

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

The BE1-27 Undervoltage, BE1-59 Overvoltage and BE1-27/59 Under/Overtoltage 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/overtoltage function.
- Low sensing and supply burdens.
- Warranty 5 years.

### ADDITIONAL INFORMATION

**INSTRUCTION MANUAL**

Request Publication 9170600990

**STANDARDS, DIMENSIONS and ACCESSORIES**

Request Bulletin SDA

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<b>ORDERING INFORMATION</b>  Pages 7 and 8

## 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

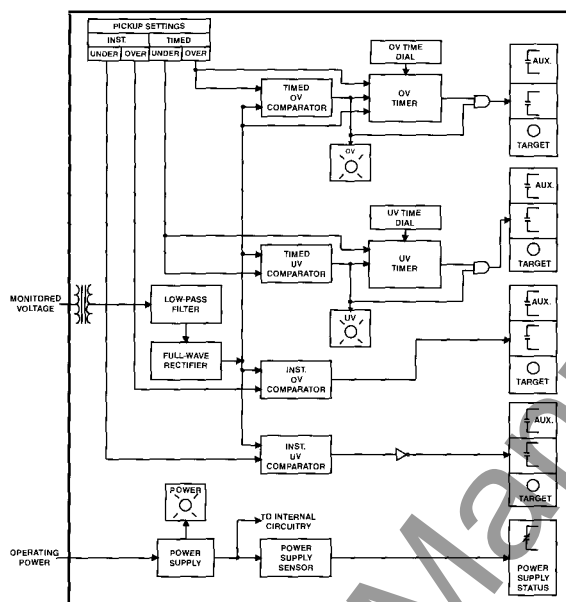


Figure 1 - Functional Block Diagram

### 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/Overtoltage 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

### 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 0.2A in the output trip circuit to actuate, and trip circuit current must not exceed 30A for 0.2 seconds, 7A for 2 minutes, and 3A 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 30A for 0.2 seconds, carry 7A continuously, break 7A.

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

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

#### Inductive

120/240 Vac, 125 Vdc, 250 Vdc - break 0.3A  
(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 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

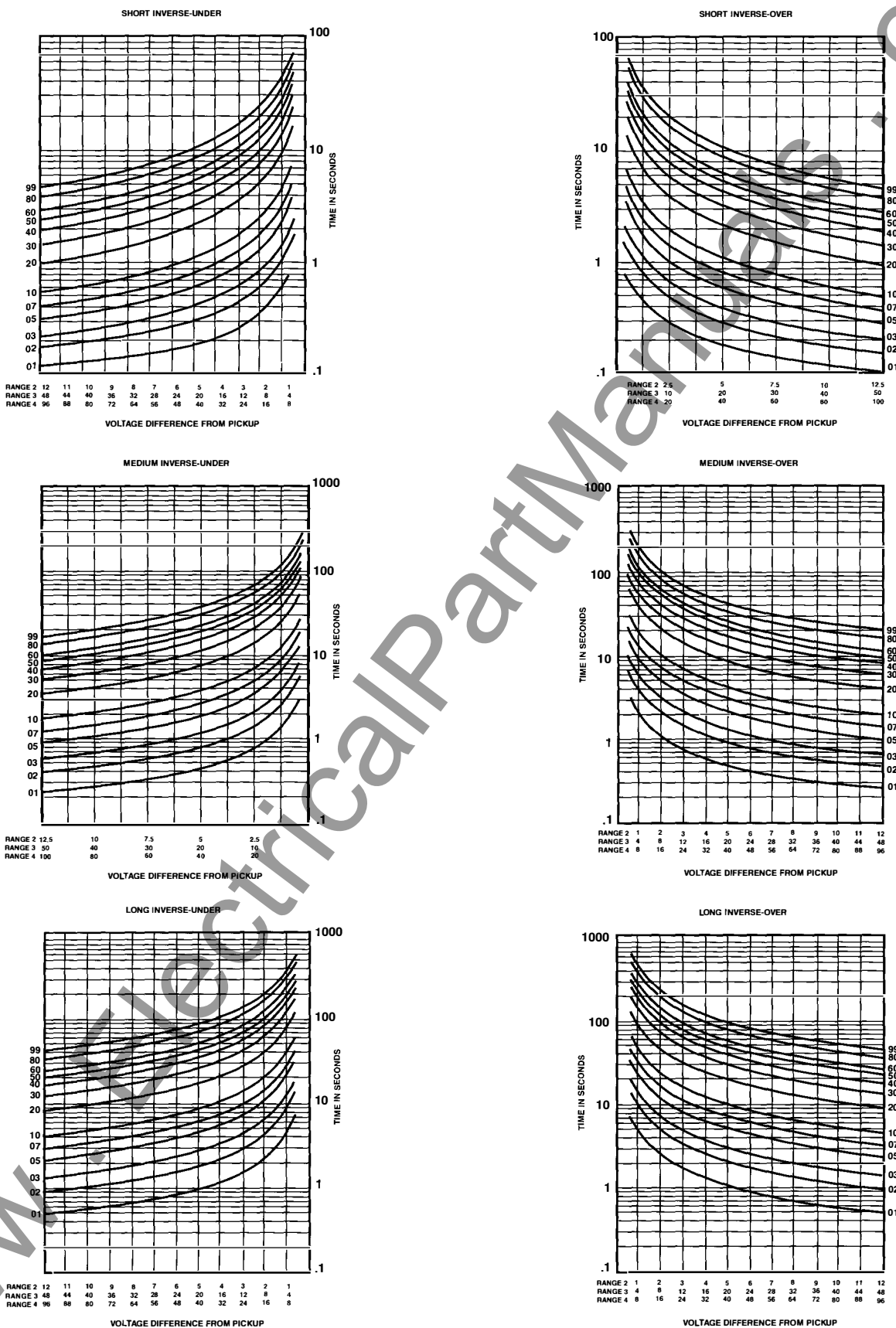


Figure 2 - Inverse Timing Characteristic Curves

# CONNECTIONS

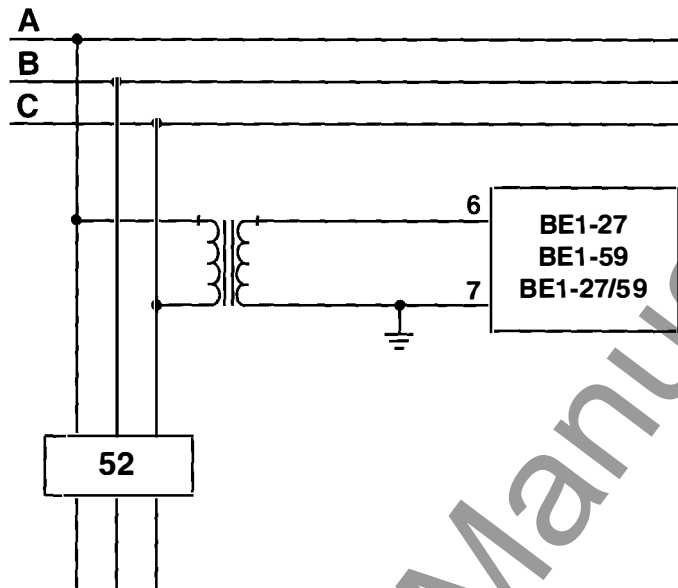


Figure 3 - Voltage Sensing

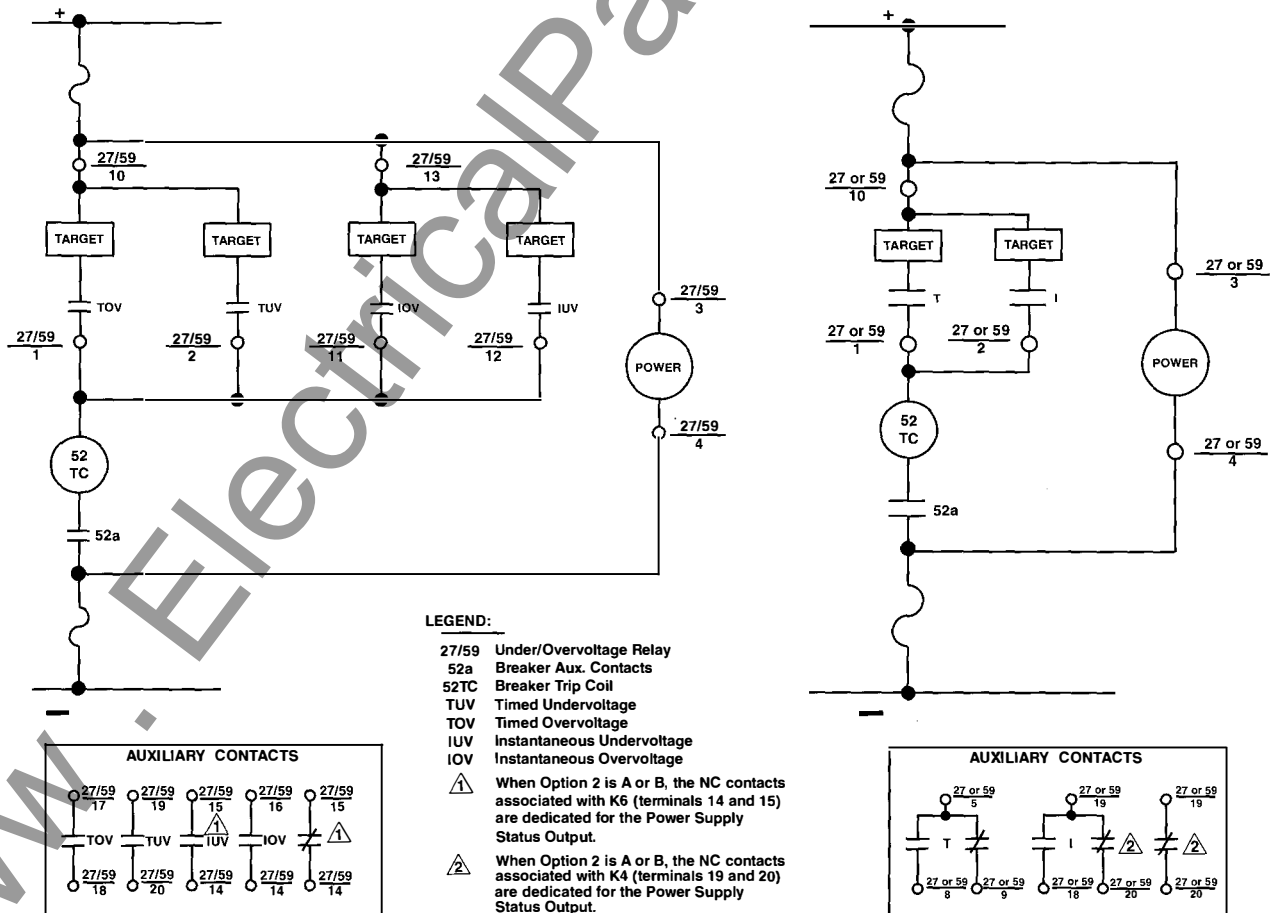


Figure 4 - Control Circuits

## 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.

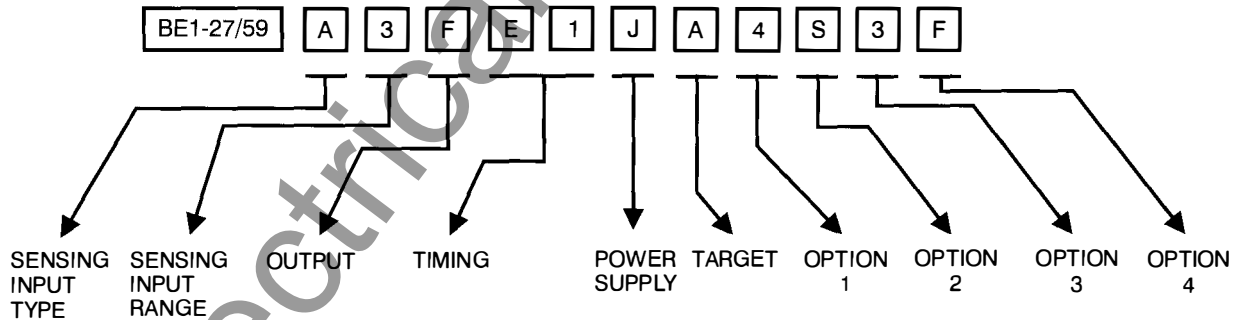
### SAMPLE STYLE NUMBER A3FE1JA4S3F

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) Two 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) Instantaneous 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.

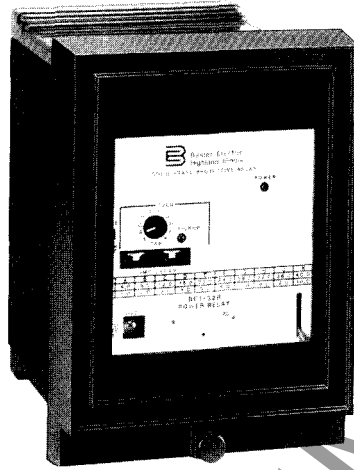
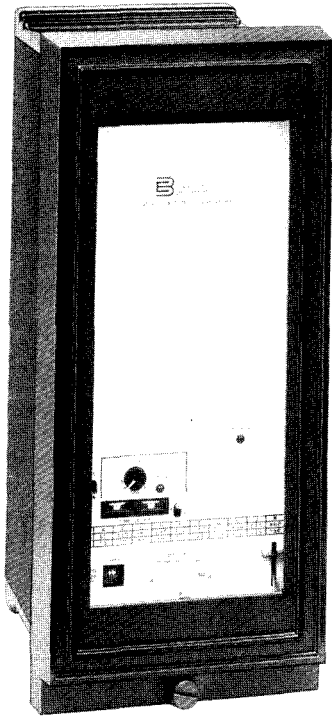
#### Test Plug

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 9165500100.





## BE1-32R, BE1-32 O/U DIRECTIONAL POWER RELAY

The BE1-32R Directional Overpower Relay and the BE1-32 O/U Directional Over/Underpower Relay are solid-state devices which provide versatility and control in protecting machines against reverse power flow, underpower and overpower conditions.

### ADVANTAGES

- Measures Real Power -  $EI \cos \theta$ .
- Wide variety of input configurations are available including single-phase and three phase, 3 and 4 wire systems.
- Sensing ranges available from 0.5 to 6000 watts secondary.
- Instantaneous, definite and inverse timing characteristics available.
- Low input sensing and supply burdens.
- Qualified to the requirements of IEEE C37.90.1-1989 and IEC 255 for fast transient and surge withstand capability; IEC 255-5 for impulse.
- UL Recognized under Standard 508, UL File #E97033.
- Two year warranty.

### ADDITIONAL INFORMATION

#### INSTRUCTION MANUAL

Request Publication 9171100990

#### STANDARDS, DIMENSIONS, AND ACCESSORIES

Request bulletin SDA

#### APPLICATION

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#### EXTERNAL CONNECTIONS

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#### ORDERING INFORMATION

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## APPLICATION

### PURPOSE

The BE1-32R Directional Overpower Relay and the BE1-32 O/U, Directional Over/Underpower Relays sense real power flow ( $EI \cos \Theta$ ). These relays are solid-state devices designed for use in single-phase or three-phase systems to provide equipment protection for overpower and/or underpower or to be used for supervisory control of circuits. Both relay configurations may be used to monitor either forward or reverse power. In the following application examples, single-phase connections are shown for simplicity.

### APPLICATION EXAMPLES

The BE1-32 relays (R and O/U) are typically used in applications where excessive power flow in the tripping direction is indicative of undesirable situations. Typical examples are discussed below:

#### EXAMPLE 1 - ANTI MOTORING

In this example, the power relay is used to protect the prime mover rather than the generator. When an ac generator, operating in parallel with a power system, loses prime mover torque, it remains in synchronism with the system and continues to run as a synchronous motor drawing sufficient power from the system to drive the

prime mover. Sustained motoring can cause severe damage to the prime mover. The Directional Power Relay, with its wide sensitivity range, can detect levels of reverse real power flow as low as 0.5 Watts secondary and provide an alarm or trip the unit off line (See Figure 1). In this example, single phase sensing is usually considered sufficient, since motoring is a balanced condition.

#### EXAMPLE 2 - COGENERATOR CONTROL

Given that a co-generation system has automatic engine controls, auto synchronizer, and automatic kW and kVar controls, the system will virtually operate by itself. The only functions not readily apparent are the start/stop signals to the generators. Two system configurations using a Power Relay may be utilized to generate contact closures for start and/or stop signals.

The first configuration (Figure 2) shows a power relay connected to the utility to sense kW. The pickup point of the relay is set at the maximum desired utility power level. If the power relay contact closes, the generator will be started and automatically paralleled with the utility system. A time delay of 15 seconds or more is generally included in the "start" circuit to ignore transient overload conditions.

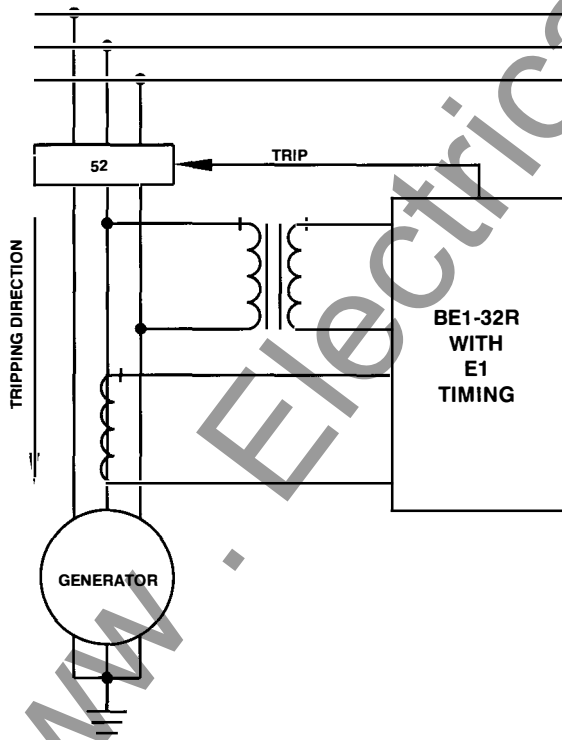


Figure 1 - Power Relay Motoring Protection

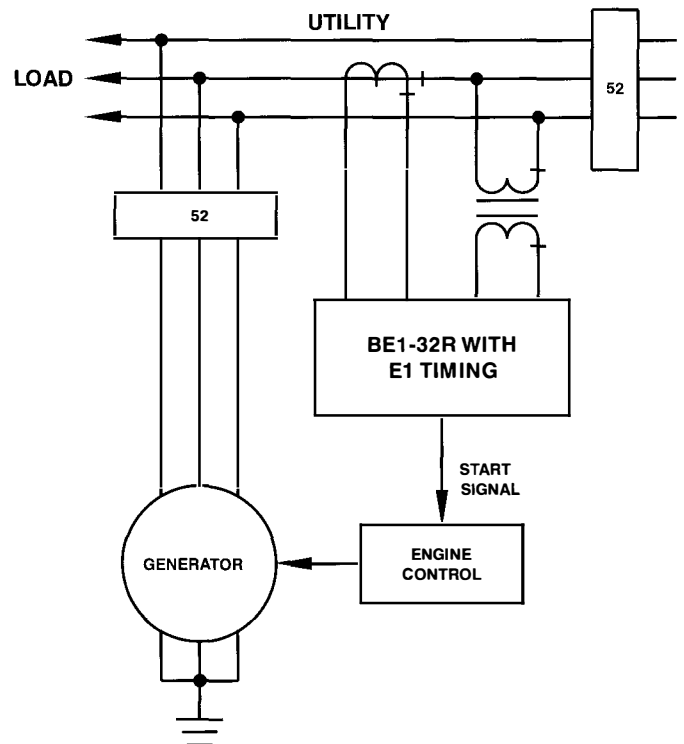


Figure 2 - Power Relay Start Control

## APPLICATION

(continued)

When the generator is paralleled and loaded, the kW signal will decrease by the amount of load the generator accepted. An underpower relay can measure utility power and generate a "stop" signal when utility power decreased below a selected level. A definite time delay will generally be provided for the "stop" signal of one minute or more. The Basler Model BE1-32 O/U Power Relay incorporates both over and under power sensing in one relay, which makes it ideal for this application.

In the second configuration (Figure 3) the "start" signal is generated as in that of Figure 2. The setpoint of the start signal should be above the import power setting. The "stop" signal will require an underpower relay on the generator output. This system is illustrated in Figure 3.

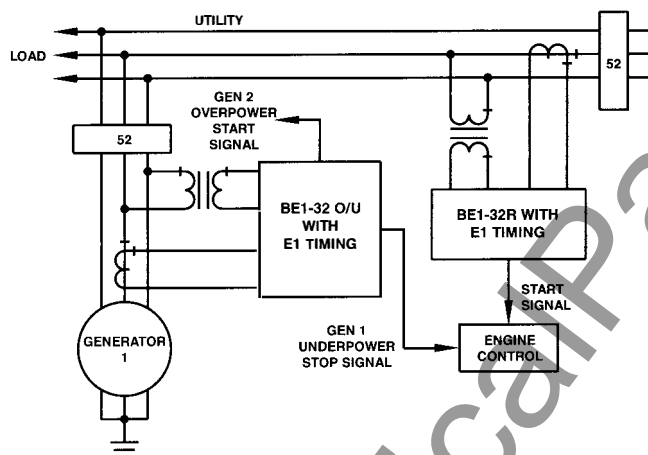


Figure 3 - Power Relay Start/Stop Control

### EXAMPLE 3 - GENERATOR OVERLOAD

Refer to Figure 3. Whenever excessive load has been connected to a generating system, the Power Relay will initiate the corrective action by energizing an alarm to alert the station operator or will initiate an automatic sequence to either shed non-critical load or start and parallel an in-house generator to assume the excess load.

### EXAMPLE 4 - DISTRIBUTION SYSTEM OVERLOAD

Another typical use, addressing excessive load, concerns distribution protection, see Figure 4. A high-voltage bus supplies two transformers. T1 and T2 together can supply all connected load. However, neither T1 or T2 is capable of supplying the total load. To provide adequate protection for the distribution system, the overpower function is used to sense overload conditions on each transformer and the underpower function is used to sense power flowing through the transformers in an undesired direction.

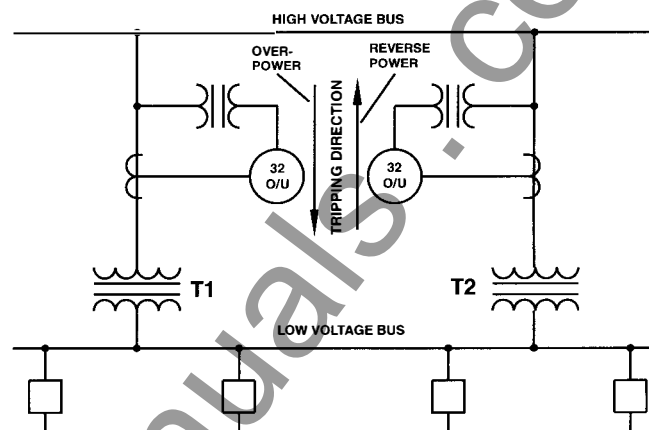


Figure 4 - Distribution Protection

### EXAMPLE 5 - REACTIVE POWER (VARs) DETECTION

This example deals with the Directional Power Relay's ability to measure real or reactive power.

Real power (watts) is supplied to the generator by the prime mover, and reactive power (vars) is supplied to the field by the exciter. When field excitation is significantly reduced and the connected system can provide sufficient reactive power to maintain the generator's terminal voltage, reactive power will flow into the machine and cause it to operate as an induction generator with essentially the same kW output. This situation causes problems; first, the additional reactive loading of the faulty generator must be redistributed to other synchronous generators on the system. Secondly, a synchronous generator is not designed to function as an induction generator. Excessive heating occurs in the damper (Amortisseur) windings, slot wedges, and in the surface iron of the rotor due to slip frequency current flow which results when a synchronous generator is operated as an induction generator. The Directional Power Relay can be applied to respond to this reactive power flow.

The Basler BE1-32 Directional Power Relay is designed to respond to true power as defined by the equation:

$$P = EI \cos \Theta$$

where: P = real power (watts)  
 E = effective emf or system voltage  
 I = effective current  
 $\Theta$  = the phase angle between E and I

## APPLICATION

(continued)

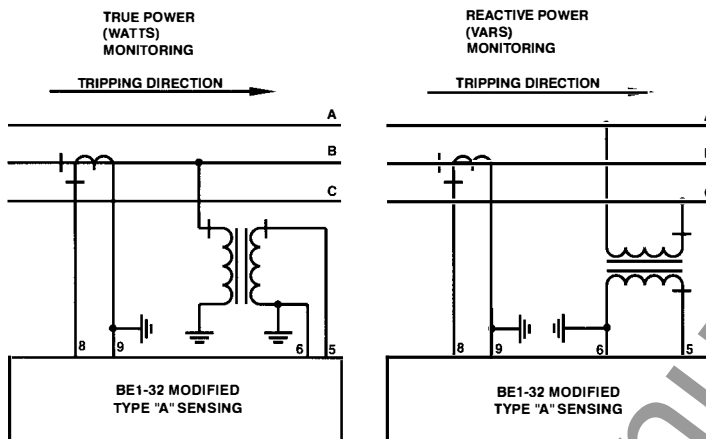


Figure 5 - VARs Measuring

However, reactive power is defined by the equation:

$$Q = EI \sin \Theta$$

Since the sine of Q equals the cosine of (Q - 90°) the relay can be connected to measure only reactive power by adding 90° in the connection of the PTs as shown in Figure 5. The relay is now capable of detecting the

inability of the excitation system to supply adequate reactive power.

With the many options and combinations of options available, the Basler Electric Directional Power Relays can be adapted to multitude of systems and situations to provide the utmost in overpower and underpower protection of system equipment.

## SPECIFICATIONS

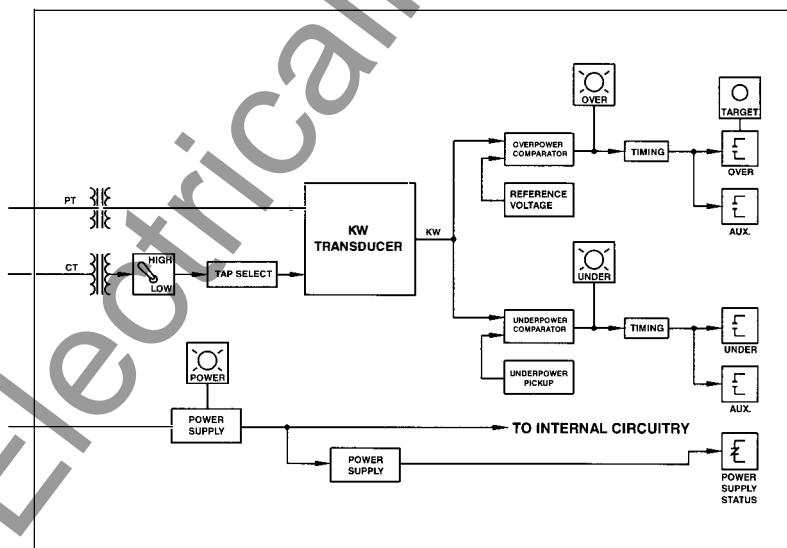


Figure 6 - Functional Block Diagram

### FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to exactly satisfy a specific application requirement. The block diagram, Figure 6, illustrates how the various standard features, as well as the options, function together.

### INPUTS

#### Current Sensing

System current transformers (CTs) with nominal 5 A secondaries supply the Directional Power Relay's input transformers with one, two or three phase currents. If sensing input range 1, 4 or 7 is selected, the input transformers are capable of 7 A continuous current, 10 A for 1 minute and 140 A for 1 second.

## SPECIFICATIONS, continued

If sensing input range 2, 3, 5, 6, 8 or 9 is selected, the input transformers are capable of 10 A continuous current, 15 A for 1 minute and 200 A for 1 second.

Maximum burden for each current input (2 terminals) is 1 VA at threshold over the frequency range of 45 to 65 Hz.

### Voltage Sensing

System potential transformers (PTs) with 120 or 240V secondaries supply the Directional Power Relay's input transformers with single or three-phase voltages. The voltage sensing inputs are nominally rated at 100 or 220V (50 Hz) and 120 or 240V (60 Hz) with a maximum burden of 1 VA per input (2 terminals) over the frequency range of 45 to 65 Hz. Maximum continuous voltage is limited to 150% nominal.

### SENSING INPUT TYPES

There are 6 sensing input types as defined by the Style Chart (page 12). The Directional Power Relay's input circuitry receives voltage and current signals from system PTs and CTs. The CT signal is adjusted in level by a front panel range switch before it is applied to the kW transducer circuitry. Several input circuit configurations are available, the selection of which is determined by the specific application. The following paragraphs provide a brief description of each input sensing type and their calibration

**Type A Sensing:** Single-Phase (Figure 7). The type A sensing configuration monitors line-to-neutral voltage and a single phase current of a three-phase, four-wire circuit and calculates the power flowing in the tripping direction. Relays with this sensing type are calibrated in single-phase watts.

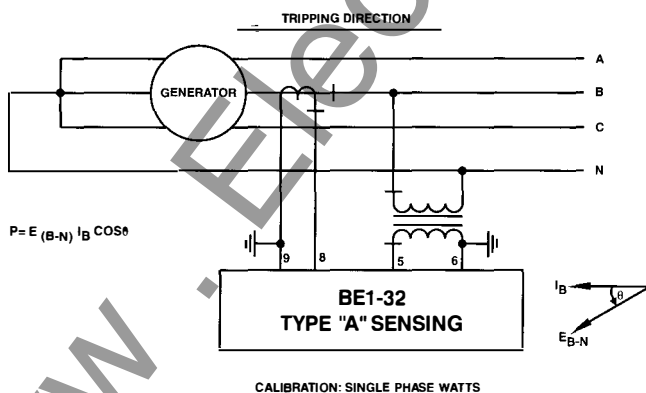


Figure 7 - Single Phase, Type A Sensing

**Type B (60 Hz) or Type V (50 Hz) Sensing:** Single-Phase (Figure 8) with 30° phase shift. This sensing configuration monitors a line-to-line voltage and a single phase current of a three-phase, three-wire circuit and calculates the power flowing in the tripping direction. Since the input voltage leads the input current by 30° (assuming unity power factor) a 30° lagging phase shift network is designed into the voltage input circuit. Relays with this sensing type are calibrated in single-phase watts. Note: Type B or V configurations are phase rotation sensitive.

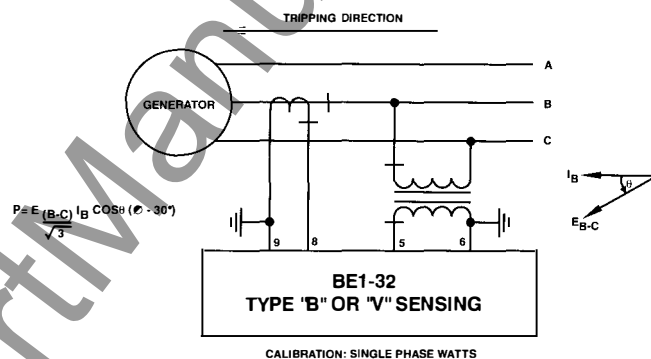


Figure 8 - Single Phase, Type B or V Sensing

**Type C Sensing:** Three-phase Scott Tee (Figure 9). The type C sensing configuration monitors three line-to-line voltages and a single phase current of a three-phase, three-wire circuit and calculates the power flowing in the tripping direction. The relay measures actual power even if the system voltages are not balanced. Relays with this sensing type are calibrated in three-phase watts.

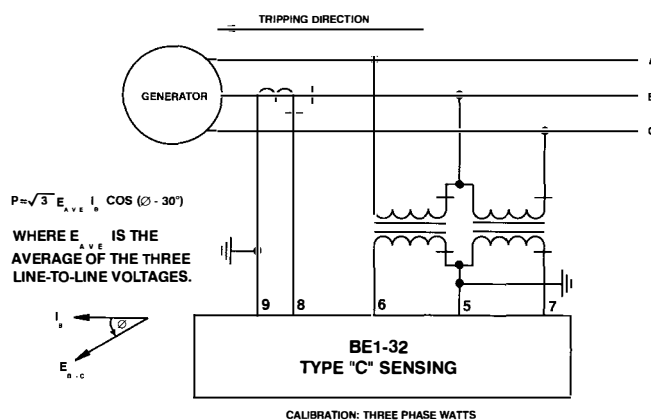
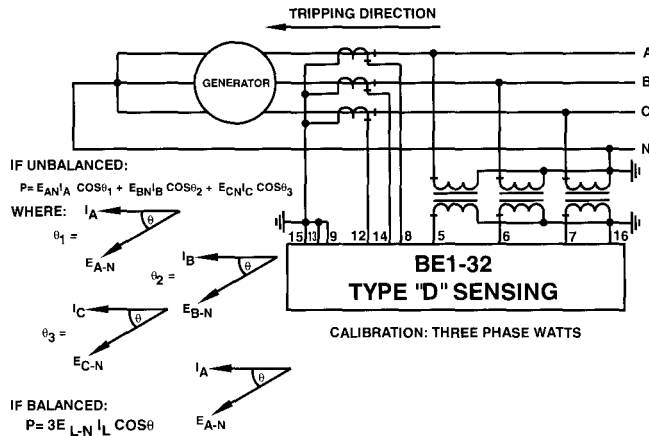


Figure 9 - Three Phase, Type C Sensing

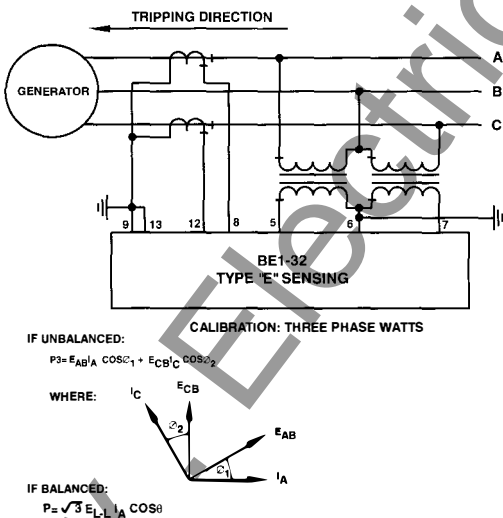
## SPECIFICATIONS, continued

**Type D Sensing:** Three-Phase (Figure 10). The type D sensing configuration monitors three line-to-neutral voltages and three phase currents of a three-phase, four-wire circuit and calculates the power flowing in the tripping direction. Relays with this sensing type are calibrated in three-phase watts.



**Figure 10 - Three Phase, Type D Sensing**

**Type E Sensing:** Three-Phase (Figure 11). The type E sensing configuration monitors three line-to-line voltages and two of the phase currents of a three-phase, three-wire circuit and calculates the power flowing in the tripping direction. The power equation assumes that conditions are balanced. Relays with this sensing type are calibrated in three-phase watts. Note: Type E configurations are phase rotation sensitive.



**Figure 11 - Three Phase, Type E Sensing**

### Power Supply

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

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
O	48 Vdc	24 to 60 Vdc	6.5 W
P	125 Vdc 120 Vac	62 to 150 Vdc 90 to 132 Vac	6.0 W 15.5 VA
†R	24 Vdc	12 to 32 Vdc	7.5W
T	250 Vdc 230 Vac	140 to 280 Vdc 190 to 270 Vac	9.5 W 27.0 VA

† Type R Power Supply may require 14 Vdc to begin operation. Once operating, the voltage may be reduced to 12 Vdc.

**Table 1 - Power Supply Options**

### POWER RANGE PICKUP

Overpower pickup of the relay is adjustable by means of a front panel 10 position rotary TAP select switch used in conjunction with the front panel HIGH/LOW switch over the defined ranges listed in Table 2. Underpower pickup is continuously adjustable from 10 to 95% of the selected overpower tap. Pickup accuracy is within 2% (or 0.05 watts) of the front panel setting for unity power factor. Pickup accuracy is within 5% of the front panel setting for all other power factors between 0.9 and 0.5. The range of voltage for proper operation is 40 to 150 percent of the nominal value.

When the calculated value for power exceeds the overpower pickup setting or falls below the underpower pickup setting and is in the tripping direction, the appropriate LED is illuminated and timing is initiated. One indicating LED is provided for each measuring function within the relay.

### KW TRANSDUCER

The kW Transducer samples the current and voltage of each phase on a continuous basis. The resulting signals representing current and voltage are multiplied and integrated to develop a dc voltage level that is representative of true kW.

### COMPARATOR CIRCUITS

The dc output of the kW Transducer is then compared to front panel settings for underpower and/or overpower. When the reference level of the comparator (or comparators if applicable) is crossed, the output of the comparator is used to either energize the appropriate output (if instantaneous timing has been specified) or to initiate the timing circuits (definite, or inverse).

### TIMING

Time delay is defined as the elapsed time between the application of the condition to the input terminals of the relay and the transition of the output contacts.

# SPECIFICATIONS

(continued)

Sensing Input Type	Nominal Volts	Range	Switch Positions (in Watts)										
			A	B	C	D	E	F	G	H	J	K	
A, B, or V 1 $\phi$	120	1	Hi	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0
			Lo	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
		2	Hi	20	40	60	80	100	120	140	160	180	200
			Lo	5	10	15	20	25	30	35	40	45	50
		3	Hi	100	200	300	400	500	600	700	800	900	1000
			Lo	25	50	75	100	125	150	175	200	225	250
C, D, or E 3 $\phi$	120	1	Hi	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	60.0
			Lo	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
		2	Hi	60	120	180	240	300	360	420	480	540	600
			Lo	15	30	45	60	75	90	105	120	135	150
		3	Hi	300	600	900	1200	1500	1800	2100	2400	2700	3000
			Lo	75	150	225	300	375	450	525	600	675	750
A, B, or V 1 $\phi$	208 or 240	4, 7	Hi	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0
			Lo	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
		5, 8	Hi	40	80	120	160	200	240	280	320	360	400
			Lo	10	20	30	40	50	60	70	80	90	100
		6, 9	Hi	200	400	600	800	1000	1200	1400	1600	1800	2000
			Lo	50	100	150	200	250	300	350	400	450	500
C, D, or E 3 $\phi$	208 or 240	4, 7	Hi	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0
			Lo	3.0	6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0	30.0
		5, 8	Hi	120	240	360	480	600	720	840	960	1080	1200
			Lo	30	60	90	120	150	180	210	240	270	300
		6, 9	Hi	600	1200	1800	2400	3000	3600	4200	4800	5400	6000
			Lo	150	300	450	600	750	900	1050	1200	1350	1500

**Table 2 - Power Range Pickup Settings**

Each model, BE1-32R or BE1-32 O/U is capable of instantaneous trip, definite time delay trip, or an inverse time delayed trip as defined and selected by the Style Chart.

Instantaneous response time of the relay is within 80 ms (60 Hz) or 100 ms (50 Hz) for a real power magnitude of 2 times the setting.

The definite time delay is adjustable over the ranges of 0.1 to 9.9 seconds and 01 to 99 seconds. Selection of the ranges is accomplished by a front-panel multiplier switch which selects either 0.1 or 1.0 as a multiplier of the front panel Time Dial thumbwheel switch. (A Time Dial setting of 00 enables instantaneous operation.) Definite timing accuracy is  $\pm 5\%$  of the setting or 50 ms, whichever is greater.

Inverse time delayed trip is available for the overpower function only. The inverse time delay curve is adjustable from 01 to 99 by means of a front-panel thumbwheel switch. Incrementing the thumbwheel switch moves the inverse curve along the vertical axis. (See Figure 12 for Inverse Time Characteristics.) A Time Dial setting of 00 enables instantaneous operation. Inverse time is accurate to within  $\pm 5\%$  of the published curve or 50 ms, whichever is greater.

## POWER SUPPLY STATUS OUTPUT (OPTIONAL)

The power supply status 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 continuously energized with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is deenergized, closing the NC output contact.

## SPECIFICATIONS, continued

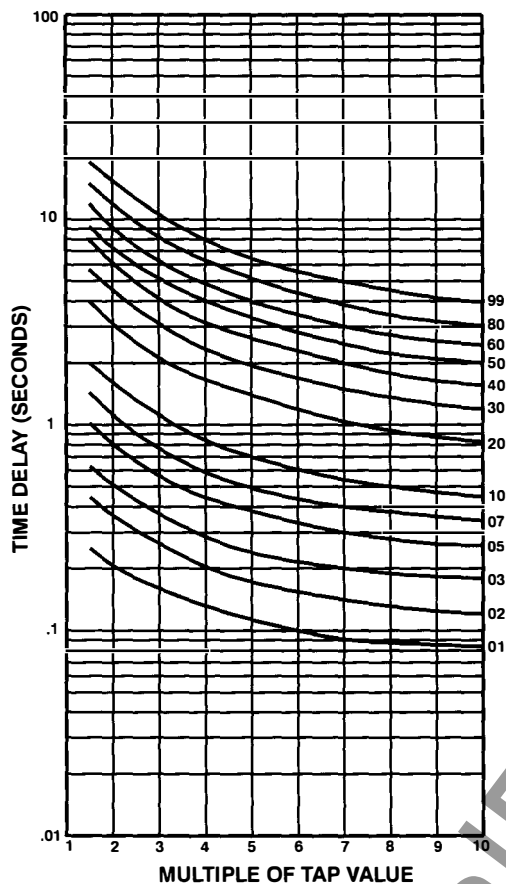


Figure 12 - Overpower Inverse Characteristics

### OUTPUTS

Output contacts are rated as follows:

#### Resistive

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

250 Vdc - make and carry 30 A for 0.2 seconds,  
carry 7 A continuously, break 0.3 A.

500 Vdc - make and carry 15 A for 0.2 seconds,  
carry 7 A continuously, break 0.1 A.

#### Inductive

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

### TARGETS

Magnetically latched, manually reset target indicators are optionally available to indicate that a trip output has energized. Either internally operated or current operated target may be specified. Current operated targets require 0.2 A in the output trip circuit to actuate, and trip 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.

### 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 IEEE C37.90.1-1989 Surge Withstand Capability Test and IEC 255.

### FAST TRANSIENT

Qualified to IEEE C37.90.1-1989 Fast Transient Test.

### IMPULSE TEST

Qualified to IEC 255-5.

### MECHANICAL

#### Operating Temperature

-40°C(-40°F) to +70°C(+158°F).

#### Storage Temperature

-65°C(-85°F) to +100°C(+212°F).

#### Weight

M1 - 18.5 pounds max.

S1 - 13.5 pounds max.

#### 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 each sweep, without structural damage or degradation of performance.

### CONNECTIONS

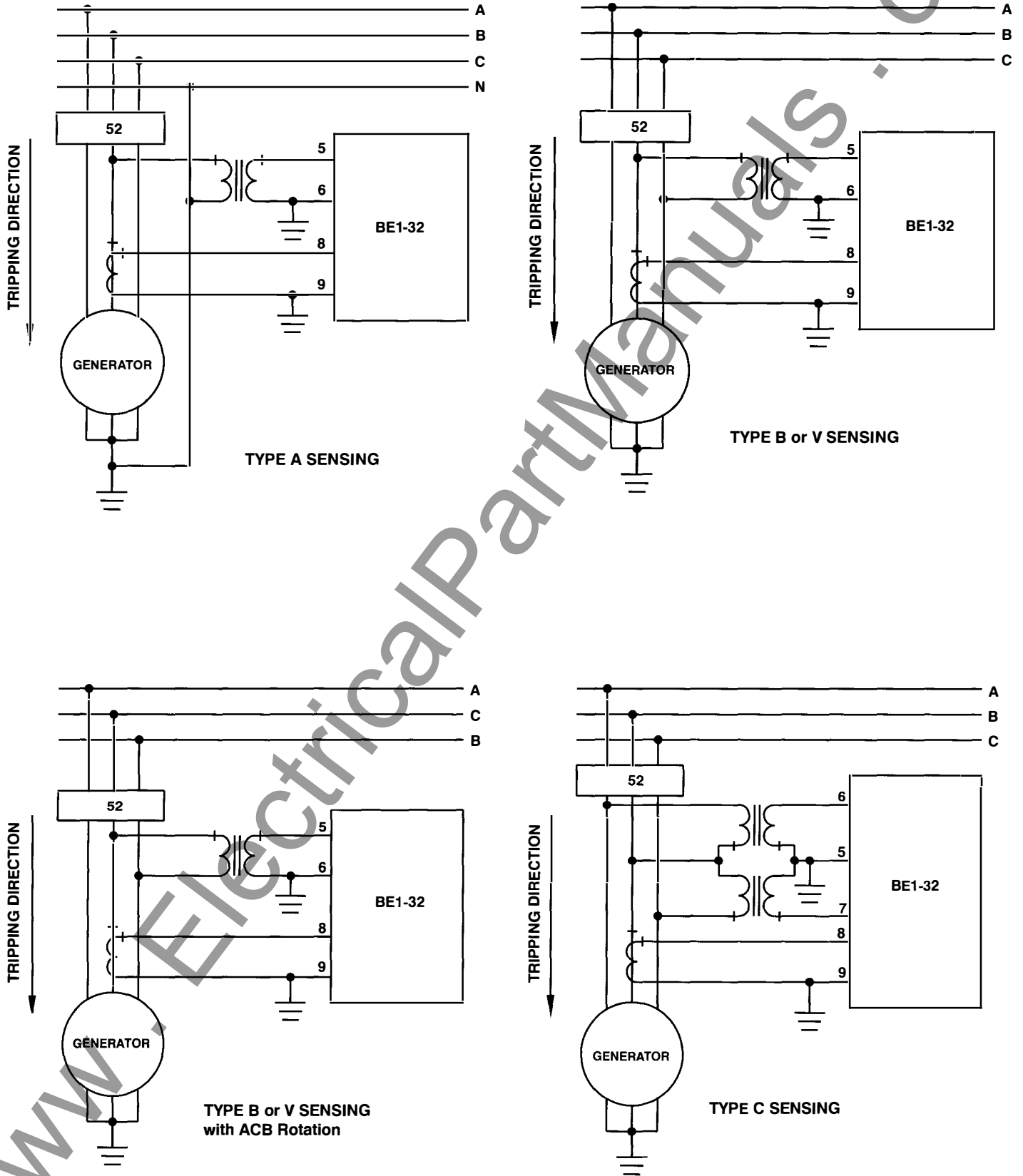


Figure 13 - Sensing Connections  
(Continued next page)

## CONNECTIONS (continued)

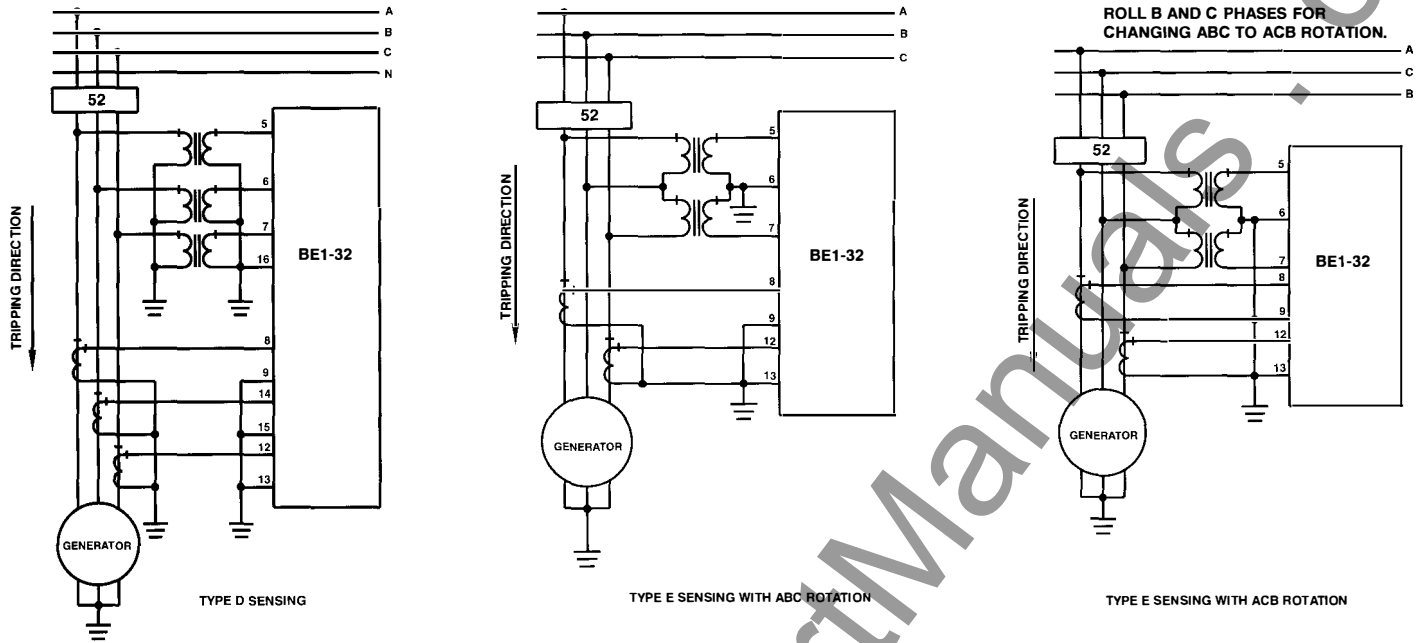
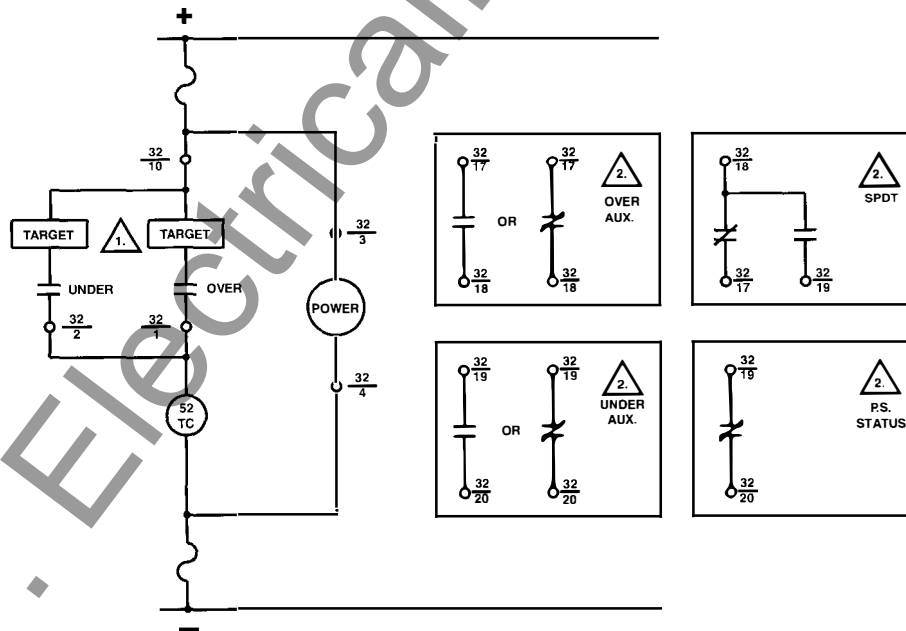


Figure 13 (continued) - Sensing Connections



- 1. Overpower, underpower, and power supply status output contacts are optionally normally open or normally closed.
- 2. Auxiliary output contacts are optionally normally open, normally closed, or SPDT. If SPDT, power supply status is not available.

Figure 14 - Control Circuits

## ORDERING

### MODEL NUMBER

BE1-32R Directional Power Relay and BE1-32 O/U Directional Over/Underpower Relay.

### STYLE NUMBER

The style number 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 below illustrates the manner in which the various features are designated. The Style Number Identification Chart (page 12) defines each of the options and characteristics available for this device.

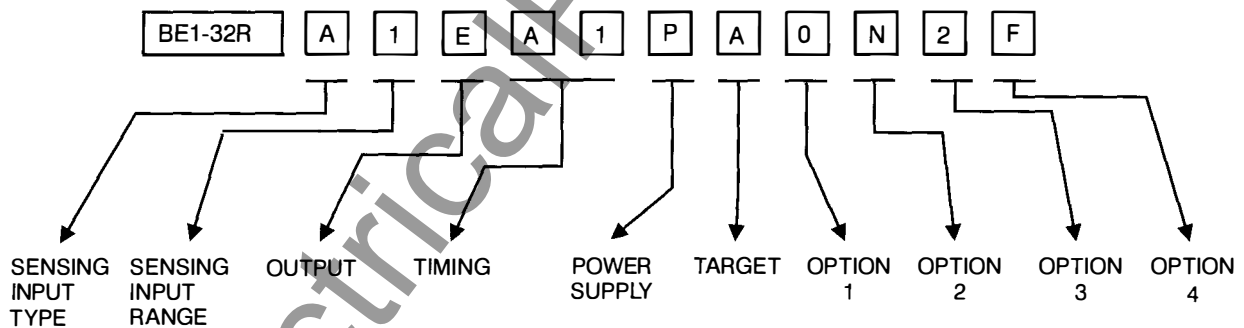
SAMPLE STYLE NUMBER A1EA1PA0N2F

The style number above describes a BE1-32R Directional Power Relay having the following features.

Sensing Input Type (A) Single-phase current and L-N voltage sensing

Sensing Input Range (1)	120 Vac, 0.5-20W
Output (E)	One Output relay with normally open contacts
Timing (A1)	Instantaneous timing
Power Supply (P)	125 Vdc/120 Vac input power supply
Target (A)	One internally operated target
Option 1 (0)	None
Option 2 (N)	None
Option 3 (2)	One auxiliary output relay with normally closed contacts
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.

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

### STANDARD ACCESSORIES:

The following accessories are available for the BE1-32R or BE1-32 O/U Directional Power Relays.

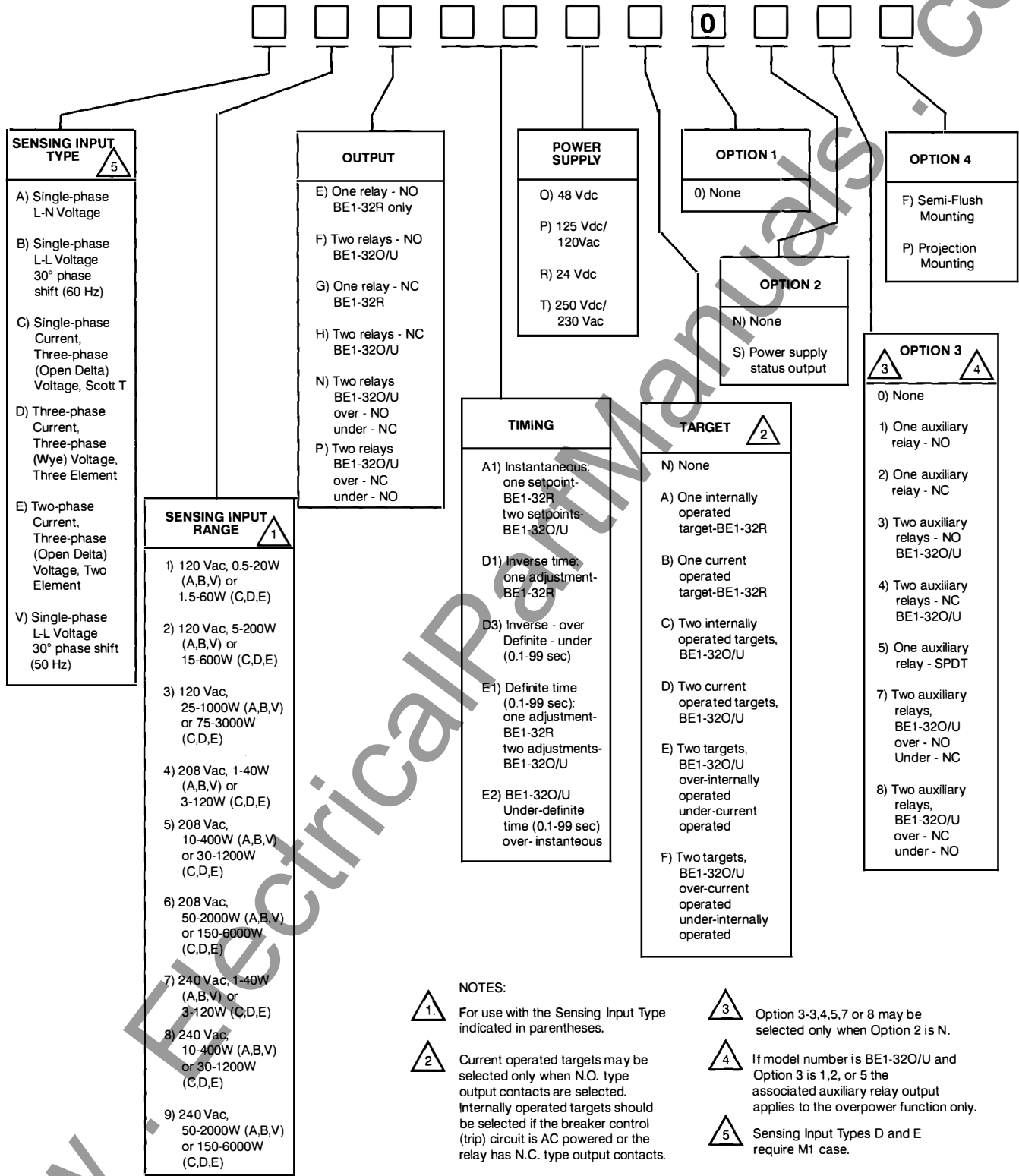
#### Test Plug

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

#### Extender Board

The extender board permits troubleshooting of the printed circuit boards outside of the relay cradle. Order Basler Electric part number 91655001 00.

## STYLE NUMBER IDENTIFICATION CHART



# Basler Electric

