



# 18th International Zurich Symposium on Electromagnetic Compatibility

## IF-2 on Wednesday September 26

Title industrial forum	Network analysis in EMC
Subtitle	The use of network analyzers in EMC equipment design and calibration and in EMC laboratories
Organizer's name	Manfred Stecher
Organizer's affiliation	Rohde & Schwarz, Munich, Germany

### Short summary of the workshop:

Network analyzers are used in many areas of EMC test and design:

- calibration of test equipment, like cables and coupling networks (impedance and phase of LISNs and CDNs, voltage division factors), current and voltage probes, absorbing clamps and measuring antennas (conversion factors),
- validation of test sites (conducted emission arrangement, absorbing clamp test sites, open area test sites, semi-anechoic and fully-anechoic rooms),
- antenna check: vswr, cross-polarization performance and balun imbalance
- validation of common-mode absorption devices (CMADs like ferrite clamps),
- characterization of the influence of turntable materials on site attenuation,
- the characterization of striplines and TEM waveguides and for the measurement of filters,
- shielding effectiveness of cables and enclosures
- symmetry of networks and cables

This industrial forum will present a number of these examples by real experts in a way easy to understand for practitioners without a deep theoretical background

### Program:

1. Introduction and calibration of coupling networks and antennas (Stecher, R&S)
2. Screening efficiency of cables and connectors (Bernhard Mund, Bedea)
3. Characterization of striplines and test setups (Dr. Bernd Körber, FH Zwickau).
4. Measurement of EMI filters and components (the new CISPR 17)  
(Wolfgang Sammet, EPCOS)
5. Validation of absorber lined rooms 1 to 18 GHz (Wolfgang Müllner, ARCS).
6. Validation of OATS and SAC 30 to 1000 MHz (Dr. Markus Metzger, Conformitas)
7. Characterization of symmetrical networks (Bernd Schincke, R&S)
8. Validation of Common Mode Absorption Devices (CMADs) (Heinrich Ryser, Metas, CH)
9. Measurement of PCB's Radar Cross Section in a GTEM Cell (Dr. David Pouhe, TU Berlin)

Title contribution 1	Introduction and calibration of coupling networks and antennas
Speaker	Manfred Stecher
Affiliation speaker	Rohde & Schwarz, Munich, Germany

#### Abstract

The use of network analyzers for the verification and calibration of test equipment is explained. This includes cables and coupling networks (impedance with magnitude and phase and voltage division factors of line-impedance stabilization networks (LISNs), and coupling-decoupling networks (CDNs) as well as ISNs), current and voltage probes, absorbing clamps and measuring antennas (antenna factors).

Title contribution 2	Screening efficiency of cables and connectors
Speaker	Bernhard Mund
Affiliation speaker	Bedeia, Germany

#### Abstract

The report gives the physical basics of the screening efficiency of communication cables and connectors. With the triaxial test set-up described, one can measure both, the transfer impedance  $Z_T$  in the lower frequency range as well as the screening attenuation  $a_S$  in the higher frequency range up to and above 8 GHz in one test set-up. Furthermore one can measure the coupling attenuation  $a_C$  of screened balanced pairs. With the tube in tube procedure, one can measure the screening attenuation of connectors and connecting hardware. A further development of the triaxial method deals with the measurement of EMC of feed-throughs and EMC gaskets.

Title contribution 3	Characterization of striplines and test setups
Speaker	Dr. Bernd Körber
Affiliation speaker	FH Zwickau, (University of Applied Sciences, Zwickau), Germany

The contribution gives some examples for using vector network analyzers for characterization of RF behavior and coupling function of EMC Test methods. This includes the characterization of Stripline and  $\mu$ TEM cell test set-ups and test circuit boards for IC-EMC testing using TDR, VSWR and Insertion loss measurements. Additionally an example for verification of simulation models for the EMC test method Tubular Wave Coupler is explained.

Title contribution 4                      Measurement of EMI filters and components (the new CISPR 17)  
Speaker                                      Wolfgang Sammet  
Affiliation speaker                      EPCOS, Heidenheim, Germany

EMC filters and components are characterized by insertion loss as defined in CISPR 17. This standard is subject to a revision that shall modernize and improve the current version and adapt it to today's test equipment like network analyzers. Insertion loss measurement is intended to be a reproducible method to get RF characteristics of EMC filters but cannot replace the EMC test of the equipment where a EMC filter will be used to reduce RFI disturbances. The differences between insertion loss and attenuation measurement and the need for a special test method will be discussed.

Title contribution 5                      Validation of absorber lined rooms 1 to 18 GHz  
Speaker                                      Wolfgang Müllner  
Affiliation speaker                      Austrian Research Center, Seibersdorf, Austria

Abstract  
The validation of absorber lined rooms for radiated emission testing in the frequency range 1 - 18 GHz (Site VSWR) is described in CISPR 16-1-4. How to use a network analyser optimally for Site VSWR validation is explained. The omnidirectional validation antenna and considerations regarding power level (noise floor) are the key issues for a successful validation.

Title contribution 6                      Validation of OATS and SAC 30 to 1000 MHz  
Speaker                                      Dr. Markus Metzger  
Affiliation speaker                      Conformitas, Germany

Abstract  
The validation of test-sites for radiated emissions in the frequency range from 30 MHz – 1 GHz (NSA) is explained and the difference between the testing with test-receiver and signal generator to the use of NWA shown.

Title contribution 7                      Characterization of symmetrical networks

Speaker                                      Bernd Schincke

Affiliation speaker                      Rohde & Schwarz, Munich, Germany

Abstract

Since symmetrical network structures exhibit certain advantages over unbalanced structures; they are now also used in high-frequency applications. Using modern network analyzers it is possible to analyze phenomena occurring in practical applications. The principles to measure differential and common mode signals is explained as well as mode conversion e.g. at baluns the single-ended to common mode conversion.

Title contribution 8                      Validation of Common Mode Absorption Devices (CMADs)

Speaker                                      Heinrich Ryser

Affiliation speaker                      METAS, Switzerland

Abstract

The application of Common Mode Absorption Devices (CMADs) is explained. The parameters of the CMAD are measured with the VNA using the TRL calibration method. This procedure will be explained and illustrated with different measured examples. The TRL calibration method will also be compared to the classical SOLT calibration method.

Title contribution 9                      Measurement of PCB's Radar Cross Section in a GTEM Cell

Speaker                                      Dr. David Pouhe

Affiliation speaker                      Technical University of Berlin, Germany

Abstract:

The usefulness of investigating radiations from PCBs with RCS being the main parameter of interest is demonstrated. The necessity of using the GTEM cell as test facility to carry out RCS measurements is underlined. The proposed technique offers a quick and precise means of investigating EMI from PCBs. The procedure is based on the application of the relation between the backscattering cross section and the cell's reflection coefficient which enables the theoretical prediction of resonances.

## **Schedule IF-2, Wednesday September 26**

8:40-9:00 M. Stecher, Introduction and calibration of coupling networks and antennas

9:00-9:20 B. Mund, Screening efficiency of cables and connectors

9:20-9:40 B. Körber, Characterization of striplines and test setups

9:40-10:00 W. Sammet, Measurement of EMI filters and components  
(the new CISPR 17)

10:00-10:30 Coffee Break

10:30-10:50 W. Müllner, Validation of absorber lined rooms 1 to 18 GHz

10:50-11:00 M. Metzger, Validation of OATS and SAC 30 to 1000 MHz

11:00-11:20 B. Schincke, Characterization of symmetrical networks

11:20-11:40 H. Ryser, Validation of Common Mode Absorption Devices (CMADs)

11:40-12:00 D. Pouhe, Measurement of PCB's Radar Cross Section in a GTEM Cell