

**For emission and immunity testing according to
IEC 61000-4-20**



Theory of operation

GTEM-cells (Giga-hertz Transversal Electro-Magnetic cells) are waveguide structures intended for electromagnetic compatibility measurements, as well as biomedical applications. The elec-

Electromagnetic field distribution inside the cell is in TEM mode. With TEM mode propagation, there is no component of electric and magnetic field in the direction of propagation of electromagnetic wave. Therefore the field components are strictly perpendicular. Assuming the field distribution ideal TEM below the cut-off frequency of the cell (before the introduction of higher order modes), the electromagnetic field distribution can be considered static.

Applications

- EMI and EMS devices
- Radiation and susceptibility test
- and dosimetric applications
- Isotropic E-Field sensors and probes calibration
- Receiver sensitivity test
- Measurement of radiated power and sensitivity of wireless communication equipments
- Evaluation of shielding materials

Specifically designed for telecom applications

Specifications *

Operating range:	0,1MHz-20GHz
RF Input:	max continuous. input power: 500W RF, Peak 2Kw.
Input connector type	"N" UG-21 connector
Shielding:	better than 60 to 100dB depending from frequencies
Absorbers:	650 mm anechoic pyramidal foam
Outer cell dimension:	(L)3000x(W)1125x(H)1688 cm
Door Size:	40 x 40 cm (clear entrance)
Construction	hot galvanized and inox steel 10/10 and 20/10

Technical panel *

Power supply / Filter box - I/O. *

N.1 Feed-thru "N" connector	N.1 16 Amps 250VAC, two phases +Ground line filter
N.2 Feed-thru "SMA-SMA" connectors	N.1 6A Amps 250VDC, two terminals
N.1 feed-thru fibre optic penetration for 3 couples.	

Options

Fully Inox steel construction
Inspection window with shielded polycarbonate glass 20 cm Diam.
Feed-trough panels, pipes connector, customized filters
multi holes feed-thru fibre optic penetration for 6 couples.
N.1 filtered 10 poles connector 10A 600Vdc

N.3 filtered banana sockets 1A 1000Vac
Honeycomb air vents
Exhaust fan
TDK 6mm. ferrite tiles on the bottom

* dates are subject to variations without notices

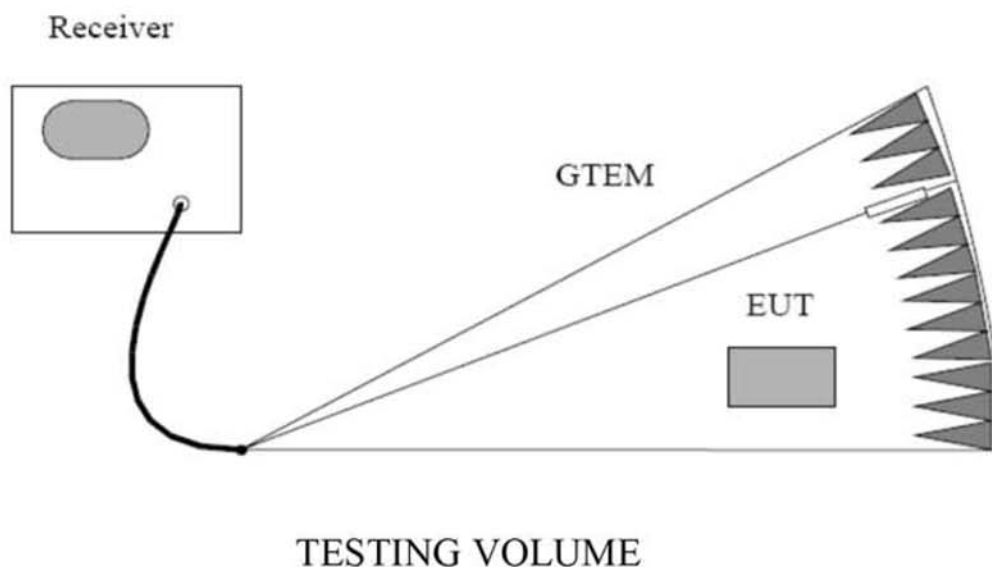
Installation manual and general safety instructions

The GTEM (GigaHertz Transverse Electromagnetic) cell is a precision electromagnetic compatibility (EMC) test instrument primarily intended for use as radiated immunity and radiated emission test facility without environmental electromagnetic interference.

The cell is electrically similar to a coaxial cable with one side open (the apex) and other side closed on the impedance of the generator or receiver connected. In this case with a multi-meter appears as 50 Ohm resistance.

Measurement setup

The setup for emission measurements in a GTEM cell is shown in Fig.1. the EUT is placed inside the GTEM and its radiation is measured with a receiver. The receiver can be software controlled, and some software that includes the GTEM to OATS correlation is commercially available.



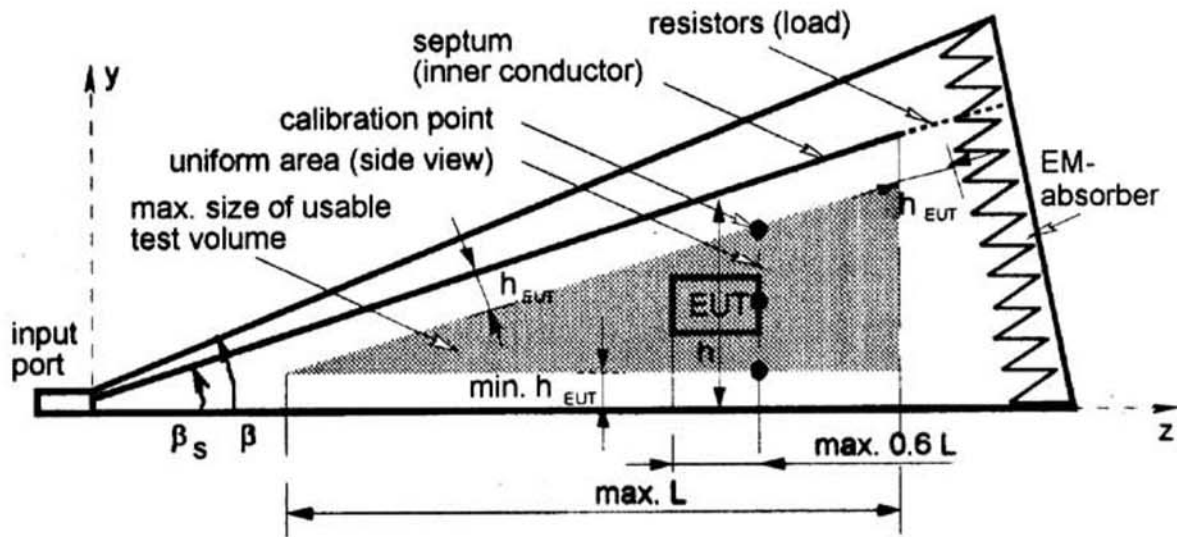


Fig.2 - Maximum EUT size and maximum size of the usable test volume in a GTEM cell, longitudinal section

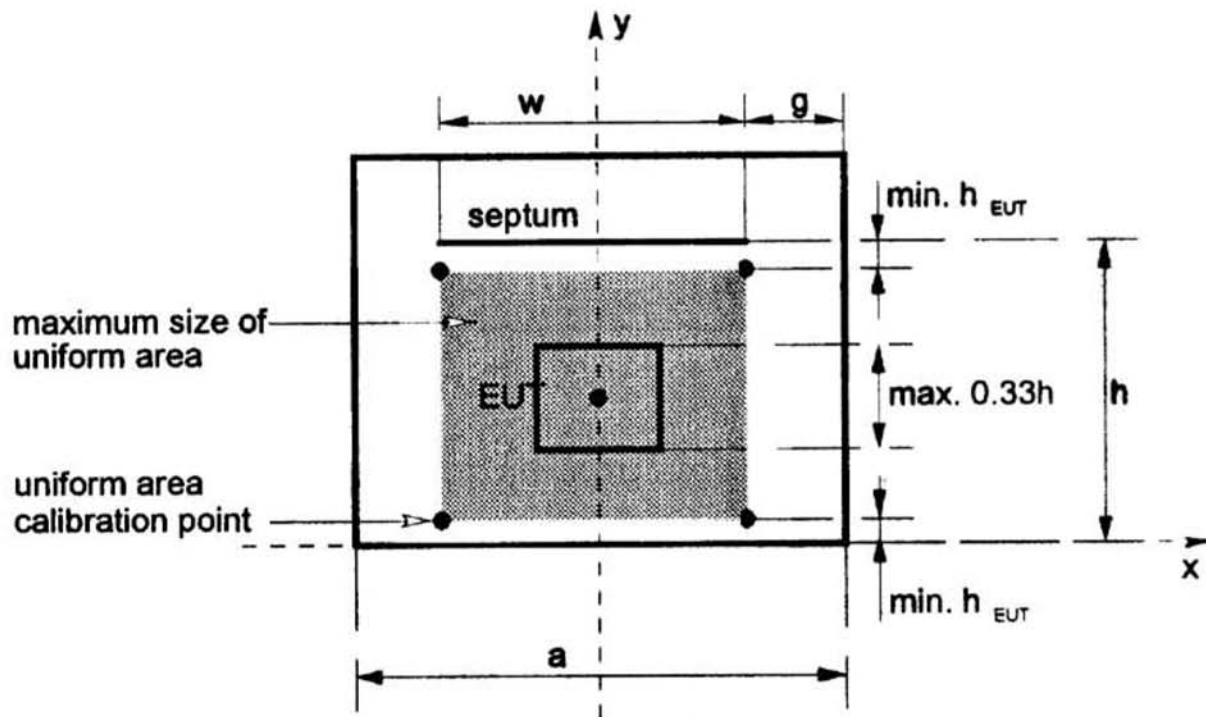


Fig.3 Maximum EUT size and maximum size of the usable test volume in a GTEM cell, cross section

G T E M 5 0 0	
Septum Height (h)	500 mm. in the test section.
Outer cell dimension:	(L)2380x(W)1220x(H)830 + 750mm. Trolley
Input connector type	"N" UG-21 connector or 7/16" female.
Shielding:	better than 45 to 100dB depending from frequencies
Absorbers:	350 mm Hybrid anechoic pyramidal foam + ferrite tiles 6mm. thickness
Door Size:	40 x 40 cm
Construction	Fully Hot galvanized and steel 10/10 and 20/10mm

- Specifically designed for telecom application

Technical panel *	Power supply / Filter box - In and out. *
N.1 Feed-thru "N-N" connector	N.1 16 Amp. 250VAC, 2 poles + Ground line main filter
N.2 Feed-thru "SMA-SMA" connectors	N.1 6 Amp. 250VDC, 2 poles secondary filter
N.1 3 pairs Fibres optical feed-throu	Ready to accept options: DB9, DB25, RJ45...

EMC GTEM-500

Gtem Cell

Power required / Electric field Vs. frequency\

Calculating Power Required. Theory.

Basically, we have to consider the volts per meter, the height of the septum, an allowance for voltage peaks caused by amplitude modulation and the flatness with frequency. For flatness, we generally allow 3 dB, this only takes effect after the first resonance point.

The example above shows 10 V/m with a GTEM 500

GTEM 500

Septum height = 0,5 m

Flatness = 3 dB = 2

Power Required = $(E \times h)^2 / R \times \text{Flatness} \times \text{Modulation Allowance}$

Where E = required field strength: h = septum height: R = GTEM input impedance (50Ohm)

Power Required = $(10 \times 0,50)^2 / 50 \times 2 \times 3,24 = 3,24 \text{ Watt}$

Fig. 1, shows the power required for all GTEM 500 with 80 % amplitude modulation.

GTEM Calculating Power requirement

Field Strenght E V/m	Flatness 3dB = 2	Modulation allowan- ce 80% AM	Required power modulated Watts	Required power CW Watts
3	2	3,24	0,09	0,29
10	2	3,24	3,24	1
30	2	3,24	29,16	9
100	2	3,24	324	100

GTEM Factory Tested Power requirement (Flatness 0, Power CW)

Frequency	W for 3V/m	W for 10V/m	W for 30V/m	W for 100V/m
1	-	0,5	4,2	-
10	-	0,6	4,6	-
100	0,04	0,46	4,6	-
500	0,04	0,36	3,25	30
600	0,06	0,47	4,85	32
700	0,05	0,37	3,62	30
800	0,05	0,46	4,38	35
900	0,05	0,53	4,21	35
1000	0,07	0,67	5,11	64

Performance tests

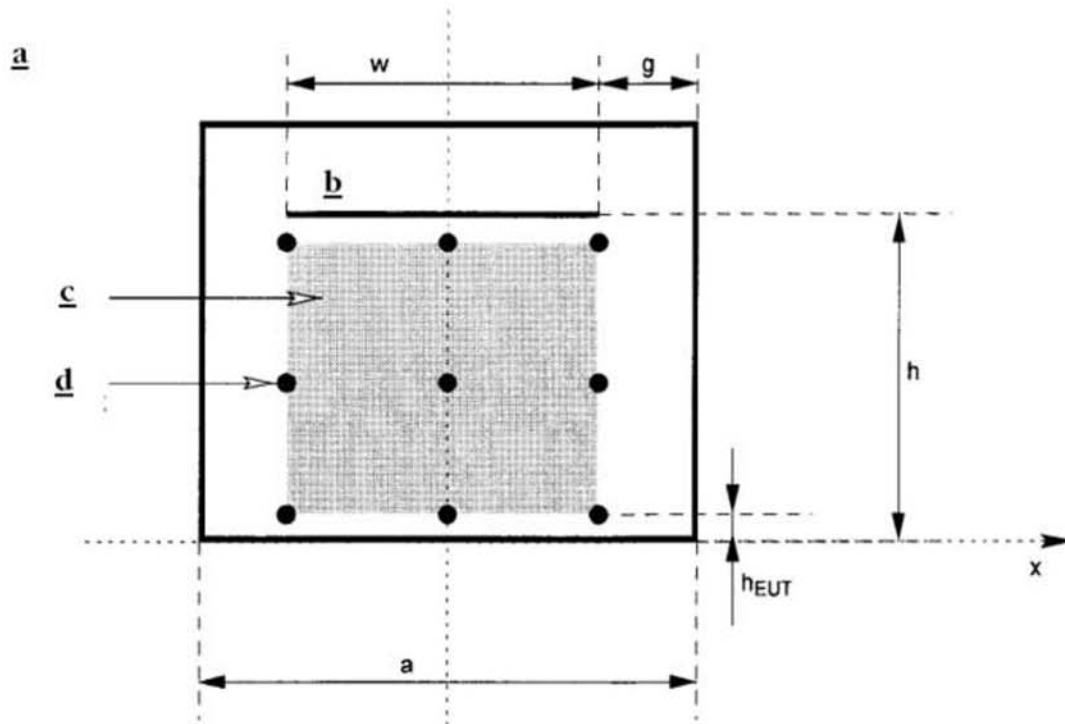
A verification test was performed at 0,450 mt. height cross section. Test was performed at differet frequency.

A test plane with a 3 x3 points matrix has been sampled.(not included)

A template placed in the middle of the section was delimiting a 45 x 45cm. test area.

Instruments used for the tests

- Advantest Network analyzer 40Mhz-3,8GHz
- R&S generator 9KHz-3,6GHz
- Minicircuit 900MHz. 10W amplifier
- Triaxial Isotropic sensor EMCO.
- Bird Mod. Analyst, RF wattmeter



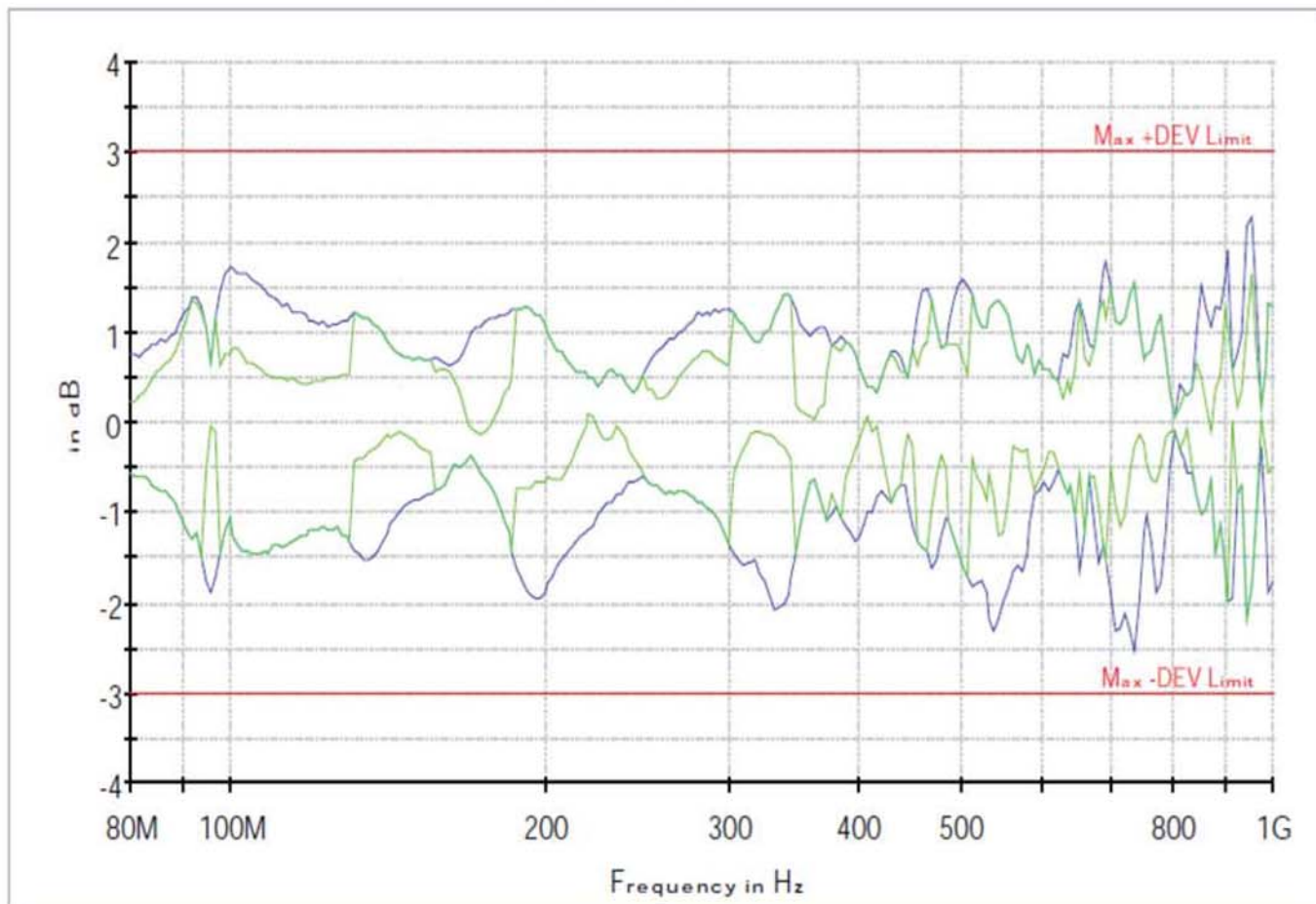
a =Cross Section

b= Septum

c= Uniform Area

d= Uniform area claibration point

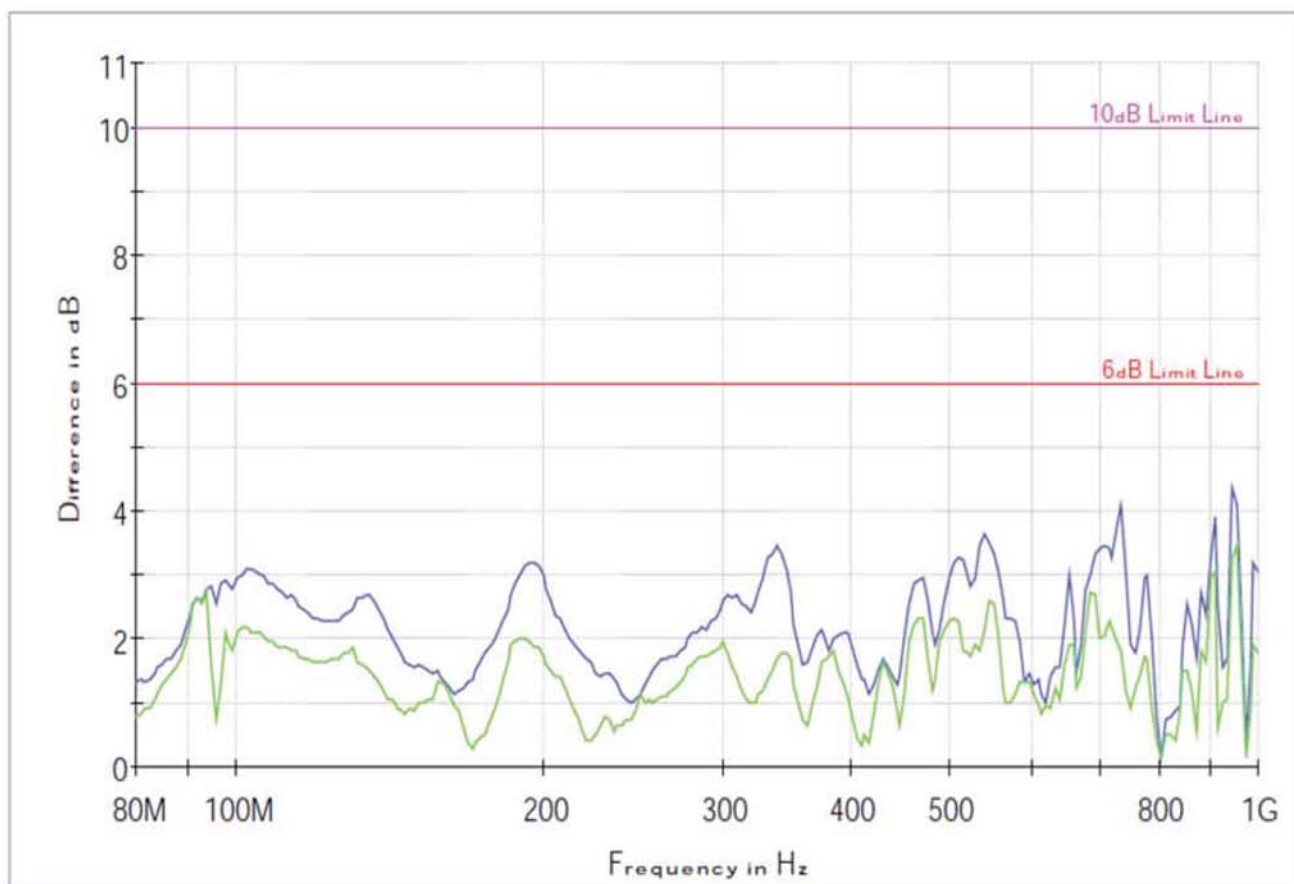
UNIFORMITY



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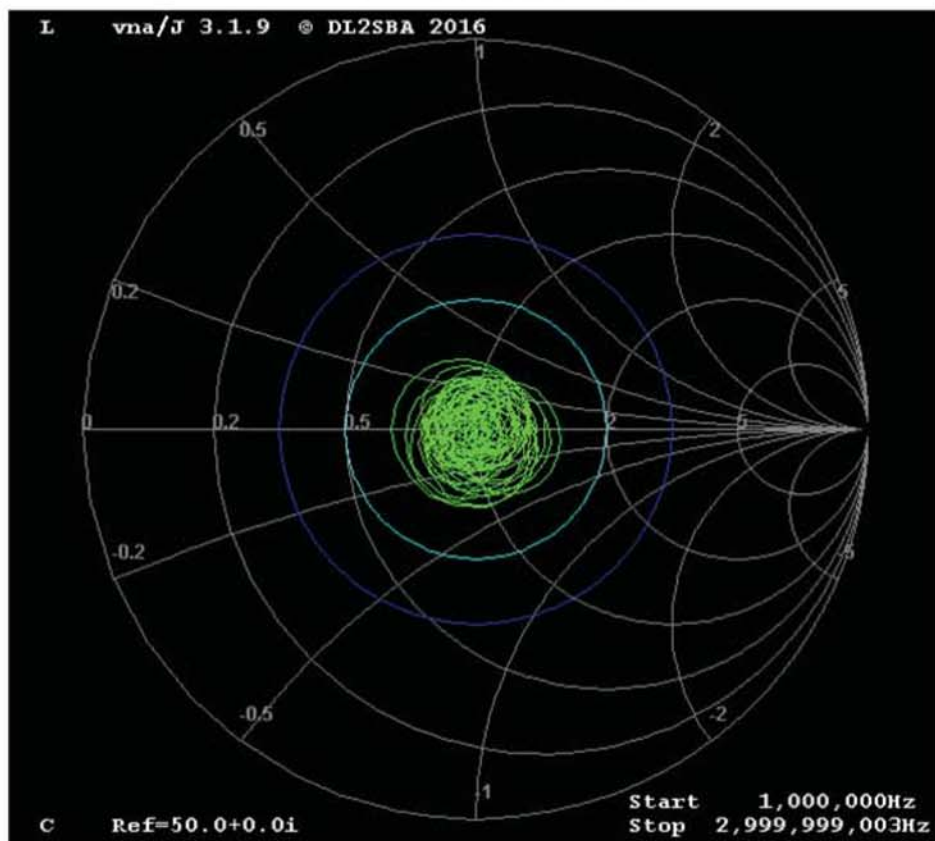


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RETURN LOSS

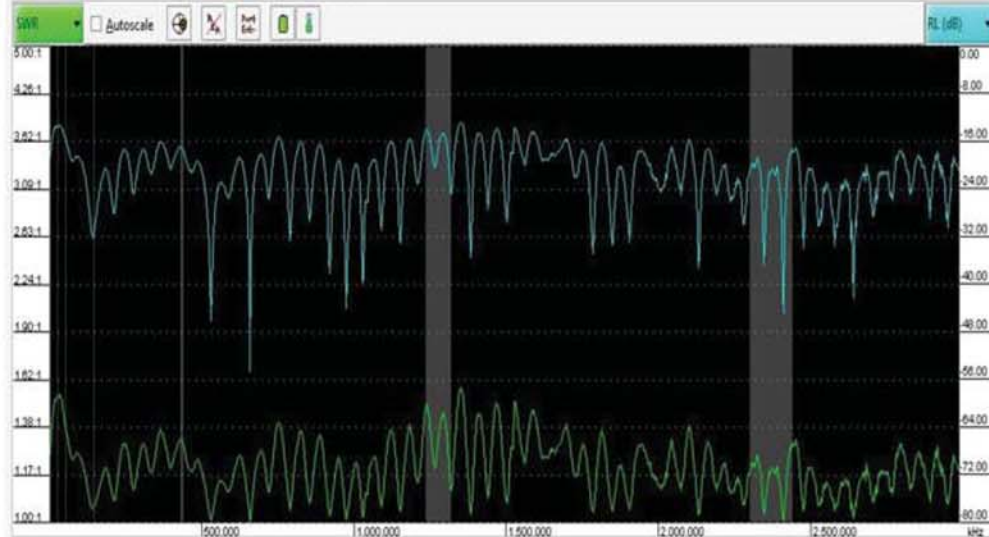


vna/ Version 3.1.9

File Tools Calibration Export Analyzer Presets

Help

SWR Autoscale



Frequency
Start (Hz) 1,000,000
Stop (Hz) 2,999,999,026

Presets (Hz)

Start	Stop

	Freq. (Hz)	RL (dB)	RP (°)	Z (Ω)	Rs (Ω)	Xs (Ω)	Theta	SWR	
M									<input type="checkbox"/> V_{11} V_{21}
1									<input type="checkbox"/> V_{11} V_{21}
2									<input type="checkbox"/> V_{11} V_{21}
3									<input type="checkbox"/> V_{11} V_{21}
4									<input type="checkbox"/> V_{11} V_{21}

Mode
Reflection
Zoom
☐ Freerun ☒ Single scan
Speed: -8 -4 0 4 8

miniVNA Tiny/COM4

1000.0

@38.8°C

G T E M 500 - Guaranteed reflection coefficient S11.	
Reflection coefficient S11	S11 accuracy magnitude/phase
≤ 14 dB in 100 MHz-3,8 GHz	± 2 dB / 1 degrees

FILTER UNITS – Schematic Diagram



Mains Line Filter



Feed-thru filters



Component List:

N.1 16Amps magneto-thermally switch.

N.1 16A 250V IEC input power line panel male socket (External)

N.1 250V SCHUCO output power line female tape (Internal)

FILTER: DELTA ELECTRONICS INC. Mod. 30VBGS5 250Vac 2x30A, 50/60 Hz

$L=2 \times 0,6 \text{ mH}$, $C_x=2 \times 0.1 \text{ uF}$, $C_y=2 \times 4700 \text{ pF}$, $R=1,0 \text{ MOhm}$

Filter: SCHURTER Mod.5500-2061, FSW2-65-6/5 250VAC 6Amps, 50-60 Hz

INSTRUCTION

Before using the GTEM 500 please read the following instructions



The cell is made to work in Horizontal position.
The Input port N connector at the top of the pyramid is very delicate: please take care avoiding to break the internal pin. For frequent use leave a coax cable in a stable connection.
The internal coaxial semi-rigid cable require care during handle, don't make torsion or fold too much .
The filter and the technical panel units contents feed-trough connections Pin-to-pin to supply EUT (Equipments under test) with AC or DC source or I/O connection. Please refer to the max limit stated in the specification section.
Don't apply over currents and over-voltage.



The unit must be separately earthed, or connected to an AC main source with a hearth connection.
Possibly supply energy from a tapes source equipped with earth connection and differential magneto- thermic protection switch



During immunity test, Don't leave open door, Radio frequency could interfere with civil communications. Long term Expositions at High RF levels could be dangerous for the health.



Maintenance require periodically check of the gaskets and the lock system. Don't apply strong pressure on to the gaskets. Leave the door open when the cell is stored for a long time, it preserve the gaskets. Keep clean the internal ambient of the cell from the carbon residual, it could cause short circuit in the E.U.T. and between the connections! If necessary help you with an air vacuum cleaner.

WARNINGS! READ BEFORE USING

- All the parts are covered from guarantee for a period of 1 year except ones subject to normal consumption as: gasket, coaxial type N or SMA connectors, anechoic pyramids.

- In case you discover defective parts please enter in contact through email: sales@frankonia-emv.com

ASSISTANCE

- Refer to our local dealer or contact us sending a mail at: sales@frankonia-emv.com

- The GTem cell is a professional test equipment intended for EMC emissions and immunity test purposes operated by trained personnel. Some care is necessary:

- don't hang or lift the apex to move the cell, push or pull from the frame trolley, before move the cell, loosen the fixing screws and than tight again.

- - Open or close the door softly.

- - Insert always straight the N and SMA connectors, don't tight too much, it is not necessary!.

- - One N type corner adaptor connector is supplied to protect the apex, please don't remove it.

- In case of break replace it.

RADIO FREQUENCY RADIATION

- Personnel should not be exposed to the microwave energy which may radiate from this device. All inputs or output RF connection gaskets must be leak proof. Never look inside or leave doors open when this device is energized!.

ELECTROMAGNETIC FIELD

- Strong RF levels may cause de-magnetization and interference to others services. Operate always with the door closed and keep far from sensitive devices.

SHOCK HAZARD

- Accidental short circuit or leakage current may occurs: Supply the unit through magneto-thermal differential switches lines. Keep always the GTem cell grounded also with power supply disconnected. During normal tests operation connect energy only with the door closed.

ELECTROSTATIC DISCHARGE

- To avoid ESD keep always the GTem cell grounded fitted with a permanent earth
16 sq.mm. wire conductor.

DANGER

- Risk of injury at hands and head or cuts around the metallic surfaces of the chamber may occurs. Leave around the cell a free area from obstacles.

MAINTENANCE

- Verify periodically:

- - the status of the door gasket,

- I/O connectors integrity.
 - Oil the wheels of the trolley and the door hinges.
 - Clean inside the chamber excess of dust with a vacuum cleaner.
 - Protect metallic surfaces against corrosion, cleaning with a soft cloth wet of Vaseline, Silicon or Parafine oils.
- Avoid cleaning with water based products or chlorine solutions!**

TROUBLESHOOTING

- **No power supply:** switch OFF, or over current >16A
- **No field with RF power applied:** pin of the coaxial connector broken: replace urgently with one similar

ADDITIONAL INFO

- **Power supply:** when necessary connect the AC 230V power cord only to tapes with differential switch and magneto-thermal switch.
- **Load:** Do not apply over load to the AC line filter: remember the max. load is 15A for the plug and 10Amps DC for the banana jacks,
- **Ground:** A ground connection is necessary for your safety: connect permanently the ground screw placed nearby the filter box at the your building earth system with a 16mm². Verify periodically the status of the connection. Remember that the metallic structure is conductive
- **Additional holes:** Make only on the technical panel (remove if it is necessary)
- **RF Power input:** No care necessary: the terminations are over dimensioned (the limit of the components is 500W when well cooled and operating temperature can reach 100°C without damages).