

# EMC Regulations : Levels

Limits for conducted disturbance at the mains ports of Class A ITE		
Frequency range MHz	Limits dB( $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	79	66
0.5 to 30	73	60
Note – The lower limit shall apply at the transition frequency		

Limits for conducted disturbance at the mains ports of Class B ITE		
Frequency range MHz	Limits dB( $\mu$ V)	
	Quasi - peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50
Notes		
1. The lower limit shall apply at the transition frequencies		
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz		

# EMC Regulations : Levels

Limits for radiated disturbance of Class A ITE at a measuring of 10 m

Frequency range MHz	Quasi – peak limits dB( $\mu$ V/m)
30 to 230	40
230 to 1000	47

Notes

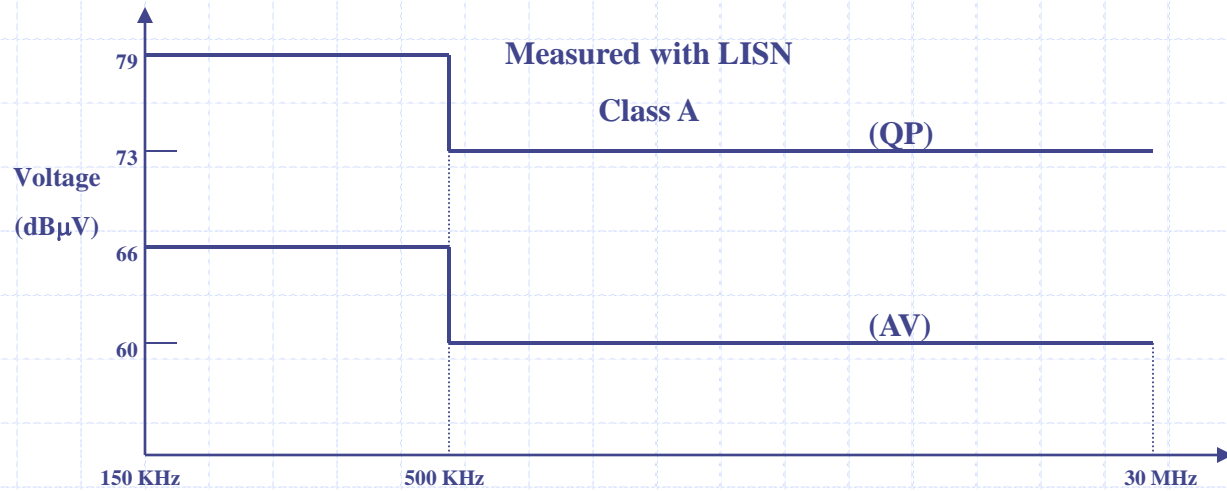
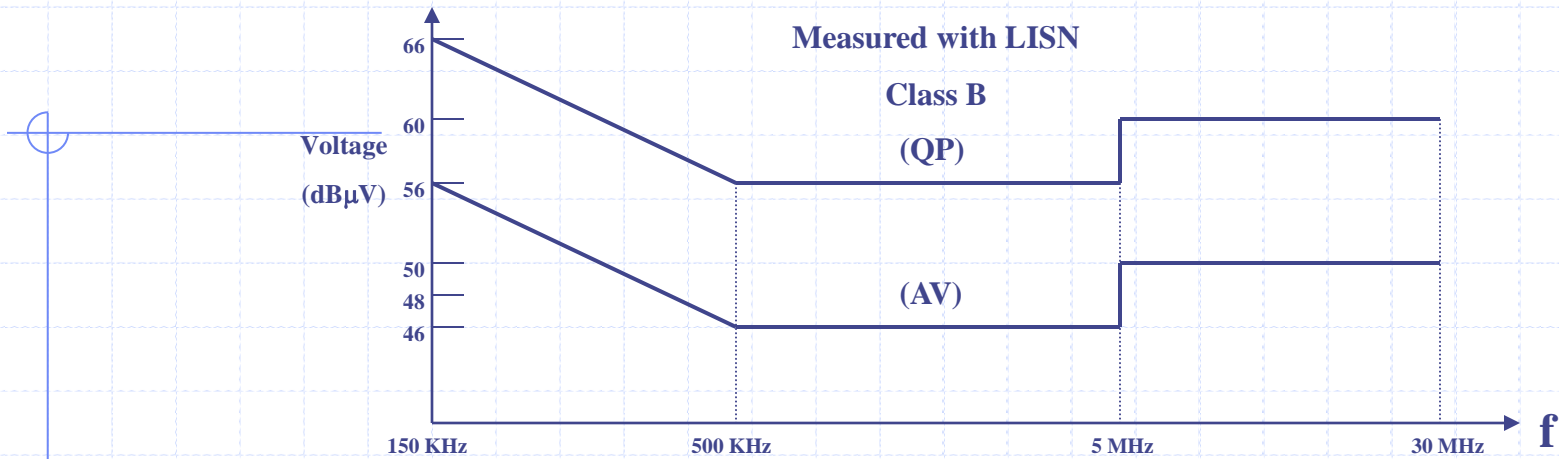
1. The lower limit shall apply at the transition frequency
2. Additional provisions may be required for cases where interference occurs

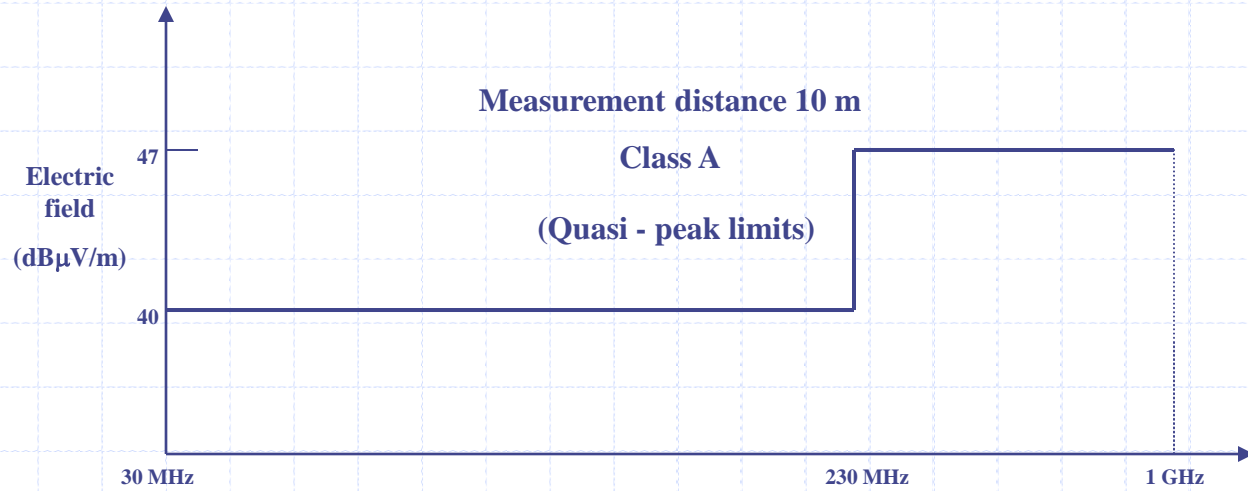
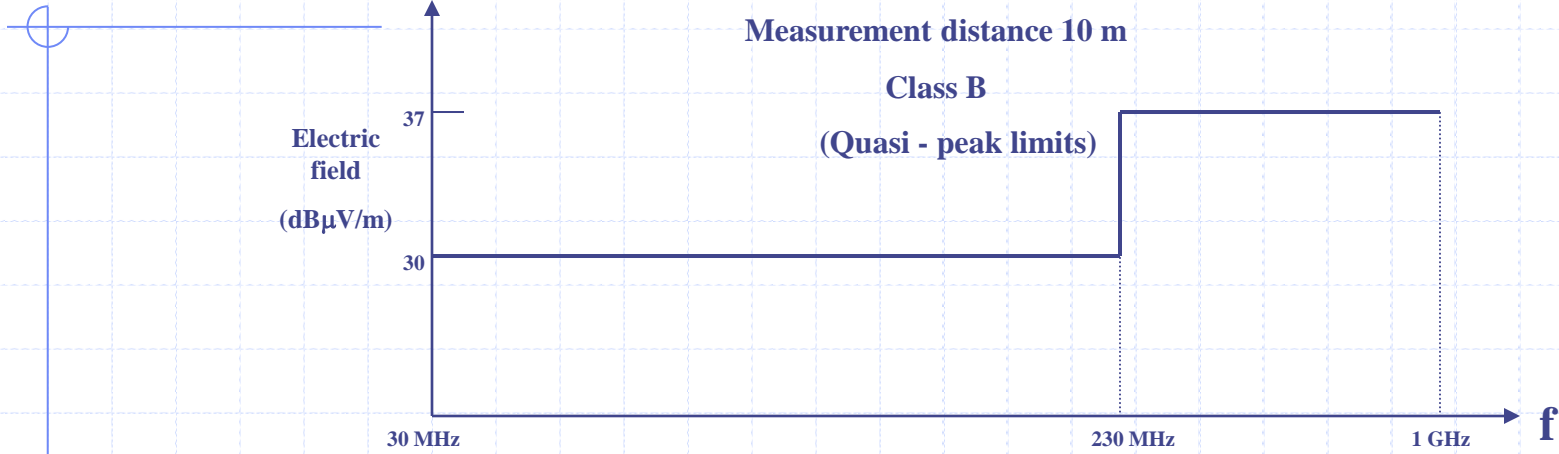
Limits for radiated disturbance of Class B ITE at a measuring of 10 m

Frequency range MHz	Quasi – peak limits dB( $\mu$ V/m)
30 to 230	30
230 to 1000	37

Notes

1. The lower limit shall apply at the transition frequency
2. Additional provisions may be required for cases where interference occurs



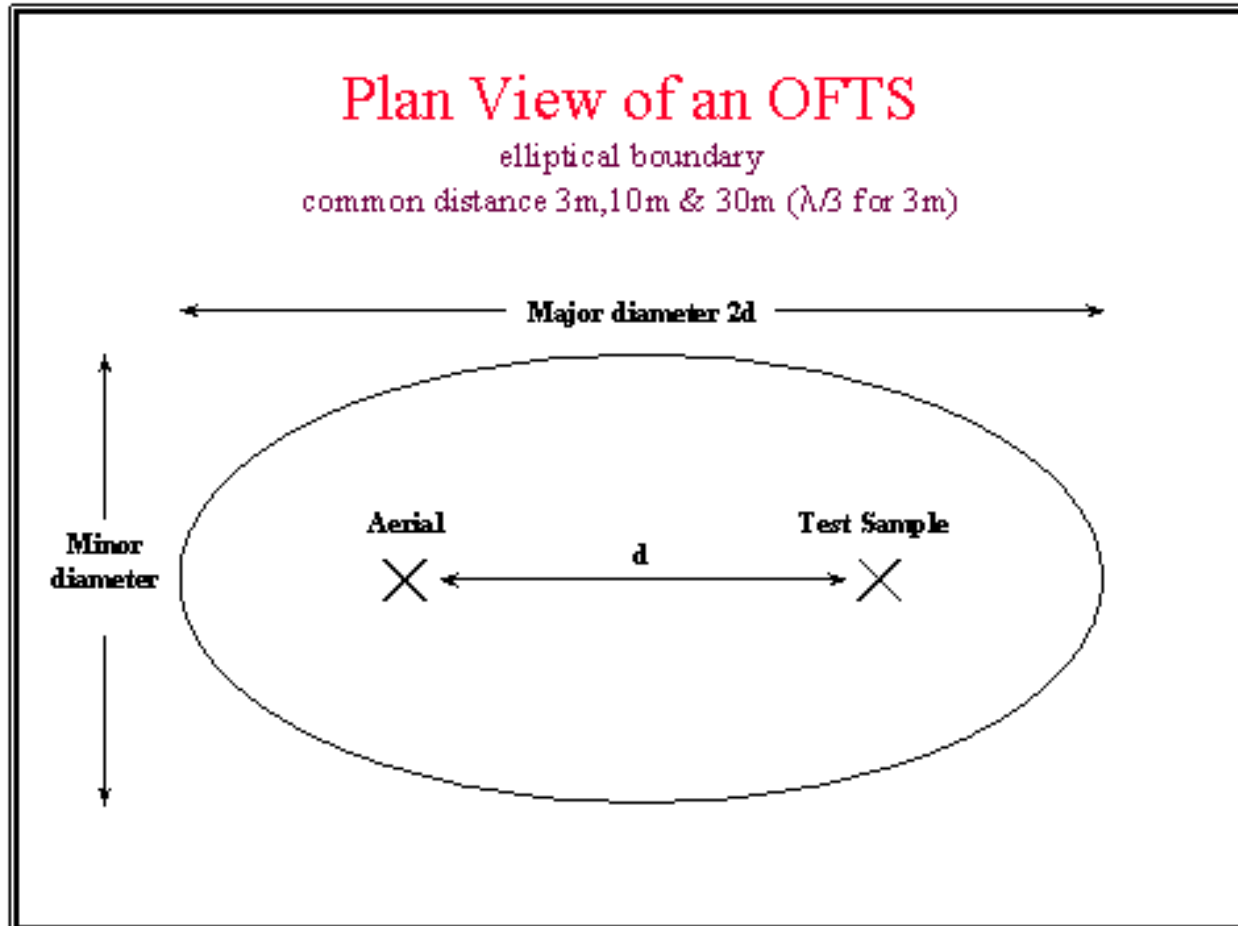


# Open Area Test Site (OATS)

## RE measurement (EN55022)

- OATS
- elliptical boundary
- common distance 3m, 10m & 30m ( $\lambda/3$  for 3m)
- size of DUT =  $2D^2/\lambda$  (Rayleigh Range criterion)
- ground plane roughness  $\pm 20\text{mm}$
- Ground plane conductor ( max mesh size 20mm)
- site attenuation  $\pm 3\text{db}$
- antenna positioned at 1-4m for maximum field strength

# Open Area Test Site (OATS)



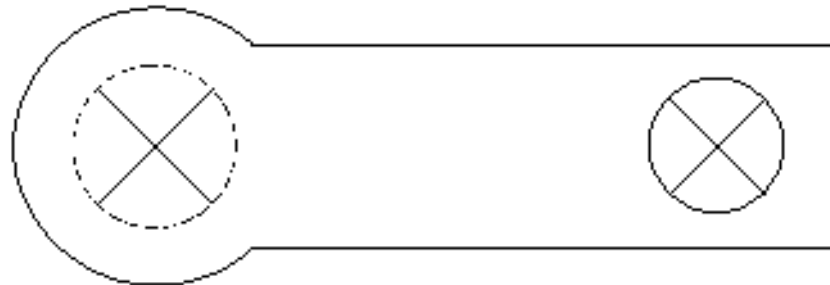
# Open Area Test Site (OATS)

## OATS Groundplane Minimum Area

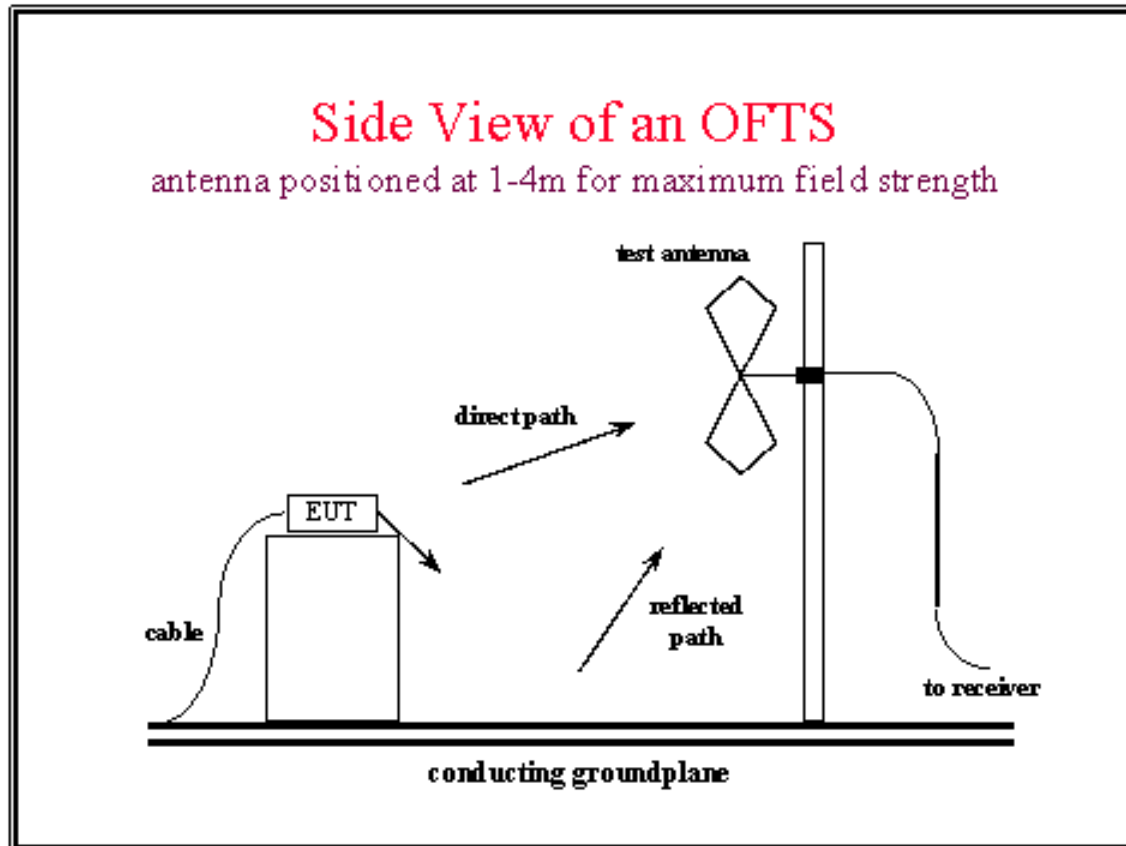
ground plane roughness  $\pm 20\text{mm}$   
Ground plane conductor ( max mesh size 20mm)

equipment under test

aerial

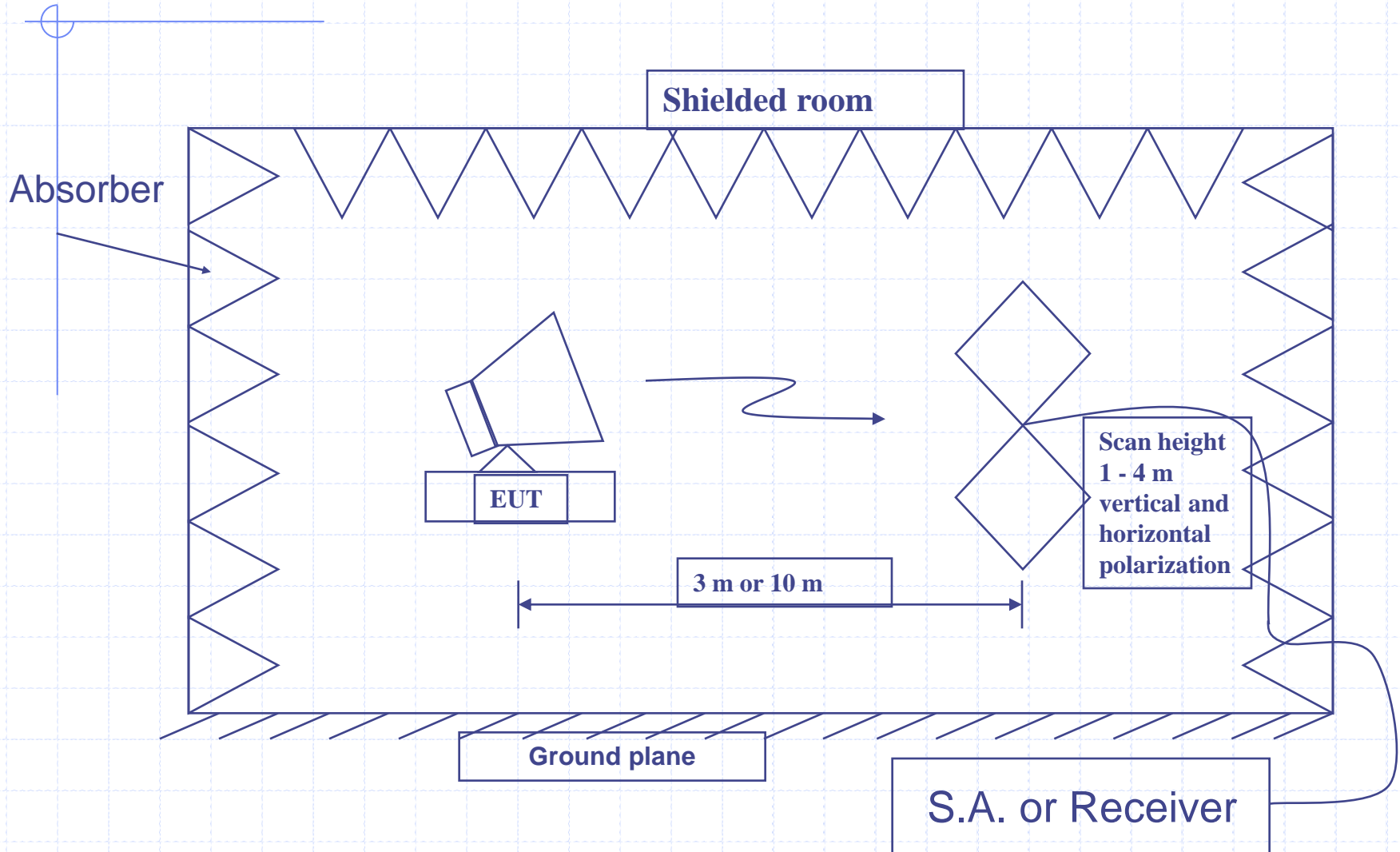


# Open Area Test Site (OATS)



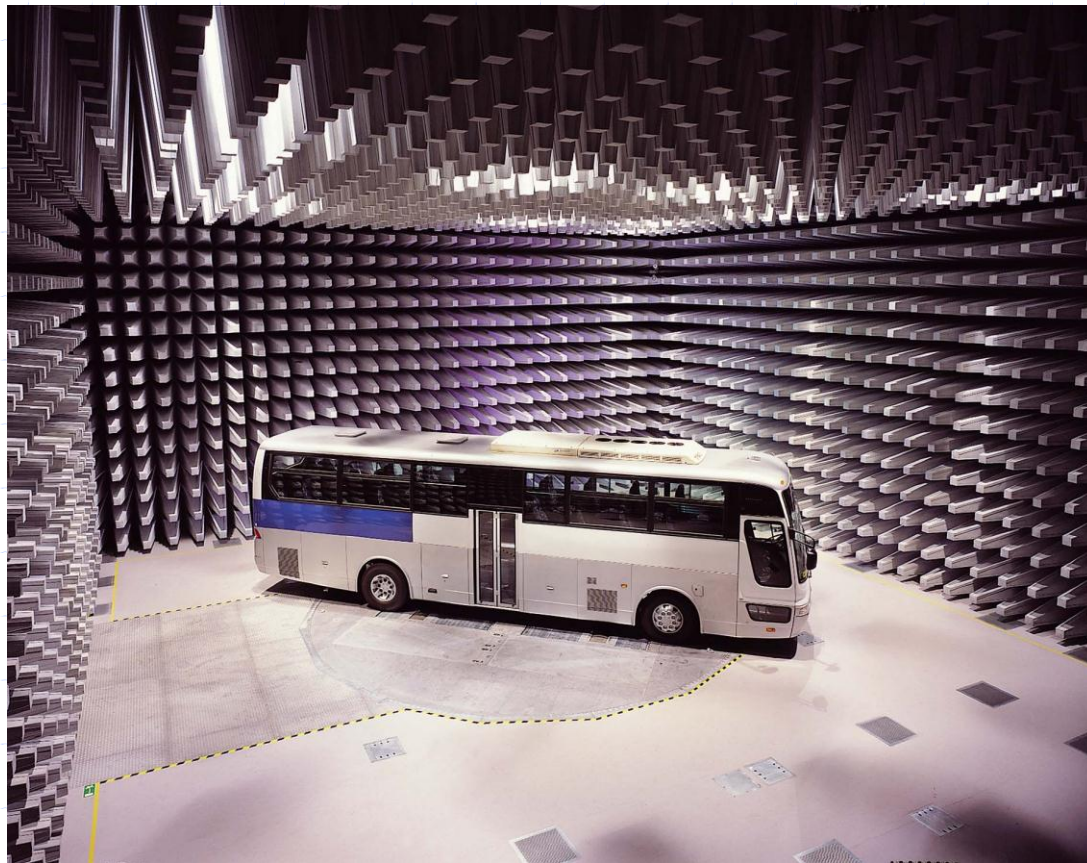


# Semi-Anechoic Chamber



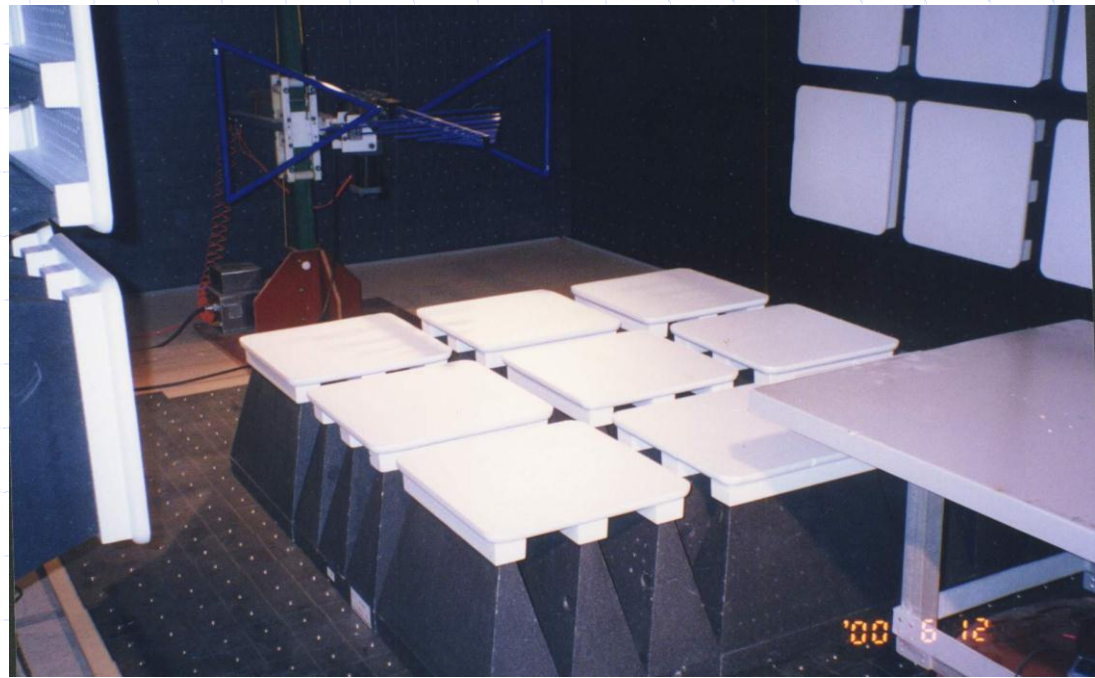
# Measurement: EMI

## System Level

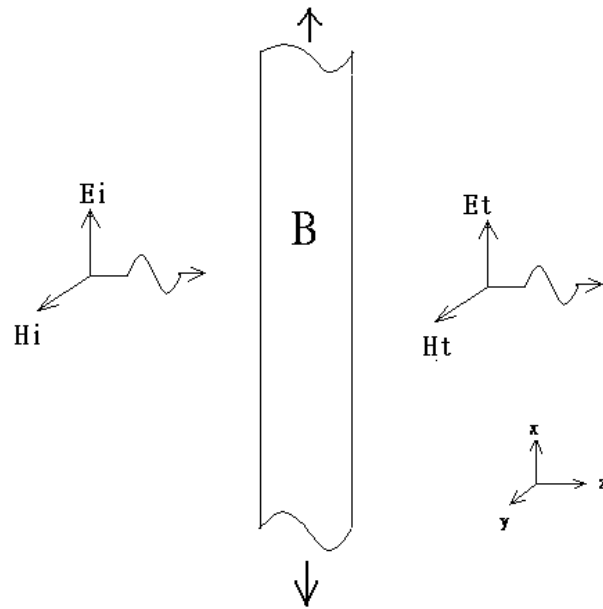


# Fully Anechoic Chamber

## EMI Measurement Environment

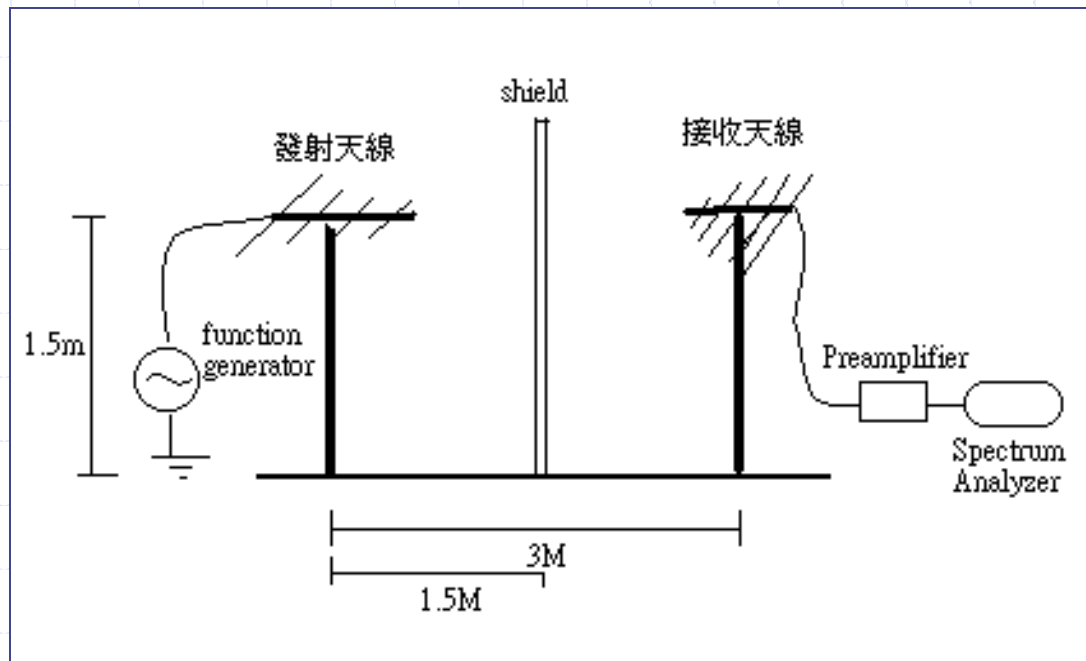


# Shielding Effectiveness (EN50147-1)

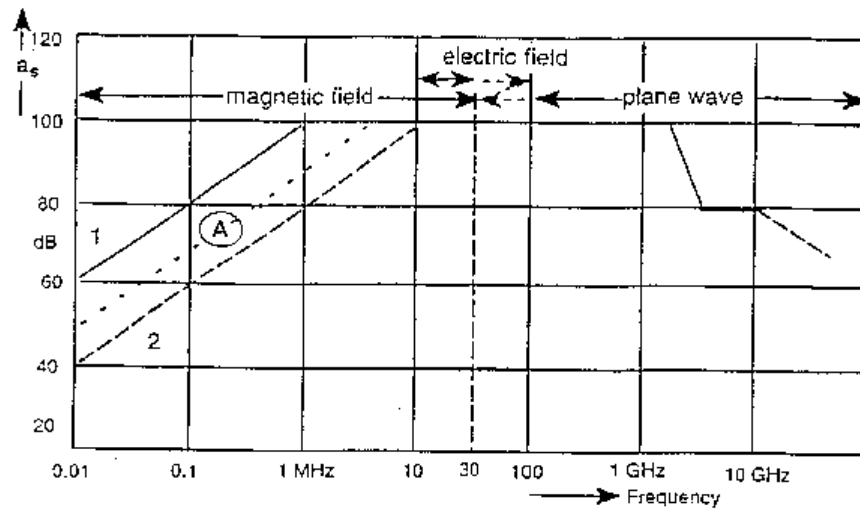


$$SE \equiv 20 \log \left| \frac{E_i}{E_t} \right|$$

# Shielding Effectiveness (EN50147-1)



# Shielding Effectiveness (EN50147-1)

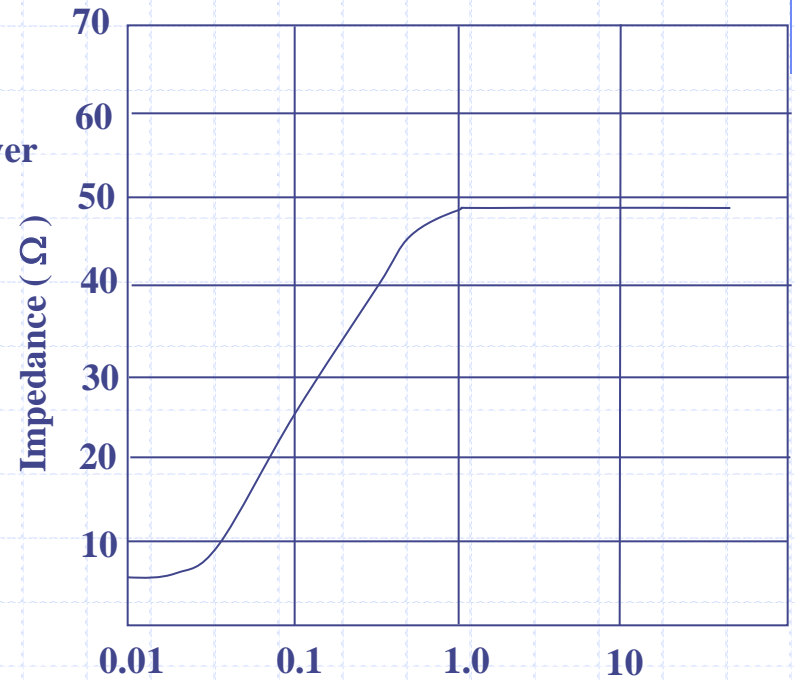
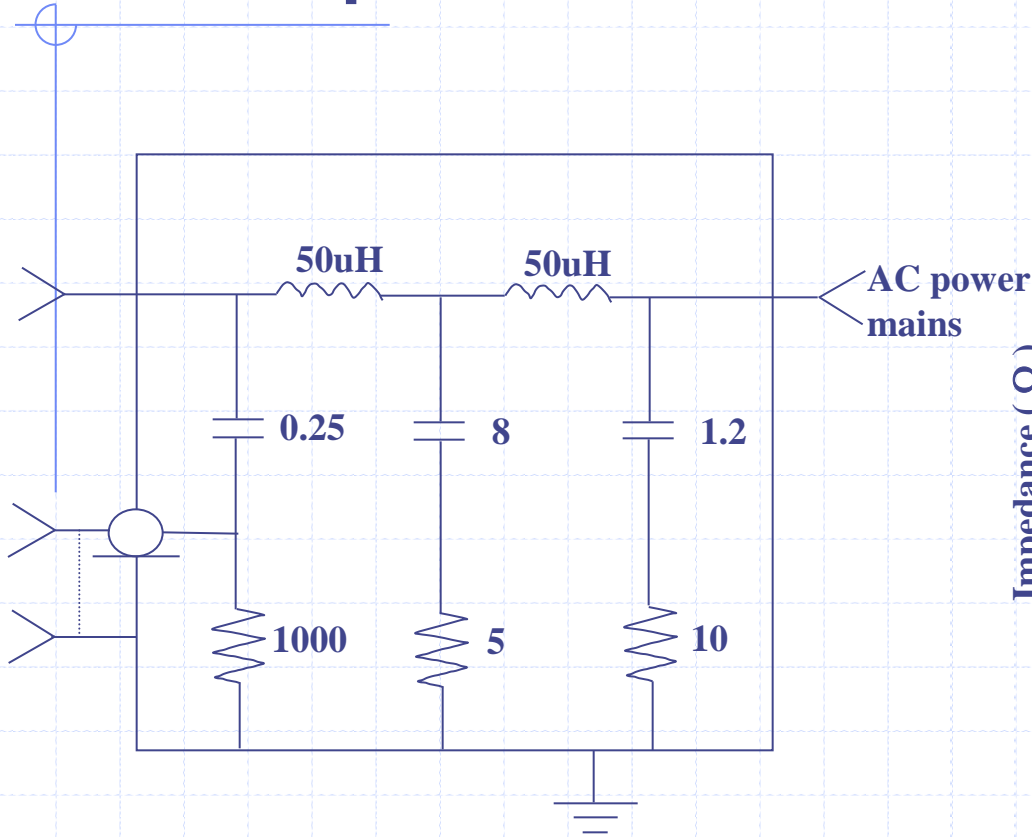


- $a_s$  = shield attenuation in dB
- curve A = tolerated performance of the door seams for high performance shielded enclosure
- curve 1 = high performance of a shielded enclosure
- curve 2 = standard performance of a shielded enclosure

Figure 2: Typical shield attenuation values



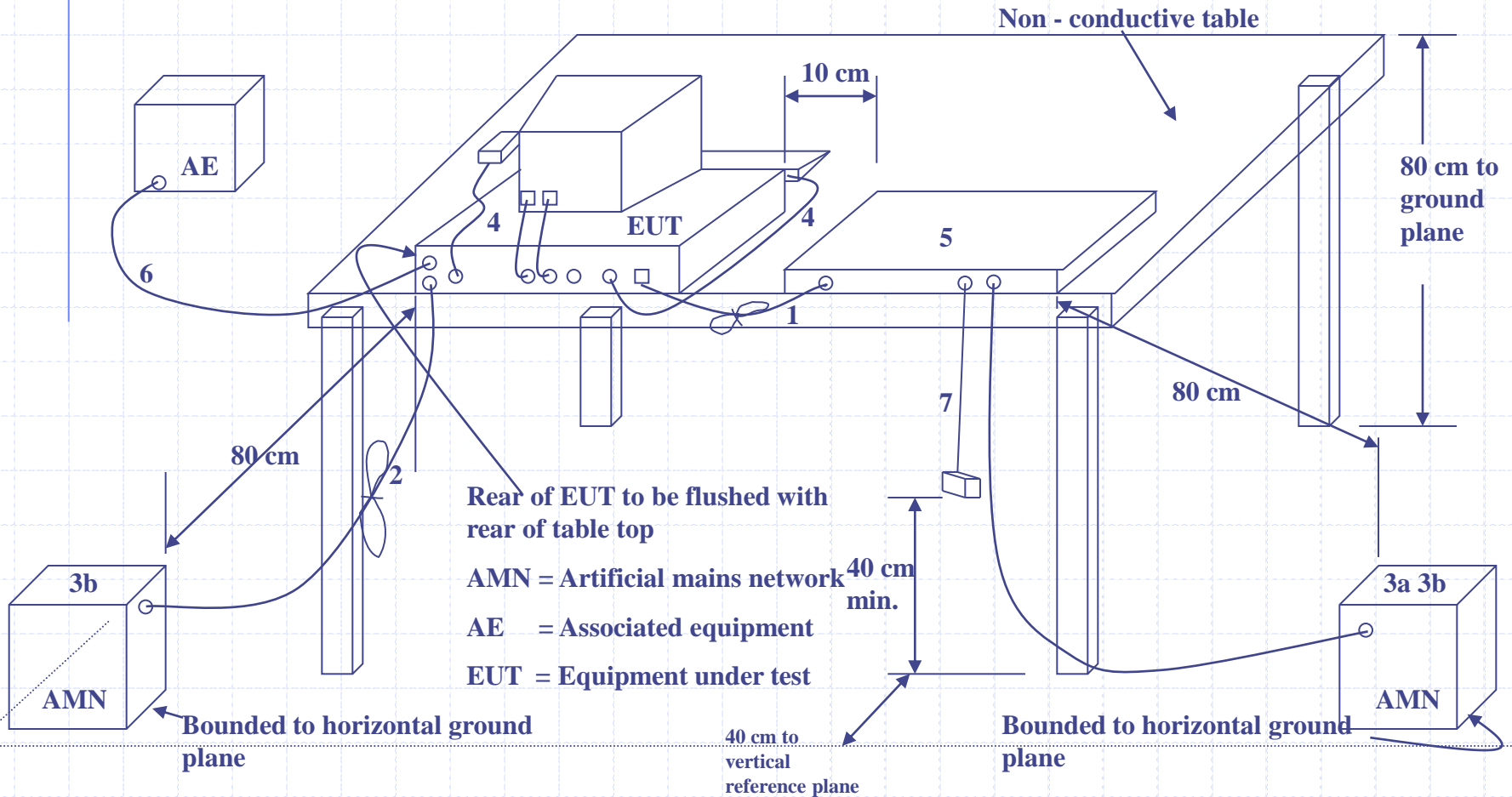
# Line Impedance Stabilization Network (LISN)



Impedance characteristic of the LISN at EUT port

# Test Setups and Illustrations

**Test configuration : tabletop equipment ( conducted measurement )**





If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to approximate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long. Excess mains cord shall be bundled in the center or shortened to appropriate length.

EUT connected to one AMN. All AMNs may alternatively be connected to the vertical reference plane or metal wall.

3a) All other units of a system powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.

3b) AMN 80 cm from EUT and at least 80 cm from other units and other metal planes.

3c) Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.

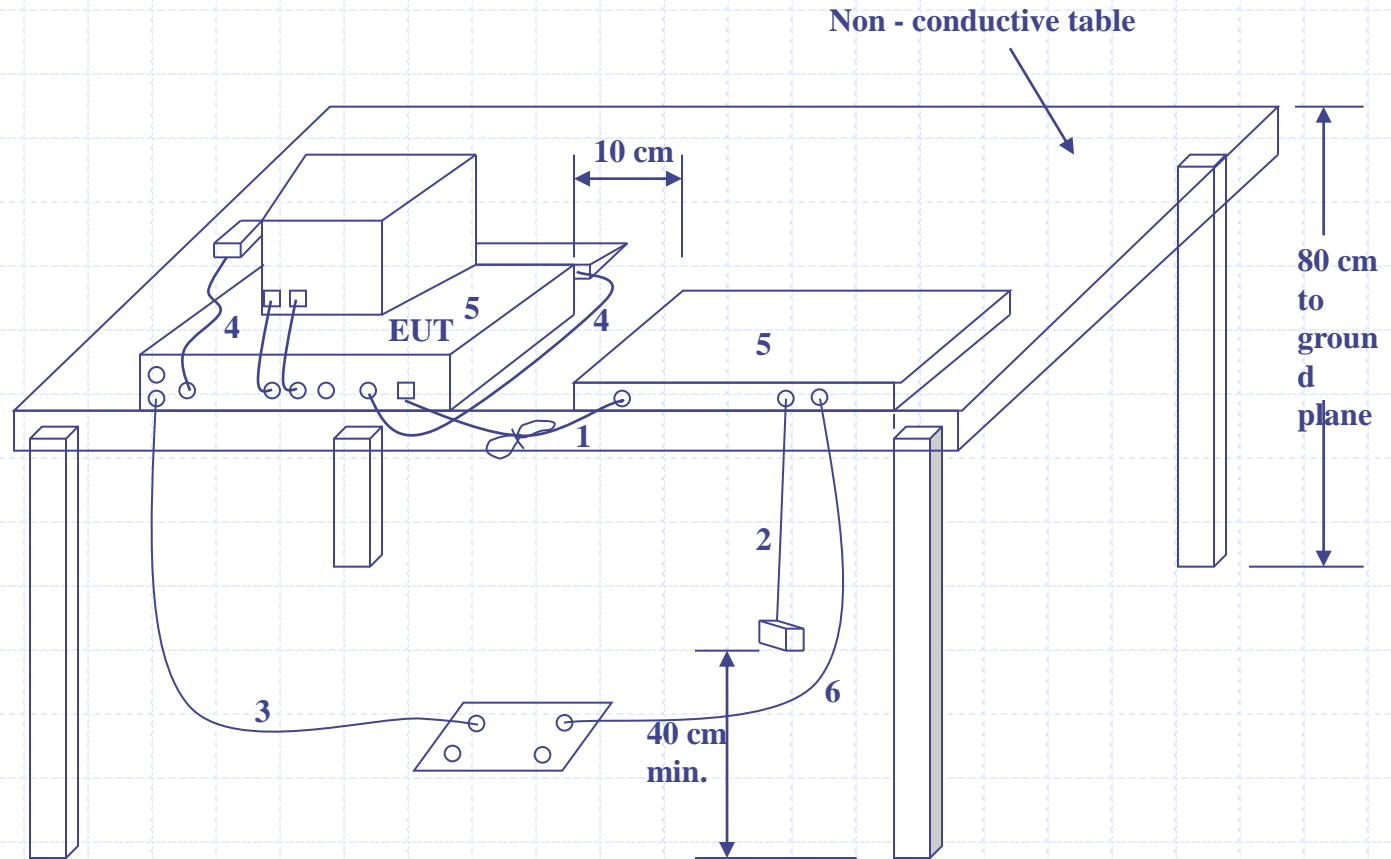
Cables of hand operated devices, such as keyboards, mouses, etc. shall be placed as for normal usage.

Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if for an acceptable installation practice, shall be placed directly on the top of the controller.

I/O signal cable intended for external connection.

The end of the I/O cables which are not connected to an AE may be terminated if required using correct terminating impedance.

## Test configuration : tabletop equipment ( radiated measurement )



**If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to approximate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long. The end of the I/O cables which are not connected to a peripheral may be terminated if required for proper operation using correct terminating impedance.**

**Mains junction box(s) shall be flush with and bonded directly to the metal ground plane.**

**NOTE - If used, the AMN shall be installed under the horizontal metal ground plane.**

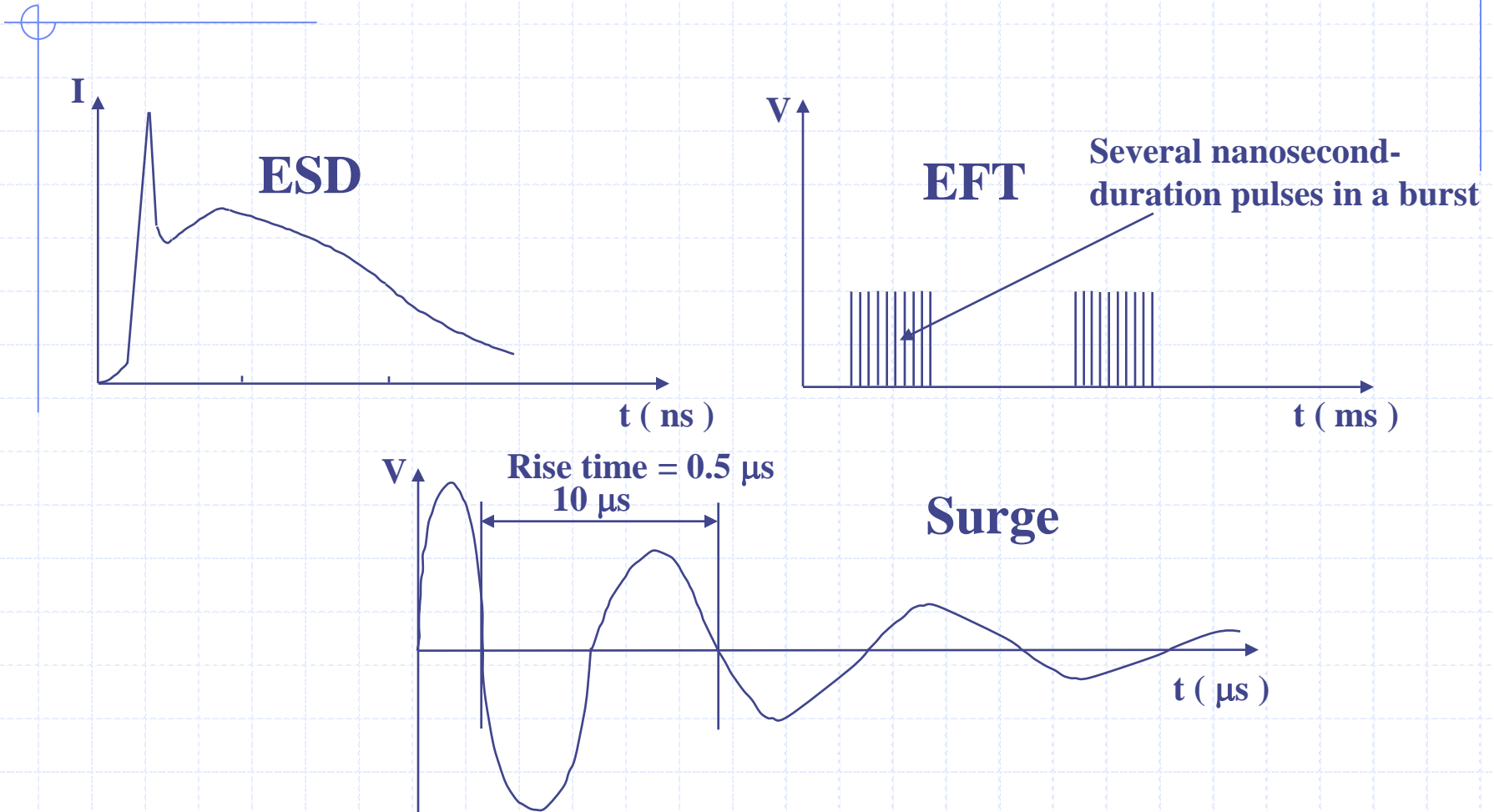
**Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage. Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if for an acceptable installation practice, shall be placed directly on the top of the controller.**

**Mains cables shall drape to the floor and then be routed to the receptacle. No extension cords shall be used to the mains receptacle.**

# Typical Characteristics of Pulsed EMI

	ESD	EFT	Surge
<b>Waveform</b>	See the next page		
<b>Feature</b>	Superfast rise time	Fast rise time, repetitive pulses, and box-car integration	Relatively slower rise time, large energy concentrator
<b>Rise time</b>	less than 1 ns	~ 5 ns	μs
<b>Energe</b>	low ( mJ )	medium ( mJ )	high ( J )
<b>Duration</b>	ns	ns, and repeating	ms
<b>Peak voltage ( into high impedance)</b>	up to about 15 kV	kV	several kV
<b>Peak current ( into low impedance)</b>	medium ( A )	low ( A )	high ( kA )
<b>Sources</b>	accumulation of static electricity	activation of gaseous discharge, make / break of electrical circuits	lightning, power switching

# Waveforms of pulsed EMI



# Test Levels and Test Result Classifications

1a – Contact discharge			1b – Air discharge		
Level	Test voltage kV		Level	Test voltage kV	
1	2		1	2	
2	4		2	4	
3	6		3	8	
4	8		4	15	
x	Special		x	Special	

“x” is an open level. The level has to be specified in the dedicated equipment specification. If higher voltages than those shown are specified, special test equipment may be needed.

Waveform parameters					
Level	Indicated voltage kV	First peak current of discharge $\pm$ 10% A	Rise time $\xi$ with discharge switch ns	Current ( $\pm$ 30%) at 30 ns A	Current ( $\pm$ 30%) at 60 ns A
1	2	7.5	0.7 to 1	4	2
2	4	15	0.7 to 1	8	4
3	6	22.5	0.7 to 1	12	6
4	8	30	0.7 to 1	16	8

**Test levels for radiated immunity  
( 80 MHz to 1000 MHz)**

Level	Test field strength V/m
1	1
2	3
3	10
x	Special

NOTE – x is an open test level. This level may be given in the product specification. The signal is 80 % amplitude modulated with 1 kHz sinewave to simulate actual treats.

**Test levels for EFT test**

Open – circuit output test voltage (  $\pm 10\%$  ) and repetition rate of the impulses (  $\pm 20\%$  )

Level	On power supply port , PE		On I/O ( input /output ) signal data and control ports	
	Voltage peak kV	Repetition rate kHz	Voltage peak kV	Repetition rate KHz
1	0.5	5	0.25	5
2	1	5	0.5	5
3	2	5	1	5
4	4	2.5	2	5
x	Special	Special	Special	Special

X is an open level. The level has to be specified in the dedicated equipment specification.

# Test Result Classifications

Normal performance within the specification limits

Temporary degradation or loss of function or performance which is self - recoverable

Temporary degradation or loss of function or performance which requires operator intervention or system reset

Degradation or loss of function which is not recoverable due to damage of equipment ( components ) or software, or loss of data