

# MSCDN – MP2A

Capacitor unbalance protection

## 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

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## 1 Introduction

These commissioning recommendations apply to the testing, putting into service and subsequent maintenance of MSCDN-MP2A (**Modular II**) series integrated capacitor bank protection.

A software program called Reydisp Evolution is available for download from the [www.siemens.com](http://www.siemens.com) website. This allows access to settings, waveform records and event records via relay communications with an IBM PC compatible computer.

Before starting the test procedures, the protection settings, the D.C. inputs, output relay configuration details must be available. This requires the following information: Damping network resistor rating, values and tolerances and the C.T. ratios.

It is recommended that use is made of all the tables provided so that a comprehensive record of the protection settings, as commissioned, is available for reference.

## 2 Safety

The commissioning and maintenance of this equipment should only be carried out by skilled personnel trained in protective relay maintenance and capable of observing all the safety precautions and Regulations appropriate to this type of equipment and also the associated primary plant.

Ensure that all test equipment and leads have been correctly maintained and are in good condition. It is recommended that all power supplies to test equipment be connected via a Residual Current Device (RCD) which should be located as close to the supply source as possible.

The choice of test instrument and test leads must be appropriate to the application. Fused instrument leads should be used when measurements of power sources are involved, since the selection of an inappropriate range on a multi-range instrument could lead to a dangerous flashover. Fused test leads should not be used where the measurement of a current transformer (C.T.) secondary current is involved, the failure or blowing of an instrument fuse or the operation of an instrument cut-out could cause the secondary winding of the C.T. to become an open circuit.

Open circuit secondary windings on energised current transformers are a hazard that can produce high voltages dangerous to personnel and damaging to equipment, test procedures must be devised so as to eliminate this risk.

## 3 Sequence Of Tests

If other equipment is to be tested at the same time as the MSCDN-MP2A, then such testing must be co-ordinated to avoid danger to personnel and equipment.

When cabling and wiring is complete, a comprehensive check of all terminations for tightness and compliance with the approved diagrams must be carried out. This can then be followed by the insulation resistance tests, which if satisfactory allows the wiring to be energised by either the appropriate supply or test supplies. When injection tests are completed satisfactorily, all remaining systems can be functionally tested before the primary circuit is energised. Some circuits may require further tests, e.g synchronising before being put on load.

## 4 Test Equipment Required

Various test sets designed for protection testing can be used to test the relay providing these provide the required current source with sinusoidal waveform within practical limits.

Test currents of the following range are required:

Testing of the R1/R2 Open circuit elements requires a minimum of 2 sources to be applied simultaneously.

Thermal Overload	up to $3 \times I_N$
Open Circuit	up to $2.5 \times I_N$

Where  $I_N$  is the relay nominal current rating being used.

The basic test equipment for primary and secondary injection test is as follows:

- a) A digital test set capable of at least 1 x three phase current injection. The set must be capable of injecting at least 4 x the rated current on any of the relay inputs. For relay models with voltage inputs the amplifiers need to be reconfigured for voltage output.
- b) 1 - 500V insulation resistance test set.
- c) 1 – Digital Multimeter
- d) Laptop PC to drive the test set and the Reydisp Evolution relay software.
- e) 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
- b) C.T. secondary wiring connected to module AN2
- c) 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.

- d) 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.

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 should not normally be considered satisfactory.

## 6 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 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.

## 7 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.

### 7.1 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 bottom 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 setting to be confident the correct setting are installed.

### 7.2 Setting via relay fascia

The relay can be set from the fascia by utilising the ↑, ↓, ⇒ 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 ↑ and ↓ 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.

## 8 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 CMC256 (or CMC156 plus CMA156) as this has a program to input the settings and the thermal characteristic is automatically generated and tested. The Omicron set should be connected in accordance with the manufacturer’s instructions. Using the OMICRON I2T Overcurrent

characteristic with the parameters A =1second, P = 2 and Q = 1 may be used if a full thermal curve is required. Pickup and Time constant should be as applied to relay.

Ensure that the resistor thermal elements are disabled at this stage to avoid confusing results.

Gn R1 49 Thermal Overload <i>Selects whether the thermal overload protection element is enabled for Resistor R1</i>	Disabled, Enabled	Disabled
Gn R2 49 Thermal Overload <i>Selects whether the thermal overload protection element is enabled for Resistor R2</i>	Disabled, Enabled	Disabled

Ensure that the resistor open circuit elements are disabled at this stage to avoid confusing results.

Gn 50 OC <i>Selects whether the DTL Resistor Open Circuit Overcurrent element is enabled</i>	Disabled, Enabled	Disabled
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## 8.1 Accuracy of Measurement

Inject all of the current inputs with nominal current in turn, and record the Relay Currents measured by the relays in the table below.

RESISTOR	A	B	C
R1			
R2			

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

## 8.2 Checking the thermal characteristic

Enable the thermal elements.

Gn R1 49 Thermal Overload <i>Selects whether the thermal overload protection element is enabled for Resistor R1</i>	Disabled, Enabled	Enabled
Gn R2 49 Thermal Overload <i>Selects whether the thermal overload protection element is enabled for Resistor R2</i>	Disabled, Enabled	Enabled

When testing the thermal characteristic, the status each thermal element can be displayed on the LCD by changing to the INSTRUMENTS mode and scrolling down to either [R1 METERS] or to [R2 METERS] as required. The Instruments to view to help check the relay thermal characteristics are

INSTRUMENT	DESCRIPTION
[ R1 METERS ] --> press down <--	Start of resistor 1 meters
R1 Primary Currents 0.0 0.0 0.0 kA	Resistor 1 primary currents (requires CT ratios to be entered correctly)
R1 Nom Currents 0.00 0.00 0.00 xIn	Resistor 1 secondary nominal currents
R1 Thermal Status 0.0 0.0 0.0 %	Resistor 1 thermal status, 100% = Fully operated, 0-99% = thermal state of resistors
[ R2 METERS ] --> press down <--	Start of resistor 2 meters
R2 Primary Currents 0.0 0.0 0.0 kA	Resistor 2 primary currents (requires CT ratios to be entered correctly)
R2 Nom Currents 0.00 0.00 0.00 xIn	Resistor 2 secondary nominal currents
R2 Thermal Status 0.0 0.0 0.0 %	Resistor 2 thermal status, 100% = Fully operated, 0-99% = thermal state of resistors

The thermal status meters show the current thermal state of the elements. When applying secondary injection current these values will change to show how the resistor model is warming up. Sufficient time must be allowed between tests to allow the thermal model to reset otherwise operate times may be misleading. To

accelerate testing of the thermal elements it is possible to reset the thermal state between tests via a setting via the FASCIA LCD only:

R1 49 Reset Therm State <i>Control that allows thermal state to be manually reset</i>	NO, YES
--	---------

and

R2 49 Reset Therm State <i>Control that allows thermal state to be manually reset</i>	NO, YES
--	---------

Selecting YES will reset the thermal state for either R1 or R2.

Alternatively it is possible to program a status input to reset the thermal state, which may be conveniently operated from a spare thermal trip contact if a full characteristic is required. Applying rated current to each resistor should result in the thermal state of the element settling to the following level:

$$\theta_F = \frac{I^2}{I_\theta^2} \times 100\%$$

I = applied thermal current

I<sub>θ</sub> = thermal overload current setting (or k.I<sub>B</sub>)

The thermal pickup level can be checked by decreasing the thermal time constant to 1s and adjusting the currents so that about 100% thermal capacity is shown on the Instruments. The operate time can be checked by first calculating the expected value and injecting current at a multiple of pickup to cause a thermal trip. It is worth using the thermal time constant to be used during this test but inject current at a high multiple of setting to speed up the test.

Resistor 1	A	B	C	
Current Applied				Amps
Final thermal state				%
PU Test	A	A	A	Th. Capacity=100%
Timing Test; Tau TC = Calculated Time= ____s Current Injected ____ x PU				(s)

Repeat for R2.

Resistor 2	A	B	C	
Current Applied				Amps
Final thermal state				%
PU Test	A	A	A	Th. Capacity=100%
Timing Test; Tau TC = Calculated Time= ____s Current Injected ____ x PU				(s)

Check that the Nominal Currents on the Instruments display value are at an expected value.

### 8.3 Checking the open circuit protection

**Apply the same current (nominal or below) to all phases.**

Enable the resistor open circuit elements.

Gn 50 OC <i>Selects whether the DTL Resistor Open Circuit Overcurrent element is enabled</i>	Disabled, Enabled	Enabled
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The element should NOT operate at this time. If operation occurs please check the instruments display and ensure that R1 and R2 nominal current meters all display the same current (within defined tolerances).

INSTRUMENT	DESCRIPTION
[ R1 METERS ] --> press down <--	Start of resistor 1 meters
R1 Nom Currents 0.00 0.00 0.00 xIn	Resistor 1 secondary nominal currents (A,B,C xIn)
[ R2 METERS ] --> press down <--	Start of resistor 2 meters
R2 Nom Currents 0.00 0.00 0.00 xIn	Resistor 2 secondary nominal currents (A,B,C xIn)
[ OPEN CCT METERS ] --> press down <--	Start of resistor open circuit meters
Open Cct Currents 0.00 0.00 0.00 xIn	Resistor open circuit nominal currents (A,B,C xIn)

Lower resistor R1 one phase A current until operation occurs and record results below. Raise until R1 phase A current equals R2 phase A current and element resets. Repeat with phases B and C verifying that the LED indication is as expected in each case.

Repeat for resistor R2.

RESISTOR	A	B	C
R1			
R2			

Return all settings to those to be used, and reset the thermal capacity.

## 9 Primary Injection Tests

Primary injection tests are required to prove the CT ratio and secondary connections to the relay. A polarity test is NOT required for this relay.

Inject using a primary injection test set and record and verify the expected levels on the instruments on the relay.

RESISTOR	Ia Primary Injection	Ia Relay Instruments	Ib Primary Injection	Ib Relay Instruments	Ic Primary Injection	Ic Relay Instruments
R1						
R2						

## 10 Tripping And Intertripping Tests

Re-connect the auxiliary d.c. supplies for trip and alarm operations and insert the Trip and InterTrip 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 MSCDN-MP2A relay and check for correct PROTECTION INOPERATIVE alarm. Operate the thermal protection and the open circuit protections in turn by primary or secondary injection and check that the correct tripping, indication occurs.

## 11 Putting Into Service

Ensure that: The trip supply is connected.  
All the RED LEDs are off  
The GREEN LED is ON steady.

Ensure that all earth links, trip links and inter-trip links are in their normal operational positions.

Ensure that the thermal states of the resistor thermal protections are reset



R1 49 Reset Therm State <i>Control that allows thermal state to be manually reset</i>	NO, YES
R2 49 Reset Therm State <i>Control that allows thermal state to be manually reset</i>	NO, YES

Selecting YES will reset the thermal state for either R1 or R2.

Operate the Cancel PUSH BUTTON

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

MSCDN-MP2A
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Replace the cover. The above reading will remain for approximately 1 hour then the screen will go blank.