



Product manual

Passive Temperature Transducer (PTT)

(011-01-A001-1)



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1. Introduction

1.1 Scope

This document is valid for the following products:

- Passive Temperature Transducer (PTT)

1.2 Content

This technical manual provides an overview of the Passive Temperature Transducer (PTT) and the information necessary for installation, use, and end-of-life treatment of the device.

1.3 Limitations

The technical content presented in this document aims to provide general guidance suitable for most users in typical installations. Specific use cases and applications may vary from the content of this document - please contact Synaptec to discuss your application-specific requirements.

1.4 Revision and feedback

While Synaptec has made reasonable efforts to ensure the accuracy of the information stated herein at the time of publication, it is presented without any guarantee or warranty other than as explicitly stated in a valid contract. Synaptec may change this document at any time without notice.

Please report any errors or opportunities for improvement to Synaptec. Our policy is to provide the information necessary to help you safely specify, engineer, install, commission, maintain and end-of-life treatment of this product. If you require further guidance, please contact us.

All feedback should be sent to us via info@synapt.ec.

1.5 Target audience

This manual is aimed towards all professionals involved in:

- Product installation
- Commissioning
- Use and operation
- End of life treatment

For each section, the reader is assumed to be a competent person who possesses the necessary technical knowledge.

1.6 Glossary

For the purposes of this document, the following definitions apply:

- PTT – Passive Temperature Transducer. Sometimes referred to as “the product”.
- OTDR – Optical Time-Domain Reflectometry

2. Product overview

2.1 Introduction to the PTT

The PTT is Synaptec's passive point temperature sensor for power network applications. It uses established, high-performance fibre Bragg grating (FBG) temperature sensing techniques which are fully compatible with Distributed Electrical Sensing, enabling remote circuits to be instrumented passively without data networks, control power, or expensive civil works.

The PTT uses established FBG sensing technology to measure point temperature at a specific location of interest, such as an electrical termination. Surface temperature is measured and digitised at a central location by a Synaptec Interrogator, connected to sensors in series over standard single-mode optical fibre.

Multiple sensors can be connected in series on a single fibre, enabling highly efficient large-scale monitoring.

The PTT can be deployed on existing fibre optic infrastructure, such as within underground or subsea cable networks. The PTT does not require auxiliary power, civil works, digital telecoms, or local time

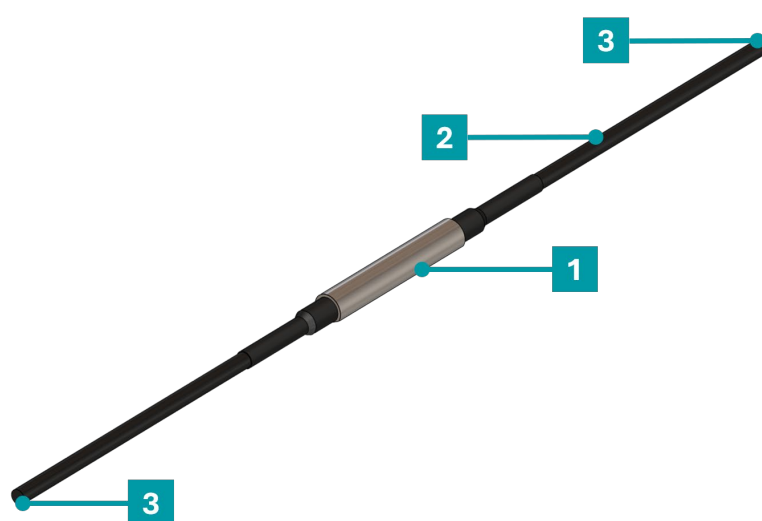
synchronisation at measurement locations, providing a cost-effective solution for instrumenting new or existing infrastructure.

2.2 Features and functions

Table 1: Key components of the PTT.

Item	Designation	Description
1	Sensor hosting	Stainless steel 304 housing for fibre optic temperature sensor
2	Fibre optic cable	Single-core fibre cable to connect sensor into the optical network (full length not shown)
3	Fibre end/connector	End of supplied PTT fibre pigtails. Ends are typically supplied with LC/APC connectors, or may be left unterminated for on-site splicing

Figure 2.1: PTT design. Numbered items are identified in Table 1.



2.3 Overview of optical fibre routing

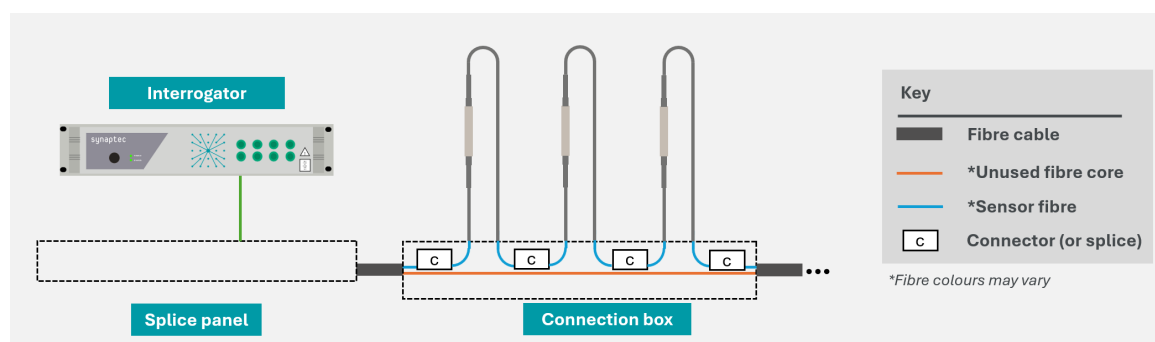
The PTT is connected in series into an optical network of sensors. The sensor network is monitored at a single end by a Synaptec Interrogator.

Optical fibre may be existing or new single-mode fibre.

Each PTT is connected into the optical fibre network via a local fibre connection box or splice box, not provided by Synaptec.

A general approach to fibre routing and connection is shown below. Refer to Section 3 for detailed installation instructions.

Figure 2.2: Example fibre routine between multiple PTT units at a single location and a Synaptec Interrogator (DMS Interrogator shown). Connections may be made within a single enclosed unit (represented here by the “Connection box”), or in multiple separate enclosed units..



3. Product installation

3.1 Prerequisites

3.1.1 Further references

- DMS Installation checklist (TD-050)

Figure 3.1: Installation Checklist Indicator



When this icon appears, it means the section includes information that is required for completing the installation checklist or contains steps directly linked to it.

3.1.2 Associated documents

Documentation related to the PTT and supplied to the installer prior to installation shall include:

- PTT Product Manual (this document)
- Detailed system design pack for the full delivered system, signed by Synaptec and the end-user/client

The detailed system design pack includes:

- System specifications
- Topology and fibre routing diagrams
- Bill of materials
- Any exceptions to the standard product installation guides
- Laser hazard guidance

This information will indicate the installation location of each PTT sensor, indexed by serial number, and other relevant information related to its installation and operation. Particular attention should be given to the location of each PTT by serial number, as any deviations from this design during installation will impact system performance. Where no exceptions are listed to the installation information provided in this manual, that information should be followed.

3.1.3 Competencies

Installation of the PTT requires no specialist competencies that are unfamiliar to the installation of measurement or telecoms hardware in the power sector.

All mechanical and electrical installation works should be carried out by qualified installers. Typical skills required for mechanical installation works will include:

- Mechanical mounting of components to a suitable structure identified during project design

All fibre optic work should be carried out by qualified fibre optic engineers. Synaptec systems use only single-mode fibre. Typical skills required for fibre optic works during PTT installation may include:

- Cleaning and installation of angle-polished connectors (APC)
- Fibre end cleaving, cleaning and inspection
- Single-mode fibre splicing
- Fibre optic routing and the use of connector/splice boxes and patch panels
- Optical time-domain reflectometry (OTDR) and loss measurement

For additional competencies related to the installation of Interrogator products, refer to the appropriate product manual.

3.1.4 Tools

Tools for mechanical installation, for example:

- Cable ties (see Section 3.4)

Tools for fibre optic inspection, splicing and protection, for example:

- Fibre optic inspection equipment
- Fibre optic cleaning (See Section 3.7)

3.2 Receipt of products and documentation

This section discusses requirements for receiving and unpacking the goods, as well as associated considerations regarding product care and user safety.

3.2.1 Handling and product care

Handle the product carefully at all times during installation to avoid damage. Special care should be taken with the optical fibre pigtailed on each sensor. The fibre should not be subjected to tight bends, crushing, or significant tensile force.

After initial unboxing to confirm receipt, the product should be carefully re-packed in the original packaging for storage and onward transport to final installation locations. The product should not be removed again from packaging until the time of installation.

Ensure that loose components are retained with the product, in the packaging. These should accompany the product to its installation destination and afterwards be stored in a dedicated safe location. Digital copies of all documentation are available from the Synaptec website.

It is recommended that during installation of the PTT, the site environment is appropriate for the product installation to be carried out properly. This includes consideration of lighting, cleanliness, vibration and weather conditions. This particularly applies where installation is being carried out at the same time as construction work.

3.2.2 Receipt

Open the product packaging on receipt to confirm the products and accessories are correct and there has been no external damage in transit. Do not remove the product from packaging unless required.

Re-seal the product in its original delivery packaging for storage and onward transport.

3.2.3 Storage

If the product is not intended for immediate installation, store in a place free from dust, moisture and high humidity, between -20 to 65 °C in the original packaging. Products should be stored in a way that avoids crushing the packaging.

On subsequent unpacking, make sure that any dust on the carton does not fall inside.

3.3 Preparing for installation

3.3.1 Installation method

In advance of installation, a plan for the installation should be developed. This should establish a safe and practical method for the work and consider factors such as access, lighting, environmental factors, cleaning

or preparation of the site for the work. Safety is always a priority when conducting installations or maintenance and the method of work should be consistent with the asset owner's policies, as well as regional best practices and regulatory requirements.

3.3.2 Sensor location

The PTT is a point temperature sensor designed for surface mounting to the substrate to be measured. To ensure good thermal contact between the PTT and the substrate, it is important that the installation surface is as flat as possible in the direction of the PTT sensor housing axis, and that it is cleaned of dust or grease.

Many application-specific factors should be considered when selecting the sensor location. For example, consideration should be given to operator safety, environmental conditions, drainage provision, restriction of access to public or operatives, and restricted space.

3.4 Mechanical mounting

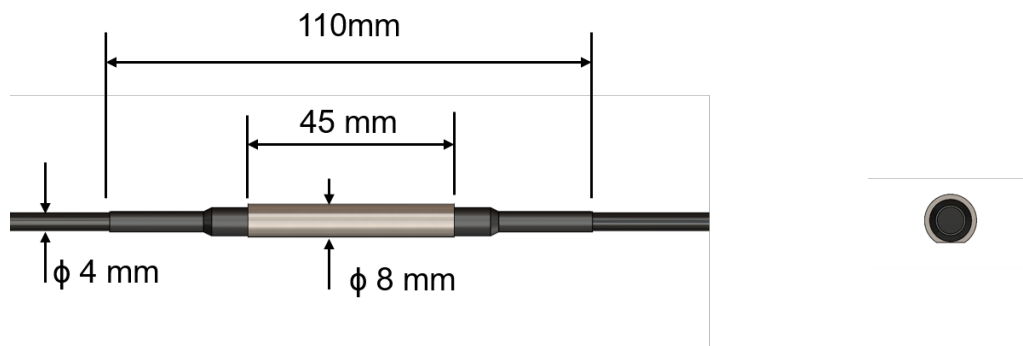
The PTT should be mechanically secured using a method which ensures robust contact between the sensor housing and measurement substrate without applying excessive crushing or bending force to the housing or fibre cable. In general, this can be satisfied through the use of Nylon cable ties or self-amalgamating tape. It is recommended to test the fastening method before use, to confirm suitability for the specific application.

If using cable ties, these should be applied to the housing directly, and not to the fibre cables, to avoid applying crushing or bending forces to the fibre cores. A minimum of two cable ties are recommended, spaced equally along the sensor housing to maintain equal pressure along the sensor axis.

For good thermal contact, the substrate should be as flat as possible along the PTT housing axis (see Figure 3.3 for dimensions). Should this not be possible, it is recommended to apply a layer of thermal grease to the substrate before mechanical mounting, to ensure good thermal contact.

Adequate provision should be made to enable removal without damage to the cable insulation if required.

Figure 3.2: Overall dimensions of the PTT



INSTALLATION
CHECKLIST

After completing the PTT mechanical mounting, take a clear photo showing the mechanical mounting.

3.5 Fibre optic connections

Caution: Working with optical fibres should be performed according to an approved method of work which meets the asset operator's safety protocols.

Warning: Optical fiber connections on the PTT must not be made or altered when the addressing Interrogator is turned on. Synaptec Interrogators must only be operated when the optical system is fully installed and tested.

Caution: Use of controls or adjustments or performance of procedures other than those specified herein might result in exposure to hazardous invisible laser radiation in the range 1500-1600 nm.

3.5.1 Installing the fibre optic cable

The PTT is typically supplied with at least 1 m of fibre optic cable pre-installed on either side of the sensor housing, but this may vary based on project requirements. The cable is 3mm armoured cable, appropriate for installation in harsh environments.

Fibre optic connections between each PTT and the wider sensor network should be made inside enclosures with an appropriate IP rating for the environment and use case.

The fibre cable should be secured at regular intervals between the PTT and the connecting enclosure. The method of securing should be selected to relieve stress from the connections at the PTT and the connecting enclosure. Once secured, the fibre cable should not be able to move, for example due to wind.

The fibre cable securing method, or any other fastening or associated part, should not crush, pinch, or mark the fibre cable.

The PTT fibre cable bend radius should be no less than 30 mm at any point.

3.5.2 Connections

The available ends of the PTT fibre cable are by default supplied with LC/APC connectors for easy connection to the sensor network. Under special conditions, the fibre cable may be supplied unterminated for direct fibre splicing.

LC/APC connections should be made using appropriate in-line mating connectors. For connection into the existing installed fibre network, it may be necessary to connectorise the existing fibre ends with an appropriately rated LC/APC connector, or to use an adaptor to convert a pre-installed connector to LC/APC. No flat-polished (UPC or PC) connectors should be deployed in the sensor network, as these can introduce significant issues into the optical scheme and may impact operation of the measurement system.

Under special conditions, the fibre cable may be supplied unterminated for direct fibre splicing. Refer to project-specific documentation for final fibre optic specifications. In this case, detailed instructions shall be supplied for stripping and splicing the 3mm armoured PTT fibre.

Fibre optic connections or splices should be performed by trained individuals using appropriate tools.

3.5.3 Laser safety risk assessment and mitigation

The Synaptec PTT is a passive optical device intended only for use as part of an Optical Fibre Communication System (OFCS) per IEC 60825-2 in conjunction with a Synaptec Interrogator, which contains an invisible laser light source emitting in the invisible wavelength region between 1500-1600 nm. It is important that, according to IEC 60825-2, appropriate measures are taken to prevent users of the system from being exposed to potentially harmful laser radiation.

The asset operator and installer ("the user") takes responsibility for the safe installation and maintenance of the optical system.

The user should identify whether each splice box in the optical system is a **restricted** or **controlled** location. It is not recommended to locate splice boxes in **unrestricted** locations, i.e. those where members of the public have free access.

- **Restricted:** locations are inaccessible, except to authorised personnel who might not have appropriate laser safety training
- **Controlled:** locations are inaccessible, except to authorised personnel who do have appropriate laser safety training.

Synaptec will provide laser safety warning labels for both restricted and controlled locations. The user should confirm their labelling requirements and ensure the appropriate labels are affixed.



INSTALLATION
CHECKLIST

After making fibre optic connections, note the connection method (e.g., LC/APC connector). If splices are performed, record the optical loss (dB) and loss measurement method. Take photos showing clearly each installed PTT secured to the substrate, the fibre cable routing, and the connection inside the connection box.

3.6 Completing the installation checklist

After the product installation is completed, ensure that:

- The provided installation checklist has been completed and signed off by the installer(s) and approver(s)
- All the required evidence and photos have been taken and provided to Synaptec

4. Use of the product

4.1 Condition inspection

Note: In ordinary use, the Synaptec PTT requires no maintenance. Correct functionality can be verified by analysis of the optical spectrum and temperature measurements at the central Interrogator.

To maximise the product lifespan, it is recommended to conduct condition inspections of the system when access is available:

Item	Suggested inspection
Sensor housing	Visual inspection to identify corrosion or contamination. Confirm that the sensor mechanical mounting is acceptable and good contact is maintained with the measured substrate.
Fibre optic cable	Visual inspection to identify ageing or damage (for example, brittleness or discolouration of the cable), confirm correct cable restraint and that there has been no movement.
Fibre optic connection box	Visual inspection to identify ageing or damage. Verification that connectors remain secure and free of contamination.

4.2 In-use notices

Synaptec draws the user's attention to the following notices:

- Do not cut any optical fibre or cable when the addressing Interrogator is powered on. This could cause exposure to potentially harmful invisible laser radiation
- Do not open the PTT housing at any time. Any opening of the PTT other than for fibre optic splicing purposes voids the product warranty and may damage the product, and poses a risk exposure to potentially harmful invisible laser radiation
- If any connection or splice box in the optical system is opened or moved, the optical connectors and splices can be disturbed and dB attenuation can change. If this is the case, check at the Synaptec Interrogator that the sensor system is valid
- If any changes may alter the environmental conditions, such as exposure of the PTT to direct sunlight, windage, vibrations, precipitation or mechanical load, it is recommended to re-assess the installation and, if necessary, discuss the changes with Synaptec
- If any changes may alter access restrictions to the any fibre optic connection points, it is important to re-assess the classification of the location and take appropriate actions

5. End of life treatment

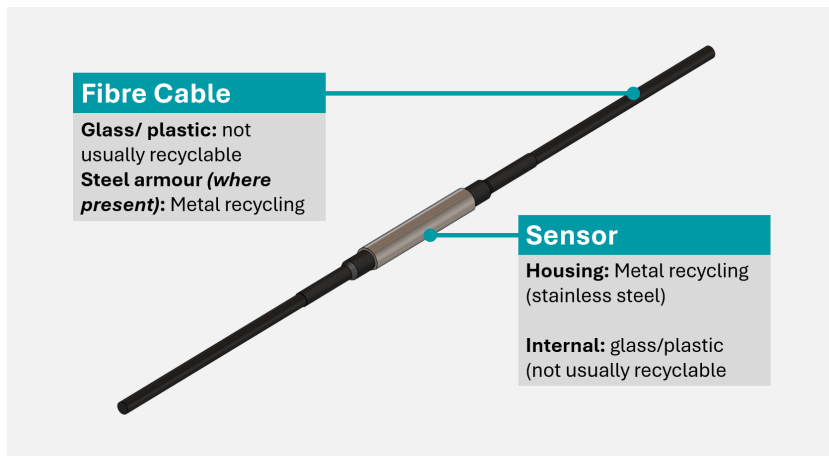
Note: If PTT sensors are no longer required please **contact Synaptec to discuss end-of-life options**, such as collection of sensors. When possible, returning equipment to Synaptec provides the best opportunity for equipment to be recycled or reused in a safe and environmentally sustainable way.

5.1 Product disposal summary

Synaptec PTT is a complex optical assembly and due to the highly integrated nature of its construction, it is not recommended to attempt disassembly. Recycling services differ between regions and countries and users should always seek up-to-date guidance for their region. Treatment should only be conducted by an appropriately registered and qualified recycling operator in accordance with regional best practice.

The PTT consists of two main components, in terms of material type. It is therefore recommended to treat the product in two parts:

Figure 5.1: PTT recommended breakdown for disposal



5.2 Hazard and waste classification

Synaptec is committed to minimising harm to people and the environment as far as reasonably possible. The following aims to support operators in identifying and addressing risks associated with treatment:

- Product contains optical fibres and other parts which can be sharp and irritant to the skin
- Product contains small quantities of epoxies which can be irritant to the skin and lungs on contact or inhalation

TD-051 Rev.00

For technical support, please visit <https://synapt.ec/technical-support/>, call +44 (0)141 488 3664, or email support@synapt.ec

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