



# **NOVARIS**

Application Note  
(0015-D69V2)

## **OVERCURRENT PROTECTION OF SINGLE PORT SURGE DIVERTERS**

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## Introduction

This document provides recommendations for the effective over-current protection of shunt connected (single port) Surge Protection Devices (SPDs). It describes the use of and highlights the advantages of the Novaris Surge Circuit Breaker over conventional fuses and circuit breakers in this role.

## Description

Many shunt/parallel connected SPDs utilise Metal Oxide Varistors (MOVs) as a voltage clamping element. These components can overheat and explode if the connected voltage is raised above their nominal operating voltage for any extended period. This time period can be as short as 2-3 seconds if the applied voltage is significantly higher than the nominal operating voltage of the circuit. This is known as a Temporary Over Voltage (TOV).

A common over current protection method is the use of fuses or circuit breakers in series with the connections from the phases to the SPD. These act as the Over Current Protection Device (OCPD) for the SPD and will open circuit when their current rating is exceeded.

These two types of OCPD are not ideal for two reasons.

1. To pass the high frequency surge currents the fuses or circuit breakers need to have a higher AC current rating than consistent with good protection against overheating and fire within the SPD in the case of a TOV.
2. Surge currents can cause the fuses to blow or a circuit breaker to trip even when the SPD is still healthy; this is called nuisance tripping and it may not be detected. This leaves the facility with no surge protection until the trip is noticed.

Neither a fuse or a standard circuit breaker can discriminate between a surge current that can be many thousands of amps and the power frequency current that flows through the SPD when it is exposed to a TOV.

This means that in almost all cases the current rating of these OCPD devices are much too high to effectively protect the SPD from the power frequency currents flowing during a TOV event. Usually the SPD is destroyed in this scenario.

The Novaris Surge Circuit Breaker (SCB) provides superior overcurrent protection. This new device is purpose designed to provide protection for SPDs during TOV conditions.

The Novaris SCB has the ability to discriminate between a power frequency current and a surge current. It can pass the full rated surge current of the SPD without tripping, but it will trip when there is a TOV with only three amps (3 Amps) of power frequency (50 or 60Hz) current flowing. This protects the SPD from damage.

The Novaris SCB provides the best possible overcurrent protection for shunt connected SPDs and can simply be reset like a normal circuit breaker should it trip.

## Models

There are two models of Novaris SCB available based on their surge current ratings.



For surge diverters with  $I_{max}$  up to 80kA (8/20 $\mu$ s) or limp of up to 8.0kA (10/350 $\mu$ s) use the SCB1-3-80 and for surge diverters with  $I_{max}$  up to 200kA (8/20 $\mu$ s) or limp of up to 25.0kA (10/350 $\mu$ s) use the SCB1-3-25.

The SCB is suitable for use with single port surge diverters from all suppliers based on the surge current ratings noted above.

Both models are suitable for both 50 and 60Hz power frequencies.

**Specifications**

The data sheets listed below provide all the specification information.

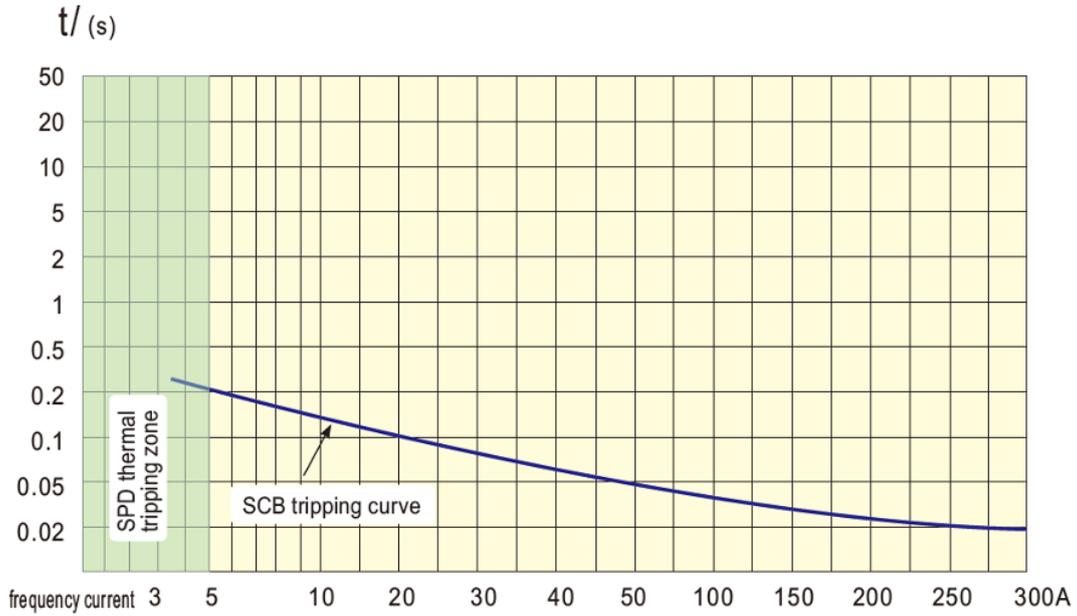
SCB1-3-80, 3 Amps AC and 80kA 8/20µs, Data sheet number NDS3.1379

SCB1-3-25, 3 Amps AC and 25kA 10/350µs, Data sheet number NDS3.826

**SCB Tripping Curve**

Three phase systems are used where higher power requirements are needed and for most higher voltage parts of supply and distribution systems. They are used as they are more efficient in supplying power compared to single phase systems when the amount of conductor material is factored in due to the lower phase currents.

There are two popular systems in use in most parts of the world but it is not uncommon to find both in use in a single country sometimes with transformers to convert between the two types.



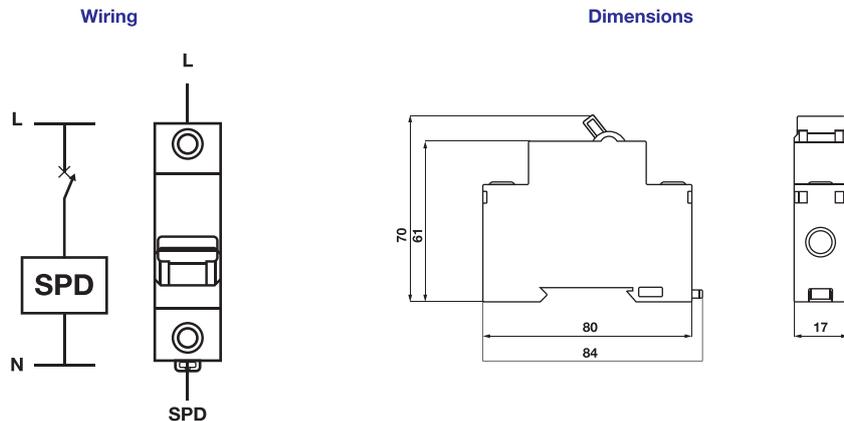
**Installation**

SCB's should be installed on the live side and in series with the SPD being protected as shown in the wiring diagrams below.

The wiring from the live bus bars through the SCB and to the SPD terminals as well as on the neutral side should be kept as short and straight as possible to minimise inductive voltage drop. IEC 60364, AS1768 and appendix F of AS/NZS 3000 provide guidance on how to minimise inductive voltage drop.

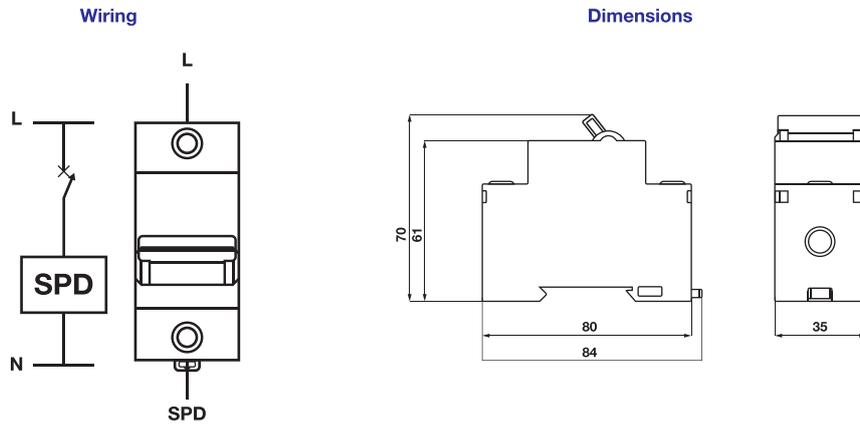
Do not wire the SCB in series with the live load as this will simply result in normal AC tripping if the load is 3A or more.

Novaris recommends a minimum wire cross section of 6mm<sup>2</sup>.



SCB1-3-80

03



**SCB1-3-25**

For single phase systems a single SCB is required, for two phase systems two SCB's are required and for three phase systems three SCB's are required.

The SCB's are suitable for installation on a standard DIN rail and simply clip into place using the yellow spring-loaded clip at the base.

**Maintenance**

Novaris surge circuit breakers are virtually maintenance free. Maintenance is limited to routine visual inspections and periodic checking of the tightness of the screw clamp terminals. If the surge diverter the SCB is protecting is damaged by a large surge current, then it is recommended that the SCB is replaced along with the surge diverter.

## Installation Examples

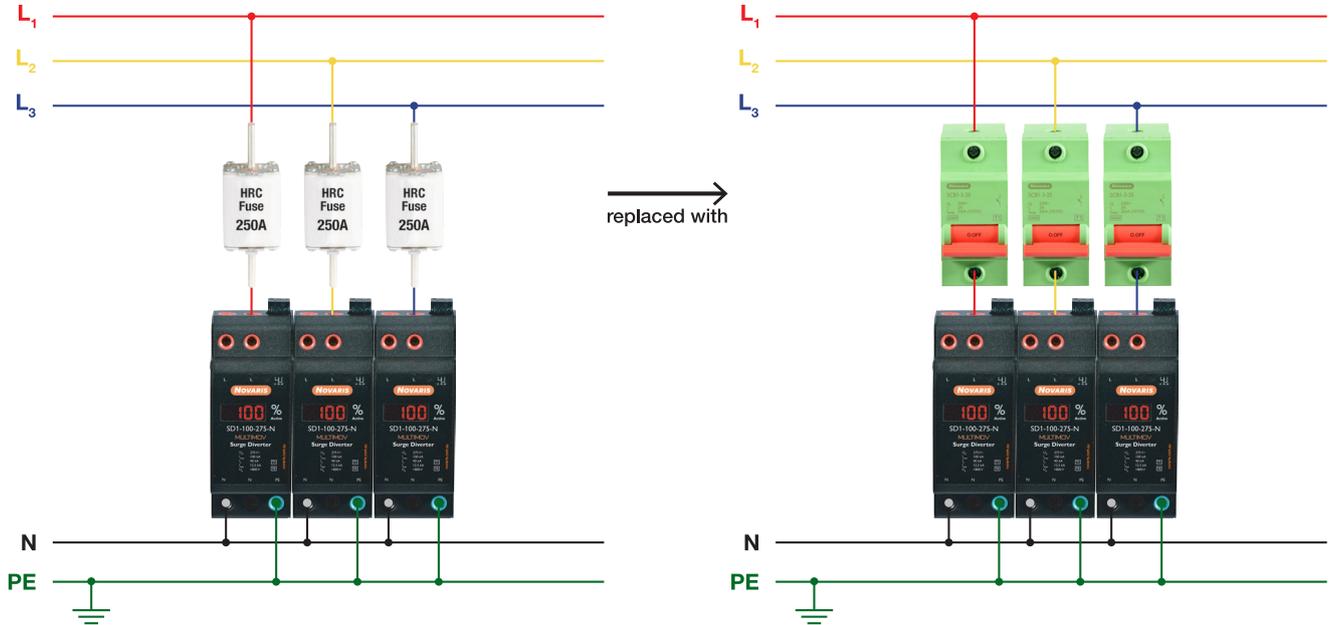
The following diagrams detail three installation examples where NOVARIS Surge Circuit Breakers (SCB) are used as an Overcurrent Protection Device (OCPD) for an SPD, replacing traditional fuses or circuit breakers. The benefits for installers or switchboard builders are,

- Heavy gauge wiring due to high fuse/CB ratings to the SPD is no longer needed, 6mm<sup>2</sup> is usually adequate
- Expensive HRC fuse holders and fuses are eliminated

### Examples of Over Current Protection for SPD of Type 1

MSB with incoming rating of 1000A 3-phase, and SPDs of surge current rating  $I_{imp}$  25kA /  $I_{max}$  80kA.

#### Wiring Configurations in a Three Phase Circuit with Type 1 or Type 1+2 SPD



Overcurrent Protection of SPD with Fuse or Circuit Breaker

- Typically, 250A circuit breaker/HRC fuse will be used as an OCPD for SPD with  $I_{imp}$  of 25kA.
- Under normal operation, no current will flow through breaker.
- During a TOV event, the fuse rating of 250A is too high to prevent damage to the SPD.
- The 250A HRC fuse may not even pass the rated surge current of SPD, leading to downstream equipment damage.

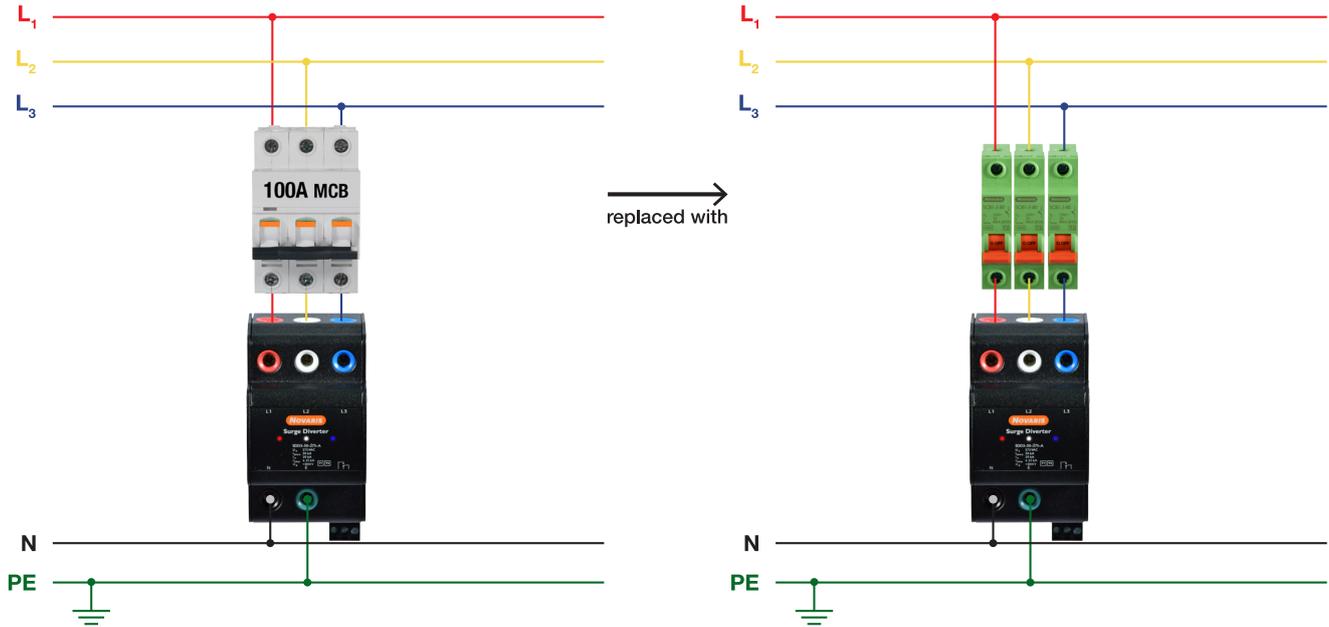
Overcurrent Protection of SPD with Surge Circuit Breaker

- SCB1-3-25 is used as OCPD for SPD with  $I_{imp}$  of 25kA.
- Under normal operation, no current will flow through SCB.
- During a TOV event the SCB will trip at an AC current of only 3A (50Hz or 60Hz), effectively protecting the SPD.
- SCB can pass the full rated surge current of the SPD without tripping.

## Examples of Over Current Protection for SPD of Type 1+2

SSB/DB with incoming rating of 250A 3-phase, and SPDs of surge current rating  $I_{imp}$  6.25kA /  $I_{max}$  50kA is used.

### Wiring Configurations in a Three Phase Circuit with Type 1+2 SPD



Overcurrent Protection of SPD with Fuse or Circuit Breaker

- Typically, 100A-125A ratings of circuit breaker/ fuse will be used as an OCPD for SPD with  $I_{imp}$  6.25kA /  $I_{max}$  50kA.
- Under normal operation, no current will flow through breaker.
- During a TOV event, the fuse rating of 100A-125A is too high to prevent damage to the SPD.
- If using breaker / fuse with lower current rating (e.g. 63A), it may not pass the rated surge current of SPD, leading to downstream equipment damage.

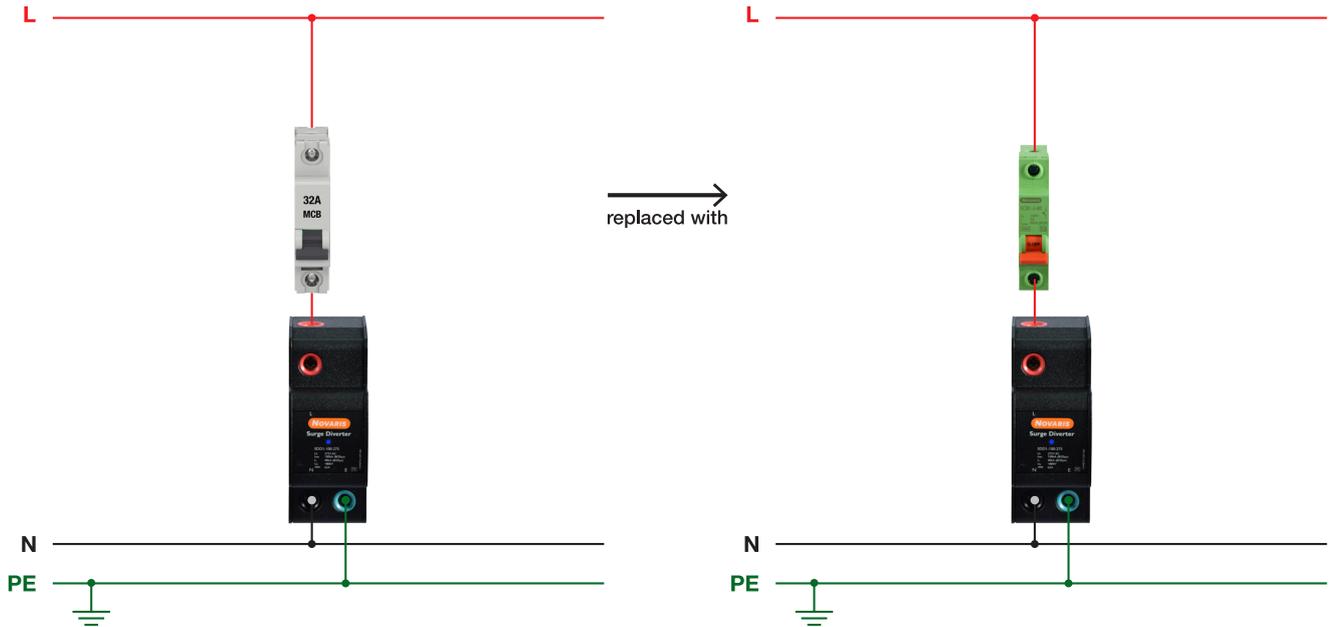
Overcurrent Protection of SPD with Surge Circuit Breaker

- SCB1-3-80 is used as OCPD for SPD with  $I_{imp}$  6.25kA /  $I_{max}$  50kA.
- Under normal operation, no current will flow through SCB.
- During a TOV event the SCB will trip at an AC current of only 3A (50Hz or 60Hz), effectively protecting the SPD.
- SCB can pass the full rated surge current of the SPD without tripping.

## Examples of Over Current Protection for SPD of Type 2

DB with incoming rating of 63A single-phase, and SPDs of surge current rating  $I_{max}$  50kA is used.

### Wiring Configurations in a Single Phase Circuit with Type 2 SPD



Overcurrent Protection of SPD with Fuse or Circuit Breaker

- Typically, 32A-40A rating range of circuit breaker / fuse will be used as an OCPD for SPD with  $I_{max}$  50kA.
- Under normal operation, no current will flow through breaker.
- During a TOV event, the fuse rating of 32-40A is too high to prevent damage to the SPD.
- If using breaker/fuse with lower current rating (e.g. 20A), it may not pass the rated surge current of SPD, leading to downstream equipment damage.

Overcurrent Protection of SPD with Surge Circuit Breaker

- SCB1-3-80 is used as OCPD for SPD with  $I_{max}$  50kA.
- Under normal operation, no current will flow through SCB.
- During a TOV event the SCB will trip at an AC current of only 3A (50Hz or 60Hz), effectively protecting the SPD.
- SCB can pass the full rated surge current of the SPD without tripping.

Note:

The circuit breaker ratings shown in the cases above are typical examples, recommended OCPD ratings may differ between SPD manufacturers.