

**BE SURE POWER IS DISCONNECTED PRIOR TO INSTALLATION!
FOLLOW NATIONAL, STATE AND LOCAL CODES.
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION.**

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.

Electrical shock can cause death or serious injury.

Installation should be done by qualified personnel following all national, state and local electrical codes.

CONNECTIONS

- Using the four corner tabs or the DIN rail mounting bracket, mount the Model 777-MV near the magnetic contactor. To use the DIN rail bracket, hook the top clip first, then apply downward pressure until the lower clip snaps onto the rail.
 - External current transformers (CTs) must be used with the 777-MV (see Figure 1). If the motor full load amps is 12.5–25A, the CT secondaries must pass through the 777-MV twice. Insert the CT secondaries down through the round holes, back up through the rectangular holes, and back down the round holes on the 777-MV.
 - Power input to the Model 777-MV can be 3-phase or single-phase. 3-phase inputs to the Model 777-MV should have instrument transformers with 120VAC secondaries, 5VA minimum. A separate power supply potential transformer should be used to power the contactor coil because its signal will vary as the load is energized and de-energized.
 - 3-phase voltage input:** 120V 3-phase can be made available by using three potential transformers in a wye-wye configuration. Reverse-phase protection, single-phase and unbalance protection is available when using the wye-wye configuration shown in Figure 2A. The motor will not start under these voltage fault conditions. Connect the 3-phase power from the secondary of the potential transformers to L1, L2 and L3 on the Model 777-MV using #12-18 AWG wire.
 - 3-phase voltage input:** Alternatively, a 3-phase voltage input may be constructed by connecting two potential transformers in an open delta configuration (Figure 2B).
 - Single-phase voltage input:** If only single-phase, 120V control power is available, insert control power into L1 and L2 inputs (Figure 2B). L3 does not need to be connected. When single-phase voltage input is used, single-phase faults are detected only after the motor starts and reverse-phase protection is not available.
- NOTE: VUB must be set to 999 for proper operation with single-phase voltage input.**
- Connect the output relay to the circuitry to be controlled (see Figure 3). To control a motor, connect the normally open contact in series with the magnetic coil of the motor starter as shown. To sound an alarm, connect the normally closed contact in series with the alarm (not shown).

Full Load Amps	CT Ratio	Passes through 777-MV with CT Secondaries	MULT
12.5–25	50:5	2	25
25–50	50:5	1	50
50–75	75:5	1	75
75–100	100:5	1	100
100–150	150:5	1	150
150–200	200:5	1	200
200–300	300:5	1	300
300–400	400:5	1	400
400–500	500:5	1	500
500–600	600:5	1	600

Table 1. External CT Selection Based on Motor Amps

CURRENT TRANSFORMER WIRING DIAGRAM FOR MODEL 777-MV (12.5 TO 800 AMPS)

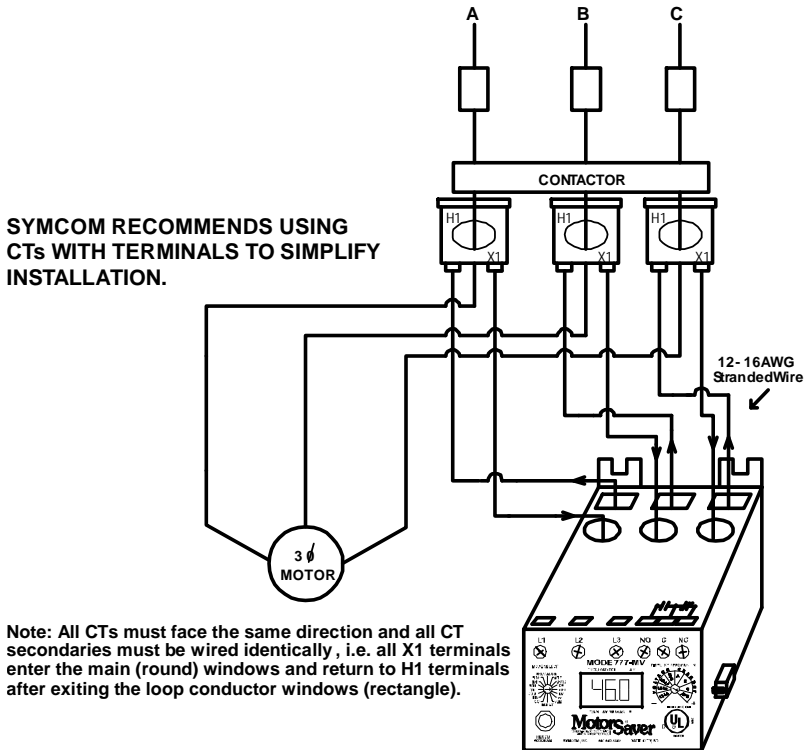


Figure 1. Typical Wiring Diagram for CTs

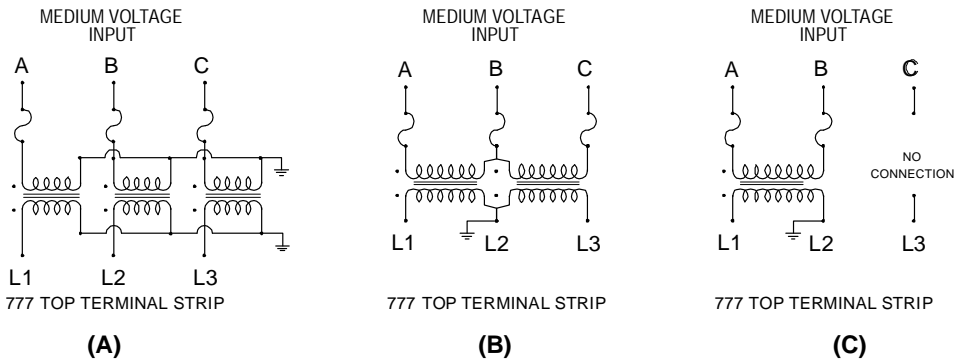


Figure 2. Potential Transformer Diagrams

NOTE: All potential transformers typically have 120VAC secondaries. The 777-MV may be installed with 3-phase voltage input (Figures 2A & 2B) for full voltage monitoring and protection. If the single-phase voltage input is used (Figure 2C), the 777-MV is a current monitor only.

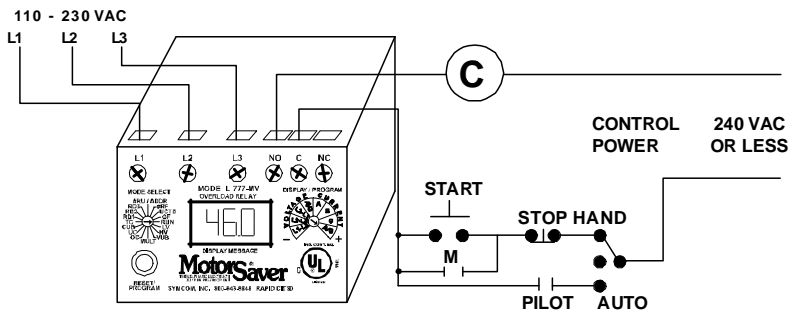


Figure 3. Typical Wiring Diagram

MULTI-FUNCTION SYSTEM DISPLAY

The output display can show several system operating parameters:

- L1-L2 Voltage
- L3-L1 Voltage
- L1 Current (A)
- L3 Current (C)
- L2-L3 Voltage
- Average Voltage
- L2 Current (B)
- Average Current

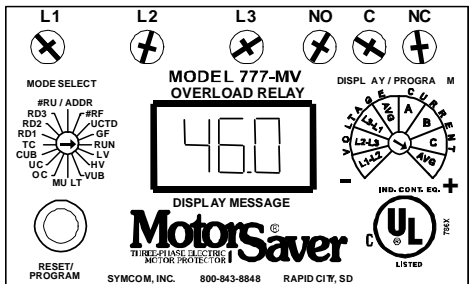
When the MODE SELECT switch is in the RUN position, the LED will display one of the above operating parameters. To select or change the displayed parameter, turn the DISPLAY/PROGRAM knob to the desired position as shown on its label.

The multi-function display also announces system faults such as low voltage, high voltage, single-phasing, voltage unbalance, current unbalance, and reverse-phasing errors. Anytime the MODE SELECT switch is in the RUN position, the RESET/PROGRAM button may be pushed to view the last fault that occurred. The following table shows the possible messages.

Displayed Message	Meaning
oc	Tripped on overcurrent
SP	Tripped on single-phasing
ub	Tripped on voltage or current unbalance
uc	Tripped on undercurrent
CF	Tripped on contactor failure (3-phase voltage input only)
GrF	Tripped on ground fault
HI	Tripped on high voltage
Lo	Tripped on low voltage
rP	Incoming phases have been reversed. The motor may run backwards if started. (3-phase voltage input only)
oFF	A stop command was issued from a remote source.

PROGRAMMING

1. Select the feature to program by rotating the MODE SELECT switch to the desired position. The MULT setting must be programmed before any of the current settings to ensure proper display of actual current setpoints. Therefore, SymCom recommends programming the LV setting first, then moving clockwise through the positions to complete the process.



2. Press and hold the RESET/PROGRAM button.
3. Rotate the DISPLAY/PROGRAM knob to the desired setting of the feature as shown on the display.
4. Release the RESET/PROGRAM button. The setting is programmed when the button is released.
5. Continue steps 1-4 until all features are programmed.

NOTE: Some MODE SELECT positions are dual functioning such as #RU/ADDR. When the MODE SELECT switch is in the #RU/ADDR position, #RU and ADDR can be viewed and programmed. To view the two settings rotate the DISPLAY/PROGRAM knob across its entire range. The #RU setting will be displayed when the DISPLAY/PROGRAM knob is approximately between the 7 o'clock and 11 o'clock position. The ADDR setting will be displayed when the DISPLAY/PROGRAM knob is between 11 o'clock and 5 o'clock.

To program #RU or ADDR, follow the programming instructions above. The #RU setting will only be programmed when the DISPLAY/PROGRAM knob is between approximately 7 o'clock and 11 o'clock. Likewise, the ADDR setting will only be programmed when the DISPLAY/PROGRAM knob is between approximately 11 o'clock and 5 o'clock. ADDR settings will be an A followed by a number between 1 and 99.

SUGGESTED SETTINGS

Consult the Motor Manufacturer for their recommendations.

Refer to the programming examples on page 8.

LV/HV- The recommended settings for **LV** (low voltage) and **HV** (high voltage) depend on any factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for HV and LV settings. However, the NEMA MG1 standard recommends that LV and HV be set to no more than $\pm 10\%$ of the motor's nameplate voltage. The setting can be determined by multiplying the motor's nameplate voltage by the recommended percent overvoltage and undervoltage (e.g. The motor nameplate voltage is 4160V and the potential transformer(s) is 4160V/120V. Therefore, set LV to $0.9 \times 120 = 108$ and HV to $1.10 \times 120 = 132$).

LV cannot be set higher than HV, so HV may have to be adjusted higher before the proper LV setting can be programmed.

VUB- **VUB** is the voltage unbalance trip point. The NEMA MG1 standard does not recommend operating a motor above a 1% voltage unbalance without derating the motor. Voltage unbalance is determined from the following formula: % Voltage Unbalance = [(Maximum Deviation from the Average) / Average] x 100% The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. Therefore, a setting of 5 is a good place to start but SymCom recommends consulting the motor manufacturer for specific tolerances.

Note: A setting of 999 in this position will disable reverse-phase, single-phase and voltage unbalance protection. This setting should be used when single-phase voltage control power is used. Single-phase faults will only be detected from current measurements after the motor starts.

MULT- **MULT** is the multiplication factor for determining true current settings based on current transformer ratio of external CTs. The appropriate number can be determined from Table 1 on page 2. **MULT** must be correctly programmed in order to accurately program the current settings.

OC- **Represents the manufacturer's maximum service factor amperage.** The **OC** (overcurrent) setting depends on many factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for OC settings. However, OC is typically set to the service factor amps (SFA) or between 110% and 125% of full load amperage (FLA).

UC- The **UC** (undercurrent) setting is typically set to 80% of full load amperage (FLA). The overload relay with a UC setting of 80% of FLA will typically detect a loss of load for many pumps and motors such as a dry-well condition for submersible pumps. The UC setting may be set to 0.00 to disable undercurrent (loss of load) protection.

CUB- **CUB** is the current unbalance trip point. Most motor manufacturers recommend operating under no more than 5% current unbalance; therefore, a setting of 5 is a good place to start. However, the motor manufacturer should be contacted for an exact setting.
Note: A setting of 999 will disable single-phasing and current unbalance protection.

TC- **TC** designates the trip class for overload protection. The trip class defines the trip delay when an overload is detected. Trip class is determined by the type of motor and application. The motor manufacturer should be consulted for the proper setting. Table 2, page 7, shows each trip class and gives a general description of possible applications.

- RD1-** **RD1** is the rapid-cycle timer. It will engage when the motor is first powered-up or after the motor controls shut down the motor. An RD1 setting of 2-5 minutes will generally protect the motor from rapid, successive power outages or short cycling caused by the motor controls. A setting of 0 will allow the motor to start immediately after power-up and will allow the NO contacts to remain energized following a normal shutdown, but will disable rapid-cycle protection.
- RD2-** **RD2** is the restart delay after the overload relay trips on current unbalance, single-phasing and overload (if "oc" is programmed in #RF). This delay allows the motor to cool down after experiencing the above faults. It is also known as a motor cool-down timer. The motor manufacturer should be contacted to determine this setting. Under normal circumstances, though, a setting of 5-10 minutes should give the motor enough time to cool down between faults.
- RD3-** **RD3** is the restart delay after an undercurrent. It is also known as a dry-well recovery timer and is usually used in submersible pumping applications. The setting of RD3 depends on the recovery time of the water well and varies widely from application to application.
- #RU-** **#RU** is the number of successive restart attempts allowed after an undercurrent fault before the overload relay requires a manual reset. A setting of 0 is manual, and A is automatic reset. (See the PROGRAMMING instruction note for explanation of dual-function settings.)
- ADDR-** **ADDR** is the address setting for RS-485 communications. Available settings are from A01-A99. This setting is programmed on the right half of the DISPLAY/PROGRAM knob. Ignore this setting if RS-485 communications are not used.
- #RF-** **#RF** is the number of successive restart attempts allowed after the unit trips on current unbalance, single-phasing or overload (if "oc" is programmed in #RF). The following settings are available: 0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, and ocA. A setting that includes "oc" will include overload trip in the restart attempts. (e.g. A setting of oc2 will allow the unit to reset 2 times after a current unbalance, single-phasing or overload trip. A setting of 2 will allow the unit to restart 2 times after a current unbalance or single-phase trip) A setting that does not include "oc" requires a manual reset after all overload faults. A setting of 0 is manual reset and a setting of A is continuously automatic.
- UCTD-** **UCTD** is the undercurrent trip delay timer. This setting represents the maximum time that the Model 777-MV will tolerate an undercurrent condition. Typically, UCTD is set from 2-4 seconds.
- GF-** **GF** is the ground fault protection amperage threshold. This setting detects a leakage current to ground and signals an insulation breakdown in the system. The GF setting should be somewhere between 10% and 20% of the full load motor current. Short circuit protection is provided by separate branch protective devices such as circuit breakers or fuses. Ground fault protection is a Class II ground fault protector and should not be used for personnel safety, but can be used to indicate motor degradation for maintenance purposes.

Trip Class	Application Description
5	Small fractional horsepower motors where acceleration times are almost instantaneous or where extremely quick trip times are required
10	(Fast Trip) Hermetic refrigerant motors, compressors, submersible pumps and general-purpose motors that reach rated speed in less than 4 seconds.
15	Specialized applications.
20	(Standard Trip) Most NEMA-rated general-purpose motors will be protected by this setting.
30	(Slow Trip) Motors with long acceleration times (>10 seconds) or high inertia loads.
J Prefix	Programming any of the trip classes with the J prefix will enable jam protection. This additional protection is enabled 1 minute after the motor starts and provides a 2-second trip time for motors exceeding 400% of the SFA (OC setting), regardless of trip class.

Table 2. Trip Class Descriptions

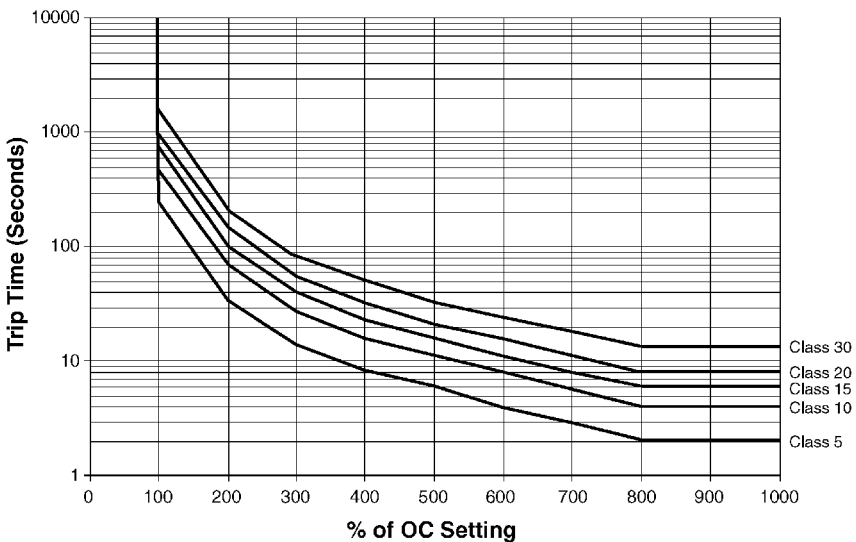


Figure 4. Overload Trip Classes

PROGRAMMING EXAMPLES

#1- Motor to be protected: 3-phase, 4160 Volt, 400 hp vertical hollow shaft pump with a full load amperage of 56.2A and maximum service factor amps of 61.6A. Three potential transformers (4160/120) have been installed in a wye-wye configuration to allow 3-phase voltage protection. This voltage monitoring will prevent the motor from starting on a reverse-phase, single-phase or unbalance condition.

Use the following calculations and reasoning to determine the appropriate settings for this application.

LV- $120 \times 0.90 = 108$

HV- $120 \times 1.10 = 132$

VUB- $5\% = 005$

MULT- From Table 1, MULT = 75 with 75:5 CTs

OC- Service Factor Amperage = 61.6

UC- $FLA \times 0.80 = 56.2 \times 0.80 = 45.0$

CUB- Manufacturer suggests 5%, CUB = 005

TC- General purpose motor, TC = 20

RD1- To protect the pump from rapid cycling and reduce the number of starts per hour, RD1 = 5 minutes

RD2- Since the motor is large it will cool off slowly, RD2 = 30 Minutes

RD3- The well history shows that it will fully recover in 2 hours. RD3 = 120 Minutes

#RU- In this application, we know that the well will eventually recharge itself, #RU = A.

#RF- This well is known for sand to jam the impeller, therefore "oc" should be included so the pump will automatically restart after an overloaded condition. History shows that 1 start attempt usually clears the sand out of the impeller. #RF = oc1

UCTD- Setting UCTD = 10 will allow normal operation and not allow the motor to run too long in an undercurrent failure mode

GF- Because it may take several days to get a new pump motor and schedule for maintenance personnel to remove and replace the pump motor, GF setting of 10% of full load amperage will give the well owner enough time to prepare for pump replacement. $GF = 56.2A \times 0.10 = 5.6$

#2- Motor To Be Protected: 3-phase , 4160 Volt, 200 hp air compressor with a full load amperage rating of 27A and maximum service factor amps of 30A. Use the following calculations and reasoning to determine the appropriate settings for this application. One 4160/120 potential transformer is used for control power. Voltage monitoring and reverse-phase protection is not implemented.

LV- $120 \times .9 = 108$

HV- $120 \times 1.1 = 132$

VUB- Since L3 is not connected, VUB = 999

MULT- From Table 1, MULT = 50 with 50:5 CTs

OC- Service Factor Amperage = 30

UC- $FLA \times 0.80 = 27A \times 0.80 = 21$

CUB- Standard NEMA motor = 5%, CUB = 005

TC- General purpose motor, TC = 20

RD1- Since this compressor takes about 60 seconds to bleed off excess pressure after a shutdown, setting RD1 = 2 minutes will allow the compressor to unload before being restarted.

RD2- Because the motor may be hot from running in an unbalance or single phase condition, a motor cool down time of 10 minutes, RD2 = 10, should be appropriate.

- RD3- Because an undercurrent would signal a serious problem in this application (a broken shaft or belt), #RU should be set = 0 for manual reset. Therefore, RD3 has no function.
- #RU- #RU = 0 (see RD3 setting)
- #RF- Because an overload (overcurrent) fault signals a serious problem in this application (e.g., worn bearings), "oc" should **not** be included in the #RF setting so that a manual reset after an overload fault is required. #RF = 1 will give the system 1 chance to recover from an unbalance or single-phasing problem before a manual reset is required.
- UCTD- Setting UCTD = 5 will allow normal operation and not allow the motor to run too long in an undercurrent failure mode.
- GF- A ground fault setting of 15% of full load amps will be a significant indicator that the motor should be evaluated for repair or replacement. Thus, GF = 27A x 0.15 = 4.0.

OPERATION

Once the overload relay has been programmed, turn the MODE SELECT switch to the RUN position. The LED display will flash RUN alternatively with a number representing the parameter indicated by the DISPLAY/PROGRAM knob. After the period of time programmed into RD1, the output contacts will close and the value of the parameter indicated by the DISPLAY/PROGRAM knob will appear on the LED display.

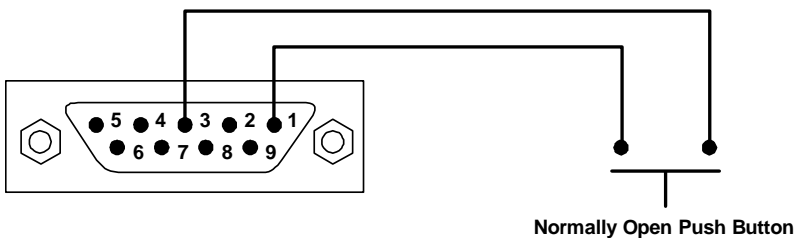
If a message other than those indicated above is shown on the display, see the TROUBLESHOOTING section to diagnose the problem.

COMMUNICATIONS PORT / REMOTE RESET

The Model 777-MV comes standard with a 9-pin sub-D connector for remote communications. The Model 777-MV supports RS-485 communication standard. This standard allows up to 99 Model 777-MVs to be controlled and monitored from a single remote personal computer.

NOTE: An RS485MS-2W module and software is required to operate the communications bus. (Refer to RS485MS-2W installation instructions for more information on this subject.)

The communications port also provides connections for remote reset as shown below.



TROUBLESHOOTING

PROBLEM	SOLUTION
<p>The unit will not start. Display alternates "rP" with the DISPLAY/PROGRAM parameter value.</p>	<p>The voltage inputs are reverse phased. If this is the initial start-up, swap any two of the leads connected to L1, L2, or L3 on the 777-MV to correct the problem. If the overload relay has been previously running, the power system has been reverse phased. Check the phase sequence of the incoming power lines. Note: L1 must be tapped from conductor Phase A, L2 from B, and L3 from C for correct power factor measurements on remote communications.</p>
<p>The unit will not start. Display alternates "SP", "ub", "HI", or "Lo" with the DISPLAY/ PROGRAM parameter value.</p>	<p>The incoming voltage is not within the limits programmed in the VUB, HV, and LV settings. Adjust the DISPLAY/ PROGRAM knob to read the incoming line voltage values. Correct the incoming power problem and check programmed limits to verify they are correct.</p>
<p>Display alternates "SP", "ub", or "oc" with "run."</p>	<p>The unit has tripped on the fault shown on the display and is timing down RD2 before restarting.</p>
<p>Display alternates "uc" with "run."</p>	<p>The unit has tripped on undercurrent and is timing down RD3 before restarting. If undercurrent is not a normal condition for this installation, check for broken shafts, broken belts, etc.</p>
<p>Display is showing a solid "SP", "ub", or "oc."</p>	<p>The unit has tripped on the fault shown and a manual reset is required because of the programmed setting in #RF. Check the system for problems that would produce the single-phase, overload or current unbalance fault, such as a jam.</p>
<p>Display is showing a solid "uc."</p>	<p>The unit has tripped on undercurrent and a manual reset is required because of the setting in #RU. Check the system for problems that would produce a loss of load such as a broken belt or a lack of liquid to pump.</p>
<p>Display is showing a solid "CF." (Not available on single-phase voltage input)</p>	<p>The unit has tripped on current single-phasing, but was not single-phased by the incoming voltage. Check for damaged contacts or loose wiring.</p>

MODEL 777-MV SPECIFICATIONS	
Input voltage	115–230VAC, single or 3-phase (programmable)
Frequency	50/60 Hz
Motor full load amp range	12.5–600, 3-phase (external CTs)
Programmable Operating Points Range	Range
LV - Low voltage threshold	85V–HV setting
HV - High voltage threshold	LV setting–264V
VUB - Voltage unbalance threshold	2–25% or 999 for single-phase 120V input
MULT - CT ratio (XXX:5)	25–600 ratio
OC - Overcurrent threshold	92–122% of CT primary
UC - Undercurrent threshold	0, 20–90% of CT primary
CUB - Current unbalance threshold	2–25% or 999 (OFF)
TC - Overcurrent trip class **	5, J5, 10, J10, 15, J15, 20, J20, 30, J30
RD1 - Rapid-cycle timer	0, 2–500 minutes
RD2 - Restart delay after all faults except undercurrent (motor cool-down timer)	2–500 minutes
RD3 - Restart delay after undercurrent (dry-well recovery timer)	2–500 minutes
#RU - Number of restarts after undercurrent	0, 1, 2, 3, 4, A (automatic)
ADDR - RS485 Address	A01–A99
#RF - Number of restarts after all faults except undercurrent ***	0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA
UCTD - Undercurrent trip delay	2–60 seconds
GF - Ground fault current threshold	10–20% of CT primary or OFF
Physical Specifications	
Output contact rating (pilot duty) SPDT	480VA @ 240VAC
Transient protection (internal)	2500V for 10ms
Accuracy	
Voltage	±1%
Current	±3% (<10 amps direct)
Timing	5% ± 1 second
Repeatability	
Voltage	±0.5%
Current	±1% (<10 amps direct)
Temperature range	0° to 70 °C
Dimensions	3.0"H x 5.1"D x 3.6"W
Power consumption	5 Watts (max.)
Weight	1.2 lbs.

NOTES: SymCom's overload relay can be preprogrammed prior to installation by applying 120VAC between the L1 and L2 terminals.

** If a "J" is displayed in the trip class (TC) setting, jam protection is enabled.

*** If "oc" is displayed in the #RF setting, overcurrent will be included as a normal fault and the relay will automatically restart after RD2 expires, otherwise, a manual reset is required after an overcurrent fault.

CLEARING LAST FAULT

The last fault stored can be cleared on the MotorSaver® by following these steps:

1. Rotate the MODE SELECT switch to GF.
2. Press and hold the RESET/PROGRAM button. Adjust the DISPLAY/PROGRAM knob until "cLr" appears on the display. Release the RESET/PROGRAM button.

To verify the last fault was cleared, place the MODE SELECT switch in the RUN position. Press and hold the RESET/PROGRAM button, "cLr" should be on the display.

TAMPER GUARD

The MotorSaver's setpoints can be locked to protect against unauthorized program changes.

1. Rotate the MODE SELECT switch to GF.
2. Rotate the DISPLAY/PROGRAM knob fully clockwise.
3. Press and hold the RESET button. Adjust the DISPLAY/PROGRAM knob until "Loc" appears on the display.
4. Release the RESET button.
5. Turn the MODE SELECT switch to RUN.

The program is now locked, but all settings can be viewed. The unit can be unlocked by following the same steps except adjust the DISPLAY/PROGRAM knob to "unl" in the GF position.

SymCom warrants its microcontroller-based products against defects in material or workmanship for a period of five (5) years from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material and workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, returns, and cancellations, please refer to the SymCom Terms and Conditions of Sale document.