPM) **Factory set to 500 GPM.**
S96	**FLOW BYPASS DLY:** This delay begins timing when an auto start condition is accepted by the controller. The Flow stop S93, and the external flow switch are armed when this delay expires. (adjustable from 0 to 9,999 seconds). **Factory set to 180.**
S97	**FLOW BUBBLE TIMER:** This delay begins timing when a flow stop condition occurs, either by S93 or the external flow switch. The condition must remain throughout this delay on every occurrence or the delay resets. (adjustable from 0 to 9,999 seconds). **Factory set to 30.**
S98	**FLOW MAX:** Set this to the maximum value of the flow transducer. For example, if the transducer range is 0 to 10,000 GPM, enter 10,000. (adjustable from -500 to 10,000 GPM) **Factory set to 10,000 GPM.**
S99	**FLOW MIN:** Set this to the minimum value of the flow transducer. For example, if the transducer range is 0 to 10,000 GPM, enter 0. (adjustable from -500 to 10,000 GPM) **Factory set to 0.**
S100	**FLOW CNT MAX:** 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.** (If transducer is 0-5 VDC, enter 1023 in this set point)
S101	**FLOW CNT MIN:** 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)
S102	**AUXILIARY 1 INPUT CONFIG.** Enter; "Aux 1", "Flow Switch", "Pivot Shutdown", "Vibration", "Low Suction", "Fuel Leak", "Aux 1 Shutdown". **Factory set to Aux. 1.**
S103	**AUXILIARY 2 INPUT CONFIG.** Enter "Aux. 2", "System Flow", "Pivot Shutdown", "Vibration", "Low Suction", "Fuel Leak", "Aux. 2 Shutdown". **Factory set to Aux. 2.**
S104	**AUXILIARY 3 INPUT CONFIG.** Enter; "Aux 3", "Pivot Shutdown", "Vibration", "Low Suction", "Fuel Leak", "Aux. 3 Shutdown", "Request Regen". **Factory set to Aux. 3.**

P-Number Description and Listing

The EMS PRO 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 Secret Code Supplement for this code number.

P-Number	Description
P0	Manual 'EXIT' from the S-number setup mode. Press " 'MENU' TO EXIT"
P1	**SUN SELECT:** 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 SELECT:** 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 SELECT:** 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**.
P4	**WED SELECT:** 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**.

P-Number	Description
P5	**THUR SELECT:** 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 SELECT:** 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 SELECT:** 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	**CLCK 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 12 available start times per day (A – L). **Factory set to 0.0.**
P9	**CLCK 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	**CLCK 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	**CLCK 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 12 available start times per day (A – L). **Factory set to 0.0.**
P12	**CLCK 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	**CLCK 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.**
P14	**CLCK 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 12 available start times per day (A – L). **Factory set to 0.0.**
P15	**CLCK 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	**CLCK 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	**CLCK D 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 12 available start times per day (A – L). **Factory set to 0.0.**
P18	**CLCK D 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.**
P19	**CLCK D 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.**
P20	**CLCK E 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 12 available start times per day (A – L). **Factory set to 0.0.**
P21	**CLCK E 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.**

P-Number	Description
P22	**CLCK E 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.**
P23	**CLCK F 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 12 available start times per day (A – L). **Factory set to 0.0.**
P24	**CLCK F 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.**
P25	**CLCK F 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.**
P26	**CLCK G 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 12 available start times per day (A – L). **Factory set to 0.0.**
P27	**CLCK G 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.**
P28	**CLCK G 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.**
P29	**CLCK H 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 12 available start times per day (A – L). **Factory set to 0.0.**
P30	**CLCK H 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.**
P31	**CLCK H 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.**
P32	**CLCK I 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 12 available start times per day (A – L). **Factory set to 0.0.**
P33	**CLCK I 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.**
P34	**CLCK I 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.**
P35	**CLCK J 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 12 available start times per day (A – L). **Factory set to 0.0.**
P36	**CLCK J 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.**
P37	**CLCK J 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	Description
P38	**CLCK K 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 12 available start times per day (A – L). **Factory set to 0.0.**
P39	**CLCK K 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.**
P40	**CLCK K 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.**
P41	**CLCK L 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 12 available start times per day (A – L). **Factory set to 0.0.**
P42	**CLCK L 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.**
P43	**CLCK L 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.**
P44	**DISCH PSI @ SD:** Shows what the discharge pressure was when the controller initiated the last failure shutdown.
P45	**LEVEL @ SD:** Shows what the system level was when the controller initiated the last failure shutdown.
P46	**AMB TEMP @ SD:** Shows what the ambient temperature was when the controller initiated the last failure shutdown.
P47	**OIL PSI @ SD:** Shows what the engine oil pressure was when the controller initiated the last failure shutdown.
P48	**ENG TEMP @ SD:** Shows what the engine jacket water temperature was when the controller initiated the last failure shutdown.
P49	**FUEL LVL @ SD:** Shows what the engine fuel level was when the controller initiated the last failure shutdown.
P50	**RPM @ SD:** Shows what the engine speed was when the controller initiated the last failure shutdown.
P51	**LAST SHUTDOWN:** Shows what caused the last failure shutdown and the time in running hours that it occurred.
P52-60:	**##th SHUTDWN:** P52 to P60 store the 2nd through the 10th cause of failure shutdown with the date and time the shutdown occurred.
P61	**RUN COUNTDOWN:** This timer operates when LOCAL PUSHBUTTON is selected in S35. Zero disables this feature. (Adjustable from 0 to 9,999 minutes) **Factory set to 0.**
P62	**PROGRAM #**: The value in this window is the program and version number. This is helpful information to have before calling the factory for technical help.

Inputs and Outputs

When wiring to the EMS PRO Controller, please refer to the schematic illustrating connector pin outs for the following list of dedicated I/O:

Digital Inputs

- 1-Auto Position of Key Switch
- 2-Man Position of Key Switch
- 3-Single, Float, or Momentary Start Contact
- 4-Single, Float, or Momentary Stop Contact
- 5-Pump Low Oil Level Switch (i.e. L-129)
- 6-Un-Assigned (Reserved for Future Use)
- 7-Pump Housing High Temperature Switch (N.C. Opens on Fault).
- 8-Auxiliary 1 (Switch to Ground or B+)

Analog Inputs

- 1-Engine Temperature Sender (Murphy ES2T or VDO) Set in SENDER TYPES (S39) to Default to Murphy Senders.
- 2-Engine Oil Pressure Sender (Murphy ES2P or VDO) Set in SENDER TYPES (S39) to Default to Murphy Senders.
- 3-Engine Low Coolant Level (Switch to Ground, e.g. L-150)
- 4-Engine Low Oil Level (Switch to Ground, e.g. L-129)
- 5-Fuel Level Sender (Murphy ES2F)
- 6-Discharge Pressure Transducer (4-20mA)
- 7-Local Potentiometer Throttling (0-5 VDC) (Option)
- 8-Pump High Oil Temperature (Switch to Ground, e.g. 20P)
- 9-System Level Transducer (4-20mA)
- 10-Auxiliary 2 (Switch to Ground)
- 11-Auxiliary 3 (Switch to Ground)
- 12-Temperature Start/Stop, 0-5 VDC (Murphy AIR TEMP – Model 12)

Digital Outputs

ALL OUTPUTS ARE PILOT DUTY. The first 3 outputs (DO 1-3) are B+ FET's rated 8-32VDC at 1Amp. The remaining 9 outputs (DO 4-12) are relays rated 30VDC at 5Amps. Consult the engine manufacturer to determine if the current draw is too large and a separate remote relay is needed.

- 1-Fuel / Ignition / ECU Enable (B+)
- 2-Auxiliary 1 (Tied to Aux Input #1) (B+)
- 3-Alt Excite (B+)
- 4-Throttle Decrease (Murphy Throttle Actuator ATO3069) (Optional Grounded Contact)
- 5-Throttle Increase (AT03069) (Optional Grounded Contact)
- 6-Clutch (SPDT Dry Contacts)
- 7-Common Fail (Dry Contacts)
- 8-Prestart (B-)
- 9-Overspeed (Time Delay Air Damper) (B-)
- 10-Crank (B+)
- 11-Auxiliary 2 (Tied to Aux Input #2) (B-)
- 12-Auxiliary 3 (Tied to Aux Input #3) (B-)

PCBA Shunts

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

RS485 Terminating Resistor (LK3 Shunt):

This shunt allows for the 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 allows for sender resistor heating (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 24VDC.

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

RELAY PCBA SHUNTS:

Throttling Mechanical Engines or Electronic Engines. These shunts allow the user to switch between FET throttling for Mechanical engines and Relay throttling for Electronic engines.

- LK1 – Default RLY
- LK2 – Default RLY

General Information

LCD CONTRAST ADJUSTMENT ON STARTUP

If the front display is not viewable upon power up its possible the contrast setting may be incorrectly adjusted. In order to correct this, take the following steps:

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.
4. Look for a counting number in the mid to lower portion of the display.
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 several precautions during initial installation that can reduce chances of failure over time. Many of these steps may take a few extra minutes to do at the time of installation; however, they can also save many headaches in the future. Enovation Controls strongly recommends that these precautionary steps are followed.

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 drop during cranking.

Pilot excessive loads

Many of the outputs on the EMS PRO 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 it is subjected to movement.

Separate AC and DC wiring.

Never run AC and DC handling wiring together. AC signals may get 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. Failing 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 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 also be required in especially "noisy" environments.

Use shielded cable on magnetic pickup

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

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

Fuses

There are two 10A fuses installed in the controller. One is on the faceplate and is used for the main power to the panel (Glass SAE type). The second fuse (ATC type) is located under the faceplate and is used for the cranking circuit.

Communications

CAN

CAN port designated for J1939 communications.

RS-485

RS-485 port designated for externally mounted PVA Gages or Modbus RTU (slave to master) for SCADA. If no PVA gages are selected for use in the S numbers, Modbus is available on this port using the same Modbus map detailed under RS-232.

> **NOTE:** Harness kit 40000536 is available to "bring out" the (2) wire RS485 to the bottom of the enclosure. The RS232 is accessed via a DB9 connector located on the display/CPU board. Customer modification to the enclosure is required to use either port.

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

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

RS-232

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

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

CPU PCB WIRING INTERFACE LIST (J2) DB9 CONNECTOR

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

Description

The EMS PRO implements a MODBUS RTU style communications protocol. The following will describe the communications and the register and coil implementation for the EMS PRO.

Protocol

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

- MODBUS® command code 03
  Read Holding Register Status: Reads the binary contents of the holding register in the EMS PRO controller.
- MODBUS® command code 06
  Preset Single Register: Presets a value into a single holding register.
- MODBUS® command 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 controller beyond the published amount of registers, the EMS PRO controller will ignore 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: The following is a description of the bits:
		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.
40008	Read Only	Shutdown Status: The following is a description of the bits:
		Bit 0 (LSB) Low Oil Pressure: (1) yes, (0) no.
		Bit 1 High Engine Temperature: (1) yes, (0) no.
		Bit 2 Low Coolant Level: (1) yes, (0) no.
		Bit 3 High Low Oil Level: (1) yes, (0) no.
		Bit 4 Loss of Speed: (1) yes, (0) no.
		Bit 5 No Speed Signal: (1) yes, (0) no.

REGISTER #	TYPE	DESCRIPTION
		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 Loss of Temperature Sender: (1) yes, (0) no.
		Bit 14 Pump High Oil Temperature: (1) yes, (0) no.
		Bit 15 (MSB) Pump Low Oil Level: (1) yes, (0) no.
40009	Read Only	Shutdown Status: The following is a description of the bits:
		Bit 0 (LSB) Pump High Housing Temperature: (1) yes, (0) no.
		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.
		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. Toggle type
40013	Read / Write	Maximum RPM Set Point.
40014	Read Only	Ambient temperature. Current ambient temperature measured by Model 12.
40015 through 40037	Read Only	Reserved
40038	Read / Write	Start Pressure. Factory set to 40 psi.
40039	Read / Write	Stop Pressure. Factory set to 60 psi.
40040	Read / Write	Maintain Pressure. Factory set to 50 psi.
40041	Read / Write	Start Level. Factory set to 15.0 feet.

REGISTER #	TYPE	DESCRIPTION
40042	Read / Write	Stop Level. Factory set to 5.0 feet.
40043	Read / Write	Maintain Level. Factory set to 10.0 feet.
40044	Read / Write	Stop Flow. Factory set to 1000 GPM.
40045	Read / Write	Maintain Flow. Factory set to 5000 GPM.

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 this customization.

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**.

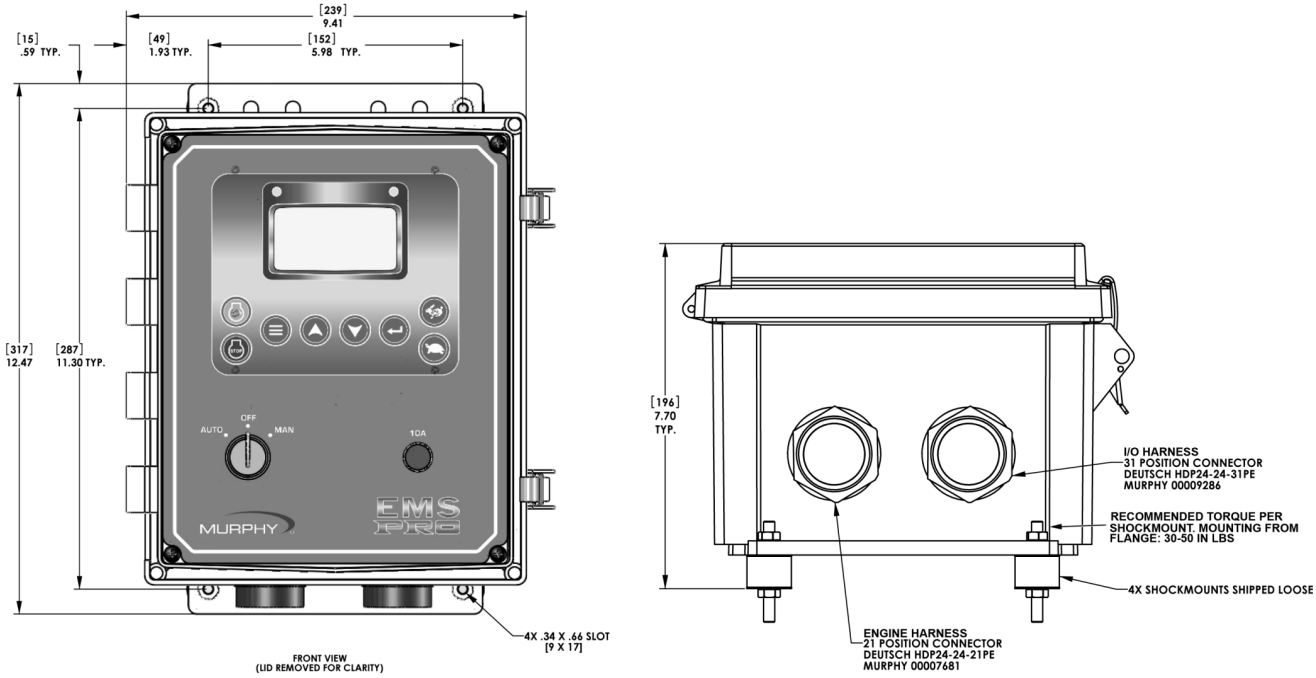
LOADING PROGRAM

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

Installation

EMS PRO Mounting and Dimensions

The EMSPRO should be mounted in a location that is accessible to the operator. Use connection harnesses to connect to the I/O and the engine. See the diagram below for connection instructions.



Specifications

Operating Voltage: 8 VDC Minimum to 32 VDC Maximum. (Designed to work on 12 and 24 VDC systems.)

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

> **NOTE:** Care should be taken when selecting the optional clear door when used in applications involving direct sunlight exposure. Direct sunlight can cause premature component failure by allowing the sealed enclosure temperature to exceed the rated 80°C/175°F.

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

Environmental Sealing: IP66

> NOTE: Meets IP66 when the door is closed and latched.

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

Standby Current: 220mA @12VDC; 244mA @ 24 VDC

CAN Bus: SAE J1939 Compliant

Enclosure: Polycarbonate NEMA 4 (UL Certified)

Analog Inputs: 12 designated via program; sender/ground digital 4-20mA, 0-5 VDC

Digital Inputs: 8 high/low (Both Battery+ and ground are detected as active inputs. No signal is OFF).

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

Fuel Sender Input: 33 Ohm full, 240 Ohm empty

Analog Output: 1 optional; 4-20mA or .4 to 4.2VDC
Output pin assignment changes between two selections (modification to controller required to use these ports - the software was written to accommodate future enhancements).

Digital Outputs: 3 FET B+ (rated at 1A), 9 digital outputs tied to relays

Relays: 1 SPDT and 8 SPST (5 Amp pilot relays)

> **NOTE:** Maximum relay ground current limited to 23 amps.

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

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

Shipping Weight: 11 lb. (5kg.)

Shipping Dimensions (all models): 15 x 15 x 11 in. (381 x 381 x 279.4 mm)

Real-time Clock: 24hr Format

NOTES

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