

Triggered Spark Gap Surge Reduction Filters



Advanced Technologies – The ERICO® Advantage

TSG-SRF Combined Technology Surge Protection

TSG-SRF combines rugged Triggered Spark Gap technology with effective true L-C filtering and Transient Discriminating (TD) Technology to help create the ultimate in effective and reliable AC surge protection.

Primary Surge Diversion

- Triggered Spark Gap Technology for high surge handling capability

Filter Circuit

- High efficiency ferrous-cored inductors
- TSG eliminates the need for large non-saturating inductors
- Robust capacitor elements - UL® Recognized components

Secondary Surge Diversion

- TD Technology for high over-voltage withstand
- Secondary, accurate level of performance



Line side isolation and over-current protection

Optional surge counter

- For performance monitoring (Model TSG-SRF3125 and larger)

Enclosure

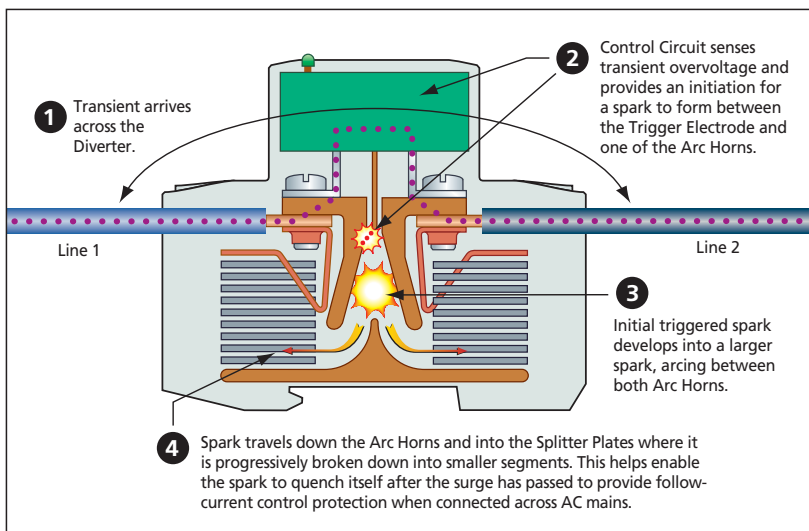
- Standard escutcheon panel for additional safety
- Up to IP55 rating



Triggered Spark Gap (TSG) Technology

The TSG-SRF has as its primary surge diversion stage a Triggered Spark Gap from each phase to neutral and from neutral to ground. These devices offer remarkable surge diversion capability (rated at 130 kA 8/20 μ s), but required several obstacles to be overcome through good design.

One of the criticisms of traditional spark gap technology has been the high initiating voltage required to form the arc, typically as much as three to four thousand volts. Clearly this is inappropriate for sensitive AC supplied equipment where surges of several hundred volts can be lethal to that equipment. ERICO® has addressed this problem by incorporating a triggering device, which senses the arrival of a transient and initiates a spark to ionize the region surrounding the spark gap electrodes. This enables the spark gap to operate on significantly lower transient voltages.



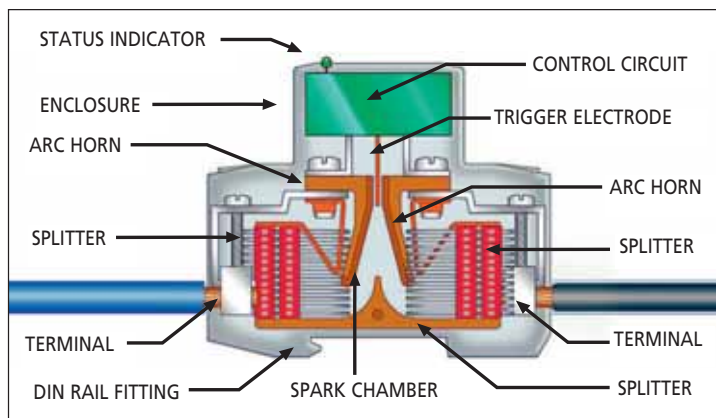
Activation of the Triggered Spark Gap.



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A second major criticism of traditional spark gaps has been their follow-current performance. Spark gaps have a low clamping voltage and can clamp a surge below the peak of the AC mains voltage, thereby causing significant follow-current to flow until the next zero crossing point is reached, and the arc is extinguished.

ERICO® has incorporated a method of increasing the arc voltage thereby extinguishing it earlier and significantly reducing the follow-current. This feature is effective even on AC supplies with higher prospective fault current capacities and has the added benefit of preventing upstream fuses or circuit breakers from activating.



Internal components of Triggered Spark Gap.

Filtering Technology

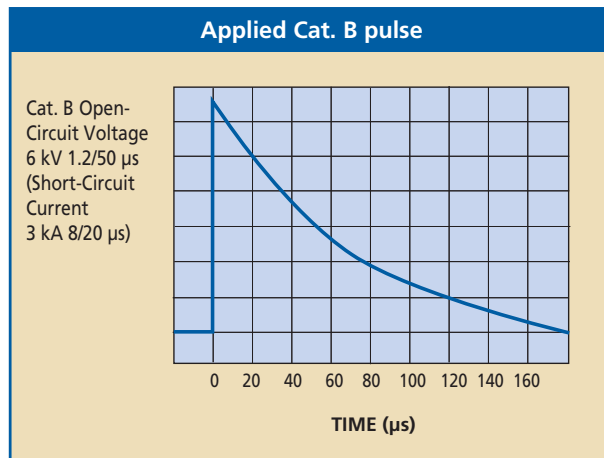
Surge protection devices may include a filtering stage to help condition the waveshape, thereby providing superior protection for sensitive electronics. This said, it is important to realize that a number of different topologies of filter circuit exist, each providing significantly different performance. At its simplest, a manufacturer may include a capacitor in parallel with the output. This will serve to reduce any fast ringing voltages and will also help absorb the energy in a small transient thereby providing a level of attenuation.

A far more effective approach is the series LC filter. This type of filter is connected after the surge limiting components and is in series with the supply powering the equipment. It consists of a series inductor and parallel capacitors. Surge protection devices of this nature are often referred to as "two port" devices since they have a distinct input and output side.

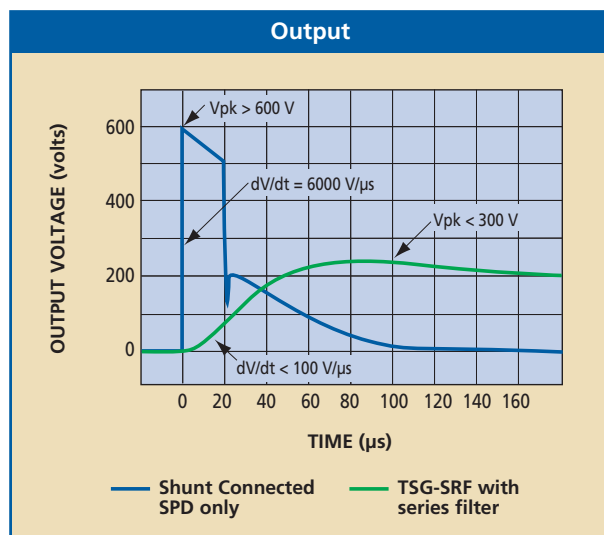
SPDs with filters offer two primary benefits:

- 1) They reduce the transient voltage reaching the equipment.
- 2) They reduce the rate-of-rise of the leading edge of the impulse. The residual leading edge spike after a standard SPD, although it may only be 500 V to 900 V in amplitude, can cripple electronics due to its extremely high rate-of-voltage rise of 3,000-12,000 V/μs. Effective filtering reduces this rate-of-rise to less than 100 V/μs. This slower change in voltage is better withstood by electronic equipment using switched mode power supplies. The filter also helps to attenuate small signal RFI/EMI noise problems.

The TSG-SRFs use true series LC filtering. Since the load current feeding the equipment to be protected has to go through the TSG-SRF, the inductors have to be rated to carry this load current. As a consequence, the range consists of a number of models to suit increasing load currents, with the larger current models being physically larger. In addition to the heavy duty inductors, the capacitors used in this filter stage are of a special high reliability type, having received safety approvals from a number of ratings agencies.



Applied voltage pulse.



Improved reduction in dv/dt with filtering incorporated.



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Transient Discriminating Technology

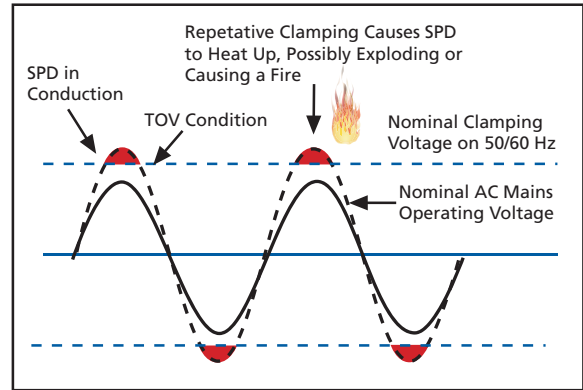
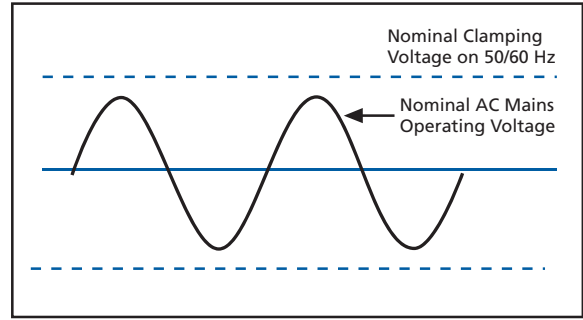
To meet the fundamental requirements of performance, longer service life and greater safety under real world conditions, ERICO® has developed Transient Discriminating (TD) Technology.

This quantum leap in technology adds a level of “intelligence” to the Surge Protection Device enabling it to discriminate between sustained abnormal over-voltage conditions and true transient or surge events. Not only does this help ensure safe operation under practical application, but it also prolongs the life of the protector since permanent disconnects are not required as a means of achieving internal over-voltage protection.

Traditional Technologies

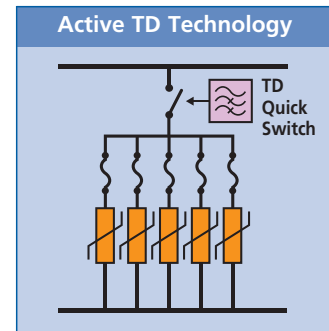
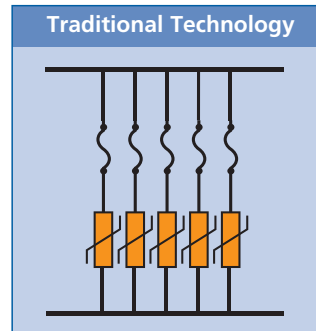
Conventional SPD technologies utilize metal oxide varistors and/or silicon avalanche diodes to clamp or limit transient events. However, these devices are susceptible to sustained 50/60 Hz mains over-voltage conditions which often occur during faults to the utility system. Such occurrences present a significant safety hazard when the suppression device attempts to clamp the peak of each half cycle on the mains over-voltage. This condition can cause the device to rapidly accumulate heat and in turn fail with the possibility of inducing a fire hazard.

The diagram shows how a traditional SPD is chosen to have a nominal clamping voltage that is above the peak of the nominal AC mains voltage. However, in the lower diagram, it can be seen that when the AC mains experiences a Temporary Over-Voltage (TOV), the SPD attempts to clamp the over-voltage, and rapidly heats up, resulting in failure, often accompanied by fire or explosion.



The Core of TD Technology

The secret to ERICO’s Transient Discriminating Technology is its *active frequency discrimination* circuit. This patented device can discriminate between a temporary over-voltage (TOV) condition and a very fast transient, which is associated with lightning or switching-induced surges. When the transient frequencies are detected, the patented Quick-Switch within TD activates to allow the robust protection to limit the incoming transient. The frequency discriminating circuit that controls the Quick-Switch helps ensure that the SPD device is immune to the effects of a sustained 50 or 60 Hz TOV. This allows the device to keep operating, in order to help provide safe and reliable transient protection, even after an abnormal over-voltage condition has occurred.

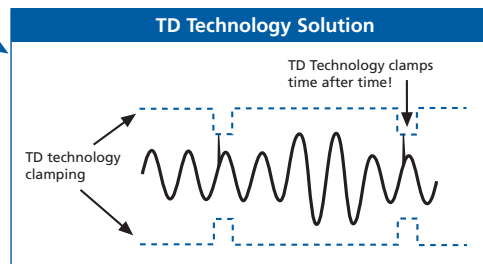
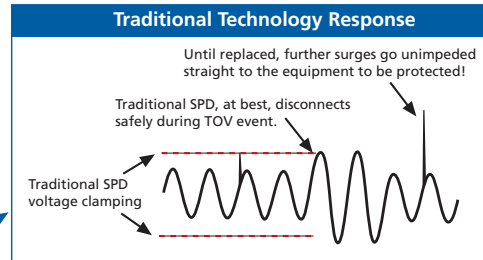
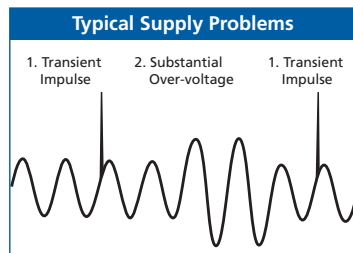


Effectively, TD Technology allows the SPD to have two clamping levels – one well above the peak of a TOV (up to twice its nominal AC voltage!), and the other much lower, to effectively and swiftly clamp lightning transients.

As the explanatory illustration shows, this allows the TD circuit to still remain operational after TOV events, thus continuing to clamp transients and providing a much longer operational life.

The TSG-SRF (incorporating TD Technology) is especially recommended for any site where sustained over-voltages are known to occur, and where failure of traditional SPD technologies cannot be tolerated.

TD Technology Provides Continued Protection - Even After Over-Voltages



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Combining Technologies into an Ultimate AC Surge Protector

Development of surge reduction filters

ERICO® strives to employ the most suitable technology for each application across its range of SPDs, including high performance Surge Reduction Filters (SRFs). The ERITECH® Surge Reduction Filter is the most recent development bringing together for the first time, TSG Technology with the benefits of series filtering.

Fundamental breakthrough in filter design

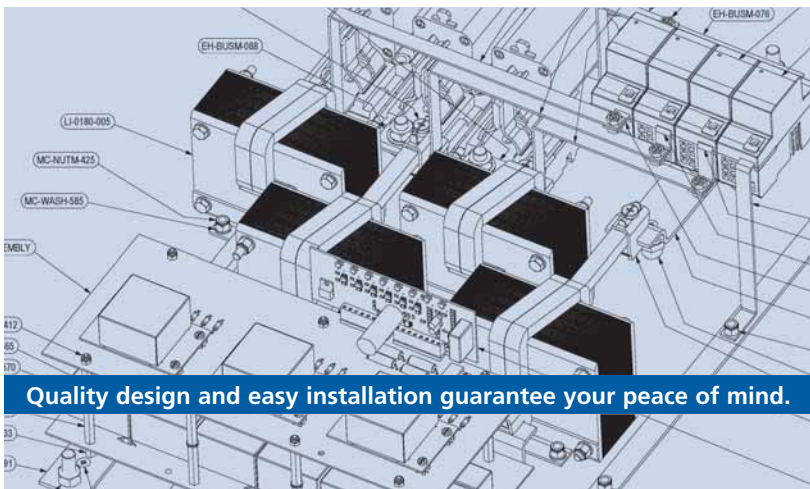
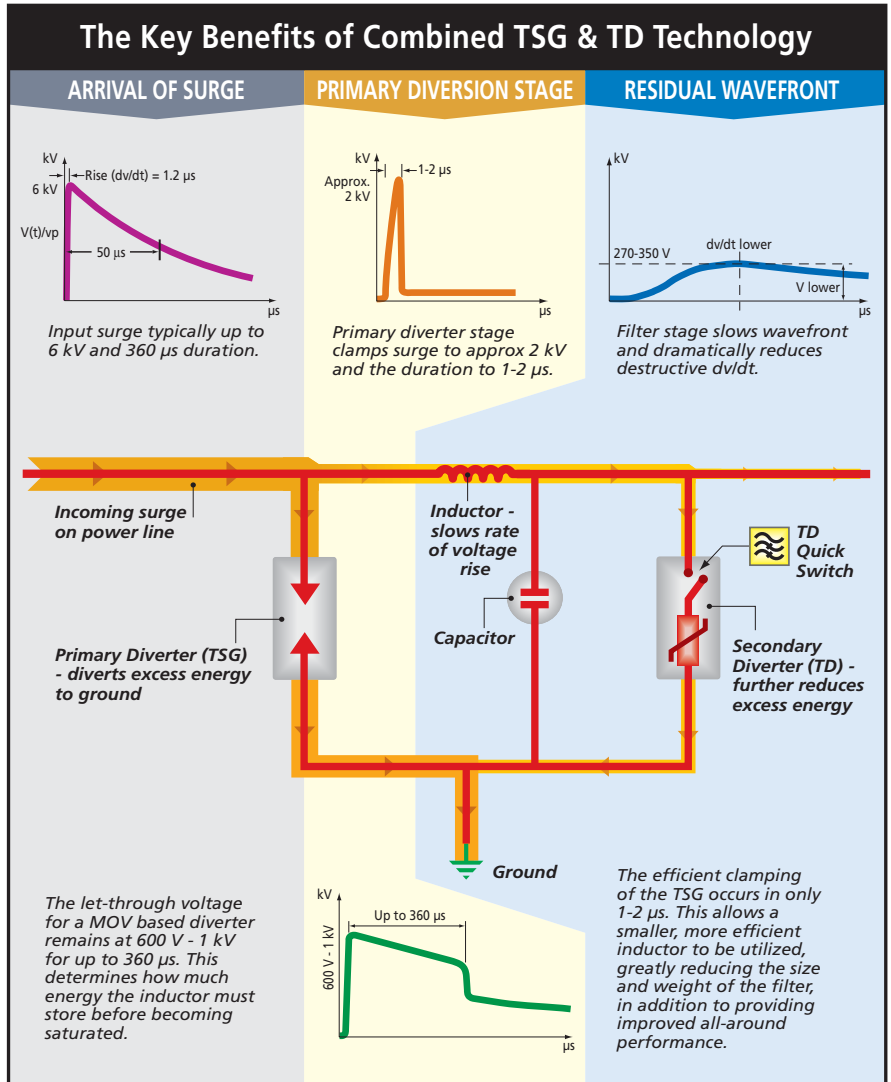
Incorporating TSG Technology into a surge reduction filter has allowed a fundamental breakthrough in the overall design of the filter. Ferrous-cored inductors, which are much smaller than non-saturating air-cored inductors required in MOV based surge reduction filters, have been used in the ERITECH® brand of TSG-SRF.

The use of ferrous-cored inductors is possible because the let-through voltage from a TSG remains high for only a few microseconds. In comparison, the let-through voltage from a MOV based device remains between 600 V and 1000 V for the duration of the surge. This time can range up to 400 milliseconds for long tail pulses and determines how much energy the inductor will have to store before reaching saturation and becoming ineffective.

The secondary TD Technology diverter adds additional protection, and is particularly useful for clamping transients generated within the facility.

What benefits flow from this technology?

The combination of TSG and series filtering provides the benefits of high surge capability, low let-through voltage and considerably reduced rate of voltage rise (dv/dt). Additional benefits of reduced size, weight and heat dissipation also result.



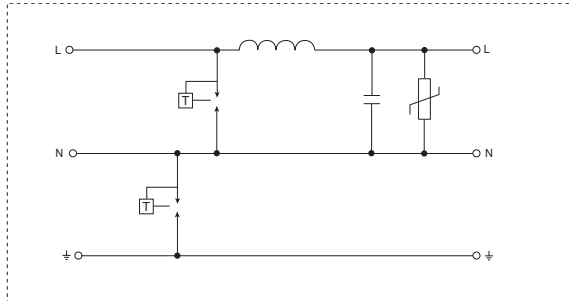
Triggered Spark Gap Surge Reduction Filter (Single Phase)

Features

- Incorporates TSG and TD Technologies – high performance protection
- High surge rating – ideal for exposed critical service entrance applications
- Surge Reduction Filters dramatically reduce let-through voltage – provides optimum protection
- Surge Reduction Filters reduce rate-of-voltage rise (dv/dt) – improved protection for electronic equipment
- Small size/weight – aids installation
- Escutcheon panel – improved safety

Triggered Spark Gap Surge Reduction Filters are designed to provide high-energy surge diversion, making them ideal for primary service protection applications. The units also provide efficient low pass filtering to substantially reduce the risk of physical equipment damage by reducing the rate-of-voltage rise.

The high energy diversion ability of the spark gap has allowed the size and weight of the units to be considerably reduced.



Backplane version available upon request.

Single Phase

Model	TSG-SRF140	TSG-SRF163	TSG-SRF1125
Nominal Voltage, U_n	220-240 V		
Distribution System	1Ph 2W+G		
System Compatibility	TN-C, TN-S, TT		
Max Cont. Operating Voltage, U_c	275 V AC		
Stand-off Voltage	440 V		
Frequency	50/60 Hz		
Max Line Current, I_L	40 A	63 A	125 A
Max Discharge Current I_{max}	130 kA 8/20 μ s (NEMA-LS1 per mode)		
Impulse Current, I_{imp}	50 kA 10/350 μ s		
Protection Modes	All modes protected		
Technology	Triggered Spark Gap In-line series, true L-C low pass sine wave tracking filter 40kA 8/20 μ s tertiary TD Technology		
Voltage Protection Level, U_p	L-N 210 V @ 3 kA 180 V @ 20 kA	L-N 262 V @ 3 kA 247 V @ 20 kA	L-N 413 V @ 3 kA 392 V @ 20 kA
Filtering	-40 dB @ 100 kHz		
Status	Change-over contact (Form C dry), 125V/~600mA. 4kV isolation Primary Protection LED Tertiary Protection LED		
Dimensions H x D x W: mm (in)	400 x 170 x 300 (16 x 7 x 12)		
Weight: kg (lbs)	11 (24)		13 (29)
Enclosure	Metal, IP55 (NEMA-12)		
Heat Dissipation @ I_L	13 W		19 W
Connection Input	\leq 50 mm ² (1/0 AWG)		8 mm stud
Connection Output	\leq 35 mm ² (#2 AWG)		8 mm stud
Mounting	Wall mount		
Back-up Overcurrent Protection	See Table		125 A
Approvals	AS3100, C-Tick, Certificate of Suitability		
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 3, 100 kA 8/20 μ s, 10 kA 10/350 μ s		

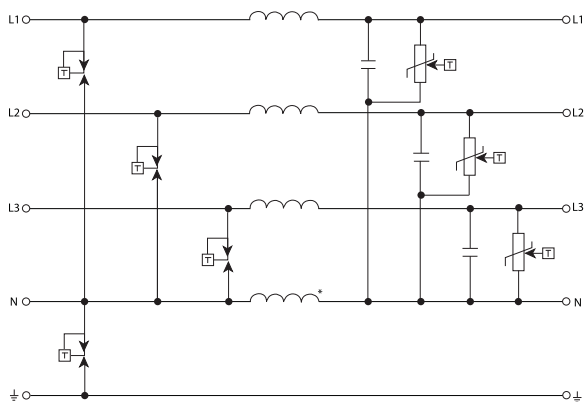
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WARNING

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Triggered Spark Gap Surge Reduction Filter (Three Phase)



* Neutral inductor omitted in 40A and 63A models

**Back-up overcurrent protection
for 40A and 63A rated units:**

Supply Rating	Min. Circuit Breaker Rating	Min. Fuse Rating
500 A (<10 kAIC)	100 A	40 A
750 A (<15 kAIC)	100 A	63 A
1000 A (<20 kAIC)	125 A	80 A
2000 A (<43 kAIC)	160 A	100 A

Three Phase

Model	TSG-SRF340	TSG-SRF363	TSG-SRF3125	TSG-SRF3200	TSG-SRF3400	TSGSRF3630	TSG-SRF31250	TSG-SRF32000
Nominal Voltage, U_n	220/480 VAC to 240/415 VAC							
Distribution System	3Ph Y 4W+G							
System Compatibility	TN-C, TN-S, TN-C-S, TT							
Max Cont. Operating Voltage, U_c	275/476 VAC							
Stand-off Voltage	440/762 VAC							
Frequency	50/60 Hz							
Max Line Current, I_L	40 A	63 A	125 A	200 A	400 A	630 A	1,250 A	2,000 A
Max Discharge Current I_{max}	130 kA 8/20 μ s (NEMA-LS1 per mode)							
Impulse Current, I_{imp}	50 kA 10/350 μ s							
Protection Modes	All modes protected							
Technology	Triggered Spark Gap In-line series, true L-C low pass sine wave tracking filter 40kA 8/20 μ s tertiary TD Technology					Triggered Spark Gap In-line series, true L-C low pass sine wave tracking filter 80kA 8/20 μ s tertiary TD Technology		
Voltage Protection Level, U_p	L-N 210 V @ 3 kA 180 V @ 20 kA	L-N 352 V @ 3 kA 282 V @ 20 kA	L-N 325 V @ 3 kA 404 V @ 20 kA	L-N 347 V @ 3 kA 447 V @ 20 kA	L-N 500 V @ 3 kA 500 V @ 20 kA			
Filtering	-40 dB @ 100 kHz							
Status	Change-over contact (Form C dry), 125V/-600mA. 4kV isolation Primary Protection LED Tertiary Protection LED							
Dimensions H x D x W: mm (in)	500 x 170 x 400 (20 x 7 x 16)		650 x 175 x 500 (26 x 7 x 20)	780 x 215 x 500 (31 x 8 x 20)	1,100 x 233 x 650 (43 x 9 x 26)	1,150 x 220 x 850 (45 x 9 x 33)	1,650 x 315 x 1,200 (65 x 12 x 47)	
Weight: kg (lbs)	20 (44)		38 (84)	52 (115)	98 (216)	115 (254)	288 (635) 360 (794)	
Enclosure	Metal, IP55 (NEMA-12)					IP32		
Heat Dissipation @ I_L	29 W	36 W	63 W	90 W	175 W	225 W	350 W	600 W
Connection Input	\leq 50 mm ² (1/0 AWG)		8 mm stud	10 mm stud				Inquire
Connection Output	\leq 35 mm ² (#2 AWG)		8 mm stud	10 mm stud				Inquire
Mounting	Wall mount							
Back-up Overcurrent Protection	See Table		125 A	200 A	400 A	630 A	1250 A	2000 A
Approvals	AS3100, C-Tick, Certificate of Suitability							
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 3, 100 kA 8/20 μ s, 10 kA 10/350 μ s							

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