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 250

GTEM 250

Septum height = **0,250** m

Flatness = 3 dB = 2

Power Required = (E x h)^2 /R x Flatness x Modulation Allowance

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

Power Required = (10 x0,250)^2 / 50 x 2 x 3.24 = 0,25 Watt

Power required for all GTEM 250 with 80 % amplitude modulation.

GTEM-250 Calculating Power requirement				
Field Strenght E	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM**	**Watts**	**Watts**
3	2	3,24	0,073	**0,0225**
10	2	3,24	0,81	**0,25**
30	2	3,24	7,29	**2,25**
100	2	3,24	81	**25**
200	2	3,24	324	**50**

GTEM 400

Septum height = **0,400** m

Flatness = 3 dB = 2

Power Required = (E x h)^2 /R x Flatness x Modulation Allowance

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

Power Required = (50 x0,400)^2 / 50 x 2 x 3.24 = 51,84 Watt

Power required for GTEM 400 with 80 % amplitude modulation.

GTEM-400 Calculating Power requirement				
Field Strenght E	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM**	**Watts**	**Watts**
3	2	3,24	0,19	0,07
10	2	3,24	2,07	0,64
50	2	3,24	**51,84**	**16**
100	2	3,24	199,68	61,73

GTEM 500

Septum height = **0,5** m

Flatness = 3 dB = 2

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

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

Power Required = (10 x0,50)^2 / 50 x 2 x 3,24 = 3,24 Watt

GTEM-500 Calculating Power requirement				
Field Strenght E	Flatness	Modulation allowance	Required power modulated	Required power CW
V/m	3dB = 2	80% AM	Watts	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
200	2	3,24	1296	200

GTEM 750

Septum height = **0,75** m

Flatness = 3 dB = 2

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

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

Power Required = (10 x0,75)^2 / 50 x 2 x 3,24 = 7,29 Watt

GTEM-750 Calculating Power requirement				
Field Strenght E	Flatness	Modulation allowance	Required power modulated	Required power CW
V/m	3dB = 2	80% AM	Watts	Watts
3	2	3,24	0,66	0,20
10	2	3,24	7,29	2,25
20	2	3,24	29,16	9
30	2	3,24	65,61	20,25
50	2	3,24	182,25	56,25
100	2	3,24	729	225
200	2	3,24	2916	900

GTEM 1000

Septum height = **1,0** m

Flatness = 3 dB = 2

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

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

Power Required = (10 1,0)^2 / 50 x 2 x 3,24 = 12,96 Watt

GTEM-1000 Calculating Power requirement				
Field Strenght E	Flatness	Modulation allowance	Required power modulated	Required power CW
V/m	3dB = 2	80% AM	Watts	Watts
3	2	3,24	1,17	0,36
10	2	3,24	13	4
20	2	3,24	116	36

100	2	3,24	1296	400

GTEM 1250

Septum height = **1,250** m

Flatness = 3 dB = 2

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

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

Power Required = $(10 \times 1{,}250)^2 / 50 \times 2 \times 3.24$ = 20,25 Watt

G T E M 1 2 5 0 – Calculating Power requirements				
Field Strenght [E]	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM**	**Watts**	**Watts**
3	2	3,24	1,8	0,56
10	2	3,24	20,25	5,6
30	2	3,24	182,25	50,6
100	2	3,24	2025	562

GTEM-1500

Septum height = **1,5** m
Flatness = 3 dB = 2
Power Required = $(E \times h)^2 / R \times$ Flatness x Modulation Allowance
Where E = required field strength: h = septum height: R = GTEM input impedance (50Ohm)
Power Required = $(10 \times 1{,}5)^2 \times 2 \times 3.24$ = 29,16 Watt

GTEM-1500 Calculating Power requirement				
Field Strenght E	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM**	**Watts**	**Watts**
10	2	3,24	29,16	**4,5**
30	2	3,24	262,44	**40,5**
100	2	3,24	2916	**450**

GTEM 1750

Septum height = **1,75** m

Flatness = 3 dB = 2

Power Required = $[(E \times h)^2 / R] \times$ Flatness x Modulation Allowance

Where:

E [V/m] = required field strength: (i.e. 10V/m)

h [m] = septum height

R = GTEM input impedance (50 Ohm)

Power Required = $[(10 \times 1.75)^2 / 50] \times 2 \times 3.24$ = 51,84 Watt

G T E M 1 7 5 0 - Calculating Power requirements				
Field Strenght [E]	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM, 1Khz**	**Watts**	**Watts**
3	2	3,24	3,46	1,07
10	2	3,24	39,96	12,33
30	2	3,24	357,21	110,25

GTEM 2000

Septum height = 2 m

Flatness = 3 dB = 2

Power Required = [(E x h)2 /R] x Flatness x Modulation Allowance

Where

E [V/m] = required field strength:

h [m] = septum height

R = GTEM input impedance (50 Ohm)

Power Required = [(10 x 2)2 / 50] x 2 x 3.24 = 51,84 Watt

G T E M 2 0 0 0 -Calculating Power requirements				
Field Strenght [E]	**Flatness**	**Modulation allowance**	**Required power modulated**	**Required power CW**
V/m	**3dB = 2**	**80% AM, 1Khz**	**Watts**	**Watts**
3	2	3,24	4,67	1,44
10	2	3,24	51,84	16
30	2	3,24	466,56	144

The field strength at the position of the EUT is

$$E = \frac{\sqrt{P \cdot Z}}{h}. \tag{2.2}$$

So the field strength is a function of the input power and the distance h from the bottom outer to the center conductor. In figure 2.3 the nominal field strength in the testing volume is plotted against h for different values of P with a characteristic line impedance of $Z = 50\ \Omega$.

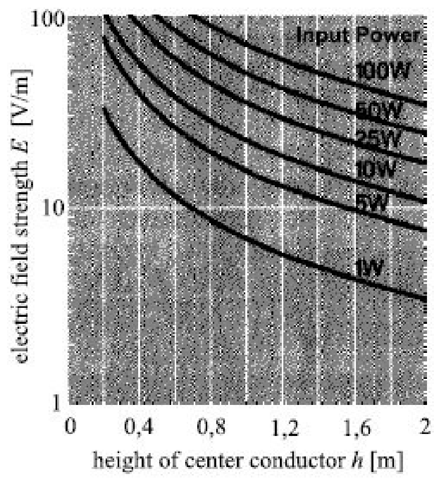

Figure 2.3: *The calculated nominal field strength in the center of the volume below the center conductor as a function of input power and distance h between the bottom outer conductor and the center conductor.*

A nominal field strength in the testing area of 10 V/m will meet most requirements for EMC measurements. For a small cell with a distance $h = 0.5$ m at the testing volume a nominal field strength of 10 V/m can be achieved with an input power of $P = 0.5$ W according to (2.2). Even for larger cells the input power is much less than the necessary input power for susceptibility measurements performed in anechoic rooms, where the EUT is typically situated 3 or 10 m from the transmitting antenna.