



## Coupling Networks ENY

for EMI emission and immunity tests on unshielded symmetrical telecommunication ports

- ◆ Four-wire and double two-wire networks (ISNs)
- ◆ Conducted emission measurements to CISPR22 and EN55022 (150 kHz to 30 MHz)
- ◆ Conducted immunity measurements to CISPR24 and EN55024 (150 kHz to 80 MHz)
- ◆ CISPR/A/307/CD complied with
- ◆ Adapter sets to meet LCL requirements (50 dB, 60 dB and 80 dB) and various telecommunication standards
- ◆ High transfer bandwidth for useful signal (100 MHz)



**ROHDE & SCHWARZ**



Coupling Networks ENY22 and ENY41 have been designed to measure the asymmetrical (common-mode) RFI voltage of unshielded symmetrical telecommunication ports of EUTs in the frequency range 150 kHz to 30 MHz according to CISPR22 (1997) and EN55022 (1998). In these product standards, this type of coupling networks is referred to as ISN (impedance stabilization network), whereas in basic standards they are called AAN (asymmetrical artificial network), Y-network (CISPR 16) or CDN (coupling/decoupling network, IEC61000-4-6). In addition to emission measurements, ENY22 and ENY41 also enable immunity testing of the above-mentioned EUTs in the frequency range 150 kHz to 80 MHz according to CISPR24 (1997), EN55024 (1998) and IEC61000-4-6. They are tested and calibrated to CISPR/A/307/CD. ENY22 comprises two separate two-wire networks with two receiver ports in one box, whereas ENY41 includes one four-wire network.

ENY22 and ENY41 terminate the interface of the EUT with 150 Ω (asymmetrical or common-mode impedance) and couple the asymmetrical impedance to the test receiver with a voltage-division factor of typ. 10 dB. The useful symmetrical (differential-mode) signal passes through the network almost unattenuated with a bandwidth of up to 100 MHz (measured for a symmetrical impedance of 100 Ω).

At the same time the coupling network decouples the test circuit from interference effects (RFI voltage, impedance) at the AE (auxiliary equipment) port.

CISPR22 (1997) specifies two alternative methods of conformance testing to assess electromagnetic interference at telecommunication ports:

- ◆ Measurement of the EUT with a very high suppression of the symmetrical (differential-mode) signal or
- ◆ Measurement of the EUT with a suppression of the symmetrical signal corresponding to the category of the connected cable (requirements for cable categories 3 and 5 are defined in the standard)

In order to implement these test procedures, ENY22 and ENY41 consist each of a high-symmetry basic network and a number of adapter sets for implementing the required longitudinal conversion losses (LCL) to CISPR22. Each adapter set contains adapters for LCL values of 50 dB, 60 dB and 80 dB.

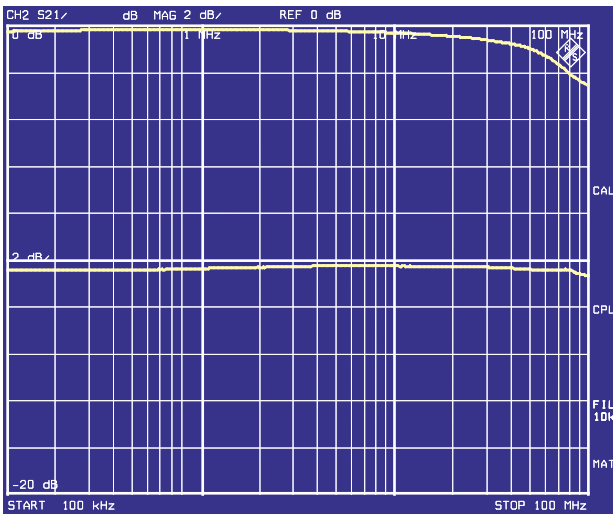
The calibration data supplied with the coupling networks refer to a symmetrical impedance of 100 Ω.

The double two-wire ISN ENY22 comes with two adapter sets (see table on page 4), one of which has RJ45 connectors (type V) and the other screw-on connections for user-selectable wiring (type VI). The four-wire ISN ENY41 comes with two basic adapter sets: type I (RJ45 connectors) and type VI (screw-on connections). ENY41 can therefore be used for ISDN basic rate access as well as for other common pin configurations of the RJ45 connector (type I) and for special cases (type VI). With regard to other telecommunications standards (10BaseT, 100BaseT, ATM (asynchronous transfer mode), FDDI (fiber distributed data interface) with its configurations in copper wiring)) and ISDN primary rate access, three other adapter sets (types II, III and IV) are available as option ENY4-B1.

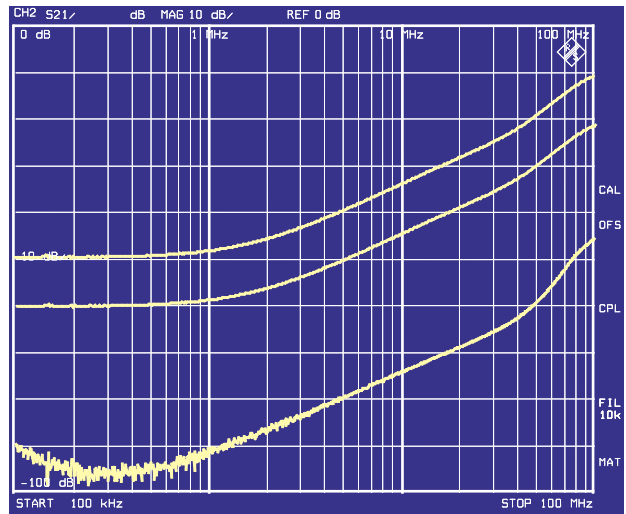
All RJ45 connectors are arranged two-fold – one with the non-symmetry components on a wire of each wire pair and one with these components on the other wire of each wire pair. This feature is necessary (although not yet described in the standard) to avoid compensation effects. Otherwise an EUT could be tuned to pass the test by compensating the non-symmetry of the ISN.



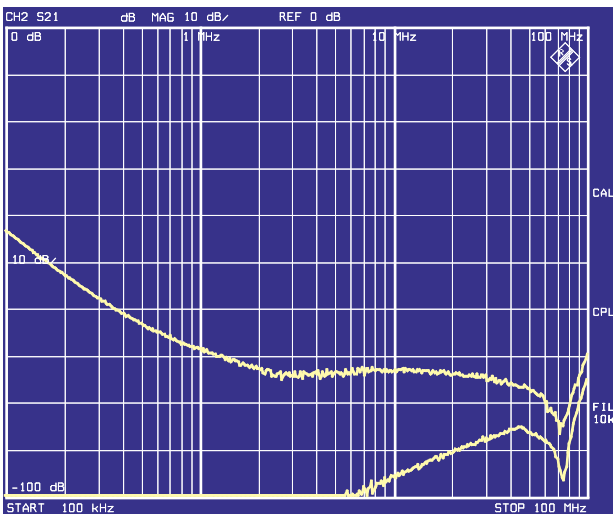
*ENY41 including ENY4-B1*



**Fig. 1:** The insertion loss of the symmetrical circuit, measured with a line impedance of 100  $\Omega$  (upper curve), determines the transmission bandwidth of the network for the useful signal. The voltage-division factor (lower curve) is to be added to the measured voltage for the frequency range 150 kHz to 30 MHz for comparison with the emission limit



**Fig. 2:** The three curves of the longitudinal conversion loss as required by CISPR22/EN55022. All curves are valid for the frequency range 150 kHz to 30 MHz. They also have significance for immunity tests up to 80 MHz



**Fig. 3:** Decoupling attenuation between AE port and EUT port, measured between AE port and receiver port with EUT port short (upper curve) and open (lower curve). This curve is valid for the frequency range 150 kHz to 30 MHz, but has also significance for immunity tests up to 80 MHz

Certified Quality System  
**ISO 9001**  
 DQS REG. NO 1954-04

Certified Environmental System  
**ISO 14001**  
 REG. NO 1954

For immunity tests a 150-to-50  $\Omega$  adapter (100  $\Omega$  resistor in series according to IEC61000-4-6) is supplied with the basic configuration of ENY22 and ENY41. This is helpful for the calibration of the test system.

The mechanical design of ENY22 and ENY41 features bare screw threads for the connection of a reference ground plane in either horizontal or vertical arrangement.

Interface standard	Usual connector		Pin configuration of RJ45 connector								Adapter set, type
	RJ45		8	7	6	5	4	3	2	1	
		RJ11		6	5	4	3	2	1		
Deutsche Telekom	X				a	W	E	b		I	
Deutsche Telekom $V_{PN}$ , $V_{PO/E}$	X				a			b		V	
Siemens	X				E	b	a	W		I	
Siemens $V_{PN}$ , $V_{PO/E}$	X					b	a			V	
US standard	X				W	b	a	E		I	
Token Ring	X				RX	TX	TX	RX		I	
10BaseT	X				RX			RX	TX	TX	
100BaseT	X				RX			RX	TX	TX	
ATM	X		X	X					X	X	
FDDI	X		X	X					X	X	
ISDN basic rate access	X				X	X	X	X			
ISDN primary rate access 2048 kbit/s	X					X	X		X	X	
ISDN primary rate access 1544 kbit/s	X					X	X		X	X	

**Overview of RJ45 adapter sets: Types I through IV are available for four-wire ISN ENY41. For double two-wire ISN ENY22, type V is available. For the latter, pins 3, 4 and 5, 6 are connected in parallel. In addition, there is an adapter set for user-selectable wiring (type VI)**

## Specifications

### Frequency range

Emission measurements	150 kHz to 30 MHz
Immunity measurements	150 kHz to 80 MHz

### Asymmetrical impedance

Impedance (0.15 MHz to 30 MHz)	150 $\Omega$ $\pm$ 20 $\Omega$
Phase angle (0.15 MHz to 30 MHz)	0 $\pm$ 20°
Impedance (150 kHz to 80 MHz)	150 $\Omega$ $\pm$ 40 $\Omega$

### Voltage-division factor in asymm. circuit

150 kHz to 30 MHz	10 dB $\pm$ 1 dB (typ.) (calibration data supplied <sup>1)</sup> )
30 MHz to 80 MHz	10 dB $\pm$ 3 dB (typ.)

### Transfer bandwidth (3 dB)

In symm. circuit	>100 MHz (for 100 $\Omega$ source and load impedances)
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### Longitudinal conversion loss (LCL)

	Adapter		
	80 dB	60 dB	50 dB
150 kHz to 1.5 MHz in dB	80 - 3	60 $\pm$ 3	50 $\pm$ 3
1.5 MHz to 30 MHz in dB	>(80 to 55) - 3	(60 to 35) $\pm$ 3	(50 to 25) $\pm$ 3

### Decoupling attenuation

150 kHz to 1.5 MHz	>35 dB to 55 dB (linear increase with logarithmic frequency)
1.5 MHz to 80 MHz	>55 dB

<sup>1)</sup> The calibration data contain asymmetrical impedance and phase, voltage-division factor and longitudinal conversion loss.

### Maximum values

Max. permitted RF input voltage	17 V
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Max. permitted DC and low-frequency AC voltage between symm. line and ground	160 V
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Max. DC current (phantom current)	150 mA (current on each individual wire of one pair or on different pairs)
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### Connectors

Output to receiver/ input from signal generator EUT and auxiliary equipment (AE)	BNC connectors adapters with screw terminals and RJ45 connectors
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### General data

Nominal temperature range	+5°C to +40°C
Storage temperature range	-40°C to +70°C
Dimensions	
Basic unit	144 mm x 95 mm x 52 mm
Unit with adapters	168 mm x 96 mm x 52 mm
Weight	
Unit with adapters	535 g
Carrying case with basic adapter set	2170 g
Option ENY4-B1	330 g

### Order designations

Double Two-Wire ISN to CISPR22	ENY22	1109.9508.02
Four-Wire ISN to CISPR22	ENY41	1110.0175.02
Option for ENY41: 3 additional RJ45 adapter sets	ENY4-B1	1109.9950.02

### Accessories supplied

plastic carrying case with foam material, calibration data
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