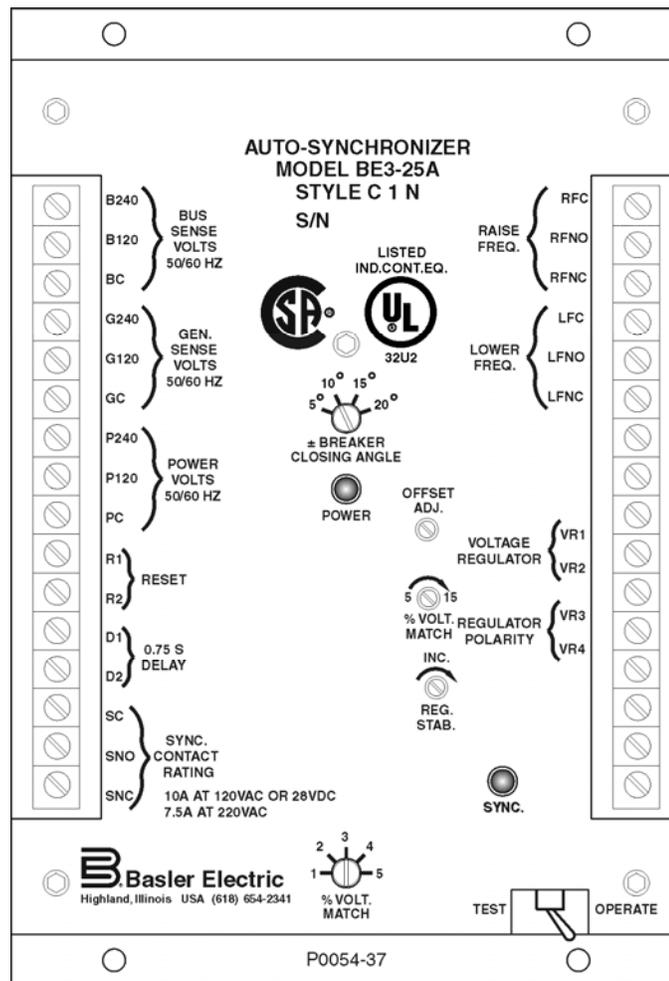


INSTRUCTION MANUAL

FOR

AUTO-SYNCHRONIZER

BE3-25A



INTRODUCTION

This instruction manual provides information about the operation and installation of the BE3-25A Auto-Synchronizer. To accomplish this, the following information is provided:

- General Information and Specifications
- Controls and Indicators
- Functional Description
- Installation
- Maintenance

WARNING!

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

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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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CONTENTS

SECTION 1 • GENERAL INFORMATION	1-1
INTRODUCTION.....	1-1
FEATURES	1-1
DESCRIPTION.....	1-1
Frequency Matching	1-1
Voltage Matching Options	1-2
Dead Bus Closing Option	1-2
STYLE DEFINITION	1-2
SPECIFICATIONS	1-2
Operating Power Input.....	1-2
Bus and Generator Sensing Inputs	1-3
Output Contacts.....	1-3
Summing Point Outputs.....	1-3
Settings.....	1-4
Type Tests	1-4
Physical	1-4
SECTION 2 • CONTROLS AND INDICATORS	2-1
INTRODUCTION.....	2-1
POTENTIOMETERS, SWITCHES, AND INDICATORS.....	2-1
Controls Cross-Reference Chart	2-2
JUMPERS	2-3
Reset Jumper	2-3
0.75 Second Delay Jumper	2-3
Governor Stability Range Jumper	2-4
Regulator Polarity Jumper	2-4
Dead Bus Jumper.....	2-4
SECTION 3 • FUNCTIONAL DESCRIPTION	3-1
GENERAL FUNCTIONAL DESCRIPTION	3-1
Basic Synchronizer Function	3-1
Frequency Matching	3-1
Voltage Matching.....	3-2
Dead Bus Closing.....	3-2
DETAILED FUNCTIONAL DESCRIPTION.....	3-2
Power Supply.....	3-2
Generator and Bus Sensing	3-2
Frequency Difference Comparator	3-2
Phase Angle Comparator	3-2
Voltage Difference Comparator.....	3-2
Gating/Time Delay Circuitry.....	3-4
Closing Circuit.....	3-4
Dead Bus Closing.....	3-4
Frequency/Phase Matching.....	3-4
Voltage Matching.....	3-4
SECTION 4 • INSTALLATION	4-1
MOUNTING.....	4-1
CONNECTIONS.....	4-1
Operating Power and Sensing.....	4-1
Synchronizing Output	4-3
Raise/Lower Frequency and Raise/Lower Voltage Contacts.....	4-3
Summing Point Outputs.....	4-4
SECTION 5 • OPERATION AND MAINTENANCE.....	5-1
OPERATION	5-1
Initial Setup	5-1
Preoperational Checkout.....	5-2
Operation.....	5-2

TROUBLESHOOTING	5-2
BE3-25A Power indicator does not light.....	5-2
No control of governor	5-2
No control of the voltage regulator	5-2
Synchronism indicator lights but the breaker does not close	5-3
Synchronism indicator does not light.....	5-3
PREVENTIVE MAINTENANCE	5-3

SECTION 1 • GENERAL INFORMATION

INTRODUCTION

The BE3-25A Auto-Synchronizer provides automatic synchronization of a generator with an energized station bus. Monitoring the voltage on each side of the generator circuit breaker, the BE3-25A determines when the proper frequency, phase angle, and voltage relationship exists between the generator and the bus. If the frequency, phase angle, and voltage magnitude of the generator, with respect to the station bus, are not within the tolerances allowed for proper synchronizing, the BE3-25A provides frequency and voltage correction signals prior to circuit breaker closure.

When one of two voltage matching options are specified, the BE3-25A provides precise matching of the generator voltage to the bus prior to synchronization.

A dead bus option is available for emergency generator applications that require a generator to close onto a de-energized bus.

FEATURES

- Generator frequency, phase angle, and voltage matching through either bipolar correction signals or raise/lower correction output contacts
 - Frequency matching capture range is ± 3 hertz of the bus frequency
 - Dead bus closing option
 - Bipolar correction signal output provides direct control of a Basler Electric voltage regulator
 - Automatic or remote reset of corrective signals
 - Built-in operational test feature
 - UL recognized and CSA certified
 - Qualified to the requirements of IEEE C37.90a-1974, Surge Withstand Capability and IEC 255-5, 6, and 20
 - Compact, mechanically-rugged assembly with high reliability
-

DESCRIPTION

The basic BE3-25A monitors the oncoming generator and bus voltages and permits synchronizing of the generator to an energized station bus (or another generator) when the following three predetermined conditions are satisfied:

1. Slip frequency is ± 0.1 hertz or less.
2. Phase angle differential is equal to or less than the selected setting. (Phase angle differential has a setting range of $\pm 5^\circ$ to $\pm 20^\circ$ adjustable in 5° increments.)
3. Generator and bus voltage differential is less than the selected voltage difference setting. (This setting is continuously adjustable of the range of $\pm 5\%$ to $\pm 15\%$ of the bus voltage.)

When the generator frequency, phase angle, and voltage are within predetermined limits, the BE3-25A energizes the isolated synchronizing output, lights the front panel Sync indicator, and resets the frequency and phase angle correction signals.

Frequency Matching

The BE3-25A provides correction signals when the phase angle and/or slip frequency exceed the settings. These signals cause the governor to increase or decrease the prime mover's speed. One of four frequency matching types may be specified:

Type A frequency matching (style AXX) provides a low-voltage signal to an AMBAC® International summing-point, electronic governor, type CU673C.

Type B frequency matching (style BXX) provides a proportional bipolar signal to Barber-Colman summing-point, electronic governors, types DYN1 and ILS.

Type C frequency matching (style CXX) provides raise and lower contact outputs for motor-operated control operation.

Type W frequency matching (style WXX) provides a proportional bipolar signal to Woodward summing-point, electronic governors, types 1712/1724, 2301, and 2301A.

Correction signals are proportional to the magnitude of the slip frequency and phase angle, and continue until the conditions for breaker closure are satisfied. Maximum frequency correction signals are applied until the generator frequency is within ± 3 hertz of the station bus frequency. At this point, the signals become proportional to the difference in frequency.

Voltage Matching Options

When equipped with optional voltage matching, the BE3-25A provides correction signals to the generator voltage regulator when the voltage difference between the generator and bus voltage exceeds the front panel setting. Two voltage matching types are available as options.

In summing point voltage matching (style X1X), the BE3-25A supplies a bipolar correction signal for use with the summing point input of a Basler Electric voltage regulator. This correction signal is proportional to the magnitude of the monitored voltage difference. Basler Electric voltage regulator types SSR, SR, and KR and exciter-regulator types SSE and SER-CB are compatible with this voltage matching type.

A motor-operated control can be controlled by the raise and lower voltage matching output contacts of a style X2X BE3-25A. Corrective contact closures are continuous until conditions for breaker closure are satisfied.

Dead Bus Closing Option

The dead bus closing option enables the BE3-25A to close the generator breaker and connect the generator to a de-energized bus. This feature is enabled and disabled by a jumper connected to the BE3-25A.

STYLE DEFINITION

BE3-25A capabilities and features are defined by a combination of letters and numbers. The style chart of Figure 1-1 illustrates the available BE3-25A style selections.

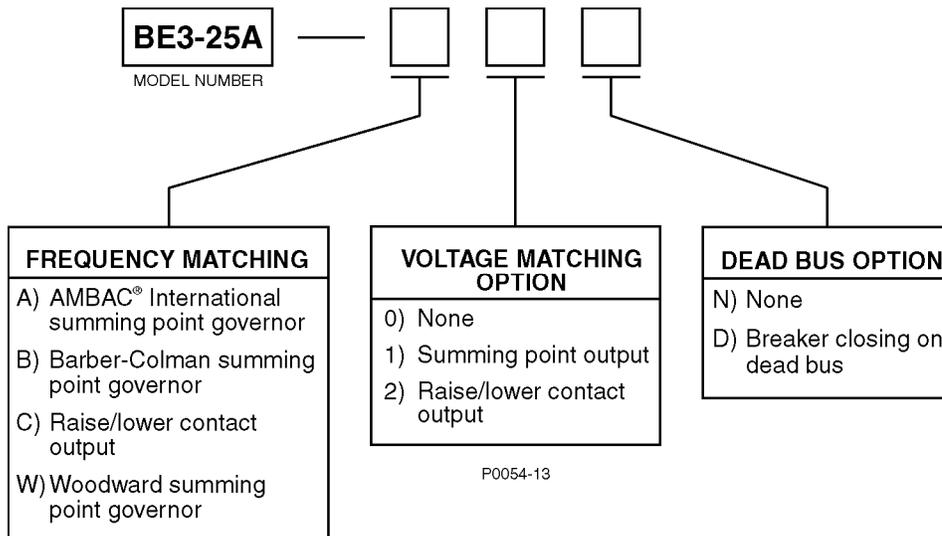


Figure 1-1. BE3-25A Style Chart

SPECIFICATIONS

Operating Power Input

120 Vac Nominal Input

60 Hz Voltage Range:	87 to 153 Vac
50 Hz Voltage Range:	80 to 140 Vac
Burden:	11 VA
Terminals:	P120, PC

240 Vac Nominal Input

60 Hz Voltage Range:	167 to 304 Vac
50 Hz Voltage Range:	180 to 264 Vac

Burden: 11 VA
Terminals: P240, PC

Bus and Generator Sensing Inputs

120 Vac Nominal Input

60 Hz Voltage Range: 87 to 153 Vac
50 Hz Voltage Range: 80 to 140 Vac
2 Second Rating: 180 Vac
Frequency: 50/60 Hz
Burden: 2 VA
Bus Terminals: B120, BC
Generator Terminals: G120, GC

240 Vac Nominal Input

60 Hz Voltage Range: 167 to 304 Vac
50 Hz Voltage Range: 180 to 264 Vac
2 Second Rating: 360 Vac
Frequency: 50/60 Hz
Burden: 2 VA
Bus Terminals: B240, BC
Generator Terminals: G240, GC

Output Contacts

Synchronizing Output

Ratings: 120 Vac at 10 Aac resistive
220 Vac at 7.5 Aac resistive
28 Vac at 10 Aac resistive
Terminals: SNO, SNC, SC

Raise/Lower Frequency (Style CXX), Raise/Lower Voltage (Style X2X) Output

Ratings: 120 Vac at 10 Aac resistive
240 Vac at 6 Aac resistive
28 Vac at 6 Aac resistive
Raise Frequency Terminals: RFNO, RFNC, RFC
Lower Frequency Terminals: LFNO, LFNC, LFC
Raise Voltage Terminals: RVNO, RVNC, RVC
Lower Voltage Terminals: LVNO, LVNC, LVC

Summing Point Outputs

Frequency/Phase Angle Correction

Style AXX

Correction Signal: 0 to +10 Vdc signal provides ± 3 Hz of control for AMBAC
International electronic governors
Terminals: CU673C, C

Style BXX

Correction Signal: ± 4 Vdc signal provides ± 3 Hz of control for Barber-Colman electronic
governors
Terminals: ILS, C

Style WXX

Correction Signal: ± 7 Vdc signal provides ± 3 Hz of control for Woodward electronic
governors
Terminals: 1712/1724, 2301, 2301A, C

Voltage Matching

Matching Signal: Bipolar control signal is compatible with Basler Electric voltage
regulator types SSR, SR, KR, and XR, and exciter-regulator types
SSE and SER-CB.
Terminals: VR1, VR2

Terminal VR3, VR4 Jumper Positions

KR, SR-F, SR-E, SR-H:	jumper installed across terminals VR3, VR4
SR4A, SR8A:	jumper removed from terminals VR3, VR4
XR2001, XR2002, XR2003:	jumper removed from terminals VR3, VR4
SSE, SER-CB:	jumper installed across terminals VR3, VR4
SSR:	jumper removed from terminals VR3, VR4

Settings

Breaker Closing Angle:	5, 10, 15, or 20°, switch selected
Voltage Matching	
Style x0x:	±5 to ±15% of bus voltage, potentiometer adjusted
Style x1x, x2x:	1,2 ,3, 4, or 5%, switch selected
Governor Stability	
Style AXX, BXX, WXX:	Adjustment range (minimum, medium, or maximum) selected by pigtail/jumper at terminals G1, G2. Specific setting made with potentiometer.
Dead Bus Breaker Closing:	10 to 50 Vac, potentiometer adjusted (120 Vac tap)

Type Tests

Shock

Withstands up to 15 G in each of three mutually perpendicular axes.

Vibration

Withstands:	5 to 18 Hz at 0.06 inch double amplitude
	18 to 30 Hz at 1 G
	30 to 48 Hz at 0.02 inch double amplitude
	48 to 70 Hz at 2.5 G

Physical

Temperature

Operating:	−40 to 70°C (−40 to 158°F)
Storage:	−65 to 85°C (−85 to 185°F)

Weight

Net:	1.81 kg (4.0 lb)
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SECTION 2 • CONTROLS AND INDICATORS

INTRODUCTION

BE3-25A controls and indicators consist of potentiometers, switches, indicator lights and jumpers.

POTENTIOMETERS, SWITCHES, AND INDICATORS

BE3-25A potentiometers, switches, and indicators are shown in the composite illustration of Figure 2-1. A given style of BE3-25A will not have all of the controls shown in Figure 2-1. Locator letters in Figure 2-1 correspond to the control and indicator descriptions listed in Table 2-1.

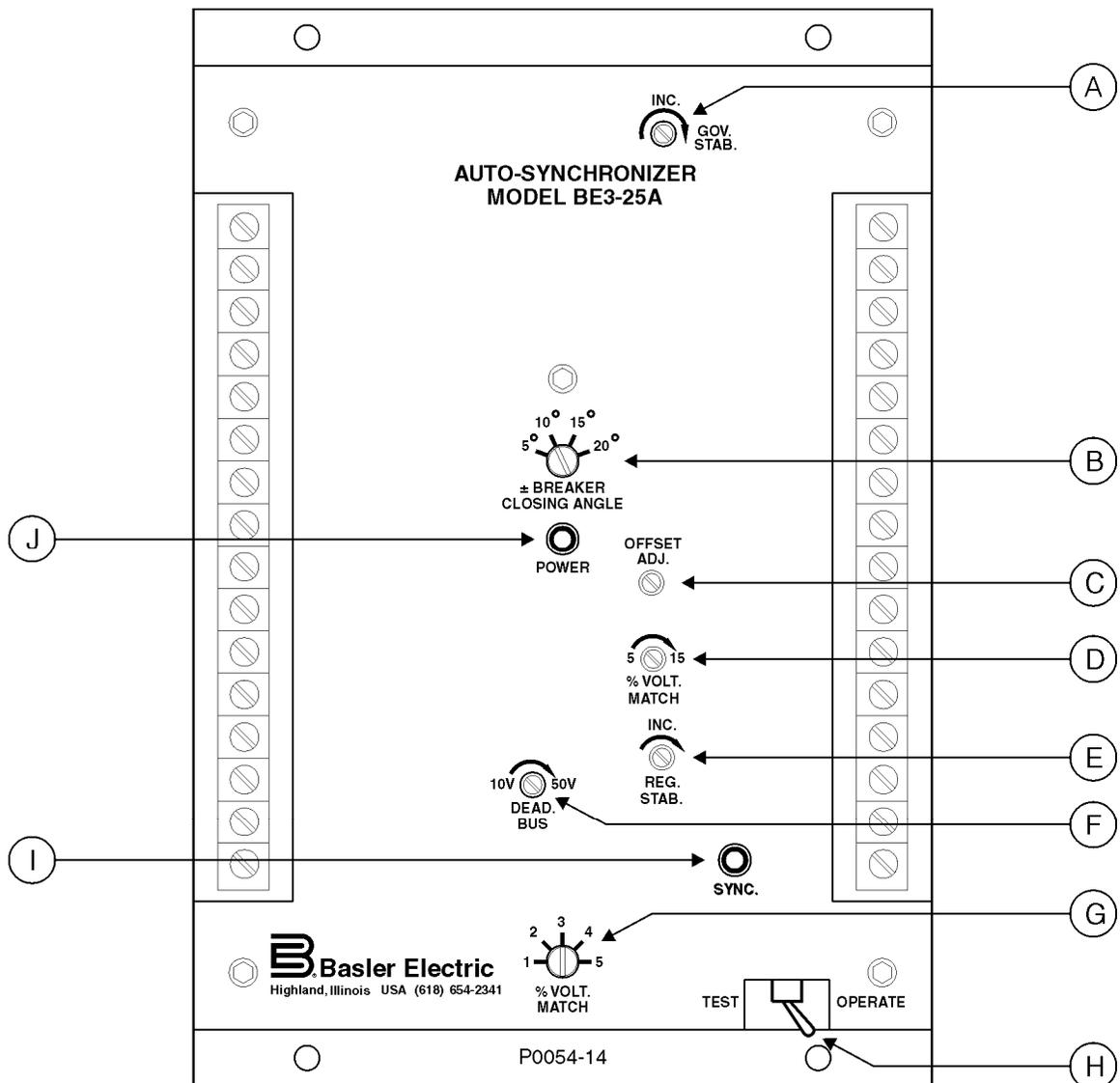


Figure 2-1. Potentiometer, Switch, and Indicator Locations

Table 2-1. Potentiometer, Switch, and Indicator Descriptions

Locator	Description
A	<i>Governor Stability Potentiometer.</i> This potentiometer adjusts the stability and response time of the governor used with the BE3-25A. Three ranges of stability adjustments are available through the placement of a pigtail/jumper. See <i>Jumpers</i> for information about pigtail/jumper placement. Provided on styles AXX, BXX, and WXX.
B	<i>Breaker Closing Angle Switch.</i> This four-position switch selects the maximum allowable phase angle difference (5, 10, 15, or 20°) between the generator and station bus prior to breaker closure. Provided on all BE3-25A styles.
C	<i>Offset Adjustment Potentiometer.</i> This potentiometer adjusts the amount of offset voltage required for the AMBAC International CU673C governor. Provided on styles AXX.
D	<i>Voltage Matching Potentiometer.</i> This potentiometer establishes the maximum voltage difference between the generator and bus prior to allowing closure of the breaker. The setting range for this potentiometer is ± 5 to $\pm 15\%$ of the bus voltage. Provided on styles X0X.
E	<i>Regulator Stability Potentiometer.</i> This potentiometer adjust the stability and response time of the Basler Electric voltage regulator used with the BE3-25A. Provided on styles X1X.
F	<i>Dead Bus Potentiometer.</i> This potentiometer determines the maximum level of bus voltage that will allow the BE3-25A to close the generator breaker and connect the generator to a dead bus. The setting range for this potentiometer is 10 to 50 Vac. Provided on styles XXD.
G	<i>Voltage Matching Switch.</i> When the BE3-25A is equipped with voltage matching, this switch establishes the allowable voltage difference between the generator and bus voltage. If the voltage difference between the two voltages (expressed as a percentage) is greater than the switch setting, the BE3-25A issues correction signals to the voltage regulator or excitation system. A setting of 1, 2, 3, 4, or 5% may be selected. Provided on styles X1X and X2X.
H	<i>Test/Operate Switch.</i> During normal operation, this two-position switch should be left in the Operate position. The Test position is selected for initial setup and testing of the BE3-25A. When the BE3-25A is operating with the switch in the Test position, the Synchronism indicator operates normally but the Synchronizing output contacts are inhibited. Provided on all BE3-25A styles.
I	<i>Synchronism Indicator.</i> This LED (light emitting diode) indicator lights to indicate that the generator is synchronized with the bus and coincides with closure of the Synchronizing output contacts. Provided on all BE3-25A styles.
J	<i>Power Indicator.</i> This LED indicator lights when control power is applied to BE3-25A power terminals P120/P240 and PC. Provided on all BE3-25A styles.

Controls Cross-Reference Chart

Table 2-2 summarizes the controls provided with each style of the BE3-25A. The Breaker Closing Angle Switch, Test/Operate Switch, Synchronism Indicator, and Power Indicator are provided on all styles of the BE3-25A.

Table 2-2. Controls Cross-Reference Chart

BE3-25A	Frequency Matching Options		Voltage Matching Options			Dead Bus Option
Style Number	Governor Stability Pot	Offset Adjust Potentiometer	Voltage Matching Pot	Voltage Matching Switch	Regulator Stability Pot	Dead Bus Potentiometer
A0D	●	●	●			●
A0N	●	●	●			
A1D	●	●		●	●	●
A1N	●	●		●	●	
A2N	●	●		●		
B0D	●		●			●
B0N	●		●			
B1D	●			●	●	●
B1N	●			●	●	
B2D	●			●		●
B2N	●			●		
C0D			●			●
C0N			●			
C1D				●	●	●
C1N				●	●	
C2D				●		●
C2N				●		
W0D	●		●			●
W0N	●		●			
W1D	●			●	●	●
W1N	●			●	●	
W2D	●			●		●
W2N	●			●		

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JUMPERS

The function of each BE3-25A jumper is described in the following paragraphs. A particular style of BE3-25A may not have provisions for all of the jumpers described here.

Reset Jumper

Reset jumper terminals are provided on BE3-25A styles AXX, BXX, and WXX. The Reset jumper connects across terminals R1 and R2.

With the jumper installed, internal reset operation is selected. The BE3-25A will continue to issue frequency correction signals until the phase angle difference is within the front panel Breaker Closing Angle Switch setting.

With the jumper removed, external reset operation is selected and the BE3-25A will continue to issue frequency correction signals until the external reset contacts are closed.

0.75 Second Delay Jumper

All styles of the BE3-25A have terminals for the 0.75 Second Delay jumper. The 0.75 Second Delay jumper connects across terminals D1 and D2.

With the jumper installed, a 0.75 second delay occurs between synchronization and operation of the Synchronizing output contacts.

With the jumper removed, the time delay is bypassed and the BE3-25A provides instantaneous operation of the Synchronizing output contacts.

Governor Stability Range Jumper

Governor Stability Range Jumper terminals are provided on BE3-25A styles AXX, BXX, and WXX. Jumper connections consist of a pigtail connected to terminal G1 or G2 and may include a jumper connected across terminals G1 and G2.

The Governor Stability Range Jumper is used in conjunction with the front panel Governor Stability Potentiometer to adjust the stability and response time of the governor used with the BE3-25A. As illustrated in Figure 2-2, three ranges of stability are available through the placement of the pigtail/jumper.

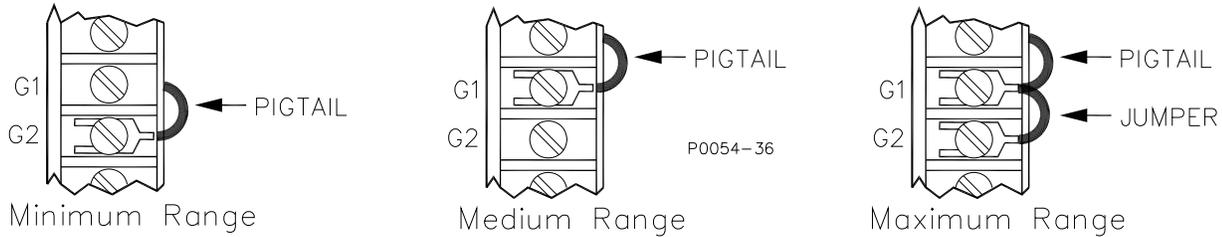


Figure 2-2. Governor Stability Range Pigtail/Jumper

Regulator Polarity Jumper

Regulator Polarity Jumper terminals are provided on BE3-25A style X1X. Jumper connections are provided at terminals VR3 and VR4.

Installation or removal of the Regulator Polarity Jumper controls the polarity of the Voltage Matching output signal (supplied at terminals VR1 and VR2) for the voltage regulator used. Basler regulator models KR, SR-F, SR-E, SR-H, SSE, and SER-CB require installation of a jumper across terminals VR3 and VR4. No jumper should be installed across VR3 and VR4 for regulator models SR4A, SR8A, SSR, XR2001, XR2002, and XR2003.

Dead Bus Jumper

Dead Bus jumper terminals are provided on BE3-25A style XXD. The Dead Bus jumper connects across terminals DB1 and DB2.

With the jumper installed, the dead bus closing function is enabled and the Synchronizing output contacts will close when the sensed bus voltage is less than the setting of the front panel Dead Bus potentiometer. Removing the jumper disables the dead bus closing function.

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL FUNCTIONAL DESCRIPTION

A general description of BE3-25A function is provided in the following paragraphs. Figure 3-1 illustrates the flow of signals to and from the synchronizer in a typical application.

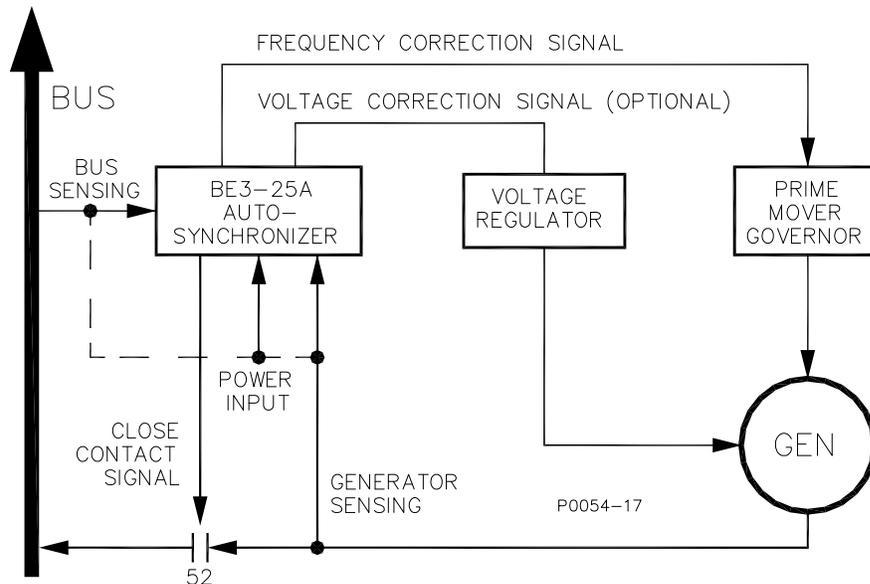


Figure 3-1. Application Block Diagram

Basic Synchronizer Function

As the prime mover brings the oncoming generator up to rated speed, the generator output voltage builds and is applied to the BE3-25A. The BE3-25A begins to sense the generator and bus for voltage, frequency, and phase angle when the generator output voltage rises to the BE3-25A's minimum generator/bus voltage sensing threshold. For 60 hertz applications, this minimum threshold is 87 Vac (120 Vac nominal) or 167 Vac (240 Vac nominal). For 50 hertz applications, this minimum threshold is 80 Vac (120 Vac nominal) or 180 Vac (240 Vac nominal). When the BE3-25A senses that all oncoming generator parameters are matched with the bus, the BE3-25A Synchronizing output operates and initiates a breaker closure that connects the oncoming generator to the bus.

Frequency Matching

BE3-25A frequency matching is available with a summing-point output (styles AXX, BXX, or WXX) or a contact output (style CXX).

Summing Point Output

With summing-point frequency matching, the BE3-25A issues maximum frequency correction signals until the generator frequency is corrected to within ± 3 hertz of the bus frequency. Once the generator frequency falls within the ± 3 hertz window, the frequency correction signals become proportional to the difference frequency. If the Reset jumper is installed (across terminals R1 and R2) to provide internal reset operation, the BE3-25A will continue to issue frequency correction signals until the phase angle difference is within the front panel Breaker Closing Angle switch setting. If the Reset function is being controlled externally, the correction signals will continue until the external reset contacts are closed.

Contact Output

When frequency matching is controlled by a contact output, the contacts are closed at any phase angle difference greater than the front panel Breaker Closing Angle switch setting. The contacts are open only when there is no phase angle difference (0°) or if the phase angle difference is within the Breaker Closing Angle Switch setting.

Voltage Matching

BE3-25A voltage matching is optional and may be omitted (style X0X), equipped with a summing-point output (style X1X), or equipped with a contact output (style X2X).

Summing Point Output

With summing-point voltage matching, the BE3-25A issues a bipolar correction signal that is proportional to the amount of voltage difference. The greater the voltage difference between the generator and bus voltage, the larger the voltage correction signal issued by the BE3-25A. If the Reset jumper is installed (across terminals R1 and R2) to provide internal reset operation, the BE3-25A will continue to issue voltage matching signals until the voltage difference is within the front panel Voltage Matching switch. If the Reset function is being controlled externally, the correction signals will continue until the external reset contacts are closed.

Contact Output

When voltage matching is controlled by a contact output, the contacts are closed at any voltage difference greater than the front panel Voltage Matching switch.

Dead Bus Closing

BE3-25A dead bus closing is optional and may be omitted (style XXN) or specified (style XXD). When equipped with dead bus closing, the BE3-25A will initiate breaker closure when the bus is de-energized or at a very low potential. The dead bus threshold is adjusted over the range of 10 to 50 Vac with the front panel Dead Bus potentiometer.

DETAILED FUNCTIONAL DESCRIPTION

A functional description of each synchronizer function/circuit is provided in the following paragraphs. Figure 3-2 illustrates a detailed block diagram for the BE3-25A.

Power Supply

Either the oncoming generator or bus voltage is used to supply the BE3-25A with operating power. The BE3-25A accepts 120 Vac nominal operating power at terminals P120 and PC or 240 Vac nominal operating power at terminals P240 and PC. The power applied to the synchronizer is stepped down, rectified, and filtered to provide +12 Vdc and -12 Vdc to the internal circuitry.

Generator and Bus Sensing

Generator sensing and bus sensing circuits monitor and process the oncoming generator and bus voltages. The outputs of these circuits are applied to the Frequency Difference Comparator, Phase Angle Comparator, Voltage Difference Comparator, Dead Bus Closing circuit, Frequency/Phase Matching circuit, and Voltage Matching circuit.

Frequency Difference Comparator

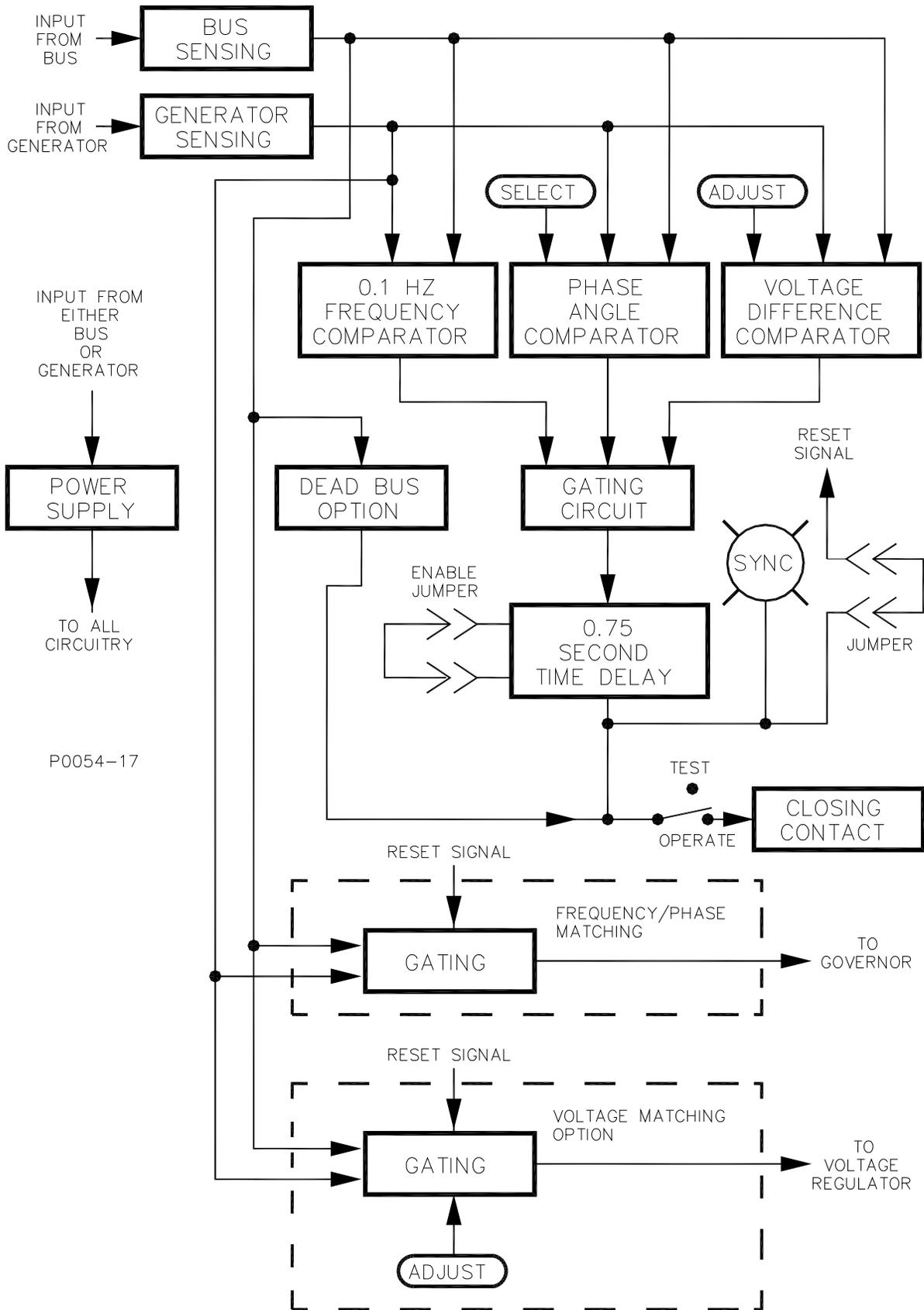
The Frequency Difference Comparator compares the frequencies of the bus and oncoming generator. If the two frequencies are within 0.1 hertz of each other, an output signal is applied to the Gating Network.

Phase Angle Comparator

The Phase Angle Comparator compares the phase angle of the bus to that of the oncoming generator. When the phase angle difference decreases below the Breaker Closing Angle switch setting (5, 10, 15, or 20°), the resulting output signal is applied to the Gating Network.

Voltage Difference Comparator

The Voltage Difference Comparator compares the voltage difference between the bus and the oncoming generator. When the voltage difference decreases to less than the setting of the front panel Voltage Matching Potentiometer (style X0X) or Voltage Matching Switch (style X1X or X2X), the resulting output signal is applied to the Gating Network. The Voltage Matching potentiometer has a setting range of ± 5 to $\pm 15\%$ and the Voltage Matching Switch has a setting range of 1, 2, 3, 4, or 5%.



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Figure 3-2. BE3-25A Block Diagram

Gating/Time Delay Circuitry

When outputs from the Frequency Difference Comparator, Phase Angle Comparator, and Voltage Difference Comparator are all present at the Gating circuitry input, the Time Delay circuitry is triggered and begins counting down. All three inputs must be present for at least 0.75 seconds before the Closing circuit will operate. If any one of the three input signals is removed before the end of the timing period, the Closing circuit will not operate. Removal of the 0.75 S Delay jumper (at terminals D1 and D2) will bypass the 0.75 second time delay and provide instantaneous operation of the Closing circuit.

Closing Circuit

When energized, the Closing circuit lights the front panel Synchronism indicator and operates the SPDT Synchronizing output contacts at terminals SNO, SC, and SNC. A reset signal is also generated to cause a reset of all control signals.

The front panel Test/Operate switch affects the control that the Closing circuit has over the Synchronizing output contacts. When placed in the Test position, the Test/Operate switch inhibits the Closing circuit from operating the Synchronizing output contacts. Synchronism indicator operation is not affected by the position of the Test/Operate switch.

Dead Bus Closing

When the sensed bus voltage is less than the voltage setting of the front panel Dead Bus potentiometer, an output signal is applied to the Closing circuit which lights the Synchronism indicator and operates the Synchronizing output contacts. The Dead Bus Closing function has a setting range of 10 to 50 Vac (for a 120 Vac nominal input).

Frequency/Phase Matching

The Frequency/Phase Matching circuitry supplies output signals to the Gate Circuit that are proportional to the difference in frequency between the bus and oncoming generator. When the slip (difference) frequency exceeds ± 3 hertz, these correction signals are at their maximum level. Frequency correction signals are applied to the output circuit only when the sensed bus and generator voltage levels are above the BE3-25A's minimum generator/bus voltage sensing threshold.

Frequency/Phase Matching Output Signals

Output signals supplied by the Frequency/Phase Matching circuitry will be one of two types: raise and lower contact outputs or a bipolar type output.

BE3-25A synchronizers with a style number of CXX supply raise and lower contact outputs for use with motor operated control (MOC) type governors. Raise frequency output contacts are provided at terminals RFNO, RFNC, and RFC. Lower frequency output contacts are provided at terminals LFNO, LFNC, and LFC.

BE3-25A synchronizers with a style number of AXX, BXX, or WXX supply a bipolar type output for use with summing point type electronic governors. Style AXX synchronizers provide a 0 to +10 Vdc signal at terminals CU673C and C for control of an AMBAC International electronic governor. Style BXX synchronizers provide a ± 4 Vdc signal at terminals ILS and C for control of a Barber-Colman electronic governor. Style WXX synchronizers provide a ± 7 Vdc signal at terminals 1712/1724, 2301, 2301A and C for control of a Woodward electronic governor.

Voltage Matching

When the difference between the bus voltage and oncoming generator voltage exceeds the Voltage Matching Switch setting (of 1, 2, 3, 4, or 5%), a signal is applied to the Gate circuit. Voltage matching signals are applied only when the sensed bus and generator voltage levels are above the BE3-25A's minimum generator/bus voltage sensing threshold.

Voltage Matching Output Signals

Output signals supplied by the Voltage Matching circuitry will be one of two types: raise and lower contact outputs or a bipolar type output.

BE3-25A synchronizers with a style number of X2X supply raise and lower contact outputs for use with motor operated control (MOC) type voltage regulators. Raise voltage output contacts are provided at terminals RVNO, RVNC, and RVC. Lower voltage output contacts are provided at terminals LVNO, LVNC, and LVC.

BE3-25A synchronizers with a style number of X1X provide a bipolar control signal that is compatible with Basler Electric voltage regulator types SSR, SR, KR, and XR, and exciter-regulator types SSE and SER-CB. Regulator Polarity terminals VR3 and VR4 accept a jumper for proper polarity of the Voltage Matching output signal supplied at terminals VR1 and VR2. Regulator models KR, SR-F, SR-E, SR-H, SSE, and SER-CB require installation of a jumper across terminals VR3 and VR4. No jumper should be installed across VR3 and VR4 for regulator models SR4A, SR8A, SSR, XR2001, XR2002, and XR2003.

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SECTION 4 • INSTALLATION

MOUNTING

Figure 4-1 illustrates the BE3-25A mounting dimensions in inches with millimeters in parenthesis. The BE3-25A is convection cooled and should be mounted vertically for optimum convection cooling. The BE3-25A should not be mounted near heat generating equipment or inside an enclosure where the temperature rise could exceed the synchronizer's operating temperature limit.

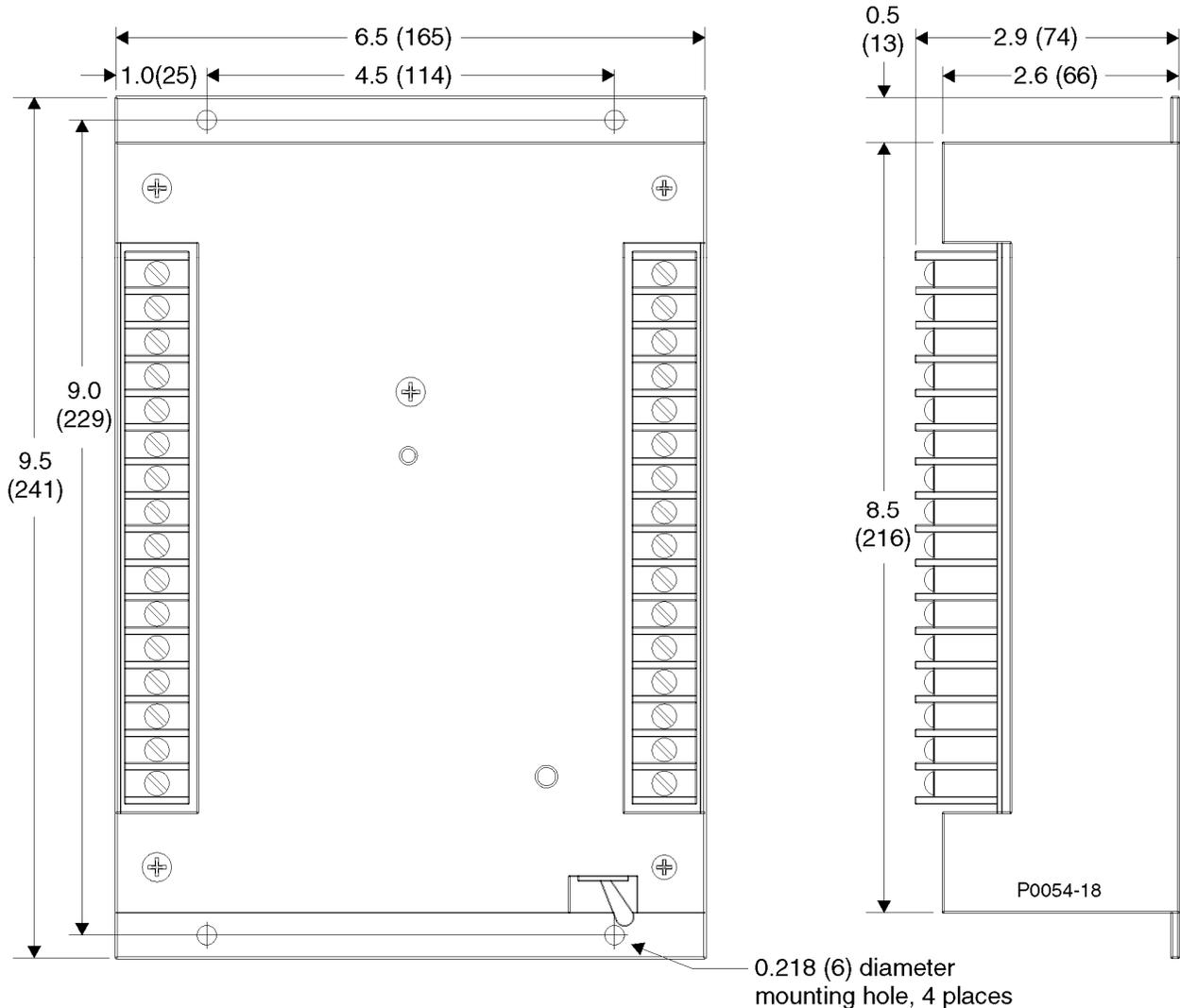


Figure 4-1. BE3-25A Mounting Dimensions

CONNECTIONS

BE3-25A connections are illustrated and described in the following figures and paragraphs.

Operating Power and Sensing

Operating power can be obtained from the bus or generator sensing inputs. Connections for 240 Vac sensing and operating power are illustrated in Figures 4-2 (operating power obtained from the bus) and 4-3 (operating power obtained from the generator). Connections for 120 Vac sensing and operating power are illustrated in Figures 4-4 (operating power obtained from the bus) and 4-5 (operating power obtained from the generator).

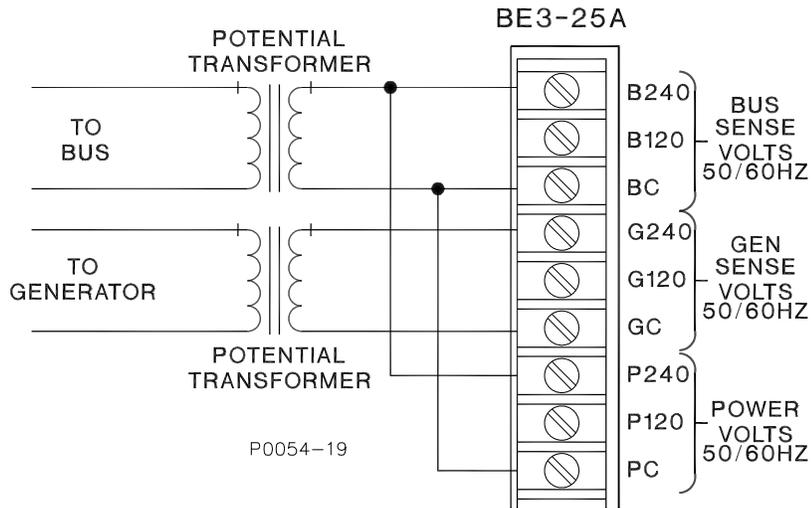


Figure 4-2. Operating Power and Sensing Connections, 240 Vac, Power From Bus

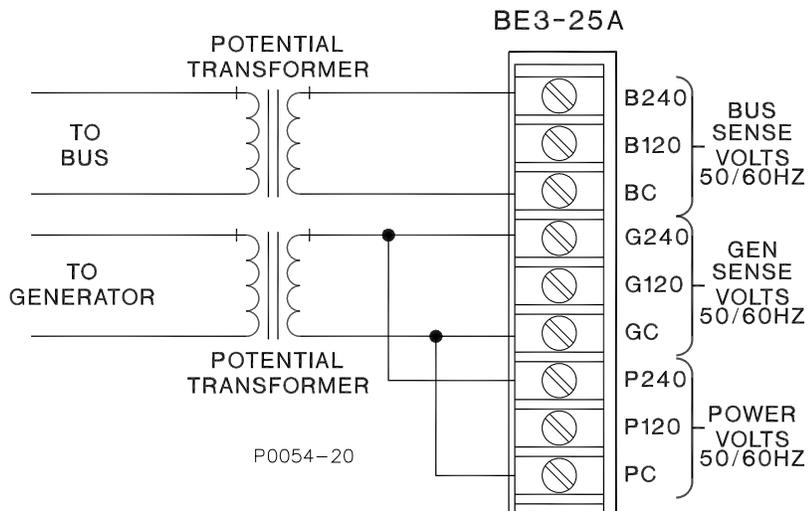


Figure 4-3. Operating Power and Sensing Connections, 240 Vac, Power From Generator

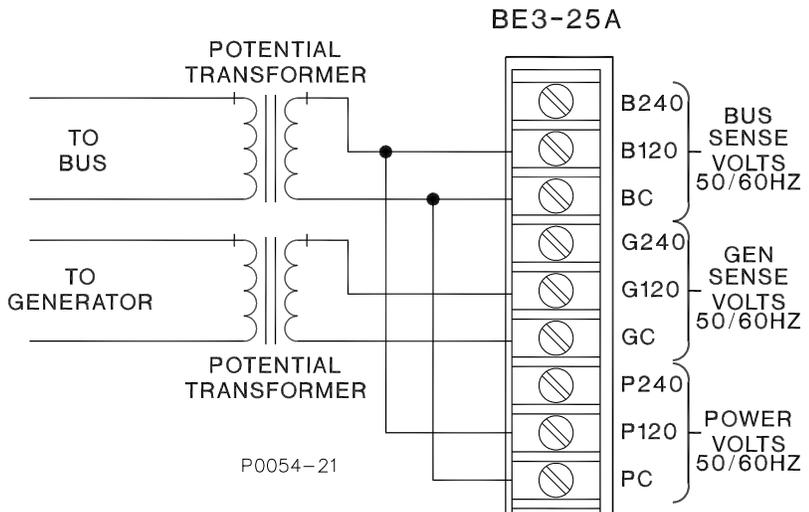


Figure 4-4. Operating Power and Sensing Connections, 120 Vac, Power From Bus

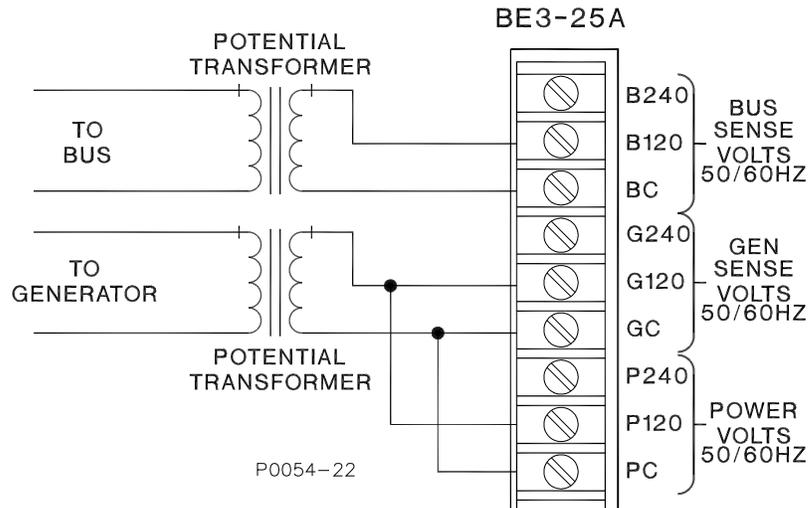


Figure 4-5. Operating Power and Sensing Connections, 120 Vac, Power From Generator

Synchronizing Output

Table 4-1 cross-references the BE3-25A Synchronizing output terminals with the controlled circuit breaker connections.

Table 4-1. Synchronizing Output Connections

Synchronizing Output Terminals	Circuit Breaker Connections
SC	C
SNO	NO
SNC	NC

Raise/Lower Frequency and Raise/Lower Voltage Contacts

Raise/Lower contact connections for control of frequency and voltage are illustrated in Figure 4-6.

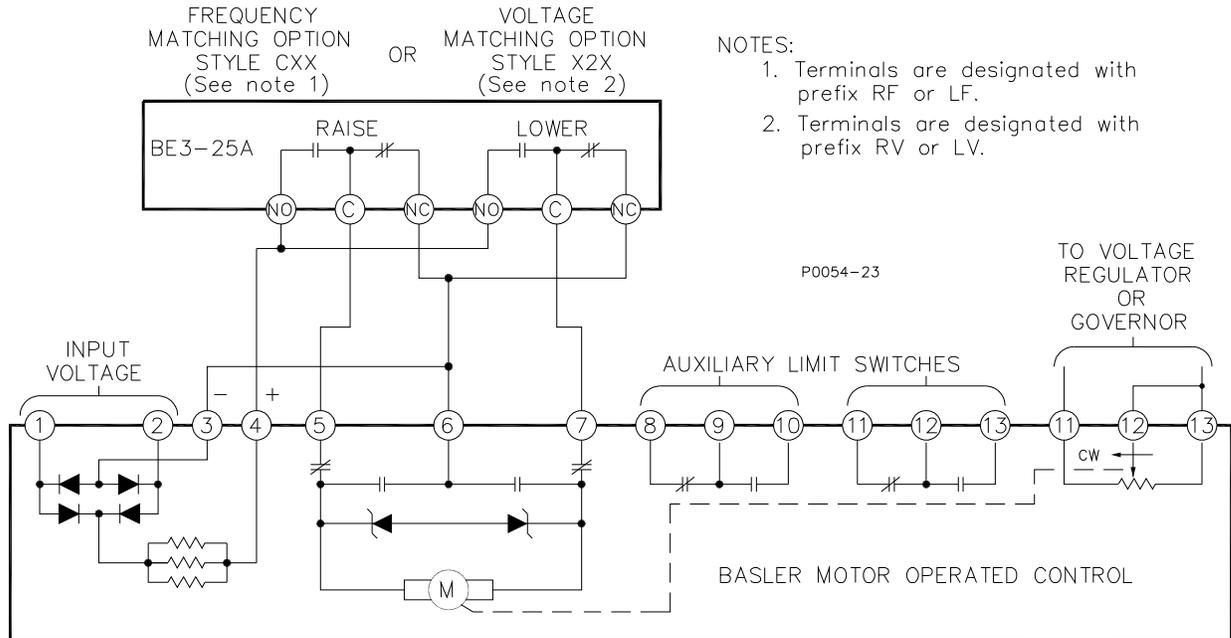


Figure 4-6. Raise/Lower Contact Connections

Summing Point Outputs

Summing point output connections for frequency matching and voltage matching are described and illustrated in the following paragraphs and figures.

Frequency Matching

BE3-25A summing point output connections for frequency matching are illustrated in Figures 4-7 through 4-12.

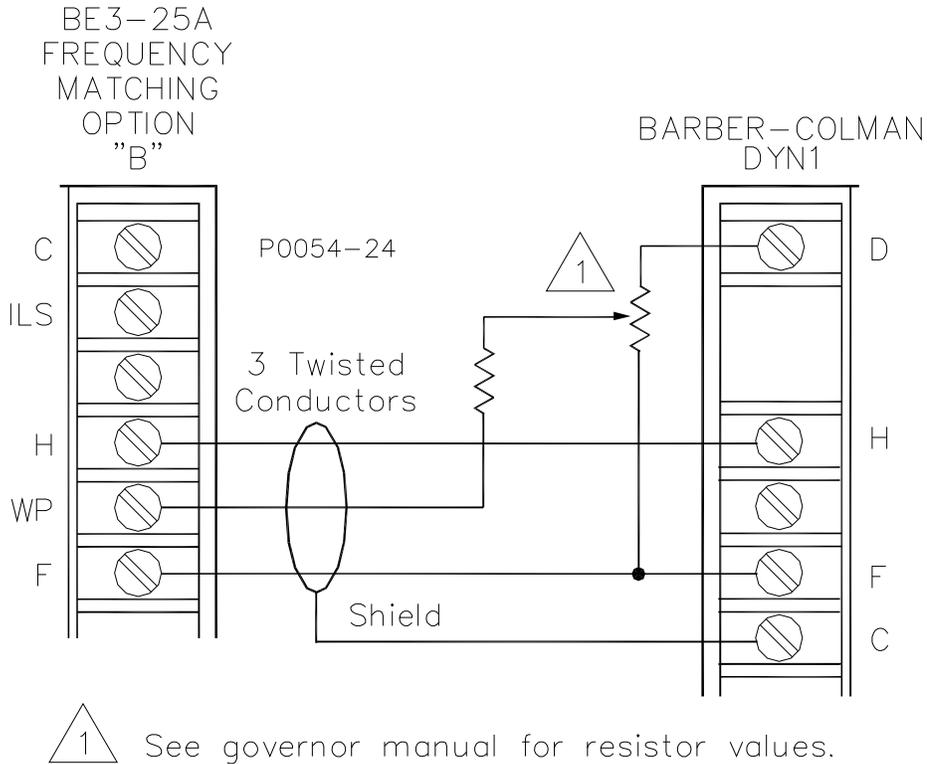


Figure 4-7. Frequency Matching Connections, Barber Colman DYN1 Governor

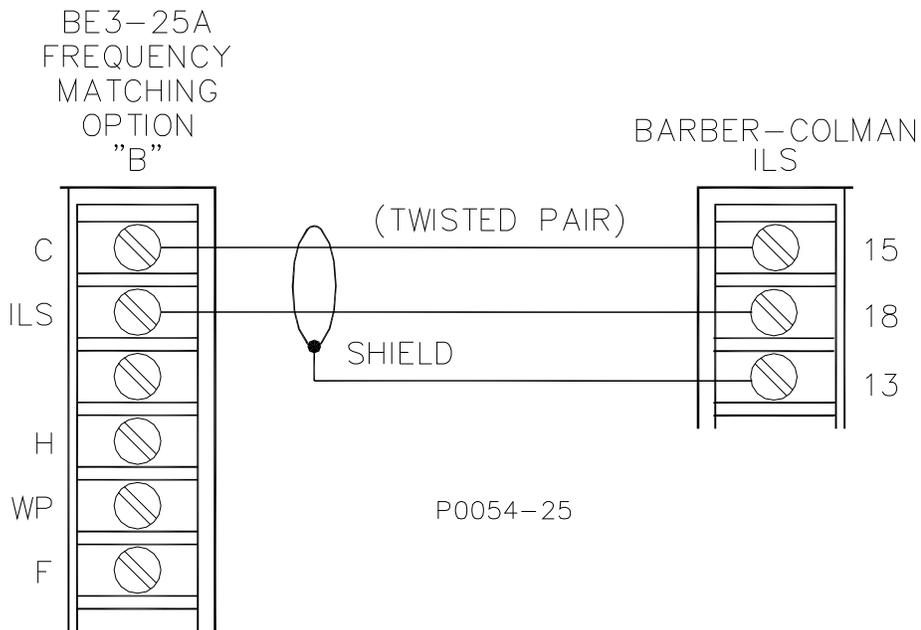


Figure 4-8. Frequency Matching Connections, Barber-Colman ILS Governor

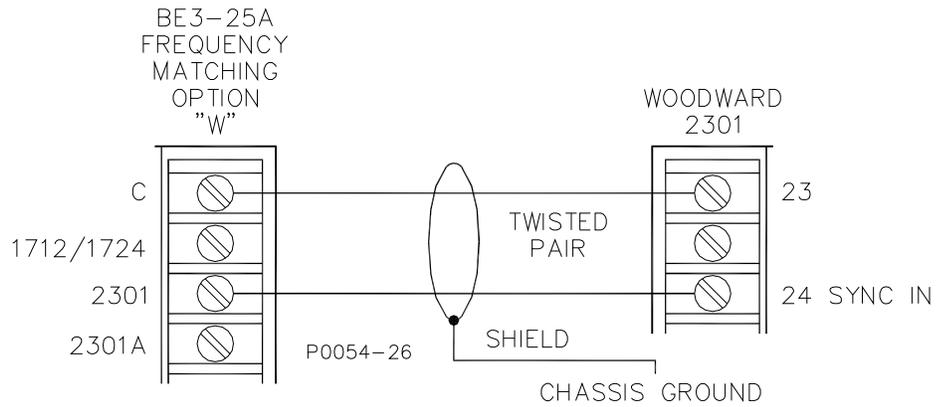


Figure 4-9. Frequency Matching Connections, Woodward 2301 Governor

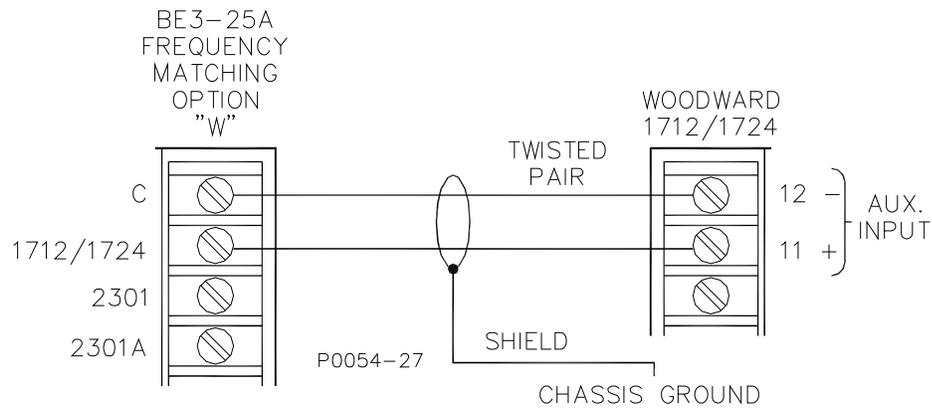
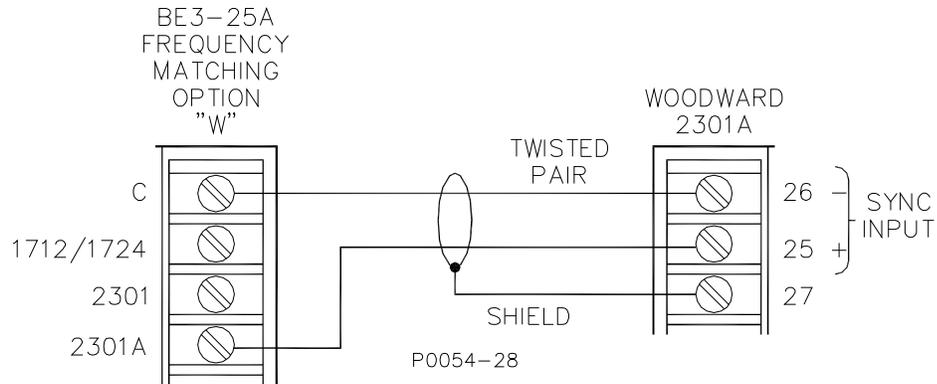
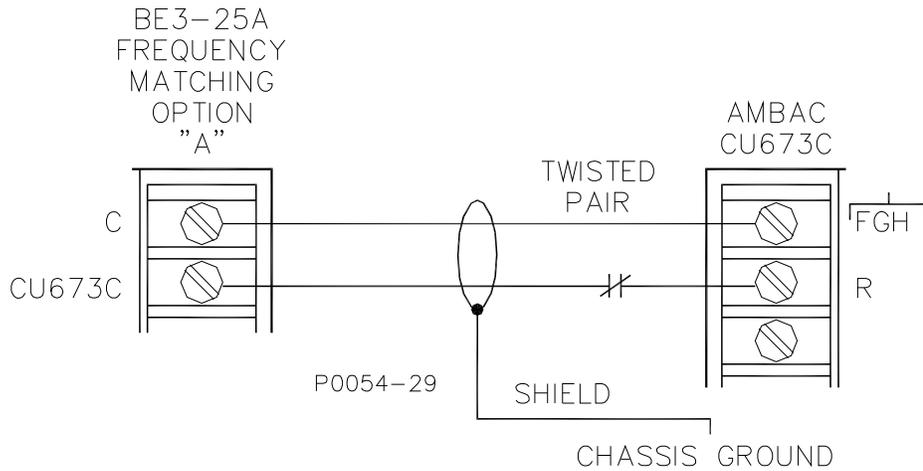


Figure 4-10. Frequency Matching Connections, Woodward 1712/1724 Governor



NOTE: When the possibility exists that the shield is connected to chassis ground or earth ground, do not connect the shield to terminal 27. Ground the shield to the chassis at one point only.

Figure 4-11. Frequency Matching Connections, Woodward 2301A Governor



NOTE: A normally-closed contact is required between the synchronizer and pin "R" which will open after sync or when power is removed from the BE3-25A.

Figure 4-12. Frequency Matching Connections, AMBAC International CU673C Governor

Voltage Matching

BE3-25A summing point output connections for voltage matching are illustrated in Figures 4-13 through 4-17.

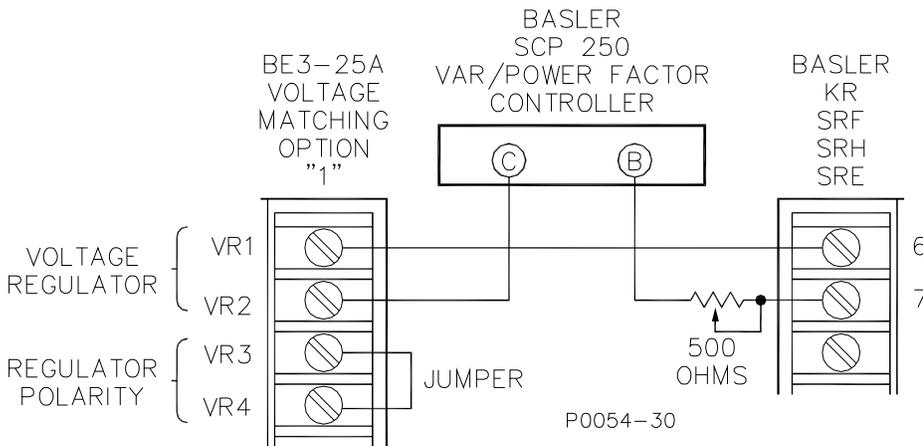


Figure 4-13. Voltage Matching Connections, KR, SR-F, SR-E, and SR-H Regulators

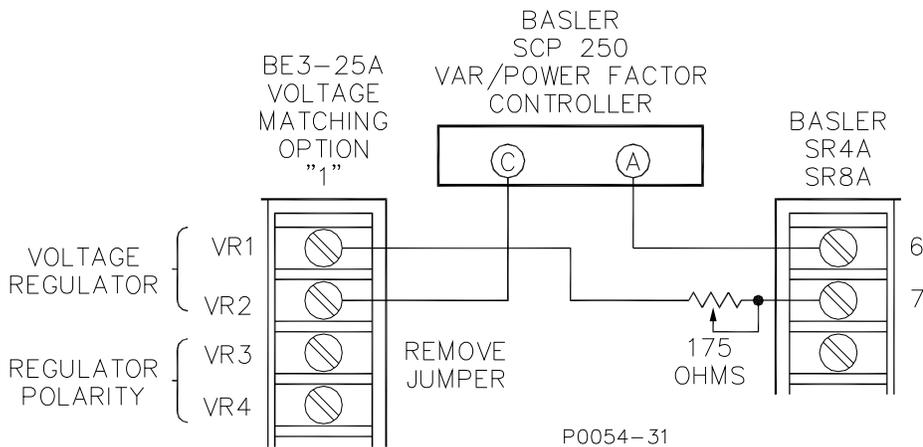


Figure 4-14. Voltage Matching Connections, SR4A and SR8A Regulators

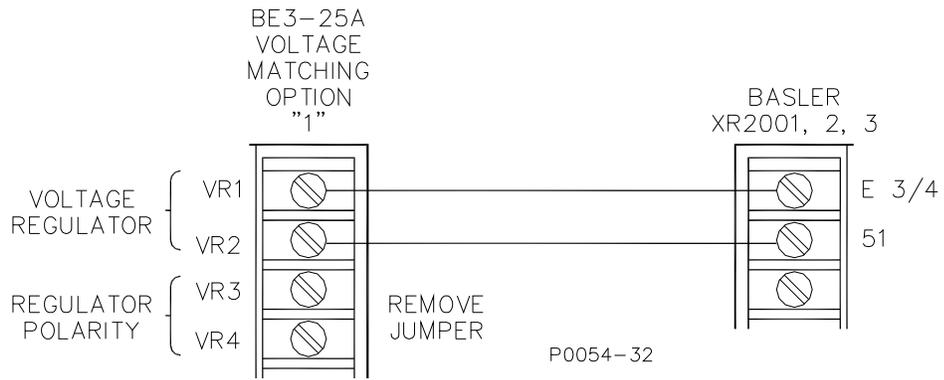


Figure 4-15. Voltage Matching Connections, XR2001, XR2002, and XR2003 Regulators

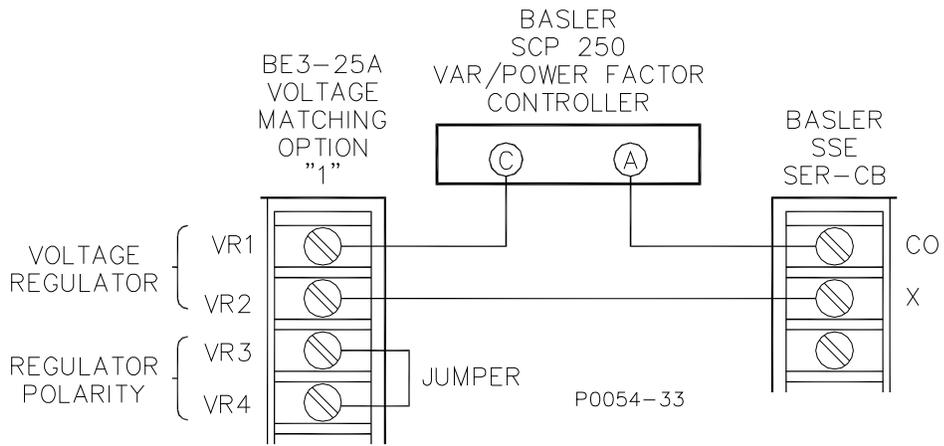


Figure 4-16. Voltage Matching Connections, SSE and SER-CB Regulators

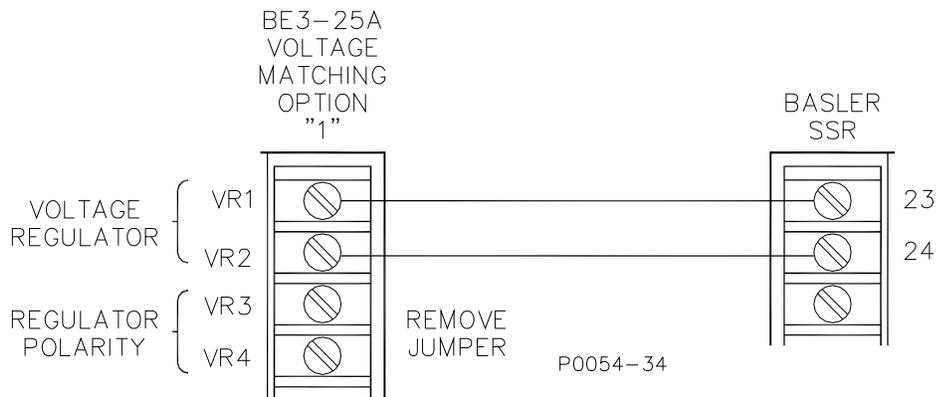


Figure 4-17. Voltage Matching Connections, SSR Regulator

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SECTION 5 • OPERATION AND MAINTENANCE

OPERATION

The following procedures should be performed before placing the BE3-25A in service.

Initial Setup

Perform only those steps that are applicable to your BE3-25A. Steps that apply to a particular style of BE3-25A have the affected style number(s) listed (in parenthesis) at the beginning of the step.

NOTE

If the governor and voltage regulator are not properly adjusted, the BE3-25A may not be able to drive the governor or voltage regulator enough to allow synchronization. Consult the governor and voltage regulator manuals for information regarding their adjustment.

1. *All models.* Place the front panel Test/Operate switch in the Test position.
2. *Styles AXX, BXX, and WXX.* If the internal reset feature is desired, connect the external jumper (if not already installed) across terminals R1 and R2. If the reset function will be controlled externally, remove the jumper and connect the external control contacts (a switch or 52a contacts) across the terminals.
3. *All models.* To enable the 0.75 second delay between synchronization and breaker closure, connect an external jumper (if not already installed) across terminals D1 and D2. To provide instantaneous time between synchronization and breaker closure, remove any jumper connected across these terminals.
4. *Style XXD.* To enable the dead bus closing feature, connect an external jumper (if not already installed) across terminals DB1 and DB2. To disable this option, remove any jumper connected across these terminals.
5. *Style X1X.* Using Figures 4-13 through 4-17 as a guide, either remove or install the Regulator Polarity jumper at terminals VR3 and VR4.
6. *Styles AXX, BXX, and WXX.* Using Figure 2-2 as a guide, connect the Governor Stability jumper for a medium response time.
7. *Styles X1X and X2X.* Set the front panel Voltage Matching Switch at the desired voltage difference (1, 2, 3, 4, or 5%) that is required for synchronization.
8. *All styles except X1X and X2X.* Adjust the front panel Voltage Matching Potentiometer to midrange.
9. *All models.* Set the front panel Breaker Closing Angle Switch to the desired closing angle (5, 10, 15 or 20°).
10. *All models.* Set all other front panel controls to midrange.
11. *Style AXX.* Set the governor offset as follows:
 - a. Install the Reset jumper across terminals R1 and R2.
 - b. While observing a frequency meter, adjust the generator frequency until the front panel Synchronism indicator is lit.
 - c. Adjust the front panel Offset Adjustment Potentiometer until there is no frequency correction signals output from the BE3-25A.
 - d. If external reset is desired, remove the jumper from terminals R1 and R2 and connect the external Reset contacts to the terminals.
12. *All styles except X1X and X2X.* Adjust the voltage difference between the bus and generator to the desired level. Then adjust the front panel Voltage Matching Potentiometer until the front panel Synchronism indicator just turns off.
13. *Style XXD.* Decrease the bus voltage to the desired “dead bus” threshold and then adjust the front panel Dead Bus potentiometer until the front panel Synchronism indicator just lights. Return the bus voltage to the previous level.

14. *All models.* Stop the prime mover and then restart the prime mover while observing the generator frequency and voltage. If needed, adjust the Governor Stability and/or the Regulator Stability Potentiometer for the best response time with frequency or voltage hunting (oscillations).

Preoperational Checkout

1. Use the appropriate interconnection diagram to verify that all connections are correct.
2. Place the front panel Test/Operate switch in the Operate position.
3. Verify that all BE3-25A jumpers are properly configured for the application.
4. Ensure that all BE3-25A controls are set correctly for the application.

Operation

1. Apply operating power and observe that the front panel Power indicator lights.
2. When the BE3-25A synchronizes the oncoming generator with the bus, observe that the front panel Synchronism indicator lights.

TROUBLESHOOTING

Use the following troubleshooting procedures when difficulties are encountered in the operation of the synchronizing system.

BE3-25A Power indicator does not light

1. Check all wiring for proper connections.
 - a. Correct any wiring errors.
 - b. If the wiring is correct, proceed to step 2.
2. Verify that the level of operating power applied to the BE3-25A is correct.
 - a. If voltage level of operating power is incorrect, connect proper level of operating power voltage to the BE3-25A.
 - b. If the operating power voltage level is correct, proceed to step 3.
3. Replace the BE3-25A if the above steps fail to correct the problem.

No control of governor

1. Check all wiring for proper connections.
 - a. Correct any wiring errors.
 - b. If the wiring is correct, proceed to step 2.
2. Check for a defective governor.
 - a. If the governor is malfunctioning, refer to the governor instruction manual.
 - b. If the governor is operating correctly, proceed to step 3.
3. Check the BE3-25A frequency matching output contacts with a meter or measure the BE3-25A bipolar, frequency-matching output with a high-impedance meter (digital voltmeter with a 1 M Ω input) for proper operation of the summing point output.
 - a. If the output is defective, replace the BE3-25A.

No control of the voltage regulator

1. Check all wiring for proper connections.
 - a. Correct any wiring errors.
 - b. If the wiring is correct, proceed to step 2.
2. Check for a defective voltage regulator.
 - a. If the voltage regulator is malfunctioning, refer to the voltage regulator instruction manual.
 - b. If the voltage regulator is operating correctly, proceed to step 3.

3. Check for a defective motor operated control.
 - a. If the motor operated control is malfunctioning, refer to the motor operated control instruction manual.
 - b. If the motor operated control is operating correctly, proceed to step 4.
4. Check the BE3-25A voltage matching output contacts with a meter or measure the BE3-25A bipolar, voltage-matching output with a high-impedance meter (digital voltmeter with a 1 M Ω input) for proper operation of the summing point output.
 - a. If the output is defective, replace the BE3-25A.

Synchronism indicator lights but the breaker does not close

1. Check the position of the Test/Operate switch.
 - a. If the switch is in the Test position, place it in the Operate position.
 - b. If the switch is in the Operate position, proceed to step 2.
2. Check all BE3-25A wiring for proper connections.
 - a. Correct any wiring errors.
 - b. If the wiring is correct, proceed to step 3.
3. Check for a defective breaker.
 - a. If the breaker is malfunctioning, refer to the breaker instruction manual.
 - b. If the breaker is operating correctly, proceed to step 4.
4. Replace the BE3-25A if the above steps fail to correct the problem.

Synchronism indicator does not light

1. Check all BE3-25A wiring for proper connections.
 - a. Correct any wiring errors.
 - b. If the wiring is correct, proceed to step 2.
2. Check that the phase angle, voltage difference, and/or slip frequency limits are not being exceeded.
 - a. If the limits are being exceeded, adjust the governor and/or voltage regulator.
 - b. If the limits are not being exceeded, proceed to step 3.
3. Replace the BE3-25A if the above steps fail to correct the problem.

PREVENTIVE MAINTENANCE

The BE3-25A requires no preventive maintenance other than periodic inspection to ensure that the synchronizer is clean and free from accumulations of dust and moisture. Also ensure that all wire connections are clean and secure.

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