



PO BOX 900788
PALMDALE, CALIFORNIA 93590
PHONE (805) 272-4700
FAX (805) 947-7570

SELECTRONIC® CONTROLLER

EMS447 / 448 Controller
Operation Manual

FOR USE WITH: PROGRAM # A94035

GENERAL INFORMATION

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EMS MODES OF OPERATION

The EMS447 and EMS448 monitor your engine conditions and count down the service reminders. When a shutdown occurs, the fuel valve will turn off and the display will show the cause of shutdown. Power to the EMS must be removed to reset the unit for another start.

This program has two standard modes of operation which can be configured in the S-numbers. These modes of operation are described as follows:

Manual Mode: When this mode is selected, the EMS performs as a monitoring engine panel. It will alarm when faults are detected and initiate shutdowns based on shutdown switches and gage senders. It will also remind you when service is required for your equipment.

Automatic Mode: In the Automatic Mode, two of the shutdown inputs available in the Manual Mode are redefined. Instead of shutdowns for V-belt Break and Low Oil Level, automatic throttling inputs are available. All S-numbers are used and must be configured in the Automatic Mode.

OPERATION DIRECTIONS

CONTROL SEQUENCE OUTLINE

Automatic Mode of Operation

(TOA switch is in Auto, see Scrolling Main Displays)

I. A Start Signal is received

- a. The start delay begins timing. If the start signal is sustained throughout this delay, step B is executed. If the start signal is not sustained throughout this delay, nothing happens.
- b. The prelube/glowplug output turns on throughout the prelube/glowplug delay.
- c. The fuel and Crank outputs turn on. The crank output turns on for the adjustable crank time. It then turns off for the adjustable rest time. If the engine starts, step D is executed. If the engine does not start in the adjustable number of cranking attempts, the unit will display OVERCRANK, turn off the fuel and crank outputs, and turn on the common fail output. If the engine false starts, the unit will wait through the adjustable re-crank delay before attempting another engine crank.
- d. When the unit senses an engine RPM higher than the crank stop RPM, the crank and glowplug outputs turn off and the following begin timing:
 1. Internal hourmeter
 2. Lockout Delay. Low Oil Pressure and High Engine Temperature shutdowns are locked out during this delay.
 3. Warm-up Delay.
- e. The unit signals the engine to throttle up to the warm-up RPM.
- f. Once the warm-up delay expires, the EMS signals the engine to throttle up to Minimum RPM and the clutch output turns on. If the engine throttling inputs call for an engine increase or decrease, the unit will signal the engine to respond accordingly. (Note: The EMS will always try to throttle the engine between the minimum and maximum RPM set-points when in the AT-Load state.

II. A Stop Signal is received

- a. The stop delay begins timing. If the stop signal is sustained through the stop delay, step B is executed. If the stop signal is not sustained throughout the stop delay, the unit will continue to run.
- b. The Cooldown delay begins timing.
- c. The unit signals the engine to throttle down to an idle.
- d. When the engine speed reaches the clutch release RPM, the clutch output turns off.
- e. When the cooldown delay expires, the following items occur.
 1. Fuel valve output turns off
 2. Internal hourmeter stops timing.
- f. The unit is ready for another start signal. If the TOA switch is moved to the TEST position, delay on start and stop will be ignored. The unit will start normally and run through the sequence. When TOA switch is moved to OFF, the unit will signal the engine to shutdown without a cooldown period.

Manual Mode of Operation

In the manual mode, the unit gets its power from the ignition position of the engine start key switch. The following sequence occurs when the unit first powers up.

I. Power is Supplied to the EMS

- a. Fuel valve output turns on.
- b. The "Failed to Start" Delay will begin timing (fixed to 5 minutes). If the engine is not started within 5 minutes, "Failed To Start" is displayed and the fuel valve output is turned off.
- c. When the engine speed is sensed to meet or exceed the Crank Stop set-point, the following delays will begin timing.
 1. Internal hourmeter.
 2. Lockout Delay. Oil pressure and engine temperature shutdowns are locked out during this delay. If after the lockout delay is expired, the engine senses the engine speed dip below the Crank Stop RPM set-point, the unit will turn off the fuel valve output and show No Speed Signal.

II. Key Switch is turned OFF (power removed from EMS)

- a. Fuel valve output turns off.

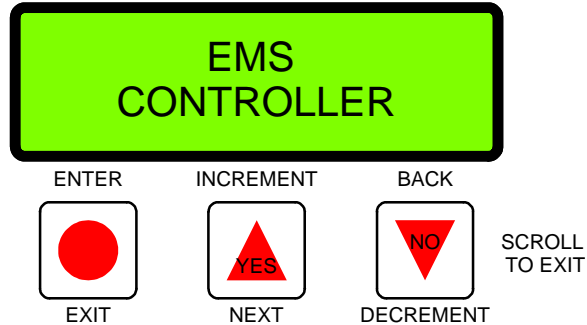
OPERATION DIRECTIONS

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.

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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 CONTROL
PROGRAM #01**

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 OVERSPEED set-point for this example.

5. 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**

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

6. Now, press the ▲ button six times to see the following screen:

OPERATION DIRECTIONS

I1-4 0000
S3 OVERSPEED

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

I1-4 0000
2000 RPM

8. Next, press the ▲▼ buttons until the appropriate value is displayed. For demonstration purposes, set the unit to WEDNESDAY.

I1-4 0000
2100 RPM

9. Finally, press the ● button once. You have now changed the OVERSPEED set-point to 2100 RPM.

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 ▼ button until the following screen is displayed and then press the ● 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

SCROLLING MAIN DISPLAYS

During normal operation, the unit allows you to scroll through a number of informative front displays by using the ▲▼ buttons. You can manually scroll through monitored information by pressing ▲ and ▼ buttons, or you may set the unit for automatic scrolling. While scrolling, the EMS remains fully operational. When a shutdown occurs or a service reminder is due, the unit will display the corresponding information regardless of the scrolling mode. When first powered up, the EMS will delay for one minute before starting to scroll. When the scrolling mode is changed, a 10 second delay must time out before scrolling resumes.

To set the Automatic scroll, press the ● and ▲ buttons simultaneously. To set the Automatic scroll mode to off, press ● and ▼ buttons at the same time. The Automatic scroll off enables you to Manually scroll the unit and monitor a value without the hassle of it scrolling off the screen. While in Automatic scrolling mode, you can still manually scroll through the informative displays. A listing and explanation of each follows:

- 1. MURPHY EMS**
This is the first line of the title page.
- 2. PROGRAM #01**
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.
- 3. RUN HOURS = XXXX.X**
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.
- 4. BATTERY XX.X VDC**
This displays your engine battery voltage.
- 5. ENG SPD XXXX RPM**

OPERATION DIRECTIONS

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

6. **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.

7. **ENG TEMP XXX °F**

This displays the current engine jacket water temperature as sensed from an electric gauge sender. The unit will signal the engine to shutdown if this temperature reading exceeds the shutdown set-point.

8. **SELECTOR - XXXX**

(Replaced with MANUAL MODE when unit is used as a manual panel)

There are three positions on the selector switch that are displayed on this line: TEST, OFF and AUTO or (TOA). When this window shows AUTO, your TOA switch is in the AUTO position. When in AUTO, the unit is ready to start the engine or already has started it. When this window shows OFF, your TOA 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, your TOA 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.

9. **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, PRELUBE, CRANK ON, CRANK OFF, RECRANK DLY, 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.

PRELUBE: This state occurs after the Start Delay expires. During the Prelube state, the unit energizes the prelube circuit for the prelube delay time.

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.

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.

RECRANK DLY: This state occurs if a false start occurs. A false start occurs when the engine speed rises above crank disconnect RPM and then drops back below. This delay will not allow the controller to re-engage the starter. The purpose is to allow the engine to stop moving before allowing the controller to re-engage the starter. This state can only occur during the lockout delay.

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

AT LOAD: This state occurs after the Warm-up 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 Warm-up 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.

10. **CHG OIL XXX HRS**

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

11. **OIL FLT XXX HRS**

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

OPERATION DIRECTIONS

12. FUEL FLT XXX HRS

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

13. 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.

14. SERV BAT XXXX HRS

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

SERVICE REMINDERS

The EMS has the above built in service reminders. When a service reminder comes due, the EMS will stop scrolling and display the service reminder message. If you cannot perform the service at that moment, you may press the ● (ENTER) button and the message will go away for 4 hours and normal scrolling will resume within 10 seconds.

Once you perform the service, enter the P-numbers and select the service that is due. Toggle the (NO) to a (YES) and the count down timer will reset to the number of hours programmed in the S-numbers.

LOSS OF SENDER FEATURE

If the EMS senses that a sender wire has broken or the value from the sender is out of known bounds, the EMS will display a "Los of Sender" alarm message and initiate a shutdown. There are alarms for loss of temperature sender, oil pressure sender and magnetic pick-up speed sensor.

If you get a lost sender message for temperature or pressure, check the connections between the controller and the sender. Also check that the sender has a good ground. If the alarm is for the magnetic pick-up, confirm you are getting at least 2 Vrms from the magnetic pick-up.

HOW TO ACCESS THE S-NUMBERS

1. Press the ▼ button until the title page appears.
2. Press the ● button until the entry code screen appears.
3. Press the ▲ and ▼ buttons until the corresponding entry code is displayed.
4. Press the ● button once. The S-numbers main menu will be displayed.

All Set-points use the above described procedure. You can exit the set-up mode by depressing and holding the ▼ button until the exit screen is displayed. Now press the ● button to set the EMS back into the Main Displays. If you forget to exit the S or P-numbers menu, the EMS will exit you after a 5 minute delay.

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.

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:
RUN HOURS
ENGINE SPEED
SYSTEM VOLTAGE
OIL PRESSURE
ENGINE TEMPERATURE
INPUT / OUTPUT STATUS

Note: The input / output status information will show an X on an I/O if that particular input is or output is active. If there is no input or the output is OFF, the unit will display an O. This can be used for testing wiring before starting the engine. For more information, see the section titled "Double Checking Your Wiring".

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- S-2: **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 120.**
- S-3: **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 2000.**
- S-4: **UNDERSPEED:** If the engine speed dips to the RPM in this set-point, an automatic shutdown will be initiated. This is only useful on a generator set. If you are using this controller on a pump engine or other application other than a generator set, set this set-point to 0. **Factory set to 0.**
- S-5: **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 30.**
- S-6: **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 15.**
- S-7: **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 30.**
- S-8: **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 low speed oil pressure set-point, the unit will initiate an automatic shutdown. **Factory set to 600.**
- S-9: **LOP HI SPEED:** Set this to your engine maximum speed. If the engine is running at this speed, and the oil pressure reaches the high speed oil pressure set-point, the unit will initiate an automatic shutdown. **Factory set to 1600.**
- S-10: **HI ENG TEMP:** Adjust this setting to the engine jacket water temperature you do not want to exceed. If the unit senses a temperature higher than this set-point, it will initiate an automatic shutdown. **Factory set to 220.**
- S-11: **PRESS UNITS:** Select the units of pressure you would like displayed on the digital read out. Your choices are: PSI (Pounds Per Square Inch); KPA (Kilo Pascals); BAR (Bar); KG□CM (Kilograms Per Square Centimeter). **Factory set to PSI.**
- Note: You can also select to view the pressure in Bar graph form with the above listed units.**
- S-12: **TEMP UNITS:** Select the units of temperature you would like displayed on the digital read out. Your choices are: °F (Fahrenheit); °C (Celsius) **Factory set to °F.**
- Note: You can also select to view the temperature in Bar graph form with the above listed units.**
- S-13: **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 300.**

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S-14: **SPARE 1 TYPE:** This set-point lets you pick the way the controller will handle an input on the spare 1 terminal. Your choices include: IMMEDIATE ALARM ONLY, IMMEDIATE ALARM AND SHUTDOWN, IMMEDIATE ALARM BEFORE SHUTDOWN, DELAY ALARM ONLY, DELAY ALARM & SHUTDOWN and DELAY ALARM BEFORE SHUTDOWN. An immediate alarm is processed when the input is active. A delay alarm is processed after the lockout delay.

The next option is RPM LIMIT ENABLE. When selected, an input to spare 1 terminal will signal the unit to throttle the engine to the maximum set-point. When this input is not grounded, the unit will throttle the engine to the minimum speed set-point. The controller must be in the AT LOAD state for this throttle type to take effect. In Manual mode, this option is not functional.

The final option is LOW OIL LEVEL. When this is selected, the unit will display LOW OIL LEVEL on the screen and shut the engine down immediately if an input is sensed on the spare 1 terminal.

Factory set to DLY ALM & SHTDWN

----- S-15: **CHANGE OIL:** Set the interval in engine running hours you wish to be prompted to change your engine oil. **Factory set to 500.**

----- S-16: **CHG OIL FLTR:** Set the interval in engine running hours you wish to be prompted to change your engine oil filter. **Factory set to 500.**

----- S-17: **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.**

----- S-18: **SERV AIR CLN:** Set the interval in engine running hours you wish to be prompted to service your engine air cleaner. **Factory set to 10.**

----- S-19: **SERV BATTERY:** Set the interval in engine running hours you wish to be prompted to service your cranking battery. **Factory set to 120.**

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-20: **PANEL MODE:** You have two options: MANUAL or AUTOMATIC. When Manual is selected, the unit will function as a standard engine monitoring panel. You must manually start the engine and throttle it to the desired speed. It will initiate shutdowns when faults are detected. Set-points relating to the Automatic mode will no longer display when this mode is selected. When AUTOMATIC is selected, the unit will perform all engine control automatically. **Factory set to MANUAL.**

----- S-21: **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 300 seconds). **Factory set to 30.**

----- S-22: **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 60.**

----- S-23: **PRELUBE DLY:** If you have the requirement for prelube or possibly a glowplug, you can use this delay. Set in the number of seconds you wish the unit to turn on this output before it initiates a crank. **Factory set to 1.**

----- S-24: **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 1.**

----- S-25: **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 1.**

----- S-26: **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.**

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- S-27: **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-28: **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 10.**
- S-29: **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-30: **MIN ENG RPM:** Minimum engine RPM is the speed at which your engine must run for its driven equipment to start performing work. For example, in a pumping application, minimum engine RPM is the speed at which an engine must run for fluid to begin being pumped. Set this variable to that speed. **Factory set to 900**
- S-31: **MAX ENG RPM:** Maximum engine RPM is the speed at which engine driven pump performance peaks. If the engine exceeds this speed, pump performance starts to deteriorate. This would be at the peak of a pump curve, for example. Set this set-point to that peak speed. For auto throttling at load, the controller will vary your engine speed between minimum and maximum RPM. **Factory set to 1600.**
- S-32: **WARMUP RPM:** You can set a specific speed you would like the engine to run during the warm-up time delay in this set-point. Consult your engine manual for the optimum warm-up speed. **Factory set to 700.**
- S-33: **RATE INC RPM:** This set-point is used to customize how fast or slow you wish the unit to increase the engine speed during throttling. Experiment with this number until the desired throttling is achieved. Factory default for this set-point is 10 RPM per second. **Factory set to 10.**
- S-34: **RATE DEC RPM:** This set-point is used to customize how fast or slow you wish the unit to decrease the engine speed during throttling. Experiment with this number until the desired throttling is achieved. Factory default for this set-point is 10 RPM per second. **Factory set to 10.**
- S-35: **CLUT REL RPM:** During cooldown, the unit brings the engine to an idle. While it is throttling down, it passes through the clutch release RPM and drops out the clutch. Set this point to the RPM you would like the unit to automatically release the clutch during Cooldown. **Factory set to 800.**
- S-36: **STRT/STOP TYPE:** This set-point allows you to configure the type of automatic start / stop inputs you will use. If this set-point is adjusted to OPL, a momentary input to terminal 1(447), (31 on 448) will cause a start and a momentary input to terminal 15(447), (34 on 448) will cause a stop. If this set-point is adjusted to 1 MAINTAIN CNTCT, a start input must be present the entire time a run condition is required on terminal 1(447), (31 on 448). When this input is taken away, the unit interprets this as a stop signal. If this set-point is adjusted to 2 MAINTAIN CNTCT, a start input must be present on both 1(447), (31 on 448) and 15(447), (34 on 448) before the unit will acknowledge a start. A stop is initiated after both inputs are removed. **Factory set to OPL START/STOP.**
- S-37: **THR MIN PULS:** This set-point is used to further customize the way the unit throttles your engine. Higher numbers cause the throttling outputs to stay active for longer periods of time when the unit demands an increase or decrease in the throttling. If it hunts around the set-point, lower the setting. If the engine never reaches the set-point, raise the number. **Factory set to 700.**

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- S-38: **THR FDBK DLY:** This set-point adjusts the amount of time in quarter seconds that the controller waits to sample the change made from the previous throttle pulse. Lower numbers cause less of a wait than larger numbers. If the system pressure, for example, takes quite a long time to change based on speed changes from the engine, this set-point should be increased. On the other hand, if the system pressure reacts quickly with changes in engine RPM, lower the set-point. **Factory set to 2.**
- S-39: **THR SENSITVY:** This set-point adjusts the throttle sensitivity when it closes in on the desired set-point. Higher numbers cause it to make more coarse signal adjustments when approaching a set-point than lower numbers. This set-point is used to keep the unit from overshooting or undershooting a set-point. If it hunts around the set-point, lower the setting. If the engine never reaches the set-point, raise the number. **Factory set to 700.**

P-NUMBER DESCRIPTION AND LISTING

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:
RUN HOURS
ENGINE SPEED
SYSTEM VOLTAGE
OIL PRESSURE
ENGINE TEMPERATURE
- P-2: **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-3: **TEMP @ SHDWN:** Shows what the engine jacket water temperature was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-4: **TACH @ SHDWN:** Shows what the engine speed was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P-5: **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-6- 14: **##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-15: **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-16: **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-17: **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-18: **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.

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- P-19: **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.
- P-20: **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.

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:

| |
|--|
| I1-4 00X0 ENTER SELECTION |
|--|

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

1. AUTO POSITION ON TOGGLE SWITCH

OPERATION DIRECTIONS

2. TEST POSITION ON TOGGLE SWITCH
3. EXTERNAL SPARE 1 SHUTDOWN INPUT
4. NOT USED FOR THIS APPLICATION

The next screen shows the rest of your inputs:

I5-12 00X0 0000
ENTER SELECTION

5. BATTERY VOLTAGE INPUT (IGNORE)
6. TEMPERATURE SENDER (For test purposes, you can ground this input to make sure you have run your wire properly.)
7. OIL PRESSURE SENDER For test purposes, you can ground this input to make sure you have run your wire properly.)
8. LOW COOLANT LEVEL INPUT
9. OPL STARTINPUT / REMOTE S/S INPUT
10. OPL STOP INPUT
11. OPL INCREASE INPUT (low oil level in Manual mode)
12. OPL DECREASE INPUT (V-belt break in Manual mode)

The next screen shows the state of your outputs:

01- 07 00X0 000
ENTER SELECTION

1. FUEL VALVE OUTPUT
2. STARTER CIRCUIT OUTPUT
3. COMMON FAIL OUTPUT
4. THROTTLE DECREASE OUTPUT
5. THROTTLE INCREASE OUTPUT
6. PRELUBE OUTPUT
7. CLUTCH OUTPUT

OPERATION DIRECTIONS

CUSTOMER WIRING INTERFACE LIST

The EMS448 controller has a user interface board, S449 module, for making the connections to the controller. Refer to bulletin EMS-94132N for more information on the user interface. The following chart is a description of the i/o layout for the EMS448.

| EMS447 Pin Assignment | EMS 448 Terminal | RELAY | HARDWARE ASSIGNMENT | PROGRAM PIN ASSIGNMENT |
|-----------------------|--|-------|---------------------|--|
| 1 | 31 | | Analog 4 | OPL Start |
| 2 | 33 | | Analog 0 | Battery Monitor (No customer hookup) |
| 3 | 35 | | Analog 7 | OPL Decrease Input |
| 4 | 37 | | Analog 1 | Electric Gauge Sender for Engine Water Temperature |
| 5 | 39 | | Input 1 | Auto Position of Test Off Auto Toggle Switch |
| 6 | 11 | | Input 2 | Test Position of Test Off Auto Toggle Switch |
| 7 | COM 1=B+ NO=8 NC=7 COM 2=18 NO=16 NC=17 | K6 | Output 1 | Fuel Solenoid Output |
| 8 | 20 | | Battery + | Battery Plus |
| 9 | 20 | | Battery + | Battery Plus |
| 10 | COM 1=6 NO=4 NC=5 COM 2=15 NO=13 NC=14 | K2 | Output 2 | Starter Output |
| 11 | 9 & 10 | | Battery - | Ground |
| 12 | NO = 21 & 22 | K1 | Output 3 | Common Fail Output |
| 13 | 1 | | Frequency Input | Frequency Input |
| 14 | 32 | | Analog 6 | OPL Increase Input |
| 15 | 34 | | Analog 5 | OPL Stop Input |
| 16 | 36 | | Analog 3 | Low Coolant Level (from L150) |
| 17 | 38 | | Analog 2 | Electric Gauge Sender for Engine Oil Pressure |
| 18 | 40 | | Input 3 | External Spare 1 shutdown |
| 19 | 12 | | Input 4 | Not Available for this application |
| 20 | NO = 23 & 24 | K3 | Output 4 | Throttle Decrease Output |
| 21 | NO = 25 & 26 | K4 | Output 5 | Throttle Increase Output |
| 22 | NO = 27 & 28 | K5 | Output 6 | Prelube |
| 23 | NO = 29 & 30 | K7 | Output 7 | Clutch |
| 24 | 2 | | RS485 - | RS485 (-) |
| 25 | 3 | | RS485 + | RS485(+) |