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EMS448 ENGINE CONTROLLER

SELECTRONIC® EMS448 CONTROLLER

OPERATION MANUAL

FOR USE WITH : PROGRAM # A96020 V1

DATE: 26-DEC-1998

GENERAL INFORMATION

DESCRIPTION

The EMS448 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.

OPERATING THE EMS CONTROLLER

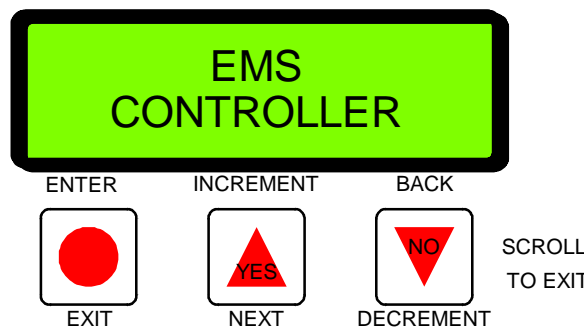
The EMS Controller is very simple to operate. Once the Setup numbers have been configured for your operation, the unit will automatically perform its duties with very little user interface.

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.

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, At Load, 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 EMS
PROGRAM A96020**

2. Now, press the \bullet button once. This will bring up the entry code screen.
3. Next, press the \blacktriangle ∇ buttons until the appropriate entry code is displayed. See the Classified Code Supplement for your number.
4. Finally, press the \bullet 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.

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

**ENG SPD #####
S-1 LINE 1 SELECT**

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

2. Now, press the \blacktriangle button to see the following screen:

**ENG SPD #####
S-4 OVERSPEED**

3. Next, press the \bullet button once. This will bring up the following screen:

**ENG SPD #####
RPM**

4. Next, press the \blacktriangle ∇ buttons until the appropriate value is displayed. For demonstration purposes, set the unit to 1800 RPM.

**ENG SPD #####
1800 RPM**

5. You have now changed the "Overspeed" to 1800 RPM.

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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 \bullet button once. This will put the unit back into the main display. If you forget to exit the S-numbers, the unit will exit for you after a pre-programmed amount of time.

ENG SPD ####
S-0 EXIT TO MAIN

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:

- 1. MURPHY EMS**
This is the first line of the title page.
- 2. PROGRAM A96020**
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 elapsed time on the hour meter.
- 4. RUN TIME XXXX.X**
This displays the time remaining on the minimum run timer. The unit will ignore a stop signal until this reads 0000.0.
- 5. BATTERY XX.X VDC**
This displays your engine battery voltage.
- 6. ENG SPD XXXX RPM**
This displays the current engine RPM. Decisions to stop cranking and shutdown on overspeed are based on this number.
- 7. LEVEL XX.X FEET**
This displays the current sump or tank level. The control of the engine is based on this level.
- 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. WATER TEMP XXX °F**
This displays the current water temperature as sensed from an electric gauge sender. The unit will signal the engine to shutdown if this temperature reading exceeds the shutdown point.
- 10. SELECTOR XXXX**
This displays the current position of the "Test - Off - Auto" selector switch.
- 11. ST: XXXX**
ST stands for STATE. This window shows what state your controller is in. These states include the following: CRANK ON, CRANK OFF, AT LOAD, and SHUTDOWN.

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NOT READY: This state occurs when the selector is in the Off position. The panel will not accept an auto start signal in this state.

PANEL READY: This state occurs when the selector is in the Auto position. The panel will accept an auto start signal in this state.

START DLY: This state occurs when a start signal is received and the start delay is timing. The start signal must be present through out this delay, for an auto start to occur.

PRELUBE DLY: This state occurs after a start signal has been accepted. The prelube pump is energized during this delay.

CRANK ON: This state occurs after the Glow Plug 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.

WARMUP: This state occurs after the engine has started. During this state, the engine is throttled to the warm-up rpm set point. The engine remains at this set point until the delay expires.

AT LOAD: This state occurs after the warm-up delay has expired. The engine is throttled to at least the minimum rpm set point.

STOP DLY: This state occurs when a stop signal is received and the stop delay is timing. The stop signal must be present through out this delay, for an auto stop to occur.

COOLDOWN: This state occurs after a stop signal has been accepted. The engine is throttled to an idle. The engine is signaled to stop when this delay expires.

SHUTDOWN: This state occurs if a shutdown condition is detected. Reasons for shutdown include low oil pressure, high water temperature, overspeed, etc. During this state, the engine is signaled to shutdown and all start signals are ignored until the state is reset by the remote reset switch.

12. CHG OIL XXX HRS

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

13. OIL FLT XXX HRS

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

14. FUEL FLT XXX HRS

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

15. 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.

16. 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 Classified Code Supplement for the entry code number.

- S. 0: Manual 'EXIT' to main from the S-number setup mode. Press ● to " EXIT TO MAIN"
- 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
BATTERY VOLTAGE
OIL PRESSURE
WATER TEMPERATURE
I/O STATUS
- S. 2: **ENG SPEED:** The current engine rpm is displayed.
- S. 3: **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. 4: **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. 5: **UNDERSPEED:** This setting allows you to enter the lowest speed the engine can run before damage is caused. If the unit senses that the engine has dropped below this speed, it will signal the engine to shutdown. **Factory set to 0.**
- S. 6: **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. 7: **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. 8: **LOP @ HI SPD:** This set-point is the higher oil pressure shutdown point that is referred to in number S7 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. 9: **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 S7, the unit will initiate an automatic shutdown. **Factory set to 600.**

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- S. 10: **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 S8, the unit will initiate an automatic shutdown. **Factory set to 1600.**
- S. 11: **HI WATER TEMP:** Adjust this setting to the 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 210.**
- S. 12: **WARMUP DLY:** The engine will remain at the warm-up rpm set throughout this delay. (adjustable from 1 to 300 seconds). **Factory set to 30.**
- S. 13: **COOLDOWN DLY:** The engine will remain at an idle throughout this delay. (adjustable from 1 to 300 seconds). **Factory set to 60.**
- S. 14: **PRELUBE DLY:** This is the length of time of prelube prior to cranking the engine. (adjustable from 1 to 300 seconds). **Factory set to 1.**
- S. 15: **ENGINE START DLY:** The auto start signal is ignored throughout this delay. (adjustable from 1 to 300 seconds). **Factory set to 1.**
- S. 16: **ENGINE STOP DLY:** The auto stop signal is ignored throughout this delay. (adjustable from 1 to 300 seconds). **Factory set to 1.**
- S. 17: **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. 18: **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. 19: **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 20.**
- S. 20: **CRK STOP RPM:** This RPM set-point is used to adjust where the unit releases the starter after starting. Set this to the RPM the engine attains just as it starts. This way, the starter is not engaged unnecessarily after the engine starts. This is how the unit senses whether the engine is running or not. **Factory set to 300.**
- S. 21: **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. 22: **MIN ENG RPM:** The engine will not throttle below this set point when "at load". **Factory set to 900.**
- S. 23: **MAX ENG RPM:** The engine will not throttle below this set point when "at load". **Factory set to 1600.**
- S. 24: **WARMUP RPM:** The engine will throttle to this set point during the warm-up delay. **Factory set to 700.**

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- S. 25: **RATE INC RPM:** This is the rate that the controller will increase the internal "target" rpm. **Factory set to 10.**
- S. 26: **RATE DEC RPM:** This is the rate that the controller will decrease the internal "target" rpm. **Factory set to 10.**
- S. 27: **CLUT REL RPM:** This is the rpm that the controller will dis-engage the clutch during the cooldown delay. **Factory set to 4000.**
- S. 28: **STRT / STP TYPE:** There are two choices on how the engine is started automatically. Choose "**remote**" if a single remote contact is used. This contact must close and remain closed to initiate an auto start. When this contact re-opens, an auto stop will occur. Choose "**level**" if a local level transducer is used. In this case, auto start/stop is determined by set points, S43 and S44. **Factory set to level.**
- S. 29: **THR MIN PULS:** This is the length of the "pulse" sent to the throttler, when increasing or decreasing engine rpm. The higher the number, the more sensitive (faster moving) the throttling will be. The lower the number, the less sensitive (slower moving) the throttling will be. **Factory set to 700.**
- S. 30: **THR FDBK DLY:** This is the length of time between the above "pulses". Each number represents one quarter second. For slower throttler response use a higher number. For faster throttler response, use a lower number. **Factory set to 2.**
- S. 31: **THR SENSITVY:** This is how directly the throttling routine approaches the desired set point. The set point being the "maintain level". **Factory set to 700.**
- S. 32: **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. 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 a 30 sec. delay has expired. **Factory set to Delay alarm & shutdown.**
- S. 33: **CHANGE OIL:** Set the interval in engine running hours you wish to be prompted to change your engine oil. **Factory set to 500.**
- S. 34: **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. 35: **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. 36: **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. 37: **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.

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- S. 38: **MAINTAIN LEVEL:** Enter in the desired sump level to be maintained. The engine is throttled between the minimum and maximum rpm set points, to keep the sump level at this maintain level set point.
- S. 39: **DEADBAND:** This set point extends above and below the maintain set point. When the level is in the deadband, the throttling is stopped. Example: The maintain level is 15 ft. and the deadband is 2.0 ft. There would be no increasing or decreasing of engine speed when the level is 13 ft. and above, and 17 ft. and below. This example is a 5 ft. deadband.
- S. 40: **DAMPING DLY:** This allows for smooth throttling of the engine. The preset value of 10 is recommended for this application.
- S. 41: **LEVEL MAX:** Enter in the maximum range of the level transducer.
- S. 42: **SET SLOPE:** Enter a number that matches the number displayed on the top line. Do this with the level transducer wired to the controller and zero pressure on the transducer.
- S. 43: **HIGH SUMP LEVEL:** Enter the level desired for a high level alarm / shutdown. . This function is an alarm only when "empty" is chosen in S48. The alarm will clear when the level drops below this set point. This condition is a shutdown if "Fill" is chosen in S48, then requiring manual reset of the controller before normal operation can resume.
- S. 44: **LOW SUMP LEVEL:** Enter the level desired for a low level alarm / shutdown. This function is an alarm only when "fill" is chosen in S48. The alarm will clear when the level rises above this set point. This condition is a shutdown if "empty" is chosen in S48, then requiring manual reset of the controller before normal operation can resume. In either case, this feature is locked out for 20 seconds after the warmup delay expires.
- S. 45: **START LEVEL:** Enter the level desired for an auto start.
- S. 46: **STOP LEVEL:** Enter the level desired for an auto stop.
- S. 47: **MIN RUN TIME:** This delay begins timing after an auto start occurs. An auto stop condition is ignored until this delay expires. **Factory set to 0.**
- S. 48: **LEVEL TYPE:** Fill / Empty. If the application requires pumping out of a sump (flood control, sewage lift, etc.) choose empty. If pumping into a sump, choose fill. **Factory set to Empty.**
- S. 49: **SET ADJ DLY:** This is the delay between increasing and decreasing the internal target rpm. For a fast reacting system, a short delay is desired. For a slow reacting system, a longer delay is desired. **Factory set to 2.**

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 Classified Code Supplement for this code number.

P-NUMBER DESCRIPTION AND LISTING

- P. 0: Manual 'EXIT' to main from the S-number setup mode. Press ● to " EXIT TO MAIN"
- 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:

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ENGINE SPEED
RUN HOURS
BATTERY VOLTAGE
OIL PRESSURE
WATER TEMPERATURE

- P. 2 **OIL PR @ SHDWN:** Shows what the engine oil pressure was when the unit initiated the last failure shutdown. To view the information, press the ● button.
- P. 3: **WATER TEMP @ SHDWN:** Shows what the 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 SHUTDOWN:** 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.
- 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 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.

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- 2. Wire power leads directly to battery Post.**
When hooking your power supply to your control panel, 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. | INPUT 1 | Auto position of selector switch |
| 2. | INPUT 2 | Test position of selector switch |
| 3. | INPUT 3 | External spare 1 shutdown |
| 4. | INPUT 4 | Not used for this application |

The next screen shows the rest of your inputs:

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15-12 00X0 0000 ENTER SELECTION

- | | | |
|----|----------|-----------------------------|
| 1. | ANALOG 0 | Battery monitor (NO HOOKUP) |
| 2. | ANALOG 1 | Temperature sender |
| 3. | ANALOG 2 | Oil pressure sender |
| 4. | ANALOG 3 | Low coolant level |
| 5. | ANALOG 4 | Remote start / stop |
| 6. | ANALOG 5 | Not used |
| 7. | ANALOG 6 | 0-5 vdc Level transducer |
| 8. | ANALOG 7 | Low oil level |

For test purposes, you can ground the senders and check for the "X" to confirm your wiring.

The next screen shows the state of your outputs:

01- 07 00X0 000 ENTER SELECTION

- | | | |
|----|----------|--------------------|
| 1. | OUTPUT 1 | Fuel / ignition |
| 2. | OUTPUT 2 | Starter |
| 3. | OUTPUT 3 | Common fail |
| 4. | OUTPUT 4 | Throttler decrease |
| 5. | OUTPUT 5 | Throttler increase |
| 6. | OUTPUT 6 | Prelube pump |
| 7. | OUTPUT 7 | Clutch |