



QUALITROL®

T/Guard 405™

**Fiber Optic Thermometer Systems
For Industrial & Power Transformer Applications**

**2- to 16- Channel Systems
OptiLink and OptiLink-II Software
With Modbus & Double-Calibration Support & Data Logging**

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Warning

Permanent damage may be done to the thermometer if the power supply connections are not done correctly. In particular, do not connect the power input (20-48 VDC) to any of the analog output connectors. Note that the 20 mA analog output options are self-powered interfaces (by opposition to loop-powered interfaces), and thus do not require any external supply. Maximum loop impedance should be kept at 400 Ω (current output); internal impedance is approximately 0.7 Ω (voltage output).

Fiber optic probes and extension cables are fragile, and will break if the bending radius becomes less than 1 cm, even temporarily. Furthermore, as T2 probe tips are fragile, exercise care to:

- **Make sure the last ~1 cm of probes is free standing, and not pressurized by any glue, or by the spacers**
- **Avoid bending the last 1 cm of probes.**

Furthermore, due to the unique construction of the Neoptix T2 type probes, it is important that you avoid applying glue to the last 1 cm of the probes during their installation in transformer windings.

Probe and extension cable breakages are not covered under the standard Neoptix warranty.

To assure cleanliness of optical connectors, keep caps on unused connectors at all time. This is also required during operation, as parasitic light entering via unused connectors into the T/Guard module may cause false temperature readings, even on other channels.

The Neoptix T/Guard products are CE marking certified.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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1.1 *T/Guard Family and Neoptix Probe Warranty Notice*

Your *T/Guard* unit (model 405) is guaranteed (Parts and Workmanship) for one full year from the date of purchase. Upon written notification of any defect, Neoptix will either repair or replace any faulty product or components thereof. A Return Authorization Number (RMA) must be obtained from Neoptix Canada LP or authorized distributor prior to any merchandise return.

Due to the unique nature of the fiber optic material that is used with the Neoptix Conditioner system, probes and extension cables are not warranted.

When using any electrical appliance, basic safety precautions should be followed, including the following:

- Do not operate in wet / damp environments
- Do not operate in explosive atmospheres
- Keep product surface dry and clean.

Always make sure all electrical installations are made in accordance with local authorities' regulations and laws.

2 INTRODUCTION

The Qualitrol® *T/Guard 405*TM is a multichannel fiber optic temperature monitoring system for power transformer hot spot measurements and other similar industrial applications. It has been developed with long-term performance and stability in mind. This fiber-optic temperature monitoring system offers accuracy, toughness, ease of use and long-term resistance to failure.

Coupled with the *T/Guard 405* system, the Qualitrol® T2 fiber-optic temperature probes provide accurate and direct temperature monitoring of transformer windings. This solution provides a realistic, real-time view of winding conditions that is quicker and more accurate than WTI (Winding Temperature Indicator) top oil thermocouple measurements, and greatly complements indirect measurements based on thermal models.

Since its inception, Neoptix, a member of the Qualitrol family, has developed expertise in monitoring temperatures of hot spots in power transformers, and is considered a world leader in this field. Our user guide called, "*Probe Installation Guide, inside power transformers*" (part number G1009rXX) should be used by transformer manufacturers as a guide to safely install the probes inside windings of a power transformer. Make sure you instruct all of your employees that fiber optic components, contrary to conventional copper wires, are fragile. Generally speaking, fiber optics, contrary to copper wires, cannot be repaired once broken!

The Qualitrol® *T/Guard 405* gives the exact temperature of optical probes in as little as 250 milliseconds per channel. Peak loads or emergency overloads are thus detected almost instantaneously. The *T/Guard 405* system is specifically designed to meet power transformer industry requirements: extended intervals between servicing, low maintenance, rugged components and the ability to withstand the harshest conditions. All components have been specifically selected for long term performance, including the light source that has an MTBF far superior (>300 years) to the expected life of the transformer. Moreover, our sensor, based on solid-state semiconductors, does not fade or drift over time, allowing a constant and absolute temperature measurement of your transformer windings over the lifespan of the equipment.

Qualitrol fiber-optic probes are based on the proven GaAs technology and made only with dielectric materials. They are designed to withstand initial manufacturing conditions, including kerosene desorption and heat runs¹, as well as long term oil immersion and vibration.

The *T/Guard 405* system is available with 2, 4, 6, 8, 10, 12, 14 or 16 optical channels. There is one four-digit high powered LED display for each channel², allowing a clear view in day time to someone standing at a good distance from the device. Signal conditioner power consumption of the system is 15 watts.

The *T/Guard 405* can be mounted in the back of a control cabinet using 4 screws or mounted directly on the cabinet swing door using the four bolt anchors. It comes standard with a built-in data logging memory (32 MB) that allows utilities and transformer operators to record temperature data points directly into their *405* temperature monitoring system, without the need for permanent connection to a remote acquisition system. The memory available will allow up to about 10 years of data logging of all channels once every ten minutes for a transformer instrumented with eight temperature probes. Moreover, data points are saved with a time stamp that comes from the internal real-time clock. The information can be accessed through serial port RS-485

The *T/Guard 405* system provides an easy to use interface to an existing SCADA or substation system through its 4-20 mA analog outputs or through its RS-485 serial port using either the Modbus protocol or the Neoptix native communication mode. Smart protocols DNP 3.0 and IEC 60870-5-101 will be available as options; these two later protocols are described in a different document, # g1030; do not hesitate to ask Neoptix a copy if you need it. A new OptiLink-II software package is now offered to make parameter entry easier than using the built-in keypad.

¹ Also called "Temperature Rise Test".

² Systems with more than 8 channels toggle between 2 banks of 8 channels on the LED display.

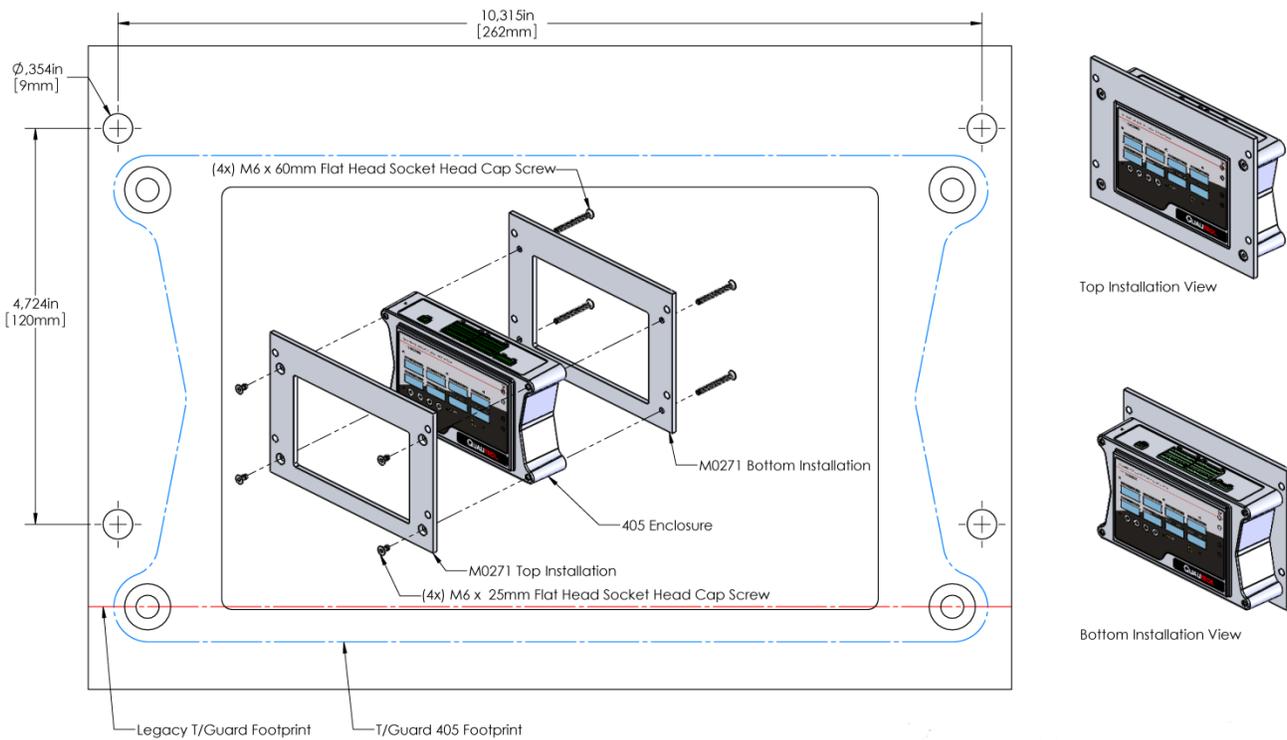
With its small footprint, the 405 is a space-efficient and versatile instrument. All connections are made through detachable terminal blocks for easy and seamless installation and after-sales service.

The *T/Guard 405* system has been designed to monitor temperatures only; it cannot control cooling or generate alarms; thus, it does not have any relay.

The system's configuration is made through its industrial grade front panel keypad, serial terminal or PC software (OptiLink and OptiLink-II for Windows).



It is possible to mount a *T/Guard 405* where there was a legacy *T/Guard* before. A plate kit, M0271, is available from Neoptix for this. The plate concept is illustrated below.

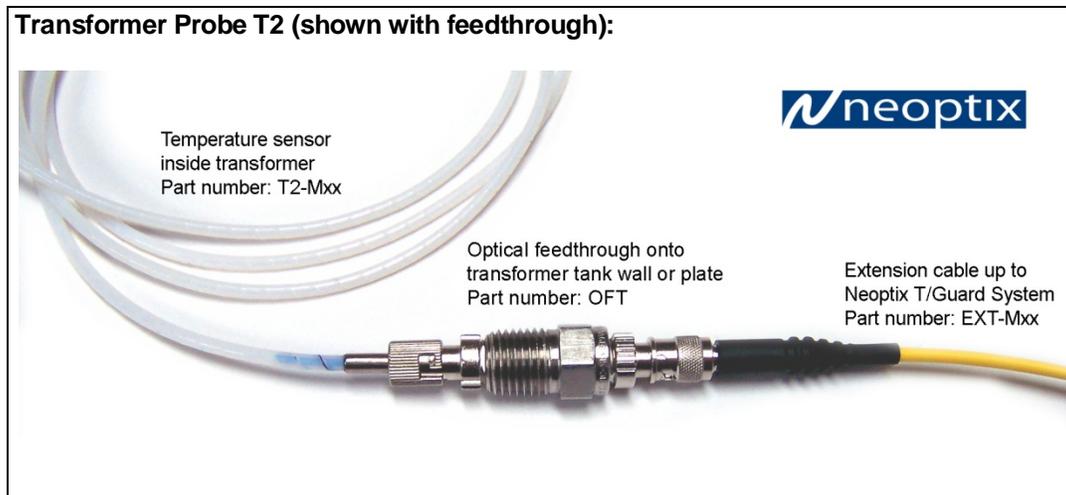


2.1 T/Guard 405 product specifications

Resolution	0.1 °C
Accuracy	+/- 1 °C
Calibrated Temperature Range	-40 ° to 200 °C
Supported probes	Support for Nortech Fibronic Inc. type probes
Usable Temperature Range	-80 ° to 250 °C
Number of channels*	2 to 16
Probe length	1 to 300 meters
Response time	Typically 0.3 second per channel (probe configuration dependent)
Unit	User selection of °C or °F
Operating temperature	-30° to 72 °C, non-condensing
Storage temperature	-40° to 85 °C
LED display	Display of channel number and temperature readings (8 channels)
Power	20 to 48 VDC, 0.5 A (nominal 24 VDC)
Size	265L x 148W x 62D mm
Weight	1.2 kg
Standard interface	RS-485 (2W or 4W, user configurable), Modbus Analog output 4-20 mA Options: DNP 3.0 and IEC 60870-5-101 ³ (on serial port)
Data logging	32 MB (permanent flash memory) (will store ~400,000 16-channel points)
Optional interface	TCP-IP (Ethernet bridge) ⁴
Sensor	Dielectric epoxy or silicone tipped optical fiber

*: Selection must be specified at time of order.

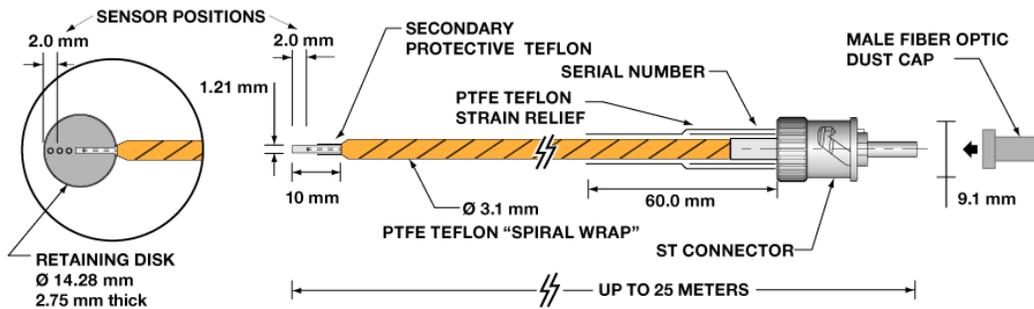
The following figure gives a description of some probe configurations and options that are available from Neoptix.



³ The DNP 3.0 and IEC 60870-5-101 are documented in a different guide, #g1030; do not hesitate to ask Neoptix for a copy if you need it.

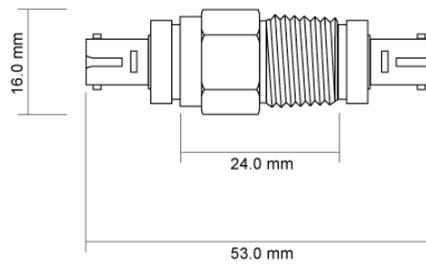
⁴ If an Ethernet interface is required, product T/Guard-408XT is recommended.

General Purpose Probe T2:



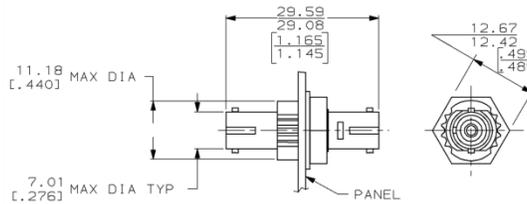
OFT Coupling (Feedthrough):

(for transformer tank wall application, and other similar applications)

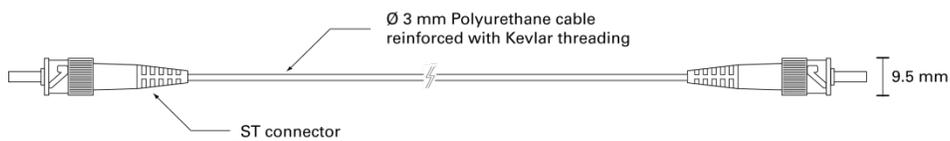


ST Coupling (also called ST-ST Mating)

(for other general-purpose applications)



ST-ST Extension Cable



Other options and configurations are also possible; contact Neoptix for more information.

2.2 Calibration

Your T/Guard thermometer comes factory-calibrated. Experience has shown that re-calibration is not required over the whole product life; however, if your ISO rules state that an annual re-calibration is required, then it is your responsibility to comply with those rules. For laboratory applications, a new calibration is standard every 12 months or whenever performance verification indicates that calibration is necessary; NIST traceable calibration certificates are available. All calibrations are performed at the factory. Contact your Neoptix Representative for further information.

2.3 Transformer applications

One of the main applications for the T/Guard product is monitoring temperature of hot spots in power transformers. Since its inception, Neoptix has developed expertise in this application, and is considered as a world leader in this field. Sister products of the T/Guard, the T/Guard-2B, T/Guard-Link, T/Guard-408, are ideal for the power transformer industry. Neoptix publishes a User Guide, called "Probe Installation Guide", totally dedicated to the power transformer industry; do not hesitate to ask for your copy if you are working in this field (Neoptix document # g1009).

3 UNPACKING

Before using your T/Guard thermometer, check the box content to be sure all items have been included. Your package should normally contain:

- T/Guard-405 signal conditioner unit
- Mating connectors for the power input, serial port and for the analog output
- User manual (this manual) (paper copy not included, supplied as a PDF document on DVD)
- Neoptix OptiLink™ Pro software on DVD (supplied with an unlocking key to transformer OEMs only)
- Neoptix OptiLink-II software on DVD
- Calibration Certificate.

Warning: NO AC power supply is included with this T/Guard unit; a power supply must be ordered separately, or supplied by the user (nominally 24 VDC).

Options:

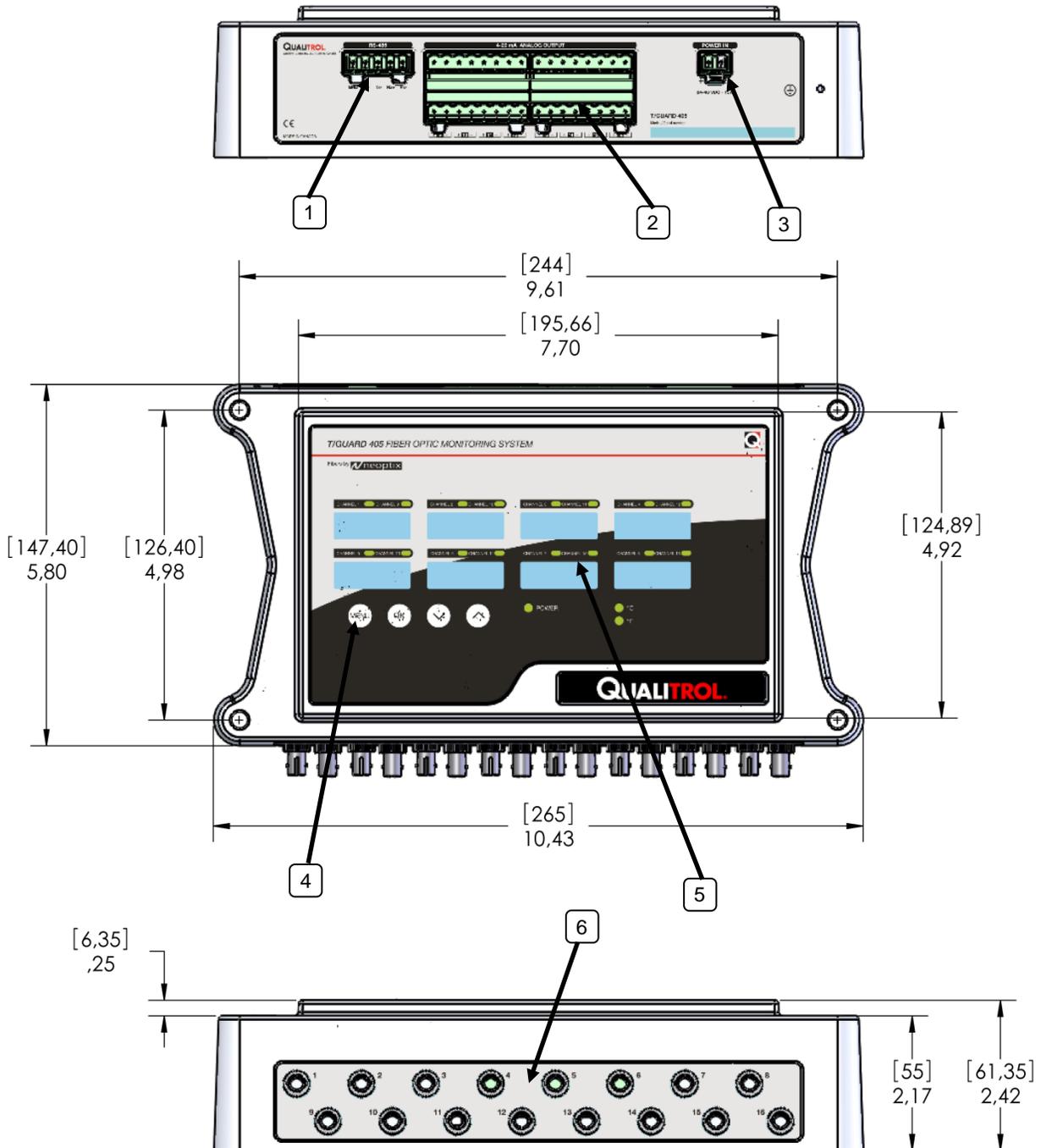
- Fiber optic temperature sensor probes
- Fiber optic extension cables
- Fiber optic coupling and feedthroughs
- USB to RS-485 communication interface (NXP-341)
- 24 VDC Power supply module (universal input: 90-265 VAC, 47-63 Hz or 110-370 VDC). Table top and DIN mounted models are available. Acceptable supply voltage range is from 20 to 48 VDC.
- Carrying case & accessories.

Make sure all listed items have been received and are in good condition. Note any evidence of rough handling in transit; immediately report any damage to the shipping agent. Should a part be missing or damaged, please contact your distributor immediately. Returns must be made with the original packaging, accompanied by a return authorization number (RMA). Your distributor will provide you with information concerning the return of merchandise.

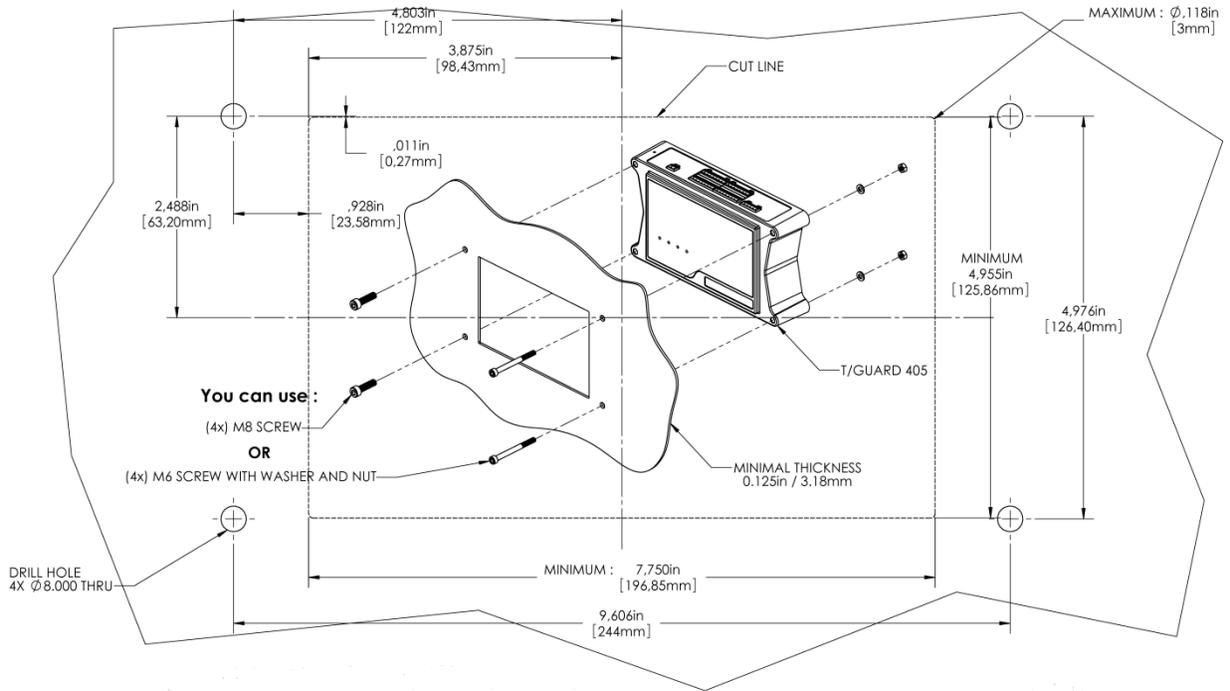
The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment becomes necessary.

4 T/GUARD-405™ HARDWARE REFERENCE

The following figure shows the T/Guard thermometer mechanical layout, including dimensions and mounting hole positions (the 405 case is the same for any number of optical channels, 2 to 16):

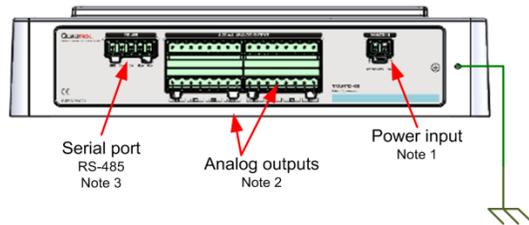


The following drawing, below, could be useful especially if you mount the unit on a swing panel, as it gives the details of the required cutout hole for such installation. Furthermore, details on the required bolts are given (M8).



The following drawing gives more details on the electrical connectors, as well as pin-out information.

Back



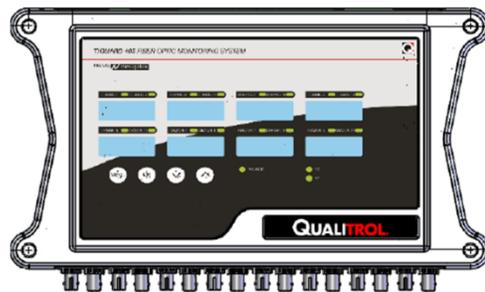
Note 1

Input voltage:
24-48 VDC, 15W

Note 2

Analog output 4-20 mA
(one per channel)
Total max impedance: 400 Ohms per channel

TOP



Note 3

Serial Port

	RS485 2W	RS485 4W
1	GND	GND
2	TX/RX a	TX+
3	TX/RX b	TX-
4	TX/RX a	RX+
5	TX/RX b	RX-

Note on wiring

Shielded cables are recommended.
Shield should be grounded at one end only,
preferably at the T/Guard end.

Front



Description of each pointed elements:

1) RS-485 serial communication interface: This port is used to configure and extract information for the instrument. This modular connector can be wired externally by the user in 2-wire mode (half duplex) or 4-wire mode (full duplex). See Chapter 6 for a complete description of the serial commands that are available. Please note that all software packages that can be used with the 405 can be in either mode. It is very important that your outside wiring and interface to computer match your selection of 2W or 4W.

2) Analog output connectors: There are a total of up to 16 connection pairs, one pair for each optical channel. Prior to shipment, your T/Guard thermometer was factory set to 4-20 mA analog output. The minimum analog output value corresponds to minus 100°C and the maximum analog output value corresponds to 300°C. The thermometer normal range is from minus 80°C to 250°C, so a minimum value indicates an under-range error; likewise, a maximum value indicates an over-range error condition. If there is a sensor problem for a given channel, the analog output may take one of the following 3 states (refer to the serial “o” command, Section 6.4):

- a) It will toggle between the minimum and maximum values, at approximately 0.5 Hz; this indicates a sensor problem for that channel (“o0”). This is the default setting; to change it, you will need to use the serial command “o1” or “o2”.
- b) The analog output is forced to its maximum value (“o1”); this would indicate a “too-hot” situation.
- c) The analog output is forced to its minimum value (“o2”); this would indicate a “too-cold” situation.

Warning: 1- Do not connect any external voltages to these outputs; this may cause permanent damage to the thermometer unit. 2- Avoid shorting output leads together, as this may destroy the electronic drivers inside the unit.

16-position mating connectors are supplied with the T/Guard system. When using long wires to the analog outputs (4-20 mA), it is recommended to use shielded twisted pairs, size AWG 24 or 22. The shield should be grounded at one end only, preferably the T/Guard end.

3) 20-48 Volt DC power connector: You must use a DC power supply. Internal electronic is protected against wrong polarity wiring. This model has an internal fuse (not user replaceable), but does not have a power switch.

A 2-position mating connector is supplied with this T/Guard system. The provided Phoenix Contact connections are made to accept wire gauges ranging from 24 to 14 AWG. Optimal torque is 0.22 to 0.25 N.

4) 4-button keypad: This keypad can be used to configure the T/Guard; the available functions are described in details in the next chapter.

5) Large LED display: Under normal use, the display will show the temperature readings for the user selected channels; when more than 8 channels are available, the readings are multiplexed at an adjustable rate, normally 2 seconds. The temperatures are displayed in either °C or °F. If temperatures are unreadable, ---- will be displayed.

When the keypad is used, information will be displayed to guide you through the various available menus.

6) Sensor connector(s): These are ST type connectors, mating to each of the 16 optical temperature sensors. If you need to extend a sensor fiber, you should use optional extension cables that are available from your Neoptix supplier.

Warning: The fiber type that is used with your T/Guard thermometer is of a special type, and it is recommended that you get ALL of your extension cables from Neoptix or a Neoptix authorized distributor.

Warning: Make sure all unused optical connector inputs are blocked with dust caps, to prevent any spurious light from entering the thermometer, as this can cause false temperature readings on other channels.

Grounding terminal. A screw is available on the 405 case to allow the user to ground the 405 enclosure to the local system ground. It is highly recommended to make this connection; experience has shown that this should increase the communication and system reliability.

4.1 Mating connectors

The mating connectors (terminal blocks) are supplied with the instrument. In case you need to get additional terminal blocks, here is the Phoenix Part Numbers.

Function	Number of contacts	Phoenix part number
Power in	2	1777280
Analog Outputs	8	1777345
RS-485 port	5	1777316

This page provides a diagram of the sub-menus for the 405 model, available from the main menu:



5.2 Keypad setup menu

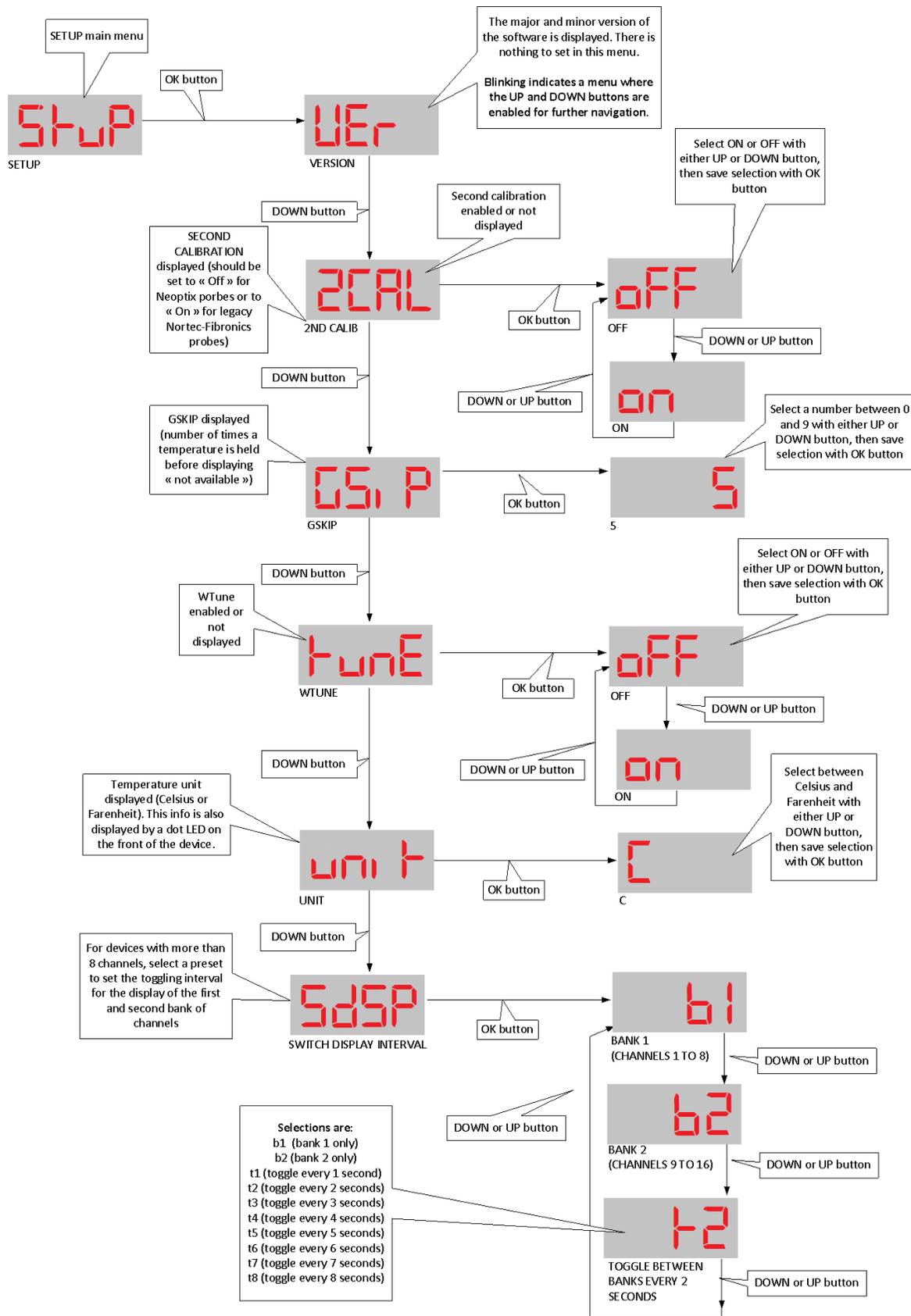
This functionality provides information about:

- the device's internal software version; there is nothing to set here, this is information that would be useful only if you were to place a support call;
- whether there is a second calibration of temperatures; this depends on whether the fiber optic probes are legacy (Nortech Fibronic probes), in which case: "enabled", or not: "disabled";
- the number of times a temperature is held internally before displaying "not available"; normally there is almost never any need to change this value (for transformer applications, 5 is recommended);
- whether Wtune (also known as "Mode CCDAuto") is enabled or not (for transformer applications, this should be enabled) (maximum sensitivity is obtained with Wtune enabled);
- whether temperatures are displayed in degrees Fahrenheit or Celsius;
- the interval of time (for T/Guard 405 devices with more than 8 channels) between the presentation of channels 1 to 8 (bank 1) on the display and the presentation of the remaining channels (bank 2), from 1 to 8 seconds;
- whether the serial communication is functioning properly (visual test using a LED).

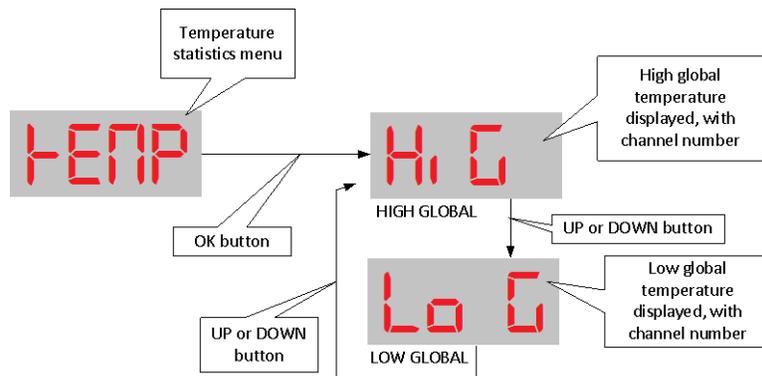
If you change the temperature unit while the device is set to save temperatures to a log file, then a new log file will be started with the new correct unit and the old log file will be archived. This ensures the correct temperature unit is displayed in the log headers at all times.

Either the current log file or the archived log file(s) can be retrieved by file download; file download requires the use of the OptiLink-II software, see Section 7.4 for more information.

Here are schematics of the various menus (next page):



5.3 Temperature menu



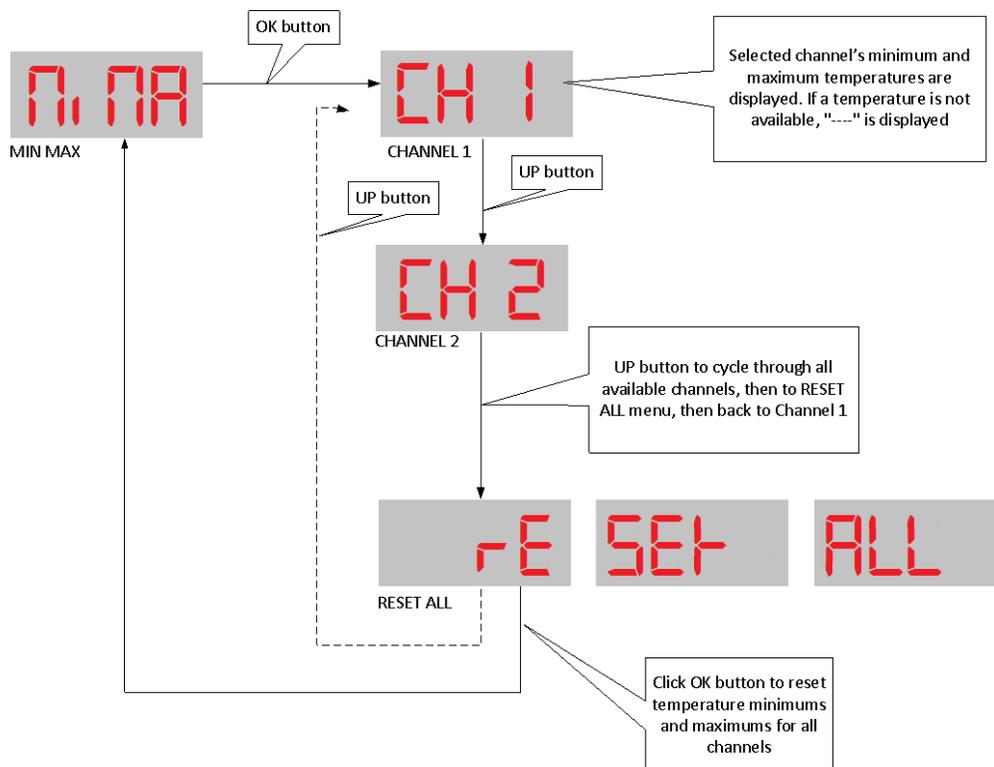
There is nothing to set in the Temperature menu.

The High Global value displayed here indicates the highest temperature that was observed on the device, and on which channel it was observed on.

Respectively, the Low Global value will indicate the lowest temperature that was observed, and on which channel it was observed on.

The High Global and Low Global indicate values since the device's last restart.

5.4 Minimum-Maximum menu

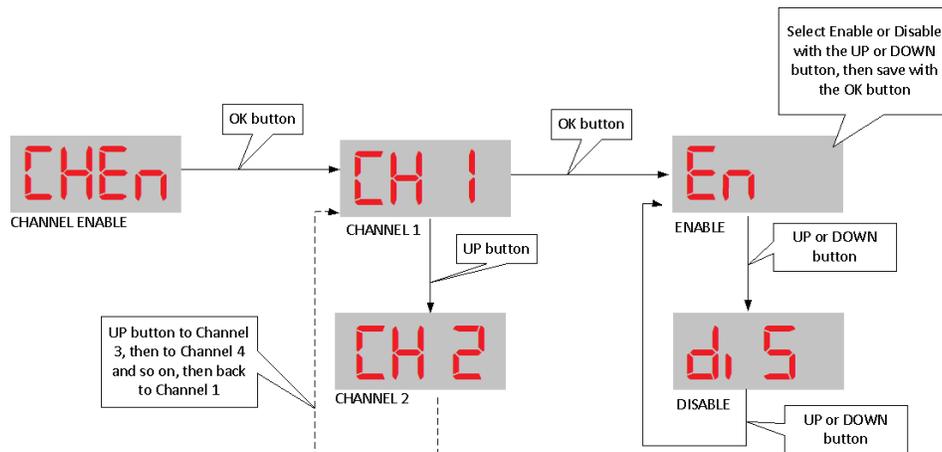


In this menu, you can view at a glance what the minimum and maximum temperatures measured were for each available channel.

Minimum and maximum temperatures are calculated based on the set of temperatures encountered since the device was rebooted. If you wish to reset the minimum and maximum values without restarting the device, you simply need to navigate to the "Reset All" menu item and click the OK button.

This will return you to the base menu at the "MIMA" menu position.

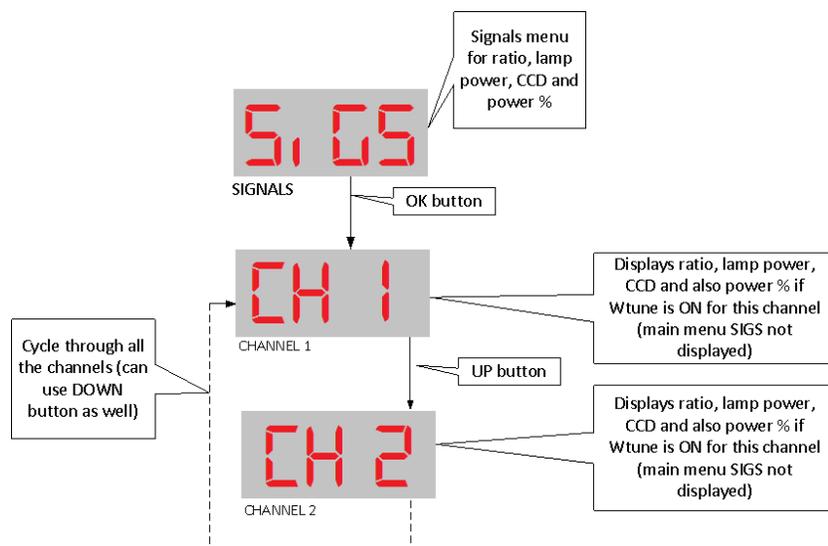
5.5 Channel Enable menu



In this menu, you can enable or disable a channel from displaying a temperature. You might want to do this if a fiber optic probe was not hooked up (values for this channel do not apply) or if a probe was broken along the way and thus the displayed temperature is known to be incorrect.

A disabled channel has its corresponding display as blind (i.e. is left blank).

5.6 Signals menu



There is nothing to set in the Signals menu.

Here, you can view at a glance the minimum/maximum ratio (at the time of this writing multiplied by 100), lamp power index and CCD (length of exposure to light in milliseconds) for each available channel.

When you select the "SiGS" sub-menu by clicking the OK display button, the first channel will be displayed preceded by an "r" for ratio, so you don't confuse this menu with another.

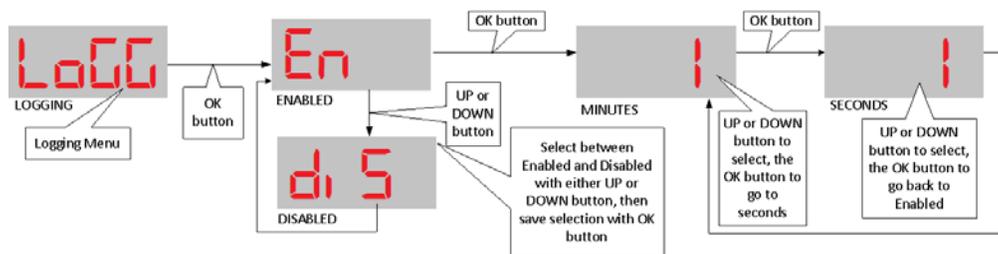
The "CH1" will blink to indicate you can navigate to the other channels with the UP or DOWN buttons.



Respectively, after the channel number will be the ratio value (preceded with an *r*), the lamp power value (preceded by an *L*) and the CCD value (in msec) (preceded by a *C*). On the second LED line, the Power % value (preceded with a *P*), ranging from 0 to 100%, is also given; this parameter is a sort of amalgamation that simplifies the interpretation of optical signal strength⁵. Finally, the last number given in the 2nd row is an error code, which should normally be '00'. See Appendix 6.4.1 for a detailed discussion regarding the interpretation of these parameters.

At any time, you can exit the SIGNALS menu by clicking the left-most MENU button.

5.7 Logging menu



By default out of the box, the *T/Guard 405* logs once every 10 minutes.

To reduce internal file I/O on the internal disk media, it is possible to turn off logging completely using this menu here.

In general, it is recommended to leave the data logging on using a logging rate of 10 minutes or more (except for heatrun tests (temperature rise tests), where 1 or 2 minute intervals are recommended).

Please note that if you reduce the logging rate to less than once per minute, and the device is restarted, that logging rate will automatically be reset to one per minute by design. This is because a logging rate this frequent is considered an extraordinary value, probably only to be used in the case of an emergency and undesirable in the long run (after the emergency is over).

5.7.1 Logged data information

The logged data is internally stored as binary files. The files consist of up to 65,000 lines of data, each line representing the temperatures for 16 channels (always 16 channels) along with a date-time stamp. This means that the 32 MB total space can accommodate a total of 6 such files. This represents a grand total of 390,000 lines, or about 7.5 years of data if the sampling rate is 1 line per 10 minutes. Once all 6 files have been filled up, the *oldest* log file is deleted without any warning and replaced by a new one.

⁵ For oil-filled power transformer application, experience has shown that this reading be at least 100% for a probe alone, and a minimum of 65% when testing a probe connected to OFT feedthrough and extension cable (at room temperature).

These 6 files can be downloaded using the OptiLink-II software.

File name conventions:

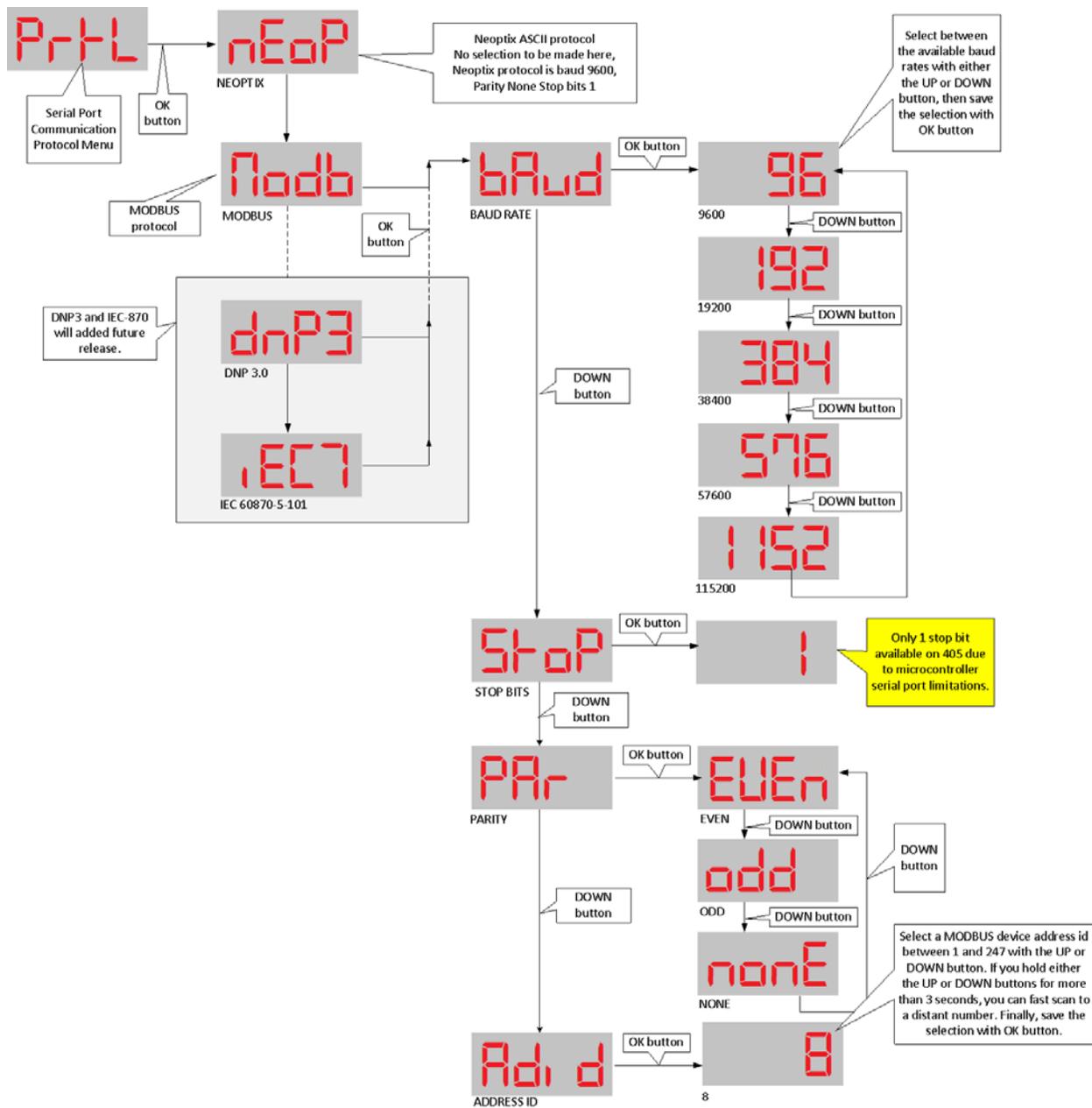
- The current log file is always called temperatures.com
- When the current file is full, it is archived with the same name but by adding to it a prefix that corresponds to the date and time at the time of closing the file.

5.8 Serial protocol menu

The Neoptix ASCII protocol and Modbus are standard features for the 405. DNP 3.0 and IEC 60870-5-101 are offered as options. Contact Neoptix for more information about buying them. At the time of writing of this guide, these protocols were planned, but not fully implemented; contact Neoptix for exact development status.

Modbus is fully implemented; see Chapter 9 for a full description.

You should use the Neoptix ASCII protocol to connect to both OptiLink software packages, and also HyperTerminal, or Tera Term.



5.8.1 Neoptix ASCII protocol

For backward compatibility with other Neoptix products, the Neoptix ASCII protocol is at baud rate 9600, Parity None, Stop Bits 1. Although this baud rate can be tweaked at run time to make a file download or upload faster (see *Troubleshooting* section for a how-to concerning this), such a change is strictly temporary and non-persistent: the baud rate for this protocol is always set to 9600 at boot time.

Please refer to Chapter 6 “*Serial Communication Description*” for the complete command syntax for this protocol.

This selection is necessary to use software such as OptiLink, OptiLink-II, HyperTerminal and Tera Term.

5.8.2 Modbus protocol

For Modbus, baud, parity and stop bits settings are configurable. Please note however that as per the protocol's specifications, only some combinations of these settings are allowed:

- parity even, stop bit 1
- parity odd, stop bit 1
- parity none, stop bit 2

The Modbus protocol also has an Address ID value (also called *Node address*) that indicates the device's position, i.e. where it is daisy chained (or networked) with other devices. Valid ID addresses are from 1 to 247.

Please refer to Chapter 9 for the complete reference regarding this protocol.

5.8.1 DNP 3.0 protocol

For DNP 3.0, the baud rate is adjustable. Parity is fixed at *None* and Stop bit is fixed at *1* as per protocol specifications. Address id is not available. Master station address by default is *65500* and secondary station address by default is *1*. It is recommended to keep these default values. If you need to change them, however, it is possible through the following Neoptix protocol serial commands:

```
master:XXXXX .. Define DNP 3.0 master station address (normally 65500)
second:XXXXX .. Define DNP 3.0 secondary station address (normally 1)
```

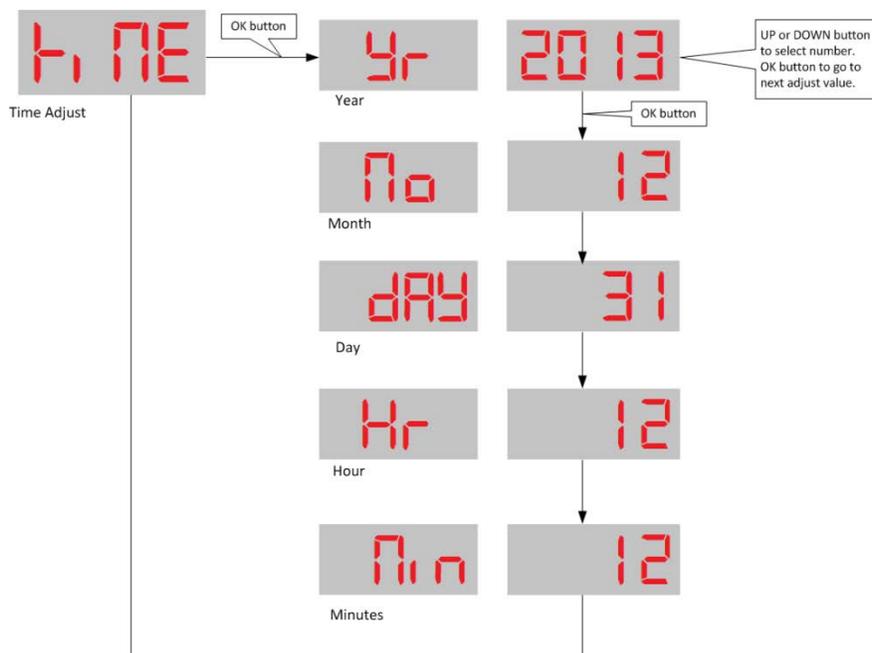
5.8.2 IEC 60870-5-101 protocol

For IEC 60870, baud rate and address id are modifiable. Parity is fixed at *Even* and Stop bit is fixed at *1* as per protocol specifications.

5.9 Time menu

The time menu can be used to initialize the *405* clock. It can be used to set the date and the time. It should be noted that the *405* does not have any time zone setting capability.

An internal battery assures that time is not lost when no external power is applied to the *405*.



6 SERIAL COMMAND PROTOCOL DESCRIPTION

You can communicate with your T/Guard thermometer via its standard RS-485 port. A description of the cable requirements is given above, under front panel item # 1.

Recommendation: The use of OptiLink-II software is highly recommended as an alternative to the serial command protocol described in this chapter; for more information on OptiLink-II, see chapter 7 below.

Serial functions (or commands) can be accessed with a computer and communication software (such as Windows HyperTerminal or Tera Term) or with OptiLink' Console software package. Your software should be set at 9600 Baud, 1 Stop-Bit and No-Parity. Furthermore, the new OptiLink-II software can also be used to upload most parameters.

6.1 Using OptiLink Console

The OptiLink software package includes a convenient console option that can be used to “exercise” your 405 serial communication protocol. With this console, there are almost no more reasons to use HyperTerminal or equivalent to use the serial commands that are described in this Section, except if you want to transfer a file, as this requires the OptiLink-II software package.

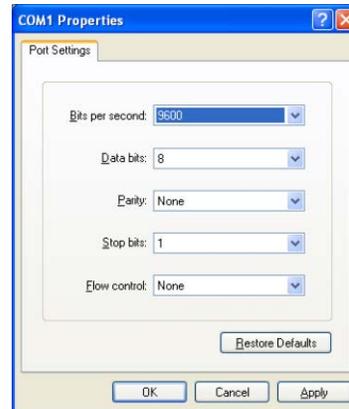
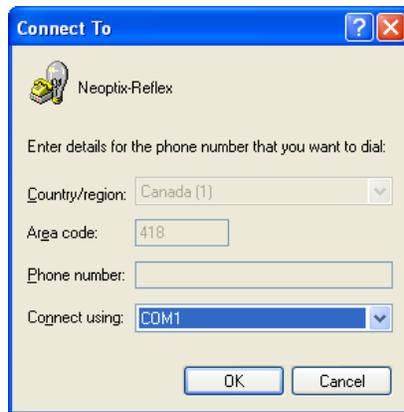
Refer to the next Chapters for instructions on how to use OptiLink-II and OptiLink.

6.2 Using HyperTerminal in Windows

Hyper Terminal is a standard Windows program (XP and previous versions⁶) that can be easily used to exercise your T/Guard thermometer. To use Hyper Terminal you first set its properties as follows:

- 1- In the “Connection Description” window, enter a name that suits you, such as “Neoptix-Reflex”. Click OK.
- 2- In the next window, “Connect To”, select COM1 (or another COM port, if you are planning to use another port than COM1) in the box called “Connect using”. Click OK.
- 3- Then the COM1 Properties window will come up. As indicated above and as shown in the figure at right, set the port parameters to 9600 Baud, 1 Stop-Bit and No-Parity; Flow control must be set to None. Click OK.
- 4- You are ready to go. Type “h E ” to test your setup (see below). Warning: the characters that you enter are not echoed to you!

⁶ Vista, Win-7 and Win-8 users: HyperTerminal is not included with Vista and subsequent Windows versions. However, an equivalent program (HTPE) can be downloaded (for a fee) at the following website: <http://www.hilgraeve.com/hpe/download.html>. Tera Term (freeware) has also given good results; see <http://tssh2.sourceforge.jp/>.



6.3 Serial command help menu

To use the following commands, you will need a properly configured serial port client such as *HyperTerminal* or *Tera Term* on the Windows platform, or the like.

We recommend *HyperTerminal* as it was used extensively during the development of the *T/Guard 405*, and it provides functionalities that are not found in all such software tools. However, for any file transfers, one MUST use the OptiLink-II tool, as the transfer file format is Neoptix proprietary.

The OptiLink Console is also an excellent tool for entering serial commands, as long as the commands and the answers are only ASCII characters (this Console does not support file transfers). The Console can be invoked by first stopping the acquisition in OptiLink, then by selecting "Open Console" from the Window menu. See Section 8.5 for more information on the Console in OptiLink.

However it should be noted that *Tera Term* is a newer program, is friendlier for resizing windows, copying and pasting, as well as changing font and background color on the terminal's command prompt, and is free and Open Source (<http://ttssh2.sourceforge.jp/>).

```

b ..... Read internal temperature (not implemented yet)
baud:nnnnn ... Set baud rate to 'nnnnn' bit per second, valid rates are:
                9600, 19200, 38400, 57600, 115200 (remember to reconnect)
c:xxxxxxxx ... Clean up (delete) log file xxxxxxxx
d:xxxxxxxx ... Download a temperature log or a protocol pointmap file among:
                [ temperatures.tem / dnp3pt.txt / 60870pt.txt ].
                A list of available downloadable files can be obtained with
                the "l" command. Require OptiLink-II
e[1;2;...;n] .. Enable channels to scan; if no argument scan all;
                To disable, use e-[channel number]
f[i;j] ..... Set point adjustment on channel [i] to [j]
format ..... Erase all log file(s)
gskip[i] ..... Skip up to i (0 to 9) marginal read cycles
h ..... Help menu (this screen)
i ..... Get factory and status Information
j ..... List channel names
j[i]:xxxxxx ... Write channel [i] name
l ..... List log, status and other information file(s)
logging[i] .... Logging+ to enable logging, logging- to disable
mb ..... Modbus configuration tool (mb:? For help)
n+[i] ..... Toggle calibration (n+e for Neoptix, n+o for Nortech-Fibronic)
o[i] ..... Analog out if error (0:Max-Min 1Hz, 1:Max level, 2:Min level)
rd ..... Read date and time
rr ..... Read logging rate
resetoff ..... Reset temperature offsets to zero
s[i;j] ..... Specify analog output Span [j] for channel [i]
status ..... Download status information file (with OptiLink-II)

```

```

t[i] ..... Get Temperature reading, channel [i]
u[i] ..... Unit(c= degrees Celsius, f= degrees Fahrenheit)
wd:yyyy/mm/dd Write current date
wt:hh:mm ..... Write current time
wr[n] ..... Write logging rate
    n           Logging rate
    1,2,3,4,5   1,2,5,10,30 sec
    6,7,8,9     1,5,10,30 min
    10          1 hour
wtune[i] ..... Optimize CCD read time (wtune+ to enable, wtune- to disable)
Y ..... Signal Strength
z[i;j] ..... Temperature [j] for analog output Zero on channel [i]

```

DNP 3.0 serial configuration commands:

```

master:XXXXX .. Define DNP 3.0 master station address (normally 65500)
second:XXXXX .. Define DNP 3.0 secondary station address (normally 1)

```

All commands must be terminated by a carriage return and are case insensitive (i.e. either upper case or lower case can be used for letter characters). Please note, however, that **file names are case sensitive**.

6.4 Detailed Description of the ASCII Commands

- `b` *Internal temperature*
Returns the temperature value inside the T/Guard enclosure. Not implemented yet (March 2015).
- `baud:nnnnnn` ... *Change baud rate*
Making a change in the baud rate used to communicate with the serial port will automatically disable your serial port client program: you will then need to disconnect *HyperTerminal* or *Tera Term*, modify the setting on your serial client to match the setting you just saved, then reconnect. This command is useful if you need to transfer files faster: by raising the baud rate you will also make the file transfer faster. Remember that a baud rate change for the Neoptix protocol is not persistent after a reboot.
- `c:xxxxxxxx` ... *Clean up (delete) log file*
The content of log files is designed to be easy to copy and paste into a Microsoft Excel spreadsheet. Certain older versions of Excel had a limitation of about 65,000 lines which could be copied and pasted into it. For this reason, when a log file reaches that size, it is archived and a new log file is started. This has the benefits of saving disk space as well as providing a relatively small log file containing the latest readings ready for download. Archived log files can also be downloaded, or they can be disposed of file-by-file using this command.
- `d:xxxxxxxx` ... *Download log file. These files can only be downloaded using the OptiLink-II program utility. See chapter 7 for more information.*
File names are case-sensitive. To obtain a list of file names first, use the "l" command to list the log files. In addition to the *temperatures.tem* and older archived log files, you can download the *messages* system log file which might be useful in the unlikely event where the device did not behave as it should and Neoptix support requests it.

Logged temperatures are saved in a total of 6 files (32 MB total size), each having 65,000 temperature points (each temperature points has a date-time stamp and 16 temperature values).

The DNP 3.0 serial protocol pointmap.txt can be downloaded with this command, as can the IEC 60870-5-101 serial protocol pointmap.txt file. Please note that these files are automatically generated on first start of these protocols and will therefore be absent until the protocol is enabled for the first time.

- `e[1;2;...;n]` .. *Enable channels to scan*

By default all channels are enabled, but a specific channel can be disabled. A disabled channel will show an empty string (nothing displayed) on its red LED display.

- `f[i;j]` *Set point adjustment*

This command forces an actual temperature reading (j) for channel # i; any resulting offset will be applied to all future measurements for that channel. This is useful to compensate for small temperature deviations that may occur between sensors, such as forcing older Nortech-Fibronic, Inc. probes to read similar temperatures as the newer Neoptix probes. A maximum offset of ± 5 °C is recommended; if it is required for you to force a larger offset, your thermometer probably requires a new factory calibration; In that case, please consult your distributor or Qualitrol Support for more information. This procedure can also be called a one-point calibration. If the “j” parameter is not used, the command will clear any previously entered offset for channel “i”.

Remember that this command alters the internal calibration of the instrument. Always follow the following recommended procedure:

- I. Apply a stable and known temperature to the sensor tip;
- II. Check the display reading for abnormal deviation from the known temperature;
- III. Send the “f” command followed by channel number, a blank character and the reference temperature value (example “f2;27.0” followed by [ENTER]).
Temperatures must be entered in units as specified by the “u” command;
- IV. Wait a few seconds;
- V. Confirm that the readings correspond to the known temperature.

You can revert at any time to the factory calibration using the “*resetoff*” command. This will in effect clear any offset that you may have entered, for all channels.

Important: always make sure you are reading a valid temperature value before using the “f” command; otherwise, your thermometer may display a random value for a channel where the “f” command has been used.

- `format` *Erase all log files*

This command deletes the current as well as all archived log files. This preserves disk space but is not necessary in normal use, even after several years, unless the logging rate has been reduced substantially on the device for long periods of time.

- `gskip[i]` *Skip up to i (0 to 9) marginal read cycles*

This command is useful to eliminate annoying dropouts that can happen when using “weak” probes. The parameter “i” indicates the number of scans that the T/Guard 405 will perform before actually indicating that it cannot read the probe on a specific channel. The range of i is from 0 to 9; a value of 0 indicates that the T/Guard 405 makes no attempt at removing dropouts. A value of 3 to 5 is recommended for transformer applications.

- `h` *Help menu*

This will list the first half of all available commands. To see the second half, as indicated, enter the letter “p”. The listing will fit inside a *HyperTerminal* prompt window without cropping.

- `i` *Get factory and status Information*

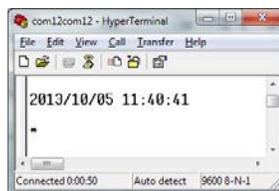
Returns general information regarding the instrument, including:

- Model number
- Unique serial number
- Number of Channels on device
- Calibration Type (Neoptix probe or Nortech-Fibronic, Inc. probe)
- Internal Software version
- Factory Calibration Date

- Temperature unit (degrees Celsius or Fahrenheit)
 - Analog out, if error
 - Analog Zero per channel
 - Analog Span per channel
 - Enabled or Disabled status per channel
 - Temperature offset per channel
- `j[i]:xxxx...` *List or set optical channel names*
 With no parameters, this command will list user-defined channel names. With parameters, it can be used to set optical channel name "i" to name "XXXX"
- `l` *List files that are available to the user*
 This lists the files that you can download using the "d" command. This would include the temperature log files, as well as some information file related to the smart protocols, and other system files, such as "status". File size is also given, for download time estimation
- `logging[i] ..` *Enable and Disable logging*
 Convenience to start (logging+) and to stop (logging-) temperature logging in internal memory
- `mb` *Modbus configuration tool*
 Modbus configuration tool. Mb:t,b,p,a
 Where

t (type)	: 0=RTU (default), 1=ASCII (ASCII is not available)
b (baud)	: 0=9600, 1=19200, 2=38,400, 3=57,600, 4=115,200
p (parity)	: 0=even (default), 1=odd, 2=none
a (addr)	: 1 to 247 (dec)

 Example: `mb:0,1,0,21` For RTU mode at 19200, even parity, Modbus address 21 (15hex).
- `n+[i]` *Toggle calibration (n+e for Neoptix, n+o for Nortech-F)*
 "n+o" or "n+e" This command can be used to change the calibration type that is active at any given time. "n+o" should be used to enable the Nortech-Fibronic, Inc. calibration, while "n+e" should be used for Neoptix probes.
- `o[i]` *Analog out if error (0:Max-Min 1Hz, 1:Max level, 2:Min level)*
 This command can be used to change the behavior of the analog output(s) in a situation when the T/Guard 405 thermometer cannot read a temperature for this channel. "i" can take one of three values:
 - `i=0`. This is the default value, to assure compatibility with older Nortech Fibronic inc. probes. With this setting, the analog output will oscillate between its maximum and its minimum value at a rate of approximately 1Hz.
 - `i=1`. In case of a probe problem, the analog output for this channel will be forced to its maximum possible value (e.g., 10V or 20mA).
 - `i=2`. In case of a probe problem, the analog output will be forced to its minimum possible value (e.g., 0V or 4mA).
- `resettoff` *Reset all offsets to 0.0, for all optical channels*
 Please refer to command "f", described above. This will reset the offset for all channels, using a single command
- `rd` *Read date and time*
 This will display the current T/Guard 405 system date and time in the format "yyyy/mm/dd hh:mm:ss" (these settings are configurable with two separate commands, `wd` for the date and `wt` for the time, with the exception of seconds which cannot be set). Here is an example (from HyperTerminal):



- `rr` *Read logging rate*
This displays the interval in seconds currently set on the system for logging. By default this value is set to once every ten minutes (600 seconds). This interval can be reduced all the way down to one second, but this is considered an extraordinary value, probably only to be used in the case of a transformer overheating emergency. For this reason, if the logging rate is set to a number of seconds less than 60, the system will reset this value on reboot to 60 seconds.
- `s[i;j]` *Specify analog output Span [j] for channel [i]*
This command will set the analog output span for the analog channel # i, the “i” parameter specifies the channel to which the command is addressed. The “j” parameter specifies the span that can range from 1.0 to 1000.0, in temperature unit (Celsius or Fahrenheit) that is defined by the “u” command.
- `status` *Download status information file. . This file can only be downloaded using the OptiLink-II program utility. See chapter 7 for more information.*
This will generate a report file and prompt for its download. Among the information provided by this file is:
 - Serial number
 - Firmware version
 - Hardware code and version
 - Calibration date
 - Up time
 - Serial hardware
 - Currently selected settings

For a detailed list of the information provided by the status file, please refer to Section 7.4.1.

- `t[i]` *Get Temperature reading, channel [i]*
Without parameters, the “t” command will display temperatures for all available channels in the temperature unit currently defined on the system. If one provides a valid channel number, only the temperature for that channel will be displayed. An unavailable temperature will be displayed as “- -”.
- `u[i]` *Unit (c= degrees Celsius, f= degrees Fahrenheit)*
Set units of measurements to either Celsius (i=c) or Fahrenheit (i=f). Note that this unit selection is the same as the temperature unit selection made from the keypad.

Ex: “uc” followed by a carriage return, to select °C (Celsius).
- `wd:yyyy/mm/dd..` *Write current date*
This will reset the system date of the T/Guard 405 to a provided valid value. This value will be used in system and temperature logs. The system date is persistent even after a prolonged power down of the device. To view the current system date, refer to the “rd” command.
- `wt:hh:mm` *Write current time*
This will reset the system clock of the T/Guard 405 to provided hour and minute values. The system time is persistent even after a prolonged power down of the device. To view the current system time, refer to the “rd” command.

- `wr[n]` *Write logging rate*

<i>n</i>	<i>Logging rate</i>
1,2,3,4,5	1,2,5,10,30 sec
6,7,8,9	1,5,10,30 min
10	1 hour

The default logging rate is once every ten minutes. A logging rate less than once per minute is considered abnormal and is automatically reset to once per minute following a reboot. Log files can be listed with the “l” command and downloaded with the “d:xxxxx” command.

- `wtune[i]` *Optimize CCD read time (wtune+ to enable, wtune- to disable)*

This command can be used to increase the optical integration time of each channel (each of the 1 to 8 channels are treated independently) to force the *T/Guard 405* system to read temperatures when the optical signal is weak, at the expense of a slower response (slower temperature update frequency or rate). This command (wtune+) enables this feature for all channels (individual channel cannot be enabled or disabled). It should be noted that in general the scanning rate of the system would slow down when this command is enabled. It is highly recommended for power transformer applications.

Warning: When wtune is enabled, and when a probe is inserted, or removed, it may take some time (several seconds), when multiple channels are being optimized at the same time) for the *T/Guard 405* to detect the probe, due to the optimization process that takes place.

- `y` *Signal Strength*

The “y” command can be used to confirm the “signal strength” of a probe and/or its connection. It can be used as a diagnostic tool to confirm the good operation of a probe and its extension cable (if applicable) connected to a channel. The returned value can be between 1.00 to approximately 3.00; a higher value is better. A minimum of 1.25 is required for a channel to return a temperature. Values of 1.0 to 1.1 indicate that no probe is detected for this channel.

For a more complete discussion regarding this parameter, please refer to Appendix 6.4.1.

- `z[i;j]` *Temperature [j] for analog output Zero on channel [i]*

This command is used in conjunction with the “s” command, as it sets the temperature that corresponds to the analog zero (minimum value of analog output). The “i” parameter specifies the channel to which the command is addressed; valid values are 1, 2, 3 and 4. The “j” parameter specifies the zero temperature value, and can range from -100.0 to 1000.0, in units that are defined by the “u” command. Factory default is -100.0.

- `master:XXXXX` ... *Define DNP 3.0 master station address (normally 65500)*

This command should normally not be used unless your DNP 3.0 setup is unusual.

- `second:XXXXX` ... *Define DNP 3.0 secondary station address (normally 1)*

This command should normally not be used unless your DNP 3.0 setup is unusual.

6.4.1 Recommended configuration, for transformer applications

For transformer applications, it is recommended that the following parameters be set as follows:

Feature	Benefit description	Command
Ignore bad scans	This allows for better stability of the analog outputs, when working with “weak” or “marginal” probes.	gskip5
Auto-tune CCD	Optimize the CCD operation, especially useful when working with “weak” or “marginal” probes. Has the advantage also to lower the voltage on the internal lamps, thus improve long-term system reliability.	wtune+

Analog output zero	Adjust the analog output zero setting, for each channel. Warning: this command must be sent individually for each channel.	z1 -50 z2 -50, etc.
Analog output span	Adjust the analog output span setting, for each channel. Warning: this command must be sent individually for each channel.	s1 200 s2 200, etc.
Analog output, if no probes	Adjust the analog output behavior, when no probe is detected. Warning: this command must be sent individually for each channel.	See “o” command description, above

Most of these command settings can be confirmed with the “i” command. The “wtune” command can be confirmed with the “y” command.

6.4.2 Interpretation of “y” command results

The Neoptix T/Guard systems are fitted with a function that gives an evaluation about probe signal strength or signal power; in Neoptix jargon, this is called the “y” command. The easiest method to access this command is to use Windows’ HyperTerminal, or OptiLink’ Console; the Nomad, when in Engineering mode, can also be very useful to display this information.

Typically, the “y” command will return the following information:

CH1: 85%, ratio:1.83, lamp:90, CCD:150ms (auto) +24.5

CH1 indicates the channel number (typically 1 to 16, for a 16-channel T/Guard system)

1.83 is a signal strength (power) indicator that can span from about +0.3 to +2.7. You can interpret it approximately as follows:

- 0.3 to 1.07: no probe is detected
- 1.07 to 1.25: a probe is probably present, but exhibits a very weak signal; its reading is usually rejected, as it is considered as unreliable
- 1.25 to 2.7: a good probe is present (the higher the power the more healthy the probe).

Lamp attenuation: gives an indication about the white light lamp intensity for this channel. It ranges from 210 (weak lamp) to 100 (intense lamp). A weak lamp is usually preferred and indicates a “healthy” probe.

CCD time: this is the CCD (charge couple device) optical integration time in millisecond; it can range from 50 to 500 ms. A weak probe will normally have a long integration time.

The “%” number gives an approximate compounded power value that takes into consideration the ratio, the lamp attenuation and the CCD time.

The “auto” information indicates that the “wtune” feature is enabled.

To summarize, a very good probe is characterized by a good power indicator (>1.8), then by a high lamp attenuation (>150) and finally by a short integration time (<200ms). Also, dirty connectors will contribute to lower probe strength; always assure that all fiber connections are clean before evaluating probe performance.

Warning: After a power-on or after changing (or exchanging) probes or extension cords, allow sufficient time for the T/Guard optimization process to complete before invoking the y command; in most cases, it may take as much as 1 minute for this optimization to complete, especially when the number of enabled channels is high, e.g., 8.

6.5 Typical temperature reading sequence

Once all parameters have been set, the following sequence should normally be followed to extract temperature information from your Neoptix thermometer. 2 procedures can be used for this purpose. The first method consists in using the “ta” command (preferred), while the second sequence would be:

- a) The host computer should send the “t” (or “t[i]”) command, followed by an E character.
- b) The thermometer responds by echoing the requested temperature values, as indicated above; the transmission is terminated by a “*” character.

- c) When the “*” character is received, it is suggested to immediately terminate the dialog session by having the host computer issue the “r” command followed by an E character.

6.6 Error codes

The following error messages are displayed under certain error conditions:

ASCII comment	Display	Analog Out	Description
Err2	Err2		Internal memory checksum error. Memory corruption. When a channel has its calibration table corrupted. Contact Neoptix.
“- . . -”	“- -”	Hi-Lo, 0.5 Hz*	Temperature out of maximum instrument limits or no signal
Err5			Argument out of range
Err6			Unrecognized command

*: The exact analog output behavior is a function of the command “o”; see previous Chapter.

Note that these error codes are not applicable when using the OptiLink and OptiLink-II software packages. These high-level software packages are programmed to automatically handle all types of errors, as outlined in the next sections.

7 OPTILINK-II SOFTWARE DESCRIPTION (FOR THE 405)

OptiLink-II is particularly interesting for users of the 405 as this instrument does not have an Ethernet interface (web server). It offers a friendlier procedure to load various parameters, such as optical channel parameters that would otherwise require to be set by hand using the instrument 4-button keypad. Neoptix has recently started the development of this new software package, called OptiLink-II. The goals and purposes of this software packages are as follows:

- Display temperature information, for up to 16 channel per instrument
 - Can display temperatures for up to 4 compatible instruments at the same time (all Neoptix models are supported, except the T/Guard2⁷)
 - Can provide results in graphical form
- Initialize and manage 405 optical channel and associated control parameters
- Upload new 405 firmware (software upgrade)
- Download data and event logging files from the 405, and other files.

7.1 Installation and initial operation

The current release is available in 2 versions: a) For Windows XP, or 2) For Windows Vista and above, including Win8; make sure you install the version that fits your PC OS. Recommendation: unless you use XP, install the second version, as it is much faster and should run with less problems. If you are using a newer version than the one described here, you should expect some differences in the use of OptiLink-II.

The Neoptix OptiLink-II tool is installed using a standard Microsoft Windows setup.exe package. Double-click on setup.exe to launch and accept the usual Windows Security warning to proceed.

OptiLink-II requires the Microsoft .NET Framework version 4.5. If this dependency is not present on the target computer, then it will be automatically installed first and a reboot will probably be required before resuming the installation.

On the T/Guard 405, make sure you have set the protocol to “Neoptix” (this is an easy thing to overlook). Make sure your serial port parameters are correct and that your cable matches your port duplex settings! Neoptix protocol serial settings are baud 9600, Parity None and Stop bits 1.

Warning: To reinstall the software, or install a new version, you will need to first uninstall the older version. This must be done by using the “Programs and Features”, found in Windows Control Panel.

After installing all the required software, a master application window will open as follows:



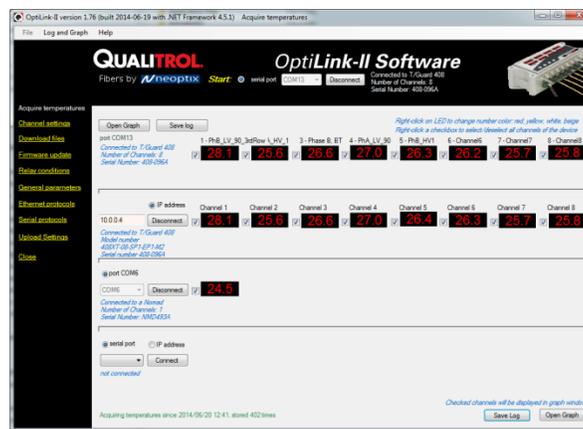
This application requires that you know which serial com port or which IP address will be used by OptiLink-II. The COM port selector will only list the currently available ports on your Windows; this is the same list of available ports you would view in your Windows Hardware Device Manager. With the 405, the IP connection option is not available, as the 405 does not support an Ethernet link. Click the Connect button. The following window will open:

⁷ The newer version of the T/Guard2, the T/Guard-2B is compatible with OptiLink-II.



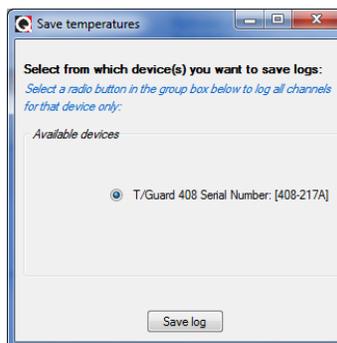
7.2 Acquire and Display Temperature Data

The “Acquire Temperatures” application will display up to 64 temperatures (16 temperatures for up to 4 instruments), as follows:



This window also includes a “Graph” button, which will open an additional window that will show a trend graphic for all previously selected channels (channel selection should be made prior to opening this second window). See section 7.2.2 for more information.

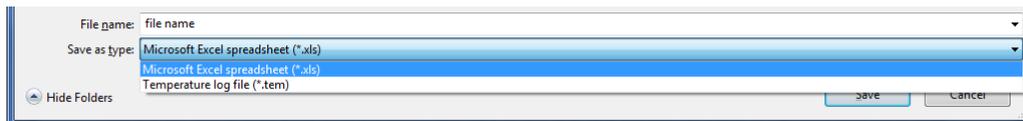
The main window also includes a feature whereby the user can save the data acquired since this window was open; this data file has the default extension .tem, and is a .CSV type file that can be directly read by Excel. Direct saving to an .xls file is also possible. Please note that data is being acquired ONLY when the “Acquire temperatures” window is active; however, the data will be saved only after the “Save log” button is clicked; this will open the following window:



If you have more than one instruments connected, then instead, this window will look like this, where more options are available to conditionally save specific channels:



Then, you will need to enter a file name and select if you want to save your data as a text .csv file, or as a genuine Excel file already acquired in kept in memory, and can be saved as any time using the menu item “Log” and then “Save log”, or by using the “Save Log” button found in the lower right corner of the main window. It is also possible to save data directly to Excel, if the file you select to save it is an .xls file, as illustrated here:



Then, all future data will be logged on your hard disk.

The latest version of OptiLink-II now supports data transfers to an Excel file; this transfer can be punctual or can proceed as temperature data is being acquired. Make sure you download the latest version from the Neoptix web site (www.neoptix.com).

Warning: this current implementation is weak in term of supporting user interaction with the Excel file during temperature acquisition; make sure you do not write or handle anything in the Excel application while an acquisition is active.

Information: This PC data logging never interferes with the instrument on-board logging. If the data logging is enabled on your 405 instrument, this logging will continue uninterrupted whenever OptiLink-II is running.

7.2.1 Data Acquisition, Logging and Graphing Rates

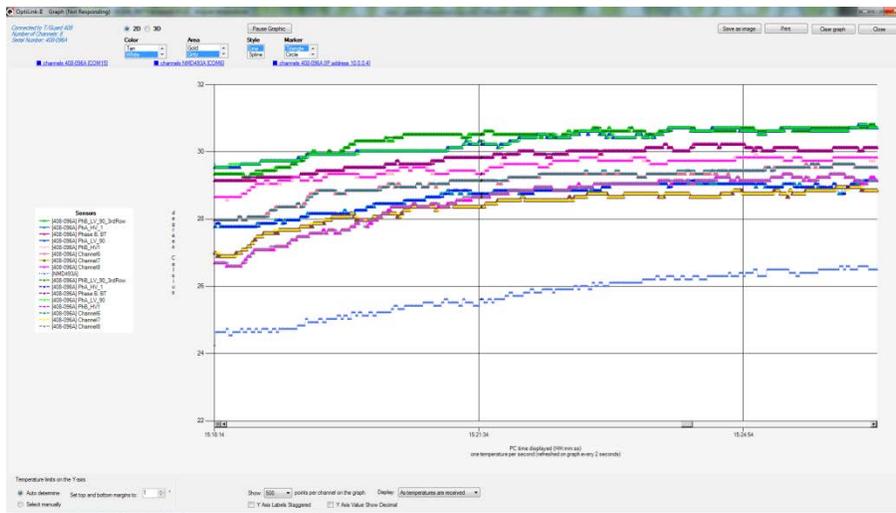
Logging and graphing rates (or frequencies) in OptiLink-II is very flexible, but could be also a bit confusing. This section explains the acquisition rate philosophy that is implemented in the software.

When the “Display Temperature” window is active, the software will continuously acquire and temporarily store the data in a very large software buffer; this buffer is being filled at a rate that is called “Acquisition Rate” (now fixed at 1 per second; averaging is possible, and this will show down the acquisition rate to one per minute. This buffer will keep filling as long as the “Acquire temperatures” window is active.

7.2.2 Graphs

This window allows presenting in graphical form both data 1) that is now being acquired, and 2) data previously acquired and that is saved in the instrument log memory (not implemented at the time of this writing). Similar to the previous windows whereby one can display up to 64 channels from 4 instruments, this window can also display up to 64 channels.

The example below shows a graph while data is being acquired.



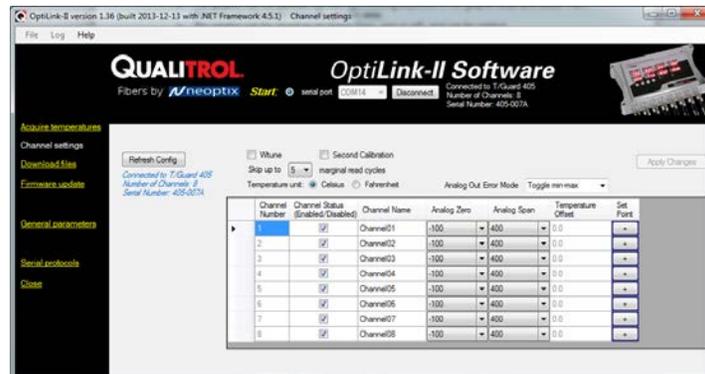
The code behind this window is quite heavy, so this window may sometime appear non-responsive; please be patient!

Description of some options that are offered to you:

- You can adjust the colors of the window background, marker style, etc. With the 3D option, more variances are available, such as graph rotation, etc.
- The graphic can be zoomed, by first right-clicking anywhere in the graphic area, and select “Zoom”; then select an area that you would like to zoom with your mouse. The zoom is cancelled either after one minute, or by clicking the “Zoom out” button.
- The graphic can be panned, by first right-clicking anywhere in the graphic area, and select “Pan”; then use your mouse to move the graphic area.
- The window can be saved as an image (jpeg, png or gif), and can be printed.
- A “Pause Graph” option is useful if one want to examine in details some parts of the graphic. The graphic can be later resumed, without loss of data.

7.3 Optical channel settings tool

- This tool is useful to set up parameters that are related to the optical channels of your T/Guard system. Click “Refresh Config” to download the current information, which will be displayed as follows (for an 8-channel system):



Once you have made the required changes to the displayed matrix of parameters, you must upload these changes by clicking “Apply Changes”.

7.4 Download files tool

This tool can be very useful to download these types of file:

- Status.txt: This is the status file described elsewhere in this document. It essentially gives an overview of all parameters of your system, which can easily be e-mailed or printed. See example below
- Temperatures.tem: This is the current logging file for temperature information. When this files gets to 65,000 lines long, it will be archived by using the date and time at the time of the archive as a prefix to the temperatures.tem file, and a new current temperatures.com file will be open.

This figure shows the download tool:



When you download a file, its name is fixed. To avoid overwriting a file, it is suggested to rename the previously downloaded file first. Downloading large file can take some time... the download rate is approximately 1 kilobyte per second.

7.4.1 An example of status file

Here is an example of a typical status file. The content of this file gives an instantaneous “picture” of your T/Guard system. When contacting Neoptix for support, try to email a copy of this file with your request.

```
T/Guard 405 - Status Report
2013/12/20 09:04:13
```

```
Serial Number: 405-007A
Firmware version: 1.06
Hardware code: 1
Calibration date: 13/10/9
Up time: 2 days, 14 hours, 20 minutes, 34 seconds
```

```
----- Serial Interface -----
Serial Hardware: RS485-4w
Protocol: Neoptix
Address Id: None
Baud: 9600
Parity: None
```

```
----- Temperature Data Logging -----
Logging Enabled: yes
Logging rate: 600 seconds
```

```
List of files:
>temperatures.tem (89.216 KB)
```

Total: 1 files, 89.216 KB

----- Acquisition -----

Wtune: ON
Gskip: 5
Analog out err: Toggle Max-Min 1 Hz
Calibration type: Neoptix probe

----- Temperature Statistics -----

Unit: Celsius
Global Highest: 23.14
Global Lowest: 21.8

----- Channel Settings -----

Chan name	EnableZero	Span	Offset
Channel01	Y	-100.0400.0	0.0
Channel02	Y	-100.0400.0	0.0
Channel03	Y	-100.0400.0	0.0
Channel04	Y	-100.0400.0	0.0
Channel05	Y	-100.0400.0	0.0
Channel06	Y	-100.0400.0	0.0
Channel07	Y	-100.0400.0	0.0
Channel08	Y	-100.0400.0	0.0

----- Signal Quality -----

CH1:	100	ratio:2.67	lamp:170	CCD:60ms (auto)	21.8 C
CH2:	100	ratio:2.53	lamp:170	CCD:60ms (auto)	23.14 C
CH3:	100	ratio:2.34	lamp:175	CCD:40ms (auto)	22.8 C
CH4:	0	ratio:1.08	lamp:165	CCD:400ms (auto)	----
CH5:	0	ratio:1.00	lamp:165	CCD:400ms (auto)	----
CH6:	0	ratio:1.00	lamp:165	CCD:400ms (auto)	----
CH7:	0	ratio:1.00	lamp:165	CCD:400ms (auto)	----
CH8:	0	ratio:1.00	lamp:165	CCD:400ms (auto)	----

----- Enabled Protocols -----

Licensed serial protocols: Modbus

(end)

7.5 Firmware update tool

This tool provides a simple way to upgrade the 405 internal software code. Please note that an upgrade of a 405 will take about 15 minutes using the OptiLink-II software.

To get an upgrade file, you must contact Neoptix support, at support@neoptix.com.

Warning: Upgrading firmware is a delicate operation! Pay attention to these points:

- Make sure your upgrade file is on a local hard disk (normally C:).
- During the upgrade, avoid using your PC for any other tasks.
- You may get a few “retry” messages during the upgrade; this is perfectly normal.
- If logging, the current temperatures.tem file will be deleted; it is strongly suggested that you download any logged temperatures before attempting the firmware upgrade.

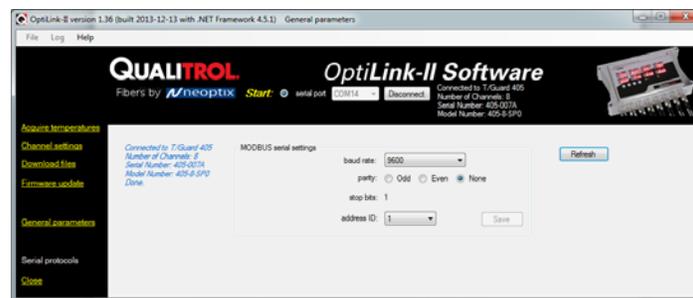
7.6 General parameters

This window allows setting up the time and controlling the temperature logging. Also use for data logging parameter settings.



7.7 Serial protocol parameters

This window gives you the opportunity to control the serial communication parameters that are to be used when a specific protocol is used. Please note that these parameters will be available only for protocols that have been licensed for your specific instrument (however, Modbus is always available). You cannot start these protocols using OptiLink-II, as then there would be a conflict over what takes control of the serial port; the best way to start a serial protocol would be to use the local keypad, as explained in Section 5.8.



7.8 Troubleshooting

Here are some tricks you can try to fix OptiLink-II issues:

- 1- Make sure the serial protocol on the *T/Guard 405* is set to “Neoptix”.
- 2- Make sure the COM port is listed correctly in the Windows Device Manager. Check the port properties.
- 3- Use the appropriate cables:

The standard interface on the T/Guard 405 is a RS-485 port, not a RS-232 port. You will probably need a converter, either a RS-232 to RS-485 converter or a USB to RS-485 converter; the latter is recommended (Neoptix part number NXP-341).

Make sure your wiring matches your computer interface. For example, if your wiring is for 4-wires, make sure the whole cabling and software setting are set for full-duplex.

- 4- Make sure your duplex settings match.
- 5- Try connecting to the port with a HyperTerminal (or Tera Term) client to see if it is responsive.

- 6- To download files from the 405, the use of OptiLink-II is mandatory, as the transfer file format is Neoptix proprietary (it is not compatible with the XModem format).
- 7- Try rebooting Windows.
- 8- Make sure you use the proper version of OptiLink-II, as it is available in two versions according to your PC operating system. One version is compatible with XP to Win7, and the second one with Vista to Win8.
- 9- Try re-installing your USB to serial port drivers on Windows.
- 10- When reinstalling OptiLink-II, make sure you use the Programs and Features facility in Control Panel of Windows.

8 OPTILINK SOFTWARE PACKAGE

The OptiLink™ software package (formerly NeoLink) option allows using your thermometer system in a highly flexible manner. The built-in functions allow for temperature displaying and data logging, as well as exporting to a variety of standard spreadsheet packages.

8.1 The “Lite” vs. the “Pro” version

OptiLink is now offered in two versions. The “Lite” version is now shipped as a standard item with every Neoptix thermometer. The “Pro” version includes more features and support more instruments and/or channels simultaneously. Contact your Neoptix Representative or the Neoptix factory to buy an unlocking code.

Note: The T/Guard system is normally supplied with OptiLink Pro.

8.1.1 Differences between the 2 versions

The “Lite” version exhibits the following limitations:

- Only one instrument is supported (when scanning the COM ports (going from 1 to 32), the first instrument that is detected by OptiLink will be the active instrument).
- Only 1 channel is supported.
- No DDE temperature data logging is supported.

The remaining of this Chapter describes the “Pro” version.

8.2 Getting started with OptiLink

OptiLink was designed to acquire temperature readings from all models of the Neoptix T/Guard thermometer family. This versatile software package is designed to work with Microsoft Windows operating system; to fully exploit the capabilities of OptiLink, it is recommended to use it in conjunction to commercial spreadsheet software, such as Microsoft Excel.

8.2.1 Hardware and software requirements

The following list includes the minimum requirements for running the OptiLink software:

- A Pentium class or higher CPU
- SVGA or higher resolution display system supported by Windows
- 512 MB of RAM memory (operating system dependent)
- At least 40 MB of hard disk space
- A CD/DVD disk drive (to load software); software is also available for down load from Neoptix website (contact Neoptix if required)
- A mouse or other Windows pointing device
- A RS-485 interface (COM1 to COM32). Up to 4 thermometer units are supported, each one requiring its own COM port
- Windows XP or later, including Vista and Windows 7 or 8.

OptiLink works correctly with both half-duplex and full-duplex Neoptix thermometers.

8.2.2 Installing OptiLink

Before opening the CD and installing the software, please refer to the **License and Limited Warranty Agreement** at the beginning of this manual.

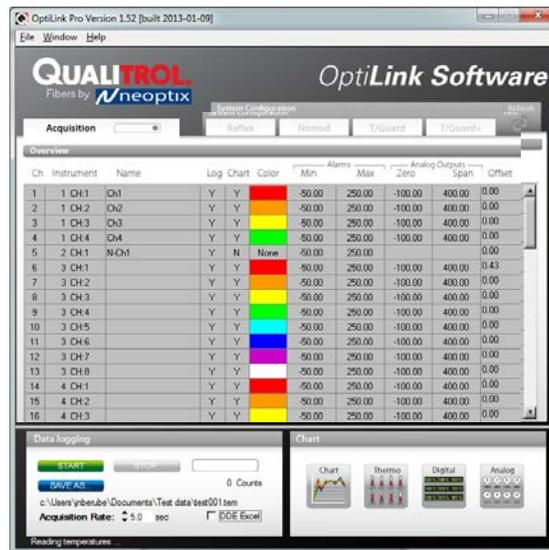
You must have at least one, or more, properly installed T/Guard thermometer unit(s).

- 1- Start Windows, and make sure you are not running any other Windows program.
- 2- By inserting the CD in your computer, the SETUP application should automatically start; if not, manually start it.
- 3- Follow the instructions that are displayed.
- 4- Restart your computer.

8.3 A quick tour of OptiLink

- 1- Connect your T/Guard unit(s) to free COM port(s).
- 2- Start OptiLink, if not already running.
- 3- The thermometers that are turned on and connected to your PC through a proper RS-485 connection should normally be automatically detected by OptiLink⁸ (this process takes a few seconds, for a typical installation).
- 4- If a thermometer is connected after OptiLink is started, you should click the “Refresh” button so OptiLink rescans the COM ports (1 to 32). If a thermometer is not automatically detected, make sure your RS-485 port and cable is correctly configured and that the unit is turned on.

You should normally see a window similar to this (acquisition window):



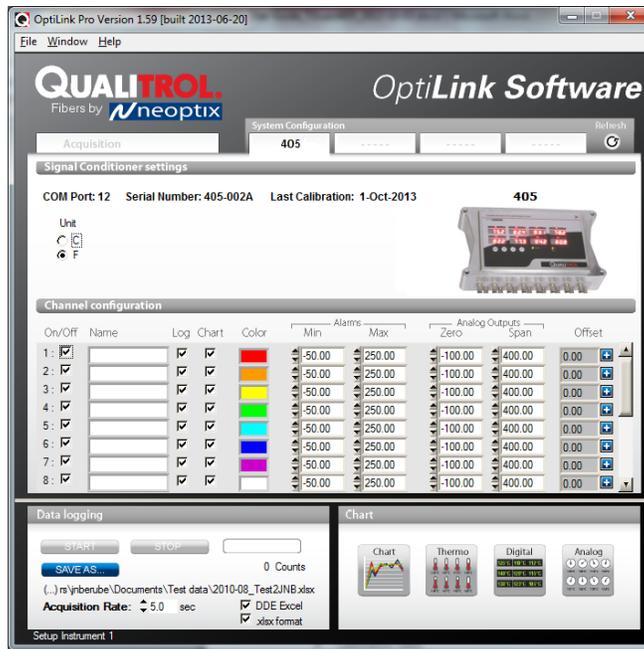
In this example, we see that OptiLink has detected 4 thermometers: a Reflex, a Nomad, a T/Guard and a T/Guard+ (in test mode only; OPC mode is not supported by OptiLink).

OptiLink is now properly installed and ready to use!

8.3.1 Working with the Configuration Window

OptiLink starts with the “Acquisition” window active, as shown in the figure above. To switch to the “System Configuration” window, you need to click on one of the instrument names that have been detected; for example, by clicking on “T/Guard” or “405”, you will get the following window:

⁸ If the automatic COM port scanning is causing problems with some of your other programs, specific COM port can be excluded from being scanned. Refer to Section 8.6.1.3 for more information.



For each instrument, this configuration window gives some information about this particular information and allows you to set some parameters.

The top portion of the window gives information about the specifics of the thermometer, such as:

- COM Port number
- Serial Number
- Calibration date.

Description of the parameters that can be set:

- Unit: You can select °C or °F.
- Scan Rate: Fast (recommended for most applications) or Slow.
- For Modbus-enabled T/Guard system: A special “Config Modbus” button appears to allow for setting up Modbus parameters. See Section 9.1 below for more information.

Furthermore, for each channel, you can set the following parameters:

- On / Off: You can turn on or off the temperature for each channel.
- Name: Up to 16 characters. You can enter a probe name here that suits your application.
- Log: If checked, the temperature data for this channel will be logged, when data logging is active.
- Chart: If checked, the temperature data for this channel will be displayed when one of the 4 chart windows is open.
- Color: This is the color of the curve that will be used when the Chart window is open.
- Alarms, Min and Max: Allows setting alarm limits. When one of more alarms are detected, a message is given at the bottom of the main window (must be in Acquisition mode). For a given channel, alarms are monitored only when its corresponding “Chart” or “Log” checkbox is checked, in the Configuration window pane. Alarms are monitored only when Acquisition is active.

- Analog Outputs: Allows configuring the analog output parameters, Zero and Span. See Section 6.4 for a complete description of these parameters.
- Offset: Allows adding an offset to this channel. See below.

8.3.1.1 Adjusting a temperature offset

OptiLink allows you to add an offset to the temperature readings that are returned by a thermometer. This feature is equivalent to the “f” serial command, as described in Section 6.4 although its implementation in OptiLink is somewhat different than it is for the serial command.

An offset can be useful for the following two cases:

- 1- To temporarily change the reading of a probe that is believed to be in error (one-point calibration procedure). This usually requires that a good temperature reference be available.
- 2- To force an offset to a reading, for example may want to monitor a temperature variation from a given set temperature. In this case, you can simply enter the “0” value as a forced temperature setting, and the resulting reading will give you a + or – deviation from the set temperature point.

Warning: Doing a temperature offset adjustment on a channel will alter its reading. In effect, it alters the thermometer own calibration. It must be used with care!

To perform an offset adjustment, follow these instructions:

- 1- Click the “Offset Adjust” button () that is just next to the channel number you want to calibrate. The following menu window is available:



- 2- Type in the “Set Point” box the actual temperature that you would like to force for this channel (this temperature is normally obtained using an accurate NIST-certified primary temperature reference).
- 3- Press the “OK” button to activate the reference temperature. The “Offset” value will reset to its new value, as a result of your new forced temperature; this new offset is now displayed in the main window.
- 4- To reset this forced temperature setting, go back to the “Channel Offset” window, and click the Clear button.
- 5- Repeat the same procedure for the other channels that you want to modify.

8.4 Acquiring and viewing temperature data

Once all your thermometers are properly connected and configured, you may want to log data to a file, or to display their values on screen. A number of tools are available for that.

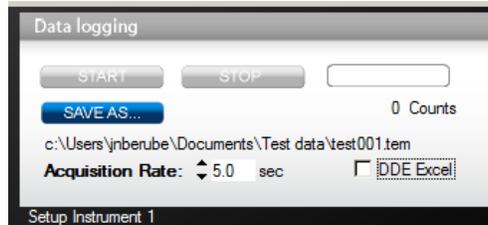
To view or acquire data, the “Acquisition” pane must be active.

8.4.1 Logging temperature data to a file

OptiLink offers the possibility to log temperature values to an Excel compatible file. The default file extension is .tem; this file can be subsequently open using Excel, which should open it and automatically recognize as an Excel compatible file (tab delimited).

Furthermore, OptiLink Pro offers the possibility to log directly to an .xls Excel file, using the Microsoft DDE data transfer protocol. This is described in Section 8.4.1.2 below.

The parameters that are useful to control the logging are shown in the lower left portion of the window, as shown here:

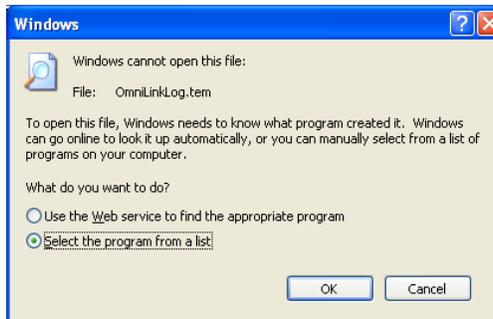


- To set the logging filename, click on “SAVE AS...”; this allows you to enter a file name. For information, the current filename is displayed just below this button. Default file location is “My Documents”, for Windows 7 and above.
- To set the acquisition rate, enter a number, in seconds, in the appropriate text box. Rate can be set from 0.2 to 3600 seconds (1.0 to 3600 seconds if logging to an Excel file).
- To start acquiring data, click the “START” button. Conversely, to stop the acquisition, click the “STOP” button.

A convenient record counter is provided, confirming that logging is actually active.

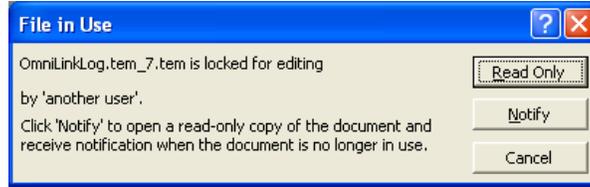
8.4.1.1 Logging to a .tem file

When subsequently trying to opening the *.tem file, it is possible that you may get the following message:



Select “Select the program from a list”, and click OK. In the next window, you should instruct Windows to always open this type of file with Microsoft Excel.

If you get the following message, you should select “Read Only”.



In Excel, the data file should look like this:

	A	B	C	D	E	F	G	H	I	J	K	
1	Neoptix inc.											
2	Instrument(serial):	1(RFX88A)	1(RFX88A)	1(RFX88A)	1(RFX88A)	2(NMD218A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	
3	Channel name:	1:Ch1	2:Ch2	3:Ch3	4:Ch4	1:N-Ch1	1:00	2:00	3:00	4:00		
4	Channel #:	1	2	3	4	5	6	7	8	9		
5	13/02/2007 19:34:07	23.2	100.2	24.7	-999.66	23.9	28.5	39.3	18.5	29.1		
6	13/02/2007 19:34:07	23.2	100.2	24.7	-999.66	23.9	28.5	39.3	18.5	29.1		
7	13/02/2007 19:34:07	23.2	100.2	24.7	-999.66	23.9	28.5	39.3	18.5	29.1		
8	13/02/2007 19:34:08	23.2	100.2	24.7	-999.66	23.9	28.5	39.3	18.5	29.1		
9	13/02/2007 19:34:08	23.2	100.2	24.7	-999.66	23.9	28.5	39.4	18.5	29.1		
10	13/02/2007 19:34:08	23.2	100.2	24.7	-999.66	23.9	28.5	39.4	18.5	29.1		

- Notes:
- 1) If a column shows “#####”, this means that this column is too narrow to display the data; use your mouse to widen this column.
 - 2) If you open a logging file during acquisition, the Excel window is not refreshed as the acquisition is taking place. To get a more recent version of the file, close the Excel program, and start Excel again.
 - 3) A value of -999.xx indicates that no reading is available for this channel. Check the probe connection.

If you stop the acquisition, and start it again with the same file name, the new values will simply be appended to the existing file content. However, a new 5-line header is inserted first, as shown here:

35	13/02/2007 19:34:13	23.2	100.3	24.7	-999.66	23.9	28.5	39.4	18.5	29.1		
36	13/02/2007 19:34:13	23.2	100.3	24.7	-999.66	23.9	28.5	39.4	18.5	29.1		
37	13/02/2007 19:34:13	23.2	100.3	24.7	-999.66	23.9	28.5	39.4	18.5	29.1		
38	13/02/2007 19:34:14	23.2	100.3	24.7	-999.66	23.9	28.5	39.4	18.6	29.1		
39	Neoptix inc.											
40	Instrument(serial):	1(RFX88A)	1(RFX88A)	1(RFX88A)	1(RFX88A)	2(NMD218A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	3(TGP528A)	
41	Channel name:	1:Ch1	2:Ch2	3:Ch3	4:Ch4	1:N-Ch1	1:00	2:00	3:00	4:00		
42	Channel #:	1	2	3	4	5	6	7	8	9		
43	13/02/2007 19:34:31	23.2	100.2	24.7	-999.66	23.9	28.6	39.4	18.6	29.1		
44	13/02/2007 19:34:36	23.2	100.2	24.8	-999.66	23.9	28.6	39.3	18.5	29.1		

When logging temperatures for a very long time, one needs to note that a standard Excel sheet is limited to 65535 lines. If this limit is reached, the logging process will close the current data-logging file, and will open a new one, with the same name but with “_1” appended to the file name, and so on (“_2” ...), until the application is stopped or your disk becomes full.

8.4.1.2 Logging to a .xls (or .xlsx) file

This logging method requires the Microsoft Excel application, which must be already installed. This logging method has some advantages over the previously described logging method, namely:

- Temperatures are directly stored in a genuine .xls file; no intermediary file is used.
- It allows the user the look at the data as it is written in real time in the .xls file.

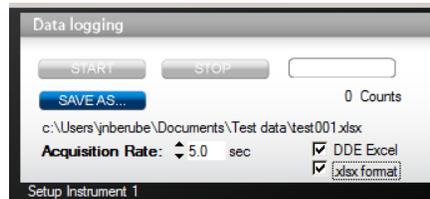
- It allows the user to write comments directly in the .xls file, as the data is being acquired.

Warning: An English language Excel is required; logging using Excel in other languages may work, but is not guaranteed by Neoptix. Furthermore, it is highly recommended that you do not use Excel for other purposes when DDE data logging is taking place; failure to respect this may result in lost data (your data or temperature data).

Before you can use this logging method, you must set it up on your PC. This needs to be done only once.

DDE logging setup

Click the DDE Excel checkbox, as illustrated here:



Then, you will get an invitation to specify the location of your Excel application (excel.exe). Once the Excel location and language selection⁹ are confirmed (look into “C:\Program files\Microsoft Office\OfficeXX”), logging will start as described below.

If you are using Office 2007 or later, make sure to check the box “.xlsx format”. With Office 2007 or later, files can be saved only in the new format .xlsx.

DDE logging

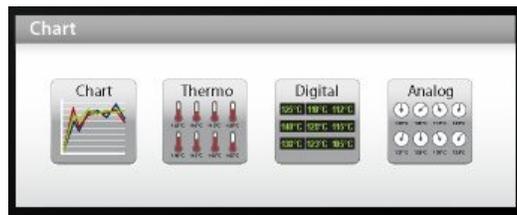
Click the START button to start the logging process. The Excel application will open, and you will be able to see the data being written to the file. **Do not close this Excel sheet;** however you may minimize it without any problem.

To stop logging, click the STOP button in OptiLink; this will automatically close the Excel sheet and application. Do not close the Excel application yourself!

Otherwise, the DDE logging is very similar to logging to a .tem file, as described above. Acquisition rate is limited to 1 second.

8.4.2 Viewing temperature data

Temperature values can be displayed on your computer screen in a number of ways. Click one of the four “Chart” button to active one or more of these windows.

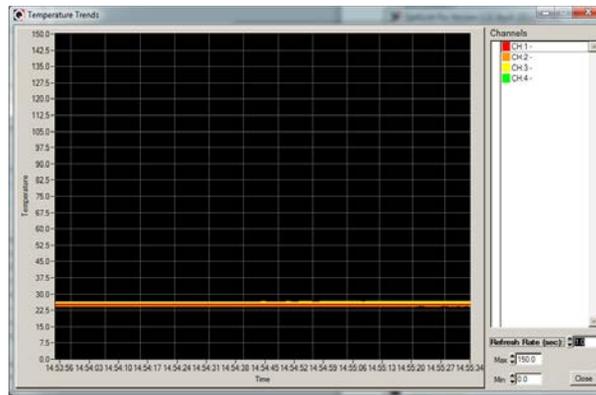


⁹ You have two choices: English or French. If you are using Excel in another language, you must select English.

Note that more than one window type can be displayed simultaneously; in addition, you can log temperatures to a file independently from these display windows. Note that each of these 2 modes have each their own acquisition time base.

8.4.2.1 *Displaying temperature trends*

Click the “Chart” button to get the following window.

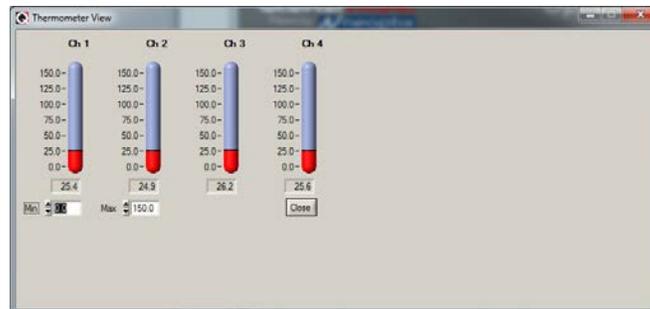


Adjust the “Refresh Rate” (minimum is 0.2 sec) and Min / Max to suit your viewing needs.

Note that the setting of curve colors and other parameters must be done in the “System Configuration” window pane. Up to 64 trends can be displayed.

8.4.2.2 *Displaying analog thermometers*

Click the “Thermo” button; the following window will appear.



All thermometers share the same Min / Max reading setting. Refresh rate is fixed at 1.0 sec. The size of this window will change depending on the number of channels to display. Up to 16 thermometers can be shown; if you want to display more than 16 channels, only the first 16 detected channels will be shown (note that any channel that has its “Chart” checkbox unchecked, in the main window, will not be shown).

If an alarm is active for a channel, the corresponding thermometer numbers will change color: blue for a low temperature alarm, or red for a high temperature alarm.

8.4.2.3 *Displaying digital values*

To display digital temperatures, click on the “Digital” button. The following window will appear.

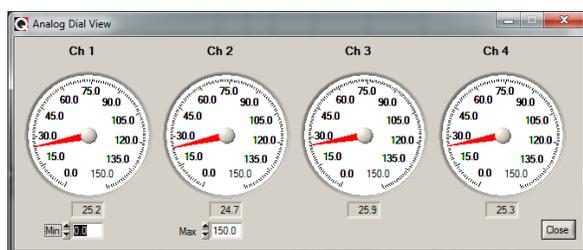


The size of this window will adapt to the number of channels to display. Up to 32 values can be shown. Refresh rate is always 1.0 sec.

If an alarm is active for a channel, the corresponding display will change color: blue for a low temperature alarm, or red for a high temperature alarm.

8.4.2.4 *Displaying analog values (dials)*

To display analog temperatures (using dials), click on the “Analog” button. The active window becomes this:



All dials share the same Min / Max reading setting. Refresh rate is always 1.0 sec. The size of this window will adapt to the number of displayed channels. Up to 16 dials can be shown; if you want to display more than 16 channels, only the first 16 detected channels will be shown (note that any channel that has its “Chart” checkbox unchecked, in the main window, will not be shown).

If an alarm is active for a channel, the corresponding dial numbers will change color: blue for a low temperature alarm, or red for a high temperature alarm.

8.5 *The OptiLink Console*

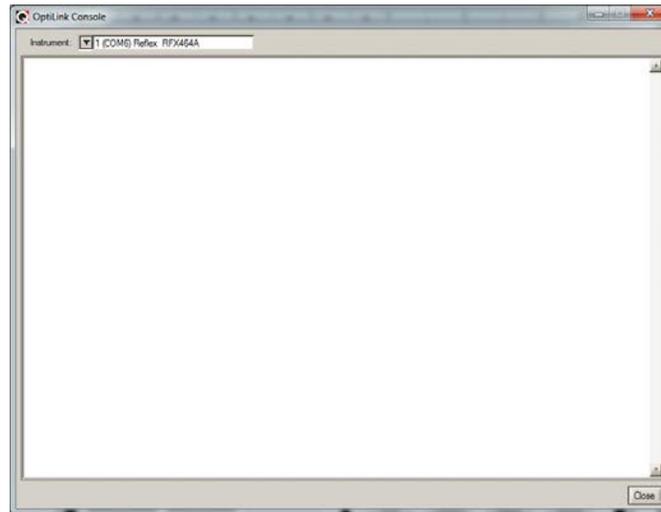
You must be in “System Configuration” mode to use the console.

The console, which can be invoked through the Window and then Open Console from OptiLink main window menu bar, is useful to manage each Neoptix thermometer in details. Take note that the console can only be open when no temperature acquisition is taking place. It can be useful also to understand problems and malfunctions that a module may exhibit. It operates in a similar fashion as Windows HyperTerminal, which Neoptix suggests to use with all thermometer models (such as the Reflex or T/Guard).

The console can be used to get information such as:

- Information on calibration date, serial number, etc.
- Enable / disable channels
- Set the analog output parameters (zero and span)
- Control operational features, such as fast/slow scanning more, wtune, etc.
- Calibration type, Neoptix or Nortech Fibronic, Inc.
- And so forth.

The following illustrates the OptiLink Console:

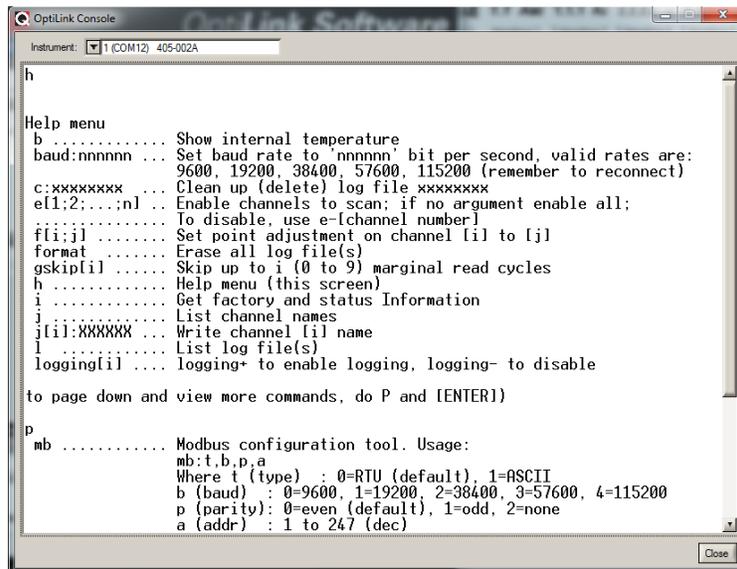


Before sending commands and receiving information from a specific module, it is necessary to select the instrument you want to interrogate. Please note that only ONE instrument can be selected at a time; if the same command is to be sent to all thermometers, then, it is necessary to repeat the command for each individual module.

You can use “Copy and Paste” Windows commands (such as the following shortcuts: `ctl-c` and `ctl-v`) to copy selected content of the console content to other Windows programs, such as Notepad, etc.

8.5.1 Console help menu

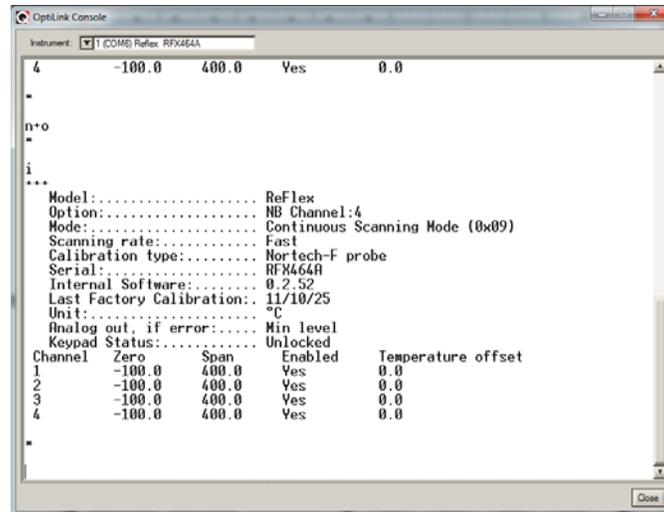
The following is the menu as displayed by the instrument when sending the “h” command. This help menu can be used as a reminder of all available commands, for this specific instruments.



For a complete description of all commands, refer to Section 6.4 above.

8.5.2 Switching between calibration types

The OptiLink Console is a very useful tool that can easily be used to change the calibration types, for T/Guard system that have the double calibration feature enabled (Neoptix and older Nortech Fibronic, Inc. probes). One can simply enter the “n+o” to enable the Nortech-Fibronic calibration, or “n+e” for the Neoptix calibration. This is illustrated in the figure below:



8.6 OptiLink functions

This section explains in details each one of the functions provided by the menus of the OptiLink software package. This Section only gives a brief overview of the commands that are possible; for operational details, please refer to the above Sections.

8.6.1 The File menu

The *File* menu provides the user with basic functions to handle Configuration files.

8.6.1.1 Find Instruments (Refresh)

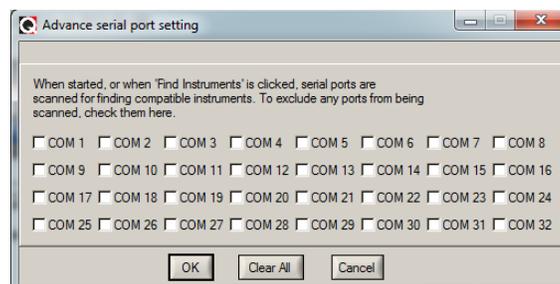
This is equivalent to the “Refresh” button, found on the main window.

8.6.1.2 Disconnect Instruments

This will release all COM ports, select this menu item. OptiLink becomes idle, and to bring it to life again requires you to click the “Refresh” button (or to select the Find Instruments (Refresh)” menu item

8.6.1.3 Advance serial port setting

This command allows the user to force the exclusion of one or more COM ports from being scanned when clicking the “Refresh” button. This may be useful when one finds that the automatic COM port refresh feature of OptiLink is interfering with equipment that are using defined COM ports. You can check all ports that you want to exclude from the automatic scanning process. This window looks like this:



8.6.1.4 Quit

Select Quit from the File menu to exit OptiLink. Any configuration or setting that you might have done to any parameters is automatically saved, so the same configuration will be available the next time you open OptiLink.

8.6.2 The Window menu

From this menu, you can open the following 5 windows:

- Console view
- Trend view
- Thermometer view
- Digital view
- Analog (dial) view

8.6.2.1 Open Console

Open Console can be very useful for developers and other users who want to interrogate the “internal” parameters of a Neoptix thermometer. It should be used only by experienced users.

8.6.2.2 View Trends

Select this menu item to open a window that gives you a graphical representation of your temperature readings, as a function of time. Up to 64 curves can be simultaneously displayed. The sampling time base is adjustable.

8.6.2.3 View Thermometers

Select this menu item to display thermometers that will give you temperature data on up to 16 channels. Sampling rate is fixed at one reading per second.

8.6.2.4 View Digital meters

Select this menu item to display digital readouts that will give you temperature data on up to 32 channels. Sampling rate is fixed at one reading per second.

8.6.2.5 View Analog Dial meters

Select this menu item to display analog dials that will give you temperature data on up to 16 channels. Sampling rate is fixed at one reading per second.

8.6.3 The Help Menu

This is a standard Windows Help menu.

From this menu, you can also enter an unlocking code to convert OptiLink from a “Lite” version to the “Pro” version.

9 THE MODBUS PROTOCOL

Information: For a description of the DNP 3.0 and IEC 60870-5-101 serial smart protocols, refer to the Neoptix user guide # g1030; do not hesitate to ask a copy if you need it.

The MODBUS protocol is a messaging structure developed by Modicon in 1979, used to establish master-slave / client-server communication between intelligent devices. It is a de-facto standard, truly open and the most widely used network protocol in the industrial manufacturing environment. The Modbus protocol provides an industry standard method that Modbus devices use for parsing messages. The Neoptix Modbus option has been developed to support Modbus over a Serial Line protocol.

A master-slave type system has one node (the master node) that issues explicit commands to one of the “slave” nodes and processes responses. Slave nodes (such as the T/Guard systems) will not transmit data without a request from the master node, and do not communicate with other slaves.

At the physical level, Modbus over Serial Line systems may use different physical interface (RS-485, RS-232). RS-485 two-wire interface is the most common. As an add-on option (contact Neoptix), RS-485 four-wire interface may also be implemented. Furthermore, the Neoptix Modbus option has been successfully tested over a TCP/IP network, using a Lantronix device server; however, if this type of interface is required, we suggest that you use a Neoptix T/Guard-408XT instead of a T/Guard-405.

Neoptix has experienced some communication problems when configuring multiple Modbus-RS-485 systems together. This is usually caused by unstable grounding problems, such as what can be encountered when dealing with power transformers. To solve these problems, all Neoptix T/Guard's now have their serial port opto-isolated and thus should not cause problems over a RS-485 network bus. Refer to Section 10.1 for more information on RS-485 adapters.

9.1 Configuring the Modbus option

Enabling and configuring the Modbus option must be done when the T/Guard system is *not* in Modbus communication mode. When the Modbus option has been purchased, the help menu (see Section 6.3) is slightly modified, as the following line is added:

mb: Modbus configuration tool, type: 'mb:?' for help;

Typing “mb:?” gives:

Modbus configuration tool

```
mb:t,b,p,a<CR>
```

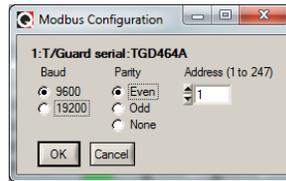
Where t (type) : 0=RTU (default), 1=ASCII
b (baud) : 0=9600, 1=19200
p (parity) : 0=even (default), 1=odd, 2=none
a (addr) : 1 to 247 (dec)

Example: mb:0,1,0,21

For RTU mode at 19200, even parity, Modbus address 21 (15hex)

Note: The number of stop bits cannot be changed for the T/Guard-405: it is always 1 bit.

Note for OptiLink and OptiLink-II software users: The Modbus parameters can also be set up using OptiLink. A special “Config Modbus” button appears (shown below) when OptiLink is connected to a Modbus-enabled T/Guard system.



Modbus mode is confirmed if “Modb xxx” is briefly displayed on the LED display (xxx is the currently active Modbus node address, 1 to 247), immediately after power on. You are now ready to connect the T/Guard to your Modbus enabled network.

9.2 Supported serial transmission mode

The transmission mode defines the bit contents of the message bytes transmitted along the network, and how the message information is to be packed into the message stream and decoded. The current implementation of Neoptix-Modbus supports only the RTU mode ASCII mode is not supported.

9.3 RTU transmission mode

Coding system	8 bit binary
Number of data bits per character	10 bits start bits –1 data bits – 8 parity bits – 0 or 1 (even or odd) stop bits – 1 (2 if no parity bit used)
Parity	Not used or even or odd parity
Bit transfer rate	9600 or 19200 Baud
Duplex	Full or Half
Error checking	CRC (cyclic redundancy check)
Polynomial	(CRC-16 101000000000001)
Bit transfer order	LSBit first, MSByte first
End of message	Idle line for 3.5 or more characters.

The link layer includes the following properties /behaviours:

- Slave address recognition
- Start / End of Frame detection
- CRC-16 generation / checking
- Transmit / receive message time-out
- Buffer overflow detection
- Framing error detection
- Idle line detection.

9.4 Modbus function code and register addresses

Warnings:

- Registers can only be read in groups of up to 16 registers.
- Multiple write to more than one register is not supported.

Temperature if no signal: -9996 (-999.6)

Temperature if channel is disabled: -9995 (-999.5)

9.4.1 Register content details

	Name	Reg Type Modscan	Read Write	405	Description (type)
	Device Internal temperature	03	R	41	
	Number of channels	03	R	42	(Signed 16 bit integer)
	Soft version	03	R	43	(Signed 16 bit integer)
	Soft revision	03	R	44	(Signed 16 bit integer)
	Device type	03	R	45	= 18 for
	Mode A	03	R	46	(Signed 16 bit integer)
	Mode B	03	R	46	(Signed 16 bit integer)
Power %	Powerpct channel 1	03	R	101	Power % (Signed 16 bit integer)
	Powerpct channel 2	03	R	102	
	Powerpct channel 3	03	R	103	
	Powerpct channel 4	03	R	104	
	Powerpct channel 5	03	R	105	
	Powerpct channel 6	03	R	106	
	Powerpct channel 7	03	R	107	
	Powerpct channel 8	03	R	108	
	Powerpct channel 9	03	R	109	
	Powerpct channel 10	03	R	110	
	Powerpct channel 11	03	R	111	
	Powerpct channel 12	03	R	112	
	Powerpct channel 13	03	R	113	
	Powerpct channel 14	03	R	114	
	Powerpct channel 15	03	R	115	
	Powerpct channel 16	03	R	116	
Lamp attenuation	Lamp attn Channel 1	03	R	201	Value between 0 and 255
	Lamp attn Channel 2	03	R	202	
	Lamp attn Channel 3	03	R	203	
	Lamp attn Channel 4	03	R	204	
	Lamp attn Channel 5	03	R	205	
	Lamp attn Channel 6	03	R	206	
	Lamp attn Channel 7	03	R	207	
	Lamp attn Channel 8	03	R	208	
	Lamp attn Channel 9	03	R	209	
	Lamp attn Channel 10	03	R	210	
	Lamp attn Channel 11	03	R	211	
	Lamp attn Channel 12	03	R	212	
	Lamp attn Channel 13	03	R	213	
	Lamp attn Channel 14	03	R	214	
	Lamp attn Channel 15	03	R	215	
	Lamp attn Channel 16	03	R	216	
CCD Time	CCD time Channel 1	03	R	301	Non-auto (wtune-) = 50
	CCD time Channel 2	03	R	302	Auto (wtune+) = 20 to 500, Signed 16 bit integer
	CCD time Channel 3	03	R	303	
	CCD time Channel 4	03	R	304	
	CCD time Channel 5	03	R	305	
	CCD time Channel 6	03	R	306	
	CCD time Channel 7	03	R	307	

	CCD time Channel 8	03	R	308	
	CCD time Channel 9	03	R	309	
	CCD time Channel 10	03	R	310	
	CCD time Channel 11	03	R	311	
	CCD time Channel 12	03	R	312	
	CCD time Channel 13	03	R	313	
	CCD time Channel 14	03	R	314	
	CCD time Channel 15	03	R	315	
	CCD time Channel 16	03	R	316	
Ratio (signal strength)	Ratio Channel 1	03	R	401	Ratio * 100 (Signed 16 bit integer)
	Ratio Channel 2	03	R	402	
	Ratio Channel 3	03	R	403	
	Ratio Channel 4	03	R	404	
	Ratio Channel 5	03	R	405	
	Ratio Channel 6	03	R	406	
	Ratio Channel 7	03	R	407	
	Ratio Channel 8	03	R	408	
	Ratio Channel 9	03	R	409	
	Ratio Channel 10	03	R	410	
	Ratio Channel 11	03	R	411	
	Ratio Channel 12	03	R	412	
	Ratio Channel 13	03	R	413	
	Ratio Channel 14	03	R	414	
	Ratio Channel 15	03	R	415	
	Ratio Channel 16	03	R	416	
Analog zero	Analog zero Channel 1	03	R/W	2001	Temperature * 10, Signed 16 bit integer
	Analog zero Channel 2	03	R/W	2002	
	Analog zero Channel 3	03	R/W	2003	
	Analog zero Channel 4	03	R/W	2004	
	Analog zero Channel 5	03	R/W	2005	
	Analog zero Channel 6	03	R/W	2006	
	Analog zero Channel 7	03	R/W	2007	
	Analog zero Channel 8	03	R/W	2008	
	Analog zero Channel 9	03	R/W	2009	
	Analog zero Channel 10	03	R/W	2010	
	Analog zero Channel 11	03	R/W	2011	
	Analog zero Channel 12	03	R/W	2012	
	Analog zero Channel 13	03	R/W	2013	
	Analog zero Channel 14	03	R/W	2014	
	Analog zero Channel 15	03	R/W	2015	
	Analog zero Channel 16	03	R/W	2016	
Analog span	Analog span Channel 1	03	R/W	2101	Temperature * 10, Signed 16 bit integer
	Analog span Channel 2	03	R/W	2102	
	Analog span Channel 3	03	R/W	2103	
	Analog span Channel 4	03	R/W	2104	
	Analog span Channel 5	03	R/W	2105	
	Analog span Channel 6	03	R/W	2106	
	Analog span Channel 7	03	R/W	2107	
	Analog span Channel 8	03	R/W	2108	
	Analog span Channel 9	03	R/W	2109	
	Analog span Channel 10	03	R/W	2110	
	Analog span Channel 11	03	R/W	2111	

	Analog span Channel 12	03	R/W	2112	
	Analog span Channel 13	03	R/W	2113	
	Analog span Channel 14	03	R/W	2114	
	Analog span Channel 15	03	R/W	2115	
	Analog span Channel 16	03	R/W	2116	
Offset on channel	Offset Channel 1	03	R/W	2201	Temperature * 10, Signed 16 bit integer
	Offset Channel 2	03	R/W	2202	
	Offset Channel 3	03	R/W	2203	
	Offset Channel 4	03	R/W	2204	
	Offset Channel 5	03	R/W	2205	
	Offset Channel 6	03	R/W	2206	
	Offset Channel 7	03	R/W	2207	
	Offset Channel 8	03	R/W	2208	
	Offset Channel 9	03	R/W	2209	
	Offset Channel 10	03	R/W	2210	
	Offset Channel 11	03	R/W	2211	
	Offset Channel 12	03	R/W	2212	
	Offset Channel 13	03	R/W	2213	
	Offset Channel 14	03	R/W	2214	
	Offset Channel 15	03	R/W	2215	
	Offset Channel 16	03	R/W	2216	
Enable channel	Enable Channel 1	03	R/W	2301	0 = disable ; 1 = enable
	Enable Channel 2	03	R/W	2302	
	Enable Channel 3	03	R/W	2303	
	Enable Channel 4	03	R/W	2304	
	Enable Channel 5	03	R/W	2305	
	Enable Channel 6	03	R/W	2306	
	Enable Channel 7	03	R/W	2307	
	Enable Channel 8	03	R/W	2308	
	Enable Channel 9	03	R/W	2309	
	Enable Channel 10	03	R/W	2310	
	Enable Channel 11	03	R/W	2311	
	Enable Channel 12	03	R/W	2312	
	Enable Channel 13	03	R/W	2313	
	Enable Channel 14	03	R/W	2314	
	Enable Channel 15	03	R/W	2315	
	Enable Channel 16	03	R/W	2316	
	Calibration type	03	R/W	2501	0 = Neoptix ; 1 = Nortech Fibronic
	Unit	03	R/W	2502	0 = °C ; 1 = °F
	wtune	03	R/W	2504	0 = disable ; 1 = enable (optimize CCD time)
	Analog out if error	03	R/W	2505	0 = max if no signal ; 1 = min if no signal
Temperature, actual	Channel 1 temperature	04	R	1	Temperature * 10, Signed 16 bit integer
	Channel 2 temperature	04	R	2	
	Channel 3 temperature	04	R	3	
	Channel 4 temperature	04	R	4	
	Channel 5 temperature	04	R	5	
	Channel 6 temperature	04	R	6	
	Channel 7 temperature	04	R	7	
	Channel 8 temperature	04	R	8	
	Channel 9 temperature	04	R	9	
	Channel 10 temperature	04	R	10	

	Channel 11 temperature	04	R	11	
	Channel 12 temperature	04	R	12	
	Channel 13 temperature	04	R	13	
	Channel 14 temperature	04	R	14	
	Channel 15 temperature	04	R	15	
	Channel 16 temperature	04	R	16	
Channel status	Channel 1 status	02	R	17	0 = No signal * 1 = Probe detected
	Channel 2 status	02	R	18	
	Channel 3 status	02	R	19	
	Channel 4 status	02	R	20	
	Channel 5 status	02	R	21	
	Channel 6 status	02	R	22	
	Channel 7 status	02	R	23	
	Channel 8 status	02	R	24	
	Channel 9 status	02	R	25	
	Channel 10 status	02	R	26	
	Channel 11 status	02	R	27	
	Channel 12 status	02	R	28	
	Channel 13 status	02	R	29	
	Channel 14 status	02	R	30	
	Channel 15 status	02	R	31	
	Channel 16 status	02	R	32	

9.4.2 Functions and Modbus exceptions

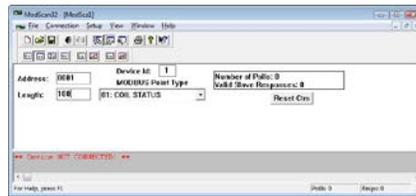
TGD, TGL T/Guard 2	Supported Function Codes		
	Function code	Name	Usage
x	01 (01h)	Read Coils	Device config and channel enable
x x	02 (02h)	Read Discrete Inputs	Optical signal present
x x	03 (03h)	Read Holding Register	Device config and temperatures
x	04 (04h)	Read Input Register	Measured temperature values
x	05 (05h)	Write Single Coil	Device config and channel enable
x x	06 (06h)	Write Single Register	Device config
x	15 (0Fh)	Write Multiple Coil	Device config and channel enable
x	16 (10h)	Write Multiple Registers	Device config

Supported Exception Codes			
	Function code	Name	Usage
x	x	01 (01h)	ILLEGAL FUNCTION The function code received in the query is not an allowable action for the server (or slave).
x	x	02 (02h)	ILLEGAL DATA ADDRESS The data address received in the query is not an allowable address for the server (or slave)..

9.5 ModScan examples

ModScan be purchased from <http://www.win-tech.com/html/modscan32.htm>. ModScan is a good and simple program that can be used to exercise Modbus links. Furthermore, it can also be used to perform some simple data logging. Please note that this program must be purchased separately, it is not supplied as a standard item with the T/Guard system.

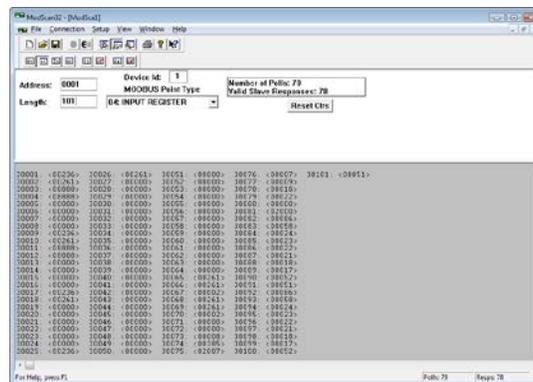
When started, the following screen will appear:



Make sure your T/Guard systems are connected to your PC computer. Usually, as a PC computer does not have a RS-485 port, you will normally need a RS-232 to RS-485 adapter or a USB to RS-485 converter (available as an option from Neoptix). You must first connect to your PC, by selecting Connection from the main menu, and then Connect. The following window will open:



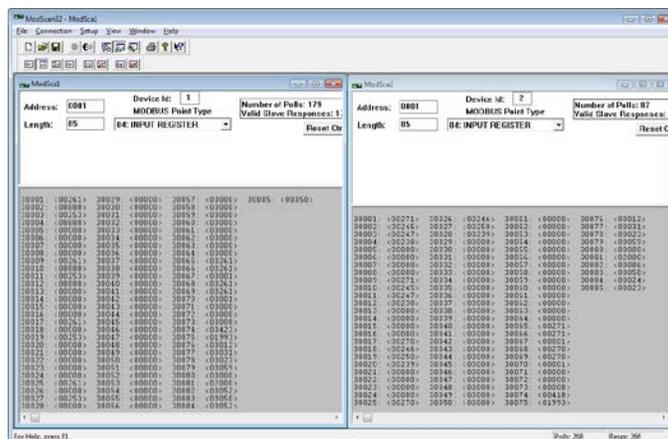
Make sure the Com port, baud rate and parity are set correctly (Word length should always be 8). Click OK. Next, make sure "Device Id:" is set to the proper Modbus address. You should now be connected and ready to monitor data. For example, the following figure shows values for all 101 input registers; you can see that temperature on channel # 1 is 23.6°C, and so forth. Temperature values are multiplied by 10, and are given as integers, not floating point numbers.



9.5.1 Monitoring multiple T/Guard

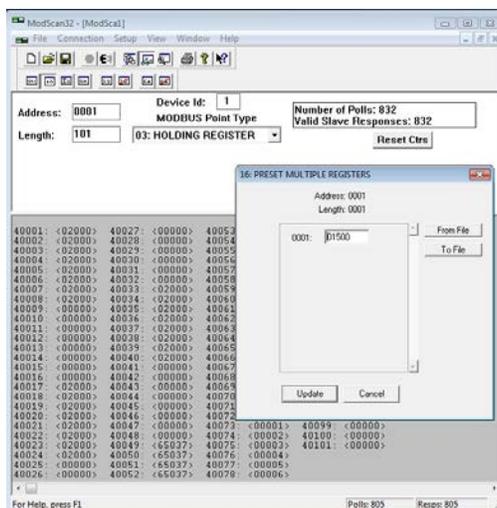
ModScan can be used to monitor either multiple T/Guard systems (as shown below), or multiple type of variables, for example, the input registers and coil status. To do this, simply open multiple windows within ModScan (from the main menu bar, select File and then New).

Warning: if you are opening many windows at once, it may be a good idea to slow down the data refresh rate. This can be done by selecting Setup from the main menu, then Data Definition, and then by entering something like 5 seconds in the Scan rate box; please remember than you will need to perform this setting for each opened window.



9.5.2 Writing parameters

To write data, you must select either Holding Register, or Coil Status. Then, from the main menu bar, select Setup, then Extended, then Preset Regs. Make sure the value of “Number of Points” is 1 (you cannot write to multiple registers at once). Make sure the Slave Device is corrected set (node number), and that the Address points to the register address you want to modify. For example, to change a temperature value, say from 200 to 150, you will enter (remember to multiply the temperature value by 10):



Click update to “write” your new value.

9.5.3 Data logging

ModScan allows you to log either in a text file (.txt) or a database file (.mdb, Microsoft Access format). Both are similar. Here is a quick example, saving to a text file.

Select Setup from the main menu, and then Text Capture. In the Save As box, enter a proper file name (if using Windows Vista or Windows 7, make sure your file is not saved in the Program File directory). In the next window, enter the frequency at which you want to log data:

10 RS-485 CONVERTERS

10.1 RS-485 to USB converter

As most PC computers today don't have serial ports, Neoptix recommends using a RS-485 to USB converter (also called adapter). Neoptix part number NXP-341 is a complete opto-isolator kit (RS-485 to USB). It works great with all T/Guards, T/Guard-408, T/Guard-405, T/Guard-2B systems. This converter works for both 2W and 4W RS-485 installations; no external power supply is required. It also offers 2000V RMS optical isolation, which is great for electrically noisy applications or when grounding may be a problem. The following figure shows this adapter (when purchased from Neoptix, the adapter will be fitted with a terminal block connector suitable for use for both 2W and 4W applications):



Note that this converter requires a special software driver that needs to be installed before you use the device; you will find all details on the CD that comes with the unit.

Furthermore, the converter has 4 dip switches that need to be configured depending on your exact installation: there are 2 possibilities, as follows:

- a) If you have a 2W (2-wire, also called "half-duplex") installation, then the four dip switches must be set as follows:
 - a. Switch 1 must be on (RS-485 mode)
 - b. Switch 2 must be on (Echo Off)
 - c. Switch 3 must be on (2 Wire mode)
 - d. Switch 4 must be on (2 Wire mode).

- b) If you have a 4W (4-wire, also called "full-duplex") installation, then the four dip switches must be set as follows:
 - a. Switch 1 must be on (RS-485 mode)
 - b. Switch 2 must be off or on (Echo On or Off)
 - c. Switch 3 must be off (4 Wire mode)
 - d. Switch 4 must be off (4 Wire mode).

Warning: When dealing with very long cables (e.g., more than 300 meters), your RS-485 network might need a termination resistor (typically 120 Ω). Consult Neoptix for more details.

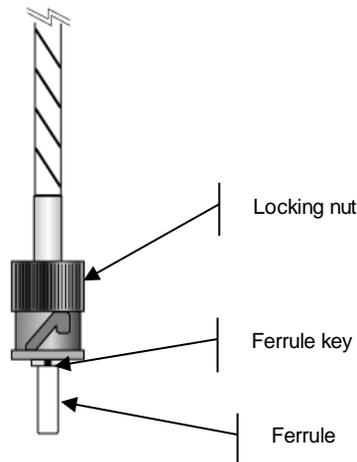
11 USING THE TEMPERATURE PROBES

11.1 Caution

Each time you connect a temperature probe to the unit, the probe **optical connector should be cleaned beforehand**. Otherwise, particles of grease or dirt may obstruct the device internal connector and affect the measurements by completely blocking the signal or by generating too much attenuation when using a long fiber length.

Never use a cloth other than the type recommended for fiber optic cleaning. Dampening the cloth with pure isopropyl alcohol ensures good cleaning.

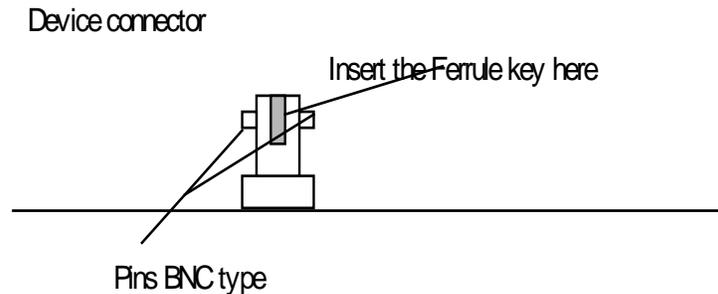
Occasionally, clean the inside of the bulkhead connector (attached to the thermometer) with a wipe or cotton swab dipped in alcohol (2.5 mm mini foam swabs work best).



For very dirty connectors, acetone can also be used, but should be used very carefully, as it is a very strong solvent. Care should be exercised so you do not apply any on plastic materials, etc.

11.2 Description

The optical connector used is a standard ST type connector.



To install the connector,
Slide the ferrule key gently into the above key.
Then, turning, insert the two BNC pins into
The appropriate slots on the ST connector

11.3 Warning

The T1S and T2S probes are quite fragile and it must be handled carefully. Please note that any probe damages are not covered by the standard warranty.

Do not expose your probes to temperatures that are higher than specified. Permanent damage can be caused to probes that have been exposed to temperatures that are higher than their limits.

Warning: Make sure all unused connector inputs are blocked with dust caps, to prevent any spurious light from entering the thermometer, as this can cause false temperature readings on other channels.

11.4 Working with long probes

This note is important when using probes or extension cables that have a combined length of 100 meters or more. Working with long probes or extension cables may present special problems. To limit the amount of back reflection caused by the fiber optic connector located on the thermometer unit, you may have to use a matching gel optical couplant in the connector. This gel is a grease-like compound with high clarity, good resolution properties and a refractive index close to quartz. Apply the gel onto connector end faces.

Avoid disconnecting the connectors for which gel has been used. In other words, it is recommended to use the gel only for permanent installations. If the connectors are disconnected many times, you may have to clean entirely the connector assemblies that have had the gel; this may require opening the instrument enclosure to remove the excess gel.

Note that it is not required to use this gel with connectors that are far away from the thermometer electronic unit.

11.5 Working with cryogenic probes

The use of a cryogenic probe required special attention. In particular, the probes become more brittle at very low temperatures. Avoid cycling the probes quickly between cryogenic temp and ambient temperatures, as this may cause material fatigue at the probe tips.

Warning

Always wear protective gloves and clothing when working with cryogenic material.

Never use general purpose probes at cryogenic temperatures. Neoptix sells special probes that can be used at cryogenic temperatures.

Please note that your T/Guard thermometer will require a special factory calibration to be used at cryogenic temperatures (below -80°C). Consult Neoptix for more information.

11.6 Installing probes in power transformers

Neoptix offers a complete line of T2 type probes that are specifically designed to be installed inside transformer windings, to monitor temperatures of hot spots. Please refer to the Neoptix' "Probe Installation Guide Inside Power Transformers" (document G1009rxx) for recommendations and instructions on how to install and handle these probes, to maximize your success rate for this application.

12 COMMISSIONING PROCEDURE FOR NEOPTIX T/GUARD-405

12.1 Introduction

This procedure should be used to confirm the good operation of a Neoptix T/Guard-405 system, which is already installed in a transformer control cabinet; this means that the system is fitted with a proper 24 VDC power supply, and has been completely tested by the transformer manufacturer at his manufacturing plant. This procedure is intended to be used by the transformer end user (utility). This procedure should be used in conjunction with the Neoptix applicable documentation, in particular this user guide.

12.2 Required tools

These tools will be required to perform the procedure completely:

- A PC with a serial port (with a USB adapter)
 - OptiLink or OptiLink-II software, must be already installed on your PC
 - These software packages are either on the Neoptix CD or DVD that should have been shipped with the transformer, or you can download them from the web (see instructions below)
- A milli-ammeter (ampere-meter), to test the analog outputs.

To perform the procedure in its entirety, a PC computer will be required, along with a proper RS-485 serial interface. Make sure you set your port wiring for either 2-wire (half duplex) or 4-wire (full duplex). The part number should give you the communication port details, as per this chart:

12.3 Software downloads

To perform this procedure completely, you will need either OptiLink or OptiLink-II. The new OptiLink-II software is recommended. You can download them from the Neoptix website, as follows¹⁰:

To download OptiLink, go to web page <http://neoptix.com/download.asp> and click on the appropriate link. When prompted, enter:

User name: [ftp36681896-8](ftp://ftp36681896-8)

Password: NeolN03?

To download OptiLink-II version 1.59:

For the regular Windows 7 or 8 version (recommended), go to:

[http://neoptix.com/downloads/neolink/OptiLink-II Version1.59 Windows Installer from Windows Vista up to Windows 8.zip](http://neoptix.com/downloads/neolink/OptiLink-II%20Version1.59%20Windows%20Installer%20from%20Windows%20Vista%20up%20to%20Windows%208.zip)

File size: 91MB

Or for the Windows XP version (which runs on a much older and slower .NET Framework), go to:

[http://neoptix.com/downloads/neolink/OptiLink-II Version1.59 Windows Installer from Windows XP to Windows 7.zip](http://neoptix.com/downloads/neolink/OptiLink-II%20Version1.59%20Windows%20Installer%20from%20Windows%20XP%20to%20Windows%207.zip)

File size: 52MB

¹⁰ The software versions indicated below were current at the time of this writing (July 2014). These links should be adapted to other versions as needed.

User name: [ftp36681896-8](ftp://36681896-8)

Password: NeolN03?

Please copy the zip file to a local hard drive and de-compress it before trying to launch the setup.exe.

12.4 Testing probes

We assume here that the utility does not have any spare probes, so we will rely on the probes that are installed in the transformer. The user should know the approximate temperatures inside the transformer; the easiest is to perform this commissioning procedure when the transformer has not had any load for some days, in which case the inside temperature will be approximately the ambient temperature.

Make sure the T/Guard-405 is power on.

Confirm that ALL channels display a temperature that is compatible with the current transformer situation. If no display is available for one or more channels (display: - - -), confirm that the extension cable is connected for this channel, or confirm with the transformer manufacturer that the corresponding probe was working at the factory. It may happen from time to time that a reading is not available on a probe due to damages caused during transformer manufacturing; if this is the case, you will not be able to get a reading for this channel.

12.5 Analog output testing

Note: A milli-ammeter will be required to test the analog outputs (4 to 20 mA range).

Note: The factory default for analog outputs is “zero = -100 °C” and “span = 400 °C”; If you are not familiar with these 2 parameters, you should read more about it in this user guide. These defaults can be changed to your liking, by using one of the OptiLink software’s.

You can use the milli-ammeter to read the current for any channels by connecting it to the corresponding 2 connections on the analog output terminal block. For example, assuming the default settings for the analog channels, you should read 9 mA for a temperature of 25 °C; if you have the zero set to “0 °C” and the span to “160 °C”, then you should read 6.5 mA, and so forth.

12.6 Conclusion

This terminates the commissioning procedure. If you have any questions, do not hesitate to contact Neoptix, support@neoptix.com.

You can perform other functions with the OptiLink software, such as data logging, Modbus communication settings, etc.; refer to the user guide for more information.

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