

GTEM cells

Application note:

Alternative emission measurements on automotive components below 30 MHz in a GTEM cell



Contents

1	General.....	4
1.1	Measurement set-up in general	4
1.2	Measurement set-up (from CISPR 25).....	4
1.3	Problems with standard procedure	5
2	Alternative procedure – GTEM cell	5
2.1	GTEM cell measurement set-up (top view).....	6
2.2	GTEM cell measurement set-up (side view)	6
2.3	Calculation of the transducer factor	7
2.4	Using of the transducer factor	7
2.5	Tables of the transducer factor for septum height 1.0 m – 0.8 m	8
2.6	Tables of the transducer factor for septum height 0.71 m – 0.56 m	9
3	Comparison screened room - GTEM-cell	10
3.1	Correlation of measurement results	10
3.2	Advantages of the GTEM cell procedure	10
3.3	Conclusions.....	10

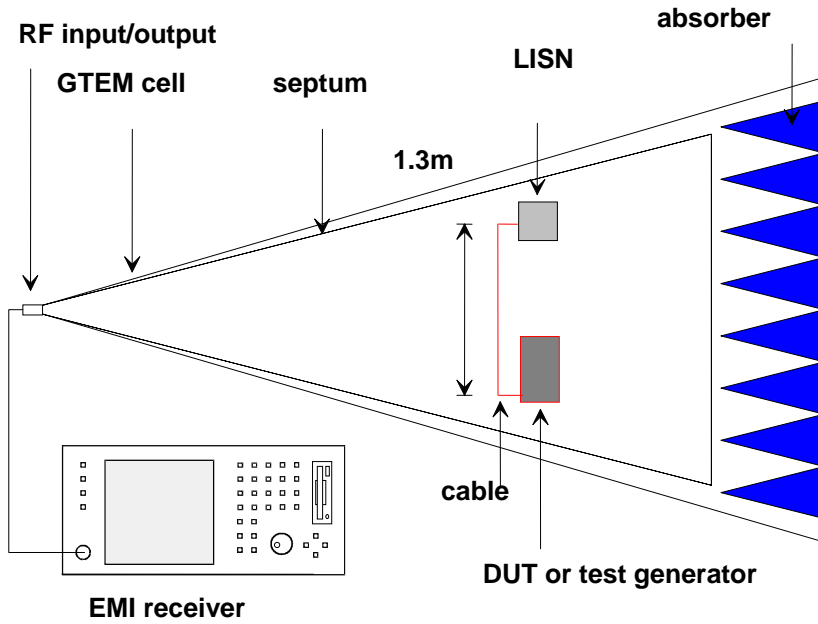
1.3 Problems with standard procedure

- proper grounding required, difficult in OATS and FAR
- hence, size of ground plane has influence
- resonant set-up with DUT possible
- standard requires only minimum size
- ideal: infinite large ground plane

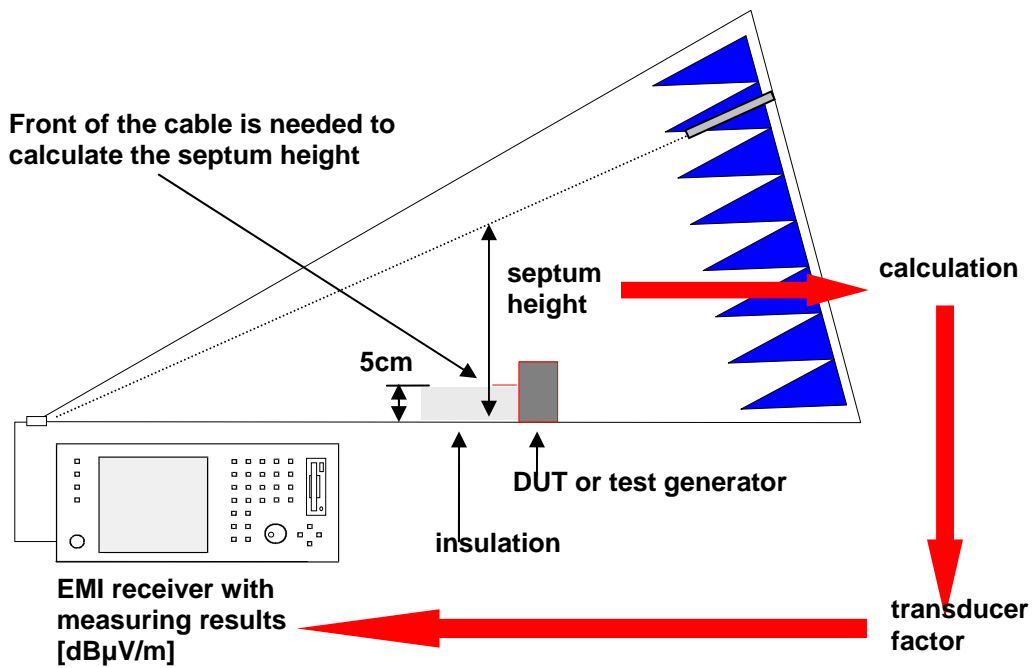
2 Alternative procedure – GTEM cell

- GTEM cell suitable for measurement of vertical E-fields (similar to rod antenna)
- set-up in GTEM cell similar to standard
- DUT on the floor of GTEM-cell
- test cable 5 cm above the floor of the GTEM cell with right angle to the axis of the GTEM cell
- front of the cable is needed to calculate the septum height in relation to the position in the GTEM (see measurement set-up side view)
- measured voltage u [dB μ V] + calculated factor k [dB/m] = field strength e [dB μ V/m]

2.1 GTEM cell measurement set-up (top view)



2.2 GTEM cell measurement set-up (side view)



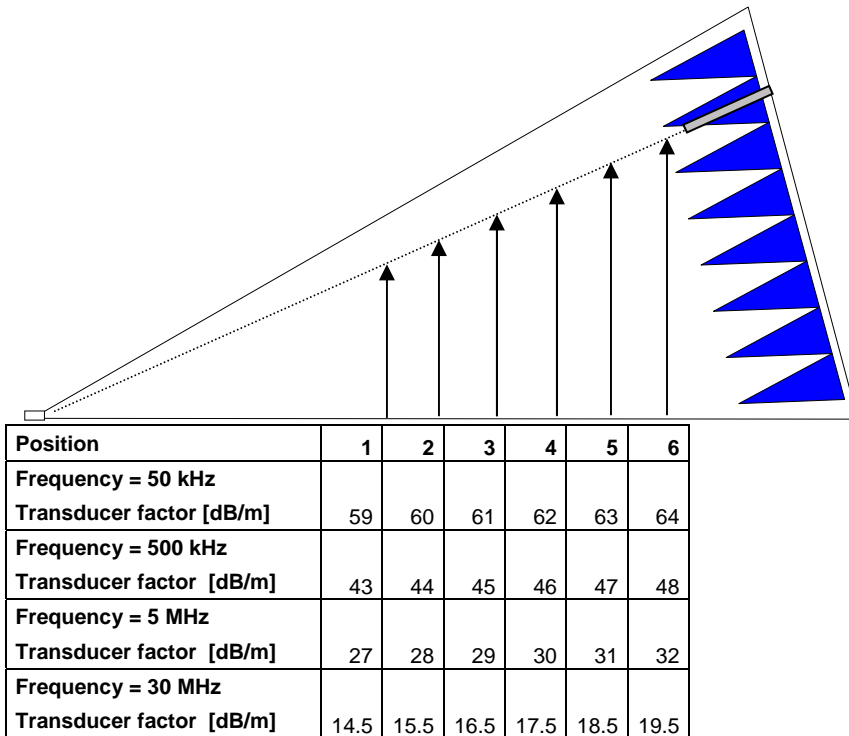
2.3 Calculation of the transducer factor

$$k = -16 * \log(f / 500 \text{ MHz}) + 20 * \log(h_{\text{septum}})$$

k in [dB/m]
h_{septum} in [m]

example: GTEM 1000
 used septum height: h_{septum} = 1.0m
 k = 75 dB/m @ 10 kHz
 k = 20 dB/m @ 30 MHz

2.4 Using of the transducer factor



2.5 Tables of the transducer factor for septum height 1.0 m – 0.8 m

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	1.00	75.2
0.015	1.00	72.4
0.020	1.00	70.4
0.025	1.00	68.8
0.030	1.00	67.5
0.040	1.00	65.6
0.050	1.00	64.0
0.060	1.00	62.7
0.075	1.00	61.2
0.100	1.00	59.2
0.150	1.00	56.4
0.200	1.00	54.4
0.250	1.00	52.8
0.375	1.00	50.0
0.500	1.00	48.0
0.750	1.00	45.2
1.000	1.00	43.2
1.500	1.00	40.4
2.000	1.00	38.4
3.000	1.00	35.5
4.000	1.00	33.6
5.000	1.00	32.0
7.500	1.00	29.2
10.000	1.00	27.2
15.000	1.00	24.4
20.000	1.00	22.4
25.000	1.00	20.8
30.000	1.00	19.5

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	0.89	74.2
0.015	0.89	71.4
0.020	0.89	69.4
0.025	0.89	67.8
0.030	0.89	66.5
0.040	0.89	64.5
0.050	0.89	63.0
0.060	0.89	61.7
0.075	0.89	60.2
0.100	0.89	58.2
0.150	0.89	55.4
0.200	0.89	53.4
0.250	0.89	51.8
0.375	0.89	49.0
0.500	0.89	47.0
0.750	0.89	44.2
1.000	0.89	42.2
1.500	0.89	39.4
2.000	0.89	37.4
3.000	0.89	34.5
4.000	0.89	32.5
5.000	0.89	31.0
7.500	0.89	28.2
10.000	0.89	26.2
15.000	0.89	23.4
20.000	0.89	21.4
25.000	0.89	19.8
30.000	0.89	18.5

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	0.80	73.2
0.015	0.80	70.4
0.020	0.80	68.4
0.025	0.80	66.9
0.030	0.80	65.6
0.040	0.80	63.6
0.050	0.80	62.1
0.060	0.80	60.8
0.075	0.80	59.2
0.100	0.80	57.2
0.150	0.80	54.4
0.200	0.80	52.4
0.250	0.80	50.9
0.375	0.80	48.1
0.500	0.80	46.1
0.750	0.80	43.2
1.000	0.80	41.2
1.500	0.80	38.4
2.000	0.80	36.4
3.000	0.80	33.6
4.000	0.80	31.6
5.000	0.80	30.1
7.500	0.80	27.2
10.000	0.80	25.2
15.000	0.80	22.4
20.000	0.80	20.4
25.000	0.80	18.9
30.000	0.80	17.6

2.6 Tables of the transducer factor for septum height 0.71 m – 0.56 m

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	0.71	72.2
0.015	0.71	69.4
0.020	0.71	67.4
0.025	0.71	65.8
0.030	0.71	64.6
0.040	0.71	62.6
0.050	0.71	61.0
0.060	0.71	59.8
0.075	0.71	58.2
0.100	0.71	56.2
0.150	0.71	53.4
0.200	0.71	51.4
0.250	0.71	49.8
0.375	0.71	47.0
0.500	0.71	45.0
0.750	0.71	42.2
1.000	0.71	40.2
1.500	0.71	37.4
2.000	0.71	35.4
3.000	0.71	32.6
4.000	0.71	30.6
5.000	0.71	29.0
7.500	0.71	26.2
10.000	0.71	24.2
15.000	0.71	21.4
20.000	0.71	19.4
25.000	0.71	17.8
30.000	0.71	16.6

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	0.63	71.2
0.015	0.63	68.4
0.020	0.63	66.4
0.025	0.63	64.8
0.030	0.63	63.5
0.040	0.63	61.5
0.050	0.63	60.0
0.060	0.63	58.7
0.075	0.63	57.2
0.100	0.63	55.2
0.150	0.63	52.4
0.200	0.63	50.4
0.250	0.63	48.8
0.375	0.63	46.0
0.500	0.63	44.0
0.750	0.63	41.2
1.000	0.63	39.2
1.500	0.63	36.4
2.000	0.63	34.4
3.000	0.63	31.5
4.000	0.63	29.5
5.000	0.63	28.0
7.500	0.63	25.2
10.000	0.63	23.2
15.000	0.63	20.4
20.000	0.63	18.4
25.000	0.63	16.8
30.000	0.63	15.5

Frequency	Septum height	Transducer factor
MHz	m	dB/m
0.010	0.56	70.1
0.015	0.56	67.3
0.020	0.56	65.3
0.025	0.56	63.8
0.030	0.56	62.5
0.040	0.56	60.5
0.050	0.56	59.0
0.060	0.56	57.7
0.075	0.56	56.1
0.100	0.56	54.1
0.150	0.56	51.3
0.200	0.56	49.3
0.250	0.56	47.8
0.375	0.56	45.0
0.500	0.56	43.0
0.750	0.56	40.1
1.000	0.56	38.1
1.500	0.56	35.3
2.000	0.56	33.3
3.000	0.56	30.5
4.000	0.56	28.5
5.000	0.56	27.0
7.500	0.56	24.1
10.000	0.56	22.1
15.000	0.56	19.3
20.000	0.56	17.3
25.000	0.56	15.8
30.000	0.56	14.5

3 Comparison screened room - GTEM-cell

3.1 Correlation of measurement results

- correlation of measurement results provides a
linear correction factor
- correction factor can be used to convert the measured voltage of the GTEM cell into the equivalent field strength
- correction factor can be implemented in emission software for automatic field strength measurements

3.2 Advantages of the GTEM cell procedure

- simple set-up
- highly stable procedure
- very high sensitivity
- excellent reproducibility
- no problems with grounding
- can fully replace measurements using 1 m rod antenna in 1 m distance for frequencies below 30 MHz

3.3 Conclusions

- Screened room. FAR: exact observance of the measurement conditions required
- especially grounding is a critical parameter
- GTEM-cell: simple and excellent reproducible procedure
- limits:
 - change of polarisation not possible
 - large GTEM-cells for large DUT required