MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MODEL 77C ELECTRONIC OVERLOAD RELAY

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

1. Using the four corner tabs OR the DIN rail mounting bracket, mount the Model 77C directly above or below 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.
2. Insert the motor conductors through the round holes marked A and B. Terminate the conductors at the line or load side of the magnetic contactor. **For motors with full load amps less than 25 Amps,** loop the conductors through the holes marked A and B according to Table 1. The rectangular holes are provided for wire looping (see Figure 1).
3. **For motors with full load current above 90 A**, an external current transformer (CT) must be used (see Figure 2). SymCom recommends using CTs with terminals for installation convenience. When using an external CT, five passes must be made through the holes in the Model 77C.
4. Connect the single-phase power from the line side of the contactor to L1 and L2. First insert a#12 - #18 AWG copper wire into the top of the terminal marked L1 and tighten the screw on the front of the overload relay. Connect the other end of the wire to the line side of the contactor. Repeat these steps for L2 (see Figure 1).
5. Connect the output relay to the circuitry to be controlled (see Figure 1). To control a motor, connect the NO (normally open) contact in series with the magnetic coil of the motor starter as shown. To sound an alarm, connect the NC (normally closed) contact in series with the alarm (not shown).

II-77C-B

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Recommended Full Load Amps	OC Range (Amps)	UC Range (Amps)	# of Passes through each Window	MULT (CT Ratio)
2-2.5	2-10	0, 1-9.8	10	10
2.5-3	2.22-11.1	0, 1.11-10.8	9	9
3-3.5	2.5-12.5	0, 1.25-12.2	8	8
3.5-4	2.85-14.2	0, 1.42-14	7	7
4-5	3.33-16.6	0, 1.66-16.3	6	6
5-6	4-20	0, 2-19.6	5	5
6-8	5-25	0, 2.5-24.5	4	4
8-12	6.66-33.3	0, 3.33-32.6	3	3
12-25	10-50	0, 5-49	2	2
25-90	20-100	0, 10-98	1	1
u EXTERNAL CTs REQUIRED. SEE EXTERNAL CT WIRING DIAGRAM. u				
80-110	80-140	0, 40-120	5	100 (100:5)
110-160	120-210	0, 60-180	5	150 (150:5)
160-220	160-280	0, 80-240	5	200 (200:5)
220-320	240-420	0, 120-360	5	300 (300:5)
320-420	320-560	0, 160-480	5	400 (400:5)
400-520	400-700	0, 200-600	5	500 (500:5)
480-600	480-840	0, 240-720	5	600 (600:5)
540-700	560-980	0, 280-840	5	700 (700:5)
560-800	640-992	0, 320-960	5	800 (800:5)

Table 1: Wiring Configuration Based on Motor Amps

MULTI-FUNCTION SYSTEM DISPLAY

When the MODE SELECT switch is in the RUN position, the display will show either L1-L2 Voltage or L2 Current (B). To select the displayed parameter, adjust the DISPLAY/PROGRAM dial to the desired position as shown on its label.

The multi-function display also shows system faults. Any time the MODE SELECT switch is in the RUN position, the RESET/PROGRAM button may be pushed to view the last fault that occurred. The table below shows the possible messages.

Displayed Message	Meaning
Oc	tripped on overcurrent
Uc	tripped on undercurrent
HI	high voltage condition exists
Lo	low voltage condition exists
oFF	a stop command was issued from a remote source

Table 2: Multifunction Display Fault Messages

PROGRAMMING

1. Select the feature to program by rotating the MODE SELECT dial to the desired position. The MULT setting must be programmed before programming 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. Push and hold the RESET/PROGRAM button.
3. Rotate the DISPLAY/PROGRAM dial to the desired setting of the feature as shown on the display.
4. Release the RESET/PROGRAM button. The Model 77C is programmed when the button is released.
   NOTE: If a setting jumps back to its original number when the button is released, the tamper guard is set. Refer to the TAMPER GUARD section (page 11) to unlock the setpoints.
5. Repeat steps 1-4 until all features are programmed.

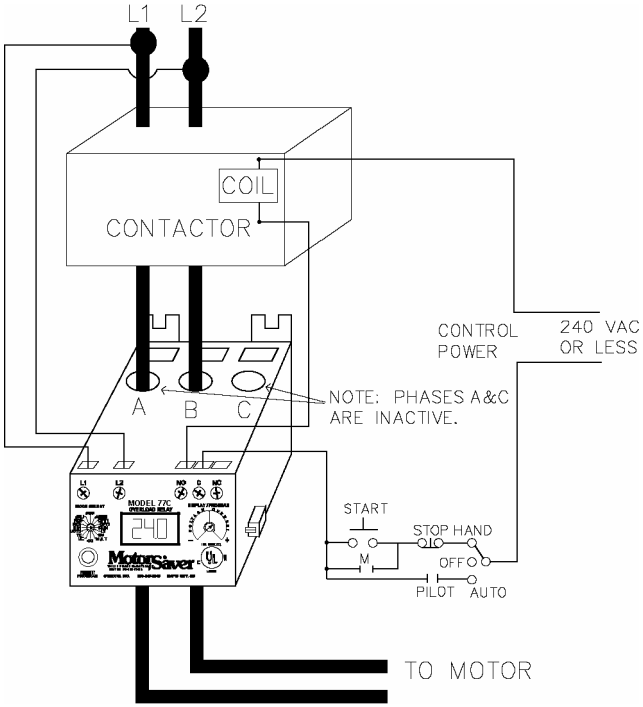


Figure 1: Typical Wiring Diagram

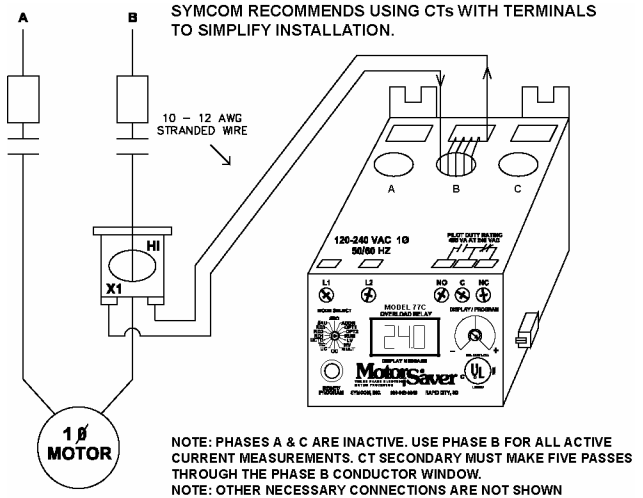
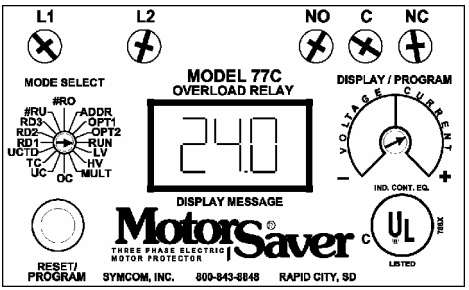


Figure 2: External CT wiring diagram

SUGGESTED SETTINGS

Consult the motor manufacturer for recommended settings. Refer to the PROGRAMMING EXAMPLES section for additional assistance.



LV/HV- The recommended settings for LV (low voltage) and HV (high voltage) depend on many 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 ±10% of the motor's nameplate voltage. The setting can be determined by multiplying the motor's nameplate voltage by the recommended percent over and under voltage. (e.g., The motor nameplate voltage is 230V, set LV to 0.9x230=207, set HV to 1.10x230=253)

NOTE: LV cannot be set higher than HV – HV may have to be adjusted higher before the proper LV setting can be programmed.

MULT- MULT is the multiplication factor for determining true current settings and represents the number of conductors passing through the main current window marked B, or current transformer ratio of external CTs. The appropriate number can be determined from Table 1 on page 1. **MULT must be correctly programmed in order to accurately program the current settings.**

OC- OC Represents the motor'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 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.

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 4 shows the trip classes and gives general application descriptions.

RD1- RD1 is the rapid-cycle timer. **It will engage when the motor is first powered-up and after the motor controls shut down the motor.** An RD1 setting of 20-30 seconds will generally protect the motor from rapid, successive power outages or short cycling caused by the motor controls. A setting of 0 seconds will allow the motor to start immediately after power-up or normal shutdown.

RD2- RD2 is the restart delay after the overload relay trips on overload. This delay allows the motor to cool down after experiencing an overcurrent. It is also known as a motor cool-down timer. The motor manufacturer should be contacted to determine this setting. Under normal circumstances, a setting of 5-10 minutes will 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 manual resetting. A setting of 0 is manual reset and a setting of A is continuously automatic reset.

#RO- #RO is the number of successive restart attempts allowed after an overcurrent fault. The following settings are available: 0, 1, 2, 3, 4 and A. A setting of 0 is manual reset and a setting of A is continuously automatic.

ADDR- ADDR is the address setting for RS-485 communications. Available settings are from A01 - A99. This setting is ignored if RS-485 communication is not used.

UCTD- UCTD is the undercurrent trip delay timer. This setting represents the maximum time the Model 77C will tolerate an undercurrent condition. Typically, UCTD is set to 2-4 seconds.

OPT1- OPT1 is the linear overcurrent trip delay (2-60 seconds). This programming position is used only if the TC position is set to "LIn." This setting will determine the period of time that will expire before tripping on overcurrent, after the amperage exceeds the OC setting (see programming example #2).

OPT2- OPT2 is the used to set RD2 and RD3 in seconds or minutes. (e.g., RD2=10, RD3=20, if OPT2=2 (from the table below), RD2=10 seconds and RD3=20 minutes.)

OPT2	RD2	RD3
0	Minutes	Minutes
1	Minutes	Seconds
2	Seconds	Minutes
3	Seconds	Seconds

Table 3: OPT2 Settings

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	Certain specialized applications
20	(Standard Trip) This setting will protect most NEMA-rated, general-purpose motors.
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% OC, regardless of trip class.
LIn	Programming the trip class to LIn disables the normal trip classes and enables a linear trip delay on overcurrent. The linear trip delay is set at program position OPT1.

Table 4: Trip Class Descriptions

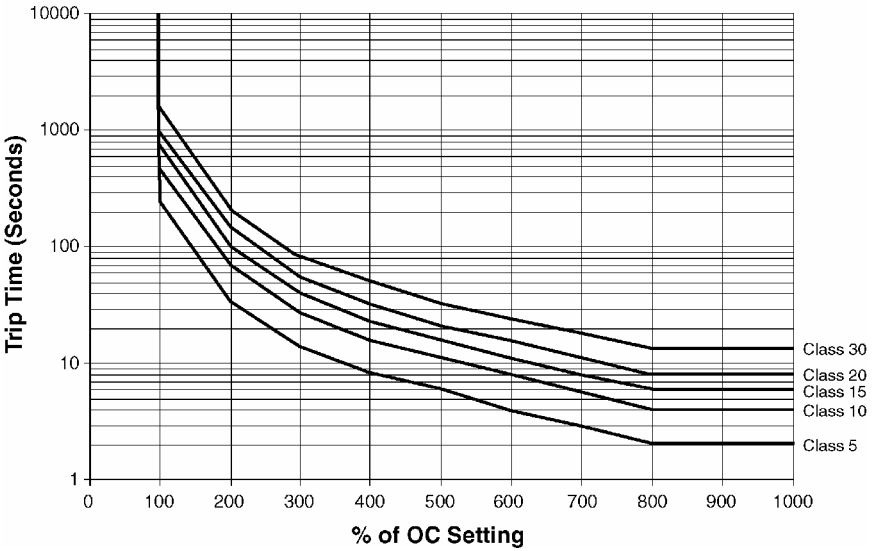


Figure 3: Overload Trip Curves

PROGRAMMING EXAMPLE

Motor to be protected: single-phase, 230V, 10hp raw material transfer auger. This auger moves material from a large bulk delivery pit to the production area main storage hopper. The motor has a full load amperage rating of 50 Amps and a maximum service factor of 57 Amps. Use the following calculations and reasoning to determine the appropriate settings for this application.

LV- 230 x 0.90 = 207

HV- 230 x 1.10 = 253

MULT - From Table 1; MULT = 1

OC- 57

UC- Since the motor current will unload at least 20% if a shaft shear pin breaks or the auger runs out of material, UC = 50A x 0.80 = 40

TC- Because the motor is a general purpose motor and the motor should be protected from being jammed by a foreign object, TC = J20

UCTD- 5-10 seconds (undercurrent trip delay)

RD1- To protect the motor from rapid successive power outages, RD1 = 20

RD2- N/A, see #RO setting.

RD3- N/A, see #RU setting.

#RU- Setting #RU to 0 will require a manual reset after an undercurrent trip. Therefore, RD3 has no affect in this application. This setting will allow the auger to be started, and left unattended, and will run until the delivery pit is empty. Pressing a remote reset button will start the auger for the next load.

#RO- Setting #RO to 0 will require a manual reset after an overcurrent trip. Therefore, RD2 has no affect.

ADDR- N/A

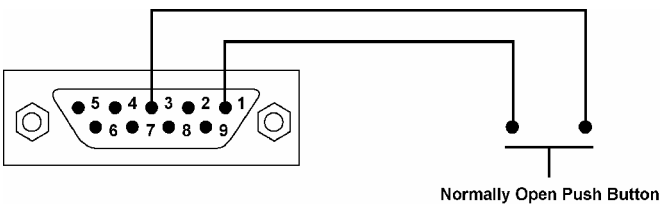
OPT1- N/A

OPT2- N/A

COMMUNICATIONS PORT / REMOTE RESET

The Model 77C comes standard with a 9-pin sub D connector for remote communications. The Model 77C supports RS-485 communication standard. This standard allows up to 99 Model 77Cs to be controlled and monitored from a single remote personal computer.
NOTE: An RS485MS-2W communications module and software are required to operate the communications bus. Refer to RS485MS-2W installation instructions for more information (available at www.symcominc.com).

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



TROUBLESHOOTING

Problem	Solution
Unit will not start - display alternates “HI” or “Lo” with the DISPLAY/PROGRAM dial parameter value	The incoming voltage is not within the limits programmed in the HV and LV settings. Adjust the DISPLAY/PROGRAM dial to read the incoming line voltage value. Correct the incoming power problem and check programmed limits to verify they are correct.
Display alternates “oc” with “run”	The overload relay has tripped on overcurrent and is timing down RD2 before restarting
Display alternates “uc” with “run”	The overload relay has tripped on undercurrent and is timing down RD3 before restarting. If underload is not a normal condition for this installation, check for broken shafts, broken belts, etc.
Display is showing a solid “oc”	The unit has tripped on overcurrent and a manual reset is required because of the programmed setting in #RO. Check the system for problems that would produce the overload fault, for example, a jam.
Display is showing a solid “uc”	The unit has tripped on undercurrent and a manual reset is required because of the programmed setting in #RU. Check the system for problems that would produce an underload condition like a broken belt or shear pin.
Unable to change parameter - setpoint bounces back to previous setting	Unlock tamper guard. See page 11.
Motor starts and stops a short time later but there is no fault indicator	Control circuit may be wired to NC relay rather than NO relay (see Figure 1, page 3).
Current readings are incorrect	Check MULT, CT ratio and/or number of wraps through the B current window.

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 adjustment. After the period of time programmed into RD1, the output contacts will close and the value of the parameter indicated by the DISPLAY / PROGRAM adjustment will appear on the LED display.

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

MODEL 77C SPECIFICATIONS

Electrical	
Input Voltage	100-240VAC, single-phase
Frequency	50/60 Hz
Motor Full Load Amp Range	2-25A (loops required) 25-90A (direct) 80-800A (external CTs)
Short Circuit	100kA per UL, 10kA per CSA
Power Consumption	10 Watts (max.)
Output Contact Rating SPDT (Form C)	Pilot duty rating: 480VA @ 240VAC General purpose: 10A @ 240VAC
Expected Life	
Mechanical	1 x 10^6 operations
Electrical	1 x 10^5 operations at rated load
Accuracy at 25° C (77° F)	
Voltage	±1%
Current	±3%(<100A direct, no external CT)
Timing	5% ±1 second
Repeatability	
Voltage	±0.5% of nominal voltage
Current	±1% (<100A direct, no external CT)
Safety Marks	
UL	UL508, UL1053
CE	IEC 60947-1, IEC 60947-5-1
Standards Passed	
Electrostatic Discharge (ESD) Radio Frequency Immunity (RFI), Conducted Radio Frequency Immunity (RFI), Radiated	IEC 1000-4-2, Level 3, 6kV contact, 8kV air IEC 1000-4-6, Level 3 10V/m IEC 1000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kV input power
Surge	
IEC	1000-4-5 Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
Mechanical	
Dimensions	3.0"H x 5.1 " D x 3.6"W
Terminal Torque	7 in.-lbs.
Enclosure Material	Polycarbonate
Weight	1.2 lbs.
Maximum Conductor Size Through 77C	0.65" with insulation
Environmental	
Temperature Range	Ambient Operating: -20° to 70° C (-4° to 158°F) Ambient Storage: -40° to 80° C (-40° to 176°F)
Pollution Degree	3
Class of Protection	IP20, NEMA 1
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Programmable Operating Points	**Range**
LV- Low Voltage Threshold	85V - HV Setting

HV- High Voltage Threshold	LV Setting - 264V
MULT- # of Conductors or CT Ratio (XXX:5)	1-10 Conductors or 100-800 Ratio
OC- Overcurrent Threshold	(20-100A) ÷ MULT or 80-120% of CT Primary
UC- Undercurrent Threshold	(0, 10-98A) ÷ MULT or 40-100% of CT Primary
TC- Overcurrent Trip Class **	5, J5, 10, J10, 15, J15, 20, J20, 30, J30
RD1- Rapid-Cycle Timer	0, 2-500 Seconds
RD2- Restart Delay After All Faults Except Undercurrent (motor cool-down timer)	2-500 Minutes/seconds
RD3- Restart Delay After Undercurrent (dry-well recovery timer)	2-500 Minutes/seconds
#RU- Number of Restarts After Undercurrent	0, 1, 2, 3, 4, A (Automatic)
ADDR- RS485 Address	A01- A99
#RO-Number of Restarts After Overcurrent	0, 1, 2, 3, 4, A (Automatic)
UCTD- Undercurrent Trip Delay	2-60 Seconds

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

*If J Prefix is displayed in trip class setting, jam protection is enabled. If programmed to LIn position, overcurrent trip delays are fixed linear time delays set in OPT1 position.

**RD2 & RD3 can be changed from minutes to seconds under program position OPT2.

CLEARING LAST FAULT

The last fault stored can be cleared on the PumpSaver®:

1. Rotate MODE SELECT to OPT2.
2. Press and hold RESET/PROGRAM.
3. Adjust DISPLAY/PROGRAM until “cLr” appears on the display.
4. Release RESET/PROGRAM.

To verify the last fault was cleared, turn MODE SELECT to RUN. Press and hold RESET/PROGRAM – “cLr” should be on the display.

TAMPER GUARD

The PumpSaver® can be protected from unauthorized program changes by locking the setpoints.

1. Rotate MODE SELECT to OPT2
2. Press and hold the RESET button. Adjust DISPLAY/PROGRAM until ”Loc” appears on the display.
3. Release the RESET button.
4. Turn MODE SELECT to RUN.

The program is now locked, but all settings can be viewed. The unit can be unlocked by following the procedure above except step three; adjust DISPLAY/PROGRAM until “unL” appears.

NOTES:

1) If a setting jumps back to its previous setpoint when changed, the tamper guard is locked.
2) The state of the tamper guard cannot be viewed directly.

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