

**Giant Fountain
SubMonitor Motor Protection System
Owner's Manual**



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SubMonitor Motor Protection System

The SubMonitor Motor Protection System represents the ultimate in protection for the three phase submersible motors used in the Giant Fountain. The submersible motor and the SubMonitor system are both manufactured by Franklin Electric.

Digital electronics has made it possible to develop a unique programmed system capable of detecting overloads, underloads, overvoltage, undervoltage, unbalanced currents, chattering contacts, and phase reversal. Operates with the Subtrol-equipped submersible motor to provide motor overheat protection. SubMonitor turns off the submersible motor when any of these faults occur and provides a visual display of the fault condition and status which is recorded in the system's history. When the Giant Fountain is in operation the SubMonitor monitors and displays the three phase voltages, three phase currents, and the pump status.

The SubMonitor Motor Protection System will come prewired and programmed in the Giant Fountain Power Control Center from the factory. The programming can be verified by following the "Quick Guide to Setup" section in the Franklin SubMonitor Installation & Operation Manual. See Table 1 for the settings of each motor rating. All other programmable settings should remain at the default settings.

Additional contents of the Franklin SubMonitor Installation & Operation Manual are as follows:

- Password Protection
- Event History
- Key Parameters in Event History
- Other Features
- Troubleshooting

WARNING: This equipment should be installed by a technically qualified electrician in compliance with national and local electrical codes.

WARNING: SubMonitor is NOT compatible with phase converters, reduced voltage starters or variable-speed inverter drives.

WARNING: The Warranty is VOID if the SubMonitor program settings are changed without first consulting with Otterbine.

Before Installing the SubMonitor System

1. Read both manuals thoroughly.
2. Be sure the incoming power supply is turned off before working on motor or controls.

SubMonitor Settings (Table 1)

<u>HP</u>	<u>Voltage</u>	<u>Hz</u>	<u>SF Amps</u>
7.5	230	60	24.6
7.5	460	60	12.3
10	230	60	32.2
10	460	60	16.1
15	230	60	47.4
15	460	60	23.7
25	230	60	75.0
25	460	60	37.5

Limited 3 Year Warranty
Otterbine® Product
Giant Fountain with SubMonitor System

WARRANTY: Barebo, Inc 3840 Main Road East, Emmaus Pennsylvania 18049,U.S.A. hereby warrants, subject to the conditions hereinbelow set forth, that should the **OTTERBINE** product prove defective by reason of improper workmanship or materials at any time during the warranty period the Purchaser at retail will be guaranteed that **BAREBO** will repair or replace the said **OTTERBINE** product as may be necessary to restore it to satisfactory operating condition, without any charge for materials or labor necessarily incident to such repair or replacement, provided that:

- a) The enclosed Warranty Registration Card should be mailed to **BAREBO** within fifteen (15) days of the original receipt by the Purchaser at retail in order to avoid delays;
- b) The **OTTERBINE** product must be delivered or shipped, prepaid, in its original container or a container offering an equal degree of protection, to **BAREBO** or a facility authorized by **BAREBO** to render the said repair or replacement services or, if purchased from an authorized **OTTERBINE** dealer, to such dealer;
- c) The **OTTERBINE** product must not have been altered, repaired or serviced by anyone other than **BAREBO**, a service facility authorized by **BAREBO** to render such service, or by an authorized **BAREBO** dealer, and the serial number of the **OTTERBINE** product must not have been removed or altered: and
- d) The **OTTERBINE** product must not have been subjected to lightning strikes and other Acts of God, vandalism, freezing-in, accident, misuse or abuse, and must have been installed in conformance with applicable electrical codes (including proper electrical protection), and also installed, operated and maintained in accordance with guidelines in the Owner's Manual shipped with the Otterbine product.

No implied warranties of any kind are made by **BAREBO** in connection with this **OTTERBINE** product, and no other warranties, whether expressed or implied, including implied warranties of merchantability and fitness for a particular purpose, shall apply to this **OTTERBINE** product. Should this **OTTERBINE** product prove defective in workmanship or material, the retail Purchaser's sole remedy shall be repair or replacement as is hereinabove expressly provided and, under no circumstances, shall **BAREBO** be liable for any loss, damage or injury, direct or consequential, arising out of the use of, or inability to use, the **OTTERBINE** product, including but not limited to retail Purchaser's cost, loss of profits, goodwill, damages due to loss of product or interruption of service, or personal injuries to Purchaser or any person.

SubMonitor

Installation & Operation Manual



Franklin Electric



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SubMonitor Submersible Pump Motor Protection System

Franklin's SubMonitor is an easy to use, programmable protection device for Franklin Electric three phase submersible motors.

SubMonitor's features provide advanced protection for submersible motors:

- SubMonitor operates over the full range of three phase motor voltages, 200 - 575 volts, 50 and 60 Hz.
- Operates on motors with service factor current rating of 3 amps through 359 amps - no external current transformers required.
- Protects motors and pumps from overloads, underloads, overvoltage, undervoltage, unbalanced currents, chattering contacts, and phase reversal.
- Operates with a Subtrol-equipped submersible motor to provide motor overheat protection.
- Monitors and displays three phase voltages, three phase currents, and pump status.
- When a fault occurs, displays the fault conditions and status.
- Records and displays the history of up to 502 fault trip events, plus records changes to programmable parameters.
- Records total pump operating time.
- Features a detachable display unit which may be mounted on the front of a panel for viewing operating status.
- Includes the option of password protection to avoid tampering.
- Easy mounting with DIN rail mounts.
- Totally integrated unit - current transformers are built in.

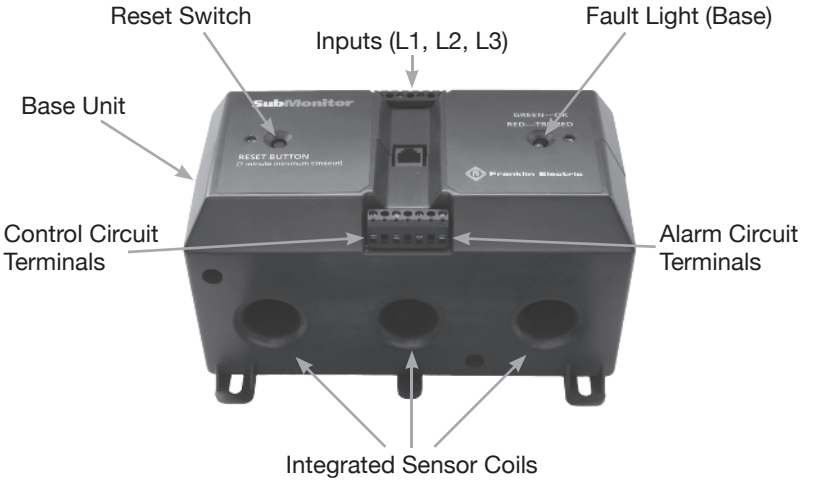
Simple Programming

SubMonitor has been pre-programmed with default settings for submersible motors and pumps. Set-up is as simple as setting the motor ratings - voltage, Hertz, and SF max amps.

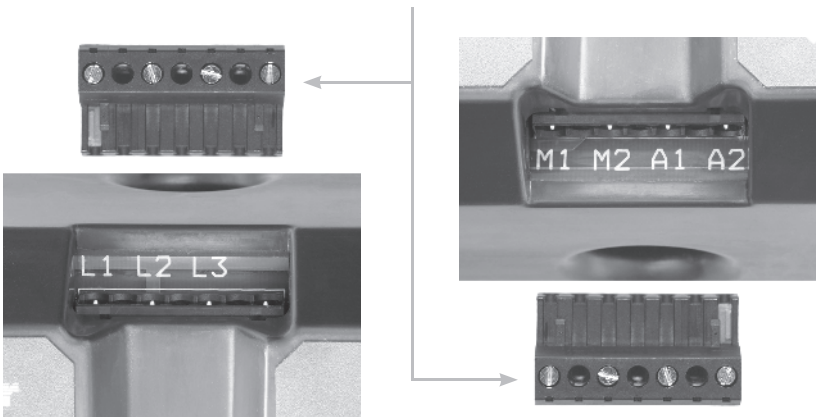
Additional programming options can be selected if desired to customize the features and levels of protection. See page 7 for an overview of the menu structure and page 12 for a full list of programmable options.

All programming set-up can be made prior to installing at the field site by connecting 230 volts single phase between voltage inputs L1 and L3 of SubMonitor and entering the motor data and any other options.

Components



Plug-in Wiring Connectors



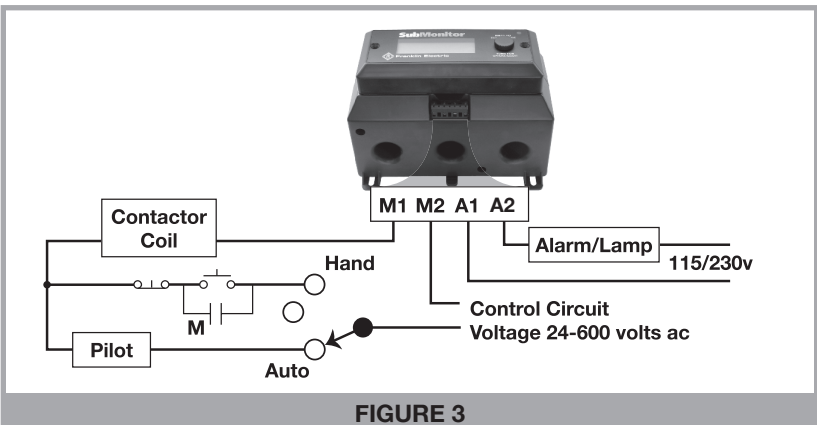
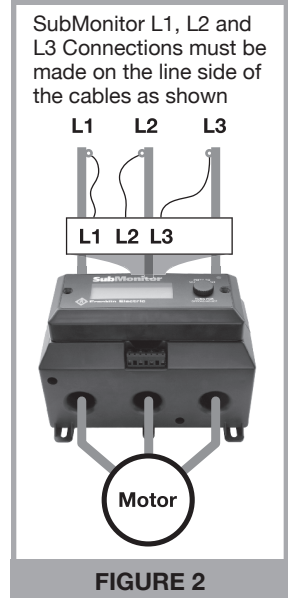
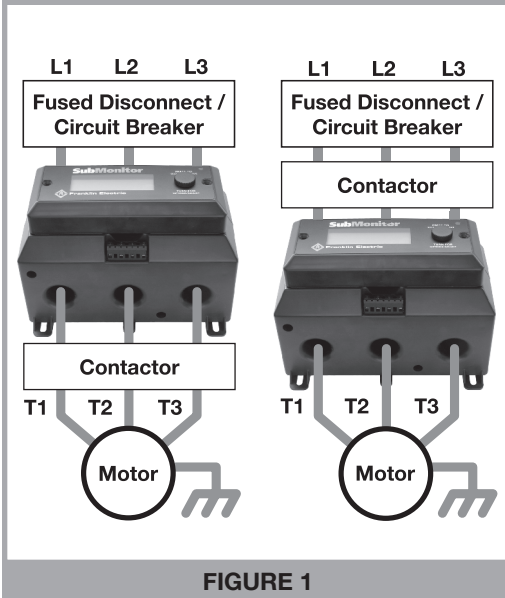
Components



WARNING: Hazardous Voltage.

Electrical shock can cause death or serious personal injury.

This equipment should be installed by technically qualified personnel. Failure to install in compliance with national and local electrical codes and within Franklin Electric recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure.



SubMonitor Wiring

1. Read this section of the manual thoroughly.
2. Disconnect power & verify that power is off before installing SubMonitor.
3. Install SubMonitor as illustrated in the wiring diagram in Figure 1. SubMonitor may be mounted above or below the contactor as shown. To use the DIN rail mount, first attach the DIN rail clip to the bottom of the base unit. Then secure the SubMonitor to the DIN rail. Attach to the top of the rail first, then apply downward pressure until the DIN clip snaps into the bottom of the rail.
4. Connect three phase power leads to the plug-in connector L1, L2, and L3 terminals as shown in figure 2. Wire strip length is 5/16" (8mm). **The L1, L2, L3 connections must be made to the line side of the cables passing through the sensor coils as shown in figure 2.** (This is because the overheat signal from the motor must first pass through the sensor coils, then into the L1, L2, and L3 terminals of SubMonitor).
5. Connect the control circuit wires to the M1 and M2 plug-in connector terminals, and signal circuit wires to the A1 and A2 plug-in connector terminals (Figure 3). Tighten all terminals to 4.5 in-lbs and install the plug-in connectors into SubMonitor (plugs are keyed to avoid misconnection).
6. Pass the T1, T2, and T3 motor power leads through the sensor coils in the base unit.
7. **NOTE:** 6-lead Wye-Delta motors - for a 6-lead motor with a Wye-Delta control panel, each sensor coil must encircle a pair of leads which connect to the same line in the delta connection, such as T1-T6; T2-T4 or T3-T5.
8. As an option, the SubMonitor display unit is detachable and can be mounted on the exterior of the panel door (requires a small punch-out, gasket and two screw holes). Use the extension cable provided in the kit to connect the base unit to the display unit.

Lightning Arrestor

1. Install the lightning arrestor and connect line leads to the line side of the contactor as shown in Figure 4.
2. The lightning arrestor ground lead must be connected to water strata ground to provide suitable surge protection. Connect metal-to-metal to well casing, drop pipe, or to the submersible motor with wire the same size as drop cable wires.

NOTE: Refer to Franklin Electric Submersible Motor, Application, Installation and Maintenance (AIM) manual for further discussion of lightning protection.

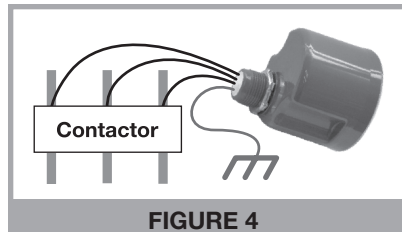


FIGURE 4

Quick Guide to Setup

Points 1 through 3 below describe navigation: how to get around among the two menus and several screens. Point 4 describes how to change a parameter.

1. On initial power-up, **the control circuit will be locked out until the motor voltage and SF Amps are set**. After a 30 second delay while data sync is completed, the monitor screen will report SF Amps Set Too High: Locked Out*. Notice →MENU in the lower right corner—the arrow indicates that pressing the knob will take you to the menu Basic Setup.
2. From Basic Setup, rotate to Select Motor and press, and you will arrive at the Select Motor screen where you can set motor Hz, volts, and SF Amps (read point 4 below). Set the SF Amps to match the motor SF Max Amps by adjusting each digit individually. When you are done with this screen, rotate to →OK and press, thereby going back to Basic Setup.
3. Note that selecting Detailed Setup takes you to a longer menu with items that are lettered. Select Back: Basic Setup to return to Basic Setup. Refer to charts on page 7 and page 10 for structure and available options of menus.
4. When you are on a selected screen of either Basic Setup or Detailed Setup and you want to change a setting:
 - a. Rotate the knob until the arrow points to the item to be changed.
 - b. Press the knob and the arrow will blink. Turning the knob now changes the value of the item.
 - c. When the item is correctly adjusted, press the knob and the arrow stops blinking.
 - d. You can now rotate the knob to another item on the screen. Selecting →OK returns you to the parent menu.

SubMonitor is now set up to protect your motor and pump, and will allow the motor to start when you return to the Monitor screen and select Manual Reset. After any Manual Reset there is a one minute off-time delay before the motor starts.

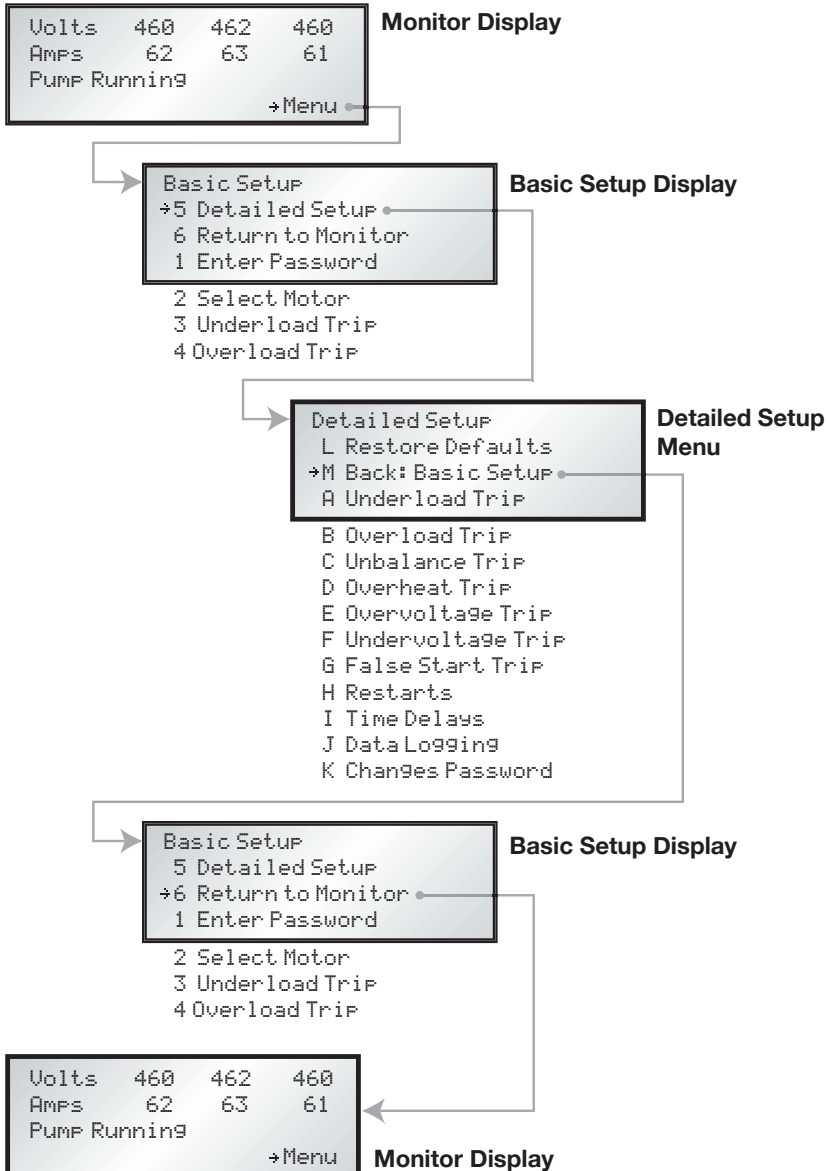
Note that the signal circuit and red Fault LED are ON until the motor data is entered and Manual Reset is pressed.

* **Phase Reversal**—SubMonitor has a built in phase sequence meter. If initial power up displays Phase Reversal, the incoming voltage at SubMonitor's L1,L2, L3 terminals is negative sequence, and the contactor is locked out until the phase sequence is corrected.

Figure 2 on page 4 shows SubMonitor inputs L1, L2, and L3 connected to motor leads T1, T2, and T3 respectively. While this order is not critical for operation of SubMonitor, it should provide proper motor rotation with positive sequence line voltage.

Additional Programmable Options

The table on page 10 shows the parameters that may be changed in the Basic Menu and Detailed Menu screens, including the default settings.



Password

1. The password is factory preset to 0 0 0, which **disables** the password protection. With the password protection disabled, all functions in the menus can be changed by any user.
2. If the password protection is **enabled**, all parameters in the menus can be viewed but not changed until the correct password is entered.
3. Using the password function:
 - a. Go into the Detailed Setup menu and select Change Password. Enter the three digits of the password sequentially left to right, just like a combination lock. Select >OK to return to the Detailed Setup menu.
 - b. Go to the Basic Setup menu and select Enter Password. Enter the password sequentially left to right.
4. If you forget your password, refer to the Enter Password screen which shows a password code. You may call the FE Hotline at 1-800-348-2420 to convert the code into your three digit password.
5. The password resides in the Base Unit. If you change display units, you will need to know the password that was used with the base unit.
6. If you wish to disable the password protection:
 - a. Go to Enter Password in the Basic Setup menu. Enter the correct password.
 - b. Go to Change Password in the Detailed Setup menu. Enter the password 0 0 0 sequentially left to right.
7. When a correct password has been entered, changes can be made for the next 20 minutes. To get another 20 minutes, re-enter the password.
8. The 20 minute valid password interval is terminated if power is disconnected.
9. If the password protection is enabled, the Event History can be reviewed after entering the correct password.

Event History

Information Logged

Up to 502 events can be logged and stored in the display unit in a rolling data set. Information stored includes:

- Event (trip fault, power interruption, etc)
- Time of event (pump run time)
- 3 motor currents
- 3 line voltages

Reviewing Events

- Before events can be reviewed, a valid password must be entered (if the password is other than 0 0 0).
- Each event is represented by one screen of information.
- Each event is numbered (0-511).
- Each event has a time stamp displayed in days (0-1165), hours (0-23), minutes (0.0-59.9). The time stamp displayed is the total pump run time.
- You can sequence through the events by turning the knob; CCW goes backward in time, CW goes forward in time.
- Entering the Event Review system is itself an event that is logged. This event provides the Total (pump) Run Time. This will be the first event shown upon entry into the Event History, and is identified as "Total Run Time".

Events Logged

- Total Run Time (always the most recent event)
- Power Up Delay (records power interruptions)
- Tripped : Underload
- Tripped : Overload
- Tripped : Unbalance
- Tripped : Overheat
- Tripped : Overvoltage
- Tripped : Undervoltage
- Tripped : FalseStart
- Manual Reset
- Protection Change (Trip Point, etc.) (New protection data recorded)
- Defaults Restored (New protection data recorded)
- Motor Change (Hz, Volt, SFA) (New motor data recorded)

When "detailed" logging mode is selected, every switch event and timed reset is recorded. This mode is typically used only for detailed system troubleshooting. Additional events logged:

- Timed Reset (Motor Start by SubMonitor)
- Switch On (Motor Start by External Control)
- Switch Off (Motor Stop by External Control)

Key to Parameters in Event History

Whenever a setting is changed in the menu, the change is recorded in the event history as a Parameter Change. The parameter that was changed is identified with a parameter number per the following table, and the new setting is recorded.

Parameter Number	Description
0	Motor Rated Frequency
1	Motor Rated Voltage
2	Motor SFA - hundreds digit
3	Motor SFA - tens digit
4	Motor SFA - ones digit
5	Motor SFA - tenths digit
7*	Trip Enable Flags
8*	Auto Restart Flags
9	Number of Underload Restarts
10	Number of Other Restarts
11	Time Between Starts
12	Power-Up Time Delay
13	Underload Trip Point
14	Timeout for Underload Trip
15	Overload Trip Point
16	Timeout for Overload Trip
17	Unbalance Trip Point
18	Timeout for Unbalance Trip
19	Timeout for Overheat Trip
20	Overvoltage Trip Point
21	Timeout for Overvoltage Trip
22	Undervoltage Trip Point
23	Timeout for Undervoltage Trip
24	Number of False Starts
25	Timeout for False Start Trip

* Flags are binary format (ei. 1101001) where 1=enabled; 0=disabled.
Order of flags: underload, overload, unbalance, overheat, overvoltage, undervoltage, false start.

For example, for flags 1101001:

Underload, overload, overheat, and false start trips are enabled.
Unbalance, overvoltage, and undervoltage trips are disabled.

Other Features

Reset

The receiver will not allow a reset for several minutes after a fault trip, depending on the programmed reset time and fault mode. This allows time for the motor to cool before it is restarted after a problem has occurred. Any Manual Reset causes the motor to restart in exactly one minute.

Operation without the Display Unit

After the **Select Motor** parameters are entered (volts, Hz, and SF Amps), the base unit of SubMonitor provides full motor protection even when the Display Unit is disconnected.

When operating with a Base Unit only:

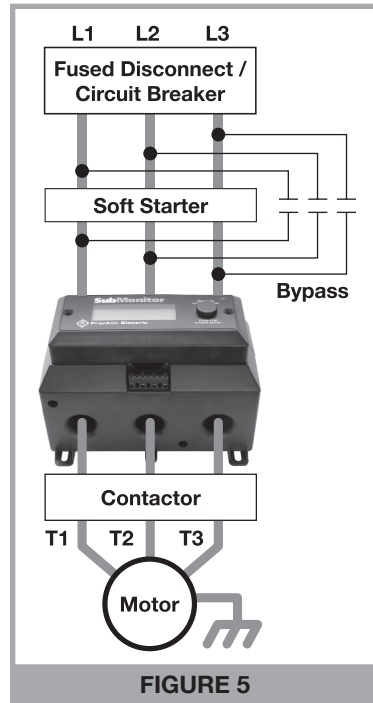
- A “run enable” condition is indicated by a green LED
- A trip condition is indicated by a red Fault LED
- Manual reset is initiated by pressing the Reset Switch
- The Event History is not recorded (total run time is recorded).

Special Conditions

Note: The SubMonitor is not compatible with variable frequency drives, electronic phase converters, or solid state soft starters. These devices will cause nuisance tripping of the motor overheat fault, or may cause damage to SubMonitor components.

Reduced voltage starters may be used with SubMonitor if they are bypassed during normal running condition (Figure 5), and if the starting time does not exceed 3 seconds.

Power Factor or Surge Capacitor—across-the-line capacitors for either power factor correction or surge protection may be used with SubMonitor. If used, these capacitors must be connected to the power supply lines before these lines pass through the SubMonitor sensor coil windows or motor overheat protection may be lost.



Programmable Options

	Trip Point Settings				Timeout Settings						
	Default Setting	Min	Max	Increment	Adjustable Range	Min	Max	Increment	Adjustable Range		
General Parameters											
Restart Attempts - Underload	On	3	0	10*	1	Restarts					
Restart Attempts - All Other	On	3	0	10*	1	Restarts					
Time Between Starts							1	0	10	1	min
Power Up Delay							30	10	120	10	sec
Specific Parameters											
Underload	On	65%	30%	100%	5%	of SFA	30	10	120	10	min
Overload	On	125%	80%	125%	5%	of SFA	10	5	60	5	min
Undervoltage	Off	90%	80%	90%	2%	of Vrated	1	1	15	1	min
Overvoltage	Off	110%	110%	120%	2%	of Vrated	1	1	15	1	min
Current Unbalance	Off	5%	2%	10%	1%		10	5	60	5	min
Overheated Motor	On						10	5	60	5	min
False Start (Chattering)	On	10	0	0	0	starts in 10 sec.	1	1	15	1	min

* Unlimited restarts (***) may also be selected.

Troubleshooting

Fault Message	Problem / Conditions	Possible Cause
SF Amps Set Too High	SF Amps setting above 359 Amps	Motor SF Amps not entered
Phase Reversal	Reversed incoming voltage phase sequence	Incoming power problem
Underload	Normal line current	Wrong SF Max Amps setting
	Low line current	Over pumping well
		Clogged pump intake
		Closed valve
		Loose pump impeller
		Broken shaft or coupling
Phase loss		
Overload	Normal line current	Wrong SF Max Amps setting
	High line current	High or low line voltage
		Ground fault
		Pump or motor dragging
Motor stalled or bound pump		
Overheat	Motor temperature sensor has detected excess motor temperature	High or low line voltage
		Motor is overloaded
		Excessive current unbalance
		Poor motor cooling
		High water temperature
		Excessive electrical noise (VFD in close proximity)
Unbalance	Current difference between any two legs exceeds programmed setting	Phase loss
		Unbalanced power supply
		Open delta transformer
Overvoltage	Line voltage exceeds programmed setting	Unstable power supply
Undervoltage	Line voltage below programmed setting	Poor connections in motor power circuit
		Unstable or weak power supply
False Starts	Power has been interrupted too many times in a 10 second period	Chattering contacts
		Loose connections in motor power circuit
		Arcing contacts

Specifications

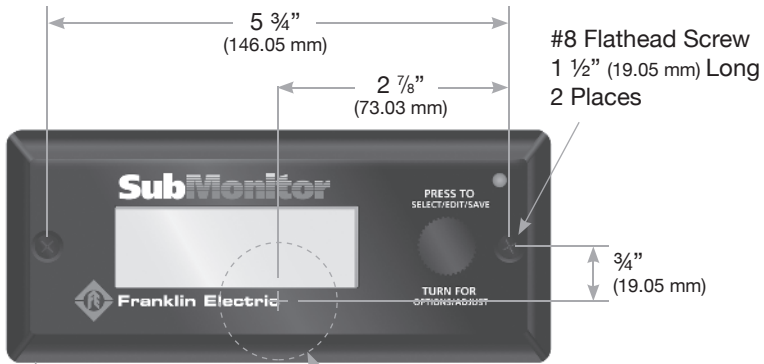
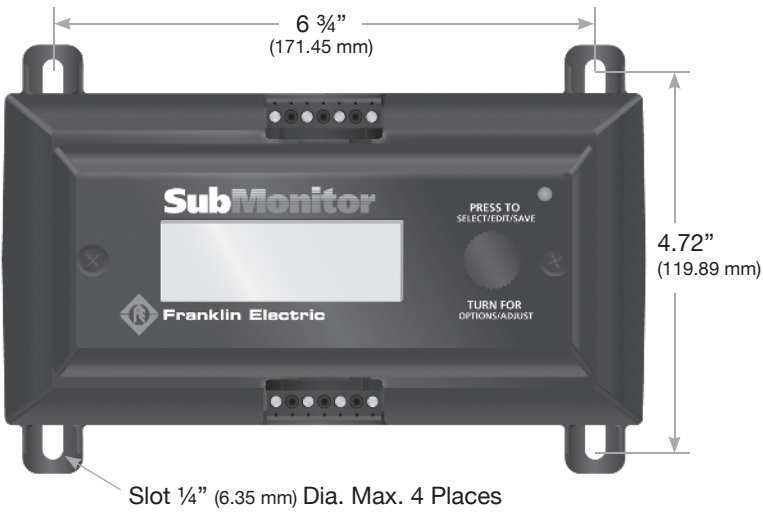
Electrical

Input Voltage	3-Phase 190-600 VAC
Frequency	50 Hz or 60 Hz
Motor SF (Max) Amps Range	3 amps to 359 amps
Maximum Conductor Size Through Sensors	0.920" (23mm) Diameter Max
Measurement Accuracy	
Voltage	1% ± 1 digit
Current	1% ± 1 digit
Trip Time	
Overload, underload, overheat, unbalance, overvoltage, undervoltage	3 seconds
Input Current, L1, L2, L3	0.15 amps
Control Circuit Rating	1.5 amps AC, up to 600 volts
Signal Circuit Rating	1 amp AC, up to 250 volts Incandescent lamp, 100 watts max
Agency Approvals	UL 508 classification NKCR file E160632 cUL
Standards Met	
Surge	ANSI/IEEE C62.41
Electrical Fast Transient	IEC 1000-4-4 Level 4, 4kV
ESD	IEC 1000-4-2 Level 3, 6kV

Mechanical

Dimensions (WxHxD)	
Base Unit	8.0" x 5.35" x 4.3" (20.3 x 13.6 x 10.9 cm)
Display Unit	7.0" x 3.0" x 1.4" (17.8 x 7.6 x 3.6 cm)
Total Unit	8.0" x 5.35" x 5.7" (20.3 x 13.6 x 14.5 cm)
Weight	
Base Unit	46 oz (1.3 kg)
Display Unit	7 oz (0.2 kg)
Total Unit	53 oz (1.5 kg)
Operating Temperature Range	-20°C to +60°C
Storage Temperature Range	-30°C to +80°C
Relative Humidity	10-95% non-condensing
Protection Class	
Display Unit	NEMA 3R
Base Unit	NEMA 1

Mounting Dimensions



Install Gasket Between the Panel and the Back of the Display Unit

1 1/2" (19.05 mm) Dia. Clearance Hole in Control Panel Cover for RJ Cable

For Mounting Detachable Display Unit on the Cover of a Control Panel

SubMonitor

Notes

TOLL-FREE HELP FROM A FRIEND
Franklin Electric SUBMERSIBLE SERVICE HOTLINE 800-348-2420



Franklin Electric
QUALITY IN THE WELL



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