WESCHLER INSTRUMENTS

DIVISION OF HUGHES CORP.

# Transformer Advantage CT

## Owners Manual


## Manual Part Number OMG4T200

**Revision 1, October, 2004**

Use with Revision 02 of Firmware G4T02 and G4T03

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# 1.0 Introduction

## Description

The Transformer Advantage CT is a compact, fully electronic, programmable instrument designed for accurate and reliable thermal management of liquid immersed power and distribution transformers. The computing engine in this implementation is based on the Motorola ColdFire microprocessor. The CX monitors the temperature of the top oil and load current and calculates the temperature of the windings. Calculations of the winding temperature use several key user-configurable transformer parameters and a proprietary algorithm based on concepts contained in world recognized transformer standards.

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 or 1 Amp.
- ★ Winding Temperature Algorithm based on IEEE and IEC transformer concepts.
- ★ Optional DNP-3 Slave Level 1 Communications Protocol.
- ★ Firmware is Upgraded by Simple Upload of an Electronic File Through Digital Communications.
- ★ Time Stamped Peak and Valley Values. History is downloaded via Digital Communications.
- ★ Real Time Clock Power Back-up Five Days Standard, Thirty Days Optional.
- ★ 3 Button Front Panel Programming. No Covers to Open.
- ★ Walk-up Selectable Display of Five Operating Measurements and Alarm Annunciators.
- ★ Alpha-Numeric Displays for Prompts/Units and Values make Indications Clear and Non-confusing.
- ★ User-Entered Transformer Parameters for On-Site Custom Tailoring of Thermal Profiles.
- ★ Standard Cooling Control Module with 5 Form B and 1 Form C High Capacity Set Point Relays.
- ★ Optional Cooling Control Module with 4 Form C High Capacity Relays for Assignment Flexibility.
- ★ Two Cooling Control Modules Can be Combined to Provide 5 Form B and 5 Form C, or 8 Form C Relays.
- ★ 1 Optional High Capacity Auxiliary Set Point Relay for Logic or Alarm Functions.
- ★ Relays are Independently Assignable to Eight Sources and a Remote Digital Command.
- ★ Relay Set Up Options include User-Programmable Response to Sensor Failure.
- ★ Up to Three Analog Retransmit Channels to Remotely Indicate any 3 of Eight Selectable Values.
- ★ Rugged Extruded, Hardcoated Aluminum, NEMA 4X+ Enclosure.
- ★ Compact Size; 6 ¾ W x 10 ½ H x 6 d D. Mounting Plate 8 ¼ W x 13 d H.
- ★ Two power source options: 48 vdc (36-72) and universal 85-264 vac, 110-300 vdc.

## Intended Usage

The Transformer Advantage CT 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.

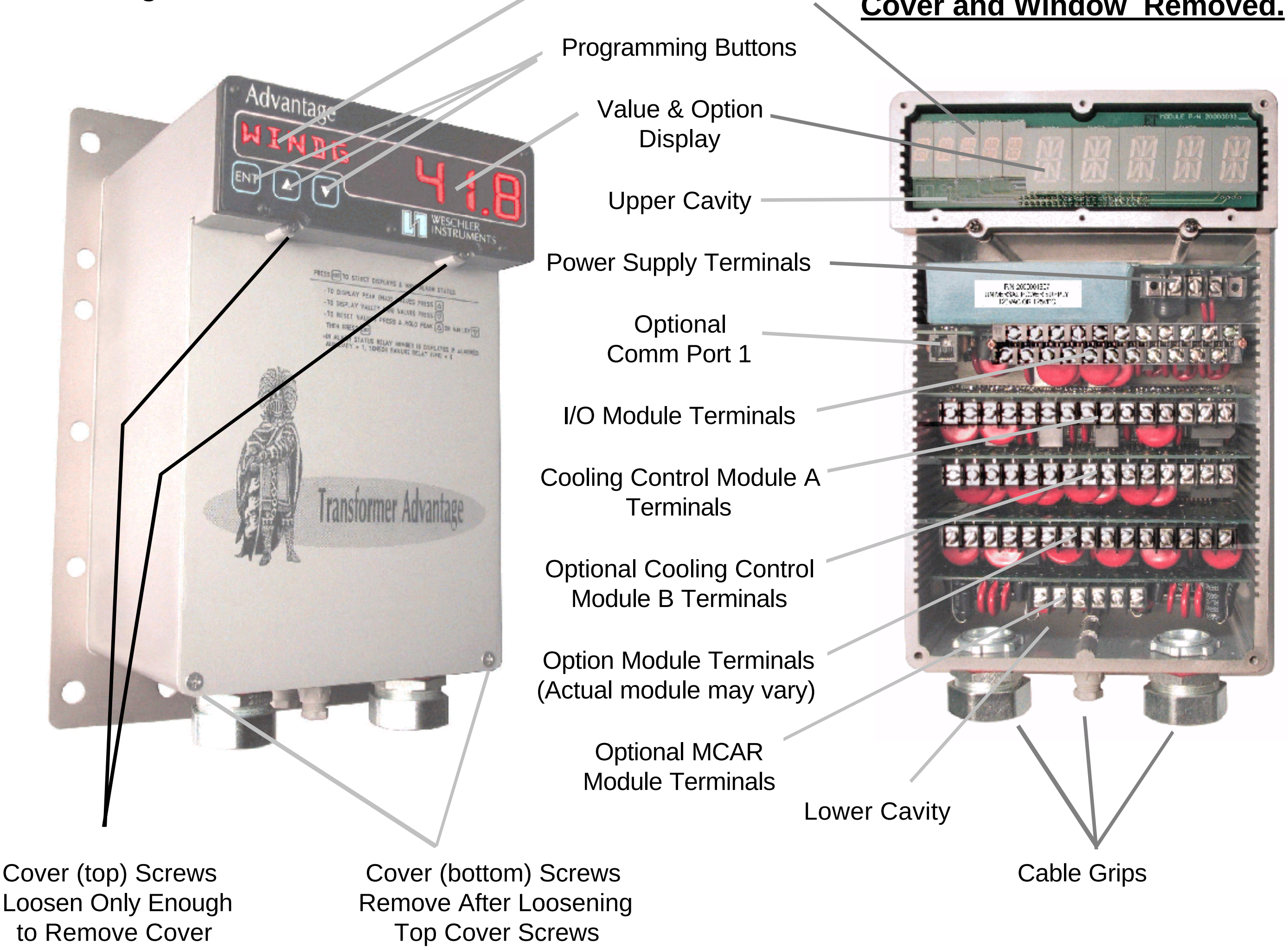
## Feature and Module Locations

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 15 and 18.

Note that access to the modules is from the front for Surface mount and from the rear for Through-Panel mount. For each of the two mounting configurations the modules are positioned in the same order, and slot position.

**Figure 1A. Surface Mount**

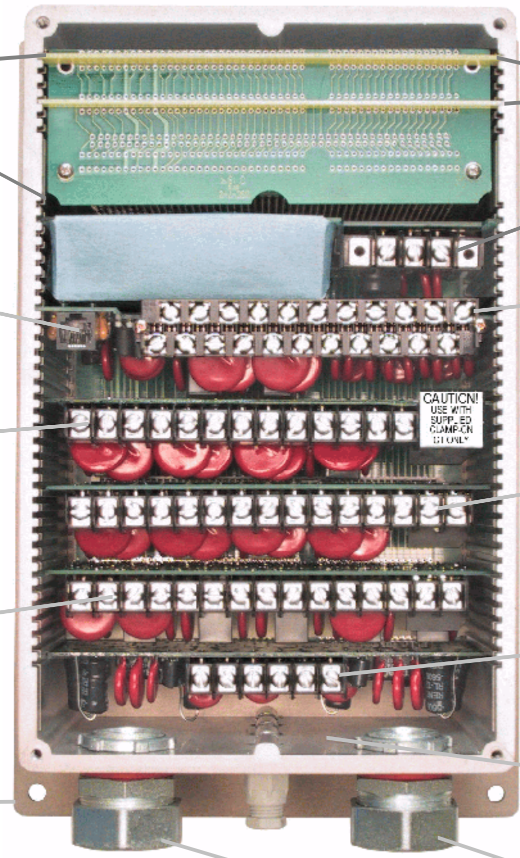
**Figure 1B Surface Mount with Cover and Window Removed.**




The figures and text of this manual describe or illustrate all optional equipment and features which are available in the Advantage CT model. Since each Advantage CT 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.

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. Feature and Module Locations**
Through-Panel mount Case




## 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, hardware and spares kit, 2 standard cable grips for 0.65 to 0.70 inch diameter cable, 2 or 3 cable grips (depending on number of probes ordered), and any RTD probes which were ordered with the instrument. Other accessories such as external (clamp-on) current probes, 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 (Surface 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.

## Terminal - by - Terminal Connection Guide

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 (Surface mount) or rear (through-panel mount) cover. This diagram is also printed in this manual, see Figures 5A and 5B on pages 15 and 16.

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 grip is sized to fit the RTD cable of the probe which was 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 and 5B. For example, the terminals for Cooling Control Module A (CCA) are labeled as 24 to 38 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 4 on page 49. 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**

| Module | Jumper ID | Function | Position |
|---|---|---|---|
| Power Supply | JA1 | 120vac | 1-2 and 7-8 |
| Power Supply | JA1 | 240vac | 3-5 and 4-6 |
| Input / Output | J2 | RTD1, 3 / 4 Wire | Installed / Removed |
| Input / Output | J3 | Not Used | N/A |

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)

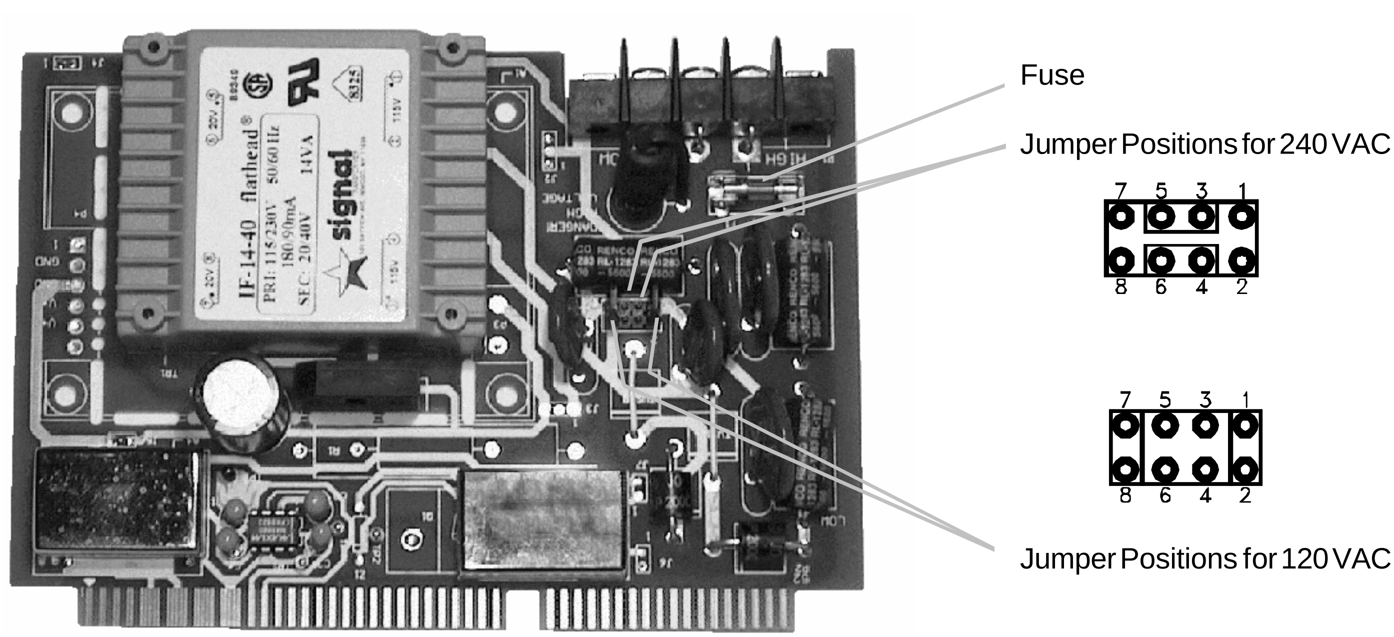
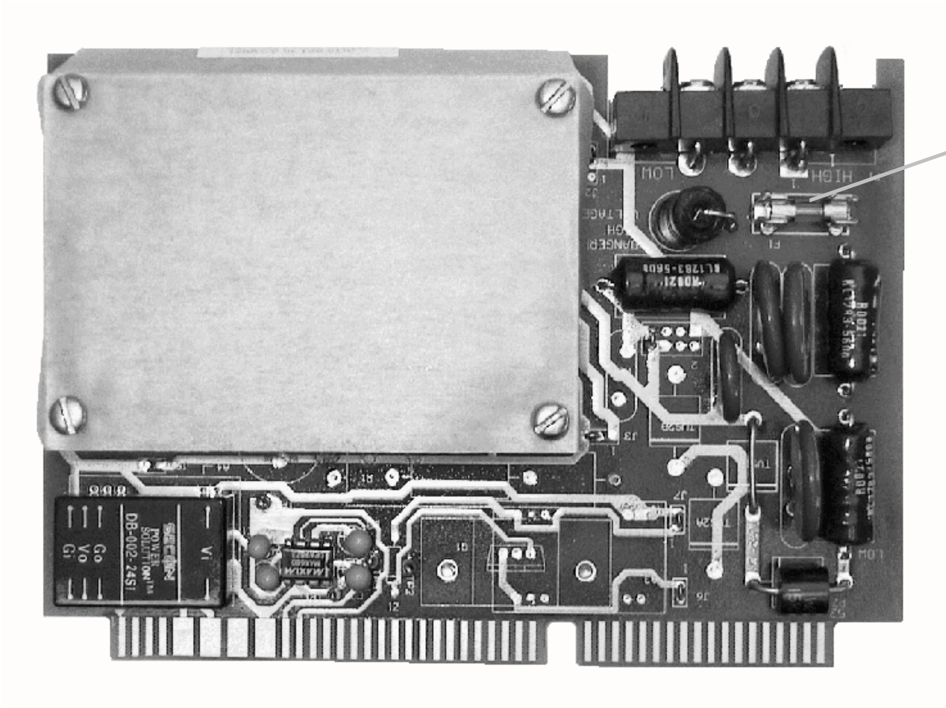


**Figure 3B. Universal Power Supply Fuse Location**



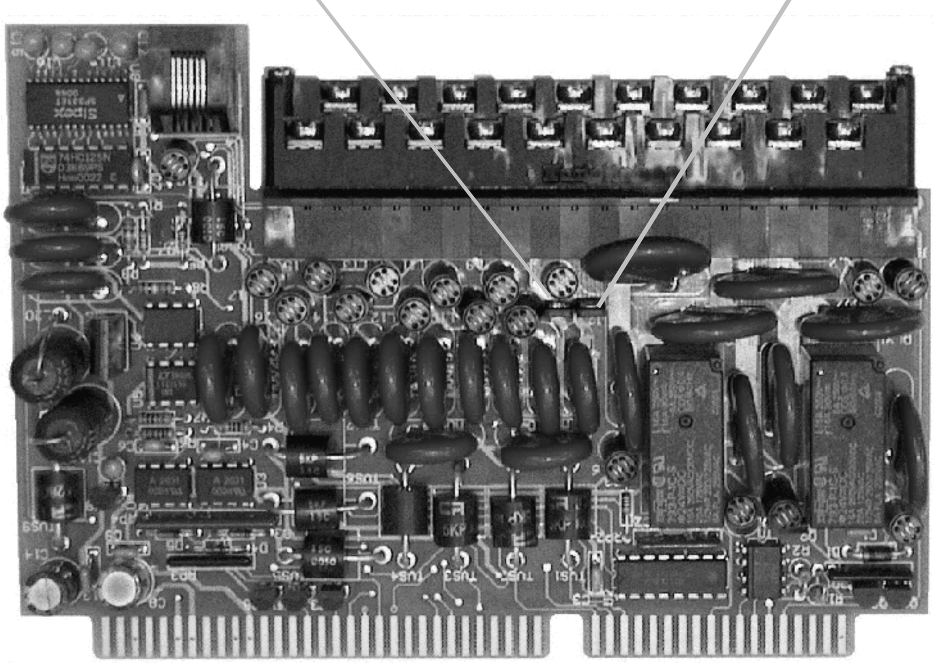




**Figure 3C. 3 Wire RTD Jumper Locations**

## 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 "Terminal by Terminal Connection Guide" on page 4 for details regarding the metric screws used on the I/O module.

### Analog Retransmit, Terminals I/O-1 and I/O-2

The analog retransmit which is supplied on the I/O module is a single channel version of any individual MCAR channel detailed below. This optional output is provided in the event that multiple analog retransmit channels are not required. If the screws are missing from the terminal block, the feature is not installed.

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.

### Auxiliary and Sensor Failure Relays, Terminals I/O-3 to I/O-8

Terminals I/O-3 to I/O-5 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 figure 5A or 5B 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-6 to I/O-8 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 or 5B for connections and Configuration Section 5 for details regarding SFR function.

### RTD Inputs, Terminals I/O-9 to I/O-15

Terminals I/O-9 through I/O-11 and I/O-15 are for the RTD input. 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 figure 5A or 5B 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.

The I/O module has one jumper (3) that needs to be set according to which RTD configuration is being used. See Figure 3C above for the jumper's location. 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 the jumper should be installed on one pin of the header only. The default setting is 4-wire; a 3-wire jumper is provided in the hardware and spares kit in the event that a 3-wire RTD is 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 10), step down to the SLFCK prompt (Figure 12D), press ENTER, select the CALYS option and press ENTER again. Channel 1 will be matched to the RTD probe automatically.

Digital Communications, Terminals I/O-16 to I/O-20

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 reduce signal reflections when long data lines are used. 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 when long data lines are used. It is suggested that the system be tested first without the resistors, and if it performs properly, do not install it.

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-20; one at the Advantage end and one at the host end, to reduce circulating currents.

## Cooling Control Module Connections:

The Advantage 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 (Figure 5A).
- A 6-relay module in the CCA position and a 4-relay module in the CCB position, referred to as the 6-4 configuration (Figure 5A).
- A single 4-relay module in the CCA position only, referred to as the 4-0 configuration (Figure 5B).
- 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).

Note that in configurations with two cooling control modules, only the module in the CCA position has current sense input hardware installed on the module. If your hardware feature set includes a polyphase current input module (PCI), the CCA module will not have a current sense input. In this case, see the sub-section in optional modules, " Polyphase Current Input Module" later in this section for details on connections. Connections to the relay terminals can be made using the lugs described in the connections general section above. Lugs and hook-up wire conductor should be appropriate for the current level plus expected overloads. Hook up wire insulation should be chosen assuming an open circuit in the CT secondary could occur at any point in the circuit.

Special attention must be taken when wiring to the current sense inputs if wiring directly to the current transformer (CT) since the **open secondary of a CT can generate high voltages which are lethal to personnel.** Precautions must be taken to either de-energize the transformer (preferred) or short circuit the CT secondary before making any wiring changes. Consult with your safety personnel for appropriate practice prior to making any wiring connections. Once connections to the current sense terminals are made, the sense circuit must be calibrated to the transformer's CT, by performing the ICAL operation. Reference the calibration section paragraph titled "Current Transformer (CT) Calibration on page 42 for details on how to perform this operation.

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 normal 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.

## Optional Module Connections

The modules in this section are not part of the Advantage standard hardware feature set. They are generally ordered as an optional feature at the same time as the Advantage, but may be ordered separately. In the latter case, installation instructions will be included with the module in the shipping carton.

## Multiple Channel Analog Retransmit (MCAR) Module Connections:

The MCAR module provides an analog signal which is proportional to any three of eight displayable values selected by the user in the RTX1, RTX2 or RTX3 configuration loops. See Figure 9C 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.

The MCAR module has been factory calibrated to meet 0.5% accuracy requirements for the standard output range of four to twenty milliamps. If the output range is changed, the output settings will need to be reset in order to achieve maximum accuracy. This can be done by using a standard milliammeter for comparison or by using an offset calculated from the analog retransmit coefficient which is printed on a label adhered to the inside bottom of the case.

The desired nominal endscale output settings are calculated by multiplying the analog retransmit coefficient by the desired endscale value. The settings for the low nominal endscale value (four ma for example) and high nominal endscale values (twenty ma for example) are available for adjustment through firmware configuration in the main configuration loop. Reference figure 10 (page 25) to enter the configuration loop, figure 11 (page 26) to navigate to the RTXn submenus and figure 12C (page 29) to navigate within the analog retransmit configuration loop.

For example; to adjust the low endscale nominal value (4 ma in this example) of retransmit number one (RTX1 in the configuration loop) for maximum accuracy, follow this procedure:

Analog retransmit coefficient from label: 0.988

0.988 x 4000 = 3952 Note that the 4 ma is expressed as 4000 microamps

Enter 3952 as the RZER1 value in the RTX1 configuration menu.

Likewise, to adjust the high endscale nominal value (20 ma in this example) of retransmit number one (RTX1 in the configuration loop) for maximum accuracy, follow this procedure:

Analog retransmit coefficient from label: 0.988

0.988 x 20000 = 19760 Note that the 20 ma is expressed as 20000 microamps

Enter 19760 as the RFUL1 value in the RTX1 configuration menu.

For a 0 to 1 ma output range, the low endscale is zero, so no offset is required. For example, to calculate the low endscale value for RTX2:

0.988 x 0000 = 0

0000 + 0 = 0

Enter 0 as the RZER2 value in the RTX2 configuration menu.

Like wise, to adjust the high endscale nominal value (1 ma in this example) of retransmit number two (RTX2 in the configuration loop) for maximum accuracy, follow this procedure:

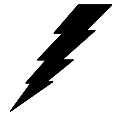
0.988 x 1000 = 988 Note that the 1 ma is expressed as 1000 microamps

Enter 988 as the RFUL2 value in the RTX2 configuration menu.

The milliammeter method requires that known endscale input signals be applied to the source channel while the milliammeter monitors the output and the RZER and RFUL variables are set to correspond to the desired output current. This method can be used to set accuracies better than the 0.5% factory accuracy, and is generally employed after many years of operation. Reference section 7 for performance of this operation.

## Polyphase Current Input (PCI) Module

The Polyphase Current Input (PCI) module incorporates three separate, electrically isolated channels to convert the current signals from individual CT's into a single one to be displayed as ILOAD. The PCI incorporates circuitry to automatically compare the three signals and select the one having the greatest magnitude for display.



Special attention must be taken when wiring to the current sense inputs if wiring directly to the current transformer (CT) since the **open secondary of a CT can generate high voltages which are lethal to personnel.** Precautions must be taken to either de-energize the transformer (preferred) or short circuit the CT secondary before making any wiring changes. Consult with your safety personnel for appropriate practice prior to making any wiring connections.Once connections to the current sense terminals are made, the sense circuit must be calibrated to the transformer's CT, by performing the ICAL operation. Reference the calibration section paragraph titled "Current Transformer (CT) Calibration on page 42 for details on how to perform this operation.

Referring to figure 5A or 5B, the PCI module has the same terminal layout as the Option Module (OM). Connections to the PCI are made at terminals OM-1 and OM-2 (phase A), terminals OM-8 and OM-9 (phase B) and terminals OM-14 and OM-15 (phase C). Delta or Wye connections are permissible. For Wye connections polarity should be high to terminals OM-1, OM-8 and OM-14 and neutral to terminals OM-2, OM-9 and OM-15. For delta circuits OM-1 and OM-2 should be connected A-B, OM-14 and OM-15 should be connected B-C and OM-14 and OM-15 should be connected C-A. Lugs and hook-up wire conductor should be appropriate for the current level plus expected overloads. Hook up wire insulation should be chosen assuming an open circuit in the CT secondary could occur at any point in the circuit.

## 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 7.0, Calibration for details of calibration checks.

## Surface Mounting

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.

## Through-Panel Mounting

The Advantage through-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 through-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.

## Channel Assignment

The following functions are assigned to the CT input signal channels:

| Channel Number | Assignment | Note |
|---|---|---|
| 1 | Fluid Temperature | - |
| 2 | Current Sense Input | - |

## 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.

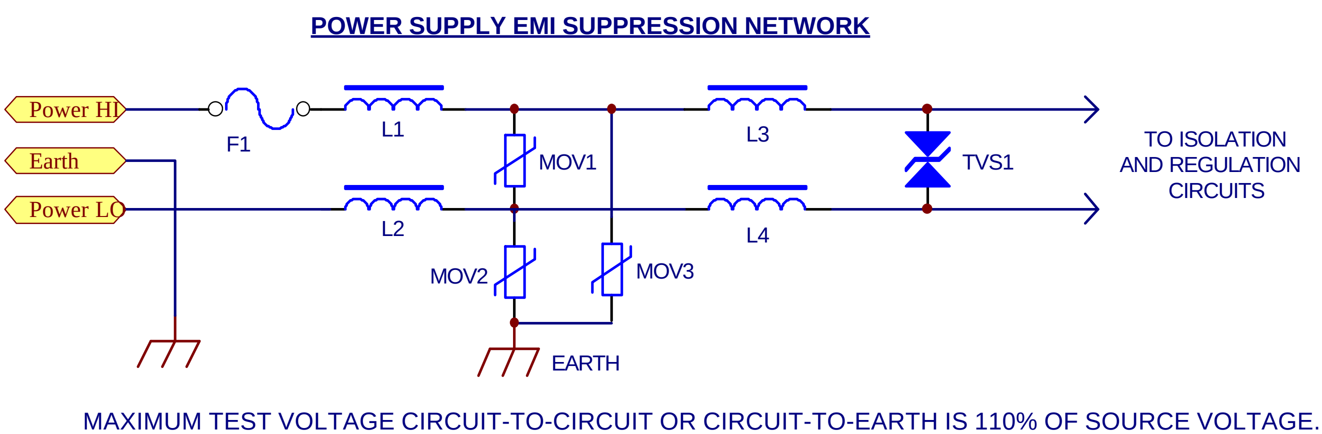



**Figure 4A. Power Supply Input EMI Suppression Network**

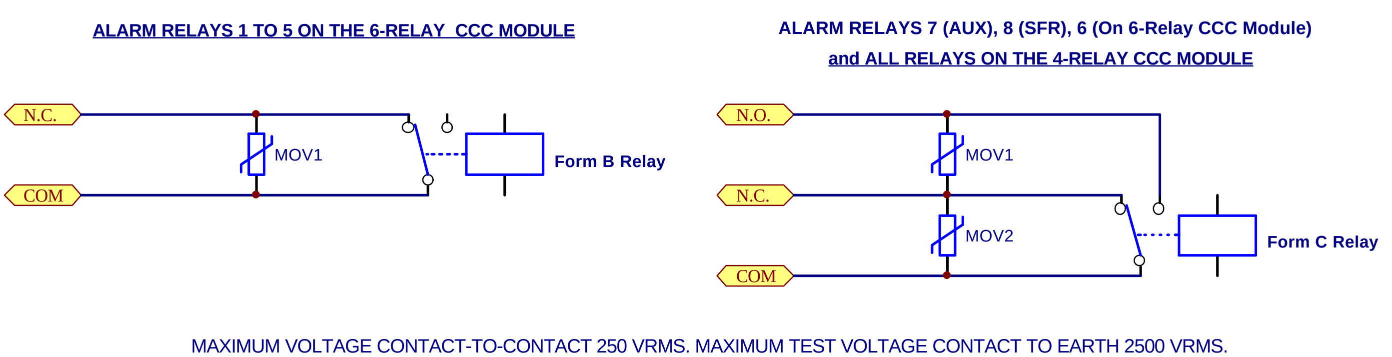
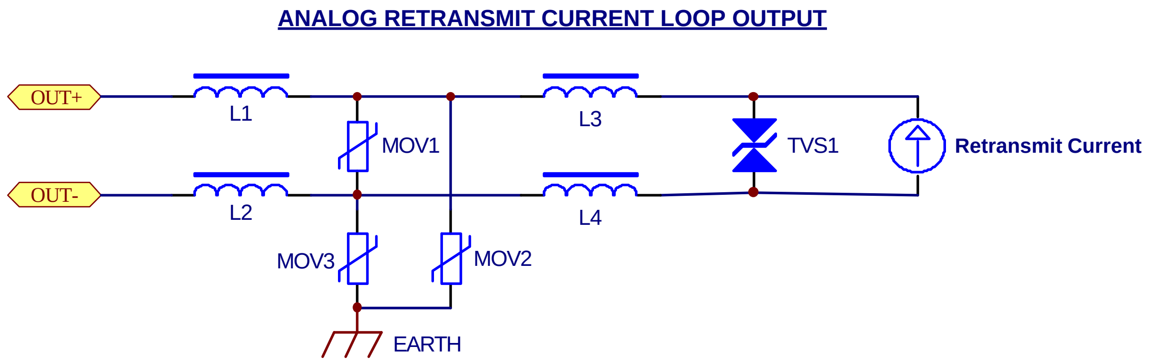
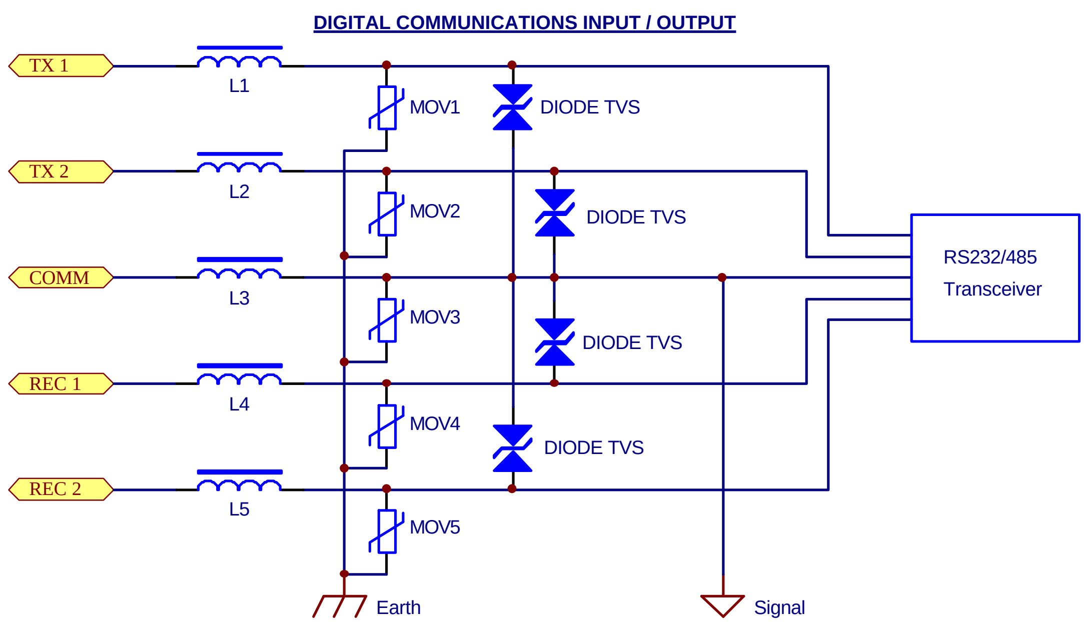



**Figure 4B. Alarm Relay EMI Suppression Networks**




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

**Figure 4C. Analog Retransmit EMI Protection Network**




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

**Figure 4D. Digital Communications EMI Protection Network**

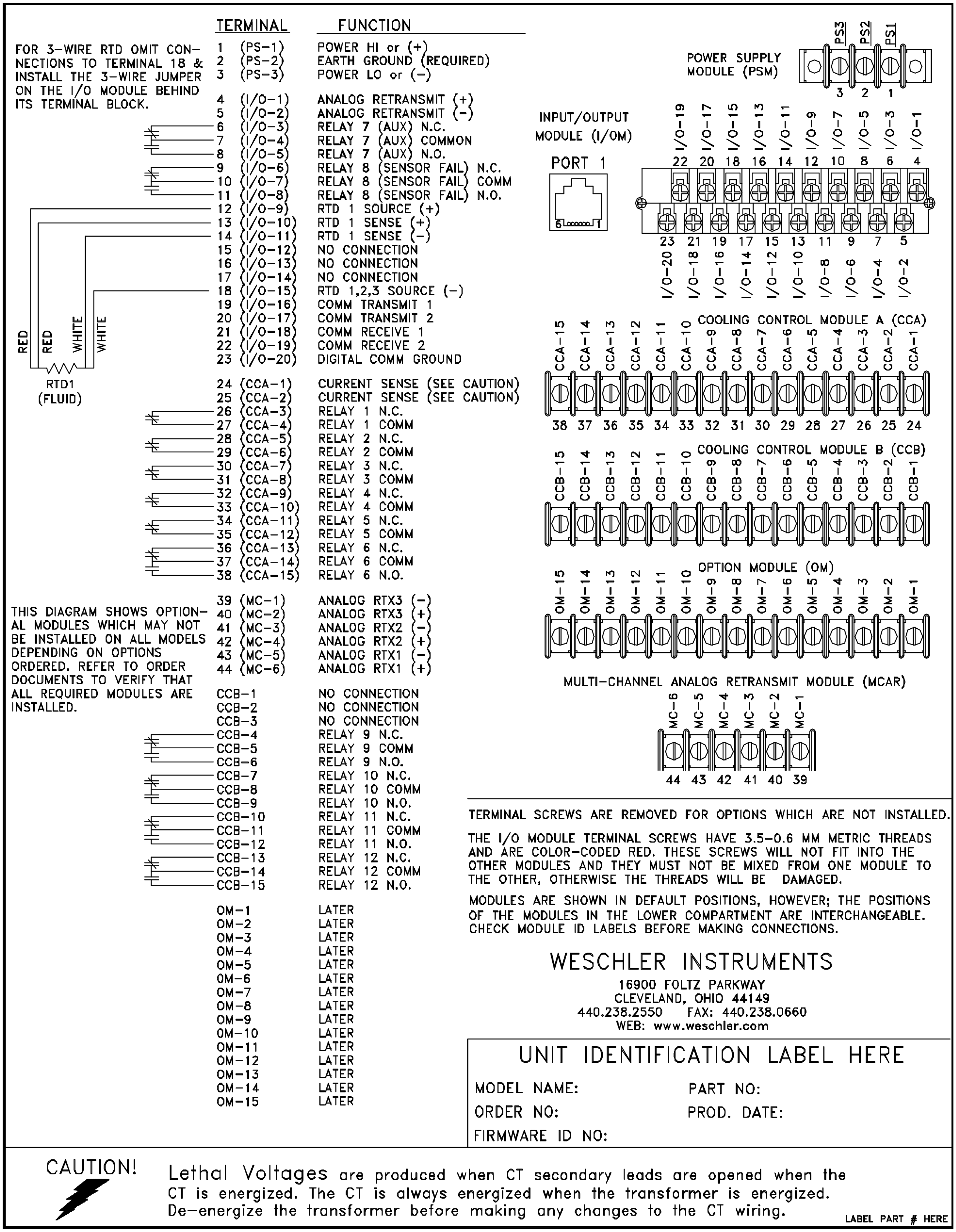



**Figure 5A. Terminal Assignments and Locations. Models with 6/0 or 6/4 Relay Module Scheme**

Terminal screws on all modules except the I/O module have #6-32 threads. Do not mix I/O module screws with screws from another module or thread damage will result.

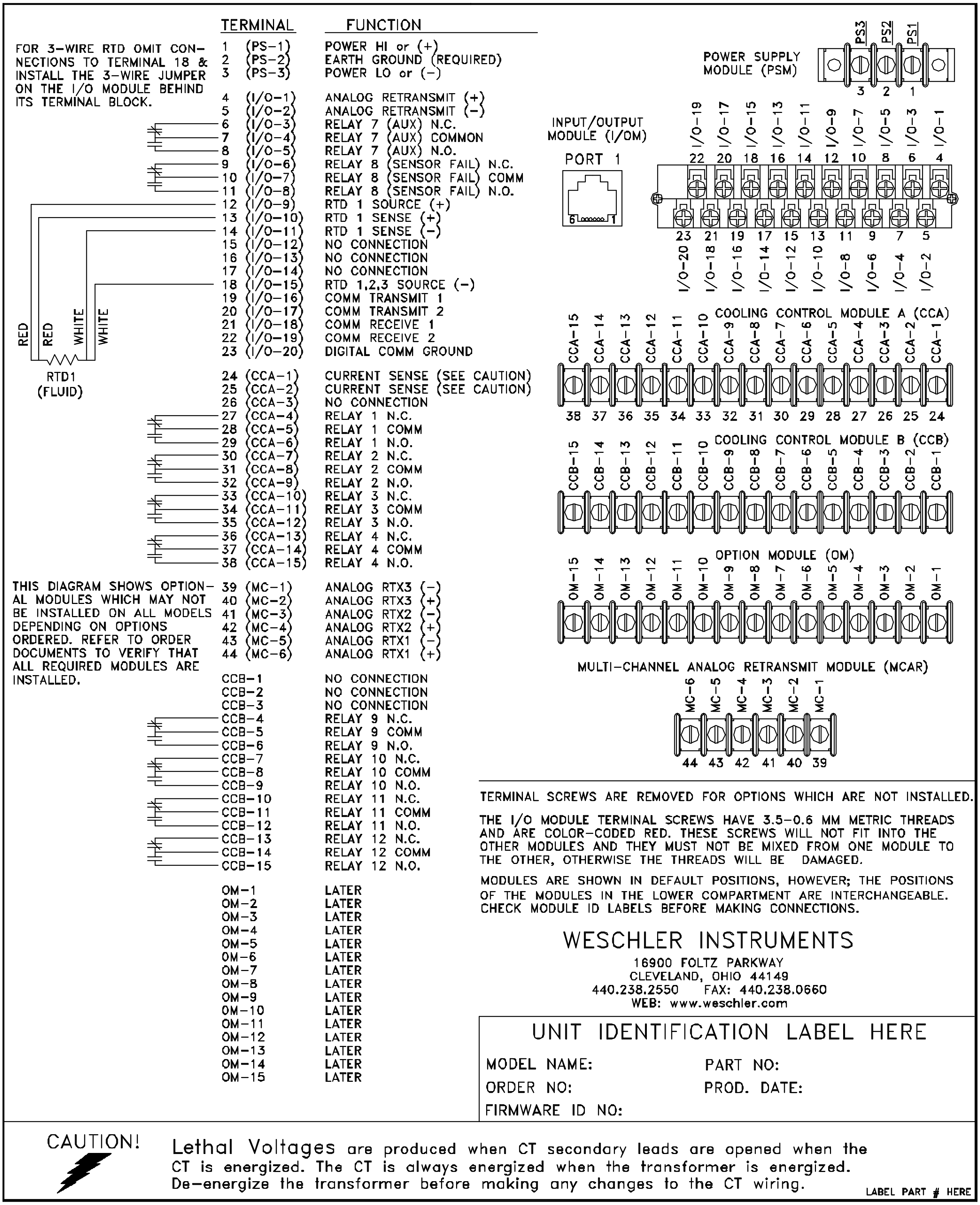



**Figure 5B. Terminal Assignments and Locations. Models with 4/0 or 4/4 Relay Module Scheme**

Terminal screws on all modules except the I/O module have #6-32 threads. Do not mix I/O module screws with screws from another module or thread damage will result.

## Relay Configuration 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).**

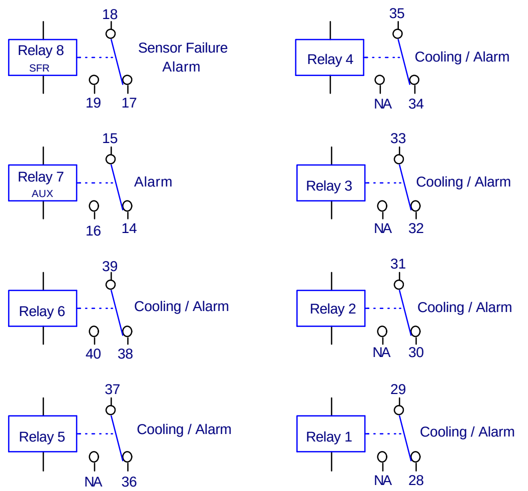



**Figure 5A-1. The 6-Relay Cooling Control Module in Primary Cooling Control Position A (CCA).**

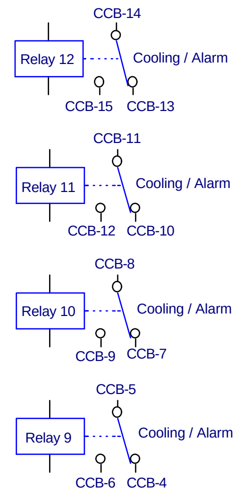



**Figure 5A-2. The 4-Relay Cooling Control Module in Secondary Cooling Control Position B (CCB).**

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## 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).**

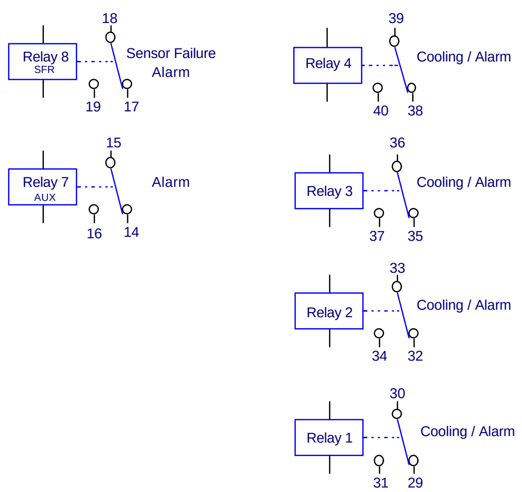



**Figure 5A-3. The 4-Relay Cooling Control Module in Primary Cooling Control Position A (CCA).**

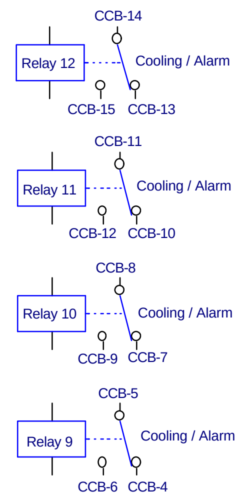



**Figure 5A-4. The 4-Relay Cooling Control Module in Secondary Cooling Control Position B (CCB).**

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

Shown with both cooling control modules and the maximum number of relays per module. Other CT hardware complements may not have both modules nor all relays installed. Relays are shown in their de-energized states.

**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.**

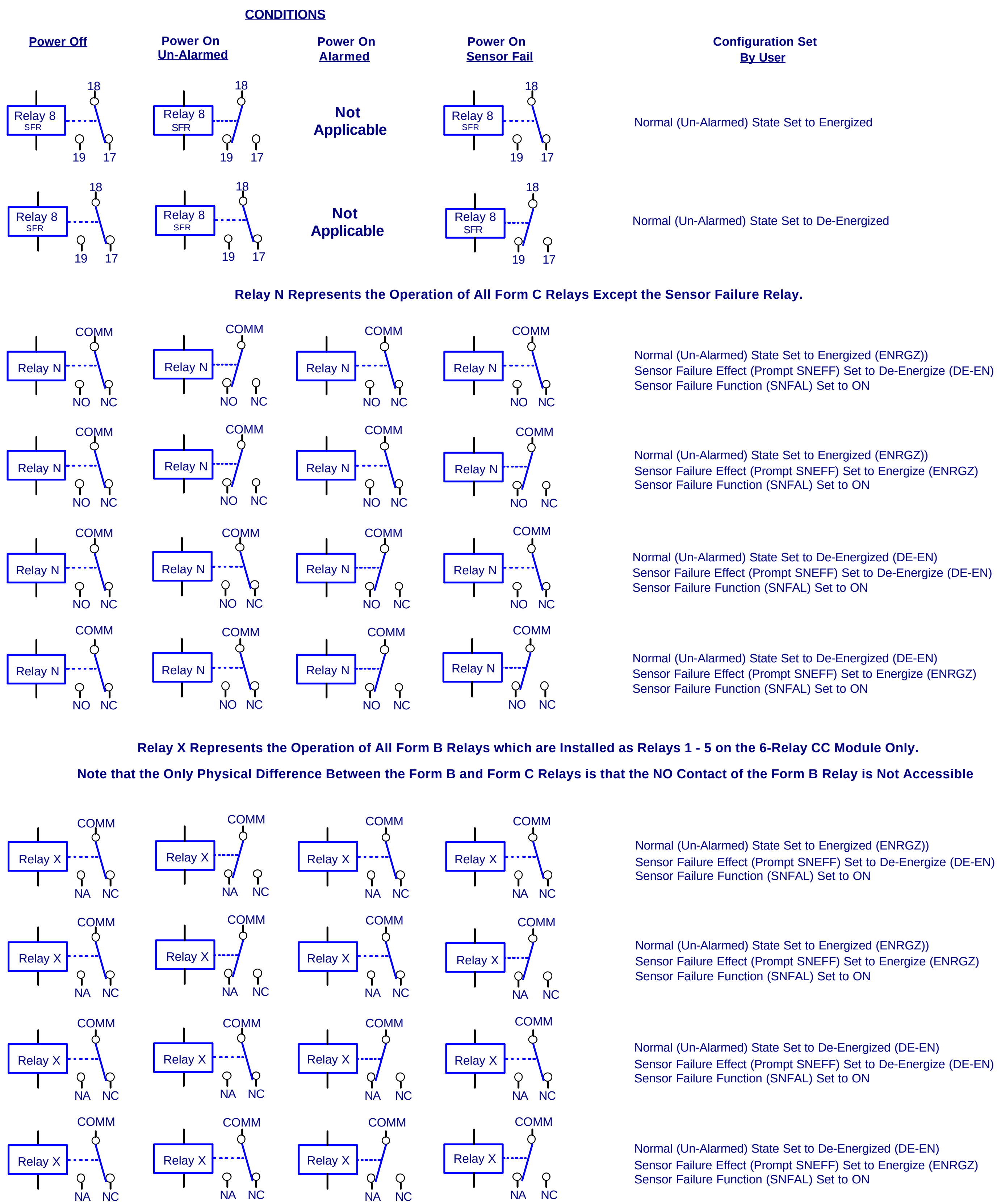


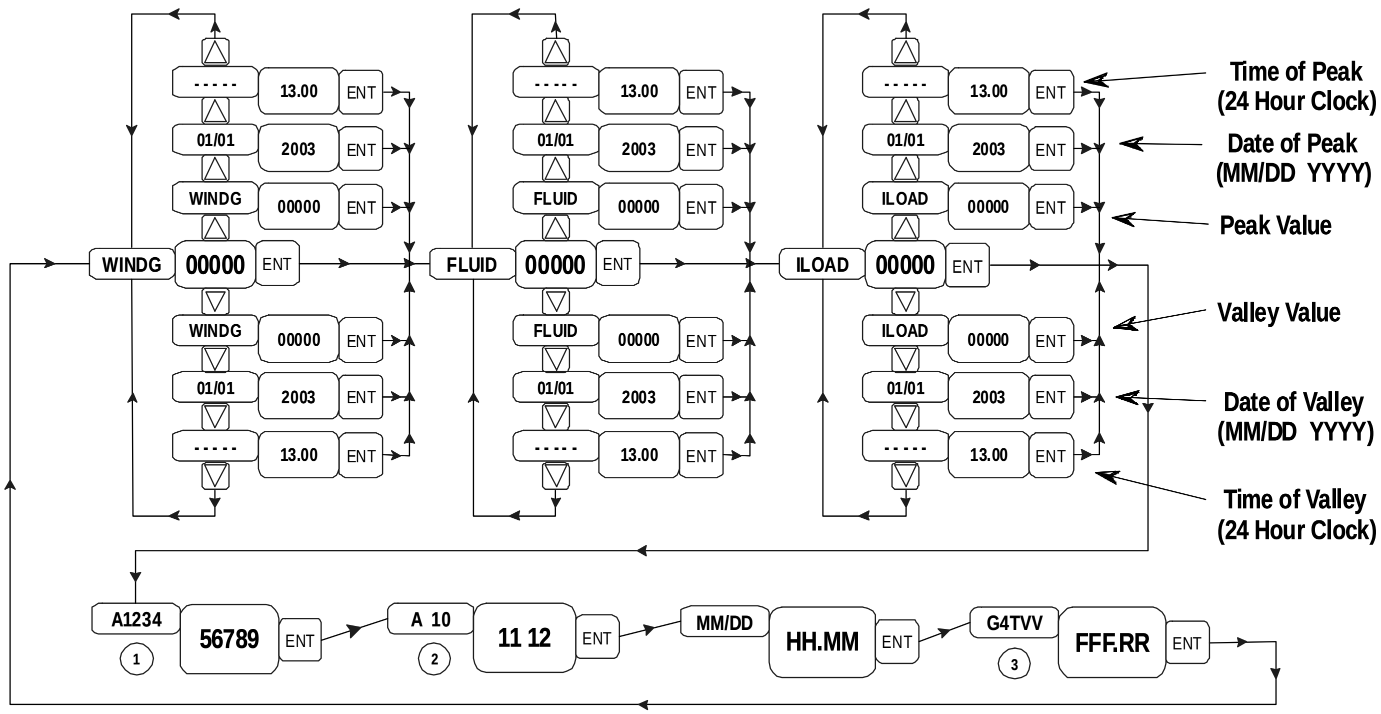

**Figure 6B. Relay Operation for Various Alarm and Power Conditions**

# 4.0 Operation

## Walk-up Functions

The walk-up functions are those which can be performed while in the normal operating mode, with single or dual simultaneous keystrokes. The functions affect the display and storage of measurement information. Any of the titles in the walk-up display loop may be stepped through and the PEAK and VALLEY values and corresponding time stamp may be viewed and cleared. The displays are stepped through by repeatedly pressing and releasing the ENTER button.

A measurement's historical peak value can be viewed by pressing the up button once when the display shows the desired measurement title. A second press of the up button will display the date that the peak value occurred. A third press of the up button will display the time, in 24 hour format, that the peak value occurred. The valley values can be viewed using the same sequence, except by pressing the down button instead of the up button. The values which are shown are those which have occurred since the last time the peak or valley values were cleared. Figure 7 below shows the keystroke steps available in the normal operation mode.




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

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

3 This Display Shows Firmware Version Information. G4T = CT MODEL, VV = VERSION and RR = Revision Level. FFF is Reserved for Factory use, and Should Always Show 000. This Display is the Same one that Appears at Start Up.

△ 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.

Temperaatures in Degrees Celsius and Time in 24 Hour Format.

**Figure 7. Walk-Up Menu 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 the Supervisor Mode, section 5 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 9 on the next page 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 (see figure 10) and enable it (see figure 12C) 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 12B 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. 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 8 illustrates how the alarm displays look when sensor and internal failure events occur. For a more detailed treatment of alarm function, refer to the paragraphs beginning with “Alarm Conventions” in section 5 on page 35.

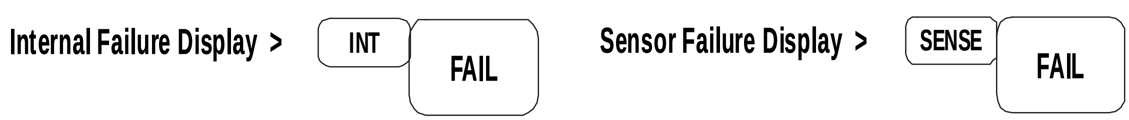



**Figure 8. Alarm Displays**

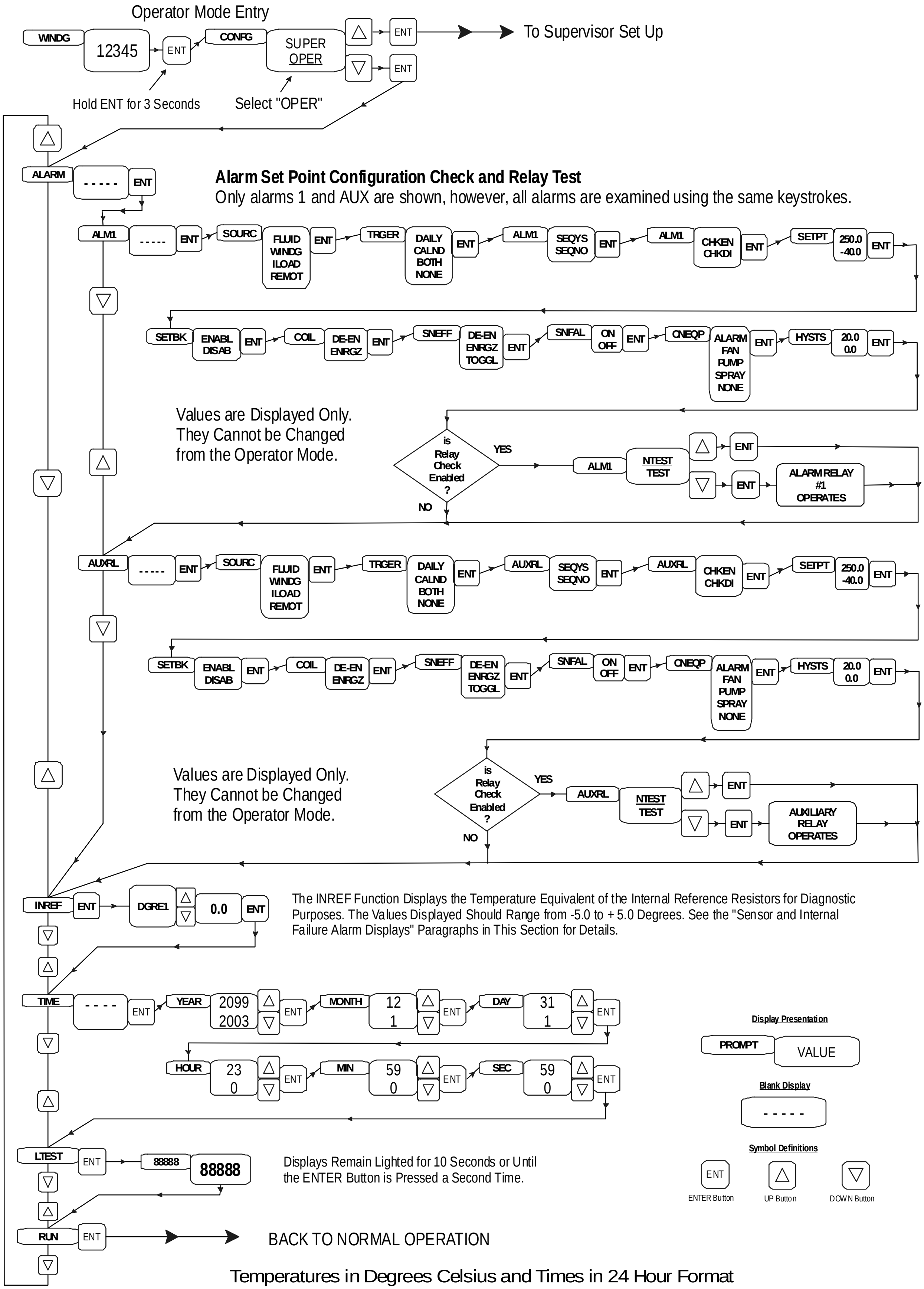



**Figure 9. Operator Loop Keystroke Diagram**

# 5.0 Configuration

The configuration section describes actions the operator can take to set up the Advantage for first use or modify settings as required at other times. This section first presents the method and keystrokes necessary to enter and navigate through the menus accessible from the front panel, followed by a keystroke by keystroke guide to options offered in the menus.

If digital communications has been ordered, it may be used with the included configuration software to enter set up parameters from a personal computer (PC) as an alternative to the front panel programming method. Also included in the digital communications package is a monitor program which allows for remote viewing of measured and stored values on a PC. In addition to these features, the digital communications package allows the user to update the firmware using a PC and a simple communications program which is supplied with every copy of MicroSoft Windows. Refer to the SMG4T200 manual for more details.

Regardless of input method, the  keystroke by keystroke guide provides valuable recommendations for setting up your Advantage.

**Supervisory Setup**

The supervisor setup routine, also referred to as the main configuration loop, is used to configure parameters which will fit the advantage to the application and transformer being monitored. The keystroke diagram of figure 10 summarizes the steps required to enter the configuration loop. Figure 11 is the summary keystroke diagram of the main configuration loop. Figures 12A - 12D are the detail keystroke diagrams of the main configuration loop.

When the Advantage is first powered on, the supervisor setup USER loop, followed by the ALARM loop are automatically entered in order that the person performing the configuration can enter parametric information which tailors the winding temperature algorithm to the specific transformer being managed. The normal entry, using the password, is bypassed this one time in order that the necessary values are entered prior to the first usage. If a user has supplied Weschler with a configuration profile, and it has been installed at the factory, the required values will already have been entered and the automatic USER and ALARM loop entry will be bypassed.

In the USER loop there are 13 values for the winding temperature function which **may** be entered and seven which **must** be entered in order to exit the loop. If any of the 7 required values are not entered, the user will be repeatedly returned to the prompt which requests it. This method is designed to ensure that valid values, specific to the transformer, are entered. Without this information the Advantage cannot function properly. In the detail keystroke diagram of figure 12A, the seven values are labeled as “Required Parameters” to highlight their importance. Please visit the keystroke by keystroke guide in this section for further information on required parameters.

After the USER parameters are entered, the display automatically changes to the alarm menu in order to direct the user to declare assignments and other settings for the installed alarms. It is assumed that the Advantage CT will operate cooling equipment as part of its winding temperature function, and in order to control the equipment the Advantage must be “told” what type of cooling equipment it is connected to. In order to exit the alarm function, the user must, as a minimum, select the type of equipment each alarm will be controlling. The selection is made when the “CNEQP” prompt appears under the ALARM menu.  If the user has not yet decided which alarms to assign to which equipment and source, (s)he may select the “NONE” option and return to this menu later to make final assignments.

Once the USER and ALARM parameters are entered, the user may freely navigate to other set up menus or exit the configuration loop to normal operation.

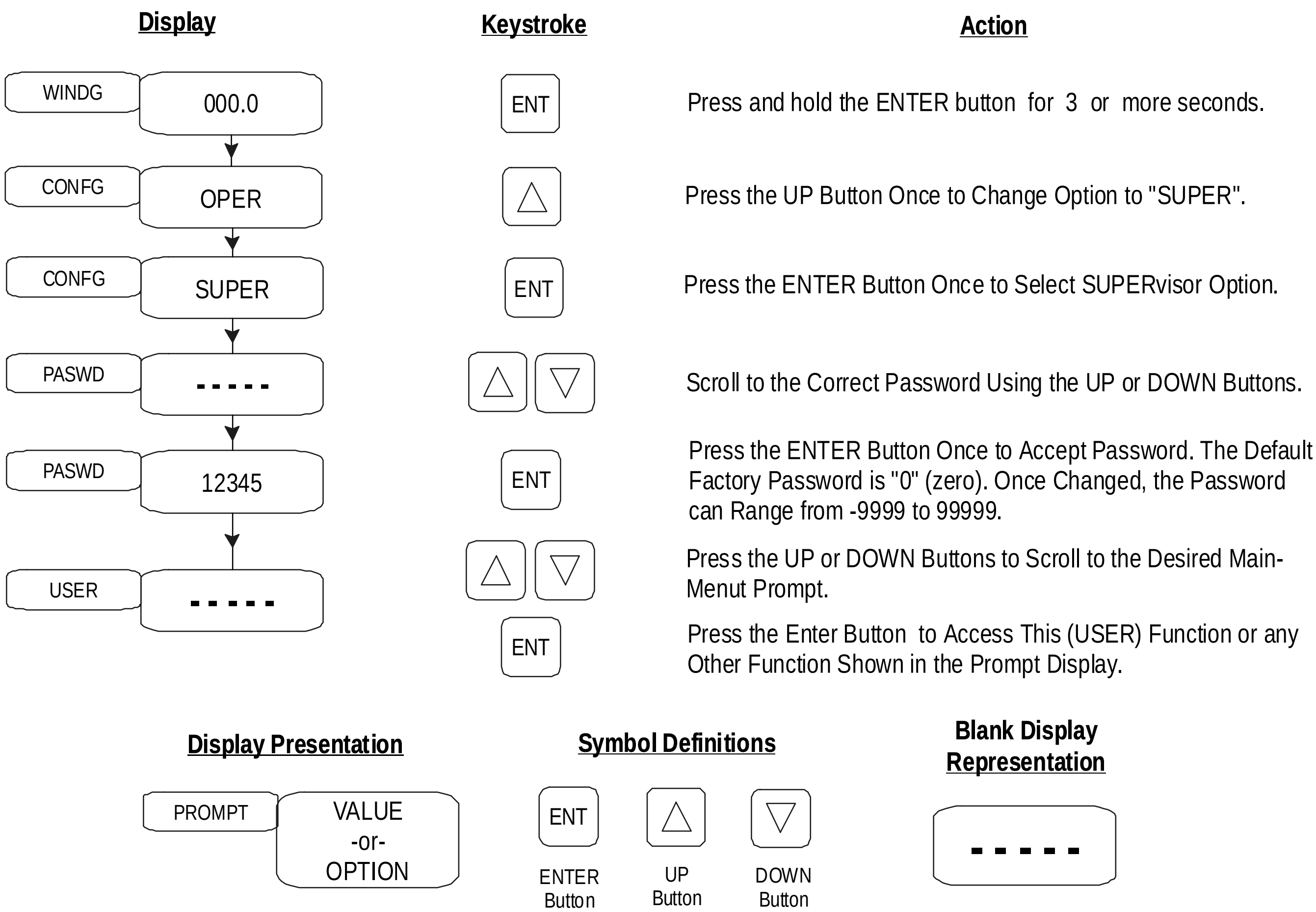



**Figure 10. Keystroke Diagram for Supervisor Mode Entry**

Figure 10 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 sub loop menu below it. When the sub loop menu is entered, the prompt display may change to a units display, showing AMPS, TONS or other units, 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. If you want to simply view a value, press the enter button after the value is shown, without pressing an up or down button. If you want to change a value, you must first set the value with the up or down button, then press the enter button to accept it.

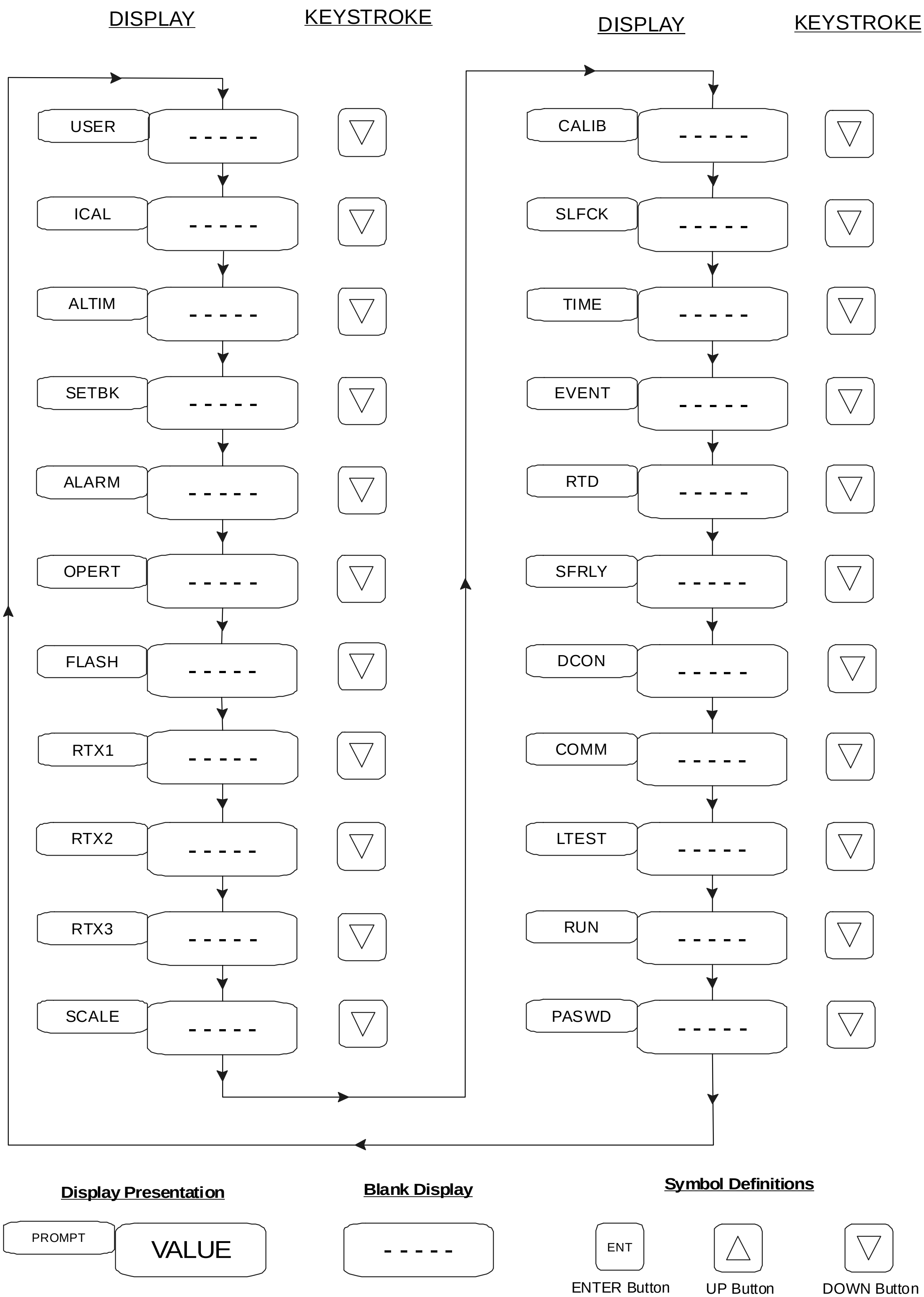



**Figure 11. Main Configuration Loop Summary Keystroke Diagram**

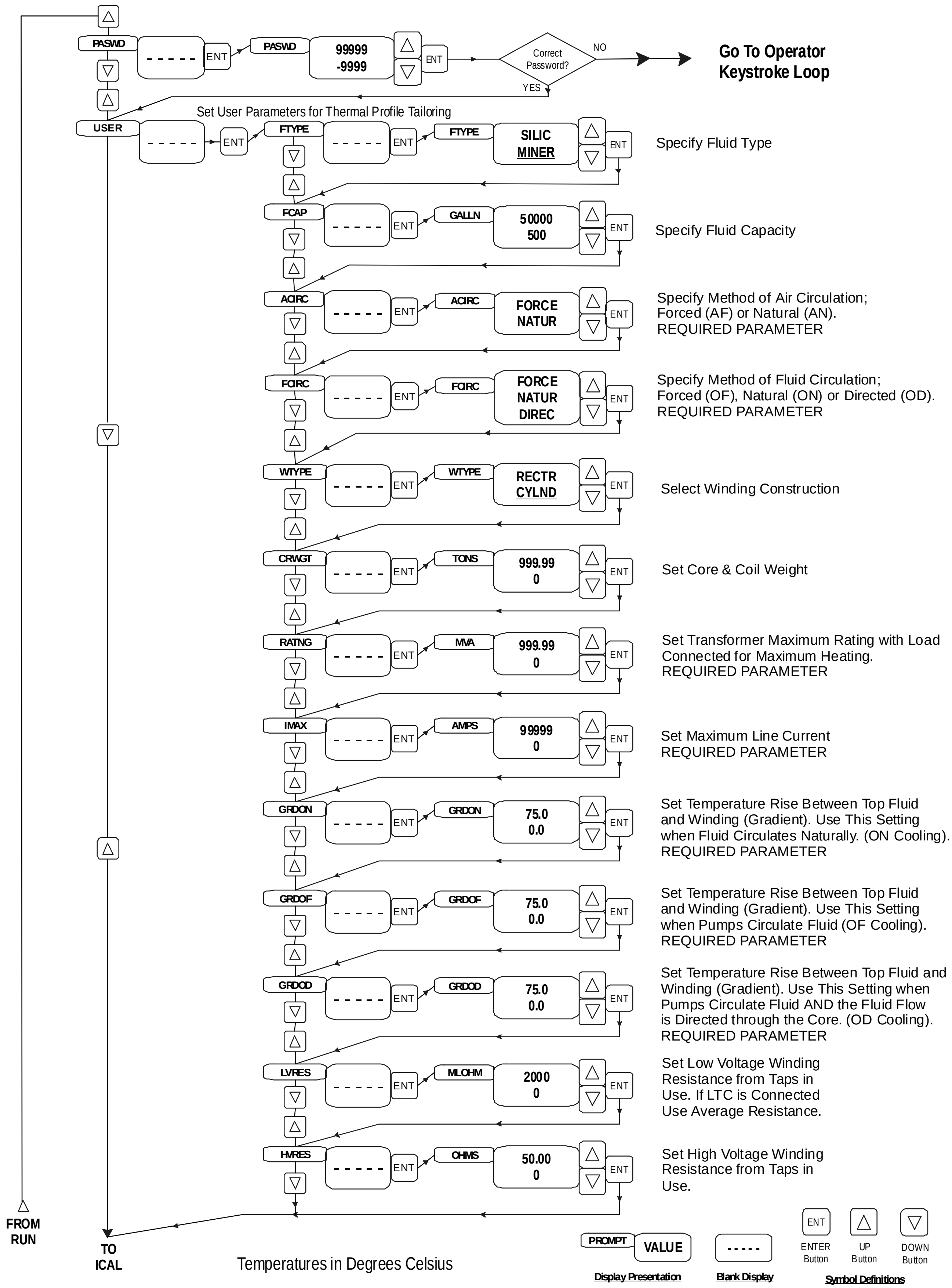



**Figure 12A. Main Configuration Loop Detail Keystroke Diagram**

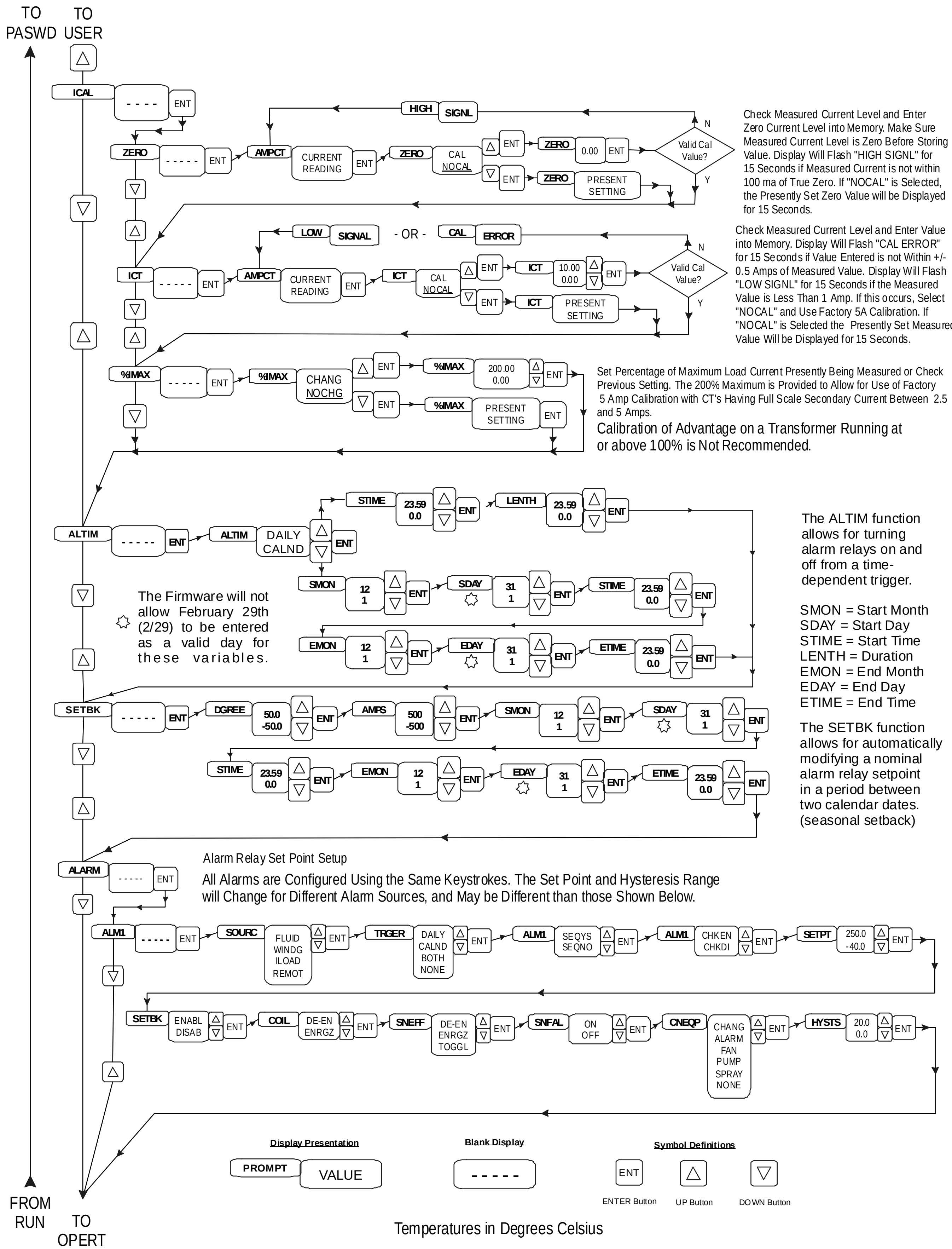
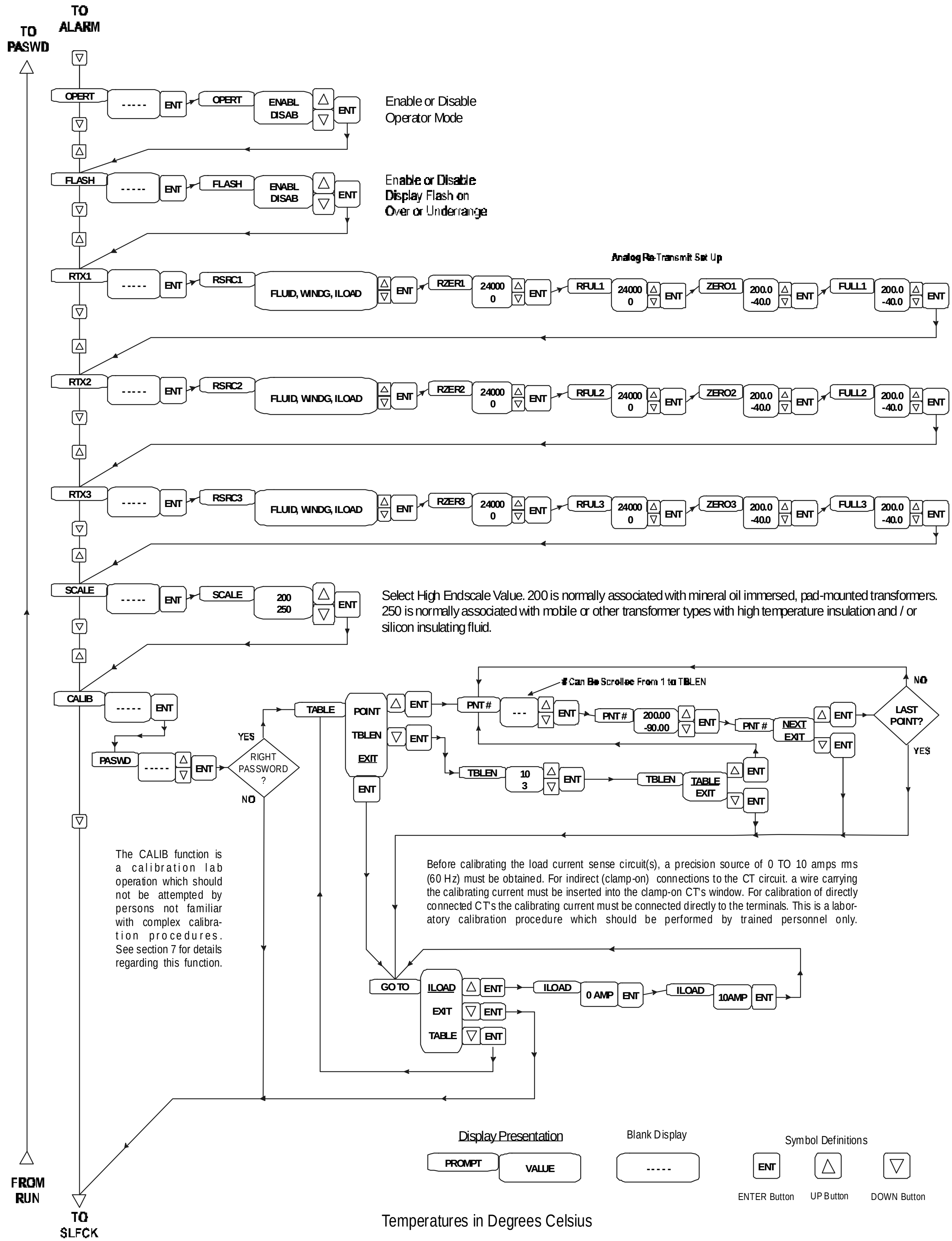



**Figure 12B. Main Configuration Loop Detail Keystroke Diagram (continued)**




Temperatures in Degrees Celsius

**Figure 12C. Main Configuration Loop Detail Keystroke Diagram (continued)**

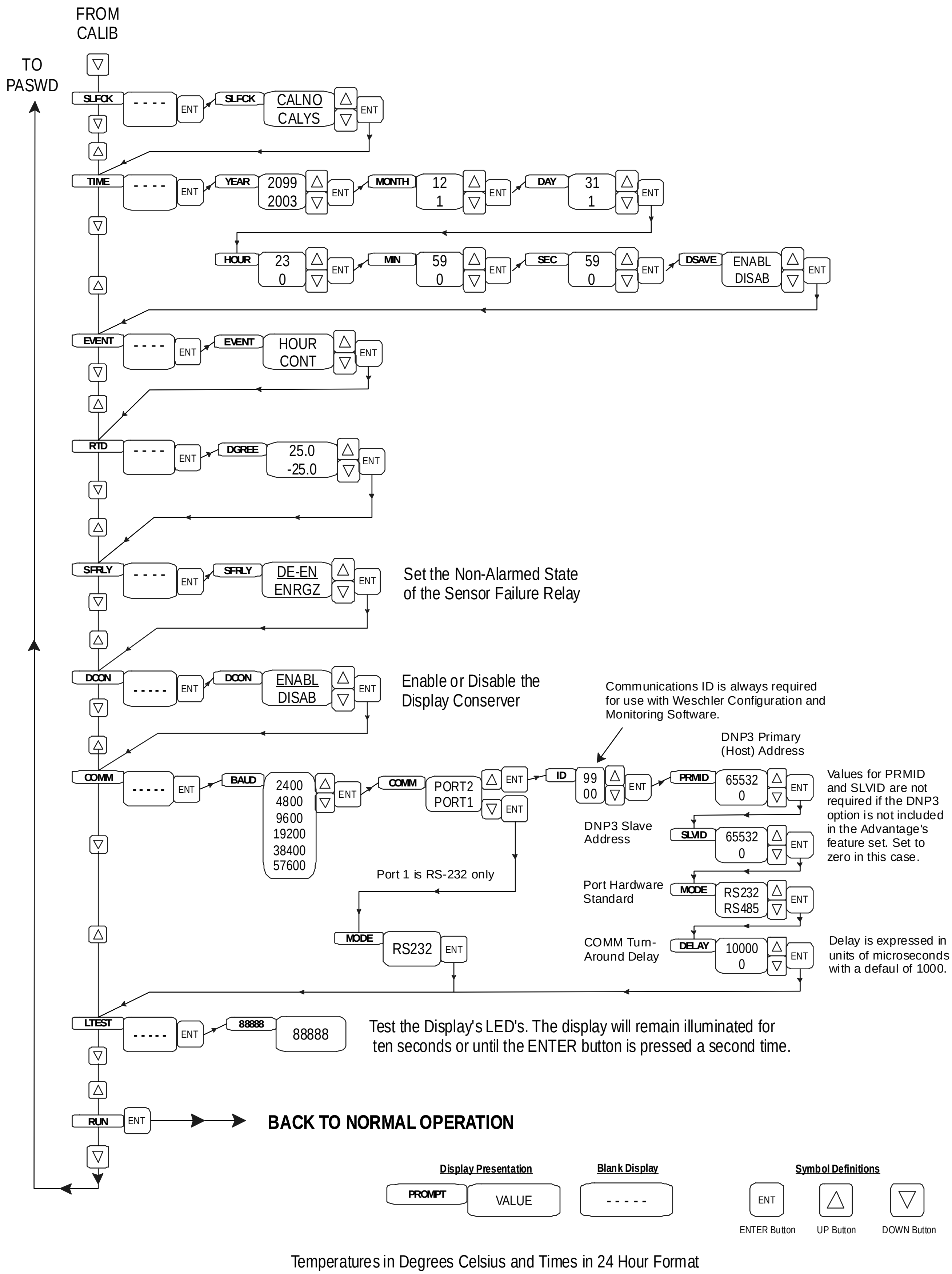



**Figure 12D. Main Configuration Loop Detail Keystroke Diagram (conclusion)**

### 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, figure 12A

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 10 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.

Prompt **USER**, User Loop, figure 12A

The user loop has a sub loop of 13 items which the user can set. Seven of these items are required for the proper operation of the Advantage winding temperature algorithm (WTA) and they ***must*** be set up in order to exit the loop. If one or more of them are left in their factory default value, the user loop will be automatically re-entered as the user attempts to scroll out the “bottom” of the loop. The remaining six items are not critical; however their values contribute to the calculation of rate of winding temperature rise and the more accurate and specific their values are, the more accurate the indication will be.

The WTA uses equations which are based on the logic and mathematical relationships which are expressed in the IEEE Guide for Loading Mineral-Oil-Immersed Transformers, IEEE Std C57.91-1995. The Guide considers many more variables than the Advantage WTA because many of them are design based, and not available to the owners of the installed base of transformers. Thus their inclusion in ths WTA would render it impractical for general use. The Advantage has been designed with a knowledge-based upgrade path in mind, and as the state-of-the-art in winding temperature advances, so can the Advantage.

The variables which the Advantage WTA uses are discussed below. All are straightforward and only require a brief explanation. Some are included as data plate information, some are contained in the manufacturer’s reports and some are part of operating experience. Not all are required, but supplying them will improve the measurement accuracy.

If you are unsure of a value, set it on the conservative side. You can easily change it later if experience shows it to be warranted. The user loop keystroke diagram appears in Figure 12A on page 27.

Prompt **FTYPE**, Fluid Type Variable, figure 12A

The fluid type refers to the fluid which the core and coil are immersed in. The choices are mineral, option MINER or silicon, option SILIC. Generally, silicone fluid is reserved for high temperature transformers such as mobile units where rapid heat transfer and resistance to high temperature fluid degradation is required. Because silicone fluid has a slightly lower specific heat, it will carry more heat away from the winding than mineral oil. This will result in slower heat rise and faster heat decay. If you are unsure what fluid is in use, select MINER.

Prompt **FCAP**, Fluid Capacity Variable, figure 12A

The fluid capacity refers to fluid in the main tank and must not include the contents of conservators or other expansion tanks. The value may range from 500 to 50000 gallons. It should be listed on the transformer's data plate. Fluid capacity is in inverse proportion to general temperature rise in transformers; as the oil capacity is increased, the rate of heating or cooling is decreased. If the value is not available, use the default or the capacity from a like-rated transformer of known capacity.

Prompt **ACIRC**, Air Circulation Variable, figure 12A **(Required Parameter)**

The air circulation option refers to the method used to move air through the radiators. The choices are forced, option FORCE or natural, option NATUR. These choices correspond to the industry standard AF and AN descriptions. There is no default; if you attempt to exit the user loop without selecting one of the choices, you will be returned to this menu item. Generally the choice is determined by the existence of fans on the radiators; if they exist the circulation is forced; if not the circulation is natural. If the transformer has no radiators for air-cooling, such as may be the case in water cooled units, select NATUR as the option for this parameter.

Prompt **FCIRC**, Fluid Circulation Variable, figure 12A **(Required Parameter)**

The fluid circulation option refers to the method used to move the fluid through the radiators or other heat exchanging device. The choices are forced, prompt FORCE, directed, prompt DIREC or natural, prompt NATUR. These choices correspond to the industry standard OF, OD and ON descriptors. There is no default; if you attempt to exit the user loop without selecting one of the choices, you will be returned to this menu item. It is important to choose the correct fluid circulation method because of the very profound effect forced and directed oil cooling equipment have on the winding temperature time constant. Directed oil cooling has a unique effect in that its activation normally causes a rapid rise in the top oil temperature. The top oil and winding temperatures actually converge when the pumps are operated. The determination of forced or natural fluid is generally determined by the existence or lack of pumps in the fluid circuit. The determination of whether the forced circulation is directed or not is more difficult. It is not required to be listed on the data plate but would probably be included in the transformer's test report. To clarify, the forced and directed fluid options both employ pumps to move the fluid; but the directed option uses special manifolds to make the fluid flow directly from the heat exchanger outlet into the coil ducts. The directed option is more efficient (and costly) than the simple forced option; and if the fluid is directed the increased efficiency should be used to the operator's best advantage. If it is not known whether the fluid is directed or simply forced, for initial conditions the forced option should be chosen to be more conservative.

Prompt **WTYPE**, Winding Type Variable, figure 12A

The winding type refers to winding construction. The choices are rectangular, prompt RECTR and cylindrical, prompt CYLND. Rectangular construction is used mostly in transformers rated below 10 MVA and this construction is generally less efficient at removing heat in windings near to the core. Because of the number of available cooling ducts in cylindrical windings (disc types) they enjoy a slight advantage in cooling efficiency. This factor is considered in the WTA. If the winding construction is unknown, for initial conditions assume cylindrical above 10 MVA, and rectangular as the more conservative choice below 10 MVA.

Prompt **CRWGT**, Core Weight Variable, figure 12A

The core weight refers to the weight of the core and coil, minus fittings. It is generally referred to on data plates as untanking weight. The relationship of the core mass to thermal time constant is an inverse proportion; the greater the mass the longer it takes to respond to a step change in generated heat. The unit of measure on the data plate is frequently pounds but the unit of measure in the menu is tons. This is done to express weights in excess of 99999 pounds, such as may exist in large GSU transformers. To convert pounds to tons, divide pounds by 2000. If the core weight is not known, use the default or a known core weight from a same-rated transformer of same core construction.

Prompt **RATNG**, Power Capacity Rating Variable, figure 12A**(Required Parameter)**

The power capacity rating refers to the maximum power that can be routed through the transformer with all cooling apparatus on and still remain below the guaranteed winding temperature rise. On data plates the rating is frequently expressed as a series of increasing values coordinated with the number and type of cooling apparatus which is turned on. The rating to be entered here is the highest of these ratings, assuming all cooling stages are connected and operating correctly. The unit of measure used for this parameter is mega volt-amps which is the normal multiplier for transformers rated above 999 kilo volt-amps. Attempting to exit the user loop without entering a value between .01 and 99.999 MVA will result in a return to this menu item.

Prompt **IMAX**, Maximum Line Current Variable, figure 12A **(Required Parameter)**

The maximum line current refers to the line (primary) current which will pass through a reference CT when the transformer is at its power capacity rating. The reference CT is the CT which supplies secondary current to the current sense input of the Advantage. This may be a bushing or instrument transformer. The electrical location of the CT, on the high side or low side of the transformer is unimportant. Attempting to exit the user loop without entering a valid value, between 1 and 99999 Amps will result in a return to this menu item.

Prompt **GRDON**, Oil Natural Gradient Variable, figure 12A **(Required Parameter)**

The oil natural (ON) gradient refers to the temperature differential between the top oil and winding temperatures when the oil is circulating through heat exchangers (radiators etc) without the aid of pumps. On transformer test reports the ON gradient will be provided for ONAF cooling. This value is required regardless of the type of fluid circulation declared in the FCIRC menu item. The reason for requiring this additional gradient when OF or OD cooling is also provided is that the transformer heats up in response to the ON heating curve, prior to cooling equipment turn-on. The ON curve is generally steeper with regard to temperature rise per unit time, than the curves of oil forced (OF) or oil directed (OD) equipment. If the value is not provided on a test report, the next best approximation can be determined by operating experience, if data is available. If no other source is available, use three times the OF gradient, four times the OD gradient or 1½ times the AF gradient. Attempting to exit the user loop without entering a value between 0 and 75.0 °C will result in a return to this menu item.

Prompt **GRDOF**, Oil Forced Gradient Variable, figure 12A **(Required Parameter)**

The oil forced (OF) gradient refers to the temperature differential between the top oil and winding temperatures when the oil is circulating through heat exchangers (radiators etc) with the aid of pumps. This value is only required if the OF fluid circulation method is selected in the FCIRC menu item. If the OF method has been selected in FCIRC, and an attempt to exit the user loop is made without entering a value between 0 and 75.0 °C, the user will be returned to this menu item.  The OF gradient should be included on transformer test reports.

Prompt **GRDOD**, Oil Directed Gradient Variable, figure 12A **(Required Parameter)**

The oil directed (OD) gradient refers to the temperature differential between the top oil and winding temperatures when pumped oil is circulating through heat exchangers and special manifolds which route the oil directly into the coil's cooling ducts. This value is only required if the OD fluid circulation method is selected in the FCIRC menu item. If the OD method has been selected in FCIRC, and an attempt to exit the user loop is made without entering a value between 0 and 75.0 °C, the user will be returned to this menu item. The OD gradient should be included on transformer test reports.

Prompt **LVRES**, Low Voltage Winding Resistance Variable, figure 12A

This variable requires a numeric input. It is not a required value. The variable will accept values from 1 to 2000 milliohms (0.001 to 2 ohms). Winding resistance is one of two contributors to heat generation, however; without the considerable number of design variables required to use this value in heat gain / loss equations, its value is minimal. The Advantage WTA uses this value only for reference as a statistical factor. As the industry knowledge base increases, so may its value, and the opportunity to record it is provided here with a view towards future upgrade.

Prompt **HVRES**, High Voltage Winding Resistance Variable, figure 12A

This variable requires a numeric input. It is not a required value. The variable will accept values from 1 to 50.00 ohms. Winding resistance is one of two contributors to heat generation, however; without the considerable number of design variables required to use this value in heat gain / loss equations, its value is minimal. The Advantage WTA uses this value only for reference as a statistical factor. As the industry knowledge base increases, so may its value, and the opportunity to record it is provided here with a view towards future upgrade.

Prompt **ICAL**, Current Transformer Secondary Current Calibration Loop, figure 12B

The ICAL loop is provided to calibrate the Advantage to the transformer CT which supplies the load current sense signal for use by the winding temperature algorithm. Detail information on this function is contained in Section 7, Calibration.

**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 SETBK function also allows for seasonal adjustment of alarm(s) which operate in response to load current (ILOAD) magnitude. The AMP variable of this feature provides for a ± 500 amp range of adjustment, referred to the maximum load current, which is the “IMAX” value declared in the USER loop. Refer to 12A for the menu location of this variable. This variable operates same as the DGREE variable, above.

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, figure 12B

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 12B, 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, figure 12B

The SOURC variable allows for the choice of one of four alarm sources; FLUID (top fluid temperature), WINDG (winding temperature), ILOAD (Load current, typically load-side line current), and REMOT (a signal lock-out, not a true signal). When any one of these except REMOT is selected, Advantage uses the value for that variable for comparison to the set point value.

The REMOT signal source is intended to make the alarm being configured responsive to a remote 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 present 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, figure 12B

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, figure 12B

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 **SETPT**, Set Point Value Variable, figure 12B

The alarm set point function provides two different ranges of values, depending upon the alarm source. For all temperature measurements the range is -40.0 to 250.0 °C. For the current alarm source the range is 0 to the value defined as IMAX (maximum load current) in the USER loop. An alarm signal will be sent to the relay when the measured or calculated temperature or current is more positive than this 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, figure 12B

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. The sensor failure relay also offers this function, but the prompt is SFRLY instead of COIL.

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, figure 12B

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, figure 12B

The sensor failure enable function offers 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 for a particular relay will nullify the effect of the SNFAL variable for that relay.

Prompt **CNEQP**, Connected Equipment Variable (Required Variable), figure 12B

The connected equipment function offers five effective variables and one place-holder variable. The place-holder variable CHANG is the default which only remains displayed if the connected equipment has never been declared. Once a user selects another option the CHANG variable will disappear permanently.

The other options, ALARM, FAN, PUMP, SPRAY and NONE are the most common forms of cooling. While most of the terms seem self-explanatory, in cooling schemes where fans and pumps are being turned on by the same relay, the PUMP option must be chosen. Note that the minimum on time for a pump is 10 minutes; thus if the measured temperature drops below the set point one minute after it was turned on, the pump will remain on for 9 more minutes before turning off. This feature is included to avoid excessive pump start up wear.

All of the alarms must have their connected equipment variable declared before normal operation will begin. If they are not declared the operation will be held in the “ALARM” display until the connected equipment is selected. The “NONE” option can be chosen for any alarm, but the winding temperature algorithm requires that at least one of the alarms must be defined as having some form of cooling equipment. This is why the this is referred to as a required variable. If no cooling equipment is declared and an attempt is made to exit the alarm loop, the display will flash “NO COOLING” for 15 seconds, then return to the alarm loop.

Prompt **HYSTS**, Alarm Hysteresis Variable, figure 12B

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 12D. 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.

Prompt **OPERT**, Operator Mode Enable Variable, figure 12C

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 4, Operations for more details on the operator mode.

Prompt **FLASH**, Display Flash Enable Variable, figure 12C

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.

Prompts **RTX1, RTX2 or RTX3**, Analog Retransmit Set Up Loop, figure 12C

One or three configuration loops are provided to set up the one or three corresponding channels of analog retransmit. The CT may be ordered with a single retransmit channel, connected on the I/O module, or with three retransmit channels, connected on the optional MCAR module. If only a single channel is installed, only a single configuration loop will apear. The loop variables are set up identically to each other. There are three 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.

Prompts RSRC1, RSRC2, RSRC3, Signal Source Variable, figure 12C

The signal source variable specifies which signal the firmware will use to transform into a proportional current output. The three options are; FLUID (fluid temperature), WINDG (winding temperature), and ILOAD (load current).

Prompts RZER1, RZER2, RZER3, Retransmit Zero Scale Current Output Variable, figure 12C

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.

Prompts RFUL1, RFUL2, RFUL3, Retransmit Full Scale Current Output Variable , figure 12C

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.

Prompts ZERO1, ZERO2, ZERO3, Retransmit Zero Scale Display Variable, figure 12C

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 250.0 for temperature sources and 0 to the value defined as IMAX (maximum load current) in the USER loop.
As an example, if the user wants to produce a 4 to 20 ma output, based on the current range between 0 and 1000 amps, (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 500 to 1000 amps, this value would be set to 500. 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, figure 12C

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 250.0 for temperature sources and 0 to the value defined as IMAX (maximum load current) in the USER loop.

As an example, if the user wants to produce a 4 to 20 ma output, based on the current range between 0 and 1000 amps, (s)he would set this value to 1000. If, however; the user wanted to produce the same output, but base it on a the span of 250 to 750 amps, this value would be set to 750. This is frequently done to get higher resolution on a smaller part of the display range.

Prompt **SCALE**, Select High Endscale Value

The SCALE variable is set according to the expected highest measured temperature. The value is used internally, primarily to determine if a sensor failure has occurred. The value is typically set to 200 when the Advantage is being used to monitor stationary transformers with mineral oil insulating fluid and insulation with a 135 °C threshold loss-of-life temperature. The 250 value is typically set for mobile and other transformers with high threshold insulation and insulating fluid.

Prompt **CALIB**, Calibration Loop, figure 12C

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 7, Calibration.

Prompt **SLFCK**, Internal RTD Sense Circuit Self-Check Calibration, figure 12D

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 in the signal path 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. An RTD probe or calibrator need not 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 the section titled "Sensor and Internal Failure Alarm Function" in section 5 on page 37.

- ★ Enter the main configuration loop using the keystrokes of figure 10 on page 25.
- ★ Scroll down to the "SLFCK" prompt using repeated depressions of the down button.
- ★ Press the enter button.
- ★ 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, figure 12D

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. The DSAVE function enables or disables the automatic adjustment of system time in geographic locations where daylight savings time is observed.

Prompt **EVENT**, Peak and Valley Recording Interval, figure 12D

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, figure 12D

The RTD loop contains one sub-loops, RTD1, which is used to add an offset to the temperature measurements from channel 1 (fluid). 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 .

Prompt **SFRLY**, Sensor Failure Relay Un-Alarmed Coil State Variable, figure 12D

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 +200 °C. The sensor failure function cannot detect probe damage which results in an on-scale value between the display limits. The relay is also triggered in the event that the firmware detects an internal error such as may be due to an amplifier failure.

Prompt **DCON**, Display Conserver Enable, figure 12D

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, figure 12D

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.

Port 2, Prompt ID, Communications Unit Identifier, figure 12D

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, figure 12D

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, figure 12D

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, figure 12D

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, figure 12D

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.

Prompt **LTEST**, Lamp Test Function, figure 12D

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 10 seconds, or until the enter button is pressed a second time, whichever is longer. The function will then exit to the RUN prompt.

Prompt **RUN**, Return to Normal Running Mode, figure 12D

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.

## 6.0 Calibration

The calibration of Advantage CT requires 4 distinct operations; self-check reference calibration, current transformer calibration, current memory calibration and linearizing table entry. The self-check and CT calibration steps are 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 should be checked at five year intervals. At each of these calibration intervals the self-check function should be operated.

**Current Transformer ( CT ) Calibration**

The CT calibration operation is intended to "tell" the Advantage what level of current is flowing from the bushing CT and what percentage of the full load current it is. For example, if you measure 6 amps in the CT secondary, and you know that at full load the current is 10 amps, then the current flow you are measuring is 60% of full load. This calculation is used in conjunction with the "IMAX" variable value set in the "USER" application tailoring loop to display the actual load current being supplied by the transformer.

The maximum line current that the transformer is capable of carrying can be calculated from data plate information for rated maximum power capacity and line voltage. The line current at the present time can be read from the station ammeter or may be obtained from the dispatch center.

If you don't have a way of determining the value of the CT current at full load, or it is more convenient, you may be able to call the dispatch center to provide the percent loading at the present time. With that information the percent of full load is a direct entry and the CT current is a simple calculation.

The Advantage current sense circuit may also be bench calibrated using an AC standard ammeter and a variable AC current source. If you know the CT ratio of the transformer that the unit will be installed on, you can preset the Advantage and simply install it on-site without further set up calibration.

The Advantage CT current measurement hardware includes a feature which will measure current in the CT secondary and display its value directly. This ammeter has an accuracy of ± 1% of full scale above 20% of scale. If better accuracy is required, a higher accuracy AC ammeter, connected either in-line or equipped with a clamp-on probe, may be used to measure the CT secondary current. This more accurate data can be used to override the automatic ICT value entry.

While executing this procedure, refer to Figure 12B, prompt ICAL, for CT calibration keystroke details. If the Advantage is equipped with a polyphase current input (PCI) module, refer to the section on PCI module connections on page 11 for a description of terminal layout.

Caution! Lethal voltages are generated when the secondary circuits of transformer CT's are opened, while the transformer is energized. Take all precautions to ensure personnel safety before disturbing CT wiring. Best practice is to de-energize the transformer while working on CT circuits.

## 1.0 Setting the zero input point.

1.1 If the Advantage is equipped with a clamp-on CT:

If the current input is on the $C^3$ module, connect a jumper between terminals CCA1 and CCA2.

If the current input is a PCI module which uses clamp-on CT's, a jumper must be placed across each of its three pair of terminals OM-1 and OM-2, OM-8 and OM-9 and OM-14 and OM-15.

1.2 If the current sense circuit is connected to the bushing CT:

If the current input is on the $C^3$ module, shunt the bushing CT's leads to terminals CCA1 and CCA2 **in the control cabinet**, then disconnect the lead with the lowest potential from terminal CCA1 or CCA2.

If the current input is a PCI module, safety shunt each pair of the bushing CT's leads to the PCI's three pair of terminals OM-1 and OM-2, OM-8 and OM-9 and OM-14 and OM **in the control cabinet**, then disconnect the lead with the lowest potential from terminal OM-8 or OM-9.

1.3 Enter the main configuration loop using the keystrokes of figure 10 on page 25.

1.4 Scroll down to the "ICAL" prompt using repeated depressions of the down button.

1.5 Press the enter button. The ZERO prompt will appear with a blank value display

1.6 Press the enter button. The title AMPCT will appear in the prompt display and the present CT secondary current will be displayed in the value display. No current should be flowing in the CT secondary at this time. The displayed value should be at zero or within 0.01 to 0.03 amps of zero.

1.7 Press the enter button and toggle the value display to CAL. Press the enter button to accept the zero measurement. If the value is too high (> 0.8 amps) the entry will be rejected and the words HIGH SIGNAL will appear on the displays. This indicates that there is current flowing in the CT circuit. Check the circuit and correct the cause before continuing. Once the problem is rectified, perform step 5 again.

Note: If the user only needs to know what the current zero setting is, without changing it, (s)he may perform step 1.7 and simply toggle the display to NOCAL before pressing enter. The present setting will be displayed for 15 seconds.

## 2.0 Setting the high endscale point:

2.1 Remove the jumper installed between terminals CCA1 and CCA2 of the I/O module, or terminals OM-8 and OM-9 of the PCI module.

2.2 If you are bench-calibrating, connect the current source in series with an ammeter standard at this time, but do not energize the source. For current input to an I/O module, connect to terminals CCA1 and CCA2. For current input to a PCI module, connect to terminals OM-8 and OM-9. If you are bench calibrating with a clamp-on CT, run the current source lead through the CT's window and ensure that the CT's jaw is closed.
If you are calibrating from a bushing CT, reconnect the lead disconnected in step 1.2.

2.3 Verify the current circuit integrity.

2.4 If you are calibrating to a bushing CT, remove the safety jumper from the terminals in the control cabinet which is connected to terminals CCA1 and CCA2 of the Advantage I/O module, or terminals OM-8 and OM-

9 of the Advantage PCI module. If you are bench calibrating, turn on the current source and adjust it to the value of the target transformer's maximum CT secondary current.

2.5 Enter the main configuration loop using the keystrokes of figure 10 on page 25.

2.6 Scroll down to the "ICAL" prompt using repeated depressions of the down button.

2.7 Press the enter button. The ZERO prompt will appear with a blank value display.

2.8 Press the down button once. The ICT should now be shown on the prompt display. Press and release the enter button and the title AMPCT will appear in the prompt display and the present CT secondary current will be displayed in the value display.

2.9 Read the current level shown on the value display and press the enter button. If you are using a high accuracy ammeter as a standard, and wish to use that value, scroll the Advantage display to the ammeter's value using the up or down button. When the correct value is displayed, or if you elect to accept the Advantage's reading, press the enter button.

If you are unsure what to do at any point, simply wait 45 seconds and the ICAL loop will be automatically exited. Any settings which have not been accepted by pressing the enter button will not be changed.

2.10 The I%MAX prompt will then be displayed. Press the enter button, then toggle the value display from "NOCHG" to "CHANG" and press the enter button again.

2.11 Scroll the value display to the correct percent-of-load. If you are performing a bench calibration the display should be scrolled to 100.00. If you are using a value that was calculated or provided by the dispatch center, scroll the display to that value. Press the enter button. The ICAL loop will be exited and you will be advanced to the "STEP" prompt.

This completes CT calibration. As the keystroke chart of Figure 12B shows, you can step through the ICAL loop using the enter button alone if you only want to check (not change) values.

## 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. The CT model has a single linearization table.

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 10 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 10 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 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 Advantage Configuration 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 12C and follow the steps below.

1. Enter the main configuration loop using the keystrokes of Figure 10 on page 25.
2. Scroll down to the "CALIB" prompt using the keystrokes of Figure 11 on page 26. Press the enter button.
3. 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 prompt, press the enter button and skip to step 6.
5. By default the length of the table is 12 points. The table can have as few as 3 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.
11. When the last point is calibrated the TABLE loop will exit and the "GOTO" prompt will appear. This function is used select whether to go back and re-access the table, exit the calibration loop or calibrate the current memory. If you want to calibrate the current memory, continue immediately below. If you are done, scroll to the EXIT prompt and press the enter button.

<u>Current Memory Calibration</u>

Current memory holds the factory calibration values of the full 10 amp span of the CT current measurement circuit. These values are used to calibrate the CT circuit and to determine if a CT circuit calibration error is being made. It is normally unnecessary to perform this calibration, but it is a simple procedure and if the unit is in for calibration it may be performed at the same time.

A precision (better than 0.25% uncertainty) ammeter and a variable AC current source are required.

1. If the current sense input is connected to the I/O module, connect an ammeter standard and an AC source in series with Advantage terminals CCA1 and CCA2.

If the current sense input is connected to an optional PCI module, connect the ammeter standard and AC current source in series with Advantage terminals OM-8 and OM-9.

Turn on the Advantage and the ammeter, but not the AC source.

2. From the GOTO prompt, select the ILOAD prompt option and press enter. Verify that there is no current flowing in the current circuit. Press the enter button a second time. The ILOAD prompt will appear.

3. Turn on and set the AC source to 10.00 amps exactly. Allow the source to stabilize and verify on the ammeter that 10.00 amps is flowing in the current circuit. Readjust the current source as necessary. Press the enter button to accept the value.

4. The GOTO prompt will again appear on the prompt display. Scroll to the EXIT option and press enter. The memory re-write function will be run automatically for a few seconds, then the SLFCHK prompt will appear, indicating exit of the calibration loop.

**Table 3 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 | 186.8 |
| 6 | 80.0 | 130.89 | 12 | 250.0 | 194.1 |

**Multi Channel Analog Retransmit (MCAR) Module Calibration (milliammeter method)**

1 Connect the Advantage channel one inputs to an RTD simulator or resistance decade. Reference figure 5A or 5B for connections. Connect a standard milliammeter to MCAR terminals MC-1 and MC-2. Turn on the Advantage and set the signal input to indicate exactly 100 ° C.
2. Navigate to the RTX1 menu of the main configuration loop (figure 12C on page 29). Enter the RTX1 sub-loop and set the RSRC1 = FLUID, RZER1 =0, RFUL1 = 24000, ZERO1 = 0 and FULL1 = 100.
3. Note the error indicated on the milliammeter and record it in microamps. Divide this number by 24000 and record the result as the analog retransmit coefficient.
4. Return all retransmit channel one settings to the values they held prior to calibration.
5. Refer to the installation section 3, Optional Module Connections, MCAR Module Connections on page 9 for details of applying the analog retransmit coefficient.

# 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 12D and Prompt SLFCK on page 30 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 4 Detail Specifications

**Accuracy:**

| | |
|---|---|
| <u>Display</u> | |
| Fluid Temperature | ± 0.1 °C [1] |
| Winding Temperature | ± 1.0 °C [2] |
| Current | ± 1.0 % [3] |
| Ambient, Bottom Oil | ± 1.0 °C / ± 1 °C [1, 6] |
| <u>Setpoints</u> | |
| Alarm | Same as Display |
| Auxiliary | “ |
| Analog Retransmit | ± 0.5% of Display |
| Clock Accuracy | ± 3.024 Seconds/Day |

**Displays**

| | |
|---|---|
| <u>Type:</u> | <u>Layout:</u> |
| Prompt & Units | 14 Segment Alphanumeric |
| Value & Option | 14 Segment Alphanumeric |
| <u>Height:</u> | |
| Prompt & Units | 0.5 Inches |
| Value & Option | 0.8 Inches |
| <u>Resolution</u> | |
| Fluid & Winding Temp. | 0.1 °C |
| Current | 1 Amp |

**Setpoint Relays:**

| | |
|---|---|
| <u>Contact Ratings</u> | 10A @ 125Vac[4]<br>10A @ 240Vac[4] |
| (All Relays) | ½HP @120/240Vac<br>10A @ 30VDC [4, 5]<br>1A @ 125 VDC [4, 5] |
| <u>Contact Protection:</u> | |
| Metal Oxide Varistors (MOV) | 250 vac, 6500A I PK (8 x 20 µs) |
| Temperature Trip Sources | Fluid & Winding |
| Utility Trip Sources | Load Current, Remote, Clock & Calendar |
| 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% | 0.09 amps |
| 120/240 vac ± 15% | 10.3 va / 14 va |
| 120vac/125vdc ± 15% | 10.3 va / 0.09 amps |

**Communications:**

| | |
|---|---|
| <u>Port 1</u> | |
| Protocol | RS-232 only |
| Connection | RJ-11 or RJ-12, I/O Module |
| Cabling | See Figure 12 |
| <u>Port 2</u> | |
| Protocols | RS-232, RS-485 4-wire Bi Di<br>RS-422 4-wire Bi Di |
| Baud (Bit Rate) | Software Selectable 2400, 4800, 9600, 19200, 38400 or 57600 |
| Connection | See Figure 9D, Prompt COMM. |
| Cabling | Term Block of I/O Module<br>RS-232: Terms 19, 21 & 23<br>RS-485 & 422: Terms 19-22<br>See Figure 5A or 5B. |

**Inputs:**

| | |
|---|---|
| Temperature | One<br>100Ω Platinum RTD’s, α=0.385 Ω/°C per DIN 43760-1980 |
| Current | 0-10 Amps, 50-60 Hz<br>Burden 0.05 VA |

**Outputs:**

| | |
|---|---|
| Analog Retransmit | Software selectable zero and fullscale between 0 and 24 madc |
| <u>Setpoints</u> | <u>Settable Range</u> |
| 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 DIN 43760-1980. 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 uncertainty of Weschler probes is ± 1 °C .
2. Winding temperature accuracy is stated with relation to a standard curve as calculated by an internal algorithm, in response to test-standard user variable values, precision current and RTD resistance values. The ultimate winding temperature accuracy will depend upon the accuracy of field calibration of the current circuit and RTD and the accuracy of the values of the user-entered variables.
3. The current accuracy is stated with relation to precision current standards. Field calibration, using non-precision equipment will effect the absolute accuracy of the measurement.
4. Resistive Load
5. DC voltages above 30 volts may require contact protection in addition to the MOV’s supplied. This protection is usually provided by clamp diodes connected in shunt to the load in a polarity which will block conduction to energizing current.
6. The accuracy of the sensor in magnetically attached probes is the same as for the thermowell-mounted probes, however; the panel to which the probe mounts will introduce significant skin effect errors due to its exposure to the elements. The accuracy stated is based on the basic accuracy of the sensor as it measures the temperature of a panel under laboratory conditions, with no skin effect errors. Errors can be reduced in the field by installing weather shields on the probes and by compensating using the RTD offset functions.

**Figure 13. Port 1 Cabling**

Note that the Connectors are Viewed from the Cable End

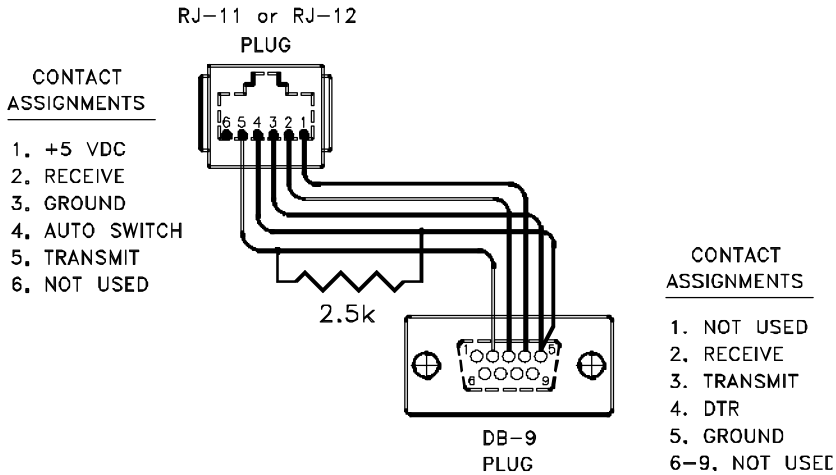



**Figure 14. Surface Mount outline and Drilling**

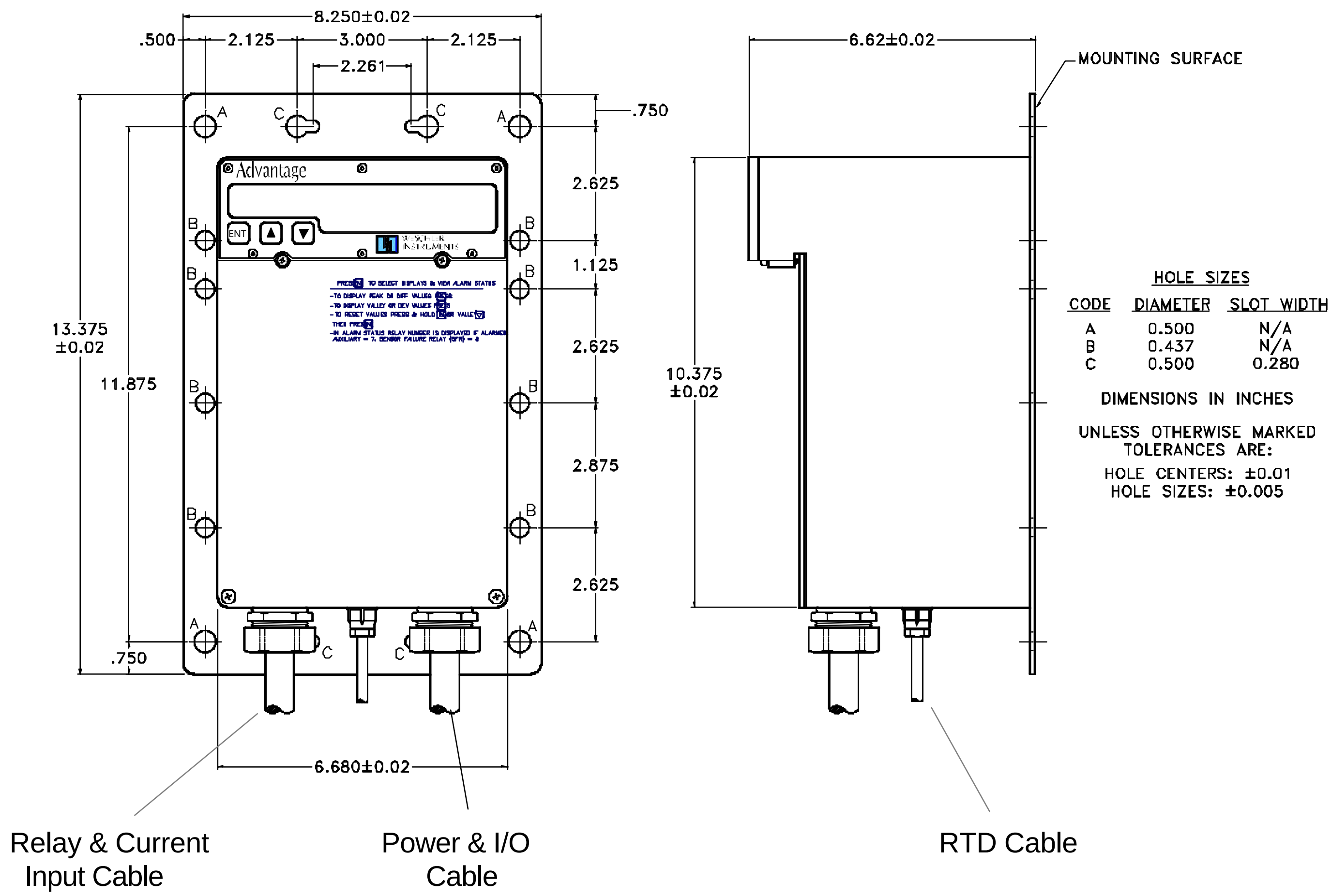


**Figure 15. Recommended Surface Mounting Methods**

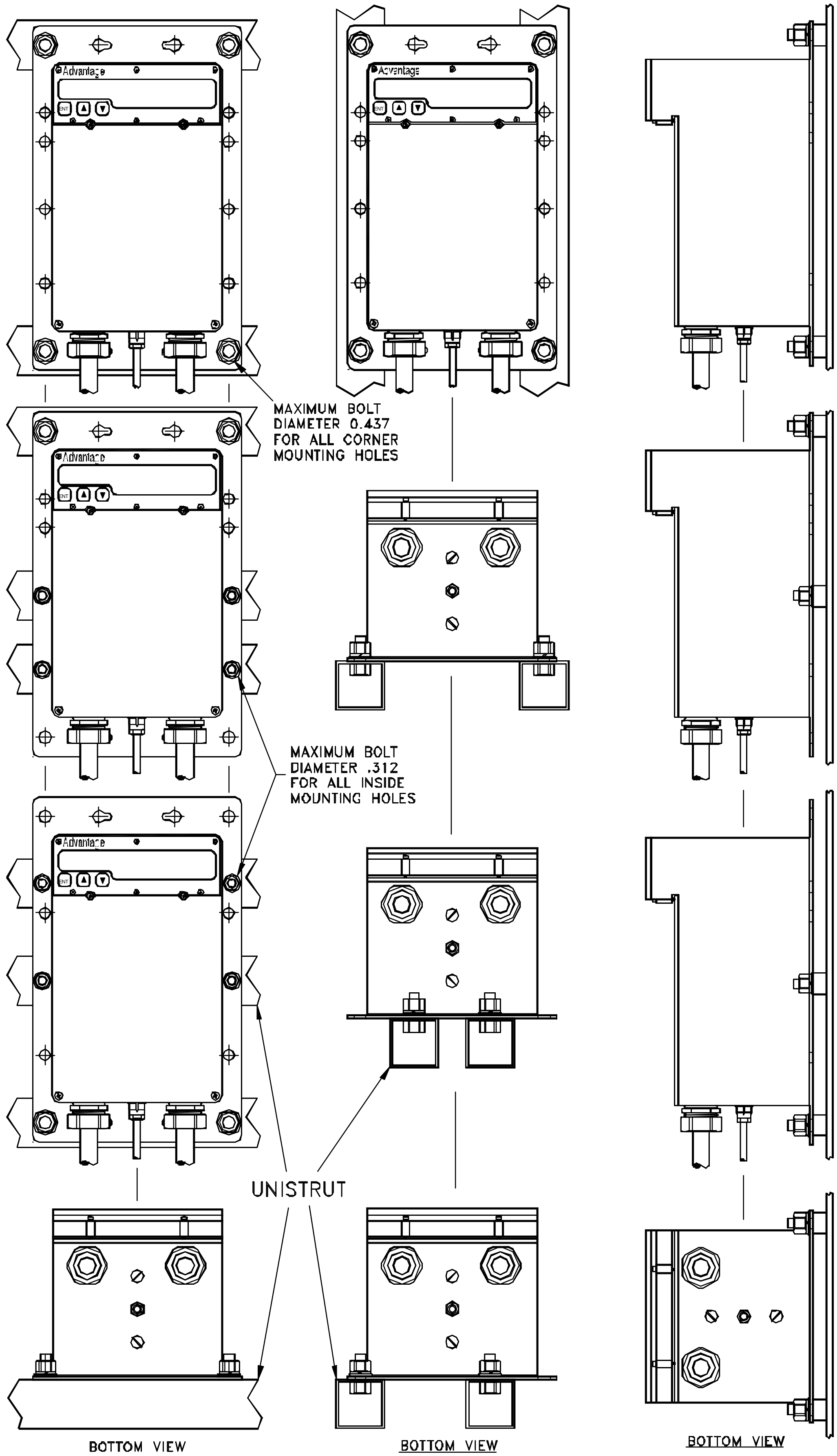


**Figure 16. Prohibited Surface Mounting Methods**

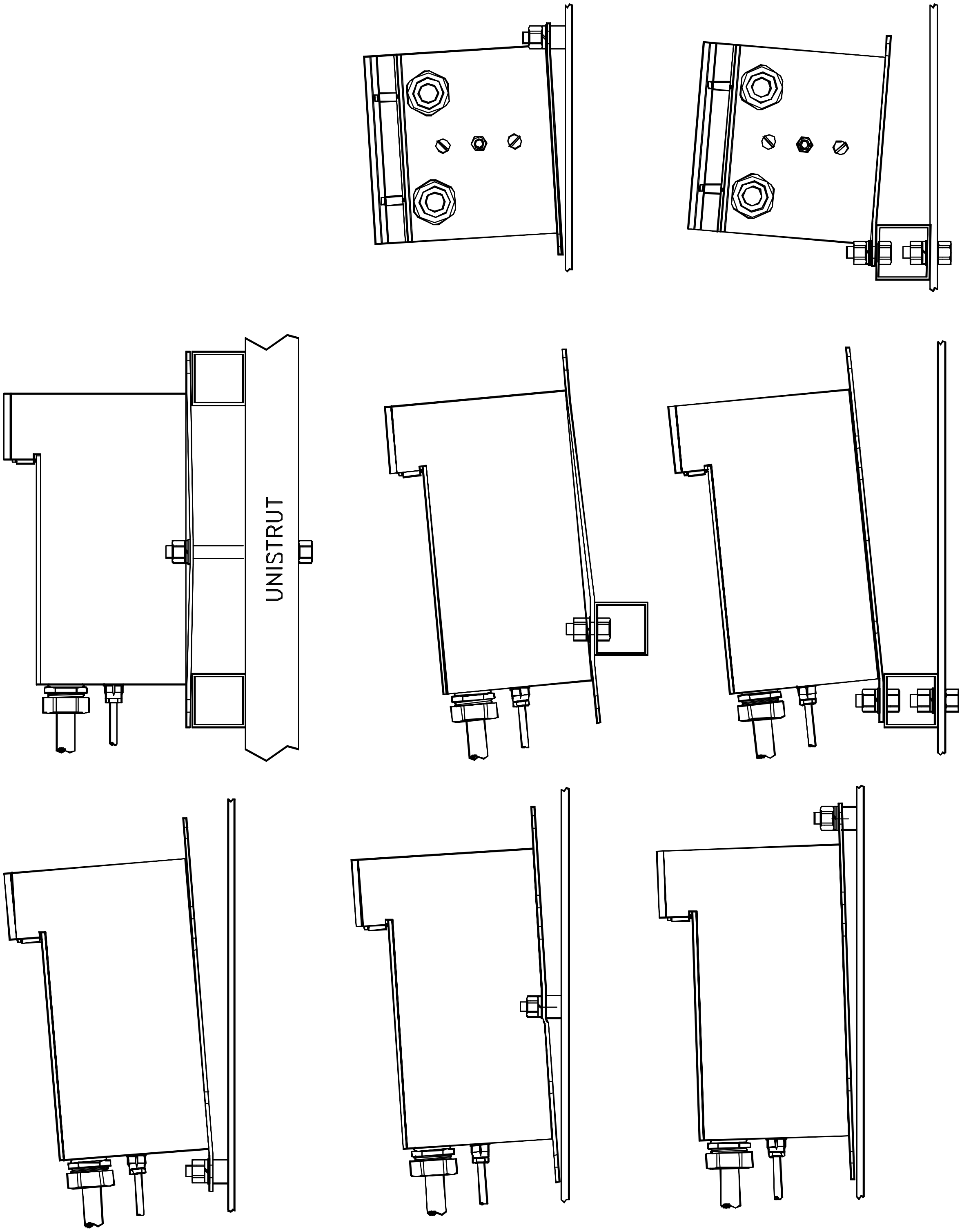
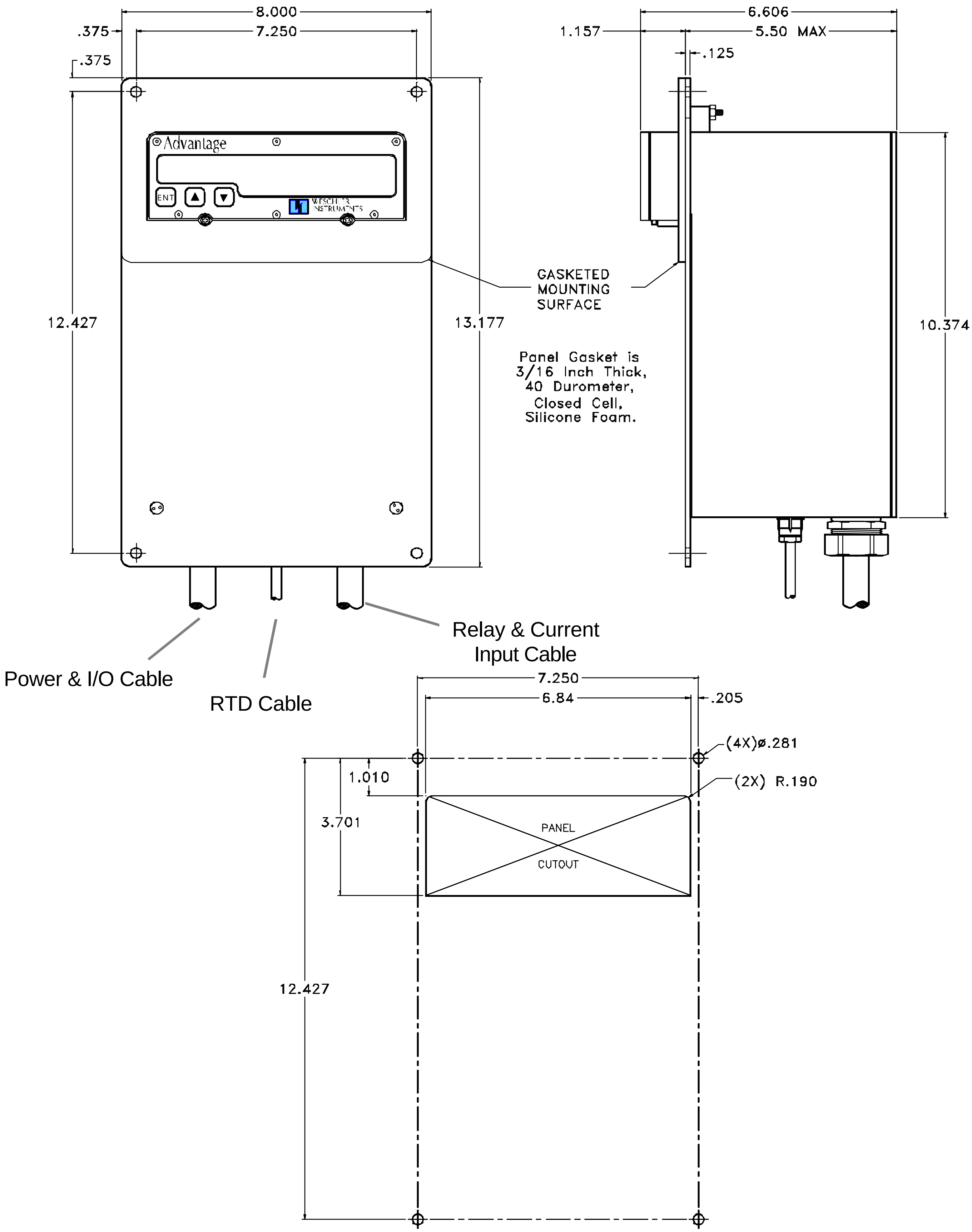


**Figure 17. Panel Mount Outline and Drilling**

Dimensions in Inches



# 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

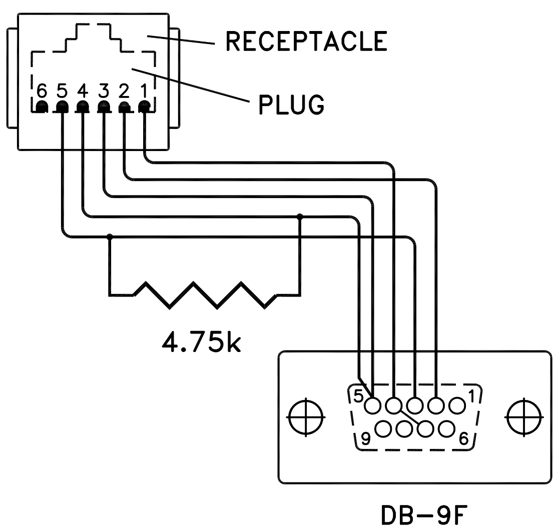
Document: OMAMT200

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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