

TEMpact GHz TEM-Cell

Compact testing system for
EMC radiation testing



The cell is delivered either as „simple unit“, or
as a complete computer-controlled test assembly
with all necessary testing equipment.



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TEMPact GHz

The TEMPact GHz TEM Cell was developed especially to permit EMC radiation testing of smaller EUT (equipment under test) in a shorter time and at a lower price. In addition to the comparatively low purchase price of the cell itself, the cost incurred by the necessary measuring equipment, too, will be reduced. Another advantage is the little space required for the cell itself as well as the space-saving disposition of all the measuring and testing equipment on the undercarriage of the cell. TEMPact can be used both for immunity tests conforming to the standard IEC/EN 61000-4-3 as well as for pre-compliance emission measurements in the frequency range from DC to 2 GHz. Due to this, an immediate and reliable survey regarding the compliance with EMC regulations can be obtained already in the development phase of electronic equipment.

Technical construction

TEMPact is a „real“ TEM cell with a closed outer conductor and an inner conductor (septum) corresponding to the well tested principle after „Crawford“. To avoid cavity effects, which arise in the standard Crawford cells from approx. 200 MHz onwards, the TEMPact is partially equipped with ferrite absorbers so that the cell can be used without any problems for the frequency range from DC to 2 GHz. TEM conditions (transversal electro-magnetic field) are given if both an electric and a magnetic field are generated, which are perpendicular in their propagation. This case is also called „far field condition“. This requirement can be fulfilled with the TEMPact due to the configuration closed outer conductor / inner conductor, as can be seen from Fig. 1.

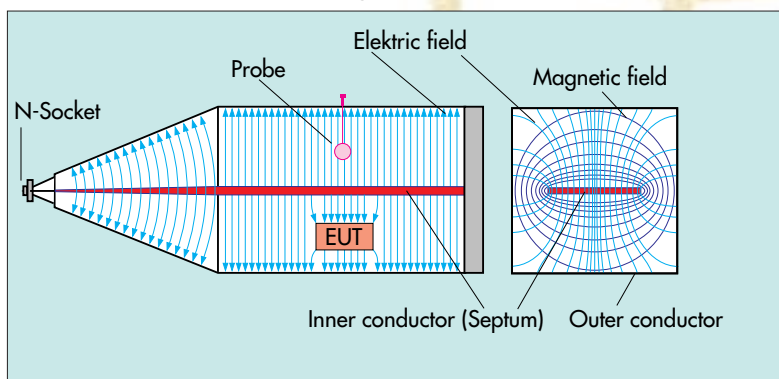


Fig. 1

The electric field is propagating from the inner conductor in direction to the outer conductor. Resulting from the current flow: feeding point - inner conductor - terminating resistor, a magnetic field is generated around the inner conductor. It has to be pointed out that this requirement is fulfilled not by all constructions offered on the market.

Functional principle

The TEMPact GHz TEM Cell provides defined TEM field conditions from 0 Hz up to the GHz range, avoiding at the same time the stimulation of undesired higher modes. The configuration of the cell assures a useful area of a constant cross-section; the TEM field generated in the test volume is therefore not depending on a certain location. The pyramid-shaped extension which allows to direct the signal injections to the useful area, has a minimum opening angle, so that an almost ideal plane wave front is generated in the useful area, which permits to simulate the real field conditions. The characteristic wave impedance of the TEMPact GHz TEM Cell is optimized in view of a desired value of $Z_0 = 50\Omega \pm 1\Omega$ so that reflections of the line structure are negligible.

The termination of the cell is realized by means of a so-called hybrid termination whose essential detail consists in a plane terminating resistor. The plane resistance of this termination element is designed in a way to assure an adapted termination of the line wave resistance for each cell geometry in the lower frequency range. Possible radiation or reflection effects of this plane termination at higher frequencies are avoided by installing ferrite absorbers at the septum (inner conductor) as well as in the auxiliary space at the end of the cell. In addition, this auxiliary space assures the decoupling between outside area of the cell and useful area.

This hybrid termination directly provides an effective damping of the higher modes, which are stimulated in classic TEM cells, and which have a limiting effect to the band width. In addition, the installation of ferrite absorbers in the useful area permits to avoid almost entirely the resonances of higher wave forms. These advantages are confirmed in practice by the respective measuring results. The maximum field strength deviation of -0dB to +6dB, requested by IEC/EN 61000-4-3, is easily reached in the specified test volume; this allows to perform immunity tests which are fully conforming to standards.



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Immunity tests in accordance with IEC/EN 61000-4-3

According to IEC/EN 61000-4-3 the alternative use of TEM cells - instead of anechoic chambers - is allowed for immunity testing in the frequency range from 80 MHz to 2000 MHz, provided that a sufficient homogenous field (maximum field strength deviation - 0dB to +6dB), in relation to the size of the EUT, is assured. Another criterion is the suitability of the cell for the whole relevant frequency range (up to 2 GHz). The TEM-pact fulfills both of these requirements.

If desired, we deliver the TEM-pact GHz TEM Cells including all the necessary measuring and testing equipment, completely installed and ready for operation. As far as equipment is already existing, it may be integrated in the system.

The following components are required for immunity testing (see also block diagram, Fig. 2):

- ◆ signal generator with amplitude modulation
- ◆ power amplifier
- ◆ field strength measuring equipment with probe
- ◆ software for control and documentation
- ◆ PC for system control (IEEE bus)
- ◆ optionally automated monitoring of the EUT by means of fibre-optic system or by multimeter.

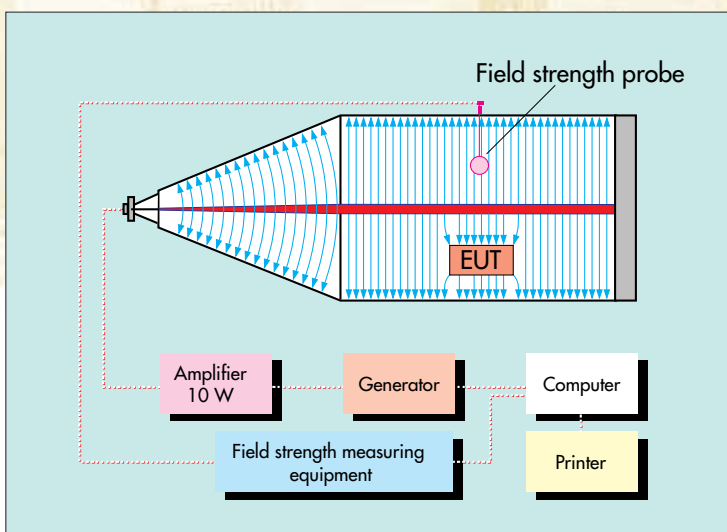


Fig. 2

The control software assures a constant field strength in the test volume over the whole frequency range. To permit this, it is necessary to establish a relation between generator output voltage and the desired field strength. For this purpose, a reference run is performed with „empty“ TEM-pact, during which the output voltage of the signal generator required for the respective field strength will be determined and stored for each frequency. The values thus determined are available as reference file for all future testings. Due to the symmetrical construction of the cell, the field strength may be recorded permanently during testing (with the reference file) by means of the probe installed in the upper half of the cell, without influencing the field in the test volume unacceptably. This permits on the one hand, to verify if field strength is really available during automatic testing, and, on the other hand, to perform tests manually.

Fig. 3 shows which amplifier output voltage is necessary for a field strength of 10V/m, depending on the respective frequency.

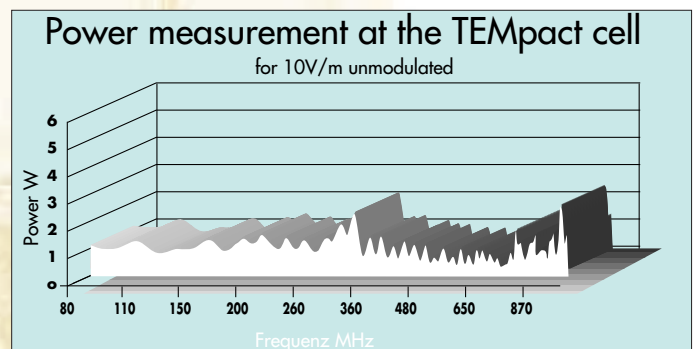


Fig. 3

Emission measurements

In the international standardization, TEM cells or strip lines are not officially permitted as alternative measuring method for emission measurements. Consequently, they cannot replace the final acceptance measurement conforming to standards on an open area test site or in an anechoic chamber.

The high quality of the TEM-pact, however, permits already during the development phase to perform emission measurements which are very reliable and absolutely reproducible, so that the effort caused by the use of a test assembly conforming to the standards (effort of time and hiring charges) can be reduced to a minimum. Comparison measurements with open area test sites conforming to standards have proved that an EUT can be „prepared“ optimally with TEM-pact for the acceptance measurement. One reason for this is the defined cable layout which is realized by means of a plexiglass holding device beneath the septum. An undefined cable layout (as can often be seen in other cells) would lead to a considerable limitation

of the reproducibility as well as of the correctness of the measuring results.

Due to the very elaborate damping of cavity effects by means of ferrite absorbers, the TEM_{compact} will not require the so-called „correlation software“ which is frequently offered in order to correct resonances of the cell by calculation.

In emission measurements, the TEM_{compact} is used as receiving equipment and - just as in the tests with antennas - connected via RF cable with N connectors to any measurement receiver conforming to CISPR 16, or to a spectrum analyser. Testing may then be started immediately. The test setup can be seen from the block diagram, Fig. 4.

If a measurement receiver does not exist, we can also deliver a completely computer-controlled test site for emission measurements.

In case of an all-inclusive delivery of TEM_{compact}, immunity test site and emission measuring site, the complete control software will be installed on one common computer, so that the desired test can be called by simple mouseclick.

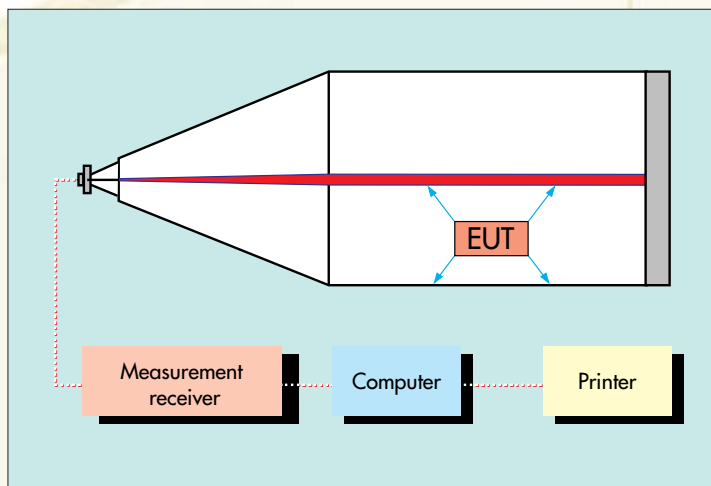


Fig. 4

Technical Data

External dimensions	(L x D x H) 3.020mm x 1.080mm x 1.900mm
Test volume	(L x D x H) 750mm x 450mm x 300mm
Return loss:	
Typical value for $f \leq 1\text{GHz}$	< -20dB
Return loss:	
Maximum value for $f \leq 1\text{GHz}$	< -18dB
Maximum field strength deviation in the test volume, with constant input power for $f \leq 1\text{GHz}$	-4dB to +6dB
Maximum field strength deviation in the test volume, with regulated input power conforming to IEC/EN 61000-4-3 for $f < 2\text{GHz}$	-0dB to +6dB
Required amplifier output power for field strengths of 10V/m at 80 % AM	10 Watt



FRANKONIA
EMV-Mess-Systeme GmbH

Frankonia EMV Mess-Systeme GmbH:

Weiherweg 14 • 96199 Zapfendorf • Germany
Phone ++ 49 (0) 95 47/94 01 0 • Fax ++ 49 (0) 95 47/94 01 20
<http://www.frankonia-emc.com> • e-mail: frankonia.emv@t-online.de

Frankonia GmbH:

Rambacher Straße 2 • D-91180 Heideck • Germany
Phone ++ 49 (0) 9177/98 500 • Fax ++ 49 (0) 9177/98 520
<http://www.frankonia-emc.com> • e-mail: info@frankonia-emc.com