DIN EN 16603-20-07:2022-12 (E)

Space engineering - Electromagnetic compatibility; English version EN 16603-20-07:2022

Contents

Page

European Foreword 7

Introduction 9

1 Scope 10

2 Normative references 11

3 Terms, definitions and abbreviated terms 12

3.1 Terms from other standards 12

3.2 Terms specific to the present standard 13

3.3 Abbreviated terms 15

4 Requirements 17

4.1 General system requirements 17

4.2 Detailed system requirements 17

4.2.1 Overview 17

4.2.2 EMC with the launch system 17

4.2.3 Lightning environment 18

4.2.4 Spacecraft charging and effects 18

4.2.5 Spacecraft DC magnetic emission 19

4.2.6 Radiofrequency compatibility 19

4.2.7 Hazards of electromagnetic radiation 20

4.2.8 Intrasystem EMC 20

4.2.9 EMC with ground equipment 20

4.2.10 Grounding 21

4.2.11 Electrical bonding requirements 21

4.2.12 Shielding (except wires and cables) 23

4.2.13 Wiring (including wires and cables shielding) 23

5 Verification 25

5.1 Overview 25

5.1.1 Introduction 25

5.1.2 Electromagnetic effects verification plan 25

5.1.3 Electromagnetic effects verification report 25

5.2 Test conditions 25
  5.2.1 Measurement tolerances..25
  5.2.2 Test site 26
  5.2.3 Ground plane 28
  5.2.4 Power source impedance..28
  5.2.5 General test precautions 30
  5.2.6 EUT test configurations..30
  5.2.7 Operation of EUT 33
  5.2.8 Use of measurement equipment 34
  5.2.9 Emission testing..36
  5.2.10 Susceptibility testing..37
  5.2.11 Calibration of measuring equipment..39
  5.2.12 Power bus voltage..40
  5.2.13 Photographic data..40
5.3 System level 40
  5.3.1 General 40
  5.3.2 Safety margin demonstration for critical or EED circuits 40
  5.3.3 EMC with the launch system 41
  5.3.4 Lightning 41
  5.3.5 Spacecraft and static charging 41
  5.3.6 Spacecraft DC magnetic field emission 42
  5.3.7 Intra–system electromagnetic compatibility 42
  5.3.8 Radiofrequency compatibility 42
  5.3.9 Grounding 42
  5.3.10 Electrical bonding..42
  5.3.11 Wiring and shielding..42
5.4 Equipment and subsystem level test procedures 43
  5.4.1 Overview..43
  5.4.2 CE, power leads, differential mode, 30 Hz to 100 kHz..43
  5.4.3 CE, power and signal leads, 50 kHz to 100 MHz..45
  5.4.4 CE, power leads, inrush current 48
  5.4.5 DC Magnetic field emission, magnetic moment..51
  5.4.6 RE, electric field, 30 MHz to 18 GHz 54
  5.4.7 CS, power leads, 30 Hz to 100 kHz..58
  5.4.8 CS, bulk cable injection, 50 kHz to 100 MHz 61
  5.4.9 CS, power leads, transients 65
  5.4.10 RS, magnetic field, 30 Hz to 100 kHz 69

5.4.11 RS, electric field, 30 MHz to 18 GHz 72
5.4.12 Susceptibility to wire-coupled electrostatic discharges (legacy method)....79
5.4.13 Susceptibility to wire-coupled electrostatic discharges (current injection probe method)....84
5.4.14 Susceptibility to electrostatic discharges into the chassis....87
5.4.15 CE, power leads, time domain 90

Annex A (informative) Subsystem and equipment limits.... 92

A.1 Overview 92
A.2 CE on power leads, differential mode, 30 Hz to 100 MHz 92
A.3 CE on power leads, in-rush currents....94
A.4 CE on power and signal leads, common mode, 50 kHz to 100 MHz 94
A.5 <<deleted>> 95
A.6 DC magnetic field emission 95
  A.6.1 General....95
  A.6.2 Characterization....95
  A.6.3 Limit....96
A.7 RE, low-frequency magnetic field....96
A.8 RE, low-frequency electric field....96
A.9 RE, electric field, 30 MHz to 18 GHz....97
A.10 CS, power leads, differential mode, 30 Hz to 100 kHz 97
A.11 CS, power and signal leads, common mode, 50 kHz to 100 MHz....98
A.12 CS, power leads, short spike transients....99
A.13 RS, magnetic field, 30 Hz to 100 kHz....100
A.14 RS, electric field, 30 MHz to 18 GHz....101
A.15 Susceptibility to wire-coupled electrostatic discharges (legacy method)....102

Figures

Figure 4-1: Bonding requirements 22
Figure 5-1: RF absorber loading diagram 27
Figure 5-2: Line impedance stabilization network schematic 29
Figure 5-3: General test setup....31
Figure 5-4: Typical calibration fixture....35
Figure 5-5: Conducted emission, 30 Hz to 100 kHz, measurement system check....45
Figure 5-6: Conducted emission, 30 Hz to 100 kHz, measurement setup....45
Figure 5-7: Conducted emission, measurement system check....46
Figure 5-8: Conducted emission, measurement setup in differential mode....47

Figure 5-9: Conducted emission, measurement setup in common mode....................47
Figure 5-10: Inrush current: measurement system check setup..................................49
Figure 5-11: Inrush current: measurement setup...49
Figure 5-12: Smooth deperm procedure...54
Figure 5-13: Electric field radiated emission. Basic test setup 56
Figure 5-14: Electric field radiated emission. Antenna positioning 56
Figure 5-15: Electric field radiated emission – Multiple antenna positions 57
Figure 5-16: CS, power leads, measurement system check set-up 59
Figure 5-17: CS, power leads, signal injection...60
Figure 5-18: Bulk cable injection, calibration set-up..64
Figure 5-19: Signal test waveform 64
Figure 5-20: CS, power and signal leads, bulk cable injection 65
Figure 5-21: CS, power leads, differential mode transients, calibration setup 66
Figure 5-22: CS, power leads, differential mode transients, injection setup 67
Figure 5-23: <<deleted>> 67
Figure 5-24: CS, power leads, common mode transients, calibration setup................67
Figure 5-25: CS, power leads, common mode transients, probe injection setup..........68
Figure 5-26: Measurement system check configuration of the radiating system 70
Figure 5-27: Basic test setup...70
Figure 5-28: <<deleted>> 74
Figure 5-29: Example of electric field calibration test setup 75
Figure 5-30: RS Electric field – Multiple test antenna positions....................................76
Figure 5-31: <<deleted>> 76
Figure 5-32: Susceptibility to ESD: calibration configuration..81
Figure 5-33: Susceptibility to ESD: test equipment configuration................................82
Figure 5-34: Example of compliant discharge current shape 83
Figure 5-35: Test setup for calibration of test waveform 85
Figure 5-36: Typical ESD pulse measured during calibration (3 A/div, 4 ns/div) 86
Figure 5-37: Wire-coupled ESD test setup (current injection probe method)................86
Figure 5-38: Discharge current verification setup..89
Figure 5-39: Ideal contact discharge current waveform at 8 kV 89
Figure 5-40: Conducted emission, power leads, time domain: measurement setup.....91
Figure A-1 : Power leads, differential mode conducted emission limit..........................93
Figure A-2 : Common mode conducted emission limit...95
Figure A-3 : Radiated electric field limit 97
Figure A-4 : Conducted susceptibility limit, frequency domain 98
Figure A-5 : Calibration level at the measurement port of the calibration fixture 99

Figure A-6 : CS, voltage spike in percentage of test bus voltage 100
Figure A-7 : Radiated susceptibility limit 101

Tables

Table 5-1: Absorption at normal incidence...27
Table 5-2: Bandwidth and measurement time 36
Table 5-3: Maximum step sizes for susceptibility tests...38
Table 5-4: Correspondence between test procedures and limits 43
Table A-1 : Equipment: susceptibility to conducted interference, test signal 99