7SG17 Rho 3

Multifunction Protection Relays

Document Release History

This document is issue 2010/02. The list of revisions up to and including this issue is:

Pre release

2010/02	Document reformat due to rebrand

Software Revision History

Table of Contents

1. REQUIRED TEST EQUIPMENT

- 500V Insulation resistance test set
- Variable secondary injection current source rated 10A or greater
- Time interval meter
- Primary injection equipment
- A d.c. supply with nominal voltage within the working range of the relay's d.c. auxiliary supply rating
- A d.c. supply with nominal voltage within the working range of the relay's d.c. input rating Additional equipment for testing the communications channel:
- Portable PC with the fibre optic modem connections
- Portable printer to operate from the above PC

2. INSPECTION

Ensure that all connections are tight and in accordance with the relay wiring diagram and the scheme diagram. Check the relay is correctly programmed and the relay is fully inserted into the case. Refer to the Description of Operation for programming the relay.

3. APPLYING SETTINGS

The relay settings for the particular application should be applied before any secondary testing occurs. If they are not available then the relay has default settings which can be used for pre-commissioning tests. Note the tripping and alarm contacts must be programmed correctly before any scheme tests are carried out. See the Relay Setting section of this manual for the default settings. Rho 3 relays feature eight alternative setting groups. In applications where more than one setting group is to be used then it may be necessary to test the relay in more than one configuration. When using setting groups it is important to remember that the relay need not necessarily be operating according to the settings which are currently being displayed. There is an 'active setting group' on which the relay operates and an 'edit/view setting group' which is visible on the display and which can be altered. This allows the setting in one group to be altered while protection continues to operate on a different unaffected group. The 'active setting group' and the 'edit setting group' are selected in the 'System Configuration Menu'. Elsewhere in the setting menu system, those settings which can be altered or different groups are indicated by the symbols G1, G2 etc. in the top left of the display. Other settings are common to all groups.

4. PRECAUTIONS

Before testing commences the equipment should be isolated from the current transformers and the CT's short circuited in line with the local site procedures. The tripping and alarm circuits should also be isolated where practical.
Ensure that the correct d.c. auxiliary voltage is applied to the circuit. See the relevant scheme diagrams for the relay connections.

5. TESTS

5.1. Insulation

Connect together all of the C.T. terminals and measure the insulation resistance between these terminals and all of the other relay terminals connected together and to earth. Connect together the terminals of the DC auxiliary supply circuit and measure the insulation resistance between these terminals and all of the other relay terminals connected together and to earth. Connect together the terminals of the DC status input circuits and measure the insulation resistance between these terminals and all of the other relay terminals connected together and to earth. Connect together the terminals of the output relay circuits and measure the insulation resistance between these terminals and all of the other relay terminals connected together and to earth. Satisfactory values for the various readings depend upon the amount of wiring concerned. Where considerable multi-core wiring is involved a reading of 2.5 to 3.0 megohms can be considered satisfactory. For short lengths of wiring higher values can be expected. A value of 1.0 megohm should not be considered satisfactory and should be investigated. Remove temporary connections.

5.2. Secondary injection

Select the required relay configuration and settings for the application. Note that the Rho 3 may be connected as either 1A or a 5A rated device. The User should check this before commencing secondary testing.

5.3. Pickup and reset

These tests check the accuracy and soundness of the relay's input transducers. Set the phase and earth fault trip settings to minimum. Inject single phase current into each of the phase and earth fault inputs, in turn. Slowly increase the current until the I>Is LED (yellow) operates and record the pick-up current. Reduce the current until the LED extinguishes and record this reset level. Check that all pick-up current levels are within 95% and 105% of the applied setting, and that the reset levels are ³95% of the measured pick-up value. Note: Depending on the applied setting, a trip could occur if the current is on for longer than the relay operating time. This may be undesirable while measuring pick-up and reset levels. The fault trigger setting (in the data storage menu) can be used to disable tripping indication temporarily during this test. Restore the phase and earth settings to calculated values.

5.4. Thermal characteristics

This test checks the accuracy of the thermal characteristics and that the relay has been correctly set. The relay should be fully programmed to the calculated settings, output relays mapped to the protection scheme being used for this test. The NPS weighting factor, K, should be set to zero in order to allow a single phase test of the thermal characteristic. Inject a current equal to 2x the set thermal overload setting (Iq) through the three phase inputs connected in series. Depending on the selected heating time constant (th) set, the relay should operate in the following times assuming the initial thermal state = 0% ie cold curves:-

τ_e value (mins)	Operating time (sec)
0.5	8.6
1.0	17.3
2.0	34.5
3.0	51.8
4.0	69
5.0	86.3
10	173
15	259
20	345
25	432
30	518
50	863
100	1726

The measured times should be ±5% of these values. Restore the NPS weighting factor, k, to the required value. The cooling characteristic can be checked by timing the rate of reduction of the thermal capacity. A sufficiently accurate check can be made by employing the restart inhibit feature. Programme this to operate an output contact and to reset at 50% of thermal capacity.

Start external timer at 100% (trip) level and the timer to be stopped when 50% is reached. Depending on the selected cooling time constant (tc) the re-start inhibit, with setting of 50% thermal capacity, should reset in the following times assuming the initial thermal state = 100%

τ_c value (mins)	Re-set time (sec)
0.5	20.8
1.0	41.6
2.0	83.2
3.0	124.8
4.0	166.4
5.0	207.9
10	415.9
15	623.8
20	831.8
25	1039.7
30	1247.7
50	2079.4
100	4158.9

5.5. Over/under current protection

Two high set instantaneous or delayed elements are available designated phase fault trip and phase fault alarm. Where the motor control equipment (ie contactor or circuit breaker) is only capable of breaking a limited fault current, one of these functions can be mapped to a set of contacts wired to trip an upstream circuit breaker with sufficient fault breaking capability if the fault current is above the limit. If used, this feature should be checked. For fault levels within the capability of the controlling device the high set overcurrent trip feature should be employed to trip the local breaker instantaneously and tested as follows. The starter (I>Is) LED should be used. Inject a current below the setting and increase this until the LED lights. Decrease the current and read the value at which the LED extinguishes. Record all values. The pick-up should be ±5% of the setting. For high levels of current the thermal level of the relay must not be exceeded. Refer to the Performance Specification in this manual. To avoid exceeding the thermal withstand an alternative test method is as follows. Increase current to 105% of setting and switch on/off three times to prove operation.

Set current to 95% of setting and switch on/off three times to prove non-operation. To test the operating time, a current of 1.5 times setting should be applied and the set time delay checked by means of a time interval meter connected to the programmed contacts. The timer should be started by the injection source and stopped by the relevant contacts. Test each phase. Similarly, the earth fault and undercurrent elements should be tested.

5.6. Phase unbalance protection

For this test, an injection test set with a variable 3 phase output is require (such as a pair of doble test sets). The current unbalance (or NPS) as selected on the relay is injected, this value should be read on the metering display as ID or I2, and depending on the time multiplier set, the relay should trip in accordance with the inverse time characteristics.

5.7. Number of starts

The relay should be checked to ensure that the control selected and wired into the ‘close’ circuit is operated when the ‘starts per period’ feature set has been exceeded.

5.8. Temperature protection

The correct operation of each RTD or thermistor used should be checked by simulating the operation of the devices with potentiometers. Table 1 shows the RTD resistance values for different types at various temperatures. The operation of the Rho 3 relay should be checked by monitoring both the metered display and output trip contacts at high simulated RTD temperatures.

5.9. Output and status configuration

The operation of every output relay contact (both normally open and normally closed) and every status input unit used in the motor protection scheme must be checked to ensure correct programming and operation.

5.10. Circuit breaker fail

The 2-stage circuit breaker failure feature should be tested if required by the application. If only one of the stages is to be used then only CBF delay I need be tested. In order to test both stages of the CBF feature then the two CBF delays should be programmed to operate output contacts other than the main trip output. They should also be programmed with their appropriate delays. CBF delay I is initiated by the main trip output. After timing out it generates a trip output of its own and also initiates CBF delay 2 which subsequently generates a final trip output. Connect the main trip output to start a time interval meter. Connect the output from CBF delay I to stop both the timer and the current source. Inject current of 2x setting into any pole and record the first CBF time delay. Connect the CBF delay I output to start the time interval meter. Connect the output from CBF delay 2 to stop both the timer and the current source. Inject current of 2x setting into any pole and record the second CBF time delay. Check that the measured delays are within ±5% of the set values.

Temp C^0	OHMS 100 OHM Pt (DIN 43760)	OHMS 120 OHM NI	OHMS 100 NI	OHMS 10 OHM Cu
0	100.00	120.00	100.00	9.04
10	103.90	127.17	105.97	9.42
20	107.79	134.52	112.10	9.81
30	111.67	142.06	118.36	10.19
40	115.54	149.79	124.82	10.58
50	119.30	157.74	131.45	10.97
60	123.24	165.90	138.25	11.35
70	127.07	174.25	145.20	11.74
80	130.80	182.84	152.37	12.12
90	134.70	191.54	159.70	12.51
100	138.50	200.54	167.20	12.90
110	142.27	209.85	174.87	13.28
120	146.06	219.29	182.75	13.67
130	149.82	228.96	190.80	14.05
140	153.58	238.85	199.04	14.44
150	157.32	248.95	207.45	14.83
160	161.04	259.30	216.08	15.22
170	164.76	269.91	224.92	15.61
180	168.47	280.77	233.97	16.00
190	172.46	291.96	243.30	16.39
200	175.84	303.46	252.88	16.78

Table 1