



T/Guard2 System

Fiber Optic
Power Transformer
Winding Temperature
Monitoring System



T/Guard2™ Fiber Optic Power Transformer Winding Temperature Monitoring System

The Neoptix™ T/Guard2™ is a multichannel fiber optic temperature monitoring system for power transformer hot spot measurements. The T/Guard2 system has been developed with long-term performance and stability in mind. This fiber-optic temperature monitoring system for power transformers offers accuracy, toughness and long-term resistance to failure.

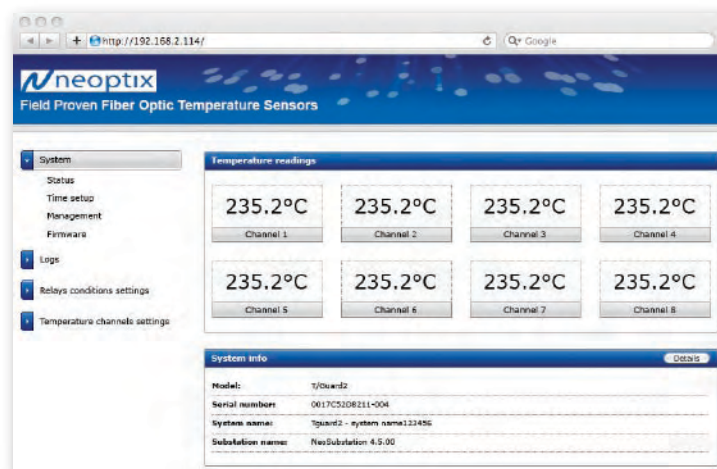
Coupled with the T/Guard2 system, the Neoptix™ T2™ fiber-optic temperature probes provide accurate and direct temperature monitoring of transformer windings. This solution provides a realistic, real-time view of winding conditions that is quicker and more accurate than top oil thermocouple measurements, and greatly complements indirect measurements based on thermal models.

Neoptix™ T/Guard2 give the exact temperature of optical probes in 250 milliseconds per channel. Peak load or emergency overloads are thus detected almost instantaneously. With Neoptix technology, you have a new tool to optimize high-voltage transformer performance and life expectancy.

The T/Guard2 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, compared to other technologies available on the market, such as fluorescent decay, our sensor, based on solid-state semiconductor, do not fade or drift over time, allowing a constant and absolute temperature measurement of your transformer windings over the lifespan of the equipment.

Neoptix fiber-optic probes are made only with dielectric materials and are designed to withstand initial manufacturing conditions, including kerosene desorption and heat runs, as well as long term oil immersion and vibration. Moreover, the Neoptix™ temperature probes are interchangeable and no calibration or inconvenient gage factors are required when changing sensors.

The system is based on the proven GaAs technology. An original algorithm is used to analyze the signal and provides repeatable and reproducible measurements.



T/Guard2™ can be configured and accessed using its built-in Web Server

The T/Guard2 system is available with 1 to 16 optical channels and comes standard with a large (320 x 240 pixels) LCD display with LED based backlight. Signal conditioner power consumption of the system is 12 watts; up to 48 Watts with all relays enabled.

The mounting brackets are integrated directly into the T/Guard2 enclosure, which allows a clean and robust installation into your control cabinet or substation. It is optionally available mounted in a NEMA4-12 enclosure. Automatic cooling and heating could be ordered with this protective enclosure.

The T/Guard2™ system can be delivered with a built-in 1GB data logging memory that allows utilities and transformer operators to record temperature data points and alarm status information directly into their T/Guard2 temperature monitoring system, without the need for permanent connection to a remote acquisition system. One GB memory represents more than twenty years of data logging for a transformer instrumented with eight temperature probes. The information can be accessed through any web browser. Moreover, data points are saved with a time stamp that comes from the internal real-time clock of the T/Guard2 system.

The T/Guard system is easy to interface to an existing marshaling or substation system through its 4-20 mA analog outputs (0-10 Volts optional) or its MODBUS communication interface. It also has RS-232 or RS-485 communication. The T/Guard2 is Ethernet savvy and incorporates the newest IEC-61850 protocol. Information collected by the system can also be accessed through any web browser using TCP/IP.

With its small footprint, the T/Guard2 is a space-efficient instrument. It is specifically designed to be installed inside the control cabinet; no need to add a large supplementary enclosure to protect the system. The T/Guard can also be delivered with DIN rail mount brackets for a clean and streamlined layout.

The T/Guard2 system has 16 Form-C (SPDT) industrial relays with galvanic isolation that can also be set up as Form-A or Form-B relays by user. The system has a fail safe mode whereby relays can be activated in case of system problem.

System's configuration is made through the industrial grade front panel keypad, serial terminal or the built-in web-based server.



The space-efficient T/Guard2™ system allows perfect integration into control cabinet



The T/Guard2™ comes with industrial-grade relays featuring galvanic isolation



A multichannel fiber optic system for high voltage and transformer hot spot temperature measurement

Features

- **Tough and ruggedized sensors**
- **No gage factor or calibration**
- **Serial communication:**
 - RS-232, RS-485, MODBUS or DNP3
- **Ethernet communication:**
 - IEC-61850 and HTTP
- **Voltage or current output**
- **Accuracy of $\pm 1^{\circ}\text{C}$**
- **Available with 1 to 16 channels**
- **1 GB internal datalogging memory**
- **Quick and easy web-based configuration**
- **8 or 16 Form-C relays blocks**

Benefits

Accurate, direct temperature reading in the winding's hot spot:

- Predicts or adjusts the dynamic loading of high voltage transformers
- Prevents premature failures
- Provides cost effective monitoring of transformer temperature

Extends transformer life:

- Helps estimate the insulation degradation rate
- Complements predictive hot-spot algorithm simulations



Accessories

T2™ Temperature probe

This temperature probe is designed to withstand initial manufacturing conditions, including kerosene desorption and heat runs, as well as long term oil immersion and vibration. The T2 probe consists of a 400-microns OD solid-state crystal and optical fiber sheathed with an oil permeable protective PTFE Teflon sheath. Only chemical resistant dielectric materials are used for these temperature probes. The temperature range is -80°C to $+250^{\circ}\text{C}$. The probes can be embedded in a standard spacer or attached directly onto any other location inside power transformer copper windings. All T2 optical temperature probes are available in custom length from 1 to 25 meters.

T2K™ Temperature probe

Answering the needs of specific customers, T2K probe version has the same accuracy and long term performances than our standard T2 probe with the advantage of being constructed using a Teflon jacket with Kevlar threads. As for the standard T2, the T2K features an oil permeable protective white Teflon helix "spiral wrap" providing an optimal mechanical strength. This probe is available in custom length from 1 to 25 meters.

Tank wall optical feedthrough

Specifically designed for tank wall transformers, this feedthrough has a simple design that provides both toughness and long-term leak-free operation. It is made from 316 stainless steel and relies on proven glass-to-metal bonding techniques. The feedthrough uses 1/4" NPT ANSI threads and can be installed directly into the tank wall or on a tank wall mounting plate.

NEMA-4 Enclosure

The T/Guard system can be mounted in a NEMA-4 enclosure that houses and protects the instrument for long-term exterior use. All fiber-optic extension cables are connected inside this enclosure. The NEMA-4 enclosure includes a clear polycarbonate window-door and is compliant with NEMA/EMAC Type 4 and 12 standards.

External fiber-optic extension cables

These cables are made with a polyurethane jacket reinforced with Kevlar threads and are designed to withstand the harshest conditions. External fiber-optic extension cables come in standard 5 or 10 meter lengths. Custom lengths are also available from 1 meter to 1 kilometer. The temperature range is -50°C to $+85^{\circ}\text{C}$. Cables can be routed into protective conduits or tracks.

Tank wall mounting plate

Up to 12 feedthroughs can be mounted on a tank wall mounting plate. The plate is made with carbon steel and has a standard size of 25.4 cm (10 inches) diameter. Tank wall mounting plates can be customized in size or material according to customer specifications, with larger plates allowing more feedthroughs. The mounting plate comes with the JBox™ (patent pending) protective enclosure.



The tank wall mounting plate shown with JBox™ protective enclosure

Technical Specifications

SYSTEM SPECIFICATIONS

Model name:

T/Guard2 Transformer Hot Spot Monitoring System

Number of channel:

Multi-channel instrument ; from 1 to 16 optical channels

Resolution:

0.1°C (0.1°F)

Accuracy:

±1.0°C (1.6°F) or 1 % Full-Scale input range

Calibration:

No system recalibration needed over lifespan to remain within specifications

System sampling rate:

250 ms switching rate between each channel; Rate can be adjusted by user from 250 milliseconds to one point per week

Data output rate:

Data output rate can be adjusted by user from one point every 250 milliseconds to one point per week.

Built-in calculations and algorithms :

Averaging, data smoothing, delta between probes, min/max per channel and global, internal temperature.

Upgradability - Firmware:

Flash ROM upgradeable through Ethernet/Web browser

Display:

One 320 pixels by 240 pixels graphical liquid crystal display (LCD), FSTN Positive, Transflective, Wide Temperature LCD with white LED Backlight

Units:

User selectable, Metric or Imperial

Data logging memory :

1 GB on-board datalogging memory. Logging feature available for probes, alarms, system status, internal temperature, relays fonctions in an ASCII file. (equivalent to 20 years of logging on 16 channels at every 5 minutes)

Temperature measurement range:

-80 to 300°C (-112 to 572°F)

COMMUNICATION AND I/O

Operating Mode:

System front panel keypad, ASCII commands over RS-232/RS-485 or Ethernet (web-based configuration)

Communication (hardware):

- Ethernet (RJ-45)
- Serial (RJ-45) on optically isolated RS-232 and RS-485

Communication protocols:

- SERIAL:
- ASCII (terminal console)
 - MODBUS RTU (Full or Half-Duplex)
 - DNP 3.0 (optional)
- ETHERNET:
- HTTP (Web based)
 - IEC 61850

Remote (SCADA) output :

4-20 mA output (Max allowable load resistance of 450 ohms
0-10 Volts (optional)

Relays:

16 built-in relay drivers for transformer cooling control, enclosure cooling/heating, trips, alarms, etc.
DIN rail relay block : 8 or 16 Form-C (SPDT) relays (5A/240VAC or 0.3A/240VDC or 34 A/24VDC max @ 50°C)
Relays are indepently user replaceable
One system fault relay
Fail safe mode

Relay drive:

Direct with system's built-in calculation algorithms

Analog Outputs :

Detachable header connector blocks, 5.08 mm pitch.
One analogue I/O per channel
Standard: 4-20 mA, Optional (no cost) : 0-10 Volts.

System status reading and indicators :

- System has internal built-in temperature sensor; info can be logged into internal memory or sent through serial communication. Built-in thermocouple temperature sensor can control enclosure's cooling and heating apparatus;
- Light Emitting Diodes (LED) status: One for the system and one for each probe; can be linked to serial communication

MECHANICAL AND ENVIRONMENTAL

Operating temperature:

-40 to +75°C, 5-90% humidity, non-condensing

Storage temperature:

-50 to +85°C, 5-90% humidity, non-condensing

Board level environmental protection:

MIL-I-46058C (IPC-CC-830) Type SR silicone conformal coating

Light source MTBF:

Light source lifespan and optimal system performance superior to 300 years of continuous use. No degradation of total system accuracy over light source lifespan.

Vibration :

60/120 Hz @ 0.1 mm displacement

Shock :

10 G half-sine in three orthogonal planes

Form factor:

IP 65 enclosure

Front membrane :

UV stabilized polyester with 5 million push MTBF keys

Connectors:

Optical: Standard ST connector
Analogue and power-in: 5.08 mm pitch connectors socket for headers with screw terminals
Relays: 19-pins circular connector
Ethernet, serial and external display: 3x RJ-45

Dimensions/weight:

Width: 250 mm ; Height: 150 mm; Thickness: 60 mm
Mounting holes: 4x M6/ANSI 1/4-20 bolts
Mounting hole specs: 265 mm x 130 mm;
Weight: 1.6 Kg

COMPLIANCE

Conducted/Radiated Emissions and Surge Withstand :

IEC 6100-4-2 ESD
IEC 6100-4-3 Radiated RFI
IEC 6100-4-4 Burst
IEC 6100-4-5 Surge
IEC 6100-4-6 Induced (Conducted) RFI
IEC 6100-4-8 Magnetic field
IEC 60255-5 Dielectric strength
IEEE C37.90 Dielectric strength
IEEE C37.90.1-2002 Fast transient
IEEE C37.90.1-2002 Oscillatory

Environmental :

IEC 60068-2-1 Cold temperature
IEC 60068-2-2 Dry heat
IEC 60068-2-30 Humidity (damp heat, cyclic)
IEC 60255-21-1 Vibration
IEC 60255-21-2 Shock
UL 60950 Temperature range

POWER

Power requirements:

24 VDC

Power consumption:

12 Watts (48 Watts with all relays energized)

OTHER

Probe compatibility:

Compatible with all of Neoptix GaAs fiber optic temperature probes and transducers.

Probe signal optimization:

System has built-in Neoptix™ WTune™ probe optimization algorithm

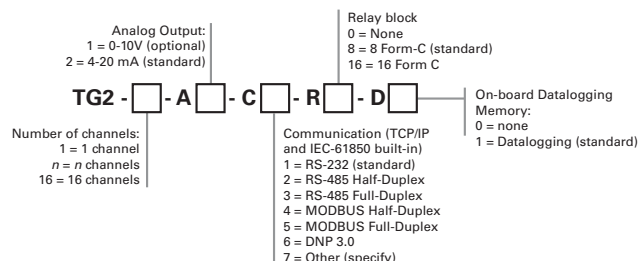
Warranty:

Five-year complete international warranty
Extended warranty available

ACCESSORIES/OPTIONS

- Panelmount support brackets
- DIN Rail mounting brackets
- External panelmount LED display

SYSTEM ORDERING CODES:



QUALITROL
Neoptix, Inc. is a Qualitrol company

