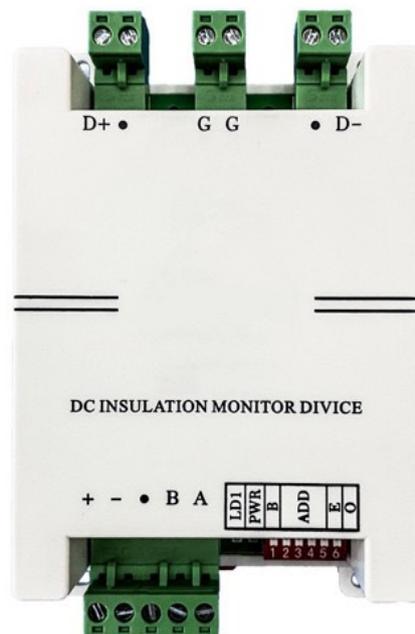


# Energom-DU-S1 Series

## DC Insulation Monitor User Manual



Version: 1.0

Revision 2023.05

## Read me

**When you use EnergoM-DU-S1 Series, be sure to read this user manual carefully, and be able to fully understand the implications, the correct guidance of operations in accordance with user manual, which will help you make better use of EnergoM-DU-S1 Series, and help to solve the various problems at the scene.**

1. Before turning on the power supply, be sure that the power supply within the provisions of the instrument;
2. When installation, the current input terminal must non-open, voltage input terminals must Non-short circuit;
3. Communication terminal (RS485) is strictly prohibited to impose on high pressure;
4. Be sure the instrument wiring consistent with the internal system settings;
5. When communicating with the PC, instrument communication parameters must be consistent with the PC.



- **Please read this user manual carefully**
- **Please save this document**

## Directory

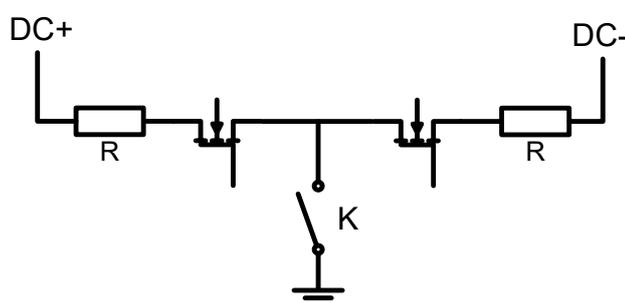
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## 1. - SUMMARIZE

Energom-DU-S1 Series is a DC insulation monitoring device based on MODBUS protocol, including DC to ground insulation impedance monitoring, DC voltage monitoring, DC voltage reverse connection alarm and other safety monitoring functions. It can be used for electric vehicle DC charging system, photovoltaic system, energy storage system, DC grid and other DC systems below 1000V. This product has the function of starting and stopping insulation monitoring. After insulation monitoring is started, the insulation resistance of positive and negative poles to ground can be monitored in real time. The monitoring result is not affected by DC voltage fluctuation, and is not affected by the symmetry of insulation resistance of positive and negative poles.

### Insulation monitoring function introduction

The product can send communication frames through RS485 to turn on or off the insulation monitoring function. After the insulation monitoring function is turned on, the high-voltage grounding switch K is closed and the real-time measurement of insulation resistance is realized. After the insulation monitoring function is turned off, the high-voltage grounding switch K is disconnected. The host machine can send read command to read the insulation resistance value of positive and negative poles at any time.



The insulation resistance monitoring can be realized only when the DC voltage is between 100V and 1000V. If the insulation monitoring is off, or the DC voltage is less than 100V, or just opened for a short time, the value of Bit1 of 0x001B is 0, then the read insulation resistance is 65535, namely 0xFFFF (invalid value). Only when the Bit1 value of 0x001B is 1, the read insulation resistance is an effective value. The monitoring range of insulation resistance is between 1kΩ and 10MΩ. When the measured value is greater than 10MΩ, the received value is 60000, namely 0xEA60 (infinity value).

The user can turn the insulation monitoring on and off by writing the 0x0102 register, and can determine whether the current insulation monitoring is on or off by reading the Bit2 of the 0x001B register. The opening and closing of insulation monitoring only determines whether the insulation resistance monitoring is enabled, and does not affect the DC voltage monitoring. After the product is powered, the DC voltage is continuously monitored.

After the insulation monitoring function is enabled, the product continuously monitors the insulation resistance in real time. The user can read the insulation resistance value at the earliest 1s after the function is enabled. For the presence of DC ground capacitance, the module can adaptively monitor the ground capacitance below 3 $\mu$ F (the positive and negative ground capacitance are respectively below 3 $\mu$ F, and the total capacitance is below 6 $\mu$ F). When the ground capacitance exists, the monitoring time is less than 2.5s.

## FEATURES

- Widely power supply range
- Widely insulation monitoring range (100V~1000VDC)
- insulation monitoring equipment self-test
- Adaptive capacitance to ground
- Convenient parameter setting
- Remote monitoring and management
- Monitor positive and negative poles
- Ground insulation resistance
- Voltage reverse polarity alarm

## APPLICATIONS

- Insulation Resistance Monitoring
- DC voltage monitoring
- Guarantee the safety and stability of charging
- Improvement of the efficiency and charging quality
- Personnel and equipment security

## 2. - TECHNICAL PARAMETERS

### Basic parameters

Parameter	Value		
Power supply	10-30VDC, Power 3w		
DC voltage range	0V~1000V		
DC voltage measurement accuracy	$\leq 2V + 0.3\%$		
Insulation resistance measurement range	1K $\Omega$ ~10 M $\Omega$ (DC System voltage:100V~1000V)		
	<b>C<sub>Y</sub> range</b>	<b>Resistance range</b>	<b>Accuracy</b>
Insulation monitoring accuracy (When :DC voltage:100V-1000V)	0~0.8 $\mu$ F	$\leq 60k\Omega$ 60k $\Omega$ <R $\leq$ 1M $\Omega$	$\leq 3k\Omega$ $\leq 5\%$
	0.8 $\mu$ F ~3 $\mu$ F	$\leq 60k\Omega$ 60k $\Omega$ <R $\leq$ 1M $\Omega$	$\leq 6k\Omega$ $\leq 20\%$
Off-line pressure test	<2mA		
Standard	IEC 61851-23 (2014-03):2014-11		
Humidity	85%		
Storage temperature	- 40°C ~125°C		
Operating temperature	- 40°C ~75°C		

#### Notes:

1. When facing the ground insulation resistance  $R_{ISO+}$  and negative insulation resistance to ground  $R_{ISO-}$ , The difference is too large, Multiplier of difference >5 times,  $R_{ISO+}$  and  $R_{ISO-}$  Large resistors may not be typical values.

2. C<sub>Y</sub> Refers to the positive and negative Y capacitance values of the system bus to ground.

**Other parameters**

<b>Pressure point</b>	<b>Maximum voltage rating</b>	<b>Time</b>
DC+/DC- To GND	4200VDC/3000VAC	≤1min
Power supply +/- To GND	3500VDC/2500VAC	≤1min
RS485 A/B To GND	3500VDC/2500VAC	≤1min
DC+/DC- To Power supply +/-	3500VDC/2000VAC	≤1min
DC+/DC- TO A/B	3500VDC/2000VAC	≤1min

**Note:**

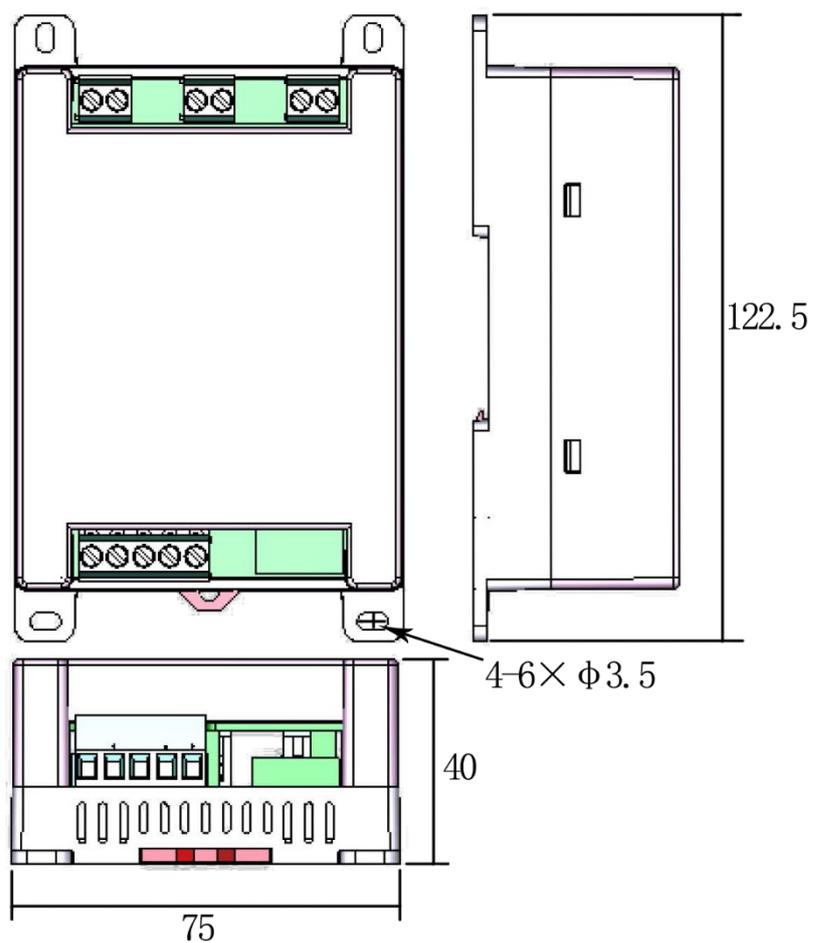
The power supply side (+/-), RS485(A/B), and Ground(G) should be isolated from each other

### 3. - INSTALLATION AND STAR UP

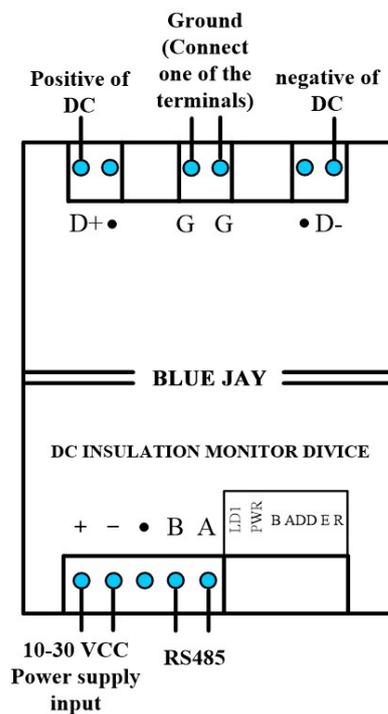
#### 3.1. - Mounting

Energom-DU-S1 Series module can be installed by rail or screw. Guide rails use standard width of 35mm. Overall dimensions are shown in Figure 1 below: (Unit: mm)

**Dimensions: L\*W\*H (mm) 122.5\*75\*40**



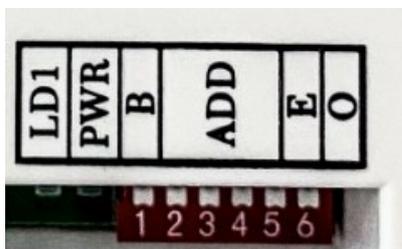
### 3.2. - Connection Terminal



Interface	Connection mode	Definition
D+	Positive pole of DC	DC interface
D-	Negative pole of DC	
A	RS485-A	
B	RS485-B	
+	Positive pole of power supply	9-30VDC
-	Negative pole of power supply	
GND	Grounding point	

### 3.3.- The LED display

After the module is powered on, the PWR indicator is on.



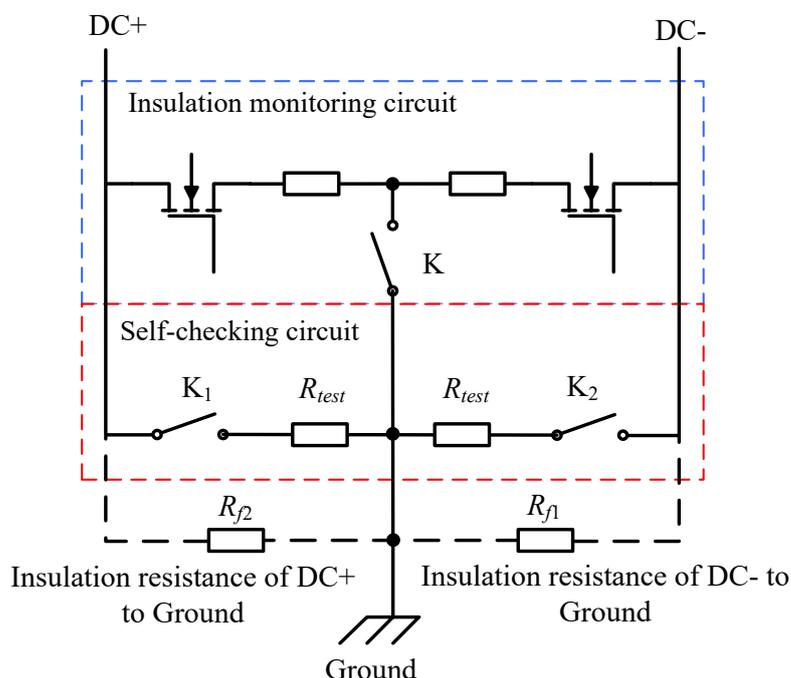
<b>'LD1' light flashing logic</b>	
insulation monitoring function is ON, and the self-check function is OFF	'LD1 lights Normally ON
insulation monitoring function is OFF, and the self-check function is OFF	'LD1' is ON for 1.5 seconds and OFF for 0.5 seconds
Insulation monitoring function is OFF, self-check function is ON	'LD1' is OFF for 0.5 seconds and OFF for 1.5 seconds
insulation monitoring function is OFF, and the self-test function is OFF	'LD1 lights Normally OFF

### 3.4.- Insulation monitoring self-test function (Optional, model with '-ST')

The function of insulation monitoring self-test is to test whether the equipment can work normally by self-switching the grounding resistance inside the device.

If the device can detect the grounding resistance, it means that the insulation monitoring function can work normally, that is, self-test success;

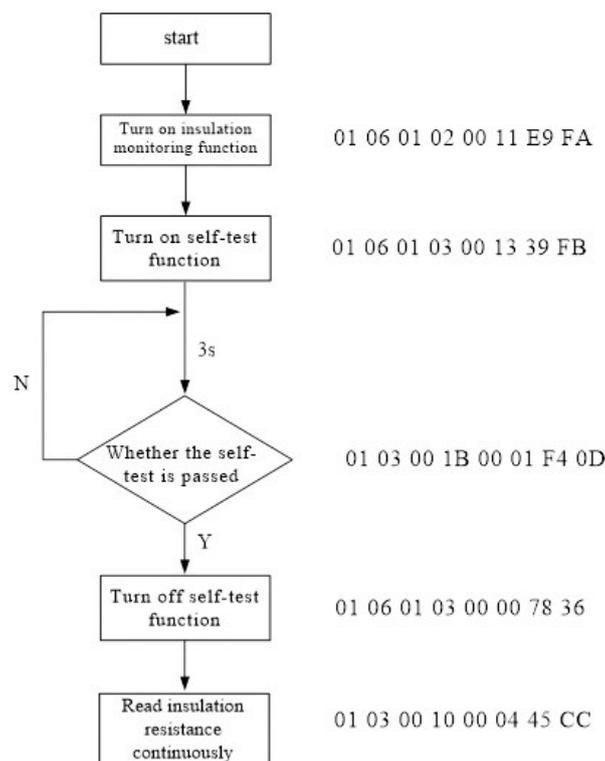
If the device cannot detect the switch resistance, it means that the insulation monitoring function cannot work normally, that is, the self-test fails.



The self-checking circuit and the insulation monitoring circuit are independent and do not affect each other.

When the user opens the self-test circuit, the self-test switches K1 and K2 are closed, and the positive and negative self-test resistance  $R_{test}$  is set as 470k $\Omega$  here; When the user closes the self-test circuit, the self-test switches K1 and K2 are disconnected.

When the user opens the insulation monitoring circuit, the ground switch K is closed and the insulation monitoring starts to work. When the user closes the insulation monitoring circuit, the ground switch K will be disconnected and the insulation monitoring will stop working.



### 3.4.1 - Self-test function conditions:

- (1) Turn on the insulation monitoring circuit (send 01 06 01 02 00 11 E9 FA);
- (2) Turn on the self-test circuit (send 01 06 01 03 00 13 39 FB);
- (3) DC voltage above 100V (the greater the DC voltage, the more accurate result).

Note:

At this time, 'LD1' is ON for 1.5 seconds and OFF for 0.5 seconds.

The insulation monitoring circuit and self-test circuit are both ON, and the self-test function is ON.

### 3.4.2 - View self-test results:

You can view the result 3S after the above three conditions are ON. You can view the self-test result by either of the following methods (the second method is recommended):

- (1) Check by reading the insulation resistance value. Register addresses 0x0012 and 0x0013 are the positive and negative insulation resistance to earth respectively. If open self-checking circuit is negative in front of the insulation resistance of Rf2 respectively and Rf1, self-checking circuit open across the electrodes of 3 seconds after read across the electrodes of insulation resistance should be opened before the self-checking circuit insulation resistance and resistance of self-check  $R_{test}$  parallel values, namely,  $R_{f2} \parallel R_{test}$  and  $R_{f1} \parallel R_{test}$ , if read value and time value were similar, that means the self-test passed.

(2) Check whether the self-test passes by reading the Bit4 bits of the register address 0x001B.

If Bit4=1, the self-check passes.

If Bit4=0, the self-check fails. When the self-check function is turned off, the Bit4 bit is 0. In this case, the Bit4 bit should not be read.

### **3.4.3 -Possible causes of self-test failure:**

After passing the self-test, you can close the self-test function; If the self-test fails, the possible causes are:

- (1) The insulation monitoring is not ON
- (2) The self-test circuit is not ON
- (3) The DC voltage is below 100V
- (4) The waiting time after starting is too short, you can wait for another 3 seconds to read the self-test result
- (5) The insulation monitoring function is faulty.

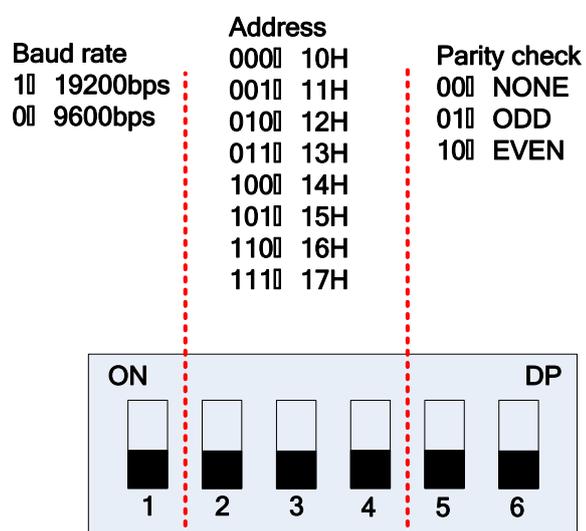
## 4. - COMMUNICATION INTERFACE

### 4.1. - Connection for RS485

Users can send and receive data frames through the RS485 communication port. The circuit is equipped with 510Ω terminal resistance. For details, see 6 Communication Protocol. Terminals A and B correspond to RS485 outputs A and B respectively.

#### Communication Parameter configuration bit

Dip switch 1 bit is used to set the baud rate, 2 to 4 bits are used to set the communication address, and 5,6 bits are used to set the parity check. The setting mode is shown below.



## 4.2. - Communication Protocol

Energom-DU-S1 Series provides Modbus RTU protocol interface, using Modbus RTU 0x03/0x06 command; Baud rate, communication address, parity check mode, can be set by DIP switch, stop bit 1, data bit 8. The interval between each byte in the sent frame must not exceed 20ms; otherwise, the frame will be cleared. This module works in slave mode.

### Modbus RTU Frame Format:

<b>Address code</b>	<b>1 BYTE</b>	<i>Slave device address 1-247</i>
<b>Function code</b>	<b>1 BYTE</b>	<i>Indicates the function codes like read coils / inputs</i>
<b>Data code</b>	<b>4 BYTE</b>	<i>Starting address, high byte Starting address, low byte Length of registers, high byte Length of registers, low byte</i>
<b>Error Check code</b>	<b>2 BYTE</b>	<i>Cyclical Redundancy Check (CRC)</i>

### MODBUS FUNCTIONS:

<b>Code</b>	<b>Meaning</b>	<b>Description</b>
<b>FUNCTION 03</b>	Read hold register	<i>This function permits to read all the electrical parameters</i>
<b>FUNCTION 06</b>	Write single register	<i>This function permits to write a value into a single holding register.</i>

## 4.3 - Command samples

### 4.3.1 - Read Command (Function x 03)

**Sample 1** Read the DC bus voltage and positive and negative electrode resistance to the ground(read 4 registers)

**Host inquiry:**

01 03 00 10 00 04 45 CC

**Slave response:**

01 03 08 13 88 02 58 EA 60 02 58 C8 75

Notes:

Read the DC voltage 0X1388(500V),  
The total insulation resistance 0X0258 (600KΩ),  
The positive insulation resistance 0XEA60 (infinite),  
The negative insulation resistance 0X0258 (600KΩ).

**Sample 2** Read IO status

**Host inquiry:**

01 03 00 1B 00 01 F4 0D

**Slave response:**

(1) 01 03 02 00 84 B8 27

Means that: bus voltage reverse connection, insulation monitoring is ON (ground relay is OFF), insulation resistance monitoring is OFF.

(2) 01 03 02 00 06 38 46

Means that: no reverse connection of bus voltage, insulation monitoring is ON (ground relay is OFF), and insulation resistance monitoring is ON.

(3) 01 03 02 00 0C B8 41

Means that: the self-test circuit is ON (self-test relays K1 and K2 are OFF), but the self-test fails because the insulation monitoring circuit is OFF.

(4) 01 03 02 00 1E 38 4C

Means that: the self-test circuit and insulation monitoring circuit are ON, the insulation resistance monitoring is effective, and the self-test is passed.

#### 4.3.2 -Write Command (Function x 06)

**Sample 1** Turn on insulation monitoring:

**Host inquiry:**

01 06 01 02 00 11 E9 FA

**Slave response:**

01 06 02 00 11 78 84

**Sample 2** Turn off insulation monitoring:

**Host inquiry:**

01 06 01 02 00 00 29 F6

**Slave response:**

01 06 02 00 00 B8 88

## 4.3.3 - Register Map

Register	Data	Instruction
0x0010	DC bus voltage	Unit 0.1V, 16-bits
0x0012	Insulation resistance of DC+ to Ground	Unit K $\Omega$ , Take an integer
0x0013	Insulation resistance of DC- to Ground	Unit K $\Omega$ , Take an integer
0x001B	IO Status	<p>Bit1: Whether the insulation resistance monitoring function is effective. (1-effective, 0-ineffective).</p> <p>Bit2: Whether the insulation monitoring is turn on and the ground switch is closed. (1- on, 0- off).</p> <p>Bit3: Whether the self-test function is turned on and whether the self-test relay is closed (1- on, 0- off).</p> <p>Bit4: If the self-test is passed, set it to 1 if the self-test is passed. If the self-test is not passed, set it to 0. If the self-test function is disabled, the default value is 0.</p> <p>Bit7: Bus voltage reverse connection alarm (When the reverse connection voltage is above 100V, set 1)</p>
0x0102	Insulation monitoring control	Turn on insulation monitoring function
	Insulation monitoring control	Turn off insulation monitoring function
0x0103	self-test control	Turn on self-test function
	self-test control	Turn off self-test function
0x 66	The host reads the slave address	<p>Example of reply from the slave 0xFF 0x66 0x01 0xAB 0x90 The slave machine address is 0x01</p>

## 5. - MODEL SELECTION SHEET

Energom-DU-S1 Series	
Energom-DU-S1	Single-circuit DC insulation monitor
Energom-DU-S1S	Single-circuit DC insulation monitor with self-test function

## 6. - SAFETY CONSIDERATIONS



All installation specification described at the previous chapters named: **INSTALLATION AND STARTUP, INSTALLATION MODES and SPECIFICATIONS.**

Please note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

- ◆ The device must have a professional installation and maintenance
- ◆ Any operation of the device, you must cut off the input signal and power;

## 7. - MAINTENANCE

The EnergoM-DU-S1 Series does not require any special maintenance. No adjustment, maintenance or repairing action should be done when the instrument is open and powered on, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allows a quick replacement in case of any failure.