

Coupling / Decoupling Networks (CDN)

For immunity testing according to IEC / EN 61000-4-6
(10 kHz) 150 kHz - 230 MHz (300 MHz)



Immunity testing

CDNs are the preferred coupling and decoupling devices, for reasons of test reproducibility and protection of the auxiliary equipment (AE). CDNs shall be used for appropriate coupling of the disturbing signal to the various cables connected to the equipment under test (EUT) and for preventing applied test signals from affecting other devices, equipment and systems that are not under test.

Following you find descriptions of the most frequently used types for unshielded cables CDN-AF, CDN-M, CDN-T and CDN-S for shielded cables.

Please request information on types not specified here.

Emission testing

Some selected CDNs meet the requirements of CISPR 15 and CISPR 22 for emission testing in the extended frequency range of 80 MHz to 300 MHz.

Along with the common mode impedance a curve of the voltage division factor over the frequency range of up to 300 MHz is supplied with these CDNs.

Currently the types CDN-AF2, CDN-M2, CDN-M3 and CDN-M2+3 meet the requirements of CISPR 15 / CISPR 22.

Please request information on types not specified here.

Setting the output voltage at the CDNs EUT port

1. The test generator (RF out) shall be connected via the 6 dB-attenuator to the RF-input port of the CDN.
2. The EUT port of the CDN shall be connected in common mode via a 150 Ω to 50 Ω adapter to a measuring equipment having a 50 Ω input impedance.
3. The AE-port shall be loaded in common mode with a 150 Ω to 50 Ω adapter, terminated with 50 Ω . The assembly is outlined below.

With direct injection to screened cable (CDN-S types), the 150 Ω load at the AE-port is not required as the screen will be connected to the ground reference plane at the AE-port side.

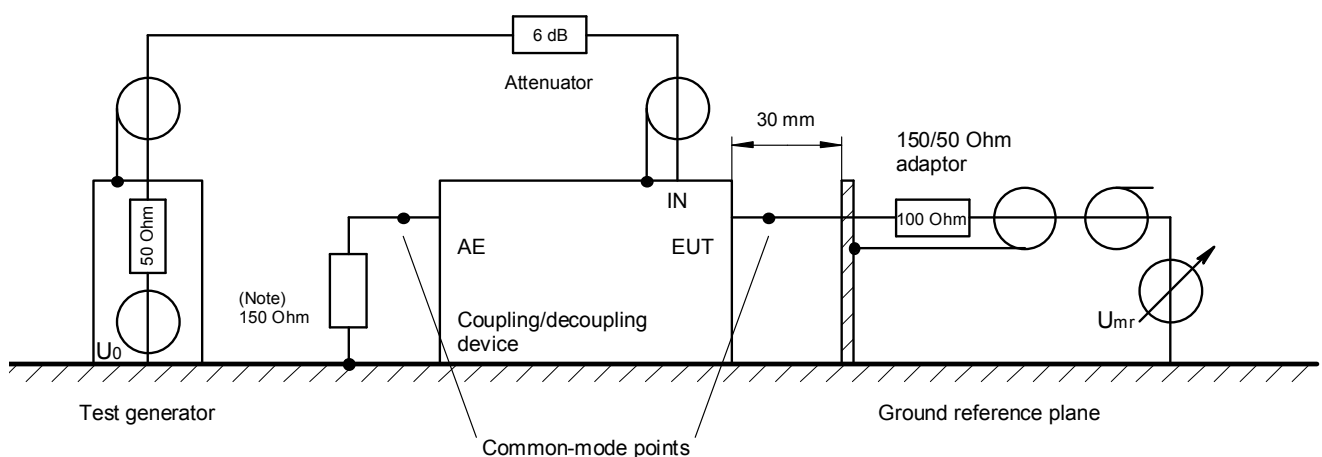
With the CDN M-types, CDN AF-types and CDN T-types the 150 Ω connector is according to standard prescribed, yet the calibration values for these CDN types are virtually independent of the load. This is due to the fact that these types have capacitors against ground at the AE-port side, which generate a RF-short circuit, comparable to those of the S-types.

Thus with the CDN M-types, CDN AF-types and CDN T-types the load of 150 Ω at the auxiliary equipment connector can be dispensed with.

In order to calibrate a CDN you require:

- specific calibration adapter
- mounting bracket
- 150 Ω to 50 Ω adapter

For the first CDN a mounting bracket and a 150 Ω to 50 Ω adapter need to be acquired. For each additional CDN only a specific calibration adapter needs to be acquired.



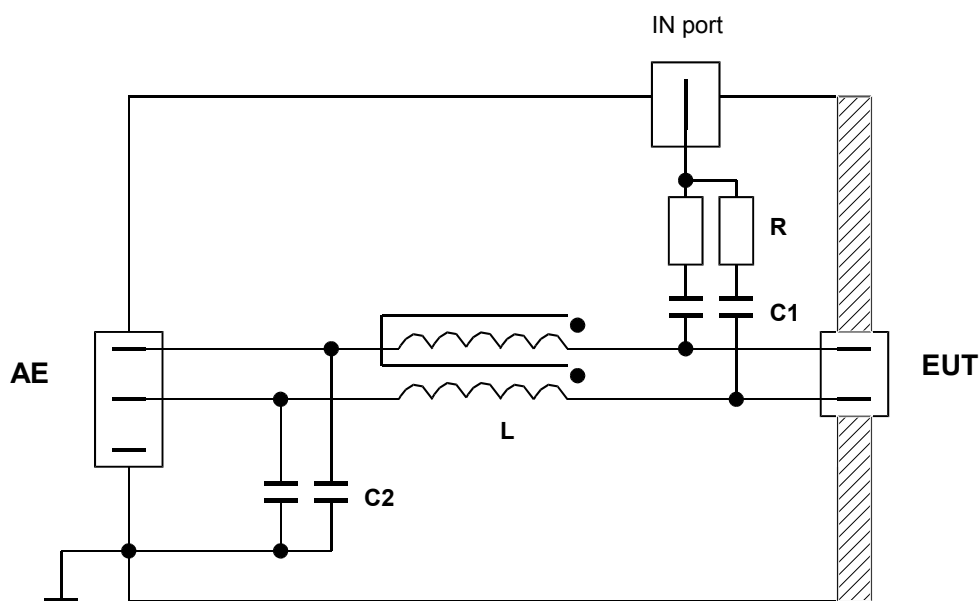
Note: The 150 Ω loading e.g. a 150 Ω to 50 Ω adapter terminated with a 50 Ω load), at the AE-port shall only be applied to unscreened cables (screened cables have their screen connected to the ground reference plane at the AE-side).

CDN-AF2 / -AF3 / -AF4 / -AF8



Description

CDN-AF type networks are required for coupling and decoupling disturbing signals to unscreened cables with non-balanced lines.



Simplified circuit diagram CDN-AF2

Specifications

Type	CDN-AF2/3/4/8
RF In	
Frequency range (RF In)	(10 kHz) 150 kHz – 230 MHz (300 MHz)
Rated power (RF In)	6 W (continuous)
Decoupling attenuation (RF In – AE)	> 20 dB (150 kHz – 230 MHz) > 40 dB (1 MHz – 100 MHz)
Insertion loss (RF In – EUT)	10 dB $\pm$ 1 dB (150 kHz – 230 MHz)
Connector	BNC
EUT / AE	
Operating voltage AC	100 V
Operating voltage DC	150 V
Rated current (AE – EUT)	1 A
Insertion loss (AE – EUT)	< 1dB (DC – 100 kHz)
Connector	Terminal block
Mechanical specifications	
Dimensions (W x H x L)	160mm x 84.5mm x 190mm

Order number	Description
AF2	CDN-AF2, EUT/AE: terminal block 2 pole, optionally 4mm safety banana jack
AF2-N	CDN-AF2, Namur, EUT/AE: terminal block 2 pole
AF3	CDN-AF3, EUT/AE: terminal block 3 pole, optionally 4mm safety banana jack
AF4	CDN-AF4, EUT/AE: terminal block 4 pole, optionally 4mm safety banana jack
AF4-N	CDN-AF4, Namur, EUT/AE: terminal block 4 pole
AF8	CDN-AF8, EUT/AE: terminal block 8 pole, optionally 4mm safety banana jack
KAL	Mounting bracket for calibration adapter incl. 50/150 Ohm adapter and 1 pc. calibration adapter KAL-AD
KAL-AD	Calibration adapter for AF2/T2, optionally available for AF3, AF4/T4, AF8/T8
	Custom design solutions are always available on request!

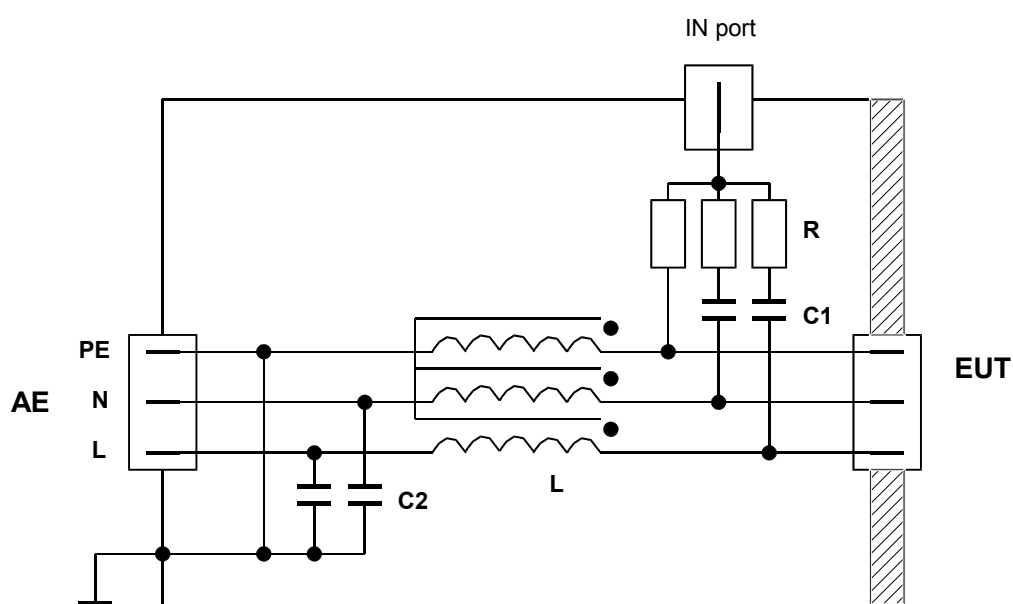
CDN-M1 / -M2 / -M2+3 / -M4 / -M5



Description

CDN M-types are used for all power supply lines.

Numerous types are available for EUT voltages of up to 600 VAC and EUT currents of up to 125 A.



Simplified circuit diagram for CDN-M3 used with unscreened supply (mains) lines

Specifications

Type	CDN-M1/2/3/4/5	CDN-M2/3/4/5/-600	CDN-M2/3/4/5/80/100/125
RF In			
Frequency range (RF In)	(10 kHz) 150 kHz – 230 MHz (300 MHz)		
Rated power (RF In)	6 W (continuous)		
Decoupling attenuation (RF In – AE)	> 30 dB (150 kHz – 80 MHz) > 20 dB (80 MHz – 230 MHz)	> 30 dB (150 kHz – 80 MHz) > 15 dB (80 MHz – 230 MHz)	
Insertion loss (RF In – EUT)	10 dB ± 1 dB (150 kHz – 80 MHz) 10 dB + 2 dB (80 MHz – 230 MHz)	10 dB ± 1 dB (150 kHz – 80 MHz) 10 dB + 3 dB (80 MHz – 230 MHz)	
Connector	BNC		
EUT / AE			
Operating voltage AC	250 V	600 V	250 V
Operating voltage DC	400 V	1000 V	400 V
Rated current (AE – EUT)	16 A / 32 A / 80 A / 100 A / 125 A ; (M1 / M2+M3 / M3 / M5 I _{PE} <0.5 A)		
Insertion loss (AE – EUT)	< 1dB (DC – 100 kHz)		
Connectors	4 mm safety banana jack / 6 mm round connector for currents > 32 A		
Mechanical specifications			
Dimensions (W x H x L)	160mm x 84.5mm x 190 mm	200mm x 122.5 mm x 400 mm	

Order number	Description
M1	CDN-M1,0.5A, EUT/AE: 4mm safety banana jack
M1-N	CDN-M1,0.5A, Namur, EUT/AE: 4mm safety banana jack
L1	CDN-L1,16A, EUT/AE: 4mm safety banana jack
M2	CDN-M2,16A, EUT/AE: 4mm safety banana jack
M2/32	CDN-M2,32A, EUT/AE: 4mm safety banana jack
M2/32-600	CDN-M2,32A,600VAC,1000VDC, EUT/AE: 4mm safety banana jack
M2/80	CDN-M2,80A, EUT/AE: 6mm round connector
M2/80-600	CDN-M2,80A,600VAC,1000VDC, EUT/AE: 6mm round connector
M2/100	CDN-M2,100A, EUT/AE: 6mm round connector
M2/125	CDN-M2,125A, EUT/AE: 6mm round connector
M2+M3	CDN-M2+M3,16A, EUT/AE: 4mm safety banana jack
M2+M3-N	CDN-M2+M3,16A, Namur, EUT/AE: 4mm safety banana jack
M2+M3/32	CDN-M2+M3,32A, EUT/AE: 4mm safety banana jack
M3	CDN-M3,16A, EUT/AE: 4mm safety banana jack
M3/32	CDN-M3,32A, EUT/AE: 4mm safety banana jack
M3/32-600	CDN-M3,32A,600VAC,1000VDC EUT/AE: 4mm safety banana jack
M3/80	CDN-M3,80A, EUT/AE: 6mm round connector
M3/80-600	CDN-M3,80A,600VAC,1000VDC, EUT/AE: 6mm round connector
M3/100	CDN-M3,100A, EUT/AE: 6mm round connector
M3/125	CDN-M3,125A, EUT/AE: 6mm round connector
L3	CDN-M3,16A-L1,L2,L3, EUT/AE: 4mm safety banana jack
L3/32	CDN-M3,32A-L1,L2,L3, EUT/AE: 4mm safety banana jack
M4	CDN-M4,16A, EUT/AE: 4mm safety banana jack
M4-N	CDN-M4,16A, Namur, EUT/AE: 4mm safety banana jack
M4/32	CDN-M4, 32A, EUT/AE: 4mm safety banana jack
M4/32-N	CDN-M4,32A, Namur, EUT/AE: 4mm safety banana jack
M4/80	CDN-M4,80A, EUT/AE: 6mm round connector
M4/32-600	CDN-M4,32A,600VAC,1000VDC, EUT/AE: 4mm safety banana jack
M4/100	CDN-M4,100A, EUT/AE: 6mm round connector

Order number	Description
M4/125	CDN-M4,125A, EUT/AE: 6mm round connector
M5	CDN-M5,16A, EUT/AE: 4mm safety banana jack
M5-N	CDN-M5,16A, Namur, EUT/AE: 4mm safety banana jack
M5/32	CDN-M5,32A, EUT/AE: 4mm safety banana jack
M5/32-N	CDN-M5,32A, Namur, EUT/AE: 4mm safety banana jack
M5/32-600	CDN-M5,32A,600VAC,1000VDC, EUT/AE: 4mm safety banana jack
M5/80	CDN-M5,80A, EUT/AE: 6mm round connector
M5/80-600	CDN-M5,80A,600VAC,1000VDC EUT/AE: 6mm round connector
M5/100	CDN-M5,100A, EUT/AE: 6mm round connector
M5/125	CDN-M5,125A, EUT/AE: 6mm round connector
KAL	Mounting bracket for calibration adapter incl. 50/150 Ohm adapter and 1 pc. calibration adapter KAL-AD
KAL-AD	CDN-M1 / M2 / M3 calibration adapter optionally for CDN-M1/M2/M3/M4/M5
KAL-AD-80-125	CDN-M1 / M2 / M3 (> 32A) calibration adapter optionally for CDN-M1/M2/M3/M4/M5 (>32A)
	Custom design solutions are always available on request!

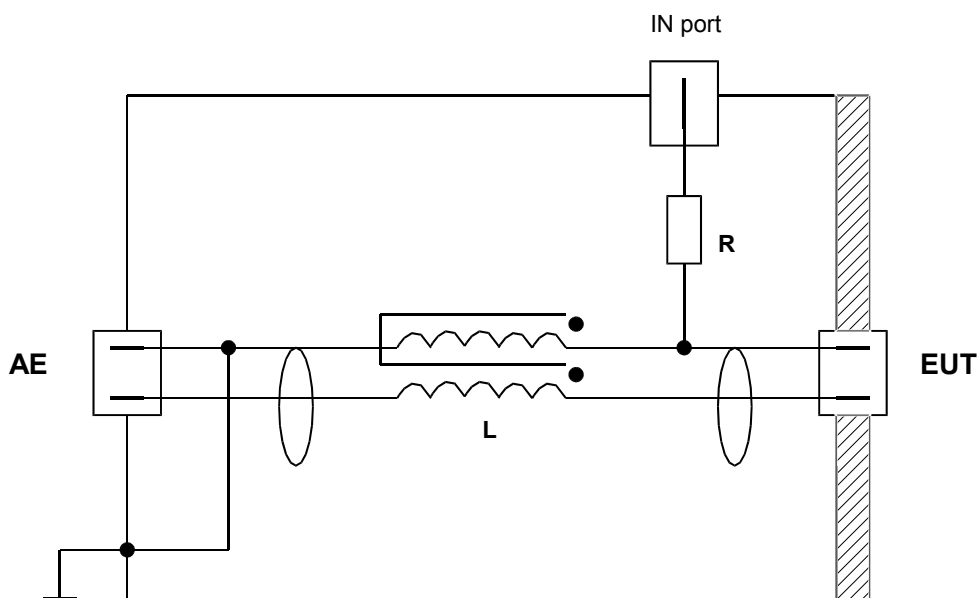
CDN-S1 / -S2 / -S4 / -S8 / -S9 / -S15 / -S25 / -S36 / -S37 / -S1/75
CDN-1394 / -HDMI
CDN- RJ45-S / -USB-C / -USB-P



Description

For coupling and decoupling of interference signals on screened lines CDN S-Types are used. Despite the variety of connectors the interference signal is in all cases coupled to the cable shield via a 100 Ω resistor.

A device for direct coupling is also available (without decoupling network).



Simplified circuit diagram CDN-S1

Specifications

Type	CDN-S1	CDN-S2	CDN-S4	CDN-S8	CDN-S9	CDN-S15	CDN-S25
RF In							
Frequency range (RF In)	150 kHz – 230 MHz						
Rated power (RF In)	6 W (continuous)						
Decoupling attenuation (RF In – AE)	> 35 dB (150 kHz – 80 MHz) > 30 dB (80 MHz – 230 MHz)						
Insertion loss (RF In – EUT)	10 dB ± 1 dB (150 kHz – 80 MHz); 10 dB + 2 dB (80 MHz - 230 MHz)						
Connector	BNC						
EUT / AE							
Operating voltage AC	150 V						
Operating voltage DC	200 V						
Rated current (AE – EUT)	0.5 A						
Insertion loss (AE – EUT)	< 1dB (0 – 10 MHz) < 10 dB (10 MHz – 500 MHz)						
Connectors	BNC	XLR	5-pin XLR	8-pin Mini-DIN	9-pin Sub-D	15-pin Sub-D	25-pin Sub-D
Mechanical specifications							
Dimensions (W x H x L)	160mm x 84.5mm x 190 mm						

Specifications

Type	CDN-S36	CDN-S37	CDN-S1/75	CDN-1394	CDN-HDMI
RF In					
Frequency range (RF In)	150 kHz – 230 MHz				
Rated power (RF In)	6 W (continuous)				
Decoupling attenuation (RF In – AE)	> 35 dB (150 kHz – 80 MHz) > 30 dB (80 MHz – 230 MHz)				
Insertion loss (RF In – EUT)	10 dB ± 1 dB (150 kHz – 80 MHz); 10 dB + 2 dB (80 MHz - 230 MHz)				
Connector	BNC				
EUT / AE					
Operating voltage AC	150 V				
Operating voltage DC	200 V				
Rated current (AE – EUT)	0.5 A				
Insertion loss (AE – EUT)	< 1dB (0 – 10 MHz) < 10 dB (10 MHz – 500 MHz)				
Connectors	Centronics	37-pin Sub-D	BNC (75 Ω)	Firewire	HDMI
Mechanical specifications					
Dimensions (W x H x L)	160mm x 84.5mm x 190 mm				

Specifications

Type	USB-C	USB-P	RJ11-S	RJ45-S
RF In				
Frequency range (RF In)	(10kHz) 150 kHz – 230 MHz			
Rated power (RF In)	6 W (continuous)			
Insertion loss (RF In – AE)	> 50 dB (150 kHz – 80 MHz) > 25 dB (80 MHz – 230 MHz)		> 30 dB (150 kHz – 230 MHz)	
Insertion loss (RF In – EUT)	10 dB ± 1 dB (150 kHz – 80 MHz) 10 dB + 2 dB (80 MHz – 230 MHz)		10 dB ± 1 dB (150 kHz – 80 MHz) 10 dB + 2 dB (80 MHz – 230 MHz)	
Connector	BNC			
EUT / AE				
Operating voltage AC	100 V			
Operating voltage DC	150 V			
Rated current (AE – EUT)	0.25 A			
Insertion loss (AE – EUT)	< 1dB (DC – 10 MHz) < 10 dB (10 MHz – 500 MHz)		< 0.3 dB (DC – 10 MHz) < 1 dB (10 MHz – 100 MHz) < 3 dB (100 MHz – 500 MHz)	
Connectors	EUT: USB-B, AE: USB-A	EUT: USB-A, AE: USB-B	Shielded RJ11 jack	Shielded RJ45 jack
Mechanical specifications				
Dimensions (W x H x L)	160mm x 84.5mm x 190 mm			

Device for direct injection

100 Ω connection for RF disturbances 150 kHz – 230 MHz



The disturbing signal coming from the test generator is injected on to screened and coaxial cables via a 100 Ω resistor (even if the shield is ungrounded or grounded at one end only). In between the auxiliary equipment (AE) and the injection point, a decoupling circuit shall be inserted as close as possible to the injection point. To increase decoupling and to stabilize the circuit, a ground connection shall be made from the screen of the direct injection device's input port to the ground reference plane.

Specifications

Frequency range (RF In)	150 kHz – 230 MHz
Common mode impedance (IN/OUT)	100 Ω
Rated power (RF In)	6 W (continuous)
Connector Out	Alligator clip; max. cable diameter 20 mm (30 mm on request)

Order number	Description
S1	CDN-S1, EUT/AE: BNC
S1-N	CDN-S1, Namur, EUT/AE: BNC
S1/75	CDN-S1, EUT/AE: BNC, 75 Ω
S1/75-N	CDN-S1, Namur, EUT/AE: BNC, 75 Ω
S2	CDN-S2, EUT/AE: XLR
S2-N	CDN-S2, Namur, EUT/AE: XLR
S4	CDN-S4, EUT/AE: 5-pin XLR
S4-N	CDN-S4, Namur, EUT/AE: 5-pin XLR
S8	CDN-S8, EUT/AE: 8-pin Mini-DIN
S8-N	CDN-S8, Namur, EUT/AE: 8-pin Mini-DIN
S9	CDN-S9, EUT/AE: 9-pin Sub-D
S9-N	CDN-S9, Namur, EUT/AE: 9-pin Sub-D
S15	CDN-S15, EUT/AE: 15-pin Sub-D
S15-N	CDN-S15, Namur, EUT/AE: 15-pin Sub-D

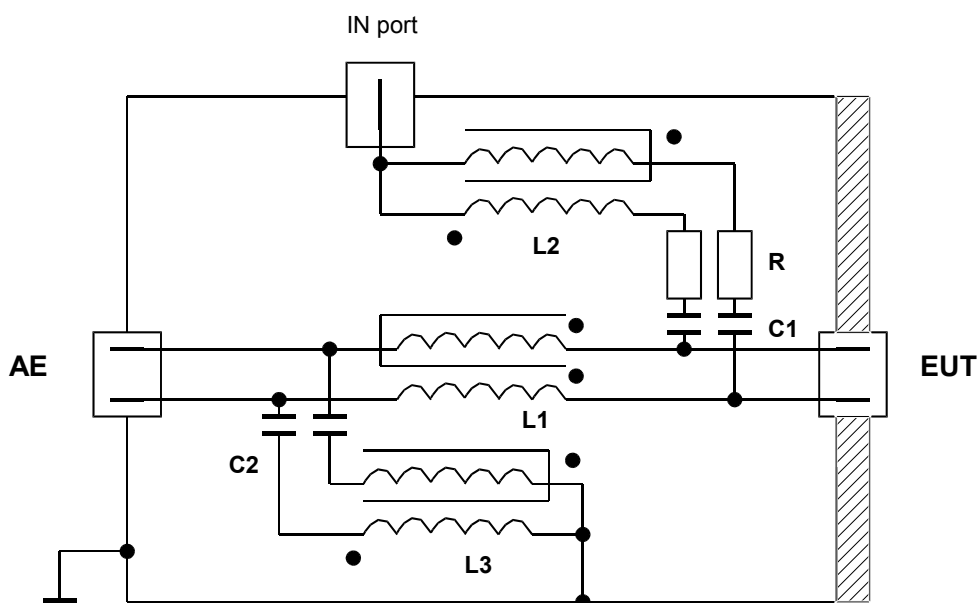
Order number	Description
S25	CDN-S25, EUT/AE: 25-pin Sub-D
S25-N	CDN-S25, Namur, EUT/AE: 25-pin Sub-D
S36	CDN-S36, EUT/AE: Centronics
S36-N	CDN-S36, Namur, EUT/AE: Centronics
S37	CDN-S37, EUT/AE: 37-pin SUB-D
S37-N	CDN-S37, Namur, EUT/AE: 37-pin SUB-D
USB-C	CDN-USB-C, EUT: USB-B, AE: USB-A
USB-C-N	CDN-USB-C, Namur, EUT: USB-B, AE: USB-A
USB-P	CDN-USB-P, EUT: USB-A, AE: USB-B
USB-P-N	CDN-USB-P, Namur, EUT: USB-A, AE: USB-B
RJ11-S	CDN-RJ11/S, EUT/AE: shielded RJ11
RJ11-S-N	CDN-RJ11/S, Namur, EUT/AE: shielded RJ11
RJ45-S	CDN-RJ45/S, EUT/AE: shielded RJ45
RJ45-S-N	CDN-RJ45/S, Namur, EUT/AE: shielded RJ45
1394	CDN-1394 (Firewire), EUT/AE: 6 pole IEEE 1394 receptacle
HDMI	CDN-HDMI, EUT/AE: 19-pole HDMI 1.3 receptacle
KAL	Mounting bracket for calibration adapter incl. 50/150 Ohm adapter and 1 pc. calibration adapter KAL-AD
S-DIR	Device for direct injection; 100 Ohm; alligator clip
KAL-AD	CDN-S1 calibration adapter optionally for CDN-S2/S4/S8/S9/S15/S25/S36/USB-C/USB-P/RJ11-S/RJ45-S/1394(Firewire)/HDMI
	Custom design solutions are always available on request!

CDN-T2 / -T4 / -T8 / -RJ11 / -RJ45



Description

For coupling and decoupling of disturbing signals to unscreened cables with balanced lines, CDN T-types are applied.



Simplified circuit diagram CDN-T2

Specifications

Type	CDN-T2/4/8	CDN-RJ11/RJ45
RF In		
Frequency range (RF In)	(10 kHz) 150 kHz – 230 MHz	
Rated power (RF In)	6 W (continuous)	
Decoupling attenuation (RF In – AE)	> 20 dB (150 kHz – 230 MHz)	
Insertion loss (RF In – EUT)	10 dB $\pm$ 1 dB (150 kHz – 230 MHz)	10 dB $\pm$ 1 dB (150 kHz – 80 MHz) 10 dB + 2 dB (80 MHz – 230 MHz)
Connector	BNC	
EUT / AE		
Operating voltage AC	100 V	
Operating voltage DC	150 V	
Rated current (AE – EUT)	0.5 A	0.25 A
Insertion loss (AE – EUT)	< 1 dB (DC – 1 MHz) < 10 dB (1 MHz – 100 MHz)	< 1 dB (DC – 10 MHz) < 3 dB (10 MHz – 100 MHz) < 10 dB (100 MHz – 500 MHz)
Connectors	Terminal block	RJ11 / RJ45 jack
Mechanical specifications		
Dimensions (W x H x L)	160mm x 84.5mm x 190 mm	

Order number	Description
T2	CDN-T2, EUT/AE: terminal block 2 pole
T2-N	CDN-T2, Namur, EUT/AE: terminal block 2 pole
T4	CDN-T4, EUT/AE: terminal block 4 pole
T4-N	CDN-T4, Namur, EUT/AE: terminal block 4 pole
T8	CDN-T8, EUT/AE: terminal block 8 pole
RJ11	CDN-RJ11, EUT/AE: RJ11 jack
RJ45	CDN-RJ45, EUT/AE: RJ45 jack
KAL	Mounting bracket for calibration adapter incl. 50/150 Ohm adapter and 1 pc. calibration adapter KAL-AD
KAL-AD	CDN-AF2/T2 calibration adapter optionally for T4/T8/RJ11/RJ45
	Custom design solutions are always available on request!