



BE1-64F

Ground Fault Relay

Instruction Manual



 **WARNING:** California's Proposition 65 requires special warnings for products that may contain chemicals known to the state of California to cause cancer, birth defects or other reproductive harm. Please note that by posting this Proposition 65 warning, we are notifying you that one or more of the Proposition 65 listed chemicals may be present in products we sell to you. For more information about the specific chemicals found in this product, please visit <https://www.basler.com/Prop65>.

Preface

This instruction manual provides information about the installation and operation of the BE1-64F. To accomplish this, the following information is provided:

- General information and specifications
- Control and indicator descriptions
- Functional description
- Installation guidance
- Testing procedures

Conventions Used in this Manual

Important safety and procedural information is emphasized and presented in this manual through warning, caution, and note boxes. Each type is illustrated and defined as follows.

Warning!

Warning boxes call attention to conditions or actions that may cause personal injury or death.

Caution

Caution boxes call attention to operating conditions that may lead to equipment or property damage.

Note

Note boxes emphasize important information pertaining to installation or operation.



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Warning!

READ THIS MANUAL. Read this manual before installing, operating, or maintaining this equipment. Note all warnings, cautions, and notes in this manual as well as on the product. Keep this manual with the product for reference. Only qualified personnel should install, operate, or service this system. Failure to follow warning and cautionary labels may result in personal injury or property damage. Exercise caution at all times.

Caution

Installing previous versions of firmware may result in compatibility issues causing the inability to operate properly and may not have the enhancements and resolutions to issues that more recent versions provide. Basler Electric highly recommends using the latest version of firmware at all times. Using previous versions of firmware is at the user's risk and may void the warranty of the unit.

Basler Electric does not assume any responsibility to compliance or noncompliance with national code, local code, or any other applicable code. This manual serves as reference material that must be well understood prior to installation, operation, or maintenance.

For terms of service relating to this product and software, see the *Commercial Terms of Products and Services* document available at www.basler.com/terms.

This publication contains confidential information of Basler Electric Company, an Illinois corporation. It is loaned for confidential use, subject to return on request, and with the mutual understanding that it will not be used in any manner detrimental to the interests of Basler Electric Company and used strictly for the purpose intended.

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. Over time, improvements and revisions may be made to this publication. Before performing any of the following procedures, contact Basler Electric for the latest revision of this manual.

The English-language version of this manual serves as the only approved manual version.

Revision History

A historical summary of the changes made to this instruction manual is provided below. Revisions are listed in reverse chronological order.

Instruction Manual Revision History

Manual Revision and Date	Change
H, May 2025	<ul style="list-style-type: none"> Updated China RoHS compliance
G, Feb 2024	<ul style="list-style-type: none"> Added China RoHS compliance Removed EAC certification
F, Nov 2022	<ul style="list-style-type: none"> Added a note about alternate leakage paths in the <i>Specifications</i> chapter Added UKCA mark to rear panel terminal illustrations
E, Aug 2022	<ul style="list-style-type: none"> Added a note about EMI suppression in the <i>Installation</i> chapter Minor text edits
D, Sep 2021	<ul style="list-style-type: none"> Added UKCA compliance statement Updated style of manual
C2, Mar 2019	<ul style="list-style-type: none"> Revised wording of California Proposition 65 warning statement
C1, Jan 2019	<ul style="list-style-type: none"> Added California Proposition 65 warning statement
C, Jan 2017	<ul style="list-style-type: none"> Added coverage of part numbers 9367200200, 9367200201, 9367200202, and 9367200203 for positive field (F+) connections Added RoHS and EAC certifications Updated style of manual
B, Feb 2014	<ul style="list-style-type: none"> Updated product dimensions to reflect thicker rear panel overlay Corrected output contact ratings Added electrolytic capacitor maintenance recommendation
A, Jan 2008	<ul style="list-style-type: none"> Added coverage of part number 9367200104 Added CE compliance information
—, Mar 2005	<ul style="list-style-type: none"> Initial release



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1 • Introduction

The BE1-64F Ground Fault Relay detects and annunciates ground faults in the normally ungrounded field circuit of a synchronous machine. A short-circuit in a synchronous machine's field can often be prevented by detecting and removing a ground fault before a second ground fault results in serious damage.

BE1-64F relays are compatible with continuous field voltages up to 600 Vdc and forcing voltages up to 750 Vdc for one minute. During reverse excitation (negative forcing), BE1-64F relays will withstand up to 1,200 Vdc for one minute.

Note

To ensure protection against field grounds, the rotor iron must be grounded. Do not rely on a ground path through the rotor bearings. Grounding must not be installed where it bypasses the bearing insulation that prevents shaft currents. Rotor grounding recommendations for a machine should be obtained from the machine manufacturer.

Two sets of relay outputs and front panel indicators are provided for fault annunciation and tripping duty. One set of output contacts, one front panel indicator, and a latching target indicator annunciate the detection of a ground fault in the field winding. A second set of output contacts and a front panel indicator annunciate the detection of lower than normal resistance across the field winding and ground.

Replacement of an ABB 64F with the BE1-64F is simplified because the panel cutout and drilling pattern for the BE1-64F matches that of the ABB 64F.

Part Numbers

Each BE1-64F has a designated 10-digit part number located on the rear overlay. BE1-64F part numbers are listed in Table 1-1 with their corresponding functional characteristics.

Table 1-1. BE1-64F Part Numbers

Part Number	Connection Type*	Trip/Test Pushbuttons
9367200102†	F–	Yes
9367200103	F–	Yes
9367200104	F–	No
9367200200†	F+	Yes
9367200201	F+	Yes
9367200202†	F+	No
9367200203	F+	No

- * BE1-64F relays with an F– connection are compatible only with applications that have access to the negative side of the exciter or main field of the generator. BE1-64F relays with an F+ connection are compatible only with applications that have access to the positive side of the exciter or main field of the generator.

- † A component of Basler Electric excitation systems.



2 • Controls and Indicators

BE1-64F controls and indicators consist of pushbuttons and light-emitting diodes (LEDs) located on the relay front panel. Figure 2-1 illustrates the BE1-64F controls and indicators. Table 2-1 references the locators in Figure 2-1 and provides a description of each BE1-64F control and indicator.

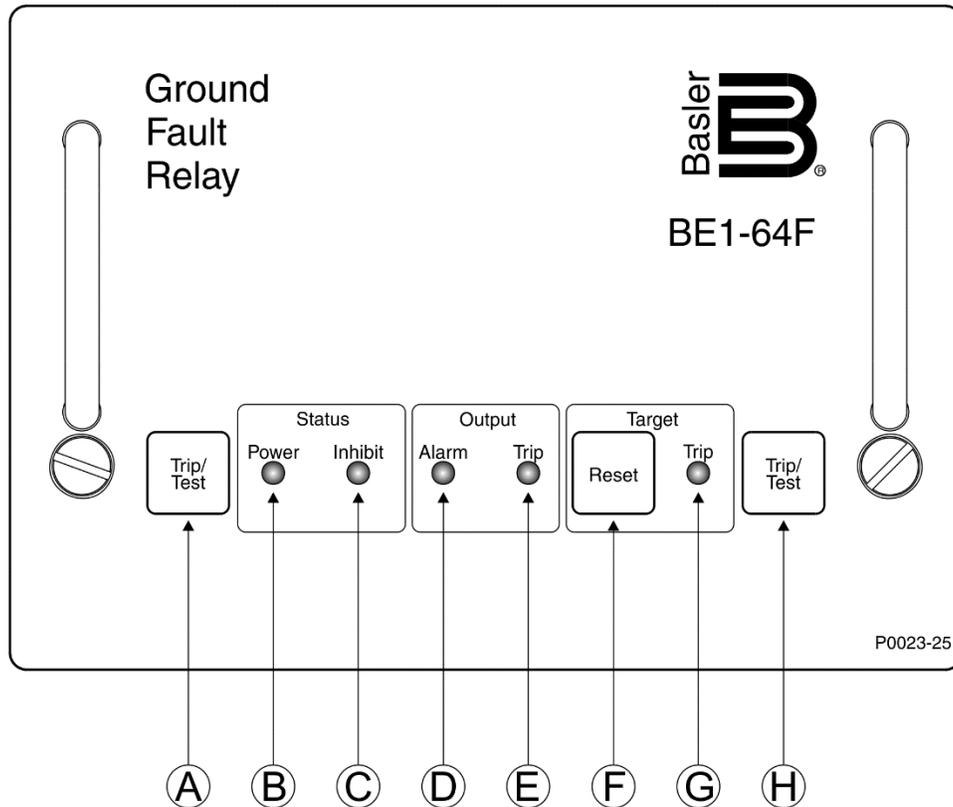


Figure 2-1. BE1-64F Controls and Indicators

Table 2-1. Control and Indicator Descriptions

Locator	Description
A	<i>Trip/Test Pushbutton.</i> Simultaneously pushing the two Trip/Test pushbuttons (locators A and H) causes the Ground Trip output contacts to close, the Pre-Alarm output contacts to close, the Trip Output indicator (locator E) to light, the Alarm output indicator (locator D) to light, and the Trip Target indicator (locator G) to latch on. This control is not provided on BE1-64F relays with part numbers 9367200104, 9367200202 and 9367200203.
B	<i>Power Status Indicator.</i> This green LED lights when operating power is applied to the relay.
C	<i>Inhibit Status Indicator.</i> This red LED lights when the Block input is energized and BE1-64F tripping is disabled.
D	<i>Alarm Output Indicator.</i> This red LED lights when the relay senses less than 20kΩ of resistance from the machine field to ground and the Pre-Alarm output contacts close. This function may be disabled by a user-adjustable jumper located on the draw-out printed circuit board. See the <i>Installation</i> chapter for the jumper location and jumper placement instructions.

Locator	Description
E	<i>Trip Output Indicator.</i> This red LED lights when the relay senses less than 5 k Ω of resistance from the machine field to ground and the Ground Trip output contacts close.
F	<i>Target Reset Pushbutton.</i> This control is pressed to reset the latching Trip Target indicator (locator G) after a ground in the machine field circuit has been removed.
G	<i>Trip Target Indicator.</i> This red indicator latches on when the Ground Trip output closes due to a ground in the machine field circuit. Target status is maintained when relay operating power is removed. When relay operating power is restored, the Trip Target LED indicates the target status prior to the removal of operating power. The Trip Target indicator is reset by operating the Target Reset pushbutton (locator F).
H	<i>Trip/Test Pushbutton.</i> Simultaneously pushing the two Trip/Test pushbuttons (locators A and H) causes the Ground Trip output contacts to close, the Pre-Alarm output contacts to close, the Trip Output indicator (locator E) to light, the Alarm output indicator (locator D) to light, and the Trip Target indicator (locator G) to latch on. This control is not provided on BE1-64F relays with part numbers 9367200104, 9367200202 and 9367200203.

3 • Functional Description

The BE1-64F Ground Fault Relay detects and annunciates ground faults in the normally ungrounded field circuit of a synchronous machine.

The BE1-64F applies a dc voltage between the field circuit and ground. When a ground fault occurs, the BE1-64F detects the flow of current and annunciates the fault. Detection of ground faults by the BE1-64F depends upon the nominal field voltage and the location of the ground fault in the field winding.

BE1-64F Function Blocks

BE1-64F functions are illustrated in Figure 3-1. The following paragraphs describe each of the function blocks illustrated in Figure 3-1.

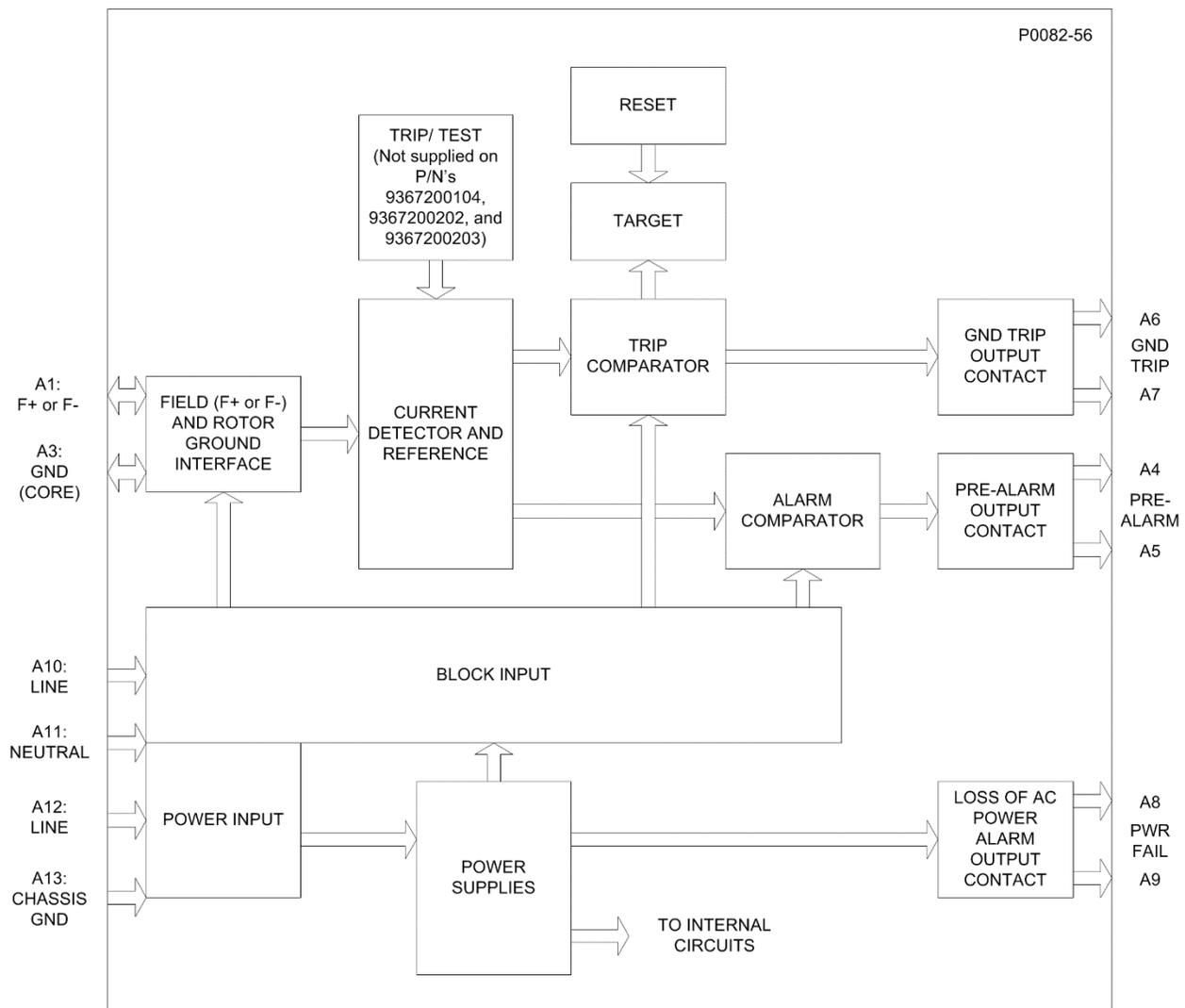


Figure 3-1. BE1-64F Function Block Diagram

Power Input

Operating power applied to terminals A12 (line) and A11 (neutral) is stepped down and applied to the power supplies in the relay. The power input accepts voltage in the range of 90 to 132 Vac.

Power Supplies

Stepped-down ac voltage from the power input is rectified, filtered, and regulated. The power supplies apply regulated dc voltage to internal relay circuitry and supply the dc voltage impressed across the protected circuit and ground.

Block Input

Applying voltage to terminals A10 (line) and A11 (neutral) disables the relay alarm and trip functions and removes the dc voltage impressed across the protected circuit and ground. The block input accepts voltage in the range of 90 to 132 Vac. Note that the block input shares terminal A11 (neutral) with the power input.

Field (F+ or F-) and Rotor Ground Interface

This interface supplies approximately 55 Vdc to the protected circuit through terminals A1 (F+ or F-) and A3 (GND (CORE)). This interface voltage is removed when the block input is energized.

Current Detector and Reference

If a ground fault occurs between the protected circuit and ground, fault current flows from terminal A1 (F+ or F-) to A3 (GND (CORE)). This fault current is measured and scaled by the current detector. A compensated reference is also developed for comparison with the scaled current detector output level. The reference and current detector levels are supplied to the trip comparator and alarm comparator circuits for use in the determination of alarm and trip conditions.

Alarm Comparator

The alarm comparator compares the output level of the current detector with a scaled version of the reference output. An alarm condition is determined if the current detector output level exceeds the scaled reference output level for approximately 0.75 seconds. When an alarm condition is determined, the alarm comparator sends a signal to the pre-alarm output contact circuit. The pre-alarm output contact closes and the front panel Alarm LED lights for as long as the alarm condition exists.

Pre-Alarm Output Contact

This circuit is controlled by the alarm comparator output and closes the output contact for the duration of an alarm condition (unless the block input is energized). Connections to the pre-alarm output contact are made at terminals A4 and A5 (PRE-ALARM).

Trip Comparator

The output levels of the current detector and reference are compared by the trip comparator. A trip condition is determined when the current detector output level exceeds the reference output level for approximately 0.75 seconds. During a trip condition, the trip comparator sends a signal to the ground trip output contact circuit, the ground trip output contact closes, the front panel Output Trip and Output Alarm LEDs light, and the Target Trip LED latches on. If the trip condition is cleared, the Output Trip and Alarm LEDs turn off, but the Target Trip LED remains on until the Target Reset pushbutton is pressed.

Ground Trip Output Contact

This circuit is controlled by the trip comparator output and closes the output contact for the duration of a trip condition (unless the block input is energized). Connections to the ground trip output contact are made at terminals A6 and A7 (GND TRIP).

Loss of AC Power Alarm Output Contact

This output contact is open during normal operation and closes when relay operating power is lost. Contact connections are made at terminals A8 and A9 (PWR FAIL).

Target

The target circuit latches the front panel Target Trip LED on when a trip occurs. The target circuit remains latched even when relay operating power is lost. Pressing the front panel Target Reset pushbutton resets the target and Target Trip LED (unless an active trip condition is present).

Reset

The reset circuit responds to the front panel Target Reset pushbutton and returns the target to an untripped condition (unless an active trip condition is present).

Trip/Test

The trip/test circuit tests relay functionality by internally simulating a trip condition. A trip or test is initiated by pressing the two front panel Trip/Test pushbuttons simultaneously. The simulated trip condition is removed when either or both of the Trip/Test pushbuttons are released. The Target Trip LED remains lit until the Target Reset pushbutton is pressed.

The trip/test function is not provided on BE1-64F relays with part numbers 9367200104, 9367200202, and 9367200203.



4 • Installation

Figures 4-1 through 4-3 show the overall dimensions of the BE1-64F. Figure 4-1 shows the front view, Figure 4-2 shows the side view, and Figure 4-3 shows the top view. A panel cutting and drilling diagram is provided in Figure 4-4. All dimensions are shown in inches with millimeters in parenthesis.

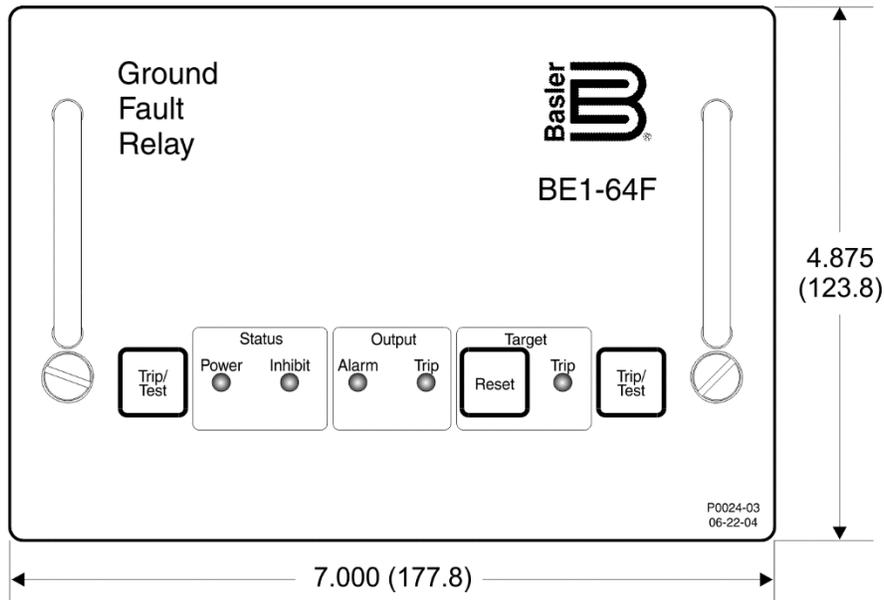


Figure 4-1. BE1-64F Dimensions, Front View

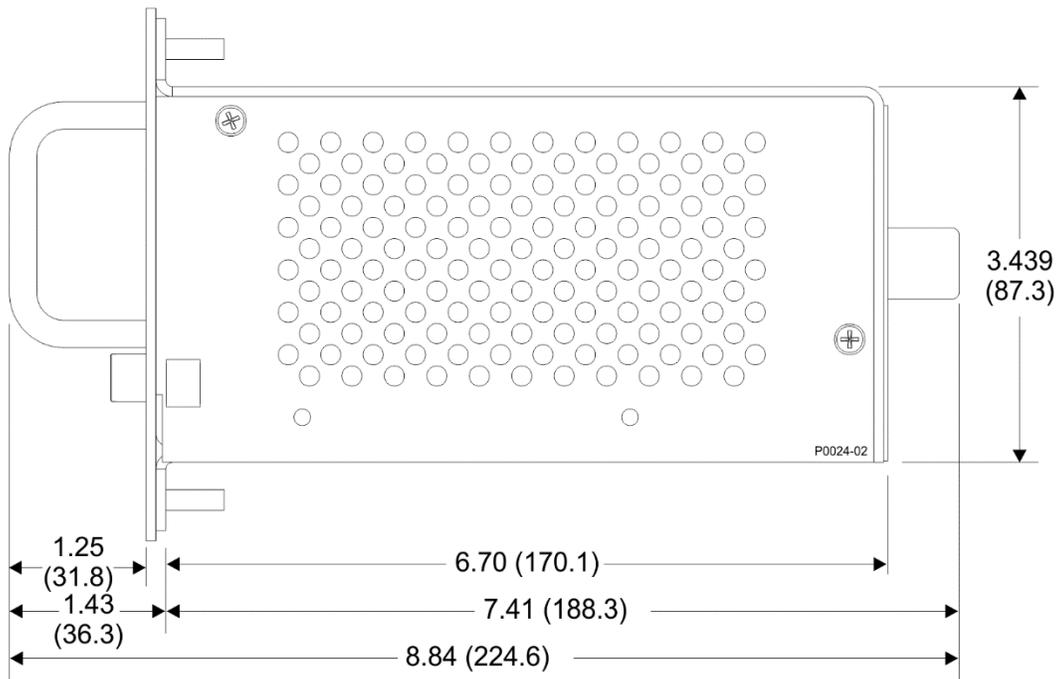


Figure 4-2. BE1-64F Dimensions, Side View

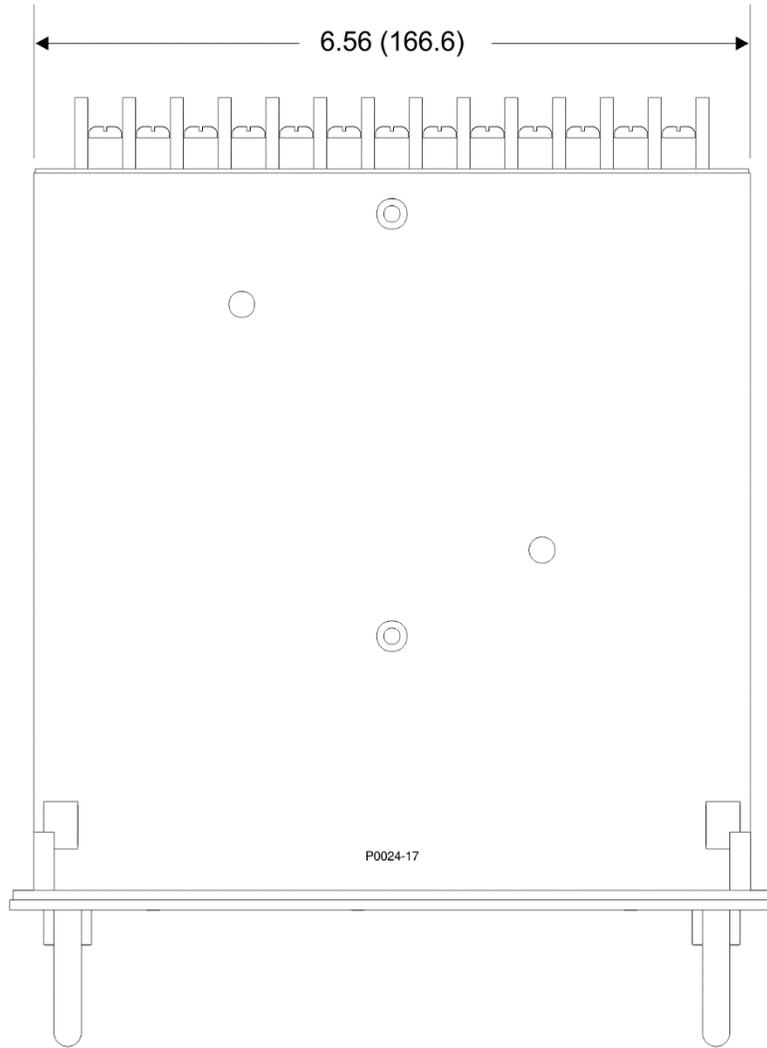


Figure 4-3. BE1-64F Dimensions, Top View

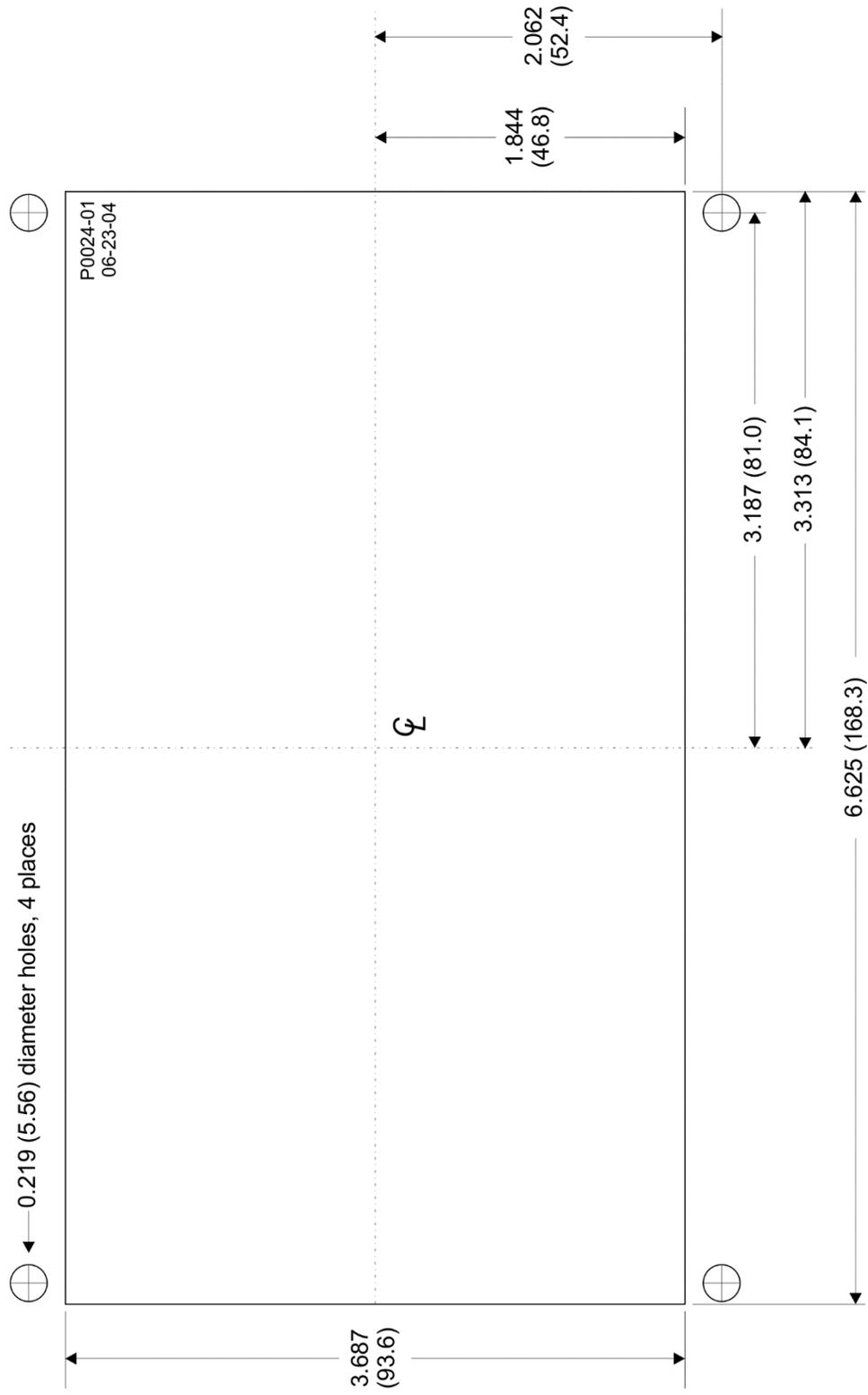


Figure 4-4. BE1-64F Cutout and Drilling Diagram

Pre-Alarm Jumper

The pre-alarm jumper (J1) can be positioned by the user to enable or disable pre-alarm annunciation. J1 is located on the circuit board of the draw-out assembly (Figure 4-5). J1 is accessed by loosening the two captive front-panel screws and removing the draw-out assembly from the case.

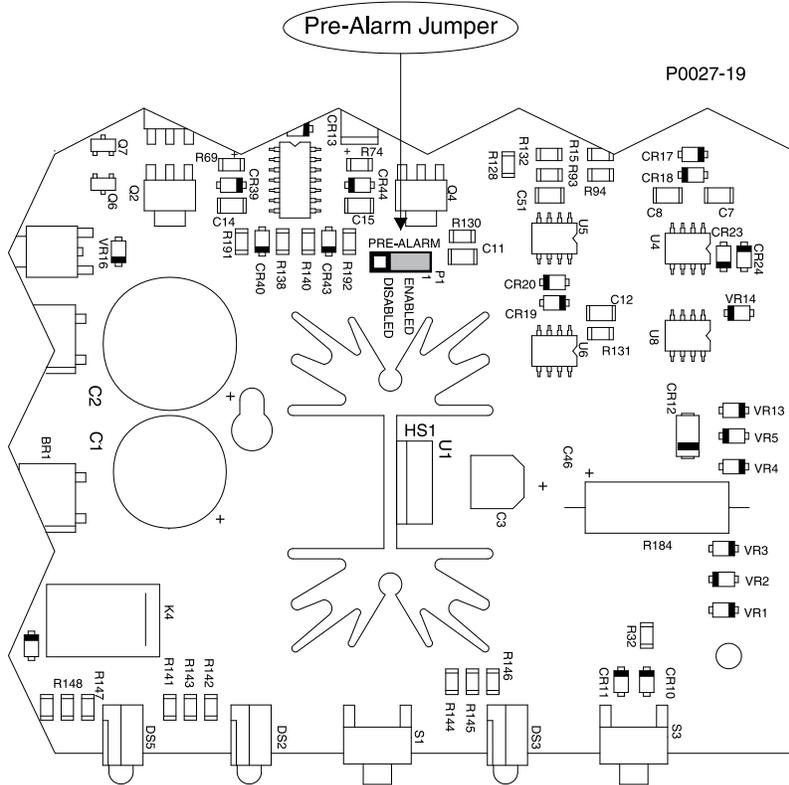


Figure 4-5. Pre-Alarm Jumper Location

Caution	
Observe all applicable electrostatic discharge (ESD) precautions when handling the draw-out assembly.	

Table 4-1 lists the jumper positions required to enable and disable the pre-alarm function.

Table 4-1. Pre-Alarm Jumper Positions

Pre-Alarm Annunciation	Jumper Position (P1 Pins)
Enabled	1 to 2
Disabled	2 to 3

Connections

Notes

Be sure that the BE1-64F is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the unit case. When the relay is configured in a system with other devices, it is recommended to use a separate lead to the ground bus from each unit.

It is recommended in all applications, where contact outputs drive relay coils, that a reverse-biased flyback diode be implemented in parallel with the relay coil for EMI suppression.

Figure 4-6 illustrates the BE1-64F terminal connections with an F+ connection.

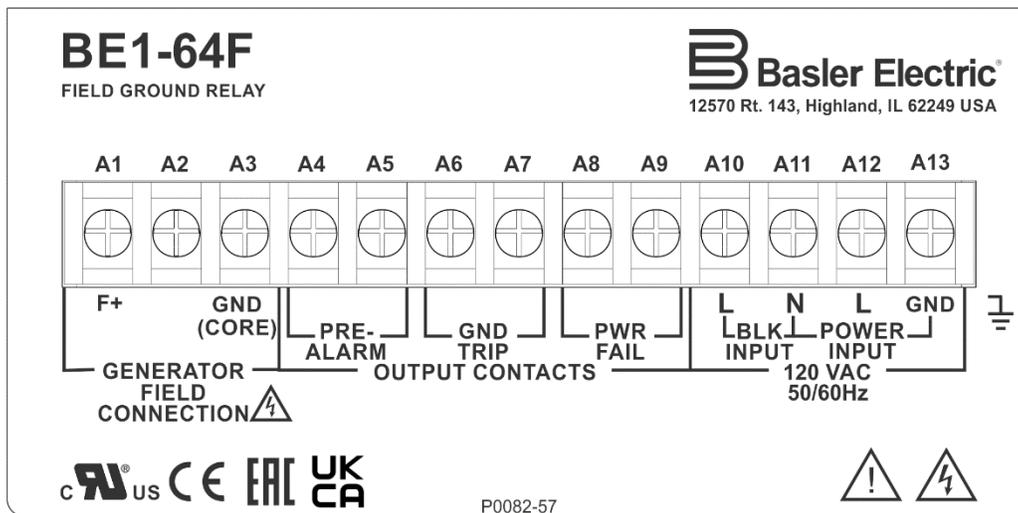


Figure 4-6. BE1-64F Terminal Connections with F+ Connection Type

Figure 4-7 illustrates the BE1-64F terminal connections with an F- connection.

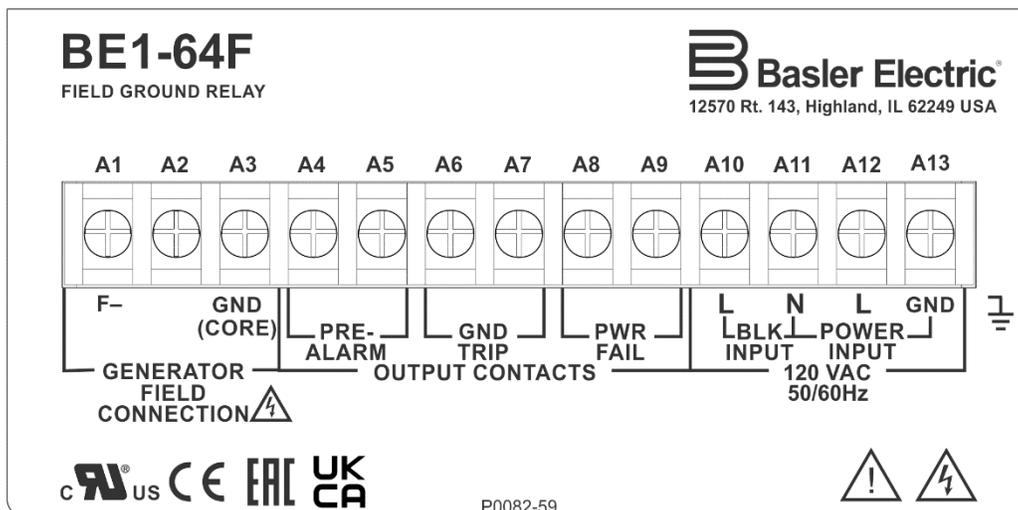


Figure 4-7. BE1-64F Terminal Connections with F- Connection Type

Figure 4-8 shows BE1-64F connections for a typical application (F+ connection).

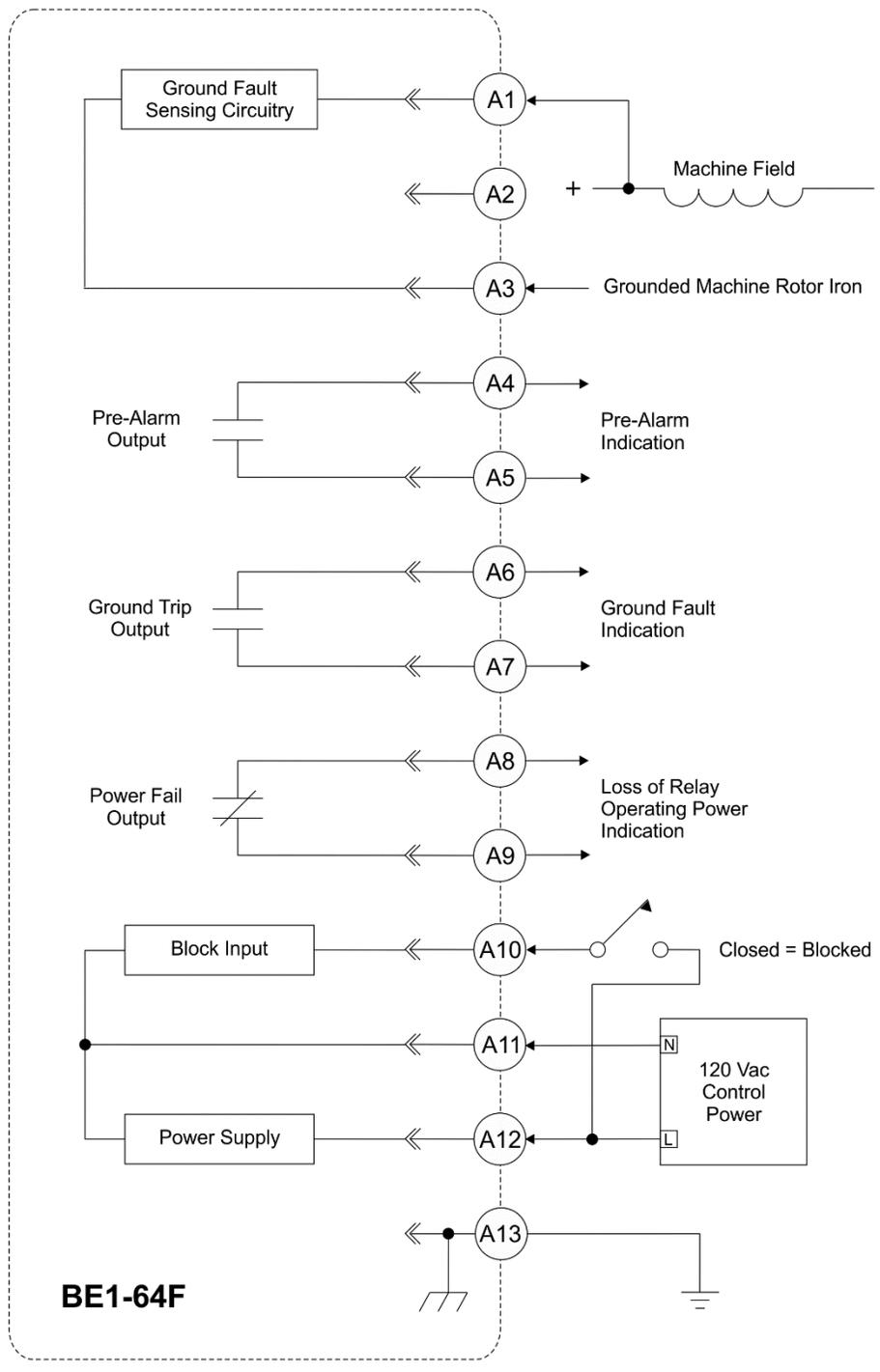
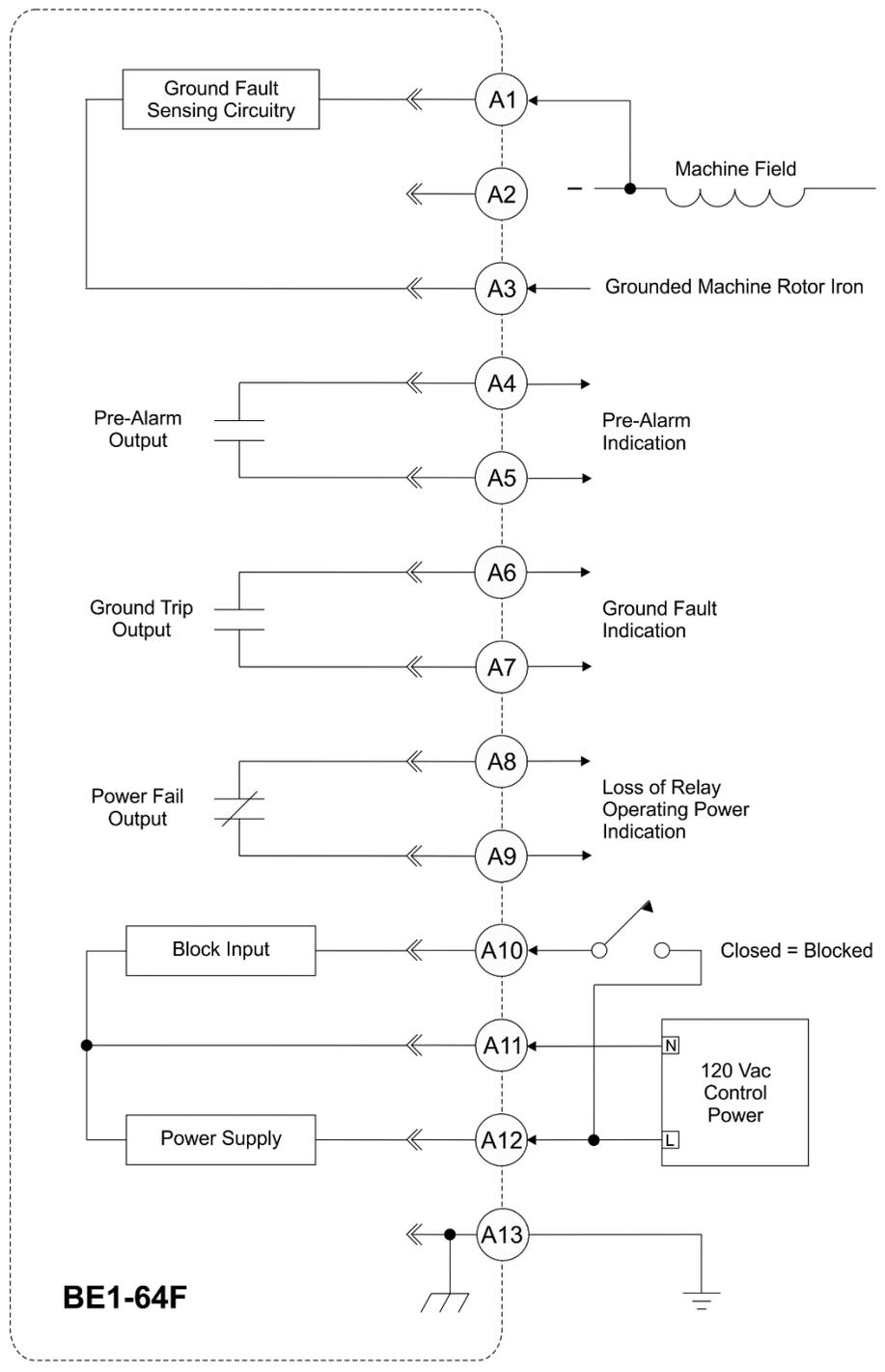


Figure 4-8. BE1-64F Typical Connections (F+)

Figure 4-9 shows BE1-64F connections for a typical application (F- connection).



P0082-60
Figure 4-9. BE1-64F Typical Connections (F-)

Storage

This device contains long-life aluminum electrolytic capacitors. For devices that are not in service (spares in storage), the life of these capacitors can be maximized by energizing the device for 30 minutes once per year.



5 • Testing

To test BE1-64F operation, perform the following procedures.

Test Setup

Prepare the relay for testing by making the connections shown in Figure 5-1. Set switches S1 and S2 in the positions indicated by Figure 5-1.

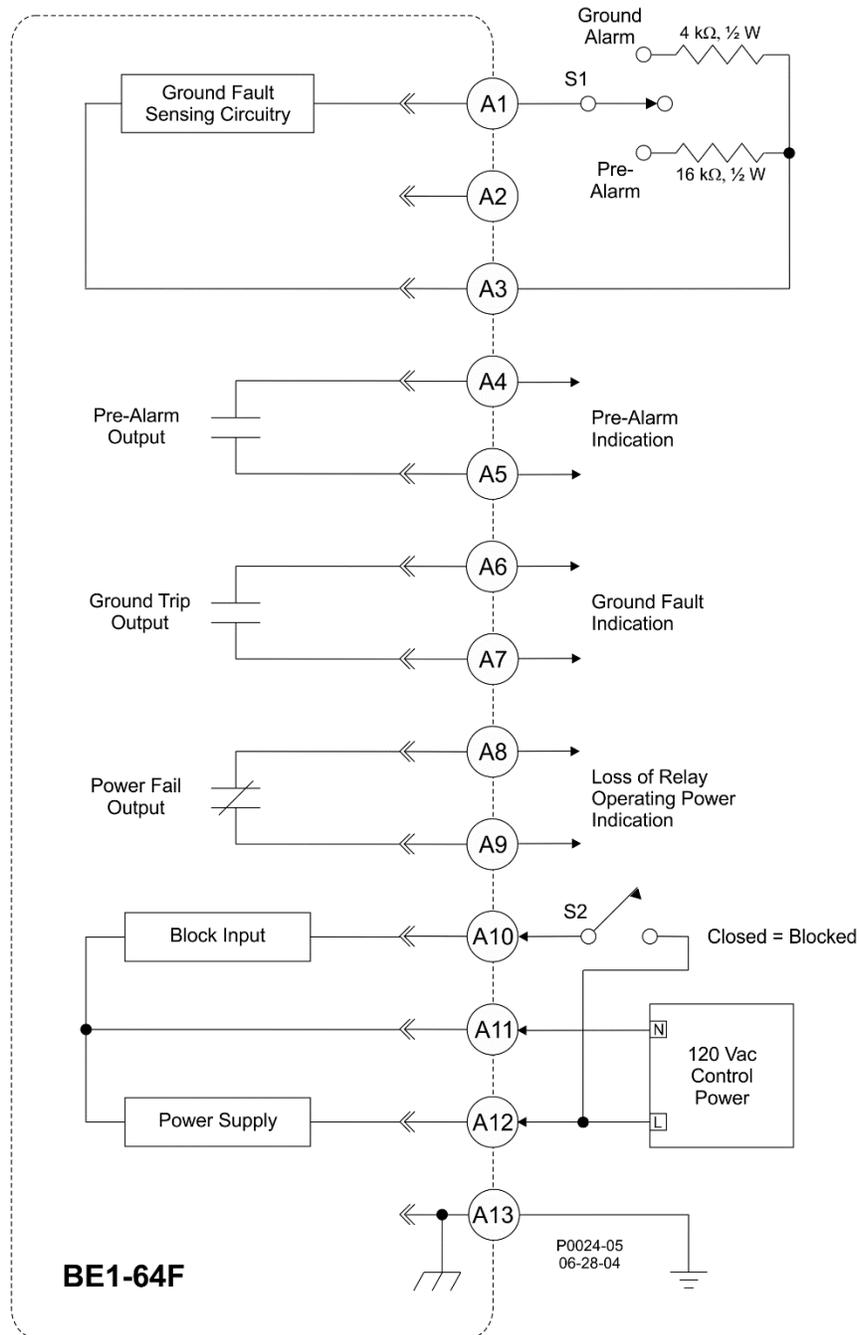


Figure 5-1. BE1-64F Test Setup

Power-Up

1. Prior to applying relay operating power, verify that the Power Fail output contacts at terminals A8 and A9 are closed.
2. Apply 120 Vac operating power to terminals A11 and A12. The Power Fail output contacts should open.
3. Press the Target Reset button. All front panel indicators should be off except for the green Power Status LED. The Pre-Alarm output contacts at terminals A4 and A5 and the Ground Trip output contacts at terminals A6 and A7 should be open.

Trip/Test Pushbuttons

1. BE1-64F relays with part numbers 9367200104, 9367200202, and 9367200203 are not equipped with the Trip/Test function and pushbuttons. The following steps do not apply to relays with these part numbers.
2. Press and hold both front panel Trip/Test pushbuttons. The Pre-Alarm output contacts (terminals A4 and A5) and Ground Trip output contacts (terminals A6 and A7) should close, the front panel Alarm Output and Trip Output LEDs should light, and the Trip Target LED should latch on.
3. Release the Trip/Test pushbuttons. The Pre-Alarm output contacts and Ground Trip output contacts should open and the Alarm Output and Trip Output LEDs should turn off. The latching Trip Target LED should remain on.

Target Retention

1. Perform steps 1 and 2 of *Trip/Test Pushbuttons* so that the Trip Target LED is latched on.
2. Remove operating power from the relay. Wait several seconds and then apply relay operating power. Verify that target status is retained by observing that the Trip Target LED lights when relay operating power is restored.
3. Reset the Trip Target LED by pressing the Target Reset pushbutton.

Pre-Alarm

1. Place switch S1 in the Pre-Alarm position so that the 16 k Ω resistor is connected between relay terminals A1 and A3. The Pre-Alarm output contacts should close and the front panel Alarm Output LED should light.
2. Return switch S1 to the position shown in Figure 5-1. The Pre-Alarm output contacts should open and the Alarm Output LED should turn off.

Ground Trip

1. Place switch S1 in the Ground Alarm position so that the 4 k Ω resistor is connected between terminals A1 and A3. The Ground Trip output contacts should close, the Trip Output LED should light, and the Trip Target LED should latch on.
2. Return switch S1 to the position shown in Figure 5-1. The Ground Trip LED will remain lit until the Target Reset pushbutton is pressed.

Block Input

1. Place switch S2 in the closed position.
2. Place switch S1 in the Pre-Alarm position. The relay should not respond with an output contact closure or a front panel indication.
3. Place switch S1 in the Ground Alarm position. The relay should not respond with an output contact closure or a front panel indication.
4. Open switch S2 and verify that the relay responds to the ground alarm condition.

6 • Specifications

BE1-64F electrical and physical specifications are described below.

Electrical Specifications

Operating Power

Voltage Range 90 to 132 Vac
 Frequency 50/60 Hz
 Burden 150 mAac nominal, 200 mAac maximum
 Terminals A11 (N), A12 (L), A13 (GND)

Field Voltage Input

Continuous Rating 600 Vdc
 One Minute Forcing 750 Vdc
 One Minute Negative Forcing 1,200 Vdc
 Terminals A1 (F+ or F-), A3 (GND (CORE))

Block Input

Turn-On Threshold 70 Vac, ± 20 Vac
 Operating Range 90 to 132 Vac
 Frequency 50/60 Hz
 Burden 2 mAac
 Terminals A10 (L), A11 (N)

Operating Time

At 95% of Trip Value ≤ 1 s

Sensitivity

Expressed as resistance from field negative lead to ground. See Figure 6-1 for the sensitivity characteristic. In Figure 6-1, the dc fault voltage is the field voltage measured from the positive or negative lead, pending BE1-64F style, to the faulted point in the field winding.

Trip Function $5,000 \Omega$, $\pm 200 \Omega$
 Pre-Alarm Function $20,000 \Omega$, $\pm 1,000 \Omega$

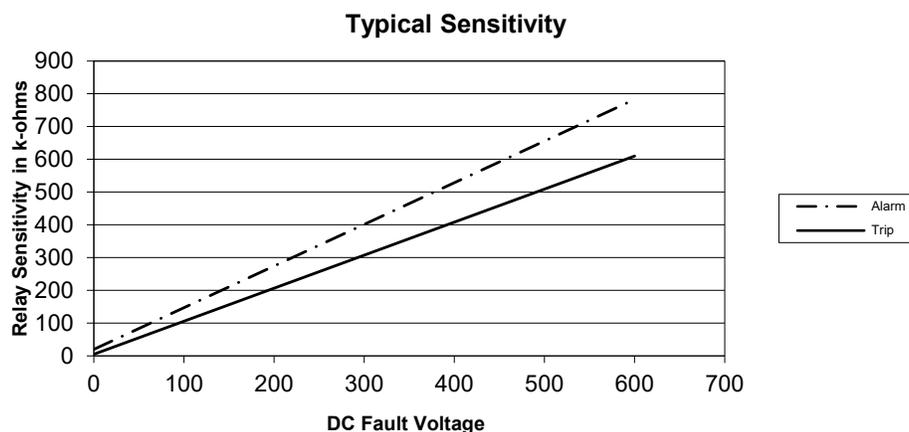


Figure 6-1. Sensitivity Characteristic

Note

The BE1-64F monitors all resistive paths from the field circuit to ground. Any path that does not go through the field winding (such as through the exciter power stage) will affect BE1-64F operation as defined by the sensitivity characteristic of Figure 6-1.

General Specifications

Output Contacts

Type Form A, B
 Functions Ground Trip, Pre-Alarm, Power Fail

Resistive Ratings

120/240 Vac Make 30 Aac for 0.2 s, carry 7 Aac continuously,
 and break 7 Aac
 250 Vdc Make and carry 30 Adc for 0.2 s, carry 7 Adc continuously,
 and break 0.3 Adc
 500 Vdc Make and carry 15 Adc for 0.2 s, carry 7 Adc continuously,
 and break 0.1 Adc

Inductive Ratings

120/240 Vac Make 30 Aac for 0.2 s, carry 7 Aac continuously,
 and break 0.3 A (L/R = 0.04)

Contact Configurations

Ground Trip Form A, close on ground trip condition
 Pre-Alarm Form A, close on pre-alarm condition
 Power Fail Form B, close on loss of operating power

Terminal Assignments

Ground Trip A6, A7
 Pre-Alarm A4, A5
 Power Fail A8, A9

Temperature

Operating -40 to 70°C (-40 to 158°F)
 Storage -40 to 85°C (-40 to 185°F)

Type Tests

Vibration IEC 255-21-1
 Shock IEC 255-21-2
 Surge Withstand Capability IEEE C37.90.1-1989
 Radio Interference IEC 61000-4-3
 Electrostatic Discharge IEC 255-22-2
 Isolation Power, Block inputs withstand 1,500 Vac for one minute. Output contact sets withstand 2,000 Vac for one minute. Field connection tested to IEEE 421.3.

Agency Recognition

UL Recognized Component

Recognized per UL Standard 508, CSA Standard C22.2 No. 14, and UL 1053, *Standard for Safety for Ground-Fault Sensing and Relaying Equipment (UL File E97033)*

CE and UKCA Compliance

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives:

- Low Voltage Directive (LVD) — 72/23EEC as amended by 93/68/EEC
- Electromagnetic Compatibility (EMC) — 89/336/EEC as amended by 92/31/EEC and 93/68/EEC
- Hazardous Substances (RoHS 2) – 2011/65-EU

Harmonized Standards Used for Evaluation:

- EN 50178 - *Electronic Equipment for use in Power Installations*
- EN 50581 - *Technical Documentation for the Assessment of Electrical and Electronic Products with Respect to the Restriction of Hazardous Substances*
- EN 61000-6-2 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*
- EN 61000-6-4 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*

China RoHS

The following table serves as the declaration of hazardous substances for China in accordance with PRC standard SJ/T 11364-2014. The EFUP (Environment Friendly Use Period) for this product is 40 years.

PRODUCT: BE1-64F		有害物质 Hazardous Substances									
零件名称 Part Name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr ⁶⁺)	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲 酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲 酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲 酸二酯 Bis(2- ethylhexyl) phthalate (BEHP)	邻苯二甲 酸二异丁 酯 Diisobutyl phthalate (DIBP)	
金属零件 Metal parts	O	O	O	O	O	O	O	O	O	O	
聚合物 Polymers	O	O	O	O	O	O	O	O	O	O	
电子产品 Electronics	X	O	O	O	O	O	O	O	O	O	
电缆和互连 配件 Cables & interconnect accessories	O	O	O	O	O	O	O	O	O	O	
绝缘材料 Insulation material	O	O	O	O	O	O	O	O	O	O	
<p>本表格依据 SJ/T11364 的规定编制。</p> <p>O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。</p> <p>X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。</p> <p>This form was prepared according to the provisions of standard SJ/T11364.</p> <p>O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26572.</p> <p>X: Indicates that the hazardous substance content in at least one of the homogenous materials of this part exceeds the limit specified in standard GB/T 26572.</p>											

Weight

Unit.....4.65 lb. (2.11 kg)
Shipping6.10 lb. (2.77 kg)

Dimensions

Height, Width, Depth4.875 in, 7.0 in, 8.693 in (123.8 mm, 177.8 mm, 220.8 mm)



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