

# EMC for Space Environments

Ken Newman

EMC Manager  
United Kingdom

# Introduction

This presentation will discuss the stages a sub system or payload will require with respect to EMC.

# Space System or Sub-system

- A space system (for example a scientific instrument or experiment) may be a stand alone device or be made up of several sub-systems
- Each sub-system may not be designed and manufactured by the same organisation

# Space System or Sub-system

- EMC control plan
  - Should be part of the specification of a new product  
(It may even be a requirement of the contract tender)
  - Why is it important?
    - Very little maintenance can be undertaken when in it's intended environment
    - Projects are undertaken with increasingly tight timescales
    - Minimizes the risk of system EMI before the system is first connected together
    - Expensive (and not always possible) to add components to a product late in the design stage to solve EMI

# Space System or Sub-system

- How can the risk of EMI be mitigated?
  - Know the EMC requirements before the design is started
  - Know how the EMI phenomena can affect the design
  - Consider limited testing to ‘A’ model prototypes
  - Conduct design reviews that consider EMI
  - Test to confirm compliance

# Space System or Sub-system

- Stand alone system will usually be tested to all applicable requirements
- Systems and Sub-systems
  - Usually two methodologies
    - Limited sub assembly tests and full system tests
    - Full sub assembly tests and limited system tests
- Several systems may form part of a satellite that will be a payload on the launch vehicle

# Launch Vehicle

- Each payload of the launch vehicle will need to be assessed or tested to ensure electromagnetic compatibility with both the launch site and the launch vehicle
- The extent of the tests will be specified by the authority of the launch facility and / or vehicle.

# Satellite Interoperability

- Several systems on each satellite
- Need to ensure the that experiments do not interfere with each other
- Need RF communications to receive instructions and transmit experiment data and results
- Need to ensure that the structure of the fully built satellite does not interfere with the intended radiation pattern of the communication antennas

# Required Tests

- Due to the international nature of the business, MIL-STD 461 is usually specified
- Unlike testing for the military market where previous versions of MIL-STD 461 are still specified for legacy equipment and installations, the latest version (MIL\_STD 461E) is normally used.

# A Brief History

- Early satellites
  - Sputnik 1, launched 4<sup>th</sup> October 1957
  - Sputnik 2, launched 3<sup>rd</sup> November 1957
  - Explorer 1, launched 31<sup>st</sup> January 1958
  - Vanguard 1, first successful orbit 17<sup>th</sup> March 1958
- From these early satellites, the systems on board became more and more complex
- The need to consider EMC and EMI became more and more important.

# A Brief History

- Brief history of MIL-STD 461 (Space Systems):
  - 461A (1/8/68 to 3/7/73) has no requirements
  - 461B (1/4/1980)
  - 461C (4/8/1986 to 1/4/87)
  - 461D (11/1/1993)
  - 461E (20/8/1999)

# A Brief History

- 461B and 461C
  - Category A2a
    - Equipment on spacecraft or launch vehicle
  - Category A2b
    - Aerospace ground equipment required for the checkout and launch

# A Brief History

- 461D and 461E
- Equipment and subsystems installed in, on, or launched from the following platforms or installations:
  - Space systems including launch vehicles

# Test Requirements

- Applicable requirements:
  - CE102  
Conducted Emissions, Power Leads, 10 kHz to 10 MHz
  - CS101  
Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz
  - CS114  
Conducted Susceptibility, Bulk Cable Injection, 10 kHz to 200 MHz
  - CS115  
Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation

# Test Requirements

- Applicable requirements (cont):
  - CS116  
Conducted Susceptibility, Damped Sinusoidal Transients, Cables and Power Leads, 10 kHz to 100 MHz
  - RE102  
Radiated Emissions, Electric Field, 10 kHz to 18 GHz
  - RS103  
Radiated Susceptibility, Electric Field, 2 MHz to 40 GHz

# Test Requirements

- Limited requirements:

- CE106

- Conducted Emissions, Antenna Terminal, 10 kHz to 40 GHz

- RE103

- Radiated Emissions, Antenna Spurious and Harmonic Outputs,  
10 kHz to 40 GHz

# Test Requirements

- Requirements specified by the procurement documentation:
  - CS103  
Conducted Susceptibility, Antenna Port, Intermodulation,  
5 kHz to 10 GHz
  - CS104  
Conducted Susceptibility, Antenna Port, Rejection of Undesired Signals,  
30 Hz to 20 GHz
  - CS105  
Conducted Susceptibility, Antenna Port, Cross-Modulation,  
30 Hz to 20 GHz

# Questions

If you have any questions or would like any further information on our capability please come along see us at our stand.