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Testboy® TV 465

Instruction manual

Version 1.0

Distributor:

Manufacturer:

Testboy GmbH
Elektrotechnische Spezialfabrik
Beim Alten Flugplatz 3
D - 49377 Vechta

Tel: 0049 (0)4441 / 89112-10
Fax: 0049 (0)4441 / 84536

www.testboy.de
info@testboy.de

CE Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) concerning safety and electromagnetic compatibility regulations

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1 General description

The multifunctional portable appliance tester TV 465 is intended to perform measurements for testing the electrical safety of portable electrical equipment.
The following tests can be performed:

- earth continuity resistance;
- insulation resistance;
- insulation resistance of isolated accessible conductive parts;
- substitute leakage current;
- substitute leakage current of isolated accessible conductive parts;
- functional and visual inspection;
- IEC cord polarity test;
- TRMS voltage meter.

Some instrument's highlights:

- graphic LCD with resolution of 128 x 64 dots, with backlight;
- large data flash memory for storing test results & parameters (approx 1500 tests can be stored);
- two communication ports (USB and RS232C) for communication with PC, barcode reader, printer and RFID reader/writer;
- built in real time clock;
- fully compatible with new PC SW TV 465 PC software package;
- In built calibration unit.

Powerful functions for fast and efficient periodic testing are included:

- pre-programmed test sequences;
- fast testing with the help of barcodes and RFID tags;
- test sequences can be uploaded from PC.

The graphic display with backlight offers easy reading of results, indications, measurement parameters and messages. Two LED Pass/Fail indicators are placed at the sides of the LCD.
The unit is very intuitive to use and has help menus describing how to perform each test. The operator therefore does not need any special training (except reading this instruction manual) to operate the instrument.

1.1 Warnings

In order to reach a high level of operator safety while carrying out various measurements using the instrument, as well as to keep the test equipment undamaged, it is necessary to consider the following general warnings:

- ⚠ **Warning on the instrument means »Read the Instruction manual with special care to safety operation«. The symbol requires an action!**
- **Read this instruction manual carefully, otherwise use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!**
- **If the test equipment is used in manner not specified in this instruction manual the protection provided by the equipment may be impaired!**
- **Do not use the instrument and accessories if any damage is noticed!**
- **Appliances MUST be fully disconnected from the mains supply before it is connected to the TV 465 in order to perform a PAT test.**
- **Do not touch any test leads/terminals while the appliance is connected to the TV 465.**
- **The Instrument should not to be used for measurements while charging.**
- **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- **Use only standard or optional test accessories, supplied by your distributor!**
- **Instrument servicing and adjustment is only allowed to be carried out by competent authorized personnel!**
- **Hazardous voltages can exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before opening the battery compartment.**
- **Instrument contains rechargeable NiCd or NiMh battery cells. The cells should only be replaced with the same type as defined on the battery placement label or in this manual. Do not use standard alkaline battery cells while power supply adapter is connected, otherwise they may explode!**
- **If a test code with an earth bond test current higher than 200 mA is selected (manually, with barcode reader or with RFID reader/writer) the TV 465 instrument will automatically perform the Earth continuity test with a 200 mA test current. Other test parameters remain unchanged. The operator must be competent to decide if performing the test with a 200 mA current is acceptable!**
- **The Substitute leakage current / Substitute leakage - P tests can be carried out as an alternative for the Leakage and Touch leakage tests if there are no mains supply dependent switches inside the equipment. The operator must be competent to decide if performing the Substitute leakage current test is applicable!**
- **If a test code with a Leakage current is selected (manually, with barcode reader or with RFID reader/writer) the TV 465 instrument will automatically perform a Substitute leakage test. Other test parameters remain unchanged. The operator must be competent to decide if performing the Substitute leakage test is acceptable!**
- **If a test code with a Touch leakage current is selected (manually, with barcode reader or with RFID reader/writer) the TV 465 instrument will automatically perform a Substitute leakage - P test. Other test parameters remain unchanged. The operator must be competent to decide if performing the Substitute leakage - P test is acceptable!**

1.2 Battery and charging

The instrument uses six AA size alkaline or rechargeable Ni-Cd or Ni-MH battery cells. Battery condition is always displayed in the upper right corner of the display.
If the battery power becomes too weak, the instrument indicates this as shown in figure 1.1. This indication appears for a few seconds and then the instrument turns itself off.

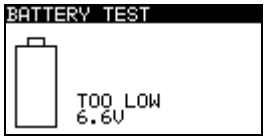


Figure 1.1: Discharged battery indication

Whenever the power supply adapter is connected, the instrument will automatically start charging the batteries. The power supply socket polarity is shown in figure 1.2. The instruments internal circuitry controls the charging and to ensure maximum battery life.

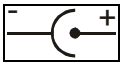


Figure 1.2: Power supply socket polarity

Symbols:

	Indication of battery charging

Figure 1.3: Charging indication on display

- ⚠ **Before opening the battery compartment cover, disconnect all accessories connected to the instrument and switch off the instrument.**
- Ensure that the battery cells are inserted correctly otherwise the instrument will not operate and the batteries could be discharged.
- If the instrument is not to be used for a long period of time, remove all batteries from the battery compartment.
- Alkaline or rechargeable Ni-Cd or Ni-MH batteries (size AA) can be used. Testboy recommends only using rechargeable batteries with a capacity of 2100mAh or higher.
- Do not recharge alkaline battery cells!
- Use only power supply adapters delivered from the manufacturer or distributor of the test equipment to avoid possible fire or electric shock! Maximum short-term voltage of external power supply adapter is 14 V!

1.3 New battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during the charging of new battery cells or cells that have been left unused for a longer period (more than 3 months). Ni-MH and Ni-Cd cells can be subjected to these chemical effects (sometimes called the memory effect). As a result the instrument operation time can be significantly reduced during the initial charging/discharging cycles of the batteries.

In this situation, Testboy recommend the following procedure to improve the battery lifetime:

Procedure	Notes
‣ Completely charge the battery.	At least 14h with the in-built charger.
‣ Completely discharge the battery.	This can be performed by using the instrument normally until the instrument is fully discharged.
‣ Repeat the charge / discharge cycle at least 2-4 times.	Four cycles are recommended in order to restore the batteries to their normal capacity.

Note:

- The charger in the instrument is a pack cell charger. This means that the battery cells are connected in series during the charging. The battery cells have to be equivalent (same charge condition, same type and age).
- One different battery cell can cause an improper charging and incorrect discharging during normal usage of the entire battery pack (it results in heating of the battery pack, significantly decreased operation time, reversed polarity of defective cell,…).
- If no improvement is achieved after several charge / discharge cycles, then each battery cell should be checked (by comparing battery voltages, testing them in a cell charger, etc). It is very likely that only some of the battery cells are deteriorated.
- The effects described above should not be confused with the normal decrease of battery capacity over time. Battery also loses some capacity when it is repeatedly charged / discharged. Actual decreasing of capacity, versus number of charging cycles, depends on battery type. This information is provided in the technical specification from battery manufacturer.

1.4 Standards applied

The TV 465 is manufactured and tested in accordance with the following regulations:

Electromagnetic compatibility (EMC)	
EN 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements Class B (Hand-held equipment used in controlled EM environments)
Safety (LVD)	
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
EN 61010-031	Safety requirements for hand-held probe assemblies for electrical measurement and test
Functionality	
EN 61557	Electrical safety in low voltage distribution systems up to 1000 V_{AC} and 1500 V_{AC} – Equipment for testing, measuring or monitoring of protective measures Part 2 Insulation resistance Part 4 Resistance of earth connection and equipotential bonding Part 10 Combined measuring equipment for testing, measuring and monitoring of protective measures
VDE 0404-1	Testing and measuring equipment for checking the electric safety of electric devices - Part 1: General requirements
VDE 0404-2	Testing and measuring equipment for checking the electric safety of electric devices - Part 2: Testing equipment for tests after repair, change or in the case of repeat tests
Other reference standards for testing portable appliances	
VDE 0701-702	Inspection after repair, modification of electrical appliances – Periodic inspection on electrical appliances General requirements for electrical safety
NEN 3140	Guidelines for safe working practices The IEE Code of Practice for In-service Inspection and Testing of Electrical Equipment 3rd edition

Note about EN and IEC standards:

- Text of this manual contains references to European standards. All standards of EN 6XXXX (e.g. EN 61010) series are equivalent to IEC standards with the same number (e.g. IEC 61010) and differ only in amended parts required by European harmonization procedure.

2 Instrument description

2.1 Front panel

Figure 2.1: Front panel

Legend:

1	LCD	128 x 64 dots matrix display with backlight.
2	FAIL	Red indicator — Indicates PASS/ FAIL of result.
3	PASS	Green indicator
4	TEST	Starts testing / confirms selected option
5	UP	Selects parameter / changes value of selected parameter.
6	DOWN	
7	MEM	Store / recall / clear tests in memory of instrument.
8	TAB	Selects the parameters/ item/ option in selected function.
9	ON / OFF	Switches the instrument power on or off. To switch the instrument Off the key must be pressed for 2 seconds. The instrument automatically turns off 15 minutes after the last key was pressed.
	ESC	Returns to previous level.
10		Mains test socket.

2.2 Connector panel

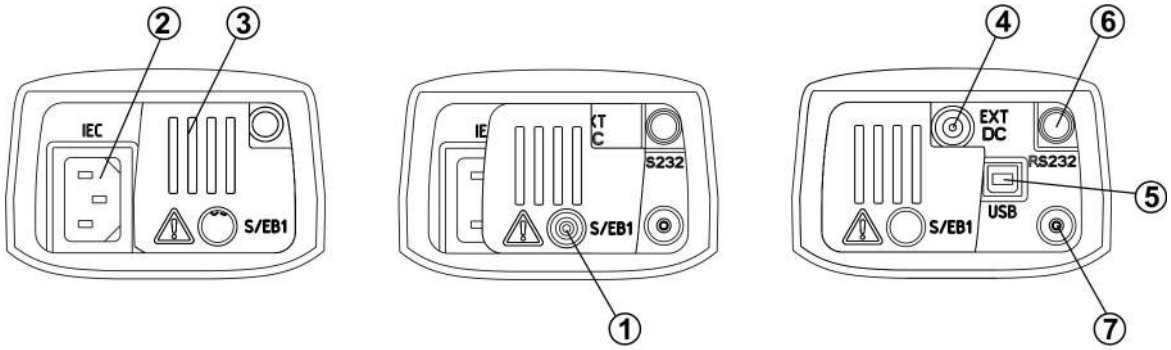


Figure 2.2: Connector panel

Legend:

1	S/EB1	Probe and Earth continuity terminal
2	IEC	IEC / Voltage input
3	Protection cover	
4	Charger socket	For connection of external charger
5	USB connector	Communication with PC USB (1.1) port
6	PS/2 connector	Communication with barcode reader Communication with printer Communication with RFID reader/writer Communication with PC RS-232 port
7	PE terminal	For checking S/EB test lead

Warnings!

- **Maximum allowed voltage between IEC test terminals is 300 V (CAT II)!**
- **Maximum short-term voltage of external power supply adapter is 14 V!**

2.3 Back side

Figure 2.3: Back side

Legend:

1	Inserts for side belt
2	Battery compartment cover
3	Fixing screw for battery compartment cover
4	Back side information label
5	Holder for inclined position of the instrument

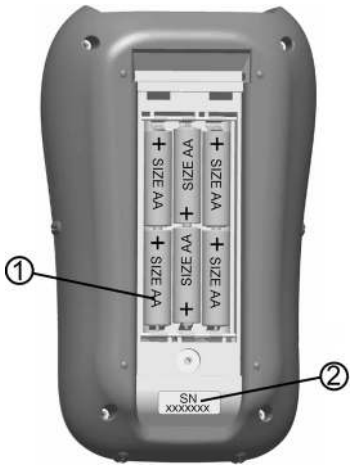


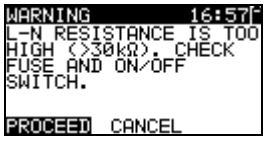
Figure 2.4: Battery compartment

Legend:

1	Battery cells	Size AA, alkaline or rechargeable NiMH / NiCd
2	Serial number label	

2.4 Meaning of symbols and messages on the instrument display

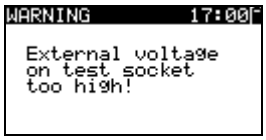
Before performing a measurement, the instrument performs a series of pre-tests to ensure safety and to prevent any damage. These safety pre-tests are checking for any external voltage and load condition on test terminals. If a pre-test fails, an appropriate warning message will be displayed. Warnings and protective measures are described in this chapter.



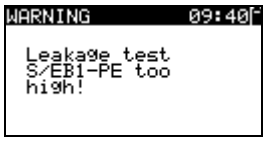
WARNING!
An excessively high resistance was measured in the fuse pre-test. This indication means that the device under test has extremely low power consumption or it is:

- not connected;
- switched off;
- contains a fuse that has blown.

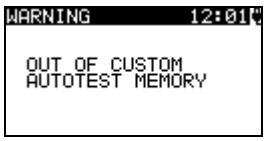
Select **PROCEED** or **CANCEL**.



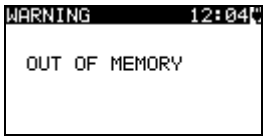
WARNING!
Voltage on mains test socket between LN - PE terminals is higher than approximately 20 V (AC or DC)!
Disconnect the device under test from the instrument immediately and determine why an external voltage was detected!



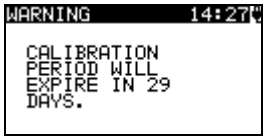
WARNING!
Current on test probe (S/EB1 - PE) is higher than approximately 10mA (AC or DC)!
Disconnect the test probe from the device under test and determine why an external current was detected!



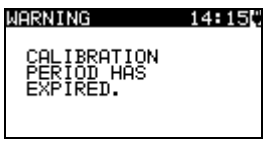
WARNING!
The custom autotest memory has reached the limit of 50 sequences.



WARNING!
The internal memory is full!



WARNING!
The calibration period will expire in less than 1month. The instrument counts down the days.



WARNING!
The calibration period has expired. Recalibrate the instrument!

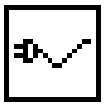
WARNING!
A high insulation test voltage will be present on the output of the instrument!

WARNING!
A high insulation test voltage is present on the output of the instrument.

Measurement in progress.

Test result can be saved.

Connect the test lead to the S/EB1 test socket.



Flex the mains cable of appliance during the test.

Check that the device under test is switched on (to ensure that the complete circuit is tested).

Connect the cord to be tested to the IEC test terminal.

Test passed.

Test failed.

2.4.1 Battery indication

The indication indicates the charge condition of battery and connection of external charger.

Battery capacity indication.

Low battery.
Battery is too weak to guarantee correct result.
Replace or recharge the battery cells.

Recharging in progress (if external charger is connected).

3 Technical specifications

3.1 Earth continuity

Range	Resolution	Accuracy
0.00 Ω ÷ 19.99 Ω	0.01 Ω	±(5 % of reading + 3 digits)
20.0 Ω ÷ 199.9 Ω	0.1 Ω	Indication only
200 Ω ÷ 1999 Ω	1 Ω	

Test currents ..... 200 mA into 2.00 Ω
Open circuit voltage ..... <9 V AC
Pass levels ..... 0.10 Ω, 0.20 Ω, 0.30 Ω, 0.40 Ω, 0.50 Ω, 0.60 Ω, 0.70Ω, 0.80 Ω, 0.90 Ω, 1.00 Ω, 1.50 Ω, 2.00 Ω
Test duration ..... 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s
Test method ..... 2-wire measurement

Test terminals:

Earth continuity	PE (mains test socket) ↔ S/EB1 (probe)

3.2 Insulation resistance

Range	Resolution	Accuracy
0.00 MΩ ÷ 19.99 MΩ	0.01 MΩ	±(5 % of reading + 3 digits)
20.0 MΩ ÷ 49.9 MΩ	0.1 MΩ	
50.0 MΩ ÷ 199.9 MΩ	0.1 MΩ	Indication only

Nominal voltages ..... 250 V DC, 500 V DC (- 0 %, + 10 %)
Measuring current ..... min. 1 mA at 250 kΩ (250 V), 500 kΩ (500 V)
Short circuit current ..... max. 2.0 mA
Pass levels ..... 0.01 MΩ, 0.10 MΩ, 0.25 MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ,
Test duration ..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s

Test terminals:

Insulation	LN (mains test socket) ↔ PE (mains test socket)
Insulation-P	LN (mains test socket) ↔ S/EB1 (probe)

3.3 Substitute leakage current

Range	Resolution	Accuracy
0.00 mA ÷ 9.99 mA	0.01 mA	±(5 % of reading + 3 digits)
10.0 mA ÷ 20.0 mA	0.1 mA	

Open circuit voltage ..... <50 V AC at rated mains voltage
Short circuit current..... <2,5 mA
Pass levels:
Substitute leakage ..... 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2,25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA,9.00 mA, 10.0 mA, 15.0 mA, ---- mA
Substitute leakage - P..... 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2,00 mA, --- mA
Test duration..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, ∞
Displayed current..... calculated to appliance nominal mains supply voltage (230 V) x 1.06.

Test terminals:

Sub. leakage	LN (mains test socket) ↔ PE (mains test socket)
Sub. leakage-P	LN (mains test socket) ↔ S/EB1 (probe)

3.4 Polarity test

Test voltage ..... <50 V AC
Detects..... PASS, L OPEN, N OPEN, PE OPEN, L-N CROSS, MULTIPLE FAULT.

Test terminals:

Polarity	Main test socket ↔ IEC test socket

3.5 Voltage measurement

Range	Resolution	Accuracy
0 ÷ 300 V	1 V	±(2 % of reading + 2 digits)

Result type..... True r.m.s. (trms)
Nominal frequency range..... 0 Hz, 50 Hz ÷ 60 Hz
Frequency accuracy ..... Indication only

Test terminals:

Voltage TRMS	IEC test socket

3.6 Checkbox specification

Instrument

Function	Reference value	Accuracy
Earth continuity	0.50 Ω	+/- 1 % of value
Earth continuity	2.00 Ω	+/- 1 % of value
Substitute leakage current	5.90 mA	+/- 1 % of value
Substitute leakage current	0.50 mA	+/- 1 % of value
Insulation resistance	1.20 MΩ	+/- 1 % of value
Insulation resistance	10.00 MΩ	+/- 1 % of value

S/EB test lead

Function	Reference value	Accuracy
Earth continuity	0.00 Ω	+/- 0.05 Ω

IEC test cord

Function	Reference value	Accuracy
Earth continuity	0.00 Ω	+/- 0.05 Ω
Polarity	PASS	n.a.

3.7 General data

Power supply voltage..... 9 V_{DC} (6×1.5 V battery or accu, size AA)
Operation..... typical 8 h
Charger socket input voltage ..... 12 V ± 10 %
Charger socket input current..... 400 mA max.
Battery charging current..... 250 mA (internally regulated)

Overvoltage category..... 300 V CAT II

Protection classification ..... double insulation
Pollution degree..... 2
Protection degree case..... IP 40
Protection degree test connectors .... IP 20

Display..... 128 x 64 dots matrix display with backlight

Dimensions (w × h × d) ..... 14 cm × 8 cm × 23 cm
Weight ..... 0.86 kg, without battery cells

Reference conditions
Reference temperature range..... 10 °C ÷ 30 °C
Reference humidity range..... 40 %RH ÷ 70 %RH

Operation conditions
Working temperature range ..... 0 °C ÷ 40 °C
Maximum relative humidity ..... 95 %RH (0 °C ÷ 40 °C), non-condensing

Storage conditions
Temperature range ..... -10 °C ÷ +70 °C
Maximum relative humidity ..... 90 %RH (-10 °C ÷ +40 °C)
80 %RH (40 °C ÷ 60 °C)

Memory.....1500 memory locations
The error in operating conditions could be at most the error for reference conditions (specified in the manual for each function) +1 % of measured value + 1 digit, unless otherwise specified in the manual for particular function.

Communication transfer speed
RS232 interface ..... 9600 bps, 1 start bit, 8 data bits, 1 stop bit
RS232 connector ..... PS/2 connector, female
USB interface..... 115200 bps
USB connector..... type B

Protection pre-tests
- External voltage between LN and PE (DC and AC).
- Excessive leakage between S/EB1 and PE (DC and AC).

Connectivity (fuse) pre-test
- Appliance not switched on or too high resistance between L and N

Maximum resistance for connectivity pre-test ..... 30 kΩ

4 Main menu and test modes

4.1 Instrument Main menu

From the Main menu of the instrument there are five instrument operation modes, Help and Setup that can be selected:

Figure 4.1: Instrument Main menu

Keys:

⮝ / ⮟ **TAB**	Select one of the following menu items: <**VDE ORGANIZER**> pre-programmed test sequences according to the VDE 0701-0702 norm, see *chapter 6.1 VDE organizer setup menu* ; <**SINGLE TEST**> individual tests, see *chapter 5 Single test*; <**CUSTOM AUTOTEST**> user defined pre-programmed sequences, see *chapter 6.2 Custom autotest* ; <**SIMPLE TEST**> simple pre-programmed sequences, see *chapter 6.3 Simple test* <**CODE AUTOTEST**> code-based test sequences, suitable for working with barcodes and RFID tags, see *chapter 6.4 Code autotest*; <**HELP**> help screens; <**SETUP**> menu for setup of the instrument/ help screens, see *chapter 4.7 Setup menu*;
TEST	Confirms selection.

4.2 VDE Organizer menu

This menu offers creation and performing of VDE compatible test sequences. The sequence setup and its parameters are the same as suggested in the VDE 0701-0702 standard. After an autotest sequence has been created in the VDE organizer, it can be run as an autotest or stored in the Custom autotest menu.

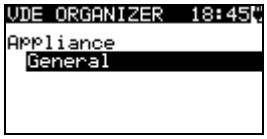


Figure 4.2: VDE organizer menu

See chapter *6.1 VDE organizer setup menu* for more information.

4.3 Single test menu

In single test menu individual tests can be performed.

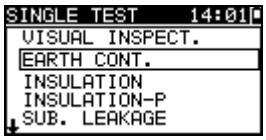


Figure 4.3: Single test Main menu

See chapter *5 Single test* for more information.

4.4 Custom Autotest menu

This menu contains a list of custom prepared autosequences. The commonly used autotest sequences are added to the list by default. Up to 50 custom autotest sequences can be pre-programmed in this autotest mode. Custom autotest can also be downloaded to and/or uploaded from the PC SW TV 465.

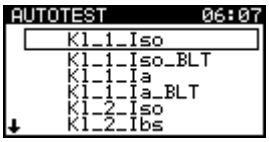


Figure 4.4: Custom Autotest menu

See chapter *6.2 Custom autotest* for detailed description about this test mode.

4.5 Simple test menu

This menu contains a list of simple test sequences.

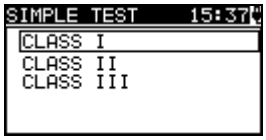


Figure 4.5: Simple test menu

See chapter *6.3 Simple test* for detailed description about this test mode.

4.6 Code Autotests menu

Code Autotests menu supports operation with predefined test codes, barcodes and RFID tags. Test codes can be selected with the barcode reader, RFID reader/writer or with the ▲ / ▼ keys.

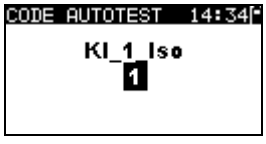


Figure 4.6: Code Autotest menu

See chapter *6.4 Code Autotest* for more information.

4.7 Help menu

Help menu contain schematic diagrams to illustrate how to correctly connect a device under test to the PAT testing instrument.

Figure 4.7: Example of help screens

Keys:

⮝/⮟	Selects next / previous help screen.
TEST, ESC	Returns to ***Main menu*.**

4.8 Setup menu

In the Setup menu different parameters and settings of the instrument can be viewed or set.

Figure 4.8: Setup menu

Keys:

⮝ / ⮟	Select the setting to adjust or view: <**MEMORY**> to recall, print or clear stored results, print labels and write RFID tags; <**LANGUAGE**> instrument language; <**LCD**> LCD contrast and backlight settings; <**CHECKBOX**> to access the internal calibration function; <**TEST SPEED SETUP**> to select the speed of the test; <**DATE/TIME**> date and time; <**USER DATA**> user data settings (initials); <**INSTRUMENT DATA**> basic instrument information; <**INIT. SETTINGS**> factory settings.
TEST	Confirms selection.
ESC	Returns to the ***Main menu***.

4.8.1 Memory

Stored results can be recalled, printed or deleted. Labels can be printed and RFID tags can be written in this menu.

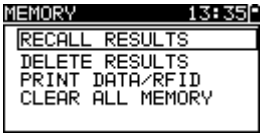


Figure 4.9: Memory menu

See chapter *7 Working with autotest results* for more information.

4.8.2 Language selection

The instrument language can be set in this menu.

Figure 4.10: Language menu

Keys:

⮝ / ⮟	Selects the language.
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.

4.8.3 LCD contrast and backlight

In this menu the contrast and backlight mode of the LCD can be set.

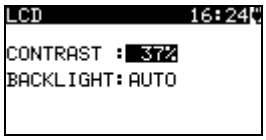


Figure 4.11: LCD menu

Backlight modes:

AUTO	The high backlight level is active for 30 seconds after last pressing of any key. Then the backlight level returns to low level until a key is pressed again.
OFF	Backlight level is low.
ON	Backlight level is high.

Keys:

TAB	Toggles between setup of contrast and backlight
⮝ / ⮟	Sets contrast value or backlight mode
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.

Note:

- If you press the down (⮟) key while starting up the instrument you will automatically jump to the LCD contrast menu.

4.8.4 Checkbox

The in-built Checkbox provides a simple and effective means of checking the calibration of the TV 465 instrument and accessories. According to the Code of Practice the on-going accuracy of the PAT tester should be verified at regular intervals and recorded. This is of special importance if the PAT tester is used on a daily basis. The TV 465 includes an in-built Calibration Unit ('Checkbox') that is independent from the other instrument's electronic circuitry and connected directly to the output terminals of the instrument. During the calibration with the in-built Checkbox all main instrument functions and accessories can be verified. The calibration results are automatically stored into the instrument's memory and can be viewed with the PC SW TV 465 software.

Note:

- The Checkbox feature should be used to ensure that the meter is reading correctly between calibrations but should not be regarded as a substitute for a full manufacturers calibration on the unit.

The Checkbox starting screen is displayed first. In the REF column the Checkbox reference values are displayed.

Figure 4.12: Checkbox starting screen

Keys:

TEST	Starts instrument calibration procedure.
⮝ /⮟	Switches between Checkbox screens.
ESC	Returns to ***Setup menu*** without changes.

Carrying out the instrument calibration

The Checkbox instrument calibration starting screen is displayed first. Before conducting calibration, disconnect all accessories connected to the instrument.

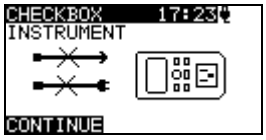


Figure 4.13: Instrument calibration starting screen

Keys:

TEST	Starts instrument calibration procedure.
ESC	Skips calibration procedure.

Checking the S/EB test lead

The connection for checking the S/EB test lead is displayed. Before conducting the check, connect the S/EB test lead.

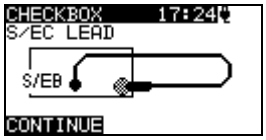


Figure 4.14: S/EB test lead check starting screen

Keys:

TEST	Starts test lead checking procedure.
ESC	Skips further tests.

Checking the IEC test cord

The connection for checking the IEC test cord is displayed. Before conducting the check, connect the IEC test cord.

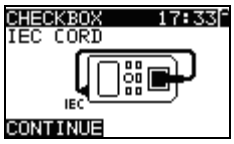


Figure 4.15: IEC test cord check starting screen

Keys:

TEST	Starts IEC test cord checking procedure.
ESC	Skips IEC test cord check.

After all steps were carried out the measured values together with an overall indication are displayed in the CAL column.

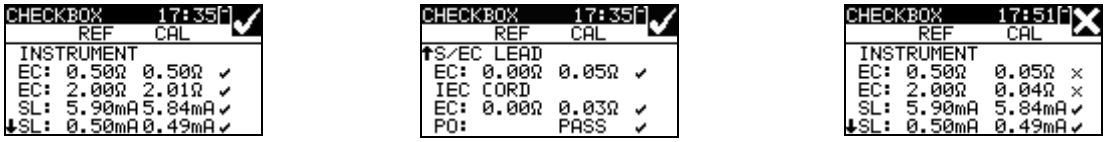


Figure 4.16: Examples of Checkbox result screens

Meaning of indications:

✓	Accuracy of result is inside the given accuracy limits.
*	Accuracy of result is close to the specified accuracy limits. **Warning:** The accuracy of the instrument could lie slightly out of specified limits!
×	**Warning:** The accuracy of the instrument lies out of specified limits!

Keys:

▲ /▼	Displays all calibration results.
TEST	Starts new calibration procedure.
ESC	Returns to ***Setup menu.***

4.8.5 Test speed setup

In this menu the instrument test speed can be set:

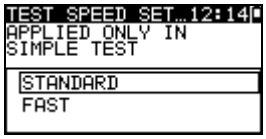


Figure 4.17: Test speed menu

Options:

STANDARD Tests with pauses.
FAST No pauses during tests (default).

Keys:

⮝ / ⮟	Selects the list.
TEST	Confirms selection and returns to ***Setup menu.***
ESC	Returns to ***Setup menu*** without changes.

Note:

- When enabling the fast mode then Visual Inspection and Functional Test will automatically be set to PASS.

4.8.6 Setting date and time

Date and time can be set in this menu.

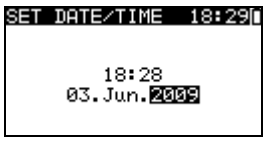


Figure 4.18: Date and time menu

Keys:

TAB	Selects the field to be changed.
⮝ / ⮟	Modifies selected field.
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.

Note:

- Date is attached to each stored autotest result and ‘Checkbox’ calibration.

Warning:

- If the batteries are removed for more than 1 minute the set time and date will be lost.

4.8.7 User data

User data can be set in this menu.

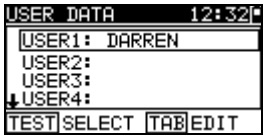


Figure 4.19: User data menu

Keys:

▲ / ▼	Selects the user name.
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.
TAB	Enters ***Edit user data menu***.

Edit user data:

Figure 4.20: Edit user data menu

Keys:

▲ / ▼	Selects a letter.
TEST	Selects the next letter.
MEM	Confirms name and returns to ***User data menu***.
ESC	Deletes last letter. Returns to ***User data menu*** without changes.

Notes:

- The selected user will be printed on the simple label (initials).
- Five different user names can be set.

4.8.8 Instrument data

In this menu the following instrument data is shown:

- producer name;
- instrument type;
- model number;
- calibration date;
- serial number;
- firmware and hardware version.

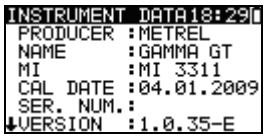


Figure 4.21: Instrument data menu

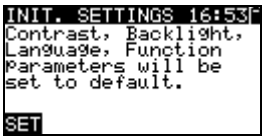
Keys:

⮝ / ⮟	Switches between Instrument data screens.
TEST, ESC	Returns to ***Setup menu*.**

4.8.9 Initial settings

In this menu the following instrument parameters can be set to their initial values:

- all measurement parameters in single test mode;
- LCD settings;
- test speed setting;
- language;
- user data;
- appliances names;
- custom autotest sequences are replaced by factory pre-programmed ones.



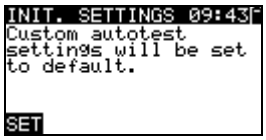


Figure 4.22: Initial settings menu

Keys:

TEST	Confirms selection and returns to ***Main menu*.**
ESC	Returns to ***Setup menu*** without changes.

5 Single test

In a Single test mode individual tests can be performed. This is especially helpful for troubleshooting.

5.1 Performing measurements in single test mode

Select appropriate Single test in Single test Main menu.

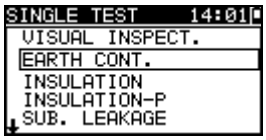


Figure 5.1: Single test Main menu

Keys:

▲ / ▼	Selects a single test.
TEST	Enters ***Single test Measuring menu.***
ESC	Returns to ***Main menu.***

A single test can be started from any Single test measuring menu. Before carrying out a test the parameters / limits can be edited.

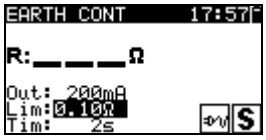


Figure 5.2: Example of single test measuring menu

Keys:

TAB	Selects a parameter.
▲ / ▼	Changes a parameter / limit.
TEST	Starts a single test.
ESC	Returns to ***Single test Main menu.***

Note:

- Last set parameters will be stored automatically.

Single measurements are stored in the same way as autotest results. See chapter *7.1 Saving autotest results* for more information.

5.2 Measurements and inspections

5.2.1 Visual inspection

A thorough visual check must be carried out before each electrical safety test.
The following items should be checked:

- Inspection of device under test for sign of damage.
- Inspection of the flexible power supply cable for damage.
- Any signs of pollution, moisture, dirt that can jeopardize safety. Especially openings, air filters, protection covers and barriers must be checked!
- Are there signs of corrosion?
- Are there signs of overheating?
- Inscriptions and markings related to safety must be clearly readable.
- Installation of the device under test must be performed according to the instruction manual.
- During visual inspection the measuring points for the electrical testing have to be determined too.

Visual inspection procedure

- Select the VISUAL INSPECT. function.
- Check the device under test.
- Select PASS or FAIL according to the result of visual inspection.
- Store the result by pressing MEM key (optional).

Figure 5.3: Visual inspection menu

5.2.2 Earth continuity resistance

This test ensures that the connections between the protective conductor terminal in the mains plug of the device under test and earthed accessible conductive parts of the device under test are satisfactory and of sufficiently low resistance. This test has to be performed on Class I (earthed) appliances. The instrument measures the resistance between:

- Mains test socket's PE terminal and the S/EB1 terminal.

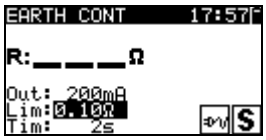


Figure 5.4: Earth continuity menu

Test parameters for Earth continuity resistance measurement

LIMIT	**Maximum resistance** [0.10 Ω, 0.20 Ω, 0.30 Ω, 0.40 Ω, 0.50 Ω, 0.60 Ω, 0.70 Ω, 0.80 Ω, 0.90 Ω, 1.00 Ω, 1.50 Ω, 2.00 Ω]
TIME	**Measuring time** [2 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

Test circuits for earth continuity resistance measurement

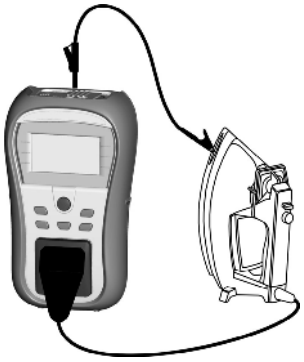


Figure 5.5: Measurement of Earth continuity resistance

Earth continuity resistance measurement procedure

- Select the EARTH CONT. function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.5).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.6: Examples of Earth continuity resistance measurement results

Displayed results:
Main result ..... Earth continuity resistance

Note:

- Consider displayed warnings before starting measurement!

5.2.3 Insulation resistance

The insulation resistance test checks the resistance between live conductors and earthed (or isolated) accessible metal parts of a device under test. This test can disclose faults caused by pollution, moisture, deterioration of the insulation material etc.
The instrument measures the insulation resistance between:

- The mains test socket (L+N) and PE / (S/EB1) terminals.

This function is primarily intended for testing Class I appliances.

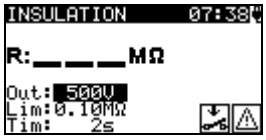


Figure 5.7: Insulation menu

Test parameters for insulation resistance measurement

OUTPUT	**Test voltage** [250 V, 500 V]
LIMIT	**Minimum resistance** [0.01 MΩ, 0.10 MΩ, 0.25 MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

Test circuits for Insulation resistance measurement

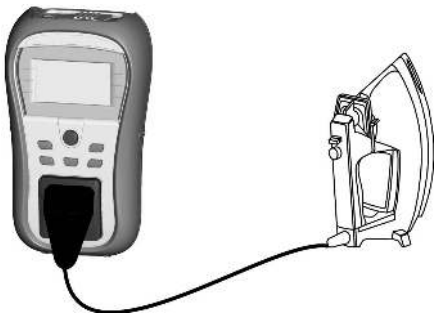


Figure 5.8: Measurement of insulation resistance

Insulation resistance measurement procedure

- Select the INSULATION function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.8).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.9: Examples of Insulation resistance measurement results

Displayed results:
Main result ..... Insulation resistance

Notes:

- When S/EB1 probe is connected during the test then the current through it is also considered.
- Consider any warning on the display before starting the measurement!
- Do not touch or disconnect the device under test during the measurement or before it is fully discharged! The message »Udisch …« will be displayed while the voltage on the device is higher than 20 V!

5.2.4 Insulation resistance - P

The insulation resistance test checks the resistance between live conductors and isolated accessible metal parts of the device under test. This test can disclose faults caused by pollution, moisture, deterioration of the insulation material etc.
The instrument measures the insulation resistance between:

- Main test socket (L+N) and S/EB1 test terminal

This function is primarily intended for testing Class II appliances and Class II parts of Class I appliance.

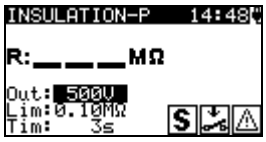


Figure 5.10: Insulation resistance - P menu

Test parameters for Insulation resistance - P measurement

OUTPUT	**Test voltage** [250 V, 500 V]
LIMIT	**Minimum resistance** [0.01 MΩ, 0.10 MΩ, 0,25MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

Test circuits for Insulation resistance - P measurement

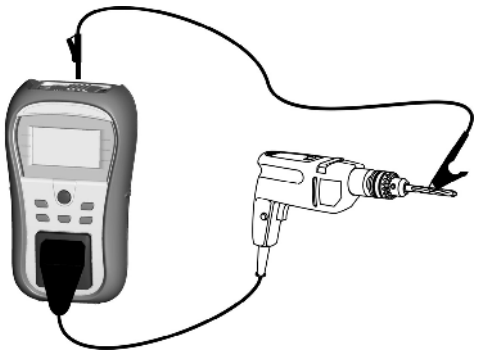


Figure 5.11: Measurement of Insulation resistance - P

Insulation resistance - P measurement procedure

- Select the INSULATION-P function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.11).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.12: Example of insulation resistance - P measurement results

Displayed results:
Main result ..... Insulation resistance (LN – P)

Notes:

- The currents flowing through the PE terminal of the mains test socket will NOT be considered.
- Consider any warning on the display before starting the measurement!
- Do not touch / disconnect the device under test during the measurement or before it is fully discharged! The message »Disch…« will be displayed while the voltage on the device is higher than 20 V!

5.2.5 Substitute leakage

Leakage currents between live conductors and accessible metal parts (housing, screws, handles etc.) are checked with this test. Capacitive leakage paths are included in the result too. The test measures the current flowing at a test voltage of 30 VAC and the result is scaled to the value of a nominal mains supply voltage.
The instrument measures the insulation resistance between:

- Main test socket (L+N) and PE / (S/EB1) test terminals

This function is primarily intended for testing Class I appliances.

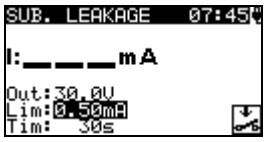


Figure 5.13: Substitute leakage menu

Test parameters for Substitute leakage current measurement

OUTPUT	Test voltage [30 V]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10 mA, 15 mA, --- mA]
TIME	**Measuring time** [2s, 3s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

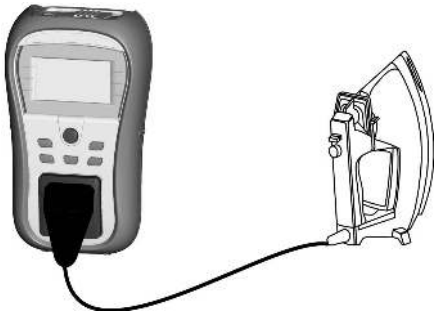


Figure 5.14: Measurement of Substitute leakage current

Substitute leakage measurement procedure

- Select the SUB. LEAKAGE function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.14).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.15: Example of substitute leakage current measurement results

Displayed results:
Main result ..... Substitute leakage current

Notes:

- Consider any displayed warning before starting measurement!
- When S/EB1 probe is connected during the test then the current through it is also considered.
- Substitute leakage current may differ substantially from that of leakage current test because of the way the test is performed. For example, the difference in both leakage measurements will be affected by the presence of filter capacitors between neutral and earth.

5.2.6 Substitute leakage - P

Leakage currents between live conductors and isolated accessible metal parts (screws, handles etc.) are checked with this test. Capacitive leakage paths are included in the result too. The test measures the current flowing at a test voltage of 30 V AC and the result is scaled to the value of a nominal mains supply voltage.
The instrument measures the insulation resistance between:

- Main test socket (L+N) and S/EB1 test terminals

This function is primarily intended for testing Class II appliances and Class II parts of Class I appliances.

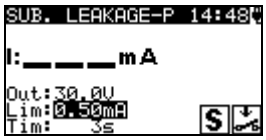


Figure 5.16: Substitute leakage - P menu

Test parameters for substitute leakage - P current measurement

OUTPUT	Test voltage [30 V]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, --- mA]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

Test circuits for substitute leakage - P measurement

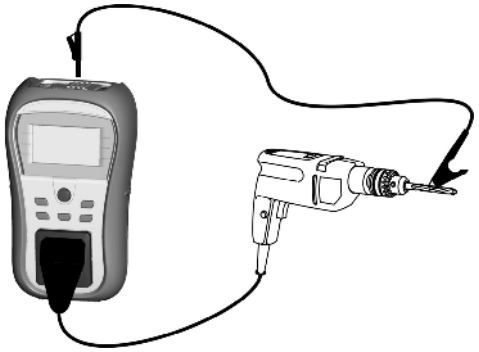


Figure 5.17: Measurement of Substitute leakage - P current

Substitute leakage - P measurement procedure

- Select the SUB. LEAKAGE-P function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.17).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.18: Example of substitute leakage - P current measurement results

Displayed results:
Main result……..Substitute leakage current LN – P

Notes:

- Consider any displayed warning before starting measurement!
- The currents flowing through the PE terminal of the mains test socket will not be considered.

5.2.7 Polarity test

This test checks the polarity of supply cords. The following faults can be detected: L OPEN, N OPEN, PE OPEN, L-N CROSS and MULTIPLE FAULT.

Figure 5.19: Polarity test menu

Test circuit for polarity test

Figure 5.20: Polarity test of IEC cord

Polarity test procedure

- Select the POLARITY function.
- Connect the IEC cord to the instrument as shown on figure 5.20.
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).

Figure 5.21: Examples of polarity test result

Displayed results:
Main result ..... PASS/FAIL, description of fault

Note:

- Consider any displayed warnings before starting test!

5.2.8 Functional test

In its simplest form a functional test is a check to ensure that the appliance is working properly.

Note:

- This test should only be performed once the appliance has passed all other tests applicable to the device under test.

Scope of test

Check following items while the appliance is operating:

- RCDs and other disconnection devices.
- How hot the appliance becomes during operation.
- Rotating parts, fans, etc.
- Power consumption.
- Lamps and indicators.
- Etc.

Especially safety relevant functions should be checked.

Functional test procedure

- Select the FUNCTIONAL TEST function.
- Plug the device under test into the mains supply. Switch on the appliance and check that it operates correctly.
- Select PASS or FAIL according to the result of functional test.
- Store the result by pressing MEM key (optional).

Figure 5.22: Functional test menu

5.2.9 Voltage TRMS

It is a simple function that continuously measures the voltage across the IEC cord connector.

Test circuit for voltage measurement

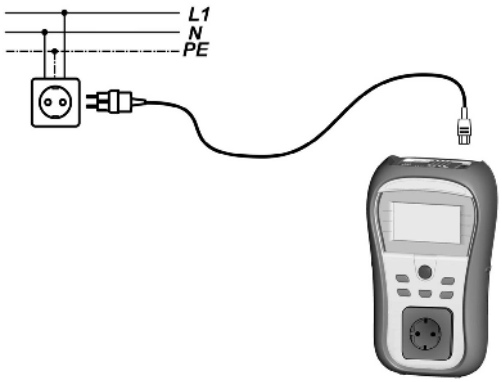


Figure 5.23: IEC cord voltage measurement

Voltage TRMS procedure

- Select the VOLTAGE TRMS function.
- Connect the IEC cable to the instrument and into the normal mains supply as shown on figure 5.23.
- Store the result by pressing MEM key (optional).

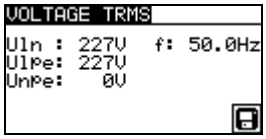


Figure 5.24: Voltage TRMS test result

Note:

- One of the safety features incorporated into the TV 465 is that the voltage measurement will start automatically from any mode when a voltage higher than approximately 50 V (AC or DC) is applied to the IEC connector! If the voltage test has not been preselected then the voltage cannot be stored, but all measurements were prohibited until the voltage is removed.

6 Autotest sequences

Autotest is the fastest and easiest way to test appliances. During the autotest pre-programmed measurements run automatically in a sequential order. The complete autotest results can be stored together with the associated appliance ID and appliance NAME.

Note:

- The TV 465 instrument does not include all test functions and parameters covered in the Autotest codes. If such a Autotest code is set the instrument automatically perform alternative tests :
  - a 200 mA Earth continuity test if a test current of more than 200 mA is set.
  - a Substitute leakage and Insulation resistance test if Leakage test is selected.
  - a Substitute leakage - P and Insulation resistance - P test if Touch leakage test is selected.

  The operator must decide by itself if the alternative tests are applicable. Refer to chapter *1.1 Warnings* for more information.

6.1 VDE organizer setup menu

Select VDE Organizer in Main menu.
In first step the appliance type, means of protection and additional protection are to be set.

Appliance types are:

- General
- Cords and cables without electronic parts
- Appliances with heating elements

Means of protection are:

- Accessible conductive part is connected to protective conductor (principle Class I),
- Accessible conductive part is protected by isolation (principle Class II) or SELV/ PELV measures
- Combined Class I and Class II/ SELV/ PELV measures
- There are no accessible conductive parts
- Device is a Class III device

Figure 6.1: Selection of type and means of protection

Keys:

⮝ / ⮟	Selects Organizer option. Selected option is highlighted.
ESC	Cancels VDE sequence and returns to Main menu.
TEST	Confirms selection and proceeds to next step.

After the appliance type and means of protection are set the appropriate test sequence can be started.

6.1.1 Carrying out a test sequence set with VDE Organizer

General meaning of keys during a VDE Organizer autotest sequence:

▲/ ▼	Sets Organizer option or set value in selected (highlighted) item.
ESC	Cancels VDE sequence and returns to Main menu.
TEST	Starts / repeats selected measurement or proceeds to next step.

After the test sequence is finished the instrument proceeds to the 'Autotest Result' menu. For more information refer to chapter *7 Working with Autotest results.*

Note:

- If any of the inspections are marked as failed or if any test fails the test sequence is stopped and the instrument automatically goes to the Result menu.

Visual inspection

Measurement is described in chapter *5.2.1 Visual inspection.*

Figure 6.2: VDE Organizer – Visual inspection menu

Options in Visual test:

PASS / FAIL	To be applied manually.

Earth continuity resistance measurement

The test is offered if it is applicable according to the VDE Organizer setting.
The measurement is described in chapter *5.2.2 Earth continuity resistance*.

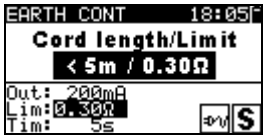


Figure 6.3: VDE Organizer – Earth continuity starting screen

Options in Earth continuity starting screen:

▲/ ▼	Sets power cord length.

Note:

- Earth continuity resistance limit is automatically set on base of set cord length.

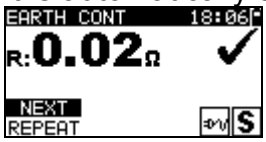


Figure 6.4: VDE Organizer – Earth continuity result screen

Options in Earth continuity result screen:

NEXT	Proceeds to next step.
REPEAT	Repeats the test (in case of multiple earthed points). Highest result will be stored.

Insulation resistance measurement

This test is offered if it is applicable according to the VDE Organizer setting.
The measurement is described in chapter *5.2.3 Insulation resistance*.

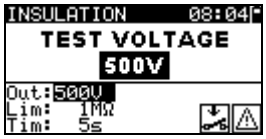


Figure 6.5: VDE Organizer – Insulation resistance starting screen

Options in insulation resistance starting screen:

500 V	Standard test voltage
250 V	To be set if overvoltage protection devices are installed or SELV/ PELV protection measures.

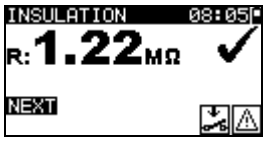
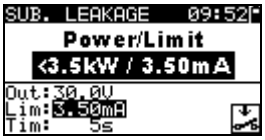


Figure 6.6: VDE Organizer – Insulation resistance result screen

There are no special options to be set in the insulation resistance result screen.

Substitute leakage measurement

This test is offered if it is applicable according to the VDE Organizer setting.
The measurement is described in chapter *5.2.5 Substitute leakage*.



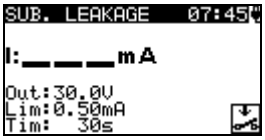


Figure 6.7: VDE Organizer – Substitute leakage starting screens

Options if **Appliances with heating elements** is set:

⮝/ ⮟	Sets power of heating elements.

Note:

- The leakage current limit is automatically set on base of set appliance power.

There are no special options to be set if other Appliance type is set.

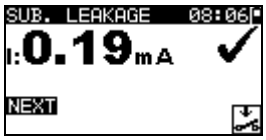


Figure 6.8: VDE Organizer – Substitute leakage result screen

There are no special options to be set in the Substitute leakage result screen.

Insulation resistance - P measurement

This test is offered if it is applicable according to the VDE Organizer setting.
The measurement is described in chapter *5.2.4 Insulation resistance - P*.

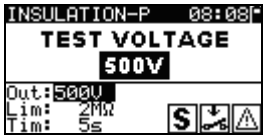


Figure 6.9: VDE Organizer autotest – Insulation resistance - P starting screen

Options in Insulation resistance - P starting screen:

500 V Standard test voltage

250 V To be set if overvoltage protection devices are installed or SELV/ PELV protection measures.

Figure 6.10: VDE Organizer – Insulation resistance - P result screen

Options in Insulation resistance - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated/SELV/PELV accessible points). Lowest result will be stored.

Substitute Leakage - P current measurement

This test is offered out if it is applicable according to the VDE Organizer setting.
The measurement is described in chapter *5.2.6 Substitute leakage - P.*

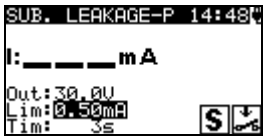


Figure 6.11: VDE Organizer – Substitute leakage - P starting screen

There are no special options in the Substitute leakage - P starting screen.

Figure 6.12: VDE Organizer – Substitute leakage - P result screen

Options in Substitute leakage - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated/SELV/PELV accessible points). Highest result will be stored.

Functional test

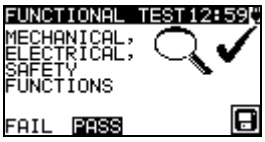


Figure 6.13: VDE Organizer – Functional result screens

Options in Functional test result screen:
PASS / FAIL To be applied manually.

Option if **IEC leads, multiple outlets without electronic parts** is set:
POLARITY Starts Polarity test.

6.2 Custom autotest

In the autotest custom menu user-defined autotest procedures can be performed via the PC SW TV 465. Up to 50 custom autotest sequences can be pre-programmed in this autotest mode.
Commonly used pre-programmed autotest sequences are added to the list by default.
The custom sequences can be also uploaded from the PC software PC SW TV 465. Refer to chapter *8 Communication* for more information.
New custom sequences can be also uploaded from the VDE Organizer. Refer to chapter *7 Working with autotest results f*or more information.
The pre-programmed sequences can be restored to default settings by selecting *Initial settings* in *Setup menu*.
Select Custom Autotest function in Main menu.

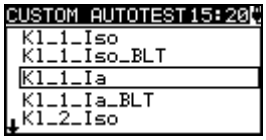


Figure 6.14: Custom autotest menu

Keys:

⮟ / ⮝	Selects the custom autotest.
START	Starts the selected custom autotest. See chapter *6.5 Carrying out (Code, Simple and Custom) autotest sequences*.
ESC	Returns to Main menu.

Note:

- If more than 50 autotests are saved, »Out of custom autotest memory« message is displayed.

6.3 Simple test

Simple test sequences are commonly used pre-programed autotest sequences with possibility of fast testing. Fast testing mode can be enabled in Test speed setup function in Setup menu. Refer to chapter *4.8.5 Test speed setup* for more information.

Select Simple test function in Main menu.

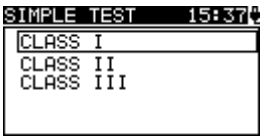


Figure 6.15: Simple test menu

Keys:

⮟ / ⮝	Selects the test sequence from the list
START	Starts the selected test. See chapter *6.5 Carrying out (Code, Simple and Custom) autotest sequences*.
ESC	Returns to Main menu.

Note:

- Limits of the CLASS I, II and III tests are shown in *Appendix D*

6.4 Code Autotest

Code Autotest menu supports operation with pre-defined test codes, barcodes and RFID tags.
The instrument supports the following functions:

- manual selection of pre-defined autotest shortcut codes;
- reading pre-defined autotest shortcut codes from barcode labels;
- reading pre-defined autotest shortcut codes from RFID tags;
- reading appliance ID numbers from barcode labels;
- reading appliance ID numbers from RFID tags;
- reading pre-defined autotest shortcut codes and appliance ID numbers from barcode labels (double barcode format);
- programming empty RFID tags.

Refer to Appendix A Barcode formats for more information regarding barcode labels.

Reading a Code autotest sequence (with barcode reader, RFID reader/writer or manually)
Connect barcode reader or RFID reader/writer to the instrument RS232 / PS2 connector first.

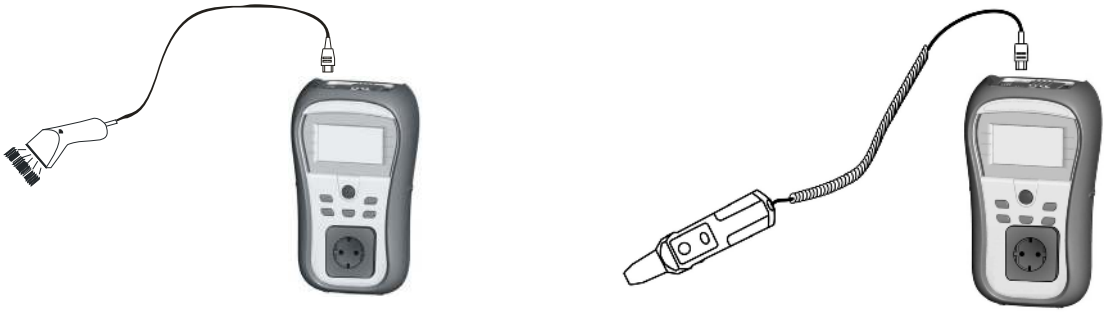


Figure 6.16: Connection of the barcode reader and RFID reader/writer

Select Code Autotest in Main menu. The latest received or set autotest sequence name and its code is displayed. A new autotest sequence (received from the barcode reader or RFID reader/writer) will be accepted by the instrument (refer to Appendix for available autotest sequences and its codes). A successful receive of the barcode or RFID tag is confirmed by two short confirmation beeps.

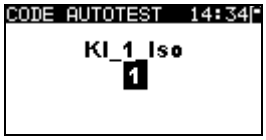


Figure 6.17: Code autotest menu

The autotest sequence and its code can be also set manually.

Keys:

▼ / ▲	Manually selects autotest sequence by setting its code.
TEST	Starts selected autotest sequence. Refer to chapter *6.5 Carrying out (Code, Simple and Custom) autotest sequences*.
ESC	Returns to Main menu.

Reading appliance ID number with barcode reader or RFID reader/writer

When the instrument is in the Save results menu, appliance ID can be scanned from a barcode label with the barcode reader or can be read from RFID tag with the RFID reader/writer. A successful receive of the barcode or RFID tag is confirmed by two short confirmation beeps.

6.5 Carrying out (Code, Simple and Custom) autotest sequences

General meaning of keys during a Code, Simple and Custom autotest sequence:

TAB, ⮝/⮟	Sets option. Sets limit value in selected (highlighted) item.
ESC	Cancels autotest sequence and returns to the (Code, Simple and Custom) autotest menu without changes.
TEST	Starts / repeats selected measurement or proceeds to next step.

Notes

- If any of the inspections are marked as failed or if any test fails the test sequence is stopped and the instrument automatically goes to the Result menu.
- If a test parameter (limit, duration, output voltage) is changed the setup is valid only for the particular test.
- If the test limit, output voltage or test duration is changed in Code autotest sequence the autotest code will not be stored (as the settings do not correspond with the code anymore).

6.5.1 Visual inspection

Measurement is described in chapter *5.2.1 Visual inspection*.

Figure 6.18: Visual test menu

Options in Visual test:

PASS / FAIL To be applied manually.

6.5.2 Earth continuity resistance measurement

The test is offered if it is applicable according to the autotest setting. The Earth continuity starting screen is displayed first. Measurement and options in Earth continuity starting screen are described in chapter *5.2.2 Earth continuity resistance*.

Figure 6.19: Earth continuity starting screen

After the measurement is carried out the Earth continuity result screen is displayed.

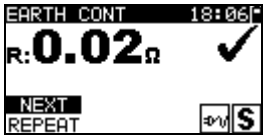


Figure 6.20: Earth continuity result screen

Options in Earth continuity result screen:

NEXT Proceeds to next step.

REPEAT Repeat the test (use in case of multiple earthed points). Highest result will be stored.

6.5.3 Insulation resistance measurement

The test is offered if it is applicable according to the autotest setting. The Insulation starting screen is displayed first. Measurement and options in Insulation starting screen are described in chapter *5.2.3 Insulation resistance*.

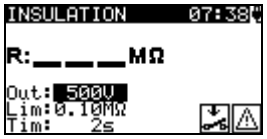


Figure 6.21: Insulation resistance starting screen

After the measurement is carried out the Insulation result screen is displayed.

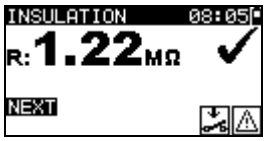


Figure 6.22: Insulation result screen

There are no special options to be set in the Insulation resistance result screen.

6.5.4 Substitute leakage measurement

The test is offered if it is applicable according to the autotest setting. The Substitute leakage current starting screen is displayed first. Measurement and options in Substitute leakage starting screen are described in chapter 5.2.5 Substitute leakage.

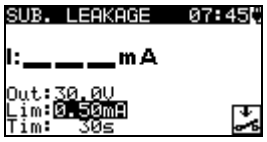


Figure 6.23: Substitute leakage starting screen

After the measurement is carried out the Substitute leakage result screen is displayed.

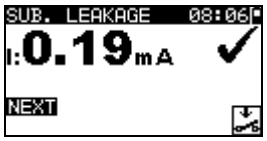


Figure 6.24: Substitute leakage result screen

There are no special options to be set in the Substitute leakage result screen.

6.5.5 Insulation resistance - P measurement

The test is offered if it is applicable according to the autotest setting. The Insulation resistance - P starting screen is displayed first. Measurement and options in Insulation resistance - P starting screen are described in chapter *5.2.4 Insulation resistance - P*.

Figure 6.25: Insulation resistance - P starting screen

After the measurement is carried out the Insulation resistance - P result screen is displayed.

Figure 6.26: Insulation resistance - P result screen

Options in Insulation resistance - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated/SELV/PELV accessible points). Lowest result will be stored.

6.5.6 Substitute Leakage - P measurement

The test is offered if it is applicable according to the autotest setting. The Substitute leakage - P starting screen is displayed first. Measurement and options in Substitute leakage - P starting screen are described in chapter *5.2.6 Substitute leakage - P*.

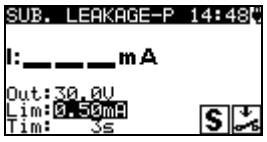


Figure 6.27: Substitute leakage - P starting screen

After the measurement is carried out the Substitute leakage - P result screen is displayed.

Figure 6.28: Substitute leakage - P result screen

Options in Substitute leakage - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated/SELV/PELV accessible points). Highest result will be stored.

6.5.7 Polarity test

The test is offered if it is applicable according to the autotest setting. The Polarity test starting screen is displayed first. Measurement and options in Polarity test starting screen are described in chapter *5.2.7 Polarity test*.

Figure 6.29: Polarity test starting screen

After the measurement is carried out the Polarity test result screen is displayed.

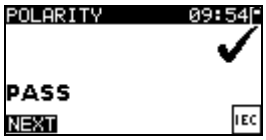


Figure 6.30: Polarity test result screen

There are no special options in the Polarity test starting screen.

6.5.8 Functional test

The test is offered if it is applicable according to the autotest setting. The Functional test starting screen is displayed first.

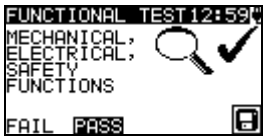


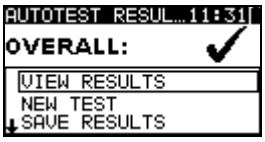
Figure 6.31: Functional result screens

Options in Functional test result screen:
PASS / FAIL To be applied manually.

For more information regarding measurement and test parameters see chapter *5.2.8 Functional test*.

6.6 Handling autotest results

After the Code, Simple or Custom autotest is finished, the Main autotest result screen will be displayed including an overall ✓ / × indication.



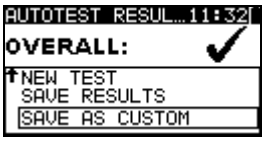


Figure 6.32: Main autotest result screen

Options in Autotest results screen:

VIEW RESULTS	Views individual results.
NEW TEST	Returns to Code, Simple or Custom menu.
SAVE RESULTS	Saves Autotest results. Refer to chapter *7.1 Saving autotest results* for more information regarding saving of autotest results.
SAVE AS CUSTOM	Saves test setup as Custom test. Refer to chapter *6.2 Custom autotest* for more information regarding Custom autotests.
ESC	Returns to Code, Simple or Custom menu.

Viewing autotest results

In the View results screen performed tests, results and their PASS / FAIL status are displayed. Furthermore the selected test results can be displayed with full details.

Options in View result screen.

⮝ / ⮟	Selects result of measurement (to be displayed with in full details).
TEST	Enters selected result of measurement (to be displayed in full details).
ESC	Returns to previous result screen.

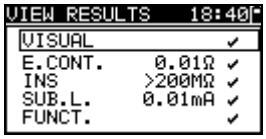


Figure 6.33: Overall result screen

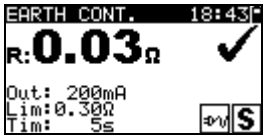


Figure 6.34: Detailed result screen

Saving autotest as Custom autotest

In the Save as custom screen last autotest can be stored as CUSTOM AUTOTEST.

Options in Save as custom screen.

⮟ / ⮝, TEST	Edit Autotest name.
MEM (SAVE)	Saves Autotest name.
ESC (DEL)	Deletes last character of Autotest name.
ESC (CANCEL)	Returns to the previous menu.

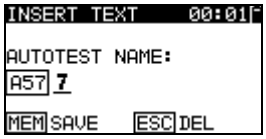


Figure 6.35: Save as custom screen

7 Working with autotest results

7.1 Saving autotest results

After selecting Save results in Autotest results menu, the autotest results will be stored in the internal memory of the instrument.
The appliance ID number and NAME can be added to the test results before the results are saved:

Figure 7.1: Save results menu (Appliance ID)

Keys:

⩛ / ⩚, TEST	Edit Appliance ID data.
MEM (OK)	Saves Appliance ID.
ESC (DEL)	Deletes last character of Appliance ID.
ESC (CANCEL)	Returns to the previous menu.

An Appliance ID of up to 14 numeric characters can be entered. The Appliance ID can also be scanned with a barcode reader or RFID reader/writer.

Figure 7.2: Save results menu (Appliance NAME)

Keys:

⩛ / ⩚, TEST	Edit Appliance NAME data.
TAB (LIST)	Offers last forty entered names.
ESC (DEL)	Deletes last character of Appliance NAME.
ESC (CANCEL)	Returns to the previous menu.
MEM (SAVE)	Saves Appliance NAME and returns to Autotest result menu.

An Appliance NAME of up to 14 numeric characters can be entered.

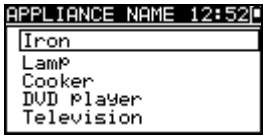


Figure 7.3: List menu (Appliance NAME)

Note

- The instrument remembers last 40 entered appliances names.

7.2 Recalling results

Saved autotest results can be recalled, printed or deleted from the Memory menu. Enter the Memory menu from the Setup menu.

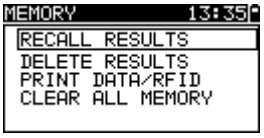


Figure 7.4: Memory menu

To enter the Recall results menu select Recall results in Memory menu. A list of Appliance ID's and NAMES are displayed in a chronological order (last performed measurement is displayed at the top of the list).
In the lower display the following data is displayed:

- Appliance ID, NAME;
- Date and time of the selected test;
- The overall ✓ / ✕ status of the selected test.

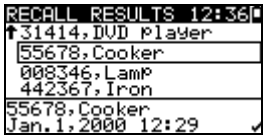


Figure 7.5: Recall results menu

Keys:

▲/▼, TEST	Enters View results menu for viewing autotest results.
ESC	Returns to Memory menu.

Note

- MEM key can be used as shortcut to enter Recall results menu.

In the View results screen performed tests, results and their PASS / FAIL status are displayed. Furthermore the selected test results can be displayed with full details.

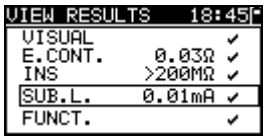


Figure 7.6: Overall result screen

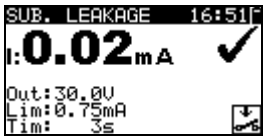


Figure 7.7: Detailed result screen

Options in View result screen

▲/▼	Selects result of measurement (to be displayed in full details).
TEST	Enters selected result of measurement (to be displayed in full details).
ESC	Returns to previous result screen.

7.3 Deleting individual autotest results

To enter the Delete results menu select ***Delete results*** in ***Memory*** menu. A list of Appliance ID's and NAMES are displayed in a chronological order (last performed measurement will be displayed at the top of the list).
In the lower window of the display the following data is displayed:

- Appliance ID, NAME;
- date and time of the selected test;
- the overall ✓ / × status of the selected test.

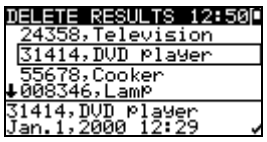


Figure 7.8: Delete results menu

Keys:

▲ / ▼, TEST	Deletes selected autotest result.
ESC	Returns to *Setup menu*.

7.4 Clearing complete memory content

Select ***CLEAR ALL MEMORY*** in MEMORY menu. A warning will be displayed.

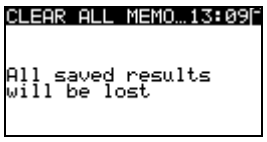


Figure 7.9: Clear all memory menu

Keys:

TEST	Confirms clearing of complete memory content.
ESC	Exits back to Memory menu without changes.

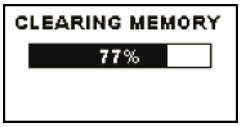


Figure 7.10: Clearing memory in progress

7.5 Printing and RFID tagging of individual autotest results

To print labels or results and write RFID tags select ***Print data / RFID*** in ***Memory*** menu. A list of Appliance ID's and NAMES are displayed in a chronological order (last performed measurement will be displayed at the top of the list).
In the lower window of the display the following data is displayed:

- Appliance ID, NAME;
- date and time of the selected test;
- the overall ✓ / × status of the selected test.

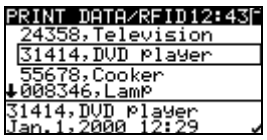


Figure 7.11: Print data / RFID menu

Keys:

⮝ / ⮟	Selects saved individual result.
TEST	Confirms selected result and enters ***Printer / RFID*** menu.
ESC	Exits back to Memory menu without changes.

In the Printer / RFID menu four options can be selected: Print simple label, Print label, Print results and Write RFID tag.

Figure 7.12: Printer / RFID menu

Keys:

⮝ / ⮟	Selects action.
TEST	Confirms and executes selected action.
ESC	Exits back to Print data / RFID menu without changes.

Print Simple label
Printed label includes: Appliance Id, Name, Test date, Initials and Overall result (Pass or Fail).

Print label
Printed label includes: Appliance Id, Barcode, Test date and Overall result (Pass or Fail).

Print results
All the data stored at the specified location will be printed. That includes Appliance ID, Appliance NAME, Test date and time, Overall and individual measurement result (Pass or Fail), individual measurement values, limits and other settings.

Write RFID tag
The test information is copied to RFID reader/writer. Pressing a R/W key on the RFID reader/writer writes Appliance ID, Test Date,Time and autotest code to RFID tag. (For detail information look at RFID reader/writer instruction manual.)

8 Communication

The instrument can communicate with the PC SW TV 465 PC software. The following actions are supported:

- Saved results can be downloaded and stored to a PC.
- Checkbox results can be downloaded and stored to the PC.
- Custom Auto sequences can be uploaded to the instrument.

A special communication program on the PC automatically identifies the instrument and enables data transfer between the instrument and the PC.
There are two communication interfaces available on the instrument: USB or RS 232.
The instrument automatically selects the communication mode according to the detected interface. USB interface has priority.

How to transfer stored data:

- RS 232 communication: connect a PC COM port to the instrument PS/2 connector using the PS/2 - RS232 serial communication cable.
- USB communication: connect a PC USB port to the instrument USB connector using the USB interface cable.
- Switch on the PC and the instrument.
- Run the PC SW TV 465 program.
- The PC and the instrument will automatically recognize each other.
- The instrument is prepared to upload / download data to the PC.

Note:

- USB drivers should be installed on PC before using the USB interface. Refer to USB installation instructions available on installation CD.

9 Maintenance

9.1 Periodic calibration

It is essential that all measuring instruments are regularly calibrated in order for the technical specification listed in this manual to be guaranteed. We recommend an annual calibration. The calibration should be done by an authorized technical person only.

9.2 Service

For repairs under or out of warranty please contact your distributor for further information.
Unauthorized person is not allowed to open the TV 465 instrument. There are no user replaceable parts inside the instrument.

9.3 Cleaning

Use a soft cloth, slightly moistened with soapy water or alcohol to clean the surface of the instrument. Leave the instrument to dry totally before using it.

Notes:

- Do not use liquids based on petrol or hydrocarbons!
- Do not spill cleaning liquid over the instrument!

10 Instrument set and accessories

Standard set of the instrument

- Instrument TV 465
- Small soft carrying bag
- Test probe (black)
- Crocodile clip (black)
- Test lead (1.5 m, black)
- IEC cord 2 m
- 6 x AA NiMH batteries
- Power supply adapter
- Instruction manual
- Calibration certificate

Optional accessories

See the attached sheet for a list of optional accessories that are available on request from your distributor.

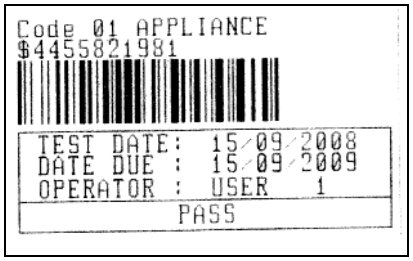
Appendix A – Barcode formats

The instrument TV 465 supports two barcode formats (single and double).

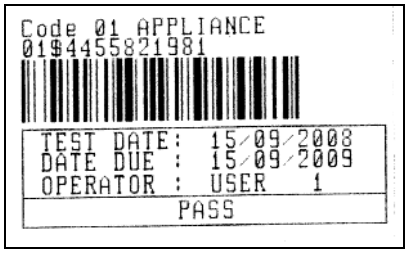
Autotest code and appliance ID
Autotest codes are represented as a three digit code. These autotest codes can also be represented by the barcode.
Using the barcode reader, the instruments can accept autotest code from barcode label.

Autotest code

Also appliance ID can be read from barcode label.



barcode system: single



barcode system: double

Examples of appliance labels

A01	Autotest code
$	Separator
4455821981	Appliance ID

Note:

- Special character »$« between autotest code and appliance ID is used to distinguish code from appliance ID.

Appendix B – Pre-programmed autotests (GER)

Pre-programmed autotest sequences table

Autotest shortcut code		A01	A02	A03	A04
		KI_1_Iso	KI_1_Iso_BLT	KI_1_Ia	KI_1_Ia_BLT
Visual test		☑	☑	☑	☑
Earth continuity	Output	200 mA	200 mA	200 mA	200 mA
	Limit	0.30 Ω	0.30 Ω	0.30 Ω	0.30 Ω
	Time	5 s	5 s	5 s	5 s
Insulation	Output	500 V	500 V	☒	☒
	Limit	1.00 MΩ	1.00 MΩ	☒	☒
	Time	5 s	5 s	☒	☒
Insulation (probe)	Output	☒	500 V	☒	☒
	Limit	☒	2.00 MΩ	☒	☒
	Time	☒	5 s	☒	☒
Sub leakage	Output	40 V	40 V	☒	☒
	Limit	3.50 mA	3.50 mA	☒	☒
	Time	5 s	5 s	☒	☒
Sub leakage (probe)	Output	☒	40 V	☒	☒
	Limit	☒	0.50 mA	☒	☒
	Time	☒	5 s	☒	☒
Differential leakage	Output	☒	☒	230 V	230 V
	Limit	☒	☒	3.50 mA	3.50 mA
	Time	☒	☒	180 s	180 s
Touch leakage	Output	☒	☒	☒	230 V
	Limit	☒	☒	☒	0.50 mA
	Time	☒	☒	☒	180 s
Power	Output	230 V	230 V	230 V	230 V
	Limit	☒	☒	☒	☒
	Time	180 s	180 s	180 s	180 s
TRMS clamp current	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Polarity test		☒	☒	☒	☒

Pre-programmed autotest sequences table (cont'd)

Autotest shortcut code		A05	A06	A07	A08
		KI_2_Iso	KI_2_Ibs	KI_1_Isola	KI_1_IsolaBLT
Visual test		☑	☑	☑	☑
Earth continuity	Output	☒	☒	200 mA	200 mA
	Limit	☒	☒	0.30 Ω	0.30 Ω
	Time	☒	☒	5 s	5 s
Insulation	Output	☒	☒	500 V	500 V
	Limit	☒	☒	1.00 MΩ	1.00 MΩ
	Time	☒	☒	5 s	5 s
Insulation (probe)	Output	500 V	☒	☒	500 V
	Limit	2.00 MΩ	☒	☒	2.00 MΩ
	Time	5 s	☒	☒	5 s
Sub leakage	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Sub leakage (probe)	Output	40 V	☒	☒	☒
	Limit	0.50 mA	☒	☒	☒
	Time	5 s	☒	☒	☒
Differential leakage	Output	☒	☒	230 V	230 V
	Limit	☒	☒	3.50 mA	3.50 mA
	Time	☒	☒	180 s	180 s
Touch leakage	Output	☒	230 V	☒	230 V
	Limit	☒	0.50 mA	☒	0.50 mA
	Time	☒	180 s	☒	180 s
Power	Output	230 V	230 V	230 V	230 V
	Limit	☒	☒	☒	☒
	Time	180 s	180 s	180 s	180 s
TRMS clamp current	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Polarity test		☒	☒	☒	☒

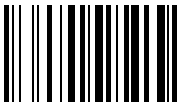
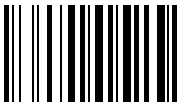
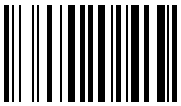
Pre-programmed autotest sequences table (cont'd)

Autotest shortcut code		A09	A10	A11	A12
		KI_2_Isolbs	KI_2	KI_3_Iso	KI_3
Visual test		☑	☑	☑	☑
Earth continuity	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Insulation	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Insulation (probe)	Output	500 V	☒	500 V	☒
	Limit	2.00 MΩ	☒	0.250 MΩ	☒
	Time	5 s	☒	5 s	☒
Sub leakage	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Sub leakage (probe)	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Differential leakage	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Touch leakage	Output	230 V	☒	☒	☒
	Limit	0.50 mA	☒	☒	☒
	Time	180 s	☒	☒	☒
Power	Output	230 V	230 V	---	---
	Limit	☒	☒	☒	☒
	Time	180 s	180 s	180 s	180 s
TRMS clamp current	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Polarity test		☒	☒	☒	☒

TESTBOY GmbH VDE tester test type card

Code	*Autotest sequence name and descriptions*		*Limits*	*Barcode*
A01	**KI_1_Iso**	Testing according to VDE. Class 1 device. Insulation resistance and substitute leakage current measurements are applicable.	Earth bond: 0.30 Ω Insulation: 1.00 MΩ Sub leakage: 3.50 mA	A0 1
A02	**KI_1_Iso_BLT**	Testing according to VDE. Class 1 device with isolated accessible cinductive parts. Insulation resistance and substitute leakage current measurements are applicable.	Earth bond: 0.30 Ω Insulation: 1.00 MΩ Insulation - P: 2.00 MΩ Sub leakage: 3.50 mA Sub leakage - P: 0.50 mA	A0 2
A03	**KI_1_Ia**	Testing according to VDE. Class 1 device. Prüfung für Differenzstrom wird eingestellt.	Earth bond: 0.30 Ω Leakage: 3.50 mA	A0 3
A04	**KI_1_Ia_BLT**	Testing according to VDE. Class 1 device with isolated accessible conductive parts. Prüfungen für Differenz- und Berührungsstrom werden eingestellt.	Earth bond: 0.30 Ω Leakage: 3.50 mA Touch leakage: 0.50 mA	A0 4
A05	**KI_2_Iso**	Testing according to VDE. Class 2 device with isolated accessible conductive parts. Insulation resistance and substitute leakage current measurements are applicable.	Insulation - P: 2.00 MΩ Sub leakage - P: 0.50 mA	A0 5
A06	**KI_2_Ibs**	Testing according to VDE. Class 2 device. Prüfung für Berührungsstrom wird eingestellt.	Touch leakage: 0.50 mA	A0 6
A07	**KI_1_Isola**	Testing according to VDE. *Class 1 device.* Prüfungen für Isolation und Differenzstrom werden eingestellt.	Earth bond: 0.30 Ω Insulation: 1.00 MΩ Leakage: 3.50 mA	A0 7
A08	**KI_1_IsolaBLT**	Testing according to VDE. Class 1 device with isolated accessible conductive parts. Prüfungen für Isolation, Differenz- und Berührungsstrom werden eingestellt.	Earth bond: 0.30 Ω Insulation: 1.00 MΩ Insulation - P: 2.00 MΩ Leakage: 3.50 mA Touch leakage: 0.50 mA	A0 8
A09	**KI_2_Isolbs**	Testing according to VDE. Class 2 device with isolated accessible conductive parts. Prüfungen für Isolation und Berührungsstrom werden eingestellt.	Insulation - P: 2.00 MΩ Touch leakage: 0.50 mA	A0 9

TESTBOY GmbH VDE tester test type card (cont'd)

A10	**KI_2**	Testing according to VDE. Class 2 device without any isolated accessible conductive parts.		 A1 0
A11	**KI_3_Iso**	Testing according to VDE. Class 3 device with isolated accessible conductive parts.	Insulation - P: 0.25 MΩ	 A1 1
A12	**KI_3**	Testing according to VDE. Class 3 device without any isolated accessible conductive parts.		 A1 2

Appendix C – Pre-programmed autotests (NL)

Pre-programmed autotest sequences table

Autotest shortcut code		01	02	03	04
		KI_1_ALG	KI_2_ALG	KI_1_HEATERS	KL_1_PC
Visual test		☑	☑	☑	☑
Earth continuity	Output	200 mA	☒	200 mA	200 mA
	Limit	0.30 Ω	☒	0.30 Ω	0.30 Ω
	Time	5 s	☒	5 s	5 s
Insulation	Output	500 V	☒	500 V	☒
	Limit	1.00 MΩ	☒	0.50 MΩ	☒
	Time	5 s	☒	5 s	☒
Insulation (probe)	Output	☒	500 V	☒	☒
	Limit	☒	2.00 MΩ	☒	☒
	Time	☒	5 s	☒	☒
Sub leakage	Output	☒	☒	40 V	☒
	Limit	☒	☒	7 mA	☒
	Time	☒	☒	5 s	☒
Sub leakage (probe)	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Differential leakage	Output	☒	☒	☒	230 V
	Limit	☒	☒	☒	0.50 mA
	Time	☒	☒	☒	120 s
Touch leakage	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Power	Output	☑	☑	☑	☒
	Limit	☒	☒	☒	☒
	Time	10 s	10 s	10 s	☒
TRMS clamp current	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Polarity test		☒	☒	☒	☒

Pre-programmed autotest sequences table (cont'd)

Autotest shortcut code		05	06	07	08
		KI_3_ALG	KI_1_AGMD	KABEL_5M_2.5MM	KABEL_15M_2.5MM
Visual test		☑	☑	☑	☑
Earth continuity	Output	☒	200 mA	200 mA	200 mA
	Limit	☒	0.30 Ω	0.30 Ω	0.50 Ω
	Time	☒	5 s	5 s	5 s
Insulation	Output	☒	500 V	500 V	500 V
	Limit	☒	1.00 MΩ	1.00 MΩ	1.00 MΩ
	Time	☒	5 s	5 s	5 s
Insulation (probe)	Output	500 V	500 V	☒	☒
	Limit	0.50 MΩ	2.00 MΩ	☒	☒
	Time	5 s	5 s	☒	☒
Sub leakage	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Sub leakage (probe)	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Differential leakage	Output	☒	230 V	☒	☒
	Limit	☒	1 mA	☒	☒
	Time	☒	5 s	☒	☒
Touch leakage	Output	☒	230 V	☒	☒
	Limit	☒	0.50 mA	☒	☒
	Time	☒	5 s	☒	☒
Power	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
TRMS clamp current	Output	☒	☒	☒	☒
	Limit	☒	☒	☒	☒
	Time	☒	☒	☒	☒
Polarity test		☒	☒	☑	☑

Pre-programmed autotest sequences table (cont'd)

Autotest shortcut code		09	10
		KABEL_25M_2.5MM	KABEL_50M_2.5MM
Visual test		☑	☑
Earth continuity	Output	200 mA	200 mA
	Limit	0.70 Ω	1.00 Ω
	Time	5 s	5 s
Insulation	Output	500 V	500 V
	Limit	1.00 MΩ	1.00 MΩ
	Time	5 s	5 s
Insulation (probe)	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Sub leakage	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Sub leakage (probe)	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Differential leakage	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Touch leakage	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Power	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
TRMS clamp current	Output	☒	☒
	Limit	☒	☒
	Time	☒	☒
Polarity test		☑	☑

Appendix D – Simple test codes

Simple test codes		CLASS. I	CLASS. II	CLASS. III
Visual test		☑	☑	☑
Earth continuity	Output	200 mA	☒	☒
	Limit	0.30 Ω	☒	☒
	Time	5 s	☒	☒
Insulation	Output	500 V	☒	☒
	Limit	1.00 MΩ	☒	☒
	Time	2 s	☒	☒
Insulation (probe)	Output	☒	500 V	500 V
	Limit	☒	2.00 MΩ	0.25 MΩ
	Time	☒	2 s	5 s
Sub leakage	Output	40 V	☒	☒
	Limit	3.50 mA	☒	☒
	Time	2 s	☒	☒
Sub leakage (probe)	Output	☒	40 V	☒
	Limit	☒	0.50 mA	☒
	Time	☒	5 s	☒
Differential leakage	Output	☒	☒	☒
	Limit	☒	☒	☒
	Time	☒	☒	☒
Touch leakage	Output	☒	☒	☒
	Limit	☒	☒	☒
	Time	☒	☒	☒
Power	Output	☒	☒	☒
	Limit	☒	☒	☒
	Time	☒	☒	☒
TRMS clamp current	Output	☒	☒	☒
	Limit	☒	☒	☒
	Time	☒	☒	☒
Polarity test		☒	☒	☒