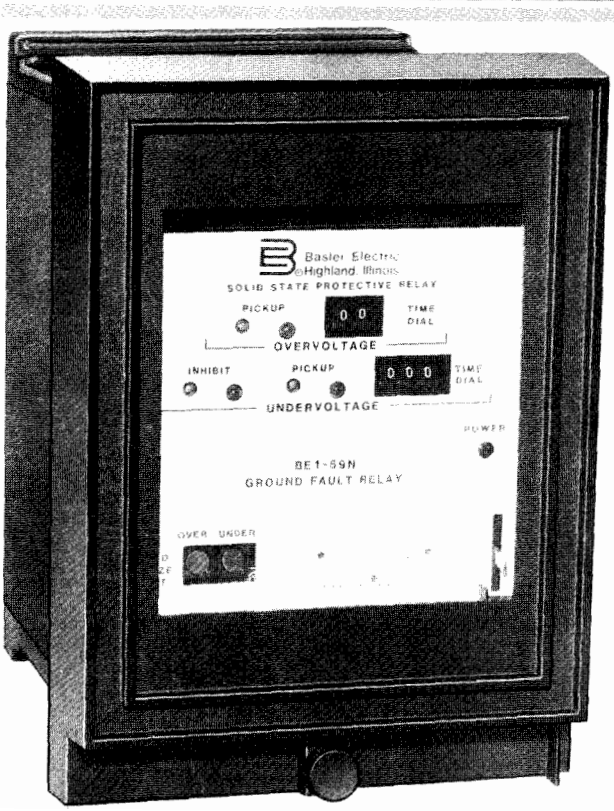


BE1-59N GROUND FAULT OVERVOLTAGE RELAY

The BE1-59N Ground Fault Overvoltage Relay provides sensitive protection for ungrounded and high resistance grounded systems.

ADVANTAGES

- Provides 100% stator ground fault protection.
- 100/120 Vac or 200/240 Vac nominal sensing input.
- Four sensitivity ranges for overvoltage are available: 1-20 and 10-50 Vac for a 100/120 Vac input and 2-40 and 20-100 Vac for a 200/240 Vac input.
- Four sensitivity ranges for undervoltage are available: 0.1-2.5 Vac and 0.5-12 Vac for a 100/120 Vac input and 0.2-5 Vac and 1-24 Vac for a 200/240 Vac input.
- Instantaneous, definite, and inverse time characteristics.
- 40 dB harmonic filtering.
- Low sensing input burden.
- Power supply status contact.
- Qualified to the requirements of
  — ANSI/IEEE C37.90.1-1989 and IEC 255 for surge withstand capability;
  — IEC 255-5 for impulse.
- UL Recognized under Standard 508, UL File #E97033.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request publication 9-1714-00-990

STANDARDS, DIMENSIONS & ACCESSORIES
Request bulletin SDA

Basler Electric
P. O. BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UBG-6
10-95

APPLICATION

PURPOSE

The available fault current for single-phase-to-ground faults is very limited for ungrounded systems and systems which are grounded through a high resistance. This current limiting reduces the possibility of extensive equipment damage, and eliminates the need for a neutral breaker by reducing the fault current below the level required to sustain an arc.

But it remains important to detect and isolate single-phase-to-ground faults in order to prevent their evolution into more dangerous faults such as phase-to-phase-to-ground and three-phase-to-ground faults. Sensitive voltage relays can be used to detect ground faults where the fault current is very small. The BE1-59N is especially suited to the task.

HIGH RESISTANCE GROUNDING

A common method of grounding an ac generator is to connect a distribution transformer between the neutral of the generator and the station ground. The distribution transformer's primary voltage rating is equal to, or greater than, the generator's rated line-to-neutral voltage. Its secondary is rated at 200/240 Vac or 100/120 Vac. A resistor is connected across the secondary winding of the transformer. When reflected through the transformer it is effectively a high resistance.

$$R_p = R_s \times N^2$$

where R_p is the effective primary resistance
R_s is the actual value of the secondary resistor
N is the turns ratio of the distribution transformer

The available single-phase-to-ground fault current at the generator terminals is greatly reduced by the high effective resistance of the distribution transformer and secondary resistor. The distribution transformer provides isolation for the protection scheme and reduces the voltage to a convenient level.

The BE1-59N ground fault overvoltage relay is connected across the secondary resistor to detect the increase in voltage across the distribution transformer caused by a ground fault in the generator stator windings. A ground fault at the generator terminals will result in rated line-to-neutral voltage across the transformer primary, while ground faults near the neutral will result in lower voltages. The overvoltage relay setpoint must be higher than any neutral voltage resulting from normal unbalances in order to avoid nuisance trips. This will allow a certain percentage of the stator windings near the neutral to go unprotected by the overvoltage relay. The overvoltage relay function typically protects 90 to 95% of the generator stator windings.

The BE1-59N ground fault overvoltage relay monitors the fundamental frequency (50 or 60 Hz) voltage which accompanies a ground fault, and is insensitive to the third harmonic voltage present during normal operation.

One hundred percent protection of the generator stator windings is obtainable with the optional overlapping undervoltage element. The undervoltage element is tuned to measure the third harmonic voltage which is present in the generator neutral under normal operating conditions. The undervoltage element detects the reduction of the normal third harmonic voltage which accompanies a ground fault near the neutral point of the generator.

An undervoltage inhibit feature is included with the third harmonic undervoltage element. This feature supervises the undervoltage element of the ground fault relay to prevent misoperation during startup and shutdown by monitoring the generator terminal voltage.

UNGROUNDED SYSTEMS

The BE1-59N ground fault overvoltage relay is used to detect ground faults on ungrounded three-phase-three-wire systems. The relay is connected as shown in Figure 1. A set of voltage transformers are wired with a grounded wye primary and a broken delta secondary. The BE1-59N is connected across the broken delta. It is often necessary to connect a resistor across the broken delta to avoid ferroresonance.

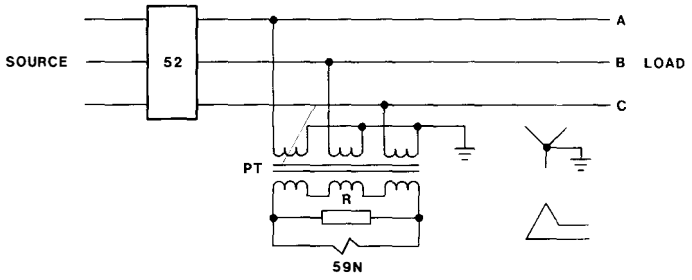


FIGURE 1. UNGROUNDED 3-PHASE, 3-WIRE SYSTEM

APPLICATION (Continued)

The grounded wye/broken delta voltage transformers act as a zero sequence filter by summing the three phase voltages. Under normal conditions this sum is zero. When a ground fault occurs, the BE1-59N ground fault overvoltage relay will detect the presence of the secondary zero sequence voltage ($3V_0$).

The BE1-59N ground fault overvoltage relay greatly reduces the risk of equipment damage by detecting and isolating the first ground to occur on an ungrounded system.

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the features and options that can be combined to exactly satisfy an application requirement. The block diagram (Figure 2) illustrates how the various standard features, as well as the options, function together.

INPUTS

Nominal sensing input ratings, defined by the style number, are 100/120 or 200/240 Vac with a maximum burden of 2 VA single-phase at nominal 50/60 Hz. The maximum continuous voltage rating is 360 Vac for 100/120 Vac nominal, and 480 Vac for 200/240 Vac nominal.

Overvoltage Sensing

In a typical application, the BE1-59N Ground Fault Overvoltage Relay monitors the voltage across a resistor in the generator's grounding circuit. The voltage across the resistor is supplied to the sensing transformer in the relay.

The derived secondary voltage is applied to an active filter to obtain the fundamental component of the input voltage. If this voltage exceeds the OVERVOLTAGE PICKUP (controlled at the front panel), an LED illuminates, and an internal signal is developed which may be employed three different ways, depending upon the timing option selected.

1. The overvoltage output relay is energized instantaneously.
2. A definite time delay is initiated whose period is determined by the front panel TIME DIAL over a range or 0.1 to 99.9 seconds. At the expiration of the time delay, the overvoltage output contacts close.
3. An inverse time delay is initiated whose period is determined by two factors:
   a. Magnitude of the overvoltage condition (±2% or 100 mV or whichever is greater for the 120 Vac pickup range or ±2% or 200 mV for the 240 Vac pickup range), and
   b. Selection of a particular response curve by the front panel TIME DELAY over the range of 01 to 99 (±5% or 25 mSec, whichever is greater) (Reference Figure 4.)

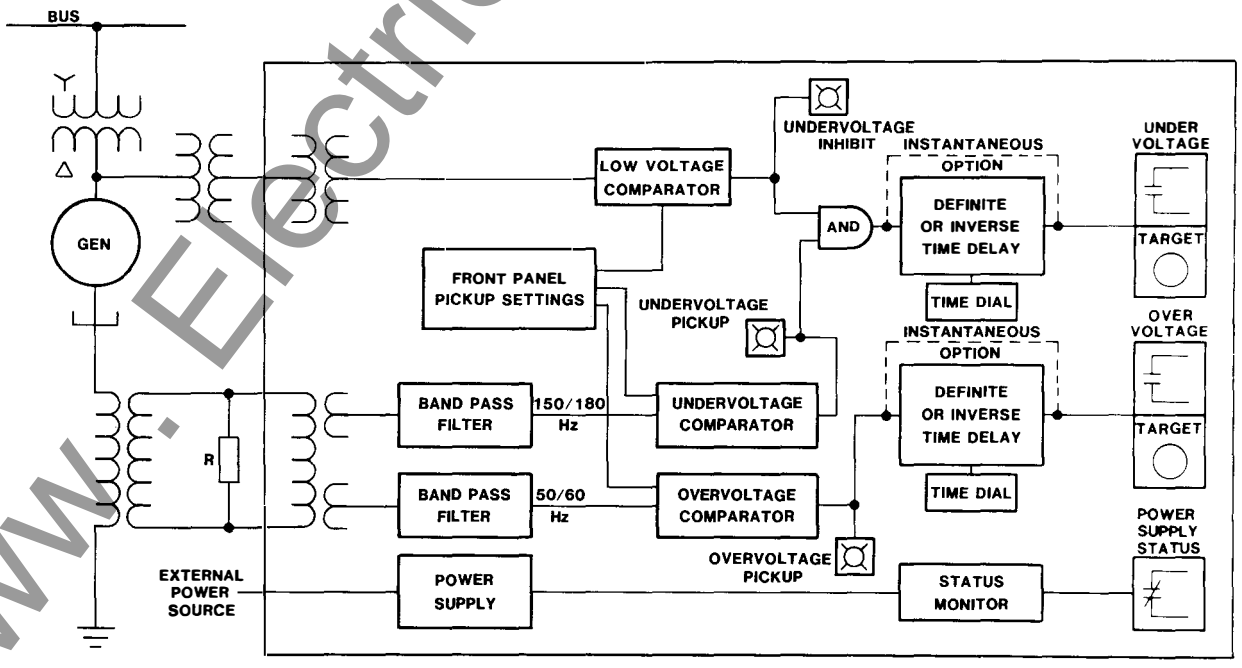


FIGURE 2. FUNCTIONAL BLOCK DIAGRAM

SPECIFICATIONS (Continued)

Undervoltage Sensing Option

An optional undervoltage measuring element is sensitive to the third harmonic (150 Hz or 180 Hz) voltage present at the generator neutral, and insensitive to the fundamental frequency (50 or 60 Hz). The undervoltage element determines within 5 cycles whether the third harmonic voltage is above or below the UNDERVOLTAGE PICKUP setting on the front panel. If below, the UNDERVOLTAGE LED will illuminate, and an internal signal is developed which may be employed three different ways, depending upon the timing option selected.

1. The undervoltage output relay is energized instantaneously.
2. A definite time delay is initiated whose period is determined by the front panel TIME DIAL over a range or 0.1 to 99.9 seconds. At the expiration of the time delay, the undervoltage output contacts close.
3. An inverse time delay is initiated whose period is determined by two factors:
   a. Magnitude of the undervoltage condition (±2% or 100 mV or whichever is greater for the 120 Vac pickup range or ±2% or 200 mV for the 240 Vac pickup range), and
   b. Selection of a particular response curve by the front panel TIME DIAL over the range of 01 to 99 (±5% or 25 mSec, whichever is greater) (Reference Figure 3.)

Undervoltage Inhibit

When the undervoltage sensing option is selected, an undervoltage inhibit circuit is included which monitors the generator terminal voltage. When the terminal voltage is less than the UNDERVOLTAGE INHIBIT setting on the front panel, the undervoltage sensing option is inhibited to prevent relay operation during start-up or shutdown of the generating unit.

The UNDERVOLTAGE INHIBIT range is continuously adjustable from 40 to 120 Vac for the nominal 100/120 Vac units, and 80 to 240 Vac for the 200/240 Vac units.

PICKUP ACCURACY

Relay pickup will not vary from its setting more than as follows for variations in input power or operating temperature within the specified limits.

For 120 Vac sensing range: ±2.0% or 100 millivolts, whichever is greater.

For 240 Vac sensing range: ±2.0% or 200 millivolts, whichever is greater.

DROPOUT RATIO

Overvoltage and undervoltage elements reset within 2.0% of their actual pickup level within seven cycles.

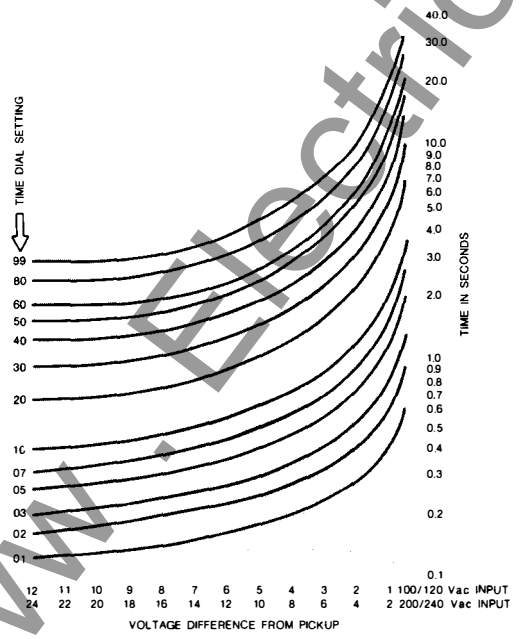


FIGURE 3. UNDERVOLTAGE INVERSE TIME CHARACTERISTIC CURVES

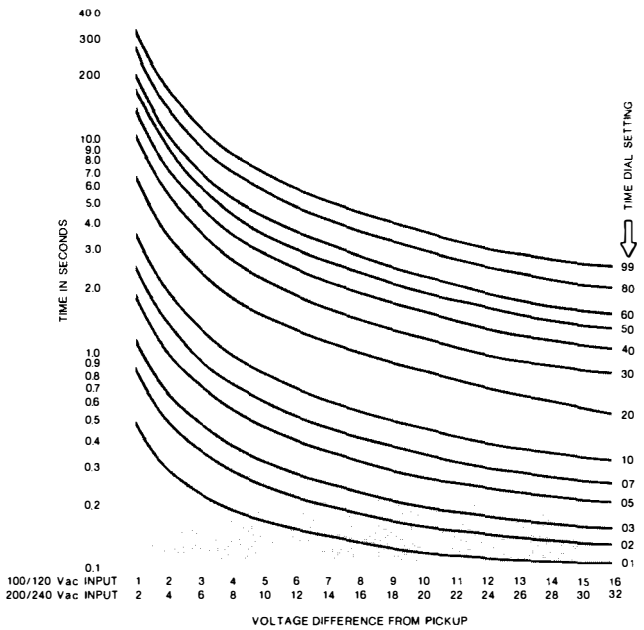


FIGURE 4. OVERVOLTAGE INVERSE TIME CHARACTERISTIC CURVES

SPECIFICATIONS (Continued)

TIMING ACCURACY

Definite time is adjustable from 00.1 to 99.9 seconds, in steps of 0.1 seconds. Accuracy is within ±½% of least significant digit ±25.0 milliseconds.

Inverse time is adjustable from 01 to 99 in increments of 01. The setting defines a curve as illustrated in Figures 3 and 4. Inverse timing is accurate within ±5% or 25.0 milliseconds, whichever is greater, for any combination of time dial and pickup setting.

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	7.0 W	7.5 W 15.0 VA	7.5 W	7.0 W 7.5 W	12.0 W 33.5 VA

* The type Y power supply is field selectable for use with either 48 or 125 Vdc. Selection must be accomplished at the time of installation and prior to the application of power.

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 deenergized, closing the NC output contact.

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 0.1 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 0.1 A (L/R = 0.04).

Push-to-Energize Output Pushbuttons

Accessible with a thin non-conducting rod through the front panel, push-to-energize pushbuttons are available to energize each output relay for testing the external control/protective system wiring.

TARGET

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.

SURGE WITHSTAND CAPABILITY

Qualified to ANSI/IEEE C37.90-1978, C37.90a-1974, 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)

Case Size: S1.

Weight

13.6 pounds maximum.

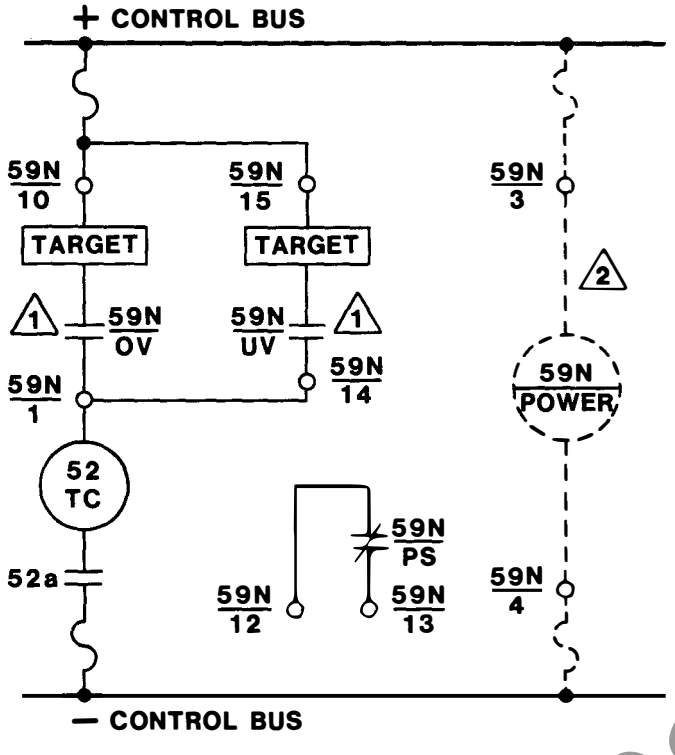
Shock

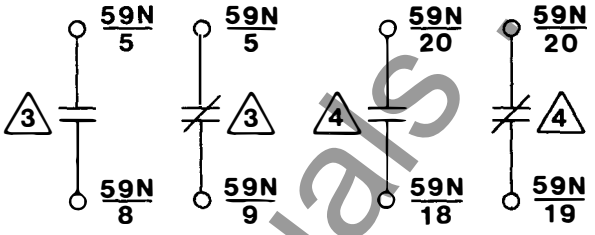
In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

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.

CONNECTIONS

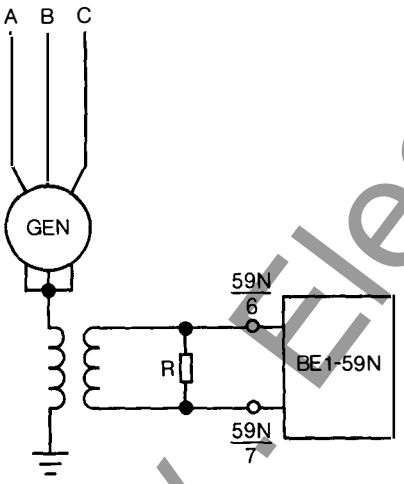




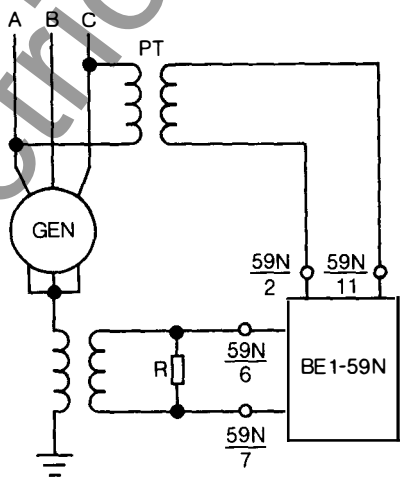
LEGEND:

59N	GROUND FAULT OVERVOLTAGE RELAY
52	POWER CIRCUIT BREAKER
	FUSE
TC	TRIP COIL
OV	OVERVOLTAGE CONTACTS
UV	OPTIONAL UNDERVOLTAGE CONTACTS
PS	POWER SUPPLY STATUS

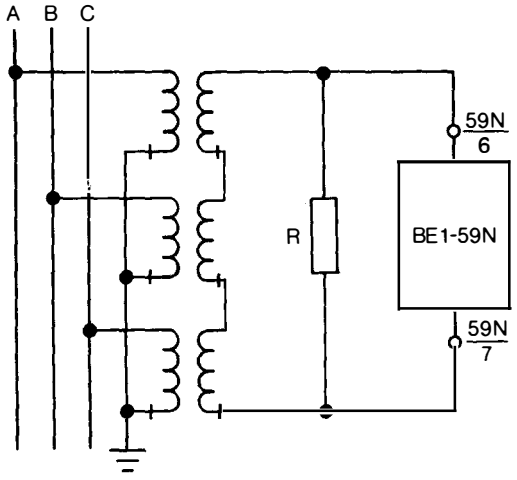
1. N.O. CONTACTS SHOWN. ALSO AVAILABLE WITH N.C. CONTACTS. TARGET AVAILABLE WITH N.O. CONTACTS ONLY.
2. DASHED LINES APPLY ONLY TO D.C. POWERED MODELS.
3. OPTIONAL AUXILIARY OVERVOLTAGE RELAY AVAILABLE WITH N.O. OR N.C. CONTACTS.
4. OPTIONAL AUXILIARY UNDERVOLTAGE RELAY AVAILABLE WITH N.O. OR N.C. CONTACTS.



GROUND FAULT OVERVOLTAGE



OVERLAPPING GROUND FAULT
(UNDERVOLTAGE AND OVERVOLTAGE)



UNGROUNDED SYSTEM

FIGURE 5. TYPICAL CONNECTIONS

ORDERING

MODEL NUMBER

BE1-59N Ground Fault Overvoltage Relay.

STYLE NUMBER

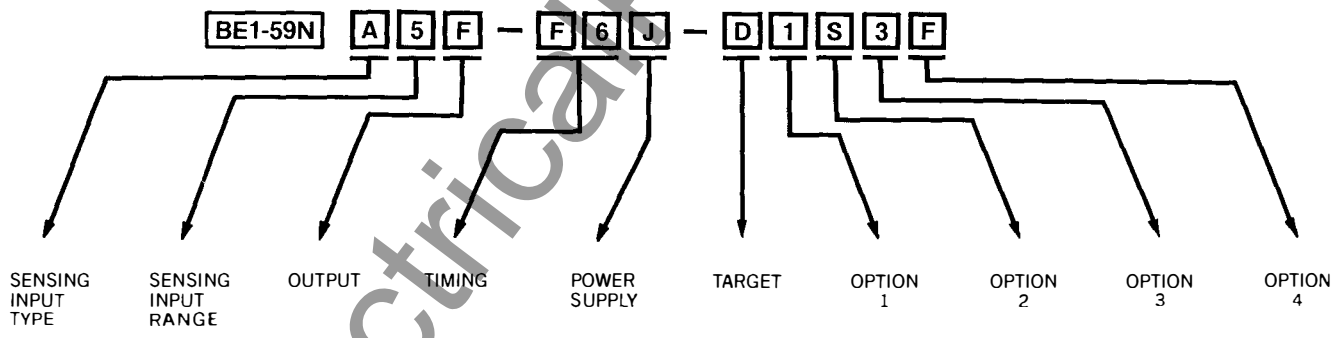
The style number appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number below illustrates the manner in which the various features are designated.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

SAMPLE STYLE NUMBER: A5F F6J D1S3F

The style number above describes a BE1-59N Ground Fault Overvoltage Relay having the following features.

Sensing Input Type	(A)	Single-phase
Sensing Input Range	(5)	120 Vac, 60 Hz (nominal) with 1-20 Vac pickup range
Output	(F)	Two NO output relays: one for the overvoltage function and one for the undervoltage function
Timing	(F6)	Inverse for the overvoltage function; definite time for the undervoltage function
Power Supply	(J)	125 Vdc or 100/120 Vac
Target	(D)	Two (one for each function), current operated
Option 1	(1)	Undervoltage element
Option 2	(S)	Push-to-energize outputs
Option 3	(3)	Two NO 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.



SAMPLE STYLE NUMBER ILLUSTRATED

HOW TO ORDER:

Designate the model number followed by the complete Style Number.

BE1-59N 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 into the appropriate square. (Two squares are used to indicate time delay characteristics.) All squares must be completed.

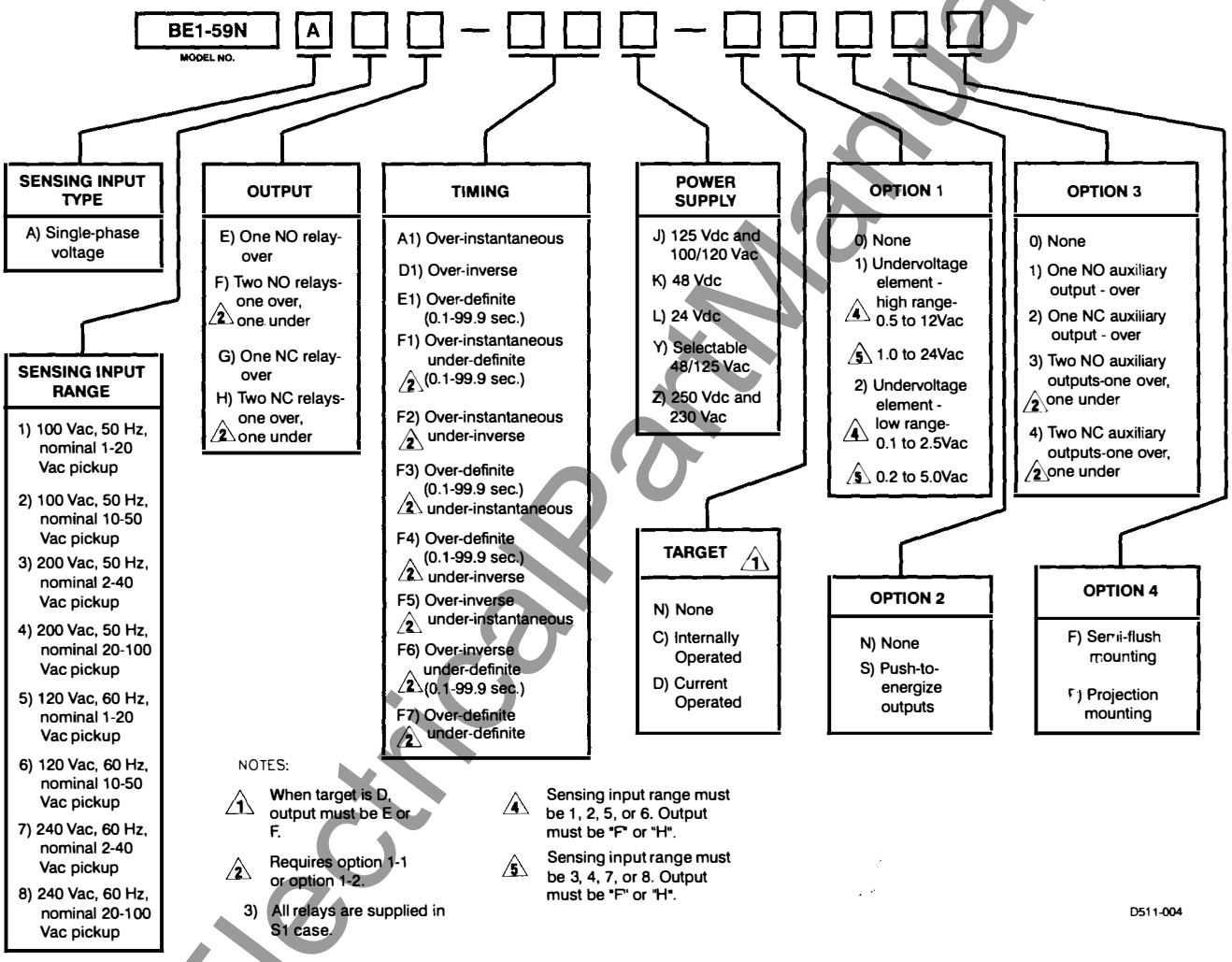
STANDARD ACCESSORIES:

The following accessories are available for the BE1-59N Ground Fault Overvoltage Relay.

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 9 1655 00 100.

STYLE NUMBER IDENTIFICATION CHART
BE1-59N



NOTES:

1. When target is D, output must be E or F.
2. Requires option 1-1 or option 1-2.
3. All relays are supplied in S1 case.
4. Sensing input range must be 1, 2, 5, or 6. Output must be "F" or "H".
5. Sensing input range must be 3, 4, 7, or 8. Output must be "F" or "H".

D511-004

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