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Instruction Manual

Full Service *LXi* Fire Pump Controllers

- ☐ *LXi*-11/2100 Solid State Soft Start/Stop
- ☐ *LXi*-12/2200 Across-The-Line
- ☐ *LXi*-13/2300 Auto-Transformer
- ☐ *LXi*-14/2400 Primary Resistor
- ☐ *LXi*-17/2700 Part Winding
- ☐ *LXi*-18/2800 Wye-Delta Closed Transition
- ☐ *LXi*-19/2900 Wye-Delta Open Transition

For use with electric motor driven fire pumps,
with and without Automatic Transfer Switches

Version 2.1
Publication No. 193

August 2002

Notes
Refer to job drawings for options.
For combination Automatic Transfer Switch/Fire Pump Controller applications, refer to Publication No. 201 for the LX-450 Transfer Switch.

Introduction

The Hubbell Full Service Fire Pump Controllers provide automatic and manual control of an electric motor driven fire pump.

All Controller components are inside the cabinet with indicating displays, control panels, and switch handles located next to the door. A pressure transducer initiates automatic starting of the pump motor. The Controller monitors the power phases, current, and voltage. The ISOLATING SWITCH has a door interlock feature to prevent the door from being opened when the switch is closed. The Controller also has a EMERGENCY MANUAL CONTROL handle to start the fire pump manually.

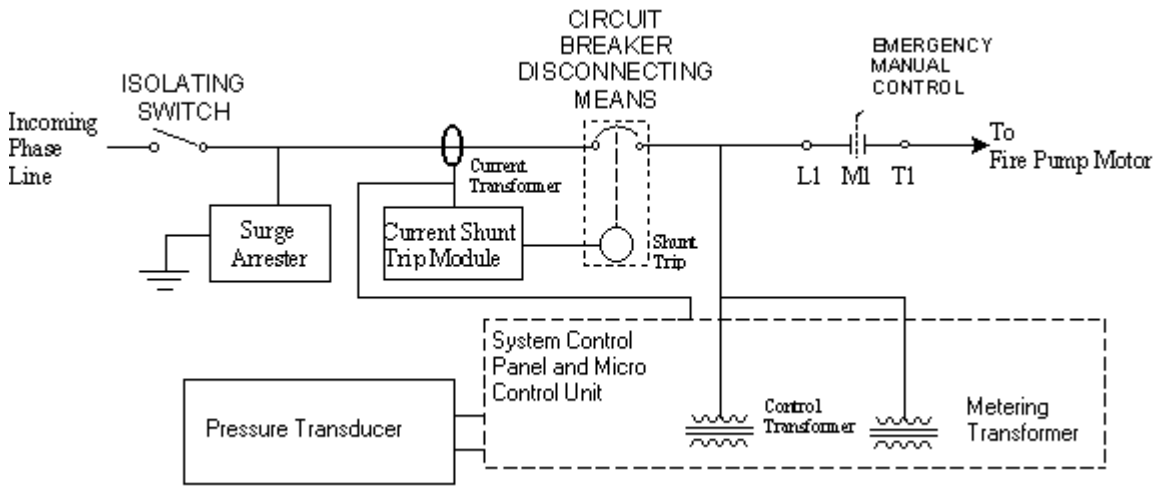

Figure 1 **Block diagram of Across-The-Line type Controller showing one phase**

The System Control Panel and Micro Control Unit are responsible for performing most of the system functions, including monitoring the System Power Quality, Automatic Start Functions, and System Timer operations. The Control Panel is powered by a self contained power supply that is fed from the control transformer. The Metering transformer is used to convert the Line voltages to levels appropriate for analysis by the Micro Controller.

The LCD Display panel consists of a 4 x 20 character text display that continuously displays the system pressure, three phase voltages, three phase line currents, and time. The LCD panel also contains a numeric keypad for user entry and programming of the user setable functions.

The LED display panel provides real time information regarding the status of the system including power availability, presence of alarm conditions, and indication of any active timers.

Specifications and Certifications

Specifications

Micro Controller System	Hitachi H8 – 2144F
A/D Converter	7 Channels of 10 Bit A/D
Power Supply	+5V, +/- 12V
LED Indications	20 LEDS (16 on LED panel 4 on LCD Panel)
Inputs Buttons	Numeric Keypad + various special Functions
Initialization Delay	2 Second Delay for Displaying System Info
Power Quality Specifications **Voltage (two ranges 240 and 480)**	240V Range - 200, 208, 220, 230, 240 480V Range - 380, 415, 440, 460, 480 VAC
Phase Loss/Reversal Detection	A-B-C phase rotation
Maximum Voltage	10% of highest nominal voltage
Maximum Frequency Shift	0.1 Hz
Phase Loss / Failure	Excess of +/- 15% nominal voltage in one phase
Shunt Trip Current Monitor Output	22–28 VDC at 2.5 A max. +12 VDC
Indication	blue LED, Power, motor current present red LED, Overload motor current more than three times FLC
Surge Arrestor	650 V rating
Temperature	Operating: –4° F to 104° F (–20° C to 40° C) Storage: –4° F to 182° F (–20° C to 85° C)

Certifications

All Hubbell Full Service Fire Pump Controllers are built to NFPA 20 requirements. The Controllers are listed by:

Underwriters Laboratory Factory Mutual

New York City-MEA Dept. of Buildings

Receiving, Handling, and Storage

1. Immediately upon receipt, carefully unpack and inspect the Controller for damage that may have occurred in shipment. If damage or rough handling is evident, file a damage claim with the transportation carrier.
2. If the Controller must be stored, cover it and then place it in a clean, dry location. Avoid unheated locations where condensation can result in damage to the insulation or corrosion of metal parts.

Installation

1. Consult the motor nameplate to determine voltage, current, and horsepower rating and compare with the Controller nameplate for matching data. Also, ensure that the Controller is correct for the motor, wye-delta, part winding, etc.
2. Release the door interlock by moving the ISOLATING SWITCH to the OFF position. The door interlock can also be released by using a screwdriver to turn the interlock defeat on the side of the operating handle.
3. Inspect the control transformer's primary connections for agreement with the line voltage of the incoming power.
4. Inspect the metering transformers high side voltage rating for agreement with the line voltage of the incoming power.
5. Check panel wiring and component mountings for loose fasteners resulting from vibration during shipping.
6. Check all power wire and power component connections (bus bars and cables to circuit breakers) for loose fasteners resulting from vibration during shipping.
7. Exercise all switches and contactors, without power, to see that they operate freely.
8. Choose a location or base for the Controller that is non-combustible and within site of the motor. The base should not be subject to excessive vibration The Controller should be level.

Caution: Before drilling and punching holes in the cabinet for wiring connections, cover the components inside the cabinet with a protective covering. Debris may cause shorts or prevent operation of components.

9. Punch holes in the top or the bottom of the cabinet for conduit.
7. Connect the water pressure sensing line to the Pressure Transducer (1/4 NPT internal, 3/4-16 external, brass) fitting, bottom left, of the cabinet. For further details, consult the latest edition of NFPA 20.
8. Connect the power supply conductors to the line side of the ISOLATING SWITCH in the correct A-B-C phase sequence.
9. Connect the motor conductors to the load side of the motor contactor(s).

Note

Refer to the Controller field connection diagrams. Per the requirements of NFPA 20, conductors are sized for no less than 125% of the motor FLC (full load current) and not more than the lug sizes provided, as shown on the Controller field connection diagrams. Refer to the NFPA 70 (NEC) for cable ratings. Secure conductors inside the cabinet so they do not interfere or rub against the components

10. Connect the remote alarm contacts. Refer to the supplied Controller field connection diagram for terminal points.

Controller Operation

Closing the ISOLATING SWITCH and CIRCUIT BREAKER-DISCONNECTING MEANS energizes the Control and Metering transformers which in turn energizes the system Controller. Upon System Initialization, the LCD displays a hello message for two seconds.

At this point, the system is enabled and the Power Available LED (on the LED panel) should be green and the phase reversal LED should be dark. If a phase failure is present (i.e. a missing phase), the Power Available light will be red and the PFR relay contacts will de-energize. If there is a phase reversal, this will be indicated by a red Phase Reversal LED and the PRR relay contacts will provide remote indication of phase reversal by de-energizing. The presence of either a phase failure or a phase reversal condition will also cause the common alarm relay to de-energize.

The *LXi* series Fire Pump Controller is a microprocessor based system. The Controller continuously monitors the "real time" line voltages, currents, and pressure. This information is displayed on the LCD display by default. The Controller is also responsible for the starting and stopping sequences (both manual and automatic with the exception of the Emergency Manual Start).

The Controller contains a programming menu system which may be accessed by pressing the "ESC/DEL" key. Upon pressing this key, the display will prompt for the access code to keep unauthorized users from changing the system operation parameters. The access code is a four digit number (between 0000 and 9999). If the ESC key is pressed a second time (at the prompt), the system will return to normal operation and restore the default display. Similarly, if no entry is made within ten seconds, the system will also return to normal. After the correct password is entered, the system will display one of the menu options. The menus are navigated with the up and down scroll buttons. Once the desired menu option is displayed pressing the ENTER key will activate the selection. At any time pressing ESC will back the display up to the previous level (or exit the menu system).

LXi Series Controller User Interface

The User Interface to the *LXi* Series controller consists of two panels. The top panel contains an 20 x 4 character alpha-numeric LCD display, a numeric keypad, special function buttons, and four status indicator LEDs. The bottom panel consists of sixteen

LEDs arrayed in two columns. These LEDs are labeled with the corresponding meaning and are used to convey status information about system status, alarms, pump operation, and power quality. Not all LEDs are used in all applications, therefore the some labels may be blank.

Display Indicators

The display system of the *LXi* Series Fire Pump Controller is broken into two major subsections, the LCD panel and the LED panel. The details of the output indicators on the two panels including the meaning of the LEDS is provided in the sections below.

LCD Panel

One of the primary functions of the LCD panel is to provide real time status information regarding the system voltage, motor currents, and pressure. This information is displayed on the default screen. Additional screens which display various other system operating parameters are accessed by using the up and down scroll buttons. The scroll buttons are indicated by the directional arrows on the numeric keypad (buttons 8,2 for up/down and 4,6 for left/right). Scrolling either up or down will cause the display to change to the next alternate screen. The system will return to the default screen after a ten second delay if no additional buttons are pressed.

In addition to the LCD, the panel also provides four LED indicators. The indicators and their functions are presented here:

Local Manual Start: This (yellow) LED indicates that the system has started the pump because the local manual start button was pressed.

Remote Start: This (yellow) LED indicates that the Controller has detected and started due to a closure of the Remote Start Contacts.

Emergency Manual Start: This (red) LED indicates that the system was started by the emergency manual start lever. While the system will stop, if the emergency manual start is disengaged, the light will remain lit to indicate the abnormal condition.

Local Manual Stop: This (yellow) LED will remain lit for two seconds following a local stop command (pressing the red Stop button). After the system has returned to idle, this light will go out.

LED Panel

The LED panel consists of 16 LEDs that show various system status indications. A list of the common indicators is presented here:

Power Available / Phase Failure: This LED is green when the Controller senses that all three phases are available and within specification. In the case of a phase failure condition, this LED turns red. The method of determining a phase failure depends on the state of the system. If the system is idle, a phase failure is detected by an abnormal line voltage(s) whereas if the pump is running, due to the potential of back EMF from the motor, a phase failure is detected by an excessive current imbalance.

Pressure Switch Start: This LED is used to indicate that the system started due to the pressure falling outside of the allowable window as determined by the Start Pressure and Stop Pressure set points (see section on system programming). The LED turns yellow when a pressure start sequence has been initiated and is unlit otherwise. The light goes out, when the system returns to idle.

Accelleration Timer Active: When the system is performing a reduced voltage start, this LED blinks green while the Start Acceleration timer is active. Once the timer has expired, this light goes dark. Note: This item only applies to system with reduced voltage starting capability.

Run Timer Active: When the system starts by automatic (pressure start), this LED blinks green while the minimum run timer (set to ten minutes by default) is active. Once the timer has expired, the led will go out.

Lockout On: The lockout indicator turns yellow, when the external lockout signal is active. During a lockout condition, the system will not start. Since the lockout input is multiplexed with the input for a low suction condition, if the lockout input is asserted while the pump is running, the condition will be interpreted as a low suction condition, which will halt the pump. **Note: This feature is not allowed per NFPA 20 and is permitted only when acceptable to the authority having jurisdiction**.

Locked Rotor (Trip): If the controller senses that current draw in excess of 600% of the Full Load Amps (FLA) followed by a firing of the shunt trip module, the system will activate the common alarm and turn this LED red.

ATS Connected to Normal Power: This indicator, which only applies to systems with a transfer switch, will turn green when the ATS is supplying from the Normal source. If the ATS is not supplying from the Normal source, or if no transfer switch is present, this LED will remain unlit.

Ats Connected to Emergency Power: This indicator, which only applies to systems with a transfer switch, will turn red when the ATS is supplying from the Emergency Source. If the ATS is not supplying from the Emergency source, or if no transfer switch is present, this LED will remain unlit.

Phase Reversal: This LED indicates that a phase reversal (non A-B-C sequence) has been detected. In order for a phase reversal to be detected properly, all three phases must be present for the signals to be sensed by the phase sequence detector. Consequently a phase failure (e.g. under voltage) could cause indeterminant phase readings. Therefore, a phase reversal condition will not be alarmed unless all three phases are present and within fifteen percent of normal spec.

Pump Start Delay Active: In systems that have been programmed for a pump start delay this LED will blink green when the delay timer is activated and then go out once the pump is running. The Start Timer only activates when the system has started automatically (pressure start). Consequently, a local manual start will not cause a start delay.

Pump Running: The Controller looks for the presence of sufficient motor current as the indication that the pump has successfully started. This LED will turn green when the Controller determines that the pump is has successfully started and is running. If the pump should be running and the Controller is unable to detect sufficient line current this led will turn either YELLOW or RED to indicate the failure. The LED will turn YELLOW when an insufficient (but non zero) current flow is detected and RED if the Controller is unable to detect any current.

Low Suction Shutdown: This LED will turn red when the lockout signal goes active during a pump running condition, which causes the pump to stop. See Lockout Section. **Note: This feature is not allowed per NFPA 20 and is permitted only when acceptable to the authority having jurisdiction**.

Fail To Start: If the Controller has attempted to start the pump, but has determined that the pump is not running by the lack of sufficient current load, the system will activate the common alarm and this LED will turn red.

Overload: The Controller monitors the currents during both the start and run conditions. If during a run condition one or more phase currents exceeds 120% of the rated FLA the system will generate an alarm and this LED will turn red.

User Input

In addition to display functions, the LCD panel also servers as the primary interface for user input and system programming. The details of the user input functions are described in the sections below.

Keypad Buttons

The Keypad (on the LCD panel) contains a number of buttons including a numeric keypad with zero through nine (0 to 9), an ESC / DEL, a Decimal Point (.) and an Enter Key. Additionally There are a number of special function buttons. The details of how to input data and the functional description of these special buttons is provided here.

Normal Buttons

The normal buttons are used to enter programming data, enter calibration data, and navigate through the system displays and menus. There are a two different styles of input that are utilized depending on the nature of data required. For example, when entering a number for the Start Timer use of the 0 through 9 keys is required to input a (non pre-specified) number. Alternatively, some of the options require selection of an item from a pre-determined set such as the system voltage. In these instances, the scroll buttons are used to select the desired item from the pre-determined list. After providing the required input, pressing the Enter key will accept the data. The LCD display will provide prompts indicating whether to use the numeric keypad or the scroll buttons for the particular input. For information on the system menu layout and instructions on programming and calibration, refer to the appropriate sections in this manual.

Special Function Buttons

In addition to the general purpose buttons described above, there are a number of special buttons that perform dedicated functions. The operation of these buttons is described here:

Local Manual Start: This button is used to locally start the motor. If the Controller is a reduced voltage starting type, the starting sequence will be performed though no delays will be executed. When the system is started by way of the local (or remote) start, the system can only be stopped by pressing the red Stop button.

Soft Stop: In systems that contain a Soft Start / Stop system, pressing this button will cause the controller to execute a soft stop sequence.

Lamp Test: This button causes the controller display to cycle all the LEDs through the four possible color combinations allowing verification that the lights are all operational.

Alarm Silence: Pressing this button will cause the controller to de-activate the common alarm contacts and to silence the external siren (if the option is present). If a new alarm occurs, however, the common alarm will re-activate. Additionally, the alarm will only remain silenced for a period of ten minutes before it will automatically re-activate. After alarm condition clears, alarm will sound again until silence button is pushed.

Stop: This button is used to locally stop the pump. The motor contactors will be disengaged. Note: pressing this button will cause a soft stop system to stop immediately without a ramp down period.

Enter: This button is used to complete numerical data entries or to select an item from a menu.

ESC: The ESC button serves multiple purposes depending on the system status. While the machine is displaying one of the standard display screens, pressing ESC will cause the system to prompt for the user access code (see section on password protection below). During menu selection, pressing the escape key will cause the system to either back up one menu level, or to exit the selection process entirely. While entering numerical data, if a mistake is made, pressing this key will activate the DEL(ete) function and the last digit entered will be erased. If all digits have been erased, pressing this key will exit out of the entry mode.

Password Protection

Many of the system functions are protected by a user password. The password consists of a four digit number between 0000 and 9999. If the ESC key is pressed while the Controller is displaying a standard display screen, a prompt for the pass code will appear. At this point, enter the user pass code and press the Enter key. If the password is accepted, a brief message to this effect will be displayed and then the configuration menu will appear. If the password is invalid, an error message will be displayed and the machine will return to the default display. If a mistake is made while entering the passcode, pressing the ESC/DEL key will cause the last digit entered to be erased or will cause the Controller to exit out of password entry if there are no digits entered presently.

The user password is set to 1234 by factory default, and it is recommended that this number be changed to a different value. Note: it is important that this number not be lost, as this will prohibit the ability to change the operational parameters, though the machine will continue to operate according to its present configuration. In the event that access to the machine can not be obtained due to a lost password, immediately contact your local Hubbell representative for assistance.

Navigating the System Menus

The menu system of the *LXI* Fire Pump Controller consists of two levels. The first level selects the function category and the second level selects the function within the category. Use the scroll buttons (8 and 2) and the Enter key to select a particular menu.The menus are broken down into the following Arrangement:

Calibration Menu:

Calibrate Voltages: Perform a fine tune calibration of the line voltages
Calibrate Currents: Perform a fine tune calibration of the phase currents
Calibrate Pressure: Allows a fine tune adjustment to the system pressure
Set Full Load Amps: Used to designate the motor FLA from the nameplate

Pressure Settings Menu:

Stop Pressure: Sets the automatic stop pressure value (if enabled)
Auto Pressure Stop Enable: Auto stopping by pressure is disabled by default
Start Pressure: Sets the automatic Start Pressure. Note an entry of 0 psi is invalid and will cause an automatic starting of the pump.

Time And Date Setup:

Set Time hh:mm:ss: Sets the system Real Time Clock for display and logging
Set Date dd:mm:yy: Sets the system Date for event logging purposes

Timer Config Menu:

Minimum Run Time: Allows adjustment of the Minimum Run Period timer In seconds. Automatically defaults to ten (10) minutes of run time (600 seconds) on every powerup.
Start Accel Control Time: Sets the amount of time in second that the system will remain in the reduced voltage start state (if applicable).
Pump Start Delay: Hold off time in Seconds before a pressure start will start the motor.

System Config Menu:

Configuration String: Allows input of the system configuration code. This code Should be displayed on a label on the inside of the door panel.
Change Access Code: Used to change the configuration system access code.

Serial Comms Config:

Serial Comms Enable: Sets whether or not serial communications are enabled The default is for communications to be disabled.
Baud Rate Setting: Sets the serial communications baud rate (default 9600)
Parity Setting: Select No Parity, Odd Parity, or Even Parity (default is none)
Data Bits: Select either 7 or 8 data bits (default is 8)
Stop Bits: Select either 1 or 2 stop bits (default is 1)

Remote Inputs

In addition to the the panel buttons, the machine also handles Remote inputs. The remote inputs, require an external (remote) contact closure. The Remote inputs are fed (120 Vac and Neutral) by the Remote Power feed located on the terminal strip for user wiring. The contacts should return this power to the controller when the remote input is active. The following list describes all of the remote inputs, though not all inputs are supported by every model of controller.

ATS On Emergency and ATS on Normal: These inputs are supported by machines equipped with the Transfer Switch option (12XX machines). These signals are used by the Controller to sense which source the Transfer Switch is currently connected to.

Low Suction / Lockout: This input is used to signal the controller of either a Low Suction Pressure condition which will cause the motor to stop or to Lockout the Controller which will prevent it from automatically starting. The interpretation of this signal depends on the current state of the system.

(This feature is not allowed per NFPA 20 and is permitted only when acceptable to the authority having jurisdiction.) The lockout circuit requires the closure of remote contacts to stop the motor. If the lockout signal is applied while the motor is running, it will stop and then restart once the signal is removed.

Remote Start: This input is used to command the pump to start from a remote location. Once started in remotely, though, it can only be stopped locally.

Programming and Calibration Procedure

During initial system startup, the Controller needs to be programmed with certain pieces of information, such as the Start and Stop pressures and the delay timer, that are dependant on the system design as a whole. These particulars of the Controller operation can be adjusted by the user to meet the specific application needs. While some functions are hard coded into the machine, such as the voltage rating and the hardware options, the user is able to adjust some operation parameters including the start / stop pressure, and the Start Acceleration timers. Additionally, while the machine's meters are calibrated at the factory, a fine tune adjustment may be made to the meters if desired. This section describes the procedures for performing these calibrations and adjustments.

Programming operational Set points

To be able to perform any calibration and programming it is necessary to first enter the valid pass code. Pressing the 'ESC' button while the controlleris displaying the normal display screen will cause the passcode prompt to appear. If at the prompt or if no menu selections or user input is made within a 10 second timeout period, the system will abort the programming and calibration procedure. The purpose of the time limit is to ensure that the machine does not get left in programming mode.

Timers

The system contains three timers that are adjustable by the user. These timers are the Minimum Run Period Timer, the Start Acceleration Control Timer, and the Start Delay Timer. While the procedure for adjusting each of the timers is the same, the limits allowable on each timer vary. To set each of the timers, a value is entered through the numeric keypad that represents the timer period in SECONDS including the Min Run Period Timer. Therefore if a value of minutes is desired, multiply the number of minutes by sixty (e.g. a 15 minute Min run timer would be set to 15 x 60 = 900.

Minimum Run Period Timer

This timer controls how much time the machine will run following an automatic pressure start. To Set the Minimum Run Period Timer, select the Minimum Run Time option from the timers menu. The screen will prompt for a value (number of seconds), which should be entered using the number keys '0' through '9'. The range of allowable values is zero seconds to 90 minutes corresponding to an entry between 0 and 5400 (seconds).

Notes:

1 - The Minimum Run Period Timer will default back to 10 minutes on EVERY power up cycle.

2 – The minimum run time may be overridden by pressing the Stop button.

Start Acceleration Timer

The Start Acceleration timer determines the amount of time the Controller will spend in the "start" state where a reduced voltage is applied to the Motor. This feature is only applicable to Controllers that support a form of reduced voltage starting. The factory default value for this timer is five (5) seconds. In an across the line start system, any value programmed into this timer will be ignored.

To set this timer, select the "Start Accel Cont Time" from the Timers Menu. The screen will prompt for a value (number of seconds), which should be entered using the number keys '0' through '9'. The range of allowable values is zero seconds to 60 seconds.

Start Delay Timer

The Start Delay Timer is used to cause the Controller to hold off the starting sequence on an automatic (pressure) start. To set this timer, select the Seq Start Delay Time from the timers menu. The screen will prompt for a value (number of seconds), which should be

entered using the number keys '0' through '9'. The range of allowable values is zero seconds to 10 Minutes corresponding to an entry between 0 and 600 seconds).

Start and Stop Pressure

The automatic Start and Stop pressures are individually settable to allow for customization to the needs of the particular application. Additionally, by factory default setting, the system will not automatically stop once the stop threshold has been reached though this feature may be enabled through the menu system.

Note: Some values, while acceptable, may be outside to the recommended norms. In these instances, the Controller will prompt the user to confirm the setting before the new value is accepted and applied.

Start pressure

The start pressure determines the pressure at which point the system will automatically start the pump. The factory default for this value is 1 psi, which is designed so that the system does not start automatically before it is configured.

NOTE: The allowable range of values for this range is 0 to the maximum value of the pressure transducer. However, if a value of 0 psi or a value that is greater than the System Stop Pressure is entered (and confirmed) the system will start the pump! Therefore it is also recommended that the if adjustment to the Stop Pressure is desired, that this adjustment be made first.

Stop Pressure

The stop pressure setting, if enabled, determines the pressure at which point the system will automatically stop the pump. The factory default for this value is the maximum value of pressure transducer which is either 300 psi or 600 psi depending on the application.

Auto Pressure Stop Enable

By default, the auto pressure stop feature is disabled. To enable this feature, select the "Auto Prs Stop Enable" option from the Pressure Settings Menu and use the scroll keys to select '1' for enabled and '0' for disabled.

Full Load Current

The setting for the full load current is provided to allow the system to alarm on a locked rotor (current) condition or on a current overload condition. If during the start sequence, the current exceeds 600% (six times) the rated FLA of the motor, the common alarm will be triggered and the LED panel will indicate a locked rotor condition. Similarly, if during the pump running phase, the current exceeds 120% of the rated FLA, a common alarm will be generated and the overload led will be illuminated. If either one of these conditions is occurring, verify the FLA setting versus the motor nameplate and verify the

calibration accuracy of the current meter displays. If no cause for the overloads can be determined, contact your local Hubbell representative for assisance.

Time and Date Setup

The controller features a real time clock with date and time capability. The time is displayed in HH:MM format on the main screen. All times are in 24 hour format and dates are in MM-DD-YY format. The procedures for setting the date and time are described below.

Time

To set the time, select the Time and Date setup menu, and then the set time option. The display will indicate the current data stored in the real time clock chip in HH:MM:SS format with a blinking cursor over the left most HH digit. Use the numeric keypad to enter the current hour and use the DEL key if a mistake is made to back up. Once the hour has been entered, press ENTER to move to the minutes field. Repeat the procedure for the minutes and seconds. If a mistake is made to a previous entry (e.g. entering seconds and wish to change minutes) it is necessary to either complete the time entry operation or press ESC to abort and then restart.

Date

The Date is set in the same fashion as the time, but the format is now MM:DD:YY.

Communications Parameters

The *LXi* series Fire Pump Controller is capable of communicating to a terminal device through the RS-232 port. Through the communications port, it is possible to download a snap shot of the system operating conditions including system voltages, currents, pressure, present alarms and operating history. The individual communications parameters are settable by using the scroll keys to choose one of the preset values. The parameters include baud rate, number of stop and data bits, and parity setting. Additionally, the RS-232 communications may be disabled entirely.

Restoring the System Configuration

In the System Configuration menu, there is an option for restoring the system configuration by way of the System Config String. This string of ten digits, completely configures the basic operating parameters of the machine. While it should never be necessary to restore this configuration, if an emergency does occur where it becomes necessary, the machine can be re-configured by entering the ten digit string that is printed on the door label.

Notes:

1 – The configuration data and a checksum are encoded in the string. While it is unlikely that a “valid” configuration string could be generated by accidentally typing a wrong character, it is recommended that the configuration string be entered exactly as it appears

on the label. Failure to enter the string correctly may result in a machine that does not operate correctly.

2 – if an invalid string is entered, an error message will temporarily be displayed, and the machine will not re-configure.

System Calibration

The Controller is calibrated at the factory to compensate for any variances in the analog circuitry and should not require adjustment at installation. If however, adjustment is required or desired the following items may be field calibrated.

Calibrating Line Voltages, Currents, and Pressure

The three phase line voltages may be adjusted if desired. To adjust the system calibrations, it is necessary to first measure the incoming signals (line-line voltages, phase currents or pressure) with a reference meter (or in the case of the pressure transducer, the gauge on the transducer should serve as a reference). It is recommended that the meter remain connected while the calibration data is being entered to ensure maximum accuracy. The calibration procedure is as follows:

1 – Determine the reference that the Controller is being calibrated to and make all appropriate measurements.

2 – Select the desired calibration option from the calibration menu.

3 – using the numeric keypad enter the calibration values in order of appearance (Vab, Vbc, Vca or Ia, Ib, Ic or the pressure reading)

4- Press the Enter key after each value is entered.

5 – Double check the values entered, by verifying the system display.

Note: If wild values are entered during the calibration phase, it is possible to cause the machine to enter an alarm condition or to cause the automatic start and stop pressures to work incorrectly. Therefore it is recommended that these procedure be performed only by authorized and trained personnel.

Automatic and Manual Starting Methods

The following sections discuss the automatic versus manual operation of the Controller and describe the sequence of operation for the different types of reduced voltage starting systems.

Manual Start of the Controller

While the Controller's primary mode of operation is automatic, it has the additional capability of being operated manually. There are three ways to manually command the controller to start the pump. These methods are discussed next.

Local Manual Start

Local Manual Start is achieved by pressing the Yellow "'Local Manual Start" button on the keypad located on the LCD panel. Pressing this button causes the Controller to immediately initiate its startup sequence. The controller will still perform the standard startup sequence including reduced voltage starting, however, it will not perform any start delay (*note: see section on types of motor starting systems*). When started by the Local Manual Start button, the system can only be stopped by pressing the Stop button (or the Soft Stop button on an 11/1200 machine with the electronic soft start / soft stop).

Remote Start

Remote Start is similar to local manual start, in that the Controller will execute its normal startup sequence minus any start delays. The difference is that a Remote Start is achieved by contact closure of the external "Remote Start Contacts" (see above section on remote inputs).

Emergency Manual Start

The emergency start handle should only be used if the Controller fails to start automatically or with the Local Manual Start button. If control power is available and the emergency handle is closed, the Controller will track the operation and close the starter contacts to energize M1 and start the motor. The motor runs until the handle is returned to the OFF position or the circuit breaker is opened. **This operation is considered an abnormal start and will cause the machine to alarm**. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

Note: For *LXi* 1100/2100 soft start/stop controllers, operating the emergency manuals start handle will energize the "shorted SCR" LED. Turn off power to reset the LED after start handle is turned off.

Automatic start and Automatic Stop Functions

As previously mentioned, the primary mode of operation of the *LXi* Series Fire Pump Controller is a automatic. In automatic mode, the Controller continuously monitors and compares the system pressure against a set of user definable set points. When the pressure falls below the threshold of the Start Pressure (set point), the motor is activated.

When starting automatically, the Controller will first perform any Start Delay as defined by the Start Delay timer. Once the timer has expired the Controller will apply starting voltage to the motor. If the system is an "across the line" type, the CR2 motor run relay will be engaged at this point. Otherwise, the controller will activate the CR1 motor start relay and initialize Start Acceleration Timer. When this timer has expired the CR2 motor run relay will then be engaged (*see note*). After the motor has entered the run state, the

Minimum Run Timer, which defaults to ten (10) minutes will be activated. When this timer has expired, if the system pressure has climbed above the Stop Pressure set point and automatic stop is enabled, the system will stop. If either the automatic stop is disabled, which is the default condition, or the system has not reached adequate pressure the pump will continue to run. If the automatic stop feature has been enabled, the motor will stop after the pressure has reached the Stop setpoint any time after the Minimum Run Timer has expired. Additionally, the pump may be manually stopped at any time by pressing the Stop Button (or Soft Stop button if equipped) on the LCD panel.

Note: The actual timing and sequencing of the CR relays and the corresponding motor contacts depends on the type of reduced voltage starting system used. Refer to the section on Types of Starting below for more information.

System Timers

The Controller provides three system timers which have been mentioned throughout this manual. The following table is included for reference on the behavior of the three timers.

Timer Name	Timer Function	Min Setting	Max Setting	Default Setting
Start Delay	Used to tell the Controller to delay starting on an automatic (pressure) start	0 Seconds	10 Min or 600 Seconds	0 Seconds
Start Acceleration	Controls how much time is spent in the reduced voltage starting state (if applicable)	0 Seconds	1 Min or 60 Seconds	5 Seconds
Minimum Run Time	Determines the minimum amount of time that the pump will run when started automatically.	0 Seconds	90 Min or 5400 Seconds	10 Min or 600 Seconds

Types of Starting Systems

The different models of *LXi* Series Fire Pump Controller each utilize different methods of starting the motor. While, from a user standpoint, the operation of the Controller is the same for each of these types of starting methods there are slight differences in the sequence of events amongst the different types of starting systems. All of the starting system use either one, two, or four motor contactors which in turn require a different sequencing of the CR relays from the Controller. This section describes the different starting methods and the corresponding sequence of events.

LXi-11/2100 Solid State Soft Start/Stop

General - The 5413 Soft Start Motor Controller consists of a control board, snubber board, and a SCR (Silicon Controlled Rectifier) assembly. The soft start system is controlled by the Initiate and Permissive inputs and provides variable ramp time adjustable voltage motor control with a relay output to activate the SCR bridge bypass contactor for continuous running.

The control board produces the firing pulses for the SCR assembly and provides adjustments for Accel Time, Decel Time, Initial Torque/Idle Level and Idle Time. Additionally, eight status LED's provide indication for Ramp Up, Ramp Down, Idle, Ready, Run, SCR Shorted, Initiate, and Permissive.

The snubber circuit provides the means to limit the rate of change of voltage with respect to time (dV/dt) across the SCR. The RC time constant of the snubber circuit limits the rate of rise of reapplied voltage to prevent an unintended turn on due to a line transient or step voltage change.

The SCR assembly consists of the heat sinks and the three power electronic switches, SCRs, to complete the reduced voltage starting of three phase induction motors.

Start: When the Controller energizes the CR1 motor start relay, the S^2MC (Soft Start Motor Control) begins to apply voltage through the SCRs to accelerate the motor. Voltage increases until full voltage is reached. The Voltage Ramp time is field adjustable from 0.5–10 seconds, factory set at 4 seconds. *Note: the four second ramp up time will allow the motor to reach full speed before the Start Acceleration Timer expires.*

After the S^2MC accelerates the motor to full speed, at the end of the Start Acceleration Time (see timers section), the Controller energizes CR2 to close main contactor M1, bypassing the S^2MC module. The STR (over temperature relay) can energize CR2 too

Emergency Stop - The Stop button overrides the S^2MC and CR2 de-energizes to immediately stop the motor unless the Emergency Manual Control is in the ON position. If the system water pressure is low, the motor will restart. To prevent the motor from restarting, open the Isolating Switch or CIRCUIT BREAKER-DISCONNECTING MEANS.

Soft Stop - The SOFT STOP button de-energizes CR1, the CR1 contacts open, signaling the S^2MC to begin decelerating the motor by reducing the voltage through the SCRs. If the pressure is low the CR1 will remain energized and the motor will continue to run.

SCR Temperature - If the S^2MC thermostat senses high temperature, the thermostat contacts close, energizing the STR (SCR temperature relay). In the advent of an over temp condition, the Controller will activate the CR2 relay, energizing M1 to bypass the S^2MC, and run the motor. This condition will be accompanied by an SCR Over Temp LED and activation of the common alarm relay. If this LED is on, immediately contact your local Hubbell representative.

SHORTED SCR - When a SCR fails, it usually fails by shorting, thereby passing full voltage. If the S^2MC senses a shorted SCR, the SSCR contacts close to signal to the

Controller that an SCR has shorted. This will result in a Shorted SCR LED and an alarm. Closing the Emergency Manual Control handle when there are no starting signals present also causes the SHORTED SCR LED to come on. Reset the Controller by opening and then closing the Controller circuit breaker. If the LED comes on again, immediately contact your local Hubbell representative.

Note: Starting the pump with the emergency manual handle will energize the "shorted SCR" LED. Turn power off after the start handle is turned off to reset the LED.

S^2MC Adjustments

Function	Label	Range
Initial Torque/Idle Level (Standard NEMA B motor)	INIT TORQUE/ IDLE LEVEL	10–40% torque 25–50% voltage
Voltage Acceleration Ramp Time	ACCEL TIME	0.5–10 seconds
Voltage Deceleration Ramp Time	DECEL TIME	0.5–10 seconds
Idle Time	IDLE TIME	3–30 seconds
Start and Idle current based on optimization of A and B above.		150–300% FLC

Indications

Function	Label	Indication
Permissive - active input	PERM	Blue, LED2
Initiate - active input	INIT	Blue, LED1
Ready - unit powered up awaiting Permissive and/or Initiate	READY	Green, LED6
Acceleration - immediately follows Initiate with Permissive	RAMP DN	Yellow, LED7
Run - follows Acceleration at full on condition, Run relay energized	RAMP UP	Yellow, LED4
Deceleration - immediately follows Initiate deactivate during Run	DECEL TIME	Yellow, LED8
Idle - follows Deceleration at end of Deceleration Period	IDLE	Yellow, LED3
Shorted SCR - if activated during Ready condition, indicates shorted SCR, Shorted SCR relay energized	SCR SHORT	Red, LED5

Field Set Up

The 5413 Soft Start Motor Controller requires adjustments to be made to optimize its performance for each installation. Each application should have some of the following specifications:

- time required to ramp up to full speed
- maximum torque delivered to the load during ramp up
- maximum current allowed during ramp up
- minimum time to ramp down

- maximum rate of change of torque during ramp down
- minimum speed or torque during the idle period
- the length of the idle period

The factory settings for Accel and Decel time (dial setting of 50, approximately 4 s), Initial Torque/Idle level (dial setting of 20, 15 to 25% torque) and Idle time (100, approximately 10 s) are usually the best place to start for each application.

Make field adjustments to ensure that a critical specification is not exceeded. Most often, the starting current needs adjustment. Make these adjustments using a clamp on ammeter, a Digital Multimeter, a stopwatch, and a pocket screwdriver.

Maximum motor starting current is a function of acceleration time and initial torque/idle level. As acceleration time is reduced or initial torque/idle level is increased, the peak motor starting current increases. With ACCEL TIME set to maximum, 100, adjust the INIT TORQUE/IDLE level until the pump motor just begins to turn when the initiate input is activated, LED1 on. Next, permit a start and monitor the starting current level for a peak and then a decline. Note the time in seconds when the current value falls. This is the optimum starting acceleration timing. Readjust the ACCEL TIME potentiometer accordingly.

Set the IDLE TIME to accommodate restarts during the idle period, otherwise, it should be kept to a minimum. These adjustments are made to enable the Controller to respond to the system load requirements while minimizing the impact on the associated mechanical, electrical, hydraulic, or pneumatic components.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the START push button. If control power is available and the handle is in the ON position, the EMC contacts close to energize M1 and start the motor across-the-line. The motor runs until the handle is moved to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-12/2200 Across-the-Line

The Across-the-Line system uses the CR2, motor run, relay to energize the M1 contactor. The across the line starter behaves exactly as described in the above sections with the exception that it does not utilize the Start Acceleration Timer and will ignore a non zero setting.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control power is available and the emergency handle is closed, the EMC contact closes to energize M1 and start the motor across-the-line. The motor runs until the handle is

returned to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-13/2300 Auto-Transformer

The start procedure of the Auto-Transformer start begins with closure of the CR1 contacts to energize the M1 contactor coil and start the motor. The normally closed contacts of CR2 are used while the motor is starting, energizing the neutral contactor, S. The motor now starts at reduced voltage through the autotransformer.

Contactors S and M2 are interlocked both mechanically and electrically. While S is energized, M2 is locked out by contact Sb1. After the start period, which is defined by the Start Acceleration Timer, the normally closed set of CR2 contacts open to de-energize the S contactor. The normally open set of CR2 contacts and the Sb1 contacts close to energize the M2 contactor. Contact M2b1 keeps the S contactor locked out. The motor now runs at full voltage.

The autotransformer taps can be field changed if required. The factory setting is the 65% voltage tap, 50% and 80% are also supplied. This should be changed only by a qualified service person.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control power is available and the emergency handle is closed, the EMC contact closes to energize M2 and start the motor across-the-line. The motor runs until the handle is returned to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-14/2400 Primary Resistor

The Primary Resistor system starts by closing contacts CR1 which causes the motor contactor M1 to energize and start the motor at reduced current through the starting resistors. After the start period defined by the Start Acceleration Timer, The controller activates the motor run relay CR2. The CR2 contacts close to energize the M2 contactor, applying full voltage to the motor.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control

power is available and the emergency handle is closed, the EMC contacts close and energize M2 to start the motor across-the-line.

The motor runs until the handle is returned to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-17/2700 Part Winding

When starting the Part Winding system, the Controller first activates the CR1 relay to energize the M1 contactor coil to start the motor at reduced current through one motor winding. After the start period, defined by the Start Acceleration Timer, the Controller activates CR2. Contacts CR2 close, energizing contactor M2 to apply voltage to the second winding in the motor to run at full speed.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control power is available and the emergency handle is closed, the EMC1 and EMC2 contacts close and energize M1 and M2 to start the motor across-the-line. The motor runs until the handle is returned to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-18/2800 Wye-Delta Closed Transition

The Wye-Delta Closed Transition starts by activating the CR1 contacts close to energize the M1 and S1 contactors and start the motor at reduced current connected in the Wye configuration.

The Neutral contactor, S1, connects the motor windings to complete the wye connection. Contactors S1 and M2 are interlocked both mechanically and electrically. While S1 is energized, M2 is locked out by the S1b1 contact. After the start period, defined by the Start Acceleration Timer, the Controller activates CR2. The CR2 contacts close to energize the transitional contactor, S2. Current briefly flows through the transitional resistors and contactor S2 to maintain motor torque. Then contacts S2b1 open to de-energize the S1 contactor. The sequence is complete when the S1b1 contact energizes the M2 contactor to connect the motor in the delta configuration.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control power is available and the emergency handle is closed, the EMC-1 and -2 contacts close to energize M1 and M2 to start the motor across-the-line. The EMC-3 contacts open to prevent the S2 contactor from closing. The motor runs until the handle is returned to the OFF position or the circuit breaker is opened.

To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

LXi-19/2900 Wye-Delta Open Transition

The Wye-Delta Open Transition starts by activating the CR1 relay. The CR1 contacts close to energize the M1 and S1 contactors to start the motor connected in the wye configuration at a reduced current. The Neutral contactor, S1, connects the motor windings to complete the wye connection. Contactors S1 and M2 are interlocked both mechanically and electrically. While S1 is energized, M2 is locked out by the S1b1 contact. After the start period, defined by the Start Acceleration Timer, the Controller de-activates CR1, which de-energizes the S1 and M1 contactors and the S1b2 contacts close. Motor torque is momentarily lost until the CR2 relay is activated. The CR2 contacts close to re-energize the M1 contactor and energize the M2 contactor. The motor then connects in the delta configuration and runs at full speed.

Note: EMERGENCY MANUAL CONTROL - The emergency start handle should only be used if the Controller fails to start automatically or with the Start button. If control power is available and the emergency handle is closed, the EMC-1 and -2 contacts close and energize M1 and M2 to start the motor across-the-line. The motor runs until the handle is returned to the OFF position or the circuit breaker is opened. To start the motor when control power is not available, **move the handle in one fast continuous motion to the full ON position and secure in the closed position with the spring-loaded latch**.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

Startup Procedure

Danger: Shocks, burns, or death may result from high voltage.

Caution: Only personnel who are familiar with the power distribution system and this manual should be allowed to perform this procedure.

1. Verify that the motor nameplate horsepower and voltage match the Controller nameplate and that the Controller is correct for the type of motor, e.g. wye-delta, part winding, etc.
2. Verify that the ISOLATING SWITCH and CIRCUIT BREAKER-DISCONNECTING MEANS are open. Check with the electrician to see if the Controller is connected directly to the main transformer. If so, apply the Service Disconnect label above the ISOLATING SWITCH handle operator.

Caution: The CSTM is not set at the factory. The CSTM must be set before starting the pump.

3. Check the motor nameplate for the full load amperage and set the Controller CSTM (Current Shunt Trip module) as shown by the chart located on the inside of the enclosure door. Turn the dial on the CSTM to the number shown on the chart. This calibrates the breaker trip curve per NFPA 20.
4. **Ensure that power components are secure and all power component connections (including bus bars to circuit breakers) are tight. Ensure that connections to the ISOLATING SWITCH and contactor(s) are properly tightened.**
5. If the Controller is a Soft Start/Stop, LX-110/2100, refer to the Field Setup section on page 9.
6. Close the cabinet door and close the ISOLATING SWITCH and CIRCUIT BREAKER-DISCONNECTING MEANS. After a few seconds power-up delay during which the Controller will display an initialization screen, verify that the Power Available led is on and that it is green. If equipped with a Transfer Switch, verify that the LED labeled ATS on Normal Power is green after a five-second delay.

Caution: Note that the pump should be primed and the water source available before running to avoid damage to the pump. To avoid flooding, ensure the sprinkler system is completely installed and ready to be pressurized.

8. With power turned on, *Bump* the motor to check for proper rotation by quickly pressing the Start and then the Stop buttons. If not correct, open the ISOLATING SWITCH and change any two leads on the load side of the M1 contactor. If the M2 contactor is supplied, change the same phase leads on the load side of M2.
9. Press the Start button. Verify that the motor starts properly and runs at full speed.
10. Press the Stop button to stop the motor.
11. Start and stop the motor with the EMERGENCY MANUAL CONTROL handle. Use **one quick motion** to the full ON position to start and **one quick motion** to the full OFF position to stop the motor.

Caution: Failure to move the handle in one fast and continuous motion can result in damage to the contactor and failure to start the motor.

If equipped with an LX-450 automatic Transfer Switch, complete the following additional tests:

1. Verify connection of the engine generator set start wires to PTB1-1 and PTB1-2 at the top of the LX-450 Transfer Switch power panel.
2. Close the ALTERNATE (emergency) SOURCE ISOLATION SWITCH and open the ISOLATING SWITCH. The automatic Transfer Switch should transfer to the alternate source per system requirements. *Bump* the motor to check for proper rotation. If incorrect, move the ALTERNATE SOURCE ISOLATION SWITCH to the OFF position and switch the generator set off using the switch located on the generator. Switch any two leads on the line side of the ALTERNATE SOURCE ISOLATION SWITCH. Return the generator set control switch to the Auto position and close the ALTERNATE SOURCE ISOLATION SWITCH. The generator set may start.
3. Operate the pump on the alternate (emergency) source using the Start and Stop buttons.
4. Close the ISOLATING SWITCH. The Control Module should now be sensing normal power and timing for retransfer. Press the BYPASS RETRANSFER TO NORMAL push button to return the Transfer Switch to the normal position.

Maintenance

Preventative Maintenance

Danger: **Do not open the Controller cabinet until ALL power is disconnected. Shocks, burns, or death may result from high voltage.**

Caution: **Only personnel who are familiar with the power distribution system and this manual should be allowed to inspect or perform maintenance on the Controller.**

Preventive Maintenance

A. Protect the equipment against accumulation of dust and metal chips.

B. Protect the equipment against conditions that result in excessive moisture.

C. Exercise the equipment every week as part of routine maintenance to verify the integrity of the Controller, Transfer Switch, generator set, power conductors, pump, and motor.

D. Field lubrication is not necessary or required.

Troubleshooting

Warning: **Disconnect ALL power supply sources to the Controller before servicing to prevent shock or accident hazard.**

Before attempting any troubleshooting on the Controller, verify that the cause of a problem is not due to the motor, pump, or power source. Then visually inspect the Controller for component damage and lose wiring. If the problem cannot readily be resolved, review the appropriate Sequence of Operation section for proper operation. Then refer to the supplied wiring diagram and schematic and use a volt/ohm meter to check the wiring to determine which component is faulty.

Coil and Contact Replacement

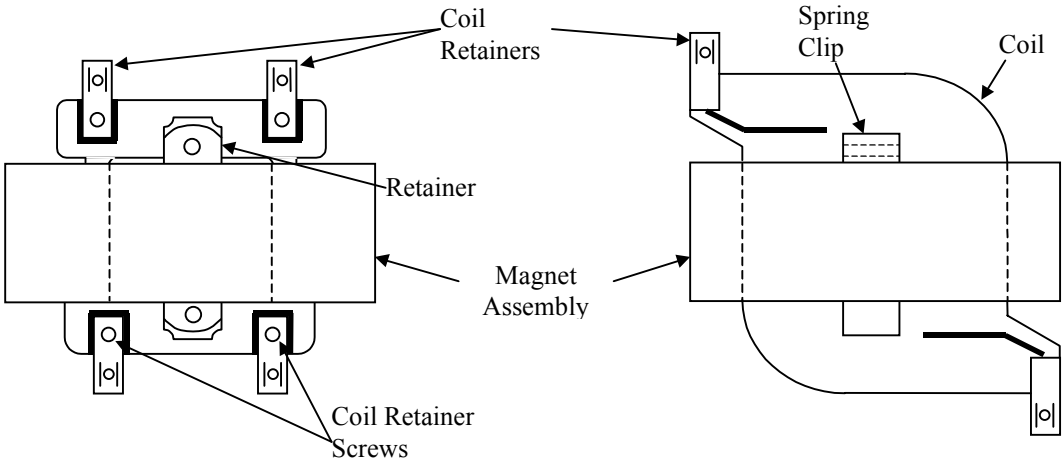

Figure VI-1 Magnet Assembly and Retainers

Coil Replacement*		
	CR3CT and CR3CV	CR3CL and CR3C
1.	Isolate all power sources.	Isolate all power sources.
2.	Remove screw from one end of the retainer and slide it out of the slot.	While pressing against the coil pull up slightly on the coil retainers and remove retainers.
3.	Remove the magnet assembly.	Pull the magnet assembly, coil, molded cover, and movable arm from the contactor.
4.	Loosen the four coil retainer screws.	Remove the spring clip and remove the armature from movable arm.
5.	While pressing against the coil, pull the coil retainers up and out.	Remove the coil from the magnet.
6.	Remove the coil from magnet.	Replace the coil and reassemble.
7.	Replace the coil and reassemble.	

Contact Replacement*		
	CR3CT and CR3CV	CR3CL and CR3C
1.	Complete steps 1 through 5 above.	Complete steps 1 through 5 above.
2.	Remove the magnet assembly by pulling the whole assembly from the contactor.	Remove the magnet assembly from the molded cover and movable arm.
3.	With the magnet assembly resting on its side, remove the movable arm by sliding it out the back of the assembly.	Remove the return spring from the center of movable arm.
4.	Press the moving contact and spring to slide moving contact from movable arm.	Remove the molded cover from movable arm.
5.	Remove the screws holding stationary contact in place and remove stationary contact.	Press and slide the movable contact and spring from movable arm.
6.	Replace contacts and reassemble.	Remove the screws holding stationary contacts in place and remove stationary contacts.
7.		Replace contacts and reassemble.

Notes for re-assembly*:

a. The molded cover only fits one way.

b. The magnet and movable arm fit either way but operates more quietly if reassembled the same way before removal.

c. Do not attempt to remove or replace arc traps in cover.

*Source: General Electric, GEH-5168 and GEH-5171

Current Shunt Trip Module

General

The CSTM (Current Shunt Trip Module) receives power from the current transformers to monitor the three phase motor current. A voltage representative of the average three phase motor current is scaled and compared to a set reference representing 300% of the FLC (Full Load Current). Motor current exceeding 300% of the FLC initiates a timing sequence based on a non-linear inverse time specification established by the National Fire Protection Association, NFPA 20, for Electrical Fire Pump Protection. The self powered CSTM provides sufficient energy to activate a shunt trip mechanism in the circuit breaker. The operational characteristics of the CSTM are an inverse time trip in 8 to 20 seconds at 600% of the FLC, an instantaneous trip at 1200% of the FLC, and no trip at 300% of the FLC or less.

The CSTM operates independently of system voltage. The motor FLC determines which of six current transformer assemblies are required to power the CSTM.

J2 provides an output connection of the scaled voltage representative of the motor FLC along with a regulated +12 V and ground.

Application Information

The CSTM monitors three-phase motor current to provide inverse time and instantaneous trip functions for fire pump circuit breaker applications. The CSTM is connected to an assembly of three CT's (current transformer) providing four current monitoring ranges. These CSTM and CT assemblies are available for 15–400 hp, 200–575 VAC applications.

Caution: The CSTM is not set at the factory. Set the module before starting the pump motor.

Use the calibration curve, posted on the inside of the cabinet door, to calibrate the CSTM to the motor FLC. Determine the motor FLC from the motor nameplate and set the dial to the number on the CSTM calibration curve.

CSTM Assemblies

Assembly Part Number		Motor FLC Range
91107-001	Range 1	25 A to 65 A
91108-001 91109-001	Range 2	65 A to 165 A
91110-001 91111-001	Range 3	165 A to 425 A
91112-001	Range 4	425 A to 1100 A

Troubleshooting

The function of CSTM is to monitor AC motor current and initiate an *inverse time* trip sequence for all conditions above 300% FLC. The unit should allow for continuous operation at 300% FLC or less, 8–20 seconds of operation at 600% FLC, and an instantaneous trip at or above 1200% FLC.

Proper operation of the CSTM requires at least two of three phases drawing current in a system. Single phase trips at 600% FLC should occur within 12 to 20 seconds.

At greater than 10% FLC, the blue PWR (power) LED should come on any time a motor start sequence is initiated. If it does not, the CSTM is defective and requires replacement. A starting sequence should also briefly energize the red OVERLOAD LED. Typically, the OVERLOAD LED should turn off in 1 to 8 seconds, approximate the time the motor accelerates to 80% speed.

If the OVERLOAD LED does not come on, the CSTM may not be set correctly. Verify the calibration setting and recheck operation. If the calibration setting is correct according to the attached calibration label, then complete the following:

1. Check fully loaded motor line currents with a clamp on ammeter, preferably with RMS type read out. Verify that this measurement matches motor name plate data.
2. Using the calibration label, posted inside the door, find the calibration set point for the motor nameplate Full Load Current Value. The red LED should come on when motor currents exceed three times the nameplate value.
3. Open the ISOLATION SWITCH and verify that the calibration potentiometer is set to this resistance value with an ohmmeter at test points A and B.
4. If the set point is different, adjust the calibration potentiometer to match the motor nameplate data and recheck operation of the CSTM. If the red LED does not light when the measured current exceeds three times FLC, then replace the module.
5. For soft start Controllers, *LXi*1100, decrease the acceleration ramp times to one-half of its set value, and recheck operation of the CSTM. If the CSTM responds, then return the ramp time of the *LXi*1100 to the original setting. The soft start Controller can be set up to limit starting currents to just less than 300% FLC thus preventing the red OVERLOAD LED from coming on.
6. For autotransformer Controllers, *LXi*1300, with the 65% or 50% tap, the red OVERLOAD LED may come on briefly as the Controller transitions from transformer to across-the-line.
7. For primary resistor Controllers, *LXi*1400, with less than 300% FLC resistance, the red OVERLOAD LED may come on when the primary resistors are bypassed to run across-the-line.

Full Service Fire Pump Controller Parts

Spares	Symbol	Description	Function	Part No.
1	CR	Relay, 240 V max.	Control	31658122
1		Micro board, Main Logic Board (SPC)		999022045001
1		Relay board, Interface Logic Board (ICD)		999052049002
1		Power Supply,120/220 VAC, +5V,+12V,-12V		PS3031

1	PLM	Phase Monitor, 208/230 V 480 V 380–415 V, 50 HZ 380–415 V, 60 HZ 575–600	Phase Loss/Reversal	57418398 57418399 57418401 57418467 57418400
	CSTM	Current Shunt Trip Module	Breaker Trip Control	49224201
1	XFMR-1	Transformer, 208/230/460 V Transformer, 380/415/575 V Transformer, 380/415/575 V	Control Power, 100 VA Control Power, 100 VA Control Power, 250 VA	57511323 57511312 57511314
1	PX	Pressure Transducer, 600 psi		57529010
	EPR	Pressure Recorder, 300 psi Pressure Recorder, 500 psi	Battery Driven Battery Driven	57501013 57501014
		Operating handle Operating handle	Isolation, Circuit Breaker Emergency Operator	57504379 91116001
	PB1 PB2 PB3	Push button NO, green Push button NC, red Push button, mushroom head	Start push button Stop push button Emergency Stop	80320105 80320104 80322101
	PL4, 5, 6, 7	Lamp Socket	Indicating lights	402066520
	PL5, 6, 7 PL4	Red lens Clear lens	Indicating lights	402067520 402157520
2	PL4, 5, 6, 7	Bulb	Indicating lights	80324905
	SS	Surge Arrestor	Surge Suppression	402165820
Spares	**Symbol**	**Description**	**Function**	**Part No.**
	ISO	Breaker, 100 A Breaker, 150 A Breaker, 250 A Breaker, 400 A Breaker, 600 A	Isolating Switch	57504349 57504350 57504351 57504352 57504353
	CB	Breaker, 100 A Breaker, 150 A Breaker, 250 A Breaker, 400 A Breaker, 600 A	Circuit Breaker	57504428 57504429 57504430 57504431 57504432
	EMC	NC Contact NO Contact	Emergency Manual Operator Contacts	57471463 57471462

	M1, M2, S1, S2, S, MC	Contactor, CR3CKE Contactor, CR3CME Contactor, CR3CNE Contactor, CR3CPE Contactor, CR3CRE Contactor, CR3CVE Contactor, CR3CUE Contactor, CR3CTE	Motor starting, 200–208 V	57300329 57300339 57300345 57300351 57300357 57300363 57300369 57300375
	M1, M2, S1, S2, S, MC	Contactor, CR3CKB Contactor, CR3CMB Contactor, CR3CNB Contactor, CR3CPB Contactor, CR3CRB Contactor, CR3CVB Contactor, CR3CUB Contactor, CR3CTB	Motor starting, 230–240 V	57300330 57300336 57300342 57300348 57300354 57300360 57300366 57300372
	M1, M2, S1, S2, S, MC	Contactor, CR3CKR Contactor, CR3CMR Contactor, CR3CNR Contactor, CR3CPR Contactor, CR3CRR Contactor, CR3CVR Contactor, CR3CUR Contactor, CR3CTR	Motor starting, 380 V, 50 Hz	57300334 57300340 57300346 57300352 57300358 57300364 57300370 57300376

Spares	Symbol	Description	Function	Part No.
	M1, M2, S1, S2, S, MC	Contactor, CR3CKC Contactor, CR3CMC Contactor, CR3CNC Contactor, CR3CPC Contactor, CR3CRC Contactor, CR3CVC Contactor, CR3CUC Contactor, CR3CTC	Motor starting, 460–480 V	57300331 57300337 57300343 57300349 57300355 57300361 57300367 57300373
	M1, M2, S1, S2, S, MC	Contactor, CR3CKD Contactor, CR3CMD Contactor, CR3CND Contactor, CR3CPD Contactor, CR3CRD Contactor, CR3CVD Contactor, CR3CUD Contactor, CR3CTD	Motor starting, 575–600 V	57300332 57300338 57300344 57300350 57300356 57300362 57300368 57300374
		Auxiliary Contact, for	Pump Run Contact	

		CR3CK–CR3CR Contactors CR3CV–CR3CT Contactors	1 NO and 1 NC Contact	57300391

Replacement Coils			
Voltage	**Part No.**	**Voltage**	**Part No.**
Replacement coils for contactors CR3CK, CR3CM, CR3CN, CR3CP, and CR3CR			
200–208 V	57300570	460–480 V	57300573
230–240 V	57300571	575–600 V	57300574
380 V, 50 Hz	57300572		
Replacement coils for contactors CR3CV, CR3CU, and CR3CT			
200–208 V	57300576	460–480 V	57300579
230–240 V	57300577	575–600 V	57300580
380 V, 50 Hz	57300578		

Notes
Specify Controller serial number, model number, horsepower, and voltage when ordering parts.
Refer to Bulletin 1000 for information on one-year parts and labor warranty.