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BE1-25
Sync-Check Relay

The BE1-25 Sync-Check Relay monitors the voltages on both sides of a circuit breaker and determines that proper phase angle and voltage exist prior to closing the circuit breaker.

FEATURES

- Phase angle limit is adjustable over the range of 1 to 99 degrees.
- Time delay is adjustable over a range of 1 to 99 cycles or 0.1 to 99 seconds.
- Voltage monitoring circuits provide independent determination of bus and line voltage levels for selectable closing conditions.
- Voltage difference provides additional verification of proper breaker closing conditions.
- Expandable phase window option provides the capability to quickly close critical system ties under emergency conditions.
- Separate sync and voltage monitor output contacts are available.
- Optional external selection of voltage conditions.
- Qualified to the requirements of
  – IEEE C37.90-1978, C37.90a-1974, and IEC 255 for surge withstand capability;
  – IEEE C37.90.1-198X for fast transient;
  – IEC 255-5 for impulse.
- UL Recognized under Standard 508, UL File #E97033.
- Five year warranty.

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ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9170200990

Basler Electric

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APPLICATION

The primary application of this relay is in situations that require verification that synchronism exists prior to closing a circuit breaker. These include the paralleling of a generator to a system, reestablishing an interconnection between two parts of a power system, and supervision of fast transfer schemes where fast pickup and dropout of the phase measuring circuit and required.

DESCRIPTION

General

The basic BE1-25 is a solid state synchronism check relay, designed to permit breaker closure only after the specified phase angle conditions have been verified and the condition satisfied for a specified time period. The design provides for ease of setting the phase angle and time period requirement through front panel thumbwheel switches. The design also includes up to five optional voltage measuring circuits to verify various line and bus voltage conditions prior to permitting breaker closure.

The BE1-25 Sync-Check relay is designed to measure the phase angle between the monitored single phase voltages on the line and bus sides of a breaker and verify this angle is less than or equal to the front panel setting. If the measured angle has met this criteria for the time period defined by the front panel setting, the output relay is energized and the breaker will be permitted to close. The allowable phase angle is adjustable over the range of 1 to 99 degrees. The time delay requirement is adjustable over either of two ranges: 1 to 99 cycles, 50/60 Hz (using the bus frequency as the reference); or, 0.1 to 99 seconds (using the internal crystal reference). (See Figure 1).

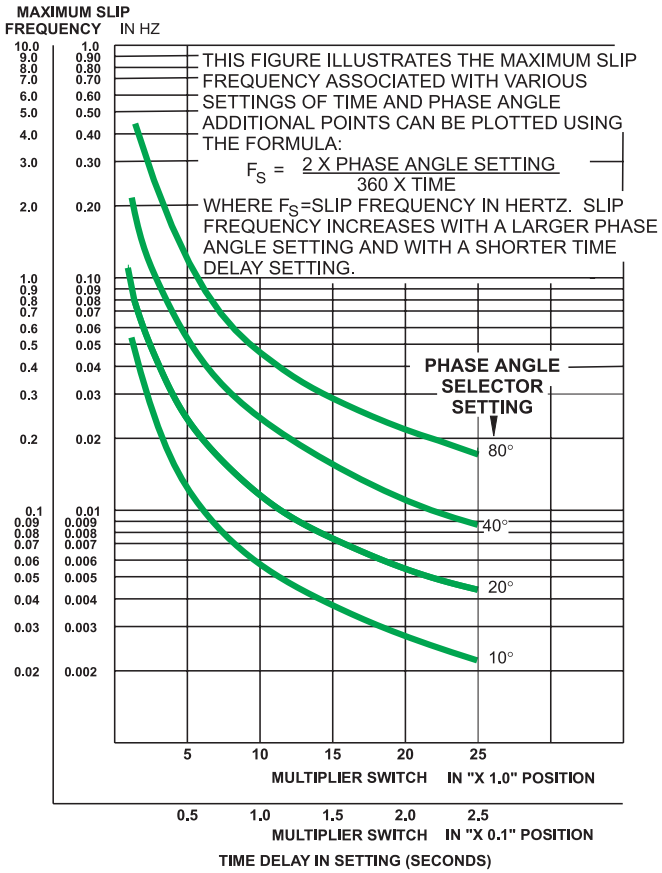


Figure 1 - Slip Frequency vs. Time Delay

An optional target may be specified to indicate operation of the sync-check function.

In order to control the operation of the relay, one additional input (in addition to the Bus and Line potentials and power supply) is required. This input defines the position of the circuit breaker. If the breaker is open the relay will perform its function. When the breaker closes this input changes state and deenergizes the output. This input uses a contact of the breaker (52b) to define position. Two configurations of this input's circuitry – Isolated contact sensing and Nonisolated contact sensing – provide additional flexibility to the control/protection circuit designer. With isolated contact sensing, the relay monitors a current through a dedicated contact. With non-isolated contact sensing, the relay senses the presence of voltage at its input due to the closure of a non-dedicated contact.

Voltage Monitoring

To supplement the basic sync-check function of the BE1-25, optional voltage measuring circuits may be included. These include magnitude measurements of the line and bus inputs, which may be used by the voltage monitoring logic to determine whether the input is live, dead or overvoltage. CONDITION switches, either on the voltage monitor card or external to the relay, determine the desired relay response to these voltage conditions. MODE switches are included on the voltage monitor card to define the desired mode of operation for the Dead Bus/Bus Not Overvoltage (DB/OV) measuring elements. One MODE switch is provided for each voltage input so that the operation of the relay can be tailored to the specific application.

When the MODE switches are in the NORMAL position (up), the two measuring elements associated with an input establish separate live and dead reference levels for the input signal.

DESCRIPTION, continued

When the MODE switches are in the NOT OVERVOLTAGE position (down), the two measuring elements associated with each input establish separate dead/live and not-overvoltage reference levels for the input signal. (See Figure 2).

CONDITION switches provide the means of selecting the desired action to be taken by the BE1-25 relay. Switch selections include: Live Line/Live Bus (Sync-Check only), Live Line/Dead Bus, Dead Line/Live Bus, and Dead Line/Dead Bus. When any of the selected voltage conditions have been satisfied, the voltage monitor circuit will energize either the sync-check output relay, or the separate (optional) voltage monitor output relay. (It is installed when specified by the style number).

With this logic, when the MODE switches are in the Normal Position, a DEAD level is defined as a monitored voltage level below the DEAD reference setting. A LIVE level is defined as a monitored voltage above the LIVE reference setting.

When the MODE switches are in the NOT OVERVOLTAGE position, a DEAD level is defined as a monitored voltage less than the LIVE reference setting, a LIVE level is defined as a monitored voltage greater than the LIVE reference setting and less than the NOT OVERVOLTAGE reference setting. The input is considered to be Overvoltage when it exceeds this reference setting.

This flexibility allows the relay to be used to permit closing a generator breaker onto a dead bus, as well as, preventing closure if the bus voltage is too high.

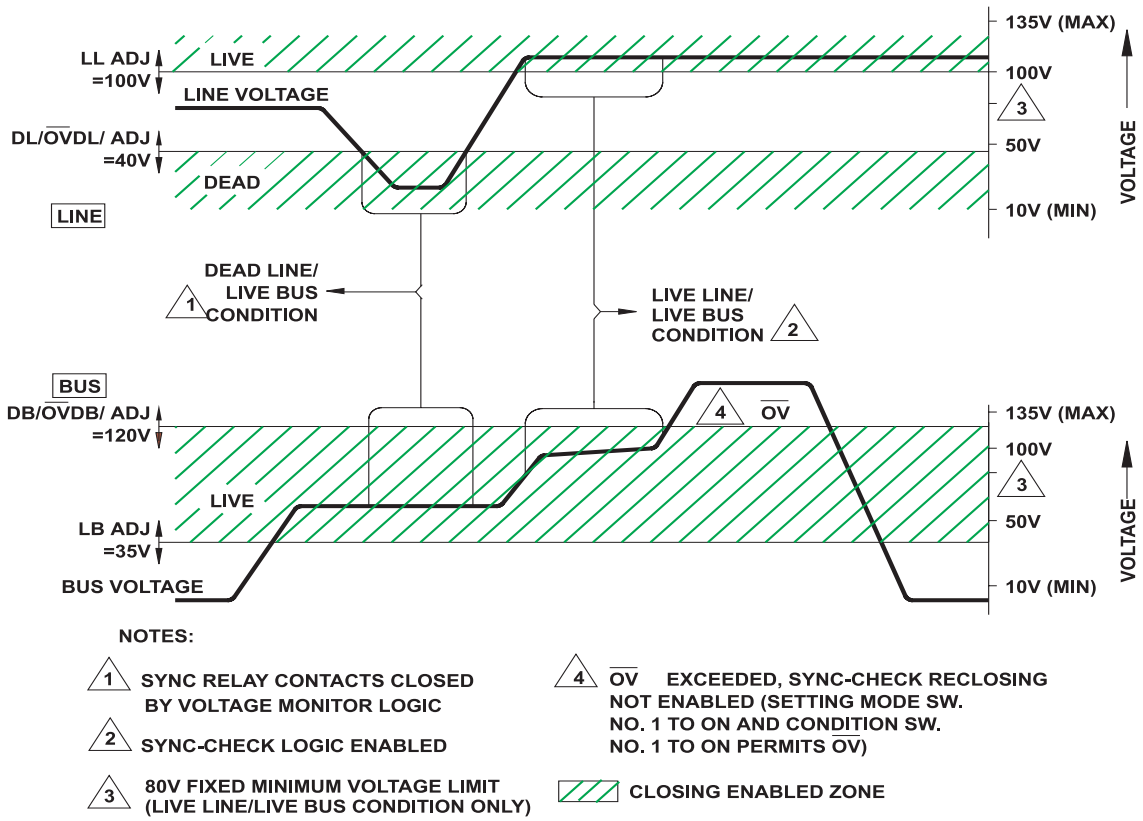


Figure 2 - Voltage Monitor Acceptance Zones

OPTIONS

Voltage Difference
Another voltage monitoring function may be included to monitor the vector voltage difference between the two inputs. This function provides an internal backup to the voltage monitoring and sync-check functions to prevent the closure of a generator breaker if this difference is too great even though the phase angle and voltage level monitoring circuits indicate proper closing conditions have been met. See Figure 3.

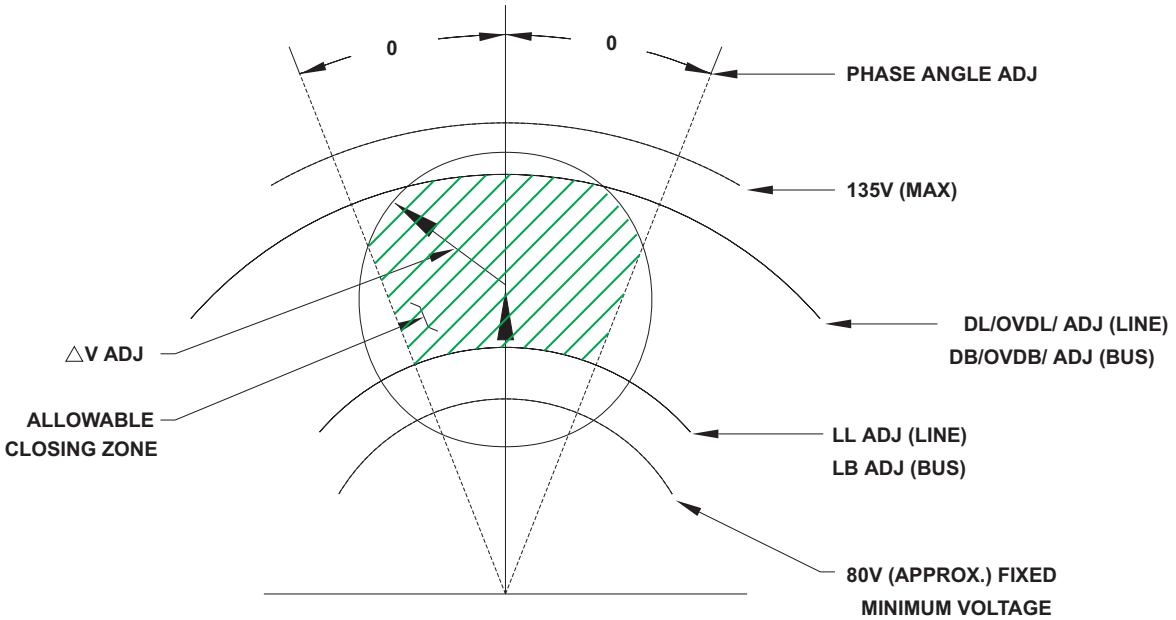
A separate contact output may be included with the voltage monitoring option when selected by the style number. This contact may be used in the breaker closing circuit to provide a separate supervised closing circuit or indication of the existing voltage conditions to the supervisory control system.

Push-to-Energize Output
Push-to-Energize Output push buttons are available and provide a means of verifying external output wiring without the inconvenience of having to test the entire relay in the panel for this wiring check. These optional push buttons are provided for each isolated output function within the relay. They are accessible from the front of the relay and actuated by inserting a small nonconductive rod through the metal cover of the cradle assembly.

Expandable Window
An Expandable Window option is available to enable a local operator, through a switch, or a remote dispatcher, through the supervisory control system to expand the preset phase angle window by a preprogrammed ratio under emergency conditions. Under normal conditions the phase angle setting is determined for a distribution or transmission line breaker by the calculated angular difference that will exist for expected load flow through the total system. Under emergency conditions, the load flow throughout the system may result in an excessive phase angle separation across the controller breaker.

In order to reestablish load on a previously faulted line quickly, it may be necessary to expand the allowable phase window. With this option, closing a contact input to the relay expands the preset phase setting by a preprogrammed multiple. Programming the multiple to 2 or 3 is accomplished by moving a jumper on the circuit card. Opening the contact input restores the phase angle limit to the front panel setting.

For a generator breaker the phase angle setting is determined by the maximum phase difference that can be tolerated by the generator when connected to the system. An excessive angle can result in excessive mechanical forces in the generator and its associated mountings. This option is not suggested for use in generator applications.



Relationship between ΔV and Θ is:

$$\Delta V = \sin \Theta V_{bus} \quad \Theta = \sin^{-1} \frac{\Delta V}{V_{bus}}$$

Figure 3 - Closing zone Using Voltage Difference, Sync-Check, and Line/Bus Voltage Monitor

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to satisfy an application requirement. The block diagram, Figure 4, illustrates how various standard features, as well as the options, function together.

INPUTS

Voltage Sensing (Phase Angle Measurement)
Standard system potential transformers (PTs) with 120V nominal secondaries supply the Sync-Check Relay's input transformer with single-phase line and bus voltage. The voltage sensing inputs are capable of 160% of nominal voltage continuously, and operate with a maximum burden of 1 VA over the voltage range of 80 to 130V, 40 to 70 Hz.

Contact Sensing
The Sync-Check Relay monitors the state of external user-supplied contacts. These contacts must have a minimum rating of 0.05A at 250 Vdc. Depending on the selection option, they current through the contacts may be obtained from the relay itself (isolated contact sensing), or from a dc source with a voltage rating equal to the relay's power supply input (non-isolated contact sensing).

User-supplied contacts perform the following functions.

Breaker (52b) - Form B auxiliary contact of the controller breaker used to determine the state of the breaker.

Extend Phase Angle Option - Form A contact causes the Phase Acceptance Angle to widen by a factor or 2 or 3 (depending upon the position of a field adjustable jumper).

Remote Switching Option - Four sets of user-supplied form A contacts allow external control of the relay's response to various live/dead conditions. Without this option, control is obtained by DIP switches on voltage monitor board.

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.

Power Supply
One of our power supplies may be selected to provide internal operating power. These are described in Table 1. The burden is given in Table 2.

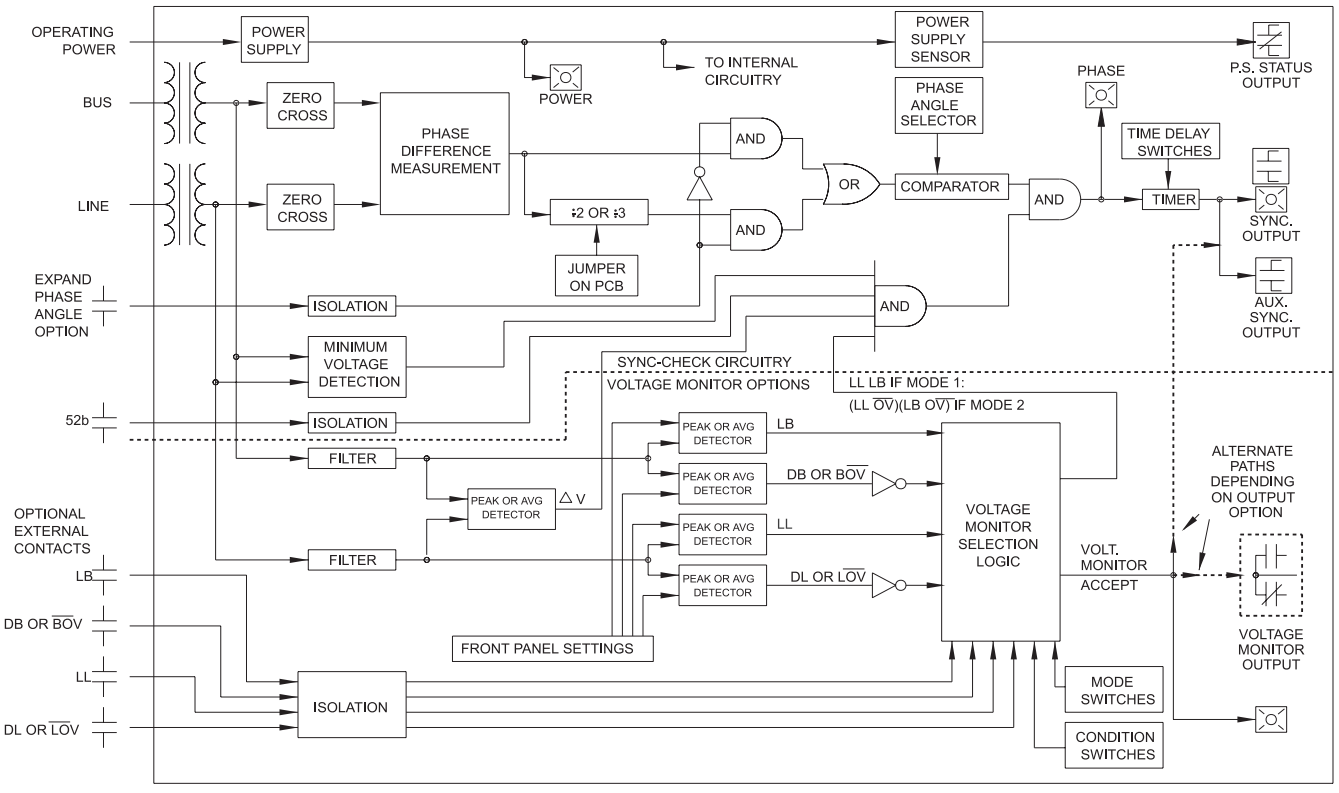


Figure 4 - Functional Block Diagram

SPECIFICATIONS, continued

Type	O	P	R	T*
Nominal Voltage	48 Vdc	125 Vdc 120Vac	24 Vdc	250 Vdc 230 Vac

* External modules required for contact sensing when type T power supply is specified.

Table 1 - Power Supply Options

Relay Configuration	Burden According to Sources of Operating Power						
	50 Hz 100 Vac	60 Hz 120 Vac	125 Vdc	48 Vdc	24 Vdc	250 Vdc	60 Hz 230 Vac
Without Voltage Monitor	12 VA	18 VA	9 W	9W	9W	12 W	28 VA
With Voltage Monitor	20 VA	26 VA	15 W	15 W	15 W	21 W	41 VA

Table 2 - Burden

OUTPUT CONTACTS

Refer to Bulletin SDA

Resistive Rating

ACCURACY

Phase Angle
Phase angle selection is within ±0.5 or ±5.0% (whichever is greater) of the front panel setting for degrees, for a nominal input frequency of 50/60 Hz, a sensing input range of 80 to 135 volts, and at -25°C. Phase angle setpoint accuracy is ±0.5 or ±4% (whichever is greater) from a reference measurement at 25°C, at nominal input voltages of 80 to 130 Vac.

OPTIONS

Timing
The time delay is within 25 msec or 5% of the front panel setting for time (whichever is greater) for a nominal input frequency of 50/60 Hz at 25°C. over the full temperature, voltage, and frequency range, accuracy is ±10 mSec or ±2% (whichever is greater) of the time delay at 25°C. Selection of 00 time delay inhibits the closing of the sync-check output.

Option A6 allows time delay selection in 0.1 second increments over a range of 0.1 to 9.9 seconds, and in 1 second increments over a range of 01 to 99 seconds.

Option A7 provides an adjustable time delay in range of 01-99 cycles in one-cycle increments.

Line and Bus Voltage Monitor
The optional voltage monitor circuitry provides four front panel-mounted controls to define live bus, live line, dead bus, and dead line limit levels. These controls provide continuous adjustment over the range of 10 to 135 Vac. Four condition switches determine the closing conditions that the relay will recognize. Response time is 50 msec or less.

Voltage Difference (△V) Monitor
The front panel control permits continuous adjustment of the allowable limit of voltage difference between the line and bus voltages over a range of 1-135 Vac. The setpoint shall not vary more than 0.5V or 5% (whichever is greater) from a reference measurement at 25°C with nominal input frequency, and with temperature and voltage within specified operating range. This setpoint shall not vary more than 3% from a reading at 25°C over the limited range of +15 to +40°C.

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 0.2 A in the output trip circuit to actuate, and trip circuit current must not exceed 20 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 C37.90a-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)

Weight
13.5 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

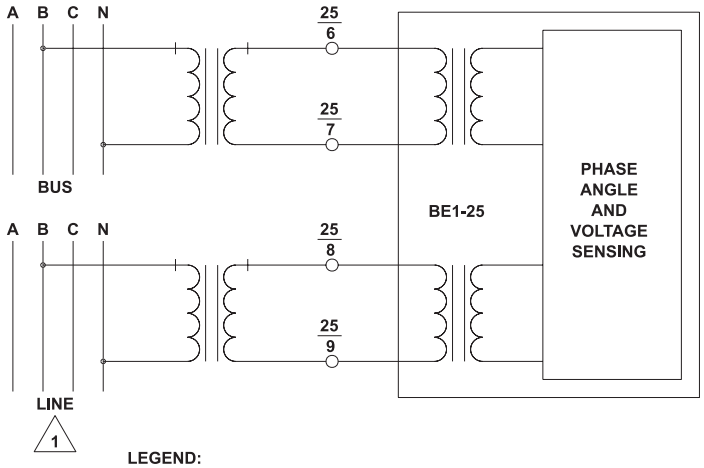


Figure 5 - Voltage and Phase Sensing

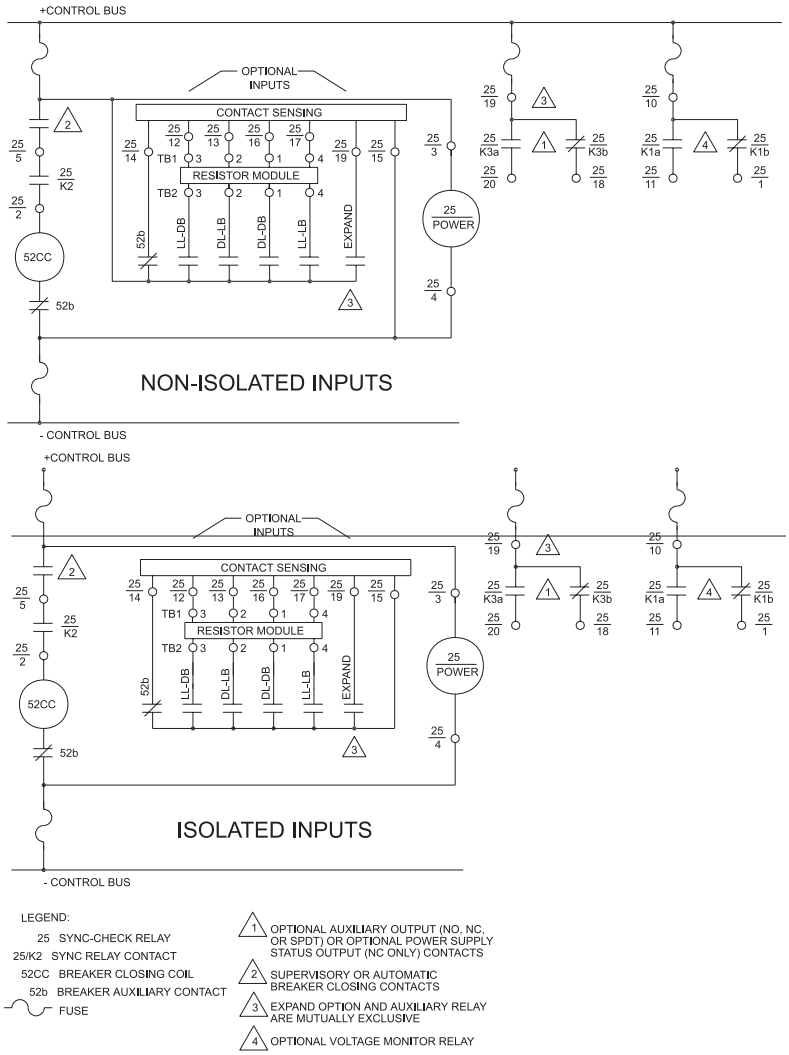


Figure 6 - Control Circuit Connections (Typical)

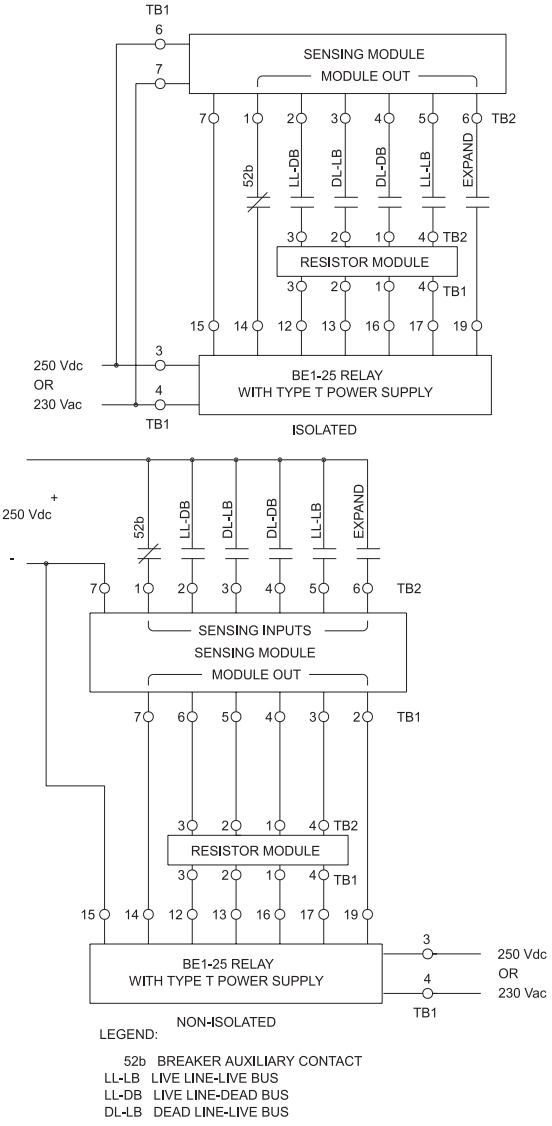


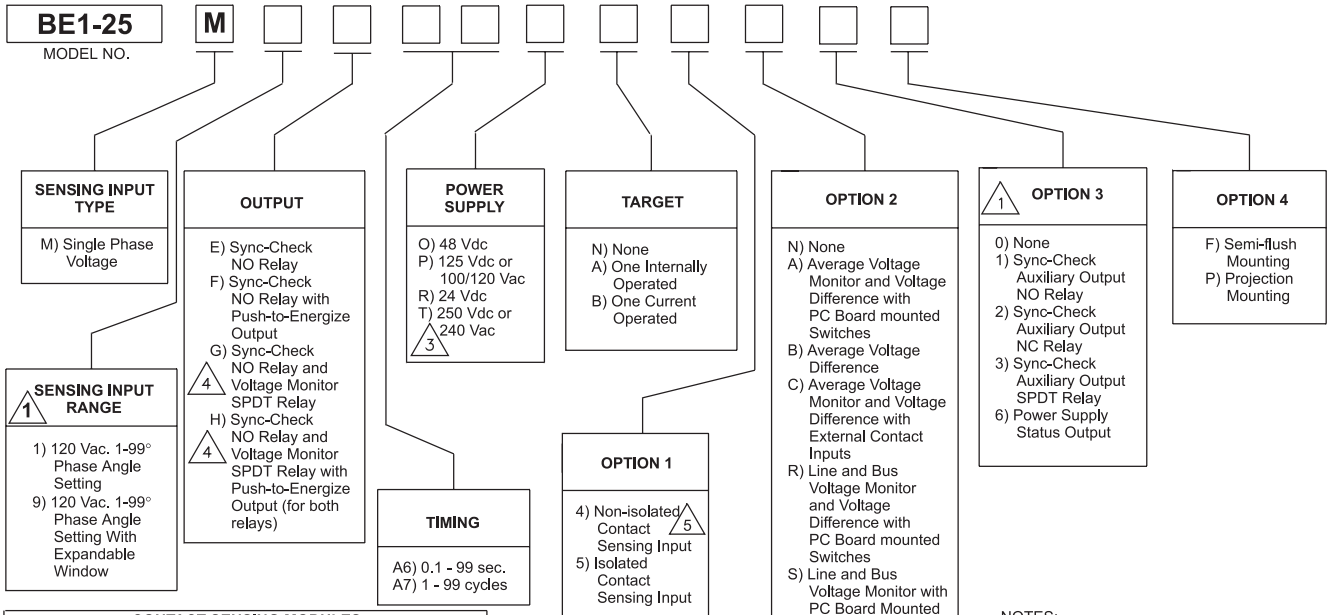
Figure 7 - Contact Sensing Using Modules (Only for Relays with Type T Power Supply)

ORDERING

SAMPLE STYLE NUMBER

The style number BE1-25M1EA6PN4R0F describes a BE1-25 Synch Check Relay having the following features:

- **(M)** - Sensing Input Type - Single-phase voltage
- **(1)** - Sensing Input Range - 120 Vac nominal 1-99° phase setting
- **(E)** - Output - Sync-check, NO
- **(A6)** - Timing - 0.1 to 99 seconds
- **(P)** - Power Supply - 125 Vdc or 100/120 Vac external power source
- **(N)** - Target - None
- **(4)** - Option 1 - Nonisolated contact sensing
- **(R)** - Option 2 - Line and bus voltage monitor with voltage difference, and PC board mounted switches
- **(0)** - Option 3 - None
- **(F)** - Option 4 - Semi-flush mounting



CONTACT SENSING MODULES
(Required when Type T Power Supply is specified)

Relay Options	Number of Contacts Sensed	Module Ordering Number	
		Isolated Contact Sensing	Non-Isolated Contact Sensing
Voltage Monitor with External Contact Inputs plus Expandable Phase Window	6	9170206100	9170206106
Voltage Monitor with External Contact Inputs	5	9170206101	9170206107
Expandable Phase Window	2	9170206104	9170206110
None of the above	1	9170206105	9170206111

NOTES:

1. When Sensing Input Range "9" is selected from the style chart, Option 3 must be "0".
2. All relays are supplied in an "S1" size case.
3. Requires Contact Sensing Module. See chart.
4. Not available if Option 2 is "N", "B", or "T".
5. Non-isolated Contact Sensing requires DC power.

STANDARD ACCESSORIES:

The following accessories are available for the BE1-25 Sync-Check 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 board outside of the relay cradle. Order Basler Electric part number 9165500100.

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