

CS1 Series STABILINE®

Surge
Protective
Devices

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Your Guide to Installation of the CS1 Series STABILINE® Surge Suppression System

Today's sophisticated electronic equipment requires superior suppression filter systems. By selecting Superior Electric's devices, you have taken a critical step toward decreasing downtime and ensuring longer product life for your equipment.

The CS1 series STABILINE® Surge Suppression System is designed to be connected to your electrical distribution system to protect connected sensitive electrical and electronic equipment against the harmful effects of lightning strikes, internally generated transients and high frequency noise. The reliable CS1 fulfills the single-pulse surge current capacity testing recommendations per NEMA LS1-1992, paragraphs 2.2.9 and 3.9.

It combines easy and flexible installation with many special features to deliver more performance than other devices in its class.

The CS1 offers a full range of monitoring options from the most basic phase indicator lights and audible alarms to the most sophisticated power quality monitoring features offered in any surge suppression product. These features include the following:

- Display of true RMS phase voltages
- Display of neutral-to-ground voltage and current
- Counting of swells, surges, sags and outages
- Display of percent available protection remaining

The CS1 series incorporates redundant MOV fusing that prevents individual component failure from rendering the protection mode useless. Instead, the failed component safely removes itself from the circuit and all remaining protection is allowed to continue operating as designed. Special circuitry allows the percent remaining protection to be measured and automatically alarmed if capacity drops below 50 percent.

The standard CS1 is available in a fiberglass-reinforced polyester NEMA 4X enclosure. It is available with or without an integral disconnect. Units equipped with disconnects are available only with a metallic NEMA 4/12 enclosure.

Thank you for choosing a CS1 series STABILINE® Surge Suppression System. We look forward to fulfilling your facility-wide surge suppression filter system needs.

Installation Assistance

**Monday through Friday, 8:00 a.m. to 5:00 p.m. (EST):
800.787.3532 or 860.507.2025, ext.70782**

Seven-Year Limited Warranty

CS1 series STABILINE® products are warranted for a period of seven years from date of purchase.

Purpose and Applications of the CS1 Series Stabiline® Surge Suppression Products

The CS1 series is designed to provide surge suppression to all connected loads within a distribution system. The CS1 uses proven Metal Oxide Varistors (MOVs) and an efficient capacitive filter system to reduce or eliminate transients, impulses, and high-frequency noise within a building's electrical system.

The Importance of Correct Installation

This manual provides guidelines for the proper installation of the CS1 series of devices. Proper product selection and compliance with these guidelines will help your new suppression system provide years of reliable service. If installers are unsure about the facility's electrical configuration or have other installation-related questions, it is recommended they consult with a master electrician or other qualified electrical professional.

When shortcuts are taken or installation procedures are not followed, the CS1 system may be damaged or may not provide adequate protection. Improper installation may also void the warranty. It is extremely important to follow these installation procedures carefully.

This manual is designed to assist you with the installation of the CS1 product and connecting it to your electrical system. However, should you have questions about installing the CS1, please call Superior Electric at 800.787.3532.

W A R N I N G !

WARNING! The CS1 series warranty is voided if the unit is damaged as a result of improper installation or the installer's failure to verify the following conditions prior to installation.

Pre-Installation Checklist

Before beginning

➤ Confirm that the voltage(s) and service configuration shown on the CS1 product label are consistent with the voltage and service configuration of the facility to which it is being attached. A model number is printed on the label affixed to the inside of the CS1 enclosure. Each model number corresponds to the voltage and service configurations printed in the table below:

PRODUCT LABEL DESIGNATION	SYSTEM VOLTAGE, SERVICE CONFIGURATION
CS1-xx-120/240-2G	120/240VAC, 1ø 3-wire SPLIT-PHASE, w/ground
CS1-xx-120/208-3GY	120/208VAC, 3ø 4-wire WYE, w/ground
CS1-xx-220/380-3GY	220/380VAC, 3ø 4-wire WYE, w/ground
CS1-xx-277/480-3GY	277/480VAC, 3ø 4-wire WYE, w/ground
CS1-xx-347/600-3GY	347/600VAC, 3ø 4-wire WYE, w/ground
CS1-xx-120/240-3GHD	120/240VAC, 3ø 4-wire high-leg DELTA, w/ground (B phase must be 208V)
CS1-xx-240-3DG	240VAC, 3ø 3-wire DELTA, w/ground
CS1-xx-480-3DG	480VAC, 3ø 3-wire DELTA, w/ground

Note: Indicate CS1 surge current rating by substituting 60, 80, 100, 125, 150, 200, 250, or 300 for “xx” in the above model numbers.

➤ Check to ensure that a proper Xo bond is installed between the neutral and ground terminals at the transformer upstream from all 3ø WYE, 3ø high-leg DELTA, or 1ø SPLIT-PHASE TVSS devices (see NEC Article 250.) Lack of a proper bond will damage the CS1 and void the warranty.

➤ Confirm that the environmental conditions are consistent with the following ranges:

- Ambient Temperatures: The CS1 must be installed in an area with a temperature between -40° and +140°F.
- Humidity: The CS1 must be installed in an area with relative humidity between 5% and 95% non-condensing.
- Altitude: The CS1 must be installed in a location whose altitude is below 13,000 feet.

WARNING!

WARNING! Discontinue installation if (1) your conditions are inconsistent with the checklist above or (2) your conditions cannot be verified. Call Technical Support at 860.507.2025, ext. 70782 if you have any questions.

Installation Methods for Common Service Configurations for the Design Engineer and the Installer

The CS1 is to be connected in parallel with the electrical system. It may be connected via a circuit breaker, molded case switch, fused switch, or connected directly to the bus of the panelboard or switchboard it is protecting. If direct bus connection is used, Superior Electric recommends that the CS1 be equipped with the optional integral disconnect switch.

- Do not connect the CS1 to the line side of the main service breaker or disconnecting means.
- Do not install the CS1 where the available short circuit current to the unit is less than 1500 RMS symmetrical amperes.

Service Configurations

Figures 1-4 show the electrical relationship between the CS1 and these four basic service configurations: WYE, DELTA, High-Leg DELTA and SPLIT-PHASE.

FIG. 1:
3-Phase, 4-Wire WYE

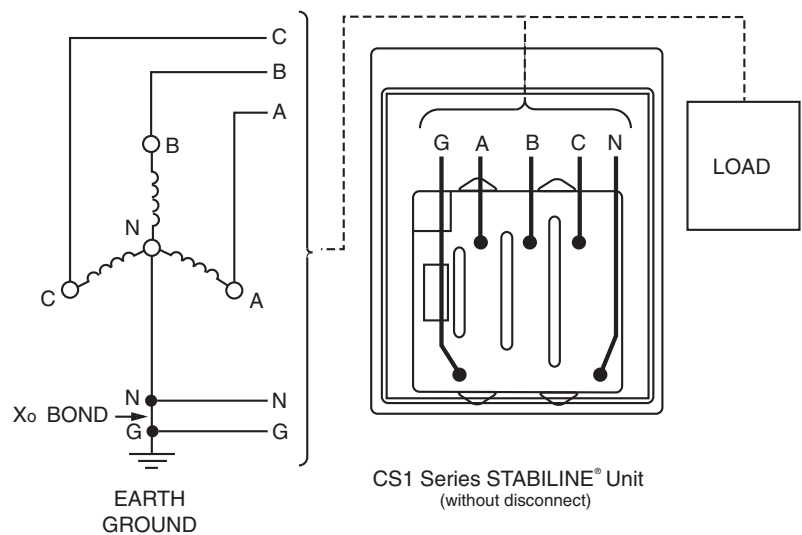


FIG. 2:
3-Phase, 3-Wire DELTA

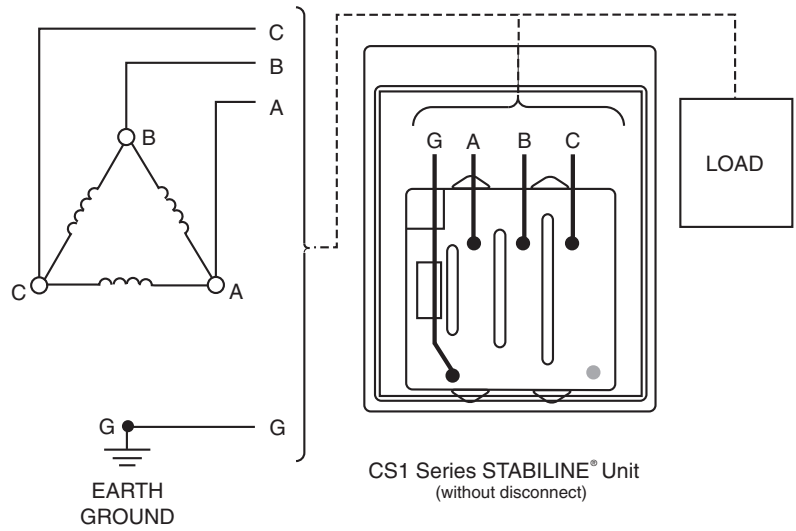
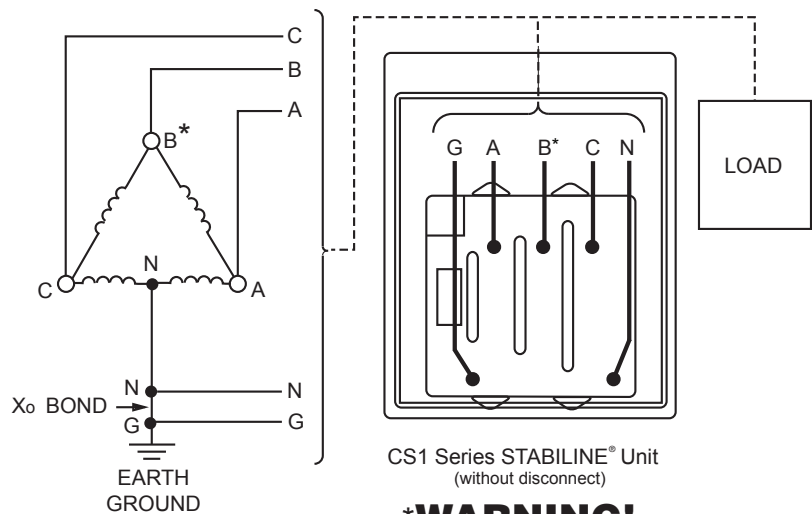
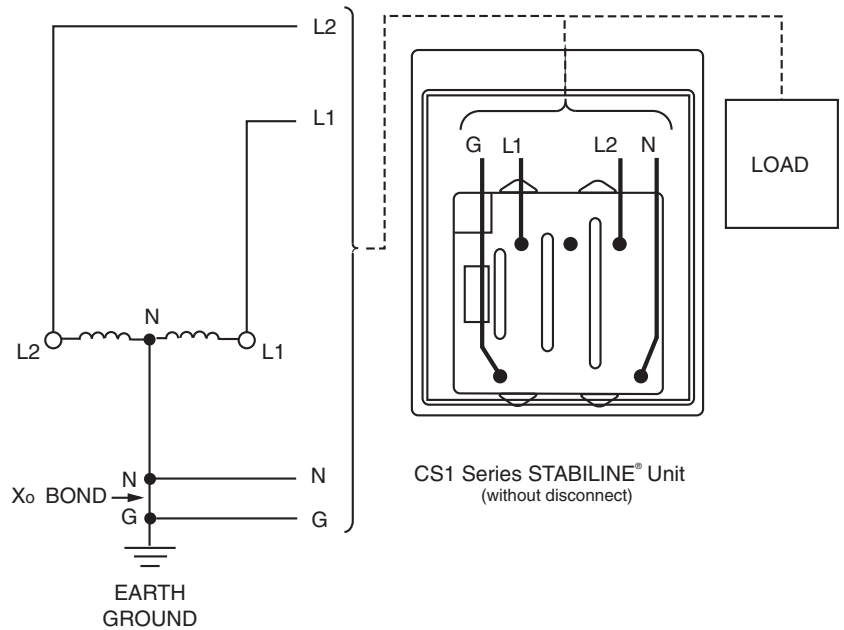


FIG. 3:
3-Phase, 4-Wire High-Leg DELTA



***WARNING!**
HIGH LEG MUST BE B PHASE

FIG. 4:
1-Phase, 3-Wire
SPLIT-PHASE



Plan Your Installation

WARNING: The performance of the CS1 will be severely limited if the conductors are too long, are of too small a wire gauge, have too many bends or have sharp bends.

Conductor Routing: The above factors should be addressed during the design of an installation to ensure that there is a suitable place for the CS1 reserved next to its point of connection to the electrical system. The selected mounting location should ensure short conductor runs providing a direct route with a minimum of bends. If bends are required they should be sweeping bends. Do not make sharp 90° bends for “aesthetic” purposes.

Conductor Sizing and Overcurrent Protection

Conductor Sizing: Superior Electric recommends installing the CS1 using conductors less than 10 feet in length and using the following conductor sizes for phase, ground, and neutral connections. Where space and bending radii permit use a larger conductor size:

Model	Use conductor lengths less than 10 feet
CS1-60	#8 AWG
CS1-80	#8 AWG
CS1-100	#6 AWG
CS1-125	#6 AWG
CS1-150	#6 AWG
CS1-200	#2 AWG
CS1-250	#2 AWG
CS1-300	#2 AWG

Note: The above conductor sizing recommendations ensure that the effective clamping voltage of the CS1 at the point of connection is kept to a minimum in order to maximize protection. Increasing conductor size to compensate for distances over 10 feet has a negligible effect on minimizing clamping voltage. Additionally, conventional voltage drop calculations appropriate for 60 Hz do not apply to transients.

Overcurrent Protection: The design may require, or the installer may choose, to connect the CS1 to a circuit breaker, molded case switch or fused disconnect.

Superior Electric recommends feeding all CS1 models not equipped with an integral disconnect with a circuit breaker, molded case switch or fused switch.

If a breaker or molded case switch is used for connecting the phase conductors, Superior Electric recommends a 100 amp rating.

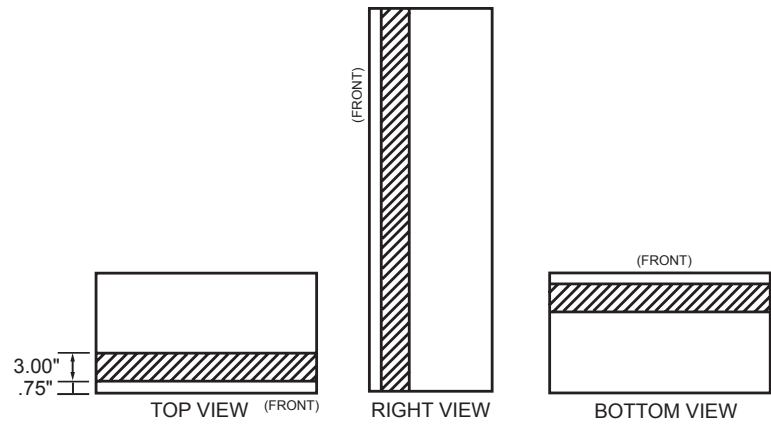
WARNING!

WARNING: If the available short circuit current at the CS1 is less than 1500 RMS symmetrical amperes, do not install the CS1. Examples of systems with available short circuit currents less than 1500 amperes include the outputs of small UPS systems and small AC inverters.

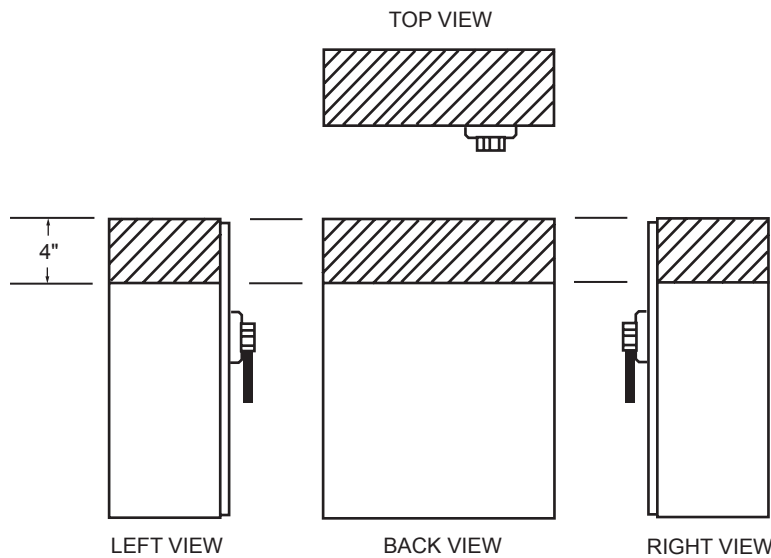
**Conduit Openings
(Non-Metallic Enclosure,
NEMA 4X)**

If desired, punch holes at this time for the conduit or nipple
or wait until the CS1 is mounted to the building structure.

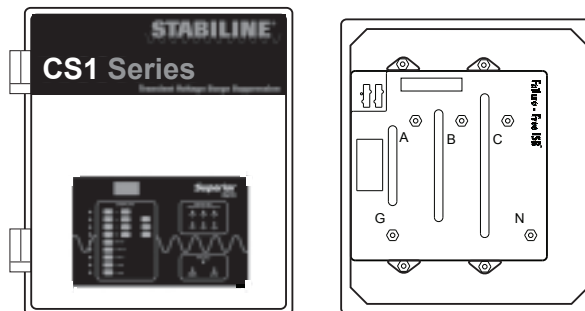
Punch holes only in the shaded areas as shown in the
following illustrations.



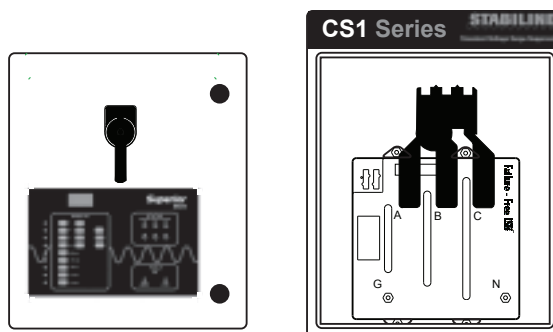
**Conduit Openings
(Metallic Enclosure,
NEMA 4/12)**



Typical Enclosure Configurations For All CS1 Series STABILINE® Products



CS1 Series with Non-Metallic Enclosure



CS1 Series with Metallic Enclosure and Disconnect

Mounting

Mount the CS1 to the building structure using construction methods and hardware appropriate for your site. Install the conduit and pull the conductors as specified previously or according to the engineer's design.

Electrical Connections

Phases, Neutral* and Ground: Connect the phase, neutral and ground conductors.

For CS1 series models equipped with an integral disconnect switch connect the phase conductors to the line-side lugs on the disconnect and the ground and neutral* conductors to the lugs labeled "G" and "N" on the internal yellow Integrated Suppression Bus.

Connecting Form C Dry Contacts

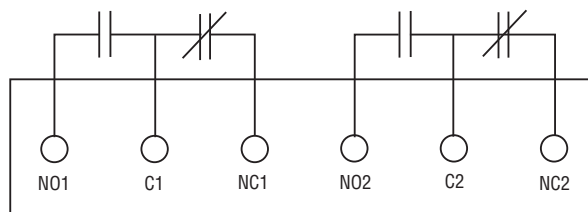
For CS1 series models without an integral disconnect switch, connect the phase conductors to the lugs labeled “A”, “B”, and “C” on the internal yellow Integrated Suppression Bus and the ground and neutral* conductors to the lugs labeled “G” and “N”.

* DELTA-connected CS1 models do not have a neutral conductor.

Dry Contacts: CS1 models equipped with Advanced Monitoring options have a dual set of Form “C” dry contacts available for connection to user-provided remote alarm and monitoring circuits.

The installer must provide the appropriate raceway and wiring for this circuit observing the restrictions on conduit openings illustrated in an earlier section of this manual. The installer must route the monitoring conductors via the CS1's door hinge to the blue terminal blocks on the door-mounted circuit board. Select the appropriate materials and routing to allow the door to open and close.

The following diagram shows the Form “C” contact configuration. The annotations on the diagram match the markings on the blue terminal block.



FCC TERMINAL BLOCK

Field Testing

Your CS1 unit has been carefully tested before leaving the factory.

If you have questions about Field Startup Testing or would like to arrange for this service, call Technical Support at 860.507.2025 ext. 70782.

Before Applying Power: Checklist

- **Confirm Pre-Installation Checklist:** Confirm that the “Pre-Installation Checklist” found on page 5 of this manual was completed correctly before proceeding.
- **Battery Installation:** Your CS1 unit will be equipped with a 9-volt battery if you purchased “L3 Advanced” monitoring. Look at the circuit board behind the door. If there is a 9-volt battery present it will need to be removed, turned around and reinserted into the holder so that the contacts “snap” into place. If the alarm sounds, press the “ALARM DISABLE” button on the front of the door. The battery is installed backwards for shipping purposes.
- **Confirm Line Voltage:** Measure the line to line voltages feeding the panelboard and be sure they are within -30% to +10% of the rated line voltage of the CS1 unit. Use the following table to determine the range of acceptable voltages for each model of the CS1 series.

Acceptable Voltage Ranges for All Models

CS1 MODEL NO.	NOMINAL L-L VOLTAGE	-30% TO +10% L-L VOLTAGE
CS1-xx-120/240-2G	240	168 to 264
CS1-xx-120/208-3GY	208	146 to 228
CS1-xx-220/380-3GY	380	266 to 419
CS1-xx-277/480-3GY	480	336 to 528
CS1-xx-347/600-3GY	600	420 to 660
CS1-xx-120/240-3GHD	240	168 to 264
CS1-xx-240-3DG	240	168 to 264
CS1-xx-480-3DG	480	336 to 528

Note: “xx” specifies rating of 60, 80, 100, 125, 150, 200, 250, 300 kA

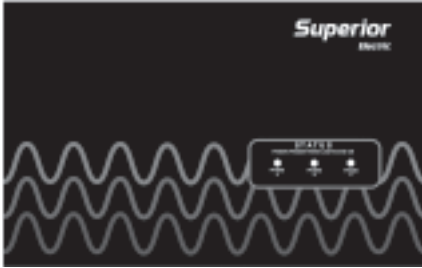
NOTE: The sag counter of the L3 Advanced Monitoring option considers line voltage deviations below -10% of nominal as sags.

WARNING!

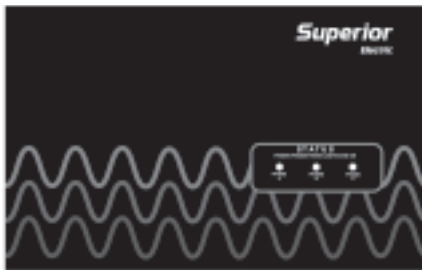
WARNING! Do not apply power if the measured voltage is not within the range specified for the CS1 model being installed.

- Apply power to the CS1 by closing the circuit breaker or switch (if any) feeding the CS1 or closing the integral disconnect.
- If you have L3 Advanced Monitoring option, be sure to re-enable the alarm by pressing the “ALARM DISABLE” button. The “ALARM DISABLED” light should not be illuminated and the alarm should not be audible.

Verify Proper Operation



CS1 Series STABILINE®
with Base Monitoring.



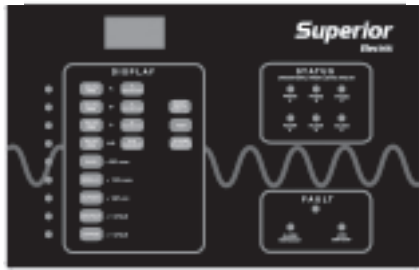
CS1 Series STABILINE®
with LI Primary Monitoring.

Depending on which monitoring option your CS1 series STABILINE® surge suppression system came with you can verify proper operation of the unit as follows:

► **If your CS1 has Base Monitoring** (see picture): Verify that the green indicating lights are illuminated. Three-phase units have three (3) green indicating lights labeled “A”, “B”, and “C”. Split-phase units should only have lights “A” and “C” illuminated.

► **If your CS1 has L1 Standard Monitoring** (see picture): Verify that only the green indicating lights are illuminated and that there are no red lights illuminated. Green lights indicate a normal condition for each phase. Red lights indicate a fault condition. Three-phase units have three indicating lights labeled “A”, “B”, and “C”. Split-phase units should only have lights “A” and “C” illuminated.

The L1 Standard Monitoring option is equipped with two sets of Form “C” contacts. The relay containing the contacts is in the “alarm condition” when the power is off to the unit, when the unit is encountering loss of power to one or more phases, or the CS1 is encountering more than 50% loss of capacity due to internal fuse operation. Test the operation of the Form “C” contacts by de-energizing the CS1 and checking the state of the contacts with a continuity tester or observing the effect of the contacts on the user-provided remote alarm circuits.



CS1 Series STABILINE®
with L3 Advanced Monitoring.

► **If your CS1 has L3 Advanced Monitoring** (see picture): Verify that the green indicating lights are illuminated and that the red “fault” lights are off. Three-phase units have three (3) green indicating lights labeled “A”, “B”, and “C”. Split-phase units should only have lights “A” and “C” illuminated.

The L3 Advanced Monitoring option contains an audible alarm that should not operate under normal conditions. The alarm can be tested by pressing the “ALARM TEST” button on the front of the door. The “LOW BATTERY” light should not be illuminated. If it is, change the 9-volt battery on the circuit board behind the door.

The L3 Advanced Monitoring option is equipped with two sets of Form “C” contacts. The relay containing the contacts is in the “alarm condition” when the power is off to the unit, when the unit is encountering loss of power to one or more phases, or the CS1 is encountering more than 50% loss of capacity due to internal fuse operation. Test the operation of the Form “C” contacts by de-energizing the CS1 and checking the state of the contacts with a continuity tester or observing the effect of the contacts on the user-provided remote alarm circuits.

The L3 Advanced Monitoring option has the same features as the L1 Advanced Monitoring plus these additional features:

- Audible Alarm
- RMS Voltage readout
- % Protection Available
- Swell Counter
- Surge Counter
- Sag Counter
- Outage Counter

Troubleshooting

Your CS1 series STABILINE® surge suppression system does not require periodic maintenance. The unit's heavy-duty design should preclude the need for any repairs; however, the following indications and procedures may be appropriate:

INDICATION	PROCEDURE
One or more phase indicator lights are off.	<ol style="list-style-type: none">1. Check that the external power source supplying power to unit is energized.2. Check that the circuit breaker or switch (if appropriate) feeding the CS1 is turned "on."3. Check the cables connecting the door-mounted devices to the suppression module.4. If all of above are O.K., contact factory.
CS1 advanced hand-held test unit or Advanced Monitoring indicates less than 50% available capacity.	Contact factory.

Installation Assistance

Contact Technical Support

**Monday through Friday, 8:00 a.m. to 5:00 p.m. (EST):
800.787.3532 or 860.507.2025, ext. 70782**

Operation / Maintenance

The CS1 series STABILINE® Surge Suppression System should provide years of uninterrupted service.

With several levels of monitoring available, the user should be able to verify the normal operation of the CS1 and confirm that it is connected correctly to the power system.

Superior Electric does recommend two periodic tests in order to:

- Verify that the unit is able to clamp surges to an acceptable level
- Verify that the unit has acceptable surge handling capacity

These tests should be coordinated with scheduled maintenance events in your facility. They can be performed in house with the aid of the CS1 hand-held test unit or requested as a service from Superior Electric or an authorized service representative.

Options

The CS1 series STABILINE® Surge Suppression System is available with the following options:

- L1 Standard Monitoring
- L3 Advanced Monitoring
- Integral Disconnect Switch
- CS1 hand-held test unit

Seven-Year Limited Warranty

The CS1 is warranted to be defect-free and performance-guaranteed for seven years.

Specifications

Size and Weight:

MODEL	ENCLOSURE SIZE/WEIGHT NON-METALLIC ENCLOSURE	ENCLOSURE SIZE/WEIGHT METAL ENCLOSURE (with integral disconnect switch)
CS1-200-300	19.5"H x 17.5"W x 9.5"D / 57 lbs	28"H x 16"W x 9.5"D / 91 lbs
CS1-100-150	17.5"H x 15.5"W x 7.0"D / 40 lbs	20"H x 16"W x 9.5"D / 59 lbs
CS1-60-80	15.5"H x 13.5"W x 7.0"D / 28 lbs	16"H x 16"W x 9.5"D / 45 lbs

Single-Pulse Surge Ratings: The following single-pulse surge ratings are measured and presented in accordance with NEMA LS1-1992 and can be verified with independent laboratory test reports:

- CS1-60: 60 kA, all modes
- CS1-80: 80 kA, all modes
- CS1-100: 100 kA, all modes
- CS1-125: 125 kA, all modes
- CS1-150: 150 kA, all modes
- CS1-200: 200 kA, all modes
- *CS1-250: 250 kA, all modes
- *CS1-300: 300 kA, all modes

*In compliance with NEMA LS1-1992, CS1 series STABILINE® suppression filter systems are single pulse surge current tested in all modes at rated currents of the product by an industry-recognized independent test laboratory. Single pulse surge current capacities of 200,000 amps or less are established by single-unit testing of all components or sub-assemblies within each mode. Due to present industry test equipment limitations, single pulse surge current capacities over 200,000 amps are established via testing of individual components or sub-assemblies within a mode. Per ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1992, CS1 series STABILINE® suppression filter systems are repetitive surge current capacity tested per mode utilizing a 1.2 x 50 µsec 20KV open circuit voltage, 8 x 20 µsec 10 kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current.

REPETITIVE SURGE CURRENT CAPACITY PER MODE	
MODEL	IMPULSES
CS1-60	> 3,500
CS1-80	> 4,000
CS1-100	> 4,500
CS1-125	> 5,000
CS1-150	> 5,500
CS1-200	> 6,500
CS1-250	> 7,000
CS1-300	> 7,500

Repetitive Surge Rating: The repetitive surge current capacities were achieved in all modes utilizing a 1.2 x 50 µsec, 20 kV open circuit voltage, 8 x 20 µsec, 10 kA short-circuit current Category C3 bi-wave at one minute intervals without performance degradation of more than 10% deviation of clamping voltage.

Operating Frequency: 47 to 63 Hertz

Noise Attenuation: The following EMI-RFI noise rejection, or attenuation values, for CS1 units are in compliance with test and evaluation procedures outlined in NEMA LS1 –1992, paragraphs 2.2.11 and 3.11:

Note: Standardized insertion loss data obtained utilizing MIL-STD-220A 50 ohm insertion loss methodology. Noise source path = 100' to model maximum average circuit distance, filter connection distance = 6".

EMI-RFI FILTER ATTENUATION (dB)				
PRODUCT	ATTENUATION FREQUENCY			
	100 KHz	1MHz	10MHz	100MHz
CS1-60, 80	50 dB	37 dB	38 dB	53 dB
CS1-100, 125, 150	44 dB	33 dB	36 dB	53 dB
CS1-200, 250, 300	41 dB	31 dB	35 dB	53 dB

Standards and Listings

The following standards and listings apply to the CS1 series STABILINE® models:

ANSI/IEEE C62.41 – 1991 and C62.45 – 1992

ANSI/IEEE C62.1 and C62.11

Canadian Standards (cUL)

FIPS PUB 94

NEMA LS1-1992 Guidelines

NFPA (NEC), 75 and 78

UL 1449 2nd Edition, 1283, 489, 198, 248-1

NOTES

NOTES

Distribution Coast-To-Coast and International

CS1 Series STABILINE® surge suppressors are obtainable worldwide through an extensive authorized distributor network. These distributors offer literature and technical assistance.

In addition, Superior Electric sales engineers are available to provide prompt attention to customer needs. Call or fax for ordering and application information or for the address of the closest authorized distributor.

In U.S.A. and Canada

28 Spring Lane, Suite 3, Farmington, CT 06032 Tel: 860-507-2025 Fax: 860-507-2050

Customer Service: 1-800-787-3532 Ext.70782 Product Application: 1-800-787-3532 Ext. 72058

Product Literature Request: 1-800-787-3532 Fax: 1-800-821-1369

Voltage Control Components

VOLT-PAC® Variable Transformers
POWERSTAT® Variable Transformers
LUXTROL® Lighting Controls
5-WAY® Binding Posts
SUPERCON® Electrical Connectors

Voltage Control Components are available worldwide through an extensive Authorized Stocking Distributor network. These Distributors offer literature, technical assistance and a wide range of models off the shelf for fastest possible delivery and service.

Power Quality Solutions

STABILINE® Automatic Voltage Regulators
STABILINE® Surge Protective Devices
STABILINE® Uninterruptible Power Supplies
STABILINE® Power Conditioners

STABILINE Power Quality Solutions are available worldwide through an extensive Authorized Distributor and Reseller network which offer literature, technical assistance and a select range of models off-the-shelf for fastest possible delivery and service.

In addition, Superior Electric Manufacturer's Representatives are available to provide prompt attention to customer needs. Call or Fax for ordering and application information or for the address of the closest Manufacturer's Representative, Authorized Distributor or Reseller.

The right to make engineering refinements on all products is reserved. Dimensions and other details are subject to change.



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