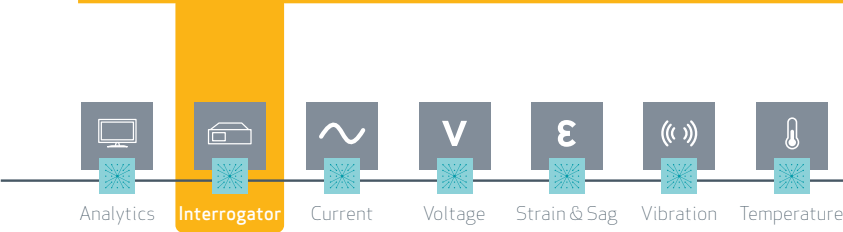


Interrogators



Distributed Electrical Sensing (DES) Interrogator

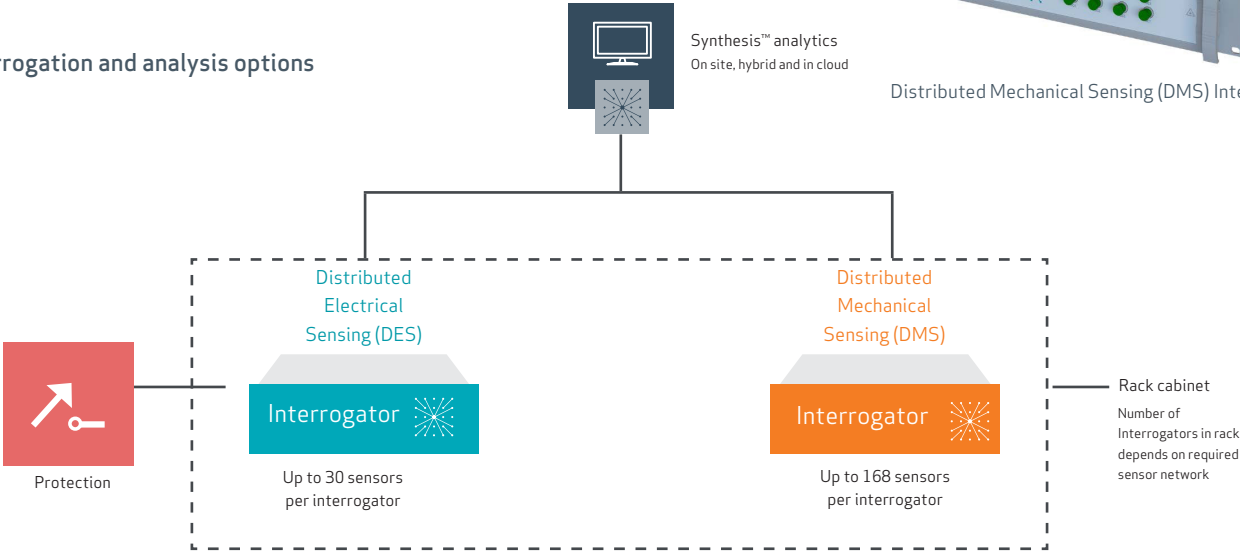


Distributed Mechanical Sensing (DMS) Interrogator

Interrogators are the core component in our ECG™ holistic cable monitoring system, centrally gathering, time-stamping and publishing synchronous data from every passive sensor and providing actionable commands and alarms to auxiliary equipment.

Modular and scalable, they fully support any mix of our electrical and mechanical sensors and perform real-time analysis of the performance and condition of power networks.

Interrogation and analysis options



Max sensors per fibre	30	21
Max fibres per Interrogator	1	8
Max publishing rate	14,4 kHz (synchronised waveforms)	1 Hz
Applications	Protection, metering and condition monitoring	Condition monitoring
Supported electrical sensors*	PSC	n/a
Supported mechanical sensors	PST, OHLS, PTT	PST, OHLS, PTT

*PSC: Passive Secondary Converter, PST: Passive Strain Reducer, OHLS: Overhead Line Sensor, PTT: Passive Temperature Transducer.

Interrogators



The DES Interrogator is a high-performance Interrogator, designed primarily for Distributed Electrical Sensing (DES). The DES Interrogator streams live data in industry standard formats including IEC 61850 Sampled Values or custom data formats, and alarms in GOOSE format. All measurements are time-synchronised, accurately time-stamped to within a microsecond, and published at up to 14.4 kHz, enabling the system to support a combination of protection, metering, and condition monitoring applications. The DES Interrogator synchronously monitors up to 30 sensors over 60 km of standard telecoms fibre, processing and streaming waveform data in real time with industry-leading latency and detail.

The DMS Interrogator monitors mechanical sensors for temperature, strain and overhead line sag at the slower rate of 1 Hz appropriate for such measurands. Available with up to 8 optical channels, each of which can monitor up to 21 mechanical sensors, the DMS Interrogator enables highly-efficient, highly-multiplexed mechanical condition monitoring for power systems assets.

The uniquely powerful and flexible nature of the Interrogators makes them ideal for long-range, multi-point protection, automation, control and condition monitoring applications. Streaming data from DES and DMS Interrogator modules are brought together by Synthesis™ to provide live system condition visualisation, configurable alarms, performance insights, and decision support for asset managers.

Specifications

	DES Interrogator	DMS Interrogator
Mechanical		
Dimensions	19" 3U rack (447 x 425 x 132 mm)	19" 2U rack (483 x 400 x 88 mm)
Weight	8.3 kg	7 kg
Power supply		
Voltage	100 - 240 VAC 110/220 VDC	100 - 240 VDC
Frequency	50/60 Hz	50/60 Hz
Maximum power consumption	90 W	17.5 W
Redundancy	Integrated dual-redundant	Single
Environmental		
Operating temperature	-25 to +55 °C	0 to +50 °C
Storage temperature	-25 to +70 °C	-20 to +70 °C
Humidity	to 93% at +40 °C	to 90% at +40 °C
Shock endurance	15 g (in each axis); 11 ms pulse (IEC 60255-21-2)	20 g (in each axis); 11 ms pulse (IEC 60068-2-27)
Sinusoidal vibration endurance	1g (10 - 150 Hz); 20 cycle/axis (IEC 60255-21-1)	2.5 g (5 to 65 Hz); 30 min/axis (IEC 60068-2-6)
IP rating	IP3X	IP20

Interrogators

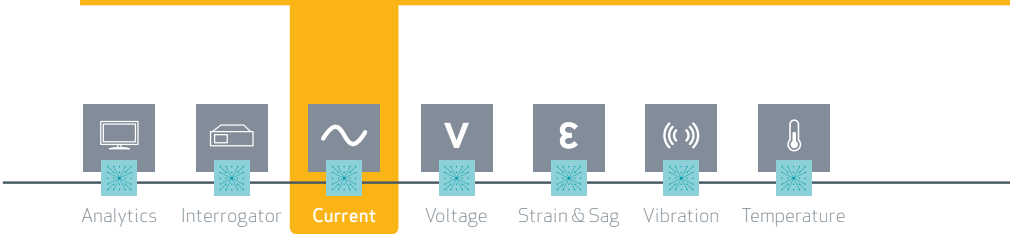
Specifications (continued)

Optical input		
Number of optical channels	1	8 (max)
Number of sensors per channel	30 ¹	21 ²
Fibre type	Standard simplex single-mode	Standard simplex single-mode
Interface	SC/APC	FC/APC
Communications interfaces and IO		
Number of Ethernet ports	6x Gigabit Ethernet	1x Ethernet
Ethernet interface	SFP (user selectable interface type, and included with the Interrogator)	RJ45
Redundancy	IEC 62439-3 PRP	n/a
Protocol(s)	IEC 61850-9-2 "LE", IEC 61869-9, IEC 61850-8-1 (GOOSE), customised datasets	SCPI
Supported sampling rates	4 kHz, 4.8 kHz, 14.4 kHz	1 Hz
Watchdog contact	Normally open (NO) and normally closed (NC) terminals	n/a
Time synchronisation		
Protocol(s)	PTP: IEC/IEEE 61850-9-3 PPS: input and output via optical multimode ST fibre NTP: synchronisation of system clock to a specified NTP server (not suitable for precision synchronisation of waveform samples)	NTP
HMI		
Software configuration and management	Secure web interface – integrated within Interrogator	Secure web interface – integrated within Interrogator
Configuration port	Front panel: RJ45 Gigabit Ethernet	RJ45 Ethernet
Display	2x16 alphanumeric	n/a
LEDs	Indicators for alarms, Ethernet connections, and power	Indicators for power and status
Reference standards		
Environmental/EMC	Product safety per IEC 60255-27 Climatic environment per IEC 60255-1 (IEC 60068-2) Mechanical environment per IEC 60255-1 (IEC 60255-21) EMC per IEC 60255-1 (IEC 60255-26)	IEC 60068-2

¹ Assumes 5P10 class Passive Secondary Converter with operating temperature range -5 °C to +40 °C.

² Assumes Passive Temperature Transducers with operating temperature range -40 °C to +100 °C.

Primary Current Transducer (PCT)

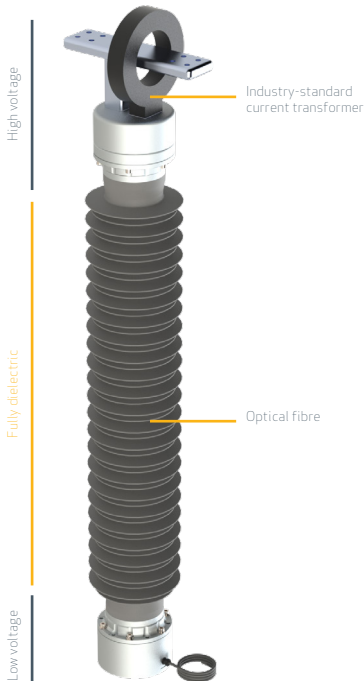


Primary Current Transducer (PCT) combines industry-standard current transformers (CTs) with Distributed Electrical Sensing (DES) technology, enabling remote circuits to be instrumented passively without data networks, control power, or expensive civil works.

Up to 30 PCTs can be daisy-chained per fibre within the substation, or over a distance of up to 60 km from the substation fence to obtain high-fidelity, synchronised current measurements for use in protection and control applications.

PCTs can be configured as IEC 60044 and IEC 61869 compliant protection class devices. Measurements are available in real time within the substation firewall through the Interrogator unit, and can be published using the standardised IEC 61850-9-2 / IEC 61869-9 sampled values protocols.

The PCT is ideal for multi-zone differential protection, discrete auto-reclosing, and remote asset condition monitoring and early failure warning.



Specifications

Electrical	
Nominal current	User specified up to 40 kA
Accuracy class	5P / 10P
Voltage	Up to 600 kV
Insulator	User specified to match voltage rating
Environmental	
Operating temperature range	-40 to +40 (IEC 61869-1), extension to +80 available upon request
Humidity	90%
Vibration	1G
Optical	
Fiber type	Standard single mode
Fiber connection	Single mode fiber splice

Passive Strain Transducer (PST)

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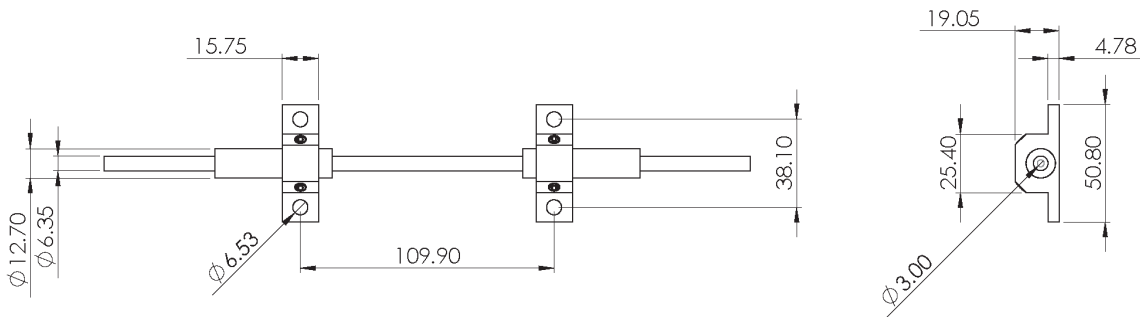
The Passive Strain Transducer (PST) utilises established, high-performance mechanical sensing techniques which are fully compatible with our Distributed Electrical Sensing (DES) technology, enabling remote circuits to be instrumented passively without data networks, control power, or expensive civil works.

Up to 15 PSTs can be daisy-chained per fibre over a distance of up to 60 km from the substation and can be combined with Synaptec’s current and voltage sensors to obtain high-fidelity, synchronised measurements of intrusion, weather damage, or asset tampering over a wide area.

Measurements are available in real time within the substation firewall through Synaptec’s Interrogator unit, and are published using the standardised IEC 61850 sampled value protocol.

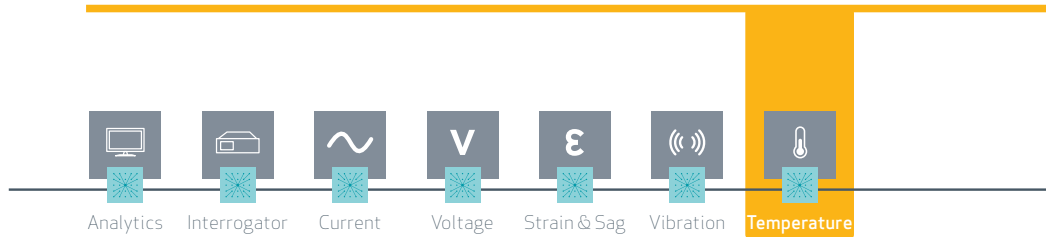
Specifications

Performance	
Strain resolution	0.1 $\mu\epsilon$
Operating strain range	$\pm 2500 \mu\epsilon$
Operating temperature range	-40 to +80 °C
Mechanical	
Dimensions	31.5 x 15.0 x 7.6 mm
Weight	15 g (sensor only without cable or fixings)
Housing material	302 stainless steel
Cable type	3 mm armoured cable
Mounting method	Spot-weld, epoxy



Passive Temperature Transducer (PTT)

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Our range of Passive Temperature Transducers (PTT) utilises established, high-performance temperature measurement techniques which are fully compatible with our Distributed Electrical Sensing (DES) technology, enabling remote circuits to be instrumented passively without data networks, control power, or expensive civil works.

Up to 30 PTTs can be daisy-chained per fibre over a distance of up to 60 km from the substation and can be combined with Synaptec's current and voltage sensors to obtain high-fidelity, synchronised measurements of resistive heating and thermal capacity.

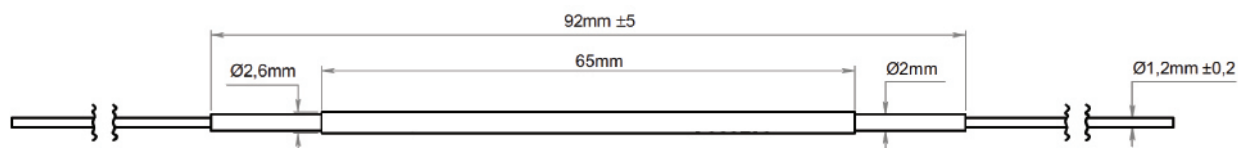
Measurements are available in real time within the substation firewall through Synaptec's Interrogator unit, and are published using the standardised IEC 61850 sampled value protocol.

Synaptec's PTT is available in multiple form factors and constructions for different deployment environments and applications.

PTT-A

The PTT-A is a small diameter sensor for applications where space is a limitation and incorporates a braided single-mode fibre cable for quick routing and installation. The PTT-A can be used as a sensor for accurate and reliable temperature measurements and is ideal for remote condition monitoring of joints and terminations in underground or subsea power cables, transformers and other critical HV assets.

PTT-A standard dimensions

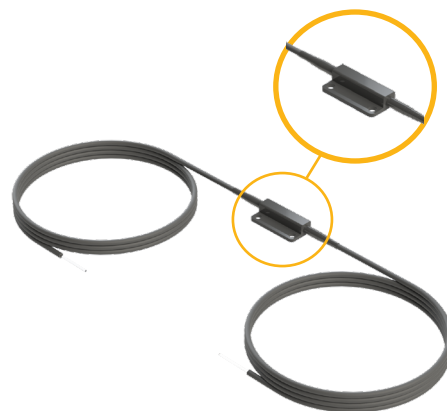


Passive Temperature Transducer (PTT)

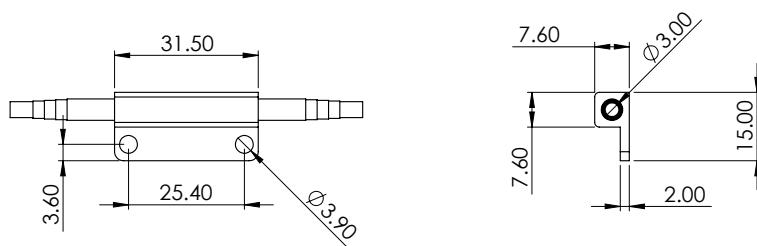
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PTT-B

The PTT-B is a ruggedised temperature sensor for use in harsh environments. The PTT-B is prepared for surface mounting on flat or curved surfaces by choice of external housing, and so is ideal for remote condition monitoring of cables, transformers or other critical HV assets.



PTT-B standard dimensions

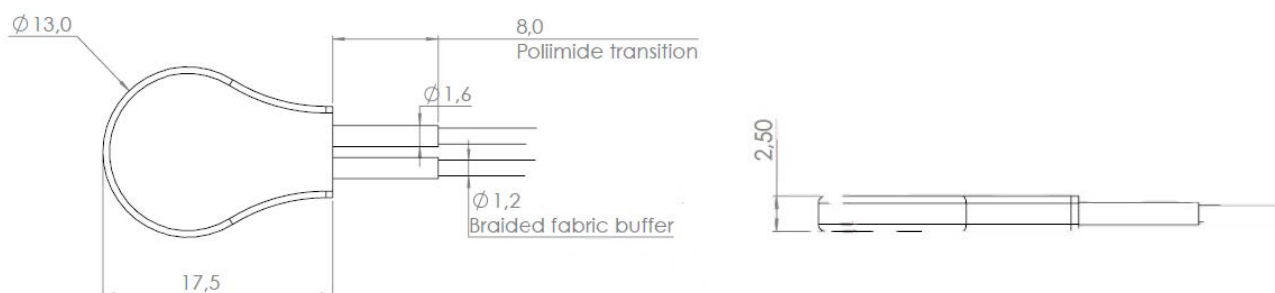


PTT-D

The PTT-D employs an all-dielectric construction and tight fibre optic bend radius for applications where electrical field strengths are high and space is a limitation. The PTT-D is ideally suited to monitoring of hard-to-reach joints and terminations in underground, offshore or subsea power networks.



PTT-D standard dimensions



Passive Temperature Transducer (PTT)



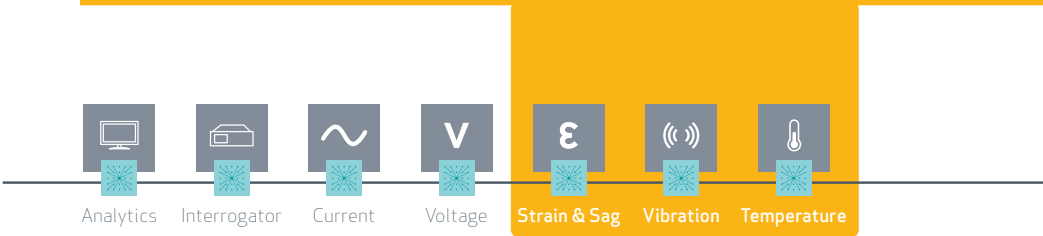
Specifications

	Unit	PTT-A	PTT-B	PTT-D
Resolution ¹	°C	0.02	0.05	0.05
Measurement error	°C	±0.5	±0.5	±0.5
Measurement range	°C	-40 to +100	-40 to +150	-20 to +140
Storage temperature	°C	-20 to +80	-40 to +150	-20 to +80
Operation and storage humidity	%	≤100, <95	≤100	<95
Attachment method	n.a.	Epoxy or mechanical fixing/strapping	Epoxy or mechanical fixing/strapping	Tape, epoxy
Weight ²	g	8	36	2
Main materials	n.a.	Stainless steel, ormocer®	Stainless steel	Alumina, polyimide and ormocer®
Inputs / Outputs				
Cable type	n.a.	Ø 1 mm braided cable	Ø 3 mm armoured cable	Ø 1 mm braided cable
Cable bend radius	mm	> 16	> 15	> 16

¹ For 0.5 pm resolution in wavelength measurement, as found in Distributed Mechanical Sensing (DES) Interrogator.

² Weights assume short pigtails on either side and no connections.

Overhead Line Sensor (OHLS)



Overhead Line Sensor (OHLS) combines multiple high-performance optical measurement techniques into one completely passive device, enabling remote circuits to be instrumented without data networks, control power, or expensive civil works.

The OHLS can be retrofitted to any overhead power line to enable active monitoring of ampacity, vertical clearance, ice loading, and general condition monitoring.

Multiple OHLSs can be daisy-chained per fibre over a distance of up to 60 km, and can be combined with Synaptec’s current and voltage sensors to obtain high-fidelity, synchronised measurements over a wide area. Measurements are available in real time within the substation firewall through Synaptec’s Interrogator unit, and are published using the standardised IEC 61850 sampled value protocol.

The OHLS is particularly well-suited to instrumentation of extremely remote critical spans, where electronic and wireless sensing suffers from poor coverage and challenging maintenance access.

Performance	
Sag resolution	5 mm ¹
Operating sag range	±15 m ¹
Operating temperature range (ambient)	-40 to +80 °C
Estimated microstrain error	±15µe
Mechanical	
Dimensions	Ø140 x 290 mm
Weight	6 kg
Housing material	Aluminium 6082 (default) Alternative materials available upon request

¹ Estimate based on 400 m conductor span with 4 m nominal line sag.
For detailed estimates of performance please contact Synaptec with application information.

Passive Secondary Converter (PSC)

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Passive Secondary Converter (PSC) combines industry-standard instrument transformers with Distributed Electrical Sensing (DES) technology, enabling remote circuits to be instrumented passively without data networks, control power, or expensive civil works.

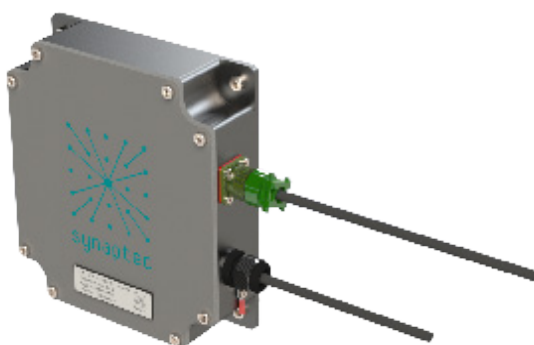
Utilising passive sensing techniques, the PSC encodes the secondary electrical quantity of a CT or VT into an analogue optical signal in standard single-mode telecoms fibre.

Networks of PSCs are multiplexed over standard single-mode fibre and monitored at a central location by Synaptec's Distributed Electrical Sensing (DES) Interrogator. This technique enables existing instrument transformers to be digitised and centralised, and new instrument transformers to be installed outside the substation fence for wide-area monitoring and multi-zone differential protection schemes without recourse to auxiliary power supplies, digital telecoms equipment or GPS receivers. In this way, footprint and weight are minimised, and the retrofitting of current and voltage sensors is made quick and safe in remote locations.

The PSC is available in two form factors:

- The **PSC-1** is designed for all-weather outdoor installations. The PSC-1 has a universal wall-mount design and provides a single-phase measurement of new or existing instrument transformers.
- The **PSC-3** is designed for installation in a substation environment. The PSC-3 installs in a standard 19 inch rack and provides a three-phase measurement of existing instrument transformers.

PSC-1



PSC-3



The PSC is available in both current (C) or voltage (V) formats.

Passive Secondary Converter (PSC)



Specifications

	PSC-1-C	PSC-1-V	PSC-3-C	PSC-3-V
Electrical				
Nominal amplitude	1 A	User specified	1 A	User specified
Accuracy class	5P	3P	5P	3P
Rated continuous thermal current	2 A	-	2 A	-
Rated short-time thermal current	40 A, 1 s	-	40 A, 1 s	-
Environmental				
Operating temperature range	-40 to +80 °C		-5 to +40 °C	
Humidity	100% storage, 90% operating			
Mechanical				
Dimensions	190 x 175 x 52 mm		1U x 376 mm	
Weight	2.6 kg		4.8 kg	
Mounting	Universal flange-mount		19" rackmount	
IP protection	IP66		IP2X	
Optical				
Fibre type	Standard simple-mode simplex			
Fibre connection	Single-mode fibre splice		SC/APC patch cable	