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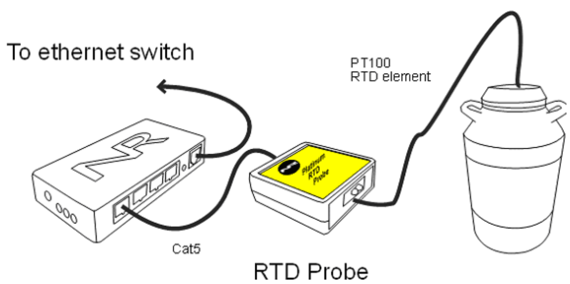
Resistance Temperature Detector Probe, RTD-1 (#30014)

The Networked Robotics Platinum RTD Probe collects temperature data from extreme sources such as liquid nitrogen or high-temperature ovens via standard computer networks. The probe is used in conjunction with the Networked Robotics NTMS (Network Telemetry Monitoring System) hardware and Networked Robotics' Tempurity™ System software. The Tempurity System is designed for data collection and monitoring in FDA-regulated environments including pharmaceutical, medical, and food industries.

TEMPURITY
AUTOMATED TEMPERATURE MONITORING SYSTEMS BY NETWORKED ROBOTICS



Description

Networked Robotics' Platinum RTD probe enables the remote monitoring of extreme temperatures, between -200 and 600 C, via standard computer networks. The unit is used with a 100-ohm platinum (PT100) 3-wire RTD element with an alpha=0.00385 curve that is shipped with this product. There are also a variety of commonly available compatible PT100 resistive temperature devices with varying ranges and other performance characteristics that will be usable with this device.

Packing List

This package includes the basic hardware you will need to connect the Resistance Temperature Detector (RTD) probe to the NTMS.

- (1) Resistance Temperature Detector Probe, RTD-1
- (1) CAT5E cable, RJ45 to RJ45
- (1) A PT100 .00385 resistive temperature detector element
- (3) Suction cups (some shipments)

Hardware Installation

There are three major steps in the installation of this hardware:

1) Physical installation
2) Configuration of the Networked Robotics NTMS hardware
3) Manual testing of data collection via the network

Each of these steps should be performed successfully before attempting to configure continuous real-time network data collection via the Tempurity System. Detailed information on configuring this monitored device through Tempurity is available in the Tempurity Systems User's Guide (Networked Robotics document number "Tempurity-04-0006.5") on the Networked Robotics web site.

1. Physical Installation

Plan the Installation

Determine the best location for the PT100 RTD element inside the unit. In liquid nitrogen cryofreezers the probe can be used in either the liquid or vapor phases of freezer. The placement of the sensor element, especially the vertical position, inside the monitored device can have an effect on the reading.

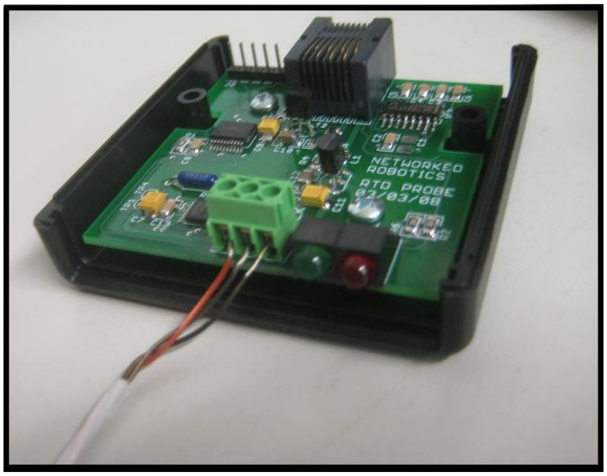
The RTD Probe electronics can be located as far as 100 meters from the Networked Robotics NTMS network hardware and connections are easily extendable with CAT5 cable couplers. You may wish to install the Networked Robotics NTMS hardware in a network closet, and then "patch' to the RTD Probe electronics via your company's network cable plant.

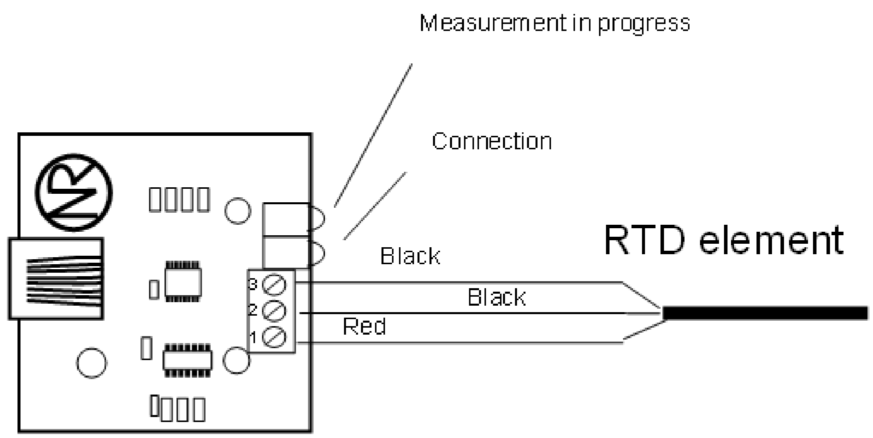
Attaching the PT100 RTD

In most cases the RTD element is shipped already attached to the RTD Probe electronics. If not, or if you want to use your own RTD you will need both a small Phillips-head, and a small flat-blade screwdriver for installation.

First turn the unit over and remove the two screws on the back, which hold the case together.

Next locate the green screw terminals at the bottom of the board. This is a three-position screw terminal. You need to feed the element wires through the cutout in the case end-panel before connecting the wires to the terminals.





Resistance Temperature Detector (RTD) Probe

Most PT100 devices will have pre-stripped wires. If not, strip approximately ¼" of insulation from the end of the wire.

Attach the red wire of the resistive temperature detector to the screw terminal labeled RED on the RTD board. This is the leftmost pin when facing the LEDS.

Attach either black wire of the element to one of the screw terminals labeled BLACK on the RTD board. This is either the center or rightmost pin when facing the LEDS.

Attach the other back wire of the element to the last screw terminal labeled BLACK on the RTD board.

Insert the wires into the screw terminal as shown in the figure above and tighten down with a small flat head screwdriver. If the RTD element has a shield, or extra conductors, do not connect them to the RTD Probe electronics.

Replace the cover and its screws. Then use the provided CAT5E cable to connect the RTD to any of the four measurement probe ports on Networked Robotics' NTMS network hardware. If needed, you can use a longer length of CAT5 cable. The maximum distance, however, should not exceed 100 meters.

Using Suction Cup Mounting in Cryofreezers

In larger cryofreezers the RTD element may be secured in place to the interior, in the vapor phase of the cryofreezer by using the included suction cups.

Create a mixture of 80% glycerine and 20% tap water. Dip the suction cup in the solution and apply to the interior, vapor phase, wall of the cryofreezer using a gloved hand. YOU MUST USE GLOVES DESIGNED FOR LIQUID NITROGEN USE WHEN PERFORMING THIS PROCEDURE.

Repeat using other suction cups to place the RTD element in the desired location. Run the RTD element through the channels in the suction cups.

Do not attempt to attach the RTD element to the wall directly.

The suction cups will come off once the freezer is warmed and will need to be reattached once the freezer returns to near liquid nitrogen temperature.

Verifying Connections
If the NTMS is powered up, and the CAT5E cable connection is made correctly between the RTD and the NTMS, the green LED on the RTD will illuminate. The red light will blink quickly ten times.

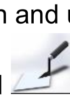
The green LED indicates that the unit is connected to the NTMS. If the NTMS measurement port is configured properly the red light will blink on and off at approximately 10 second intervals. The blinking of the red light indicates that a measurement has been made. The RTD Probe is capable of reporting new temperatures after each time that the red light is activated.

Secure the RTD Probe electronics to a convenient location using the dual-lock provided on the back. The dual-lock sticks best to metal or plastic surfaces. It may not adhere as well to surfaces such as drywall or wood, or to porous materials such as concrete.

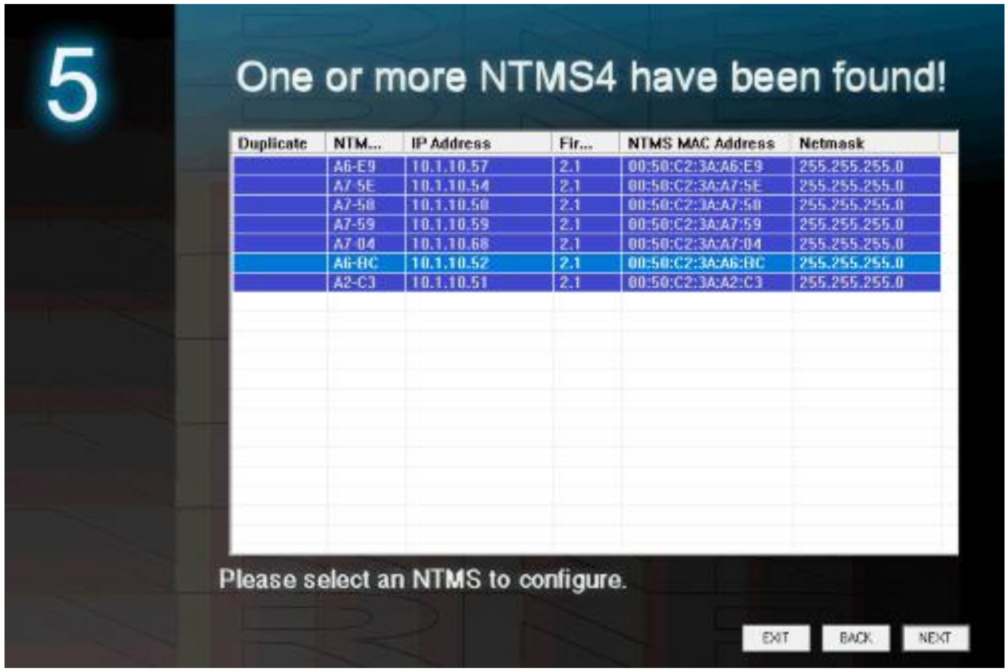
2. Configuring the NTMS Physical Port for the Appropriate Data Collection Type

Configure your NTMS network hardware for data collection from this type of instrument.

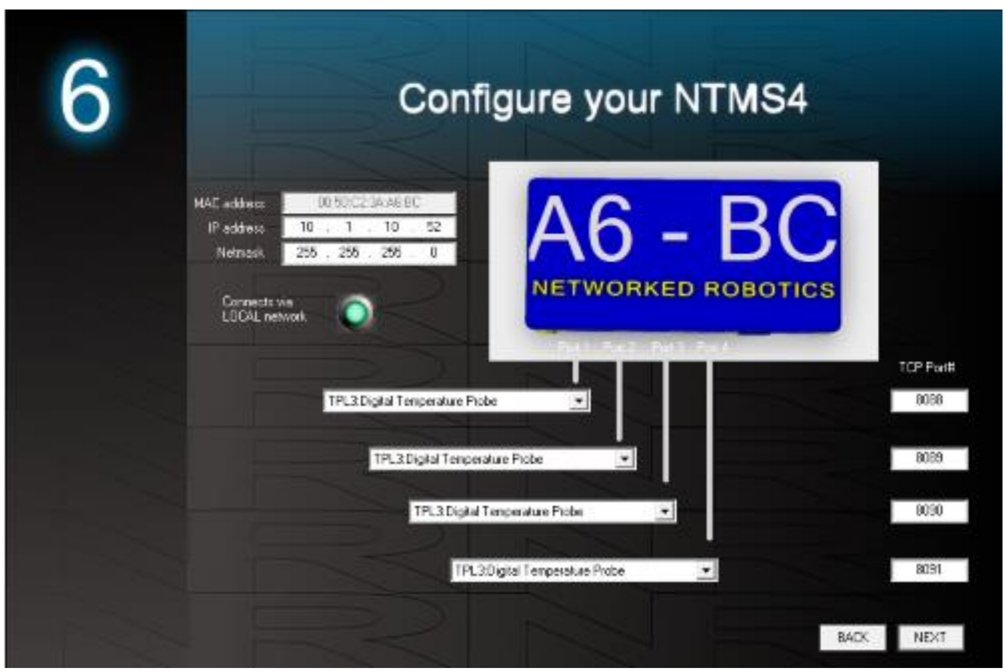
This is done by running the latest version of the NTMS Configuration Wizard  from any PC that is on the same subnet (behind the same router) as the NTMS to be configured. You can obtain the configuration wizard from the “download” section of the Networked Robotics web page. New sensor and interface types are being added periodically to the wizard so the screens below may change.

1. Run the wizard and verify that the NTMS to which the interface is attached is discovered. This NTMS must be running firmware revision 2.0 or higher. If it is not, stop the installation and upgrade your NTMS hardware’s firmware with the NTMS Upgrade Wizard  available from the Networked Robotics download-page. There are special precautions needed when upgrading an NTMS running firmware version 1.x to firmware version 2.0 or higher.

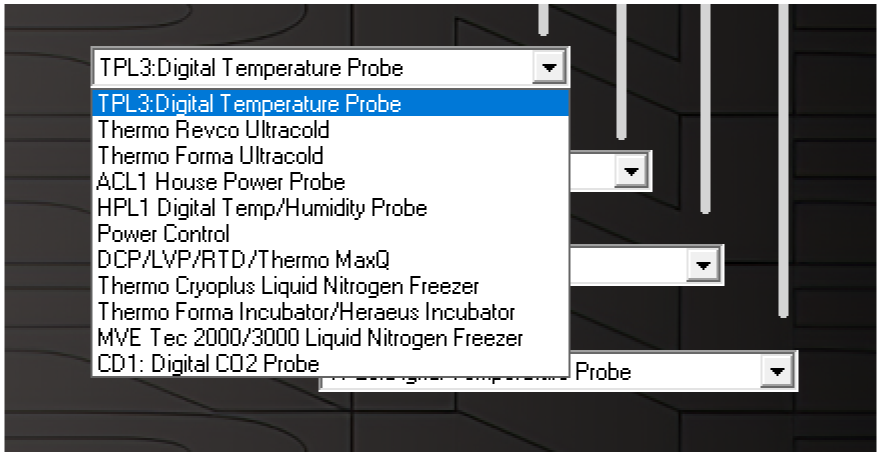
2.



3. Select the NTMS to which the interface is attached and proceed to the "NEXT" screen. (IP addresses must be set properly for your institution. If you are uncertain about the IP address to use, check with your network administrator.)



4. Click on the drop-down for the physical port on the NTMS where the probe is connected, and under the “Device Type” drop down, select DCP/LVP/RTD.



3. Testing Data Collection through the Network

Once the configuration is complete, we recommend manually testing the ability to make network temperature measurements by using the common “Telnet” utility. This can be done from any networked computer with access to the NTMS network hardware.

Telnet is included with Windows but you may need to activate it. On Windows 10 and 11 computers activate the Telnet utility as follows: 1 Start 2 Control panel 3 Programs 4 Turn Windows Features on or off 5 Check “Telnet Client” 6 Click Ok

1. From the Windows Command Prompt. On some Windows versions click the Windows key (start), then type “CMD”, and then click on the command prompt.

2. At the black screen type “Telnet*”* + *IP Port* (where *IP* is the IP address and *Port* is the network port address (e.g.8088) as selected by your use of the NTMS Configuration Wizard in screen 6 as described above.)

   For example ”Telnet 10.1.200.3 8088”

3. If you are successfully connected through the network you will see a blank screen.

4. Type a capital “T” the command character for this probe. A temperature and the associated checksum value should be returned.

Failure to connect indicates a network problem. An "error" message indicates a problem in the connection at the instrument. If a temperature is not returned, check network parameters, network ports, firewalls and connections and try again. It is best to confirm successful network data collection using Telnet before attempting to configure data collection in the Tempurity System.

For more about debugging network connections to probes see the appendix of the Tempurity System User's Guide.

Operation

During normal operation, the green LED on the RTD Probe will be on. The red LED will occasionally blink. The blink indicates an active temperature read by the NTMS. If the red LED does not blink periodically this is an indication that the configuration of the NTMS port is not correct for an RTD Probe, or if both lights are out, then the connection to the NTMS is lost and the cables or NTMS status (is the power unplugged?) should be checked.

Temperature reads are made at approximately ten second intervals. The Tempurity System reports the last-read temperature of the RTD to the Tempurity Server upon request.

Reference

Unique IDs

All Networked Robotics hardware holds electronic globally unique IDs. RTD Probe IDs are of the format:

08:0000:0000:0002

Where 8 indicates the product number, and the other characters indicate the electronic ID of the unit. Electronic IDs can be read through USB connection to a Windows computer using the Networked Robotics "Digital Probe Calibration Programmer" (Part number #30010) hardware.

Communications Specifications

The RTD communicates with the NTMS using RS-232 at 1200bps.

On the NTMS RJ45 jack the pins used are: 4 ground, 5 transmit to the RTD Probe, 6 send from the RTD Probe.

Electrical Specifications

The RTD Probe derives its power from the regulated 5 volts DC supplied by the Networked Robotics NTMS hardware, so no external power supply is required.

Physical Specifications

Weight:	59 grams (2.1 ounces)
Length:	67.22 mm (2.647 inches)
Width:	66.22 mm (2.607 inches)
Height:	28 mm (1.102 inches)

Support

If you need assistance with your RTD Probe or other products, contact Networked Robotics by phone at 877-FRZ-TEMP (877-379-8367) or by email at support@networkedrobotics.com

Appendix: Accuracy Discussion

The RTD-1 unit is designed to never require adjustment. This means, however, that there are sources of error for which there is no hardware compensation. The Tempurity System allows correction factors via the Tempurity Software.

ADC Noise

The RTD-1 unit uses a 24-bit Delta-Sigma ADC from Analog Devices (AD7793), which is specifically designed for instrumentation applications. It includes an on-chip low noise instrumentation amplifier that allows small signals to be interfaced directly to the ADC. It does, however, still have noise which results in an error range of approximately +/- .01 degrees Celsius.

The ADC Reference Resistor

The 24-bit ADC uses a .1% precision 4.99Kohm reference resistor. This resistor can be as much as 5 ohms high or low.

If the RTD has a resistance of 100 ohms (about 0 Celsius), one would expect the raw ADC reading to be 1,344,867. Because of variation in the reference resistor, the ADC may actually read anywhere between 1,343,521 and 1,346,216. This results in the resistance measurement being anywhere between 99.900 and 100.100 ohms. This yields a potential error in the measured temperature of -0.26 to +0.26 Celsius. This range of uncertainty increases as the temperature goes up and the resistance of the RTD Probe increases.

The RTD

RTD which comply with DIN-IEC Class B have an intrinsic error of +/- .012%. At 0 degrees Celsius, this results in a resistance range of +/- 0.30 ohms and a temperature range of +/- 0.3 Celsius. As the temperature changes, the range increases as shown:

Temperature (Celsius)	Ohms	Degrees
-200	+/- 0.56	+/- 1.3
-100	+/- 0.32	+/- 0.8
0	+/- 0.12	+/- 0.3
100	+/- 0.30	+/- 0.8
200	+/- 0.48	+/- 1.3
300	+/- 0.64	+/- 1.8
400	+/- 0.79	+/- 2.3
500	+/- 0.93	+/- 2.8
600	+/- 1.06	+/- 3.3

The Callendar-Van Dusen Calculation

The Callendar-Van Dusen Calculation is used to determine temperature value based on the resistances of the element. The internal calculation is switched from 5th order negative function to a positive function at 80 ohms or about -50C, where temperatures under this value are using the 5^{th} order negative function. See the Analog Devices (AD7793) documentation for more information.