

Motor Arc Protection (MAP):
***proactive** protection*



MAP enhances the protection of motors in Mining, Oil, Gas and Petrochemical environments by providing a novel method for low level short circuit and series arc detection



Motor Arc Protection (MAP): the **proactive** protection relay

Redefining protection convention; the MAP relay intelligently operates **before** a fully developed fault occurs and **before** the fault has the opportunity to cause major damage.

Conventional protection relays are forced to react to overload conditions and balance the reaction speed, fast enough to avoid equipment damage, yet slow enough in order to discriminate with other protective devices.

With the MAP relay, **the trade-off between selective fault level and time coordination is no longer required.**



Case Study

A Mining Application

Typical in large longwall mines are fixed power centres and long cable runs to equipment at the coal face. The distance of the cable run is often limited due to volt drop and the effect that conventional short circuit protection at the power centre may not respond, even to a bolted short circuit at the coal face, because of the cable length.

In this case MAP would provide fast protection by detecting the low-level occurrence of short circuit current and isolating the motor supply.

Visible Arc v Measured Arc

Electrification of industrial locations is necessary to operate equipment and processes but it also poses the most serious risk by providing a networked ignition source.

Existing arc detection systems are currently expensive to install and require optical detection, i.e. the fault needs to develop into a visible arc before the light sensitive detection system can react.

They do not detect any changes in the condition of the cables and connections extending from the switchgear.

Junction boxes, interconnections and cable runs from the switchgear power centre to the motor load present themselves as opportunities for loose connections to occur which can go unnoticed until they become an ignition source or develop further beyond a series fault.

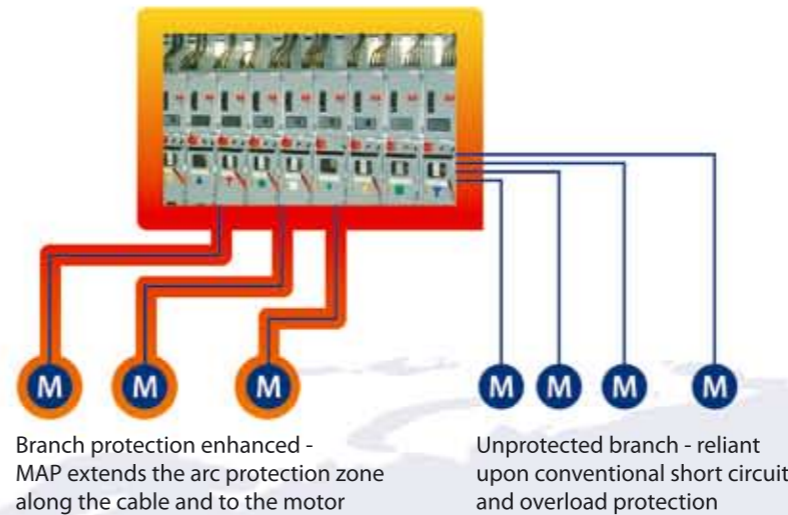
The PBSI method does not require expensive installation or use of visual detection equipment; instead it uses conventional current and voltage transformers.

This allows MAP to be retrospectively applied to existing circuits as easily as it is to new installations.

Series Arc can be fitted in tandem with Visible Arc detection to offer a much more robust protection system than light detection alone.

The visible system which is looking for internal arc events in the switchgear and the MAP system providing protection along the length of the motor cable run. Preventing arcing and ignition due to the capability of early detection of the developing fault.

Extent of visible arc protection zone - limited by position/range of transducer detection



Branch protection enhanced - MAP extends the arc protection zone along the cable and to the motor

Unprotected branch - reliant upon conventional short circuit and overload protection

Where is its use?

MAP has been designed for industrial environments where arc flash has the potential for catastrophic asset damage and the endangerment of life.

How is it applied?

MAP is designed for direct connection to 100-5000V rated motors without the use of voltage transformers (VTs).

Above this, VTs with 110V AC secondary rating should be used, the primary/secondary phase shift introduced by the VT must be compensated for by the relay.

3x phase current transformers (CTs) of conventional ring type arrangement with 1A or 5A rated secondary at class 5p10 or 10p10 1VA (min.) are needed to provide the current measurement input.



A series arc condition: During the peak current of motor starting a series arc has developed, MAP operates and breaks the current flow far quicker than the conventional protection (right).

Detecting 2 primary conditions:

Series Arc

Overload faults rarely occur instantaneously, they develop over time before reaching high levels of destructive energy.

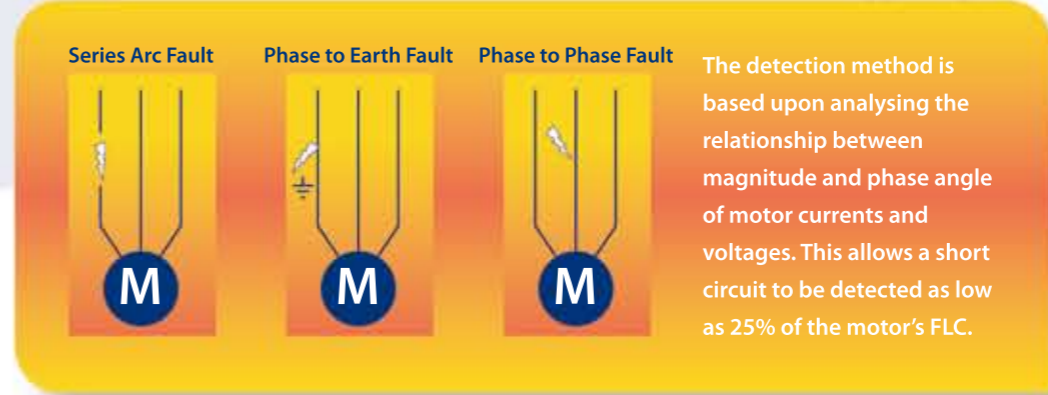
Often, a fault occurs first as a series (or in-phase) arc which can go unnoticed before developing further into a phase-earth or phase-phase fault.

The patented Series Arc principle is a preventative protective function rather than purely reactive protective function, detecting the pre-cursive nature of the developing overload, allowing early detection of those previously undetectable faults.

Short Circuit Protection

Short circuit levels are set above the thermal overload threshold in order to allow a motor to start normally and without spurious tripping. This discrimination however requires that a short circuit has to fully develop into a high magnitude fault before conventional protection will operate.

The MAP relay ignores the starting characteristic of motor current inrush entirely. Providing sensitive short circuit protection below FLC and without the normal fault energy which conventional short circuit detection relies upon in order to operate.



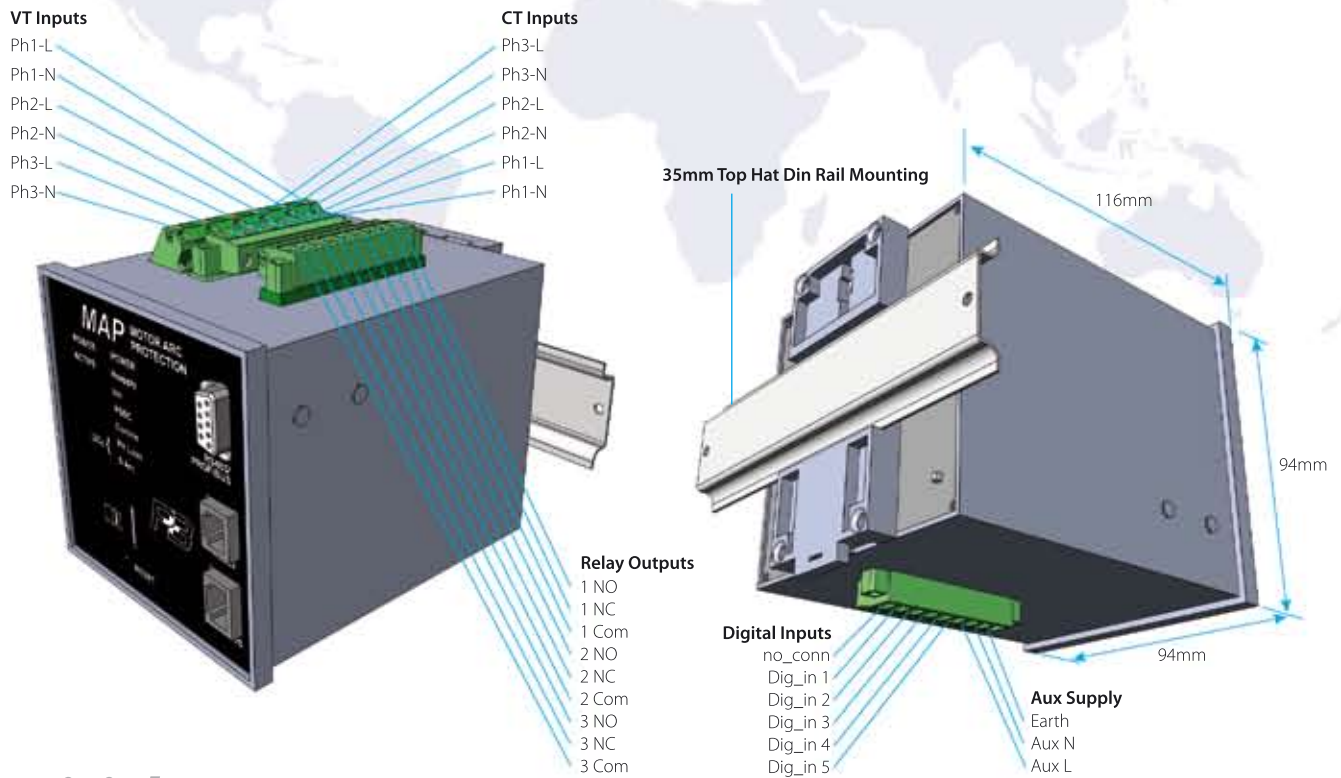
The detection method is based upon analysing the relationship between magnitude and phase angle of motor currents and voltages. This allows a short circuit to be detected as low as 25% of the motor's FLC.

Protective Functions of MAP:

- Series Arc
- Sensitive Short Circuit
- Unbalance
- Single Phasing
- Phase Loss

Benefits:

- Does not require expensive transducers – uses existing CTs and VTs
- Detects onset conditions at much lower current levels
- Operates before fault maturity and before an arc can fully develop
- Reduces risk of equipment damage during the fault withstand
- Substantially reduces risk of fire and reduces the potential for risk to life



British Engineering *Electrical Protection Redefined*

MAP provides operators with an **increase in plant safety**, a **reduction of downtime** and **reduces the potential for asset damage** caused by series arcing, excess heat build-up and short circuit faults.

Contact Details

P&B
Protection Relays

Belle Vue Works, Boundary Street, Manchester, M12 5NG, United Kingdom
T: 0044 (0)161 230 6363 F: 0044 (0)161 230 6464 E: relays@pbsigroup.com



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