INSTRUCTION MANUAL

Compact EMC TEST Generator for the electronic equipment of vehicles

CAR – TE14

HILO-TEST GmbH, Am Hasenbiel 42, D-76297 Stutensee, Tel.07244 20500-0, www.hilo-test.de

Table of contents:

1. General

- Before using the generator, please read this instruction manual and obey all safety precautions.

- The generator delivers life-threatening high-voltage at its output. The generator is an inherently dangerous device.

- High-voltage pulse tests and especially electrical fast transient tests are able to radiate energy to the vicinity of the test set-up. It is the responsibility of the user to avoid any critical failure of interference to other electrical devices when making these tests in a given installation. Operating the generator inside a screened room and additional filtering of the mains power supply may be necessary. People with heart pacemaker or any other device likely to be influenced, should be excluded from those tests.

- It is the responsibility of the operator to ensure that adequate precautions are taken to ensure that no human contact to the live parts of the output terminals, the cascaded test-object or associated leads is possible. Before energising the generator, the operator must assure that all safety precautions are complete and fully operational.

- The device must only be operated by professionally trained and educated personnel. Safety regulations according to VDE 0104, VBG 4 or specific national safety codes must be obeyed.

- The generator must only be operated from properly installed mains with protective earth. Interruption or isolation of the protective earth connector is not allowed. Cabinet, chassis and grounded parts of the coaxial measuring and output voltage connectors possess equal potential and are connected with protective earth of the mains.

- If safe operation of the device is obviously not possible, the generator must be shut down and secured against improper use. For example, this applies when the device exhibits external damage, contains loose parts or components, no longer operates according to its technical specifications or has been stored under adverse conditions.

- There are no serviceable parts inside the generator. Calibration and service of the generator without cabinet must only be conducted by professionally educated personnel which is aware of the inherent high-voltage hazards.

- Unauthorised modification or any use in contrary to the instructions contained in this manual, will invalidate the warranty and relieve the manufacturer of any further liability or responsibility.

- The information contained in this manual, including but not limited to all schematics, PCB-layouts and parts lists are the sole copyright of HILO-TEST GmbH. A reproduction or unauthorised use of the information contained herein is expressly prohibited.

2. Introduction

The CAR-TE14 is a compact EMC test unit designed for testing the electromagnetic immunity of electrical equipment of vehicles against pulsed and conducted interference.

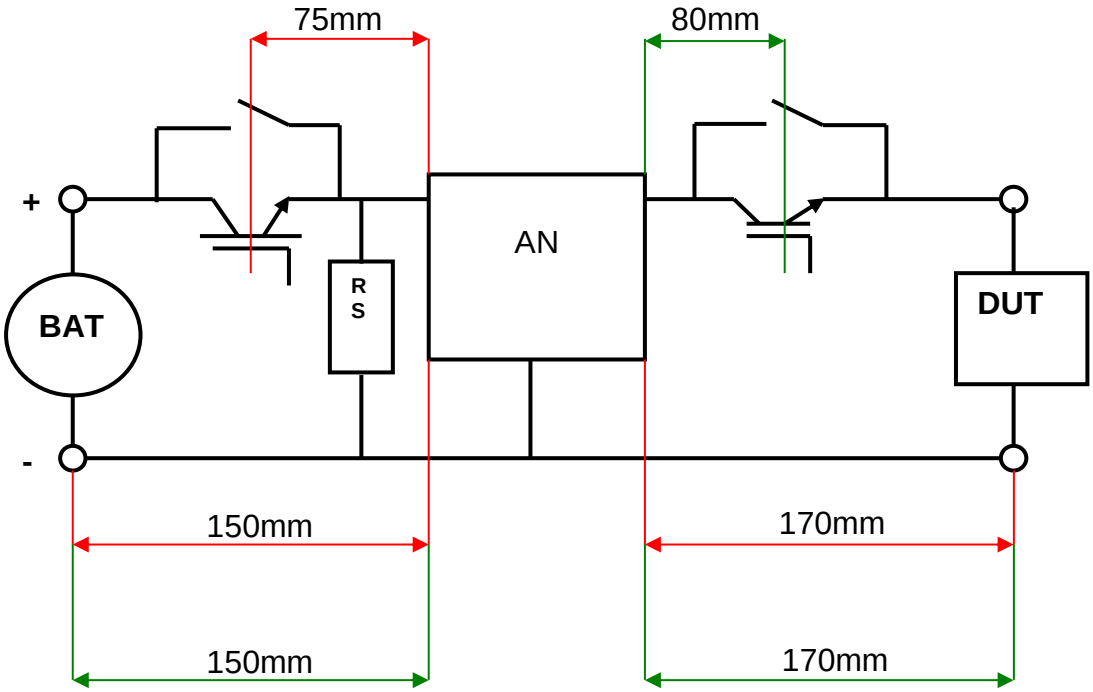

Figure 1: Schematic of the CAR-TESTER

BAT = Battery/ Power Supply
DUT = Device Under Test
AN = Artificial Network
RS = Shunt Resistor
Test setup: Slow pulses, Fast pulses

The generator features a microprocessor controlled user interface and a 5” touch screen unit for ease of use. The microprocessor allows the user to execute either standard test routines or a “user defined” test sequence. A standard USB port provides the ability to print a summary of the test parameters to a USB stick.

Moreover all generator functions may be computer controlled via the isolated optical interface. The software program CAR-TEST allows full remote control of the test generator, documentation and evaluation of test results, accordingly to IEC 17025.

The CAR-TE14 excels by its compact design, simple handling and precise reproducibility of test impulses. High-voltage switching is accomplished by means of a maintenance-free semiconductor switches.

The power supply voltage of the device under test connected to the CAR-TE14 can be delivered from a battery or an electronically power supply unit.

3. Functional Description

The generator features a micro-processor controlled touch display unit. The micro-processor control circuitry includes the mains switch, the monitoring of the external safety interlock and the control of external warning lamps.

3.1 Safety interlock, external warning lights

The external safety interlock and external warning lights serve as a safety measure for the total test set-up.

The external safety interlock loop is connected to the SAFETY connector on the rear panel. Interruption of the external safety loop automatically de-energises the high-voltage power supply and discharges the energy-storage capacitor. The green signal lamp lights to indicate that the generator is in stand-by mode, and the generation of high-voltage output pulses is inhibited.

After closing the external safety-loop the red signal lamp lights, indicating that the generator is now in operating mode. The red light indicates “DANGER” and lights if the high-voltage section of the generator is either in stand-by mode or in operation. After any further operation of the control interface, life-threatening high-voltages may be present at the generator output.

The external red & green warning lights may be connected to the EXT. RD/GN output connector on the rear panel of the generator. They will have the same function as the red and green lights on the front panel but are powered by the mains voltage, 60W max. The external red and green warning lights must be used in test arrangements complying with further safety measures according to VBG 4, VDE 0104 or specific national safety codes.

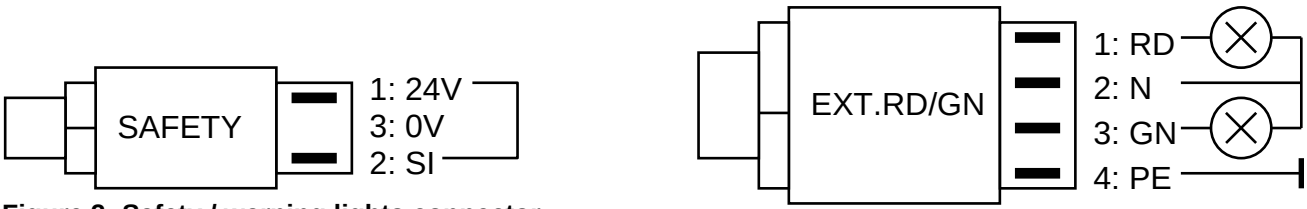

Figure 2: Safety / warning lights connector

3.2 USB

A standard USB interface provides the ability to save a summary of the test parameters whilst testing is being carried out.
Any USB storage device can be connected to the USB bush which is located on the front panel.

3.3 Trigger Input / Trigger Output

During manual operation, a 10V trigger signal appears at the BNC-connector TRIG-OUT whilst the output pulse is generated. TRIG-IN is without function.

3.4 Remote Control

All generator functions, including the settings of the built-in Coupling-/Decoupling Network, may be computer controlled via the isolated optical interface. Control commands and reply signals are transferred by a light guide ring.

The software program allows full remote control of the test generator, as well as documentation and evaluation of test results.

For further information please refer to the software instruction manual.

3.5 Connecting terminals of the CAR-TE14

The power supply, the external safety and the external warning lamps connectors are located on the back of the equipment.

The external safety circuit is connected to the connector SAFETY, the external warning lights to the EXT. RD / GN.
The power supply is connected to the unit via the power connector. The supply voltage is 230 V.

The DUT connected at the output of the CAR-TE14, is powered by an external voltage source that is connected to the sockets **+BAT** and **-BAT**.
This input voltage of the battery is located on the left side. The corresponding outputs **+/- OUT** and the monitor output **Um**, in order to monitor the pulse shape, are located on the right side.
An external load resistor can be connected at ports 2 Ω ext.

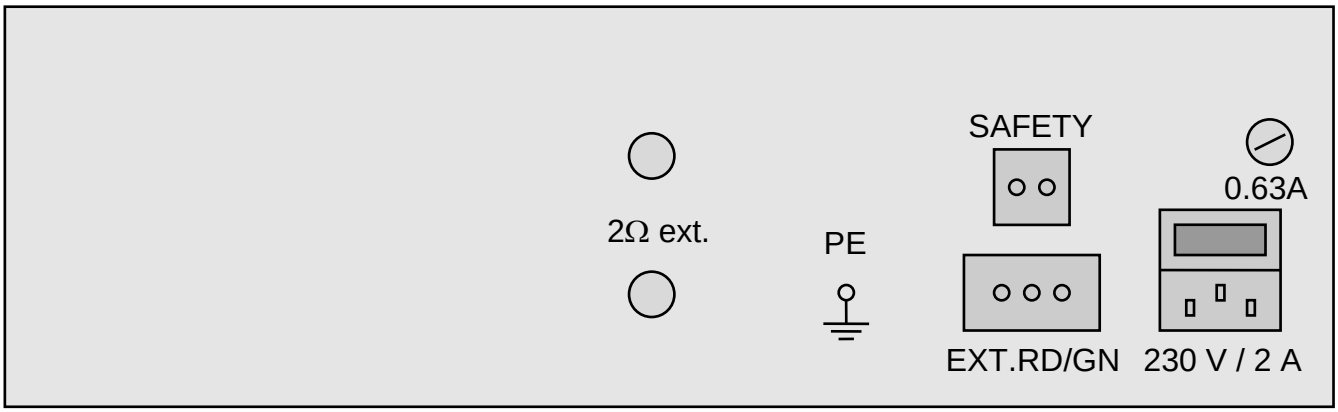

Figure 3: Connecting terminals

The DUT is connected to the outputs **+/- OUT** connector.
The switched supply voltage of the power amplifier / power supply is available at this output.

The monitor output **Um** allows to check the voltage at the DUT with an oscilloscope.
The ratio of the built-in divider is 100:1 and the bandwidth is 10 MHz.

4. Operation of the CAR-TESTER

The CAR-TE14 features a microprocessor controlled touch display for ease of use. The test parameters, which are shown on the built-in display, are easily selected and can simply be adjusted by use of the touch function of the display.

The task menu is organised in a hierarchical structure. Selecting one of the function keys will lead to the next lower menu level. Operating ‘exit’ or ‘back’ leads back to the next higher level.

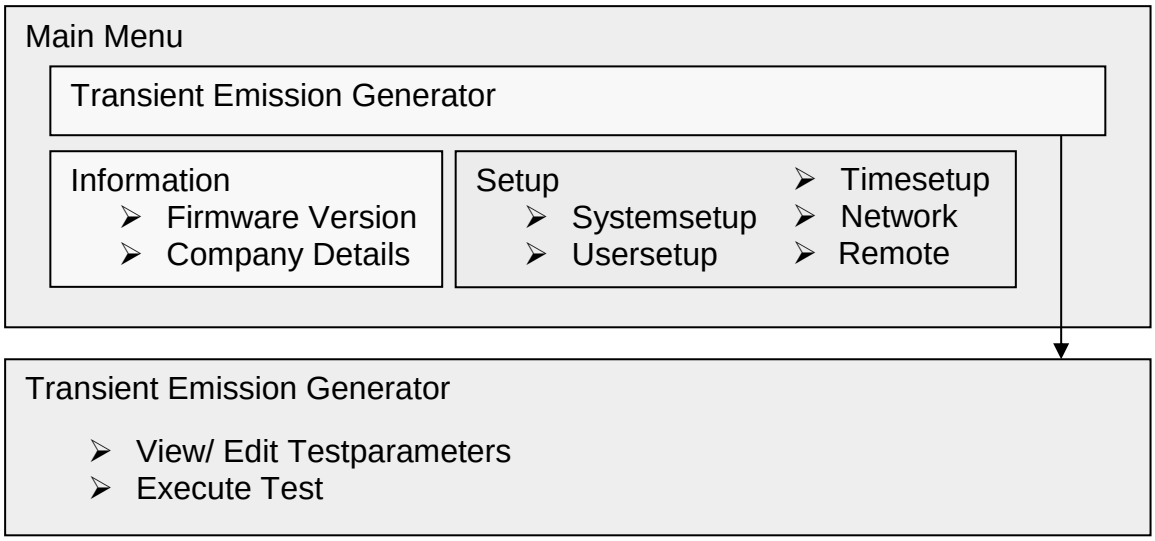

Figure 4: Menu in hierarchical structure

4.1 Turn-key Switch

Upon operating the turn-key switch on the front panel, the generator is energised and ready for use within 20 seconds.

Removing the key prevent from unauthorised use of the generator

4.2 Main menu

The CAR-TE14 starts with following menu :

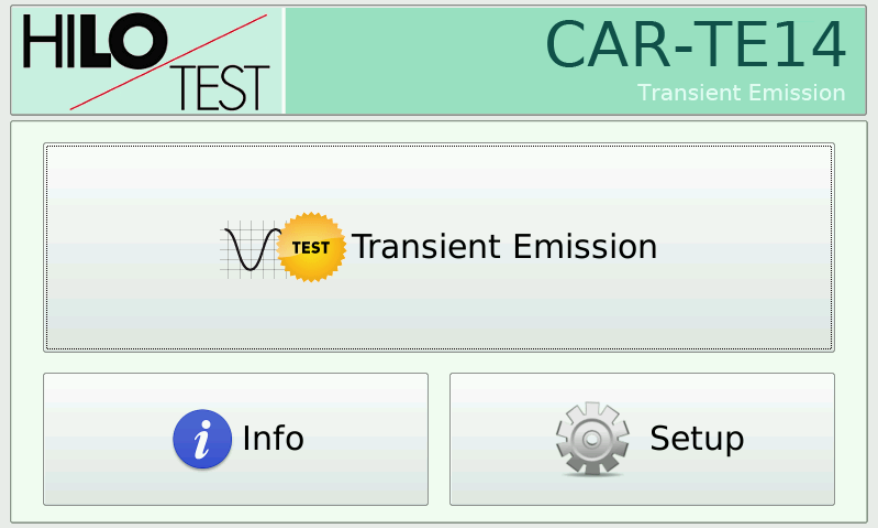

Figure 5: Main Menu

Going to “Transient Emission” starts the Transient Emission Generator, permits to modify all test parameters and start tests.
The "Setup" function is used to adjust the clock, user specific information and to change system settings.
The function "Info" provides further information about the generator and firmware updates can be performed.

4.3 Transient Emission

By selecting "Transient Emission", all test parameters can be set.

Detailed description:

Test setup: to set the position of the switch to the artificial network
"fast pulses" means the switch is located between the input and artificial network
"slow pulses" means the switch is located between the output and artificial network

Switch type: to select the type of switch
mechanical switch (relay) or electrical switch (IGBT)

Mode: mode "manual" to turn on the switch manually with the specified parameters manually. "ON" and "OFF" buttons allow to switch manually
mode "Auto" to execute the test automatically. "Period" and "Toff" is processed sequentially

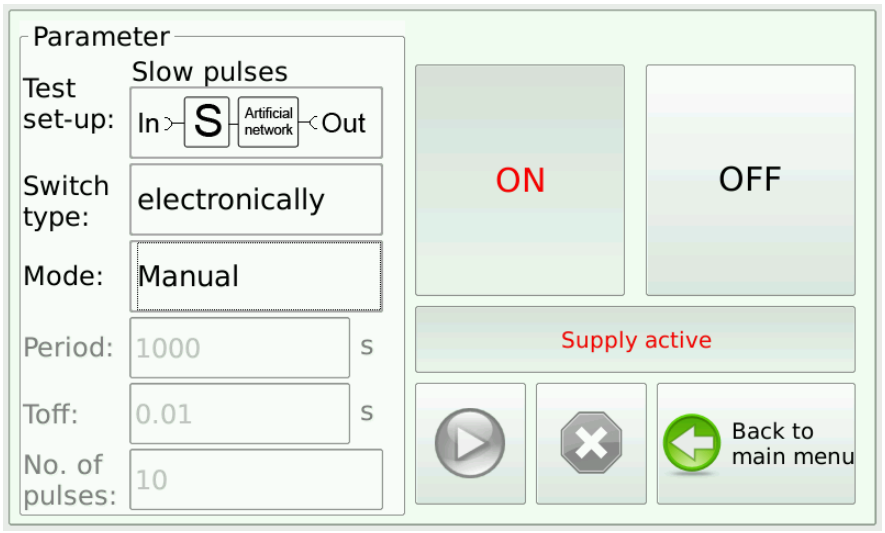

Figure 6: Manual test

A counter that counts the performed switching cycles is shown on the right top of the screen. Next to it ist the current test time presented. Below ist the current state of the test visualized. With the "Play", the "Stop" and the "Pause" buttons ,a test gets started, stopped, or paused.

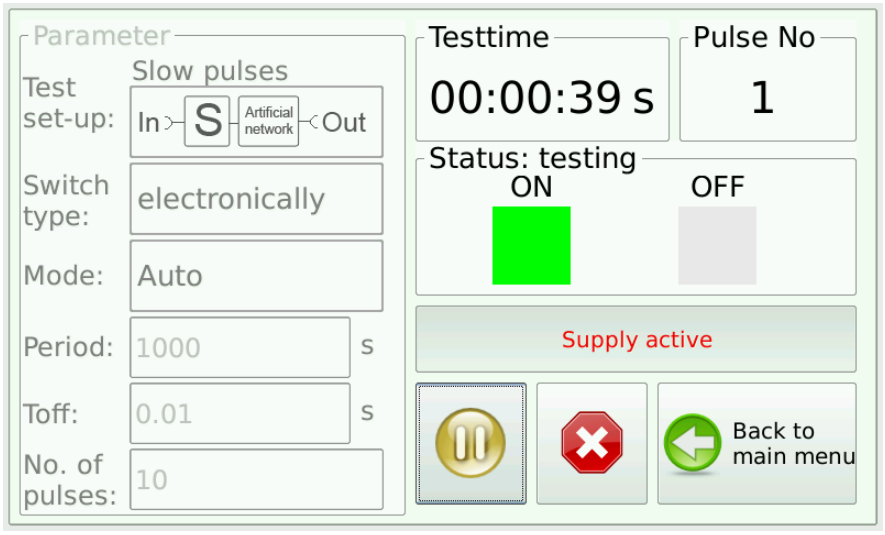

Figure 7: Auto test

Period: Time in seconds

Toff: Time in seconds, while the switch is open

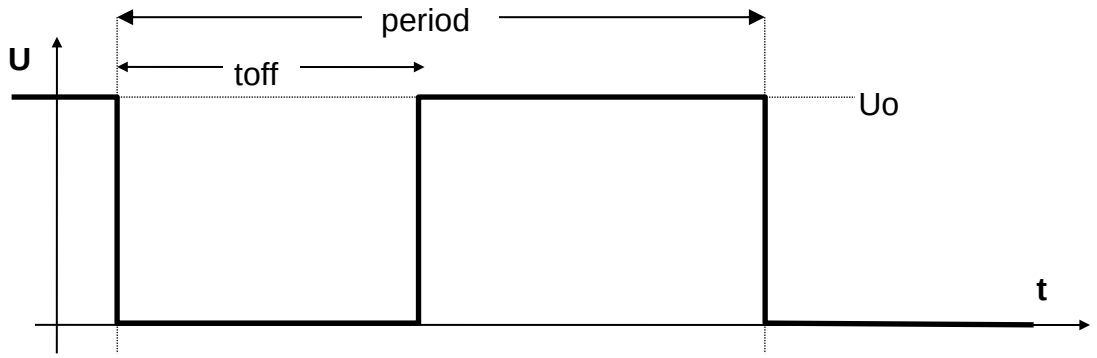

Figure 8: Transient Emission times

Overview:

Test set-up	possible states	fast pulses	
		slow pulses	
Switch type	possible states	electrically	mechanically
Mode	possible states	manual	
		auto	
Period	min	0.1s	1s
	max	1000s	
	inc	0.01s	0.1s
Toff	min	0.01s	0.5s
	max	1000s	
	inc	0.01s	0.1s

By operating “Stop” the automatic test can be stopped at any time.
If ‘Display Results’ was activated in the ‘Setup’ menu, a test result listing is generated and ready to be saved as *.csv on a USB device (Figure 9). If ‘Display Results’ was deactivated, the current test is just carried out and can be restart immediately

Figure 9: Result

4.4 Setup

The function ‘Setup’ shows the configurations of the CE-TESTER

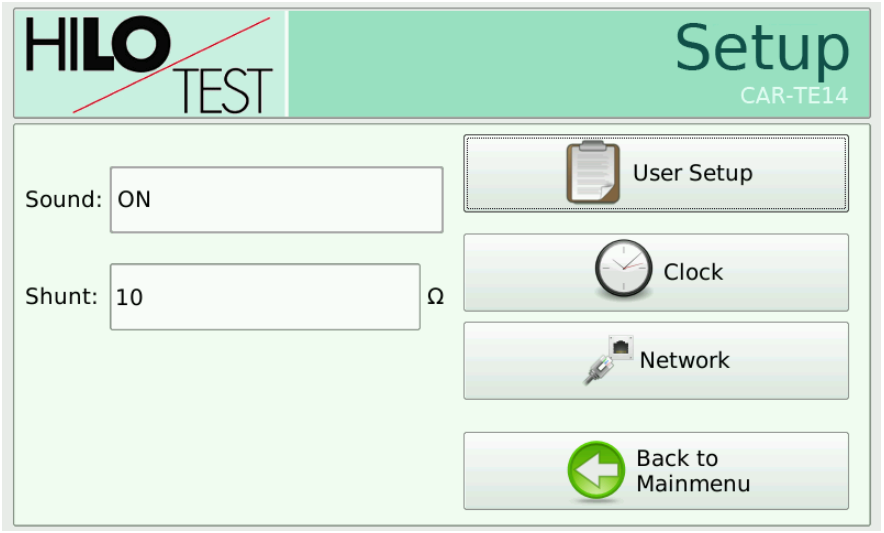

Figure 10: Setup

4.4.1 General Setup

- **Sound**

Permits to activate or deactivate the sound emitted by controlling the generator as well as by executing tests.

- **Shunt**

Selection of the shunt resistor value
Possible settings: 10Ω, 20Ω, 40Ω, externer Shunt, off

4.4.2 User Setup

Allows to insert information about the device under test and the test laboratory which are shown on the head of the saved test results.

Figure 11: Setup / User setup

4.4.3 Date/ Time

Permits to adjust the date as well as the time.
The selected parameter is displayed in colour and can be modified by pressing ‘plus’ or ‘minus’. By pressing the disk button, the changes are saved. To exit without saving, press the red stop button.

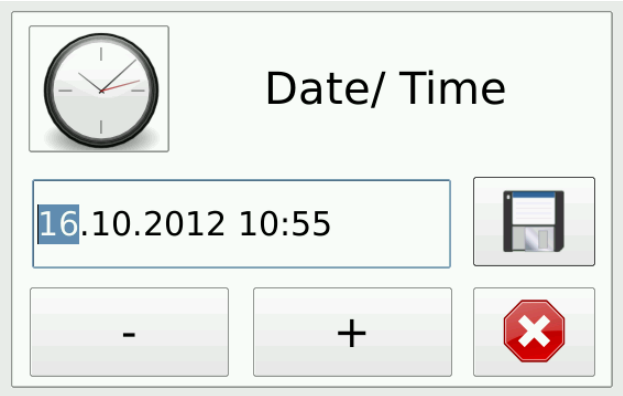

Figure 12: Setup / Clock

4.4.4 Network

Allows to change the network settings of the generator.

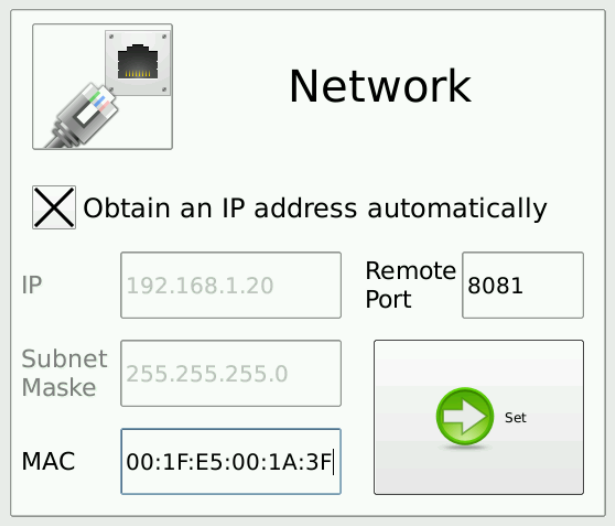

Figure 13: Setup / Network

By selecting “obtain a IP address automatically”, the generator gets an IP address and subnet mask by DHCP. If it is not selected, manual values can be entered.
The MAC address cannot be changed as it is a unique identifier assigned to network interfaces for communications on the physical network segment.
The Remote Port permits to connect the generator with the HILO-Remote software on a personal computer.
With the set button all changed values get saved.

4.4.5 Remote Modus

This mode enables the control of the generator via the built-in computer interface. This mode will be activated automatically when a valid command was received.

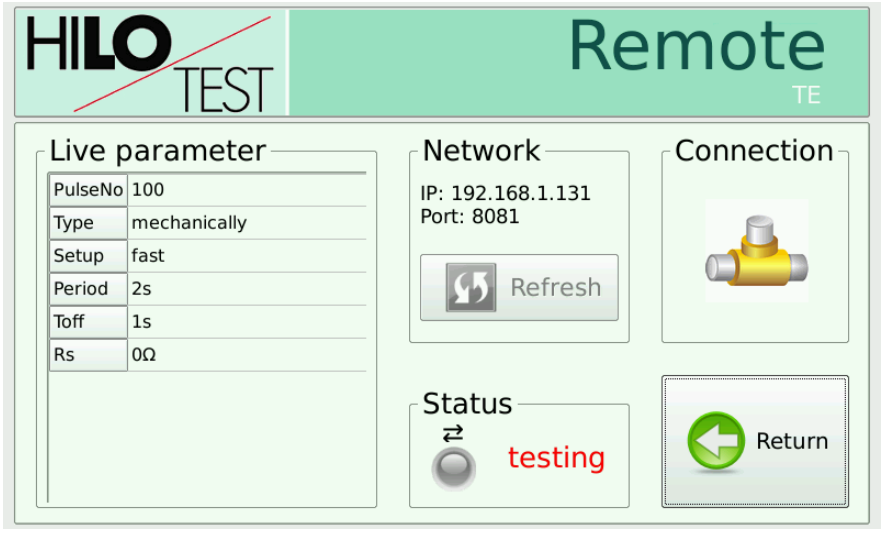

Figure 14: Setup / Remote mode

In 'Remote' the generator functions are remotely controlled by the software “HILO-remote” running on an external computer via the built-in optically isolated computer interface.
On the left the set parameters are displayed. It also displays information about the network connection and the status of the generator.

The generator is successfully connected to remote control as shown in Figure 15, the connection is broken as shown in Figure 16.

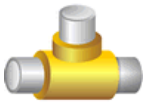

Figure 15: : Remote connected

Figure 16: : Remote not connected

The remote control mode is terminated by selecting the arrow button leading back to the setup menu.
For more information, please refer to the software instruction manual.

4.5 Information and Firmware Update

By selection “Information” in the main menu, general information will appear.

Figure 17: Information

The firmware version is displayed on the top. A firmware update function is also available.
Next to it are further information about the generator, the date and time.
Other information as our company address / contact and disc space are displayed.

Instructions for the firmware update:

- Copy the new firmware file to the root directory of a USB stick (make sure, that there is no other HILO Firmware on the USB stick)
- Insert the stick into the front of the generator and press “*update via usb stick*”
- Follow the instructions
- The generator will automatically restart after a successful update

5. Technical specifications	CAR-Transient-Emission 14		
Mainframe			
Microprocessor controlled touch panel	5”, 800X480, 24 bit		
Optical Ethernet Interface for remote control of the generator	optional		
Interface for saving reports	USB		
External trigger input /output	10 V at 1 kΩ		
Connector for external safety interlock loop	24 V =		
External red and green warning lamps acc. to VDE 0104	230 V, 60W		
Mains power	230 V, 50/60 Hz		
Dimensions desk top case, W * H * D	450*320*180 mm^3		
Weight	35kg		
Transient Emission Test, Power Switch Transients, acc. to ISO 7637-2 : 2011			
Max. operating voltage	70V		
High short circuit current capability	900A		
Voltage drop over switch at 25A	< 2V		
Switching time	< 300ns		
Max. peak over voltage protection	500V		
Nominal voltage	0 - 100%		
Turn off time	10ms - 1000s		
Period	100ms - 1000s		
Number of tests	1 - 1000		
Artificial network			
Series inductance	5 µH, **100 A**		
Load impedance	0.1 µF + 50 Ω		
Load resistor Rs, switchable	10 / 20 / 40 Ω		
Connectors for external load resistor, 2.0 Ω	build in		
Artificial network	on / off		
Power supply switch			
Max. output current	TE14-1	**TE14-2**	TE14-3
	50A	**100A**	200A
Max. reverse voltage	800 V		
Trigger input, connectable to external modules	Built-in		
Measurement probes, Transient immunity test			
Impulse voltage divider	100:1, 10 MHz, 1kV-peak		
Option PC Software Car-Remote (mandatory with PS)			
Software to control the CAR - Tester 14 over Ethernet LWL to control the PS 66-55 to control the PG2804 to control the CAR-SYS14			

5.1 Environment Conditions

The generator is designed to be used under the following environment conditions:

- Indoor use
- Height up to 2000 m above sea level
- Temperature range 5°C - 40 °C
- Maximum relative humidity 80% for temperature up to 31°C, decreasing linearly to 50% at 40°C
- Voltage variation of power supply voltage: ±10% of nominal value.
- Transient over-voltages according to class II
- In order to meet all requirements of EMC-directive this unit may be operated only inside a screened room supplied with a power line filter.

6.1 Functional test: Serial No.: [1704095]

- Firmware Version V 5.1
- Switch test OK [x]
- Time settings test of the Power Switch OK [x]
- Waveform check at the OUT- connectors OK [x]

6.2 ESD-TEST acc. to IEC 1000-4-2, Level 3

no malfunction OK [x]

6.3 EFT-TEST acc. to IEC 1000-4-4, Level 3

no malfunction OK [x]

6.4 CWG-TEST acc. to IEC 1000-4-5, Level 3

no malfunction OK [x]

6.5 Safety test

Resistance of protective earth	[0,09] Ω
Isolation resistance	[> 20] MΩ
Equivalent leakage current	[0,45] mA
max. supply current	[0,35] A
metal contact areas are potential free	OK [x]

6.6 Enclosures (in paper form)

- Waveform test certificate
- Declaration of conformity

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Kalibrierschein
Calibration certificate

Kalibrierzeichen *Calibration mark*	**1704095**
	CAL ISO 9001
	2020.02

Gegenstand *Object*	**EMC** **Test Generator**
Hersteller *Manufacturer*	**Hilo- Test GmbH**
Typ *Type*	**CAR-TE14 II**
Serien-Nr. *Serial number*	**1704095**
Auftraggeber *Customer*	**Xxxx** **Xxx**
Auftragsnummer *Order number*	**5863J**
Anzahl der Seiten *Number of pages*	**5**
Datum der Kalibrierung *Date of calibration*	**10.10.2017**

Die Kalibrierergebnisse beziehen sich ausschließlich auf den genannten Kalibriergegenstand. Die Kalibrierung erfüllt die Anforderungen nach DIN EN ISO 9001 oder vergleichbarer QM-Richtlinien. Das Qualitätsmanagement der HILO-TEST GmbH ist gemäß DIN EN ISO/ IEC 9001 zertifiziert. Dieser Kalibrierschein dokumentiert die Rückführbarkeit auf nationale Normale des DKD (Deutscher Kalibrierdienst) bzw. PTB (Physikalisch-Technische Bundesanstalt) oder anderer nationaler Normale zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem internationalen Einheitensystem (SI).

Für die Einhaltung der Intervalle der Kalibrierung ist der Benutzer verantwortlich.

The calibration results refer exclusively to the object. The calibration satisfies the requirements of DIN EN ISO 9001 or equivalent QM guidelines. The quality management of HILO-TEST GmbH is accredited in accordance to DIN EN ISO/ IEC9001. This calibration certificate documents the traceability to national standards maintained by the DKD (Deutscher Kalibrierdienst), the PTB (Physikalisch-Technische Bundesanstalt) or other national standards, which realize the physical units of measurement according to the international System od Units (SI).

The user is obliged to have the object recalibrated at appropriate intervals.

Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*

HILO-TEST GmbH, Am Hasenbiel 42, D-76297 Stutensee, Tel.07244 20500-0, www.hilo-test.de

Kalibrierzeichen *Calibration mark*	**1704095**
	CAL ISO 9001
	2020.02

1. Kalibriergenestand / *Calibration device*
CAR-TE14 II

2.* Kalibrierverfahren / *Calibration method
Das Kalibrierverfahren ist in AW_calib.docx übereinstimmend mit der ISO7637-2 und ISO16750-2 dokumentiert.
The calibration procedure is documented in AW_calib.docx consistent with the ISO 7637-2 and ISO16750-2.

3.* Umgebungsbedingungen / *Calibration conditions
Umgebungstemperatur / *Ambient temperature*: (21 ± 2) °C
Relative Luftfeuchte / *Relative humidity*: (55 ± 20) %

4.* Messbedingungen / *Measurement conditions
Anschlussfeld / *Connector panel:* Front- + Rückseite / *front+ back panel*
Starteinstellungen / *Start-up conditions:* keine / *none*
Messwerterfassung / *Measurement value acquisition:* automatisiert / *automated*

5. Messunsicherheiten / *Measurement uncertainty*
Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsichheit durch Multiplikation mit dem Erweiterungsfaktor k = 2 ergibt. Sie setzt sich aus den Messunsicherheiten der Messgeräte und dem des Kalibrierverfahrens während der Kalibrierung zusammen. Ein Anteil für die Langzeitstabilität des Kalibriergegenstandes ist nicht erhalten. Der gemessene Wert liegt mit einer Wahrscheinlichkeit von 95% im zugeordneten Wertintervall. Dimensionslose Messunsicherheiten beziehen sich auf den Kalibrierwert.
The measurement uncertainty is made of standard uncertainty multiplied with a coverage factor k = 2. It consists of the uncertainty of measurement equipment and the uncertainty of the calibration method during the calibration. There is no long-term stability included. The measured data is with 95% probability in range. Non-dimensional measurement uncertainty are related to measured data.

Uncertainty of measurements (Surge)	
Open circuit peak voltage	2,70 %
Risetime /tr	3,88 %
Pulsewidth /th	3,71 %

6. Durchgeführte Zusatzarbeiten / *Additional work*

☐ Reparatur / *Repair* ☐ Reinigung / *Cleanup* ☐ Abgleich / *Adjustment*

7. Konformitätsaussage (Auslieferung) / *Statement of compliance (outgoing)*

Die ermittelten Messwerte liegen / *The measurement results show*

☐ innerhalb der Spezifikationen / *conformity*

☐ außerhalb der Spezifikation / *out of specifications (X)*

8. Rückführbarkeit der verwendeten Messeinrichtungen / Traceability of measurement systems

Mesurement device	**Type**	**Hilo-Test Inventory-No.**	**DAKKS No.**	**Calibration date**	**Calibration valid to**
Messgerät	**Type**	**Hilo-Test Inventar-Nr**	**DAKKS Nr.**	**Kalibrier Datum**	**Kalibrier gültig bis**
Digital Voltmeter, 5 ½ Digit	HP 34401a	# 490039	D-K-15180-01-00	11.07.2017	11.07.2018
Oszilloscope	RTE1102	# 410256	D-K-15180-01-00	12.07.2017	12.07.2018
Voltage divider	HVT20-RCR	# 410253	D-K-15070-01-01	03.07.2017	03.07.2018

9. Messwerte / *Measurement results*

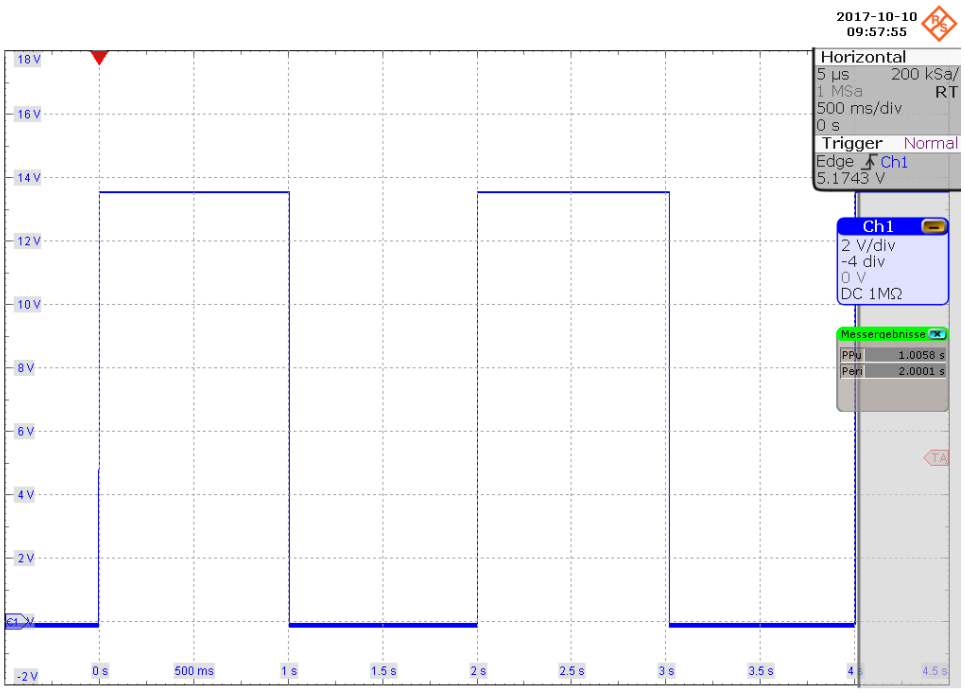
9.1 Time settings test of the Power Switch

Tolerance: ±2%

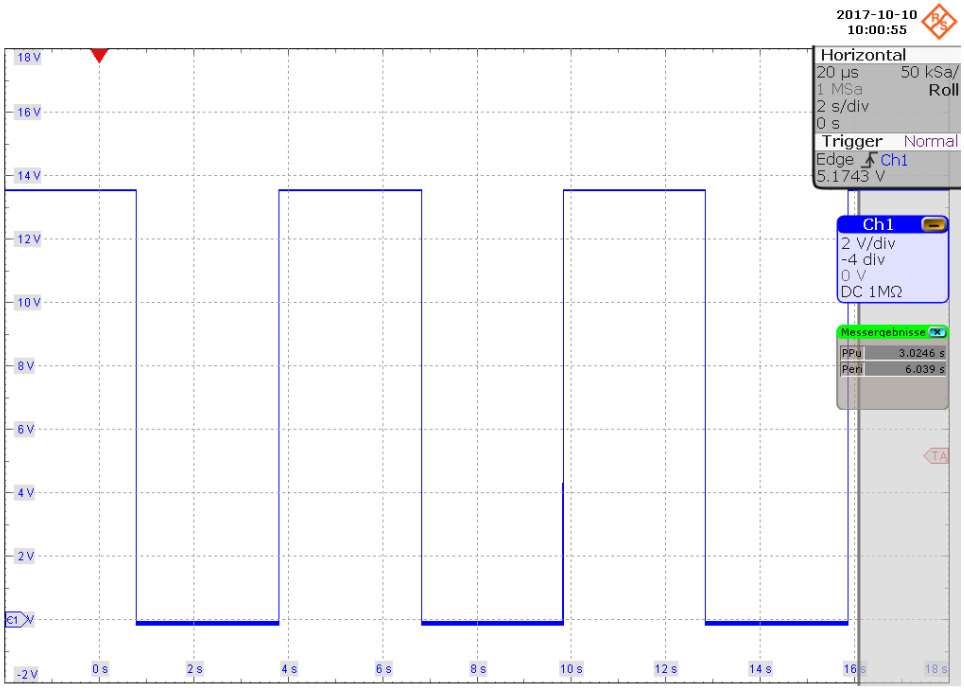
Test setup: Slow pulses, Switch type: mechanically, Mode: auto
(mechanically – switch left)

Settings		Measurement	
period	t_{off}	period (±2,5%)	t_{off} (±2,5%)
2s	1s	2,0s	1,006s
6s	3s	6,04s	3,02s

T= 2s / t_{off} = 1s



T= 6s / t_{off} = 3s



Test setup: Fast pulses, Switch type: electronically, Mode: auto
(electronically – switch right)

Settings		Measurement	
period	t_{off}	period (±2,5%)	t_{off} (±2,5%)
200ms	100ms	200,01ms	100,04ms
1s	0,5s	1,0s	500,04ms

T= 200ms / t_{off} = 100ms

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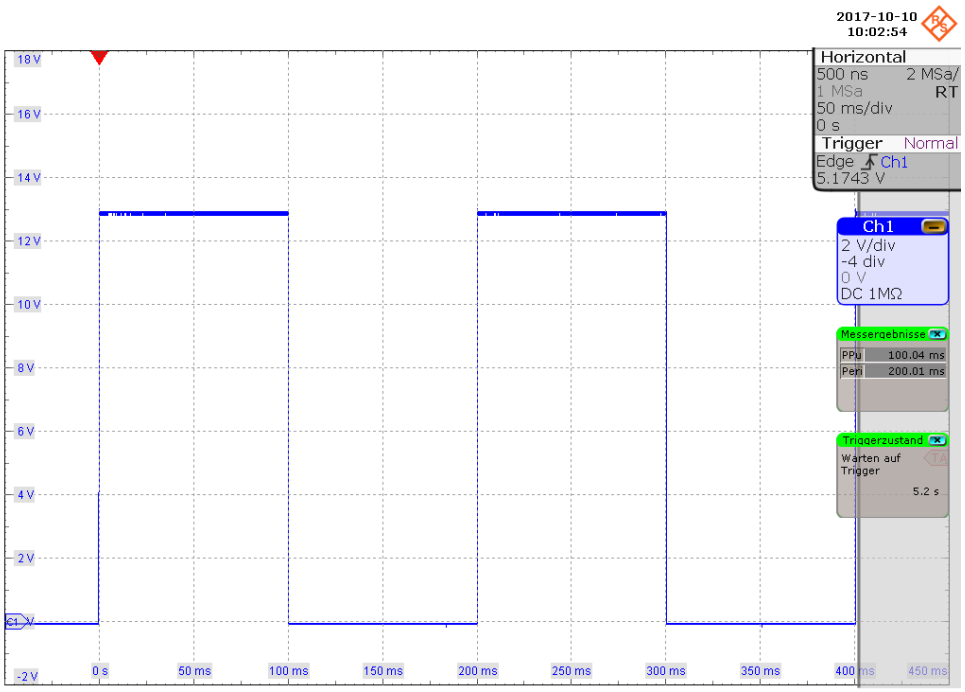
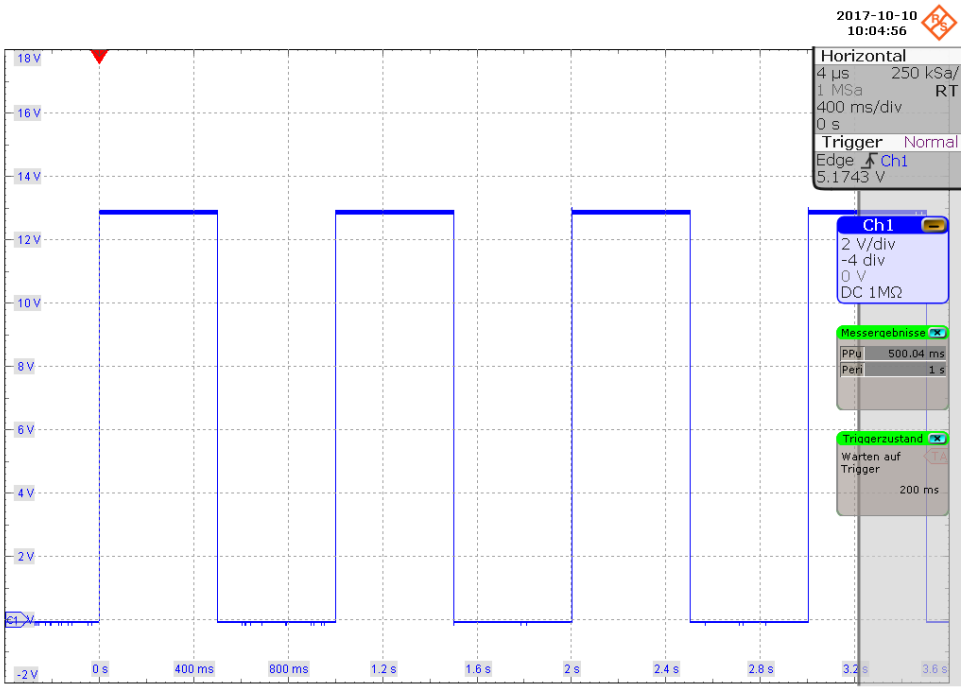


T= 1s / t_{off} = 0,5s



9.2 Voltage Drop *electronically* switch

Settings: 25A, Drop ≤ 2V

Switch right		Switch left	
U_{IN}	U_{OUT}	U_{IN}	U_{OUT}
3,29V	2,00V	3,29V	2,02V
Drop: 1,29V		Drop: 1,27V	

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