CM-1
CIRCUIT MONITORING SYSTEM

NELSON HEAT TRACE

EMERSON

TABLE OF CONTENTS

GENERAL INFORMATION

The Nelson CM-1 Circuit Monitor is a scanning microprocessor system which sequentially monitors and displays each circuit number and the status of each circuit.

The CM-1 is environmentally hardened and requires no protected operative environment. It can be located in a control room or out in a plant. The low voltage, optically isolated design allows the unit to be installed in Division 2 Hazardous Locations.

The CM-1 monitoring system:

- Monitors electrical characteristics of each heater circuit, including voltage, amperage, & continuity.
- Is totally passive.
- Has built in filters to eliminate false alarms due to electrical noise.
- Monitors self-regulating, constant voltage, & series types of heaters.
- Independent of control scheme - will work with ambient or pipe sensed systems.
- Can be retrofitted into existing systems.

The main components of the system include:

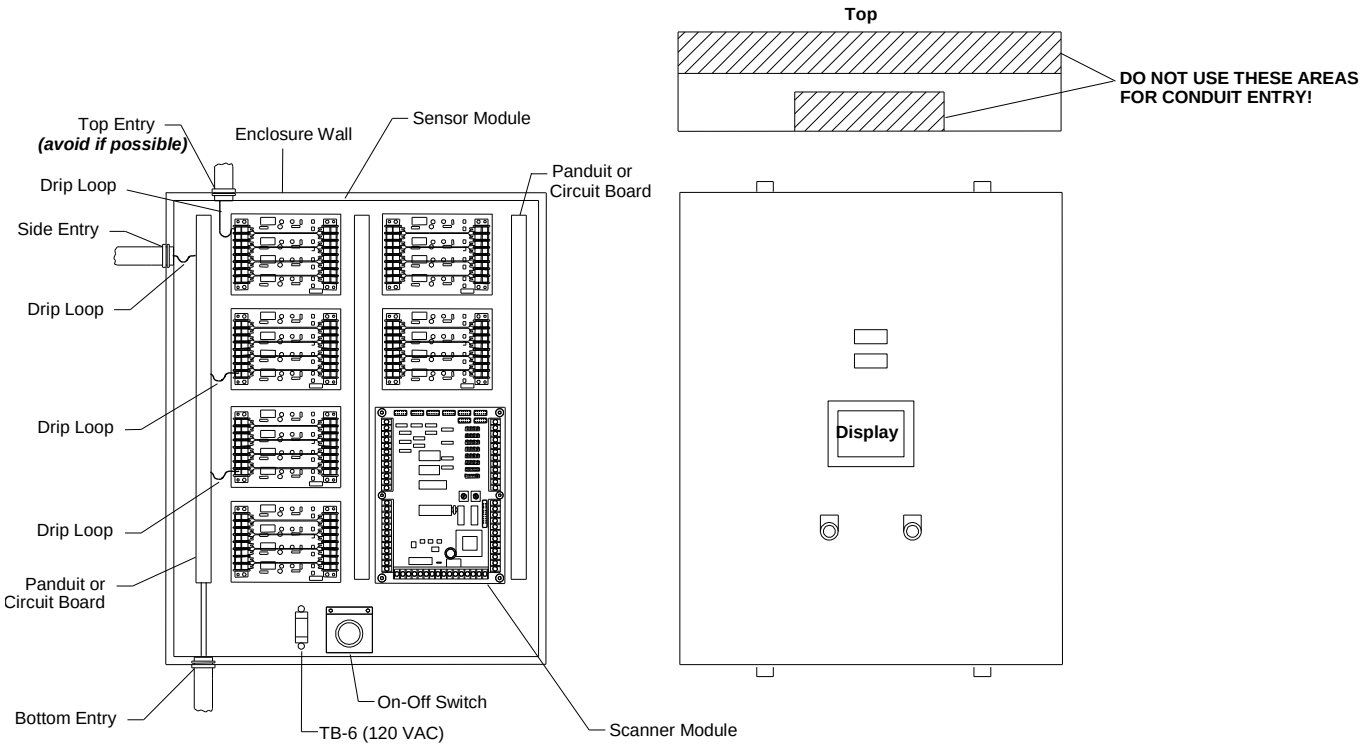
- A microprocessor based scanner that interrogates all circuit sensor cards and compares the data to its programmed parameters. The maximum number of circuits monitored is 24.
- Sensor Card - the sensor card contains the circuitry for 4 heater circuits. Six cards are supplied in a 24 circuit system. The sensor card monitors the current and voltage to each circuit and is interrogated by the scanner.
- Display - the display shows what circuit is being monitored (.5" readouts). The status of the heater cable controller is displayed. The L.E.D. bar lights display continuity, current and voltage status of each circuit.
- Continuity Monitor Device (CMD) - The CMD is a passive component. Parallel type cables require the attachment of a CMD at the end of each circuit. The microprocessor looks for the device's presence every time a parallel circuit is scanned to verify continuity of both bus wires. The CMD draws a low level capacitive current when connected.

INSTALLATION

When routing conduit to the panel, avoid top entry into the CM-1 enclosure. Top conduit entry provides a potential moisture path to the electronic circuit boards. Bottom conduit entry is recommended. If top entry cannot be avoided, avoid the area directly over the circuit boards. Drip loops as shown are recommended for side and top entry when they cannot be avoided. A drip loop is a dip or bend in the circuit wire to block or shed moisture, which may follow a wire to the circuit boards.

⚠ WARNING:

Moisture intrusion can damage the CM-1 electronic circuit boards. Do not place conduit entry directly over the circuit boards.



CM-1 Conduit / Wiring Entry for Enclosure

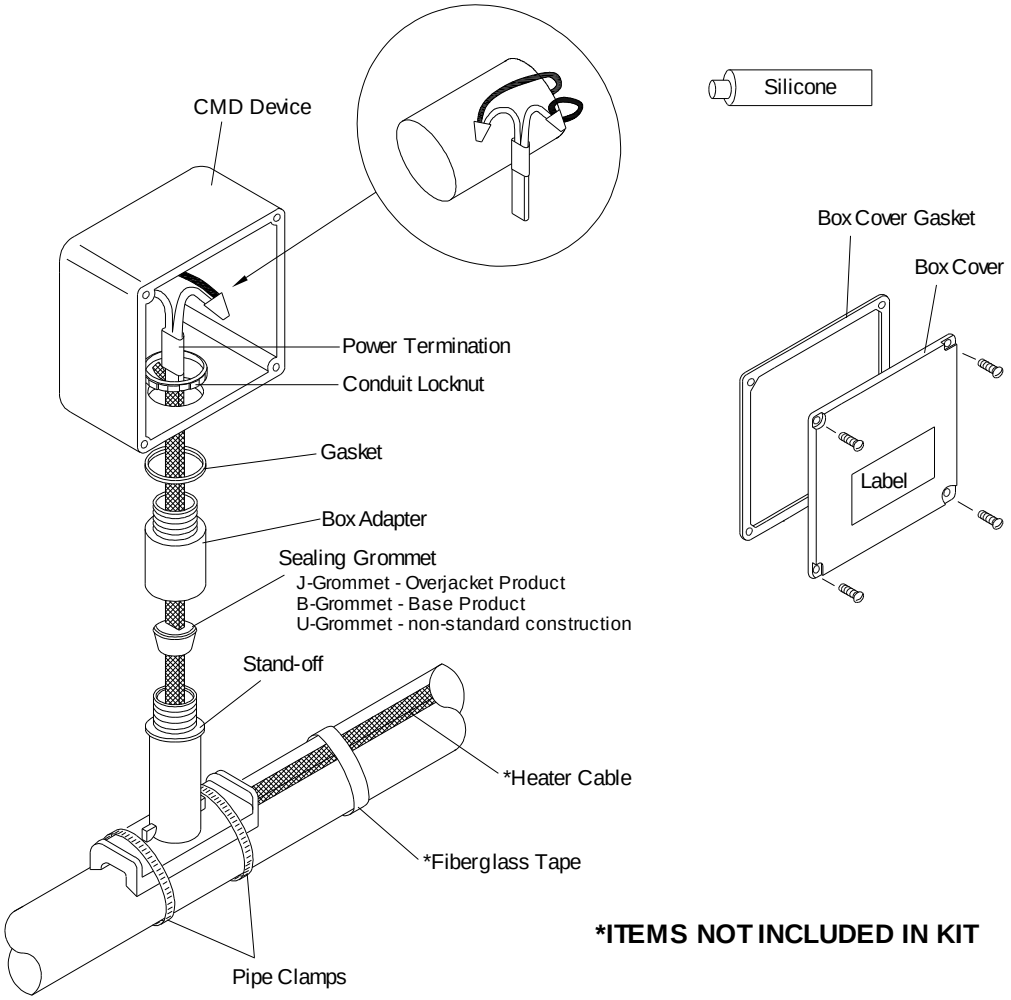
Figure 1

SIGNAL WHEN TO MONITOR HEATER

The monitor looks for a closed contact signal from a temperature controller before it tries to monitor the heater for current, voltage, and continuity. The default set-up requires an input signal for each monitor channel. When a group of heater channels are controlled by a single thermostat (grouped or ambient control), the panel inputs have to wire in parallel to the single contact signal. Stamped brass jumpers are provided with the panel to reduce the wiring required for this type of connection.

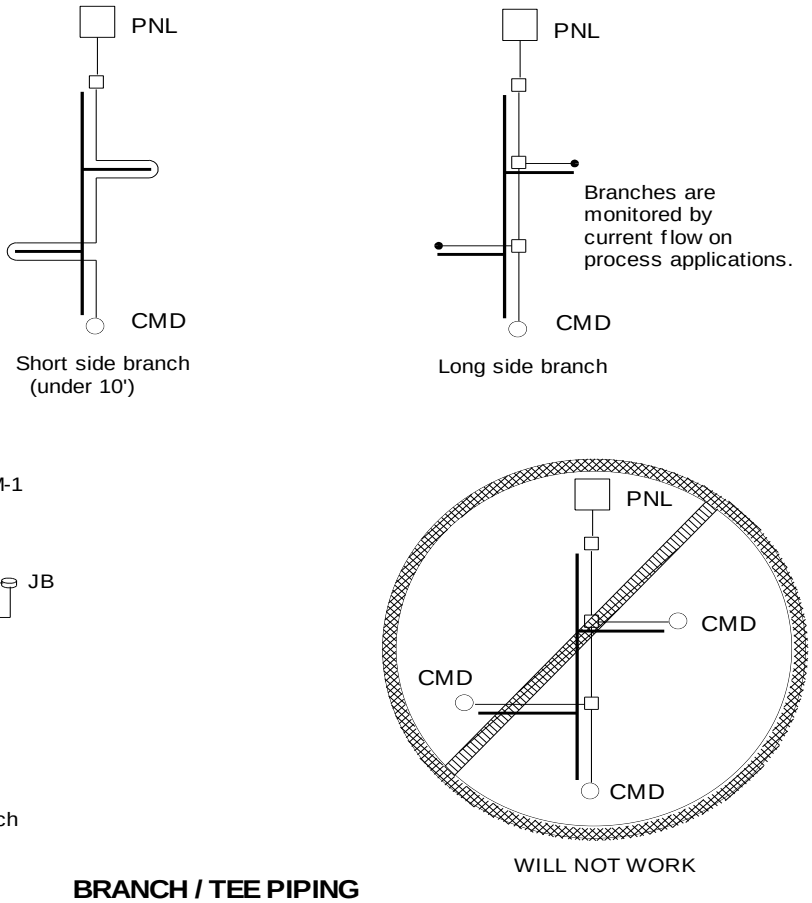
FIELD WIRING

Typical system wiring diagrams are included in this manual for field wiring. These wiring diagrams are located at the back of the manual. The PLT-CMD is used to monitor bus continuity on a parallel type heating cable. After the installing the heater cable on the pipe, connect the PLT-CMD to the opposite end of the power connection kit.

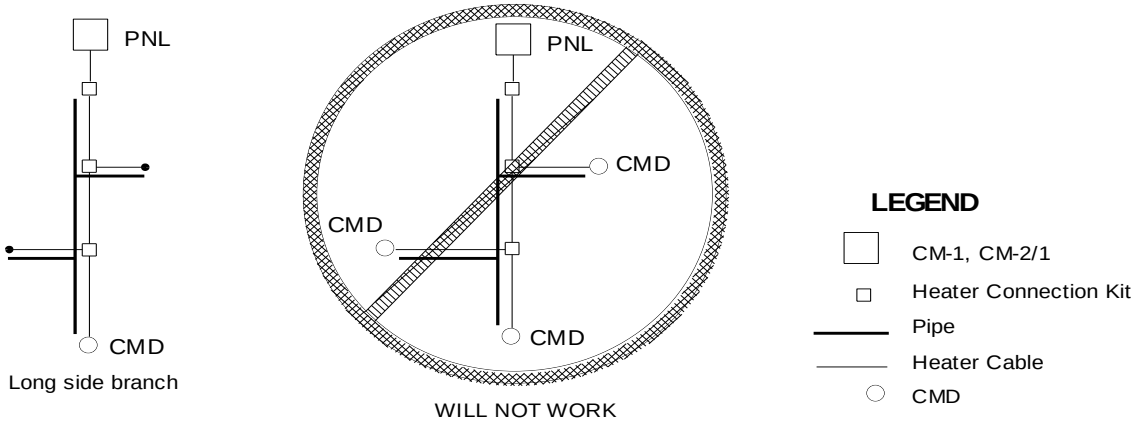


PLT-CMD Continuity Monitor Device

Figure 2



BRANCH / TEE PIPING
(single circuit, multiple cable segments)



GROUPED SEGMENTS
(several separate cables thru single monitor point)

PLT-CMD Cable Connections to CM-1

Figure 3

PROGRAMMING

The CM-1 is shipped with programming to monitor all available circuits. With this configuration, all 24 circuits will be scanned for alarms. Alarm delay is set for 5 minutes, alarm reset is automatic, and the display speed is fast. Each of these features and options will be covered on the next few pages. However, the system is suitable to be powered in the existing configuration. When programming, refer to *Figure 13*, which is also provided inside the door of the CM-1 enclosure. If all 24 circuits are not active (monitor not required) flip the corresponding programming switches. Programming can be changed in the field by flipping switches between on or off.

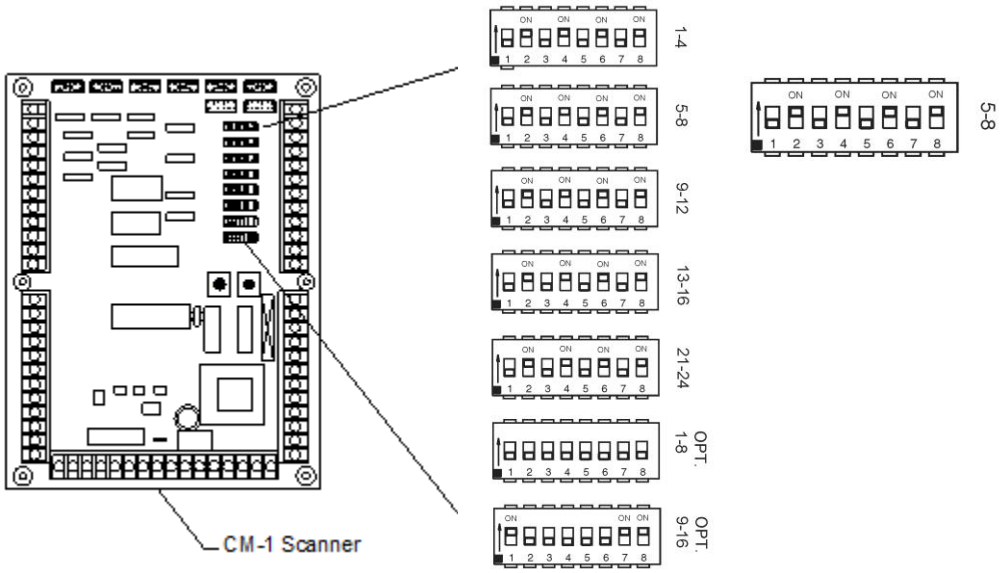


Figure 4

Programming of the CM-1 is accomplished by flipping the program switches located on the scanner board.

CIRCUIT MONITOR OPTIONS

The top 6 rows of option switches in the programming area are the circuit monitor switches. As the system is shipped, all circuits available in the system will be monitored, or "active". If a circuit is de-activated, flip the appropriate programming switch off, and the circuit will be skipped in the monitor sequence. The mode switch is left on if a CMD is used, (parallel heaters) in the circuit.

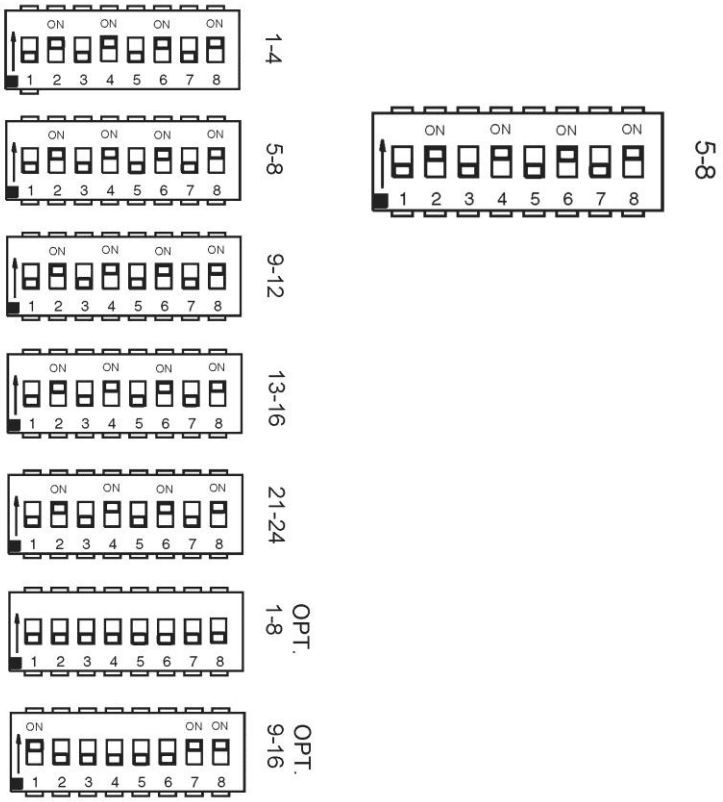


Figure 5

Examples:

If circuit #6 is to be de-activated, flip this switch off. This circuit will not be scanned or monitored until the programming switch is flipped on.

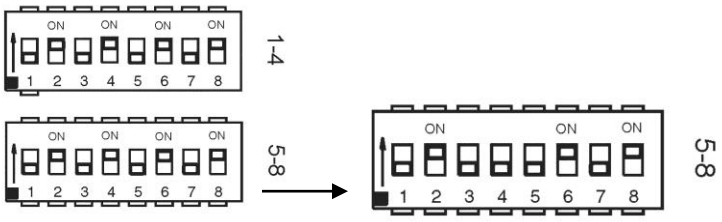


Figure 6

If circuit #5 is not going to use a CMD, Flip switch 2 of row 2 off, and switch 1 of row 2 on.

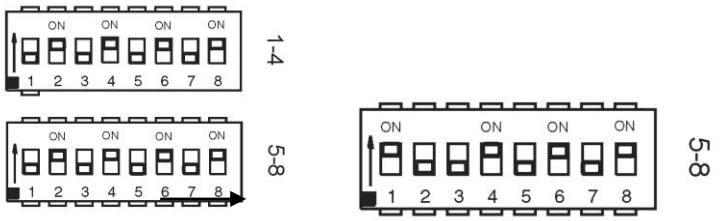


Figure 7

POWER FREQUENCY

As shipped from the factory, the system is suitable for 60 Hz. If 50 Hz is required, programming option Switch #8 must be flipped to ON position.

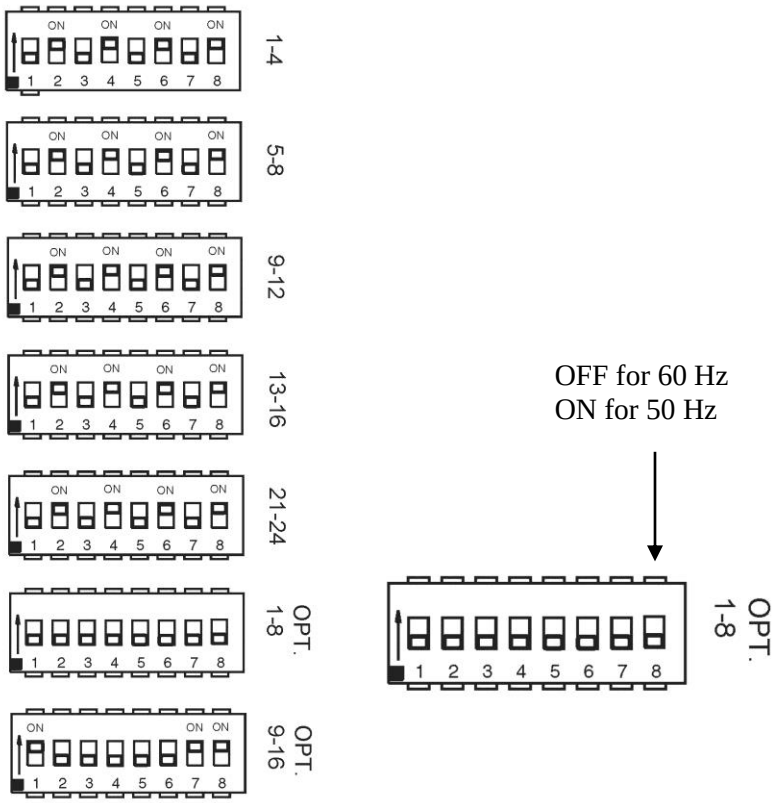


Figure 8

ALARM SILENCE TIME-OUT

This establishes the amount of time the acknowledged alarm is silenced before re-alarm. If an alarm is acknowledged (which silences the remote alarm relay), and the voltage problem is not corrected, the system will re-activate the remote alarm relay.

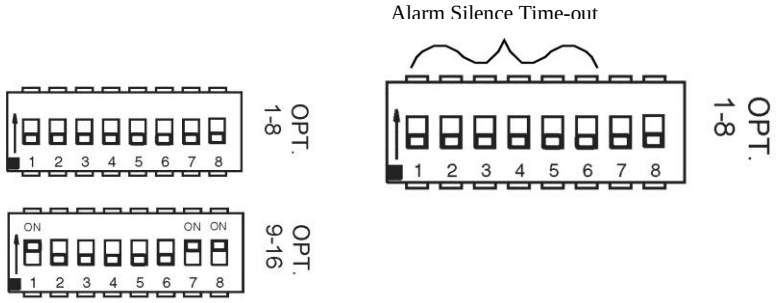


Figure 9

SCAN SPEED

This is a customer preference option. Recommended practice is to leave this Switch in ON position for active fast scan (option switch #16), for installation and set up. Flip Switch OFF for slow scan (option switch #16), during normal operation.

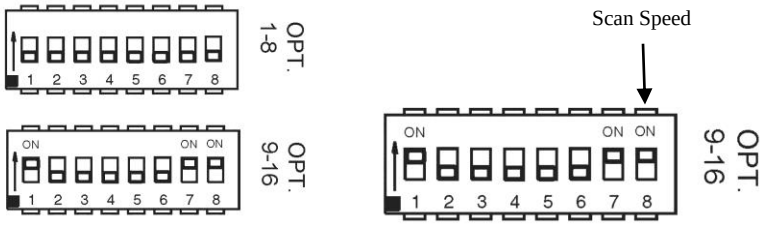


Figure 10

ALARM RESET AUTO/MANUAL

In auto reset mode, (Switch in ON position): The alarm status and remote alarm will clear automatically when a circuit fault clears. In manual mode, (Switch in OFF position): When a fault is cleared, both the scanner display and the remote output will remain in alarm until the reset button is pressed.

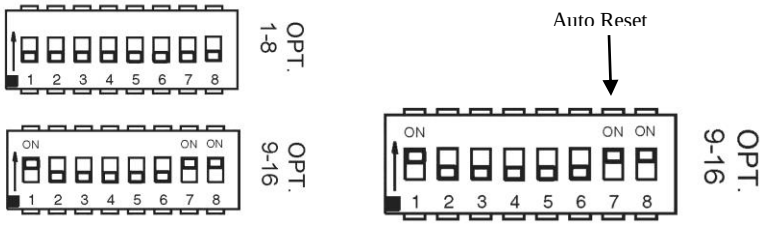


Figure 11

Note: After any change in the system program, press the "Alarm Reset" button on the front of the enclosure, this will reset all options and finalize any changes that have been made.

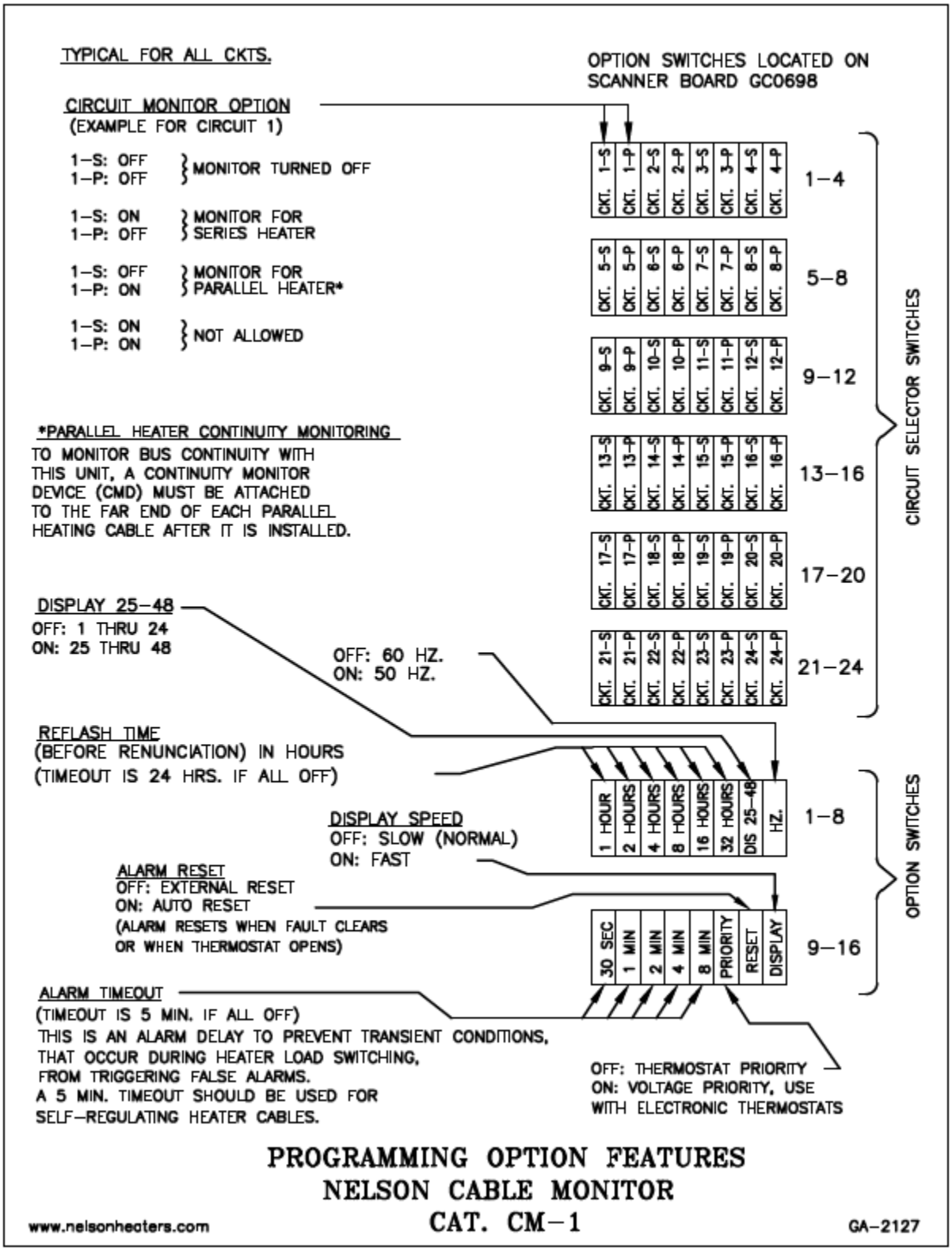

TYPICAL FOR ALL CKTS.
OPTION SWITCHES LOCATED ON SCANNER BOARD GC0698
CIRCUIT MONITOR OPTION
(EXAMPLE FOR CIRCUIT 1)
1-S: OFF
1-P: OFF
MONITOR TURNED OFF
1-S: ON
1-P: OFF
MONITOR FOR SERIES HEATER
1-S: OFF
1-P: ON
MONITOR FOR PARALLEL HEATER*
1-S: ON
1-P: ON
NOT ALLOWED
CKT. 1-S
CKT. 1-P
CKT. 2-S
CKT. 2-P
CKT. 3-S
CKT. 3-P
CKT. 4-S
CKT. 4-P
1-4
CKT. 5-S
CKT. 5-P
CKT. 6-S
CKT. 6-P
CKT. 7-S
CKT. 7-P
CKT. 8-S
CKT. 8-P
5-8
CKT. 9-S
CKT. 9-P
CKT. 10-S
CKT. 10-P
CKT. 11-S
CKT. 11-P
CKT. 12-S
CKT. 12-P
9-12
CKT. 13-S
CKT. 13-P
CKT. 14-S
CKT. 14-P
CKT. 15-S
CKT. 15-P
CKT. 16-S
CKT. 16-P
13-16
CKT. 17-S
CKT. 17-P
CKT. 18-S
CKT. 18-P
CKT. 19-S
CKT. 19-P
CKT. 20-S
CKT. 20-P
17-20
CKT. 21-S
CKT. 21-P
CKT. 22-S
CKT. 22-P
CKT. 23-S
CKT. 23-P
CKT. 24-S
CKT. 24-P
21-24
CIRCUIT SELECTOR SWITCHES
*PARALLEL HEATER CONTINUITY MONITORING
TO MONITOR BUS CONTINUITY WITH THIS UNIT, A CONTINUITY MONITOR DEVICE (CMD) MUST BE ATTACHED TO THE FAR END OF EACH PARALLEL HEATING CABLE AFTER IT IS INSTALLED.
DISPLAY 25-48
OFF: 1 THRU 24
ON: 25 THRU 48
OFF: 60 HZ.
ON: 50 HZ.
REFLASH TIME
(BEFORE RENUNCIATION) IN HOURS
(TIMEOUT IS 24 HRS. IF ALL OFF)
1 HOUR
2 HOURS
4 HOURS
8 HOURS
16 HOURS
32 HOURS
DIS 25-48
HZ.
1-8
DISPLAY SPEED
OFF: SLOW (NORMAL)
ON: FAST
ALARM RESET
OFF: EXTERNAL RESET
ON: AUTO RESET
(ALARM RESETS WHEN FAULT CLEARS OR WHEN THERMOSTAT OPENS)
30 SEC
1 MIN
2 MIN
4 MIN
8 MIN
PRIORITY
RESET
DISPLAY
9-16
OPTION SWITCHES
ALARM TIMEOUT
(TIMEOUT IS 5 MIN. IF ALL OFF)
THIS IS AN ALARM DELAY TO PREVENT TRANSIENT CONDITIONS, THAT OCCUR DURING HEATER LOAD SWITCHING, FROM TRIGGERING FALSE ALARMS.
A 5 MIN. TIMEOUT SHOULD BE USED FOR SELF-REGULATING HEATER CABLES.
OFF: THERMOSTAT PRIORITY
ON: VOLTAGE PRIORITY, USE WITH ELECTRONIC THERMOSTATS
PROGRAMMING OPTION FEATURES
NELSON CABLE MONITOR
CAT. CM-1
www.nelsonheaters.com
GA-2127

Figure 12

CM-1 AMBIENT PANEL START-UP PROCEDURES

1. Always use caution when energizing heater cables, especially when the ambient temperature is above 50°F.

   Note: Start-up requires that the cables be energized. One way to accomplish this is to set the panel thermostat to a temperature above the current ambient air temperature until start-up is completed.

2. Make sure the heat tracing circuit breakers are in the on position and allow the heater cables to be energized for 30 minutes.

3. Check the CM-1 alarm display on the front of the CM-1 panel for any alarms. If any alarms are indicated use the alarm trouble-shooting guide included with these instructions to resolve each alarm one by one.

   Note: Current alarms can sometimes be resolved by adjusting the current sensing trimpot located on the sensor card using the "Current Adjustment Procedure" section in the CM-1 manual. Press the <Alarm Reset> button on the CM-1 panel to verify all alarms.

4. If an alarm is still present after troubleshooting the circuit, check the CM-1 Program switch configuration using the CM-1 manual. The program switch configuration allows the CM-1 to monitor both self-regulating and series resistance heater cables.

   Note: Each circuit must be configured according to the type of cable being used. Use the CM-1 manual to check for the correct programming switch configuration for each circuit.

5. Using the current trimpot adjustment procedure from the CM-1 manual adjust the current trimpot for each circuit.

6. Reset the ambient thermostat to the correct maintain temperature.

7. Heater cable testing and trouble-shooting guides are available to assist in resolving alarms.

MODBUS RTU COMMUNICATIONS

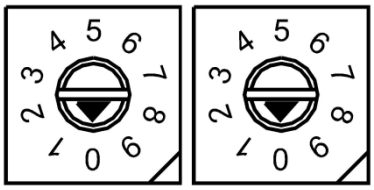
These MODBUS RTU Communication instructions are specific to the Modbus communications setup for the CM-1 Monitoring System. Modbus communications are only provided on recent production Scanner Board GC0698.

Wiring Instruction

From modbus master
Modbus connection wire A connects to Scanner Board GC0698 - TB5 – 7
Modbus connection wire B connects to Scanner Board GC0698 - TB5 – 9

Address settings:

- S1 = Ones (0-9)
- S2 = Tens (10-90)



S2 **S1**

Communications settings:

- Baud Rate = 4800
- Data Bits = 8
- Stop Bits = 1
- Parity = None

CM-1 Register Addresses/Descriptions

Write (06) address:

40000 Data = 1, acknowledges all alarms, Data = 2, resets board/all alarms

Read (03) addresses:

40000 - 40023 Channel Flag Table*
40256 - 40264 CM-1 Board ID String (ASCII)
40512 Option Jumpers 1-8
40768 Option Jumpers 9-16

*Channel Flag Bit Significance:

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0

b15 – b10 Not Used
b9 Series Mode
b8 Parallel Mode
b7 Channel ON
b6 Channel in Alarm
b5 Alarm Pending
b4 Alarm Acknowledged
b3 Not Used
b2 Continuity Out of Tolerance
b1 Current Out of Tolerance
b0 Voltage Out of Tolerance

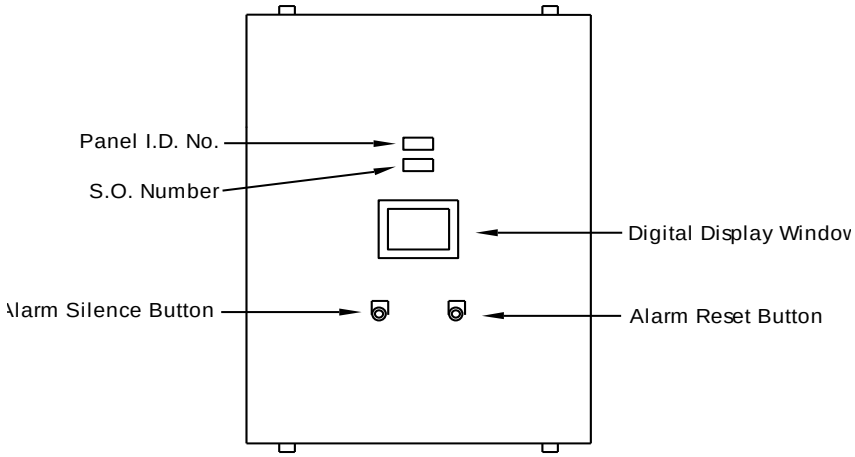
OPERATION

After installation and programming is completed, and 120VAC has been applied to TB-1, turn the power switch to "ON". *See Figure 1.*

For a moment both the red and green L.E.D. bars will light, then the system will start scanning. The green light bar will always appear under each active circuit, the first scan after powering up or resetting alarms. The green bars will continue to appear under the circuit number until the thermostat turns the heater off, or a loss of voltage occurs, or continuity is lost, or amperage drops below the threshold. After the alarm delay time-out, the red bar will light up and the remote alarm will energize. This alarm condition will continue until the problem is fixed, and the alarm reset switch is pressed, if the system is in manual reset mode.

⚠ WARNING:

During normal operation of the system, the cabinet door will not need to be opened. Therefore, keep the door closed and completely fastened to protect the electronics from dirt and moisture.

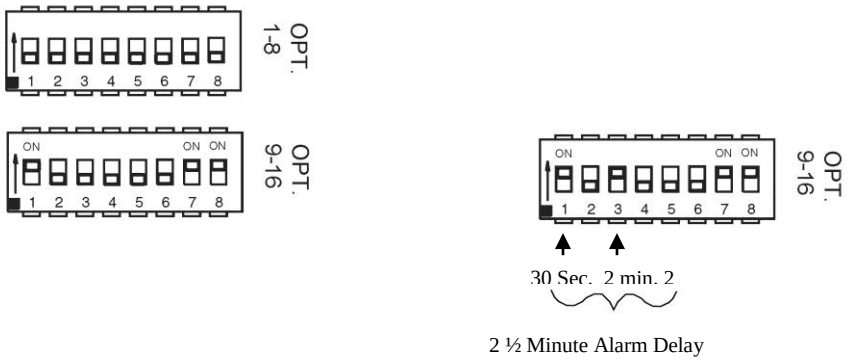


CM-1 Panel Enclosure
Figure 13

ALARM DELAY

This is a customer preference option. This option establishes the minimum time delay before a loss of voltage condition is registered by the scanner. The option range is from 30 seconds to 8 minutes. Times (shown in seconds and minutes) are additive. Longer alarm delay times are recommended to prevent alarming of temporary power interruptions.

Example:
For a 2 ½ minute delay; turn on the 30 second and 2 minute switches:



2 ½ Minute Alarm Delay

Figure 14

ALARM SILENCE BUTTON

This button will temporarily silence the remote alarm (up to 24 hours depending on the program pins; see the Programming section for "*Alarm Silence Time-out*"). While corrective actions are being taken on failed circuit(s) the alarm will re-enunciate if a new circuit fails when the system is silenced. Pressing the "*Alarm Silence Button*" will silence the remote alarm relay and reset the timer.

When voltage has been restored to all of the failed circuits, press the "*Alarm Reset*" button to clear all alarms from the system if the "*Manual Reset*" has been selected.

CURRENT ADJUSTMENT PROCEDURE

The CM-1 sensor card has an adjustable current alarm. The current adjust feature works with all types of heater cables; self-regulating, constant wattage and MI. The sensor cards come from the factory preset to a minimum current alarm level of 50 milliamps. Current flow above the minimum threshold is indicated by a red L.E.D. located on the sensor card by each circuit.

1) Each circuit must be individually adjusted under operating load conditions. Circuits are sequential, starting with circuit No. 1 on sensor card M1. There are four circuits per sensor card.
2) Apply power to first circuit to be calibrated. Be sure that the thermostat contacts are calling for heat. This may require that you temporarily adjust the thermostat set-point higher to get the unit to close, if you do, **BE SURE TO RETURN IT TO THE PROPER SET-POINT AFTER CALIBRATION.**
3) At this point the circuit to be calibrated should be indicating "HEATER ON" (green light ON). Some heater cables have a higher inrush current when first turned on. **ALLOW HEATER TO OPERATE NORMALLY FOR 24 HOURS BEFORE STARTING CALIBRATION OF CURRENT ALARM.**
4) Locate the sensor card's current trimpot for the circuit to be calibrated. The trimpot is a blue 13mm x 19mm (0.5" x 0.75") device with a brass adjusting screw located about 25mm (1.0") to the left of the Load Terminal Strip. See Figure 17 for red L.E.D. and the adjustment trimpot located for each.
5) Turn adjusting screw clockwise with an INSULATED SCREWDRIVER until the red L.E.D. dims. With the L.E.D. turned off the circuit is in ALARM.
6) Turn adjusting screw counter clockwise until the red L.E.D. comes fully ON. The circuit is now out of ALARM and calibrated for the existing voltage and temperature conditions.

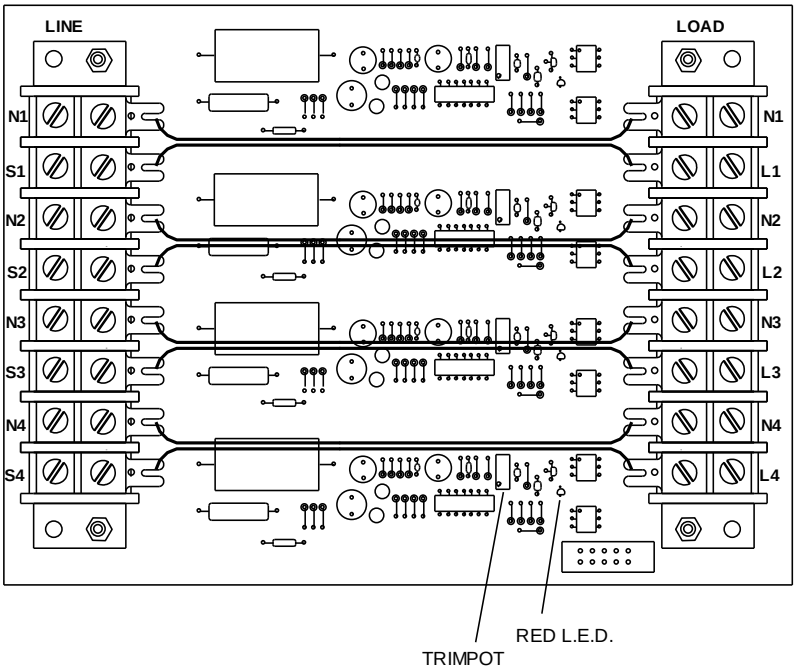
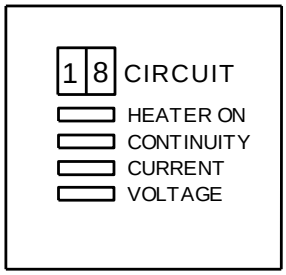


Figure 15

DIGITAL DISPLAY WINDOW

The circuit numbers being scanned by the system are displayed here in the status area.



Monitor Display
Figure 16

Conditions:

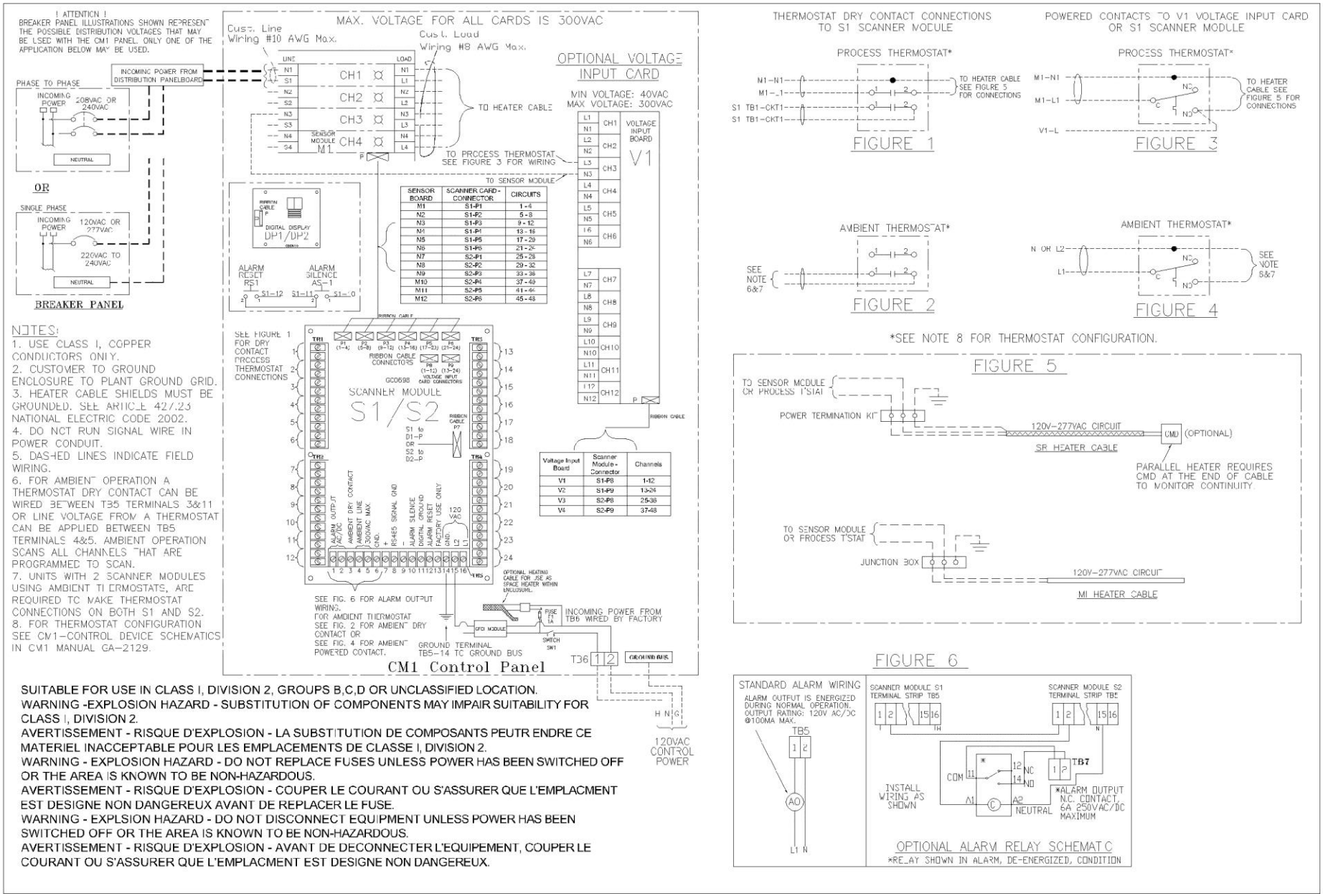
1) No light bar energized below the circuit number indicates the circuit is de-energized. This is a non-alarm condition.
2) The green light bar energized indicates that the circuit is energized and functioning satisfactorily. This is a non-alarm condition.
3) **Voltage -** the (red) indicator energized indicates that voltage is not present when the circuit should be energized. This is an alarm condition.
4) **Current** - the (red) indicator energized indicates that current flow has dropped below the adjustable level set on the sensor card. The minimum level is 50mA, the maximum is 30A. This would indicate an open circuit on a series heating cable. On parallel cables this would indicate a possible break in the power wiring between the heater cable power termination and the CM-1 panel or the failure of a portion of the parallel heating cable.
5) **Continuity** - the (red) indicator energized would indicate a loss of continuity in the bus wires of a parallel heater cable.

SPECIFICATIONS

PERFORMANCE

Ambient Temperature:	-40° to +130°F
Power Input:	120VAC; 1A
Heater Voltage Range:	85VAC to 300VAC
Amperage Range:	0.05 to 30.0A
Relative Humidity:	0-95% max. non-condensing boards are conformal coated and gold plated connectors are used.
Hazardous Locations:	Approved for Class I, Division 2, Groups A, B, C, & D; Class II, Groups F & G; Class III, Div. 1 & 2.
Alarm Output:	Solid State output; 120V AC/DC @ 100ma max. Optional relay with dry contact available. Output is energized during normal operation.
Display:	Scanner - Single line numeric L.E.D. Alarm - L.E.D. bar indicators for voltage, current, and continuity.

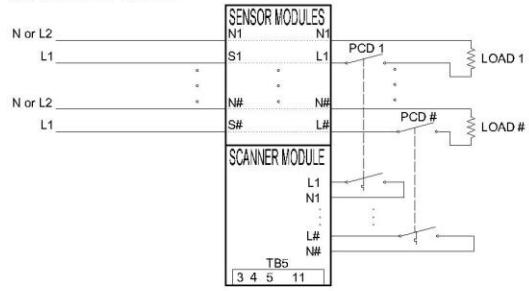
FIELD WIRING DIAGRAM



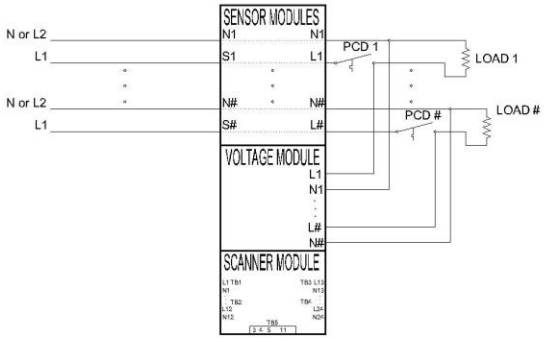
SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS B,C,D OR UNCLASSIFIED LOCATION.
WARNING -EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUTR ENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.
WARNING - EXPLOSION HAZARD - DO NOT REPLACE FUSES UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
AVERTISSEMENT - RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACMENT EST DESIGNE NON DANGEREUX AVANT DE REPLACER LE FUSE.
WARNING - EXPLSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACMENT EST DESIGNE NON DANGEREUX.

CM1 - Control Device Schematics

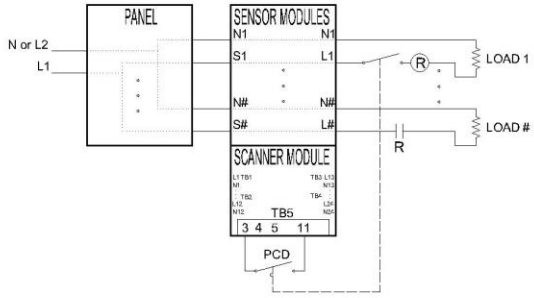
TYPE: 1A - DOWNSTREAM THERMOSTAT
WITH AUXILIARY DRY CONTACTS
MODE: THERMOSTAT PRIORITY
OR VOLTAGE PRIORITY



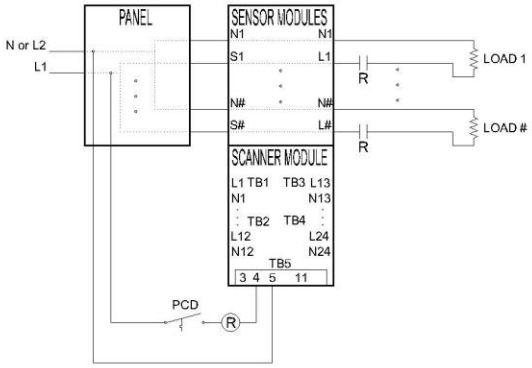
TYPE: 1B - DOWNSTREAM THERMOSTAT
WITH DIRECT WET CONTACTS
MODE: THERMOSTAT PRIORITY
OR VOLTAGE PRIORITY



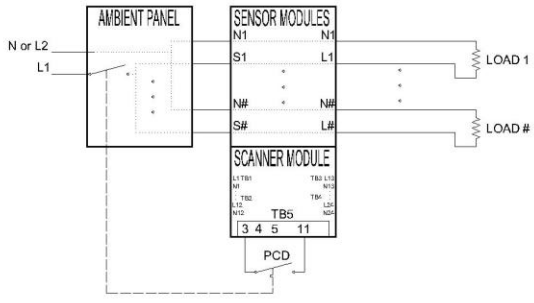
TYPE: 2A - AMBIENT THERMOSTAT WITH
AUXILIARY DRY CONTACTS AND
DOWNSTREAM LOAD SWITCHING
MODE: THERMOSTAT PRIORITY
OR VOLTAGE PRIORITY



TYPE: 2B - AMBIENT THERMOSTAT WITH
DIRECT WET CONTACTS AND DOWNSTREAM
LOAD SWITCHING
MODE: THERMOSTAT PRIORITY
OR VOLTAGE PRIORITY



TYPE: 3A - AMBIENT THERMOSTAT WITH
AUXILIARY DRY CONTACTS AND UPSTREAM
LOAD SWITCHING
MODE: THERMOSTAT PRIORITY



NOTE:
PCD = Primary Control Device

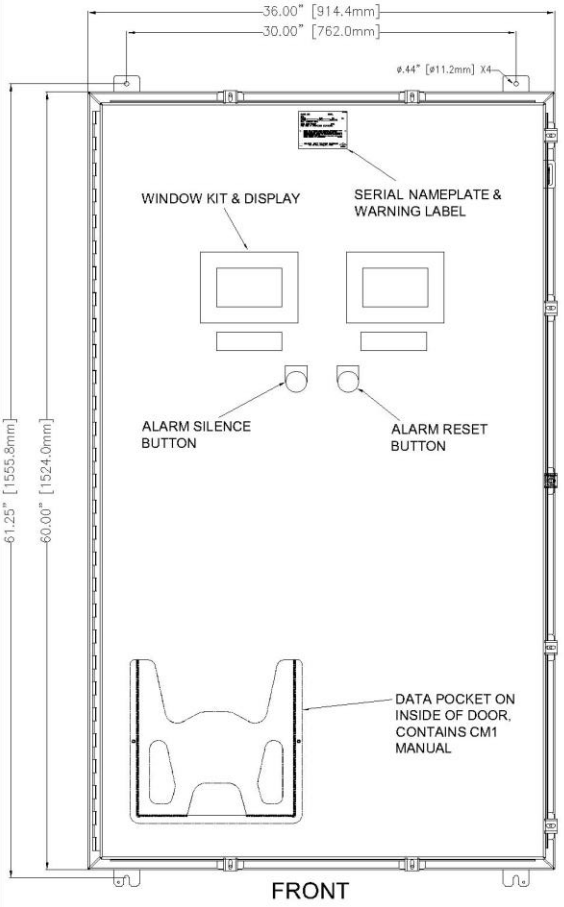
R = Relay

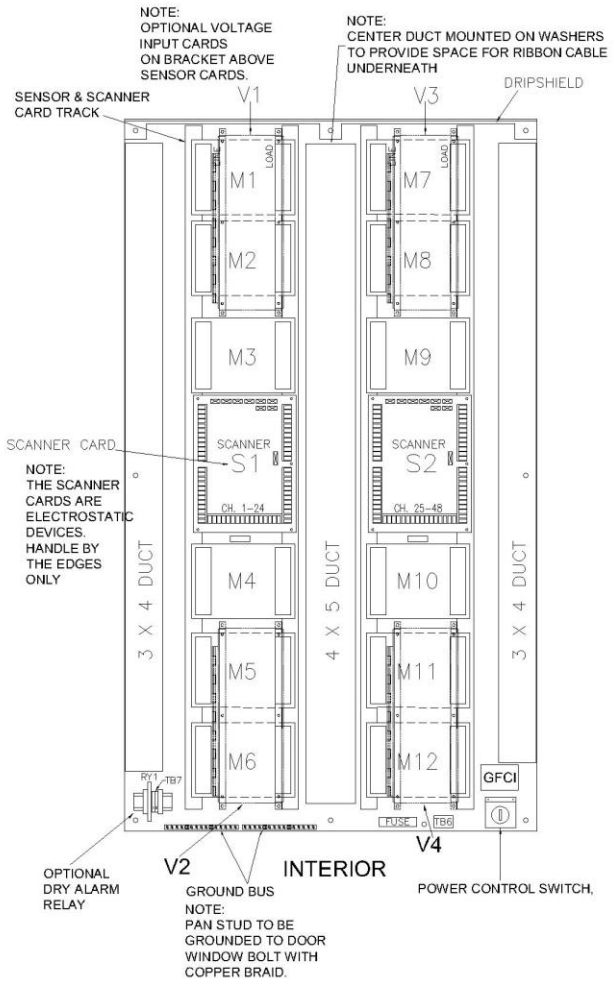
(R) = Contactor

= Thermostat

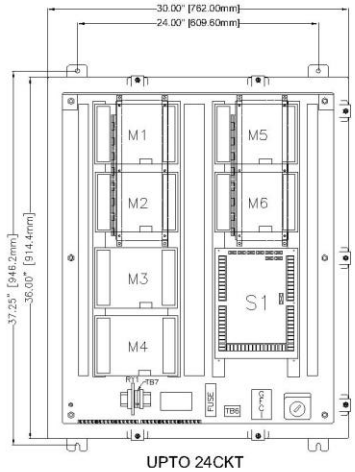
= Mechanically connected switch

CM1 ASSEMBLY DIAGRAM

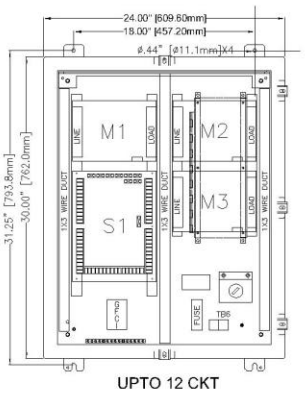




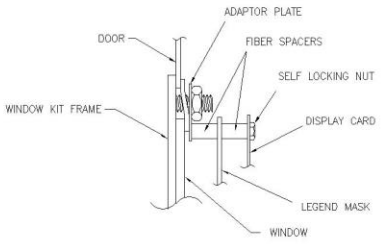
UPTO 48CKT



UPTO 24CKT



UPTO 12 CKT



DISPLAY INSTALLATION

NOTES:

Nelson Heat Tracing System products are supplied with a limited warranty. Complete Terms and Conditions may be found on Nelson's website at www.nelsonheaters.com.