



## SE2000B-3P Series 3-Phase Static Exciter

The Power-Tronics SE2000B-3P Series 3-Phase Static Exciters are a self-contained complete Static Exciter designed for operation at 125/250vdc at up to 200Adc!

The SE2000B-3P Series is uniquely designed to sit in a compact footprint while being passively convection cooled for a long service life. Because of its unique modular design, the SE2000B-3P Series minimizes downtime should a repair ever be necessary! The compact design allows a wide variety of installation methods, including installations where space is at a premium.

Retrofitting an existing application with non-standard transformer voltage is easy thanks to the wide range of suitable input voltages to the rectifier section! Designing a new installation is simplified thanks to the ability to accept standard transformer secondary voltages.

The SE2000B-3P Series is a time-proven design, utilizing high-reliability components and a unique modular design to simplify repair. Regulation circuitry is powered by sensing voltage which provides a graceful shutdown in the case of lost sensing voltage to give a passive loss-of-sensing protection.

The SE2000B-3P Series is capable of parallel operation with other generators or with a utility buss. Power-Tronics' wide variety of optional accessories also allows the SE2000B-3P Series to be remotely operated by dry contact switching or by a PLC controller!

The SE2000B-3P Series is designed to provide a lifetime of service and is specifically built to minimize failures and potential downtime!

### Specifications

Input Voltage (SE2125B-3P):	160 - 240vac, 3 $\phi$
Input Voltage (SE2250B-3P):	320 - 416vac, 3 $\phi$
Sensing Voltage:	100 - 120vac, 3 $\phi$ , 50VA
Frequency:	50 or 60 Hz
Voltage Regulation:	+/- 1% From NL to FL
Output Voltage (SE2125B-3P):	0-250vdc @ 240vac input
Output Voltage (SE2250B-3P):	0-433vdc @ 416vac input
Maximum Continuous Output:	200Adc
Minimum Field Resistance:	.83 $\Omega$ (SE2125B-3P) 1.7 $\Omega$ (SE2250B-3P)
Regulation Type:	Flat Response
Physical Size:	22 3/4 x 24 1/4 x 9 in.
Weight:	35 lb.
Voltage Regulator Module:	VRMSE-3P
Parallel Operation:	Yes
Minimum Buildup Volts:	5vac at AC Power Input
Internal Protection:	Fuses, cartridge type
External Voltage Control:	Yes, 0-10vdc @ 4-20mA
Loss of Sensing Protection:	Yes, Passive



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## Introduction and Functional Description

# **Caution: Read This Installation Manual Carefully and Entirely!**

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**Warning:** Do not use digital equipment to read voltage, Hz, or amperage during this installation. Use only Analog sensing equipment! Failure to do so may result in damage to equipment or in personal injury!

**ALWAYS** perform all setup procedures off-line

**ALWAYS** wear eye protection

**ALWAYS** strip wire insulation properly or use insulated connectors

**ALWAYS** use analog metering equipment when setting up the regulator

**ALWAYS** ensure the static exciter receives ample airflow

**ALWAYS** use adequate fusing

**NEVER** hold the static exciter in your hand or lap when energized

**NEVER** install the static exciter in a place it can get wet or is exposed to the elements

**NEVER** mount the static exciter over a screw, bolt, rivet, seam, or other fastener

**NEVER** remove the regulator cover while the unit is in operation

**NEVER** insert a screwdriver or other object under the regulator cover

**NEVER** touch any exposed part of the Static Exciter during operation (**LIVE HEATSINKS**)

**NEVER** install a switch in the DC portion of the static exciter's wiring

**NEVER USE A DIGITAL FREQUENCY METER** (*It can give a false reading!*)

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## Functional Description

The SE2000B-3P Series 3-Phase Static Exciters are the result of over 20 years of engineering efforts and offers high-demand features at a competitive price point. The SE2000B-3P Series is a proven design and is engineered to greatly simplify setup while offering extreme reliability. When properly installed, the SE2000B-3P Series 3-Phase Static Exciters are designed to provide a lifetime of service.

A Generator voltage regulator has several automated tasks it must perform in order to provide reliable, clean, and regulated electricity. It must regulate the terminal voltage within its design specifications and protect both itself and the generator should a fault situation arise.

The SE2000B-3P Series 3-Phase Static Exciters are designed to replace older obsolete static exciters or rotating exciters with a minimum of connections and a minimum of required installation space. The SE2000B-3P Series 3-Phase Static Exciters contains an internal filter for voltage sensing, internal field-replaceable 200A fusing, and internal DC field noise suppression. The SE2000B-3P Series is designed to be user-serviceable should a problem arise. Fuse or rectifier replacement in the field takes only minutes, thanks to the unique modular design.

The SE2000B-3P Series features passive loss of sensing protection and will shut down if sensing voltage is lost. This feature prevents a runaway condition prevalent in many separate-sensing designs and will result in a graceful shutdown!

Due to its extreme simplicity, the SE2000B-3P Series 3-Phase Static Exciter is uncommonly reliable and offers features and regulation accuracy usually only offered by much more complicated and often much more expensive static exciters.



## **Determining Correct Application Sizing**

The SE2000B-3P Series 3-Phase Static Exciters are designed for use with 160-240VAC or 320-416VAC 3 $\phi$  input. It contains internal suppression for use with brush-type generator sets. Before installation, it is necessary to verify that the SE2000B-3P Series is the correct product for your application.

To determine if the SE2000B-3P Series is the correct product for your generator you need to know any two of the following 3 specifications from the rating plate of your generator:

- 1: Exciter Field Voltage (in DC Volts) [Generally given in full load Voltage on nameplates]
- 2: Exciter Field Resistance (in Ohms) [**See Note Below**]
- 3: Exciter Field Amperage (in DC Amps) [Generally given in full load Amps on nameplates]

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**Using the specifications obtained from your generator exciter, verify that your generator fits the specifications from the chart below:**

- Exciter full load voltage is **125VDC or less**, and your exciter field resistance is **.83 $\Omega$  or greater**. **Use SE2125B-3P**
  - Exciter full load voltage is **250VDC or less**, and your exciter field resistance is **1.7 $\Omega$  or greater**. **Use SE2250B-3P**
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**WARNING:** BRUSH AND SLIP RING CONNECTION PROBLEMS ARE THE #1 SOURCE OF VOLTAGE CONTROL PROBLEMS AND FAILURE OF STATIC EXCITERS!!! DO NOT INSTALL THE SE2000B-3P SERIES IF THE BRUSHES AND/OR SLIP RINGS ARE NOT IN EXCELLENT CONDITION!!!

**STOP AND CORRECT BRUSH AND SLIP RING CONNECTION PROBLEMS IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:**

- GROOVES IN SLIP RINGS
- ROUGH SLIP RING APPEARANCE OR GHOSTING (CHATTERING)
- OIL CONTAMINATION ON BRUSHES OR SLIP RINGS
- DULL, ROUGH, STRIPED, PITTED, OR METALLIC APPEARANCE OF BRUSH FACES
- FIELD RESISTANCE MEASURED BETWEEN SLIP RING BRASS AND FIELD RESISTANCE MEASURED BETWEEN FIELD LEADS EXCEEDS 1-2% DIFFERENCE



## Note about Field Resistance:

- When measuring field resistance on a brushless generator, simply measure the resistance of the exciter field through your field leads with a multimeter.
- When measuring field resistance on a brush-type generator, measure the resistance through both the field leads as well as directly on the slip rings themselves. **The readings you obtain should ideally be the same, but no more than 1% difference.** If you show more than 1% difference in reading your generator has brush and ring contact problems and will need cleaning or maintenance before installing the SE2000B-3P Series. **Failure to correct brush and ring contact problems will result in severe damage to the voltage regulator as well as possible PERMANENT damage to the slip rings themselves!** NEVER use emery cloth, carborundum stones, “comm sticks”, or Tuner cleaner to dress or clean slip rings. They will make a bad problem much, much worse! Only use Garnet or Flint sandpaper and clean with a clean rag soaked with Acetone for best results!

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***If you do not have any of the specifications of your generator’s exciter, or if you don’t know where to start when trying to determine your exciter specs, please see the section below for instructions on measuring and calculating your exciter specifications.***

- Measure your exciter field resistance using a multimeter on your field leads. Record this value. If you have a brush-type generator, also take a resistance reading on your slip rings: the value you obtain on the slip rings should be no more than 1% difference from the value you obtained through the field leads.
- Next, start and run the generator and apply 12V from a battery through your field leads and record the AC voltage produced by the generator. To determine your full load exciter field voltage, use the following formula:

$$E_{Exc.} = \frac{E_{Gen.Conf.}}{\left( \frac{E_{Gen.Output}}{E_{Battery}} \right)} * 2$$

Where  $E_{Gen.Conf.}$  is your Generator’s configured voltage (e.g.: 120, 208, 240, 480V, etc.),  $E_{Gen.Output}$  is your recorded output voltage, and  $E_{Battery}$  is your battery voltage (12V usually).

- Next, calculate your maximum exciter field amperage using your measured field resistance and your calculated exciter voltage using the following formula:

$$I = \frac{E}{R}$$

Where  $I$  is your maximum exciter field current,  $E$  is your calculated field voltage from the above formula, and  $R$  is your measured field resistance.

**Using the values you just measured and calculated, see the chart on the previous page to determine whether the SE2000B-3P Series is the correct product for your application.**



## Input Power & Field Connection Diagram

(See pages 9-12 for control wiring diagrams)

The SE2000B-3P Series is a half-controlled 3-phase Full-Wave rectified static exciter, which allows a maximum of 250/433VDC at 100 ADC with an input voltage of 240/416VAC 3 $\phi$ .

This product is typically used on slip-ring generators with full load field voltages of 125/250VDC or less and full load exciter field amperages between 80 and 160ADC.

**Note that the maximum input voltage to the SE2125B-3P Series 3-Phase Static Exciter is 240VAC 3 $\phi$ ! Maximum input voltage to the SE2250B-3P Series 3-Phase Static Exciter is 416VAC 3 $\phi$ ! DO NOT input inappropriate voltage into the SE2000B-3P Series! Severe damage to the unit will result!**

**NEVER** install a switch or breaker on the DC or Exciter side of the voltage regulator!

Only install a switch or disconnect on the AC Side of the regulator!

### Main Power Transformer Rating

SE2125B-3P:

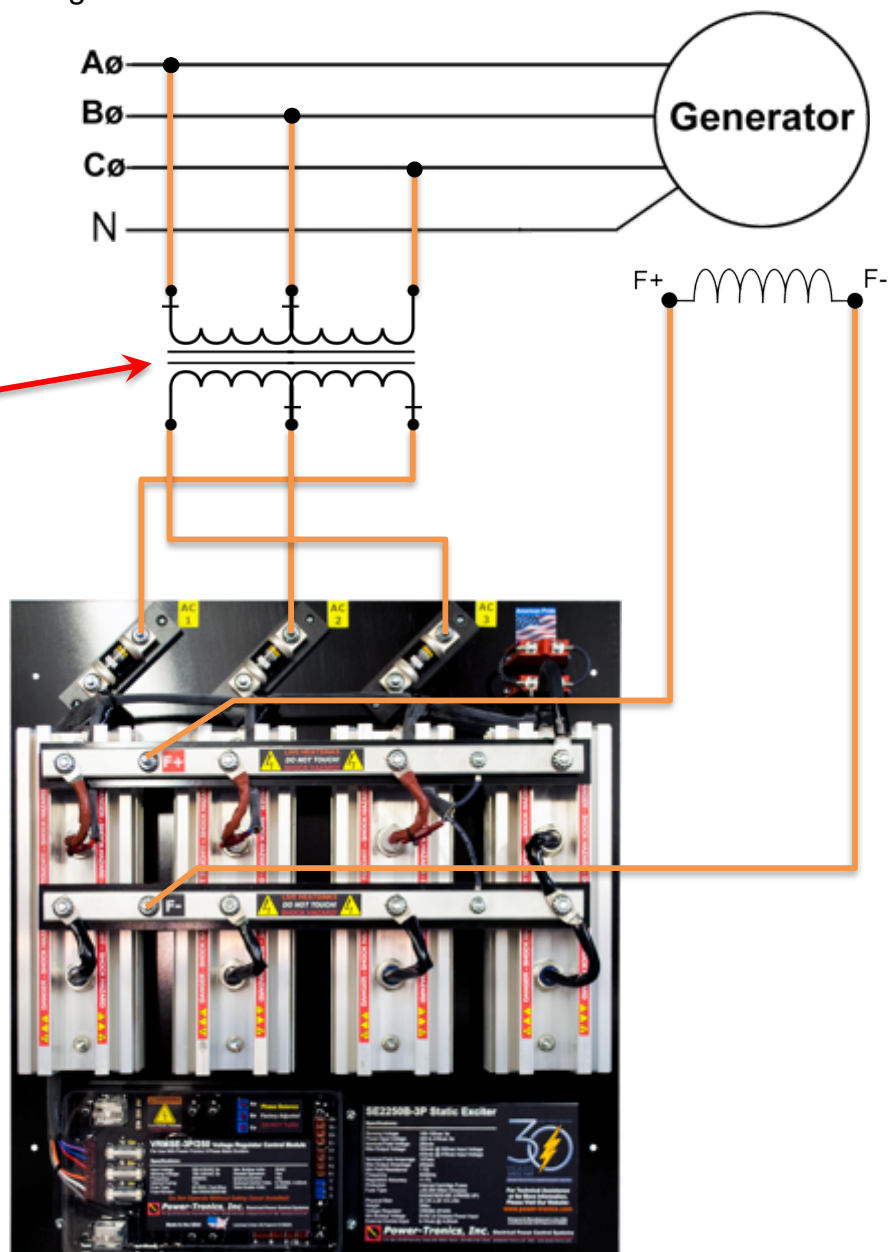
75KVA @ 240VAC

SE2250B-3P:

130KVA @ 416VAC

**Torque All Terminal Connections to 125 in•lbf (15 N•M)**

**See Pages 9-12 for Control Wiring Diagrams**





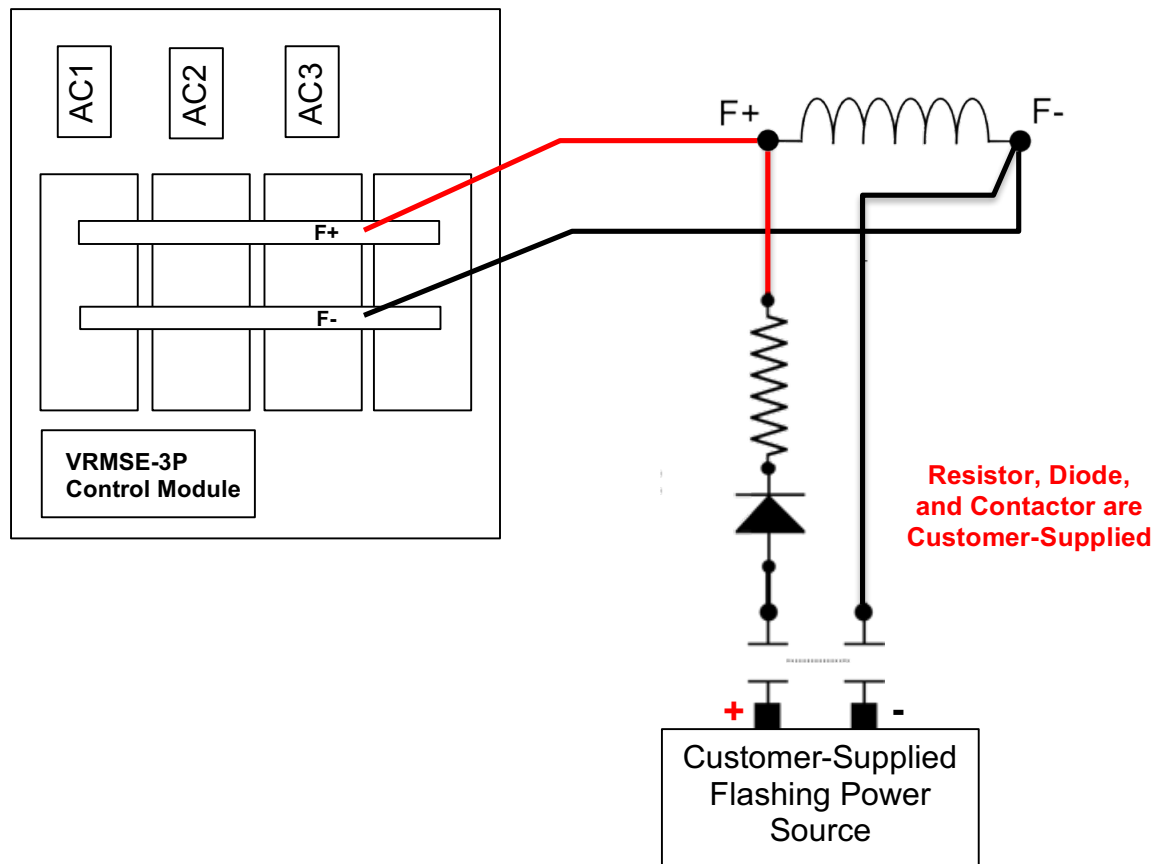
## Creating an External Flashing Circuit

The SE2000B-3P Series 3-Phase Static Exciters are designed primarily for industrial or commercial installations, such as hydroelectric dams or power stations where a station battery or existing power source is normally present. The SE2000B-3P Series contains an internal residual voltage flashing circuit, or use an external flashing source to bring the generator up to voltage during startup.

The diagram below shows how to create a safe flashing circuit to prevent damage to the SE2000B-3P Series or the power source during the flashing procedure.

A typical flashing power-source is a 125vdc station battery. Contactor, diode, and resistor should be sized to fit the power source being used. Please contact Power-Tronics for sizing assistance.

**To avoid damage to the SE2000B-3P Series Static Exciter or possible damage to the flashing power source, the flashing source should be completely disconnected from the SE2000B-3P Series and the generator field once the flashing sequence is complete!**

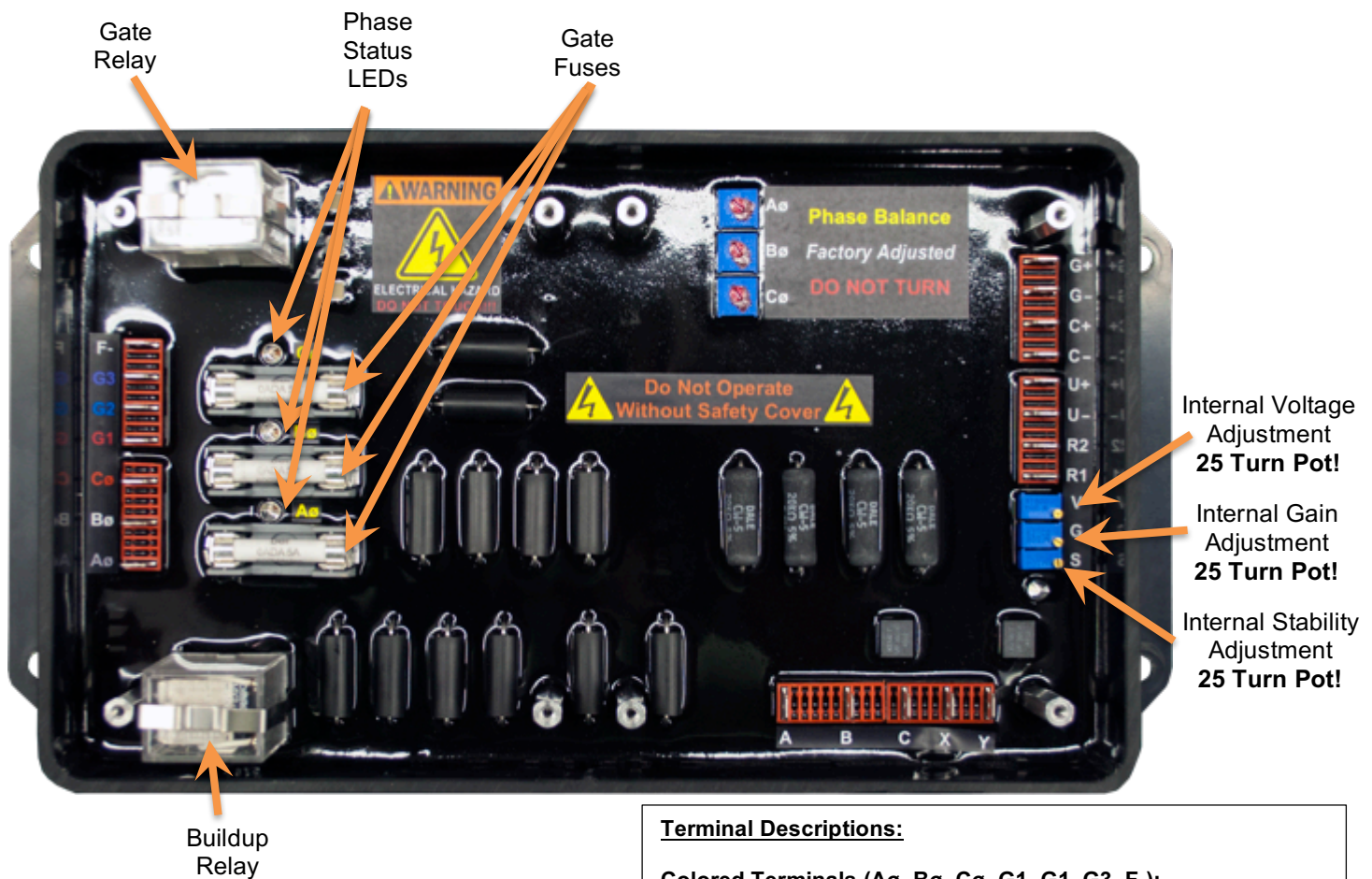




## VRMSE-3P Control Module

The VRMSE-3P Control Module is an integrated device designed to replace multiple discrete components in previous generations of Static Exciters. It incorporates an Automatic Voltage Regulator, AC Filtering, Automatic Residual AC Flashing Circuit, Firing circuitry, and integrated 0-10VDC / 4-20mA Interface Module.

The unitary design simplifies installation in the field, and greatly simplifies replacement if a fault occurs with the control module. The unit has 7 color-coded wires with quick-connect terminals, and can be quickly swapped out in under 5 minutes without the need to remove the chassis from its enclosure or tray.



### Terminal Descriptions:

**Colored Terminals (A $\phi$ , B $\phi$ , C $\phi$ , G1, G1, G3, F-):**  
Chassis Wiring (Color-Coded)

**A, B, and C:**  
100-120VAC 3 $\phi$  Sensing Voltage

**X & Y:**  
Paralleling CT Input

**G+ & G-:**  
Gate Enable Pins  
Apply 24VDC to G+ & G- To Run Exciter

**R1 & R2:**  
Remote Adjustment Input

**U+ & U-:**  
Output From Internal 0-10V or 4-20mA Interface Module

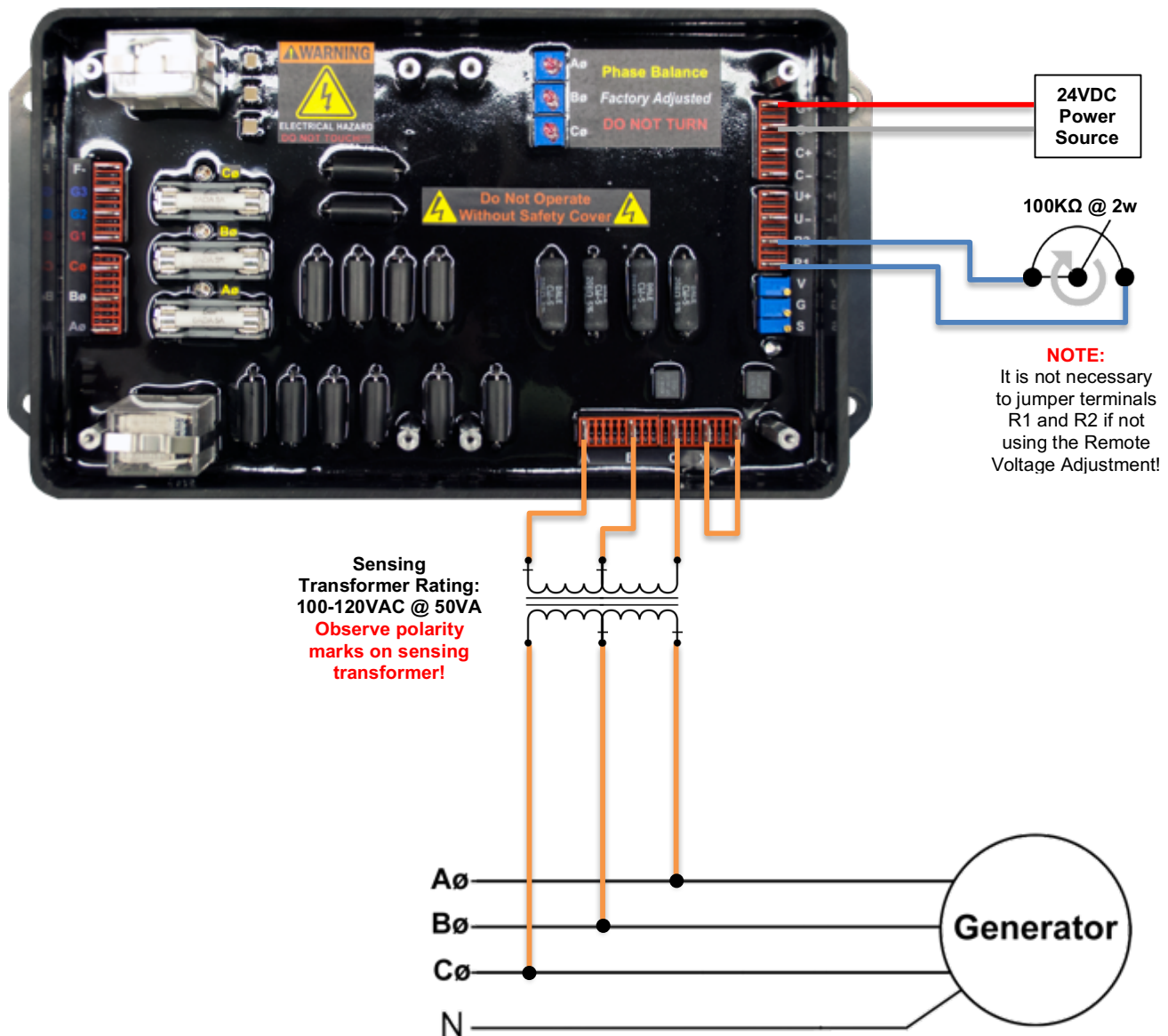
**C+ & C-:**  
Input for 0-10V or 4-20mA Signal



## Standard Control Wiring Diagram

This wiring diagram shows the default control wiring configuration.  
Power wiring is shown on Page 6.

**This diagram assumes an isolated (unit/islanded) operating environment with manual remote adjustment.**



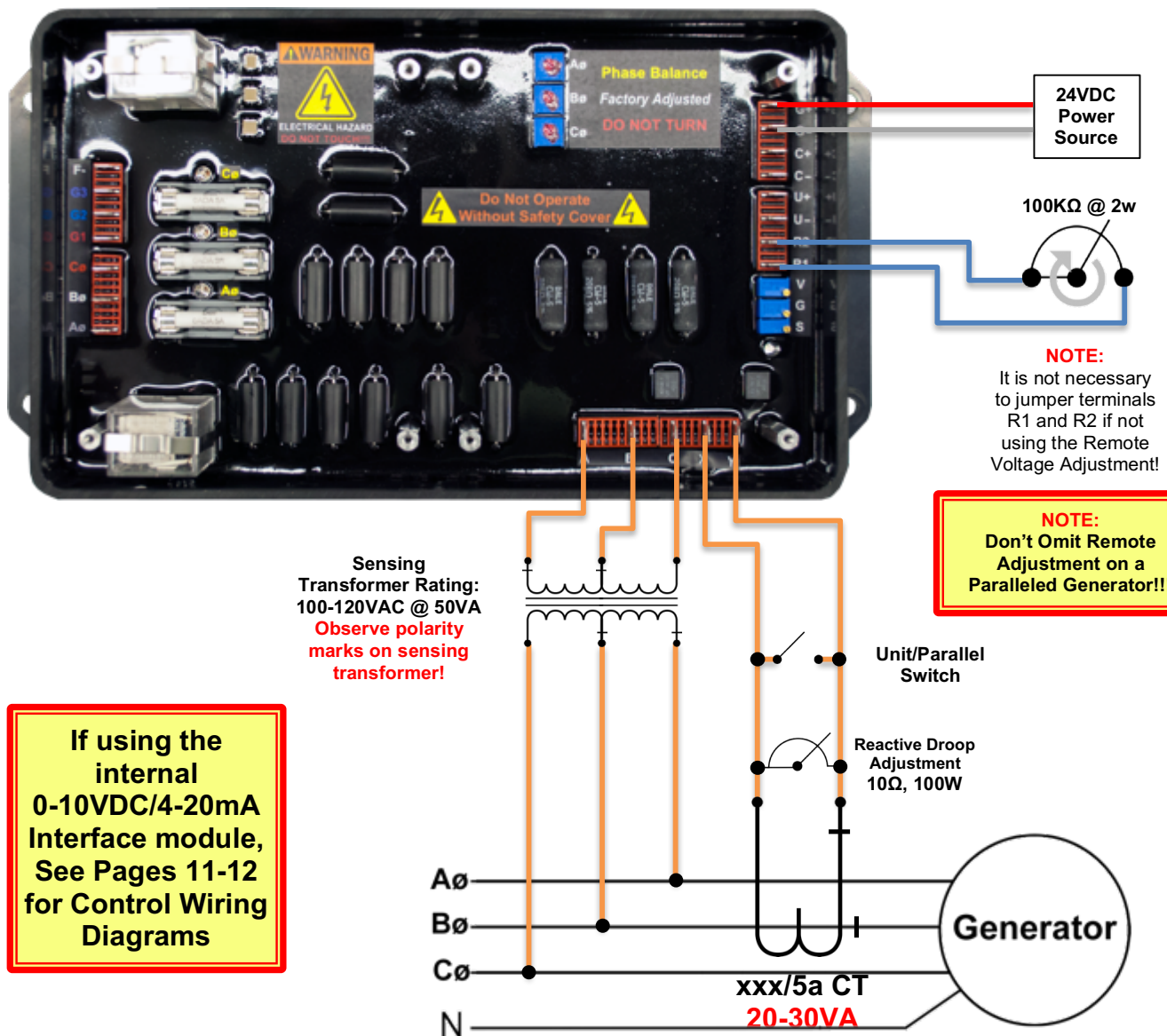


## Parallel Control Wiring Diagram

To use the SE2000B-3P Series Static Exciters in a parallel configuration either with another generator or with a buss such as a utility, use the diagram below for proper hookup. **Power wiring is shown on Page 6.**

**This diagram assumes a paralleled operating environment with manual remote adjustment.**

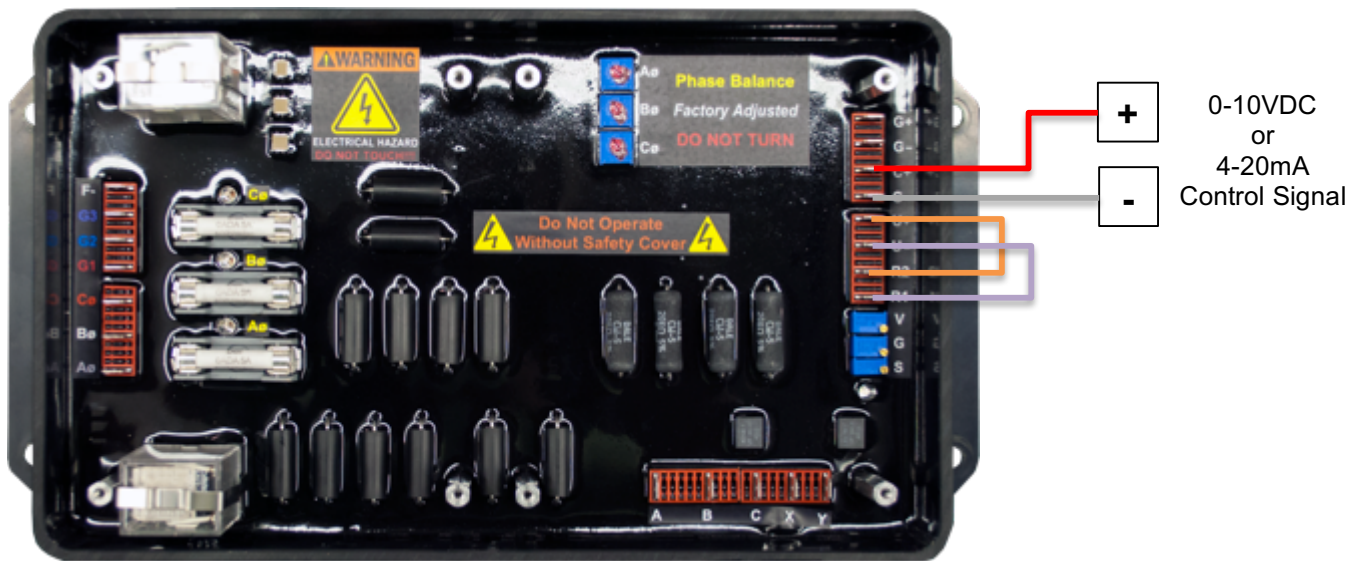
**NOTE:** Power-Tronics products parallel using the Reactive Droop compensation method. This allows our products to parallel with existing systems easily while also allowing islanded operation with the flip of a switch. **When initially installing the droop resistor, set it for approximately 2Ω before final adjustment later.** If the droop is excessive when load testing, reduce the resistance a bit at a time until satisfactory droop is achieved. **CT should be sized at 20-30VA capacity!**





## Fully Automatic Remote Adjustment Wiring Diagram

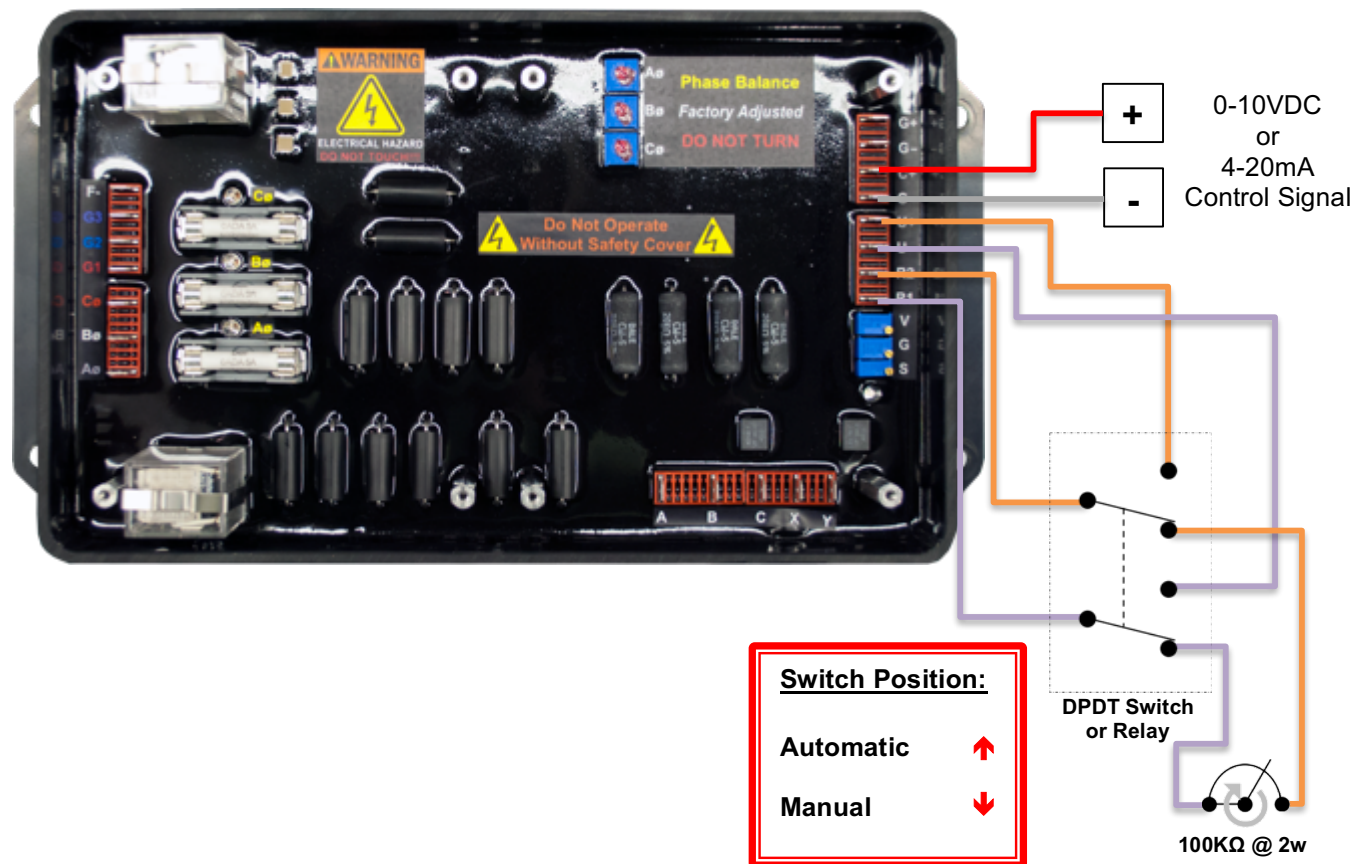
This wiring diagram shows ONLY the control wiring configuration for fully-automatic Remote Control of the Static Exciter using the internal 0-10VDC/4-20mA interface. Control wiring is shown on Pages 9 and 10.





## Automatic / Manual Selectable Remote Adjustment Wiring Diagram

This wiring diagram shows ONLY the control wiring configuration for selectable manual/automatic Remote Control of the Static Exciter using the internal 0-10VDC/4-20mA interface. **Control wiring is shown on Pages 9 and 10.**





## Initial Setup and Commissioning

1. Install the SE2000B-3P Series and wire according to the correct wiring diagram (See Pages 6-12).
2. If installing the SE2000B-3P Series on a brush-type generator, verify that the brushes and brush riggings are isolated, ungrounded, and connected ONLY to the SE2000B-3P Series.
3. Turn the internal voltage control on the VRMSE-3P control module 15 or more turns counter clockwise (left) or until you hear the screw click. This procedure is necessary in case the original factory settings have been altered.
4. If you are using a remote voltage adjustment, set it at 50% of adjustment. If you are using the internal 0-10V/4-20mA interface module, set your external controller to approximately 50% of its output range (6V or 12mA).
5. If the generator is to be paralleled, set the droop resistor to roughly 2Ω.
6. Start up the prime mover and bring up to operating speed, then apply 24vdc to terminals G+ and G- on the VRMSE-3P control module.
7. If your model requires an external flashing source, apply the external flashing source to the exciter field to build the generator up. As soon as the generator begins to build voltage, remove the flashing source and the VRMSE-3P control module will take over.
8. Set the internal voltage adjustment on the voltage regulator to the desired voltage setting for the generator output by turning the adjustment screw clockwise (right).  
**Note that the voltage adjustment is a 25-turn pot!** *If using the internal 0-10V/4-20mA Interface Module, verify that your external control can adjust the generator voltage by varying the controller output signal.*
9. Place the generator on line and observe the frequency and voltage.
10. If terminal voltage is hunting or pulsating after adjustment, adjust the internal Stability control. Turning the screw clockwise will increase stability. **Note that the terminal voltage will rise as the screw is turned, keep terminal voltage in-range with the internal voltage adjustment!**
11. If the generator is being paralleled, measure the droop during loading and adjust the droop resistor as necessary. Reducing droop resistor resistance will reduce droop.  
**NOTE: Loading the generator with a purely resistive load-bank may cause undesirable droop characteristics such as no droop, very slight droop, or even rising terminal voltage. Measure droop with a mixed load for best results.**
12. If paralleling and the terminal voltage rises or excessive amperage exportation occurs during loading with a mixed load connected, reverse the CT leads or reverse the wires connected to X and Y and try again.
13. Observe voltage regulation during no-load and full-load conditions. Once the voltage is set, proper control is observed, and regulating characteristics are satisfactory the installation procedure is complete.



## **Application Troubleshooting**

<b>Problem:</b>	<b>Possible Cause</b>
No Voltage	1 3 5 7 9 11 13 15 20 21
Pulsating Voltage	4 5 6 12 16
Flickering Voltage	4 6 7 14 21 22
High Voltage	6 7 8 9 12 13 17 18 20 21 22
Voltage Drop on Load	5 8 10 12 16 23 24
Low Voltage	5 8 12 13
Poor Voltage Regulation	2 4 10 12 13 16 23 24
No Voltage Control	13 19 20 21 22 23 24

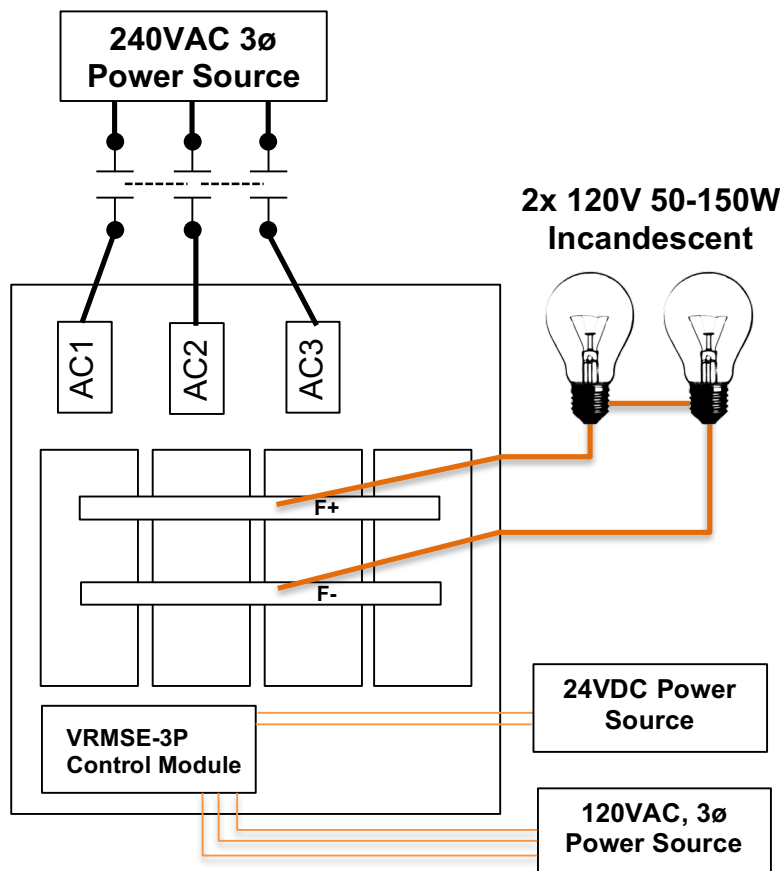
### **Possible Causes:**

1. External Flashing procedure failed, external sensing disconnected, blown internal or external fuses.
2. Unbalanced generator load.
3. Open exciter field or defective generator.
4. Non linear load or defective connection in exciter field.
5. Open diode in exciter or shorted rotor in generator.
6. Loose component in voltage regulator.
7. Loose wiring connections.
8. Input voltage to regulator is too low.
9. Exciter field is grounded.
10. Non linear load or wrong selection for regulator hookup.
11. Exciter fields are reversed.
12. Wrong selection of regulator wiring configuration.
13. Defective voltage regulator.
14. SCR or Inverter drive effecting generator waveform.
15. 24vdc not applied to terminals G+ and G- on VRMSE-3P Control Module.
16. Isolation transformer is too small.
17. Isolation transformer is needed.
18. Exciter fields are not isolated from other circuits.
19. Input and field circuit are being fed by a common cable or conduit.
20. Incorrect hookup or wiring.
21. Poor brush contact to commutator or sliprings.
22. Damaged, pitted, or grooved slip ring surface.
23. Current transformer has reversed polarity or is not shorted during non parallel operation.
24. Input to regulator is from an auxiliary winding and not the generator main stator.



## Bench Check Procedures

1. Wire the SE2000B-3P Series as shown in the figure below.
2. Connect two 120 volt 50 to 150 watt light bulbs in series to the F+ and F- Terminals.
3. Install a switched 24vdc power source to terminals G+ and G- on the VRMSE-3P Control Module.
4. Turn the internal voltage adjustment on the VRMSE-3P Control Module fully Counter-Clockwise (Left) before beginning the testing procedures below.
5. Input 208-240VAC, 3 $\phi$  fused at no more than 5A into the SE2000B-3P Series and input 120VAC 3 $\phi$  into terminals A, B, and C and install a temporary jumper on terminals X and Y on the VRMSE-3P Control Module. **The test light should be OFF.**
6. Turn on the 24vdc power source to terminals G+ and G- on the VRMSE-3P Control Module. **The test light should be OFF.**
7. Slowly turn the internal voltage adjustment on the VRMSE-3P Control Module (Right) until the lights glow. **The test light should light to FULL Brightness. NOTE: It may take several turns of the adjustment screw before the lights illuminate!**
8. Slowly turn the internal voltage adjustment of the VRMSE-3P Control Module Counter-Clockwise (Left) until the lights go dark. **The test light should be OFF. NOTE: It may take several turns of the adjustment screw before the lights go dark!**
9. Turn off power and disconnect the SE2000B-3P Series from your power sources. Inspect all electronic components on the SE2000B-3P Series to ensure they are isolated from touching any part of the housing or chassis.
10. If you were able to successfully perform all of these tests, the SE2000B-3P Series is good.



### Fuse Replacement Information:

#### SE2000B-3P SERIES:

Rating: 200A @ 600VAC

Qty: 3

PTI Part # 5CF-808

Cooper-Bussman Part # JJS-200

#### VRMSE-3P Control Module:

Rating: 5A @ 600VAC/DC

Qty: 3

PTI Part # 5R3-795

Bel Part # 0ADAC5000-BE



## Installation Warranty Form

It is very important that you fill out this form completely when installing a voltage regulator.

This form serves as a history record on the application. This form also contains the information needed by Power-Tronics, Inc., for repair and troubleshooting of any product you may be having problems with.

**Failure to fill out this form during installation will result in a cancellation of your warranty coverage! Filling out this form takes only minutes but will save hours or days later on if your product should require service!**

Product Model:	Additional Module(s) or Options:
Serial #:	
Date of Installation:	
<b><u>This Section for Brushless Generators Only</u></b>	
Exciter Field Voltage:	Exciter Field Resistance:
<b><u>This Section for Brush-Type Generators Only</u></b>	
Shunt-Field Voltage:	Shunt-Field Resistance:
Rotor Resistance @ Brush Leads:	Rotor Resistance on Slip-Rings:
Rotor Excitation Voltage:	
<b><u>Generator Wiring/Usage Information</u></b>	
Generator Leads (Check One:) <input type="checkbox"/> 12 <input type="checkbox"/> 10 <input type="checkbox"/> 6 <input type="checkbox"/> 4 (3ø) <input type="checkbox"/> 4 (1ø) <input type="checkbox"/> 3	
Generator Wiring Mode (Check One:) <input type="checkbox"/> High-Wye <input type="checkbox"/> Low-Wye <input type="checkbox"/> Series Delta	
<input type="checkbox"/> Zig-Zag <input type="checkbox"/> Double-Delta <input type="checkbox"/> Single-Phase <input type="checkbox"/> Other	
Terminal Voltage:	Residual AC Voltage:
Rated KW:	Rated KVA:
Primary Load (Please Explain):	
<b><u>Repair/Warranty Request Information</u></b>	
Company Name:	
Contact Person:	
Telephone Number:	
Email Address:	
Ship-To Address (City, State, Zip, Country):	
Problem Description/History (Please be detailed!!!):	



## **PRODUCT WARRANTY**

**Power-Tronics, Inc.**, assumes no liability for damages due to incorrect voltage or other voltage related damages resulting from either output of the generator or input to the generator exciter system. These problems should be protected with external devices provided by the customer such as ***fuses, surge suppressors, over/under voltage and frequency controls.***

**Power-Tronics, Inc.**, warranties **only parts and workmanship** of this product for a **period of 3 years from the original date of purchase from Power-Tronics, Inc.** Under warranty, Power-Tronics, Inc. will replace, exchange or repair the defective product **without labor or parts cost to the customer.** Remaining warranty of the original product will be transferred to the replaced or repaired product. To obtain warranty, a copy of the original Installation Warranty Form must be sent in with the defective product, which clearly shows the purchase date and serial number of the defective part. A repair request form must be sent in with the product before repairs will begin. You can obtain this form by contacting Power-Tronics, Inc.

**Send repairs to: Power-Tronics, Inc., 2802 Cobbler Ln., Kerrville Texas USA 78028.**

***Send in repairs only by UPS or FedEx. USPS will NOT deliver to our facility!***

**Any one of the following conditions will void the warranty:**

- ❖ Overheating of the power supply resistor on the printed circuit card.
- ❖ Overheating of the SCR or freewheeling diode.
- ❖ Physical damage to the printed circuit card, housing or components.
- ❖ Unauthorized repair or alteration of printed circuit card.
- ❖ Installation by anyone other than a qualified professional generator service technician.
- ❖ Conductive or corrosive contamination of the circuit card.
- ❖ Removal of our company identification from the product.
- ❖ Removal of any conformal coating of the printed circuit card or components.
- ❖ Overheating of foil on the printed circuit card.
- ❖ Inappropriate or infeasible application.
- ❖ Use with any external device other than manufactured by Power-Tronics, Inc.
- ❖ Failure to fill out the attached warranty card during installation

**No other warranty is expressed or implied.**