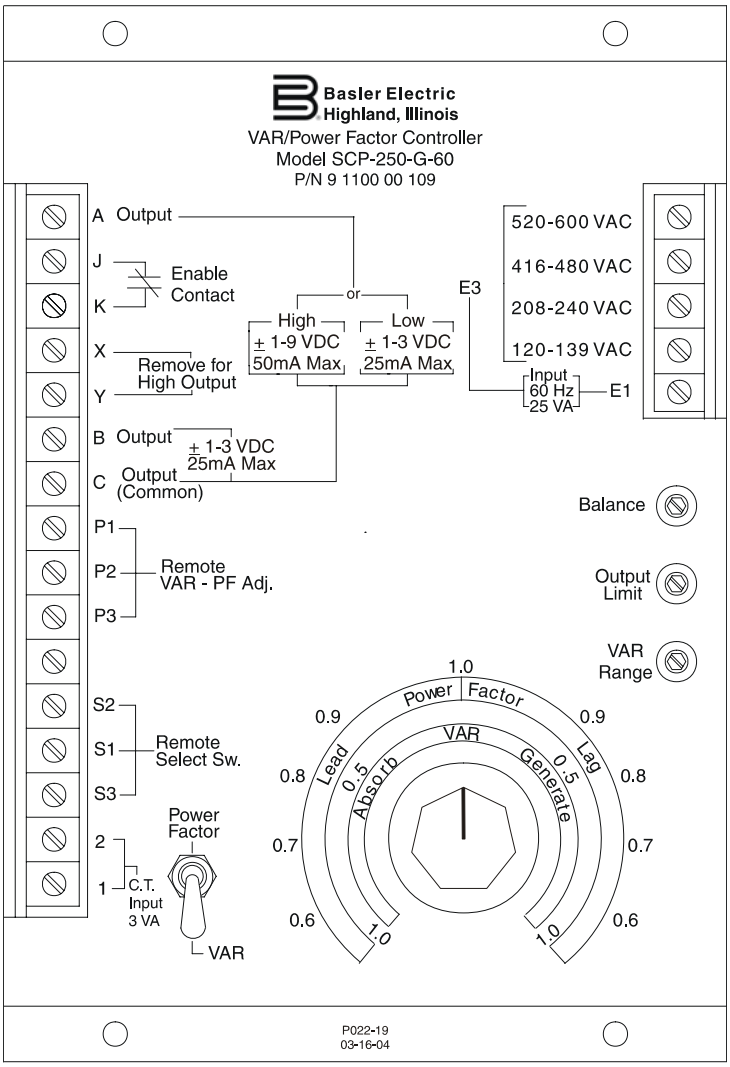
INSTRUCTION MANUAL

FOR

VAR/POWER FACTOR CONTROLLER

SCP 250



Basler Electric

Publication: 9 1100 00 99Y
Revision: T 01/08

INTRODUCTION

This instruction manual provides information about the operation and installation of the SCP 250 Var/Power Factor Controller. To accomplish this, the following information is provided.

- General Information and Specifications
- Control Descriptions
- Functional Description
- Installation Drawings
- Operating Procedures

WARNING!

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures in this manual.

CAUTION

The use of high potential test equipment will damage SCP 250 circuitry.

First Printing: November 1984

Printed in USA

January 2008

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric.

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SECTION 1 • GENERAL INFORMATION

INTRODUCTION

The SCP 250 controls generator (SCP 250-G) or motor (SCP 250-M) power factor or vars by monitoring the voltage and current and supplying a control input to a voltage regulator.

When the SCP 250 is controlling vars, the voltage regulator (or static exciter) output changes to attain the selected reactive load current.

When the SCP 250 is controlling power factor, the voltage regulator adjusts the excitation until the selected power factor is obtained.

The SCP 250 monitors the open/closed state of the circuit breaker so that the voltage regulator controls excitation when the breaker is open and the SCP 250 controls excitation when the breaker is closed.

A voltage limiting feature in the SCP 250 prevents the voltage regulator from supplying full or no excitation if utility power is lost and the peaking generator main breaker remains closed. Voltage limiting is adjustable between ±10% and ±30%.

Because the SCP 250 is designed for behind-the-panel mounting, provisions are included for locating the Var/PF switch and potentiometer remotely.

FEATURES

SCP 250 Var/Power Factor Controllers have the following features.

- Suitable for use in generator or synchronous motor applications
- Provide system control over a wide range of loading conditions
- Accommodate standard voltage sensing inputs
- Front panel selection of either var or power factor control
- Do not require use of motor operated control
- Specifically designed to operate with the standard Basler SR , KR, selected AVCs, SSR regulator series, and SSE static exciter-regulators
- During power factor control, reactive load changes automatically when kW load is changed
- Easily calibrated on site
- UL recognized and CSA certified

APPLICATION

The SCP 250 is suitable for use in generator peaking and synchronous motor applications.

Generator Peaking Application (SCP 250-G)

In peaking generator applications, the paralleling circuit of a voltage regulator presents large changes in reactive current when the bus voltage changes by a relatively small amount. However, the regulator's ability to compensate for large changes in bus voltage can be exceeded. Two examples illustrate typical problem areas.

> *Example 1.* A generator equipped with a voltage regulator adjusted for 4% droop can have a variation in var load from zero to 100% with a 4% decrease in bus voltage. Further decreases in bus voltage would overload the generator.
>
> *Example 2.* An increase in bus voltage can cause leading power factor conditions with the associated danger of the machine pulling out of synchronization.

To minimize the possibility of either example occurring, the SCP 250 is used and adjusted for operation in a "safe" region with either a regulated "fixed" var level or a "fixed" power factor. Thus, for a large change in reactive current due to bus voltage changes, the operating generator is unaffected.

Synchronous Motor Application (SCP 250-M)

In synchronous motor applications, the SCP 250 allows the desired operating power factor to be pre-programmed so that the motor power factor remains constant during normal loading conditions. During transient loading conditions, the SCP 250 makes corrective motor field excitation adjustments through a regulator or exciter-regulator and thereby minimizes the possibility of synchronous pullout.

CAUTION

The SCP 250 should not be put into operation until after the motor is up to rated speed and the field is excited.

Isolated Bus Applications

The SCP 250 is not intended for use on isolated bus systems (systems providing power independent of a larger power source, such as a utility). In an isolated bus system using precise voltage regulators with parallel compensation, the var load is automatically divided between the generators by the regulator and its associated paralleling circuit.

PART NUMBERS

Table 1-1 lists the model numbers, part numbers, and application information for standard-order SCP 250 controllers.

Table 1-1. SCP 250 Part Numbers

Model Number	Part Number	Application
SCP 250-G-60	9 1100 00 109	60 Hz generators
SCP 250-G-50	9 1100 00 110	50 Hz generators
SCP 250-M-60	9 1100 00 111	60 Hz motors
SCP 250-M-50	9 1100 00 112	50 Hz motors

SPECIFICATIONS

SCP 250 electrical and physical specifications are listed in the following paragraphs.

Voltage Sensing and Input Power

60 Hz Voltage Range: 120 to 139 Vac, 208 to 240 Vac, 416 to 480 Vac, 520 to 600 Vac, ±10%
50 Hz Voltage Range: 100 to 120 Vac, 190 to 208 Vac, 380 to 415 Vac, 440 to 500 Vac, ±10%
Configuration: Single-phase
Common Terminal: E1

Current Sensing

Nominal Rating: 3 to 5 Aac
15 Second Rating: 30 Aac
Configuration: Single-phase
Burden: 3 VA
Terminals: 1, 2

Output Signal

Low Range: ±1 to ±3 Vdc (jumper installed at terminals X and Y)
High Range: ±1 to ±9 Vdc (jumper removed)
Terminals: A, B, C

Enable Contact

Rating: 60 Vac, 39 mA
Terminals: J, K

Control Accuracy

Power Factor: Reactive component of current is proportional to real component within ±5% of maximum rated current.
Vars: Reactive component of current maintained at programmed level within ±5% of maximum rated current.

Type Tests

Vibration:	2 G in each of three mutually perpendicular planes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes per sweep
Shock:	Withstands up to 15 G in each of three mutually perpendicular planes

UL Recognition

Recognized per standard 508, UL file E75380

GOST R Certification

Gost R certified No. POCC US.ME05.B03392; is in compliance with relevant standards of Gosstandart of Russia. Issued by accredited certification body POCC RU.0001.11ME05.

Operating Temperature

Range:	–40 to 70°C (–40 to 158°F)

Weight

Net:	6.75 lb (3.06 kg)
Shipping:	8.0 lb (3.63 kg)

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SECTION 2 • CONTROLS

CONTROLS ILLUSTRATION AND DESCRIPTION

SCP 250 controls are shown in Figure 2-1 and described in Table 2-1.

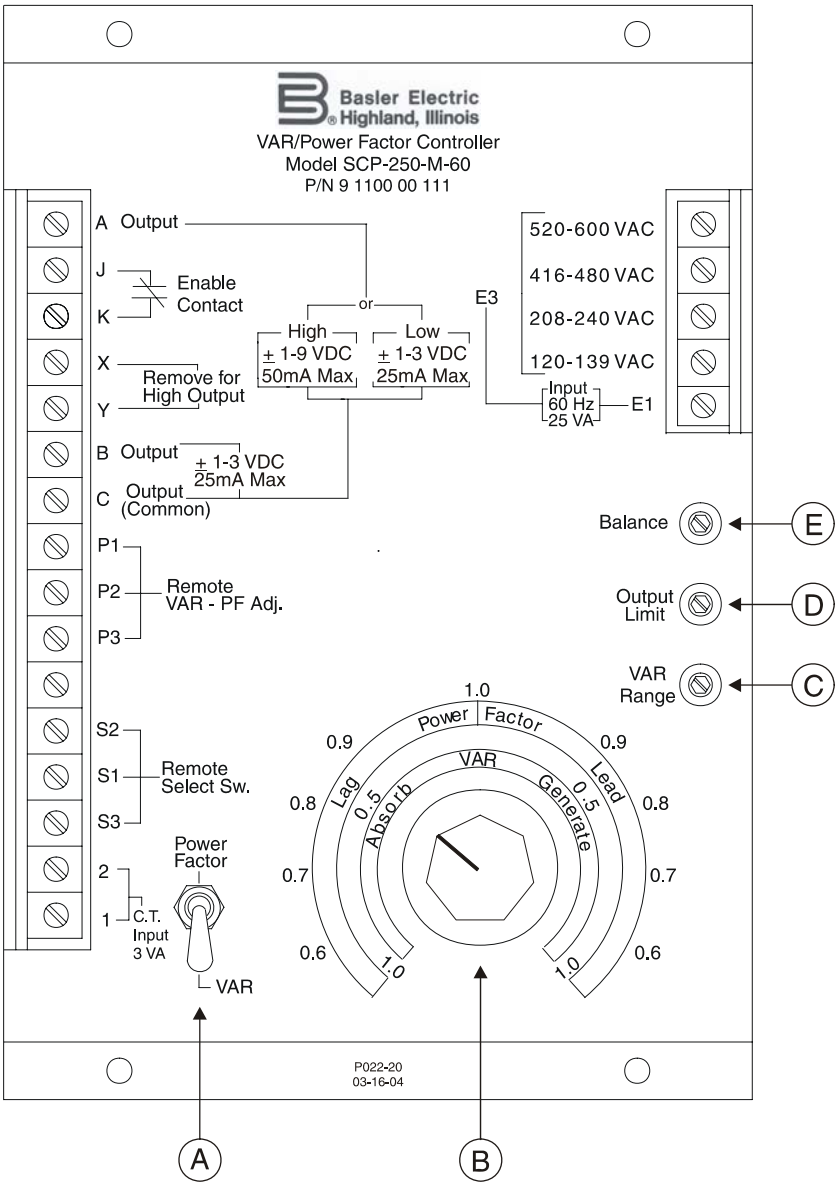


Figure 2-1. SCP 250 Controls

Table 2-1. Description of SCP 250 Controls

Locator	Control Description
A	*Mode Switch.* This switch selects between var and power factor control. When the mode switch is in the VAR position, the desired reactive power level is established with the Var/Power Factor Adjust control. The var level is then held constant and will not vary if changes in watt load occur. When the mode switch is in the Power Factor position, the desired power factor is established using the Var/Power Factor Adjust control. The power factor is held constant even if watt load varies.

Locator	Control Description
B	*Var/Power Factor Adjust Control.* This control is used to establish the var level or power factor, depending on the position of the mode switch. The control has two sets of calibration marks—one set for var control and one set for power factor control. The power factor calibration marks shown in Figure 2-1 are for an SCP 250-M and will differ from the power factor calibration marks on an SCP 250-G.
C	*VAR Range Control.* This single-turn potentiometer calibrates the SCP 250 when the mode switch is the VAR position. Var calibration is described in Section 5, *Operation*.
D	*Output Limit Control.* This single-turn potentiometer adjusts the control output of the SCP 250. The output is adjustable from approximately ±1 Vdc (fully counterclockwise) to approximately ±3 Vdc (fully clockwise) or ±9 Vdc (jumper removed from terminals X and Y). This causes a corresponding change in generator output voltage of about ±10% to ±30% when the generator is isolated from the bus.
E	*Balance Control.* This single-turn potentiometer is ordinarily set at its midrange position. It can be adjusted to attain extra precision in the maintenance of power factor in peaking service over a wide range of kW loading. Use of the balance control is described in Section 5, *Operation*.

SECTION 3 • FUNCTIONAL DESCRIPTION

INTRODUCTION

SCP 250 functions are illustrated in Figure 3-1 and described in the following paragraphs.

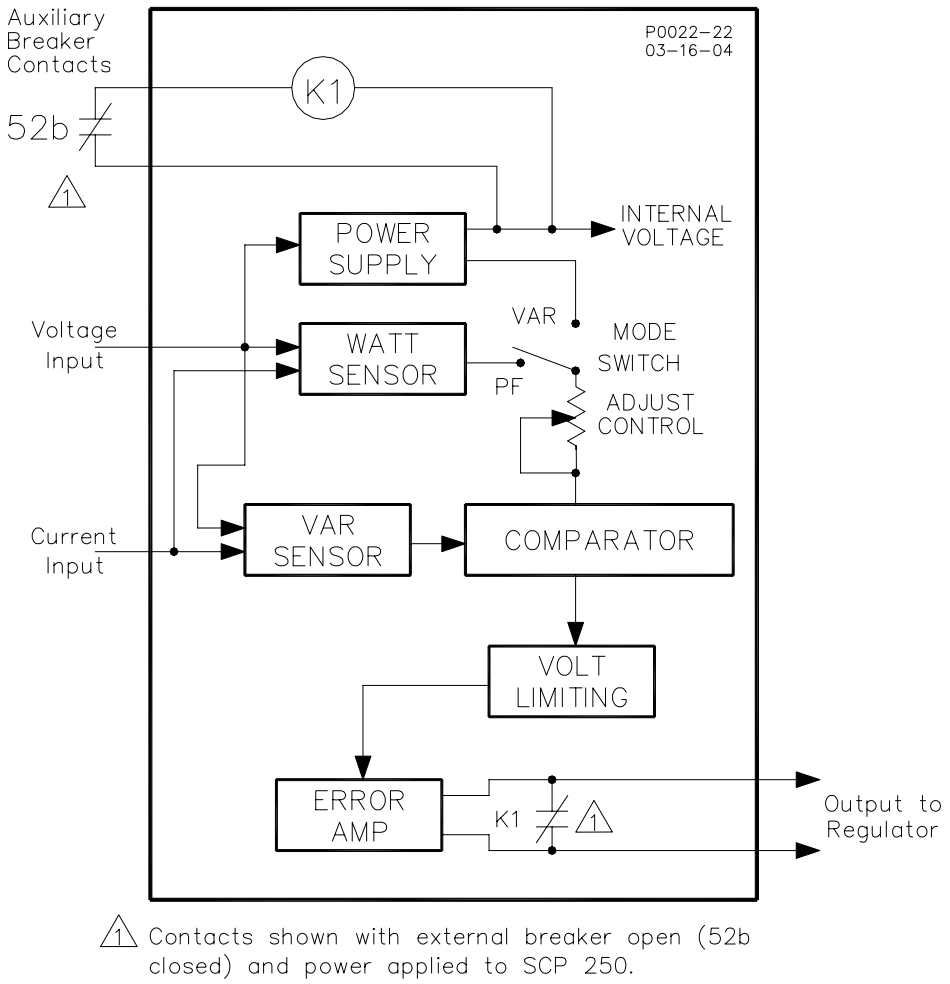


Figure 3-1. SCP 250 Function Block Diagram

INPUTS

The SCP 250 has two inputs: a voltage input and a current input. The SCP 250 measures the real and reactive power based on these two inputs. The voltage input also supplies operating power to the SCP 250 power supply.

COMPARATOR AND ERROR AMPLIFIER

When var control is selected, the reactive component is compared to an adjustable dc reference and the error signal from this comparison is amplified and supplied to the voltage regulator. As a result, the voltage regulator (or static exciter regulator) changes its output until the programmed reactive load current is attained.

When power factor control is selected, the reactive component is compared with an adjustable sample of the real power component, which serves as a reference. The error signal from this comparison is amplified and supplied to the voltage regulator. The regulator responds by changing the excitation until the selected power factor is attained.

VOLTAGE LIMITING

The SCP 250 voltage limiter prevents the voltage regulator from supplying full or no excitation if utility power is lost and the generator main breaker remains closed. Voltage limiting is adjustable between ±10% and ±30%.

CONTROL RELAY

The control relay (K1) enables and disables the SCP 250 output and is controlled by the Enable Contact input (terminals J and K). The Enable Contact input is typically interconnected with external breaker auxiliary contacts (52b).

When the external breaker is open (52b contacts closed), K1 energizes and its contacts short-circuit the SCP 250 output terminals together. This disables the SCP 250 output and gives the voltage regulator total control of generator excitation.

When the external breaker is closed (52b contacts open), K1 de-energizes and enables the SCP 250 output. The SCP 250 control output is applied to the voltage regulator and the SCP 250 assumes a major portion of excitation control.

SECTION 4 • INSTALLATION

GENERAL

Upon receipt of an SCP 250, check the part number against the requisition and packing list for agreement. Inspect for damage, and if there is evidence of such, file a claim with the carrier and notify the Basler Electric regional sales office, your sales representative, or a sales representative at Basler Electric, Highland, Illinois.

MOUNTING

The SCP 250 is intended for back-of-the-panel mounting in any plane. It should not be installed in a location where ambient operating temperature exceeds the range of –40 to 70°C (–40 to 158°F).

SCP 250 dimensions are shown in Figure 4-1. All terminal screws are 6-32 on 0.375 inch (9.5 millimeter) centers. Drawing dimensions are shown in inches with millimeters in parenthesis.

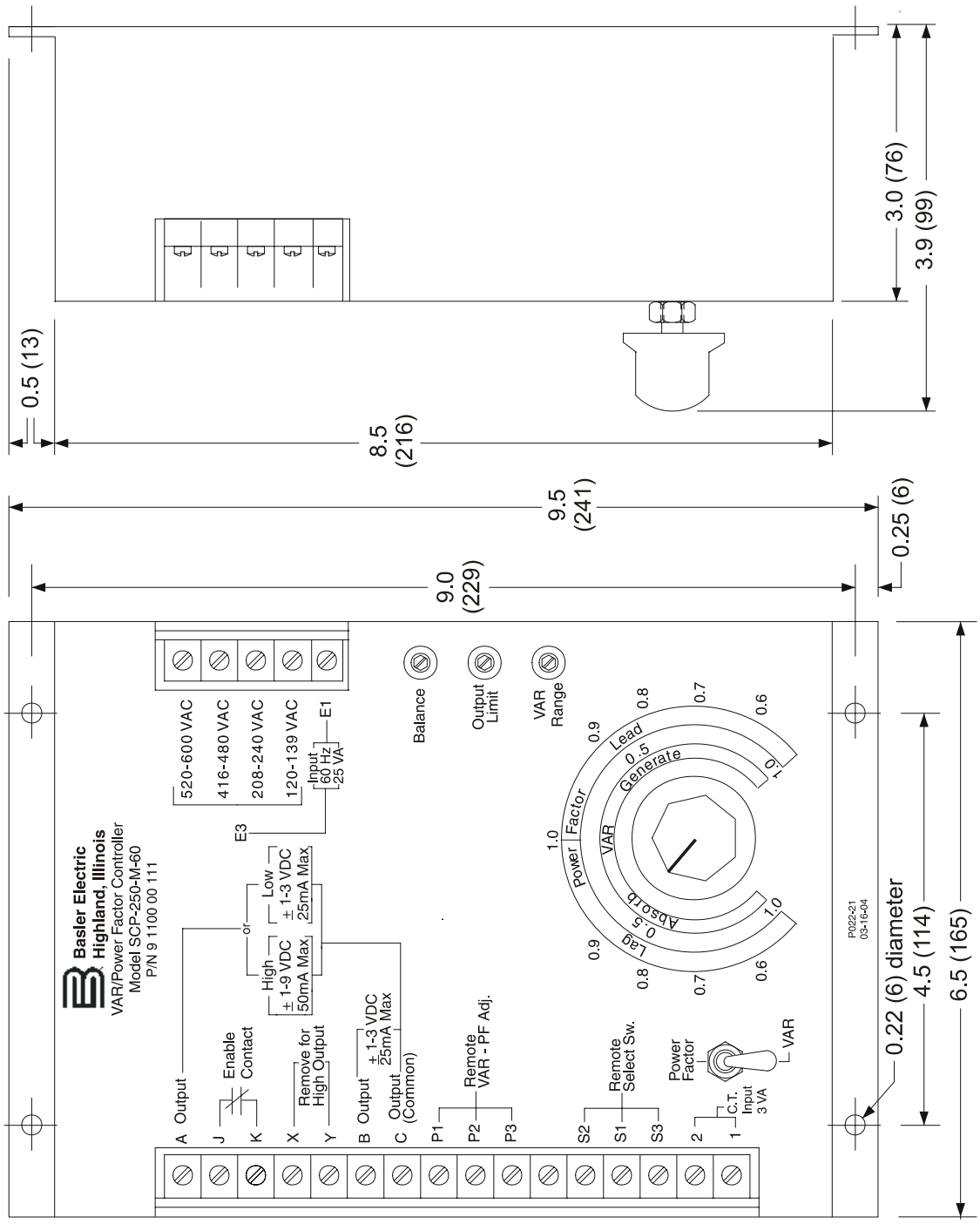


Figure 4-1. SCP 250 Outline and Drilling Dimensions

CONNECTIONS

SCP 250 connections will vary according to the application (generator or motor) and the type of voltage regulator used.

The secondary voltage of the potential transformer used in an application determines which SCP 250 power connections are used. Input power (operating power and sensing voltage) is applied to terminal E1 and one of the following terminals: 120-139 Vac, 208-240 Vac, 416-480 Vac, or 520-600 Vac.

CAUTION

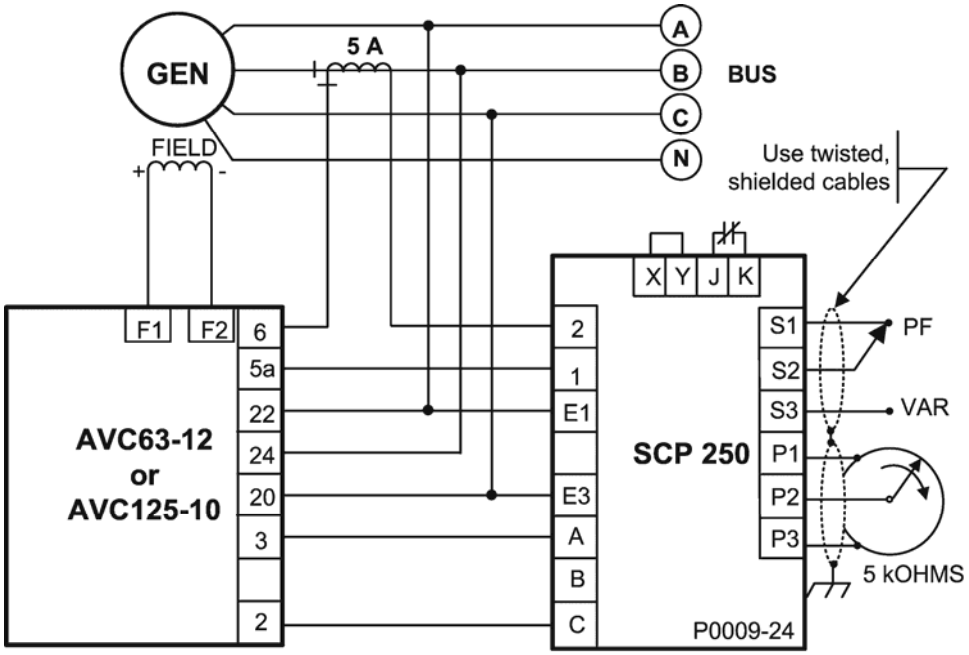
The use of high potential test equipment will damage SCP 250 circuitry.

Interconnection Diagrams

The SCP 250 should be connected using the appropriate interconnection diagram. Table 4-1 lists the interconnection diagrams for common applications using the SCP 250 and other Basler control devices.

Table 4-1. SCP 250 Interconnection Diagrams

Application	Diagram
AVC63-12/AVC125-10 voltage regulator and SCP 250-G	Figure 4-2
KR-F/KR-FF voltage regulator and SCP 250-G	Figure 4-3
KR-F/KR-FF voltage regulator and SCP 250-M	Figure 4-4
MVC 236 manual voltage control, RA-70P reference adjuster, and SCP 250-M	Figure 4-5
SR-A voltage regulator and SCP 250-G	Figure 4-6
SR-A voltage regulator and SCP 250-M	Figure 4-7
SR-E/SR-F/SR-H voltage regulator and SCP 250-G	Figure 4-8
SR-E/SR-F/SR-H voltage regulator and SCP 250-M	Figure 4-9
SSE control chassis and SCP 250-G	Figure 4-10
SSE control chassis and SCP 250-M	Figure 4-11
SSR voltage regulator and SCP 250-G	Figure 4-12
XR2001/XR2001F voltage regulator and SCP 250-G	Figure 4-13
XR2001/XR2001F voltage regulator, SCP 250-G, and three-phase sensing module	Figure 4-14
XR2002/XR2002F voltage regulator and SCP 250-G	Figure 4-15
XR2003/XR2003F voltage regulator and SCP 250-G	Figure 4-16



1. ABC rotation shown.
2. Connect voltage input to proper tap to Match generator output voltage.

Figure 4-2. AVC63-12/AVC125-10 and SCP 250-G Connections

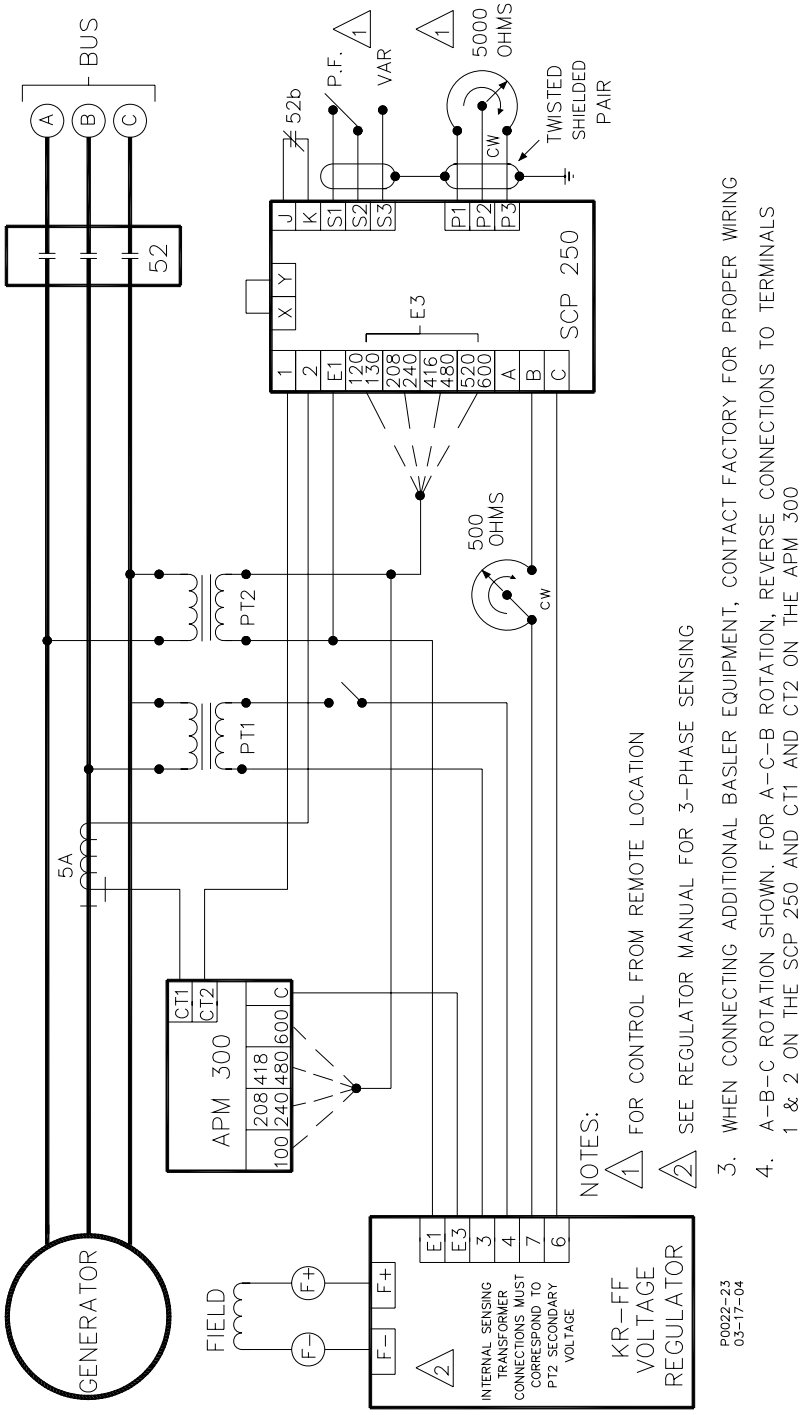


Figure 4-3. KR-F/KR-FF and SCP 250-G Connections

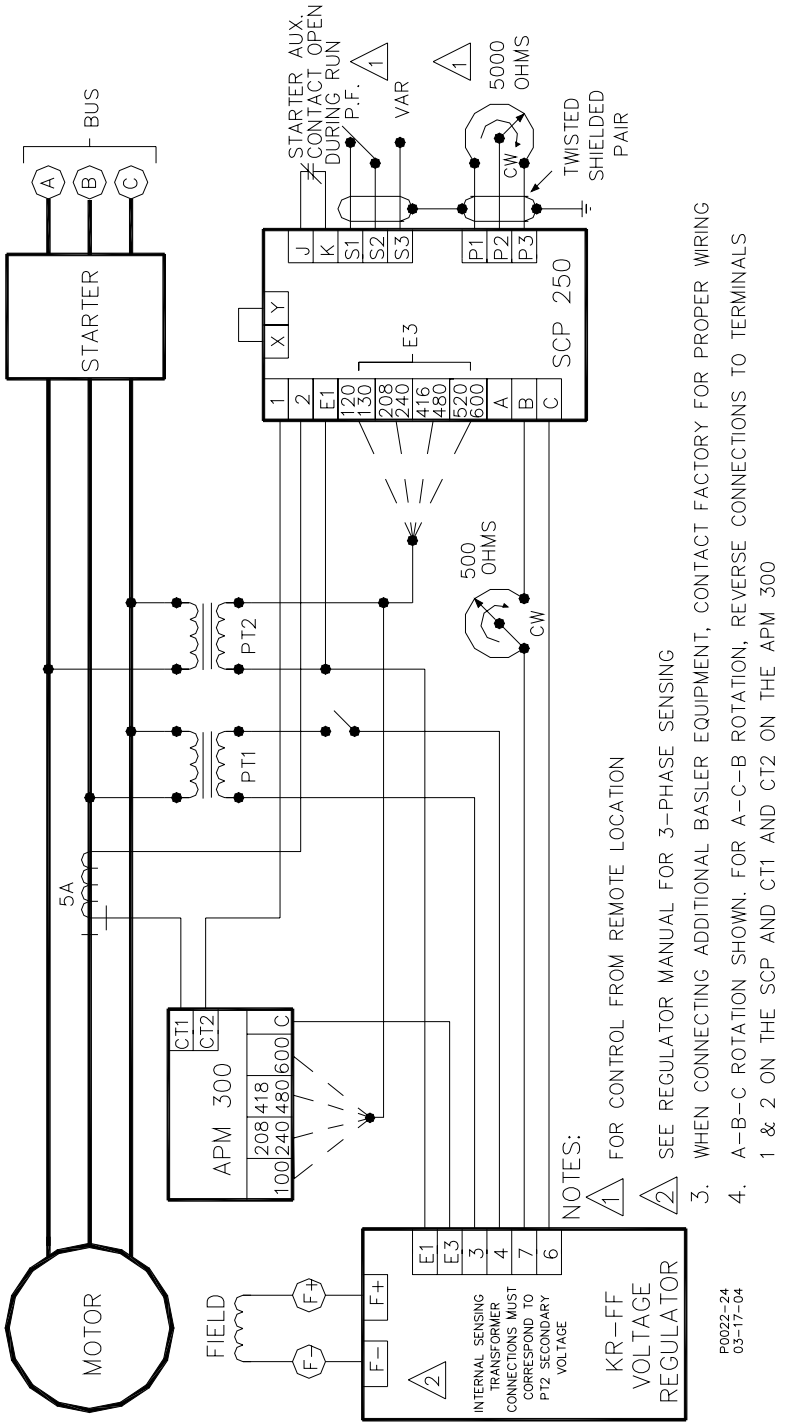


Figure 4-4. KR-F/KR-FF and SCP 250-M Connections

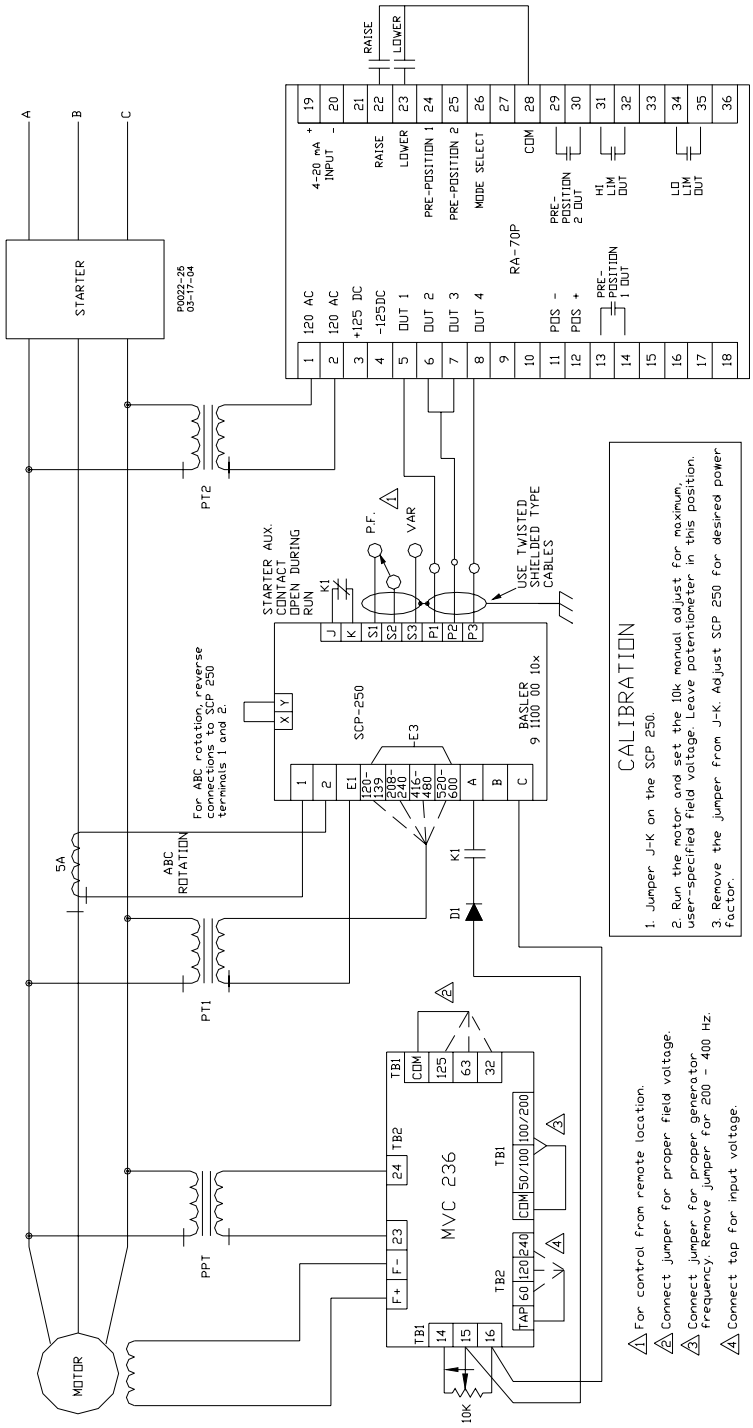


Figure 4-5. MVC 236, RA-70, and SCP 250-M Connections

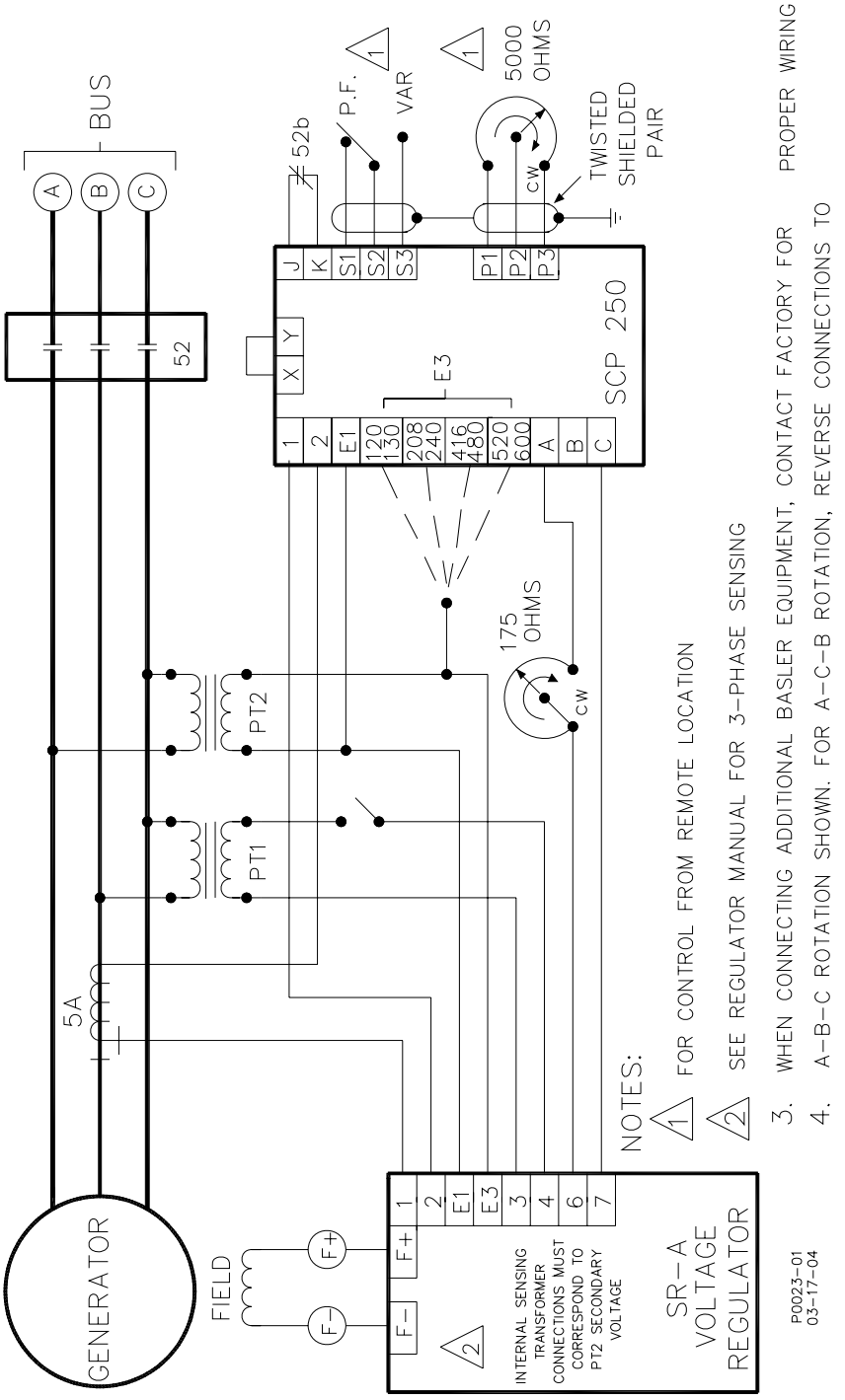


Figure 4-6. SR-A and SCP 250-G Connections

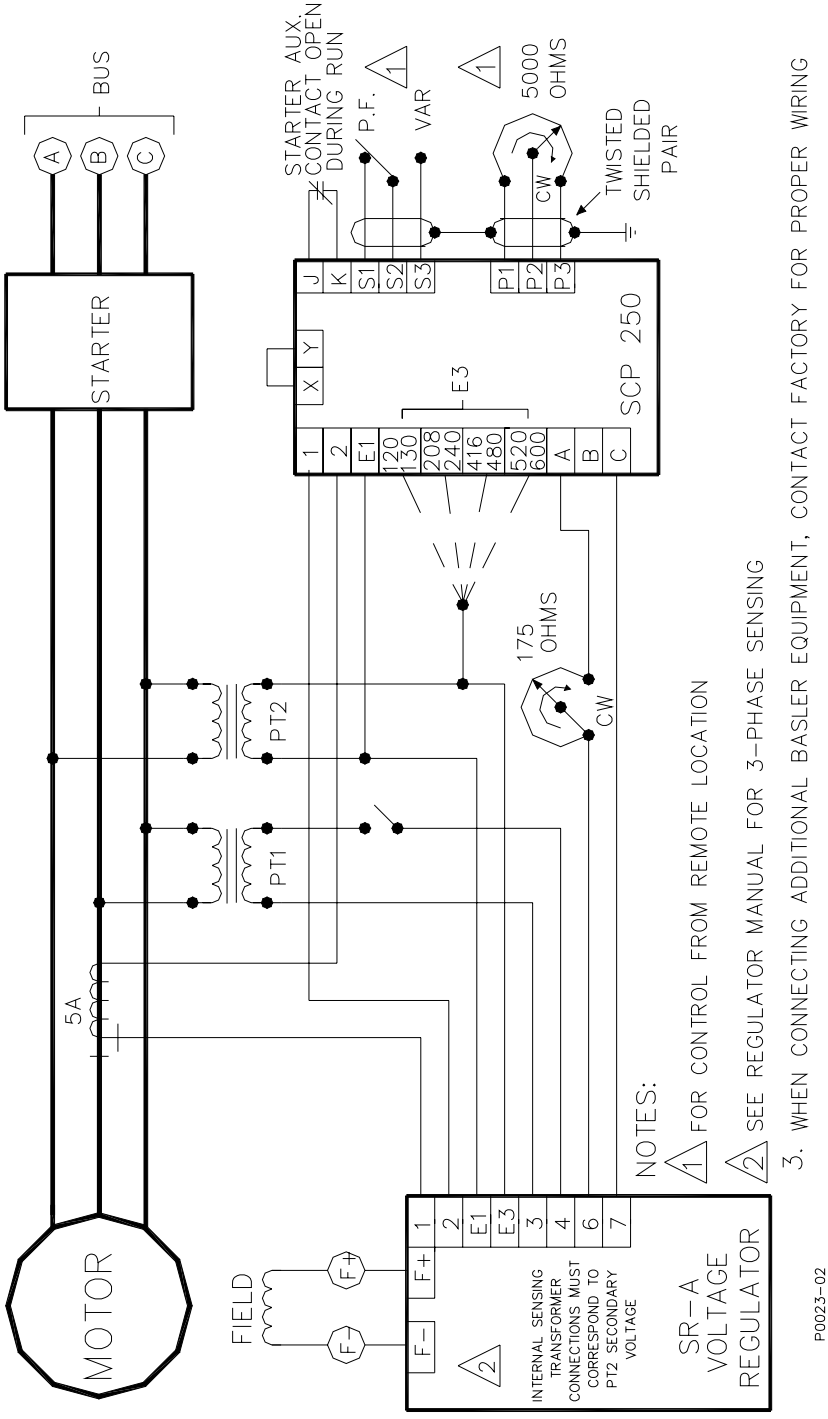


Figure 4-7. SR-A and SCP 250-M Connections

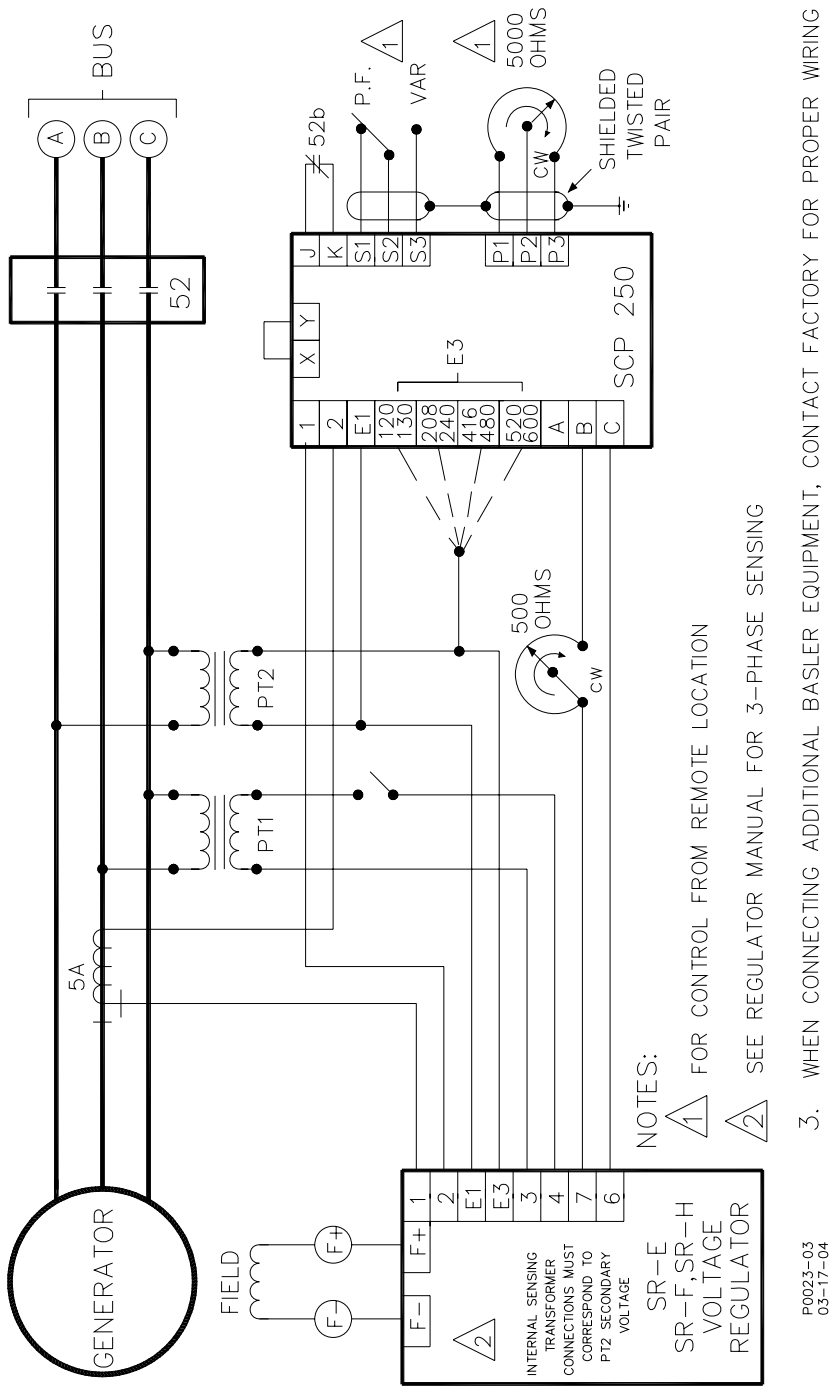


Figure 4-8. SR-E/SR-F/SR-H and SCP 250-G Connections

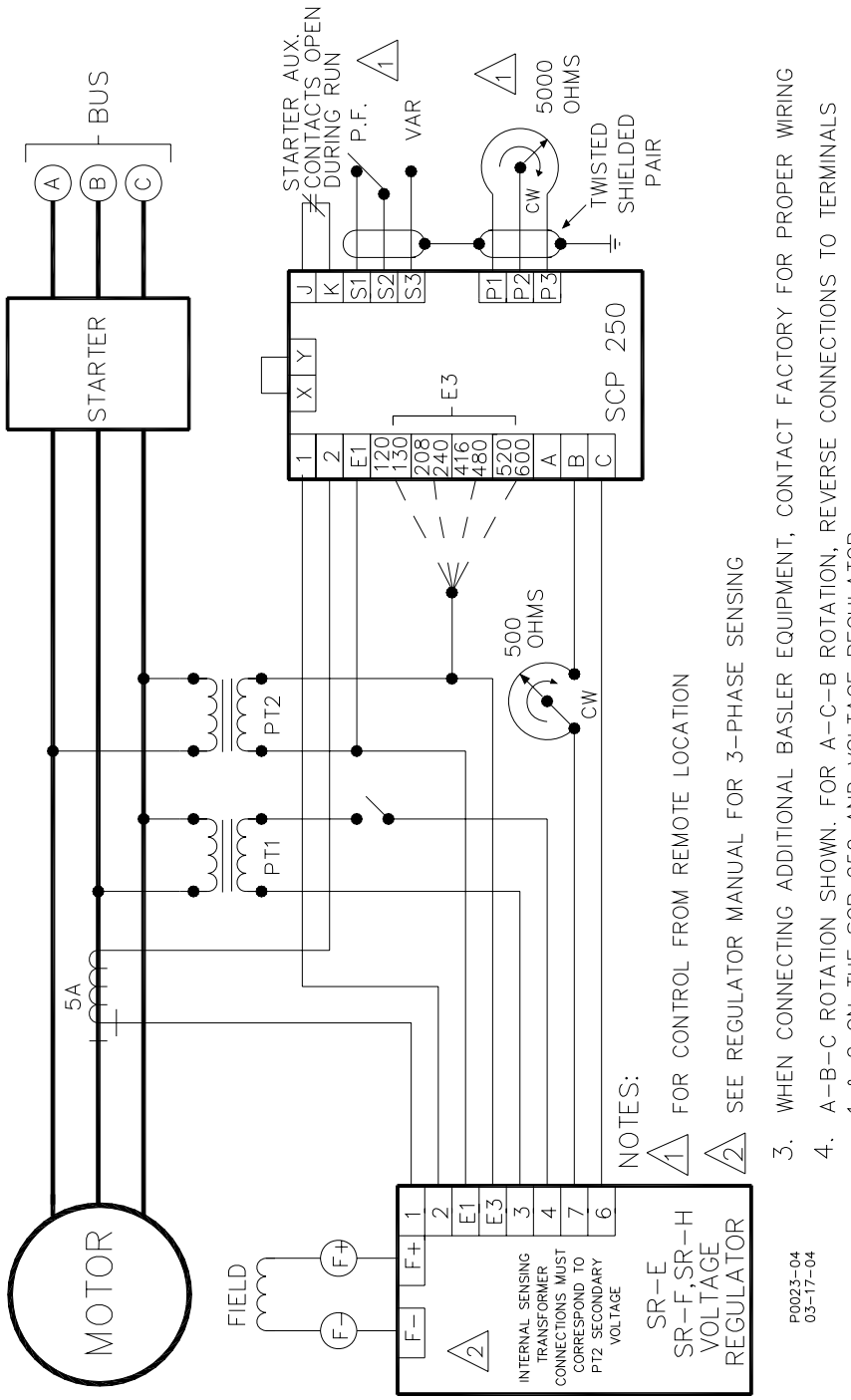


Figure 4-9. SR-E/SR-F/SR-H and SCP 250-M Connections

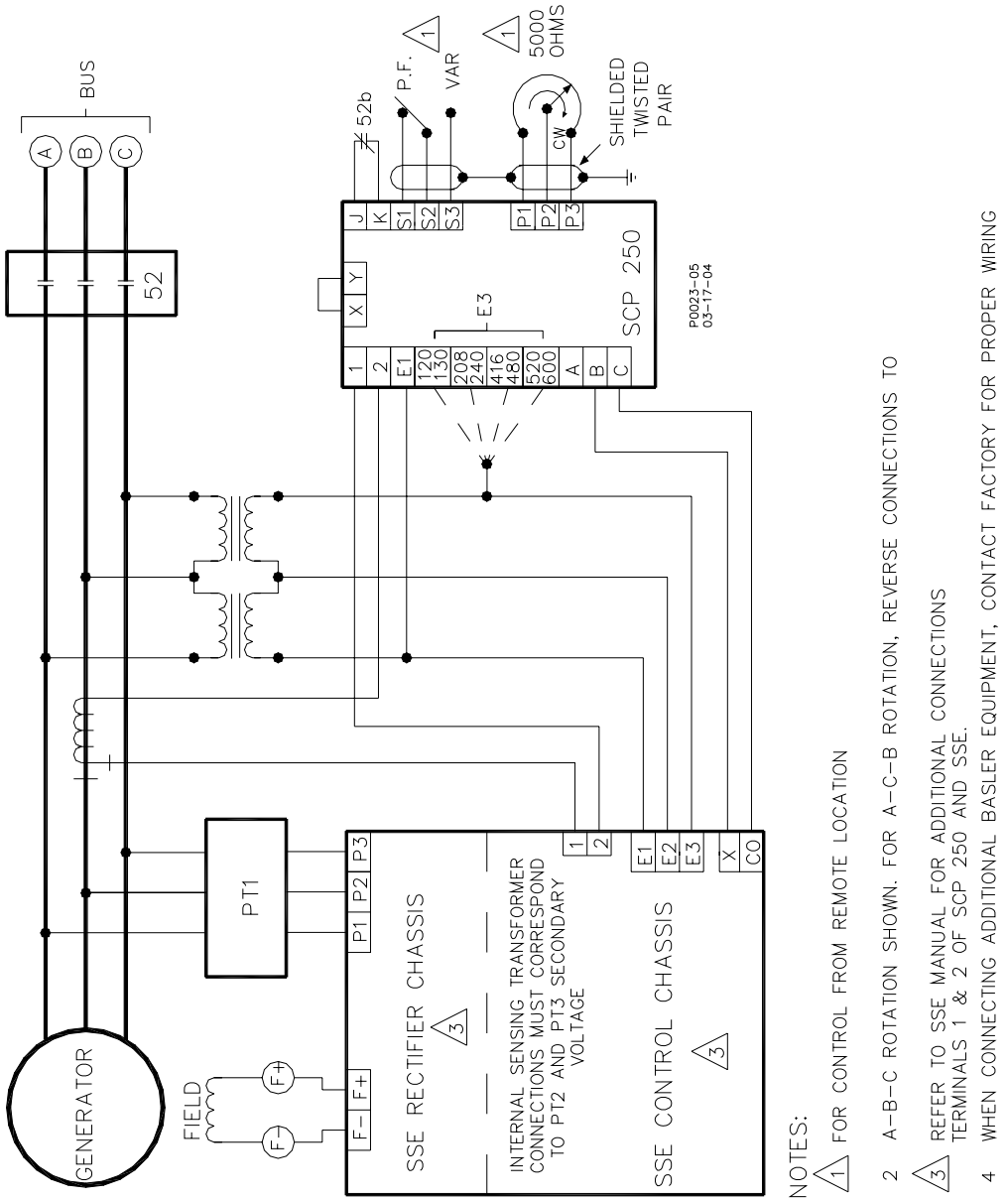


Figure 4-10. SSE and SCP 250-G Connections

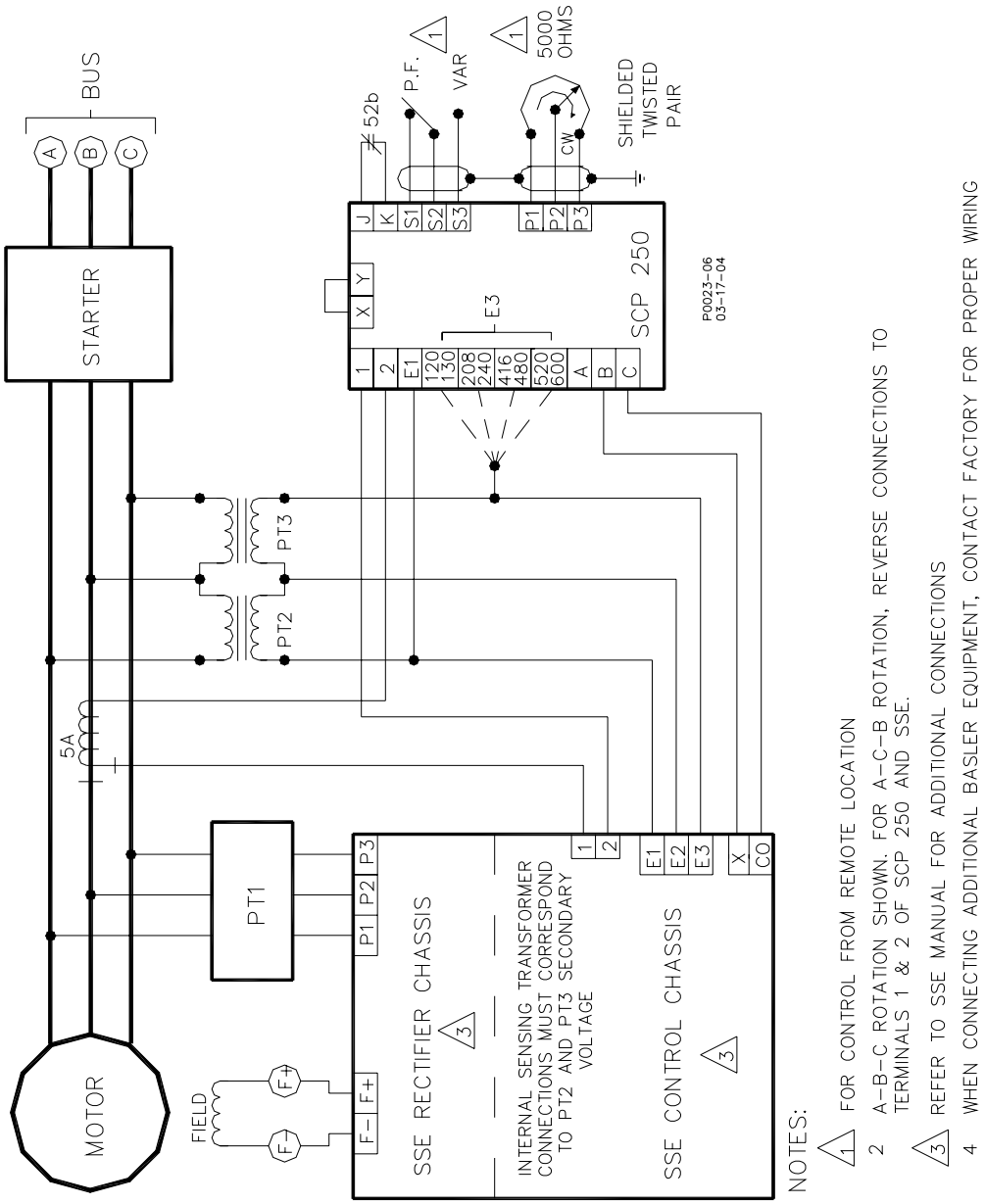


Figure 4-11. SSE and SCP 250-M Connections

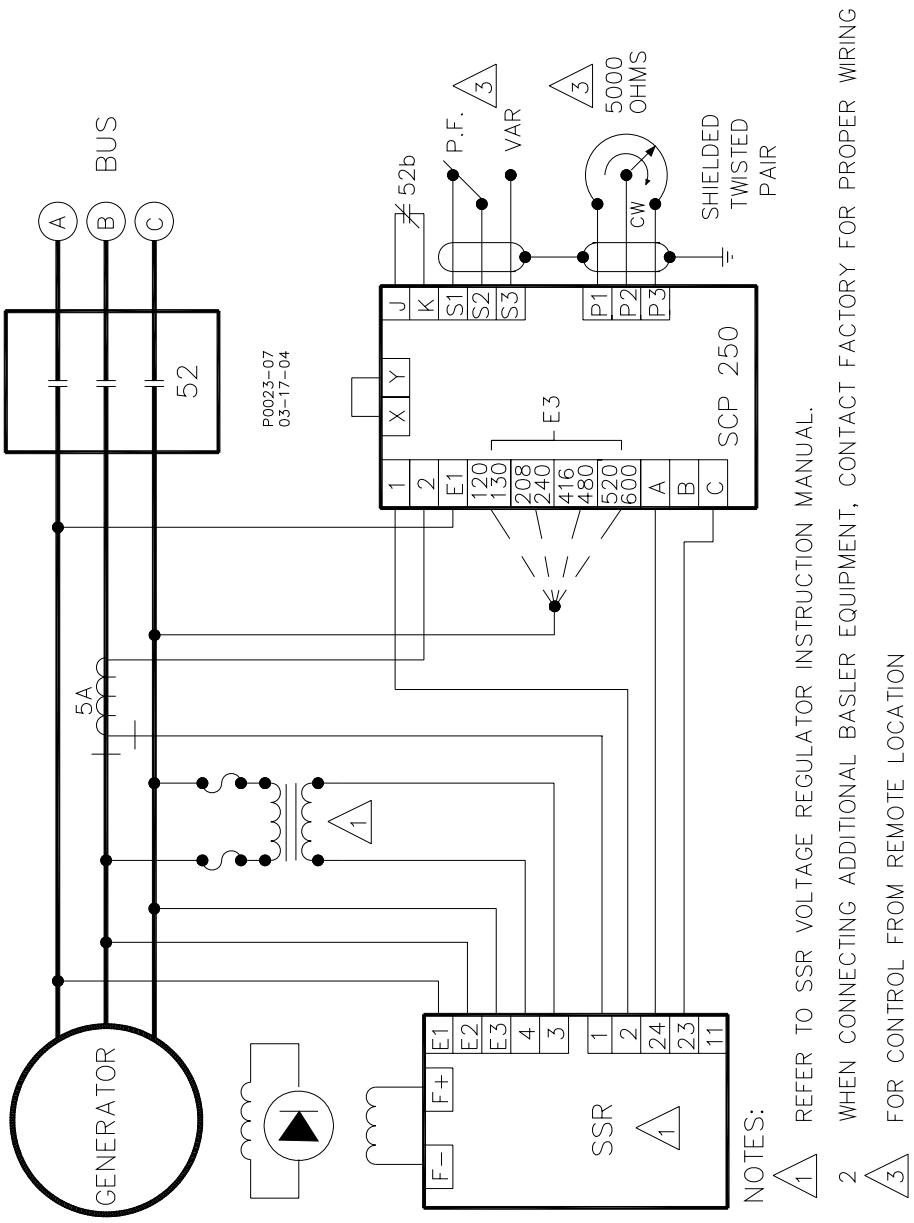


Figure 4-12. SSR and SCP 250-G Connections

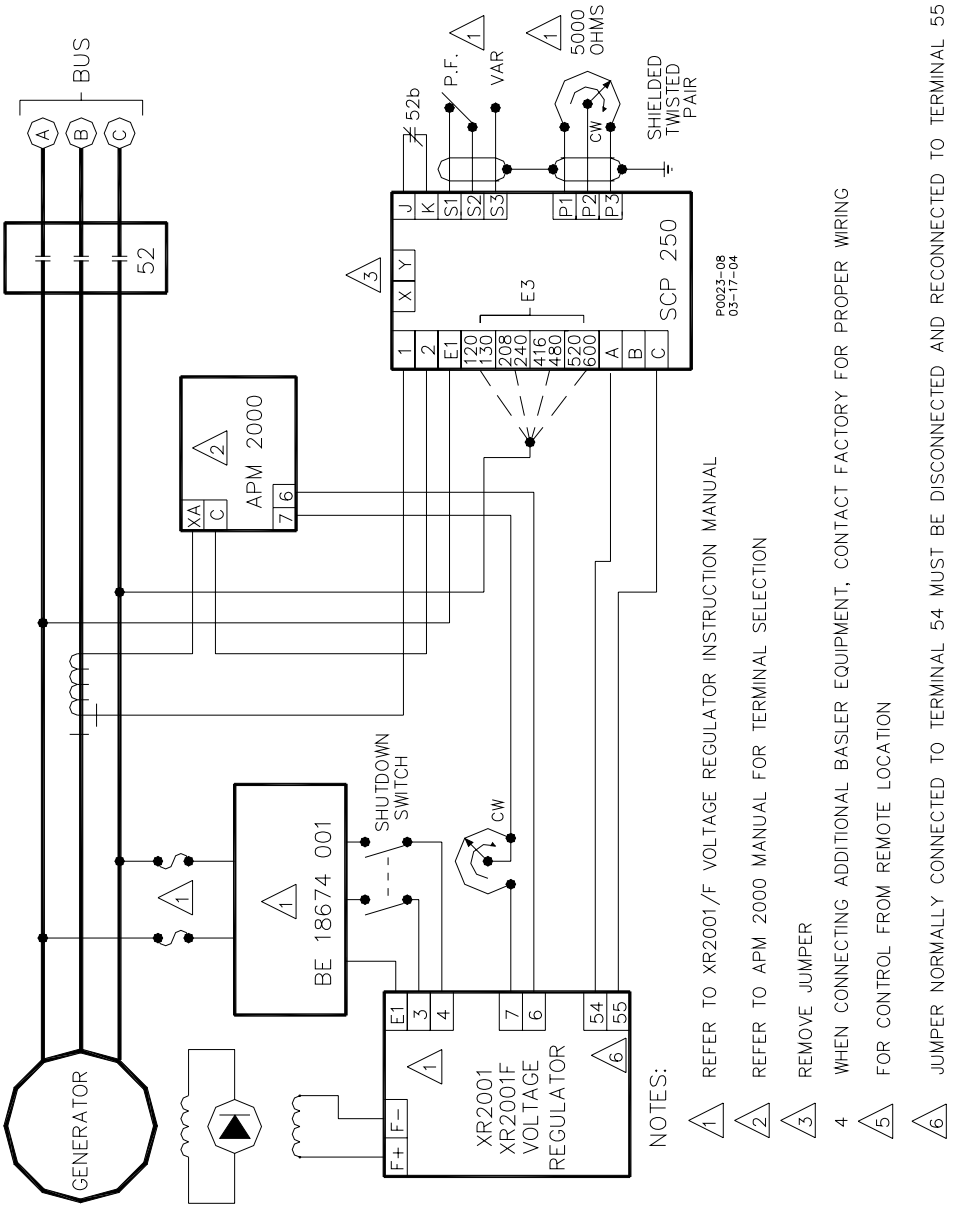


Figure 4-13. XR2001/XR2001F and SCP 250-G Connections

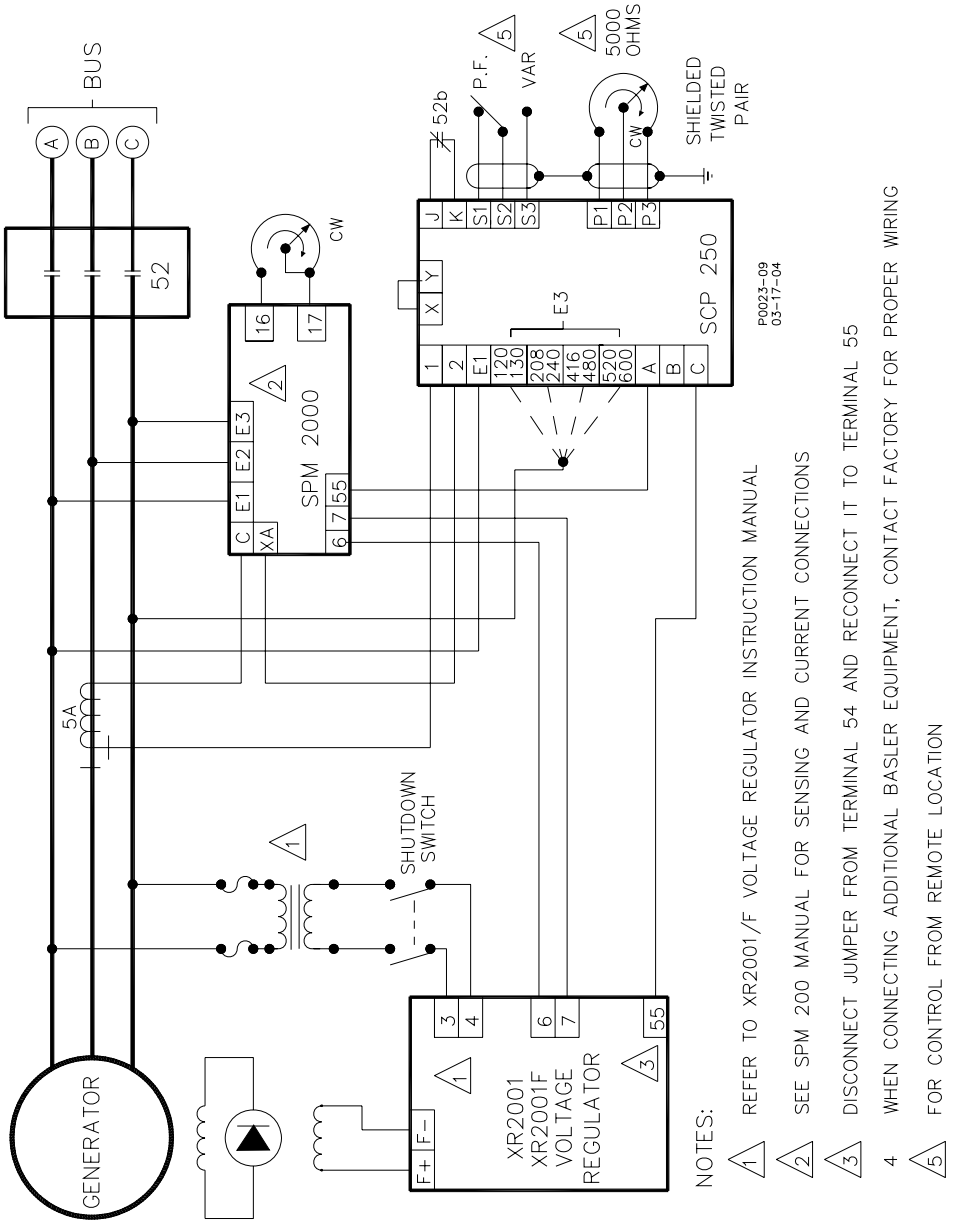


Figure 4-14. XR2001/XR2001F, SPM 2000, and SCP 250-G Connections

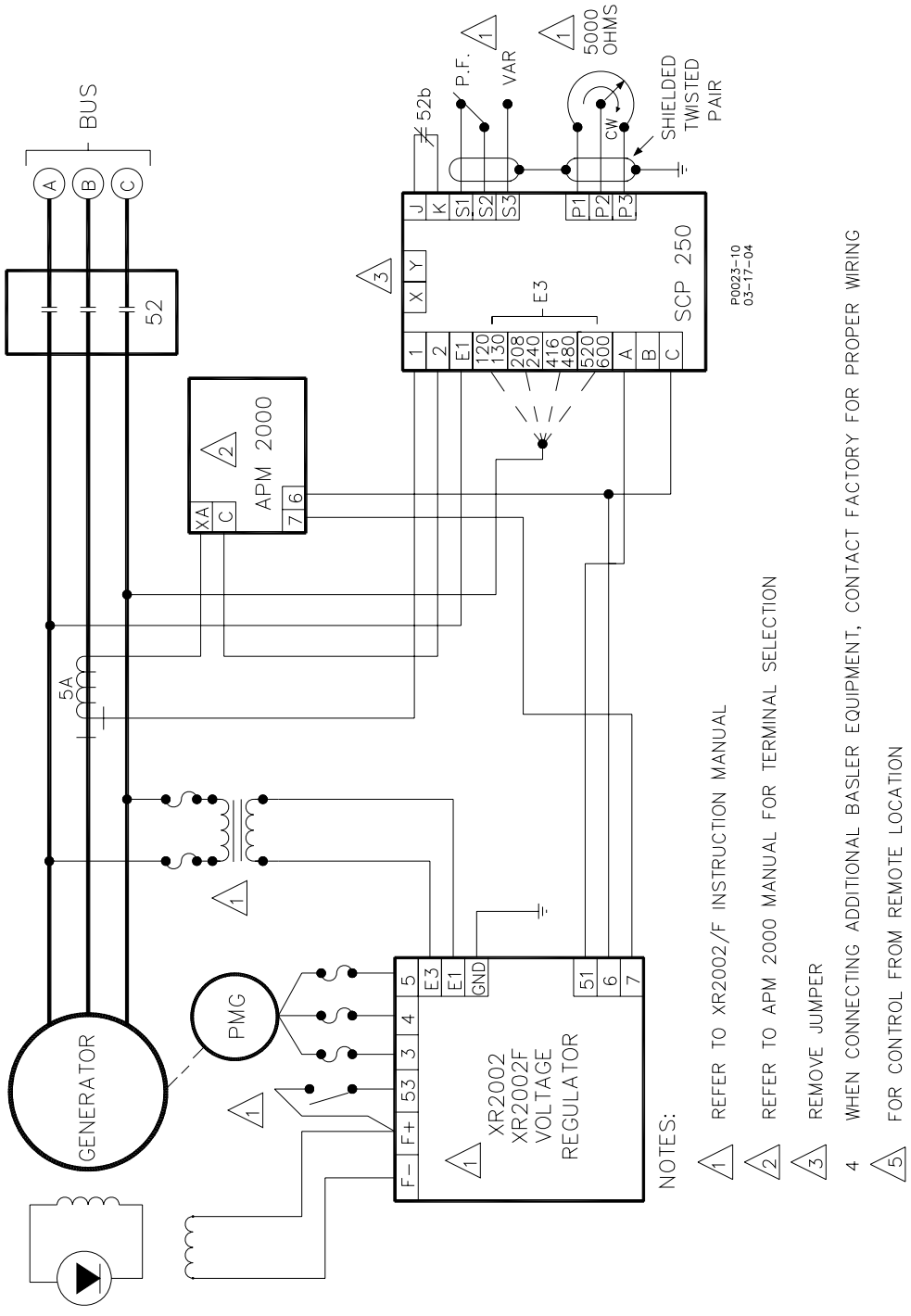


Figure 4-15. XR2002/XR2002F and SCP 250-G Connections

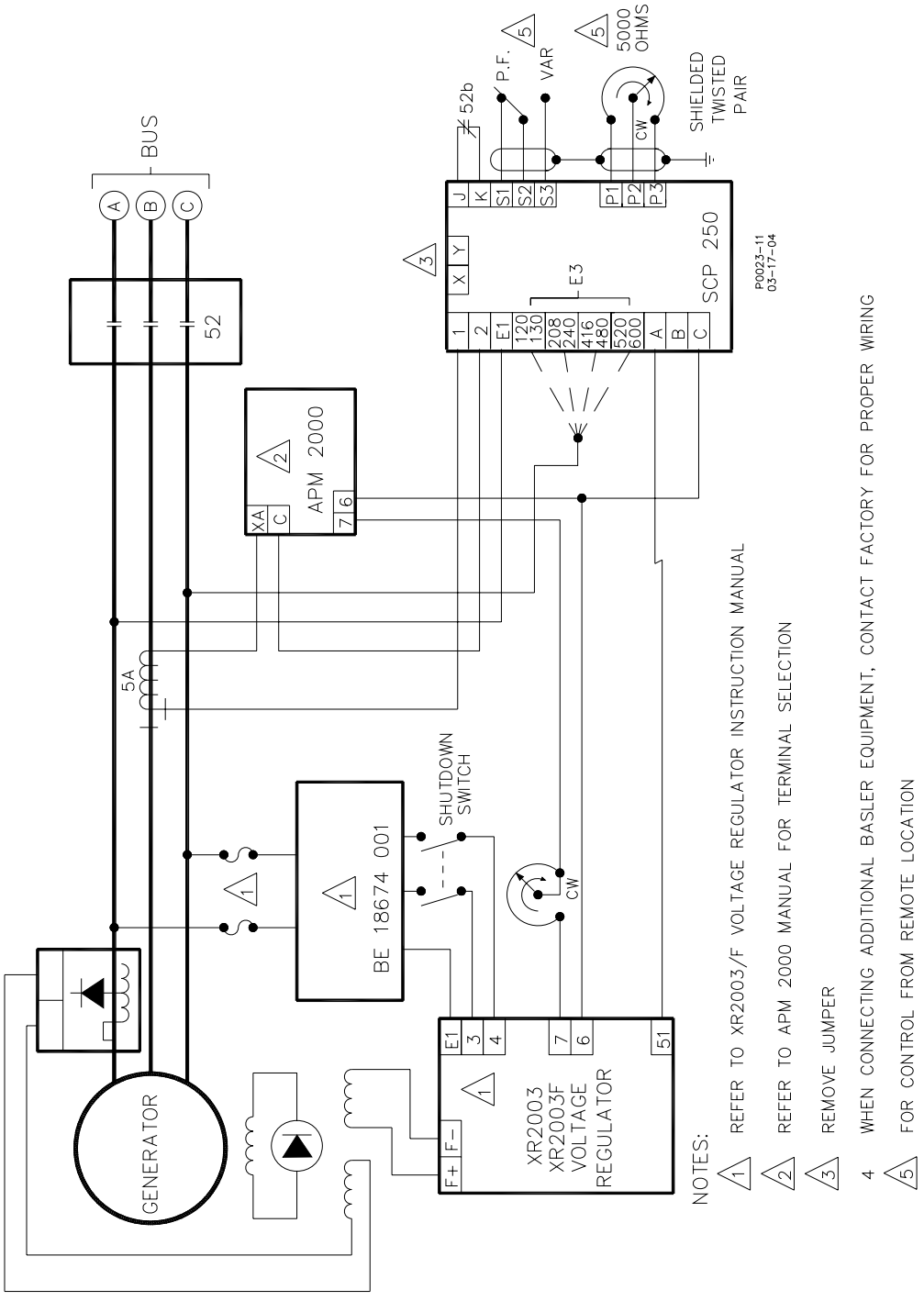


Figure 4-16. XR2003/XR2003F and SCP 250-G Connections

Remote Control of the SCP 250

If desired, the Var/Power Factor Adjust control and Mode switch can be relocated away from the SCP 250. To relocate the potentiometer and switch, perform the following steps. If only one of the controls is to be relocated, perform only the instructions pertaining to the control to be removed.

If user-supplied controls will be used, the controls installed on the SCP 250 chassis may be left in place. However, the controls must be disconnected from the SCP 250 by unsoldering and removing the control leads or taping the lead ends.

1. Gain access to the potentiometer and switch connections by removing the five screws that secure the circuit board to the chassis.
2. Disconnect the potentiometer and/or switch leads from the SCP 250 terminals.
3. Remove the potentiometer and/or switch from the chassis.
4. Secure the circuit board to the chassis with the five screws removed in step 1.
5. Unsolder and remove the leads from the potentiometer and/or switch.
6. Mount the potentiometer and/or switch in the desired location.
7. Connect wires from the potentiometer and/or switch to the SCP 250 terminals. Figure 4-17 illustrates the potentiometer and switch connections to the SCP 250.

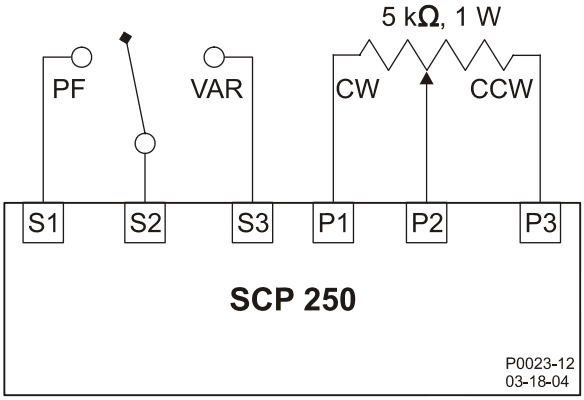


Figure 4-17. Potentiometer and Switch Connections

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SECTION 5 • OPERATION

INTRODUCTION

The graph of Figure 5-1 illustrates the relationship between power factor and the corresponding ratios of reactive power to real power in an ac system. For example, in a 0.8 power factor load, reactive power is 75% of real power. This graph can be useful when adjusting the SCP 250 and evaluating system performance. This is particularly true when a varmeter and wattmeter are available but a power factor meter is not available.

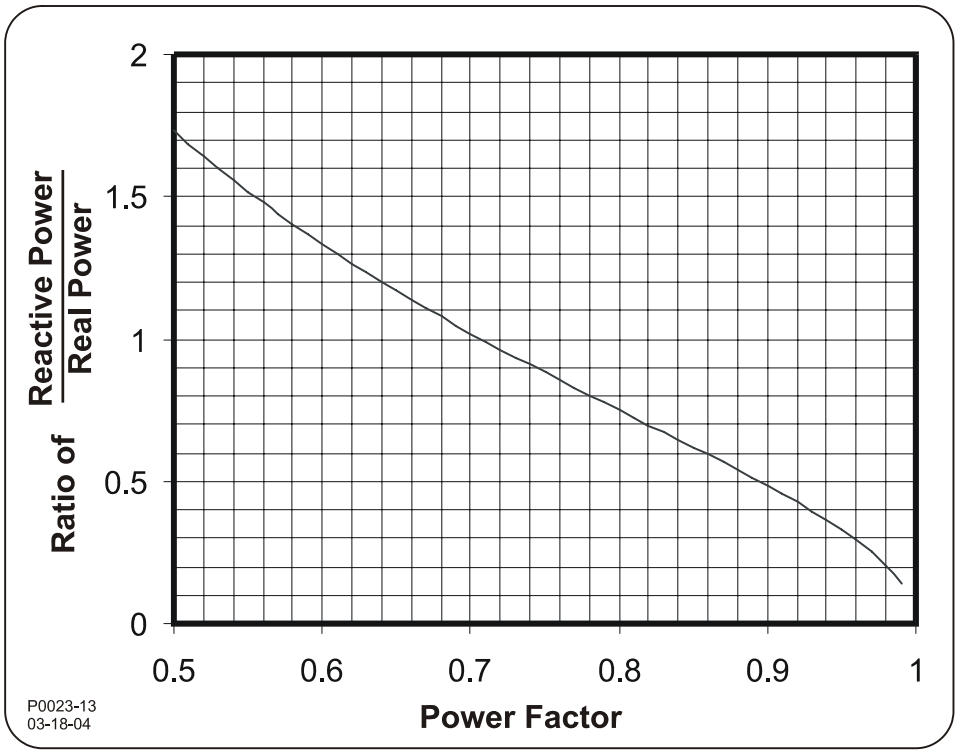

Figure 5-1. Power Factor Relationships

GENERATOR APPLICATIONS

The following procedures contain instructions for preliminary adjustment of the SCP 250 in generator applications.

Preliminary Adjustments for Var Control

1. Rotate the Output Limit control fully counterclockwise.
2. Place the Mode switch in the VAR position.
3. Adjust the Balance control to the midrange position.
4. Rotate the VAR Range control fully counterclockwise.
5. Connect a jumper across terminals J and K.
6. Start the generator and set its voltage at nominal with the voltage regulator's voltage adjust control.

> **NOTE**
>
> With the 52 breaker open, voltage drift may be observed. This drift will disappear when the breaker is closed in step 12.

7. Remove the jumper from terminals J and K.

8. Vary the Var/Power Factor Adjust control from one end of its range to the other. The generator voltage will vary between 10% above nominal to 10% below nominal. When the Output Limit control is turned clockwise, the variation of generator voltage is extended.
9. Set the Output Limit control for the variation that corresponds to about 5% more than the worst-case fluctuation of bus voltage. If the Output Limit control is set for too narrow a band, the SCP 250 may not provide control if bus voltage variation exceeds the percentage established by the Output Limit control.
10. Position the Var/Power Factor Adjust control at the 0 var position.
11. Connect a jumper across terminals J and K. (If the SCP 250 is connected according to the interconnection diagrams in Section 4, these terminals should already be shorted by the breaker's 52b auxiliary contacts.)
12. Parallel the generator with the bus using conventional procedures. The SCP 250 J to K connection should now be open (52b contact open). If the SCP 250 is operating properly and system interconnection is correct, there should be zero var flow.
13. Rotate the Var/Power Factor Adjust control clockwise. Vars should gradually increase but should be less than rated.
14. Slowly rotate the Var/Power Factor Adjust control clockwise until the generator is delivering rated kvars, as determined using system instrumentation. Control of var flow (absorb/generate) is now obtained directly using the Var/Power Factor Adjust control.

Preliminary Adjustments for Power Factor Control

1. Rotate the Output Limit control fully counterclockwise.
2. Place the Mode switch in the VAR position.
3. Adjust the Balance control to the midrange position.
4. Connect a jumper across terminals J and K.
5. Start the generator and set its voltage at nominal with the voltage regulator's voltage adjust control.
6. Remove the jumper from terminals J and K.

NOTE

With the 52 breaker open, voltage drift may be observed. This drift will disappear when the breaker is closed in step 12.

7. Vary the Var/Power Factor Adjust control from one end of its range to the other. The generator voltage will vary between 10% above nominal to 10% below nominal. When the Output Limit control is turned clockwise, the variation of generator voltage is extended.
8. Set the Output Limit control for the variation that corresponds to about 5% more than the worst-case fluctuation of bus voltage. If the Output Limit control is set for too narrow a band, the SCP 250 may not provide control if bus voltage variation exceeds the percentage established by the Output Limit control.
9. Place the Mode switch in the Power Factor position.
10. Position the Var/Power Factor Adjust control at the 1.0 power factor position.
11. Connect a jumper across terminals J and K. (If the SCP 250 is connected according to the interconnection diagrams in Section 4, these terminals should already be shorted by the breaker's 52b auxiliary contacts.)
12. Parallel the generator with the bus using conventional procedures. The SCP 250 J to K connection should now be open (52b contact open).
13. Adjust the Var/Power Factor Adjust control to the desired power factor.
14. Vary kW loading from no load to maximum load. At maximum load, compare the power factor as indicated on the system power factor meter with the desired power factor set in step 13. If they are not identical, adjust the Var/Power Factor Adjust control until the power factor meter displays the desired power factor. Decrease the kW load to a minimum value. The desired power factor should be

maintained over the entire range of loading. In the event that power factor is not maintained at low loading, perform the following steps.

a) Reduce kW loading to about 20% of rated load.

b) Adjust the Balance control until the system instrumentation indicates the desired power factor has been obtained.

MOTOR APPLICATIONS

The following procedures contain instructions for preliminary adjustment of the SCP 250 in motor applications.

CAUTION

Avoid establishing a lagging power factor so low as to cause the motor to pull out of synchronization.

Avoid establishing a leading power factor so high as to cause field overheating.

Appropriate protective devices should be considered to remove field excitation in the event a pull-out condition occurs.

Preliminary Adjustments for Power Factor Control

1. Adjust the Balance control to the midrange position.
2. Adjust the VAR Range control to the midrange position.
3. Adjust the Output Limit control to the midrange position.
4. Place the Mode switch in the Power Factor position and adjust the Var/Power Factor Adjust control to the desired power factor.
5. Connect a jumper across terminals J and K.
6. Start the motor.
7. Vary the voltage regulator's voltage adjust control until the motor power factor is at the desired value.
8. Remove the jumper from terminals J and K. Carefully monitor field current and/or voltage to assure proper phasing. Control of power factor is now directly obtained using the Var/Power Factor Adjust control.

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