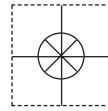# User's Guide

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WARNING: These products are not designed for use in, and should not be used for, human applications.

CONTENTS

Overview of the RHB-3

The OMEGA® RHB-3 is a chilled mirror monitor and can be used in a wide variety of applications. It provides accurate and reliable measurements over an extended range for long periods of time with the new ACCU-Star self-correcting feature.

- Dew/frost point from 22°C to –40°C @ an ambient temperature of 25°C
- Relative humidity from 0.002% to 100%

The RHB-3 offers a remote multifunction display and can display two selectable measurements simultaneously, while outputting two selectable analog outputs, one selectable alarm point and any combination of selected measurements on a serial port.

The RHB-3 is a bench top monitor with panel mount capability.

Three sensing configurations of the RHB-3 are available: dew point, temperature and pressure.

RHB-3 Specifications

Dew Point Range	-40°C to 24°C @25°C
Accuracy	+/- 0.2°C
Repeatability	+/-0.05°C
Hysteresis	None
Temperature (optional)	100 Ohm 4 wire PRT 0.00385 Ohm
Pressure (optional)	4-20mA abs. pressure sensor
Analog RS232 Alarms	Dual 0-5Vdc & 4-20mA Any parameters 100mA AC/DC Opto-Isolators
Operating Temperature	0 to 60 deg C
Operating Pressure	0-1Mpa
Power	85 to 265Vac 50/60HZ 100W
Weight	5kg
Sensor dimensions Meter dimensions	360*110*130mm 210*110*30mm

Overview of the RHB-4

The Shinyei RHB-4 is a chilled mirror monitor and can be used in a wide variety of applications. It provides accurate and reliable measurements over an extended range for long periods of time with the new ACCU-Star self-correcting feature.

- Dew/frost point from 22°C to –60°C @ an ambient temperature of 25°C
- Relative humidity from 0.002% to 100%

The RHB-4 offers a remote multifunction display and can display two selectable measurements simultaneously, while outputting two selectable analog outputs, one selectable alarm point and any combination of selected measurements on a serial port.

The RHB-4 is a bench top monitor with panel mount capability.

Three sensing configurations of the RHB-4 are available: dew point, temperature and pressure.

RHB-4 Specifications

Dew Point Range	-55°C to 24°C @25°C
Accuracy	+/- 0.2°C
Repeatability	+/-0.05°C
Hysteresis	None
Temperature (optional)	100 Ohm 4 wire PRT 0.00385 Ohm
Pressure (optional)	4-20mA abs. pressure sensor
Analog RS232 Alarms	Dual 0-5Vdc & 4-20mA Any parameters 100mA AC/DC Opto-Isolators
Operating Temperature	0 to 60 deg C
Operating Pressure	0-1Mpa
Power	85 to 265Vac 50/60HZ 100W
Weight	5kg
Sensor dimensions Meter dimensions	360*110*135mm 210*110*30mm

System Components

The complete system consists of the following items:
- The electronic display
- Dew point sensor
- Interconnecting sensor cable
- AC line cord
- Operators manual
- Certificate of Calibration
- Maintenance Kit
- RS232 cable

Measurement parameters available:

Dew Point	Degree C or F
Temperature	Degree C or F
Pressure	kPa, mbar, psia
Relative Humidity	%RH
Absolute Humidity	PPMv, PPMw, g/m3, grains/lb

Available interfaces are as follows:

- 2 Analog outputs: 0-5V and 4-20mA (all parameters)
- "Analog outputs" may be configured as 0/5 volt and 4/20mA alarms, optional 100mA AC/DC Opto-isolated add-on module available
- Alarm relay: 100mA AC/DC Opto-isolated
- RS-232: Any parameter
- 4-20mA Pressure sensor inputs
- 100 Ohm PRT 4 wire 0.00385 Ohm

Feature:

The ACCU-STAR feature provides automatic contaminations correction allowing your Dewpoint Monitor to continue providing accurate and reliable measurements over extended periods of time without having to physically interrupt your measurement process.

Theory of Operation

Optical condensation hygrometry is a precise technique for determining the water vapor content in gases by directly measuring dew point or frost temperatures. Using this technique, a metallic mirror is cooled until it reaches a temperature at which a thin layer of condensation begins to form on it. The dew layer is detected optically, and the mirror is held at that temperature. The mirror temperature, measured with a platinum resistance thermometer, is an accurate indicator of the dew or frost point. Because these hygrometers are so accurate, they are widely used as a standard in many of the world's metrology laboratories. The condensate mirror is illuminated with a high-intensity, solid state, light emitting diode (LED). A photo- detector monitors the LED light reflected from the mirror. The photo detector is fully illuminated when the mirror is clear of dew, and it receives less light as dew forms. A separate photo detector is used as a known reference to compensate for any thermally induced changes in the optical components. The photo detectors are measured by a microprocessor, the output of the microprocessor controls the electrical current to the thermoelectric cooler. A high cooler current is sent when the mirror is dry, causing the mirror to cool toward the dew point. As dew begins to form on the mirror, less light is reflected, and the current output decreases. A rate feedback loop within the microprocessor ensures critical response, causing the mirror to stabilize quickly at a temperature that maintains a thin dew or frost layer on the mirror surface. A precision thermometer element embedded within the mirror directly monitors this dew point temperature.

Operating from display
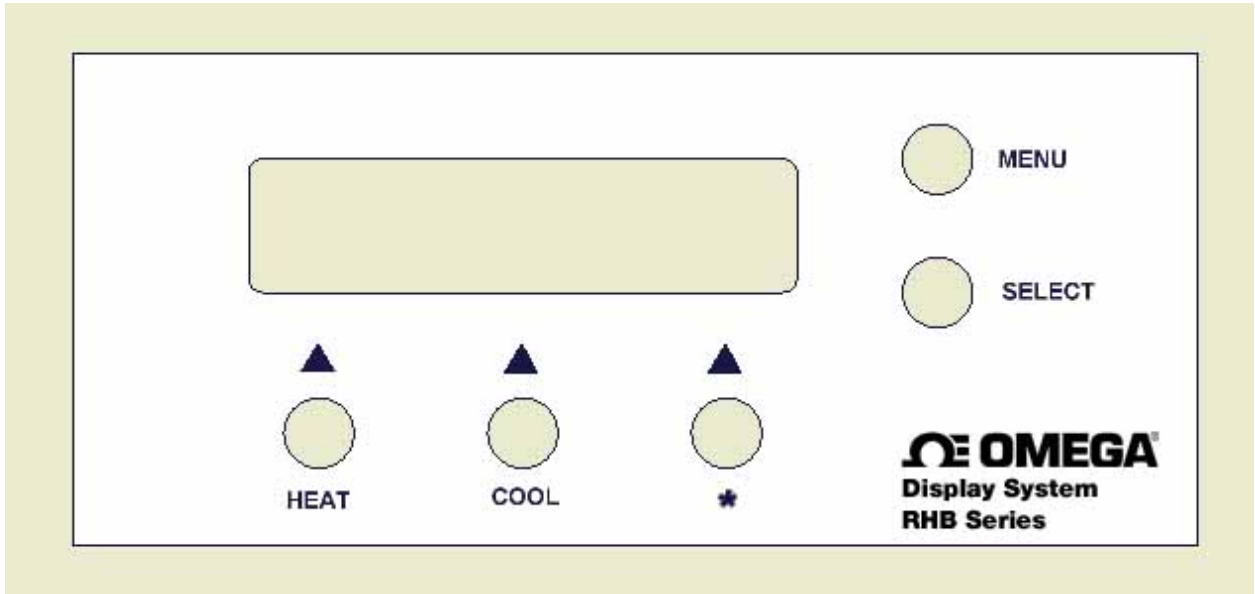
Power up

Should read OMEGA Dewpoint system RHB.

Begin power-up Accu-Star
        Unit automatically goes into heat mode
        Stays in heat until mirror is dry (min 20 sec)
        Unit then goes into cool mode until mirror is flooded
        Unit heats to clear mirror, and check optics.

Checkpoint: lower right hand of display a star will appear indicating unit is in accustar mode. If star switches to a DT, clean the mirror.

The ACCU-STAR mode balances the optics, checks the clean mirror condition, if these two conditions are met unit goes into operate. If the mirror is dirty, it will try to clean it automatically, if it fails to clean mirror twice the DT letters will appear in the lower left of the display. After two cycles of cleaning, unit goes into operate mode.

If it is in operate mode and has found a stable dew point, then the letters OK will appear in the lower left of the display.

Cleaning Mirror
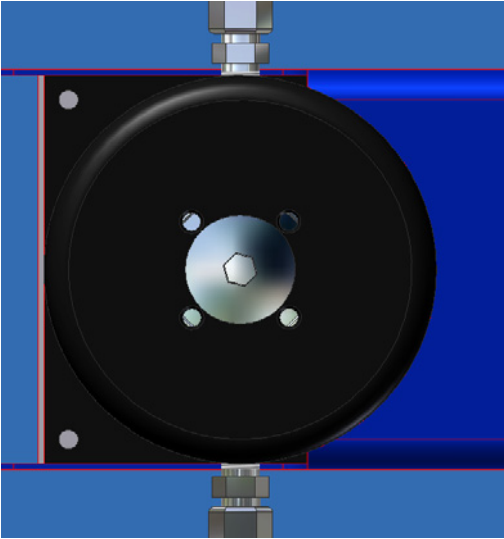
Power down

Unscrew sensor cap

Using cotton swab and cleaning solution (provided in the MC Kit), wipe mirror with the wetted end of the cotton swab, dry mirror with the other end of the cotton swab.

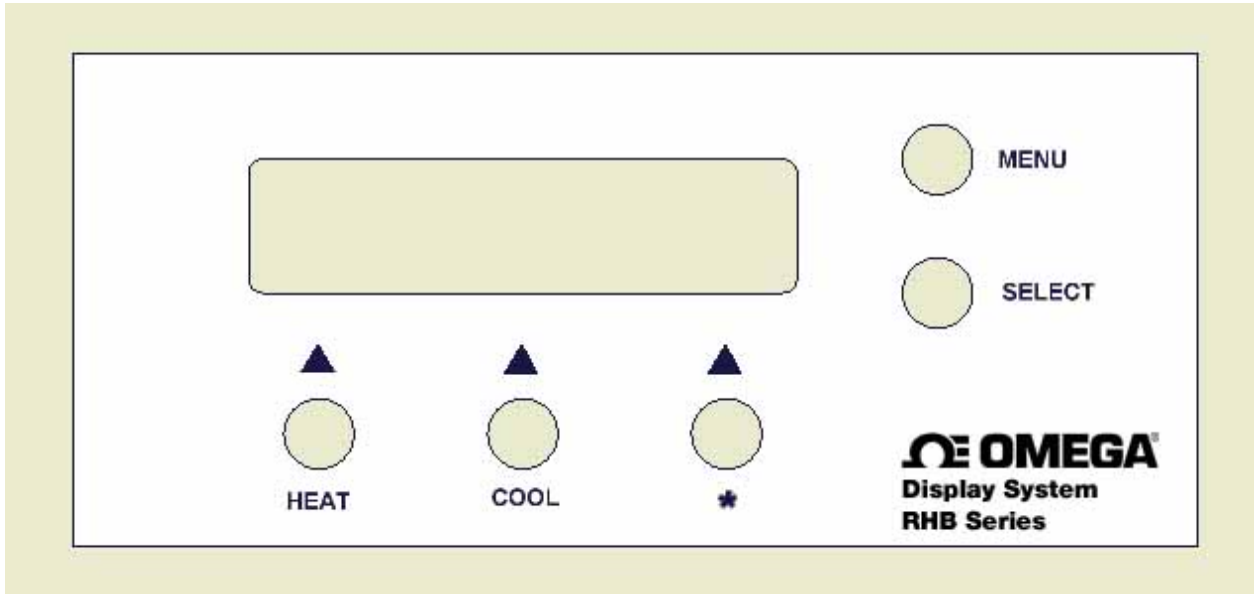Power unit up and unit will rebalance.

Alternate procedure:

Push heat button,

Using cotton swab and cleaning solution (provided in the MC Kit), wipe mirror with the wetted end of the cotton swab, dry mirror with the other end of the swab.

Push * button. Unit will rebalance.

Menu

Overview:
To scroll forward through the menu items, press the menu button. To scroll backwards, press cool. When you see the menu item that you want to change, press select. The existing setting or units will appear. To scroll forward through the setting or units, press the menu button. To scroll backwards, press cool. When you see the setting or units that you want, press select.

To set numbers, scroll up or down using the up or down keys (heat or cool), the increment can be changed using the incr key (*). In all cases, when the setting is as you like it, press select.

Main menu choices:
Units Line 1
>Selects the Units for top line of display

Units Line 2A
>Selects the Units for second line of display

Units Line 2B
>Selects the Alternate Units for second line of display, quick switch by pressing select while the unit is operating.

Units Output 1
>Selects the Units for Output channel 1,
>>Set the LO range (0 volt, 4mA) using the number select procedure.
>>Set the HI range (5 volt, 20mA) using the number select procedure.
>>>Select Analog or Alarm mode.

Units Output 2

Selects the Units for Output channel 2,

Set the LO range (0 volt, 4mA) using the number select procedure.
Set the HI range (5 volt, 20mA) using the number select procedure.

Select Analog or Alarm mode.

Units Alarm

Selects the Units for the Alarm,

Set the LO range (alarm open) using the number select procedure.
Set the HI range (alarm closed) using the number select procedure.

Note: Outputs and alarms can be set normal or inverted. When the HI value is lower than the LO value the analog scaling is inverted. For alarms the range of values between the HI and LO values is the hysteresis or dead band, for analog outputs it is the linear range.

Units Comm Port

Selects the Units to be output on the COMM port,

Scroll through the Units and press either include or exclude to decide which units are sent to the COMM port.

Accu* Set up

Set the time interval between automatic ACCU*s.

Select track to have the progress of the ACCU* tracked on the display and outputs.

Select hold to have the last reading held until the ACCU* is over.

Scale Pressure

Set the LO range (4mA) of the pressure sensor in kPa, using the number select procedure.

Set the HI range (20mA) of the pressure sensor in kPa, using the number select procedure.

Note: pressures are absolute. Also if you do not have a pressure transducer, you can enter local atmospheric pressure as the LO and some higher pressure as the HI. This will then use local pressure in pressure based calculations.

Set Mol Wt

Set the Molecular weight of the gas you are measuring using the number select procedure.
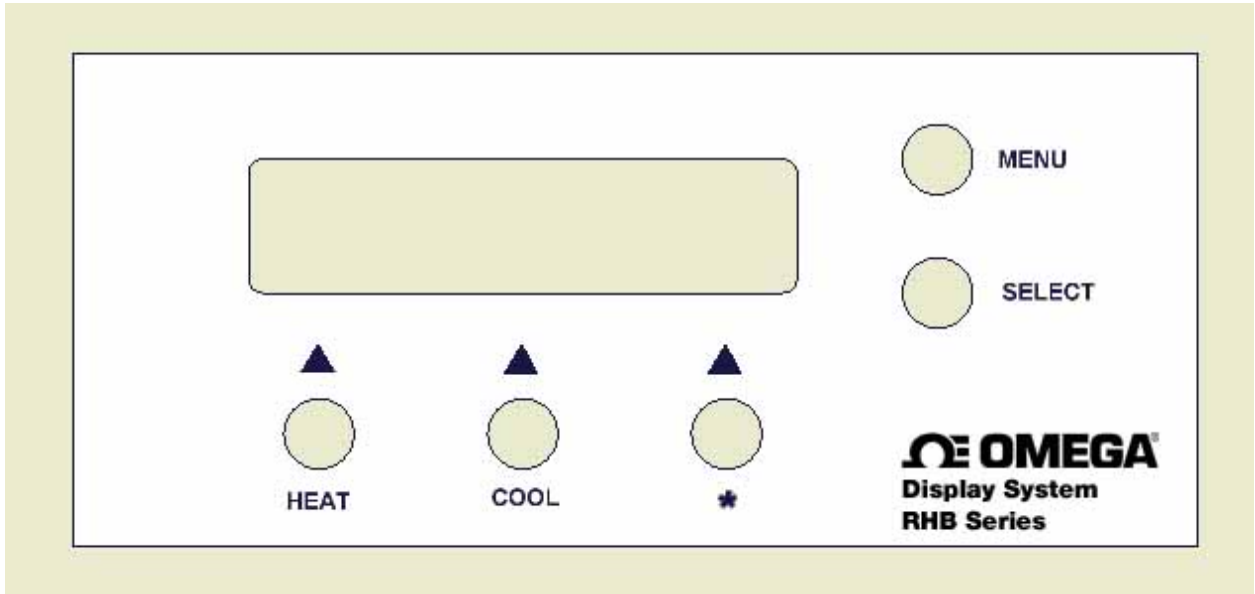
Set Average

Set the number of points to average over.
Note: Averaging is only applied when the unit is stable at the dew point.

Non SI Units (Sensor)

Include or exclude Non-SI sensor units from the units scroll.

Display/Sensor Controls

When in operation, the second line of the display can be toggled between units 2A and 2B by pressing the select button.

When the Monitor is running, measurements are shown on the left side of lines one and two of the display. The right hand edge of the display is used for status indication.

Line one status can be clear or show an "A" if the alarm is active.

Line two status can show clear, OK, DT, *, H, C or X

OK shows that the sensor is stable and at the dew point.
DT means that the last ACCU* failed to clean the mirror properly, see mirror cleaning procedure.
"*" means that the unit is in ACCU*
H shows that the sensor has been manually placed into heat.
C shows that the sensor has been manually placed in maximum cool.
X shows that the sensor heat pump has been manually turned off.

To manually place the sensor into heat, press the heat button until the word HEAT appears. This is done to clear the mirror of dew.
To manually place the sensor into cool, press the cool button until the word COOL appears. This is done to cover the mirror with dew.
To exit either heat or cool, press the same button again.

To manually place the sensor into ACCU* press the star button.

To shut down the heat pump, press heat, until the word HEAT appears, than press cool until OFF appears.
To reactivate the heat pump, press either heat or cool until ON appears.

Electrical connections to the display module

+12V
GND
Dout
Din
CLK
Lock
Lock
N/C
RS-232
ALM
ALM
Iout1
Vout1
GND
Iout2
Vout2
GND

The Cable to the Sensor chassis plugs in here.
To make your own longer cable, connect
with the terminals on the chassis. Make sure that the
Dout (Data out) from the chassis goes to the Din (Data in)
Of the display module, and vice versa.

When the lock pins are shorted together the buttons on the display are active.
If the shorting plug is removed, the module is locked.

Plug into the 9600 Baud RS-232 port here using the 9 pin to stereo adaptor cable
included with RHB-4.

Alarm terminals, 300 V AC/DC, 100 mA max, opto isolated MOSFET relay.

4-20 mA source for channel 1
0-5volt output channel 1
0-5 volt or 4-20 mA return
4-20 mA source for channel 2
0-5volt output channel 2
0-5 volt or 4-20 mA return

The optional output alarm isolator module connects to the $I_{(out)}, V_{(out)}$ and $G_{(nd)}$
terminals of either output 1 and(or) 2 to provide (an) additional alarm(s).

Electrical connections to the sensor chassis

N/C N/C N/C	Reserved for future use, do not connect.
- CLOCK - DATA IN - DATA OUT - GND + 12V OUT	The Cable to the Sensor chassis plugs in here. To make your own longer cable, connect with the terminals on the chassis. Make sure that the Dout (Data out) from the chassis goes to the Din (Data in) Of the display module, and vice versa.
PT 4-20 SRC ⎤ PRES PT 4-20 RTN ⎦	Connect the + terminal of Pressure transducer here, (4-20mA V+) Connect the - terminal of Pressure transducer here, (4-20mA V-)
SHIELD	Connect pressure transducer and/or Temperature sensor shield here.
SOURCE ⎤ HI SENSE ⎥ AIR TEMP LO SENSE ⎥ RETURN ⎦	Connect two wires from same side of 100Ohm PRT here. Connect two wires from other side of 100Ohm PRT here.

RS232 Connection

Connecting and using the Monitor RS-232 output

The Monitor includes an RS-232 output on the Display Module. The RS-232 port is a 3.5mm round connector which can be used with the cable supplied with your unit.

The choice of information transmitted is selected from the menu on the display module, and can include any combination of humidity, temperature or pressure units available from the system. In addition the RS-232 port will send a status word including information about the control status, mirror cleanliness, and any buttons that have been pressed, and lastly the hours left until the unit enters an ACCU self cleaning cycle. The data is sent in a CSV format (comma separated variable) which can be imported directly into many software packages such as Microsoft Excel.

The data is transmitted at 9600 BAUD, 8 Bit, 1 Stop Bit, No flow control, no parity. Any Microsoft Windows (version 3.11 and up) based system with a serial port can access this data using a standard program included in Windows called HyperTerminal. This is generally found in "windows\accessories\communications". Please refer to your

computer help files for the correct configuration of your computer serial port. After your computer is correctly configured you will see a data stream such as:

```
C DP= 32.3607  ,PPMw= 32524.1328  ,gr/#= 227.6689  ,00001100 ,24.
C DP= 33.5534  ,PPMw= 34905.6015  ,gr/#= 244.3392  ,00001100 ,24.
C DP= 34.7088  ,PPMw= 37366.4843  ,gr/#= 261.5653  ,00001100 ,24.
C DP= 35.8230  ,PPMw= 39892.1250  ,gr/#= 279.2448  ,00001100 ,24.
C DP= 36.8813  ,PPMw= 42438.3515  ,gr/#= 297.0684  ,00001100 ,24.
C DP= 37.9010  ,PPMw= 45035.6250  ,gr/#= 315.2493  ,00001100 ,24.
C DP= 38.8769  ,PPMw= 47661.3281  ,gr/#= 333.6293  ,00001100 ,24.
C DP= 39.8022  ,PPMw= 50284.4218  ,gr/#= 351.9909  ,00001100 ,24.
C DP= 40.6960  ,PPMw= 52948.1953  ,gr/#= 370.6373  ,00001100 ,24.
C DP= 41.5535  ,PPMw= 55629.8671  ,gr/#= 389.4090  ,00001100 ,24.
C DP= 42.3635  ,PPMw= 58282.5390  ,gr/#= 407.9777  ,00001100 ,24.
```

The first part of each line transmits the units that you have selected.
The code 00001100 is the status code.
24 is the number of hours left before the next ACCU cycle.

The Status word at the end of the RS-232 string is a Binary word, (BIT7>> 00001100 <<BIT0)
Bit7=ACCU* button pressed,
Bit6=Heatpump OFF
Bit5=COOL ON
Bit4=HEAT ON
Bit3=System is in ACCU*
Bit2=Air Temp PRT OPEN or not Attached
Bit1=System IN CONTROL
Bit0=Dirty Mirror

Calibrating the Monitor analog outputs

The Analog outputs on the Monitor are both 0-5volts and 4-20mA outputs, on adjacent terminals for each output, (output#1, output#2, etc.). The ranges for the outputs may be set from the display, using the "SET OUTPUT(X)" menu. The 0-5 volt outputs are derived from an internal voltage reference and no calibration is necessary or possible. The 4-20mA outputs are derived from the 0-5volt outputs and may be calibrated at the 4mA and 20mA values.

To calibrate the 4-20mA output(x), first set the output(x) to a range where the output should be at 4mA such as DP C , LO= -100°C , HI= -120°C , Analog. With these settings the output should be at 4mA unless the dew point being measured is below –100°C. Then adjust the 4mA adjustment pot until the output is 4mA.

Next set the output(x) range so that the output should be 20mA, such as LO = -120°C and HI= -100°C. This should generate 20mA unless the dew point is below –100°C. Then adjust the 20mA adjustment pot until the output is 20mA.

The output adjustment pots are found on the display module. They are labeled as follows.

Output #1 4mA, R33 Output#1 20mA, R32
Output #2 4mA, R21 Output#2 20mA, R19

The last pot, R1 is used to adjust the display contrast.

Final Calibration

Final Calibration is a test for accuracy where the unit under test is compared against a NIST transfer standard at a number of different dew points/frost points. A dew point/frost point generator will create a desired dew point/frost point and will provide a sample flow at 1L/min to the units under test and the transfer standard. Typically, the units will be connected in series but should be connected in parallel when testing more than one unit.

A typical set of test points for a 2 stage dew point monitor is: 15°C, 0°C, -20°C,-30°, -40°C but can be customized to its application.

The only adjustment that can be made during final calibration is the cleaning of the mirror and the display unit will indicate if the mirror is dirty by blinking the letters 'DT'. See the section (page 7) on cleaning the mirror.

RHB-3 (2-stage) and RHB-4 (3-stage) Measurement Range

Legend:
- Dry Bulb
- 2 Stage
- 3 Stage

X-axis: Ambient Temp (°C)
Y-axis: Measurement
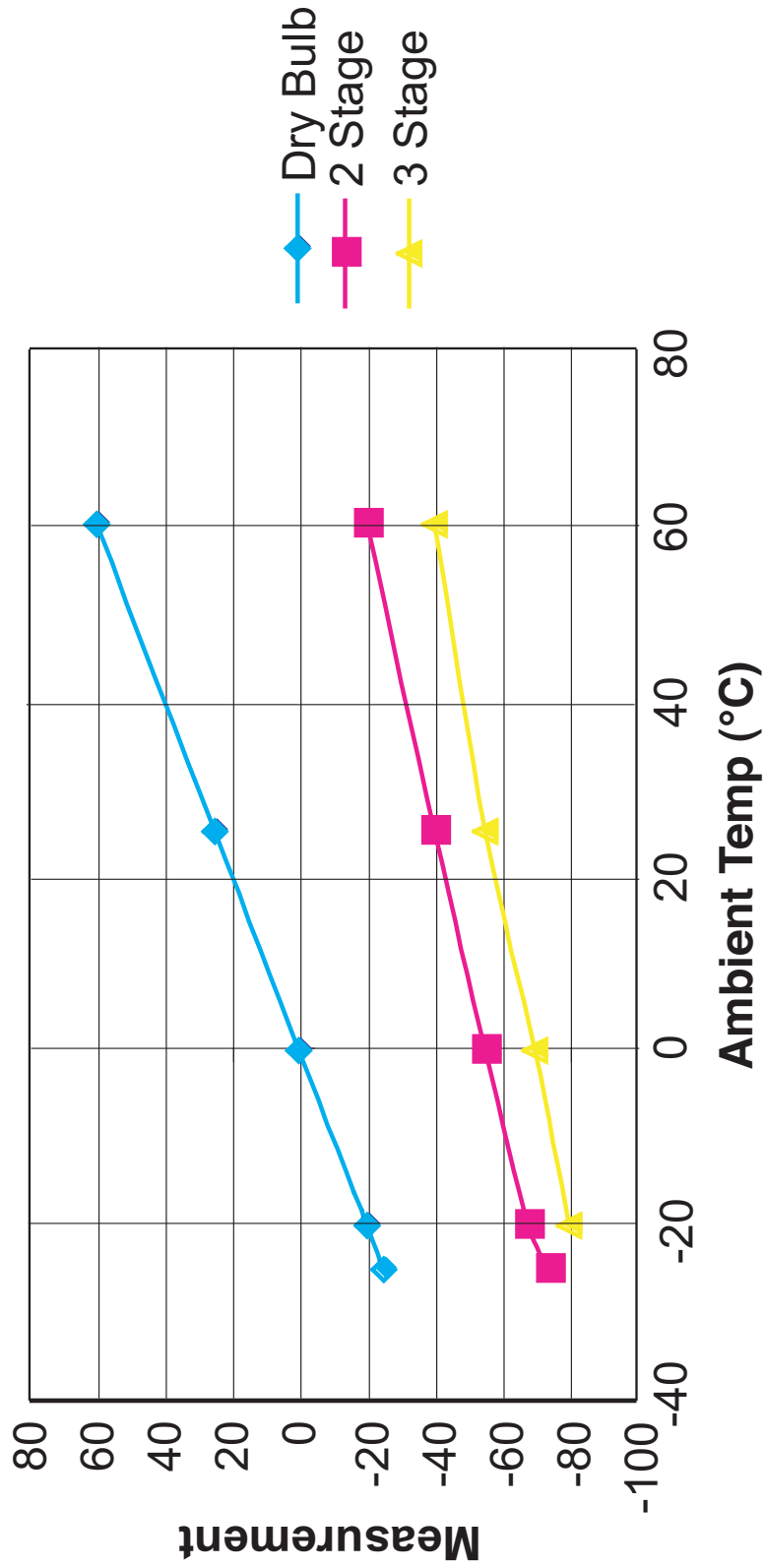
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FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

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.

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