DIN EN 14777:2005-10 (E)

Space engineering - Multipaction design and test; English version EN 14777:2004

Inhalt

Seite

Foreword 5
Introduction 6
1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviated terms 8
3.1 Terms and definitions 8
3.2 Abbreviated terms 10
4 Verification 10
4.1 Verification process 10
4.2 Verification levels 11
4.3 Verification plan 11
4.3.1 Introduction 11
4.3.2 Generation and updating 11
4.3.3 Description 11
4.4 Verification routes 12
4.5 Classification of component type 12
4.6 Single carrier 13
4.6.1 General 13
4.6.2 Margins 13
4.6.3 Route to demonstrate conformance 14
4.7 Multi-carrier 16
4.7.1 General 16
4.7.2 Threshold above equivalent CW peak power 16
4.7.3 Threshold below equivalent CW peak power 16
4.7.4 Route to demonstrate conformance 17
5 Design analyses 19
5.1 General 19
5.2 Field analysis 19
5.3 Critical region identification 19
5.4 Multipaction sensitivity analysis 20
5.5 Venting analysis 21
5.6 Inspection 21
6 Test conditions 21
6.1 Cleanliness 21
6.2 Pressure 21
6.3 Temperature 21
6.4 Frequencies 22
6.5 Pulse duration 22
6.5.1 General 22
6.5.2 CW units 22
6.5.3 Pulse units 23
6.6 Electron seeding 23
6.6.1 CW test 23
6.6.2 Pulsed test 23
6.6.3 Multi-carrier test 23
6.6.4 Seeding sources 23
7 Methods of detection 24
7.1 General 24

7.2 Detection methods ... **24**
7.3 Detection method parameters ... **24**
7.3.1 Sensitivity ... **24**
7.3.2 Rise time ... **25**

8 Test procedures ... **25**
8.1 Test configurations ... **25**
8.2 Test facility validation ... **25**
8.3 Test execution ... **26**
8.3.1 General ... **26**
8.3.2 Test procedure ... **26**
8.4 Acceptance criteria ... **27**
8.4.1 General ... **27**
8.4.2 Multi-carrier test ... **27**

Annex A (informative) Multipaction background ... **28**
A.1 Physics of multipaction ... **28**
A.2 Other physical processes ... **29**
A.3 RF operating environment ... **29**
A.4 Parallel plate multipaction ... **35**
A.5 Coaxial line multipaction ... **40**

Annex B (informative) Component venting ... **43**
B.1 Introduction ... **43**
B.2 Discharge dependence on pressure ... **43**
B.3 Test example ... **43**
B.4 Venting dimensions ... **44**
B.5 Venting hole calculations ... **44**
B.6 Payload vacuum ... **44**
B.7 Venting model used ... **44**
B.8 Pumping conductance of a venting hole ... **45**
B.9 Ultimate pressure ... **46**
B.10 Venting experiment ... **48**
B.11 Venting guidelines ... **48**

Annex C (normative) Cleaning, handling, storage and contamination ... **50**
C.1 Generic processes ... **50**
C.2 Cleaning, handling and storage ... **50**
C.3 Contaminants ... **52**

Annex D (normative) Electron seeding ... **55**
D.1 Introduction ... **55**
D.2 CW test ... **55**
D.3 Pulsed test ... **55**
D.4 Multi-carrier test ... **55**
D.5 Types of seeding source ... **57**

Annex E (informative) Test methods ... **58**
E.1 Introduction ... **58**
E.2 General test methods ... **58**
E.3 Transient tests methods ... **62**
E.4 Test facility validation ... **69**

Bibliography ... **70**

Figures

Figure 1 — Routes to conformance for single carrier ... 15

Figure 2 — Routes to conformance for multi-carrier case ... 18

Figure 3 — The susceptibility zone boundaries for aluminium, copper, silver, gold and alodine 1200 ... 20

Figure A.1 — Total secondary electron emission as a function of energy of the incident electron 36
Figure A.2 — Multipaction susceptibility zones for parallel plates of aluminum.....37
Figure A.3 — Multipaction thresholds for all materials studied, plotted in a single graph as labeled 42
Figure B.1 — The basic venting model 45
Figure E.1 — Generic close to carrier noise multipaction test site 59
Figure E.2 — Principal multipaction test set-up for nulling detection method.....61
Figure E.3 — Test configuration (mode 1) 63
Figure E.4 — Test configuration (mode 2) 64
Figure E.5 — Detected envelope of a five carrier waveform.....66
Figure E.6 — Charge probe 68

Tables

Table A.1 — Worst case mode order for susceptible gaps for gold.....31
Table A.2 — Worst case mode order for susceptible gaps for silver 32
Table A.3 — Worst case mode order for susceptible gaps for aluminium 33
Table A.4 — Worst case mode order for susceptible gaps for alodine.....34
Table A.5 — Worst case mode order for susceptible gaps for copper 35
Table A.6 — Constants for the most used materials.....40
Table A.7 — Critical voltages for multipaction in 50 Ω coaxial lines 41
Table B.1 — Outgassing rate for space components used in space applications 46