Manual

For Operation

UCS 500Nx

The ultra-compact simulator
and its system modules

UCS 500 N5
UCS 500 N7

Modules for Telecom surge
Tsurge5 / Tsurge7
CNT 508 / CNT 516

UCS500Nx - designed as a modular system - is the most intelligent solution offering exactly what you need for full-compliant immunity tests against transient and power fail phenomena. The distinct operation features, convenient DUT connection facilities, a clearly arranged menu structure and display philosophy as well as the pre-programmed standard test routines make testing easy, reliable and safe. Extendable by a variety of test accessories the UCS 500Nx is a universal equipment for abroad range of recommendations even for three-phase applications up to 100A

EN/IEC 61000-4-4
EN/IEC 61000-4-5
EN/IEC 61000-4-8
EN/IEC 61000-4-9
EN/IEC 61000-4-11
EN/IEC 61000-4-12
EN/IEC 61000-4-29
EN 61000-6-1
EN 61000-6-2

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Contents

1. Model Overview

The following manual is based on the following or later firmware:

- UCS 500N5 : V 5.00xx
- UCS 500N7 : V 8.00xx
- UCS 500N7 : V 9.00xx Supports ANSI A/B coupling method. Requires IEC.control V 5.2.3.0 or higher

Devices with the Firmware

- UCS 500N5 : V 4.40**u**xx
- UCS 500N7 : V 7.40**u**xx

Have a reduced PFS function of the PFS module. For UCS generators with this firmware version exist a separate manual with the version 5.09. This manual can be ordered at EM TEST if required.

1.1. UCS Models

Standard models

Model	U pulse	CDN		Remarks	
UCS 500N5	5.5kV	300V	16A 1- ph		
UCS 500N5.1	5.5 kV	300V	32A 1- ph	+ Tsurge	6HU
UCS 500N7	7kV	300V	16A 1- ph	DC 300V / 16A ANSI	
UCS 500N7.1	7kV	300V	32A 1- ph	DC 300V / 32A ANSI	9HU

Additional extensions

TSurge5	4kV	Built-in 10/700us pulse module up to 5kV,	ITU K22 & IEC 61000-4-5
TSurge7	6kV	External 10/700us pulse module up to 7kV,	ITU K22 & IEC 61000-4-5

UCS500N with one built in module

The device includes only one module Surge, Burst oder Power Fail. The technical data are identical with the standard UCS500N5. An extension with additional modules is not possible.

UCS500N5V	5kV	UCS500 mit Surge Modul
UCS500N5E	5.5kV	UCS500 mit EFT Burst Modul
UCS500N5P	--	UCS500 mit Power Fail Modul

Module for UCS500N7

Modul	Remarks
EFT/N7	Built-in 5.5kV BURST MODULE
VCS/N7	Built-in 7.0kV SURGE MODULE
PFS/N7	Built-in POWER FAIL MODULE 300 volts/ 16 amps. Mandatory for EUT power switch off
RWG/N7	Built-in Ring Wave Module 6 kV / 100 kHz as per ANSI (not available for UCS 500N7.1 or UCS 500N7.2)
TSurge7	External 10/700us pulse module up to 7.0kV, ITU K22 & IEC 61000-4-5

Special models

Model	V Pulse	CDN		Remarks
UCS 500N5.2	5.5kV	400V	16A 1- ph	
UCS 500N5.3	5.5 kV	400V	32A 1- ph	
UCS 500N5.4	5.5kV	300V	16A 1- ph	DC 300V 16A
UCS 500N5.5	5.5 kV	300V	32A 1- ph	EFT/5 and VCS/5 10Ω/40Ω for supply lines EN 55121-3-2:2006 (Railway)
UCS 500N5.6	5.5 kV	300V	32A 1- ph	EFT/5 VCS/5 and PFS/5 10Ω/40Ω for supply lines EN 55121-3-2:2006 (Railway)
UCS 500N5.7	5.5kV	300V	16A 1- ph	EFT/5 and VCS/5
UCS 500N5.8	5.5kV	300V	16A 1- ph	EFT/5 and PFS/5; 1ph CDN 300V/16A
UCS 500N5.9	5.5 kV	300V	16A 1- ph	10Ω /40Ω for supply lines EN 55121 (Railway)
UCS 500N5.10	5.5kV	690V	16A 1- ph	VCS/5 without built-in coupler
UCS 500N5.11	5.5kV	690V	16A 1- ph	EFT/5, VCS/5 / Tsurge
UCS 500N7.2	7kV	400V	16A 1- ph	EFT/7, VCS/7, PFS/7 (ANSI)
UCS 500N7.3	7kV	300V	16A 1- ph	EFT/7, VCS/7, PFS/7 (ANSI)
UCS 500N7.6	7kV	690V	16A 1- ph	EFT/N7, VCS/N7, RWG/7, without built-in coupler! AC Voltage 690V
UCS 500N7.7	7kV	690V		EFT/N7, VCS/N7, without built-in coupler! AC Voltage 690V(p-p)
UCS 500N7.8	7kV	400V	16A 1- ph	EFT/N7, RWG/N7 (output impedance 12 and 25 ohm); (ANSI)
UCS 500N7.9	7kV	690V		EFT/N7, VCS/N7, RWG/7 (Ri 12Ω & 50Ω), no built-in coupler, 690V(p-p)
UCS 500N7.10	7kV	690V		VCS/7, no built-in coupler! Application Voltage 690V(p-p)

Other models up to 2009

Model	Name up to 2008	Pulse voltage	CDN	
UCS 500 N4.1	UCS 500 M4 S1	4kV	250V	32A single phase
UCS 500 N6	UCS 500 M6B	6kV	250V	16A single phase
UCS 500 N6.1	--	6kV	250V	32A single phase
UCS 500 N6.3	--	6kV	480V	32A single phase

Models up to 2008

Model	Pulse voltage	CDN		
UCS 500	4kV	250V	16A single phase	upgrade version
UCS 500 M4	4kV	250V	16A single phase	
UCS 500 M6	6kV	250V	16A single phase	
UCS 500 M6A	6kV	250V	16A single phase	

Special models

Special models have the index UCS500Mx **S**x. The difference to the standard models are: Voltage- and current ranges. The operation is the same as by the standard UCS equipment's.

Model	Pulse voltage	CDN		
UCS 500 M4 S1	4kV	250V	32A single phase	
UCS 500 M4 S2	4kV	690V	16A single phase	
UCS 500 M4 S3	4kV	690V	32A single phase	
UCS 500 M4 S5	4kV	280V	16A single phase	
UCS 500 M6 S2	6kV	690V	16A single phase	ANSI

Model	Pulse	EUT	Modules
UCS 500 M6B S1	6kV	250V 32A	EFT/6, VCS/6 and PFS/6; 1ph CDN 250V / 32A (ANSI) module RWG/6 not available
UCS 500 M6B S2	6kV	690V 16A	EFT/6, VCS/6 and PFS/6; 1ph CDN 690V / 16A (ANSI) 480V dc module RWG/6 not available

1.2. Standards covered by UCS N Series

A fully equipped UCS 500N covers the following standards

		UCS 500	N5	N7
- IEC 61000-4-4	**Burst**		**X**	**X**
- IEC 61000-4-5	**Surge**		**X**	**X**
- IEC 61000-4-8	**50/60Hz Magnetic Field**		**X**	**X**
- IEC 61000-4-9	**Pulse Magnetic Field**		**X**	**X**
- IEC 61000-4-11	**Voltage Dips** **Voltage Interruptions** **Voltage Variations for ac power mains supply**		**X**	**X**
- IEC 61000-4-12	**Ringwave**			**X**
- IEC 61000-4-29	**Voltage Interruptions** **Voltage Dips for dc power supply systems**		**X**	**X**
- ANSI	**Surge with 2Ω coupling**			**X**
- ITU and ETS	**Telecom Surge**		**(X)**	**(X)**
- FCC	**Part 68**		**(X)**	**(X)**

2. Safety information

Attention

Before using this equipment, read the operating manual and the separate delivered **safety manual** carefully

3. Operating Functions

3.1. Front view

1	Display	**6**	Exit	**11**	HV pulse Burst output 50 Ω
2	Function keys "F1..F7	**7**	Escape	**12**	Ground reference
3	"Test On"	**8**	CRO U (surge)	**13**	Coupling (Burst, Surge and EFT)
4	Knob (Inc / Dec	**9**	CRO I (surge)	**14**	Channel PF1 and PF2
5	Cursor keys "←" and "→"	**10**	CRO Trigger output ↑ 5V	**15**	EUT test supply

1 Display
All functions and parameters are displayed (8 lines with max. 40 characters).

2 Function keys "F1 .. F7"
Parameters and functions, displayed in the lowest line, can be selected with the related function key.

3 Test On
By pressing the key "Test On" the test procedure is initiated with the preselected parameters. The red LED indicates the trigger of a burst event.

4 Knob (Inc / Dec
The knob increments or decrements test parameters with a numeric value or selects from a list of parameters.

5 Cursor keys
Parameters and functions can be changed on-line. The selection of these parameters is realized with the cursor moving to the left or to the right.

6 Exit
Pressing of the Exit function will cause a reset of the firmware. This is only possible if no test routine is running.

7 ESC
When pressing the ESC button the user moves back one page in the menu.

8 CRO U (surge)
At the BNC output the voltage pulse (surge) of the generator can be measured.
The max. output level is 10V ±10% at 5 kV / 7kV output voltage.

9 CRO I (surge)
At the BNC output the current pulse (surge) of the generator can be measured.
The max. output level is 10V ±10% at 2.5 kA / 3.5kA output current.

10 BNC - CRO Trigger
At the BNC output the generator trigger can be checked, e.g. the burst duration, the burst repetition rate and the spike frequency (+5 V rectangular). This output can be generally used as oscilloscope trigger output and is synchronous to the following events.
- Burst and surge release
- Voltage dip or interruption, start of the event

1	Display	**6**	Exit	**11**	HV pulse Burst output 50 Ω
2	Function keys "F1..F7	**7**	Escape	**12**	Ground reference
3	"Test On"	**8**	CRO U (surge)	**13**	Coupling (Burst, Surge and EFT)
4	Knob (Inc / Dec	**9**	CRO I (surge)	**14**	Channel PF1 and PF2
5	Cursor keys "←" and "→"	**10**	CRO Trigger output ↑ 5V	**15**	EUT test supply

11 HV pulse burst output 50 Ω
External coupling devices such as the capacitive coupling clamp and the 3-phase coupling network are connected to the coaxial 50 ohm output. Also the calibration of the generator is handled at this output.
Note: The burst signal is present on this output at every coupling mode.

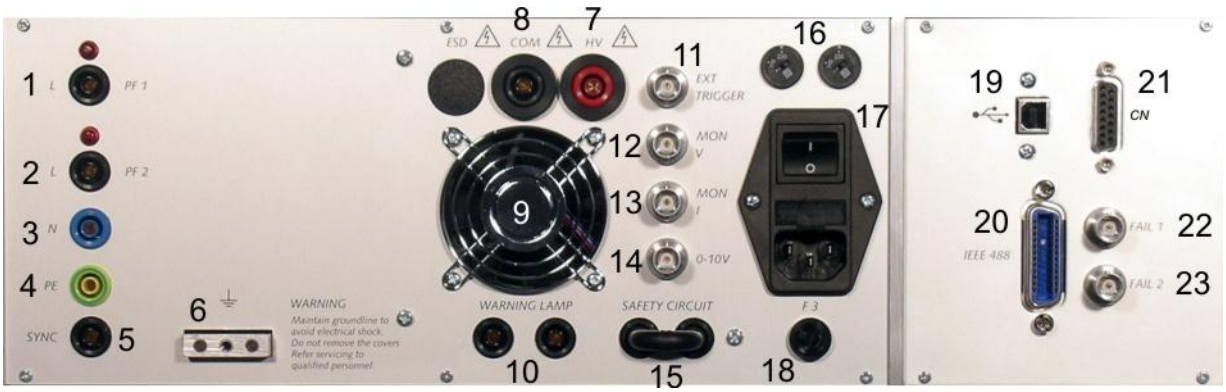
12 Ground reference
During test or calibration procedure the burst generator must be grounded to the reference ground plane

13 Coupling mode
The actual coupling mode is indicated by LED

14 Channel PF1/PF2
This LED indicates the channel mode during the power fail test.

15 EUT test supply
For single-phase EUT the coupling/decoupling network is part of the generator. The EUT is powered via the safety banana plugs at the front panel of the simulator.

3.2. Rear view



1 Test supply input; channel PF1 together with the red lamp for phase indication
2 Test supply input; channel PF2 together with the red lamp for phase indication
3 Test supply input neutral
4 Test supply input PE
5 Sync input

1 Test supply PF1
The phase of the power supply for the EUT is connected to the banana connector PF1. The phase L is conducted to the EUT voltage supply via PF1 if channel PF1 is selected in the set-up menu.
To guarantee a correct function of the synchronization the phase shall be connected to this input. The red lamp than shall be alighted.

2 Test supply PF2
This input is generally used for the reduced dip voltage for testing as per IEC 61000-4-11. At this PF2 input a variac transformer is connected with a reduced voltage, e.g., 0-250V. A motor driven variac transformer can be controlled via a 0-10V analogue control output.
To guarantee a correct function of the synchronization the phase shall be connected to this input. The red lamp than shall be alighted.

3 Test supply neutral (PF1/PF2)
The neutral line of the power supply for the EUT is connected to the banana connector N.

4 Test supply PE (PF1/PF2)
The protective earth line of the power supply for the EUT is connected to the banana connector PE.

5 SYNC input
An ac voltage to which the events shall be synchronized is connected to this input. If no voltage is available the tests are started automatically in asynchronous mode. Normally this input shall be connected directly to L of the channel PF1. Umax. Sync = Umax. EUT

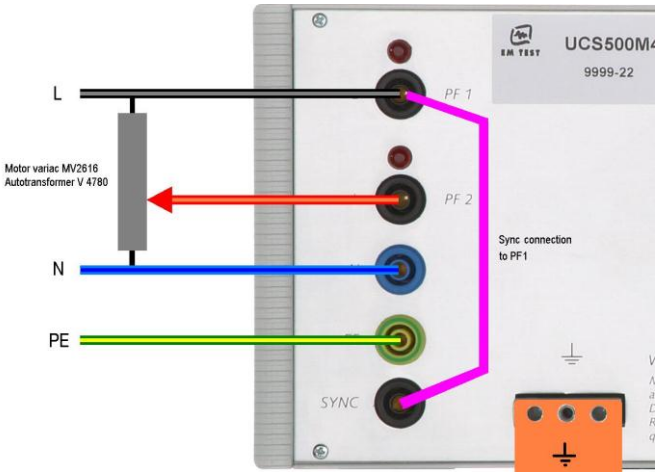
Connection EUT supply

The EUT power supply is normally connected to the UCS plugs PF1, N and PE

A tap of a motor variac transformer or adapting transformer for power fail testing is connected to the connection PF2.

The phase synchronisation SYNC must be connected to PF1. By missing this connection all tests runs in asynchronous mode with no phase angle adjust for pulse release.

The earth bolt must be connected to the ground reference.



6 Reference Earth connection
7 HV output for Surge pulse
8 Common output for Surge pulse
9 Ventilation
10 Warning lamp
11 External trigger
12 BNC connector MON U
13 BNC connector MON I

6 Reference earth connection
The generator has to be connected to the reference earth plane of the test set up. The connection at the rear part of the generator is an alternative to the grounding point at the front panel

7 HV output
The coax plug is the HV HIGH output of the simulator. It is used for external coupling/decoupling networks.

8 COM output
The Com output is the HV LOW output of the simulator. The output is floating

Attention

The direct output of the surge generator is located at the rear panel of the instrument, HV and COM. It is not allowed to connect these outputs to any other coupling/decoupling network than manufactured by EM TEST, e.g. the types CNV and CNI. Before to connect any external networks to this output the operator must contact the manufacturer. Any damages due to this matter are not covered by warranty.

The direct pulse output shall also not be used to connect the generator directly to any power conducting lines

The wave shape measured at the direct pulse output must not be within the tolerances specified in IEC 61000-4-5. The pulse shape shall be verified at the CDN output directly, no matter whether it is an internal or external CDN.

9 Ventilation
After long term duration tests the generator should keep on running for some minutes to cool down the system.

10 Warning lamp
A voltage free contact is available for external warning indications (warning lamp). The signal is generated after pressing TEST ON.

11 External trigger
One single event, burst, surge, voltage dip or ESD can be released. Trigger level 5V positive going.

12 BNC connector MON U
At this BNC connector the output power supply voltage for the EUT can be measured. Ratio 100:1 ± 5%.
Impedance measuring instrument : ≥ 1MΩ.

13 BNC connector MON I
At this BNC connector the output current for the EUT can be measured, e.g. the nominal current or the peak inrush current. The rating is 10mV/A ± 5%. Maximum current = 1000A
Impedance measuring instrument : ≥ 1MΩ.

14 Control output 0-10V
15 Security circuit
16 Mains selector 115V / 230V
17 Power on switch
18 Fuse of the high voltage power supply
19 Serial interface USB
20 Parallel interface IEEE
21 Remote control connector
22 FAIL 1
23 FAIL 2

14 Control output 0-10V
The voltage is used to control external power sources. The source is normally connected to the channel PF2 (normally a motor driven variac transformer). The voltage level is selectable via the operating facilities of the UCS 500M. The voltage level can also be selected within the service menu under the function „setup.
This output is not mounted on UCS500N5E and UCS500N5V.

15 Safety circuit
The test can only be started if the security circuit is closed. If the circuit is opened during a running test the simulator will be switched off immediately.

14 Mains selector
Selection of 115V / 230V

17 Power on switch
The switch is part of the mains filter. Mains fuses are part of the filter. (230V / 1A and 115V / 2A)

18 Fuse of the high voltage power supply
The high voltage power supply is protected by this fuse „F3“. In case that no high voltage is generated but the control unit works properly this fuse shall be checked.

19 USB interface
USB interface “USB B” connector. For data-transfer a USB interface is available. The internal RS 232 interface is converted to USB standard. Therefore the user must set the same baud-rate in the device and control software.
Using the USB interface may cause EMC problems during burst tests at the computer or notebook side of the communication line. Therefore a high quality USB cable (USB 2.0 standard) shall be used.

20 Parallel interface GPIB / IEEE 488
IEEE 488 interface with IEEE connector

21 Remote control connector CN
External coupling devices are controlled via this remote control connector.

22 Fail detection FAIL 1 EUT control (TEST STOP
Grounding this input will cause a complete stop of the running test procedure. (+15V to ground) The test must be completely restarted.

23 Fail detection FAIL 2 EUT control (TEST PAUSE
Grounding this input will cause a break for the running test procedure (+15V to ground).The test will be continued when the input is no more connected to ground.

4. Operation

4.1. Description of the menus

The simulator is operated by an easy menu control system. Seven function keys are available to select parameters and functions. All functions are indicated on the display; max. 8 lines and 40 characters.

The selected parameter is blinking and can be changed by turning the knob (incr./decr.).

←→ : The digit for change can be selected with the cursor (←→).
- Selected values are direct indicated on the screen.
- Status on the bottom lines shows the desired status after pressing the function key.

ESC : ESC will take you back to the previous level in the menu and set the displayed values. The latest settings are stored automatically and will be recalled when the menu is selected again.

EXIT : The firmware will reset to the main screen.

EM TEST	Burst Surge Power Fail
UCS 500 N5	
Ultra Compact Simulator V 5.00a02	SWN: 001234

The serial number and the version number SWN are used for traceability reasons. These numbers are listed in the test reports and calibration certificates. These numbers also are listed within the test reports generated by the IEC.control software.

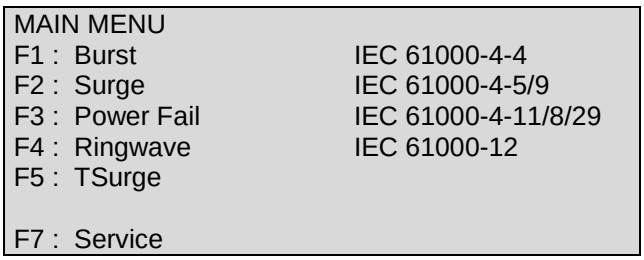
Start-up display example UCS 500N5. The models type is displayed after startup.

4.2. Menu structure

Level 0...4

Level 0	Level 1	Level 2	Level 3	Level 4
MAIN MENU **F1** BURST IEC 61000-4-4 **F2** SURGE IEC 61000-4-5/9 **F3** PFS IEC 61000-4-11/8/29 **F7** SERVICE	**Burst** IEC 61000-4-4 **F1** Quick Start **F2** Standard routines **F3** User test routines	**Quick Start** **F1** Start **F2** Change **F3** Continue	**Start** Start the test routine **Change** Select all parameters **Continue** Continue the test routine	
	Surge IEC 61000-4-5/9	**Standard routines** Preprogrammed test routines as per standard requirements	**Standard routines** **F1 : F4** IEC 61000-4-4 Level 1-4 **F5** Generic Standard EN 61000-6-1 **F6** Generic standard EN 61000-6-2 **F7** Manual standard routine	**Standard routines F1..F3** **F1** Start **F2** Change **F3** Continue
	Power Fail IEC 61000-4-8/11/29	**User test routines** Preprogrammed test routines for evaluation and design support	**F1** Synchronous to the mains **F2** Random burst release **F3** Change V after T by ΔU **F4** Frequency sweep I **F5** Frequency sweep **II** **F6** Frequency sweep III **F7** Change polarity after T	**User test routines F1..F3** F1 Start F2 Change F3 Continue
	Service **F1** Addresses **F3** Setup **F4** Change standard levels	**Setup** **F1** Change language **F2** LCD backlighting **F3** Interfaces **F4** ESD/keyboard beeper **F5** Running time clock **F6** Set voltage **F7** Magnetic field factors	**Change language** Gern or English **LCD backlighting** On, Off or Auto **Interfaces** Select all parameters **ESD/keyboard beeper** (on, off) **Running time clock** Display of the TEST ON time **Set voltage** (ext. motor variac) **Magnetic field factors** Correction factors for magnetic field antenna and current transformer	
		Change standard level	**Change standard level** **F1** All parameters to standard level **F2** IEC 61000-4 **F3** EN 61000-6-1 **F4** EN 61000-6-2	**Change standard levels** **F1** IEC 61000-4-4 Burst **F2** IEC 61000-4-5 Surge ...

4.3. Main Menu



F1 Burst test
With function key F1 the user can select Burst Test as per **IEC 61000-4-4** . The test pulses are fast transients with a pulse shape of 5/50ns.

Attention: The generator covers the new specifications given in the draft revision IEC 61000-4-4 edition 2. This means a new spike frequency which is selectable between 5kHz and 100kHz. The burst duration is automatically matched between 15ms and 0.75ms. The common mode coupling is new with all couplings at the same time.

F2 Surge test
With function key F2 the user can select Surge Test as per **IEC 61000-4-5** . The test pulses are high energy pulse with a voltage shape of 1,2/50µs and a short circuit current shape of 8/20µs.
In addition the test procedure for Pulse Magnetic Field testing as per **IEC 61000-4-9** is included in this menu.

F3 Power Fail test
With function key F3 the user can select the Power Fail Test as per **IEC 61000-4-11**.

The simulator will generate voltage dips and voltage variations with preselectable parameters. **IEC 61000-4-11** is valid for ac power supply systems. For dc supply system in future **IEC 61000-4-29** shall be recommended.

In addition the test procedure for 50/60Hz Magnetic Field Testing as per IEC 61000-4-8 is included within the menu.

The Power fail menu includes a **Voltage Variation** test as per IEC 61000-4-11 as test procedure. The simulator will generate voltage variations in the second range.

Attention: The generator covers already the new specifications given in FDIS IEC 61000-4-11: 2004. This means the introduction of a new 80% test level as well as a new function for the Voltage Variation test.

F4 Ringwave as per IEC 61000-4-12 (UCS500 N7)
With function key F4 the user can select the Ring Wave Test as per **IEC 61000-4-12** or **ANSI/IEEE.** The test pulses are single-shot with an oscillating and decaying waveshape.

F5 Telecom Surge Test
With the Option TSurge a Telecom Surge pulse 10/700µs as per IEC 61000-4-5 , ITU, ETS or FCC part 68 Pulse B is available.

F7 Service
Setup and servicing routines are available.

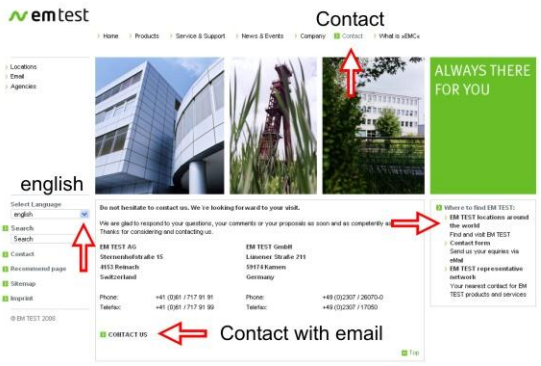
4.4. Service

SERVICE
F1 : Addresses
F3 : Set-up
F4 : Change standard levels
F7 : Status

F1 F2 F3 F4 F5 F6 F7

F1 Addresses
The addresses of the EM TEST AG and the EM TEST GmbH are shown. The addresses of all EM TEST sales agencies are listed on the web site of EM Test under :

www.emtest.com



F3 Set-up
The software will clearly explain the set-up procedure.

F4 Change standard levels
The stored standard test levels can be changed within this menu.

SERVICE Change standard levels
F1 : Reset all standard levels
F2 : IEC 61000-4
F3 : EN 61000-6-1
F4 : EN 61000-6-2

F1 F2 F3 F4 F5 F6 F7

The user can change the stored standard levels

F1: Set all parameters acc to standard The stored standard test levels can be changed within this menu. The settings are actualized to the standards dated in summer 2004.

F2: IEC 61000-4

F1: IEC 61000-4-4	Burst
F2: IEC 61000-4-5	Surge
F3: IEC 61000-4-8	Magnetic field AC
F4: IEC 61000-4-9	Magnetic field Surge
F5: IEC 61000-4-11	Power Fail AC
F6: IEC 61000-4-29	Power Fail DC

F3: EN 61000-6-1 Generic

F1: EN 61000-6-1	Generic Burst
F2: EN 61000-6-1	Generic Surge
F3: EN 61000-6-1	Generic Power Fail

F4: EN 61000-6-2 Generic

F1: EN 61000-6-1	Generic Burst
F2: EN 61000-6-1	Generic Surge
F3: EN 61000-6-1	Generic Power Fail

F7 Status
Status information of the equipment.

UCS500N5 UCS500N7

Page 1

UCS500N5 V5.00 005000	Built in Modules
Operating 00000035.53 hrs Test time 00000015.53 hrs	DI-Status 0000 SCR-Status 0000

Model Version SW Number	Burst Surge Power Fail	Ringwave Int. 1Ph
Information of operating	Status information	

Page 2

Keyboard Beep Countdown Beep Backlighting	off off 5 min		RS 232 IEEE	19200 15
DAC adjust +0, +0 +0, +0 +0, +0	Voltage V Vn CH	264 230 PF1	H-field Af Tf If	

Setup information	Interface information	
DAC Adjust	Parameter Set voltage	H-filed parameter

4.5. Setup

SETUP
F1 : Change language / Sprache ändern
F2 : LCD backlighting
F3 : Interfaces
F4 : Beep
F5 : Timer
F6 : Set voltage
F7 : Magnetic field correction factors

F1 F2 F3 F4 F5 F6 F7

F1 Change language
The user can chose between two languages, German and English.

F2 LCD backlighting
With the use of F2 the backlighting can be switched on or off.
Additionally the **Auto Off** function can be programmed to switch off the backlighting after a defined time that the equipment has not been in operation (1 - 30minBecause of the limited lifetime of LCD displays, approx. 10,000h this function should always be activated.

F3 Interfaces
This menu will help the user to define the status of the integrated serial and parallel interfaces, e.g. the baud rate of the RS 232 or the address of the IEEE interface.

F4 Beep
F1 is the selector for the keyboard beeper ON/OFF mode. (Short beep at every keyboard hit)
F3 is the selector for the countdown-beeper ON/OFF mode. (Short beep before surge pulse releasing)
To indicate that a running test is finished the beeper sounds always 3 times (not changeable).

F5 Operating time
Pressing of F5 will show the different operating time and status of the test equipment.
Operating time : Total time where the UCS is powered on.
Testing Time : Total time during a running test.
DI – Status : Service information about internal digital inputs.
SCR – Status : Service information about surge switch operation

F6 Set voltage
For control of an external power supply source an analogue control voltage can be programmed (0-10V dc).
The operator can specify the following parameters:

F1: **Max. variac voltage** V [V] Maximal output voltage at 100% position of the external motor variac or dc controlled voltage source. The analogue reference value for the max. voltage is 10V.

F2: **Mains supply voltage** V [V] of the device under test. This voltage shall be specified by the operator and depends on the type of equipment under test. The variac normally is automatically set to this output voltage.

F3: **Default channel**. The operator select the default channel PF1 or PF2 from which the EUT is powered.

F7 Magnetic field correction factors

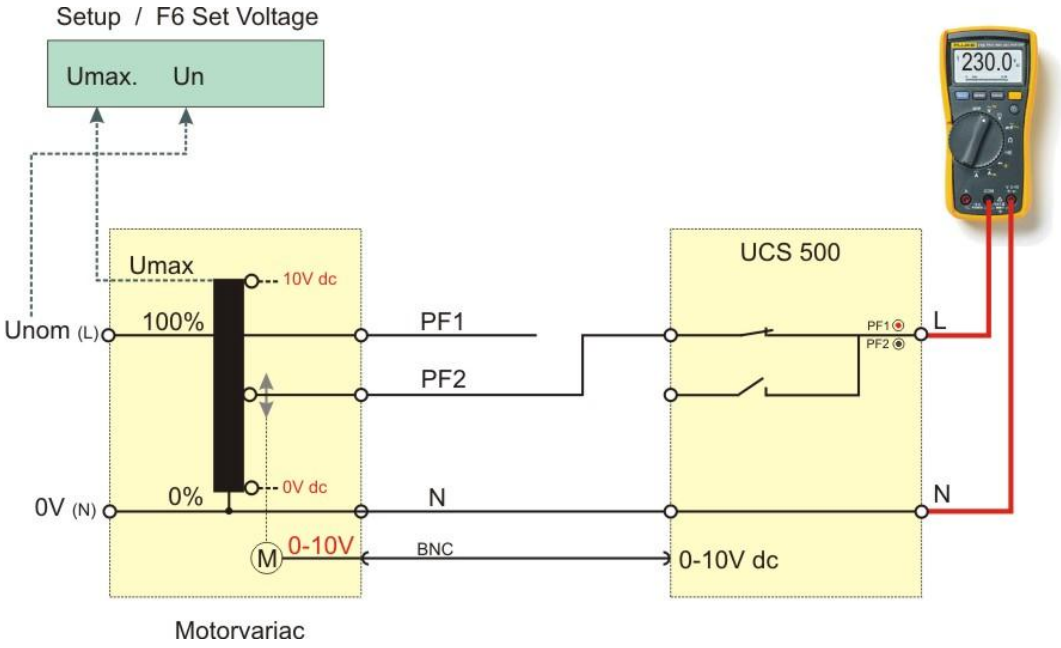
F1 : Coil factor	Af [A/m]	Range [0.20...9.99	step 0.01]
F2 : Transformer factor	Tf [A/V]	Range [0.020...9.999	step 0.001]
F3 : Impedance factor	If [A/V]	Range [0.20...1.00	step 0.01]

These values are delivered together with the necessary options to conducted magnetic field testing.

- Coil factor depends on the type of antenna which is used for the test.
- Transformer factor depends on the type of transformer which is used for the test.
- Impedance factor depends on the type of surge generator which is used for the test. A generator with a source impedance of 2Ω needs an impedance factor of approx. If = 0.5

4.6. Setup procedure for Set voltage

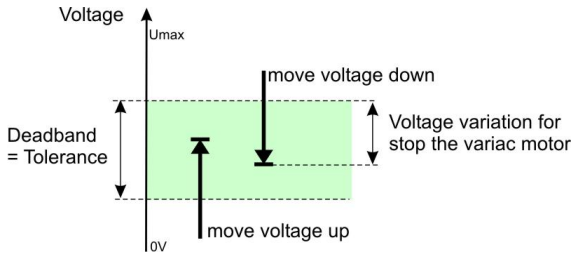
The UCS 500 is able to control an external voltage source. The output voltage is a 0-10V analogue dc signal. The 10V level corresponds to the max. output voltage of the connected voltage source. For the correct setting it is necessary to know the max. output voltage of the source. For setting for ac or dc source the same procedure is necessary.



Setup for adjust the external voltage variac to the UCS 500Nx

The voltage setting is a regulating procedure where one winding of the motor-variac is approx. 1.9V. Additionally the control needs some mechanical tolerance for stop the step motor. Therefore the selected voltage is normally in a tolerance of ±3V

The motor-variac control has an internal deadband where the voltage will not be adjusted.



The following procedure will guide the user through the Set Voltage procedure.
The setting for Umax and Un are listed in the boxes below. After each setting the user has to **press the ESC button** for make the setting.

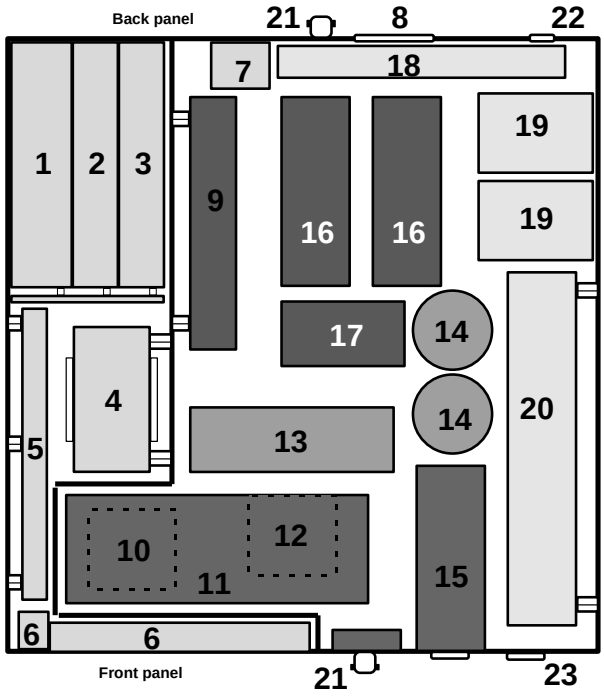
Step	Umax.	Un	CH	Remarks	
A	--	--	PF2	Set the UCS 500 to PF2 mode for measure the variable voltage	
B	100	100	PF2	The variac moves to his max. voltage. (10V dc at the 0-10V output) Read Umax. voltage from the voltmeter. (MV2616 approx. 257V)	
C	Umax	230	PF2	Enter Umax. and set Un to 230V (115V)	
D	Umax	100	PF2	Check the 100V at the voltmeter.	Tolerance ±3V
E	Umax	0	PF2	Check the 0V at the voltmeter.	Tolerance < 2V
F	Umax	100	PF2	Check the 100V at the voltmeter.	Tolerance ±3V
G	Umax	230	PF2	Check the 230V at the voltmeter.	Tolerance ±3V

If the output voltage is not inside the tolerance or you like to make a better adjustment:
- Change the Umax voltage and restart the check procedure from step C to G.

5. Test Equipment UCS 500N

The simulator UCS 500N is separated in different main parts. The control unit is screened to all other parts.

5.1. UCS 500 N5



Control unit

1 Power supply board
2 Interface board
3 Controller board
4 Power supply transformer
5 Filter board / connecting board
6 Keyboard / LCD- display
7 General power supply input, filter
8 Ventilation

High voltage unit

9 High voltage power supply
10 Storage capacitor
11 HV- board
12 ESD controller board
13 Surge switch-board
14 Coupling capacitors for surge mode
15 High voltage switch for burst mode
16 Power switches for voltage dip mode PF1, PF2
17 Current sensor

Coupling/decoupling unit

18 Filter board
19 Decoupling chokes
20 Coupling/decoupling network
21 Measuring and control output
22 Input for the power mains supply of the EUT
23 Output for the EUT supply

5.2. UCS 500 N7

Control unit

1 Power supply board
2 Interface board
3 Controller board
4 Power supply transformer
5 Filter board / connecting board
6 Keyboard / LCD- display
7 Measuring and control outputs
8 General power supply input, filter
9 Ventilation

High voltage unit

10 High voltage power supply
11 Surge/Burst storage capacitor
12 Ringwave storage capacitor
13 HV switching board
14 Burst module
15 Surge module
16 Ringwave module
17 Power Fail module

Coupling/decoupling unit

18 Surge/Ringwave coupling capacitors
19 Coupling network
20 Decoupling chokes
21 Filter board for the EUT supply
22 Input for the EUT supply
23 Output for the EUT supply

6. Technical data

6.1. EFT Electrical Fast Transients Burst as per IEC 61000-4-4

Test Level	**Model N5**	**Model N7**
Open circuit *	200V - 5500V ± 10% Step 20V	200V – 5500V ± 10% Step 50V
Wave shape into a 50Ω load	100V – 2750V	100V – 2750V
Rise time tr	5ns ± 30%	5ns ± 30%
Pulse duration td	50ns ±30%	50ns ±30%
Wave shape into a 1000Ω load	200V – 5500V	200V – 5500V
Rise time tr	5ns ± 30%	5ns ± 30%
Pulse duration td	35ns - 150ns	35ns – 150ns
Source impedance	Zq = 50Ω ± 20%	Zq = 50Ω ± 20%
Polarity	Positive / negative	positive / negative

Trigger

Trigger of bursts	AUTO, MANUAL, EXTERN
Synchronization	0 - 360° (16 - 500Hz) Asynchronous = 0° a reference signal is connected to the Sync input.
Burst duration td	0.10ms – 999ms
Burst repetition rate tr	10ms – 9999ms
Spike frequency f	0.1kHz – 1000kHz
Test duration T	0:01 min - 99:59 min

Range	Step
< 10 kHz	0.1 kHz
10 – 100 kHz	1.0 kHz
100 – 250 kHz	10.0 kHz
> 250 kHz	50.0 kHz

Output

Direct via 50Ω coaxial connector	To connect ext. coupling devices	To connect ext. coupling devices
Coupling network	To L, N, PE all combinations	To L, N, PE all combinations
DUT power mains supply	AC 300 V / 16 A / 50/60 Hz DC 300 V / 10 A	AC 300 V / 16 A / 50/60 Hz DC 300 V / 10 A

Test routines

Quick Start	Immediate start, all parameters adjustable during a running test
Standard test as per	IEC 61000-4-4 level 1 IEC 61000-4-4 level 2 IEC 61000-4-4 level 3 IEC 61000-4-4 level 4 EN 61000-6-1 Generic EN 61000-6-2 Generic IEC 61000- 4-4 Manual operated standard test routine
User test routines	Synchronous burst release Random burst release Change level V after T by steps of dV Frequency sweep in one single burst Frequency sweep with constant pulses Frequency sweep, constant burst duration Change polarity after T

* With Burst pulses as per. IEC 61000-4-4 Ed2 : 2004 the max. output voltage can be limited.

6.2. SURGE Immunity requirements as per IEC 61000-4-5

Test Level	**Model N5**	**Model N7**
Open circuit voltage	160V - 5000V ± 10% Step 20V	250V - 7000V ± 10% Step 50V
Wave shape		
Rise time tr	1,0µs ± 30%	1,0µs ± 30%
Pulse duration	50µs ± 20%	50µs ± 20%
Short circuit current	80A - 2500A ± 10%	125A - 3500A ± 10%
Wave shape		
Rise time tr	6.4µs ± 20%	6.4µs ± 20%
Pulse duration	16µs ± 20%	16µs ± 20%
Polarity	Pos., Neg., Alt	Pos., Neg., Alt
Repetition rate	max. 1Hz (1s* - 999s)	max. 0.5Hz (2s* - 999s)
Events preselection	1 - 30'000 or endless	1 - 30'000 or endless
Counter	1 - 1000000	1 - 1000000
Trigger		
Trigger of pulses	AUTO, MAN, EXTERN	AUTO, MAN, EXTERN
Synchronization	0 - 360° (16 - 500Hz)	
	Asynchronous = 0°	a reference signal is connected to the Sync input.
Resolution	1°	1°
Measurements		
CRO	5V Trigger	5V Trigger
CRO Û	10Vp at 5kV	10Vp at 7.0kV
CRO Î	10Vp at 2.5kA	10Vp at 3.5kA ; ± 1 Digit ± 50A
Peak voltmeter	5000V	7000V
Peak current meter	2500A : Display ± 1 Digit ± 20A	3500A : Display ± 1 Digit ± 50A
Current limiter setting	10A...3000A step 10A	10A...4000A step 10A

Output		**N5**	**N7**
Direct	HV-Banana connector, Zi = 2Ω	X	X
Coupling network	L – N with Z = 2Ω	X	X
	L-PE, N-PE, L+N-PE with Z = 12Ω	X	X
	L-PE, N-PE, L+N-PE with Z = 2Ω	na	X
DUT supply	AC 300V / 16A / 50/60 Hz	X	X
	DC 300V / 10A	X	X

Test routines	
Quick Start	Immediate start, all parameters adjustable during a running test
Standard test routines as per	IEC 61000-4-5 level 1 IEC 61000-4-5 level 2 IEC 61000-4-5 level 3 IEC 61000-4-5 level 4 EN 61000-6-1 Generic EN 61000-6-2 Generic IEC 61000-4-5 Manual operated standard routine
User test routines	Change polarity after n pulses Change coupling mode after n pulses Change voltage level V after n pulses by ΔV Change phase angle A after n pulses by ΔA
Magnetic field test	test routine as per IEC 61000-4-9 test level 100, 300 and 1000A/m cont. adjustable within Quick Start

* depends on charging voltage

6.3. Power Fail Generator as per IEC 61000-4-11

EUT supply	**Model N5**	**Model N7**
Channel PF1 and PF2		
AC voltage/current	max. 300V/16A	max. 300V/16A
Mains frequency	50/60 Hz	
DC voltage/current	max. 300V/10A	max. 300V/10A
Inrush current	more than 500A	
Protection	Electronic fuse for continuos overcurrent / inrush currents Electronic control of overheating PF1 and PF2 are safe against short circuit	
max. current channel PF1	nominal current continuous	
max. current channel PF2	nominal current with intermittently 10s (50% duty cycle)	
Trigger		
Events trigger	AUTO, MAN, EXTERN	
Repetition rate	0.01s – 9'999s	Accuracy 0.05% + phase sync
Duration of events	0.02ms – 9'999s	Accuracy 0.05%
Synchronization	0 - 360° (16 - 500Hz) Asynchronous = 0° if a reference signal is connected to the Sync input.	
Max Sync input voltage	Max. 300V or same as EUT voltage specs.	
Resolution	1°	
Measurements		
DUT supply	AC/DC voltage in the LCD display, divider ratio 1:100 +/- 10%	
BNC output MON U	Measurement of the EUT supply divider ratio 1:100 ± 5%	
BNC output MON I	Measurement of the EUT current and the inrush current 10mV/A ± 5%, max. 1000A	
CRO TRIGGER	positive going flank	
0-10V Control Output	0-10V DC for external voltage source	
Test routines		
Quick Start	Immediate start, all parameters adjustable during a running test	
Standard test routines	as per IEC 61000-4-11 as per IEC 61000-4-29 as per IEC 61000-6-1 as per IEC 61000-6-2 Manual operated standard test routine	ac power ports dc power ports Generic Generic
User test routines	Voltage variation, external variac control Change phase angle W after n events by dA Change events duration td after n events by dtd Inverse mode	
Magnetic field test	test routine according to IEC 61000-4-8 test level 1, 3, 10 and 30A/m with MC 2630 and a variac test level 100, 300 and 1000A/m with MC26100	

Magnetic field tests per IEC 61000-4-8 and -9

The test routines for handling the magnetic field tests are included in the internal UCS 500M firmware. All functions to control external options as voltage/current sources or magnetic field antennas are included. In addition the following hardware is required:

Option required for Magnetic Field Test per IEC 61000-4-9

- Magnetic field antenna (square 1mx1m coil MS 100)
- Adapter for connecting the square coil to the surge output.

Option required for Magnetic Field Test 50/60Hz per IEC 61000-4-8

- External variac (MV2616) and magnetic field antenna (square 1mx1m coil MS 100)
- External current transformer (MC2630) to test 1, 3, 10 and 30A/m levels
- External current transformer (MC26100) to test level 100, 300 and 1000A/m levels (short term).

6.4. RINGWAVE Immunity requirements as per IEC 61000-4-12

The Ringwave module is available for the UCS500 N7 generator.

Test level

Open circuit voltage	6000V ± 10%
Wave shape	
Rise time first peak T1	0,5 ± 30%
Oscillation frequency 1/T	100kHz ± 10%
Decaying of Pk1 to Pk2	40% - 110%
Decaying of Pk2 to Pk3	40% - 80%
Decaying of Pk3 to Pk4	40% - 80%
Decaying other peaks	no requirements for other peaks
Short circuit current 12Ω	500A ± 10%
Short circuit current 30Ω	200A ± 10%
Wave shape	
Rise time first peak tr T1	< 1µs
Oscillation frequency 1/T	100kHz ± 10%
Decaying	no requirements
Polarity	positive / negative / alternating
Repetition rate	250V - 4000V max. 1Hz (1s - 999s)
	> 4000V max. 0.1Hz (10s – 999s)
Events preselection	1 - 30'000 or endless
Counter	1 - 1000000

Trigger

Trigger of pulses	AUTO, MAN, EXTERN
Synchronization	0 - 360°
Resolution	1°

Output

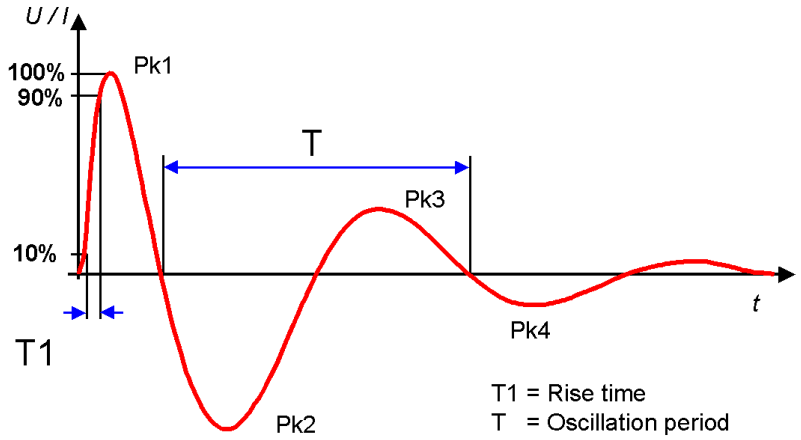
Direct	HV-coaxial connector; Zi = 12Ω / 30Ω
HV-coaxial connector; Zi = 12Ω	
Coupling network	L-N, L-PE, N-PE, L+N-PE
DUT power mains supply	AC 300 V / 16 A / 50/60 Hz
	DC 300 V / 16 A

Measurements

CRO	5V Trigger
CRO Û	10Vp at 6.6kV
CRO Î	10Vp at 3.3kA
Peak voltmeter	0 - 6600V
Peak current meter	50 - 500A

Test routines

Quick Start	Immediate start, all parameters adjustable during a running test



6.5. Telecom Surge Generator as per IEC 61000-4-5 (TSurge module)

	TSurge5 (built in)	TSurge7 (external)
As per ITU and ETS recommendations		
Output voltage open circuit	160V – 5'000V ±10%	250V – 7'000V ±10%
Pulse 10/700µs		
Front time T_F (rise time tr)	10µs ± 30% (1.0µs ± 30%)	
Pulse duration td	700µs ± 20%	
As per FCC part 68 Pulse B		
Output voltage open circuit	160V – 5'000V ±10%	250V – 7'000V ±10%
Front time T_F	9µs ± 30%	
Pulse duration td	720µs ± 20%	
Output current short circuit	4 – 100A	6 – 175A
Rise time tr	5µs ± 30%	
Pulse duration td	320µs ± 20%	
As per IEC 61000-4-5		
Pulse 10/700µs		
Open circuit output voltage	160V – 5'000V ±10%	250V – 7'000V ±10%
Rise time tr	6.5µs ± 30%	
Pulse duration td	700µs ± 20%	
Short circuit output current	4 – 100A	6 – 175A
Rise time tr	4µs ± 20%	
Pulse duration td	300µs ± 20%	
Coupling		
As per ITU	For 2 wire T1 and T2 with 25Ω each For 4 wire T1,T2,T3,T4 with 100Ω each	
As per FCC part 68	For 2 wire T1 and T2 with 25Ω each	
As per IEC 61000-4-5	External networks are required (options)	
General		
Energy storage capacitor	20µF	
Polarity	Positive, negative or alternating	
Counter select	1 – 30,000 or endless	
Dimensions		
Housing	19", 3HU, 450x500x155mm (ext. TSurge6.1 module)	
Weight	approx. 11.85kg	
Accessories Included		
HV cable set	Connect the TSurge module to UCS 500M6B	
Control cable	To control TSurge via UCS 500M6B	
EUT adapter	socket depends on the country of use	

6.6. EUT Supply Specifications

Standard models

Model	CDN		Remarks
UCS 500N5	300V	16A 1- ph	
UCS 500N5.1	300V	32A 1- ph	
UCS 500N7	300V	16A 1- ph	DC 300V / 16A ANSI
UCS 500N7.1	300V	32A 1- ph	DC 300V / 32A ANSI

Special models

Model	CDN		Remarks
UCS 500N5.2	400V	16A 1- ph	
UCS 500N5.3	400V	32A 1- ph	
UCS 500N5.4	300V	16A 1- ph	DC 400V 16A
UCS 500N5.5	300V	32A 1- ph	EFT/5 and VCS/5 10Ω/40Ω for supply lines EN 55121-3-2:2006 (Railway)
UCS 500N5.6	300V	32A 1- ph	10Ω/40Ω for supply lines EN 55121-3-2:2006 (Railway)
UCS 500N5.7	300V	16A 1- ph	
UCS 500N5.8	300V	16A 1- ph	EFT/5 and PFS/5; 1ph CDN 300V/16A
UCS 500N5.9	300V	16A 1- ph	10Ω/40Ω for supply lines EN 55121-3-2:2006 (Railway)
UCS 500N5.10	690V	16A 1- ph	
UCS 500N5.11	690V	16A 1- ph	
UCS 500N7.6	690V	16A 1- ph	EFT/7, VCS/7, RWG/7, without built-in coupler! Application Voltage 690V

DC current specification for all UCS500N model: Imax. = 10A dc (where not otherwise specified)

EUT Fuse
The UCS 500Nx models have **no internal fuse for the EUT** supply.
The user is responsible to adapt a suitable fuse for the EUT outside the UCS 500Nx

6.7. General Specifications

Mains supply	230V/115V, 50/60Hz
Power consumption	110W
Fuse	230V : 2 AT slow blow 115V : 4 AT slow blow
Safety	
Safety circuit	External interlock capability
Warning lamp	voltage free contact max. 250V 5A
Design	per IEC 1010, EN 61010
Interfaces	
Serial	USB (compatible to USB 1.1 and 2.0)
Parallel IEEE	Address 1-31
Analog output	0-10V DC, to control an external power supply

	UCS 500N5	**UCS500N7**
Dimensions	19" / 3 HU	19" / 6 HE
Weight	app. 25 kg	ca.. 30 kg

=> Not relevant data for the standards can be changed by the manufacturer <=

6.8. Technical data spec. generators

This chapter describes differing technical data from spec.generators

6.8.1. UCS 500N5.5 for Railways application

Standards:

- EN 50121-3-2 :2006
- EN 50121-4 :2007-07

Module : Burst
Surge

EUT: 300V 32A

Module

Built in modules	Burst, Surge
Surge Couppling	L - N, L - PE, N - PE, L + N - PEΩ
Surge impedance Ri	2Ω, 10Ω, 40Ω Must be set manually by a bridge

REMARK : The complete Ri impedance is the addition of the 2Ω ganerator impedance und the manually setted impedance (10Ω, 40Ω).

Coupling\ Ri	2Ω	10Ω	40Ω
L - N	ok	ok	ok
L - PE **N - PE**	⚠ no pulse	ok	ok
L + N - PE	⚠ no pulse	ok	ok

Dimensions and weight

Dimension	450 x 550 x 285 mm
Weight	34.2kg
Housing	6HU

6.8.2. UCS 500N5.11

Module : Burst
Surge
Tsurge (optional)

EUT: 690V 16A

Module

vorhandene Module	Burst, Surge, Tsurge
Surge Kopplung	L - N, L - PE, N - PE, L + N - PEΩ

Dimensions and weight

Dimension	445 x 500 x 420 mm
Weight	37.6kg
Housing	9HU

6.8.3. UCS 500N6.5

Module : Surge
Ringwave

CDN External CNV503B7 6kV 32A

EUT: Three Phase
3x440V 32A

Module

Built in modules	Surge, Ringwave, TSurge		
Couppling	external CNV503B7 and TSurge		

Dimensions and weight

Dimension	450 x 550 x 285 mm		
Weight	26.0kg (UCS500N6.5)	38.0kg (CNV503B7)	12.1kg(TSurge)
Housing	6HU		

6.8.4. UCS 500N6.7

Modules : Surge
Power Fail
Ringwave

EUT: Single Phase
Coupling Network 40A

Module

Built in modules	Surge, Power Fail, Ringwave	
Surge decoupling inductance	0.6mH	internal dV at 40A 50Hz 230V approx. 15V

Dimensions and weight

Dimension	663 x 550 x 600mm
Weight	94 kg
Housing	Minirack 12HU / rolls 50mm

6.8.5. UCS 500N7.1

Modules : EFT
Surge
Power Fail
T-Surge (option)

EUT: Single Phase 300V 32A

Module

Built in modules	EFT, Surge, Power Fail
Optional module	T-Surge
Remark	Ringwave not possible

Dimensions and weight

Dimension	445 x 500 x 420mm
Weight	approx. 37.6 kg
Housing	9HU

=> Not relevant data for the standards can be changed by the manufacturer <=

7. Maintenance setup and service

7.1. General

The generator is absolutely maintenance-free by using a solid state semiconductor switch to generate transients

7.2. Test set- up

When setting up the test national and international regulations regarding human safety have to be guaranteed.

It is recommended to connect the simulator to the ground reference plane of the test set-up.

The generators of the series 500, UCS, VCS, CSS, TSS and CNI, can be linked together to a fully automotive test set-up.

The set-up communicates via the IEEE / GPIB bus and is controlled by iec.control software. For setting up the system see the following figures:

Each generator can be operated individual as a single equipment.

7.3. Fuse for the EUT power supply

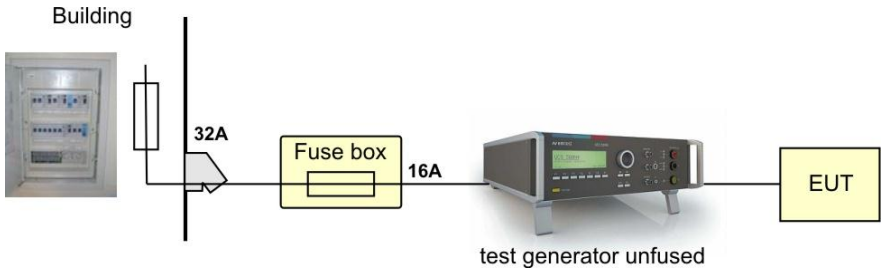
The EM Test pulse generators have no built in fuse for the EUT power supply. It is in the scope of responsibility of the user to protect the EUT external for the rated current.

The design of the external fuse must be match the following rules:

- fuse dimension must be **equal or smaller** than the **rated EUT current** of the connected **test generator**
- fuse must be designed for **protect the connected EUT** device under test in malfunction

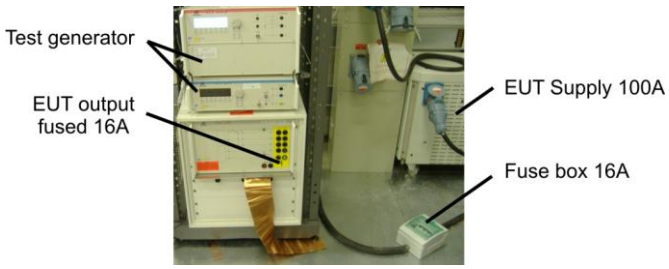
Example of external fuse

Fuse in the building is designed for 32A. A Fuse box with 16A fuse protection is installed between the building supply and the test generator.
Test generator and EUT are now fused for 16A rated current



Example
16A protection with a 100A installation with a 3-phase fuse box.

The user has protected his Equipment Under Test with this additional fuse box for a rated current of 16A.



7.4. Insulating- or external transformator for EUT power supply

The recommended power of an external transformer must be **> 500VA**. The reason is the capacitive current of the internal filter capacitors inside the UCS 500N5 / N7.

7.5. Calibration and verification

7.5.1. Factory calibration

Every EM TEST generator is entirely checked and calibrated as per international standard regulations before delivery. A calibration certificate is issued and delivered along with a list of the equipment used for the calibration proving the traceability of the measuring equipment. All auxiliary equipment and accessories are checked to our internal manufacturer guidelines.

The calibration certificate and the certificate of compliance (if available) show the date of calibration.

The EM Test equipment are calibrated in the factory and marked with a calibration mark. The used measuring instruments are traceable to the Swiss Federal Office of Metrology.
The calibration date is marked. The validity of the calibration is to the responsibility of the user's quality system. Neither the certificate of calibration nor the corresponding label mark any due date for re-calibration.

Example: Calibration mark

7.5.2. Guideline to determine the calibration period of EM Test instrumentation

Our International Service Departments and our QA Manager are frequently asked about the calibration interval of EM TEST equipment.

EM TEST doesn't know each customer's Quality Assurance Policy nor do we know how often the equipment is used and what kind of tests are performed during the life cycle of a test equipment. Only the customer knows all the details and therefore the customer needs to specify the calibration interval for his test equipment.

In reply to all these questions we like to approach this issue as follows :
EM TEST make use of a solid state semiconductor switch technique to generate high voltage transients. A precious advantage of this technique is the absolute lack of periodical maintenance effort. In consequence thereof a useful calibration period has to be defined based on two criteria :

- The first one is the customer's Quality Assurance Policy. Any existent internal regulation has to be applied at highest priority. In the absence of such internal regulation the utilization rate of the test equipment has to be taken into consideration.

- Based on the experience and observation collected over the years **EM TEST recommend a calibration interval of 1 year** for frequently used equipment. A 2-years calibration interval is considered sufficient for rarely used test generators in order to assure proper performance and compliance to the standard specifications.

7.5.3. Calibration of Accessories made by passive components only:

Passive components do not change their technical specification during storage. Consequently the measured values and the plots stay valid throughout the storage time. The date of shipment shall be considered as the date of calibration.

7.5.4. Periodically In-house verification

Please refer to the corresponding standard before carrying out a calibration or verification. The standard describes the procedure, the tolerances and the necessary auxiliary means. Suitable calibration adapters are needed. To compare the verification results, EM Test suggests to refer to the waveshape and values of the original calibration certificate.

All calibrations and verifications are always done without mains supply voltage connected to the coupling network input.


Danger

Before starting the calibration or verification

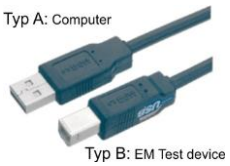
remove the EUT Mains Supply

from the generator and from the coupling network

8. Delivery Groups

8.1. Basic equipment

- Generator type UCS 500N5 with recommended modules (Burst, Surge, Power Fail, TSurge)
  UCS 500N7 with recommended modules (Burst, Surge, Power Fail, TSurge, Ringwave)
- Mains cable
- Mains cable for the EUT supply
- Cable black 0.5m 4mm Safety plug for phase synchronization (PF1-SYNC)
- K - USB cable USB A / B , 3m
- Adapter for power cable
- Manual
- Calibration certificate



8.2. Accessories and options

- **ESA Adapter for adapt different power mains connectors**

As accessories adapters to different power mains connectors are part of the delivery of EM TEST surge generators. E.g. these are adaptors for Schuko - US - AUS - UK power mains connectors.

Most of these commercially available power mains sockets can not withstand surge voltages higher than 4000V. Therefore each of these EM TEST adaptors are labeled to be **used up to 4000V** maximum.

In case that the EM TEST surge generator can generate higher surge voltages than 4000V a sparkover at the power mains socket may occur.

Customers shall be aware of this matter and shall **not use higher voltages than labeled** on the adapter.

For **testing higher voltages** it is necessary to use high voltage cables with sufficient isolation and safety banana connectors connected direct to the generator output plugs (L-N-PE).

Burst

- **CA EFT Kit** Calibration Adapter for Burst verification on EUT output + KW50 + KW1000
- **KW 50** Matching resistor 50 Ω with integrated attenuator (1:100)
- **KW 1000** Matching resistor 1000 Ω with integrated attenuator (1:500)
- **HFK** Capacitive coupling clamp as per IEC 61000-4-4 to couple the fast transients to signal and data lines.

- **CA HFK** Calibration kit for capacitive coupling clamp as per IEC 61000-4-4 Ed.3
  - Flexible plate insulated
  - Support for KW 50 and adapter to KW 50

- **CNE 503** external 3 phase coupling/decoupling network
  - EUT Mains 400 V rms max. // 480V for USA
  - Rated current In = 16 A / 32A / 63A / 100 A rms
  - Mains frequency 50/60 Hz
  - Coupling to all phases Lx, N, PE. Control with EFT 500.

- ITP Radiating set for immunity and emission

- **A6dB** as additional 6 dB / 50 Ω attenuator of the test signal
- **PUW 500** EUT monitoring

Surge

- Coupling/decoupling network as per IEC 61000-4-5 for signal lines type CNV 504/508 (4 wires and 8 wires)
- 3 phase CNV 503 up to 100A
- TSurge module

TSurge 7

Power Fail

- **V4780 transformer with taps**
  – Transformer with taps at 40%&, 70%, 80%
  - 230V / 16A
- . **MV 2616 Variac**
  – Motorvariac 0-260V / 16 or 32A
  – Control signal 0-10V dc.

Magnetic field

- **MS 100** Magnetic field antenna
-
- **MC 2630** Current transformer up to 30A/m
- **MC 26100** Current transformer up to 1000A/m

MC2630

MC26100

General for Burst and Surge

- **CNI 503 external coupling/decoupling network**
  - EUT mains supply 400 V rms max. // 480V for USA
  - Nominal current In = 16 A / 32A / 63A / 100 A rms
  - Frequency 50/60 Hz
  - Coupling to all lines, N, PE
  - 50Ω Burst output The coupling will be controlled by the UCS 500 or EFT 500
  - Output for Surge coupling to other coupling networks as CNV types ...

- **User software " iec.control "**
  - Test, analysis and documentation with windows
  - License version for testing according the most automotive standards
  - Report generator with export function to word-processing software

USB Interface

- **FER-USB**
  Ferrite for suppress burst pulses on the USB cable.
  Application: 8 turns for the best result. max. 10cm above ground.

  The included USB cable has integrated ferrites and is suitable for burst tests with the UCS 500. Interferences usually occur on the computer side. With the ferrite-FER USB Interference will be attenuated additionally on the USB cable.

9. EFT Burst as per IEC 61000-4-4

Burst Module 5/50ns

Warning

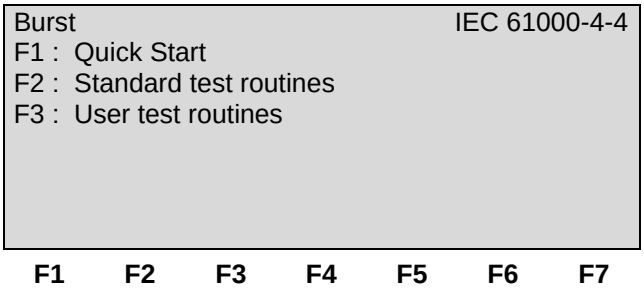
If the user reduces the test voltage in **Quick Start** or in the **Manual Standard Test Routine**, the **storage capacitor will be discharged only by the burst pulses**. The result is a higher test voltage on the EUT than indicated on the display until the storage capacitor is discharged to the preselected value.

If the voltage reduction is several 100V the discharge time to the correct test voltage can be some seconds. The discharge time depends on the repetition rate tr and the duration td of the burst pulse.

Pressing STOP / START will discharge the storage capacitor over the discharge resistor immediately. After the START the test will continue with the correct voltage level.

9.1. Operation

The Burst menu offers different test routines for burst testing.



F1 Quick Start
Easy and fast online-operation with the equipment.

F2 Standard test routines
The operator can select between various preprogrammed test routines as required in different standards

F3 User test routines
The operator can select between various preprogrammed test routines which helps to accelerate testing and which are very helpful especially during design.

9.1.1. Quick Start

Easy and very fast operation of all standard functions of the equipment. The latest simulator settings are stored automatically and will be recalled when Quick Start is next selected.

Burst					Quick start
V	=	500V	f	=	5kHz
td	=	15ms	tr	=	300ms
cpl	=	L	+/-	=	+
T	=	01:00min			
START	CHANGE				

F1 F2 F3 F4 F5 F6 F7

Press ***CHANGE*** and the test parameters parameter can be changed.

Select the desired parameter with the related function key and change the value by turning the front panel knob. The cursor allows the user to define the digit to be changed (fast or slow change).

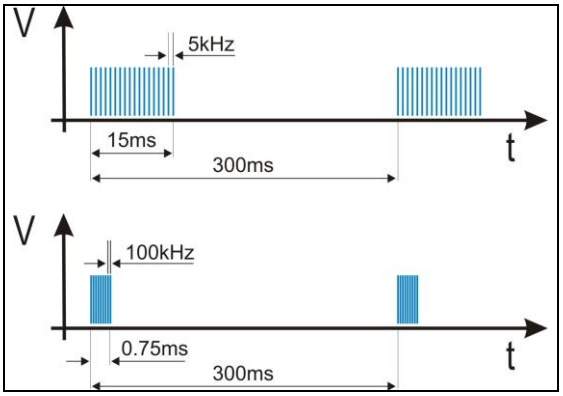
Press ***START*** and the test starts immediately with the displayed test parameters.

The operator now can navigate with the ***Cursor*** from parameter to parameter. The blinking parameter can be changed by turning the front panel knob.

Burst specification as per IEC 61000-4-4 Ed2 : 2004

f = 5kHz
td = 15ms
tr = 300ms

f = 100kHz
td = 0.75ms
tr = 300ms



9.1.2. Standard test routines

The user can select preprogrammed standard test routines.

Page 2

Burst Standard test routines		
F1 : IEC 61000-4-4	Level 1	500V
F2 : IEC 61000-4-4	Level 2	1000V
F3 : IEC 61000-4-4	Level 3	2000V
F4 : IEC 61000-4-4	Level 4	4000V
F5 : EN 61000-6-1	Generic	1000V
F6 : EN 61000-6-2	Generic	2000V
F7 : Manual test routine		

F1 F2 F3 F4 F5 F6 F7

Page 3 (Show parameters and start the test)

Burst	IEC 61000-4-4 Level 3
V = 2000 V	f = 100 kHz
cpl = COM	
START CHANGE	

F1 F2 F3 F4 F5 F6 F7

T	:	00:01 min	99:59 min
f	:	5.0 kHz	100 kHz
cpl	:	COM / ALL / CCC	

T	f	cpl
1:00	100	COM

F1 F2 F3 F4 F5 F6 F7

The function „**Change**“ enables the operator to switch between 5kHz/100kHz spike frequency. The burst duration will be automatically matched to 15ms respectively 0.75ms.
The coupling mode can be selected depending on the IEC 61000-4-4 edition version (ALL 1994 / COM 2004)
Additionally the operator can enter the required test time.

Manual standard test routine

Burst Standard routine	IEC 61000-4-4
<- -> O	
Level 3 + 2000V L N	5.0 kHz
	Test time 0:00:45 h
START + /- L N PE	L N PE f

F1 F2 F3 F4 F5 F6 F7

Within this test routine all standard parameters can be changed online during testing. This procedure therefore is very easy and fast to use.

By pressing the function „f“ the operator can select between 5kHz and 100kHz spike frequency. The burst duration will be automatically matched to 15ms respectively 0.75ms.

Attention: The couplings are controlled manually. The user is responsible to test according the old or new standard IEC 61000-4-4.

Example:

- By pushing the cursor ←→ the test level will be increased/decreased to the next standard level.
- By turning the INC knob (o) the test level can be continuously adjusted.
- Pressing the function keys the related function will be immediately activated.
- The displayed time will be reset to zero after every new setting.

All functions can be operated during the running test.

9.1.3. User Test Routines

The user can program, save and recall his own specific test routines. The next pages shows the selection of the functions.

USER TEST ROUTINES
F1 : Synchronized
F2 : Random burst release
F3 : Voltage change after T by
F4 : Frequency sweep in one single burst
F5 : Frequency sweep with constant pulse numbers
F6 : Frequency sweep with constant burst duration
F7 : Change polarity +/- after T

F1 F2 F3 F4 F5 F6 F7

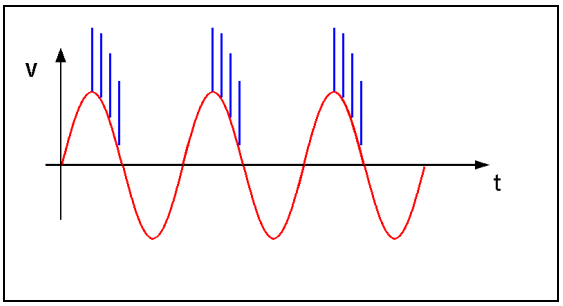
After selection the last used test parameters will be indicated on the display.

Customized test routines

The software controls user test routines according to the specification of the user. All limitations are the same as defined under Quick Start.

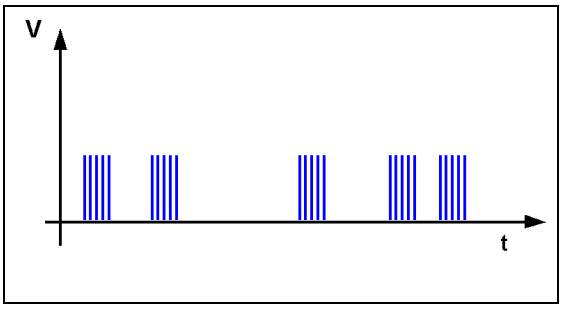
Synchronized with a fixed phase angle

The burst is triggered with respect to the phase angle of the power supply connected to the Sync input at the rear panel of the equipment. The power supply must be an AC voltage with a nominal frequency of 16 to 500Hz. The phase must be connected to L. This can be checked by the lamp connected to the L input.

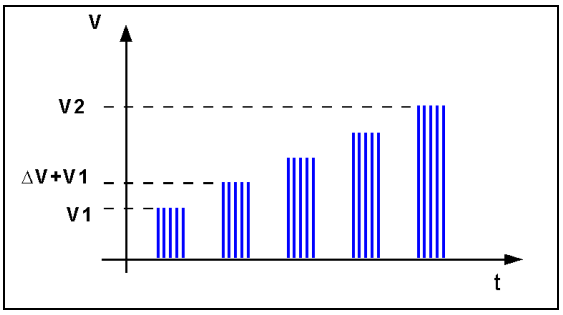


Random burst release

No repetition rate is selected. The single burst will be triggered by statistics in the limits of 20 to 2000ms as time between two bursts. All limitations are the same as defined under Quick Start.



Voltage change after T by ΔV The test voltage is increased from V1 to V2 by steps of ΔV after the defined test time T. All limitations are the same as defined under Quick Start. The limitation of the max. generated number of spikes is related to the higher voltage of V1 or V2.



Frequency sweep in one single burst

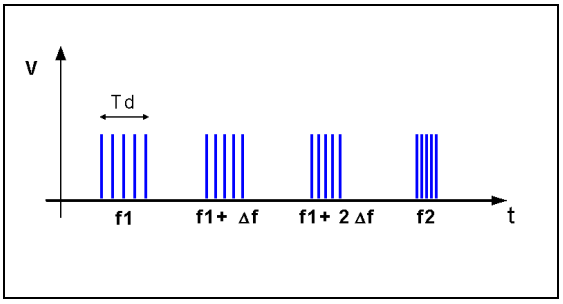
During one single burst the frequency sweeps from f1 to f2. For this function the following limitations have to be respected:

tr.	>=	100 ms
f1	<=	f2
td	>=	5.0 ms
td	>=	5 / f1
tr. -td	>=	50 ms

Note: The maximum value for frequency, burst duration td and voltage are in dependence of each other and therefore limited by the generator performance. The practical limits of the UCS500N7 are 20kHz for f2 and 50ms for the burst duration td. The limits of the generator model UCS 500N5 are approx. 10 times higher.

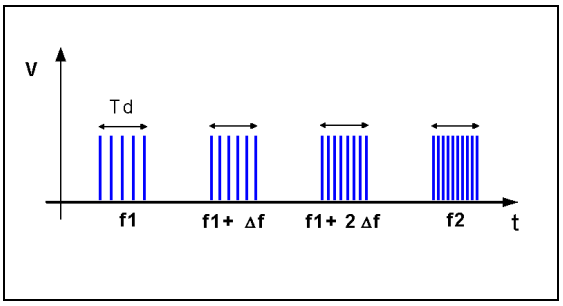
Frequency sweep with a constant pulse numbers

The burst duration is increased from td1 to td2 by steps of Δ td after the defined test time T. All limitations are the same as defined under Quick Start. The limitation of the max. generated number of spikes is related to the higher duration of td1 or td2.



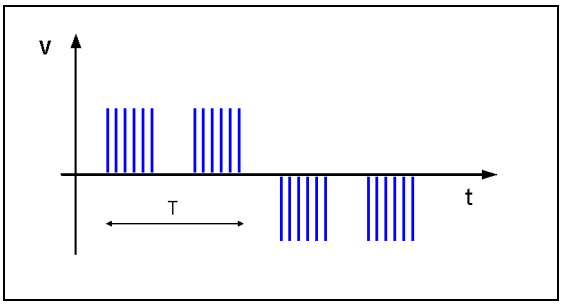
Frequency sweep with a constant duration after T by Δf

The spike frequency is increased from f1 to f2 by steps of Δf after the defined test time T. All limitations are the same as defined under Quick Start. The limitation of the max. generated number of spikes is related to the higher frequency of f1 or f2.



Polarity change after T

The polarity will be changed from + to - after the defined test time T.

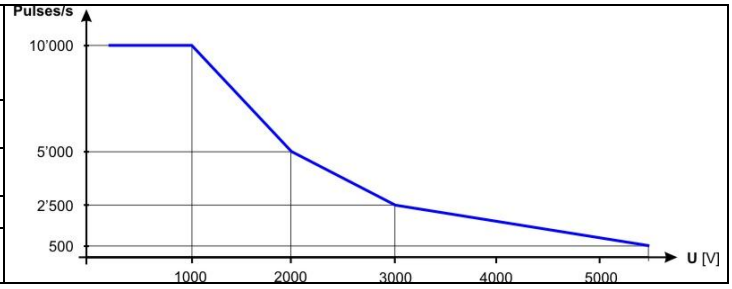


9.2. Burst generation

Discharge switch:
The discharge switch is a highly reproducible semiconductor switch. Spike frequencies up to 1000kHz are by a factor of 10 higher than recommended in the actual EFT standards. This means of course that also the pulse energy would be 10 times higher. This is not generally possible for the high voltage switch. Therefore the following limitation protects the pulse forming circuit against overload:

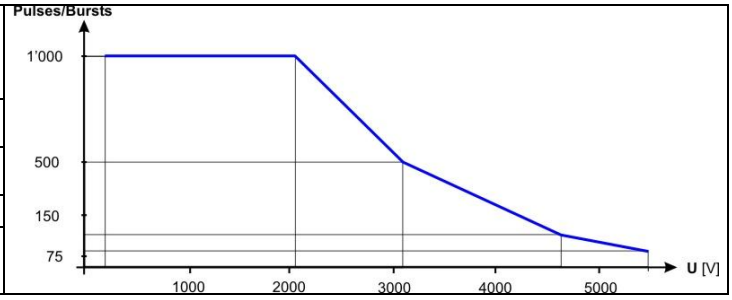
Pulses / s

Voltage U	max. pulses / s td * f / tr.
<= 1'000V	10,000
> 1'000V <= 2'000V	linear decrease to 5'000
> 2'000V <= 3'000V	linear decrease to 2'500
> 3'000V <= 5'500V	linear decrease to 500



Pulses / burst

Voltage U	max. pulse / burst td * f
<= 2'000V	1'000
> 2'000V <= 3'000V	linear decrease to 500
> 3'000V <= 4'500V	linear decrease to 150
> 4'500V <= 5'500V	linear decrease to 75



9.3. Test level with Burst as per IEC 61000-4-4 Ed.2.

Burst generators, which the specifications in accordance with. IEC 61000-4-4 Ed2: 2004 fulfills, have a limitation of the maximum output voltage. The efficiency of the burst pulses decreases with the numbers of couplings.

Therefore the maximum test level is limited by the number of coupling on several lines.

Generators with the modification in accordance with IEC 61000-4-4 Ed2: 2004 the. max. test levels have the following limits:

Coupling	UCS N5	UCS N7
50 Ω	5500V	5500V
1 coupling any	5500V	5500V
2 couplings any	5500V	5000V
3 couplings any	5500V	5000V

Generator with CNI 503 / CNE 503		
50 Ω	5500V	5500V
1 coupling any	5500V	5500V
2 couplings any	5000V	5000V
3 couplings any	5000V	5000V
4 couplings any	4500V	4500V
5 couplings any	4500V	4500V

9.4. Coupling/decoupling network

The decoupling part of the coupling network has to:

- filter the interference pulses in the direction to the power supply;
- protect other systems that are connected to the same power supply and
- realize a high impedance of the power supply, e.g. battery supply.

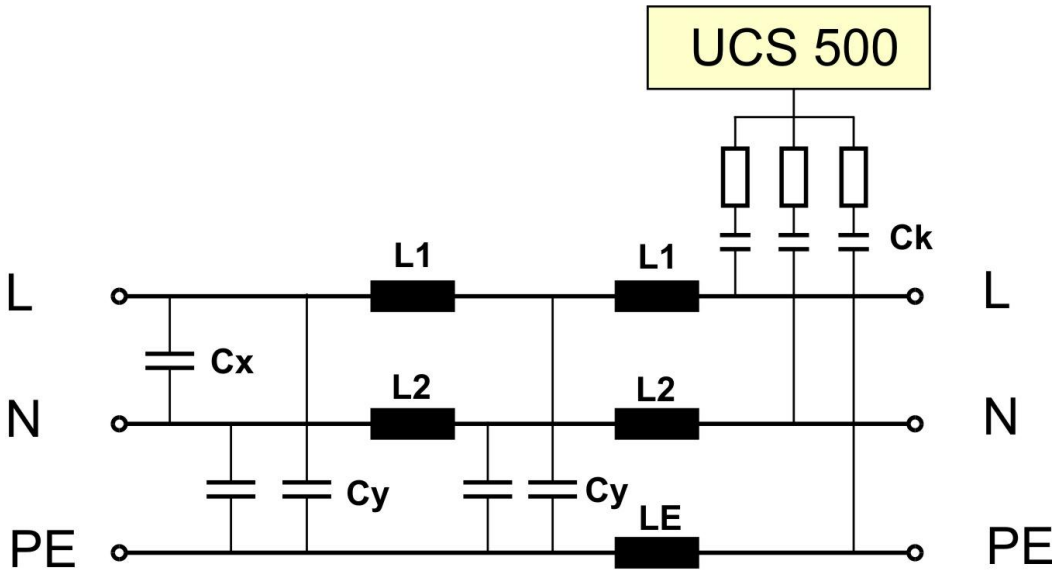
9.4.1. Coupling/decoupling network for ac/dc power lines

The coupling network has to couple the interference pulses to the lines of a power supply system (AC or DC). As coupling devices capacitors of sufficient strength and bandwidth shall be used according to IEC 61000-4-4.

-	**Normal Mode**	Line Neutral	=> =>	GND GND
-	**Common Mode**	Line + Neutral	=>	GND
-	**Protective Earth PE**	The PE of the EUT is decoupled from the power supply side by a choke. The interference source is coupled directly to the PE of the EUT.		

The decoupling part of the coupling network has two purposes:

- to filter the interference pulses in the direction of the power supply side;
- to protect other systems that are connected to the same power supply and
- to realize a high impedance of the power supply, e.g. battery supply.



Coupling network as per IEC 61000-4-4

The coupling on signal lines can usually not be effected capacitively without interfering with the signal flow. It is often impossible to contact the required circuit (direct), e. g. coaxial or shielded cables. In this case the coupling is realized with the capacitive coupling clamp. The interference simulator can be connected on both sides of the coupling clamp.

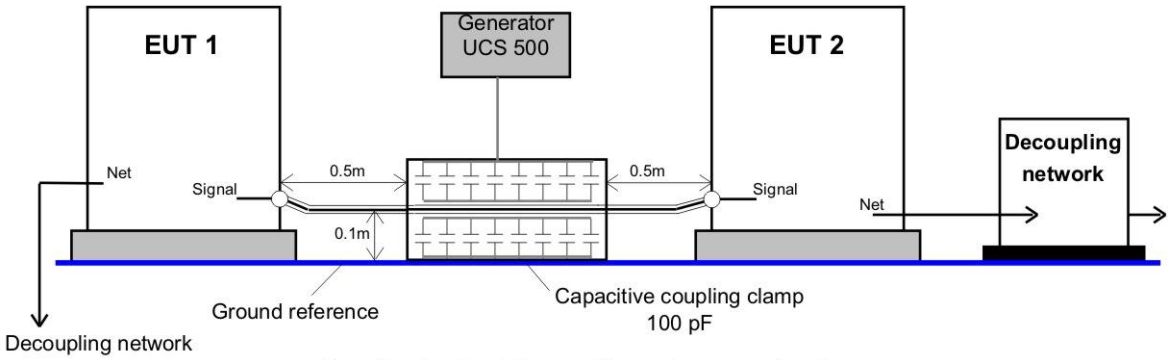
Attention:

The actual published IEC 61000-4-4 (1995) requires all lines to be tested individually.

The new draft revision IEC 61000-4-4 edition 2 (2004) requires the Common Mode coupling only. This means all lines simultaneously to ground.

9.4.2. Capacitive coupling clamp

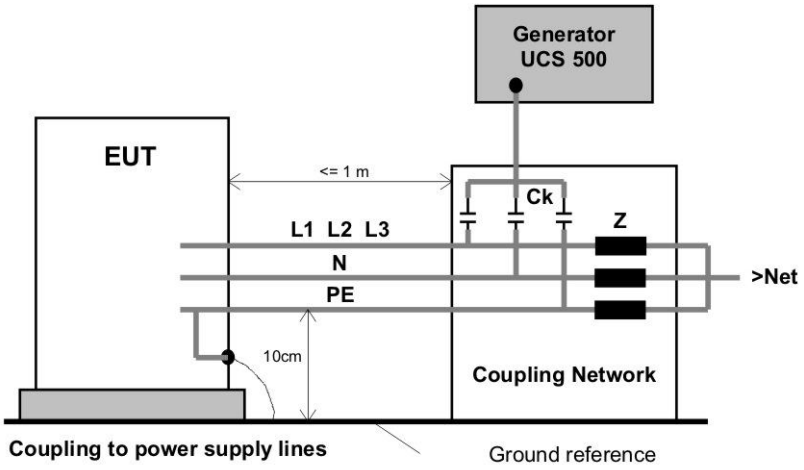
- The coupling clamp is not matched by 50 ohm. If the clamp is matched there exists an additional magnetic coupling, which may cause completely different test results.
- The clamp should be placed in a distance of 0.5m to the equipment under test. When using shorter distances, the EUT may be influenced by radiation.
- If the EUT is built up by two different equipment, the test should be conducted on each single equipment with the required distance.



Coupling to signal lines or lines where no galvanic contact is possible (e.g. shielded lines)

9.5. Burst Test Setup

- The test generator and the coupling network should be connected to the reference ground plane (acc. to high frequency requirements).
- The equipment under test must be isolated from the reference ground plane. The distance should be 10cm. Being part of the EUT, these requirements are also recommended for all connected cables. The EUT should only be grounded if this is recommended by the installation guideline. For safety reasons, the test without any ground connection should be conducted as well (at 100MHz 1m ground cable has an impedance of about 600 ohm)
- Whenever possible the test set-up and the cabling should always be the same; e.g. for testing power lines it would be possible to fix the cables on the test table for all tests in the same way.
- Lines under test and all other lines should be decoupled strictly.



10. Surge Immunity as per IEC 61000-4-5

Surge Module 1.2/50µs – 8/20µs

WARNING

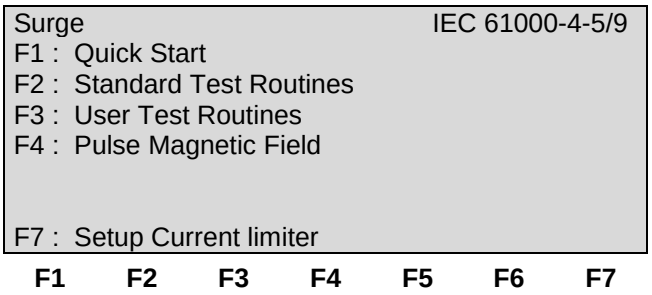
The internal coupling network is designed for **mains frequency 50Hz / 60Hz**.

When L – N coupling is selected an **additional current of approx. 1.5A** flows, caused by the 18µF coupling capacitor and the pulse forming network. A similar current appears during the couplings to PE.

Tests with 400 Hz mains frequency **destroy the coupling network**. An external coupling network is recommended with inductors and capacitors matched to the 400Hz mains frequency.

10.1. Operation

The Surge menu offers different test routines for burst testing.



F1 Quick Start
Easy and fast online-operation of the equipment.

F2 Standard test routines
The operator can select between various preprogrammed test routines. By pressing the related function key the test will be started automatically with the specified test parameters.

F3 User test routines
The operator can select between various preprogrammed test routines which helps to accelerate testing and which are very helpful especially during design.

F4 Pulse Magnetic Field
Within this menu the pulse magnetic field test as per IEC 61000-4-9 is supported.

F7 Set-up Current limiter
Within this menu the operator can select the maximum allowable surge current for the EUT. The limiter can be selected for both coupling modes, common mode (line to ground) and differential mode (line to line).

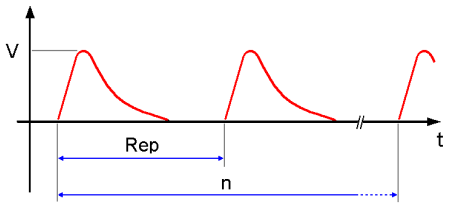
10.1.1. Quick Start

Easy and very fast operation of all standard functions of the equipment. The latest simulator settings are stored automatically and will be recalled when Quick Start is next selected.

```
Surge                                        Quickstart
V     =  2000V        A     =  0      dgr
+/-   =  +            cpl   =  L + N - PE
tr    =  10s          tri   =  Auto
n     =  endl


START  CHANGE
```

F1 F2 F3 F4 F5 F6 F7



Press ***CHANGE*** and the test parameters parameter can be changed.

Select the desired parameter with the related function key and change the value by turning the front panel knob. The cursor allows the user to define the digit to be changed (fast or slow change).
At polarity setting ALT it is necessary to double the number of impulses. Example n=2 => one impulse positive and one impulse negative.
Pressing the ESC button will bring the user back to the previous level from where the test can be restarted with new levels.

Press ***START*** and the test starts immediately with the displayed test parameters.

All functions keys except F2 (if MAN TRIGGER is selected) can stop the test routine. The latest setting will be displayed.
Any pressing of a function key will indicate the functions START, CHANGE or CONTINUE. F3 will continue the same test routine. If the user selects at first START or CHANGE the test will be stopped completely

Press ***ESC*** will bring the user back to the previous menu level.

Page 3 (Start)

```
Surge                                        Quickstart
V     =    2000V        A=    0  dgr
+/-   =    +            cpl   =    L + N - PE
Rep   =   10 s          tri   =     Auto
n     =  endl.

Vsoll =  2000V   U =  + 2000V       COUNTER
STOP             I  =  + 0000A       0000043
```

F1 F2 F3 F4 F5 F6 F7

While a test is running the user can select parameters with the cursors ←→. The selected parameter then can be changed online with the inc/dec knob.

10.1.2. Standard test Routine

Page 2

Standard test routines		
F1 : IEC 61000-4-5	Level 1	500V
F2 : IEC 61000-4-5	Level 2	1000V
F3 : IEC 61000-4-5	Level 3	2000V
F4 : IEC 61000-4-5	Level 4	4000V
F5 : EN 61000-6-1	Generic	2000V
F6 : EN 61000-6-2	Generic	2000V
F7 : Manual test routine		

F1 F2 F3 F4 F5 F6 F7

With the selection of F1 ....F6 the test is conducted automatically with the parameters and the test sequence as required per IEC 61000-4-5. The only parameters the operator is able to change are the repetition rate and the number of pulses per test level. With a faster repetition rate as required in the standard the total testing time can be reduced significantly.

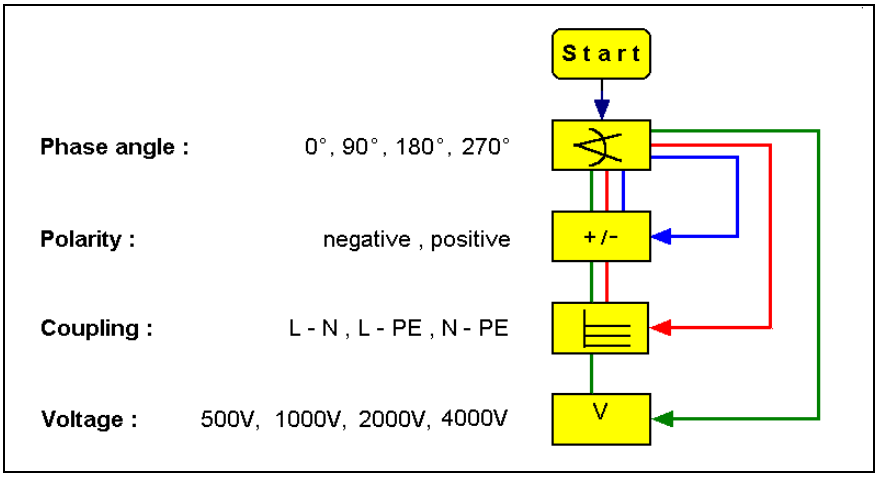
Tests with the function keys F1…F4 use the given testlevel with all couplings (common- and differential mode).

Iteration of the standard test procedure as per IEC 61000-4-5

The surges have to be applied synchronized to the voltage phase at the respective angle and the peak value of the a.c. voltage wave (positive and negative).

The surges have to be applied line to line and line(s) and earth. When testing line to earth the test voltage has to be applied successively between each of the lines and earth.

The test voltage has to be increased by steps from the lowest test level up to the test level specified in the product standard or test plan.



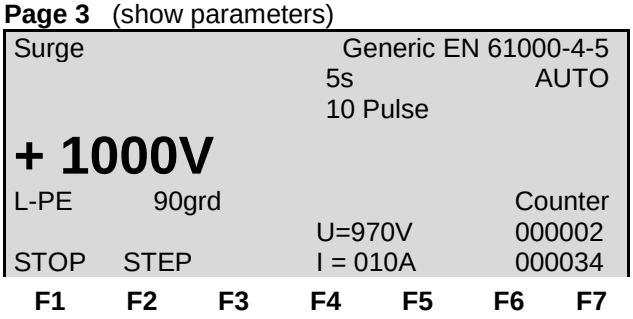
List of settings EN 61000-6-1 (each setting with 5 pulses)

Setting	Voltage	Coupling	Polarity	Phase angle
1	500	L-N	pos	0
2				90
3				180
4				270
5			neg	0
6				90
7				180
8				270
9		L-PE	pos	0
10				90
11				180
12				270
13			neg	0
14				90
15				180
16				270
17		N-PE	pos	0
18				90
19				180
20				270
21			neg	0
22				90
23				180
24				270
25	1000	L-N	pos	0
26				90
27				180
28				270
29			neg	0
30				90
31				180
32				270

Setting	Voltage	Coupling	Polarity	Phase angle
33	1000	L-PE	pos	0
34				90
35				180
36				270
37			neg	0
38				90
39				180
40				270
41		N-PE	pos	0
42				90
43				180
44				270
45			neg	0
46				90
47				180
48				270
49	2000	L-PE	pos	0
50				90
51				180
52				270
53			neg	0
53				90
55				180
56				270
57		N-PE	pos	0
58				90
59				180
60				270
57			neg	0
58				90
59				180
60				270

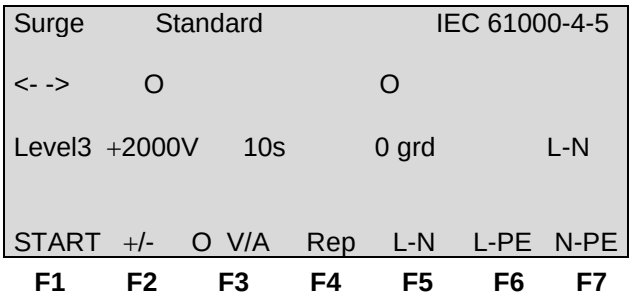
Standard Test Routines

Page 3 (show parameters)



- The counter shows the number of triggered pulses per actual test level as well as the number of all triggered test pulses within the running test sequence.
- Pushing the function key F2 STEP will bring you into the next iteration sequence.

Manual test routine



Within this test routine all standard parameters can be changed online during testing. This procedure therefore is very easy and fast to use.

Example:

- Operating the cursor will increase/decrease the test level to the next level required in the standards
- By turning the inc knob the test voltage V resp. the phase angle A will be adjusted continuously. The blinking circle shows which parameter can be changed. Pressing the function „O V/A“ will change between both parameters.
- Pressing the function keys will activate immediately the related function.
All functions can be changed during the running test.

10.1.3. User Test Routines

The user can program, save and recall his own specific test routines. The next pages shows the selection of the functions.

User Test Routines	
F1 : Change polarity after n pulses	
F2 : Voltage change after n pulses by ΔV	
F3 : Change the phase angle after n pulses by Δa	
F4 : IEC coupling after n pulses	USC 500N7 Firmware 9.00 and iec.control V 5.2.3.0 or later
F5 : ANSI A coupling after n pulses	USC 500N7 Firmware 9.00 and iec.control V 5.2.3.0 or later
F6 : ANSI B coupling after n pulses	

F1 F2 F3 F4 F5 F6 F7

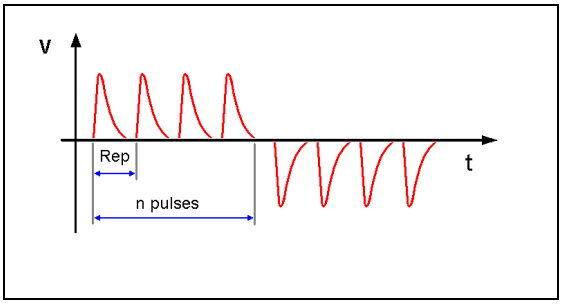
After selection the last used test parameters will be indicated on the display.

Customized test routines

The software controls user test routines according to the specification of the user. All limitations are the same as defined under Quick Start.

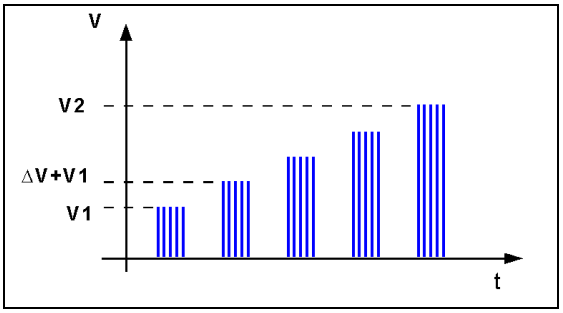
F1 Change polarity after n pulses

After the release of the preselected number of pulses the polarity is changed. The procedure always starts with positive polarity and changes than to negative. The same parameters as under Quick Start can be selected.



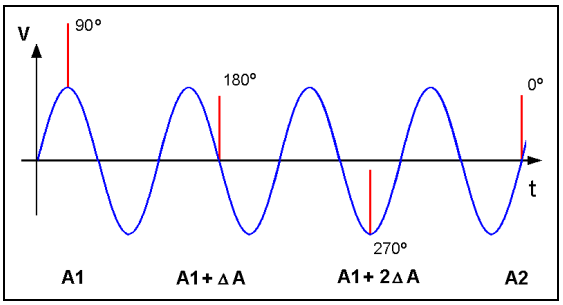
F2 Change test level V after n pulses by ΔV

The test voltage V is changed from V1 to V2. After the preselected number pulses the test level is changed by ΔV until V2 is reached. The same parameters as under Quick Start are selectable. For the limitation of the max. admissible repetition rate the higher value of V1 and V2 is valid.



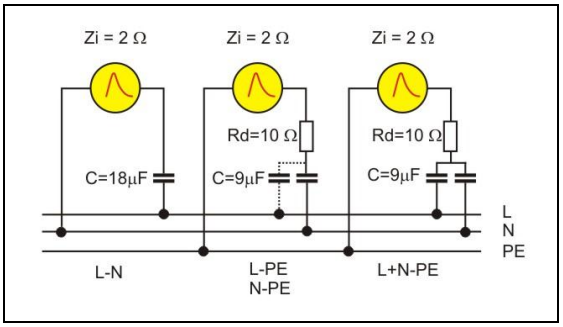
F3 Change the phase angle A after n pulses by ΔA

The phase angle related to which the surge pulse is released is changed from A1 to A2. After the preselected number of n pulses the actual phase angle is changed by ΔA until A2 is reached. The same parameters as under Quick Start can be selected.



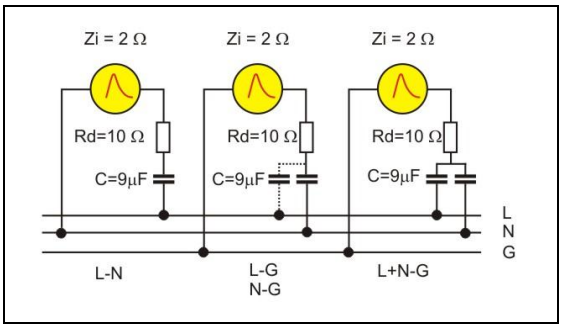
F4 IEC coupling after n pulses

The coupling mode will automatically be changed after the preselected number of pulses has been released. All possible coupling modes will be selected. . The same parameters as under Quick Start can be selected.



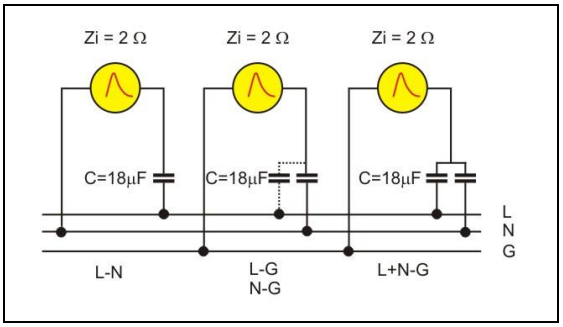
F5 ANSI A coupling after n pulses

The coupling mode with 12Ω und 9µF will automatically be changed after the preselected number of pulses has been released. All possible coupling modes will be selected. . The same parameters as under Quick Start can be selected.



F6 ANSI B coupling after n pulses

The coupling mode with 2Ω und 18µF will automatically be changed after the preselected number of pulses has been released. All possible coupling modes will be selected. . The same parameters as under Quick Start can be selected.



Surge Generator and coupling impedances

	Line to Line	**Line to PE** (IEC) **Line to GND** (ANSI)
IEC	2Ω; 18µF	12Ω; 9µF
ANSI A	12Ω; 9µF	12Ω; 9µF
ANSI B	2Ω; 18µF	2Ω; 18µF

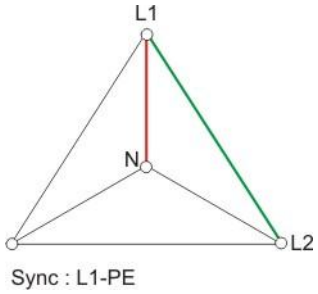
10.1.4. Phase sychronisation in 3-phase system

Device	Firmware versions	
UCS 500N5	From **V 4.41** to **V 4.99** and	from **V 5.00** and higher
UCS 500N7	From **V 7.43** to **V 7.99** and	from **V 8.03** and higher

The built in hardware phase synchronization is between the sync input and PE. The user must connect the synchronizen line L1 with the sync plug.

The synchronisation is based on a 3-phase system where neutral is connected to PE in the supply system.

As Standard **line L1 is connected to the sync** plug. For coupling other lines, the UCS500 hardware will automatically shift the phaseangle in relation to the used coupling.



The tables below shows the correction angels considering the phase in a 3-phase system with connected L1 to the sync input. The UCS500 firmware will automatically add the correctionangle to the setted value.

Synchronisation: L1 to Sync input

	Sync. Source	Correction angel added by the UCS 500 firmware					
Coupling	**L1-PE**	**L1-N**	**L2-N**	**L3-N**	**L1-L2**	**L1-L3**	**L2-L3**
Sync.-Angel	**0°**	0°	120°	240°	330°	30°	90°
	90°	0°	210°	300°	60°	120°	180°
	180°	0°	300°	30°	150°	210°	270°
	270°	0°	30°	150°	240°	300°	0°

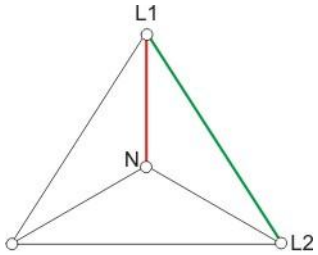
The correct phase angle will be setted automatically from the UCS 500N.

Device	Firmware versions
UCS 500N5	Up to **V 4.40**
UCS 500N7	Up to **V 7.42** and from **V 8.00** to **V 8.02**

The built in hardware phase synchronization is between the sync input and PE.
The user must connect the synchronizen line with the sync plug.

The synchronisation is based on a 3-phase system where neutral is connected to PE.

As Standard **line L1 is connected to the sync** plug.



Sync : L1-PE

The table below shows the correction angels considering the phase in a 3-phase system.

Synchronisation: L1 to Sync input

	Sync. Source	Setted phase angel value for coupling:					
Coupling	**L1-PE**	**L1-N L1-PE**	**L2-N L2-PE**	**L3-N L3-PE**	**L1-L2**	**L1-L3**	**L2-L3**
Sync.-Angel	**0°**	0°	0°	0°	330°	30°	90°
	90°	90°	90°	90°	60°	120°	180°
	180°	180°	180°	180°	150°	210°	270°
	270°	270°	270°	270°	240°	300°	0°

Example: For setting the coupling L1-L2 with a 180° phase angle **set the generator phase to 150°**

10.1.5. Pulsed magnetic field as per IEC 61000-4-9

Page 2 (Select function)

Surge Magnetic field						IEC 61000-4-9
F1 : Quick Start						
F2 : Magnetic field as per IEC 61000-4-9						
F7 : Setup magnetic field						
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**

The operation of the pulse magnetic field test is similar as to the standard surge routines.

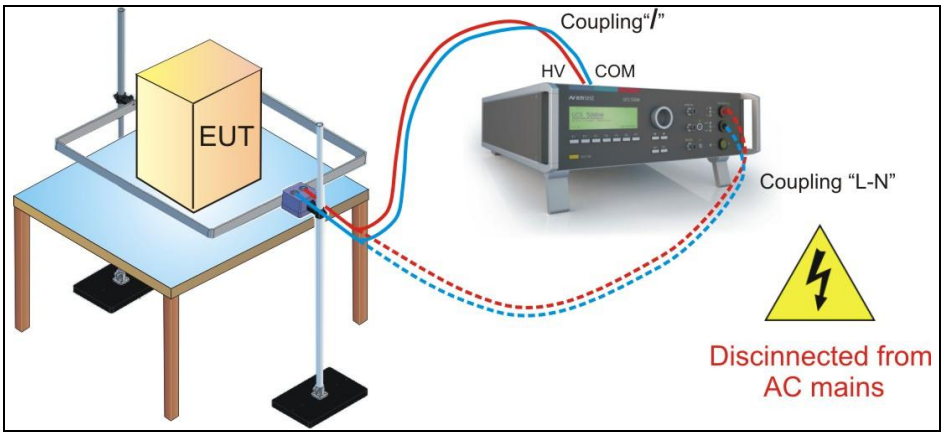
Page 2 (show parameter)

QUICKSTART						
H	=	300A/m	A	=	0 dgr	
+/-	=	+	cpl	=	“/” or “L-N”	
tr	=	10s	tri	=	Auto	
n	=	10				
START CHANGE						
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**

Press **START** and the test routines begin to work.
Press **CHANGE** and the actual parameters can be changed.

For magnetic field testing the antenna correction factor shall be included. The operator can enter this factor within the setup menu under the service routine.

Setup pulsed magnetic Test field



Warning

Disconnect all power cables on the rear side at the Test supply plugs.

PF1, PF2 and N

Don’t touch the antenna during the test!

10.1.6. Setup current limiter for surge current

The current limiter stops the test run when during a test the measured peak current of a surge pulse is higher than the preselected current value. This safety function protect the EUT for further surge pulses can occur any dangerous situation.
Depends of the different impedance of the surge generator, one current limiter for each impedance (2Ω, 12Ω) is available.

Page 2 (show parameter)

```
SETUP  Current limiter

F1 : I - Limiter   Differential mode    I_D
F2 : I - Limiter   Common Mode          I_C

I_D      I_C
500A     54A
```

F1 **F2** **F3** **F4** **F5** **F6** **F7**

I_D = Current limiter Differential mode (line to line): The generator impedance is 2Ω

I_C = Current limiter Common mode (line to ground): The generator impedance is 12Ω

REMARK

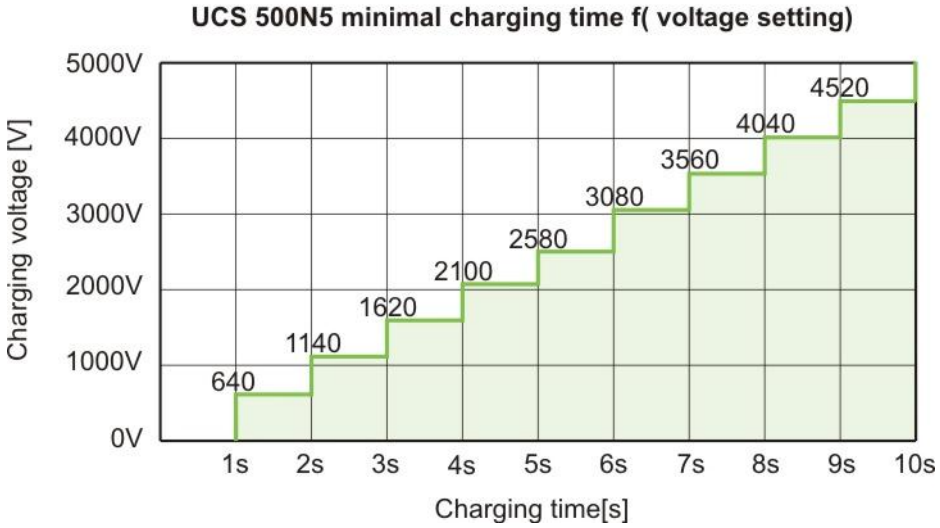
The current limits in Software and Manual operation are two individual settings.

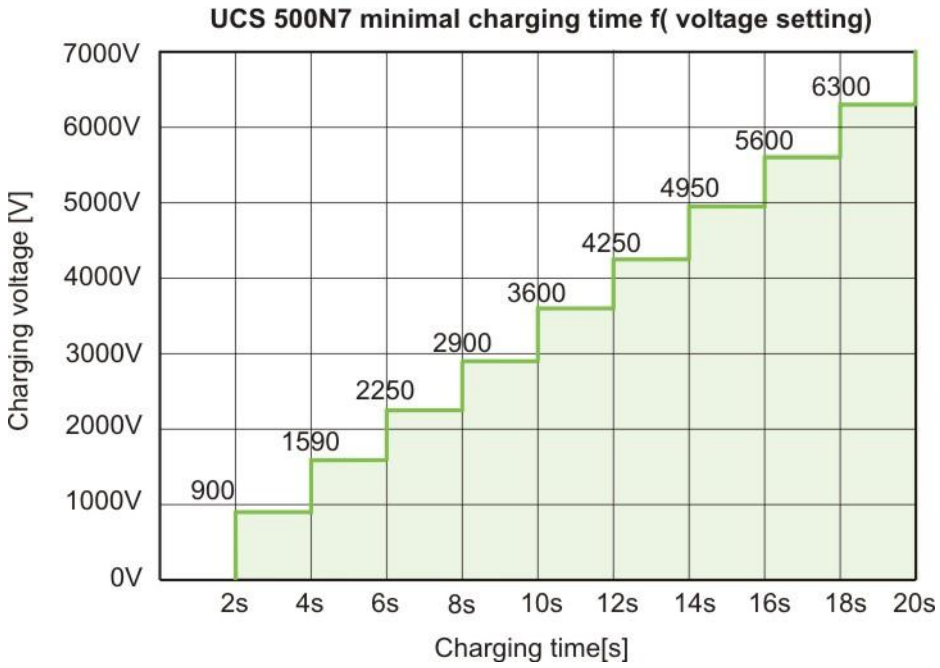
Software uses the **software settings** for I_D and I_C
Manual operating uses the **device settings** for I_D and I_C

Note : Surge pulses with the coupling position "\" (potential free output at the rear side of the generator) use the settings of common mode. This is general used for the coupling network CNV 504 / 508 with 42Ω impedance. Using a coupling network CNI 503 or CNV 503, UCS uses the limits of differential and common mode.

10.1.7. Charging time for surge

The energy for charging the surge generator depends on the charging voltage of the internal capacitor of 11uF therefore the following minimum charging time is requested:





10.2. Surge pulse generation

Discharge switch:
The discharge switch is a highly reproducible semiconductor switch.

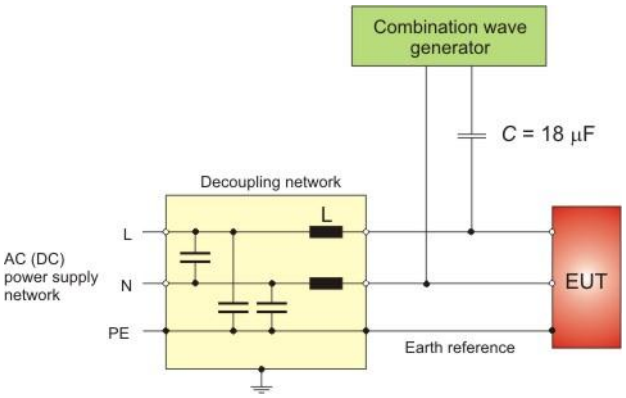
10.3. Coupling/decoupling network

The coupling network has to couple the interference pulses to the lines of a power supply system (AC or DC). Capacitive coupling is the specified coupling mode for surge testing.

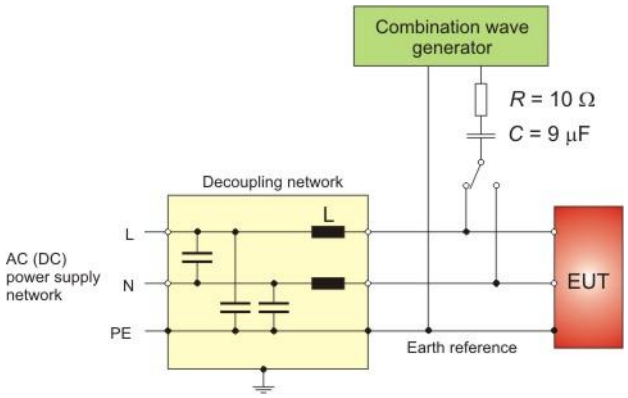
10.3.1. Coupling to ac/dc power supply lines

The surge generator UCS 500 has an integrated coupling network in accordance with IEC 61000-4-5. It must be possible to test with different coupling modes:

Line	→	GND or	(source impedance is 12Ω)
Neutral	→	GND or	(source impedance is 12Ω)
L + N	→	GND or	(source impedance is 12Ω)
Line	→	Neutral	(source impedance is 2Ω)



Coupling Line to Line



Coupling Line to Earth

The release of the surge pulses is mostly related to a certain phase angle.
The surge pulses are synchronized to the input signal at the rear Sync-connector.

Attention: The decoupling part of the coupling/decoupling network includes some capacitors for filtering of 20µF related tp protective earth (chassis of the generator). This is to be conform with the requirement of IEC 61000-4-5 concerning attenuation of the surge transients in direction to the power mains supply input of the CDN.
As consequence there will exist an increased current to PE (protective earth) which might be hazardous to the operator in case of a failure or wrong installation. Therefore it is very important to take the following points into account before setting the generator into full operation.:

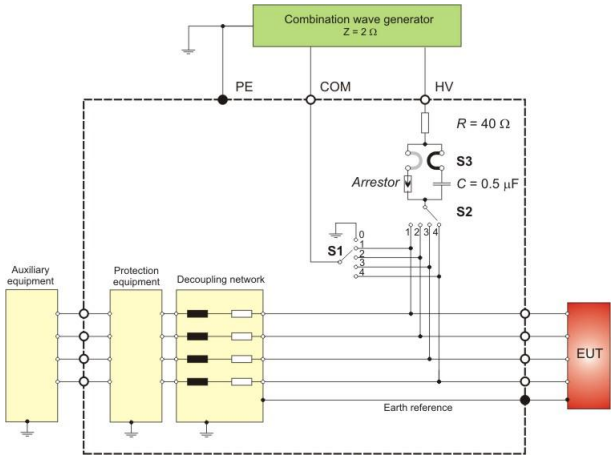
1. Due to this increased current into the PE system no earth fault current protectors can be used within a surge testing area.

2. As consequence the surge generator shall be connected always to Protective Earth, even if no test is conducted.
- **via plugged in power mains supply cable including the PE wire!!!!!!**
- **via plugged in EUT power mains supply at the rear side of the generator, including the PE wire !!!!**
- **via Ground Reference Connector, screwed to the chassis of the generator.**

These measures result in double safety in case of a fault

10.3.2. Coupling to I / O lines

The coupling to I/O lines is generally realized with other coupling networks than for power supply lines. The loading of the I/O lines with big coupling capacitors is mostly not possible. The data transmission may be disturbed.
For coupling to I/O lines special couplers as per IEC 61000-4-5 are available, such as the CNV 504 and the CNV 508 for four respectively for eight wire systems.



Danger

Using coupling networks CNV series

Switch OFF the high voltage during manual change of the coupling

10.4. Test set-up

According to the specifications of IEC 61000-4-5, the surge generator has a source impedance of 12ohm when the simulator is coupled between the lines and protective earth.

This will activate fault current detectors or protectors which may be installed in the laboratory.

Therefore it is important
- not to disconnect the surge simulator form protective earth (power cable)
- to have an installation where the simulator is connected via its ground reference connector to earth

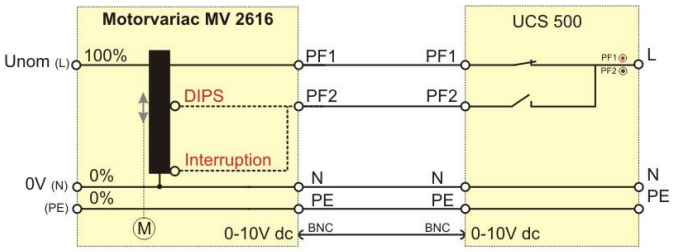
11. Voltage Dips as per IEC 61000-4-11

Dips Module for voltage Dips and short interruptions.

11.1. Test setup for DIPS and Interruption tests

Voltage DIPS

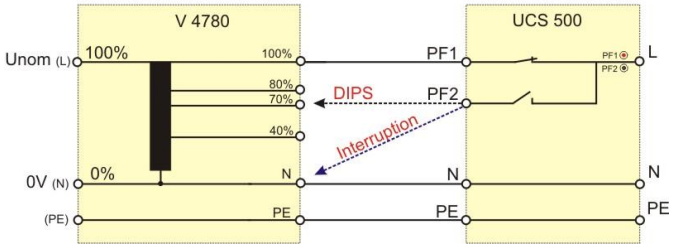
For voltage DIPS a connection must be made from the PF2 UCS input to the motorvariac PF2 or V4780, where the reduced voltage is present.



Interruption tests

For Interrupts connect the PF2 UCS input to the neutral as follows:

- **Motorvariac** : PF2 output (default setting) set motorvariac to zero volt.
- **V 4780** : Connect the cable to the N output at the V 4780



11.2. Operation

The Surge menu offers different test routines for burst testing.

Power Fail	IEC 61000-4-11 / 8 / 29
F1 : Quick Start	
F2 : Standard test routines	
F3 : User test routines	
F4 : Magnetic field	

F1 F2 F3 F4 F5 F6 F7

F1 Quick Start
Easy and fast online-operation of the equipment.

F2 Standard test routines
The operator can select between various preprogrammed test routines as required in different standards. With the function key F4 the operator can select the standard routine for 50/60Hz magnetic field testing as per IEC 61000-4-8.

F3 User test routines
The operator can select between various preprogrammed test routines which helps to accelerate testing and which are very helpful especially during design.

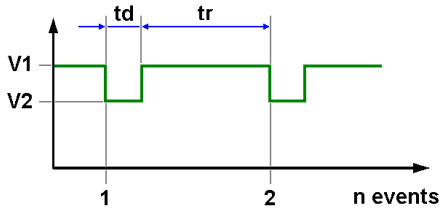
F4 Magnetic Field
The operator can perform 50 / 60 Hz magnetic field test as per IEC / EN 61000-4-8.

11.2.1. Quick Start

Easy and very fast operation of all standard functions of the equipment. The latest simulator settings are stored automatically and will be recalled when Quick Start is next selected.

Power Fail					Quickstart
A	=	0dgr	td	=	10.00ms
rep	=	0.50s	CH	=	ΔU
V2	=	250V	tri	=	Auto
n	=	endl.			
START CHANGE					

F1 F2 F3 F4 F5 F6 F7



Press **START** and the test routines begin to work.
Press **CHANGE** and the actual parameters can be changed.

All function keys except F2 (manual trigger) can ***Stop*** the test routine.

Explanations	
A	Phase angle
td	Duration of a single event
Rep	Repetition rate (time between two events)
CH	Channel select (PF1, PF2 or ΔV)
V2	Variable test voltage (controlled by 0-10 V analog voltage)
n	Number of events
tri	Trigger mode

Page 3 (Start)

Power Fail						Quickstart
A	=	0dgr	td	=	10.00ms	
rep	=	0.50s	CH	=	ΔU	
U2	=	250V	n	=	endl.	
tri	=	Auto				
			V =	230 V		Counter
STOP			I =	0.5 A		002317

F1 F2 F3 F4 F5 F6 F7

After "**START**" the display indicates the voltage and current at the TEST SUPPLY output. The measured voltage is (V peak / √2) if there is a ac-signal on the sync input, otherwise Vpeak. The voltage dips will be repeated with the preselected repetition rate and the counter will be increased.

When the operator is using faster repetition rates the indicated voltage level is not stable. A correct value can not be displayed.
All function keys, except F2 Manual **Trigger**, can stop the running test. After Stop the last setting is displayed for about 2 seconds. Then the functions **START**, **CHANGE** or **CONT** are indicated. F3 will continue the test.

During the QUICK START procedure the value for the angle is blinking. The blinking value always and at any time can be changed by turning the knob (inc/dec). With the cursor the actual blinking function can be changed.

Page 4 (Change)

Power Fail						Quickstart
A : 0dgr - 360dgr / async.						
A	td	rep	CH	U2	tri	n
0	10.00	050	ΔU	250	Auto	endl.

F1 F2 F3 F4 F5 F6 F7

The parameter to change can be selected by pressing a function key. The corresponding range will then be displayed.

11.2.2. Standard Test Routines

```
Standard test routines

F1 :  IEC 61000-4-11    (ac power supply mains)
F2 :  IEC 61000-4-29    (dc power supply systems)
F3 :  EN 61000-6-1      Generic standard
F4 :  EN 61000-6-2      Generic standard

F7 :  Manual test routine
```

F1 F2 F3 F4 F5 F6 F7

11.2.2.1. F1: IEC 61000-4-11 (AC power supply mains)

Page 3

```
Power Fail      IEC 61000-4-11
F1:    Level 1      0%     10.0 ms
F2:    Level 2      0%     20.0 ms
F3:    Level 3     40%      200 ms
F4:    Level 4     70%      500 ms
F5:    Level 5     80%     5000 ms
F6:    Short Interruptions
F7:    Voltage Variation
```

F1 F2 F3 F4 F5 F6 F7

As long as the external variac MV2616 is used, controlled by an analogue 0-10V control voltage, the test is conducted automatically. If this option is not available the manual test routine shall be used.

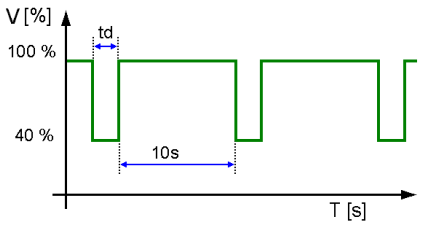
Using a tapped transformer V 4780, the user must connent the PF2 UCS input with the correct plug at the V4780. At 0% selection the PF2 input must be connected to the neutral (0V) plug.

F1 ... F5: DIPS Level 1 to Level 5
Page 4 (Show parameter)

```
Power Fail      IEC 61000-4-11          Level 3
V2%  =   40%                A    =   0 dgr
td   =   200ms              tr   =   10s
                            n    =   3.


                                       Counter
START / STOP                           000002
```

F1 F2 F3 F4 F5 F6 F7



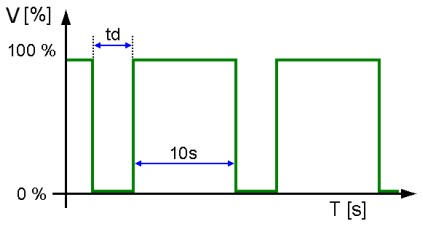
F6: Short interruptions

Page 4 (Show parameter)

```
Power Fail  IEC 61000-4-11     Interruption
V2%  =   0 %                A    =   0 dgr
td   =   5000ms             tr   =   10s
                            n    =   3


                                       Counter
START / STOP                           000002
```

F1 F2 F3 F4 F5 F6 F7

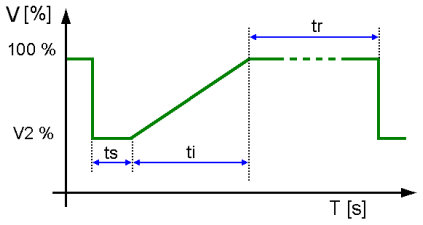


F7: Voltage Variation

Page 4 (Show parameter)

Power Fail	IEC 61000-4-11		Variation		
V2%	=	70%	**A**	=	0 dgr
ts	=	20ms	**tr**	=	10s
ti	=	0.5s	**n**	=	3
					Counter
START / STOP					000002

F1 F2 F3 F4 F5 F6 F7



Attention: This is a new Voltage Variation function which is required in the new FDIS IEC 61000-4-11. The Voltage Variation function which is conform with the actual published IEC 61000-4-11 is available in the USER TEST ROUTINES.

Attention: This is a new Voltage variation function which is required in the IEC 61000-4-11: (2004-03) and simulate a voltage dip during a motor start. For this test requires for the ramp function a motorized variac MV 2616 is mandatory.

The parameters, defined in the standard are fix. The user can modify the bold marked parameters :

- Phase angle W [0 ... 360 dgr / asynchron]
- Repetition time tr [5s ... 999s]
- Number of Events n [1 ... 30'000 / endless]

The Voltage Variation function which is conform with the older IEC 61000-4-11:1995 is available in the menu **User test routines**.

11.2.2.2. F1: IEC 61000-4-29 (DC power supply mains)

Page 3

```
Power Fail      IEC 61000-4-29
F1:    Level 1      40%    10.0 ms
F2:    Level 2      40%    30.0 ms
F3:    Level 3      40%     100 ms
F4:    Level 4      40%     300 ms
F5:    Level 5      40%    1000 ms
```

F1 F2 F3 F4 F5 F6 F7

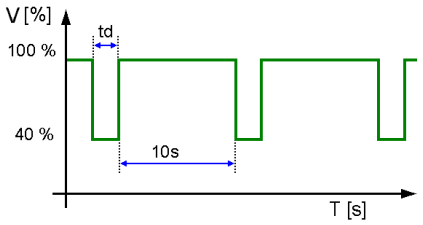
F1 ... F5: DIPS Level 1 to Level 5

Page 4 (Show parameter)

```
Power Fail      IEC 61000-4-11          Level 3
V2%  =   40%                Ch   =  ΔU
td   =   100ms              tr   =  10s
                            n    =  3.


                                    Counter
START / STOP                        000002
```

F1 F2 F3 F4 F5 F6 F7



As long as the external dc supply is used, controlled by an analogue 0-10V control voltage, the test is conducted automatically. If this option is not available the manual test routine shall be used.

11.2.2.3. F3 / F4: EN 61000-6-1 / -2 (Generic)

F3...F4: Generic Test Routines

Page 3

```
Power Fail      EN 61000-6-2  Generic
V2            td              A       n
 70%      10.0 ms        0 / 180     3
 40%       100 ms        0 / 180     3
 40%      1000 ms        0 / 180     3
  0%      5000 ms        0 / 180     3

START CHANGE
```

F1 F2 F3 F4 F5 F6 F7

This test proceeds automatically with a blinking status of the actual sequence in the display. As long as the external variac MV2616 is used, controlled by an analogue 0-10V control voltage, the test is conducted automatically. If this option is not available the manual test routine shall be used.

Change parameters

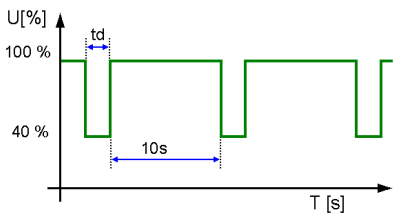
Page 4 (**Show parameter**)

```
Power Fail      EN 61000-6-2  Generic


tr  :  0.01 s        -          99s


tr
 10
```

F1 F2 F3 F4 F5 F6 F7

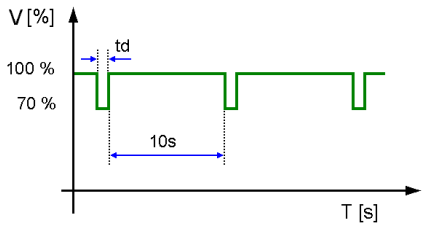


11.2.2.4. F7: Manual test routine

In this menu the user can easy change the parameter online during the test.

Page 4 (**Show parameter**)

Power Fail		standard routine			IEC 61000-4-11	
<- ->	O				O	
Level 4	70%	500ms			0 grd	
START	oV2/td			A		
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**



Example:

- Selecting the 70% level requires a 70% Vn power supply voltage at the input of PF2 at the rear panel of the UCS. Use for that the variac MV2616 (automatic), the matching transformer V4780 or your own power mains source available in your laboratory.

- By pushing the function keys will immediately activate the function
  – F1 : Start
  – F3 : oV2/td Exchange the knob function V2Level [%] / Dip duration
  – F6 : W Angle 0°, 180°, asynchronous

- By turning the inc knob the duration of a single event can be adjusted.

11.2.3. User Test Routines

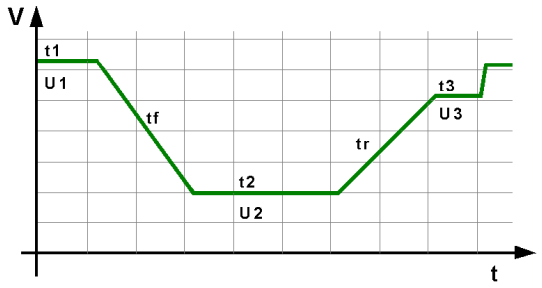
Page 2 (Selection)

Power Fail User test routines
F1 : Voltage variation as per IEC 61000-4-11
F2 : Change angle after n events by dA
F3 : Change duration after n events by dA
F4 : Inverse mode

F1 F2 F3 F4 F5 F6 F7

F1 Voltage variation as per IEC 61000-4-11

An external power source or motor driven variac is controlled by a 0-10V control signal. The operator can select the time per voltage level, the ramp up and ramp down of the voltage change and the voltage levels itself.



Page 2 (show parameters)

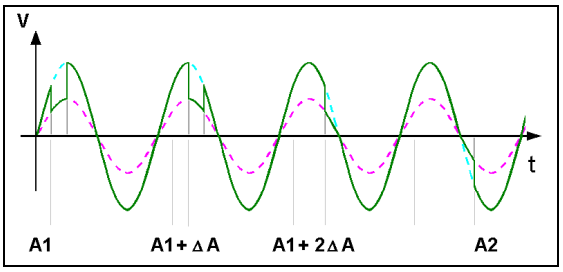
Power Fail		Voltage Variation			
V1	=	220 V	T1	=	10 s
V2	=	120 V	T2	=	1 s
V3	=	220 V	T3	=	10 s
Tf	=	2.0 s	Tr	=	2.0 s
tri	=	AUTO	n	=	00010
START CHANGE					

F1 F2 F3 F4 F5 F6 F7

Press **START** and the test routines begin to work.
Press **CHANGE** and the actual parameter can be changed.

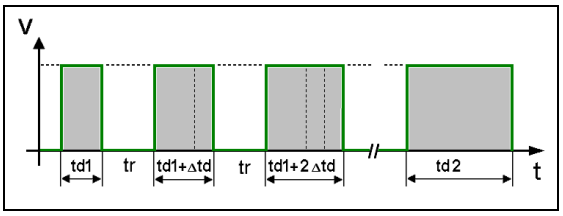
F2 Change angle after n events by ΔA

After n events the phase angle related to which the events are released will change from A1 to A2 by steps of ΔA until A2 is reached. The same parameters as under Quick Start can be selected.



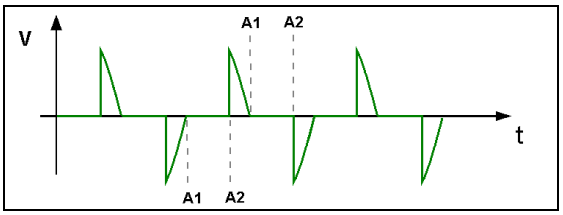
F3 Change duration after n by Δtd

After n events the duration of a single event will change from td1 to td2 by steps of Δtd until td2 is reached.
The same parameters as under Quick Start can be selected.



F4 Inverse mode

The inverse mode can simulate a phase control circuit, switching power (voltage) on/off at a certain phase angle. The phase angle is selectable in the range of 0-180°. The voltage will be switched on/off in each half-wave. Inverse is only working in **ΔU** mode.



11.3. The Power Fail Test

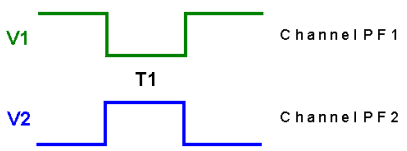
The power fail simulator operates in the following mode:

PF1: The voltage supply at channel PF1 will be interrupted for the preselected time T1.

PF2: The voltage supply at channel PF2 will be interrupted for the preselected time T1.

ΔU: Channels PF1 and PF2 are supplied with different voltages; e.g. channel PF1 with nominal voltage, channel PF2 with 15% under-voltage.

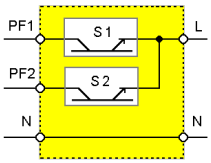
- channel PF1 is switched off for the preselected time T1.
- channel PF2 is switched on for T1.



LED

Two LED's mounted on the front panel show if a channels is active or not. The LED of an active channel is lighted. During mode ΔU the LED display switches from one channel to the other.

Voltage interference



In order to accelerate the test procedure the voltage interference may be generated repetitively. In the operating mode „AUTO" the events are released at a preselected interval time.

Power switches

The power unit of the simulator consists of two electronic power switches S1 and S2. The two separated input channels PF1 and PF2 are connected to each other at the front panel of the simulator via S1 and S2.

Input channels

The input channels PF1 and PF2 are located at the rear part of the equipment. Attention has to be given to the following:

1. **The phase shall be connected correctly. When putting into operation check the lines with a phase tester or with the incorporated LED phase.**
2. **Phase must be set on L, neutral must be set on N.**
3. **This applies to both channels. If during installation phase and neutral is changed, the operator will cause a short-circuit at the input plug of the channel.**
4. **The neutral of both channels is connected internally and directly leads to the output.**
5. **The power switches can bear no more than a voltage of 350Veff.**
6. **If isolating transformers are used special care shall be taken to have both channels in phase. Otherwise too high voltages, in difference mode, may occur and destroy the internal protection devices (varistors).**

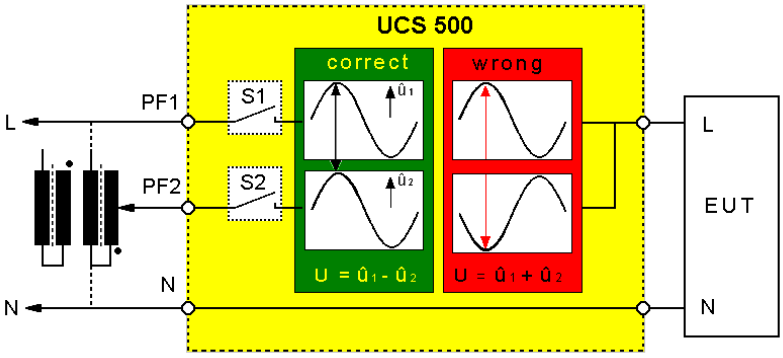
11.4. Overcurrent

Power switches

The power switches are electronically protected against overload and short-circuits. The nominal current of the switches is 25A.

Special protection requirements of the EUT must be separately assured by the user.

Inrush currents of < = 500A are permitted. To avoid higher inrush currents of the EUT an electronic control limiting the inrush current is incorporated in the device.



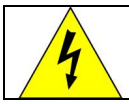
Correct phase relation between PF1 and PF2

Over-voltage generated by connecting or disconnecting additional loads will be limited internally by varistors in parallel to the electronic switch.

Power Fail						Quickstart
W	=	0dgr	td	=	10.00ms	
Rep	=	0.50s	CH	=	ΔU	
U2	=	250V	n	=	endl.	
Tri	=	Auto				
Overcurrent REMOVE SHORT CIRCUIT ! ON						
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**

Example overcurrent message in display

Occurs an overcurrent during a test, The PF switches will switch off the immediately and the display shows:

	**Overcurrent REMOVE SHORT CIRCUIT ! ON**

This error message appears after a short circuit at the EUT output plugs. This current can be up to 700A during few µs and will be detcted fron the overcurrent detection.

For overcurrent handling proceed as follow:

1. **Disconnect the short circuit** and make sure tho remove the failure.
2. Press **F7 ON**. This will switch on the PF switch again and returns the power to the EUT output.
3. Continue in the start menu with CHANGE, START or CONTINUE.

11.5. The Power Fail Test

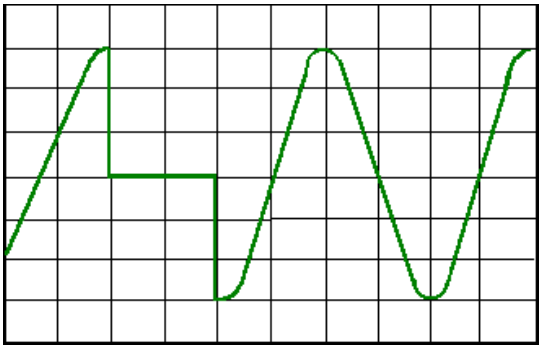
The generator type UCS 500N5/M7 simulates the following interference :

- Voltage dips
- Voltage interruptions
- Voltage variations
- Inverse

11.5.1. Voltage Interruptions

Depending on the preselected test parameters at the front panel of the simulator the power supply for the EUT is interrupted for a certain time and at a certain phase angle (AC power supplies).

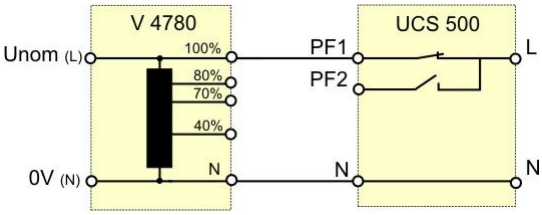
The power supply for the EUT is connected at the rear part of the simulator to channel PF1.
The power supply may be taken directly from the mains power supply or from a separate voltage source. Mostly used for this tests are motor driven variacs



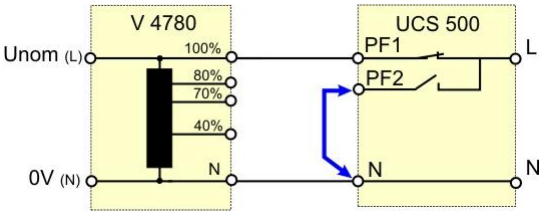
Power fail tests are normally carried out at a nominal voltage and at maximum tolerance under-voltage.
The nominal voltage may be connected to PF1 and the reduced dip voltage to PF2.

The power fail test may be carried out in various operating modes:

High impedance interruptions
With ΔU mode the EUT supply is interrupted by the electronic switch. The PF2 input is not connected. The EUT must discharge itself internally.



Low impedance interruptions
The EUT supply is connected to PF1. The channel PF2 is short-circuited (L-N). The EUT supply is disconnected by the electronic switch of PF1 and the EUT will be discharged into a low impedance via the electronic switch of PF2

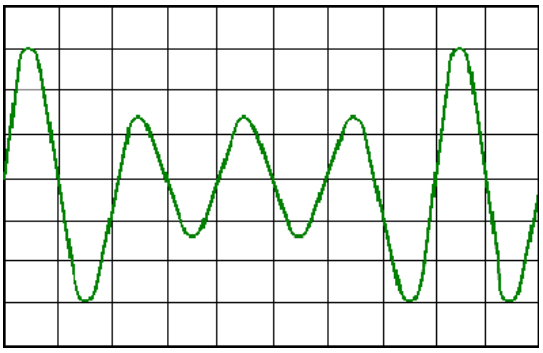


11.5.2. Voltage dips, voltage variations

Depending on the preselected test parameters, the test voltage is changed to a higher or to a lower value for a certain duration and at a certain phase angle.

Voltage variations are normally related to the nominal value of the supply voltage. Therefore two different variacs shall be connected at the rear side of the simulator.

- PF1 → Nominal voltage
- PF2 → Under- / overvoltage



The operation mode ΔU shall be preselected. The voltage variation is realized by switching the power supply from channel PF1 to channel PF2.

If a motor driven variac is available, it is also possible to drive the source by an analogue voltage 0 - 10V. This control voltage is available at the coaxial output at the rear part of the simulator

The control voltage is to be set via the operator menu or the interfaces of the PFS. A complete user software to drive ramps and functions is also available

11.6. DC Power networks

Basically there is no difference in the operation of the equipment between AC and DC power supplies. The only point the user should take care of are the grounding conditions.
The voltmeter, the "MONITOR" output and the LED are related to protective earth or to the simulator's chassis, respectively. Therefore these instruments can be used to check line or neutral and to measure at the output CRO U while the test procedure is running.
It results for the DC power supply operation:

- If it is possible to ground the "MINUS" pole of the DC supply, from the EUT point of view, the blue output plug (minus) should be connected to the green/yellow plug.

- By this way the power supply source connected at the rear side of the simulator might be grounded.

→ All measuring facilities are available if
- it is not possible to ground the "MINUS" pole and therefore the voltmeter cannot indicate the DC voltage.
- the phase indication led at the EUT supply input are not glowing
- there is no signal at the "CRO U" output.

11.7. Test setup and accessories

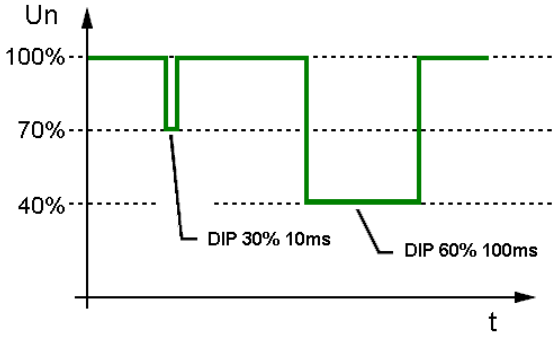
11.7.1. Transformer type V4780

The transformer shall be used to generate under-voltages in ac power supply systems. According to the IEC 61000-4-11 and the EN 50081-2 voltage dips shall be generated as shown in fig. below. Different test levels are recommended

11.7.1.1. Voltage interruptions **(DIP)**

Voltage interruptions will cause a reduction of the power supply voltage for a certain period of time. Three different test levels are required:

- Voltage dip by 100% to 0% of the nominal voltage for 10ms or. ½ period
- Voltage dip by 100% to 0% of the nominal voltage for 20ms respectively 1 period
- Voltage dip by 60% to 40% of the nominal voltage for 200ms respectively 10 periods
- Voltage dip by 30% to 70% of the nominal voltage for 500ms respectively 25 periods
- Voltage dip by 20% to 80% of the nominal voltage for 5000ms respectively 250 periods



Standard voltage dips

V 4780 S2 with automatic tap control

The transformer is an accessory to the following devices
- UCS 500Mx, PFS 500

11.7.1.2. Device models V 4780

V4780	250V 16A, manual control	
V4780 S1	250V 16A manual control	additional tap at 120%
V4780 S2	250V 16A, automatic control	
V4780 S3	250V 32A, manual control	

11.7.1.3. Control V4780 S2

The V4780 S2 is controlled through the analogue input (0...10Vdc). The control circuit switches to the related tap, 40%, 70% or 80%, proportional to the applied dc reference voltage (0...10V dc) to the output PF2.
Is the reference dc voltage out of the tolerance (± 0.25V), the control will not switch to any tap to the PF2 output.

Operating with ramps the control circuit will not select a tap, if the ramp (0-100%) is shorter than approx. 4s. Programming longer ramps, each tap will switch on and off when the reference is in the valid range.

Voltage taps	**DC reference voltage**
80% of Unom	8.00V ± 0.25V
70%	7.00V ± 0.25V
40%	4.00V ± 0.25V

Settings on UCS for V4780 S2
The UCS must be matched to the 0-10V input of the V4780. Therefore a **V4780 must be configured as a motor variac.** For V and Vn must set to the same value which is the value of the voltage of your power supply.

Setup: **F7**- Service/ **F3**-Setup/ **F6** Set voltage

Settings	V	Vn	CH
Example for 230V mains	230V	230V	1

11.7.1.4. Technical Data V4780

Design Tapped auto-transformer with 40% , 70%, 80%, 100 % output voltage

Input:

Voltage	Uin: max. 250V
Frequency	50/60Hz
Tap selection	manually (V4780) banana plugs for 40%, 70%, 80%
Remote control	0.10V dc (V4780 S2) for 40%, 70%, 80%

Output:

Voltage tap [% Unom]	120% (V4780 S1) 100% 80% 70% 40%

	V4780, S1, S2	**V4780 S3**
Current Imax.	16A	32A
Power	4.1 kVA	8.2 kVA
Fuse	2x 16A	2x 35A

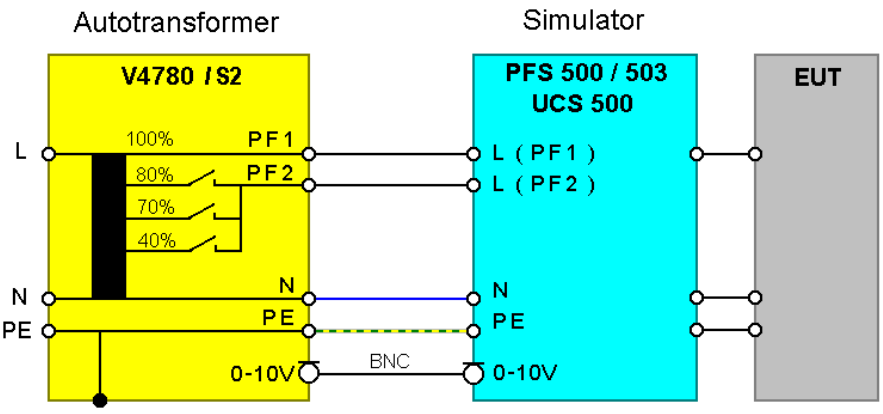
Weights and measures

Dimensions	95 x 170 x 190 mm (H x B x T)	200 x 170 x 190 mm (H x B x T)
Weights	ca. 7 kg	ca. 14 kg
Temp Ambiance	10°C - 35°C	10°C - 35°C

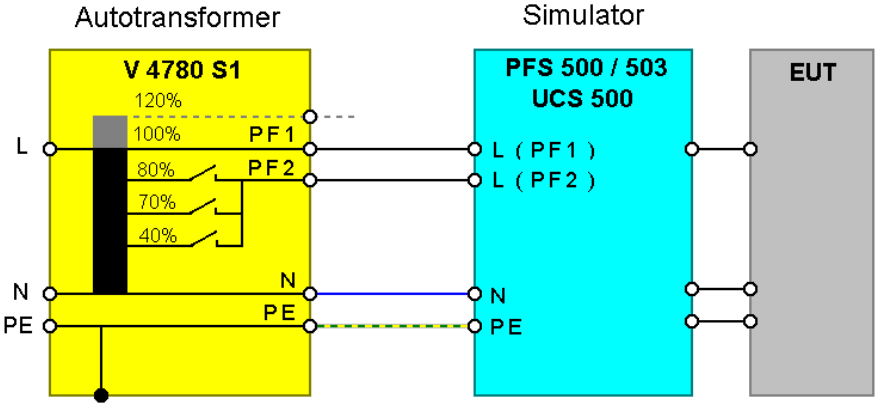
11.7.1.5. Setup V4780

The output voltages are available at safety banana plugs. For safety reasons the related safety cables shall be used.

The power supply input is realized with a power connector for L, N and PE. The voltage shall be 100% of the nominal voltage Vn.



Connection V 4780 / V4780 S2



Connection V4780 S1

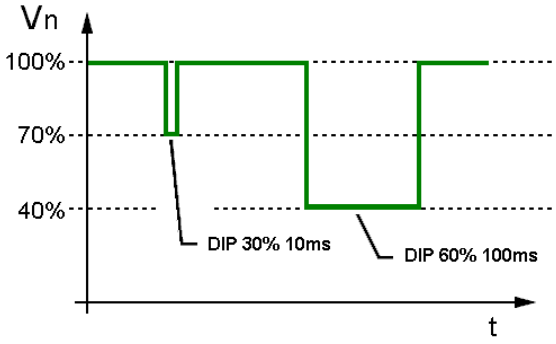
11.7.2. Motor variac type MV 2616

The motor variac can be used to simulate power supply failures as under-voltages, voltage interruptions and voltage variations. The basic standard IEC 61000-4-11 and the generic standard EN 50081-2 are specifying these phenomena.

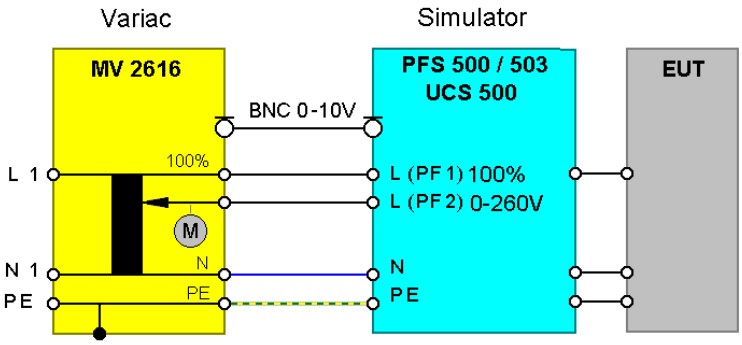
11.7.2.1. Voltage dips / interruptions

Voltage interruptions will cause a reduction of the power supply voltage for a certain period of time. Three different test levels are required:

- Voltage dip by 100% to 0% of the nominal voltage for 10ms or. ½ period
- Voltage dip by 100% to 0% of the nominal voltage for 20ms respectively 1 period
- Voltage dip by 60% to 40% of the nominal voltage for 200ms respectively 10 periods
- Voltage dip by 30% to 70% of the nominal voltage for 500ms respectively 25 periods
- Voltage dip by 20% to 80% of the nominal voltage for 5000ms respectively 250 periods



Standard voltage dips



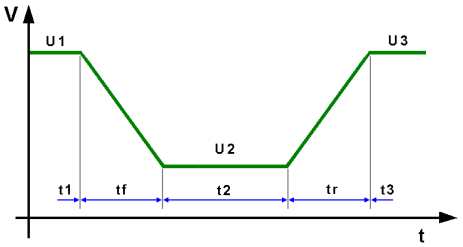
Connection diagram MV2616

The unit has to be connected at the rear part of the equipment. For connection safety laboratory cables shall be used.

11.7.2.2. Voltage variation

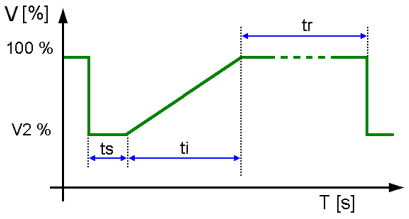
Additionally it is possible to drive certain functions of variation, which also are required in IEC 61000-4-11. These functions can easily be programmed within the simulators itself or within the related windows software ISMIEC

V2	Test level [%U1]:	40%, 0%
tf	Time for decreasing voltage [sec]	2 ± 20%
t1	Time at retained voltage [sec]	1 ± 20%
tr	Time for increasing [sec]	2 ± 20%



For new FDIS IEC 61000-4-11 (2004) use a new procedure for voltage variation , who simulate a voltage dip during a motor start.

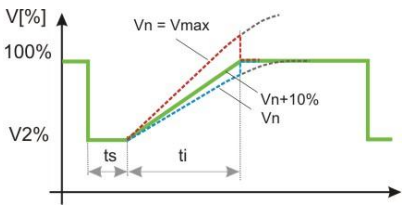
The motor variac will be set previously to the voltage V2. The switch to PF2 happens in the UCS 500. Then the motor variac increase the voltage controlled by the UCS. After ti the voltage change back to PF1



The speed of the voltage variation depends on the max. speed of the motorvariac and the control setting of the integral action controller.
The behavior can be influenced by the parameter Vnominal. Setting in the setup menu Setup / F5 Voltage setting.

The user can optimize his setting for the test.

Vn = Vmax of motorvariac	Red curve the voltage rising is too fast.
Vn = 110% of Vnominal	Green curve optimum setting
Vn = Vnominal	Blue curve the voltage regulation is too slow.



11.7.2.3. Technical data MV 2616

Input:

Voltage	Vin: max. 250V
Frequency	50/60Hz

Output

Voltage	Vout: 0 - 260V for channel PF2

additionally Vout=Vin for channel PF1

Current	max: 16A
Power	0 - 4.1 kVA

Control

Main switch	On/Off for the output voltages
Control voltage	analogue 0 - 10V DC for 0-260V output voltage
Time 0..100%	< 2s

Dimensions and weight

Dimensions	19" 6HE	266x485x400mm (HxBxT)
Weight	app 27 kg	
Power supply	115/230V	
Fuse	20A (PF1), 16A (PF2)	
Environment Tmax	40°C	

11.8. 50/60Hz Magnetic Field as per IEC 61000-4-8

Magnetic field standard routine IEC 61000-4-8						
<- -> O O						
5 A/m 01:00 min						
START O H/T						
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**

With the inc knob the values for the magnetic field strength and test duration can be changed. The actual parameter is indicated by a blinking circle.

Test setup

Warning

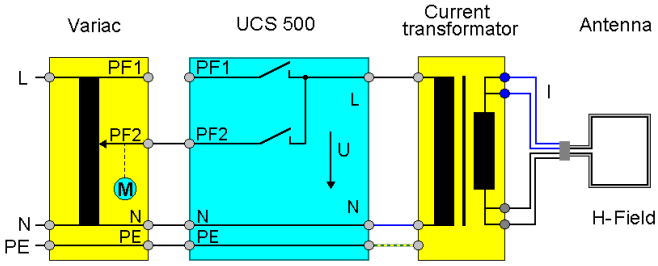
For magnetic field testing the power mains input at PF1 shall be disconnected.; 230V/16A.

The voltage V is adjusted with a variac as long as the required antenna current is available and the related H field is generated in the center of the magnetic field antenna.

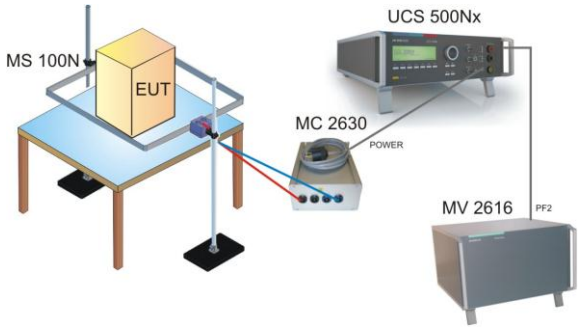
The variac, type MV 2616 may be controlled automatically via the test generator. Any equivalent variac available in the lab can be used to control the current manually. Please take care that the variac has a sufficient current capability.

For more detailed information the operator can require an additional manual especially for magnetic field testing. This manual is part of the delivery of magnetic field testing accessories.

Test setup with MC 2630 for H-Fields up to 30A/m



Schematics



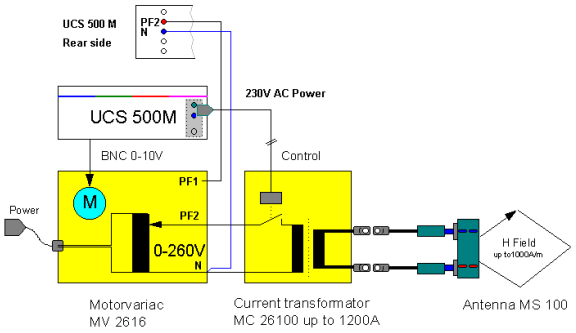
Test setup

Schematics and Test setup with UCS500Nx, MV 2616, MC 2630 and MS 100N

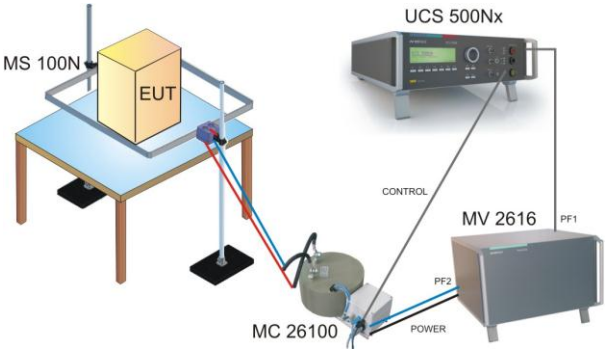
Option for required magnetic field tests as per IEC 61000-4-8

- External motor variac **MV 2616**
- External Magnetic field antenna **MS 100N**
- External current transformer **MC 2630** to test 1, 3, 10 and 30A/m levels

Test setup with MC 26100 for H-Fields up to 1000A/m



Schematics



Test setup

Schematics and Test setup with UCS500Nx, MV 2616, MC 26100 and MS 100N

Option for required magnetic field tests as per IEC 61000-4-8

- External motor variac **MV 2616**
- External Magnetic field antenna **MS 100N**
- External current transformer **MC 26100** to test 100 to 1000A/m levels

12. Ringwave Immunity as per IEC 61000-4-12

Ringwave Module 0.5µs – 100kHz

12.1. Operation

The menu offers different test routines for ring wave testing.

```
Ring wave
F1 :  Quick Start
```

F1 F2 F3 F4 F5 F6 F7

F1 Quick Start
Easy and fast online-operation of the equipment.

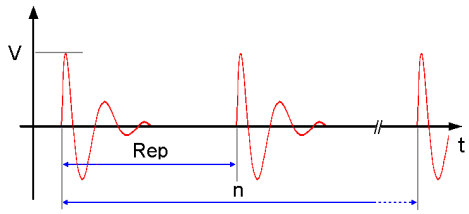
12.1.1. Quick Start

Easy and very fast operation of all standard functions of the equipment. The latest simulator settings are stored automatically and will be recalled when Quick Start is next selected.

```
Ring wave                                  Quick start
V     =  2000  V          Imp   =    12   Ohm
A     =     0 dgr         +/-   =    +
cpl   =  L+N–PE           tr    =    1s
tri   =  Auto             n     =    endl


START CHANGE
```

F1 F2 F3 F4 F5 F6 F7



Press **START** and the test routines begin to work.
Press **CHANGE** and the actual parameters can be changed.

All function keys except F2 (manual trigger) can ***Stop*** the test routine.

Page 3 (START)

```
Ring wave                                  Quick start
V     =  2000  V          Imp   =    12   Ohm
A     =     0 dgr         +/-   =    +
cpl   =  L+N–PE           tr    =    1s
tri   =  Auto             n     =    endl

USet =   2000V          U = +  2000V   Counter
STOP                    I  = +     0A   0000043
```

F1 F2 F3 F4 F5 F6 F7

The user can select the parameter with the related function key and can change the value with the knob. The cursor allows the user to define the value of the digit which should be changed (fast or slow change).

Pressing the ESC button will bring the user back to the previous level from where the test can be restarted with new levels. After restart the actual test time is displayed. All functions keys except F2 (MAN TRIGGER) can stop the test routine. The latest setting will be displayed.

Any pressing of a function key will indicate the functions START, CHANGE or CONTINUE. F3 will continue the same test routine. Also the test time will continue running. If the user selects at first START or CHANGE the test will be stopped completely.

Page 3 (CHANGE)

Ring wave						Quick start
Voltage	V	:	250V	-	6000V	
angle	A	:	0dgr	-	360dgr	
Events	n	:	1	-	30000	
Repetition	Rep	:	2s	-	999s	

V	Imp	A	+/-	cpl	tr	
250	12 Ohm	0	+	L+N+PE	1	1/2
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**

Note: At polarity setting ALT it is necessary to double the number of impulses. Example n=2 => one impulse positive and one impulse negative.

12.2. Ring wave pulse generation

Discharge switch:
The discharge switch is a highly reproducible semiconductor switch.

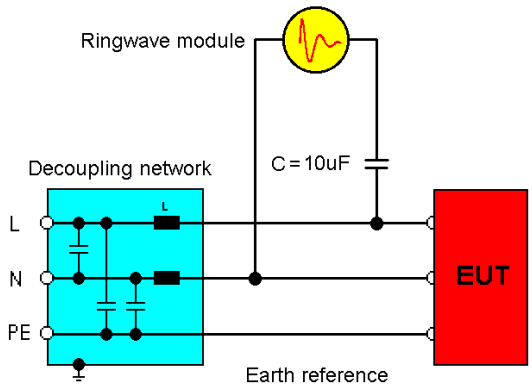
12.3. Coupling/decoupling network

The coupling network has to couple the interference pulses to the lines of a power supply system (AC or DC). Capacitive coupling is the specified coupling mode for surge testing.

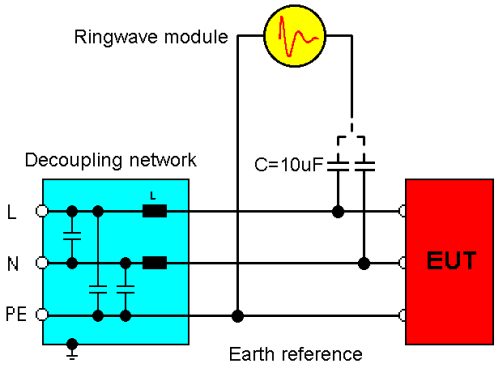
12.3.1. Coupling to ac/dc power supply lines

The surge generator UCS 500 has an integrated coupling network in accordance with IEC 61000-4-12. It must be possible to test with different coupling modes:

Line	→	GND or
Neutral	→	GND or
L + N	→	GND or
Line	→	Neutral



Coupling Line to Line



Coupling Line to Earth

The release of the surge pulses is mostly related to a certain phase angle.
The surge pulses are synchronized to the input signal at the rear Sync-connector.

Attention: The decoupling part of the coupling/decoupling network includes some capacitors for filtering of 20µF related tp protective earth (chassis of the generator). This is to be conform with the requirement of IEC 61000-4-5 concerning attenuation of the surge transients in direction to the power mains supply input of the CDN.
As consequence there will exist an increased current to PE (protective earth) which might be hazardous to the operator in case of a failure or wrong installation. Therefore it is very important to take the following points into account before setting the generator into full operation.:

12.4. Test set-up

According to the specifications of IEC 61000-4-12, the ring wave generator has a source impedance of 12 ohm when the simulator is coupled between the lines and protective earth.

Therefore it is important
- not to disconnect the surge simulator form protective earth (power cable)
- to have an installation where the simulator is connected via its ground reference connector to earth

1. **Due to this increased current into the PE system no earth fault current protectors can be used within a surge testing area.**
2. **As consequence the surge generator shall be connected always to Protective Earth, even if no test is conducted.**

- **via plugged in power mains supply cable including the PE wire!!!!!!**
- **via plugged in EUT power mains supply at the rear side of the generator, including the PE wire !!!!**
- **via Ground Reference Connector, screwed to the chassis of the generator.**

These measures result in double safety in case of a fault

13. Telecom Surge

For Telecom pulses there are the following extensions modules:

- TSurge5 as built in module to the UCS500N5 who will be boosted up to 6HU.
- TSurge7 as an additional module to the UCS500N7

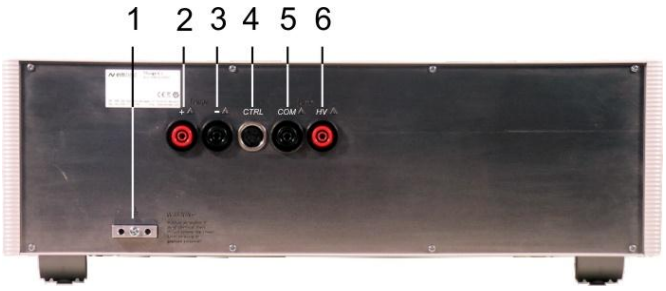
TSurge : Module for Telecom Surge.

10µs / 700µs as per. ITU and ETS
9µs / 720µs gem. FCC part 68 Pulse B
10µs / 700µs gem. IEC 61000-4-5

External TSureg7 module for UCS500N7

13.1. TSurge7 Module

1	ON LED display TSurge active
2	Output COM plug 15 Ω
3	Output HV plug 15 Ω
4	Output T1...T4 4x100Ω
5	Output T1, T2 2x25Ω



1	Earth plug
2	+ polarity charging
3	- polarity charging
4	Control TSurge
5	COM Input TSurge – UCS 500N7
6	HV Input TSurge – UCS 500N7

13.2. TSurge Menu

TSurge test are possible in the menu TSurge Quickstart. This menu is only available if the CTRL cable between TSurge7 module and UCS500N7 is connected and the TSurge is detected by the UCS500N7.

The menu offers different test routines for ring wave testing.

```
TSURGE
F1 :  TSurge Quick Start
```

F1 **F2** **F3** **F4** **F5** **F6** **F7**

F1 Quick Start
Easy and fast online-operation of the equipment.

13.2.1. Quick Start

Easy and very fast operation of all standard functions of the equipment. The latest simulator settings are stored automatically and will be recalled when Quick Start is next selected.

```
TSURGE                                  Quick start
V     =  2000  V        +/-    =    +
tr    =  1s             n      =    endl
tri   =  Auto


START CHANGE
```

F1 **F2** **F3** **F4** **F5** **F6** **F7**

Press **START** and the test routines begin to work.
Press **CHANGE** and the actual parameters can be changed.

All function keys except F2 (manual trigger) can ***Stop*** the test routine.

Page 3 (START)

```
TSURGE                                  Quick start
V     =  2000  V        +/-    =    +
tr    =  1s             n      =    endl
tri   =  Auto


Uset =   2000V                        Counter
STOP                                  0000043
```

F1 **F2** **F3** **F4** **F5** **F6** **F7**

The user can select the parameter with the related function key and can change the value with the knob. The cursor allows the user to define the value of the digit which should be changed (fast or slow change).

Pressing the ESC button will bring the user back to the previous level from where the test can be restarted with new levels. After restart the actual test time is displayed. All functions keys except F2 (MAN TRIGGER) can stop the test routine. The latest setting will be displayed.

Any pressing of a function key will indicate the functions START, CHANGE or CONTINUE. F3 will continue the same test routine. Also the test time will continue running. If the user selects at first START or CHANGE the test will be stopped completely.

Page 3 (Change)

```
TSURGE                                        Quickstart
Voltage          V     :   250V    -    6000V
Events           n     :   1       -    30000
Repetition       Rep   :   2s      -    999s


  U       Imp       A      +/-      cpl          tr
 250    12 Ohm      0       +     L+N+PE        1      1/2
```

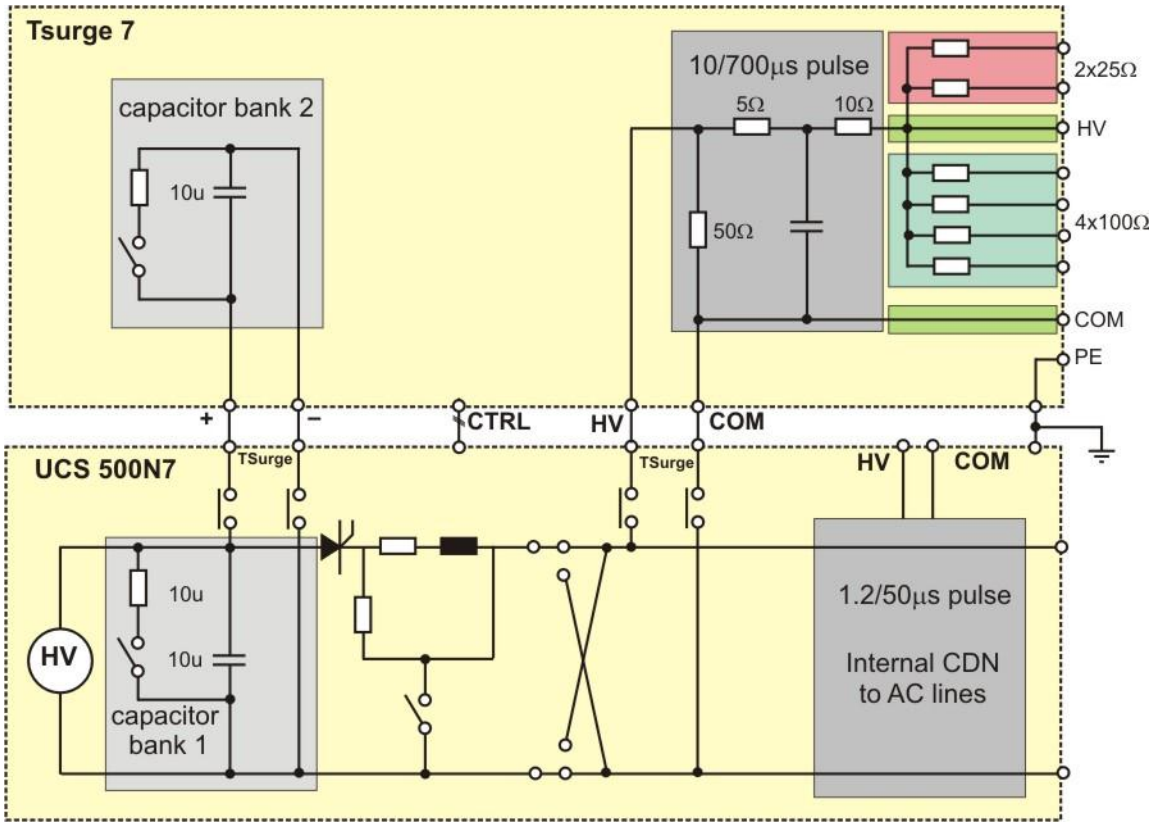
F1 **F2** **F3** **F4** **F5** **F6** **F7**

Note: At polarity setting ALT it is necessary to double the number of impulses. Example n=2 => one impulse positive and one impulse negative.

13.3. Coupling Network

The coupling network is responsible to couple the test pulse to the lines (ac or dc or signal lines) using single coupling resistors inside the TSurge module.

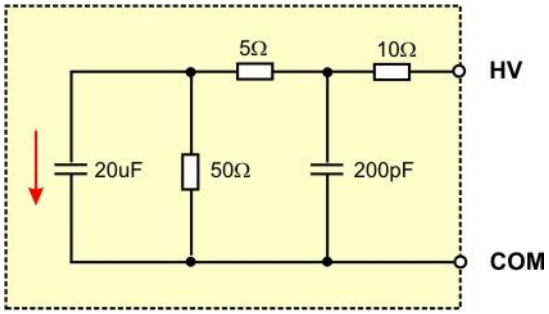
The Telecom surge is generated and coupled to the EUT as shown in the next figure.



The charging rectifier charges the both 10µF capacitor banks in the UCS500N7 and TSurge module
Depend of the polarity the pulse forming network will be charged. The discharge switch is a highly reproducible semiconductor switch.

Pulse 10/700µs and **9/720µs** as per:

- ETS 300046
- ETS 300047
- CCITT K12
- FCC part 68 for Surge B



10/700µs pulse network

13.4. Test Setup

Setup
The TSurge6.1 must be placed on the top of the UCS 500N7 generator.

Cabling

1. Earth cable		UCS500N7 – TSurge7
2.	**HV** and **COM** cable	UCS500N7 – TSurge7
3.	Charging cables **+ / -**	UCS500N7 – TSurge7
4.	Control cable **CTRL**	UCS500N7 – TSurge7

Test Setup UCS500N7 and TSurge7

13.5. Test pulses TSurge Modules

13.5.1. Waveshape Definitions according IEC 61000-4-5

Definition of Voltage Front Time
The voltage front time is calculated by measuring the duration between 30% and 90% (tr) of the maximum pulse amplitude and multiplying that value by 1.67

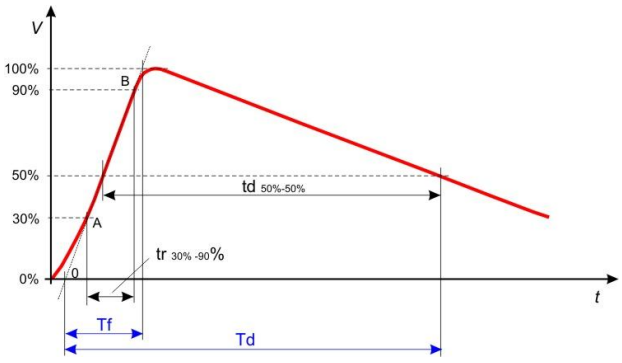
$Tf = tr_{30\%-90\%} \times 1.67$

Definition of Current Front Time
The current front time is calculated by measuring the duration between 10% and 90% (tr) of the maximum pulse amplitude and multiplying that value by 1.25

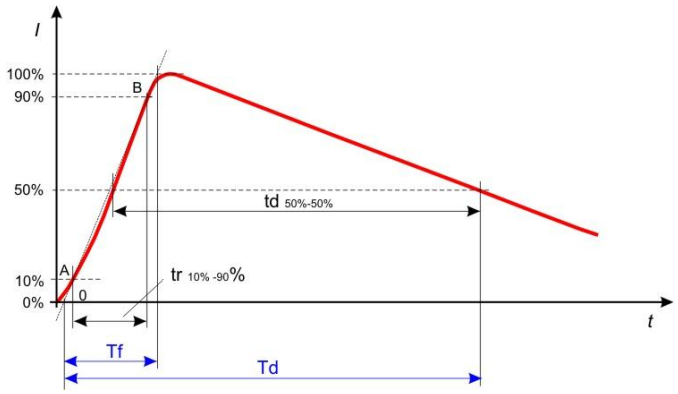
$Tf = tr_{10\%-90\%} \times 1.25$

Definition of Decay Time
The decay time is calculated by measuring the time from the initial rise of the waveform to the point where it decays to 50% of the maximum value. Because the time of the initial rise is difficult to measure the decay time can be calculated by adding the time between 50% of the amplitude of rising to 50% of the amplitude of decaying and 50% of the front time as defined before.

$Td = td_{50\%-50\%} + Tr/2$



Voltage impulse TSurge



Current impulse TSurge

13.5.2. Pulse 10 / 700µs as per IEC 61000-4-5

Voltage verification

Test level : 2000 V for N5 type respectively 5000V for N7 Type.
Pulse : 10 / 700µs open circuit voltage waveshape
Output : 25Ω
Load : open circuit

Tolerances no load

	U peak	Tf	Td
pulse 10 / 700µs	2000 V +/- 10%	10µs +/- 30%	700µs +/- 20%

Current verification

Test level : 2000 V for N5 type respectively 5000V for N7 Type.
Pulse : 4 / 300µs short circuit current wave shape
Output : 25Ω
Load : short circuit

Tolerances

	I peak	tr	td
short circuit	50 A +/- 10%	4 µs +/- 20%	300 µs +/- 20%

13.5.3. Pulse 9 / 720µs as per FCC

Voltage verification

Test level : 2000 V for N5 type respectively 5000V for N7 Type.
Pulse : 9 / 720µs open circuit voltage waveshape
Output : 25Ω
Load : open circuit

Tolerances no load

	U peak	Tf	Td
pulse 9 / 720µs	2000 V +/- 10%	9 µs +/- 30%	720µs +/- 20%

Current verification

Test level : 2000 V for N5 type respectively 5000V for N7 Type.
Pulse : 5 / 330µs short circuit current wave shape
Output : 25Ω
Load : short circuit

Tolerances

	I peak	Tf	Td
short circuit	50 A +/- 10%	5 µs +/- 20%	330 µs +/- 20%

14. Appendix

14.1. Declaration of CE-Conformity

Manufacturer :	**EM TEST (Switzerland) GmbH**
Address:	Sternenhofstr. 15 CH 4153 Reinach BL1 Switzerland

declares, that under is sole responsibility, the product's listed below, including all their options, are conformity with the applicable CE directives listed below using the relevant section of the following EC standards and other normative documents.

Product's name:	Ultra compact generator
Model Number(s)	UCS 500N5, UCS 500N7 UCS500N5V, UCS500N5E, UCS500N5P UCS500Nx.x Telecom Surge Module : TSurge7 Coupling Network Telecom : CNT 516

Low Voltage Directive 2006/95/EC

Standard to which conformity is declared:

EN 61010-1 : 2006	Safety requirements for electrical equipment for measurement, control, and laboratory use.

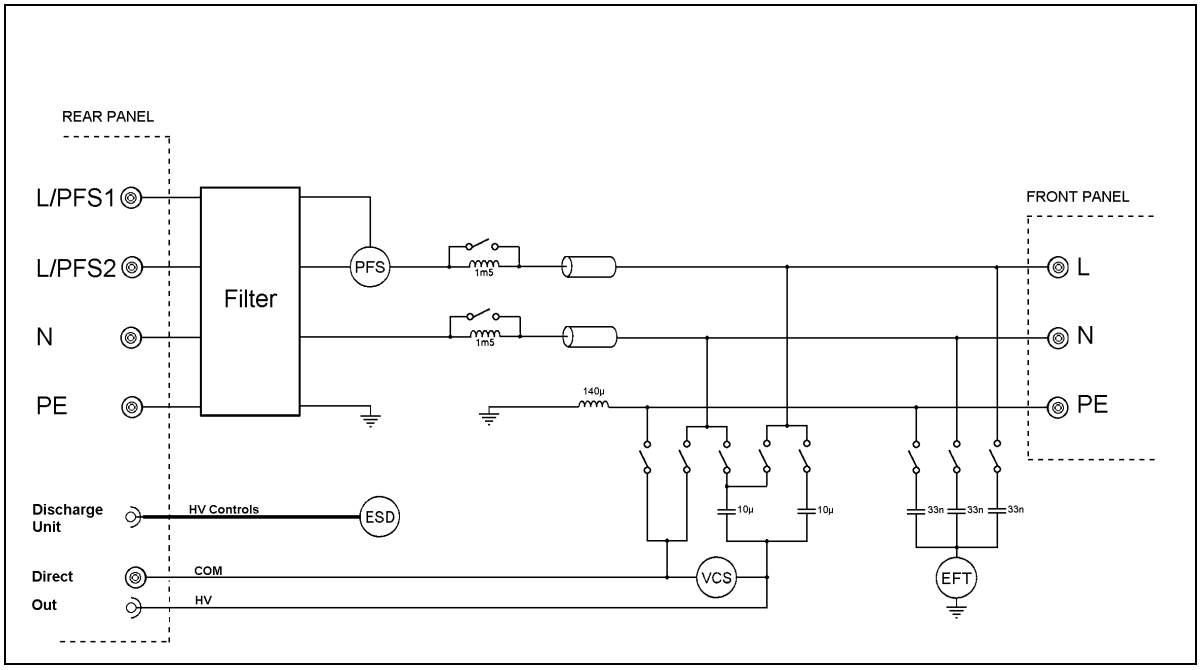
EMC Directive 2004/108/EG

Standard(s) to which conformity is declared:

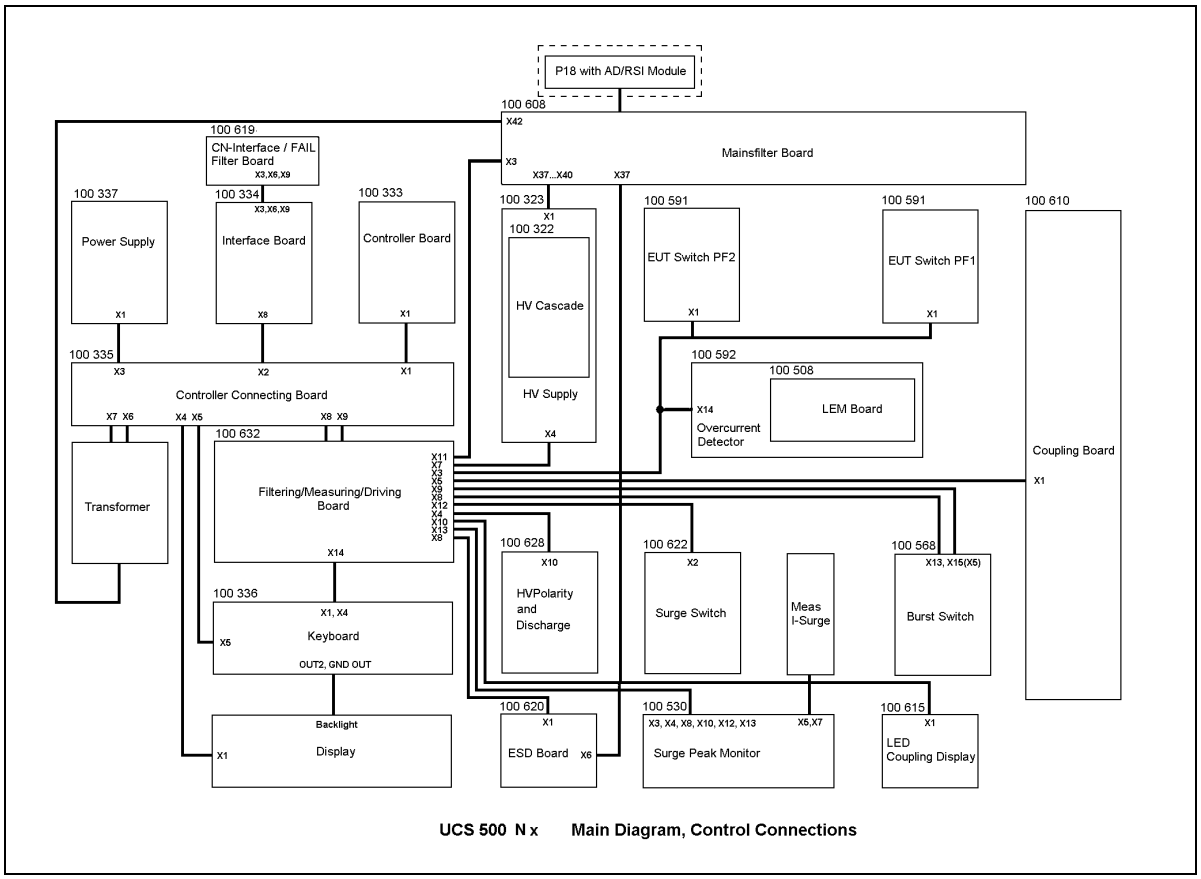
EN 61326 : 2006	Electrical equipment for measurement, control and laboratory use Class A
EN 61000-3-2 : 2007	Limits for harmonic current emissions
EN 61000-3-3 : 2005	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

	European representative	Manufacturer
	EM TEST GmbH Lünenerstr. 211 D 59174 Kamen Tel: +49 (0) 2307 / 26070-0 Fax: +49 (0)2307 / 17050	EM TEST (Switzerland) GmbH Sternenhofstr. 15 CH 4153 Reinach Tel: +41 61-7179191 Fax: +41 61-7179199
By	U. Flor General manager	A. Burger Design and Research
Place	Kamen, Germany	Reinach BL , Switzerland
Date	22. September 2011	22. September 2011

14.2. UCS 500N - General Diagram

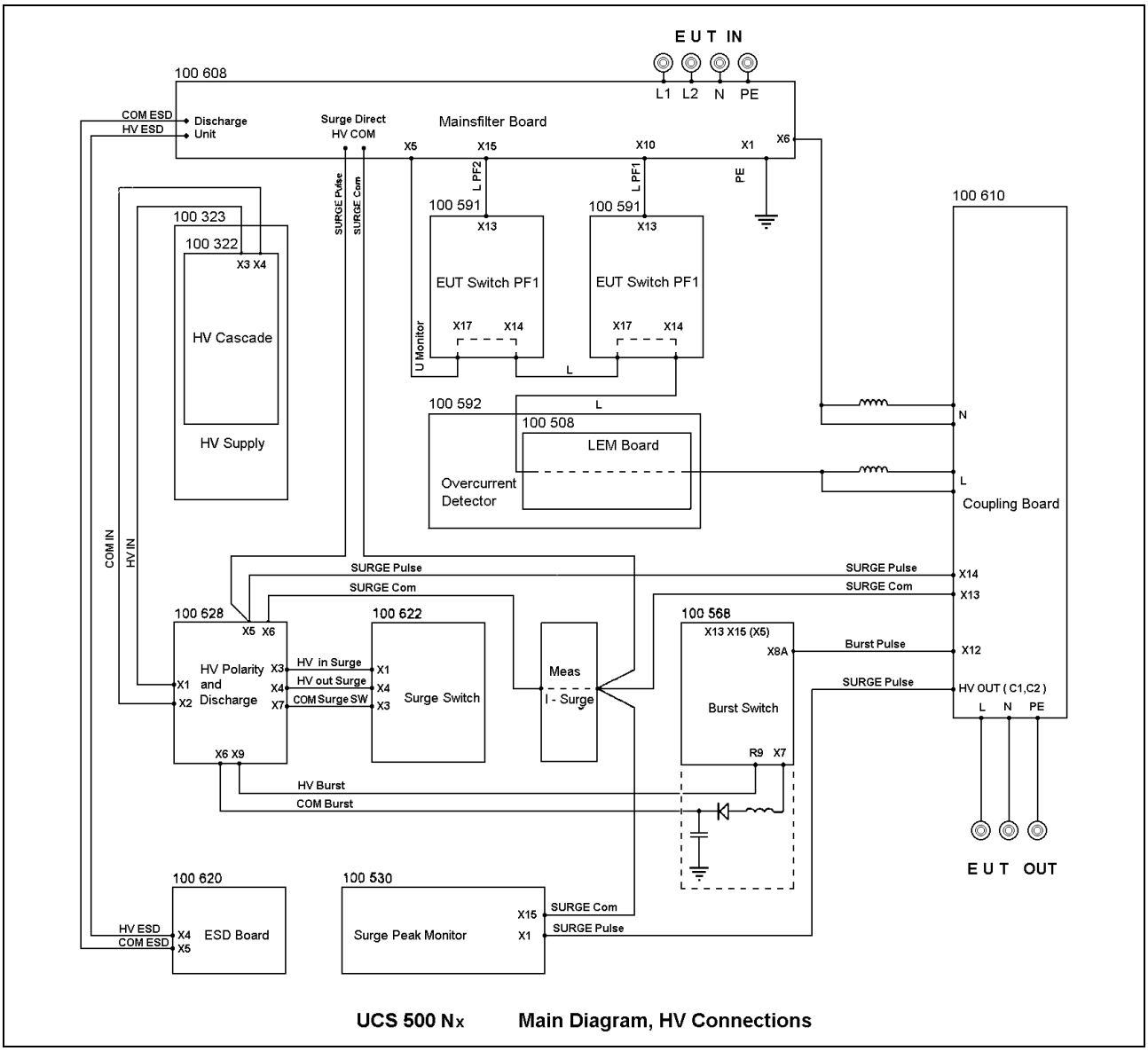


14.3. Main diagram control connection



UCS 500 N x Main Diagram, Control Connections

14.4. Main diagram high voltage connection

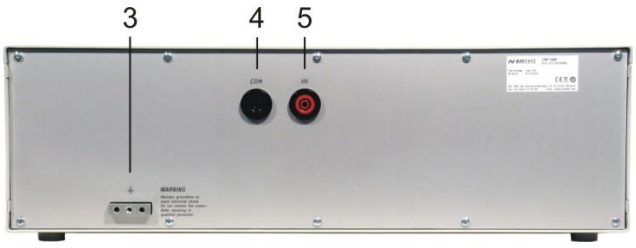


UCS 500 Nx Main Diagram, HV Connections

14.5. CNT 508N

The CNT 508N is a coupling network for coupling surge pulses to 8 lines via a 25Ω resistor. Depends from where the pulse is adapted different waveshapes can be applied to the EUT.

14.5.1. Operating elements



1 HV Output T1...T8
2 COM output

3 Earth bolt
4 COM input
5 HV input

14.5.2. Technical data:

As per IEC 61000-4-5 and other relevant standards

Pulse 10/700µs or 1.2/50µs

Open circuit voltage	160V – 7,000V ±10%
Serial resistor per output	25 Ω ±10%
Number of parallel HV outputs	8
Number of COM outputs	2

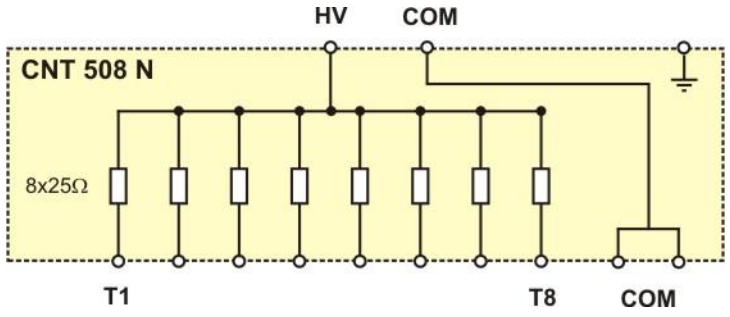
Coupling

Channels	8 channels in parallel T1 to T8 with 25Ω each

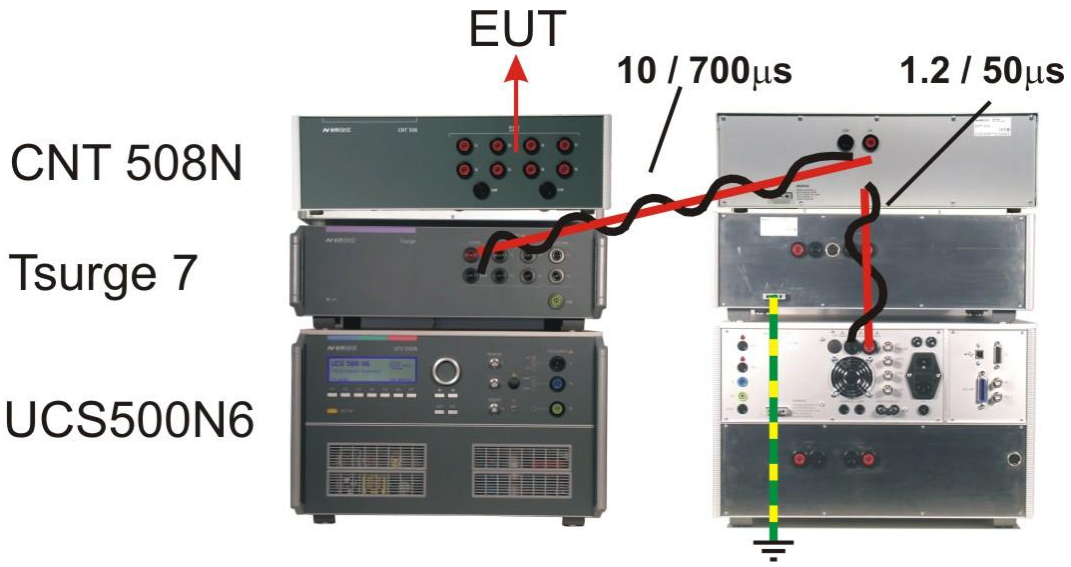
Dimensions

Housing	19“, 3HU, 448x250x143mm
Weight	6.05 kg

14.5.3. Main diagram



14.5.4. Test Setup



14.5.5. Accessories:

Srew set Earth cable

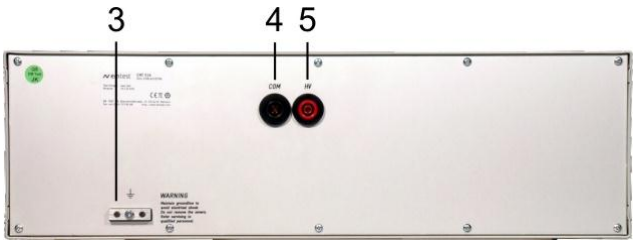
HV cable COM cable

8 (red) + 2 (black) EUT cables 2m

14.6. CNT 516

The CNT 516 is a coupling network for coupling surge pulses to 16 lines via a 25Ω resistor. Depends from where the pulse is adapted different waveshapes can be applied to the EUT.

14.6.1. Operating elements



1 HV Output T1...T16
2 COM output

3 Earth bolt
4 COM input
5 HV input

14.6.2. Technical data:

As per IEC 61000-4-5 and other relevant standards

Pulse 10/700µs or 1.2/50µs	
Open circuit voltage	160V – 7,000V ±10%
Serial resistor per output	25 Ω ±10%
Number of parallel HV outputs	16
Number of COM outputs	3

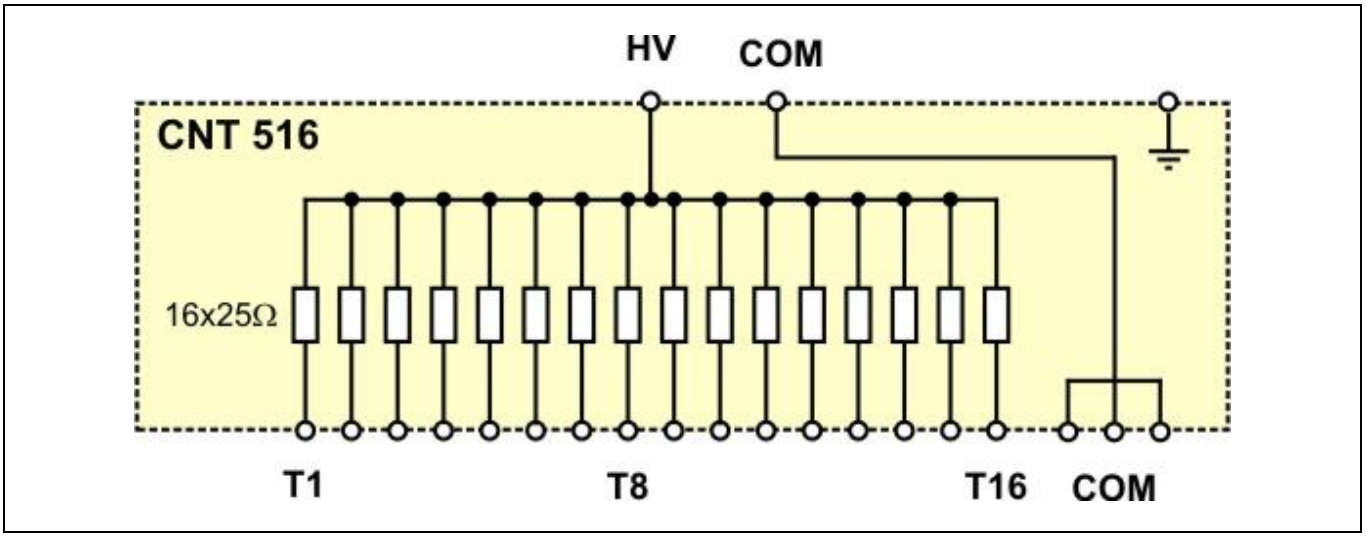
Coupling

Channels	16 channels in parallel T1 to T16 with 25Ω each

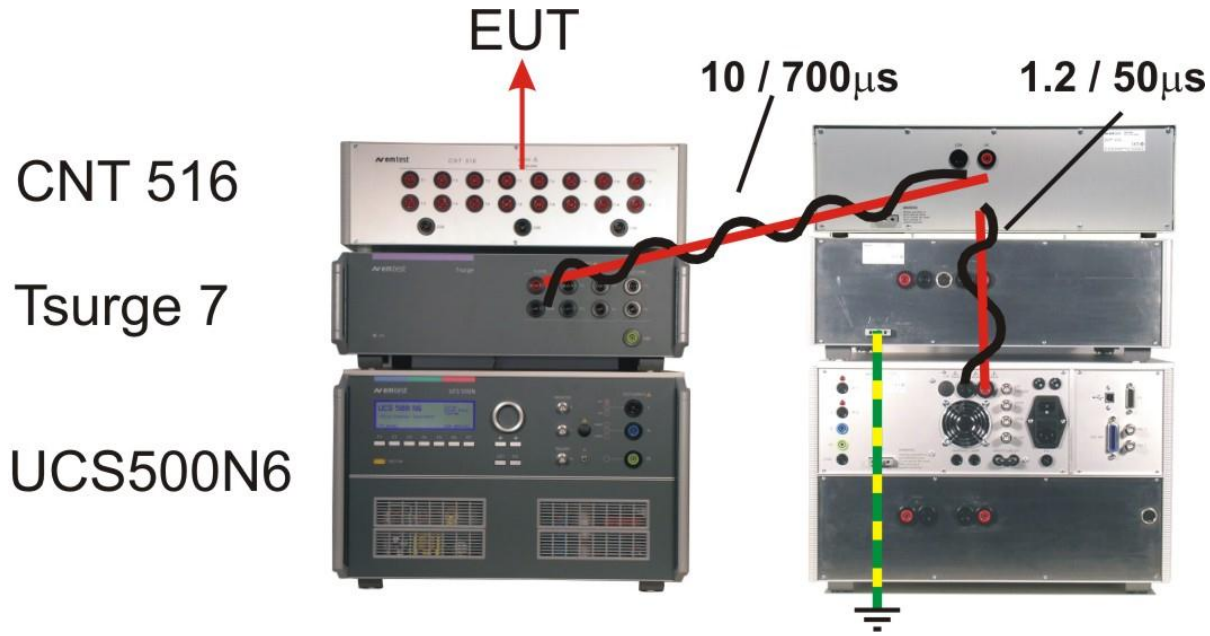
Dimensions

Housing	19“, 3HU, 448x250x143mm
Weight	6.25kg

14.6.3. Main diagram



14.6.4. Test Setup



14.6.5. Accessories:

Srew set Earth cable

HV cable COM cable

16 (red) + 3 (black) EUT cables 2m

14.7. USB interface

USB interface “USB B” connector. For data transfer a USB interface is available. The internal RS 232 interface is converted to USB standard. Therefore the user must set the same baud rate in the device and control software.
Using the USB interface the user can have EMC problems during burst tests. Therefore a high quality USB cable (USB 2.0 standard) must be used.

The experience shows that usually the computer USB port is disturbed by interference’s. The ferrite FER-USB reduces additional the interferences on the USB cable.

If there are still interferences, the whole test set-up with the wiring has to be reconsidered.

USB cable setup

The USB cable must be above ground with a distance of at least 10 cm. Otherwise the cable can be an antenna for the common mode burst pulses and the communication may be influenced.

EM test provides a suitable ferrite as accessories under the name UBS FER.

Best results are reached with 8 turns.