

Manual

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



CNI 508N2 Assembly

Coupling decoupling assembly for unshielded and shielded high-speed communication lines up to 1Gbit/s

CNI 508 N2

SPN 508 N1

Coupling/decoupling network available on the market to couple Surge onto unshielded and shielded high-speed communication lines with data rates up to 1,000MBit/s.

The CNI 508N2 assembly includes a coupling network, and a decoupling network. As protection equipment the SPN 508N1 limits the residual voltage at the AE side. Additionally, the CNI 508N2 can be used as a coupling/decoupling network to apply Surge as well as Ringwave and Burst pulses to shielded lines.

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



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Specifications subject to change

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1. List of assembly components

1.1. CNI 508 N2 Coupling / decoupling network

The CNI 508N2 is a specifically designed CDN for testing high-speed communication lines. Its unique design allows data rates of up to 1,000MBit/s to be transmitted without degradation by the coupling/decoupling network. The decoupling network protects the auxiliary equipment limiting the residual voltage to max. 40V@2kV for common-mode surge test pulses.

Moreover, the CNI 508N2 fully supports PoE and PoE+ standard requirements as per IEEE 802.3.

The CNI 508N2 may also be used for testing shielded cables as per IEC/EN 61000-4-5, Fig. 16.

It simplifies the test set-up and offers proper decoupling of the auxiliary equipment as well as a high safety for the operator as the surge is coupled through the CNI 508N2 rather than being directly applied to the metallic case of the DUT.

Additionally, the CNI 508N2 may also be used to couple Ringwave pulse (0.5us/100kHz) and burst pulses to shielded cables.

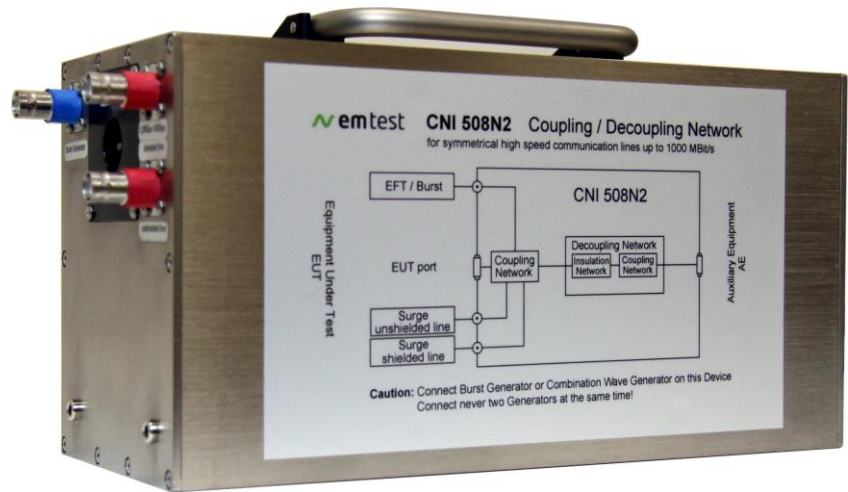


Fig 1.1: CNI 508N2

1.2. SPN 508 N1 Surge Protection Network

The SPN 508N1 protects the auxiliary equipment with a residual voltage of less than 10V. This Ethernet surge protection device can alternatively use for all other application where the user must protect his devices from any overvoltage.

The SPN 508N1 has a galvanic isolation of the signal between protected and unprotected side.

For decoupling the pulse in direction to the AE port, the CNI 508N2 and the surge protection network SPN 508 N1 must mandatory be connected at the other side of the CNI 508N2.



Fig 1.2: SPN 508N1

2. Operating Functions

2.1. Front and Rearside CNI 508N2 view

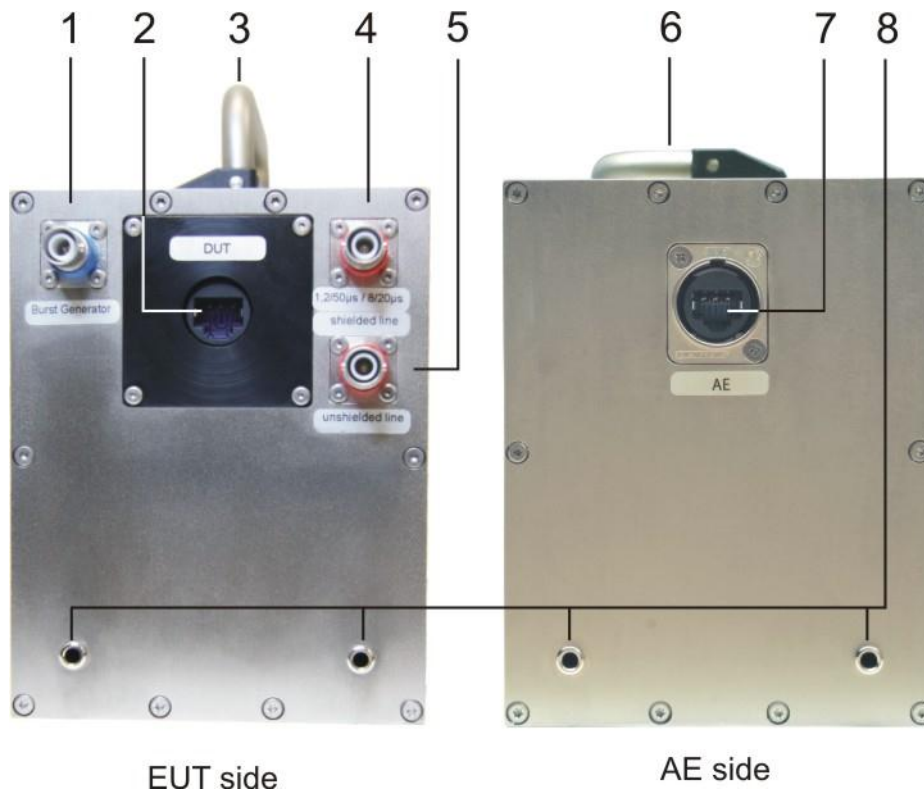


Figure 2.1 : CNI 508N2 front and rear views

- | | | | |
|---|--|---|---|
| 1 | Burst input from Burst Generator | 5 | Surge input from Surge Generator to lines |
| 2 | Output to EUT Port | 6 | Handle closed position |
| 3 | Handle open position | 7 | Output to RJ45 AE Port |
| 4 | Surge input from Surge Generator to shield | 8 | Earth plugs |

1 Burst input

Input for the burst pulse application to the shield of the Ethernet cable. The burst pulse is applied over a 50Ω resistor.

2 Output to EUT Port

RJ 45 output to EUT Port. The connector is insulated up to 5kV from the housing. It is possible to replace the connector after the connector lifetime. RJ 45 connector type Neutrik Ethercon CAT 6 chassis connector PartNo NE8FDY-C6

3 Handle open position

Handle open position for carrying the CNI 508 N2.

4 Surge input to shield

Input for the surge pulse application to the shield of the Ethernet cable. The surge pulse is applied direct to the shield.

5 Surge input to lines

Input for the surge pulse application to the the lines of the Ethernet cable.

6 Handle closed position

Handle closed position for operate the CNI 508 N2.

7 Output to AT Port

RJ 45 output to AE Port. The connector is not insulated from the housing. It is possible to replace the connector after the connector lifetime. RJ 45 connector type Neutrik Ethercon CAT 6 chassis connector PartNo NE8FDY-C6

8 Earth plugs

Connectors for connect the frames between the different devices of the CNI 508N2 assembly. The earth cable must be connected to reference GND.

2.2. Frontsides SPN 508N1

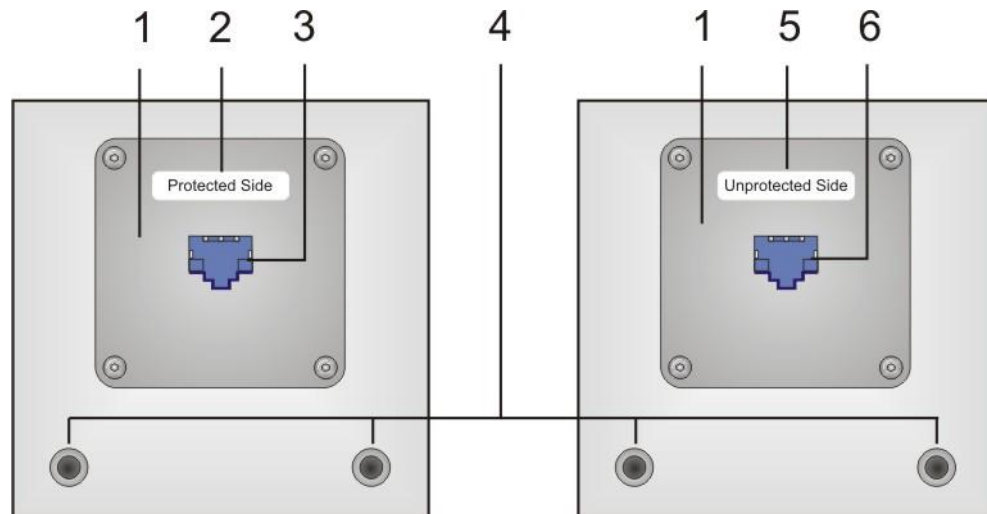


Figure 2.2 : SPN 508N1 front views

- | | | | |
|---|---------------------------|---|---|
| 1 | Insulating plate | 4 | Earth plugs |
| 2 | Indication Protected side | 5 | Indication Unprotected side |
| 3 | Output Port AE | 6 | Output Port EUT via coupling/decoupling network |

1 Insulating plate

High voltage insulation plate for insulate the RJ45 connector against the metal part of the device housing. The withstand voltage is >5kV.

2 Indication Protected side

This side is protected against the high voltage.

3 Output Port AE side RJ45 connector

RJ 45 output to AE Port. The connector is insulated from the housing. It is possible to replace the connector after the connector lifetime. RJ 45 connector type Neutrik Ethercon CAT 6 chassis connector PartNo NE8FDY-C6

4 Earth plug

Earth plug on front and rear side with 4mm banana plugs. During the test the user must connect all devices of the CNI 508N2 assembly with the delivered yellow ground cable. These connections are the equipotential bonding between the devices during the surge test.

5 Indication Unprotected side

From this side the user connect the shielded RJ45 cable to the CNI 508N2. This side is not protected against high voltage.

6 Output EUT Port

Output port EUT to the coupling/decoupling network CNI 508N2. The RJ 45 connector is insulated from the housing. It is possible to replace the connector after the connector lifetime. RJ 45 connector type Neutrik Ethercon CAT 6 chassis connector PartNo NE8FDY-C6

3. General

Coupling of the surge pulses is achieved by means of the coupling / decoupling network CNI 508N2. For additional protection of the auxiliary equipment by reducing the residual voltage level the SPN 508N1 is used.

The CNI 508N2 design is based on the
 - IEC 61000-4-5 (Ed2.0: 2005) figure 15 and
 - Draft IEC 61000-4-5 (Ed3.0: 2012) figure 11.

The **CNI 508N2** allows the following couplings with separate input connectors:

- Surge and Ringwave pulses to datalines
- Surge and Ringwave pulses to shield
- Burst pulses to shield

For an additional overvoltage protection of the AE port the SPN 508N1 can be used for limit the residual voltage to approx. 10V. t

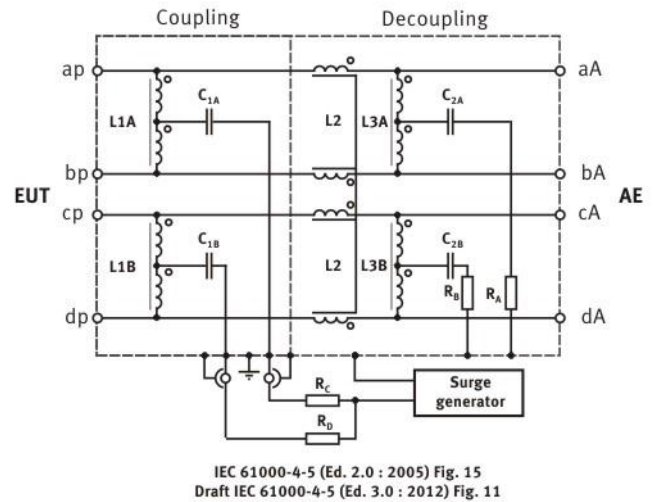


Fig 3.1: Principle design of the CNI 508N2 for Surge to high speed datalines

3.1. Test methods for surge to high speed datalines

The IEC 61000-4-5 Ed.2 surge standard shows in figure 15 a coupling network for testing high speed datalines. The international IEC standard committee TC 77 removed at the meeting (January 2011) in Malaysia the figure 15 in the standard IEC 61000-4-5. The committee was of the opinion; the network in figure 15 does not work. Therefore EM Test makes a proposal for a working solution.

The solution for a new coupling/decoupling is based on the existing methods of surge testing. There are two different Methods for testing surge pulses on datalines.

Coupling to shielded lines

Test to shielded line is adapted from the figure 16 where the surge is applied direct to the shield of the data cable.

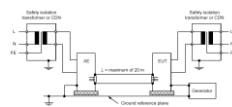


Fig. 16 IEC 61000-4-5

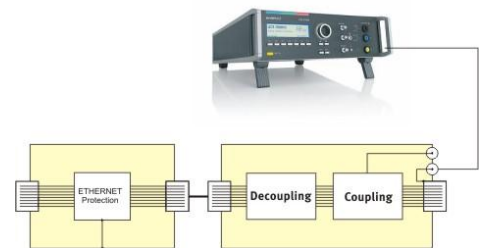


Fig 3.2: coupling to shielded lines

Coupling direct to high speed lines

Test with coupling direct to the data-lines is based to figure 15 of IEC 61000-4-5 standard. The surge is applied direct to unshielded symmetrical high speed data-lines. For decoupling and protection it is necessary to use separate devices of the CNI 508N2 assembly.

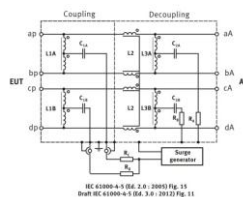


Fig. 15 IEC 61000-4-5

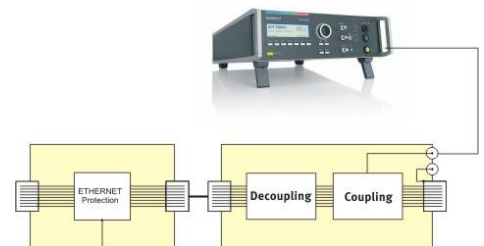


Fig 3.3: coupling to lines

4. Technical Data CNI 508 N2 assembly

4.1. Technical Data CNI 508N2

Surge Test Mode	
Coupling mode	shielded and unshielded cable with up to 4 pairs
Test voltage	Max. 3kV* (1.2/50us) (* only with connected RJ45 connector; if left open the max. test voltage is limited to 1.5kV)
Residual voltage	Max. 40V @2kV Surge, line - PE
Ring wave Test Mode	
Coupling mode	Shielded and unshielded cable with up to 4 pairs
Test voltage	Max. 3kV* (0.5us/100kHz) (* only with connected RJ45 connector; if left open the max. test voltage is limited to 1.5kV)
Residual voltage	Max. 40V @2kV Ringwave, line - PE
Burst Test Mode	
Coupling mode	shielded cable with up to 4 pairs
Test voltage	Max. 4kV* (5/50ns) (* only with connected RJ45 connector; if left open the max. test voltage is limited to 1.5kV)
Residual voltage	Max. 40V @2kV Burst, line - PE
Inputs	
Surge/Ringwave shield	SHV connector
Surge/Ringwave unshielded	SHV connector
Burst	SHV connector over 150Ω
Telecom line specification	
Input/Output	RJ45 female connectors for telecom lines
Terminal layout	Pair 1: pins 1 / 2 Pair 2: pins 3 / 6 Pair 3: pins 4 / 5 Pair 4: pins 7 / 8
Data rate	up to 1,000MBit/s
Protection	± 60V between two pairs
Operating voltage	max. 57 VDC
Operating current	max. 1A
Connector RJ45	Neutrik NE8FDY-C6
Connector lifetime	> 1000 matching cycles
General Data	
Dimensions	270mm x 110mm x 140mm (LxWxH)
Weight approx.	6.65kg
Temperature	5°C - 40°C (operation)
Rel. humidity	10% - 90%, non condensing

4.2. Technical Data SPN 508N1

Surge Test Mode	
Number of lines	4 twisted pairs
Max. discharge current	2kA (8/20us) without destruction to RJ45 contacts
Residual voltage	Max. 10V
Insertion loss	< -1.5dB (300kHz - 100MHz)
Telecom line specification	
Input/Output	RJ45 female connectors for telecom lines
Terminal layout	Pair 1: pins 1 / 2 Pair 2: pins 3 / 6 Pair 3: pins 4 / 5 Pair 4: pins 7 / 8
Data rate	up to 1,000MBit/s
General Data	
Dimensions	115mm x 80mm x 80mm (LxWxH)
Weight approx.	0.70kg
Temperature	5°C - 40°C (operation)
Rel. humidity	10% - 90%, non condensing

5. Test set up

Generator output plugs

The Surge and Ringwave output plugs are located at the rear side of the impulse generator. The surge generator impedance is 2Ω. The additional impedance is inside the CNI 508N2.

Surge, Ringwave:
Output HV –COM on rearside of the generator with direct coupling.
Set Coupling mode to “/”

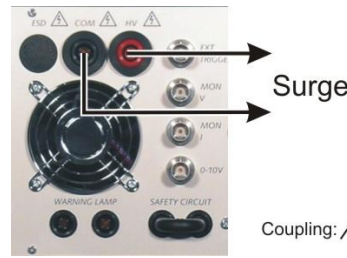


Fig 5.1: Surge output on rearside

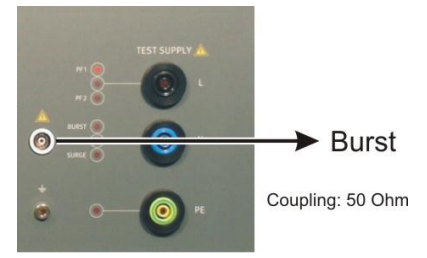


Fig 5.2: Burst pulse output

Grounding: The generator and the used devices of the CNI 508N2 assembly must be grounded properly to the reference ground.

5.1. Surge test to shielded datalines

This test will couple the surge pulse to the shield of a shielded RJ24 data-cable. The cable to the EUT must be mandatory a shielded cable.

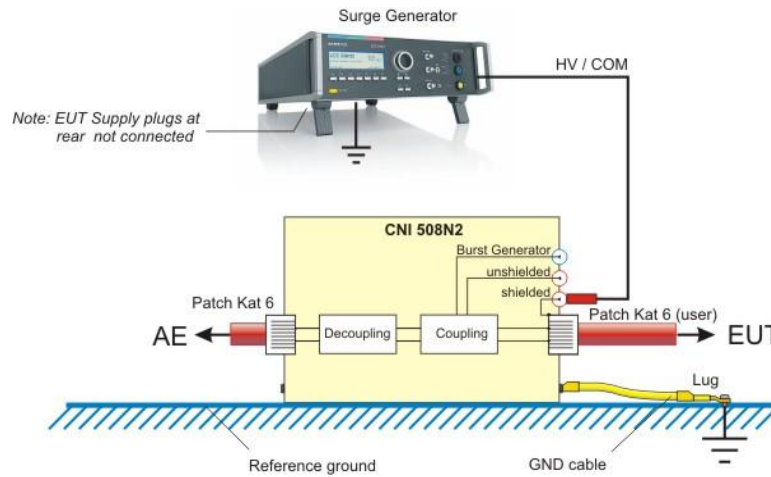


Figure 5.3: Setup for surge test to shielded datalines

The surge current on the cable shield can be very high and is limited by the 2Ω generator impedance. To use the SPN 508N1 protection device will protect the AE port side and all connected devices.

The surge coupling voltage and current to the lines depends on the impedance connected at the CNI508N2 AE port.

In case of a short circuit as shown in figure 5.4, the coupling to the lines is nearly 1:1 and a current wave 8/20us appears... The protection network SPN 508N1 get during the surge pulse low impedance.

Is the at the AE Port a high impedance, an impulse waveshape 1.2/50us appears at the EUT Port

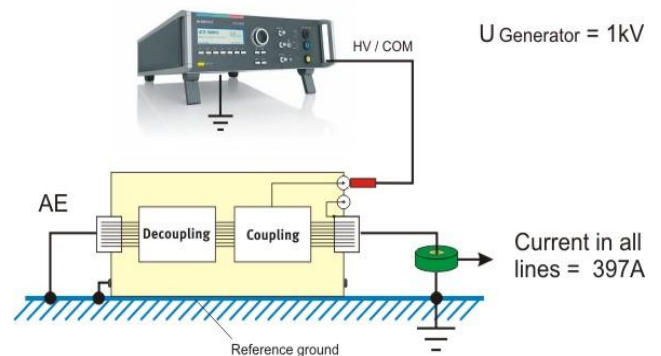
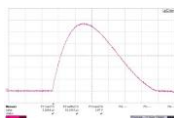


Fig 5.4: CNI 508 N2 with Short circuit at the AE port



Current on lines approx. 400A
8/20us current wave with short circuit on AE Port



Voltage on line shield
1.2/50us voltage impulse with open circuit on AE port.

5.2. Surge test to datalines

This test will couple the surge pulse direct to the 8 datalines of the RJ45 cable. The cable to the EUT can be a shielded or unshielded data-cable. Figure 5.5 shows the test setup for surge to datalines.

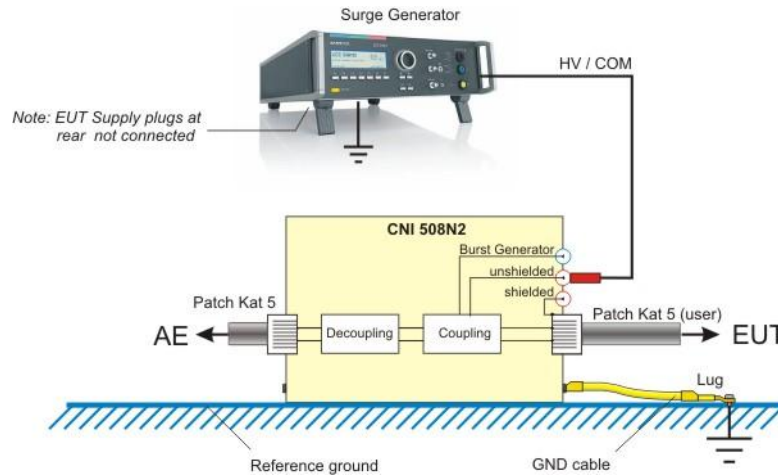
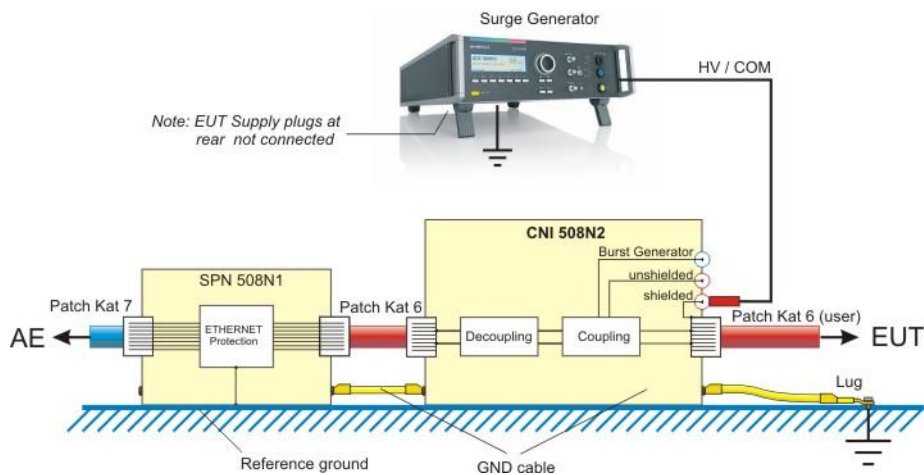


Figure 5.5 Setup for surge to datalines

5.3. Surge test to datalines with SPN 508N1 protection

In case of a high protection level of approx. 10V at the AE port, the user can connect additional the SPN 508N1. This protection will separate the AE side the surge by a galvanic insulation from the surge circuit. Figure 5.6 illustrates the setup with using a SPN 508N1 protection device.



5.4. Burst test to datalines

The burst pulse is applied from the 50Ω front side EFT output to the blue HV-BNC plug of the CNI 508N2. The coupling is to the shield. The burst pulse can be measured on the shield as on the datalines.

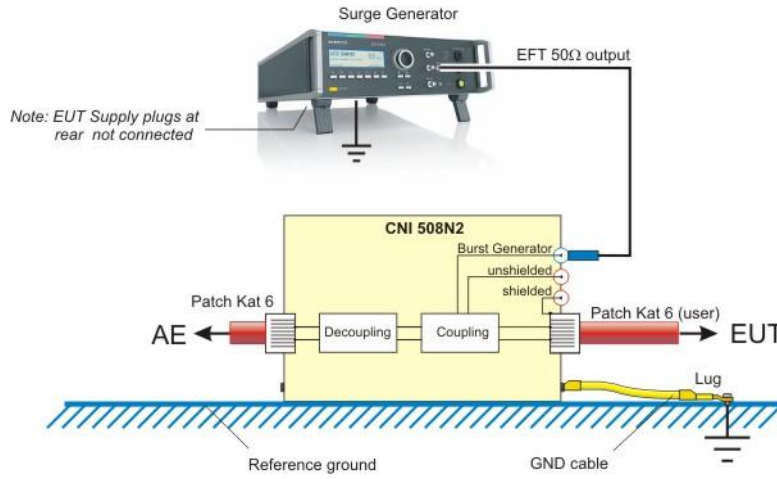


Fig 5.7: Setup for EFT / Burst testing

5.5. Power over Ethernet

In general, the power supply model is required depends the EUT. Therefore, in the most case it is necessary that PoE power supply is manufactured from the EUT supplier.

It is advantageous that the EUT and the PoE's power supply are tested with the same Surge pulse. In the both components are installed and have to withstand surge pulses.

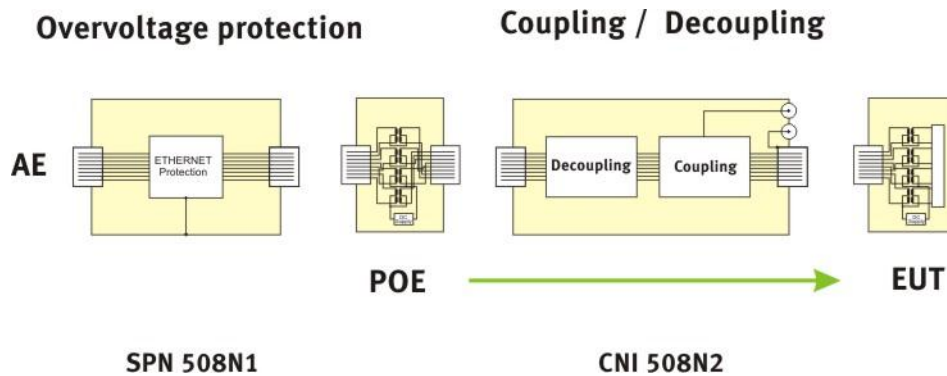


Figure 5.7 Principle layout of a power over Ethernet installation setup.



POE Supply must be connected between the SPN 508N1 and CNI 508N2

6. Maintenance and calibration

6.1. General

The coupling network is absolutely maintenance-free by using.

6.2. Calibration and Verification

6.2.1. 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

6.2.2. 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.

6.2.3. 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.

6.2.4. 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 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.

7. Delivery Groups

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

7.1. Basic equipment and accessories

- Coupling / decoupling network or Surge Protection Network as per list below
- Manual for CNI 508 N2 Assembly on CD

7.1.1. CNI 508 N2

- CNI 508N2 Coupling/ decoupling network
- 1 HV cable Surge: 1 Meter HV Cable SHV to Banana
- 1 HV Cable Burst: 1 Meter HV Cable SHV to F-103A
- 1 Patch Cable : 0.5 Meter Cat.6 shielded red
- 1 Patch Cable : 0.5 Meter Cat.5 unshielded grey
- Ground cable: 0.3 Meter yellow
- 1 piece lug for one end (one per assembly)

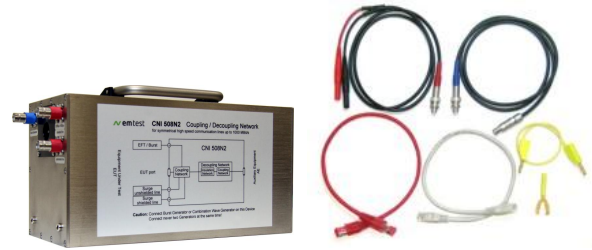


Fig 7.1

7.1.2. SPN 508 N1

- SPN 508 N1 Protection network
- 1 Patch Cable : 0.5 Meter Cat.7 shielded blue
- 1 Ground cable: 0.3 Meter yellow
- 1 piece lug for one end (one per assembly)



Fig 7.2

8. Appendix

8.1. Declaration of CE-Conformity

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

Declares, that under its sole responsibility, the product's listed below, including all their options, are in 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 508 N2 , SPN 508 N1

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.

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Place	Kamen, Germany	Reinach BL , Switzerland
Date	16. November 2012	16. November 2012

8.2. Pin configuration at different systems

Worldwide the RJ 45 connector is used. Therefore some limits are given by the connector specification. Many manufactures have no specification of the withstand voltages of the connectors in their datasheet. The maximum Surge voltages are limited by the RJ45 connectors. Therefore the user can be limited depend on the coupling mode of the surge test in relation to the used cables and connectors.

Voltages withstand

Contact - Contact : 500V ac 1 min
Contact - Shield : 1500V ac 1 min



Fig 8.1

There are different wiring configuration for datatransmission cables using RJ45 connectors. Table 8.1 shows the most used pin configuration.

Pin	Telefon analog	Telefon (alt)	T+T Schweiz	DSL-Splitter	ISDN (S0)	ISDN (UK0/UP0)	Ethernet 10BaseT 100BaseT	Gigabit-Ethernet	Token Ring	TP-PMD	IBM AS400	IBM 3270	ATM
S					(S)	(S)	S	S	S	S	(S)	(S)	S
1							TX+	D1+		TX+			X
2							TX-	D1-		TX-			X
3	W	a	1b		2a		RX+	D2+	RX+			RX+	
4	a		1a	a	1a	a		D3+	TX-		TX+	TX+	
5	b		(2a)	b	1b	b		D3-	TX+		TX-	TX-	
6	E	b	(2b)		2b		RX-	D2-	RX-			RX-	
7								D4+		RX+			X
8								D4-		RX-			X

Table 8.1 Connector pin arrangement of RJ 45 for different applications

8.3. Transfer Characteristics CNI 508N2

The transfer function shows the characteristics of the cables, decoupling induction and connectors. The surge coupling part was disconnected, cause this part will short the measurement.

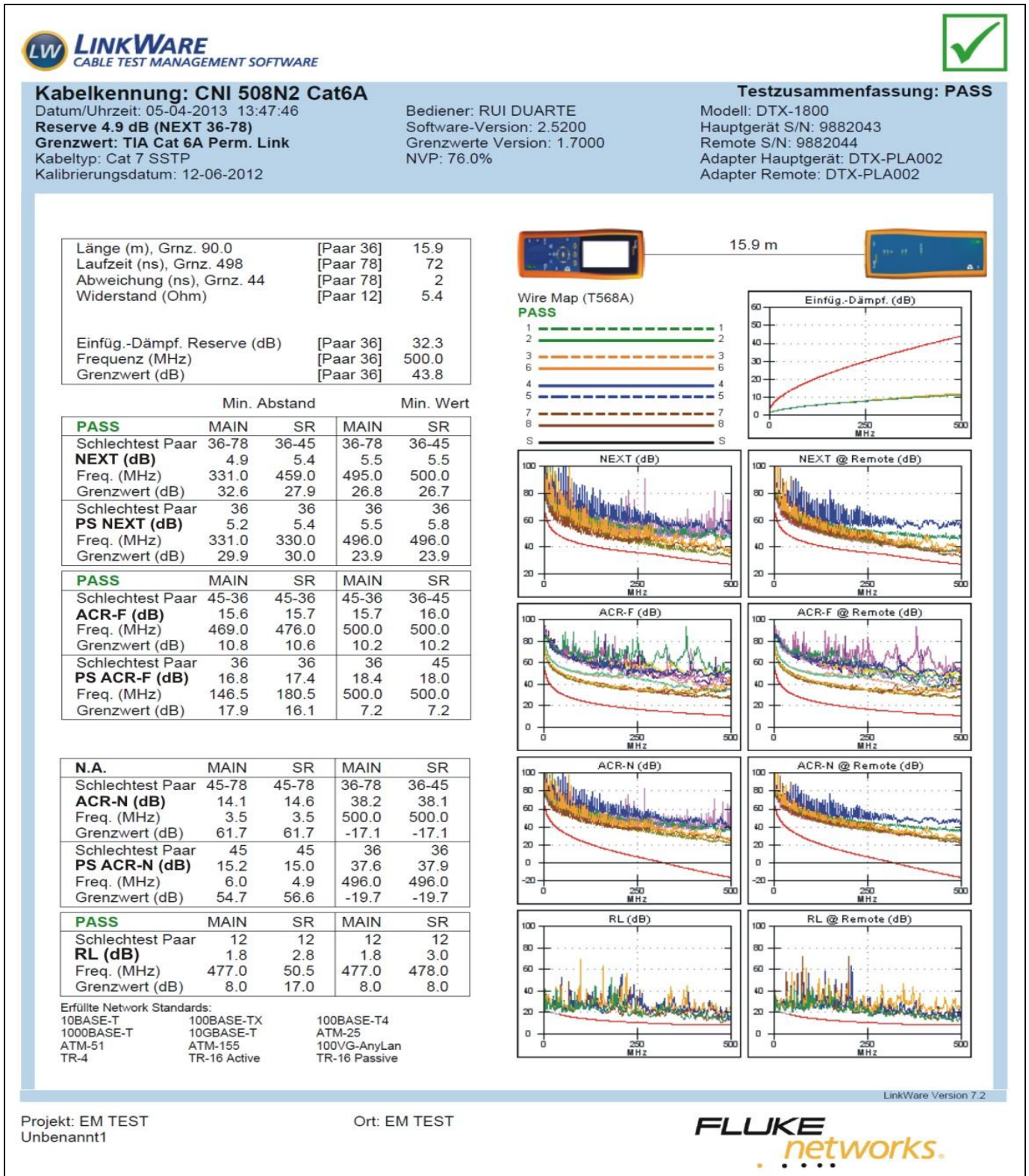


Table 8.2 Transfer characteristics CNI 508N2 with Cat 6A

8.4. NE8FDY-C6 connector replacement

The connector NE8FDY-C6 from Neutrik has a lintime of > 1000 mating cycles and can be replaced by the user himself. The attached pictures shows how to replace the connector.

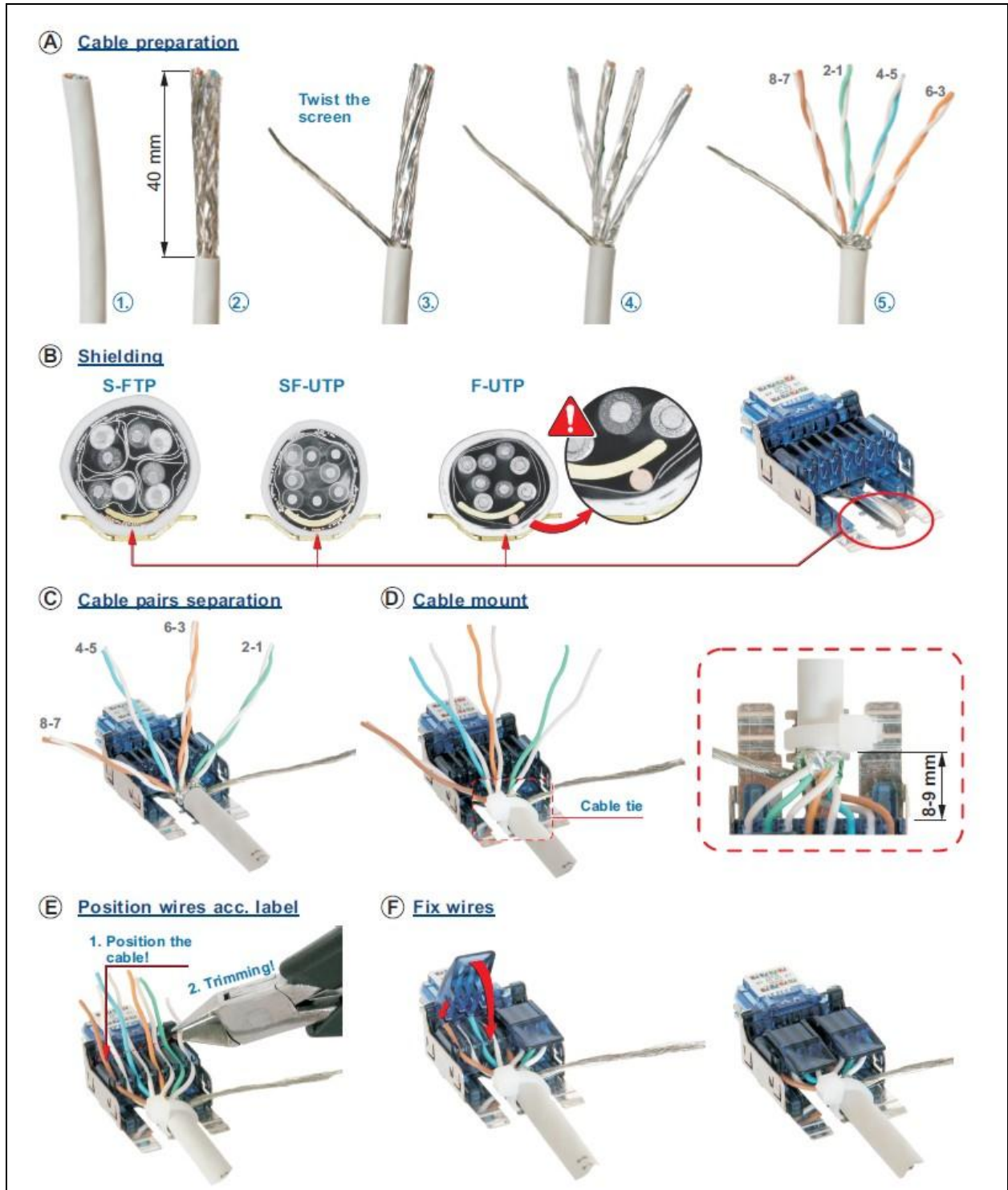


Fig 8.2: Instruction RJ45 connector replacement



Note for Right-Angle Version

Working steps same as above.

Except:

- Step B - References to step B and bend the reinforcement metal right angle below.
- Step G - The cable outlet must not be interrupted.



Fig 8.3: Instruction RJ45 connector replacement