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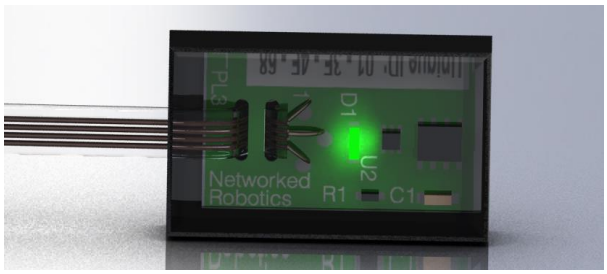
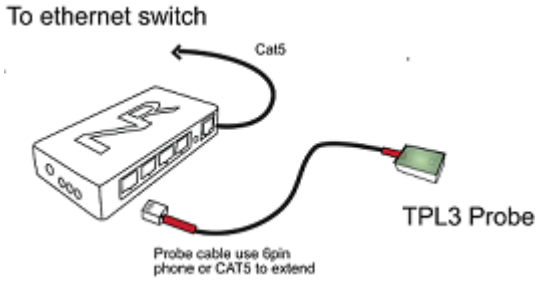
Digital Temperature Probe TPL3 and TPL3U with Internal Calibration (#30002 and #30012)

The Networked Robotics TPL3 digital temperature probe is used with Networked Robotics' NTMS (Network Telemetry Monitoring System) hardware and Networked Robotics' Tempurity™ System software. The Tempurity System is engineered for data collection and monitoring in FDA-regulated environments including the pharmaceutical, medical, and food industries.





Description

TPL3-series digital temperature probes are designed for regulatory use. Each probe contains a permanent and electronically readable unique ID which is displayed in the "window" of each probe. Probes are color-coded by the last hexadecimal digit of this electronic ID. Calibration information such as the date last calibrated and an empirically-determined offset can be programmed into the probe and read electronically.

National Institute of Standards and Technology-traceable-calibrations are available as an option from Networked Robotics and must be ordered separately. New probes ordered with this option are shipped with stored internal calibration data.

Probes are waterproof and can be used between -80º C and +120º C. The ultra-thin and low-temperature wire minimizes any disruption of freezer door seals. An on-board microprocessor-controlled LED indicates the status of the probe for network data collection. This LED is a logical indicator of network data collection rather than an indication of power status.

Packing List

This package includes the hardware you will need to connect the TPL3-series digital temperature probe to Networked Robotics' NTMS network hardware and to the "monitored device".

- (1) TPL3-series digital temperature probe (color coded)
- (1) RJ-45 Coupler for extensions (may be color coded)

Versions

The TPL3 version of the probe is most commonly used in standard refrigerators, freezers, and rooms. The TPL3U version are most commonly used in ultracold (-80º C) freezers. The electronics in both versions are equivalent. The differences are physical - in the wire and in the method of attachment:

-TPL3U version probes (Product #30012) utilize low-temperature wire and attach via a suction cup.

-TPL3 version probes (Product #30002) utilize -40 to 100º C wire, and if used independently, without a glycerine cell, attach via dual-lock.

Installation

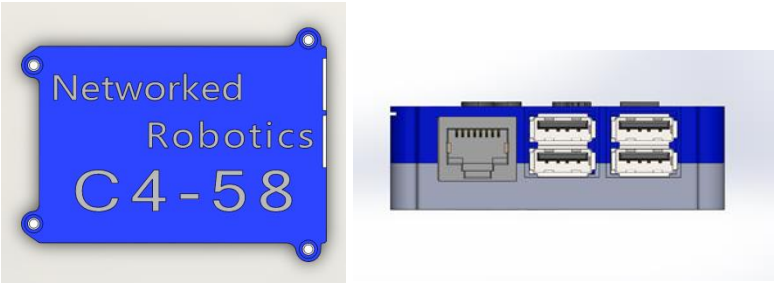
There are three major steps in the installation of this digital sensor for network data collection:

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

Each of these steps, especially manual testing through the network, as described below, should be performed successfully before attempting to configure real-time data collection via the Tempurity System. Detailed information on configuring this monitored device through Tempurity is available in the Tempurity System's User's Guide which is available on the Networked Robotics web site.

Connecting to the Networked Robotics NTMS4p Version

This product can be networked with either the NTMS4i or NTMS4p versions of Networked Robotics' network hardware. An adapter (Networked Robotics product #30034) is needed to connect the probe to the NTMS4p version which is shown below.



The adapter is connected to any of the four USB ports on the NTMS4p. The TPL3-series phone-style connector is plugged into the adapter. The NTMS4p supports wired or wireless data acquisition.

Glycerine Cells

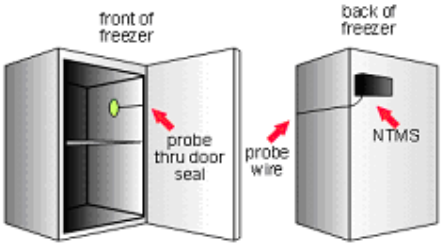
Optional glycerine cells (Networked Robotics product numbers #50001 and #50003) are custom-designed for use with our TPL3 digital temperature probes. Glycerine cells stabilize temperature readings. They are useful for companies that are required to use glycerine to either meet the specific regulatory requirements for their industry or to match the thermal mass of their stored material. Product #50001 (35 ml) is shown below. Installation instructions are found in Networked Robotics' "Glycerine Cells for TPL3 Probes" manual which is available on our web site.

1. Physical Installation

Attaching a TPL3 Probe to the Inside of a Refrigerator or Freezer

Select an appropriate position for the probe inside the monitored device. Some regulatory rules, including vaccine standards, recommend a given position such as in the center of the freezer. Consult the regulatory rules that apply to your laboratory or material. Some regulated or highly sensitive customers will wish to perform detailed freezer mapping studies in order to select the most appropriate probe location.

Networked Robotics recommends that probes be positioned ¼ of the way from the top of a refrigerator or freezer and about one foot deep on the door-hinge side wall. Placing the probe on the hinge side reduces the degree of fluctuation in temperature measurement caused by opening the door. (The use of Networked Robotics' glycerine cells is the best way to reduce fluctuations in readings.) Higher placement will usually result in a warmer reading. In a standard-size upright refrigerator a gradient of 4 degrees is common between the top and the bottom of the unit.



1. Ensure that the freezer wall is dry. If frost or condensation has built up on the wall, use a warm, gloved hand, and a paper towel to dry any moisture.
2. Insert the probe through the hinge and secure the TPL3 to the monitored site using the dual-lock® provided on the back. The dual-lock sticks best to metal (except aluminum) and plastic surfaces. It may not adhere as well to surfaces such as drywall or wood, or to porous materials such as concrete.

Probes are waterproof and can be submerged in either Networked Robotics' glycerine cells or in water if needed.

Attaching the TPL3U Probe in an Ultracold Freezer

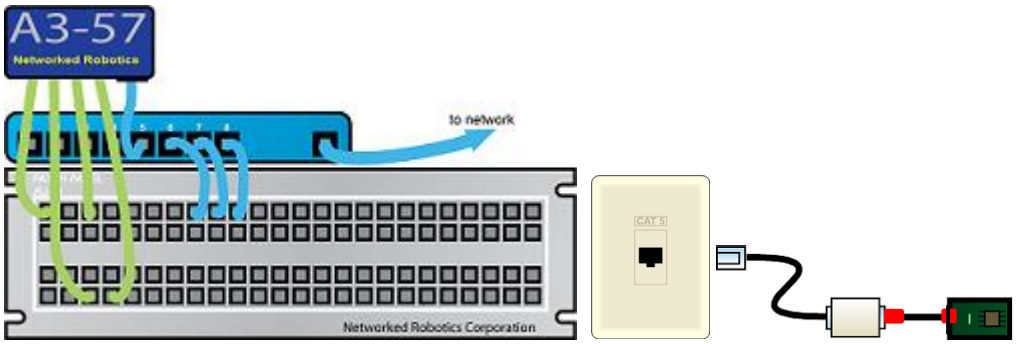
The harsher temperature of an 'ultracold' (-80º C) freezer asserts high mechanical stress on the wire of a TPL3U probe. In ultracolds, which often have both an exterior door and compartmental doors, the position of the probe and lead installation should seek to minimize mechanical stress on the lead.

1. Clear off any frost at the location of attachment.
2. Dip the suction cup of the TPL3U probe in hydrated glycerine. You should use 80% glycerine 20% water. Do not use pure water for this procedure as a water-dipped probe will not adhere to the wall. Use gloves. It's important to ensure that your hand is not touching any glycerine solution during this process.
3. Press the glycerine-soaked suction cup against the wall of the ultracold.
4. Hold briefly, up to about 20 seconds, until it freezes. If the probe does not adhere within seconds of application in a freezer at -70º C or below, you may wish to dilute the glycerine solution with water and try again. The frozen glycerine provides a very high bond and the suction cup will be difficult to remove without the application of heat.
5. Attach the probe to the suction cup.

Using Your Building's Network Wall Plates

In offices or laboratories that are well-populated with free network jacks you can measure temperatures through your building's CAT5 infrastructure. Using this installation method, NTMS units are mounted on rack hardware in a network closet as shown. Each digital temperature probe and thus each freezer are patched to the NTMS via the RJ-45 jack in the network wall plate.

Using this method and short versions of the TPL3 it is easy to implement room temperature monitoring in every room of a building as long as the wall plate infrastructure is available.



network closet wall plate in room or lab

Extensions and Length

Probes can be extended to 300 feet from the Networked Robotics NTMS network hardware. Use the included RJ-45 coupler as shown in the figure above and standard CAT5 network cable or 6-pin phone cable. Standard lead length is 10' however 2" versions are available that are useful for room temperature or for very long extended runs of cable.

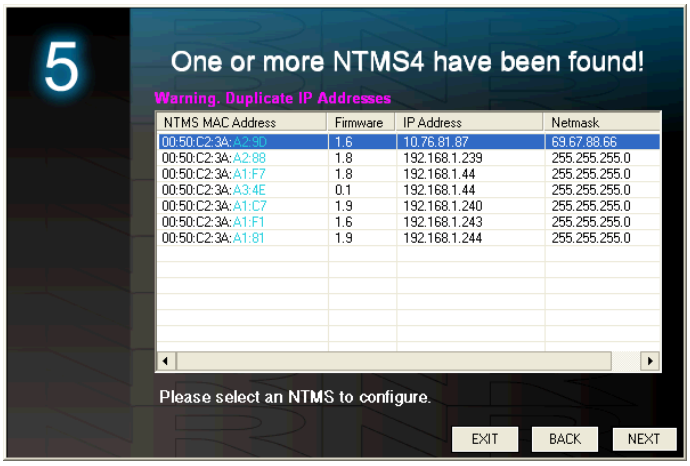
You can also shorten probes easily if needed with common telecom equipment (see the reference section of this manual on "Reattaching an end connector").

2. Configuring the NTMS for Data Collection

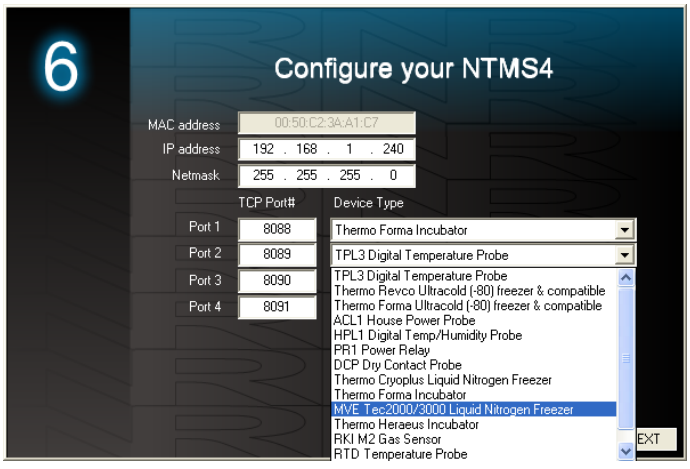
Configure your NTMS network hardware for data collection from this instrument. This is done by running the latest version of the NTMS Configuration Wizard from any PC that is on the same subnet as the NTMS to be configured. You can obtain the configuration wizard from the "download" section of the Networked Robotics web page.

See http://www.NetworkedRobotics.com\download\. New interface and sensor types are being added periodically to the wizard so the screens below may change.

1. Run the wizard from the same local area network as the NTMS and verify that the NTMS is discovered. (NTMS hardware must be running firmware revision 1.6 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 at the link above.



2. Select the NTMS, and proceed to the "NEXT" screen.
3. Enter the correct static IP address and subnet mask for your facility.
4. Click on the NTMS measurement port where the probe is connected, and under the "Device Type" drop down, select the TPL3 temperature probe option.



5. Click "NEXT" to complete the NTMS configuration.

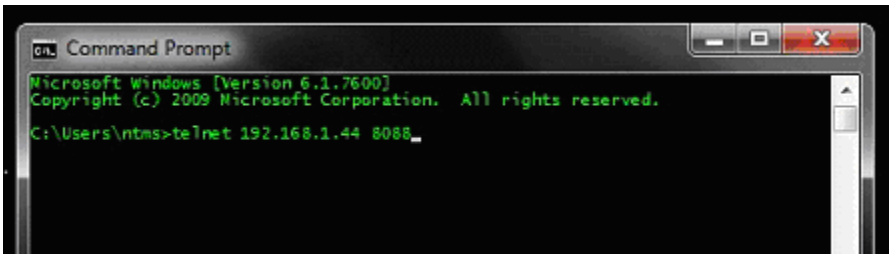
3. Testing Data Collection Manually through the Network

Once the configuration is complete, we recommend manually testing the ability to make network temperature measurements by using the "Telnet" utility from any PC. This commonly-used network utility sends simple network commands that will elicit a

temperature reading from the TPL3. For more about debugging network connections to probes see the appendix of the Tempurity System User's Guide.

On Windows 7,8, and 10 computers you may need to enable 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 "START", then "RUN", and then type "CMD" and return.
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.)



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.

If a temperature is not returned, check network parameters, network ports, firewalls and connections and try again before attempting to configure data collection using Tempurity System software.

Operation

Green LED State

When first connected, the TPL3's green LED will blink once on and off. This indicates that the probe has recognized that it is configured properly and is communicating properly with the NTMS network hardware.

The table below shows conditions where the green indicator LED of the probe is either on or off.

Condition	LED Status
NTMS network hardware is unplugged	OFF
Probe is not connected to the NTMS	OFF
NTMS port is set to device type other than TPL3	OFF
Probe plugged into wrong NTMS measurement port setting	Probably ON -depends on wrong port
Bad probe	Depends on probe problem
Tempurity Server or Monitor down	ON
Temperature out-of-range	ON

TPL3U probes may blink on and off slowly at times, especially in ultracold environments.

The NTMS port must be configured to "TPL3 Digital Temperature Probe" in order for the LED to light and for temperature data acquisition to occur. If a mismatched configuration

type (e.g. “Temperature of Revco Compatible Devices”) is selected, the probe LED will not be lit.

Timing

The NTMS network hardware continually reads temperatures from the TPL3. Each reading takes about 3 seconds. The most recent values are available for network-side requests by the Tempurity System.

85ºC Readings

Under certain circumstances the internal wires of the probe can touch in a way that will read either 0ºC, 85 ºC, or rarely 127.9ºC. Such a probe is likely to have intermittent mechanical problems where internal electrical connections are intermittently bridged. A probe that has been working for a long period of time and then shows these values is likely to be damaged. The most likely cause is mechanical stress such as contact with an often opening or closing door.

If you see these values consider replacing the probe. Inspect the probe along its entire length for breaks or damage. In some cases it may be helpful to recrimp the end connector. See the Reference section below for a link with instructions.

Electronically Stored Calibration Data

Calibration data can be read and stored using the latest version of Networked Robotics’ Digital Probe Calibration Programmer hardware (Product #30010) and a Windows computer. New calibration information can be rewritten each time the probe is recalibrated.

Electronically embedded IDs are permanent and cannot be changed (see reference section below).

The probe is capable of storing offsets between 12.7 and -12.7º C with .1 degree precision.

Calibration dates are stored as the month and year of calibration.

The error of the probe should never reach the probe’s maximum programmable offset. If you have a TPL3 that is showing a greater-than-allowable error, contact Networked Robotics for a replacement. The “performance” chart below indicates the distribution of accuracies at a given temperature in a population of TPL3 probes.

All Networked Robotics TPL3-series digital temperature probes shipped since 2004 are capable of storing regulatory data internally.

National Institute of Standards and Technology (NIST) – traceable documented calibration is available for this product for an additional fee. Networked Robotics’ calibration contractors utilize the full regulatory capabilities of the probe by storing calibration data internally in the sensor.

Reference

Communication

The TPL3 Temperature probe communicates with the NTMS via a one-wire protocol specific to Dallas/Maxim integrated circuits. NTMS pins used are: 2 vcc, 3 bidirectional data, and 4 gnd. Three of the possible four TPL3 wire strands carry signal. The fourth wire, if present, is not used.

Reattaching an End Connector

If you would like to replace an end connector, shorten the probe, or temporarily remove the connector for inserting the probe into an instrument with a tight door seal see our support page at:

http://www.networkedrobotics.com\support\Attaching the TPL3 Digital Temperature Probe End Connector.pdf

Electronically Embedded Unique IDs

All Networked Robotics TPL3-series digital temperature probes built since 2004 contain electronically embedded unique IDs. Newer probes display the unique ID in the probe's see-through window. All TPL3 models produced by Networked Robotics in any year contain an electronic ID whether or not the ID is visibly printed in the window.

Electronic IDs can never be edited or overwritten; they are embedded in the chip in the probe used to measure temperature by Dallas/Maxim® at the time of the chip's manufacture.

An example electronic ID is:

00 00 03 3F 44 09

This example ID would be displayed in the probe's clear window as "03-3F-44-09". The first two pairs of hexadecimal numbers (always 0s to date) are not printed.

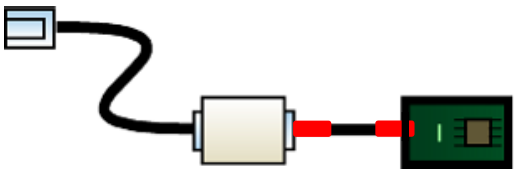
Because the ID is assigned by Dallas/Maxim the electronic ID is globally unique among all digital temperature sensors of any manufacturer utilizing this chip including those of Embedded Data Systems as described below.

Electronic IDs can be read using a Windows® computer using the Networked Robotics Digital Probe Calibration Programmer Unit (Part number #30010) via a USB connection.

Electronic ID and Color Coding

Probes are color-coded with up to 16 different colors in order to simplify installation, maintenance, and regulatory operation such as recalibration schedules. Probe colors correspond to the last hexadecimal digit of the electronic ID. Several colors may be used for more than one last digit. In older TPL3 versions IDs, "9", "A", and "2" are all blue, in newer versions each ID has a different version of blue.

Example: The electronic ID "00 00 03 3F 44 09" would be color-coded dark blue.



RJ45 couplers may be color coded

Colored mesh sleeving near probe head and end connector

Last Digit of Electronic ID	Color	Last Digit of Electronic ID	Color

0 Green 

1 Yellow 

2 Dk Blue and Black 

3 Brown 

4 Gray 

5 Orange 

6 White Silver 

7 Black Gold Silver 

8 Black 

9 Dk Blue 

A Lt Blue 

B Green and Black 

C White 

D Red 

E Red and Black 

F Purple 

Compatible Digital Temperature Probes

Digital temperature probes manufactured by Embedded Data Systems™ are compatible with the Networked Robotics TPL3 series and can be used with Networked Robotics NTMS network hardware. The Networked Robotics' Probe Calibration Programmer hardware (Product #30010) is capable of storing calibration data inside of the digital temperature probes built by Embedded Data Systems.

Physical Specifications

Probe head (ultra-thin wire, dual lock, and end connector not included unless indicated):

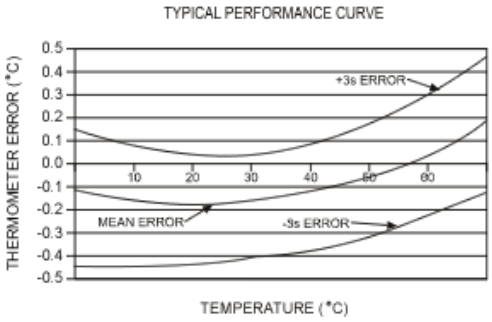
Weight:	8 grams (with dual lock)
Length:	3.17 cm
Width:	1.90 cm
Height:	0.70 cm

Dual Lock: 3M SJ3560 or 3M SJ4580

Suction cup diameter (TPL3U version only): 3.17 cm

Performance and Accuracy

The probe's digital temperature measurement capability is built around a Dallas/Maxim integrated circuit. The chip reports to .1 degrees Celsius and has a distribution of accuracies based on the temperature. The chip has an accuracy of about .1 degrees C at 37º C, and an accuracy of about 3 degrees at -80º C.



Support

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