ENGINEERING SPECIFICATION

SYMCOM MODEL 777-MV-P2

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 equipment 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-MV-P2, 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
            g. Undercurrent
            h. Overcurrent
            i. Current unbalance
            j. Current single-phase/phase loss
            k. Low control voltage
            l. Ground fault
            m. Contact failure
            n. Low power
            o. High power

    B. Communication Capabilities

        1. The equipment shall provide the following communications capabilities when combined with the appropriate SymCom network communications modules (Visit www.symcom.com for the current list of communication modules):
            a. Modbus RTU
            b. Modbus TCP
            c. DeviceNet™
            d. Profibus

        2. The equipment interface shall have the capability of connecting to the following systems:
            a. HMI (Human-Machine Interface)
            b. SCADA (Supervisory Control and Data Acquisition)

      c.   DCS (Distributed Control System)
      d.   PLC (Programmable Logic Controllers)
      e.   SymCom Model RM-1000 Modbus remote display
      f.   SymCom Model RM-2000 Modbus remote display

3. The equipment shall support the following communication parameters:
      a.   9600 baud, Even parity, and 1 stop bit
      b.   9600 baud, Odd parity, and 1 stop bit
      c.   9600 baud, No parity, and 1 stop bit
      d.   19200 baud, Even parity, and 1 stop bit
      e.   19200 baud, Odd parity, and 1 stop bit
      f.   19200 baud, No parity, and 1 stop bit

4. The equipment shall provide setpoints that are readable and writable via the Modbus RTU, Modbus TCP and DeviceNet™ interfaces.

5. The equipment shall provide the ability to energize and de-energize the relay via the Modbus RTU, Modbus TCP, Profibus and DeviceNet™ interfaces

6. The equipment shall provide a Modbus network watchdog with a 10-second trip delay to trip the relay when Modbus communication is lost.

7. The equipment shall provide two programmable Modbus assemblies for reading large blocks of data.

8. The equipment shall provide configurable bus pre-bias/pre-polarization and post-bias/post –polarization on either side of the RS-485 transmission eliminating the need for a biasing terminator.

9. The equipment shall provide an 8 bit Modbus memory map.

10. The equipment shall provide a 16 bit Modbus memory map.

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 scale factor
      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
          9)   Low control voltage
          10)   Low power
          11)   High power
      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)   Overcurrent pending
          10)   Ground fault pending
          11)   Low control voltage pending
          12)   ABC/CBA phase rotation

        13)   Global warning
        14)   Relay status
        15)   Low power pending
        16)   High power pending
t.   Last fault 1
u.   Last fault 2
v.   Last fault 3
w.   Last fault 4
x.   Last fault 5
y.   Last fault 6
z.   Last fault 7
aa.   Last fault 8
bb.   Last fault 9
cc.   Last fault 10 (oldest fault)
dd.   Unit ID
ee.   Model code
ff.   Software revision
gg.   Thermal capacity remaining
hh.   Start count
ii.   Start duration 1
jj.   Start duration 2
kk.   Start duration 3
ll.   Start duration 4
mm. Warning status of the following:
        1)   Low voltage warning
        2)   High voltage warning
        3)   Voltage unbalance warning
        4)   Overcurrent warning
        5)   Undercurrent warning
        6)   Current unbalance warning
        7)   Ground fault warning
        8)   Low frequency warning
        9)   High frequency warning
        10)   High power warning
        11)   Low power warning
nn.   Line frequency
oo.   OC Time to trip

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) are used.
e.   Current divisor, used to scale the current reading properly when amp turns are used.
f.   Overcurrent trip point
g.   Undercurrent trip point
h.   Current unbalance trip point
i.   Trip class setpoint
j.   Restart Delay 1 setpoint
k.   Restart Delay 2 setpoint
l.   Restart Delay 3 setpoint
m.   Number of restarts after an undercurrent fault (#RU) setpoint
n.   Number of restarts after a fault other than undercurrent (#RF) setpoint
o.   Undercurrent trip delay setpoint
p.   Ground fault trip point
q.   Modbus address setpoint
r.   Network status setpoint to enable the following features:
        1)   Network watchdog
        2)   Network program disable
        3)   Front panel lock
s.   Communication parameters setpoint to set the following:
        1)   9600 baud, Even parity, and 1 stop bit
        2)   9600 baud, Odd parity, and 1 stop bit
        3)   9600 baud, No parity, and 1 stop bit
        4)   19200 baud, Even parity, and 1 stop bit
        5)   19200 baud, Odd parity, and 1 stop bit
        6)   19200 baud, No parity, and 1 stop bit
        7)   Enable/disable front porch
        8)   Enable/disable back porch
t.   Trip enable setpoint to enable the following:
        1)   Ground fault trip

2) Voltage unbalance trip
3) Current unbalance trip
4) Undercurrent trip
5) Overcurrent trip
6) Low power trip
7) High power trip
u. Motor run hours
v. Low control voltage trip delay
w. Low control voltage trip percentage
x. Configuration control setpoint to set the following options:
1) Undercurrent Trip Delay in minutes or seconds
2) Restart Delay 1 in minutes or seconds
3) Restart Delay 2 in minutes or seconds
4) Restart Delay 3 in minutes or seconds
5) High power trip delay in minutes or seconds
6) Zero L2 and L3 voltage readings
7) Single-phase voltage monitoring
8) Single-phase current monitoring
9) Disabled reverse-phase protection
10) Enable low control voltage trips
11) Enable stall 1
12) Enable stall 2
13) CBA phase rotation is not a fault
14) RD1 is loaded on power-up
15) RD1 is loaded on current loss
16) Enable emergency run
y. Linear overcurrent trip delay
z. Current unbalance trip delay
aa. Motor acceleration enable setpoint for the following faults:
1) Contact failure
2) Undercurrent/low power
3) Ground fault
4) Current unbalance
5) Current single-phase
6) Low control voltage
7) High power
bb. Motor acceleration trip delay
cc. Hot overcurrent percentage, increases the thermal capacity consumption rate by this percentage, 1 minute after motor start-up.
dd. 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
ee. Modbus back door address
ff. Warning enable setpoint to enable the following warnings:
1) Low voltage warning
2) High voltage warning
3) Voltage unbalance warning
4) Overcurrent warning
5) Undercurrent warning
6) Current unbalance warning
7) Ground fault warning
8) Low frequency warning
9) High frequency warning
10) High power warning
11) Low power warning
gg. Warning level setpoint to set the desired warning level:
1) Low voltage warning level
2) High voltage warning level
3) Voltage unbalance warning level
4) Overcurrent warning level
5) Undercurrent warning level
6) Current unbalance warning level
7) Ground fault warning level
8) Low power warning level

                    9)   High power warning level
                    10)   High frequency warning level
                    11)   Low frequency warning level
              hh.   Warning delay enable setpoint to enable the following warning delay:
                    1)   Low voltage warning delay
                    2)   High voltage warning delay
                    3)   Voltage unbalance warning delay
                    4)   Overcurrent warning delay
                    5)   Undercurrent warning delay
                    6)   Current unbalance warning delays
                    7)   Ground fault warning delay
                    8)   Low power warning delay
                    9)   High power warning delay
              ii.   Stall 1 trip delay
              jj.   Stall 1 trip inhibit delay
              kk.   Stall 1 trip percentage
              ll.   Stall 2 trip delay
              mm.   Stall 2 trip inhibit delay
              nn.   Stall 2 trip percentage
              oo.   Ground fault trip delay
              pp.   Voltage faults enable setpoint for the following faults:
                    1)   Low voltage enable
                    2)   High voltage enable
                    3)   Voltage unbalance enable
                    4)   Reverse-phase enable
                    5)   Voltage single-phase enable
              qq.   Ground fault scale factor
              rr.   Fault count
              ss.   Modbus assembly 500 words 1-37
              tt.   Modbus assembly 501 words 1-23

   D.   Capabilities and Features

        1.   Inputs
             a.   The equipment shall require external CT's
             b.   The equipment shall accept full load current rating 10-800Amps.
             c.   The equipment shall accept a 3-phase input voltage 100-240VAC.
             d.   The equipment shall accept a single-phase input voltage 100-240VAC.
             e.   The equipment shall accept a 3-phase input voltage 50/60 Hz.
             f.   The equipment shall accept a single-phase input voltage 50/60 Hz.
             g.   The equipment shall provide a connection to an optional external remote reset switch.
             h.   The equipment shall provide a connection to a 9V battery used for programming without line power.

        2.   Outputs
             a.   The equipment shall include SPDT output relay contacts pilot duty rated 480VA @ 240VAC.
             b.   The equipment shall include SPDT output relay contacts general purpose rated 10A @ 240VAC.

        3.   The equipment shall include the following front panel setpoint ranges:
             a.   an adjustable low voltage (LV) setpoint range of 85-262VAC
             b.   an adjustable high voltage (HV) setpoint range of 86-264VAC
             c.   an adjustable multiplier (MULT) setpoint range of 25, 50, 75, 100, 150, 200, 300, 400, 500, 600, 700, 800
             d.   an adjustable overcurrent (OC) setpoint range of 10-999
             e.   an adjustable undercurrent (UC) setpoint range of 0, 5-999
             f.   an adjustable ground fault current (GF) setpoint range of either 6-40% of CT Primary or OFF
             g.   an adjustable voltage unbalance (VUB) setpoint range of 2-25% or 999 (disabled)
             h.   an adjustable current unbalance (CUB) setpoint range of 2-50% or 999 (disabled)
             i.   an adjustable trip class (TC) setpoint range of 02-60 or J2-J60 and L00-L60, or oFF
             j.   an adjustable rapid-cycle timer 1 (RD1) of 0-999 seconds or 0 to 546 minutes
             k.   an adjustable motor cool-down timer (RD2) of 2-500 minutes or 2-500 seconds
             l.   an adjustable undercurrent restart delay timer (RD3) of 2-500 minutes or 2-500 seconds or A (automatic)
             m.   an adjustable number of restarts after undercurrent (#RU) setpoint range of 0-4, A (automatic)
             n.   an adjustable device communication address (ADDR) setpoint range of A01-A99
             o.   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 overcurrent trips are included in the restart counts, otherwise overcurrent is not
                   included.
             p.   an adjustable communications parameter (COMM) set to C00-C07
             q.   an adjustable undercurrent trip delay (UCTD) setpoint range of 2-999 seconds or 2-546 minutes

        4.   The equipment shall provide ground fault protection that meets UL1053 requirements.

        5.   The equipment shall provide three independent adjustable restart delays, one for power-up and rapid-cycle protection,
             one for overcurrent, current unbalance, current single-phasing, low control voltage and high power faults and another one
             for undercurrent and low power faults.

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6. The equipment shall provide RD1 to be configured as follows:
   a. RD1 is rapid-cycle and power-up timer
   b. RD1 is only a power-up timer
   c. RD1 is only a rapid-cycle timer
   d. RD1 is disabled

7. The equipment shall provide an undercurrent/low power trip delay.

8. The equipment shall provide an overcurrent trip delay

9. The equipment shall provide a current unbalance trip delay.

10. The equipment shall provide a configurable high power trip delay.

11. The equipment shall provide a configurable ground fault trip delay.

12. The equipment shall provide for manual or automatic restart after a fault.

13. The equipment shall display the last trip fault.

14. The equipment shall provide two independent jam/stall timers that trip the relay providing overcurrent protection in the case of jam or stall events.
    a. Each timer shall have an independent adjustable inhibit time.
    b. Each timer shall have an independent adjustable trip delay.
    c. Each timer shall have an independent adjustable overcurrent trip level.

15. The equipment shall provide a motor acceleration delay to prevent tripping on motor startup for the following faults:
    a. Contact failure
    b. Undercurrent/low power
    c. Ground fault
    d. Current unbalance
    e. Current single-phase
    f. Low control voltage
    g. High power

16. The equipment shall provide a motor start counter.

17. The equipment shall provide a fault counter.

18. The equipment shall store the last 10 motor faults.

19. The equipment shall record the duration of the last four motor run times in minutes

20. The equipment shall provide a linear overcurrent trip delay.

21. The equipment shall provide a method to enable/disable the following trip conditions:
    a. Ground fault
    b. Voltage unbalance
    c. Current unbalance
    d. Undercurrent
    e. Overcurrent
    f. Low Power
    g. High Power

22. The equipment shall provide a motor run hour meter.

23. The equipment shall provide a front panel tamper guard, to prevent accidental setpoint changes.

24. The equipment shall provide the ability to clear the last fault using the front panel.

25. The equipment shall provide a hot overcurrent percentage, which increases the thermal capacity consumption rate by this percentage, 1 minute after motor start-up.

26. The equipment shall provide the ability to set the communication parameters using the front panel.

27. The equipment shall provide an indication of the time left before tripping on an overcurrent fault.

28. The equipment shall provide automatic restart timing after undercurrent when RD3 is set to A as follows:
    a. Run time >1 hr the next restart delay will be 6 minutes
    b. Run time 30-59.99 minutes the next restart delay will be 15 minutes
    c. Run time 15-29.99 minutes the next restart delay will be 30 minutes
    d. Run time <15 minutes the next restart delay will be 60 minutes

29. The equipment shall provide warning indication for the following conditions:
    a. Low voltage
    b. High voltage
    c. Voltage unbalance
    d. Overcurrent
    e. Undercurrent
    f. Current unbalance
    g. Ground fault
    h. Low frequency
    i. High frequency
    j. High power
    k. Low power

30. The equipment shall provide independent warning levels for the following warnings:
    a. Low voltage warning
    b. High voltage warning
    c. Voltage unbalance warning
    d. Overcurrent warning
    e. Undercurrent warning
    f. Current unbalance warning
    g. Ground fault warning
    h. Low frequency warning
    i. High frequency warning
    j. High power
    k. Low power
31. The equipment shall provide independent warning delays for the following warnings:
    a. Low voltage warning
    b. High voltage warning
    c. Voltage unbalance warning
    d. Overcurrent warning
    e. Undercurrent warning
    f. Current unbalance warning
    g. Ground fault warning
    h. High power
    i. Low power
32. The equipment shall provide line frequency measurements.
33. The equipment shall provide a method to disable the following voltage faults:
    a. Low voltage enable
    b. High voltage enable
    c. Voltage unbalance enable
    d. Reverse-phase enable
    e. Voltage single-phase enable
34. The equipment shall be able to set either ABC or CBA phase rotation as a fault.

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 overcurrent trip delay time that follows an inverse time trip curve.

F. Accuracy Requirements

1. The equipment shall provide a timing accuracy on all timers of ±0.5 second.

2. The equipment shall provide a current measurement accuracy of ±3% for currents <100 amps direct for A, B, C phase currents.

3. The equipment shall provide a voltage measurement accuracy of ±1%.

4. The equipment shall provide a ground fault measurement accuracy of ±15% (< 100A)

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 Cool Down Timer (RD2)
    k. Undercurrent Restart Delay Timer (RD3)
    l. Number Of Restarts After Undercurrent (#RU)
    m. Device Communication Address (ADDR)
    n. Number Of Restarts After Other Faults (#RF)
    o. Communications setting (COM)
    p. Undercurrent Trip Delay (UCTD)
    q. 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. Measured voltage unbalance
e. A phase current
f. B phase current
g. C phase current
h. Measured current unbalance
i. Measured ground fault 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
e. Activate emergency run

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 radiated radio frequency emissions per IEC 61000-4-3, Level 3. Specified limits shall be 10V/m.

3. The equipment shall be immune to conducted radio frequency emissions per IEC 61000-4-6, Level 3. Specified limits shall be 10V.

4. 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.

5. The equipment shall be immune to electrical surges per IEC 61000-4-5, Level 3. Specified limits shall be 2kV line-to-line and Level 4, 4kV line-to-ground.

6. The equipment shall be immune to surge and ring wave per ANSI/IEEE C62.41. Specified limits shall be 6kV line-to-line.

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. Enclosure Class of Protection: The equipment shall provide IEC IP20 (finger-safe) protection.

K. Short Circuit Requirements

1. The equipment shall provide a short circuit rating of 100kA.

L. Environmental Requirements

1. The equipment shall operate continuously without derating in ambient temperatures of -20° to 70°C (-4° to 158°F).

2. The equipment shall operate continuously without derating 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).

M. Dimensions: The equipment dimensions shall not exceed 3.0" in height X 3.6" in width X 5.1" in depth.

N. Mounting:

1. The equipment shall be mountable on standard 35mm DIN rail.

2. The equipment shall be surface mountable.

O. 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