Test cells for investigating emission and susceptibility
Attractively priced alternatives to the anechoic chamber

Measurements to verify the compliance of electronic equipment with regulations regarding emission of and susceptibility to interference either necessitate a laboratory of your own or you have to call on the services of an external provider. Both can be very expensive, especially for small and medium-sized companies that have to carry out such measurements quite often. The alternative is a compact system enabling precompliance measurements and preparation for final acceptance in your own development lab. Rohde & Schwarz offers several test cells covering the frequency range 150 kHz to 40 GHz that can also be equipped in part with climatic chambers (FIG 1).

Measurement in your own or an external lab?

Standard test sets and systems require a lot of technical know-how, extensive aids and fittings and normally also shielded anechoic chambers. The investment (some hundred thousand to several million DM) is hardly a paying proposition for small to medium-sized businesses. So in many cases an external test lab will be asked to assist. But the costs for complete measurements carried out by an external service provider can easily amount to between 200 DM and 500 DM per hour. So it is well worth considering what you could do in your own lab by purchasing just part of the T&M inventory that is necessary. Relatively little investment will enable precompliance tests to be performed in your own lab, so you need not call on the assistance of a fully fitted, external test lab until it is time for compliance testing. That not only means significant cost savings, it also saves a lot of time thanks to less shipping and travelling backwards and forwards.

S-LINE:
measurement environment for frequencies up to 1 GHz

Rohde & Schwarz has developed cost-attractive packages for the performance of precompliance emission and susceptibility measurements in the...
The package for emission measurements consists of EMI Test Receiver ESPC, a shielded S-LINE test cell (TEM line) plus a PC with EMI Software ESPC-K1. Thanks to compact dimensions of only 1.5 m x 1 m x 1 m (S-LINE 1000) or 1 m x 0.8 m x 0.8 m (S-LINE 700), such a test cell will fit into practically any development lab (FIG 2). S-LINE provides a high degree of shielding effectiveness of over 60 dB and maintains uniform field strength in the test volume (max. 50 cm x 50 cm x 50 cm) for susceptibility measurements. A large door opening at the chamber’s front allows simple access to the EUT, which is easily observed during measurement through a shielded window and chamber lighting.

For susceptibility measurements the test setup consists – apart from S-LINE – of a signal generator with RF amplifier, a power meter and a field sensor. Depending on the equipment used, field strength of over 50 V/m can be produced in the 150 kHz to 2 GHz range. Here too, a PC working with EMS-K1 software controls and supervises the setup and measures and analyzes the results according to the applicable standard.

There is a special version of S-LINE available that is suitable for integration in an automatic production line. It comprises an automatically closing bulkhead at the rear that allows automatic feeding of the EUT into the test cell.

M-LINE: measurements in the range above 1 GHz

Increasing use of the frequency spectrum above 1 GHz for wireless speech and data communication has led to more stringent requirements for measurement of both wanted and unwanted emissions of the equipment involved. Such measurements are prescribed by EMC standards and are mandatory in acceptance tests of terminal equipment for example. While
some EMC standards have included the microwave range for some time (eg MIL-STD-461/462D, ISO11452), others have only recently extended the EMC measurement range from 1 GHz to 2 GHz (eg IEC 61000-4-3). Acceptance tests on equipment for wireless speech and data communication – eg Bluetooth – require measurement of radiated spurious emission up to 13 GHz.

Rohde & Schwarz has consequently developed a new test cell – based on S-LINE – for applications in the microwave range [2]. Unlike S-LINE, which has a symmetrical TEM line, M-LINE uses a built-in antenna for generating the required field at higher frequencies.

**Design and characteristics**

The external dimensions of M-LINE correspond to those of S-LINE 1000. To eliminate reflection, the cell is lined with 21 cm high pyramid absorbers. They exhibit attenuation of 30 dB at a frequency of 1 GHz, which even increases to 50 dB at higher frequencies. The test cell consequently produces reflection attenuation of 25 dB to 35 dB in the useful frequency range from 0.8 GHz to 40 GHz inside a quiet volume of 40 cm in diameter. For immunity tests a homogeneous area of 30 cm x 30 cm can be generated in M-LINE with a maximum distance of 70 cm between antenna and EUT. Optionally M-LINE can also be fitted with a semi-automatic positioning device for the EUT. Depending on application and frequency range, various types of antennas such as horns, circularly polarized or small logarithmic-periodic antennas can be fitted (FIG 3).

Measurements with different antennas show that field strength of typically 100 V/m in the frequency range of 1 GHz to 7.5 GHz can be achieved inside M-LINE with 200 W amplifier power. The same amplifier power even yields a typical figure of 200 V/m between 7.5 GHz and 18 GHz.

The test cell can be fitted with a temperature chamber for measurements under extreme environmental conditions, especially required in acceptance testing (FIG 1). This allows an EUT to be subjected to temperatures between −25°C and +50°C. The temperature in the chamber can either be set manually from an integrated control panel or remotely on a serial interface.

**Focal M-LINE applications**

M-LINE was primarily devised for measurements at microwave frequencies on small EUTs. It is suitable for precompliance emission and susceptibility measurements in a range from 0.8 GHz to 4 GHz. Another application is RF testing via the air interface during production. This kind of measurement is required for a large number of products operating at frequencies above 800 MHz, such as RF modules, mobile or satellite phones. The test cell’s lower limit frequency of 800 MHz was chosen with a particular view to mobile phones operating in the GSM900 band.

**Summary**

Depending on their functionality, these small systems are available at prices clearly below 100,000 DM. They soon pay for themselves because of the time saved in precompliance measurements and the costs saved on external services.

Dr Matthias Wuschek

**REFERENCES**

[1] Göpel, Dr Klaus-Dieter: EMC Test Cell S-LINE: Compact EMC test cell of high field homogeneity and wide frequency range. News from Rohde & Schwarz (1996), No. 151, pp 7–9


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**Condensed data of S-LINE**

| Frequency range | 150 kHz to 2 GHz
| Input power | 100 W CW max.
| Input impedance | 50 Ω
| Homogeneous area | approx. 50 cm x 50 cm
| S-LINE 1000 | approx. 35 cm x 35 cm
| S-LINE 700 | 

**Condensed data of M-LINE**

| Frequency range | 800 MHz to 40 GHz
| Input power | 200 W CW max.
| Quiet zone | 400 mm in diameter (with reflection attenuation typ. ≥35 dB)

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