

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

SELECTRONIC® CONTROLLER

EMS447-14 TRIPLEX MOTOR CONTROLLER

OPERATION MANUAL

FOR USE WITH: PROGRAM # M96022.V1

DATE: 13-SEP-1996

GENERAL INFORMATION

DESCRIPTION

The EMS Controller is a microprocessor based level controller. The controller monitor the level of the tank, in elevation, via a 4-20 ma transducer. The controller will automatically stage the electric motor driven well pumps on according to the level in the tank. Pumps #1 and #2 will automatically alternate and pump #3 will always run in the last starting position. For more detail of the operation refer to the sequence of operation section below.

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.

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 Murphy 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 EMS447 controller has a total of seven (7) open collector transistor outputs. One (1) of these can be selected as an input. 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.

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SEQUENCE OF OPERATION

CONTROL SEQUENCE OUTLINE

START SEQUENCE

- I. If the tank level decreases to a field adjustable STAGE 1 START level set-point the controller will initiate an auto start sequence (note that this sequence will assume that all the well pumps are auto ready and that the starting sequence is pump #1, pump #2 then pump #3):
 - A. The controller has a STAGE 1 START DELAY function. The controller will ignore the automatic start signal for the delay period. 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. After this delay expires the controller will energize the PUMP 1 START circuit.

NOTE: If for any reason the contact for the PUMP READY is not closed the controller will automatically go switch to the next pump in the alternation sequence. Also if these contacts should open at any time during the operation the controller will fail the motor and use the next pump in the alternation
 - B. If the level continues to drop to a field adjustable STAGE 2 START level set-point. The controller has a STAGE 2 START DELAY function. The controller will ignore the automatic start signal for the delay period. 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. After this delay expires the controller will energize the PUMP 2 START circuit.
 - C. If the level continues to drop to a field adjustable STAGE 3 START level set-point. The controller has a STAGE 3 START DELAY function. The controller will ignore the automatic start signal for the delay period. 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. After this delay expires the controller will energize the PUMP 3 START circuit.

STOP SEQUENCE

- II. As the tank level increases to the field adjustable STAGE 3 STOP level set-point the controller will initiate an auto stop sequence:
 - A. The controller has a STAGE 3 STOP DELAY function. The controller will ignore the automatic stop signal for the delay period. 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. After this delay expires the controller will de-energize the PUMP 3 START circuit.
 - B. If the level continues to rise to a field adjustable STAGE 2 STOP level set-point. The controller has a STAGE 2 STOP DELAY function. The controller will ignore the automatic start signal for the delay period. 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. After this delay expires the controller will de-energize the PUMP 2 START circuit.
 - C. If the level continues to rise to a field adjustable STAGE 1 STOP level set-point. The controller has a STAGE 1 STOP DELAY function. The controller will ignore the automatic start signal for the delay period. 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. After this delay expires the controller will de-energize the PUMP 1 START circuit.

SPECIAL FEATURES

SPECIAL FEATURES

PUMP ALTERNATION

The controller will have the capability to choose between manual and automatic alternation. The choices will include AUTOMATIC, 1-2-3 and 2-1-3.

AUTOMATIC: With this selection the controller will automatically alternate the lead pump every time a start sequence begins. If pump #1 is lead for this start cycle, then the next start cycle pump # 2 will start.

1-2-3: With this selection the controller will always start pump #1 as the lead pump.

2-1-3: With this selection the controller will always start pump #2 as the lead pump.

The alternation, no matter what the selection above will always be first on last off.

BACK-UP MODE

The controller will have a back-up mode of operation. If the tank level drops down to the low float level the controller will start all pumps and run until the high float level. The LCD will flash BACK-UP MODE. The purpose of this mode of operation is in the case that the transducer fails. To reset the controller from back-up mode back to normal mode, break power to the control module. If this feature is not used, don't connect to the float level inputs.

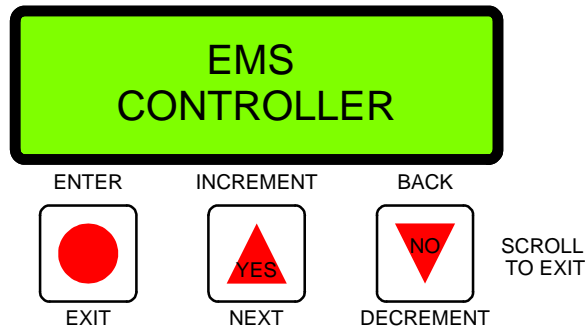
OPERATION DIRECTIONS

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.

EMS Controller



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 EMS447
PROGRAM M96022**

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

MAIN DISPLAYS

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

- 1. MURPHY EMS447**
This is the first line of the title page.
- 2. PROGRAM M96022**
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. TANK XXXX.X FT.**
This displays the current tank level. The controller uses this to determine the staging the pumps.
- 4. STAGE X**
This displays the current stage the controller is in the auto sequence.
- 5. P1 ST: XXXXXXXXX**
This window shows the status of pump #1. These include the following: STAND BY, RUNNING and NOT READY.
STAND BY: This status occurs when the pump HOA selector switch is in the "AUTO" position no failure and the pump is not required.
RUNNING: This status occurs when the controller requires the pump to run.
NOT READY: This status occurs when the HOA selector switch is in the "OFF" or "HAND" position.
- 5. P2 ST: XXXXXXXXX**
This window shows the status of pump #2. These include the following: STAND BY, RUNNING and NOT READY.

OPERATION DIRECTIONS

STAND BY: This status occurs when the pump HOA selector switch is in the "AUTO" position no failure and the pump is not required.

RUNNING: This status occurs when the controller requires the pump to run.

NOT READY: This status occurs when the HOA selector switch is in the "OFF" or "HAND" position.

5. **P3 ST: XXXXXXXXX**

This window shows the status of pump #3. These include the following: STAND BY, RUNNING and NOT READY.

STAND BY: This status occurs when the pump HOA selector switch is in the "AUTO" position no failure and the pump is not required.

RUNNING: This status occurs when the controller requires the pump to run.

NOT READY: This status occurs when the HOA selector switch is in the "OFF" or "HAND" position.

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:

STAGE #

P1 ST: XXXXXXXXX

P2 ST: XXXXXXXXX

P3 ST: XXXXXXXXX

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".

----- S-2: **1 START LVL:** Set this set-point to the level that the controller will start the stage 1 pump. **Factory set to 5180.**

----- S-3: **1 STOP LVL:** Set this set-point to the level that the controller will stop the stage 1 pump. **Factory set to 5186.**

----- S-4: **1 START DLY:** Set this delay on stage 1 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-5: **1 STOP DLY:** Set this delay on stage 1 stop to the number of seconds that the stop signal must be present before the unit accepts it and initiates an auto stop sequence (adjustable from 1 to 300 seconds). **Factory set to 2.**

_____ S-6: **2 START LVL:** Set this set-point to the level that the controller will start the stage 2 pump. **Factory set to 5178.**

_____ S-7: **2 STOP LVL:** Set this set-point to the level that the controller will stop the stage 2 pump. **Factory set to 5186.**

_____ S-8: **2 START DLY:** Set this delay on stage 2 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-9: **2 STOP DLY:** Set this delay on stage 2 stop to the number of seconds that the stop signal must be present before the unit accepts it and initiates an auto stop sequence (adjustable from 1 to 300 seconds). **Factory set to 2.**

OPERATION DIRECTIONS

- _____ S-10: **3 START LVL:** Set this set-point to the level that the controller will start the stage 3 pump. **Factory set to 5175.**
- _____ S-11: **3 STOP LVL:** Set this set-point to the level that the controller will stop the stage 3 pump. **Factory set to 5186.**
- _____ S-12: **3 START DLY:** Set this delay on stage 3 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-13: **3 STOP DLY:** Set this delay on stage 3 stop to the number of seconds that the stop signal must be present before the unit accepts it and initiates an auto stop sequence (adjustable from 1 to 300 seconds). **Factory set to 2.**
- _____ S-14: **LVL MAX:** Set this to the maximum value of the transducer. For example, if the transducer is rated for 0 to 100 Feet then a 100 should be entered. **Factory set to 200.**
- _____ S-15: **LVL OFFSET:** Set this to the value of the offset for the transducer to read the feet in altitude. **Factory set to 5077.**
- _____ S-16: **SET SLOPE:** This helps with the calibration of the analog reading. To calibrate, power up the transducer, remove all pressure from the transducer and make the set-point match the raw count displayed on the top line. **Factory set to 51.**
- _____ S-17: **HIGH LEVEL:** This set-point allows you to set a pump shutdown point on high level. **Factory set to 5187.**
- S-18: **HIGH RESET:** This set-point allows you to set a pump shutdown reset point on high level. **Factory set to 5186.**
- _____ S-19: **LOW LEVEL :** This set-point allows you to set a pump shutdown point on Low level. **Factory set to 5170.**
- _____ S-20: **LOW RESET:** This set-point allows you to set a pump shutdown reset point on low level. **Factory set to 5172.**
- _____ S-21: **ALTERNATION:** The controller will have the capability to choose between manual and automatic alternation. The choices will include AUTOMATIC, 1-2-3 and 2-1-3. **Factory set to AUTO.**

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:
STAGE #
- P-2: **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.

OPERATION DIRECTIONS

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. PUMP #1 AUTO READY
2. PUMP #2 AUTO READY
3. PUMP #3 AUTO READY
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. NOT USED INPUT
7. NOT USED INPUT
8. HIGH LEVEL FLOAT

OPERATION DIRECTIONS

9. LOW LEVEL FLOAT
10. NOT USED INPUT
11. LEVEL TRANSDUCER INPUT (For test purposes, you can ground this input to make sure you have run your wire properly.)
12. NOT USED INPUT

The next screen shows the state of your outputs:

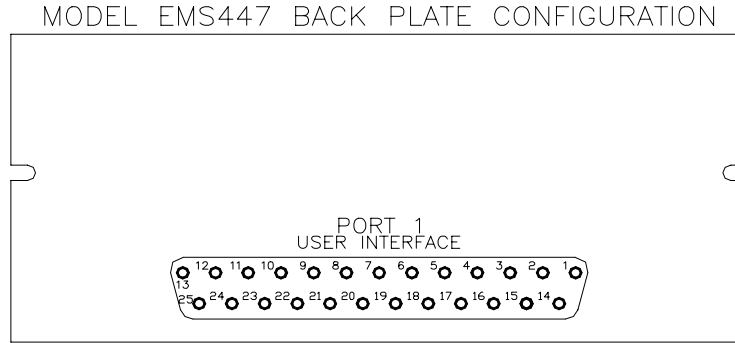
01- 07 00X0 000
ENTER SELECTION

1. PUMP #1 START
2. PUMP #2 START
3. PUMP #3 START
4. SPARE OUTPUT
5. SPARE OUTPUT
6. COMMON ALARM
7. SPARE OUTPUT

USER INTERFACE

PORT CONNECTION DESCRIPTION

The EMS447 controller has ONE (1) connector on the back.



This is the back plate of the EMS447 showing the location of the connector. This view is looking at the back of the EMS controller.

PORT 1

USER INTERFACE. 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	Low Level Float input (for back-up operation, N.O. closes on indication)
2	Analog 0	Battery Monitor (No customer hookup)
3	Analog 7	Spare Analog Input
4	Analog 1	Spare Analog Input
5	Input 1	Pump #1 H.O.A. Auto Ready
6	Input 2	Pump #2 H.O.A. Auto Ready
7	Output 1	Pump #1 Start
8	Battery +	Battery Plus
9	Battery +	Battery Plus
10	Output 2	Pump #2 Start
11	Battery -	Ground
12	Output 3	Pump #3 Start
13	Frequency Input	Frequency Input
14	Analog 6	4-20 ma Level Transducer input
15	Analog 5	Spare Analog Input
16	Analog 3	High Level Float input (for back-up operation, N.O. closes on indication)
17	Analog 2	Spare Analog Input
18	Input 3	Pump #3 H.O.A. Auto Ready
19	Input 4	Not Available for this application
20	Output 4	Spare Output
21	Output 5	Spare Output
22	Output 6	Common Alarm
23	Output 7	Spare Output
24	RS485 -	RS485 (-)
25	RS485 +	RS485(+)

ENTRY CODE SUPPLEMENT

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 secret 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 secret code number is **64**.