synaptec
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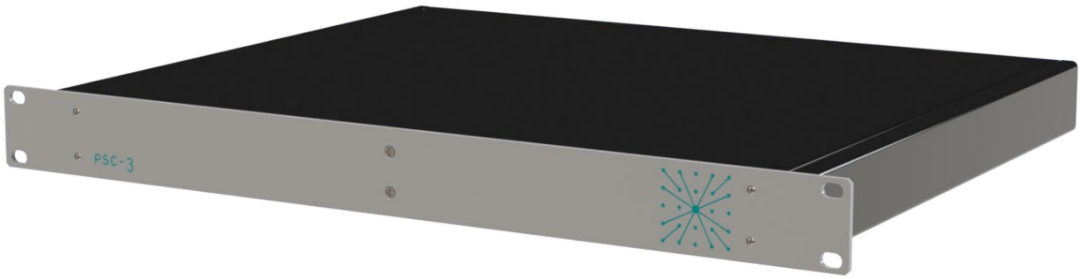
Installation manual

Passive Secondary Converter Three-Phase (PSC-3)



Contents

1. Introduction

1.1 Chapter overview

This chapter provides some general information about the technical manual and an introduction to the device(s) described in this manual.

This chapter contains the following sections:

- Chapter overview
- Foreword

1.2 Foreword

This technical manual provides a functional and technical description of Synaptec's three-phase Passive Secondary Converter (PSC-3), as well as a comprehensive set of instructions for installation and use of the device. The level at which this manual is written assumes that you are already familiar with power systems instrumentation and have experience in this discipline. The description of principles and theory is limited to that which is necessary to understand the product.

The technical content presented in this document is based on an actual case or as-designed parameters, and therefore should not be relied upon for any specific application and does not constitute a performance guarantee for any projects. Actual results are dependent on variable conditions. Accordingly, Synaptec does not make representations, warranties, or assurances as to the accuracy, currency or completeness of the content contained herein. If requested, we will provide specific technical data or specifications with respect to any customer's particular applications. Our company is constantly involved in engineering and development. For that reason, we reserve the right to modify, at any time, the technology and product specifications contained herein.

We would therefore be very pleased to hear from you if you discover any errors or opportunities for improvement. Our policy is to provide the information necessary to help you safely specify, engineer, install, commission, maintain and eventually dispose of this product. We consider that this manual provides the necessary information, but if you consider that more details are needed, please contact us.

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

1.2.1 *Target audience*

This manual is aimed towards all professionals charged with installing, commissioning, maintaining, troubleshooting or operating any of the products within the specified product range. This includes installation and commissioning personnel as well as engineers who will be responsible for operating the product.

The level at which this manual is written assumes that installation and commissioning engineers have knowledge of handling electronic equipment and fibre optics.

1.2.2 *Nomenclature*

Due to the technical nature of this manual, many special terms, abbreviations and acronyms are used throughout. Some of these terms are well-known industry-specific terms, while others are product-specific terms used by Synaptec. The first instance of any acronym or term used in a particular chapter is explained. In addition, a glossary is included in Section 1.2.3.

British English is used throughout this manual.

1.2.3 *Glossary*

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

- CT – Current Transformer
- DES – Distributed Electrical Sensing
- OHLS – Overhead Line Sensor
- OTDR – Optical Time-Domain Reflectometry
- PSC – Passive Secondary Converter
- PSC-1 – Passive Secondary Converter – Single-Phase
- PSC-1-C – Passive Secondary Converter – Single-Phase – Current
- PSC-1-V – Passive Secondary Converter – Single-Phase – Voltage
- PSC-3 – Passive Secondary Converter – Three-Phase
- PSC-3-C – Passive Secondary Converter – Three-Phase – Current
- PSC-3-V – Passive Secondary Converter – Three-Phase – Voltage
- VT – Voltage Transformer
- PST – Passive Strain Transducer
- PTT – Passive Temperature Transducer

2. Product scope

2.1 Chapter overview

This chapter provides information on the product and its use.

This chapter contains the following sections:

- Product overview
- Features and functions
- Compliance
- Functional overview

2.2 Product overview

The PSC retrofits Synaptec's passive photonic sensing technology to the secondary circuits of new or existing CTs or VTs to deliver reliable, centralised power system instrumentation. The PSC-3 is a three-phase measurement device.

The PSC, in combination with Synaptec's unique optical sensing architecture, allows standard instrument transformers in the substation to be digitized without recourse to multiple powered Merging Units and digital telecoms. The PSC may be configured as an IEC 60044- or IEC 61869-compliant protection class device.

Synaptec's photonic sensing technology allows the PSC-3 to be completely optically isolated: no electronics, batteries, data communications, power supplies or time synchronisation is required at the measurement location. Secondary connections to existing CTs or VTs are made via standard screw terminal connections to the rear panel.

Each PSC-3 is installed in combination with Synaptec's Distributed Electrical Sensing (DES) Interrogator measurement device. Multiple PSC-3 units may be installed in series on a single optical fibre, connected to the Interrogator at a single end (typically in a substation environment). The PSC-3 may also be interoperated with Synaptec's other electrical and mechanical sensors (PSC-1, PTT, PST, OHLS, etc.) to provide comprehensive local and remote infrastructure monitoring, protection, and metering. The distance from the Interrogator to the final PSC in the chain may be as much as 60 km (with larger distances possible on request).

2.3 Features and functions

The PSC-3 is shown in Figure 2.1, with numbered items described in Table 2.1. The standard form factor of the PSC-3 is 1U 19” rack-mount, but other options may be considered based on the use case.

Table 2.1: Key components of the PSC-3, with reference to the numbering in Figure 2.1.

Item	Issue	Resolution	Qty
1	Mounting holes	Through-holes with standard 19” rack-mount spacing (1U height)	1
2	Fibre connection port	SC/APC fibre connection ‘Optical IN’ connects to the upstream fibre (Interrogator or preceding sensors) ‘Optical OUT’ connects to the downstream fibre (the following sensors more distant from the Interrogator)	2
3	Terminal block	6-pole terminal block, labelled 01…06 for connection of instrument transformer secondaries	1
4	Earth bonding point	For earthing of the PSC-3 chassis	1

Figure 2.1: PSC-3 design. Numbered items are identified in Table 2.1.

2.4 Optical fibre routing

The PSC is designed to be monitored by Synaptec’s DES Interrogator, utilising existing or new single-mode fibre to make series connection to each sensor in the fibre network. Each PSC-3 is typically connected into the optical fibre network via SC/APC terminated patch cables or single-mode fibre splices, depending on system architecture. Final fibre routing shall be agreed with the customer at the design stage of each project, but will follow this same general principle

3. PSC-3 Installation

3.1 Chapter overview

This chapter provides a generic guide for installation of the PSC-3. The PSC-3 will always be supplied as part of a wider Synaptec Distributed Electrical Sensing (DES) system, and therefore installation should be completed with reference not only to this document, but to the DES Installation Manual[1] and to the installation manuals for other products in the same sensor network. Guidance on verification and troubleshooting is provided, as well as a checklist to be completed by the installer to guide and evidence successful installation.

This chapter contains the following sections:

- Chapter overview
- Competencies
- Tools
- Receipt of hardware and documentation
- Preparation of the installation environment

[1] TD-014 DES Installation Manual

- Mechanical mounting
- Secondary connection
- Fibre optic connection

3.2 Competencies

Installation of the PSC-3 requires no specialist competencies that are unfamiliar to 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 and electrical installation works will include:

- Mechanical mounting of components in a standard 19” rack, including installation of additional support where this is required for structural security of the hardware
- Wiring of CT secondary terminals, or of voltage transformer or divider secondary terminals

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 PSC-3 installation will include:

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

For additional competencies related to the wider DES system installation, refer to TD-014 DES Installation Manual.

3.3 Tools

For the purposes of installation, it is presumed that the installer has access to the following tools:

- Tools necessary for stripping, crimping, and connecting wires of up to 2.5 mm^2 cross-section, for connection between the PSC-3 and the instrument transformer
- Bolts and appropriate hex key or screwdriver, for mounting the PSC-3 in a substation rack per the instructions in Section 3.6
- Fibre optic inspection equipment

3.4 Receipt of hardware and documentation

Synaptec’s products are of robust construction but require careful handling and treatment until installation is complete. This section discusses requirements for receiving and unpacking the goods, as well as associated considerations regarding product care and user safety.

3.4.1 *Receipt*

On receipt, confirm the correct product has been delivered. Unpack the product immediately to ensure there has been no external damage in transit. If the product has been damaged, make a claim to the transport contractor and notify Synaptec promptly.

If the product is not intended for immediate installation, repack it in its original delivery packaging.

Refer to TD-014 DES Installation Manual for further information related to receipt of DES system hardware.

3.4.2 *Unpacking*

The PSC-3 is designed for installation indoors in substation environments, adjacent to devices such as protection relays or merging units. However, care must nevertheless be taken when unboxing the hardware to ensure that no damage is incurred. After initial unboxing of the hardware to confirm receipt, any PSC-3s

should be re-packed in the same manner in which they were found for transport to final installation locations and should not be removed again from packaging until the time of installation.

When unpacking and installing the product, take care not to damage any of the parts and make sure that additional components are not accidentally left in the packaging or lost. Do not discard any technical documentation. These should accompany the product to its installation destination and be stored in a dedicated safe location.

The site should be well-lit to aid inspection, and should be clean, dry, and reasonably free from dust and excessive vibration. This particularly applies where installation is being carried out at the same time as construction work.

The PSC-3 should be handled carefully during installation. Special care should be taken with mechanical mounting, and with connection of instrument transformer secondaries and the networking fibre optic cable. The fibre should not be subject to tight bends, crushing, or significant tensile force.

3.4.3 *Storage*

If the product is not intended for immediate installation, store it in a place free from dust and moisture in its original packaging.

On subsequent unpacking, make sure that any dust on the carton does not fall inside. Avoid storing in locations of high humidity. The device can be stored between -25 °C to 55 °C (see technical specifications).

3.4.4 *Documentation and communication*

Documentation related to the PSC-3 and supplied to the installer prior to installation shall include:

- The PSC-3 Installation Manual (this document)
- The detailed system design pack for the full DES system, signed by Synaptec and the end-user/client.

The detailed system design pack shall include system specifications, topology and fibre routing diagrams, bill of materials, and any exceptions to the standard product installation guides. This information will indicate the installation location of each PSC-3 sensor, indexed by serial number, and other pertinent information related to its installation and operation. Particular attention should be given to the location of each PSC-3 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.

3.5 Preparing for installation

It should be ensured that a suitable mounting location is available for the PSC-3 in a 19” rack with access to existing instrument transformer secondary wiring and fibre optic connections. In advance of installation, the installation location should be cleared of mess and debris.

It is at the client and installer’s discretion whether an electrical outage should be arranged for installation of this equipment, since this will depend on the complete scope of work and the electrical safety protocols under which the work will be taking place.

3.6 Mechanical mounting

The PSC-3 should be secured into the 19” rack using the mounting holes on the front panel flanges using standard rack-mount tools. It is recommended that a suitable shelf or additional rack support is employed to support the weight of the device, or that it is installed directly above other Synaptec equipment, subject to the installation guidelines for that equipment.

No ventilation is present in the PSC-3 chassis, and so it is suitable for installation directly above or below other rack-mountable devices without an air gap, subject to the installation guidelines for those devices.

After mounting, and before the equipment is energised, the enclosure should be earthed to a local common earthing/ground point by connection to the earth bonding point on the housing. The earthing wire should be terminated in a suitable ring lug for connection to the M4 earthing point.

3.7 Secondary connection

The PSC-3 will be delivered in one of two formats: a PSC-3-C for current, or a PSC-3-V for voltage. For both formats, secondary connections from the instrument transformer are made via M4 screw terminals on the rear panel, as indicated in Figure 2.1. Secondary wiring should be terminated in a suitable ring lug for connection to the screw terminal.

Table 3.1 indicates the connection order for each phase with reference to the terminal numbering on the rear panel. This format should be used for both PSC-3-C and PSC-3-V, unless otherwise agreed.

Table 3.1: Terminal block wiring order. S1 and S2 refer to the connections to the secondary wiring for each phase, determined by the polarity of the CT. The convention is to connect these such that energy flows from S1 to S2.

Terminal Label	Secondary Wiring Connection	
	PSC-3-V	PSC-3-C
1	Phase A	Phase A S1
2	Neutral	Phase A S2
3	Phase B	Phase B S1
4	Neutral	Phase B S2
5	Phase C	Phase C S1
6	Neutral	Phase C S2

3.8 Fibre optic connection

Unless otherwise agreed or deemed necessary for optimum optical efficiency during system design, the PSC-3 is supplied with standard single-mode SC/APC fibre ports for connection into the sensor network. A simplex, single-mode SC/APC fibre optic patch cable should be used to connect the PSC-3 to the preceding device in the sensor network (or the Interrogator if the PSC-3 in question is the first in the network) and to the following device, providing uninterrupted line-of sight through the fibre to the other sensors in the network and the Interrogator.

The following convention should be followed for all PSC-3 installations:

- The Opt IN (input) port should be connected into the fibre network in the direction of the previous sensor in the chain, in the direction of the Interrogator.
- The Opt OUT (output) port should be connected into the fibre network in the direction of the next sensor in the chain, away from the Interrogator.

Should fibre optic splices be required, these should be performed by trained individuals using a suitable fusion splicer. Fibre optic cabling should be routed and protected per the installer and operator's best practices and to ensure reliable connection with minimal loss, and the dB loss of each splice or connector should be measured where possible and reported in the checklist in the TD-017 PSC-3 Checklist.

For typical optical loss guidelines, and instructions on verification of the complete sensor fibre network following installation of a DES system, refer to TD-014 DES Installation Manual.

3.9 Troubleshooting

Issue	Resolution
Connector exhibits losses >-0.3dB, or > custom limit specified in design documentation	Disconnect and inspect fibre connector. Clean fibre connector end if necessary. Replace fibre connector or patch lead if necessary. Repeat until loss is inacceptable range.
Received electrical signal following commissioning is 180° out of phase	Re-wire CT secondaries with correct polarisation

4. Technical data

4.1 Chapter overview

This chapter describes the technical specifications of the product.

This chapter contains the following sections:

- Chapter overview
- Mechanical specifications
- Environmental specifications

4.2 Electrical specifications

Item	Specification
Rated input	1 A[2]
Accuracy class	1/10TPM (IEC 61869-13)
Rated continuous thermal current	2 A[3]
Rated short-time thermal current	40 A, 1 s

4.3 Mechanical specifications

4.3.1 *Physical parameters*

Item	Specification
Dimensions	1U x 376 mm
Weight	4.8 kg
Mounting	19” rackmount
IP protection	IP2X (IEC 60529)

4.4 Environmental conditions

4.4.1 *Ambient temperature range*

Item	Specification
Operating temperature range	-5 to +40 °C
Storage temperature range	-25 to +55 °C

4.4.2 *Ambient humidity range*

Item	Specification
Operating	90% at 40 °C
Storage	100% at 40 °C

4.4.3 *Altitude*

Item	Specification
Operating altitude	Below 2,000 m

[2] Other ratings available on request
[3] Assuming 1 A rated current

For technical support, please call +44 (0)141 488 3664
or email support@synapt.ec

Synaptec Ltd, 368 Alexandra Parade, Glasgow, G31 3AU, United Kingdom
T: +44 (0)141 488 3664 | info@synapt.ec | synapt.ec