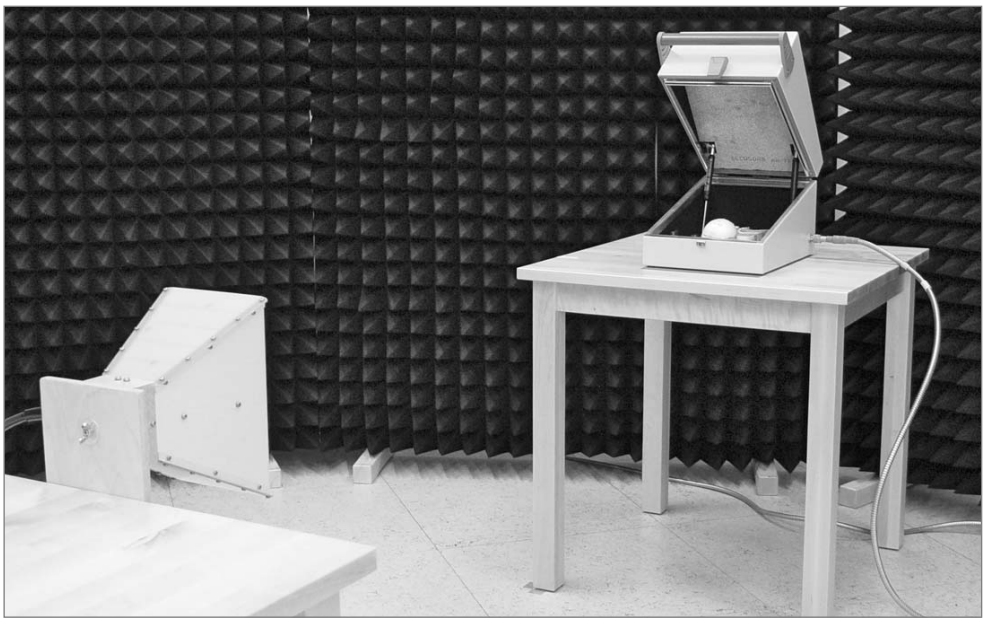
White Paper

will'tek

Applying a measurement standard to ensure a specified shielding performance



boosting wireless efficiency

Testing of wireless devices such as mobile phones must not affect real networks or other test stations. For the purpose of isolating the wireless device under test, shielding boxes such as the Willtek 4921 RF Shield are available on the market. The shielding factor is the most important parameter when selecting a shielding device, but Willtek is not aware of any other vendor verifying the specified shielding performance against a measurement standard.

Measurement standard

There is only one independent specification describing how to measure the shielding performance of smaller shielding enclosures up to a frequency range of 1 GHz, and that is a German military standard[1)], released in February 1997 and reworked in July 2004. To enhance this frequency range and to seek ways how to adapt the standard to the frequencies which are used for mobile communications, Willtek cooperated with the independent and qualified EMC (Electromagnetic Compatibility) laboratory of IABG. The result was that this measurement specification can also be applied at higher frequencies, at least up to 6 GHz.

The military standard describes in detail the measurement setup and the test procedure to measure the shielding performance. Details of the measurement set-up are given below. The standard was applied when testing a batch of prototypes of the Willtek 4921 RF Shield at the independent EMC laboratory, to ensure that the design fits the specified requirements for testing 3G wireless devices. To verify the boxes in series testing, Willtek rebuilt the test environment at its factory (see Figure 1). Willtek transformed a room into an anechoic chamber; this is now being used to measure each box at specific frequencies, verifying that the 4921 RF Shield exceeds the typical isolation values specified in the data sheet.

On customer request, Willtek offers a special certificate issued by the EMC laboratory. The lab measures the shielding of the box using the same set-up as during prototype testing. Willtek delivers an overview of the shielding performance in all the specified frequency bands.

Figure 1: Measurement room in the Willtek factory

Measuring shielded enclosures

The measurement standard requires the test to be performed in an anechoic chamber with specified dimensions. The room should exceed an effective length and width of 5 m and a height of 3 m. The measurement setup is as follows:

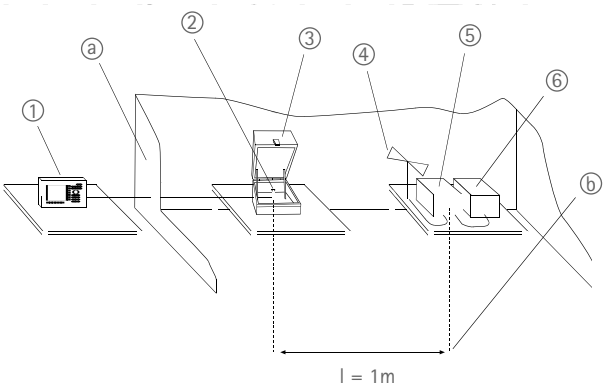


Figure 2: Measurement setup

Legend

① Receiver (spectrum analyzer)
② Receiving antenna
③ Device under test (e.g. Willtek 4921 RF Shield)
④ Transmitting antenna
⑤ Power meter
⑥ Transmitter
ⓐ Anechoic chamber (absorber room)
ⓑ l = Distance between transmitting and receiving antenna

[1)] VG 95373-15, "Electromagnetic Compatibility - Electromagnetic Compatibility of Equipment-Part 15: Test Method for Coupling and shielding", Germany

It is required that the RF cables used for example to connect the receiving antenna in the Device under Test (DUT) and the receiver, exceed an isolation of 100 dB in the used frequency band. Willtek, for example, uses the high performance RF cables Sucoflex 106 supplied by cable manufacturer Huber & Suhner. These cables meet the requirement of more than 100 dB shielding in the tested frequency range.

Another precondition is that the size of the receiving antenna in the DUT must be smaller than the dimensions of the DUT. This antenna must be placed in the middle of the object to be tested. In order to gain a high level of measurement repeatability, Willtek constructed a special mounting device for the antenna, ensuring that the position of the antenna is the same in each device to be tested.

The DUT should be placed on an insulating base, e.g. a wooden table. Based on the wavelength of the lowest frequency, the distance between the transmitting antenna and the DUT must exceed 1 metre. If, on the other hand, the distance is too high then the receiver might not be able to measure any signal because the isolation of the DUT and the attenuation over the air add up. While the EMC laboratory applies a distance of 2.0 metres which is close enough for the high sensitivity receiver to catch the signal power with the accumulated attenuation, Willtek takes the measurements in a 1.5 m distance, exceeding the requirements from the test standard.

This test standard also demands measurements in two dimensions, each from both sides. Accordingly, Willtek tests the DUT, the 4921 RF Shield, from the front, back, right and left. The right side and the back side are most critical, as the hinges and the customised rear panel are located on the back and the standard RF output connector can be found on the right hand side. The transmit power and the receive level must be recorded with the respective frequency.

The measurements are then repeated without the DUT. The shielding performance is then calculated as the difference between both receive levels in dB.

The above procedure allows Willtek to verify and prove that the 4921 RF Shield exceeds the specified shielding of 80 dB in the main frequency bands used for mobile communications.

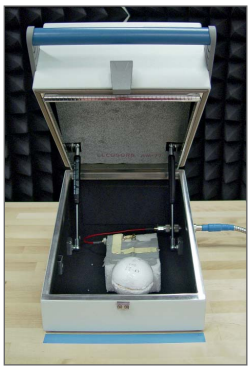


Figure 3: Receiving antenna in 4921 RF Shield

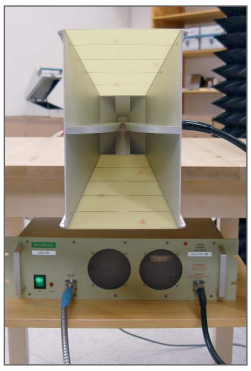


Figure 4: Transmitting antenna

Certificate of Compliance

The Willtek 4921 RF Shield,

serial number 318,

has been tested according to measurement standard TN-TR40-0051.

The RF Shield exceeded the specified radio frequency isolation of 80 dB.

Frequency range Isolation

700 MHz - 1000 MHz: min. 90 dB
1700 MHz - 2000 MHz: min. 105 dB
2000 MHz - 2500 MHz: min. 110 dB

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ISO 9001

Test laboratory:
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IABG
ISO 9001 EN 17025

Ottobrunn, 2005-05-13

For the manufacturer

For the test laboratory

Figure 5: Certificate

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