USER MANUAL for:

SEFELEC 64-SC

PENT7761 reference

(ENGLISH)

CONTENTS

1. INTRODUCTION

General points

These instructions present the SEFELEC 64-SC series, a channel scanner intended to be used with a device in the 5x range.

According to the number of channels required, the scanner has the form of additional cards installed in a device in the 5x series (internal scanner - max. 8 channels) or in the form of a 19'' rack 3U high in which 8-channel modules are integrated with a maximum of 8 modules per rack. These modules are intended for several types of measurement:

- Strength/Insulation
- Ground continuity.

According to need, it is possible to equip a rack with 1 to a maximum of 8 modules of one type, of the other or any combination of these modules.

In the event more than 64 channels are needed, it is possible to connect one or more extension racks to the first rack with a max. of 64 channels each with a maximum of 8 racks (i.e. 512 channels).

The SEFELEC 64-SC scanner makes it possible to automatically conduct dielectric strength tests, high-value insulation resistance measurements and earth continuity measurements on several test points.

The information required for usage in accordance with the rules in effect for safe operation, commissioning and maintenance of devices is provided in the instructions.

Since 1965, the mission of our teams has been the designing and manufacturing of electrical resistance measuring devices, dielectric strength testers and cable testers.
Our experience in these fields has been recognised by most companies using leading-edge technologies in military, aeronautic, railway-related and civilian fields.

1.1. GUARANTEE

EATON guarantees that this appliance is free from any construction and packaging defect. EATON also guarantees that the appliance will comply with the characteristics indicated in this document when used correctly.

If the appliance does not comply with its specifications in the year following its initial delivery, it will be repaired free of charge at our premises in Lognes.

Modifications to the appliance or one of its accessories carried out without the approval of EATON shall cancel this guarantee.

EATON is not liable for any indirect damage resulting from use of the appliance.

ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).

1.2. PICTOGRAMS USED

Warnings are used in these instructions with symbols that must be complied with to guarantee safe operation of the devices.

The warnings and symbols used in these instructions are:

ATTENTION

Indicates imminent danger.

Death or very serious injury may occur if suitable safety measures are not taken.

CAUTION

Indicates a situation which may be dangerous.

Slight injury may occur if suitable precautionary measures are not taken.

IMPORTANT

Indicates a situation which may be dangerous.

Damage to equipment or to parts of the installation may occur, if suitable precautionary measures are not taken.

NOTE

Indicates important information on the device.

The following symbols may appear on the devices:

	Direct current		Attention (See accompanying documents).
	Direct current and alternating current.		Caution: risk of an electric shock.
	Alternating current		is covered by a DEEE recycling procedure
	Earth terminal.		

When the symbol  is fitted to the device or to one of its accessories, it is imperative to refer to these instructions to know the nature of the potential hazards and actions to take in order to avoid them.

1.3. WARNING AND SAFETY INSTRUCTIONS

The devices in the SEFELEC 64-SC series are intended for conducting dielectric strength tests, high-value or low-value resistance measurements.

Warning:

IMPORTANT

- The device must be used only in compliance with the provisions mentioned hereinabove.
- Correct usage of a device assumes transport, installation, handling and maintenance according to the instructions.
- The admissible environmental conditions must also be complied with.

Safety instructions before use:

ATTENTION

- Before using the device, check the integrity of the power cord and more particularly that the latter has not been subjected to any mechanical damage that can render a wire directly accessible and/or a connection cut-off.
- Before using the device, check the integrity of the measuring cords and more particularly that the latter have not been subjected to any mechanical damage that can render a wire directly accessible and/or a connection cut-off.
- Before using the device, check the connection of the latter with a ground cable directly connected via the stud bolt at the rear of the device.
- Before using the device, check that none of the vents are obstructed and that they allow air to flow freely.
- Before using the device, check that the connectors on the front panel of the latter are nor damaged and/or not locked.
- Use the ON/OFF push-button to turn the device on and check that the blue indicator light of the push-button is lit on the front panel of the measuring device.

Safety instructions after use:

ATTENTION

- Use the ON/OFF push-button to turn the device off and check that the blue indicator light of the push-button is not lit on the front panel of the measuring device.
- Disconnect the tested product.

1.4. DECLARATION OF CONFORMITY

SEFELEC 64-SC series devices are compliant with the regulatory provisions defined by:

European directives

2014/35/EU	on the safety of electrical equipment designed for use within certain voltage limits (LVD)
2014/30/EU	on electromagnetic compatibility (EMC)
2011/65/EU	on the restriction of the use of certain hazardous substances

Harmonised standards

IEC 61010-1:2010 + AMD1:2016 and EN 61010-1:2010 + A1:2019 **IEC 61010-2-034:2017 and EN61010-2-034:2021**	Safety requirements for electrical equipment for measurement, control, and laboratory use.
EN 61326-1 from 2021, IEC 61000-3-2 from 2019 & IEC 61000-3-3 from 2013 + A1 (2019)	Electrical equipment for measurement, control and laboratory use – EMC requirements

A copy of the declaration of conformity document is provided at the end of these instructions.

1.5. QUALIFICATION OF THE PERSONNEL

These instructions are intended for qualified persons, who have received instructions prior to using the device and who have had training authorising work on electrical devices.
The instructions provide the information required for mounting and correctly using devices of the SEFELEC 64-SC series.
The instructions for use and the corresponding technical documents must be read and understood before using the device and the instructions must be observed.

1.6. EXCLUSION OF LIABILITY

This documentation presents the devices in their standard version.
Despite in-depth verification of the content of the instructions, we cannot guarantee that there are absolutely no errors. The manufacturer assumes no liability for any inaccuracies or omissions.
In case of doubt or for technical questions, please contact your technical representative.

1.7. SERVICE DEPARTMENT

For any technical questions you may have, please contact your technical representative or the after-sales service at the following address:

EATON

SEFELEC SAS

19 rue des Campanules

F-77185 - LOGNES

FRANCE

Tel. +33 (0)1 64 11 83 40

Website: https://www.sefelec.com

2. PRESENTATION OF THE DEVICE

2.1. THE VARIOUS MODELS IN THE SEFELEC 64-SC RANGE

The SEFELEC 64-SC series is a range of products that allow dielectric strength tests, insulation measurements and earth continuity measurements to be automated very simply and in a very complete way.

Sefelec 64-SC scanners allow you to switch several measurement points (from 4 to 512). They come in the form of a module (internal scanner) to be integrated into a 5x series device or in the form of an external rack (external scanner) to be connected to a 5x series device via a CAN link.

Dielectric strength tests are conducted with voltages that can be adjusted from 100VAC to 5,000VAC and from -100VDC to -6,000VDC. The nominal current is 10 mA for the 50 VA models and 100 mA for the 500 VA models.

Measuring insulation resistance is done under voltages from -20VDC to -1000VDC.
The device provides a direct reading and displays the units and resistance values from 100 kΩ to 200 GΩ.

The earth continuity resistance measurement is done with currents from 5 to 32A AC with a max. voltage in open circuit of 6VAC. The device provides a direct reading and displays the units and resistance values from 0.1 mΩ to 1,000 mΩ.

SEFELEC 5x series devices come standard to communicate with any system that has an API, RS232, USB, ETHERNET or even IEEE 488 interface (optional). To use SEFELEC 64-SC devices without 5x series device, we suggest a SEFELEC 64-SCPLC version that provides direct access to the relay coils.

SEFELEC 5x series devices combined with SEFELEC 64-SC scanners make it possible to conduct the tests and measurements on all types of insulators such as resin, porcelain, oil, plastic, on finished products such as capacitors, transformers, switches, cables, connectors, as well as electrical devices connected to the mains or powered by batteries. These allow for earth continuity measurements in accordance with most of the existing standards in the fields of measuring devices, medicine, office devices, machines, etc.

2.2. REFERENCES FOR THE INTERNAL SCANNER

Internal scanner references	Description
SEFM-4IHC	4-channel module Earth continuity internal scanner
SEFM-4IHV	4-channel module Strength-Insulation internal scanner
SEFM-4IHVHC	4-channel module Strength-Insulation and 4-channel Earth continuity
SEFM-8IHC	8-channel module Earth continuity internal scanner
SEFM-8IHV	8-channel module Strength-Insulation internal scanner
SEFA-SCHV4-02	4-channel cord Strength-Insulation L=2 metres
SEFA-SCHV4-05	4-channel cord Strength-Insulation L=5 metres
SEFA-SCHC4-02	4-channel cord Earth continuity L=2 metres
SEFA-SCHC4-05	4-channel cord Earth continuity L=5 metres
SEFA-SCHV8-02	8-channel cord Strength-Insulation L=2 metres
SEFA-SCHV8-05	8-channel cord Strength-Insulation L=5 metres
SEFA-SCHC8-02	8-channel cord Earth continuity L=2 metres
SEFA-SCHC8-05	8-channel cord Earth continuity L=5 metres
SEFA-SCHVHC4-02	4-channel HV cord and 4-channel Earth continuity L=2 metres
SEFA-SCHVHC4-05	4-channel HV cord and 4-channel Earth continuity L=5 metres

Rear view of a 5x series device equipped with an SEFM-xx option

IMPORTANT

The installation of an internal scanner is not compatible with the use of an external scanner.

2.3. REFERENCES FOR THE EXTERNAL SCANNER

External scanner reference	Description
SEFELEC 64-SC	Max. 64 channel basic rack
SEFELEC 64-SCPLC	Max. 64 channel basic rack with direct relay control
SEFM-8EHV	8 channel module Strength-Insulation
SEFM-8EHVHO	8 channel module Strength-High insulation
SEFM-8EHC	8-channel modules Earth continuity
SEFA-SCHV4-02	4-channel cord Strength-Insulation L=2 metres
SEFA-SCHV4-05	4-channel cord Strength-Insulation L=5 metres
SEFA-SCHC4-02	4-channel cord Earth continuity L=2 metres
SEFA-SCHC4-05	4-channel cord Earth continuity L=5 metres
SEFA-SCHV8-02	8-channel cord Strength-Insulation L=2 metres
SEFA-SCHV8-05	8-channel cord Strength-Insulation L=5 metres
SEFA-SCHC8-02	8-channel cord Earth continuity L=2 metres
SEFA-SCHC8-05	8-channel cord Earth continuity L=5 metres
SEFO-64INHC	Earth continuity input
SEFO-64INHV10	Insulation input (Sefelec 1000-M)
SEFO-64INHV	Strength-Insulation input
SEFO-64INHVAUX	Strength-Insulation input for device other than 5x
SEFO-64OUTHC	Earth continuity output for extension rack
SEFO-64OUTHV	Strength-Insulation output for extension rack
SEFA-KR	Mounting in a 19’’ rack

Configuration example for a SEFELEC 64-SC with 6 SEFM-8EHV modules and 2 SEFM-8EHC modules

3. SPECIFICATIONS

3.1. OVER-VOLTAGE CATEGORY

Device is powered by a **CAT II** mains network.

3.2. POLLUTION DEGREE

Pollution 2: occasional conductive pollution only by condensation.

3.3. SAFETY CLASS

Class I: appliance connected to protective ground by the power cord, Earth < 3 Ω, Brief power cut < 10 ms

3.4. ENVIRONMENT

The tester should be cleaned regularly to remove dust. For optimum operation of the electronics, the tester should be used in an ambient temperature range of 15°C to 35°C. The tester air inlets must be kept clear. The appliance must be used indoors, horizontally or tilted on its feet.

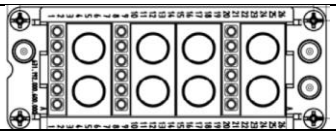
3.5. GENERAL CHARACTERISTICS

Mains	100-240Vac ±10% 50/60Hz single-phase		
Power	500 VAC max.		
Mains protection	T10AH 250V time delay fuse (x2)		
Temperature range	Storage	Use	
	-10°C to +60°C	-0°C to +45°C	
Accuracy	Specified when turned on after 1/2 hour with RH <50% and temperature between 15 and 35°C		
Altitude	Up to 2,000 metres		
Relative humidity	80% max. @ 31°C - linear decrease to 50%RH @40°C		
Sound pressure	Max. 80 dBA @ 1 metre		
	SEFELEC 64-SC	SEFELEC 64-SCPLC	
Empty housing weight	12 kg	12 kg	
HV module/unit	1.2 kg	1.2 kg	
HC module/unit	0.6 kg	0.6 kg	
	2 people are needed to handle weights > 25 kg		
Weight of the carton	Add 2.5 kg		
Mini pallet weight	Add 5 kg		
Dimensions	Height	Width	Depth
	131 mm	440 mm	455 mm

4-channel SEFM-4IHV and 8-channel SEFM-8IHV Strength-Insulation modules (internal scanner only)

Dielectric strength tests	
Max. voltage AC	5,000 VAC
Sinusoidal AC frequency	50 Hz or 60 Hz
Leakage current for an 8-channel module	< 100µA x (U_test / 5,000)
Max. voltage DC	6000 VDC
Pole + in DC	earthed
Max. passing current, switching in the absence of voltage	2A AC or DC
Maximum capacity of the sample measured	< 1µF (discharge time < 10 sec.)
Min. DELTA-I adjustment for 8 channels	>1mA for 50VA
	>5mA for 500VA
Insulation resistance measurement	
Max. insulation resistance	$20x10^9$ Ω under 500 VDC and 1,000VDC
Degradation of the insulation	See next page
	With RH<50% and temperature from 15 to 35°C
Protection resistance	
On common hot point	120 Ω +/- 5%
At the end of the channels	120 Ω +/- 5%
Switching time	
1-channel closing	Typically 5 msec.
Closing of all channels	20 msec max.
Number of manoeuvres	
With no load and in the absence of voltage	> $1x10^6$

ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).

Output connector	
ODU-Mac Blue-Line High voltage Multipin: 4 channels HV	
Accessory presence detection	If the male connector is not connected, the relays cannot be controlled
Organisation of a channel	
Hot bus (High Voltage)	1 Normally Open (NO) relay
Cold bus (Earth)	1 Normally Closed (NC) relay

Accuracy of the insulation resistance measurement with the SEFM-4IHV and SEFM-8IHV modules:

The accuracy of the insulation resistance measurement depends on the measurement time. To achieve the desired accuracy value, apply the voltage for the minimum amount of time defined in Table 1 below.

The data below is valid for the following atmospheric conditions:

- Relative humidity less than 50%,
- Temperature between 15°C and 35°C.

Table 1		
Resistance range (Ω)	Accuracy	Minimum time on resistive load (second)
100k < R ≤ 1G	$\leq (2\% + 1U)$	$t \geq 5$
1G < R ≤ 10G	$\leq (8\% + 1U)$	$t \geq 30$
R > 10G	$\leq (42\% + 1U)$	$t \geq 60$
$G = 1 \times 10^9$; $M = 1 \times 10^6$; $k = 1 \times 10^3$		
t = test time (second)		
U = display digit (example: +/- 10 MΩ @10 GΩ)		

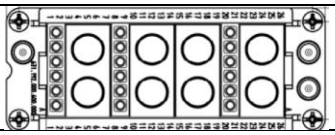
With a series 5x device equipped with an internal scanner, it is always possible to take measurements from the high voltage standard output with the SEFA-TE65 accessory. In this configuration, refer to Table 2 below for the accuracies for insulation measurement:

Table 2		
Resistance range (Ω)	Accuracy	Minimum time on resistive load (second)
100k < R ≤ 1G	$\leq (1{,}5\% + 1U)$	$t \geq 5$
1G < R ≤ 10G	$\leq (5\% + 1U)$	$t \geq 30$
R > 10G	$\leq (25\% + 1U)$	$t \geq 60$

IMPORTANT

During dielectric strength tests and insulation measurements in a 5x device equipped with an internal scanner, high voltage will be present on the selected channels of the scanner and on the main High Voltage output (LEMO HV terminal and SEFA-TE65) of the device as well as on the guard terminal. Take the usual precautions for use with High voltage

8 Channel module - Strength-Insulation SEFM-8EHV

Dielectric strength tests	
Max. voltage AC	5,000 VAC
Sinusoidal AC frequency	50 Hz or 60 Hz
Leakage current for an 8-channel module	< 150µA x (U_test / 5,000)
Max. voltage DC	6000 VDC
Pole + in DC	earthed
Max. passing current, switching in the absence of voltage	2A AC or DC
Maximum capacity of the sample measured	< 1µF (discharge time < 10 sec.)
Min. adjustment of the DELTA-I	>2mA for 50VA, to adjust according to configuration
	>10mA for 500VA, to adjust according to configuration
Insulation resistance measurement	
Max. insulation resistance	$20x10^9$ Ω under 500 VDC and 1,000VDC
Degradation of the insulation/channels	See next page
	With RH<50% and temperature from 15 to 35°C
Protection resistance	
On common hot point	120 Ω +/- 5%
At the end of the channels	120 Ω +/- 5%
Switching time	
1-channel closing	Typically 5 msec.
Closing of all channels	20 msec max.
Relay coil	
Voltage	24 VDC
Resistance	1000 Ω +/-10%
Number of manoeuvres	
With no load and in the absence of voltage	> $1x10^6$
ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).	
Output connector	
ODU-Mac Blue-Line High voltage Multipin: 8 channels HV	
Accessory presence detection	If the male connector is not connected, the relays cannot be controlled
Organisation of a channel	
Hot bus (High Voltage)	1 Normally Open (NO) relay
Cold bus (Earth)	1 Normally Closed (NC) relay

Accuracy of the insulation resistance measurement with the SEFM-8EHV modules:

The accuracy of the measurement of the insulation resistance depends on the measurement time and on the number of switching modules.
To achieve the desired accuracy value, apply the voltage for the minimum amount of time defined in Table 1 below and take the limits in Table 2 into account.
To guarantee measurements beyond 10GΩ or obtain better accuracies, please use the SEFM-8EHVHO modules.
The data below is valid for the following atmospheric conditions:

- Relative humidity less than 50%,
- Temperature between 15°C and 35°C.

Table 1

Resistance range (Ω)	Accuracy	Minimum time on resistive load (second)
100k < R ≤ 100M	$\leq (1{,}5\% + (0{,}2\% \times \mathrm{Nb\_mod}) + 1\mathrm{U})$	$t \geq 5$
100M < R ≤ 500M	$\leq (1{,}5\% + (1\% \times \mathrm{Nb\_mod}) + 1\mathrm{U})$	$t \geq 5$
500M < R ≤ 1G	$\leq (1{,}5\% + (2\% \times \mathrm{Nb\_mod}) + 1\mathrm{U})$	$t \geq 60$
1G < R ≤ 10G	$\leq (1{,}5\% + (8\% \times \mathrm{Nb\_mod}) + 1\mathrm{U})$	$t \geq 60$
R > 10G	$\leq (1{,}5\% + (40\% \times \mathrm{Nb\_mod}) + 1\mathrm{U})$	$t \geq 60$

$G = 1 \times 10^9$; $M = 1 \times 10^6$; $k = 1 \times 10^3$

Nb_mod = from 1 to 64 SEFM-8EHV modules, i.e. from 8 to 512 channels

t = test time (second)

U = display digit (example: 10 MΩ @10 GΩ)

Table 2

Resistance range (Ω)	Nb_mod (number of 8-channel modules)														
	1	2	3	4	5	6	7	8	16	24	32	40	48	56	64
100k < R ≤ 100M															
100M < R ≤ 500M															
500M < R ≤ 1G															
1G < R ≤ 10G															

Accuracy from 1.5% to 9.9%

Accuracy from 10% to 50%

Accuracy greater than 50% (not recommended, see SEFM-8EHVHO module)

Examples according to the number of modules:

R_measured (Ω)	Nb_mod	Accuracy
100M	1	≤ (1.7% +1U)
100M	4	≤ (2.3% +1U)
100M	8	≤ (3.1% +1U)
100M	64	≤ (14.3% +1U)

R_measured (Ω)	Nb_mod	Accuracy
1G	1	≤ (3.5% +1U)
1G	4	≤ (9.5% +1U)
1G	8	≤ (17.5% +1U)
1G	64	≤ (129.5% +1U)

Current available for the dielectric strength tests with the SEFM-8EHV modules:

With a dielectric strength test voltage in AC, the parasitic capacitances (earthed and guard) of the SEFELEC 64-SC scanner consume leakage currents that are provided by the generator of the 5x.
This has the effect of limiting the current available for the test of the sample according to the formula given hereinbelow:

$$I\_avail\ (A) = \frac{Power}{5000} - \left\{\frac{UAC\_test}{5000} \times \frac{L\_accessory}{2} \times \frac{Frequency}{50} \times ((270\mu A \times Nb_{HV\ chan}) + 500\mu A)\right\}$$

- I_avail: Value of the current available for the test of a sample
- Power: Value in VA, 50 for the SEFELEC 56H, D, S module or 500 for the SEFELEC 506H, D, S module
- UAC_test: Value of AC voltage configured for the dielectric strength test
- L_accessory: Length in metres of the test accessory (2m or 5m)
- Frequency: 50 or 60Hz according to the configuration of the test
- Nb_HV_Chan: Number of channels brought to the high voltage potential during a dielectric strength test

Example 1:
With a Sefelec 56-H device, conducting of a dielectric strength test at 2,500VAC 50Hz with an accessory 2 metres long on 4 channels brought to high voltage with respect to 4 channels at earth potential.

$$I\_avail\ (A) = \frac{50}{5000} - \left\{\frac{2500}{5000} \times \frac{2}{2} \times \frac{50}{50} \times ((270\mu A \times 4) + 500\mu A)\right\}$$

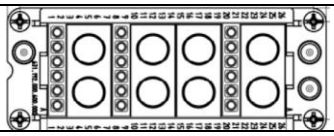
$I\_avail\ (A) = 0{,}01 - \{0{,}5 \times ((270\mu A \times 4) + 500\mu A)\}$ = 0.010 – 0.000790 = 0.00920 A = **9.20 mA**

Example 2:
With a Sefelec 56-H device, conducting of a dielectric strength test at 5,000VAC 50Hz with an accessory 5 metres long on 10 channels brought to high voltage with respect to 4 channels at earth potential.

$$I\_avail\ (A) = \frac{50}{5000} - \left\{\frac{5000}{5000} \times \frac{5}{2} \times \frac{50}{50} \times ((270\mu A \times 10) + 500\mu A)\right\}$$

$I\_avail\ (A) = 0{,}01 - \{1\ x\ 2{,}5 \times ((270\mu A \times 10) + 500\mu A)\}$ = 0.010 – 0.008 = 0.002 A = **2.00 mA**

8 Channel module - Strength-High Insulation (SEFM-8EHVHO)

Dielectric strength tests	
Max. voltage AC	5,000 VAC
Sinusoidal AC frequency	50 Hz or 60 Hz
Leakage current for an 8-channel module	< 100µA x (U_test / 5,000)
Max. voltage DC	6,000 VDC
Pole + in DC	earthed
Max. passing current, switching in the absence of voltage	2A AC or DC
Maximum capacity of the sample measured	< 1µF (discharge time < 10 sec.)
Min. adjustment of the DELTA-I	>1mA for 50VA, to adjust according to configuration
	>5mA for 500VA, to adjust according to configuration
Insulation resistance measurement	
Max. insulation resistance	> $200x10^9$ Ω under 500 VDC and 1,000VDC
Degradation of the insulation/channels	See next page
With	RH<50% and temperature from 15 to 35°C
Use of a guard potential	<1000VDC
Protection resistance	
On common hot point	120 Ω +/- 5%
At the end of the channels	120 Ω +/- 5%
Switching time	
1-channel closing	Typically 5 msec.
Closing of all channels	20 msec max.
Relay coil	
Voltage	24 VDC
Resistance	1000 Ω +/-10%
Number of manoeuvres	
With no load and in the absence of voltage	> $1x10^6$
ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).	
Output connector	
ODU-Mac Blue-Line High voltage Multipin: 8 channels HV	
Accessory presence detection	If the male connector is not connected, the relays cannot be controlled
Organisation of a channel	
Hot bus (High Voltage)	1 Normally Open (NO) relay
Cold bus (Earth)	1 Normally Closed (NC) relay

Accuracy of the insulation resistance measurement with the SEFM-8EHVHO modules:

The accuracy of the insulation resistance measurement depends on the time the measurement voltage is applied. This application time depends on the resistance, test voltage and the number of switching modules. To achieve the desired accuracy value, apply the voltage for the minimum amount of time defined in Table 1.
The data below is valid for the following atmospheric conditions:

- Relative humidity less than 50%
- Temperature between 15°C and 35°C.

Table 1		
Resistance range (Ω)	Accuracy (%)	Minimum time on resistive load (second)
100k ≤ R ≤ 1G	≤ (1.5% + 1U)	$t \geq (0{,}5 \times Nb\_mod)$
1G < R ≤ 10G	≤ (1.5% + 1U)	$t \geq (5 \times Nb\_mod)$
10G < R ≤ 200G	≤ (1.5% + 1U)	$t \geq (50 \times \frac{R}{100 \times 10^9} \times \frac{U\_essai}{1000} \times \mathrm{Nb\_mod})$
	≤ (5% +1U)	$t \geq (8 \times \frac{R}{100 \times 10^9} \times \mathrm{Nb\_mod})$
	≤ (10% +1U)	$t \geq (3 \times \frac{R}{100 \times 10^9} \times \mathrm{Nb\_mod})$
$G = 1 \times 10^9$; $M = 1 \times 10^6$; $k = 1 \times 10^3$		
Nb_mod = from 1 to 64 SEFM-8EHVHO modules, i.e. from 8 to 512 channels		
t = test time (second)		
U = display digit (example: 10 MΩ @10 GΩ)		

The table below shows the various accuracies according to the number of 8-channel modules with a minimum test time of 60 seconds:

Table 2																
Resistance range (Ω)		*Nb_mod* (number of 8-channel modules)														
		1	2	3	4	5	6	7	8	16	24	32	40	48	56	64
100k < R ≤ 1G																
1G < R ≤ 10G																
10G < R ≤ 200G																

Accuracy from 1.5% to 5%

Accuracy from 5.1% to 10% (to improve accuracy, increase the test time by referring to the minimum time formulas in Table 1)

Accuracy greater than 10% (to improve accuracy, increase the test time by referring to

the minimum time formulas in Table 1)

Example according to the number of modules:

R_measured (Ω)	Nb_mod	U_test (V)	Accuracy (%)	Minimum time (second)
10G	1	1000	≤ (1.5% +1U)	≥ 5
10G	4	1000	≤ (1.5% +1U)	≥ 20
10G	8	1000	≤ (1.5% +1U)	≥ 40
10G	64	1000	≤ (1.5% +1U)	≥ 320

R_measured (Ω)	Nb_mod	U_test (V)	Accuracy (%)	Minimum time (second)
100G	1	1000	≤ (1.5% +1U)	≥ 50
100G	4	1000	≤ (1.5% +1U)	≥ 200
100G	8	1000	≤ (1.5% +1U)	≥ 400

Example according to the required accuracy:

R_measured (Ω)	Nb_mod	U_test (V)	Accuracy (%)	Minimum time (second)
10G	4	1000	≤ (1.5% +1U)	≥ 20
10G	4	1000	≤ (5% +1U)	≥ 4
10G	4	1000	≤ (10% +1U)	≥ 2

R_measured (Ω)	Nb_mod	U_test (V)	Accuracy (%)	Minimum time (second)
100G	4	1000	≤ (1.5% +1U)	≥ 200
100G	4	1000	≤ (5% +1U)	≥ 32
100G	4	1000	≤ (10% +1U)	≥ 12

Current available for the dielectric strength tests with the SEFM-8EHVHO modules:

With a dielectric strength test voltage in AC, the parasitic capacitances (earthed and guard) of the SEFELEC 64-SC scanner consume leakage currents that are provided by the generator of the 5x.
This has the effect of limiting the current available for the test of the sample according to the formula given hereinbelow:

$$I\_avail\ (A) = \frac{Power}{5000} - \left\{\frac{UAC\_test}{5000} \times \frac{L\_accessory}{2} \times \frac{Frequency}{50} \times ((270\mu A \times Nb_{HV\_chan}) + 500\mu A)\right\}$$

- I_avail: Value of the current available for the test of a sample
- Power: Value in VA, 50 for the SEFELEC 56H, D, S module or 500 for the SEFELEC 506H, D, S module
- UAC_test: Value of AC voltage configured for the dielectric strength test
- L_accessory: Length in metres of the test accessory (2m or 5m)
- Frequency: 50 or 60Hz according to the configuration of the test
- Nb_HV_Chan: Number of channels brought to the high voltage potential during a dielectric strength test

Example 1:
With a Sefelec 56-H device, conducting of a dielectric strength test at 2,500VAC 50Hz with an accessory 2 metres long on 4 channels brought to high voltage with respect to 4 channels at earth potential.

$$I\_avail\ (A) = \frac{50}{5000} - \left\{\frac{2500}{5000} \times \frac{2}{2} \times \frac{50}{50} \times ((270\mu A \times 4) + 500\mu A)\right\}$$

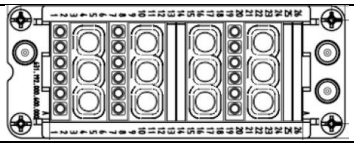
$$I\_avail\ (A) = 0{,}01 - \{0{,}5 \times ((270\mu A \times 4) + 500\mu A)\} = 0.010 - 0.000790 = 0.00920\ A = \mathbf{9.20\ mA}$$

Example 2:
With a Sefelec 56-H device, conducting of a dielectric strength test at 5,000VAC 50Hz with an accessory 5 metres long on 10 channels brought to high voltage with respect to 4 channels at earth potential.

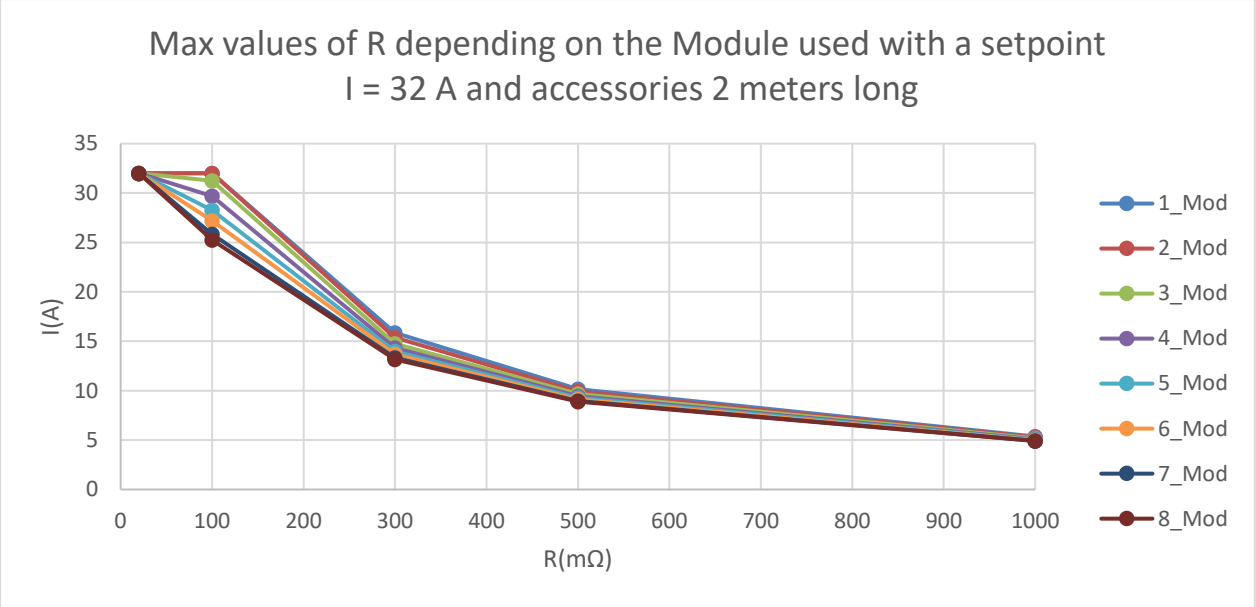
$$I\_avail\ (A) = \frac{50}{5000} - \left\{\frac{5000}{5000} \times \frac{5}{2} \times \frac{50}{50} \times ((270\mu A \times 10) + 500\mu A)\right\}$$

$$I\_avail\ (A) = 0{,}01 - \{1\ x\ 2{,}5 \times ((270\mu A \times 10) + 500\mu A)\} = 0.010 - 0.008 = 0.002\ A = \mathbf{2.00\ mA}$$

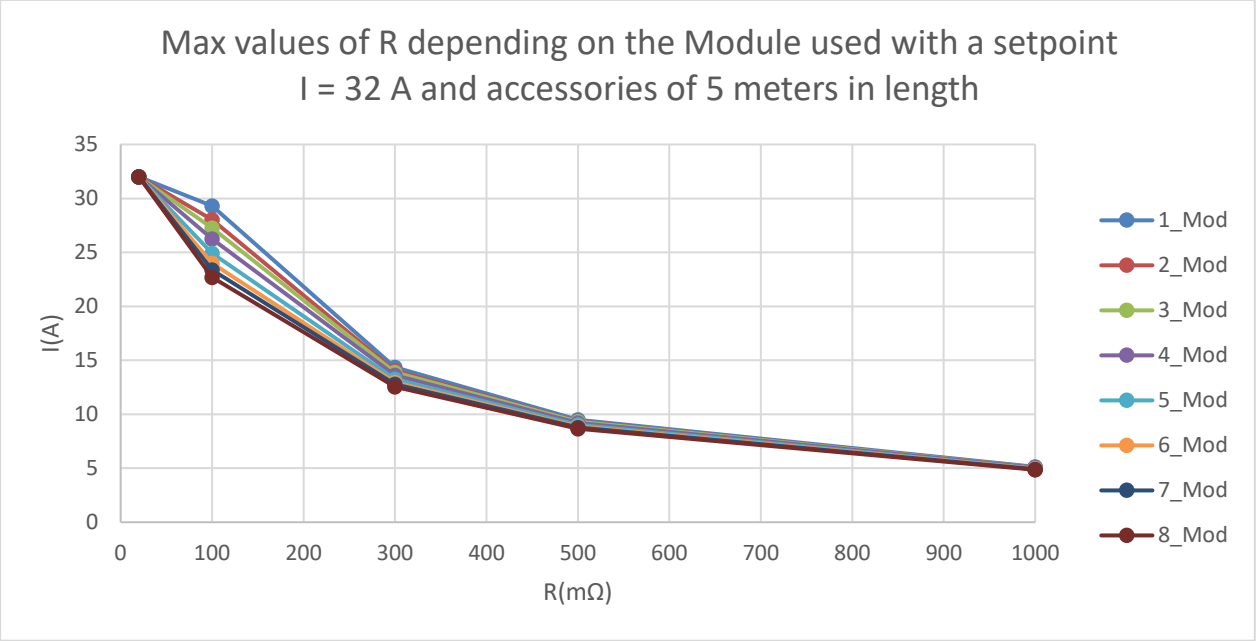
8-channel module Earth continuity (SEFM-8EHC)

Switching of the current	
Max voltage	30 VAC
Max. passing current, switching in the absence of voltage and current	32A AC or DC
Contact resistance	< 10 mΩ
Coil voltage	Nominal 24VDC
Coil resistance	480 Ω +/-10%
1-channel switching time	Typically 15 msec.
Closing of all channels	20 msec max.
Number of manoeuvres without load	> $3x10^4$
Voltage switching	
Max voltage	30 VAC
Max. passing current, switching in the absence of voltage and current	2A AC or DC
Contact resistance	< 50 mΩ
Coil voltage	Nominal 24VDC
Coil resistance	2880 Ω +/-10%
1-channel switching time	Typically 5 msec.
Closing of all channels	20 msec max.
Number of manoeuvres without load	>$5x10^5$
ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).	
-	
Output connector	
ODU-Mac Blue-Line High current Multipin: 8-channel High current and 8-channel low level for the voltage measurement	
Accessory presence detection	If the male connector is not connected, the relays cannot be controlled
Organisation of a channel	
current bus	1 Normally Open (NO) relay
voltage bus	1 Normally Open (NO) relay
2-wire switching mode (external straps)	8 channels
4-wire switching mode	4 channels

Influence of the measurement channel and the length of the accessories on the maximum resistance value depending on the current.

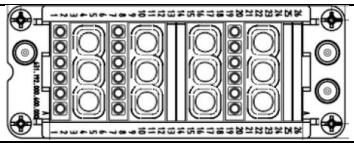


For example, for 32AAC we can measure 100 mΩ on SEFM-8EHC modules no. 1 and no. 2 and for module no. 8 the current is reduced to 25AAC.

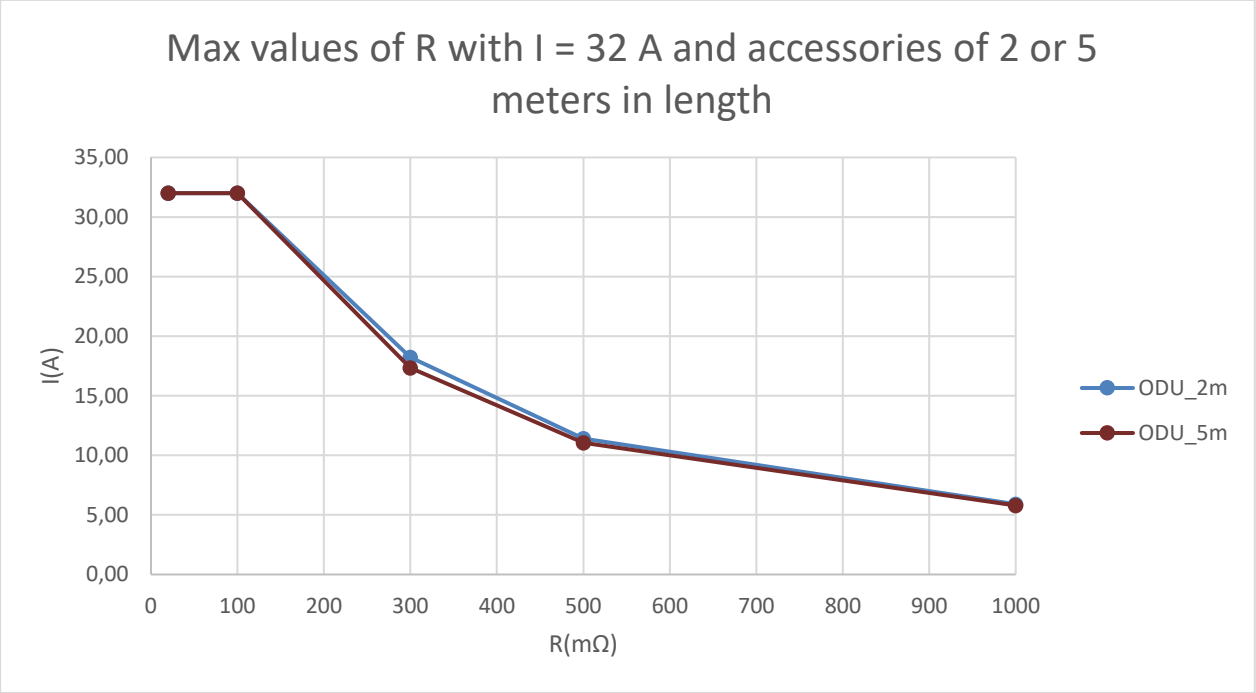


For example, for 30AAC we can measure 100 mΩ on module SEFM-8EHC n°1 and for module n°8 the current is reduced to 22AAC.

4-channel module Earth continuity: SEFM-4IHC, internal scanner only

Switching of the current	
Max voltage	30 VAC
Max. passing current, switching in the absence of voltage and current	32A AC or DC
Contact resistance	< 10 mΩ
1-channel switching time	Typically 15 msec.
Closing of all channels	20 msec max.
Number of manoeuvres without load	> $3x10^4$
Voltage switching	
Max voltage	30 VAC
Max. passing current, switching in the absence of voltage and current	2A AC or DC
Contact resistance	< 50 mΩ
1-channel switching time	Typically 5 msec.
Closing of all channels	20 msec max.
Number of manoeuvres without load	>$5x10^5$
ATTENTION: The characteristics indicated are valid for switching conditions with a zero voltage and zero current (cold switching).	
Output connector	
ODU-Mac Blue-Line High current Multipin: 4-channel High current and 4-channel low level for the voltage measurement	
Accessory presence detection	If the male connector is not connected, the relays cannot be controlled
Organisation of a channel	
Current bus	1 Normally Open (NO) relay
Voltage bus	1 Normally Open (NO) relay
2-wire switching mode	4 channels
4-wire switching mode	Unavailable

SEFM-4IHC internal scanner: Influence of the length of the accessories on the maximum resistance value depending on the current.



4. SAFETY

4.1. SAFETY WHEN WORKING WITH ELECTRICAL EQUIPMENT

ATTENTION

Danger of electric shock!

- All the precautions concerning the use of equipment connected to the electricity grid must be taken when using it.
- In particular, the equipment must absolutely be earthed with the power cord and via the earth stud provided for this purpose on the rear face of the device (see paragraph 20.1 mark Z2)
- Always make sure that the high voltage presence light is off before plugging in or unplugging a part for testing.

4.2. SAFETY DEVICES

- Disconnection of the equipment via the power cord.

ATTENTION

Danger of electric shock!

- **The test zone should be protected by safety circuits to prevent the access of unauthorised personnel.**

ATTENTION

Disconnection device!

- **The power cord is the primary power supply disconnection device for the equipment. After installation, ensure that the latter remains accessible. In the event the power cord is replaced, always use a power cord that is adapted to the power less than 3 metres long and CE certified.**

4.2.1. SAFETY LOOPS

Sefelec 64-SC series devices are used combined with devices from the 5x series of which the voltages and currents in question can be dangerous if touched. Protection for the personnel is the responsibility of the management of the site where the devices are installed.

EATON can only provide recommendations: the safety manager of the company using the device must ensure that safety requirements are met.

The 5x series devices have a **double safety circuit** to meet the requirements of CEI 61010-2-034, EN60591, either intrinsically or by the addition of external accessories (emergency stop buttons, light curtains, beacons, safety cages, etc.).

This double loop acts, by electromechanical cut-off of the high voltage generators, as soon as one of the loops is open. The software reacts with an alarm message and a stop in the test process. It can only leave if the loops are closed and on the operator's orders.

To complete the safety circuit of the 5x series, Sefelec 64-SC scanners have a presence detector for the male connector incorporated into the ODU-Mac Blue-Line output connectors that do not allow the relays to be controlled if the male connector is not connected to the socket.

Connecting the safety circuits

Sefelec 5x devices have a double "safety circuit" available on pins 1-9 and 2-10 of the rear socket C5. The latter must be connected to authorise the execution of a test.
Note: it is recommended that you place dry contacts in series in these connections subject to safety conditions (closed door, cover lowered, etc.).
It is possible to connect a red/green signal lamp (SEF-CO160) on terminal plug C5 to visibly indicate at a distance the presence or absence of voltage on the output terminals of the device.

Reminder of the standard: Contact with live parts

The effects of a current passing through the human body are described in the text of NF EN 50191 of 20 January 2003, available from AFNOR. This text applies to the "*installation and operation of electronic test equipment".*

It is considered that the human body presents a non-inductive resistance of about 2kΩ.

Case with alternating current

For voltages greater than 25 V: A current of 3 mA (RMS)

Case with direct current

For voltages greater than 60 V: 12-mA current

The discharge energy must never exceed 350 mJ.

NOTE: *A peak current of 0.7 mA can be felt by some people even though it does not present a risk.*

4.2.2. OPTIMISING THE SAFETY

In any case, a properly used safety circuit offers the best protection.

The safety system protects the device being tested as well as the operator. It is independent of the voltage applied and current injected for the measurements.

ATTENTION

Danger of electric shock!

- **Access to the appliance must be restricted to personnel "made aware of electrical hazards".**
- **It is strongly recommended not to handle the equipment being tested (risk of faults and electric shocks).**

A double safety circuit is provided as standard.

ATTENTION

High voltage!

- **For dangerous voltages, signalling using a suitable Red/Green lamp (Option SEFO-CO160) must be implemented.**

EATON on request can supply a locking system used during the test to control a type CA001, CA002 (image below) or CA003 safety cage to conduct the tests in complete safety.

4.3. PRECAUTIONS FOR USE

IMPORTANT

The equipment must never switch or receive external electrical power supplies that it does not control via its own software. Such power supplies include relay coils not fitted with "free-wheel diodes" or capacitors that are not discharged.

IMPORTANT

During insulation measurements on capacitance > 100 µF, setting up a discharge system that makes it possible to ensure that the capacitor is discharged is mandatory.

If this instruction is not complied with, the measuring device can be damaged.

IMPORTANT

To maintain the protection provided by the equipment, all the very low voltage electrical circuits that are connected to it (USB output, Ethernet, CAN…) must have double insulation or reinforced insulation with respect to any circuit operating at a dangerous voltage.

NOTE

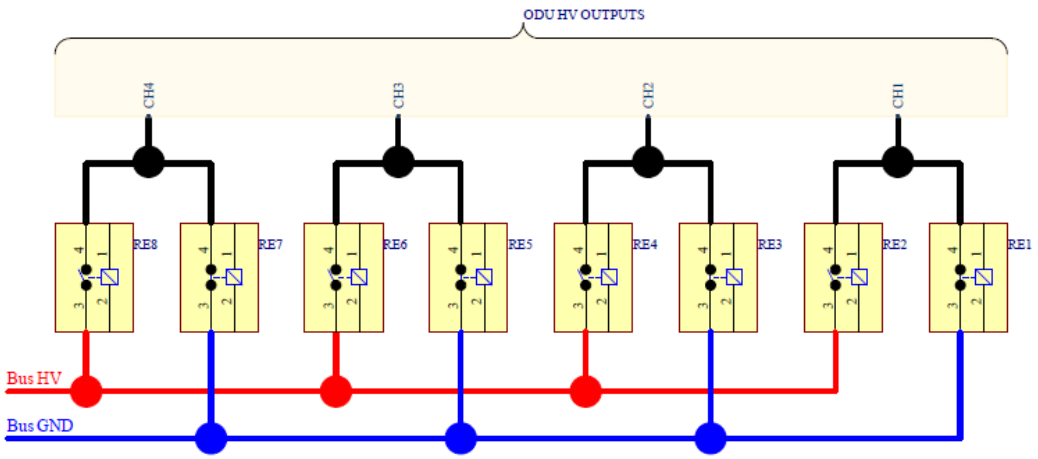
During use of SEFELEC 64-SC series devices, EATON cannot be held liable for any equipment faults or loss of production resulting from damage to the tester by failure to comply with the operating conditions set out above (environment, mains power supply and operation).

5. OPERATING PRINCIPLE

5.1. CHANNEL MODULE - STRENGTH-INSULATION

This configuration concerns references:

- Internal scanner: SEFM-4IHV, SEFM-8IHV, SEFM8IHVHC
- External scanner: SEFM-8EHV, SEFM-8EHVHO



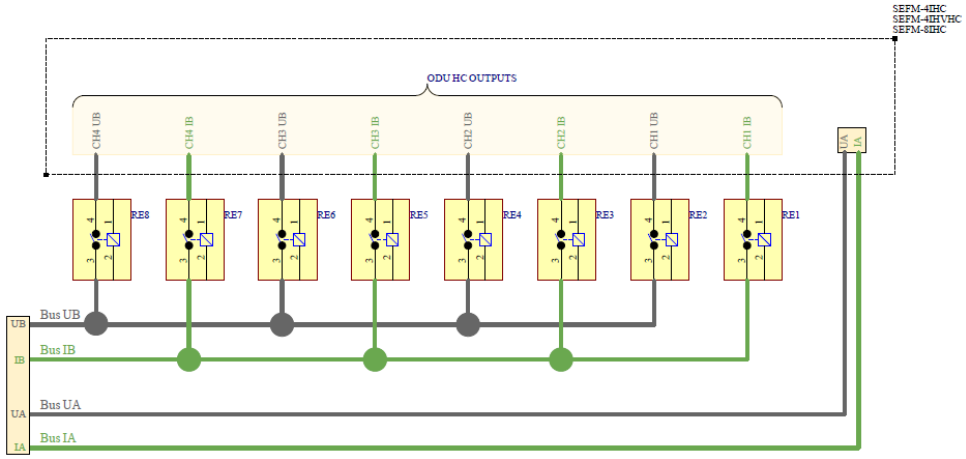
Each channel can be connected indifferently to the output of the High voltage generator (hot HV bus) or to the earth (cold GND bus). In the absence of a relay control, the channels are connected to the earth potential (cold GND bus) via Normally Closed relays.

SEFM-8EHVHO modules makes it possible to take insulation measurements with better accuracy thanks to the use of a guard potential.
The guard potential is connected to the guard potential of the generator of the Sefelec 5x device which can also be accessed on the GUARD safety socket.
The guard potential makes it possible to dump the parasite leakage currents that therefore are not measured by the 5x device ammeter.

5.2. CHANNEL MODULE - EARTH CONTINUITY

5.2.1. SCHEMATIC DIAGRAM FOR THE INTERNAL SCANNER (4-WIRE MEASUREMENT WITH 2-WIRE SWITCHING):

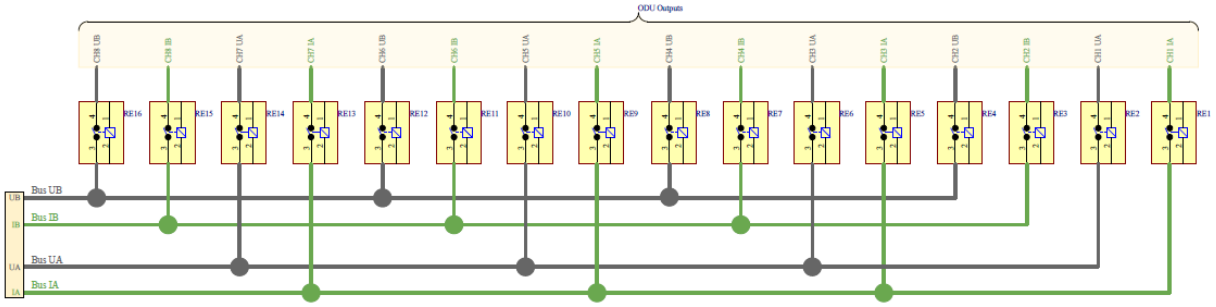
This configuration concerns references: SEFM-4IHC, SEFM-8IHC and SEFM-4IHVHC



With the internal scanner, only the 2-wire switching mode is available.
The earth continuity measurement is still done in 4-wire mode.
In this switching mode, the scanner will switch 2 wires only: current generation (IB) and voltage measurement (UB), the other 2 wires (IA / UA) will be connected in a fixed manner from the front panel of the 5x device to a reference point of the equipment to be tested.
A 4-channel module will make it possible to measure 4 different points with respect to a non-switched reference point.

5.2.2. SCHEMATIC DIAGRAM FOR THE EXTERNAL SCANNER (4-WIRE MEASUREMENT WITH 2-WIRE OR 4-WIRE SWITCHING):

This configuration concerns reference: SEFM-8EHC



With the external scanner, it is possible to select a 2-wire switching mode or a 4-wire switching mode.
The earth continuity measurement is still done in 4-wire mode.

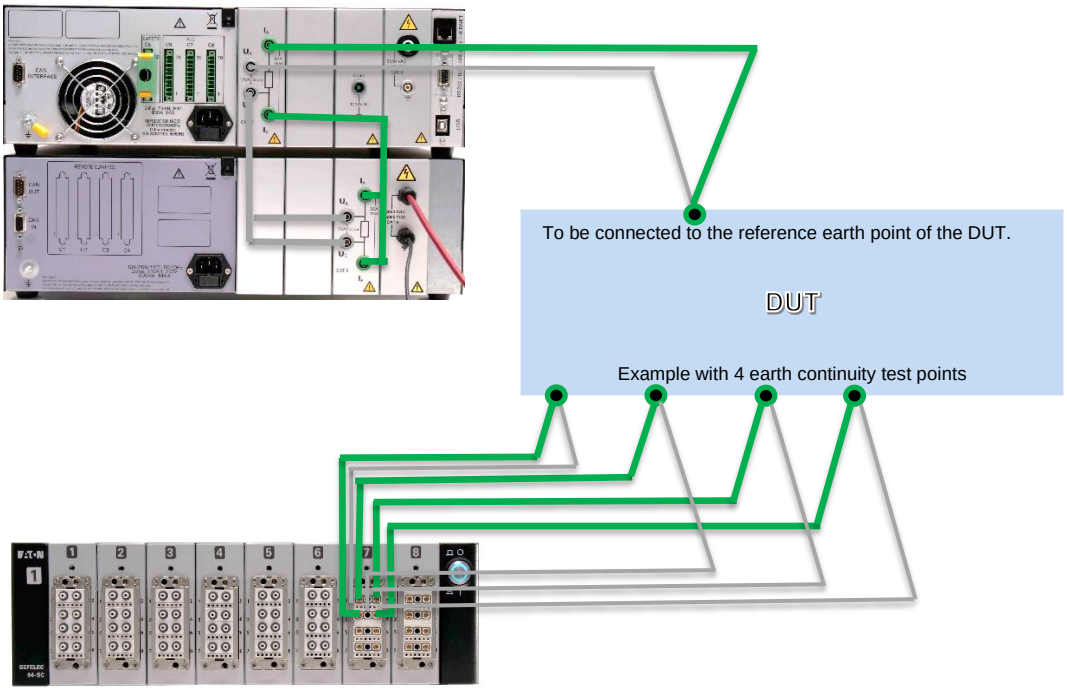
2-wire switching mode:
the scanner will switch 2 wires only: current generation (IB) and voltage measurement (UB), the other 2 wires (IA and UA) will be connected in a fixed manner from the front panel of the 5x device to a reference point of the equipment to be tested.
A 8-channel module will make it possible to measure 8 different points with respect to a non-switched reference point.
See the connection in paragraph 5.2.3

4-wire switching mode:
the outputs are designed to be connected alternatively to IA and UA or IB and UB. The tests can therefore only be carried out between an even point (2, 4, 6, 8) and an odd point (1, 3, 5, 7).
An 8-channel module will make it possible to measure four earth continuity resistances.
See the connection in paragraph 5.2.4

5.2.3. EXTERNAL SCANNER: 4-WIRE MEASUREMENT WITH 2-WIRE SWITCHING

In the 2-wire switching mode, the scanner will switch 2 wires only: current generation (IB) and voltage measurement (UB), the other 2 wires (IA / UA) will be connected in a fixed manner to a reference point of the equipment to be tested. A 8-channel module will make it possible to measure 8 different points with respect to a non-switched reference point.
The devices are delivered with UA-UB and IA-IB connection cords to be used according to the desired operating mode, therefore connected in 2-wire switching mode.

Example of a 4 wires earth continuity measurement with 2-wire switching making it possible to measure up to 8 resistances per module (4 resistances in the example):



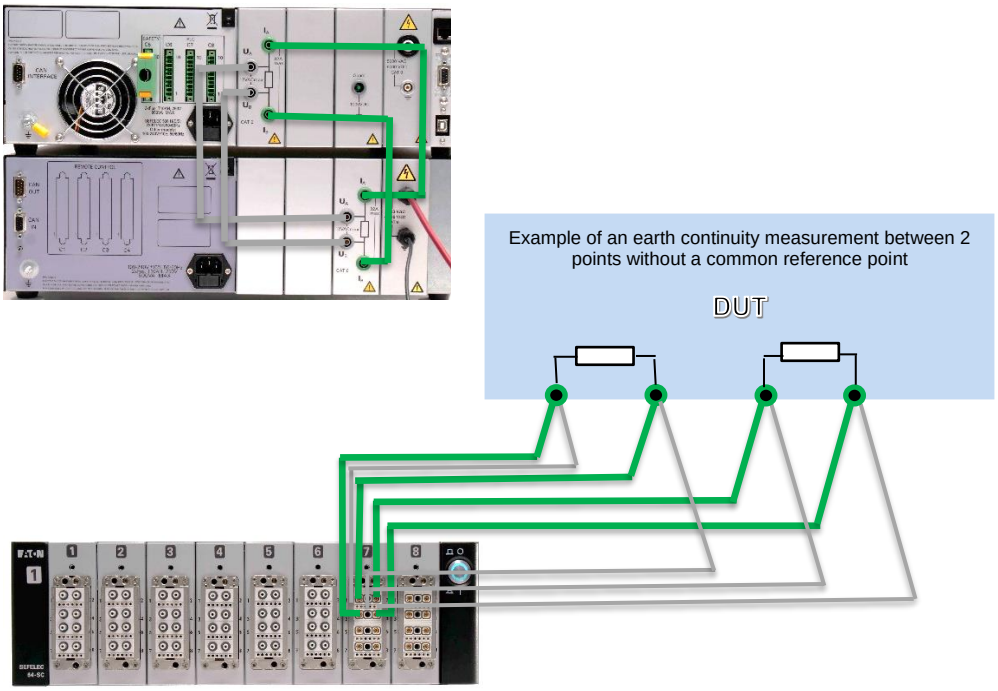
IMPORTANT

Connect only IB / UB to the scanner

5.2.4. EXTERNAL SCANNER: 4-WIRE MEASUREMENT WITH 4-WIRE SWITCHING

In the second mode called the four-wire switching mode, the outputs are designed to be connected alternately to IA or IB. The tests can therefore only be carried out between an even point (2, 4, 6, 8) and an odd point (1, 3, 5, 7).
An 8-channel module will make it possible to measure four earth continuity resistances.
The devices are delivered with UA-UB and IA-IB connection cords to be used according to the desired operating mode, therefore NOT connected in 4-wire switching mode.

Example of a 4 wires earth continuity measurement with 4-wire switching making it possible to measure up to 4 resistances per module (2 resistances in the example):



6. COMMISSIONING

NOTE

The appliance must be used indoors, horizontally or tilted on its feet. The equipment has to be installed on a horizontal surface that can support its weight, in a dry area with enough lighting. The tester air inlets must be kept clear.

ATTENTION

Danger of electric shock!

- **The equipment must be commissioned, used and maintained by qualified personnel.**
- **All the precautions concerning the use of equipment connected to the electricity grid must be taken when using it.**
- **In particular, the equipment must absolutely be earthed with the power cord and via the earth stud provided for this purpose on the rear face of the device (see paragraph 14.1 mark Z3)**
- **Always make sure that the high voltage presence light is off before plugging in or unplugging a part for testing.**

6.1. CONTENT WHEN DELIVERED

When the device is delivered, the package should contain the following items as standard:

For a SEFELEC 64-SC external scanner:

- Rack with the HV and/or HC switching modules.
- 2P+E 16A CE certified power cord 1.5m long.
- Safety manual for High Voltage Testing
- CE Certificate of Conformity (included at the end of this manual)
- Channel connection accessories (SEFA-SCHxx-0x)
- UA-UB and IA-IB connection cords provided with 4mm banana plugs.
- SEFA-CO183 cord for HC module(s) to connect the earth continuity function of the 5x with the scanner rack.
- CAN Sub-D 9-point cord 1 metre long.

The complete user manual for the device is available through a link on our internet site.

And according to your order:

- Test certificate with the measurement report.

For an internal scanner SEFM-xlxx option of a 5x series device and in addition to the contents of the 5x delivery:

- Included in the 5x series device, SEFM-xlxx option.
- CE Certificate of Conformity (included at the end of this manual)
- Channel connection accessory (SEFA-SCHxx-0x)

And according to your order:

- Test certificate with the measurement report.

The complete user manual for the scanner is available through a link on our internet site.

Please contact EATON if any items are missing. See the chapter After-sales service.

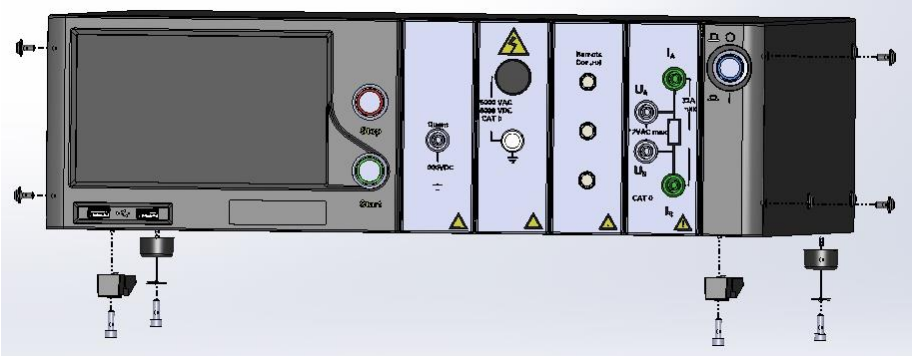
6.2. INSTRUCTIONS FOR RACK MOUNTING

When the Sefelec 64-SC series device must be incorporated into a bay, follow the instructions below:
The dimensions of the device are: height 3U, 19'' standard width, Depth of 520 mm with the connectors. Use 19'' standard bays with a depth of at least 600 mm.

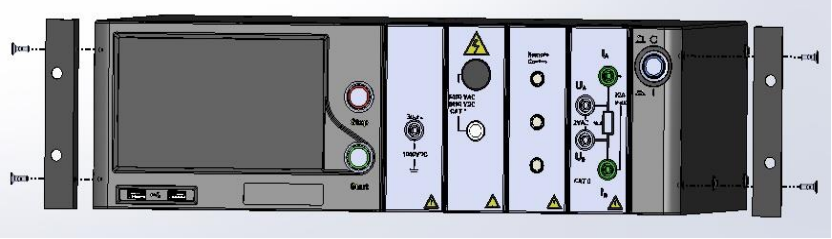
1 - Take the references of the bay and use the kit for mounting in a bay offered by the brand. For a device with a height of 3U, the kit usually comes with 2 rails and 4 screws
(Be careful to use the rails according to the depth of the bay).

2 - Preparation of the device: Remove the 4 feet by unscrewing the 4 screws (pan head socket screw). Then remove the 2 screws on each side that hold the cover on the front of the device. (Pan head Torx socket).

See below:



3- Equip the Sefelec 5x series device with the kit: SEFA-KR. It is comprised of 2 brackets and 4 screws (countersunk Torx).
Position the brackets on each side of the device as shown in the drawing and fasten them with the 4 screws. See below:



4 - Mounting the bay kit: Equip the bay with 2 slides, adjust their height according to the equipment to be placed in the bay.
5 - Install the device on the slides and slide it in order to abut the 2 brackets on the rails of the bay on the front face. Then fasten the device to the bay with the screws in the kit.
For a device with the outputs on the rear face. Provide a bay with more depth, at least 800 mm.

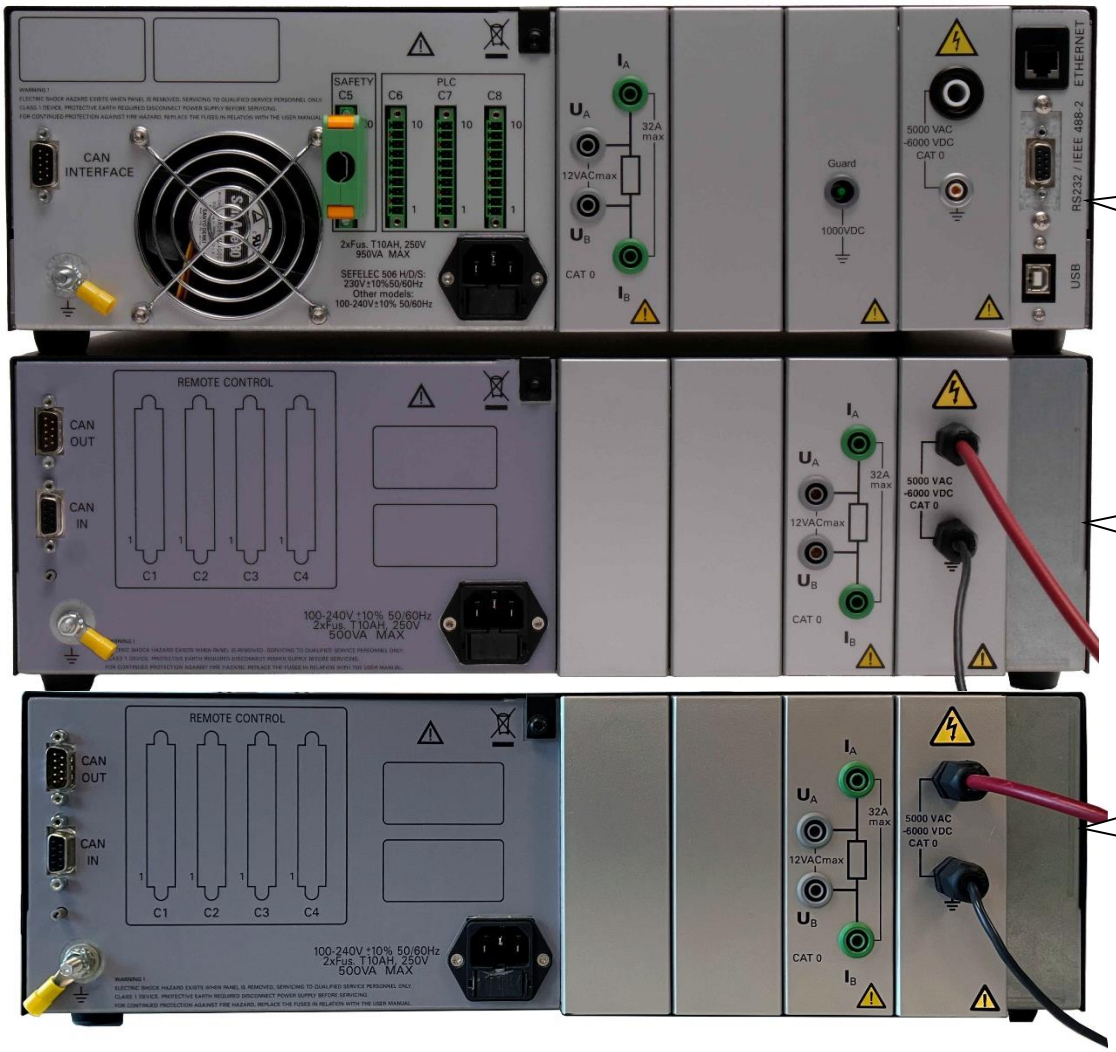
NOTE

The tester air inlets must be kept clear. The dimensions of the bay as well as the mounting of the device will allow air to circulate around the latter in order to endure a maximum operating temperature of 45°C.

7. CONNECTING AN EXTERNAL SCANNER TO A 5X DEVICE

Presentation of the connecting of one or more Sefelec 64-SC racks to a 5x series measuring device.
Example of a unit comprised of a Sefelec 56-S with outputs on the rear face (mandatory) and with two 64-channel scanners each.

7.1. GENERAL STRUCTURE OF THE EXAMPLE



7.2. RACK ADDRESSING

It is possible to form a set of 1 to 8 Sefelec 64-SC switching racks.
Each rack must be identified by an address from 1 to 8 that can be selected on the rear panel of the racks by a rotary switch located at the bottom left as shown below:

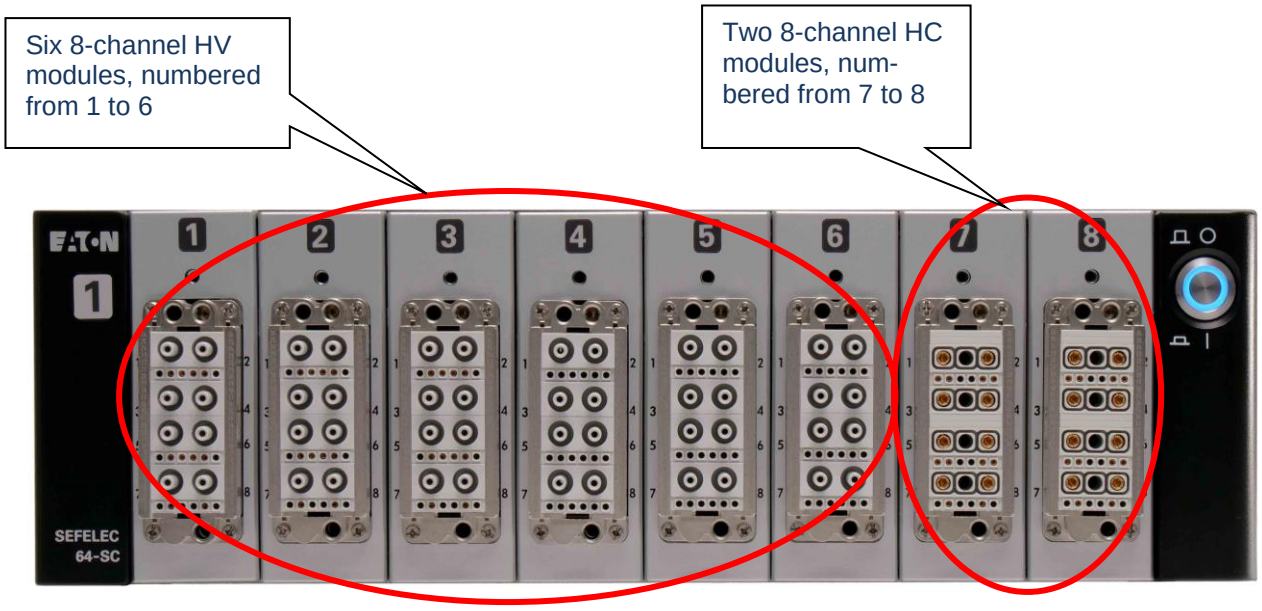
Use a small flat screwdriver to position the rotary switch facing the number that corresponds to the rack's address.
With a concern for clarity in the numbering of the channels, it is preferable (but nor required) to code the rack addresses incrementally from 1 to n.

IMPORTANT

Do not configure 2 identical addresses on 2 different racks.

Pt the switch in a marked position between 1 and 8, otherwise the rack will not be recognised

7.3. DISTRIBUTION OF MEASUREMENT CHANNELS, CONFIGURATION EXAMPLE



In the same rack, all of the HV modules are placed incrementally starting on the left of the rack, up to 8 modules. In a configuration that has less than 8 HV modules and with HC modules, the latter will be placed after the HV modules.

IMPORTANT

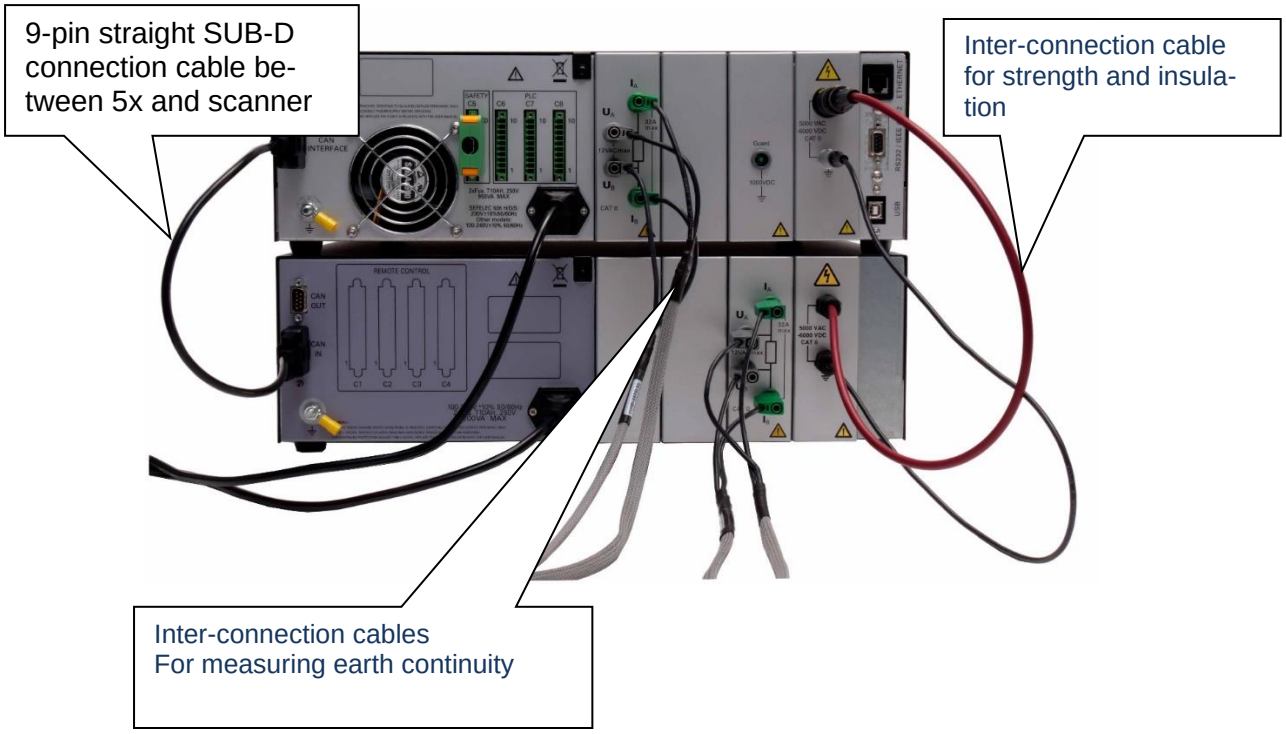
ODU Blue-Line output connectors for the Strength-Insulation and Earth continuity channels are provided with a connector presence detector. If the plug connector is not connected to its socket, the relays cannot be controlled. All the plug connectors must be connected to be able to start a test.

-

IMPORTANT

The SEFA-SCHVxx high voltage accessories come with their ends short-circuited by a WAGO type connector. The HV wires that are to be used must be disconnected and connected to the test system. Unused wires must remain short-circuited to the earth by the WAGO connector.

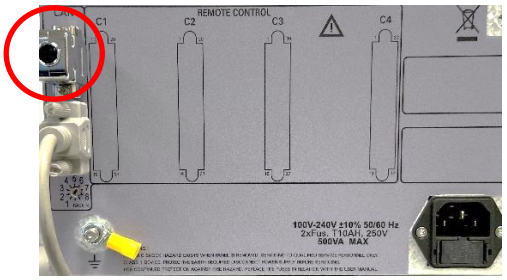
7.4. REAR PANEL CONNECTIONS



- Connect the High voltage and High current measurement connections according to the model of the 5x series device as shown in the photo above.
- Connect the 5x series device (CAN INTERFACE socket) with the Sefelec 64-SC rack (CAN IN socket) using an uncrossed 9-pin SUB-D cable.
- With several SEFELEC 64-SC racks, proceed in the same way to inter-connect all the racks.

IMPORTANT

On the last rack, it is necessary to connect the 120 Ohm CAN load connector to the socket marked CAN OUT to ensure the proper functioning of the CAN bus. See photo below:



8. TURNING ON THE DEVICE

Before turning on the devices, connect a power cord to the rear panel and to an earthed 16A wall main socket.

IMPORTANT

In the event the power cord is replaced, always use a power cord that is adapted to the power and CE certified

IMPORTANT

Turn on the external(s) scanner(s) first by pressing the ON/OFF push-button located on the right side of the device

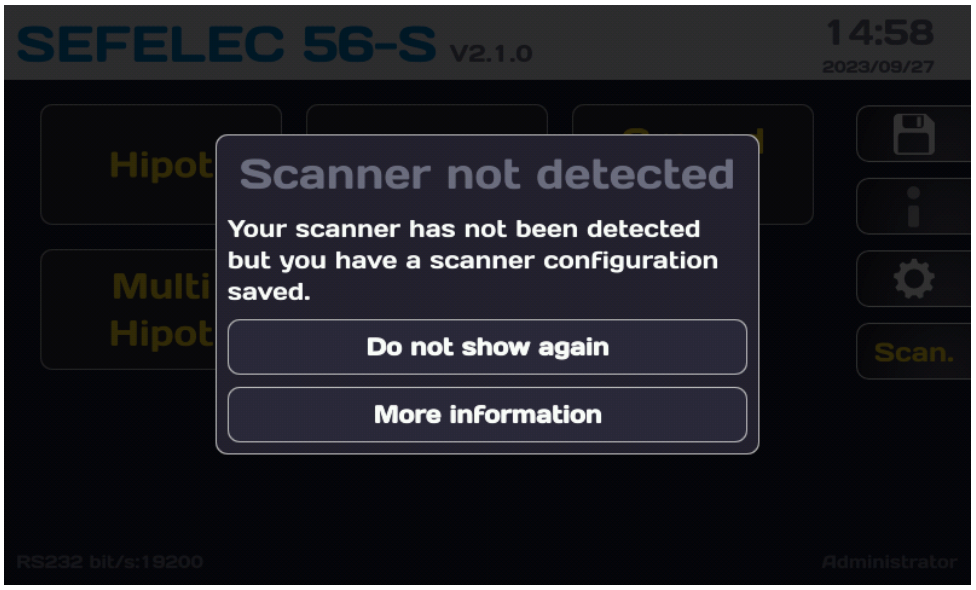
Then continue likewise for the 5x series device:

IMPORTANT

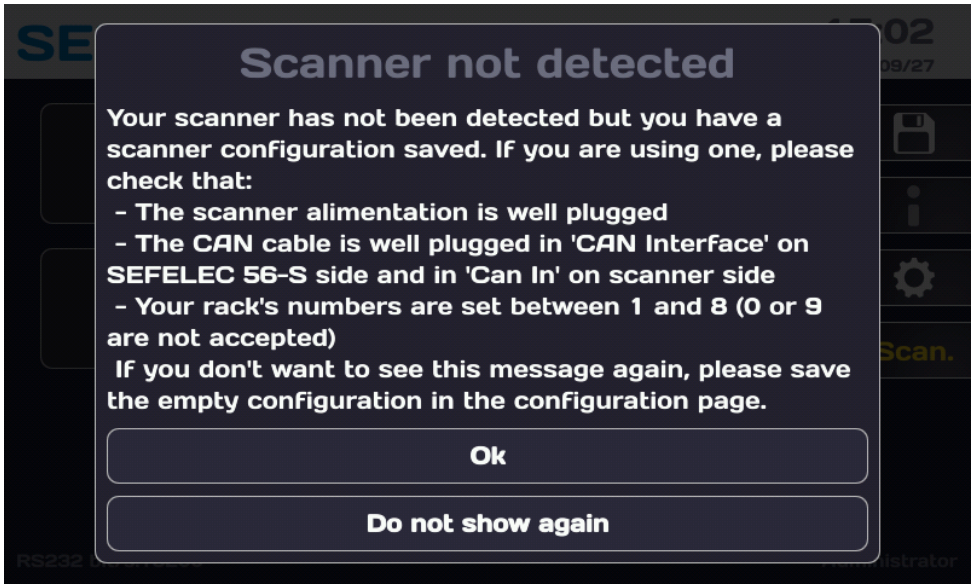
After turning off the Sefelec 64-SC device, wait 5 seconds before turning it on again.

When first turning on the 5x device and scanner together, also refer to the instructions for the 5x device in chapter 5.4.

If a scanner configuration has been saved in the 5x device but the scanner is not detected when the devices are turned on, the following message will be displayed:

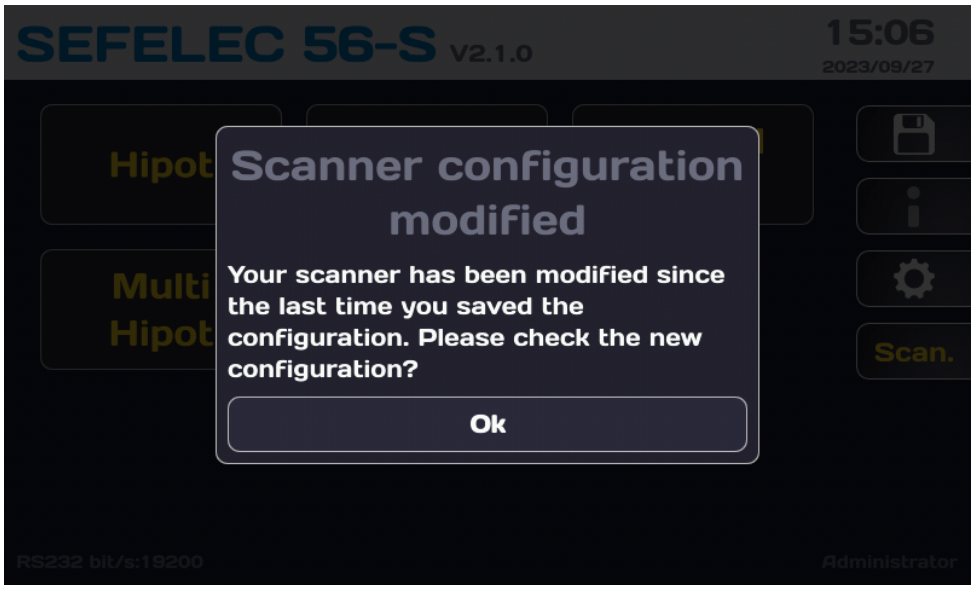


If this is normal, for example in the case where the device is used without a scanner, press the button: **Do not show again**, otherwise press the **More information** button to go to the following screen:



Follow the instructions to activate scanner detection.

With a scanner that has been detected but with a configuration that is different from the one that is memorised (missing rack or module), the following message will be displayed:



By pressing the **Ok** button, you will be taken to the following screen and the floppy disk function key will allow to save the new configuration.

If a scanner is detected with a configuration that is identical to the one memorised, the start-up screen will indicate:

Press the SCAN button to go to the following screen;

Example of a display with 4 external racks

This screen displays the information concerning the configuration of the scanner unit:

- R1 to R8: the number of recognised racks
- Inside each rack, modules M1 to M8 with the switching type HV, HVHO or HC.
- The channels of each module between 1 and 8 are green if the accessory's connector is plugged in and grey if not.

The floppy disk key allows you to save the scanner configuration in the memory of the 5x device. A grey floppy disk indicates that the configuration has been saved, yellow means that the configuration has not been saved.
Confirm proper execution of the save by pressing OK.

The key with a gear allows you to select a 2-wire or 4-wire switching mode when using an external scanner with high current switching modules (SEFM-8EHC). If the external scanner is not equipped with this type of module, this key will not be displayed.

The Abs. (Absolute) key allows you to display the numbering of the channels from 1 to n, i.e. from 1 to 64 for one rack, from 1 to 128 for 2 racks, etc.
The Rel. (Relative) key allows you to return to a numbering of the channels from 1 to 8 per module.

The circular arrow key allows you to refresh the configuration of the detected scanner and to then display it.

Press the Home icon or the blue arrow at the top left to go back to the start-up screen.

9. OPERATING THE EXTERNAL SCANNER

The external scanner is programmed by using the SEQUENCE mode.
To know all the functionalities in the SEQUENCE mode, please consult chapter 15 of the instructions for 5x series devices.
These instructions are available by clicking on this link: Download (sefelec.com)

The SEQUENCE function offers 2 programming modes for the switching measurement channels.
A first mode called AUTOSCAN or sequential exploration makes it possible to define, in one instruction for the SEQUENCE mode, a starting (X) channel and an ending (Y) channel.
At test start-up (START button) the channels from X to Y will be switched in succession and brought to the measurement potential.
The second mode, non-sequential exploration, allows you to program as many different switching configurations as desired with a SEQUENCE step per configuration.

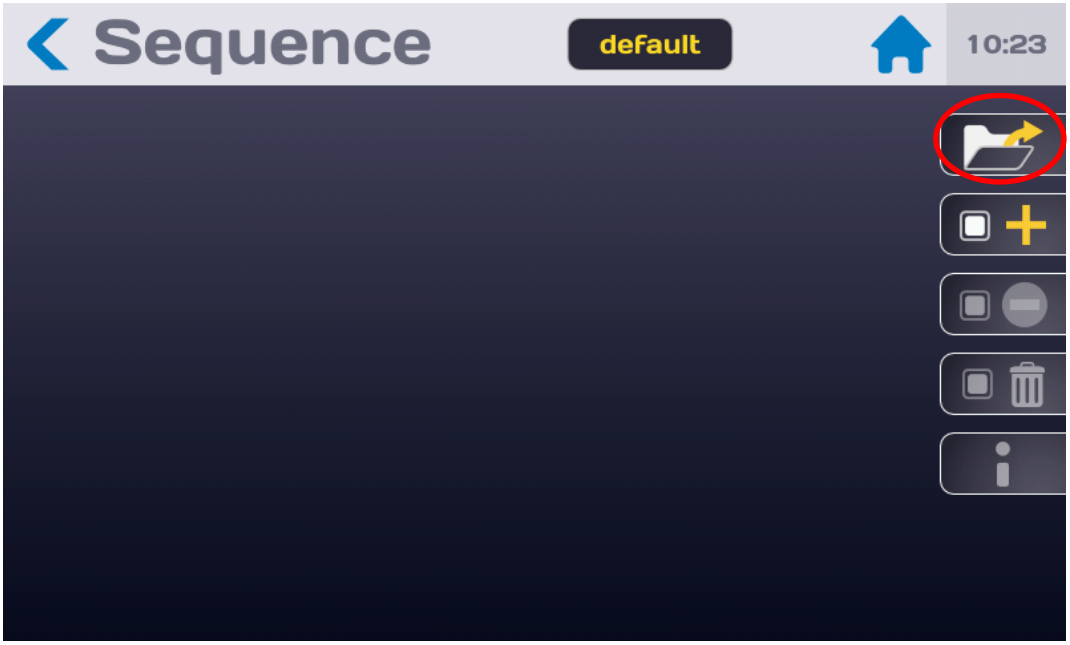
9.1. SEQUENTIAL EXPLORATION MODE FOR CHANNELS X TO Y

9.1.1. PROGRAMMING A DIELECTRIC STRENGTH TEST

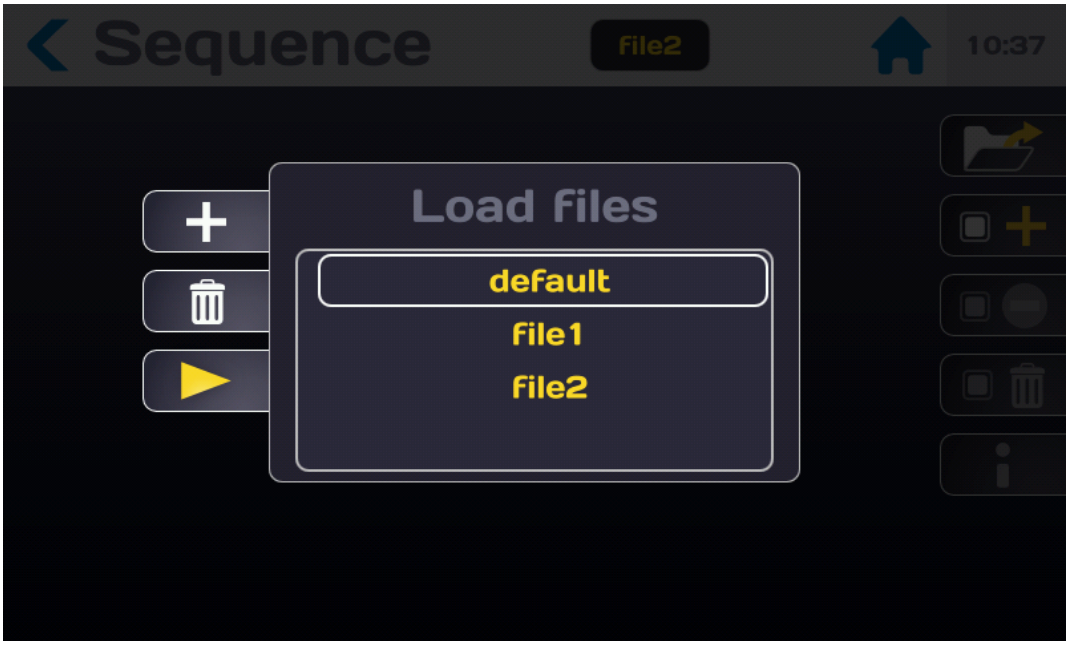
To carry out a dielectric strength test with automatic sequential exploration of channels X to Y in a single instruction of the Sequence mode, follow the procedure below:
From the home menu, go to the STRENGTH function and create a test file with the desired parameters, for example DEFAULT with the following parameters: a voltage of 1,500VAC 50Hz, cycle times from 0.5-1-0.5 seconds and a detection mode with IMAX = 1mA.

Then go to the SEQUENCE mode by pressing the Sequence key in the home menu

And create a new Sequence file by selecting the key with the folder icon:



to display the list of available files:

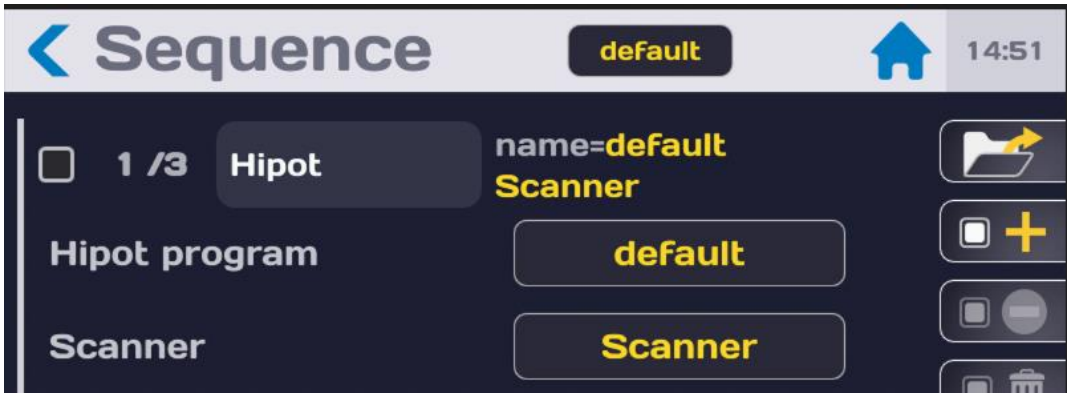


The keys:

allow you to add or delete files.
Press the + key to create a new file that will be named "fileX" with an incrementation of the number with respect to the last file created.
Press the yellow arrow.
To change the name of the file, click on the name "fileX" in yellow in the upper information bar and enter the new name for the file, for example: TEST_RIGID_01
A window offers you the possibility to rename this file or to copy it and rename it
From the SEQUENCE mode screen, to add a function, press the key:

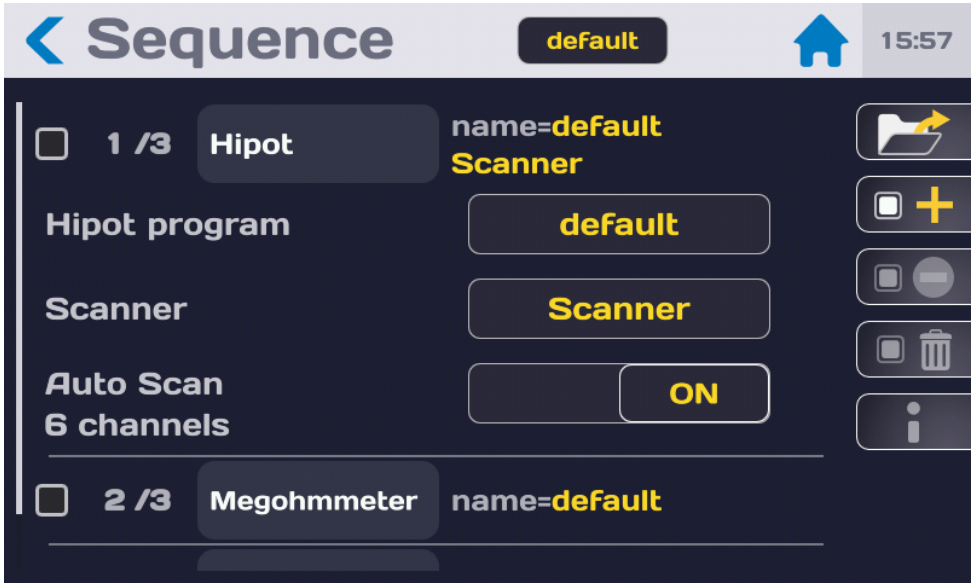
to display a drop-down list of the available functions.

Select the **Hipot** function to display the following line:

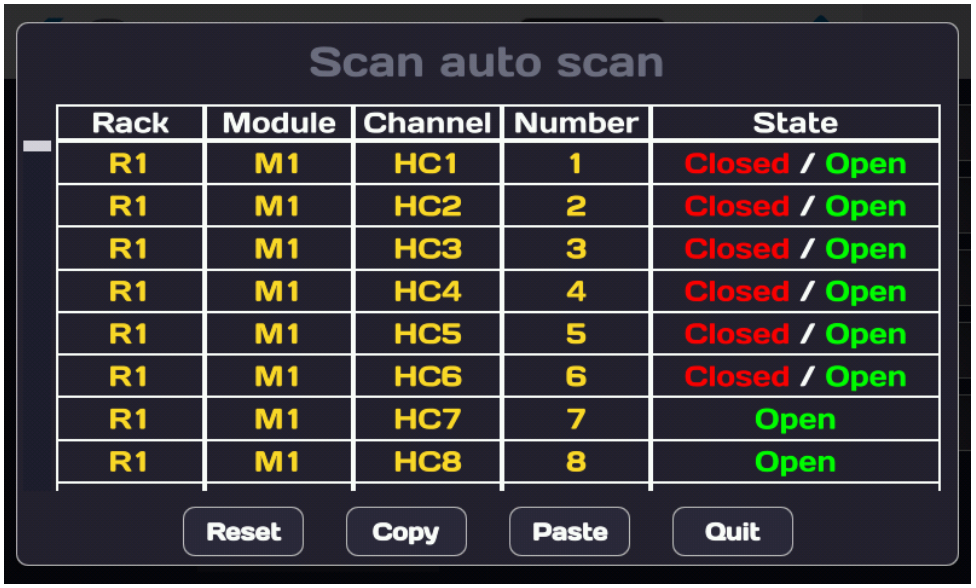


Select the configuration file (e.g.: TEST_HV_01) that you want to use for this test step by pressing the yellow area on the Hipot program line

For a sequential cycling of the channels, for example from 1 to 6 set the **Auto Scan** line to ON



The click on the yellow **Scanner** area



To select a whole rack, click in the Rack column; to unselect the rack, press again in the Rack column
To select a whole module, click in the Module column; to unselect a module, press again in the Module column.
To select channels one by one, press the lines in the Number column, in the example lines 1 to 6

Then click in the State column as many times as needed to obtain the mode:
HV / **Earth** which is reserved for the sequential cycling mode (Auto Scan)
The switching configuration is automatically saved
Exit this screen by pressing the **Quit** key
The **Reset** key allows you to reset all the channels to their initial state.
The **Copy** key allows you to copy the selected configuration
The **Paste** key allows you to paste copy the previously copied configuration.

To start the test, if the green START button light is on, press the button for more than one second.

IMPORTANT

ODU Blue-Line output connectors for the Strength-Insulation and Earth continuity channels are provided with a connector presence detector. If the plug connector is not connected to its socket, the relays cannot be controlled.

IMPORTANT

All the plug connectors must be connected to be able to start a test.

For accessories that are not connected when the START key is pressed, the following message will be displayed:

Reconnect the indicated connectors to run a test.

IMPORTANT

In order to secure the connections of the ODU connectors of the accessories, it is recommended to screw the captive screws located on the top and bottom parts of the cover of the connectors using a Philips screwdriver.

IMPORTANT

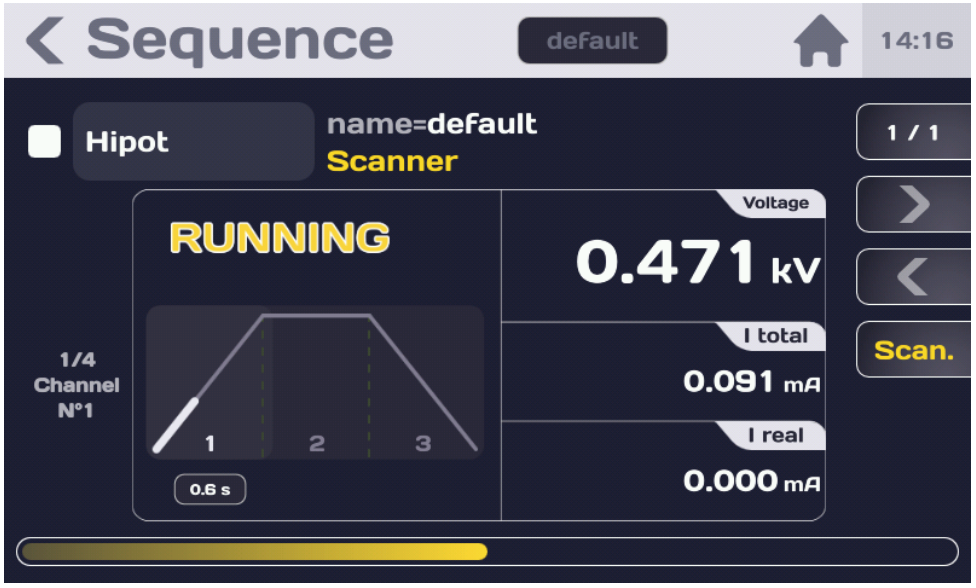
The SEFA-SCHVxx high voltage accessories come with their ends short-circuited by a WAGO type connector. The HV wires that are to be used must be disconnected and connected to the test system. Unused wires must remain short-circuited to the earth by the WAGO connector.

IMPORTANT

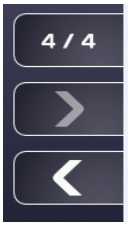
During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that must be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

After pressing the green START push-button, the test will start by running the dielectric strength configuration file TEST_RIGID01 on channels 1 to 6:

- Test step 1: channel 1 at HV, channels 2 to 6 earthed
- Test step 2: Channel 2 at HV, channels 1 and 3 to 6 earthed
- Test step 3: Channel 3 at HV, channels 1, 2 and 4 to 6 earthed
- Test step 4: Channel 4 at HV, channels 1 to 3 and 5 and 6 earthed
- Test step 5: Channel 5 at HV, channels 1 to 4 and 6 earthed
- Test step 6: Channel 6 at HV, channels 1 to 5 earthed



To execute the Sequence and present the results, consult paragraph 15.2 of the 5x series operating manual.
As long as the STOP button has not been actuated, it is possible to review the screens for the different steps with the navigation keys:



Press the Left arrow key to display the screen from the last step.
Browse through the different steps of the scanner by scrolling the screen towards the top or towards the bottom.
In the display of the test steps, a new SCAN / GRAPH key allows you to display either the standard end of test screen (GRAPH) or a representation of the channels (SCAN) with red for the channel or channels switched to HV and green for non-switched channels or switched to the earth.
Scrolling is possible only in the end-of-test screen display mode (GRAPH).

9.1.2. PROGRAMMING AN INSULATION MEASUREMENT

To take an insulation measurement with an automatic sequential exploration of channels X to Y in a single instruction of the Sequence mode, proceed as in paragraph 9.1.1 by replacing the choice of the function with INSULATION.

IMPORTANT

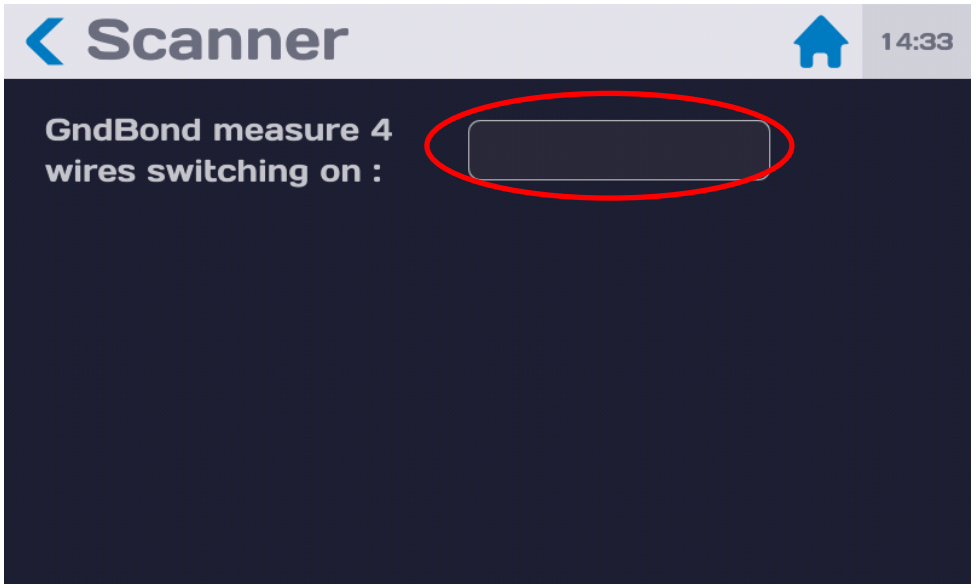
During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that have to be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

9.1.3. PROGRAMMING AN EARTH CONTINUITY MEASUREMENT

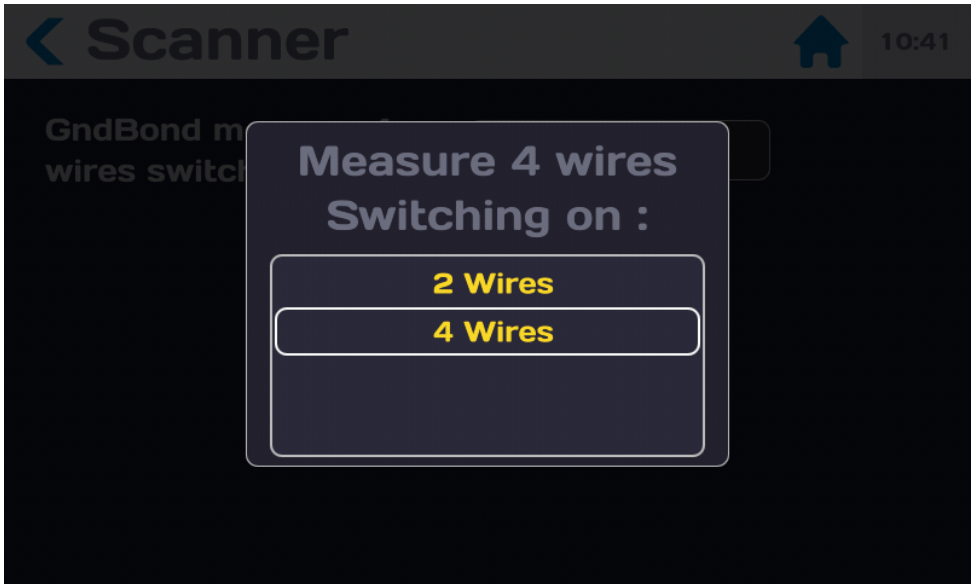
With an external scanner, the 2- or 4-wire switching mode for earth continuity measurement has to be defined (see paragraph 5.2.2)
Press the SCAN key on the welcome screen

Then press the key with the gear

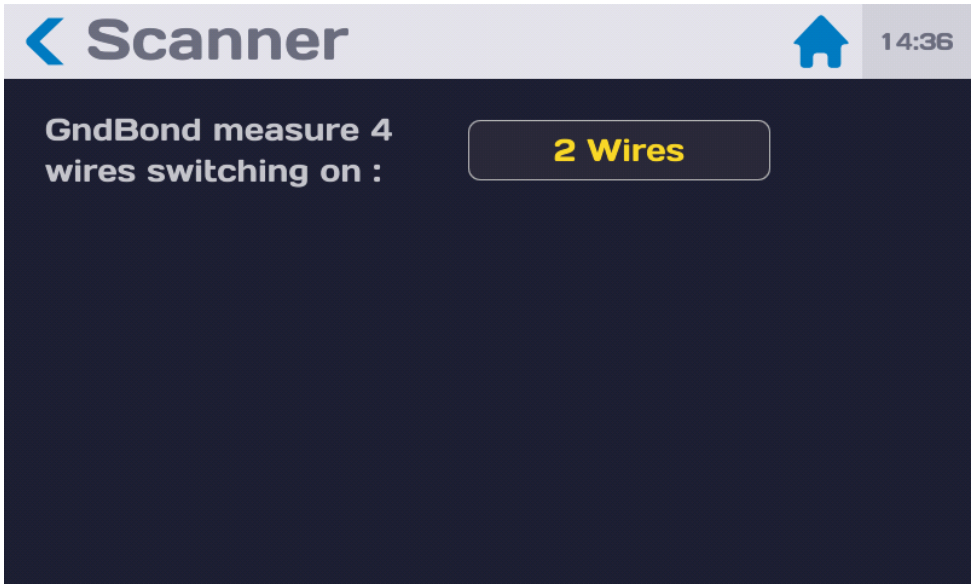
If neither 2- or 4-wire modes was selected beforehand, the following screen is displayed:



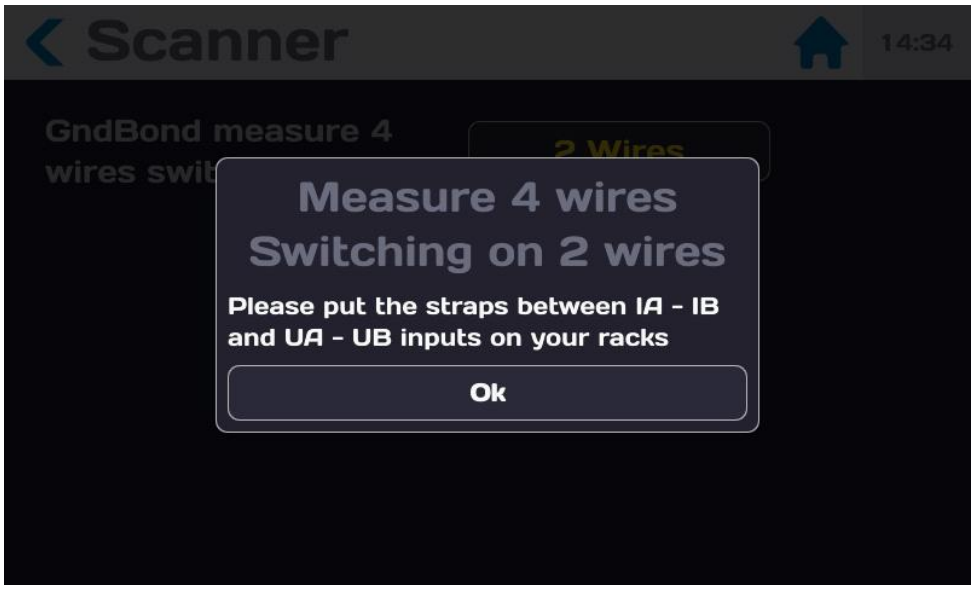
Click on the rectangular area



Choose the 2-wire or 4-wire switching mode, remember that the earth continuity measurement is always done with 4 wires regardless of the switching mode chosen.
See paragraph 5.2.2 to know the difference between the 2-wire and 4-wire switching modes.
According to the application, choose the suitable mode, for example 2 wires:

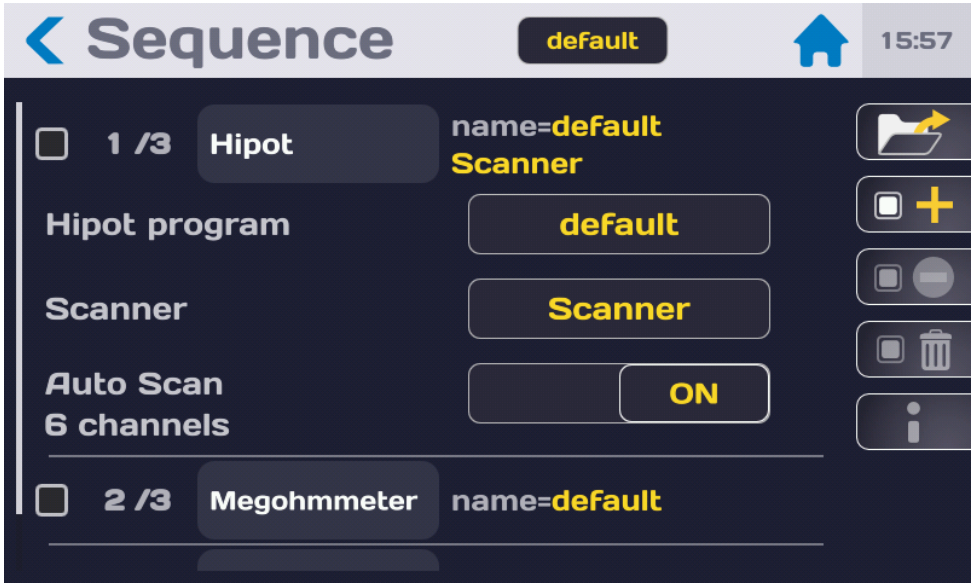


Follow the recommendation:

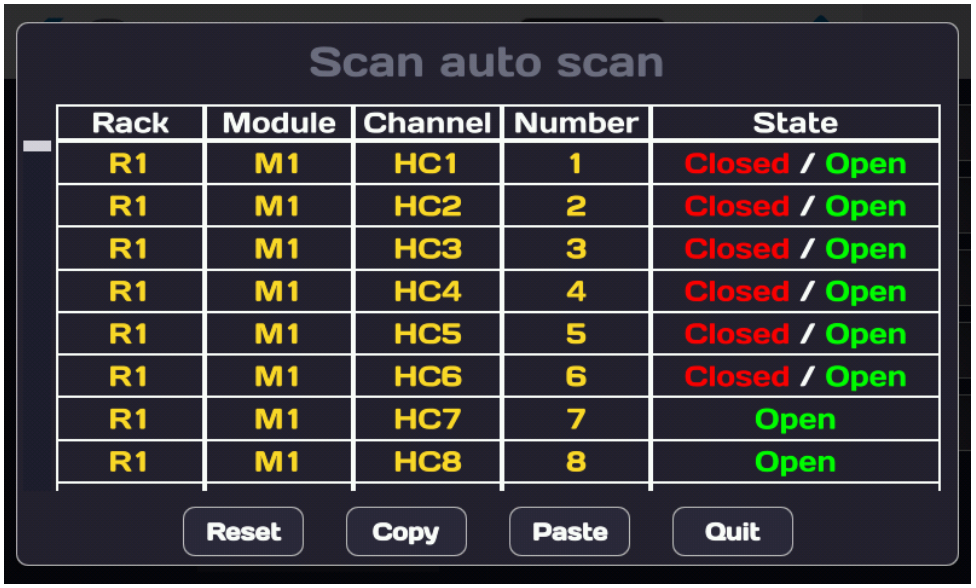


Or the 4-wire mode:

For a sequential cycling of the channels in 2-wire switching mode, for example from 1 to 6 set the **Auto Scan** line to ON



The click on the yellow **Scanner** area



To select a whole rack, click in the Rack column; to unselect the rack, press again in the Rack column
To select a whole module, click in the Module column; to unselect a module, press again in the Module column.
To select channels one by one, press the lines in the Number column, in the example lines 1 to 6
Then click in the State column as many times as needed to obtain the mode:
Closed / **Open** which is reserved for the sequential cycling mode (Auto Scan)
The switching configuration is automatically saved
Exit this screen by pressing the **Quit** key

The **Reset** key allows you to reset all the channels to their initial state.
The **Copy** key allows you to copy the selected configuration
The **Paste** key allows you to paste copy the previously copied configuration.

To start the test, if the green START button light is on, press the button for more than one second.

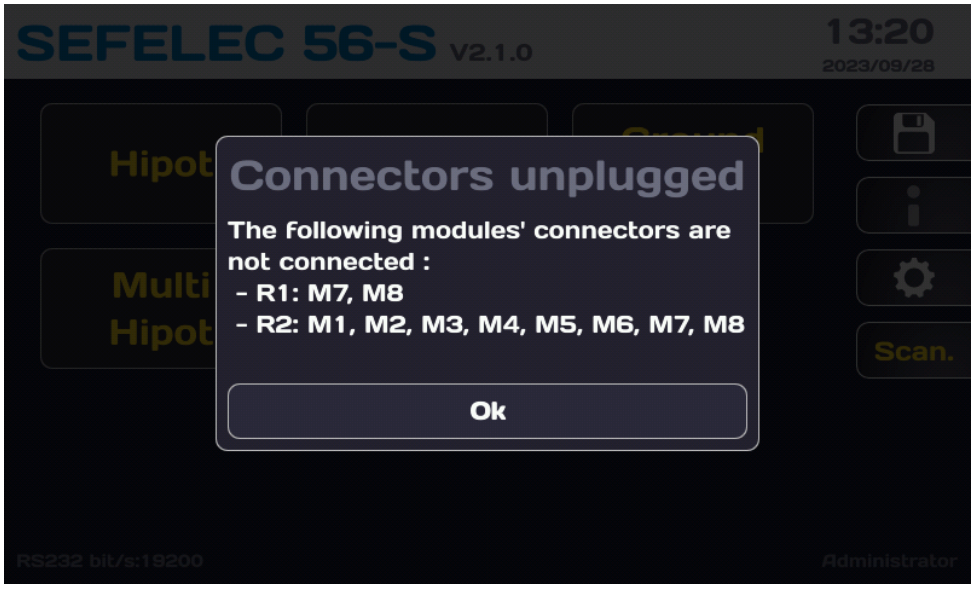
IMPORTANT

ODU Blue-Line output connectors for the Strength-Insulation and Earth continuity channels are provided with a connector presence detector. If the plug connector is not connected to its socket, the relays cannot be controlled.

IMPORTANT

All the plug connectors must be connected to be able to start a test.

For accessories that are not connect when the START key is pressed, the following message will be displayed:



Reconnect the indicated connectors to run a test.

IMPORTANT

In order to secure the connections of the ODU connectors of the accessories, it is recommended to screw the captive screws located on the top and bottom parts of the cover of the connectors using a Philips screwdriver.

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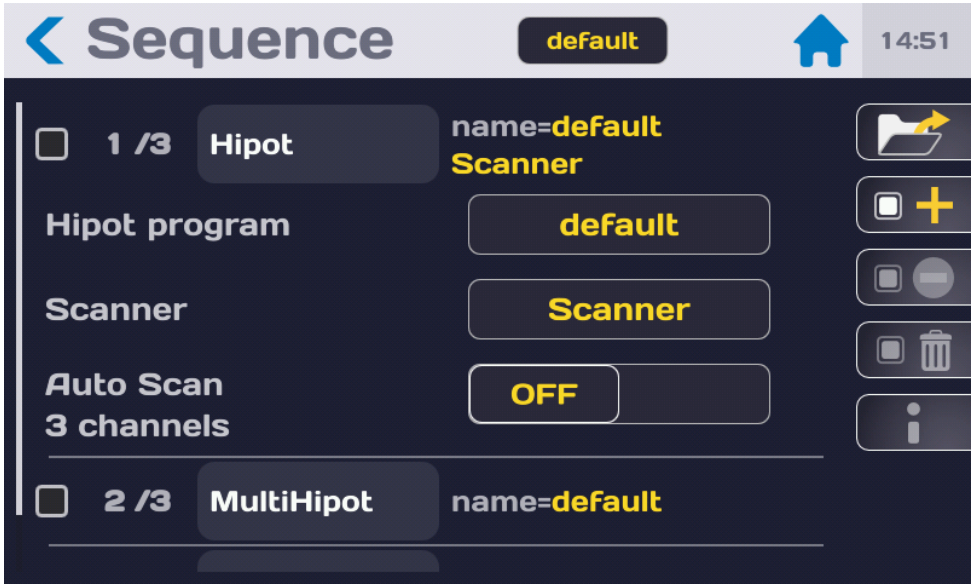
After pressing the green START push-button, the test will start by running the earth continuity configuration file on channels 1 to 6 with respect to a reference point which will be directly connected to the 5x device:

- Test step 1: channel 1 with respect to the reference channel
- Test step 2: Channel 2 with respect to the reference channel
- Test step 3: Channel 3 with respect to the reference channel
- Test step 4: Channel 4 with respect to the reference channel
- Test step 5: Channel 5 with respect to the reference channel
- Test step 6: Channel 6 with respect to the reference channel

9.2. NON-SEQUENTIAL EXPLORATION MODE:

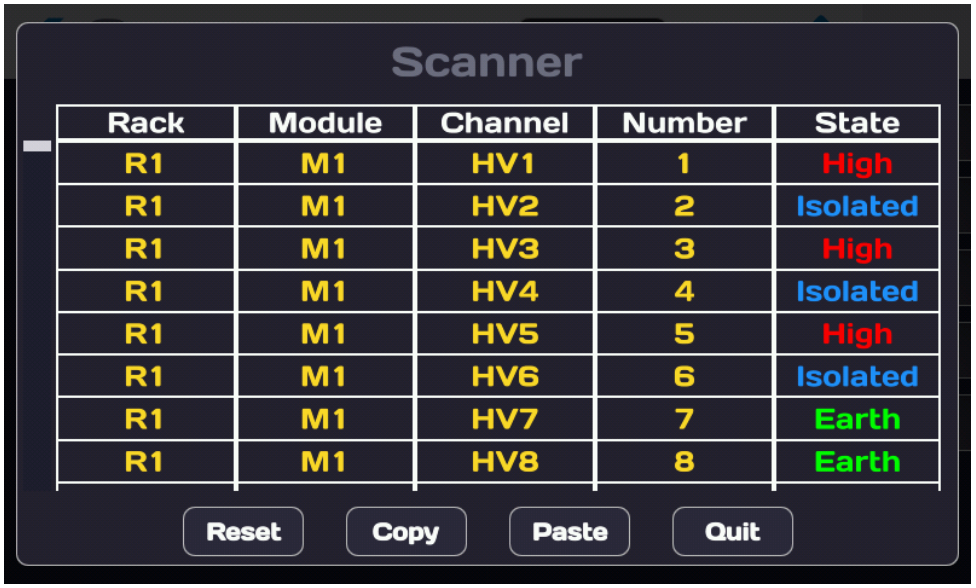
9.2.1. PROGRAMMING A DIELECTRIC STRENGTH TEST

To conduct a dielectric strength test by freely choosing the switched channels, proceed as in paragraph 9.1.1 but by setting the **Auto Scan** line to OFF.



For example, to conduct a dielectric strength test on channels 1, 3 and 5 at HV with respect to channels 7 and 8 connected to the earth with channels 2, 4 and 6 insulated.
Define a first step by selecting the Strength function
Choose the dielectric strength test configuration file, for example TEST_RIGID01
Set the **Auto Scan** line to OFF

Press the yellow zone marked Scanner:



Select channels 1, 3 and 5 by pressing in the Number column
Press as many times as needed in the State column on the selected lines to choose **High**
Unselect channels 1, 3 and 5 by pressing these lines again
Select channels 7 and 8
Press as many times as needed in the State column on the selected lines to choose **Earth**
Select channels 2, 4 and 6
Press as many times as needed in the State column on the selected lines to choose **Isolated**
Exit this screen by pressing the **Quit** key
It is possible to insert as many measurement steps with channel switching as necessary.
To start the test, if the green START button light is on, press the button for more than one second.

IMPORTANT

ODU Blue-Line output connectors for the Strength-Insulation and Earth continuity channels are provided with a connector presence detector. If the plug connector is not connected to its socket, the relays cannot be controlled.

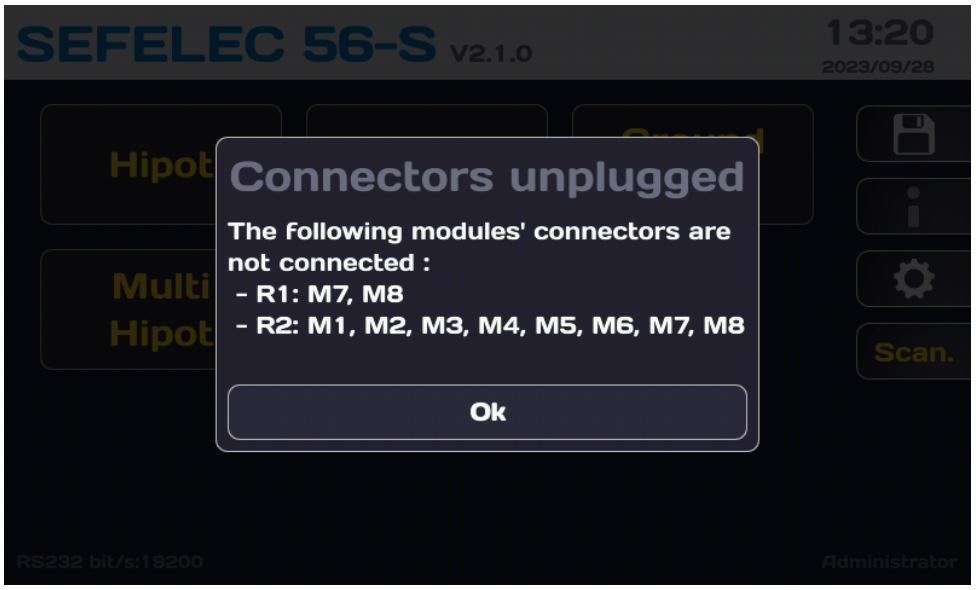
IMPORTANT

All the plug connectors must be connected in order to be able to start a test.

IMPORTANT

During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that have to be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

For accessories that are not connect when the START key is pressed, the following message will be displayed:



Reconnect the indicated connectors in order to run a test.

IMPORTANT

In order to secure the connections of the ODU connectors of the accessories, it is recommended to screw the captive screws located on the top and bottom parts of the cover of the connectors using a Philips screwdriver

/

IMPORTANT

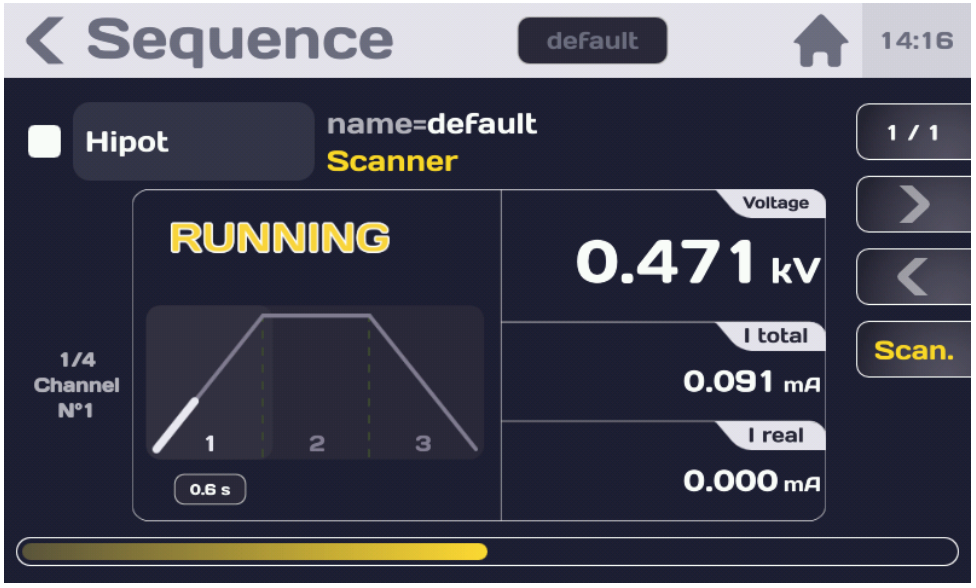
The SEFA-SCHVxx high voltage accessories come with their ends short-circuited by a WAGO type connector. The HV wires that are to be used must be disconnected and connected to the test system. Unused wires must remain short-circuited to the earth by the WAGO connector.

IMPORTANT

During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that have to be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

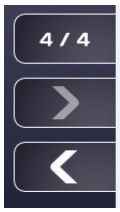
After pressing the green START push-button, the test will start by running the dielectric strength configuration file TEST_RIGID01 with channel configuration:

- Test step 1: channels 1, 3 and 5 at HV, channels 7 and 8 earthed and channels 2, 4 and 6 insulated



To execute the Sequence and present the results, consult paragraph 15.2 of the 5x series operating manual.

As long as the STOP button has not been actuated, it is possible to review the screens for the different steps with the navigation keys:



Press the Left arrow key to display the screen from the last step.
Browse through the different steps of the scanner by scrolling the screen towards the top or towards the bottom.
In the display of the test steps, a new SCAN / GRAPH key allows you to display either the standard end of test screen (GRAPH) or a representation of the channels (SCAN) with **red** for the channel or channels switched to HV and **green** for non-switched channels or switched to the earth.
Scrolling is possible only in the end-of-test screen display mode.

9.2.2. PROGRAMMING AN INSULATION MEASUREMENT

To take insulation measurements in non-sequential mode, proceed in the same way in paragraph 9.2.1 but by selecting the INSULATION function when adding a new step and by setting the **Auto Scan** line to OFF

IMPORTANT

During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that have to be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

9.2.3. PROGRAMMING AN EARTH CONTINUITY MEASUREMENT

To take earth continuity measurements in non-sequential mode, proceed in the same way in paragraph 9.2.1 but select the EARTH CONTINUITY function when adding a new step and set the **Auto Scan** line to OFF

10. THE INTERNAL SCANNER

According to the number of channels required, the scanner can have the form of additional cards installed in a device in the 5x series (internal scanner - max. 8 channels).
These cards are intended for several types of measurement:

- Strength/Insulation
- Ground continuity.

According to need, it is possible to equip a 5x series device with 1 or 2 4-channel cards for Strength/Insulation or Earth continuity or any combination of these cards.

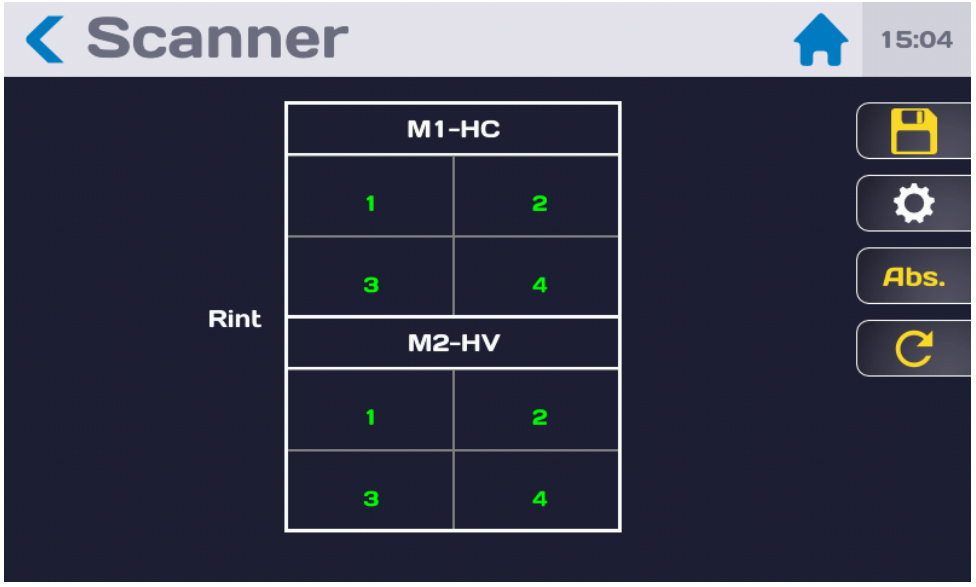
Reference	Description
SEFM-4IHC	4-channel module Earth continuity internal scanner
SEFM-4IHV	4-channel module Strength-Insulation internal scanner
SEFM-4IHVHC	4-channel module Strength-Insulation and 4-channel Earth continuity
SEFM-8IHC	8-channel module Earth continuity internal scanner
SEFM-8IHV	8-channel module Strength-Insulation internal scanner

h

Rear view of a 5x series device equipped with the SEFM-xx option: internal scanner

If an internal scanner is detected, the start-up screen will indicate:

Press the SCAN button to go to the following screen;



This screen displays the information concerning the configuration of the internal scanner unit:

- Rint: internal scanner
- M1 to M2: 4-channel modules with the HV or HC switching type
- The channels of each module between 1 and 4 are green if the accessory's connector is plugged in and grey if not.

The floppy disk key allows you to save the scanner configuration in the memory of the 5x device. A grey floppy disk indicates that the configuration has been saved, yellow means that the configuration has not been saved.
Confirm proper execution of the save by pressing OK.

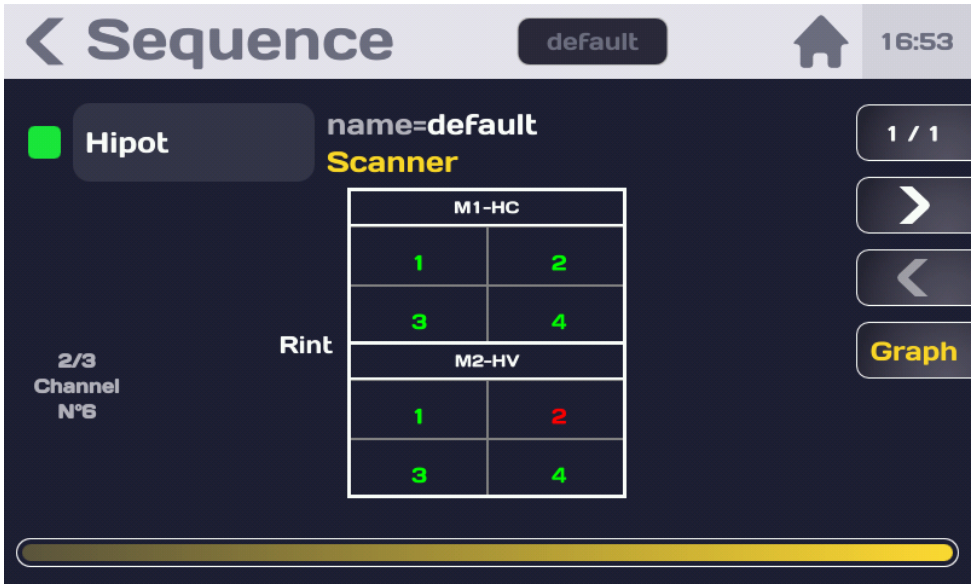
The Abs. (Absolute) key allows you to display the numbering of the channels from 1 to n, i.e. from 1 to 8 for an internal scanner
The Rel. (Relative) key allows you to return to a numbering of the channels from 1 to 4 per module.

The circular arrow key allows you to refresh the configuration of the detected scanner and to then display it.

Press the Home icon or the blue arrow at the top left to go back to the start-up screen.

10.1. USING THE INTERNAL SCANNER:

See the precautions below and refer to chapter 9: Using the external scanner

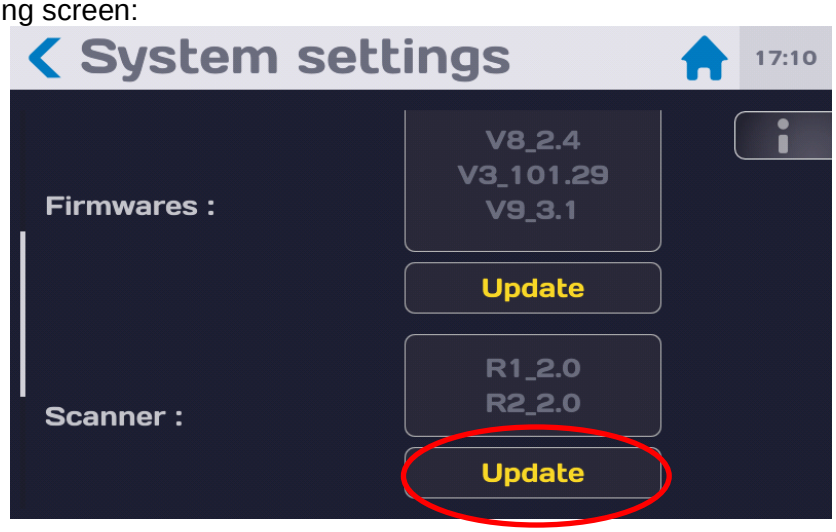


IMPORTANT

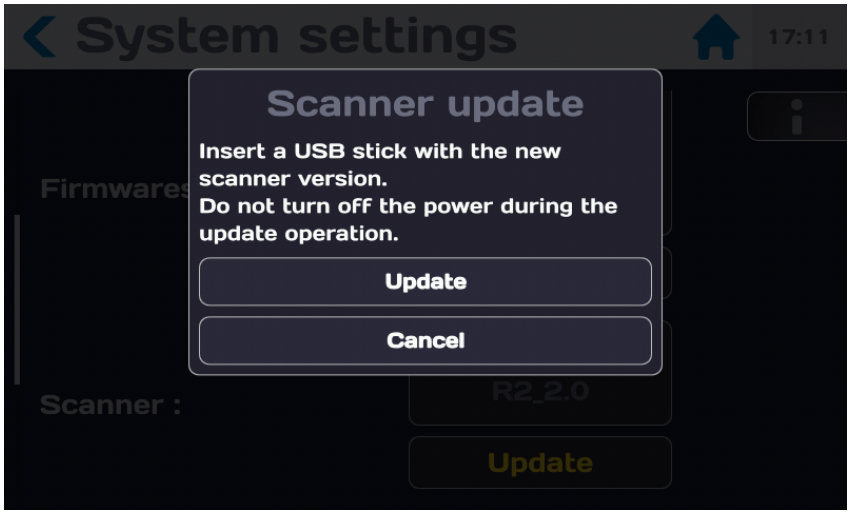
During dielectric strength tests and insulation measurements in a 5x device equipped with an internal scanner, high voltage will be present on the selected channels of the scanner and on the main High Voltage output (LEMO HV terminal and SEFA-TE65) of the device as well as on the guard terminal. Take the usual precautions for use with High voltage

11. UPDATING THE FIRMWARE OF THE RELAY CONTROL CARD OF THE EXTERNAL SCANNER:

Updating the Firmware of the relay control card can be done from a Sefelec 5x device connected to the Sefelec 64-SC scanner with the **eaton-maj-fct.zip** update file (do not unzip this file and check with our after-sales service or our website to obtain the latest version available) which will be saved on a USB key.
From the following screen:



Press the area indicating Updating of the Firmware of the scanner racks (2 racks proposed in the example above) to obtain the following screen:



Press the "Cancel" button if you do not want to run the update.
Insert the USB key with the update file.

IMPORTANT

Do not turn off the device during the update.

Please restart the device at the end of the update

Then press the "Update" button and follow the instructions

12. LIST OF RS-232C, ETHERNET, USB, IEEE488-2 COMMANDS

IMPORTANT

The commands listed in these instructions correspond to the commands that are specific to the Sefelec 64-SC channel scanner. For all the commands in the 5x series, please refer to paragraph 21 of the operating manual for the 5x series.

The syntax of the commands sent over the RS232C, Ethernet, USB connections was made compliant with the IEEE488-2 standard (1992 revision).
Reminder of the numerical formats according to standard IEEE488-2:

Format NR1: +/-<digit>...<digit>
Format NR2: +/-<digit>...<digit>.<digit>...<digit>
Format NR3: +/-<digit>...<digit>.<digit>...<digit>E+/-<digit>..<digit>

NOTE

The codes in parentheses are the expanded codes that can be interpreted by the device.

12.1.1. STANDARDISED REQUESTS

***STB?**

If a scanner is detected by the device:
The bit 0 of the *STB register is a logic AND of the device's safety circuit and of the presence detections for the connector of the scanners detected

Message returned by the device: **<HXX><CR>**

Reminder of the STB register of the 5x series:

b0	0 = Safety circuit open
	1 = Safety circuit closed
b1	0 = No error
	1 = Error (Test error, Communication error, safety circuit error on MEAS control, fan error)
b2	0 = End of test
	1 = Test in progress
b3	0 = Bad Test
	1 = Good Test
b4	Not used
b5	Logic OR of the bits of the ESR register and filtered by the ESE mask
b6	0 = No bit of the *STB register filtered by the SRE mask has changed since the last time it was read
	1 = At least one of the bits of the *STB register filtered by the SRE mask has changed since the last time it was read
b7	Not used

12.1.2. DEVICE-DEPENDENT CONTROLS

SCAN:CONF:UPDATE

Checks the scanners connected to the device and updates the configuration according to the responses obtained.
Message returned by the device: **XON**

NOTE

THIS CONTROL MUST BE SENT SYSTEMATICALLY BEFORE BEING ABLE TO CONTROL CHANNELS AT THE BEGINNING OF PROGRAMMING AND AFTER ANY COMMUNICATION ERROR WITH THE SCANNERS.

SCAN:CONF:COUNT?

Returns the number of controllable channels in the current scanner configuration in the format <NR1>.
Message returned by the device: **<NR1><CR>**

SCAN:CONF:COUNT? {CHANNEL | RACK | MODULE}

Enrichment of the COUNT? function Returns, according to the option entered, the number of channels (CHANNEL) of modules (MODULE) or racks (RACK) that can be controlled in the current scanner configuration in the format <NR1>.
Message returned by the device: **<NR1><CR>**

SCAN:CONF:NEXT?

Returns the type of cards present in the current configuration of the scanner via a code. Each sending of this control increments the number of the card of which the type is returned. The SCAN:CONF:UPDATE controls sets the iteration back to 0.
The locations of the empty card return the "EMPTY" code.
Once the scanner configuration is fully scanned, the "END" code is returned.
Message returned by the device:
<HV-8 |HV-4 | HC-8 | HC-4 | HVHO-8 |EMPTY |END><CR>

- HV-8 : 8-channel High Voltage external scanner
- HV-4 : 4-channel High Voltage internal scanner
- HVHO-8 : 8-channel High Voltage with external scanner guard
- HC-8 : 8-channel High current external scanner
- HC-4 : 4-channel high current internal scanner

In the case of an external scanner comprised of a rack that contains an 8-channel HC module and an 8-channel HV module:

```
SCAN:CONF:UPDATE  => XON
SCAN:CONF:NEXT?   => R1-HC-8
SCAN:CONF:NEXT?   => R1-HV-8
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => END
```

In the case of an external scanner comprised of a rack that contains an 8-channel HC module and an 8-channel-guard HV module:

```
SCAN:CONF:UPDATE  => XON
SCAN:CONF:NEXT?   => R1-HC-8
SCAN:CONF:NEXT?   => R1-HVHO-8
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => R1-EMPTY
SCAN:CONF:NEXT?   => END
```

SCAN:HV(@{<NR1>|<NR1>:<NR1>}...[,{<NR1>|<NR1>:<NR1>}]) {HIGH|EARTH|ISOLATED|AUTOTEST}

Controls a channel or a list of HV or HVG channels in absolute numbering in the requested state.
Message returned by the device: **XON**

Example:

```
SCAN:HV (@1) HIGH          : Controls channel 1 in the HIGH state
SCAN:HV (@1,2) HIGH        : Controls channel 1 and channel 2 in the HIGH state
SCAN:HV (@1:4) HIGH        : Controls channel 1 to 4 in the HIGH state
SCAN:HV (@1,2,9:16) HIGH   : Controls channel 1, channel 2 and channels 9 to 16 in the HIGH state
```

NOTE

If the detection of the presence of plug connectors of one of the modules concerned by the control indicates the absence of a connector:
- Dialogue error 2
- Pop-up indicating the modules of which the plug connector is absent

If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:HC(@{<NR1>|<NR1>:<NR1>}...[,{<NR1>|<NR1>:<NR1>}]) {CLOSE|OPEN},{CLOSE|OPEN}

Controls the two relays of a channel or of a list of HC channels in absolute numbering in the requested state.
Message returned by the device: **XON**

Example:

SCAN:HC (@1:4) CLOSE,OPEN	: Controls the relays of channels 1 to 4 in the CLOSE state for relays 1 of these channels and OPEN for the relays 2 of these channels

NOTE

If the detection of the presence of plug connectors of one of the modules concerned by the control indicates the absence of a connector:
- Dialogue error 2
- Pop-up indicating the modules of which the plug connector is absent

If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:RELAY(@{<NR1>|<NR1>:<NR1>}...[,{<NR1>|<NR1>:<NR1>}]) {ON|OFF}

Controls a relay or a list of relays in the requested state
Message returned by the device: **XON**

IMPORTANT

The type of commutation is not mentioned in this control.
It is important to know before if this is a HV or HC switching.

Example:

SCAN:RELAY (@1) ON	: Controls relay 1 (relay 1 of channel 1) in the ON state
SCAN:RELAY (@1,2) ON	: Controls relays 1 and 2 (relays 1 and 2 of channel 1) in the ON state
SCAN:RELAY (@1:4) ON	: Controls relays 1 to 4 2 (relays 1 and 2 of channels 1 and 2) in the ON state
SCAN:RELAY (@1,2,9:16) ON	: Controls relays 1, 2 and 9 to 16 (relays 1 and 2 of channels 1, 5, 6, 7 and 8 in the ON state)

NOTE

If the detection of the presence of plug connectors of one of the modules concerned by the control indicates the absence of a connector:
- Dialogue error 2
- Pop-up indicating the modules of which the plug connector is absent

If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:ALL {OPEN|DEFault}

Controls all the channels, regardless of their type, of the current scanner configuration in the requested state. The default state and the OPEN state are identical, namely the opening of the channels.
Message returned by the device: **XON**

No dialogue error, no pop-up. The opening of the circuit of a module causes the automatic opening of the channels.
If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:HV:ALL {HIGH|EARTH| ISOLATED |DEFault |AUTOTEST}

Controls all the HV and HVG channels of the current scanner configuration in the requested state.
Message returned by the device: **XON**

NOTE

If the detection of the presence of plug connectors of one of the modules concerned by the control indicates the absence of a connector:
- Dialogue error 2
- Pop-up indicating the modules of which the plug connector is absent

If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:HC:ALL {OPEN|CLOSE},{OPEN|CLOSE}

Controls all the HC channels of the current scanner configuration in the requested state.
Message returned by the device: **XON**

NOTE

If the detection of the presence of plug connectors of one of the modules concerned by the control indicates the absence of a connector:
- Dialogue error 2
- Pop-up indicating the modules of which the plug connector is absent

If one of the modules concerned by the control does not confirm good reception of the channel controls:
- Dialogue error 2
- Pop-up indicating that one or more scanners have not confirmed good reception of the channel controls sent
- All the channels are automatically open
- It is necessary to check the new configuration via the SCAN:CONF:UPDATE control before being able to control channels or relays again

SCAN:RESET:AUTO {ON|OFF}

Activates or deactivates automatic reset (return to the OPEN state) of all the channels following an end of test. The default value is ON.
Message returned by the device: **XON**

12.1.3. SUMMARY OF THE SPECIAL COMMANDS FOR THE SCANNER VIA THE RS232, ETHERNET, USB, IEEE488-2 LINK

Code
SCAN:CONF:UPDATE
SCAN:CONF:COUNT?
SCAN:CONF:COUNT? {CHANNEL | RACK | MODULE}
SCAN:CONF:NEXT?
SCAN:HV (@{<NR1>|<NR1>:<NR1>}...[, {<NR1>|<NR1>:<NR1>}]) {HIGH|EARTH|ISOLATED|AUTOTEST}
SCAN:HC (@{<NR1>|<NR1>:<NR1>}...[, {<NR1>|<NR1>:<NR1>}]) {CLOSE|OPEN},{CLOSE|OPEN}
SCAN:RELAY (@{<NR1>|<NR1>:<NR1>}...[, {<NR1>|<NR1>:<NR1>}]) {ON|OFF}
SCAN:ALL {OPEN|DEFault}
SCAN:HV:ALL {HIGH|EARTH| ISOLATED |DEFault |AUTOTEST}
SCAN:HC:ALL {OPEN|CLOSE},{OPEN|CLOSE}
SCAN:RESET:AUTO {ON|OFF}

12.1.4. OPERATING FAULT ON THE RS232C SERIAL LINK

If the RS-232C does not work as described in this manual, please check the following points:

The device does not react when commands are given.

- The connection cord between the SEFELEC 5X series device and the computer must be connected correctly at the two ends and be of the **uncrossed** type.
  The SEFELEC CO179 cord is not compatible with the device.

- The devices in the SEFELEC 5X series have several possible types of interfaces, check in the configuration menu that the RS232 mode was selected on the INTERFACE line.

- The character at the end of the message must be LF (hexadecimal: 0A, decimal: 10). If this character is not sent, the SEFELEC 5X series device does not process the command received.
  Check that this character is indeed added to the characters of the command given.

- The first control that must be sent is the REM control, the latter results in the display of an icon that symbolises 2 rings of a chain at the top left of the screen and the greying of the keys, the device is then ready to process the other commands.
  Attention: the first REM command must not wait for the Xon character before it is sent.

The device switches to REMOTE then seems to be blocked

Before sending another control, it is imperative to wait for the SEFELEC 5X series device to signal its availability by sending the Xon character.
If a code arrives during the processing of the preceding code, it can cause incoherent operation of the device or block it.

13. DIRECT CONTROL OF THE RELAYS (SEFELEC 64-SCPLC)

In the case of use of a Sefelec 64-SC scanner without a 5x series device, it is possible to use the SEFELEC 64-SCPLC version that retains the measurement characteristics of the Strength-Insulation and Earth continuity switching modules, but which provides direct access to the switching relay coils.
This configuration allows an API system to perform measurement point switching in complete safety while retaining the measurement characteristics.
Connectors C1 to C4 located at the rear panel provide direct access to the switching relay coils of the measurement channels.

NOTE

For users of the previous EXS3200 models, attention must be given to the polarity of the control signals of the relay coils

IMPORTANT

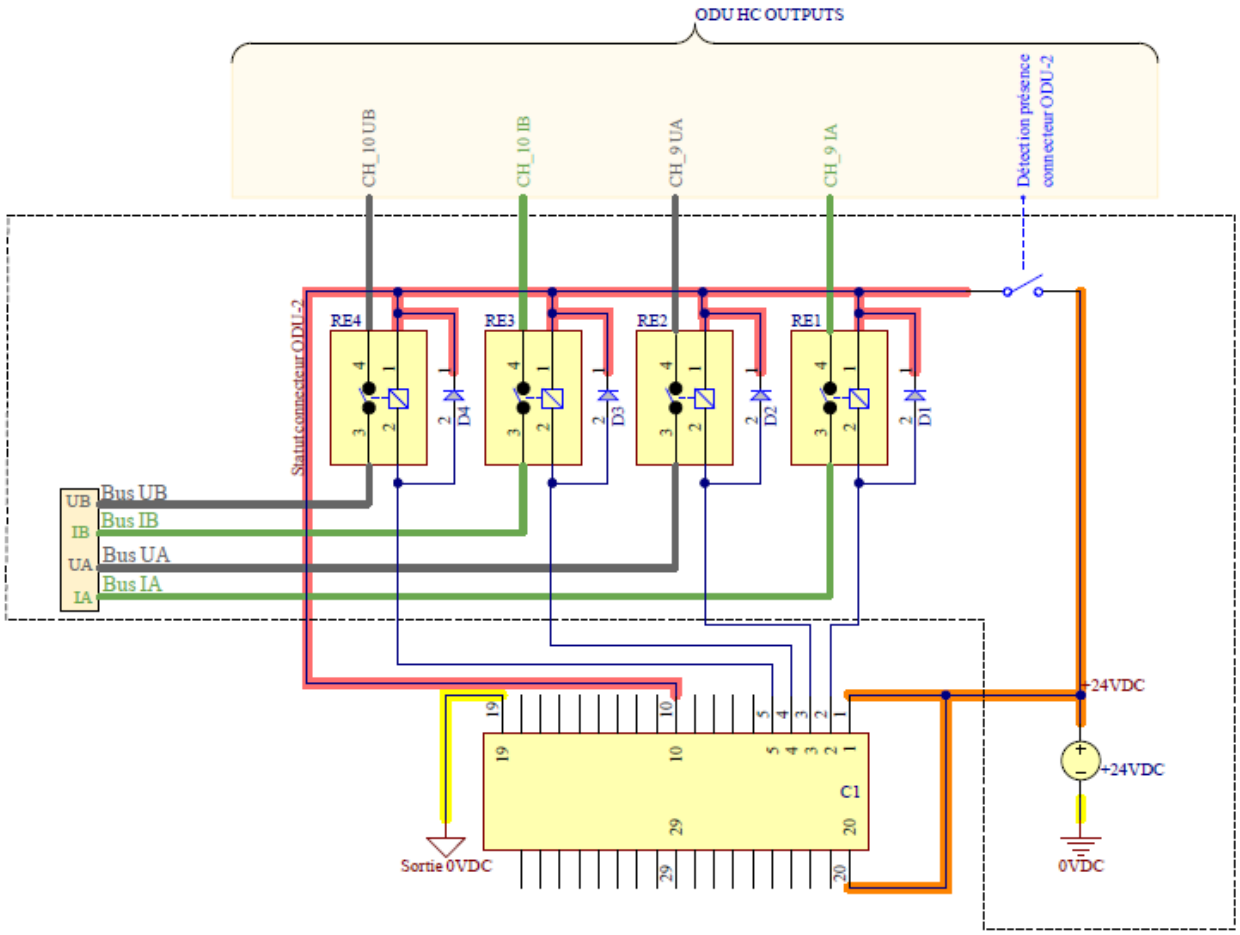
The characteristics of the relays are valid for switching conditions with a zero voltage and zero current (cold switching). To guarantee these specifications, it is imperative to comply with this requirement

IMPORTANT

During dielectric strength tests and insulation measurements, it is strongly recommended to connect all the pins that have to be earthed on the SEFELEC 64-SC via accessories of the SEFA-SCHVxx type, not directly to an earth potential.

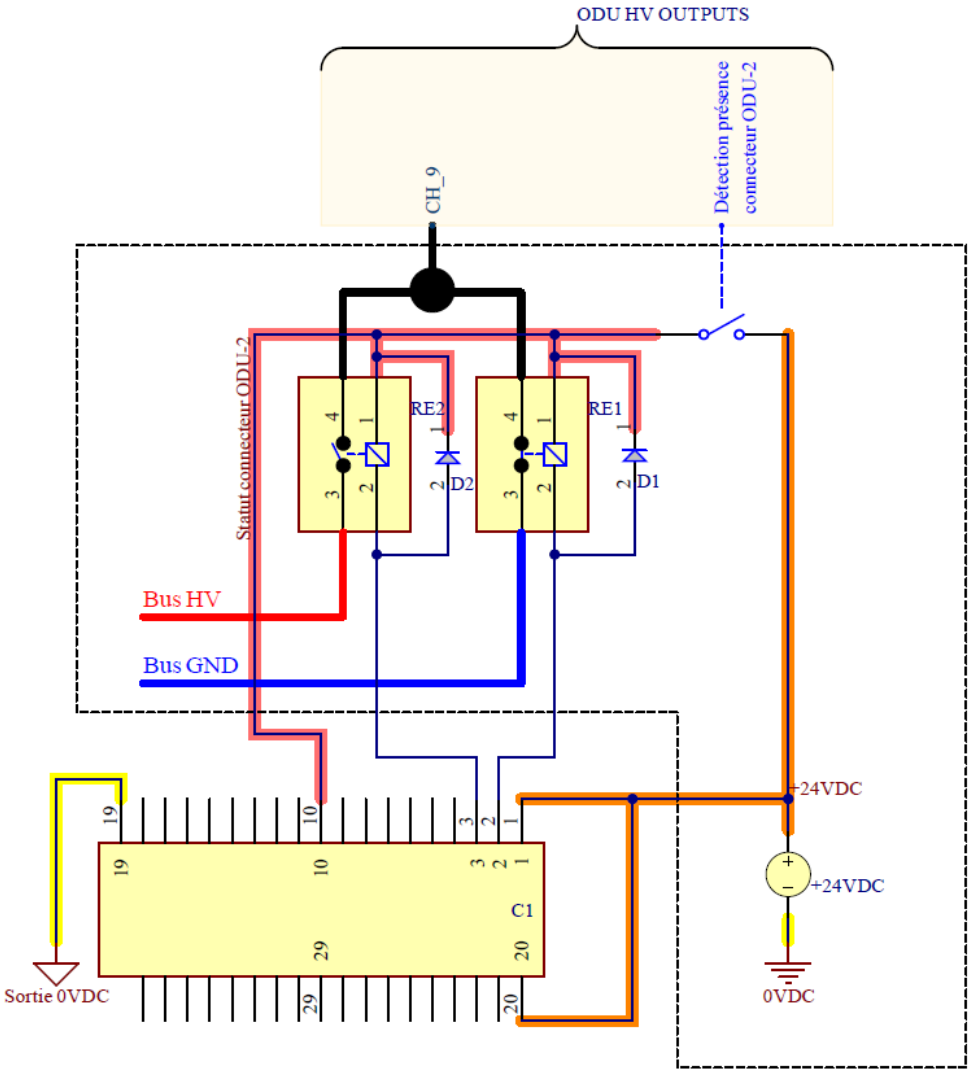
13.1. CONTROL OF THE EARTH CONTINUITY MODULES

Each channel is comprised of a NO relay (Normally Open) to switch the current and a NO relay (Normally Open) to switch the voltage measurement.
The relays are controlled by bringing an earth potential on the pin of the connector (C1 to C4 at the rear panel of the Sefelec 64-SCPLC rack) that corresponds to the desired channel.
The relays must be controlled in pairs: RE1+RE2, RE3+RE4, …



13.2. CONTROL OF THE STRENGTH-INSULATION MODULES

Each channel is comprised of a NO relay (Normally Open), RE2 in the diagram below, to switch the High voltage bus (HV Bus) and a NC relay (Normally Closed), RE1 in the diagram below, to switch the earth (GND bus).
The relays are controlled by bringing an earth potential on the pin of the connector (C1 to C4 at the rear panel of the Sefelec 64-SCPLC rack, see the list in paragraph 13.4) that corresponds to the desired channel.
In the absence of a control, the NC relays set all the channels to the earth potential.
To set a High voltage channel, the relays of the channel have to be controlled at the same time: RE1+RE2 or RE3+RE4 or …

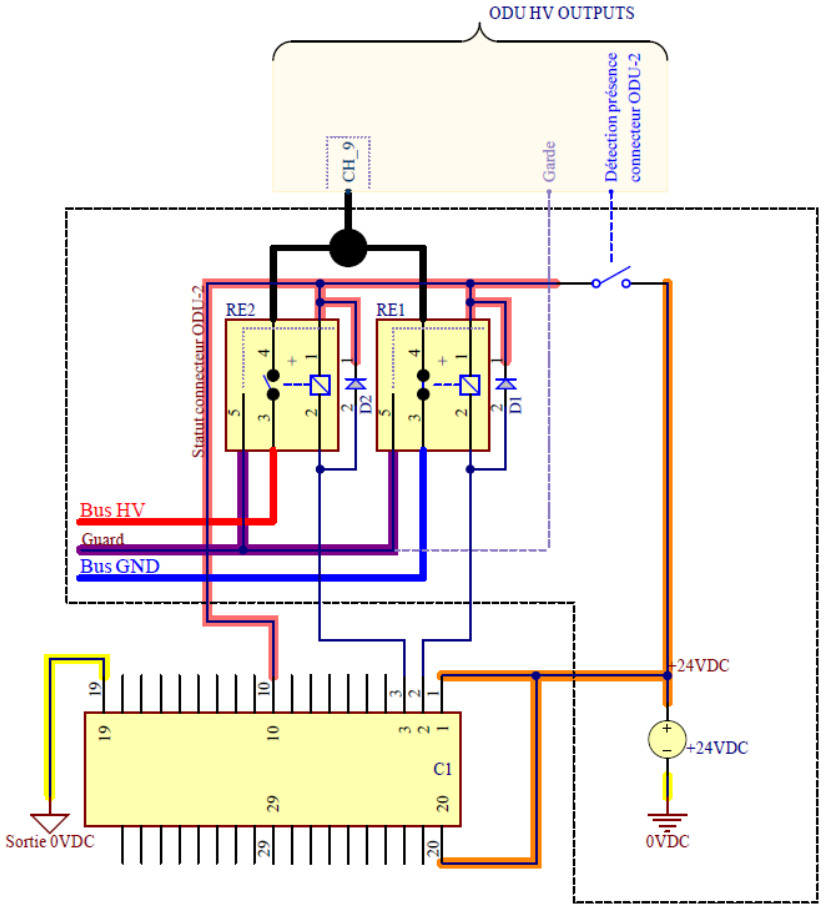


13.3. CONTROL OF THE STRENGTH-HIGH INSULATION MODULES

Each channel is comprised of a NO relay (Normally Open), RE2 in the diagram below, to switch the High voltage bus (HV Bus) and a NC relay (Normally Closed), RE1 in the diagram below, to switch the earth (GND bus).
The relays are controlled by bringing an earth potential on the pin of the connector (C1 to C4, see the list in paragraph 13.4) that corresponds to the desired channel.
In the absence of a control, the NC relays set all the channels to the earth potential.
To set a High voltage channel, the relays of the channel have to be controlled at the same time: RE1+RE2 or RE3+RE4 or …

IMPORTANT

The Strength-High Insulation modules guarantee the specifications for insulation solely in the case of use of a guard voltage. This guard potential is limited to a max. voltage of 1,000VDC.



13.4. PIN ARRANGEMENT OF CONNECTORS C1 TO C4

N°	C1		N°	C2		N°	C3		N°	C4
1	24VDC output		1	24VDC output		1	24VDC output		1	24VDC output
2	M2-RE1-CH_9		2	M4-RE1-CH_25		2	M6-RE1-CH_41		2	M8-RE1-CH_57
3	M2-RE2-CH_9		3	M4-RE2-CH_25		3	M6-RE2-CH_41		3	M8-RE2-CH_57
4	M2-RE3-CH_10		4	M4-RE3-CH_26		4	M6-RE3-CH_42		4	M8-RE3-CH_58
5	M2-RE4-CH_10		5	M4-RE4CH_26		5	M6-RE4-CH_42		5	M8-RE4-CH_58
6	M2-RE5-CH_11		6	M4-RE5-CH_27		6	M6-RE5-CH_43		6	M8-RE5-CH_59
7	M2-RE6-CH_11		7	M4-RE6-CH_27		7	M6-RE6-CH_43		7	M8-RE6-CH_59
8	M2-RE7-CH_12		8	M4-RE7-CH_28		8	M6-RE7-CH_44		8	M8-RE7-CH_60
9	M2-RE8-CH_12		9	M4-RE8-CH_28		9	M6-RE8-CH_44		9	M8-RE8-CH_60
10	ODU-2 Connector Status		10	ODU-4 Connector Status		10	ODU-6 Connector Status		10	ODU-8 Connector Status
11	M2-RE9-CH_13		11	M4-RE9-CH_29		11	M6-RE9-CH_45		11	M8-RE9-CH_61
12	M2-RE10-CH_13		12	M4-RE10-CH_29		12	M6-RE10-CH_45		12	M8-RE10-CH_61
13	M2-RE11-CH_14		13	M4-RE11-CH_30		13	M6-RE11-CH_46		13	M8-RE11-CH_62
14	M2-RE12-CH_14		14	M4-RE12-CH_30		14	M6-RE12-CH_46		14	M8-RE12-CH_62
15	M2-RE13-CH_15		15	M4-RE13-CH_31		15	M6-RE13-CH_47		15	M8-RE13-CH_63
16	M2-RE14-CH_15		16	M4-RE14-CH_31		16	M6-RE14-CH_47		16	M8-RE14-CH_63
17	M2-RE15-CH_16		17	M4-RE15-CH_32		17	M6-RE15-CH_48		17	M8-RE15-CH_64
18	M2-RE16-CH_16		18	M4-RE16-CH_32		18	M6-RE16-CH_48		18	M8-RE16-CH_64
19	0VDC output		19	0VDC output		19	0VDC output		19	0VDC output
20	24VDC output		20	24VDC output		20	24VDC output		20	24VDC output
21	M1-RE1-CH_1		21	M3-RE1-CH_17		21	M5-RE1-CH_33		21	M7-RE1-CH_49
22	M1-RE2-CH_1		22	M3-RE2-CH_17		22	M5-RE2-CH_33		22	M7-RE2-CH_49
23	M1-RE3-CH_2		23	M3-RE3-CH_18		23	M5-RE3-CH_34		23	M7-RE3-CH_50
24	M1-RE4-CH_2		24	M3-RE4-CH_18		24	M5-RE4-CH_34		24	M7-RE4-CH_50
25	M1-RE5-CH_3		25	M3-RE5-CH_19		25	M5-RE5-CH_35		25	M7-RE5-CH_51
26	M1-RE6-CH_3		26	M3-RE6-CH_19		26	M5-RE6-CH_35		26	M7-RE6-CH_51
27	M1-RE7-CH_4		27	M3-RE7-CH_20		27	M5-RE7-CH-36		27	M7-RE7-CH_52
28	M1-RE8-CH_4		28	M3-RE8-CH_20		28	M5-RE8-CH_36		28	M7-RE8-CH_52
29	ODU-1 Connector Status		29	ODU-3 Connector Status		29	ODU-5 Connector Status		29	ODU-7 Connector Status
30	M1-RE9-CH_5		30	M3-RE9-CH_21		30	M5-RE9-CH_37		30	M7-RE9-CH_53
31	M1-RE10-CH_5		31	M3-RE10-CH_21		31	M5-RE10-CH_37		31	M7-RE10-CH_53
32	M1-RE11-CH_6		32	M3-RE11-CH_22		32	M5-RE11-CH_38		32	M7-RE11-CH_54
33	M1-RE12-CH_6		33	M3-RE12-CH_22		33	M5-RE12-CH_38		33	M7-RE12-CH_54
34	M1-RE13-CH_7		34	M3-RE13-CH_23		34	M5-RE13-CH_39		34	M7-RE13-CH_55
35	M1-RE14-CH_7		35	M3-RE14-CH_23		35	M5-RE14-CH_39		35	M7-RE14-CH_55
36	M1-RE15-CH_8		36	M3-RE15-CH_24		36	M5-RE15-CH_40		36	M7-RE15-CH_56
37	M1-RE16-CH_8		37	M3-RE16-CH_24		37	M5-RE16-CH_40		37	M7-RE16-CH_56

See meaning of the pins on the next page.

Description of the pins of connectors C1 to C4:

- Designations **M1 to M8** correspond to the modules installed in a rack.
- Designations **RE1 to RE16** correspond to the channel relays of a module. A channel needs to control 2 relays, for example channel no. 1 = control RE1 and RE2 whether for insulation tests, dielectric strength or earth continuity tests.
- Designations **CH_1 to CH_64** correspond to the numbers of the channels with absolute numbering.
- **24VDC output** corresponds to the internal 24VDC power supply used to power the relay coils. It is not mandatory to use these outputs.
- **0VDC output** corresponds to the earth of the 24VDC power supply to control relays. This potential must be connected via a dry contact or a semiconductor to the **Mx-REx-CH_x** inputs to control the channel relays.
- **ODU-1 to 8 Connector Status** indicates if the accessory plug with cables is connected to the corresponding socket. A voltage of +24VDC corresponds to a connected plug, absence of voltage indicates a plug that is not connected.

ATTENTION

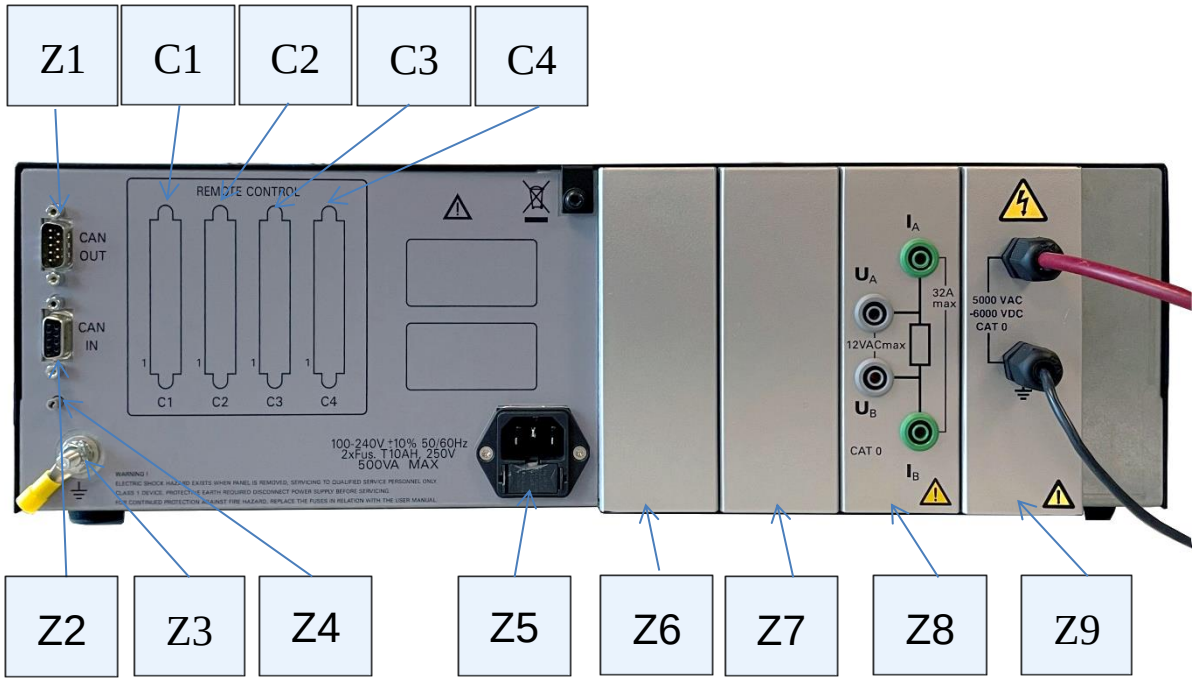
Dangerous voltages can be present on the pins of the ODU connectors. It is recommended to have all the accessory plugs connected in order to be able to start a test.

IMPORTANT

The characteristics of the relays are valid for switching conditions with a zero voltage and zero current (cold switching). To guarantee these specifications, it is imperative to comply with this requirement

14. LAYOUT OF REAR PANEL SOCKETS

14.1. REAR PANEL DESCRIPTION



The rear panel includes the following elements:

- Z1: 9-pin sub-D connector for CAN bus output for controlling an extension rack
- C1: direct control of the 37-pin sub-D relay coils
- C2: direct control of the 37-pin sub-D relay coils
- C3: direct control of the 37-pin sub-D relay coils
- C4: direct control of the 37-pin sub-D relay coils
- Z2: 9-pin sub-D connector for CAN bus input for controlling coming from the 5x
- Z3: Earth connection stud bolt.
- Z4: rotary switch for rack address selection 1 to 8
- Z5: Mains socket with incorporated fuses
- Z6: Output area of the cables for earth continuity measurement for extension rack
- Z7: Output area of the cables for strength and insulation measurement for extension rack
- Z8: Input area of the cables for earth continuity measurement
- Z9: Input area of the cables for strength and insulation measurement

15. MAINTENANCE AND CALIBRATION

15.1. PRELIMINARIES

Our warranty (see the beginning of this manual) certifies the quality of the equipment of our production. If a malfunction is suspected or for any technical information concerning the use of our devices, call our technical department for France on 33.1.64.11.83.40. For foreign countries Contact your local representative.

WARNING

Dangerous voltages may be present in the devices.

Repairs should only be performed by the manufacturer or by personnel instructed.

15.2. RETURN OF EQUIPMENT

Before returning equipment to our service department, please setup a return number (RMA) on our website at the following link:

sefelec.com/rma.html

You will find out about the conditions for the return of the equipment.

Use the original packaging or if this is not possible packaging guaranteeing the protection of the equipment during its transport.

15.3. MAINTENANCE

WARNING

Danger of electric shock!

The commissioning, use and maintenance of the equipment must be carried out by qualified personnel.

Our devices do not require special maintenance, except for calibration.

In case of problems, please contact our service department.

Cleaning the device

Only clean the device with a soft cloth or one slightly moistened with water. For the LCD screen use a microfibre cloth.

Calibration

We recommend annual calibration of our devices. This calibration may be advanced or delayed depending on the rate of use of the measurement device (ask the EATON service department for advice). The latter must be carried out by qualified personnel with the detailed procedure and duly verified calibration means. Our service department is at your disposal to carry out the annual calibrations at the best prices and as quickly as possible.

Maintenance

Our technicians are specially qualified for verification and scheduled maintenance of measuring devices.

However, the customer's maintenance staff will need to handle the cleaning, the dust filter changes (depending on the models) and the clearance of the vents of the device. In dusty environments, we recommend periodic cleaning with a vacuum cleaner inside the measuring device (compressed air not allowed).

In workshops with cold floors or using water for washing, we recommend installing the measurement device on a pedestal to limit condensation.

Recommendation:

That the metrological functions be checked at least once a year, by the customer or a specialist. If this period is exceeded, we cannot guarantee the accuracy of the measurements or the correct operation of the elements of the device.

Periodicity:

Monthly	Filter cleaning
Annually	Metrological calibration
Annually	Dust removal

16. END-USER LICENSE AGREEMENT

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EATON Intelligent Power Limited
EATON Home,
30 Pembroke Road,
Dublin 4,
D04 Y0C2,
Ireland

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EATON EULA

17. EU DECLARATION OF CONFORMITY

EU Declaration of Conformity

We,
Sefelec sas Eaton groupe
19 rue des campanules
77185 LOGNES
France

declare under our sole responsibility as the manufacturer of Electrical measurement units, that

Sefelec 64-SC series

Types within the range on page 2,

provided that if it is installed, maintained and used in the application intended for, with respect to the relevant manufacturer instructions, installation standards and "good engineering practices",

complies with the provisions of Union harmonisation legislation

2014/35/EU	*LVD – Low Voltage Directive*
2014/30/EU	*EMC – Electromagnetic Directive*
2011/65/EU	*RoHS – Restriction of Hazardous Substances*

based on compliance with European standards:

IEC 61010-1:2010 + AMD1:2016 AND EN 61010-1:2010 + A1:2019, IN CONJUNCTION WITH IEC 61010-2-034: 2017 AND EN61010-2-034: 2021
Safety requirements for electrical equipment for measurement, control and laboratory use.

EN 61326-1 of 2021, IEC 61000-3-2 of 2019 & IEC 61000-3-3 of 2013 + A1 (2019)
Measurement, control and laboratory electrical devices – EMC related instructions.

EN 50581: 2012
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Date: 4th July 2023

Didier Delacourt
Engineering Director

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Types within the range

The declaration of conformity applies to the following types within the product family:

Reference	*Description*
SEFELEC 64-SC	Empty rack max. 64 channels (main or extension)
SEFELEC 64-SCPLC	Empty rack max. 64 channels with switching relays direct drive
SEFM-8EHV	8 channels Hipot/Insulation module
SEFM-8EHVHO	8 channels Hipot/High Insulation module
SEFM-8EHC	8 channels Ground bond module
SEFA-SCHV4-02	4 channels lead Hipot/Insulation, length = 2m
SEFA-SCHV4-05	4 channels lead Hipot/Insulation, length = 5m
SEFA-SCHC4-02	4 channels lead Ground/Bond, length = 2m
SEFA-SCHC4-05	4 channels lead Ground/Bond, length = 5m
SEFA-SCHV8-02	8 channels lead Hipot/Insulation, length = 2m
SEFA-SCHV8-05	8 channels lead Hipot/Insulation, length = 5m
SEFA-SCHC8-02	8 channels lead Ground/Bond, length = 2m
SEFA-SCHC8-05	8 channels lead Ground/Bond, length = 5m
SEFO-64INHC	Ground bond input module
SEFO-64INHV10	Insulation input module (Sefelec 1000-M)
SEFO-64INHV	Hipot/Insulation input module
SEFO-64INHVAUX	Hipot/Insulation input module (third part generators)
SEFO-64OUTHC	Ground bond test output module (to extension rack)
SEFO-64OUTHV	Hipot/Insulation output module (to extension rack)
SEFA-KR	19" rackmount kit

Powering Business Worldwide

Reference	*Description*
SEFM-4IHC	4 channels Ground bond test module
SEFM-4IHV	4 channels Hipot/Insulation module
SEFM-4IHVHC	4 channels Hipot/Insulation & 4 channels Ground bond test module
SEFM-8IHC	8 channels Ground bond test module
SEFM-8IHV	8 channels Hipot/Insulation module
SEFA-SCHV4-02	4 channels lead Hipot/Insulation, length = 2m
SEFA-SCHV4-05	4 channels lead Hipot/Insulation, length = 5m
SEFA-SCHC4-02	4 channels lead Ground/Bond, length = 2m
SEFA-SCHC4-05	4 channels lead Ground/Bond, length = 5m
SEFA-SCHV8-02	8 channels lead Hipot/Insulation, length = 2m
SEFA-SCHV8-05	8 channels lead Hipot/Insulation, length = 5m
SEFA-SCHC8-02	8 channels lead Ground/Bond, length = 2m
SEFA-SCHC8-05	8 channels lead Ground/Bond, length = 5m
SEFA-SCHVHC4-02	4 channels HV and 4 channels GB lead, length = 2m
SEFA-SCHVHC4-05	4 channels HV and 4 channels GB lead, length = 5m

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