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Incorporated

445 Laguna Vista Road
Santa Rosa, CA 95401
707/527-8254 Fax 707/542-9730
www.barringtoninc.com

MODEL OWM-T

TRANSFORMER TEMPERATURE MONITOR AND COOLING CONTROL SYSTEM

With Temperature Input From Transformer Winding CT

BCI Bulletin BCI-OWM-T- Revision 1.8 12/19/2005

CONTENTS **Page**

Barrington Consultants Inc.
445 Laguna Vista Road, Santa Rosa, CA 95401 USA
1-707-527-8254 Telephone. 1-707-542-9730 fax
www.barringtoninc.com

445 Laguna Vista Road
Santa Rosa, CA 95401
707/527-8254 Fax 707/542-9730
www.barringtoninc.com

I. Description of Operation

The model OWM-T is a solid state transformer temperature monitor that is SCADA ready and monitors both oil and winding temperatures. The **OWM-T** is designed for easy installation on single or three phase single tank transformers.

> In addition to temperature monitoring and cooling control functions there are several Barrington innovations added for utility convenience and to extend the useful life of the transformer. The "LOOKBACK" feature is provided for ambient compensation. This feature allows the utility to compensate for hot spells with ambient temperature set back capability. This feature can be used to start the cooling system at a lower temperature for hot spells and can effectively provide a cooling "head start." (2) The cooling monitor feature can be set to alarm for any reduced cooling current. (i.e. One or two fans not running.) **(3)** Another selectable feature is provided to exercise the cooling system for a ten minute period each 24 hours. **(4)** The "alternate cooling stage" feature allows a user to select the mode that switches between the two cooling stages every 168 hours. This feature, if enabled, allows the unit to swap the cooling stage that is selected to operate as the first stage to exercise and use the stages equally. This can be both a labor saving and a desired maintenance feature.

Local indication includes winding temperature, peak winding temperature, top oil temperature and peak top oil temperature with manual reset. Top oil and winding temperatures are each obtained using a single pt100 RTD probe, with the winding RTD sensing origin from winding CT. Displays are .39" backlit LCD's that continuously display all four temperatures simultaneously. Communications include SCADA ready outputs, dry contacts for local annunciation and a RS232/485 port. In testing per National standards, placing a probe in a calibration oil bath, the OWM-T measurement accuracy is within plus/minus 0.3 degrees C compared with the calibration temperature of the oil bath..

The **OWM-T** is housed in an 8" X 10" X 6" NEMA 4 windowed enclosure. The enclosure is designed to be mounted on an existing transformer control cabinet. Ambient operating temperature range is -40 degrees C to 70 degrees C. Winding and oil temperatures are each obtained using a RTD probe in the top oil well of the main transformer tank and one RTD probe for winding temperature. Installation requires connecting supplied snap on CT's (current transducers) to existing cooling supply circuits. Installation is quite easy. Operation is very reliable. Power requirements are 120 or 230 VAC 50/60hz. The analog outputs can be connected to an existing SCADA system. The analog outputs supplied are 0 - 5 VDC, 4-20 ma, or 0-1ma "switchable" for oil and winding temperatures. The **OWM-T** is designed to meet IEEE/ANSI C37.90 specifications for protective relaying applications.

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OWM-T FRONT PANEL CONTROL AND DISPLAY

The **OWM-T** design includes a 2 line by 16 character alpha-numeric display and a five key keypad. This document outlines the basic operation and concepts of the various displays. The OWM-T has a standard display of temperature data. This standard display will be shown at all times except when a user has entered one of the two menus to setup the control of the OWM-T**. If the user leaves the OWM-T in one of these menus it will timeout and return to the standard display.**

The five key pad keys:

MENU	When pressed and released the OWM-T will start the main menu sequence of displays to allow the user to setup the normal operating parameters. When held for three seconds the OWM-T will enter the configuration menu. This secondary menu allows the user to setup the configuration and calibration of the OWM-T.
NEXT	When the OWM-T is displaying the standard display no action is taken. When in the main or secondary menu pressing this key will advance to the next item in the menu's sequence.
PREV	When the OWM-T is displaying the standard display no action is taken. When in the main or secondary menu, pressing this key will return to the previous item in the menu's sequence.
∇	When the OWM-T is displaying the standard display no action is taken. When in the main or secondary menu, pressing this key will reduce the current parameter to the next possible value.
Δ	When the OWM-T is displaying the standard display no action is taken. When in the main or secondary menu, pressing this key will increase the current parameter to the next possible value.
∇ Δ	Simultaneously pressing both the ∇ Δ and will reset both peak temperatures to the current values.
[MENU]	**Default display shows current top oil temperature, current winding temperature, peak top oil temperature and peak winding temperature.** The following menus & lists detail the sequence for the OWM-T. The COMM column indicates which values may be read and /or written through the communication link.

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MAIN MENU DISPLAY	**DESCRIPTION**	**COMM**
MANUAL CONTROL ON OFF	Digital control to turn on the cooling system Range: Off (normal) On	
OIL TEMP ALARM	Top oil temperature alarm value Range: -40.0 to +180.0ºC	yes
WIND TEMP ALARM	Calculated winding temperature alarm value Range-. -40.0 to +180.0ºC	yes
STAGE 1 OIL	Stage 1 cooling control oil temperature Range: -40.0 to +180.0ºC	yes
STAGE 1 WIND	Stage 1 cooling control winding temp Range: -40.0 to +180.0ºC	yes
STAGE 1 CURRENT	Stage 1 cooling current minimum value Range: 0 to 100% of full scale cooling current	yes
STAGE 2 OIL	Stage 2 cooling control oil temperature Range: -40.0 to + 180.0ºC	yes
STAGE 2 WIND	Stage 2 cooling control winding temp Range: 4.0.0 to +180.0ºC	yes
STAGE 2 CURRENT	Stage 2 cooling current minimum value Range: 0 to 100% of full scale cooling current	yes
HYSTERESIS	Control Hysteresis value Range: 0.1 to 100.0ºC	yes
ALARM DELAY	Alarm delay time Range: 0.1 to 999.9 seconds	yes
OIL TEMP TRIP	Top Oil Trip Temperature Range: 0.0 to 180ºC (Must also have standing oil temp alarm to trip)	yes
WINDING TEMP TRIP	Winding Trip Temperature Range: 0.0 to 180ºC (Must also have standing winding temp alarm to trip)	yes
TRIP DELAY	Trip Delay Time Range: 10 to 1000 Seconds	yes

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Configuration Menus

The OWM-T has secondary menus for controlling the communications, analog output signals and temperature calibration. OWM-T also provides for calibration of the five current sensing inputs.

COMM. DISPLAY	ACTION	DESCRIPTION	COMM
COMM MODE <mode>	Down/Up to select	Communications mode Modes: RS232, RS485, RS485 Multi-point	no
COMM RATE <rate>	Down/Up to select	Communication baud rate Possible rates: 1200, 2400, 4800, 9600	no
COMM FORMAT < format >	Down/Up to select *# bits- parity check- stop bit*	Communication data format Possible formats: 8-N-1, 7-N-1, 7-E-1	no
COMM ADDRESS < address >	Value entry for RS485 *Allows 1 modem to address multiple unit addresses*	Communication address (RS485 Multi only) Possible values: 0-255	no
COMM PERIOD	Value entry *0.0 selects no output*	Communication output period Range: 0.0 to 3000.0 minutes	yes
ANALOG 1 OUT <mode>	Down/Up to select	Analog output 1 mode (Top Oil Temp) Possible modes- 0 -1ma, 4-20ma, 0-5v	no
ANALOG 2 OUT <mode>	Down/Up to select	Analog output 2 mode (Winding Temp) Possible modes- 0 -1ma, 4-20ma, 0-5v	no
RTD 1 OFFSET	Value entry *Determined by calibration to known temperature*	RTD 1 offset value in tenths of a degree Range: -20.0 to +20.0ºC	read
RTD 2 OFFSET	Value entry *Determined by calibration to known tempera*	RTD 2 offset value in tenths of a degree Range: -20.0 to +20.0ºC	read
RTD3 OFFSET	Value entry *Determined by calibration to known temper*	RTD 3 offset value in tenths of a degree Range: -20.0 to +20.0ºC	
24 HR FAN CYCLE <value>	Down sets to "1" [on] Up sets to "0" [off]	Automatically run cooling stages for 10 minutes each 24 hours	yes
FAN ALTERNATE ON OFF	Down sets to [on] Up sets to [off]	Automatically alternates cooling stages every 168 hours. (Weekly)	no
LOOKBACK PERIOD <value>	Value entry *Previous hour period for setback window*	Number of previous hours used to make setback decision Range: 0 to 120 hours	no
LOOKBACK TEMP <value>	Value entry *Temp threshold to trigger count toward setback*	Ambient temp above which is counted toward setback decision Range: –40 to 180 ºC	no
LOOKBACK HOURS <value>	Value entry *Cumulative hour count above trigger threshold within setback window period*	Number of hours that the ambient temperature must be above the lookback temperature to trigger the setback Range: 1 to 120 hours	no
LOOKBACK SETBACK <value>	Value entry *Degrees C bias reduction from cooling mode start set point*	Number of degrees C that both stages of cooling start will be reduced Range: 0 to 180 ºC	no

Lookback setback example: *Given lookback period setting= 96 hours; Lookback temperature setting=+33 C ("+" sign not entered on OWM-T); Lookback hours setting= 8 hours; and Lookback setback= 10 C. In a rolling window exceeding 96 hours from any present hour, when there have been 8*

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cumulative hours during which the ambient temperature exceeded 33 C (91.4 F), the cooling devices start point will be biased to initiate 10 degrees C less than the OWM-T display cooling mode entered set point.

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NEXT DISPLAY	DESCRIPTION	COMM
AMBIENT TEMP	Display ambient temperature (RTD #2)	no
STAGE #1 % STAGE #2 %	Display cooling current percentage value	no

CALIBRATION DISPLAY *(Select Next and previous together)*	**DESCRIPTION**	**COMM**
ANALOG #1 =	Used to set analog output to match jumper settings and Calibrate analog output #1 (TOP OIL)	no
ANALOG #2 =	Used to set analog output to match jumper settings and Calibrate analog output #2 (WINDING)	no
STAGE #1 AMPS <value>	Used to set full scale cooling current value for Stage #1	no
STAGE #2 AMPS <value>	Used to set full scale cooling current value for Stage #2	no

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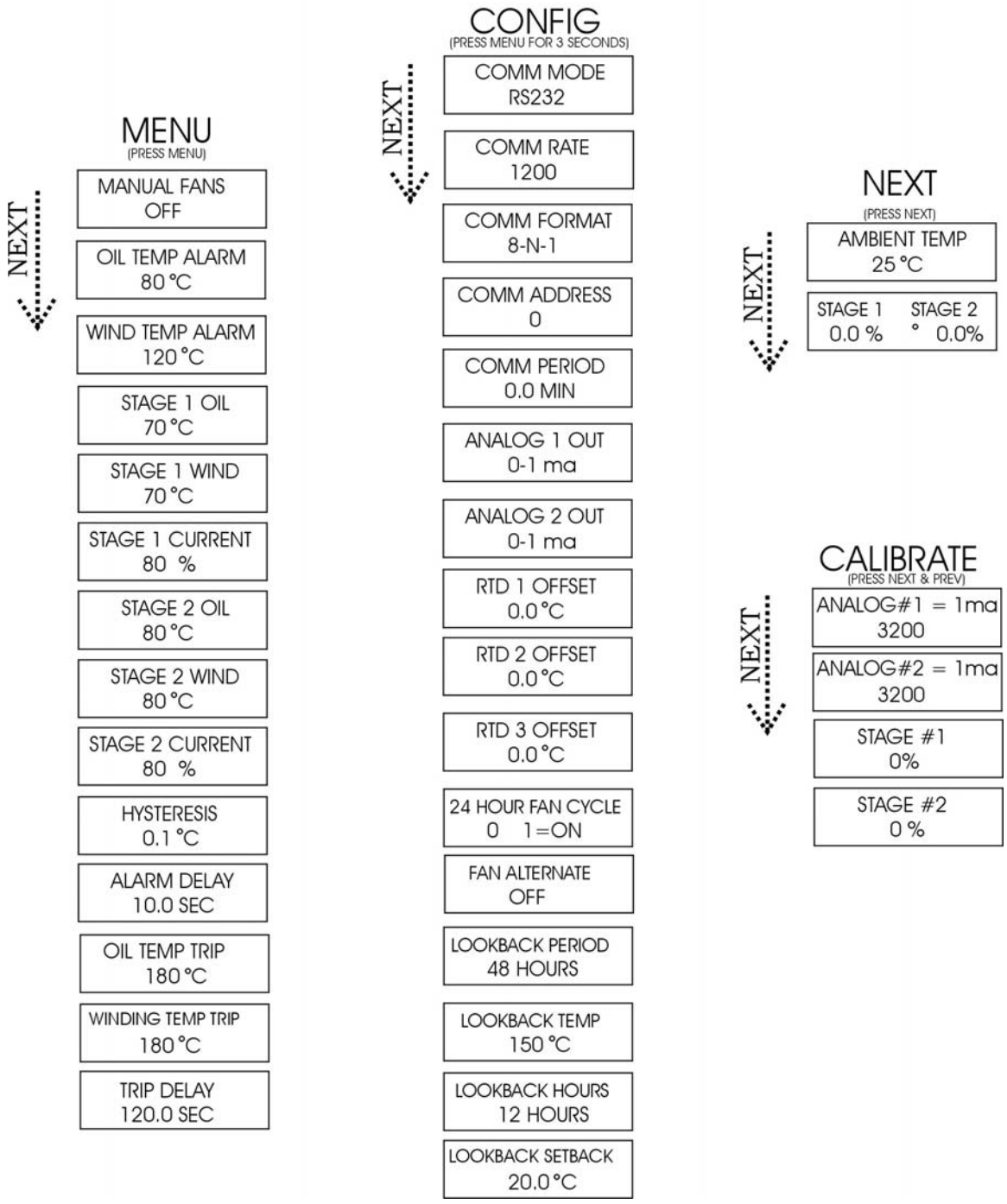
OWM-T DISPLAY SCREENS



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OWM-T – IBM (PC) INTERFACE CABLE REQUIREMENTS

SIGNAL	OWM-T	9 PIN SERIAL CABLE
RS232		
DATA FROM PC	PIN 3	PIN 3
DATA TO PC	PIN 4	PIN 2
GROUND	PIN 2	PIN 5
RS-485		
DATA +	PIN 5	
DATA -	PIN 6	
5VDC (Modem supply power)	Pin 1	

RS232 TERMINAL SETTINGS: Emulation – ANSI, Data Bits – 8, Parity – None, Stop Bits – 1, Flow Control – None, Keyboard Caps – On. (Remove JMP1)
HyperTerminal can be used. (supplied with Windows 98)

ANALOG SCALING VALUES (FOR SCADA)

	0 to 1 mA	4 to 20 mA	0 to 5 VDC
Temperature 0°C	0.200 mA	10.00 mA	1.00 VDC
Slope per °C	0.004 mA	0.050 mA	0.020 VDC
Minimum Scale	0 mA = -50°C	4 mA = -120°C	0 VDC = -50°C
Maximum Scale	1 mA = +200°C	20 mA = +200°C	5 VDC = +200°C

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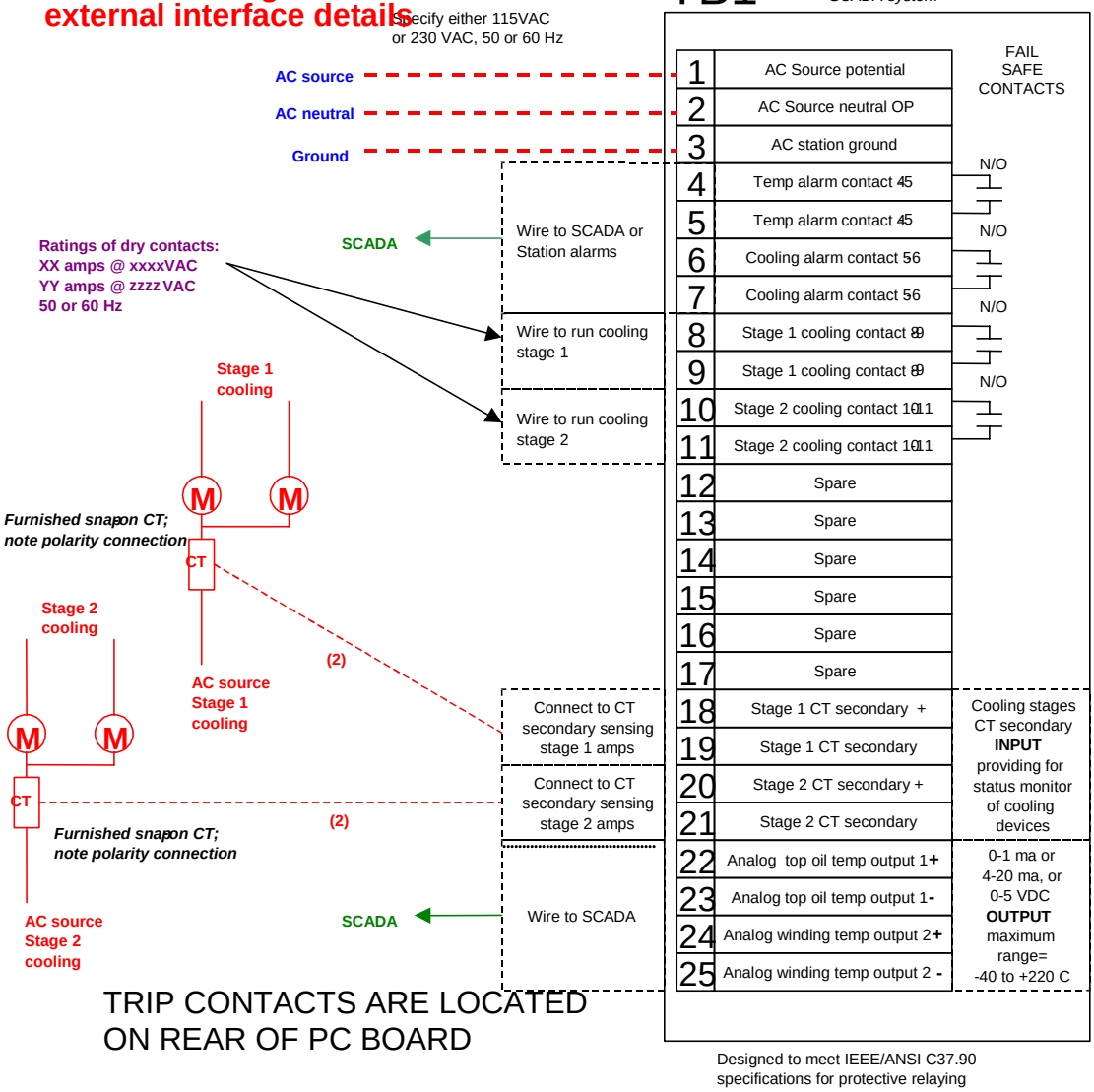
OWM FUNCTIONAL EXAMPLE

For Transformer Oil, Winding, and Cooling Control

PAGE 1 of 1 REVISED 6-16-00, jea

CAUTIONN
External wiring connections are shown only as functional examples, consult your installation engineer for external interface details

The solid state transformer monitor monitors oil and winding temperature for a single phase or three phase transformer contained in one oil filled unit, and is ready to provide input for existing SCADA system



TRIP CONTACTS ARE LOCATED ON REAR OF PC BOARD

Designed to meet IEEE/ANSI C37.90 specifications for protective relaying

OWM-T Functional Diagram

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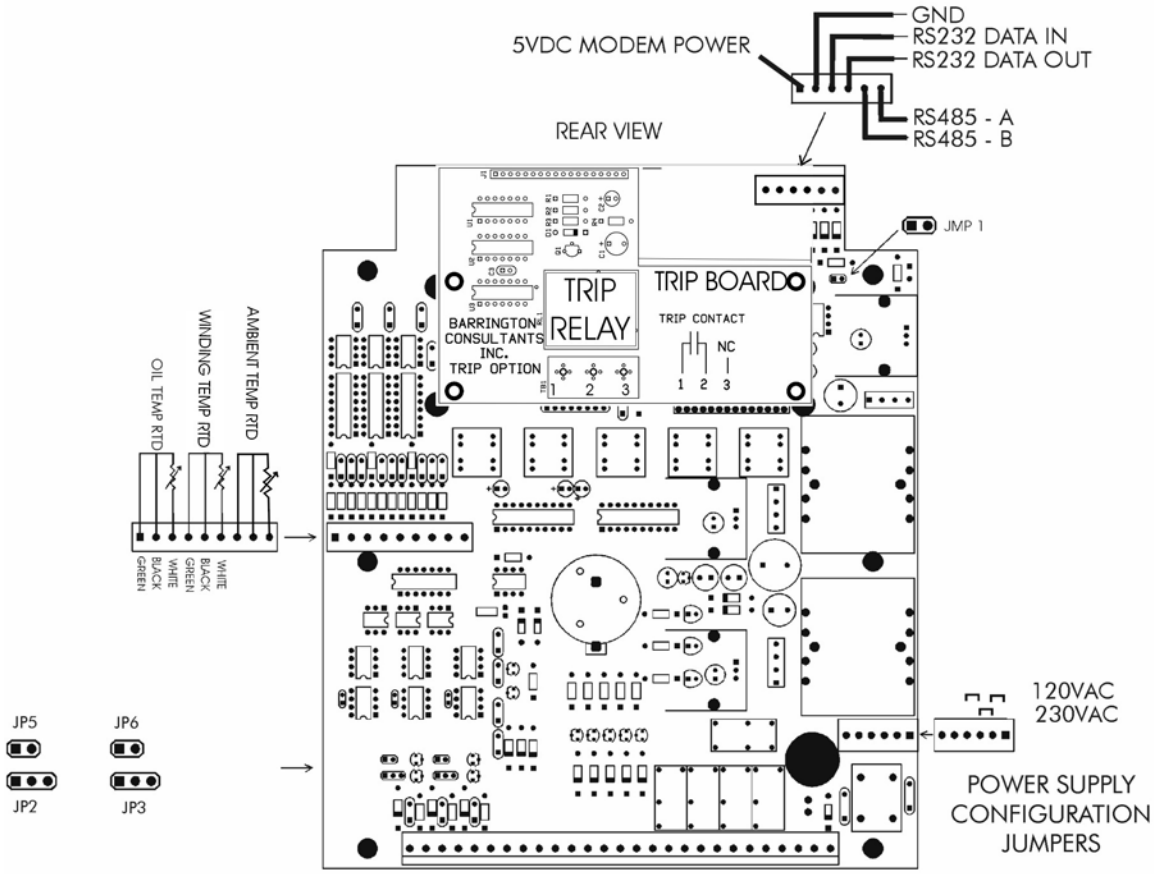

CONFIGURATION JUMPERS: (* = DEFAULT)

JP3	Top Oil Analog Output	Jumper on 1&2 – Enables Voltage **Jumper on 2 & 3 - Enables Current ***
JP2	Winding Analog Output:	Jumper on 1 & 2 - Enables Voltage **Jumper on 2 & 3 - Enables Current ***
JP6	Top Oil Analog Output	Jumper on - 4 to 20 ma **Jumper off - 0 to 1 ma** *
JP5	Winding Analog Output	Jumper on - 4 to 20 ma **Jumper off - 0 to 1 ma** *
JMP1	RS485 Termination.	Jumper on – RS485/Enables 120 Ohm termination * **(Remove for RS232)**

COMMUNICATIONS STRING FORMAT

	Syntax:
[..]	Optional items
<..>	Value field
?	Value query
*	Preceding item may be repeated
<cr>	Carriage return
<If>	Line feed
<chksum>	Checksum, sent only if received with command. Sum of all ASCII characters up to and including =

COMMANDS

```
 [<adr>:] <nem> (?|<value>) [,<nem> (?|<value>)]*  [=<chksum>] (<cr>|<lf>)
________   ______   ___________   _______________________   ______________   ____________
   |        |        |             |                        |                |
   |        |        |             |                        |                |_Ending
   |        |        |             |                        |_Optional          checksum
   |        |        |             |_Mnemonics may be repeated
   |        |        |_Query (?) or value
   |        |_Mnemonic command – see table below
   |_Communications address – Multipoint protocol only
```

RESPONSES

```
 [<adr>:] <nem> <value>  [,<nem> <value>]*  [=<chksum>]  <cr><If>
________   ______   ________   ____________________   ______________   __________
   |        |        |          |                      |               |
   |        |        |          |                      |               |_Ending
   |        |        |          |                      |_Checksum, if received
   |        |        |          |_Mnemonics may be repeated
   |        |        |_Value
   |        |_Mnemonic command – see table below
   |_Communication Address – multipoint only
```

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TERMINAL COMMUNICATION COMMANDS

GARY Check current OWM-T manual reference CWT= "calculated Winding temp" ID----**

OWM-T?|<value> 0.0 to +3000.0 minutes per transmission
Output: [<adr>:] TOT, CWT, POT, PWT [=<checksum>]<cr><lf>
TOT is Top Oil Temp CWT Winding Temp
POT is Peak Oil Temp PWT is Peak Winding Temp

OTA	?|<value>	-40.0 to+180.0 ºC	(Top Oil Temp Alarm)
WTA	?|<value>	-40.0 to+180.0 ºC	(Winding Temp Alarm)
S1O	?|<value>	-40.0 to+180.0 ºC	(Stage 1 [Oil Cooling Control])
S1W	?|<value>	-40.0 to+180.0 ºC	(Stage 1[Winding Cooling Control])
S1C	?|<value>	0.0 to 100.0 % Full Scale	(Stage 1 cooling current minimum value in %)
S2O	?|<value>	-40.0 to +180.0 ºC	(Stage 2 [Oil Cooling Control])
S2W	?|<value>	-40.0 to+180.0 ºC	(Stage 2[Winding Cooling Control])
S2C	?|<value>	0.0 to 100.0 % Full Scale	(Stage 2 cooling current minimum value in %)
FST	?|<value>	0.0 to +180.0 ºC	(Full Scale Temperature)
FCC	?|<value>	0 OR 1	(Fan Cycle – off / on)
LBP	?|<value>	0.0 to 120 Hours	(Lookback Period)
LBH	?|<value>	1 to 120 Hours	(Lookback Hours)
LBT	?|<value>	-40 to +180.0 ºC	(Lookback Temperature)
LBS	?|<value>	0 to +180.0 ºC	(Lookback Setback Temperature)
ADT	?|<value>	0 to 1000sec	(Alarm Delay Time)

FRONT PANEL LED INDICATORS AND ALARMS

EACH LED INDICATOR WILL LIGHT CONTINUOULSY WHILE AN ALARM CONDITION IS PRESENT. EACH LED WILL BLINK IF THE ALARM CONDITION IS NO LONGER VALID. BLINKING WILL CONTINUE UNTIL THE OWM-T HAS BEEN RESET BY PUSHBUTTONS. This feature is useful to identify the cause of short term alarm conditions.

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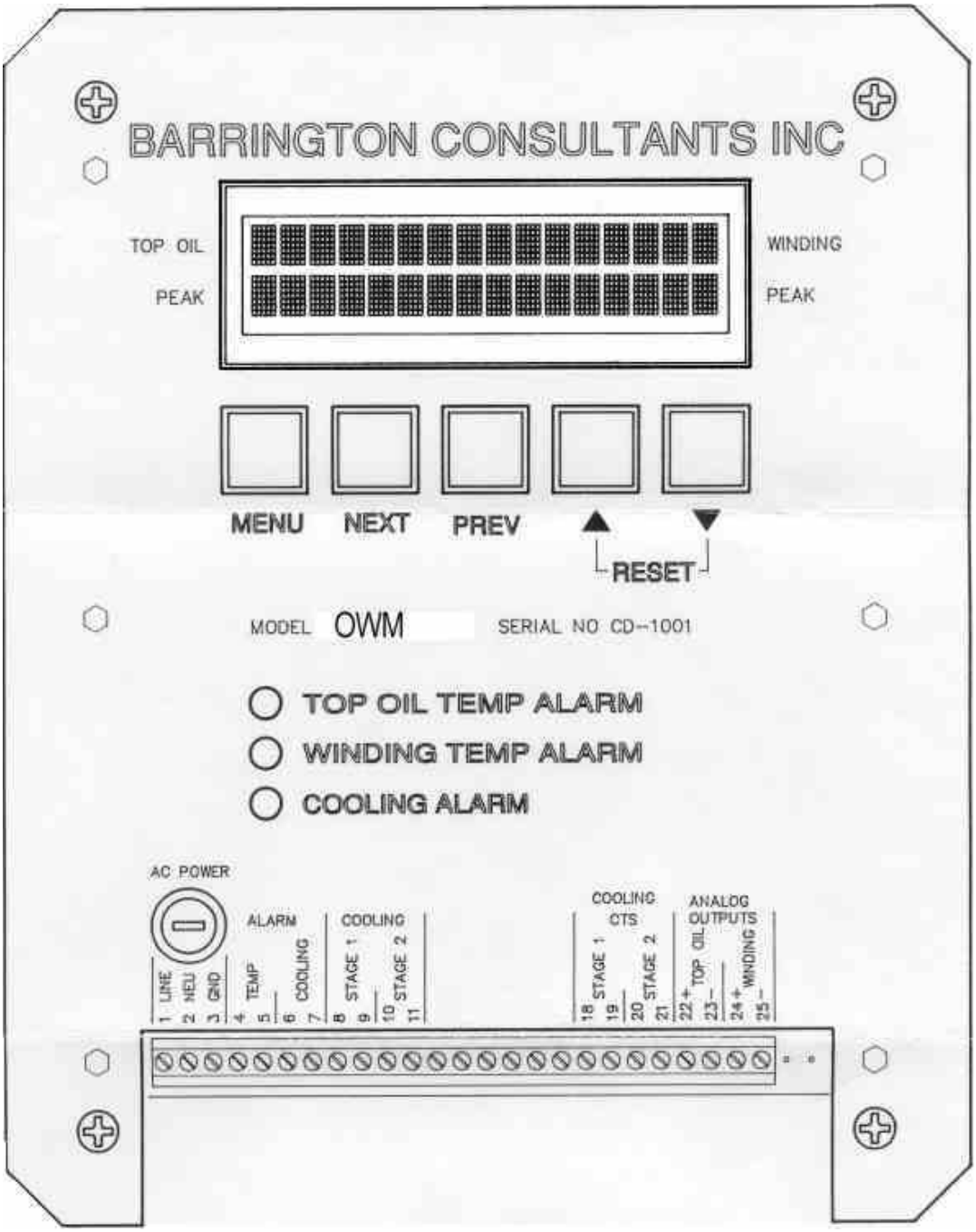
II. OWM-T INSTALLATION GUIDE



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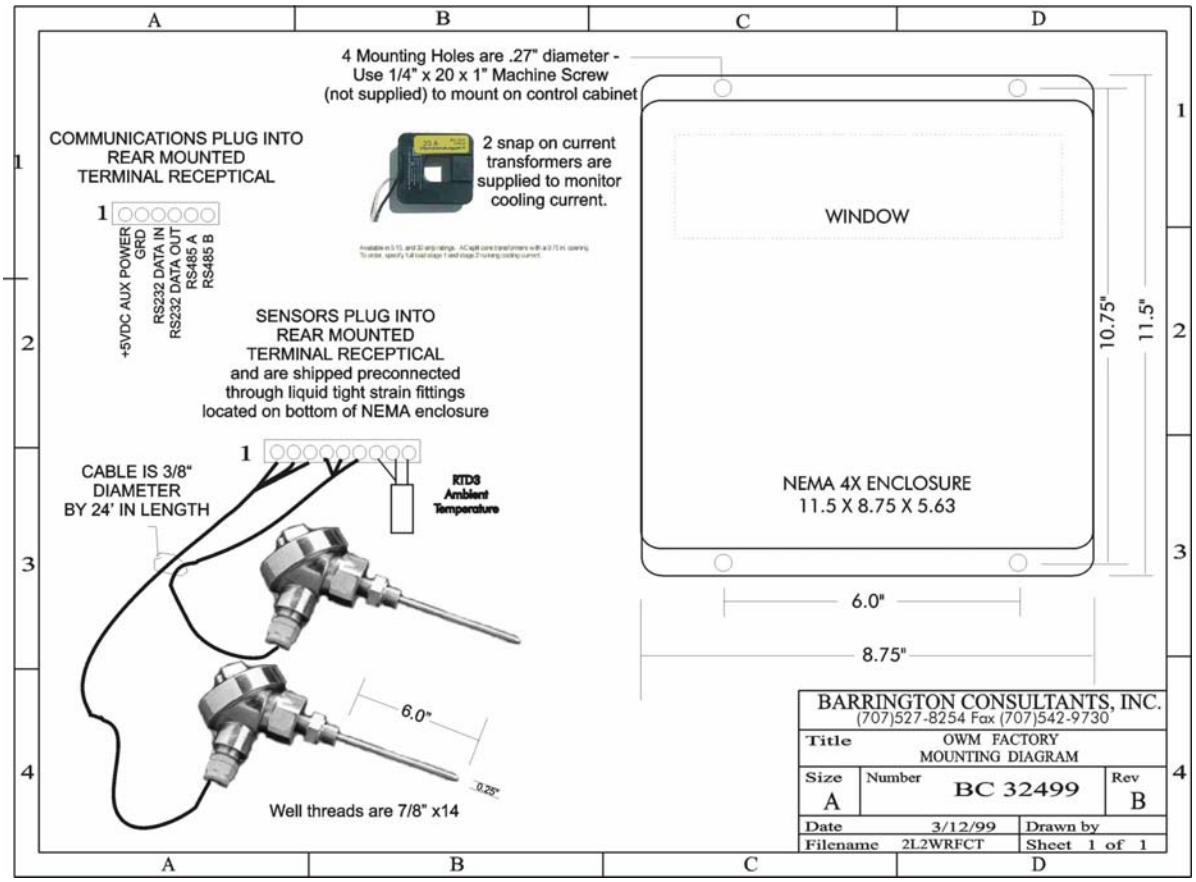

All relay contacts are normally closed until power is applied to the OWM-T. This will provide a "fail safe" mode of operation. Before installation, always safety check your work area, review your plans, and apply caution to preclude accidents, errors, or undesired outcomes.

MOUNTING & INSTALLATION

1. Mount the OWM-T using four machine screws.
2. Punch and mount a 3/4" conduit elbow from the underside of the OWM-T to the interior of the control cabinet. Provide AC power to the OWM-T.
3. Install the temperature probes. The temperature probes supplied are ¼" X 6" (spring loaded). Each probe can be installed in a ½" thermowell by using the ½" sleeve adapter. This procedure will insure adequate heating transformation from the top oil or winding to the RTD probe.
   . Additionally an adapter is supplied for ½" NPT to 7/8" X 14 thread thermowells. Coil up the extra probe cable and tie wrap, or shorten to desired length.
4. Set the analog out put jumpers on the back of the circuit board for the desired analog output modes. (see page #7) <u>0-1 ma is the factory default</u>
5. Configure the OWM-T (Using the Configuration Menu) for the same analog scaling values selected above.
6. Connect the top oil / winding alarm contact point to an existing annunciation system. The contacts are "dry" and are compatible with existing annunciators.
7. Snap the stage one and stage two snap on current transducers around the power source to each stage of cooling. (Usually available and located at the cooling contactor.) Wire them to the cooling CT input terminals. (18-21)

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CALIBRATING TOP OIL AND WINDING TEMP ANALOG OUTPUT VALUES

Pressing "NEXT" AND "PREVIOUS" at the same time enters the calibration mode.

1. Determine which analog output is desired and configure the jumpers on the rear of the circuit board. Note: Remove the 120 ohm termination jumper (JMP1) for RS232 applications. The following is a description of the 0 – 1 mA calibration procedure.
2. Enter the configuration mode by pressing menu and holding for 3 seconds.
3. Configure the analog outputs to match the output jumpers selected in step 1.
4. Press "MENU" (or wait for 30 seconds) to return to the default four temperature display.
5. Enter calibration procedure by pressing "NEXT" AND "PREV" AT THE SAME TIME.
6. Display will read ANALOG #1.
7. With a very accurate DC ammeter, read current across analog output #1.
8. Current should read 1.000 DC ma.
9. Using the up and down arrows, adjust the output voltage to read 1.000 DC mA.
10. Pressing "NEXT" will display ANALOG OUTPUT #2.
11. Repeat steps 7 and 8 for analog #2.
12. Press the "MENU" key (or wait for 30 seconds) to return to normal operation.

CALIBRATING STAGE 1 AND STAGE 2 100% CURRENT VALUES

Pressing "NEXT" AND "PREVIOUS" at the same time enters the calibration mode.

1. After entering the calibration mode, press next until the Stage#1 display appears.
2. While stage #1 cooling is running, adjust the percentage to 100%. Use up or down arrow to nudge the percentage values. Note: Pressing both the up and down arrows simultaneously will automatically set the 100% value. The current transformer normally supplied is rated for 15 amps AC cooling current. (Other ranges are available)
3. Press next until the Stage#2 display appears.
4. While stage #2 cooling is running, adjust the percentage to 100%. Use up or down arrow to nudge the percentage values. Note: Pressing both the up and down arrows simultaneously will automatically set the 100% value. The current transformer normally supplied is rated for 15 amps AC cooling current. (Other ranges are available)

Barrington consultants would appreciate any feedback about the OWM-T. We want to provide top quality products to satisfied customers. We will be happy to answer any questions you might have about installation or operation of our products.

It is the user's responsibility to determine proper set points, adequately engineer, test, install, and ensure desired operating status.

Barrington Consultants Inc. assumes no responsibility for installation or user operation of the OWM-T.

445 Laguna Vista Road
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OWM-T SPECIFICATIONS

RTD	-100°C to 600°C (DIN 43760 Class B) .00385 ohms/ohm/ °C
STABILITY	Maximum change in ice point resistance of less than 0.2°C/Year
REPEATABILITY	0.05% of actual span

INPUT	Dual Pt 100 RTD (One Top Oil Temp & One Ambient Temp)
TOP OIL INPUT PROBE TYPE	(1ea) 6" X ¼" probe W ½" NPT Thread (7/8" X 14 thread adapter supplied) or (1ea) 75LB Pull Surface Magnetic
INPUT PROBE CABLE	24' type UV/SJT
INPUT SPAN	-40 C Min 200°C Max
ANALOG OUTPUT	0 - 5V, 0-1mA or 4-20mA (Independently selectable)
CALIBRATION	Automatic -40°C to 200°C
LINEARITY	Better than 0.2% of span
LEAD WIRE COMP.	Automatic – 3 wire
TEMPERATURE STABILITY	Better than .03% /°C of span
SURGE WITHSTAND	Designed to meet ANSII/IEEE C37.90
C.M.R.R.	120db DC to 60 Hz
POWER SUPPLY RANGE	115/230VAC - 50/60Hz
OPERATING TEMP.	-20°C (-40 optional heater) to +75°C
ENCLOSURE	NEMA 4 10" X 8" X 6"

DIGITAL RESOLUTION:	>12 bits.
OVERALL ACCURACY	Less than 0.3°C input temperature / display
ALARM:	Dry contact spst relay output rated @ 5A 250 VAC.
ALARM RESPONSE TIME:	Programmable - .1 sec to 1000 sec.
ALARM HYSTERESIS	0.1 TO 100 DEG C (DEAD BAND)
DISPLAY:	16 × 2 Character .39" LCD indicator for programming and display of input and output parameters and status.
SUPPLY:	AC: 115 or 230 VAC 50/60 Hz ± 10%,
OPERATING CONDITIONS:	-40°C to +75°C. 0-95% RH, non condensing.
STORAGE TEMP.:	-55°C to 105°C.
HUMIDITY:	0-95% RH, non condensing.
TURN-ON TIME:	Within 10 seconds to rated response.
RESPONSE TIME:	5 seconds to 99% of reading. (1 update/second).
DAMPING FACTOR:	3.0 Seconds.
OWM-T LONG TERM STABILITY:	Less than ±0.1% of span for six months.
(D/A) LINEARITY:	±O.O5% of span.
LINEARIZATION:	better than ±0.03°C for Pt-100 RTD,
CALIBRATION:	adjustable on-site, factory preadjusted

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The OWM may be special ordered with the following options:

1. Universal power input capability 100 to 270 Volts AC/DC (AC/DC option)
1. Special sensor probe lengths and threads.
2. Top Oil and/or Winding Temperature TRIP capability (-T Option)
3. Various Cooling CT ratioes. 5, 15, 30, 60, 100 Amp
4. Substitute Magnetic surface mount RTD temperature probes instead of thermowell RTD probes.
5. ¼" x 6" ½"NPT Brass Thermowells
6. 7/8 x 14 thread adapter for 7/8 x 14 thermowell

****

SIMILAR PRODUCT AVAILABLE

TTM, Oil & Winding Temperature Monitor, Complete with Standard 6" X ½ NPT thread replacement RTD well probe, 24ft SJT UV treated connector cable, 5 Snap-On current transformers, SCADA ready outputs for Top Oil & Winding Temperatures, Two adjustable dry contacts for temperature and cooling alarms, Ambient compensation, 2 stage cooling control, Four display readout with Top oil, Winding, Peak Top oil, and Peak Winding temperatures, RS232/485/485 multipoint communications. **NEMA type 4 windowed enclosure. Delivery 6-8 weeks ARO**