



## ENGINEERING SPECIFICATION

### SYMCOM MODEL 777-FT Electronic Overload Relay

#### PART 1 GENERAL

##### 1.1 REFERENCES

- A. UL 508 Industrial Control Equipment – Underwriters Laboratories
- B. IEC 60947 Low Voltage Switchgear and Controlgear – International Electrotechnical Commission
- C. CSA C22.2 No. 14 Industrial Control Equipment – Canadian Standards Association
- D. ANSI/IEEE C62.41 – American National Standards Institute/Institute of Electrical & Electronics Engineers
- E. MODBUS over Serial Line Specification and Implementation Guide V1.02
- F. UL 1053 Ground-Fault Sensing and Relaying Equipment – Underwriters Laboratories

##### 1.2 WARRANTY

- A. Manufacturer Warranty: The manufacturer shall guarantee the overload relay to be free from material and workmanship defects for a period of five years from the date of manufacture when installed and operated according to the manufacturer's requirements.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

The equipment specified shall be the Model 777-FT, manufactured by SymCom, Inc.

##### 2.2 DESCRIPTION

- A. Regulatory Requirements:
  1. The equipment shall be UL Listed as type NKCR—Industrial Control Equipment-Motor Controllers-Auxiliary Devices.
  2. The equipment shall be ULC Listed as type NKCR7—Industrial Control Equipment-Motor Controllers-Auxiliary Devices Certified for Canada.
  3. The equipment shall be CE marked for use in the European Union and evaluated against IEC 60947 Low Voltage Switchgear and Controlgear.
  4. The equipment shall be CSA certified as class 3211-03—Industrial Control Equipment-Motor Controllers-Auxiliary Devices.

##### 2.3 PERFORMANCE/DESIGN CRITERIA: 3-PHASE ELECTRONIC OVERLOAD RELAY

- A. Protective Relay Functions
  1. The equipment shall provide protection against the following conditions:
    - a. voltage single phase/phase loss
    - b. phase reversal
    - c. low voltage
    - d. high voltage
    - e. voltage unbalance
    - f. rapid cycling to prevent on-off cycling of the motor in rapid succession
    - g. undercurrent
    - h. overcurrent
    - i. current unbalance
    - j. current single phase/phase loss
    - k. ground fault
    - l. contact failure, to trip the motor, if the motor starter is damaged which causes a current single phase.
- B. Communication Capabilities
  1. The equipment shall provide Modbus RTU communications capabilities when combined with the appropriate SymCom network communications modules. Visit [www.symcom.com](http://www.symcom.com) for the current list of communication modules.
  2. The equipment interface shall have the capability of connecting to the following systems:
    - a. MMI (Man Machine Interface)
    - b. SCADA (Supervisory Control and Data Acquisition) programs.
    - c. DCS (Distributed Control System)
    - d. PLC (Programmable Logic Controllers)
  3. The equipment shall support 9600 baud, Even parity, and 1 stop bit.
  4. The equipment shall provide set points that are readable and writable via the Modbus interface.
  5. The equipment shall provide the ability to energize and de-energize the motor via the Modbus interface.
  6. The equipment shall provide a 10-second Modbus network watchdog to trip the relay when Modbus communication is lost.



C. Network Capabilities

1. The equipment shall provide registers to read the following real-time values:
  - a. L1-L2 line voltage
  - b. L2-L3 line voltage
  - c. L3-L1 line voltage
  - d. Average line voltage
  - e. Phase A current
  - f. Phase B current
  - g. Phase C current
  - h. Average phase current
  - i. Voltage unbalance
  - j. Current unbalance
  - k. Current multiplier
  - l. Power factor
  - m. Ground fault current
  - n. Restart Delay 1 (RD1) Time Remaining
  - o. Restart Delay 2 (RD2) Time Remaining
  - p. Restart Delay 3 (RD3) Time Remaining
  - q. Power in KW
  - r. Trip status of the following:
    - 1) Manual reset status
    - 2) Network off command status
    - 3) Contact failure
    - 4) Undercurrent
    - 5) Overcurrent
    - 6) Ground fault
    - 7) Current unbalance
    - 8) Current single phase
  - s. Status of the following:
    - 1) Low voltage pending
    - 2) High voltage pending
    - 3) Voltage unbalance pending
    - 4) Undercurrent pending
    - 5) Reverse phase pending
    - 6) Current unbalance pending
    - 7) Voltage single phase pending
    - 8) Current single phase pending
    - 9) Over current pending
    - 10) Ground fault pending
    - 11) Relay status
  - t. Last fault 1
  - u. Last fault 2
  - v. Last fault 3
  - w. Last fault 4
  - x. Unit ID
  - y. Model code
  - z. Motor run hours
2. The equipment shall provide the following readable/writable setpoints:
  - a. Low voltage trip point
  - b. High voltage trip point
  - c. Voltage unbalance trip point
  - d. Current multiplier, used to scale the current reading properly when Current Transformers (CTs) or amp turns are used.
  - e. Overcurrent trip point
  - f. Undercurrent trip point
  - g. Current unbalance trip point
  - h. Trip class setpoint
  - i. Restart delay 1 setpoint
  - j. Restart delay 2 setpoint
  - k. Restart delay 3 setpoint
  - l. Number of restarts after an undercurrent fault (#RU) setpoint
  - m. Number of restarts after a fault (#RF) setpoint
  - n. Undercurrent trip delay setpoint
  - o. Ground fault trip point
  - p. Modbus address setpoint
  - q. Trip enable setpoint to enable the following:
    - 1) Ground Fault trip
    - 2) Voltage Unbalance trip
    - 3) Current Unbalance trip



- 4) Undercurrent trip
- r. Command line to respond to the following commands:
  - 1) Network program enable
  - 2) Network program disable
  - 3) Clear run hours
  - 4) Clear fault history
  - 5) Enable network watchdog
  - 6) Disable network watchdog
  - 7) Start the motor
  - 8) Stop the motor

#### D. Capabilities and Features

1. Inputs
  - a. The equipment shall require a 3-phase input voltage of 200-480 VAC.
  - b. The equipment shall require no external CT's for motors with full load current ratings between 2 and 90 amps.
  - c. The equipment shall require external CT's for motors with full load current ratings greater than 90 amps.
  - d. The equipment shall accept full load current of 2-800 amps.
  - e. The equipment shall require a 3-phase 50/60 Hz input voltage.
  - f. The equipment shall provide connection to an external remote reset switch.
2. Outputs
  - a. The equipment shall include one Form C (SPDT) output relay. Contacts pilot duty rated 480VA@240VAC. Contacts general purpose rated 10A@240VAC.
3. Functional Specifications
  - a. The equipment shall include the following front panel setpoint ranges:
    - 1) an adjustable low voltage (LV) setpoint range of 170-524VAC
    - 2) an adjustable high voltage (HV) setpoint range of 172-528VAC
    - 3) an adjustable voltage unbalance (VUB) setpoint range of 2-15% or 999 (disabled)
    - 4) an adjustable multiplier (MULT) setpoint range of 1-10, 100, 150, 200, 300, 400, 500, 600, 700, 800
    - 5) an adjustable overcurrent (OC) setpoint range of (20-100A) ÷ MULT or 80-120% of CT Primary
    - 6) an adjustable undercurrent (UC) setpoint range of (0, 10-98A) ÷ MULT or 40-100% of CT Primary
    - 7) an adjustable current unbalance (CUB) setpoint range of 2-25% or 999 (disabled)
    - 8) an adjustable trip class (TC) setpoint range of 05,J05,10,J10,15,J15,20,J20,30,J30, J00 (fast linear trip mode)
    - 9) an adjustable rapid-cycle timer 1 (RD1) of 0-500 seconds (x 0.5 if TC = J00)
    - 10) an adjustable motor acceleration (MA) timer of (0-250) x 0.158 seconds
    - 11) an adjustable motor cool-down timer (RD2) of 2-500 minutes (x 0.5 if TC = J00)
    - 12) an adjustable overcurrent trip delay of (2-250) x 0.158 seconds
    - 13) an adjustable undercurrent restart delay timer (RD3) of 2-500 minutes (x 0.5 if TC = J00), A (automatic)
    - 14) an adjustable number of restarts after undercurrent (#RU) setpoint range of 0-4, A (automatic)
    - 15) an adjustable device communication address (ADDR) setpoint range of A01-A99
    - 16) an adjustable number of restarts after all other faults (#RF) setpoint range of 0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, or ocA, where an oc prefix means that over current trips are included in the restart counts, otherwise over current is not included
    - 17) an adjustable undercurrent trip delay (UCTD) setpoint range of 2-60 seconds
    - 18) an adjustable ground fault current (GF) setpoint range of (3-20A) ÷ MULT or 10-30% of CT Primary or oFF
  - b. The equipment shall provide ground fault protection that meets UL1053 requirements.
  - c. The equipment shall provide three independent adjustable restart delays, one for power-up and rapid-cycle protection, one for overcurrent, current unbalance and current single phasing (contact failure), and another one for undercurrent faults.
  - d. The equipment shall provide an undercurrent trip delay.
  - e. The equipment shall allow manual or automatic restart after a fault.
  - f. The equipment shall have the ability to display the last fault that caused the relay to trip off.
  - g. The equipment shall provide a jam feature that trips the relay if any current phase exceeds 400% of the OC setpoint, 1 minute after start up.
  - h. The equipment shall provide a method to enable/disable the following trip conditions:
    - 1) Ground Fault
    - 2) Voltage Unbalance
    - 3) Current Unbalance
    - 4) Undercurrent
  - i. The equipment shall provide a motor run hour meter.
  - j. The equipment shall provide a front panel tamper guard, to prevent accidental setpoint changes.
  - k. The equipment shall provide the ability to clear the last fault using the front panel.
  - l. The equipment shall provide automatic restart timing after undercurrent when RD3 is set to A as follows:
    - 1) Run time >1 hr the next restart delay will be 6 minutes
    - 2) Run time 30-59.99 minutes the next restart delay will be 15 minutes
    - 3) Run time 15-29.99 minutes the next restart delay will be 30 minutes



- 4) Run time <15 minutes the next restart delay will be 60 minutes

E. Timing Requirements

1. The equipment shall provide a ground fault trip delay that follows an inverse time curve with a maximum trip time of 8 seconds and a minimum trip time of 2 seconds.
2. The equipment shall provide a current unbalance trip delay that follows an inverse time curve with a maximum trip time of 30 seconds and a minimum trip time of 2 seconds.
3. The equipment shall provide an overload trip time that follows an inverse time trip curve.

F. Accuracy Requirements

1. The equipment shall provide a timing accuracy on all timers of 5%  $\pm$ 1 second.
2. The equipment shall provide a current measurement accuracy of  $\pm$ 3% for currents <100 amps direct for A, B, C phase currents.
3. The equipment shall provide a ground fault current measurement accuracy of  $\pm$ 15% for currents <100 amps direct.
4. The equipment shall provide a voltage measurement accuracy of  $\pm$ 1%.

G. Human Interface Features

1. The equipment shall provide an adjustment dial to set the following setpoints:
  - a. Low Voltage (LV)
  - b. High Voltage (HV)
  - c. Voltage Unbalance (VUB)
  - d. Multiplier (MULT)
  - e. Overcurrent (OC)
  - f. Undercurrent (UC)
  - g. Current Unbalance (CUB)
  - h. Trip Class (TC)
  - i. Rapid-Cycle Timer (RD1)
  - j. Motor Acceleration (MA)
  - k. Motor Cool-Down Timer (RD2)
  - l. Overcurrent Trip Delay (OCTD)
  - m. Undercurrent Restart Delay Timer (RD3)
  - n. Number Of Restarts After Undercurrent (#RU)
  - o. Device Communication Address (ADDR)
  - p. Number Of Restarts After Other Faults (#RF)
  - q. Undercurrent Trip Delay (UCTD)
  - r. Ground Fault (GF)
2. The equipment shall provide an adjustment dial to view the following runtime information:
  - a. L1-L2 line voltage
  - b. L2-L3 line voltage
  - c. L3-L1 line voltage
  - d. Average line voltage
  - e. A phase current
  - f. B phase current
  - g. C phase current
  - h. Average phase current
3. The equipment shall provide a 3-digit 7-segment display for viewing operating parameters of the device.
4. The equipment shall provide a push button switch for the following functions:
  - a. Programming the device
  - b. Viewing the last fault
  - c. Resetting the device after a fault
  - d. Resetting the device during a restart delay

H. Electromagnetic Compatibility

1. The equipment shall be immune to electrostatic discharge per IEC 61000-4-2, Level 3, 6kV contact discharge and 8kV air discharge.
2. The equipment shall be immune to electrical fast transient bursts exceeding IEC 61000-4-4, Level 3. Specified limits shall be 3.5kV input power.
3. The equipment shall be immune to electrical surges per IEC 61000-4-5, Level 3. Specified limits shall be 2kV line-to-line; Level 4, 4kV line-to-ground.
4. The equipment shall be immune to surge and ring wave per ANSI/IEEE C62.41. Specified limits shall be 6kV line-to-line.
5. The equipment shall be immune to radiated radio frequency emissions per IEC 61000-4-3, Level 3. Specified limits shall be 10V/m.
6. The equipment shall be immune to conducted radio frequency emissions per IEC 61000-4-6, Level 3. Specified limits shall be 10V.



- I. Vibration/Shock Requirements
  - 1. The equipment shall withstand vibrations per IEC 68-2-6. Specified limits shall be 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis.
  - 2. The equipment shall withstand shocks per IEC 68-2-27. Specified limits shall be 30g, 3 axis, 11ms duration, half-sine pulse.
- J. Dielectric Isolation: Equipment withstands an alternating current potential of 1000V plus twice the rated voltage of the equipment for 1 minute without breakdown between uninsulated live parts and the enclosure with the contacts open and closed; between terminals of opposite polarity with the contacts closed; and between uninsulated live parts of different circuits.
- K. Enclosure Class of Protection: The equipment shall provide IEC IP20 (finger safe) protection.
- L. Short Circuit Requirements
  - 1. The equipment shall provide a short circuit rating of 100kA.
- M. Environmental Requirements
  - 1. The equipment shall operate continuously without de-rating in ambient temperatures of -20° to 70°C (-4° to 158°F).
  - 2. The equipment shall operate continuously without de-rating in relative humidity of up to 95% non-condensing per IEC 68-2-3.
  - 3. The equipment shall operate properly after storage in ambient temperatures of -40° to 80°C (-40° to 176°F).
- N. Dimensions: The equipment dimensions shall not exceed 3.0" in height X 3.6" in width X 5.1" in depth.
- O. Mounting:
  - 1. The equipment shall be mountable on standard 35 mm DIN rail.
  - 2. The equipment shall be surface mountable on a backplane.
- P. Conformal coating:
  - 1. The equipment shall contain harsh environment conformal coating to help extend product life and to protect from hostile environments including moisture, temperature variations, salt spray, organic attack (fungus), and aggressive chemicals and vapors.

End of Section