WESCHLER INSTRUMENTS
DIVISION OF HUGHES CORP.

Transformer Advantage SC, DC & TC
Owners Manual

Manual Part Number OMGVT200
Revision 2, July, 2004

Use with Firmware G3T0200001, G7T0200001 or G9T0200001
G3T0300001, G7T0300001 or G9T0300001

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1.0 Introduction

Description

The Transformer Advantage SC, DC & TC series are compact, fully electronic, programmable instruments designed for accurate and reliable thermal management of liquid immersed power and distribution transformers. The monikers SC, DC and TC stand for single channel, dual channel and triple channel respectively. As the names imply, they monitor one, two or three temperatures using RTD probes either inserted into the heated or unheated thermowells, attached to the tank using a magnetic clamp or mounted in free air to measure ambient. The temperatures are displayed with user-selectable titles selected from a menu of popular choices. Alarm set points are assignable individually to any input channel.

Single channel units are typically used as a low-cost option to monitor a single temperature such as top oil or winding. Dual Channel units are typically used to monitor top oil and winding temperatures simultaneously.

Triple channel units are capable of performing three temperature measurement functions simultaneously in several different combinations:

- Three Winding Temperatures [1].
- Winding Temperature [1], Top Fluid (Oil) and Ambient Temperatures.
- Winding Temperature [1], Top Fluid (Oil) and Bottom Fluid Temperatures.

[1] Using Heated Thermowell(s)

The enclosure and electrical components of the Advantage are designed to withstand the harshest operating environment. The electronics have been designed to continue functioning under extreme EMI/RFI conditions, including close proximity walkie-talkie keying and near lightning strike. Their performance has been documented through testing to world recognized EMC standards.

Major Features

★ High accuracy 22 bit, 8 channel A/D conversion. Resolvable Accuracy ± 0.1 Degrees.
★ Measures Top Fluid (Oil)Temperature using a Probe in the Unheated Thermowell
★ Measures Simulated Winding Temperature using a Probe in the Heated Thermowell
★ 3 Button Front Panel Programming. No Covers to Open.
★ Relay set points are individually assignable to any temperature channel, Time or Remote (digital) control.
★ Walk-up Selectable Display for Channel Measurements, Time, Firmware Version and Active Alarms.
★ Alpha-Numeric Displays for Prompts/Units and Values make Indications Clear and Non-confusing.
★ Multiple Measured-Quantity Title Choices for Clear Indication of which Temperature is Displayed.
★ Up to 10 High Capacity Set Point Relays for Control of Cooling Fans, Pumps or Alarms.
★ Relay Module Types can be Mixed to Meet Variation of Form C and Form B Requirements.
★ Relay Modules Plug In for Simple Maintenance or Configuration Changes.
★ Relay Setup Options Include User-Programmable response to Sensor Failure.
★ 1 Optional High Capacity Form C Auxiliary Set Point Relay for Logic or Alarm Functions.
★ 1 Standard Sensor Failure Relay for Alarm or Cooling Supervisory Applications.
★ One (SC) Two (DC) or Three (TC) Optional Retransmit Channels to Remotely Indicate Any Measurement.
★ Rugged Extruded, Hardcoated Aluminum, NEMA 4X Enclosure.
★ Compact Size; 10 **d** H x 6 $^{11}/_{16}$ W x 6 $^{9}/_{16}$ D. Mounting Plate 13 **d** H x 8 ¼ W.
★ Many Power Source Options.

Intended Usage

The Transformer Advantage is intended to be used on liquid immersed power and distribution transformers where a high degree of accuracy, faithfulness to thermal response profile and reliability is required.

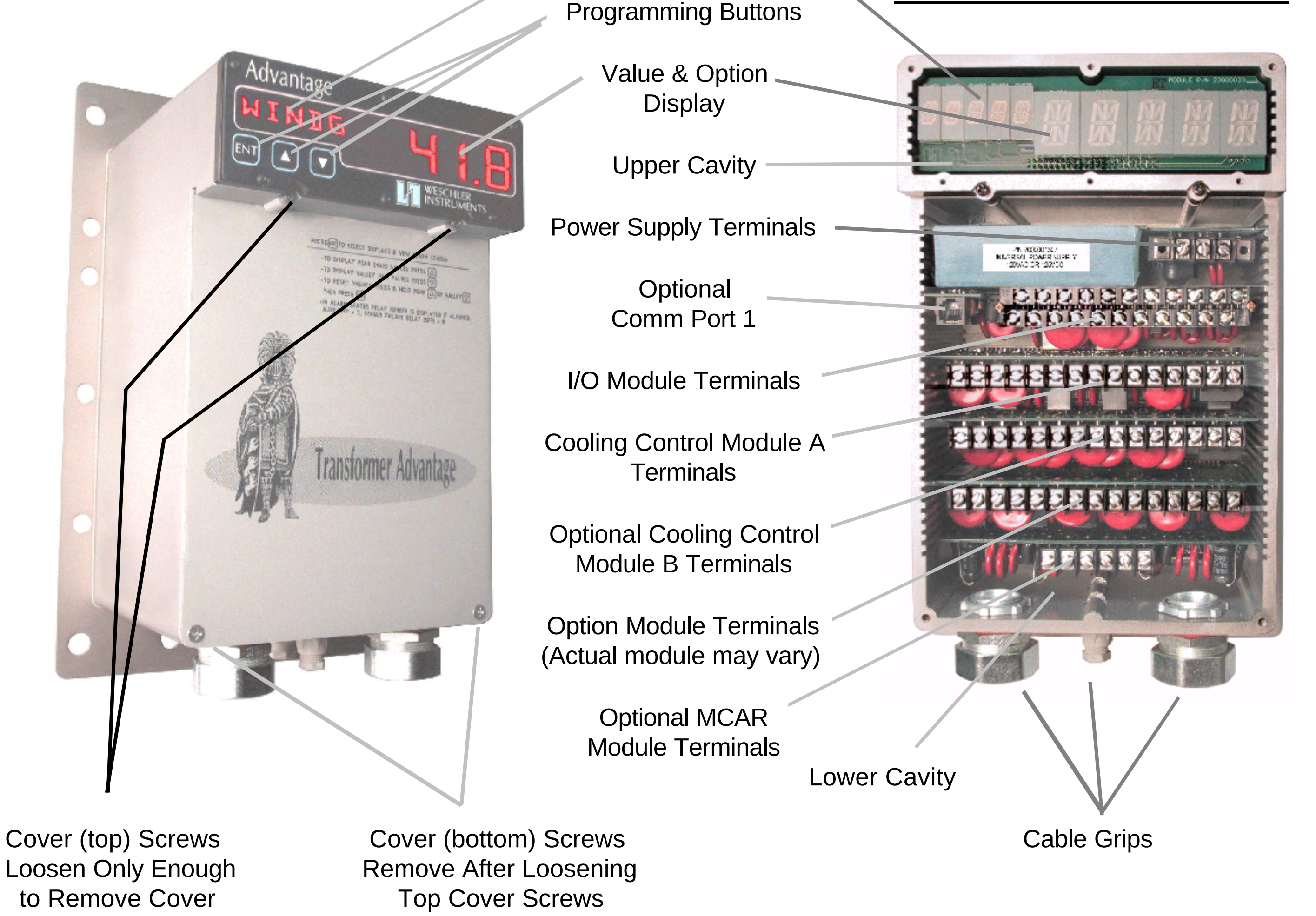
Feature and Module Locations

The feature locations are illustrated in Figure 1 below and Figure 2 on page 3. Detail dimensions are contained in the specifications section and Figures 14 and 17. Note that Projection mounting is a term borrowed from instrumentation specifications. It is sometimes referred to as surface or flush mounting in the transformer industry. Likewise, the panel mount is synonymous with through-panel mounting.

Access to the modules is from the front for projection mount and from the rear for panel mount. For each of the two mounting configurations the modules are positioned in the same order, and slot position.

Figure 1A. Projection Mount

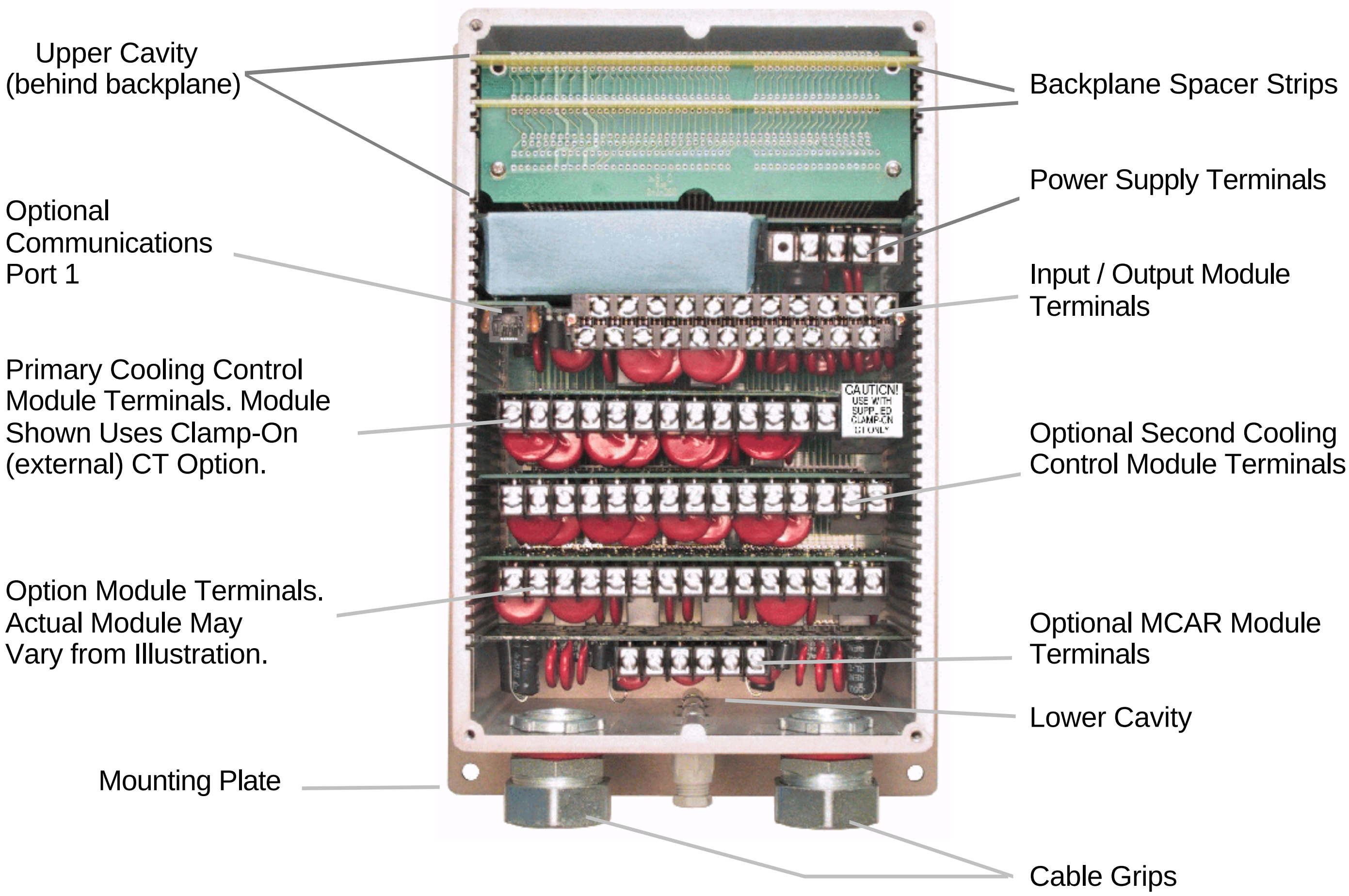
Figure 1B Projection Mount with Cover and Window Removed.



The figures and text of this manual describe or illustrate all optional equipment and features which are available in the Advantage SC, DC and TC. Since each Advantage is built-to-order from many catalog options, the optional equipment and features will only be present if they are ordered so-equipped or upgraded later in the factory or the field. Generally the TC and DC look and feel differ from each other and the SC model only by the number of channels. One notable difference in hardware is that the DC and TC locate their retransmit connections on an option module, whereas the SC model has its single retransmit channel located on the I/O module. The terminal assignments diagrams (figures 5A to 5D) show clearly the two different schemes.

The positions of the modules in the upper cavity, illustrated in figures 1 and 2 must not be changed. The positions of modules in the lower cavity show the default locations, as they would be shipped from the factory, for most configurations. The locations were selected based primarily on convenience of wiring for installers. The actual position of the modules is optional and they may be moved to other slots as required.

Figure 2. Rear View of Panel Mount with Cover Removed



2.0 Receipt Inspection

Packaging Inspection

The packaging in which your Advantage is shipped is designed to protect its contents against normal shipping shock and vibration. If the external carton is damaged in any way, report any damage to the carrier as soon as possible and immediately unpack the carton for internal inspection.

Unpacking

The Advantage is packaged with this manual, a software and protocol manual if equipped with digital communications, hardware and spares kit, two standard cable grips for 0.65 to 0.70 inch diameter cable, RTD cable grips, and any RTD probes which were ordered with the instrument. Other accessories such as calibration tools, additional cable grips, or other items which may have been ordered at the same time will be included only if the packaging integrity is not compromised. Please remove all packing materials and check them for included accessories before discarding them.

Physically inspect the Advantage and its accessories for signs of hidden shipping damage. Evidence of excessive roughness in shipping include bent mounting plates and distorted display windows. Remove the front cover (projection mount models) or the rear cover (panel mount models) and check for dislodged modules or other parts adrift inside the case.

3.0 Installation

Internal Inspection

Prior to operation, remove the cover plate and inspect the module cavity for accessories and shipping blocking items. In some cases spare parts bags may be placed in the bottom cavity for installation convenience. These bags contain terminal screws, jumpers and other items which may be misplaced during the installation process. Remove any panels which have the word “DISCARD” printed on them. Check to see that the modules were not twisted or dislodged from their slots by violent shipping shock by comparing the slot they are in with the slot marking on the front edge of the case. If a module has been dislodged, correct the misalignment by pulling it straight out of the case, then reinserting in the correct slot. If this cannot be easily accomplished, contact the shipping carrier and the factory to report the damage and receive further instructions.

Connections (General)

All connections are made at the terminal strips mounted at the edge of the cooling control, I/O, power supply and optional modules. If your Advantage is not equipped with a particular feature the terminal screws will be omitted. The standard terminations for all but the I/O module use #6-32 binding head screws suitable for retaining spade or eyelet lugs. The I/O module’s standard screws have METRIC 3.5-0.6 threads which will also accommodate spade or eyelet lugs for #6 screws. The screws from the I/O module must not be mixed with the screws from the other modules or thread damage will result. The I/O module may optionally be fitted with phoenix-type terminals suitable for connection of stripped conductor. Stripped conductor connections are not recommended for the power supply and cooling control and current input modules. The connection assignments are printed on a sticker attached to the inside of the front (projection mount) or rear (panel mount) cover. This diagram is also printed in this manual, see Figures 5A through 5F on pages 15 through 20. When wiring the RTD common leads, it is advised that all three wires be crimped into a single terminal lug.

It is preferred that the power and communications (digital and analog retransmit) enter through the right hand cable grip and that relay and current sense cables enter through the left hand cable grip. This orientation will result in the least electrical noise transfer to the communications wiring. The signal input (RTD) cables enter through the small center cable grip holes.

The standard large cable grips are designed to handle jacketed cables with a diameter of from 0.65 to 0.70 inches. Grips for other diameter cables are available from the factory as an option. The installer can substitute appropriately sized liquid-tight grips provided they form a satisfactory seal to the case. The RTD grips are sized to fit the RTD cables of the probes which are shipped with the unit. In the case of user-supplied probes, the standard ¼ inch ID grip will be supplied unless another size is specifically ordered. It is important to have as tight a seal as possible to prevent the entry of dust and moisture. While it is recognized that a perfect seal is sometimes difficult, the service life of the Advantage will be reduced by inadequate attention to sealing.

The terminal numbering convention used in the connections section of this manual shall refer to the module-specific numbers shown on figures 5A through 5D. For example, the terminals for Cooling Control Module A (CCA) are labeled as 26 to 40 and CCA-1 to CCA-15. The module specific numbers are those with the CCA prefix. This was done to make terminal identification easier when making connections. The dual marking was adopted to allow users of earlier models to use later versions without needing to change documentation.

Power Supply Module Connections

The Advantage is powered by one of the power sources listed in table 5 on page 46. The voltage level, including deviations due to battery charging and expected fluctuations, must not exceed the stated tolerances given in the table. This requirement is based on EMI/RFI fence circuitry which clamps excessive voltages to prevent damage to sensitive electronic circuitry.

The 120 / 240 vac power supply has field-selectable voltage options which are chosen by repositioning jumpers from one pair of pins to another pair of pins. The pins are numbered 1-3-5-7 on one side and 2-4-6-8 on the other. See figure 3A below for the location of the jumpers. The other power supply modules do not have field selectable jumpers.

Table 1. Fuse Ratings and Sizes

Power Supply Voltage	Fuse Rating	Fuse Size	Power Supply Voltage	Fuse Rating	Fuse Size
24 vdc	1 amp Slow-Blow	2 AG (4.5 x 15mm)	240 vac / 250 vdc	¼ amp Slow-Blow	2 AG (4.5 x 15mm)
48 vdc	¾ amp Slow-Blow	"	120/240 vac	½ amp Slow-blow	"
125vdc	½ amp Slow-Blow	"	120 vac / 125 vdc	½ amp Slow-Blow	"

In order for the EMI/RFI protection circuitry to work properly, **an earth ground cable of 12-14 AWG must be installed** between power input terminal 2 and the substation ground net. The cable must be as short as possible and may connect directly to the transformer tank or control cabinet if it is in turn sufficiently grounded. Simply mounting the Advantage to the transformer will not adequately ground the unit because the anti-corrosive hard coat treatment which is applied to the case is also an electrical insulator.

Power connections to terminals 1 and 3 should be made using 12-14 AWG wire with insulation appropriate to the power source voltage level. Insulated crimp-type eyelet terminals for #6 studs are recommended. Do not over-tighten the terminal screws.

Table 2. Summary of Field Configurable Jumpers

Model	Module	Jumper ID	Function	Position
All	Power Supply	JA1	120vac	1-2 and 7-8
All	Power Supply	JA1	240vac	3-5 and 4-6
SC	Input / Output	J2	RTD1, 3 / 4 Wire	Installed / Removed
SC	Input / Output	J3	RTD2, 3 / 4 Wire	Not Used
DC, TC	Input / Output	J2	RTD1, 3 / 4 Wire	Installed / Removed
DC, TC	Input / Output	J3	RTD2, 3 / 4 Wire	Installed / Removed
TC	Input / Output	J4	RTD3, 3 / 4 Wire	Installed / Removed
All	4-Relay C^3	J4	Primary/Secondary	Pri / Sec

No other user-configurable jumpers are used in Advantage. All other settings are made using the programmable firmware. See the configuration keystroke diagrams of Figures 7 through 9D.

Figure 3A. Power Supply Jumper & Fuse Location (120/240 vac Only)

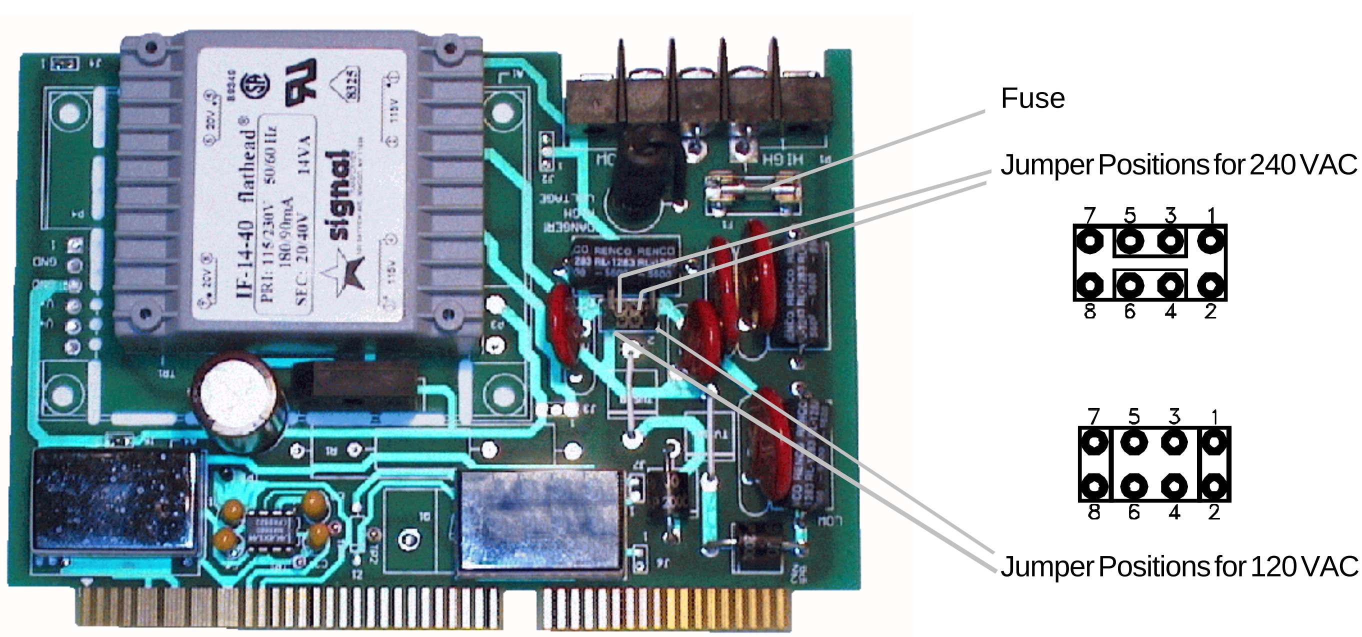
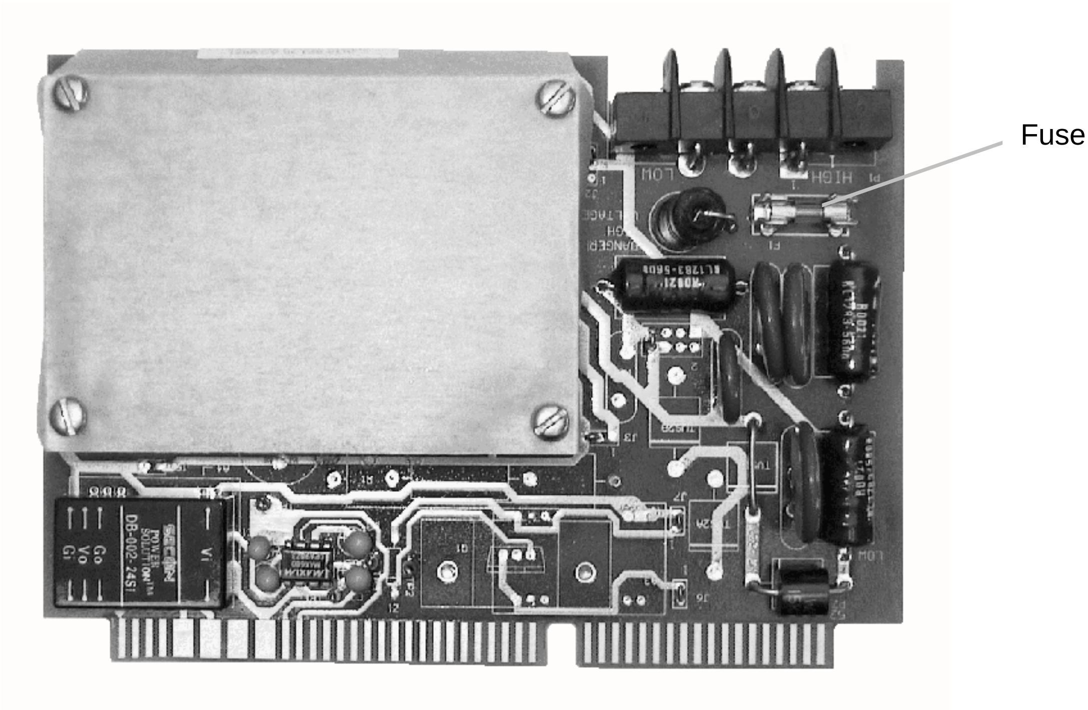


Figure 3B. Universal Power Supply Fuse Location



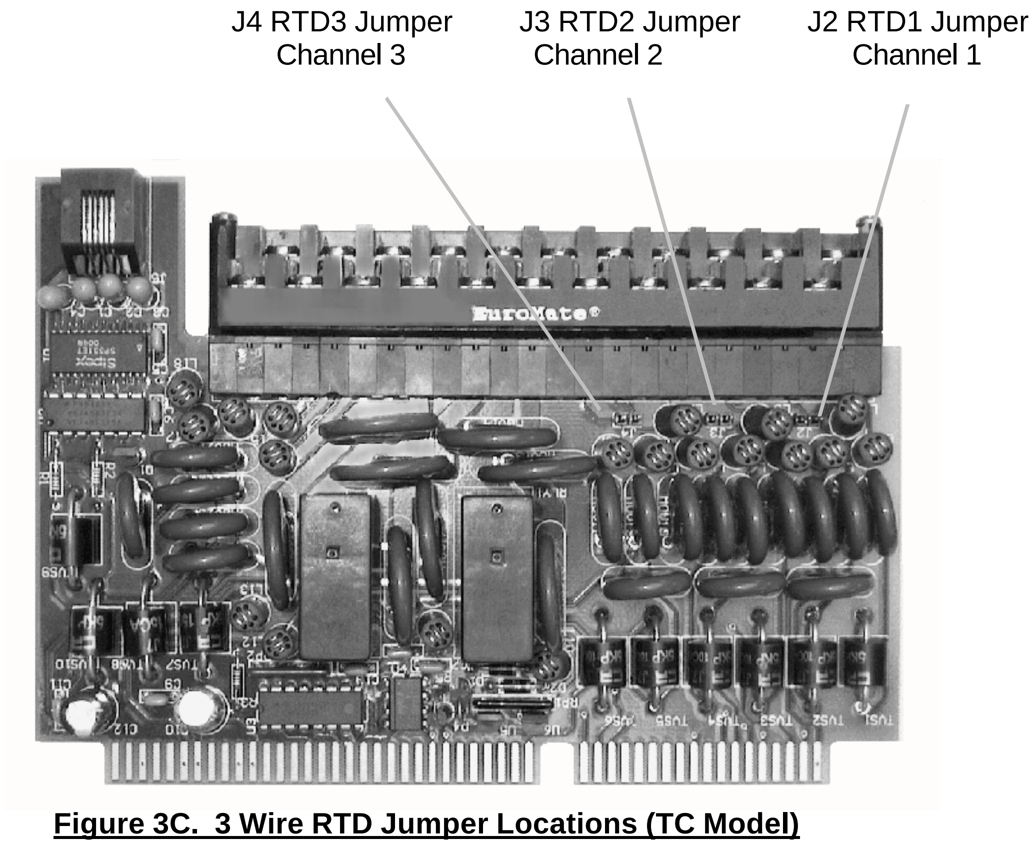


Figure 3C. 3 Wire RTD Jumper Locations (TC Model)

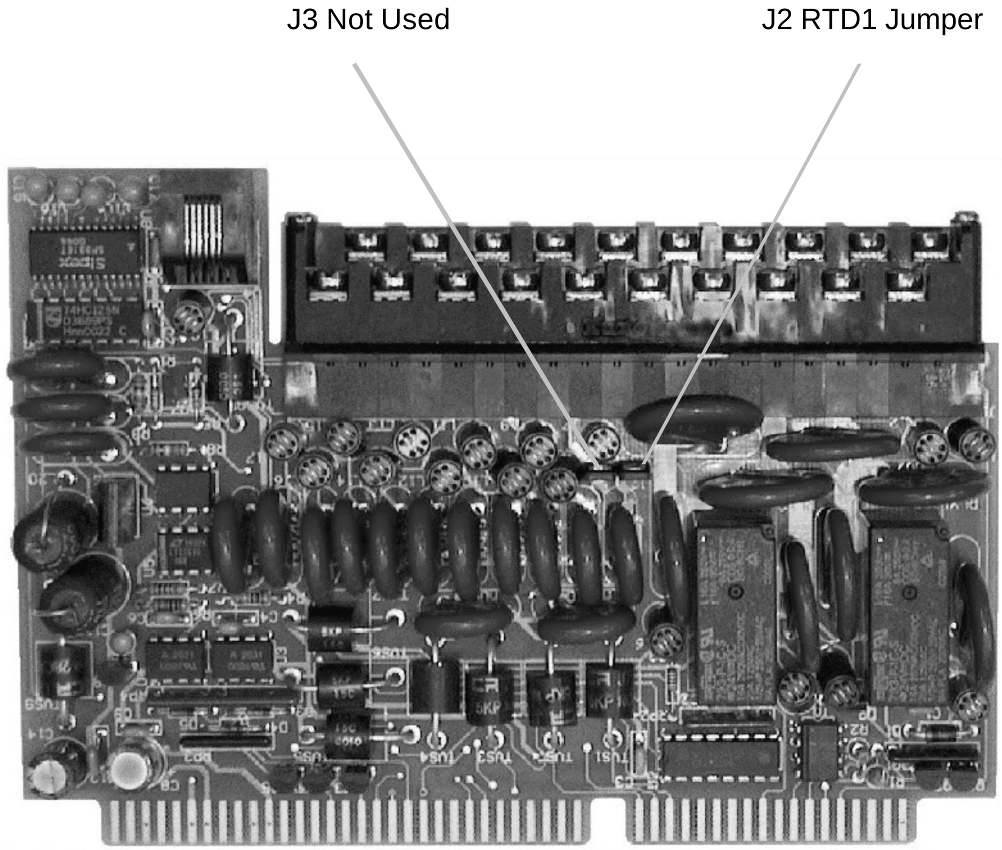
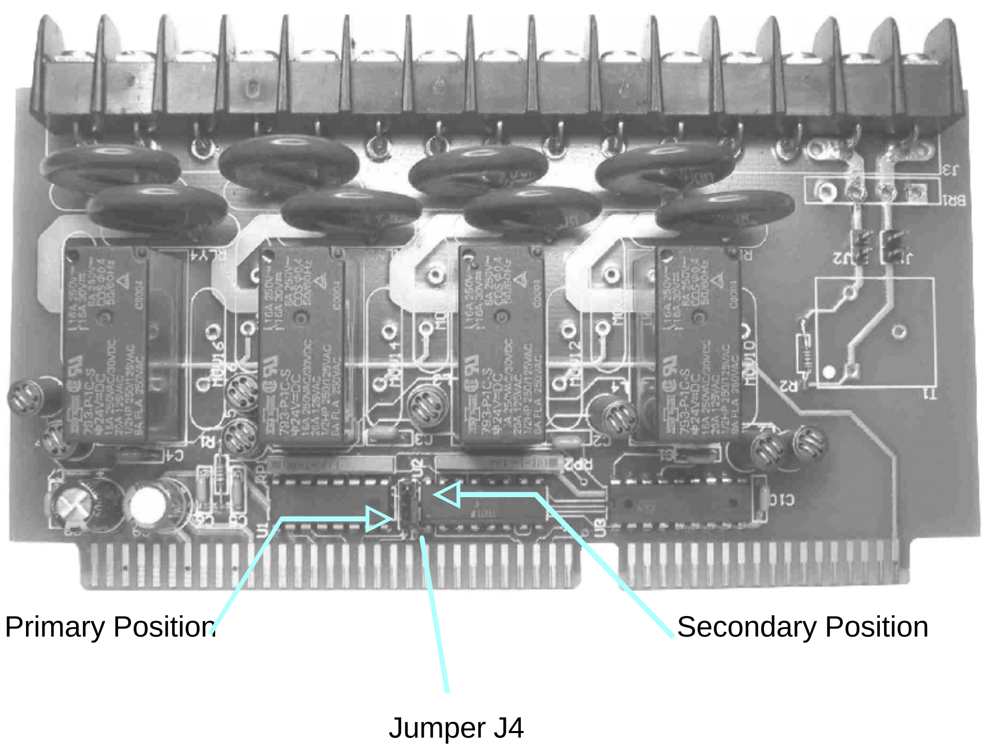


Figure 3D. Three Wire RTD Jumper Location (SC & DC Models)

Figure 3E. Four Relay C[3] Module Primary / Secondary Jumper Location



I/O Module Connections

The connector block may be removed, with connections intact, by unscrewing the small screws on either side of the block. Be sure to re-tighten the screws after re-plugging the block to the module. See "Connections General" on page 4 for details regarding the metric screws used on the I/O module.

RTD Inputs

On SC models, terminals I/O-9, 10, 11 and I/O-15 are for the RTD input. On DC and TC models, terminals I/O-1 through I/O-10 are for the two or three RTD inputs. Either 3 wire or 4 wire RTD's can be connected. The Weschler standard probe is 4 wire, chosen for enhanced probe accuracy regardless of lead length. The standard wire is 24 AWG and a crimp terminal suitable for 22-26 AWG wire and a #6 stud should be used. Users should consult the documentation that came with their probes if they are not using Weschler probes. Refer to figures 5A through 5D of this manual or the label affixed to the back of the Advantage terminal cavity cover for connections. Note that like colors are assigned to like polarities. For example, red wires are connected to ***positive*** sense and ***positive*** source and white wires are connected to ***negative*** sense and ***negative*** source. On SC models terminal I/O-15 is the source negative terminal for the RTD. On DC and TC models terminal I/O-10 is the common source negative for all RTD's To avoid the difficulty in connecting three crimp lugs to this terminal, it is suggested that the three RTD leads be twisted together and the splice be crimped into a single lug suitable for 20-24 AWG wire. On later model Weschler RTD probes a fifth wire is provided for grounding of the woven stainless steel shield. The wire is typically color coded gray, but may be any color other than white, red or green. This wire must be connected to the middle terminal (number 2) of the power supply.

The I/O module has one (SC) , two (DC) or three (TC) jumpers that need to be set according to which RTD configuration is being used. See Figure 3C (DC & TC) or 3D (SC) above for the jumper's locations. If a three wire RTD is used the jumper must be installed across both header pins. If a 4 wire probe is being used the jumper must be removed, or can be installed on one pin of the header only. The default setting is 4-wire; 3-wire jumpers are provided in the hardware and spares kit in the event that 3-wire RTD's are used. Any mix of 3 and 4-wire RTD's may be connected as required, provided the appropriate jumpers are used.

Whenever an RTD is connected for the first time or is replaced, the SLFCK (self-check) function should be performed to match the new RTD to the internal error monitoring circuitry. To run the SLFCK function, enter the supervisory loop (Figure 7), step down to the SLFCK prompt (Figure 9C), press ENTER, select the CALYS option and press ENTER again. Channel 1 will be matched to the RTD probe automatically. If channels 2 and 3 are not turned off (Figure 9A, prompt TITL2 or TITL3) they will also be matched automatically to their probes. See the Keystroke-by-Keystroke guide in section 4, heading "Channel Titles, Prompt TITL1, TITL2, TITL3" for more details.

Auxiliary and Sensor Failure Relays

Terminals I/O-6 to I/O-8 (SC) or terminals I/O-11 to I/O-13 (DC & TC) are for connections to the form C auxiliary (AUX) relay. If the screws are missing from the terminal block, the relay is not installed. Refer to figures 5A through 5D for connections. This relay is intended primarily for supervisory functions, but it is configured identically to the relays on the cooling control modules.

Terminals I/O-9 to I/O-11 Terminals I/O-14 to I/O-16 (DC & TC) are for connections to the form C sensor failure relay. This relay is always included in the hardware and is intended for supervisory functions. See figure 5A through 5D for connections and Configuration Section 4 for details regarding SFR function.

Digital Communications; SC & DC Models

Hard wired connections for digital communications are made at terminals I/O-16 to I/O-20. RS-232 is connected to I/O-16 (comm transmit 1), I/O-18 (comm receive 1) and I/O-20 (digital comm ground). Note that the ***digital communications ground is for communications only*** ; internal circuitry may be damaged if earth or other protective ground is connected to this terminal.

RS-485 may be connected as two wire or 4 wire. For 2-wire connections the host's (+) conductor is connected to I/O-16 (comm transmit 1) and the host's (-) conductor is connected to I/O-17 (comm transmit 2). A jumper must be installed between I/O-16 and I/O-18 and a second jumper must be installed between I/O-17 and I/O-19. A 120 ohm resistor may be required across terminals I/O-18 and I/O-19 to comply with the RS-485 specification. It is suggested that the system be tested first without the resistor, and if it performs properly, do not install it.

For RS-485 4-wire connections the host's receive (+ or 1) conductor is connected to terminal I/O-16 (comm transmit 1) and the host's receive (- or 2) conductor is connected to I/O-17 (comm transmit 2). The host's transmit (+ or 1) conductor is connected to terminal I/O-18 (comm receive 1) and the host's transmit (- or 2) is connected to I/O-19 (comm receive 2). A 120 ohm resistor may be required between each of terminals I/O-16 and I/O-17 and between I/O-18 and I/O-19 to comply with the RS-485 specification. It is suggested that the system be tested first without the resistors, and if it performs properly, do not install it.

TC models

Hard wired connections for digital communications are made at terminals I/O-17 to I/O-21.

RS-232 is connected to I/O-17 (comm transmit 1), I/O-19 (comm receive 1) and I/O-21 (digital comm ground). Note that the ***digital communications ground is for communications only*** ; internal circuitry may be damaged if earth or other protective ground is connected to this terminal.

RS-485 may be connected as two wire or 4 wire. For 2-wire connections the host's (+) conductor is connected to I/O-17 (comm transmit 1) and the host's (-) conductor is connected to I/O-18 (comm transmit 2). A jumper must be installed between I/O-17 and I/O-19 and a second jumper must be installed between I/O-18 and I/O-20. A 120 ohm resistor may be required across terminals I/O-19 and I/O-20 to comply with the RS-485 specification. It is suggested that the system be tested first without the resistor, and if it performs properly, do not install it.

For RS-485 4-wire connections the host's receive (+ or 1) conductor is connected to terminal I/O-17 (comm transmit 1) and the host's receive (- or 2) conductor is connected to I/O-18 (comm transmit 2). The host's transmit (+ or 1) conductor is connected to terminal I/O-19 (comm receive 1) and the host's transmit (- or 2) is connected to I/O-20 (comm receive 2). A 120 ohm resistor may be required between each of terminals I/O-17 and I/O-18 and between I/O-19 and I/O-20 to comply with the RS-485 specification. It is suggested that the system be tested first without the resistors, and if it performs properly, do not install it.

All Models

The connections for RS-422 communications are the same as the RS-485 4-wire configuration. The RS-485/422 specification has a differential signal and should not require a communications ground between the host and Advantage. Some systems will not work properly; however, if the communications ground is not connected. It is suggested that the system be tested first without the ground and if it functions normally, do not connect the ground. If a ground is necessary, two 100 ohm resistors must be placed in series between the host's communications ground and the Advantage communications ground terminal I/O-21; one at the Advantage end and one at the host end, to reduce circulating currents.

Cooling Control Module Connections:

The Advantage SC, DC and TC can be equipped with two cooling control modules, referred to as CCA and CCB. There are two types of cooling control modules, classified by the number of relays, either 4 or 6. The 4-relay module can have up to 4 form C relays and the current sense input. The 6-relay module can have up to 5 form B relays, 1 form C relay and the current sense input. The standard configuration includes a single 6-relay cooling control module with the current sense input, as CCA. The second (CCB) cooling control module can be ordered as an option. The four module configurations are:

- A single 6-relay module in the CCA position only, referred to as the 6-0 configuration (Figures 5A, 5C & 5E).
- A 6-relay module in the CCA position and a 4-relay module in the CCB position, referred to as the 6-4 configuration (Figures 5A, C & E).
- A single 4-relay module in the CCA position only, referred to as the 4-0 configuration (Figures 5B, D & F).
- A 4-relay module in the CCA position and a 4-relay module in the CCB position, referred to as the 4-4 configuration. (Figure 5B, D & F).

Form C relays offer both form A (normally open) and form B (normally closed) contacts with a single terminal which is common to both contacts. The #6 relay on 6-relay cooling control modules, and all relays on the 4-relay cooling control module offer form C contact arrangement.

The form B contacts are considered to be a normally closed failsafe configuration. This means that in an unalarmed state the contacts are held open by an electrical current. In the event that an alarm is called for the current is shut off and the contacts revert to their normally closed condition. The failsafe label comes from the fact that if an alarm is required, or power fails or an internal failure occurs, the relay current will fail and the contacts will also revert to their normally closed condition. These contacts are normally used for fan circuits and power-fail alarms. Form B contacts are the only configuration available on relays 1 to 5 of the 6-relay cooling control module.

Multiple Channel Analog Retransmit (MCAR) Module Connections:

The MCAR module is ordered as an optional feature. It provides an analog signal which is proportional to any of the three of displayable values selected by the user in the RTX1, RTX2 or RTX3 configuration loops. See Figure 9B for selection details.

The outputs are constant current sources of up to 24 madc within the compliance voltage range of 0-24 vdc. The maximum loop resistance is determined by dividing 24 by the loop current desired.

The outputs' isolation is determined by the surge and EMI fence circuitry. Figure 4C shows a simplified circuit representation of the retransmit outputs. Adjacent channel isolation is greater than 1 megohm when the output voltage difference channel-to-channel is less than 48 volts. Circuit-to-earth ground isolation is also greater than 1 megohm when the circuit-to-earth ground voltage is below 24 volts.

The MCAR module terminals are numbered MC-1 to MC-6. Connections to the MCAR terminals may be made using #6 lugs suitable for the wire size which meets the maximum loop resistance calculated above. It is recommended that at least 24 AWG wire be used, for reasons of ruggedness. A distance of 19000 feet can be covered by a pair of 24 AWG wires without exceeding the maximum loop resistance at 24 madc loop current.

Calibration Check

It is generally unnecessary to check calibration prior to installation, because all adjustments are made in firmware and there are no manual adjustments that are sensitive to shipping shock and vibration. Some user's standard operating practice requires pre-installation calibration verification to satisfy quality assurance mandates. Please refer to section 6.0, Calibration for details of calibration checks.

Projection (Flush) Mounting

"Projection mounting" is a term borrowed from instrumentation specifications to mean the device "projects from its mounting surface". It is sometimes referred to as surface or flush mounting in the transformer industry.

The Advantage may be mounted on studs welded to main or LTC tank side walls, structural channels or control cabinets or may be bolted to uni-strut type universal mounting channels. When mounted directly to main or LTC tank walls, spacers must be installed to provide a minimum **d** inch space between the mounting plate and the wall, for air circulation. Elastomeric Vibration isolation washers, spacers or grommets can be used but are not required.

The location of the Advantage on the transformer should be determined by agreement with the transformer manufacturer, following recognized practice standards. It can be mounted in any compass direction; however, consideration should be made as to ability of service personnel to install, configure and read the displays comfortably. Although the displays have been selected for their excellent brightness, readability of the display in direct sunlight may be impaired. An accessory hood is available for conditions where sunlight's effect becomes objectionable.

Refer to Figure 14 for mounting and overall dimensions and figures 15 and 16 for recommended and prohibited mounting methods. The minimum recommended mounting stud or screw diameter for 3 or 4 point mounting is 5/16 inch. The minimum diameter stud or screw diameter for 2 point mounting is **d** inch. The holes towards the center of the mounting plate are intended to be used with a uni-strut type channel in which the screw can be inserted through the mounting plate and channel and the nut can be tightened from the channel side. Flat and Lock washers must be used.

Panel Mounting

The term "panel mounting" is synonymous with "through-panel mounting". The Advantage panel mounting configuration is designed to be installed such that the case's display area alone protrudes through an opening cut in a panel. The panel may be an exterior one, allowing the display to be exposed to the outdoors, or may be an interior one, mounting the unit totally inside of the control cabinet. The operating temperature of the Advantage must be considered if mounting inside of a control cabinet. If the temperature will exceed 70 °C the unit must be mounted in another location.

The location of the Advantage on the transformer should be determined by agreement with the transformer manufacturer, following recognized practice standards. It can be mounted in any compass direction; however, consideration should be made as to ability of service personnel to install, configure and read the displays comfortably. Although the displays have been selected for their excellent brightness, readability of the display in direct sunlight may be impaired. An accessory hood is available for conditions where sunlight's effect becomes objectionable.

Refer to Figure 17 for mounting panel cut-out and drilling details. The recommended screw and thread size is ¼-20. The panel mount installation material includes a silicon-poron gasket for sealing the space between the front of the mounting plate and the mounting panel. The gasket must be installed for applications where the display projection is to be exposed, but it need not be installed if the unit is entirely enclosed in a cabinet. Flat and Lock washers must be used.

Table 3. Channel Assignment

The three input channels are assigned as follows:

Model	Channel Number	Assignment	Note
SC, DC & TC	1	RTD1	-
DC & TC	2	RTD2	1
TC Only	3	RTD3	1

Notes:

1. If channel 2 on the DC model or channels 2 and/or 3 on the TC model are unused, the title selection must be set to "OFF". This suppresses all channel operation, including display, set point alarms, internal failure alarms and sensor failure alarms. It also causes calibration of the channel to be by-passed. See the TITL2 and TITL3 loops in Figure 9A on page 25.

High Potential (Hi Pot) and Insulation Resistance (Megger) Testing

Power and Input / Output Transient Protection Circuitry:

The Advantage incorporates surge and transient suppression circuitry on its power, input and output circuits to protect sensitive internal electronic components from electrical disturbances which are common to the application environment. The suppression circuitry forms a classic filter and clamp network. Typical examples of the input and output network's suppression circuitry are shown below in Figures 4A through 4D. The clamping components used are chokes, varistors and TVS diodes. These components protect internal components by blocking large and rapid voltage changes or conducting current when their clamping voltage is exceeded. The components are capable of handling large amounts of power but only for the very short duration typical of transients. It is therefore necessary when doing hi-pot testing, to disconnect the circuits under test from the Advantage to prevent damage to these components. Advantage internal circuit integrity can be verified using megger testing. When doing megger testing, set the applied voltages below the voltages shown in Figures 4A - 4D in order to avoid false indication of low insulation resistance.

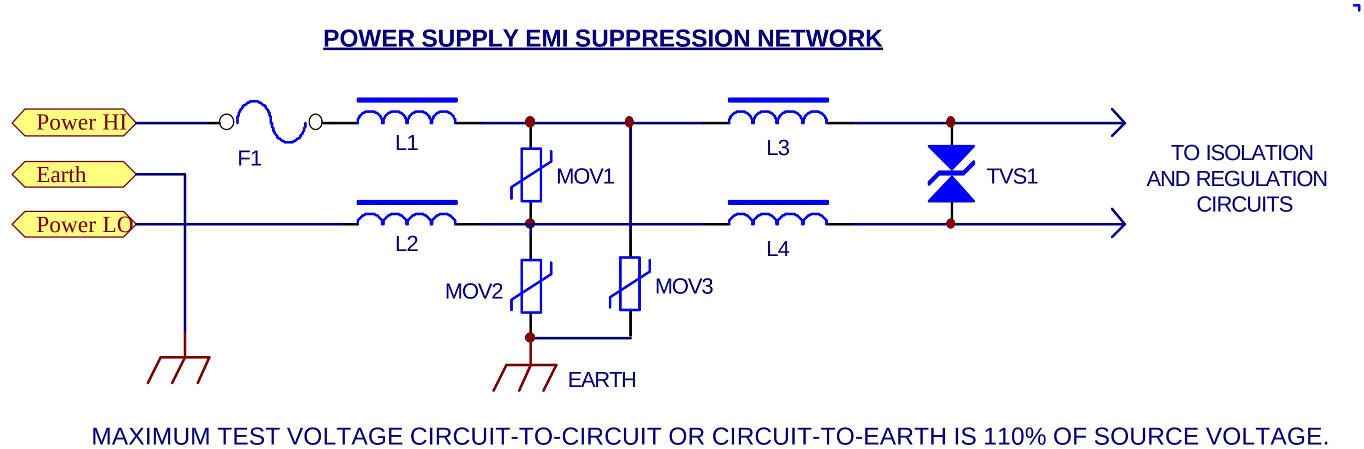


Figure 4A. Power Suppply Input EMI Suppression Network

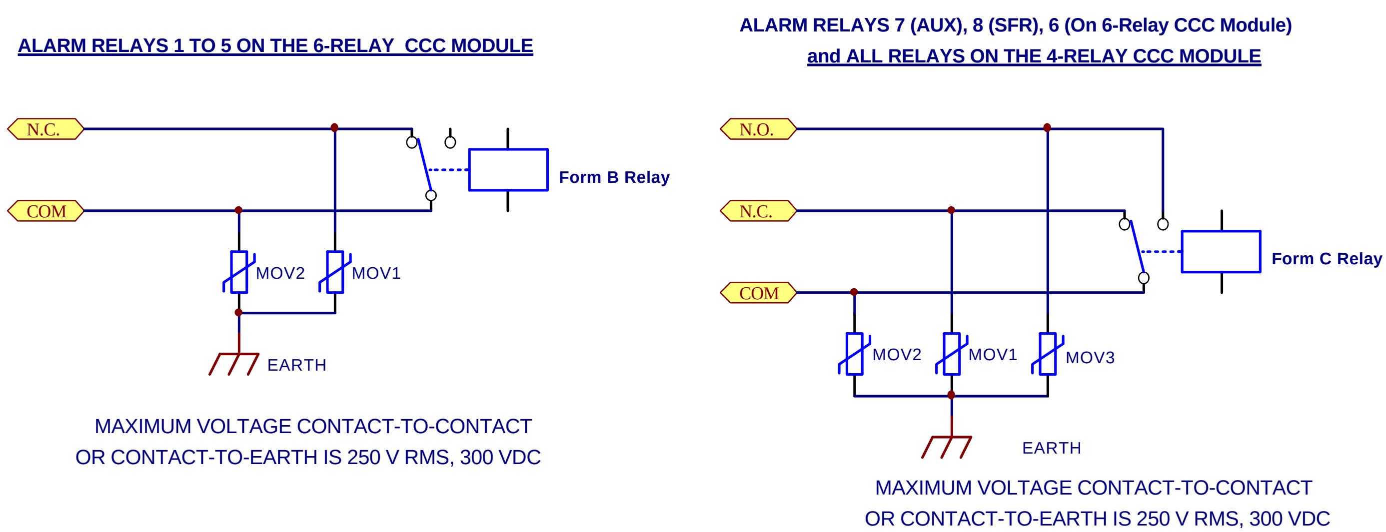
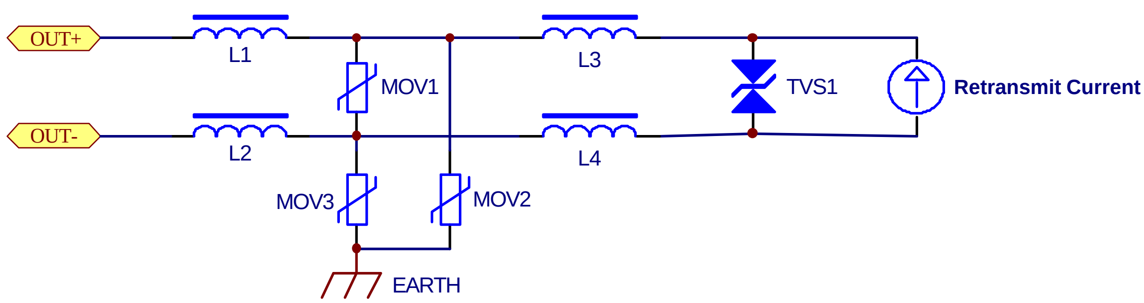


Figure 4B. Alarm Relay EMI Suppression Networks

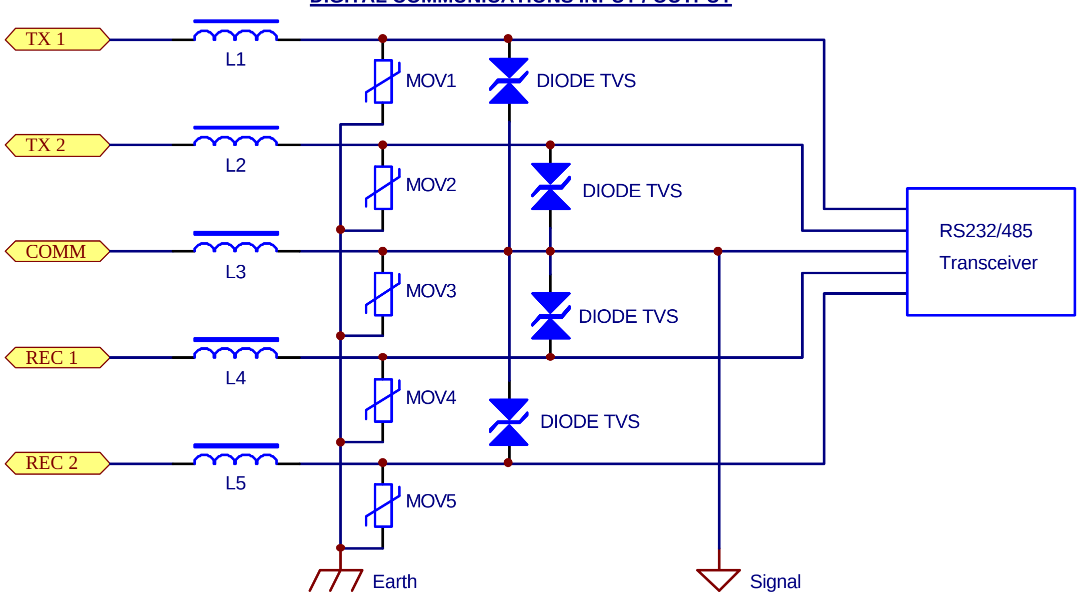
ANALOG RETRANSMIT CURRENT LOOP OUTPUT



MAXIMUM TEST VOLTAGE OUTPUT-TO-OUTPUT OR OUTPUT-TO-EARTH IS 24 VOLTS.

Figure 4C. Analog Retransmit EMI Protection Network

DIGITAL COMMUNICATIONS INPUT / OUTPUT



MAXIMUM TEST VOLTAGE INPUT OR OUTPUT TO EARTH OR SIGNAL GROUND IS 12 VOLTS

Figure 4D. Digital Communications EMI Protection Network

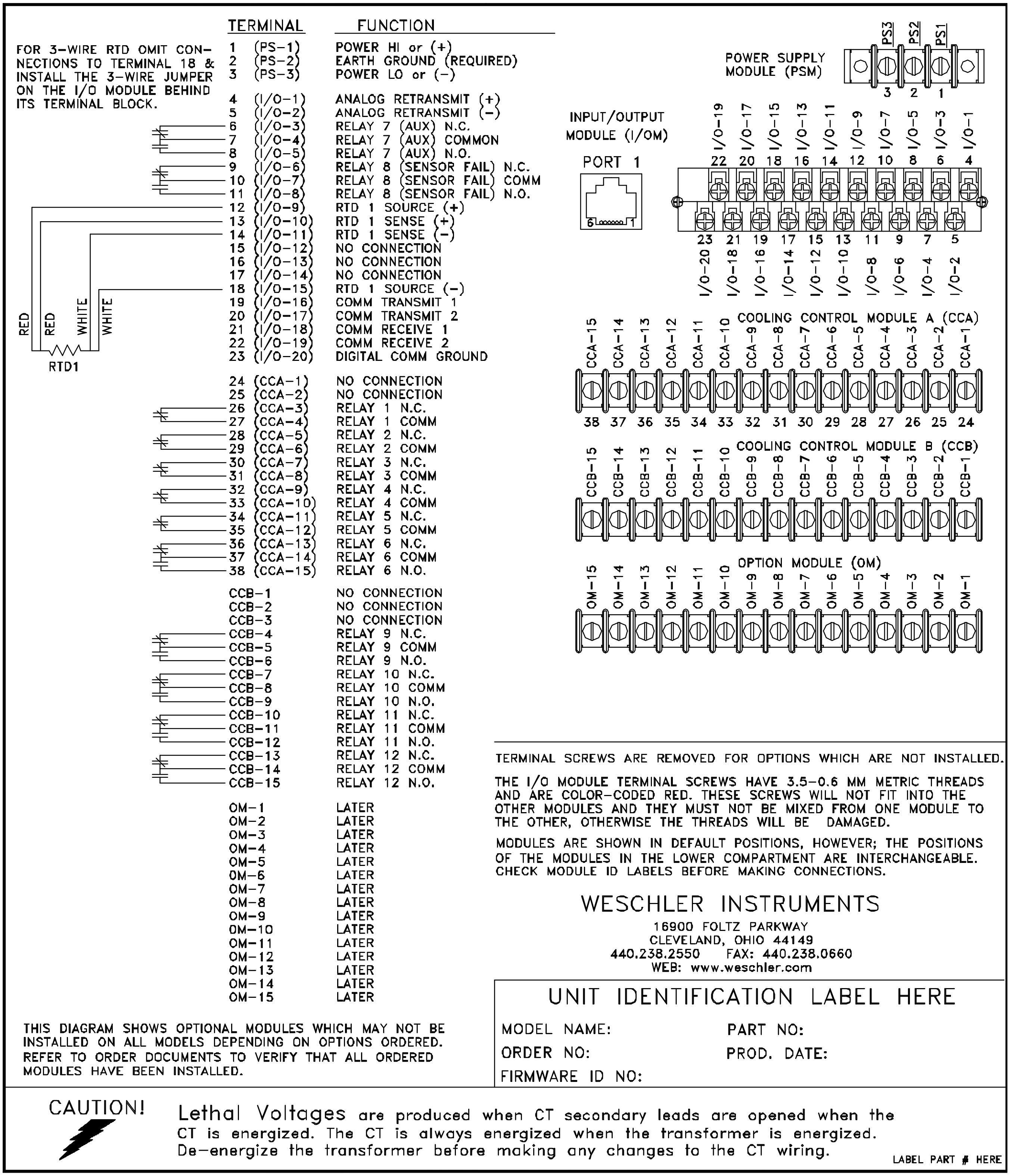


Figure 5A. Terminal Assignments and Locations. SC Models with 6/0 or 6/4 Relay C[3] Module

Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

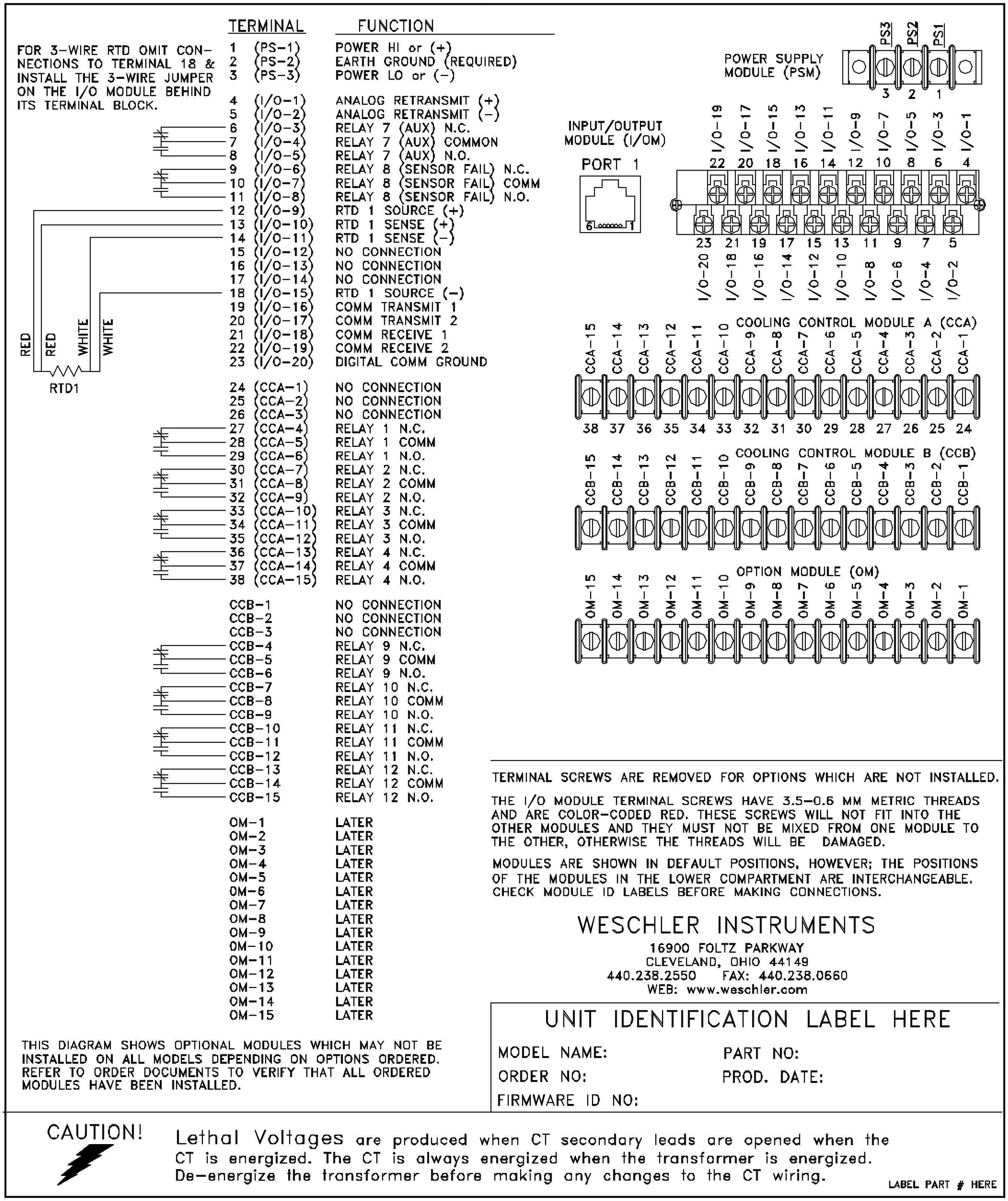


Figure 5B. Terminal Assignments and Locations. SC Models with 4/0 or 4/4 Relay C^3 Module

Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

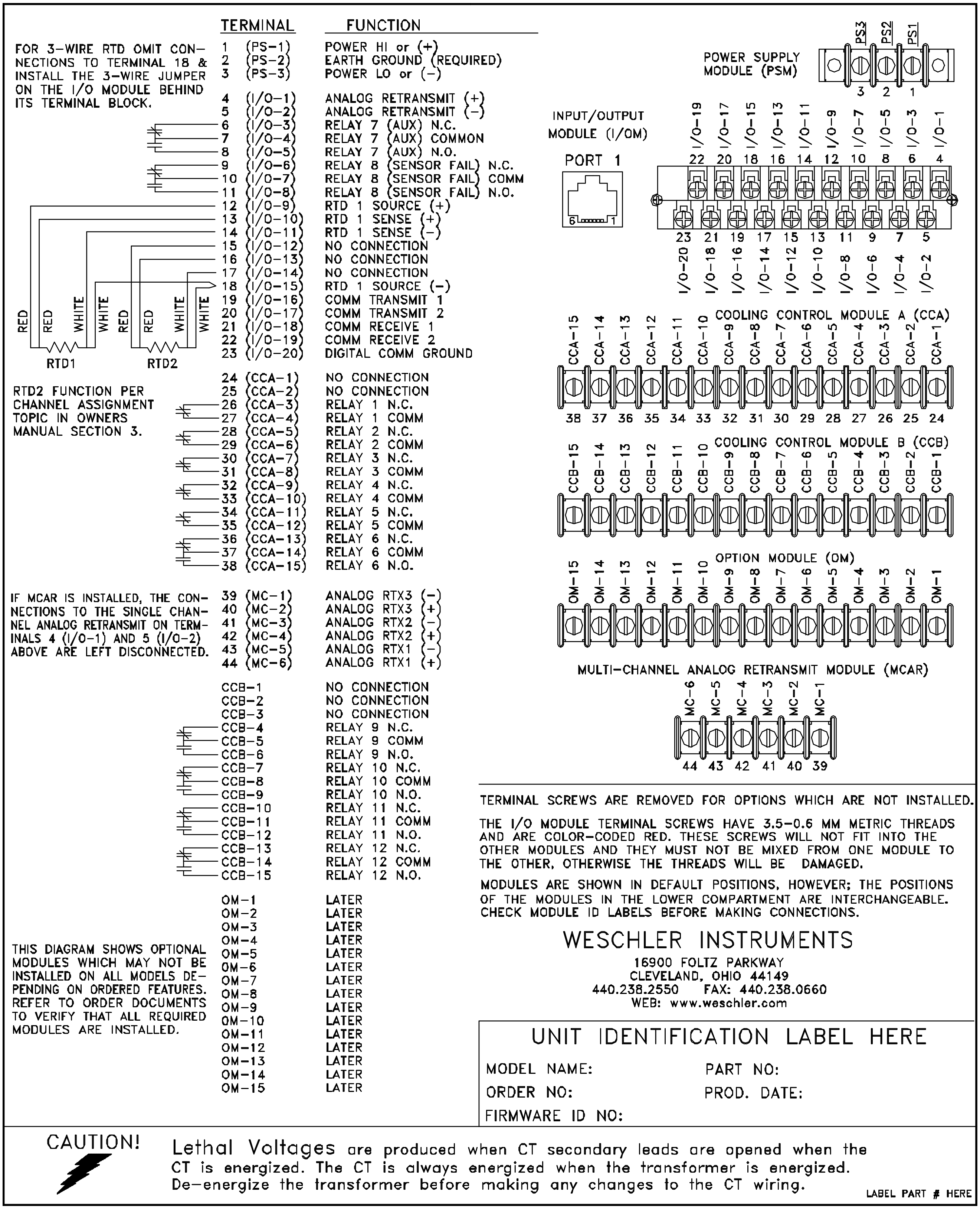


Figure 5C. Terminal Assignments and Locations. DC Models with 6/0 or 6/4 Relay C^3 Module

Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

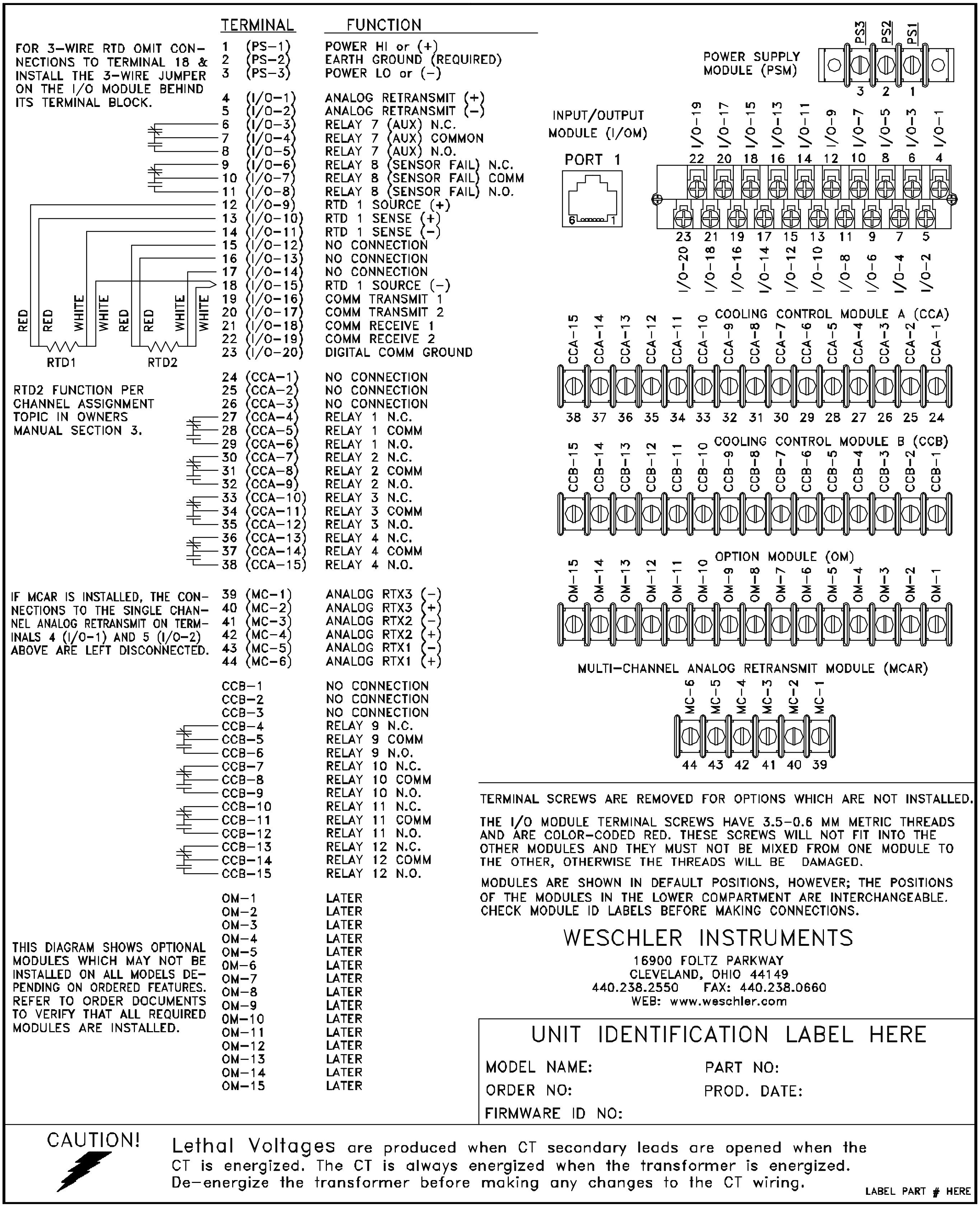


Figure 5D. Terminal Assignments and Locations. DC Models with 4/0 or 4/4 Relay C³ Module
Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

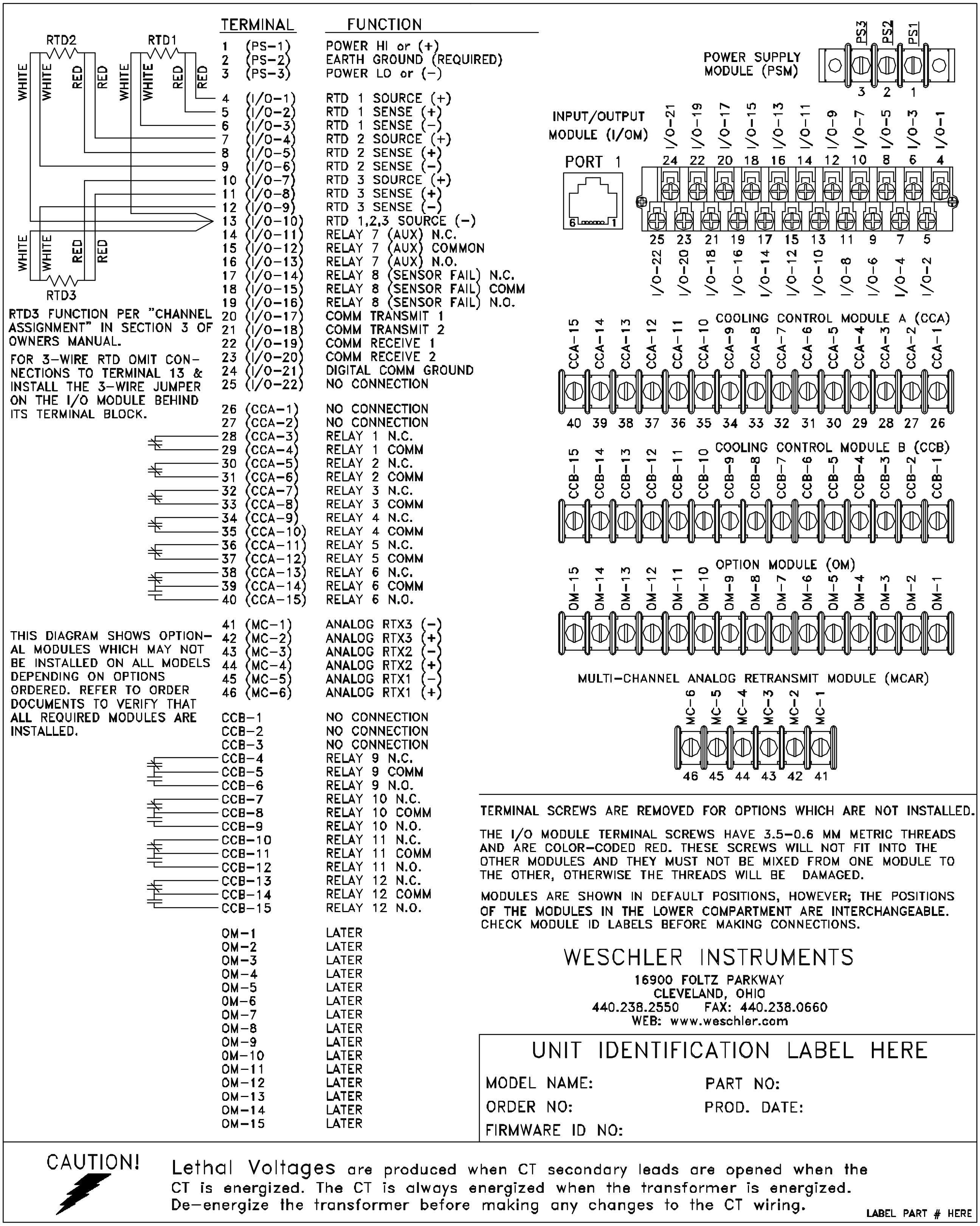


Figure 5E. Terminal Assignments and Locations. TC Models with 6/0 or 6/4 Relay C^3 Module

Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

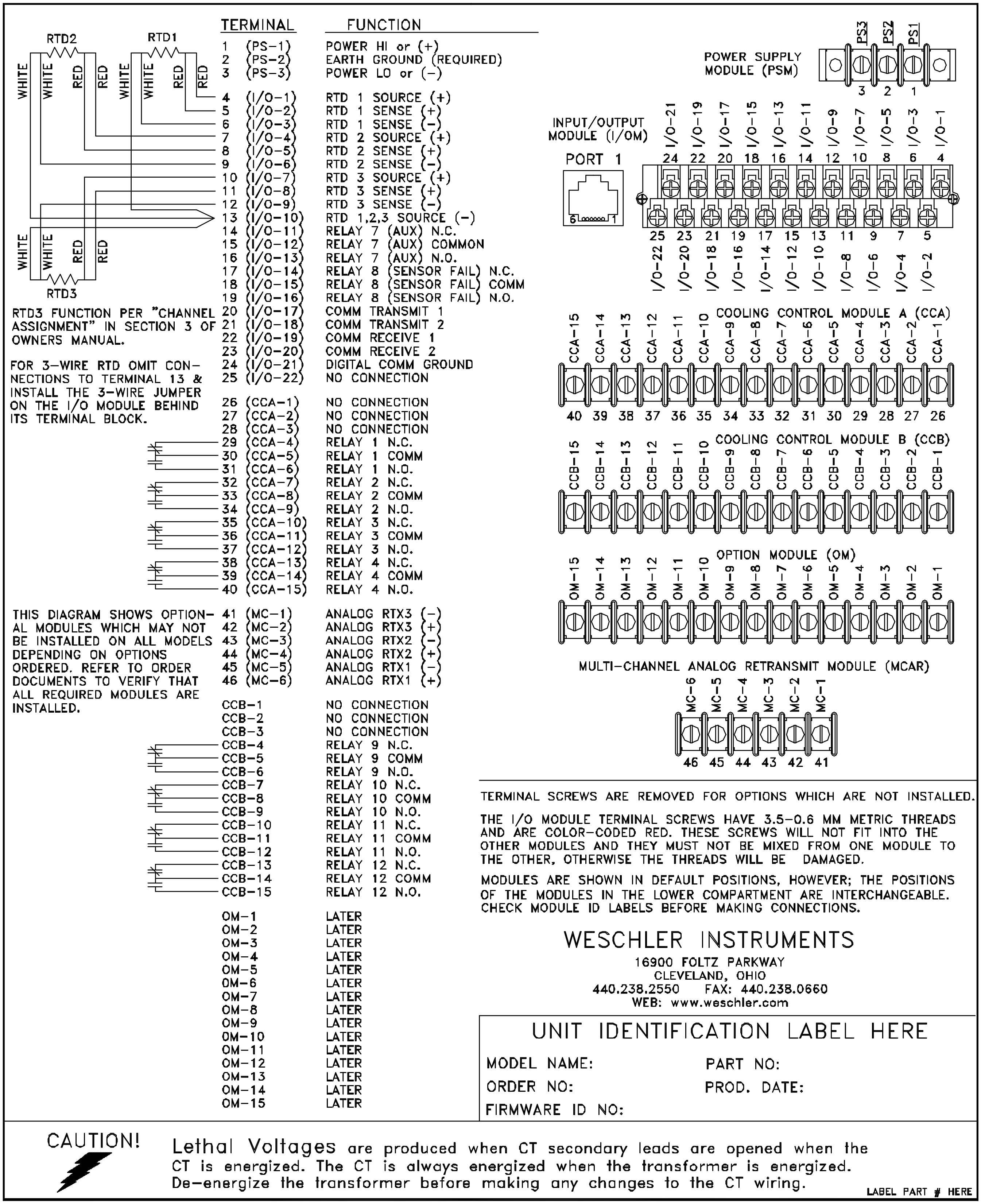
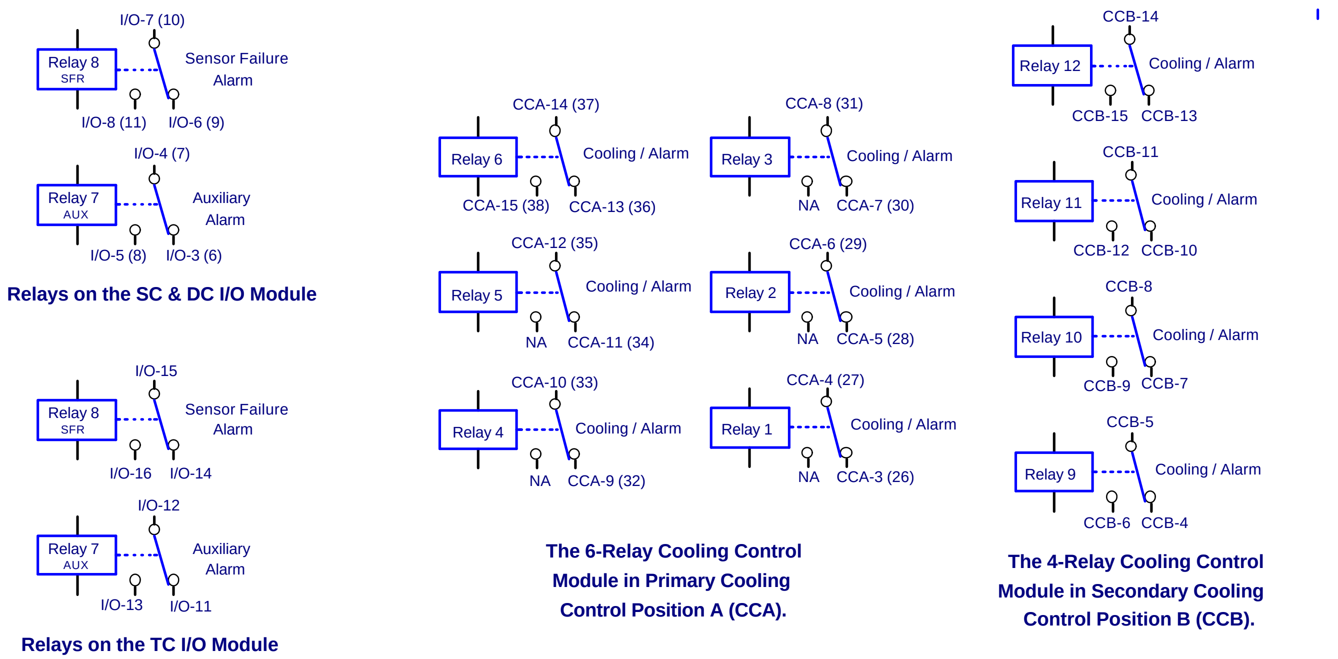


Figure 5F. Terminal Assignments and Locations. TC Models with 4/0 or 4/4 Relay C[3] Module

Terminals are dual marked to meet present convention and planned future expansion. Pay special attention to the note on the diagram regarding terminal screw threads.

Relay Configurations in the 6 Relay / 4 Relay (6/4) Dual CC Module Scheme

Note that when a Single CC Module is Ordered it is Installed in the Primary Cooling Control Position A (CCA).



Relay Configuration in the 4 Relay / 4 Relay (4/4) Dual CC Module Scheme

Note that when a Single CC Module is Ordered it is Installed in the Primary Cooling Control Position A (CCA).

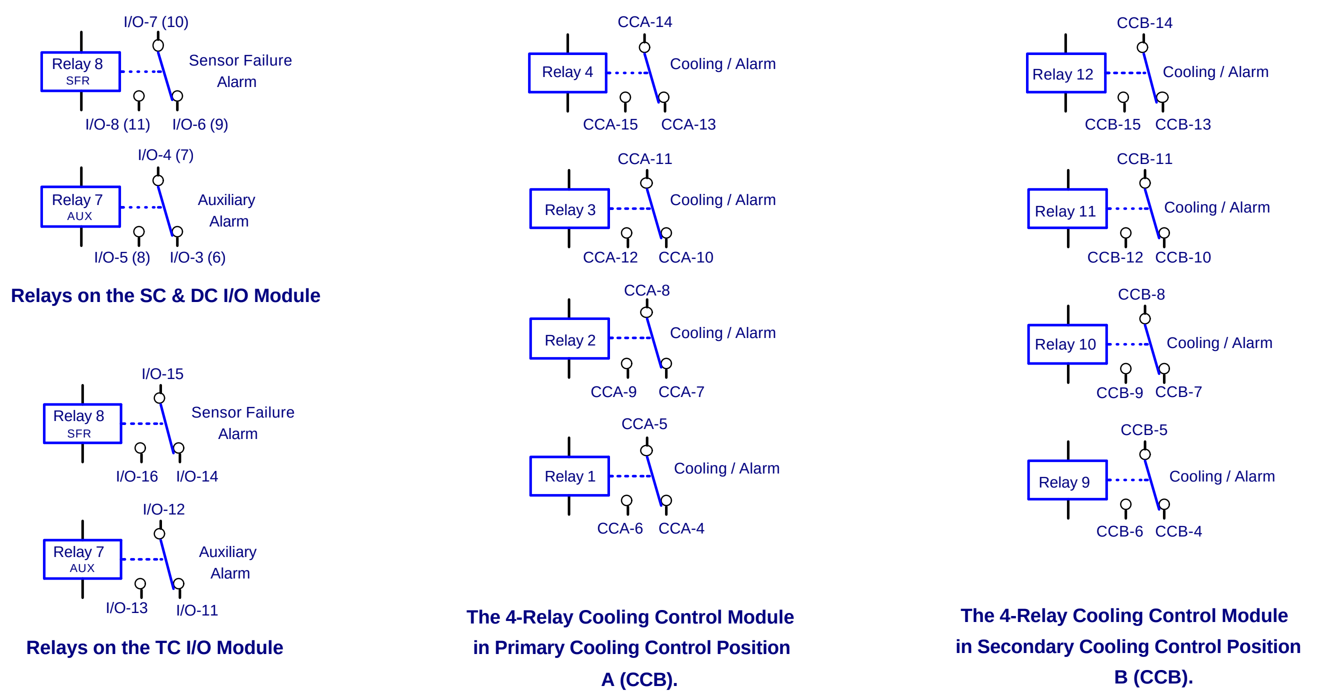


Figure 6A. Relay Combinations Using 6-Relay and 4-Relay Cooling Control Modules

This figure shows both CC modules and the maximum number of installed relays per module. Not all Advantage models will be equipped with both CC modules nor all relays per module. All relays are shown in their normal state, which is also referred to as the de-energized state. Terminal numbers in parentheses are from the legacy terminal numbering system.

Relays Below are Shown with the Sensor Fail Function Turned On (SNFAL = "ON").

If the Sensor Failure Function is Set to off (SNFAL = "OFF") the Relay Will Remain in its Currrent State when a Sensor Failure is Detected.

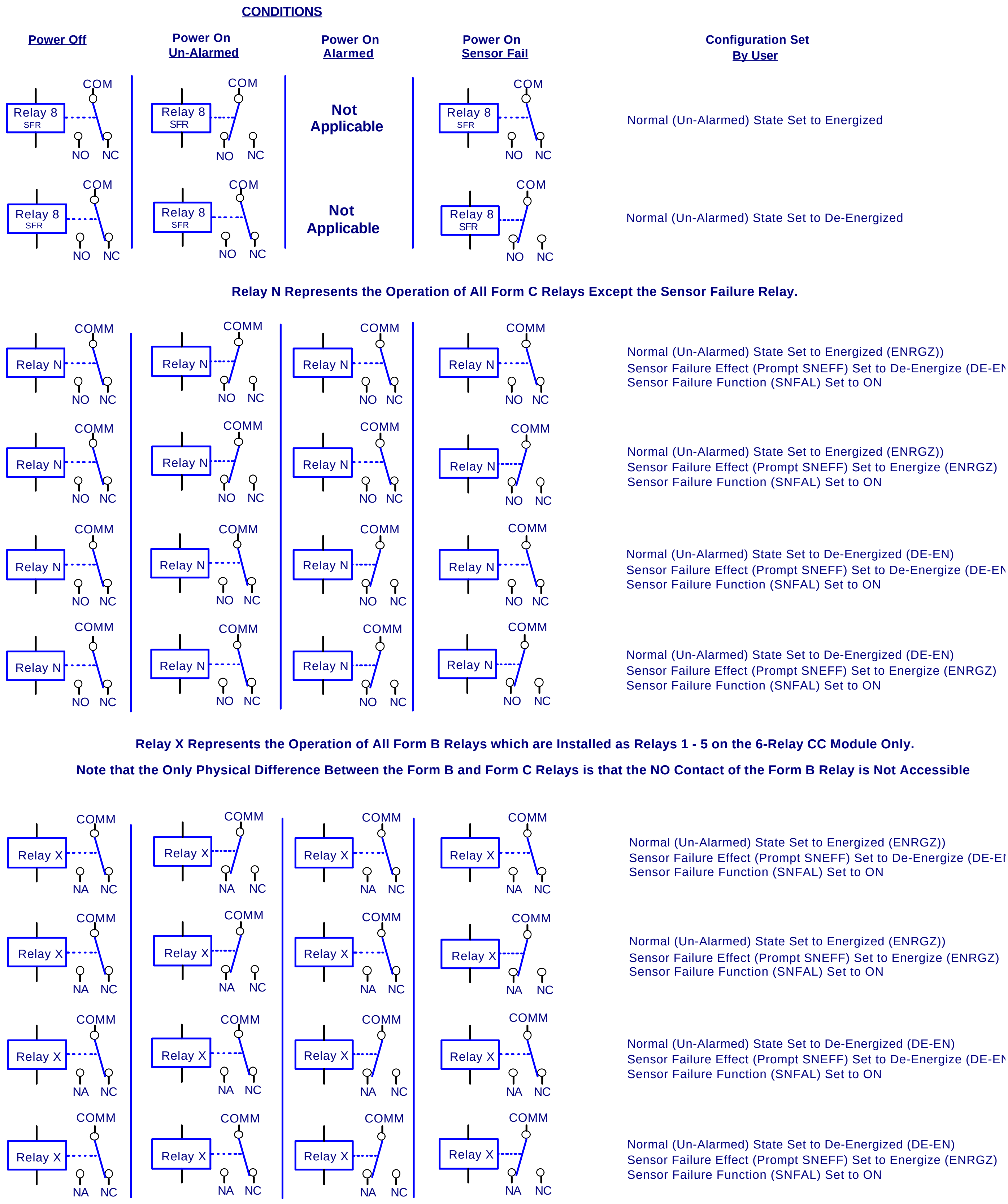


Figure 6B. Relay Operation for Various Alarm and Power Conditions

4.0 Configuration

Supervisory Setup

The supervisor setup routine, also referred to as the configuration loop, is used to configure parameters which will fit the advantage to the application and transformer being monitored. The keystroke diagram of figure 7 summarizes the steps required to enter the configuration loop. Figure 8 is the summary keystroke diagram of the main configuration loop. Figures 9A to 9C are the detail keystroke diagrams of the main configuration loop.

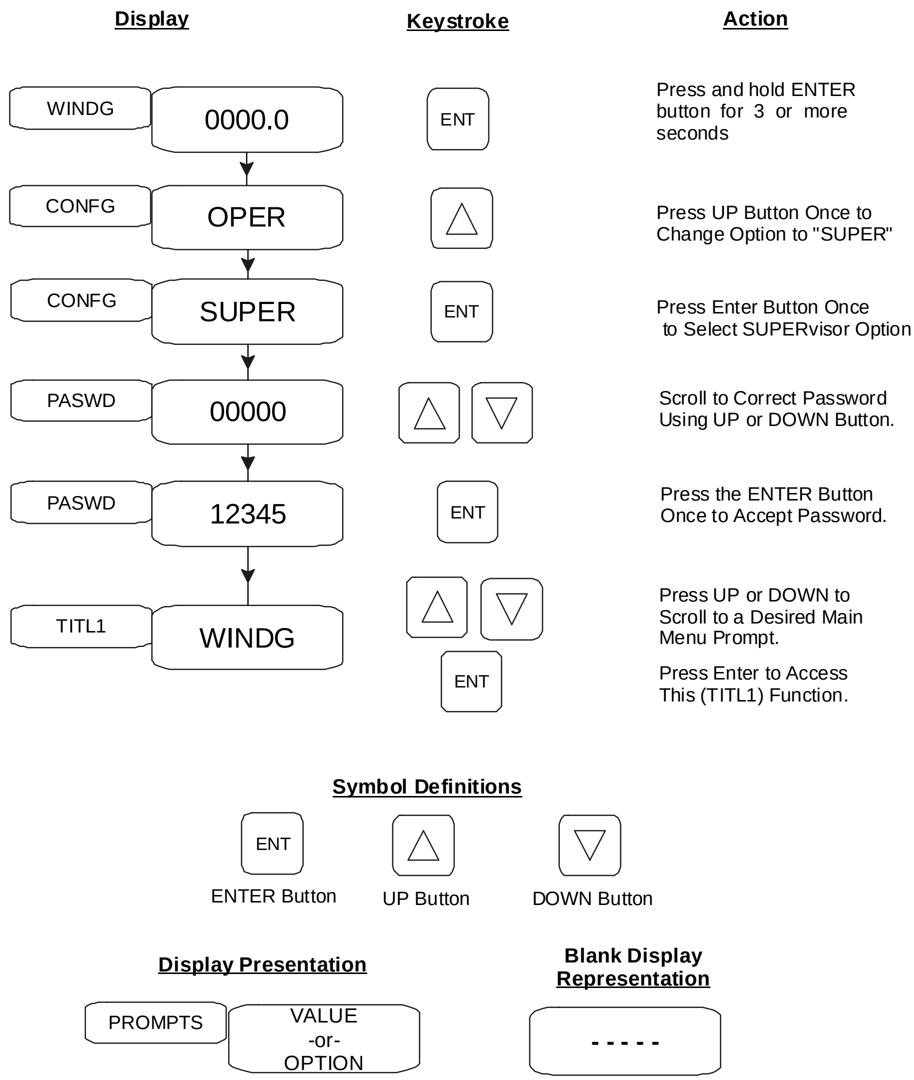
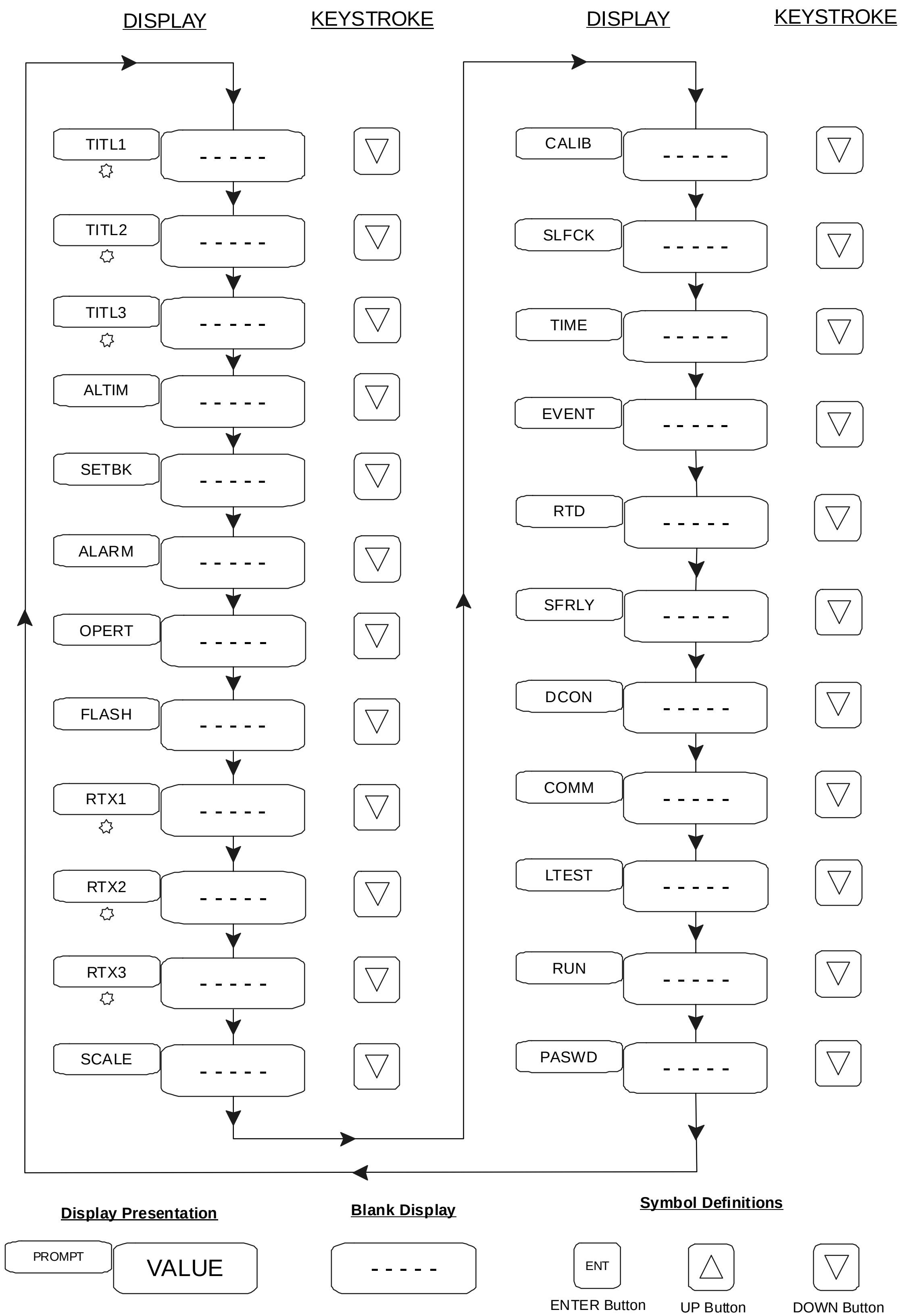


Figure 7. Configuration Loop Entry Keystroke Diagram

Figure 7 illustrates the conventions used in all keystroke diagrams. The display presentation corresponds to the actual front panel display, as also shown in Figure 1A. In the main configuration loop, the prompt display contains the name of the menu below it. When the menu is entered, the prompt display may change to a context sensitive display, to guide the user in his or her selection. The value / option display shows a list or range of values the user can select. If the value / option display is blank while navigating the various menus this means the user is in the main loop.

The UP and DOWN buttons are used to switch between option choices or increase or decrease numeric values. Using these buttons is referred to as "scrolling" to a value or choice. The ENTER button is used to accept a value or option and move on to the next menu item. The enter button may also be used to step through the menu items without changing any values.



✩ Only menu items TITL1 and RTX1 can appear in single channel (SC) models. Menu items TITL1, TITL2, RTX1, RTX2 & RTX3 can appear in dual channel (DC) models. Triple channel (TC) models can display all three title and retransmit menu items. The menu item(s) for disabled retransmit channel(s) will not be displayed.

Figure 8. Main Configuration Loop Summary Keystroke Diagram

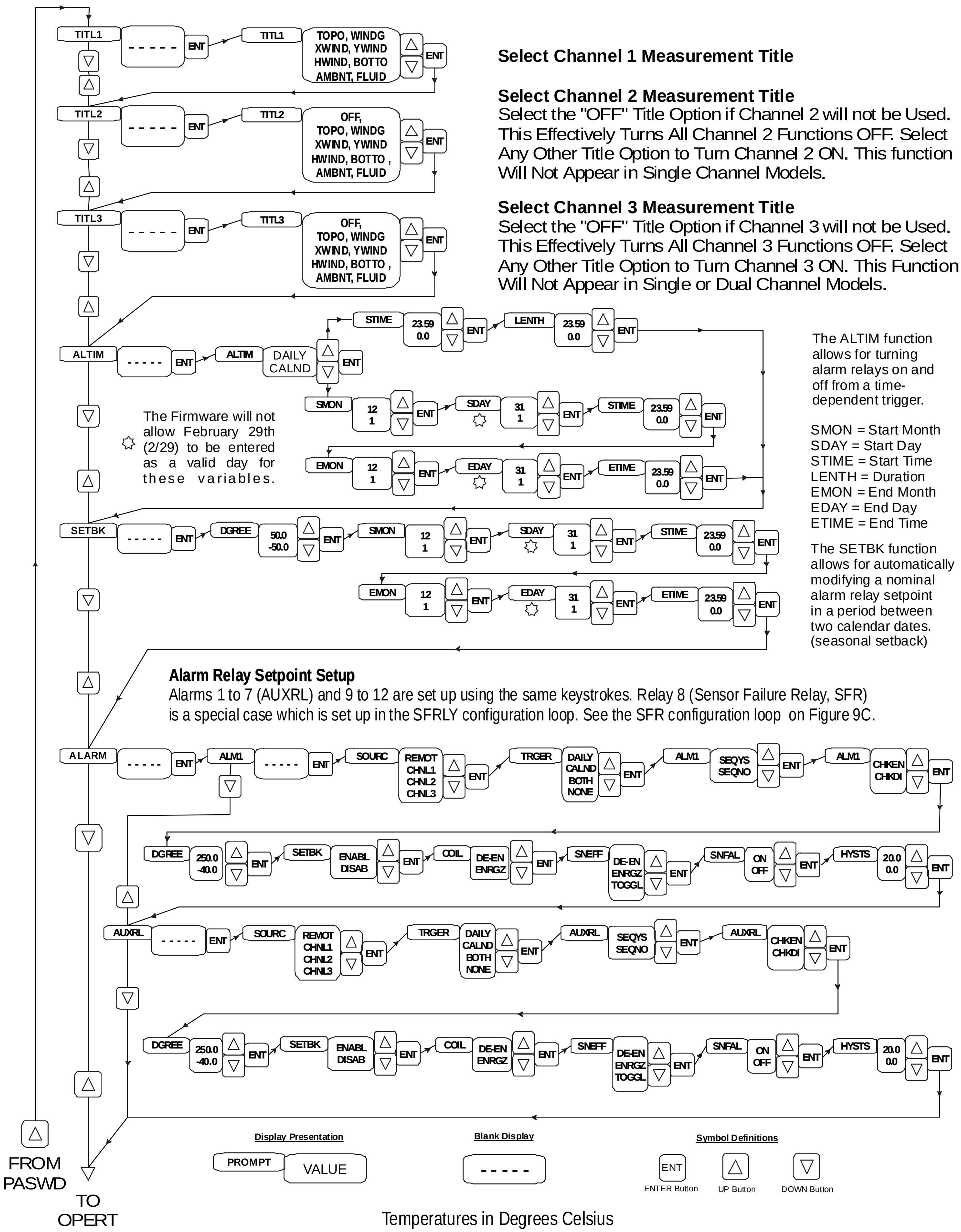


Figure 9A. Main Configuration Loop Detail Keystroke Diagram

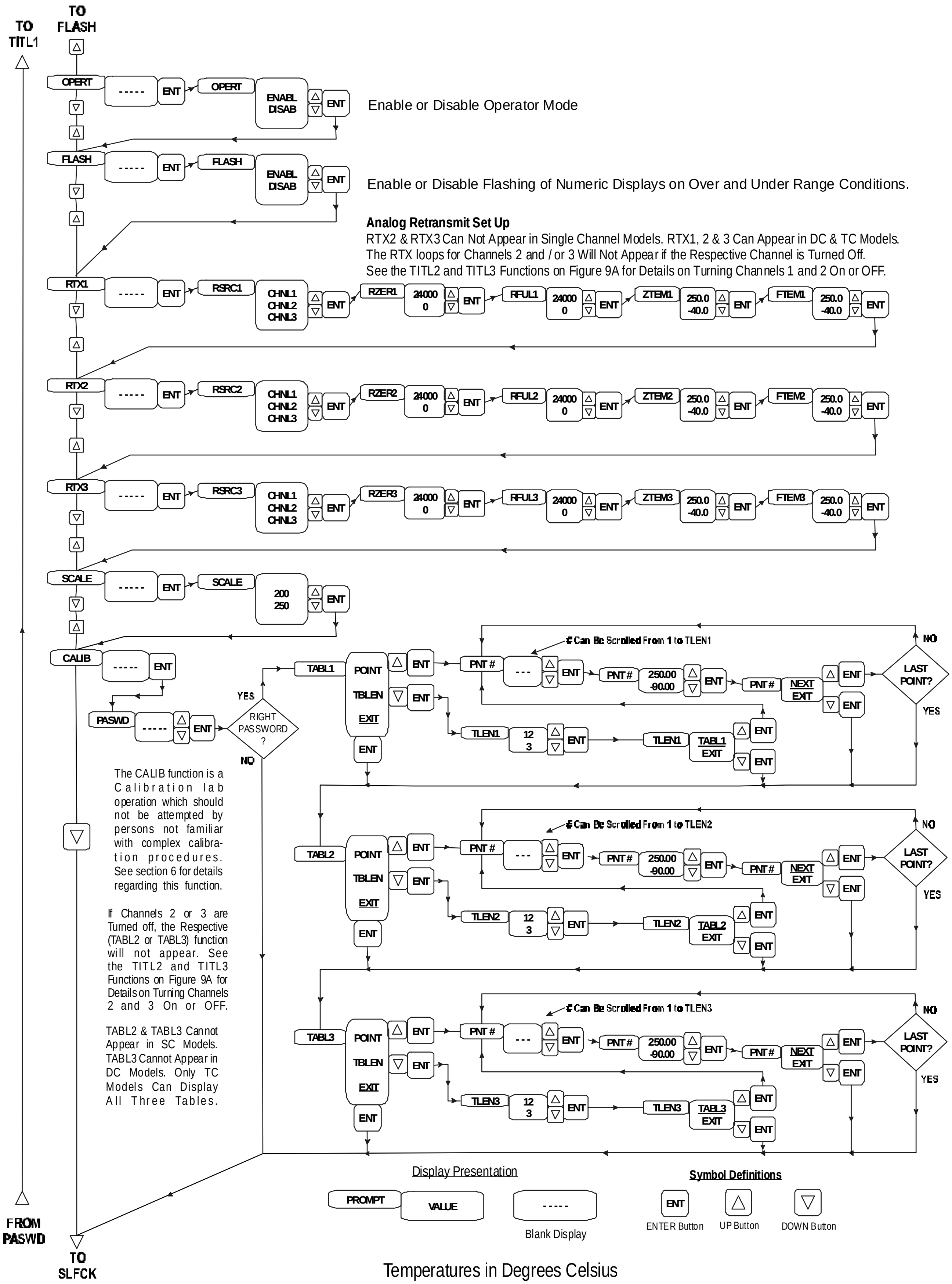


Figure 9B. Main Configuration Loop Detail Keystroke Diagram (continued)

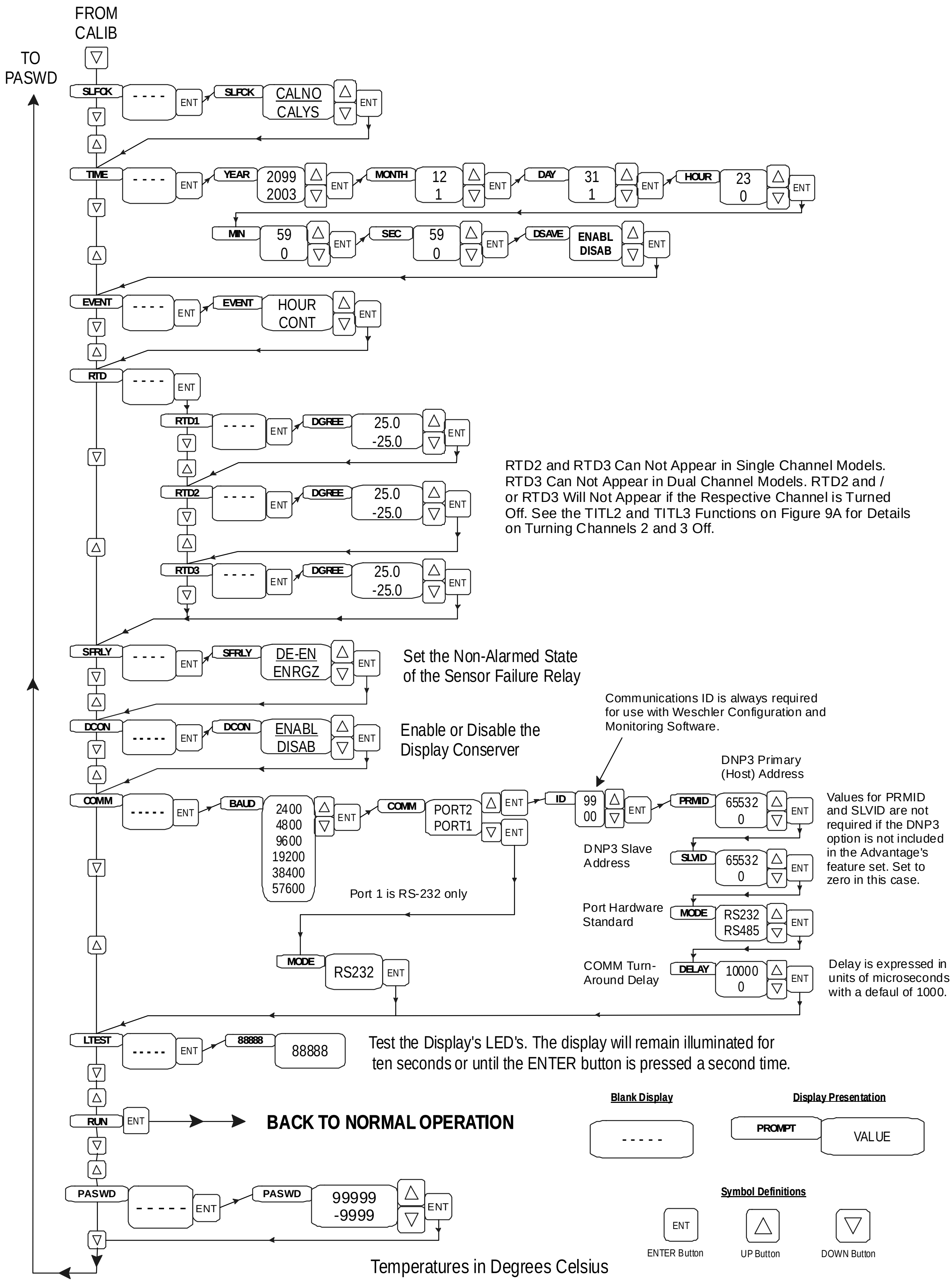


Figure 9C. Main Configuration Loop Detail Keystroke Diagram (conclusion)

Keystroke by Keystroke Guide to Setup

This guide describes operation of the functions and options available in the various front panel menus. It is structured and sequenced in the same order as the keystroke diagrams for a direct reference as values are entered. The descriptions and recommendations are the same for those using the configuration software, but since the software allows the user to enter data in a more random fashion, more attention should be paid to the front panel sequence if using the software for the first time.

For brevity, the main configuration set up loop is referred to as the main loop.

Prompt PASWD, Password Loop

The password function is the gateway which protects the entry to the main loop. This security feature is intended to prevent unauthorized alteration of critical applications data. The factory default password is 0 (zero). When the user first powers the unit the password function will be bypassed. After setting up the user and alarm items, the user can return to the password loop and change the password if desired.

The password can be any numerical value between -9999 and 99999. To change the password you must first gain access to the main loop. Refer to Figure 7 for access to the main loop. If the password has not been changed, it will be zero, the factory default. Simply press enter when the “0" appears in the value display. If the password has been changed, and you know what it is, scroll to that value and press enter. If you do not know the password, contact Weschler sales (440) 238-2550 and request the password key. Once the password has been accepted, the prompt display will show “USER”. Press the UP button to scroll back to the PASWD function, then press the ENTER button. Using the UP or DOWN button, scroll to the new password, record the new password and press enter to accept it.

Any time after the password has been changed the user will need to enter the correct password to gain access to the main loop.

Prompts TITL1, TITL2 and TITL3, Channel Titles

The channel title loops are provided to allow users to define what is being measured on the 3 RTD inputs. There are 7 options for the TITL1 menu option and 8 options for TITL2 and TITL3. As the names imply, TITL1 applies to channel 1, TITL2 applies to channel 2 and TITL3 applies to channel 3.

Option	Description	Applicability	Option	Description	Applicability
OFF	Turns Channel Off	DC: CH2 Only TC: CH2 or CH3	YWIND	Wye Winding Temp	CH1, 2 & 3
TOPO	Top Oil Temp	CH1, 2 & 3	HWIND	H Winding Temp	CH1, 2 & 3
WINDG	Winding Temperature	CH1, 2 & 3	BOTTO	Bottom Oil temp	CH1, 2 & 3
XWIND	Ex Winding Temp	CH1, 2 & 3	AMBNT	Ambient Temperature	CH1, 2 & 3

The titles function places a title in the prompt display for the reference of operators. The titles which are shown are defaults; other titles may be added for a small fee; consult the Weschler Sales Department for details

If channel 2 or 3 or both are not being used for temperature sensing, the “OFF” option must be chosen, to suppress all channel features.

Prompt ALTIM, Alarm on Time

The ALTIM menu loop provides for time-based control of cooling auxiliaries. It has two sub loops, DAILY and CALND.

The DAILY loop is intended for users who want to operate an alarm relay at the same time, and for the same period, each day. The user has controls for trip time in hours and minutes and length of the operate period. This feature is used to exercise fans and pumps to keep bearings and seals in shape, to discourage the ingress of various animals (critter control) and to activate a cooling stage during a known daily high demand period.

The CALND loop is intended for users who need to operate an alarm relay for an extended period of time which typically spans months. This is typically employed when a utility needs to run a cooling stage continuously during a certain period of the year when a high demand is expected day and night. These two features allow a user the choice of running one stage on a daily basis and another on a seasonal basis. The CALND sub loop allows the user to set relay operate periods using start and end times in months (SMON)/EMON), days (SDAY/EDAY) and hours and minutes (STIME/ETIME). The month number is limited to 12 and the day number is limited to the actual number of days in the particular month. For example, If a user enters 31 or a higher number for the day number in month number 4 (April), the firmware will correct the day number to 30. The leap year day of February 29^{th} is similarly not supported. The firmware will enter 28 as the valid day number if “2" is set as the SMON or EMON variable and any number higher than 28 is entered as the day number.

The default settings for times in the ALTIM loop is zero hundred hours (0.0). This includes the “LENTH” variable in the DAILY sub loop. These settings will guarantee no alarm response if the user inadvertently selects a trigger source in the alarm loops but neglects to configure the DAILY and/or CALND settings. The default setting for months and days is “1".

The selected start and end months may span the new year without consequence.

It is important to remember that the ALTIM function is normally used in conjunction with the operation of the cooling apparatus. It is seldom used in conjunction with high temperature alarms. It is also important to note that the timing functions will act in concert with the set point function as far as operating a relay INTO the alarm state, but will not override a set point function with regard to dropping the relay out of the alarm state.

Prompt SETBK, Seasonal Setback

The SETBK function allows users to adjust temperature alarm settings to changing ambient conditions. When enabled in an alarm’s configuration loop, and when the actual date is between the configured start and end dates, the value of the SETBK function’s DGREE variable will be added to the value of the ALMX function’s DGREE variable to calculate the new alarm set point value.

If the SETBK function’s DGREE variable is set to a negative number, the new calculated alarm setpoint value will be lower than the original. If the SETBK function’s DGREE variable is set to a positive number, the new calculated alarm setpoint value will be higher than the original. While the result is the same, the SETBK function may be used to increase the temperature alarm value during the summer months (positive DGREE value) or decrease the temperature alarm value during the winter months (negative DGREE value).

The set back function’s time settings are divided into starting and ending specifications which bracket the effective period of operation. The prompts SMON (starting month), SDAY (starting day) and STIME (starting time-of-day) define the instant the period is to begin. The prompts EMON (ending month), EDAY (ending day) and ETIME (ending time-of-day) define the instant the period is to end.

The SETBACK function acts with the set point values and it can therefore be used with the alarm timing functions of the ALTIM loop with no conflict.

Prompt Alarm, Set Point Alarm Configuration Loop

This section describes alarm set up and function in detail. The first part of the section describes the choices available to the user and their functions. The second section covers general alarm terminology and operational explanations of the system alarms which the Advantage is equipped with. The alarm configuration loops are diagramed in Figure 9A, and this may be used as a map for option sequence. All alarms, except the sensor failure alarm, are set up using the same keystrokes and all functions operate the same. Note that each of the variables discussed in this section are configurable on an individual alarm basis and the settings of one alarm will not affect the settings for the others.

Prompt SOURC, Alarm Signal Source Variable

The SOURC variable allows for the choice of one of 4 options. They are CHANL1 (channel 1), CHANL2 channel 2), CHANL3 (channel 3) or REMOT (a signal lock-out, not a true signal). When any one of these except REMOT is selected, Advantage uses the signal value for that channel for comparison to the set point value.

The REMOT signal source is intended to make the alarm being configured responsive to a remote digital command only. When this option is chosen, all other parameters for this alarm number are ignored.

Prompt TRGER, Time-Based Alarm Trip Sources

The DAILY and CALND sub-loop names are also used as auxiliary alarm sources in the alarm set up loops. These auxiliary sources are referred to as trigger sources to differentiate them from the auxiliary alarm and the standard alarm sources. A user may elect to set up the DAILY and/or CALND settings globally in the ALTIM loop and then elect to use either of them as a trigger source.

You can use both the DAILY and CALND variables as trigger sources in the same alarm and these may be used in conjunction with the standard alarm sources. Thus, If the standard alarm source is set to winding and the trigger source is set to "BOTH" the alarm's relay will operate when the winding temperature exceeds its setpoint or the daily trigger time has arrived or the actual date is between the start and end dates. This can be used by utilities to turn on one stage during a high daily loading period in a season when load is not generally high, and turn on the same stage 24 hours a day when the seasonal load is generally high.

The default setting for the TRGER variable is "NONE". This setting disables time based alarm operation for the individual alarm.

Prompt ALM1 to ALM12 and AUXRL, Alarm Sequencing Variable

The alarm sequencing function offers a choice of two options; SEQYS, (sequence yes) which turns the function on and SEQNO (sequence no) which turns the function off. Alarm sequencing provides a rotation scheme whereby alarms with a common alarm source will alternate duty when alarms at different set point levels turn on and off. The most frequent use of this function is to alternate fan or pump stages during cooler weather such that all cooling equipment is exercised more or less equally.

It is recommended that all alarms which are not used for cooling have this function turned off. The danger is if the function is turned on for a particular alarm number, and that alarm is used for a high winding temperature warning, the relay assigned to that alarm number would operate in rotation with other relays with the winding temperature alarm source and the alarm would eventually be tripped by a set point which is lower than the desired value.

Prompt ALM1 to ALM12 and AUXRL, Alarm Check Variable

The alarm check function offers a choice of two options; CHKEN, (check enable) which turns the function on and CHKDI (check disable) which turns the function off. This function allows operators to set the alarms to their alarm state temporarily in order to check their operation.

The operator checks the alarms by entering the operator mode, which is not password protected, scrolling to the appropriate alarm and selecting the TEST option when prompted. The alarm will stay in the alarm state for 45 seconds, or until the operator presses the enter button a second time.

Prompt DGREE, Set Point Value Variable

The alarm set point function provides a range of temperature measurement values from -40.0 to 200.0 °C. An alarm signal will be sent to the relay when the measured temperature is more positive than this set point value.

Prompt SETBK, Seasonal Setback

This variable provides for enabling the seasonal setback function on an individual alarm basis. The parameters that govern the function must be set up in the SETBK loop in order for this function to have an effect on the alarm. See “Prompt SETBK” above.

Prompt COIL, Relay Coil Un-Alarmed State Variable

The COIL function offers a choice of two options; DE-EN, (de-energized) which shuts off power to the relay coil in an un-alarmed condition; and ENRGZ (energize) which applies power to the relay coil in an un-alarmed condition. These two choices are provided in order to be able to set up fail safe relays. The option is available on all alarms except the sensor failure alarm.

Fail safe relays are used in several situations where an alarm condition and some otherwise unrelated failures would require the relay to move to its alarm condition. Examples of unrelated failures would be any cause of power interruption to the relay coil, such as hardware or instruments power failure, or some forms of firmware malfunction. If the relay is configured with the COIL variable set to energized, the normal or unalarmed state would be energized, meaning the relay would be picked-up in an unalarmed state. Any interruption in power to the relay coil, due to the above events, will cause the relay to drop out. If the contacts which are normally closed with the relay de-energized, are used for the alarm it will be configured for failsafe operation.

Prompt SNEFF, Sensor Failure Effect Variable

The sensor failure effect function provides a choice of three options; DE-EN (de-energize), ENRGZ (energize) and TOGGL (toggle) for all alarms except the sensor failure alarm itself. The options allow the user to specify that a relay coil will de-energize, energize or change to the opposite state respectively, whenever a sensor or internal failure is detected. Normally this option allows a user to coordinate the alarm state of a relay due to a planned event with an unplanned sensor failure event. The TOGGL function can be used as a signal to run a mean-time-between failures timer. This function cannot operate unless the next variable, SNFAL is set to ON.

Prompt SNFAL, Sensor Failure Enable Variable

The sensor failure enable function offer two options, ON and OFF. This function determines whether a relay will or will not respond to a sensor failure event. This is used frequently in station trip lock-out schemes to prevent a station trip relay form operating in the event that a sensor failure occurs. Selecting the OFF option fro a particular relay will nullify the effect of the SNFAL variable for that relay.

Prompt HYSTS, Alarm Hysteresis Variable

The hysteresis function allows two ranges of values; from 0.0 to 20.0 °C for temperature measurement or 10 to 200 amps for current measurement.

When referred to set point operation, hysteresis is the magnitude, or amount, that a signal or process value must retreat from an alarm condition, to cause the alarm to reset.

This definition is concise and correct for all types of alarms, but it still may not help visualize the implications of the term. If, for example, an alarm is set for 55 °C and the process temperature reaches 55 °C, you would rightfully expect the alarm to operate. Let's assume that the alarm is connected to a cooling device and when the alarm operates, the cooling equipment turns on and the temperature immediately drops to 54.9 °C, shutting the cooling equipment down. Depending on the heat source, the temperature might immediately rise, the cooling equipment would again operate and the cycle would continue endlessly until the heat generated was greater than the heat removed, the heat source subsided or, of course, the cooling equipment broke down.

Let's now assume that a hysteresis value of 2 degrees was set and that the heat-up rate is 0.1 degree / minute and the assisted cool-down rate is 1 degree / minute. Now when the same 55 °C set point is exceeded the cooling equipment will run for 2 minutes to cool the apparatus to 53 °C and will remain off for 20 minutes as the equipment warms back up to 55 °C. See the connected equipment paragraph above for more information on how pumps affect cooling equipment cycling.

Alarm Conventions

The convention used to describe alarms is three dimensional, meaning alarms can be active or inactive, they may be in or out of an alarm condition and they provide an energize or de-energize signal to their assigned relay. An alarm which is active for a particular set point means the hardware assigned to it will respond physically in the event of an alarm condition. This physical response is typically referred to as relay "operation"; which is any change in contact state, regardless of initial or final position. Relay contact state will be further described in the section below on relay module hardware. An ALARMED condition merely means the set point value has been exceeded. An UN-ALARMED condition means the set point value has not been exceeded. Hysteresis plays a part in this definition, and an explanation shall be covered below. The energize or de-energize signal provided by the alarm instructs the relay drivers to physically apply or turn off power to the coil of the relay assigned to the alarm. Industry practice describes an energized relay as being picked up and a de-energized relay as being dropped out.

Sensor and Internal Failure Alarm Function

The sensor and internal failure alarm is provided to allow the user to remotely signal a sensor ***or*** internal failure event. Terminal connections are provided for all 3 contacts in the form C configuration. The only program option for this relay is the un-alarmed coil state (energized or de-energized). Its set up is performed by following the keystrokes of Figure 9C. The Advantage contains circuitry and logic which continuously monitors the sensor and internal functions for correct operation. If a gross malfunction of the sensor, such as an open or shorted condition occurs, the alarm causes the sensor failure relay (SFR) to operate and the alarm signal is made available to the other alarms.

When an internal or sensor failure is detected, an alert signal is sent to the sensor failure relay (SFR) to operate and a second alert signal is sent to the alarm relay logic indicating that a failure has been detected. The sensor failure relay's alert signal envelopes the alarm relay signal such that the SFR will change to its alarm state one second before the alarm relay and the SFR will be released from its alarm state one second after the alarm relay. This allows the SFR to supervise the action of the alarm relay(s) for complex protection schemes such as automatic station tripping.

Sensor and Internal Failure Alarm Troubleshooting

The Advantage has been designed to detect failures in itself and its sensors and report the failures in the form of unique display annunciation.

Sensor Failure Events

Sensor failures typically fall into the category of one or more open or shorted leads, and more rarely an open sensor chip. All of these failures would result in very high or low erroneous indications if not detected. The Advantage contains circuitry and logic which traps these types of indications and displays the message SENS1 FAIL, SENS2 FAIL or SENS3 FAIL, depending on which channel's sensor failed. Refer to figure 11 in section 5, Operation, for an illustration of the actual displays. When the failed sensor is replaced, the display will resume normal indication. Recalibration of the Advantage after sensor replacement is not necessary, but it would be wise to check the new sensor's function after it is replaced.

Internal Failure Events

Internal failures may be due to damage caused by exceptionally high transient surge levels or component random failure or drift. The entire sense circuit, from the amplifiers and filters through the A/D converter is checked every 10 minutes for errors. The check is performed by automatic comparison to a known reference resistance (100 ohms). If the resulting measurement falls outside of a set tolerance band, the Advantage displays the flashing message INT1 FAIL, INT2 FAIL or INT3 FAIL depending on which channel has failed. Refer to figure 11 in section 5, Operation for an illustration of the actual displays. If this display appears, the INREF function in the operator mode loop should be run to see if the error is minor or major. Reference Figure 12 in section 5, Operation, for details on accessing the INREF function.

The temperature displayed when running INREF should be between -5.0 and +5.0 °C. If the temperature is within these limits, the error is minor and it can be corrected by running the SLFCK calibration function from the main configuration loop. Refer to Figure 9C and Prompt SLFCHK on page 35 for details on the SLFCK function. If the value is between +/-5 and +/10 °C and there is no prior note in the Advantage's maintenance log, component aging may be a factor. Make a note on the Advantage's maintenance log and perform the SLFCHK calibration function. If the INREF value is beyond ± 10.0 °C , component(s) damage may have occurred.

If the INREF values are beyond the ±10 °C limits for all three channels it is likely that one or more modules have become dislodged, or the A/D converter on the CPU module has failed. First check that all modules are firmly seated in their slots. If re-seating the modules does not solve the problem, the CPU module should be substituted with a new one. The CPU module is the top-most module in the upper cavity, behind the display module. Shut off power, replace the CPU module, re-power the unit and run the INREF function. If the problem is resolved, run the SLFCHK function, check the Advantage's calibration and return it to service. Return the failed CPU module to the factory for analysis and repair.

If the INREF value is beyond the ±10 °C limits for one or two channels, it is likely that component failure in the lower signal path is at fault. To isolate the cause of the problem, shut off power to the Advantage, substitute the I/O module with a new one and re-run INREF to see if the problem is solved. Note that the connector block can be unplugged from the I/O module without removing the wiring to the block. Loosen the small screws on either end of the block and unplug it. Remember to re-tighten the screws after reinstalling the block. If the problem is not resolved, shut off power, replace the original I/O module, substitute the Input Conditioning and Data Display module and run INREF again. If the problem is resolved, run the SLFCHK function, check the Advantage's calibration and return it to service. Modules which are not the failure cause may be left in place. Return failed modules to the factory for repair.

Prompt OPERT, Operator Mode Enable Variable

The operator mode enable variable can have two values; ENABL (enabled) or DISAB (disabled), which either allow an operator to respectively gain or be denied access to the operator mode. See section 5, Operations for more details on the operator mode.

Prompt FLASH, Display Flash Enable Variable

The display flash enable variable has two values; either ENABL (enabled) or DISAB (disabled), which either allow or inhibit display flash when a display variable exceeds its upper or lower limits. This function also allows or inhibits display flash in the event of a sensor or internal failure.

RTX1, RTX2 or RTX3, Analog Retransmit Set Up Loop

Three configuration loops are provided to set up the three corresponding channels of analog retransmit. All three loop variables are set up identically to each other. There are eight possible signal sources, as shown in the RSRCX prompt list. The analog retransmit outputs provide up to three independent sources with current levels proportional to the source quantity. The current outputs are independent of load impedance within the compliance window of 0.576 volt-amps, with 24 volts as the voltage limit and 24 ma as the current limit.

The SC model has only one available analog retransmit output. The DC model may be equipped with one or three analog retransmit outputs. The TC model is only available with three or no analog retransmit outputs.

Prompt RSRC1, RSRC2, RSRC3, Signal Source Variable

The signal source variable specifies which signal the firmware will use to transform into a proportional current output. The three options are CHNL1, CHNL2 and CHNL3.

Prompt RZERO1, RZERO2, RZERO3, Retransmit Zero Scale Current Output Variable

The retransmit zero scale current output variable sets the lower limit of current output. Its range extends from 0 to 24000 microamps DC. The value is expressed in microamps in order to fine-tune the output to within ± 0.010 % of the display value. This value is normally set to 0.0 for a 0 to 1 ma span or 4000 for 4 to 20 ma span. Because this value can be set at or near 24 ma, the output current can actually be made to decrease for an increasing measured quantity.

Prompt RFUL1, RFUL2, RFUL3, Retransmit Full Scale Current Output Variable

The retransmit full scale variable sets the upper limit of current output. Its range extends from 0 to 24000 microamps DC. The value is expressed in microamps in order to fine-tune the output to within ± 0.010 % of the display value. This value is normally set to 20000 for a 4 to 20 ma span or 1000 for 0 to 1 ma span. Because this value can be set at or near 0 ma, the output current can actually be made to decrease for an increasing measured quantity.

Prompt ZERO1, ZERO2, ZERO3, Retransmit Zero Scale Display Variable

The retransmit zero scale display variable defines the point in the display range where proportional current output will begin. Below this display value the zero scale current will be output. Above this display value proportional current will be supplied. The range for this variable is -40.0 to 200.0.
As an example, if the user wants to produce a 4 to 20 ma output, based on the temperature range between 0 and 160 degrees, (s)he would set this value to 0.0. If, however; the user wanted to produce the same output, but base it on a the span of 50 to 150 degrees, this value would be set to 50. This is frequently done to get higher resolution on a smaller part of the display range.

Prompt FULL1, FULL2, FULL3, Retransmit Full Scale Display Variable

The retransmit full scale display variable defines the point in the display range where proportional current output will end. Beyond this display value the full scale current will be output. Below this display value proportional current will be supplied. The range for this variable is -40.0 to 200.0.

As an example, if the user wants to produce a 4 to 20 ma output, based on the temperature range between 0 and 160 amps, (s)he would set this value to 160. If, however; the user wanted to produce the same output, but base it on a the span of 50 to 150 degrees, this value would be set to 150. This is frequently done to get higher resolution on a smaller part of the display range.

Prompt CALIB, Calibration Loop

The calibration function, as its name implies is used to calibrate the Advantage to reference standards. It is a complex loop to navigate, and special knowledge of calibration operations is required. The loop is covered in detail in section 6, Calibration.

Prompt SLFCHK, Internal RTD Sense Circuit Self-Check Calibration

The internal RTD circuit self-check calibration function runs an automatic operation in which each channel re-calibrates itself to a reference resistor value, when the CALYS (calibrate yes) option is selected. If the CALNO (calibrate no) option is selected the self-check function is bypassed.

The self check circuit detects and warns about potential damage to the circuitry between the sensor input and the display. It uses a ultra-low drift, low temperature coefficient reference resistor which is switched into the sensor circuit and measured every 10 minutes. If the value of the resistor appears to have deviated beyond a stored tolerance, the internal failure alarm is activated. When the Advantage is factory calibrated the resistor is automatically measured and the value, along with the computed tolerance is stored. As time passes, some of the components in the sensor measurement circuit may drift slightly. The self-check (SLFCK) calibration function has been provided to compensate for this drift. It is not intended to compensate for rapid drift, however; which is a sign of component failure. The self check calibration should be performed once a year, during normal site inspection routines. It requires no tools, just a few keystrokes. A properly functioning RTD probe or calibrator must be connected to correctly run the self-check calibration. Do not run the self-check calibration if any sensor failure indication is displayed, without referring to section 4 Configuration, Prompt Alarms, Sensor and Internal Failure Alarm Displays.

1. Enter the main configuration loop using the keystrokes of figure 7 on page 23.
2. Scroll down to the “SLFCK” prompt using repeated depressions of the down button.
3. Press the enter button.
4. Press the down or up button to toggle to the “CALYS” (calibrate yes) prompt and press the enter button.

The calibration will be performed automatically for all channels and you will be returned to the main configuration loop at the “RTD” prompt. At this point you can scroll to the “RUN” prompt and exit configuration, or scroll to another function or just wait, and in 45 seconds the Advantage will return to normal operation automatically.

Prompt TIME, Real Time Clock Setting

As the name implies this loop sets the current time on the real time clock. The time is expressed in twenty four hour format, and there is no provision for a 12 hour (am - pm) format. The time is updated as soon as the enter button is pressed after the seconds are entered, therefore the most accurate method of setting the time is to enter all of the time elements (year, month, day hour, minute and second) 30 seconds ahead of the actual time, but wait to press the enter button following seconds entry for the actual time to catch up.

Prompt EVENT, Peak and Valley Recording Interval

The EVENT feature provides a way of recording peak and valley values in two ways . The first option is hourly, selected using the prompt HOUR. This method will automatically transfer peak and valley values to the second level peak and valley memory, then clear the old value each hour, on the hour. This will allow a user to log hourly values for all measurements with peak and valley capability. It is essentially a data logging feature with a one hour sample period. The second option stores the peak and valley values in first level memory until the values are cleared manually from the front panel or through digital communications, whereupon the cleared values are placed in second level memory. See the paragraph titled "Effect of Resetting the Peak and Valley Values" in the Operation section (4.0) for more details regarding peak and valley memory.

Prompt RTD, RTD Offset LOOP

The RTD loop contains three sub-loops; RTD1, RTD2 and RTD3 which are used to add offsets to the temperature measurements from channels 1, 2 and 3. This is typically required if there is a known linear probe error or compensation is being made for skin effect errors of magnetically attached probes. The adjustment range is ± 25 °C .

The model type will determine which of the RTD prompts appear. In SC models only RTD1 will appear. In DC models only RTD1 and RTD2 can appear. In TC models RTD1, RTD2 and RTD3 can appear. In DC and TC models, if a channel is turned off (see TITL2 and TITL3 topics in this section) the corresponding RTD offset loop will not appear.

Prompt SFRLY, Sensor Failure Relay Un-Alarmed Coil State Variable

This variable has two options, DE-EN (de-energized) and ENRGZ (energized). The option is provided to facilitate setting up the relay for failsafe operation. See the section above dealing with alarm configuration, prompt "COIL" for details on failsafe operation.

The sensor failure relay (SFR) is intended for use in standard alarm and supervisory functions. The relay is triggered when the firmware senses that a probe or its cabling has become damaged to the point that its resistance has increased or decreased such that the measured temperature exceeds the temperature display limits of -80 to +250 °C. The sensor failure function cannot detect probe damage which results in an inaccurate but on-scale value between the display limits.

Prompt DCON, Display Conserver Enable

The display conserver function has two options; ENABL (enabled) or DISAB (disabled). If ENABL is selected, the display, except for the radix will blank out 45 seconds after the last button depression. Any subsequent button depression will restore the display for another 45 seconds. If DISAB is selected the display will stay on continuously. This feature is provided to avoid attracting the attention of hunters to a potential practice target.

Prompt COMM, Communications Port Set Up Loop

The communications ports set up loop has two sub-loops for set up of the two digital comm ports. Port 1 is designed for connection to a portable PC using an RJ-12 connector, for walk-up convenience. See figure 14 for cabling details. Port 1 is only designed to communicate using the RS-232 protocol and the loop therefore has a read-only informative display, indicating the protocol type. Port 1 is responsive to the same unit ID as port 2, and if the user intends to use port 1 in a comm scheme which will require a unique address, the unit ID can be used by changing it in the port 2 loop. Port one also responds to the delay setting in the port 2 loop, and if the communications string requires a turnaround delay in for port 1, it will need to be set in the port 2 loop.

Prompt “BAUD”, Serial Bit Rate

The BAUD setting allows the user to set the Advantage to communicate at any of six bit rates; 2400, 4800, 9600, 19200, 38400 or 57600 bits / second. The rate should be set to agree with the host’s baud setting.

Port 2, Prompt ID, Communications Unit Identifier

The communications unit identifier is a two digit number with a range of 00 to 99. It is used for addressing two or more communicative devices which share a common pair of comm cables. In order to communicate with host devices like a PC, the unit ID on the Advantage and the host must share the same unit ID number.

Port 2, Prompt PRMID, DNP-3 Protocol Primary Communications ID

The PRMID variable is used by Advantage when it is communicating digitally, using the DNP-3 protocol. It is not required, and will be ignored if DNP-3 communications is not used. The PRMID variable is the address of the host to which the Advantage is communicating.

Port 2, Prompt SLVID, DNP-3 Protocol Primary Communications ID

The SLVID variable is used by Advantage when it is communicating digitally, using the DNP-3 protocol. It is not required, and will be ignored if DNP-3 communications is not used. The SLVID variable is the address of the Advantage in a communications scheme containing many devices.

Port 2, Prompt MODE, Communications Protocol Type

The communications protocol type variable has two options, RS232 and RS485. Port 2 is designed for communications with RS-232, RS-485 and RS-422. To use the RS-232 protocol, select RS232. To use the RS-422 or RS-482 protocols, select RS-485.

The RS -232 protocol as a minimum requires 3 wires; one for transmit, one for receive and one common. RS-485 and RS-422 are related by electrical parameters, but RS-485 generally uses a pair of bi-directional wires for transmit and receive while RS-422 uses two pair of uni-directional wires, one pair each for transmit or receive. RS-485 can function with a 4-wire configuration like RS-422, but it is not nearly as common as the 2-wire format.

Prompt DELAY, Turn-around Delay Period

The delay period is used primarily in RS-485 2-wire configurations where the hardware external to the Advantage requires a short time between transmitting and receiving data. This becomes necessary in instances where line converters (RS-232 to RS-485 for example), line isolators and repeaters need a finite period in which to turn off their drivers and turn on their receivers. This feature can also be used where signal reflections make it necessary to wait for the noise on the line to die out.

The units of the setting are microseconds, with a range of 0 to 10000. This corresponds to 0 to 10 milliseconds.

The communications ports set up loop has two sub-loops for set up of the two digital comm ports. Port 1 is designed for connection to a portable PC using an RJ-12 connector, for walk-up convenience. See figure 13 for cabling details. Port 1 is only designed to communicate using the RS-232 protocol and the loop therefore has a read-only informative display, indicating the protocol type. Port 1 is responsive to the same unit ID as port 2, and if the user intends to use port 1 in a comm scheme which will require a unique address, the unit ID can be used by changing it in the port 2 loop.

Prompt LTEST, Lamp Test Function

The lamp test function requires no option selection. When the user presses the enter button with the LTEST prompt displayed, all segments of the display will light for 5 seconds, or until the enter button is released, whichever is longer. The function will then exit to the RUN prompt.

Prompt RUN, Return to Normal Running Mode

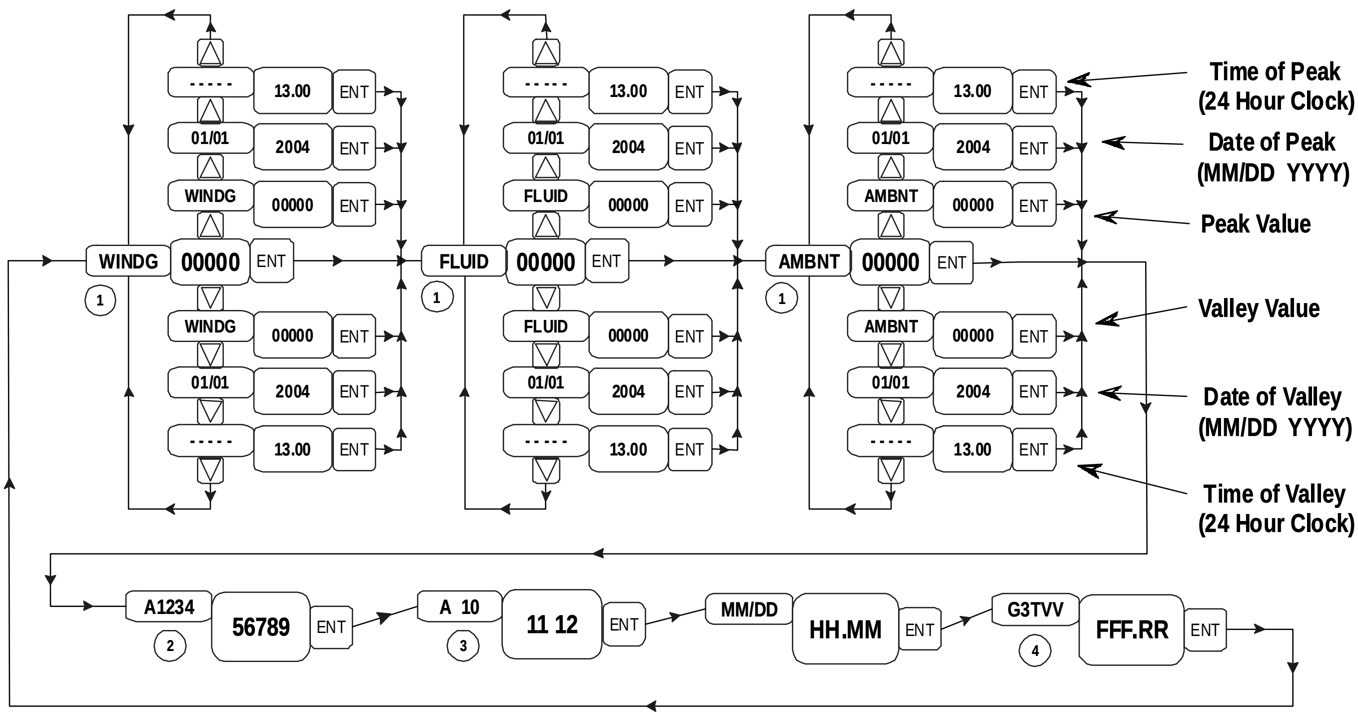
The RUN prompt is the standard exit point of the main configuration set-up loop. When the user presses the enter button with the RUN prompt displayed, normal mode is resumed. Normal mode can also be resumed automatically by waiting 45 seconds from the last keystroke.

5.0 Operation

Walk-up Functions

The walk-up functions are those which can be performed with single keystrokes, without entering a menu loop. The functions affect the display of information only. The display may be stepped through 3 temperature indications for triple channel units. The alarm status can be displayed and PEAK and VALLEY values may also be viewed and cleared.

Figure 10 shows the keystroke steps available in the walk-up or normal operation mode. Please note that the measured-quantity titles shown beloware for illustrative purposes only. The actual title displayed will be that which the user selects for channels 1, 2 and 3 under the TITL1, TITL2 and TITL3 menus of the supervisory setup loop. See Figure 9A on page 25 for details of setting the display titles.



1 May Display any Title on the TITL1, TITL2 or TITL3 List. See Fig 9A for List.

2 If No Alarms Are Tripped, the Display will Look Like > A NONE

3 This Display Only Appears if Alarms 10, 11 or 12 are Tripped.

4 This Display Shows Firmware Version Information. This is the Same Display that Appears at Start-up.
G3T = SC (Single Channel) Model, G7T = DC (Dual Channel) Model and G9T = TC (Triple Channel) Model.
VV = Firmware Version
RR = Firmware Revision Level.
FFF is Reserved for Factory use, and Should Always Show 000.

△ ENT To Reset the Peak Values for the Displayed Data, Press and Hold the UP, Then the ENTER Key. Values for Each Measurement Must be Cleared Separately.

▽ ENT To Reset the Valley Values for the Displayed Data, Press and Hold the DOWN, Then the ENTER Key. Values for Each Measurement Must be Cleared Separately.

Temperatures in Degrees Celsius

Figure 10. Walk-Up Function Keystroke Diagram

Alarm Annunciator Displays

The alarm display is designed to inform the operator of which alarms are currently active. It is a two-page display, meaning that if an alarm higher than number 9 is active, a second alarm display will appear when the ENTER button is pressed with the first alarm display shown. If only alarms 9 and below are active, only the first display will be shown. If only alarms 10, 11 and/or 12 are active, the first page of the alarm display will show the word NEXT, and the user will need to press the enter button to see the active alarms. If no alarms are active the first page of the alarm display will show the word NONE, and the second page will not appear.

Time and Date Display

The Advantage is equipped with a real time clock (RTC) which keeps track of time of day, month, day and year. The clock conforms to the 24 hour standard, displaying 0:00 to 23:59. There is no 12 hour clock provision. The date is shown as month / day on the prompt (small) display and year on the value (large) display. See configuration section 4, prompt TIME for more technical details on the RTC.

Effect of Resetting Peak and Valley Values:

There are two levels of peak and valley memory. The first level is display memory, which contains the value that is displayed when the up or down buttons are pressed. The second level is historical memory, which stores values sequentially each time the peak or valley value is reset. When a peak or valley value is reset, the display memory value is placed into the historical memory beneath the last value recorded, and the value which is presently being measured is then placed in the display memory as the current peak and valley. In a sense the reset function may be thought of as a peak and valley store function.

Display memory is volatile, meaning the values stored in it will be lost in the event of a power failure. The historical memory is not volatile and will continue to store values until it is filled. It is therefore important to remember that the peak and valley values must be reset in order to protect them from loss due to power failure. The Advantage offers a choice of two reset methods, selectable in the “EVENT” menu item. See figure 12D for the keystrokes used to select the methods. The CONT (continuous) option will record peak and valley values continuously to the display memory, but will require an operator to manually reset the values from the front panel or through communications. The HOUR (hourly) option will cause the Advantage to automatically reset the values every hour, on the hour, and store them into historical memory.

The Advantage can store up to 1000 peak and valley values in historical memory for each measurement title. When the historical memory is filled it will be erased in its entirety and logging will resume in an empty memory space. If the hourly option is chosen the memory will fill in slightly more than 41 days. The entire tabulation of peak and valley data can be downloaded from the memory if the unit is equipped with digital communications. See the SMG4T200 software manual for details. It is important to remember that the memory must be downloaded before it is filled; otherwise it will be erased to make room for new data and the old data will be lost. No provision has been made for stepping backwards through the memory, using the front panel controls.

Operator mode

Operator mode allows for checking the various set-up parameters associated with the alarm setpoints, and provides a means of operating the set point relays in order to check the operation of the cooling and alarm circuits and equipment. Refer to Figure 12 below for details regarding features available and navigating in the operator mode.

In order to access the operator mode, it must have been enabled when the unit was configured. You must enter the configuration loop (figure 7) and enable it (see figure 9A) in the "OPERT" sub-loop.

The relay check is the only feature in the operator mode which allows a walk-up user to cause a control action to be performed. This feature allows the user to temporarily set a relay to its alarm state to verify operation of the relay and connected equipment. In order to allow an operator to use the setpoint relay check function, it also must have been previously enabled. Like enabling the operator mode, the relay check function is enabled in the configuration loop, within the alarm configuration sub-loop. Refer to figure 9A for the keystrokes (CHKEN or CHKDI) necessary to enable or disable the function.

The INREF function is used to manually check the condition of the RTD circuit internal to the Advantage. It is used primarily as a diagnostic tool to determine if the internal RTD circuit is functioning properly. When the INREF function is entered, an internal reference resistor's value is measured and converted to its equivalent temperature display. All three RTD channels may be checked this way. The value displayed must be between + 5 degrees and -5 degrees. When the values drift beyond this point, the internal failure alarm will activate.

Figure 11 illustrates how the various alarm displays look when sensor and internal failure events occur. For a more detailed treatment of alarm function, refer to the Prompt ALARM section, heading Sensor and Internal Failure Alarm Troubleshooting on page 32.

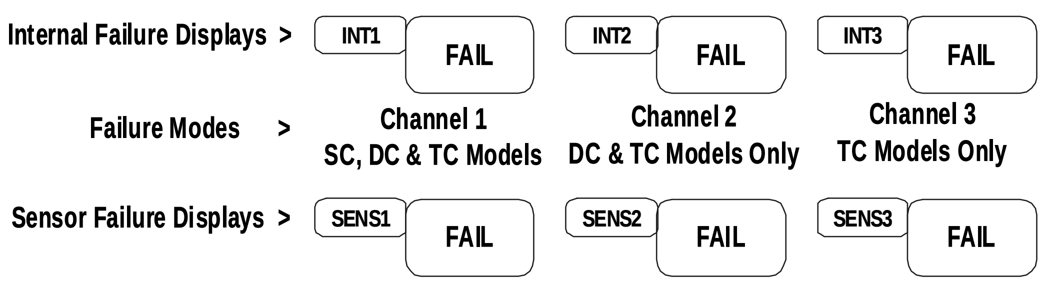


Figure 11. Alarm Displays

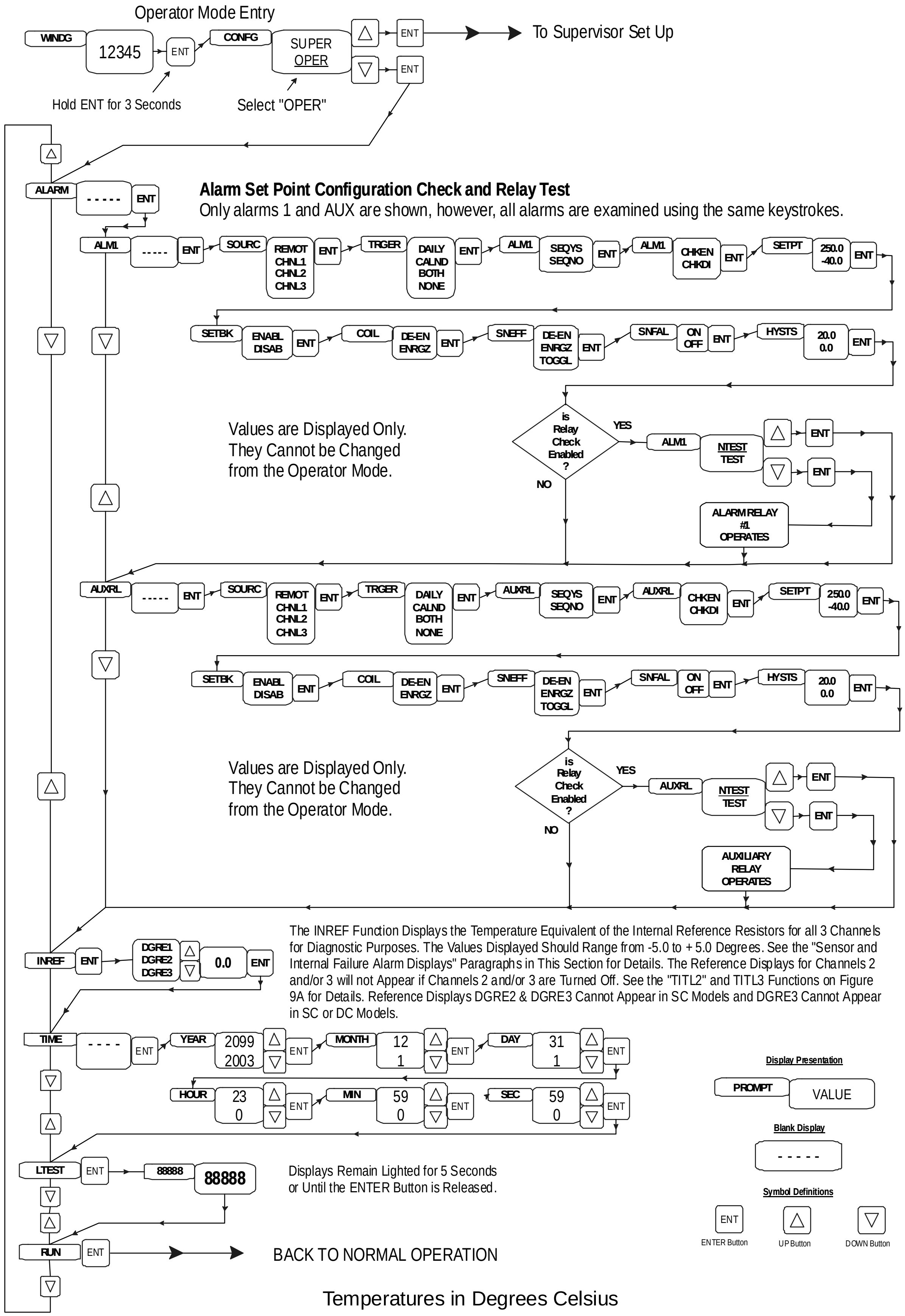


Figure 12. Operator Mode Keystroke Diagram

6.0 Calibration

The calibration of the Advantage requires 2 distinct operations; self-check reference calibration and linearizing table entry. The self-check calibration step is easily performed from the front panel programming buttons. The linearizing table calibration operation can be performed from the front panel programming buttons or, if equipped, with the communications option, from a personal computer using Weschler setup and calibration software. The software method is much quicker and less tedious than the front panel method, though both achieve the same goal.

The calibration of Advantage models must be checked at five year intervals as an absolute minimum. At each of these calibration intervals the self-check function must be operated and the CALIB function must be entered and exited, as a minimum, to ensure memory retention. It is not necessary to enter the calibration password to exercise this function.

Linearizing Table Calibration

The linearizing table is designed to provide a means of calibrating the scale end points and correcting measurements for non-linearities due to sensor characteristics. Platinum RTD's of the type used by Advantage are extremely linear over the limited transformer operating temperature range, but other linearity errors can also be corrected using this process. Each channel has its own table, and each table must be entered separately.

Since the linearizing table contains the calibration data, it must not be altered unless a calibration check shows an indication error which is not due to a sensor or input circuit malfunction. To prevent the table from inadvertent alteration, the function is protected by a password which is not the same as the supervisory password. The password may be obtained by calibration technicians, by contacting the sales office at the phone number or website printed on the front cover of this document.

The calibration operation simply allows the technician to "tell" Advantage what value to display at up to 12 defined points within the scale range. The measurement logic then interpolates between the defined points to determine what the intermediate values are. The technician is simply filling in cells of a look-up table. The number of points calibrated or checked depends upon the user's calibration program requirements. Weschler recommends a minimum of 5 calibration points. Factory calibration is performed at the table maximum of 12 points.

To prepare for calibration, an adjustable precision resistance standard (decade resistor) or RTD calibrator must be connected to the RTD terminals corresponding to the type (3 or 4 wire) of RTD which is to be used. Note that the precision resistance standard can be used to simulate temperatures typically to within ± 0.01 °C. Several hand-held calibrators Weschler has tested use solid state circuitry to simulate the resistance of the RTD. In our experience, these devices cannot nearly match the accuracy of the resistance standard.

A calibration check using a resistance standard is performed by setting the resistance standard to the values shown on Table 2 and comparing the actual indication to the tabulated temperature value. The indicated temperature should match the tabulated temperature within ± 0.1 °C. A calibration check using a calibrator requires simple comparison of the calibrator's display value, with the Advantage display value. Bear in mind that the Advantage may be more accurate than the calibrator, especially if it is a hand held device.

If the communications option has been installed, and you have a PC available, the ADT Calibration software automates the following steps and simplifies calibration to simple resistance or temperature selections and mouse clicks. The software is available from Weschler. Contact the Sales Department for ordering details.

For manual calibration, refer to the CALIB keystroke diagram of Figure 9B and follow the steps below.

1. Enter the main configuration loop using the keystrokes of Figure 7 on page 23.
2. Scroll down to the “CALIB” prompt using the keystrokes of Figure 8 on page 24.
3. If you only want to rewrite the memory, press the enter button twice. If you want to do a calibration or check table points, enter the password per factory instructions.
4. If you want to check or change the number of table points, scroll to the TBLEN value and press the enter button, otherwise, scroll to the POINT value, press ENTER and skip to step 6.
5. By default the length of the table is 12 points. The table can have less than 12 points but it is more accurate to use the default. If the number is set to other than 12 points, use the up or down buttons to set the value to 12. Press the enter button to store the value.
6. With the “PNT1” prompt showing, press the enter button to access the table edit loop. The “PNT1" will remain in the prompt display and the temperature for point 1 (-90.0 °C) will appear in the value display.
7. Set the RTD calibrator to -90 °C or set the decade to 64.30 Ω. Increment the value on the Advantage display to -89.9 °C and back to -90.0 °C, using the up, then down button. This is a very important step. If the value isn’t changed the Advantage will assume you only wanted to view it. As far as the Advantage is concerned, a desire to calibrate a point is signaled by any change, even if it is changed back to the original value.
8. Press the enter button twice more to display the value for point 2, -40.0 °C.
9. Set the RTD calibrator to -40 °C or set the decade to 84.27 Ω. Increment the value to -39.9 °C and back to -40.0 °C, using the up, then down button. Remember to perform this very important step.
10. Perform steps 4 through 9 for the remaining 10 points on the table. All of the temperature and resistance equivalents are listed below in table 3. When the last point is calibrated the TABL1 loop will exit and if this is a DC or TC model, the “TABL2” prompt will appear. The operation for loading table 2 is identical to table 1, except the prompts referred to as TABL1 above will be TABL2.
11. Perform steps 4 through 9 for the 12 points on the table. All of the temperature and resistance equivalents are listed below in table 2. When the last point is calibrated the TABL2 loop will exit and, if the unit under test (UUT) is a triple channel model, the “TABL3” prompt will appear. The operation for loading table 3 is identical to tables 1 and 2, except the prompts referred to as TABL1 or TABL2 above will be TABL3.
13. When the last point is calibrated the TABLX loop will exit and the “SLFCK” prompt will appear.

Table 4. Temperature / Resistance RTD Equivalence

Calibration Point Number	Temperature (°C)	Resistance (Ω)	Calibration Point Number	Temperature (°C)	Resistance (Ω)
1	-90.0	64.30	7	110.0	142.29
2	-40.0	84.27	8	140.0	153.58
3	-10.0	96.09	9	170.0	164.76
4	20.0	107.79	10	200.0	175.84
5	50.0	119.40	11	230.0	186.82
6	80.0	130.89	12	250.0	194.07

7.0 Troubleshooting

Digital Communications Troubleshooting

It has been found, from experience, that more than 90% of communications problems are due to cabling deficiencies and configuration errors. The remaining 10% of problems are typically divided into application problems (6%), hardware failures (2%) documentation errors (2%).

Before condemning the Advantage hardware, use substitution methods and ohmic measurements for cabling and triple check all configuration settings. Protocol standard, baud rates, turn-around delay times and converter settings are the most typical sources of error. Signal reflection and noise problems exist, but to a much lesser degree.

Be careful with regard to the arbitrary use of terminating resistors on RS-485 data lines. They are typically needed only on long lines. Refer to the installation section for details of there use.

Please note that some brands of RS-232 to RS-485 converters use dual labeling of their terminals. For example, one manufacturer uses “A” and “B” as well as (+) and (-). Within this manufacturer’s converter lines, one model uses A (+) for the one terminal and B (-) for the other. Another of this manufacturer’s converter models uses A (-) for one terminal and B (+) for the other. While you cannot depend on letter marking, experience has shown that you can depend on the polarity markings.

There are also many RS-232 to RS-485 converters which have multiple jumper settings, some of which may not be clear. For example, we have seen where one converter manufacturer refers to a state where the receivers are always on as being an “echo enable”. This “echo enable” term is only true for two-wire operation. In fact, the “echo enable” or receivers always on selection is definitely not desirable for two wire operation, but is definitely desireable for four wire operation.

Sensor and Internal Failure Alarm Troubleshooting

The Advantage has been designed to detect failures in itself and its sensors and report the failures in the form of unique display annunciation.

Sensor Failure Events

Sensor failures typically fall into the category of one or more open or shorted leads, and more rarely an open sensor chip. All of these failures would result in very high or low erroneous indications if not detected. The Advantage contains circuitry and logic which traps these types of indications and displays the message SENSE FAIL accordingly. Refer to figure 8 in section 4, Operation, for an illustration of the actual display. When the failed sensor is replaced or connections repaired, the display will resume normal indication. Recalibration of the Advantage after sensor replacement is not necessary, but it would be wise to check the new sensor’s function after it is replaced.

Internal Failure Events

Internal failures may be due to damage caused by exceptionally high transient surge levels or component random failure or drift. The entire sense circuit, from the amplifiers and filters through the A/D converter is checked every 10 minutes for errors. The check is performed by automatic comparison to a known reference resistance (100 ohms). If the resulting measurement falls outside of a set tolerance band, the Advantage displays the flashing message INT FAIL. Refer to figure 8 in section 4, Operation for an illustration of the actual display. If this display appears, the INREF function in the operator mode loop should be run to see if the error is minor or major. Reference Figure 9 in section 4, Operation, for details on accessing the INREF function.

The temperature displayed when running INREF should be between -5.0 and +5.0 °C. If the temperature is within these limits, the error is minor and it can be corrected by running the SLFCK calibration function from the main configuration loop. Refer to Figure 9C and Prompt SLFCK on page 35 for details on the SLFCK function. If the value is between +/-5 and +/10 °C and there is no prior note in the Advantage's maintenance log, component aging may be a factor. Make a note on the Advantage's maintenance log and perform the SLFCK calibration function. If the INREF value is beyond ± 10.0 °C , component(s) damage may have occurred.

If the INREF value is beyond the ±10 °C limit it may be due to simple engagement of the modules in their edgecard connectors. First check that all modules are firmly seated in their slots. If re-seating the modules does not solve the problem proceed to the following paragraph.

If the INREF value is beyond the ±10 °C limit and the fluid temperature channel is indicating a similar measurement error, it is likely that component failure in the lower signal path is at fault. If the fluid measurement channels is accurate, but only the INREF values are inaccurate, proceed to the next paragraph. To isolate the cause of the problem, shut off power to the Advantage and remove the I/O module. Note that the connector block can be unplugged from the I/O module without removing the wiring to the block. Loosen the small screws on either end of the block and unplug it. With the module removed, inspect the fingers of the printed circuit board (pcb) and edgecard connector for damage. If the egdecard connector is damaged, the backplane will need to be replaced. If the connector is OK, substitute the I/O module with a new one and re-run INREF to see if the problem is solved. If the problem has been resolved, re-tighten the terminal block retaining screws and run SLFCK.. If the problem is not resolved, shut off power; reinstall the original I/O module and proceed to the next paragraph.

If the INREF value is beyond the ±10 °C limit, but the fluid channel's indications are accurate, it is likely that the Input Conditioning and Data Display (ICD^2) module has a failed self-check relay. The ICD^2 module is the bottom module in the upper cavity, to which the display module is connected. Remove the module and inspect the fingers of the pcb and edgecard connector for damage. If the egdecard connector is damaged, the backplane will need to be replaced. If the connector is OK, substitute a known good ICD^2 module and run INREF again. If the problem is resolved, run SLFCK, check and adjust the Advantage's calibration as necessary and return it to service.

If the INREF value is still beyond the ±10 °C limit, the only remaining likely cause is that the A/D converter on the CPU module has failed. the CPU module should be substituted with a new one. The CPU module is the top-most module in the upper cavity, behind the display module. Shut off power and remove the CPU module. With the module removed, inspect the fingers of the pcb and edgecard connector for damage. If the egdecard connector is damaged, the backplane will need to be replaced. If the connector is OK, substitute the CPU module with a new one, re-power the unit and run the INREF function. If the problem is resolved, run the SLFCK function, check and adjust the Advantage's calibration as necessary and return it to service.

Modules which are not the failure cause may be left in place. Return failed modules to the factory for analysis and repair.

8.0 Specifications

Table 5. Detail Specifications

Accuracy:

Display	
Channels 1, 2 & 3 Temperature	± 0.1 °C [1]
Setpoints	
Alarm	Same as Display
Auxiliary	"
Analog Retransmit	± 0.5% of Display

Displays

Type:	Layout:
Prompt & Units	14 Segment Alphanumeric
Value & Option	14 Segment Alphanumeric
Height:	
Prompt & Units	0.5 Inches
Value & Option	0.8 Inches
Resolution	
Temperature, Either Channel	0.1 °C

Setpoint Relays:

Contact Ratings	10A @ 125Vac [2] 10A @ 240Vac [2]
(All Relays)	½HP @120/240Vac 10A @ 30VDC [3]
Contact Protection:	
250 vac, 20mm MOV	Max V_{CLAMP} 650v @ 100a (8 x 20µs)
Trip Sources	All relays independently assignable to Channel 1, 2, 3 or Remote
Hysteresis	Selectable 0-20°C

Environment:

Operating Temperature	-40 to 70°C
Storage Temperature	-40 to 85°C
Enclosure	Nema 4X

Power Requirements:	**Burden:**
24 vdc ± 18%	0.40 amps
48 vdc ± 18%	0.20 amps
125vdc ± 18%	0.12 amps
250 vdc ± 18%	0.045 amps
120/240 vac ± 15%	10.3 va / 14 va
120vac/125vdc ± 15%	10.3 va / 0.09 amps
240acv ±15% / 250vdc ±18%	10.3 va / 0.045amps

Communications:

Optional Protocols	ASCII, DNP-3 Level 1 Slave
Port 1	RS-232 only
Physical Layer	RJ-11 or RJ-12, I/O Module
Connection	See Figure 13
Cabling	
Port 2	RS-232, RS-485 2 or 4-wire
Physical Layer	RS-422 4-wire Bi Di
	Term Block of I/O Module
	RS-232: Terms 19, 21 & 23
Connection	RS-485 & 422: Terms 19-22
Cabling	See Figure 4

Inputs:

Channels 1, 2 & 3	100Ω Platinum RTD, α=0.00385 per DIN 43760-1980

Outputs:

Analog Retransmit	Jumperless user selectable zero and fullscale between 0 and 24 madc. Source is selectable from Channels 1, 2 or 3.

Setpoints	Settable Range
Cooling Control Relays 1 - 6, 9-12	-40 to 250 °C
Auxiliary Relay	-40 to 250 °C
Sensor Failure Relay	Not User Settable

Notes:

1. Accuracy is based on reference to a precision resistance standard set for the absolute values of resistance specified in DIN43760-1980. Accuracy of the system depends on the tracking of the RTD element in comparison to the DIN standard curve. The RTD error is additive to the instrument error. The maximum initial uncertainty of Weschler probes is +/- 1 °C .
2. Resistive Load
3. DC voltages above 30 volts may require contact protection in addition to the MOV's supplied. This protection is usually clamp diodes connected in shunt to the load in a polarity which will block conduction to energizing current.

Figure 13 Port 1 Cabling
Connectors are viewed from the cable ends

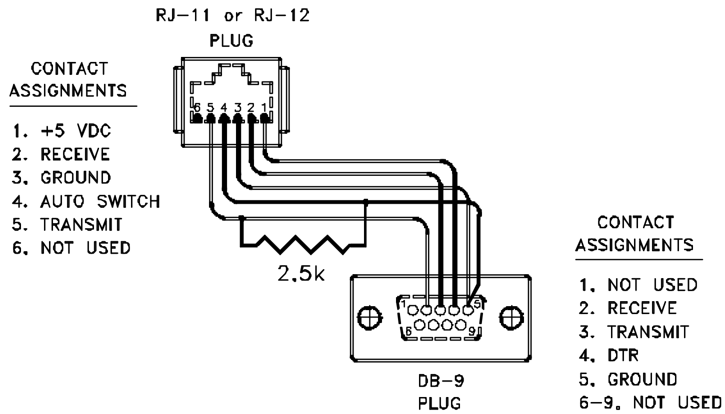


Figure 14. Projection (Flush) Mount Outline and Drilling

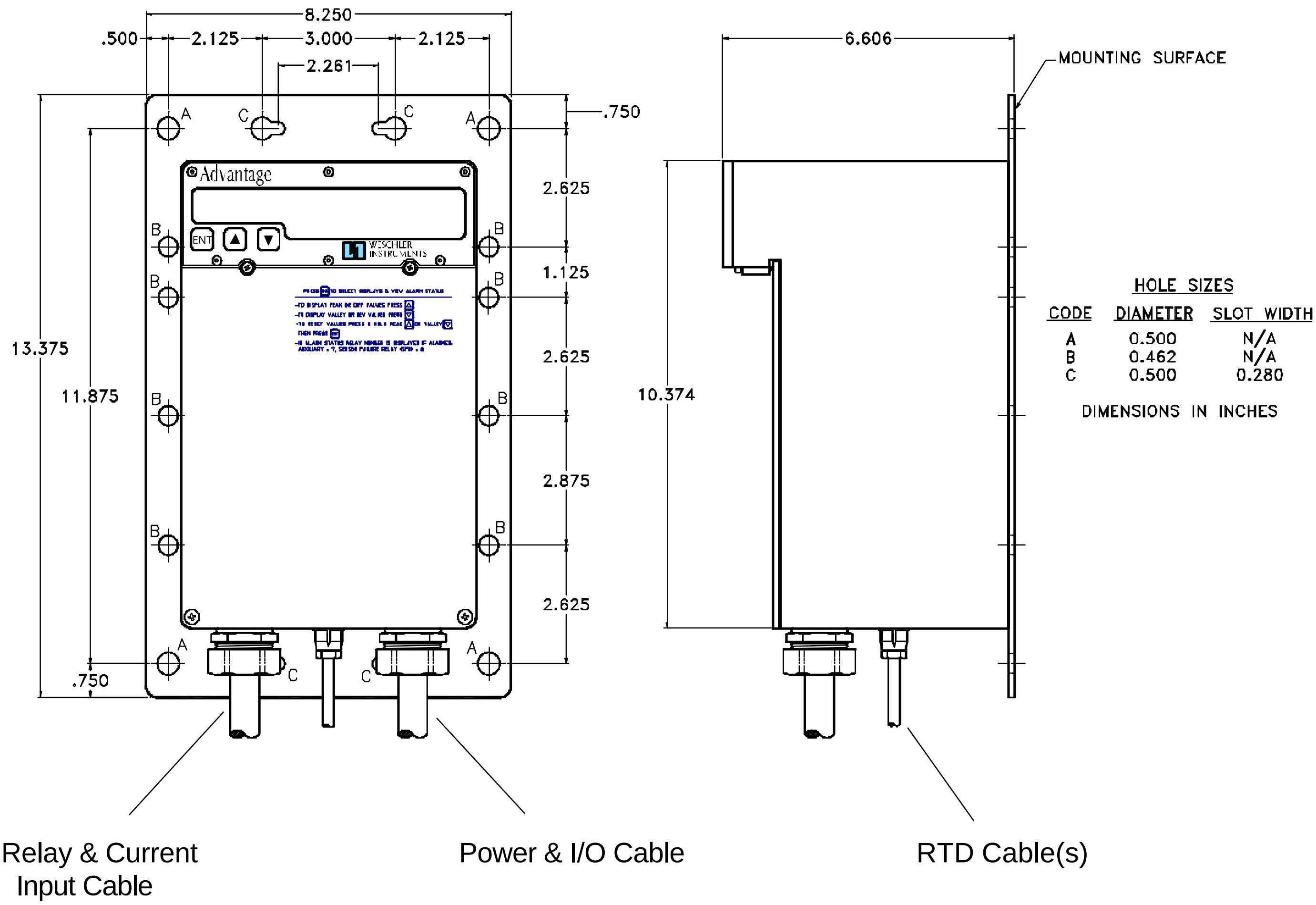


Figure 15. Recommended Projection Mounting Methods

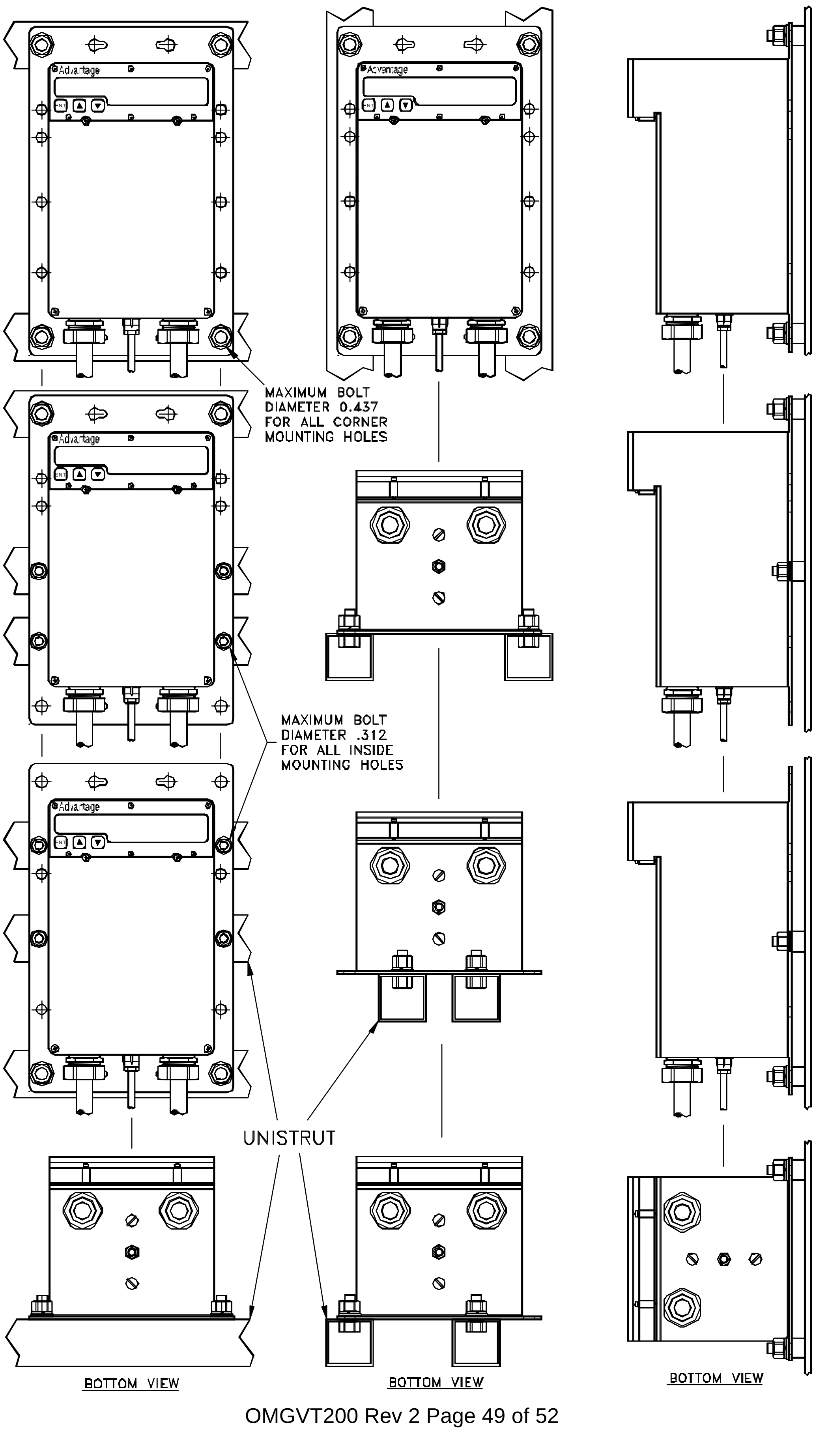
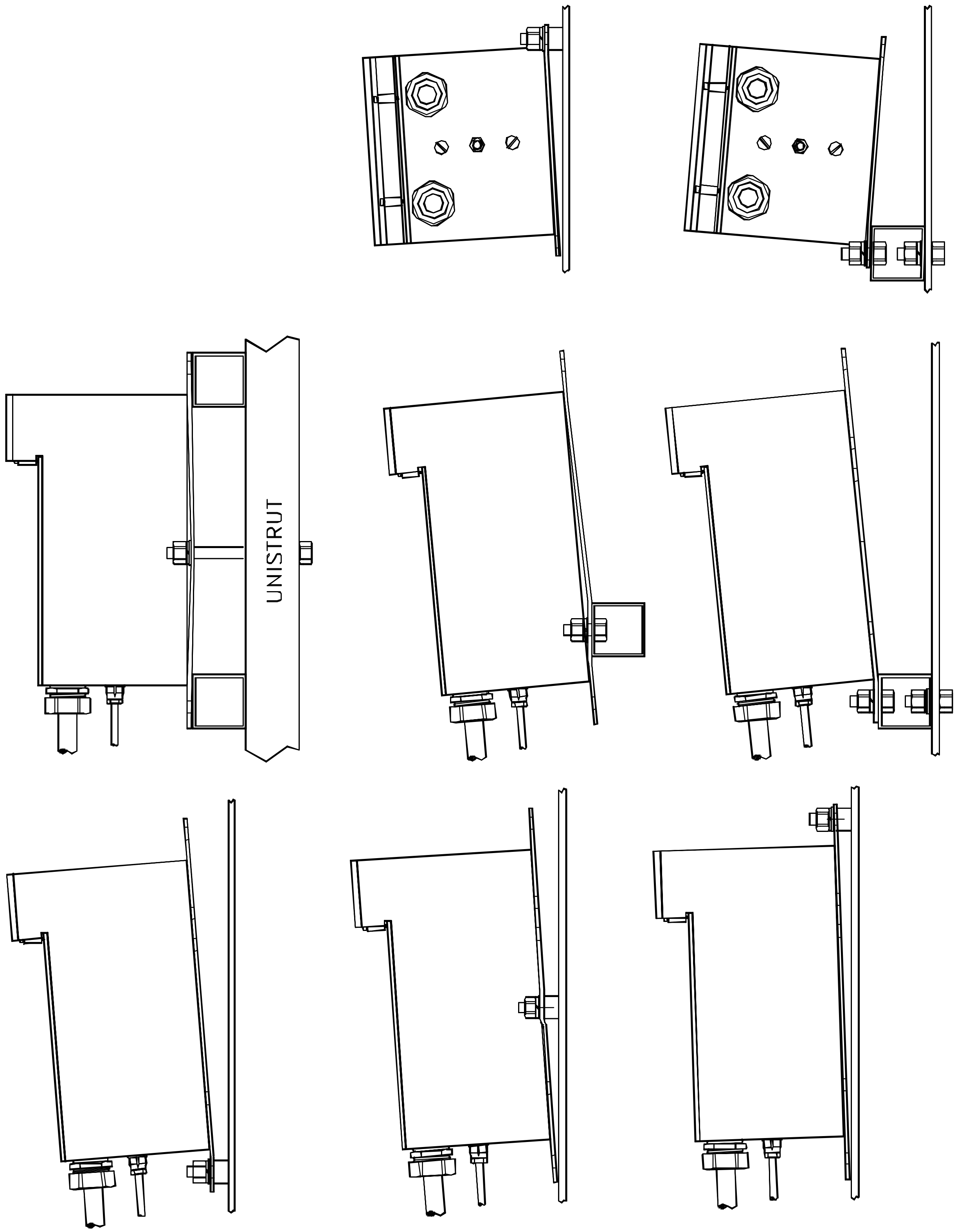


Figure 16. Prohibited Projection Mounting Methods



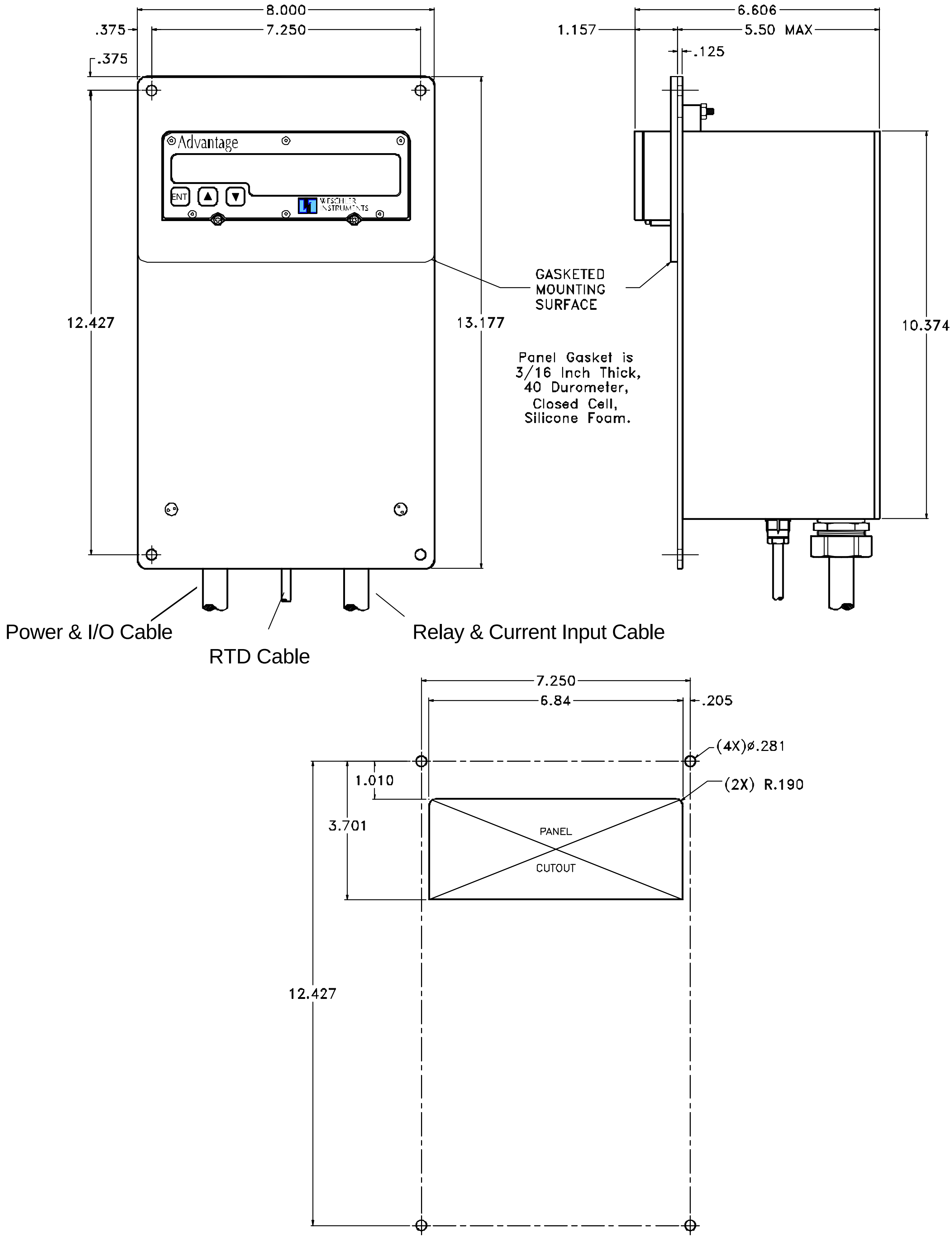


Figure 17. Panel Mount Outline and Drilling

WARRANTY

All Weschler Instruments Transformer Advantage products are warranted against defects in material and workmanship for a period of **five years** from date of delivery. Weschler Instruments, at its option, will repair or replace any defective product returned to it during the warranty period without charge, provided there is no evidence that the equipment was mishandled or abused. Any repairs or modifications not performed by an authorized factory representative are not warranted by Weschler Instruments. Field service is only available on a contract basis.

Customers must contact Weschler Instruments for an RMA number and shipping instructions BEFORE returning any product.

All products returned to Weschler Instruments must be insured by sender and carefully packed to prevent breakage from shock and rough handling.

WESCHLER INSTRUMENTS
DIVISION OF HUGHES CORPORATION

Correction to *Transformer Advantage II* Enhanced Series Owners Manual

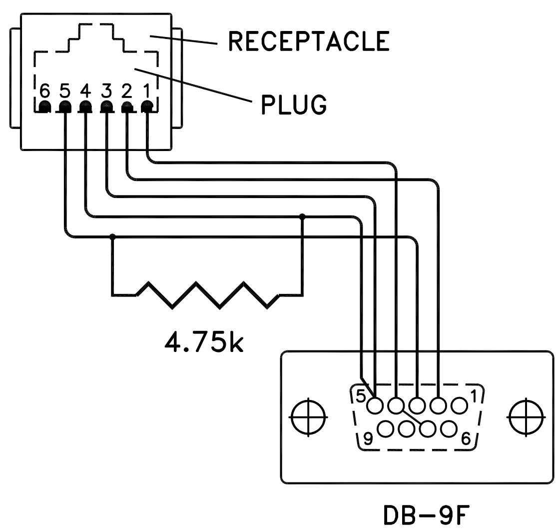
Document: OMAMT200

The diagram for the Digital Communications Port 1 Adapter Cabling is incorrect. The correct information is shown below.

This information replaces: Figure 21 in Revision 2,
Figure 26 in Revision 4,
Figure 27 in Revision 5,
Figure 25 in Revision 6.

RJ-11 6P6C CONTACT ASSIGNMENTS

1. +5 VDC
2. TRANSMIT
3. AUTO SWITCH
4. GND
5. RECEIVE
6. NOT USED



DB-9F CONTACT ASSIGNMENTS

1. NOT USED
2. RECEIVE
3. TRANSMIT
4. DTR (+5v)
5. GROUND
6. NOT USED
7. RTS (+5v)
8. NOT USED
9. NOT USED

This correction also applies to earlier Owners Manuals:
OMGVT200 Rev. 2, Fig. 13
OMG4T200 Rev. 1, Fig. 13
OMG8T200 Rev. 3, Fig. 14

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OMAMT200_Cable_Addendum
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