

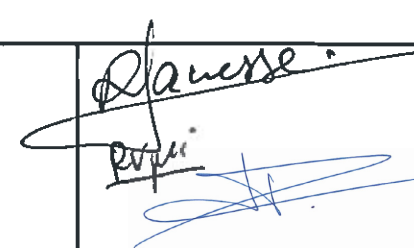
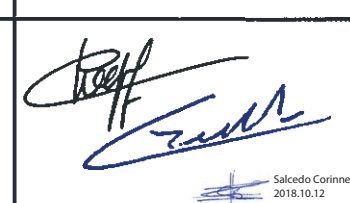


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ISIS EMC SPECIFICATION

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FOREWORD

ISIS (Initiative for Space Innovative Standards) is a set of specification documents established by CNES, Airbus Defence & Space, and Thales Alenia Space France, hereafter called the Partners, with the goal of rationalizing space housekeeping services, from onboard equipment to in-orbit operations, and with the ultimate goal of decreasing overall mission costs.

This documentation is intended to serve as a guide to future mission specific specifications, in order to introduce performance requirements in coherence with incremental evolutions of the industrial satellite platforms product lines, and as to ultimately allow for standardized spacecraft operations.

The ISIS documentation was developed in compliance with the European ECSS standards and is meant to become gradually applicable to future space missions, in function of their needs and capability.

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INDEX SHEET

CONFIDENTIALITY :

KEYWORDS :

TITLE :

ISIS EMC SPECIFICATION

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CHANGES

Version	Date	Comments
1.0	30/06/2011	First issue for ISIS
2	23/09/2011	Update following FEPS PK3 n°149 and workshop meeting dispositions
3	10/10/2012	DM ISIS-FT-139 : - Version issued after import into DOORS and entering under configuration management with RCM - Requirement identification and version added. - report of " Notes" included in the text of requirements. - requirements split when several requirements included in the same one.
4	21/11/2013	DM ISIS-FT-272 - Implementation of requirements that were lost between versions 1.1 and 1.2 not referenced.
5	3/04/2018	DM ISIS-FT-363 : - § 2.1 : RD-07 supprimé, RD-10 (MNU Ariane 5) et RD-11 (MNU Ariane 6) ajoutés, - § 4.3.1 : Spacecraft RE notches update for compatibility with Launchers (Table 1) + § 4.4.1 : Spacecraft RS notches update for comp. with Launchers (Table 2) : • A5 and A6 added • Rockot verified (covered by ISIS spec) • PSLV removed (not considered anymore) • Cosmos removed (expressed in power)

TBC TABLE

Requirement Identifier	Paragraph Number	TBC Comment
[ISIS-EMC-REQ-0260 (v.3)]	4.4.1	TBD Frequency range : - in Table4 : "Radiated Susceptibility Levels". TBC E-Fields level for Ariane 6 in table5 "Radiated Susceptibility of SC for compatibility with Launchers".
[ISIS-EMC-REQ-0390 (v.2)]	4.7	Figure for PCDU perturbing profile for voltage ripple verification.

TBD TABLE

Requirement Identifier	Paragraph Number	TBD Comment
[ISIS-EMC-REQ-0240 (v.3)]	4.3.1	TBD Frequency range : - in Table 2: Radiated Emission Notch Limits, - in Table 3 : Radiated Emissions of SC for compatibility with Launchers
[ISIS-EMC-REQ-0260 (v.3)]	4.4.1	TBD Frequency range : - in Table4 : "Radiated Susceptibility Levels". TBC E-Fields level for Ariane 6 in table5 "Radiated Susceptibility of SC for compatibility with Launchers".

TBW TABLE

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1. INTRODUCTION

1.1. PURPOSE

This specification defines the requirements applicable to the ISIS platform satellites as far as the various electromagnetic compatibility aspects are concerned. This specification is based on the tailored ECSS.

The goal of these requirements is to ensure that the ISIS platform is electro-magnetically self-compatible and compatible with its environment during all operational phases and to demonstrate adequate margins.

Those requirements are the basis for the definition of the activities of the EMC control plan to ensure satellites compatibility.

1.2. FIELD OF APPLICATION

This document is applicable to the teams of the Subcontractor charged with designing, developing, integrating, verifying and validating the EMC requirements.

2. DOCUMENTS

2.1. REFERENCE DOCUMENTS

RD	Reference	Title
RD-01	MIL-STD 461 F	Electromagnetic Emission and Susceptibility requirements for the Control of EMI
RD-02	IEC 1000-4-2 Issue 1995 + Annex 1 1998 +Annex 2 2000	ESD Immunity and Transient Current
RD-03	Issue 3/ Revision 0 March 2006	VEGA user's manual
RD-04	Issue 4/ Revision 0 November 2004	ROCKOT user's manual
RD-05	Issue 1/ Revision 0 June 06	SOYUZ from the Guiana space center user's manual + DC/BD/ST/VGO/N14-036 du 24 avril 2015
RD-06	ST-GTD-SUM-01 is.3/ Rev.0 April 2001	SOYUZ user's manual
RD-07	N/A	N/A
RD-08	Rev 2, October 21st, 2015	FALCON 9 user's manual
RD-09	Issue 2, November 2001	DNEPR user's manual
RD-10	Issue 5, 2007	PSLV user's manual
RD-11	Issue 5, Rév. 2, Octobre 2016	Ariane 5 User Manual
RD-12	Issue 1, Revision 0, Mars 2018	Ariane 6 User Manual

2.2. APPLICABLE DOCUMENTS

Refer to the list of applicable documents provided to the unit dedicated SOW.

2.3. APPLICABLE NORMS AND STANDARDS

Refer to the list of applicable documents provided to the unit dedicated SOW.

ND	Reference	Title
ST01	ECSS-E-ST-20-07C Rev1	European Cooperation for Space Standardization, Space

	(Feb. 2012)	engineering, Electromagnetic compatibility
ST02	ECSS-E-ST-20C	European Cooperation for Space Standardization, Space engineering, Electrical and Electronic

2.4. TERMINOLOGY AND ABBREVIATIONS

2.4.1. TERMINOLOGY

Terms	Definitions
Unit	Equipment that is viewed as an entity for purposes of analysis, manufacturing and maintenance (e.g. valves , actuators, batteries, electronic boxes, power conditioning unit, ...).

2.4.2. ABBREVIATIONS

Abbreviations	Definitions
AD :	Applicable Document
AWG :	American Wire Gauge
BB :	Broadband
BOL :	Beginning of life
BW :	Bandwidth
CE :	Conducted Emission
CFRP :	Carbon Fiber Reinforced Plastic
CM :	Common Mode
CS :	Conducted Susceptibility
DC :	Direct Current
DM :	Differential Mode
DRD :	Document Requirement Definition
ECSS :	European Cooperation for Space Standardization
EGSE :	Electrical Ground Support Equipment
EMC :	Electromagnetic Compatibility
EMI :	Electromagnetic Interference
EQM :	Engineering and Qualification Model

ESA :	European Space Agency
ESD :	Electrostatic Discharge
EUT :	Equipment Under Test
FM :	Flight Model
GDIR :	General Design Interface Requirements
i. a. w. :	in accordance with
ICD :	Interface Control Document
i. e. :	(id est) that is to say
IEC :	International Electrotechnical Commission
LCL :	Latch Current Limiter
LISN :	Line Impedance Stabilisation Network
LV :	Launch vehicle
MGSE :	Mechanical Ground Support Equipment
NB :	Narrowband
PFM :	ProtoFlight Model
PLM :	Payload Module
RD :	Reference Document
RE-E :	Radiated Emission E-field
RE-H :	Radiated Emission H-field
RF :	Radio Frequency
r.m.s. :	Root Mean Square
RS-E :	Radiated Susceptibility E-field
RS-H :	Radiated Susceptibility H-field
S/C :	Spacecraft
STD :	Standard
TBC :	To Be Confirmed
TBD :	To Be Defined
TM :	Telemetry
TT&C :	Telemetry Tracking and Command
USO :	Ultra Stable Oscillator
UUT :	Unit Under Test
VEB :	Vehicle Equipment Bay
w.r.t. :	with respect to

3. TAILORING OF ECSS-E ENGINEERING STANDARD

The Electromagnetic Compatibility shall fulfil the requirements of the ECSS-E-ST-20-07C [ST01] with the requirements amended, completed or newly raised as listed hereafter and tailored.

Tailored requirements are defined in chapter 4 of this document

4. EMC REQUIREMENTS

4.1. CONDUCTED EMISSIONS

4.1.1. Inrush Current

ISIS-EMC-REQ-0010 v : 1

Inrush current at unit switch on shall not exceed the following characteristics:

- $dI/dt < 2 \text{ A}/\mu\text{s}$, Maximum 20A
- $Q < 0.5 \times T_{\text{trip-off}} \times I_L$ (for LCL protected units only)

With : I_L = LCL Trip-Off current in [A] and $T_{\text{trip-off}}$ = minimum specified LCL trip-off duration for I_L

For unregulated power busses, this requirement shall be tested at maximum and minimum bus voltage.

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A3]

4.1.2. Voltage Transient¹

ISIS-EMC-REQ-0020 v : 1

The transient on the primary power bus distribution during switch-ON/OFF of a unit shall stay within the limits of the voltage transient envelope (see Figure1) This requirement is only applicable for units with internal switching devices.

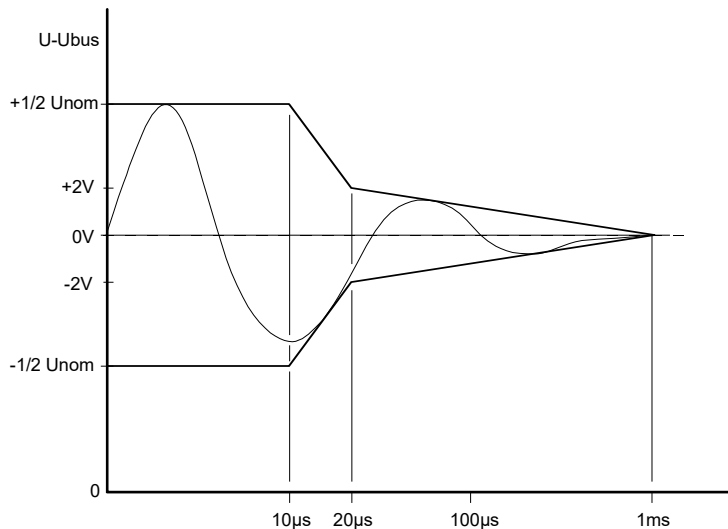


Figure1 : Voltage Transient Envelope

Verification Method : **Test**

4.1.3. Voltage Transient2

ISIS-EMC-REQ-0030 v : 1

Conducted voltage transients on the primary power bus, appearing during nominal mode switching (excluding ON / OFF) or appearing during periodic < 1 Hz or aperiodic activities shall be ≤ 1 Vpp when measured with at least 100 MHz bandwidth.

Verification Method : **Test**

4.1.4. Conducted Emissions on Power Leads, Frequency Domain, Differential mode

ISIS-EMC-REQ-0040 v : 2

Conducted narrow band current emissions (differential mode) in the frequency range 30Hz - 100MHz appearing on the unit's primary power lines shall not exceed the limits of Figure 2.

- The figure 2 is applicable for units up to 1 A DC current consumption, at frequencies below 100kHz, the CE shall be < 80 dBµA (rms)

- For units demanding more than 1 A DC but not exceeding 100 A, this figure can be scaled proportionally to the actual DC current demand only for low frequencies, with an increase in dB given by $20 \log_{10}(I_{DC})$.
- For units demanding more than 100A DC current consumption, the CE shall be $< 120 \text{ dB}\mu\text{A (rms)}$ for low frequencies.

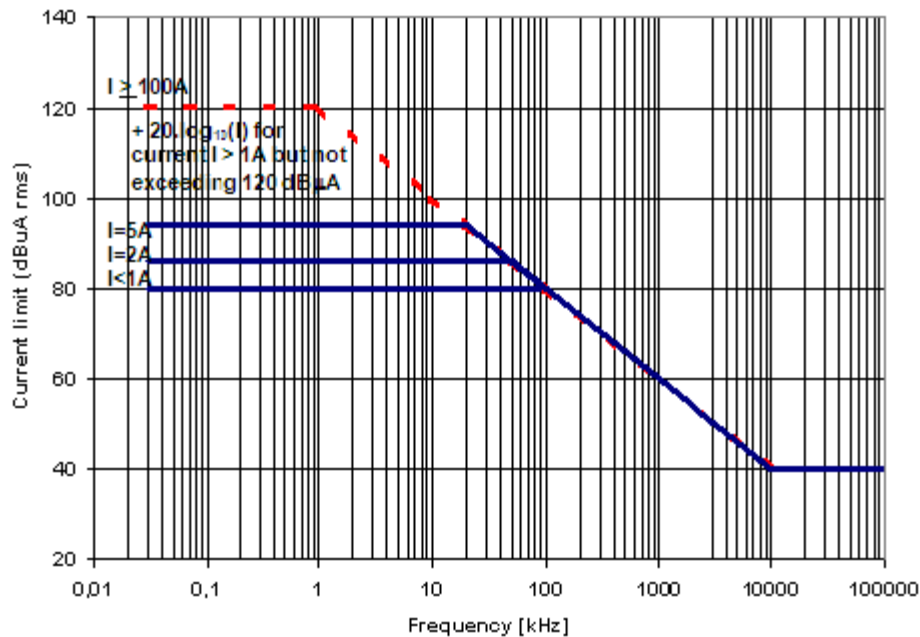


Figure 2 : Conducted Emission Power Lines, Differential Mode

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A2]

4.1.5. Conducted Emissions on Power Leads, Frequency Domain, Common mode

ISIS-EMC-REQ-0050

v : 1

Conducted narrow band current emissions (common mode) in the frequency range 10kHz - 100MHz appearing on the unit's primary power lines shall not exceed the limits of Figure 3.

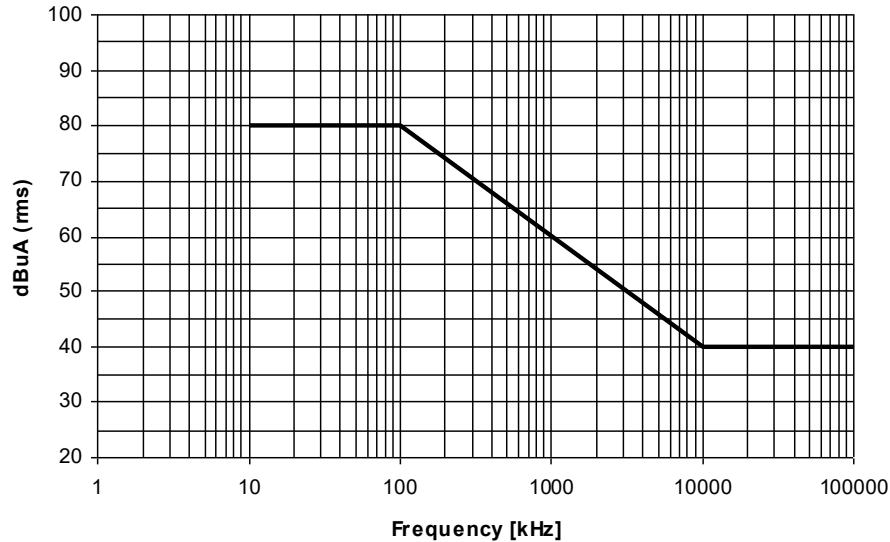


Figure 3 : Conducted Emission Power Lines, Common Mode

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A4]

ISIS-EMC-REQ-0060 v : 1

In case of internal redundancy, conducted emission test frequency domain, differential mode and common mode, and time domain emission tests shall be performed in both nominal and redundant configuration of the unit.

Verification Method : **Review of design**

4.1.6. Conducted Emissions on Power Leads, Time Domain

ISIS-EMC-REQ-0070 v : 2

For primary power users, time domain conducted emissions, differential mode (ripple and spikes) shall be ≤ 300 mVpp. The voltage ripple shall be measured with at least a 100 MHz bandwidth.

Time domain current emissions shall be $< 10\%$ of the units current consumption or < 300 mApp, whatever is less. The current ripple shall be measured with at least a 100 MHz bandwidth.

Verification Method : **Test**

ISIS-EMC-REQ-0080 v : 1

In case of internal redundancy, time domain emission tests shall be performed in both nominal and redundant configurations of the unit.

Verification Method : **Review of design**

4.1.7. Conducted Emissions in case of failure

ISIS-EMC-REQ-0090 v : 2

In the event of a single failure, the amplitude of the spectral signatures on the primary power lines shall not exceed by more than 6dB the limits required for both differential and common mode emissions.

The analysis is limited to a single failure on the main elements of the primary power interface.

The unit subcontractor will justify by analysis or by breadboard tests the compliance to the present requirement.

Verification Method : **A or T**

4.1.8. Conducted Emissions on Secondary Power Lines

The following requirements only apply in the case where an electrical unit supplies secondary power lines to another unit.

4.1.8.1. CE for secondary power supply units, Frequency Domain

ISIS-EMC-REQ-0100 v : 1

The maximum voltage emission levels for secondary power supplies shall be less than:

- 20 mVrms from 30 Hz up to 100 MHz in differential mode,
- 20 mVrms from 10 kHz up to 100 MHz in common mode.

The secondary supplies will be loaded by the representative (R, L, C) loads specified in the unit interface specifications.

The load networks grounding (isolated or not from ground) shall be representative of the flight configuration for these measurements.

Verification Method : **Test**

4.1.8.2. CE for secondary power supply units, Time Domain

ISIS-EMC-REQ-0110 v : 1

The voltage ripple and spikes on secondary power supplies shall be less than:

- 50mVpp with at least 100 MHz bandwidth, in differential mode,
- 50mVpp with at least 100 MHz bandwidth, in common mode.

The secondary supplies will be loaded by the representative (R, L, C) loads including representative sec. power harness specified in the unit interface specifications.

The load networks shall follow the grounding concept of the source and the load.

The requirement shall be met when the unit is subjected to CS on primary power lines.

Verification Method : **Test**

4.1.9. Conducted Emissions on Signal Bundles, Common Mode

ISIS-EMC-REQ-0120

v : 1

Conducted Narrow band conducted emissions (common mode) in the frequency range 10 kHz - 100MHz as measured on the unit's signal bundles shall not exceed the limits of Figure4.

This requirement applies also to secondary power bundles.

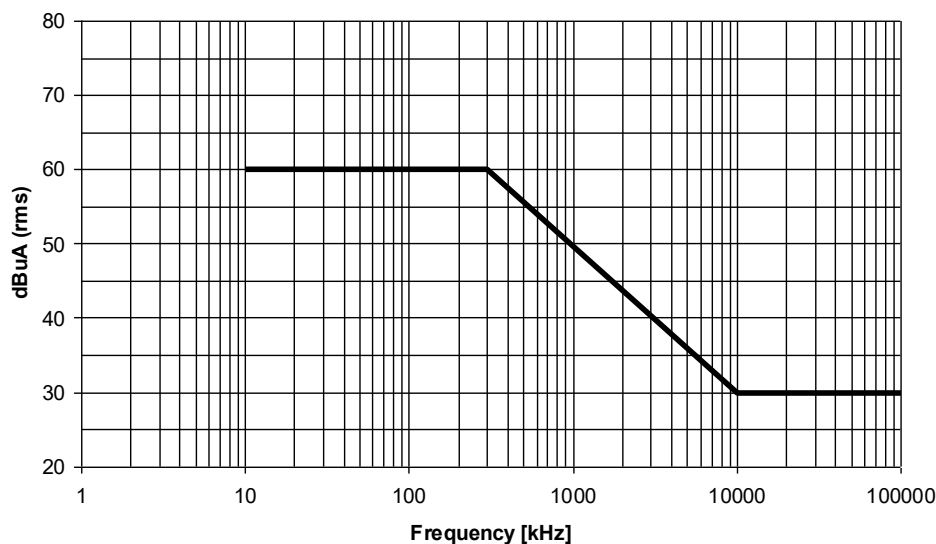


Figure 4 : Conducted Emission on Signal Bundles, Common Mode

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A4]

4.2. CONDUCTED SUSCEPTIBILITY

4.2.1. CS Sine Wave, Differential Mode on power lines

ISIS-EMC-REQ-0130 v : 2

Primary power bus powered units shall not exhibit any failures, malfunctions within its specified tolerances or unintended responses when subjected to sine wave voltages :

- in the frequency range 30 Hz - 100 kHz at the power input terminals (differential mode). The applied voltage shall be 1 Vrms.

The requirement shall be considered as met when, the specified test voltage cannot be generated but the injected current has reached the value of 1 Arms and the subsystem equipment is still operating without malfunctions within its specified tolerances.

- in the frequency range 100 kHz - 100MHz at the power input terminals (differential mode). The applied voltage shall be 1 Vrms and the unit is still operating without malfunctions within its specified tolerances.

In the case where the specified voltage level cannot be generated, the injected current shall be limited 0.3Arms.

The applied sine wave shall be pulse-modulated according to [include ECSS-E-ST-20-07C annex A.11 table A-1].

Frequency range	Pulse repetition frequency	Duty cycle
50 kHz-1 MHz	1 kHz	50 % (squarewave)
1 MHz-10 MHz	100 kHz	20 %
10 MHz-100 MHz	100 kHz	5 %

Table 4.5-1: CS Modulation

The frequency stepping shall be in accordance with the § 5.2.10.1 of the ND ST01.

Verification Method : **A or T**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A10]

ISIS-EMC-REQ-0140 v : 1

The equipment DM input filter shall be sized to sustain the DM CS test below rating.

Verification Method : **Analysis**

Comment(s) : It has to be verified via analysis.

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A10]

ISIS-EMC-REQ-0150 v : 1

In case of equipment susceptibility, the injected interference level will be reduced until the units recovers its nominal performances.

The susceptibility level threshold has to be recorded.

Verification Method : **Review of design**

ISIS-EMC-REQ-0160 v : 1

Differential mode voltage and current has to be controlled. In addition the induced common mode voltage has to be measured in order to not exceed the specified limits. They have to be recorded for each frequency tested.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A10]

4.2.2. CS Sine Wave, Common Mode on power lines

ISIS-EMC-REQ-0170 v : 1

Primary power bus powered units shall not exhibit any failure, malfunction or unintended responses when sine wave voltages of 1.5Vpp in the frequency range 50 kHz - 100 MHz are injected between the primary power return and structure (common mode).

- The injected current shall be limited to 3App, if necessary the voltage shall be reduced.
- The applied sine wave shall be pulse-modulated i.a.w. ECSS-E-ST-20-07C annex A.11 table A-1.

Frequency range	Pulse repetition frequency	Duty cycle
50 kHz-1 MHz	1 kHz	50 % (squarewave)
1 MHz-10 MHz	100 kHz	20 %
10 MHz-100 MHz	100 kHz	5 %

Table 4.5-1: CS Modulation

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A.11]

ISIS-EMC-REQ-0180 v : 1

The equipment CM input filter shall be sized to sustain the CM CS test below rating.

Verification Method : **Analysis**

4.2.3. CS Transient on power lines

ISIS-EMC-REQ-0190

v : 2

The unit shall not exhibit any failures, malfunctions or unintended responses when the following transient voltages are superimposed on the primary power bus inputs, see Figure 5

The transient voltages to be applied on Units connected to power bus shall be the one defined in Table 1.

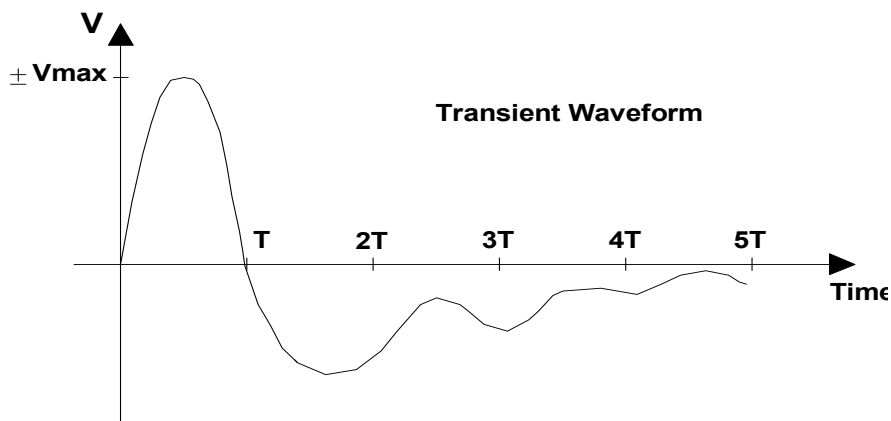


Figure 5: CS Transient Waveform

Injection Mode	DM (slow)	DM (fast)	CM
Max. Voltage (% of nominal bus voltage)	±10%	± 100%	± 50%
Duration (T)	500μs	10μsec	10μsec
Repetition frequency	10Hz	10 Hz	10 Hz
Applied time	1 - 5 min	1 - 5 min	1 - 5 min

Table 1 : Specific Conducted Susceptibility Transient Levels

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A12]

4.2.4. CS on secondary power lines

The following requirements only apply in the case where an electrical unit supplies secondary power lines to

another unit and when the same supplier is responsible of both units

ISIS-EMC-REQ-0200 v : 1

When secondary lines power a unit, the unit shall be tested with twice the maximum noise (or ripple) identified in the relevant power specification or better measured between these 2 units. Those fixed CS levels shall be submitted to Prime for approval.

Verification Method : **Test**

ISIS-EMC-REQ-0210 v : 1

When a unit delivers secondary lines, the unit shall demonstrate under all EMC susceptibility tests (especially conducted susceptibility on primary power lines) that the maximum noise (or ripple) identified in the relevant power specification between these 2 units is not exceeded.

Verification Method : **Test**

4.2.4.1. CS Sinewave injection for secondary power supply units

ISIS-EMC-REQ-0220 v : 1

The conducted susceptibility specification for secondary power supplied units shall be at least:

- 100 mV RMS from 30 Hz up to 100 MHz in differential mode,
- 100 mV RMS from 10 kHz up to 100 MHz in common mode.

Verification Method : **Test**

4.2.5. CS on secondary reference

CS CM Sinewave injection on secondary reference

ISIS-EMC-REQ-0230 v : 1

The unit shall not exhibit any failures, malfunctions or unintended responses when sine wave current of 80dB μ Arms in the frequency range 50 kHz - 100 MHz is injected into the bonding strap (the EUT chassis been isolated from the ground plane).

Verification Method : **Test**

4.3. RADIATED EMISSIONS

4.3.1. Radiated Emissions (E-field)

ISIS-EMC-REQ-0240

v : 3

The unit shall not exceed the specified limits in the range 30 MHz - 18GHz (see Figure 6).

For non RF equipment, the specified upper frequency limit can be reduced to 2.5 GHz. Nevertheless the RE-notches described in table 2 above 1GHz shall be measured for all units.

The limits are given in the Figure 6 and table 2 for the notches.

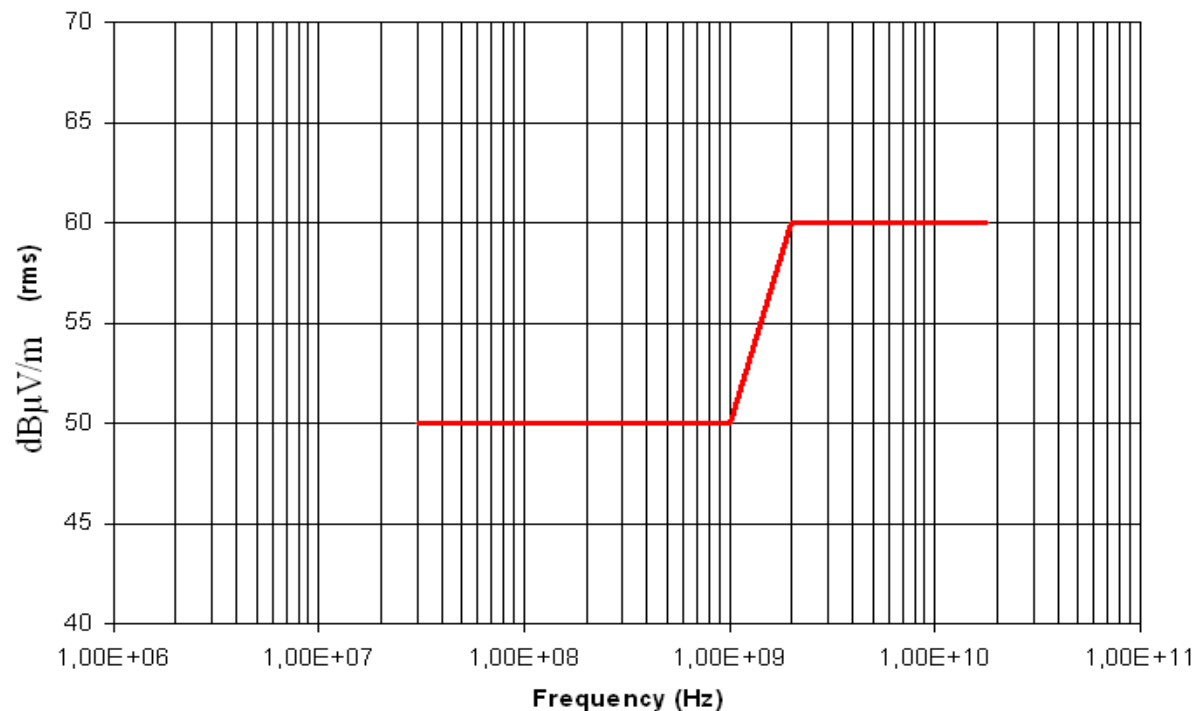


Figure 6 : Radiated Emissions, E-field, NB

Frequency Range	Field level for units in direct view of RF antenna (peak values) (note1)	Field level for units hidden from the RF antenna (see note 1)	Remarks	Integration BW (note 2)
2.025 – 2.110 GHz	0 dB μ V/m	15 dB μ V/m	S-Band TT&C	S-Band TT&C
1.555 – 1.595 GHz (L1)	0 dB μ V/m	20 dB μ V/m	GPS receiver	GPS receiver
1.207 – 1.247 GHz (L2)	0 dB μ V/m	20 dB μ V/m	GPS receiver	GPS receiver
TBD	See note 3			

Table 2: Radiated Emission Notch Limits

Since COSMOS specification is defined in power (dBm) and not in field (dB μ V/m), please address ISIS units compatibility to launcher authorities

PSLV is not considered anymore in ISIS baseline

For only units that are powered at launch, the Launcher Radiated Emissions limits are applied (see table 3), limits coming from Launcher user's manuals reference documents listed in §2.1.

Frequency Range	E-Field level (dBμV/m)	Notes
420 – 480 MHz	35	Soyuz launcher (Kourou)
1573 – 1620 MHz	19	
2720 – 2730 MHz	50	
1566 – 1623 MHz	20	Soyuz (Baikonour)
2716 – 2734 MHz	47	
5745 – 5765 MHz	48	
420 – 480 MHz	35	VEGA launcher
410 – 430 MHz	22	Falcon 9
1565 – 1585 MHz	46	
All Rockot's spec. are covered by ISIS specification		Rockot launcher
1570 – 1620 MHz	10	Dnepr launcher
420 – 480 MHz	35	Ariane 5
420 – 480 MHz	35	Ariane 6
TBD	TBD	

Table 3 : Radiated Emissions of SC for compatibility with Launchers

Verification Method : **Test**

Comment(s) : Note 1: external units potentially in direct view of an RF antenna should be identified as such in the unit technical specification (default case = hidden). The case used (direct view/ hidden) shall be recalled by the supplier in the Statement of Compliance to the GDIR and subject to approval by the prime. The internal units are considered as similar as the units hidden from the RF antennas.

Note 2: Care must be taken to ensure that the resolution bandwidth and sweep time are correct so that the filter response of the receiver/ spectrum analyser can fully resolve any signal that might be present, to its maximum amplitude around the emission limit.

Note 3: Project-specific receiver notches may be defined in addition.

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A9]

Maturity : TBD on : TBD Frequency range : - in Table 2: Radiated Emission Notch Limits, - in Table 3 : Radiated Emissions of SC for compatibility with Launchers

4.3.2. Radiated Emissions (magnetic field)

ISIS-EMC-REQ-0250 v : 2

The radiated magnetic field generated by Units, shall not exceed the limits specified in Figure 7.

The RE-magnetic test shall only be performed on units which can generate magnetic fields (below 100 kHz), for example compressors, reaction wheels, ...

The test has to performed according the test procedure RE-101 of the MIL-STD-461E.i.e measurement at 7cm.

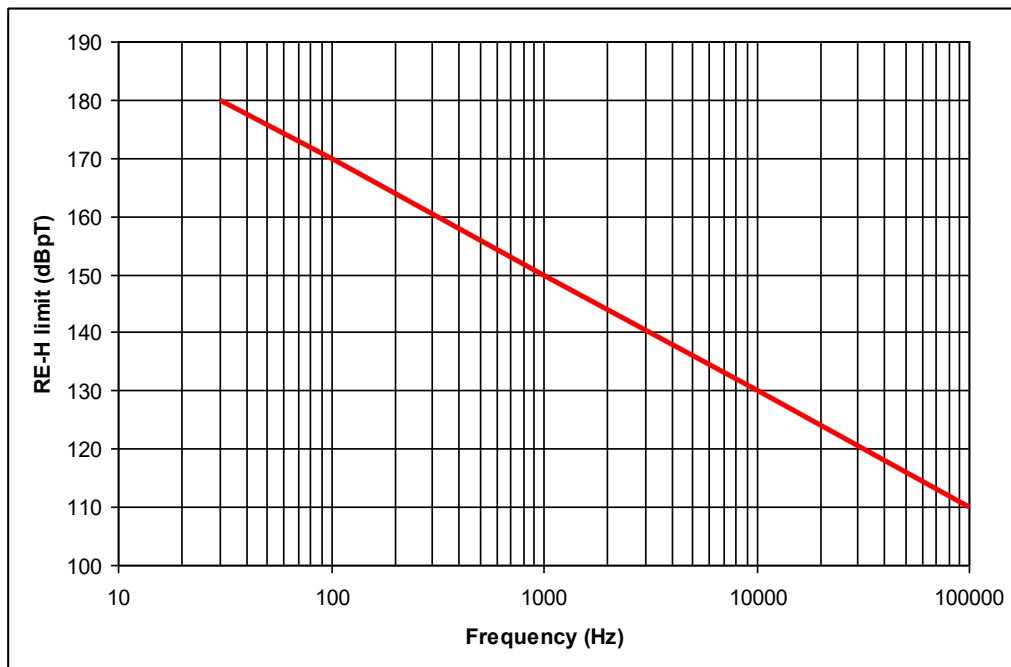


Figure 7 : Radiated Emissions, magnetic-field

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A7]

4.4. RADIATED SUSCEPTIBILITY

4.4.1. Radiated Susceptibility (E field)

ISIS-EMC-REQ-0260 v : 3

The unit shall not show any malfunction or deviation from the specified performance when irradiated with the following E-fields:

- 30 MHz to 18 GHz: 126 dB μ V/m rms
- In notch frequency bands defined in table4

The radiated E-field shall be amplitude modulated by a sine wave at 1 kHz with a modulation depth of 50 % or pulse Amplitude Modulated (PAM) by a pulse at 1 kHz, 50 % duty cycle.

Frequency Range	E-Field Level	Notes
2.0 – 2.3 GHz	20 Vrms/m	S-Band Transmitter
7.8 – 8.4 GHz	20 Vrms/m	X-Band Transmitter
TBD	TBD	Specific Payload Transmitter

Table 4 : Radiated Susceptibility Levels

For units that are powered at launch, the Launcher Radiated Susceptibility levels are applied (see table 5), limits coming from the Launcher user's manuals reference documents listed in §2.1.

Frequency Range	E-Field level (dB μ V/m)	Notes
1 – 1.5 GHz	145	Soyuz launcher (Kourou)
2.2 – 2.29	145	
2.75 – 3.4	145	
5.4 – 5.9	145	
2 200 – 2 300 MHz	140	Falcon 9
5 755 – 5 775 MHz	154	
125 – 250 MHz	140	Dnepr launcher
1 000 – 1 050 MHz	140	
2 750 – 2 900 MHz	154	
7 500 – 7 600 MHz	140	
1 – 1.5 GHz	145	Ariane 5
2.2 – 2.29 GHz	145	
2.9 – 3.4 GHz	145	
5.4 – 5.9 GHz	145	
1 – 40 GHz	150 (TBC)	Ariane 6

Table 5: Radiated Susceptibility of SC for compatibility with Launchers

Verification Method : **Test**

Comment(s) : - Since COSMOS specification is defined in power (dBm) and not in field (dB μ V/m), please adress ISIS units compatibility to launcher authorities.

- All Rockot's spec. are covered by ISIS specification.
- PSLV is not considered anymore in ISIS baseline.

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A14]

Maturity : TBC

TBD on : TBD Frequency range : - in Table4 : "Radiated Susceptibility Levels".

TBC E-Fields level for Ariane 6 in table5 "Radiated Susceptibility of SC for compatibility with Launchers".

4.4.2. Radiated Susceptibility (magnetic field)

ISIS-EMC-REQ-0270

v : 2

Units shall not show any malfunction or deviation from the specified performance when irradiated along any axis with an induced magnetic field level of :

- In the frequency range 0.1 - 10 Hz :

- For SM units: 3 mT

- For payload unit : with the hypothesis that the payload is mounted on an interface plane, the following values of the magnetic field (0.1 - 10 Hz) has to be taken into account :

Distance to the PF/PL interface plane	B field (see note)
≤100 mm	3 mT
≤200 mm	1.5 mT
≤400 mm	0.6 mT
≤600 mm	0.3 mT
≤800 mm	0.1 mT
≤1000 mm	0.08 mT

Note: the levels are based on the use of 300 A.m² MTBs

In the case that the payload module is integrated inside the platform then the injected level = 3mT.

In the frequency range : 30Hz-100kHz :

- applicable only to units in the vicinity of magnetic field sources ($d \leq 20\text{cm}$, those units will be defined by the Prime at beginning of the project)

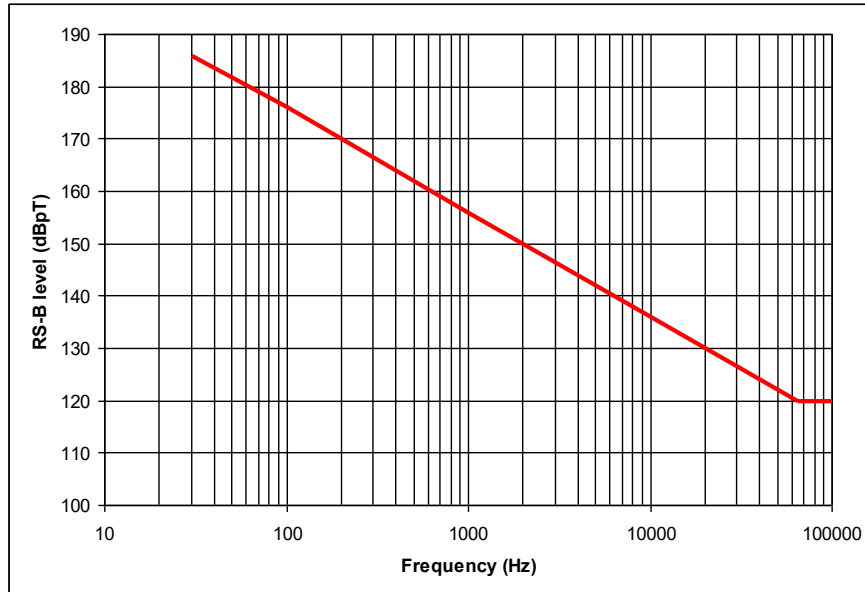


Figure 8 : Radiated Susceptibility, B-field

- for all other units which can be susceptible in this frequency range : 120dBpT in 30Hz-100KHz

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A13]

ISIS-EMC-REQ-0280 v : 1

In the case where a unit uses technologies which are known to be sensitive to AC or DC magnetic fields (e.g. USO's, motors, etc.), this sensitivity shall be reported together with an estimate of the maximum allowed magnetic field.

Verification Method : **Review of design**

4.5. DC MAGNETIC REQUIREMENTS

To reduce the magnetic moment of the spacecraft, it is generally recommended to use non-magnetic materials.

ISIS-EMC-REQ-0290 v : 1

The use of ferro-magnetics shall be avoided for parts, components, and equipment structure. Materials shall be used which are non-magnetic or, if magnetic characteristics cannot be avoided, have the lowest residual field. In particular soft magnetic material shall be avoided whenever possible.

Verification Method : **Review of design**

Comment(s) : Note 1: Concerning its remanent magnetisation, a ferromagnetic material can be soft or hard depending on the value of the coercive field, denoted H_C and expressed in A/m, which is the intensity of the

applied magnetic field needed to reduce its magnetisation to zero after it has been driven to saturation. If remanent magnetisation is stable up to a given threshold of applied field, the material is considered hard. If remanent magnetisation however changes at levels below such a given threshold, the material is considered soft. In the literature, the threshold is usually assumed to be 100 microT, i.e. about twice the amplitude of Earth's magnetic field.

Note2: Aluminium and its alloys, fiberglass, CFRP, magnesium and its alloys, titanium and its alloys are all not ferromagnetic. These are among the most desirable materials to be used structurally.

ISIS-EMC-REQ-0300 v : 2

~~DELETED : Aluminium and its alloys, fibreglass, CFRP, magnesium and its alloys, titanium and its alloys are all non magnetic. These are among the most desirable materials to be used structurally.~~

Verification Method : **Review of design**

ISIS-EMC-REQ-0310 v : 2

Steel or other ferromagnetic materials shall be avoided for use in the mechanical hardware, and their use shall be minimised in any support equipment. If the use of steel in the mechanical hardware is unavoidable, it shall be stainless steel of proven non-ferromagnetic characteristics.

Verification Method : **Review of design**

Comment(s) : Note: It is not intended to use high permeable shielding foil for the harness.

ISIS-EMC-REQ-0320 v : 1

The use of relays shall be limited to the most critical functions, which cannot be handled by solid state switching.

Verification Method : **Review of design**

ISIS-EMC-REQ-0330 v : 2

The use of ferromagnetic materials shall be subject to prior approval. For each mechanical or electrical part made partly or wholly of a ferromagnetic material, the Unit supplier shall compile a file including the following information :

- Type of ferromagnetic material used
- Geometric shape
- Mass and density
- Maximum magnetic permeability (μ)
- Coercitive magnetic field (H_c)
- Location
- Estimated or measured value of part's magnetic moment (amplitude, direction)

This file shall be included within the unit ICD

Verification Method : **Review of design**

ISIS-EMC-REQ-0340 v : 1

The magnetic moment of the unit/subsystem is specified in the unit specification.

If not explicitly defined in unit specification, the magnetic moment of any unit, when measured along any reference axis, shall be kept lower than 0.1 Am^2 .

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A6]

ISIS-EMC-REQ-0350 v : 2

Unit level magnetic moments shall be measured and/ or assessed using configurations considering maximum consumptions wrt. power or current.

Verification Method : **A or T**

Comment(s) : Note: This requirement can be verified either by Test or by Analysis. It is not mandatory to verify this requirement by both methods

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A6]

4.6. ESD SUSCEPTIBILITY

ISIS-EMC-REQ-0360 v : 1

ESD susceptibility testing is only applicable to Qualification Model, Engineering Model unit builds only. It shall not be performed on Proto Flight or Flight unit builds.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A15]

ISIS-EMC-REQ-0370 v : 2

The unit shall not be susceptible when submitted to pulses of 30 Ap min, 30 ns min duration at mid height and a rise time $\geq 3A/\text{ns}$, generated via a 6 kV spark gap and coupled into the unit harness over 20 cm of coupling wire. If the spark gap is difficult to procure, commercial ESD generator with an appropriate ad hoc circuit R,C can be an acceptable alternative.

The pulses shall be applied at a rate of 1 Hz, with at least 15 positive and 15 negative pulses.

Verification Method : **Test**

Comment(s) : Note: The verification method is only applicable for all models which are neither PFM nor FM.

Origin Standard Id: [ECSS-E-ST-20-07_008014 1], ND ST01 : [Annex A15]

4.7. PCDU TD EMISSIONS

Important notice : This chapter is applicable only to PCDU.

ISIS-EMC-REQ-0380 v : 1

Time domain conducted differential mode voltage ripple on the primary power bus distribution outlets, measured between positive and return lines shall be ≤ 150 mVpp. The voltage ripple shall be measured with at least 100 MHz bandwidth.

Verification Method : **Test**

ISIS-EMC-REQ-0390 v : 2

Those performances of the PCDU shall be demonstrated by test when submitted to the following current profile :

For the square wave perturbing profile the current transient shall be with $dI/dt \geq 1A/\mu s$.

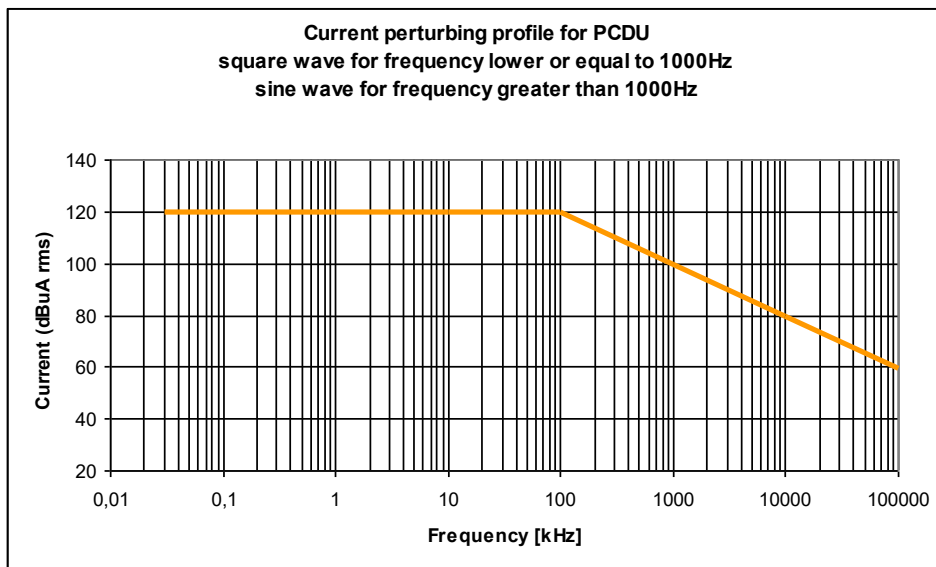


Figure 9 : PCDU perturbing profile for voltage ripple verification (TBC)

Verification Method : **Test**

Maturity : TBC on : Figure for PCDU perturbing profile for voltage ripple verification.

5. VERIFICATION

5.1. GENERAL

5.1.1. EMC control plan

The “EMC control plan” defines the approach, methods, procedures, resources and organization to design, produce and verify a product to operate within its specified electromagnetic environment and performance characteristics.

It provides the instruction for conducting all activities related to the management, the design requirements and the verification of the electromagnetic compatibility of all items of equipment and subsystems of project.

ISIS-EMC-REQ-0400	v :	1
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The unit or subsystem supplier shall provide a “Unit EMC Control Plan” or “Subsystem EMC Control Plan” based on this specification including the magnetic cleanliness control plan. The EMC Control Plan shall be established in accordance with the document requirement definition (DRD) of the annex A of the ECSS-E-ST-20C.

Verification Method : **Review of design**

5.1.2. EMC Verification Plan

ISIS-EMC-REQ-0410	v :	1
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The unit or subsystem supplier shall provide a “Unit EMC Verification Plan” or “Subsystem EMC Verification Plan”.

The EMC Verification Plan shall be established in accordance with the document requirement definition (DRD) of the annex B of the ECSS-E-ST-20C.

Verification Method : **Review of design**

5.1.3. EMC Verification Report

ISIS-EMC-REQ-0420	v :	1
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The unit or subsystem supplier shall provide a “Unit EMC Verification Report” or “Subsystem EMC Verification Report”.

The EMC Verification Report shall be established in accordance with the document requirement definition (DRD) of the annex C of the ECSS-E-ST-20C.

Verification Method : **Review of design**

5.1.4. EMC Verification UNIT MODELS TAILORING

ISIS-EMC-REQ-0430

v : 2

The following tables defining the requirements to be verified by tests on the different models for 2 development philosophies, shall be applicable. The qualification tests for EM/EQM/PFM and the acceptance tests for FM are described in the following tables.

EMC Requirement to be verified by tests	EM	PFM	FM
Inrush Current	X	X	X
Voltage Transient 1	X	X	X
Voltage Transient 2	X	X	X
Conducted Emissions on power leads, Frequency Domain, Differential Mode	X	X	X
Conducted Emissions on power leads, Frequency Domain, Common Mode	X	X	X
Conducted Emissions on power leads, Time Domain	X	X	X
Conducted Emissions on secondary power lines, Frequency Domain	X	X	X
Conducted Emissions on secondary power lines, Time Domain	X	X	X
Conducted Emissions on signal bundles, Common Mode	X	X	
Conducted Susceptibility sine wave, Differential Mode on power lines	X	X	
Conducted Susceptibility sine wave, Common Mode on power lines	X	X	
Conducted Susceptibility transient on power lines	X	X	
Conducted Susceptibility on secondary power lines	X	X	
Conducted Susceptibility on secondary reference	X	X	
Radiated Emissions E-field		X	
Radiated Emissions magnetic field		X	
Radiated Susceptibility E-field		X	
Radiated Susceptibility magnetic field		X	
Magnetic Moment		X	
ESD susceptibility	X		

EMC Requirement to be verified by tests	EQM	FM1	FM2
Inrush Current	X	X	X
Voltage Transient 1	X	X	X
Voltage Transient 2	X	X	X
Conducted Emissions on power leads, Frequency Domain, Differential Mode	X	X	X
Conducted Emissions on power leads, Frequency Domain, Common Mode	X	X	X
Conducted Emissions on power leads, Time Domain	X	X	X
Conducted Emissions on secondary power lines, Frequency Domain	X	X	X
Conducted Emissions on secondary power lines, Time Domain	X	X	X
Conducted Emissions on signal bundles, Common Mode	X		
Conducted Susceptibility sine wave, Differential Mode on power lines	X		
Conducted Susceptibility sine wave, Common Mode on power lines	X		
Conducted Susceptibility transient on power lines	X		
Conducted Susceptibility on secondary power lines	X		
Conducted Susceptibility on secondary reference	X		
Radiated Emissions E-field	X		
Radiated Emissions magnetic field	X		
Radiated Susceptibility E-field	X		
Radiated Susceptibility magnetic field	X		
Magnetic Moment	X		
ESD susceptibility	X		

5.2. TEST CONDITIONS

~~ISIS-EMC-REQ-0440~~ v : 2

~~DELETED : For all unit/subsystem tests, all test conditions defined in the following chapters shall be applied.~~

Verification Method : **Review of design**

ISIS-EMC-REQ-0450 v : 2

The test conditions, including the description of the material used, shall be defined in the test requirement specification or in the tests procedures written by the unit/subsystem manufacturer.

Verification Method : **Review of design**

ISIS-EMC-REQ-0460 v : 2

All unit/subsystem RFDs relative to EMC/ESD specification shall be referenced in the unit/subsystem test report. All deviations from the test procedure appearing during tests shall be annexed to the unit/subsystem EMC test report.

Verification Method : **Review of design**

ISIS-EMC-REQ-0470 v : 1

The EGSE and MGSE used for spacecraft integration and ground testing shall be designed in order to meet the EMC required by the spacecraft, i.e. at least 6 db lower than subsystem/unit requirements for CE, as well as RE in case the EGSE is placed inside the chamber.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008050 1]

ISIS-EMC-REQ-0480 v : 1

The EGSE shall be immune to signals used for spacecraft susceptibility tests.

Verification Method : **Test**

5.2.1. Measurement tolerances

Section 5.2.1 of [ST01] is applicable.

~~ISIS-EMC-REQ-0490~~ v : 2

~~DELETED : For measurement tolerances, the section 5.2.1 in ECSS E ST 20 07C is applicable.~~

5.2.2. Test site

Section 5.2.2 of [ST01] is applicable.

~~ISIS-EMC-REQ-0500~~ v : 2

~~DELETED : For test site, the section 5.2.2 in ECSS E ST 20 07C is applicable.~~

5.2.3. Ground plane

Section 5.2.3 of [ST01] is applicable.

~~ISIS-EMC-REQ-0510~~ v : 2

~~DELETED : For ground plane, the section 5.2.3 in ECSS E ST 20 07C is applicable.~~

5.2.4. Power source impedance

Section 5.2.4 of [ST01] is applicable.

~~ISIS-EMC-REQ-0520~~ v : 2

DELETED : For power source impedance, the section 5.2.4 in ECSS E-ST-20-07C is applicable.

ISIS-EMC-REQ-0530 v : 1

LISN impedance measurement (from 30 Hz up to 100 MHz) shall be provided in the unit test report.

Verification Method : **Test**

Origin Standard Id: [ECSS-E-ST-20-07_008072 1]

5.2.5. General test precautions

Section 5.2.5 of [ST01] is applicable.

~~ISIS-EMC-REQ-0540~~ v : 2

DELETED : For general test precautions, the section 5.2.5 in ECSS E-ST-20-07C is applicable.

5.2.6. EUT test configurations.

Section 5.2.6 of [ST01] is applicable.

~~ISIS-EMC-REQ-0550~~ v : 2

DELETED : For EUT test configurations, the section 5.2.6 in ECSS E-ST-20-07C is applicable.

ISIS-EMC-REQ-0560 v : 2

The test harness shall be flight representative in terms of twisting, shielding and overshielding quality.

The information concerning the design of the flight harness will be provided by the prime.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008085 1]

5.2.7. Operation of EUT

Section 5.2.7 of [ST01] is applicable.

~~ISIS-EMC-REQ-0570~~ v : 2

DELETED : For operation of EUT, the section 5.2.7 in ECSS E ST 20 07C is applicable.

5.2.8. Use of measurement equipment

Section 5.2.8 of [ST01] is applicable.

~~ISIS-EMC-REQ-0580~~ v : 2

DELETED : For use of measurement equipment, the section 5.2.8 in ECSS E ST 20 07C is applicable.

5.2.9. Emission testing

Section 5.2.9 of [ST01] is applicable.

~~ISIS-EMC-REQ-0590~~ v : 2

DELETED : For emission testing, the section 5.2.9 in ECSS E ST 20 07C is applicable.

ISIS-EMC-REQ-0600 v : 1

Each plot of emission data shall be reported with a maximum amplitude resolution of 2 dB.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008133 1]

5.2.10. Susceptibility testing

Section 5.2.10 of [ST01] is applicable.

~~ISIS-EMC-REQ-0610~~ v : 2

DELETED : For susceptibility testing, the section 5.2.10 in ECSS E ST 20 07C is applicable.

ISIS-EMC-REQ-0620 v : 1

Data shall be provided with a maximum amplitude resolution of 2 dB for each plot.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008145 1]

5.2.11. Calibration of measuring equipment

Section 5.2.11 of [ST01] is applicable.

ISIS-EMC-REQ-0630

v : 2

DELETED : For calibration of measuring equipment, the section 5.2.11 in ECSS E-ST-20-07C is applicable.

5.3. EQUIPMENT AND SUBSYSTEM LEVEL TEST PROCEDURES

5.3.1. General

Test procedures are defined for verifying emission and susceptibility requirements at subsystem or equipment level. The following Table gives the correspondence between procedures and clauses defining the associated limits.

ISIS-EMC-REQ-0640

v : 2

For all unit/subsystem tests, all test procedures defined in the following chapters shall be applied.

Limit §	Title	Verification §
4.1	Inrush Current	5.3.5
4.1	Voltage Transient 1	5.3.4
4.1	Voltage Transient 2	5.3.4
4.1	Conducted Emissions on power leads, Frequency Domain, Differential Mode	5.3.2
4.1	Conducted Emissions on power leads, Frequency Domain, Common Mode	5.3.3
4.1	Conducted Emissions on power leads, Time Domain	5.3.4
4.1	Conducted Emissions on secondary power lines, Frequency Domain	5.3.6
4.1	Conducted Emissions on secondary power lines, Time Domain	5.3.6
4.1	Conducted Emissions on signal bundles, Common Mode	5.3.3
4.2	Conducted Susceptibility sine wave, Differential Mode on power lines	5.3.7
4.2	Conducted Susceptibility sine wave, Common Mode on power lines	5.3.8
4.2	Conducted Susceptibility transient on power lines	5.3.9
4.2	Conducted Susceptibility on secondary power lines	5.3.10
4.2	Conducted Susceptibility on secondary reference	5.3.8
4.3	Radiated Emissions E-field	5.3.11
4.3	Radiated Emissions magnetic field	5.3.12
4.4	Radiated Susceptibility E-field	5.3.13
4.4	Radiated Susceptibility magnetic field	5.3.14
4.5	Magnetic Moment	5.3.16
4.6	ESD susceptibility	5.3.15
4.7	PCDU TD Emissions	5.3.17

List of test procedures with associated limits

Verification Method : **Review of design**

ISIS-EMC-REQ-0650 v : 1

All request(s) for deviation and their description in the unit/subsystem shall be part of the related EMC test reports.

ISIS-EMC-REQ-0660 v : 1

The EMC test reports shall include photos of all test setups used during the EMC tests.

5.3.2. CE, power leads, differential mode, 30 Hz to 100 MHz

5.3.2.1. Purpose

This test is used for measuring conducted emissions in the frequency range 30 Hz to 100 MHz on all input power leads including returns.

5.3.2.2. Test procedure

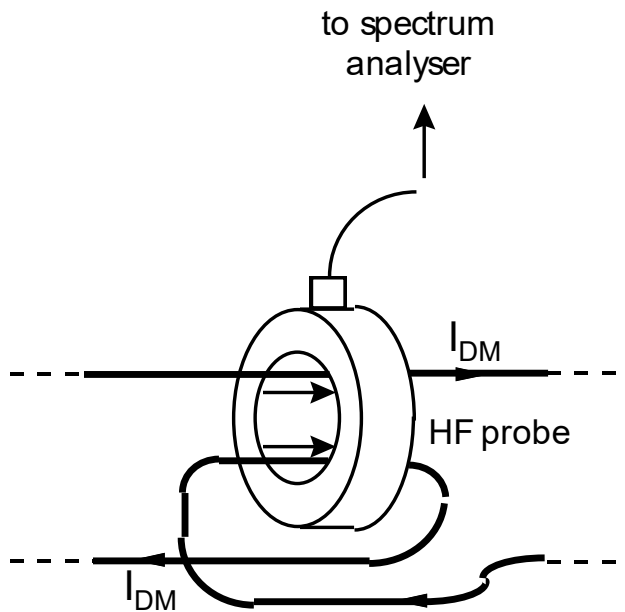
ISIS-EMC-REQ-0670 v : 1

The test shall be performed according to the test procedure defined in the § 5.4.2 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008168 1], [ECSS-E-ST-20-07_008169 1], [ECSS-E-ST-20-07_008170 1]

The ECSS requires to measure each power lead, hot line and return, separately. However it is recommended to use the setup defined on the following Figure, the measurement of the two lines is performed at the same time. With such a setup, in order to compute I_{DM}, the results have to be divided by 2.



Differential Mode measurement

5.3.3. CE, power and signal leads, 10 kHz to 100 MHz

5.3.3.1. Purpose.

This test procedure is used to verify that electromagnetic emissions from the EUT do not exceed the specified requirements for power input leads including returns, and for common mode emission.

5.3.3.2. Test procedure

ISIS-EMC-REQ-0680	v : 1
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The test shall be performed according to the test procedure defined in the § 5.4.3 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008171 1], [ECSS-E-ST-20-07_008172 1], [ECSS-E-ST-20-07_008173 1]

5.3.4. CE on Power Lines in Time Domain

5.3.4.1. Purpose

This test procedure is used to verify that the conducted emissions of the unit do not exceed the specified requirements.

5.3.4.2. Test procedure

ISIS-EMC-REQ-0690 v : 2

The test setup shall be according to the following figure:

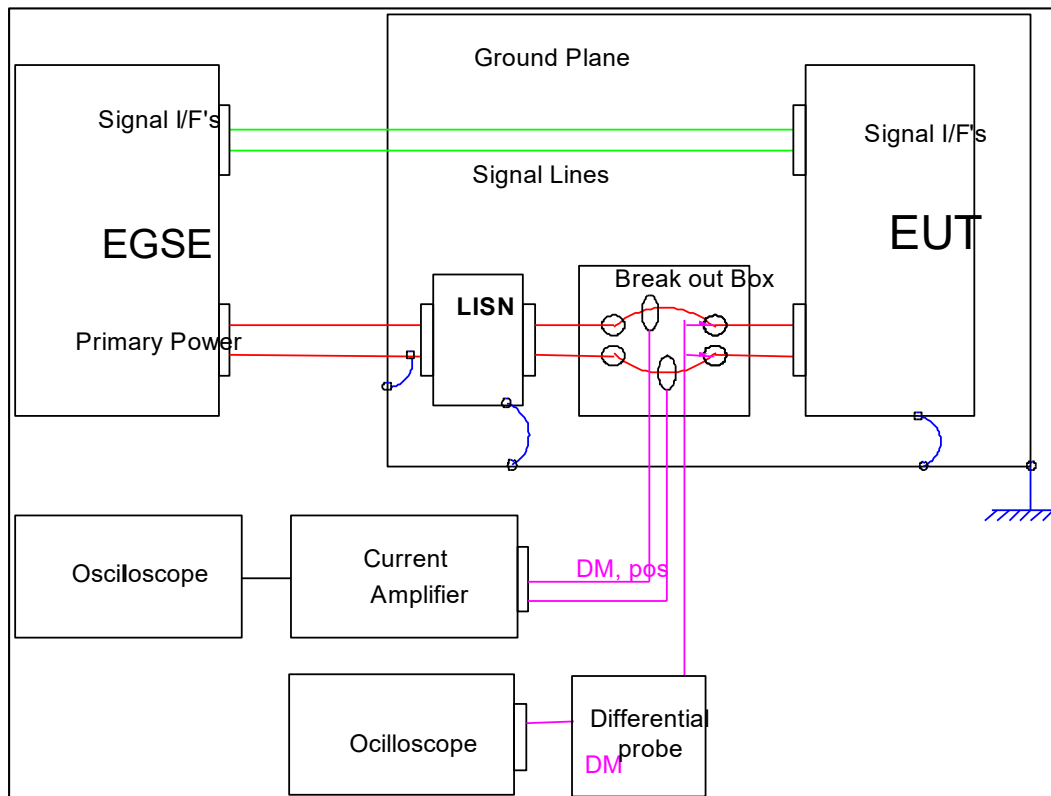


Figure 5.3.4-1: CE in time domain on primary power input , DM

Verification Method : **Review of design**

5.3.5. Inrush Current

5.3.5.1. Purpose

This test procedure is used to verify that the inrush current of the EUT does not exceed the specified requirements for power input leads.

5.3.5.2. Test procedure

ISIS-EMC-REQ-0700 v : 1

The test shall be performed according to the test procedure defined in the § 5.4.4 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008174 1], [ECSS-E-ST-20-07_008175 1], [ECSS-E-ST-20-07_008176 1]

5.3.6. CE on Secondary Power Lines

5.3.6.1. Purpose

This test procedure is used to verify that the conducted emissions of the unit (which provides secondary power lines to other unit(s)) do not exceed the specified requirements.

ISIS-EMC-REQ-0710 v : 1

The secondary power supplies shall be loaded by representative loads.

Verification Method : **Review of design**

5.3.6.2. Test procedure

ISIS-EMC-REQ-0720 v : 2

The test setups shall be according to Figure 5.3.6-1 and Figure 5.3.6-2 respectively for Time Domain Differential Mode and Common Mode measurements.

For Frequency Domain measurements , the oscilloscope has to be replaced by an EMI receiver.

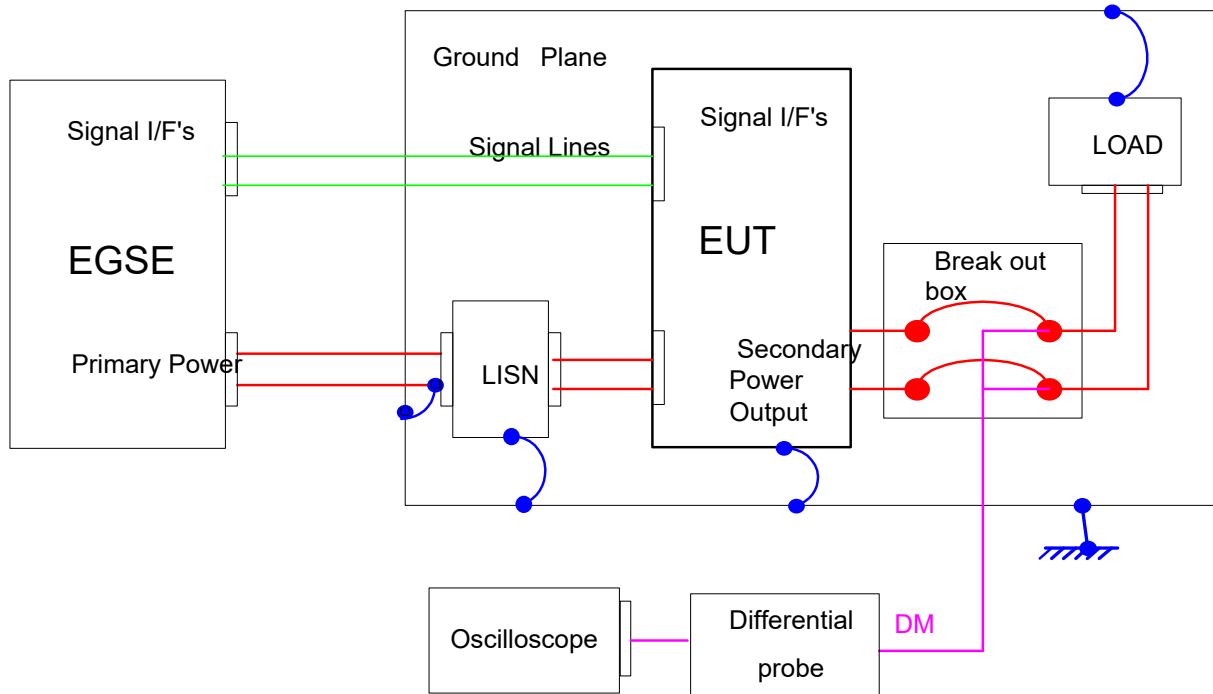


Figure 5.3.6-1: CE in time domain on secondary power output , DM

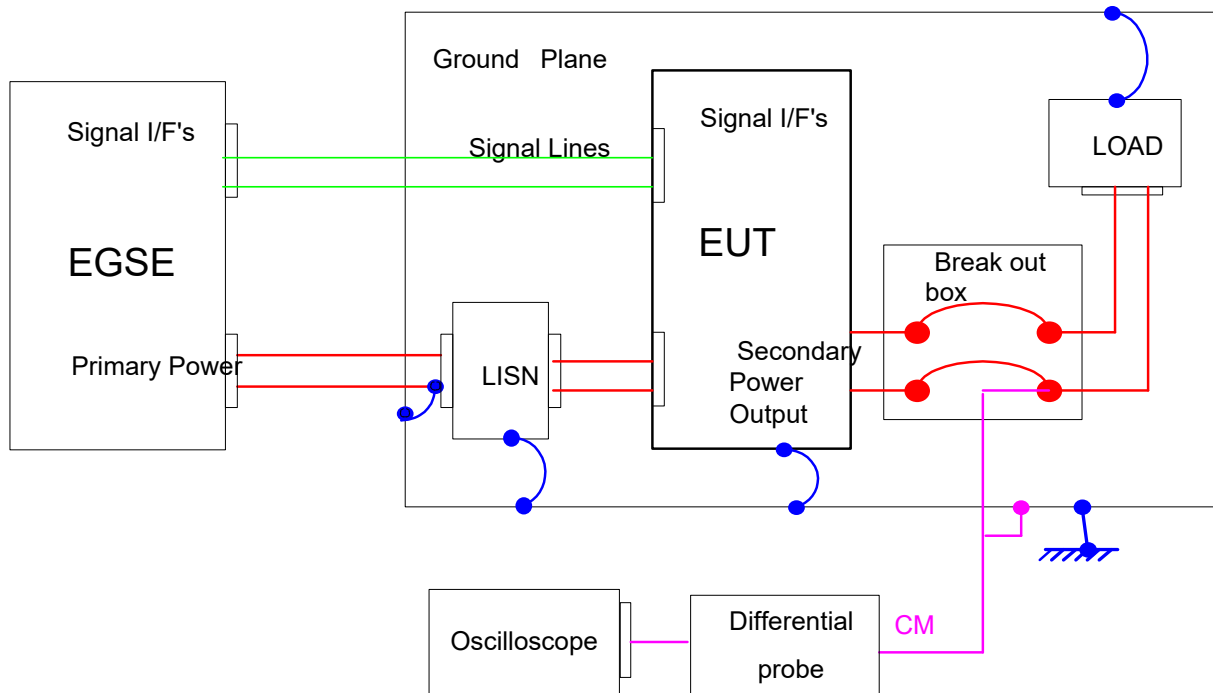


Figure 5.3.6-2: CE in time domain on secondary power output , CM

Verification Method : **Review of design**

5.3.7. CS Primary Power Lines, Differential Mode

5.3.7.1. Purpose.

This test procedure is used to verify the ability of the EUT to withstand signals coupled on input power leads.

5.3.7.2. Test procedure

5.3.7.2.1. 30 Hz up to 100 kHz

ISIS-EMC-REQ-0730	v :	1
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The test shall be performed according to the test procedure defined in the § 5.4.7 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008197 1], [ECSS-E-ST-20-07_008198 1], [ECSS-E-ST-20-07_008199 1], [ECSS-E-ST-20-07_008200 1], [ECSS-E-ST-20-07_008201 1]

5.3.7.2.2. 100 kHz up to 100 MHz

ISIS-EMC-REQ-0740	v :	1
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The test setup shall be according to the Figure 5.3.7-1:

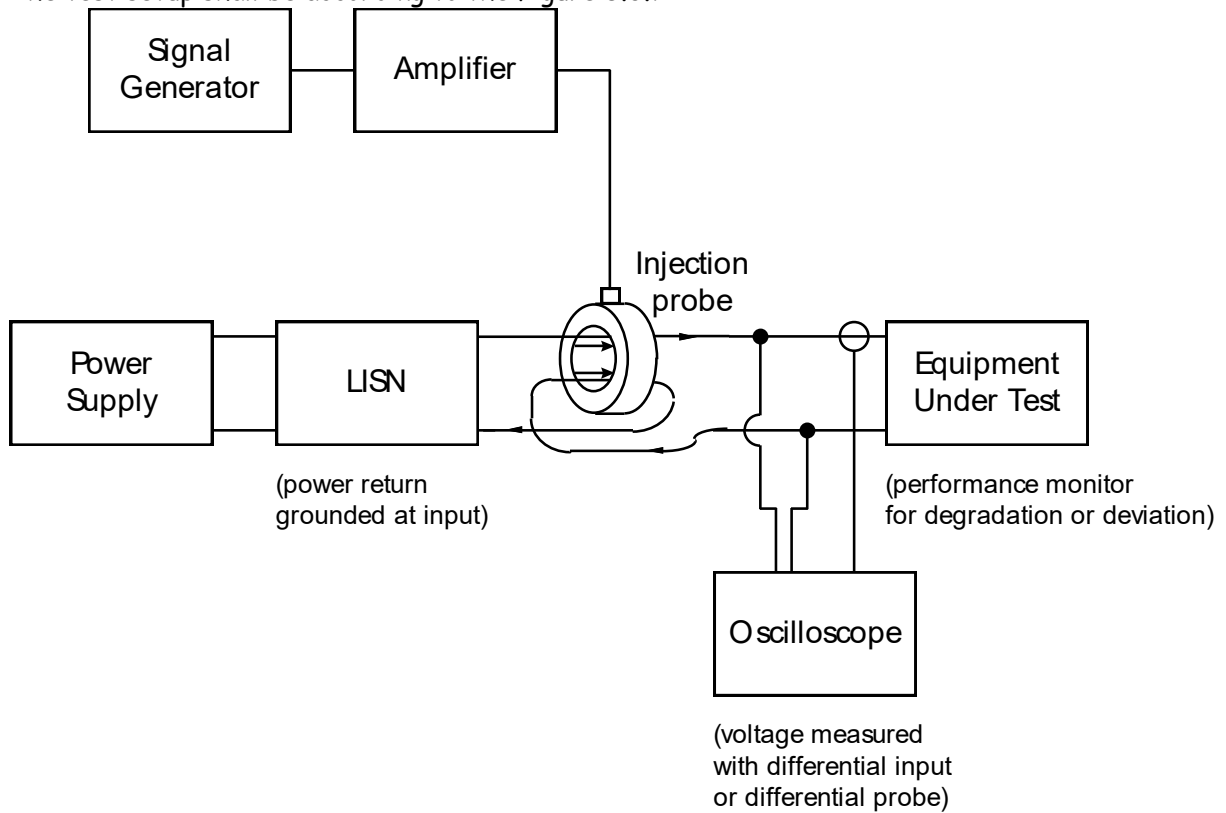


Figure 5.3.7-1: Test setup Conducted susceptibility (100 kHz - 100 MHz)

Verification Method : **Review of design**

5.3.8. CS on secondary reference

5.3.8.1. Purpose.

This test procedure is used to verify the ability of the EUT to withstand sinusoidal waves coupled on the EUT associated cables and power leads.

5.3.8.2. Test procedure.

ISIS-EMC-REQ-0750

v : 2

The test shall be performed according to the test procedure defined in the § 5.4.8 of the ECSS-E-ST-20-07C [ST01].

The test setup shall be according to the Figure 5.3.8-1:

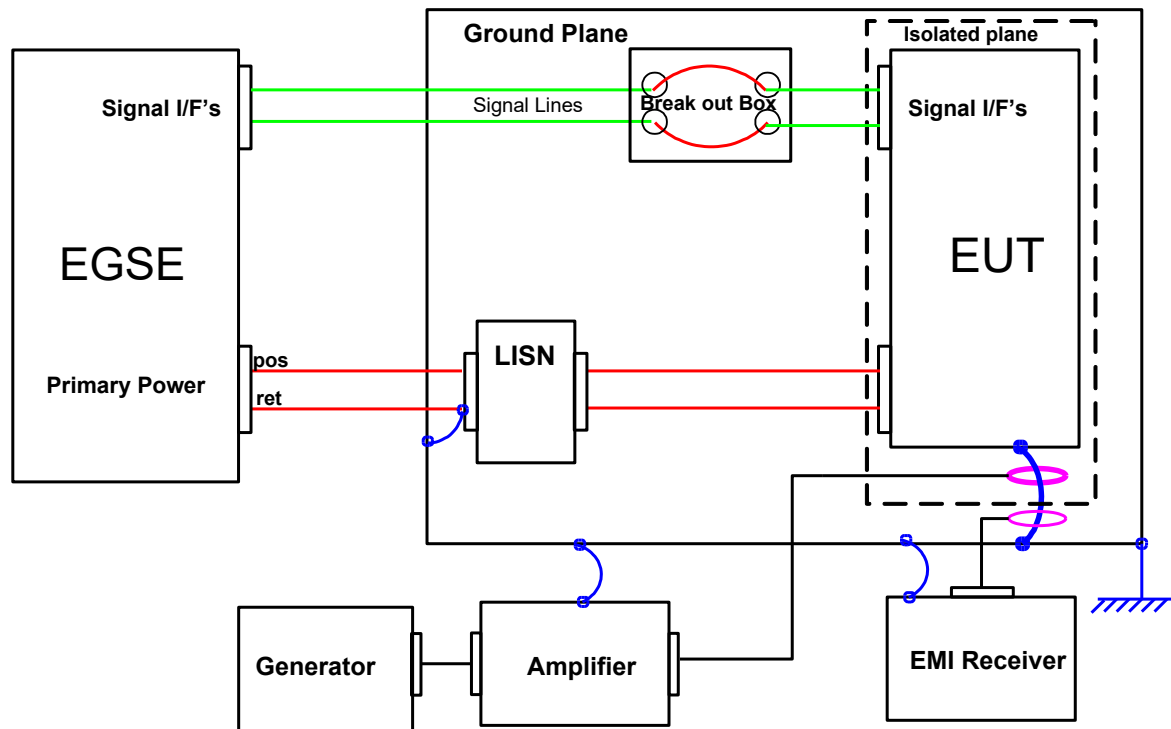


Figure 5.3.8-1: Test setup Conducted susceptibility (50 kHz - 100 MHz) on secondary reference by means of bulk current injection on the EUT bonding strap

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008202 1], [ECSS-E-ST-20-07_008203 1], [ECSS-E-ST-20-07_008204 1], [ECSS-E-ST-20-07_008205 1], [ECSS-E-ST-20-07_008206 1], [ECSS-E-ST-20-07_008207 1]

5.3.9. CS, power leads, transients

5.3.9.1. Purpose.

This test procedure is used to verify the ability of the EUT to withstand short spikes coupled on EUT power leads, including grounds and returns that are not grounded internally to the equipment or subsystem.

5.3.9.2. Test procedure

The test shall be performed according to the test procedure defined in the § 5.4.9 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008208 1], [ECSS-E-ST-20-07_008209 1], [ECSS-E-ST-20-07_008210 1]

5.3.10. CS on Secondary Power Lines

5.3.10.1. Purpose

This test procedure is used to verify the ability of the unit (which is powered by secondary power lines) to withstand signals coupled on input power leads

5.3.10.2. Test procedure

ISIS-EMC-REQ-0770

v : 2

The conducted susceptibility tests shall be performed according to the Figure 5.3.10-1 between 30 Hz and 50 kHz and according to the Figure 5.3.10-2 between 50 kHz and 100 MHz.

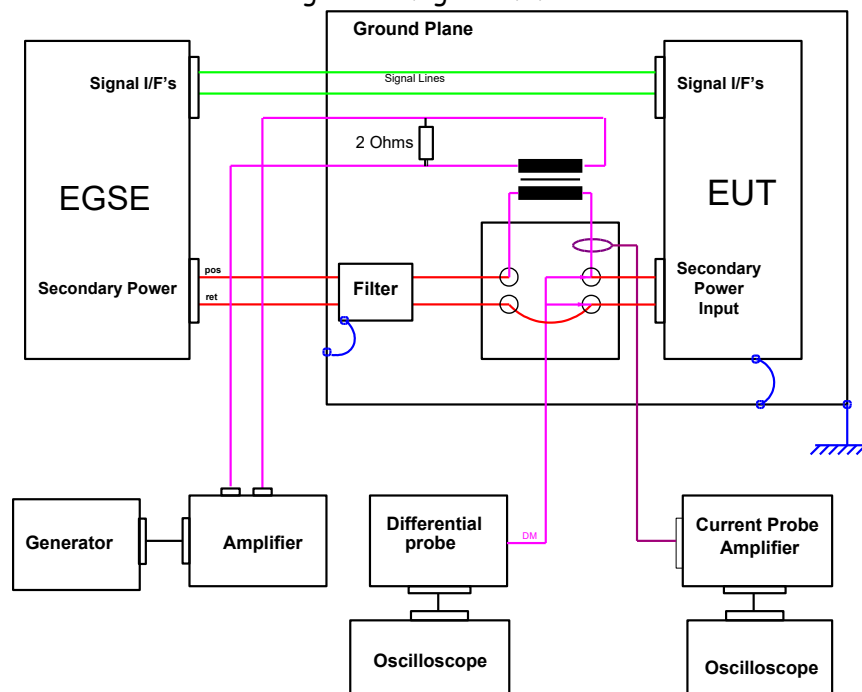


Figure 5.3.10-1: CS on secondary power input , DM, 30 Hz - 50 kHz

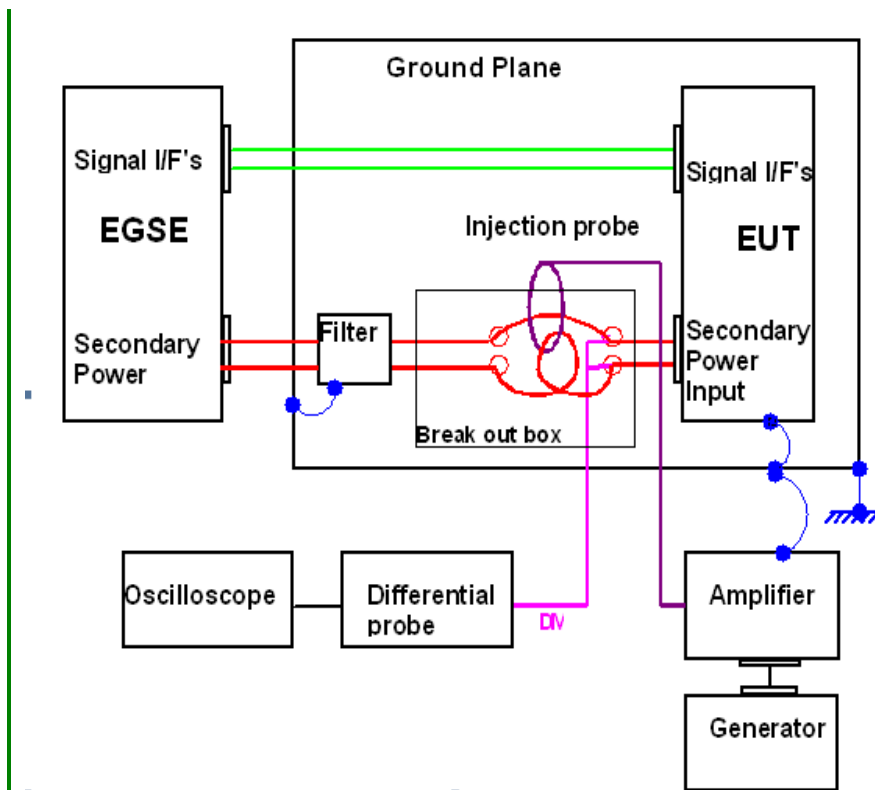


Figure 5.3.10-2: CS on secondary power input , DM, 50 kHz - 100 MHz

Verification Method : **Review of design**

5.3.11. RE, electric field

5.3.11.1. Purpose.

This test procedure is used to verify that electric field emissions from the EUT and its associated cabling do not exceed specified requirements.

5.3.11.2. Test procedure.

ISIS-EMC-REQ-0780 v : 1

The test shall be performed according to the test procedure defined in the § 5.4.6 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008186 1], [ECSS-E-ST-20-07_008187 1], [ECSS-E-ST-20-07_008188 1], [ECSS-E-ST-20-07_008189 1], [ECSS-E-ST-20-07_008190 1], [ECSS-E-ST-20-07_008191 1], [ECSS-E-ST-20-07_008192 1], [ECSS-E-ST-20-07_008193 1], [ECSS-E-ST-20-07_008194 1], [ECSS-E-ST-20-

07_008195 1], [ECSS-E-ST-20-07_008196 1]

5.3.12. RE, magnetic field AC, 30 Hz to 100 kHz.

5.3.12.1. Purpose.

This test procedure is used to verify that the magnetic field emissions from the EUT and its associated electrical interfaces do not exceed specified requirements.

5.3.12.2. Test Equipment.

ISIS-EMC-REQ-0790

v : 1

The test equipment shall be as follows:

- a. Measurement receivers
- b. Data recording device
- c. Loop sensor having the following specifications:
 - (1) Diameter: 13.3 cm
 - (2) Number of turns: 36
 - (3) Wire: 7-41 Litz wire (7 strand, No. 41 AWG)
 - (4) Shielding: Electrostatic
 - (5) Correction factor: See manufacturer's data for factors to convert measurement receiver readings to decibels above one picotesla (dBpT).
- d. LISNs
- e. Ohmmeter
- f. Signal generator

Verification Method : **Review of design**

Origin Standard Id: RD01 RE101

5.3.12.3. Setup.

ISIS-EMC-REQ-0800

v : 1

The test setup shall be as follows:

- a. Maintain a basic test setup for the EUT as shown and described in general test setup figure 5-3 §5.2.6.1 of ECSS E-20-07C.

- b. Calibration. Configure the measurement setup as shown in Figure RE H-field AC - 3.

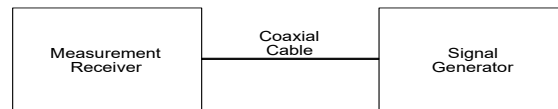


FIGURE RE H-field AC-3. Calibration configuration

- c. EUT Testing. Configure the measurement receiving loop and EUT as shown in Figure RE H-field AC - 4.

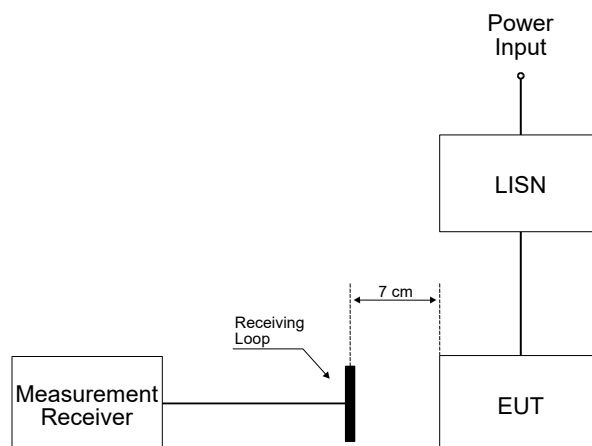


FIGURE RE H-field AC-4. Basic test setup

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008077 1], RD01 RE101

5.3.12.4. Procedures.

ISIS-EMC-REQ-0810 v : 1

The test procedures shall be as follows:

- a. Turn on the measurement equipment and allow sufficient time for stabilization.
- b. Calibration.

(1) Apply a calibrated signal level, which is at least 6 dB below the limit, at a frequency of 100 kHz. Tune the measurement receiver to a center frequency of 100 kHz. Record the measured level.

(2) Verify that the measurement receiver indicates a level within ± 3 dB of the injected signal level.

(3) If readings are obtained which deviate by more than ± 3 dB, locate the source of the error and correct the deficiency prior to proceeding with the testing.

(4) Using an ohmmeter, verify that the resistance of the loop sensor winding is approximately 10 ohms.

c. EUT Testing.

(1) Turn on the EUT and allow sufficient time for stabilization.

(2) Locate the loop sensor 7 cm from the EUT face or electrical interface connector being probed. Orient the plane of the loop sensor parallel to the EUT faces and parallel to the axis of connectors.

(3) Scan the measurement receiver over the applicable frequency range to locate the frequencies of maximum radiation, using the bandwidths and minimum measurement times of Table 5-2 of §5.2.9.1 of ECSS E-20-07C.

(4) Tune the measurement receiver to one of the frequencies or band of frequencies identified in c(3) above.

(5) Monitor the output of the measurement receiver while moving the loop sensor (maintaining the 7 cm spacing) over the face of the EUT or around the connector. Note the point of maximum radiation for each frequency identified in c(4) above.

(6) At 7 cm from the point of maximum radiation, orient the plane of the loop sensor to give a maximum reading on the measurement receiver and record the reading.

(7) Repeat c(4) through c(6) for at least two frequencies of maximum radiation per octave of frequencies below 200 Hz and for at least three frequencies of maximum radiation per octave above 200 Hz.

(8) Repeat c(2) through c(7) for each face of the EUT and for each EUT electrical connector.

Verification Method : **Review of design**

Origin Standard Id: RD01 RE101

5.3.12.5. Data Presentation.

ISIS-EMC-REQ-0820

v : 1

Data presentation shall be as follows:

- Provide graphs or a tabular listing of each measurement frequency,

- mode of operation,
- measured magnetic field,
- and magnetic field limit level.

Verification Method : **Review of design**

Origin Standard Id: RD01 RE101

5.3.13. RS, electric field

5.3.13.1. Purpose.

This test procedure is used to verify the ability of the EUT and associated cabling to withstand electric fields.

5.3.13.2. Test procedure.

ISIS-EMC-REQ-0830	v : 1
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The test shall be performed according to the test procedure defined in the § 5.4.11 of the ECSS-E-ST-20-07C [ST01].

The calibration with an electrical field sensor shall be performed without the EUT.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008217 1], [ECSS-E-ST-20-07_008218 1], [ECSS-E-ST-20-07_008219 1], [ECSS-E-ST-20-07_008220 1], [ECSS-E-ST-20-07_008221 1], [ECSS-E-ST-20-07_008222 1], [ECSS-E-ST-20-07_008223 1], [ECSS-E-ST-20-07_008224 1], [ECSS-E-ST-20-07_008225 1], [ECSS-E-ST-20-07_008226 1], [ECSS-E-ST-20-07_008227 1]

5.3.14. RS, AC magnetic field

5.3.14.1. Purpose.

This test procedure is used to verify the ability of the EUT to withstand radiated magnetic fields as required.

5.3.14.2. Test Procedure.

ISIS-EMC-REQ-0840	v : 1
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EUT operation shall be selected in order to maximize the response of the test specimen to the particular environment being created. The magnetic field generation coil shall be placed on all 5 sides of the unit under test. The coil is placed at a distance of 5 cm of the unit surface.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008211 1], [ECSS-E-ST-20-07_008212 1], [ECSS-E-ST-20-07_008214 1], [ECSS-E-ST-20-07_008215 1], [ECSS-E-ST-20-07_008216 1]

ISIS-EMC-REQ-0850 v : 2

The test shall be performed according to the test procedure defined in the § 5.4.10 of the ECSS-E-ST-20-07C. For the tests in the range 0.1 - 10 Hz, the calibration of the field level shall be performed at 10 Hz instead of 1 kHz.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008211 1], [ECSS-E-ST-20-07_008212 1], [ECSS-E-ST-20-07_008214 1], [ECSS-E-ST-20-07_008215 1], [ECSS-E-ST-20-07_008216 1]

ISIS-EMC-REQ-0860 v : 2

Other radiating item as magneto-torquer bars and sensor loops could be used and shall be submitted to Prime approval.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008211 1], [ECSS-E-ST-20-07_008212 1], [ECSS-E-ST-20-07_008214 1], [ECSS-E-ST-20-07_008215 1], [ECSS-E-ST-20-07_008216 1]

ISIS-EMC-REQ-0870 v : 1

No injection of 10dB greater than the limit specified shall be applied.

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008211 1], [ECSS-E-ST-20-07_008212 1], [ECSS-E-ST-20-07_008214 1], [ECSS-E-ST-20-07_008215 1], [ECSS-E-ST-20-07_008216 1]

5.3.15. Susceptibility to electrostatic discharge

5.3.15.1. Purpose and principle.

The purpose of this test is to determine the existence of susceptibility to electromagnetic effects of electrostatic discharges.

5.3.15.2. Test procedure

ISIS-EMC-REQ-0880 v : 1

The test shall be performed according to the test procedure defined in the § 5.4.12 of the ECSS-E-ST-20-07C [ST01], with the following test requirements:

- the ESD generator shall be set in contact discharge mode, i.e. discharge by the closure of a relay inside the ESD generator (as opposed to "air discharge).
- the ESD generator shall be compliant to the IEC 61000-4-2.
- the ground cable of the ESD generator shall be 2 meters long.
- the ground cable may pass close to the ground plane (without strong coupling) but shall stay at least 20 cm from anything else: EUT, cables, EGSE.
- the "gun" shall be held orthogonal to the surfaces under test.

Verification Method : **Review of design**

Comment(s) : Note : the capacitance value (50 pF) can be increased to 100 pF

Note: other test setups can be used, but they shall be submitted to approval of the Prime prior to the test.

Origin Standard Id: [ECSS-E-ST-20-07_008228 1], [ECSS-E-ST-20-07_008229 1], [ECSS-E-ST-20-07_008230 1], [ECSS-E-ST-20-07_008231 1]

5.3.16. DC Magnetic field emission, magnetic moment

5.3.16.1. Purpose

This test is used to measure the magnetic moment of the EUT.

5.3.16.2. Test procedure

ISIS-EMC-REQ-0890	v :	1
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The test shall be performed according to the test procedure defined in the § 5.4.5 of the ECSS-E-ST-20-07C [ST01].

Verification Method : **Review of design**

Origin Standard Id: [ECSS-E-ST-20-07_008180 1], [ECSS-E-ST-20-07_008181 1], [ECSS-E-ST-20-07_008183 1], [ECSS-E-ST-20-07_008184 1], [ECSS-E-ST-20-07_008185 1]

5.3.17. PCPU TD EMISSIONS

5.3.17.1. Purpose

This test procedure is used to verify the ability of the PCPU to maintain its voltage ripple performances when submitted to a current perturbing profile.

5.3.17.2. Test procedure

ISIS-EMC-REQ-0900

v : 2

The TD emissions tests shall be performed according to the Figure 5.3.17-1 (open PCDU case) or Figure 5.3.17-2 (closed PCDU case) between 30 Hz and 1 kHz and according to the Figure 5.3.17-3 (open PCDU case) or Figure 5.3.17-4 (closed PCDU case) between 1 kHz and 100 MHz.

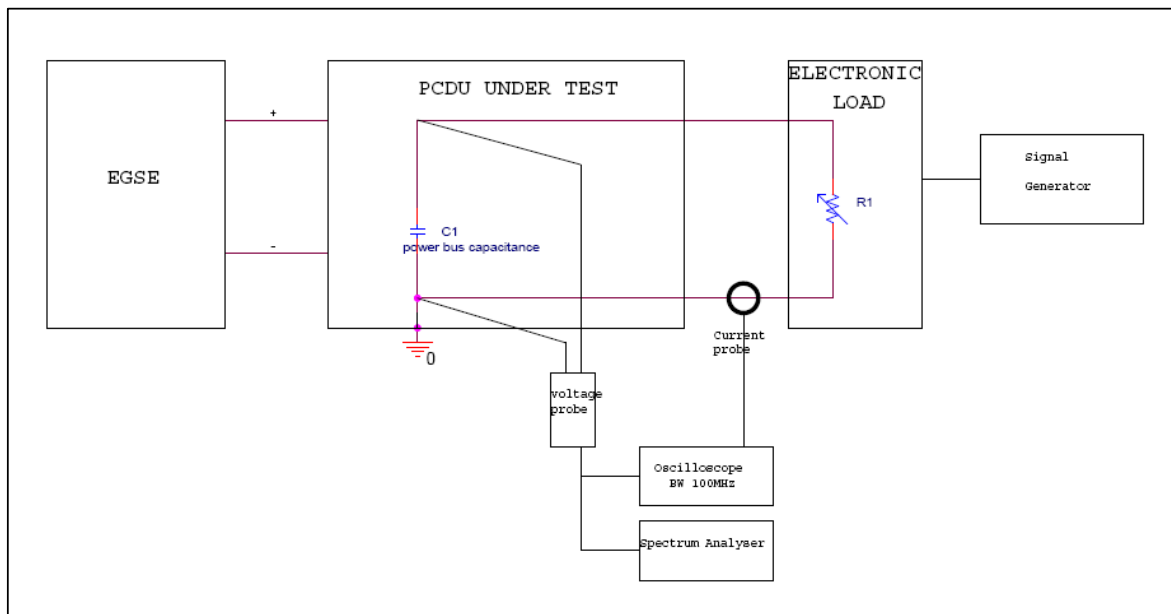


Figure 5.3.17-1 : open PCDU TD emissions test set-up for low frequency

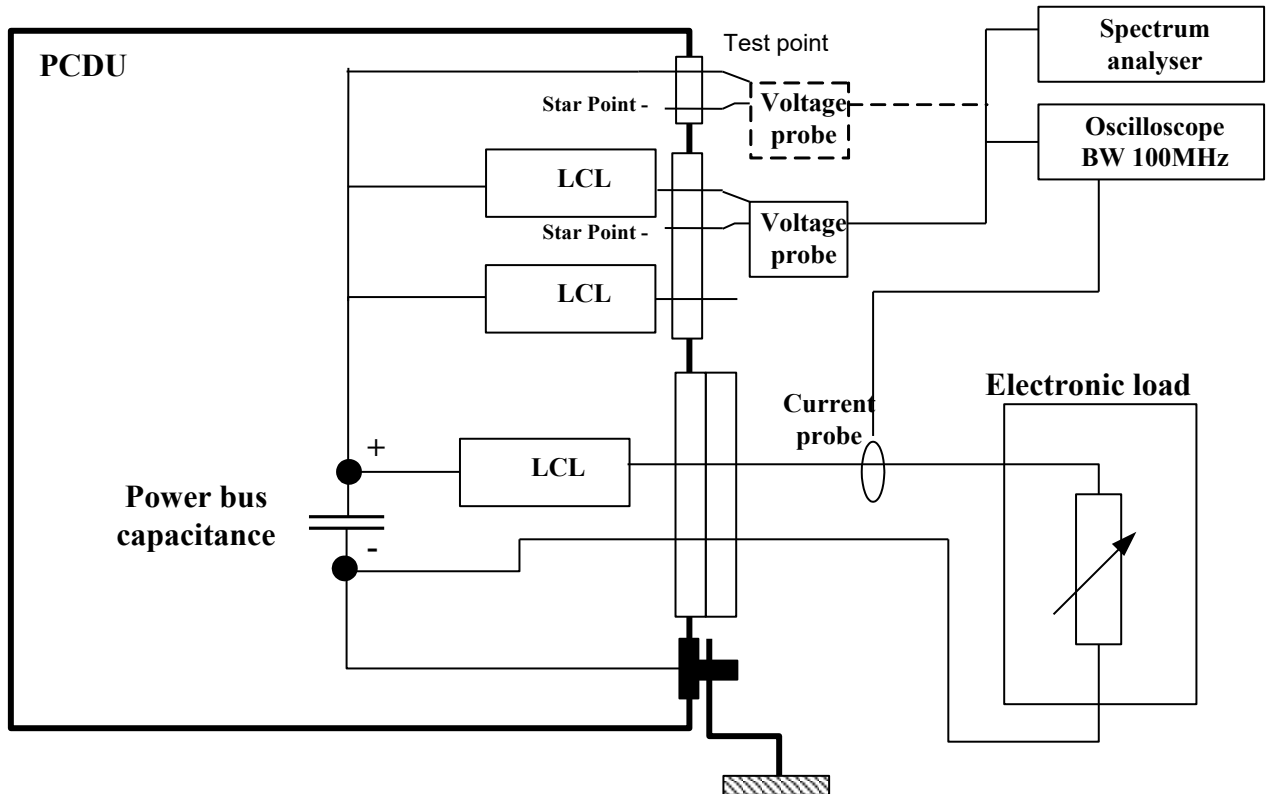


Figure 5.3.17-2 : closed PCDU TD emissions test set-up for low frequency

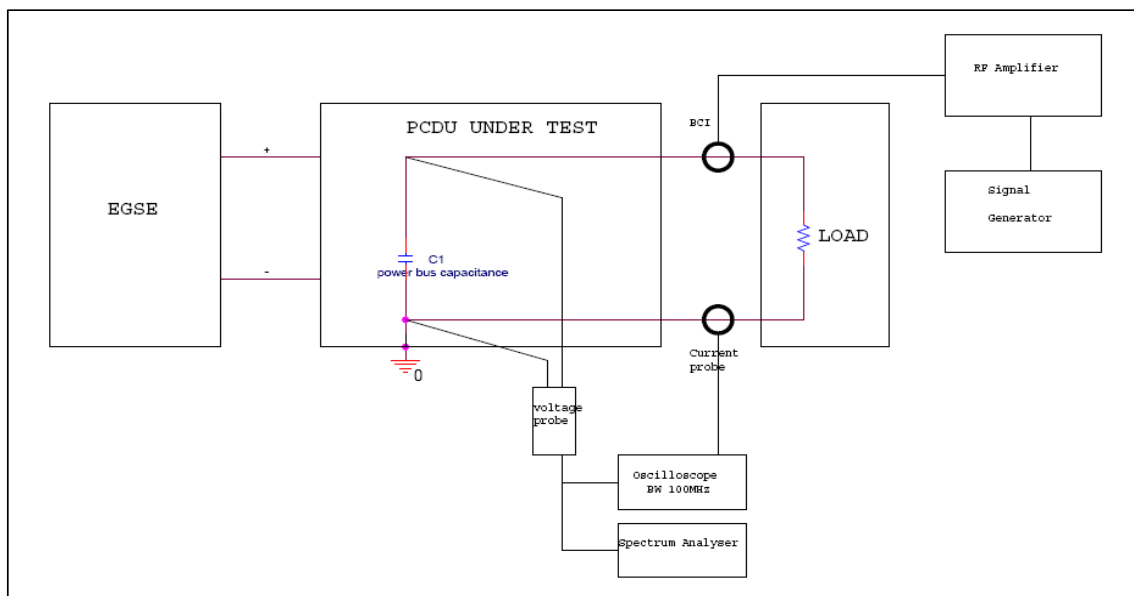


Figure 5.3.17-3 : open PCDU TD emissions test set-up for high frequency

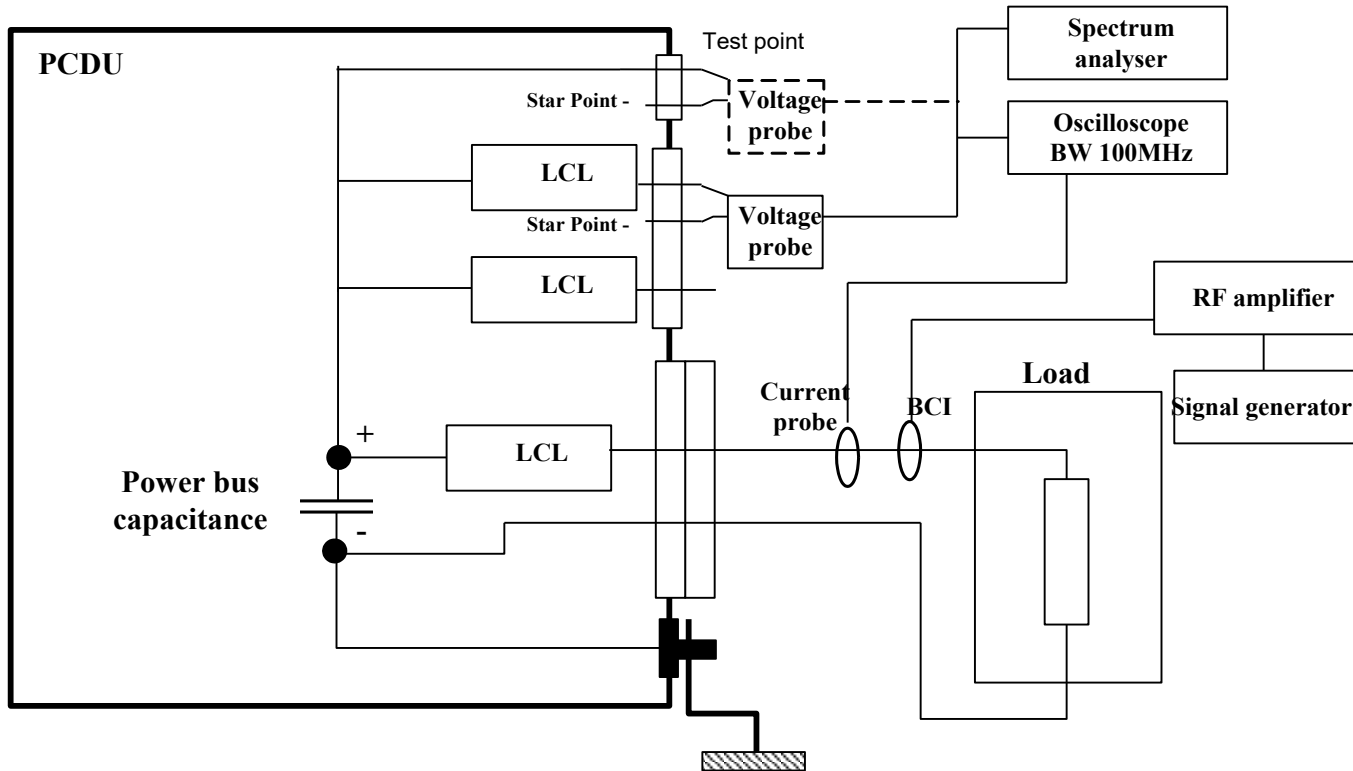


Figure 5.3.17-4 : closed PCDU TD emissions test set-up for high frequency

Verification Method : **Review of design**

DIFFUSION LIST

Name	Entity
CNES DIFFUSION	
<i>Projet Standard ISIS</i>	
ANSALAS Carole	DSO/AQ/IM
BRICOUT Jean-Noel	DSO/OT
CHARMEAU Marie Claire	DSO/AVI/CC
ELISABELAR Christian	DSO/TB/EL
GELIE Paul	DNO/OP/SSO
LANDIECH Philippe	DSO/AVI
LOUBEYRE Jean-Philippe	DSO/AVI/CC
MARTIN Christian	DSO/AQ/BA
SALCEDO Corinne	DSO/OT/MLN
PATIER Laurent	DSO/TB/EL
SERENE Fabienne	DSO/TB
<i>MISSIONS</i>	
COURAU Etienne	DSO/OT/CER
MORO Pascale	DSO/OT/MLN
REDONDO Rocio	DSO/OT/SWO

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ZUGAJ Hervé

TAS