INSTRUCTION
MANUAL

Basler Electric
Highland, Illinois

OVER EXCITATION RELAY
UNDER EXCITATION RELAY
Model Number: BE2-40-3, -4
Part Numbers: 9 0998 00 103
9 0998 00 102

Publication
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SECTION 1

INTRODUCTION

1.1 PURPOSE

The BE2-40-4 Over Excitation Relay provides protection against excessive excitation in generator and motor fields. The BE2-40-3 Under Excitation Relay provides protection against loss of excitation in generator and motor fields. When excitation current exceeds (Over Excitation Relay) or decreases below (Under Excitation Relay) a predetermined field current level, an output relay trips after a predetermined time delay.

The two Relays are identified as follows:

BE2-40-4 Over Excitation Relay, P/N 9 0998 00 103
BE2-40-3 Under Excitation Relay, P/N 9 0998 00 102

1.2 SPECIFICATIONS

Power Input:	
Voltage	100/120 Vac ±10%
Frequency	50/60 Hz
Phase	1
Burden	30 VA
Sensing Input:	200 ampere-turns nominal, 600 ampere-turns continuous
Output:	DPDT relay contacts - make 30 amperes @ 250 Vdc; break 1 ampere at 125 Vdc
Pull-In Adjust Range:	90 to 200 ampere-turns
Dropout Range:	40 to 90% of Pull-In
Time Delay:	0.2 - 60 seconds, adjustable
Operating Range:	-40°C to +70°C
Dimensions:	See outline drawings
Weight (net):	Sensing Module: 4 pounds 200 amp turn transducer: 2 pounds

SECTION 2

THEORY OF OPERATION
(See Figure 2-2)

2.1 GENERAL

(See Figure 2-1) For the Over Excitation Relay, output relay K1 is normally de-energized, and becomes energized, after a time delay set on the TIMING ADJUST, when field current exceeds the PULL-IN ADJUST setting. For the Under Excitation Relay, output relay K1 is normally energized, and becomes de-energized, after a time delay set on the TIMING ADJUST, when field current decreases below the DROPOUT ADJUST setting.

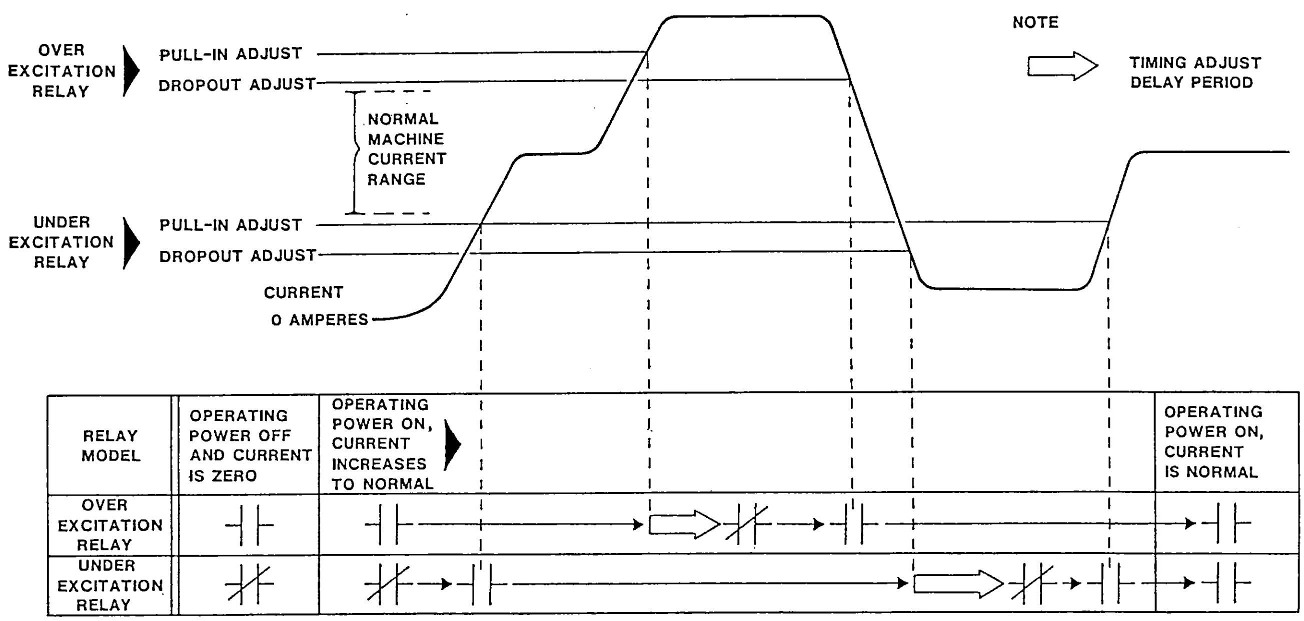


Figure 2-1. Example of Pull-in and Dropout Points with Resultant Outputs

2.2 POWER SUPPLY

The ac input is rectified, filtered and reduced to provide appropriate operating voltages. A 5 Vdc reference signal is established and applied to the comparator.

2.3 SENSING INPUT

A cable carrying generator/motor field current is run through the window of the dc transducer. The number of turns through the transducer window is dependent upon the nominal field current and the desired trip point of the Relay. The transducer, connected in series with the PULL-IN ADJUST potentiometer, is connected across the ac input. The dc current through the transducer window controls the ac current through both the transducer and the

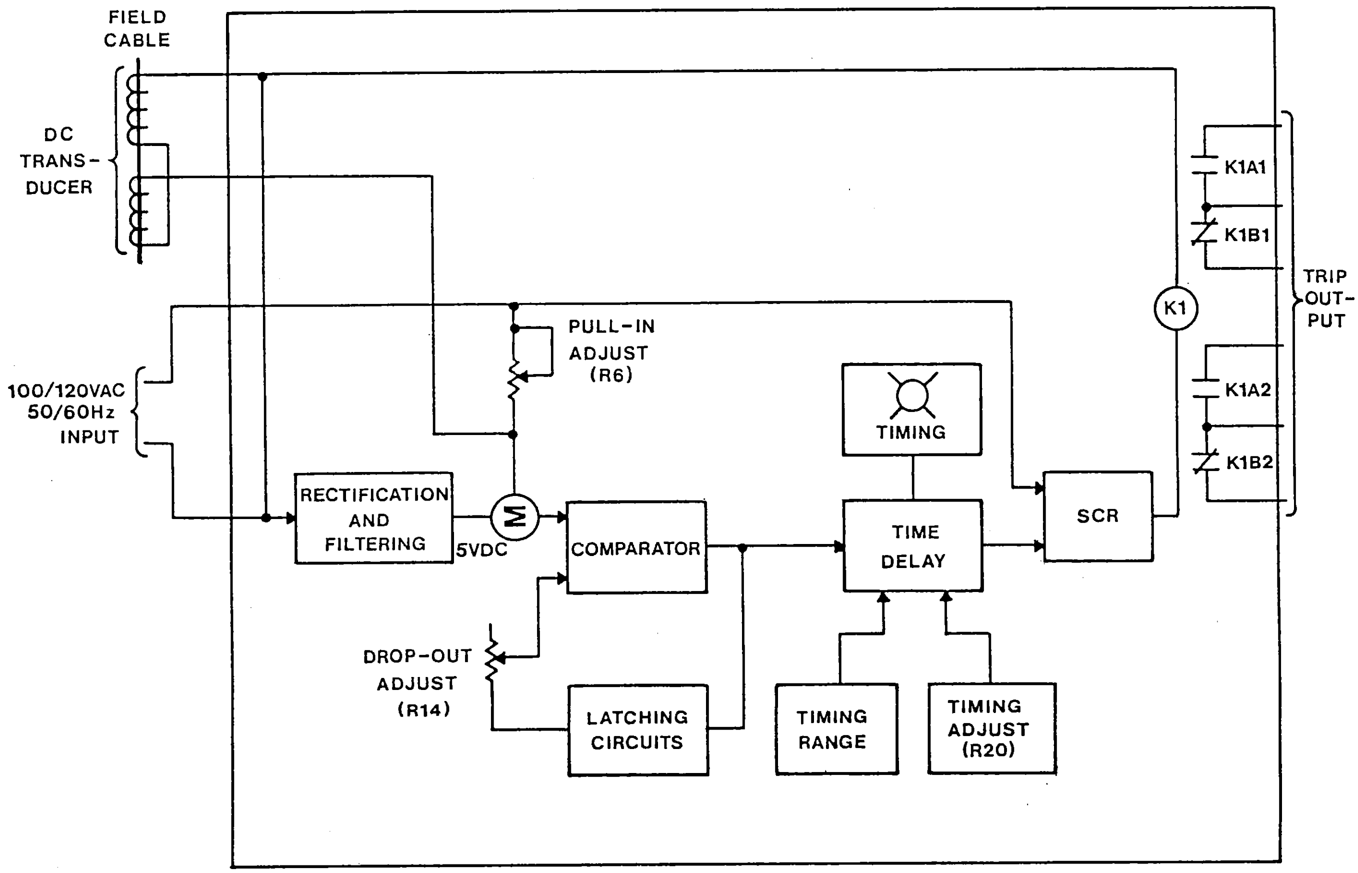


Figure 2-2. Functional Block Diagram

PULL-IN ADJUST potentiometer. The voltage drop across the potentiometer varies with the ac current through it. When dc field current is large the voltage drop across the potentiometer (and applied to the comparator) is large. Conversely, when dc field current drops, the voltage applied to the comparator drops.

2.4 COMPARATOR (OVER EXCITATION RELAY)

A positive 5 Vdc reference voltage is summed with a voltage, proportional to the dc field current, developed across the PULL-IN ADJUST potentiometer. The PULL-IN ADJUST potentiometer is set to a predetermined value above the nominal field current; when the sensed field current exceeds this value, the 5 Vdc reference voltage is overcome, causing the comparator to illuminate the TIMING indicator and initiate the time delay. The time delay circuit counts through the period selected on the TIMING RANGE selector and TIMING ADJUST potentiometer, then triggers the SCR, which energizes K1. When the sensed field current decreases below the DROPOUT ADJUST potentiometer setting (% of pull-in), K1 de-energizes and the TIMING indicator extinguishes.

2.5 COMPARATOR (UNDER EXCITATION RELAY)

A positive 5 Vdc reference voltage is summed with a voltage, proportional to the dc field current, developed across the PULL-IN ADJUST potentiometer. With the PULL-IN ADJUST potentiometer set to a predetermined value below the nominal field current, the resulting voltage across the potentiometer is greater than the reference voltage, causing the comparator to continuously fire the SCR and keep K1 energized. This is the normal condition of relay K1. When the sensed field current decreases below the DROPOUT ADJUST setting (% of pull-in) the comparator illuminates the TIMING indicator and initiates the time delay. The time delay circuit counts through the period selected on the TIMING RANGE selector and TIMING ADJUST potentiometer, then turns off the SCR, de-energizing K1. When the sensed field current increases above the PULL-IN ADJUST potentiometer setting, the comparator extinguishes the TIMING indicator and causes relay K1 to energize and remain energized until the field current again decreases below the DROPOUT ADJUST setting.

SECTION 3

CONTROLS AND INDICATORS

3.1 PULL-IN ADJUST

This control is used to establish the level of field current required to energize output relay K1 (pull-in point.) For the Over Excitation Relay the pull-in point is set slightly over the maximum limit of normal (full load or short term overload) field current. For the Under Excitation Relay the pull-in point is set at or slightly below the "no load" field current. The control is calibrated in ampere-turns (obtained by multiplying field current in amperes times the number of cable turns through the dc transducer) through the range of 90-200 Ampere-turns. For the Under Excitation Relay, typically, no-load field current is used to establish the setting of this control. For example, if no-load field current is 50 amperes, 2 turns through the transducer would be required to energize K1 (pull-in) with the control set to 100 amp-turns (50 x 2). If no-load field current was 140 amperes, only one turn through the transducer would be necessary to energize K1 with the control set to 140 amp-turns (140 x 1). For the Under Excitation Relay there is no time delay before energization of K1; for the Over Excitation Relay, K1 will energize after the time delay set on the TIMING ADJUST potentiometer.

3.2 DROPOUT ADJUST

This control establishes the percentage (40% to 90%) of the Pull-In ampere-turns at which the output relay (K1) will de-energize. For example, assume the setting is 80% and the PULL-IN ADJUST is set to 100 amp-turns. When the field current decreases to the point that the input is 80 amp-turns or less, K1 will de-energize. For the Over Excitation Relay there is no time delay before de-energization of K1; for the Under Excitation Relay, K1 will de-energize after the time delay set on the TIMING ADJUST potentiometer.

3.3 TIMING RANGE

The TIMING RANGE selector provides the selection of the three timing ranges for the TIMING ADJUST:

0.2 to 1.2 seconds
1.2 to 8.0 seconds
8.0 to 60 seconds

3.4 TIMING ADJUST

For both types of Relays, the TIMING ADJUST allows adjustment of time delay over the range selected on the TIMING RANGE selector, as follows:

Over Excitation Relay - time delay between detection of an overexcitation condition and energization of output relay K1.

Under Excitation Relay - time delay between detection of an underexcitation condition and de-energization of output relay K1.

3.5 TIMING INDICATOR

For both types of Relays, the TIMING INDICATOR illuminates when an excitation fault is detected and continues to illuminate until the excitation returns to normal as follows:

Over Excitation Relay - the TIMING INDICATOR is illuminated when the detected field current exceeds the PULL-IN ADJUST setting, and is extinguished when the field current decreases below the DROPOUT ADJUST setting.

Under Excitation Relay - the TIMING INDICATOR is illuminated when the detected field current decreases below the DROPOUT ADJUST setting, and is extinguished when the field current increases above the PULL-IN ADJUST setting.

SECTION 4

INSTALLATION

4.1 MOUNTING: The unit can be mounted in any plane.

4.2 INTERCONNECTION: Connect the Relay as shown in the interconnection drawing.

CAUTION: THIS IS A SOLID-STATE DEVICE. MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT MUST NOT BE USED.

SECTION 5

REPLACEMENT PARTS

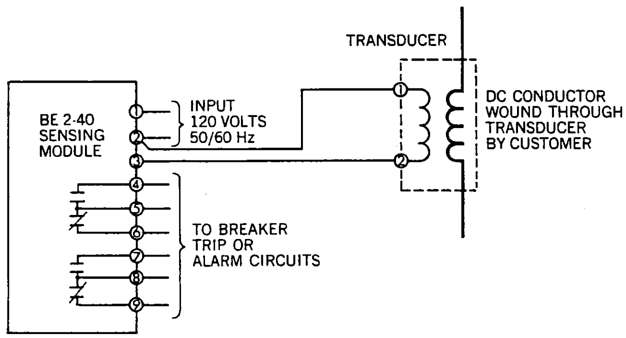
Due to the fact that most components are on a conformally coated printed circuit board, replacement of individual components is difficult and should not be attempted unless appropriate equipment and adequately trained personnel are available. Replacement of the board is the recommended approach for the repair of a unit that has malfunctioned.

SECTION 6

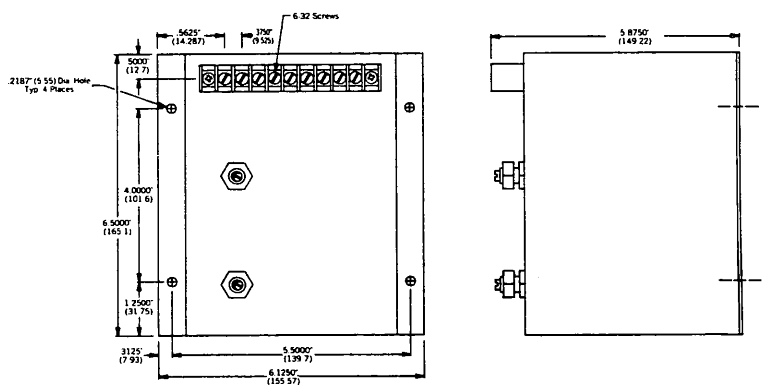
DRAWINGS

The following drawings are provided to facilitate installation and operation.

Typical Interconnection Diagram
Sensing Module Outline Drawing
200 amp-turn transducer Outline Drawing

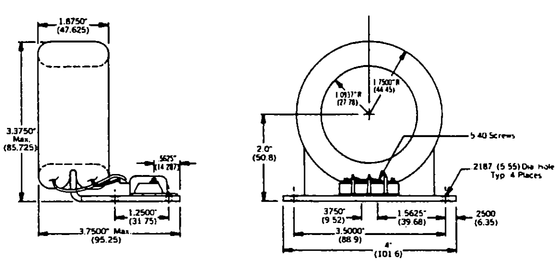


TYPICAL INTERCONNECTION DIAGRAM



Front Side

SENSING MODULE OUTLINE DRAWING



Side Front

200 AMP-TURN TRANSDUCER OUTLINE DRAWING

Note: numbers in parenthesis represent metric dimensions (millimeters).

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