

Mixed Circuit Protection

Informing safe auto-reclose in milliseconds



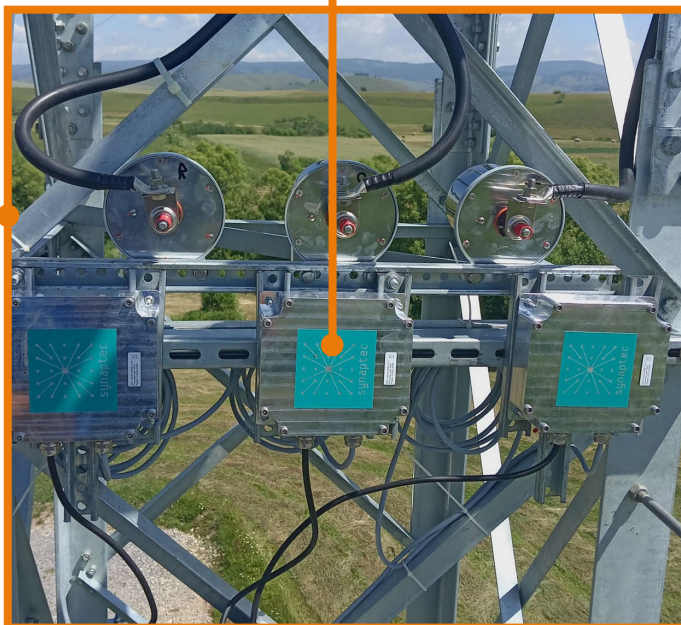
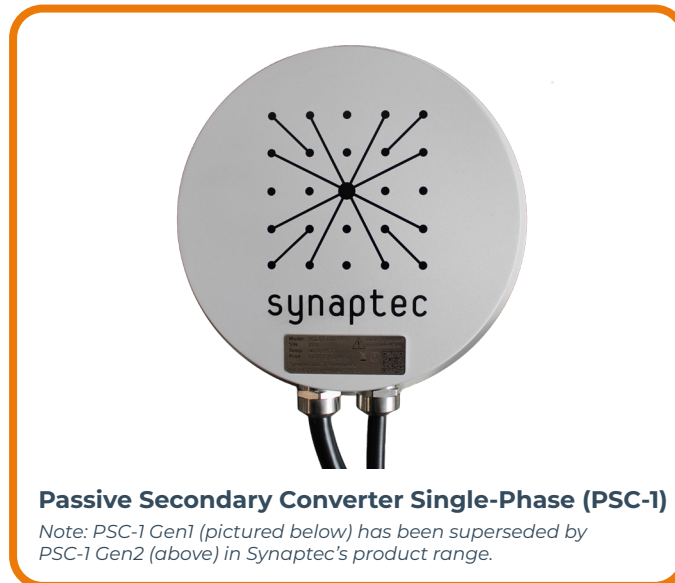
synaptec
powered by Megger®

Introduction

Mixed Circuit Protection (MCP) is Synaptec's solution to eliminate the risk of auto-reclosing on a permanent cable fault.

MCP utilises Synaptec's core technology, Distributed Electrical Sensing (DES), to instantly detect whether a fault has occurred on a cable zone. By differentiating overhead lines and underground cables, it informs the protection relay's response in milliseconds, before the breaker opens.

Adopted by Transmission System Operators (TSOs) worldwide, it is quickly becoming an essential solution to ensure continuous power supply and avoid costly damage to grid assets.



Distributed Electrical Sensing (DES) requires no control power, data networks or ongoing maintenance at sensor locations.

MCP was developed with leading transmission system operators to provide an accurate and cost-saving protection solution.

Why choose MCP?

The industry challenge

The number of circuits comprising a mix of overhead line and underground cable sections is increasing due to a range of factors; from the rise in extreme weather, to the pressure of critical new loads.

The decision of whether to allow or block auto-reclose on a mixed circuit in response to a fault comes down to a particular operator's policy.

At the extremes, an operator may decide to either:

- **Never auto-reclose** on a mixed circuit, to remove the risk of reclosing on a permanent cable fault; or
- **Always auto-reclose**, to take the risk that the fault is a transient one in the overhead line.

Both of these approaches carry with them significant dangers.

If never allowing auto-reclose, fault-finding must be carried out after the breaker opens, which is laborious and time-consuming. This in turn causes disruption to supply, and risks reputational damage to the operator, as well as penalties for lost customer minutes.

If always allowing auto-reclose, the operator risks reclosing onto a permanent cable fault (perhaps multiple times), causing significant damage to local assets. In severe cases, the damage can be catastrophic, exposing risk to life as well as fatal damage to critical assets in the surrounding network, leading to further outage time.

In reality, an operator will rely on a policy that lies somewhere between these two options. For instance, permitting auto-reclose on circuits where the cable is a small percentage of the total line length. However, a reliance on this policy does nothing to mitigate the risks and assumptions of either approach.

Never auto-reclose



No auto-reclose
Disrupted supply



Laborious fault-finding
Outage, time, labour



Damage to reputation
Deemed unreliable

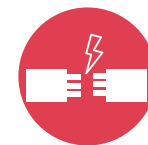
Always auto-reclose



Catastrophic consequences
Explosions, risk to life



Unconditional auto-reclosing
Reduced power quality



Weakening assets
Reducing lifetime / permanent damage

Our solution

MCP is a cost-effective and sophisticated protection solution that enable operators to never reclose on a permanent fault, and therefore safely auto-reclose on transient faults.

The solution draws on Synaptec's DES technology to inform protection systems if there is a fault in the cable section.



Scalability

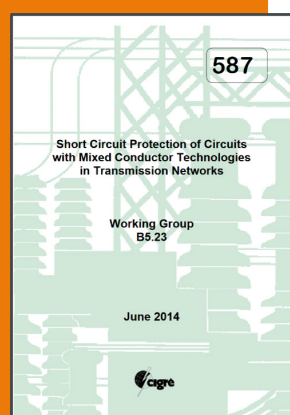
The passive sensing solution offers operators many unique benefits, including:

- **Passive sensors** – As the sensors use the existing optical fibre in the cable network, they require no control power, data networks or ongoing maintenance, so can easily be installed and left at numerous, remote locations.
- **Simple infrastructure** – One interrogator in the control rack can instrument many locations up to 60 km from substation, either in series or in parallel.

MCP solution recommended by CIGRE as 'Best in Market'

The technology that Synaptec has since industrialised as MCP was recommended by CIGRE in Technical Report 587 as the best solution for discrete auto-reclose on mixed circuits.

The authors found that Synaptec's fibre Bragg gratings technology was the best solution for this problem when compared to other approaches, such as Faraday-effect optical sensors, which all had significant drawbacks.



Safe and reliable

- **Resilient** – Our technology is immune to environmental factors such as temperature or electromagnetic interference.
- **Compliant** – It is standards-compliant and digital-ready, and so can be used with both legacy and digital substation equipment.
- **Cyber secure** – With only analogue optical signals in the fibre beyond the substation fence.
- **Millisecond response** – Each measurement is synchronised within one microsecond, and is processed to inform the protection response in sub-cycle timescales. This means that if a cable fault is identified, an AR block signal is issued long before the breaker even opens.



Easy to install

- **Compatible with communication protocols** – No additional data networking required as system is compatible with conventional relays, and streams Sampled Values and GOOSE messages for IEC 61850 / IEC 61869 systems.
- **Simple set-up** – Commissioning is done centrally, with industry-leading configuration tools to enable a streamlined experience.
- **Easily connects** – Sensors are compatible with industry standard CTs at any level, allowing any circuit to be addressed across transmission and distribution.

How it works

Passive sensors

Synaptec's passive sensors combine industry-standard instrument transformers with Distributed Electrical Sensing (DES) technology to enable remote circuits to be instrumented without complex infrastructure.

The Passive Secondary Converter (PSC), an optical sensor, connects to the secondary circuit of an industry-standard CT at the cable sealing ends, where the overhead line and underground cable connect.

Interrogator

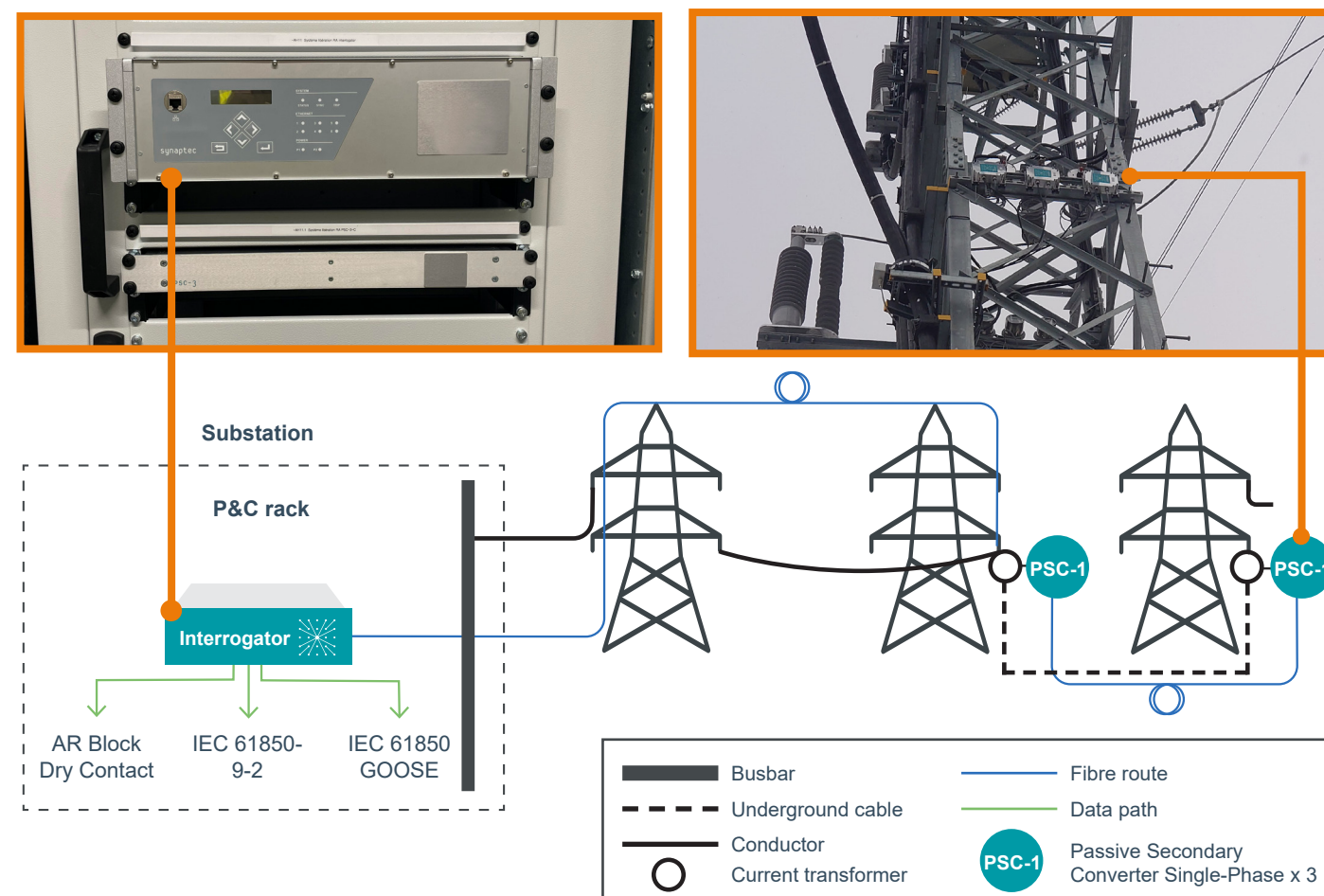
Back in the substation, which could be up to 60 km away, a single DES Interrogator is installed in the control rack, which instruments each sensor location.

Using industry-standard algorithms such as 87L differential current protection logic and ANSI 50G earth overcurrent, depending on requirements, the system instantly detects when a fault has occurred on the cable zone, and informs the protection response.

On detection of a cable fault, the DES Interrogator will instantly communicate an auto-reclose blocking signal to the main protection system.

The system therefore enables discrete auto-reclose to be permitted or blocked, depending on whether the fault has been detected in the underground cable section.

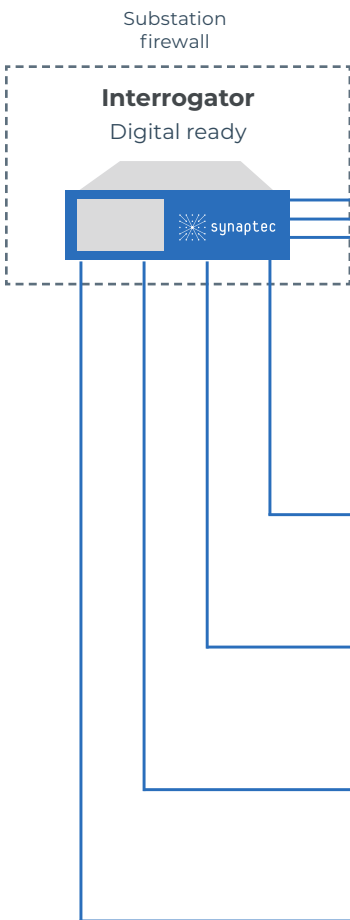
This is all done within milliseconds, well in advance of the breaker even opening, keeping the network safe and secure.



Multi-zone protection for complex topologies

Mixed Circuits are only one example of how our technology can improve protection schemes.

The solution is flexible to support a number of topologies, as one Interrogator can instrument multiple sections in series or in parallel.



● **Romania DSO | Remote cable section**
Commissioned in 2025



● **Switzerland TSO | Multi cable section**
Installed 2025, commissioning pending



● **India TSO | Cable tail end**
Commissioned in 2022

● **Dubai TSO | Double cable section**
Installation due Q1 2026

● **India TSO | Double cable section**
Installation due Q1 2026

● **Saudi Arabia TSO | Double cable section**
Installation due Q1 2026

● **France TSO | Remote cable tail end**
Installation due Q1 2026



We also help to prevent cable failures

If you want to further improve the availability and safety of your network, we also offer operators a leading cable monitoring and resilience solution: Greenlight.

Using DES technology to continuously measure key parameters at cable joints and terminations (including phase and screen current and temperatures), Greenlight can identify and provide early warning of the majority of cable failure modes before outages occur.

By monitoring these vulnerable termination locations, where the majority of cable failures occur, operators can easily target inspections and maintenance investment at the areas that need it the most.

Greenlight can also be used for Real-Time Thermal Rating (RTTR), to determine thermal headroom, and enable assets to be pushed further or dialled back to ensure resilience in all conditions.



- ✓ Continuous processing of all sensor data, 24/7
- ✓ Automatically searches for outliers in data from all configured sensors, and groups of sensors
- ✓ Generates event records for any detected anomalies
- ✓ Interfaces with operator's SCADA system for alarms

Learn more

Get in touch

If you are looking for an easy install, advanced protection solution to improve your network reliability, get in touch with our Solution Specialists today.

✉ info@synapt.ec

☎ +44(0)141 488 3664

in Connect with us

Learn more

Case studies

Technical papers

White papers

“Navigating lakes and mountains, or managing double circuits, MCP offers operators flexibility, not possible with Faraday effect optical CTs.”

Transform your network today



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