MANUAL

ELECTRIC FIRE PUMP CONTROLLERS

FOR USE WITH THE MANUAL START FIRE PUMP CONTROLLER SERIES M100, M200 AND M220 AND THE COMBINED AUTOMATIC-MANUAL START FIRE PUMP CONTROLLERS SERIES M300, M400 AND M420

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Note: This manual is subject to change without prior notice.

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PART I: GENERAL DESCRIPTION

The basic function of the Fire Pump Controller is to start the pump motor to maintain the water system pressure. This may be accomplished in automatic controllers, Series M300, M400 and M420, by automatically starting the pump motor upon drop in pressure in the water main or from a number of other demand signals. Manual controllers, Series M100, M200 and M220 must be started manually while the automatic controller can be started automatically or manually. All can be started by remote manual means, but cannot be stopped remotely. The automatic controller can be set to stop automatically or require manual stop after an automatic start.

PART II: FUNCTIONS

A. Automatic Starting From:

1. Drop in water line pressure
2. Deluge Valve operation, Option D
3. Loss of remote alarm power, Option P

B. Alarm and Signals:

1. **Remote indication of pump operation**: One (1) set of normally open (N.O.) and normally closed (N.C.) contacts located in the controller operate when the pump is running.
2. **Loss of power to the controller**: One (1) Single Pole Double Throw (SPDT) contact located in the controller operates for loss of power, loss of phase, or low voltage.
3. **Phase reversal of power to controller**: One (1) SPDT contact located in the controller operates for phase reversal of the power to the controller.
4. **Motor current exceeds 125% of normal**: One (1) SPDT contact located in the controller operates when the motor current exceeds 125% of normal.
5. **Power On pilot light on controller**: This light is on when both the isolation switch and circuit breaker of the controller are closed and the power monitor is detecting correct primary power and control power thus indicating that the controller is ready for operation.
6. **Phase reversal pilot light**: This pilot light is on whenever there is a phase reversal of the power to the controller.
7. **Engine Lockout (Option E)**: When an engine drive system is used as a backup a N.O. auxiliary contact on the motor contactor is provided to prevent the engine from starting if the electric motor is running.
8. **Electric Motor Lockout (Option M)**: The electric motor lockout is generally used in conjunction with engine lockout above. If the engine is running due to a power outage, or other reasons, the electric motor can be locked out until the engine is stopped.

C. Sequential Starting (Option S): This optional feature is provided for multiple fire pump installations. This provision times the start of the pump motors by a preset time interval so that all motors do not come on at once.

D. Principal Components of Controller:

1. Isolation Switch
2. Circuit Breaker
3. Overcurrent Monitor
4. Contactor
5. Pressure Switch

The incoming line is connected directly to the isolation switch. From there the power is fed to the circuit breaker and then to the contactor. Both the isolation switch and circuit breaker are normally closed. The contactor is operated either manually or automatically to start the motor.

PART III: INSTALLATION

The Fire Pump Controller has been assembled and wired at the factory with the highest workmanship standards. All wiring and functions have been thoroughly tested to assure correct operation when properly installed. Before operating the controller, perform the Initial Installation Start-Up Procedure, Part IV.

The cubicle should be well grounded according to local standards. Make sure that all applicable external control wires are connected to appropriate terminals as shown in External Hookup drawing. If the controller is supplied with Option "D" Deluge Valve Start, and it is not being used the terminals for this must be jumpered (See External Hookup drawing). Failure to make the proper connections will cause the controller to malfunction. Connection from the contactor to the motor may be done after the test procedure is completed. The contact ratings of the remote alarm contacts of the controller are shown on the controller Schematic drawing.

After installation has been completed, perform the Initial Installation Start-Up Procedure, Part IV before operating the controller.

PART IV: INITIAL INSTALLATION START-UP PROCEDURE

A. **General:** All but the final test can be made with the motor disconnected. This will eliminate the need for starting and stopping the motor several times during the test procedure. If the output connections from the contactor to the motor were made on initial installation, disconnect them for the first part of the Initial Installation Start-Up Procedure. Refer to External Hookup drawing for nomenclature of all controls. Refer to schematic for location of contacts for remote alarms.

The controls and their functions as follows:

1. **Isolation Switch**: This switch is connected in the circuit between the line and the circuit breaker. Its function is to disconnect the main power to the controller.

2. **Circuit Breaker**: The circuit breaker is located between the motor contactor and the isolation switch. Its function is to protect the line from damage due to a short in the load.

3. **Overcurrent Monitor**: The overcurrent monitor (1OCM) senses the motor current through a set of current transformers (CTs) in the controller. When the motor current exceeds 125% of normal a yellow LED illuminates on the monitor and a set of dry contacts change state. When the motor current exceeds 300% the monitor begins timing based on how much the current exceeds 300% of normal and a red LED begins flashing. The greater the current the shorter the time period such that at 600% of normal the monitor activates in approximately 14 seconds. When the monitor activates (at the end of timing), a set of normally open contacts close which energize the shunt trip in the circuit breaker causing it to trip.

4. **Current & Voltage Display (CVD1):** The CVD1 display unit provides a continuous display of controller voltage and motor current. A Select pushbutton is provided to toggle the display between three phase voltage readings and three phase current readings. Also, if the Select pushbutton is held for 3 seconds the unit will display the highest motor current since the last reset. This value can be reset by holding the Select button for 15 seconds. This feature is especially useful for monitoring the motor starting current. The unit, in conjunction with the 1OCM will display the value of motor current that caused the 1OCM to trip. After the 1OCM goes into a locked rotor tripped condition, the display module will display the last current that caused the 1OCM to trip until the reset pushbutton is pressed.

4. **Emergency Start Lever**: This control is used to start the fire pump in case of any malfunction within the control circuits.

5. **Start Button**: The pushbutton starts the pump motor by exciting the contactor coil so that it closes.

6. **Stop Button**: This pushbutton stops the pump motor by opening the contactor coil circuit, thereby disconnecting the current to the pump motor.

B. Series M100 Manual Non-Automatic:

1. Close isolation switch and measure voltage at output of isolation switch. Voltage should be the same as incoming line voltage.

2. Close circuit breaker and measure voltage of input of motor contactor. Voltage should be the same as in Step 1. Power On pilot light on controller should be on.

3. Push manual start button; motor contactor should close. Measure voltage at output of contactor. It should be the same as in Step 1.

4. Push stop button. Motor contactor should be open.

5. Turn circuit breaker off.

6. Connect output from contactor to pump motor.

7. Close circuit breaker.

8. Push start button; motor should start. Check the motor for proper rotation.

9. Push stop button; motor should stop.

C. Series M200 Manual Primary Resistance Start: The start-up procedure is the same for the Series M100. There are two contactors instead of one and a set of starting resistors. The starting contactor is connected in series with the resistors to reduce the voltage to the motor for a preset time. After the preset time delay, the main contactor will close in parallel with the starting contactor and resistors and thus apply full voltage to the motor. If the motor is not connected for this test, there will be no voltage drop across the resistors and full voltage will appear at the output terminals of the contactors as soon as the starting contactor closes.

D. Series M220 Manual Part-Winding Start: The start-up procedure is the same as for the Series M100. There are two contactors for part-winding start. One contactor will close immediately on demand and the other will close after a preset time delay. Full voltage will be present at the output of both contactors.

E. Series M300 Combined Manual Automatic:

1. Close isolation switch and measure voltage at output of isolation switch. Voltage should be the same as incoming line voltage.

2. Close circuit breaker and measure voltage at input of motor contactor. Voltage should be the same as in Step 1. The Power On pilot light on controller should be on. In addition, the red Phase Reversal pilot light should not be on. If it is, check that all three phases are present and of the correct voltage. If all power is correct, turn the controller isolation switch OFF, reverse any two of the three phase wires connected to terminals L1, L2, or L3, of the power monitor, then turn isolation switch and circuit breaker back ON. The Phase Reversal pilot light should not be on.

3. Push start button, motor contactor should close. Measure voltage at output of contactor. It should be the same as the incoming line voltage.

4. Push stop button, motor contactor should open.

5. Drop water pressure at water inlet to controller so pressure switch will close, motor contactor should close. Allow water pressure to return to normal. If controller is set for automatic stop, set running period timer for at least 10 minutes running time. Motor contactor should open after this time period. If the controller is set for manual stop, push stop button; motor contactor should open.

6. For controllers supplied with Option D, repeat Step 5, except momentarily open deluge valve switch instead of dropping pressure to close pressure switch.

7. Turn circuit breaker off.

8. Connect output from contactor to pump motor.

9. Close circuit breaker.

10. Push start button, motor should start. Check the motor for proper rotation.

11. Push stop button, motor should stop.

F. **Series M400 Combined Manual-Automatic Primary Resistance Start:** The start-up procedure is the same as for the Series M300. There are two contactors instead of one, and a set of starting resistors. The starting contactor is connected in series with the resistors to reduce the voltage to the motor for a preset time. After this preset time delay the main contactor will close in parallel with the starting contactor and resistors and thus apply full voltage to the motor. If the motor is not connected for this test, there will be no voltage drop across the resistors and full voltage will appear at the output terminals of the contactors as soon as the starting contactor closes.

G. **Series M420 Combined Manual-Automatic Part-Winding Start:** The start-up procedure is the same as for the Series M300. There are two contactors for part-winding start. One contactor will close immediately on demand and the other will close after a preset time delay. Full voltage will be present at the output of both contactors.

H. **Sequential Starting (Option S):** The sequential start timers provide a time delay between the pressure switch contacts closing and the motor contactor closing. Where sequential starting is used, set the sequential start timers for approximately ten (10) second intervals. Perform Initial Start-Up Procedure for appropriate controller and check for sequential timing on automatic starts. Sequential starting is bypassed by manual starting.

PART V: OPERATION OF CONTROLLER

After the installation and test procedure are completed the controller is ready for normal operation.

A. **Manual Controller:** Isolation switch and circuit breaker should be closed. Controller is now ready for manual operation. The controller is started by pushing the start button. If for some reason the motor fails to start when the start button is pushed the emergency manual lever may be moved to the "On" position. This lever must be manually locked in the "On" position or it will return to "Off" when released. This lever is for emergency use only.

B. **Automatic Controllers / (All Types):** The isolation switch and circuit breaker should be closed. For a sequential start controller and sequential start, timing relay 3TR should be set for approximately ten (10) second intervals. Local requirements may dictate different time settings. For controllers set for automatic stop, set the running period timer for at least 10 minutes running time. To activate the automatic stop feature, the jumper on the Manual Stop Jumper Block must be removed.

C. **Emergency Manual Operation:** Emergency manual operation is provided in case of failure of control circuitry. This lever is manually moved to the "On" position and must be manually latched in the "ON" position or it will return to "Off" when released. The lever should be moved from the "Off" position to the "On" position in as quickly a motion as possible to prevent burning the contacts. The circuit breaker should be tripped to disconnect circuit before releasing emergency lever. This lever is for emergency use only. A mechanical interlock switch is connected to the emergency lever to operate the contactor electrically when all circuitry is functioning properly. This is provided to prevent inadvertent slow closing of contactor and burning of contacts.

PART VI: SEQUENCE OF OPERATION

A. Introduction: The explanation of the sequence of operation will start with the assumption that the controller has been properly installed, all external connections have been made and the isolation switch and circuit breaker are closed. In other words, the controller is operational. The Power On pilot light should be on. All wiring on the primary side of the Transformer 1CPT will be referred to as the primary circuit. All wiring on the secondary side of the Transformer 1CPT will be referred to as the secondary circuit.

B. Manual Operation:

1. M100, M200 and M220 Manual Controllers: For manual operation there is a start button switch on the controller and terminals for an optional remote start switch located elsewhere. These switches have normally open contacts which close to energize 1CR. 1CR locks in on its own N.O. contact and stays energized until the stop button is depressed. The N.O. contact of 1CR in the primary circuit closes the circuit to the motor contactor to start the motor. On Models M200 and M220 a time delay relay (2TR) is wired in parallel with 1CR. After a preset time delay N.O. contacts of 2TR close to energize relay 3CR. A N.O. contact of 3CR then energizes the second or run contactor.

   To stop the controller manually the stop pushbutton switch is depressed. This breaks the circuit to the coil of 1CR and it is de-energized. At the same time the N.O. contacts of 1CR and 3CR in the primary circuit open and de-energize the motor contactor(s) and stops the motor.

2. M300, M400 and M420 Combined Manual-Automatic Controllers: Manual operation of the combined manual-automatic controllers is the same as for the manual controllers. The electrical sequence is different in that the N.O. contact of 1CR does not energize the coil directly but energizes the coil of 2CR, and a N.O. contact of 2CR in the primary circuit energizes the motor contactor. On Models M400 and M420, 1CR also energizes a time delay relay 2TR. After a preset time delay N.O. contacts of 2TR close to energize relay 3CR. A N.O. contact of 3CR then energizes the second or run contactor.

C. Automatic Operation / (Pressure Switch): On drop of water pressure the N.O. contact in the pressure switch closes energizing the coil of 2CR. 2CR locks in on its N.O. contact in the secondary circuit. At the same time the N.O. contact in the primary circuit energizes the motor contactor to start the motor. In controllers with sequential starting, 3TR is energized by the pressure switch starting its timing cycle and at the end of the timer period a N.O. contact of 3TR closes energizing 2CR. A N.O. contact of 2CR in the primary circuit closes and energizes the motor contactor as above. On Models M400 and M420 a time delay relay 2TR is wired in parallel with 2CR. After a preset time delay N.O. contacts of 2TR close to energize relay 3CR. A N.O. contact of 3CR then energizes the second or run contactor.

On controllers set for automatic stop, a running period timer is used to keep the motor running for a preset time period regardless of whether the contact of the pressure switch has opened. This is accomplished by keeping 2CR (or 3TR) locked in through the N.C. contacts of the timer (1TR) until the timer times out and these contacts open.

On controllers set for manual stop only, a jumper is installed in parallel with the N.C. contact of 1TR, thus 2CR (or 3TR) is held in the energized state. The controller must be stopped with the manual stop pushbutton switch which breaks the circuit to 2CR (or 3TR). The N.O. 2CR contact in the primary circuit opens and stops the motor.

D. Automatic Operation / (Deluge Valve - Option D): The deluge valve switch is a N.C. switch. When it opens 7CR is de-energized. The N.C. contacts of 7CR in the automatic circuit close and energize 2CR (or 3TR). The remaining sequence to start and stop the motor is the same as automatic operation with the pressure switch closing.

E. Remote / Pump Running Signal: One (1) N.O. and one (1) N.C. contact is available for remote indication that the pump is running.

F. Remote / Loss of Power, Loss of Phase, Low Voltage: One (1) SPDT contact is available for remote indication of loss of line power, loss of phase, or low voltage.

G. **Remote / Phase Reversal:** One (1) SPDT contact is available for remote indication of phase reversal of the incoming power to the controller.

H. **Engine Lockout / (Option E):** A N.O. auxiliary contact on the motor contactor is provided to prevent an engine type controller from starting if the electric motor is running. Circuitry for this is provided in engine controllers supplied with Option 'E'.

I. **Electric Motor Lockout / (Option M):** Terminals are available to connect to an external switch to lock out the electric motor. This may be necessary to prevent the motor from starting when the engine is running or when a low suction cutoff panel is used, etc. The external switch will close to energize 9CR. A N.C. contact of 9CR will break the circuit to 2CR (or 3TR) and stop the motor. With the Electric Motor Lockout feature energized it is still possible to start the motor manually.

J. **Power Failure Start / (Option P):** On loss of reliable source of 120VAC, relay 8CR will be de-energized. The N.C. contact of 8CR will close and start the electric motor in the same manner as for drop in water pressure described in Section C.

PART VII: NOMENCLATURE

1CR	Manual Start Relay
2CR	Control Relay
3CR	1MC Delay Relay
5CR	Transformer Secondary Power Available Relay
7CR	Deluge Start Relay (Option D)
8CR	Power Failure Start Relay (Option P)
9CR	Motor Lockout Relay (Option M)
1TR	Run Period Timer
2TR	1MC Delay Timer
3TR	Sequential Start Timer (Option S)
1MC	Motor Run Contactor
2MC	Motor Accelerator Contactor
1MCA	Motor Contactor Auxiliary Contacts
1CS	Stop Switch
2CS	Start Switch
1PL	Power On Pilot Light
2PL	Phase Reversal Pilot Light
1IS	Isolation Switch
1CB	Circuit Breaker
1PS	Pressure Switch
1CPT	Control Power Transformer
1PM	Power Monitor
1PR	Phase Loss Relay
2PR	Phase Reversal Relay
1OCM	Overcurrent Monitor
CVD1	Current/Voltage Display