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## R&S®ENY21 and R&S®ENY41 Coupling Networks

For radio disturbance and immunity measurements on unshielded, symmetrical telecommunications ports

- ◆ Four-wire and two-wire networks
- ◆ Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- ◆ Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- ◆ CISPR 16-1-2 complied with
- ◆ 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)



**ROHDE & SCHWARZ**

## At a glance

The R&S®ENY21 and R&S®ENY41 coupling networks have been designed to measure the asymmetrical (common-mode) RFI voltage of unshielded, symmetrical telecommunications ports of EUTs. The measurements can be performed in the frequency range from 150 kHz to 30 MHz and are in line with the CISPR 22: 2005 and EN 55022: 2006 product standards.

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 coupling networks are tested and calibrated in line with CISPR 16-1-2. The calibration data supplied refers to a symmetrical impedance of 100  $\Omega$ .

## Test methods

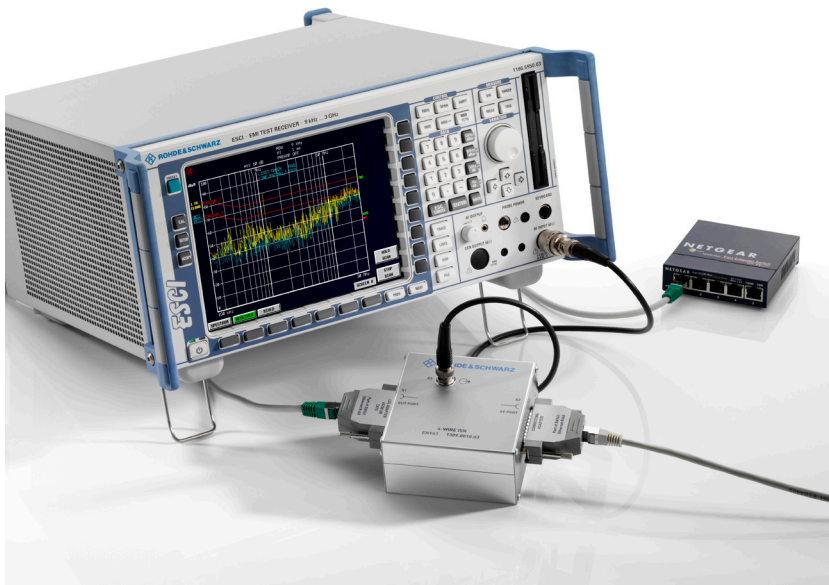
The R&S®ENY21 and R&S®ENY41 terminate the EUT's interface with 150  $\Omega$  (asymmetrical or common-mode impedance) and couple the EUT's asymmetrical impedance to the test receiver with a voltage division factor of typ. 10 dB. The wanted symmetrical (differential-mode) signal passes through the network 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 (RFI voltage, impedance) at the associated equipment (AE) port.

## Nomenclature

In the CISPR 22: 2005 and EN 55022: 2006 product standards, this type of coupling network is referred to as an impedance stabilization network (ISN). In basic standards, they are instead called asymmetrical artificial networks (AAN), Y-networks (CISPR 16), or coupling/decoupling networks (CDN), (IEC 61000-4-6).

In line with CISPR 22: 2005 and EN 55022: 2006, measurements of the RFI voltage on one unshielded symmetrical wire pair require the use of a two-wire ISN (R&S®ENY21). In the case of two unshielded symmetrical wire pairs, it is necessary to use a four-wire ISN (R&S®ENY41), and with four unshielded symmetrical wire pairs an eight-wire ISN (R&S®ENY81).

CISPR 22: 2005 and EN 55022: 2006 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 cable categories CAT 3, CAT 5, and CAT 6 are defined in the standard).



*Compact, cost-efficient test set consisting of the R&S®ESCI EMI test receiver and the R&S®ENY41 coupling network for semiautomatic measurement of the asymmetrical RFI voltage*

In order to implement these test methods, the R&S®ENY21 and R&S®ENY41 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 cable category CAT 3) and 65 dB (for cable category CAT 5).

## Adapters

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

The R&S®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). You can thus use the R&S®ENY41 both for Ethernet (10BaseT, 100BaseT) and for other conventional assignments of the RJ-45 and RJ-11 connectors. Model .13 of the R&S®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).

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 are available as the R&S®ENY-ITS option for connecting to the ISN.

## Functional testing and mechanical design

The R&S®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.

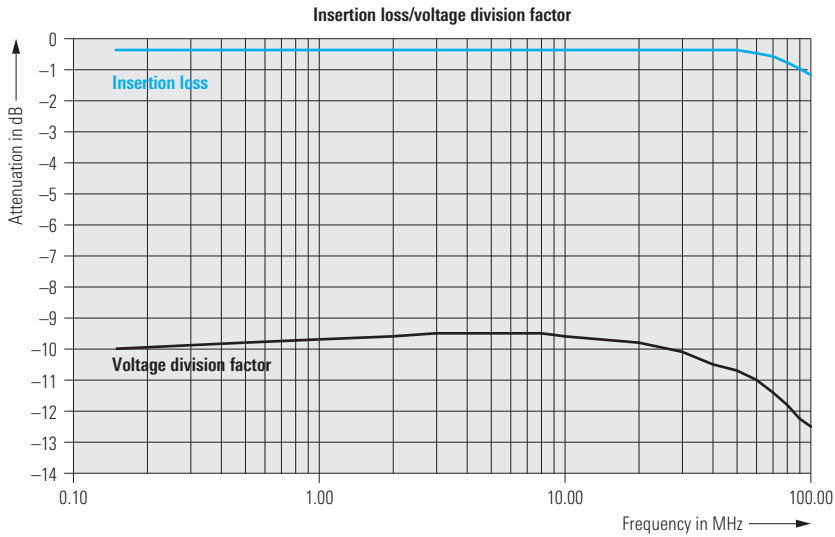
The R&S®ENY21 und R&S®ENY41 coupling networks feature bare threaded sockets for connecting them to a reference ground plane that is arranged either horizontally or vertically.

| Type  | Application                                   | Pin assignment         |      |      |    |    |
|---|---|------------------------|------|------|----|----|
|   |   | Connector              | a1   | b1   | a2 | b2 |
| R&S®ENY21 basic adapter (models .03 and .13)  | user-selectable pin assignment                | RJ-11, RJ-45, and 1 mm |      |      |    |    |
| R&S®ENY21 additional adapter (model .13 only) | U <sub>p0</sub> with RJ-45 (SIEMENS)          | RJ-45                  | 3, 4 | 5, 6 | –  | –  |
|   | U <sub>p0</sub> with RJ-11 (Deutsche Telekom) | RJ-11                  | 2, 3 | 4, 5 | –  | –  |

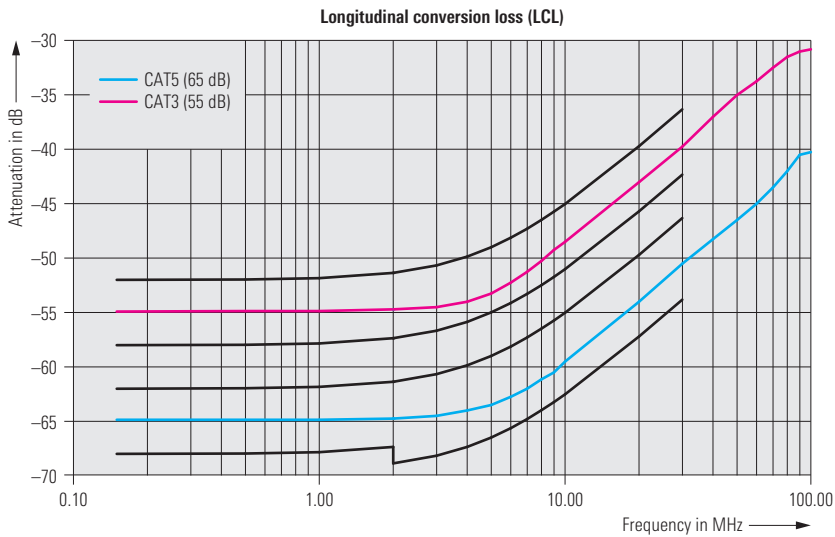
### Overview of the adapter sets for the R&S®ENY21 two-wire ISN

| Type  | Application                              | Pin assignment         |    |    |    |    |
|---|--|------------------------|----|----|----|----|
|   |  | Connector              | a1 | b1 | a2 | b2 |
| R&S®ENY41 basic adapter (models .03 and .13)  | Ethernet (10BaseT, 100BaseT)             | RJ-45                  | 1  | 2  | 3  | 6  |
|   | user-selectable pin assignment           | RJ-11, RJ-45, and 1 mm |    |    |    |    |
| R&S®ENY41 additional adapter (model .13 only) | ISDN basic rate access (S <sub>0</sub> ) | RJ-45                  | 4  | 5  | 3  | 6  |
|   | ISDN primary rate access (2 Mbps)        | RJ-45                  | 4  | 5  | 1  | 2  |

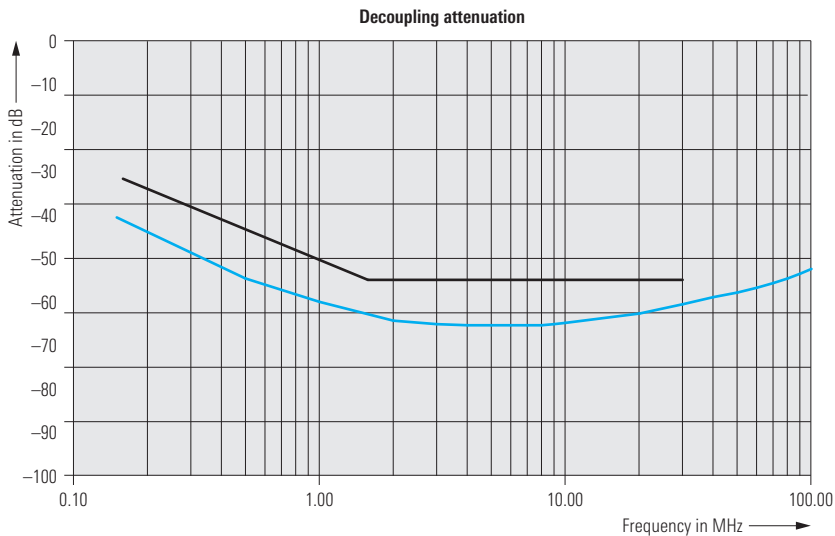
### Overview of the adapter sets for the R&S®ENY41 four-wire ISN



The typical insertion loss of the symmetrical circuit – measured with a line impedance of  $100 \Omega$  (upper curve) – 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 150 kHz to 30 MHz for comparison with the disturbance limit



Typical longitudinal conversion losses (LCL) as required by CISPR 22: 2005 and EN 55022: 2006 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



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

## Specifications

| Frequency range                                     |   |
|---|---|
| Radio disturbance 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 (>30 MHz to 80 MHz)                       | 150 $\Omega$ $\pm$ 40 $\Omega$  |
| Voltage division factor in asymmetrical circuit     |   |
| 150 kHz to 30 MHz                                   | typ. 10 dB $\pm$ 1 dB<br>(calibration data supplied <sup>1)</sup> )               |
| >30 MHz to 80 MHz                                   | typ. 10 dB $\pm$ 2 dB   |
| Transmission bandwidth (3 dB)                       |   |
|   | >100 MHz<br>(for 100 $\Omega$ source and load impedances)                         |
| Longitudinal conversion loss (LCL)                  |   |
| 55 dB adapter                                       |   |
| LCL (dB)  | 55 – 10 log(1 + (f/5) <sup>2</sup> ) 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) <sup>2</sup> ) dB   |
| Tolerance   | $\pm$ 3 dB, for f < 2 MHz,<br>–3/+4.5 dB,<br>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 80 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                         | 400 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  |   |
| Operating temperature range                         | +5°C to 40°C  |
| Storage temperature range                           | –20°C to +70°C  |
| Overall dimensions (W $\times$ H $\times$ D)        |   |
| Basic unit  | 105 mm $\times$ 65 mm $\times$ 110 mm<br>(4.1 in $\times$ 2.6 in $\times$ 4.3 in) |
| Basic unit with adapters                            | 105 mm $\times$ 65 mm $\times$ 190 mm<br>(4.1 in $\times$ 2.6 in $\times$ 7.5 in) |

| Weight   |                 |
|--|-----------------|
| Basic unit with adapters                       | 520 g (1.1 lb)  |
| R&S®ENY21 carrying case with basic adapter set | 1540 g (3.4 lb) |
| R&S®ENY41 carrying case with basic adapter set | 1640 g (3.6 lb) |

## Ordering information

| Designation   | Type        | Order No.    |
|---|-------------|--------------|
| Base units  |             |              |
| Two-Wire ISN in line with CISPR 22: 2005                                    | R&S®ENY21   | 1309.7507.03 |
| Two-Wire ISN in line with CISPR 22: 2005, with analog telephone adapter set | R&S®ENY21   | 1309.7507.13 |
| Four-Wire ISN in line with CISPR 22: 2005                                   | R&S®ENY41   | 1309.8003.03 |
| Four-Wire ISN in line with CISPR 22: 2005, with ISDN telephone adapter set  | R&S®ENY41   | 1309.8003.13 |
| Options   |             |              |
| Functional Test Set   | R&S®ENY-FTS | 1309.8703.03 |
| Immunity Test Set   | R&S®ENY-ITS | 1309.8955.03 |
| Accessories supplied  |             |              |
| Plastic carrying case with foam material, calibration data <sup>1)</sup>    |             |              |

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



R&S® ENY41 model .13 with basic and additional adapter sets



More information at  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)



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[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

Europe, Africa, Middle East +49 1805 12 42 42\* or +49 89 4129 137 74 [customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)

North America 1-888-TEST-RSA (1-888-837-8772) [customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)

Latin America +1-410-910-7988 [customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)

Asia/Pacific +65 65 13 04 88 [customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)