Introduction

ES dc millivolt sensing relays provide voltage monitoring for dc shunt and transducer applications. Three models are available: the ES-74S Over provides overvoltage protection, the ES-74S Under provides undervoltage protection, and the ES-74S Over/Under provides overvoltage and undervoltage protection. 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 dc millivolt sensing relays are equipped with a Set adjustment for undervoltage trips and/or overvoltage trips. The Set adjustment is based on a percentage of the relay's nominal sensing voltage rating. Relays with adjustable timing have a Delay adjustment that prevents premature relay operation during brief voltage fluctuations. ES-74S Over relays with inverse timing have a Time Dial adjustment that provides an inverse time delay characteristic that reacts more quickly as the magnitude of the voltage increases above the setpoint.

Relay Output Contacts and Indicators

ES dc millivolt sensing 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 6). A Power LED indicates the presence of adequate sensing voltage when continuously lit and annunciates any relay fault, detected by internal diagnostics, when flashing.

Case Sizes

ES-74S Over/Under models are supplied in a wide case, as are ES-74S Over and ES-74S Under models with auxiliary relay outputs (style 7xx0xxA0). All other ES 74S models are supplied in a narrow case.

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

Specifications

Operating Power

All units require external operating power.

Nominal Voltage:	120 Vac, 208 Vac, 240 Vac, 380 Vac, 415 Vac, 480 Vac, or 24 Vdc.
AC Operating Range:	Nominal ±25%
DC Operating Range:	Nominal ±20%
Frequency:	50 or 60 Hz

Burden

AC Power Supply:	<2.5 VA (narrow case) <3 VA (wide case)
DC Power Supply:	<1.5 W

Sensing Input

Nominal Voltage:	50 mVdc or 100 mVdc
Impedance:	100 kΩ
Overload:	10 times nominal continuously

Setpoint

Undervoltage Range:	Adjustable 5 to 80% of nominal
Overvoltage Range:	Adjustable 40 to 120% of nominal
Definite Time Delay:	Adjustable 0 to 20 s
Inverse Timing (option):	0 to 20
Repeatability:	±0.5%
Dropout (Reset):	Fixed at 1% of nominal

Output

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 mm^2/20-12 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 – *For Relays and Relay Systems Associated with Electric Power Apparatus*

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

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

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

IEEE 421.3™-1997 – *For High-Potential Test Requirements for Excitation Systems for Synchronous Machines (for field voltages up to 600 Vdc and bridge input voltages up to 1,300 Vac)*

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-74S									
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

ES-74S Over and ES-74S Under dc millivolt sensing relays have two user-adjustable controls marked Set and Delay. The ES-74S Over/Under has four controls: Under Set, Under Delay, Over Set, and Over Delay. ES-74S Over relays with inverse timing (style 7xC0x4x0) have a Time Dial control in place of the Delay control.

Set Control

The ES-74S Over Set control adjusts the overvoltage trip point. When the monitored voltage rises above the percentage established by the Set control for the duration of the adjustable time delay, a relay trip occurs. This condition energizes the relay output and lights the red *Relay/Over* LED. The overvoltage trip point is adjustable from 40 to 120% of the nominal input.

The ES-74S Under Set control adjusts the undervoltage trip point. When the monitored voltage drops below the percentage established by the Set control for the duration of the adjustable time delay, a relay trip occurs. This condition de-energizes the relay output and extinguishes the green *Relay/Under* LED. The undervoltage trip point is adjustable from 5 to 80% of nominal input.

Delay Control

The Delay control adjusts the amount of time that the sensed input exceeds the pickup level before a relay trip occurs. The time delay is adjustable from 0 to 20 seconds.

Time Dial Control

The Time Dial control adjusts the time curve used for tripping and resetting ES-74S Over relays with the inverse timing option.

Inverse timing is a variable time delay that is inversely proportional to the measured voltage. The higher the measured voltage is above the trip point, the shorter the time delay. See Equation 1 for calculating the inverse time delay in seconds and Equation 2 for calculating MOP (multiple of pickup). Inverse time curves are defined from 1.03 to 2.5 MOP. Above this range, timing is limited to 2.5 MOP, and below this range, timing is limited to 1.03 MOP. Figure 1 illustrates the inverse time curves.

$$Trip\ Time = \frac{95.908 \times Time\ Dial}{17.165 - \sqrt{(490.864 - 191.816 \times MOP)}}$$

Equation 1. Trip Time in Seconds

$$MOP = \frac{Measured\ Voltage}{Pickup\ Voltage}$$

Equation 2. MOP (Multiple of Pickup)

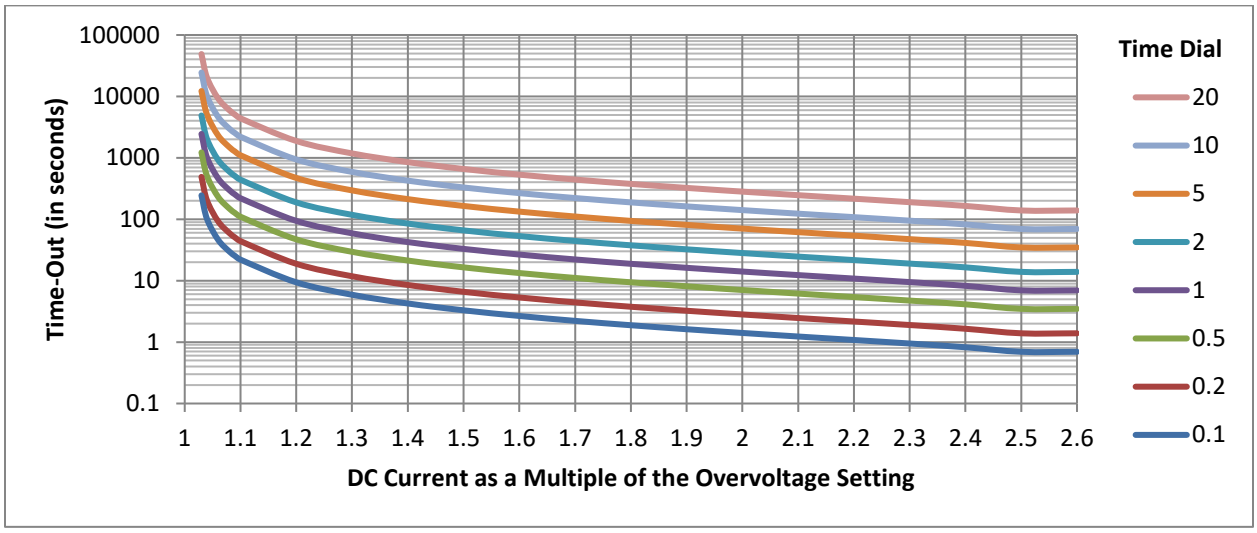

Figure 1. Inverse Time Curves

When the monitored voltage remains above the trip point for the duration of the time delay associated with that point on the time curve, a relay trip occurs. This condition energizes the relay output and lights the red Relay/Over LED. The time curve is adjustable from 0.1 to 20.

Inverse timing relays drop out when the measured voltage decreases below the trip point for the duration of the reset time delay. This time delay is proportional to the measured voltage; the lower the measured voltage is below the Set threshold, the shorter the reset time delay. See Equation 3 for calculating the reset time delay in seconds and Equation 2 for calculating MOP. Figure 2 illustrates the reset time curves.

$$Reset\ Time\ Delay = \frac{0.36 \times Time\ Dial}{(1 - MOP^2)}$$

Equation 3. Reset Time Delay in Seconds

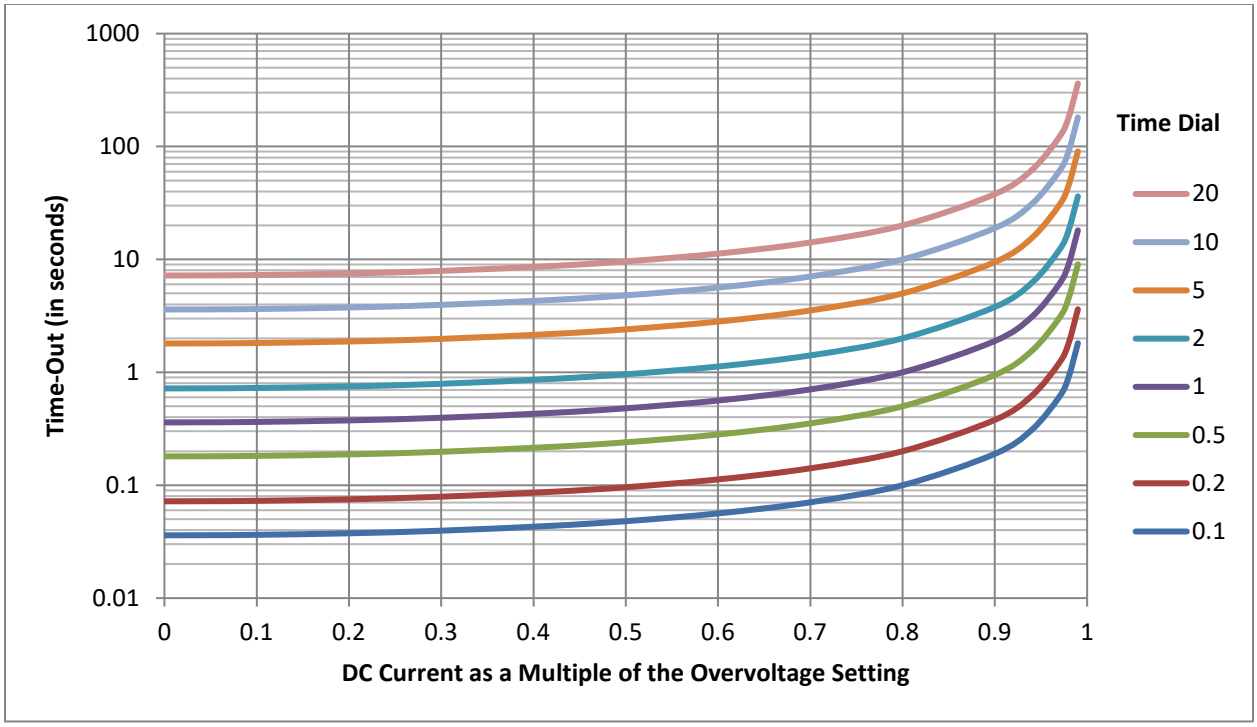

Figure 2. Reset Time Curves

When the monitored voltage remains below the trip point for the duration of the time delay associated with that point on the reset curve, a relay dropout occurs. This condition de-energizes the relay output and extinguishes the red Relay/Over LED.

Setting Example: ES-74S Over with Time Delay

An ES-74S Over relay with definite time delay and a nominal input rating of 100 mVdc has the following settings:

- Set - 80%
- Delay - 4 s

A trip occurs when the sensing voltage remains above 80 mVdc for 4 seconds. Dropout occurs when the voltage decreases below 79 mVdc (1% of nominal below the trip point).

Setting Example: ES-74S Over with Inverse Timing

An ES-74S Over relay with inverse timing and a nominal input rating of 100 mVdc has the following settings:

- Set - 80%
- Time Dial - 2

When the sensing voltage rises above 80 mVdc the relay begins timing toward trip. In this example, the measured voltage is 96 mVdc. Staying at that level, the relay trips after 188.2 seconds have elapsed.

When the sensing voltage drops below 80 mVdc, the relay begins timing toward dropout. In this example, the measured voltage is 64 mVdc. Staying at that level, the relay drops out after 2 seconds have elapsed.

Installation

Caution

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

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

ES-74S dc millivolt sensing 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 or reposition the relay, pull the release clip downward and move the relay as required. Figure 3 shows the dimensions of the ES 74S relays.

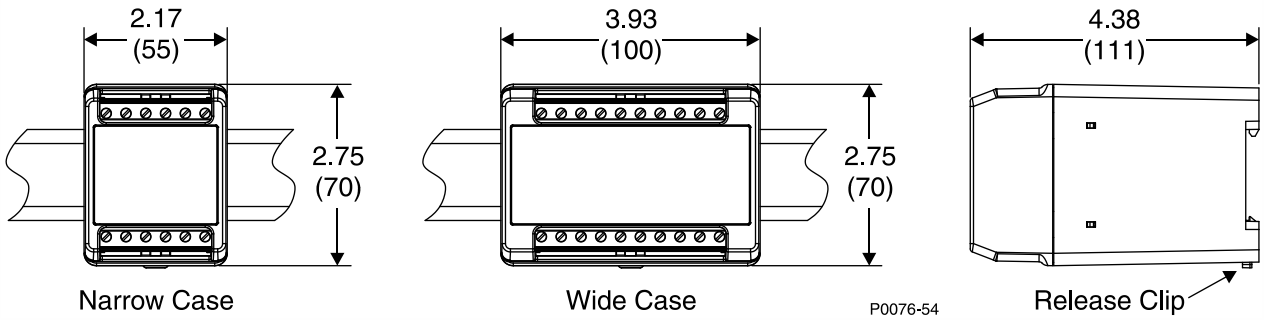

Figure 3. Relay Dimensions

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.

Relay connections should be made using wire that meets applicable codes and is properly sized for the application. Figure 4 shows the sensing and power connections for the ES 74S relays. Figure 5 illustrates the front panel appearance of ES-74S Under and ES 74S Over relays with optional auxiliary relay outputs (style 7xx0xxA0).

Calibration

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

Overvoltage with Definite Time Delay

1. Adjust the Set control fully clockwise (CW) and the delay control fully counterclockwise (CCW).
2. Apply the desired trip voltage to the relay.
3. Adjust the Set control CCW until the relay trips.
4. Decrease the applied voltage and set the Delay control to the desired time delay.
5. Increase the applied voltage to a level above the trip level set in Step 3 and measure the time to trip.
6. Adjust the Delay and repeat Steps 4 and 5 until you have the desired time delay.

Overvoltage with Inverse Timing

1. Adjust the Set control fully CW and the Time Dial control fully CCW.
2. Apply the desired trip voltage to the relay.
3. Adjust the Set control CCW until the relay trips.
4. Decrease the applied voltage and set the Time Dial control to the desired setting.
5. Increase the applied voltage to a level above the trip level set in Step 3 and measure the time to trip.
6. Adjust the Time Dial and repeat Steps 4 and 5 until you achieve the desired time delay.

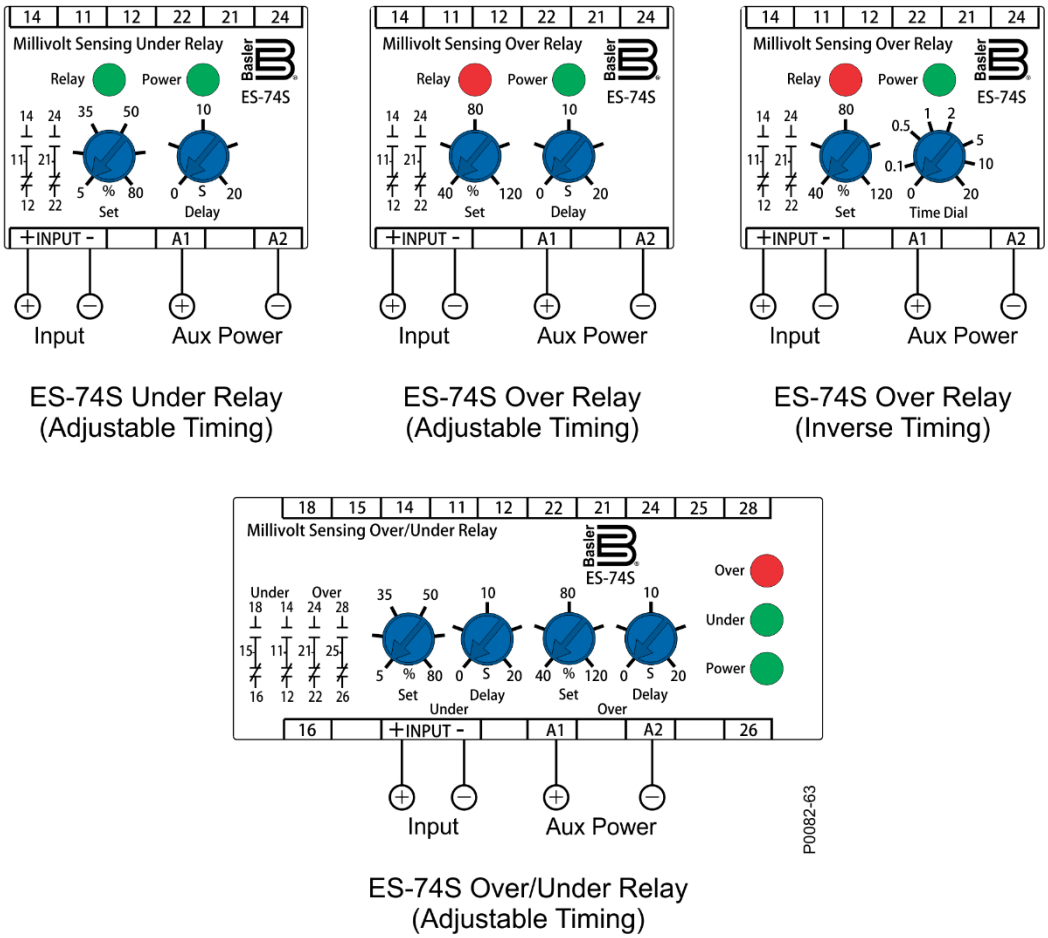

Figure 4. ES-74S Over, ES-74S Under, and ES-74S Over/Under Sensing and Power Connections

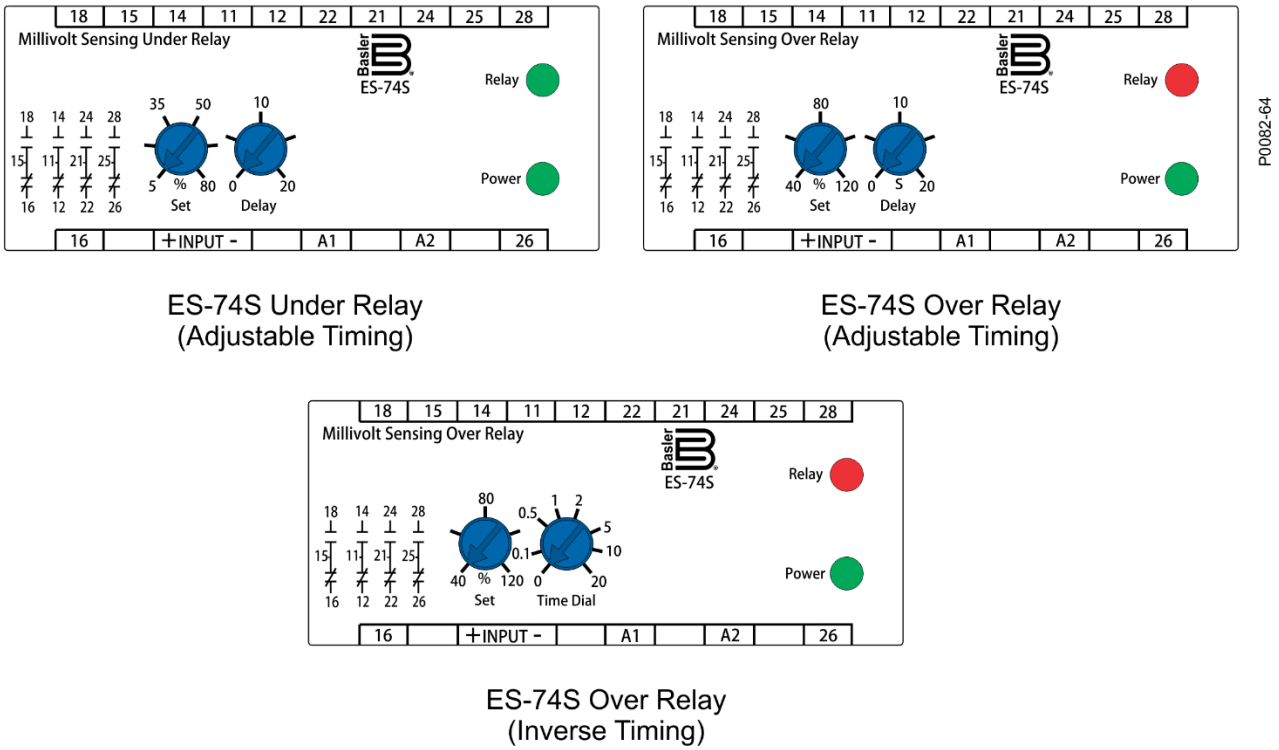

Figure 5. ES-74S Under and ES-74S Over Relays with Auxiliary Contact Outputs

Undervoltage

1. Adjust the Set and Delay controls fully CCW.
2. Apply the desired trip voltage to the relay.
3. Adjust the Set control CW until the relay trips.
4. Increase the applied voltage and set the Delay control to the desired time delay.
5. Reduce the applied voltage to a level below the trip level set in Step 3 and measure the time delay.
6. Adjust the Delay and repeat Steps 4 and 5 until the desired time delay is achieved.

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 6 shows the ES-74S relay style chart.

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

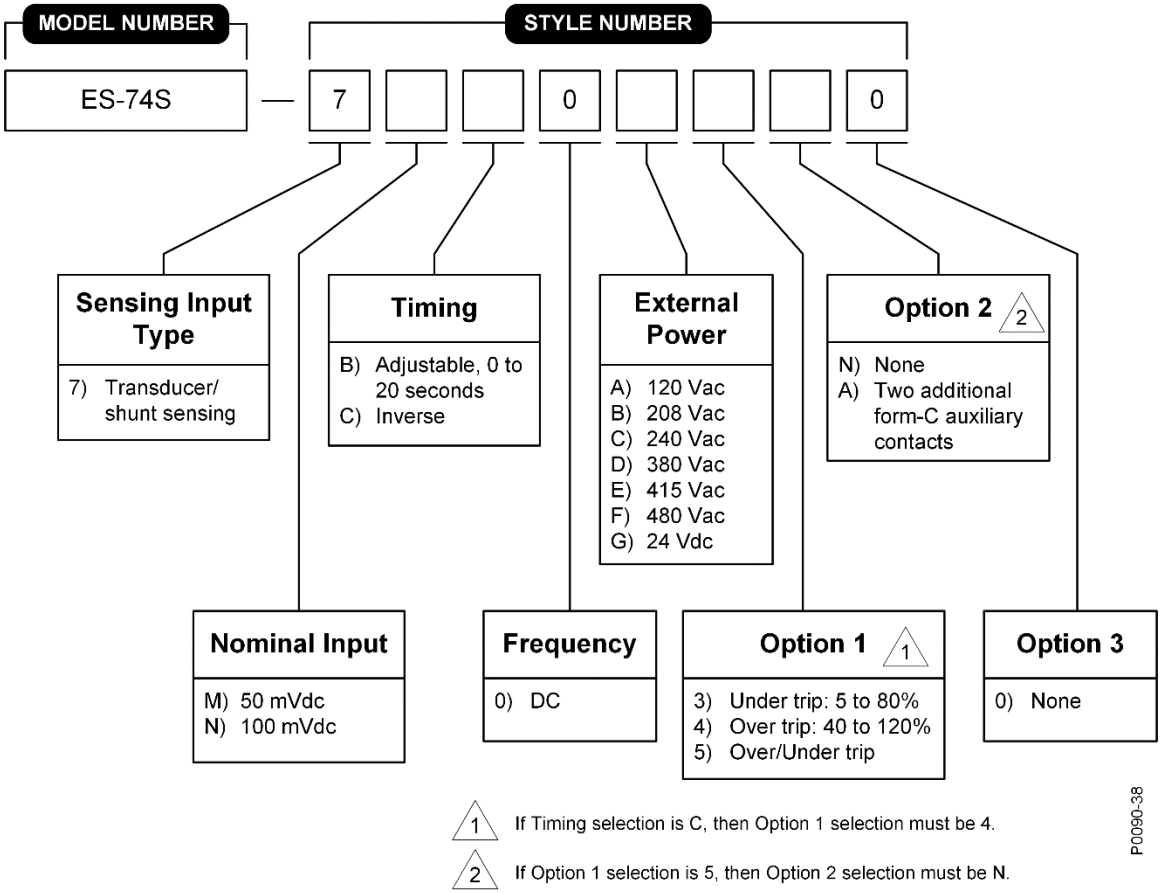

Figure 6. ES-74S Style Number Identification Chart

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