

# **CRITEC®**

## **TSG SERIES**

### **SURGE REDUCTION FILTERS (TSG-SRF)**

#### **INSTALLATION AND OPERATING INSTRUCTIONS**



# **ERICO®**

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## 1. INTRODUCTION

The CRITEC Triggered Spark Gap Surge Reduction Filter (TSG-SRF) from ERICO incorporates high energy clamping devices and special filtering circuitry. TSG-SRFs are installed in series with the circuit, usually at the point of entry to the building or structure. They are available in single or three-phase configurations for load currents from 40A to 2000A per phase.

The purpose of a TSG-SRF is to filter and protect against lightning induced transients. The SRF provides a clean, filtered supply of electricity to all output connected equipment when installed in accordance with the manufacturers' instructions.

Protection is achieved via a three-stage circuit. This includes the internal CRITEC Triggered Spark Gap unit as the primary surge diverter, a purpose designed low pass filter network

and a secondary, Transient Discriminating (TD) diversion stage to further clamp the transient energy to safe levels. This allows the TSG-SRF to:

- Provide filtering to the clamped waveform in order to reduce the rate of voltage rise.
- Provide a secondary stage of surge diversion to protect equipment from transients which may be induced onto the SRF output cables or be caused by the load itself.

The use of this combination of technologies has resulted from considerable advances in technology which have negated previous disadvantages associated with spark gaps.

The use of spark gaps has not been practical in the past due to the high initiation voltages required to activate such devices and also their poor follow-current performance.

## Introduction

Both issues have been addressed with the CRITEC TSG, a spark gap surge diverter incorporating a triggering device which enables the TSG to operate on much lower voltages than was previously possible. Additionally, the TSG is able to extinguish the spark and return to the peak mains voltage as soon as the transient event has passed, thereby greatly improving follow-current performance.

These considerable technological advances mean that the TSG can be utilised as the primary shunt diverter within the new SRF, exploiting the performance benefits of spark gap diverters.

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

The use of ferrite-cored inductors is possible because the let-through voltage from a TSG remains high for only a few microseconds ( $\mu\text{s}$ ). In comparison, the let-through voltage from a MOV based device remains at anywhere between 600V and 1000V for the duration of the surge. This time can range from 30 $\mu\text{s}$  to 400 $\mu\text{s}$  and above for longer tail pulses and determines how much energy the inductor has to store before reaching saturation and becoming ineffective.

The combination of TSG and TD technology provides the benefits of high surge capability, low let through voltage and considerably reduced  $\text{dv}/\text{dt}$ . This applies to both surge performance and over-voltage withstand from short and long duration high-energy surges.

## TSG Series Surge Reduction Filters

TD technology has been developed specifically to cater for abnormal over-voltage conditions that may occur on sites with poor voltage regulation, or due to wiring or distribution faults. TD and TSG technologies feature an extremely high over-voltage withstand. This eliminates heat build up that can occur with standard technologies when the protection devices start to clamp on the peak of each abnormal mains cycle.

Traditional MOV technology is not suitable in applications where sustained over-voltage conditions can be experienced. The range of CRITEC TSG-SRFs, with a higher abnormal over-voltage withstand, are preferred in these environments.

## Installation & Operating Instructions

**HAZARDOUS VOLTAGES EXIST WITHIN THE TSG-SRF ENCLOSURE. THIS UNIT SHOULD BE INSTALLED & SERVICED ONLY BY QUALIFIED PERSONNEL AND IN ACCORDANCE WITH RELEVANT NATIONAL ELECTRICAL & SAFETY CODES.**

**ALL INSTRUCTIONS MUST BE FOLLOWED TO ENSURE CORRECT AND SAFE OPERATION OF THE SRF.**

### 2. WARNINGS

- **PRIOR TO INSTALLATION.** Ensure that the TSG-SRF is of the correct voltage, current, phasing, and frequency, and is of the type recommended by the manufacturer for the equipment and power distribution system in use.
- **DO NOT MEGGER.** This unit contains over-voltage protection components.
- TSG-SRFs contain capacitors. Disconnect power at least 1 minute prior to removing the escutcheon panel. Check voltage prior to working on SRF internals.
- TSG-SRFs must be connected to a low impedance earth ( $<10\Omega$ ) for correct operation.
- TSG-SRFs must be installed in accordance with **ALL** relevant national electrical and safety codes.
- The power supply to the TSG-SRF should always be turned off (and locked) before the escutcheon panel is removed for any purpose. Internal circuit breakers do not fully isolate the filter.
- Check all TSG-SRF terminals for tight connections. (Some terminals may become loose during transport).
- Ensure all input and output cabling, once installed, is tightened to the correct torque settings (see table 3)
- Do not disconnect upstream Earth or Neutral connections supplying the SRF while power is still applied, as this may damage the SRF or load.
- No combustible items should be stored within the SRF during operation.
- Do not leave this manual behind the escutcheon panel after applying power to the SRF. Retain this manual for future reference.
- Failure to heed instructions or warnings may result in personnel injury, equipment damage or ineffective transient protection.

## Warnings

## Installation Cautions

## TSG Series Surge Reduction Filters

### 3. INSTALLATION CAUTIONS

#### CAUTIONS:

- Transient protection devices are usually rated to protect against non-repetitive pulses from sources such as direct or induced lightning energy.
- They are not designed to provide protection against repeated cyclic anomalies such as those caused by motor speed control notching (variable speed controls, etc).
- SRFs are not designed to provide protection against sustained over-voltage conditions where the supply voltage exceeds, for an extended period of time, the nominal rating of the protection equipment. ie continuous over-voltages from poorly regulated generators or distribution systems.
- Smaller power generation equipment does not always conform to the same standards of voltage regulation that is in place for mains power reticulation. A large number of smaller or cheaper generators have a voltage waveform that approximates 240Vrms (often poorly regulated), but more importantly, which often contains significant higher order harmonics and may exhibit a peak voltage on each half cycle far in excess of the normal 340V (peak). Such machines are usually capacitive excitation induction generators, as opposed to synchronous generators. The problem is usually increased when the generator is lightly loaded.
- Harmonic voltages may also be present in distribution systems that do not feature generators. This is normally where non-

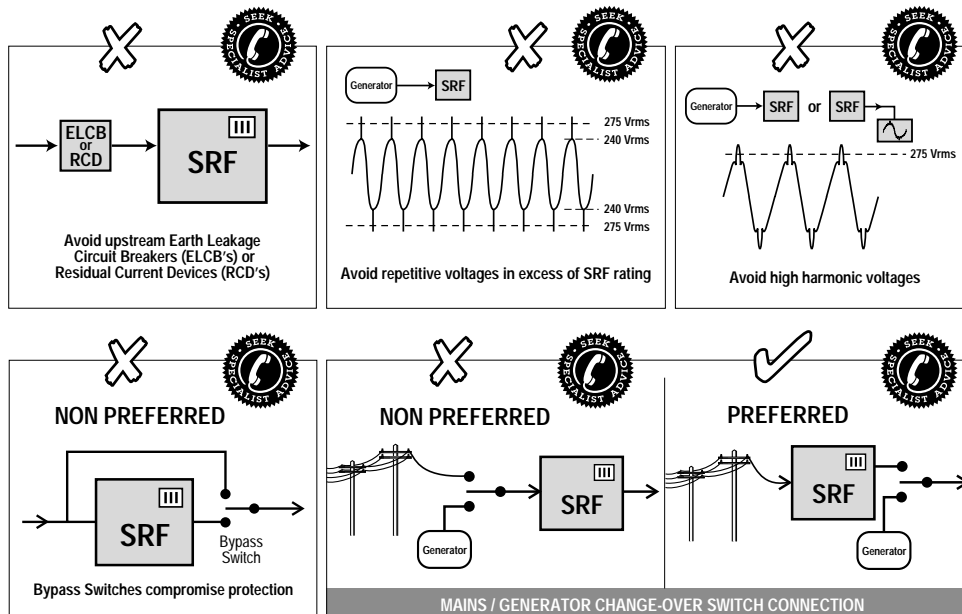


Figure 1. Seek specialist advice with the above installations.

## Installation & Operating Instructions

linear loads are used, such as UPSs, rectifiers, switch-mode power supplies and motor speed controls. The harmonic voltages may have peak voltages in excess of the protective clamping voltages, causing problems such as excessive heat build up. Because the harmonic waveforms contain higher order frequencies, capacitive leakage currents may increase to above prescribed limits and shorten the life of the SRF. It should be noted that in sites with large harmonic voltage distortion, the SRF capacitance may dramatically affect the power factor.

- Seek the manufacturers' advice before installing any SRF into a circuit which features a total harmonic voltage ratio above 5%.
- With large transients, significant energy may be passed by the SRF diverters back to the source or to earth. This may, under some circumstances, cause upstream earth leakage circuit breakers or residual current devices (ELCBs & RCDs) to nuisance trip. Where possible, these devices should be installed after the SRF in order to reduce this possibility.
- Transient protection devices often have minimum requirements for upstream fusing to ensure proper operation. See section 6.1 for fusing requirements.
- By-pass switches are not recommended to be used with SRFs as they compromise the protection offered. The connection of the by-pass switch compromises the input to output separation requirement by bringing the SRF input and output wiring into close proximity at the switch. Due to the high reliability of the SRF and, provided

## Installation Cautions

that spare fuses are on hand (for SRFs of 125A and larger), it is deemed to be unnecessary to provide a means by which to bypass the SRF. If these situations cannot be avoided, contact your local ERICO office to assess the possibility of a special design.

## Identify the Distribution System

### 4. IDENTIFY THE DISTRIBUTION SYSTEM

A number of different power distribution systems are employed in various countries around the world. It is important to identify the distribution system in use prior to installation of the SRF, and confirm that the SRF is the model recommended by the manufacturer for that distribution system.

To identify the distribution system in use, consult reputable and knowledgeable sources such as:

- The local power supply authority
- Local electrical engineers
- Applicable regulatory bodies or standards associations

## TSG Series Surge Reduction Filters

Alternatively, confirm the type of distribution system used by personal inspection. By visually tracing the neutral and earthing conductors from the load equipment or sub-distribution point back to the point of entry (and perhaps to the supply transformer), the type of distribution system should be identifiable with the aid of the following diagrams (figures 2-6).

These are prescribed in local regulations and describe the relationship between the source, exposed or conductive parts of the installation and earth. Amongst these, the TN-C, TN-S, TN-C-S and TT systems are most commonly encountered. Note that supplies such as those used in industry and mining may often use a different distribution system to that of the local supply authority.

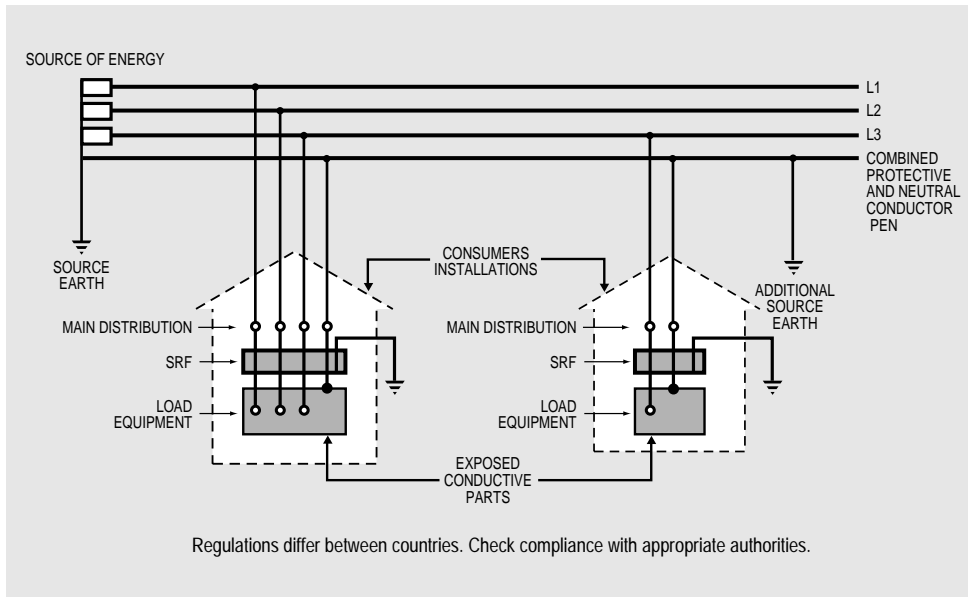


Figure 2. TN-C system: In this system, the neutral and protective earth conductor combine in a single conductor throughout. All exposed conductive parts are connected to the PEN conductor.



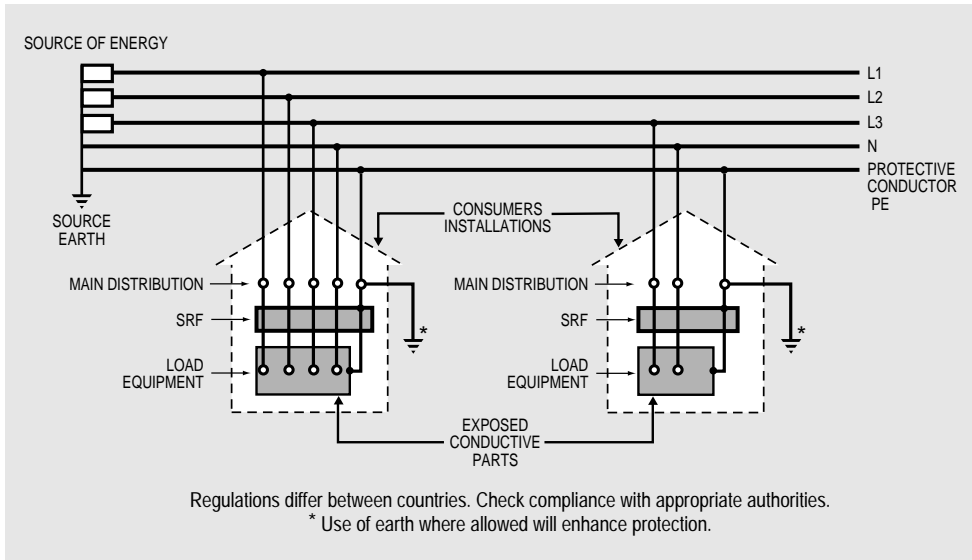


Figure 3. TN-S system: In this system, a separate neutral and protective earth conductor are run throughout. The protective PE conductor can be the metallic sheath of the power distribution cable or a separate conductor. All exposed conductive parts of the installation are connected to this PE conductor.

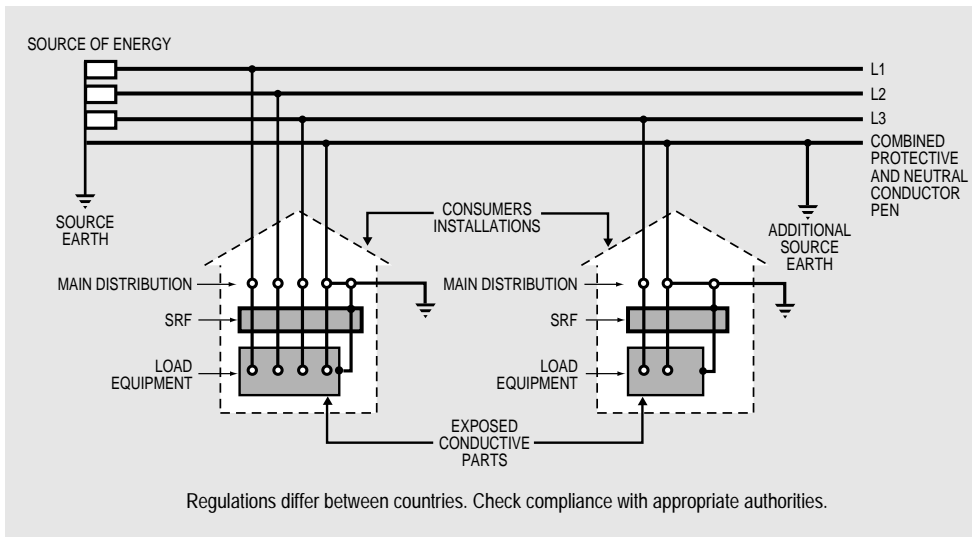


Figure 4. TN-C-S system: In this system, a separate neutral and protective earth functions combine in a single PEN conductor. This system is also known as a Multiple Earthed (MEN) system and the protective conductor is referred to as the combined neutral earth (CNE) conductor. The supply PEN conductor is earthed at a number of points throughout the network and generally as close to the consumer's point of entry as possible. All exposed conductive parts are connected to the CNE conductor.

Identify the Distribution System

TSG Series Surge Reduction Filters

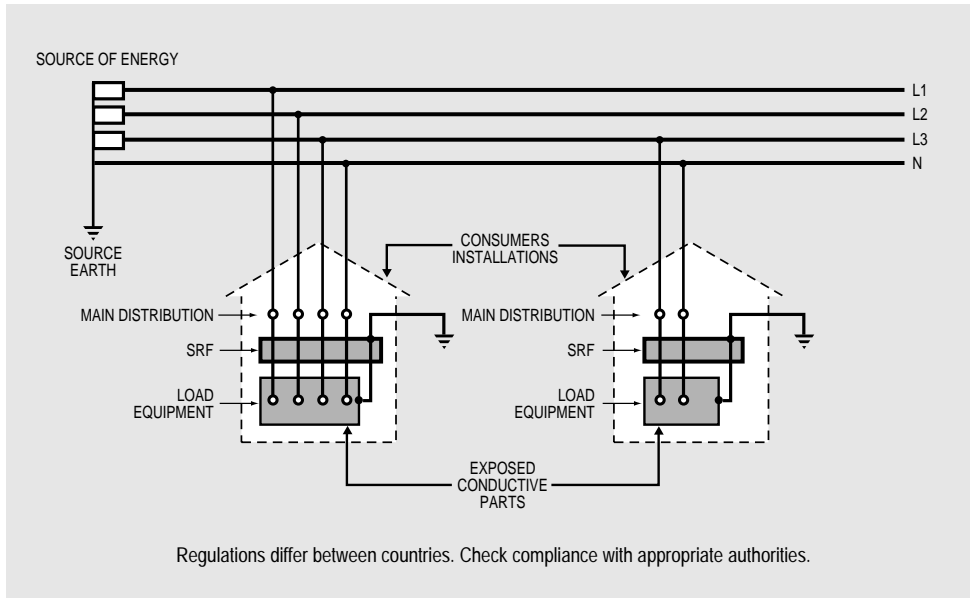
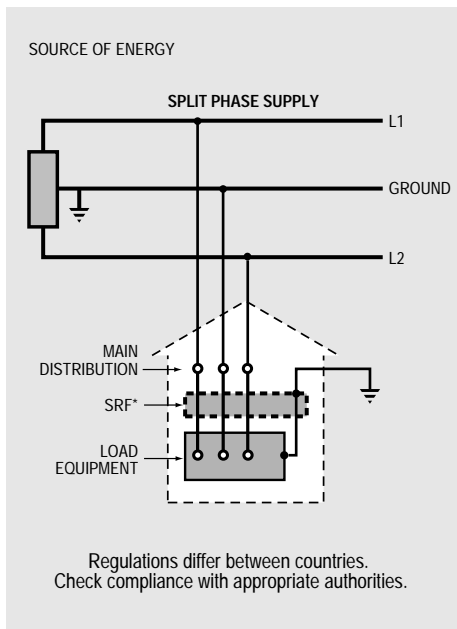


Figure 5. TT system: A system having one point of the source of energy earthed and the exposed conductive parts of the installation connected to independent earthed electrodes.



CRITEC TSG-SRFs provide protection for equipment on TN-C, TN-S, TN-C-S, TT, delta or split-phase distribution systems when selected, installed and earthed in the specified manner.

The TSG-SRFs are designed to be used in distribution systems that provide a separate earth and neutral connection. TSG-SRFs should not be used in IT distribution systems. (Refer Figure 7).

Specialist application advice should be sought in the protection of delta supplied three-phase systems (refer Figure 8) before the purchase of the protection equipment.

Figure 6. Split-phase distribution systems.

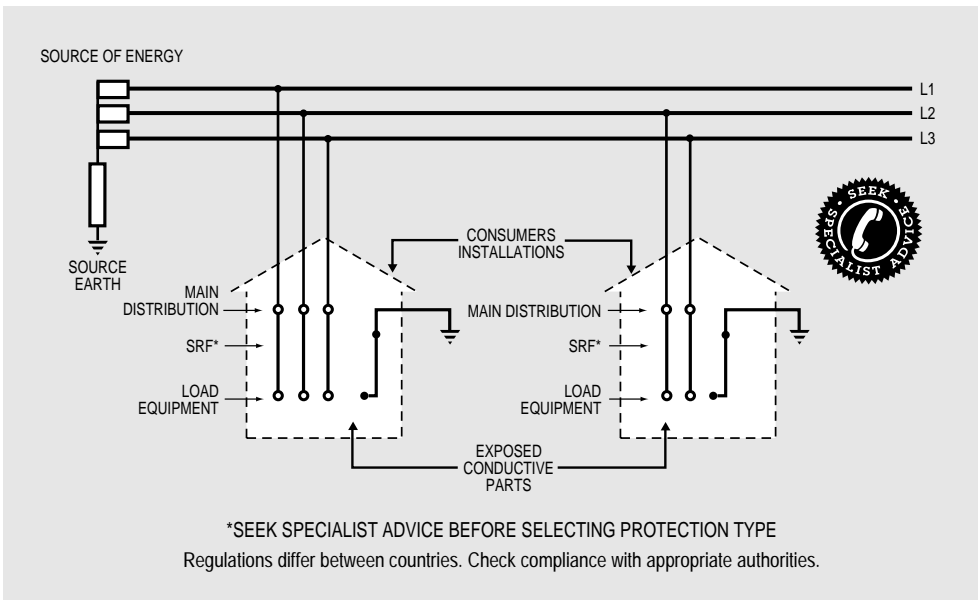
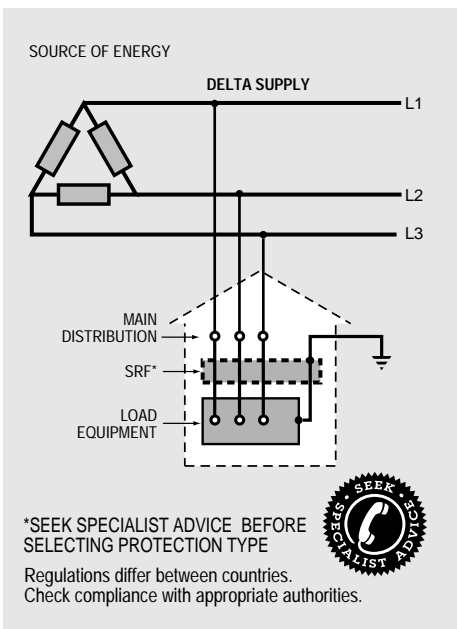


Figure 7. IT system: A system having no direct connection between live parts and earth, but having all exposed conductive parts of the installation connected to independent earthed electrodes. CRITEC Surge Reduction Filters should NOT be used in IT systems without specialist advice.



The diagrams are provided as a guide to identifying and distinguishing the distribution system in use. Metering, over-current protection, and other details have not been shown.

As electrical wiring and safety regulations differ from country to country. It is important to ensure that the installation complies with all regulations applicable to the location. Please seek further assistance if uncertain.

Figure 8. Delta connected three-phase systems. Although delta connected systems are "IT" systems, special mention is made due to their frequent use in mining and industrial applications. Standard CRITEC Surge Reduction filters may not be suitable for some applications.

## Mounting the Surge Reduction Filter

### 5. MOUNTING THE SRF

Before mounting the SRF, refer to Table 4 (weights and dimensions on last page of this manual) which provides dimensions and unit weights. Ensure that appropriate lifting equipment is used when installing the larger SRFs. When installing the SRF, consideration should be given to future service needs. Ensure that a clear view of the status indicators is provided. The SRFs should be mounted away from other electrical apparatus (300mm minimum) and in a position that avoids close proximity to combustible materials.

TSG-SRFs of 630A capacity and smaller are designed to be wall mounted. Mounting brackets (as shown in Figure 9) are supplied. Larger units are anchored through holes provided in the rear of the SRF enclosure.

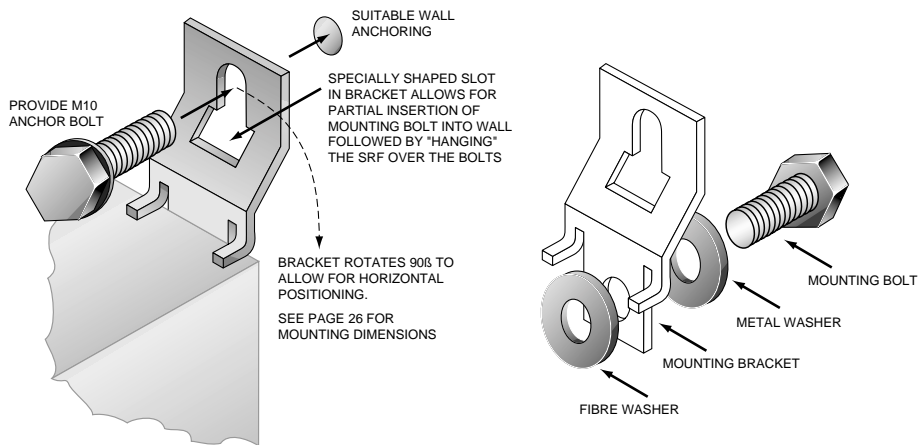
The cabling and upstream over-current protection requirements and all instructions provided in this manual, should be taken into consideration before mounting the SRF.

### TSG Series Surge Reduction Filters

- To preserve the IP rating, TSG-SRF units from 40A to 200A must be installed in accordance with figure 9 and section 6.2.
- Larger SRF units from, 400A to 2000A are ventilated and should be mounted in a dust and moisture-free, ventilated environment.
- All TSG-SRFs should be installed in a dry, well-ventilated area. Avoid sites subject to moisture ingress.
- SRFs are not intended for use in harsh or corrosive environments.

Where the SRF is to be enclosed in a switch-board cubicle, models are available without the proprietary enclosure. These backplane units are denoted by the model number suffix 'BP'.

Figure 9. Typical mounting arrangement for wall mounted CRITEC Surge reduction Filters (40-200A).



SRF MOUNTING KIT ASSEMBLED IN ORDER SHOWN

## Installation &amp; Operating Instructions

**6. OPTIMISING PERFORMANCE**

The protection equipment must be earthed and installed in accordance with all relevant national electrical and safety standards. The term "point of entry" protection, is a general descriptive concept of zonal boundary protection, as detailed in standards such as IEC 1024. Some local wiring regulations will allow the protection equipment to be mounted directly at the point of entry, while other countries require protection equipment to be installed after the metering or main circuit isolators or over-current protection.

The following installation points require attention to ensure that optimal protection is provided by the protection equipment. This information is provided as a guide only. Compliance with local electrical and safety regulations must be ensured.

**6.1 FUSING**

Over-current and short-circuit protection must be provided in order to protect the SRF and associated wiring if a fault develops. The over-current protection should be installed in such a manner as to provide a means of isolating the SRF from the mains supply. This is an important safety consideration. **Over-current protection provided within the SRF is not designed to act as a means of isolation.** Over-current protection within the SRF does not necessarily isolate all TSG-SRF components.

To allow the TSG, (the internal primary diverter) to operate correctly, it is essential that the minimum requirements for upstream fusing or circuit breakers be adhered to.

**Optimising Performance/Fusing**

Table 1 summarises the minimum requirements for upstream fusing or circuit breakers required to prevent nuisance tripping, or operation of fusing when the TSG activates.

**Upstream fusing and cabling may need to be of higher capacity than the appearance or size of filter would suggest.**

Fusing of smaller capacity may experience occasional nuisance tripping during surge and transient conditions.

Max supply fault current	Typical supply transformer rating	Minimum circuit breaker	Minimum fuse size
10kA	500A	100A	40A
15kA	750A	100A	63A
20kA	1000A	125A	80A
43kA	2000A	160A	100A

Table 1.

The table above summarises the minimum requirements for upstream fusing or circuit breakers necessary to prevent nuisance tripping or operation of fusing when the TSG primary surge diverter activates.

## Cabling

## TSG Series Surge Reduction Filters

### 6.2 CABLING

The cabling and earth wires connected to the filter input should always be run separately, with a minimum clearance of 300mm between them and all other cables or sensitive equipment (as shown in Figure 11). The input cable and earth wire will carry the transient energy, while the "protected" output cable can be considered to be a "clean filtered" supply.

By separating these cables, any incoming transients will not be induced from the input cables onto nearby "clean" cables. This clearance will reduce the possibility of arc-over from input to output cables. Where cables need to run closer together due to space restrictions, input and output cables should cross at right angles and not be installed parallel to each other. Cabling should be sized in accordance with all relevant wiring standards to ensure that the full load current can be safely supplied. All cabling or busbars connected to the protection equipment should be securely anchored to prevent undue stress being applied to the input/output terminals.

Input and output terminal requirements are detailed in Table 2.

Cable terminal torque requirements are detailed in Table 3.

- Cable glands (of an appropriate design) must be used for all input and output cables to preserve the IP rating of the 40A – 200A TSG SRFs.
- To protect input and output cabling insulation from sharp edges around the cable entry knockouts, suitable cable glands or grommets must be installed. An alternative is to extend the cable conduit through the knockout.

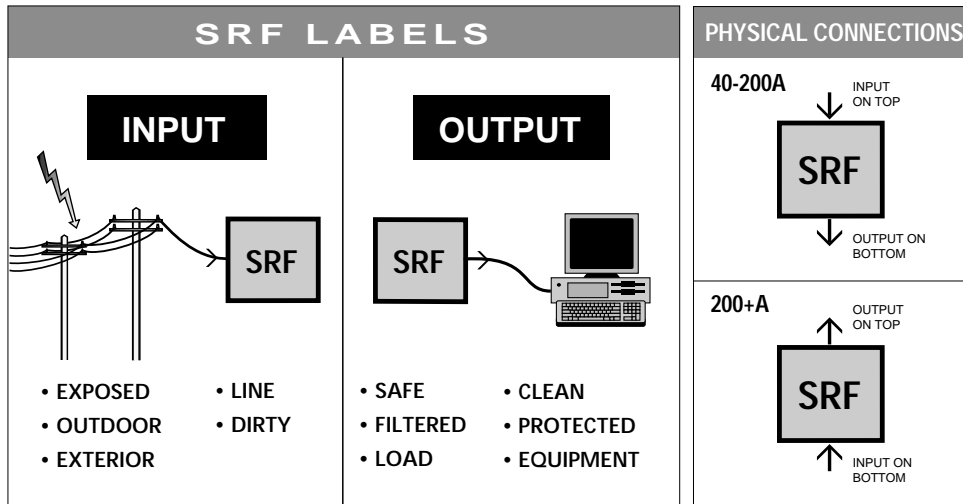


Figure 10. Identification of SRF input and output terminals.

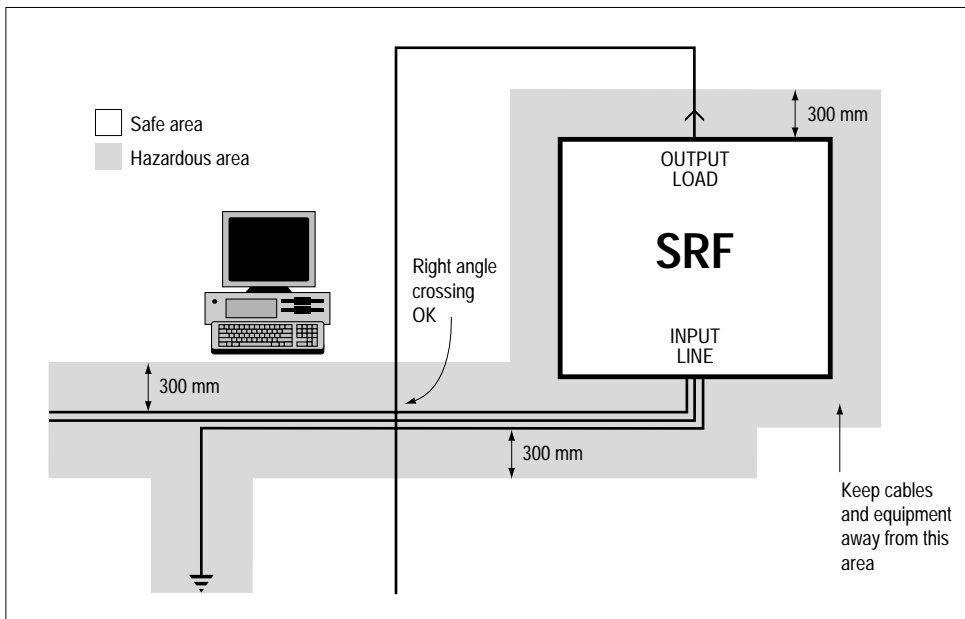


Figure 11. Maintaining clearance between input and other cabling.

## Cabling

## TSG Series Surge Reduction Filters

Filter Rating		Maximum Accepted Cable Size					
		Phases(s)		Neutral		Earth	
		Termination Method	Size	Termination Method	Size	Termination Method	Size
<b>Single Phase</b>							
40A	Input Output	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Stud*	8mm
63A	Input Output	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Stud*	8mm
125A	Input Output	Stud Stud	8mm 8mm	Stud Stud	8mm 8mm	Stud* Stud*	8mm 8mm
<b>Three-Phase</b>							
40A	Input Output	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Stud*	8mm
63A	Input Output	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Screw Clamp Screw Clamp	50mm <sup>2</sup> 35mm <sup>2</sup>	Stud*	8mm
125A	Input Output	Bolt Bolt	8mm 8mm	Bolt Bolt	8mm 8mm	Stud Stud	8mm 8mm
200A	Input Output	Bolt Bolt	10mm 10mm	Bolt Bolt	10mm 10mm	Stud Stud	8mm 8mm
400A	Input Output	Bolt Bolt	10mm 10mm	Bolt Bolt	10mm 10mm	Stud Stud	8mm 8mm
630A	Input Output	6 x Bolt 6 x Bolt	10mm 10mm	6 x Bolt 6 x Bolt	10mm 10mm	Stud Stud	8mm 8mm
1250A	Input Output	6 x Bolt 6 x Bolt	12mm 12mm	6 x Bolt 6 x Bolt	12mm 12mm	2 x Stud 2 x Stud	8mm 8mm
2000A	Input Output	6 x Bolt 6 x Bolt	12mm 12mm	6 x Bolt 6 x Bolt	12mm 12mm	2 x Stud 2 x Stud	8mm 8mm

Table 2. Termination details for TSG-SRFs.

\* Input and output earths on 40 and 63A TSG-SRFs use a common earth stud.

Bolt/Screw	Recommended Torque	Location
M6	4.2 Nm ( 3.1 ft.lbs)	TSG-SRF140, 163, 340, 363 input terminals
M6	3.5 Nm ( 2.6 ft.lbs)	all locations except as above
M8	14.0 Nm ( 10.3 ft.lbs)	TSG-SRF1125, 3125 phase input terminals
M8	8.5 Nm ( 6.3 ft.lbs)	all locations except as above
M10	44.0 Nm (32.0 ft.lbs)	TSG-SRF3200, 3400, 3630 phase input terminals
M10	17.0 Nm (12.5 ft.lbs)	all locations except as above

Table 3. Recommended tightening torques.



Installation & Operating Instructions

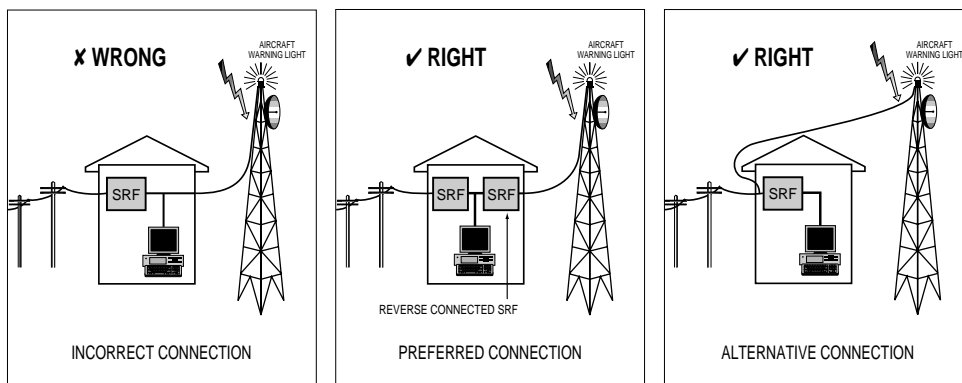
6.3 OUTPUT DISTRIBUTION

As the output of the SRF is considered to be a "clean filtered" supply it should not be subjected to situations where further transients can be introduced. The "clean" supply should not be run external to the facility, ie to provide power to an external building or tower lighting. From the aspect of transient protection, to do so would create possible "points of entry" for transient energy to the protected zone.

A similar scenario exists where the output of the SRF is fed to an electrically "noisy" load. Any transients developed by this load may also be fed to other equipment connected to the same supply.

Electrically noisy equipment should ideally be supplied from a separate SRF and all cabling should be run in isolation to other cables.

Figure 12. Connection of circuits outside the protected zone.



Output Distribution

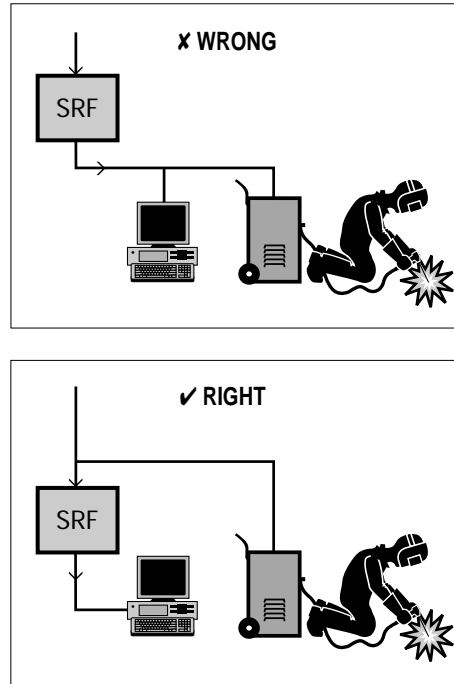


Figure 13. Isolation of sensitive equipment from noisy sources.

## Earthing

### 6.4 EARTHING

The earths for all site equipment should be integrated (preferably deploying a single point earthing approach) and an equipotential earth plane should be created. Integral to this is the elimination of earth loops. It is common, but incorrect from the point of lightning protection, for there to be separate earths for various services, ie electricity mains, telephone, computer equipment and other building services.

For sites where the interconnection of these earths is difficult, either for practical or regulatory reasons, the use of a Transient Earth Clamp (TEC) is recommended. The TEC behaves as an open circuit under normal operation, but under surge conditions it activates to effectively clamp individual points together.

The effectiveness of an SRF is intimately related to the impedance presented by the earthing system to which it is connected. A low impedance route to the earth is required (less

### TSG Series Surge Reduction Filters

than  $10\Omega$ ). This can be achieved by ensuring that the earth electrode system at the site presents a low surge impedance with respect to the ground. Additionally, the interconnecting cabling must be of adequate cross sectional area and be routed to provide as short and direct a path as is practical. Ideally the earthing system impedance should be measured using a meter which simulates the typical wave shape of a lightning transient. ERICO can provide this service.

The earth conductor for the SRF should be sized according to local regulations but with a minimum size of  $6\text{mm}^2$ . Every attempt should be made to limit the cable length to under 5 metres.

By selecting the most direct route, with the minimum possible number of bends to the earth point or internal earth bar, the risk of side flashing and excessive voltage rise across the equipment is reduced. Figure 14 depicts the correct earthing concept as described above.

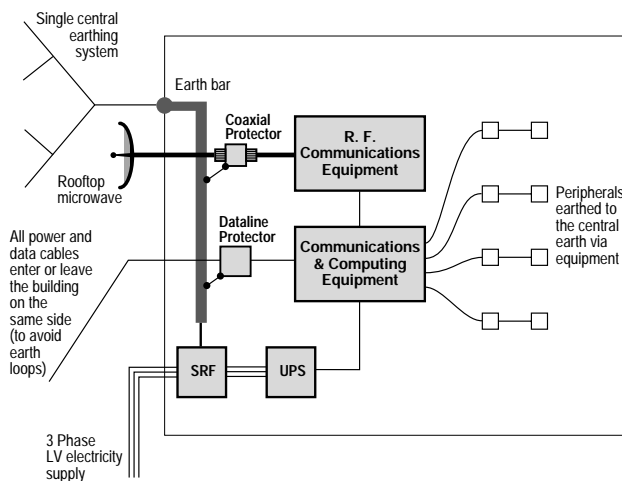


Figure 14. Preferred approach to equipotential bonding.

## Installation & Operating Instructions

### 6.5 CONNECTION OF ALARM CIRCUITS

The TSG-SRF secondary surge diverters are continuously monitored and their internal protection status is identified by a two segment LED indicator for each phase.

Reduction in surge handling capacity activates a set of voltage free alarm contacts which can be used to shut down the load or to activate an external warning. Once an alarm situation is registered, there is a three-second delay prior to the alarm contacts opening.

This three-second alarm delay is provided to eliminate the possibility of nuisance alarms that may be attributed to brief supply voltage variations.

When mains voltage is applied to the TSG-SRF and the surge diverters are fully functional, the alarm contacts will be in the energised or normal state. The NC contact will be in

## Connection of Alarm Circuits

short circuit with the COM contact. Should the surge handling capacity fall to below the alarm threshold, these contacts will be in the de-energised or alarm state and the NO contact will be in short circuit with the COM contact.

The contacts are "Fail-Safe" in that, if power to the unit fails, the contacts will revert to the de-energised or alarm state.

The alarm contacts should only be connected by an appropriately qualified person owing to the possibility of mains voltage being present in the TSG-SRF cabinet. Care should be taken to route the alarm wiring away from the input circuit and any other current-carrying conductors.

Alarm contact ratings:

- 2A @ 30Vdc
- 600mA @ 110Vdc
- 600mA @ 125Vac

## Installation arrangement for Australian MEN Systems

## TSG Series Surge Reduction Filters

### 6.6 INSTALLATION ARRANGEMENT FOR AUSTRALIAN MEN SYSTEMS

Under Australian Standards classification, SRFs are considered a piece of equipment to be connected to the mains supply. They are not intended for use as switchboards, distribution boards or other equipment. As these devices are classified as "electrical equipment" AS 3000 Wiring Regulations apply to the installation and operation of the units.

AS 3000 specifies minimum requirements for electrical equipment that is connected to switch boards or distribution boards.

For a point of entry application in the multiple earth neutral (MEN) distribution system, the SRF equipment should be installed as close as possible after the MEN point and after both the main disconnect switch/over-current protector and any metering equipment. The SRF therefore, may not be installed at the physical "point of entry" of the mains power to the building. It must be earthed and installed in accordance with all other applicable electrical and safety standards. As the protection equipment is hardwired, the installation must be inspected by an appropriately authorized electrical authority official prior to commissioning.

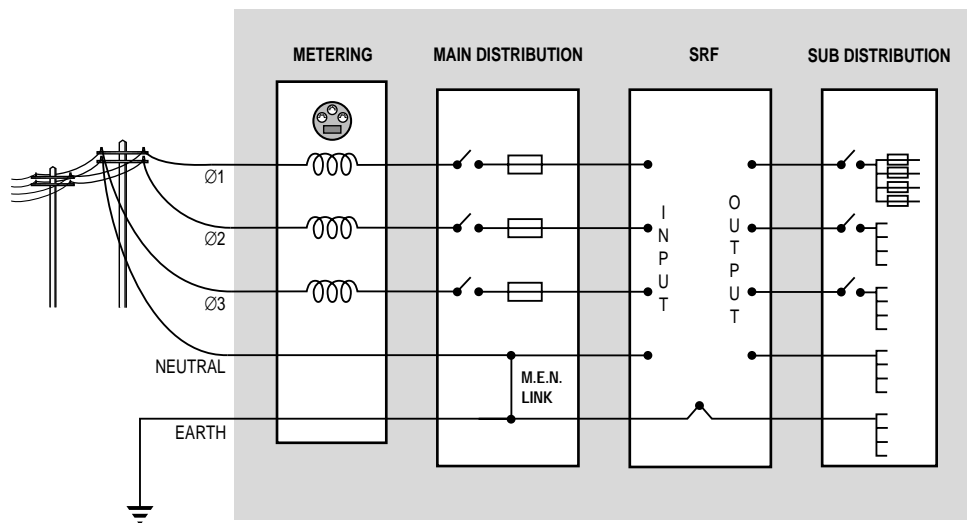


Figure 15. Typical connection detail for SRF point of entry installation in MEN system.

## Installation & Operating Instructions

## TSG-SRFs on Sub-Circuits

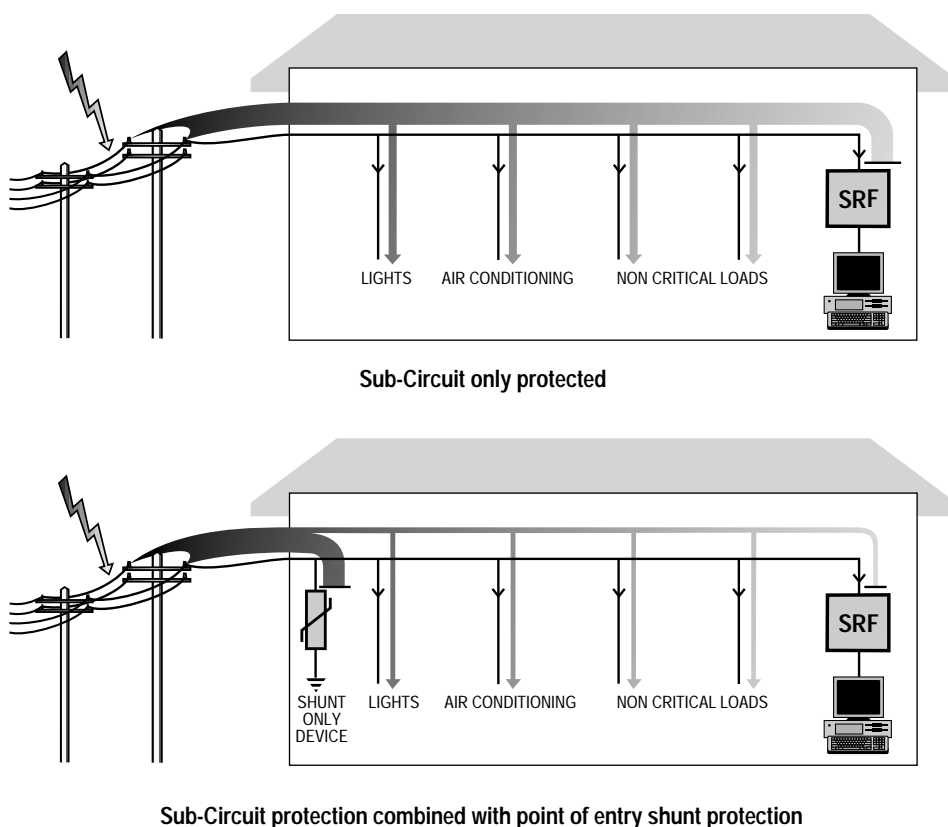
### 6.7 TSG-SRFs ON SUB-CIRCUITS

Where SRFs are installed to protect equipment on a particular sub-circuit, it is strongly recommended that additional protection be installed at the power point of entry. Primary shunt protection at the point of entry should be used to divert the peak surge currents away from the sub-circuit. This will reduce the risk of cross-coupling of transients onto adjacent circuits and will reduce the risk of flashover between the locally grounded chassis and the earth circuit.

Figure 16 details the role of point of entry protection in these instances. The cables supplying the input to the SRF and the connection to the earthing system will carry a proportion of the surge energy which has been let through the primary point-of-entry protector.

Care should be taken therefore, in the routing of these cables to ensure that this energy will not couple onto adjacent circuits.

Figure 16. Operation of primary shunt protection and SRFs on sub-circuit.



## TSG-SRFs on Sub-Circuits

In some instances it will be necessary to provide a separate earth electrode for the SRF (subject to compliance with relevant wiring regulations), particularly where the filter is to be installed on a sub-circuit some distance from the existing earth electrode. In this instance, the new electrode should be located as near as possible to the SRF. This secondary electrode must be electrically bonded to the existing earthing system via the most direct route possible, using flat copper tape and should be buried to an appropriate depth.

## TSG Series Surge Reduction Filters

This earthing arrangement is depicted in Figure 17. If a secondary earth cannot be installed, or the earth impedance through the sub-circuit to the earth is significantly above  $10\Omega$ , special care must be taken. The risk of flashover between the locally grounded chassis and the earth circuit may exist.

Careful attention must be paid to equipotential bonding of the protected equipment.

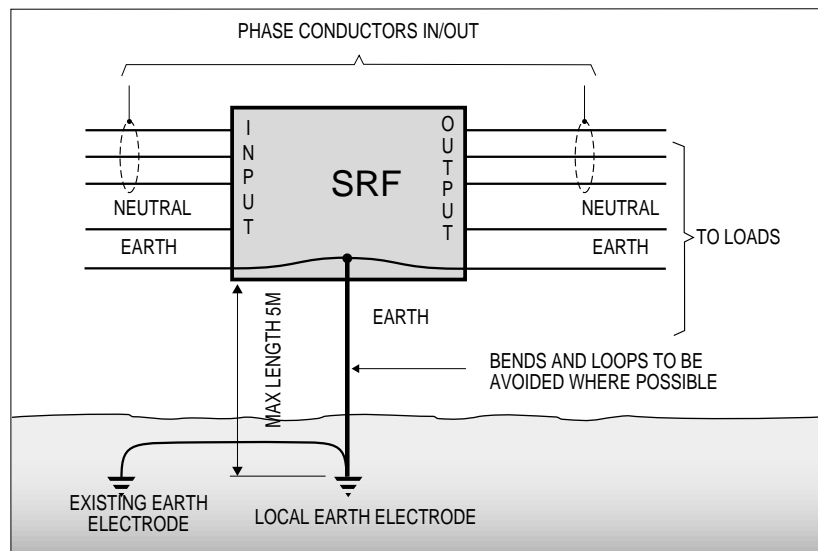


Figure 17. Earthing of an SRF remote from MEN point. (Subject to compliance with relevant national standards). Care is needed to avoid earth loops within protected environment.

## Installation & Operating Instructions

### 7. SERVICING and TROUBLE SHOOTING

**HAZARDOUS VOLTAGES EXIST WITHIN THE SRF ENCLOSURE. THE SRF SHOULD ONLY BE SERVICED BY QUALIFIED PERSONNEL, IN ACCORDANCE WITH RELEVANT NATIONAL ELECTRICAL & SAFETY CODES.**

Do not disconnect upstream earth or neutral connections supplying the TSG-SRF while power is applied to the unit, as this may damage the TSG-SRF or load.

Only replace the primary TSG or secondary TDS surge diverters with an identical type.

Voltage-free alarm contacts are activated (after a three-second delay) should the secondary protection status fall below a pre-determined level.

#### Fault Checks

All indicators, alarms and surge counters (where fitted) should be checked on a regular basis.

Should any of the display indicators fail to illuminate, check for the following conditions:

- Is power available to the TSG-SRF?
- Check the input voltage by measuring the voltage between active and neutral
- Has the line fuse blown or upstream circuit breaker or fuse tripped?

Surge reduction filters of 1250A capacity and above, have fuses installed in series with the TSG primary surge protection.

If these fuses are open circuited for any reason, or if the fuse ruptures, then the primary surge protection is removed from circuit.

## Servicing & Trouble Shooting

- For SRFs utilising input fuses, spares of the correct type and rating should be held on site.

The TSG-SRFs are essentially maintenance free, although periodic inspection is recommended to ensure that the ventilation louvres (where fitted) do not become clogged with dust. In high humidity areas, dust should be regularly vacuumed from the enclosures to prevent the possibility of voltage tracking.

#### Indicators

If power is being supplied to the TSG-SRF and the indicators still fail to illuminate, then it is possible that either the primary TSG or secondary TDS devices have exhausted their surge capacity. In such circumstances, **the particular devices should be replaced as a matter of urgency** as they are no longer providing optimum protection.

A single status indicator is provided on each TSG surge diverter to indicate the surge capacity of the primary TSG surge diverter(s). When power is applied and full surge capacity is available, the status indicator will be illuminated. **Should the indicator fail to illuminate, the TSG should be replaced, as optimum protection is no longer provided.** It should be noted that the status indicator will not illuminate (regardless of TSG surge capacity) if power is not available.

The TSG-SRF employs TD technology as the secondary protection stage on both single and three-phase models. The integrity and surge capacity of this stage is indicated by a two-segment LED display per phase, located on the escutcheon panel of the TSG-SRF. Should one or both of the secondary stage LED indicators fail to illuminate **a reduction in surge handling capacity has occurred. In this event the affected surge diverter module should be replaced.**

## Non-Standard Products & accessories

### 8. NON-STANDARD PRODUCTS & ACCESSORIES

This document details the installation procedure for our current range of standard TSG-SRFs. Non-standard units are also manufactured to suit specific customer requirements. This manual is likely also to be supplied with these units. The following are details for some of the non-standard variations and options available.

#### Backplane unit:

Normally denoted by 'BP' in the model number. These units are supplied without the proprietary enclosure and are intended to be mounted in a customer provided switchboard.

#### Low Voltage unit:

This is an alternative voltage version of the standard TSG-SRF. This unit incorporates primary and secondary surge diverters specifically designed for low voltage applications, ie 110/120VAC.

#### Surge Counter:

Optional surge counter (available for the TSG-SRF three-phase 125A to 2000A models).

Benefits of having the surge counter installed are accurate and reliable monitoring of surge activity and predictive maintenance scheduling. Accidental erasure of the surge count is prevented by the use of a non-resettable counter display.

The surge counter can be either factory or field installed. The ordering information for this option is detailed below.

- Factory installed - Add the following post-script to the part number of the product.

### TSG Series Surge Reduction Filters

(eg TSG-SRF3125 /SC for a three-phase 125A Surge Reduction Filter with factory installed surge counter)

- Field installed - Order a TDS-SC from your nearest ERICO office or distributor. When installing the TDS-SC, please follow the upgrade installation instructions which are provided with the counter.



Figure 18. Backplane unit, supplied for installation into customer provided switchboard.



9. SCHEMATIC DIAGRAMS

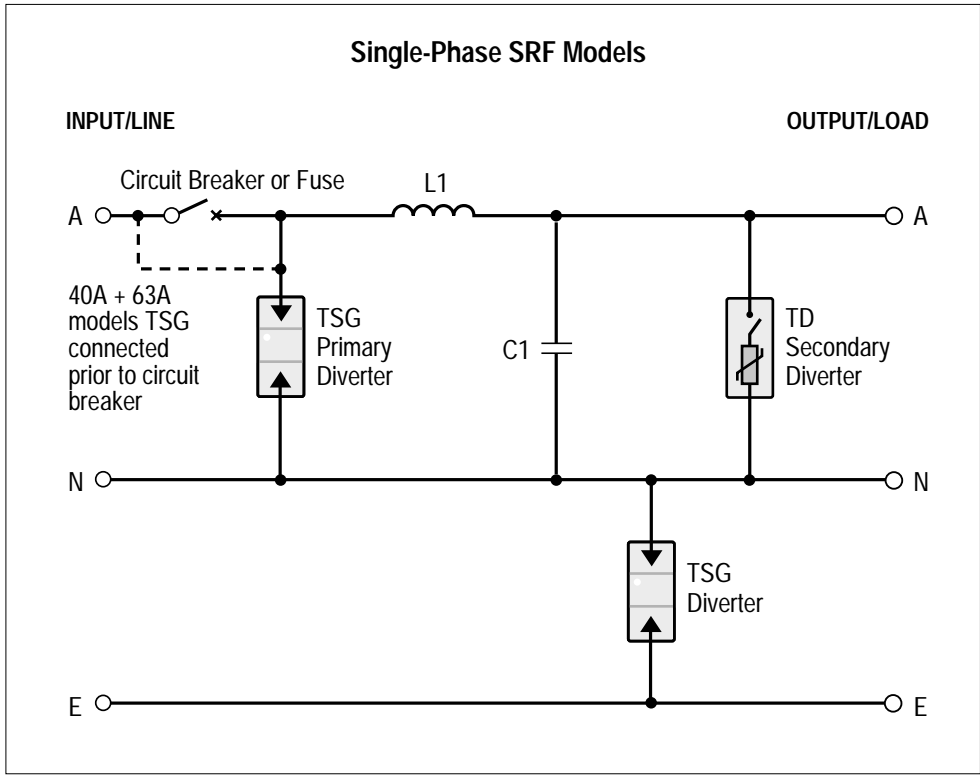


Figure 19. Schematic diagram for Single-Phase Filters.

# Schmetic Diagrams

## TSG Series Surge Reduction Filters

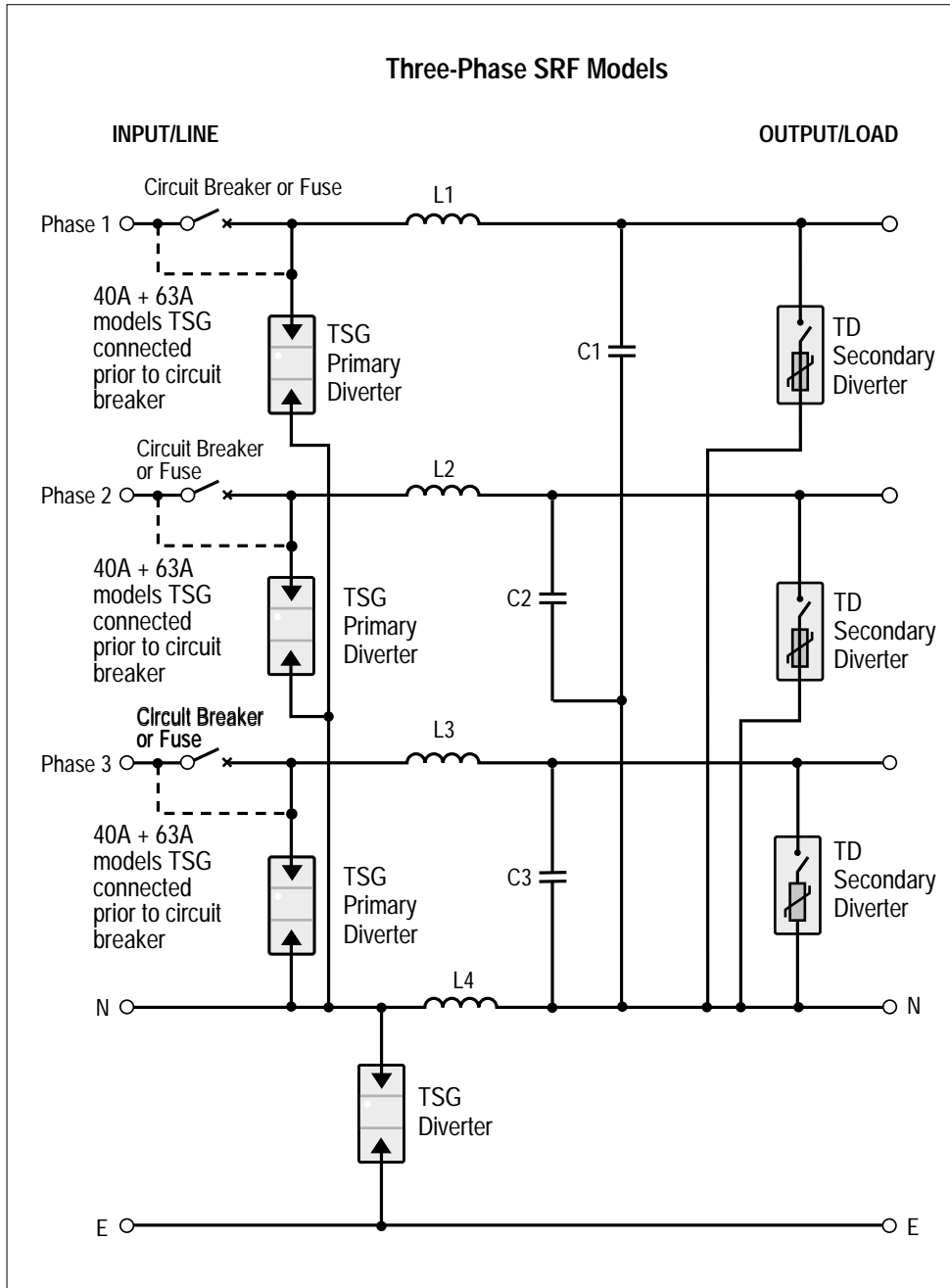


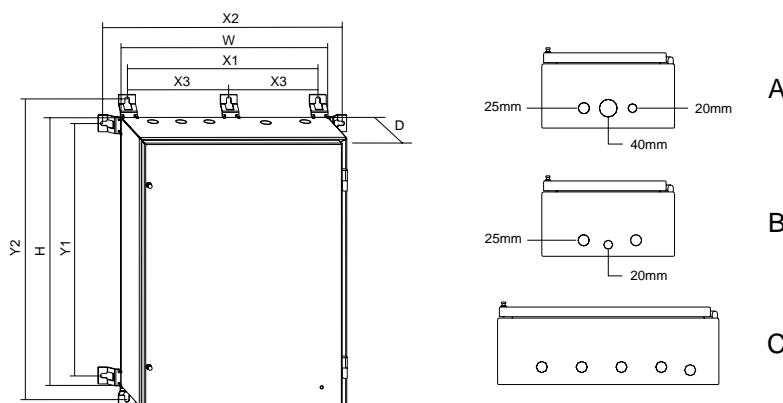
Figure 20. Schematic diagram for Three-Phase Filters.

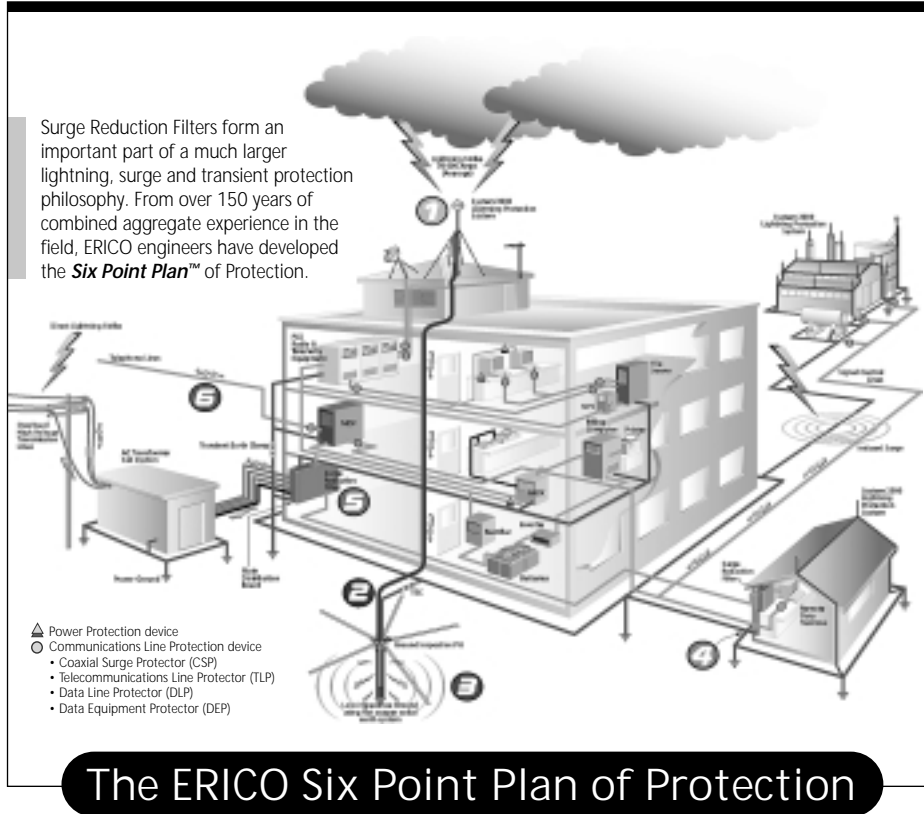
10. PHYSICAL DIMENSIONS

TSG-SRF DIMENSIONS																																																													
TSG-SRF MODEL	ENCLOSURE SIZE			MOUNTING			CABLE ENTRY	MASS																																																					
	W	H	D	X1 X2	Y1 Y2	FASTENER DIAMETER																																																							
TSG-SRF132	300	400	170	260 377	477 360	Ø10	A	11																																																					
TSG-SRF163	300	400	170	260 377	477 360	Ø10	A	11																																																					
TSG-SRF1125	300	400	170	360 377	477 360	Ø10	B	13																																																					
TSG-SRF340	400	500	170	360 477	577 460	Ø10	A	20																																																					
TSG-SRF363	400	500	170	360 477	577 460	Ø10	A </tr <tr> <td>TSG-SRF3125</td> <td>500</td> <td>650</td> <td>175</td> <td>460 577</td> <td>727 610</td> <td>Ø10</td> <td>C (Ø25mm)</td> <td>38</td> </tr> <tr> <td>TSG-SRF3200</td> <td>500</td> <td>780</td> <td>215</td> <td>460 577</td> <td>857 740</td> <td>Ø10</td> <td>C (Ø32mm)</td> <td>52</td> </tr> <tr> <td>TSG-SRF3400</td> <td>650</td> <td>850</td> <td>218</td> <td>610 727</td> <td>927 810</td> <td>Ø10</td> <td>GLAND PLATE</td> <td>100*</td> </tr> <tr> <td>TSG-SRF3630</td> <td>850</td> <td>1150</td> <td>235</td> <td>(X3) 405 927</td> <td>1227 1110</td> <td>Ø10</td> <td>GLAND PLATE</td> <td>120*</td> </tr> <tr> <td>TSG-SRF31250</td> <td>1200</td> <td>1650</td> <td>315</td> <td colspan="2">ON APPLICATION</td> <td>Ø12</td> <td>GLAND PLATE</td> <td>350*</td> </tr> <tr> <td>TSG-SRF32000</td> <td>1200</td> <td>1650</td> <td>315</td> <td colspan="2">ON APPLICATION</td> <td>Ø12</td> <td>GLAND PLATE</td> <td>400*</td> </tr>	TSG-SRF3125	500	650	175	460 577	727 610	Ø10	C (Ø25mm)	38	TSG-SRF3200	500	780	215	460 577	857 740	Ø10	C (Ø32mm)	52	TSG-SRF3400	650	850	218	610 727	927 810	Ø10	GLAND PLATE	100*	TSG-SRF3630	850	1150	235	(X3) 405 927	1227 1110	Ø10	GLAND PLATE	120*	TSG-SRF31250	1200	1650	315	ON APPLICATION		Ø12	GLAND PLATE	350*	TSG-SRF32000	1200	1650	315	ON APPLICATION		Ø12	GLAND PLATE	400*
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TSG-SRF32000	1200	1650	315	ON APPLICATION		Ø12	GLAND PLATE	400*																																																					

\* Indicative mass only. If exact mass is critical for these units, contact ERICO for confirmation.

Table 4. Physical dimensions of CRITEC TSG-SRFs





1 Capture the lightning strike to a known and preferred attachment point.



4 Bond all ground points together to eliminate ground loops and create an equipotential plane.



2 Safely convey this energy to ground.



5 Protect incoming AC power feeders.



3 Dissipate the energy into a low impedance grounding system.



6 Protect low voltage data/telecommunication circuits.

The range of TSG-SRFs fulfill some of the requirements of point 5 of the plan. Careful consideration of each of the six interdependent disciplines of the Six point Plan is important to ensure the provision of optimal protection and long-term operational viability. The degree of protection required will be determined by the individual situation and the proper application of risk management principles.

*For further advice on your electrical protection needs please contact your local ERICO office.*

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