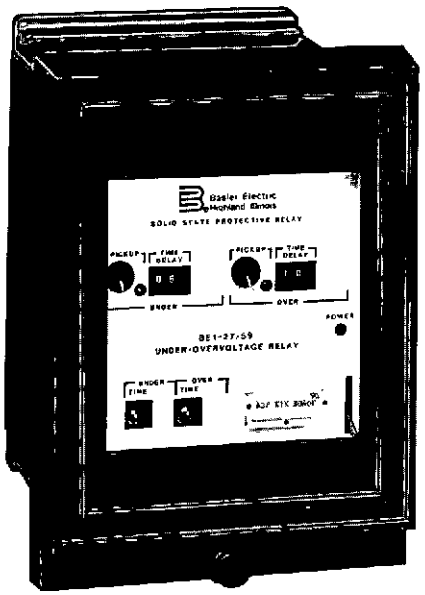

BE1-27, BE1-59 BE1-27/59 VOLTAGE RELAYS

The BE1-27 Undervoltage, BE1-59 Overvoltage and BE1-27/59 Under/ Overvoltage Relays' solid-state design provides a reliable response to protect power system equipment from adverse voltage conditions.

ADVANTAGES

- Pickup continuously adjustable over a wide range.
- Instantaneous functions offer immediate response to extreme voltage conditions.
- Individually adjustable definite, short inverse, medium inverse, or long inverse timing for each time-delayed under/overvoltage function.
- Low sensing and supply burdens.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request Publication 9-1706-00-990

SERVICE MANUAL
Request Publication 9-1706-00-620

STANDARDS, DIMENSIONS & ACCESSORIES
Request Bulletin SDA

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APPLICATION

PURPOSE

The BE1-27 Undervoltage, BE1-59 Overvoltage and the BE1-27/59 Under/Overvoltage Relays are solid-state devices which provide reliable protection for generators, motors, and transformers against adverse system voltage conditions.

APPLICATION

Electric power systems are designed to operate with relatively constant voltage. Loads utilizing commercial electric power are designed to operate at a constant input voltage level with some tolerance. Radical voltage variations on a power system are indicative of a system malfunction. Protective relays which monitor system voltage and provide an output signal when the voltage goes outside predetermined limits find a variety of applications. Some of these applications include motor and transformer protection, interface protection for cogeneration systems, ground fault detection, and supervision of automatic transfer switching schemes.

Motor Protection

When selecting the type of protection for motor applications, the motor type, voltage rating, horsepower, thermal capability during start-up, and exposure to automatic transfer restarting following a voltage interruption need to be considered. During motor start-up, a low terminal voltage condition will inhibit the motor from reaching rated speed. The BE1-27 undervoltage relay will detect this low voltage condition and trip. Critical applications requiring continuous motor operation and applications where overloads during start-up may be maintained for a given time period usually have a definite time or inverse time delay characteristic incorporated to avoid unnecessary tripping during low voltage dips. If the undervoltage condition persists for the established time delay, the relay output contacts are used to either trip the unit off line or sound an alarm at the annunciator panel, allowing the station operator to take corrective action. The BE1-59 Overvoltage relay is applied to insure the voltage does not exceed the limits established by the machine manufacturer for proper operation. Overvoltage conditions stress the insulation level of the equipment and may cause a dielectric breakdown, resulting in a flashover to ground.

Automatic Transfer Switching

Distribution substations are sometimes designed with duplicate supply circuits and transformers to eliminate service interruptions due to faults located on the primary feeder. In order to restore service within a given acceptable time period, automatic transfer switching can be applied to initiate the throwover from primary power to the alternate power source. The BE1-27 Undervoltage Relay can initiate switching after a given time delay to avoid transfer switching during temporary low voltage conditions. To return the substation to normal service upon the restoration of primary voltage, the BE1-59 overvoltage relay supervises the transition to its normal operating condition.

Cogeneration

Utilities employ the use of a voltage check scheme to supervise reclosing at the substation when cogenerators are connected to a radial distribution feeder and the cogenerator is capable of supplying the entire load when the utility circuit breaker is open. During a faulted condition, the utility requires the cogenerator to be disconnected from the system before reclosing the utility breaker. If the cogenerator remains connected to the system, the utility may attempt to reclose onto an energized line. This could result in reconnecting two systems out of synchronism. The BE1-27 undervoltage relay monitoring the line voltage at the substation will inhibit reclosing of the utility circuit breaker if the line remains energized by the cogenerator.

At the interface between the utility and the cogenerator, overvoltage and undervoltage relays are installed as minimum protection to provide an operating voltage window for the cogenerator. During faulted conditions when the cogenerator may become overloaded, the BE1-27 Undervoltage Relay will detect the decline in voltage and remove the cogenerator from the system. The BE1-59 Overvoltage Relay will protect the system from overvoltage conditions that may result when power factor correction capacitors are located on the feeder.

Transformer Protection

Voltage relays can be applied to protect large transformers from damage as a result of overexcitation. The concern for transformer overvoltage may be minimized in many power system applications where proper voltage control of the generating unit is provided. However, where a tap changing regulating transformer is located between the generating source and the load, some form of voltage protection may be required to supplement the tap changing control and to prevent equipment damage due to over, as well as undervoltages resulting from a failure of the tap changing control. The BE1-27/59 Under/Overvoltage Relay is well suited for these applications.

Ground Fault Detection

In a three-phase, three-wire system, a single conductor may break or the insulation may deteriorate resulting in a high resistance ground fault which may be sensed by an overvoltage relay connected to a grounded wye, broken delta set of voltage transformers (VT's).

SPECIFICATIONS

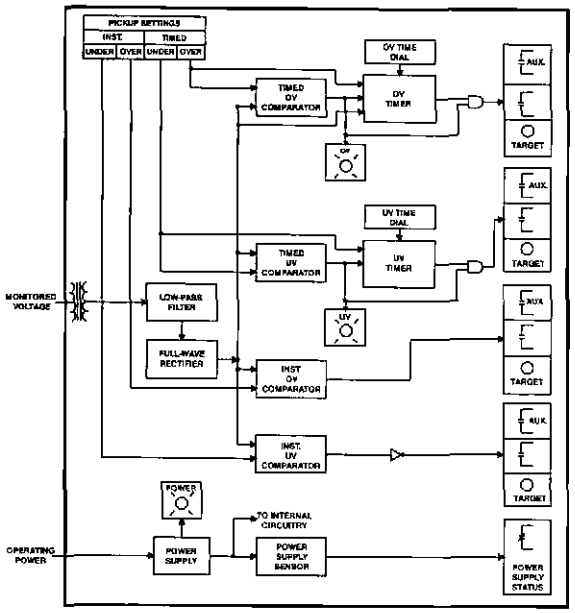


Figure 1. Functional Block Diagram

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to exactly satisfy an application requirement. The block diagram, Figure 1, illustrates how the various standard features, as well as options, function together.

INPUTS

Voltage Sensing

A system voltage transformer with standard 120/240 Volt secondary supplies the Under/Overvoltage Relay's input transformer with a single-phase voltage from the monitored circuit. This voltage is scaled, filtered, and rectified to represent the voltage magnitude of the monitored circuit.

Nominal sensing input ratings, defined by the style number, are 120 or 240 Vac with a maximum burden of 1 VA single phase at 40 to 70 Hz. The maximum continuous voltage rating is 360 Vac for 120 Vac nominal, and 480 Vac for 240 Vac nominal.

System Voltages

The BE1-27, BE1-59, and BE1-27/59 relays are available with three sensing input ranges. The 55 to 160V range is intended for use with nominal system voltages of 120V or 69V ($120/\sqrt{3}$). The 110 to 320 volt range is intended for use with nominal system voltages of 240V, 208V ($120 \times \sqrt{3}$), or 277V ($480/\sqrt{3}$). The 1 to 40V range is intended for use with a wye/broken delta VT configuration with 120V or 69V ($120/\sqrt{3}$) line-to-ground secondary voltages.

Power Supply

One of five power supply types may be selected to provide internal operating power. They are described in Table 1.

TABLE 1. POWER SUPPLY OPTIONS

Type	K	J	L	Y*	Z
Nominal Voltage	48 Vdc	125 Vdc 120 Vac	24 Vdc	48 Vdc 125 Vdc	250 Vdc 230 Vac
Burden	6.5 W	7.5 W 19 VA	7.0 W	6.5 W 7.5 VA	9.5 W 25.0 VA

* The Type Y power supply is field selectable for 48 Vdc or 125 Vdc. Selection must be implemented at the time of installation. This power supply option is factory set for 125 Vdc.

PICKUP SETTINGS

Front panel potentiometers, continuously adjustable over the range defined by the style number, establish the voltage pickup levels. One potentiometer is provided for each timed and instantaneous function. Actual pickup is within 2% of 0.5 volt of the setting, whichever is greater. Dropout is within 2% of actual pickup, occurring in 50 milliseconds or less.

PICKUP COMPARATORS

The monitored system voltage is compared individually to each pickup setting. When the system voltage is greater than the timed overvoltage setting, the appropriate pickup

SPECIFICATIONS
(continued)

indicator is illuminated and the corresponding time delay circuit is initiated. If the adverse voltage condition is present at the end of the programmed time delay the appropriate output relay is energized and, if present, the associated target indicator is enabled.

TIMING

Timed functions are available with instantaneous, definite, short inverse, medium inverse, or long inverse timing characteristics. Timing characteristics are individually selectable for undervoltage and overvoltage functions. Definite time is adjustable from 0.0 to 9.9 seconds in 0.1 second increments and accurate within 5% or 50 milliseconds (whichever is greater) of the setting. Inverse time is adjustable from 00 to 99 in increments of 01. The setting defines a curve as illustrated in Figure 2. Inverse timing is accurate within 5% of the time described by the curve. A setting of 00 will produce an instantaneous response on either definite or inverse timing.

INSTANTANEOUS FUNCTIONS

Instantaneous undervoltage and overvoltage functions are available to provide immediate response to extremely adverse voltage conditions.

When the system voltage is greater than the instantaneous overvoltage setting or less than the instantaneous undervoltage setting, the appropriate output relay is energized and, if present, the associated target indicator is enabled. This occurs in less than 50 milliseconds when the instantaneous pickup setting is exceeded by 1 volt or 5%, whichever is greater.

POWER SUPPLY STATUS OUTPUT

The power supply output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay in a continuously energized state with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

TARGETS

Magnetically latched, manually reset, target indicators are optionally available to indicate that an output has tripped. Either internally operated or current operated targets may be specified. Current operated targets require 0.2 A in the output trip circuit to actuate, and trip circuit current must not exceed 30 A for 0.2 seconds, 7 A for 2 minutes, and 3 A continuous. Current operated targets may be selected only when normally open (NO) output contacts have been specified.

OUTPUTS

Output contacts are rated as follows:

Resistive

120/240 Vac - make 30 A for 0.2 seconds, carry 7 A continuously, break 7A.

250 Vdc - make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.1 A.

500 Vdc - make and carry 15 A for 0.2 seconds, carry 7A continuously, break 0.3 A.

Inductive

120/240 Vac, 125 Vdc, 250 Vdc - break 0.3 A (L/R = 0.04).

Push-to-Energize Output Pushbuttons

Applying a thin non-conducting rod through a hole in the front panel energizes each output relay for testing the external trip circuits.

SURGE WITHSTAND CAPABILITY

Qualified to ANSI/IEEE C39.90.1-1989, Surge Withstand Capability Test and IEC 255, Impulse Test and Dielectric Test.

MECHANICAL

Operating Temperature

-40°C (-40°F) to +70°C (+158°F).

Storage Temperature

-65°C (-85°F) to +100°C (+212°F)

Weight

14 pounds

Shock

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

Vibration

In standard tests, the relay has withstood 2g in each of *three mutually perpendicular axes swept over the range* of 10 to 500 Hz for a total of six sweeps, 15 minutes for each sweep, without structural damage or degradation of performance.

SPECIFICATIONS
(continued)

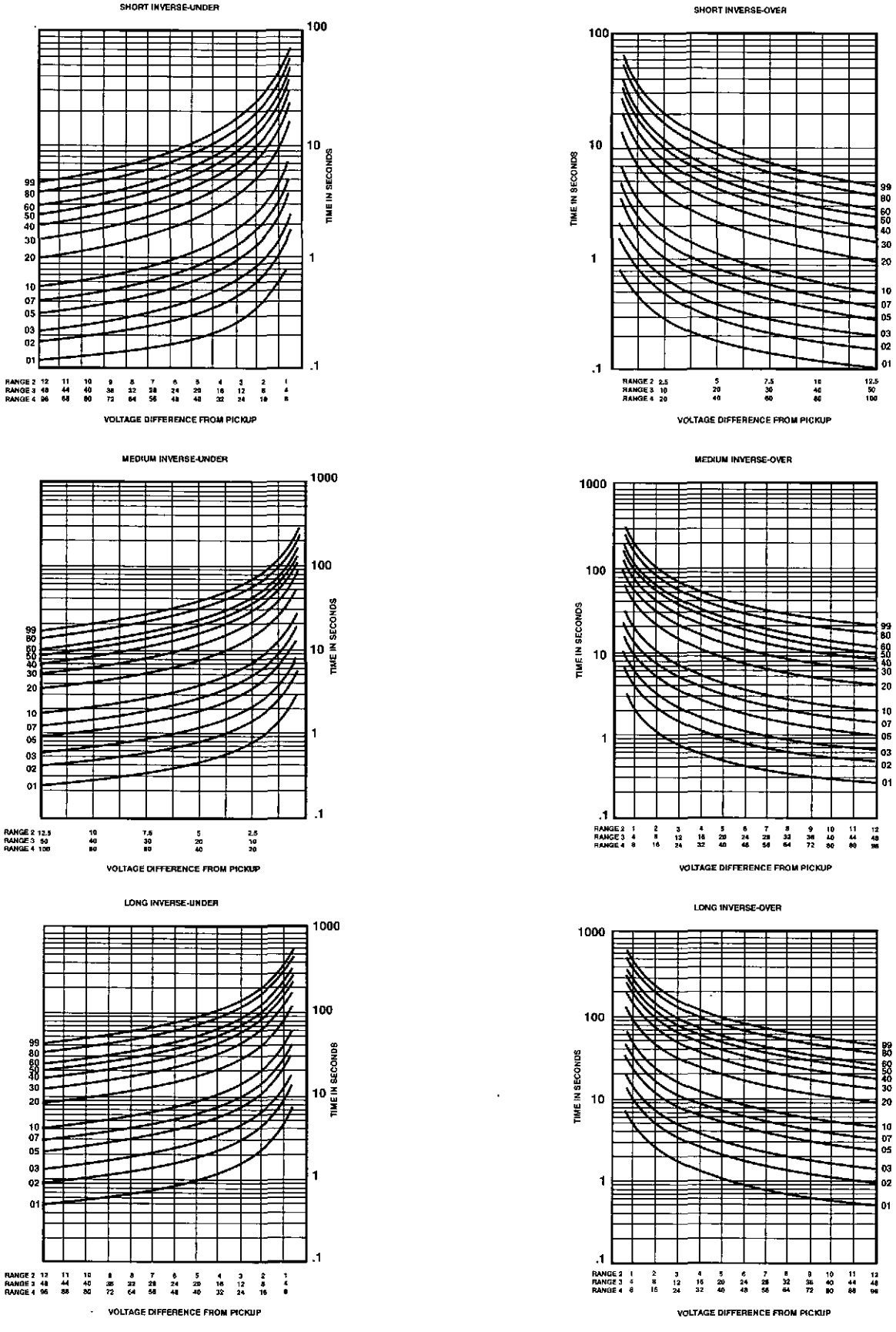


Figure 2. Inverse Timing Characteristic Curves

CONNECTIONS

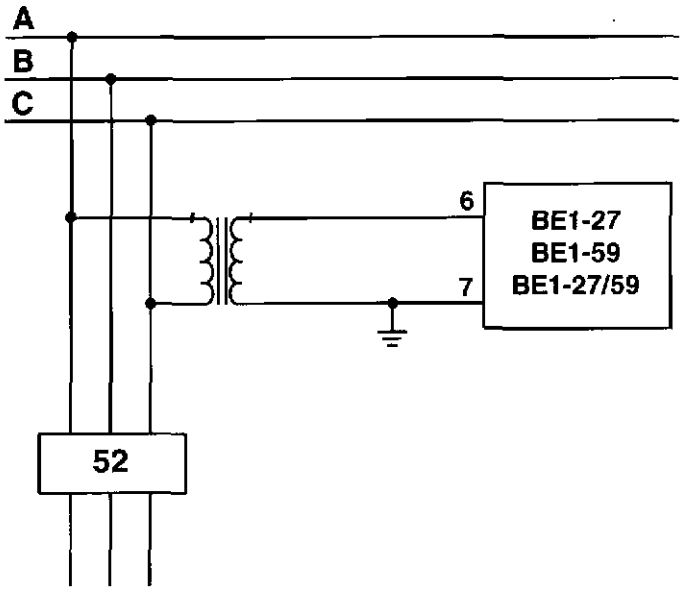


Figure 3. Voltage Sensing

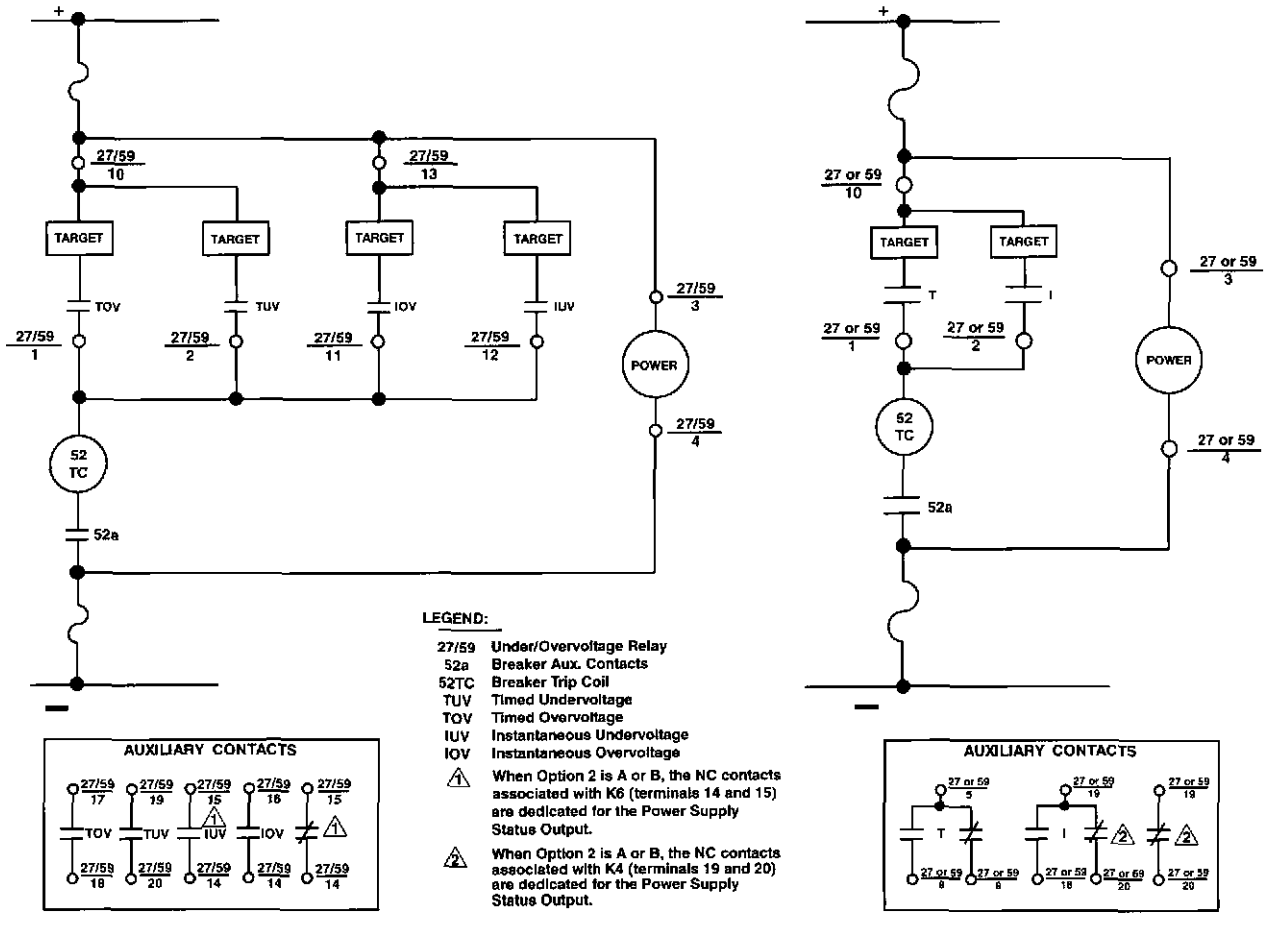


Figure 4. Control Circuits

ORDERING

MODEL NUMBER

BE1-27 Undervoltage Relay
BE1-59 Overvoltage Relay
BE1-27/59 Under/Overvoltage Relay

STYLE NUMBER

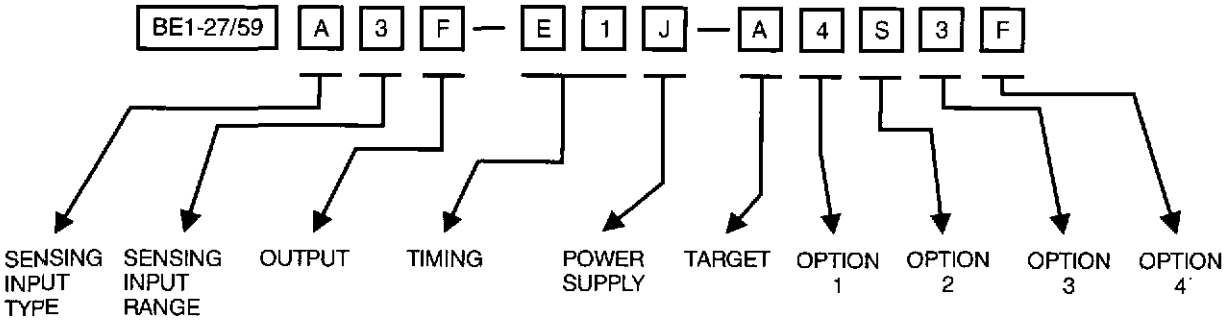
The relay model number is followed by a style number that appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number illustrates the manner in which the various features are designated. The Style Number Identification Chart (page 8) defines each of the options and characteristics for this device.

SAMPLE STYLE NUMBER A3F-E1J-A4S3F

The style number above describes a BE1-27/59 Under/Overvoltage Relay having the following features:

Sensing Input Type	(A)	Single Phase
Sensing Input Range	(3)	55 to 160 Vac pickup
Output	(F)	Four normally open output relays (one per function)
Timing	(E1)	Definite time
Power Supply	(J)	125 Vdc or 120 Vac external operating power
Target	(A)	Internally operated targets
Option 1	(4)	Instantanous Under and over functions
Option 2	(S)	Push-to-energize outputs
Option 3	(3)	Four normally open auxiliary output relays (one per function)
Option 4	(F)	Semi-flush mounting

NOTE: The description of a complete relay must include both the model number and the style number.



HOW TO ORDER:

Designate the model number followed by the complete Style Number:

BE1-27 Style No. □□□-□□□-□□□□□

BE1-59 Style No. □□□-□□□-□□□□□

BE1-27/59 Style No. □□□-□□□-□□□□□

Complete the Style Number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number in the appropriate square. (Two squares are used to indicate timing). All squares must be completed.

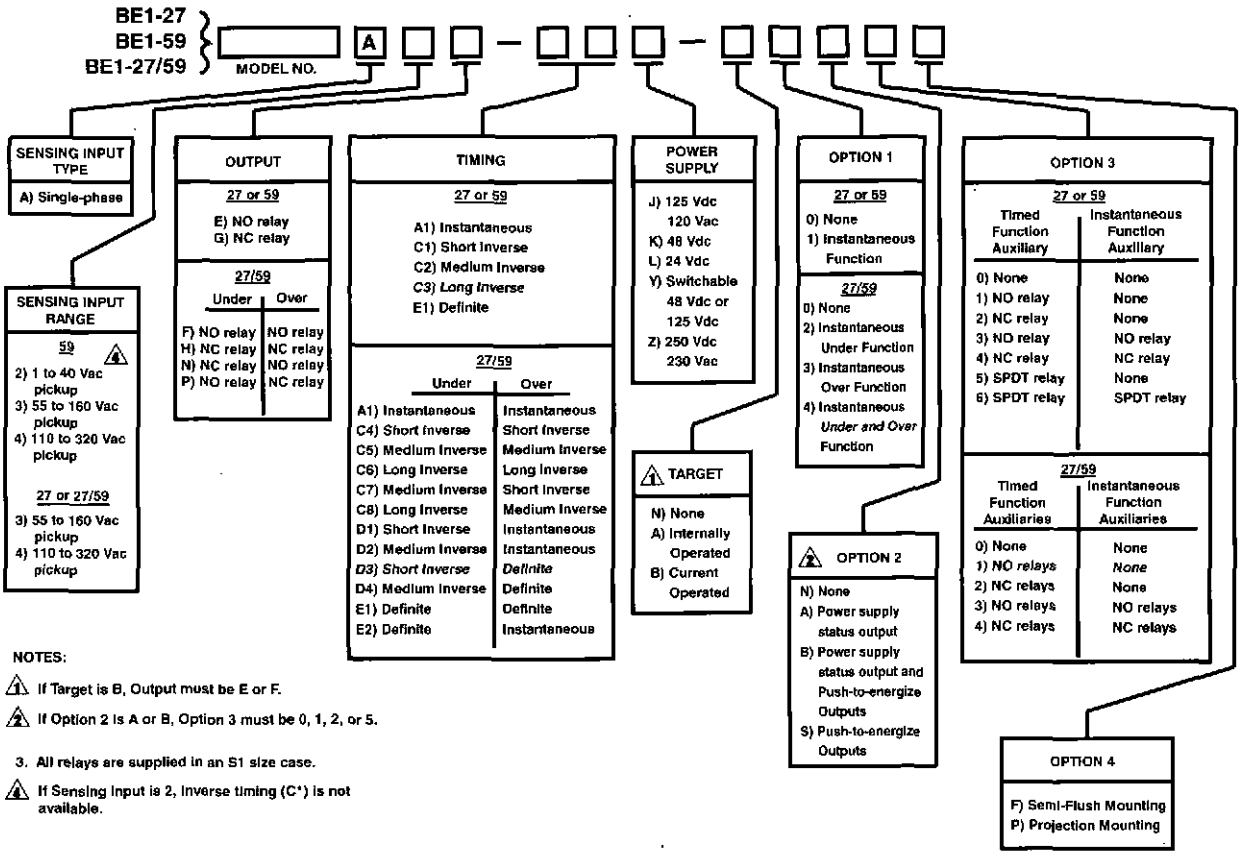
STANDARD ACCESSORIES:

The following standard accessories are available for the BE1-27 Undervoltage, BE1-59 Overvoltage, and BE1-27/59 Under/Overvoltage Relays.

Test Plug
To allow testing of the relay without removing system wiring, order two test plugs, Basler part number 10095.

Extender Board
The Extender Board will permit troubleshooting of the P. C. boards outside the relay cradle. Order Basler part number 9 1655 00 100.

STYLE NUMBER IDENTIFICATION CHART



NOTES:

1. If Target is B, Output must be E or F.
2. If Option 2 is A or B, Option 3 must be 0, 1, 2, or 5.
3. All relays are supplied in an S1 size case.
4. If Sensing Input is 2, Inverse timing (C*) is not available.

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