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SELECTRONIC® CONTROLLER

EMS547 ENGINE CONTROLLER

OPERATION MANUAL

FOR USE WITH: PROGRAM # A94116.V4

DATE: 14-Jun-99

GENERAL INFORMATION

DESCRIPTION

The EMS547 Controller is a microprocessor based engine controller with built-in service reminder features. It will automatically warn you when certain service items need to be performed and will signal your engine to shut down if a fault is detected.

The system is accessed through three push-buttons and a back-lit, dot-matrix liquid crystal display. A more detailed description of operator functions can be found in the operating instruction section.

The system will have the capability to communicate with a remote terminal, via modem communications. The user will be able to view the state and status of the controller from the remote terminal. The controller will call the remote terminal if a failure occurs.

SENSOR INPUTS

The EMS Controller accepts several different types of sensor inputs. Below is a list of which types are accepted. See the wiring hookup drawing for terminal details.

Electric Gauge Senders. These inputs allow you to use standard electric gauge type senders for pressure and temperature.

Digital alarm inputs. These inputs are negative grounding type inputs. Typically, external shutdown switches are wired to these inputs. They can include vibration, low pressures, high temperatures, and low levels.

Frequency input. This input is an optically isolated speed sensing input. You may get your speed signal from either a magnetic pickup or the tachometer post of your alternator.

OUTPUTS

The EMS547 controller has a total of seven (7) open collector transistor outputs. One (1) of these can be selected as a watchdog output. All outputs are rated for 200 ma.

OPERATING THE EMS CONTROLLER

The EMS Controller is very simple to operate. Once the Setup numbers have been configured for your operation, the unit will automatically perform its duties with very little user interface.

The front plate has three push-buttons for scrolling through information, changing set-points, and acknowledging alarms. See the Operating Instructions section for more information.

OPERATION DIRECTIONS

CONTROL SEQUENCE OUTLINE

START SEQUENCE

Control panel selector in "AUTO" position. If there are no failures, [STATUS: SELECTOR -AUTO; STATE: PANEL READY].

- I. The controller senses a start condition, refer to the special features section for start conditions, an auto start sequence is initiated [STATUS: XXXXXXXXX; STATE: START DLY]:

NOTE: XXXXXXXXX. This display will be different depending on the type of auto start that occurred. There are four types of automatic starts that can occur. Refer to the start / stop types in the special feature section below.

- A. The controller has a DELAY ON START function. The controller will ignore the automatic start signal for the DELAY ON START time delay. If this function is not used set the delay to zero (0). The delay is field adjustable from zero (0) to three hundred (300) seconds.
- B. When the DELAY ON START time expires the Vent Fan is signaled to run [STATUS: AUTO START; STATE: VENT FAN]:. The VENT FAN DELAY is field adjustable from one (1) to three hundred (300) seconds.
- C. When the VENT FAN DELAY expires, the vent fan is signaled to stop and the following shutdown circuits are "ARMED" immediately,
1. LOW COOLANT LEVEL
 2. OVERSPEED
 3. OVERCRANK
- D. The solenoid fuel valve and the starter pilot relay are energized [STATUS: XXXXXXXXX; STATE: CRANK ON/OFF].
- E. Cycle cranking begins: Crank 10 seconds; Rest 10 seconds until engine starts or OVERCRANK program operates.

*NOTE: **CYCLE CRANKING.*** If the engine does not start on the first crank, the controller will de-energize the fuel valve and starter outputs for the entire rest cycle.

*NOTE: **OVERCRANK.*** If the engine fails to start after the field-programmable number (preset to 6) of cranking attempts, **OVERCRANK** will be indicated on the alpha-numeric display. The Micro-controller Start Sequence will be halted and automatic control circuits will be locked out. The lockout must be manually reset before normal operation may be resumed.

The MURPHYMATIC® Micro-controller will **close** ENGINE FAILURE status contacts. The "Fail" Status is reset when the panel is reset by moving the panel selector to the "OFF" position.

- F. When the engine speed rises above the field-programmable Crank Disconnect speed setting, an automatic Run Sequence begins [STATUS: XXXXXXXXX; STATE: WARMUP TIMING]:
1. Cycle cranking is discontinued immediately.
 2. VENT FAN is signaled to run based on ambient temperature.
 3. Internal "hourmeter" program begins to record engine running hours.
 4. Two timing periods begin:

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a) Shutdown Lockout time delay -- field-programmable period. Preset to thirty (30) seconds.

NOTE: The second line of the display will show "SHUTDOWN DELAY TIMING" until the lockout delay expires.

b) Warmup time delay -- field-programmable to 999 seconds.

G. When the preset, Shutdown Lockout delay expires:

1. The following shutdown circuits are "armed:"
 - a) LOW OIL PRESSURE
 - b) HIGH WATER TEMPERATURE
 - c) UNDER SPEED
 - c) LOSS OF SPEED

SHUTDOWNS

When a SWICHGAGE® signals a malfunction, the appropriate Shutdown Name is shown on the second line of the display and the engine is signaled to shutdown immediately or to throttle back to a field-programmable shutdown RPM depending on type of shutdown assigned to that failure condition. The display will indicate cause of shutdown and the panel must be manually reset --selector moved to OFF position -- before normal operation may be resumed.

The Micro-controller stores the Shutdown Name in the program set point memory for future reference. On any shutdown, the Engine Failure output is turned on.

H. When the Warmup timing period expires [STATUS: XXXXXXXX; STATE: AT LOAD], Battery + is supplied to the generator regulator.

STOP SEQUENCE

- I. When all the stop conditions are satisfied, refer to the start / stop description in the special feature section, an auto stop sequence begins[STATUS: XXXXXXXX; STATE: STOP DLY]:
 - A. The controller has a DELAY ON STOP function. The controller will ignore the automatic stop signal for the DELAY ON STOP time delay. If this function is not used set the delay to zero (0). The delay is field adjustable from zero (0) to three hundred (300) seconds.
 - B. Battery + is removed from the generator regulator.
 - C. A field-programmable (0 - 999 seconds) Cooldown time delay period begins timing [STATUS: XXXXXXXX; STATE: COOLDOWN TIMING]. When this delay expires:
 1. Internal "hourmeter" program stops recording and stores current engine running hours.
 2. All shutdown circuits are locked out.
 3. The solenoid fuel valve circuit is de-energized.
 4. The VENT FAN circuit is signaled to stop.
 5. Control circuits automatically reset for next START sequence [STATUS: SELECTOR - AUTO; STATE: PANEL READY].

OPERATION DIRECTIONS

SPECIAL FEATURES

- I. **MODEM COMMUNICATIONS:** The controller contains an automatic dialer capability, that in case of failure will automatically call a remote computer to warn of failure. The user can, from the remote terminal, call the controller to observe operation. The modems for this feature are supplied by other. The following information is displayed on the remote terminal (*note:* your actual values may differ, the display is just a typical display):

CONTROLLER NAME		PROGRAM:		A94116.V1	
OIL PRESSURE	100 PSI	FUEL PRESSURE	100 PSI		
WATER TEMPERATURE	195 °F	AMBIENT TEMPERATURE	100 °F		
ENGINE HOURS	1.8 HRS	BLOCK HEATER CONTROL		OFF	
SYSTEM VOLTAGE	26.3 VDC	THERMOSTAT TEMP CONTROL		ON	
ENGINE RPM	954	SERVICE BATTERY	399	HRS REMAIN	
CHARGING BATTERY VOLTS	26.1	CHANGE OIL	500	HRS REMAIN	
CHARGING BATTERY AMPS	59.1	CHANGE OIL FLTR	500	HRS REMAIN	
SELECTOR: AUTO		CHANGE FUEL FLTR	400	HRS REMAIN	
STATUS: AT LOAD		CHANGE AIR CLNR	299	HRS REMAIN	
SHUTDOWN INFO					
FUEL PRESSURE	100 PSI				
OIL PRESSURE	100 PSI				
WATER TEMPERATURE	195 °F				
ENGINE RPM	954				
LAST: LOW COOLANT LVL		2ND:			
3RD:		4TH:			
5TH:		6TH:			
7TH:		8TH:			
9TH:		10TH:			
Type 'START' to run and 'STOP' to stop engine, do not forget the <enter> key!					

The following will describe the possible inputs from the remote terminal the controller will accept (Capitalization must be used for all entries):

1. START: By entering this, the controller will force an automatic start sequence.
2. STOP: By entering this, the controller will force an automatic start sequence, if all other stop conditions are met.
3. FAIL: By entering this, the controller will force an immediate shutdown (MODEM SHUTDOWN). The panel must be manually reset--selector moved to OFF position --or the RESET command is issued before normal operation may be resumed.
4. RESET: This command will allow for remote reset of any failure conditions.

Note: *If the operator forces the engine on from the remote terminal the controller will start and run the engine until the operator forces it off, even if the operator disconnects the communication line (except if a shutdown has occurred or power has been broken).*

Communications Set-Up

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1. The EMS547 Micro-Monitor implements communications with a standard modem via a RS232 link (Port 4). In the S#s, the user can select the type of modem the controller will use. The choices are OTHER, ZOOM 14.4 and AT&T DP 14.4. If other is selected then the controller will look to the programmable init string S#'s for the initialization string of the modem. This program init string must be entered by the user.
2. The dial in and auto dial out on fault programs are designed to communicate with a remote terminal station running a simple terminal program. For the controller to communicate to the remote terminal the software needed would be Procomm Plus for DOS. To just communicate with the micro-monitor the user can use any terminal program such as Procomm Plus for DOS or for Windows or Windows Hyper Terminal.

Remote Terminal Communication Port Set-Up.

1. 1200, 2400 or 9600.
2. No parity.
3. Eight (8) data bits.
4. One (1) stop bit.

Password: The monitor has a S# for password setup. By using ● ▲ ▼ keys the user can enter the password. This password is used two (2) ways.

1. When the user calls the controller from the remote terminal, before the controller will allow access to the system the user must enter this password. The monitor will allow ten (10) attempts before disconnecting the line.
2. When the monitor calls the remote terminal, using Procomm Plus for DOS, this password is used to log on to the remote terminal. The monitor will also have a S# for the controller name. This must be two different words. Like STATION FIVE for example. The user must make sure that the remote terminal PCPLUS.USR file is setup to accept this password and name. The Procomm Plus must be set up for remote command capability.

II. **LOW FUEL PRESSURE:** If the fuel pressure drops below a LOW FUEL PRESSURE set-point the controller will display LOW FUEL PRESSURE and turn on the common fail output. This is alarm only. The controller will also record the fuel pressure at the time of the shutdown.

III. **START/STOP CONDITIONS:** There are a total of four (4) start conditions that can occur for the controller to initiate an auto start sequence. These are BATTERY VOLTAGE, REMOTE OVERRIDE, COOLING OVERRIDE and COMMUNICATIONS START. Any one of these conditions can initiate an auto start sequence. For an auto stop sequence to occur all the stop conditions must be met. The auto start / stop sequence is described above.

1. CHARGING BATTERY [STATUS: AUTO START; STATE: START DLY]: If the charging battery voltage drops below the start (START VDC) set point, the controller will initiate an auto start sequence. The charging battery stop sequence depends on the charging voltage to exceed the stop vdc (STOP VDC) set point and the charging amps to be below the stop amps (STOP AMPS) set point.
2. REMOTE OVERRIDE [STATUS: REMOTE OVERRIDE; STATE: START DLY]: If the panel is in the AUTO mode and the REMOTE START contact close, the controller will initiate an auto start sequence. If a failure occurs during this operation, the contacts

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can be re-opened to reset the failure. When the contacts re-open the controller will initiate an auto stop sequence.

3. **COOLING OVERRIDE** [STATUS: COOLING OVERRIDE; STATE: START DLY]: If the ambient temperature rises to the start temperature (AMB TP START) set-point. The controller will initiate an auto start sequence. The chiller control output is energized after warm up is complete. If the temperature falls to the stop (AMB TP STOP) set-point, the controller will initiate an auto stop sequence. There is a field adjustable one (1) to twenty (20) minute delay on cooling override start (TEMP STRT DLY) and stop (TEMP STOP DLY).
 4. **REMOTE COMMUNICATIONS START** [STATUS: MODEM START; STATE: START DLY]: If via the remote communications, a start signal is received the controller will initiate an auto start sequence. The controller will continue to run even if communications is lost. When the stop command is entered the controller will initiate an immediate stop. The Stop command forces a shutdown.
- IV. **ENGINE BLOCK TEMPERATURE:** If the engine temperature drops below the HEATER START temperature the controller will energize the block heater. The block heater will continue to be energized until the block temperature rises above the HEATER DELTA set-point.
- V. **VENT FAN OPERATION:** The vent fan operation is based on ambient temperature. If the ambient temperature rises to exceed the vent fan start (A T FAN STRT) set point, the vent fan will be signaled to run. It will continue to run until the ambient temperature falls below the vent fan stop (A T FAN STOP) set point.
- The vent fan operation in the auto start sequence is as described above in the control sequence operation. The VENT FAN DELAY is field adjustable from one (1) to three hundred (300) seconds. The vent fan will always operate during the start sequence. Once the engine is running and warm up is complete the vent fan will be cycled on and off based on the ambient temperature.
- When the engine is not running the vent fan can be cycled on and off to cool the engine chamber down, based on ambient temperature. There is also a set point (PF EOFF ENABLE) for the enabling of this feature. If this value of this set point is set to "YES" the function is enabled and if set to "NO" the function is disabled.
- VI. **OIL PRESSURE SENDER TYPE:** The control program can be configured to accept either a sender or voltage type input for the oil pressure. There is a set point (OIL P SELECT) in the S#s for the selection of the type. The choices include 0-5 VOLTS or SENDER. Note that the hardware on the EMS547 needs to be configured to accept the different types and needs to be ordered from the factory.
- VII. **ENGINE TEMPERATURE DISPLAY:** The controller allows for the selection of the type temperature the display will show on the front displays. There is a set point in the S#s for selection of the type. Selections are OIL TEMP or H2O TEMP.
- VIII. **SERVICE REMINDERS:** The Controller will have field adjustable service reminders. The user can program the engine running hours for the controller to enunciate the service reminders. These service reminders could represent time to change the oil filter or air filter etc.. To clear the Service Reminder prompt simply go into the P#s described in the Operation section and acknowledge the Service Reminder.
- IX. **SHUTDOWN HISTORY:** The Controller stores the last five (5) shutdowns that have occurred due to system malfunctions. This does not record the alarms as they occur.

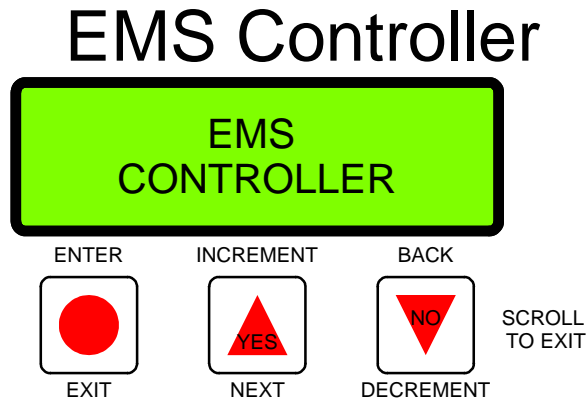
OPERATION DIRECTIONS

This record can be found in the P#s. The user can reset the history log by toggle the reset shutdown data (RST SDN DATA) set point, in the P#s from NO to YES.

OPERATION DIRECTIONS

OPERATING THE INTERFACE

By using the three push-buttons and the liquid crystal display, you can make set-point changes, acknowledge alarms, and scroll through the display. The graphic below shows the display and push-buttons. The ● ▲ ▼ keys are membrane type push-buttons. The ● button is best described as an Enter key. You can confirm a set-point and acknowledge alarms with this button. The ▲ button is used for increasing a set-point or scrolling up the display. The ▼ button is used for decreasing a set-point or scrolling down the display. The 2 line dot-matrix liquid crystal display shows information pertinent to its current running mode.



For example, if the unit receives a remote start signal, it will auto start the engine and display the current operation on the screen. These states include Crank On, Crank Off, Warm-up, Cooldown, etc. When the unit has brought the engine on stream, the display will scroll vertically through the engine vital signs. These include, Oil Pressure, Engine Temperature, Engine Speed, Running Hours, etc.

FIRST TIME SETUP

Before using the unit for the first time, it is necessary to configure all the set-points. To access the S-numbers (Setup numbers), use the following procedure:

1. Press the ▼ button until the title page appears.

**MURPHY EMS547
PROGRAM A94116**

2. Now, press the ● button once. This will bring up the entry code screen.
3. Next, press the ▲▼ buttons until the appropriate entry code is displayed. See the Secret Code Supplement for your number.
4. Finally, press the ● button once. You are now able to edit the S-numbers.

To change an S-number, the following procedure should be used. We will change the DAY OF WEEK set-point for this example.

1. Once you have accessed the S-numbers through the above procedure, the screen will show the following :

**I1-4 0000
S-1 LINE 1
SELECT**

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Note: The top line may be different. Refer to S1 in S-Number Description And Listing section.

- Now, press the \blacktriangle button six times to see the following screen:

```
I1-4 0000
S-7 SET DAY OF
    WK
```

- Next, press the \bullet button once. This will bring up the following screen: (Note: The value in the DAY OF WEEK may vary).

```
I1-4 0000
    SUNDAY
```

- Next, press the $\blacktriangle\blacktriangledown$ buttons until the appropriate value is displayed. For demonstration purposes, set the unit to WEDNESDAY.

```
I1-4 0000
    WEDNESDAY
```

- Finally, press the \bullet button once. You have now changed the DAY OF THE WEEK to WEDNESDAY.

All set-points are adjusted in the same manner as described above. The only difference is which S-number you select before scrolling the set-point change. Once you have adjusted each S-number, with the appropriate values, you must exit the S-number setup mode. To do this, hold the \blacktriangledown button until the following screen is displayed and then press the \bullet button once. This will put the unit back into normal operation mode. If you forget to exit the S-numbers, the unit will exit for you after a pre-programmed amount of time.

```
I1-4 0000
S-0 CIRCLE =
    EXIT
```

MAIN DISPLAYS

During normal operation, the unit allows you to scroll through a number of informative front displays by using the $\blacktriangle\blacktriangledown$ buttons. A listing and explanation of each follows:

- MURPHY EMS547**
This is the first line of the title page.
- PROGRAM A94116**
This is the second line of the title page. It shows which program is installed in your unit. This information is helpful when calling for technical assistance.
- TIME**
This displays the current time.
- DATE**
This displays the current date.
- RUN HOURS = XXXX.X**

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This is your on board hour meter. It digitally displays the number of hours your engine has run. All the service reminders are based on the elapse time on the hour meter.

6. **SYSTEM XX.X VDC**

This displays your engine battery voltage.

7. **ENG SPD XXXX RPM**

This displays the current engine RPM. Decisions to stop cranking and shutdown on overspeed / underspeed are based on this number.

8. **OIL PR XXX PSI**

This displays the current engine oil pressure as sensed from an electric gauge sender. Shutdowns based on oil pressure reference this number.

9. **H₂O TEMP XXX °F**

This displays the current engine temperature as sensed from an electric gauge sender. Shutdowns based on engine temperature is based on this value. Note that this display is field adjustable to read H₂O TEMP or OIL TEMP.

10. **FUEL PRS XXX PSI**

This displays the current fuel pressure.

11. **AMB T XXX ° F**

This displays the current ambient temperature.

12. **XX.X VDC**

This displays the voltage of the batteries being charged.

13. **XXX AMPS**

This displays the charging current to the batteries being charged.

14. **XXXXXXXXXXXXXXXXXXXX**

There are two positions on the selector switch that are displayed on this line: SELECTOR IN AUTO, and SELECTOR IN OFF. When this window shows AUTO, your TEST - OFF - AUTO switch is in the AUTO position. When in AUTO, the unit is ready to start the engine. When this window shows AUTO START the engine has started running. When this window shows OFF, your TEST - OFF - AUTO switch is in the OFF position. The unit will not initiate an auto start with the switch in the OFF position. If the switch is moved to the OFF position while the engine is running, the unit will signal the engine to stop. When this window shows TEST START, your TEST - OFF - AUTO switch is in the TEST position. When the switch is flipped to TEST, the unit will start the engine as if a start signal had been received; regardless of the start / stop contacts. In addition to this, There are two (2) override conditions that will display the following: REMOTE OVERRIDE and COOLING OVERRIDE.

15. **ST: XXXXXXXXXXXX**

ST stands for STATE. This window shows what state your controller is in. These states include the following: NOT READY, PANEL READY, START DLY, VENT FAN, CRANK ON, CRANK OFF, WARMUP, AT LOAD, SHUTDOWN, STOP DLY and COOLDOWN.

NOT READY: This state occurs when the selector is in the OFF position. It means that the panel is not ready to run in Automatic mode.

PANEL READY: This state occurs when the selector is in the AUTO position and no shutdowns have occurred. It means that the panel is ready to run in Automatic mode.

START DLY: This state occurs when a start signal is sensed and the start delay is timing. The start signal must be present throughout this delay before the unit goes to the next state.

VENT FAN: This state occurs after the Start Delay expires. During the VENT FAN state, the Vent Fan output is turned on.

CRANK ON: This state occurs after the Prelube Delay expires. During the Crank On state, the unit energizes the starter circuit and attempts to start the engine.

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CRANK OFF: This state occurs after the Crank On state if the unit senses that the engine has not started. During the Crank Off state, the unit removes power from the starter circuit to cool off the starter before another cranking attempt is made.

WARMUP: This state occurs after the unit senses that the engine has started. During this state, the unit throttles the engine to the warmup RPM and stays at this engine speed until the Warmup Delay expires. The Lockout Delay also begins timing when the Warmup State begins.

AT LOAD: This state occurs after the Warmup state concludes. It can also occur if a start signal is received during the Cooldown state (see Cooldown below). When the At Load state first begins, the Generator regulator output is energized to enable the generator.

STOP DLY: This state occurs when a stop signal is sensed and the stop delay is timing. The stop signal must be present throughout this delay before the unit goes to the next state.

COOLDOWN: This state occurs after the Stop Delay has expired. During the Cooldown state, the unit throttles the engine to an idle. As the engine RPM passes through the Clutch Release RPM, the unit will deactivate the clutch circuit. If a start signal is received during the Cooldown state, the unit will switch to the At Load state and ignore the Warmup state.

SHUTDOWN: This state 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 selector to the OFF position and then back into AUTO or TEST.

16. MODEM - XXXXXXXX

MODEM ST stands for state, this window shows what state your modem is in. These states include the following: 1ST #, 2ND #, 3RD #, ANS CALL, STND BY, NONE, WAITING and RESET.

1ST #: This state indicates that the controller is calling the 1ST #.

2ND #: This state indicates that the controller is calling the 2ND #.

3RD #: This state indicates that the controller is calling the 3RD #.

ANS CALL: This state indicates the controller is answering an incoming call from the remote terminal.

STND BY: This state indicates the controller is neither answering an incoming call or calling out to the remote terminal.

NONE: This state indicates there is no modem selected in the S#s' for MODEM SETUP.

WAITING: This state indicates that the modem is in a wait state.

RESET: This state indicates that the controller is resetting the modem.

17. CHG OIL XXX HRS

This display shows the number of running hours remaining before the oil must be changed in the engine.

18. OIL FLT XXX HRS

This display shows the number of running hours remaining before the oil filter on the engine must be changed.

19. FUEL FLT XXX HRS

This display shows the number of running hours remaining before the fuel filter on the engine must be changed.

20. AIR CLNR XXX HRS

This display shows the number of running hours remaining before the air cleaner on the engine must be serviced or changed.

21. SERV BAT XXXX HRS

This display shows the number of running hours remaining before the engine cranking battery must be serviced or changed.

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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 unit. 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. The factory defaults in this write are configured by the factory. They are for a starting point for configuration of the unit to meet your application. **Refer to the Polar Power supplemental information for the set points as set by Polar Power.**

S-0: Manual 'EXIT' from the S-number setup mode. Press " 'CIRCLE' TO EXIT"

S-1: **Line One Selection.** Sets the variable to be displayed on the **top line** of the display while in the Setup Select mode. Available:

TIME

DATE

RUN HOURS

ENGINE SPEED

SYSTEM VOLTAGE

OIL PRESSURE

ENGINE TEMPERATURE

FUEL PRESSURE

AMBIENT TEMPERATURE

CHARGING VOLTS

CHARGING CURRENT

I/O STATUS

S-2: Set Time **Minutes.** To adjust the minutes portion of the Real Time Clock.

S-3: Set Time **Hours.** To adjust the hours portion of the Real Time Clock.

S-4: Set Date **Day.** To adjust the day portion of the date display.

S-5: Set Date **Month.** To adjust the month.

S-6: Set Date **Year.** To adjust the year.

S-7: Set **Day of Week.** Adjusts day of week Sunday through Saturday. Day advances with date.

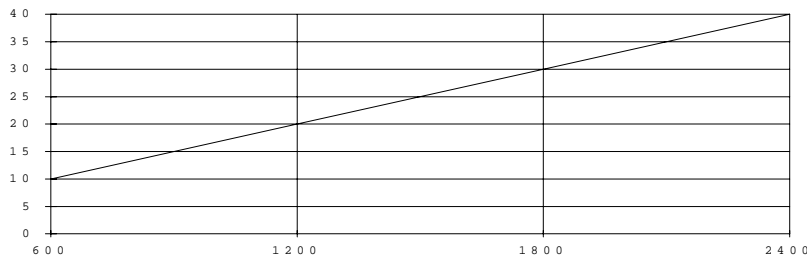
_____ S-8: **SPEED CALIB:** This setting is used to calibrate the speed signal so that the unit will display engine RPM. This setting must be adjusted for items such as crank stop RPM and OVERSPEED RPM to work. Simply enter the number of Pulses per revolution the magnetic pickup or alternator supplies to the unit . 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 6.**

_____ S-9: **OVERSPEED:** This setting allows you to enter the highest speed the engine can run before damage is caused. If the unit senses that the engine has exceeded this speed, it will signal the engine to shutdown. **Factory set to 3200.**

_____ S-10 **UNDERSPEED:** If the engine speed dips to the RPM in this set-point, an automatic shutdown will be initiated. If you do not want to use this feature, change this variable to 0. **Factory set to 2000.**

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- _____ S-11 **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 2 to 2,000 seconds). **Factory set to 10.**
- _____ S-12 **LOP @ LOW SPD:** The EMS 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 unit automatically changes the shutdown point between the Low Speed Shutdown point and the High Speed Shutdown point. **Factory set to 5.**
- _____ S-13 **LOP @ HI SPD:** This set-point is the higher oil pressure shutdown point that is referred to in number 12 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 10.**
- _____ S-14 **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 S12, the unit will initiate an automatic shutdown. **Factory set to 100.**
- _____ S-15 **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 S13, the unit will initiate an automatic shutdown. **Factory set to 600.**



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 unit automatically raises the oil pressure shutdown set-point along a straight line between the two set-points you entered. This graph represents the following set-points: S12 is set to 10, S13 is set to 45, S14 is set to 600, and S15 is set to 2400.

- _____ S-16 **HI ENG TEMP:** Adjust this setting to the engine temperature you do not want to exceed. If the unit senses a coolant temperature higher than this set-point, it will initiate an automatic shutdown. **Factory set to 320.**
- _____ S-17 **WARMUP DLY:** You can adjust this variable to the number of seconds you want your engine to warmup before it engages the clutch and throttles up to an at load condition (adjustable from 1 to 300 seconds). **Factory set to 5.**
- _____ S-18 **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 300 seconds). **Factory set to 5.**

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- _____ S-19 **VENT FAN DLY:** This delay adjustment determines how long the vent fan will be on before the cranking sequence begins (adjustable from 1 to 300 seconds). **Factory set to 5.**
- _____ S-20 **ENG STRT DLY:** Set this delay on engine start to the number of seconds that the start signal must be present before the unit accepts it and initiates an auto start sequence (adjustable from 1 to 300 seconds). **Factory set to 2.**
- _____ S-21 **ENG STOP DLY:** Set this delay on engine stop to the number of seconds that the stop signal must be present before the unit accepts it and initiates a stop sequence (adjustable from 1 to 300 seconds). **Factory set to 2.**
- _____ S-22 **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 300 seconds). **Factory set to 10.**
- _____ S-23 **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 300 seconds). **Factory set to 10.**
- _____ S-24 **RECRANK DLY:** This delay is used to adjust the amount of time the unit 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 has expired (adjustable from 1 to 300 seconds). **Factory set to 5.**
- _____ S-25 **CRK STOP RPM:** This RPM set-point is used to adjust where the unit 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. You must also set this set-point to the speed you release the starter while cranking. This is how the unit senses whether the engine is running or not. You will get a NO SPEED SIGNAL shutdown if this is adjusted to high. **Factory set to 250.**
- _____ S-26 **CRK 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 the engine and display OVERCRANK on the front display. This shutdown requires a manual reset. **Factory set to 6.**
- _____ S-27 **SPARE 1 TYPE:** This set-point lets you pick the way you want the controller to handle an input on the spare 1 terminal. Your choices include: Immediate alarm only, Immediate alarm & Shutdown, Immediate alarm before shutdown, Delay alarm only, Delay alarm & shutdown, and Delay alarm before shutdown. These types of shutdowns are self explanatory. An immediate type alarm, shutdown or both will be processed whenever the input is active. A delay type alarm, shutdown or both will be processed after the Lockout Delay has expired (S5). **Factory set to DELAY ALARM AND SHUTDOWN.**
- _____ S-28 **CHANGE OIL:** Set the interval in engine running hours you wish to be prompted to change your engine oil. **Factory set to 100.**
- _____ S-29 **CHG OIL FLTR:** Set the interval in engine running hours you wish to be prompted to change your engine oil filter. **Factory set to 200.**
- _____ S-30 **CHG FUEL FLT:** Set the interval in engine running hours you wish to be prompted to change your engine fuel filter. **Factory set to 1000.**

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- _____ S-31 **SERV AIR CLN:** Set the interval in engine running hours you wish to be prompted to service your engine air cleaner. **Factory set to 200.**
- _____ S-32 **SERV BATTERY:** Set the interval in engine running hours you wish to be prompted to service your cranking battery. **Factory set to 200.**
- NOTE:** After service reminder time values have been set, the new values will not take effect (become active) until they have also been acknowledged in the P-Numbers below.
- _____ S-33 **START VDC:** Set this to the voltage the batteries being charged must drop to for the controller to initiate an auto start. **Factory set to 48.5.**
- _____ S-34 **STOP VDC:** Set this to the voltage the batteries being charged must rise to for the controller to initiate an auto stop. **Factory set to 52.5.**
- _____ S-35 **MIN VDC:** This set-point allows the configuration of the voltage divider analog input. The value entered here represents 0 vdc from the transmitter. **Factory set to 0.**
- _____ S-36 **MAX VDC:** This set-point allows the configuration of the voltage divider analog input. The value entered here represents 5 vdc from the transmitter. Adjustable from 0.0 to 1000.0. **Factory set to 60.0.**
- _____ S-37 **BT VLT SLOPE:** With the minimum amount of voltage present on your voltage transmitter, make this value match the number on the top line. **Factory set to 0.**
- _____ S-38 **MAX AMPS:** Set this to the value the current transmitter represents at 5 vdc. For example, if the current transmitter represents 0 - 100 amps, place 100 in this set point. Adjustable from 0 to 1000. **Factory set to 870.**
- _____ S-39 **STOP AMPS:** Set this to the value the charging current must fall below for the controller to initiate an auto stop. **Factory set to 30.**
- _____ S-40 **AMPS SLOPE:** With no current present on the current transmitter, make this value match the number on the top line. **Factory set to 0.**
- _____ S-41 **FUEL PRS MAX:** Set this to the value the fuel pressure transmitter represents at 5 vdc. For example, if the fuel pressure transmitter represents 0 - 100 PSI, place 100 in this set point. Adjustable from 0 to 500 PSI. **Factory set to 250.**
- _____ S-42 **FUEL PRS SLP:** With no fuel pressure present on the transmitter, make this value match the number on the top line. **Factory set to 0.**
- _____ S-43 **LO FUEL PRS:** When the fuel pressure drops below this set point the unit will display a LOW FUEL PRESSURE alarm and turn on the COMMON FAIL output. **Factory set to 5.**
- _____ S-44 **AMB TP START:** When the temperature rises to this set point the unit will start the COOLING OVERRIDE sequence. **Factory set to 82.**
- _____ S-45 **AMB TP STOP:** When the temperature falls below this set point the unit will stop the COOLING OVERRIDE sequence. **Factory set to 72.**
- _____ S-46 **TEMP STRT DLY:** Set this delay on start to the number of minutes that the start signal must be present before the unit accepts it and initiates a COOLING OVERRIDE start sequence (adjustable from 60 to 1,200 seconds). **Factory set to 300.**
- _____ S-47 **TEMP STOP DLY:** Set this delay on stop to the number of minutes that the stop signal must be present before the unit accepts it and initiates a COOLING OVERRIDE stop sequence (adjustable from 60 to 1,200 seconds). **Factory set to 300.**

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- _____ S-48 **HEATER START:** When the engine block temperature drops below this set-point, the block heater circuit is activated. **Factory set to 32.**
- _____ S-49 **HEATER DELTA:** When the engine block temperature rises above the HEATER START temperature plus this set-point, the block heater circuit is deactivated. **Factory set to 45.**
- _____ S-50 **OIL P SELECT:** Allows for the selection of the oil pressure type. The selections include SENDER or 0-5 VDC. **Factory set to 0-5 VDC.**
- _____ S-51 **OIL PRS MAX:** If the OIL P SELECT is set to 0-5 VDC then the controller uses the value entered here to calibrate what the maximum display for the oil pressure transducer represents. For example, if the oil pressure transmitter represents 0 - 100 PSI, place 100 in this set point. **Factory set to 250.**
- _____ S-52 **PF EOFF ENBL:** This set point is used to enable or disable the vent operation when the engine is not running. If "YES" is selected then the controller will turn on the purge fan to regulate the temperature in the engine chamber. If "NO" is selected then the feature is disabled. **Factory set to YES.**
- _____ S-53 **A T FAN STOP:** If the PF EOFF ENBL is set to "YES" then the controller will use the value set in this set point to start the vent fan when the engine is off. **Factory set to 70°.**
- _____ S-54 **A T FAN STOP:** If the PF EOFF ENBL is set to "YES" then the controller will use the value set in this set point to stop the vent fan when the engine is off. **Factory set to 68°.**
- _____ S-55 **ENGINE T SELECT:** Allows for the selection of the display of the engine temperature type. The selections are OIL TEMP or H2O TEMP. **Factory set to OIL TEMP.**
- _____ S-56 **MODEM SETUP:** Enables or disables the modem communications. The selections are NONE for no modem connected. REC ONLY for the modem to receive only. XMIT ONLY for the modem to transmit only. And XMIT/REC for transmit and receive.
- _____ S-57 **CALL ATTEMPTS:** This sets the total times the controller will attempt to dial the three (3) phone numbers.
- _____ S-58 **CALL LENGTH:** This sets the total length in time the controller will stay connected to the remote terminal (adjustable from 20 to 9,999 seconds).
- _____ S-59 **1ST CALL #:** This sets 1st number the controller will attempt to call.
- _____ S-60 **2ND CALL #:** If the 1st number fails to connect, this sets the 2nd number the controller will attempt to call.
- _____ S-61 **3RD CALL #:** If the 1st and 2nd number fails to connect, this sets the 3rd number the controller will attempt to call.
- _____ S-62 **MOD RETRY DLY:** If the controller does not connect to the remote terminal with the three calls, this sets the time interval between the next cycle of calls (adjustable from 60 to 999 seconds). **Factory set to 120.**
- _____ S-63 **PASSWORD:** This sets the password required by the remote terminal.
- _____ S-64 **CNTRLR NAME:** This sets the name the controller will use to log on to the remote terminal.
- _____ S-65 **MODEM BAUD:** This sets the baud rate the controller will use to connect to the remote terminal. Adjustable from 1200 to 9600 bps.
- _____ S-66 **MODEM INIT 1:** Allows the programming of the initialization string to the modem.

OPERATION DIRECTIONS

- _____ S-67 **MODEM INIT 2:** If more room is needed for the programming of the initialization string to the modem use this set-point.
- _____ S-68 **MODEM TYPE:** Use this to set-up the type of modem. The choices are OTHER, ZOOM 14.4 and AT&T DP 14.4. If other is selected then the controller will look to the programmable init string S#'s for the initialization string of the modem.
- _____ S-69 **M INIT UPDTE:** When the set-up of the modem is complete, use this set-point to force the controller to accept the new initialization string.

ACCESSING THE P-NUMBERS

The EMS Controller has P-numbers in addition to the S-numbers you configured in the previous step. These are accessed in the same manner but using a different access code. See the Secret Code Supplement for this code number.

- P-0: Manual 'EXIT' from the S-number setup mode. Press " 'CIRCLE' TO EXIT"
- P-1: **Line One Selection.** Sets the variable to be displayed on the **top line** of the display while in the Setup Select mode. Available:
TIME
DATE
- P-2: **VDC @ SHDW:** Shows what the charging battery voltage was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-3: **AMPS @ SHDW:** Shows what the charging current was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-4: **OIL PR @ SHDW:** Shows what the engine oil pressure was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-5: **TEMP @ SHDWN:** Shows what the engine temperature was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-6: **TACH @ SHDWN:** Shows what the engine speed was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-7: **FUEL PRS @ SD:** Shows what the fuel pressure was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-8: **LAST SHUTDOWN:** Shows what caused the last failure shutdown and the time in running hours that it occurred. To view the information, press the ● button.
- P-9-17: **##th SHUTDWN:** These P-numbers store the 2nd through the 10th cause of failure shutdown and the running hours they occurred. To view the information, press the ● button.
- P-18: **ACK CHG OIL:** This setting allows the user to acknowledge that he/she has changed the oil in the engine as prompted by the unit. When this setting is toggled from NO to YES, the unit resets the counter and will not prompt the user again until the selected number of running hours has elapsed.
- P-19: **ACK OIL FLTR:** This setting allows the user to acknowledge that he/she has changed the oil filter as prompted by the unit. When this setting is toggled from NO to YES, the unit resets the counter and will not prompt the user again until the selected number of running hours has elapsed.
- P-20: **ACK FUEL FLT:** This setting allows the user to acknowledge that he/she has changed the fuel filter as prompted by the unit. When this setting is toggled from NO to YES, the unit resets the counter and will not prompt the user again until the selected number of running hours has elapsed.
- P-21: **ACK AIR CLNR:** This setting allows the user to acknowledge that he/she has changed or serviced the air cleaner as prompted by the unit. When this setting is toggled from NO to YES, the unit resets the counter and will not prompt the user again until the selected number of running hours has elapsed.
- P-22: **ACK BATTERY:** This setting allows the user to acknowledge that he/she has serviced / changed the battery as prompted by the unit. When this setting is toggled from NO to YES, the unit resets the counter and will not prompt the user again until the selected number of running hours has elapsed.

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P-23: **PROGRAM #:** The value in this window is the program and version number. This is helpful information to have before calling our office for help.

GENERAL WIRING PRECAUTIONS

There are several precautions you can take on initial installation to 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. We strongly recommend that you follow these precautionary steps.

1. Suppression 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 eliminate a source of electrical interference.

2. Wire power leads directly to battery Post.

When hooking your power supply to your Test- Off - Auto switch (AUTOMATIC MODE) or OFF-ON switch (MANUAL MODE), run your wiring directly to the battery post. This helps minimize noise generated from battery chargers and alternators.

3. Pilot excessive loads.

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

4. Use stranded wire for hookup.

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

5. 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.

6. 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.

7. Special precautions for spark ignition engines.

Magnetos and ignition coils produce high voltage and cause high frequency interference. The EMS Controller is designed to filter out much of this interference; however, precautions must be taken to protect the unit. 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.

8. Use shielded cable on magnetic pickup.

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

Remember, proper care during installation will help your EMS Controller live a long and trouble-free operating life. If for any reason you have questions during installation, feel free to give us a call.

DOUBLE CHECKING YOUR WIRING

The EMS Controller has built in diagnostic information for confirming your wiring before you attempt to auto start your engine. The diagnostic information is found in the S-numbers under S1 LINE 1 SELECT. The factory default line 1 display shows the engine RPM.

By scrolling through the displays, you will see the following:

OPERATION DIRECTIONS

I1-4 00X0
ENTER SELECTION

This represents the 4 standard digital only inputs. An 0 means that the input is not active. An X means that the input is active.

1. AUTO POSITION ON TOGGLE SWITCH
2. TEST POSITION ON TOGGLE SWITCH
3. SPARE 1 SHUTDOWN INPUT
4. REMOTE START INPUT

The next screen shows the rest of your inputs:

I5-12 00X0 0000
ENTER SELECTION

5. BATTERY VOLTAGE INPUT (IGNORE)
6. ENGINE TEMPERATURE SENDER (For test purposes, you can ground this input to make sure you have run your wire properly.)
7. ENGINE OIL PRESSURE SENDER/TRANSDUCER For test purposes, you can ground this input to make sure you have run your wire properly.)
8. LOW COOLANT LEVEL.
9. AMBIENT TEMPERATURE TRANSDUCER INPUT
10. CHARGING AMPS TRANSDUCER INPUT
11. CHARGING VOLTS TRANSDUCER INPUT
12. FUEL PRESSURE TRANSDUCER INPUT

The next screen shows the state of your outputs:

O1- 07 00X0 000
ENTER SELECTION

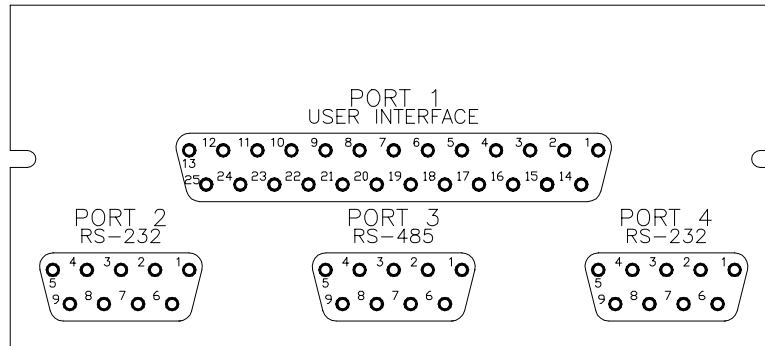
1. FUEL VALVE OUTPUT
2. STARTER CIRCUIT OUTPUT
3. ENGINE FAIL OUTPUT
4. BLOCK HEATER OUTPUT
5. CHILLER CONTROL OUTPUT
6. VENT FAN OUTPUT
7. GENERATOR LOAD OUTPUT

OPERATION DIRECTIONS

PORT CONNECTION DESCRIPTION

The EMS547 controller has four (4) DB connectors on the back. The following is a description of the ports. **UNLESS OTHERWISE SPECIFIED THE FOLLOWING FEATURES MAY NOT BE AVAILABLE IN THIS APPLICATION.** Refer to the Additional Features Section above.

MODEL EMS547 BACK PLATE CONFIGURATION



This is the back plate of the EMS547 showing the location of the connectors. This view is looking at the back of the EMS controller.

- 1. USER INTERFACE (Port #1).** DB25 connector, contains the analog and digital I/O. The following is a description of the pin connections.

PIN	HARDWARE ASSIGNMENT	PROGRAM PIN ASSIGNMENT
1	Analog 4	Ambient Temperature (0-5vdc)
2	Analog 0	Battery Monitor (No customer hookup)
3	Analog 7	Fuel Pressure Input (0-5vdc)
4	Analog 1	Electric gauge Water Temperature Sender
5	Input 1	Auto Position of Test Off Auto Toggle Switch
6	Input 2	Test Position of Test Off Auto Toggle Switch
7	Output 1	Fuel Solenoid Output
8	Battery +	Battery Plus
9	Battery +	Battery Plus
10	Output 2	Starter Output
11	Battery -	Ground
12	Output 3	Common Fail Output
13	Frequency Input	Frequency Input
14	Analog 6	Battery Voltage input (0-5vdc)
15	Analog 5	Charging Current (0-5vdc)
16	Analog 3	Low Coolant Level Input (Closed on Fault)
17	Analog 2	Electric Gauge Sender for Engine Oil Pressure
18	Input 3	Spare 1 Input (Shutdown / Alarm)
19	Input 4	Remote Start/Stop
20	Output 4	Block Heater Control
21	Output 5	Chiller control
22	Output 6	Exhaust Vent Control
23	Output 7	Generator Regulator Control
24	RS485 -	RS485 (-)
25	RS485 +	RS485(+)

OPERATION DIRECTIONS

2. **RS-232 (Port #2).** DB9 connector, 4 wire RS-232 port. The following is a description of the pin connections.

Pin #	Description	Pin #	Description
1	Not Connected	6	Not Connected
2	Receive	7	RS-232 Level Output
3	Transmit	8	RS-232 Level Input
4	Not Connected	9	Not Connected
5	Signal Ground		

3. **RS-485 (Port #3).** DB9 connector, 2 wire RS-485 communications. The following is a description of the pin connections.

Pin #	Description	Pin #	Description
1	Not Connected	6	Not Connected
2	Not Connected	7	Not Connected
3	Not Connected	8	Not Connected
4	RS-485 +	9	Not Connected
5	RS-485 -		

4. **RS-232 (Port #4).** DB9 connector, compatible with P.C. type nine (9) pin Serial Port. The following is a description of the pin connections. This is the port used for the modem communications.

Pin #	Description	Pin #	Description
1	Carrier Detect	6	Data Set Ready
2	Receive Data	7	Request To Send
3	Transmit Data	8	Clear To Send
4	Data Terminal Ready	9	Ring Indicator
5	Signal Ground		

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 away from anyone that you do not want to have access to this kind of customization.

P-NUMBERS

The P-numbers contain less critical engine operating parameters. You will find the ability to acknowledge service reminders. The shutdown history is also stored here. The entry code number is **61**.

S-NUMBERS

The S-numbers contains critical information and control functions. Items that are set improperly in the S-Numbers can cause serious operation problems. Be sure that only qualified personal have access to this entry code. The entry code number is **64**.