Aerospace & Defense

MIL-STD-461 & 464 ~ SPACE SYSTEMS EMC

COMPANY RESTRICTED

EMC STANDARDS BASED ON EUT

► Different Electronic Equipment require compliance to different Standards

Commercial Equipment:

- ISM Equipment
- Consumer Electronics Equipment
- IT / Household Equipment
- Lighting Equipment

Automotive Equipment:

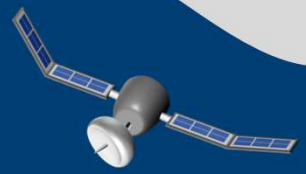
- Control Equipment
- Infotainment Equipment
- Communication Equipment

Military Equipment:

- Aircraft Equipment
- Ship & Submarine Equipment
- Land Based Equipment

Space Equipment:

- Space Vehicle Equipment
- Launch Vehicle Equipment
- Ground Based Equipment



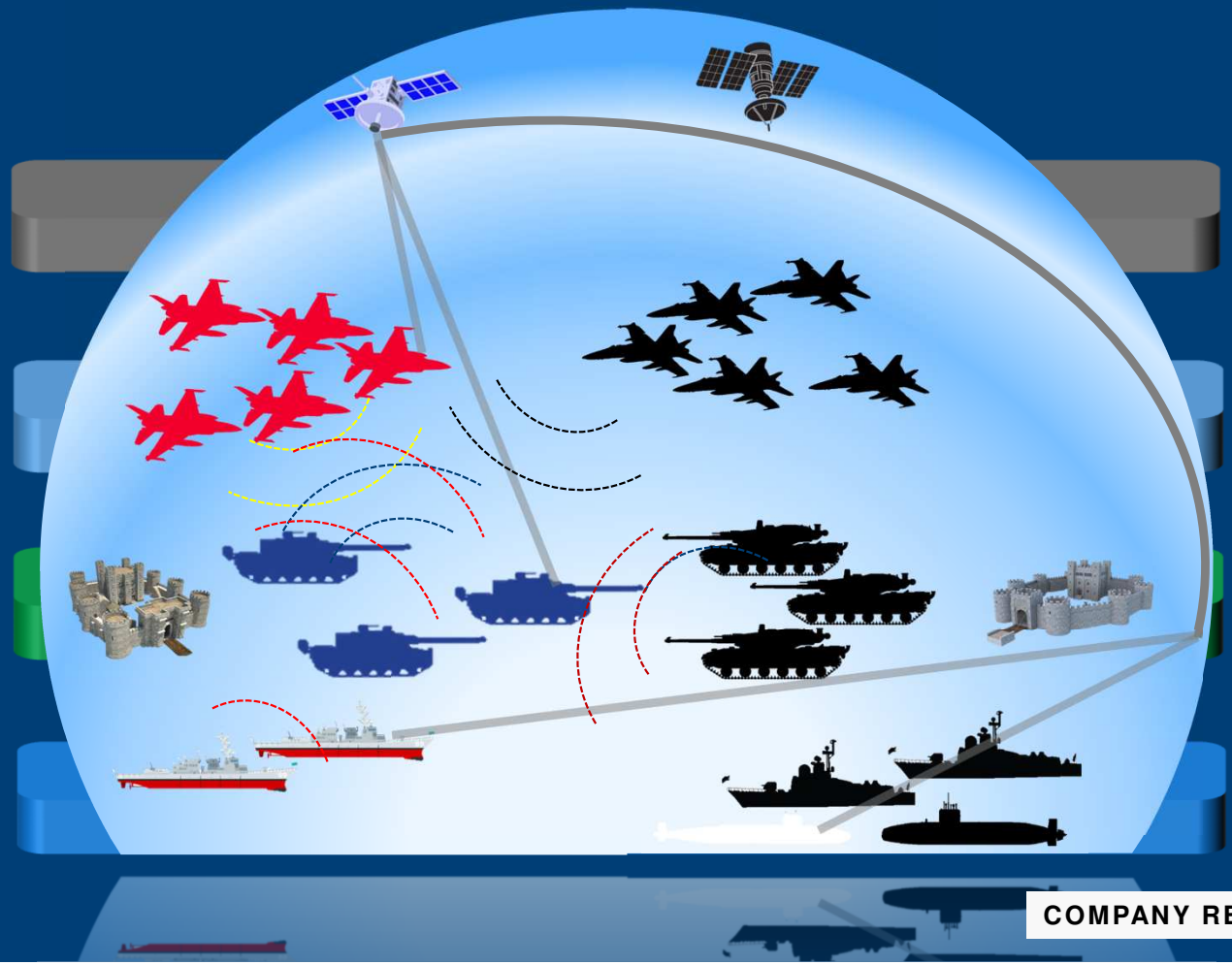
MIL-STD-464 ENVIRONMENT

Military Equipment:

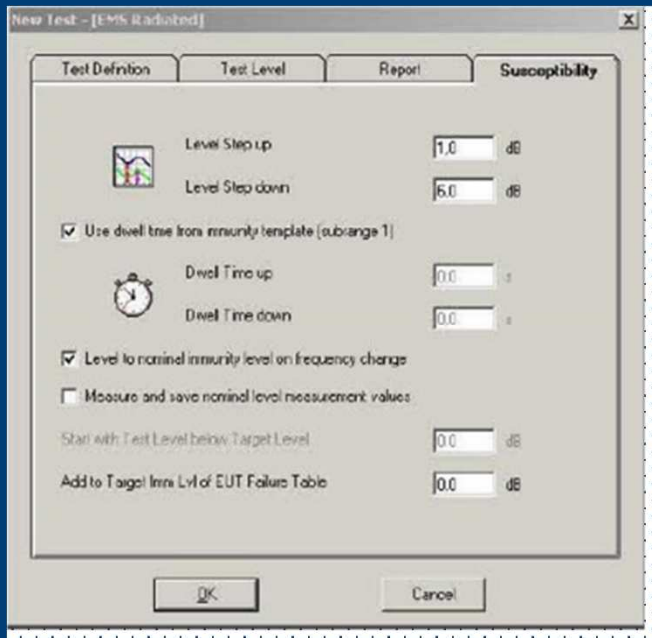
- Aircraft Equipment
- Ship & Submarine Equipment
- Land Based Equipment

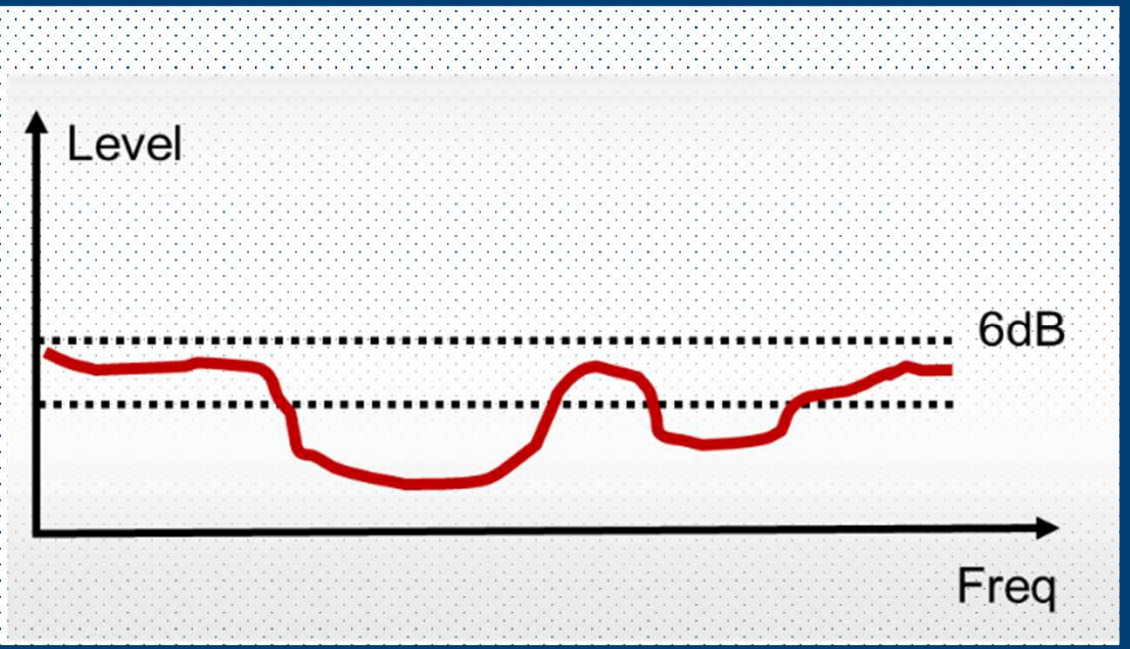
Applicable Standards:

- Mil-Std 461
- Mil-Std 464
- RTCA DO-160

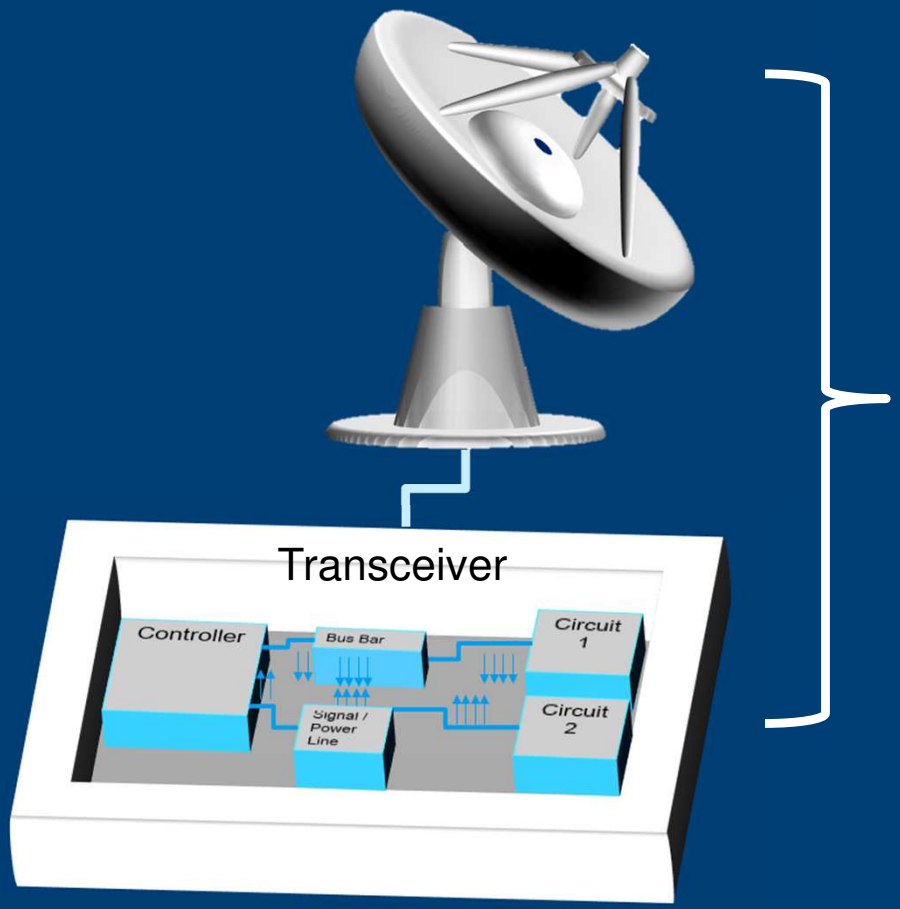


MARGIN

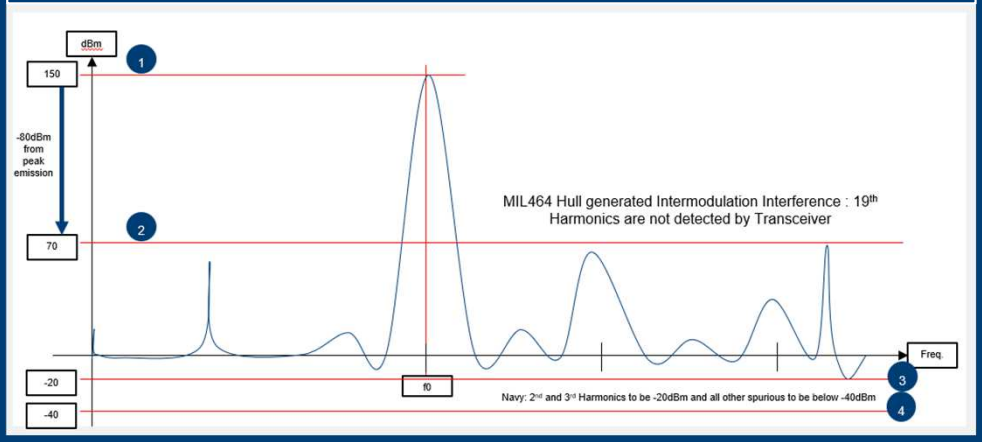




INTRA SYSTEMS ELECTROMAGNETIC COMPATIBILITY



1. Intra-systems meets EMC meets operational performance requirements. Includes Temporary and portable equipment.
2. Hull generated intermodulation interference (IMI) where orders of 19th harmonics and above are not detected by HF transceiver installed onboard.



RF ELECTRO-MAGNETIC ENVIRONMENT

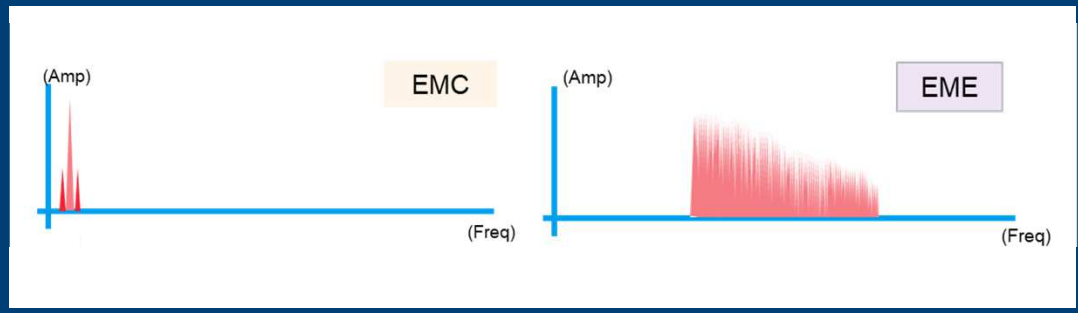
TABLE III. Maximum external EME for space and launch vehicle systems.

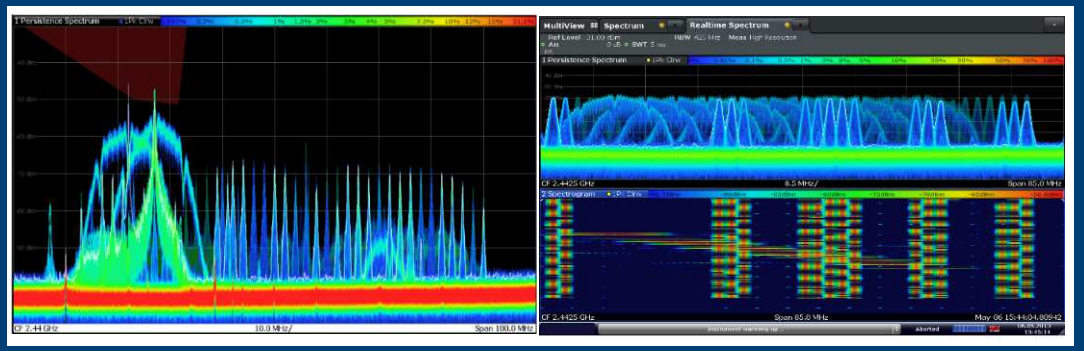
Frequency Range (MHz)		Electric Field (V/m – rms)	
		Peak	Average
0.01	2	1	1
2	30	73	73
30	150	17	17
150	225	4	1
225	400	*	*
400	700	47	6
700	790	1	1
790	1000	7	7
1000	2000	63	63
2000	2700	187	187
2700	3600	23	8
3600	4000	2	2
4000	5400	3	3
5400	5900	164	164
5900	6000	164	164
6000	7900	6	6
7900	8000	3	1
8000	8400	1	1
8400	8500	3	1
8500	11000	140	116
11000	14000	114	114
14000	18000	16	9
18000	50000	23	23

NOTE: *denotes no emitters in that frequency range.

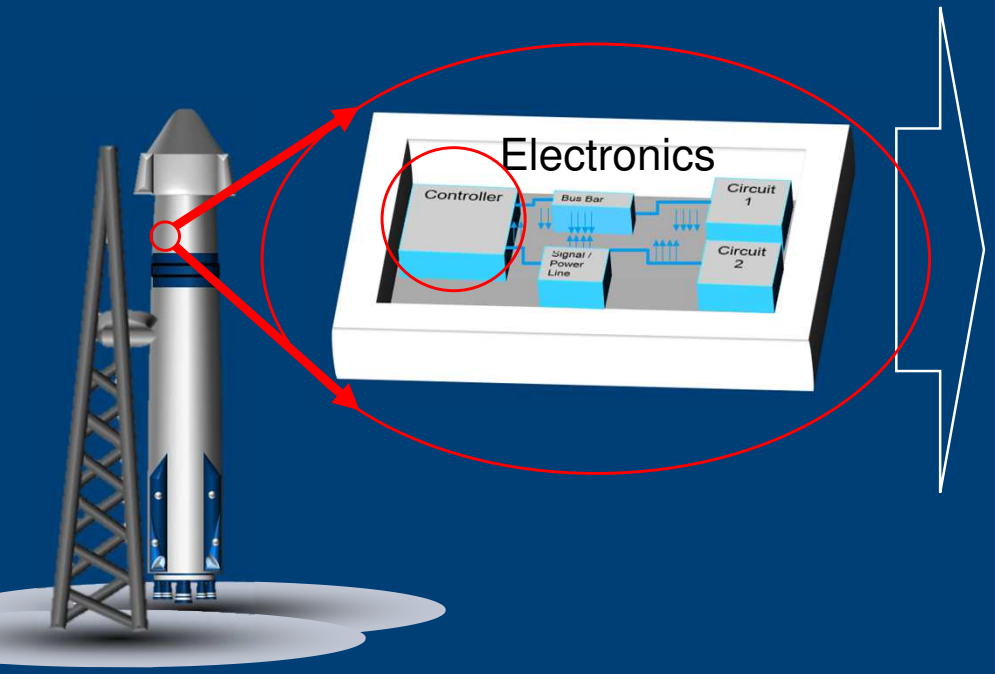
TABLE IV. Maximum external EME for ground systems.

Frequency Range (MHz)		Electric Field (V/m – rms)	
		Peak	Average
0.01	2	54	54
2	30	103	103
30	150	74	74
150	225	41	41
225	400	92	92
400	700	98	98
700	790	58	58
790	1000	58	58
1000	2000	232	94
2000	2700	638	42
2700	3600	1148	219
3600	4000	320	25
4000	5400	645	173
5400	5900	5183	129
5900	6000	40	40
6000	7900	3190	292
7900	8000	2471	296
8000	8400	2471	296
8400	8500	82	82
8500	11000	810	139
11000	14000	3454	102
14000	18000	7897	243
18000	50000	2793	48

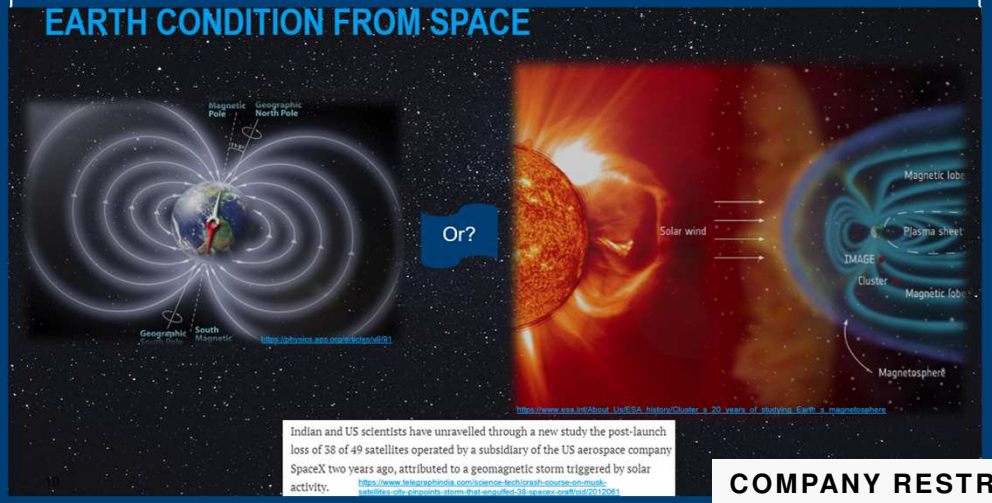




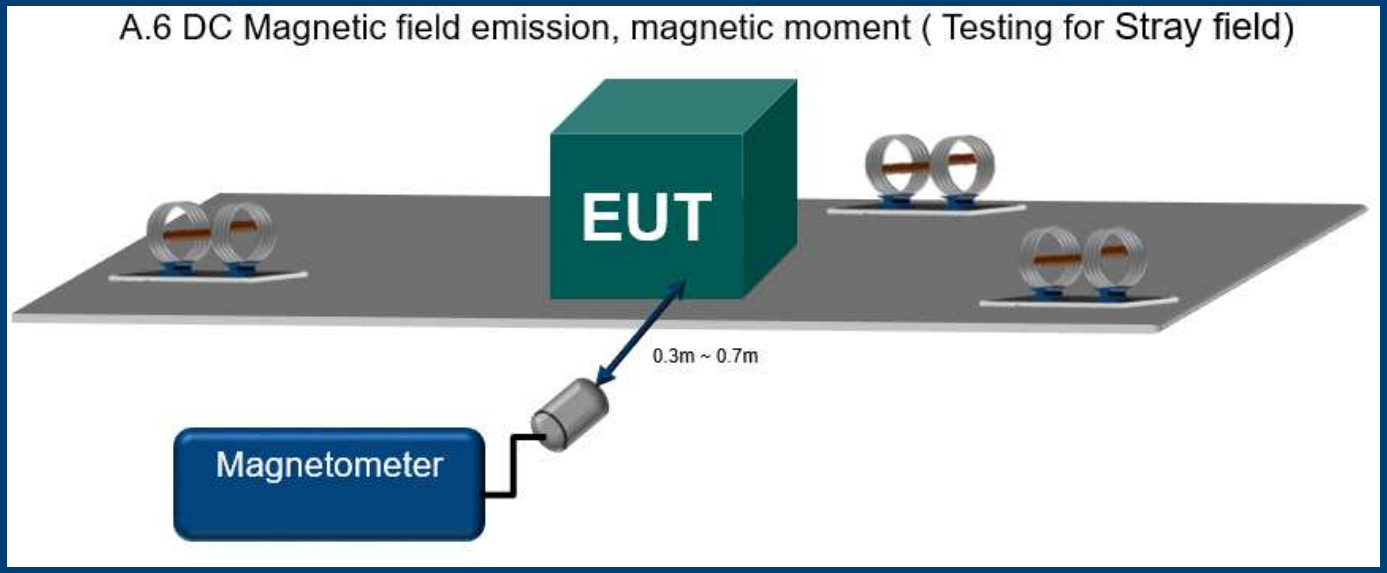
SUBSYSTEMS AND EQUIPMENT EMC



1. Portable device and carry on equipment shall meet interference control in MIL-STD-461)so that overall systems comply.
2. NDI and commercial products to meet operational performance requirement.
3. Subsystems and equipment used aboard ships shall not degraded when exposed to operational DC magnetic environment.



SUBSYSTEMS AND EQUIPMENT – MAGNETIC FIELDS



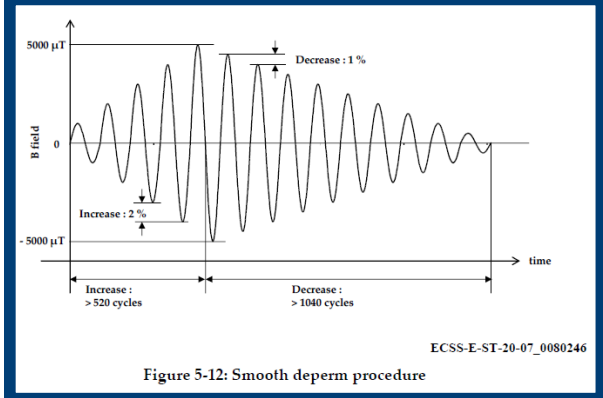
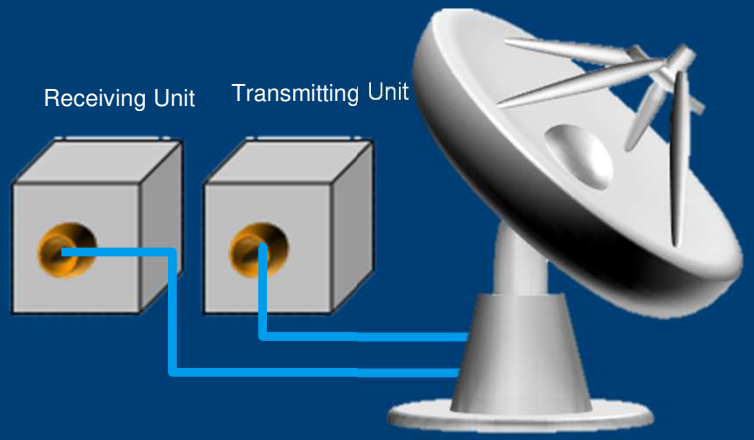


Figure 5-12: Smooth deperm procedure

EMISSION AND SPECTRUM SUPPORTABILITY

1. Unintentional radiated emissions from be controlled such that antenna-connected receivers located in the operational vicinity are not adversely impacted.
2. Spectrum-dependent systems shall comply spectrum regulations for the use.



MIL-STD-461 ~ SPACE SYSTEMS EMC

INTRODUCTION TO MIL-STD461G – APPLICABILITY

Equipment and subsystems Installed In, On or Launched from the following platforms or Installations	Applicability of Requirement Based n 461G																		
	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	CS117	CS118	RE101	RE102	RE103	RS101	RS103	RS105
Surface Ships	A	A	L	A	S	L	S	L	A	S	A	L	S	A	A	L	L	A	L
Submarines	A	A	L	A	S	L	S	L	A	S	L	S	S	A	A	L	L	A	L
Aircraft, Army, Including Flight Line	A	A	L	A	S	S	S		A	A	A	L	A	A	A	L	A	A	L
Aircraft, Navy	L	A	L	A	S	S	S		A	A	A	L	A	L	A	L	L	A	L
Aircraft, Airforce		A	L	A	S	S	S		A	A	A	L	A		A	L		A	
Space systems, Including Launch Vehicles		A	L	A	S	S	S		A	A	A	L			A	L		A	
Ground, Army		A	L	A	S	S	S		A	A	A	S	A		A	L	L	A	
Ground, Navy		A	L	A	S	S	S		A	A	A	S	A		A	L	L	A	L
Ground Airforce		A	L	A	S	S	S		A	A	A		A		A	L		A	

A: Applicable
L: Limited as specified in the individual sections of this standard
S: Procuring activity must specify in procurement documentation

MIL-STD461G APPLICABLE TO ARMY

Equipment and subsystems Installed In, On or Launched from the following platforms or Installations	Applicability of Requirement Based n 461G																		
	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	CS117	CS118	RE101	RE102	RE103	RS101	RS103	RS105
Aircraft, Army, Including Flight Line	A	A	L	A	S	S	S		A	A	A	L	A	A	A	L	A	A	L
Space systems, Including Launch Vehicles		A	L	A	S	S	S		A	A	A	L			A	L		A	
Ground, Army		A	L	A	S	S	S		A	A	A	S	A		A	L	L	A	

Army, Launch Vehicles
EMI: 30Hz - 18GHz,
EMS: 30Hz - 40GHz (10-50 V/m refer to table XI).

MIL-STD461G APPLICABLE TO AIR-FORCE

Equipment and subsystems Installed In, On or Launched from the following platforms or Installations	Applicability of Requirement Based n 461G																		
	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	CS117	CS118	RE101	RE102	RE103	RS101	RS103	RS105
Aircraft, Army, Including Flight Line	A	A	L	A	S	S	S		A	A	A	L	A	A	A	L	A	A	L
Aircraft, Navy	L	A	L	A	S	S	S		A	A	A	L	A	L	A	L	L	A	L
Aircraft, Airforce		A	L	A	S	S	S		A	A	A	L	A		A	L		A	
Ground Airforce		A	L	A	S	S	S		A	A	A		A		A	L		A	

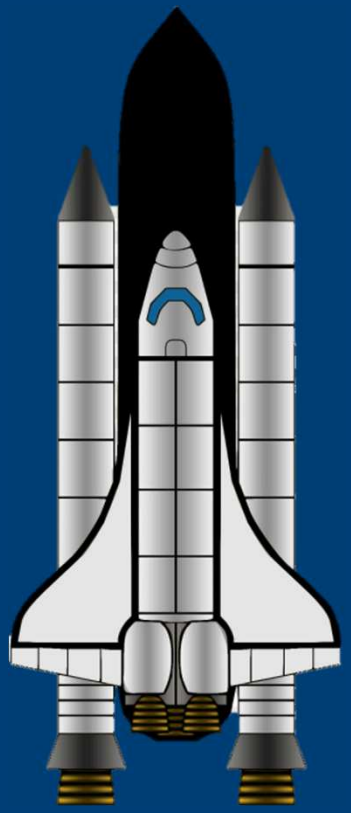
Aircraft
EMI: 30Hz - 18GHz,
EMS: 30Hz - 40GHz (60V/m - 200V/m refer to table XI).

MIL-STD461G APPLICABLE TO NAVY

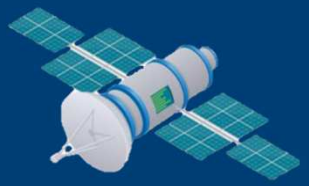
Equipment and subsystems Installed In, On or Launched from the following platforms or Installations	Applicability of Requirement Based n 461G																		
	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	CS117	CS118	RE101	RE102	RE103	RS101	RS103	RS105
Surface Ships	A	A	L	A	S	L	S	L	A	S	A	L	S	A	A	L	L	A	L
Submarines	A	A	L	A	S	L	S	L	A	S	L	S	S	A	A	L	L	A	L
Aircraft, Navy	L	A	L	A	S	S	S		A	A	A	L	A	L	A	L	L	A	L
Space systems, Including Launch Vehicles		A	L	A	S	S	S		A	A	A	L			A	L		A	
Ground, Navy		A	L	A	S	S	S		A	A	A	S	A		A	L	L	A	L

Marine, Navy
EMI: 30Hz - 18GHz,
EMS: 30Hz - 40GHz (200 V/m refer to table XI).

MIL-STD461G APPLICABLE TO SPACE SYSTEMS



Equipment and subsystems Installed In, On or Launched from the following platforms or Installations	Applicability of Requirement Based n 461G																		
	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	CS117	CS118	RE101	RE102	RE103	RS101	RS103	RS105
Space systems, Including Launch Vehicles		A	L	A	S	S	S		A	A	A	L			A	L		A	



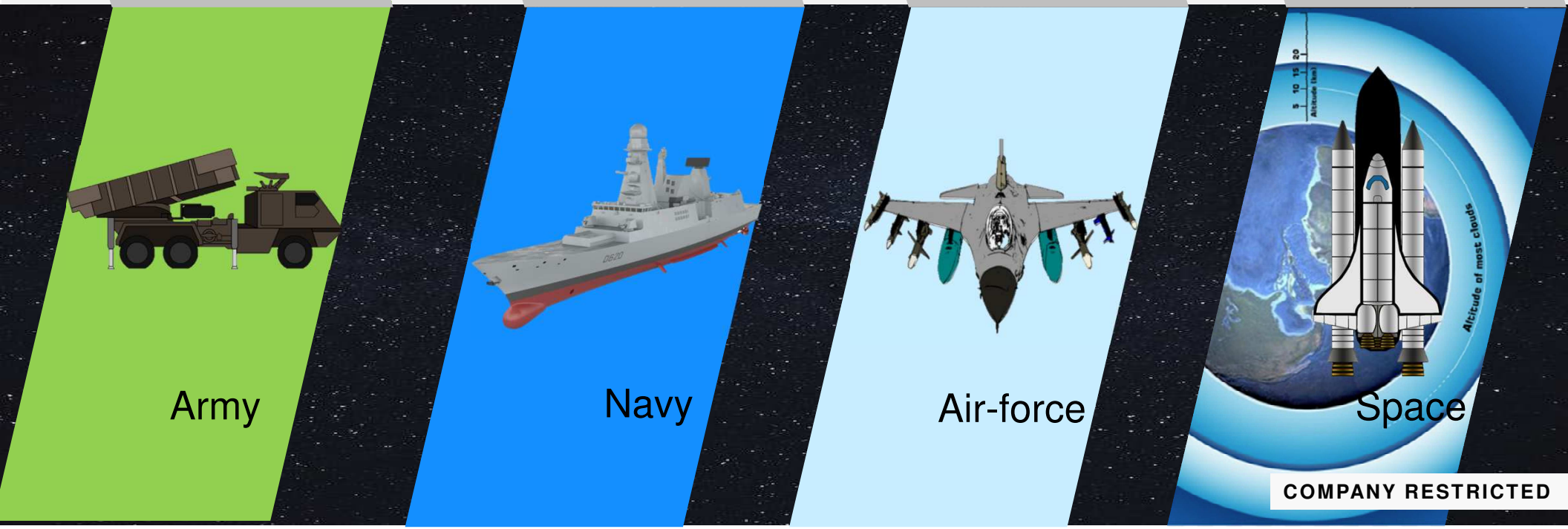
Space Systems including Launch Vehicles
EMI: 10kHz - 18GHz,
EMS: 30Hz - 40GHz (20 V/m refer to table XI).

INTERFERENCE IN KNOWN ENVIRONMENT

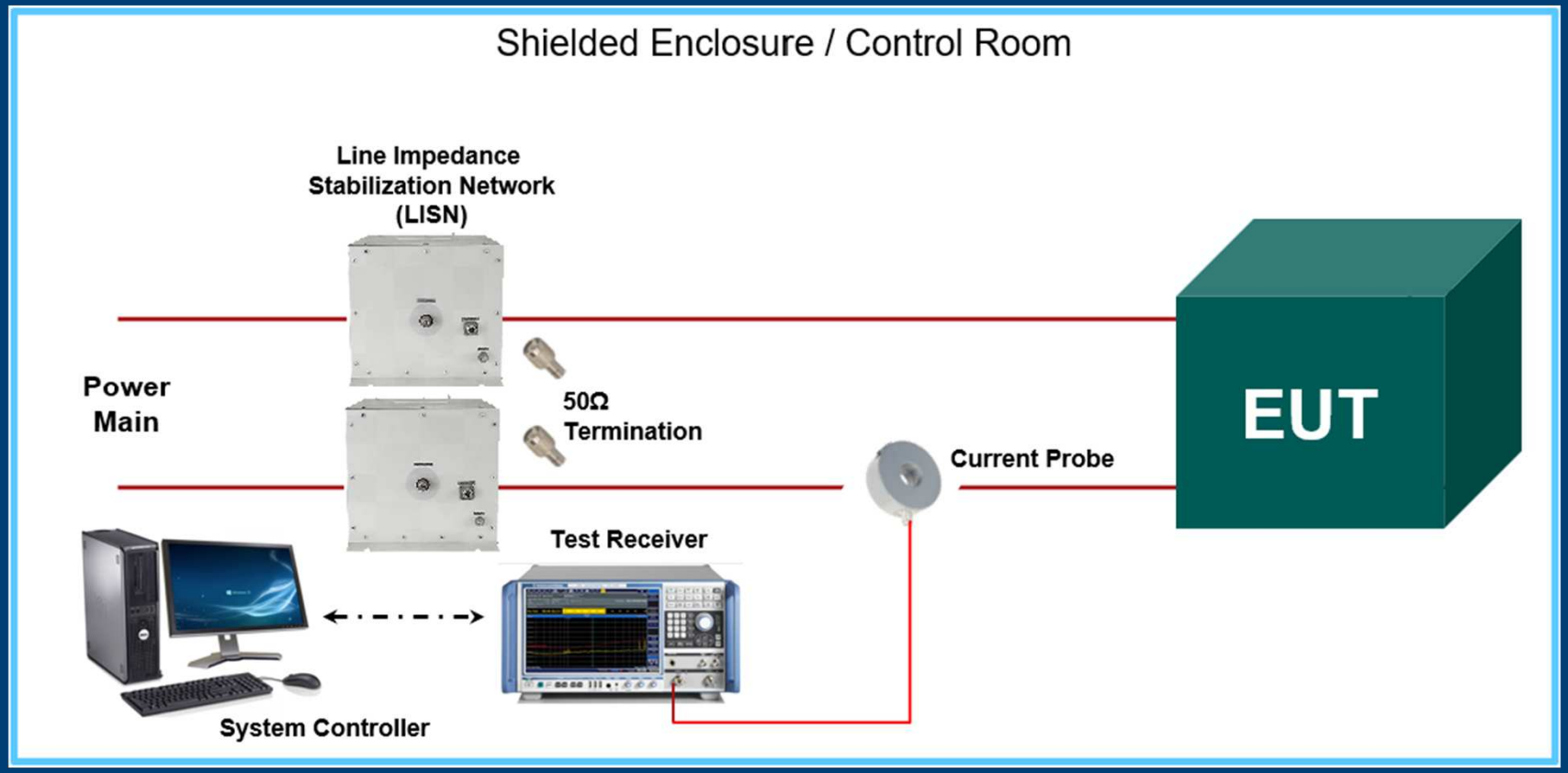
MIL-STD-461 AND MIL-STD-464 CONSIDERATION

MIL461G – Component level

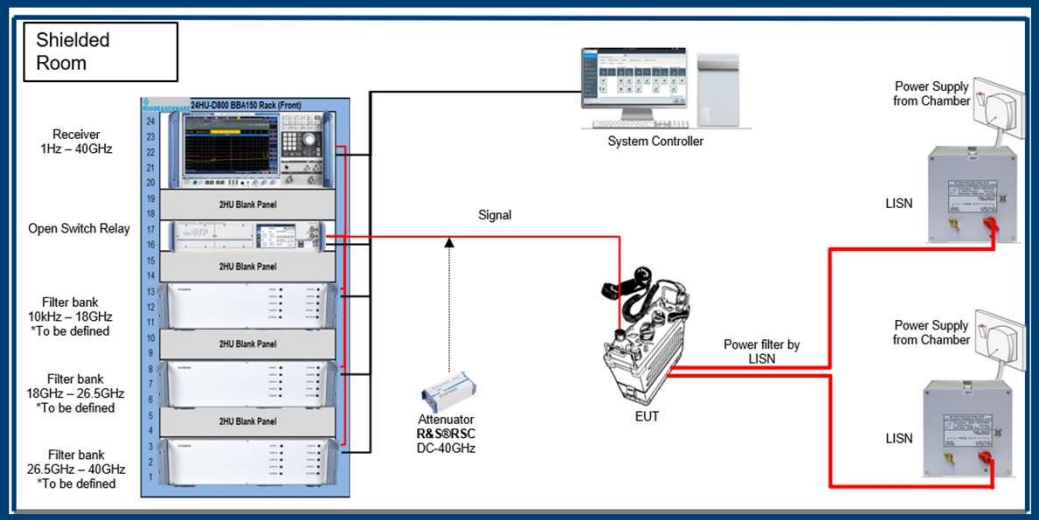
MIL-STD-464 – Systems Level and Environment of Operation

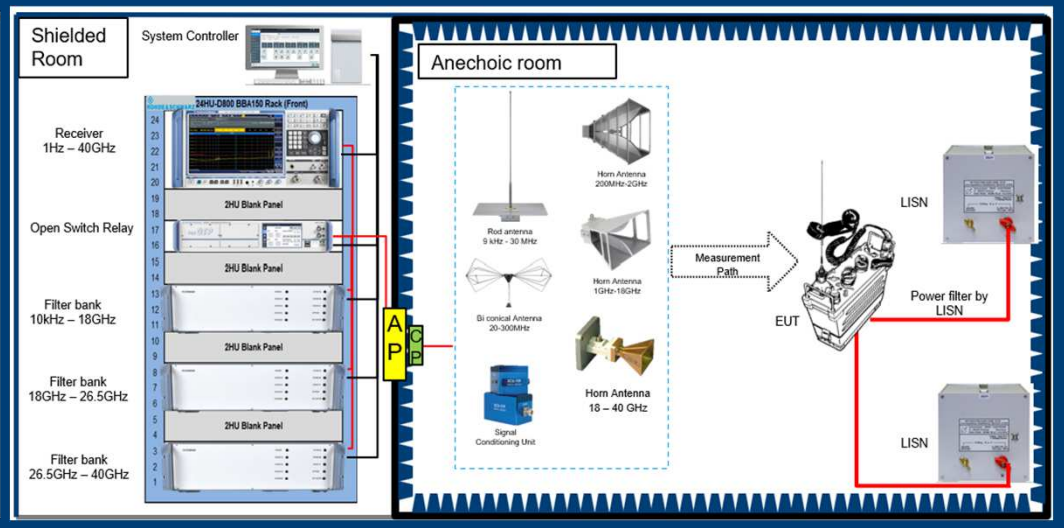


MIL-STD-461 : CE101 SYSTEM BLOCK DIAGRAM

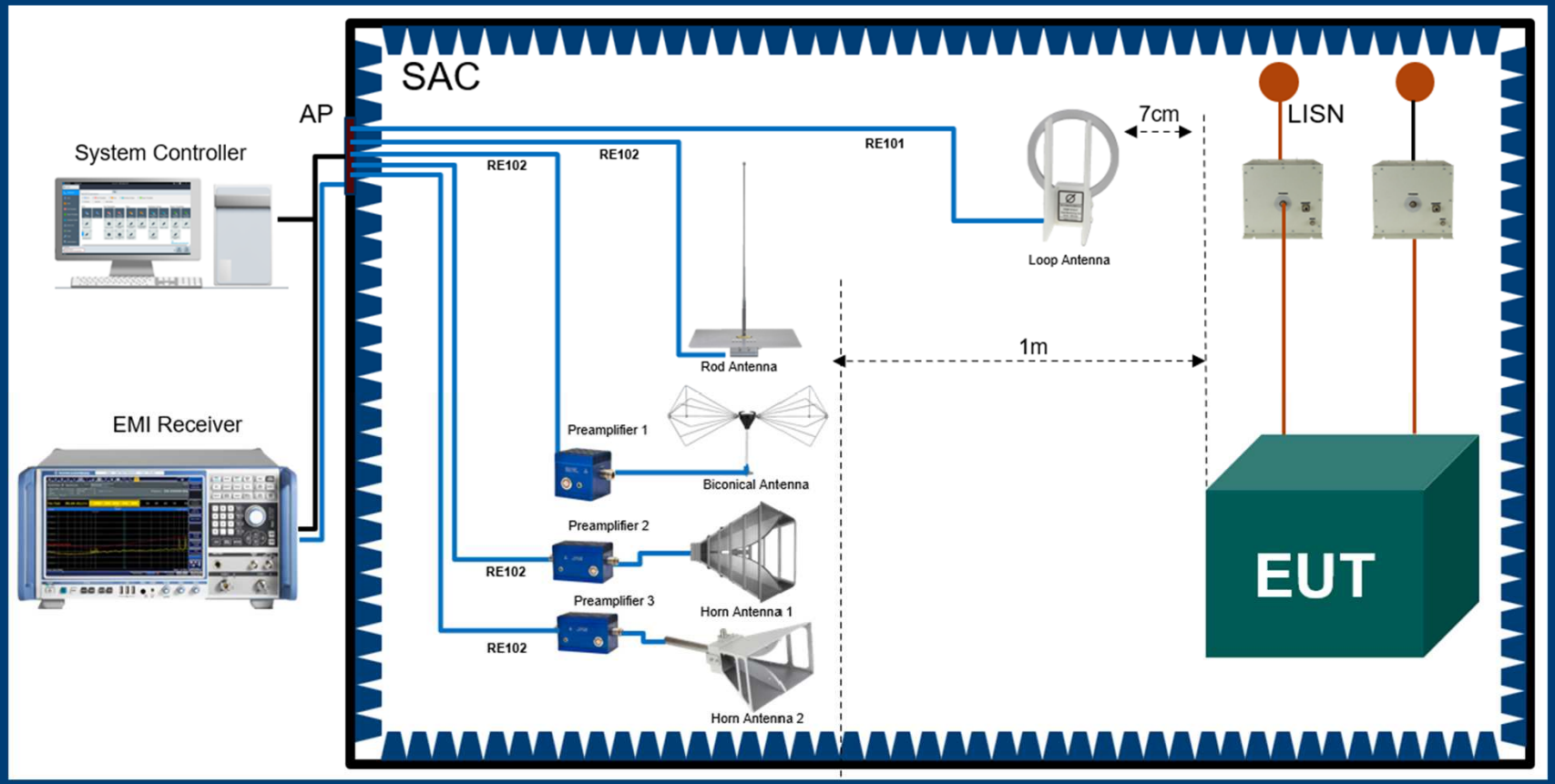


MIL-STD-461 : CE106 & RE103 SYSTEM BLOCK DIAGRAM

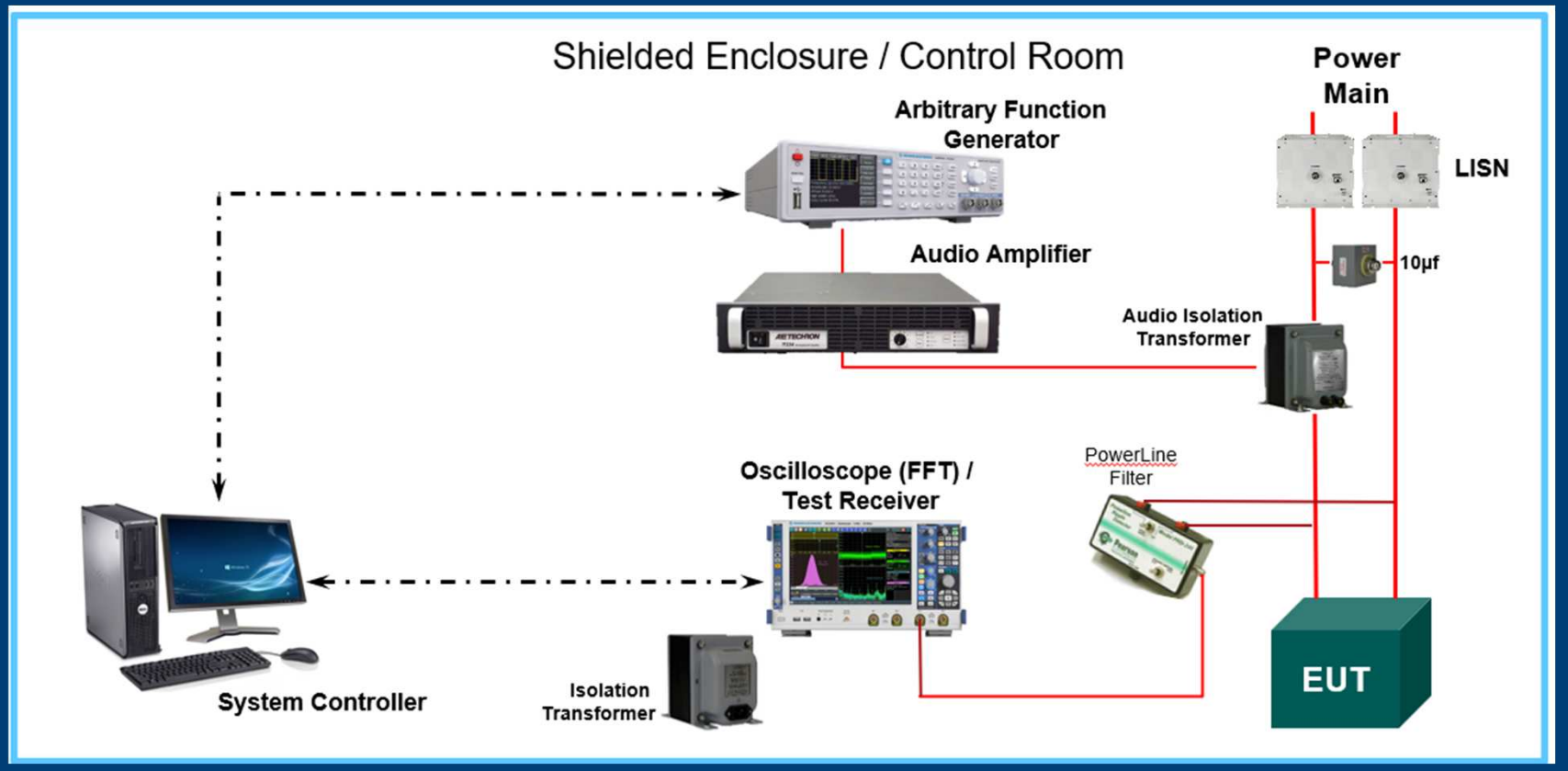




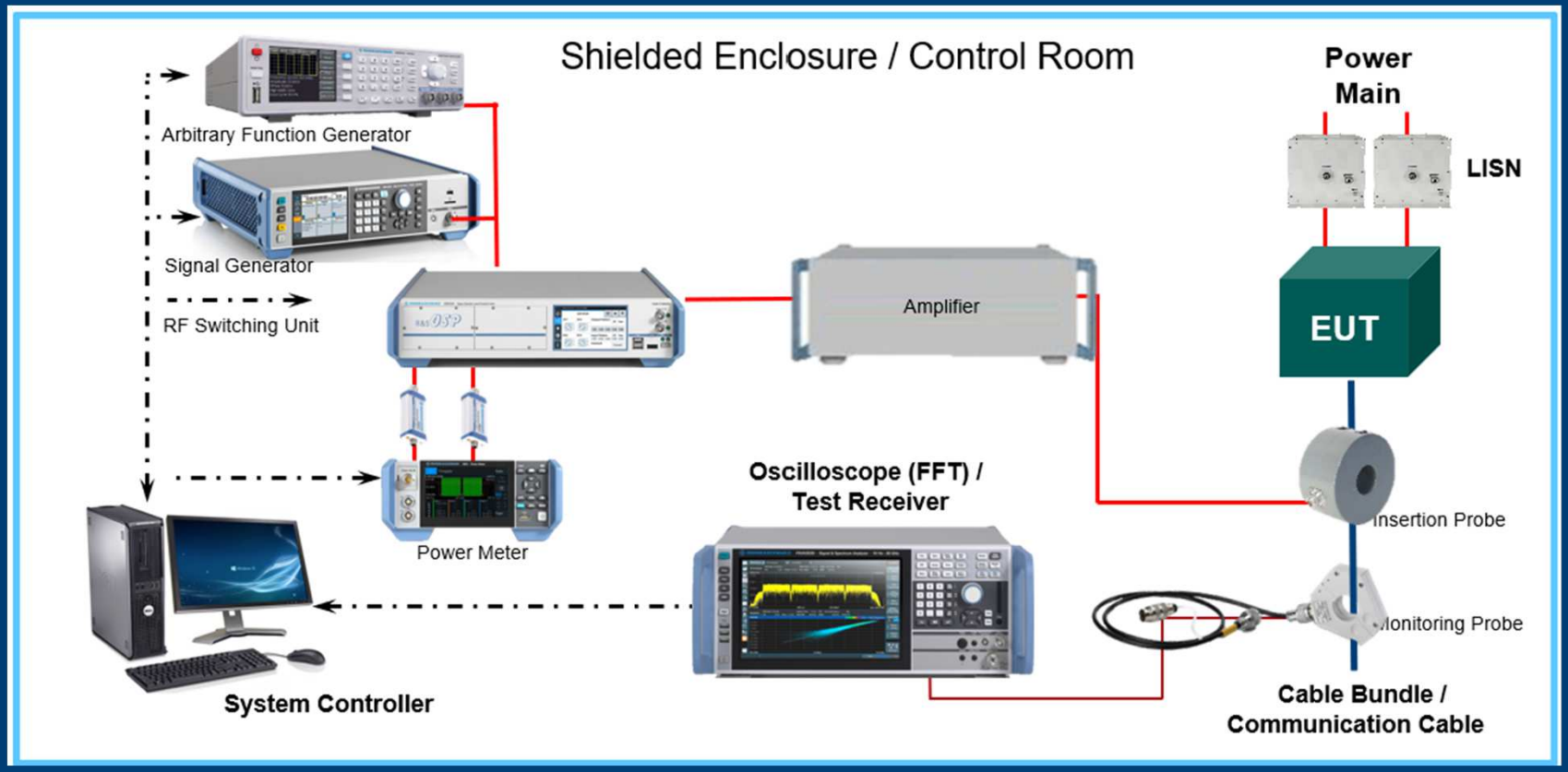
MIL-STD-461 : RE101 & RE102 SYSTEM BLOCK DIAGRAM



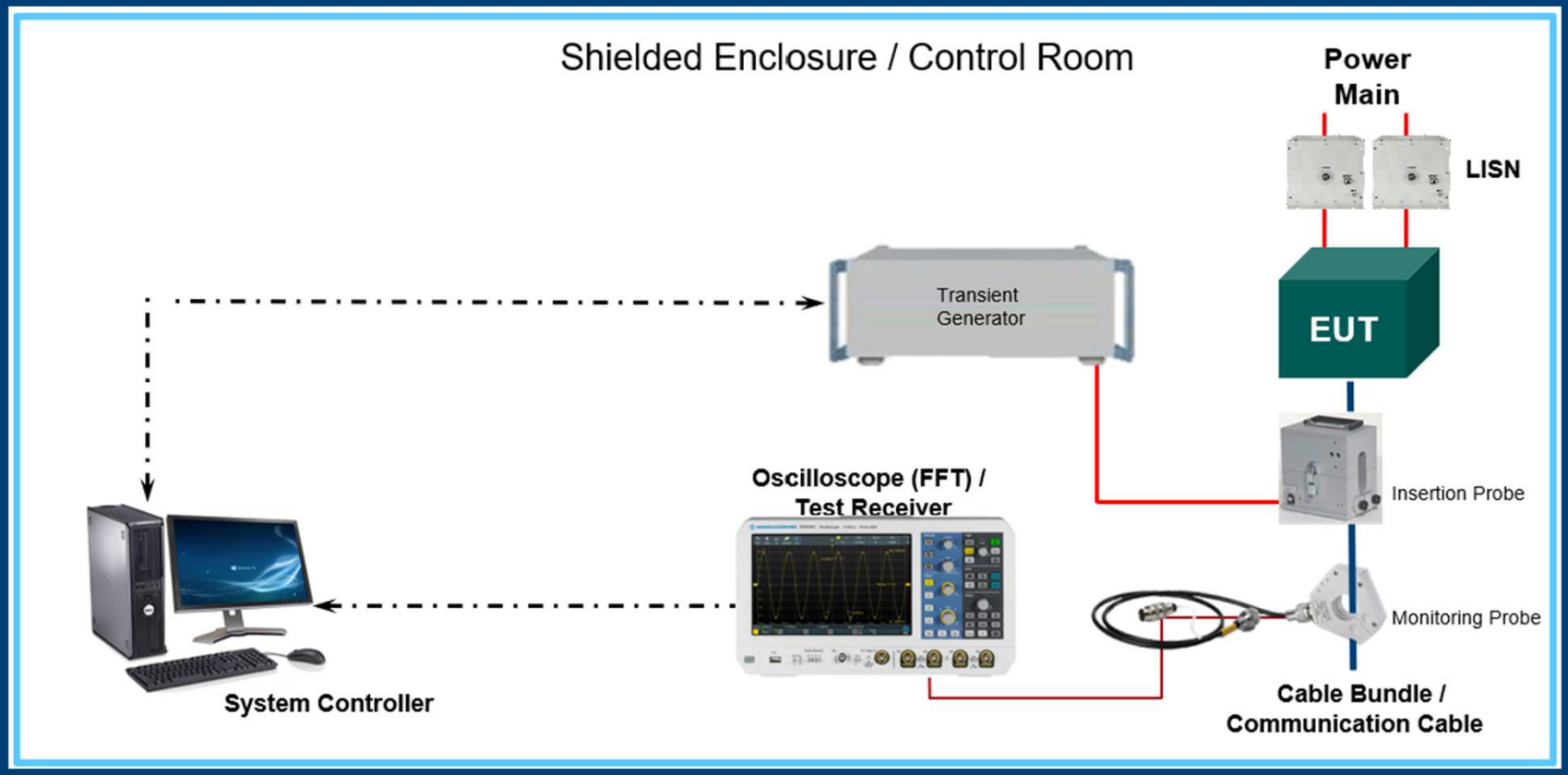
MIL-STD-461 : CS101 SYSTEM BLOCK DIAGRAM



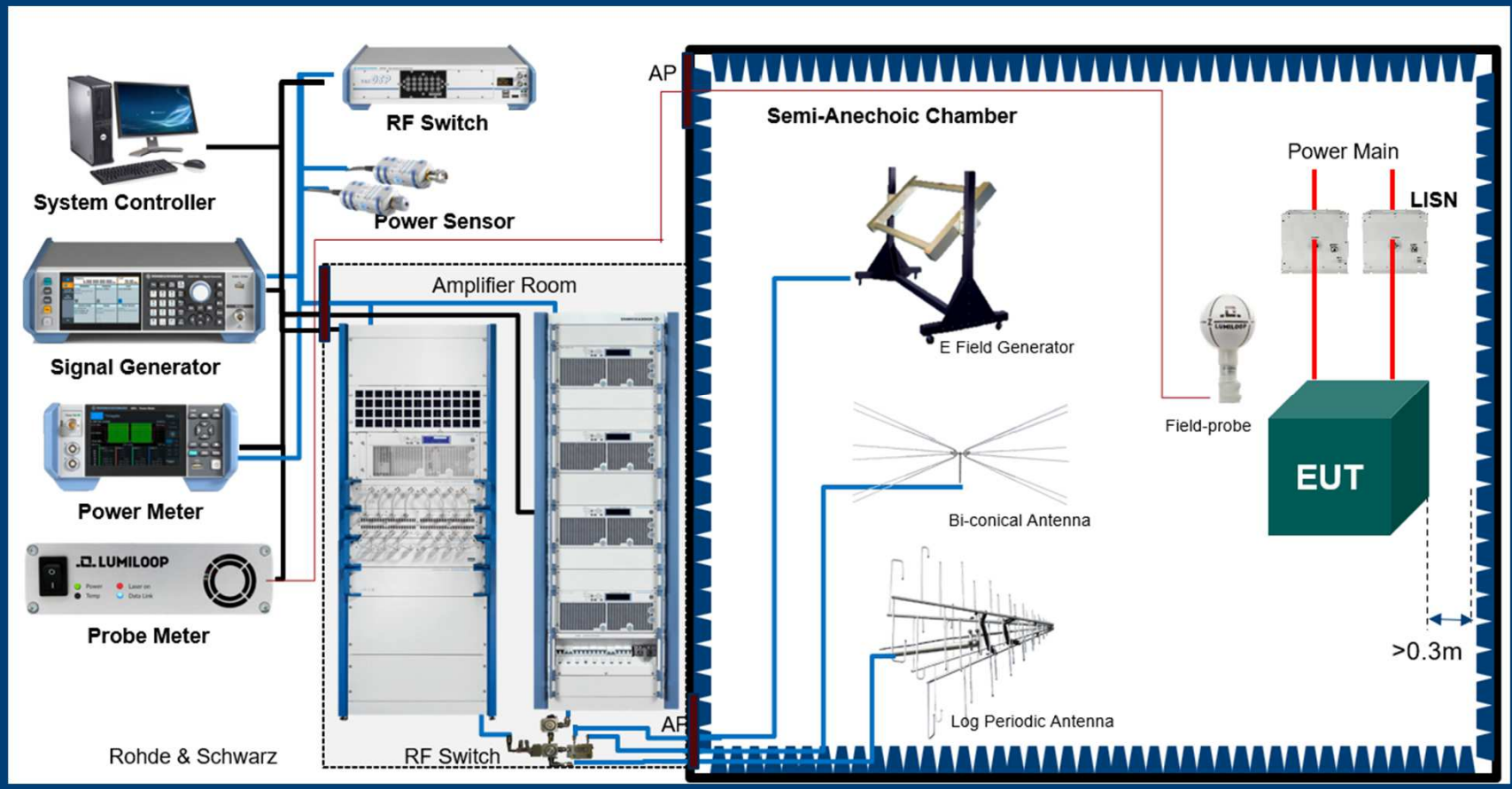
MIL-STD-461 : CS114 SYSTEM BLOCK DIAGRAM



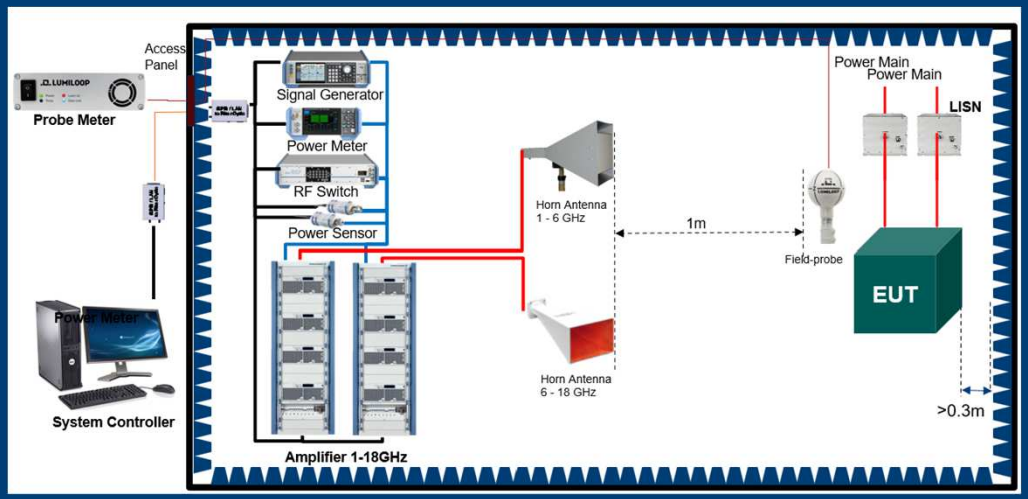
MIL-STD-461 : CS115 & CS116 SYSTEM BLOCK DIAGRAM

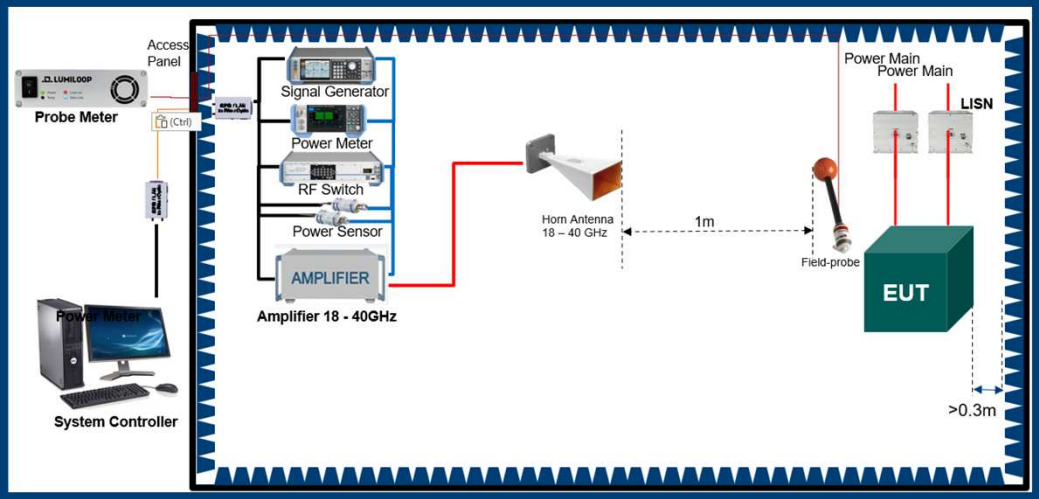


MIL-STD-461 : RS103 9KHZ – 1 GHZ SYSTEM BLOCK DIAGRAM



MIL-STD-461 : RS103 1GHZ – 40GHZ SYSTEM BLOCK DIAGRAM





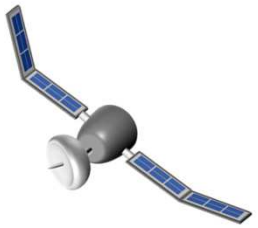
Aerospace & Defense

MARGIN & EME

COMPANY RESTRICTED

ELECTROMAGNETIC ENVIRONMENT EFFECTS

IN THE A&D DOMAIN EMC TESTS ARE SUMMARIZED AS E3



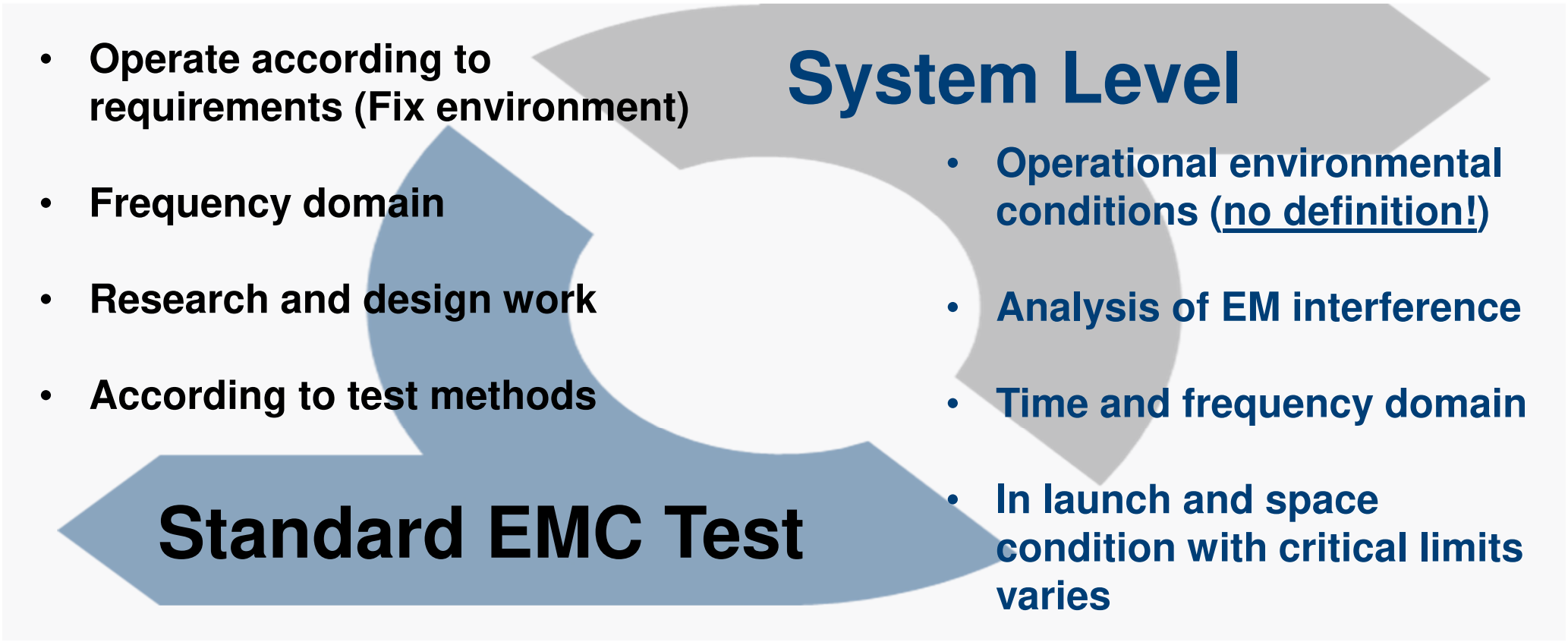
- Beside Standard EMC testing, there are RF Spectrum Measurement for Transmitters which installed on System.

- Some existing EMC customers had planned and enquired to extend their existing EMC test system (base on Mil-std-461) specifications and capabilities to meet E3 test requirements.

- Such as System Level NEMP, ESD, HIRF, HERO, HERP, PIM, Transmitter and Receiver Performance, Antenna Radiation Patterns. etc… measurements

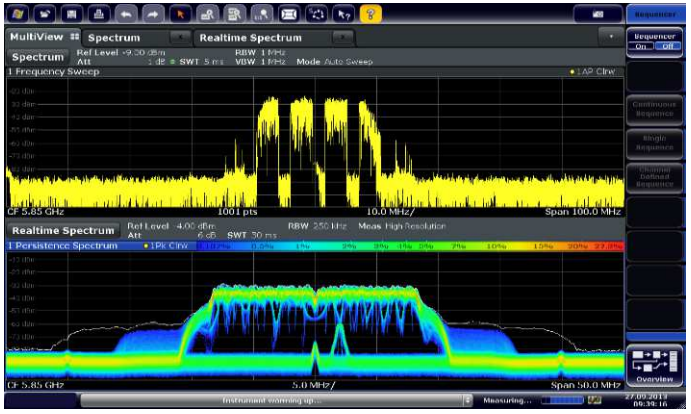
THE IMPORTANCE OF SYSTEM LEVEL EME EFFECTS TEST

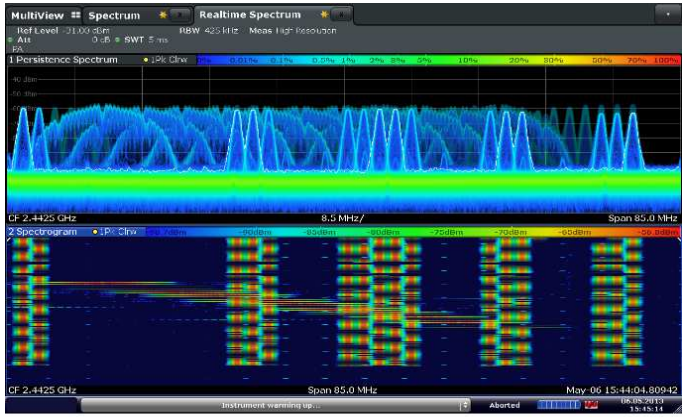
What are the differences ?

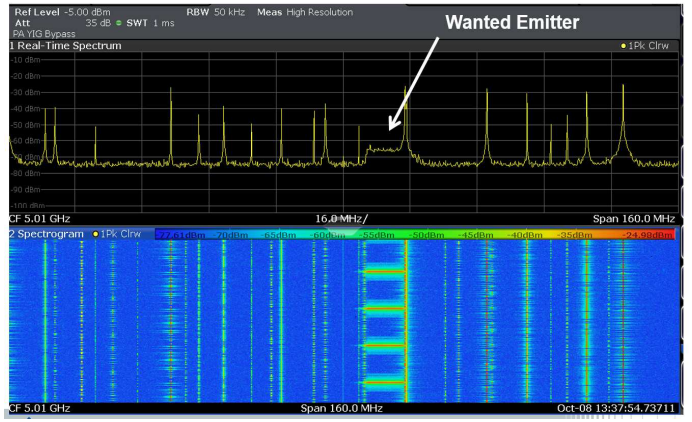


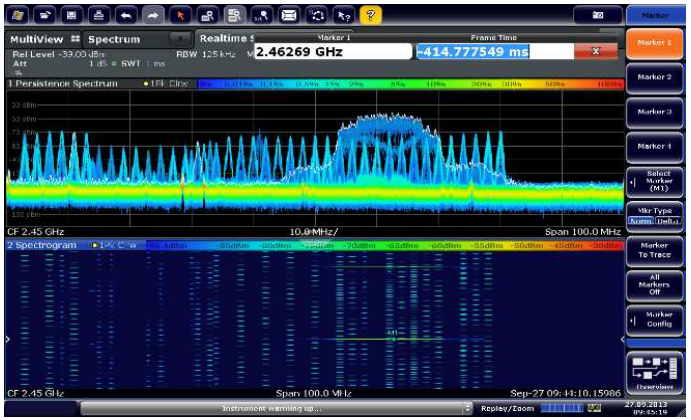
EME EFFECTS TESTING IN THE CHAMBER

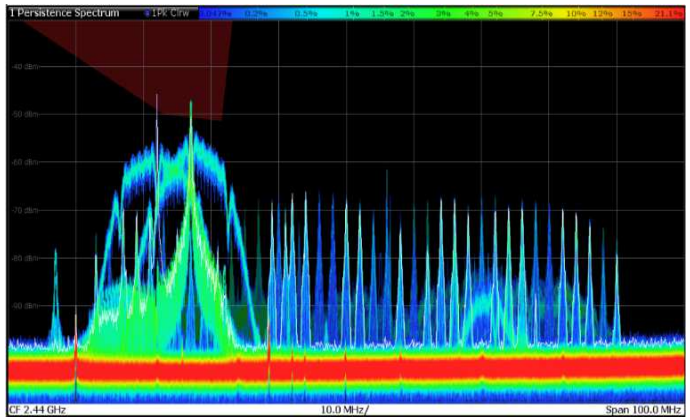
Autonomous, EME Complexity, Coexistence and Connectivity





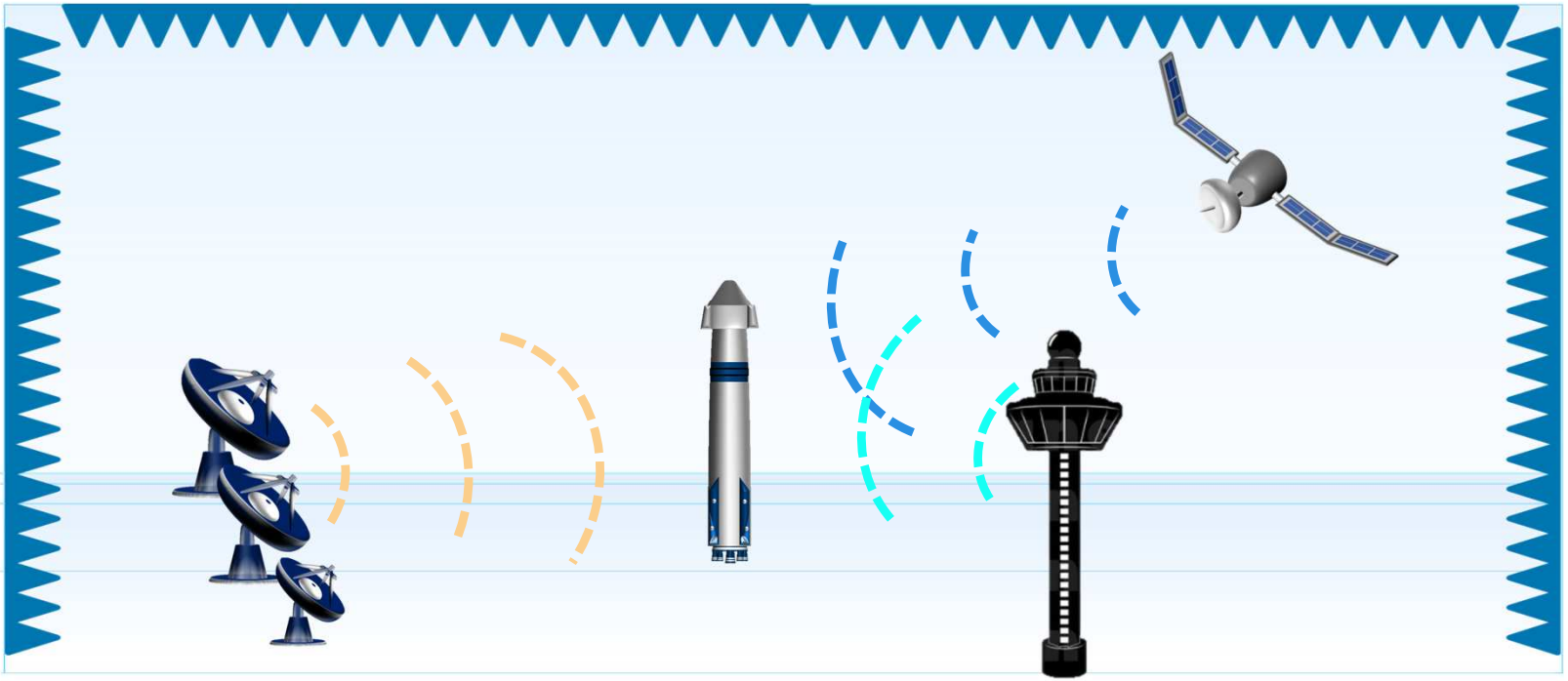






EME EFFECTS TESTING IN THE CHAMBER

Autonomous, EME Complexity, Coexistence and Connectivity.



X = EMISM (SAFETY MARGIN)

1.Establish the environment against which the system is required to demonstrate compliance of immunity.

2.Identify the system electrical and electronic equipment performing functions required for operation during application.

3.Establish the internal environment caused by external electromagnetic effects for each installed equipment.

4.Design the system and equipment protection.

5.Verify the protection adequacy, typically require an overall margin of 6 dB (16.5dB for EIDs).

SATELLITE EMC TESTING

Thank you for listening.

For any questions please contact us via chat.

ROHDE&SCHWARZ
Make ideas real