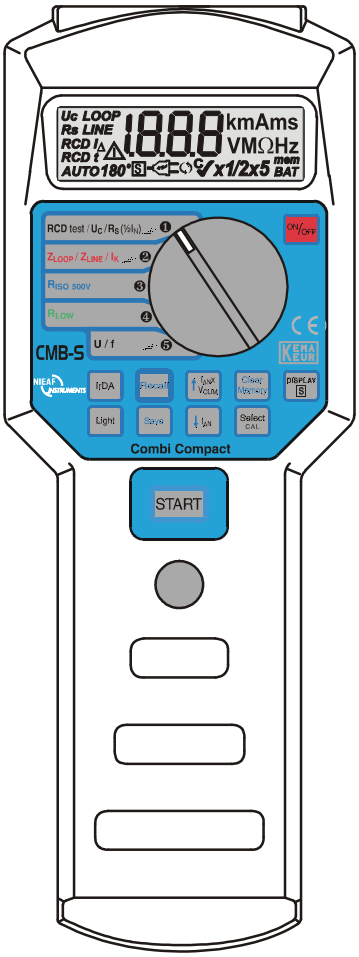
User manual
Combi Compact Installation Tester



Supplier:	Nieaf-Smitt bv Vrieslantlaan 6 3526 AA Utrecht Holland P.O. box 7023 3502 KA Utrecht
Specifications of the equipment:	CMB-S
Specifications of the user manual:	Date: 01-08-2012 Number:561.144.059 Ref.: 006

Preface

This manual describes the Combi Compact Installation tester. The information in this manual is important for proper and safe functioning of the machine. In case you are not familiar with the operation, the preventive maintenance, etc. of the Combi Compact tester, then you read this user manual from the beginning to the end thoroughly.
If you are familiar with these matters, you can use this manual for reference. You can find the required information rapidly using the table of contents.

In this user manual, the following four marking conventions are used to focus attention on certain subjects or actions.

	***TIP:*** ***Gives you suggestions and advice to perform certain tasks easier or handier.***

	***ATTENTION:*** ***A remark with additional information; draws your attention to possible problems.***

	***CAUTION:*** ***The machine may be damaged, if you do not carefully execute the procedures.***

	***WARNING FOR DANGER:*** ***You can (seriously) hurt yourself or seriously damage the product, if you do not carefully execute the procedures.***

- this document is described with the words manual or user manual;
- the test equipment is described with the words tester, instrument or test device;
- values or displayed data is placed between inverted commas for example “230 V”;
- keys or switch positions are placed between angular brackets for example [Start] key.

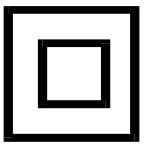
Warranty

Nieaf-Smitt bv guaranties the tester for a period of 6 months.
The period of warranty will be effective at the day of delivery. The warranty clauses and the stipulations regarding liability in terms of delivery are registered in the conditions of FME.

Warning pictograms on the tester

On the tester a number of pictograms are attached meant to warn the user for remaining risks that may be presented when using the instrument, despite its safe design.

Table 1: *Pictograms on the tester*

Pictogram	Description	Location on the tester
	Warning: General sign for danger. Read the instructions carefully before use.	At the backside of the tester, on the instruction label.
	Mark: Insulation class II (double insulation). Cat III 300V / Cat II 600 V	At the backside of the tester, on the instruction label.
	Mark: Marks the KEMA certification of the tester.	Front side of the tester.
	CE-mark: Declares the conformity with the European Directives.	The CE-mark is placed on the front side of the tester.

All peripherals that are used by this tester must be provided with a CE-mark.
This includes for example the use of a PC.

CONTENTS

Tables:

Figures:

Attachments:

Attachment 1: EU-Declaration of Conformity

Attachment 2: Circuit diagrams
- *Contact voltage (Uc);*
- *Earth loop resistance (Rs);*
- *Disconnection time (t);*
- *Disconnection current (IΔ) and disconnection time (tΔ);*
- *Line (R_{LINE}) or loop (R_{LOOP}) impedance and prospective circuit current (I_k)*
- *Insulation resistance (Riso 500V)*
- *Low resistance (R_{LOW})*
- *Mains Voltage (U) or frequency*

1 GENERAL SAFETY REGULATIONS

	***If a third party uses the tester, you being the owner are responsible, unless otherwise specified.***
	***Provide a clean, save and a sufficient lightened test area / working place.***
	***Read your manual carefully before you start working with this tester. Nieaf-Smitt bv is not liable for any physical harm, (financial) damage and/ or excessive wear due to incorrect maintenance or modification of the tester.***
	***It is not allowed to remove, to skirt or to tide over (by handy constructions) the enclosure or safeties of the tester during normal use. Measurement methods with their range are indicated at the backside of the tester.***
	***It is forbidden to place and/or to use the instrument in an unsafe room with a risk of explosion.***
	***Only Niaf-Smitt bv and its authorised distributors are allowed to repair the tester.***

2 INTRODUCTION

2.1 GENERAL

The Combi Compact-tester is intended for execution of all tests according to the standards for:
- different protective switches with differential current protection;
- line (L-N) as well as loop (L-PE) impedance;
- insulation resistance;
- low resistance.

Next to this the Combi Compact tester can be used for the measurement of mains voltage and – frequency.
The instrument is not suitable for other applications.
If the instrument is used in manner not specified in this user manual, the protection provided by the instrument may be impaired and the supplier is excluded from any responsibility.

2.1.1 Working principle

Structure

The CMB-S is a professional microprocessor-controlled instrument which combines the properties for the execution of all tests concerning different protective switches with differential current protection (RCDs), execution of line (L – N) as well as loop (L – PE) impedance, insulation resistance and low resistance.
The tests are selected by means of the rotary switch, which makes is possible to choose between the different main-groups. This makes the user able to prescribe the desired measuring method.
The test results are clearly displayed on the LCD.

Connecting

Four alkaline batteries (4 x 1,5 V IEC) power the instrument.
The tester is provided with an On/Off switch and can, after powering up, be used at once.
The test cords are connected at the upper side of the tester.

Measuring

Each test has its own specific connection diagram, which is given in the attachments.
Each measurement is done conform to EN 50110 and the EN 61557.

The next measurements are executable by the instrument:

RCDtest/Uc/Rs
- Contact voltage Uc at the current of $I_{\Delta N}$ (general type) or at the current of $2I_{\Delta N}$ (selective type) without tripping out RCD;
- Earth loop resistance Rs;
- Disconnecting current I_{Δ};
- Disconnection time t at the current of $1/2I_{\Delta N}$, $I_{\Delta N}$, $2I_{\Delta N}$, $5I_{\Delta N}$.

Zline/Zloop/Ik
- Line impedance between line and neutral conductors;
- Loop impedance between line and protective conductors;
- Prospective short circuit current;
- Protective earth terminal status (safe or dangerous).

Riso 500V
- Insulation resistance using 500V measuring voltage

Rlow
- Low resistance

U/f
- Mains voltage
- Mains frequency

2.2 SPECIFICATIONS

2.2.1 General

Rated voltage	:	100 - 250 Vac (eff)
Rated frequency	:	45 - 65 Hz
Display	:	3 digit 7 segment LCD 19 mm with additional warning signs and lighting
Memory size	:	approx. 1500 memory locations
Power supply	:	4 x 1,5 V IEC LR14 standard batteries or rechargeable batteries.
PC-communication	:	IrDA
Automatic /N exchange function	:	incorporated
Protection classification	:	double insulation
Overvoltage category	:	II 600V, III 300V
Max. voltage against ground	:	300V ~
Max. voltage L/ N	:	264V ~
Degree of protection	:	IP50
Quality standard	:	designed, developed and produced conform ISO 9001, EN 61010-1 (European safety standard) EN 50081-1 / 50082-1 (EMC), EN 61557-1,-2,-3,-4,-6
Measurements standardised conform	:	EN 50110, NEN 3140, NEN 1010-6 EN 61557, KEMA K58B, BS 57671 (16th edition)
Pollution degree	:	2
Mass (ex holster)	:	0,75 kg approx. (including batteries and accessories, excl holster)
Dimensions (WxHxD) (ex holster)	:	65 x 110 x 290 mm
Reference temp. range	:	5°C ÷ 35°C
Operating temp. range	:	0°C ÷ 40°C
Storage temp. range	:	-10°C ÷ 60°C
Max. operating humidity	:	85% RH (0°C ÷ 40°C)
Max. storage humidity	:	80% RH (40°C ÷ 60°C) 90% RH (-10°C ÷ 40°C)

2.2.2 Technical specifications

2.2.2.1 Protective switches

Types	AC (~), normal / A, selective
Rated values of fault currents	10 mA, 30 mA, 100 mA, 300 mA en 500mA

Disconnection time (t) of RCD (standard or general)

Leakage current	Range t (ms) general	Range t (ms) selective	Resolution (ms)	Accuracy
½ $I_{\Delta N}$	No disconnection	No disconnection	1	±(2% of reading + 3 ms)
$I_{\Delta N}$	300	130 – 500		
2 $I_{\Delta N}$	150	60 – 200		
5 $I_{\Delta N}$	40	50 – 150		

RMS values (10 ms) of fault currents

½ $I_{\Delta N}$ (mA)	$I_{\Delta N}$ (mA)	2 $I_{\Delta N}$ (mA)	5 $I_{\Delta N}$ (mA)
~	~	~	~
5	10	20	250
15	30	60	250
50	100	200	500
150	300	600	1500
250	500	1000	2500

Accuracy of fault current: + 10%, - 0%.**$I_{\Delta N}$ (mA), 2 $I_{\Delta N}$ (mA), 5 $I_{\Delta N}$ (mA)**
- 10%,+- 0% for **0.5 $I_{\Delta N}$ (mA)**

Contact voltage UC at the rated fault current (a general RCD type) or at the double rated fault current (selective RCD type)

Range (U_C) (V)	Resolution (V)	Accuracy
0 – 99,9	0,1	+10%, -0% (of reading) ± 0,2 V (U_B = 0 – 9,9 V)
		+ 10%, -0% (of reading) (U_B = 10,0 – 99,9 V)

Test current: 0.5 $I_{\Delta N}$

The specifications of the above table are valid under the following conditions:
- max. instability of line voltage during the instrument is ± 1;
- the protective conductor is free of interfering voltages.

Earth loop resistance Rs without tripping out RCD

$I_{\Delta N}$ (mA)	Range Rs (Ω)	Resolution (Ω)	Accuracy
10	10 – 10.00 K	1	± (5% + 10Ω)
30	3,3 – 3.33 K	0,1	± (5% + 3,3Ω)
100	1 – 1000	0,1	± (5% + 1Ω)
300	0,33 – 333	0,1	± (5% + 0,33Ω)
500	0,20 – 200	0,1	± (5% + 0,2Ω)

Test current: 0.5 $I_{\Delta N}$

Disconnecting current IΔ of a general RCD

Range I_{Δ}	Resolution	Accuracy
(0,2 – 1,1)$I_{\Delta N}$	0,05 $I_{\Delta N}$	-0,05 $I_{\Delta N}$ ... + 0,2 $I_{\Delta N}$

Disconnection time t of a general RCD at disconnecting current is in the same range as in function disconnection time t of a general of selective RCD.

Alternating voltage U_{L-PE}	
Range	0 – 250 V
Resolution	1
Accuracy	± (2% of reading + 2 digits)

Frequency	
Range	45. – 65.0 Hz
Resolution	0.1 Hz
Accuracy	± (0.1% of reading + 1 digits)

2.2.2.2 Line / loop impedance

Range (automatic selected)	0 – 19.99 Ω / 20.0 – 199.9 Ω / 200 – 1999 Ω
Resolution	0.01 Ω / 0.1 Ω / 1 Ω
Accuracy	± (5% + 2 digits)
Nominal voltage	100 – 250 V
Nominal frequency	45 – 65 Hz

Short-circuit current (I_K) standard value (impedance)

Short-circuit current I_K calculation:

$$I_K = \frac{Unom}{Z} * \left(1 + \frac{\delta}{100\%}\right)$$

U nom : factory setup 230V
δ: factory setup 6%

Unit	Loop measurement	Line measurement
Unom	Loop voltage, U L-PE	Line voltage, U L-N
Z	Loop impedance, R L-PE	Loop impedance, R L-N

	***Accuracy of I_K depends straight on the accuracy of the resistance***

I_K display range (230 V) 0.11 A ÷ 23 kA	
Range I_K	**Resolution**
0.06 – 19.99 A	0.01 A
20.0 – 199..9 A	0.1 A
200 – 1999 A	1 A
2.00 – 19.99 kA	10 A
20.0 – 23.0 kA	100 A

2.2.2.3 Insulation resistance

Nominal output voltage	500 V
Max. output voltage	1.3 x nominal voltage
Open circuit output voltage	500 V/ 0 – 10%
Measuring current	1mA minimum at 500 k Ω load
Short circuit current	≤ 1.4 mA

Range (auto ranging)	**Resolution**	**Accuracy**
0 – 1.999 MΩ	1 KΩ	± (2% reading + 2 dig)
2.00 – 19.99 MΩ	10 KΩ	± (2% reading + 2 dig)
20.0 – 199.9 MΩ	100 KΩ	± (2% reading + 2 dig)

2.2.2.4 Low resistance

Range	0 - 3 k Ω
Resolution	0 - 20 Ω: 0,01 Ω 20 Ω – 199.9 Ω: 0.1 Ω 200 Ω – 1999 Ω: 1 Ω 2 k Ω – 2 k 99: 0.01 k Ω
Accuracy	0 - 20 Ω (± 2% of reading ± 2 digits) 20 - 3 k Ω (± 5% of reading ± 5 digits)
Short circuit current	0 – 20 Ω > 200 mA at Ubat > 5 V 20 -3 k Ω< 7 mA
Open circuit output voltage	≥ 4,5 V at Ubat > 5V

2.2.2.5 Voltage and - frequency

Voltage	
Range	0 - 440 V
Resolution	1 V
Accuracy	± 2% of reading ± 2 digits
Max. input	440 Veff

Frequency	
Range	40,0 - 199,9 Hz / 200- 500 Hz
Resolution	0,1 / 1 Hz
Accuracy	± 0,1% of reading ± 1 digit

2.3 TRANSPORT

The tester is a portable test device which can be hand-held or lay down (solid foundation) during the tests. Protect the instrument during transport to avoid any damage.

2.4 CERTIFICATION

The tester and this manual have been designed, constructed and tested according to the European directives. During all these phases the relevant (preliminary) European standards have been taken into account.
The CE-mark has been fixed on the instrument. The directives and the standards mentioned are enumerated in the EC-Declaration of Conformity, attachment 1.

3 TESTER COMPOSITION

3.1 GENERAL

The CMB-S is built in an enclosure of solid ABS plastic.
The display is situated at the front side of the instrument. Testresults will be displayed here.
The main parts (see figures in Chapter 5) are listed below:

Front:
1. On/off key
2. Rotary switch
3. LCD-display (no. 13 in Figure 3)

Back:
1. Instruction label
2. Serial number
3. Battery cover
4. Battery cover fastening screw

3.2 PRINCIPLE OF MEASUREMENT

3.2.1 Visual inspection

Before executing the safety tests, the object or installation has to be checked visually.
Objective of this inspection is to ensure the electrically safety of the latter parts.
Check wires, cables and components for possible damages. If any damage has been noticed, it is not allowed to perform any tests before the test object or installation is repaired properly.

3.2.2 *Theoretical principles of RCD operation*

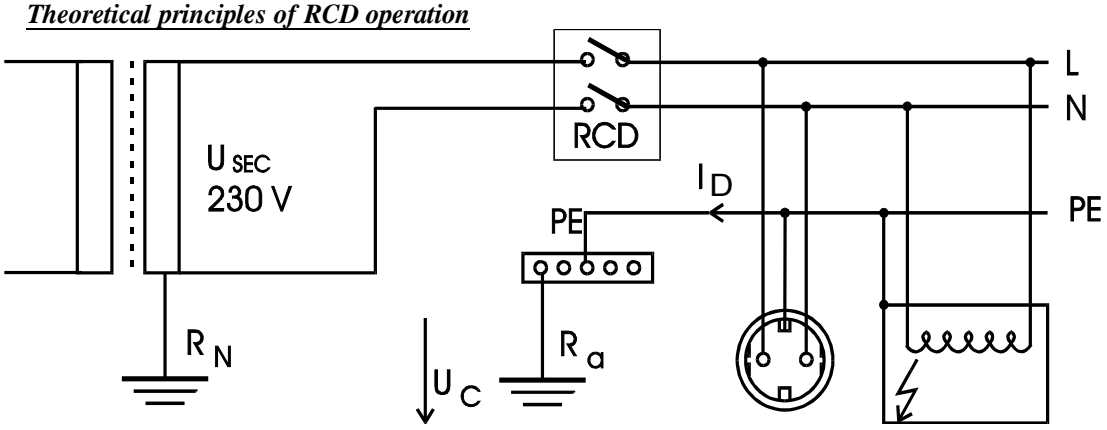
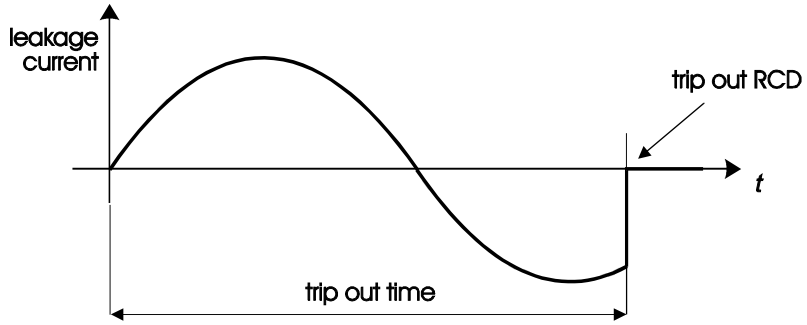


Figure 1: TT system connection

R_N = grounding resistance of transformer
R_{SEC} = resistance of transformer's secondary
R_S = grounding resistance

If a portion of the phase current is leaking through a bad insulation to the casing of an appliance and thereby to the grounding across the grounding resistance R_S, a hazardous contact voltage U_C can appear.
As some RCDs are sensitive only to positive or negative half periods, the Combi Compact has the possibility to generate fault current with positive (0°) or negative (180°) start phase, see figure 2.

a) Alternating form (starting phase 0°)



b) Alternating form (starting phase 180°)

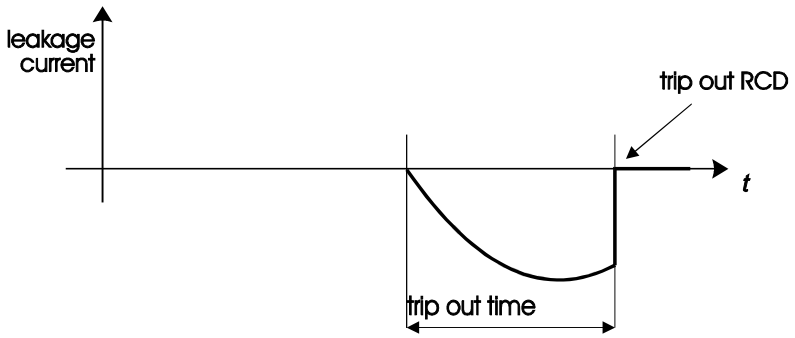


Figure 2: Alternating fault current.

3.2.3 Contact voltage and earth loop resistance without tripping out RCD

The CMB-S makes it possible to measure the contact voltage and the earth loop resistance without tripping out the RCD. For safety reasons, contact voltage measurement using half of nominal fault current is performed before any other parameter is tested. Nature of selective RCD is to contains an integration function of leakage current because of required delayed trip out, that is why the operator must wait for 30s before reaching final result eliminating the influence of test current for contact voltage measurement.

3.2.4 Line - or loop-impedance and prospective short-circuit current

Why to test line or fault loop impedance and prospective short-circuit current?
- to verify correspondence fused fuses (nominal current and breaking current capacity);
- to dimension the protection system;
- to verify the capability of the power source;
- to trace bad contacts (measurement is performed using high current impulse).

3.2.5 Insulation resistance

This test can only be done if no feeding (main)voltage is supplied to the object or the installation.

This test is set up to check the insulation resistance of a test object or installation.
The check is done between different phases, zero and PE or between different lines.
This test is executed at a voltage of 500V. The insulation resistance is sufficient if its value is, at least, 1000 times the rated power supply voltage.

Capacitive load is discharged automatically after finishing the measurement.
The discharged voltage will be displayed.

3.2.6 Low resistance

This test is set up to check the low resistance between two (earth) terminals of a test object or installation.. It is possible to execute a short (single) as well as a continuous (multiple) measurement. The continuous test makes it possible to check different positions in one action.

In order to obtain correct results, first a compensation of the test cords' resistance must be carried out. The measurement is automatically carried out in two steps. The first step is executed with the positive polarity of the test voltage, while the second step is executed with the negative polarity.
The displayed result is an average of both polarities:

$$\text{Result} = \frac{\text{Res}(+) + \text{Res}(-)}{2}$$

Result: displayed value;
Res (+): result obtained with positive polarity (can not be displayed separately);
Res (-): result obtained with negative polarity (can not be displayed separately);

3.2.7 Beeping

The CMB-S is equipped with an adjustable limits that can be used as an indication for the value of the resistance measured. This method is called "beeping" of an object and can be used for the short as well as for the continuous resistance measurement. After setting a minimum and a maximum limit, a sound signal will be produced each time a result is between these limits.

3.2.8 Voltage / frequency of mains voltage measurement

The test is executed between the several phases and the neutral of the installation.
This test is set up to check the present mains voltage and – frequency of an installation.

	***For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.***

4 STARTING AND ADJUSTING

	***The tester can only be used if no damages or defects are noticed And all original components belonging to the tester are mounted correctly.***

	***The transportation and the handling of the tester should be done carefully to prevent any damage.***

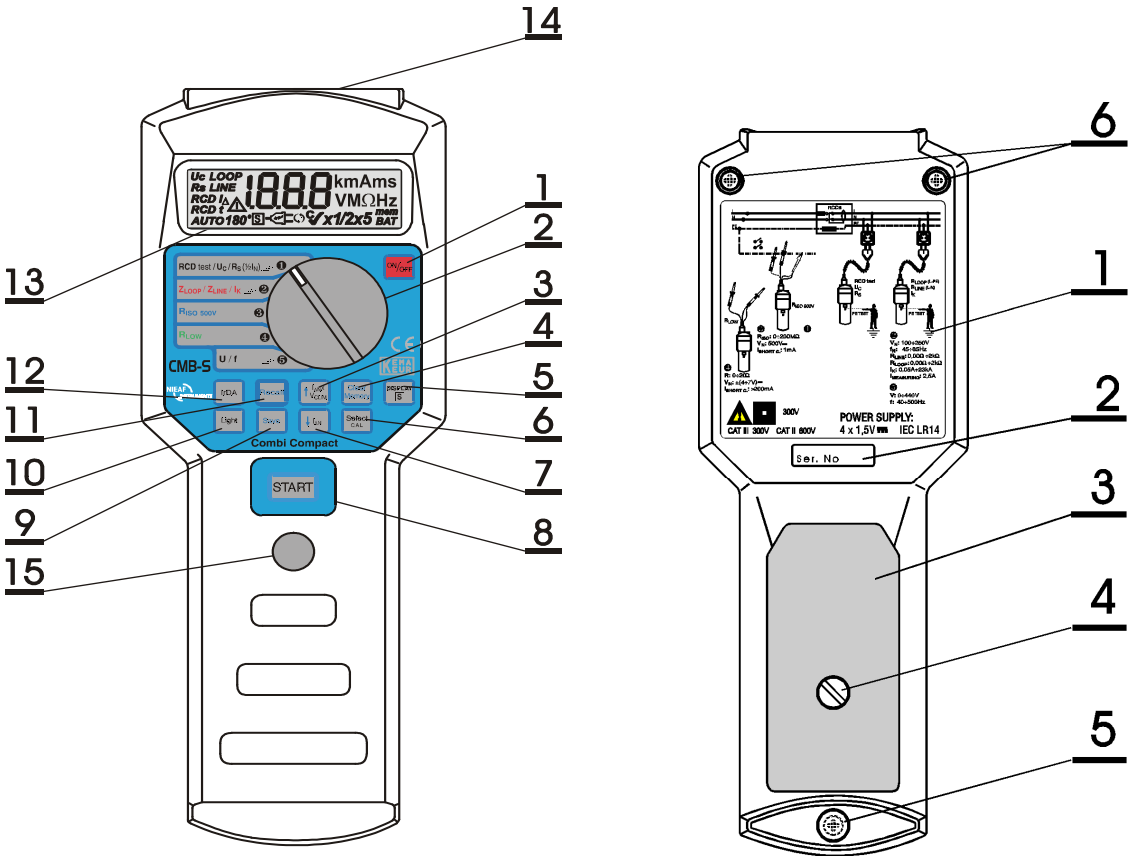
This paragraph describes the procedure to install, start up and adjust the instrument.
Only competent persons are allowed to do the installation, the starting up and the adjustment of the instrument.

1. Unpack the instrument.
   - Remove the packing materials without causing damages to the environment.
   - Check the tester on possible damages. If damages are noticed, contact Nieaf-Smitt bv.
2. Put the instrument in a horizontal position.
   - Keep enough clearance around the instrument to facilitate an easy operation, adjustment and reading of testresults, without any problems or extra danger.
3. Insert the batteries in the instrument.
4. Connect the test object according to the circuit diagrams with the CMB-S.
5. Carry out the selected test.

	***Find such a place for the manual that it is within reach During the use of the tester.***

5 OPERATING TESTER

5.1 OPERATION



Front side

1. ON/OFF key
2. Rotary switch
3. Increase memory location key
4. Clear memory key
5. DISPLAY / S key
6. Select/ CAL key
7. Decrease memory location key
8. START key
9. Save result key
10. Light key (back light)
11. Recall result key
12. IrDA communication key
13. LC Display
14. Connector part (mains and IrDA communication window)
15. PE test electrode

Backside

1. Instruction label
2. Serial number
3. Battery cover
4. Fastening screw for battery cover
5. Plastic cover of the fixing screw

Figure 3: Front- and back-side.

Keys
A short description of the keys and the rotary switch is given in table 2.

Table 2: Keys and rotary switch

Function	Description
Rotary switch (2)	
RCD-test / Uc / Rs	- Testing contact voltage / earth loop resistance / disconnecting current/ disconnecting time / automatic RCD-test
R_{LOOP} / R_{LINE} / I_K	- Testing loop impedance / line impedance/ prospective short circuit current / protective earth terminal status
$R_{ISO\ 500V}$	- Insulation resistance
R_{LOW}	- Low resistance
U / f	- Mains voltage and – frequency
Keys	
1. ON/OFF	- Switching the instrument On / Off (auto Off 10 minutes after last key has been pressed or rotary switch moved)
3 $I_{\Delta N}$x / V_{CLIM}	- increase object or measuring place identification number when saving results (↑); - check other results saved later then displayed one under the same object and measuring place identification number; - select appropriate multiplier of nominal fault current in $t_{\Delta N}$ function ($I_{\Delta N}$x); - select U_{CLIM} when rotary switch in U_C position.
4. Clear Memory	- clear data out of memory.
5. DISPLAY S	- display subresult or parameters in displayed result; - select object identification number or measuring place identification number when [Save] or [Recall] function.
6. Select	- select subfunctions; - enable compensate test cables resistance when in R_{LOW} function.
7. $I_{\Delta N}$	- decrease object or measuring place identification number when saving or recalling results; - check other results saved before then displayed one under the same object and measuring place identification number; - select appropriate nominal fault current in Uc, $t_{\Delta N}$ or t_{Δ} functions.
8. START	- Start key to start measurement or print out of results.
9. Save	- Save key to save measuring result displayed.
10. Light	- Light key to switch on back light of LCD (auto off after 20 sec).
11. Recall	- Recall key to recall saved result.
12. IrDA	- Communication key to transfer memorised results into PC.

5.1.1 Starting

	***Only competent persons are allowed to operate*** ***Never open the instrument during testing.*** ***Check before every test:*** ***Possible damages on cables and test cords;*** ***Possible damages and/or defects on the tester.***

1. Check the instrument for visible damages and/or defects.
   - Look for example at the power plug, the line cord etc.
   - Do not carry out any test with a damaged or broken instrument.
2. The instrument can be used at once.

Test selection

Carry out a visual inspection on the test object or the installation first.
Connect the tester here after according to the circuit diagrams of attachment 2.

With the rotary switch five groups of tests can be selected.
Under each of these groups the specific tests can be chosen.

Example:
Check the disconnection time of an RCD.
- *Place the rotary switch in position 1*
- *Work out test number 5.*

Table 3: Testovervieuw

Test no.	Rotary switch	Name	Possiblities
1	1 / 2 / 5		Protective Earth terminal status
2	1	**RCD-test / Uc / Rs**	Contact voltage U_c
3	1		Earth loop resistance Rs
4	1		Disconnecting current IΔ
5	1		Disconnecting time
6	2	**R_{LOOP} / R_{LINE} / I_K**	Loop impedance
			Line impedance
			Prospective short circuit current
7	3	**Riso 500V**	Insulation resistance using 500V measuring voltage
8	4	**R_{LOW}**	Short - and – en continues resistance (with beeping)
9	5	**U / f**	Mains voltage and – frequency

5.2 TESTING

	***Avoid testing of objects / installations which are under the influence of high electromagnetic and/or electrostatic fields.***

In the following paragraph the test methods will be explained.
It is considered that the starting-up is carried out as described in paragraph 5.1.1.

5.2.1 Test 1 Protective earth terminal status

	***If the rotary switch is in a position marked with the symbol , Touching the PE terminal can check the safety of the connection.***

Procedure safety check PE

1. Set the rotary switch on position RCD test / Uc / Rs❶, R_{LOOP} / R_{LINE} / I_K ❷ or U/ f ❺
2. Connect the test cable to the outlet.
3. Touch PE test electrode (key 15) with a finger.
4. If a dangerous voltage is present or if the PE conductor is interrupted (dangerous voltage is in this case present due to capacitive connection between interrupted PE conductor and phase conductor), the instrument will start beeping.

This function is used when there is doubt about the presence of a good earth connection in the wall socket or in the installation panel. It measures the voltage difference between the earth connection in the wall socket/installation against the PE install button.
The test can be performed by the person touching constantly the PE button, thus making a connection to earth. If the “PE”- sign indication appears in the CMB-S display, there is no proper earth connection. If no PE-sign appears in the display, there is a proper earthing connection.

	***Stop further tests at the mains outlet immediately. Make sure the outlet is connected well.***

5.2.2 Test 2: Contact voltage (Uc)

5.2.2.1 Setting up limited contact voltage (Uc lim)

	***- Do not remove the cords during measurements.*** ***- Do not touch the test-object during measurement.*** ***- Each result can only be saved once.***

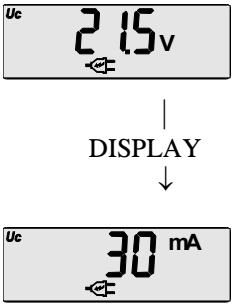
For normal household installations the admissible value for the contact voltage is 50 V.
When higher safety is required (e.g. in hospitals), its value can be as low as 25 V.
Therefore the admissible value can be pre-set on the instrument by proceeding as follows:

Setting up limited contact voltage:
1. Set the rotary switch to RCD*test* / Uc / Rs .
2. Set with the [Select] key *Uc* in the left corner of the LCD.
3. Select the correct appropriate value using the [$\uparrow I_{\Delta N}X$ / Vclim] key.

The limited value thus set is valid for all functions and remains stored even if the instrument is switched off.
After batteries have been exchanged, the instrument is set to the default value of 50 V.

5.2.2.2 Test 2:Contact voltage (Uc) without tripping out RCD

Measuring contact voltage:
1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to RCD*test* / Uc / Rs❶.
3. Set with the [Select] key *Uc*.
4. The permissible value the contact voltage has already been set in paragraph 5.2.2.1.
5. Press the [Start] key and read out the result.
6. Check the parameters if the instrument by pressing the [Display] key.
7. Save, if required, the displayed result (paragraph 5.3) and note the memory codes if necessary.
8. Disconnect the test object or carry out another test.



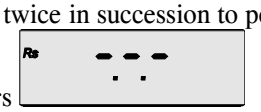
Contact voltage. (If the result is higher than the preset limit contact voltage, then the general warning sign will appear at the bottom).

Nominal leakage current (fault current) which holds the shown contact voltage.

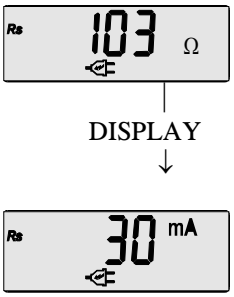
Figure 4: *Example test result contact voltage*

5.2.3 Test 3 Earth loop resistance (Rs) without tripping out RCD

Measuring earth loop resistance (Rs)

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to RCD*test* / Uc / Rs ❶
3. Set with the [Select] key *Rs*.
4. Use the [$\downarrow I_{\Delta N}$] key to set the required rated fault current.
5. The permissible value of the contact voltage has already been set (see paragraph5.2.2.1).
6. Press the [Start] key once to perform a short test (± 5 s.).
7. Read out the result.
8. Press the [Start] key twice in succession to perform an extended test (± 30 s.).
9. In the display appears 

10. Read out the result after 30 seconds.
11. Check the parameters of the instrument by pressing the [Display] key.
12. Save, if required, the displayed result (paragraph 5.3) and note the memory codes if necessary.
13. Disconnect the test object or carry out another test.



Earth loop resistance Rs.

Nominal leakage current chosen.

Figure 5: *Example test result earth loop resistance*

5.2.4 Test 4 Disconnection current (IΔ) and disconnection time (tΔ) of general RCD

Measuring disconnection current (IΔ) and disconnection time (tΔ):

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to RCD*test*/ Uc / Rs❶.
3. Set with the [Select] key RCD I_{Δ}.
4. Use the [↓ $I_{\Delta N}$ X] key to set the required rated fault current.
5. The permissible value of the contact voltage has already been set (see paragraph5.2.2.1).
6. Press the [Start] key and read the result.
7. Check the parameters of the instrument by pressing the [Display] key.
8. Save, if required, the displayed result (paragraph 5.3) and note the memory codes if necessary.
9. Disconnect the test object or carry out another test.

Disconnection current

DISPLAY ↓

Disconnection time at the disconnection current

DISPLAY ↓

Nominal leakage current value for displayed disconnection time and – current.

Figure 6: *Example test result disconnection current, - time and nominal leakage current*

5.2.5 Test 5 Disconnection time t of general or selective RCD

Measuring disconnection time

1. Connect the cords to the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to RCD*test* / U*c* / R*s* ❶.
3. Set with the [Select] key RCD RCD_t.
4. Select the required rated fault current (as displayed on the RCD to be tested) with the [↓ $I_{\Delta N}$] key.
5. Select the correct multiplier for the rated fault current with the [↑$I_{\Delta N}$X] (Table 4).
6. Use [S] key to select the standard or the selective RCD type (symbol S indicates selective type).
7. The permissible value of the contact voltage has already been set (see paragraph5.2.2.1).
8. Press the [Start] key and read the result.
9. The starting current phase can be changed by pressing the [Start] key twice in succession (180° is displayed in that case). If the selective RCD type is selected, wait 30 seconds for the result (a countdown 30 to 0 is displayed).
10. Save if required the displayed results (paragraph 5.3), and note memory codes when necessary.
11. Disconnect the test object or carry out another test.

Tripping time (t). (If the results are not according with the values in table 5, then the general warning sign will appear).

DISPLAY ↓

The nominal leakage current of the displayed disconnection time.

Figure 7: Example test result disconnection time

Table 4: Admissible ranges for disconnection times according to IEC 1008-1 standard

Type RCD	I	2I	5I	Remark
Standard	0,3	0,15	0,04	Max. disconnection time (s)
Selective	0,5	0,2	0,15	Max. disconnection time (s)
	0,13	0,06	0,05	Min. delay time (s)

5.2.6 Test 6 Autotest of general or selective RCD

Measuring disconnection time

1. Connect the cords to the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to RCD*test* / U*c* / R*s* ❶.
3. Set with the [Select] key AUTO.
4. Select the required rated fault current (as displayed on the RCD to be tested) with the [↓ $I_{\Delta N}$] key.
5. Use [S] key to select the standard or the selective RCD type (symbol S indicates selective type).
6. The permissible value of the contact voltage has already been set (see paragraph5.2.2.1).
7. Press the [Start] key and reset the RCD each time it will trips.
   If the selective RCD type is selected, wait 30 seconds for the result (a countdown 30 to 0 is displayed).
8. Save if required the displayed results (paragraph 5.3), and note memory codes when necessary.
9. Disconnect the test object or carry out another test.

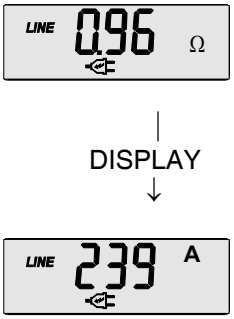
	***Because of safety reasons, contact voltage measurement using half of nominal fault current is performed before any other parameter is tested.*** ***A selective RCD has an integrated leakage current function because of the required delayed trip out. That is why the operator must wait for 30 s before reaching final result. The influence of the test current for contact voltage measurement will be compensated now.***

5.2.7 Test 7 Line or earth loop impedance and prospective short-circuit current

	***After finalising the tests, the [Display] key has to be pressed to read out the prospective short-circuit current.***

Measuring impedance and prospective short circuit current:

1. Connect the cords to the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to Z_{LOOP} / Z_{LINE} / I_K ❷.
3. Set with the [SELECT] key LINE (line impedance)or LOOP (loop impedance).
4. Press the [START] key and read the result.
5. Save if required the displayed results (paragraph 5.3), and note memory codes when necessary.
6. Both results (impedance and prospective short circuit current) will be saved.
7. Disconnect the test object or carry out another test.



Line impedance

Prospective short circuit current.

Figure 8: Example line impedance and prospective short-circuit current

5.2.8 Test 8: Insulation resistance with 500V test voltage

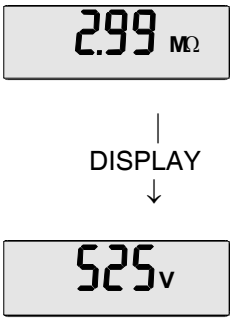
	***Do not disconnect the test cords during the measurement. The measured object can be charged.*** ***Do not touch the object or test cords during the measurement, Hazardous voltage can be present.***

	***Discharging of capacitive load is performed automatically after finishing the measurement.*** ***In case of capacitive measured object, discharging of the object after finishing the measurement is shown on display as falling voltage until safety level is reached.***

	***For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.***

Measuring insulation resistance

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to $R_{ISO\ 500V}$ ❸.
3. Press the [Start] key and release it.
4. Read out the result.
5. Save it if required, and note the memory codes when necessary.
6. Disconnect the test object or carry out another measurement.



Insulation resistance

Test voltage (parameter)

Figure 9: Example testresult insulation resistance and test voltage

5.2.9 Test 9: Low resistance

	***- Always carry out first a compensation measurement of the test leads before testing.*** ***- The displayed result is an average of both (positive and negative) polarities.*** ***- Each result can be saved only once.***

	***For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.***

5.2.9.1 Compensation of the test leads

1. Set the rotary switch to R_{LOW} ❹.
2. Connect the test cords to the instrument.
   Make sure the measure tips connect well with each other.
3. Press first the [Select / CAL] key and hereafter the [Start] key.
4. "0.00 Ω" and "√" will be displayed if the test cords are compensated well.
5. Continue with the measurement procedure (short test: paragraph 5.2.9.2, continuous test: paragraph 5.2.9.3).

5.2.9.2 Short low resistance measurement

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to R_{LOW} ❹.
3. Press the [Start] key and release it.
4. Read out the result.
5. Save it if required, and note the memory codes when necessary.
6. Disconnect the test object or carry out another measurement.

5.2.9.3 Continuous low resistance measurement

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to R_{LOW} ❹.
3. Press the [Start] key and keep it pressed during the test.
4. Place the test electrode on parts to be tested.
5. Read out the result.
6. Save it if required, and note the memory codes when necessary.
7. Disconnect the test object or carry out another measurement.

5.2.9.4 Beeping the installation

A beep sound can be used as an indication for a good result in low resistance measurement (also paragraph 3.2.7). A signal will be produced every time the measurement result will be between the upper and lower reistance limits.

In case the result falls outside the limits, no sound is produced and the ⚠ sign is shown next to the result.

Procedure setting up beep signal

- Set rotary switch to position R_{LOW} ❹.

	Pressed key	**Commentary**
1.	DISPLAY	- ON or OFF is displayed according to the current value of the buzzer status (in the second case the BUZ text lasting 2s precedes the OFF text).
2.	↑, ↓, DISPLAY, Save	- Set the buzzer status ON or OFF using [↑],[↓] keys. - To confirm selection, press [SAVE] key or press [Display] key to continue without change. - In case the ON status is selected, LO text is shown for 2s and the current value of the LOW limit is shown afterwards. - If the OFF status is selected the instrument exits this procedure and --- is displayed.
3.	↑, ↓, DISPLAY, Save	- Set LOW limit using [↑],[↓] keys. - To confirm the new limit value, press [Save] key or press [Display] key to continue without change. - HI text is shown for 2s and the current value of the HIGH limit is shown afterwards.
4.	↑, ↓, DISPLAY, Save	- Set HIGH limit using [↑],[↓] keys. - To confirm the new limit value, press [Save] key or press [Display] without change. Afterwards--- is displayed.

☝	***The LOW limit can not exceed the HIGH limit.*** ***If the operator makes a wrong selection,*** ***the limit values are automatically adjusted to satisfy this rule***

5.2.10 Test 10 Voltage / frequency of mains voltage measurement

	***Maximum allowed input voltage is 440 Volts.***

	***For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.***

Measurement of voltage and frequency

1. Connect the test cords with the instrument conform the circuit diagram of attachment 2.
2. Set the rotary switch to U / f ❺.
3. Read out the result without pressing the [Start] key.
4. The result shown is the value of the mains voltage
5. Press the [Display] key to switch to the value of the frequency.
6. Read out the result.
7. Save the results if required (both voltage and frequency will be stored), and note the memory codes when necessary.
8. Disconnect the test object or carry out another measurement.

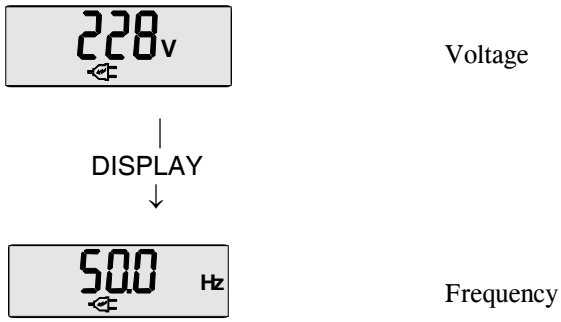


Figure 10: Example testresult mains voltage and - frequency

5.3 MEMORISING RESULTS

Each saved result is equipped with its own identification code. This code contains 2 x 4 figures. Due to limitations of the LCD, only three figures are shown for codes smaller than 1000.
For codes between 1000 and 1999 (upper limit), four figures will be shown in the display:

X.X.X.X. ← [DISPLAY] → YYYY

In this codes X.X.X.X. (marked by points) presents a code of a certain measuring place and YYYY presents a code for the tested object. For optimal use and a detailed description of these codes the ETEST software is advised.

Each displayed result can be stored as follows:

Pressed keys	**Comments**
1. [Save]	The last **changed** partial code (X.X.X.X of YYYY) used for memorising of results is displayed.
2. [↑], [↓]	Insert new codes using the [↑, ↓] keys if necessary.
3. [DISPLAY], [↑], [↓]	Check the other part of the code pressing the [Display] key and change it using the [↑, ↓] keys if necessary.
4. [Save]	Confirm saving by using the [Save Result] key.

	***In order to avoid confusion when recalling saved results, it is advisable exact plan and numeration of measuring places to be done before stating measurements.***

The displayed value is now saved to a memory location including the subresults and the parameters of the measurement that can be checked using the [Display] key.
Table 5 shows the list of sub results and parameters that are saved to memory together with the main result.

Table 5*: Sub results and parameters*.

Main result	Sub results and parameters
Contact voltage Uc	$I_{\Delta N}$ – nominal fault current - Identification number of the function (rotary switch position)
Earth loop resistance Rs	$I_{\Delta N}$ – nominal fault current - Identification number of the function (rotary switch position)
Disconnection current $I_{\Delta N}$	t – disconnection time at disconnection current $I_{\Delta N}$ – nominal fault current - Start polarity of fault current - Identification number of the function (rotary switch position)
Disconnection time t	$I_{\Delta N}$ – nominal fault current - Type of RCD (general or selective) - Multiplier of nominal fault current - Identification number of the function (rotary switch position)
LINE impedance Z_{LINE}	I_K –prospective short-circuit current - Identification number of the function (rotary switch position)
LOOP impedance Z_{LOOP}	I_K – prospective short-circuit current - Identification number of the function (rotary switch position)
Insulation resistance $R_{ISO\ 500V}$	U_{ISO} – test voltage - Identification number of the function (rotary switch position)
Low resistance R_{LOW}	- Identification number of the function (rotary switch position)
Mains L – N voltage U_{L-N}	f – mains frequency - Identification number of the function (rotary switch position)

- To abandon a current procedure (memorising), the rotary switch must be turned.

- For all measuring results, numbers from 001 up to including 1999 are available (for the object and for the measuring place).

- If object numeration is not needed, all the results can be saved under the same object code Only the measuring place code has to be changed from test to test.

- If no object numeration nor measuring place coding is needed, all the results can be saved under the same object and measuring place code, by omitting steps 2 and 3 of the upper demonstration.

5.4 RECALLING MEMORISED RESULTS.

Each memorised result is equipped with an eventual sub result and parameters of the measurement (see Table 5). Each function has an identification number (1 t/m 5; see figure below) enabling the user to identify to which function result the sub result belongs. The identification number is only displayed for a moment, just before the recalled results are displayed.

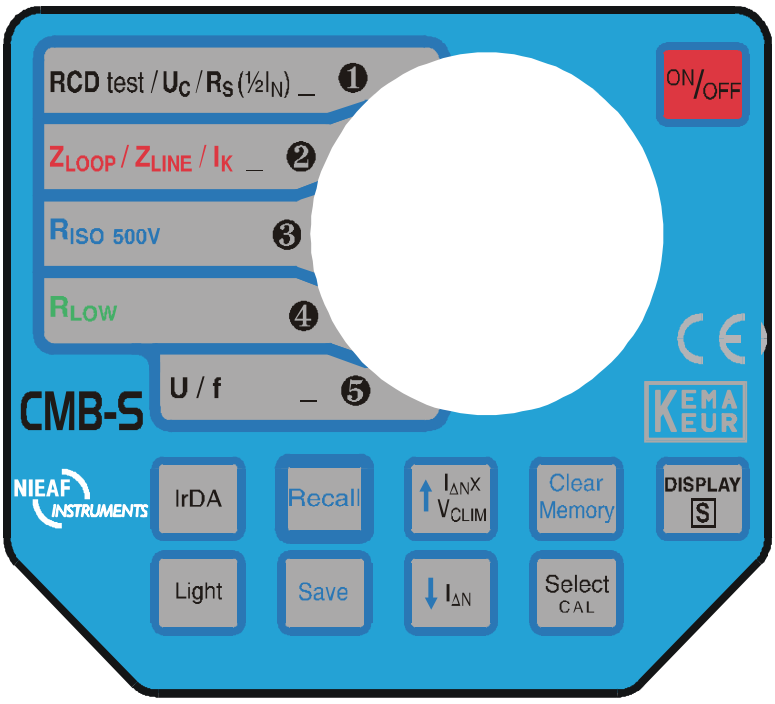


Figure 11: *Identification number of each function*

Recalling memorised results:

Pressed key	**Comments**
1. Recall	Last displayed partial code (X.X.X.X of YYYY), used for the recalling of results is displayed.
2. ↑, ↓	Insert the desired code by using the [↑, ↓] keys if necessary.
3. DISPLAY, ↑, ↓	Check the other part of the code by pressing [Display] key and change it using [↑, ↓] keys if necessary.
4. Recall	Confirm recalling pressing [Recall] key again.
	First the identification number of a function is displayed for a while and then the main result will be displayed.
↑, ↓	Check the other results saved under the same object and measuring place code by using the [↑, ↓] keys.

Form of the memory locations under a certain code X.X.X.X, YYYY:

Result 1 + sub result;
Result 2 + sub result;
…
…
Result n + sub result

	***To abandon the current procedure (recalling), turn the rotary switch.*** ***Use the [Display] key to check the sub results.***

5.5 IrDA COMMUNICATION

1. Turn Combi Compact with its upper side (IrDA eye) to PC or printer with build in IrDA communication port.
2. The distance between Combi Compact and communication port should be less than 1m.
3. Press [IrDA] key on the tester to select communication mode.
4. Use the software manual for further information.

	***To abandon the transmission, turn the rotary switch.***

5.6 ERASING RESULTS

In order to avoid confusion, it is advisable to erase all stored results before starting new measurements. Sometimes only results stored under a certain object number or measuring place of the object are to be erased, or even only a recalled result has to be erased.
To prevent confusion it is important to follow the erasing procedure correctly.

Erasing all results

Pressed keys	**Comments**
Clear Memory	 is blinking.
Clear Memory	Confirmation.

All results will be erased now.

Erasing results of a certain object (YYYY)

Pressed key	**Comments**
Clear Memory	Last displayed partial code (X.X.X.X of YYYY), used for the recalling of the results, is displayed.
DISPLAY	Use the [Display] key to select an object code (without dots) if necessary.
↑, ↓	Insert the desired code by using the [↑, ↓] keys if necessary.
Clear Memory	"  " is blinking.
Clear Memory	Confirmation.

Results of a certain object are erased

Erasing results of a certain measuring place (X.X.X.X) of the object

Pressed key	**Comments**
Recall	Last changed partial code (X.X.X.X of YYYY), used for the recalling of the results, is displayed.
↑, ↓	Insert the desired object / measuring place code by using the [↑, ↓] keys.
DISPLAY	Use the [Display] key to select a measuring place / object code.
↑, ↓	Insert desired object / measuring place code by using the [↑], [↓] keys if necessary.
DISPLAY	Use the [Display] key to select the already inserted measuring place code (with dots) if it is not already selected.
Clear Memory	"  " is blinking
Clear Memory	Confirmation.

Only results of a certain measuring place of the object will be erased.

Erasing recalled result

1. Recall the result under a certain measuring place and object code, according to the procedure under paragraph 5.4.
2. Use the [↑, ↓] keys to select the result which has to be erased.
3. Press the [Clear Memory] key,  is flashing.
4. Press the [Clear Memory] key again to confirm the erasing.

Only the recalled result under a certain measuring place of the object is erased now.
The next result saved under the same measuring place and object code is displayed.

	***To abandon the current procedure (recalling / clearing), turn the rotary switch.***

5.7 DEFAULT VALUES OF PARAMETERS

In case of malfunction of the instrument or if one wishes the parameters of the instrument to be set to default values, reset of the instrument must be performed

Reset the instrument

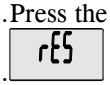
1. Switch Off the instrument.
2. Press the [Clear Memory] key and keep it pressed while switching on the instrument.
3.  is displayed for a while. Reset is performed and all parameters are set to default values, memory is erased.
4. Default values are given in the list below (Table 6: Default values)

Table 6: Default values

Parameter	Default value
$U_{C\ lim}$	50 V
All memory locations	Erased
Type of RCD	General
Start location of storing	0001/0.0.0.1 (object / meas place)
Start location of recalling	0001/0.0.0.1 (object / meas place)
Nominal fault current	10 mA
Multiplier of nominal fault current	x 1

Performing the reset function means that all memory locations will be erased.

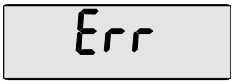
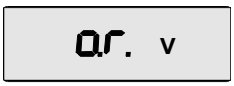
If batteries are removed from the Combi Compact and a special case according to description in paragraph 6.1 is not respected, then clear function will be performed automatically after inserting batteries and switching ON the instrument

5.8 TROUBLESHOOTING

In the next table (Table 7: General faults and warnings) possible fault messages that can appear on the display are described. For each fault a cause and a possible solution are given.

When executing various tests, various warnings can be displayed.

Table 7: General faults and warnings

Display	Cause	Possible solution
General		
	Instrument error.	Contact your supplier.
	Battery lower than 4,3V.	Replace the batteries.
	All memory locations are empty.	
	Instrument is over heated.	Wait.
	Result out of range.	
	Frequency of mains voltage is out of nominal range.	
	External voltage is present.	
	Mains voltage is present.	
	Phase and neutral terminals have been interchanged, phase terminal on the apposite side dot of shuko plug.	

Only for test/ Uc/ Rs		
	Value of present voltage V_{L-PE} flashes on display	Voltage U_{PE} out of limits 100V ÷ 264V
	Flashing.	RCD tripped during the contact voltage test with the halved rated current ($I_{\Delta N}/2$).
	Contact voltage Uc displayed.	Contact voltage Uc at the rated current $I_{\Delta N}$ or at the double rated current 2 $I_{\Delta N}$ (Selective type) is higher than the preset value Vc lim.
	Rs function detect Uc > 50V during the test.	Earth loop resistance Rs is too high.
	Disconnection time does not comply with the table 5 or contact voltage higher than the preset value Uc lim.	
	In RCDt en RCD I_{Δ} function only.	Negative polarity
	Voltage detected on the Pe or internal fault	Check your Pe wiring or contact your supplier.
	Blinking Ur and the minimum resistance value.: The measured resistance is too low to measure.	**This is not an error but a message!** The measured value is lower as the minimum value that can be measured with this instrument with this setting.

5.9 CALIBRATION AND REPAIR

To warrant good operation and sufficient accuracy of the tester, it is advisable to have the instument calibrated at least once a year. Hereby it is to be shown that the tested products are governed by an established test procedure.

The calibration will be executed by Nieaf-Smitt bv or an authorised distributor in your country.
In the calibration report the results, judgements, town, date and name of the responsible person will be mentioned.
There are no user replaceable parts in the instrument (batteries excepted)!

For calibration and/or service you can send your tester post-paid to:

Nieaf-Smitt bv.
c.o. Technical Support Department
Vrieslantlaan 6
3526 AA UTRECHT
The Netherlands

Tel.: ++ 30 288 13 11
Fax.: ++ 30 289 88 16

OR TO YOUR LOCAL DEALER

6 MAINTENANCE

⚠	***Do not replace parts yourself but call technical qualified persons (see paragraph** Fout! Verwijzingsbron niet gevonden.**).***

6.1 BATTERIES REPLACEMENT

⚠	***If there are memorised results in the instrument and the "BAT" mark appears, then transfer them first to an external printer or PC.***

⚠	***Disconnect all test cables before removing the battery cover.*** ***Caution, possible live parts under the battery cover.*** ***Throw, after using, the empty batteries in a special battery basket.***

If the "BAT" mark appears at the display, it means that the battery voltage is lower than 4,3 V. Remove the old batteries and insert new ones.

Procedure batteries replacement:
1. Disconnect all cables and cords.
2. Remove the battery cover.
3. Remove the old batteries.
4. Place the new batteries in the battery holder.
5. Always exchange all four batteries simultaneously.

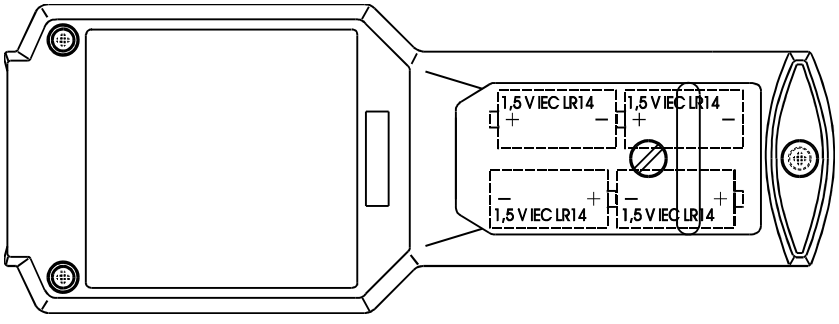


Figure 12: Batteries inserted

	***Use only battery types declared in the technical specification only.***

	***If it is not possible to transfer the memorised results (no external printer of PC available) then the next procedure has to be followed:*** 1. Switch OFF the instrument. 2. Remove battery cover. 3. Exchange batteries within 1 minute. 4. Place battery cover back and switch ON the instrument. 5. rES should not be displayed meaning memorized results are not erased.

6.2 CLEANING

	***Use only non-reagent cleaning solutions.*** ***Do not spill cleaning liquid over the instrument.***

Use soft patch moistened by water or alcohol, and leave the instrument to dry totally after the cleaning.

7 ACCESSORIES AND REPLACEABLE PARTS

Together with the Combi Compact the following accessoriesy are delivered:
- Test mains cable shuko, spiral type, 2m;
- Test cord – separate connectors, 2.0 m with 2 alligator clips and 2 test tips;
- English operating instruction;
- Protective holster.

Optional accessories:
- IrDA interface;
- E-Test software;
- Carrying case.

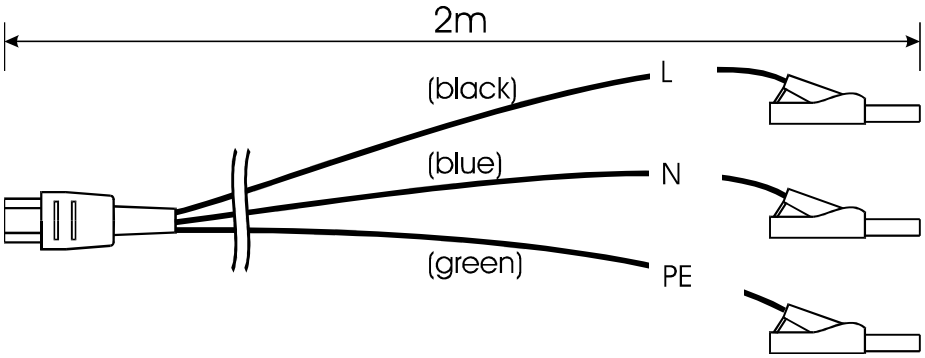


Figure 13: Test cord CMB-S

Check all the supplied items (enclosure of the instrument as well as the accessories).
If there are any damages please return the tester to the supplier for exchange or service.

Attachment 1

EU-DECLARATION OF CONFORMITY

Product: Combi Compact Installation Tester

Identification of the instrument:

Trademark: Nieaf-Smitt bv.
Model/Type: CMB-S

Nieaf-Smitt herewith declare that the instrument which this declaration refers to is in conformity with the following standards and according to the conditions of following Directives:

Low Voltage Directive	(73/23/EEG) as last amended.
EMC-Directive	(89/336/EEG) as last amended.

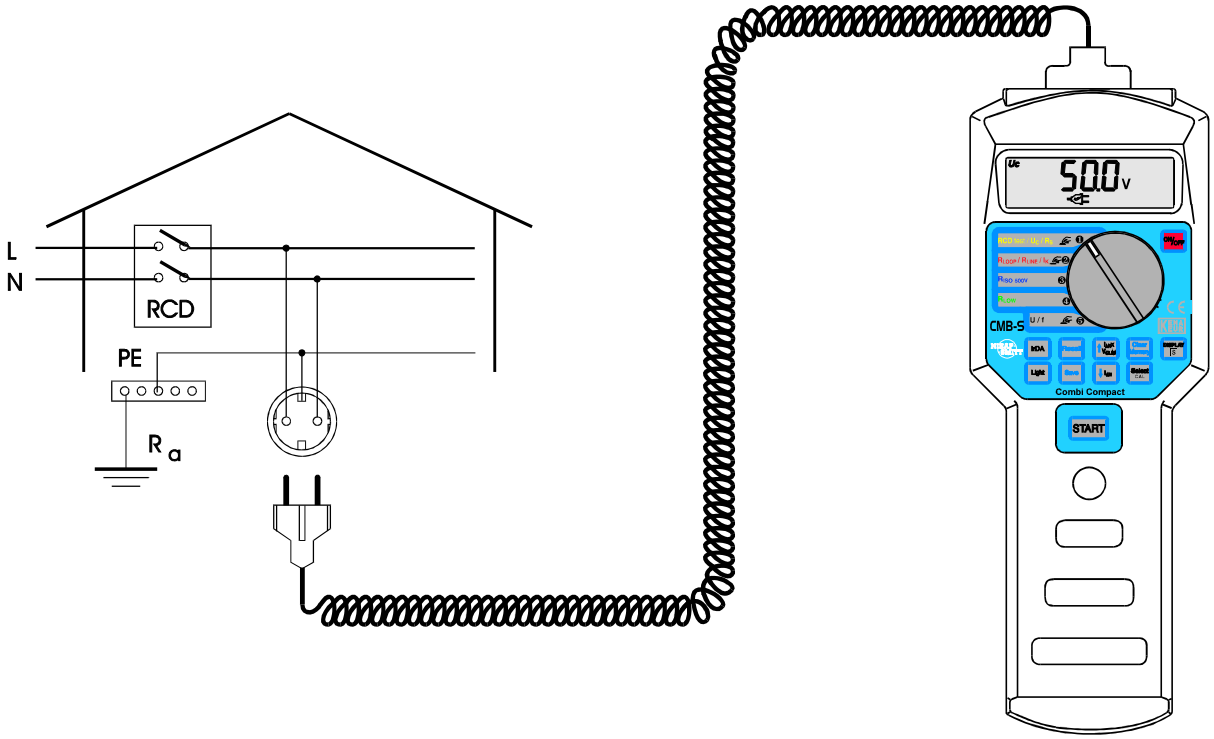
VDE0701
IEC1010-1
EN 55022 class B
NEN-EN 50081-1
NEN-EN 50082-1
IEC801-2 level 3
IEC801-3 level 2
IEC801-4 level 4

Place and date of issue

Name and signature or equivalent stamp of authorised person.

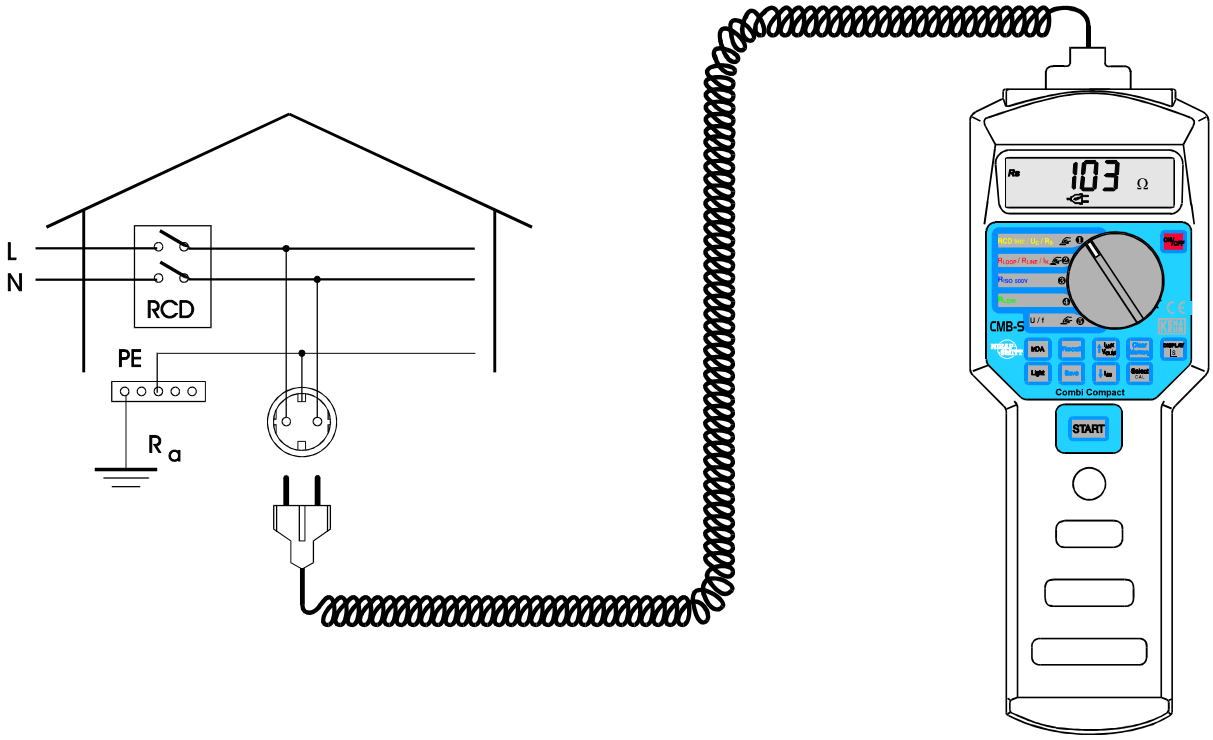
Contact voltage (U_c)

Connect the instrument to an object under test as shown below.



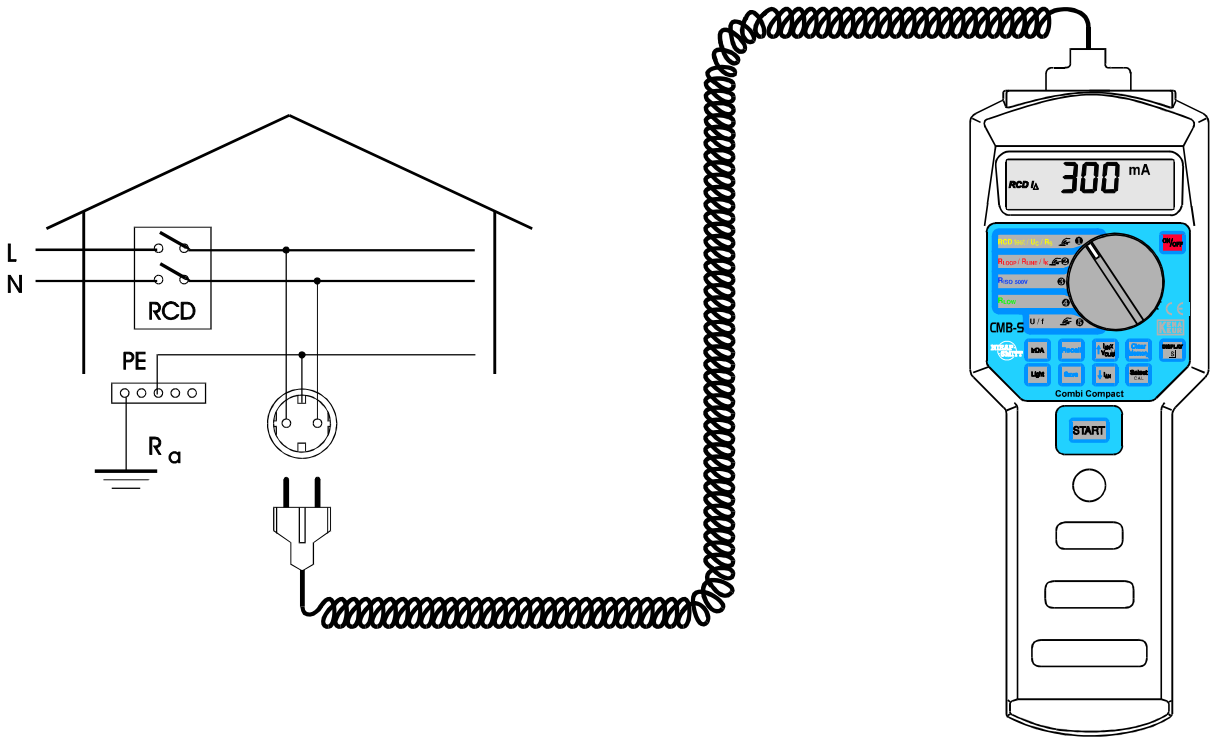
Earth loop resistance (Rs)

Connect the instrument to an object under test as shown below



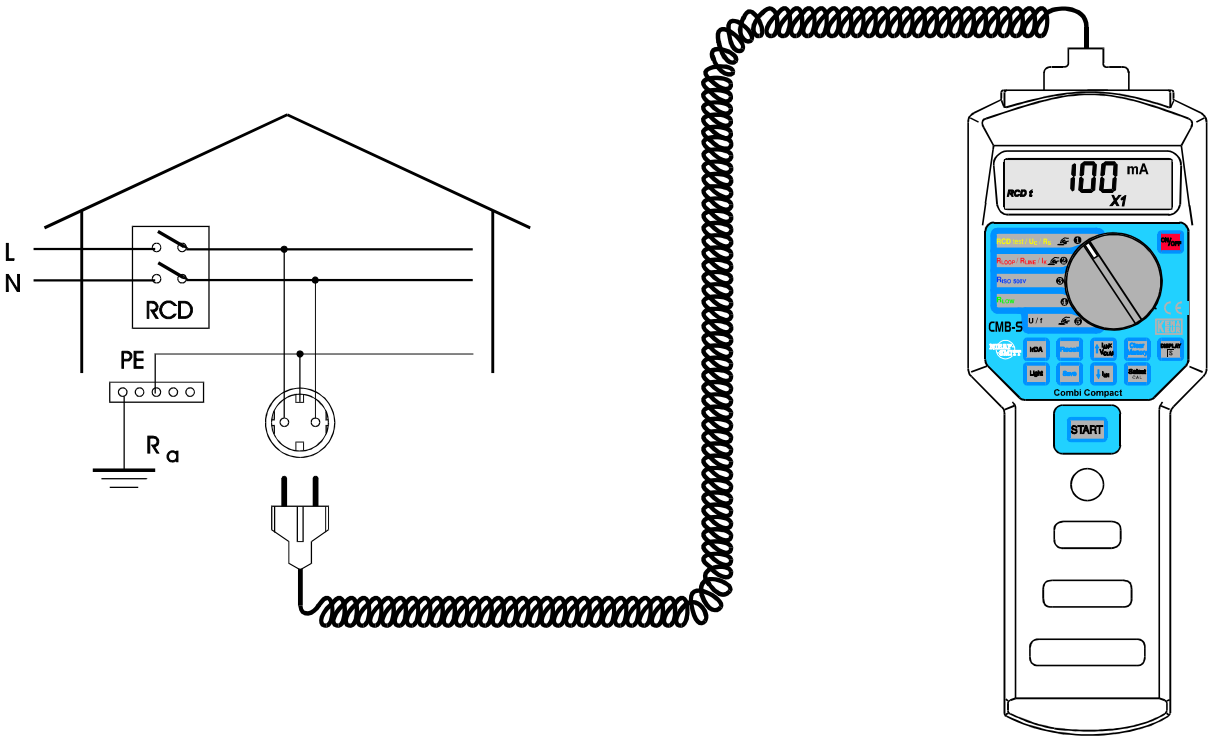
Disconnection time (t)

Connect the instrument to an object under test as shown below



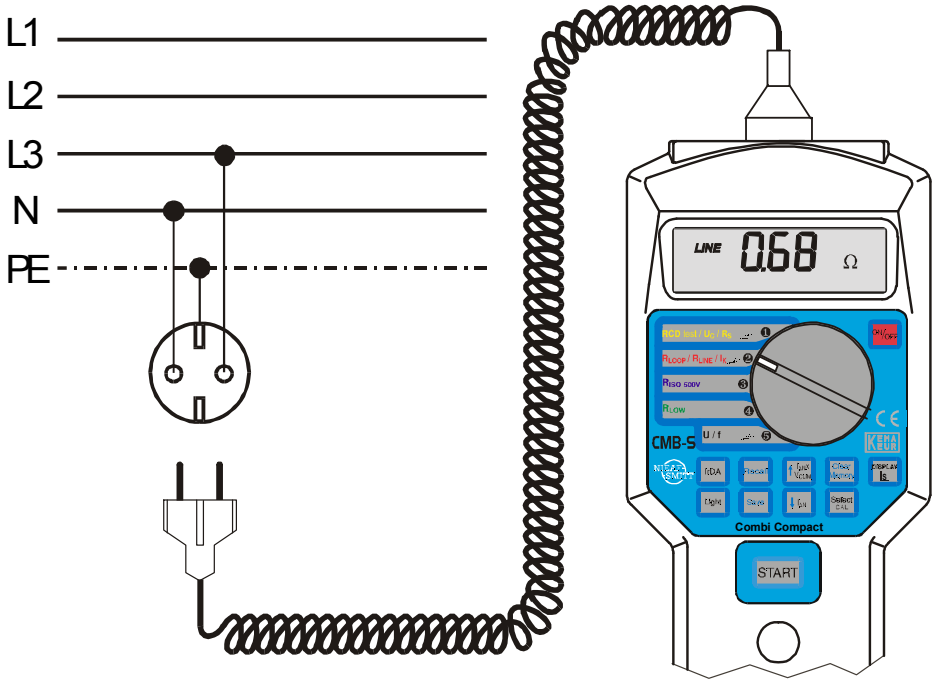
Disconnection current (I_Δ) and disconnection time (t_Δ)

Connect the instrument to an object under test as shown below



Line (Z_{LINE})- or loop (Z_{LOOP}) impedance and prospective circuit current *(I_k)*

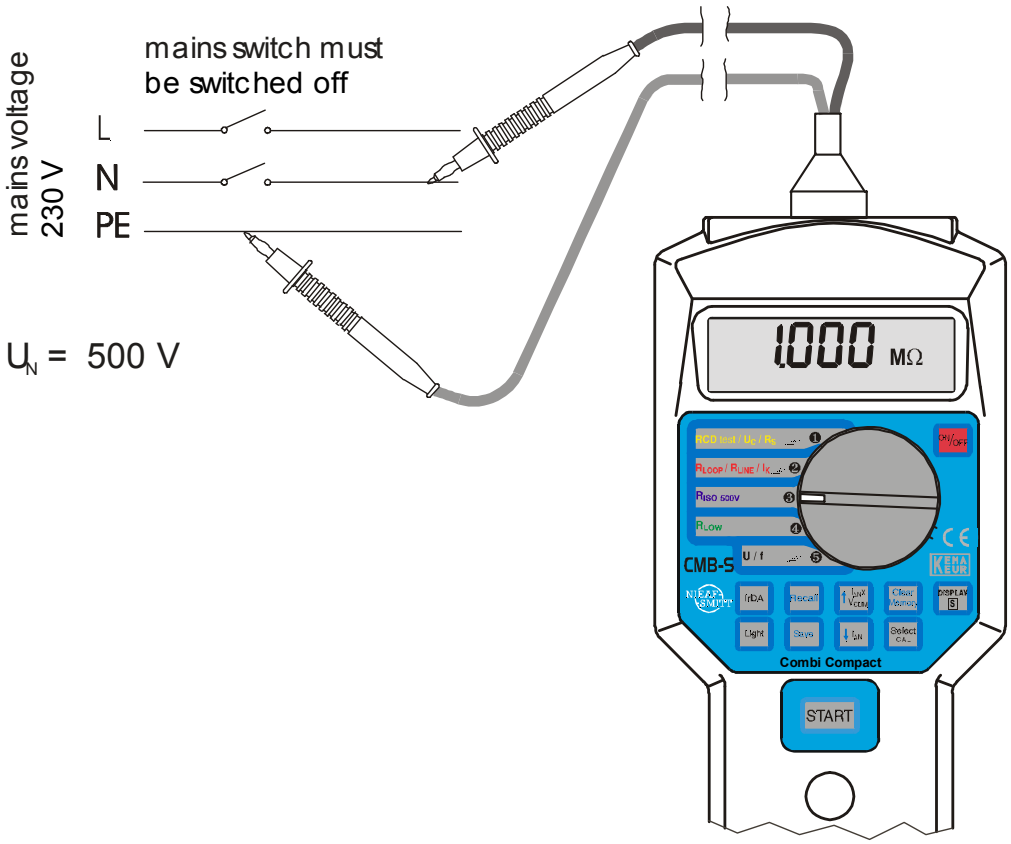
Connect the instrument to an object under test as shown below



	For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.

Insulation resistance ($R_{iso\ 500\ V}$)

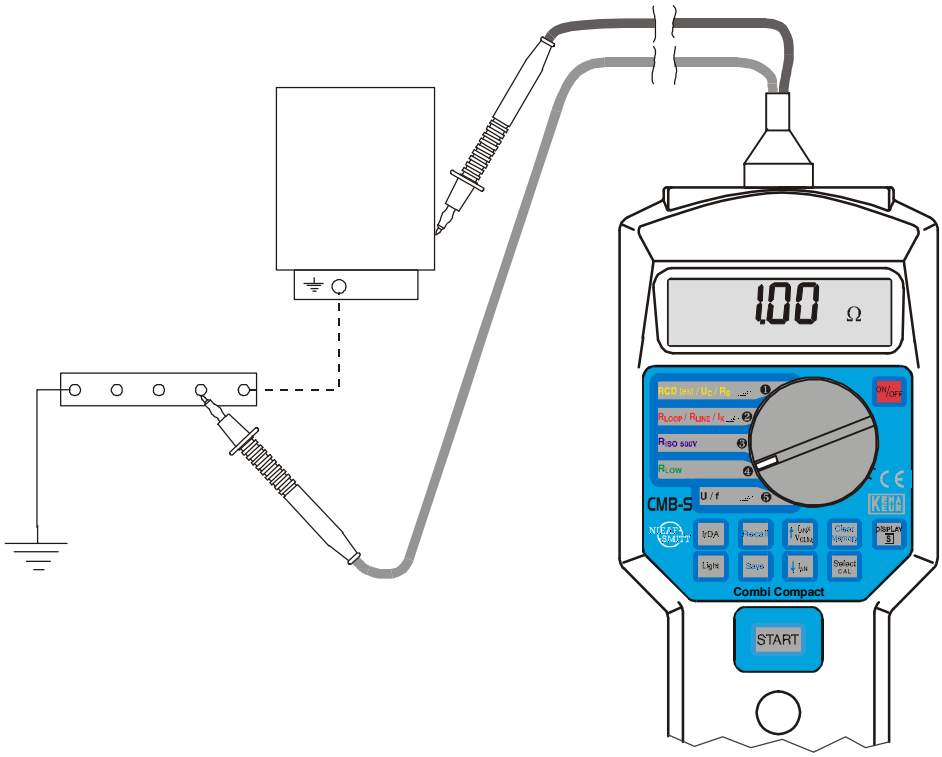
Connect the instrument to an object under test as shown below



	For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.

Low Resistance*(R $_{low}$)*

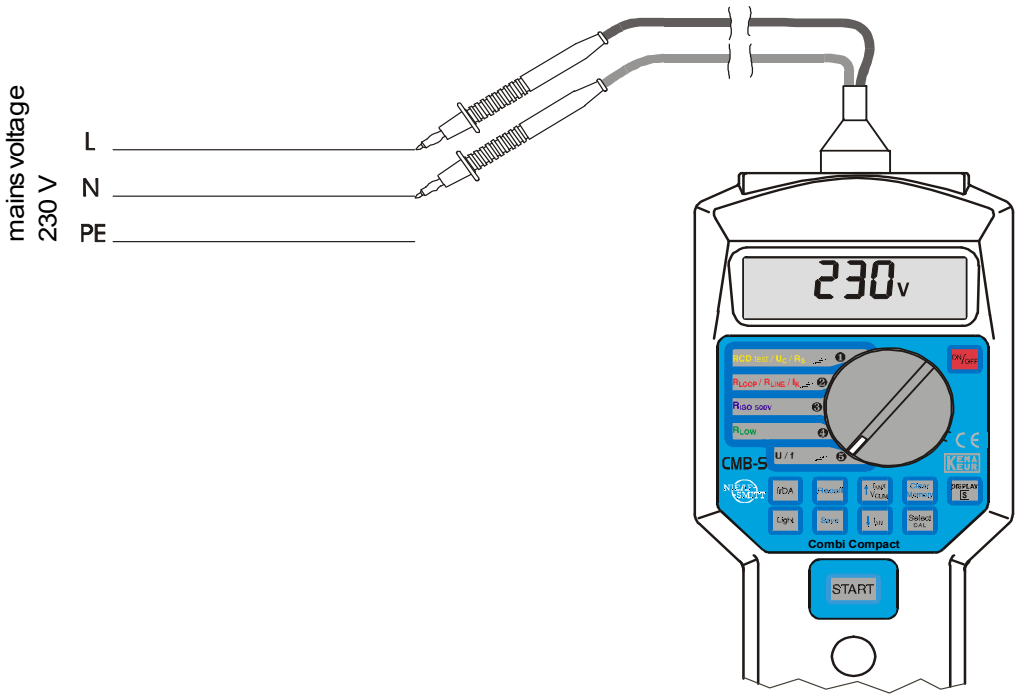
Connect the instrument to an object under test as shown below



	***For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.***

Mains voltage *(U) and frequency (f)*

Connect the instrument to an object under test as shown below



	For measuring the insulation resistance, low Ohm or voltage with the splitted test lead, you need to connect the N and Pe together.