

# 7SG12 DAD N

Numerical High Impedance Relay with CT Supervision

## 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

--	--	--

The copyright and other intellectual property rights in this document, and in any model or article produced from it (and including any registered or unregistered design rights) are the property of Siemens Protection Devices Limited. No part of this document shall be reproduced or modified or stored in another form, in any data retrieval system, without the permission of Siemens Protection Devices Limited, nor shall any model or article be reproduced from this document unless Siemens Protection Devices Limited consent.

While the information and guidance given in this document is believed to be correct, no liability shall be accepted for any loss or damage caused by any error or omission, whether such error or omission is the result of negligence or any other cause. Any and all such liability is disclaimed.

## Contents

1. Introduction .....	3
2. Safety .....	3
3. Sequence of Tests .....	3
4. Test Equipment Required.....	3
5. Insulation Resistance Test .....	4
6. Check of C.T and Secondary Wiring Resistance .....	4
7. Power Supply .....	5
8. Programming the Relay.....	5
8.1 Setting by laptop .....	5
8.2 Setting via relay fascia .....	6
9. Secondary Injection Tests .....	6
9.1 Accuracy of Measurement .....	6
9.2 Checking the Differential Element.....	6
10. Primary Injection Tests.....	7
11. Fault Setting Tests .....	7
11.1 Differential protections .....	7
12. Tripping and Intertipping Tests.....	7
13. Tests Using Load Currents.....	7
14. Putting into Service .....	8

## List of Tables

Table 1 - Insulation Resistance Values .....	4
Table 2 – Lead Resistance Values .....	5
Table 3 – Accuracy of Measurement .....	6
Table 4 – Differential Element PU/DO .....	7
Table 5 – Primary Injection Test Results .....	7



- d) Laptop PC to drive the test set and the Reydisp Evolution relay software.
- e) 500volt Variac to measure CT magnetizing characteristics.
- f) Primary test leads and injection set.

Suitable primary injection connectors and secondary injection test plugs and leads and a suitable a.c supply may be required and must be suitable for the site concerned.

When making secondary injection tests ensure that the test circuit is earthed at one point only.

## 5. Insulation Resistance Test

Before commencing to inspect the wiring take the following precautions:

Isolate the auxiliary supplies.

Remove the trip and inter-trip links.

Check that the relay wiring is complete and that all terminal connections are tight and remove the C.T. earth link for the insulation resistance tests.

Measure the insulation resistance between each section of the wiring and the other sections connected together and to earth.

The sections comprise:

- a) C.T. secondary wiring connected to module AN1 (Analogue 1 module)
- b) D.C. wiring connected to PSU and I/O modules, excluding power supply wiring to the PSU Module.

Before testing the D.C. wiring to earth, apply test connections between suitable points to short circuit each status input and series resistor to avoid possible damage to the opto-coupler should the wiring be earthed.

- c) Test the power supply wiring to module PSU separately. Note that the D.C. +ve and D.C. -ve are each connected to earth by surge capacitors.

Record the results in Table 1 - Insulation Resistance Values.

Wiring Section	Resistance MegaOhms
AN1 C.T.'s to earth and other circuits	
D.C. Wiring to Earth and other circuits	
Power Supply wiring to earth	

**Table 1 - Insulation Resistance Values**

Insulation resistance values that are considered satisfactory must depend upon the amount of wiring involved. Generally, where a considerable amount of multi-core wiring is included, a reading of 2M ohms to 3M ohms is reasonable, for short lengths of wiring on a panel, higher readings should be expected. A reading of 1M ohm would not normally be considered satisfactory.

## 6. Check of C.T and Secondary Wiring Resistance

This test is to be applied to each of the Overall Differential protections.

Isolate the auxiliary supplies.

Remove the trip and inter-trip links.

Refer to the calculated performance data for the Overall Differential. This will give the maximum permissible lead resistance values.

Measure the resistance of the wiring between the relay equipment and the C.T.'s. The readings obtained should be recorded. These should be approximately equal to or less than the values used in the calculated settings for the Overall Differential elements.

Wiring Section	Resistance Ohms
AN1C1 (Differential Phase A)	
AN1C2 (Differential Phase B)	
AN1C3 (Differential Phase C)	

**Table 2 – Lead Resistance Values**

## 7. Power Supply

Remove the relay front cover to give access to all the fascia push buttons. Relays are provided with a power supply suitable for one of the standard auxiliary supply ratings of 24V, 30V, 48V, 110V, 220V D.C. Ensure that the actual supply is the same as the relay rating as marked on the fascia. Ensure the polarity of the supply is correct before energising the relay. Note, the minimum recommended fuse rating of the supply is 6 A slow-blow or 12 A HRC fuse. Note that the relay D.C. status inputs are current rated.

With the relay energised the green LED will provide a steady illumination, all the red LEDs should be out. Operate the TEST/RESET button and check that all the red LEDs are illuminated while the push is depressed.

## 8. Programming the Relay

The relay can either be set using the fascia buttons or from a laptop PC running Reydisp Evolution. Due to the number of possible settings, it is recommended that the laptop method be used for speed and ease of commissioning.

### 8.1 Setting by laptop

The relay is supplied with an RS232 port on the front of the fascia. This should be connected to a laptop using a 25 to 9 way RS232 cable. Reydisp Evolution should be installed – this will run on any MS Windows © operating system.

To access the relay communications port the Communications Settings in the relays must match the settings Communications settings selected in the Reydisp Evolution software.

To change the communications settings on the relay use the following procedure. On the relay fascia, keep tapping the ↓ key until the COMMUNICATIONS MENU is displayed on the relay LCD. Press the TEST/RESET ⇨ once to bring up the STATION ADDRESS on the LCD. Press the ENTER button to alter the address to any desired number between 1 and 254. Set each relay to a unique number in the substation. The relays address and the relay address must be set identically. The relay address can be changed by tapping the ↓ or ↑ buttons. Press ENTER to register the selected number.

Continue to scroll down and set IEC 870 ON PORT to COM2 (front RS232 and lower rear fibre ports are COMM 3 relay ports) and set AUTO DETECT to ON. The Auto Detect feature will automatically switch the active port to the front RS232 from the bottom rear fibre port when connection is made.

Ensure that the Communications baud rate and parity check settings on the Reydisp Evolution software running on laptop and Relay are the same. It is advisable to select the maximum baud rate on the relay and Reydisp Evolution, as this speeds up response times.

The communications setting can be changed in Reydisp Evolution by selecting: OPTIONS -> COMMUNICATIONS. This window displays the active part of the laptop. Select "OK" when changes are complete. Set the address on Reydisp Evolution to be the same as the relay station address.

Check the communications link by retrieving the relay settings (Relay->Settings->Get Settings)

Reydisp Evolutions allows off line generation of relay setting by saving the relay Settings File and then downloading it. This saves time and possibly sore fingers if the relay type is a more advance model with many protection functions.

To download a Settings File on the laptop, select Relay->Settings->Send All Settings. Confirm the action and the program will inform whether the settings have been successfully entered into the relay. It is worth doing a few spot checks on the settings to be confident the correct settings are installed.

## 8.2 Setting via relay fascia

The relay can be set from the fascia by utilising the  $\uparrow$ ,  $\downarrow$ ,  $\Rightarrow$  and ENTER buttons. Settings can be selected with the arrow buttons. Pressing ENTER when the setting to change is found will make the setting flash. This allows the  $\uparrow$  and  $\downarrow$  buttons to be used to alter the setting. Once the desired setting is selected the ENTER pushbutton MUST be pressed for the relay to active the selected setting. The setting will now stop flashing indicating this value will be utilised by the relay software.

The menu structure is shown in the “Description of Operation” section of this manual.

## 9. Secondary Injection Tests

Isolate the auxiliary D.C. supplies for alarm and tripping from the relay and remove the trip and intertrip links.

We recommend the use of an Omicron Test Set Type CMA156. The Omicron set should be connected in accordance with the manufacturer’s instructions.

By default all protection elements are disabled, however if this is not the case, then disable all protection and alarm elements.

### 9.1 Accuracy of Measurement

Inject all of the current inputs with nominal current in turn, and record the following currents measured by the relay in Table 3 – Accuracy of Measurement.

Tap  $\downarrow$  to select: -

e.g. Diff Currents  
0.00 0.00 0.00 x  $I_n$

If the relay measurement is within tolerance proceed to 9.2 below. If any of the measurements are outside the stated tolerance ( $\pm 5\%$ ) the relay must be sent back to the Quality Assurance Department for investigation.

Meter	A	B	C
Diff1 Currents	A x $I_n$	B x $I_n$	C x $I_n$

Table 3 – Accuracy of Measurement

### 9.2 Checking the Differential Element

When testing the Differential Element the Differential Currents can be displayed on the LCD by changing to INSTRUMENTS mode and scrolling down to [Diff1 Currents].

Connect a single phase current source to Phase A, see Table below :-

Phase	Unit	Connection	
		Start	Finish
A	AN1C1	17	18
B	AN1C2	21	22
C	AN1C3	25	26

Modify the following settings :-

Setting Description	Setting Value
87/50 Element	Enable
87/50 Delay	0.1

Modify the operate setting and determine the PU and DO at each setting :-

Setting Description	Setting Value	PU	DO
87/50 Setting	0.05		

87/50 Setting	0.10		
87/50 Setting	0.50		
87/50 Setting	0.90		

**Table 4 – Differential Element PU/DO**

Record the results and verify the accuracy complies with performance stated in the Performance Specification.

Verify the correct operation of the Trip Relays RL4, RL5 and the LED indication.

Repeat Tests for connections to Phase B and C.

## 10. Primary Injection Tests

Primary injection tests are required to prove the CT ratio and secondary connections to the relay.

Differential Currents	A xIn	B xIn	C xIn
-----------------------	-------	-------	-------

**Table 5 – Primary Injection Test Results**

Inject using a primary injection test set and record and verify the expected levels on the instruments on the relay, the Reference Currents and corresponding Spill current will be in phase when the Spill Angle is zero.

## 11. Fault Setting Tests

Fault setting tests use primary injection testing to verify the protection settings; they can conveniently be combined with the current transformer ratio and polarity tests in section 10.1.

Isolate the auxiliary d.c. supplies for trip and alarm, remove the Trip and Intertrip links. Use the test circuit shown in Fig 8. Inject primary current and record the values at which the relay operates. Relay operation is indicated by LEDs . Check the operation of all the output relays selected for each protection function.

### 11.1 Differential protections

Isolate the auxiliary d.c. supplies for trip and alarm and remove the Trip and Intertrip links.

Check that the setting resistor is the correct ohmic value, also that the correct Differential settings are selected.

Measure the primary current for operation of the CT and 87/50 elements and record the value obtained.

## 12. Tripping and Intertripping Tests

Re-connect the auxiliary d.c. supplies for trip and alarm operations and insert the Trip and Inter-Trip links.

Simulate the operation of each external contact that initiates a status input and in each case check that appropriate LED illuminates and that the correct tripping, intertripping and alarm initiation occurs.

Disconnect the d.c. power supply to the relay and check for correct PROTECTION INOPERATIVE alarm. Operate all protection and alarm elements in turn by primary or secondary injection and check that the correct tripping and indication occurs.

## 13. Tests Using Load Currents

Isolate the auxiliary d.c. supplies for the trip and alarm functions.

Ensure that the relay is set the assigned settings for the capacitor bank installation.

Energise the Capacitor Bank.

Utilising the INSTRUMENT Display verifies the correct meter readings for each of the instruments, noting the following:-

- Ensure all primary current displays are correct, thus verifying CT Ratio settings are correct.
- Ensure all secondary current displays are correct, thus verifying CT input settings are correct.

- Verify that there is minimal Diff Currents displayed, thus verifying that the Differential circuit is balanced.

## 14. Putting into Service

Ensure that:

The trip supply is connected.

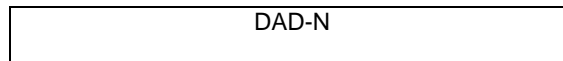
All the RED LEDs are off.

The GREEN LED is ON steady.

All earth links, trip links and inter-trip links are in their normal operational positions.

Operate the Cancel PUSH BUTTON

Check that the LCD displays the screen below, or the 'Relay Identifier' set in the SYSTEM CONFIG MENU.



Replace the cover. The above reading will remain for approximately 1 hour then the display will go blank.