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Space engineering - Guidelines for electrical design and interface requirements for power supply

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Raumfahrttechnik - Richtlinien für das elektrische Design und die Schnittstellenanforderungen von Stromversorgung

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European Foreword

This document (CEN/TR 17603-20-20:2022) 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 16603-20.

This Technical report (CEN/TR 17603-20-20:2022) originates from ECSS-E-HB-20-20A.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN 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

The power distribution by Latching Current Limiters, or LCLs, has been widely used in almost all European satellites for some decades as an effective way to achieve a very controlled and reliable load connection and disconnection from the satellite main bus, including power management in case of overload and load short circuit failures.

Additionally, power distribution by LCLs minimises inrush current events due to load filters charging (see section 5.7.2.3), and for this reason effectively allows the reduction of the loads filters themselves.

On the other side power distribution by LCLs has always been matter of “local” discussion and review, while no attempt has been done so far to collect all the available information in a congruent and explanatory handbook and to allow a product-oriented specification as presently done with ECSS-E-ST-20-20.

This handbook complements ECSS-E-ST-20-20, and it is directed at the same time to power system engineers, who are specifying and procuring units containing LCLs for power distribution and protection, and to power electronics design engineers, who are in charge of designing and verifying power distribution by LCLs.

For the system engineers, this document explains the detailed issues at circuit level and the impacts of the requirements for the design of LCLs.

For design engineers, this document gives insight and understanding on the rationales of the requirements on their designs.

It is important to notice that the best understanding of the topic of Power Distribution based by LCLs is achieved by the contextual reading of both the present handbook and the ECSS-E-ST-20-20.

Note that the present issue of the handbook covers electrical design and interface requirements for power distribution based on Latching Current Limiters only.

Future issues of the present handbook will cover additional power interfaces.

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Scope

In general terms, the scope of the consolidation of LCLs power distribution interface requirements in the ECSS-E-ST-20-20 and the relevant explanation in the present handbook is to allow a more recurrent approach for the specific designs offered by power unit manufacturers, at the benefit of the system integrators and of the Agency, thus ensuring:

- better quality,
- stability of performances, and
- independence of the products from specific mission targets.

A recurrent approach enables power distribution manufacturing companies to concentrate on products and a small step improvement approach that is the basis of a high quality industrial output.

In particular, the scope of the present handbook is:

- to explain the principles of operation of power distribution based on LCLs,
- to identify important issues related to LCLs, and
- to give some explanations of the requirements set up in the ECSS-E-ST-20-20 for power distribution based on LCLs, for both source and load sides.

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References

EN Reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
EN 16603-20-20	ECSS-E-ST-20-20	Space engineering - Electrical design and interface requirements for power supply
EN 16602-30-02	ECSS-Q-ST-30-02	Space product assurance - Failure modes, effects (and criticality) analysis (FMEA/FMECA)
EN 16602-30-11	ECSS-Q-ST-30-11	Space product assurance - Space product assurance, Derating – EEE components
	ESA PSS-02-10 Vol.1 Issue 1, Nov. 1992	Power standard
	IEEE CFP13APE-USB (2013)	MOSFET Gate Open Failure Analysis in Power Electronics, IEEE Applied Power Electronics Conference and Exposition, Long Beach, California, 17-21 March 2013, pp. 189-196 (reported as Annex G in the present HB)
	ESA SP-719 (2014)	Approach to design for stability a system comprising a non-ideal current source and a generic load, 10th European Space Power Conference, Noordwijkerhout, The Netherlands, 13-17 May 2014 (reported as Annex H in the present HB)
	ESA SP-719 (2014)	LCL current control loop stability design, 10th European Space Power Conference, Noordwijkerhout, The Netherlands, 13-17 May 2014 (reported as Annex I in the present HB)

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