

ENY21/-ENY41/-ENY81 Coupling Networks For measurement of asymmetrical (common-mode) disturbance voltage



ENY21/ -ENY41/-ENY81 Coupling Networks At a glance

The R&S®ENY21, R&S®ENY41 and R&S®ENY81 coupling networks have been designed to measure the asymmetrical (common-mode) disturbance voltage of unshielded, symmetrical telecommunications ports of EUTs.

The radio disturbance measurements can be performed in the frequency range from 150 kHz to 30 MHz. The coupling networks comply with the following product standards:

- CISPR 22:2008 and EN 55022:2010 (figure D.1 for ENY21, figure D.2 for ENY41, figure D.3 for ENY81)
- CISPR 32 and EN 55032 (figure G.1 for ENY21, figure G.2 for ENY41, figure G.3 for ENY81)

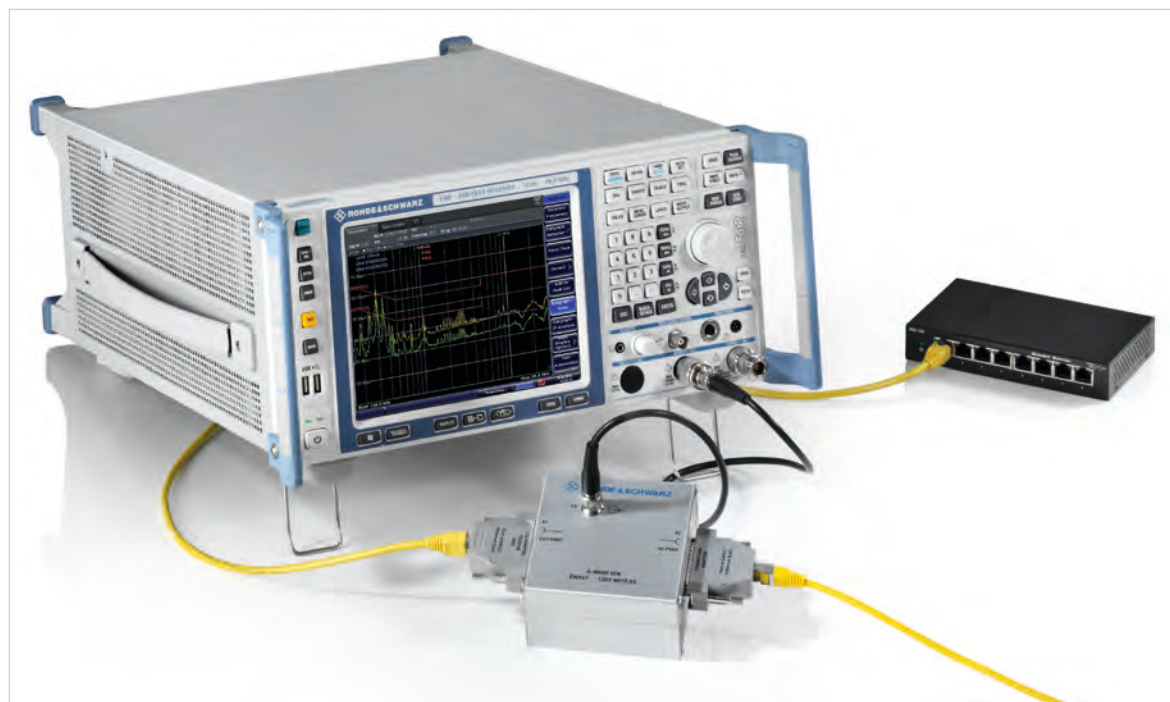
The R&S®ENY21 and R&S®ENY41 can also be used for immunity measurements of the EUTs. These measurements can be performed in the frequency range from 150 kHz to 80 MHz and are in line with the CISPR 24, EN 55024 and IEC 61000-4-6 product standards.

The ENY21, ENY41 and ENY81 are tested and calibrated in line with CISPR 16-1-2. The calibration data supplied refers to a symmetrical impedance of 100 Ω.

Key facts

- Two-wire, four-wire and eight-wire networks
- Radio disturbance measurements in line with CISPR 22:2008 and EN 55022:2010 or CISPR 32 and EN 55032 (150 kHz to 30 MHz)
- ENY21 and ENY41 also for immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- Compliance with CISPR 16-1-2
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Compact test set consisting of the R&S®ESR EMI test receiver and the R&S®ENY41 coupling network for semiautomatic measurement of the asymmetrical disturbance voltage.



Test method

The ENY21, ENY41 and ENY81 terminate the EUT's interface with $150\ \Omega$ (asymmetrical or common-mode impedance) and couple the EUT's asymmetrical disturbance signal to the test receiver with a voltage division factor of typ. 10 dB. The wanted symmetrical (differential-mode) signal passes through the network almost without attenuation up to a bandwidth of 100 MHz (valid for a symmetrical impedance of $100\ \Omega$). At the same time, the coupling networks decouple the test circuit from disturbance effects (disturbance voltage, impedance) at the associated equipment (AE) port.

In line with CISPR22 and EN 55022 or CISPR32 and EN 55032, disturbance voltage measurements on one unshielded symmetrical wire pair require the use of a two-wire ISN (ENY21). In the case of two unshielded symmetrical wire pairs, it is necessary to use a four-wire ISN (ENY41); with four unshielded symmetrical wire pairs, an eight-wire ISN (ENY81 or ENY81-CA6) is needed. Thanks to their design, the ENY41 can also be used for measurements on one wire pair, and the ENY81 or ENY81-CA6 for measurements on one, two or four wire pairs.

CISPR22 and EN 55022 as well as CISPR32 and EN 55032 specify the following conformance test method: The measurement of the EUT should be performed with a suppression of the wanted symmetrical signal corresponding

to the category of the connected cable (requirements for CAT3, CAT5 and CAT6 cable categories are defined in the standard).

In order to implement these test methods, the ENY21, ENY41 and ENY81 consist of one high-symmetry basic network each and a number of adapter sets for implementing the required longitudinal conversion losses (LCL). Each adapter set contains adapters for LCL values of 55 dB (for CAT3 cable category) and 65 dB (for CAT5 cable category). Due to the high longitudinal conversion loss, the CAT6 cable category requires the use of a separate coupling network (ENY81-CA6).

Nomenclature

In the CISPR22:2008 and EN 55022:2010 product standards, this type of coupling network is referred to as an impedance stabilization network (ISN).

In the CISPR32 and EN 55032 product standards and the CISPR16 basic standard, these networks are called asymmetrical artificial networks (AAN) and Y-networks. In the IEC 61000-4-6 basic standard, they are referred to as coupling/decoupling networks (CDN).

ENY41 model .13 with basic and additional adapter sets.



Adapters

The ENY21 two-wire ISN comes with a basic adapter set with connectors for user-selectable wiring (1 mm banana jack). Modell .13 of the ENY21 furthermore includes two additional adapter sets with RJ-11 and RJ-45 connectors for a number of telephone standards (Deutsche Telekom, Siemens).

The ENY41 four-wire ISN comes with two basic adapter sets with RJ-45 connector and with connectors for user-selectable wiring (1 mm banana jack). As a result, the ENY41 can be used both for Ethernet (10BASE-T, 100BASE-T) and for other conventional assignments of the RJ-45 and RJ-11 connectors. Modell .13 of the ENY41 furthermore includes two additional adapter sets with RJ-11 connector for connection to ISDN equipment (ISDN basic rate access and ISDN primary rate access).

The R&S®ENY81 eight-wire ISN comes with two adapter sets with RJ-45 connector and with connectors for user-selectable wiring (1 mm banana jack).

Immunity testing

For immunity tests, a 150 Ω to 50 Ω adapter (100 Ω series resistor in line with IEC 61000-4-6) is required for the calibration of the test system. This series resistor or terminating impedance as well as various adapters for connecting to the ISN are available as the ENY-ITS option.

Functional testing

The ENY-FTS option in connection with a network analyzer allows the functional testing of the ISNs. This functional testing includes the verification of the asymmetrical impedance and phase, voltage division factor, longitudinal conversion loss and decoupling attenuation.

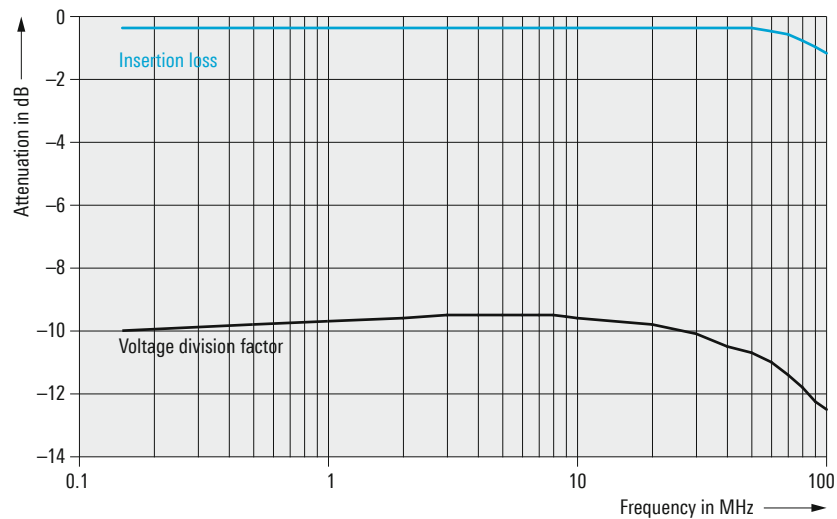
Mechanical design

The ENY21, ENY41 and ENY81 coupling networks feature bare threaded sockets for connecting them to a reference ground plane that is arranged either horizontally or vertically.

Overview of the adapter sets						
Type	Application	Pin assignment				
ENY21 two-wire ISN						
		Connector	a1	b1	a2	b2
ENY21 basic adapter (models .03 and .13)	user-selectable pin assignment	RJ-11, RJ-45 and 1 mm				
ENY21 additional adapter (model .13 only)	U _{po} with RJ-45 (Siemens)	RJ-45	3, 4	5, 6	–	–
	U _{po} with RJ-11 (Deutsche Telekom)	RJ-11	2, 3	4, 5	–	–
ENY41 four-wire ISN						
		Connector	a1	b1	a2	b2
ENY41 basic adapter (models .03 and .13)	Ethernet (10BASE-T, 100BASE-T)	RJ-45	1	2	3	6
	user-selectable pin assignment	RJ-11, RJ-45 and 1 mm				
ENY41 additional adapter (model .13 only)	ISDN basic rate access (S ₀)	RJ-45	4	5	3	6
	ISDN primary rate access (2 Mbps)	RJ-45	4	5	1	2
ENY81 eight-wire ISN ¹⁾						
		Connector	pair 1/pins 4, 5	pair 2/pins 1, 2	pair 3/pins 3, 6	pair 4/pins 7, 8
ENY81 basic adapter	Ethernet (100BASE-T4, 1000BASE-T)	RJ-45	x	x	x	x
	user-selectable pin assignment	RJ-11, RJ-45 and 1 mm				

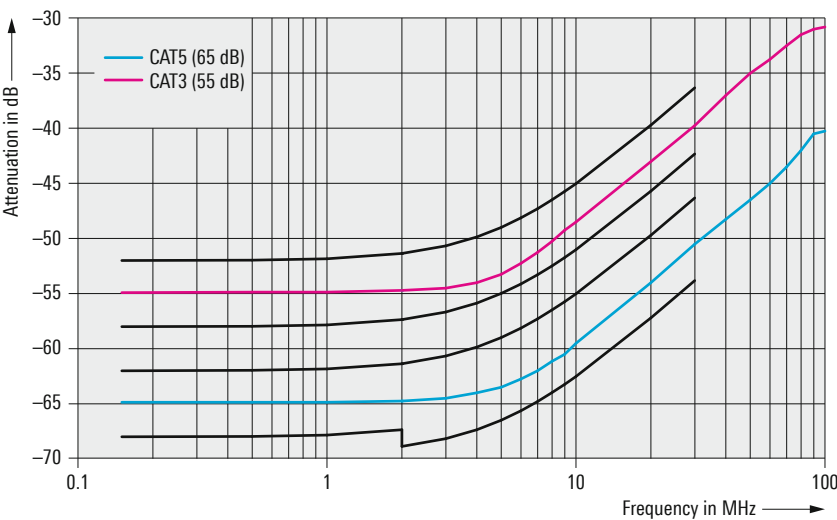
¹⁾ Pin assignment in line with EIA/TIA T568B.

Insertion loss/voltage division factor



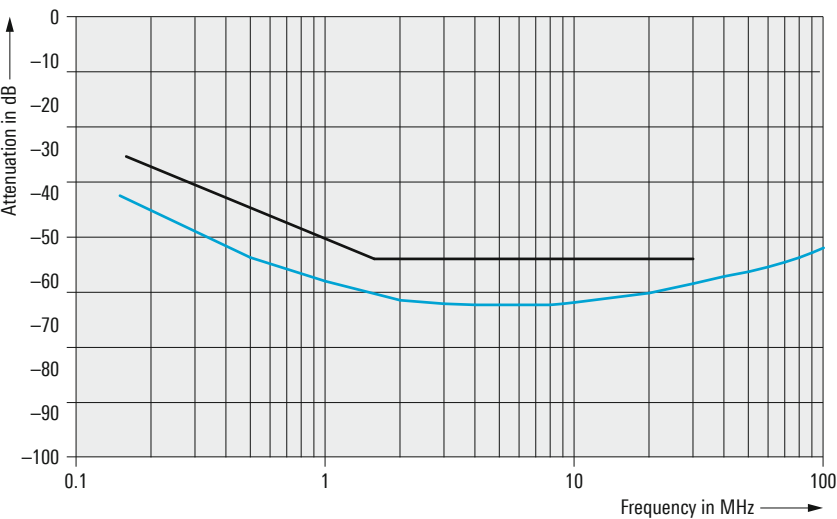
The typical insertion loss of the symmetrical circuit – measured with a line impedance of 100 Ω – determines the transmission bandwidth of the coupling network for the wanted signal; the typical voltage division factor (lower curve) is to be added to the measured voltage for the frequency range from 150 kHz to 30 MHz for comparison with the disturbance limit.

Longitudinal conversion loss (LCL)



Typical longitudinal conversion losses (LCL) as required by CISPR22: 2008 and EN 55022: 2010 or CISPR32 and EN 55032 for the CAT3 and CAT5 cable categories; all curves are valid for the frequency range from 150 kHz to 30 MHz but also have significance for immunity tests up to 80 MHz.

Decoupling attenuation



Typical decoupling attenuation between AE port and receiver port with EUT port short; the curves are valid for the frequency range from 150 kHz to 30 MHz but also have significance for immunity tests up to 80 MHz.

Specifications in brief

Specifications in brief		
Frequency range		
Radio disturbance measurements	ENY21, ENY41, ENY81	150 kHz to 30 MHz
Immunity measurements	ENY21, ENY41	150 kHz to 80 MHz
Asymmetrical impedance		
Impedance	ENY21, ENY41, ENY81: 0.15 MHz to 30 MHz	150 Ω \pm 20 Ω
	ENY21, ENY41: > 30 MHz to 80 MHz	150 Ω \pm 40 Ω
Phase angle	0.15 MHz to 30 MHz	0° \pm 20°
Voltage division factor in asymmetrical circuit	150 kHz to 30 MHz	typ. 10 dB \pm 1 dB (calibration data supplied ¹⁾)
	> 30 MHz to 80 MHz	typ. 10 dB \pm 2 dB
Transmission bandwidth	3 dB	>100 MHz (for 100 Ω source and load impedances)
Longitudinal conversion loss (LCL)		
55 dB adapter	LCL (dB)	55 – 10 log(1 + (f/5) ²) dB
	tolerance	\pm 3 dB, for 0.15 MHz \leq f \leq 30 MHz
65 dB adapter	LCL (dB)	65 – 10 log(1 + (f/5) ²) dB
	tolerance	\pm 3 dB, for f < 2 MHz, –3/+4.5 dB, for 2 MHz \leq f \leq 30 MHz
Decoupling attenuation	150 kHz to 1.5 MHz	> 35 dB to 55 dB (increases linearly with logarithm of frequency)
	1.5 MHz to 30 MHz	> 55 dB
Crosstalk (PSELFEXT, EUT/AE)	1 MHz to 100 MHz	\geq 61 dB to \geq 21 dB (increases linearly with logarithm of frequency)
Maximum values		
Max. permissible RF input voltage		< 15 V
Max. permissible DC voltage between line and ground		100 V
Max. permissible AC voltage between line and ground		63 V
Max. permissible DC current		600 mA (current on each individual wire of one pair or on different pairs)
Connectors		
Output to test receiver/input from signal generator		BNC female
Connectors for EUT and AE		adapter with 1 mm connectors and RJ-11 or RJ-45 connectors
General data		
Temperature range	operating temperature	+5°C to +40°C
	storage temperature	–20°C to +70°C
Overall dimensions (B \times H \times T)	base unit	105 mm \times 65 mm \times 110 mm (4.13 in \times 2.56 in \times 4.33 in)
	base unit with adapters	105 mm \times 65 mm \times 190 mm (4.13 in \times 2.56 in \times 7.48 in)
Weight	base unit with adapters	520 g (1.15 lb)
	ENY21 case with basic adapter set	1540 g (3.40 lb)
	ENY41 case with basic adapter set	1640 g (3.62 lb)
	ENY81 case with basic adapter set	1640 g (3.62 lb)

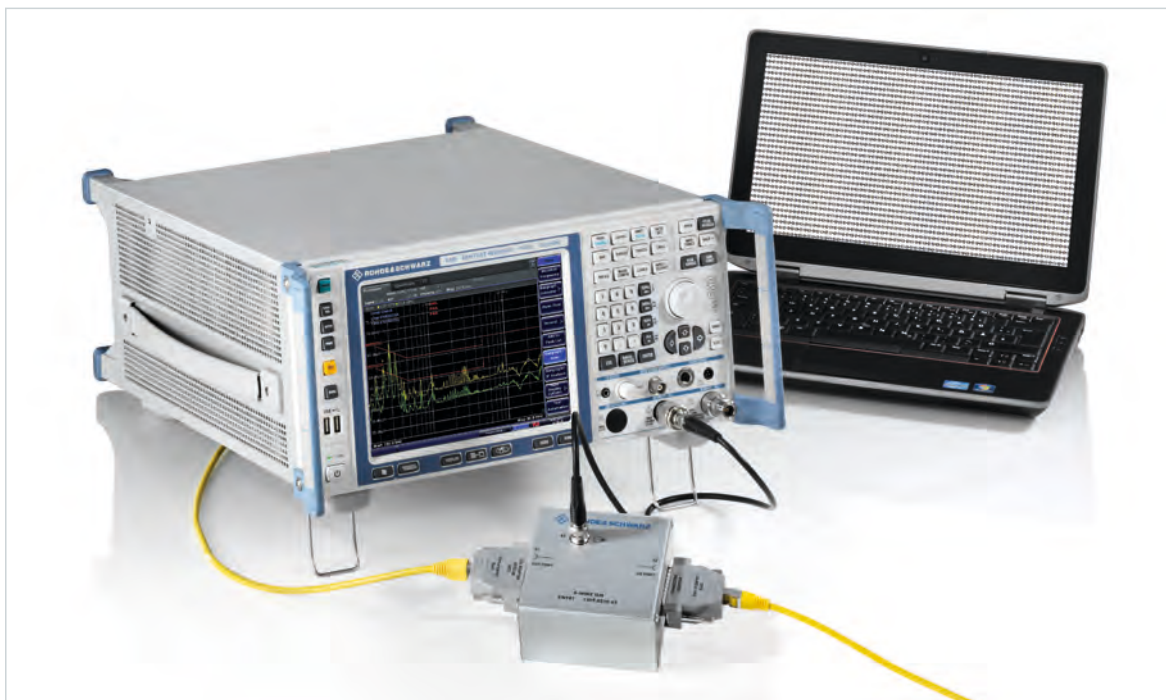
¹⁾ The calibration data includes asymmetrical impedance and phase, voltage division factor, decoupling attenuation, longitudinal conversion loss (LCL), transmission bandwidth and crosstalk.

Ordering information

Designation	Type	Order No.
Base units		
Two-Wire ISN in line with CISPR 22:2008 and CISPR32	ENY21	1309.7507.03
Two-Wire ISN in line with CISPR 22:2008 and CISPR32, with analog telephone adapter set	ENY21	1309.7507.13
Four-Wire ISN in line with CISPR 22:2008 and CISPR32	ENY41	1309.8003.03
Four-Wire ISN in line with CISPR 22:2008 and CISPR32, with ISDN telephone adapter set	ENY41	1309.8003.13
Eight-Wire ISN in line with CISPR 22:2008 and CISPR 32	ENY81	1309.8503.03
Options		
Functional Test Set	ENY-FTS	1309.8703.03
Immunity Test Set	ENY-ITS	1309.8955.13
Accessories supplied		
Plastic carrying case with foam material, calibration data ¹⁾		

¹⁾ The calibration data includes asymmetrical impedance and phase, voltage division factor, decoupling attenuation, longitudinal conversion loss (LCL), transmission bandwidth and crosstalk.

ESR EMI test receiver with ENY81 and PC.



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