Manual

f o r O p e r a t i n g

CNI 503 / CNI 501

3-phase coupling decoupling network

CNI 503x

CNI 503 A series
CNI 503 B series

1-phase coupling decoupling network

CNI 501x

Testing of electronic modules with EFT/burst, 1.2/50µs Surge or Ring Wave pulses up to 10kV, 5kA

The CNI 503 couples the surge and burst pulses from the impulses generators UCS 500Nx to a three phase test object (coupling as per. IEC or ANSI standard).

The CNI 503 is controlled from EM Test transient generator of the Series 500 (UCS 500Nx, VCS 500Nx, EFT 500Nx).

Burst, Surge and Ringwave Pulse as per.
– IEC 61000-4-4
– IEC 61000-4-5
– IEC 61000-4-12
– ANSI

EM TEST (Switzerland) GmbH
Sternenhofstrasse 15
4153 Reinach BL1
Switzerland

Phone : +41 61 717 91 91
Fax : +41 61 717 91 99

URL : http://www.emtest.com

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1. List of coupling networks

1.1. Coupling networks for IEC pulses

Device	Impulse	Phase	Supply	rated Current ac	Remarks
CNI 501	5.5kV	1	250V	32A	48V/32A dc
CNI 501 S1	5.5kV	1	250V	100A	75V/100A dc
CNI 503 A	5.5kV	3	3x480V	16A	
CNI 503 A2	5.5kV	3	3x480V	32A	
CNI 503 A3	5.5kV	3	3x480V	63A	RACK required
CNI 503 A4	5.5kV	3	3x480V	100A	RACK required
CNI 503 A4.1	5.5kV	3	3x440V	100A	EN 50121-4
CNI 503 A5	7kV	3	3x480V	16A	
CNI 503 A7	7kV	3	3x480V	32A	
CNI 503 A8	7kV	3	3x480V	63A	RACK required
CNI 503 A9	7kV	3	3x480V	100A	RACK required
CNI 503 A10	8kV	3	3x480V	16A	
CNI 503 A12	8kV	3	3x480V	32A	
CNI 503 A13	8kV	3	3x480V	63A	RACK required
CNI 503 A14	8kV	3	3x480V	100A	RACK required
CNI 503 A16	10kV	3	3x480V	16A	
CNI 503 A18	10kV	3	3x480V	32A	
CNI 503 A19	10kV	3	3x480V	63A	RACK required
CNI 503 A20	10kV	3	3x480V	100A	RACK required

1.2. Coupling networks as per IEC, ANSI and Ringwave

Device	Impulse	Phase	Supply	rated Current ac	Remarks
CNI 503 B5	7kV	3	3x480V	16A	
CNI 503 B7	7kV	3	3x480V	32A	
CNI 503 B8	7kV	3	3x480V	63A	RACK required
CNI 503 B9	7kV	3	3x480V	100A	RACK required

Device	Imp	Phase	Supply AC		Remarks
CNI 501 B9	7kV	1	AC 250V DC 75V	100A 100A	- IEC 61000-4-5, ANSI/IEEE C62.41 - TEST ON function (possibility for Emergency Switch and no Warning lamp control!!!)
CNI 503 B7.2	7kV	3	AC 3x480V DC 1000V	32A 32A	- IEC 61000-4-5, ANSI/IEEE C62.41 - No TEST ON function (no possibility for an Emergency Switch and no Warning lamp control!!!)
CNI 503 B7.3	7kV	3	AC 3x480V DC 1000V	32A 32A	- IEC 61000-4-5, ANSI/IEEE C62.41 - TEST ON function (possibility for Emergency Switch and Warning lamp control) - Needs a rack to be ordered separately
CNI 503 B7.4	7kV	3	AC 3x690V DC 1000V	32A 32A	- IEC 61000-4-5, ANSI/IEEE C62.41 - No TEST ON function (no possibility for an Emergency Switch and no Warning lamp control!!!) - Needs a UCS 500N7.2 or UCS 500N7.7
CNI 503 B7.5	7kV	3	AC 3x690V DC 1000V	32A 32A	- IEC 61000-4-5, ANSI/IEEE C62.41 - TEST ON function (possibility for Emergency Switch and Warning lamp control) - Needs a UCS 500N7.2 or UCS 500N7.7 and a rack
CNI 503 B9.2	7kV	3	AC 3x480V DC 1000V	100A 100A	- IEC 61000-4-5, ANSI/IEEE C62.41 - No TEST ON function (possibility for Emergency Switch and Warning lamp control) - Needs a rack to be ordered separately
CNI 503 B9.6	7kV	3	AC 3x480V DC 1000V	100A 100A	- IEC 61000-4-5, ANSI/IEEE C62.41 - TEST ON function (no possibility for an Emergency Switch and no Warning lamp control!!!) - Needs a rack to be ordered separately

Coupling networks for the US are generally specified for a 3 phase power mains supply of 3x480Vrms.

It is forbidden to disconnect the plug in DC operation under voltage.

Risk of a stationary spark!

1.3. Special Coupling networks

Device	Impulse	Phase	Supply	rated Current ac	Remarks
CNI 503 A.1	5.5kV	3	3x690V	16A	needs a UCS 500N5.2
CNI 503A S1	5.5kV	3	3x690V	16A	
CNI 503A S2	5.5kV	3	3x690V	32A	
CNI 503 A2.1	5.5kV	3	3x690V	32A	needs a UCS 500N5.2
CNI 503 A2.2	5.5kV	3	3x480V / DC 1000V	32A	No TEST ON function
CNI 503 A2.6	5.5kV	3	3x480V / DC 1000V	32A	With TEST ON function 500 VDC / 150 A
CNI 503A2.10	5.5kV	3	3x690V / DC 1000V	32A	No TEST ON function
CNI 503A3.1	5.5kV	3	3x690V	63A	requires MRAC or RAC 1000V dc
CNI 503A S3	5.5kV	3	3x690V	63A	requires MRAC or RAC
CNI 503A S4	5.5kV	3	3x690V	100A	requires MRAC or RAC
CNI 503B S1	7kV	3	3x690V	16A	
CNI 503B S2	7kV	3	3x690V	32A	
CNI 503B S3	7kV	3	3x690V	63A	requires MRAC or RAC
CNI 503B S4	7kV	3	3x690V	100A	requires MRAC or RAC
CNI 503B S7	7kV	3	3x208V	32A 400Hz	Burst 6.0kV
CNI 503 A14.1	8kV	3	3x480V	100A	requires Rack 32 or 34 UH
CNI 503 A12 S2	8kV	3	3x690V	32A	IEC @ANSI-B coupling (manual)
CNI 503 A16 S1	10kV	3	3x690V	16A	
CNI 503A S22	4.4kV	3	3x480V	200A	requires MRAC or RAC

CNI 501B S3	7kV	1	250V 1000 VDC	32A	Ohne Test ON Function,
CNI 501 S4	10kV	1	250V	10A	
CNI 501 S6	10kV	1	250V	16A	Generator impedance 2Ω

2. Operating Functions

2.1. Front view

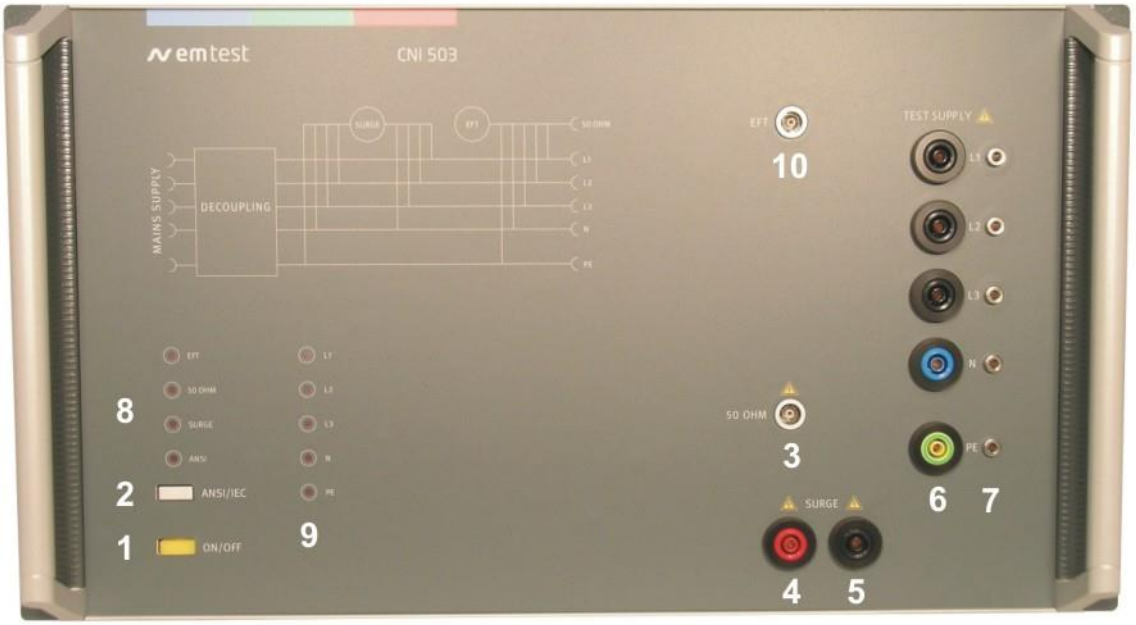


Figure 2.1: CNI 503 font view (model for 4kV)

1	"TEST ON	**6**	DUT Output L1/DC+, L2, L3, N/DC-, PE
2	Switching ANSI -IEC	**7**	Earth plug for EFT burst verification
3	EFT output to HFK coupling clamp	**8**	LED display Pulse (EFT / 50Ω HFK / Surge)
4	HV output for ext. surge coupling networks	**9**	LED display couplings
5	COM output for ext. surge coupling networks	**10**	EFT input from UCS 500Mx / EFT 500/800

1 Button Test On
Press this button to connect the power mains supply to the EUT via the built in relay switch. The yellow light in the button indicates the switched mains to the EUT.

2 Button ANSI / IEC (Option)
This button changes the coupling between ANSI coupling and IEC coupling.

LED disabled:	IEC coupling	2Ω L-L or L-N 10Ω L-PE, N-PE
LED enabled:	ANSI coupling	2Ω all couplings

2.2. Rear side

Figure 2.2: Rear side CNI 503 (4kV version)

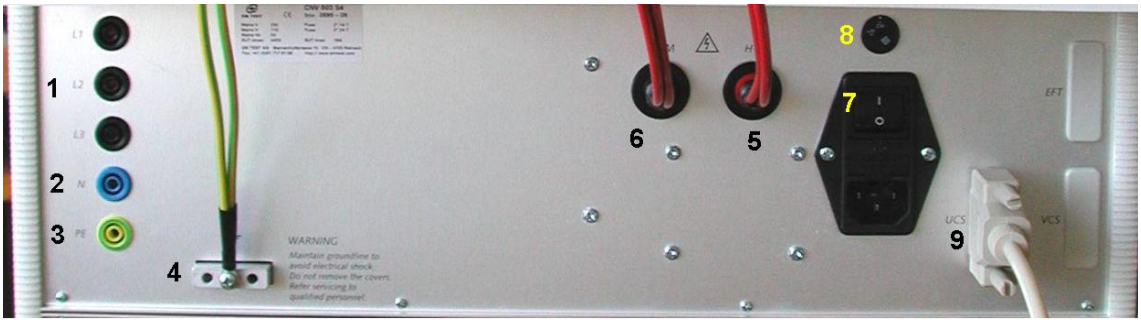


Figure 2.3: CNI 503 Rear side (> 4kV version)

1 EUT power L1, L2, L3
2 EUT power N
3 EUT power PE
4 Ground Reference
5 HV Input from generator
5 HV Input from generator
6 COM Input from generator
7 Power switch with fuse
8 Voltage selector 230V / 115V
9 CN control input from UCS generator
10 CN control input from EFT and or VCS generator

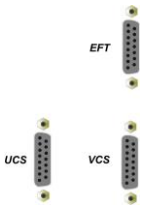
If the CNI 503 includes two or more CN interfaces for **UCS500NE** and **UCS500NV**, only one generator is allowed to communicate to the CNI 503. In case that all remote control input**, for UCS (9) and EFT/VCS (10),** are included in the CNI 503 the operator has to take care that either the UCS or the EFT/VCS is controlling the CNI.

A simultaneous operation by more than one generators is not allowed.

The CN control input is available in **two different versions**.

- Interface to generators of the series **UCS 500xx**
- Interface to generators of the series **EFT 500x** and or **VCS500x**

The connectors have different pin configurations. Therefore each generator must be plugged in as signed at the rear panel.



2.3. CNI 501 S1

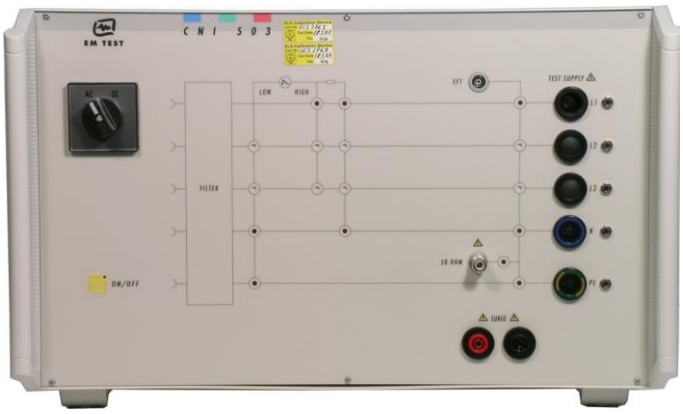


Figure 2.3: Front side CNI 501 S1 with AC / DC switch

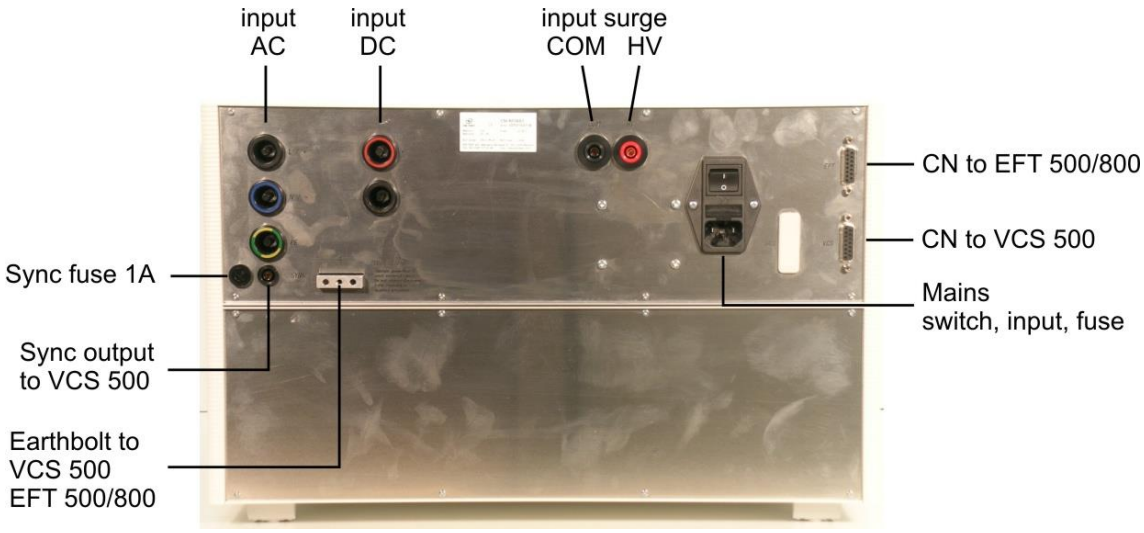


Figure 2.4: CNI 501 S1 rear side

3. General

The coupling network has to couple the transients well defined to the lines of a power supply system. The coupling is realized by discrete coupling capacitors, having a sufficient voltage capability and bandwidth. The specification is given in IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-12 and ANSI.

There are different coupling network models available:

Model	Burst	Surge IEC	Surge ANSI	Ringwave
CNI 503B	**X**	**X**	**X**	**X**
CNI 503A	**X**	**X**	**--**	**--**
CNV 503	**--**	**X**	**--**	**--**
CNE 503	**X**	**--**	**--**	**--**
CNI 501	**X**	**X**	**--**	**--**

The coupling/decoupling network is divided in two parts:

- The decoupling and filtering unit
- The coupling unit

The decoupling unit has to

- To decouple the low impedance power mains supply from the test setup.
- protect other equipment which is connected to the power mains supply
  But which is not part of the test set-up.

The coupling network superimposes the transients to the lines of a power supply system, AC as well as DC supply.

3.1. Coupling modes

The test can be conducted with different coupling modes.

61000-4-5 Surge immunity requirements

- Line or lines to protective earth (unsymmetrical) e.g. L1-PE; L1+L2+L3+N-PE
- Line to Line (symmetrical) e.g. L1-L2 or L3-N

61000-4-4 Electrical fast transients

Line or lines to reference ground. All combinations are possible. The protective earth (PE) is regarded as equal to all other lines and therefore is tested as all other lines

3.2. Coupling to Signal Lines

The coupling to I/O lines is generally realized with other coupling networks than used 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 acc. to IEC 61000-4-5 are available, such as the CNV 504 and the CNV 508 for four respectively for eight wire systems. For coupling the EFT transient to signal lines the capacitive coupling clamp is used. The clamp can also be connected and controlled via the CNI 503 networks but normally shall be connected directly to the coaxial output of the generator itself.

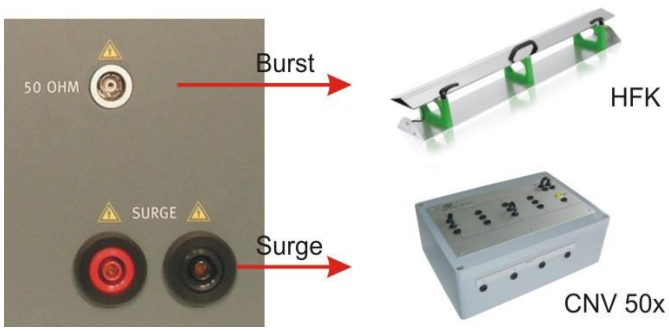


Figure 3.1: External device plug for Burst and Surge

4. Technical Data CNI 503

4.1. EUT power supply

Pulse peak voltage	Coupling network IEC, ANSI, Ringwave	Coupling network IEC	EUT supply 50/60Hz Voltage ac dc	Current ac/dc	Remarks
5.5kV		CNI 501	1x250V	32A	dc 48V/32A
		CNI 501 S1	1x250V	100A	dc 75V/100A
5.5kV		CNI 503 A	3x480V	16A	
		CNI 503 A2	3x480V	32A	
		CNI 503 A2	3x480V	32A	dc 1000V 32A
		CNI 503 A3	3x480V	63A	requires MRAC or RAC
		CNI 503 A4	3x480V	100A	requires MRAC or RAC
		CNI 503 A5 S22	3x480V	200A	requires MRAC or RAC
		CNI 503 A2.10	3x690V, 1000V	32A	No Test ON
		CNI 503 A S1	3x690V	16A	
		CNI 503 A S2	3x690V	32A	
		CNI 503 A S3	3x690V	63A	requires MRAC or RAC
		CNI 503 A S4	3x690V	100A	requires MRAC or RAC
7kV	CNI 503 B5	CNI 503 A5	3x480V	16A	
	CNI 503 B7	CNI 503 A7	3x480V	32A	
	CNI 503 B7.2		3x480V, 1000V	32A	No Test ON
	CNI 503 B7.3		3x480V, 1000V	32A	Test ON, need MRAC or RAC
	CNI 503 B7.4		3x690V, 1000V	32A	No Test ON, need MRAC or RAC
	CNI 503 B8	CNI 503 A8	3x480V	63A	requires MRAC or RAC
	CNI 501 B9		250V, 75V	100A	6 HU, Test ON
	CNI 503 B9	CNI 503 A9	3x480V	100A	requires MRAC or RAC
	CNI 503 B9.2		3x480V, 1000V	100A	No Test ON, need MRAC or RAC
	CNI 503 B9.6		3x480V, 1000V	100A	Test ON, need MRAC or RAC
		CNI 503 B S1	3x690V	16A	
		CNI 503 B S2	3x690V	32A	
		CNI 503 B S3	3x690V	63A	requires MRAC or RAC
		CNI 503 B S4	3x690V	100A	requires MRAC or RAC
8kV		CNI 503 A10	3x480V	16A	
		CNI 503 A12	3x480V	32A	
		CNI 503 A13	3x480V	63A	requires MRAC or RAC
		CNI 503 A14	3x480V	100A	requires MRAC or RAC
		CNI 503 A14.1	3x480V	100A	requires MRAC or RAC
10kV		CNI 501 S4	1x250V	10A	
		CNI 501 S6	1x250V	16A	Generator impedance 2Ω
		CNI 503 A16	3x480V	16A	
		CNI 503 A18	3x480V	32A	
		CNI 503 A19	3x480V	63A	requires MRAC or RAC
		CNI 503 A20	3x480V	100A	requires MRAC or RAC
		CNI 503 A16 S1	3x690V	16A	

4.2. DC current capability of CNI 503Nx

CNI models with a built in ac mains contactor have a reduced dc switching capability. This current rate depends on the following parameters:

- contactor model
- applied dc voltage
- time constant L/R of the dc circuit

The following list shows the dc current of the most models.

- Internal decoupling inductance 2 x 1.5 mH (16A models)

CNI 503Nx with rated power 3x480V 16A

dc time constant	dc current capability
DC-1 L/R ≤ 1ms	24V DC : 25A 48V DC : 10A 60V DC : 8A 110V DC : 2A

CNI 503Nx with rated power 3x480V 32A

dc time constant	dc current capability
DC-1 L/R ≤ 1ms	24V DC : 40A 48V DC : 23A 60V DC : 18A 110V DC : 8A 220V DC : 1A
DC-3 L/R ≤ 2ms	24V DC : 19A 48V DC : 10A 60V DC : 5A 110V DC : 1.8A 220V DC : 0.3A

CNI 503Nx with rated power 3x480V 63A / 100A

dc time constant	dc current capability
DC-1 L/R ≤ 1ms	24V DC : 70A 48V DC : 60A 75V DC : 60A 110V DC : 8A 220V DC : 6A
DC-3 - DC-5 L/R < 2ms	24V DC : 40A 48V DC : 30A 75V DC : 30A 110V DC : 3A 220V DC : 1A

CNI 503Nx with rated power 3x690V 63A / 100A

dc time constant	dc current capability
DC-1 L/R ≤ 1ms	< 75V DC : 220A 110V DC : 110A
DC-3 - DC-5 (L/R ≤ 15ms)	< 75V DC : 160A 110V DC : 80A

The IEC 60947-4-1 rating system is broken down into different utilization categories that define the value of the current that the contactor must make, maintain, and break.

DC-1	Non inductive or slightly inductive loads, resistance furnaces, heaters
DC-3	Shunt motors, starting and breaking of a shunt motor during inching or plugging. The time constant shall be less than or equal to 2 msec. On de-energization, the contactor will break around 2.5 times the starting current at a voltage that may be higher than the line voltage.
DC-5	Series-motors, starting and breaking of a series motor during inching or plugging. The time constant being less than or equal to 7.5 msec. On energization, the contactor sees about 2.5 times the nominal full load current. On de-energization, the contactor breaks the same amount of current at a voltage which can be equal to the line voltage.

4.3. Technical data special CNI 503

Differences to the standard CNI 503 devices:

Device	Based on	Differences
CNI503 B S7	CNI 503 B7 7 kV 32 A	- 3x208 V; 400 Hz - Coupling capacitor surge = 1 μF - Inductance per phase = 160 μH - Burst 6.0 kV **For the CNI 503BS7 which is designed for a 400Hz power mains supply network the series inductors had to be limited to 160uH totally. Then the pulse duration of the applied surges are reduced furthermore.**
CNI 503A12S2 		- 3x690V 50/60 Hz - 8 kV Surge - IEC & ANSI-B Kopplung manuell wählbar Dimension: 19“, 9 HU 500 mm x 448 mm x 420 mm (LxBxH) Weight: 48.9 kg
CNI 503 A14.1		- 3x440 V 50/60 Hz - 8k V Surge Dimension: 19“, 34 HU Rack Weight: 181 kg (Rack with CNI 503A14.1 no generators)

4.4. General

DC supply as per tables in 4.2

Coupling modes Surge IEC 61000-4-5

Line to Ground	all combinations	coupling capacitor 9µF	Source impedance 12Ω
Line to Line	all combinations	coupling capacitor 18µF	Source impedance 2Ω

Output sockets for testing signal and data lines with CNV 504 and CNV 508

Coupling modes Burst IEC 61000-4-4

Line(s) to ground all combinations

Output sockets for capacitive coupling clamp

Remote control

UCS 500;	all models	Burst and Surge
EFT 500,	all models	Burst
VCS 500M;	all models	Surge

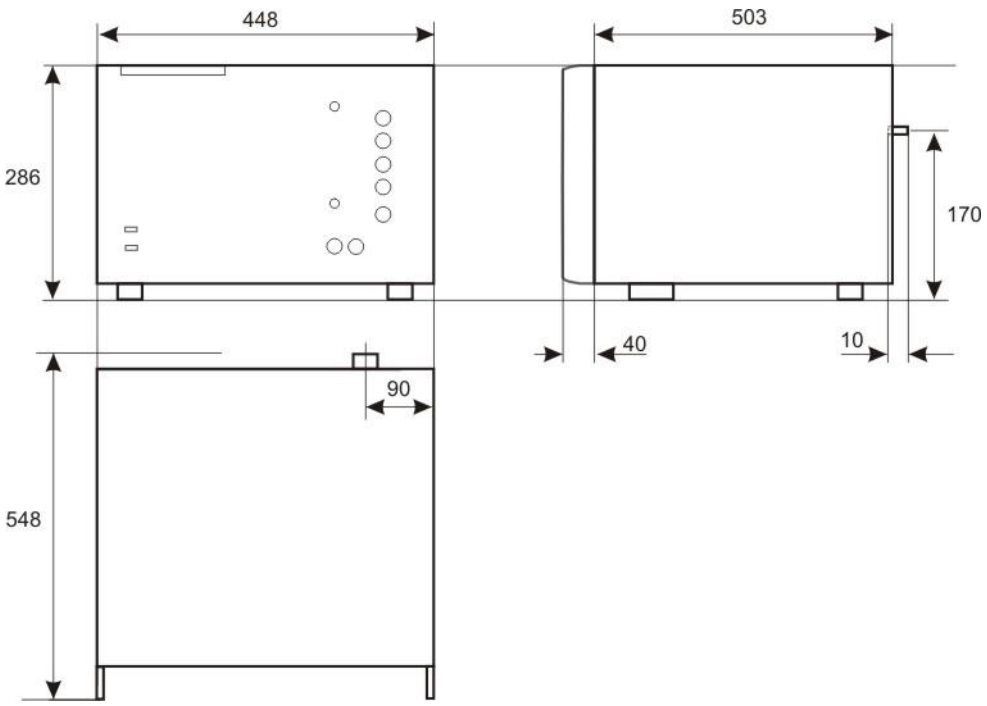
Note: In case that all remote control input at the CNI 503 are available and the user has all above mentioned generators available a simultaneous use of all generators is not allowed.
The operator has to decide either to use the UCS 500 or the EFT/VCS combination of generators.

Power supply

Mains	115 V / 230 V
Fuse	2 A slow blow all models

Dimension and weight

Housing 19” 6HU (models up to 32 A all models if not otherwise specified)



Weight	16 A	models 3-ph: Approx. 30 kg	
	32 A	models 3-ph: Approx. 45 kg	models 1-ph approx. 30 kg

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

Burst generators, which comply with the specifications of IEC 61000-4-4 Ed2: 2004, have a limitation of the maximum output voltage. Then the maximum test level is limited by the number of coupling on several lines.

Please see the following limits:

Coupling	**UCS 500** >Vers.3.0 **UCS 500M4** >Vers.3.0 **UCS 500N4** **EFT 500 /** **EFT 500 M4**	**EFT 500N5**	**UCS 500N5** **UCS500M7** **UCS 500M6B** **UCS500N6** **UCS 500M6** >Vers.3.0 **UCS 500M6A** >Vers.3.0	**EFT 500N8** **EFT 500 M8**
50 Ω	4800V	4800V	5500V	7000V
1 coupling any	4800V	4800V	5500V	7000V
2 couplings any	4800V	4800V	5000V	7000V
3 couplings any	4800V	4800V	5000V	7000V

Generator with **CNI 503 / CNE 503** **CNI 501**	**UCS 500** >Vers.3.0 **UCS 500M4** >Vers.3.0 **UCS 500N4** **EFT 500 /** **EFT 500 M4**	**UCS500N5** **EFT 500N5**	**UCS 500N5** **UCS500M7** **UCS 500M6B** **UCS500N6** **UCS 500M6** >Vers.3.0 **UCS 500M6A** >Vers.3.0	**EFT 500 M8**
50 Ω	4800V	4800V	5500V	5500V
1 coupling any	4800V	4800V	5500V	5500V
2 couplings any	4000V	4000V	5000V	5000V
3 couplings any	4000V	4000V	5000V	5000V
4 couplings any	4000V	4000V	4500V	4500V
5 couplings any	4000V	4000V	4500V	4500V

4.6. Decoupling inductors for surge pulse

To prevent unwanted voltage drops in the coupling/decoupling networks, the value of the decoupling element generally must be reduced for coupling/decoupling networks rated at >25 A. The Table below shows the reduced inductor values per line in function of the rated current.

Rated current	**Inductance per line**
16 A	1.5 mH
32 A	0.75mH
63 A	0.6mH
100 A	0.6mH
200 A	0.3mH

For this case, the “time to half value” of the open-circuit voltage waveform may be reduced in accordance with Tables 6 and 7 in standard IEC 61000-4-5.

5. Operation

5.1. Power supply input (EUT)

The power supply input for the EUT is located at the rear side of the coupler. Adapters for customized three phase connectors have to be realized by the user himself or can be manufactured on customer's specification.
The output of the power mains supply (surged lines) for the EUT is located at the front panel of the equipment.

5.2. Synchronization

The transients generally must be related to a certain phase angle of the power supply. This is required for the surge test and optional for the burst test.
The synchronization is normally realized within the VCS, the EFT and the UCS generator and is related to the power supply input at the rear of the equipment, to phase L or the "Sync" input at the rear panel of the generator.
Then when using external 3ph couplers the generator itself has no power mains supply connected to the input for the EUT supply at the rear panel.

NOTE: The hardware is designed to synchronize the connected reference phase L to PE.

Phase synchronization angle in star-delta 3-phase system

The Generator synchronizes between the connected Phase **Lx to PE**. In a 3-phase system the PE and Neutral are connected together at the supplier's transformer. The pulse generator is **designed for a 3-phase system in star mode** (L1, L2, L3, N, PE).

Then the synchronization in a 3-phase system is perfect for a 3-phase equipment with **star connection**. For 3-phase equipment with **delta connection** the shift the phase angle for triggering must be adjusted. The graphic in Figure 5.1 shows the different phase angle between connection L1-N (star-) and L1-L2 (delta mode).

The **generator manual** describes the method of the phase angle setting of the generator.

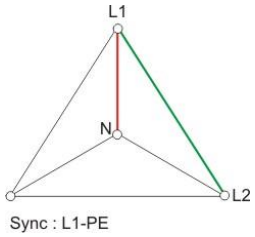


Figure 5.1 Phase shift between star and delta

Using a UCS 500N type

The synchronization is realized within the UCS generator and is related to the sync input at the rear of the UCS 500...
Then when using three phase couplers the UCS has no power at the sync input

Connect sync input of the UCS 500 to the phase L1 of the coupling network with. The UCS synchronizes to this phase L1.

The sync input of the UCS 500 is referenced to ground (PE). The phase synchronization depends from the Firmware version and is different.
Important information to the synchronization you can find into the **UCS manual**

Using a VCS 500 or EFT 500

The synchronization is realized within the VCS 500 or EFT 500 / 800 generators and is related to the power supply input at the rear of the equipment, to phase L input.
Then when use three phase couplers, the generators have no power supply at the input for the EUT.

Connect phase L1 and neutral N of the power supply input of the coupling network with phase L and neutral N at the input of the VCS, or EFT. The generator is synchronized to the phase connected at the input L. Dependant on which phase, L1, L2 or L3 is connected to the generators; the transients are synchronized to this line.

Connecting two devices VCS 500 and EFT 500 series on CNI network
In case that a Surge generator (VCS 500 series) and a Burst generator (EFT 500 series) are connected simultaneously, both generators must be switched on. Otherwise the coupling modes might be set false.

5.3. Connection of DC Equipment

For the connection of DC power supplies following connections are provided.

Polarity	3- Phase CNI	1- Phase CNI
+ Pole	L1	L
- Pole	N	N

As DC input the terminals L1 and N must be used. These two plugs are marked at the rear side of with an additional plus or minus sign.

TEST ON Switch

The switching capacity of conventional AC contactors for DC application is limited. Therefore, the specification for DC current and voltage are reduced compared to the AC specifications.
If the coupling network should have the same parameters for AC and DC, special mains switch must be installed, for meet the DC specifications. This costly expansion requires a larger enclosure than the normal version.
Cost- economical coupling networks have no internal DC switches. In this case the user has already installed an external dc switch, he can use for disconnect the dc supply in case of an emergency.

Coupling networks that require mandatory external DC contactor

The table on the right shows the coupling networks that require an external power switch mandatory for DC application.

Type	DC Parameter
CNI 503B7.4	1000V 32A
CNI 503B9.2	1000V 100A

5.4. Operation with CNI coupler or generator internal CDN

The coupling network CNI 503 is operated via the generator UCS / VCS / EFT and its operation panel or via ISM windows software. Only the different coupling modes can be changed or preselected.

Then it is very important that the control cable between surge generator and coupler, EFT generator and coupler or UCS and coupler is connected and that the coupler is switched on (power switch at the rear panel) before the test generators are switched on.

The test generator realizes that a three phase coupler is connected and shows the possible coupling modes in the display of the generator. The complete system is controlled by the generators operation panel.
If the external coupling network is connected or switched on later than the generator, the generator must be reset by switching power ON/OFF.

On the front panel of the coupler the user can switch ON/OFF the power supply of the EUT.

Using IEC.control software the coupling matrix is completely controlled by software.

CNI detection

After power ON the UCS / VCS or EFT generator, the devices check if an external CNI is detected.

CNI detected:	Working with **external CNI**
CNI not detected:	Working with **internal generator CDN**

When changing between internal CDN to external CNI it is necessary to switch OFF/ON the system. When CNI is not used switch off the CNI before power on the USC500N5

6. Test set up

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

All units, the surge generator, the EFT and the coupling matrix can be installed one above the other. **The coupling matrix should than be used as central output for the EUT and should be mounted directly onto the ground reference plane. The EFT has to be installed directly over the coupling matrix to have the output connection EFT - CNI as short as possible.**

The surge generator VCS can be mounted besides or onto the other units. The UCS has to be mounted directly above the CNI due to the short HV cable.

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

Figure 6.1: Example of a test rack with UCS 500M6 and CNI 503

Connect the following cables between the generator and coupling network

- Control cable UCS - CNI (15 pole SubD connector
- Control cable EFT - CNI (15 pole SubD connector)
  Control cable VCS - CNI (15 pole SubD connector)
- High voltage cable, UCV / VCS - CNI (rear panel)
- High voltage common UCS / VCS - CNI (rear panel)
- High voltage cable, coaxial EFT - CNI (front panel)
  (Black safety laboratory cable)

Additionally the coupling network needs a power mains supply of 115V /230V at the rear.

Connection of CNI / CNV 503:

1. Connect the earth connection from UCS 500 to the CNI 503 with the delivered brass connector plate (fig 6.7.) or the two parallel cables (fig 6.6). This reference ground and must be connected with the reference ground of the test set-up.
2. Connect the HV and COM connectors for transmit the surge pulses to the CNI 503.
3. Connect DUT power supply L1 to the AC synchronization of the UCS 500
4. CN cable for control the couplings from the impulse generator. For reduce the interference's we propose to roll up the cable and put it between the UCS500 and the CNI 503

Figure 6.2: Connections UCS 500 – CNI 503

Figure 6.3 : Connection line power and sync to UCS 500

Figure 6.4 : Connection the CN cable

6.1. Grounding

1. The coupling/decoupling network shall be connected as short as possible to the ground reference plane. Therefore the ground connector at the rear panel of the CDN shall be used.
2. The EFT generator has also to be connected as short as possible to the coupling matrix. Therefore use the ground terminal at the rear panel of the coupler and the short coaxial EFT cable at the front.
3. According to IEC 61000-4-5 the coupling network and the generator is specified in that way, that an increased earth fault current may exist.

This means:

1. **Earth current protectors shall be excluded from the test set-up.**
2. **Both, the CDN as well as the generators must be grounded well. The ground reference plane shall be connected to protective earth.**

Figure 6.5 : Connection to reference ground

Ground connection UCS 500 – CNI 503

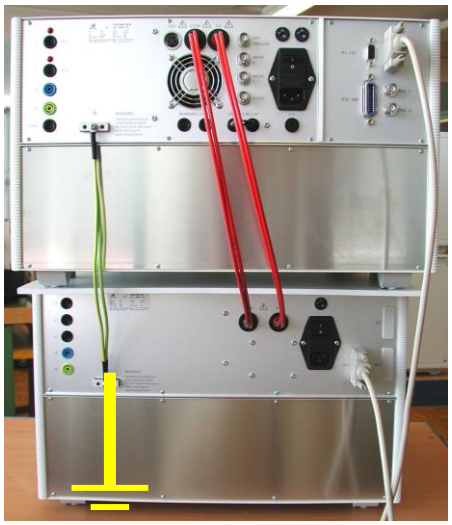


Figure 6.6: Earth connection with cables

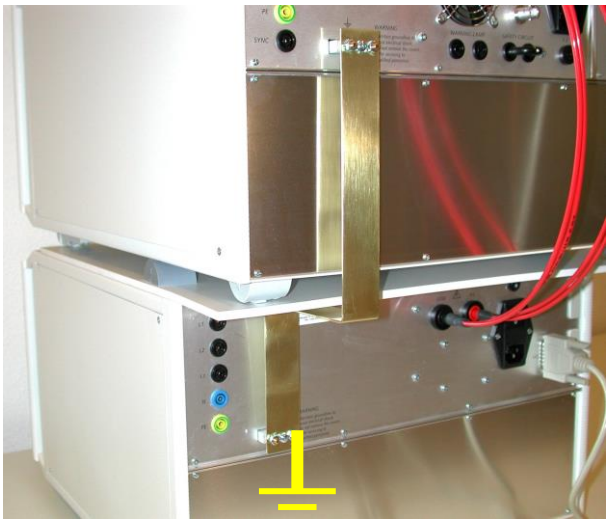


Figure 6.7: Earth connection with brass plate

Additional to the ground connection between the generator and CNI 503, it is necessary to make a solid connection to the reference ground (illustrated in yellow color in figures 6.6 & 6.7).

6.2. Surge coupling to CNV504 / 508 network for surge to signal- and data-lines

Connection of the surge coupling network for data lines to CNI 503

HV: Coaxial cable
COM: Banana cable
PE: Use a separate cable for the Ground connection

NOTE: The PE Earth should not connect to the PE output on the front side of the CNI. This output is internal separated over an additional inductance for decoupling. Use the ground bolt on rear side or the reference ground.

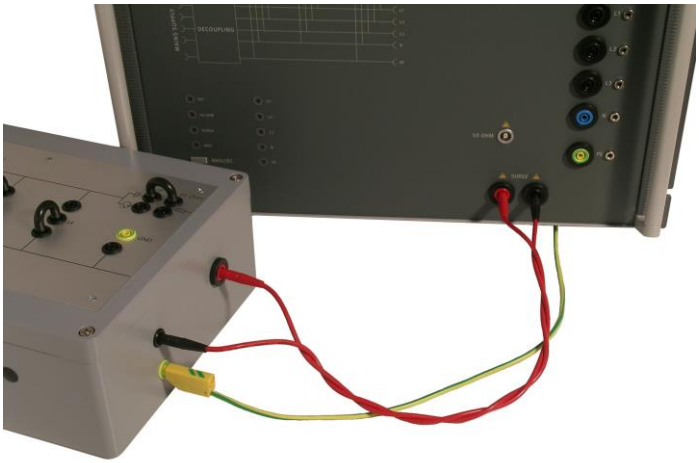


Figure 6.8: Connection of a CNV 504 to a CNI 503

6.2.1. Burst coupling to HFK capacitive coupling clamp for signal- and data lines

Connection of the capacitive coupling clamp HFK to CNI 503

Burst cable connections:
50 OHM - EFT: Coaxial cable
50 OHM -HFK: Coaxial cable

NOTE: The HFK should be placed on the reference ground. The distance from the HFK to the EUT should be at least 0.5m. The reason is the radiation of the coupling clamp.

Figure 6.9: Connection of a capacitive coupling clamp to the UCS 500 M4

6.3. Test setup CNI 503 with UCS500N5E and UCS500N5V generators

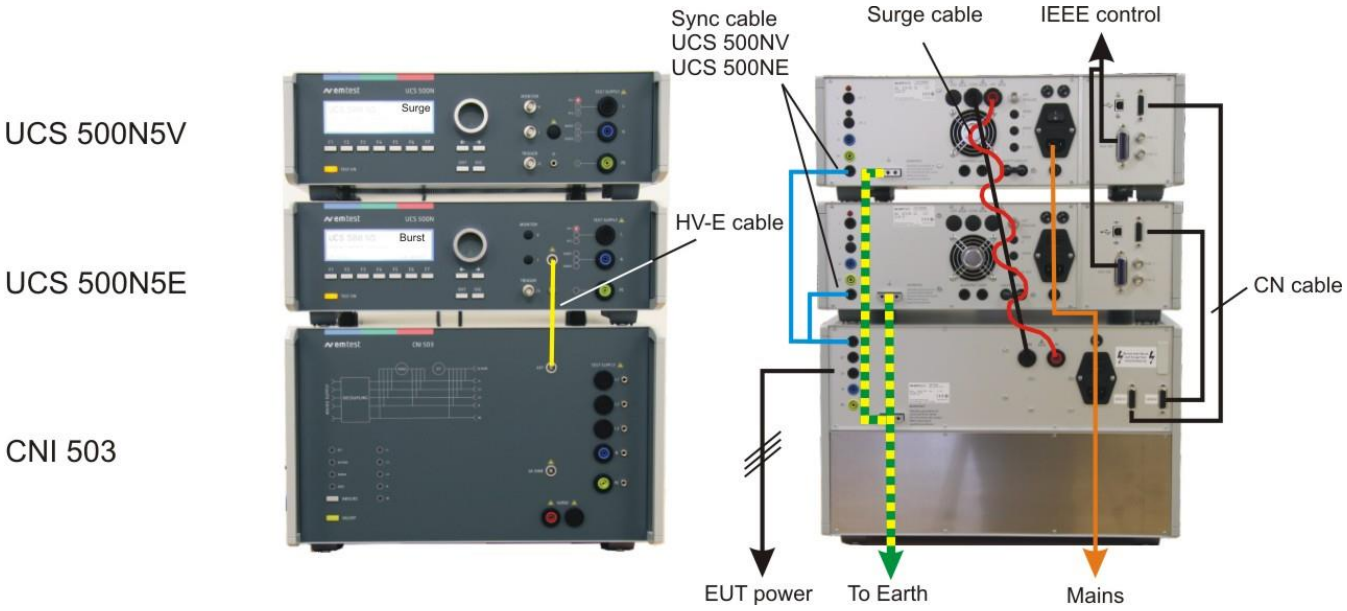


Figure 6.10: Setup and cabling

Arrangement

UCS500N5E next placed to the **CNI 503**. This allows the shortest possible cable for the EFT pulse from the generator to the CNI 503.
UCS500NV located on top of the tower.

Front side cabling:

HV-E cable: **UCS 500N5E** EFT 50Ω output to **CNI 503** EFT input

Rear side cabling:
Please take care to avoid current earth loops with the cable routing. If there are problems during the EFT / Surge test, the cable layout may be the reason.

Earth connection:
- Earth to CNI 503
- CNI 503 to UCS 500N5E
- CNI 503 to UCS 500N5V

Surge HV cable:
- 2 HV cable cables twisted

CN control cable
Connect the Sub-D 15 pole CN-cable from the UCS 500Nx generator to the CNI 503
The CN plugs on CNI 503 are coded for the
- UCS 500N5V to CNI 503 UCS V left side
- UCS 500N5E to CNI 503 UCS E right side

IEEE control cable:
- UCS 500NE to common point
- UCS 500NV

6.4. Test setup CNI 501 / 503 with EFT 500/800 and VCS 500 generators

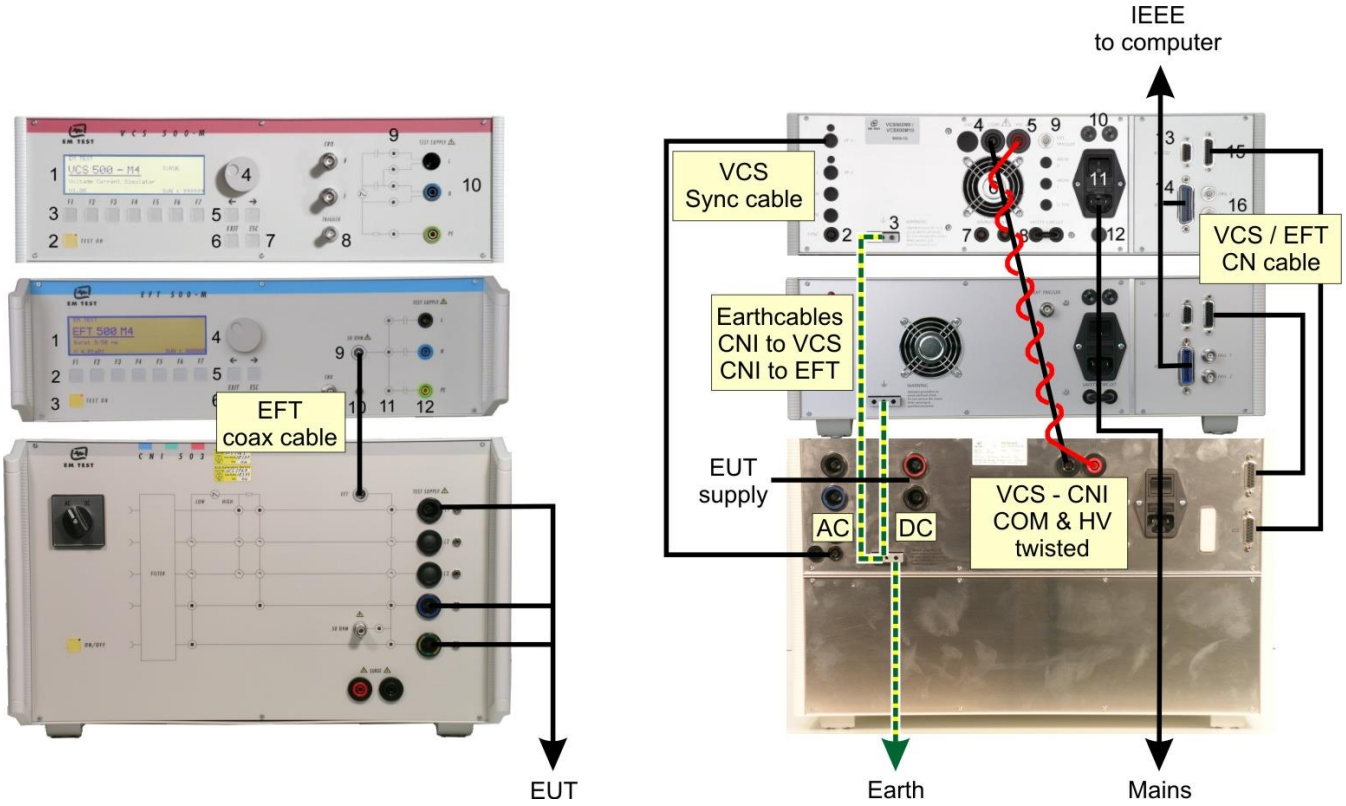


Figure 6.11: Example CNI 501 S1 100A for AC and DC

6.5. test setup with CNI 501 BS3 or CNI 503B7.5

The generator UCS 500N7.6 controls either the 3-phase CNI 503B7.5 or 1-phase CNI 503BS3. The 1-phase CNI 501BS3 is installed outside the Test-rack on a table. Before testing, the following connections between the CNI 503B7.5 and CNI 503BS3 must be rearranged.

Earth cable: The earth cable is screwed to the park position inside the rack. The earth cable must be fixed at the CNI 501B3.

Sync cabel: The AC synchronization must be connected to the socket L1 at CNI 501BS3. The end of the sync cables at the UCS side are designed, that only one synchronization cable can be connected at the UCS sync plug.

HV - COM: The twisted Surge high voltage cable must be connected to the HV-COM connectors between the switching network and the generator.

EFT Burst: The coaxial HVE cable (1m) must be connected on the front sides of the devices.

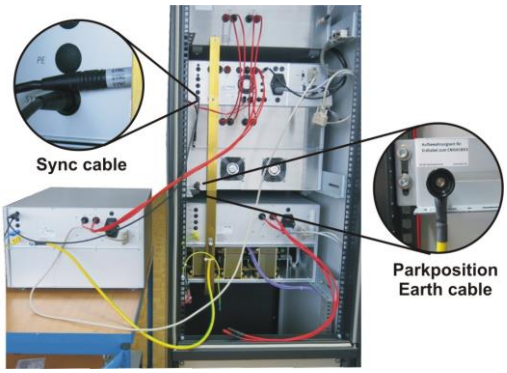


Figure 6.12

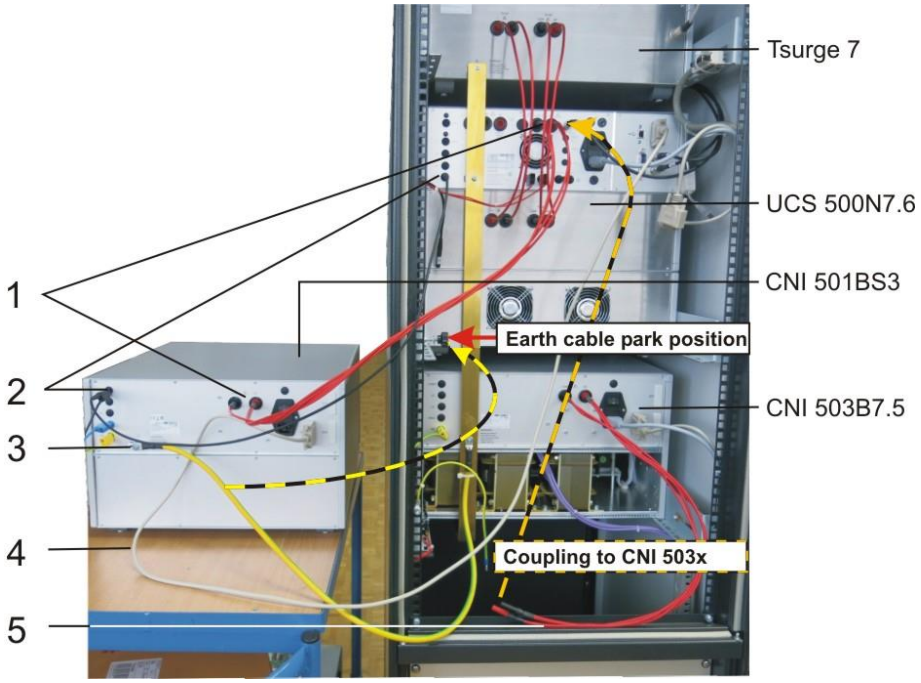


Figure 6.13

1 Surge cable HV-COM to CNI 501BS3
2 Sync cable to CNI 503BS3
3 Earth connection Rack to CNI 501BS3
4 CN control cable for control the CNI 501BS3
5 Surge cable HV-COM to CNI 503B7.6

7. ANSI Coupling (option)

The option ANSI offers to change the coupling mode for surge tests between ANSI and IEC coupling
To change the coupling mode to ANSI, it is necessary to press the button ANSI / IEC.

Disable the ANSI/IEC button (LED = off) when using the iec.control software.

Coupling

Figure 7.1:

LED disabled: IEC coupling 2Ω L-L or L-N 10Ω L-PE, N-PE
Software iec.control switches automatically between IEC and ANSII coupling.

LED enabled : ANSI coupling 2Ω all couplings
Software iec .control couples always with 2Ω as long the LED is on and cannot switch between IEC and ANSI

REMARK: The **LED indication** works only with manual operation ANSI / IEC. During remote control from UCS500N6B the LED will not be on. In each case the coupling, indicated in the generator display is correct.

Without option ANSI No function of the ANSI / IEC button and LED (ANSI)

8. CNI 503 Rack Mountain

Device	Impulse	Phase	Supply	rated Current ac/dc	Remarks
CNI 503 A3	5.5kV	3	3x480V	63A	requires MRAC or RAC
CNI 503 A4	5.5kV	3	3x480V	100A	requires MRAC or RAC
CNI 503 A8	7kV	3	3x480V	63A	requires MRAC or RAC
CNI 503 A9	7kV	3	3x480V	100A	requires MRAC or RAC
CNI 503 A13	8kV	3	3x480V	63A	requires MRAC or RAC
CNI 503 A14	8kV	3	3x480V	100A	requires MRAC or RAC
CNI 503 A19	10kV	3	3x480V	63A	requires MRAC or RAC
CNI 503 A20	10kV	3	3x480V	100A	requires MRAC or RAC

Coupling networks as per IEC, ANSI and Ringwave

CNI 503 B8	7kV	3	3x480V	63A	requires MRAC or RAC
CNI 503 B9	7kV	3	3x480V	100A	requires MRAC or RAC
CNI 503 B9.6	7kV	3	3x480V	100A	requires MRAC or RAC

Special Coupling networks

CNI 503A S3	4.4kV	3	3x690V	63A	requires MRAC or RAC
CNI 503A S4	4.4kV	3	3x690V	100A	requires MRAC or RAC
CNI 503B S3	7kV	3	3x690V	63A	requires MRAC or RAC
CNI 503B S4	7kV	3	3x690V	100A	requires MRAC or RAC
CNI 503A S22	4.4kV	3	3x480V	200A	requires MRAC or RAC

Coupling networks for the US are generally specified for a 3 phase power mains supply of 3x480Vrms.

Figure 8.1: Minirack front side

Figure 8.2: Minirack rear side

- Minirac on wheels for 63A and 100A
- Height is 16 HU; totally about 85 cm
- Weight is app. 100kg
- Ground reference connection to the test table (due to the compact size this connection is not on table height)

9. Special coupling networks

9.1. CNI 501B9

9.1.1. Operating elements

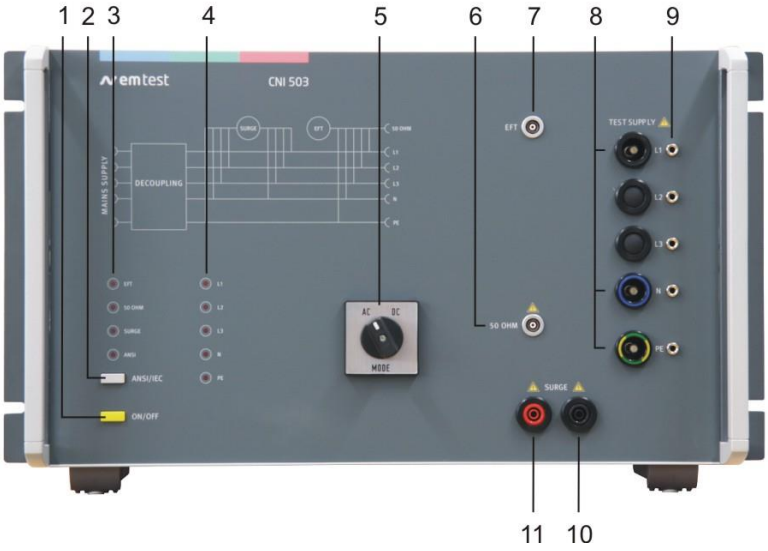


Figure 9.1: CNI 501B9 font view

1 "TEST ON
2 Switching ANSI -IEC
3 LED display Pulse (EFT / 50Ω HFK / Surge)
4 LED display couplings
5 Switch AC / DC mode
6 EFT output to HFK coupling clamp
7 EFT input from UCS 500Mx
8 EUT Output L1/DC+, L2, L3, N/DC-, PE
9 Earth plug for EFT burst verification
10 COM output for ext. surge coupling networks
11 HV output for ext. surge coupling networks

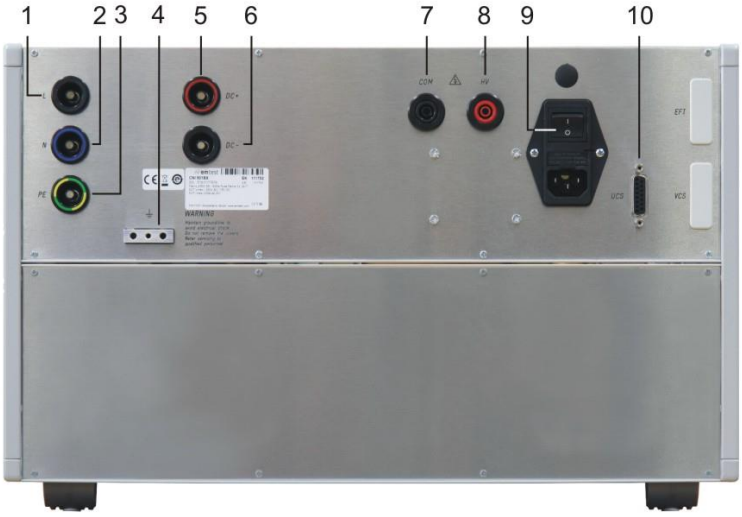


Figure 9.2: Rear side CNI 501 B9

1 EUT power L
2 EUT power N
3 EUT power PE
4 Ground Reference
5 DC+ Input from power supply
6 DC- Input from power supply
7 Surge COM Input from generator
8 Surge HV Input from generator
9 Power switch with fuse
10 CN control input from UCS generator

9.1.2. Technical Data

The general technical data are specified in chapter 4

EUT Supply	
AC Voltage	250 V, 50/60 Hz
AC Current	100 A
DC Voltage	75 V
DC Current	100 A
AC contactor	
Model	LOVATO 11BF65C
Imax (AC1)	110A (≤40°C), 90 A (≤55°C)
Max interrupt	2000 A @320 Vdc
DC contactor	
Model	LEV200A5ANA
Rated current	200 A
Contact resistance	0.2 mΩ (@200 A)
Dimension	19" / 6 HU
HxWxD	286 mm x 448 mm x 503 mm
Weight	54.5 kg
Supply (control)	
Mains	230VAC +10%/-15%
Frequency	50 / 60 Hz
Fuses	2 x 2 AT slow blow
Power	approx. 70 W
Inrush current	approx. 1.3 A

9.1.3. AC Application

Burst coupling as per IEC 61000-4-4

IEC 61000-4-4	All combinations
/ (coupling to 50 ohm output)	One coupling: L; N; PE,
L + N + PE	Two couplings: L+N; L+PE; N+PE
	Three couplings: L+N+PE

Surge coupling as per IEC 61000-4-5

The standard couplings are bolded

Coupling 20uF (18uF)	Coupling 10uF (9uF)	Other couplings
/ (coupling to HV – COM output)		
L - N	**L - PE**	L + N - PE
	N – PE	

Surge coupling as per ANSI B (ANSI/IEEE C62.41**)**

The standard couplings are bolded

Coupling 20uF (18uF)	Coupling 20uF (18uF)	Other couplings
/ (coupling to HV – COM output)		
L - N	**L - G**	L + N - G
	N – G	

9.1.4. DC Application

Burst coupling as per IEC 61000-4-4

IEC 61000-4-4	All combinations
/ (coupling to 50 ohm output)	One coupling: “+”; “-“; PE,
“+” + “-“ + PE	Two couplings: “+” & ”-“; “+”& PE; “-“N+PE
	Three couplings: “+” & “-“ & PE

Surge coupling as per IEC 61000-4-5

The standard couplings are bolded

Coupling 20uF (18uF)	Coupling 10uF (9uF)	Other couplings
/ (coupling to HV – COM output)		
“+” – “-“	**“+” - PE**	**“+”** + **“-“** - PE
	“-“ – PE	

9.1.5. Schematics

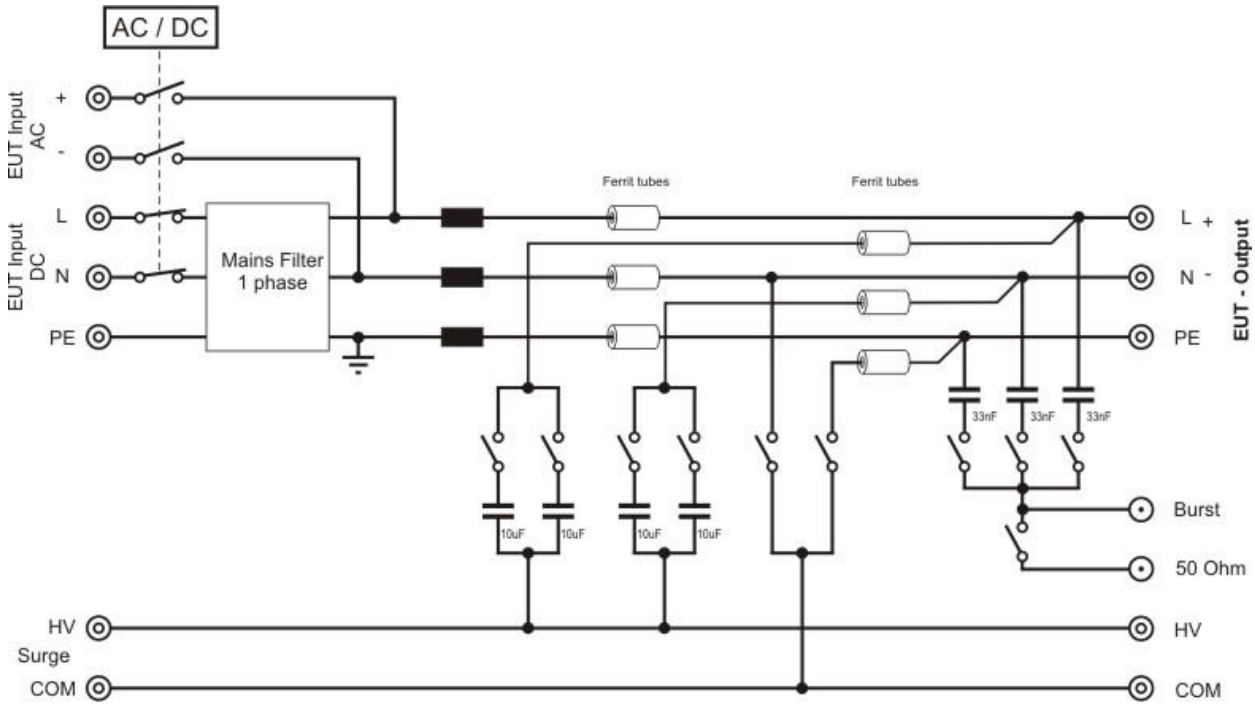


Figure 9.3: CNI 501B9 Overview

10. Maintenance and calibration

10.1. General

The coupling network is absolutely maintenance-free by using.

10.2. Calibration and Verification

10.2.1. 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

10.2.2. 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 is performed during the life cycle of 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 recommends 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.

10.2.3. 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.

10.2.4. 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 referring 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

11. Delivery Groups

11.1. Basic equipment

- Coupling network type CNI / CNV 503 xx
- Mains cable
- Mains cable for the EUT supply
- Manual on USB memory stick
- Calibration certificate
- Safety manual

Identical accessory parts are delivered only once if several devices are orders. The delivered packing list is in each case valid for the delivery.

11.2. Accessories and options

K-VCS-500R Impedance for voltage withstand testing

Technical data K-VCS-500R

Impedance: 500 Ω ± 5%
Voltage: 6000V
Current: 12A
Connector: Banana plugs on both sides

Figure 8.1

Application

- Connect the K-VCS-500R to the HV output on the rear side of the UCS500 M6B.
- Connect the other side of the K-VCS-500R to the DUT test fixture
- Connect the minus pole to the COM at the rear side of the UCS 500 M6B

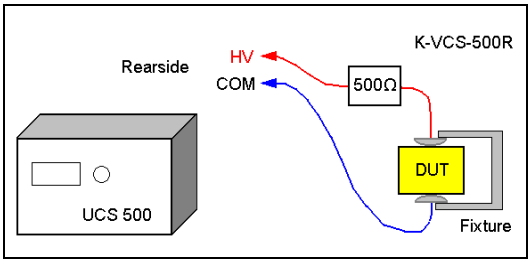


Figure 8.2:

Adapter box with mains adapter

The adapter box can be delivered according to different countries specifications.

This box is only available up to a max current of 32A

zen@zenhancer.net

Figure 8.3: Adapter box 3 phase 16A

Switchbox for Burst

- Manual control for setting the burst couplings

12. Appendix

12.1. Declaration of CE-Conformity

Manufacturer:	**EM TEST (Switzerland) GmbH**
Address:	Sternenhofstr. 15 CH 4153 Reinach 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:	Coupling Network
Model Number(s)	CNI 503Ax, CNI 503Bx, CNI 503BSx , CNI 501x, CNI 501BSx CNI 503Bx.y

Low Voltage Directive 2014/35/EU

Standard to which conformity is declared:

EN 61010-1 : 2011	Safety requirements for electrical equipment for measurement, control, and laboratory use.

EMC Directive 2014/30/EU

Standard(s) to which conformity is declared:

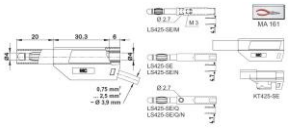
EN 61326-1 : 2013	Electrical equipment for measurement, control and laboratory use Class A
EN 61000-3-2 : 2014	Limits for harmonic current emissions
EN 61000-3-3 : 2013	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

	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	N. Holub General manager	A. Burger Design and Research
Place	Kamen, Germany	Reinach BL , Switzerland
Date	18. February 2016	18. February 2016

12.2. Connectors

For general EUT connection to the rack 4/6 mm plug from Multi Contact are proposed. Below you find some information from the Multi Contact catalogue. For detail information please refer to http://www.multi-contact.com/

12.2.1. 32 A plugs and connectors 4mm from Multi Contact

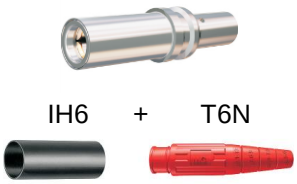


SLS425-SE/M
Stackable Ø 4 mm plugs with spring-loaded Multilam for self-assembly of test leads. With rigid insulating sleeve. Nickel-plated and gold-plated versions available.
Various types of connection:
SLS425-SE/M: Screw connection
SLS425-SE(/N): Cylindrical soldering surface
SLS425-SE/Q(/N): Cross hole for solder connection

SLB4-F SLB4-F/N-X
Insulated Ø 4 mm rigid sockets accepting spring-loaded Ø 4 mm plugs with rigid insulating sleeve. Machined brass, nickel- or gold-plated. The socket is screwed into predrilled panels of plastic, metal etc.
-Flat connecting tab 4.8 mm x 0.8 mm.
-Round connecting pin Ø 1.9 mm.

12.2.2. 100 A plugs and connectors 6mm from Multi Contact

Safety sockets KBT6AR-N/...-S with snap-in lock and crimp connection
Model KBT6AR-N/...-S safety sockets are sockets with locking devices and for crimping onto highly flexible Cu conductor with cross-sections of 10mm2, 16mm2 or 25mm2.
This safety socket is suitable for mating with either safety flush-mounting plugs or plugs model KST6AR-N. Used together with a flush-mounting plug it acts as an appliance connector and with plugs as a coupler.



Sockets BP...AR-N with snap-in lock and crimp termination
Crimp termination for flexible and highly flexible Cu-cables class 6 (according to IEC 6028). MC recommends a hexagonal crimp. Indent crimping and soldering is also possible. Cables with compacted conductors need a special crimping sleeve.

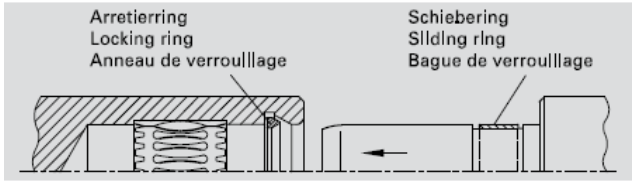
Safety branch adapter AZB6AR-N-S/6-4
Safety branch adapter with snap-in lock and ergonomic PA/TPE insulation that grips well. Mating plugs with suitable locking devices can be snap-locked into the socket. With one pick-off socket Ø 6mm and two safety sockets Ø 4mm for voltage tests up to 600V, CATIII.

Safety flush-mounting plugs ID/S6AR-N-B4S with snap-in lock and threaded stud
Model ID/S6AR-N-B4S safety flush-mounting plugs are insulated plugs designed for flush mounting in housings and panels. The plugs are designed to mate with sockets KBT6AR-N. The resulting plug connections are securable by means of snap-in lock. The plug ID/S6AR-N-B4S also mates with Ø 4mm MC Safety plugs, because the Ø 6mm plug has a Ø 4mm socket hole. The internal connection is made with an M6 threaded stud with nuts and washers. These safety flush-mounting plugs are also used to be connected with test leads according to the test accessories IEC/EN61010, (UL3111) and are UL recognised.

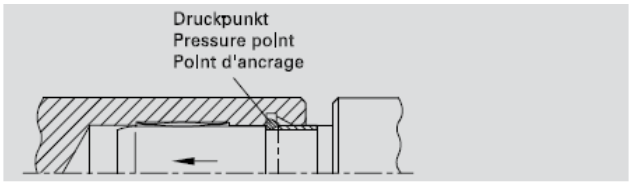
12.2.3. Multi Contact MC Locking system (AR-system)

The MC Locking system (AR) operates on the “push-pull” principle. It is self – locking when connected. Disconnection is effected by an axially displaceable coupling ring: first push, then pull to disconnect. Dirty parts should be cleaned with industrial alcohol before connecting.

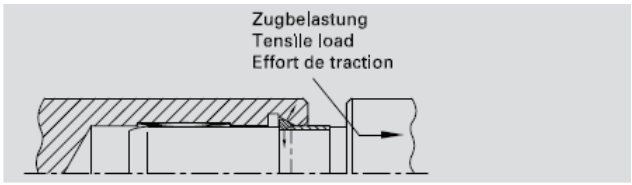
Locking



Insert plug into socket...

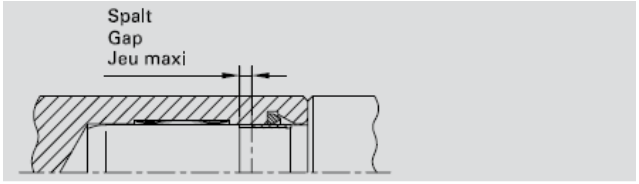


... and lock!

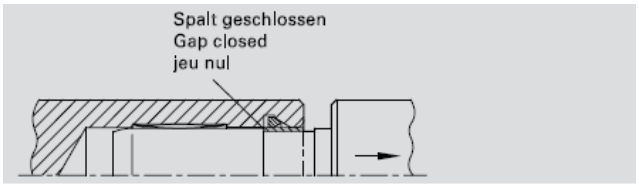


To control: Apply tensile load!

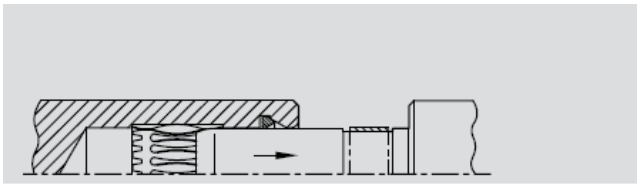
Releasing



To release, push plug further in ...



... and pull!



The connection is released!

6

12.2.4. 100 A DC plugs and connectors from Multi Contact

The Multi Contact 10BV series is used for connecting the 1000V DC supply. It is a single-pole round connectors, insulated, Ø 10mm with bayonet locking.
The panel receptable plug model is ID/S10BV-C1/C4 with bayonet locking and threaded stud.

Couplers:

Models:

KBT10BV-AX/M25/50-70-C1
Order No 15.0646C1-22

KBT10BV-AX/M25/50-70-C4
Order No 15.0646C4-21

Note: To ensure interchangeability, the following coding is recommended:
C1 (L1)
C4 (neutral)

For more information refer to the multi Contact power line 3 catalogue.

*www.**multi-contact**.com*

12.3. General diagram

Coupling capacitors and resistors for power AC / DC lines

Standard family	Coupling	Coupling capacitor	Coupling resistor
IEC	Line to line	18 µF	2 Ω
IEC	Line to ground	9 µF	12 Ω
ANSI A	Line to line	18 µF	12 Ω
ANSI A	Line to ground	9 µF	12 Ω
ANSI B	Line to line	18 µF	2 Ω
ANSI B	Line to ground	9 µF	2 Ω

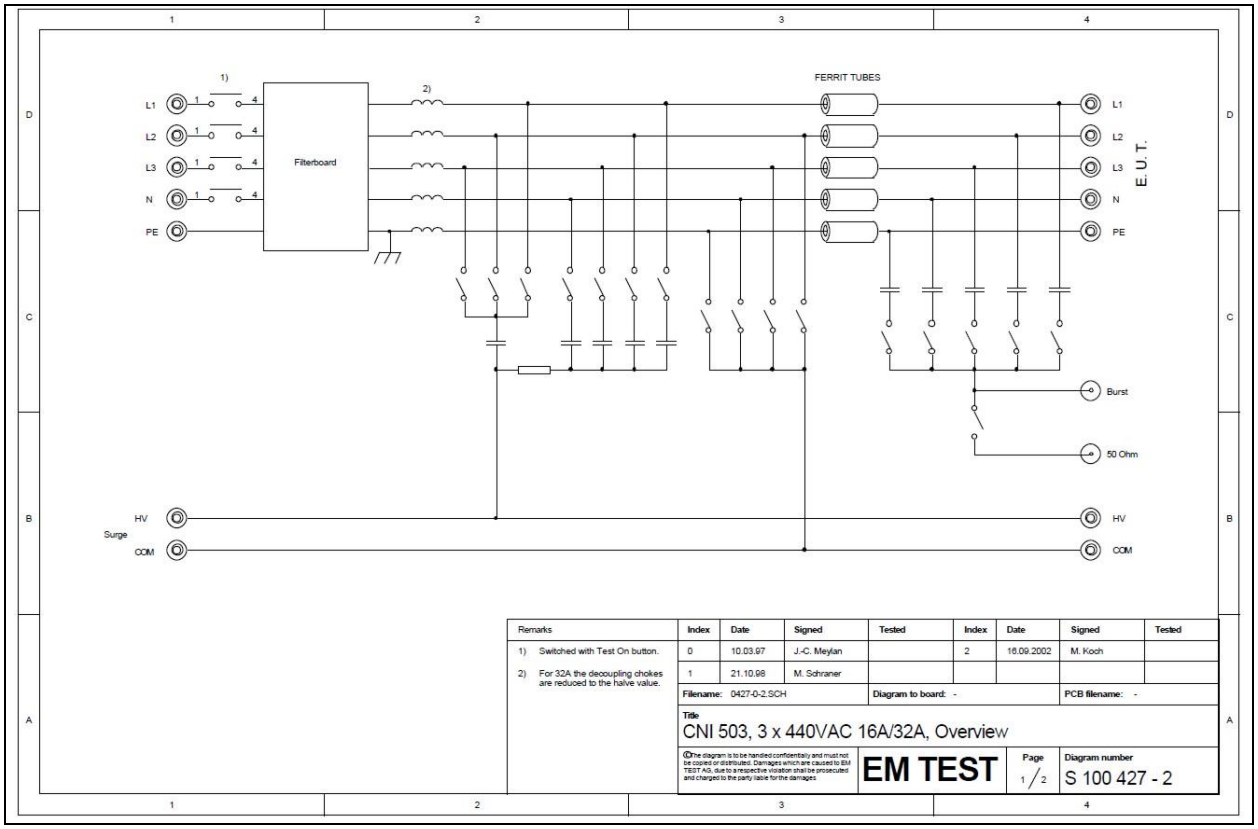
Decoupling inductances (lines / neutral)

Current	Line / Neutral	PE
16 A	1.5 mH	200 µH
32 A	0.75 mH	200 µH
63 A	0.6 mH	200 µH
100 A	0.6 mH	100 µH

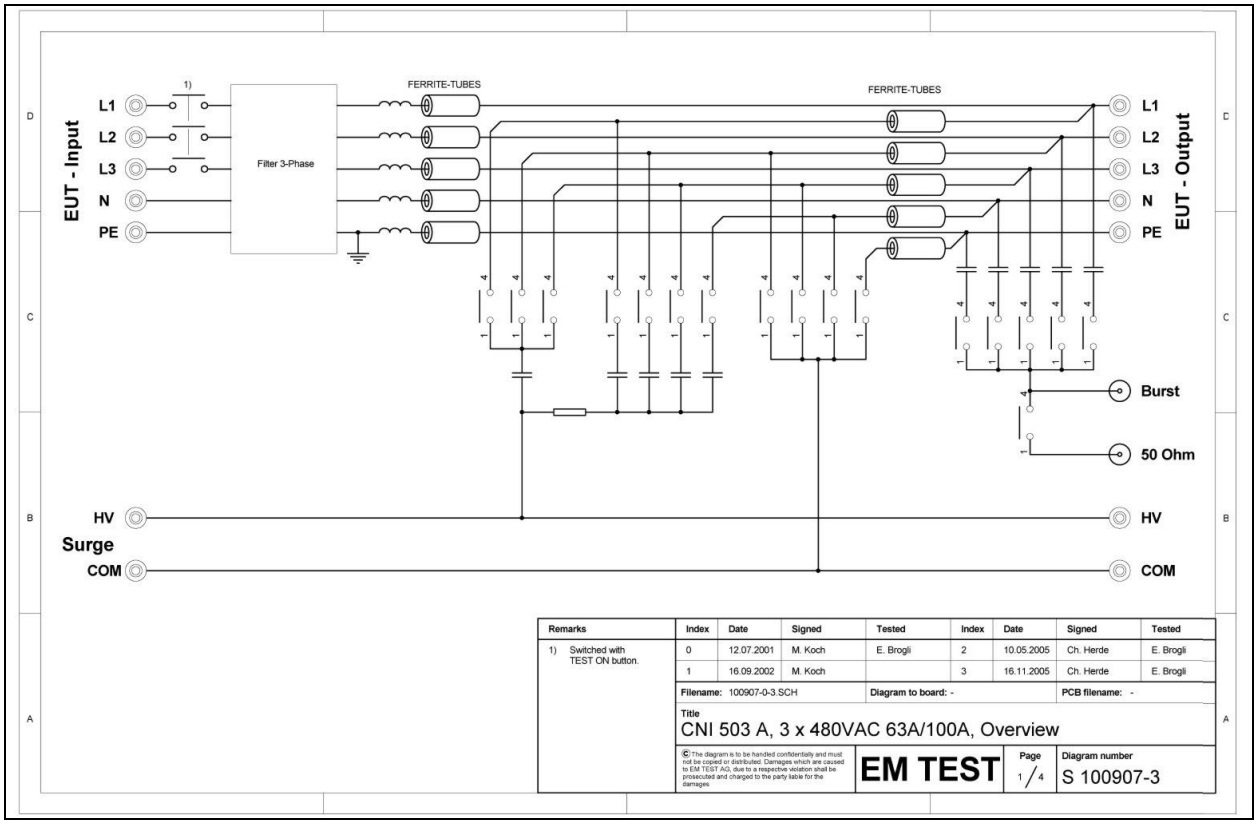
TEST ON

There are models with no TEST ON function. These models have no contactor at the EUT input.

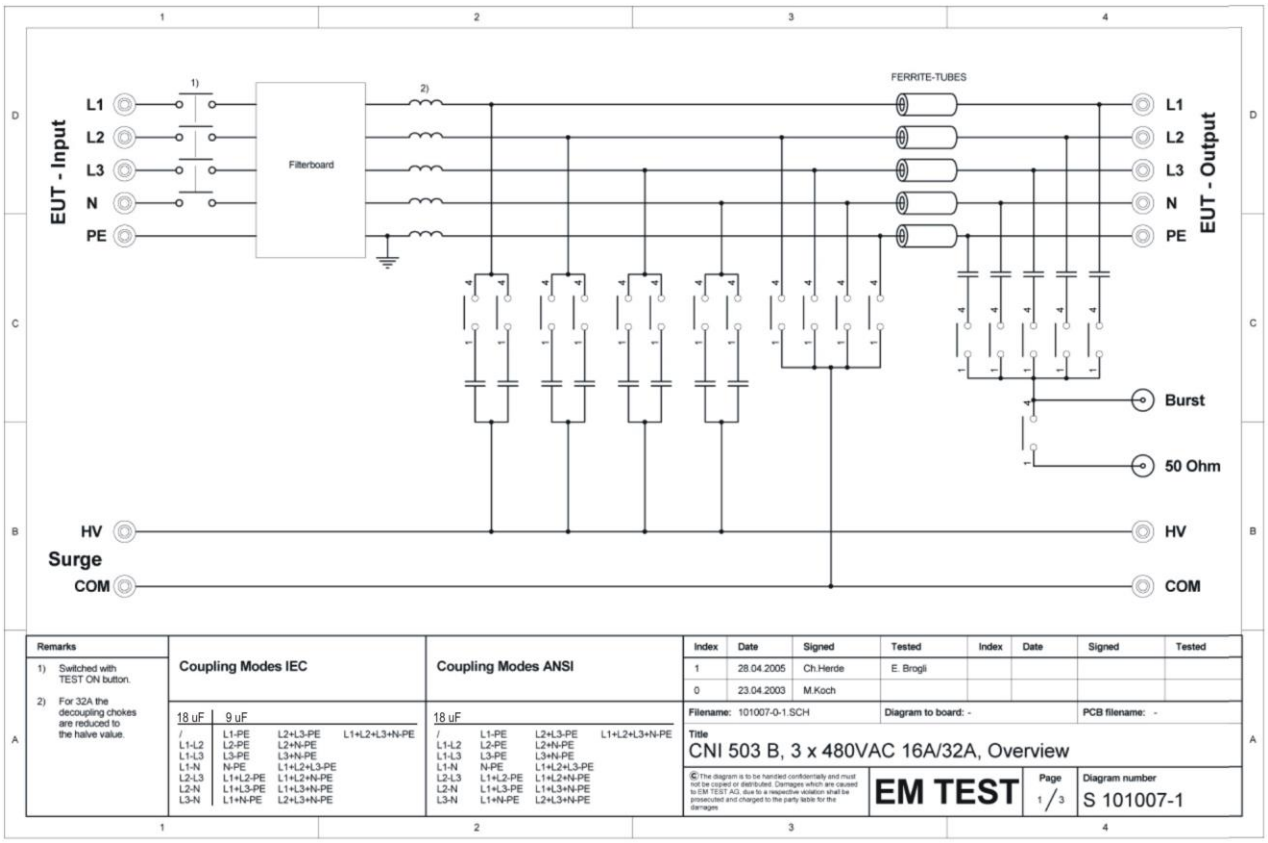
CNI 503A Models for 16 A/ 32 A with Test ON switch



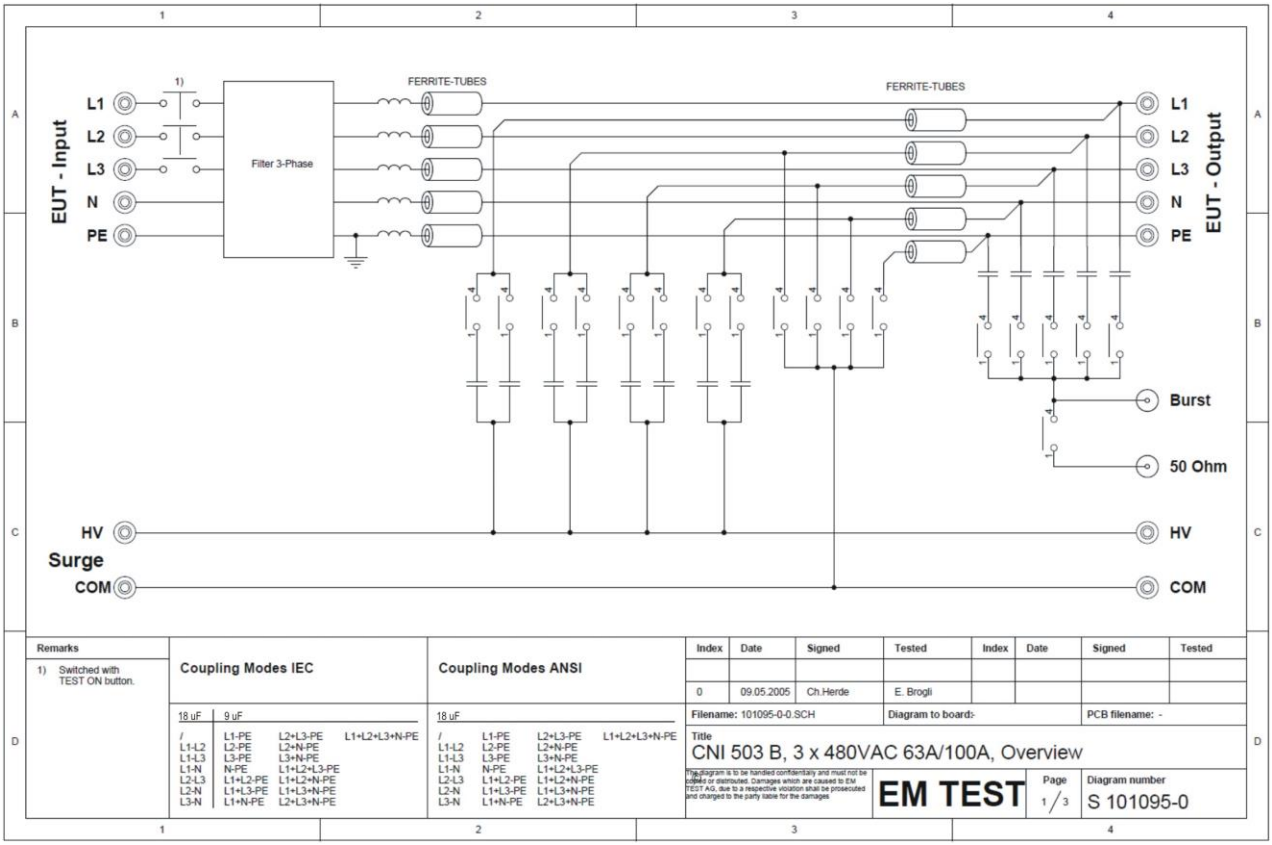
CNI 503A Models for 63A / 100A with Test ON switch



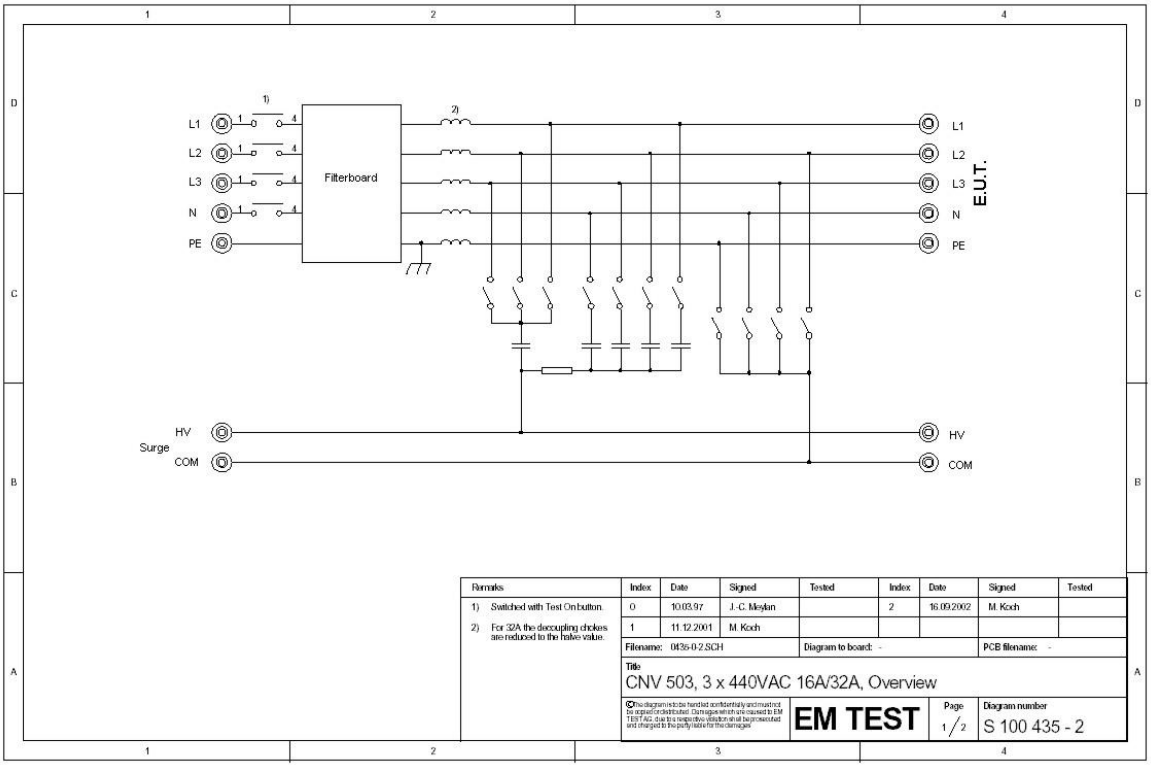
CNI 503B Models for 16 A/ 32 A with Test ON switch



CNI 503B Models for 63A / 100A with Test ON switch

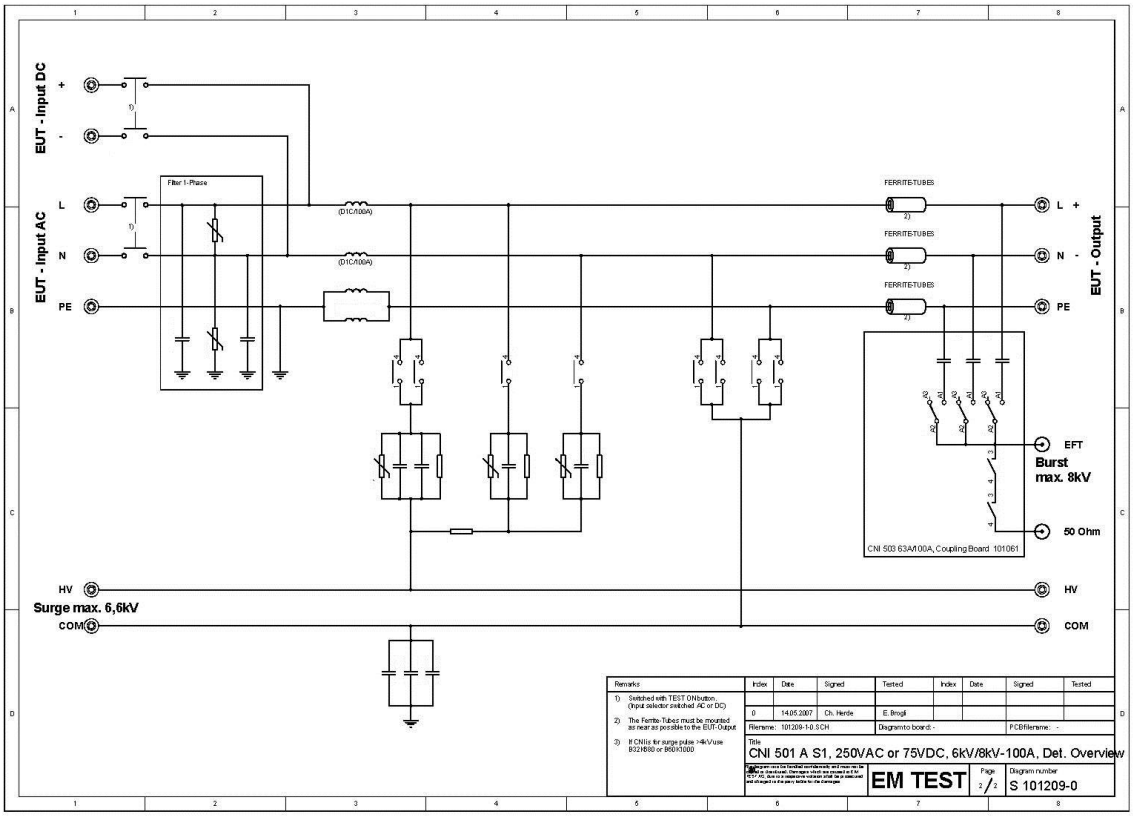


CNV 503 3x480V 16/32 A Only for surge pulses

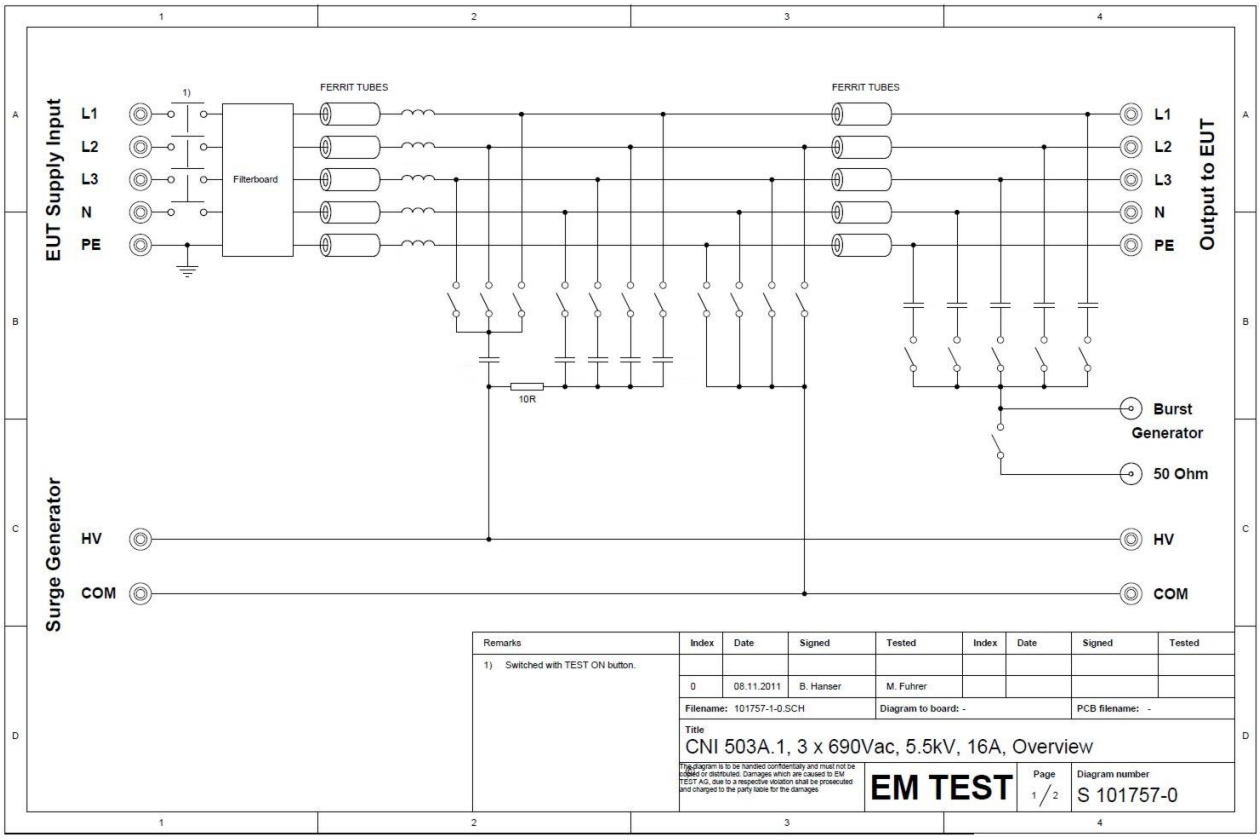


32A models have 0.75mH inductors

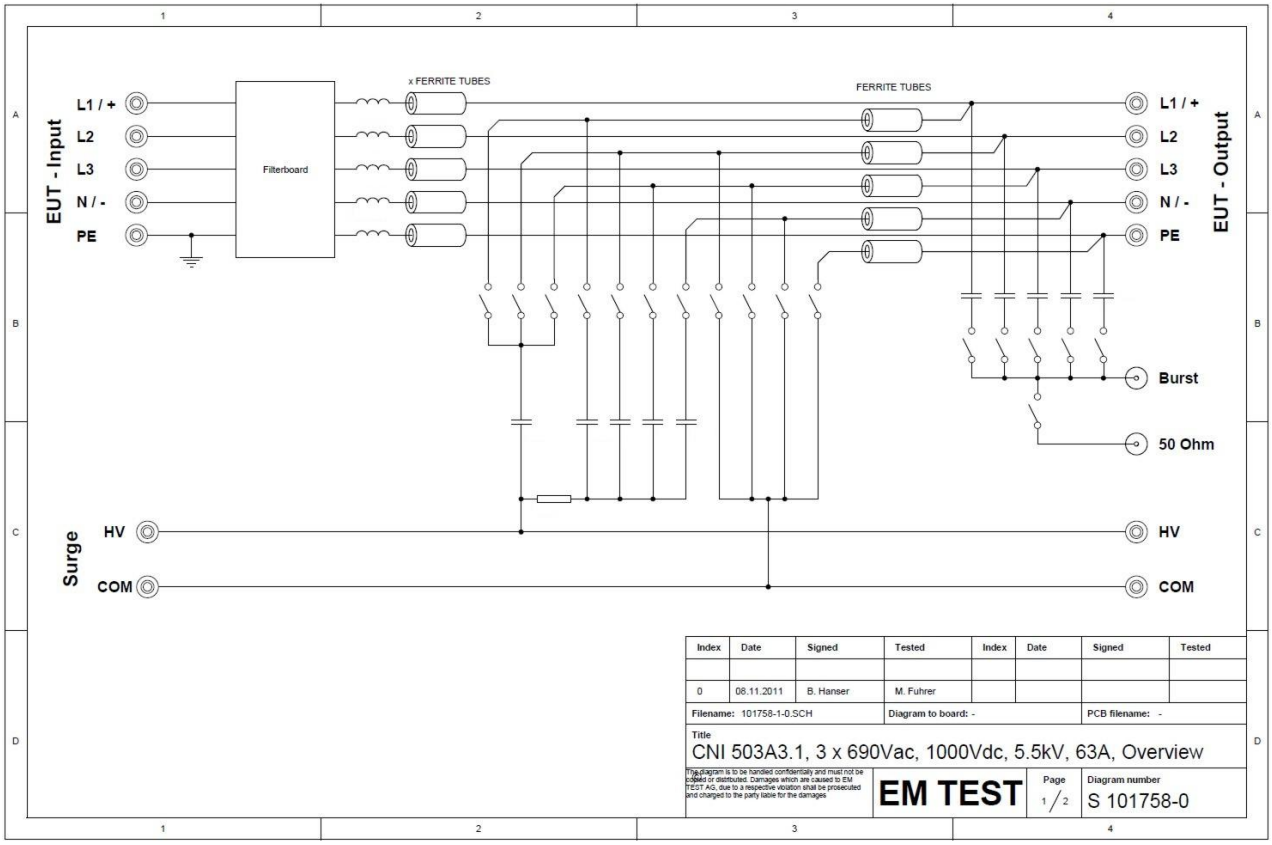
CNI 501 S1 100A (0.6mH inductors)



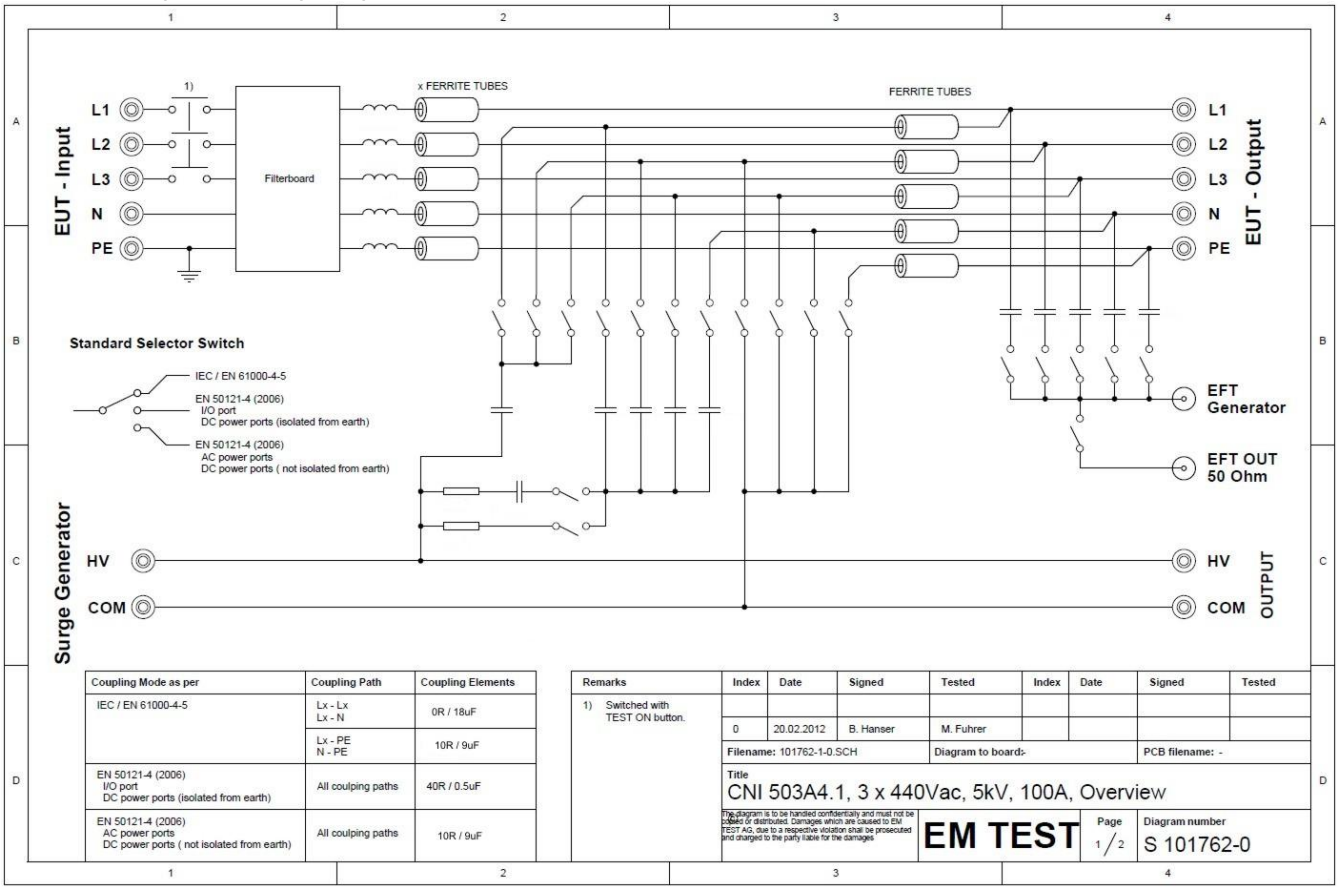
CNI 503A.1 3x690Vac 5.5kV, 16A



CNI 503 A3.1

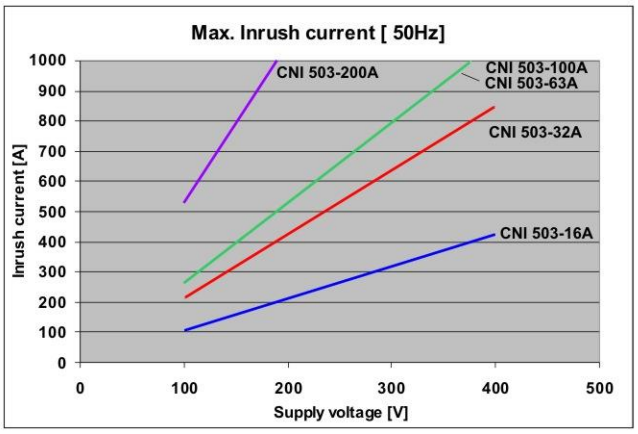


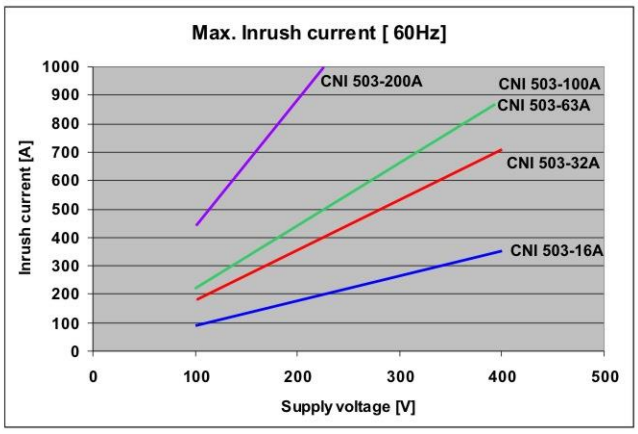
CNI 503 A4.1, 3x440Vac, 5kV, 100A Overview



12.4. Inrush current

The inrush current depends from the mains impedance, the inductance of the surge inductors and the EUT impedance. The inrush current in the tables below are max. theoretical values and cannot be reached in a real system.





Theoretical maximum Inrush current for CNI 503 for 50Hz and 60Hz system depends on supply voltage