WEIDMANN

InsuLogix® T
Product Manual

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Version 1.1

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1. Introduction

Product Warranty

The InsuLogix® T instrument is warranted (Parts and Workmanship) for two full years from the date of purchase. Upon written notification of any defect, Weidmann will either repair or replace any faulty product or components thereof. A Return Material Authorization (RMA) must be obtained from Weidmann or authorized distributor prior to any merchandise return.

The manufacturer's warranty is void in the case of any damage caused by using the product contrary to its intended use, non-compliance with these operating instructions, assignment of insufficiently qualified skilled personnel or unauthorized modifications to the instrument. the general terms and conditions contained in the technical documentation shall apply.

The optic fiber probes are not warranted due to their unique nature.

Unpacking and Inspection

When unpacking and inspecting your system components, you need to do the following:

1. Check all materials against the enclosed packing list.
2. Carefully unpack and inspect all components for visible damage.
3. Save all packing materials, until you have inspected all components and find that there is no obvious or hidden damage.
4. Before shipment, each instrument is assembled, calibrated, and tested. If you note any damage or suspect damage, immediately contact Weidmann.

NOTE: In some cases the InsuLogix® T instrument may be delivered already mounted in a housing/cabinet with or without power supply mounted in same cabinet.

Service

In case of a malfunction or service request please contact our technical support Monday-Friday between 8:30 to 17:00 MET: +49 (351) 8435990 or email: MonitoringSupport@wicor.com or info@optocon.de

RMA shipments must be sent to:

Weidmann Technologies Deutschland GmbH
Washingtonstrasse 16/16A17, 01139 Dresden
Germany
Telephone: +49 (351) 8435990

Product disposal

The unusable material must be disposed of in compliance with local regulations for electronic materials.

Safety

Ensure that all good practice procedures and standards and used during system's installation.

2. System Description

The InsuLogix® T can be delivered to user as a system, and includes:

- InsuLogix® T instrument
- Optic fiber probes
- DIN Plate and DIN Ring
- Optic fiber connectors
- Optic fiber extensions
- DIN Rail AC/DC or DC/DC converter (optional)
- NEMA 4 (IP66) cabinet (optional)

The system can also be delivered in partial shipments.

Available with 2 to 16 channels and with various instrument configurations, the InsuLogix® T monitoring system is designed to be used for hot-spot temperature monitoring in power transformer.
Temperature sensors are built using Gallium Arsenide (GaAs) crystals. No recalibration is necessary throughout the product life time.

InsuLogix® T instrument

The instrument can be equipped at factory with:
- 2 to 16 optic fiber connectors corresponding to 2 to 16 channels (in increments of two)
- 4 relays (Optional)
- Analog output board with maximum 8 outputs (Optional). 4-20mA or 0-10V DC.
- USB port
- RS485 port (with Modbus protocol)
- Ethernet (with Modbus protocol) - Optional
- LCD

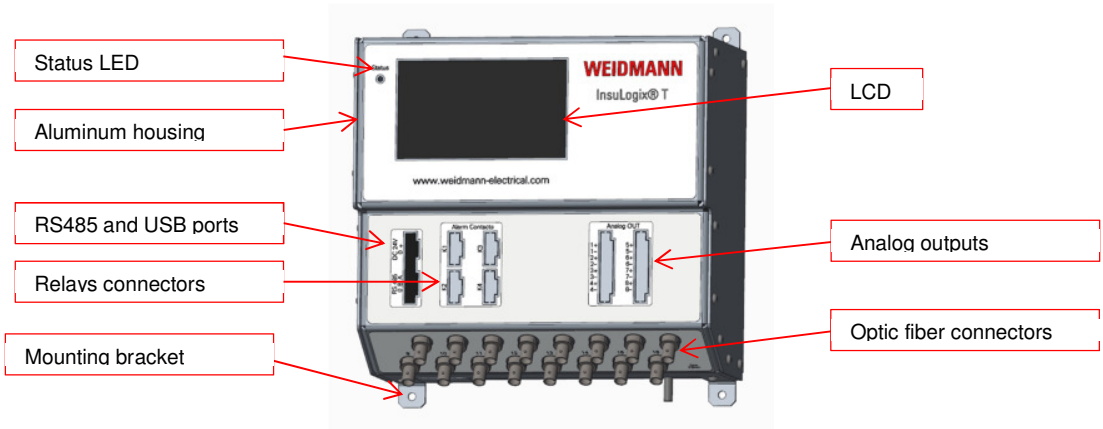

Figure 1: InsuLogix® T instrument

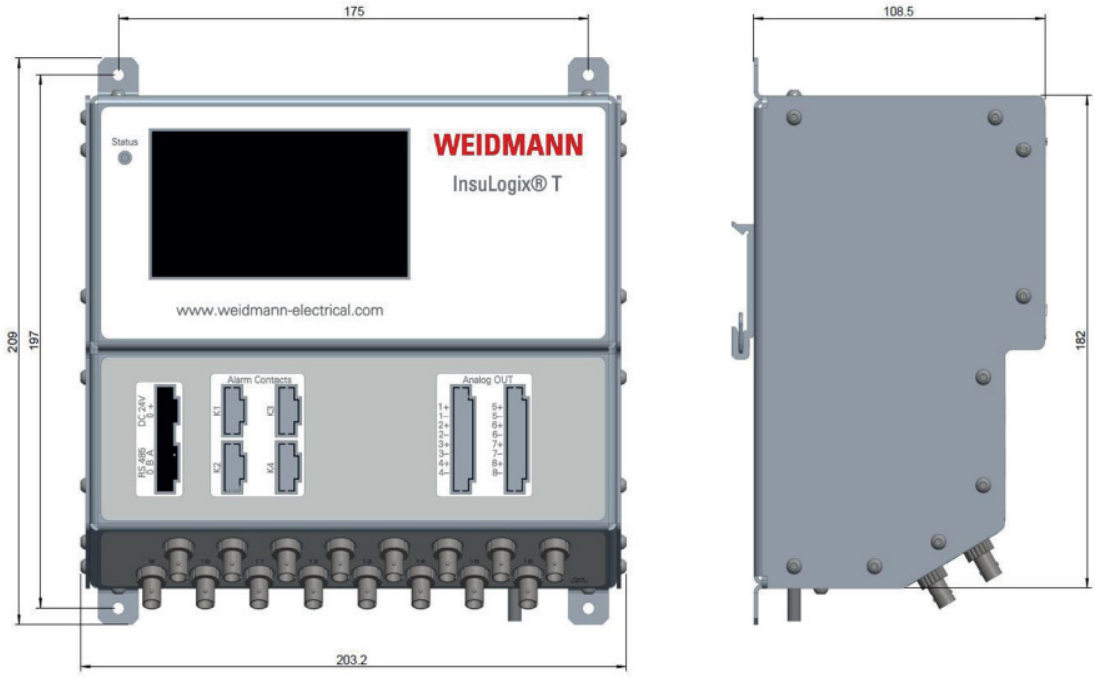

Figure 2: InsuLogix® T dimensions

Table 1: InsuLogix® T instrument specifications

Number of Channels	2 to 16
Measuring Range	-200 °C to 300 °C
Accuracy	< ± 1 K
Resolution	0.1 K
Measuring time/channel	250 ms
Operating temperature	-20 °C to 60 °C
Storage temperature	-20 °C to 70 °C
Light source lifetime	Life of the transformer
EMI/RFI susceptibility	Immune
Humidity	95 % RH non-condensing
Communication ports	Configurable at factory per customer specification: USB, RS-485, Ethernet
Communication protocol	Modbus over RS-485 and Ethernet
Analog outputs	Maximum 8 outputs - 4-20 mA or 0-10 V DC Configurable at factory
Relays	2 for temperature thresholds; Switchable voltage: 120 V AC / 60 V DC; Switching load: 240 VA; Load current: 2 (120 V AC), 2 (24 V AC) A; Max load current: 2 A; Testing voltage: 1000 V; Approbation: UL, CQC
System fault relays	1 dedicated system fault relay for instrument ; 1 dedicated relay for light signal strength. Switchable voltage: 120 V AC / 60 V DC; Switching load: 240 VA; Load current: 2 (120 V AC), 2 (24 V AC) A; Max load current: 2 A; Testing voltage: 1000 V - Approbation: UL, CQC
System status indicator	LED
Data recording	In instrument for first 8 channels. Data recording for all channels possible via connection to a PC or another device with data recording capability.
Optic fiber connectors type	ST
Auto diagnostic	Light level, signal level
Power supply/consumption	24 VDC/max. 40W
Instrument protection	IP20
Instrument mounting	DIN Rail or mounting brackets
Warranty	2 years, optionally extensible up to 5 years

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Tank wall kit

The Tank Wall Kit consists of:

- Tank wall Ring
- Tank wall Plate
- J-Box – protection for tank wall Ring/Plate/connectors
- O-ring (comes with Ring and Plate, to be installed between Ring and Plate)
- Gasket (comes with J-Box, to me installed between J-Box and Plate)
- Bolts

The components listed above are typically supplied as a kit, based on customer's orders they can also be supplied in various combinations (only the plate, plate with J-Box, etc) based on customer's order.

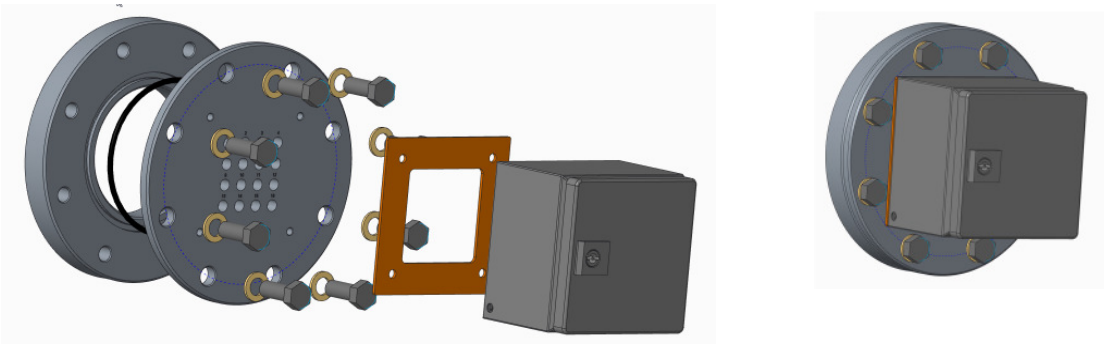


Figure 3: Tank wall kit components

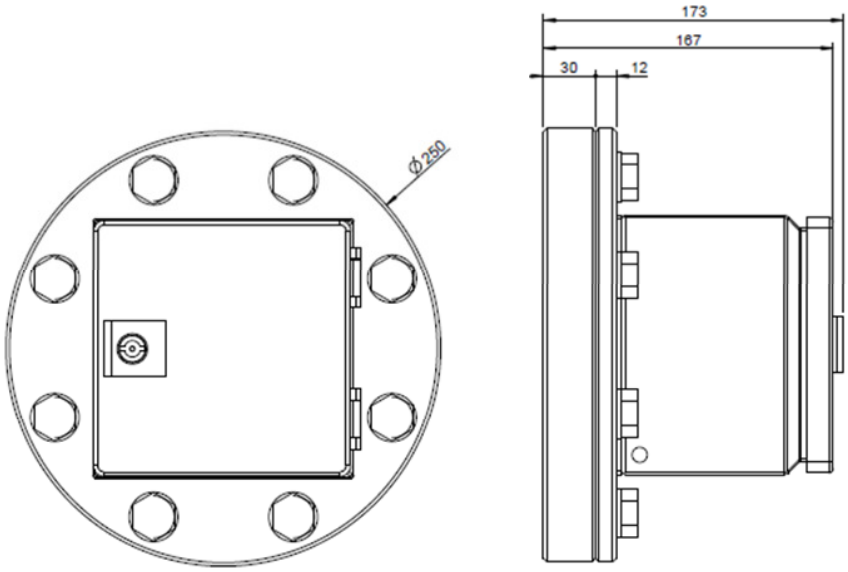


Figure 4: Tank wall kit overall dimensions

Tank wall Ring

The tank wall Ring must be installed on transformer tank wall by welding process.

A sealing O-ring is supplied with the Ring. The O-ring is to be installed between the Ring and the Plate, having the role of preventing the oil leaks.

The Ring is supplied with threaded holes for the bolts that will be used to install the Plate on the Ring.

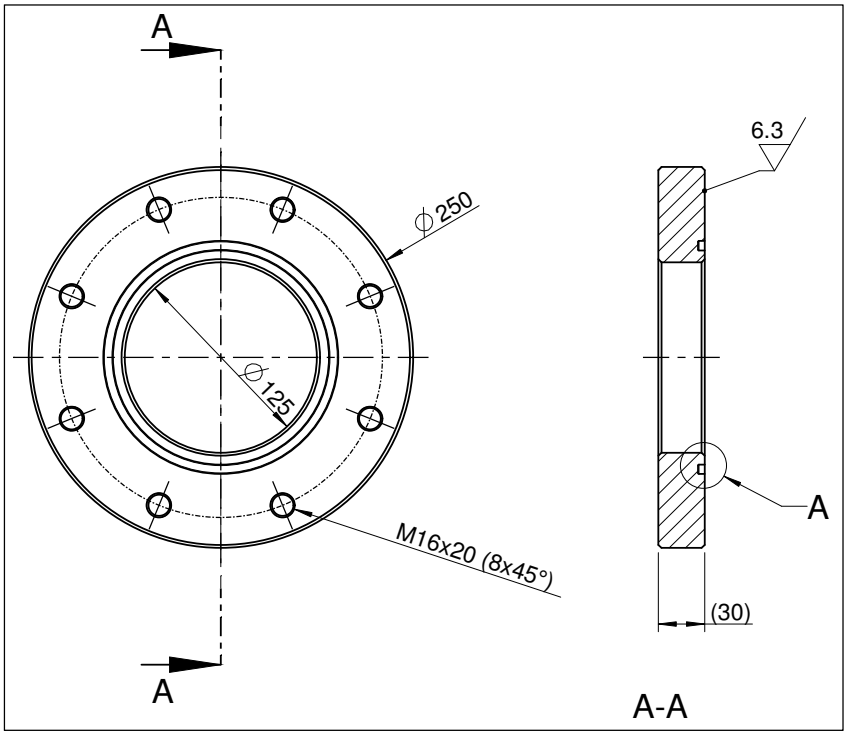


Figure 5: Tank wall Ring dimensions

Table 2: Tank wall Ring specifications

Attribute	Description
Material of tank wall Ring	1.4571, X6CrNiMoTi17-12-2, AISI316Ti
Threaded holes for Plate bolts	8 x M16 (ISO 1502)
Dimensions of Ring	DI O.D 250 mm thickness 30 mm inner diameter 125 mm
Weight	2.8 kg
Sealing O-ring	142.24 x 5.33 FKM SR 75 – AS 568-358

Tank wall Plate

The Plate is designed to be mounted on DIN Ring using 8xM18 bolts that are also supplied with the Plate.

The Plate comes with the optic fiber connectors already installed on it. The number of connectors supplied and mounted on the Plate is equal to number of optic fiber probes that will be installed inside the transformer.

The Plate comes prepared with threaded holes for installing the J-Box.

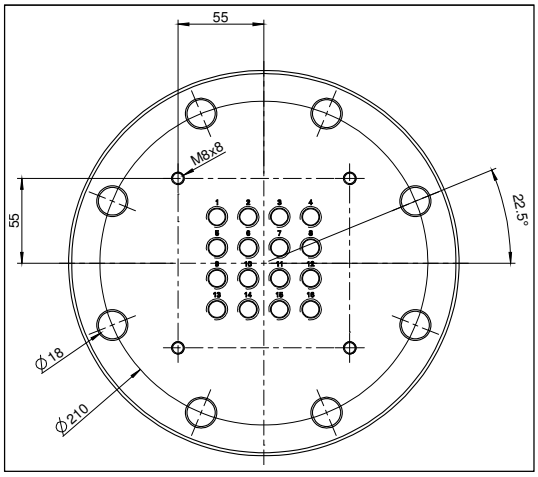


Figure 6: Tank wall Plate/Flange dimensions

Table 3: Tank wall Plate/Flange specifications

Attribute	Description
Material of tank wall plate	1.4571, X6CrNiMoTi17-12-2, AISI316Ti
Number of holes for connectors	Maximum 16/ ANSI B 1.20.1-1983 (R1992)
Threaded holes for J-Box fixation	4 x M8 (ISO 1502)
Dimensions of Plate	DIN O.D 250 mm thickness 12 mm
Weight	8.3 kg

Connectors

The number of Feedthroughs is at least equal to the probes that will be installed in the transformer tank. Make sure to clean up the connectors' fiber optic ends using the cleaning tool supplied with the instrument, and make sure to keep the caps all the time on the connectors, removing them only before connecting the extensions/probes to the plate.

Note: As the Feedhrough connectors come from factory already installed on the Plate, there is no need to tighten the connectors again.

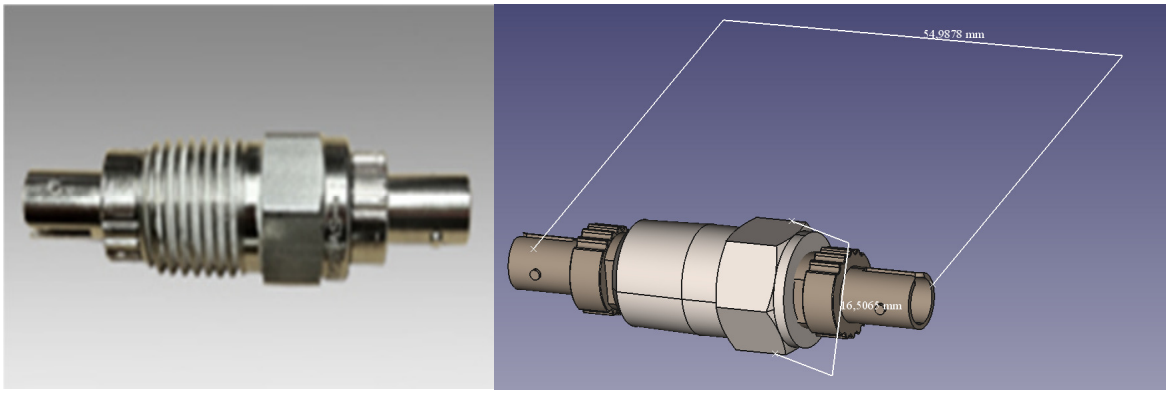


Figure 7: Optic fiber Feedthrough connector

Table 4: Optic fiber Feedthrough connector specifications

Attribute	Description
Type	No O'ring; ST-to-ST feed though
Thread	NPT 1/4"-18 or NPT 3/8"-18; ANSI B 1.20.1-1983 (R1992)
Screwing torque	20 Nm..≤25 Nm
Thread seal	PTFE
Resistance to pressure	Up to 4 bar
Resistance to temperature	-40 to 120 °C

J-Box

The J-Box is designed to be installed on the Plate and has the role of protecting the optic fiber connectors from the environment.

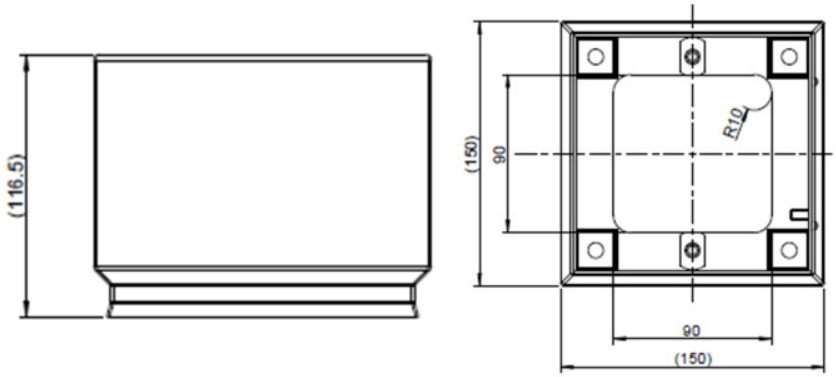


Figure 8: J-Box dimensions

Table 5:J-Box specifications

Attribute	Description
Materials	Steel powder coated
Color	RAL 7035
Dimensions	150 mm x 150 mm x 120 mm
Weight	1.7 kg
Sealing between flange and J-box	FKM
Ingress Protection	IP66 (IEC 60529), NEMA 4, ISO 20653

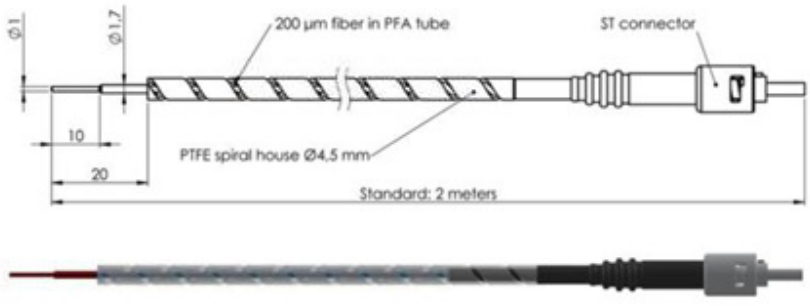
Optic fiber Probes and Extensions

The optic fiber cables that are delivered with the InsuLogix T system are:

- Optic fiber probes – consist of optic fiber with GaAs sensor and connector
- Optic fiber extensions – consist of optic fiber with two connectors

Probes

The outer jacket of the optic fiber temperature probes is made out of PTFE. A GaAs crystal (Gallium Arsenide) sensor is attached at the tip of the probe.
The probe sensor is completely non-conductive. Weidmann‘s optic fiber sensors ae completely immune to RF and microwave radiation with high temperature operating capability, intrinsic safety, and non-invasive use. The probes are also designed to withstand harsh and corrosive environments.



Probe dimensions	D1: 1,0mm D2: 1,7mm D3: 1,3mm
Fiber optic cable dimensions	L1: 10mm L2: 10mm L3: 2m standard (Other lengths on request)

Figure 9 Optic fiber probe design and dimensions

Optic fiber in Oil Coupling (Optional)

The InsuLogix® T can be supplied with optional Fiber-Optic-In-Oil-Connector. The personnel installing the probes in windings must make sure that both sides of the connector are properly cleaned and the connector is properly secured before the transformer tank is filled with oil. It is highly recommended that skilled personnel perform continuity and temperature check using a portable hand held device.

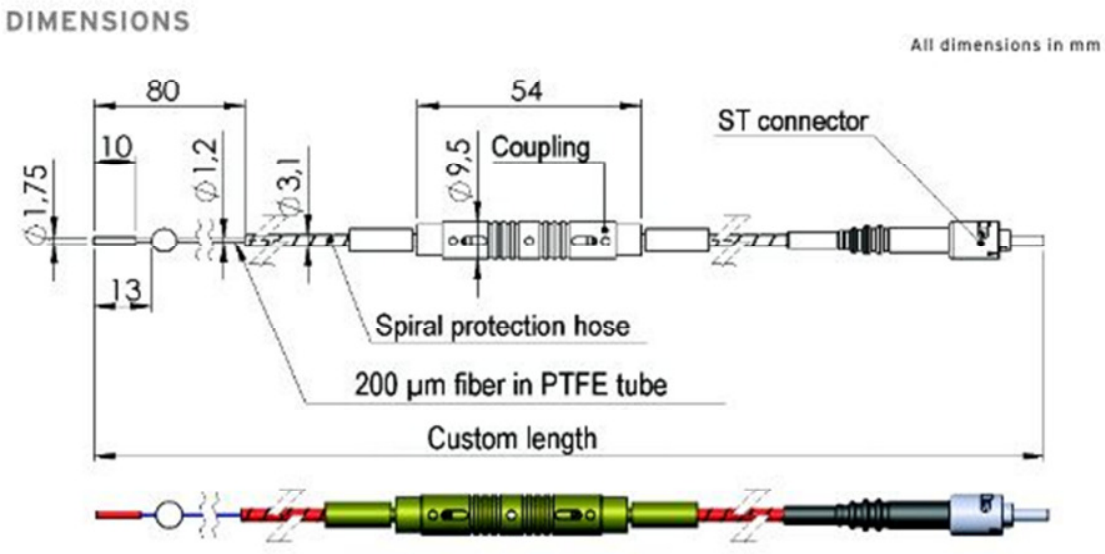


Figure 10 Optic fiber in Oil Coupling (optional) with Ceramic Disk (optional)

Extensions

The optic fiber extensions consist of protected optic fiber cable with optic fiber connectors mounted on both ends.

The extensions are used to connect the InsuLogix® T instrument to connectors that are installed on plate. The extensions conduct the light between the instrument and the connectors.

It is highly recommended to install the extensions inside metallic or plastic conduits in order to better protect them against the environment as well as against animals and unplanned personnel actions. The conduits must protect the extensions on all their length, between the J-Box and the cabinet where the Insulogix® T instrument is installed.

Table 6: Extensions specifications

Attribute	Description	Specifications/standard
Fiber glass silica O.D.	250 µm H200/220P, AD 245µm NIR/UV	H200/220P, AD 245µm NIR/UV
Coating material and thickness	20 µm Polyimide	
Inner jacked Shell material and thickness	PTFE or similar	
Outer jacket material and thickness	PTFE 0.76 mm	
Inner jacket colour	Blue	
Overall O.D.	3.17 mm	
Weight	15 g/m	
Outer jacket colour	Red	
Resistance to environment (cold, heat, UV, outdoor rated)		-50 to 85 °C; UV rated, outdoor rated
Length		Variable, per customer specifications in 1 meter increments.. Standard length not longer than 20 meters.
Connectors type	ST	

3. Installation

There are several operations that user must follow in order to install a complete system. Some of these steps will be skipped in case of partial installation (when installing only the probes, only probes and tank wall kit, etc).

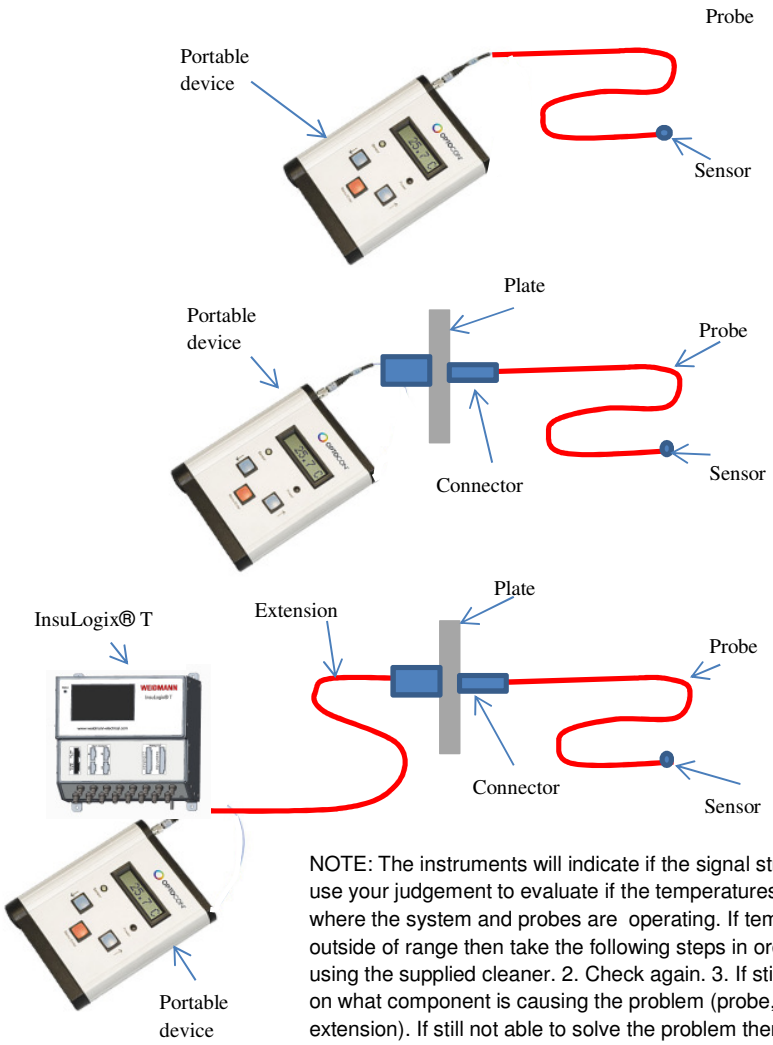
The steps to be taken in order to install a complete system are:

1. Install the optic fiber probes inside the windings and/or insulation structure
2. Install the Tank Wall Kit on transformer's tank wall
3. Install the InsuLogix® T instrument in transformer cabinet or on transformer structure (InsuLogix® T inside a separate housing)
4. Install the fiber extensions for connecting the instrument to the transformer tank wall plate.
5. Make the electrical and fiber extensions connections to the instrument (if available).
6. Use the software provided to set up the alarms and finalize the instrument commissioning.

Note: During and in between these steps is highly recommended to test the fiber continuity to make sure that fiber is not broken or connectors are clean.

Table 7: System installation steps and checks

	Operation	Pre-requisite	Pay attention to	Check
1	OPTIONAL: Verify system/components operation before installation. See the Figure 10 below this table to identify the situation you are in.	At minimum have in hand the InsuLogix® T instrument or the portable one channel instrument and the probes.	Fiber handling (see appropriate section in this document). Keep the rubber caps on connectors at all times.	At room temperature all temperatures read on the instrument must be within 2ºC from each other. If not then clean up the optic fiber connectors.
2	Install the probes in windings.	Have all necessary probes. Know where to install the tip of the probes (location for sensors).	Fiber handling (see appropriate section in this document). Keep the rubber caps on connectors at all times.	After installation use the portable device to check the sensor reading and signal strength.
3	Install the Tank Wall Kit to transformer tank wall	Kit must be available	Keep the rubber caps on connectors at all times.	-
4	Install conduit between the plate/J-Box and the location where the instrument is/will be located and route the extensions through the conduits	-	Fiber handling (see appropriate section in this document).	Use the portable instrument to verify fiber continuity through extensions, plate and probes (if all are being connected).
5	Install the instrument in transformer control cabinet and – if available - connect the fiber extensions, power and signal cables.	Instrument must be available	Remove the caps placed on the optic fiber connectors only when connecting the extensions. Fiber handling.	Clean up the connectors before connecting the extensions. Double check all wiring and power supply before powering up the system.
6	Verify fiber probes continuity, minimum at following moments: 1. After each probe installation in winding 2. Before installing the windings assembly in the tank 3. Before filling the tank with oil 4. After heat run test 5. Before shipping the transformer to end user	Have at least a portable device.	Fiber handling (see appropriate section in this document).	The signal from sensors must be within normal range (the instrument will give an error if not). Temperatures read from sensors must make sense (given where the sensors are installed)



Put the probes on a table and use the portable device to verify the probes operation.

Put the probes and the plate on a table and use the portable device to verify the probes and plate's connectors operation. If the system's extensions are not available then use the extension that was supplied with the portable instrument.

Put the probes, the plate and the extensions on a table and use the portable device to verify the probes and plate/connectors operation. Use the extensions that have been supplied with the system.

NOTE: The instruments will indicate if the signal strength through the fiber is within normal range. Also use your judgement to evaluate if the temperatures that are read are normal given the environment where the system and probes are operating. If temperatures seem to be off or the signal strength outside of range then take the following steps in order to troubleshoot: 1. Clean up the connectors using the supplied cleaner. 2. Check again. 3. If still not OK then switch the extensions to narrow down on what component is causing the problem (probe, connector on plate, the instrument's channel or the extension). If still not able to solve the problem then contact Weidmann and be prepared to inform on the results of your troubleshooting process.

Figure 11: Checking the fiber/connectors continuity and temperature measurement before the installation on transformer

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Optic fiber Probes and Extensions – Manipulation and Installation

Handling the optic fiber cables

Bending radius

200µm silica core fiber

Short time (max. 24h) bending radius: not less than 4 cm.
Permanent installation bending radius: not less than 8cm.

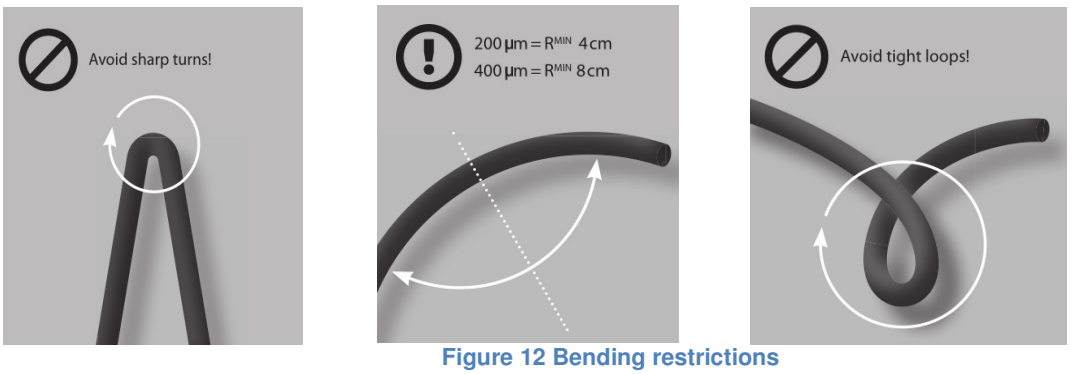


Figure 12 Bending restrictions

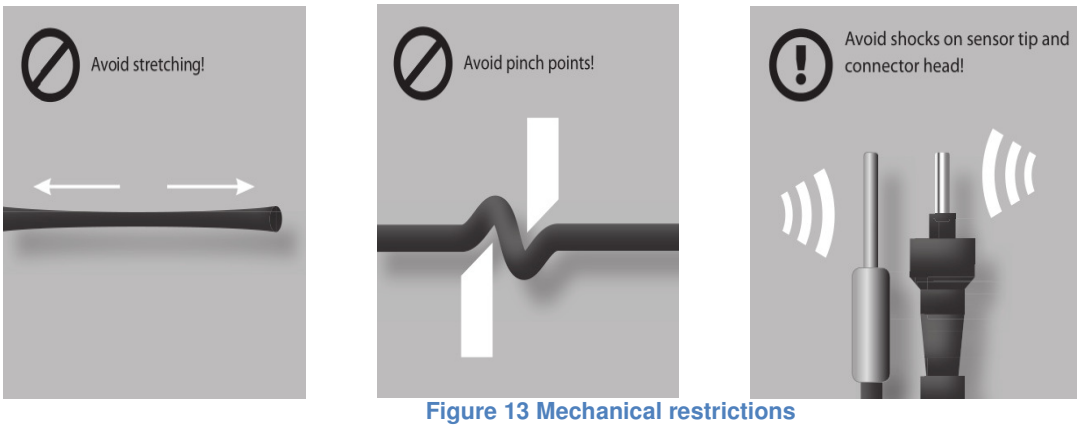


Figure 13 Mechanical restrictions

Probe Installation in Windings

The ultimate responsibility for the probe installation and performance remains with the transformer manufacturer.

The probes can be installed in windings as follows:

A. During winding process
B. After winding process and before winding compression

The OEM is generally choosing the time when to install the probes based on transformer design and based previous experience with optic fiber probes installation.

The probes can be delivered in one of the following configurations:

- Probe with a Nomex or Ceramic disk mounted at the tip. In this case the OEM will have to mount the probe into an insulation component then install the probe in the transformer insulation structure.
- Probe with an insulation component (key spacer or other) attached to its tip, with or without disk. In this case the OEM has to simply install the probe in transformer insulation structure.
- Probe only. In this case the OEM has to mount the probe into an insulation component then install the probe in the transformer insulation structure.

Attaching the Optic fiber Probe and Routing it Inside the Tank

Hot Spot location: The hottest spot of the winding is determined based on transformer specific design and can be found in transformer manufacturer design documentation.

Make sure the optic fiber connector protection caps are left on for the entire manipulation process and up to connection to connectors located on the plate. Follow the cleaning procedure included in this document before connecting the connectors to their mates.

In cases when is necessary attaching the probe to a conductor then tape should be used with the probe being attached side-on to the conductor for better thermal contact. We recommend using crepe paper for protecting the sensor when the optic fiber probe is attached to the conductor.

Special attention must be paid to securing the optic fiber probe to winding structure in such a way so the cable or the sensor is not crushed by coil's sudden contraction. Is preferable using cotton strapping in order to attach the optic fiber to transformer insulation or metallic components.

Unused parts of optic fiber probes should be attached to transformer components in loops with radius not smaller than 20 centimeters.

Special attention must be paid to not let connectors or optic fiber hanging freely during the winding manipulation (assembly and drying processes). We recommend using cotton strapping.

Routing the Probes to Feed-Through Connectors Located on the Plate

Generally the probes can all be run along the tops of the windings to one of the tank's walls.

The probes can be routed through rigid tubing or secured by using cotton strapping to any supporting structure.

Pay special attention to using tubing and strapping materials that can significantly change their properties in contact with hot oil or under thermal stress becoming stiffer or creating sharp edges. Do not over-tie the cotton straps.

Weidmann Disk™

The Weidmann Disk™ is made out of Nomex® material. **Error! Reference source not found.** shows the probe's sensing end mounted in the Nomex disk. The spacer must have hole with a diameter of 19 mm and the spacer thickness must be 3.2 mm..

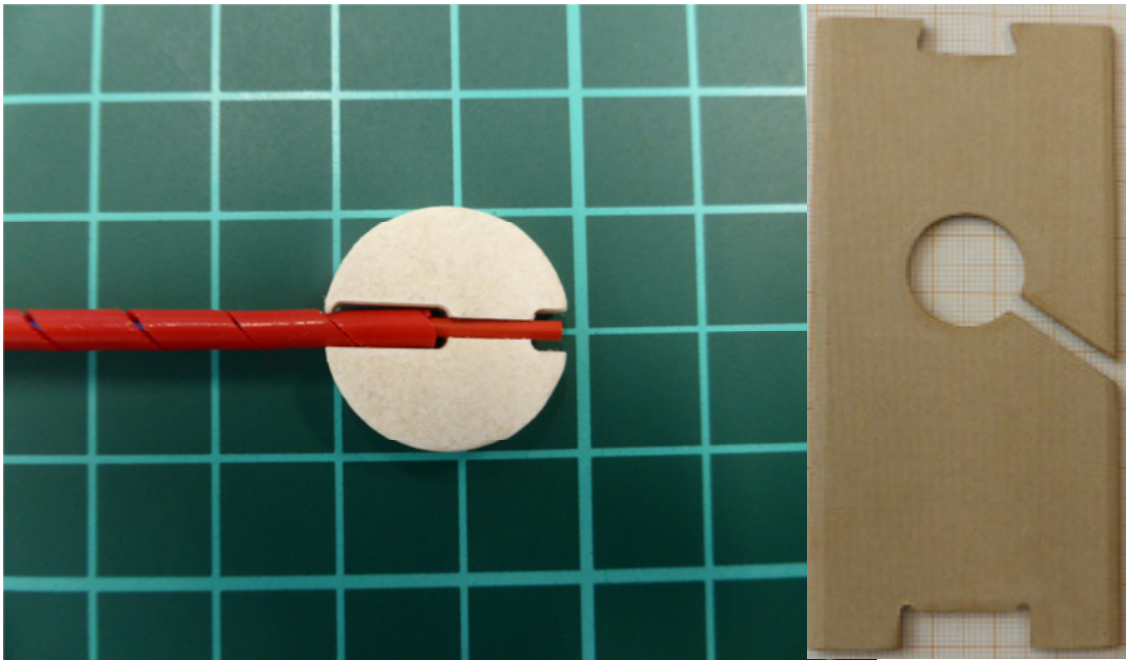


Figure 14 Weidmann Smart Spacer with Nomex disk

Weidmann Smart Spacer™

As an insulation designer and manufacturer Weidmann has in-house expertise to assembly and test the optic fiber probe-key spacer to make sure the assembly does not induce supplementary stress at the location where is installed.

The Smart Spacer™ is an assembly consisting of optic fiber probe mounted in a key spacer conform to OEMs specific design. The probe mounting in key spacer and testing of finalized product are done at Weidmann facility, following that the OEM will receive the final product along with a Testing and Performance Certificate. This eliminates the assembly and testing processes that normally the OEM is doing before installing the optic fiber in transformer windings using key spacer solution.

Smart Spacers can be manufactured by Weidmann based on transformer insulation package design specifics. Several examples for key spacer preparation for mounting the optic fiber probe are shown below.

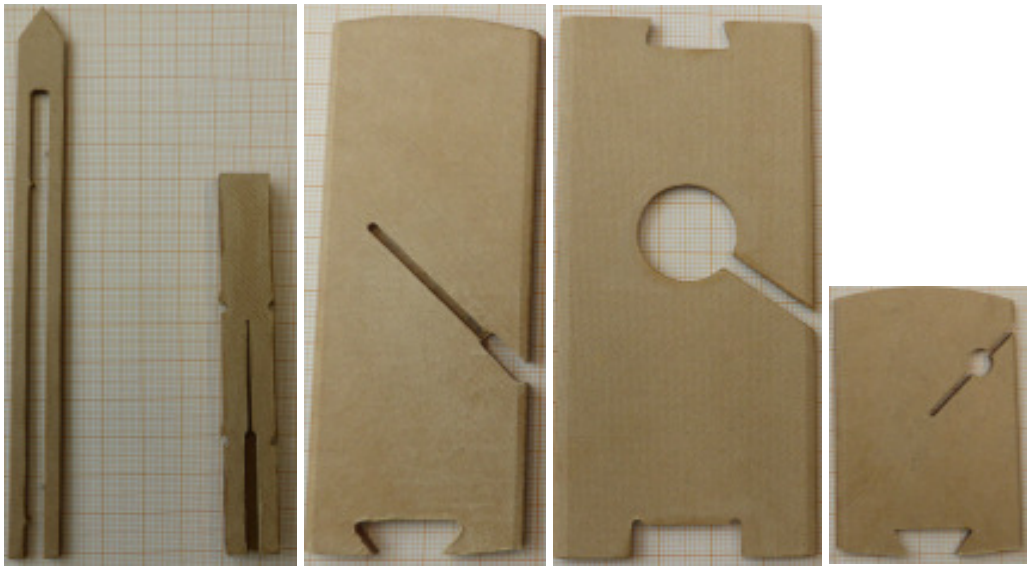


Figure 15 Examples of key spacers prepared for optic fiber probe installation

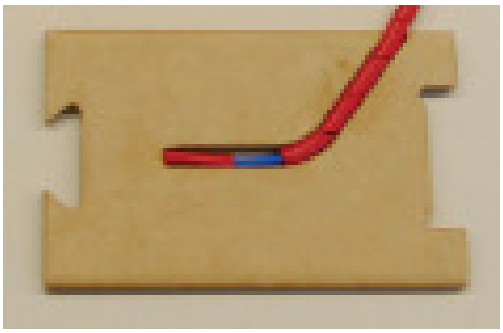


Figure 16 Examples of optic fiber probe mounting in key spacer (Smart Spacer assembly)

Feedthrough connectors installation

Weidmann is supplying the transformer tank wall plate with the connectors pre-installed on it. The connectors and leak-proof and is not needed to re-tighten them over transformer lifetime.

Optic fiber Extensions installation

The optic fiber extensions are optic fiber cables with connectors at both ends. Their role is to make the connection between the optic fiber connectors mounted on the feedthrough plate and the InsuLogix® T monitor.

The transformer OEM must install a conduit - metallic or flexible but stiff enough to provide mechanical and environment protection - between the tank wall plate J-Box protection housing and the transformer cabinet where the InsuLogix® T monitor is installed. The optic fiber extensions must be routed from the feedthrough plate to transformer control cabinet through the conduit.

Make sure to separate the optic fiber extensions from other wiring and cabling going into/from the transformer control cabinet, in this way reducing the possibility of pinching, crushing or breaking the optic fiber extensions. The conduit containing the optic fiber extensions must be connected to transformer cabinet through its own gland, separately from the other conduits and as close as possible to where the InsuLogix® T monitor is installed.

Ideally the OEM should route the extensions through their own conduit also inside the transformer control cabinet. If this is not done then Weidmann strongly recommends that optic fiber extensions sections located inside the transformer control cabinet be clearly identified by the transformer OEM with tags as "**Optic fiber - Fragile**" and "**Allowed bending radius - not less than 8 centimeters**". The fiber extensions must be secured in a single bundle until close to instrument where they can be split in order to be connected to InsuLogix® T monitor optic fiber connectors.

Do not use plastic tie-wraps to secure the optic fiber extensions inside the transformer cabinet. If possible use soft rubber material tie-wraps (or equivalent) at least one centimeter in width. **Do not** over tighten.

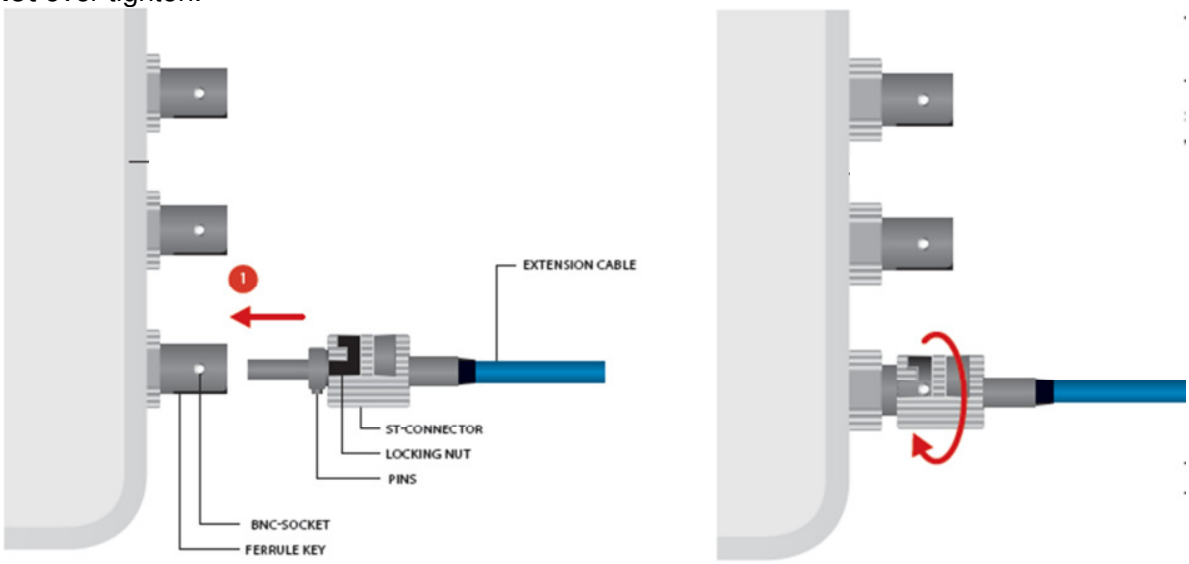
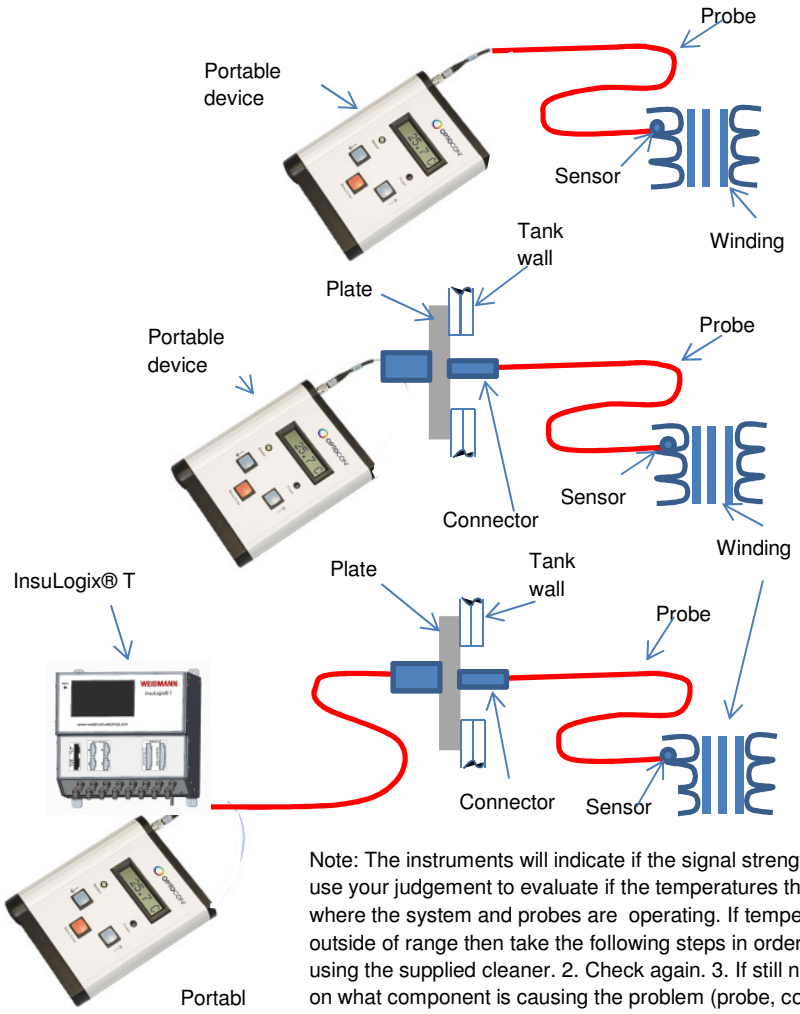


Figure 17: Connecting the optic fiber cable to connectors on plate and to instrument

Verifying the optic fiber continuity during installation process

A number of checks and verifications of installation can be done during the transformer manufacturing process. More information is give in Figure 16 below.



Use the portable one channel device to verify each probe operation after installation in winding

Use the portable one channel device to verify the probes and plate connectors operation after winding installation in tank

Use the portable one channel device to verify the probe, plate connectors and extensions operation after the transformer has been completed and the optic fiber monitoring system has been installed.

Note: The instruments will indicate if the signal strength through the fiber is within normal range. Also use your judgement to evaluate if the temperatures that are read are normal given the environment where the system and probes are operating. If temperatures seem to be off or the signal strength outside of range then take the following steps in order to troubleshoot: 1. Clean up the connectors using the supplied cleaner. 2. Check again. 3. If still not OK then switch the extensions to narrow down on what component is causing the problem (probe, connector on plate, the instrument's channel or the extension). If still not able to solve the problem then contact Weidmann and be prepared to inform on the results of your troubleshooting process.

Figure 18: Checking the fiber/connectors continuity and temperature measurement during system installation on transformer

Connectors Cleaning

Weidmann is optionally supplying a optic fiber one-click cleaner. The tool is simple and quick to use as is shown in image below.

Figure 19 Optic fiber connector cleaning tool

Optic fiber Connections Testing
During the transformer's manufacturing and testing processes the optic fiber probes must be tested at the following steps:

1. Before winding is compressed
2. After winding is compressed
3. After the outer winding installation over the inner winding
4. After drying process
5. Before and after connecting to feedthrough (remember to clean up the fiber end inside the connectors first).
6. Before and during all heat run procedures.

The probes can be tested using the InsuLogix® T monitor. If the monitor device is not available or has not been purchased then a single channel portable InsuLogix® T can be used. Weidmann strongly recommends purchasing and keeping in the winding production shop at least one InsuLogix® T portable unit to be used for testing the optic fiber monitoring systems.

InsuLogix® T Instrument Installation

The InsuLogix® T instrument must be installed in a separate housing/cabinet or inside the transformer's control cabinet.

See ANNEX A for schematic on how the instrument can be wired to transformer control cabinet.

See section Routing the Probes to Feed-Through Connectors Located on the Plate in this document for information on how to handle and route the extensions from Plate to the instrument.

4. InsuLogix® T System Configuration and Operation

The InsuLogix T is designed to measure and report the temperatures using optic fiber and Gallium Arsenide sensor technology. The system is designed for long term operation on power transformer and in substation environment.

There are two types of software delivered with the InsuLogix® T:

- Firmware: this is the software that is installed in the instrument and that is responsible with system operation, temperature measurement and data communication to SCADA. Weidmann will notify the user and will supply updates as these become available. Weidmann will also provide all necessary support during Firmware update process.
- Terminal Interface with MODBUS command set allowing the user to verify the temperatures evolution in real time as well as to configure the instrument and data recording. Weidmann will notify the user and will supply updates when these become available. Weidmann will also provide all necessary support during Firmware update process.

Integrating the InsuLogix® T into a data acquisition system

The InsuLogix® T can be integrated into a data acquisition system through one or a combination of following:

- Via instrument's relays
    - Currently four relays are available on the instrument, regardless the number of channels. Out of the four relays, one is dedicated to system's operation (WatchDog), one to signal strength and two can be allocated to various channels. In current version of the instrument is possible to apply OR logic between the first eight channels for allocation to relays, but is not possible to use AND logic. The user has the possibility to configure the relays thresholds, the logic and the channels allocation via MODBUS command set.
- Via instrument's analog outputs
    - Currently a maximum of eight analog outputs (4-20mA or 0-10V DC) are available on the instrument, regardless the number of channels. The user has the possibility to configure the analog output range via the MODBUS command set.
- Via instrument's RS485 or Ethernet ports and using the Modbus protocol.
    - It is preferable that the InsuLogix® T be integrated in SCADA using the RS485 (or Ethernet) and Modbus protocol. This way the user has access to data from all channels.
    - In the situation the connection to SCADA is not possible, the instrument can be connected to a PC that could be located in substation's Control Room. A RS485 to USB Modbus compatible converter will be needed.
    - Note: The Modbus protocol tables can be found MODBUS Protocol Manual.

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Using a PC/Laptop to connect to InsuLogix® T

The InsuLogix® T can communicate only via Modbus over RS485 or Ethernet. A converter from RS485 to USB (Modbus compatible) is required in order to connect the instrument to a computer. The user can order a converter from Weidmann or source it from a different supplier.

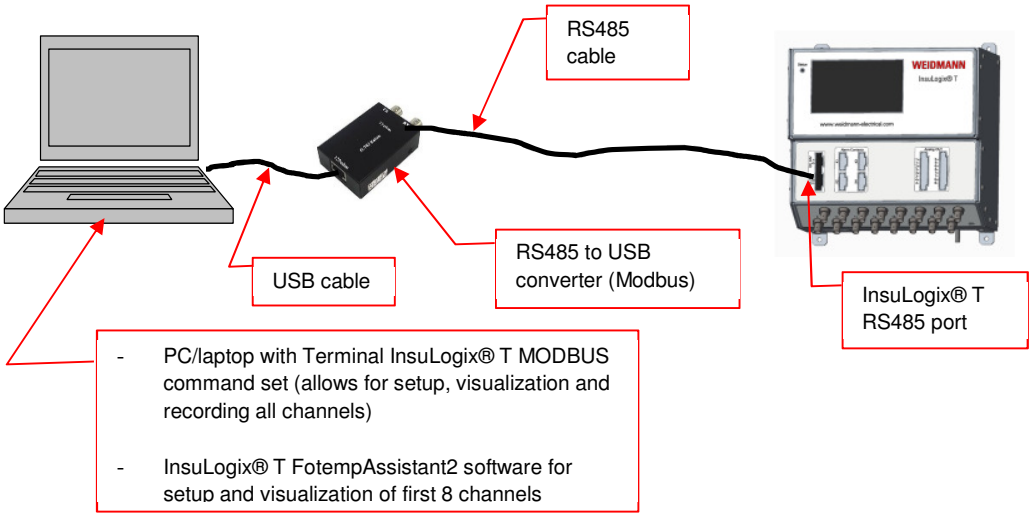


Figure 20: Connecting the InsuLogix® T to a PC/Laptop

Using a PC/Laptop to connect to InsuLogix T via Modbus over RS485
In order to communicate with the monitor via Modbus, a program that can handle Modbus protocol must be installed on the PC/Laptop. Weidmann recommends an open source program such as Python. One USB memory stick is supplied with every instrument. The USB stick contains the Python software and the scripts that the commands for setting up the monitor and for downloading the data.

Connecting the InsuLogix® T to SCADA

The monitor can be connected to SCADA via the RS485 or Ethernet ports (available with Modbus protocol). See Modbus tables in MODBUS Protocol Manual.

Relays setup and operation

Two relays (K3 and K4) are available for channels 1 to 8. The channels 1 to 8 can be allocated in any combination to one of the two relays or to both relays.

Example 1: CH1 is allocated to K3 and CH5 to K4. In this case the rest of channels (2,3,4,6,7,8) will not be allocated so the instrument will not trigger an alarm in case the thresholds set on these channels will be exceeded. The relays K3 and K4 will trigger if their channels report temperature exceeding their respective thresholds.

Example 2: CH2, CH4 and CH8 are allocated to relay K3 while the rest of channels (1,3,5,6,7) are allocated to relay K4. The relays will trigger if at least one of the allocated channels reports a temperature exceeding the set threshold.

Example 3: CH1, CH3, CH4, CH6 and CH8 are allocated to relay K3 while the channels CH1, CH2, CH4, CH5, CH7 and CH8 are allocated to relay K4. The relays will trigger if at least one of the allocated channels reports a temperature exceeding the set threshold.

Each channel can be allocated an Activation Temperature.

If the channel is allocated to a relay then the relay will trigger when the AT+hysteresis has been exceeded and will clear when temperature drops below AT-hysteresis.

Data recording

The instrument is set up at factory to record data every minute and represents the average of last four measurements. The data recording interval can be changed by user via the MODBUS set of commands.

Data from the first eight channels is recorded in the instrument, on a removable Micro SD Card with 8GB capacity. Events are also recorded in a dedicated file.

The size of a record is approximately 40 bytes. At one minute recording interval the 8 BG Micro SD card will store up to 15 years of data.

In the situation when more than eight channels are installed on an instrument, connection to a PC via RS485 or Ethernet with Modbus protocol is required in order to record the entire dataset (including the channels 9-16) in the PC.

InsuLogix® T in operation

Certain functions available for maximum 8 channels instrument configuration are not available for the channels 9 to 16. The table below provides more information.

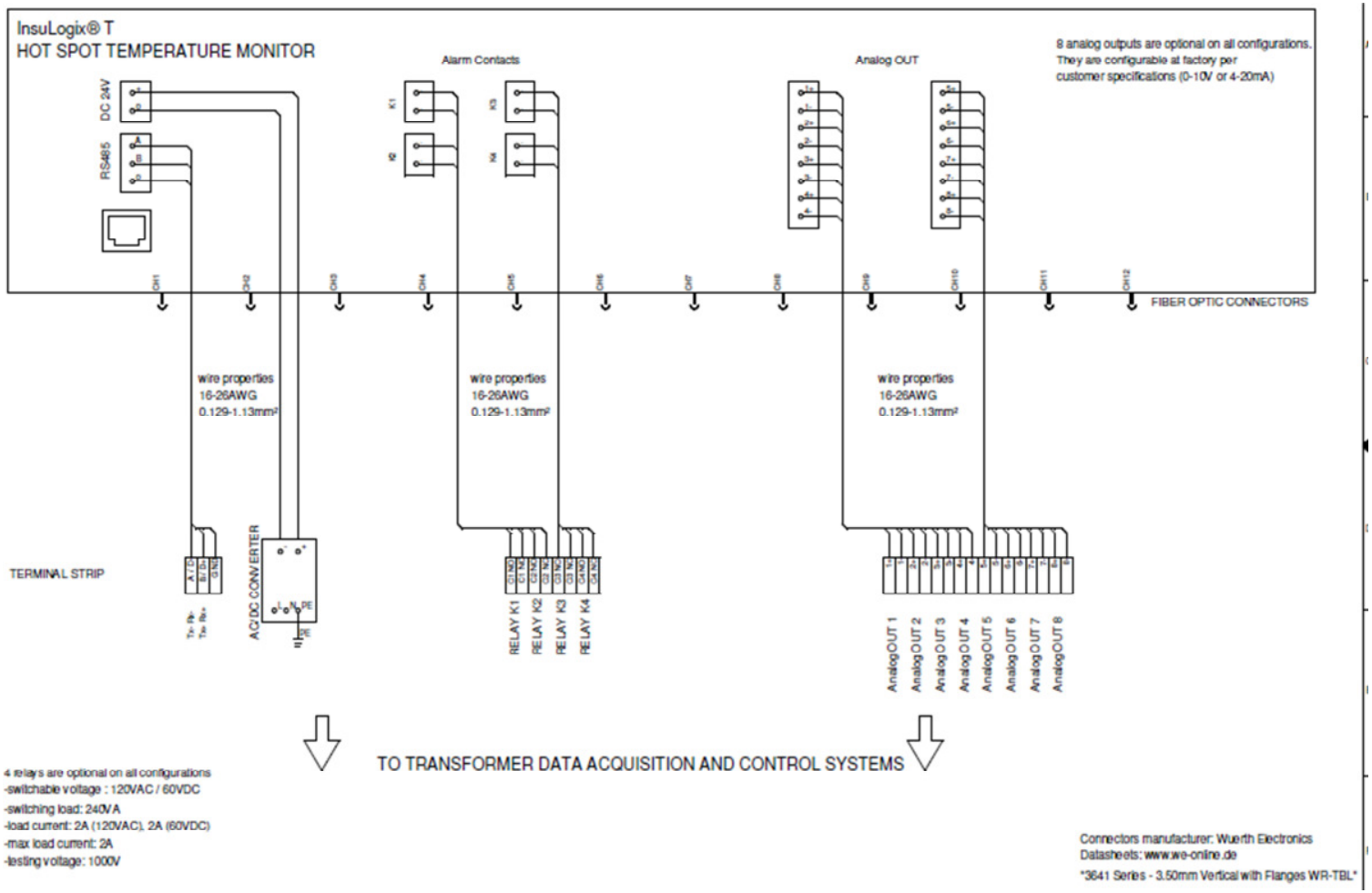
Table 8: Functions available for maximum 8 channels configuration and over 8 channels configuration

Function	Channels 1 to 8	Channels 9-16
Data logging in Micro SD Card	Yes	No
Data logging in PC via RS485/Ethernet with Modbus	Yes	Yes
Temperatures visible real time in Fotemp2 Assistant software via USB connection	Yes	No
Temperatures visible real time in Terminal window via MODBUS command	Yes	Yes
Temperatures available to SCADA via RS485/Ethernet with Modbus	Yes	Yes
Temperatures visible on local LCD	Yes	Yes
Settable Activation Temperature (for use with K3&K4 relays)	Yes	No
Channels allocable to relays K3 and K4 relays (OR logic)	Yes	No
Channels signal presence/strength error available on K2 relay	Yes	No
Channels signal presence/strength error available in Terminal window via RS485/Ethernet Modbus connection	Yes	Yes
Temperatures available via analog outputs	Yes	No

Data polling frequency can be set via MODBUS command set. Data polling from InsuLogix® T and display on InsuLogix® T LCD varies depending on the number of channels.

Figure 21: InsuLogix® T LCD

ANNEX A – Wiring Diagram for InsuLogix® T integration with the transformer control cabinet



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ANNEX B – MODBUS

See MODBUS Protocol Manual