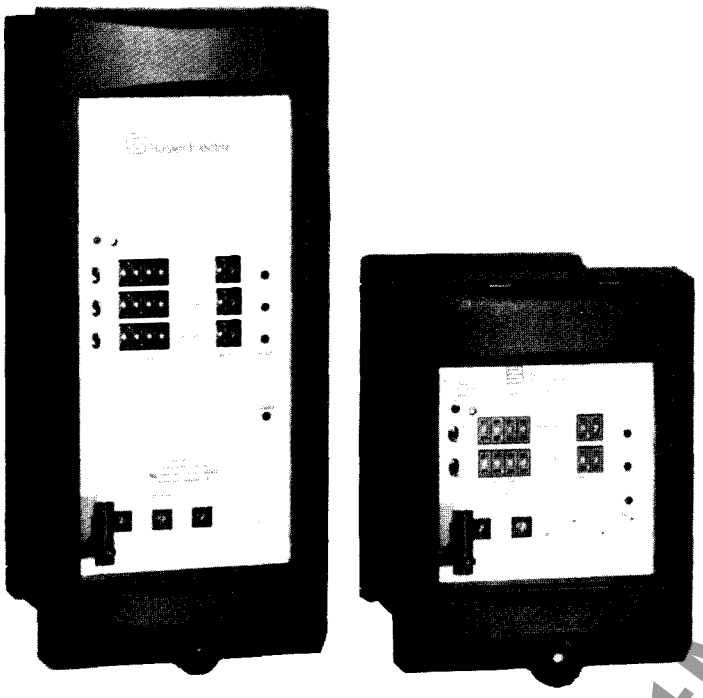
BE1-81O/U DIGITAL FREQUENCY RELAY



The BE1-81O/U Digital Frequency Relay senses an ac voltage from a power system or generator to provide protection in the event that the frequency exceeds predetermined limits.

FEATURES

- Reliable solid-state digital circuitry.
- Up to 4 independent frequency set points.
- Over or underfrequency sensing selectable for each set point.
- Convenient, precise selection of the set point frequency over the nominal range of 40 Hz to 70 Hz.
- Individually adjustable time delays and LED indicators for each frequency set point.
- Optional definite time delay characteristic.
- Undervoltage inhibit prevents undesired relay operation and provides an indication of the inhibiting condition over the adjustable range of 40-120 Vac.
- Excellent timing accuracy and repeatability.
- Low sensing and supply burdens.
- Qualified to the requirements of
  - IEEE C37.90.1-1989 for surge withstand capability
  - IEEE C37.90.1-1989 for fast transient
  - IEC 255-5 for impulse
- Five year warranty.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9137300990

STANDARDS, DIMENSIONS and ACCESSORIES

Request Publication SDA

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

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THEORY OF OPERATION

POWER SUPPLY
A variety of power supply options allows a wide range of external voltage inputs for operation of the relay. Nominal outputs of these supples are ±12 Vdc. An LED indicator on the front panel illuminates when the power supply is operational.

SENSING
A single phase voltage is applied through an input transformer and filter circuit to the undervoltage inhibit logic and the zero-cross logic.

BURDEN
2 VA maximum at nominal input.

UNDERVOLTAGE INHIBIT
This circuit prevents energizing of the output relay(s) from occurring during an undervoltage condition associated with equipment startup. The circuit prevents operation of the relay logic. The undervoltage level is nominally factory set to 80 Vac but may be adjusted by a small screwdriver, through the front panel, to any value between 40 and 120 Vac.

ZERO-CROSS LOGIC
The zero-cross logic converts the sensed frequency to pulses synchronized to each positive-going zero crossing of the waveform. The pulse frequency represents the period of the waveform and is applied to the period measurement logic.

CRYSTAL OSCILLATOR
The crystal-controlled oscillator provides accurate 1 MHz and 2 MHz timing signals for the clock and the period measurement logic.

CLOCK
The clock allows a frequency comparison to be made for each cycle of sensed frequency by initiating the generation of reference periods that are synchronized with the beginning of each cycle of the sensed frequency.

MINIMUM PERIOD DIFFERENCE LOGIC
Each zero-cross pulse causes this logic to count clock pulses up to a maximum count representing the maximum measurable frequency (minimum period) limit. When the sensed frequency is less than this maximum limit, the count goes to completion and an EOPR (End of Period Reference) pulse is generated to initiate the maximum period difference logic.

MAXIMUM PERIOD DIFFERENCE LOGIC
Following the EOPR pulse, this logic counts clock pulses representing the minimum frequency (maximum period) limit. If zero-cross pulses have properly occurred before the count ends, the measured frequency converter computes the actual frequency within the limits.

MEASURED FREQUENCY CONVERTER
This logic converts the period of the sensed frequency into a binary number corresponding to the frequency within the minimum and maximum frequency limits. The binary number is then applied to the frequency comparator logic in each independent set point.

FREQUENCY COMPARATOR LOGIC
This logic compares the binary number representing the actual sensed frequency with the set point frequency selected on the front panel thumbwheel selectors. An output is provided when the sensed frequency is less than the set point frequency if the O/U toggle switch is set to U, or when the frequency exceeds the set point frequency if the O/U toggle switch is set to O. The resultant output consists of an enabling pulse if timing type E1 or E2 (definite time delays) is present.

DEFINITE TIME DELAY LOGIC (TIMING TYPE E1 AND E2)
The enable signal from the frequency comparator logic illuminates the PICKUP indicator and initiates the count of zero-cross pulses. When the TIME DELAY selector setting in cycles is reached, the logic enables the output circuit. The PICKUP indicator remains illuminated and the output relay remains energized until the frequency condition is corrected; when the sensed frequency returns to normal, reset of the output relay and extinguishing of the PICKUP indicator is instantaneous. The time delay selector is selectable over the range of 3 cycles to 990 seconds. An undervoltage condition prevents the operation of this logic.

OUTPUT CIRCUITS
The output signal from the time delay circuit is optically coupled to the output driver. The output driver supplies operating current to energize the output relay. Either normally open or normally closed contacts may be selected for the output relay, and an optional set of auxiliary relay contacts may be specified. Each set point of the relay will be supplied with its own output relay, and the contact configuration of all output relays will be the same. The output relay(s) will remain energized for the duration of the over or underfrequency condition.

THEORY OF OPERATION, continued

POWER SUPPLY STATUS OUTPUT

The optional 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 de-energized, closing the NC output contact.

TARGET INDICATOR CIRCUITS

When required, a target indicator for each set point will be supplied. All targets within a specific relay will be of the same type.

Signal (Internal) Operated Target Driver: The output from the time delay circuit is applied to this circuit to drive the target indicator. The indicator is tripped regardless of the current level in the trip circuit.

Current Operated Target Driver: This circuit will operate when a minimum current of 0.2 amp DC flows in the output circuit. A special reed relay in series with the output contact provides the signal to the target indicator.

Target Indicator: The target indicator(s) is visible on the front panel. The target indicator is magnetically latched and must be reset manually after the abnormal frequency condition has been corrected.

FUNCTIONAL DESCRIPTION

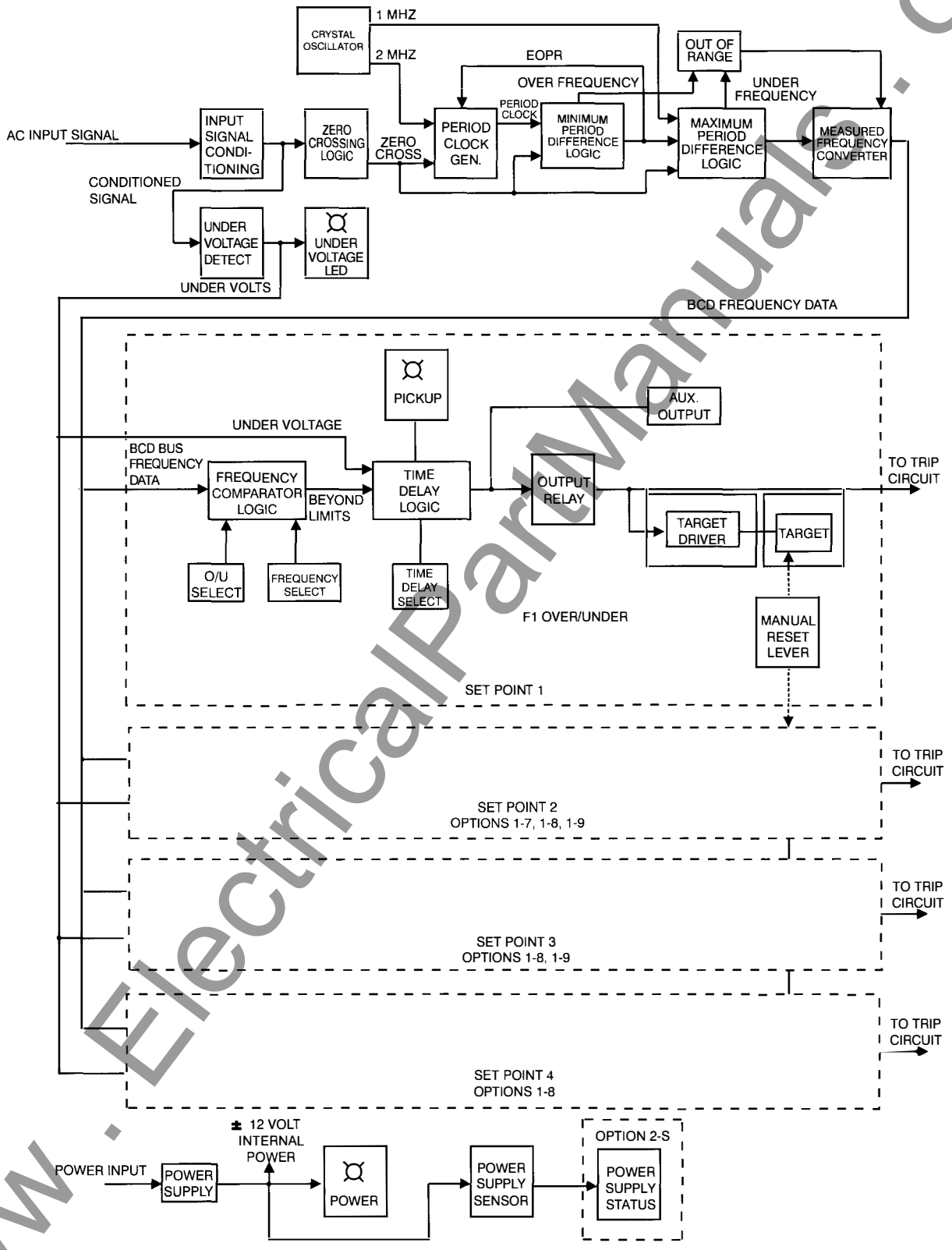


Figure 1 - Functional Block Diagram (Typical)

SPECIFICATIONS

ELECTRICAL

Power Input
One of five types of power supplies may be selected to provide Relay operating power.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
K	48Vdc	24 to 60Vdc	4.4W
J	125Vdc 120Vac	62 to 150Vdc 90 to 132Vac	4.1W 10.1VA
L*	24Vdc	12 to 32Vdc	4.5W
Y	48Vdc 125Vdc	24 to 60Vdc 62 to 150Vdc	4.4W 4.1W
Z	250Vdc 230Vac	140 to 280Vdc 190 to 270Vac	5.5W 14.8VA

* Type L power supply may require 14 Vdc to begin operating. Once operating, the voltage may be reduced to 12 Vdc.

Frequency Sensing Input
The input sensing circuit is operational over the range of 40 to 132 Vac at 40-70 Hz. Maximum sensing burden is 2VA.

Outputs
Output contacts are rated as follows:
Resistive
120/240 Vac - make, break, and carry 7 A continuously.
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 0.3 A.
Inductive
120 Vac, 125 Vdc, 250 Vdc - break 0.1 A (L/R = 0.04).

Power Indicator
A front panel LED illuminates when the power supply is providing operating voltages.

Undervoltage Inhibit Adjustment
Allows continuous adjustment of the undervoltage inhibit level for the sensed voltage between 40 and 120 Vac. Relay operation is inhibited if the sensed level is below the setting. Adjustment is by small screwdriver through the front panel.

Undervoltage Inhibit Indicator
This front panel red LED illuminates when the sensed voltage is less than the UNDERVOLTAGE INHIBIT adjustment level.

Each individual set point (1, 2, 3 and 4) has the following:
SET POINT FREQUENCY SELECTOR:
Each front panel FREQUENCY selector consists of four thumbwheel selectors providing selection of the desired set point frequency, in increments of 0.01 Hz, over the allowable nominal sensing range of 40 - 70 Hz. When the sensed frequency goes outside the selected set point, the output relay is energized after a preset time delay (Figure 2). When the frequency returns to within the “normal” limit, and remains there for three cycles, the output relay resets.

SET POINT O/U SELECTOR: An individual front panel-mounted two position toggle switch determines the O - overfrequency (increasing frequency) or U - underfrequency (decreasing frequency) function for each setpoint.

SET POINT TIME DELAY SELECTOR: Each set point includes two thumbwheel selector switches to provide selection of the desired time delay between sensing of the abnormal frequency condition and energization of the output relay. Two types of time delay characteristics are available: timing types E1 and E2 (See Note 4, Style Number Identification Chart) provide a definite time delay characteristic adjustable over a range of 3 to 99 cycles in 1 cycle increments, 10 to 990 cycles in 1 cycle increments, 100 to 9900 cycles in 10 cycle increments, 0.1 to 9.9 seconds in 0.1 second increments, 1 to 99 seconds in 1 second increments, and 10 to 990 seconds in 10 second increments. Settings of 00, 01, or 02 cycles operate the same as 3 cycles, because the timing circuits require 3 cycle continuous excursion through the set point before tripping the output circuit.

SET POINT PICKUP INDICATOR: A front panel red LED illuminates during each time delay period and continues to illuminate while the set point output relay remains energized.

SPECIFICATIONS, continued

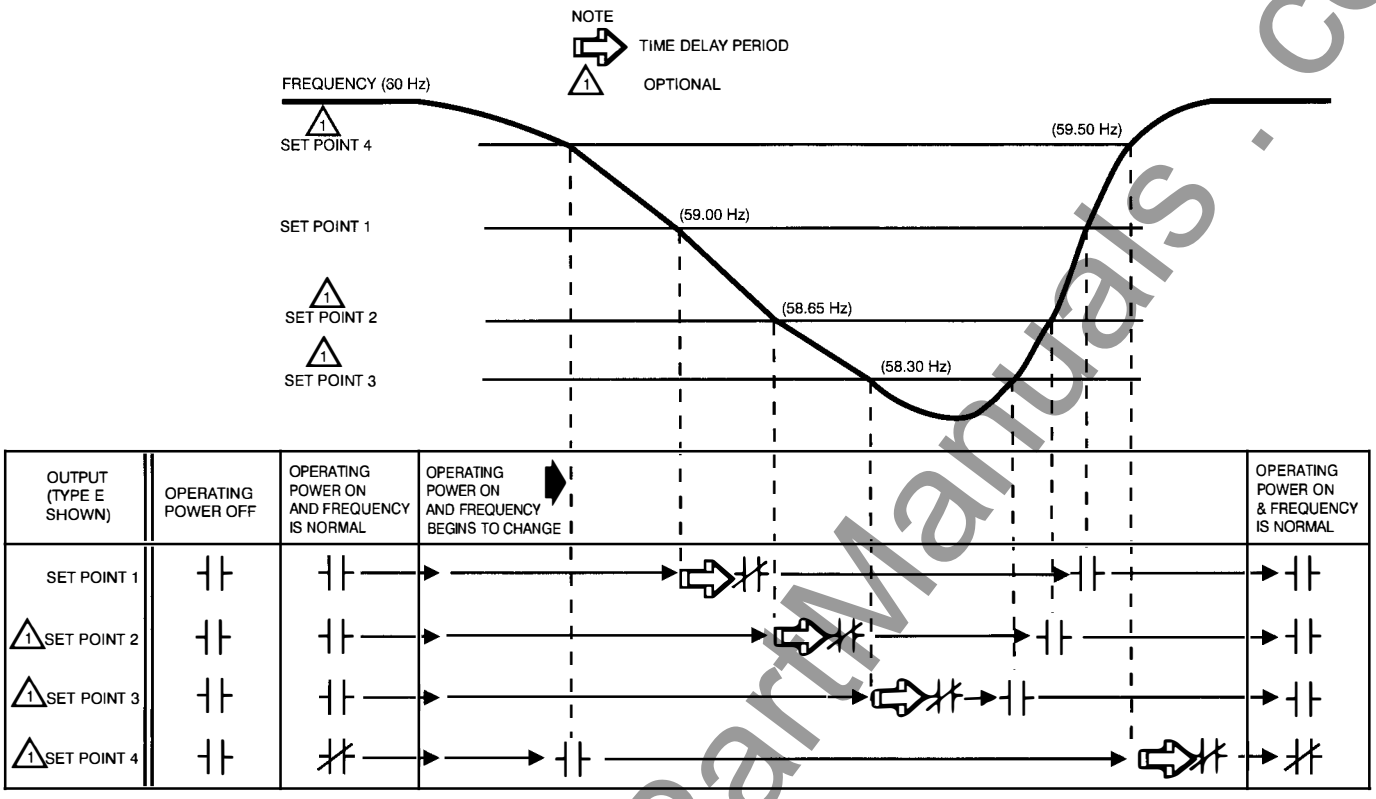


Figure 2 - Example of frequency set point and time delay selection with resultant outputs

Set Point Frequency Selectors: Thumbwheel switches provide frequency pickup settings in increments of 0.01 Hz (See Fig. 2).

Pickup: ±0.008 Hz of the set value.

Target Indicators: May be either internally operated or current operated (operated by a minimum of 0.2 A through the output trip circuit). When the target is current operated, the trip output circuit current must be limited to 30 A for 1 second, 7 A for 2 minutes, and 3 A continuously.

Timing Repeatability: ±5%.

AGENCY RATINGS

UL approved, CSA certified

ENVIRONMENTAL

Operating Temperature: -40°C to 70°C (-40°F to 149°F).

Storage Temperature: -65°C to +100°C (-85°F to 212°F).

Shock: 15 g in each of three mutually perpendicular axes.

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

Radio Frequency Interference (RFI): Field tested with a five watt, hand-held transceiver operating at random frequencies centered around 144 MHz and 440 MHz, with the antenna located six inches from the relay in both horizontal and vertical planes.

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

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

Impulse Test: Qualified to IEC 255.5.

Weight:
S1 - Approx. 13 lbs. (1 or 2 set points)
M1 - Approx. 18 lbs. (3 or 4 set points)

Case Size:
S1 - 6.65"W x 9.32"H x 9.40"D
M1 - 6.65"W x 15.32"H x 9.40"D

SPECIFICATIONS, continued

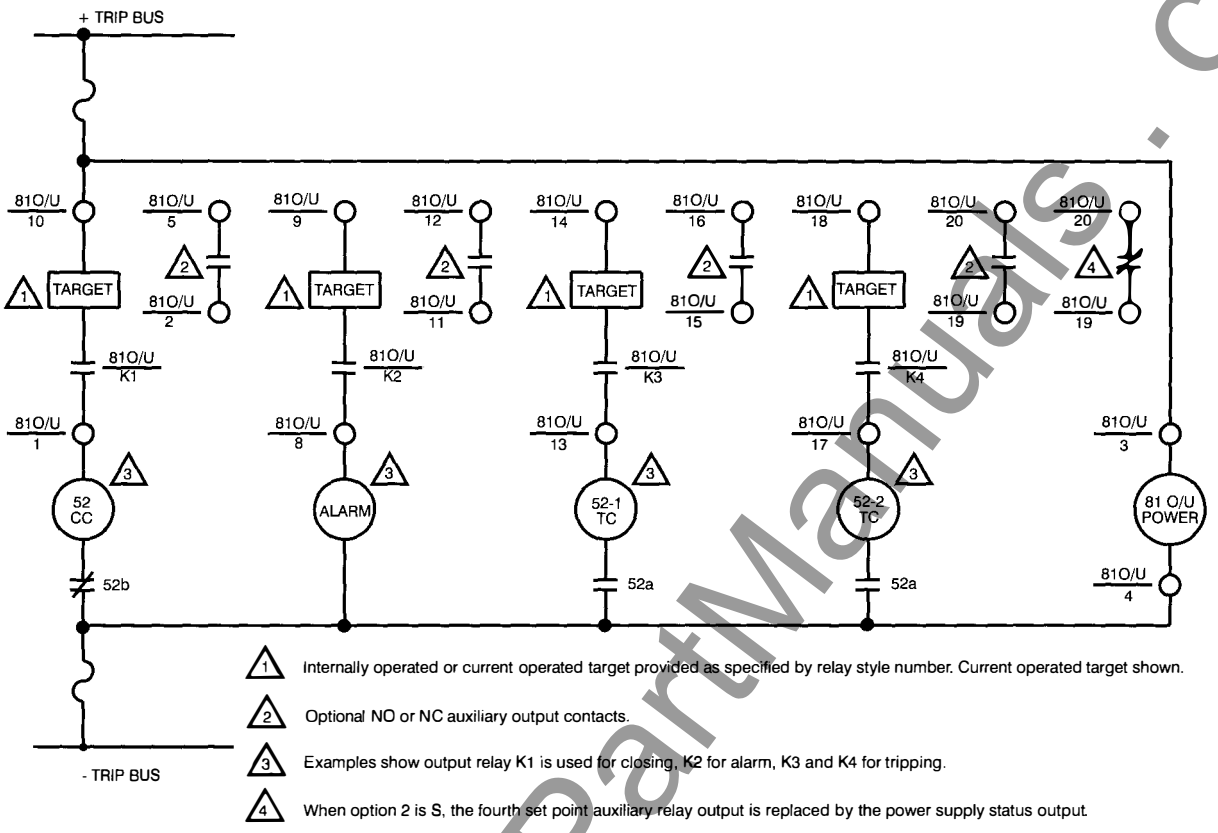


Figure 3 - Control Circuit External Connections

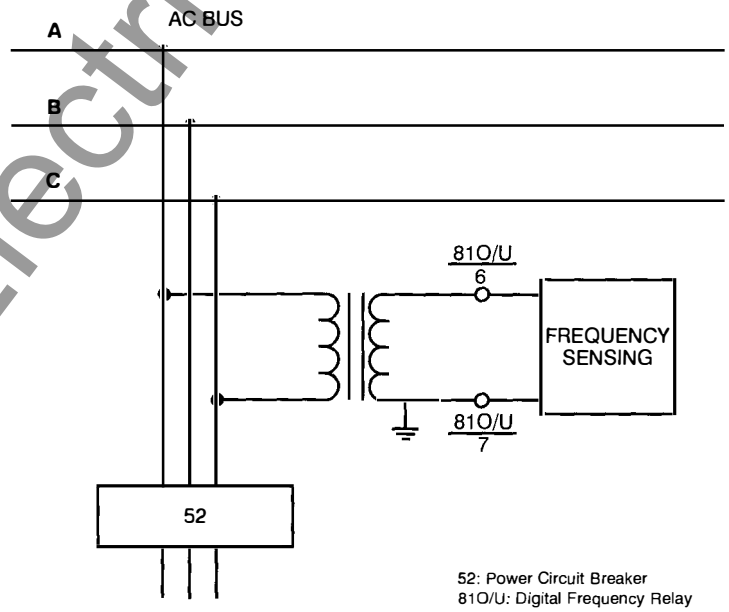


Figure 4 - Frequency Sensing External Connections

ORDERING INFORMATION

HOW TO ORDER:

Designate the model number followed by the complete Style Number.

BE1-81O/U 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 in 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 use on the BE1-81O/U Digital Frequency Relay.

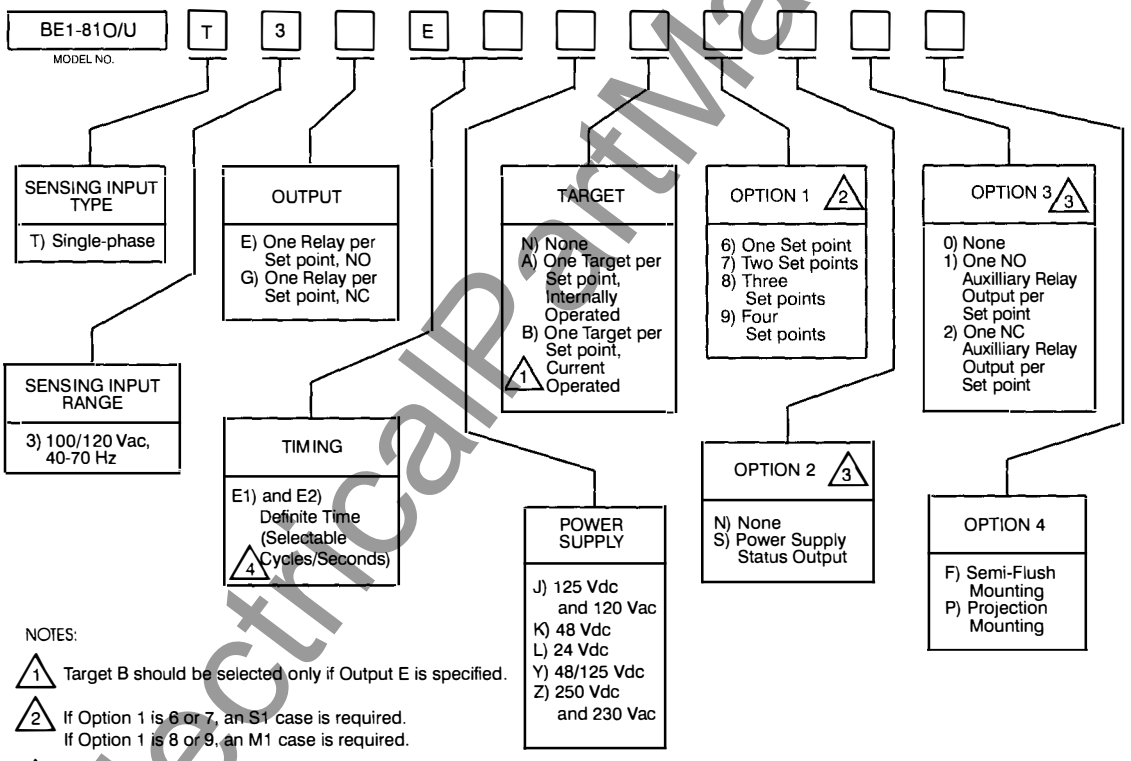
Test Plug

Order Test Plug, Basler part number 10095. (Two plugs required for complete testing capabilities.)

Extender Board

The extender board permits troubleshooting of the printed circuit boards outside the relay cradle. Order Basler Electric part number 9112930100.

STYLE NUMBER IDENTIFICATION CHART



NOTES:

1. Target B should be selected only if Output E is specified.
2. If Option 1 is 6 or 7, an S1 case is required. If Option 1 is 8 or 9, an M1 case is required.
3. If Option 1 is 9 and Option 2 is S, the auxiliary relay (Option 3 is 1 or 2) associated with set point 4 is omitted.
4. BE1-81O/U relays with hardware version M and higher, with definite timing option E1 or E2, now have their timing range extended. Earlier units with timing option E1 had a timing range of 3 cycles to 99 cycles and did not include range select switches on the individual set point boards. Earlier units with timing option E2 had a timing range of 3 cycles to 99 seconds. The new range for both timing options is identical at 3 cycles to 990 seconds (16.5 minutes). To provide rearward compatibility for users of the BE1-81O/U with timing option E1, new units are shipped with the timing range switches set in default positions to emulate the E1 timing range.

Basler Electric

ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

http://www.basler.com, info@basler.com

Visit our web site http://www.basler.com

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