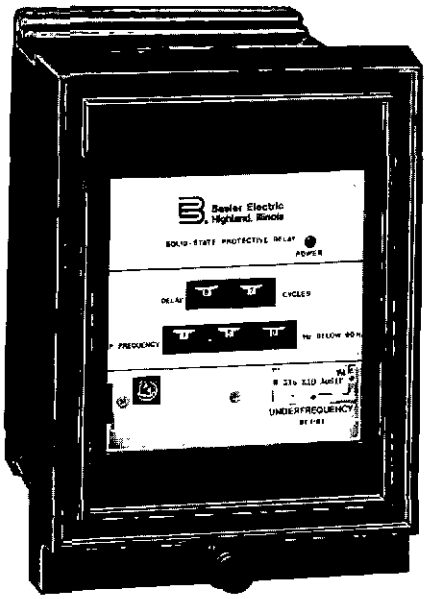

BE1-81 DIGITAL UNDERFREQUENCY RELAY

The BE1-81 Digital Underfrequency Relay is a single phase, solid state device which provides detection of underfrequency conditions for 50 or 60 Hz systems. A definite time delay model is available for underfrequency load shedding schemes. An inverse time delay model is available for protection of rotating machinery.

ADVANTAGES

- Crystal frequency reference for superior accuracy and stability.
- Pickup adjustment in 0.05 Hz increments.
- Definite time delay or inverse time delay, optionally selected.
- Instantaneous reset of timing circuit when frequency increases above selected pickup point.
- Undervoltage inhibit to prevent tripping during startup.
- Operating power may be derived from AC or DC source.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request Publication 9-1064-00-990

SERVICE MANUAL
Request Publication 9-1064-00-620

STANDARDS, DIMENSIONS & ACCESSORIES
Request Bulletin SDA

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FUNCTIONAL DESCRIPTION

Refer to Functional Block Diagram, Figure 1 below, for the following discussions.

Sensing

A 120 Vac single phase sensing input is applied to the underfrequency relay. An input transformer in the relay provides the proper signals to the Voltage Inhibit and Input Conditioning Circuits.

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 supplies are ±12 Vdc. An LED indicator on the front panel illuminates when the power supply is operational. When the "Sensing Input Power Supply" is selected in the OPTION 1 column from the Style Identification Chart (page 8), the power supply is internally connected to operate from sensing input voltage applied to relay terminals 6 and 7. This option can only be supplied when power supply option C or E is specified. The burden of the selected power supply is added to the burden of the sensing input (2 VA for 50 Hz system or 1 VA for 60 Hz system).

Voltage Inhibit Circuit

This circuit prevents undesired relay operation during transient underfrequency conditions. It inhibits sensing of underfrequency conditions until the input sensing voltage is greater than 80 Vac.

Input Conditioning Circuit

The Input Conditioning Circuit converts the AC sensing voltage to a squarewave whose transitions correspond to the zero crossings of the input waveform. The resulting squarewave (after further shaping) is applied to the Synchronizer Circuit.

Crystal Reference Oscillator

This 4 MHz crystal-controlled oscillator provides an accurate reference to the Synchronizer Circuit and to the frequency reference circuit.

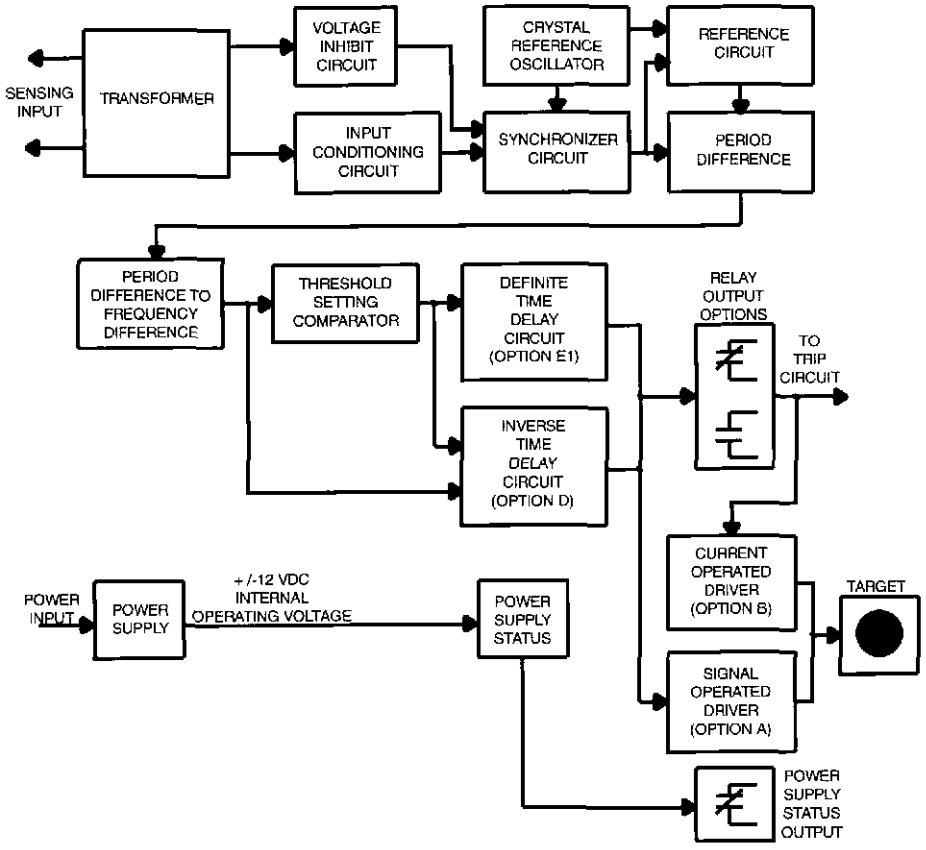


Figure 1 - Functional Block Diagram (typical)

FUNCTIONAL DESCRIPTION

(continued)

Synchronizer Circuit

This circuit synchronizes the squarewave (representative of the input waveform) with the Crystal Reference Oscillator to generate a synchronized zero crossing pulse used to reset system timing. Each time a zero crossing pulse occurs, a new frequency comparison is initiated.

Reference Circuit

This circuit generates a reference signal each 16.667 milliseconds (60 Hz nominal system frequency) or 20.000 milliseconds (50 Hz nominal system frequency) after a synchronized zero crossing pulse. This signal is generated by counting pulses from the reference oscillator. When the proper count is reached, an output signal is applied to the Period Difference circuit.

Period Difference Circuit

This circuit initiates a train of pulses beginning with the occurrence of the reference signal and ending when the synchronized zero cross pulse occurs. The time span between these two signals is the difference in period between the sensing input waveform and the nominal system frequency. Each pulse in the pulse train represents a one microsecond difference in period.

Period Difference to Frequency Difference Circuit

This circuit converts the pulses received from the Period Difference circuit to one pulse for each 0.05 Hz difference from the nominal frequency. This is accomplished by a variable scale divider which compensates for the inverse relationship between period and frequency.

Threshold Setting Comparator

This circuit counts the number of pulses coming from the Frequency Difference Circuit and compares it with the front panel control setting. When the frequency decreases beyond the difference established by the front panel control, an output pulse is applied to the appropriate timing circuit.

Definite Time Delay Circuit (Timing Option E1)

The Definite Time Delay circuit counts the number of consecutive cycles of the underfrequency waveform after the threshold setting comparator output pulse occurs. When the number of underfrequency cycles equals the front panel time delay setting, a pulse is generated to the output trip circuit. It is recommended that the time delay control be set for a minimum 3 cycle delay to reduce the possibility of a trip signal resulting from a system transient.

Inverse Time Delay Circuit (Timing Option D1)

The Inverse Time Delay circuit uses the magnitude of the underfrequency condition to determine the time delay. A set of pulses, representative of the magnitude of the underfrequency condition, is applied to an RC network to generate an inverse time delay. A front panel dial permits adjustment of the time curve over the applicable 50 Hz or 60 Hz system range shown in Figure 2. An LED on the front panel indicates the relay pickup setting has been exceeded and timing initiated.

Relay Output

The time delay circuit output signal is optically coupled to the output driver. The output driver supplies operating current for the relay output. The relay output may be defined as either normally closed or normally open contacts. An optional set of auxiliary relay contacts may be specified. The relay contacts remain in the energized condition as long as the sensed input is below pickup.

Signal (Internal) Operated Target Driver

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 amps DC flows in the output trip circuit. A special reed relay in series with the output contact provides the signal to the target indicator.

Target Indicator

The target indicator (trip) is visible on the front panel. The target is magnetically latched and must be reset manually after the fault condition has been cleared.

Power Supply Status Output (Option 2-S)

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 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.

SPECIFICATIONS

INPUTS

Power Input

One of six types of power supplies may be selected to provide relay operating power.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
B	48 Vdc	24 to 60 Vdc	3.5 W
C	125 Vdc	62 to 150 Vdc	4.5 W
	120 Vac	90 to 132 Vac	9.0 VA
D†	24 Vdc	12 to 32 Vdc	4.0 W
E	120 Vac	90 to 132 Vdc	9.0VA
W*	48 Vdc	24 to 60 Vdc	3.5 W
	125 Vdc	62 to 150 Vdc	4.5 W
X	250 Vdc	140 to 280 Vdc	9.5 W
	230 Vac	190 to 270 Vac	20.5 VA

*The Type W power supply is field selectable for 48 or 125 Vdc. Selection must be implemented at the time of installation. This power supply option is factory set for 125 Vdc.
†The Type D power supply may require 14 Vdc to begin operating. Once operating, the voltage may be reduced to 12 Vdc.

Table 2

Frequency Sensing Input

Input sensing circuits are nominally rated for 120 volts at the system frequency. Relay trip points may be manually set for a single phase underfrequency trip point from 45 to 50 Hz for the 50 Hz model, or 55 to 60 Hz for the 60 Hz model. Both models are adjustable in 0.05 Hz increments.

Sensing Burden

Burden of the frequency sensing input is 2 VA for 50 Hz model, and 1 VA for 60 Hz model.

Output Circuit

Relay contacts are rated at 250 Vdc. Contacts make 30 amps, break 0.1 amps, and will carry 30 amps for 1 second or 7 amps continuously.

Power Indicator

A front panel light emitting diode (LED) illuminates to indicate the power supply is providing nominal operating voltages to relay circuitry.

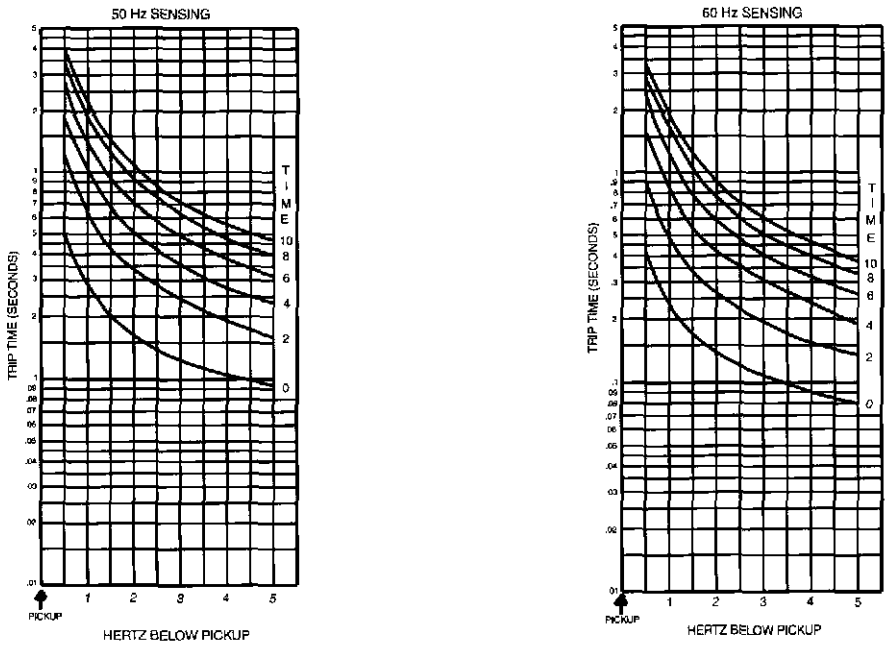


Figure 2. Inverse Time Delay Characteristic Curves (Typical)

SPECIFICATIONS
(continued)

Time Characteristics/Control

Definite time delay or inverse time delay may be optionally selected for the relay. Definite time delay may be adjusted to any desired time between 1 and 99 cycles in 1 cycle steps using two front panel thumbwheel switches. It is recommended that a minimum 3 cycle delay be used to ensure security. With inverse time delay, the relay provides a time delay inversely proportional to the measured frequency difference. A front panel adjustment permits inverse time delay circuit adjustment to cover the applicable time ranges shown in Figure 2. (Full size curves are available upon request.)

Timing Indicator (TMG) (Inverse Time Option D1 only)

A light emitting diode (LED) illuminates to indicate that the pickup point has been reached and that the relay is timing.

Target Indicator (Optional)

A magnetically latched, manually reset, target indicator is optionally available to indicate that the relay has tripped. Either an internally operated or current operated target may be specified. The current operated target requires a minimum of 0.2 amps DC for proper operation. The current operated target is rated for 30 amps for 1 second, 7 amps for 2 minutes, and 3 amps continuously. The internally operated target must be specified if the breaker control (trip) circuit is AC powered. A current operated target may be selected only when normally open (N.O.) contacts have been specified.

Reset Time

Reset of the relay is automatic and instantaneous when frequency increases above selected pickup setting. (NOTE: Target must be manually reset.)

Pickup Setting

Pickup setting is adjusted directly in Hertz below nominal system frequency in 0.05 HZ steps using three front panel thumbwheel switches.

Pickup Accuracy

The relay will pickup and start timing within ±0.025 Hz of the specified setting on a 60 Hz system, and within ±0.035 Hz on a 50 Hz system.

Dropout Ratio

99% of pickup value (frequency difference) over the specified operating temperature range.

Temperature Stability

Pickup point variation will not exceed ±0.03 Hz over the specified operating temperature range.

Undervoltage Inhibit

The relay is factory adjusted for an 80 Vac undervoltage inhibit level that prevents nuisance tripping during startup of protected equipment on power system voltage collapse. This level may be internally adjusted by the user for inhibit levels between 40 and 120 Vac except for relays using Option 1 Sensing Input Power Supply.

MECHANICAL
Operating Temperature

-20°C (-4°F) to +65°C (+149°F).

Storage Temperature

-50°C (-58°F) to +90°C (+194°F).

Shock

15 Gs in each of three mutually perpendicular axes without damage or degradation of performance.

Vibration

The relay will withstand vibrations of 1.36 Gs over the range of 5 to 26 Hz, 0.036 inch displacement over the range of 26 to 52 Hz, and 5 Gs over the range of 52 to 260 Hz without structural damage or degradation of performance. Vibration spectrum to be applied in each of three mutually perpendicular axes with a sweep time of 5 minutes.

Weight

10.5 pounds net.

EXTERNAL CONNECTIONS

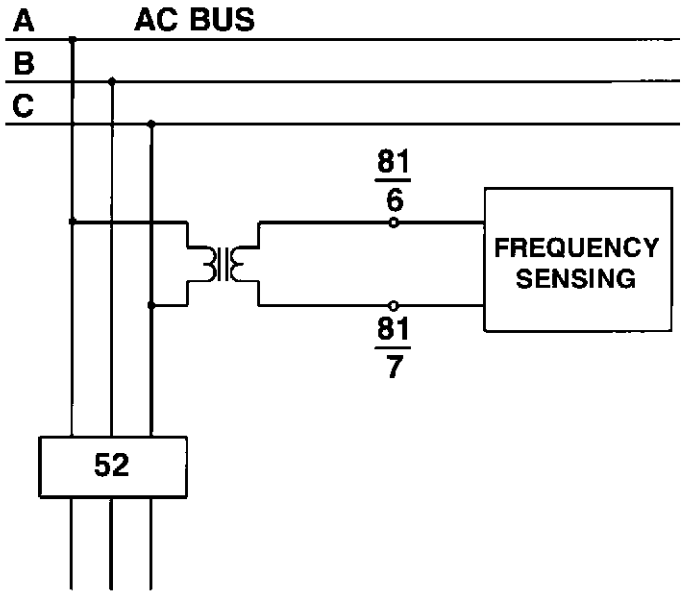


Figure 3. Voltage Sensing

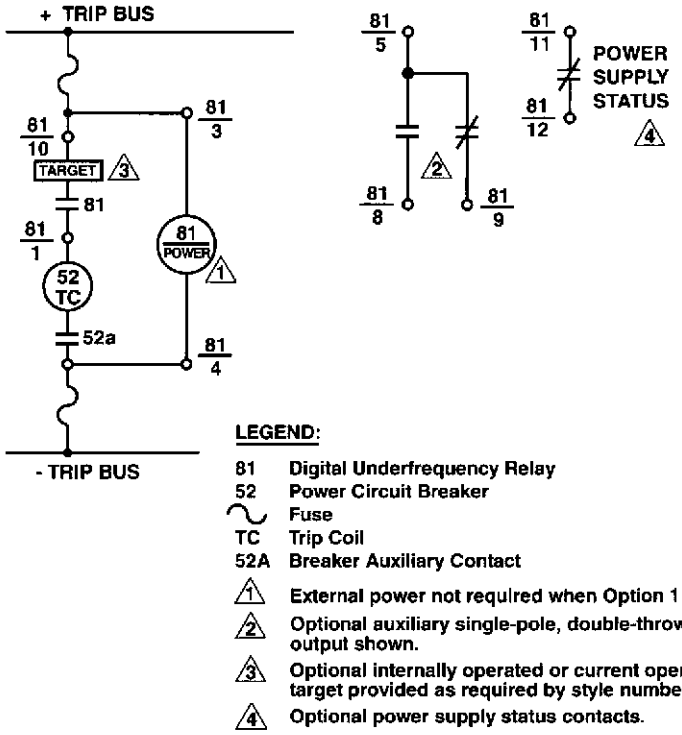


Figure 4. Control Circuits

ORDERING

MODEL NUMBER

BE1-81 Digital Underfrequency Relay

STYLE NUMBER

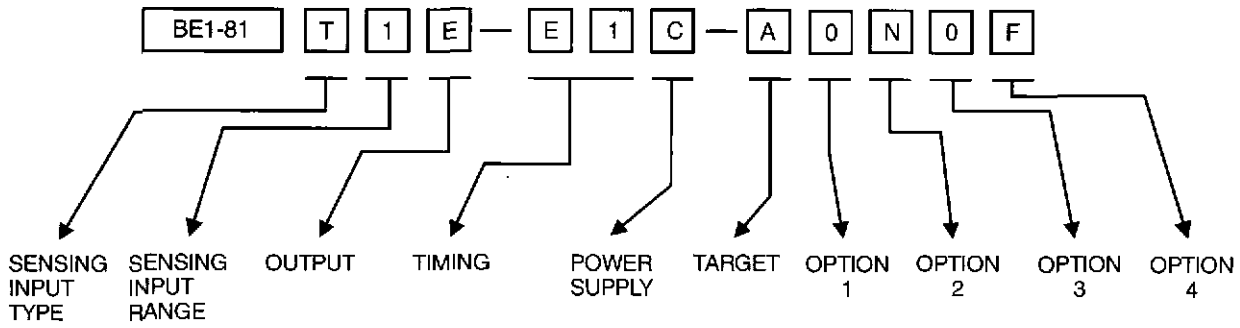
The relay model number is followed by a style number that appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number illustrates the manner in 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 T1E-E1C-A0N0F

The style number above describes a BE1-81 Digital Underfrequency Relay having the following features:

Sensing Input Type	(T)	Single Phase
Sensing Input Range	(1)	120 Vac, 60 Hz
Output	(E)	Normally open
Timing	(E1)	Definite time
Power Supply	(C)	125 Vdc/120 Vac
Target	(A)	One internally operated target
Option 1	(0)	None
Option 2	(N)	None
Option 3	(0)	None
Option 4	(F)	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:

BE1-81 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 use on the Digital Underfrequency Relay.

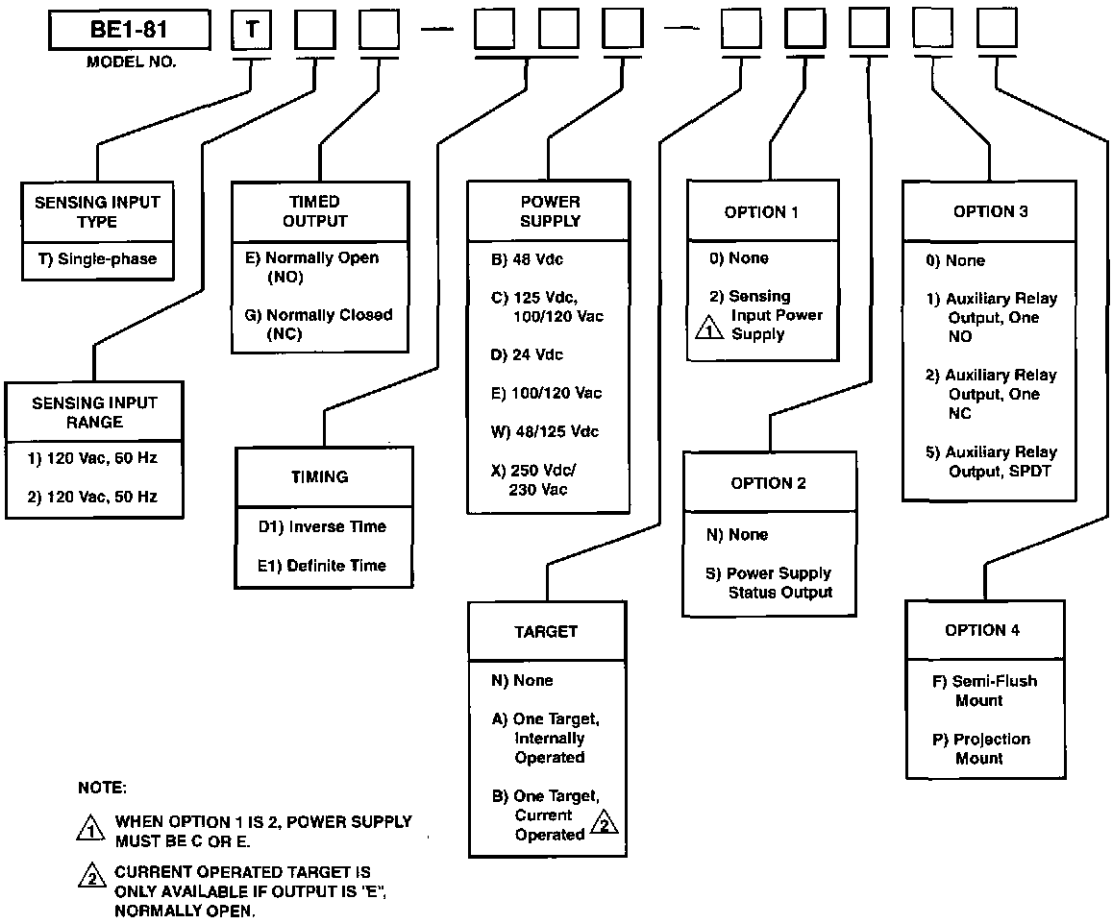
TEST PLUG

Order Test Plug, 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 1129 30 100.

STYLE NUMBER IDENTIFICATION CHART



NOTE:

1. WHEN OPTION 1 IS 2, POWER SUPPLY MUST BE C OR E.
2. CURRENT OPERATED TARGET IS ONLY AVAILABLE IF OUTPUT IS "E", NORMALLY OPEN.

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