

Center for Quality Engineering

Test Report No. : S0GQNR3S

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Client: Marburg Technic, Kirchhain (Germany)

Material Under Test: Conductive Fabric "EMC-plus3, Item No. 97450"

Manufacturer: Unknown



Task: Shielding Effectiveness Measurement in the Frequency Range from 30 MHz to 1.5 GHz

Test Specification(s): ASTM D 4935-99
[covered by accreditation]

Result: The shielding effectiveness of the material under test (MUT) is within 80 dB to 120 dB, increasing with frequency.

The results relate only to the items tested as described in this test report.

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Tested by:	Approved by:
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COMPONENTS TESTING ENVIRONMENTAL ENGINEERING ELECTROMAGNETIC COMPATIBILITY PRODUCT SAFETY
TELECOM CONFORMANCE TESTS

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1 Summary

The shielding effectiveness of a conductive fabric, which is named “EMC-plus3, Item No. 97450”, was measured according to ASTM D 4935-99 in the frequency range from 30 MHz to 1.5 GHz. The shielding effectiveness of the material under test (MUT) is within 80 dB to 120 dB, increasing with frequency.

2 References

2.1 Specifications

The test was carried out according to the standard ASTM D 4935-99 “Standard Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Materials”, American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 194428, USA, 1999.

2.2 Glossary of Terms

ASTM	American Society for Testing and Materials
EUT	Equipment Under Test
MUT	Material Under Test

2.3 Bibliographical Data

No entry.

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3 General Information

3.1 Identification of Client

Marburg Technic
Bertram-Schaefer-Strasse 11
35274 Kirchhain, Germany

Tel: +49-6422-81-0
Fax: +49-6422-81-228

Email: technic@marburg.com
URL: www.marburg-technic.com

3.2 Test Laboratory

Siemens AG
ICN TQM QE 11 „Overvoltage, Protection“
Hofmannstrasse 50
D-81359 Munich, Germany
Accreditation number: TTI-P-G 157/97-01

3.3 Storage of Records

The original of the test report is delivered to the client who administers it and stores it for future use.

3.4 Time Schedule

Delivery of MUT: 2004-04-15
Start of test: 2004-04-16
End of test: 2004-04-16

3.5 Participants

Name	Function	Company	Department	Location
Mr. S. Helmers	Accredited testing	Siemens AG	ICN TQM QE 11	Mch H/Ho 50
Mr. P. Waszecki	Testing	Siemens AG	ICN TQM QE 11	Mch H/Ho 50

4 Equipment Under Test

4.1 Description of Equipment Under Test (EUT)

The EUT is a conductive fabric, which is named “EMC-plus3, Item No. 97450”. In the following, it will be denoted as “material under test” (MUT). The textile structure of the fabric is shown in Figure 1.

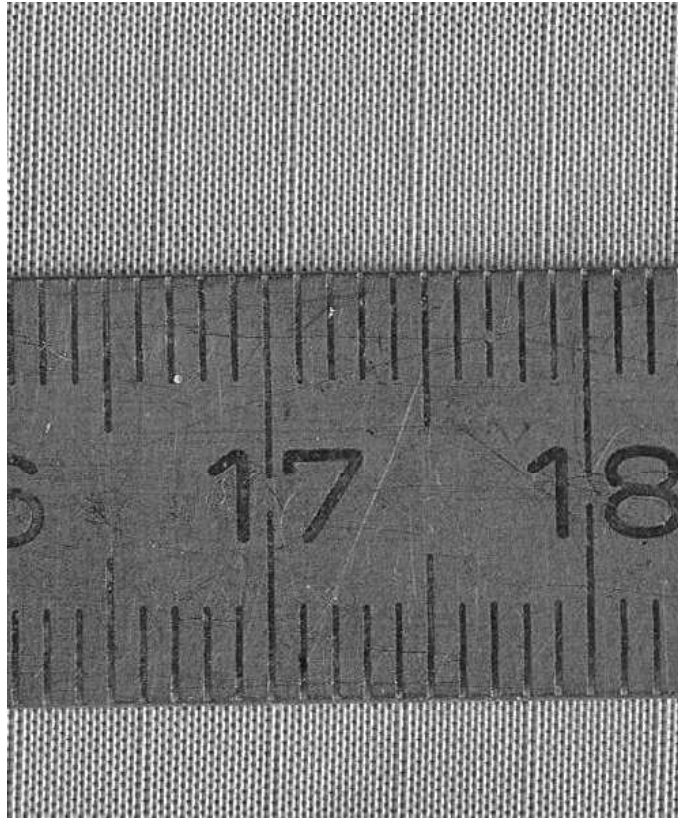


Figure 1: Textile Structure of the MUT

From this MUT, reference and load specimens were cut according to the underlying standard ASTM D 4935-99.

4.2 Configuration of EUT

Not applicable.

4.3 Operating Conditions

Not applicable.

4.4 Failure Criteria

Not applicable.

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5 Test Equipment

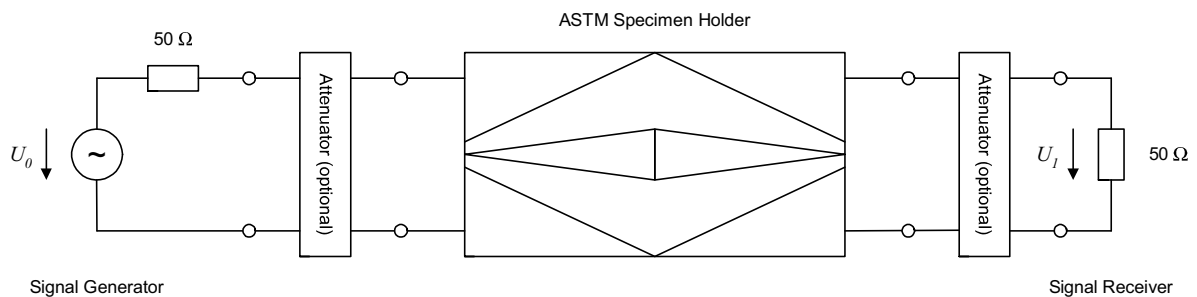
5.1 Test Facility

The measurements were made in the shielding efficiency test laboratory of Siemens AG, ICN TQM QE 11.

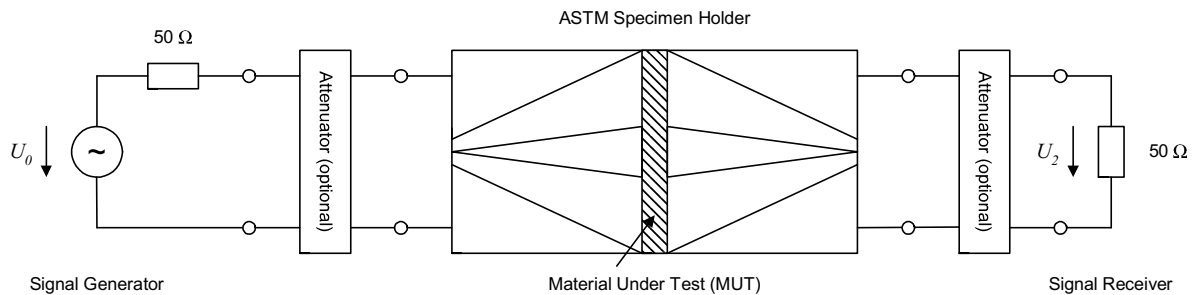
The measuring circuit is sketched in Figure 2. The shielding effectiveness of the MUT is calculated from two measurements, the reference measurement without MUT as shown in Figure 2 a) and the load measurement with MUT as shown in Figure 2 b). From the voltages U_1 and U_2 at the signal receiver, the shielding effectiveness a_S of the MUT is calculated as:

$$a_S = 20 \cdot \log_{10} (U_1 / U_2)$$

At the entry points of the ASTM specimen holder the insertion of attenuators is recommended to improve impedance matching within the measuring circuit. At the cost of increased standing waves, these optional attenuators are omitted to get the benefit of a maximum dynamic range of the measurement. Additionally, a signal amplifier is inserted to increase the voltage at the signal receiver.



a) Reference Measurement

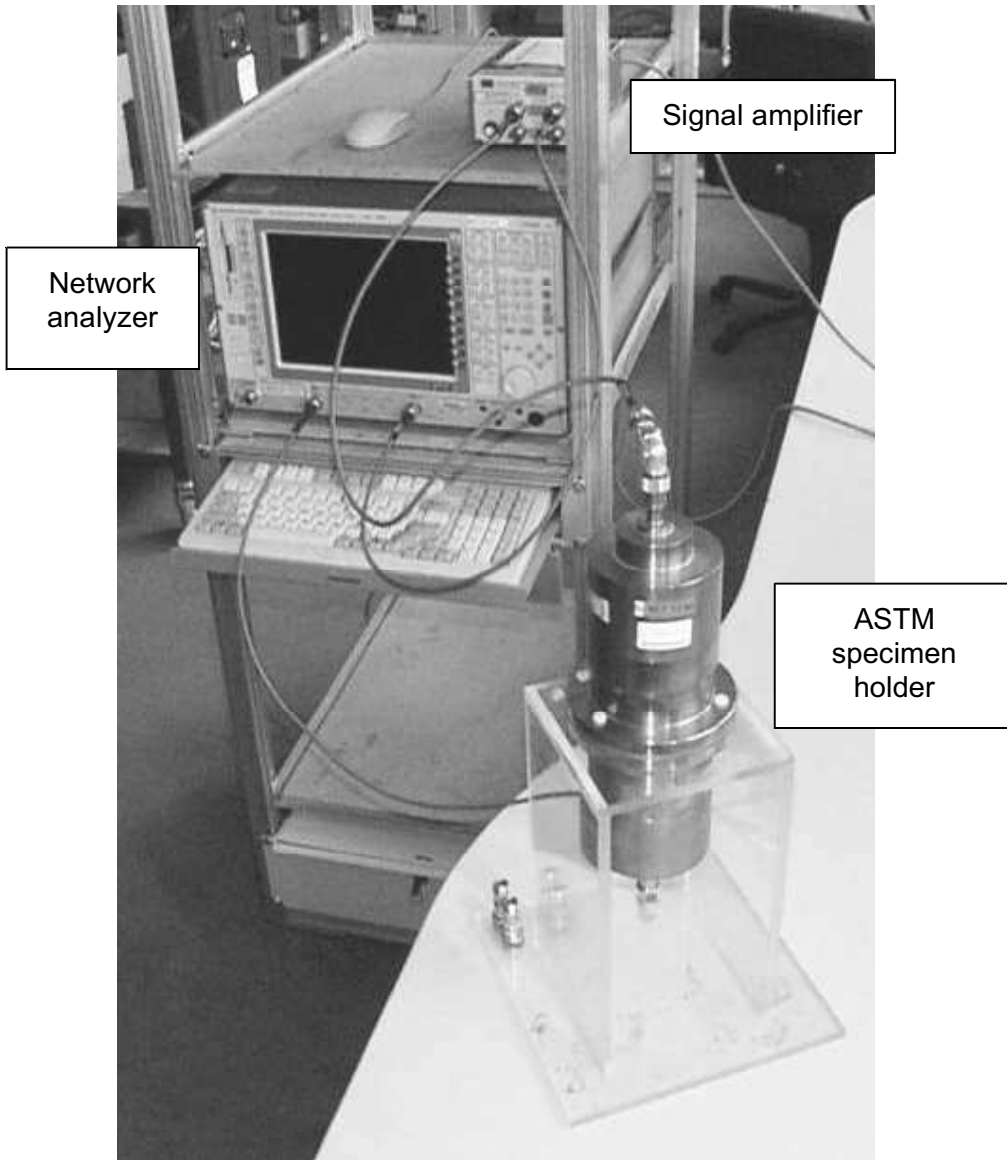


b) Load Measurement

Figure 2: Measuring Circuit

The overall test set-up is shown in Figure 3 on the following page.

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**Figure 3: Test Set-Up**

The dynamic range of the measurement is derived from a special load measurement using a brass plate of 4 mm thickness as MUT. The shielding effectiveness of this brass plate exceeds by far 300 dB in the whole measuring frequency range from 30 MHz to 1.5 GHz.

5.2 Measuring Equipment

The measuring equipment used for this test is listed in Table 1.

ID-NO	EQUIPMENT	TYPE	MANUF.	SER.-NO.	SPECIFICATION	REMARKS	STA-TUS	L-CAL	N-CAL
N0772	Network Analyzer	ZVRL Vektoriell	R&S	836941/007	with Calibration Kit ZV-Z21 (Ser.-No.: 101484/014)	with accessories	s	2002-08	2004-05
N0467	Test Specimen Holder	ASTM	W.E. Meas.	-	30 MHz - 1.5 GHz; 80-120 dB	length: 344 mm; diameter: 133 mm	n	-	-
N0491	Amplifier	7447F Opt. H64	HP	2944A03811	1:9 kHz-50 MHz; 2:0.1-1300 MHz	signal amplifier	n	-	-
N0727	Attenuator	6810.17.A	Suhner	-	10 dB; 50 Ω; DC - 12.4 GHz	N-connector	s	2004-04	2005-04
N0729	Attenuator	6810.17.A	Suhner	-	10 dB; 50 Ω; DC - 12.4 GHz	N-connector	s	2004-04	2005-04
N0810	Coaxial Cable	100-1000-51-51	Spec-trum	SN. 1	up to 18 GHz	to N0772 NA	n	-	-
N0811	Coaxial Cable	100-1000-51-51	Spec-trum	SN. 2	up to 18 GHz	to N0772 NA	n	-	-
N0812	Coaxial Cable	100-1000-51-51	Spec-trum	SN. 3	up to 18 GHz	to N0772 NA	n	-	-
c=calibrated Equipment - L/N-Cal: Last/Next calibration - s=supervised equipment (prior to use / dated) -									
i=for indication only - n=not calibrated Equipment - c(Ref)=Reference standards only									

Table 1: Measuring Equipment

5.3 Measurement Uncertainty

As described in section 5.1, the shielding effectiveness of the material under test (MUT) is calculated from two measurements, the reference measurement and the load measurement. Thus, systematic errors in the measurement circuit cancel out each other because they influence both of the two measurements. Nevertheless, a measurement uncertainty remains which is mainly due to the instability of the signal source and the receiving circuit of the network analyzer and the instability of the amplification factor of the signal amplifier. An additional contribution to measurement uncertainty arises from impedance mismatching at the entry points of the ASTM specimen holder.

So, the overall measurement uncertainty can be estimated by

Stability of signaling and receiving circuit	± 1 dB
Stability of the signal amplifier	± 0.5 dB
Impedance mismatch	± 1 dB
Total	<u>± 2.5 dB</u>

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6 Test Specifications and Results

The test results in the report refer exclusively to the test object described in section 4 and the test period in section 3.4.

6.1 Shielding effectiveness in the frequency range from 30 MHz to 1.5 GHz

The shielding effectiveness of the MUT measured in the frequency range from 30 MHz to 1.5 GHz is shown in Figure 4.

Shielding Effectiveness according to ASTM D 4935-99

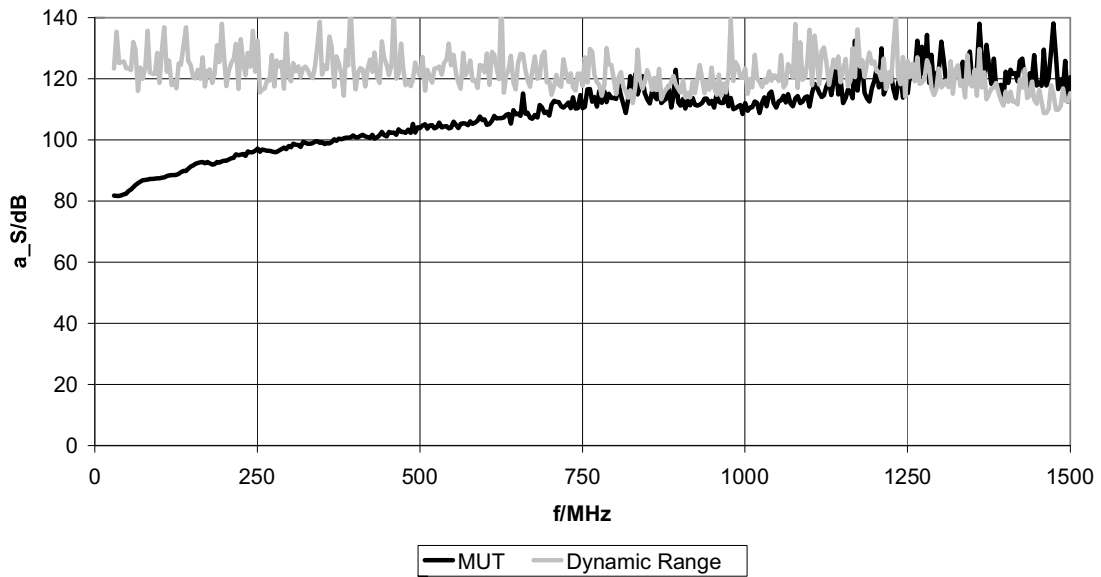


Figure 4: Shielding effectiveness of the MUT

Result

The shielding effectiveness of the material under test (MUT) is within 80 dB to 120 dB, increasing with frequency.

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