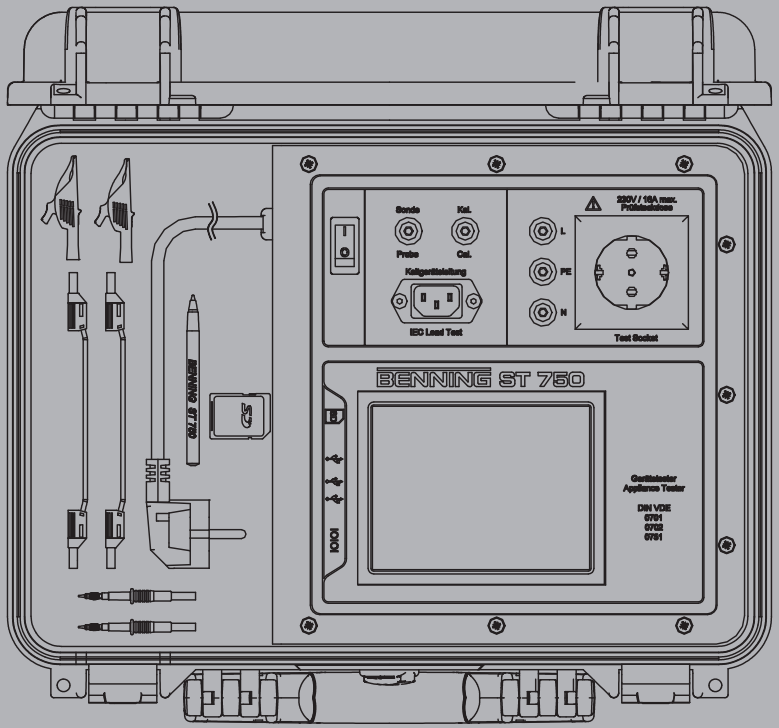
BENNING

Operating Manual

Appliance Tester for Tests in Compliance with DIN VDE 0701-0702 and DIN VDE 0751-1 (EN 62353)



BENNING ST 750

T.-Nr. 10023112.01/ 12/ 2010

Content Page

1. Safety Instructions

This operating manual contains information which is necessary to ensure proper operation of the appliance tester. Before commissioning of the appliance tester, thoroughly read and adhere to the instructions contained in this operating manual!

Please keep this operating manual for later use!

Electrical safety tests of electrical appliances must be carried out by qualified electricians or under their responsibility only.
Symbols used in this operating manual and on the device:

	Attention! Danger! Please observe documentation!
	Warning of dangerous voltage
	Note to be observed imperatively
	(DC), direct voltage or current
	(AC), alternating voltage or current
	Earth
O/I	Switch ON/OFF
	SD memory card
	USB interface
IOIO	RS232 interface
	Bluetooth connection
CE	Complying with EU directives

All technical information and standards quoted correspond to the status of the time of printing and have been determined to the best of knowledge.

For testing, the corresponding provisions, regulations and standards shall be authoritative.

The device has been built and tested in accordance with the applicable regulations (see chapter 2) and has left the factory in perfectly safe technical condition. To preserve this condition and to ensure safe operation of the device, the user must absolutely observe the notes and warnings given in this operating manual. Improper handling and non-observance of the warnings might involve severe injuries or danger to life. Do not touch the display with edged objects and do not apply pressure to the display. Only use the input stylus provided or another blunt pen. It is also possible to operate the device with your fingers. The device complies with protection class II. For operation of the "test socket", the protective conductor of the device input is looped through. The protective conductor is intended for measuring to earth. Connect the device only to a single-phase mains with 230 V, 50 Hz and a pre-fuse of 16 A. For information about the admissible load of the test socket, please refer to chapter 20 ("Technical Data").

The BENNING ST 750 Appliance Tester must be operated with earthed mains only!

For all work carried out with the device, the respective applicable accident prevention regulations of the industrial professional associations for electrical equipment must be observed.

Please observe that working on live parts and electrical components of all kinds is dangerous! Even low voltages of 30 V AC and 60 V DC may be dangerous to human life! This device must be operated by qualified electricians or by "electrotechnically trained persons" under responsibility of a qualified electrician only. Please observe the corresponding operating or maintenance manuals of the devices / test samples to be tested / to be connected. The device must be used in dry rooms only. The device outputs are not intended for permanent operation, but only for short-time tests!
Before commissioning, always check the device as well as all cables for damages.

Do not open the appliance tester. It does not contain any components which can be repaired by the user. Repair and service must be carried out by qualified personnel only!

Please use only the original measuring lines provided or corresponding safety measuring accessories!

Attention! Dangerous voltages might occur during insulation testing (RISO).
If it can be assumed that safe operation is no longer possible, switch the device off immediately and secure it against unintended operation. Safe operation can be assumed to be no longer possible, if

- the device exhibits visible damage,
- the device no longer works,
- the device has been stored under unfavourable conditions for a longer period of time,
- the device has been exposed to extraordinary stress during transport.

For device protection and for functional testing, the measuring voltages are monitored. In case of a fault, the fault will be indicated on the display. Measurement will be interrupted. In case of a fault current of ≥ 25 mA, the device will be switched off within 100 to 200 ms. When the thermal fuse is triggered, it can only be reset by switching off the test device.

In order to detect also short-circuits and body contacts occurring behind the switch-on elements (switch, thermostat, relay) of the test sample, the test sample must be switched on.

The test sample must be free of external voltage (disconnected from the mains).
The device is not intended for measurements in electrical systems!
Do not connect any external voltage to the "test socket" and to the built-in jacks or connectors. The device might get damaged!

The appliance tester must be used only in the operating and measuring ranges specified under "Technical Data".

Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

Cleaning: Regularly wipe the housing by means of a dry cloth and cleaning agent. Do not use any polishing agents or solvents!

1.1 Requirements for Testing Personnel

Electrical safety tests of portable electrical equipment can be carried out by competent persons or qualified electricians. Due to the definitions of the German technical guideline for operational safety "Competent persons – specific requirements – electrical hazards" (TRBS "Befähigte Personen – Besondere Anforderungen – Elektrische Gefährdungen"), it is no longer possible to let the testing be carried out only by electrotechnically trained persons. However, the electrotechnically trained person can take over tasks in a testing team (e.g. qualified electrician / electrotechnically trained person) within the framework of periodic tests and thus support the qualified electrician.

Competent Person
In terms of the German Health and Safety at Work Regulation, a competent person is someone who has the required expert knowledge for the testing of electrical equipment due to his/her vocational education, professional experience and contemporary occupational activity. According to the German technical guideline for operational safety "Competent persons – specific requirements – electrical hazards" (TRBS 1203, Part 3), the competent person must have finished an electrotechnical vocational education or must have another similar electrotechnical qualification suitable for the testing of portable electrical equipment to ensure protection against electrical hazards. The term professional experience means that the person has at least one year of experience regarding the installation, assembly or maintenance of electrical equipment and/or systems. For the intended testing of portable electrical equipment, the competent person must have the required detailed knowledge of electrical engineering as well as of the relevant electrotechnical regulations and must regularly update this knowledge. These demands show that safety-related evaluation of portable electrical equipment basically requires the attributes of a qualified electrician.

Qualified Electrician
In terms of the German accident prevention regulation "Electrical systems and equipment" (BGV/GUV A3), a qualified electrician is someone who is able to evaluate the tasks assigned to him/her due to his/her professional education, knowledge and experience as well as to the knowledge of the relevant provisions and who is able to recognize possible dangers (as a rule e.g. journeyman electricians, master electricians, electrical engineering technician, electrical engineer).

Electrotechnically Trained Person
An electrotechnically trained person is someone who has been informed and instructed (if necessary) by the qualified electrician regarding the tasks assigned to him/her and regarding possible dangers in case of improper behaviour. Moreover, the electrotechnically trained person has been instructed with regard to the required protection equipment and protective measures. For all this, e.g. in-house craftspeople or skilled workers, equipment maintenance personnel or facility managers can be taken into consideration.

2. Applicable Regulations

Measurements / tests	Testers and measuring equipment
DIN VDE 0701 – 0702	DIN VDE 0404, Part 1
DIN EN 62353 (VDE 0751-1)	DIN VDE 0404, Part 2
(medicine)	DIN VDE 0404, Part 3 (medicine)
ÖVE E 8701-1	DIN VDE 0404, Part 4
(similar to VDE 0701 and 0702)	DIN EN 60529 (VDE 0470, Part 1)
ÖVE E 8701-2–2	DIN EN 61010-1 (VDE 0411, Part 1)
(similar to VDE 0701 and 0702)	DIN EN 61010-2-032 (VDE 0411, Part 2-032)
BetrSichV	DIN EN 61010-031 (VDE 0411, Part 031)
TRBS 1201	DIN EN 61326 -1 (VDE 0843, Part 20-1)
TRBS 1203, Part 3	DIN EN 61557-1 (VDE 0413, Part 1)
BGV A3	DIN EN 61557-2 (VDE 0413, Part 2)
	DIN EN 61557-4 (VDE 0413, Part 4)

3. Product Description

The BENNING ST 750 Appliance Tester has been developed for making the following measurements for safety-related testing of electrical appliances in compliance with DIN VDE 0701-0702 (BGV A3) and DIN VDE 0751-1:

- measurement of the protective conductor resistance with compensation of the measuring line
- measurement of the insulating resistance
- measurement of the protective conductor current (alternative leakage current measurement, direct current measurement or differential current measurement method)
- measurement of the contact current (alternative leakage current measurement, direct current measurement or differential current measurement method)
- measurement of the device leakage current (alternative leakage current measurement, direct current measurement or differential current measurement method)
- measurement of the leakage current of the applied part (alternative leakage current measurement or direct current measurement method)
- functional test with measurement of input voltage, input current, effective power and apparent power
- testing of IEC leads and extension cables

3.1 Scope of Delivery

The scope of delivery of the BENNING ST 750 includes:

1 x BENNING ST 750 Appliance Tester
1 x 2 GB SD memory card
2 x 1 m connecting cable with 4 mm safety plug
1 x IEC connecting cable (for line test)
2 x safety probe tip (red, yellow) with 4 mm safety jack
2 x alligator clip (red, black) with 4 mm safety jack
1 x input stylus
1 x operating manual

3.2 Transport / Storage /Operating Conditions

The device is designed for being operated under the following conditions:

Ambient conditions: height up to 2000 m above sea level
Temperature range: 0 to 35 °C (operating temperature)
- 20 to 60 °C (storage temperature)
Max. relative humidity: 80 % to 30 °C, linearly decreasing
60 % to 40 °C, non-condensing

Under the carrying handle, the device is provided with a manual pressure valve: Turn it to the right (in clockwise direction) to close the valve (CLOSE) and to see a red indicator triangle. Turn it to the left (in counter-clockwise direction) to open the valve (OPEN) and to see a green indicator triangle. To protect the device and for long transport, it is recommended to close the valve. To open the device, first open the valve (for pressure compensation) and then open the cover. Please also refer to chapter 20 ("Technical Data"). Please keep the original packaging for later dispatch, e.g. for calibration. Transport damage due to improper packaging are excluded from warranty. Please store the appliance tester under dry conditions in closed rooms. If the device has been transported at extreme temperatures, it needs an acclimatization phase of at least two hours before switching it on.

3.3 Model and Type Designation

A type plate indicating the series number is located inside the housing (on the left next to the connections for peripheral devices). If you have any queries, please always state the product designation and the series number.

3.3.1 Environmental Protection

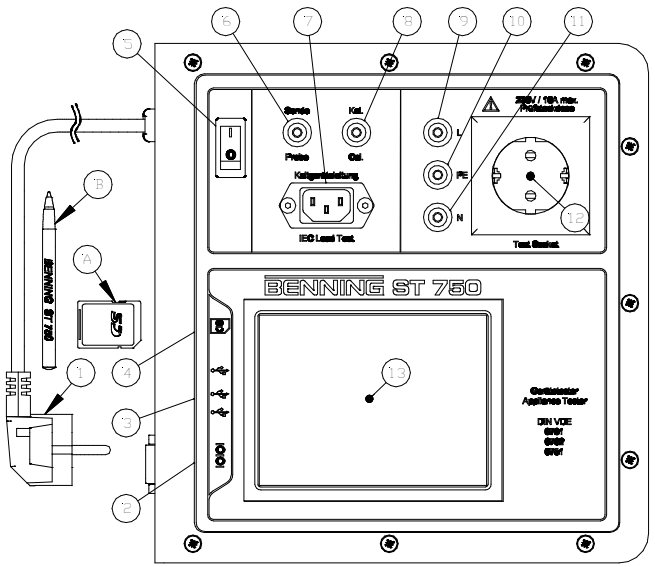
At the end of product life, dispose of the unserviceable device via appropriate collecting facilities provided in your community.

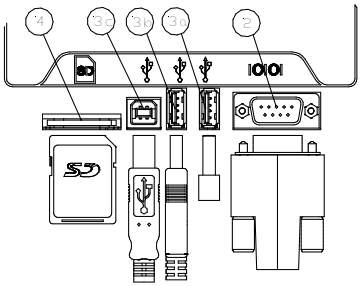
4. Equipment Characteristics / Tests

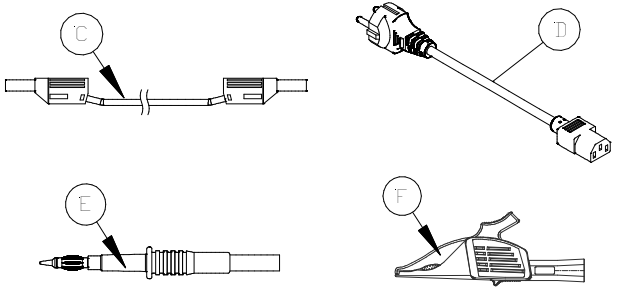
The BENNING 750 Appliance Tester can be used for the following tests:

Type of measurement	in compliance with
Measurement of the **protective conductor resistance** with 0.2 A DC (continuously) or with 10 A AC (temporarily for 5 sec). The measurement is made between the protective conductor and all accessible conductive parts connected to the protective conductor (with automatic polarity reversal in automatic mode!).	DIN VDE 0701-0702 DIN VDE 0751-1
Measurement of the **insulating resistance** L/N to PE with 500 V DC (voltage is adjustable!); also insulating resistance between primary and secondary side or active parts of devices with SELV / PELV voltages as well as medical electrical devices with patient connections of applied parts	DIN VDE 0701-0702 DIN VDE 0751-1
Measurement of the **protective conductor current, (leakage currents),** measurement of the protective conductor current and leakage current for devices of protection classes I to II with accessible conductive parts which are not connected to the protective conductor; by means of the differential current, direct current or alternative leakage current measurement method or with an external current measuring clamp (with automatic polarity reversal in automatic mode!)	DIN VDE 0701-0702
Measurement of the **contact current** for devices of protection classes I to III with accessible conductive parts which are not connected to the protective conductor; by means of the differential current, direct current or alternative leakage current measurement method or with external current measuring clamp	DIN VDE 0701-0702 DIN VDE 0701-240 (previous VDE regulation)
Measurement of the **device leakage current** (leakage currents), measurement of the protective conductor current and leakage current for devices of protection classes I to II with accessible conductive parts which are not connected to the protective conductor; device leakage currents / leakage current for medical electrical devices of applied parts of type B, BF and CF; by means of the direct current measurement or alternative leakage current measurement method or with external current measuring clamp (with automatic polarity reversal in automatic mode!)	DIN VDE 0751-1
Measurement of the **patient leakage current** (leakage current) for medical electrical devices of applied parts of type B, BF and CF; by means of the direct current measurement and alternative leakage current measurement method	DIN VDE 0751-1
Functional test after successful testing; indication of mains voltage and current (differential current measurement), fault current, effective power and apparent power	DIN VDE 0701-0702 DIN VDE 0751-1
Cable test, continuity test, measurement of the line resistance of connecting cables, extension cables and cable reels; the insulating resistance between L/N to PE must be measured separately!	DIN VDE 0701-0702 DIN VDE 0751-1
Safety extra-low voltage Ua (PELV and SELV); proof of compliance with the specifications for the rated voltage (25 V). The insulating resistance between primary and secondary side or active parts of devices with SELV/ PELV voltage has to be measured separately (see "Measuring the insulating resistance")!	DIN VDE 0701-0702

5. Description of the Operating Elements







Meaning of operating elements:

1 Mains connection cable
2 RS232 interface, 9-pin D-sub connector e.g. for barcode scanner
3a USB 2.0 interface, socket type A, e.g. for Bluetooth dongles (printer)
3b USB 2.0 interface, socket type A, e.g. for USB sticks (max. 8 GB), keyboard
3c USB 2.0 interface, socket type B
4 Adapter / slot for SD memory card (max. 2 GB)
5 Mains switch (O - I)
6 Jack, yellow, for measuring and sensing probe
7 IEC connector for cable test
8 Jack, green, for probe calibration
9 Jack, black, "L", can be connected to the test socket
10 Jack, yellow/green, "PE", hard-wired to the test / mains socket
11 Jack, blue, "N" (0), can be connected to the test socket
12 Switchable test / mains socket
13 Touchscreen

Meaning of accessories:

A SD memory card
B Touchscreen stylus / input stylus
C Connecting cable (test cable) with 4 mm safety plug (1 m)
D Connecting cable (cable test)
E Safety probe tip with 4 mm safety jack
F Alligator clip with 4 mm safety jack

6. General Information / Technical Specifications

The BENNING ST 750 Appliance Tester is provided with a touchscreen and a switchable test socket. The built-in USB interface and the "BENNING PC-Win ST 750" PC software allow read-out of the memory data as well as communication between PC and tester. The BENNING ST 750 is intended to be used for safety tests of electrical appliances after

- repair, modification and periodic inspection of electrical appliances (DIN VDE 0701-0702)
- periodic tests and after repair of medical electrical devices or systems (DIN EN 62353; VDE 0751-1; IEC 62353).

The DIN VDE 0701-0702 standard applies to tests regarding the electrical safety of electrical appliances with rated voltages of 1000 V AC / 1500 V DC. The standard shall apply together with the test procedures and tests to be applied for proving the electrical safety by observing the admissible limiting values. This standard shall also apply to tests after repair, modification and periodic tests of electrical appliances which are firmly connected to the electrical system or which are portable devices. The responsible qualified electrician shall decide whether an electrical appliance which is firmly connected to the system shall be tested during periodic testing together with the system according to DIN VDE 0105-100 (VDE 0105-100) or whether it shall be tested according to this standard, but separate from the system or together with a part of the system. Electrical appliances which are normally connected by means of a plug connection, but exceptionally are firmly connected, shall be tested according to DIN VDE 0701-0702. For testing a system, it shall be allowed to disconnect the connected devices and to test them separately according to DIN VDE 0701-0702. The standard shall not apply to devices for which specific laws, provisions, operating manuals or regulations have to be observed (e.g. explosion hazard areas, mining etc.). Test samples with three-phase connection shall be tested by means of a corresponding adapter and a separate leakage current clamp. The measuring results shall be entered manually into the appliance tester for joint logging. The tests shall be carried out by competent persons, qualified electricians or by electrotechnically trained personnel under supervision of qualified electricians.

⚠ For tests with the warning "High leakage current!", the testing must be carried out by qualified electricians only!

The necessity and time intervals of periodic tests are defined e.g. in the German accident prevention regulation BGV A3 (BGV A2 (VBG 4)) "Electrical systems and equipment" and in the German Health and Safety at Work Regulation ("BetrSichV").
§ 5 of BGV A3 (BGV A2 (VBG 4)) says:

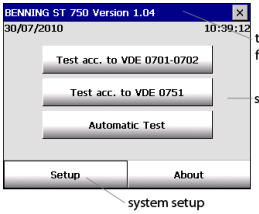
1. The company shall ensure that electrical systems and equipment are tested with regard to their proper condition:
   - before initial commissioning and after modification or repair, before recommissioning by a qualified electrician or under supervision of a qualified electrician, in defined time intervals.
   - The intervals shall be determined in such a way that assumable occurring defects can be detected in good time.
2. For testing, the corresponding electrotechnical rules shall be observed. On request of the professional association, a test book with certain entries shall be kept.

7. Commissioning / Setup

Important system settings (expert settings) can only be made by trained service specialists by entering a password!

⚠ **Remove SD memory cards only with the appliance tester being switched off!**

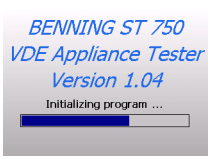
Before switching the device on, remove all test cables from the appliance tester and reconnect them only after having carried out a self-test.

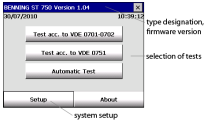


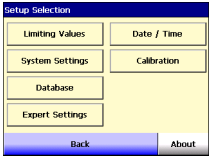
For commissioning:

- Connect the mains connection cable to the shock-proof socket (230 V, 50 Hz, 16 A).
- Set the mains switch to position "I".
- The Appliance Tester carries out a self-test and after run-up shows the firmware version in the upper line of the display.
- After run-up, press the **<Setup>** button.

7.1 Limiting Values







If desired, the factory settings of the limiting values can be changed. The setting will remain valid **until mains switch-off!** For each restart, the BENNING ST 750 Appliance Tester will be reset to the factory settings! The factory settings of the limiting values comply with the applicable VDE regulations and can be taken from chapter 20.2 "Factory Settings, Setup, Limiting Values". Setting can be done from each start menu and from each measuring type menu. For this purpose, successively select the following: **<Setup>** / **<Limiting Values>.**

Select the desired tab, select the value and press **<Input>** (display input keyboard opens). Delete and correct the old value by means of the **<Clear>** or **<<-->**. In the "Limiting Values Setup" menu, the deviating value will be highlighted in red colour. Return to the start menu by pressing **<Next>** / **<Save>** / **<Yes>** / **<Back>**.

RPE data (resistance measurement of the PE conductor):

RPE VDE 701-702	= resistance for a cable length of 5 m and 1.5mm²
RPE VDE 751	= resistance for a cable length of 5 m and 1.5mm²
RPE per 7.5 m line length	= additional resistance per 7.5 m line length
Line length	= total length of the device supply line
Cross-section	= cross-sectional area of the device supply line

RInsu data (insulation measurement):

RInsu-1 VDE 701-702	= insulating resistance of primary to PE
RInsu-1 VDE 701-702 heating elements	= insulating resistance of primary to PE
RInsu-2 / RInsu-3 VDE 701-702	= insulating resistance of secondary to PE / primary to secondary
RInsu-1 VDE 701-702 Ua (SELV/PELV)	= insulating resistance of primary to PE (SELV devices)
RInsu-1 VDE 751	= insulating resistance primary to PE
RInsu-2 VDE 751	= insulating resistance of secondary to PE
RInsu-3 VDE 751	= insulating resistance of primary to applied part
Testing voltage for primary to PE	= testing voltage for primary to PE
Testing voltage for secondary to PE	= testing voltage for secondary to PE
Testing voltage for primary to secondary	= testing voltage for primary to secondary

IAL data (alternative leakage current measurement):

IPE VDE 701-702 protection class I	= PE alternative leakage current
ILeak VDE 701-702 protection class II	= alternative leakage current of accessible parts
ILeak VDE 751 protection class I	= PE alternative leakage current
ILeak VDE 751 protection class I	= alternative leakage current of accessible parts
Patient leakage current BF	= alternative patient leakage current of applied part, type BF
Patient leakage current CF	= alternative patient leakage current of applied part, type CF

ILeak data (leakage current measurement):

IPE VDE 701-702 protection class I	= PE leakage current
ILeak VDE 701-702 protection class II	= leakage current of accessible parts
ILeak VDE 751 protection class I	= PE leakage current
ILeak VDE 751 protection class I	= leakage current of accessible parts
Patient leakage current BF	= patient leakage current of applied part, type BF
Patient leakage current CF	= patient leakage current of applied part, type CF

ICont data (contact current measurement):

ICont VDE 701-702	= contact current to PE

Functional data (functional measurement):

IPE VDE 701-702	= PE leakage current (differential current measurement)
ICont VDE 701-702	= contact current to PE (differential current measurement)
IPE VDE 751	= PE leakage current (differential current measurement)
ICont VDE 751	= contact current to PE (differential current measurement)

Ua data (measurement on PELV / SELV devices):

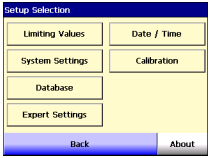
Max. output voltage	= max. output voltage for PELV / SELV devices

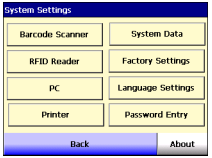
Cable data (cable measurement):

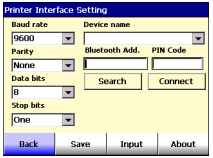
Line length	= simple line length
Cross-section	= cross-sectional area of the conductor
Conductor qty.	= conductor quantity (for total length)

7.2 System Settings

Select **<Setup>** / **<System Settings>** to modify and permanently save the baud rate, parity, data bits and stop bits e.g. for barcode scanners, RFID readers, PCs and printers.







see chapter 16 to 18

<Barcode Scanner>

The following fields are released for the user:

- setting of baud rate, parity, data bits and stop bits

<RFID Reader>

The following fields are released for the user:

- setting of baud rate, parity, data bits and stop bits

<PC>

The following fields are released for the user:

- setting of baud rate, parity, data bits and stop bits

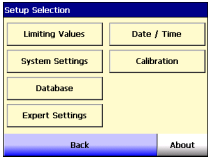
<Printer>

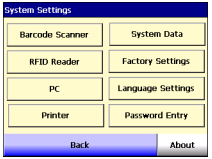
The following fields are released for the user:

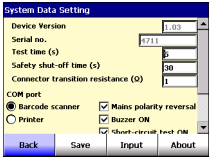
- setting of baud rate, parity, data bits and stop bits

7.2.1 System Data

The device version and serial number are listed under **<Setup>** / **<System Settings>** / **<System Data>**. The duration of the individual test procedures (standard = 5 sec.) is determined by the test time. The safety shut-off terminates a test procedure (standard = 30 sec.).
The contact surfaces between connectors have only low transition resistances. To define the transition resistance, here the assumable resistance value is entered (standard = 1Ω). Moreover, it is defined whether a printer or a barcode scanner is connected to the serial interface.





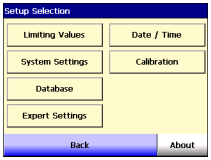


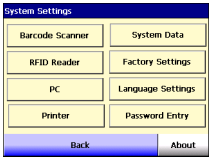
Mains pole reversal ON: On the test socket, L and N are interchanged.

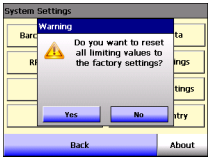
Buzzer ON:	Acoustic signal in case of faults
Short-circuit test ON:	When starting the test, first check for short-circuit.
Standard test procedures:	Automatic test procedures complying with DIN VDE 0701/0702/0752 are activated.
Custom test procedures:	Customized test procedures are activated. Customized test procedures are stored on the SD memory card.
Repetition of the test:	Test repetition for RPE, RInsu, IPE, ICont measurement active

7.2.2 Factory Settings

Select **<Setup>** / **<System Settings>** / **<Factory Settings>** to reset all limiting values to the factory settings. Confirm your entry with **<Yes>** / **<No>**!

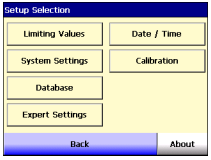


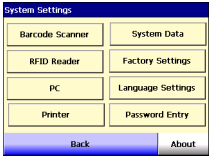




7.2.3 Language Setting

In the **<System Settings>** menu, press the **<Language Settings>** button to select the desired language. Then, press **<Save>**.

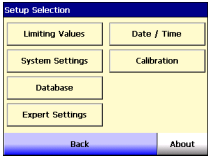


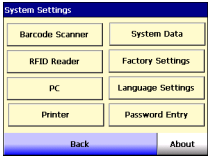


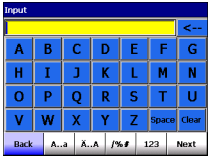
7.2.4 Entering a Password

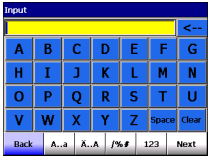
> ⚠ A lost password can only be reset by the Benning Service team (see chapter 24, "Product Support")!

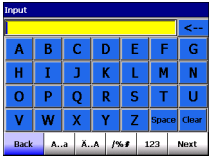
The expert setting function can only be accessed by means of a password. Upon delivery, the device is provided with the password "**Benning**". The person responsible for the BENNING ST 750 Appliance Tester shall define a new confidential password.
To define a new password, subsequently press **<Setup>** / **<System Settings>** / **<Password Entry>** / **<Input>**. First, the current password is requested. Then, the new password will be assigned, compared and saved with **<OK>**.





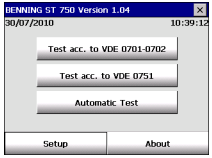


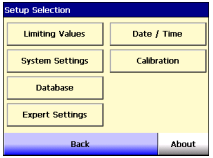


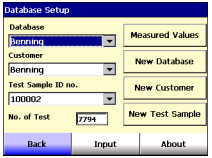


7.3 Database Settings

Under "Database Settings", test results, customer data, test sample data as well as measured value data are managed. For information on how to edit a database, please refer to chapter 14 "Database".







Go to **<Database>** to select the database you want to edit.
Then, select **<Customer>** and **<Test Sample>**.

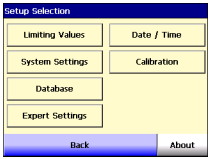
<Display Measured Values>: Displays the measured values of the selected test sample.
<New Database>: Creates a new database.
<New Customer>: A new customer is created within the selected database.
<New Test Sample>: A new test sample is created within the selected database.

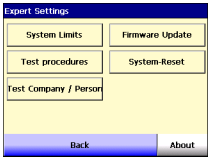
7.4 Expert Settings

In the expert settings, the following subitems can be edited:

<System Limits>: Editing the system limiting values
<Test Procedures>: Editing customized test procedures
<Test Company/Person>: Defining the test company / person
<Firmware Update>: Updating the firmware
<System Reset>: System Reset

The expert setting function can only be accessed by means of a password. The device is delivered with the password "**Benning**" (see chapter 7.2.4, "Entering a Password").





7.4.1 System Limiting Values

The factory settings of the system limiting values can be modified. **The settings of the system limiting values will remain valid permanently!**

> The delivery condition of the limiting values complies with the currently applicable VDE regulations! The factory settings are listed in chapter 20.1 under "acc. to measuring spec./ limiting Values". Setting can be done from the start menu. For this purpose, successively select the following: **<Setup>** / **<Expert Settings>** / **<System Limits>**

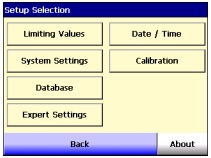
> The **<System Limits>** are identical to the limiting values. System limiting values are stored permanently, whereas limiting values are only stored until switch-off (see chapter 7.1"Limiting Values")!

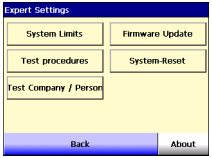
7.4.2 Creating / Modifying Test Procedures

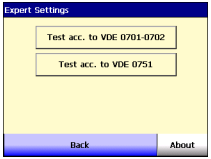
Go to the **<Expert Settings>** menu to create, modify or delete customized test procedures. Already existing customized test procedures can be copied, modified or saved under another name. Customized test procedures are stored on the SD memory card.

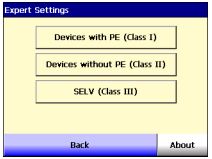
> **The test procedures predefined by the factory cannot be modified!**

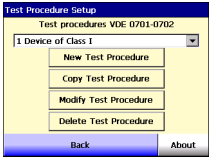
> All test procedures created by yourself can be corrected later as required.



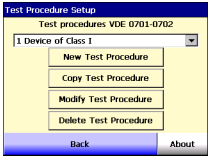


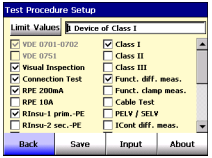


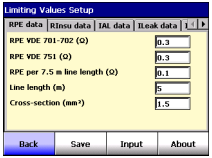




Go to the start menu and press **<Setup>** / **<Expert Settings>** to open the menu for entering the password. Select **<Test Procedures>**. Then, select the corresponding **<VDE Standard…>**. Select the device type (**<Devices with PE (Class I)>**, **<Devices without PE (Class II)>**, **<SELV (Class III)>**). All predefined and customized test procedures are listed in the drop-down list box. Keep the last number in mind to save the new test procedure under the next number (15 test procedures are permanently stored internally). To copy, modify or delete a test procedure, the respective test procedure must be selected (highlighted in blue)!







1. **Creating a new test procedure:**
   After pressing **<New Test Procedure>**, enter a new number and name in the upper field. If necessary, a pre-setting can be corrected by means of the **<<-->** button or deleted by means of the **<Clear>** button. Select / enter the desired test parameters in the main field. Press **<Limit Values>** to modify the limiting values (see chapter 7.1"Limiting Values") . After pressing **<Back>** in the "Test Procedure Setup" menu, press **<Save>** / **<Yes>** to register a new test procedure in the drop-down list box. Press **<Back>** to return to the start menu.

2. **Copying a test procedure:**
   Select the test procedure to be copied and then press **<Copy Test Procedure>**. The further proceeding is analogous to creating a new test procedure.

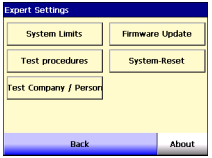
3. **Modifying a test procedure:**
   Select the test procedure to be modified and then press **<Modify Test Procedure>**. The further proceeding is analogous to creating a new test procedure. During the saving process of the **<Modify Test Procedure>** option, it is indicated that the data record already exists and you will be asked, if you want to overwrite it (**<Yes>** / **<No>**).

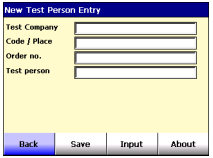
4. **Deleting a test procedure:**
   Select the test procedure to be deleted and then press **<Delete Test Procedure>**. For the **<Delete Test Procedure>** option, you will be asked, if you really want to delete the test procedure (**<Yes>** / **<No>**).

7.4.3 Test Company / Person

Go to the <**Expert Settings**> menu to create or to modify the <**Test Company / Person**>. Test company and test person are stored in the tester and will be saved in the database for each test!

⚠ **In case of several test persons, implicitly check the settings!**





7.4.4 Updating the Firmware

The firmware is installed (update) via the SD memory card. The corresponding files are provided by BENNING. Copy this file onto an SD memory card (max. 2 GB). After having inserted the memory card, install the firmware update under <**Setup**> / <**Expert Settings**> / <**Firmware Update**> and confirm the update with **<Yes>**. After successful update, switch the device OFF and ON again.

7.4.5 Updating the User Interface

It is possible to install a **software update** via the USB interface or the SD card slot. The corresponding files (Windows CE) are provided by BENNING in a directory called "PicoMODX". Copy this directory onto a USB stick. Switch the BENNING ST 750 Appliance Tester ON. After inserting the USB stick into the A jack, switch the BENNING ST 750 Appliance Tester OFF and ON again. Now, the device automatically installs the software. Remove the USB stick after completion. After successful installation, the system settings in the setup program have to be made again.

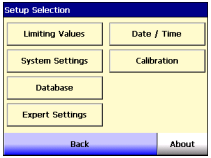
For this purpose, successively select the following: <**Setup**> / <**System Settings**> / <**System Data**>. Now, select e.g. the functions <**Barcode Scanner**>, <**Mains Polarity Reversal ON**>, <**Buzzer ON**> and <**Short-circuit Test ON**>. Save the settings with <**Save**> and return to the start menu by pressing <**Back**>.

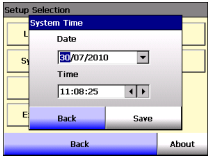
7.4.6 System Reset

By pressing <**Setup**> / <**Expert Settings**> / <**System Reset**>, all system data will be reset. Confirm the reset by pressing <**Yes**> / <**No**>. All limiting values and all user data will be reset to the factory delivery status.

7.5 Date / Time

Go to the "**Setup Selection**" menu, press the <**Date / Time**> button and enter the current values. Use the input stylus to mark the corresponding numerical values and select the values / numerals. After having finished the setting, press the <**Save**> button.

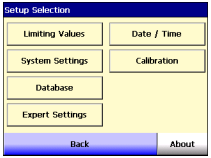


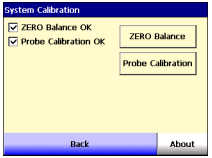


Press the <▼> button to open the "calendar view" to select the month and the year directly. Select the month from the list and choose the corresponding year by means of the arrow buttons (<◄>, <►>). To set the time, select "HH" : "MM" : "SS" respectively and set the value by means of the arrow buttons (<◄>, <►>).

7.6 Calibration / System Calibration

Probe calibration (compensation of the test cable): Depending on the test cable used, the probe should be calibrated again. This calibration is necessary, because the resistance of the test cable will be taken into consideration for the measuring result of the protective conductor resistance measurement! The calibration data will be saved permanently in the device.
Go to the "**Setup Selection**" menu and press <**Calibration**>.





Connect the connecting cable (test cable) to the yellow "Sonde / Probe" jack and to the green "Kal. / Cal." jack. Press <**Probe Calibration**> and confirm the message with <**Yes**>. Now, probe calibration has been done successfully.

A **ZERO balance** / calibration is necessary, if in standstill or with a missing signal the displayed measured values are not approximately at 0 (e.g. 0.000 mA). For this, go to the start menu and press <**Setup**>, <**Calibration**>. Then, press <**ZERO Balance**> and start it by pressing <**Yes**>. During calibration, no connecting cables of the test sample or other cables must be connected to the device!

☞ The device shall be calibrated at the manufacturer's in certain time intervals (see chapter 23 "Maintenance / Calibration").

8. Overview for Tests according to DIN VDE 0701-0702:2008-06

	Protection class I (with protective conductor) - extension cables and connecting cables - electrical equipment, e.g. electrical hand tools	Protection class II (without protective conductor) - device connecting cables - electrical equipment, e.g. electrical hand tools	Protection class III
5.1* Scope of testing: **) The figures stated refer to DIN VDE 0701-0702:2008-06.*			
5.2 Visual inspection Check for visible defects and suitability regarding the field of application: - connecting cables / plug-and-socket connections - housing, strain relief, protection against bending and kinking ...	⊗	⊗	⊗
5.3 Testing the protective conductor Continuity between the earthing contact of the mains plug and accessible conductive parts of the device or of the device connection	For cables with a rated current of ≤ 16A up to **5 m**: **≤ 0.3 Ω** for each further 7.5 m additionally: **0.1 Ω** maximum: **1.0 Ω** For cables with higher rated currents, the calculated ohmic resistance value shall apply	---	---
5.4 Measuring the insulating resistance[3]	**≥ 1 MΩ** **≥ 2 MΩ** for proving safe isolation **≥ 0.3 MΩ** for devices with heating elements[1] with a power of ≥ 3.5 kW	**≥ 2 MΩ**	**≥ 0.25 MΩ**
5.5 Measuring the protective conductor current[2, 3]	**≤ 3.5 mA**[4] at conductible components with protective conductor connection **1 mA/ kW to max. 10 mA** for devices containing heating elements with a total power of more than 3.5kW	---	---
5.6 Measuring the contact current[3]	**≤ 0.5 mA** at conductible components without protective conductor connection	**≤ 0.5 mA** at conductive components	---
5.7 Proving safe isolation (SELV, PELV)[3] For devices generating a SELV or PELV voltage by means of an isolating transformer or a switch-mode power supply	**Proving the rated voltage: (compliance with specifications (SELV/PELV))** - Output voltage measurement (e.g. for chargers, mains supply units): max. 25V AC or 60V DC for accessible active parts - Insulating resistance measurement (primary / secondary) - Insulating resistance measurement (between accessible conductive parts and active parts of the SELV / PELC circuit)		
5.8 / 5.10 Functional test	Functioning of safety equipment and function test		
Analysis, evaluation, documentation	⊗		

⚠ Additional notes concerning the table "Tests according to DIN VDE 0701-0702":

[1] If for devices containing heating elements with a power P > 3.5 kW the value falls below the limiting value, the device still shall be considered to be in proper condition as long as the limiting value for the protective conductor current is not exceeded.

[2] If for the stated insulating resistance measurements for protection class I or II
- not all parts are measured completely (e.g. if relays or semiconductor components impede the transmission of electricity) or
- if the measurements have been terminated with a negative result for devices containing heating elements,

the alternative leakage current measurement method must not be applied!
In this case, it is necessary to use the direct or differential current measurement method.

[3] Additional tests for devices with a secondary output voltage, e.g. isolating transformer, chargers, converters, mains supply units:
1. insulating resistance measurement between secondary and primary side
2. insulating resistance measurement between secondary side and the equipment body
3. contact current measurements of the secondary voltage outputs
4. measurement of the open-circuit voltage / output voltage.

[4] When exceeding the limiting value (protective conductor current), it has to be checked whether other limiting values have to be observed due to product standards or manufacturer specifications.

9. Overview for Tests according to DIN VDE 0751-1 / EN 62353:2008-08

	Protection class I (with protective conductor)			Protection class II (without protective conductor)		
5.1* Scope of testing: **) The figures stated refer to DIN VDE 0751-1:2008-08.*						
5.2 Visual inspection / inspection Check for visible damages of the following: - connecting cables / plug-and-socket connections - housing - strain relief, protection against bending and kinking ...	⊗			⊗		
5.3.2 Measuring the protective conductor resistance Continuity between the earthing contact of the mains plug and accessible conductive parts of the device or of the device connection	Medical electrical device with non-detachable mains connection cable: **≤ 0.3 Ω** Medical electrical device with detachable mains connection cable: **≤ 0.2 Ω** Detachable mains connection cable: **≤ 0.1 Ω** Detachable mains connection cable + medical electrical device: **≤ 0.3 Ω** Medical electrical device with permanent connection: **≤ 0.3 Ω** System with multiple socket: **≤ 0.5 Ω**					
5.3.3 Measuring leakage currents:	**Type B**	**Type BF**	**Type CF**	**Type B**	**Type BF**	**Type CF**
5.3.3.2 Device leakage current						
Alternative leakage current measurement:	**≤ 1000 µA**	**≤ 1000 µA**	**≤ 1000 µA**	**≤ 500 µA**	**≤ 500 µA**	**≤ 500 µA**
Direct / differential current measurement:	**≤ 500 µA**	**≤ 500 µA**	**≤ 500 µA**	**≤ 100 µA**	**≤ 100 µA**	**≤ 100 µA**
5.3.3.3 Leakage current of applied part						
Alternative leakage current measurement (AC*):	**---**	**≤ 5000 µA**	**≤ 50 µA**	**---**	**≤ 5000 µA**	**≤ 50 µA**
Direct current measurement (AC*):	**---**	**≤ 5000 µA**	**≤ 50 µA**	**---**	**≤ 5000 µA**	**≤ 50 µA**
5.3.4 Measuring the insulating resistance	⊗ No limiting values in VDE 0751-1 / EN 62353 standard.			⊗ No limiting values in VDE 0751-1 / EN 62353 standard.		
5.4 Functional test	Functioning of safety equipment and function test					
6. Measuring results, analysis, evaluation, documentation	⊗ (inspection and preparation for intended use)					

* Note 1: The DIN EN 62353 (VDE 0751-1):2008-08 standard does not contain any measuring methods and admissible values for devices generating DC leakage currents. In this case, the **manufacturer** should provide specifications in the **accompanying documents**.

* Note 2: " Particular requirements" might allow other leakage current values.

* Note 3: In the current issue of the DIN VDE 0751-1 standard, the measurement of the insulating resistance is required, if it is considered to be convenient. Insulation measurement must not be carried out, if it is excluded in the accompanying documents according to the manufacturer's specifications. **Limiting values** for the insulating resistance are not specified in the DIN VDE 0751-1/ EN 62353 standard (issue 2008). Here, it is possible to refer to recommendations of the manufacturer or to previously measured values.

10. Carrying Out Manual Measurements / Tests

First of all, each test begins with an inspection of the test object. Moreover, it has to be determined which protection class (protective measure) the test sample corresponds to and which tests / measurements (VDE regulation, manufacturer's accompanying documents, depending on the type of the test sample) have to be carried out. The order of the individual measurements (tests) has to be observed absolutely, because the measurement has to be stopped immediately in case of a failed test. Only after troubleshooting, the test can be repeated right from the beginning.

Order of the individual test steps:

- Visual inspection
- Protective conductor test (if the protective conductor exists)
- Insulation measurement (if technically possible)
- Measurement of leakage current, protective conductor current and / or contact current
- Moreover: safe isolation; proof of further protective measures; inscriptions; functional test; analysis, evaluation and documentation

If it is not directly possible to isolate the test sample from the electrical systems, proceed as follows:

- visual inspection
- protective conductor resistance measurement for devices of protection class I and
- contact current measurement on accessible protective parts of devices of protection class II as well as on accessible parts of devices of protection class I which are not connected to the protective conductor!

⚠ **The respective test steps and measuring types depend on the type of the test sample!**

Visual inspection

Important parts of the device contributing to its safety must neither be visibly damaged nor be obviously inappropriate for the device. This particularly applies to insulation and insulating parts which are accessible during repair, modification or test as well as for housings of devices with protective insulation (protection class II).

Examples for the application of visual inspections are:

- Melt inserts of fuses must comply with the parameters requested by the manufacturer (e.g. nominal current intensity and fusing characteristics);
- Air filters (if requested) must be built in;
- Cooling apertures must not be blocked;
- Protective covers requested by the manufacturer must be used and must be attached in proper condition and in due form;
- Cooling fins must not be blocked;
- The markings provided by the manufacturer, particularly those contributing to safety (warning symbols, characteristic data on fuse holders, switch positions on isolator switches and similar), must be available and perfectly legible. If necessary, markings have to be corrected after modifications.
- Mains connection cables (also enclosed device connecting cables) must not show any external defects between the connecting point of the device and the connecting point of the mains;
- Strain relief and bending protection (if applicable) of the mains connection cable must be firmly attached and efficient;
- There must not be any signs of overload or improper use;
- It is not allowed to make any improper interventions and modifications;
- Any contamination and corrosion affecting safety must be removed by cleaning.

At the beginning of a test (after requesting the corresponding VDE regulation and protection class), the "Visual Inspection" menu appears on the display. Confirm with <**OK**> to continue with the test! The tester is provided with a switchable test socket to contact the test sample. The additional test sockets "L/N" are only connected in "Test Socket" mode. The "PE" test socket is firmly connected with the earthing contact of the test socket. For measurements to earth (test samples of protection classes II and III) and for direct measurement of the leakage current, a measuring shunt in the milliohm range is integrated into the cable for PE connection. Due to a correspondingly required measuring arrangement, the "Sonde / Probe" jack is intended for measuring / testing the absence of voltage or the contact current etc. according to DIN VDE 0701-0702.
For measuring device leakage current or for the patient leakage current etc. according to DIN VDE 0751, the specified measuring arrangement "MD" (DIN VDE 0751-1) is connected to the same jack ("Sonde / Probe").

⚠ **For this reason, it is absolutely necessary to preselect the correct VDE regulation for the measurements / tests!**

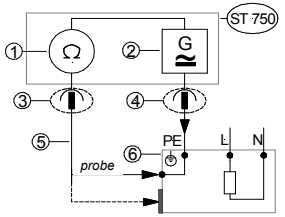
Connection test

For the first test / measurement, the tester starts a connection test to determine, whether dangerous contact voltage is applied, whether a test sample is connected and that there is no short-circuit. After a positive connection test, the measurement is started. In case of a negative connection test (e.g. open switch), an information message is displayed. Another connection test will only be started when the "Visual Inspection" menu has been passed through once again.

⚠ Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

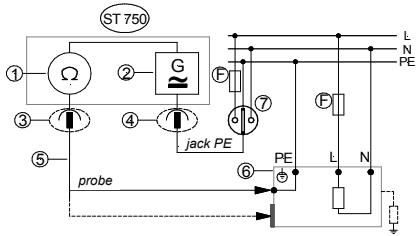
10.1 Protective Conductor Test (Protective Conductor Resistance) R_{PE}

This function is intended to measure the protective conductor resistance R_{PE} (devices of protection class I). Measurement is made with a testing current of +/- 200mA DC according to DIN VDE 0701-0702, VDE 0751-1 or a testing current of 10A AC (formerly: DIN VDE 0701 T260). For measuring, the test cable (probe) is connected to accessible metal parts of the test sample and to the earthing contact of the mains plug by means of the alligator clip. Connect the mains plug to the "test socket" of the appliance tester. If necessary, use the measuring jacks "PE" and "L/N" which are connected in parallel to the "test socket".



Protective conductor test R_{PE}:
DIN VDE 0701-0702 (protection class I)

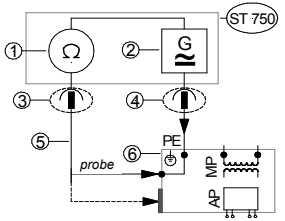
BENNING ST 750 Appliance Tester
1 ohmmeter (Ω)
2 DC or AC generator
3 "Probe" jack
4 test socket
5 test cable with alligator clip
6 test sample



Protective conductor test R_{PE}:
DIN VDE 0701-0702 (class I/ device with PE and permanent connection)

BENNING ST 750 Appliance Tester
1 ohmmeter (Ω)
2 AC generator (10 A)
3 "Probe" jack
4 jack, PE / earth connection (e.g. to PE connection of a shock-proof socket)
5 test cable with alligator clip
6 test sample
7 shock-proof socket
F fuse or disconnection point

⚠ With permanent connection, the protective conductor test must be made with a testing current of 10 A only!



Protective conductor test R_{PE}:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 ohmmeter (Ω)
2 DC or AC generator
3 "Probe" jack
4 test socket
5 test cable with alligator clip
6 test sample

During measurement, move the mains connection cable in sections over the whole length. In case of manual measurement with a testing current of 200 mA DC, the duration of the measurement depends on when the "Start" / "Stop" buttons are actuated. By pressing the **<Pause>** button, it is possible to interrupt measurement so that e.g. the test cable with the alligator clip can be connected to another measuring point without resulting in incorrect measurements / indications. Delete the measured value by pressing **<Reset>**. For thermal reasons, the 10 A AC measurement is limited to 5 seconds by the device electronics.

⚠ Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

⚠ **Note:** If resistance changes are detected during movement, it can be assumed that the protective conductor is damaged or is in improper condition at a connecting point. Please ensure proper contact between the alligator clip and the metal parts! Please observe also for manual testing with 200 mA DC, that measurement is made in both directions (+/-)! → **The worst value is displayed!**

10.2 Insulation Measurement (Insulating Resistance) RINSU

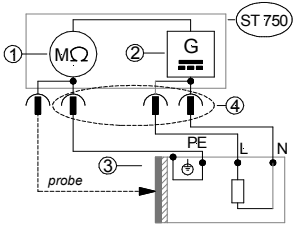
This function is intended to measure the insulating resistance RINSU. By default, measurement is made with 500 V direct voltage (DC) and a testing current of 1 mA according to DIN VDE 0701-0702 and 0751-1. To provide a better overview for setting, the insulation test can be selected from three menus (RInsu 1 to 3). The testing voltage is adjustable.

The insulating resistance has to be measured between:
- the protective conductor (accessible metal parts which are connected to the protective conductor, protection class I) and the active conductors (mains supply unit)
- the accessible conductive parts which are not connected to the protective conductor (protection classes I to III) and the active conductors (mains supply unit)
- the patient connections of applied parts and the active conductors (mains supply unit)
- all patient connections of applied parts of type F and the protective earth of device of protection class I
- all patient connections of applied parts of type F and accessible conductive parts (which are not connected to earth) for devices of protection classes I and II
- after repair / modification between the active parts of a SELV / PELV circuit and the active parts of the primary circuit
- for active parts with SELV / PELV protective measures (safety extra-low voltage) to accessible conductive parts.

The test sample must be free of external voltage (disconnected from the mains). For this, contacts of switches, relays and controlling means in active conductors must be closed (monitoring of the entire test sample and not only of the supply line). Connect the mains plug to the "test socket" of the appliance tester. If necessary, use the measuring jacks "PE" and "L/N" which are connected in parallel to the "test socket".
For test samples with accessible conductive parts (which are not connected to the protective conductor), the test must be carried out by means of the additional test cable and the safety probe tip. For this purpose, connect the test cable to the yellow jack (probe) and scan all conductive parts of the test sample by means of the safety probe tip (Attention! 500 V!). If for devices containing heating elements with a power P > 3.5 kW the value falls below the limiting value, the device still shall be considered to be in proper condition as long as the limiting value for the protective conductor current

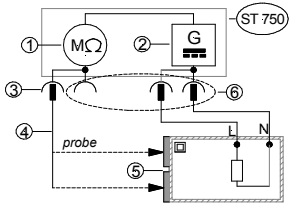
is not exceeded. In case the insulating resistance measurement is technically impossible, because controller contacts or relays are only active when mains voltage is applied, the protective conductor current shall be tested by means of the present appliance tester and the direct or differential current measurement method. For medical electrical devices, IT devices or SELV-carrying parts, the measurement may be omitted, if damages can occur due to adaptation or insulating voltage (see operating manual of the test sample!).
By pressing the <**Pause**> button, it is possible to interrupt measurement so that e.g. the test cable with the alligator clip can be connected to another measuring point without resulting in incorrect measurements / indications. Delete the measured value by pressing <**Reset**>. By means of the setup program, it is possible to set the testing voltage of the device to lower values (50-500 V DC, beyond the standard).

⚠ Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!



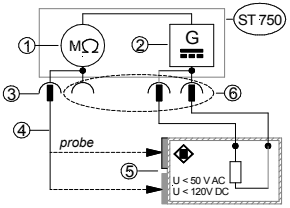
Insulating resistance RInsu:
DIN VDE 0701-0702 (protection class I)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 test sample
4 test socket



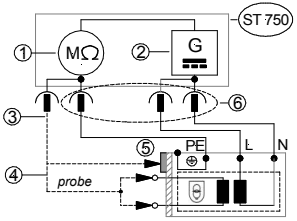
Insulating resistance RInsu:
DIN VDE 0701-0702 (protection class II)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test cable with probe tip
5 test sample
6 test socket



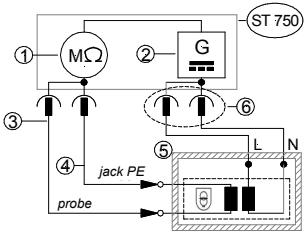
Insulating resistance RInsu:
DIN VDE 0701-0702 (protection class III)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test cable with probe tip
5 test sample
6 test socket



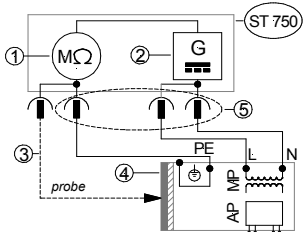
Insulating resistance RInsu:
DIN VDE 0701-0702 (protection class I with current output)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test cable with probe tip
5 test sample
6 test socket



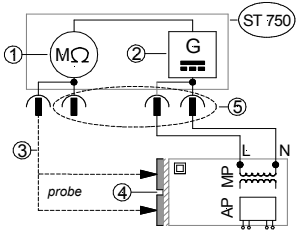
Insulating resistance RInsu:
DIN VDE 0701-0702 (protection class II with current output)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 "PE" jack
5 test sample
6 test socket



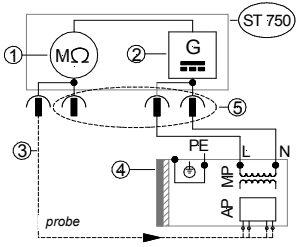
Insulating resistance RInsu:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test sample
5 test socket



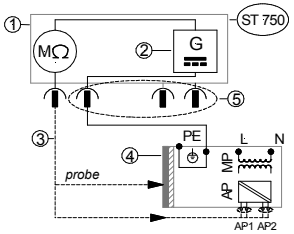
Insulating resistance RInsu:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test sample
5 test socket



Insulating resistance RInsu:
DIN VDE 0751-1 (protection classes I-II)

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test sample
5 test socket



Insulating resistance RInsu:
DIN VDE 0751-1 (protection classes I-II) / AP type F

BENNING ST 750 Appliance Tester
1 ohmmeter (MΩ)
2 generator (DC 500V)
3 "Probe" jack
4 test sample
5 test socket

10.3 Leakage Current Measurement

Depending on the devices (test samples), leakage currents
I_{PE} protective conductor current, I_{Cont} contact current,
I_{Leak} device leakage current, P_{Leak} patient leakage current etc.
can be measured by means of the following methods:

- differential current measurement **Diff**
- direct current measurement **Dir** (test sample must be placed onto insulated surface!)
- alternative leakage current measurement **Alt**
- differential current or direct current measurement **Clamp** (e.g. with leakage current clamp BENNING CM 9). Single-phase devices up to 16 A can be supplied via the test socket. Three-phase devices shall be supplied via corresponding adapters (see chapter 21 "Optional Accessories"). If the determined measured values are entered in the corresponding menu (BENNING ST 750), they will be listed in the test record as well.

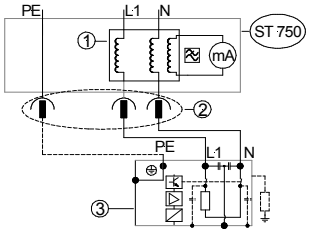
By pressing a pause button (<**Pause**> / <**Next**>), it is possible to interrupt measurement so that e.g. the test cable with the alligator clip can be connected to another measuring point without resulting in incorrect measurements / indications. The measurement is made with mains voltage in both positions (L/N – N/L) of the mains plug by pressing **<L/N>** or **<N/L>**. Delete the measured value by pressing <**Reset**>. Finish or stop the measurement by pressing <**Stop**>.

⚠ Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

10.3.1 Leakage Current Measurement / Differential Current Measurement Method (Diff) / (Clamp)

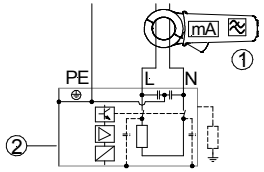
A great advantage of the differential current measurement method is that the device (test sample) does not have to be placed onto an insulated surface. The measurement is made with mains voltage in both positions (L/N – N/L) of the mains plug. For measurements according to DIN VDE 0701-0702, a different measuring arrangement shall be applied than for measurements according to DIN VDE 0751-1 (derived from IEC 60601-1). The corresponding measuring arrangement will be activated automatically depending on the preselection (DIN VDE 0701-0702 or 0751).

Measuring the protective conductor current
For devices of protection class I for which it cannot be guaranteed that all parts subjected to mains voltage are covered by the insulating resistance measurement or for which the insulating resistance measurement cannot be made, measurement of the protective conductor current according to DIN VDE 0701-702 must be carried out as differential current measurement. For measurement, the test sample must be operated both at nominal voltage and with reversed polarity. The test socket of the appliance tester is intended for supply (230 V / 16 A). During the automatic test procedure (**Diff**.), the polarity of the mains voltage is reversed automatically (indicated by: "**L/N**" – "**N/L**").



Protective conductor measurement / differential current measurement method:
DIN VDE 0701-0702 (protection classes I-II)

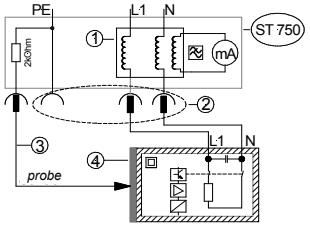
BENNING ST 750 Appliance Tester
1 differential current measurement
2 test socket, test cable
3 test sample



Protective conductor measurement / differential current measurement method:
DIN VDE 0701-0702 (protection classes I-II)

BENNING ST 750 Appliance Tester
1 leakage current clamp (mA)
2 test sample

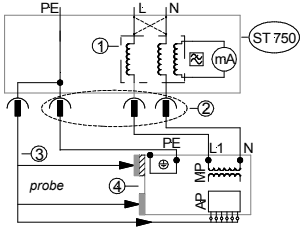
Measuring the contact current
For devices of protection classes II and III with accessible conductive parts for which there are objections to measuring the insulating resistance or for which it is impossible to interrupt operation, the contact current may be measured by means of the differential current measurement method (DIN VDE 0701-0702 and DIN VDE 0751-1).
This also applies to devices of protection class I with accessible conductive parts which are not connected to the protective conductor. For measurement, the test sample must be operated both at nominal voltage and with reversed polarity. The test socket of the appliance tester is intended for supply (230 V / 16 A). During measurement, the accessible conductive parts must be scanned in **both mains polarity directions** by means of the safety probe tip. For this, connect the test cable to the yellow "Sonde / Probe" jack.



Contact current measurement:
DIN VDE 0701-0702 (protection classes I-II)

BENNING ST 750 Appliance Tester
1 differential current measurement (mA)
2 test socket, test cable
3 test cable, connected to "Probe"
4 test sample

Device leakage currents for medical electrical devices
For medical electrical devices, the device leakage currents can be measured by means of the differential current measurement method. For measurement, the test sample must be operated both at nominal voltage and with reversed polarity. The test socket of the appliance tester is intended for supply (230 V / 16 A). During the automatic test procedure (**Diff**.), the polarity of the mains voltage is reversed automatically (indicated by: „**L/N**" – "**N/L**").
In the "**Clamp**" sub-menu, it is also possible to make differential current measurements by means of an external current measuring clamp. Single-phase device up to 16 A can be supplied via the test socket of the BENNING ST 750 by means of a polarity reversal device. Three-phase devices shall be supplied via corresponding adapters (see "Optional Accessories"). If the determined measured values are entered in the corresponding menu of the BENNING ST 750 Appliance Tester, they will be listed in the test record as well.



Device leakage current measurement (Diff) / (Clamp):
DIN VDE 0751-1 (protection classes I-II)

BENNING ST 750 Appliance Tester
1 differential current measurement (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample

⚠ For medical electrical devices of protection class I, it might be necessary to measure the leakage currents of accessible conductive parts, which are not connected to the protective conductor, in separate measurements.

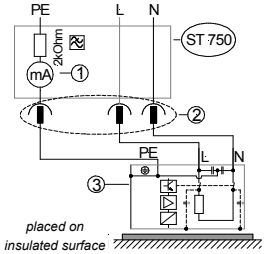
10.3.2 Leakage Current Measurement / Direct Current Measurement Method (Dir)

A direct measurement of the leakage current is only possible, if the device (test sample) is placed onto an **insulated** surface and if the leakage current is measured separately to earth in an earthed mains (e.g. measuring equipment in protective conductor line).
The measurement is made with mains voltage in both positions (L/N – N/L) of the mains plug. For measurements according to DIN VDE 0701-0702, a different measuring arrangement shall be applied than for measurements according to DIN VDE 0751-1 (derived from IEC 60601-1). The corresponding measuring arrangement will be activated automatically depending on the preselection (DIN VDE 0701-0702 or 0751).

Direct current measurement is made with the measuring arrangement between:

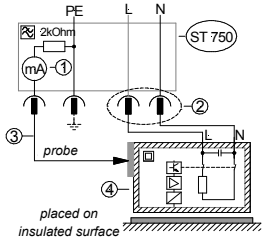
- the protective conductor (accessible metal parts which are connected to the protective conductor, protection class I) and earth
- the accessible conductive parts which are not connected to the protective conductor (protection classes I to III) and earth
- the patient connections of applied parts and earth
- all patient connections of applied parts of type F and earth for devices of protection class I (for measurement with separated protective conductor)
- all patient connections of applied parts of type F and accessible conductive parts (which are not connected to earth) for devices of protection classes I and II.

For this, contacts of switches, relays and controlling means in active conductors must be closed (monitoring of the entire test sample and not only of the supply line). Connect the mains plug to the test socket of the appliance tester. For test samples with accessible conductive parts (which are not connected to the protective conductor), the test must be carried out by means of the additional test cable and the safety probe tip. For this purpose, connect the test cable to the yellow jack (probe) and scan all conductive parts of the test sample by means of the safety probe tip. If necessary, connect a second test cable to the "PE" jack!



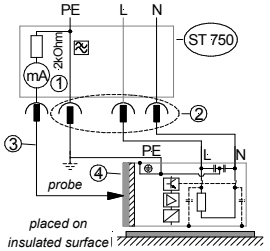
Protective conductor measurement / direct measurement:
DIN VDE 0701-0702 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 test sample



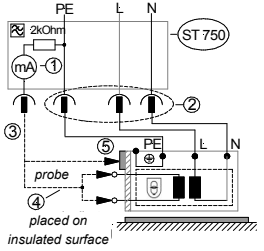
Contact current measurement / direct measurement:
DIN VDE 0701-0702 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



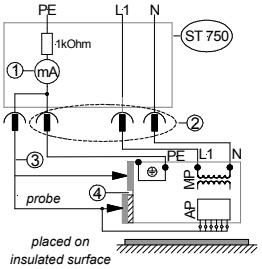
Contact current measurement:
DIN VDE 0701-0702 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



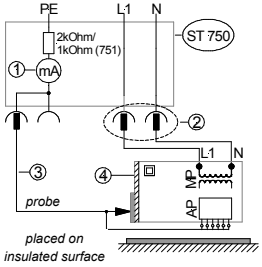
Contact current measurement:
DIN VDE 0701-0702 (protection class I), with current output

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test cable
5 test sample



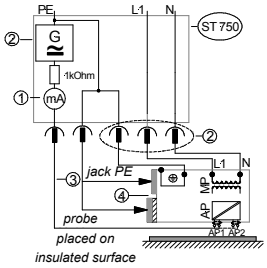
Device leakage current measurement / direct measurement:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



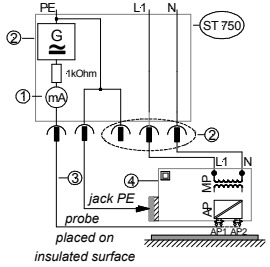
Device leakage current measurement / direct measurement:
DIN VDE 0751-1 (protection class II)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



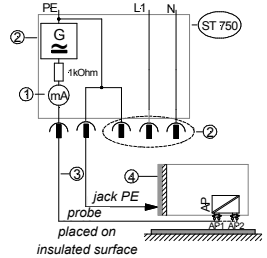
Leakage current of applied part, mains voltage on AP, type F – direct measurement:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



Leakage current of applied part, mains voltage on AP, type F – direct measurement:
DIN VDE 0751-1 (protection class II)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



Leakage current of applied part, with on-board power supply – direct measurement:
DIN VDE 0751-1

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample

10.3.3 Leakage Current Measurement / Alternative Leakage Current Measurement Method (Alt.)

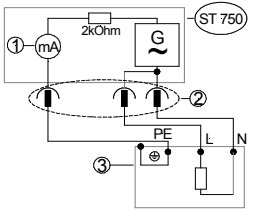
A direct leakage current measurement is not always possible, because for this type of measurement, the devices either must be placed onto an insulated surface or they must be connected to a voltage source electrically isolated from earth. For this reason, an alternative leakage current measurement is made in these cases. Measurement is made with approx. 200 V AC. For measurements according to DIN VDE 0701-0702, a different measuring arrangement shall be applied than for measurements according to DIN VDE 0751-1 (derived from IEC 60601-1). The corresponding measuring arrangement will be activated automatically depending on the preselection (DIN VDE 0701-0702 or 0751).

The leakage current measured is projected to the nominal mains voltage (230 V).

The alternative leakage current has to be measured between:
- the protective conductor (accessible metal parts which are connected to the protective conductor, protection class I) and the active conductors (mains supply unit)

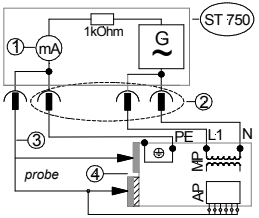
- the accessible conductive parts which are not connected to the protective conductor (protection classes I to III) and the active conductors (mains supply unit)
- the patient connections of applied parts and the active conductors (mains supply unit)
- all patient connections of applied parts of type F and the protective earth of device of protection class I
- all patient connections of applied parts of type F and accessible conductive parts (which are not connected to earth) for devices of protection classes I and II.

The test sample must be free of external voltage (disconnected from the mains). For this, contacts of switches, relays and controlling means in active conductors must be closed (monitoring of the entire test sample and not only of the supply line). Connect the mains plug to the test socket of the appliance tester. If necessary, use the measuring jacks "PE" and "L/N" which are connected in parallel to the "test socket". For test samples with accessible conductive parts (which are not connected to the protective conductor), the test must be carried out by means of the additional test cable and the safety probe tip. For this purpose, connect the test cable to the yellow jack (probe) and scan all conductive parts of the test sample by means of the safety probe tip. The protective conductor current, contact current, device leakage current and patient leakage current can be measured by means of the alternative leakage current measurement method.



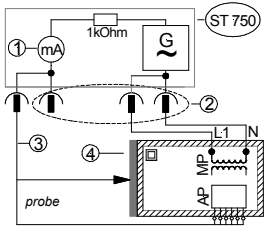
Protective conductor current measurement/ alternative leakage current measurement method:
DIN VDE 0701-0702 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 test sample



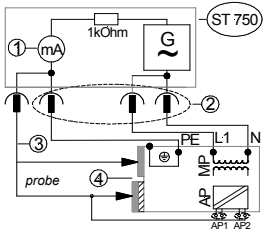
Device leakage current / alternative leakage current measurement method:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



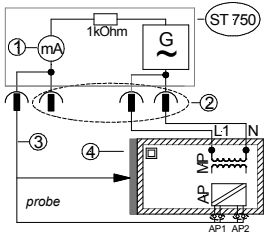
Device leakage current / alternative leakage current measurement method:
DIN VDE 0751-1 (protection class II)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



Leakage current of applied parts of type F / alternative leakage current measurement method:
DIN VDE 0751-1 (protection class I)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample



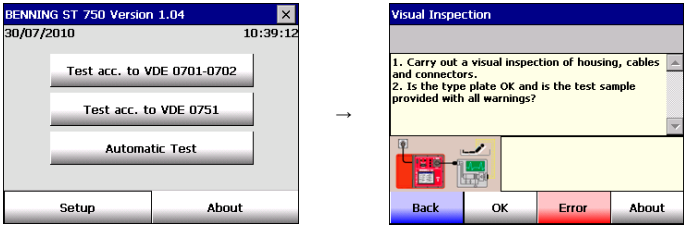
Leakage current of applied parts of type F / alternative leakage current measurement method:
DIN VDE 0751-1 (protection class II)

BENNING ST 750 Appliance Tester
1 current measuring instrument (mA)
2 test socket, test cable
3 "Probe" jack
4 test sample

Note: According to VDE 0701-0702, alternative leakage current measurements are only permitted, if the previous insulating resistance measurement has been passed! The alternative measurement might lead to results which exceed the admissible limiting values (e.g. caused by bypass capacitors in the test sample). In this case, use the direct or differential current measurement method.

10.4 Manual Tests according to VDE 0701-0702 or VDE 0751

On the main screen, the individual tests / measurements " Test acc. to VDE 0701-0702" or "Test acc. to VDE 0751" can be selected by pressing the corresponding button.



After having entered the protection class, the "Visual Inspection" menu is displayed. Confirm with **<OK>** to continue with the test! For manual measurement, the individual tests / measurements can be carried out in any order. Normally, however, the order of the individual measurements (tests) has to be observed absolutely (see chapter 11, "Standard Test Procedures"), because the measurement has to be stopped immediately in case of a failed test. Only after troubleshooting, the test can be repeated right from the beginning.

For the first test / measurement, the tester starts a connection test to determine, whether dangerous contact voltage is applied, whether a test sample is connected and that there is no short-circuit. After a positive connection test, the measurement is started.

In case of a negative connection test (e.g. open switch), an information message is displayed.

Another connection test will only be started when the "Visual Inspection" menu has been passed through once again. The test duration is determined by the time between the actuations of the <**Start**>/ <**Stop**> button. An exception is the measurement of the protective conductor resistance with 10 A. Here, the switch-on time is automatically limited to 5 seconds due to thermal reasons.

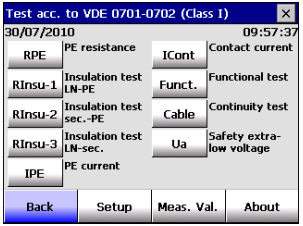
By pressing the <**Pause**> button, it is possible to interrupt measurement so that e.g. the test cable with the alligator clip or probe tip can be connected to another measuring point without resulting in incorrect measurements / indications.

> Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

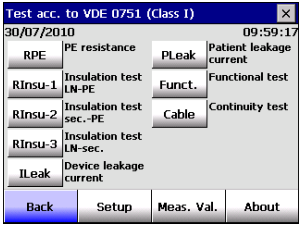
Incorrect measured values can be deleted by pressing the <**Reset**> button. Press <**Setup**> to get to the setup screen. On this screen, it is possible to make all device settings (see chapter 7, "Commissioning / Setup").
Press <**About**> to call the help function.

10.4.1 Devices with PE (Protection Class I)

Protection class I: Devices with protective conductor connection



Menu, VDE 0701-0702 (protection class I)



Menu, VDE 0751 (protection class I)

Selection of individual measurements (tests according to VDE 0701-0702):

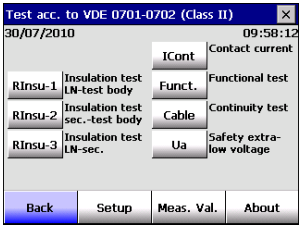
RPE	Protective conductor resistance	**ICont**	Contact current
RInsu-1	Insulating resistance LN–PE	**Funct.**	Functional test
RInsu-2	Insulating resistance sec.–PE	**Cable**	Continuity test
RInsu-3	Insulating resistance LN–sec.	**Ua**	Safety extra-low voltage
IPE	Protective conductor current		

Selection of individual measurements (tests according to VDE 0751):

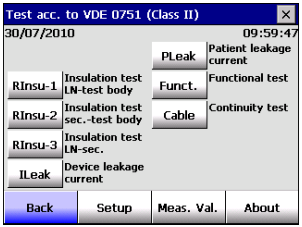
RPE	Protective conductor resistance	**PLeak**	Patient leakage current
RInsu-1	Insulating resistance prim.–PE	**Funct.**	Functional test
RInsu-2	Insulating resistance sec.–PE	**Cable**	Continuity test
RInsu-3	Insulating resistance prim.–sec.		
ILeak	Device leakage current		

10.4.2 Devices without PE (protection class II)

Protection class II: Devices without protective conductor connection



Menu, VDE 0701-0702 (protection class II)



Menu, VDE 0751 (protection class II)

Selection of individual measurements (tests according to VDE 0701-0702):

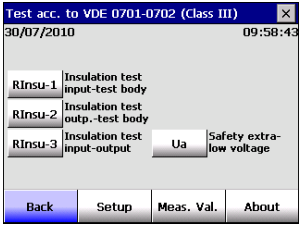
		ICont	Contact current
RInsu-1	Insulating resistance LN–test body	**Funct.**	Functional test
RInsu-2	Insulating resistance sec.–test body	**Cable**	Continuity test
RInsu-3	Insulating resistance LN–sec.	**Ua**	Safety extra-low voltage

Selection of individual measurements (tests according to VDE 0751):

		PLeak	Patient leakage current
RInsu-1	Insulating resistance LN–test body	**Funct.**	Functional test
RInsu-2	Insulating resistance sec.–test body	**Cable**	Continuity test
RInsu-3	Insulating resistance LN–sec.		
ILeak	Device leakage current		

10.4.3 SELV (protection class III)

Protection class III: Devices which are operated at safety extra-low voltage only



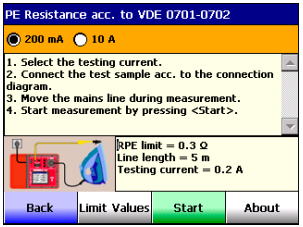
Menu, VDE 0701-0702 (protection class III)

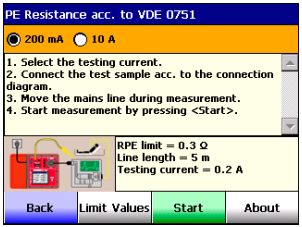
Selection of individual measurements (tests according to VDE 0701-0702):

RInsu-1	Insulating resistance input–test body		
RInsu-2	Insulating resistance output–test body		
RInsu-3	Insulating resistance input–output	**Ua**	Safety extra-low voltage

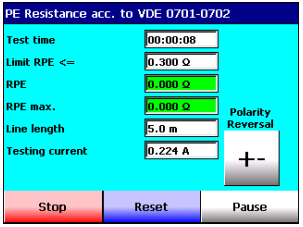
10.5 RPE – Protective Conductor Resistance

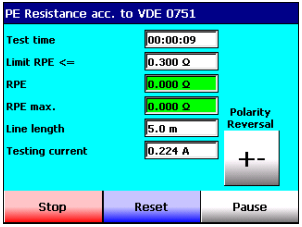
For measuring, the test cable (probe) is connected to accessible metal parts of the test sample (protection class I) and to the earthing contact of the mains plug by means of the alligator clip (see display!). In the start menu, select the corresponding <**VDE Standard…**> and then <**Protection Class**>. In the "Test acc. to VDE .... (Class .)", press the <**RPE**> button. Start measurement by pressing <**Start**>.





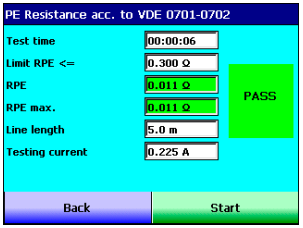
The testing current can be set to 200 mA or to 10 A. The limiting values according to VDE 0701-0702 or to VDE 0751-1 are taken into consideration.

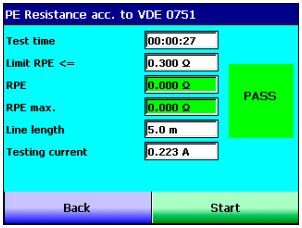




Press <**+**> to measure with reversed polarity. Finish or stop the measurement by pressing <**Stop**>, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.

Attention! Pressing the <**Pause**> button will stop the measurement. During the pause, the test socket will remain live!





Besides the worst measuring result (measured value), the overall result is displayed (e.g. "Pass" in a green field and "Fail" in a red field).

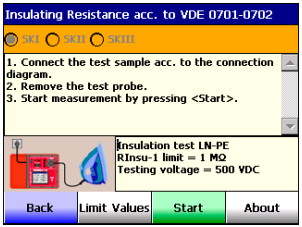
10.6 RInsu – Insulating Resistance

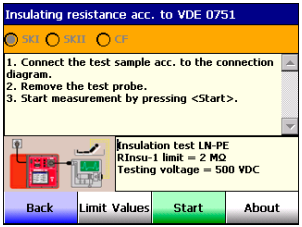
The insulating resistance is measured between the active parts and each accessible conductive part including the protective conductor. Moreover, it is measured between the active parts of a primary circuit and the active parts of the SELV / PELV circuit. It is also measured between the mains supply unit and all patient connections as well as between patient connections and accessible conductive parts including the protective earth. In the start menu, select the corresponding VDE regulation and then the protection class.
In the "Test acc. to VDE .... (Class .)", selection menu, press **<RInsu-1>**, **<RInsu-2>** and/or **<RInsu-3>**. Start measurement by pressing **<Start>**.

By means of the setup program, it is possible to set the testing voltage of the device to lower values (50-500 V DC, beyond the standard), e.g. if test samples are provided with integrated overvoltage arresters. The corresponding nominal and actual values of the testing voltage are shown on the display.

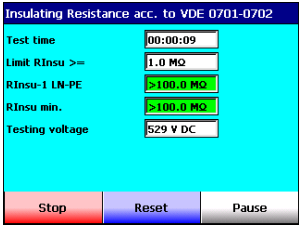
⚠ In the current issue of the DIN VDE 0751-1 standard, the measurement of the insulating resistance is required, if it is considered to be convenient. Insulation measurement must not be carried out, if it is excluded in the accompanying documents according to the manufacturer's specifications.

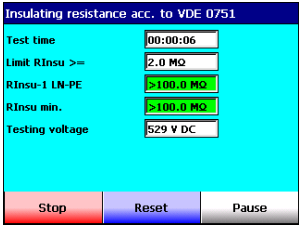
Limiting values for the insulating resistance are not specified in the DIN VDE 0751-1 standard (issue 2008). Here, it is possible to refer to recommendations of the manufacturer or to previously measured values.





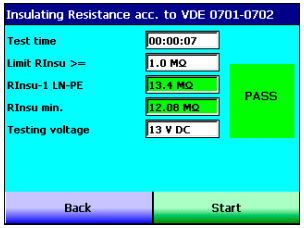
The limiting values according to VDE 0701-0702 or to VDE 0751-1 are taken into consideration.

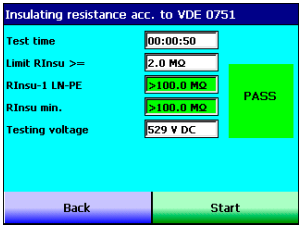




Finish or stop the measurement by pressing **<Stop>**, press **<Pause>**/**<Next>** for a measuring pause and press **<Reset>** to delete the measured value.

⚠ Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

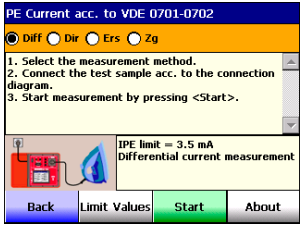


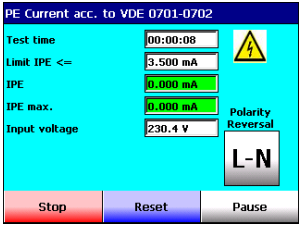


Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).
Accessible conductive parts which are not connected with the protective conductor must be scanned by means of the probe / probe tip (VDE 0701-0702; 0751-1).

10.7 IPE – Protective Conductor Current

The protective conductor current measurement, a leakage current measurement carried out by means of the differential current measurement method "**Diff**", the direct measurement method "**Dir**.", the alternative leakage current measurement method "**Alt**." and the differential current measurement method with current clamp "**Clamp**" (DIN VDE 0404-4), corresponds to the sum of all currents running through the insulation of a device to the protective conductor. For the differential current measurement method with current clamp "Clamp", the measured values of the current clamp have to be entered under "Input"!
In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the "IPE" button. Select the desired measurement method ("Diff.", "Dir.", "Alt." or "Clamp") and start measurement by pressing **<Start>**.

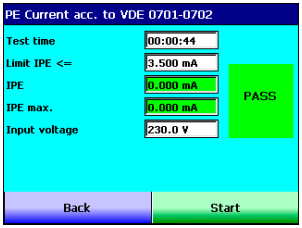




The limiting values according to VDE 0701-0702 are taken into consideration.

Press <**L-N**> to measure with reversed polarity.
Finish or stop the measurement by pressing **<Stop>**, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.

Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!



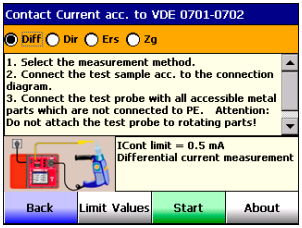
Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).
Please observe the notes!

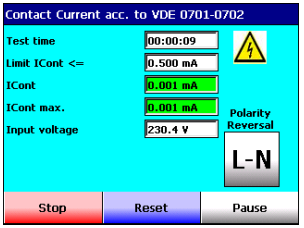
Accessible conductive parts which are not connected to the protective conductor are scanned and measured by means of the probe (probe tip) in the sub-menu **ICont** (contact current)!

10.8 ICont – Contact Current

During test, the test sample is supplied with mains voltage!

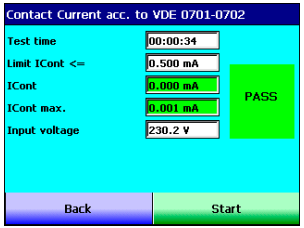
Contact current measurement corresponds to measurement between accessible conductive metal parts which are not connected to the protective conductor and earth.
The contact current can be measured by means of the leakage current measurement method, the differential current measurement method "**Diff**.", the direct measurement method "**Dir**.", the alternative leakage current measurement method "**Alt**." and the differential current measurement method with current clamp "**Clamp**".
Only one probe measurement can be carried out! In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the <**ICont**> button. Select the desired measurement method ("**Diff**.", "**Dir**.", "**Alt**." or "**Clamp**") and start measurement by pressing **<Start>**.





The limiting values according to VDE 0701-0702 are taken into consideration. Press <**L-N**> to measure with reversed polarity. Finish or stop the measurement by pressing <**Stop**>, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.

Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

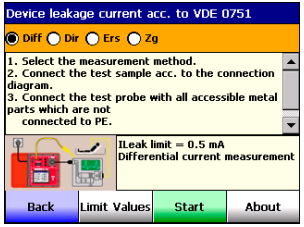


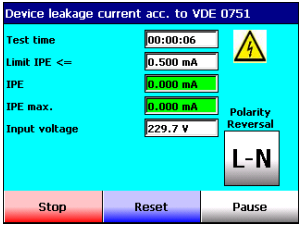
Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).

Accessible conductive parts which are not connected with the protective conductor must be scanned by means of the probe / probe tip (VDE 0701-0702).

10.9 ILeak – Device Leakage Current

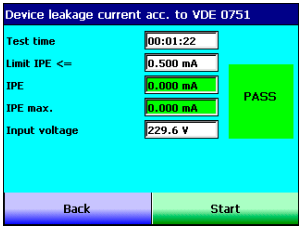
The device leakage current measurement corresponds to the measurement between the protective conductor as well as accessible conductive metal parts which are not connected to the protective conductor and earth. The device leakage current can be **measured** by means of the leakage current measurement method, the differential current measurement method "**Diff**.", the direct measurement method "**Dir**.", the alternative leakage current measurement method "**Alt**." and the differential current measurement method with current clamp "**Clamp**".
In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the <**ILeak**> button. Select the desired measurement method ("Diff.", "Dir.", "Alt." or "Clamp"). Start measurement by pressing <**Start**>.





The limiting values according to VDE 0751 are taken into consideration.
Press <**L-N**> to measure with reversed polarity. Finish or stop the measurement by pressing **<Stop>**, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.

Attention! Pressing the **<Pause>** button will stop the measurement. During the pause, the test socket will remain live!

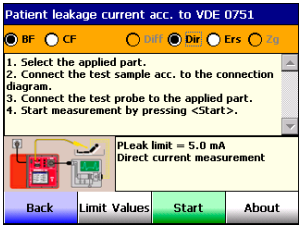


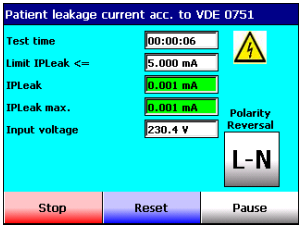
Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field). Accessible conductive parts which are not connected with the protective conductor must be scanned by means of the probe / probe tip (VDE 0751-1).

The protective conductor current is displayed and the probe current is added! For measurements by means of the current clamp, the measured values have to be entered manually!

10.10 PLeak – Patient Leakage Current

The patient leakage current measurement corresponds to the measurement between all patient connections of applied parts of type "F" (medical electrical devices) and protective earth and accessible conductive parts which are not connected to earth (protection classes I and II). The patient leakage current can be measured by means of the leakage current measurement method, the direct measurement method **Dir** or the alternative leakage current measurement method **Alt**..
Testing by means of the probe (probe tip) according to VDE 0751-1. In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the <**PLeak**> button. Select the device category ("BF" or "CF") and the desired measurement method ("Dir" or "Alt."). Start measurement by pressing <**Start**>.

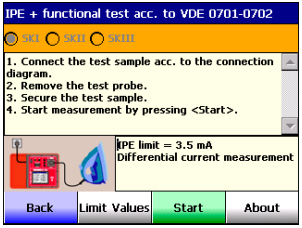


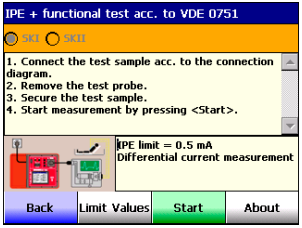


The limiting values according to VDE 0751 are taken into consideration.
Press <**L-N**> to measure with reversed polarity.
Finish or stop the measurement by pressing **<Stop>**, press <**Pause**>/ <**Next**> for a measuring pause and press **<Reset>** to delete the measured value. Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).
Measuring circuit for leakage current measurement (direct measurement) of applied parts between all patient connections of applied parts of type "F" (medical electrical devices) and protective earth and accessible conductive parts which are not connected to earth (protection classes I and II): Testing by means of the probe (probe tip) according to VDE 0751-1. Accessible conductive parts which are not connected to earth have to be connected to the "PE" jack by means of a second test cable (4)! Only the probe current is displayed!

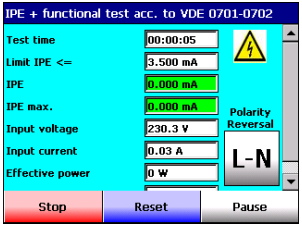
10.11 Funct. - Functional Test

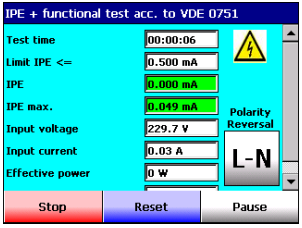
Only after a passed test, the test sample may be tested for correct functioning! The fault current measurement is carried out as differential current measurement! In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the <**Funct**.> button. Start measurement by pressing <**Start**>.

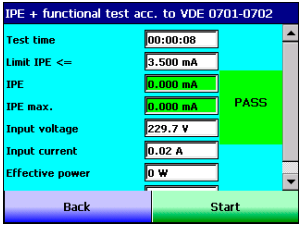


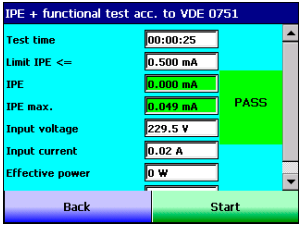


The limiting values according to VDE 0701-0702 or to VDE 0751-1 are taken into consideration.
Press <**L-N**> to measure with reversed polarity. Finish or stop the measurement by pressing <**Stop**>, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.





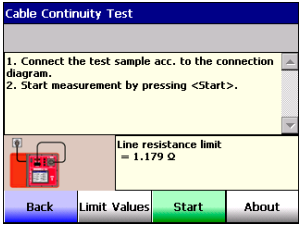


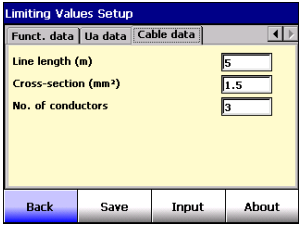


Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).

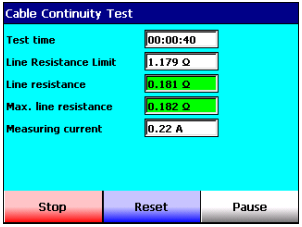
10.12 Cable Continuity Test

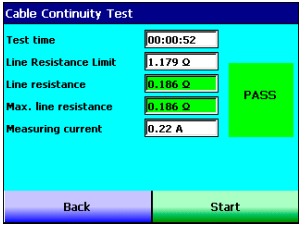
The cable continuity test is intended for measuring the line resistance of connecting and extension cables as well as of cable reels. For measurement and evaluation, all wires / single conductors, e.g. L, N and PE, are connected in series! The insulating resistance measurement between all conductors must be carried out separately (see "Measuring the **insulating resistance**")! In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the **<Cable>** (continuity test) button.



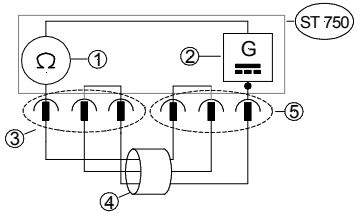


Then, press the <**Limit Values**> button. Enter the parameters line length, cross-section and conductor quantity under <**Limiting Values Setup**> / <**Cable Data**>.
Save your entry and press **<Back>**. Start measurement by pressing <**Start**>.





Finish or stop the measurement by pressing **<Stop>**, press <**Pause**>/ <**Next**> for a measuring pause and press **<Reset>** to delete the measured value. Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).
Measuring circuit for continuity test (series connection) of cables (VDE 0701-0702; 0751-1).



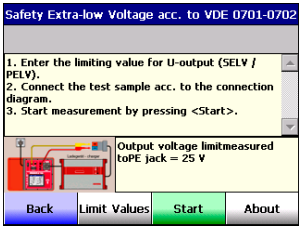
Cable continuity test DIN VDE 0701-0702; 0751-1

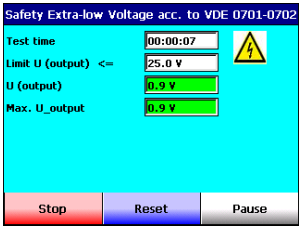
BENNING ST 750 Appliance Tester
1 ohmmeter (Ω)
2 generator (DC 200 mA)
3 IEC lead with shock-proof adapter
4 cable test sample (in series connection)
5 test socket

10.13 Ua – Safety Extra-low Voltage

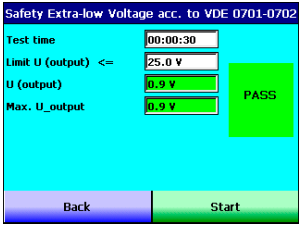
The measurement is intended for measuring the compliance with the specifications regarding the rated voltage (25 V to earth) of devices with SELV / PELV voltages.
Only one probe measurement can be carried out! The insulating resistance between primary and secondary side or active parts of devices with SELV/ PELV voltages has to be measured separately (see "Measuring the **insulating resistance**"). In the start menu, select the corresponding VDE regulation and then the protection class. In the "Test acc. to VDE .... (Class .)" menu, selection menu, press the **<Ua>** (safety extra-low voltage) button.

Measurement of the safety extra-low voltage is only possible for potential-free sources. Any (inappropriate) measurement on sources which are mains-connected and not potential-free might involve short-circuits!

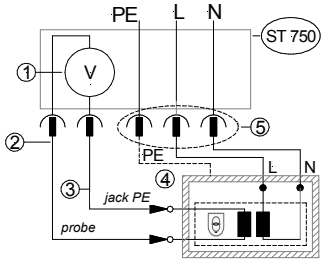




Start measurement by pressing **<Start>**. Scan the PELV / SELV voltage by means of the probe.
Finish or stop the measurement by pressing **<Stop>**, press <**Pause**>/ <**Next**> for a measuring pause and press <**Reset**> to delete the measured value.



Besides the measuring result (measured value), the overall result is displayed (e.g. "Pass" by a green field and "Fail" by a red field).

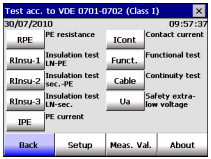


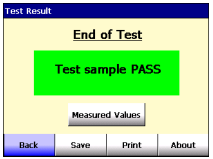
Safety extra-low voltage according to DIN VDE 0701-0702

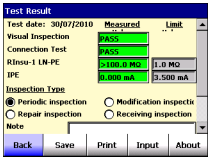
BENNING ST 750 Appliance Tester
1 voltmeter (V)
2 "Probe" jack
3 "PE" jack
4 test sample
5 test socket

Measuring circuit for measuring the compliance with specifications regarding the rated voltage (25 V to earth) of devices with SELV / PELV voltages.

10.14 Viewing, Saving and Printing Measured Values







Example, VDE 0701-0702 (protection class I)

Already after the first manual measurement / test (also connection test) of a test sample, it is possible to view, save or print the measured value. For this purpose, press the <**Measured Values**> button in the "Test acc. to VDE .... (Class .)" menu. In the opening "Test Result" menu, press the <**Meas. Value**> button. The measured values of the measurements that have already been carried out will be displayed (number of measuring results will be listed additionally). If you want to save or print the data, please make sure to enter the test type as well (see menu)!

Saving: Press the <**Save**> button to save the measuring results for a specific test sample. However, the test sample must already exist or be newly created in the "Test sample selection" (see chapter 14 "Database").

Printing: The measuring result can be printed immediately by means of a printer supporting Bluetooth (for settings see chapter 18 "Bluetooth Printer").

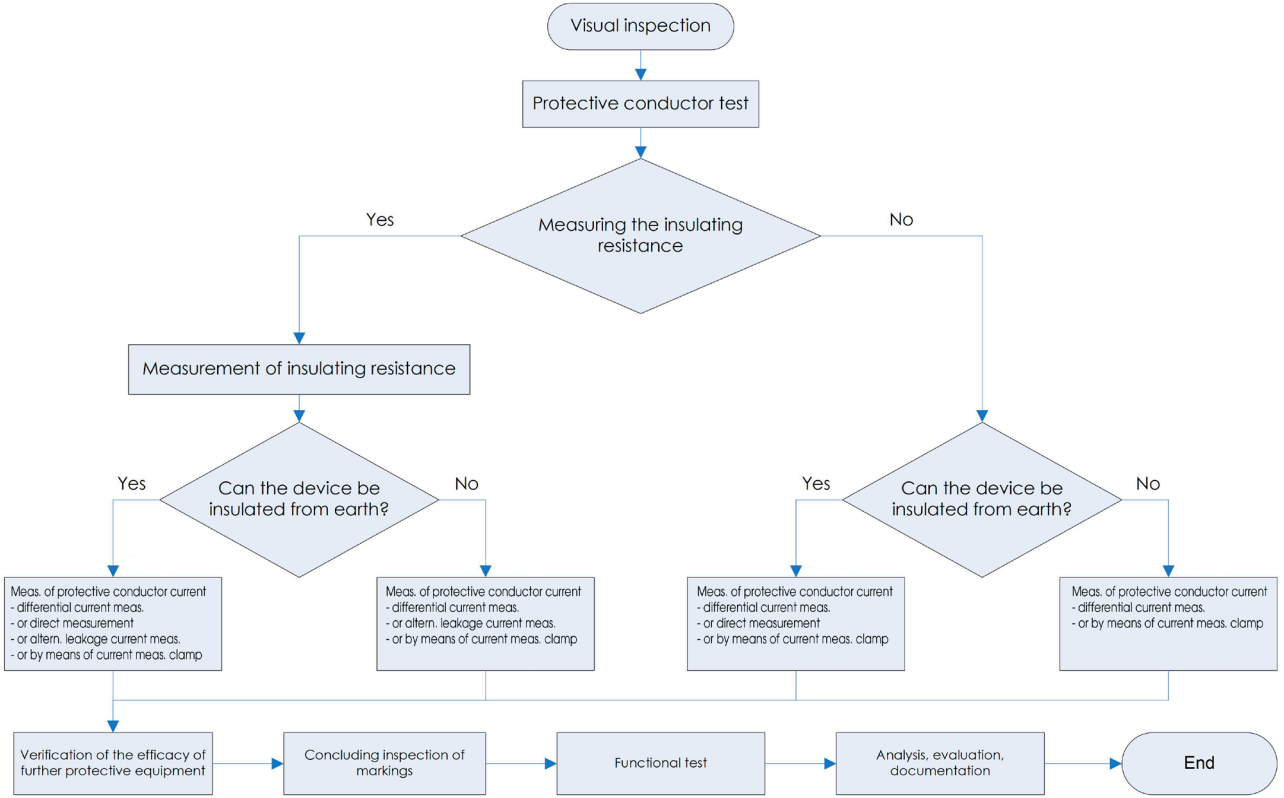
⚠ Attention! Unsaved measuring results are only available as long as you do not exit the "Test acc. to VDE .... (Class .)" menu!

11. Standard Test Procedures

As a support, the VDE regulations provide test procedure diagrams as flow charts. The following diagrams correspond to those given in the VDE regulations.

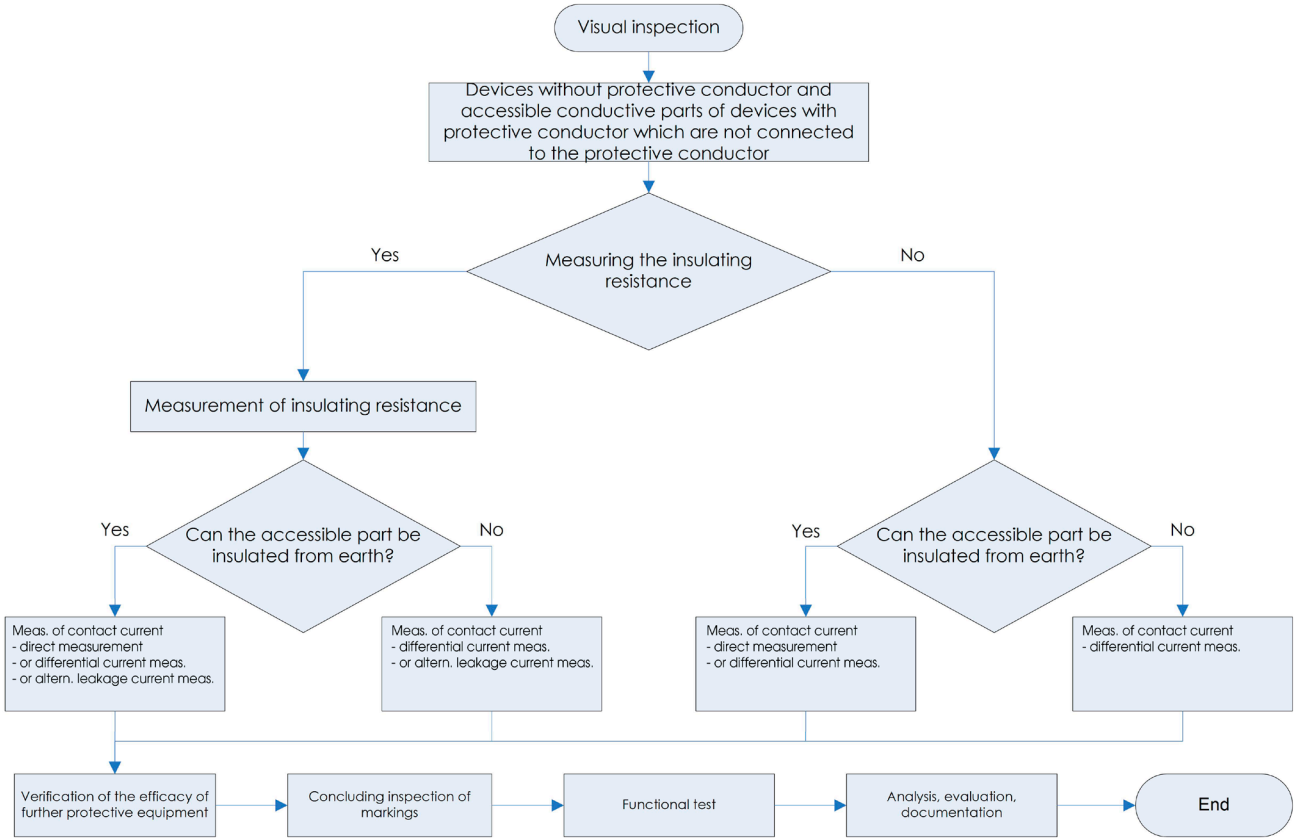
11.1 Test Procedure according to VDE 0701-0702 for Devices of Protection Class I

Test procedure diagram for devices with protective conductor (protection class I) and with accessible conductive parts (VDE 0701-0702)



11.2 Test Procedure according to VDE 0701-0702 for Devices of Protection Class II

Test procedure diagram for devices without protective conductor (protection class II) and with accessible conductive parts (VDE 0701-0702)



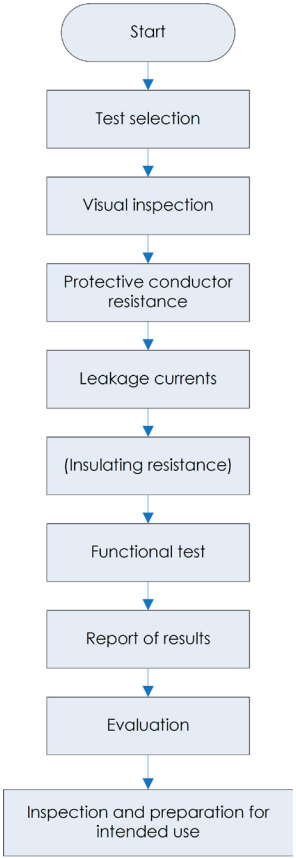
11.3 Test Procedure according to VDE 0751-1

The DIN VDE 0751-1 standard applies for tests of medical electrical devices, medical electrical systems or of parts of those devices or systems complying with the DIN EN 60601-1 (VDE0 750 Part 1) standard which are carried out prior to commissioning, inspection, maintenance or during periodic testing in order to evaluate the safety of those devices or systems or their parts. For devices which are not built according to DIN EN 60601-1 (VDE 0751 Part 1), this standard can be applied analogously under consideration of the safety standards applying to the manufacturing of the device.
(*taken from DIN VDE 0751-1:2001-10, section 1.1)*

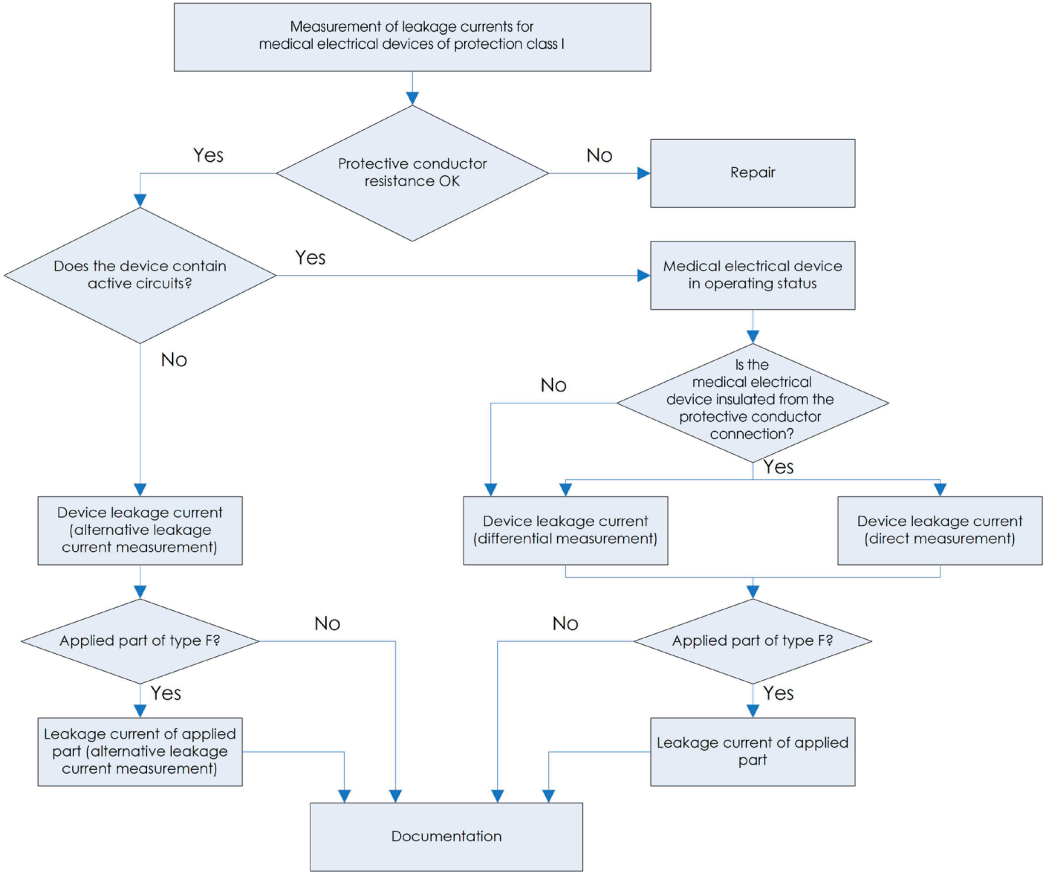
The tests must be carried out by qualified personnel. The qualification must comprise professional education, knowledge and experience as well as knowledge of the applicable standards and local provisions. Personnel evaluating safety must be able to detect possible consequences and dangers that might be caused by devices not complying with the requirements.
(taken from DIN VDE 0751-1: issue 2008-08, section 4.1)

Prior to testing, accompanying documents have to be checked for the manufacturer's recommendations regarding maintenance and repair, including conditions and precautionary measures.
In the current issue of the DIN VDE 0751-1 standard, the measurement of the insulating resistance is required, if it is considered to be convenient. Insulation measurement must not be carried out, if it is excluded in the accompanying documents according to the manufacturer's specifications. **Limiting values** for the insulating resistance are not specified in the DIN VDE 0751-1 standard (issue 2008). Here, it is possible to refer to recommendations of the manufacturer or to previously measured values. The DIN VDE 0751-1 standard recommends the following order of the tests to be carried out:

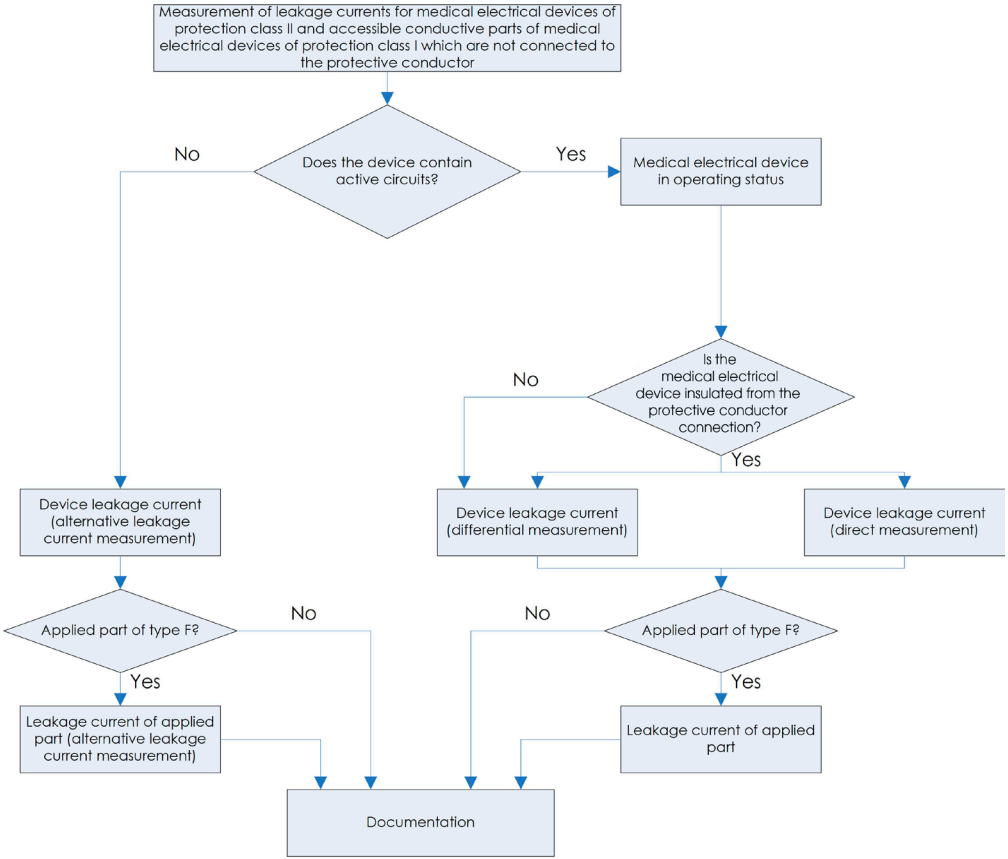
According to DIN VDE 0751-1 following sequence of tests to be recommended:



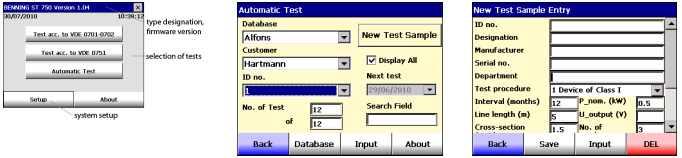
11.3.1 Test Procedure: Leakage Current Measurement for Medical Electrical Devices (Protection Class I)



11.3.2 Test Procedure: Leakage Current Measurement for Medical Electrical Devices (Protection Class II)



12. Carrying out the Integrated Automatic Test



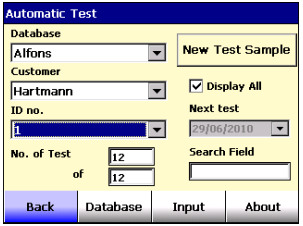
Test samples already existing in a database can be tested rapidly by means of the automatic test. The sequence described here applies to an already existing database (name), customer (name) with registered test samples (ID no.). After pressing <**Automatic Test**> in the start menu, select the following in the menu displayed:

- Selection of the database (name), only specific customers!
- Selection of the customer (name), only specific test samples!
- Selection of the test sample (ID no.), depending on the customer / database!
- Select the test sample in the "ID no." line and mark it by means of the input stylus.

Now, the menu of the selected test sample opens. The values are highlighted in grey colour and cannot be modified in this menu! After pressing the <**Start**> button, first the "Visual Inspection" menu is displayed. Confirm it by pressing a button. After a positive test and pressing a button, a connection test is started. The test is intended to determine whether a dangerous contact voltage is applied, whether a test sample is connected and to make sure that there is no short-circuit. After a positive connection test, the measurement is started. In case of a negative connection test (e.g. open switch), an information message is displayed. The individual tests (depending on the pre-setting of the test procedure) are displayed subsequently and partly have to be activated or confirmed by pressing the <**Start**> button (also see description of the individual measuring types, chapter 8). In case of faulty individual results that are dangerous, the measurement will be interrupted immediately. By pressing the <**Pause**> button, it is possible to interrupt measurement so that e.g. the test cable with the alligator clip or probe tip can be connected to another measuring point without resulting in incorrect measurements / indications.

Attention! The mains voltage applied to the test sample will persist during the "Test interrupted" message! Incorrect measured values can be deleted by pressing the <**Reset**> button. After the test has been successful and is finished, the "Test sample OK" menu is displayed. It is possible to display the results by pressing <**Meas. Value**> and to save them by pressing <**Save**>, <**Yes**>). The measuring data will be stored in the selected database (name) and can be read out via a PC.

12.1 Searching Test Samples



By means of the fields ( ) "Display All" and "Next Test", you can select the test samples of a specific "Database" and the corresponding "Customer" which shall be tested on a specific date. Untick the box ( ) "Display All" and enter the corresponding date in the field "Next Test" by means of the calendar function. The result is shown in the fields "No. of Test Samples" and "ID no.". It is possible to filter and search for different parameters like e.g. the ID no. by means of the "Search Field".

13. Internal / Automatic Test Procedures

The BENNING ST 750 Appliance Tester supports automatic test procedures. At the time of delivery, it is provided with 26 preset test procedures. Moreover, the user can create or modify own test procedures.

13.1 Internal Test Procedures for Devices according to VDE 0701/0702 (Protection Class I)

Automatic Test No.	BENNING ST 750 – Brief Description	Visual Inspection	Connection Test	RPE @ 200 mA	RPE @ 10 A	RInsu-1: L/N-PE	RInsu-1: L/N-PE @ 0.3 MΩ	RInsu-1: L/N-PE @ 250 V	RInsu-2: sec.-PE	RInsu-3: L/N-sec.	IPE (alt.)	IPE (clamp)	ICont (dir.)	Functional Test	Line	Ua Safety Extra-Low Voltage
1	Device, Class I	x	x	x		x							x			
2	Device, Class I with RPE 10 A	x	x		x	x							x			
3	Device, Class I with ICont	x	x	x		x						x	x			
4	Device, Class I without RPE + ICont	x	x			x						x	x			
5	Device, Class I with heat. < 3.5 kW	x	x	x			x						x			
6	Device, Class I with IPE (alt.)	x	x	x		x					x					
7	Device, Class I, RPE 10 A + IPE (alt.)	x	x		x	x					x					
8	Device, Class I with RInsu 250 V	x	x	x			x						x			
9	Device, Class I without RInsu	x	x	x									x			
10	Device, Class I without RInsu + ICont	x	x	x								x	x			
11	Device, Class I with sec. U-output	x	x	x		x			x	x			x	x		x
12	Device, Class I with IPE (clamp)	x	x	x		x						x				
13	Device, Class I, RPE 10 A + IPE (clamp)	x	x		x	x						x				
14	Line, shock-proof	x	x	x		x					x				x	
15	Line, shock-proof, RInsu 250 V	x	x	x			x				x				x	

1	Device of Class I with RPE (200 mA), RInsu (500 V), functional test with IPE (differential current measurement, probe switched off)
2	Device of Class I with RPE (10 A), RInsu (500 V), functional test with IPE (differential current measurement, probe switched off)
3	Device of Class I with RPE (200 mA), RInsu (500 V), ICont (direct), functional test with IPE (differential current measurement, probe switched off)
4	Device of Class I with functional earth, without RPE, RInsu (500 V), ICont directly, e.g. completely insulated coffee machine with PE connector (Class I) without accessible PE contact
5	Device of Class I with heating elements P<3.5 kW, RInsu (500V, R>0.3 MΩ), functional test incl. IPE (differential current measurement, probe switched off)
6	Device of Class I with RPE (200 mA), RInsu (500V), IPE (alternative measurement), no functional test, for measurement of heating devices. devices without switch-mode power supplies, three-phase devices via adapter 044122 / 044123
7	Device of Class I with RPE (10 A), RInsu (500V), IPE (alternative measurement), for testing extension cables up to 5 m or tools with 300 Hz such as power screwdrivers, grinding tools etc.
8	Device of Class I with overvoltage arresters with RPE (200 mA), RInsu (250 V), functional test with IPE (differential current measurement, probe switched off)
9	Device of Class I with RPE (200 mA), without RInsu, functional test with IPE (differential current measurement, probe switched off), test procedure without RInsu, only with justification
10	Device of Class I with RPE (200 mA), without RInsu, ICont (direct measurement), functional test with IPE (differential current measurement, probe switched off), test procedure without RInsu, only with justification
11	Device of Class I with RPE (200mA), 3 x RInsu(500V), ICont (direct measurement), functional test incl. IPE (differential current measurement, probe switched off), Ua at secondary output, e.g. mains supply units, chargers
12	Three-phase device of Class I via adapter 044122/044123: RPE (200 mA) + RInsu (500V) by means of CM 9 and adapter 044127/044128: IPE (clamp measurement)
13	Three-phase device of Class I via adapter 044122/044123: RPE (10 A) + RInsu (500V) by means of CM 9 and adapter 044127/044128: IPE (clamp measurement)
14	Shock-proof cable 16 A, RPE (200mA) limiting value from (I/A), preset length l=5m, cross-section A=1.5 mm^2, overall resistance: 0,3 Ω, per 7.5 m/0.1 Ω, max. 1 Ω, RInsu (500V), IPE (alternative measurement), line test
15	Shock-proof cable 16 A and overvoltage arrester, RPE (200mA) overall resistance from (I/A), preset length l=5 m, cross-section A=1.5 mm^2, overall resistance: 0,3 Ω, per 7.5 m/0.1 Ω, max. 1 Ω, RInsu (500V), IPE (alternative measurement), line test

13.2 Internal Test Procedures for Devices according to VDE 0701/0702 (Protection Class II)

Automatic Test No.	BENNING ST 750 – Brief Description	Visual Inspection	Connection Test	RInsu-1: L/N-PE	RInsu-1: L/N-PE @ 250 V	RInsu-3: L/N-sec.	ICont (dir.)	ICont (alt.)	Functional Test	Ua Safety Extra-Low Voltage
1	Device, Class II	x	x	x					x	
2	Device, Class II with ICont (alt.)	x	x	x				x		
3	Device, Class II, RInsu 250 V	x	x		x				x	
4	Device, Class II without RInsu	x	x						x	
5	Device, Class II without RInsu + ICont	x	x				x		x	
6	Device, Class II with U-output	x	x			x			x	x

1	Device of Class II with RInsu (500 V), functional test with ICont (differential current measurement),
2	Device of Class II with RInsu (500 V), ICont (alternative measurement)
3	Device of Class II with overvoltage arrester, RInsu (250 V), functional test with ICont (differential current measurement)
4	Device of Class II without RInsu, functional test with ICont (differential current measurement), test procedure without RInsu, only with justification
5	Device of Class II without RInsu, ICont (direct measurement), functional test with ICont (differential current measurement), test procedure without RInsu, only with justification
6	Device of Class II with RInsu-3 (L/N – sec.), functional test with ICont (differential current measurement), Ua at secondary output, e.g. chargers, mains supply units

13.3 Internal Test Procedures for Devices according to VDE 0701/0702 (Protection Class III)

Automatic Test No.	BENNING ST 750 – Brief Description	Visual Inspection	Connection Test	RInsu-3: L/N-sec. @ 250 V / 0.25 MΩ
1	Device, Class III	x	x	x

1	Device of Class III with RInsu-3 (prim. – sec.)

13.4 Internal Test Procedures for Devices according to VDE 0751-1 (Protection Class I)

Automatic Test No.	BENNING ST 750 – Brief Description	Visual Inspection	Connection Test	RPE @ 200 mA, 0.3 ohms	RInsu-1	ILeak. (diff.) @ 0.5 mA	Functional Test
1	Med. devices, Class I	x	x	x	x	x	x
2	Med. devices, Class I without RInsu	x	x	x		x	x

1	Medical devices of Class I
2	Medical devices of Class I without RInsu

13.5 Internal Test Procedures for Devices according to VDE 0751-1 (Protection Class II)

Automatic Test No.	BENNING ST 750 – Brief Description	Visual Inspection	Connection Test	RPE @ 200 mA, 0.3 ohms	RInsu-1	ILeak. (diff.) @ 0.5 mA	Functional Test
1	Med. devices, Class II	x	x		x	x	x
2	Med. devices, Class II without RInsu	x	x			x	x

7	Medical devices of Class II
8	Medical devices of Class II without RInsu

13.6 Creating / Modifying a Test Procedure

see chapter 7.4.2 "Creating Test Procedures"

⚠ The predefined internal test procedures cannot be modified!

14. Database

14.1 Database Content

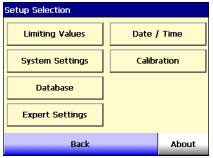
The following contents are stored in the database:

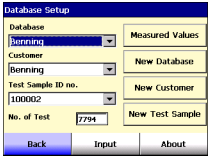
- database name,
- customer,
- test sample,
- number of test samples,
- displayed measured values.

14.2 Creating a Database

The following instructions always refer to this menu level:

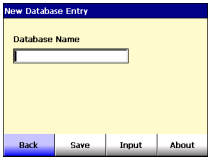
- Database Setup





14.2.1 New Database

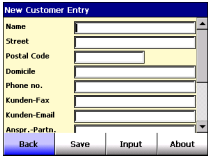
Press the **<New Database>** button.



Tap the "Database name" text field and press <**Input**>. Now, enter the name of the new database by means of the display keyboard or an externally connected PC keyboard. Press <**Save**> to create the new database. If a database with the selected name already exists, a corresponding warning message will be displayed. Press <**Back**> to exit the menu / screen without saving the entry.

14.2.2 New Customer

Press **<New Customer>**.

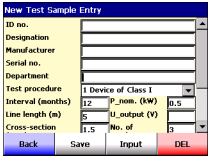


Tap the individual text fields and press **<Input>**. Now, enter the data by means of the display keyboard or an externally connected PC keyboard. Press **<Save>** to create the new customer data.

To be able to save device data (test sample), at least one customer data record must exist. If a customer file with the selected name already exists, a corresponding warning message will be displayed. Press **<Back>** to exit the menu / screen without saving the entry.

14.2.3 New Test Sample

Press the **<New Test Sample>** button.

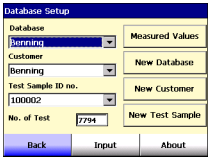


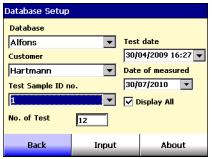
Tap the individual text fields and press <**Input**>. Now, enter the data by means of the display keyboard or an externally connected PC keyboard. If necessary, delete a pre-setting by pressing <**Clear**>.

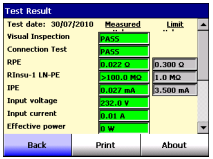
Use the drop-down list box **<Test Procedure>** to select a corresponding test procedure from the internal database (see chapter 11 "Test Procedures"). Enter a time interval in months (e.g. 12) into the "Interval" text field and the new test date (e.g. 12 months later) automatically appears in the date field "Next Test". The current date will be set automatically in the "Test Date" field. Press **<Save>**/**<Yes>** to create the new data in the database. If no unambiguous "ID no." is entered or a customer data record is missing, a corresponding warning message will be displayed. Press <**Back**> to exit the menu / screen without saving the entry.

14.2.4 Displaying Stored Measured Values

Press the **<Measured Values>** button.







Select **<Database>**, **<Customer>**, **<Test Sample>** and **<Test Date>**.

Notes:

- It is necessary to select the test date, because one test sample might be tested already several times.
- Measured values of "newly created test samples" can only be displayed under **<Setup>**, **<Database>**, if the database has been refreshed in the meantime.

14.3 Editing a Database

The database name is assigned when a database is created and can only be modified via the PC software.

⚠ It is impossible to edit measured values that have been saved!

14.3.1 Editing Customer Data

Tap the "Customer" text field, select and tap the customer to be edited and the customer editing window opens. Now, you can edit the customer data and save them by pressing <**Save**>. Press <**DEL**> to delete the customer from the current database.

⚠ The customer and all associated tests samples and measured values are deleted!

14.3.2 Editing Test Sample Data

Tap the "Test Sample ID no." text field, select and tap the test sample to be edited and the editing window opens. Now, you can edit the test sample data and save them by pressing **<Save>**. Press **<DEL>** to delete the test sample from the current database.

⚠ The test sample and all associated measured values are deleted

14.4 Recommendations Regarding the Database

⚠ Big data volumes will reduce the operating speed. For this reason, it is recommended to divide the overall data into separate databases.

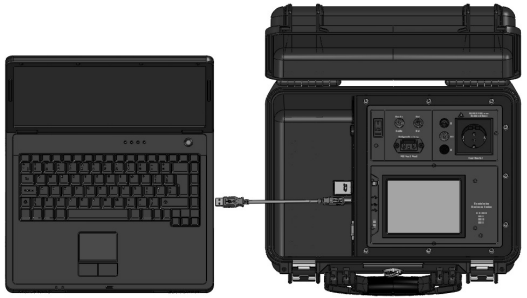
14.5 Backing Up the Database (PC)

To back up the database on a PC, use the optional BENNING PC-Win ST 750 PC software (part no. 047001).

15. Connecting to a Personal Computer (PC)

1. Insert the SD memory card into the SD card slot.
2. Connect the "A" connector of the enclosed USB cable to a USB port of your PC.
3. Now, connect the "B" connector of the USB cable to the BENNING ST 750 Appliance Tester (USB jack, type B).

Now, inserted SD memory cards are recognized as removable media under "My Computer". Saved data can be processed on the PC by means of the PC software.



16. Barcode Scanner (Optional)

The barcode scanner for the BENNING ST 750 Appliance Tester is an advanced and multifunctional tool for the management and identification of test samples. The barcode scanner is available as CCD scanner (part no. 009369).

⚠ When connecting the barcode reader, first switch off the BENNING ST 750 Appliance Tester!

16.1 Barcode Scanner Specification

Benning part no.:
009369
Interface:
RS232 with D-SUB 9 female connector
Supported barcodes:
all UPC/EAN/JAN, Code 39, Code 39 Full ASCII, Code 128, Interleave 25, Industrial 25, Matrix 25, CODABAR, Code 11, MSI/Plessey, Code 93, China Postage, Code 32
Current consumption:
typ. 60 mA (supplied by BENNING ST 750 Appliance Tester)
Operating temperature:
0 °C to 40 °C
Storage temperature:
- 20 °C to 60 °C
Relative humidity:
20 % - 85 %
Pin assignment RS232, DB 9 female:

pin 2	TXD
pin 3	RXD
pin 5	GND
pin 9	+5V

16.2 Operating the Barcode Scanner

- Connect the barcode scanner to the BENNING ST 750 Appliance Tester (RS232 connector).
- Make sure that the barcode scanner lamp switches on. The CCD scanner emits a short optical and acoustic signal (press the button at the barcode scanner).
- Select <**Automatic Test**> in the main menu → testing, alt. via <**Setup**> / <**Database**> / <**Customer**> → data management
- Hold the scanning window of the barcode scanner over the barcode and briefly press (switch on) the button on the bottom of the scanner.
- In case of successful reading, an acoustic signal will be emitted and the test sample will be displayed.

If communication with the BENNING ST 750 Appliance Tester works properly, the tester will search for the test sample with the detected barcode ID in the database. If the barcode ID read does not exist in the database, the device displays the following message: "This test sample does not exist. Do you want to create it?" Select <**Yes**> to create the test sample in the database.

16.3 Programming

By the factory, the barcode scanner has been set for optimum interaction with the BENNING ST 750 Appliance Tester. Nevertheless, in case of any problems regarding the communication between the barcode scanner and the BENNING ST 750 Appliance Tester (e.g. barcode reader reads successfully and confirmation by acoustic signal exists, but no search for / displaying of the test sample by the BENNING ST 750), please check the programming of the barcode reader with regard to standard specifications. For this, it is necessary to read a sequence of barcodes.
To conclude, check whether the test no. "10047" is identified correctly. Otherwise, run through the configuration sequence again!

The barcode scanner with the part no. "009369" has to be programmed according to the following sequence:

Set All Defaults:

Start Configuration:

RS-232 Mode:

Medium:

1. 1st Set:

All Codes:

1:

2. Complete:

>:

2. Complete:

End Configuration:

Save Parameters:

Test-ID.: ST750

The barcode scanner will search for the test sample called "**ST750**" in the BENNING ST 750. If the barcode ID read does not exist in the database under the selected customer, the following message will be displayed: "This test sample does not exist. Do you want to create it?". Select **<Yes>** to create the test sample in the database.

17. RFID Reader (Optional)

RFID is a method for automatic and electronic identification of objects per radio technology. For identification of the object, the data can be read out by wireless technology via a radio frequency channel. A marked object only sends its data, if the reader calls the transponder. An RFID system consists of two components: a transponder and a reader. The transponder (in the following referred to as "tag") is the actual data carrier.
It is possible to read it and to write on it without any contact by means of radio technology. The tag stores data of the tag and of the connected object. The reader consists of a reader/writer unit with antenna. The reader reads data of the tag and writes data to the tag. The reader is provided with a USB 2.0 interface to transmit the received data to the BENNING ST 750 Appliance Tester.
For installation of the tags, it has to be observed that metallic surfaces strongly interfere with the radio connection. Therefore, do not install them directly onto metal or a metal housing. Data exchange between reader and transponder does not require direct contact (even not a visual contact). Barcode labels can be exchanged by means of RFID transponders. The device communicates with passive HF transponders with 13.56 MHz. The reading process is started by pressing a button. If a transponder has been identified, this is confirmed by an acoustic signal. It is not necessary to configurate the RFID reader.

⚠ When connecting the RFID reader, first switch off the BENNING ST 750 Appliance Tester! Do not remove / insert the RFID reader during operation. Always switch off the device first!

☞ In case of faults, switch off the appliance tester. Remove the RFID reader, reconnect it and then switch on the appliance tester.

17.1 RFID Reader Specification

Benning part no.:
009370
Interface:
USB 2.0 interface
Operating voltage:
5V, supplied by USB interface of BENNING ST 750
Supported RFID transponders:
13.56 MHz, see chapter 21 "Optional Accessories"
Reading range:
typ. 80 mm, depending on transponder
Typical reading time:
100 ms
Current consumption:
typ. 60 mA (passive mode)
typ. 120 mA (active mode)
Operating temperature:
0 °C to 50 °C
Storage temperature:
- 10 °C to 60 °C
Relative humidity:
20 % - 85 %
Protection category:
IP30
Dimensions:
approx. 165 x 110 x 80 mm

17.2 Operating the RFID Reader

The RFID reader can be used in combination with the following device groups: BENNING ST 750

⚠ **For reading / writing processes, wait until the orange LED goes out.**
An incorrect writing process will be signalled by two consecutive acoustic signals. Repeat the process!

Commissioning:
- Switch the BENNING ST 750 Appliance Tester OFF.
- Connect the RFID reader to the BENNING ST 750 Appliance Tester (USB-A jack).
- Switch the BENNING ST 750 Appliance Tester ON.
- Make sure that the RFID lamp ("Power") switches on.

Writing onto the transponder: (inventory data)
- Create the inventory data of a test sample in an internal database or select an existing test sample (ID no.).
- **<Select>** <**Save**> and confirm the queries.
- Message: "Do you want to save the data record on the RFID transponder?". Confirm with <**Yes**>.
- The orange LED of the RFID reader flashes.
- Hold the scanning window of the RFID reader over the RFID transponder and press the button on the bottom of the scanner.
- The writing process starts. Wait until the orange LED goes out and an acoustic signal is emitted.
- The data are saved on the RFID transponder.

An incorrect writing process will be signalled by two consecutive acoustic signals. Repeat the process!

Writing onto the transponder: (measured values)
- Carry out the test.
- When the test result is displayed, select <**Save**>.
- Confirm the queries.
- Message: "Do you want to save the data record on the RFID transponder?". Confirm with <**Yes**>.
- The orange LED of the RFID reader flashes.
- Hold the scanning window of the RFID reader over the RFID transponder and press the button on the bottom of the scanner.
- The writing process starts. Wait until the orange LED goes out and an acoustic signal is emitted.
- The data are saved on the RFID transponder.

An incorrect writing process will be signalled by two consecutive acoustic signals. Repeat the process!

Reading the ID no. from the transponder and searching in internal database:
- Hold the scanning window of the RFID reader over the RFID transponder and press the button on the bottom of the scanner.

- The reading process starts. Wait until the orange LED goes out and an acoustic signal is emitted.
- The device searches for the ID no. in the internal database.
- Confirm the queries. If necessary, create the test sample.
- The data record is displayed.

An incorrect reading process will be signalled by two consecutive acoustic signals. Repeat the process!

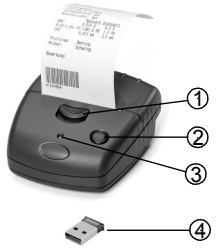
Reading data completely from the transponder: (inventory data and measured values)

- **Remove the SD memory card!**
- Delete the database from the internal memory. For this, select an empty field from the pull-down menu.
- Hold the scanning window of the RFID reader over the RFID transponder and press the button on the bottom of the scanner.
- The reading process starts. Wait until the orange LED goes out and an acoustic signal is emitted.
- Confirm the query "Reading data fron RFID transponder".
- Hold the scanning window of the RFID reader over the RFID transponder and press the button on the bottom of the scanner.
- The reading process starts. Wait until the orange LED goes out and an acoustic signal is emitted.
- The inventory data and measured values are read from the RFID transponder.
- The inventory data are displayed.
- Press **<Back>** and select the test date to display the measured values.

An incorrect reading process will be signalled by two consecutive acoustic signals. Repeat the process!

18. Bluetooth Printer (Optional)

⚠ When connecting the printer, first switch off the BENNING ST 750 Appliance Tester!



1 stopping lever
2 ON / OFF button
3 control lamp
4 Bluetooth dongle

18.1 Inserting / Removing the Batteries

- Switch the printer OFF.
- Remove the screw of the battery compartment on the back.
- Remove the battery compartment cover.
- Replace the batteries.
- Put the battery compartment cover back onto the device.

18.2 Inserting a Paper Roll

- Switch the printer OFF.
- Pull the stopping lever forward and open the cover of the paper compartment.
- Insert the paper roll and pull the front end of the paper roll over the tear-off edge.
- Close the cover so that the stopping lever locks into place.

18.3 Bluetooth Printer Specification

Benning part no.:
044150
Interface:
RS232 serial interface / via RJ12 connection
Wireless connection:
Bluetooth®
Operating voltage:
5V, supplied by an internal storage battery or via an external mains supply unit / charger

18.4 Operating the Bluetooth Printer

⚠ Configuration is only required for initial commissioning. The printer data are stored in the appliance tester. For using it again, simply insert the Bluetooth dongle and switch on the printer.

Initial configuration:

- Switch the BENNING ST 750 Appliance Tester OFF.
- Connect the Bluetooth dongle to the BENNING ST 750 Appliance Tester (USB-A jack).
- Switch the appliance tester ON.
- Switch the printer ON by pressing the ON / OFF button.
- In the main menu, select <**Setup**> / <**System Settings**> / <**Printer**> to get to the printer management.
- <**Search**> the printer.
- Device name: Tap the input field and select the printer.

☞ Printer name starts with "ASL AP…".

- Enter the PIN code (PIN code: 1234)
- <**Connect**>.
- Carry out a reset.
- The BENNING ST 750 restarts.
- If necessary, switch the printer ON again.
- After a test or via the database, it is possible to print the test result by selecting <**Measured Values**> / <**End of Test**> and pressing **<Print>**

The following data are printed:
Tester, ID no., designation, test date, next test, test result, measured values, test company, test person, comment and the barcode of the test object.

19. Technical Terms

Protective measures
The test procedure is based on the existing protective measure of the test sample for which the efficacy at the respective accessible conductive has to be proven. For the BENNING ST 750 Appliance Tester, the following classification has been made:

Devices with PE connection (protection class I)
The active parts of the device are protected against direct contact. By connecting the accessible conductive parts of the housing to the protective conductor, these parts are included in the protective measures of the system concerning direct contact (fault protection). The fault current is detected by means of the protective conductor current measurement. The device might also have accessible conductive parts which are not connected to the protective conductor. The fault current is additionally detected by means of the contact current measurement. The device is provided with a protective conductor connection (shock-proof plug).

Devices without PE connection (protection class II)
Active parts are isolated by means of reinforced or double insulation (basic insulation and additional insulation). Thus, the device is protected against direct contact. The device is also protected against indirect contact, because an insulation fault is all but impossible. However, such devices might be provided with accessible conductive metal housing parts. Devices of protection class II are equipped with a mains plug without protective conductor.

Devices at safety extra-low voltage circuits (protection class SK III)
Devices of protection class III are connected to safety extra-low voltage circuits (SELV / PELV) only. Protection against dangerous shock current is ensured by the low voltage and safe isolation regarding other circuits.

19.1 Technical Terms according to DIN VDE 0701-0702

Repair
Measures taken to restore the nominal condition of the technical means of a system

Modification
Intervention in the device which is admissible according to the manufacturer's specifications

Qualified electrician
A qualified electrician is someone who is able to evaluate the tasks assigned to him/her due to his/her professional education, knowledge and experience as well as to the knowledge of the relevant provisions and who is able to recognize possible dangers.

Electrotechnically trained person
An electrotechnically trained person is someone who has been informed and instructed (if necessary) by the qualified electrician regarding the tasks assigned to him/her and regarding possible dangers in case of improper behaviour. Moreover, the electrotechnically trained person has been instructed with regard to the required protection equipment and protective measures.

Competent person
In terms of the German Health and Safety at Work Regulation, a competent person is someone who has the required expert knowledge for the testing of electrical equipment due to his/her vocational education, professional experience and contemporary occupational activity. According to the German technical guideline for operational safety "Competent persons – specific requirements – electrical hazards" (TRBS 1203, Part 3), the competent person must have finished an electrotechnical vocational education or must have another similar electrotechnical qualification suitable for the testing of portable electrical equipment to ensure protection against electrical hazards. The term professional experience means that the person has at least one year of experience regarding the installation, assembly or maintenance of electrical equipment and/or systems. For the intended testing of portable electrical equipment, the competent person must have the required detailed knowledge of electrical engineering as well as of the relevant electrotechnical regulations and must regularly update this knowledge. These demands show that safety-related evaluation of portable electrical equipment basically requires the attributes of a qualified electrician.

Test
The test comprises measures for determining and evaluating the actual condition regarding the safety of the device.

Periodic inspection
A periodic inspection is a test which is carried out in certain time intervals and which is intended for proving the electrical safety.

Contact current
If someone touches parts of a body of an electrical equipment (device) that are not connected to the protective conductor, the contact current is the current flowing to earth via the person touching the device.

Differential current
Vectorial sum of all current flowing via the active conductors at the input (connection) of the mains side

Protective conductor current
Sum of the currents flowing through the protective conductor of devices of protection class I, if the bodies of those devices are insulated to earth

Leakage current
Current flowing to earth or to an external conductive part via the faultless insulation of a device

Fault current
Current flowing to earth or to an external conductive part via the faulty insulation of a device

Alternative leakage current
Current which would flow through the active conductors of a test sample and the protective conductor or the accessible conductive parts at nominal voltage or at nominal frequency of the test sample. Note: Please observe the test circuits!

Insulating resistance
Ohmic resistance of the insulation (insulating materials) between conductive parts. Note: Only the insulating resistance between the active parts and the accessible conductive parts is measured.

Protective conductor resistance
Resistance between a conductive part connected to the protective conductor for protective reasons

and the protective contact of the mains plug or appliance plug or the protective conductor connection point of the device respectively

Electrical appliance
Device (test sample) the condition of which shall be tested with regard to electrical safety

19.2 Technical Terms according to DIN VDE 0751-1

Accessible conductive part
Any part of a medical electrical device (except for the applied part) which can be touched by the patient or by the operator touching the patient or which might come into contact with the patient

Device leakage current
Current flowing from mains supply units to earth via accessible conductive parts of the housing and via applied parts

Functional connection
Any type of connection (electrical or other) including those used for transmission of signals and/or electric power and/or substances

Inspection
All measures taken to determine and evaluate the actual condition of the device

Medical electrical device
Electrical device which is equipped with an applied part, which serves to transfer energy to or from the patient or which indicates such an energy transfer to or from the patient and for which the following shall apply:
a) The device is provided with not more than one connection to a certain power supply network and
b) is intended for the following use by its manufacturer:
   1) diagnosis, treatment or monitoring of a patient or
   2) compensation or palliation of a disease, injury or disability

Medical electrical system
Combination of individual devices as defined by the manufacturer among which at least one must be a medical electrical device and which are connected by means of a functional connection or by using a multiple socket

Patient environment
Any kind of environment where a connection can be established intentionally or unintentionally, namely between patients and parts of a medical electrical device or system or between a patient or other perons touching parts of the medical electrical device or system

Patient leakage current
Current flowing from the patient connections via the patient to earth or which is caused by an unintended external voltage at the patient and flows from the patient via the patient connections of an applied part of type F to earth

Commissioning
Initial use of a medical electrical device or system after being installed at the responsible organization

Responsible organization
Entity responsible for the use and maintenance of a medical electrical device or system (can also be a person)

Maintenance
Any kind of measures taken to preserve the condition of a medical electrical device or system in compliance with the manufacturer's requirements

Applied parts
As an introduction, the different types of applied parts will be described in the following. According to IEC 60601-1, an applied part is a part of **the device** which **for its intended use**
- necessarily comes into physical (bodily) contact with the patient so that the device can fulfil its function or
- can be brought in contact with the patient or
- needs to be touched by the patient.

An insulated (unearthed) applied part of **type F** is described as:
an applied part which is isolated from other parts of the device in such a way that the current flowing is not higher than the patient leakage current admissible for the **first fault**, if an unintended voltage from an external source is connected to the patient and thus is applied between the applied part and earth.
Applied parts of type F are either applied parts of type BF or applied parts of type CF.
Note: For devices of protection class I, this applied part is connected to earth which can be verified by measurement with an ohmmeter.

Applied part of type B:
This is an applied part which provides protection against electric shock in compliance with the requirements defined in IEC 601-1, especially considering the admissible leakage current, and which is marked as follows:

- type B: earthed applied part  or

- type B: applied part protected by a defibrillator 

Applied parts of type B are not intended for being applied directly to the heart.

Applied part of type BF:
This is an applied part of type F which provides a more significant protection against electric shock than applied parts of type B in compliance with the requirements defined in IEC 601-1 and which is marked as follows:

type BF: applied part isolated from earth  or

type BF: applied part protected by a defibrillator 
Applied parts of type BF are not intended for being applied directly to the heart.

Applied part of type CF:
This is an applied part of type F which provides a more significant protection against electric shock than applied parts of type BF in compliance with the requirements defined in IEC 601-1 and which is marked as follows:

type CF: applied part isolated from earth and appropriate for direct application to the heart or

type CF: applied part protected by a defibrillator

Attention: Make sure which type of applied part is concerned! Non-observance might cause a short-circuit, e.g. in case of an uninsulated applied part!

20. Technical Data, Appliance Tester

Mains connection:	230 V ± 10 %, 50 to 60 Hz
Current consumption of appliance tester	
- without test socket:	0.3 A
- with test socket:	16 A
Maximum current load of the test socket:	16 A, load type, see table on page 52
Maximum pre-fuse:	16 A
Protection category:	II (for the test socket, the protective conductor is looped through)
Protection category:	IP 40 with the cover being open IP 67 with the cover being closed
Overvoltage category:	II
Contamination level:	2
Touchscreen display:	115 x 95 mm
Ambient conditions:	height up to 2000 m above sea level
- temperature range:	0 to 35 °C (operating temperature) -20 to 60 °C (storage temperature)
- maximum relative humidity:	80 % up to 30 °C linearly decreasing 60 % up to 40 °C, non-condensing
Temperature range for tolerances:	18 to 28 °C
EMC	0404-1/ 4.12, EN61326-2-2
Housing:	carrying case, surface-mounted, shock-resistant
Device regulations:	see introduction and table
Dimensions (max.):	height x width x depth
(without three-phase sockets)	170 x 410 x 350 mm
Weight:	approx. 6 kg

Note: The measuring accuracy is specified as the sum of:
- a relative part of the measured value and
- a number of digits (i.e. counting steps of the last digit). This measuring accuracy applies to temperatures from 18 °C to 28 °C and a relative air humidity lower than 80 %.

20.1 Technical Data, Measuring and Device Function

DIN VDE 0404-2/ 4.1.1: The tester must allow at least measurement of the following parameters:
- protective conductor resistance
- insulating resistance
- protective conductor current (direct measurement, differential current measurement or alternative leakage current measurement method)
- contact current (direct measurement, differential current measurement or alternative leakage current measurement method)

The application standards DIN VDE 0701-0702 and 0751-1 use different terms for the same measurement methods depending on the properties and intended use of the parts. Thus, the following terms are used for leakage currents: device leakage current, earth leakage current, protective conductor current, contact current, patient leakage current etc.
The measuring data logging works with three measuring ranges (1:1; 10:1; 100:1). Switch-over of the measuring range occurs automatically, so that measurement is always carried out in the most favourable measuring range.
The RS232 interface (COM port) for barcode scanner, RFID reader, PC and printer can be set as follows:

Baud rate: 1200; 2400; 4800; **9600**; 14400; 19200; 38400; 57600; 115200
Parity: **none**, even, odd
Data bits: 7; **8**
Stop bits: none, **one**, two

***printed in bold type** = factory setting

Max. connectable storage capacity: SD card 2 GB,
USB stick 8 GB

For data input, it is also possible to connect an external PC keyboard to the USB interface.

Factory setting, system data:

Test time:	5 seconds
Time, safety shutdown:	30 seconds
Transition resistance, connector:	1 Ω

Measurement		acc. to measuring spec. / limiting value	Tester acc. to regulation
Measurement of the protective conductor resistance (RPE, test socket)		DIN VDE 0701-702 DIN VDE 0751-1 (DIN VDE 0701, Part 260) Protection class I (up to a length of 5 m*) 0701 - 0702 0.3 Ω 0751 0.3 Ω * +0.1 Ohm per further 7.5 m up to max. 1 Ω 0701 T240 1 Ω 0751 with appliance plug 0.1 Ω or 0.2 Ω	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN EN 61557-4 (VDE 0413 T4) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Testing current: Measuring voltage:	≥ 200mA DC (– 0% / +25%) to (0…5)Ohm of both polarities! U_0 approx. 12 V DC manual / automatic pole reversal!		
Testing current: Measuring voltage:	10A AC (–0% / +30% at 0 Ohm) at 230V AC (50…60)Hz U_0 approx. 17 V AC		
Measuring range:	0.100 ... 30.000 Ω		
Resolution:	0.001 Ω		
Accuracy:	at 230 V AC ±10% + 5 digits		

Measurement		acc. to measuring spec. / limiting value	Tester acc. to regulation
Measurement of the insulating resistance (RInsu, test socket)		DIN VDE 0701-0702 Protection class I with heating devices 0.3 MΩ Protection class I 1.0 MΩ Protection class II 2.0 MΩ Protection class III 0.25 MΩ DIN VDE 0751-1 Protection class I 2.0 MΩ Protection class II 7.0 MΩ Applied part CF 70.0 MΩ (measured value, factory setting 500 V)	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN EN 61557-2 (VDE 0413 T2) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Testing voltage:	50 ... 500 V DC (-0% / +25%)		
Testing current:	> 1 mA with 500 kΩ @ 500 V DC < 15mA with 0 Ω @ 500 V DC		
Measuring range:	0.10 ... 100.00 MΩ		
Resolution:	0.1 MΩ		
Accuracy:	at 230 V AC ±10% ± 15% of the measured value at 0 ... 100 MΩ		

Measurement	acc. to measuring spec. / limiting value	Tester acc. to regulation
Measurement of the alternative leakage current, as protective conductor current, contact current , device leakage current, leakage current of applied part for medical electrical devices (patient leakage current)	DIN VDE 0701-0702, Class I Protective conductor current, 3.5 mA Heating devices up to 3.5 kW 3.5 mA for > 3.5 kW 1 mA / kW, max. 10.0 mA DIN VDE 0701-0702 Contact current (ICont) Classes I - II 0.5 mA DIN VDE 0751-1 Class I ILeak, 1.0 mA Class II ILeak, 0.5 mA DIN VDE 0751-1 PLeak (AC) type BF 5.00 mA type CF 0.05 mA IEC 60601-1 ILeak note 1 5.00 mA ILeak note 2 10.00 mA ILeak X-ray with PE 5.00 mA ILeak X-ray without PE 2.00 mA	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN VDE 0404-1 DIN VDE 0404-2
Testing voltage: approx. 200 V AC, ± 20% at 230 V AC The measured current is projected to 230V!		
Testing current: max. 25 mA		
Measuring range: 0.050 ... 25.000 mA		
Resolution: 0.001 mA		
Accuracy: at 230 V AC ± 10% ± 15% of the measured value		
Internal resistance (measuring instrument / probe) VDE 0701 – 0702 Ri 2 kΩ VDE 0751-1 Ri 1 kΩ		

Measurement	acc. to measuring spec. / limiting value	Tester acc. to regulation
Measurement by means of the differential current measurement method (test socket); measurement of the protective conductor current for devices of Class I (test socket), measurement of the leakage current, contact current, leakage currents of applied parts for medical electrical devices, patient leakage current; protection classes I to III	DIN VDE 0701-0702, Class I Protective conductor current, 3.5 mA Heating devices up to 3.5 kW 3.5 mA for > 3.5 kW 1 mA / kW, max. 10.0 mA DIN VDE 0701-0702 Contact current (ICont) Classes I - II 0.5 mA DIN VDE 0751-1 Class I ILeak, 0.5 mA Class II ILeak, 0.1 mA	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Measuring range: 0.050 ... 25.000 mA (displayed from 50 µA on)		
Resolution: 0.001 mA		
Accuracy: at 230 V AC ± 10% ± 15% of the measured value (from 100 µA on) manual / automatic pole reversal!		
Internal resistance (measuring instrument / probe) VDE 0701 – 0702 Ri 2 kΩ VDE 0751-1 Ri 1 kΩ		

Measurement	acc. to measuring spec. / limiting value		Tester acc. to regulation
Measurement by means of the direct current measurement method (test socket); measurement of the protective conductor current for devices of Class I; measurement of the leakage current, contact current, leakage currents of applied parts for medical electrical devices (patient leakage current); protection classes I to III	DIN VDE 0701-0702, Class I		DIN EN 61010-1
	Protective conductor current	3.5 mA	(VDE 0411-T1)
	Heating devices up to 3.5 kW	3.5 mA	DIN EN 61557-1
	for > 3.5 kW	1 mA / kW,	(VDE 0413 T1)
	max.	10.0 mA	DIN VDE 0404-1
	DIN VDE 0701-0702		DIN VDE 0404-2
	Contact current (ICont)		DIN VDE 0404-3
	Classes I - II	0.5 mA	
	DIN VDE 0751-1		
	Class I ILeak,	0.5 mA	
	Class II ILeak,	0.1 mA	
	DIN VDE 0751-1		
	PLeak (AC) type BF	5.00 mA	
	type CF	0.05 mA	
	IEC 60601-1		
	PLeak (AC) type BF	0.10 mA	
	type CF	0.01 mA	
	ILeak note 1/3	2.50 mA	
	ILeak note 2	5.00 mA	
	ILeak X-ray with PE	5.00 mA	
	ILeak X-ray without PE	2.00 mA	
Measuring range: 0.050 ... 25.000 mA			
Resolution: 0.001 mA			
Accuracy: at 230 V AC ±10% ± 15% of the measured value			
Internal resistance (measuring instrument / probe) VDE 0701 – 0702 Ri 2 kΩ VDE 0751-1 Ri 1 kΩ			

Measurement			acc. to measuring spec. / limiting value	Tester acc. to regulation
Test socket (functional test after successful safety test)			DIN VDE 0701-0702 DIN VDE 0751-1	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Mains line (L and N) can be connected to test socket via relay, protective conductor looped through (also PE jack!)! Cut-off relay to "tangible measuring jacks" contact clearance of 3 mm, 80 A for max. 20 ms				
Nominal voltage: Rated current: Max. breaking capacity (AC1): Max. lamp load:		230 V ± 10 % (as mains feed-in!) 16 A 3000 VA 1000 W		
Measuring range:		0.0 - 360 V AC (50 - 60 Hz) 0.10 - 20 A AC (50 - 60 Hz) 0 ... 4000 W (effective power) 0 ... 4000 VA (apparent power)		
Resolution:		0.1 V 0.01 A 1 W 1 VA		
Accuracy:	U (V) I (A) P (W) S (VA)	± 15% of the measured value ± 15% of the measured value ± 15% of the measured value ± 15% of the measured value		

Measurement			acc. to measuring spec. / limiting value	Tester acc. to regulation
Safety extra-low voltage (PELV, SELV) **Measurement by means of probe**			DIN VDE 0701-0702	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Measuring range:		0.1 ... 360 V AC		
Resolution:		0.1 V		
Accuracy:		at 230 V AC ± 10 % ± 15% of the measured value		

Measurement		acc. to measuring spec. / limiting value	Tester acc. to regulation
Continuity test (cable reels and extension cables)		DIN VDE 0701-0702	DIN EN 61010-1 (VDE 0411-T1) DIN EN 61557-1 (VDE 0413 T1) DIN VDE 0404-1 DIN VDE 0404-2 DIN VDE 0404-3
Testing current:	at 230 V AC 50 - 60 Hz ≥ 200 mA DC – 0% + 25% to 0 - 5 Ω		
Measuring range:	0.10 ... 30.000 Ω		
Resolution:	0.01 Ω		
Accuracy:	at 230 V AC ±10 % ± 15% of the measured value		
Measuring voltage:	U_0 approx. 12 V DC		

20.2 Factory Settings, Limiting Values Setup

The meaning of the data is described in chapter 7.1 "Limiting Values"!

RPE data	
RPE VDE 0701-0702	(Ω) 0.3
RPE VDE 0751-1	(Ω) 0.3
RPE per 7.5 m line length	(Ω) 0.1
Line length	(m) 5
Cross-section	(mm^2) 1.5
IAL data	
IPE VDE 0701-0702 Class I	(mA) 3.5
ILeak VDE 0751 Class I	(mA) 1.0
ILeak VDE 0751 Class II	(mA) 0.5
ILeak VDE 0751 note 1	(mA) 5.0
ILeak VDE 0751 note 2	(mA) 10.0
ILeak VDE 0751 X-ray with PE	(mA) 5.0
ILeak VDE 0751 X-ray without PE	(mA) 2.0
Patient leakage current BF	(mA) 5.0
Patient leakage current CF	(mA) 0.05
ICont data	
ICont VDE 0701-0702	(mA) 0.5
Ua data	
Contact voltage U to PE	(V) 25

RInsu data	
RInsu Class I	(MΩ) 1.0
RInsu Class I heating element	(MΩ) 0.3
RInsu Class II	(MΩ) 2.0
RInsu Class III	(MΩ) 0.25
RInsu 0751 Class I	(MΩ) 2.0
RInsu 0751 Class II	(MΩ) 7.0
RInsu 0751 CF	(MΩ) 2.0
Testing voltage prim. - PE	(V) 500
Testing voltage sec. - PE	(V) 500
Testing voltage prim. - sec.	(V) 500
ILeak data	
IPE VDE 0701-0702 Class I	(mA) 3.5
ILeak VDE 0751 Class I	(mA) 0.5
ILeak VDE 0751 Class II	(mA) 0.1
ILeak VDE 0751 note 1/3	(mA) 2.5
ILeak VDE 0751 note 2	(mA) 5.0
Patient leakage current BF (AC)	(mA) 0.1
Patient leakage current CF (AC)	(mA) 0.01
Funct. data	
IFault VDE 0701-0702 Class I	(mA) 3.5
IFault VDE 0701-0702 Class II	(mA) 0.5
IFault VDE 0751 Class I	(mA) 0.5
IFault VDE 0751 Class II	(mA) 0.1
Cable data	
Line length	(m) 5
Cross-section	(mm^2) 1.5
Conductor quantity	3

21. Optional Accessories

Figure	Designation	Item no.
	PC software BENNING PC-Win ST 750 incl. USB cable	047001
	Barcode Scanner	009369
	Barcode labels with consecutive numeric representation (1,000 pieces)	756301
	Test badges "next test" (300 pieces)	756212
	RFID reader/writer	009370
	RFID transponder (self-adhesive)	044137
	RFID transponder (ring clip)	044138
	RFID transponder (tag)	044139

Figure	Designation	Item no.
	Portable log printer / Bluetooth® BENNING PT 1	044150
	Thermographic paper roll for BENNING PT 1 (20 pieces)	044151
	Compact industrial keyboard	044154
	Leakage current clamp BENNING CM 9 for differential current / load current measurement (1 µA - 100 A AC)	044065
	Single-phase current adapter for leakage current clamp, conductors led through individually and provided with double insulation (shock-proof plug and socket)	044131

Measuring adapter for three-phase loads:

	Three-phase adapter 16 A (L1-2-3 bridged) for measuring RPE, RInsu, IAL, (CEE coupling 16 A, 5-pin and shock-proof plug)	044122
	Three-phase adapter 32 A (L1-2-3 bridged) for measuring RPE, RInsu, IAL, (CEE coupling 32 A, 5-pin and shock-proof plug)	044123
	Three-phase adapter 16 A for leakage current clamp, conductors led through individually and provided with double insulation (CEE coupling and plug 5-pin)	044127
	Three-phase adapter 32 A for leakage current clamp, conductors led through individually and provided with double insulation (CEE coupling and plug 5-pin)	044128

22. Warranty Terms

The BENNING ST 750 is subject to stringent quality testing. In case of faults with regard to correct functioning, we grant a warranty of 24 months. Manufacturing faults or material defects shall be eliminated by us free of charge as far as the device shows malfunction without external influence and is returned to us without having been opened. Damages caused by falls or incorrect use are excluded from warranty.

23. Maintenance / Calibration

Maintenance

The device does not require any special maintenance. Please make sure that the surface is clean. For cleaning, use a slightly moistened cloth. Do not use any cleaning agents, abrasives or solvents. Except for specific calibration intervals, the device does not require any special maintenance. However, in case of **malfunctions** occurring, switch the device OFF (if necessary). First, check all cable connections and check whether the device is supplied properly. Switch the device ON again. Mostly, software problems can be eliminated by reinitialization of the device.

Calibration

According to DIN VDE 0701-0702, the following shall apply as of 1st June 2008:
"The measuring instruments used for periodic testing shall be tested and calibrated regularly."
Feel free to make an appointment with us for testing and calibrating your testers.
Phone: +49 (0) 2871 / 93-555
For our address, please refer to chapter 24, "Product Support".

Return and Environmentally Sound Disposal

The device is considered to be a product of category 9 (monitoring and control instruments) as defined in the German "ElektroG" (Electrical and Electronic Equipment Act). This device is not subject to the RoHS Directive. In compliance with WEEE 2002/96/EG and the German "ElektroG" (Electrical and Electronic Equipment Act), we mark our electrical and electronic devices (as of 8/2005) with the symbol shown on the right according to DIN EN 50419.
These devices must not be disposed of via the domestic waste. Regarding the return of waste electrical and electronic equipment, please contact our Service team (for the address, see chapter 24).

23.1 Repair and Spare Parts Service

In case of need, please contact our Product Support team (see chapter 24, "Product Support").

24. Product Support

Please contact the expert personnel of the supplier or manufacturer for further information.

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