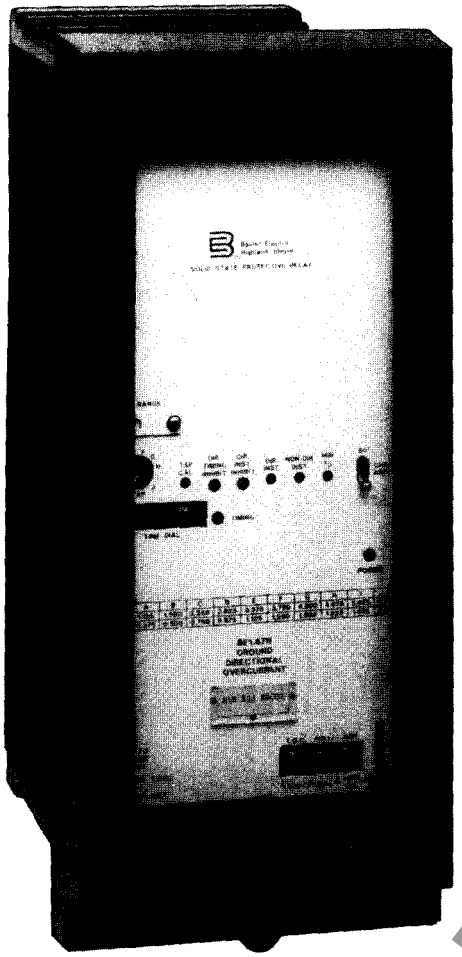


BE1-67N GROUND DIRECTIONAL OVERCURRENT RELAY

The BE1-67N Ground Directional Overcurrent Relay provides ground fault protection for transmission and distribution lines by sensing the direction and magnitude of ground (zero sequence) current into or out of the protected zone.

FEATURES

- Directional element polarized by:
  - Zero Sequence (Neutral) Current
  - Zero Sequence (Residual) Voltage
  - Phasor Sum of zero sequence quantities
- 12 Field selectable curves
- Optional directional and non-directional instantaneous overcurrent elements.
- Qualified to the requirements of:
  - ANSI/IEEE C37.90-1989, C37.90.1-1989, C37.90.2-1989 (Draft)
  - IEC 255-5

CHARACTERISTIC TIMING CURVES
Reference Publication 9-1907-00-999

INSTRUCTION MANUAL
Reference Publication Number 9-1907-00-990

INSTALLATION
Case Dimensions and Mounting Information See Bulletin SDA

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

UDR-2
5-95

FEATURES

- Dual polarized directional element capability
  - Zero sequence (Residual) voltage ($3V_0$)
  - Zero sequence (Neutral) current (I_0)
  - Phasor Summation of $3V_0$ & I_0
- Directional Sensitivity

Time Overcurrent	Instantaneous Overcurrent
I_0: 0.2 Amp V_0: 0.75 Volt	0.75 to 2 Amp 4 Volts

- Directional element is insensitive to third or higher harmonics.
- 12 Field selectable, inverse, definite time, and British Standard (BS142) time overcurrent curves.
- Independent time and instantaneous overcurrent elements.
- Optional independent directional and non-directional instantaneous overcurrent functions.
- Wide continuous setting ranges:

Current Transformer Nominal	Time Overcurrent	Instantaneous Overcurrent
5 Amp	0.25 to 6.0 Amps	2 to 100 Amps
1 Amp	0.05 to 1.2 Amps	0.4 to 20 Amps

- Current pickup accuracy ±2%
- Timing accuracy ±5%
- Time Overcurrent Reset — Instantaneous
- Optional Auxiliary Output Contact follows operation of user defined function (TOC, Dir INST, Non Dir INST)
- Drawout construction, testable-in-case
- Provision for trip circuit testing
- Less than 0.1 Ohm burden for current sensing inputs
- Standard magnetically latched targets for each trip function
- Qualified to the requirements of:
  - ANSI/IEEE C37.90.1-1989 for SWC and Fast Transient
  - ANSI/IEEE C37.90.2-1989 (Draft) for RFI
  - IEC 255-5 for impulse
- Two year warranty

APPLICATION

Directional relays are used to determine the relative location of the fault from the direction of fault current flow relative to a reference quantity such as neutral current (I_0) or residual voltage ($3V_0$). Zero sequence quantities provide a secure reference for the directional element since these quantities are defined by the total source impedance of the power system.

The BE1-67N can determine the direction of the fault and operate with either one or both the polarizing current and voltage inputs connected. An internal switch provides the user with the ability to select the polarizing quantity(s) to be used for the application.

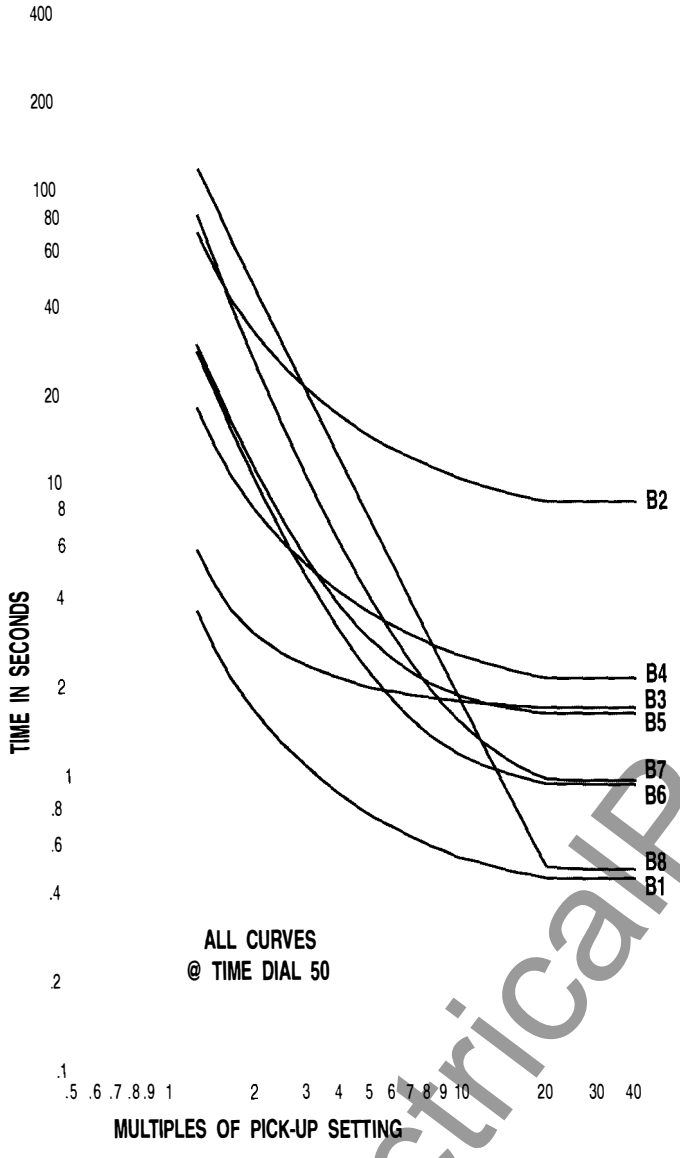
The zero sequence ($3V_0$) polarizing voltage can be obtained from the bus or the protected line by using the broken-delta secondary of a set of grounded wye voltage transformers.

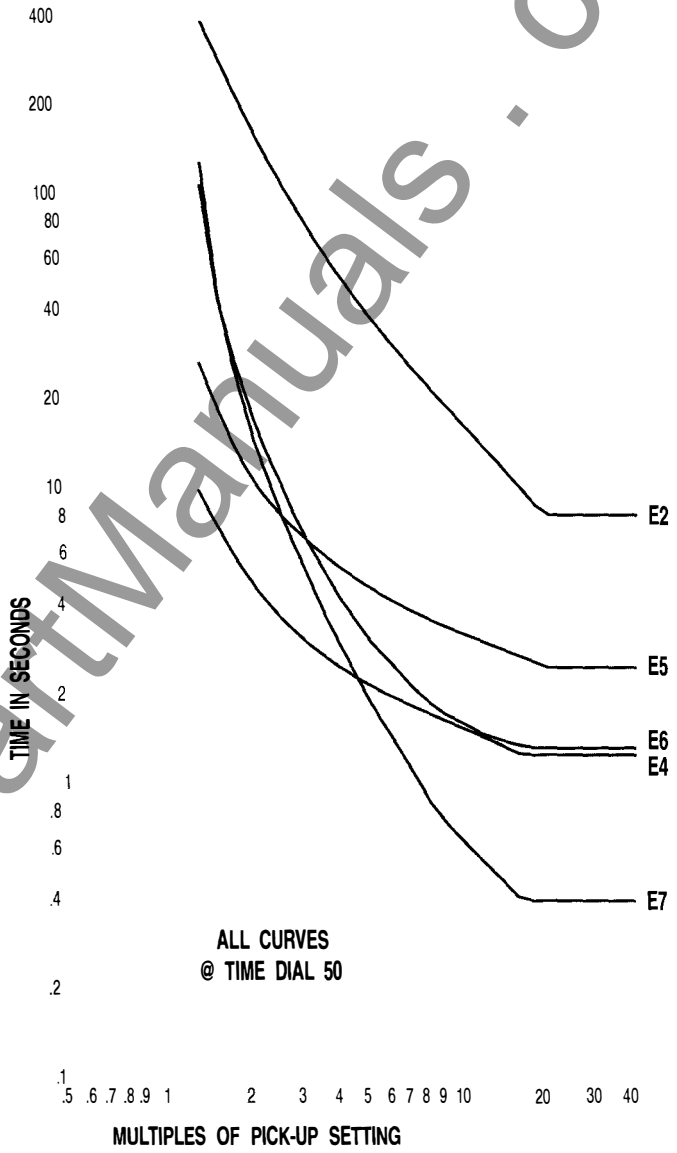
Zero sequence polarizing current is typically obtained from the neutral of a grounded wye winding of a power transformer. However, the source should be evaluated to ensure the direction of this polarizing current does not change for ground faults on the protected line.

A directional instantaneous element is recommended when the fault current behind the relay is equal to or greater than 90% of the pickup setting of the instantaneous element.

The low current burden of the directional element enhances the performance of the protection since all of the directional elements are supplied from the same polarizing source.

Twelve standard time-current characteristics are available to aid the coordination of this relay with other protective devices in the system. These include seven characteristics that are standard in North America and five that are compatible with British or IEC requirements.





B2=Long Inverse
B4=Moderately Inverse
B1=Short Inverse
B5=Inverse
B3=Definite
B6=Very Inverse
B7=Extremely Inverse

E2=Long Inverse (BS 142)
E4=Inverse (1.3 sec)(BS 142)
E5=Inverse (2.9 sec)(BS 142)
E6=Very Inverse (BS 142)
E7=Extremely Inverse (BS 142)

Figure 1. Time-Current Characteristics

FUNCTIONAL DESCRIPTION

DIRECTIONAL INPUTS ($3V_0$ and I_0)

The directional element determines the characteristic angle for the operation of the relay from the polarizing quantity. This "maximum torque" angle defines the center of the directional characteristic. When the phase relationship between the polarizing quantity and the measured fault current (I_{OP}) is within this characteristic, the directional element enables the operation of time and instantaneous overcurrent functions within the relay (Figures 4, 5, and 6).

The BE1-67N Ground Directional Overcurrent Relay includes a dual polarized directional element. This element may be polarized by either the zero sequence (Neutral) current (I_0), the zero sequence voltage ($3V_0$), or the phasor summation of both quantities.

If $3V_0$ is used, a phase shift of 0° or 60° is included to adjust the characteristic angle of the directional element to the characteristic of the power system. A setting of 0° (Figure 4) is used when the power system is grounded through a resistance. A setting of 60° (Figure 5) is used when the power system is solidly grounded.

Polarizing current may be obtained from either the neutral of a solidly grounded wye power transformer or a delta winding. The acceptability of this current polarizing source must be evaluated for the application.

CURRENT INPUT (I_{OP})

Current sensed by the relay from the residual connection of system current transformers is monitored for its phase relationship to the polarizing quantity(s). If the phase relationship is correct for tripping, the time overcurrent element and optional directional instantaneous element will be enabled. The magnitude of this current is compared to the instantaneous and the time overcurrent pickup settings.

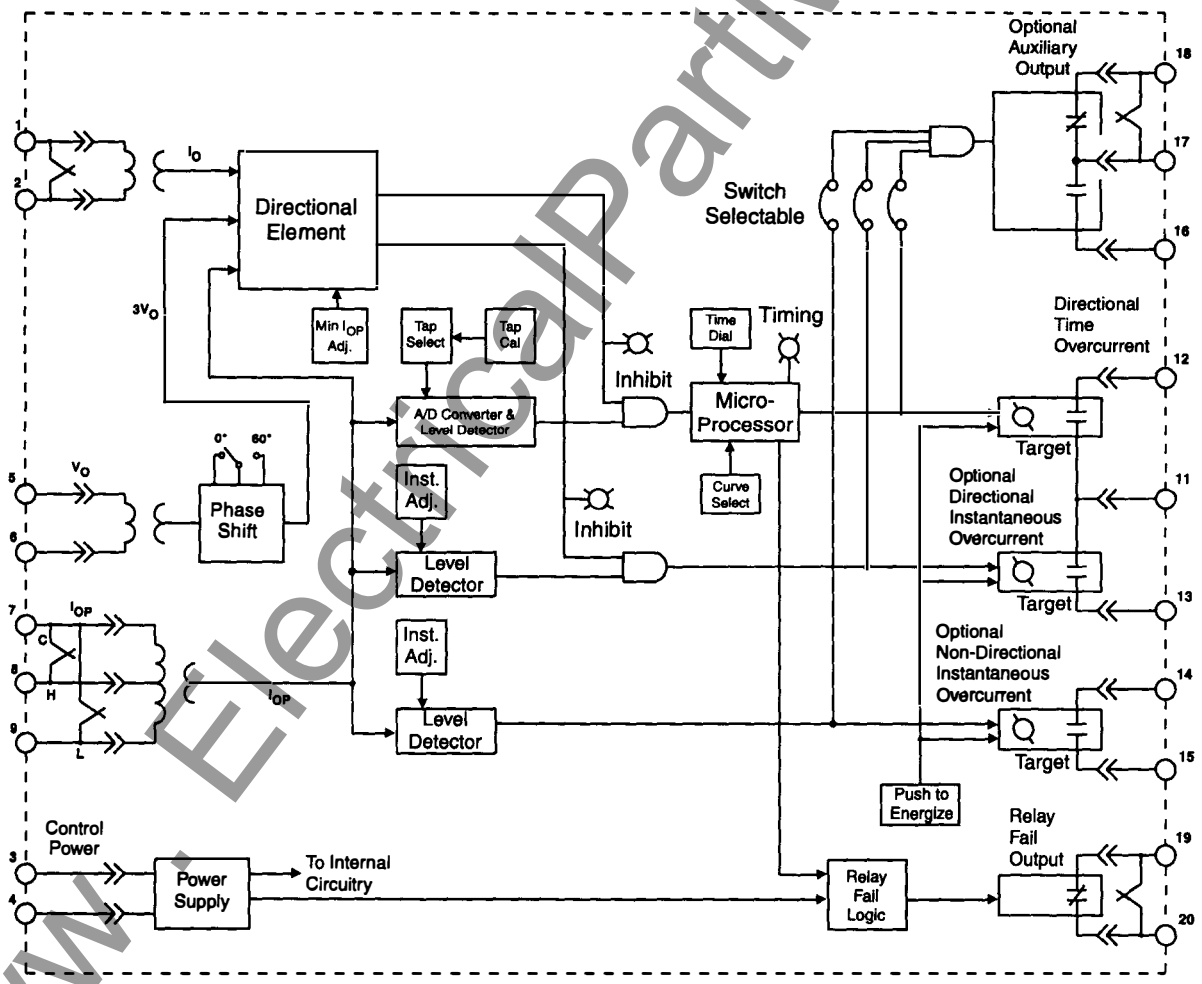


Figure 2. Functional Block Diagram

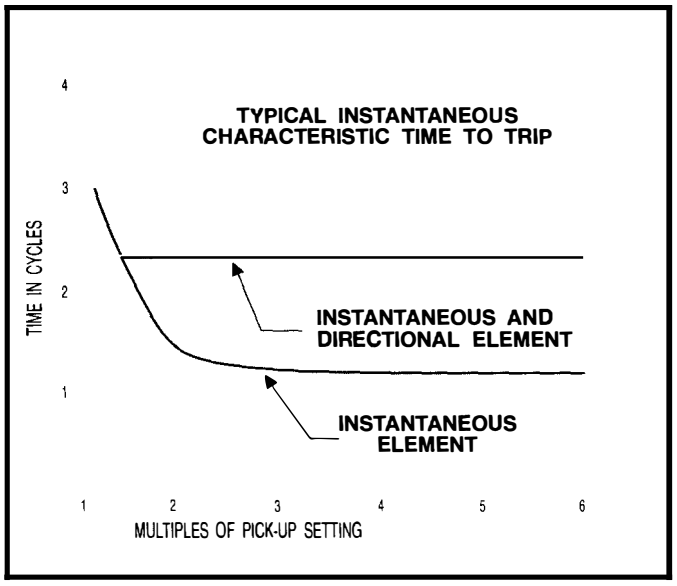


Figure 3. Instantaneous Characteristics

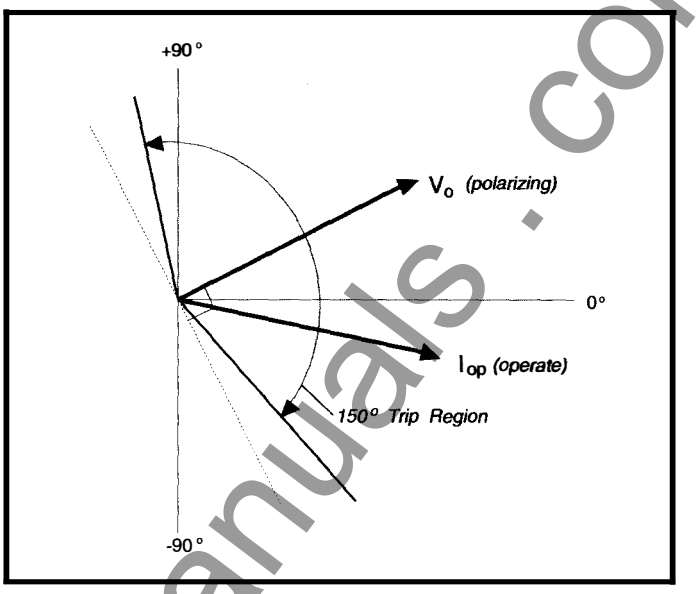


Figure 4. Phase Relationship for Residual Voltage Polarization (V_0) (0° Characteristic Angle)

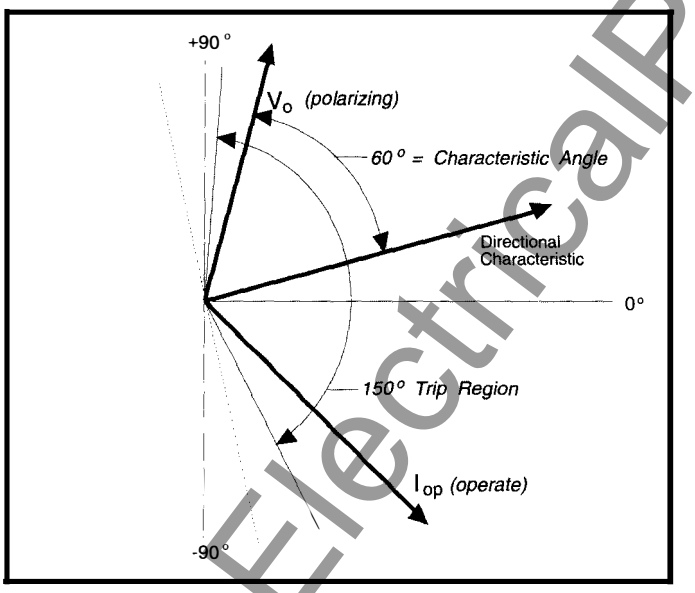


Figure 5. Phase Relationship for Residual Voltage Polarization (V_0) (60° Characteristic Angle)

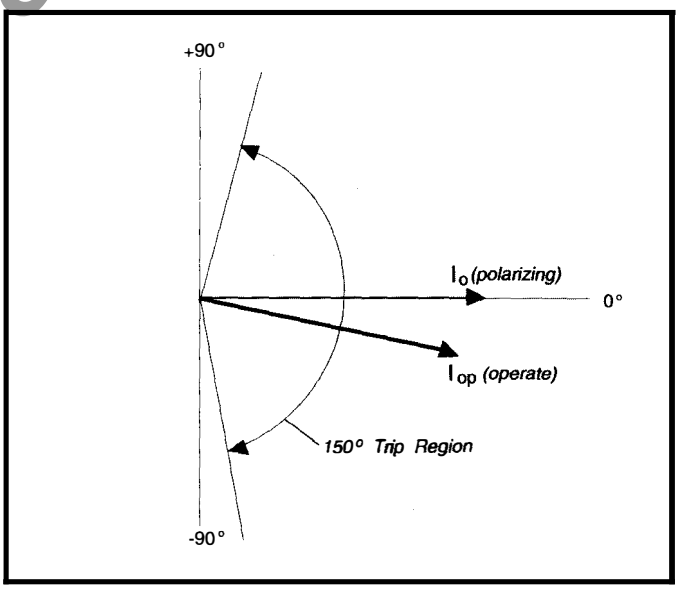


Figure 6. Phase Relationship for Zero Sequence Current Polarization (I_0)

Table 1. Current Sensing Capabilities

System CT Secondary	Maximum Continuous Current	Maximum Current for 1 Second	Time Element Pickup Range (Continuous)
5 Amps	7.5 Amps	150 Amps	0.25 to 6.0 Amps
1 Amp	1.5 Amps	30 Amps	0.05 to 1.2 Amps

Table 2. Instantaneous Element Capabilities

Instantaneous Element	Instantaneous Element Pickup Range		Minimum Directional Sensitivity
CT Secondary	5 Amps	1 Amps	I_0 (polarized)
Directional Pickup Range	2 to 100 Amps	0.4 to 20 Amps	0.75 to 2.0 Amps
Non-Directional Pickup Range	2 to 100 Amps	0.4 to 20 Amps	N/A

MICROPROCESSOR

The microprocessor is enabled when the magnitude of the measured current (I_{OP}) is in excess of the pickup setting and the directional element has determined this current is flowing in the tripping direction. The microprocessor determines the required time delay from the magnitude of the measured current (I_{OP}) relative to the pickup setting, the selected time-current characteristic, and the time dial setting.

INSTANTANEOUS ELEMENT CHARACTERISTICS

The relay may be optionally supplied with directional or non-directional instantaneous overcurrent elements.

The directional instantaneous overcurrent element is supervised by the directional element. If current polarization is used, the level of polarizing current required for tripping is adjustable independently from the time overcurrent function.

The tripping levels for the instantaneous overcurrent elements are set independently from the time overcurrent pickup.

OUTPUTS

Separate normally open or normally closed output contacts are provided for each tripping function included within the relay.

The configuration of the output relays is defined by the style number. These output contacts include an associated target indicator.

An optional auxiliary output relay is available. This auxiliary relay can be selected to operate in parallel with any combination of the output relays for the tripping functions. The configuration of the auxiliary output relay (normally open or normally closed) is defined by the style number.

A relay status alarm contact is standard. This output will be closed to indicate abnormal power supply voltages or when the microprocessor's self-diagnostics has detected an error.

TARGETS

A target is provided for each tripping function within the unit. These are magnetically latched and manually reset.

MANUAL TRIP TESTING

The relay is provided with a push-button switch for each tripping function within the unit. These switches are included to allow trip testing of the external circuitry without the need to supply currents and voltages to the sensing inputs. Only control power needs to be applied to the unit. These switches are recessed behind the front panel to prevent accidental operation.

Activation of these push-buttons (with a non-conducting rod) will energize the associated trip contact, allowing verification of trip circuit integrity.

SPECIFICATIONS

CURRENT SENSING INPUT	Continuous Current	One Second Current
5 Amp Unit	7.5 Amps	150 Amps
1 Amp Unit	1.5 Amps	30 Amps
Current Polarizing Input	10 Amps	150 Amps

- **Burden:**
  Less than 0.1 ohm for current inputs
  Less than 1VA @ 120Vac for voltage inputs

DIRECTIONAL ELEMENT

- **Switch selectable polarizing quantity:**
  Zero sequence (Neutral) current (I_0)
  Zero sequence (Residual) voltage ($3V_0$)
  Dual - Phasor summation of V_0 and I_0
- **Operating Region:**
  ±75° (150° window) centered about the characteristic angle
- **Characteristic Angle:**
  $3V_0$ - selectable as 0° or 60° lag
  I_0 - fixed 0°
- **Directional Sensitivity:**
  I_0 (for time overcurrent): 0.2 Amp
  I_0 (for instantaneous overcurrent): 0.75 to 2 Amp
  $3V_0$ (for time overcurrent): 0.75 Volt
  $3V_0$ (for instantaneous overcurrent): 4 Volts
- **Harmonic Sensitivity:**
  Polarizing quantities are insensitive to third or higher harmonics

TIME OVERCURRENT FUNCTION

- **Pickup Range** — Continuous Adjustment
  5 Amp Unit: 0.25 to 6.0 Amps
  1 Amp Unit: 0.05 to 1.2 Amps
- **Drop Out Ratio:**
  Better than 95% of pickup value
- **Time Dial Range:**
  00 to 99 in 01 steps
- **Timing Characteristics:**
  12 inverse time functions can be switch selected.
- **Timing Accuracy:**
  ±5% or 50 milliseconds, whichever is greater
- **Reset:**
  Instantaneous

INSTANTANEOUS OVERCURRENT FUNCTION

- **Pickup Range** — Continuous Adjustment
  5 Amp Unit: 2 to 100 Amps
  1 Amp Unit: 0.4 to 20 Amps
- **Drop Out Ratio:**
  Better than 98% of pickup value

TARGETS:
Magnetically latched, manually reset for TIME, and each INST function included in the relay. Targets may be specified to operate by either an internal signal or a minimum current of 0.2 Amp through the output contacts.

Target coil resistance: 0.1 Ohm
Operate Time: Less than 1 millisecond

OUTPUTS:
Resistive: 250 Vdc - Make and carry 30 Amps for 0.2 seconds, 7 Amps for 2 minutes, and 3 Amps continuously, break 1 Amp

Inductive: 250 Vdc - break 0.3 Amp, (L/R = 0.04)

ISOLATION:
1500 Vac at 60 Hz for one minute in accordance with IEC 255-5 and ANSI/IEEE C37.90.1-1989 (Dielectric Test).

SURGE WITHSTAND:
Qualified to ANSI/IEEE C37.90.1-1989
Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

FAST TRANSIENT:
Qualified to ANSI/IEEE C37.90.1-1989

IMPULSE TEST:
Qualified to IEC 255-5

RADIO FREQUENCY INTERFERENCE (RFI):
Qualified to ANSI/IEEE C37.90.2-1989 (Draft). Field tested using five watt transceiver operating at random frequencies centered around 144 MHz and 440 MHz

TEMPERATURE:
Operating Range: -40°C (-40°F) to 70°C (158°F)
Storage Range: -65°C (-85°F) to 90°C (194°F)

SHOCK:
15g in each of three mutually perpendicular planes

VIBRATION:
2g in each of three mutually perpendicular planes swept over the range of 10 to 500 Hz for a total of 6 sweeps, 15 minutes per sweep

CASE SIZE: M1

NET WEIGHT: 18 pounds maximum

ORDERING

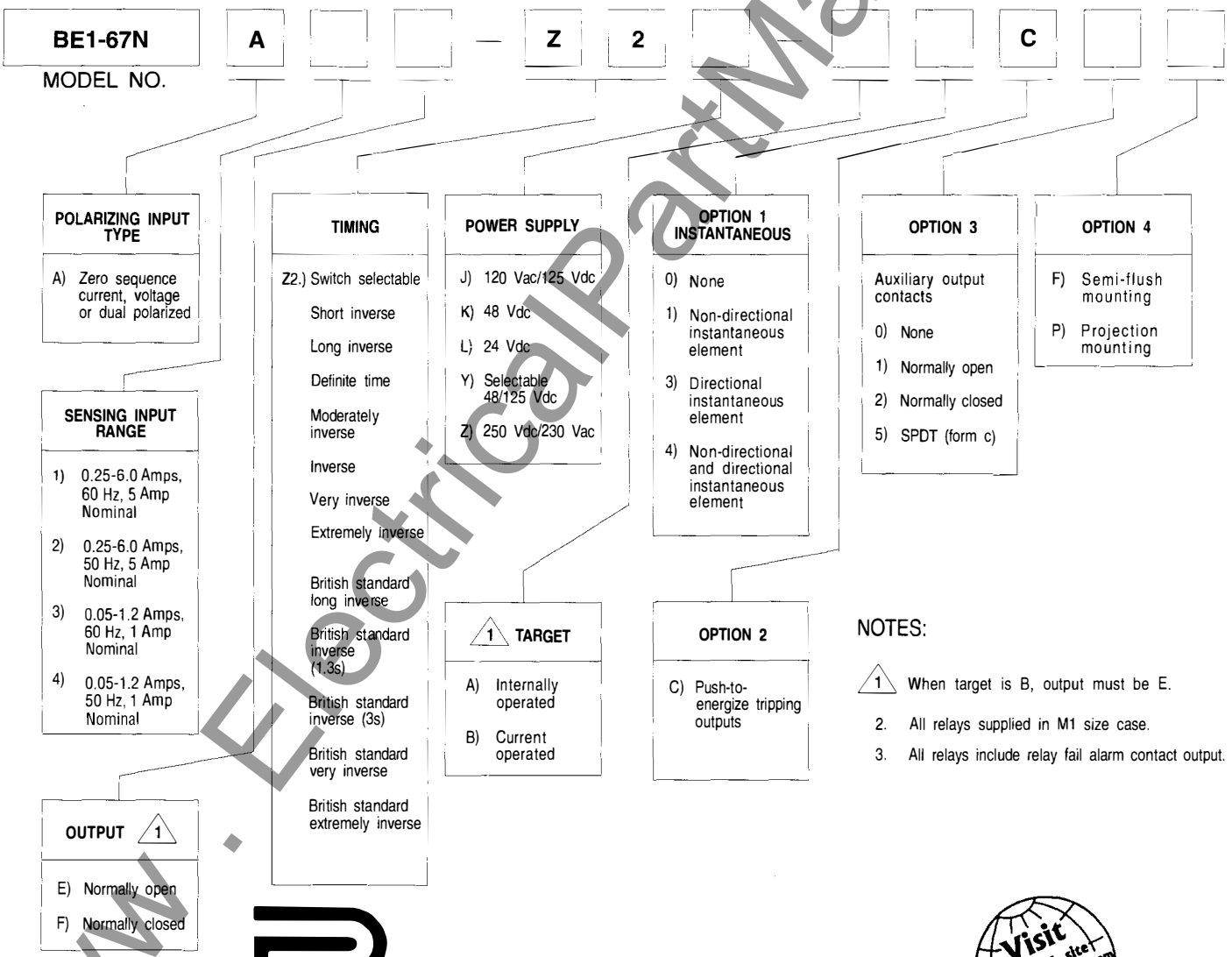
MODEL NUMBER:
BE1-67N Ground Directional Overcurrent Relay

STYLE NUMBER:
The style number appears on the front panel, drawout cradle, and inside the case assembly. This style number consists of an eleven character definition of the features included within a particular unit. The style number identification chart defines each of the standard and optional features.

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. (Two characters are used to designate the timing characteristic.)

STANDARD ACCESSORIES
The following accessories are available for the BE1-67N Ground Directional Relay.

- **Test Plug**
  To allow testing of the relay without removing system wiring, order 2 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.



NOTES:

1. When target is B, output must be E.
2. All relays supplied in M1 size case.
3. All relays include relay fail alarm contact output.

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