Grid Solutions

MHOR 04

High Speed Pilot-Wire Feeder Protection

MHOR 04 Feeder Protection

The majority of plain feeders can be protected using this arrangement which features a unit protection scheme with no time or current grading problems, even on ring circuits.

Analog current differential schemes have the advantage that they are more tolerant of poor quality or ageing pilot wires than is the case for MODEM-based digital schemes.

The three line currents are summated to provide a single phase current for comparison over a pilot circuit.

A padding resistor is provided to adjust the pilot loop resistance to a constant value of 1000 thus ensuring that the settings remain close to the design value for all pilot circuits.

The padding resistance is set to 0.5 (1000-Rp) on each relay, where Rp is the pilot loop resistance in ohms.

The diodes in the circuit are arranged in such a way that for all external fault conditions the relay X is connected at the electrical center of the pilots on one half cycle and the relay Y is connected at the electrical centre on the other half cycle. This is shown in Figure 1.

As shown in the diagram there is zero voltage developed across the relay coil for one half cycle and for the other half cycle diode D2 is reverse biased. Hence for external faults no current flows in the relay coil and the protection remains stable. For internal faults current will flow into the relay coils on successive half-cycles. Diode D3 provides smoothing for the current in the relay coil and ensures precise operation.

This is a well established type of protection for feeders. It is based on the Merz-Price circulating current system and suitable for operation over privately owned two-core pilots with a relatively high core resistance (up to 1000 loop) and lowintercore insulation level.

Customer Benefits

- High speed operation
- Through fault stability greater than 50 times relay rating
- Pilot circuits up to 1000 Ω 2.5 F
- Not reliant on MODEMs

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Technical Data

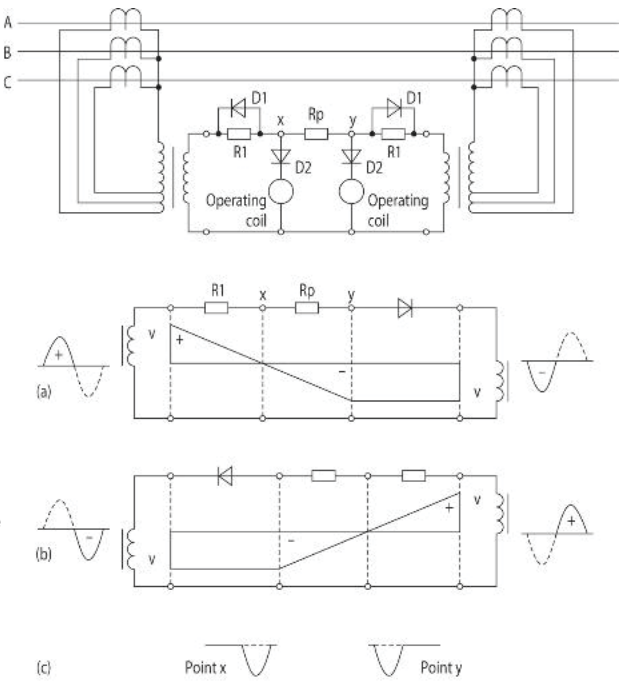
- Current rating (In) 1, 2 or 5 A
- Rated frequency 50 Hz or 60 Hz
- Current settings
- Summation ratio = 1/1/N

TYPE OF FAULT	FAULT SETTINGS		TYPE OF FAULT	FAULT SETTINGS
	(% in)			(% in)
	N = 3	N = 5		
A - N	28	18	A - B	125
B - N	32	21	B - C	125
C - N	42	25	C - A	125
			A - B - C	72

- **Operation time** — 60 ms at 3 times setting
- **Through fault stability** — Greater than 50 times relay rating
- **Contact rating**

Four make contacts are provided each capable of:

Make and carry for 1 second		7500 V with maxima seconf of 5 A and 660 V
Make and carry continuously		1250 VA with maxima of 5A and 660 V
Break	AC	1250 VA with maxima of 5 A and 660 V
	AC	100 W (resistive)
		50 W (inductive L/R = 0.04s)
		with maxima of 5 A and 660 V



(a) and (b) show the effective circuits during successive half cycles

(c) indicates the voltages across relaying points x and y during once cycle

Figure 1: Behaviour of basic MHOR 04 circuit under external fault conditions when R1 = Rp

- **Current transformer requirements**

Minimum knee point voltage of line CT's

Vk = 50/In + If (RCT+2RL) volts where

In = rated current of relay (A)

If = fault current under maximum steady state through fault conditions, referred to the secondary circuit (A)

RCT = resistance of line CT secondary winding (Ω)

RL = resistance of a single lead from the line CT's to the relay (Ω)

The knee point voltage of a current transformer is expressed as the voltage, applied to the secondary winding with the primary on open circuit, which when increased by 10% causes the magnetizing current to increase by 50%.

It is not recommended that any other burdens should be connected in the same current transformer circuit but where this is unavoidable the additional burdens should be added into the above expression for knee point voltage.

In addition to the above the secondary magnetizing current of the current transformers at opposite ends of the feeder should not differ by more than 0.05 In at 50/In volts.

- **Pilots**

Any type of pilot having an insulation grade which can withstand 500 V between cores may be used. The pilots should have a loop resistance, excluding the relay, of less than 1000 Ω and a total intercore capacitance of less than 2.5 µF.

The pilot circuit should be capable of standing a pressure test of 5 kV rms between the two cores connected together and earth.

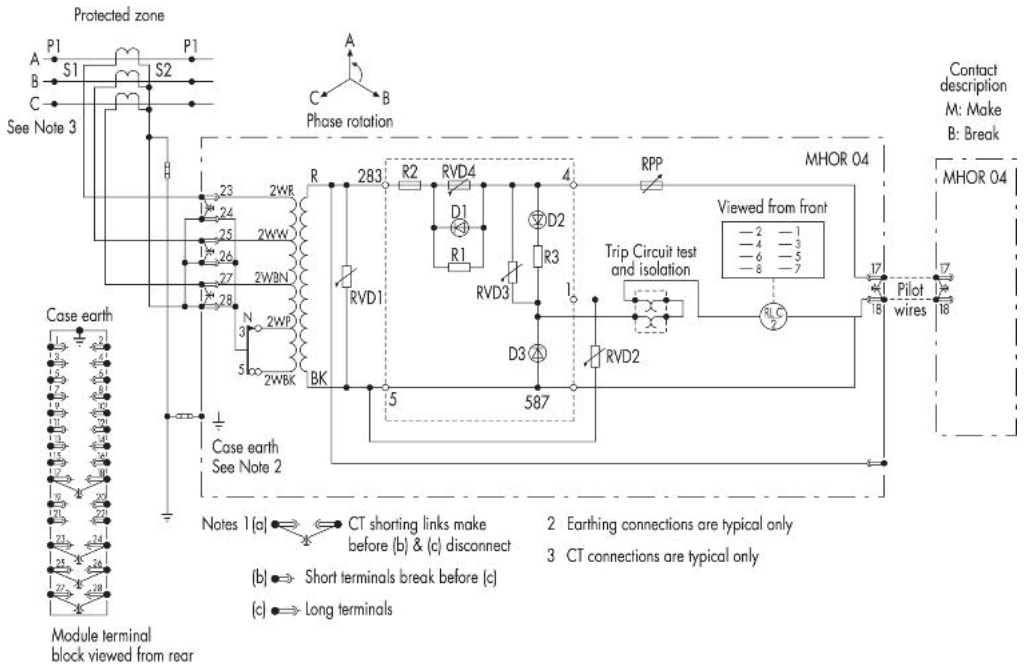


Figure 2: Typical circuit diagram for type MHOR high speed pilot wire feeder protection relay

Voltage withstand

Insulation IEC 60255 - 5

- 2 kV rms for 1 minute between all case terminals connected together and the case earth terminal
- 2 kV rms for 1 minute between independent circuits, including contact circuits
- 1 kV rms for 1 minute across normally open outgoing contact pairs
- 5 kV rms for 1 minute between all pilot circuits and all other circuits and the case earth terminal

High voltage impulse IEC 60255 - 5

- 5 kV peak, 1.2/50 s, 0.5 J between all terminals and case earth and between adjacent terminals

Environmental withstand

Temperature

- IEC 60068 - 2 - 1

Storage and transit -25°C to +70°C

- IEC 60068 - 2 - 2

Operating -25°C to +55°C

Humidity

- IEC 60068 - 2 - 3

56 days (@ 93% RH and +40°C)

Enclosure protection

- IEC 60529

IP50 (dust protected)

Vibration

- IEC 60255 - 21- 21

0.5 g between 10 and 150 Hz

Mechanical Durability

Loaded contact:
10,000 operations minimum

Unloaded contact:
100,000 operations minimum

Type MHOR 04: Well proven Merz-Price circulating current principle for fast unit protection using two-core pilot-wire systems

Grid Solutions' Track Record Pilot - Wire Feeder Protection

MBCI relay launched in 1983. Over 20,000 MBCI relays delivered
MHOR 04 relays launched in 1985. Over 10,000 MHOR 04 relays delivered

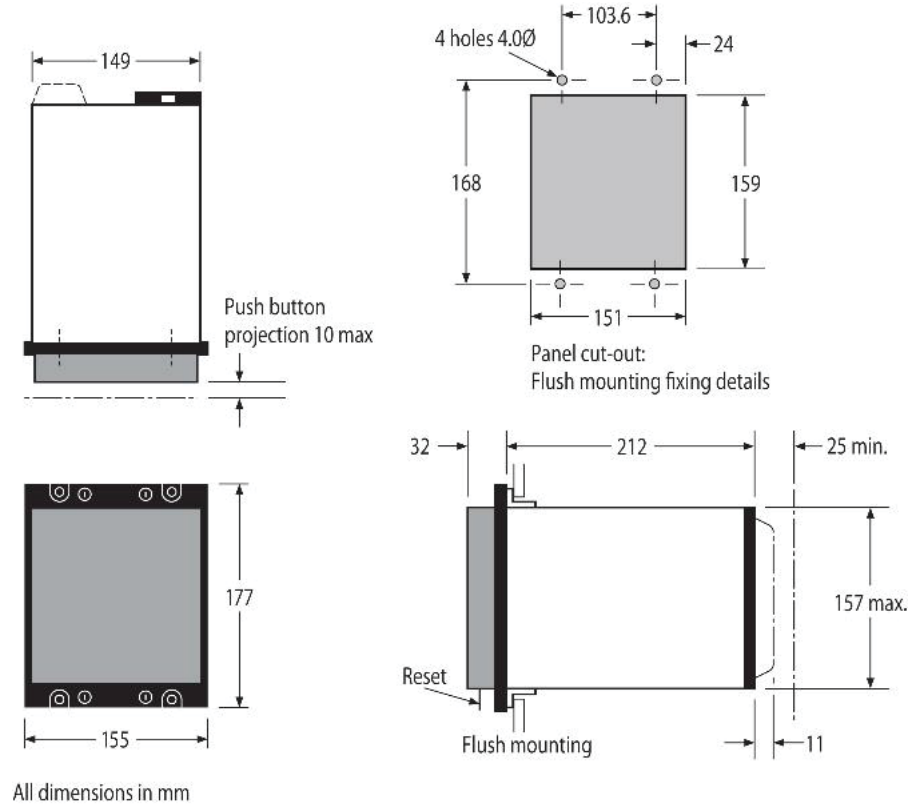


Figure 3: Case outline size 6

- Cases
  The relay is supplied in size 6 case.
  The dimensions are shown in Figure 3
- Information required with order
  current transformer secondary rating.
  Frequency rating.

For more information, visit
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