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Space engineering - Multipactor handbook

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This Technical standard information includes the English version of CEN/CLC/TR 17603-20-01:2021.

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English version

Space engineering - Multipactor handbook

Ingénierie spatiale - Manuel sur l'effet Multipactor

Raumfahrttechnik - Multipactorhandbuch

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European Foreword

This document (CEN/CLC/TR 17603-20-01:2021) has been prepared by Technical Committee CEN/CLC/JTC 5 “Space”, the secretariat of which is held by DIN.

It is highlighted that this technical report does not contain any requirement but only collection of data or descriptions and guidelines about how to organize and perform the work in support of EN 16603-20-01:2020.

This Technical report (CEN/CLC/TR 17603-20-01:2021) originates from ECSS-E-HB-20-01A.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any TR covering the same scope but with a wider domain of applicability (e.g.: aerospace).

Introduction

Multipactor is a well-understood RF breakdown mechanism in high vacuum conditions. It has been investigated both theoretically and experimentally over many years, as listed in references from [2-1] to [2-7]. Essential ingredient for multipactor is initial free electrons, also called primary electrons. Free electrons can be accelerated under the action of the high power electromagnetic signals inside the RF component. These accelerated electrons impact the RF internal surface with such a kinetic energy to knock out secondary electrons. This resonant process repeats until an avalanche-like growth of electrons is reached, and a multipactor discharge occurs. A multipactor discharge produces signal noise, power reflection and ultimately a local ionization that leads to a complete short circuit. In the worst case, this can develop to a complete system failure.

A typical multipactor event can be described as follows:

1. Free electrons exist within the RF field region of a component whose dimensions are small compared with the electron mean free path as a result of low pressure within the component.
2. The electric field within the component accelerates the free electrons towards a surface.
3. The electrons impact on the surface with appropriate energies to liberate more secondary electrons than the incident ones.
4. Under the specific condition of synchronism of the RF electric field and the electron impact time, resonance conditions are met and steps b. and c. repeat until multipactor discharge occurrence.

Beside the multipactor discharge, other electrical breakdown of different nature in RF components such as multipactor leading to corona due to local outgassing and discharge occurrence in intermediate pressure range can also arise [2-8], [2-9] and [2-10].

NOTE The Multipactor Handbook follows the same structure as the Standard. Where the WG has decided that the content of a clause of the Standard needs no supporting material this clause is left empty. The text "*No supporting material needed.* " is added there.

1 Scope

This Handbook describes the guidelines and recommendations for the design and test of RF components and equipment to achieve acceptable performance with respect to multipactor-free operation in service in space. This document is the mirror document of the ECSS-ST-20-01 normative document. Thus it includes the same contents as the normative text and has the same structure.

This Handbook is intended to result in the effective design and verification of the multipactor performance of the equipment and consequently in a high confidence in achieving successful product operation.

This Handbook covers multipactor events occurring in all classes of RF satellite components and equipment at all frequency bands of interest. Operation in single carrier CW and pulse modulated mode are included, as well as multi-carrier operations. A detailed chapter on secondary emission yield is also included.

This Handbook does not include breakdown processes caused by collisional processes, such as plasma formation.

2 References

EN Reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms
EN 16603-10-02	ECSS-E-ST-10-02	Space engineering – Verification
EN 16603-10-03	ECSS-E-ST-10-03	Space engineering - Testing
EN 16603-20-01	ECSS-E-ST-20-01	Space engineering – Multipactor design and test
EN 16601-10	ECSS-M-ST-10	Space project management – Project planning and implementation
EN 16601-40	ECSS-M-ST-40	Space project management – Configuration and information management
EN 16602-20-08	ECSS-Q-ST-20-08	Space product assurance – Storage, handling and transportation of spacecraft hardware
EN 16602-70-01	ECSS-Q-ST-70-01	Space product assurance – Cleanliness and contamination control
EN 16602-70-02	ECSS-Q-ST-70-02	Space product assurance – Thermal vacuum outgassing test for the screening of space materials
	ESCC-20600	Preservation, packaging and despatch of ESCC component
	ISO 14644–1:2015	Clean rooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration

[2-1] A. Woode & J. Petit, Diagnostic Investigations into the Multipactor Effect, Susceptibility Zone Measurements and Parameters Affecting A Discharge, ESTEC Working Paper 1556, November 1989

[2-2] Abstract Book, Workshop on Multipactor and Passive Intermodulation Products Problems in Spacecraft Antennas, ESTEC, December 1990

[2-3] Final Presentations & Working Meeting: Multipactor & PIM in Space RF Hardware, ESTEC, January 1993

[2-4] A. J. Marrison, R. May, J.D. Sanders, A. D. Dyne, A. D. Rawlins, J. Petit, A study of Multipactor in Multicarrier RF Components, Report no AEA/ TYKB/31761/01/RP/05 Issue 1, January 1997

[2-5] A. J. Hatch and H.B. Williams, J. Appl. Phys. 25, 417 (1954)

[2-6] A. J. Hatch and H.B. Williams, Phys. Rev. 112, 681 (1958)

[2-7] R. Woo, Multipacting Discharges between Coaxial Electrodes, J. Appl. Phys. 39, 1528-1533 (1968)

[2-8] R. Woo, Final Report on RF Voltage Breakdown in Coaxial Transmission Lines, JPL Technical Report 32-1500, October 1970

[2-9] F. Höhn, W. Jacob, R. Beckmann, R. Wilhelm, The Transition of a Multipactor to a low-pressure gas discharge, Phys. Plasma, 4, 940-944 (1997)

[2-10] J. M. Meek and J. D. Craggs, Electrical Breakdown of Gases, Wiley (1978)

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