Reyrolle
Protection
Devices

7PG1903 - B3

High Impedance Differential Relay

Answers for energy

SIEMENS

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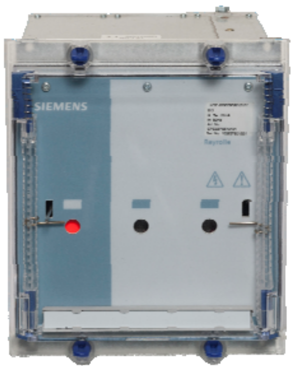
High Impedance Differential Relay



Description

The type B3 relay is a rectifier fed type B element with sensitive current setting and low operating burdens. An external series resistor is used to give the relay the voltage setting required to ensure stability under through fault conditions. This is the setting or stabilizing resistor. Other resistors in the long or short shunt configuration may also be required. A non-linear resistor (Metrosil) is fitted internally across the rectifier, however an external unit may also be required.

Non-linear resistors are used to protect the relay components, the insulation of secondary wiring and current transformers, by suppressing high voltage peaks which may otherwise be developed by the virtually unloaded current transformer secondary winding under internal fault conditions.

Resistors and non-linear resistors are fitted on a per phase basis.

Application

High impedance Busbar Protection, Circulating Current protection and Auto transformer protection.

Protection application

Where significant capacitance is included in the protected zone (e.g. in the case of restricted earth fault or a delta winding at the remote end of a feeder) sensitive settings may only be used in the conjunction with a high frequency filter. For such applications relay type 5B3 should be used. Significant capacitance is defined by comparison of the primary current setting with three times the in-zone capacitance current or nine times the in-zone capacitance current, per phase, for solid or resistance earthed systems respectively.

Technical Information

Continuous rating:	2.4 x current setting
Setting (relay only)	
Current:	33mA or 100mA
Voltage:	16.5V or 8.5V
Operating time:	17ms at 3 x setting
Burden:	0.6VA at setting
Indication:	Hand reset flag
Contact arrangements	4M, 2M 2B

Contact rating	
Make and carry continuously:	1500VA or 1500W within current limit of 3A.
Make and carry for 3 sec. Make and carry for 1 sec.	1500VA or 1500W & 8A 1500VA or 1500W & 16A
Break:	300VA a.c. or 75W d.c. (inductive L/R = 0.04) within the limits of 250V and 5A.

Cases

Modular cases:

Single pole relay: Epsilon Size 3
Three pole relay: Epsilon Size 6

Class "X" current transformers to BS 3938 can be specified to meet the above requirements and are recommended.

Determination of Stability

The stability of a current balance scheme using a high impedance relay circuit depends upon the relay voltage setting being greater than the maximum voltage which can appear across the relay under a given through fault condition. This maximum voltage can be determined by means of a simple calculation which makes the following assumptions:-

1. **One current transformer is fully saturated making its excitation impedance negligible.**
2. **The resistance of the secondary winding of the saturated CT together with the leads connecting it to the relay circuit terminals constitutes the only burden in parallel with the relay.**
3. **The remaining current transformers maintain their ratio.**

Thus the maximum voltage is given by:

$$V = I(Rct + Rl)$$

Where

Rl = The largest value of pilot loop resistance between the CT and the relay circuit terminals.

Rct = The secondary winding resistance of the CT.

I = The CT secondary current corresponding to the maximum steady-state through-fault current of the protected equipment.

For stability, the voltage setting of the relay must be made equal to (or exceed) the highest value of V calculated above.

Method of establishing the value of relay setting resistors.

To give the required voltage setting the type B3 relay operating level is adjusted by means of an external series resistor as follows:

$$R = (V - v)/i$$

Where

R = The value of the setting resistor

V = The maximum voltage as determined above

v = The operating voltage of the relay element

I = The operating current of the relay element

Fault Setting

The fault setting of a current –balance protection using a high impedance relay circuit can be calculated in the usual manner. It should, however, be noted that because the operating voltage of the relay circuit is relatively high, the excitation currents of the CTs in parallel with the relay may comprise a large portion of the fault setting.

Thus, if I0 = the relay operating current, and I1, I2, I3 etc are the excitation currents of the CTs at the setting voltage, and N is the CT turns ratio then

Primary fault setting = N(Io +I1+I2+I3)

In some cases it may be necessary to increase the basic primary fault setting of the scheme as calculated above.

For a small increase, an increase in the relay setting voltage and hence an increase in the values of I1, I2, I3 may give the required result.

For a large increase, the correct result can be obtained by connecting a resistor in parallel with the relay, thereby effectively increasing the value of Io.

Current Transformer Requirements

Experience has shown that most protective current transformers are suitable for use with this protection. When specifically designed for this protection, the overall size may in fact be smaller than that required for an alternative current balance protection using, say, a biased relay.

The basic requirements are:

1. Wherever possible, all the CTs should have identical turns ratios. Where a turns error is unavoidable, it may be necessary to increase the basic fault setting to allow for this.

2. The knee point voltage of the current transformers should be at least twice the relay setting voltage. The knee point voltage is expressed as the voltage applied to the secondary circuit of a current transformer which when increased by 10% causes the magnetising current to increase by 50%.

3. The current transformers should be of the low leakage reactance type. Generally most modern current transformers are of this type and there should be no difficulty in meeting this requirement. Low leakage reactance current transformers have a jointless core with the secondary winding evenly distributed along the whole length of the magnetic circuit, and the primary conductor passes through the centre of the core.

Diagrams

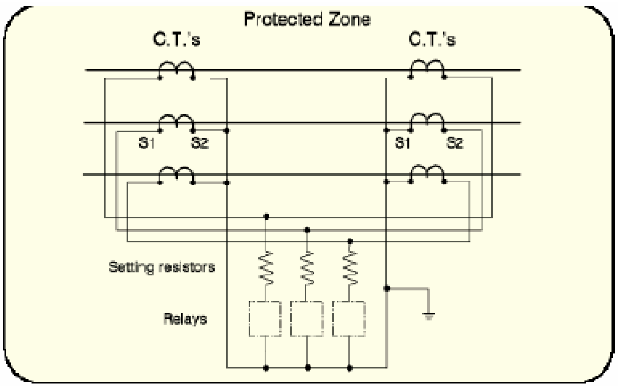


Fig. 1. Typical scheme

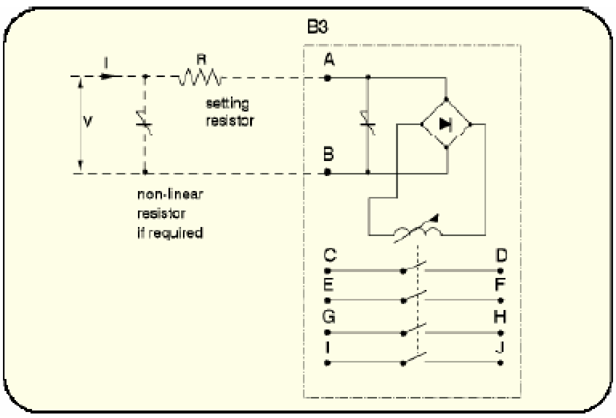


Fig. 2. Typical relay wiring diagram

Modular case terminal numbers				
Case Ref	Single Pole 3	Three pole - 6		
		A phase	B phase	C phase
A	27	23	25	27
B	28	24	26	28
C	5		5	
D	7		7	
E	6		6	
F	8		8	
G	1	13	9	1
H	3	15	11	3
I	2	14	10	2
J	4	16	12	4

Ordering Information

Contact arrangement
Relay current setting
External setting resistor value and external metrosil details if these items are required

Qualifications

Siemens protection devices limited operates a quality system accredited to ISO9001. **CE** Compliant to relevant EU Directives.

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