Introduction

ES phase balance relays provide monitoring and protection in three-phase applications. Two models are available: the ES-47N provides phase unbalance, phase loss, phase reversal/phase sequence protection and the ES-47N/27 provides the same protection as the ES-47N in addition to undervoltage protection. See note below for additional information. Microprocessor-based circuitry enhances functionality and improves performance. Internal diagnostics annunciate when relay function or accuracy is compromised.

Warning!

READ THIS MANUAL. Read this manual before installing or operating your ES series relay. Note all warnings, cautions, and notes in this manual as well as on the product. Failure to follow warning and cautionary labels may result in personal injury or property damage. Exercise caution at all times.

It is the responsibility of the user to ensure that this product is installed, operated, and used for its intended function in the manner specified by this manual or any protection provided by this product may be impaired.

Relay Adjustments

All ES phase balance relays are equipped with a Set adjustment for the relay trip point. The Set adjustment is based on a percentage of the relay's nominal sensing voltage rating. Relays are also equipped with an adjustable timing Delay which prevents relay operation during brief voltage fluctuations.

Relay Output Contacts and Indicators

ES phase balance relays come equipped with output contacts and LED indicators. Relay output contacts can be used as an alarm annunciation, a control output, or a tripping signal. Two form-C output contacts and an LED indicator are provided for each protective function. Some models provide the option for an additional pair of form-C auxiliary contacts. Refer to the style chart (Figure 4). A Power LED indicates the presence of adequate sensing voltage when continuously lit and annunciates any relay fault, detected by internal diagnostics, when flashing.

Special Symbols

Special symbols are located on the ratings label on your ES series relay. These symbols are illustrated and described in Table 1.

Table 1. Special Symbol Descriptions

Symbol	Description
	Caution, Refer to Instructions
	Caution, Risk of Electric Shock

Case Sizes

All ES-47N and ES-47N/27 models with auxiliary contacts (style 3xB1N0A0) are supplied in a wide case. All other ES-47N and ES-47N/27 models are supplied in a narrow case. See Figure 1 for case sizes.

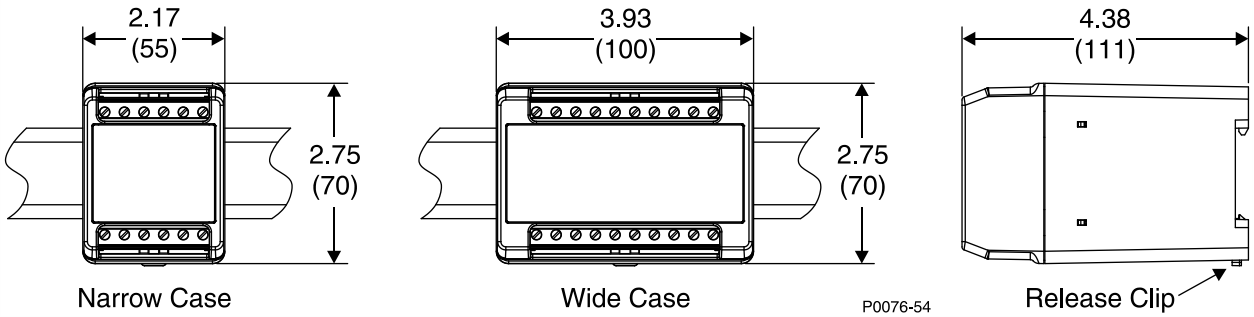

Figure 1. Relay Dimensions

Specifications

Inputs

All units are self-powered.

Nominal Voltage: 120 Vac, 208 Vac, 240 Vac, 380 Vac, 415 Vac, or 480 Vac
(For other nominal voltages, contact Basler Electric.)

Voltage Input

Operating Range: ±25% of nominal rating
Frequency: 50 or 60 Hz
Burden: <2.5 VA per phase for narrow case units. <3 VA per phase for wide case units.
Overload Withstand: 2 times nominal for 3 s

Setpoint

Range: Adjustable 5 to 15% of nominal
Repeatability: ±2% or ±1 V (whichever is greater)
Undervoltage: Preset at 85% of nominal
(ES-47N/27 only)
Time Delay: Adjustable 0 to 20 s
Dropout (Reset): Fixed at 1 % of nominal

Outputs

Output contact trip performance is in accordance with IEEE Std C37.90™-2005 and IEC 60255-1

Contact Type: Two form-C contacts per protective function

Make and Carry for Tripping Duty

30 A, 250 Vdc for 0.2 seconds per IEEE Std C37.90-2005 – IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus; 7 A continuous ac or dc

Break Resistive or Inductive

0.3 A at 125 or 250 Vdc (L/R = 0.04 maximum)

Environment

Operating Temperature: –40 to 70°C (–40 to 158°F)
Storage Temperature: –40 to 85°C (–40 to 185°F)
Temperature Coefficient: 0.02% of nominal per °C (200 ppm/°C)
Relative Humidity: ≤ 95%, non-condensing
Ingress Protection: IP50 Case, IP20 Terminals
Pollution: Degree 1
Insulation: Class II
Overvoltage: Category III

Physical

Terminals

Type:	Compression screw
Wire Size:	0.5-3.3 mm2/20-12 AWG
Screw Torque:	4.4 to 5.3 in-lb (0.5 to 0.6 N•m)
Mounting (HxD):	DIN rail 1.38 x 0.29 inches (35 x 7.5 mm) complies with IEC 60715

Size (WxHxD)

Narrow Case:	2.17 x 2.75 x 4.38 inches (55 x 70 x 111 mm)
Wide Case:	3.93 x 2.75 x 4.38 inches (100 x 70 x 111 mm)

Weight

Narrow Case:	0.85 lb (0.38 kg)
Wide Case:	1.10 lb (0.50 kg)

Applicable Standards

IEC

IEC 60255-1 Measuring relays and protection equipment – Part 1: Common requirements (includes all referenced/normative IEC standards)

IEEE

IEEE Std C37.90™-2005 – IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE Std C37.90.1™-2012 – IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE Std C37.90.2™-2004 – IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

IEEE Std C37.90.3™-2001 – IEEE Standard for Electrostatic Discharge Tests for Protective Relays

Agency Compliance

UL

This product is listed to applicable Canadian and US safety standards and requirements by UL.

- UL 508
- UL 94 V-0
- CSA C22.2 No. 0
- CSA C22.2 No. 14

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.

EU directives:

- Low Voltage Directive (LVD) 2014/35/EU
- Electromagnetic Compatibility (EMC) 2014/30/EU
- Hazardous Substances (RoHS 2) 2011/65/EU

Harmonized standards used for evaluation:

- EN 50178
- EN 50581
- EN 60255-1
- EN 60255-26
- EN 60255-27
- IEC 61000-6-4

FCC Requirements

This product complies with FCC 47 CFR Part 15.

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:	ES-47N, ES-47N/27									
零件名称 Part Name	有害物质 Hazardous Substances									
	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	X	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

本表格依据 SJ/T11364 **的**规定编制。

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。

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。

This form was prepared according to the provisions of standard SJ/T11364.

O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26252.

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.

Operation

Phase unbalance protection in the ES-47N and ES 47N/27 relays is adjusted by controls marked Set and Delay. Undervoltage protection in the ES-47N/27 is fixed and has no user adjustment.

Set Control

The Set control adjusts the relay trip point. When the monitored voltage becomes unbalanced as identified by Equation 1 for the duration of the adjustable time delay, a relay trip occurs. This condition de-energizes the relay output and extinguishes the green Relay LED. The trip point is adjustable from 5 to 15% of the nominal input.

$$\frac{Max\ Phase - Min\ Phase}{Nominal\ Voltage} \geq Setpoint$$

Equation 1. Trip Calculation

Where:

Max Phase = the measured phase voltage of the highest magnitude
Min Phase = the measured phase voltage of the lowest magnitude
Nominal Voltage = the designated nominal voltage of the relay by style

Delay Control

The Delay control adjusts the amount of time that the sensed input exceeds the pickup level before a trip occurs. The time delay applies to phase unbalance and phase reversal/phase sequence functions. The time delay is adjustable from 0 to 20 seconds.

Phase loss protection in the ES-47N/27 has no intentional time delay (instantaneous trip).

Undervoltage Protection

The undervoltage protection function of the ES 47N/27 has no user adjustment and is fixed at 85% of the nominal input voltage rating. If any one of the three phases decreases below 85% of the nominal voltage rating, the relay output de-energizes and the green Relay LED extinguishes with no intentional time delay (instantaneous trip).

Settings Example

An ES-47N/27 relay with a nominal input rating of 120 Vac has the following settings:

- Set - 10%
- Delay - 5 s

A trip occurs when the sensing voltage of the phase with the highest magnitude is greater than the voltage of the phase with the lowest magnitude by more than 10% of nominal for 5 seconds. For example, if the three measured phases are 124 V, 119 V, and 110 V, the relay picks up because (124 V - 110 V)/120 V = 11.7% which is above the Set control value. After 5 seconds of this condition, the relay trips.

Dropout occurs when the sensing voltage of the picked up phase rises above 109.2 Vac (1% of nominal above trip point) or drops below 130.8 Vac (1% of nominal below trip point).

Installation

ES relays should be installed in a dry location where the ambient temperature remains within the operating temperature range.

ES phase balance relays mount on standard DIN rails that comply with IEC 60715. Mounting involves hooking the top edge of the cutout on the base of the case over one edge of the DIN rail. The opposite side of the cutout containing the release clip is then pushed over the opposite side of the DIN rail. To remove the relay, pull the release clip downward and move the relay as required. Figure 1 shows the dimensions of the ES-47N and ES-47N/27 relays.

Relay connections should be made using wire that meets applicable codes and is properly sized for the application. Figure 2 shows the sensing terminal connections for the ES 47N and ES-47N/27 relays. Swap L2 and L3 connections for ACB rotation systems. Figure 3 illustrates the front panel appearance of ES-47N and ES-47N/27 relays with optional auxiliary relay outputs (style 3xB1N0A0).

Caution

Before commissioning, check the equipment ratings, operating instructions, and installation instructions.

Note

When contact outputs are used to apply dc control voltage to inductive windings, such as relay coils, a flyback diode in parallel with the winding is recommended for EMI suppression. Failure to add such EMI suppression can result in circuit damage.

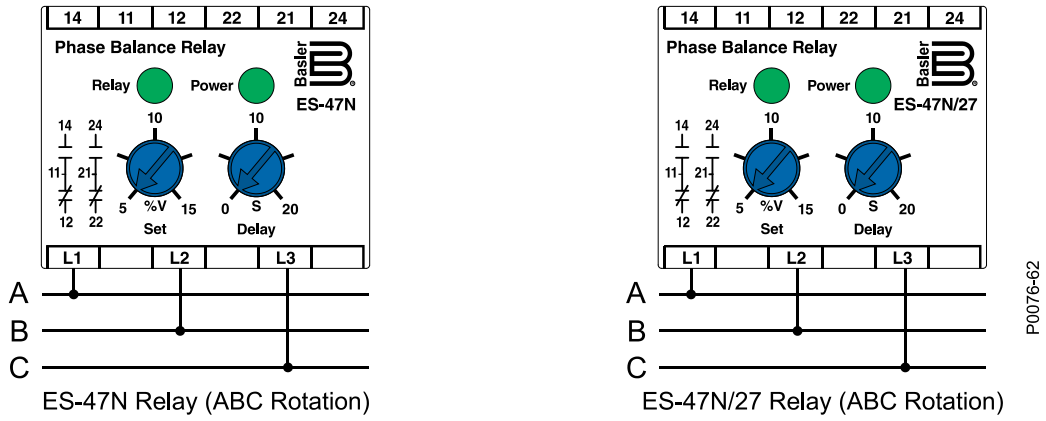

Figure 2. ES-47N and ES-47N/27 Phase Balance Relay Sensing Connections

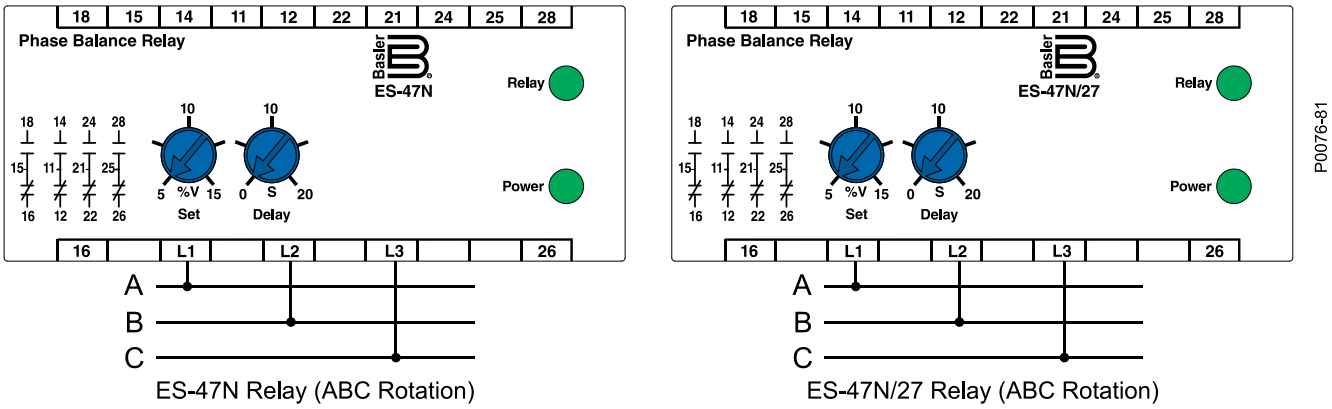

Figure 3. ES-47N and ES-47N/27 Relays with Auxiliary Contact Outputs Sensing Connections

Calibration

The calibration marks on the faceplate are provided only as guides. Proper calibration requires using an accurate voltmeter in parallel with the input signal. Use the following procedure to calibrate your relay.

1. Adjust the Set control fully clockwise and the Delay control fully counterclockwise (CCW).
2. Apply three-phase, nominal input voltage with the proper phase sequence to the relay. The output relay should energize and the green Power and Relay LEDs should light.
3. Decrease one phase of the applied voltage to the desired trip level. Adjust the Set control CCW until the relay trips.
4. Apply three-phase, nominal input voltage with the proper phase sequence to the relay.
5. Set the Delay control to the desired time setting.
6. Decrease one phase of the applied voltage to a level below the relay trip point. Using an appropriate timing device, measure the time from when the voltage is reduced until the relay trips.
7. Compare the measured time to the desired time delay and adjust the Delay control accordingly.
8. Repeat Steps 5 through 7 as required.

Maintenance

ES relays require no maintenance. In the event that your relay requires repair, contact Basler Electric, Highland, IL USA for return authorization.

Ordering Information

Figure 4 shows the ES phase balance relay style chart.

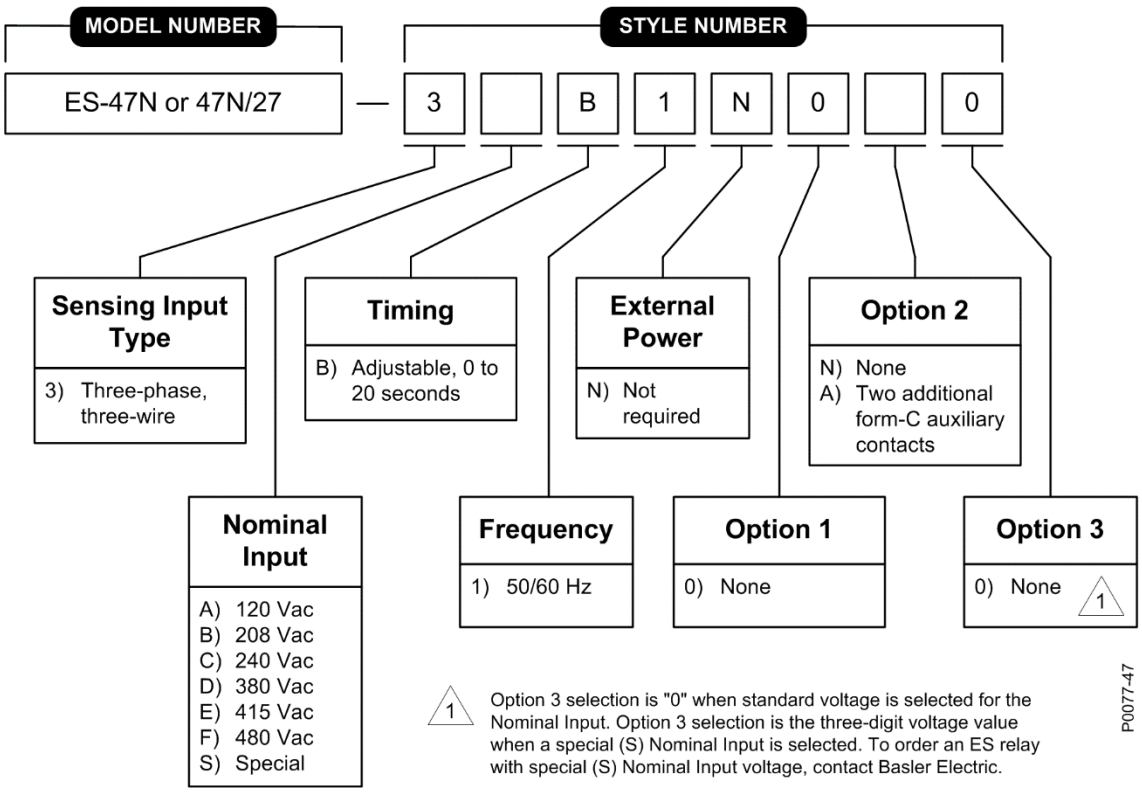

Figure 4. ES-47N, ES-47N/27 Style Number Idenntification Chart

Note
ES-47N and ES-47N/27 relays of revision level "–" (none) do not include phase reversal/phase-sequence protection and are no longer available for ordering. Revision level (REV) is located on the side ratings label of the ES relay.

Mounting accessories (DIN rails and DIN rail end stops) are available from Basler Electric. Table 2 lists the part numbers for ordering.

Table 2. Mounting Accessories

Mounting Accessories	Basler Part Number
DIN Rail, 3.0 inches (76 mm) wide	9323900001
DIN Rail, 5.5 inches (140 mm) wide	9323900002
DIN Rail, 8.0 inches (203 mm) wide	9323900003
DIN Rail, 39.4 inches (1,000 mm) wide	17366
DIN Rail End Stops	31761