

# TS3 Trip Unit Test Set instructions manual



# Index

1.	Identification .....	4
2.	Safety notice.....	4
2.1	Notes for dielectric stiffness tests.....	4
2.2	Reference standards.....	4
3	Abbreviations.....	5
4	Standard equipment.....	6
5	Technical Specification.....	7
5.1	General.....	7
5.2	Mechanical characteristics.....	7
5.2.1	Transport case.....	7
5.3	Electrical Characteristics .....	8
5.4	Environmental Characteristics .....	8
5.5	Input/Output.....	8
5.5.1	Test connector .....	8
5.5.2	Alarms .....	9
5.5.3	Timer .....	9
5.6	Operating parameters .....	10
5.6.1	Parameters .....	10
5.6.2	TS3 Setting.....	10
5.6.3	User Data - Test Report .....	11
5.7	User interface .....	12
5.7.1	knob and keys use .....	13
5.7.2	Default Settings.....	13
6	Putting into service.....	14
6.1	Procedure to Set the nominal power voltage.....	14
6.2	Connections.....	14
6.3	Menu tree .....	15
6.4	Display .....	17
6.5	Initial settings.....	17
7	Operative instructions – step by step .....	18
7.1	Setup.....	18
7.1.1	Setup Password.....	18
7.1.2	Setup Report.....	18
7.1.3	Preferences .....	19
7.1.4	Frequency.....	19
7.1.5	System date and time.....	19
7.2	Trip unit selection.....	20
7.3	CB Type, Iu and In selection.....	20
7.4	Test setup.....	21
7.5	Carrying out the TEST.....	22
7.6	Test Report.....	23
7.7	Info Menu .....	23
8	Test on protective functions.....	24
8.1	S1 trip unit functional test. ....	25
8.2	S2 trip unit functional test .....	26
8.3	AR1 trip unit functional test.....	27
8.4	PR1 trip unit functional test.....	28
8.5	PR111 trip unit functional test.....	29
8.6	PR112-PR113 trip unit functional test .....	30
8.7	PR121-PR122-PR123 trip unit functional test.....	31
8.7.1	PR121 installation .....	31

8.7.2	PR122- PR123 installation.....	32
8.8	PR331-PR332-PR333 trip unit functional test.....	33
8.8.1	PR331 installation .....	33
8.8.2	PR332- PR333 installation.....	34
8.9	PR231-PR232 trip unit functional test .....	35
9	TS3 Manager Installation .....	37
10	Upgrade Firmware.....	38
11	Troubleshooting table .....	41
11.1	In case of a fault.....	42

## 1. Identification

TS3 is a testing device that realizes functionality verification on Low Voltage ABB SACE air circuit breakers electronic trip units, with one-phase secondary current injection.

## 2. Safety notice

Read this manual carefully and completely.



**WARNING:** this symbol gives information about operations, actions or circumstances that can cause injuries to the personnel, damage to the unit or economic losses.

The use of this device should be reserved for qualified and expert personnel only.

If in doubt, about its safe usage, the unit must be put out of service to prevent any accidental use.

You must assume that safe usage is impossible if:

1. the unit shows visible signs of damage.
2. the unit does not function (for example the display does not switch on).
3. the unit has been damaged in transit.



**WARNING:** before proceed with any testing and control operation with the TS3 testing device, carefully read instructions and procedures in the following chapters.

ABB S.p.A. SACE Division disclaim all responsibility for damages to things or people, due to incorrect use of TS3 test unit or/and for negligence on the present instructions



**WARNING: Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected**

**Further, all connected power supplies must be disabled.**

### 2.1 Notes for dielectric stiffness tests



Dielectric stiffness tests on TS3, inputs and outputs, are not permitted.

In case dielectric test of any devices or circuit breakers connected to TS3, it is necessary to remove any connections between the TS3 and the device under test.

### 2.2 Reference standards

TS3 test unit is CE marked and is conform to the main international reference standards in terms of electromagnetic compatibility (EMC) and safety.

Immunity for industrial environments : IEC 61000-6-2 Standard.

Emission for industrial environments : IEC 61000-6-4 Standard.

Safety requirement for measurements, control and laboratory use electrical equipment: IEC 61010 Standard.

### 3 Abbreviations

<u>Abbreviations</u>	<u>Meaning</u>
AR1	MEGAMAX series trip unit
CB	Circuit Breaker (for example Emax)
CBTYPE	Circuit breaker version and type
CS	Current sensor
DUT	Device under test (i.e. trip unit)
Emax	ABB SACE Air Circuit breaker series
FW	Firmware
F.S.	Full Scale
HW	Hardware
In	Trip unit nominal current
Iu	Circuit breaker nominal current
Itest	Test Current
MEGAMAX	ABB SACE Air Circuit breaker series
NOVOMAX	ABB SACE Air Circuit breaker series
PR030/B	PR12x, PR23x, PR33x battery unit
PR1	MEGAMAX series trip unit
PR11x	EMAX series trip units
PR120/B	PR112, PR113 battery units
PR12x	New EMAX series trip units
PR23x	Tmax T7 series trip units
PR33x	New EMAX X1 and Tmax T7 series trip units
Trip unit	Electronic protection release
S1	NOVOMAX series trip unit
S2	NOVOMAX series trip unit
SW	Software
TC	Trip Coil
Tmax	ABB SACE Molded Case Circuit Breaker series
TS3	Trip unit test set
TS3M	Software manager

## 4 Standard equipment

TS3 is provided with the following accessories:



Power supply cable



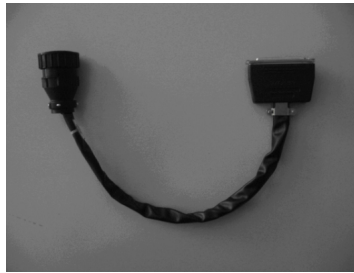
USB cable



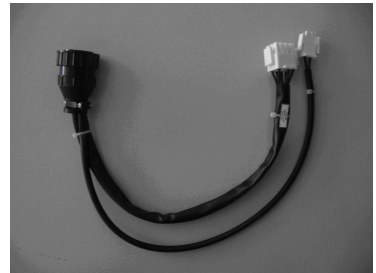
Test cable extension



AR1,S1 test cable



S2 test cable



PR1 test cable



PR111-PR112-PR113 test cable



PR121, PR122, PR123 test cable



PR231, PR232, PR331, PR332, PR333 test cable



USB memory stick



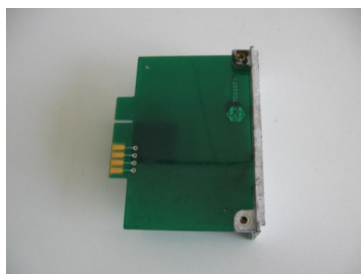
Test Key plug for PR121, PR122, PR123



Test Key plug for PR232, PR331, PR332, PR333



PR030/B



S2 Bypass module

## 5 Technical Specification

### 5.1 General

TS3 test device performs functionality test on ABB SACE S1, S2, AR1, PR1, PR111, PR112, PR113, PR121, PR122, PR123, PR231, PR232, PR331, PR332, PR333 Low voltage electronic trip unit.

Tests have to be realized with circuit breaker in out of service, in safety condition and with trip unit removed from the circuit breaker.

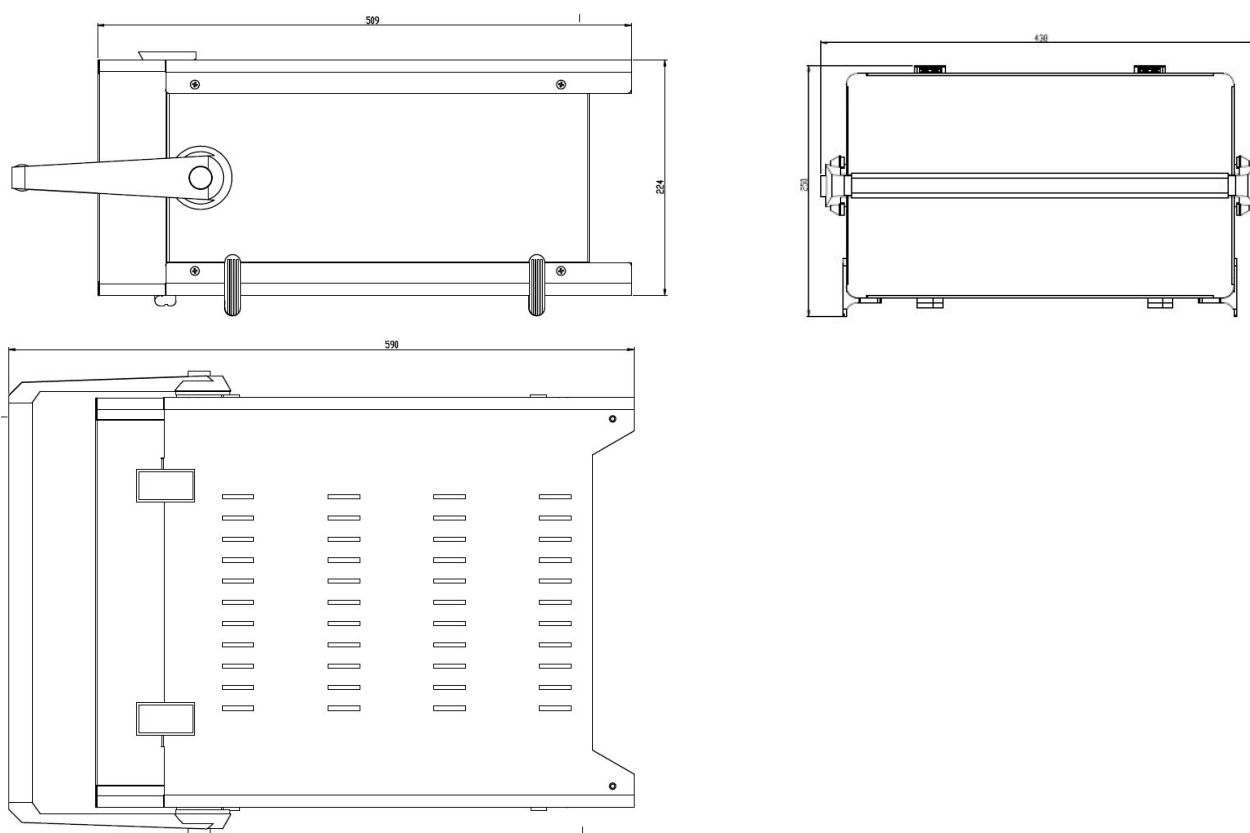
The device is realized with microprocessor digital technology and it utilizes as user interface a LCD display and membrane keyboard.

Unit parameters and functional modality are adjustable by the user using the front keyboard.

At every pressure of keys and at the end of the test, TS3 confirms with a beep signal

TS3 can work in horizontal and vertical position.

### 5.2 Mechanical characteristics



Overall dimensions : 590 x 438 x 320 mm.

Total weight (TS3 completed with accessories): 22 Kg.

#### 5.2.1 Transport case

For a safe transport of TS3, the use of the trolley-transportation case is advised: the case is supplied by ABB S.p.A. SACE Division under request (ordering code 1SDA065705R1).

	TS3	1SDH000670R0002	L3852	7/44
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### 5.3 Electrical Characteristics

Power Supply: 115/230Vac one-phase ±15% 50/60Hz (adjustable by the user)  
 Protection fuse: T10AL250V  
 Maximum power consumption: 800VA

### 5.4 Environmental Characteristics

Operating temperature +5°C...+45°C  
 Storage temperature -5°C...+60°C  
 Relative humidity 0%...95% without condensation

### 5.5 Input/Output

#### 5.5.1 Test connector

The TS3 input and output connections are available to the user by means of the frontal “Main Connector” (see chapter 5.7), to be connected at the extension cable and/or at the test cable (see chapter 4), both supplied with the test device. On this connector and consequently on the test cable, the following are available:

##### 5.5.1.1 Generated current signal

Trip Unit	In relè	Itest	Scale			Tolerances	I test max
PR1	250 ... 6300 A	0.1 ... 15 In	0...0.8In	0.8...10In	10...15In	3% f.s	94.5 KA
AR1/S1	250 ... 6300 A	0.1 ... 15 In	0...0.8In	0.8...10In	10...15In	3% f.s	94.5 KA
S2	250 ... 6300 A	0.1 ... 15 In	0...0.8In	0.8...10In	10...15In	3% f.s	94.5 KA
PR11x	250 ... 6300 A	0.1 ... 12 In	0...0.4In	0.4...5.In	5...12.In	3% f.s	75.6 KA
PR12x	400 ... 6300 A	0.1 ... Ix(*) In	0...4830A 4830...48300A			3% f.s	48.3 KA
PR23x	400 ... 1600 A	0.1 ...15In	0...5540A 5540...24000A			3% f.s	24 KA
PR33x	200 ... 1600 A	0.1 ...15In	0...5540A 5540...24000A			3% f.s	24 KA

Table 1  
 Accuracy specification

Note1: the max value to generable current **Itest** is indicated on the display.

Note2: 
$$I_x(*) = \min \left[ \frac{I_{test\ max}}{In\ relè}, 15\ In \right]$$

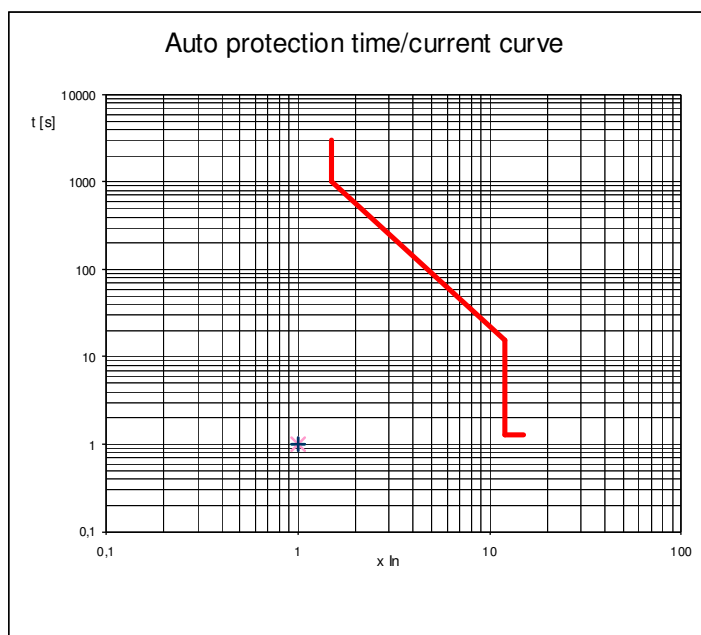
Example :

If the **In relè** is 6300 A, being the **Itest max** 48300 A, then the **Itest max** will be 48000/ 6300 = 7.66 In



### 5.5.1.2 Auto protection

The time/current curve of the auto protection function is quoted here following:



Graph 1

The auto protection function, implemented on TS3, protects the trip unit under test for incorrect setting or/and cabling by the user.

### 5.5.2 Alarms

Here following, the alarms messages visualized by the display in case of anomalies on supply voltage or internal overheating of the instrument.

Nr.	Parameter	Description	Message on the Display
1	Overvoltage	Overvoltage (115 ... 125% on the network supply voltage)	"OVERVOLTAGE"
2	Undervoltage	Undervoltage (75 ... 85% on the network supply voltage)	"UNDERVOLTAGE"
3	Overheat	Internal temperature (75 °C ±10%)	"OVERHEAT"

Table2. Alarms.

### 5.5.3 Timer

Technical characteristics

Nr.	Parameter	Value/range
1	Resolution	1 ms
2	Max Tolerances for timer stop after TC trip	2 ms ± of reading value

Table3. Timer Characteristics.

## 5.6 Operating parameters

TS3 permits personalized operating parameters by the user, according to the characteristic of the tests to be performed. Few parameters can only be read, while the other can be edit too, and will be available on the display and on the test report, produced by the TS3 at every test.

The descriptions of the parameters are mentioned in the following tables:

### 5.6.1 Parameters

Nr.	Label	Description	Selectable values	READ	EDIT
1	Timeout	Adjustable timeout of current generation	0(0= $\infty$ ) ... 4.000.000 ms, step 1 ms	x	x
2	Frequency	Output current frequency	50 / 60 Hz	x	x

Table4. Parameters.

### 5.6.2 TS3 Setting

Nr.	Label	Description	READ	EDIT
1	TS3 S/N	TS3 Serial Number	x	
2	FW version	TS3 firmware version	x	
3	Date	Date (dd/mm/yyyy)	x	x
4	Time	Time (hh:mm:ss)	x	x

Table5. TS3 Setting

### 5.6.3 User Data - Test Report

Nr.	Label	Description	READ	EDIT
1	Heading	Default Heading	X	
2	Test Nr	Test number (automatically proposed by TS3)	X	
3	Date	Date of the Test	X	
4	Hour	Time of the Test	X	
5	Test	Information defined by the user (ex. name)	X	X
6	S/N	Information defined by the user (ex. Trip unit serial number)	X	X
7	Name	Information defined by the user (ex. Operator name)	X	X
8	Note	Information defined by the user (ex. Particular note, as electrical plant reference)	X	X
9	I test	Test Current	X	
10	Phase	Name of the tested phase on trip unit (L1, L2, L3 or N)	X	
11	Test Time	Test duration	X	
12	Stop by	Action that caused the test end (TC, User, timeout, auto-protection, No Load, various alarms)	X	
13	Frequency	Supplied nominal frequency (50 or 60Hz)	X	

Table6. User data Test Report”

Example of test report:

#### ABB SACE TS3/ABB Report

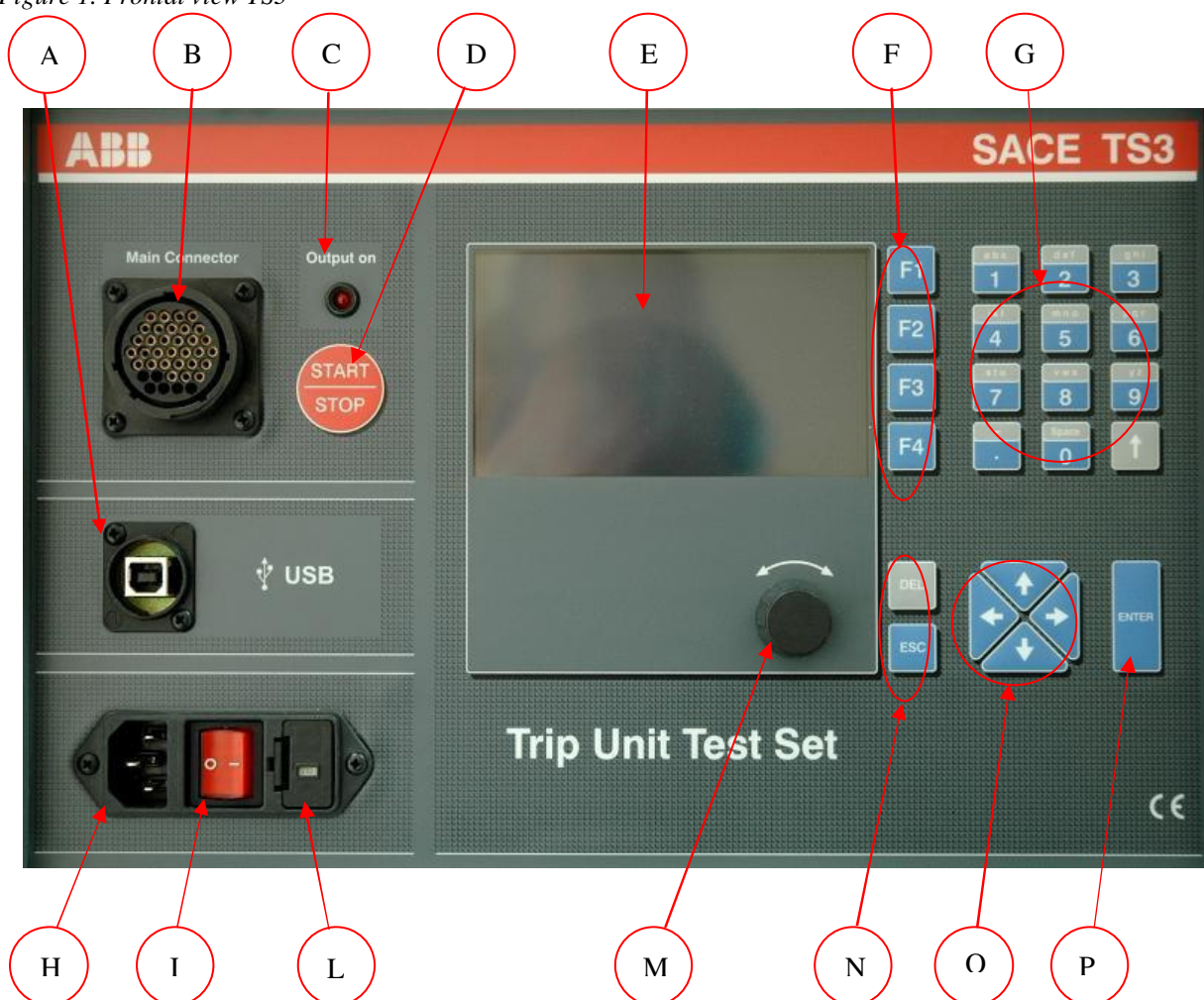
Test Nr: 43/99  
 Date: 09.06.2007  
 Hour: 15.35.23  
 # Test: PR112/PD  
 # S/N: H6625Q07A  
 # Name: Rossi P.  
 # Note: Version 1.06  
 I test: 1749A  
 Phase: L2  
 Trip Time: 5217 ms  
 Stop by: TC  
 Freq. 50 Hz

With “ # “ are indicated the information manually given by the operator/user.  
 The others are automatically available.

Test report mentions the “User Data” in memory at the moment of the test.

## 5.7 User interface

Figure 1. Frontal view TS3



Rifer.	Description
A	Type B USB connector for connection to PC
B	Main connector for ABB SACE test cable
C	“Output On” LED – Test ongoing
D	Start / Stop test pushbutton (immediate test stop)
E	Backlit LCD graphic display
F	Function keys (corresponding to the active SoftKey, in the display views)
G	Alfa-numeric keyboard for parameters introduction
H	Power supply plug
I	Power supply switch with Power On light
L	Fuse holder with power voltage selector (115V / 230V 50-60Hz AC)
M	Knob for parameters selection/movement and for adjustment of supplied current during test
N	ESC key for back command to the previous menu, and DEL to cancel entered data
O	Cursor movement keys
P	“ENTER” key to confirm data enter

Legend of TS3 front panel

### 5.7.1 knob and keys use

- ▲▼ : “UP “ “DOWN “ for unit value increase or for menu navigation.
- ◀▶ : “LEFT” “RIGHT” for menu navigation.
- ↑ : “Shift” to select alphabetic characters (grey area of keyboard)

Once in the require page, the adjustable values can be selected using the knob and/or the direction ◀▼▲▶ keys (the adjustable field is indicated with the cursor =>), the parameter is highlighted by pressing the **ENTER** key, and modified using alphanumeric keys, and confirmed with **ENTER** key.

- ESC** : press **ESC** to exit the parameter changing phase, aborting the change and go back to previous menu.
- DEL** : press **DEL** to cancel the inserted parameters in alphabetic mode.
- START/STOP** : press **START/STOP** to start or stop immediately an ongoing test.
- F1 F2 F3 F4** : press **F1 F2 F3 F4** function keys to enter in soft key menus.

### 5.7.2 Default Settings

ABB SACE provides the TS3 with the following adjusted parameters:

Label	Value
Nominal power Voltage	230Vac
Itest	0,4In
Phase	L1
Timeout	∞
Frequency	50 Hz
Beep	On
Password	00000

Table 7. Default setting

## 6 Putting into service



Immediately check the supply power voltage, before switching on the device, according the proper network voltage.

**Do not supply the TS3 with 230V AC voltage if 115V AC is indicated in the front fuse-holder!**

### 6.1 Procedure to Set the nominal power voltage

- Extract the fuse-holder cover from the TS3 ( see chapter [5.7](#) )
- Extract the fuse-holder from the cover, rotate it of 180° and re-insert it in the cover
- Re-insert the fuse-holder cover into the TS3
- Verify that the voltage value indicated is correct

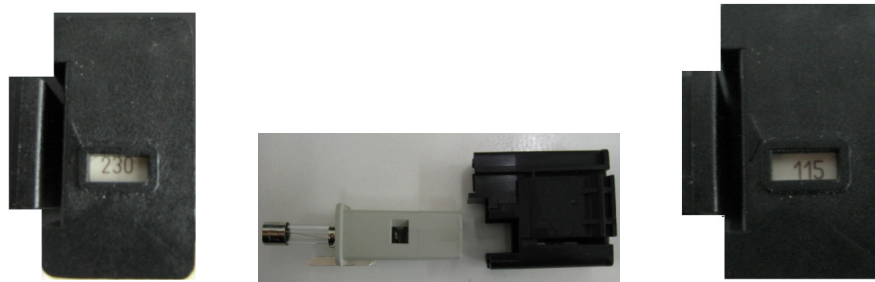


Figure 1

The following screenshot will appear after the switching on the device.

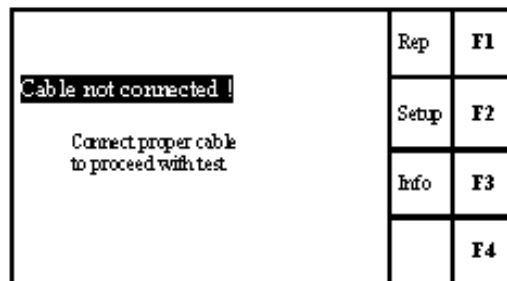


Figure 2

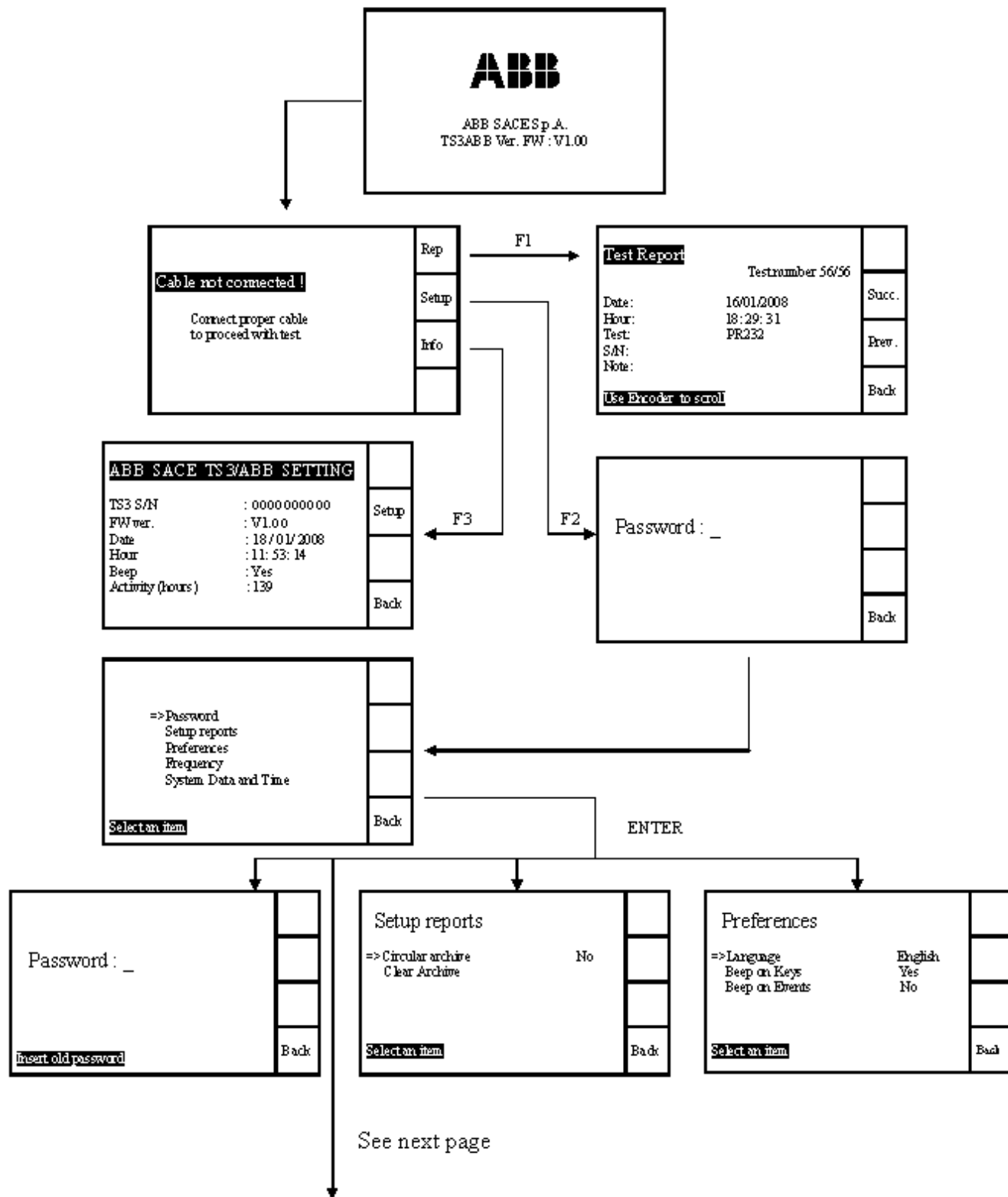
### 6.2 Connections



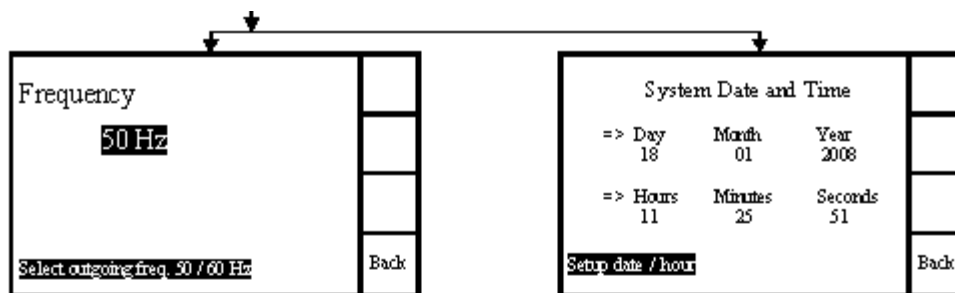
For the connections under care of the user, it is advised to exclusively use test cable and power cable provided by ABB SACE and carefully follow what mentioned in the present manual.

In this way, the TS3 test unit is able to comply with the international standards and guarantee a perfect functionality even in heavy electromagnetic ambient environments.

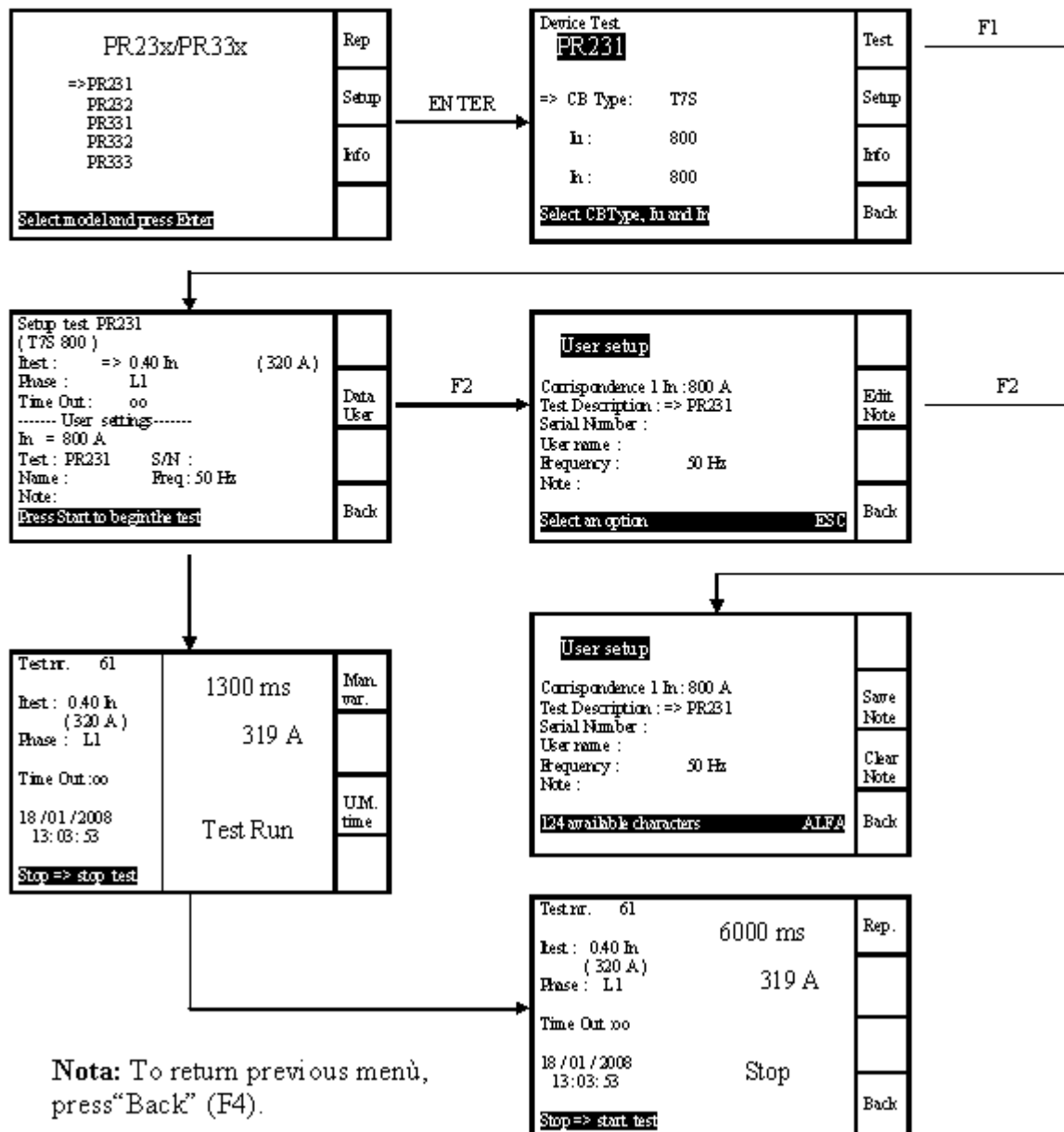
### 6.3 Menu tree



See next page



Connection Relè cable



**Nota:** To return previous menù, press "Back" (F4).



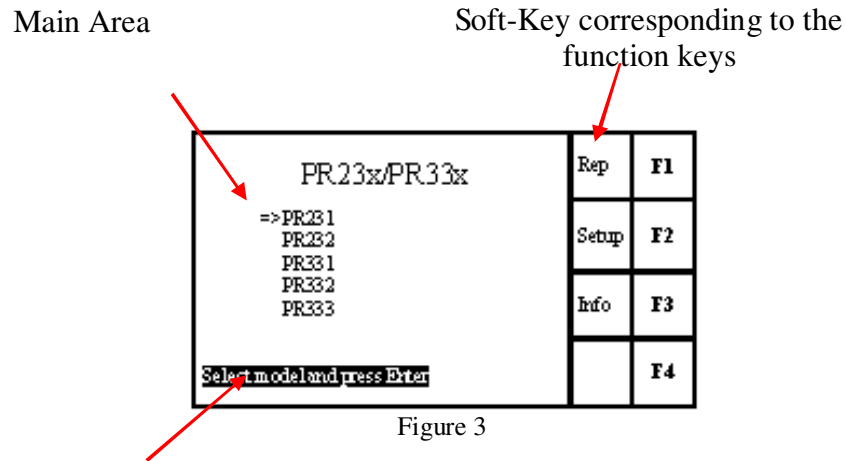
## 6.4 Display

TS3 automatically recognize the cable version connected to the main connector, ready to test the proper trip unit types.

Example.

After the connections of PR23X - PR33X test cable to the extension cable and to the frontal main connector, the following screen will be presented

In the below Figure 3, is highlighted the subdivision in areas.



Help information on the current function

In this Example, it is possible to access to Report, Setup, Info menu pressing the F1 F2 F3 keys.

## 6.5 Initial settings



The correct selections of the necessary parameters are under user care.  
Some parameters are directly accessible during Test setup phase, others a accessible on Setup menu, that can be reached with F2 key (see figure 3)

## 7 Operative instructions – step by step

### 7.1 Setup

The Setup menu is available after the user password insertion.

=>Password Setup reports Preferences Frequency System Data and Time  Select an item		<b>F1</b>
		<b>F2</b>
		<b>F3</b>
	Back	<b>F4</b>

Figure 4

To return to previous menu press **F4**.

#### 7.1.1 Setup Password

It is necessary to enter a password in order to modify some of the TS3 parameters; the default password is mentioned in chapter [5.7.2](#).

This password may be modified by the user, with a new one having a length between 1 to 5 characters; it is necessary to insert the old password, then the new one twice, to reconfirm it, and then save it pressing ENTER.

To remove the password, push ENTER as new password and reconfirm it.

#### 7.1.2 Setup Report

With the “Setup report” functions, it is possible to reset the archive and archiving mode.

It is possible to archive the reports in circular mode; when necessary, the latest report will cover the oldest one.

In not circular mode, when reached the 99<sup>th</sup> report, the user is informed that the available memory is full and no other reports will be saved. The user shall then clear the memory or change into circular mode.

Setup reports  => Circular archive           No Clear Archive  Select an item		<b>F1</b>
		<b>F2</b>
		<b>F3</b>
	Back	<b>F4</b>

Figure 5

### 7.1.3 Preferences

On the preferences screen it is possible to select the following:

- Language ( Italian, English, French, German e Spanish)
- Acoustic signal at key selections (beep)
- Acoustic signal at every event (ex. Start test, Stop test, etc.)

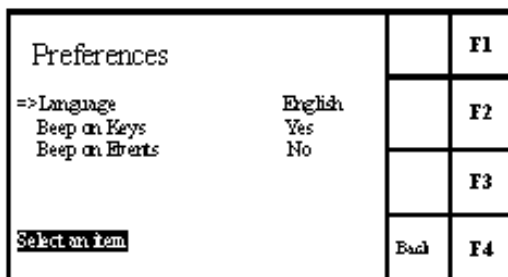


Figure 6

### 7.1.4 Frequency

The user can select the output signal frequency : 50Hz or 60Hz.

The selection is realized by means of ▲ ▼ keys or knob. Press ENTER key to confirm the selection or ESC to cancel.

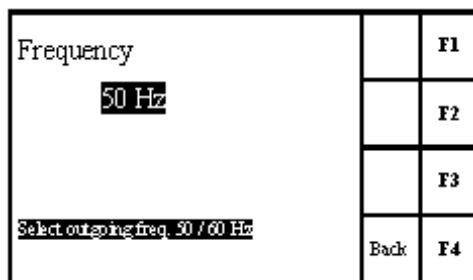


Figure 7

### 7.1.5 System date and time

Device set up

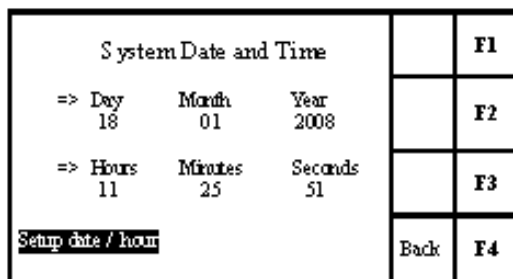


Figure 8

The selection is realized by means of ▲ ▼ keys or knob. Press ENTER key to insert the value using the alphanumeric keyboard and ENTER again to confirm the selection or ESC to cancel.

## 7.2 Trip unit selection

The TS3 is able to recognize the connected cable and automatically show the list of selectable trip units for the test. Press ▲ ▼ keys or the knob to select the correct trip unit, then confirm pressing ENTER.

The following figure shows the example with PR23x/PR33X family cable and the selection of PR231 trip unit.

PR23x/PR33x	Rep	F1
=>PR231	Setup	F2
PR232	Info	F3
PR331		F4
PR332		
PR333		
Select model and press Enter		

Figure 9

Press F1, F2 ed F3 key , to enter the Report, Setup ed Info.

## 7.3 CB Type, Iu and In selection

After having selected the trip unit, it is possible to enter three characteristic that define the circuit breaker: CB Type, Iu and In.

According to the choice made, the following valid selections are shown.

The selection is realized by means of ▲ ▼ keys or knob. Press ENTER key to confirm the selection or ESC to cancel.

Example of selection and parameter modification:

- Select the correct CB type with the arrow “=>” .
- Press ENTER.
- Selection with ▲ ▼ keys or knob.
- Press ENTER.
- Choose the correct “Iu” and “In” according to the selected CB and trip unit.

To enter the Test menu press F1.

Device Test	Test	F1
PR231	Setup	F2
=> CB Type: T7S	Info	F3
Iu : 800	Back	F4
In : 800		
Select CBType, Iu and In		

Figure 10

## 7.4 Test setup

From the screen **CB Type, Iu and In selection** ( see chapter [7.3](#)) press the F1 key to enter the Test setup screen.

In the Test setup screen the following selections are available:

- Itest as multiple of In (relative current value) and the corresponding value in Ampere (absolute current value)
- Phase to be tested (L1, L2, L3, N)
- Max time for Itest current generation

It is also possible to realize an automatic sequential test on all phases ( L1 then L2 then L3 and , if present, N) with a specific selection : L1>L2>L3 or L1>L2>L3>N

Inserted user informations are mentioned in the “User setting” area.

The item has to be selected using ▲ ▼ keys or knob.

The value incremental steps can be modified by means of ◀ ▶ keys of the selected item.

Example of setting of I test:

- Select Itest parameter with the with the arrow “=>”.
- Press **ENTER** to change parameter.
- Select the required value ▲ ▼ keys or knob.
- Press **ENTER** to confirm.

Setup test PR231 ( T7S 800 ) Itest : => 0.40 In ( 320 A ) Phase : L1 Time Out : 00 ----- User settings----- In = 800 A Test : PR231 S/N : Name : Freq : 50 Hz Note : Press Start to begin the test		F1
	Data User	F2
		F3
	Back	F4

Figure 11

Setup required phase and timeout.

Press F2 (User data) to enter in user information menu.

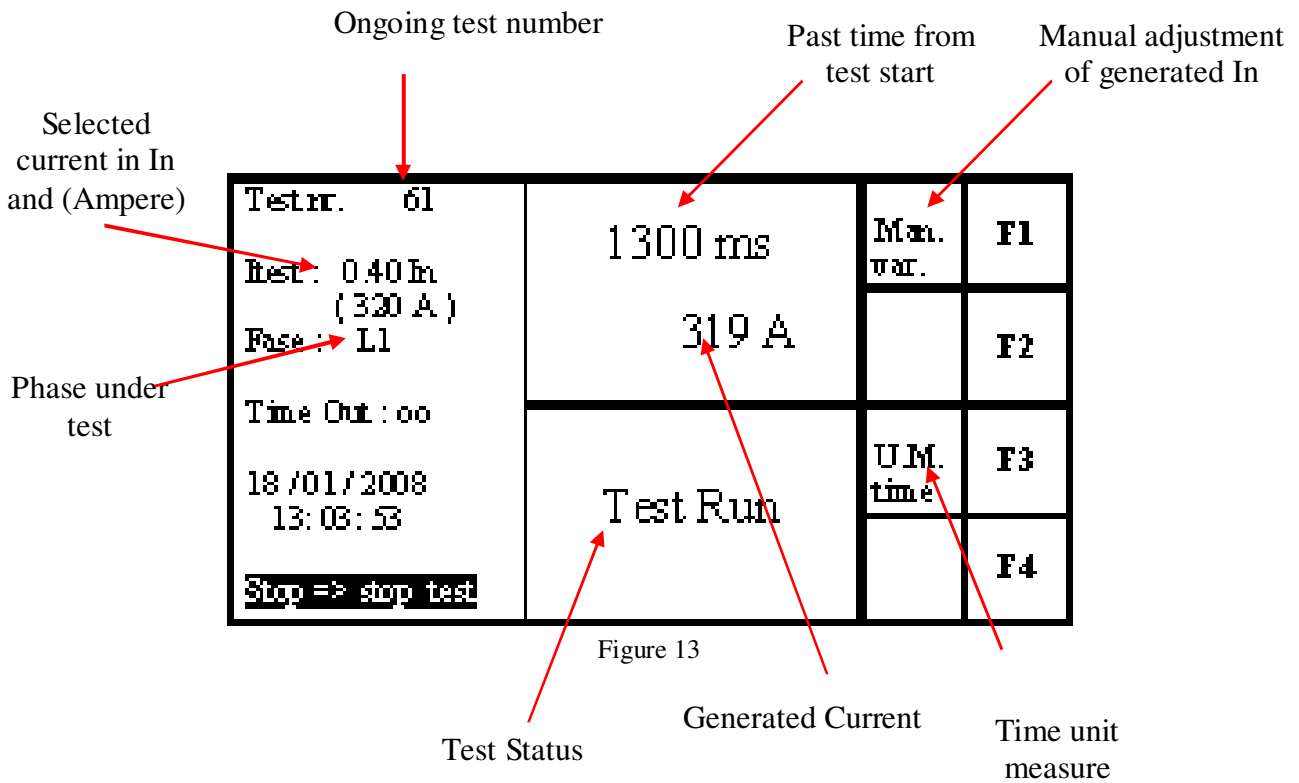
For each test, it is possible to insert a short Description, trip unit serial number, user name, and note for 124 characters.

User setup		F1
Compendence I In : 800 A Test Description : => PR231 Serial Number : Username : Frequency : 50 Hz Note :	Edit Note	F2
		F3
Select an option ESC	Back	F4

Figure 12

## 7.5 Carrying out the TEST

The test starts once the START/STOP is pressed, and the selected Itest current is generated.



Pressing **F1** key it is possible to adjust the generated current, by means of frontal knob.  
Pressing **F3** key it is possible to modify the time unit (ex. ms, s, min ...)

The test is stopped by one of the following reasons:

TRIP	When the protection release under test trips.
AUTOPROTECTION	Stop the test according the auto-protection curve to avoid damages of the DUT (see chapter <a href="#">5.5.1.2</a> ).
USER STOP	After pressing the STOP button by the user.
TIMEOUT	When the selected max time is reached
NO LOAD	In case of no load (ex. not correct connection to the trip unit)

The test result is visualized and stored in the Test Report. (see chapter [7.6](#))

## 7.6 Test Report

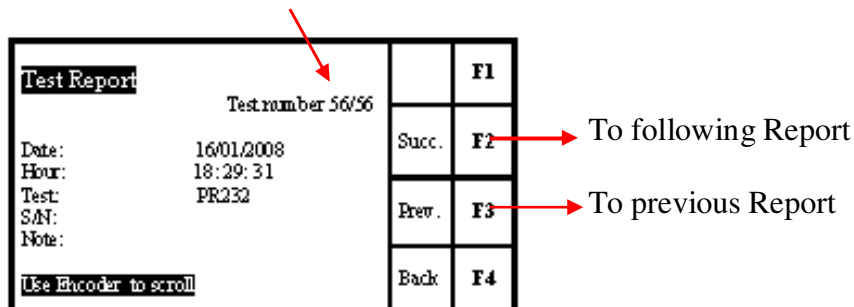
TS3 can store up to 99 reports.

To pass to previous or following test report use F2, F3 function key. The test numbering restarts from test report nr.1 when the available memory is full.

Reset or change of store mode (cyclic mode) can be done in the Setup Menu (see chapter [7.1](#)).

To scroll the report screen use the ▲ ▼ keys or knob.

Report number / total reports in memory



Test Report	Testnumber 56/56		F1
Date: 16/01/2008		Succ.	F2 → To following Report
Hour: 18:29:31		Prev.	F3 → To previous Report
Test: PR232		Back	F4
SAN:			
Note:			
Use Encoder to scroll			

Figure 14

## 7.7 Info Menu

To enter this function see menu tree (see chapter [6.3](#))

In this menu the following information are available: Firmware version and system settings.

## 8 Test on protective functions



Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected  
Further, all connected power supplies must be disabled.

In order to remove and the following reinstallation of the trip unit on the CB, please refer to the instructions or manual of installation of the CB and to the instructions sheet of the trip unit. These documents are present in the USB key of the TS3  
To verify the release of the documents, visit [www.abb.com](http://www.abb.com)

The trip unit must only be tested in self-supply. Any connections to external supply or external battery must be removed ( ex. PR030/B, PR120/B, etc..)

It is possible to realize tripping test on the L, S, I, G protective functions available on the trip units.

In the trip unit where it is set the presence of an external toroidal, an alarm for disconnection will be present on the display of the trip unit. To remove the message it is necessary to disable the “external toroidal” function.

In the trip unit where is set the differential protection, an alarm “ Gext sensor” for disconnection will be present on the display of the trip unit.

**Note3:** Pay attention to the adjustments on the different protection functions of the DUT

As an example, with the following settings  $S I_2 = 2I_n$ , 400ms and  $I = 4I_n$  and  $I_{test} = 6I_n$ , both functions S and I will be active, but the trip will be caused by the fastest function (I).

To test the S function, set the I protection = Off, or adjust a lower value of current (tolerances included).

**Note4:** As the TS3 is a one-phase secondary current generator, with the G function available and enabled, this will be always active; then in order to test the other protection functions it is necessary set the trip unit consequently. As an example in order to test the L protection, set the G=Off.



## 8.1 S1 trip unit functional test.

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° 600600.002.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Set the current and time values for the protection available on the DUT.
5. Connect the extension cable to TS3.
6. Connect the AR1/S1 test cable to the extension cable.
7. Connect the XK1 and TC connections to the DUT.

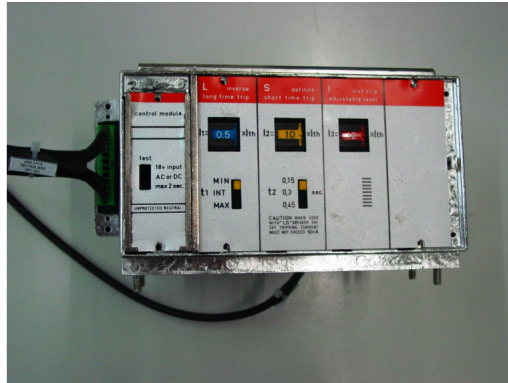


Figure 15

8. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
9. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the technical catalogue n° 6000-3-84.
10. In case of changing of settings, insert the beginning value of threshold and time.
11. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n° 600600.002

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 0.5I_n$	MIN	$3I_n$	2s
S	$t=k$	$I2 = 8I_n$	0,45s	$10I_n$	0,45s
I		$I3 = 12I_n$		$14I_n$	$\leq 60ms$
G*	$t=k$	$I4 = 0.5I_n$		$1I_n$	0.45s

Table 8

\* See Note4 in chapter [8](#).

**NOTE 5:** for the S1 trip unit with LSIG protection function, the only available tests are on the phases : L1, L2, L3.

## 8.2 S2 trip unit functional test

- 1 Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
- 2 Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° 600600.002.
- 3 Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
- 4 Do not disconnect the trip coil from the Trip Unit ( DUT ).
- 5 Set the current and time values for the protection available on the DUT.
- 6 Connect the extension cable to TS3.
- 7 Connect the S2 test cable to the extension cable.
- 8 Connect the S2 test cable the DUT.



Figure 16

- 9 If it is present G module, before testing L,S,I protection, remove G module and insert the bypass module
- 10 In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
- 11 Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the technical catalogue n° 6000-3-84.
- 12 In case of changing of settings , insert the beginning value of threshold and time.
- 13 Reinsert the G module if has been substituted by the bypass module.
- 14 Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n° 600600.002

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 1In$	A	$6In$	2s
S	$t=k$	$I2 = 8In$	0,6s	$10In$	0,6s
I		$I3 = 12In$		$14In$	$\leq 60ms$
G*	$t=k$	$I4 = 0.5In$	0,5s	$1In$	0,5s

\ Table 9

\* See Note4 in chapter [8](#)

**NOTA6: The G protection can be verified by current injection on phase L1, L2, L3 only.**

### 8.3 AR1 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° 601534 003.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Set the current and time values for the protection available on the DUT.
5. Connect the extension cable to TS3.
6. Connect the AR1/S1 test cable to the extension cable.
7. Connect the XK1 and TC connections to the DUT.



Figure 17

8. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
9. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the technical catalogue n° 649058.
10. In case of changing of settings, insert the beginning value of threshold and time.
11. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n° 601534 003.

Example of test:

Current generation on phase L1

Setting on the trip unit for L S or L I protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t = k/I^2$	$I1 = 1In$	MIN	$6In$	2s
S	$t = k$	$I2 = 8In$	0,45s	$10In$	0,45s
I		$I3 = 12In$		$15In$	$\leq 60ms$

Table 10

## 8.4 PR1 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° 601534 003.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Set the current and time values for the protection available on the DUT.
5. Connect the extension cable to TS3.
6. Connect the PR1 test cable to the extension cable.
7. Connect the XK1 and TC connections to the DUT.

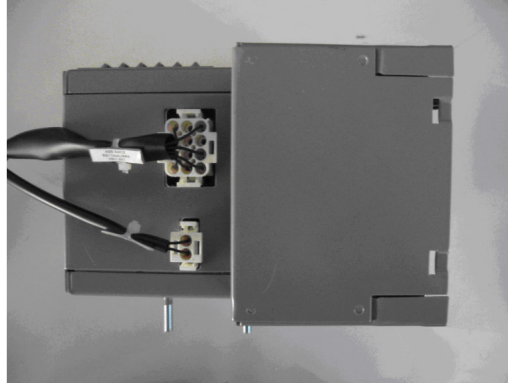


Figure 18

8. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
9. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the document (ANNEX-PI3-15).
10. In case of changing of settings, insert the beginning value of threshold and time.
11. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n° 601534 003.

Example of test:

Current generation on phase L2

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 1In$	B	6In	5s
S	$t=k$	$I2 = 6In$	E	8In	0,6s
I		$I3 = 10In$		12In	$\leq 60ms$
G*	$t=k$	$I4 = 0.6In$	E	1In	0,8 s

Table 11

\* See Note4 in chapter [8](#)

## 8.5 PR111 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° RH0228002 ÷ RH0228005 or RH0109002 and in the instructions sheet n° 601933501.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Set the current and time values for the protection available on the DUT.
5. Connect the extension cable to TS3.
6. Connect the PR11x test cable to the extension cable.
7. Connect the XK1 and TC connections to the DUT.

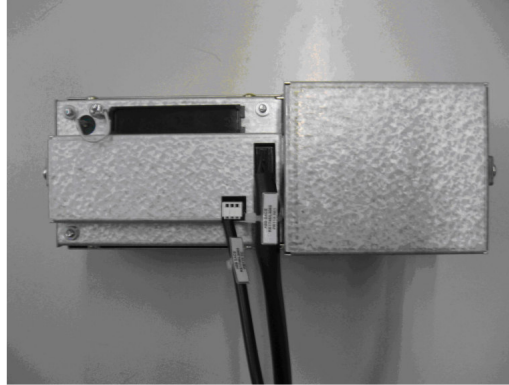


Figure 19

8. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
9. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the instruction manual of the CB n° RH0228002 ÷ RH0228005 or RH0109002.
10. In case of changing of settings, insert the beginning value of threshold and time.
11. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n°RH0228002 ÷ RH0228005 and in the instructions sheet 601933501.

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 0.4I_n$	$t1 = 6s$	$2.4I_n$	6s
S	$t=k$	$I2 = 3I_n$	$t2 = 0.25s$	$4,5I_n$	0,25s
I		$I3 = 6I_n$		$8I_n$	$\leq 60ms$
G*	$t=k/I^2$	$I4 = 0.8I_n$	$t4 = 0,8s$	$1,2I_n$	0,96.s

Table 12

\* See Note4 in chapter [8](#)

## 8.6 PR112-PR113 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n° RH0228002 ÷ RH0228005 or RH0109002 and in the instructions sheet n° 601933502 or 601933503.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Set the current and time values for the protection available on the DUT.
5. Connect the extension cable to TS3.
6. Connect the PR11x test cable to the extension cable.
7. Connect the XK1, XK2 and TC connections to the DUT.

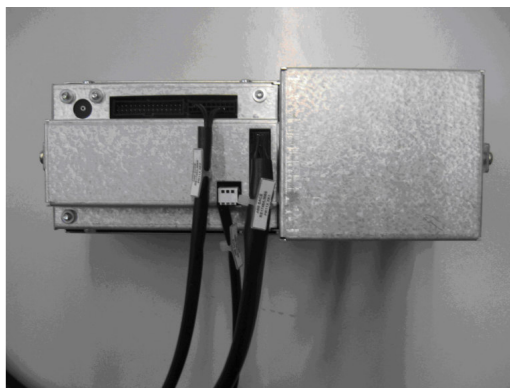


Figure 20

8. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
9. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the instruction manual of the CB n° RH0228002 ÷ RH0228005 or RH0109002.
10. In case of changing of settings, insert the beginning value of threshold and time.
11. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n°RH0228002 ÷ RH0228005 or RH0109002 and in the instructions sheet n° 601933502 or 601933503.

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1=0.4I_n$	$t1=3s$	$1.2I_n$	3s
S	$t=k$	$I2=3I_n$	$t2=0,2s$	$4I_n$	0,2s
I		$I3=5I_n$		$7I_n$	$\leq 60ms$
G*	$t=k$	$I4=0.6I_n$	$t4=0,5s$	$1I_n$	0,5s

Table 13

\* See Note4 in chapter [8](#)

## 8.7 PR121-PR122-PR123 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the installation manual of the CB n°1SDH000460R0002 ÷ 1SDH000460R0005 or 1SDH000532R0002 and in the instructions sheet n° 1SDH000460R0501, 1SDH000460R0502 or 1SDH000460R0503.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Remove the trip unit (DUT) from the CB, leaving the key plug connected to the CB (**That key plug must be reconnected to the triP unit after the test**)
5. Connect the Key plug indicated in Figure 21 to the corresponding connector on the back side of the DUT



Figure 21

6. Connect the extension cable to TS3.
7. Connect the PR12x test cable to the extension cable.
8. Connect the XK1 and TC connections to the DUT with proper key plug.

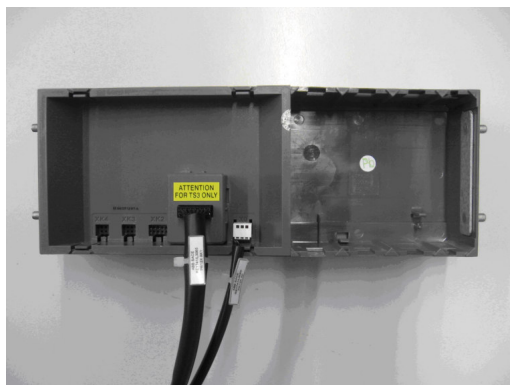


Figure 22

9. Connect the PR030/B on the front size of the trip unit.

### 8.7.1 PR121 installation

- Verify that configuration error is present, indicated with periodic blinking (1 blink every 0,5 s) of yellow led of L protection
- Press “i Test” button for few seconds until all red leds flash on, confirming the installation
- Remove the battery PR030/B.
- Set the current and time values for the protection available on the DUT.
- Reconnect the battery PR030/B.
- Verify that yellow led of L protection periodically switch on ( 1 blink every 3s)
- Remove the battery PR030/B.
- The trip unit is now ready for the test.

### 8.7.2 PR122- PR123 installation

- Enter in “Setting” menu of the trip unit
- Select “Circuit Breaker”
- Select “Unit installation”
- Insert the password
- Select “Install” and press “ENTER”
- Remove PR030/B when the red led will switch on and the display will give a “installation” message (installation error)
- Connect the XK4 connector to the DUT



Figure 23

- Reconnect the battery PR030/B.
  - Set the current and time values for the protection available on the DUT.
  - Verify that no error is present on the display
  - Remove the battery PR030/B.
  - The trip unit is now ready for the test.
10. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
  11. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the instruction manual of the CB n°1SDH000460R0002 ÷ 1SDH000460R0005 or 1SDH000532R0002.
  12. In case of changing of settings, insert the beginning value of threshold and time.

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 1In$	$t1 = 3s$	$3In$	3s
S	$t=k$	$I2 = 4In$	$t2 = 0,2s$	$5In$	0,2s
I		$I3 = 6In$		$7.5In$	$\leq 60ms$
G*	$t=k$	$I4 = 0.6In$	$t4 = 0,8s$	$1In$	0,8s

Table 14

\* See Note4 in chapter [8](#)

13. Remove the key plug indicated in figure 21 used for testing .
14. Reinstall the trip unit ( DUT ) on the CB as indicated in the instruction manual of the CB n°1SDH000460R0002 ÷ 1SDH000460R0005 or 1SDH000532R0002 and in the instructions sheet n° 1SDH000460R0501, 1SDH000460R0502 or 1SDH000460R0503.
15. Do the installation of the trip unit as indicated in the instruction manual of the CB n°1SDH000460R0002 ÷ 1SDH000460R0005 or 1SDH000532R0002



## 8.8 PR331-PR332-PR333 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the document n° 1SDH000529R0502, 1SDH000529R0503 or 1SDH000529R0504 and instructions sheet n° 1SDH000606R0001, 1SDH000606R0003 or 1SDH000606R0004 and getting started n° 1SDH000592R0001, 1SDH000593R0001.
3. Take note of the settings present on the trip unit ( DUT ); these settings must be reset after the test.
4. Remove the trip unit (DUT) from the CB, leaving the key plug connected to the CB (**That key plug must be reconnected to the trip unit after the test**)
5. Connect the Key plug indicated in Figure 24 to the corresponding connector on the back side of the DUT



Figure 24

6. Connect the extension cable to TS3.
7. Connect the PR33x test cable to the extension cable.
8. Connect the KM8 connector to the DUT.
9. Connect the PR030/B on the front size of the trip unit.

### 8.8.1 PR331 installation

- Verify that configuration error is present, indicated with periodic blinking (1 blink every 0,5 s) of yellow led of L protection
- Press “i Test” button for few seconds until all red leds flash on, confirming the installation
- Remove the battery PR030/B.
- Connect the KM4 connector to the DUT.
- Set the current and time values for the protection available on the DUT.

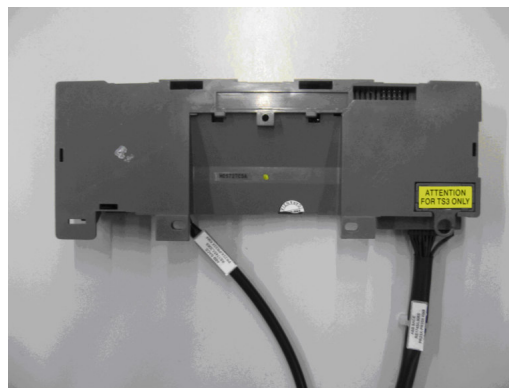


Figure 25

- Connect the PR030/B
- Verify that yellow led of L protection periodically switch on ( 1 blink every 3s)
- Remove the battery PR030/B.
- The trip unit is now ready for the test.

## 8.8.2 PR332- PR333 installation

- Enter in “Setting” menu of the trip unit
- Select “Circuit Breaker”
- Select “Unit installation”
- Insert the password
- Select “Install” and press “ENTER”
- Remove PR030/B when the red led will switch on and the display will give a “installation” message (installation error)
- Connect the KM4 connector to the DUT

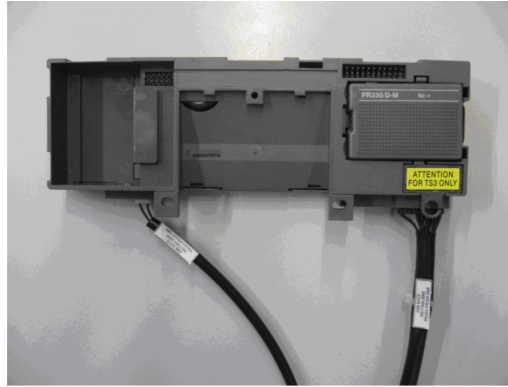


Figure 26

- Reconnect the battery PR030/B.
- Verify that no error is present on the display
- Set the current and time values for the protection available on the DUT.
- Remove the battery PR030/B.
- The trip unit is now ready for the test.

10. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
11. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the instruction manual of the trip unit n° 1SDH000587R0002 ÷ 1SDH000587R0005.

Example of test:

Current generation on phase L1

Setting on the trip unit for L, S, I, G protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 0.4I_n$	$t1 = 3s$	$1.2I_n$	3s
S	$T=k$	$I2 = 3I_n$	$t2 = 0,2s$	$4I_n$	0,2s
I		$I3 = 5I_n$		$7I_n$	$\leq 60ms$
G*	$T=k$	$I4 = 0.6I_n$	$t4 = 0.4s$	$1I_n$	0.4s

Table 15

\* See Note4 in chapter [8](#)

12. Remove the key plug indicated in figure 24 used for testing.
13. Reinstall the trip unit ( DUT ) on the CB as indicated in the document n° 1SDH000529R0502, 1SDH000529R0503, 1SDH000529R0504 and instructions sheet n° 1SDH000606R0001, 1SDH000606R0003, 1SDH000606R0004 and getting started n° 1SDH000592R0001, 1SDH000593R0001.
14. Do the installation of the trip unit( DUT) as indicated in the instruction manual of the trip unit n° 1SDH000587R0002 ÷ 1SDH000587R0005.

## 8.9 PR231-PR232 trip unit functional test

1. Prior to operate and / or carry out any replacements on the CB, this must be open, with discharged springs and disconnected
2. Remove the Trip unit ( DUT ) from the CB following the instructions in the instructions sheet n° 1SDH000529R0501 and in the document n° 1SDH000606R0001 or 1SDH000606R0003 and getting started n° 1SDH000591R0001.
3. Take note of the settings present on the trip unit ( DUT ); this settings must be reset after the test.

For PR231 follow procedure from point 4 on

For PR232or PR231 with extracode:

- Remove the key plug connected to the CB (**That key plug must be reconnected to the tri unit after the test**)
  - Connect the Key plug indicated in Figure 24 to the corresponding connector on the DUT
4. Connect the extension cable to TS3.
  5. Connect the PR232x and PR33x test cable to the extension cable.
  6. Connect the KM8 connector to the DUT.

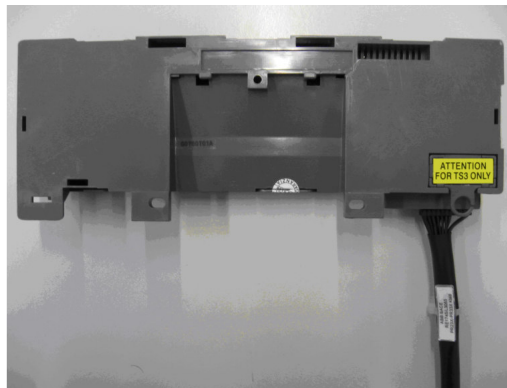


Figure 27

7. Set the current and time values for the protection available on the DUT.
8. The trip unit is now ready for the test.
9. In order to set parameters and perform the test, follow the instructions in chapters [7.3](#), [7.4](#), [7.5](#)
10. Verify that the tripping time indicated in the TS3 display is corresponding to the expected one, as indicated in the technical catalogue n° 1SDC210015D0202.
11. Remove the key plug indicated in figure 24 used for testing .
12. Reinstall the trip unit ( DUT ) on the CB as indicated in the instructions sheet n° 1SDH000529R0501 and in the document n° 1SDH000606R0001 or 1SDH000606R0003 and getting started n° 1SDH000591R0001.

Example of test on PR231:

Current generation on phase L1

Setting on the trip unit for L, S, I protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1 = 0.4I_n$	$t1 = 3s$	$2.4I_n$	3s
S	$t=k/I^2$	$I2 = 3I_n$	$t2 = 0.1s$	$3.6I_n$	0.77s
I		$I3 = 5,5I_n$		$7I_n$	$\leq 60ms$

Table 16

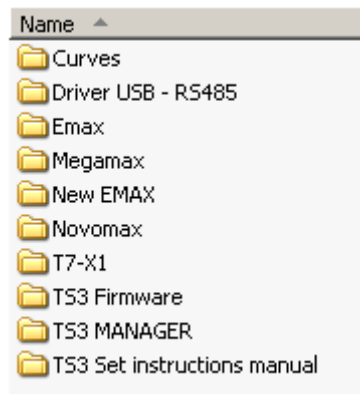
Example of test on PR232:  
 Current generation on phase L1  
 Setting on the trip unit for L, S, I protections.

Protection	Curve	Trip threshold	Trip time	I test	Expected tripping time
L	$t=k/I^2$	$I1=0.4I_n$	3s	$2.4I_n$	3s
S	$t=k$	$I2=5I_n$	$t2=0.25s$	$6I_n$	0,25s
I		$I3=7I_n$		$8.4I_n$	$\leq 60ms$

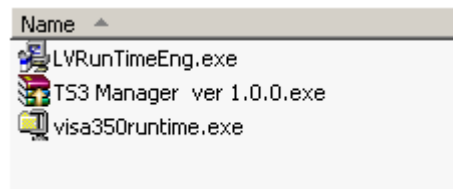
Table 17

## 9 TS3 Manager Installation

To install the TS3 Manager, follow the instructions below.  
In the USB memory stick, are stored the following folders:



In the TS3 MANAGER folder there are the following files :



run one by one the files to perform the installation.

To use the TS3Manager, see the TS3Manager User's guide 1SDH000670R0003.

## 10 Upgrade Firmware

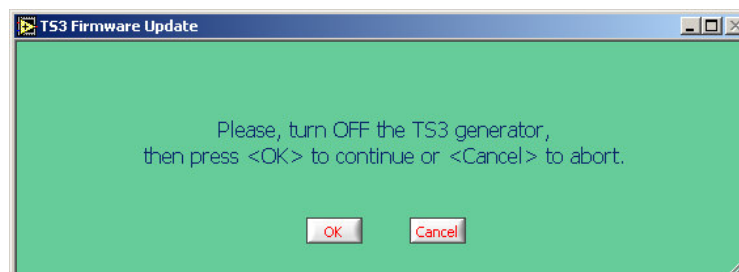


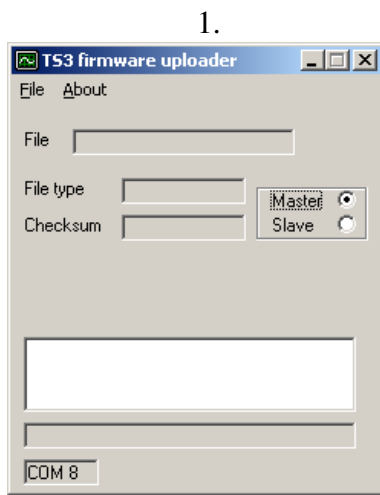
**DURING THE LOADING OF THE FIRMWARE, THE POWER SUPPLY OF THE TS3 MUST BE ALWAYS ON.  
REMOVE THE POWER SUPPLY DURING THE LOADING OPERATION CAUSE FUNCTIONAL PROBLEMS TO THE INSTRUMENT**

To check eventual FW version update, visit the web site <http://bol.it.abb.com>

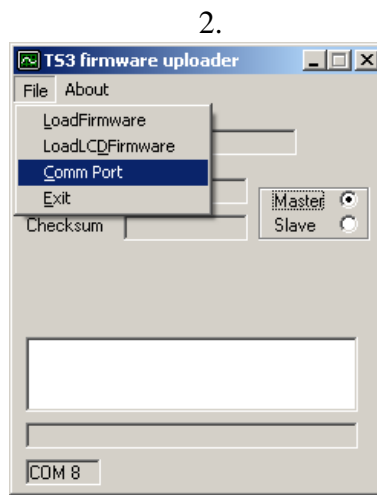
To upgrade the FW

- connect the USB cable from PC to TS3 (if necessary install the USB-RS485 converter, the driver are present in the USB stick memory in the folder Driver USB-RS485 ) ,
- run the TS3 Manager and follow the instructions below.

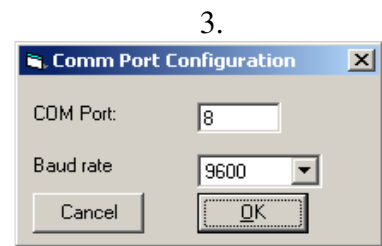




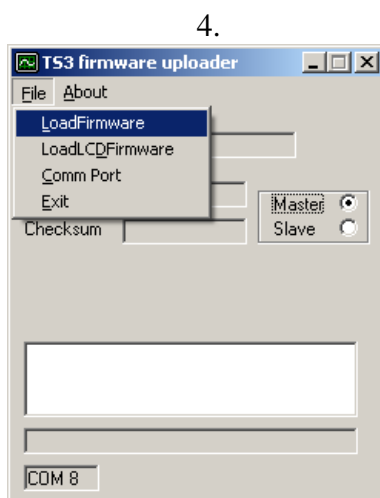
Select Master



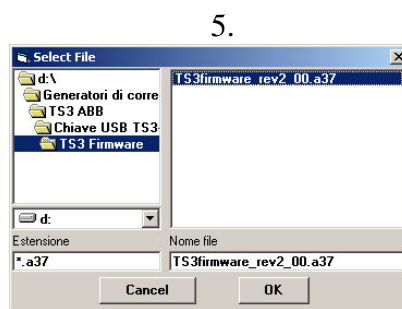
Communication setting



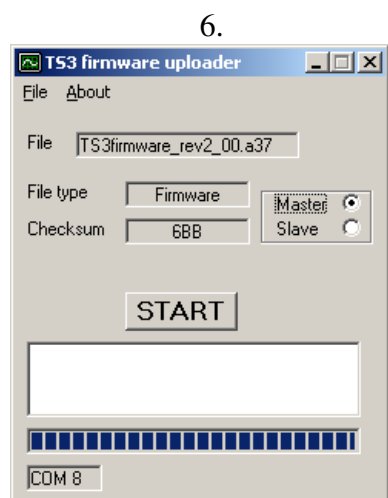
COM Port Selection



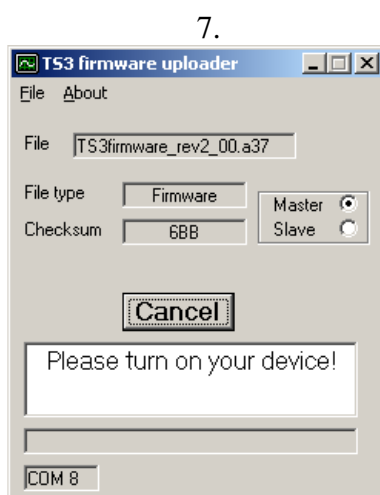
Firmware selection



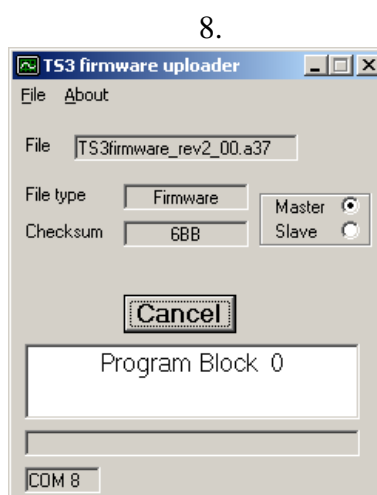
Firmware selection



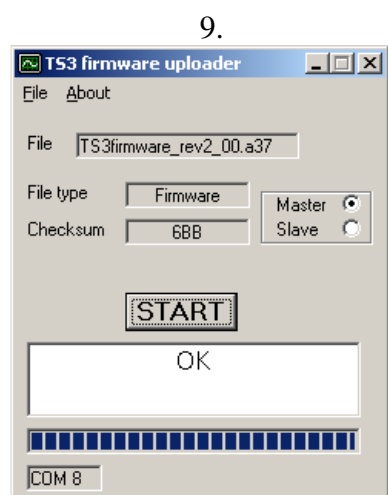
Press START to begin the firmware upload



Turn on the TS3

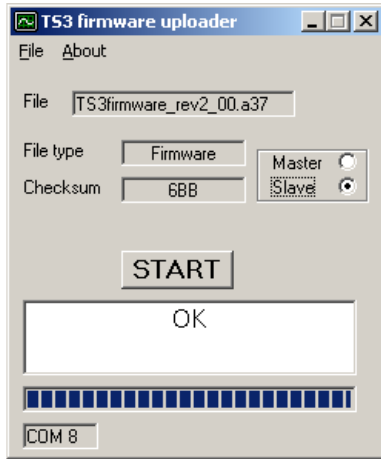


Firmware loading



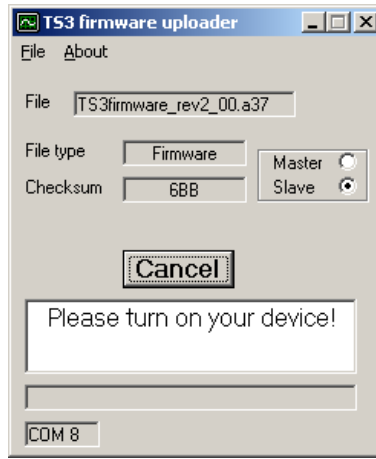
Finish firmware loading

10.



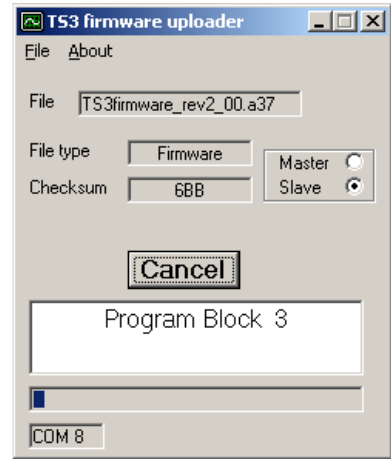
Select Slave and press START to begin the firmware upload

11.



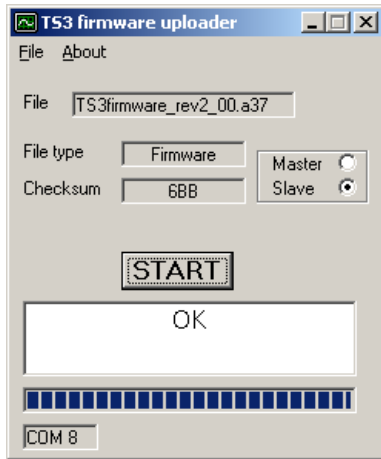
Turn on the TS3

12.



Firmware loading

13.



Finish firmware loading



## 11 Troubleshooting table

In the following table, a series of typical situation are indicated, useful to understand and solve faults or improper working

**Note 7: In case none of the following cases will help you to find a solution, please contact the nearest ABB service organization**

Nr.	Situation	Description	Suggestions
1	TS3 does not power on	The display does not switch on	<ol style="list-style-type: none"> <li>1. Check the power cable is properly connected.</li> <li>2. Check that the power switch is in on position</li> <li>3. Check the presence of the fuse on fuse-holder, and that the fuse is not interrupted.</li> </ol>
2	TS3 does not generate current	“Output on” led does not switch on	1. Press Start/ Stop button
		Message “NO LOAD” on the display	Check that the test cable and extension are correctly connected to trip unit
2		1. Message “OVERVOLTAGE” on the display	1. Network voltage is over functional limits
		2. Message “UNDERVOLTAGE” on the display	2. Network voltage is below functional limits
		3. Message “OVERHEAD” on the display	3. Internal temperature is over operational limits
3	TS3 does not stop the current generation	During the test of a Trip unit the TS3 does interrupt the current generation	<ol style="list-style-type: none"> <li>1. Check if DUT and TS3 settings are correct.</li> <li>2. Check if the Itest current is higher that the current threshold adjusted on the DUT, considering the tolerances</li> <li>3. Check the connections of testing cable</li> </ol>
4	Unexpected current interruption	During the test of a Trip unit the TS3 unexpectedly interrupt the current generation	1. Check the connections of testing cable (verify that the message “NO LOAD” is not present on TS3 display)
5	Tripping times is longer or shorter that expected	TS3 stop the current generation earlier or later that expected	<ol style="list-style-type: none"> <li>1. Check that the Itest current and adjusted parameters on DUT are correct</li> <li>2. Check that the output signal frequency is the same of what is adjusted on the DUT</li> </ol>
6	“Wrong Password”	Message “Wrong password” on the display	Check the exactitude of the inserted password
7	Forgotten the Password	In case of lost personalized password	Please contact the nearest ABB service organization
8	The FW version of TS3 is 1.00	In case of the FW version is 1.00 and missing the communication between the TS3 and PC	Install the TS3 Manager and perform the Firmware upgrade. Only from FW version 2.00 on it is possible to establish the communication.
9	Communication problem	In case of missing communication between PC and TS3	<ol style="list-style-type: none"> <li>1. Check if the USB cable is connected between TS3 and PC.</li> <li>2. Install the driver USB-RS485 converter.</li> <li>3. Check which port COM is used.</li> <li>4. Check which version of FW is installed on TS3; only from version 2.00 on is possible to use the TS3Manager.</li> <li>5. Check the ID number selected from TS3 Manager ( the default number is 1).</li> </ol>

## 11.1 In case of a fault



If the TS3 is suspected of being faulty, there are signs of malfunctions, we advise you to strictly follow the recommendations below:

1. Take note of the type of fault
2. Take note of the Serial Number, TS3 SW version ( see chapter [7.7](#) ).
3. Take note of the trip unit type.
4. Prepare a short description of the problem (which messages were present on the display? Which type of test where under test? When did it happen? How many times? Was it always under the same conditions? what current? is the event reproducible?)
5. Send/communicate all information collected, together with CB circuit diagram, to your nearest ABB Customer Assistance service..

Delivering comprehensive, accurate information to ABB Assistance service will facilitate technical analysis of the problem encountered, and allow to promptly carry out all actions useful for the user.



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Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present document may only be considered binding after confirmation by ABB S.p.A. *ABB SACE Division*

	<b>TS3</b>	<b>1SDH000670R0002</b>	<b>L3852</b>	<b>44/44</b>
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