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TABLE OF CONTENTS

1	Instrument Description.....	1-1
1.1	Specifications	1-1
1.2	Optional Accessories and Ordering Information.....	1-2
1.3	Omega Family of Thermometers	1-2
2	Preparation for Use	2-1
2.1	General Information.....	2-1
2.2	Feature Overview	2-1
2.3	Safety Notices and Information	2-2
2.4	Unpacking and Inspection	2-4
2.5	Battery Installation and Replacement.....	2-4
2.6	Making Your First Temperature Measurement.....	2-5
3	Operating Instructions	3-1
3.1	Keypad Functions.....	3-1
3.2	LCD Display.....	3-1
3.3	Setup Menu	3-3
3.4	View Modes and Statistics	3-4
3.5	Auto-Power Off	3-6
3.6	Backlight and Backlight Timeout	3-6
3.7	Hold Function	3-6
3.8	Trend Indicators.....	3-6
3.9	Battery Indicator	3-7
3.10	Probe Offset.....	3-7
3.11	Clear Function.....	3-9
3.12	Invalid Measurement Indications.....	3-9
4	Service Information.....	4-1
4.1	Inspection and Cleaning	4-1
4.2	Calibration	4-1
4.2.1	Verification Procedure.....	4-1
4.2.2	Alignment Procedure	4-4
4.3	Troubleshooting.....	4-8
4.4	Diagnostic Routines and Error Codes.....	4-9
A.	Expanded Instrument Uncertainties.....	A-i
B.	Instrument Verification Data Sheet.....	B-i

1 INSTRUMENT DESCRIPTION

1.1 Specifications

GENERAL SPECIFICATIONS:			
Basic Accuracy	$\pm(0.04\% \text{rdg} + 0.3\text{ }^{\circ}\text{C})^1$		
Conformity	ITS-90		
Temperature Ranges	°C	°F	K
K	-200 to 1372	-328 to 2502	73 to 1645
J	-210 to 1200	-346 to 2192	63 to 1473
T	-250 to 400	-418 to 752	23 to 673
E	-250 to 1000	-418 to 1832	23 to 1273
Connector Type	One (1) Mini-TC (HH911T)	Two (2) Mini-TC (HH912T)	
Probe Zero Function	Resolution 0.1 °C/°F/K		
Display	Four (4) digit LCD, with Temperature, Units, Function, Trend, Polarity, Battery, and Decimal Indicators		
Display Backlight	Four (4) LED Backlight with 30 second timeout		
Display Resolution	0.1 (-99.9 to 999.9 °)	1 ° (< -99.9 °, > 999.9 °)	
Reading Rate	3 / Second for Readings and Trend Indicators		
Battery Type	3 AA (IEC LR6, ANSI 15) Alkaline		
Battery Life	2000 Hours Typical		
Battery Indicator	Four (4) Stage Battery Charge Indicator		
Statistics	Minimum Reading Maximum Reading Average Reading	Reading Range Standard Deviation T1-T2 (HH912T only)	
Keypad	Eight (8) momentary switches with audible and tactile feedback		
Clock	Elapsed Statistics Run Time		
Power Cycle Configuration Retention	Instrument retains last selected: <ul style="list-style-type: none"> - Sensor Type - Temperature Units - Offset Values 		
Input Current	±50 nA		
Maximum Common Mode Voltage	42 V peak to earth	1 V p-p between T1 and T2	
Compliance	RoHS2		
ESD	IEC 61000-4 2:2009, Class B		
EMC	EN 55022:2010+A1:2015, Class A; EN 61000-4 3:2006+A2:2010, 10 V/m (80 MHz to 1 GHz)	MIL-PRF-28800F, Class 2	

Instrument Description

ENVIRONMENT:		
Standards	MIL-PRF-28800F, Class 2	UL 60079-0 § 26.4.2
Operating Temp	-20 to 55 °C	-4 to 131 °F
Temperature Coefficient	For specification variances due to ambient operating temperature, see the Expanded Instrument Uncertainty charts in Appendix A of this manual. For ambient operating temperatures not shown in Appendix A, accuracies shall be interpolated linearly.	
Humidity	<10 °C (50 °F): Non-condensing 10 to 30 °C (50 to 86 °F): 5 to 95% RH 30 to 40 °C (86 to 104 °F): 5 to 85% RH 40 to 55 °C (104 to 131 °F): 5 to 60% RH	
Altitude	0 to 4600 m	0 to 15,092 ft
Vibration	Random 10 – 500 Hz, 0.03 g/Hz	
Shock	30g Half Sine	
Drop	4 Drops from 1 m to Concrete	
Storage Temp	-51 to 71 °C	-59 to 159 °F
PHYSICAL CHARACTERISTICS:		
Dimensions	193 x 84 x 28 mm	7.6 x 3.3 x 1.1 in
Weight	362.9 g	12.8 oz
¹ For complete instrument accuracies, see the Expanded Instrument Uncertainty charts in Appendix A of this manual.		

1.2 Optional Accessories and Ordering Information

PRODUCT	MODEL	DESCRIPTION
Thermocouple Probes		Visit omega.com for available thermocouple probes
Printed Manual	HH911T-900	Operation Manual

1.3 Omega Family of Thermometers

Thermocouple Thermometers	HH911T	Thermocouple Thermometer, Single Input
	HH912T	Thermocouple Thermometer, Double Input
Data Thermometers	HH931T	Data Thermometer, Single Input
	HH932T	Data Thermometer, Dual Input

2 PREPARATION FOR USE

2.1 General Information

The Omega HH911T and HH912T Thermocouple Thermometers are high-accuracy handheld digital thermometers that provide accurate temperature readings in a wide range of manufacturing and service applications. These full-featured, durable, and versatile instruments simplify the process of temperature measurement through the intuitive user-interface. They are compatible with the four most popular thermocouple types, K, J, T, and E.

2.2 Feature Overview

- Keypad with audible and tactile feedback;
- 2000 hour battery life¹;
- Four (4) digit dual LCD with LED Backlight;
- Four (4) thermocouple types: J, K, T, and E;
- Comprehensive real-time statistics: MIN, MAX, AVG, RNG, STDEV, and T1-T2²;
- Easy to clean;
- Probe offset function to minimize probe error;
- 0.1° or 1 ° display resolution;
- °F, °C, and K temperature units;
- Reading HOLD mode;
- Conforms to ITS-90 thermocouple tables;
- Durable: Meets MIL-PRF-28800F, Class 2 requirements;
- Optional tilt stand/hanger;
- User-friendly operation;
- Retains measurement parameters, even when turned off;
- Self-diagnostic routine to identify fault conditions;
- Low battery and open sensor indications;


¹ Typical battery life under normal use conditions in laboratory environment. Continuous or repeated use of features such as the backlight, or use or storage at high or low temperature extremes may reduce battery life.


² T1-T2 is available on model HH912T only.


2.3 Safety Notices and Information


Symbols and Terms


Safety Notices denote hazards. They indicate an operating procedure, instruction, or practice that, if not correctly performed or followed, could result in damage to equipment, or injury or death to personnel. Do not proceed beyond a Safety Notice until all conditions and instructions are fully understood and complied with.

 **DANGER** DANGER denotes an imminent hazard that *will* result in severe injury to personnel or death.

 **WARNING** WARNING denotes a hazard that *could* result in serious injury to personnel or death.

 **CAUTION** CAUTION denotes a hazard that *could* result in minor or moderate injury to personnel.

 **NOTICE** NOTICE denotes a hazard that *could* result in damage to equipment.

 **REMINDER** denotes important information about instrument functions, menus, and measurements.

Instrument Safety Notices



MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. DO NOT ATTEMPT TO SERVICE THIS UNIT UNLESS YOU ARE QUALIFIED TO DO SO.

The American National Safety Institute (ANSI) states that a shock hazard exists when probes or sensors are exposed to voltage levels greater than 42 VDC or 42 Vpeak AC. Do not use this instrument where voltages at the measurement surface exceed these levels.

DO NOT USE IN EXPLOSIVE ENVIRONMENTS.

Never use this instrument or any temperature probe or sensor inside a microwave oven.



Do not touch a temperature probe sheath that has been exposed to toxic substances or extremely high or low temperatures.

Do not attempt to measure temperatures beyond the range of the temperature probe. Probe damage or personal injury could result from exceeding a probe's maximum temperature rating.



Preparation for Use

Read this Operation Manual thoroughly before using the instrument to become familiar with its operations and capabilities.

The batteries are accessible through a cover on the back of the instrument. To avoid electrical shock hazard, disconnect all temperature probes and sensors and turn the unit off before removing the cover.



NOTICE

Avoid making sharp bends in probe or sensor lead wires. Bending lead wires at sharp angles can damage the wire and cause probe failure.

When using both thermometer inputs and a voltage differential exists between the two measurement points, at least one probe should be electrically insulated. If not, a ground-loop current can flow through the thermocouple leads causing measurement error or instrument damage.

Static discharge through a connected temperature probe may cause instrument damage. Use care to avoid static discharge when handling the instrument or connected probes.

2.4 Unpacking and Inspection

Each instrument is electrically and mechanically inspected before shipment. Upon receiving your new Omega digital thermometer, unpack all items from the shipping container and check for any obvious damage that may have occurred during transit. Use the original packing materials if reshipment is necessary.

If any dents, broken, or loose parts are seen, do not use the equipment. Notify Omega immediately.

Check that all items are present. If any items are missing, notify Omega immediately.

The following items are included with every new instrument:

- One (1) Thermocouple Thermometer;
- One (1) Quick Start Guide;
- Statement of Traceability;
- Three (3) AA, 1.5 V batteries; and
- Optional accessories (if purchased).

2.5 Battery Installation and Replacement

Three (3) AA 1.5 V batteries are supplied with the instrument, but not installed. Read the following battery replacement instructions before attempting to install or remove the batteries.

CAUTION

Always turn the instrument off and disconnect any input connections before replacing the batteries. Re-install the battery compartment cover before resuming use of the instrument.

NOTICE

The battery compartment is sealed with a rubber gasket. Use care to not damage the gasket when removing or installing the battery compartment cover.

NOTICE

Remove the batteries when storing the instrument for an extended period of time or in a high temperature environment to prevent battery leakage and possible damage to the instrument.



All measurement parameters may be reset to factory default after battery replacement if batteries are removed while the instrument is powered on. Always turn the instrument off before changing batteries.

To install or replace batteries:

Required Tools: Phillips Head Screwdriver

1. Identify the battery compartment located on the back of the instrument (*see Figure 1 below*);
2. Remove the two (2) battery compartment retaining screws;

3. Remove the battery compartment cover;
4. If present, carefully remove old batteries being careful to not damage the battery contacts;
5. Observing proper polarity, install three (3) new, AA alkaline (IEC LR6, ANSI 15) batteries;
6. Re-install the battery cover and two (2) retaining screws;
7. At initial power on after battery replacement, allow approximately 30 seconds for instrument to stabilize.

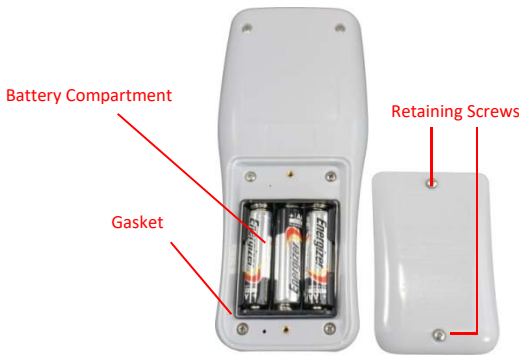


Figure 1: Battery Installation

2.6 Making Your First Temperature Measurement

Omega's HH900T and HH1000T Series Digital Handheld Thermometers are designed for easy operation, while still providing a feature-rich experience via the intuitive user interface.












To get started making temperature measurements right away, follow these steps:

1. Perform *Section 2.5, Battery Installation and Replacement*;
2. Connect a compatible temperature probe to the Channel 1 and/or Channel 2 input connector located at the top of the instrument;



To ensure best measurement accuracy, allow several minutes for the thermocouple probe and connector to thermally stabilize after connection to the instrument.

3. The instrument will immediately display a temperature measurement for the connected channels. However, to ensure valid and best accuracy measurements, continue to Step 4 below;

4. Set the desired measurement parameters as follows:
 - a. Enter the Setup Menu by pressing , hold the key down for approximately 1.5 seconds, and then release it;
 - b. The active thermocouple type is flashing on the display. Use   **Error! Reference source not found.** to select the thermocouple type of the connected temperature probe (E, J, K, or T);
 - c. Momentarily (do not hold) press  to save your selection and move to the next parameter;
 - d. The active temperature unit is flashing on the display. Use   to select the desired temperature unit (°C, °F, or K);
 - e. Momentarily press  to save your selection and move to the next parameter;
 - f. Channel 1 probe offset value is flashing on the display. If the temperature probe's offset value is known, press   to set the Channel 1 probe offset to the probe's offset value. See Section 3.10, Probe Offset, for more information.
 - g. Momentarily press  to save your selection and move to Channel 2 probe offset (if equipped);
 - h. If desired, repeat Step (f) above for Channel 2;
 - i. Momentarily press  to save your selection and exit the setup menu.







Congratulations! You're now ready to make accurate and reliable temperature measurements, wherever and whenever you may need to.

We know you are eager to begin using your new thermometer, but this overview is just the beginning. Please take a moment to familiarize yourself with this Operation Manual to learn about all the features and benefits of your new Omega Thermocouple Thermometer.

3 OPERATING INSTRUCTIONS

3.1 Keypad Functions

The instrument keypad is an eight (8) key, sealed membrane keypad. Each key provides audible and tactile user feedback when pressed. Key functions are described in *Figure 2* below.

The , , , and  keys have multiple functions which can be accessed by momentarily pressing the key, or alternatively, by pressing and holding the key for approximately 1.5 seconds. Throughout this Manual, the press and hold sequence is indicated by the key designator followed by the subscript (1.5s). For instance,  (1.5s) indicates that the  key should be pressed and held for 1.5 seconds, then released to access the desired function.














		Power instrument ON or OFF
	 (1.5s)	Disable auto-power OFF
	 (1.5s)	Enter instrument Setup Menu
		While in Setup Menu, save current value and step to next parameter
		Toggle display backlight
	 (1.5s)	Disable backlight 30 second timeout
		Hold currently displayed measurement
	 (1.5s)	Reset all statistics currently stored in memory
	While in Setup Menu, discard all unsaved changes and exit menu	
	Cycle through view modes and statistics	
	While in Setup Menu, save changes and exit menu	
	While in Setup Menu, advance or reverse selected setting	

Figure 2: Keypad Button Functional Description

3.2 LCD Display

The display is a large, easy to read, dual LCD display, with an LED backlight for clear viewing in low-light conditions. It simultaneously displays temperature measurements for Channel 1 and Channel 2, current thermocouple type and temperature unit, trend indicators for both Channel 1 and Channel 2, and a battery voltage indicator. In

Statistics View, the display substitutes the Channel 2 temperature measurement with the active statistic result, and displays an active statistic mode indicator and the elapsed time of the current statistic session. See *Figure 3* below for further description of each display indicator.

<p>The diagram shows the LCD display with the following indicators and data fields:</p> <ul style="list-style-type: none"> 1: HOLD function indicator 2: OFFSET indicator 3: Thermocouple type indicator (E, J, K, T) 4: Battery life indicator 5: Channel 1 indicator (T1) 6: Channel 1 trend indicators (up/down arrows) 7: Channel 1 temperature measurement (91.2) 8: T1-T2 temperature measurement indicator 9: Channel 2 temperature measurement (101.2) 10: Channel 2 trend indicators (up/down arrows) 11: Active temperature unit (C, F, K) 12: MIN MAX AVG RNG STDEV indicator 13: Time elapsed since start of statistics collection (23:54:19) 14: Active statistic indicator 	<table border="1"> <tbody> <tr> <td>1</td> <td>HOLD function is active</td> </tr> <tr> <td>2</td> <td>T1 and/or T2 OFFSET is active¹</td> </tr> <tr> <td>3</td> <td>The active thermocouple type</td> </tr> <tr> <td>4</td> <td>Remaining battery life</td> </tr> <tr> <td>5</td> <td>Channel 1 indicator</td> </tr> <tr> <td>6</td> <td>Channel 1 trend indicators</td> </tr> <tr> <td>7</td> <td>Channel 1 temperature measurement</td> </tr> <tr> <td>8</td> <td>T1-T2 temperature measurement indicator²</td> </tr> </tbody> </table>	1	HOLD function is active	2	T1 and/or T2 OFFSET is active ¹	3	The active thermocouple type	4	Remaining battery life	5	Channel 1 indicator	6	Channel 1 trend indicators	7	Channel 1 temperature measurement	8	T1-T2 temperature measurement indicator ²
1	HOLD function is active																
2	T1 and/or T2 OFFSET is active ¹																
3	The active thermocouple type																
4	Remaining battery life																
5	Channel 1 indicator																
6	Channel 1 trend indicators																
7	Channel 1 temperature measurement																
8	T1-T2 temperature measurement indicator ²																
<p>9 Channel 2 indicator²</p>																	
<p>10 Channel 2 trend indicators²</p>																	
<p>11 Channel 2 temperature measurement² T1-T2 measurement result², or active statistic result</p>																	
<p>12 Active temperature unit</p>																	
<p>13 When viewing statistics, time elapsed since start of statistics collection</p>																	
<p>14 Active statistic</p>																	
<p>¹ T2 Probe Offset available on model HH912T only. ² Models HH912T only.</p>																	


Figure 3: LCD Display Description


The LCD can display error information about the current measurement, as shown in *Figure 4*.





DISPLAY	DESCRIPTION
OPEn	No thermocouple probe is connected
-Or-	The applied temperature is greater than the maximum temperature for the selected thermocouple type
-Ur-	The applied temperature is less than the minimum temperature for the selected thermocouple type

Figure 4: LCD Error Indications

3.3 Setup Menu



Key designators marked with a clock icon, e.g. , indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

Measurement settings are configured in the Setup Menu. Press  to access the Setup Menu. From within the Setup Menu, press  to step through the user-definable parameters and the   keys to advance or reverse the selected value for the active parameter. The active parameter value will flash on the display.






Press  to save a setting and step to the next parameter. Press  to save a setting and exit the Setup Menu. Press  to disregard unsaved changes and exit the Setup Menu. If no key is pressed for ten (10) seconds, the current configuration is saved and the instrument will exit the Setup Menu.

Figure 5 below lists the user-definable parameters and the available values for each parameter.






To set a parameter value:

1. Press  to enter the Setup Menu;
2. Press  to cycle through parameters as shown in *Figure 5* below, until the desired parameter is reached;

PARAMETER	AVAILABLE VALUES
Thermocouple Type	E, J, K, T
Temperature Units	°C, °F, K
T1 Probe Offset	±0.1 ° increments
T2 Probe Offset ¹	±0.1 ° increments

¹ T2 Probe Offset available on model HH912T only.

Figure 5: Setup Menu Parameters and Values

3. To change the value of the current parameter, press  ;
4. To save the current parameter value and cycle to the next parameter, press .
5. To save the current parameter value and exit the Setup Menu, press .
6. To disregard changes made to the current parameter value and exit the Setup Menu, press .



If no key is pressed for ten (10) seconds, the instrument will save the current configuration and exit the Setup Menu.


3.4 View Modes and Statistics

The instrument features multiple view modes including a variety of real-time statistics, all available at the touch of a button. *Figure 6* below describes each view mode.

VIEW MODE	DISPLAY INDICATOR	DESCRIPTION
T1-T2	T1-T2	Current Channel 1 measurement – current Channel 2 measurement
Minimum	MIN	Minimum temperature recorded during current session
Maximum	MAX	Maximum temperature recorded during current session
Average	AVG	Average of all temperatures recorded during current session
Range	RNG	Maximum - Minimum
Standard Deviation	STDEV	Standard deviation of all temperatures recorded during the current session ¹ .

¹ Standard Deviation is calculated using the population formula: $\sigma = \sqrt{\frac{\sum(x-\mu)^2}{N}}$




Figure 6: View Modes and Statistics


Press  to change view modes. For each mode, the active measurement or statistic result is displayed on the second line of the display.


The T1-T2 view mode displays the current Channel 1 measurement minus the current Channel 2 measurement. The display indicates **T1-T2**

at the left side of the display. If either channel is not connected to a probe, or the current measurement on either channel is over- or under-range, T1-T2 view mode is not available.


When viewing statistics, the active statistic is indicated directly below the result. The elapsed time of the current statistics session is displayed in the lower-left corner of the display.

Statistics are calculated continuously, beginning when the instrument is powered on or when  (1.5s) is pressed. To pause statistics collection temporarily, press . To resume statistics collection, press  again.

It is important to note that changing parameter values or temperature probes will invalidate the current statistics session. When using statistics, always begin by pressing  (1.5s) to delete existing statistics data and initiate a new statistics session.

Press  to step through the available statistics. Statistics are displayed in the order shown in *Figure 7* below. For dual-channel models, the LCD T1 or T2 indicators are lit to identify the channel's statistics currently being displayed.



When using statistics, always begin by pressing  (1.5s) to clear existing statistics results and initiate a new statistics session.




The first line of the display indicates the current Channel 1 temperature, regardless of which view mode or channel's statistic is currently displayed.

MODEL	CHANNEL	STATISTIC VIEW SEQUENCE				
HH911T	T1	MIN	MAX	AVG	RNG	STDEV
HH912T	T1	MIN	MAX	AVG	RNG	STDEV
	T2	MIN	MAX	AVG	RNG	STDEV


Figure 7: Statistics Sequence


If the instrument records invalid measurement data during the statistics session such as an over-range, under-range, or open input value, ——— will be displayed for each affected statistic result.

To return to the active measurement mode, press  repeatedly to step through the remaining view modes, or cycle power.

3.5 Auto-Power Off






Key designators marked with a clock icon, e.g.  (1.5s), indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

To conserve battery life, the instrument automatically turns off if no key is pressed for 20 minutes. To disable this feature, press  (1.5s). The display will flash once, indicating auto-power off is disabled.


Auto-power off will remain disabled until instrument power is cycled. At next power on, auto-power off returns to the default enabled condition.


3.6 Backlight and Backlight Timeout

The instrument includes an LED backlight feature to ensure measurement data can be easily read in low-light conditions. To activate the backlight, press .

Once the backlight is activated, it will automatically turn off after 30 seconds if no key is pressed to preserve battery life. To disable the backlight timeout feature, press  (1.5s). The backlight will flash to indicate the timeout feature has been disabled. To re-enable the backlight timeout feature, turn the backlight off then on by pressing  twice.

3.7 Hold Function


Press  to hold the current reading and/or statistics result, and to pause statistics accumulation. **HOLD** is displayed at the top-left of the LCD display. New measurements are not displayed, trend indicators are not refreshed, and statistics are not calculated while the hold function is active.

To disable the hold function and resume normal operation and statistics data accumulation, press  again.

3.8 Trend Indicators

Trend indicators provide a visual representation of the measurement's stability, and separate indicators are provided for each channel. An up arrow indicates that the current measurement is trending upwards, while a down arrow indicates the measurement is trending downwards. Neither arrow is visible when the measurement is stable. For best accuracy, always allow the measurement to stabilize before evaluating or recording the measured temperature.

3.9 Battery Indicator

 Battery depletion or battery replacement will reset all measurement parameters to their default values and deletes all existing statistics data. After battery replacement, set measurement parameters as required.

The battery voltage indicator provides a visual representation of approximate remaining battery life. It is located at the top-right of the display.

The battery voltage indicator uses three bars to represent remaining battery life. *Figure 8* shows the approximate battery life for each bar.



BARS	APPROX. BATTERY LIFE
3	100% - 50%
2	50% - 20%
1	20% - 5%
0	0% - Shutdown Initiated

Figure 8: Battery Voltage Indicator

At zero (0) bars, the instrument will momentarily display **bATT** and initiate a shutdown sequence. To prevent disruption of the measurement process and statistics collection, the batteries should be replaced before the battery voltage indicator reaches zero (0) bars. See *Section 2.5, Battery Installation and Replacement*.

3.10 Probe Offset

The probe offset feature compensates for temperature probe errors, significantly improving overall measurement uncertainty. Probe offset can be set for Channel 1 and 2 individually. Once set, the probe offset is automatically applied to all subsequent measurements and statistics on the offset channel.

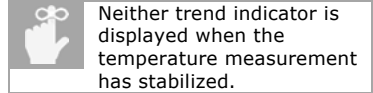
 Current statistics will be invalidated after changing settings such as probe offset. Press  to delete existing statistics data and initiate a new statistics session.

To set the probe offset when using an un-calibrated temperature probe:

1. Connect the temperature probe to Channel 1 or Channel 2 (as desired) of the instrument;
2. Place the probe into a known temperature reference such as a thermowell or ice bath³;

³ Probe offset measurement using an ice bath or thermowell should only be performed by personnel trained and qualified in the use of such instruments and related metrology methods.

3. Allow the temperature probe to stabilize in the ice bath or thermowell by observing the instrument trend indicators for the appropriate channel;





4. Press **SET** (1.5s) to enter the Setup Menu;
5. Press **SET** three (3) times to cycle to the Channel 1 Offset parameter;
6. Observe the current Channel 1 temperature measurement displayed on the top measurement line of the display, and current offset value displayed on the second line of the display;
7. Press **▲▼** to set the offset in 0.1 ° increments until the displayed temperature equals the known temperature reference value;
8. Press **SET** to save the offset value and proceed to Channel 2 offset (HH912T only), or press **VIEW** to save the offset value and exit the Setup Menu.
 - a. Alternatively, to disregard the new offset value and exit the Setup Menu, press **CLR**.
9. **OFFSET** is displayed at the top-right of the LCD display.

To set the probe offset when using a calibrated temperature probe with a known offset:

1. Press **SET** (1.5s) to enter the Setup Menu;
2. Press **SET** three (3) times to cycle to the Channel 1 Offset parameter;
3. Observe the current offset value displayed on the second line of the display;
4. Press **▲▼** to set the offset in 0.1 ° increments until the displayed offset value equals the calibrated probe offset value;
5. Press **SET** to save the offset value and proceed to Channel 2 offset (HH912T only), or press **VIEW** to save the offset value and exit the Setup Menu.
 - a. Alternatively, to disregard the new offset value and exit the Setup Menu, press **CLR**.
6. **OFFSET** is displayed at the top-right of the LCD display.

3.11 Clear Function

From active measurement mode, press  to clear the statistics registers and begin a new statistics session. The LCD display will indicate **CLr** to confirm the action.

From the Setup Menu, press  to disregard changes to the current parameter value and exit the Setup Menu.

3.12 Invalid Measurement Indications

The LCD display indicates when a measurement or statistic is invalid, as shown in *Figure 9* below.

INDICATION	DESCRIPTION
- OR -	The current measurement or statistic is over-range for the selected thermocouple type
- UR -	The current measurement or statistic is under-range for the selected thermocouple type
OPEn	No probe is connected or the probe sensor is faulty
-----	Cannot compute a valid statistical result

Figure 9: Invalid Measurement Indications

4 SERVICE INFORMATION

4.1 Inspection and Cleaning

To extend the life of the instrument, inspect and clean the instrument regularly. Inspect the instrument for any significant abrasions, cuts, cracks, dents, or other signs of damage on the case, keypad, and display lens. Inspect the connectors for breaks, dirt, or corrosion. Ensure all screws are securely fastened, and if equipped, that the tilt stand/hanger is in good condition and locks into position properly.

With all screws securely fastened and the battery compartment cover in place, use a damp cloth or towel to wipe down the instrument. Use care to avoid scratching the display lens. Mild, non-abrasive detergents may be used providing the instrument is then wiped down with a clean damp cloth or towel.

4.2 Calibration

4.2.1 Verification Procedure

1. This procedure shall be performed within environmental conditions of 23 ± 1 °C and 5% to 95% RH.
2. The unit under test ("UUT") shall be acclimated to the controlled environment for a minimum of four (4) hours.
3. The equipment listed in *Figure 10* below is required to fully verify the UUT to the expanded instrument uncertainties specified in *Appendix A*.

EQUIPMENT	FUNCTION	RANGE	SPECIFICATION (2-SIGMA)	THERMOCOUPLE CABLE CALIBRATION UNCERTAINTY (2-SIGMA)
DC Voltage Source	DC Voltage Output	-10 to 75 mV	\pm (13 ppm of output + 0.66 μ V)	N/A
Thermocouple Calibrator	Thermocouple Type E	-250 to -100 °C -100 to -25 °C -25 to 350 °C 350 to 650 °C 650 to 1000 °C	\pm 0.33 °C \pm 0.11 °C \pm 0.09 °C \pm 0.11 °C \pm 0.14 °C	\pm 0.47 °C \pm 0.15 °C \pm 0.13 °C \pm 0.15 °C \pm 0.20 °C
	Thermocouple Type J	-210 to -100 °C -100 to -30 °C -30 to 150 °C 150 to 760 °C 760 to 1200 °C	\pm 0.18 °C \pm 0.11 °C \pm 0.09 °C \pm 0.11 °C \pm 0.15 °C	\pm 0.25 °C \pm 0.15 °C \pm 0.13 °C \pm 0.16 °C \pm 0.22 °C

Figure 10 continued on next page ...

EQUIPMENT	FUNCTION	RANGE	SPECIFICATION (2-SIGMA)	THERMOCOUPLE CABLE CALIBRATION UNCERTAINTY (2-SIGMA)
Thermocouple Calibrator (cont from previous page)	Thermocouple Type K	-200 to -100 °C -100 to -25 °C -25 to 120 °C 120 to 1000 °C 1000 to 1372 °C	± 0.22 °C ± 0.12 °C ± 0.11 °C ± 0.17 °C ± 0.27 °C	± 0.31 °C ± 0.17 °C ± 0.15 °C ± 0.25 °C ± 0.38 °C
	Thermocouple Type T	-250 to -150 °C -150 to 0 °C 0 to 120 °C 120 to 400 °C	± 0.42 °C ± 0.16 °C ± 0.11 °C ± 0.09 °C	± 0.59 °C ± 0.23 °C ± 0.15 °C ± 0.13 °C
Thermocouple Cables	<p>Calibrated Thermocouple Cables with recorded correction values shall be used throughout this procedure to adhere to the expanded instrument uncertainties provided in <i>Appendix A</i>. Thermocouple Cables must be calibrated to the accuracies listed in the Thermocouple Cable Specification column of <i>Figure 10</i>, or better.</p> <p>Thermocouple Cables are only required for each desired thermocouple type.</p> <p>The thermocouple cables must be terminated at one end with a male miniature thermocouple connector for connection to the UUT. The opposite end should be terminated as appropriate for the thermocouple calibrator.</p> <p>For two channel UUTs, a split or “Y” cable may be used, terminated with two (2) male miniature thermocouple connectors. Correction values must be established for each leg of the Split Thermocouple Cable.</p>			
Copper Mini-TC Cable	<p>Copper Mini-TC Cable is required for Voltage Gain and Offset alignment only. This cable does not require calibration.</p> <p>One end shall be terminated with a male miniature thermocouple connector for connection to the UUT. The opposite end shall be terminated with copper connections appropriate for the DC Voltage Source.</p> <p>For two channel UUTs, a split or “Y” cable may be used, terminated with two (2) male miniature thermocouple copper connectors.</p>			
Straightened Paper Clip	<p>Required to access the calibration enable switch. Any rigid wire, approximately 0.8 mm in diameter, may be used.</p>			

Figure 10: Required Equipment for Instrument Verification and Alignment

4. Refer to *Appendix B* for standard measurement points and tolerances for each thermocouple type.
5. One, several, or all of the available thermocouple types may be verified as necessary. In the steps below, use the appropriate Thermocouple Cable and Thermocouple Calibrator settings as appropriate for the desired thermocouple type.
6. For two channel UUTs, both channels may be verified concurrently.

7. Set the UUT parameters as shown in *Figure 11* below. Refer to *Section 3.3, Setup Menu* as necessary for UUT parameter setup instructions.

PARAMETER	VALUE
Thermocouple Type	As Desired
Temperature Units	°C
Offset Ch. 1	0.0 °C
Offset Ch. 2 (HH912T only)	0.0 °C


Figure 11: UUT Verification Parameter Settings

8. Connect the miniature thermocouple connector of the Thermocouple Cable to Channel 1 of the UUT.
 - a. For two channel UUTs using the Split Thermocouple Cable, connect the miniature thermocouple connector of one leg to the UUT Channel 1 input, and the miniature thermocouple connector of the other leg to the Channel 2 input.
9. Connect the opposite end of the Thermocouple Cable (or the single-connector end of the Split Thermocouple Cable) to the Thermocouple Calibrator thermocouple output.
10. Set the Thermocouple Calibrator thermocouple type to the desired thermocouple type.
11. Allow at least five minutes for this connection to stabilize.
12. Set the calibrator to output to the first Standard Value in *Appendix B* for the desired thermocouple type.
13. Record the UUT measurement in the Reading column of *Appendix B* for the appropriate Standard Value.
14. Record the cable correction value for the Thermocouple cable in the Cable Correction column of *Appendix B*.
15. Subtract the Cable Correction value from the Reading and record the result as the Corrected Reading ($Reading - Cable Correction = Corrected Reading$) in *Appendix B*.
16. Compare the Corrected Reading to the tolerances stated in the 2-Sigma Tolerance column of *Appendix B* to determine whether the UUT measurement is within published specifications.
17. Repeat Steps 12 through 16 for each remaining Standard Value in *Appendix B* for the current thermocouple type.

18. Repeat Steps 7 through 17 for each desired thermocouple type.

4.2.2 Alignment Procedure

Preparation

1. This procedure shall be performed within environmental conditions of 23 ±1 °C and 5% to 95% RH.
2. The unit under test (“UUT”) shall be acclimated to the controlled environment for a minimum of four (4) hours.
3. The equipment listed in *Figure 10* above is required to align the UUT to the expanded instrument uncertainties specified in *Appendix A*.
4. Remove the UUT battery door housing to expose the alignment access hole.
5. Press UUT  to turn the UUT on.
6. Set the UUT parameters as shown in *Figure 12* below. Refer to *Section 3.3, Setup Menu* as necessary for UUT parameter setup instructions.

PARAMETER	VALUE
Thermocouple Type	Type E ¹
Temperature Units	°C
Offset Ch. 1	0.0 °C
Offset Ch. 2 (HH912T only)	0.0 °C

¹ Other thermocouple types may be used in this procedure as desired. For instance, if the UUT is used primarily with Type J applications, Cold Junction Compensation may be aligned using Type J. Note however that the expanded instrument uncertainties provided in *Appendix A* assume alignment using Type E.

Figure 12: UUT Alignment Parameter Settings

7. Insert the Straightened Paper Clip through the alignment access hole and gently press the calibration enable switch located on the circuit board. See *Figure 13* for location.








Figure 13: Alignment Access Hole Location

Voltage Gain and Offset Alignment

8. The UUT display will indicate as follows:
 - a. Line 1: CAL1
 - b. Line 2: mV portion of Channel 1 voltage reading
 - c. Line 3: nV portion of Channel 1 voltage reading
9. Connect the miniature thermocouple connector of the Copper Mini-TC Cable to the Channel 1 input of the UUT.
 - a. For two channel UUTs using the Split Copper Mini-TC Cable, connect one miniature thermocouple connector to the Channel 1 input of the UUT, and the other connector to the Channel 2 input.
10. Connect the opposite end of the Copper Mini-TC Cable (or Split Copper Mini-TC Cable) to the appropriate output connectors of the DC Voltage Source.
11. Allow at least three minutes for the connections to temperature stabilize before proceeding.

NOTICE

Do not apply voltages greater than 80 mV DC to the UUT inputs. Voltages greater than 80 mV may damage the instrument.

12. Set the DC Voltage Source to output the first Applied Voltage value in *Figure 14* below.
13. Allow the DC Voltage source output to stabilize before proceeding.
14. The UUT will display the current voltage reading.
15. Allow the UUT displayed voltage to stabilize before proceeding.
16. Press UUT  to automatically adjust the UUT voltage reading to the Applied Voltage, ± 0.001 mV.
 - a. If the UUT displayed voltage is not within ± 0.001 mV of the Applied Voltage, press   until the UUT displayed voltage is within ± 0.001 mV, adjusting as close to the Applied Voltage as possible.
17. Press UUT . The display will change to rES1 [2, 3 ...] showing the actual measured value saved in the previous step.
18. Press UUT  again. This will increment to the next CAL value.

19. Repeat Steps 12 through 18 for each remaining value in *Figure 14* below. For single channel UUTs, omit Channel 2 values.
 - a. For two channel UUTs using the single-ended Copper Mini-TC Cable, disconnect the cable from the UUT Channel 1 input, and reconnect the cable to the Channel 2 input after completing CAL4 in *Figure 14* below. Repeat Step 11.






CHANNEL	UUT DISPLAY	APPLIED VOLTAGE (MV)
1	CAL1	-10
	CAL2	75
	CAL3	-10
	CAL4	30
2	CAL5	-10
	CAL6	75
	CAL7	-10
	CAL8	30

Figure 14: Gain Alignment Values

20. Remove the copper cable from the DC Voltage Source and UUT.

Cold Junction Compensation Alignment
21. Connect one end of the Type E⁴ Thermocouple Cable to the UUT Channel 1 input.
 - a. For two channel UUTs using the Split Thermocouple Cable, connect the miniature thermocouple connector of one leg to the UUT Channel 1 input, and the miniature thermocouple connector of the other leg to the Channel 2 input.
22. Connect the opposite end of the Thermocouple Cable (or the single-connector end of the Split Thermocouple Cable) to the Thermocouple Calibrator thermocouple output.
23. The UUT display will indicate as follows:
 - a. Line 1: CALA
 - b. Line 2: temperature in °C

⁴ If substituting another thermocouple type, use the appropriate Thermocouple Cable for the selected thermocouple type.

- c. Line 3: temperature in tenths of °C (out to 1 μ or 0.000001 °C)
24. Set the Thermocouple Calibrator thermocouple type to Type E⁵.
25. Set the calibrator to output 0.0 °C.
26. Allow at least five minutes for this connection to stabilize.
27. Press UUT   to set the UUT display equal to the Thermocouple Cable calibrated correction value \pm 0.02 °C.
28. Press UUT .
29. The display will change to rESA showing the actual measured value saved in the previous steps.
30. For single channel UUTs, skip to Step 36 below.
31. For two channel UUTs, continue with Step 32.
 - a. For two channel UUTs using the single-ended Thermocouple Cable, disconnect the cable from the UUT Channel 1 input, and reconnect the cable to the Channel 2 input. Repeat Step 26.
32. Press UUT .
33. The UUT display will indicate as follows:
 - a. Line 1: CALb
 - b. Line 2: temperature in °C
 - c. Line 3: temperature in tenths of °C (out to 1 μ or 0.000001 °C)
34. Repeat Steps 27 and 28.
35. The display will change to rESb showing the actual measured value saved in the previous steps.
36. Press UUT  to save the current alignment values and return the UUT to normal operation.

⁵ If substituting another thermocouple type, set the Thermocouple Calibrator as appropriate for the selected thermocouple type.

4.3 Troubleshooting

Omega’s digital handheld thermometers are designed and built to provide years of uninterrupted use. In the event the instrument malfunctions or does not perform as expected, helpful troubleshooting tips are provided below. *Figure 15* below lists some of the more common issues and their resolutions.




SYMPTOM	DESCRIPTION	RESOLUTION
Unexpected reading on Line 2 of Display	Statistics View Mode is active	Press  to cycle through statistics views until active measurement is displayed (see <i>Section 3.4 View Modes and Statistics</i>)
Unexpected or Erroneous Measurement	Probe offset is active	Set probe offset to correct value for connected temperature probe (see <i>Section 3.10, Probe Offset</i>)
	Temperature probe has not stabilized	Observe display trend indicators and wait for stable measurement (see <i>Section 3.8 Trend Indicators</i>)
Unresponsive	Instrument is set to the wrong thermocouple type for the attached probe	Set the thermocouple type as appropriate for the attached probe (see <i>Section 3.3, Setup Menu</i>)
	Hold Mode is active	Press  , and verify that the HOLD indicator is not active (see <i>Section 3.7, Hold Function</i>)
Shuts down unexpectedly or will not power on	Static discharge through connected probes	Press  to cycle instrument power
	Batteries are low or depleted	Replace batteries (see <i>Section 2.5, Battery Installation and Replacement</i>)

Figure 15: Common Troubleshooting Issues

4.4 Diagnostic Routines and Error Codes

The instrument momentarily activates all display annunciators and segments during startup to allow for visual inspection of the LCD. Observe the LCD and verify all segments activate.

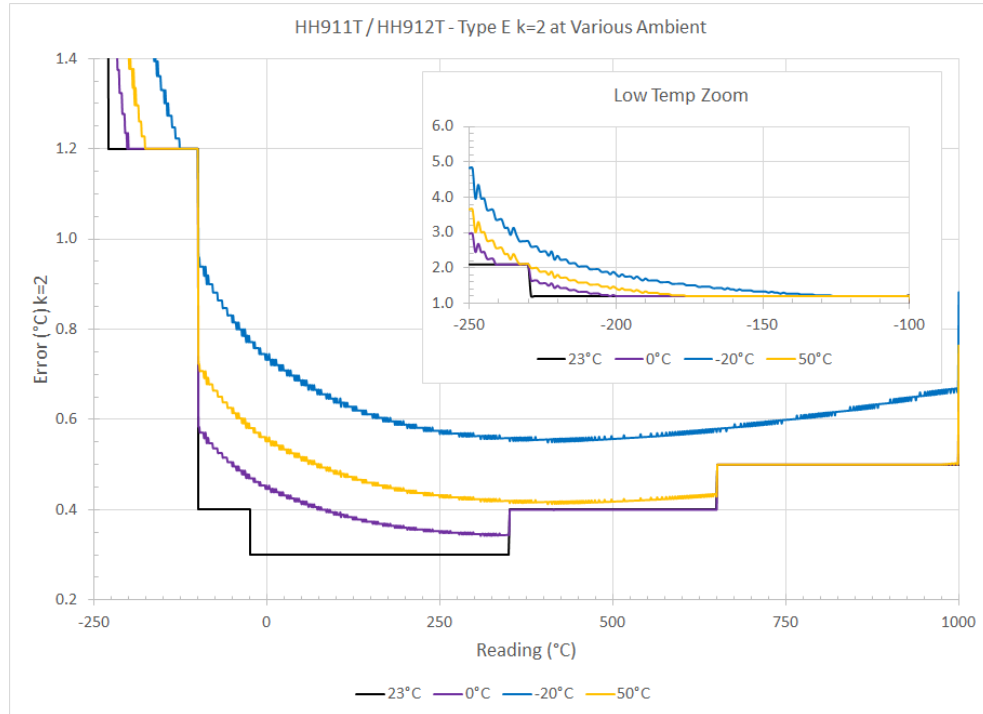
Internal diagnostic routines are also executed during startup. If any diagnostic routine detects a malfunction, an error will be displayed as shown in *Figure 16* below.

ERROR CODE	DESCRIPTION
Err ADC	Analog to digital converter error
Err CJC	Cold junction compensation error
Err FLSH	Flash memory error
Err InP	Stuck key or other keypad error

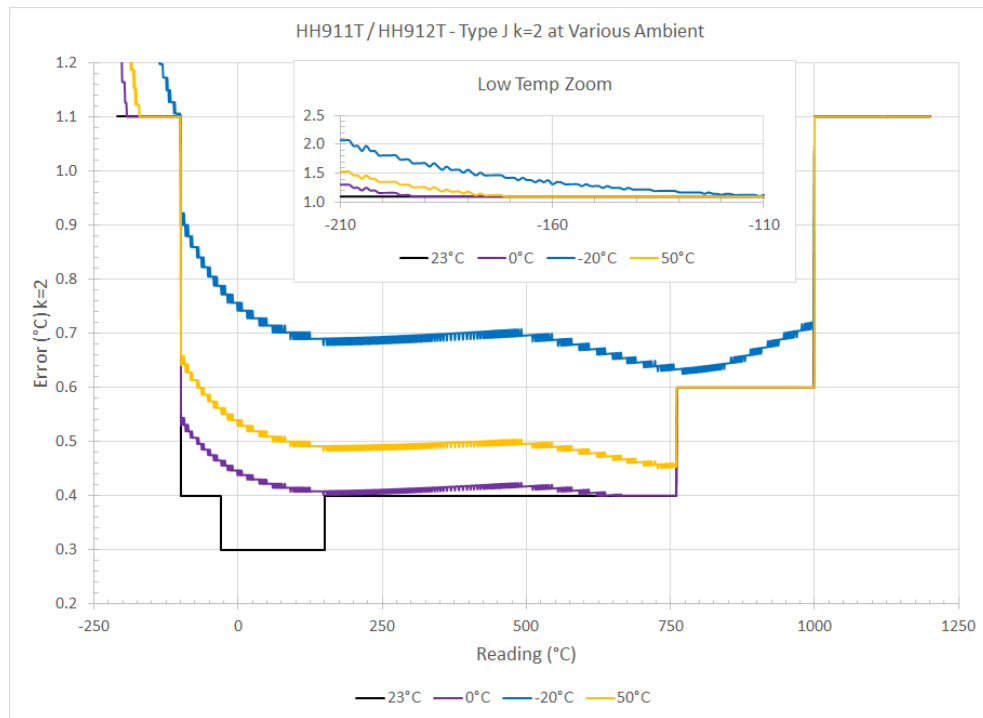
Figure 16: Diagnostic Routine Error Codes

A. EXPANDED INSTRUMENT UNCERTAINTIES

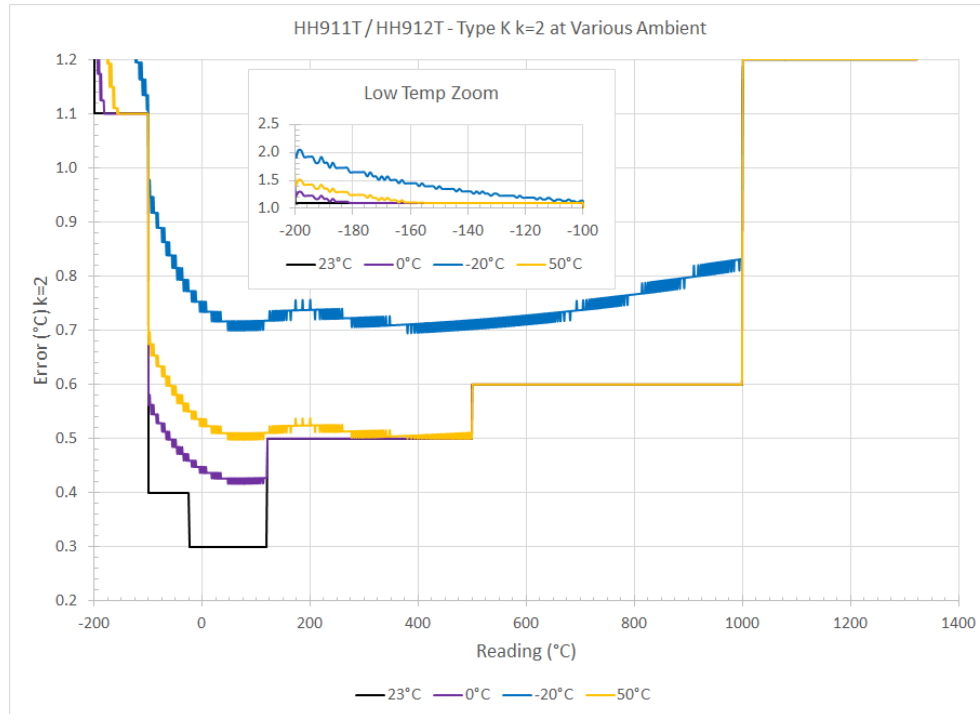
Thermocouple Type E



Thermocouple Type J

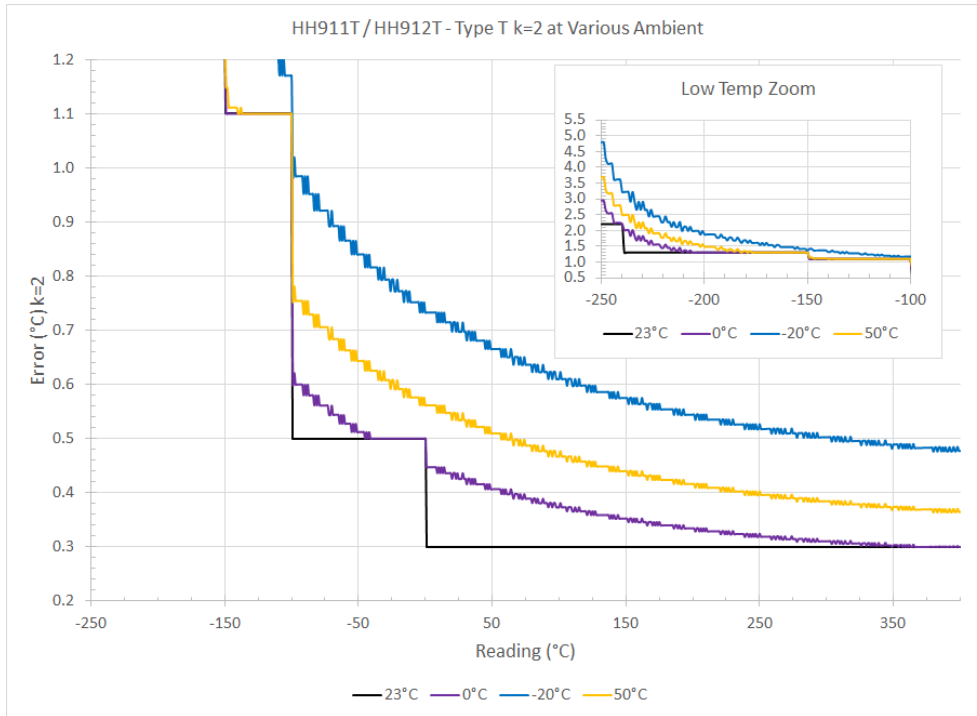


Thermocouple Type K



Thermocouple Type T

HH911T / HH912T - Type T k=2 at Various Ambient



B. INSTRUMENT VERIFICATION DATA SHEET

THERMO-COUPLE TYPE	STANDARD VALUE (°C)	READING (°C)	CABLE OFFSET (°C)	CORRECTED READING (°C)	2-SIGMA TOLERANCE (± °C)
E	-250.0				2.1
	-95.0				0.4
	0.0				0.3
	995.0				0.5
J	-210.0				1.1
	-95.0				0.4
	0.0				0.3
	995.0				0.6
	1200.0				1.1
K	-200.0				1.1
	-95.0				0.4
	0.0				0.3
	999.5				0.6
	1372.0				1.2
T	-250.0				2.2
	-95.0				0.5
	0.0				0.3
	400.0				0.3

Appendix B: Instrument Verification Worksheet

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **37 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **three (3) years product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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