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# SUBSYSTEM AND UNITS REQUIREMENTS - Electrical Design and Interfaces Requirements (AD01-P4)

## SB4-6A-AS-SP-065

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| | | | *57*<br>*58* | 6.1.6.4.2 LLC electrical parameters :<br>global revision | |
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## ACRONYMS, SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| **A/D** | Analog/numeric conversion |
| **ABM** | Apogee Boost Motor |
| **AC** | Alternating current |
| **ADPM** | Antenna Deployment and Pointing Mechanism |
| **AN** | TM Analog |
| **AOCS** | Attitude and Orbit Control Subsystem |
| **AOCSP** | Attitude and Orbit Control System PCB |
| **AOCSP_NG** | Attitude and Orbit Control System PCB_ New Generation |
| **APM** | Antenna Pointing Mode |
| **AWG** | American Wire Gauge |
| **BAPTA** | Bearing and Power Transfer Assembly |
| **BBC** | Bus Brick Connection |
| **BCRB** | Battery Connection Relay Box |
| **CM** | Common Mode |
| **CRM** | Central Reconfiguration Module |
| **DB** | TM Digital bi-level |
| **DC** | Direct current |
| **DC/DC** | Direct current/Direct current |
| **DM** | Differential Mode |
| **DOCON** | DOwn CONverter |
| **DR** | TM Digital Relay |
| **DS16** | TM Digital Serial 16 bit |
| **DSPG** | Distributed Single Point Grounding |
| **EED** | Electro-Explosive Devices |
| **EGRN** | Electrical Ground Reference Network |
| **EGRP** | Electrical Ground Reference Point |
| **EGSE** | Electrical Ground Support Equipment |
| **EMC** | Electro-Magnetic Compatibility |
| **EPC** | Electrical Power Conditioning |
| **EPS** | Electrical Power Subsystem |
| **ESD** | Electro-Static Discharges |
| **HLC** | High Level Command |
| **HPC** | High Priority Command |
| **ICD** | Interface Control Drawing |
| **IDS** | Interface Data Sheet |
| **ITO** | Iridium Tantale Oxyd |
| **IRES** | Infra-Red Earth Sensor |

| | |
|---|---|
| **LLC** | Low Level Command |
| **LMU** | Li-Ion Battery Management Unit |
| **LNA** | Low Noise Amplifier |
| **LPC** | Low Priority Command |
| **LSB** | Least Significant Bit |
| **MLC** | Memory Load Command |
| **MLI** | Multi Layer Insulator |
| **MSB** | Most Significant Bit |
| **NRZ** | Non Return to Zero |
| **NRZ-L** | Non Return to Zero Level |
| **OBDH** | On Board Data Handling |
| **OBP** | On Board Processor |
| **OSR** | Optical Surface Radiator |
| **PCB** | Printed Circuit Board |
| **PCM** | Pulse Code Modulation |
| **PCU** | Power Conditioning Unit |
| **PFDIU** | PlatForm Distribution and Interface Unit |
| **PLDIU** | Payload Distribution and Interface Unit |
| **PROP** | PROPulssion electronic (Chemical/Plasmic) PCB |
| **PPS** | Plasmic Propulsion Subsystem |
| **PPU** | Power Processing Unit |
| **PYPGP** | Pyrotechnic Pcb with GP relays |
| **RA** | Rotary Actuator |
| **RUBI** | Remote User Brick Interface |
| **RF** | Radio Frequency |
| **RX** | Receiver |
| **S/C** | Spacecraft |
| **S/W** | Software |
| **S4DSAP** | SB4000 Deployment of Solar Array PCB |
| **SA** | Solar Array |
| **SADM** | Solar Array Drive Mechanism |
| **SADP** | Solar Array and Deployment PCB |
| **SBDL** | Standard Balanced Digital Signal |
| **SDIU** | Satellite Distribution and Interface Unit |
| **SDMP** | Stepper and Deployment Motor PCB |
| **SLI** | Single Layer Insulator |
| **SMU** | Satellite Management Unit |
| **SPF** | Single Point Failure |
| **SSM** | Second Surface Mirror |
| **STR** | Star Tracker |

| | |
|---|---|
| **TC** | Telecommand |
| **TCR** | Telemetry, Command and Ranging |
| **TH** | Thermistor |
| **TLM** | Telemetry |
| **TM** | Telemetry |
| **TOM** | Thruster Orientation Mechanism |
| **TTC** | Tracking, Telemetry and Command |
| **TWT** | Travelling Wave Tube |
| **TWTA** | Travelling Wave Tube Amplifier |
| **TX** | Transmitter |
| **UPCON** | UP CONverter |
| **UPS** | Unified Propulsion Subsystem |
| **w.r.t.** | with respect to |

**Note: Applicability List**

| | |
|---|---|
| **AIT** | Assembly Integration & Test |
| **ANTRACK** | Antenna Tracking |
| **AOCS** | Attitude and Orbit Control Subsystem |
| **DATAM** | Data Management |
| **FDIR** | Failure Detection, Isolation and Recovery |
| **HARNESS** | - |
| **MECHANISM** | - |
| **PAYLOAD** | - |
| **POWER** | - |
| **PROP** | Propulsion Subsystem |
| **STRUCTURE** | - |
| **TCR** | Telemetry, Command and Ranging |
| **THERM** | Thermal Subsystem |
| **ANTENNA** | - |
| **ALL CF** | All Functional Chain |

# 1. SCOPE

This document is the system APPLICABLE DOCUMENT called **AD01part 4** applicable to **subsystems and equipments.**

This document establishes the general electrical design and interface requirements for subsystems and equipments included in SPACEBUS 4000 systems satellites to be met to ensure their correct performance during assembly, integration, testing, storage, transportation, launch and orbital operations.

Additional design requirements related to Electromagnetic and ESD environmental conditions are provided in a separate dedicated applicable document **AD01 Part 3.**

# 2. DOCUMENTS

## 2.1 Applicable documents

In case of conflict between any specification document and this applicable document, the specification document shall have precedence.

Any discrepancy shall be notified to the attention of Prime Contractor for clarification and resolution.

| Denom. | Title | Doc Ref. |
|---|---|---|
| AD01 P1 (Part 1) | *Electrical design, interface and environmental Requirements* | SB.AS.SY.0001-1 |
| AD02 P1 (Part 1) | *Mechnaical design, interface and environmental Requirements* | SB.AS.SY.0002-1 |
| AD03 Pa (Part a) | *Radiation Requirements* | REF-ASPI-CN-11-E |
| AD03 Pb (Part b) | *Space Radiation Environment Specification for Geostationnary Missions* | REF-ASPI-CN-12-E |
| AD13 | *Safety Requirements* | REF-ASPI-CN-39-E |
| IRD 01 | *Launcher to Satellite Interface Requirement* | SB3-ASPI-SP-0158 |
| IRD 02 | *Satellite/Ground interface Specification Part 1 - Physical Layer (C-band)* | SB4-ASPI-SP-0381 |
| IRD 03 | *Satellite/Ground interface Specification Part 2 - SB4100C1 TM/TC format & protocol* | SB4-ASPI-SP-0078 |
| IRD 04 | *Satellite/Ground interface Specification Part 3 - Command and Observability* | SB4-ASPI-SP-0320 |
| | *Data Bus Network Electrical and Protocol Specification* | SBF 6AV2 AS SP 338 |
| | *MIL STD 1553B Protocol and Interface Requirements for DBN* | SBF 6AV2 AS SP 504 |
| | *MIL STD 1553B "Aircraft Internal Time Division Command/Response Multiplex Data Bus", with Notice 4* | |

**Table 1:Applicable Technical Documents and Interface Documents at Satellite system level**

| Denom. | Title | Doc Ref. |
|---|---|---|
| AD 04 | *Generic Product Assurance Requirements* | REF-ASPI-AQ-21-E |
| AD 05 | *Materials, Parts & Process Requirements* | REF-ASPI-CN-10-E |
| AD 06 | *EEE Parts Requirements* | REF-ASPI-CN-7-E |
| AD 07- P1 | *Reliability Requirements* | REF-ASPI-CN-9-E |
| AD 07- P2 | *Data Base for Reliability* | REF-ASPI-CN-13-E |
| AD 12 | *Software Eng. And PA Requirements* | REF-ASPI-CN-38-E |

**Table 2:Applicable Programmatics, Quality and Product Assurance Requirements Documents at Satellite system level**

| Denom. | Title | Doc Ref. |
|---|---|---|
| AD 09 | *Configuration Requirements* | CAIS-ASPI-SP-0218 |
| | *Documentation Requirements* | CAIS-ASPI-SP-0219 |
| AD 10-P1 | *Guide de gestion des exigences* | REF-ASPI-CN-74-E |
| AD 10-P2 | *Spécification des régles de gestion des exigences* | REF-ASPI-CN-86-F |
| AD 11 | *Instruction for IDS and ICD* | REF-ASPI-CN-88-E |

**Table 3:Applicable Programmatics and Data Configuration Requirements Documents at Satellite system level**

## 2.2 Reference documents

The following documents listed hereinafter are for reference and information only. They have been used as basis for some requirements defined in the present specification.

| Denom. | Title | Doc. Ref. |
|---|---|---|
| **REF1** | *IEEE Standard for Space Applications Module, Extended Height Format E Form Factor* | IEEE Std 1101.7-1995 |
| **REF2** | *EIA-485 Standard for Electrical Characteristics of Generators and Receivers for Use in balanced digital multipoint systems (RS485 Standard), April 1983* | |
| **REF3** | *Derating Requirements Applicable to Electronic, Electrical and Electro-Mechanical Components for ESA Space Systems, Issue 2, April 1992* | PSS-01-301 |
| **REF4** | *Space system engineering Standard* | ECSS-E-20B |

# 3. GENERAL SPECIFICATIONS

## 3.1 Engineering specifications

# Reference **SB4-SAT-AD1-P4-REQ-001 b**

**[FC Applicability:** ALL CF (hardware)**]**

The metric standard (SI - International system) shall be used for design, manufacturing and testing of systems or subassemblies.

# *

# Reference **SB4-SAT-AD1-P4-REQ-638**

All requirements in this document shall be applicable in all satellite environmental conditions (mechanical, thermal, etc...)

# *

## 3.2 Electrical symbols

Possible electrical symbols used in electrical diagrams (grounding, etc...) are shown in Figure 1:

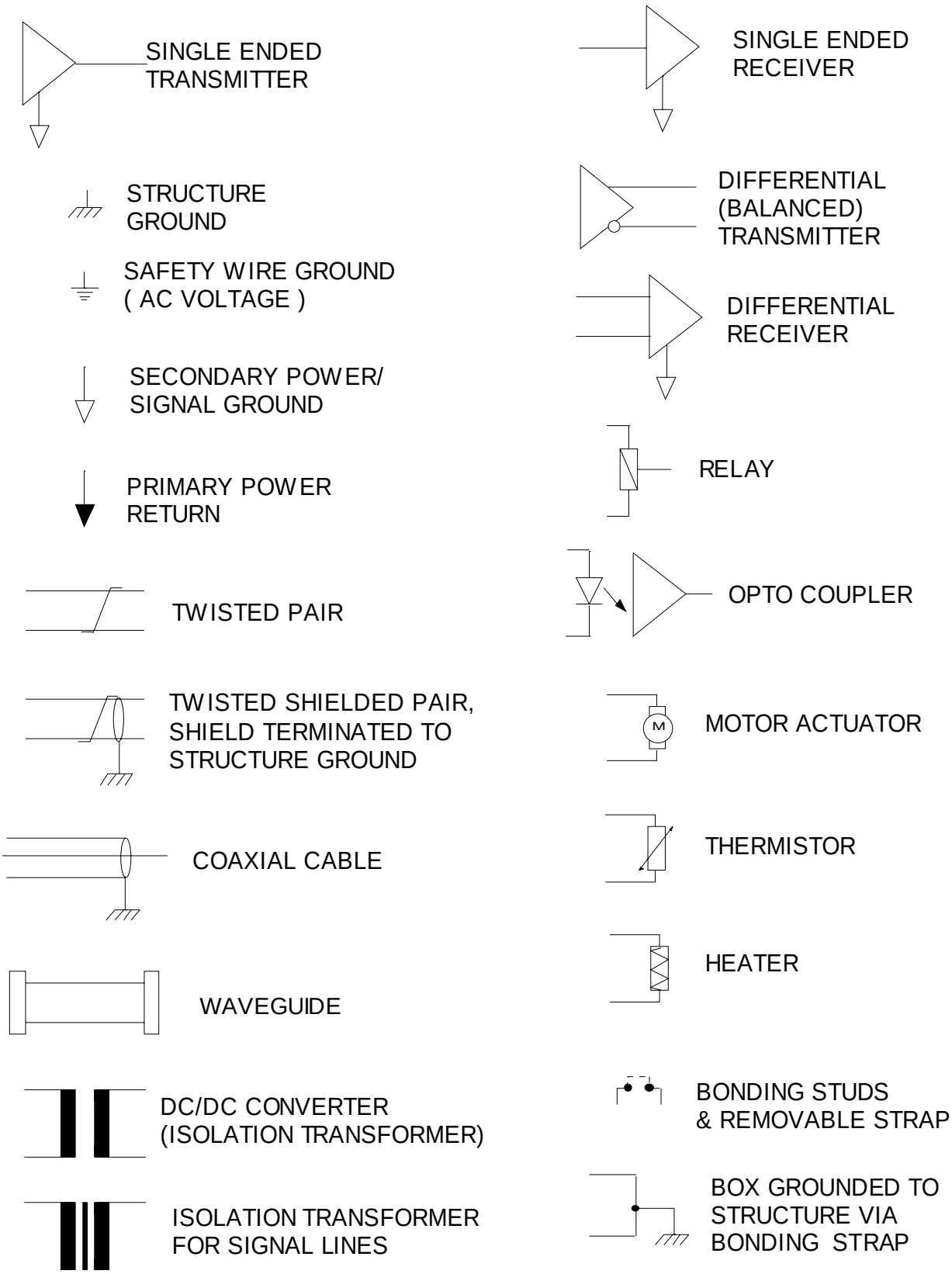



**Figure 1: Symbols for electrical diagrams**

## 3.3 Lifetime

# Reference **SB4-SAT-AD1-P4-REQ-005 b**

**[FC Applicability:** ALL CF (hardware)**]**

Units and subsystems shall be designed for a 15 years lifetime after having been stored for 5 years in a protected environment and having been used for tests and integrations for 2 years.

# *

## 3.4 Delivery

# Reference **SB4-SAT-AD1-P4-REQ-610**

**[FC Applicability:** ALL CF (hardware)**]**

All unit/subsystem shall be delivered in POWER OFF status.

# *

## 3.5 Redundancy

### *3.5.1 Redundancy rules*

# Reference **SB4-SAT-AD1-P4-REQ-544**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

When redundancy is implemented in the design, any single failure leading to total or partial loss of the unit operational capability or mission shall be forbidden.

# *

# Reference **SB4-SAT-AD1-P4-REQ-009 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

When nominal and redundant ways are designed on the same board or device, the two functions shall be separated physically in order to avoid any risk of failure propagation.

# *

# Reference **SB4-SAT-AD1-P4-REQ-400**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

Nominal and redundant ways shall use separated connectors.

# *

### *3.5.2 Units failure*

# Reference **SB4-SAT-AD1-P4-REQ-014 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL**]**

No conductive particle, smaller than 3 mm, shall cause total or partial loss of the unit or mission.

# *

# Reference **SB4-SAT-AD1-P4-REQ-401**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

All units, with nominal power consumption higher than 20W, shall always be able to switch-off in any case of failure.

# *

## 3.6 Test points

# Reference **SB4-SAT-AD1-P4-REQ-024 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

The test points shall be clearly identified in the unit ICD/IDS.

# *

# Reference **SB4-SAT-AD1-P4-REQ-026 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Test points on multi-pin connectors shall be designed to withstand, without causing damage to the unit, the highest voltage on that connector unit as well as short circuits

# *

# Reference **SB4-SAT-AD1-P4-REQ-028 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

Unit test connectors shall be provided with electrically conductive covers to ensure protection against electrical and mechanical damage.

# *

# Reference **SB4-SAT-AD1-P4-REQ-029 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

Input test points shall be fixed in potential to avoid perturbations during operational life.

# *

## 3.7 Identification of product

# Reference **SB4-SAT-AD1-P4-REQ-035 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Connecting items shall be provided with mismating avoidance provisions. (identification marks or hardware design)

# *

# 4. ELECTRICAL ARCHITECTURE REQUIREMENTS

## 4.1 Grounding and isolation requirements

Grounding is the establishment of an electrically conductive path between two points to connect electrical elements of a system to the ground reference point.

### *4.1.1 Grounding objective*

Electrical grounding and bonding is requested for all mechanical structure elements, equipment housing, thermal blanket devices and cables :

- to prevent hazard from high potentials
- to prevent build up and accumulation of electrostatic charges
- to avoid differential charge build up that could result in an electrostatic discharge
- to reduce electromagnetic interferences due to electric field or other forms of mutual coupling
- to protect from high voltage arcing
- to provide an Electrical Ground Reference Network ( EGRN ) used as an equipotential surface reference plane ( particularly important for RF unit ) to be able to withstand EMC/ESD requirements.

### *4.1.2 Grounding concept*

The Electrical Ground Network includes the following items:

- aluminium panels (honeycomb and skins)
- launcher interface ring (this ring is the spacecraft reference point)
- internal deck interface ring
- all grounding strap (metallizations) and their rivets
- all baseplates supporting equipments.

The spacecraft structure shall constitute a low impedance reference named Electrical Ground Reference Network ( EGRN ).

# Reference **SB4-SAT-AD1-P4-REQ-406**

**[FC Applicability:** STRUCTURE**]**

These grounding reference rails shall be implemented in the form of semi-rigid foil strips attached to the non-metallic structural elements and secured by inserts. These grounding reference rail shall be routed as close as possible to each unit mounted on the non-metallic structure.

# *

# Reference **SB4-SAT-AD1-P4-REQ-407**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Carbon fibre structural parts shall not be used as bounding path.

# *

# Reference **SB4-SAT-AD1-P4-REQ-410**

**[FC Applicability:** STRUCTURE**]**

The spacecraft surface fixed to the adapter shall be treated and protected in such a way that the electrical resistance between the Electrical Ground Reference Point and the adapter is kept lower than 10mΩ under 1Adc current measurement.

# *

# Reference **SB4-SAT-AD1-P4-REQ-411**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

All metallic sub-chassis, chassis and enclosures of each unit, including all connectors' shells and other fittings, shall be considered electrically as extensions of the EGRN.

# *

The grounding and bonding concept is a "returns by wires" concept with a Distributed Single Point Grounding ( DSPG ) configuration.

# Reference **SB4-SAT-AD1-P4-REQ-412**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

Each independent network ( primary power distribution and secondary power distribution, ...) based on a star-point system shall be referenced to the EGRN via an one point low impedance connection.

# *

Possible grounded solutions for unit secondary reference point are shown in Figure 2.

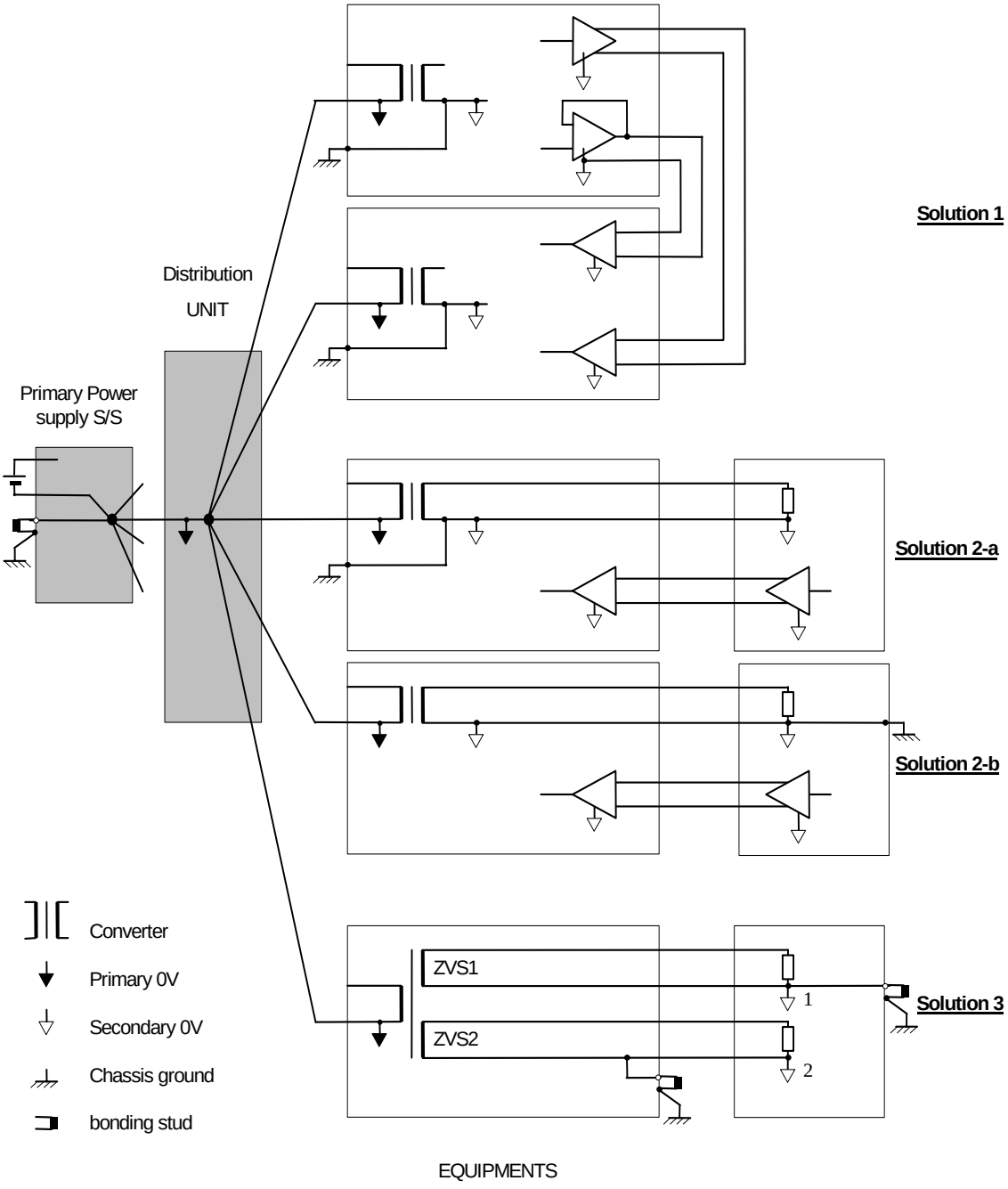



**Figure 2: Basic philosophy for Distributed Single Grounding Concept**

### 4.1.2.1 Grounding Solution 1

# Reference **SB4-SAT-AD1-P4-REQ-415**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The unit secondary reference point is insulated from the secondary reference point of other units (implying the use of insulated or differential interfaces between the units). In this case, the equipment shall be grounded internally to its own housing in order to ensure a low impedance ground path.

# *

### 4.1.2.2 Grounding Solution 2

# Reference **SB4-SAT-AD1-P4-REQ-417**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The unit secondary reference point is common to several units.

In this case :

- the unit assembly shall be grounded at only one point,

# *

### 4.1.2.3 Grounding Solution 3

# Reference **SB4-SAT-AD1-P4-REQ-418**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Each unit shall provide dedicated bounding studs so that each unit secondary reference point can be grounded externally to the equipment housing. One of the grounding stud shall be insulated from the equipment structure and connected to the unit secondary reference point; the other one shall be connected directly to the chassis ground (See Figure 3).
It shall be possible to ground the unit secondary reference point by placing a bar (removable strap) between the two bounding studs.
This requirement is not mandatory for RF equipment which have an internal link.
It must be noted that the above-mentioned bounding studs is different from the bounding strap used to connect the unit case to the mechanical structure

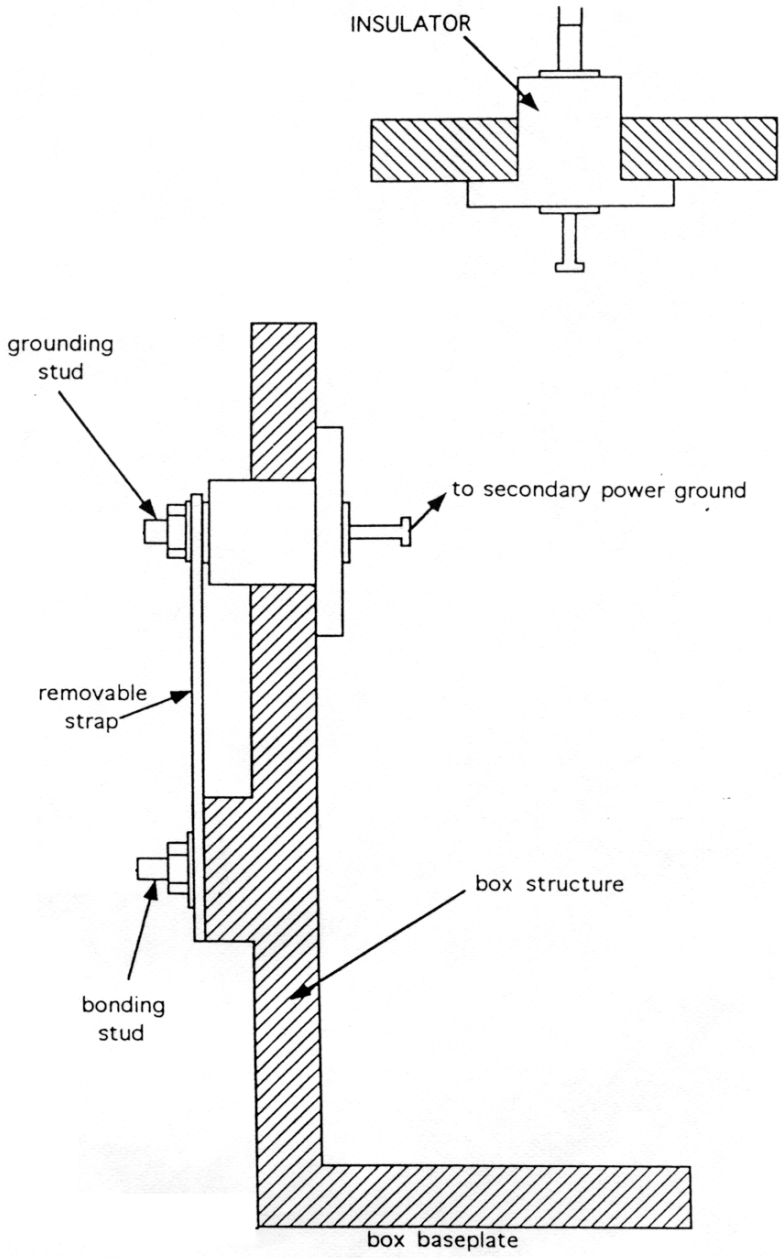



**Figure 3** : **Grounding of a unit secondary reference point via a bonding stud**

# Reference **SB4-SAT-AD1-P4-REQ-419**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The bar shall be supplied by the equipment manufacturer.

# *

#### 4.1.2.4 Specific Grounding Solution for matrix provided by SMU, CVICP and MAP.

# Reference **SB4-SAT-AD1-P4-REQ-611**

**[FC Applicability:** DATAM**]**

For matrix provided by SMU, CVICP and MAP, the secondary 0Vs shall be grounded to the structure by resistors.

Note: To check resistance value (above-mentioned resistors) in concerned chapters (LLC/HLC characteristics).

# *

### *4.1.3 Grounding and isolation diagram*

# Reference **SB4-SAT-AD1-P4-REQ-420**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

An overall zero volt and grounding diagram shall be provided in the IDS for establishing functional and electromagnetic compatibility.

# *

# Reference **SB4-SAT-AD1-P4-REQ-421**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

This diagram shall indicate any AC or DC loop, the type of isolation/insulation used, and any impedance coupling between zero volt and structure and shall be established for all Equipment and Subsystems containing electrical/electronic circuits.

# *

### *4.1.4 Power lines grounding*

# Reference **SB4-SAT-AD1-P4-REQ-425**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR**]**

The grounding connection impedance between the unit electrical 0V ground and its housing shall be lower than 2.5 mΩ measured under 1 Adc current and shall be lower than 100 nH.

# *

### 4.1.4.1 Grounding of primary power bus 0V

# Reference **SB4-SAT-AD1-P4-REQ-423**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR**]**

The return of all the power bus shall be grounded to the EGRN at a single grounding point located in the service module at the negative side of main bus capacitor within the power subsystem regulator.

# *

# Reference **SB4-SAT-AD1-P4-REQ-424**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Users of primary power shall therefore isolate the power wires from the structure

# *

# Reference **SB4-SAT-AD1-P4-REQ-426**

**[FC Applicability:** DATAM, POWER, PROP**]**

The power system regulator shall provide a dedicated stud to allow the primary return line grounding.

# *

### 4.1.4.2 Grounding of secondary power bus 0V

# Reference **SB4-SAT-AD1-P4-REQ-427**

**[FC Applicability:** ANTRACK, AOCS, DATAM, POWER, PROP, TCR**]**

Secondary power line returns shall be referenced to the electrical ground reference (structure) at only one location point, except for RF units.

# *

# Reference **SB4-SAT-AD1-P4-REQ-428**

**[FC Applicability:** PROP**]**

For PPU high voltage secondary outputs connected to the active thrusters, the secondary 0V shall be uncoupled from the mechanical ground plane by a capacitance.

# *

# Reference **SB4-SAT-AD1-P4-REQ-429**

**[FC Applicability:** ANTRACK, AOCS, DATAM, POWER, PROP, TCR**]**

In case that several units are supplied from the same DC / DC converter secondary power output, the secondary 0V shall be interconnected in a starpoint system to form the secondary reference ground, except for RF units.

# *

# Reference **SB4-SAT-AD1-P4-REQ-430**

**[FC Applicability:** ANTRACK, AOCS, DATAM, POWER, PROP, TCR**]**

All converter secondary 0V shall be insulated from one to another by design, except for RF untis.

# *

# Reference **SB4-SAT-AD1-P4-REQ-431**

**[FC Applicability:** PAYLOAD**]**

The high voltages necessary for the TWT's shall be considered as secondary power and shall be referenced at the EPC (via EPC structural part) and at the TWT side (via the TWT structural part).

# *

# Reference **SB4-SAT-AD1-P4-REQ-433**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The grounding path shall be designed and sized to withstand a current equal to 1.5 times the worst case fault current as limited by the unit primary power bus protection device. The following current shall be considered :

- either a primary current due a short-circuit between the primary power supply hot spot and the unit secondary reference point/mechanical ground.
- or a secondary current due to a short-circuit between a secondary power line and the secondary reference point/mechanical ground.

# *

# Reference **SB4-SAT-AD1-P4-REQ-435**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR**]**

All transformer screen shall be grounded to chassis.

# *

### *4.1.5 Primary and secondary power lines insulation*

# Reference **SB4-SAT-AD1-P4-REQ-170 a**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The primary power lines shall be transformer insulated from all secondary power.

# *

**Warning**: During measurement rating on components must be withstood. Derating may be exceeded.

# Reference **SB4-SAT-AD1-P4-REQ-436**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

| Insulation | isolation resistor with stray capacitance in parallel | measurement DC voltage | test conditions |
|---|---|---|---|
| Between unit primary power + (positive) input lines and structure | ( >1 MΩ ) // ( < 50 nF ) | 100Vdc | unit unpowered |

# *

# Reference **SB4-SAT-AD1-P4-REQ-631**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

| Insulation | isolation resistor with stray capacitance in parallel | measurement DC voltage | test conditions |
|---|---|---|---|
| Between unit primary power - (negative) input lines and structure | ( >1 MΩ ) // ( < 600nF ) | 50Vdc | unit unpowered |

# *

# Reference **SB4-SAT-AD1-P4-REQ-438**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

| Insulation | isolation resistor with stray capacitance in parallel | measurement DC voltage | test conditions |
|---|---|---|---|
| Between primary power leads and secondary power leads | ( >1 MΩ ) // ( < 50 nF ) | 100Vdc both polarities | unit unpowered |

# *

# Reference **SB4-SAT-AD1-P4-REQ-439**

**[FC Applicability:** ANTRACK, AOCS, DATAM, POWER, PROP**]**

| Insulation | isolation resistor with stray capacitance in parallel | measurement DC voltage | test conditions |
|---|---|---|---|
| Between any unit secondary power leads and structure (Except for Payload and TTC) | ( >1 MΩ ) // ( < 50 nF ) | 100Vdc both polarities | unit unpowered stud removed Not Applicable to grounding solution 1 (See SB4-SAT-AD1-P4-REQ-415) |

# *

# Reference **SB4-SAT-AD1-P4-REQ-440**

**[FC Applicability:** ANTRACK, AOCS, DATAM, POWER, PROP, TCR**]**

| Insulation | isolation resistor with stray capacitance in parallel | measurement DC voltage | test conditions |
|---|---|---|---|
| Between secondary power leads and other unit secondary power leads Except for Payload and TTC | ( >1 MΩ ) // ( < 50 nF ) | 100Vdc both polarities | unit unpowered stud removed |

# *

### *4.1.6 High voltage units*

# Reference **SB4-SAT-AD1-P4-REQ-624**

**[FC Applicability:** PAYLOAD, PROP**]**

For unit including high power supplies ( EPC, PPS, etc...), thermistor, relay coil, relay contact or heater leads insulation shall be guaranteed at the highest voltage level within the equipment with 6 db margin.

# *

## 4.2 Bonding requirements

### *4.2.1 General purpose*

Bonding is the establishment of a low impedance path between two metal surfaces or different structural parts.

Electrical bonds are employed for the following purposes:

- To minimise the impedance of the ground plane formed by the metallic portion of the structure.
- To assure the existence of low impedance return paths for possible failure mode-related fault current.
- To avoid the development of RF potentials between adjacent conductive surfaces raise the effectiveness of enclosure shielding.
- To provide high current capability to carry potential fault current.

# Reference **SB4-SAT-AD1-P4-REQ-488**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

To avoid discharge surfaces, each electrically conductive layer shall be grounded to structure.

# *

### *4.2.2 Bonding characteristics at unit level*

# Reference **SB4-SAT-AD1-P4-REQ-454**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, STRUCTURE, TCR, THERMAL, ANTENNA**]**

| Bonding connection | Electrical continuity |
|---|---|
| between two adjacent parts of a metal case including the resistance between any point of the case and any point of the cover or bonding point (possibly after vibration tests) | ≤ 5 mΩ under 1Adc current |

# *

# Reference **SB4-SAT-AD1-P4-REQ-459**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

| Bonding connection | Electrical continuity |
|---|---|
| between connector shell and unit structure | ≤ 2.5 mΩ under 1Adc current |

# *

# Reference **SB4-SAT-AD1-P4-REQ-460**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

| Bonding connection | Electrical continuity |
|---|---|
| between connector back-shell and connector body | ≤ 5 mΩ under 1Adc current |

# *

### *4.2.3 Bonding strap characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-449**

**[FC Applicability:** AIT, STRUCTURE**]**

Bonding between metallic structure parts shall be direct with a minimum covering area of 1cm².

# *

# Reference **SB4-SAT-AD1-P4-REQ-450**

**[FC Applicability:** AIT, STRUCTURE**]**

The bounding strap length-to-width ( L / w ) ratio shall be less than 5 to 1 assuming a strap thickness of 0.2 mm.

If this rule can not be met, the bonding strap shall respect:

- DC ohmic resistance < 2.5 mΩ
- Inductance < 100 nH

# *

# Reference **SB4-SAT-AD1-P4-REQ-451**

**[FC Applicability:** AIT, STRUCTURE**]**

The bonding strap shall be protected to avoid damage in case of bundles proximity.

# *

# Reference **SB4-SAT-AD1-P4-REQ-456**

**[FC Applicability:** AIT, STRUCTURE**]**

| Bonding connection and strap resistance | Electrical continuity |
|---|---|
| Between the active unit[1] (including external switches) bonding stud and the EGRN bonding point (including the bonding strap contacts)<br><br>[1] Internal or external units | ≤ 10 mΩ under 1Adc current |

# *

# Reference **SB4-SAT-AD1-P4-REQ-596**

**[FC Applicability:** AIT, ANTRACK, PAYLOAD, STRUCTURE, ANTENNA**]**

| Bonding connection and strap resistance | Electrical continuity |
|---|---|
| between the antenna feed or OMUX and the EGRN | ≤ 10 mΩ under 1Adc current |

# *

# Reference **SB4-SAT-AD1-P4-REQ-409**

**[FC Applicability:** AIT, STRUCTURE**]**

| Bonding connection and strap resistance | Electrical continuity |
|---|---|
| between the Electrical Ground Reference Point (EGRP) and any point of the Electrical Ground Reference Network (EGRN) | ≤ 50 mΩ under 1Adc current |

# *

### 4.2.4 Harness Bonding characteristics

# Reference **SB4-SAT-AD1-P4-REQ-461**

**[FC Applicability:** AIT, HARNESS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between overall harness shield and connector back-shell | ≤ 5 mΩ under 1Adc current |

# *

# Reference **SB4-SAT-AD1-P4-REQ-462**

**[FC Applicability:** AIT, HARNESS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| Pyro :<br>Any part of pyro shielding and connector cover<br>Any part of pyro shielding and EGRN | ≤ 2.5 mΩ under 1Adc current |

# *

### 4.2.5 Structural Part Assembly Bonding

# Reference **SB4-SAT-AD1-P4-REQ-475**

**[FC Applicability:** MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between two mating metal structural parts (metal-to-metal assembly) | * ≤ 10 mΩ under 1Adc current<br>* minimum contact size area > 1 cm² |

# *

# Reference **SB4-SAT-AD1-P4-REQ-476**

**[FC Applicability:** MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between metal part and carbon fibre part | < 100 Ω |

# *

# Reference **SB4-SAT-AD1-P4-REQ-477**

**[FC Applicability:** AIT, MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between carbon fibre parts (panels, corners, angles) | < 100 Ω |

# *

# Reference **SB4-SAT-AD1-P4-REQ-479**

**[FC Applicability:** AIT, MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between carbon fibre skins (face-sheets) and structure (EGRP) | < 100 Ω |

# *

# Reference **SB4-SAT-AD1-P4-REQ-481**

**[FC Applicability:** ANTRACK, MECHANISMS, STRUCTURE, ANTENNA**]**

| Bonding connection | Electrical continuity |
|---|---|
| between antenna reflector and structure (EGRP) | < 500 Ω |

# *

# Reference **SB4-SAT-AD1-P4-REQ-482**

**[FC Applicability:** MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between brackets, connector support and unit support and structure (EGRP) | < 100 Ω |

# *

# Reference **SB4-SAT-AD1-P4-REQ-483**

**[FC Applicability:** POWER, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between solar arrays housing and structure (EGRP) | < 25 KΩ |

# *

# Reference **SB4-SAT-AD1-P4-REQ-484**

**[FC Applicability:** MECHANISMS, STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| between batteries housing and structure (EGRP) | < 60 KΩ |

# *

# Reference **SB4-SAT-AD1-P4-REQ-485**

**[FC Applicability:** STRUCTURE**]**

| Bonding connection | Electrical continuity |
|---|---|
| Items not included in the EGRN (angles, corners, inserts…) and the structure (EGRP) | < 1 MΩ |

# *

### *4.2.6 Thermal Part Assembly Bonding*

#### 4.2.6.1 General Requirements

# Reference **SB4-SAT-AD1-P4-REQ-489**

**[FC Applicability:** AIT, STRUCTURE, THERMAL**]**

Conductive components which can not respect the bonding requirements specified in the following sections shall be connected to the ground reference network by a resistance lower than 1 MΩ.

# *

#### 4.2.6.2 MLI / SLI Requirements

# Reference **SB4-SAT-AD1-P4-REQ-492**

**[FC Applicability:** AIT, STRUCTURE, THERMAL**]**

Each part of the MLI or SLI shall be connected to the EGRN with at least :

- one point if their area is less than 0.05 square meter.
- two points if their area is more than 0.05 square meter

# *

# Reference **SB4-SAT-AD1-P4-REQ-493**

**[FC Applicability:** AIT, STRUCTURE, THERMAL**]**

The DC resistance between one of these points and the EGRN close to the connection shall be less than 300 mΩ under 1Adc measurements

# *

# Reference **SB4-SAT-AD1-P4-REQ-494**

**[FC Applicability:** STRUCTURE, THERMAL**]**

Each MLI metallized foil shall be electrically connected to the reference point of the MLI piece.

The DC resistance between this point and any point belonging to a metallized face of any foil shall be less than 200 Ω tested at 100 mA.

# *

# Reference **SB4-SAT-AD1-P4-REQ-495**

**[FC Applicability:** AIT, STRUCTURE, THERMAL**]**

External MLI Kapton thickness shall be 25 $\mu$m, except for Solar Array panel insulation that shall be 50 $\mu$m.

# *

# Reference **SB4-SAT-AD1-P4-REQ-606**

**[FC Applicability:** THERMAL**]**

MLI external surfaces (space face) shall be conductive. Some limited exceptions are acceptable (Star trackers, ADPM, RF feeds, anti earth panel).

# *

#### 4.2.6.3 SSM Requirements

# Reference **SB4-SAT-AD1-P4-REQ-497**

**[FC Applicability:** ALL CF (hardware)**]**

The use of SSM shall be avoided.

# *

#### 4.2.6.4 OSR Requirements

# Reference **SB4-SAT-AD1-P4-REQ-582**

**[FC Applicability:** STRUCTURE, THERMAL**]**

If no ITO is used, non conductive glue shall be used

# *

## 4.3 Paints and coatings characteristics

# Reference **SB4-SAT-AD1-P4-REQ-490**

**[FC Applicability:** ALL CF (hardware)**]**

Coatings (including paintings) on non conductive surface

Coatings applied on a dielectric or non-conductive surface shall be grounded to the ground reference network on the edges.

The coating surface resistivity applied on non conductive materials shall be less than 1 E9 Ω / square.

# *

# Reference **SB4-SAT-AD1-P4-REQ-491**

**[FC Applicability:** ALL CF (hardware)**]**

Coatings (including paints) on conductive surface

The coating resistivity applied on a conductive surface shall be less than 1 E9 Ω.m assuming a depth e ≤ 100 $\mu$m.

# *

## 4.4 Electrical connector requirements

Requirements in this chapter are applicable to:

- Satellite harness

- Harness of the units (i.e.: Reaction Wheel, ADPM...), except to Pcb's wires.

### *4.4.1 Connector types*

# Reference **SB4-SAT-AD1-P4-REQ-498**

**[FC Applicability:** ALL CF (hardware)**]**

All connectors shall be selected according to AD11.

# *

# Reference **SB4-SAT-AD1-P4-REQ-499**

**[FC Applicability:** ALL CF (hardware)**]**

MDM and very high density (ex.:AMP104) connectors shall not be used.

# *

# Reference **SB4-SAT-AD1-P4-REQ-507**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

All connectors dedicated to power generation and distribution outputs shall be socket type.

# *

# Reference **SB4-SAT-AD1-P4-REQ-508**

**[FC Applicability:** ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

All other connector shall be pin type.

# *

### *4.4.2 Connector characteristics*

#### 4.4.2.1 Connectors housing

# Reference **SB4-SAT-AD1-P4-REQ-506**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The housing of connectors shall be electrically connected to the unit structure.

# *

### 4.4.2.2 Specific derating requirements

# Reference **SB4-SAT-AD1-P4-REQ-510**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Mating and demating of each connector shall be less than 25 at Satellite System Integration.

# *

# Reference **SB4-SAT-AD1-P4-REQ-614**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Mating and demating of each connector shall be less than 25 before unit delivery at Satellite System Integration.

# *

### 4.4.2.3 Connector mounting requirements

# Reference **SB4-SAT-AD1-P4-REQ-511**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The connectors shall be placed in such a way that connection and disconnection on one connector shall be made without any specific tool and without disconnecting the other connectors.

# *

# Reference **SB4-SAT-AD1-P4-REQ-512**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

At least, 6mm shall be kept between two adjacent connectors.

# *

# Reference **SB4-SAT-AD1-P4-REQ-615**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The connectors shall be placed according to manufacturer connector requirements.

# *

#### 4.4.2.4 Connector identification

# Reference **SB4-SAT-AD1-P4-REQ-518**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Each unit or bracket shall be permanently marked by visible connector identification closely adjacent to the appropriate connector in order to allow a correct mating of corresponding harness connector.

# *

### *4.4.3 Connector savers*

# Reference **SB4-SAT-AD1-P4-REQ-513**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Saver connectors shall be used during integration to lower number of mating and demating cycles.

# *

### *4.4.4 Pins characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-515**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Lines which have a common return shall be placed on adjacent contacts to facilitate cable twisting and/or shielding (except for matrix concept).

# *

# Reference **SB4-SAT-AD1-P4-REQ-517**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, HARNESS, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

The connected contacts on each connector shall never be inferior to two third of its maximum capacity.

# *

### *4.4.5 Specific requirements for pyro connectors*

# Reference **SB4-SAT-AD1-P4-REQ-501**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, STRUCTURE, ANTENNA**]**

Pyrotechnic circuit connectors shall be separated from all other circuit connectors

# *

# Reference **SB4-SAT-AD1-P4-REQ-502**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, STRUCTURE, ANTENNA**]**

Pyrotechnic circuit connectors shall have a stainless steel shell or suitable electrically conductive finish

# *

# Reference **SB4-SAT-AD1-P4-REQ-503**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, STRUCTURE, ANTENNA**]**

Pyrotechnic circuit connectors shall complete the shell-to-shell connection before the pins connect

# *

# Reference **SB4-SAT-AD1-P4-REQ-504**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, STRUCTURE, ANTENNA**]**

Pyrotechnic circuit connectors shall provide for 360° shield continuity at connector side

# *

# Reference **SB4-SAT-AD1-P4-REQ-505**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, STRUCTURE, ANTENNA**]**

Pyrotechnic circuit connectors shall provide for 360° shield continuity at bundle side without gaps (minimum 85% of optical coverage)

# *

## 4.5 Harness requirements

Requirements in this chapter are applicable to:

- Satellite harness

- Harness of the units (i.e.: Reaction Wheel, ADPM...), except to Pcb's wires.

### *4.5.1 Harness definition responsability*

The subsystem internal harness definition is under system responsibility. Nevertheless, specific requirements may be submitted by the co-contractor.

The links definition between two subsystems is under the Prime responsibility.

### *4.5.2 Bundles characteristics*

#### 4.5.2.1 Bundles classification

\# Reference **SB4-SAT-AD1-P4-REQ-519**

**[FC Applicability:** HARNESS, STRUCTURE**]**

The spacecraft harness (excluding RF coaxial cable and waveguide) shall be divided into four classes

| | | |
|---|---|---|
| **Class 1** | **Power** | *If all class1 (A to D) respect the notes all lines shall be assembled in one bundle.*<br>*For heater power lower than 15W,common routing with TM/TC are accepted.* |
| Class 1A | primary power lines, PPS and heaters (P>15W) | |
| Class 1B | secondary power lines (Camp/EPC) | *The class1B shall be separated from class1A, except in of these lines are shielded.* |
| Class 1C | Solar Array/power supply link (PCU) | |
| Class 1D | Batteries/power supply link (PCU) AND Safe Line | |
| Class 1E | Motors supply lines<br>(BAPTA-M, SADM, APMM, Solar Array deployment motors in HKU, WDE-MW, AOCSP-MW, SEPTA M/SADP...). | *All class 1 E (motors supply lines) must be shielded.Any deviation must be submitted to prime approval. SA power strain gauge (SEPTA M/SADP) shall be routed with Class 1C (these lines are only used at the beginning of the satellite flight).* |
| **Class 2** | **Non sensitive signals** | |
| Class 2A | TC signals (HL, LL, valves command TVC)<br>TM signals ( Thermistors, AN, DB, DR, valves statuts TVS, TM APMM, TM Bapta/SADM) | *For the class2A, when using Relay Switch Module (RDU) or MAP (PLDIU), harness gauge must be verified in order to respect harness voltage drop and input switch voltage. Maximum resistance of harness line at 80°c: with MAP, up to 6 Ohm (taken into account a double failure in the harness); with RSD up to 2,8 Ohm.* |
| Class 2B | Others non sensitive signals. | |
| **Class 3** | **Electro-Explosive Device (EED) interface signals** | *Electro-Explosive Device (EED) interface signals i.e. between the EED itself and the last arming or firing relay* |
| **Class 4** | **Sensitive signals** | |
| Class 4A | shielded links PSSE-PSSH, OBCU-IRES, AOCSP-CSS | |
| Class 4B | Sensitive analog signals (other signals), Video links (TM/TC between CDMU/SMU and TTCRF RX/TX), batteries pressure, batteries cells voltage, signal from SAPT, LAPT, HAPT | *Class4B shall be separated from all class with a distance minimum of 5cm except for shielded links. SA signal strain gauge shall be routed with Class 1E.* |
| Class 4C | OBDH ans 1553 links | |

**Table 4: Spacecraft harness classification.**

\# *

\# Reference **SB4-SAT-AD1-P4-REQ-520**

**[FC Applicability:** HARNESS, STRUCTURE**]**

Wires falling into one class shall be assembled into one bundle.

\# *

# Reference **SB4-SAT-AD1-P4-REQ-521**

**[FC Applicability:** HARNESS, STRUCTURE**]**

Under-classes inside class 1 shall be separated from themselves.

# *

### 4.5.2.2 Bundles rules

# Reference **SB4-SAT-AD1-P4-REQ-522**

**[FC Applicability:** HARNESS, STRUCTURE**]**

The routing of bundles shall respect the minimal distance shows in Figure 4.

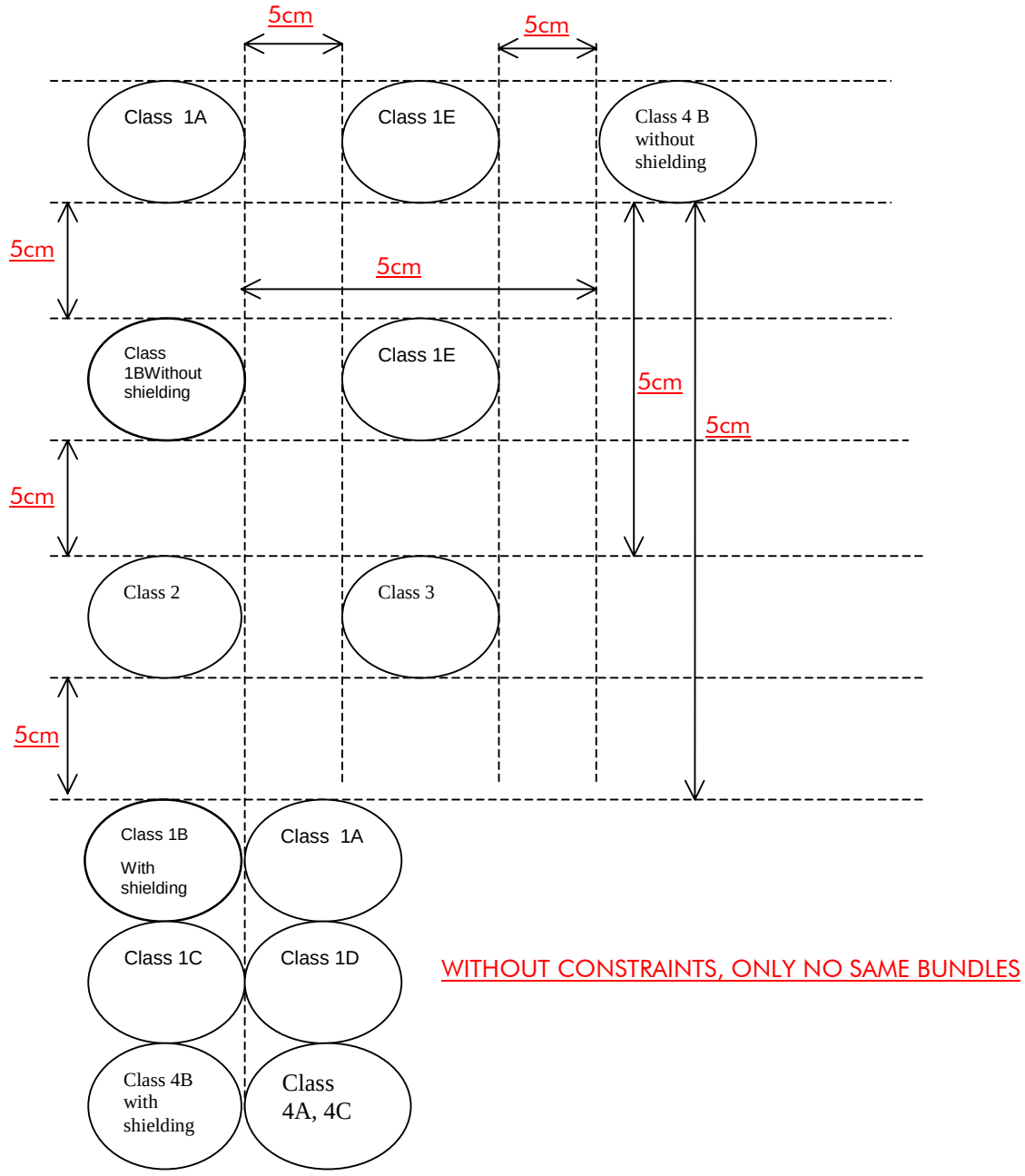



**Figure 4: Routing of several bundles**

# *

# Reference **SB4-SAT-AD1-P4-REQ-523**

**[FC Applicability:** HARNESS, STRUCTURE**]**

The different cables and cable bundle shall be routed as close as possible to the structure (preferably at a distance less than 1cm).

# *

# Reference **SB4-SAT-AD1-P4-REQ-524**

**[FC Applicability:** HARNESS, STRUCTURE**]**

All shielded lines (class 1,2 and 4) may be assembled with any other unshielded lines ( without limitation) except at the terminal; at this level the different kinds of class must be separated from any other type for 150 mm length minimum upstream the terminal (see Figure 5). Between the terminal and 150mm upstream the terminal, the distance between shielded classes must be at a minimum 1 cm (except for Pyro lines class 3).

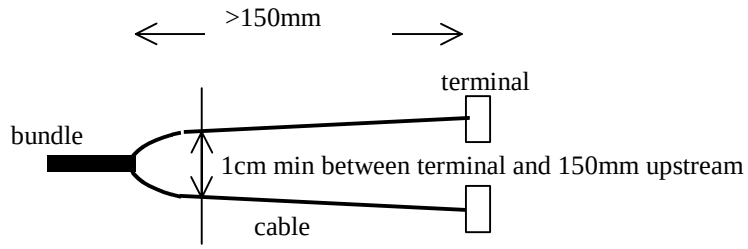



**Figure 5: Class separation at the terminal**

# *

# Reference **SB4-SAT-AD1-P4-REQ-525**

**[FC Applicability:** HARNESS, STRUCTURE**]**

Where bundles of different classes must cross each other the crossing angle shall be approximately 90 degrees.

# *

# Reference **SB4-SAT-AD1-P4-REQ-526**

**[FC Applicability:** HARNESS, STRUCTURE**]**

Where closer distances between categories than those shown in Figure 4 cannot be avoided, shield shall be added along the commonly routed paths or metallic barriers between adjacent bundles.

# *

# Reference **SB4-SAT-AD1-P4-REQ-539**

**[FC Applicability:** HARNESS, STRUCTURE**]**

The mechanical and wiring harness layout shall be such that circuit access and ease of dismantling is provided.

# *

# Reference **SB4-SAT-AD1-P4-REQ-540**

**[FC Applicability:** HARNESS, STRUCTURE**]**

Routing shall enable accessibility of shielded terminations, grounded connections and allow easy connector mating.

# *

# Reference **SB4-SAT-AD1-P4-REQ-541**

**[FC Applicability:** HARNESS**]**

The bundle diameter shall be less than 5 cm.

# *

### *4.5.3 Connectors*

# Reference **SB4-SAT-AD1-P4-REQ-509**

**[FC Applicability:** ALL CF (hardware)**]**

Pin and socket connectors shall be mechanically locked together, to prevent inadvertent disconnection.

# *

# Reference **SB4-SAT-AD1-P4-REQ-514**

**[FC Applicability:** HARNESS**]**

Connector pins and sockets shall be removable on the harness connectors.

# *

# Reference **SB4-SAT-AD1-P4-REQ-623**

**[FC Applicability:** HARNESS**]**

The shielding pigtail lenth shall be less than 3 cm in all cases. In case of impossibility an EMC/ESD back-shell must be added.

# *

# Reference **SB4-SAT-AD1-P4-REQ-639**

**[FC Applicability:** ANTRACK, AOCS, HARNESS, MECHANISMS, PAYLOAD, PROP, THERMAL, ANTENNA**]**

All external connectors shall include connector back-shell.

The shells shall be:

- electrically conductive
- bonded to the overall harness shield or to all the cable shields
- connected to the connector case to provide a 360° termination around the internal cable bundle

# *

### *4.5.4 Wire specifications*

#### 4.5.4.1 Wire selection

# Reference **SB4-SAT-AD1-P4-REQ-619**

**[FC Applicability:** HARNESS**]**

The AWG wire shall be selected to withstand the fuse size.

# *

# Reference **SB4-SAT-AD1-P4-REQ-537**

**[FC Applicability:** HARNESS**]**

Copper wires smaller than AWG 28 (diameter 0.32 mm) shall not be used.

# *

# Reference **SB4-SAT-AD1-P4-REQ-538**

**[FC Applicability:** HARNESS**]**

Aluminium wires smaller than AWG 22 shall not be used.

# *

#### 4.5.4.2 Twisted links

# Reference **SB4-SAT-AD1-P4-REQ-528**

**[FC Applicability:** HARNESS**]**

All active wire(s) shall always be twisted around its return wire, except for primary power lines (PCU/Batteries, PCU/SDIU, PCU/BCRB/Batteries), in this case the harness routing minimises the wire loop.

# *

# Reference **SB4-SAT-AD1-P4-REQ-529**

**[FC Applicability:** HARNESS]

When several lines share the same return line, the whole bundle shall be twisted with its return.

# *

### 4.5.4.3 Shielded links

# Reference **SB4-SAT-AD1-P4-REQ-600**

**[FC Applicability:** HARNESS]

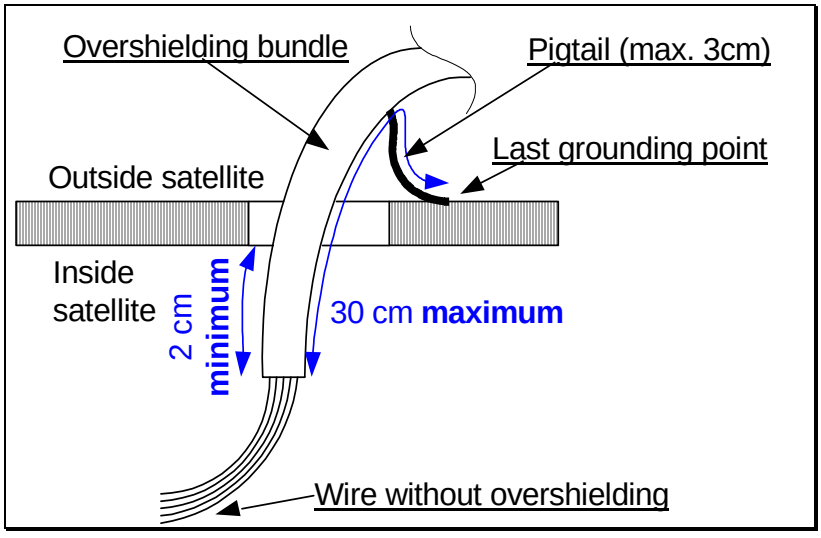
All links between outside and inside the spacecraft shall be over shielded on their external part (except for solar array).

# *

# Reference **SB4-SAT-AD1-P4-REQ-640**

**[FC Applicability:** HARNESS]

When the external overshielded wire is going inside the satellite, the overshield shall respect the distances shown in the following figure:




# *

# Reference **SB4-SAT-AD1-P4-REQ-641**

**[FC Applicability:** HARNESS]

External shields with ribbons shall be grounded to the EGRN every 40 cm maximum by bonding of 3cm (5cm maximum).

# *

# Reference **SB4-SAT-AD1-P4-REQ-533**

**[FC Applicability:** HARNESS]

The use of shielded wires shall only occur inside the spacecraft when specified in the relevant subsystem specification.

# *

# Reference **SB4-SAT-AD1-P4-REQ-534**

**[FC Applicability:** HARNESS]

Shields shall be connected to connector housing at both ends.

# *

# Reference **SB4-SAT-AD1-P4-REQ-535**

**[FC Applicability:** HARNESS]

Each harness connector shall be able to support a grounding grid for shielding purposes.

# *

# Reference **SB4-SAT-AD1-P4-REQ-545**

**[FC Applicability:** HARNESS]

For ML16 and DS16 harness shall be shielded.

# *

#### 4.5.4.4 High voltage specific derating requirements

# Reference **SB4-SAT-AD1-P4-REQ-532**

**[FC Applicability:** HARNESS]

For high voltage cables, the maximum ac voltage or ripple shall not exceed 5% of the dc rating.

# *

#### 4.5.4.5 Crimping of wires

# Reference **SB4-SAT-AD1-P4-REQ-542**

**[FC Applicability:** HARNESS]

A maximum of two wires shall be crimped together at one connector contact according to qualification rules.

# *

### 4.5.5 Matrix harness concept

# Reference **SB4-SAT-AD1-P4-REQ-205 b**

**[FC Applicability:** AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR**]**

Matrix command positive voltages shall be connected to matrix row.

# *

# Reference **SB4-SAT-AD1-P4-REQ-206 b**

**[FC Applicability:** AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR**]**

Matrix command return line shall be connected to matrix column.

# *

# Reference **SB4-SAT-AD1-P4-REQ-208 b**

**[FC Applicability:** AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR**]**

The basis definition of the matrix harness shall be unshielded lines.

# *

# Reference **SB4-SAT-AD1-P4-REQ-209 c**

**[FC Applicability:** AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR**]**

Each row or column line coming from the nominal function shall be routed in daisy chain to several receivers before returning back to the redundant function.

# *

### 4.5.6 Specific requirements for pyro circuits

# Reference **SB4-SAT-AD1-P4-REQ-536**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

For pyro, shielded twisted pairs shall be used.

# *

# Reference **SB4-SAT-AD1-P4-REQ-543**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

For pyro lines, only one wire per contact shall be used.

# *

# 5. POWER SUBSYSTEM INTERFACES REQUIREMENTS

## 5.1 Power Bus Definition

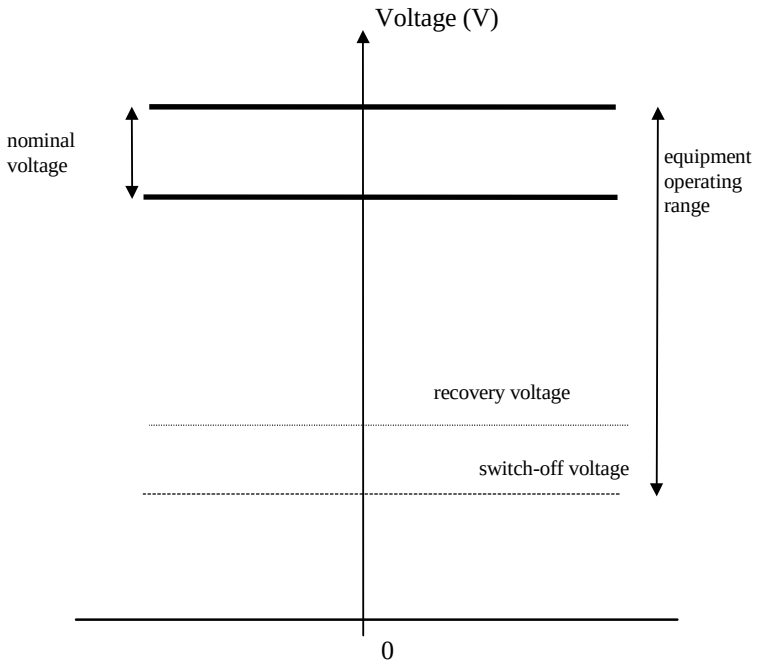



**Figure 6: Equipment operating range.**

## 5.2 Power bus nominal voltage

The power conditioning subsystem provides one regulated 100 V power bus, which is distributed to the spacecraft users.

# Reference **SB4-SAT-AD1-P4-REQ-131 a**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

At the loaded input connector of user, the nominal bus voltage is defined as follows :

Maximal DC bus voltage : 102V

Minimal DC bus voltage : 98V

# *

## 5.3 Power bus operational voltage

# Reference **SB4-SAT-AD1-P4-REQ-133 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The DC/DC of spacecraft equipment shall be able to operate according to the following voltage.

| Function | DC MIN VOLTAGE (V) |
|---|---|
| High Power Payloads Units (> 20W) | 95 |
| PYRO Pcb / FSMP | 95 |
| SADP/S4DSAP | 70 |
| Other Platform Sub-systems | 70 |
| Low Power Payloads Units ( < 20W) | 95 |
| AOCS-UPS | 70 |
| SMU / TTC RF (TX + RX) - Ciphering Units | 70 |

**Table 5: Regulated 100V Power bus operating voltage limits**

# *

## 5.4 Equipment operating requirements

# Reference **SB4-SAT-AD1-P4-REQ-134 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Units shall not be affected **in their nominal performances** if the power bus voltage is under their automatic switch-off voltage level during less than 10 $\mu$s.

# *

# Reference **SB4-SAT-AD1-P4-REQ-135 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Units shall be automatically switched off if the power bus voltage is under their automatic switch-off voltage level during more than 10 $\mu$s

| Function | AUTOMATIC Switch-Off Voltage (V) | AUTOMATIC RECOVERY | RECOVERY VOLTAGE(V) |
|---|---|---|---|
| High Power Payload Units (> 20 W) | 94 ± 1 | NO | ≥ 95 |
| PYRO Pcb / FSMP | 94 ± 1 | NO | ≥ 95 |
| SADP/S4DSAP/PROP/CVICP | 70 | NO | 72 ± 1 |
| Other Platform Sub-Systems / Pcb | 70 | NO | 72 ± 1 |
| Low Power Payload Units (< 20W) | < 95 **or** | NO/YES | ≥ 95 |
| | No automatic Switch-Off voltage | YES | ≥ 95 |
| AOCS-UPS Units | 70 | NO | 72 ± 1 |
| SMU-TTC RF (RX+TX) - Ciphering Units | < 70 | YES | 72 ± 1 |

**Table 6: Regulated 100V, Equipment operating requirements**

# *

## 5.5 Distribution requirements

The main power bus distribution is based on a single point failure free concept at the distribution point (no failure of a part or insulation can cause the loss of the power bus).

# Reference **SB4-SAT-AD1-P4-REQ-139 a**

**[FC Applicability:** DATAM, POWER, PROP**]**

The main bus protection shall be either by current limiting device or by fuses, combined with double insulation between the power distribution point and the limiting device.

# *

# Reference **SB4-SAT-AD1-P4-REQ-145 b**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The unit input ON/OFF relay contact shall be sized to withstand twice the current peak value corresponding to the long peak power demand.

# *

### 5.5.1 Double insulation requirements

# Reference **SB4-SAT-AD1-P4-REQ-616**

**[FC Applicability:** DATAM, HARNESS, POWER, PROP, STRUCTURE**]**

Double insulation shall be implemented by at least two independent layers of insulating materials

# *

# Reference **SB4-SAT-AD1-P4-REQ-464**

**[FC Applicability:** DATAM, HARNESS, POWER, PROP, STRUCTURE**]**

All power lines located between power generation (Batteries or solar array or umbilical) and circuit protections installed inside the conditioning and distribution boxes (BCRB, PCU and SDIU) shall present a double insulation.

# *

# Reference **SB4-SAT-AD1-P4-REQ-617**

**[FC Applicability:** DATAM, HARNESS, POWER, PROP, STRUCTURE**]**

All power lines located between power generation (Batteries or solar array or umbilical) and circuit protections installed inside the high power units (PPU ...) shall present a double insulation.

# *

# Reference **SB4-SAT-AD1-P4-REQ-618**

**[FC Applicability:** DATAM, HARNESS, POWER**]**

Battery cells voltage monitoring lines and power pyro lines shall present a double insulation.

# *

# Reference **SB4-SAT-AD1-P4-REQ-465**

**[FC Applicability:** DATAM, HARNESS, POWER, PROP**]**

All power lines inside power units (PCU, PPU, BCRB, Battery, Solar Array, SADM, SDIU) shall be double insulated.

# *

### 5.5.2 Fuses

# Reference **SB4-SAT-AD1-P4-REQ-146 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

Fuses shall not be implemented inside equipments excepted distribution units (PLDIU, PFDIU) and batteries.

# *

# Reference **SB4-SAT-AD1-P4-REQ-147 b**

**[FC Applicability:** DATAM, POWER, PROP**]**

The fuse rating shall not exceed 15A

# *

# Reference **SB4-SAT-AD1-P4-REQ-148 c**

**[FC Applicability:** DATAM, POWER, PROP**]**

In case of use of wire fuses, they shall be redounded. The redundant fuse shall be used with a serial resistance. The value of this resistance shall be such that at least 75 % of the operational current pass through the nominal fuse.

# *

# Reference **SB4-SAT-AD1-P4-REQ-149 c**

**[FC Applicability:** DATAM, POWER, PROP**]**

For 100V regulated power bus, the use of fuse rating less than 1A is prohibited.

# *

### *5.5.3 High power units*

# Reference **SB4-SAT-AD1-P4-REQ-603**

**[FC Applicability:** PROP**]**

For high power units (>500W), input protection shall be implemented and it shall limit the maximum power consumption to 2 times the mean power demand.

# *

### *5.5.4 Primary Power Line fluctuation*

# Reference **SB4-SAT-AD1-P4-REQ-150 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

All users of these power lines shall safely survive any standing or fluctuation voltage in the full range 0V to 102 V and recover nominal operating performances witht bus voltage rise time to reach its nominal range of dV/dt < 1V/$\mu$sec.

# *

# Reference **SB4-SAT-AD1-P4-REQ-152 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

During power bus voltage fluctuations tests, the unit under test shall be initally in a configuration which maximise the interferece (ex : unit in ON state ).
Units are not required to meet performance parameters under these conditions but must safely survive without any over-stressing or damage and must recover all their nominal operating performance.

# *

# Reference **SB4-SAT-AD1-P4-REQ-155 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

Low speed power fluctuation (integration and hardware verification).

The test shall be performed when the bus voltage starts from 0V to nominal voltage (100V) with 20V/ms < dV/dt < 10 V/s (see figure below). During such event, the bus voltage shall be within hatched areas.

The unit input current shall be recorded and included in test report.

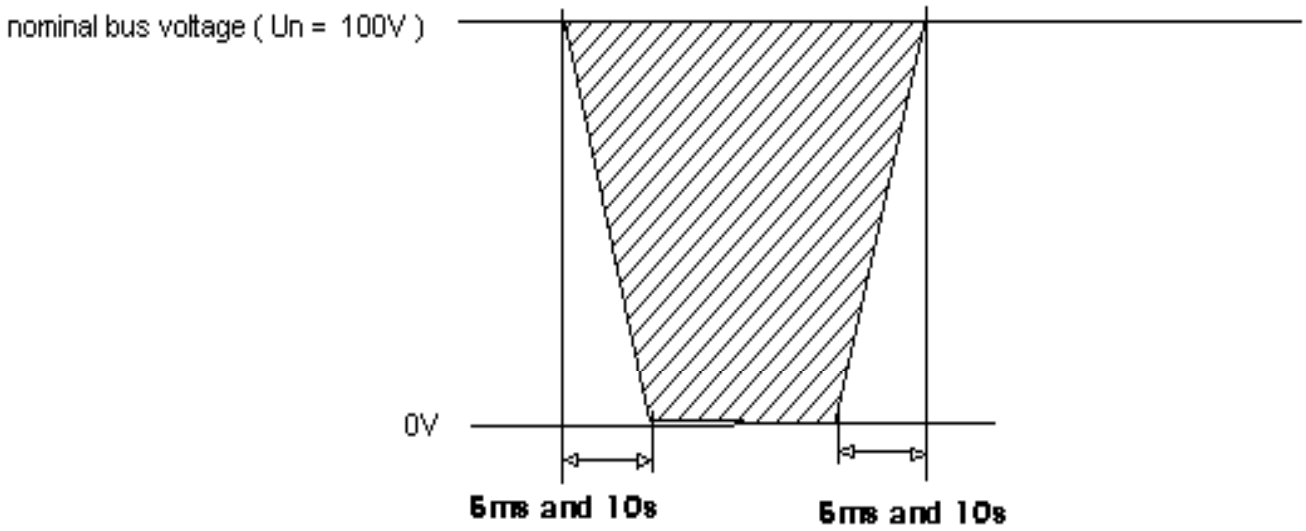



**Figure 7: Low speed power bus fluctuation (low dV/dt)**

# *

## 5.6 Mean power demand

# Reference **SB4-SAT-AD1-P4-REQ-161 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

The mean power demand shall be measured in voltage nominal conditions (see chapter "Power bus nominal voltage") during a period of 5 minutes

# *

## 5.7 Peak power demand

# Reference **SB4-SAT-AD1-P4-REQ-162 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

The long peak power demand shall be measured in voltage nominal conditions (see chapter "Power bus nominal voltage") at worst functional case of equipment (wheel spin up, telecomand generation, etc)

# *

## 5.8 Load current limitation

# Reference **SB4-SAT-AD1-P4-REQ-164 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, HARNESS, PAYLOAD, POWER, PROP, TCR, THERMAL**]**

The maximum current drawn by the unit from the supply lines in case of failure, shall be limited to 1.5 times the current peak value corresponding to the long peak power demand (except during the unit ON/OFF sequence)

# *

# 6. SIGNAL LINE INTERFACE REQUIREMENTS

# Reference **SB4-SAT-AD1-P4-REQ-442**

**[FC Applicability:** ALL CF (hardware)**]**

Signal interface shall use a return by wire concept.

# *

## 6.1 Conventions

- Time duration :The time duration is defined at 50% of the measured full amplitude.

- Signal rise and fall times : The rise and fall times of a signal are defined as the time between 10% and 90% of the measured voltage swing.

- Measurements : Measurements are made at the unit (or harness) connector level.

## 6.2 Command interface

### *6.2.1 Low Level and High Level Commands (LLC & HLC)*

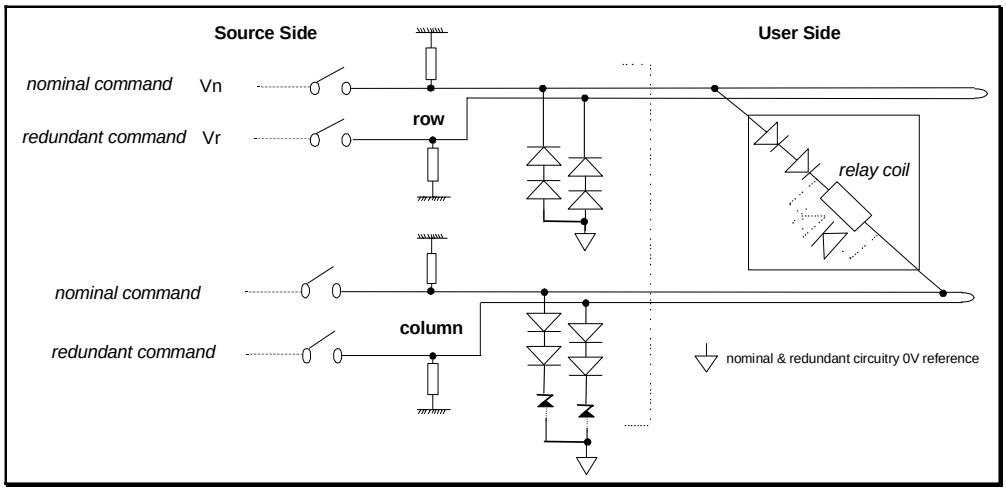
HLC and LLC commands are generated through matrix row and column drivers. One row pulled up to a positive voltage and one column pulled down to the secondary 0v in order to command only the device at the node of the activated row and column.

The command signal is a differential voltage pulse distributed to the user for :

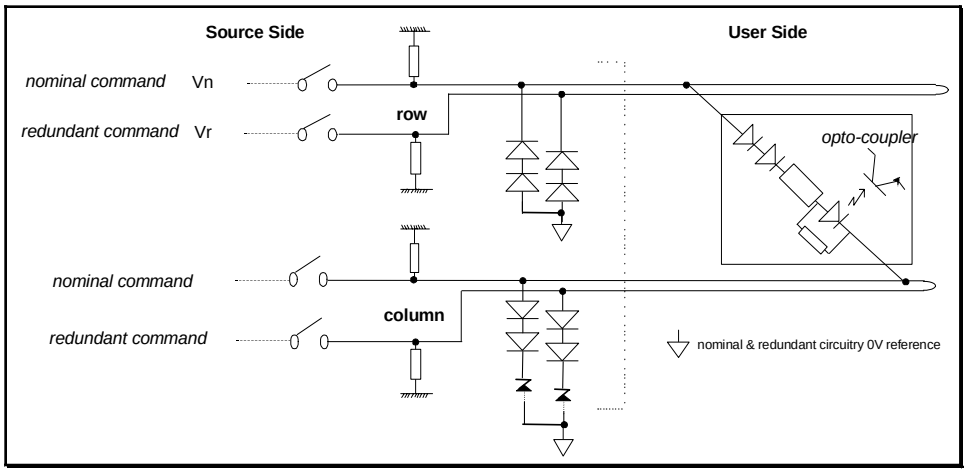
- relay driving or general logic control application with low level commands
- payload waveguide relay driving with high level commands

### 6.2.1.1 Matrix command schematics

Relay interface




Opto coupler interface




### 6.2.1.2 Source side requirements

\# Reference **SB4-SAT-AD1-P4-REQ-182 b**

**[FC Applicability:** DATAM**]**

The command lines (rows and columns) shall be double insulated inside the equipment (except external side of I/O connectors) and no failure propagation shall occur between rows, between columns or between row and column.

\# *

# Reference **SB4-SAT-AD1-P4-REQ-184 a**

**[FC Applicability:** DATAM**]**

matrix command (LLC and HLC) outputs shall be protected by a current limiting device

# *

# Reference **SB4-SAT-AD1-P4-REQ-191 b**

**[FC Applicability:** DATAM**]**

For matrix MAP, the pulse duration shall be programmed between 15ms to 1s.

# *

# Reference **SB4-SAT-AD1-P4-REQ-621**

**[FC Applicability:** DATAM**]**

For Short LLC, TI shall be between 3ms and 7ms (Td < 40ms).

# *

# Reference **SB4-SAT-AD1-P4-REQ-622**

**[FC Applicability:** DATAM**]**

For Long HLC, TI shall be between 110 ms and 210ms (Td > 530ms).

# *

# Reference **SB4-SAT-AD1-P4-REQ-192 a**

**[FC Applicability:** DATAM**]**

row and column switches shall be closed after the pulse during the demagnetisation of the relay coil.

# *

# Reference **SB4-SAT-AD1-P4-REQ-193 a**

**[FC Applicability:** DATAM**]**

only one command shall be activated at the same time ; simultaneously commands are not allowed.

# *

# Reference **SB4-SAT-AD1-P4-REQ-194 a**

**[FC Applicability:** DATAM**]**

Only one row and one column shall be activated per command and per matrix

# *

#### 6.2.1.3 User side requirements

# Reference **SB4-SAT-AD1-P4-REQ-195 a**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

all telecommand users shall provide two diodes in series with the commanded device at any matrix node.

# *

# Reference **SB4-SAT-AD1-P4-REQ-196 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For user interface with relay coil, two serial free wheel diodes shall be implemented in parallel with the relay coil at user side.

When the time constant of relay (L/R) is inferior to 1ms for LLC or 5ms for HLC, the diodes could be non implemented in the receiver interface.

# *

# Reference **SB4-SAT-AD1-P4-REQ-637**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

L/R time constant of the relay/RF switch shall be lower than 15 ms

# *

# Reference **SB4-SAT-AD1-P4-REQ-201 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The user shall not impose any potential or grounding reference on any row or column.

# *

##### *6.2.1.3.1 Failures management*

# Reference **SB4-SAT-AD1-P4-REQ-202 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The user interface design shall permit the unit power on/off without damage when the electrical interfaces are not fully connected.

# *

# Reference **SB4-SAT-AD1-P4-REQ-235 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Unpowered equipments shall not be damaged and degraded in their performances when command signals are applied.

# *

# Reference **SB4-SAT-AD1-P4-REQ-236 b**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Each input shall be sufficiently decoupled (fault propagation) from each input/ output :

- normal condition (powered equipment, without failure)
- unpowered equipment
- unpowered equipment and with any one failure.

# *

# Reference **SB4-SAT-AD1-P4-REQ-237 b**

**[FC Applicability:** DATAM**]**

Each command source failure shall not cause the loss of more than 1 command.

# *

# Reference **SB4-SAT-AD1-P4-REQ-630**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Any short circuit of one row (+ TC at user side) or (-exclusive) one column (- TC at user side) to the structure shall not cause the loss of any TC.

# *

### 6.2.1.4 Command signal characteristics

#### *6.2.1.4.1 Command signal waveform*

Signal duration (Td): time between crossing points of rise and fall time to 50% of the full amplitude

Signal rise/fall time (Tr ; Tf): maximum between 10% and 90% of the nominal voltage swing

Delay between 2 signals: time between the voltage crossing point at 50% of the full amplitude level

Closed time Tc:Command duration with switch closed

Free wheeling time: Duration between end of pulse and switch opening

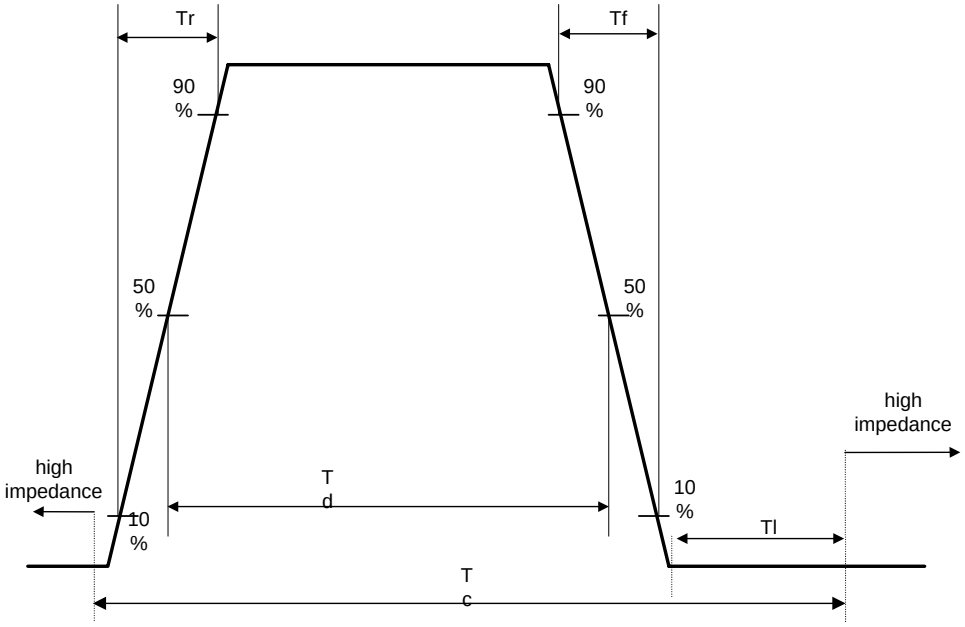



**Figure 8: Matrix command signal waveform**

### *6.2.1.4.2 LLC electrical parameters*

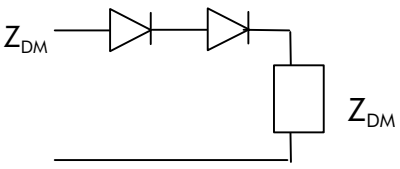
# Reference **SB4-SAT-AD1-P4-REQ-238 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The LLC commands shall comply with these LLC electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Differential | | for matrix drivers organisation |
| Req-2 | Input type | | Differential | |
| **B** | **VOLTAGE** | | | |
| Req-1 | DM low « 0 » voltage | -29V/ +4V | -29V / +4V | User shall also comply with Req-H1 |
| Req-2 | DM high « 1 » voltage | 26 V (+3V / -2V) | 26 V (+3V / -5V) | |
| Req-3 | Threshold | | $11V \leq V_T \leq 19V$ | |
| Req-4 | CM Permanent Fault Voltage Emission | Not allowed | Not allowed | DM = 0 |
| Req-5 | DM Permanent Fault Voltage | Not allowed | Not allowed | |
| Req-6 | DM Transient Fault Voltage Emission | -63 V/1 s<br>+33V/80ms | ± 2V / 25 ms | |
| Req-7 | DM Transient Fault Voltage Tolerance | -63 V/1 s<br>+33V/80ms | -63 V/1 s<br>+33V/80ms | |
| **C** | **CURRENT** | | | |
| Req-1 | Driving capability | > 180 mA | | |
| Req-2 | Load current | | 2,2 mA ≤ *load* ≤180 mA | Considering the whole DM high level voltage range |
| Req-3 | Overcurrent | ≤400 mA | | |
| Req-4 | short circuit between 2 outputs | Withstand | | |
| **D** | **IMPEDANCE (Differential impedance excluding the two serial diodes (see figure NOTE 1) )** | | | |
| Req-1 | Impedance under DM low voltage | | R≤ 9kΩ | |
| Req-2 | Impedance during free wheeling time (TI) | <10Ω | | Excluding diodes inside matrix source |

**NOTE 1**

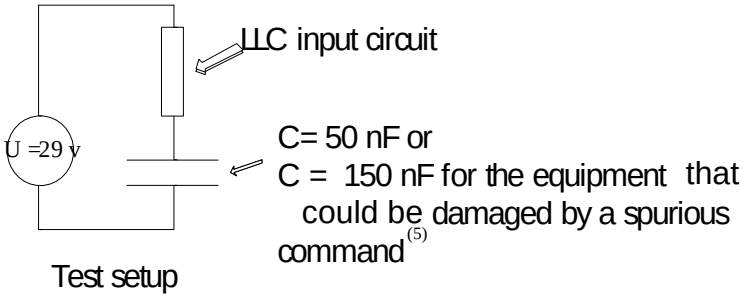


| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **E** | ***TIME*** | | | |
| Req-1 | Rise Time (Tr) | 50 $\mu$s ≤ Tr ≤ 500 $\mu$s | | Matrix output loaded by a user impedance in accordance with Code C and D. |
| Req-2 | Fall Time (Tf) | 1 $\mu$s ≤ Tf ≤ 600 $\mu$s | | Matrix output loaded by a user impedance in accordance with Code C and D. |
| Req-3 | « On » duration (Td) | 40 ms ≤ Td ≤ 50 ms | | |
| Req-4 | Closed duration (Tl) | 20 ms ≤ Tl ≤ 30 ms | | Matrix requirement |
| Req-5 | Spurious Command | | Td ≤ 0,1 ms | Td = time duration |
| **F** | ***MATRIX COMMAND GROUNDING AND ISOLATION*** (2) | | | |
| Req-1 | Between matrix ground and Chassis: R equivalent | 113 KΩ< R < 2 MΩ | > 10 MΩ | |
| Req-2 | between one row or one column and Chassis: Equivalent Capacitance (In // R equivalent) | C_CM < 1nF | C_CM<500 pF (3) | (3) Around 10 KHz |
| Req-3 | Between matrix ground and Chassis: C equivalent (In // R equivalent) | C_CM < 34 nF(3) (for SMU and PFDIU) C_CM < 50 nF(3) (for PLDIU) | | (3) Around 10 KHz |
| Req-4 | between row / column lines and relay or opto-coupler at user side | | galvanic isolation | use of relay coil or opto-coupler at user side |
| **H** | ***SPECIFIC REQUIREMENT*** | | | |
| Req-1 | Transient low "0" voltage | N/A | The input LLC shall not be activated with the following setup hereafter(4) | U=29V with tr 50 to 500 $\mu$s |

(2) Primary and users secondary grounds shall be considered connected to chassis for measurements

Note: CM: Common mode / DM: Differential Mode

Test setup(4)




Test setup

(5) 150 nF is only applicable to Payload units.

**Table 7: LLC electrical characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-587**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For LLC a single return shall be allowed for a maximum of 4 LLC commands.

# *

# Reference **SB4-SAT-AD1-P4-REQ-588**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Each return shall be electrical insulated from other return.

# *

### *6.2.1.4.3 HLC electrical parameters*

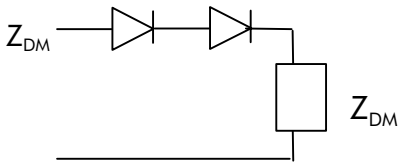
# Reference **SB4-SAT-AD1-P4-REQ-239 c**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The HLC commands shall comply with these HLC electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Differential | | for matrix drivers organisation |
| Req-2 | Input type | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | DM low « 0 » voltage | -29 V / +4V | -29 V / +4V | User shall also comply with Req-H1 |
| Req-2 | DM high « 1 » voltage | 26 V (+3V / - 3V) | 26 V (+3V/- 5.5V) | |
| Req-3 | Threshold | | $11V \leq V_T \leq 20,5V$ | |
| Req-4 | CM Permanent Fault Voltage Emission | Not allowed | Not allowed | DM=0 |
| Req-5 | DM Transient Fault Voltage Emission | -63 V / 1s<br>+33V/1s | ± 2 V / 125 ms | |
| Req-6 | DM Transient Fault Voltage Tolerance | -63 V / 1s<br>+33V/1s | -63 V / 1s<br>+33V/1s | |
| **C** | ***CURRENT*** | | | |
| Req-1 | Driving capability | > 500 mA | | |
| Req-2 | Load current | | 22 mA ≤ *load* ≤ 500 mA | Considering the whole DM high level voltage range |
| Req-3 | Overcurrent | ≤ 1 A | | |
| **D** | **IMPEDANCE (Differential impedance excluding the two serial diodes (see figure NOTE 1) )** | | | |
| Req-1 | Impedance under DM low voltage | | R≤ 9kΩ | |
| Req-2 | Impedance during free wheeling time (TI) | <10Ω | | Excluding diodes inside matrix source |

**NOTE 1**

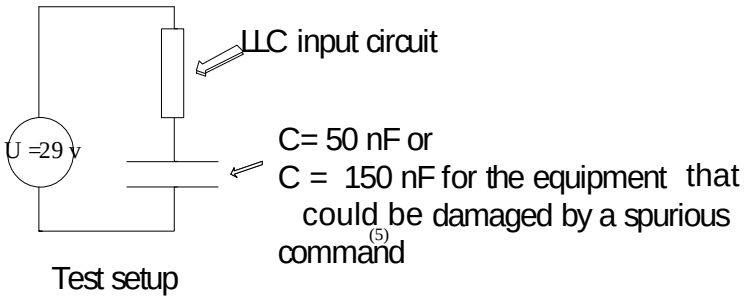


| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **E** | ***TIME*** | | | |
| Req-1 | Rise Time (Tr) | 50 $\mu$s ≤ Tr ≤ 500 $\mu$s | | Matrix output loaded by a user impedance in accordance with Code C and D. |
| Req-2 | Fall Time (Tf) | 1 $\mu$s ≤ Tf ≤ 600 $\mu$s | | Matrix output loaded by a user impedance in accordance with Code C and D. |
| Req-3 | « On » duration (Td) | 500ms ≤ Td ≤ 530ms | | |
| Req-4 | Closed duration (Tl) | 110ms ≤ Tl ≤ 140ms | | Matrix requirement |
| Req-5 | Spurious Command | | Td ≤ 0,1 ms | Td = time duration |
| **F** | ***MATRIX COMMAND GROUNDING AND ISOLATION*** (2) | | | |
| Req-1 | Between matrix ground and Chassis: R equivalent | 113 KΩ< R < 2 MΩ | > 10 MΩ | |
| Req-2 | between one row or one column and Chassis: Equivalent Capacitance (In // R equivalent) | C_CM < 1nF | C_CM<500 pF (3) | (3) Around 10 KHz |
| Req-3 | Between matrix ground and Chassis: C equivalent (In // R equivalent) | C_CM < 50 nF (3) (for PLDIU)( | | (3) Around 10 KHz |
| Req-4 | between row / column lines and relay or opto-coupler at user side | | galvanic isolation | use of relay coil or opto-coupler at user side |
| **H** | ***SPECIFIC REQUIREMENT*** | | | |
| Req-1 | Transient low "0" voltage | N/A | The input LLC shall not be activated with the following setup hereafter(4) | U=29V with tr 50 to 500 $\mu$s |

(2) Primary and users secondary grounds shall be considered connected to chassis for measurements

Note: CM: Common mode / DM: Differential Mode

Test setup(4)




Test setup

(5) 150 nF is only applicable to Payload units.

**Table 8: HLC electrical characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-589**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Each return shall be electrical insulated from others returns.

# *

# Reference **SB4-SAT-AD1-P4-REQ-590**

**[FC Applicability:** ANTRACK, AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For HLC a single return shall be allowed for a maximum of 4 HLC commands.

# *

### *6.2.2 SBDL Electrical Characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-626**

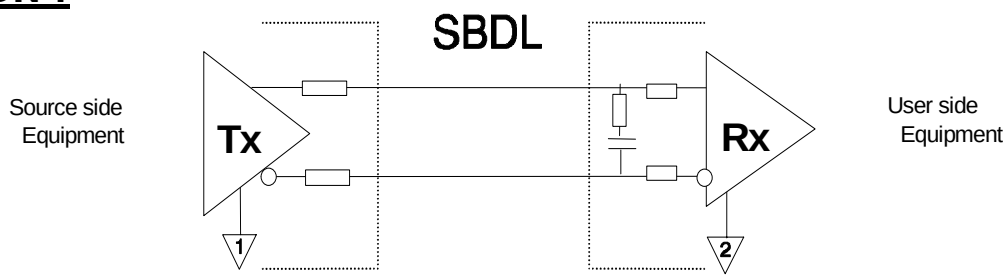
**[FC Applicability:** AOCS, DATAM, TCR**]**

The following electrical characteristics shall be applied to a "point to point" connection. The cross strap of two redundant transmitters (MASTER) inside the unit (the same Pcb) is allowed.

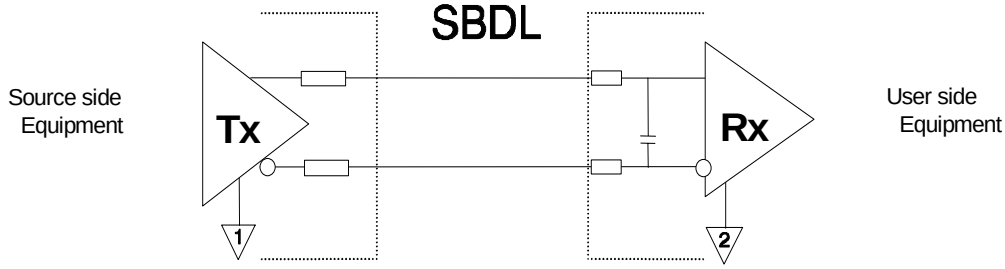
# *

SBDL electrical interface is according to one of these schematics (Option1 and Option2):

**OPTION 1**




**OPTION 2**




# Reference **SB4-SAT-AD1-P4-REQ-241 b**

**[FC Applicability:** AOCS, DATAM, TCR**]**

SBDL serial link differential signals shall be identified as "non-inverted" and "inverted line".

# *

# Reference **SB4-SAT-AD1-P4-REQ-559**

**[FC Applicability:** AOCS, DATAM, TCR**]**

The status of the signal shall be defined as true (logical « 1 ») when the non-inverted line has a positive voltage level w.r.t. the inverted line, i.e. when the non inverted line is at a high voltage level and the inverted line is at a low voltage level.

# *

# Reference **SB4-SAT-AD1-P4-REQ-560**

**[FC Applicability:** AOCS, DATAM, TCR**]**

The status of the signal shall be defined as false (logical « 0 ») when the non-inverted line has a negative voltage with respect to the inverted line, i.e. when the non-inverted line is at a low level and the inverted line is at a high level.

# *

# Reference **SB4-SAT-AD1-P4-REQ-627**

**[FC Applicability:** AOCS, DATAM, TCR**]**

ML16 clock and address receiver internal state shall not change in case of:
- logical "1" state transition to OFF bus state transition
- OFF bus state transition to logical "1" state.

# *

# Reference **SB4-SAT-AD1-P4-REQ-243 c**

**[FC Applicability:** AOCS, DATAM, TCR**]**

The SBDL interfaces shall comply with the following characteristics:

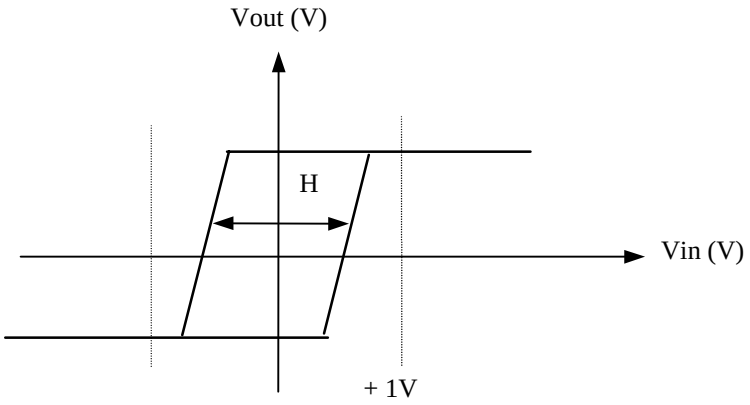
| Code | PARAMETERS | SOURCE SIDE (transmitter) | USER SIDE (receiver) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Differential driver or balanced driver | | Differential driver required for ML16 drivers |
| Req-2 | Input type | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Low level output voltage (VOL) | 0V to 0.5V | | D-Req4 (common mode) |
| Req-2 | High level output voltage (VOH) | 4 V to 5.5V | | D-Req4 (common mode) |
| Req-3 | Low level differential output voltage (logical 0) | -5.5 V to -3.5 V | See (1) | D-Req5 |
| Req-4 | High level differential output voltage (logical 1) | 3.5 V to 5.5 V | See (1) | D-Req5 |
| Req-5 | Logical « 0 » differential threshold | | -1V min | |
| Req-6 | Logical « 1 » differential threshold | | +1V max | |
| Req-7 | CM Permanent Fault Voltage Emission | -0.5V to +7V | | |
| Req-8 | CM Permanent Fault Voltage Emission | | -0.5V to +7V | through 2KΩ |
| Req-9 | Overvoltage Tolerance (CM) | -7V to +12V | | through 2KΩ |
| Req-10 | Overvoltage Tolerance (CM) | | -7V to +12V | |
| **C** | ***CURRENT*** | | | |
| Req-1 | Current capability | 20mA min.<br>100mA max. | | Differential short circuit |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | Power on differential Impedance | 120Ω ± 10% | | Serial resistor required |
| Req-2 | Power off differential Impedance | 4 KΩ min. | | |
| Req-3 | AC differential Impedance | | 120 Ω in series with 100 pF to 1nF max. | Option 1 |
| Req-4 | AC differential Impedance | | 2 x 2.2 KΩ min with 10 pF min. in parallel | Option 2<br>(Max. capacitor value is limited by propagation time) |
| Req-5 | DC in line series resistor | | 2.2 KΩ min. | the value is related to each receiver input |
| Req-6 | DC differential Impedance | | 10 KΩ min. | |

| Code | PARAMETERS | SOURCE SIDE (transmitter) | USER SIDE (receiver) | COMMENT |
|---|---|---|---|---|
| **E** | ***TIME*** | | | |
| Req-1 | Rise Time (Tr) | 10 ns ≤ Tr ≤ 100 ns | | Measured on 120 Ω with 50pF in parallel.<br>Only applicable to ML16/DS16 |
| Req-2 | Fall Time (Tf) | 10 ns ≤ Tf ≤ 100 ns | | Measured on 120 Ω with 50pF in parallel<br>Only applicable to ML16/DS16 |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | from Secondary Ground (0Vs) | Circuit is referenced to 0Vs | Circuit is referenced to 0Vs | |
| Req-2 | from Primary Ground | Isolated<br>(> 1MΩ // 50nF) | Isolated<br>(> 1MΩ // 50nF) | |
| Req-3 | from chassis | Connected | Connected | |

**Table 9: SBDL characteristics**

**(1)** Two solutions are acceptable for the receiver :

*use a classical differential receiver with the following characteristics




- The hysteresis H has to be greater than 0.8V

- The high level threshold has to be under 1V and the low level threshold has to be above -1V (differential measure).

* use the differential line receiver **HS-26C(T)32MS** specially designed for such applications.

### *6.2.3 Memory Load Command (ML16)*

#### 6.2.3.1 Command Definition

The purpose of the memory load command (or 16-bit serial load command) interface is to transfer a 16-bit data word, in serial form, from a Master toward a Slave.
The interface consists of clock, address and data signals and use SBDL interface. The three signals are sent by the Master (Source side) to the Slave (User side).

The following notation is used:
- ML16_ADDRESS: ML16 address signal
- CLOCK: ML16 and DS16 common clock signal
- ML16_DATA: ML16 data signal

# Reference **SB4-SAT-AD1-P4-REQ-548**

**[FC Applicability:** AOCS, DATAM**]**

Outside the data transfer period, ML Address & ML/DS Clock shall be in logical « 1 » state.

# *

# Reference **SB4-SAT-AD1-P4-REQ-550**

**[FC Applicability:** AOCS, DATAM**]**

One dedicated address line shall be provided to each ML16 user.

# *

# Reference **SB4-SAT-AD1-P4-REQ-551**

**[FC Applicability:** AOCS, DATAM**]**

One clock signal shall be provided to each user, for telecommand and telemetry.

# *

# Reference **SB4-SAT-AD1-P4-REQ-552**

**[FC Applicability:** AOCS, DATAM**]**

The data shall be valid only when the address line is active (level "0").

# *

# Reference **SB4-SAT-AD1-P4-REQ-553**

**[FC Applicability:** AOCS, DATAM**]**

For each data transfer, 16 clock pulses shall be generated on the clock line.

# *

# Reference **SB4-SAT-AD1-P4-REQ-240 b**

**[FC Applicability:** AOCS, DATAM**]**

The Master shall shift the data on the rising edge.

# *

# Reference **SB4-SAT-AD1-P4-REQ-628**

**[FC Applicability:** AOCS, DATAM**]**

The Slave shall acquire the data on the falling edge.

# *

# Reference **SB4-SAT-AD1-P4-REQ-554**

**[FC Applicability:** AOCS, DATAM**]**

One data line shall be provided to each ML16 user.

# *

# Reference **SB4-SAT-AD1-P4-REQ-555**

**[FC Applicability:** AOCS, DATAM**]**

The data shall be a 16-bit word code.

# *

# Reference **SB4-SAT-AD1-P4-REQ-557**

**[FC Applicability:** AOCS, DATAM**]**

The data word shall be clocked out with the MSB first (bit 0)

# *

# Reference **SB4-SAT-AD1-P4-REQ-242 b**

**[FC Applicability:** AOCS, DATAM**]**

The ML16 commands shall comply with the SBDL electrical characteristics (See chapter "SBDL Electrical Characteristics")

# *

### 6.2.3.2 Memory Load Command timing

# Reference **SB4-SAT-AD1-P4-REQ-561**

**[FC Applicability:** AOCS, DATAM**]**

The Memory Load Command shall respect the following timing:

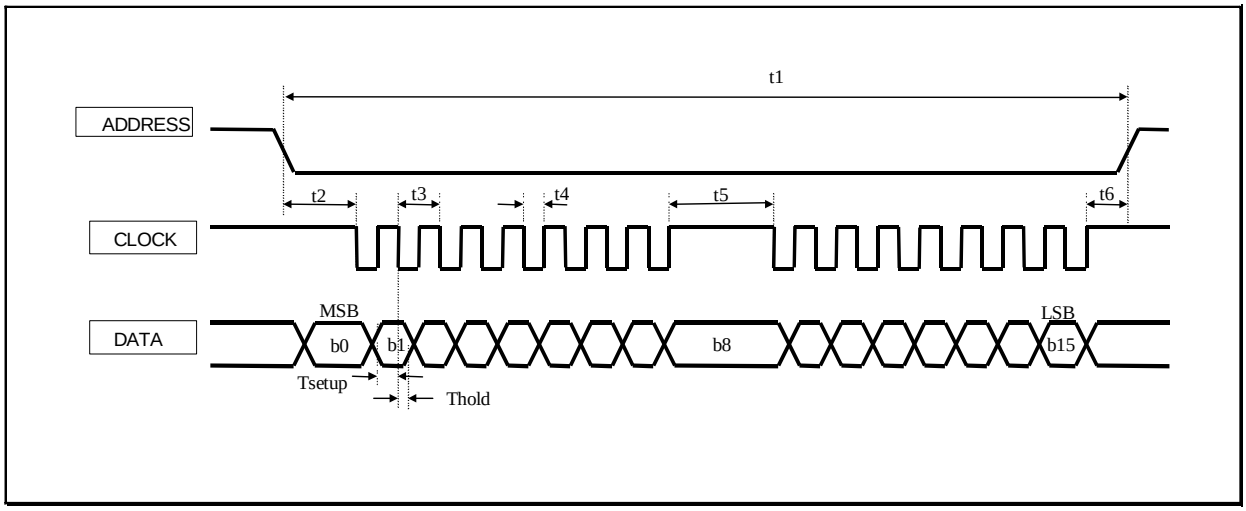



**Figure 9: Memory load command signal waveform diagram**

| TIMING | | | |
|---|---|---|---|
| | | MASTER | SLAVE |
| t | Reference time | t=0,954$\mu$s ± 5% | t=0,954$\mu$s ± 5% |
| t1 | Address active state duration | 125t max. | 125t max. |
| t2 | Address to clock delay | 28t ± t | 27t min. |
| t3 | Clock period | 4t ± 0.1t | 4t ± 0.1t |
| t4 | Active to inactive edge of clock delay (Half Clock period) | 2t ± 0.3t | 2t ± 0.5t |
| t5 | Middle frame gap | 1.8t min.<br>36t max. | 1.5t min.<br>37t max. |
| t6 | Clock rising to end of address | 1.8t min. | 1.5t min. |
| Tcc | Command to command delay | 3.8t min. | 3.5t min. |
| Tsetup | Data valid setup time to clock falling edge | 1.5t min. | 0.5t min. |
| Thold | Clock falling edge to data change | 1.5t min. | 0.5t min. |

**Table 10: Memory load command timing**

# *

# Reference **SB4-SAT-AD1-P4-REQ-604**

**[FC Applicability:** AOCS, DATAM**]**

All equipment sequencing constraints differing from the following table shall be approved by the Prime and indicated in the equipment IDS.

| | | Master | Slave |
|---|---|---|---|
| Command to acquisition delay | Tca | 3.8t min | 3.5t min |
| Acquisition to command delay | Tac | 3.8t min | 3.5t min |

# *

## 6.3 Telemetry interface

### *6.3.1 Telemetry channel types*

The telemetry channel types are :

- **a.** Analog Channel (AN)
- **b.** Digital Bi Level Channels (DB)
- **c.** Digital relay channels (DR)
- **d.** Digital Serial Channel 16-bit (DS16)
- **e.** Thermistors Power Supply and Conditioning (TH)

### *6.3.2 Analog channels*

#### 6.3.2.1 Analog channels definition

For ADSP users the analog TM is coded in 12 bits.
For unit including BBC/RUBI device, the analog TM is coded in 10 bits.

The system accuracy of the analog channels is better than ± 1 % of full scale.

### 6.3.2.2 Analog channels accuracy

# Reference **SB4-SAT-AD1-P4-REQ-244 b**

**[FC Applicability:** AOCS, DATAM, POWER**]**

The accuracy of the analog channel signal conditioning in the source shall be as specified in the corresponding subsystem specification but shall be limited to ± 0.5 % of full scale.

# *

# Reference **SB4-SAT-AD1-P4-REQ-613**

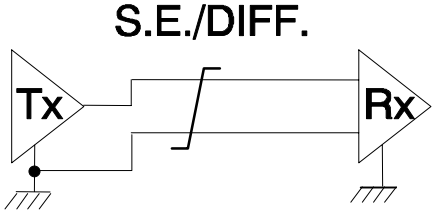
**[FC Applicability:** AOCS, DATAM, POWER**]**

The overall A/D conversion accuracy including sampling error, quantization error plus offset shall be less than ± 0.5 % of full scale.

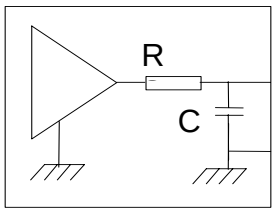
# *

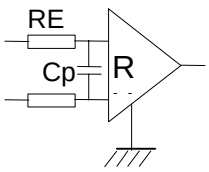
### 6.3.2.3 Analog channels characteristics

- Standard analog channel:




- Parameter definition:



# Reference **SB4-SAT-AD1-P4-REQ-250 c**

**[FC Applicability:** AOCS, DATAM, POWER**]**

The analog telemetry shall comply with these analog electrical characteristics:

| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Single ended | | |
| Req-2 | Input type | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Range | 0 V / 5.12V | | |
| Req-2 | Fault Voltage Emission | ± 15 V | ± 15 V | |
| Req-4 | Fault Voltage Tolerance | ± 17 V | ± 17 V | |
| **C** | ***CURRENT*** | | | |
| Req-1 | Over-current | ≤ 15 mA | | permanent |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | impedance ON | Rs ≤ 5 KΩ in parallel with 100 nF ≤ C ≤ 1 µF (RS x C ≥ 0,1 ms) | ≥ 1 MΩ | |
| Req-2 | impedance OFF | RP ≤ 100 kΩ **(2)** | ≥ 1 MΩ | |
| Req-3 | Receiver input Capacity | | 100 pF Max | 500 pF for harness |
| Req-4 | DC in line series resistor | | Re ≥ 3 KΩ | value related to each receiver input |
| Req-5 | Receiver filter Capacity | | Cp ≥ 10nF | |
| **E** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | from secondary ground (0Vs) | Connected | ≥ 1 MΩ | |

**Table 11: Analogic telemetry characteristics**

**(2)** Rp is the impedance between positive output and the ground when the unit (source side) is OFF.

# *

### *6.3.3 Digital Bi-level channel*

#### 6.3.3.1 Digital Bi-Level channel definition

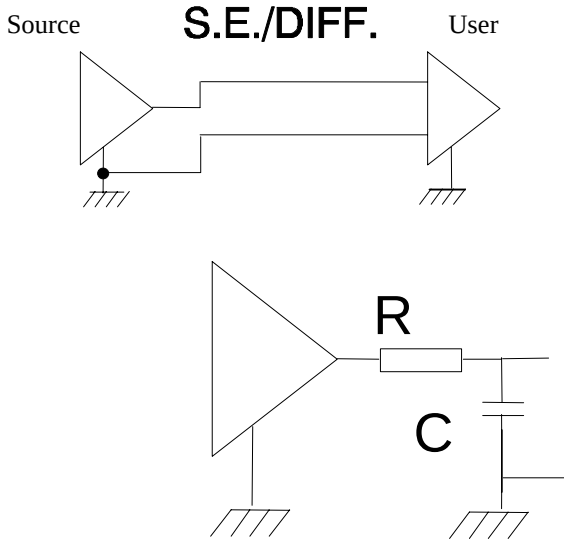
# Reference **SB4-SAT-AD1-P4-REQ-562**

**[FC Applicability:** AOCS, DATAM**]**

The digital bi-level information shall be presented by the source in the form of a voltage that can assume only two distinct values, an on-level («ONE» level) and an off level («ZERO» level).

# *

#### 6.3.3.2 Digital Bi-Level channel characteristics



# Reference **SB4-SAT-AD1-P4-REQ-260 c**

**[FC Applicability:** AOCS, DATAM**]**

The digital bi-level telemetry shall comply with these digital bi-level electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Single ended | | |
| Req-2 | Input type | | Differential | |
| Req-3 | Transfer | DC COUPLER | DC COUPLER | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Low level output voltage (discrete ''0'') | 0V to 0.5V | | |
| Req-2 | High level output voltage (discrete ''1'') | +3.5V to +10V | | |
| Req-3 | Fault Voltage Emission | ± 15 V | ± 15 V | |
| Req-4 | Fault Voltage Tolerance | ± 17 V | ± 17 V | |
| **C** | ***CURRENT*** | | | |
| Req-1 | Over-current | ≤ 10 mA | | permanent |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | impedance ON | Rs ≤ 5 KΩ in parallel with 100 nF ≤ C ≤ 1 µF (RS x C ≥ 0,1 ms) | ≥ 220 kΩ | |
| Req-2 | impedance OFF | RP ≤ 100 kΩ **(2)** | ≥ 1 MΩ | |
| Req-3 | Capacitance | | 100 pF max | 500 pF for harness |
| **E** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | from secondary ground (0Vs) | connected | isolated (≥ 1 MΩ) | |

**Table 12: Digital bilevel telemetry characteristics**

**(2)** Rp is the impedance between positive output and the ground when the unit (source side) is OFF.

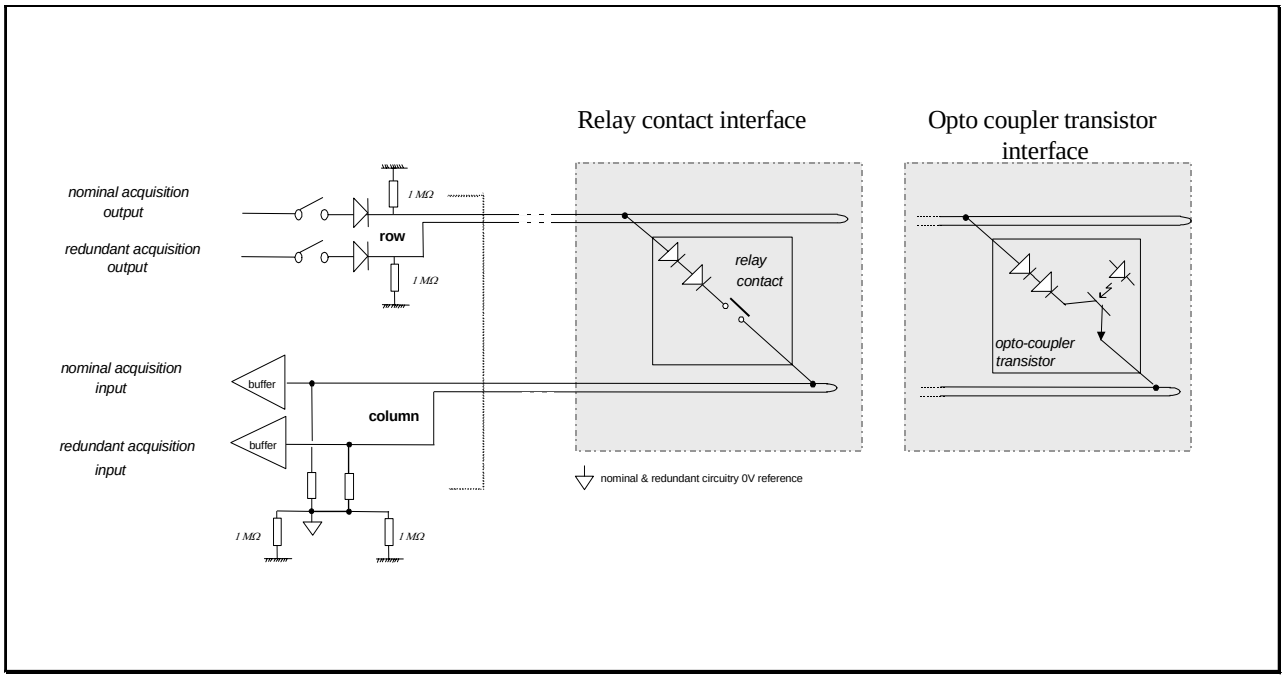
# *

### *6.3.4 Digital switch closure channel telemetry*

The Digital relay acquisition also called DR shall be used to transmit a relay or a switch status signal.

6.3.4.1 Matrix switch closure acquisition definition

The matrix switch closure acquisitions are performed through a matrix organisation. One row is pulled up to a positive voltage and the switch closure status is acquired on the column.




*6.3.4.1.1 Source side requirements*

Source side is related to the switch closure location

# Reference **SB4-SAT-AD1-P4-REQ-266 b**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

All source shall provide two diodes in series with the switch closure device.

# *

# Reference **SB4-SAT-AD1-P4-REQ-267 a**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Each row and column line shall be insulated from the mechanical ground inside the source equipment

# *

# Reference **SB4-SAT-AD1-P4-REQ-268 a**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The source equipment shall provide a galvanic isolation between the switch closure (contact or opto-coupler transistor) lines and the source electrical circuitry

# *

# Reference **SB4-SAT-AD1-P4-REQ-269 b**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

The source equipment shall not impose any potential or grounding reference on any row or column.

# *

# Reference **SB4-SAT-AD1-P4-REQ-563**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Closed contact shall correspond to the TM "Zero" level with the unit powered or active

# *

# Reference **SB4-SAT-AD1-P4-REQ-564**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

Open contact shall correspond to the TM "One" level with the unit unpowered or inactive

# *

#### *6.3.4.1.2 Receiver (or user) side requirements*

Receiver side correspond at one hand to the switch closure polarisation outputs and at the other hand to the switch closure acquisition input.

# Reference **SB4-SAT-AD1-P4-REQ-272 b**

**[FC Applicability:** DATAM**]**

Each node of the matrix switch closures shall be polarised by a nominal or a redundant separated interrogation command circuits.

# *

# Reference **SB4-SAT-AD1-P4-REQ-565**

**[FC Applicability:** DATAM**]**

Each set of switch closure status shall be selected by the nominal or the redundant acquisition input circuits

# *

# Reference **SB4-SAT-AD1-P4-REQ-274 b**

**[FC Applicability:** DATAM**]**

The command lines (rows and columns) shall be double insulated inside the equipment (except external side of I/O connectors) and no failure propagation shall occur between rows, between columns or between row and column.

# *

# Reference **SB4-SAT-AD1-P4-REQ-275 b**

**[FC Applicability:** DATAM**]**

In case of failure, the concerned row output or the concerned column acquisition input shall be in a high impedance state.

# *

# Reference **SB4-SAT-AD1-P4-REQ-276 a**

**[FC Applicability:** DATAM**]**

The polarisation outputs of the matrix switch closure shall be protected by a current limiting device

# *

# Reference **SB4-SAT-AD1-P4-REQ-281 a**

**[FC Applicability:** DATAM**]**

The matrix acquisition pulse duration shall be at least 20 ms .

# *

# Reference **SB4-SAT-AD1-P4-REQ-566**

**[FC Applicability:** DATAM**]**

At least one serial diode shall be inserted on the positive output (row line output).

# *

# Reference **SB4-SAT-AD1-P4-REQ-282 a**

**[FC Applicability:** DATAM**]**

Only one row shall be selected per interrogation.

# *

# Reference **SB4-SAT-AD1-P4-REQ-283 b**

**[FC Applicability:** DATAM**]**

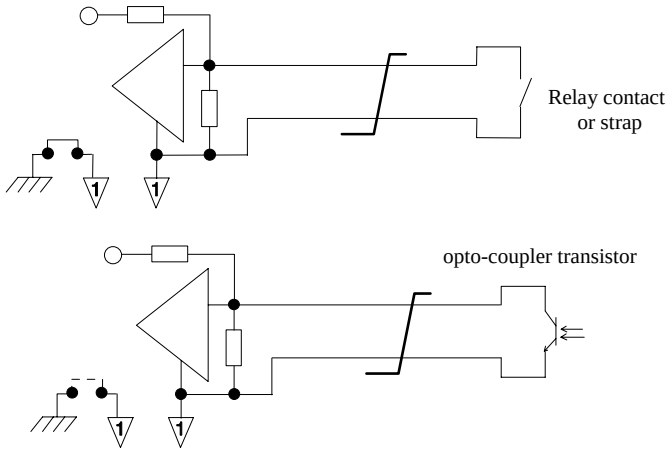
The matrix acquisition input interfaces shall not overload the source during normal operation (16 status (column lines, worst case) could be acquired simultaneously).

# *

### 6.3.4.2 Single ended switch closure acquisition definition

Direct switch closure acquisition shall be performed via a dedicated circuits referenced to the secondary 0V.

Digital relay channel telemetry schematics (Relay and opto-coupler transistor):




#### *6.3.4.2.1 Source side requirements*

Source side is related to the switch closure location.

# Reference **SB4-SAT-AD1-P4-REQ-301 a**

**[FC Applicability:** DATAM, PROP**]**

Digital switch closure channels shall be completely isolated from any other return inside the source equipment

# *

# Reference **SB4-SAT-AD1-P4-REQ-302 a**

**[FC Applicability:** DATAM, PROP**]**

The source equipment shall provide a galvanic isolation between the switch closure lines and the source electrical circuitry

# *

# Reference **SB4-SAT-AD1-P4-REQ-303 a**

**[FC Applicability:** DATAM, PROP**]**

Separated returns for nominal and redundant channels shall be provided.

# *

# Reference **SB4-SAT-AD1-P4-REQ-567**

**[FC Applicability:** DATAM, PROP**]**

Closed contact shall correspond to the TM "Zero" level with the unit powered or active

# *

# Reference **SB4-SAT-AD1-P4-REQ-568**

**[FC Applicability:** DATAM, PROP**]**

Open contact shall correspond to the TM "One" level with the unit unpowered or inactive

# *

#### *6.3.4.2.2 Receiver (or user) side requirements*

Receiver side correspond to the switch closure acquisition inputs

# Reference **SB4-SAT-AD1-P4-REQ-304 b**

**[FC Applicability:** DATAM, PROP**]**

Digital relay shall be referenced to the secondary ground inside the user equipment

# *

### 6.3.4.3 Digital relay channel telemetry characteristics

# Reference **SB4-SAT-AD1-P4-REQ-308 c**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For matrix organisation, the digital relay telemetry shall comply with these digital relay electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE DR | USER SIDE PCB | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | differential | | |
| Req-2 | Input type | | differential | for matrix organisation |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Row min. voltage | N/A | 9V | |
| Req-2 | DM fault voltage emission | Not allowed | ±17 V | |
| Req-3 | DM fault voltage tolerance | -17 V | N/A | permanent, ON or OFF |
| Req-4 | DM fault voltage tolerance | ±17 V | N/A | permanent OFF only |
| Req-5 | CM fault voltage emission | Not allowed | ±17V | |
| Req-6 | Drop voltage («ON state ») | ≤ 3,7V at 1mA | | - relay :<br>2 diodes + 1 relay contact<br>- opto :<br>2 diodes+1 transistor junction |
| Req-7 | CM Fault Voltage Tolerance | ±17 V | ±17 V | DM = 0 |
| **C** | ***CURRENT*** | | | |
| Req-1 | Contact capability 'ON' | I ≥ 1mA | 0,5mA<I<5mA | Permanent, closed contact |
| Req-2 | Contact capability 'OFF' (leakage) | <200µA @ 17V | | Permanent, open contact |
| Req-3 | Fault Current emission | N/A | <100mA | |

| Code | PARAMETERS | SOURCE SIDE DR | USER SIDE PCB | COMMENT |
|---|---|---|---|---|
| **E** | ***MATRIX DR GROUNDING AND ISOLATION*** (1) | | | |
| Req-1 | between row / column lines and Chassis | ≥ 1 MΩ//<br><50 pF for switch**<br><500 pF for all the other equipment** | 113 KΩ<R<10 MΩ<br>//< 25 pF | ** Only stray capacitance, no physical capacitance shall be added.<br>Note: For Repeater Subsystem only the equivalent capacitance for one MAP equivalent matrix (contribution of all units connected) shall be lower than 33nF. |
| Req-2 | Between matrix ground and Chassis | | 113 KΩ<R<10 MΩ //<br>10nF<C_CM<50nF for PLDIU or<br>10nF<C_CM<34nF for PFDIU | |
| Req-3 | Between switch closure lines and the electrical circuitry | galvanic isolation | | use of relay contact or opto-coupler transistor at source side |

(1) Primary and users secondary grounds shall be considered connected to chassis for measurements

**Table 13: Digital relay telemetry characteristics (For matrix acquisition)**

# *

# Reference **SB4-SAT-AD1-P4-REQ-632**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For single ended acquisition, the digital relay telemetry shall comply with these digital relay electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE DR | USER SIDE PCB | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | differential | | |
| Req-2 | Input type | | Single ended | for single ended acquisition |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | DM fault voltage emission | Not allowed | ±16 V | |
| Req-2 | DM fault voltage tolerance | ±16 V | N/A | permanent OFF only |
| Req-3 | Drop voltage («ON state ») for DR ABM / MBSV / Umbilical | ≤ 4V / 400mA / 50ms | | Only for ABM / MBSV / Umbilical |
| | Drop voltage («ON state ») for DR BSV/ SMU / PYPGP | ≤ 0,5V / 10mA | | Only for BSV/ SMU / PYPGP |
| | Drop voltage («ON state ») for DR TOM/ BAPTA / SADM | ≤ 1V / < 1mA | | Only for TOM/ BAPTA / SADM |
| **C** | ***CURRENT*** | | | |
| Req-1 | Contact capability 'OFF' (leakage) | <100µA @ 5V | | Permanent, open contact |
| Req-2 | Fault Current emission | N/A | <100mA | |

| Code | PARAMETERS | SOURCE SIDE DR | USER SIDE PCB | COMMENT |
|---|---|---|---|---|
| **E** | ***SINGLE COMMAND GROUNDING AND ISOLATION*** | | | |
| Req-1 | From Primary or Secondary Ground | Galvanic isolation | | Not applicable to optical switches (BAPTA/SADM) |
| Req-2 | Chassis | Isolated ( ≥1MΩ) | | Not applicable to optical switches (BAPTA/SADM) |

**Table 14: Digital relay telemetry characteristics (Single ended acquisition)**

# *

# Reference **SB4-SAT-AD1-P4-REQ-591**

**[FC Applicability:** AOCS, DATAM, PAYLOAD, POWER, PROP, TCR**]**

For an equipment all digital relay telemetry return shall be insulated from all other digital relay telemetry return and from grounding

# *

### *6.3.5 Digital serial channels : DS16*

#### 6.3.5.1 Telemetry definition

The function of this interface is to transfer in a serial form a 16-bit data word from the Slave to the Master.
The interface consists in clock, sample and data signals, and it uses SBDL interface.
Clock and Sample signals are provided by the Maste. Data signal is provided by the Slave.

The following notation is used:
- DS16_SAMPLE: DS16 sample signal
- CLOCK: ML16 and DS16 common clock signal
- DS16_DATA: DS16 data signal

The interface consists of clock, sample and data signals shall use SBDL interface.

# Reference **SB4-SAT-AD1-P4-REQ-570**

**[FC Applicability:** AOCS, DATAM**]**

Outside the data transfer period, DS Sample & ML/DS Clock shall be in logical « 1 » state.

# *

# Reference **SB4-SAT-AD1-P4-REQ-571**

**[FC Applicability:** AOCS, DATAM**]**

The data transfer shall be valid only when sample line is active (level "0").

# *

# Reference **SB4-SAT-AD1-P4-REQ-572**

**[FC Applicability:** AOCS, DATAM**]**

One dedicated sampling signal line shall be provided to each DS16 user.

# *

# Reference **SB4-SAT-AD1-P4-REQ-573**

**[FC Applicability:** AOCS, DATAM**]**

One clock signal shall be provided to each user, for telecommand and telemetry.

# *

# Reference **SB4-SAT-AD1-P4-REQ-575**

**[FC Applicability:** AOCS, DATAM**]**

For each data word transfer, 16 clock pulses shall be generated on the clock line.

# *

# Reference **SB4-SAT-AD1-P4-REQ-309 b**

**[FC Applicability:** AOCS, DATAM**]**

The Slave shall shift the data on the falling edge.

# *

# Reference **SB4-SAT-AD1-P4-REQ-629**

**[FC Applicability:** AOCS, DATAM**]**

The Master shall acquire the data on the falling edge.

# *

# Reference **SB4-SAT-AD1-P4-REQ-576**

**[FC Applicability:** AOCS, DATAM**]**

Each DS16 Slave shall provide one data line to its corresponding Master.

# *

# Reference **SB4-SAT-AD1-P4-REQ-578**

**[FC Applicability:** AOCS, DATAM**]**

The data shall be clocked out with the MSB first (bit 0).

# *

### 6.3.5.2 Digital serial Electrical characteristics

# Reference **SB4-SAT-AD1-P4-REQ-313 b**

**[FC Applicability:** AOCS, DATAM**]**

The digital serial telemetry shall comply with the SBDL electrical characteristics (See chapter:"SBDL Electrical Characteristics")

# *

### 6.3.5.3 Digital serial telemetry timing

# Reference **SB4-SAT-AD1-P4-REQ-580**

**[FC Applicability:** AOCS, DATAM**]**

The Digital Serial Telemetry shall respect the following timing:

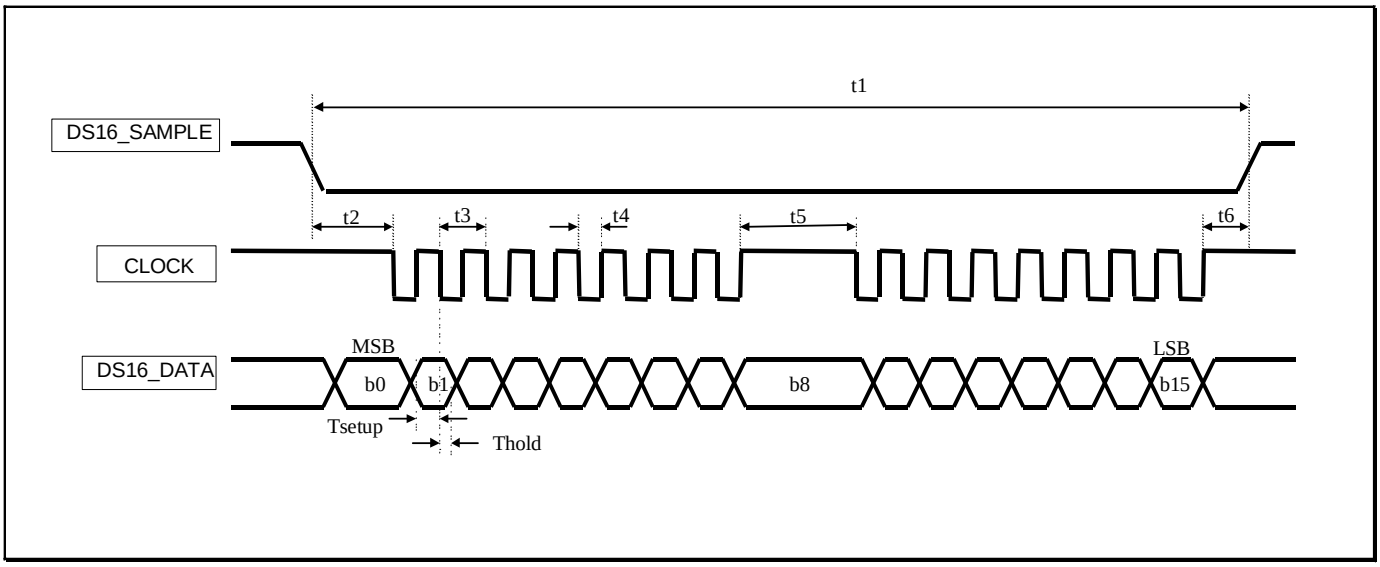


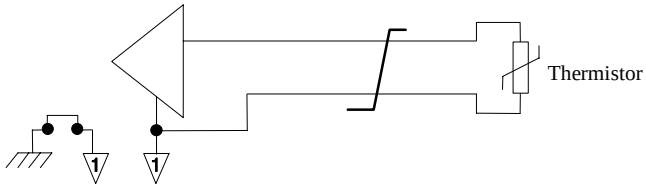

**Figure 10: Digital Serial 16-Bit Telemetry Signal Waveform Diagram**

| TIMING | | | |
|---|---|---|---|
| | | MASTER | SLAVE |
| t | Reference time | t=0,954$\mu$s ± 5% | t=0,954$\mu$s ± 5% |
| t1 | Sample active state duration | 125t max. | 125t max. |
| t2 | Sample to clock delay | 28t ± t | 26.5t min. |
| t3 | Clock period | 4t ± 0.1t | 4t ± 0.1t |
| t4 | Active to inactive edge of clock delay (Half Clock period) | 2t ± 0.3t | 2t ± 0.5t |
| t5 | Middle frame gap | 1.8t min<br>36t max | 1.5t min<br>37t max |
| t6 | inactive edge clock to transfer end<br>Clock rising to end of sample | 1.8t min | 1.5t min |
| Taa | Acquisition to acquisition delay | 3.8t min | 3.5t min |
| Tsetup | Data valid setup time to clock falling edge | 1.5t min | 2.8t min |
| Thold | Clock falling edge to data change | 0t min | 0t min |

**Table 15: Digital serial telemetry timing**

# *

### *6.3.6 hermistors power supply and conditioning (TH)*




#### 6.3.6.1 Thermistors type

# Reference **SB4-SAT-AD1-P4-REQ-636**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

Thermistor type shall be chosen according to the following table:

| DESIGNATION | TYPE | Temperature range | Corresponding R range |
|---|---|---|---|
| FENWAL or equivalent | 526-31BS13 or equivalent | - 60 °C to + 160 °C | 1342 KΩ to 0.302 KΩ |
| BETATHERM or equivalent | G15K4D425 or equivalent | - 60 °C to + 160 °C | 1342 KΩ to 0.302 KΩ |
| GULTON or Victory Engineering or equivalent | 34 TD 25 | - 55 °C to + 125 °C | 408,34 KΩ to 0.1317 KΩ or 385.5 KΩ to 0.137 KΩ |
| ROSEMOUNT | 118 MF | - 200 °C to + 260 °C | 0.34 KΩ to 3.97 KΩ |
| ROSEMOUNT | 118 MF | - 50 °C to + 400 °C | 1.5 KΩ to 5 KΩ |
| Thruster thermistor | PT200 | - 200 °C to + 520 °C | 37.04 to 575.23Ω |

**Table 16: Thermistors type**

# *

*6.3.6.1.1 Type: FENWAL or equivalent*

The 25°C value is 15000 Ohms

| Temperature | Résistance ohm | Résistance Tolerance ±% | Temperature | Résistance ohm | Résistance Tolerance ±% |
|---|---|---|---|---|---|
| -60 | 1342000 | 10,00 | 55 | 4923 | 1,03 |
| -55 | 957000 | 9,01 | 60 | 4160 | 1,03 |
| -50 | 690500 | 8,07 | 65 | 3531 | 1,04 |
| -45 | 503700 | 7,17 | 70 | 3009 | 1,05 |
| -40 | 371300 | 6,31 | 75 | 2576 | 1,04 |
| -35 | 276200 | 5,48 | 80 | 2213 | 1,03 |
| -30 | 207500 | 4,71 | 85 | 1908 | 1,04 |
| -25 | 157200 | 4,02 | 90 | 1652 | 1,05 |
| -20 | 120100 | 3,35 | 95 | 1434 | 1,03 |
| -15 | 92500 | 2,72 | 100 | 1250 | 1,02 |
| -10 | 71940 | 2,11 | 105 | 1094 | 1,02 |
| -5 | 56310 | 1,54 | 110 | 959,4 | 1,02 |
| 0 | 44420 | 1,00 | 115 | 844,3 | 1,03 |
| 5 | 35300 | 1,00 | 120 | 745,3 | 1,03 |
| 10 | 28230 | 1,01 | 125 | 659,8 | 1,02 |
| 15 | 22730 | 1,03 | 130 | 585,9 | 1,02 |
| 20 | 18410 | 1,84 | 135 | 521,7 | 1,02 |
| **25** | **15000** | **1,02** | 140 | 465,5 | 1,02 |
| 30 | 12300 | 1,02 | 145 | 416,7 | 1,02 |
| 35 | 10130 | 1,03 | 150 | 373,6 | 1,01 |
| 40 | 8397 | 1,03 | 155 | 335,7 | 1,01 |
| 45 | 6995 | 1,03 | 160 | 302,4 | 1,00 |
| 50 | 5855 | 1,03 | | | |

**Table 17: FENWAL thermistors characteristics**

*6.3.6.1.2 Type: BETATHERM or equivalent*

The 25°C value is 15000 Ohms

| Temperature | Résistance ohm | Résistance Tolerance ±% |
|---|---|---|
| -60 | 1342000 | 10,00 |
| -40 | 371300 | 6,30 |
| -20 | 120100 | 3,35 |
| 0 | 44420 | 1,00 |
| **25** | **15000** | **1,01** |
| 50 | 5855 | 1,03 |
| 70 | 3009 | 1,05 |
| 100 | 1250 | 1,02 |
| 125 | 659,8 | 2,00 |
| 140 | 465,5 | 3,00 |
| 160 | 302,4 | 4,00 |

**Table 18: BETATHERM thermistors characteristics**

*6.3.6.1.3 Type : Gulton 34 TD 25 or equivalent*

The 25°C value is 4000 Ohms

Maximum ratings :

current : 29 mA (recommended nominal maximum operating current : 1 mA)

power : 0.1 W at 25°C

- Old version

| Temperature | Résistance K. ohm | Résistance Tolerance ±% | Temperature | Résistance K.ohm | Résistance Tolerance ±% |
|---|---|---|---|---|---|
| -55 | 408,34 | 3,3 | 45 | 1,7362 | 0,75 |
| -45 | 197,88 | 2,8 | 55 | 1,1814 | 0,73 |
| -35 | 100,81 | 2,3 | 65 | 0,8203 | 0,67 |
| -25 | 53,74 | 2,0 | 75 | 0,5805 | 1,0 |
| -15 | 29,85 | 1,6 | 85 | 0,4168 | 0,96 |
| -5 | 17,21 | 1,2 | 95 | 0,3055 | 0,91 |
| 5 | 10,269 | 1,0 | 105 | 0,2275 | 1,16 |
| 15 | 6,321 | 0,89 | 115 | 0,172 | 1,33 |
| **25** | **4** | 0,84 | 125 | 0,1317 | 1,53 |
| 35 | 2,608 | 0,81 | | | |

**Table 19: GULTON 34TD25 thermistor characteristics (Old Version)**

- New version

| Temperature | Résistance K. ohm | Résistance Tolerance ±% | Temperature | Résistance K.ohm | Résistance Tolerance ±% |
|---|---|---|---|---|---|
| -55 | 385,48 | 3,3 | 45 | 1,7476 | 0,75 |
| -45 | 188,80 | 2,8 | 55 | 1,1944 | 0,73 |
| -35 | 97,08 | 2,3 | 65 | 0,8332 | 0,67 |
| -25 | 52,16 | 2,0 | 75 | 0,5928 | 1,0 |
| -15 | 29,18 | 1,6 | 85 | 0,4288 | 0,96 |
| -5 | 16,928 | 1,2 | 95 | 0,3154 | 0,91 |
| 5 | 10,156 | 1,0 | 105 | 0,23544 | 1,16 |
| 15 | 6,284 | 0,89 | 115 | 0,17808 | 1,33 |
| **25** | **4** | 0,84 | 125 | 0,13668 | 1,53 |
| 35 | 2,6128 | 0,81 | | | |

**Table 20: GULTON 34TD25 thermistor characteristics (New Version)**

### *6.3.6.1.4 Type : ROSEMOUNT 118MF Platinum resistance*

The 118 MF type are Platinum Thermistors.

The model « 2000 ohms at 0°C » shall be considered.

Maximum ratings :

current : 10 mA (recommended nominal maximum operating current : 1 mA)

power : 0.1 W at 25°C

| Temperature | Résistance K. ohm | Résistance Tolerance ±% | Temperature | Résistance K.ohm | Résistance Tolerance ±% |
|---|---|---|---|---|---|
| -200 | 343,69 | 3,4 | 140 | 3085,2 | 2,0 |
| -160 | 689,2 | 2,6 | 180 | 3386,9 | 2,0 |
| -120 | 1026,44 | 2,3 | 220 | 3684,9 | 2,0 |
| -80 | 1356,2 | 2,0 | 260 | 3979,2 | 2,0 |
| -40 | 1680,2 | 2,0 | 300 | 4269,6 | 2,0 |
| **0** | **2000** | 2,0 | 340 | 4556,8 | 2,0 |
| 40 | 2314,7 | 2,0 | 380 | 4812 | 2,0 |
| 80 | 2625,7 | 2,0 | 400 | 4980 | 2,0 |
| 100 | 2779,8 | 2,0 | | | |

**Table 21: ROSEMOUNT 118MF Platinum thermistor characteristics**

#### *6.3.6.1.5 Thruster thermistor(PT200)*

The PT200 type are Platinum Thermistors.

The model « 200 ohms at 0°C » shall be considered.

Maximum ratings :

current : 10mA

power : 0.1W

| Temperature(°C) | resistance (ohms) | Resistance tolerance (%) | temperature(°C) | resistance (ohms) | Resistance tolerance (%) |
|---|---|---|---|---|---|
| -200 | 37,04 | 3,4 | 80 | 261,79 | 2 |
| -180 | 54,19 | 2,9 | 100 | 277,01 | 2 |
| -160 | 71,09 | 2,6 | 140 | 307,17 | 2 |
| -140 | 87.75 | 2,3 | 180 | 336,96 | 2 |
| -120 | 104.22 | 2,3 | 220 | 366,38 | 2 |
| -100 | 120.51 | 2 | 260 | 395,42 | 2 |
| -80 | 136,65 | 2 | 300 | 424,1 | 2 |
| -60 | 152,66 | 2 | 340 | 452,41 | 2 |
| -40 | 168,54 | 2 | 380 | 480,35 | 2 |
| -20 | 184,32 | 2 | 400 | 494,18 | 2 |
| 0 | 200 | 2 | 440 | 521,57 | 2 |
| 20 | 215,59 | 2 | 480 | 548,59 | 2 |
| 40 | 231,08 | 2 | 520 | 575,23 | 2 |
| 60 | 246,48 | 2 | | | |

**Table 22: PT200 thermistor characteristics**

### 6.3.6.2 Thermistors channel telemetry characteristics

# Reference **SB4-SAT-AD1-P4-REQ-601**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

| Code | PARAMETERS | SOURCE SIDE (TH) | USER SIDE (DHP) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | differential balanced lines | | |
| Req-2 | Input type | | Single ended | |
| **B** | ***POWER*** | | | |
| Req-1 | Maximum operating power | | < 5mW | |
| **C** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | from secondary ground (0Vs) | isolated (≥ 10 MΩ) | grounded | |

**Table 23: Thermistor telemetry characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-592**

**[FC Applicability:** AIT, ANTRACK, AOCS, DATAM, MECHANISMS, PAYLOAD, POWER, PROP, TCR, THERMAL, ANTENNA**]**

For an equipment all thermistor telemetry return shall be insulated from all other thermistor telemetry return.

# *

## 6.4 UMBILICAL INTERFACE

### *6.4.1 Umbilical definition*

Proper telemetry and telecommand PCM signals shall be routed to the umbilical connector from Command Control sub-system.

These signals are :

- two separate inputs for TC
- two separate outputs for TM

# Reference **SB4-SAT-AD1-P4-REQ-593**

**[FC Applicability:** AIT, DATAM, HARNESS, POWER, PROP**]**

The current of all umbilical lines which cannot be switched off at the power source (at EGSE level or S/C level), shall be limited to 5mA (short circuit current value), during and after filling operations.

# *

# Reference **SB4-SAT-AD1-P4-REQ-620**

**[FC Applicability:** AIT, DATAM, HARNESS, POWER, PROP**]**

Current through umbilical connectors during lift-off shall be lower than:
- 100 mA, and
- Voltage lower than 85V, and
- Maximum power limitation of 2W.

# *

### *6.4.2 Umbilical TC requirements*

# Reference **SB4-SAT-AD1-P4-REQ-331 a**

**[FC Applicability:** AIT, DATAM, HARNESS, POWER, PROP**]**

The TC umbilical interface shall comply the TC transceivers interface characteristics.

# *

### *6.4.3 Umbilical TM requirements*

# Reference **SB4-SAT-AD1-P4-REQ-332 b**

**[FC Applicability:** AIT, DATAM, HARNESS, POWER, PROP**]**

The umbilical TM interface shall comply the TM video signal

# *

# Reference **SB4-SAT-AD1-P4-REQ-323 b**

**[FC Applicability:** AIT, DATAM, HARNESS, POWER, PROP**]**

The electrical characteristics of umbilical strap shall be as follows :

| Code | PARAMETERS | SOURCE SIDE | USER SIDE (strap) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Differential | | |
| Req-2 | Input type | | Single ended | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | Impedance open | ≥ 10 MΩ | ≤ 100 kΩ | separated |
| Req-2 | Impedance closed | ≤ 10 Ω | ≤ 100 KΩ | not separated |

**Table 24:Umbilical Strap Characteristics**

# *

## 6.5 SMU / Transceiver interfaces

### *6.5.1 SMU / Receiver interfaces*

# Reference **SB4-SAT-AD1-P4-REQ-583**

**[FC Applicability:** DATAM, TCR**]**

The interface between receiver and the SMU shall provide (form SBDL signal): Squelch, Clock, Lock Status and Data signals.

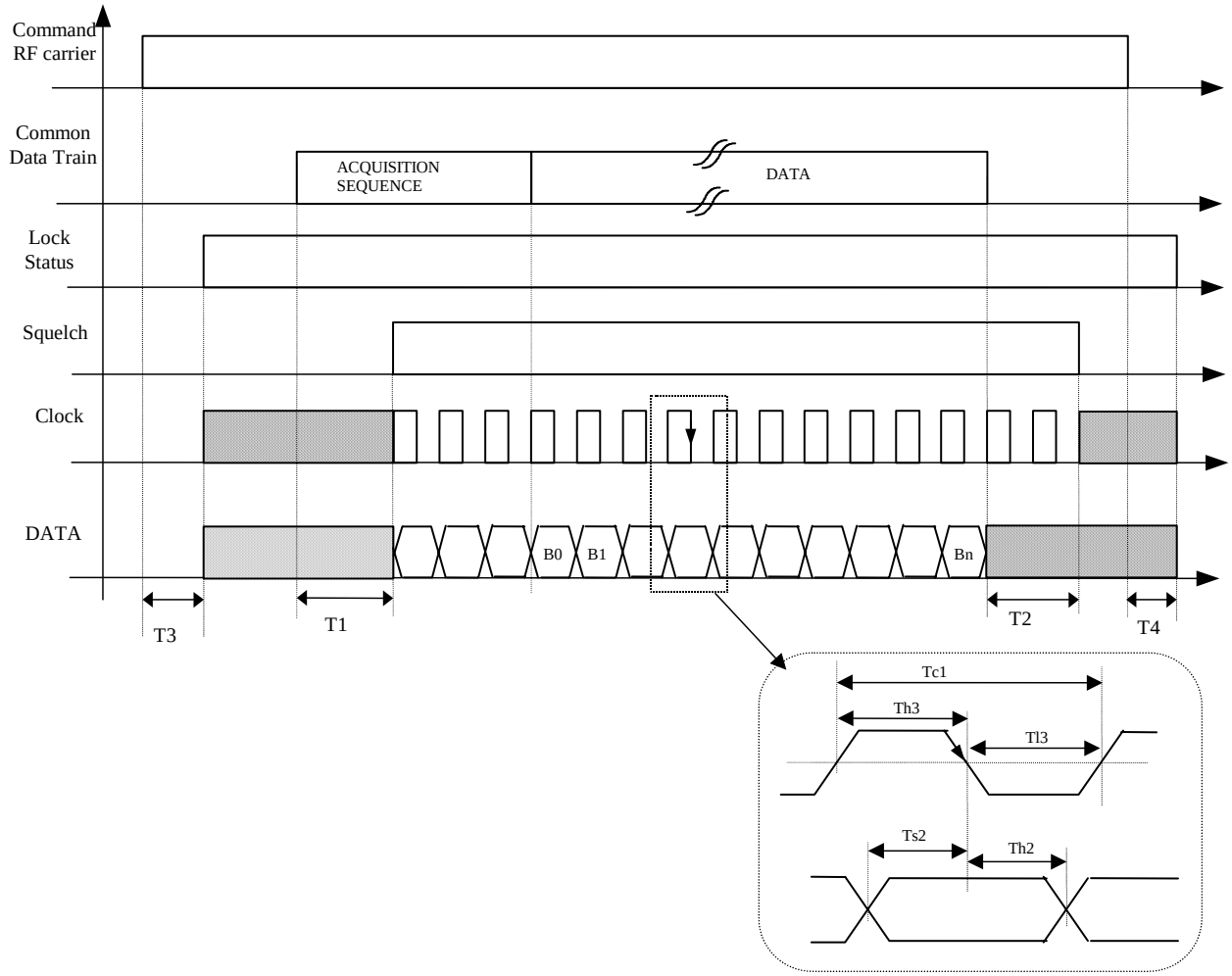



**Figure 11: Signals between receiver and SMU.**

T1 : *≤168 bits duration*

*1 bit duration ≤T2 ≤128 bits duration*

T3 & T4 *≤100ms*

Tc1 (Bit clock period) = 1 Bit rate +/-5%

Th3 (TC bit clock high level duration at 50% edge) : ≥60*µs*

Tl3 (TC bit clock low level duration at 50% edge) : ≥60*µs*

Ts2 (Set-up time from NRZ DATA bit stable to clock falling edge (sampling edge)) : ≥10*µs*

Th2 (Hold time from clock falling edge to NRZ DATA bit change) : ≥20*µs*

The above described interface is used to transmit from the receiver to the SMU the following signal : SQUELCH , CLOCK , DATA

# *

# Reference **SB4-SAT-AD1-P4-REQ-584**

**[FC Applicability:** DATAM, TCR**]**

The receiver bit clock shall be running as soon as Lock Status is 'high'.

# *

# Reference **SB4-SAT-AD1-P4-REQ-326 b**

**[FC Applicability:** DATAM, TCR**]**

Data Validation shall be performed on the falling edge of the clock signal.

# *

# Reference **SB4-SAT-AD1-P4-REQ-327 a**

**[FC Applicability:** DATAM, TCR**]**

The bit clock stability shall be better than +/- 5% as soon as SQUELCH is high and until SQUELCH falls to low.

# *

### *6.5.2 SMU / Transmitter interfaces*

# Reference **SB4-SAT-AD1-P4-REQ-330 c**

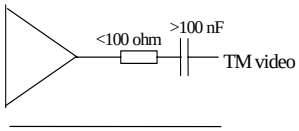
**[FC Applicability:** DATAM, TCR**]**

The TM video signals shall comply with the following characteristics :

| Code | PARAMETERS | Transmitter side SMU | Receiver side | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | single ended | | |
| Req-2 | Input type | | differential | |
| Req-3 | Type of Modulation | BPSK | BPSK | |
| Req-4 | Waveform | Filtered quasi sine wave | Filtered quasi sine wave | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | output AC voltage | 3V ± 5.7% peak to peak | | |
| Req-2 | DC Fault Voltage Emission | -1V<U<10V | ±17V in series with >2kΩ | |
| Req-3 | DC Fault Voltage Tolerance | ±17V in series with >2kΩ | -1V<U<10V | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | output impedance **(1)** | < 100Ω in series with > 100nF | | |
| Req-2 | input impedance | | >10kΩ// <500pF | |
| **D** | ***SPECIFIC REQUIREMENT*** | | | |
| Req-1 | TM sub-carrier frequency | 65536 Hz | 65536 Hz | upgrade : 32768Hz |
| Req-2 | TM sub-carrier frequency stability | $\pm 10^{-4}$ | | |
| Req-3 | TM bit rate | 4096 bit/s or 8192 bit/s | 4096 bit/s or 8192 bit/s | |
| Req-4 | Phase plot accuracy | ± 2° | | Difference between theoretical and real phase |
| Req-5 | group delay variations | < 1μs peak to peak | | |
| Req-6 | Amplitude distortion | <1 dB peak to peak | | |
| Req-7 | signal to noise ratio | 65 dBHz | | |

| Code | PARAMETERS | Transmitter side SMU | Receiver side | COMMENT |
|---|---|---|---|---|
| Req-8 | Spurious and Harmonics | • **<-20dBc** : 0<f<220kHz<br>• **<-60dBc :** f>220kHz<br>32768Hz +/-8kHz<br>65536 Hz +/- 8kHz<br>[15kHz ;30kHz]<br>100kHz +/-1kHz | N/A<br>N/A | With respect to TM sub carrier levels<br>TM signal bandwidth<br>TM signal bandwidth<br>Ranging signals bandwidth<br>Ranging signals bandwidth |
| Req-9 | phase step response accuracy | ± 5% **(2)** | | |
| **E** | ***FAIL SAFE PROTECTION*** | | | |
| Req-1 | protection | short circuit proof | | |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | From secondary ground 0Vs | Grounded | Galvanic isolation | |
| Req-2 | From primary ground | Isolation ≥ 1MΩ | Isolation ≥ 1MΩ | |
| Req-3 | From chassis | Grounded | Isolation ≥ 1MΩ | |

**(1)**




**(2)** At all times, for more than 25% of a sub-carrier period after a phase reversal, the phase of the modulated sub-carrier shall be within ±5% of a perfect signal.

**Table 25: TM Video Signal Characteristics.**

# *

### *6.5.3 SMU / Ciphering*

# Reference **SB4-SAT-AD1-P4-REQ-635**

**[FC Applicability:** DATAM**]**

The SMU digital TM output channel shall provide a 3 signals interface composed of:
- TM_VAL-FRAME: indicates output data is valid
- TM_DATA: serial data stream
- TM_OUT-CLOCK: output synchronised clock

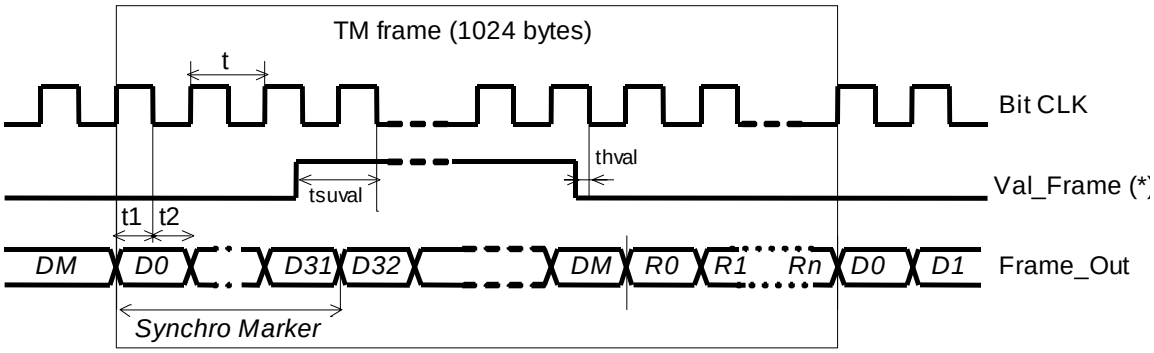
# *

# Reference **SB4-SAT-AD1-P4-REQ-634**

**[FC Applicability:** DATAM**]**

The SMU digital TM output signals shall be compliant with chronograms given hereafter :

The SMU digital TM output signals shall be compliant with chronograms given hereafter :




t : bit duration = 244 µsec typ
t1= 0,25 t
t2= 0,25 t

$t \leq tsuval \leq t+100ns$

$-100\ ns \leq thval \leq 0ns$

(*) At user's interface, Val_Frame signal shall be half period shifted in order to be synchronised with data.

The Val_Frame signal shall be activated on the last bit of the TM Synchro Marker and shall be deactivated on the last bit of the Trailer Frame (DM).

**Table 26: SMU digital TM output characteristics.**

# *

## 6.6 Alarm signal

### *6.6.1 Alarm signal characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-334 d**

**[FC Applicability:** AOCS, DATAM, PROP**]**

The Alarm signal interface shall comply the SBDL electrical characteristics for: STARTRACKER, IRES, AOCSP, PROP .

# *

# Reference **SB4-SAT-AD1-P4-REQ-335 b**

**[FC Applicability:** AOCS, DATAM, PROP**]**

Requirements **B Req-7** to **B Req-1**, from Table 9**:** SBDL Characteristics (SB4-SAT-AD1-P4-REQ-243), are not applicable to SBDL alarm signals. The fault voltage emission and tolerance shall be ±7V.

# *

# Reference **SB4-SAT-AD1-P4-REQ-585**

**[FC Applicability:** AOCS, DATAM, PROP**]**

Alarm signals shall be processed by the SMU.

# *

## 6.7 Synchronisation signals

The SMU provides three synchronisation signal:

- 1Hz: Distributed to PROP Pcb.
- 10Hz: Distributed to PROP Pcb, AOCSP Pcb and STR.
- 1000Hz: Distributed to PROP.

Each signal is redunded.

The 1 Hz signal period accuracy is better than 1s ±1$\mu$s by period.

10Hz, 1Hz clock rising transition is synchronous to 1000 Hz rising clock transitions.

# Reference **SB4-SAT-AD1-P4-REQ-343 c**

**[FC Applicability:** AOCS, DATAM, PROP**]**

The synchronisation signals shall use the RS485 standard.

# *

# Reference **SB4-SAT-AD1-P4-REQ-344 b**

**[FC Applicability:** AOCS, DATAM, PROP**]**

Any failure on the Nominal or (-exclusive) Redundant source signals shall not affect the operational capability of the user unit.

# *

# Reference **SB4-SAT-AD1-P4-REQ-345 c**

**[FC Applicability:** AOCS, DATAM, PROP**]**

The electrical characteristics are defined in the Chapter "SBDL electrical characteristics". Requirements **B Req-7** to **B Req-10**, and **F** (Req-1 and Req-2) from **Table 9** (SB4-SAT-AD1-P4-REQ-243) are not applicable to synchronisation signals.

# *

# Reference **SB4-SAT-AD1-P4-REQ-612**

**[FC Applicability:** AOCS, DATAM, PROP**]**

The fault voltage emission and tolerance shall be ±7V.

# *

# Reference **SB4-SAT-AD1-P4-REQ-348 b**

**[FC Applicability:** AOCS, DATAM, PROP**]**

The rise and fall time shall be : 100 ns<t<500ns.

# *

## 6.8 Propulsion interfaces

Pull-in voltage is the voltage required to open the valve and maintain it in its last commanded position.
Holding voltage is the voltage required to maintain opened valve.
Drop-out voltage is the voltage required at which valve resume its initial position.

### *6.8.1 ABM valves*

# Reference **SB4-SAT-AD1-P4-REQ-356 c**

**[FC Applicability:** DATAM, PROP**]**

The ABM valve interface shall comply with the following characteristics :

| Code | PARAMETERS | USER SIDE ABM | COMMENT |
|---|---|---|---|
| **A** | ***TYPE*** | | |
| Req-1 | Input type | differential 2 coil in series | |
| **B** | ***VOLTAGE*** | | |
| Req-1 | Pull-in Voltage | ≤ 40 V | For two coils in series |
| Req-2 | Drop-out Voltage | ≥ 3 V | For two coils in series |
| Req-3 | Holding Voltage | ≤ 15 V | For two coils in series |
| Req-4 | Fault voltage tolerance | 54V | 2 coil in series |
| **D** | ***TIME*** | | |
| Req-1 | Opening response time | ≤30ms | At 21°C, 21 V |
| Req-2 | Closing response time | ≤30ms | |
| | ***IMPEDANCE*** | | |
| Req-1 | Coil Inductance | ≤900mH | at 21°C |
| Req-2 | Coil Resistance | 16,6 Ω<R<28.7 Ω | including temperature range |
| **F** | ***GROUNDING AND ISOLATION*** | | |
| Req-1 | Insulation resistance to from chassis | >100 MΩ | |

**Table 27: ABM Interface Characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-594**

**[FC Applicability:** DATAM, PROP**]**

The PROP interface (source side) shall comply with the following characteristics:

| Code | PARAMETERS | SOURCE SIDE PROP | COMMENT |
|---|---|---|---|
| **A** | ***TYPE*** | | |
| Req-1 | Output type | Single ended | |
| **B** | ***VOLTAGE*** | | |
| Req-1 | Pull-in Voltage (V1 & V2)) | 46V < V < 53V | V1 & V2: Refer to figure below |
| Req-2 | Holding Voltage (V3 & V4) | 20V < V < 53V | V3 & V4: Refer to figure below |
| Req-3 | Drop-out Voltage (V5) | < 1V | V5: Refer to figure below |
| Req-4 | Fault voltage emission | < 53V | |
| **D** | ***TIME*** | | |
| Req-1 | Pull in pulse duration (t1) | 100ms -25ms/+5ms | At 80% of max. pull in voltage<br>t1: Refer to figure below |
| Req-2 | Holding pulse duration (t2) | ≥ 1 min. | t2: Refer to figure below |
| **F** | ***GROUNDING AND ISOLATION*** | | |
| Req-1 | Insulation resistance to from chassis | >1 MΩ under 50V max. | |

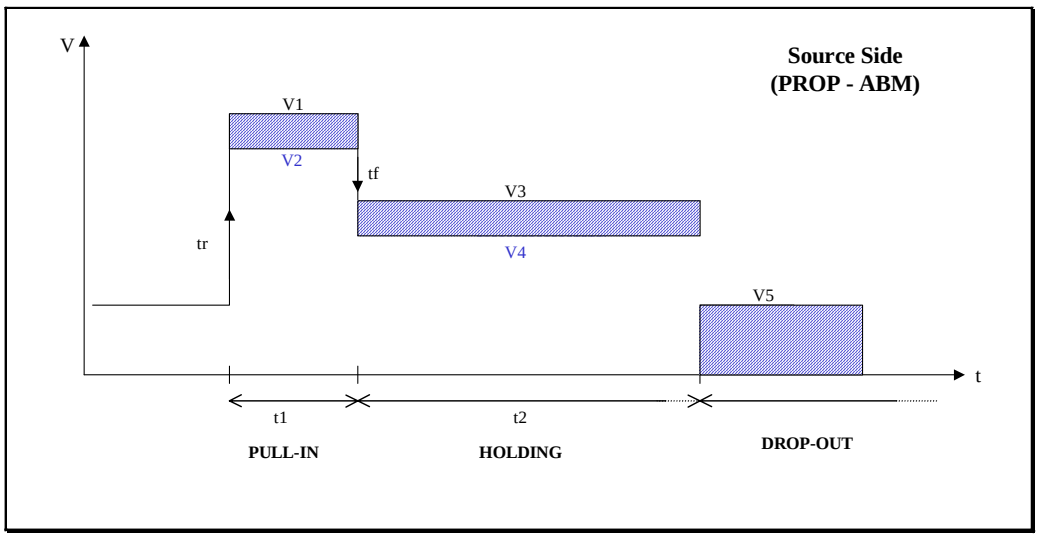



**Table 28: PROP-ABM Interface Characteristics**

### *6.8.2 Thruster Bi-stable valves*

The bi-stable commands functioning are equivalent to command matrix functioning.

Electrical characteristics are different .

Pull-out voltage is the minimum voltage required to close the valve and maintain it in its last commanded position.

# Reference **SB4-SAT-AD1-P4-REQ-357 d**

**[FC Applicability:** DATAM, PROP**]**

The Bistable valve interface shall comply with the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (PROP) | USER SIDE Bi-stable Valve | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Single ended | | |
| Req-2 | Input type | | differential | bistable |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Pull-in Voltage | 33,5 V< V< 42 V | ≤ 32V | |
| Req-2 | Pull-out Voltage | 33,5 V< V< 42 V | ≤ 32V | |
| Req-3 | Fault voltage emission | 55V (55ms) | | |
| Req-4 | Fault voltage tolerance | | 55V (55ms) | |
| **D** | ***TIME*** | | | |
| Req-1 | Opening/closing response time | | <15ms | 50V at 21°C |
| Req-2 | Voltage Pulse duration | 55±5ms | | @50% of max pulse amplitude |
| Req-3 | Rise/fall time | < 5ms | | |
| **E** | ***IMPEDANCE*** | | | |
| Req-1 | Coil Inductance | | ≤ 1 H | at 21°C |
| Req-2 | Coil Resistance | | 260 Ω<R<485 Ω | including temperature range |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to from chassis | | >100 MΩ | at 20°C |

**Table 29: Bi-Stable Valve characteristics**

# *

### 6.8.3 PPS Bi-stable valves

# Reference **SB4-SAT-AD1-P4-REQ-358 c**

**[FC Applicability:** DATAM, PROP**]**

The PPS valve interface shall comply with the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (PROP) | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Single ended | | |
| Req-2 | Input type | | Differential | bistable |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage Range | 31V<Vn<51V | 30V to 51V | |
| Req-2 | Fault voltage Tolerance | | 55V | |
| Req-3 | Fault voltage Emission | <55 | | |
| **C** | ***POWER*** | | | |
| Req-1 | Power consumption | | 42W | 50V & 21°C |
| Req-2 | Current | | 0.82A | |
| **D** | ***TIME*** | | | |
| Req-1 | Opening/closing response time | >50ms | <50ms | 50V & 21°C |
| **E** | ***IMPEDANCE*** | | | |
| Req-1 | Coil Inductance | | ≤ 250mH | 1kHz |
| Req-2 | Coil Resistance | | 47Ω <R<75 Ω | including temperature range |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to from chassis | | 100 MΩ | 500VDC |

**Table 30: PPS Valve characteristics**

# *

### *6.8.4 Thruster Mono-Stable Valves*

# Reference **SB4-SAT-AD1-P4-REQ-359 b**

**[FC Applicability:** DATAM, PROP**]**

The mono-stable valve command shall be pulse type, with a 1ms resolution on pulse duration and on pulse start.
The mon-stable command shall operate simultaneously up to 8 valves continuously.

# *

# Reference **SB4-SAT-AD1-P4-REQ-360 a**

**[FC Applicability:** DATAM, PROP**]**

Each command generated by the function shall be read back to generate a mono-stables status .

# *

# Reference **SB4-SAT-AD1-P4-REQ-361 a**

**[FC Applicability:** DATAM, PROP**]**

The On time of the mono-stables shall last from 1 ms to hours with repetition frequency of 33Hz.

# *

# Reference **SB4-SAT-AD1-P4-REQ-362 d**

**[FC Applicability:** DATAM, PROP**]**

The Mono-stable valve interface shall comply with the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (PROP) | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | single ended | | |
| Req-2 | Input type | | differential | monostables |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Pull-in Voltage | 36 V< V<42 V | ≤ 25V | |
| Req-2 | Drop-out Voltage | <1V | ≥ 2V | |
| Req-3 | Fault voltage emission | 55V (50ms) | | |
| Req-4 | Fault voltage tolerance | | 55V (30s) | |
| **D** | ***TIME*** | | | |
| Req-1 | Opening/closing response time | | < 2.8 ms | 50V at 45°C |
| Req-2 | Voltage Rise time + switch ON delay | <150$\mu$s | | On 190 Ω MSV load |
| Req-3 | Voltage Fall time + switch OFF delay | <300$\mu$s | | On 478 Ω MSV load |
| **E** | ***IMPEDANCE*** | | | |
| Req-1 | Coil Inductance | | < 1H | at 21°C |
| Req-2 | Coil Resistance | | 190 Ω<R<478 Ω | including temperature range |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to from chassis | | >100 MΩ | at 20°C |

**Table 31: Mono-Stable Valves characteristics**

# *

### *6.8.5 Pressure Transducer*

6.8.5.1 Standard pressure transducer

*6.8.5.1.1 Standard pressure transducer supply characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-363 c**

**[FC Applicability:** DATAM, PROP**]**

The standard pressure transducer supply interface shall comply with the following characteristics:

| Code | PARAMETERS | SOURCE SIDE (PROP) | USER SIDE (SAPT) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | single ended | | |
| Req-2 | Input type | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage Range | 26.5 >Vop> 28.5V | 26 to 28.5V | |
| Req-2 | Fault voltage emission | <30V | | |
| Req-3 | Fault voltage tolerance | | ≥30V | |
| **C** | ***CURRENT*** | | | |
| Req-1 | Inrush Current | | 200 mA max, 4ms | 100 A/s max |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | Input impedance | | >1.4 kΩ | 10 m of 26 AWG between PROP and Pressure transducer<br>Input current range: 16 to 20mA |
| **E** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance from chassis | | >100 MΩ | 50V |
| **F** | ***TIME*** | | | |
| Req-1 | Time between Power On application and TM data availability | NA | < 1s | |
| Req-2 | Power OFF step response | NA | < 20s | |

**Table 32: Standard Pressure Transducer Input Characteristics.**

# *

### *6.8.5.1.2 Standard pressure transducer telemetry characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-364 c**

**[FC Applicability:** DATAM, PROP**]**

The standard pressure transducer telemetry interface shall comply the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (SAPT) | USER SIDE (PROP) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | Differential | | |
| Req-2 | Input type | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Voltage Range | 0 V/ 5V | | Output noise : 20mVpp (20MHz bandwidth) |
| Req-2 | Output voltage OFFSET | ± 5mV | | |
| Req-3 | Fault Voltage Emission | U<15V | ± 15 V Ω (Rs > 47,5 KΩ) | |
| Req-4 | Fault Voltage Tolerance | ± 15 V (Rs > 47,5 KΩ) | -1.5V<U<15V | |
| **C** | ***CURRENT*** | | | |
| Req-1 | short circuit current | <30mA | | |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | ON impedance | < 100 Ω | ≥ 1 MΩ | |
| Req-2 | OFF impedance | < 20 KΩ | ≥ 1 MΩ | |
| **E** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | From supply ground | > 10 MΩ | ≥ 1 MΩ | |
| Req-2 | Chassis | ≥ 10 MΩ | ≥ 1 MΩ | |

**Table 33: Standard Pressure Transducer Telemetry Characteristics.**

# *

6.8.5.2 High Accuracy Pressure Transducer :

*6.8.5.2.1 High accuracy pressure transducer supply characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-365 c**

**[FC Applicability:** DATAM, PROP**]**

The high accuracy pressure transducer supply interface shall comply with the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (PROP) | USER SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Input type | | Differential | |
| Req-2 | Output type | Single ended | | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage Range | 11V +/-5 % | 9V < V < 12V | |
| Req-2 | Fault voltage emission | <16V | | |
| Req-3 | Fault voltage tolerance | | ≥ 16V | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Input resistance | | ≥ 800 Ω | |
| **D** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to from chassis | | >20MΩ (50V) 100nF | |

**Table 34: High Accuracy Pressure Transducer Input Characteristics.**

# *

### *6.8.5.2.2 High accuracy pressure transducer telemetry characteristics*

# Reference **SB4-SAT-AD1-P4-REQ-366 b**

**[FC Applicability:** DATAM, PROP**]**

The high accuracy pressure transducer telemetry interface shall comply the following characteristics :

| Code | PARAMETERS | SOURCE SIDE | USER SIDE (PROP) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output type | single ended | | square wave AC coupled |
| Req-2 | Input | | Differential | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | High level | 4.5 V < V < 5.5V | | |
| Req-2 | Low level | 0 V < V < 0.5V | | |
| **D** | ***IMPEDANCE*** | | | |
| Req-1 | Output Impedance | <2 KΩ | | |
| Req-2 | Input Impedance | | > 5kΩ | |
| **E** | ***TIME*** | | | |
| Req-1 | Pressure frequency range | 2 to 50 kHz | | |
| Req-2 | Temperature frequency range | 2 to 200 kHz | | |
| **F** | ***GROUNDING AND ISOLATION*** | | | |
| Req-3 | From chassis | >20MΩ (50V) // 100nF | ≥ 1 MΩ // <50nF | |

**Table 35: High Accuracy Pressure Transducer Telemetry Characteristics.**

# *

## 6.9 Heaters characteristics

# Reference **SB4-SAT-AD1-P4-REQ-602**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, STRUCTURE, THERMAL, ANTENNA**]**

| Code | PARAMETERS | SOURCE SIDE (HEATER) | USER SIDE (DHP) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Differential | | |
| **B** | ***POWER*** | | | |
| Req-1 | 120W heater Maximum power | 120W | 120W | Tolerance:+0/-10% |
| Req-2 | 80 W heater Maximum power | 80W | 80W | Tolerance: ± 10% |
| Req-3 | 60 W heater Maximum power | 60W | 60W | Tolerance: ± 10% |
| Req-4 | 40 W heater Maximum power | 40W | 40W | Tolerance: ± 10% |
| Req-5 | 30 W heater Maximum power | 30W | 30W | Tolerance: ± 10% |
| Req-6 | 15 W heater Maximum power | 15W | 15W | Tolerance: ± 10% |
| Req-7 | 7 W heater Maximum power | 7W | 7W | Tolerance: ± 10% |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Max capacitance | <5nF | | |
| Req-2 | Max inductance | 5 $\mu$H | | +7$\mu$H Harness : twisted pair:AWG 24 or 26 |
| Req-3 | Max resistance | **(1)** | | Up to 200Ω/cm$^2$ |
| **D** | ***GROUNDING AND ISOLATION*** | | | |
| Req-1 | from Primary Ground | / | connected | |
| Req-2 | from chassis | >100 MΩ | ≥ 1 MΩ // ≤ 50 nF | |

**(1)** The maximum resistance is defined by the heater power.

**Table 36: Heater interface characteristics**

# *

## 6.10 Deployment, Full Step, Sinus Cosinus motors Interfaces

### *6.10.1 Bi and three phases steppers interface characteristics*

6.10.1.1 BAPTA / SADM motor interfaces

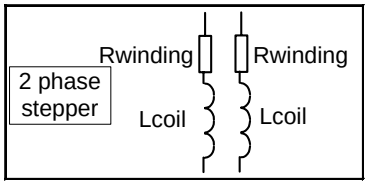
# Reference **SB4-SAT-AD1-P4-REQ-368 b**

**[FC Applicability:** DATAM, POWER**]**

The BAPTA interfaces shall comply with the following characteristics :

| Code | PARAMETERS | BAPTA MOTOR | SADP Pcb | COMMENT |
|---|---|---|---|---|
| **A** | ***CURRENT*** | | | |
| Req-1 | Current | I<200mA | 200mA ± 20mA | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | 2 phase winding resistance | 60Ω<Rwinding<115Ω | | Including temperature range |
| Req-2 | typical 2 phase winding inductance | L coil=200mH ± 20% | | Including temperature range |
| Req-3 | Driver OFF impedance | | > 1KΩ | Only in case of switched current in winding. Not applicable to quasi-static (DC) current source |
| **C** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance between windings | >50 MΩ | | Measured under 100 Vmin |
| Req-2 | Insulation resistance : Winding/case | >50 MΩ | | Measured under 100 Vmin |

**Table 37: BAPTA interfaces**




For information, the 2 phase winding resistance at ambient temperature(25°C) is :

88Ω<Rwinding<91Ω

# *

# Reference **SB4-SAT-AD1-P4-REQ-607**

**[FC Applicability:** DATAM, POWER**]**

The SADM interfaces shall comply with the following characteristics:

| Code | PARAMETERS | SADM MOTOR | SADP Pcb | COMMENT |
|---|---|---|---|---|
| **A** | ***CURRENT*** | | | |
| Req-1 | Current | I<300mA | 300mA ± 30mA | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | 2 phase winding resistance | 26Ω < R < 77Ω | | Including temperature range |
| Req-2 | typical 2 phase winding inductance | L coil=170mH ± 20% | | Including temperature range |
| Req-3 | Driver OFF impedance | | > 1KΩ | Only in case of switched current in winding. Not applicable to quasi-static (DC) current source |
| **C** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance between windings | >50 MΩ | | Measured under 100 Vmin |
| Req-2 | Insulation resistance : Winding/structure | >50 MΩ | | Measured under 100 Vmin |

**Table 38: SADM Motor interfaces**

# *

### 6.10.1.2 Antenna pointing motor interfaces

# Reference **SB4-SAT-AD1-P4-REQ-369 b**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, ANTENNA**]**

The antenna pointing interfaces (motor and Pcb) for a **3 phases rotary actuator** shall comply with the following characteristics :

| Code | PARAMETERS | Antenna pointing motor | Motor PCB (FSXP) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage range | 26V ±10% | 26V ±10% | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | 3 phase winding resistance | 40Ω < R < 120Ω | | Including temperature range |
| Req-2 | 3 phase winding inductance | L coil=20.4mH ± 20% | | Operating at 20°C |
| **C** | ***CURRENT*** | | | |
| Req-1 | Over current protection threshold | | > 700 mA | Operating at 20°C |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance between windings | >50 MΩ | | Measured under 200 Vmin |
| Req-2 | Insulation resistance : Winding/case | >50 MΩ | | Measured under 200 Vmin |

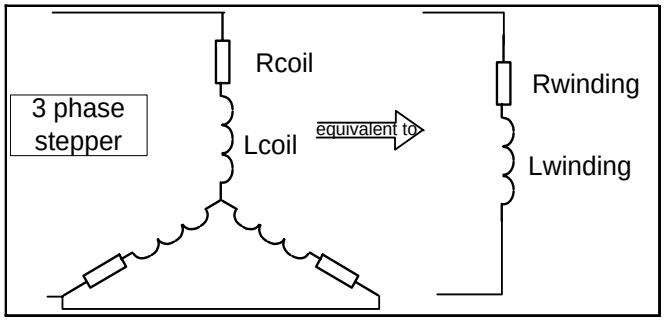



**Table 39: Antenna Pointing Motor (3phases RA) and PCB interfaces**

# *

# Reference **SB4-SAT-AD1-P4-REQ-625**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, ANTENNA**]**

The antenna pointing interfaces (motor and Pcb) for a **2 phases rotary actuator** shall comply with the following characteristics :

| Code | PARAMETERS | Antenna pointing motor | Motor PCB (FSXP) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage range | 26V ±10% | 26V ±10% | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | 2 phase winding resistance | Rwinding=76 Ω ± 10% | | Operating at 20°C |
| Req-2 | 2 phase winding inductance | L coil=150mH ± 30% | | Operating at 20°C |
| **C** | ***CURRENT*** | | | |
| Req-1 | Over current protection threshold | | > 700 mA | Operating at 20°C |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance between windings | >50 MΩ | | Measured under 200 Vmin |
| Req-2 | Insulation resistance : Winding/case | >50 MΩ | | Measured under 200 Vmin |

**Table 40 : Antenna Pointing Motor (2 phases RA) and PCB interfaces**

# *

### 6.10.1.3 Thruster orientation motor interfaces

# Reference **SB4-SAT-AD1-P4-REQ-370 b**

**[FC Applicability:** DATAM, PROP**]**

The thruster orientation interfaces (motor and Pcb) shall comply with the following characteristics :

| Code | PARAMETERS | Thruster Orientation Motor | Motor PCB (FSXP) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage range | 26V ±10% | 26V ±10% | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | 3 phase winding resistance | 60Ω<Rwinding<120Ω | | Including temperature range |
| Req-2 | 3 phase winding inductance | L coil=200mH ± 20% | | Including temperature range |
| **C** | ***CURRENT*** | | | |
| Req-1 | Over current protection threshold | | > 700 mA | Operating at 20°C |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance between windings | >50 MΩ | | Measured under 200 Vmin |
| Req-2 | Insulation resistance : Winding/case | >50 MΩ | | Measured under 200 Vmin |

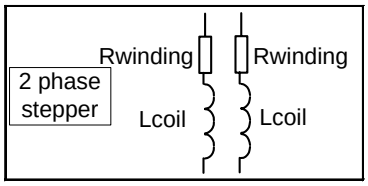



**Table 41: Thruster Orientation Motor and PCB interfaces**

# *

### *6.10.2 Brush motor interface*

Two types of Brush Motor can be used. The motor selected shall comply with one of the following requirements (depending on the Motor Pcb)

# Reference **SB4-SAT-AD1-P4-REQ-371 b**

**[FC Applicability:** DATAM, POWER**]**

The Brush motor interfaces (motor and Pcb (SADP)) shall comply with the following characteristics :

| Code | PARAMETERS | BRUSH MOTOR | MOTOR PCB (SADP) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Operating Voltage: generator mode | | <9.6 V | |
| Req-2 | Operating Voltage : motor mode | | 5.5V < V < 6.9V | |
| Req-3 | Overvoltage Tolerance | 9V ± 5% | 9V ± 5% | Motor mode |
| **B** | ***CURRENT*** | | | |
| Req-1 | Operating Current | | 220 mA< I <260 mA | |
| Req-2 | Fault Current Emission | \|I\| < 275 mA | I < 250 mA | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | winding resistance | 15 Ω ± 5 Ω | | Including temperature range |
| Req-2 | winding inductance | 1mH<L<4mH | | |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation Impedance : Winding/case | ≥ 10 MΩ | | |
| Req-2 | Insulation Impedance : Winding/: Winding | ≥ 1 MΩ | | |
| Req-3 | Capacitance: Winding/case | ≤ 10nF | | |

**Table 42: Brush motor and PCB (SADP) interfaces**

# *

# Reference **SB4-SAT-AD1-P4-REQ-609**

**[FC Applicability:** DATAM, POWER**]**

The Brush motor interfaces (motor and Pcb (S4DSAP)) shall comply with the following characteristics :

| Code | PARAMETERS | BRUSH MOTOR | MOTOR PCB (S4DSAP) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Over voltage emission | | 35 V * | * During less than 10 ms |
| Req-2 | Supply voltage | | 22 V < V < 29 V | |
| **B** | ***CURRENT*** | | | |
| Req-1 | Inrush Current | 2 A for up to 10 ms | | |
| Req-2 | Operating Current | | 200 mA | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Winding resistance | 38Ω ± 4Ω | | At room temperature |
| Req-2 | Winding inductance | 2mH<L<3mH | | |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation Impedance : Winding/case | ≥ 10 MΩ | | |
| Req-2 | Insulation Impedance : Winding/Winding | ≥ 1 MΩ | | |
| Req-3 | Capacitance: Winding/case | ≤ 10nF | | |

**Table 43: Brush motor and PCB (S4DSAP) interfaces**

# *

### *6.10.3 Sensors Interfaces*

#### 6.10.3.1 Potentiometers Interfaces

# Reference **SB4-SAT-AD1-P4-REQ-372 c**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, POWER**]**

The potentiometers interfaces shall comply with the following characteristics (except for SADM motors):

| Code | PARAMETERS | SOURCE SIDE | USER SIDE (motor pcb) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Floating | | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | Resistance range | 5 kΩ<R< 22 kΩ | >3MΩ | |
| **C** | ***VOLTAGE*** | | | |
| Req-1 | Maximum voltage | 20 V | 20 V | |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance : leads | >100MΩ 100V | | |

**Table 44: Coarse and fine potentiometer characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-608**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, POWER**]**

The SADM potentiometers interfaces shall comply with following characteristics:

| Code | PARAMETERS | SOURCE SIDE | USER SIDE (SADP) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Floating | | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | Resistance range | 90 kΩ<R< 110 kΩ | >3MΩ | |
| **C** | ***VOLTAGE*** | | | |
| Req-1 | Maximum Voltage | 20 V | 20 V | |
| **D** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance : leads | >100MΩ 100V | | |

**Table 45: SADM Coarse potentiometer characteristics**

# *

### 6.10.3.2 Micro-switch Interface

DR single ended interface is applicable (See requirement SB4-SAT-AD1-P4-REQ-632)

### 6.10.3.3 Optical switch interface

# Reference **SB4-SAT-AD1-P4-REQ-377 c**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, POWER**]**

The FSMP and SADP Pcbs shall be able to supply and acquire optical switch in compliance with the following characteristics :

| ***Parameter*** | ***Value*** |
|---|---|
| Redundancy | cold redundancy |
| Power supply (Vs) | +5V (DC) ± 5% |
| Max. Consumption (Vs=5V) | 50 mA |
| Output interface | open collector (Compliant with DR Single ended acquisition: See SB4-SAT-AD1-P4-REQ-632) |
| Reference duration (tp) | >5ms |
| Switching time (td) | <100ms |

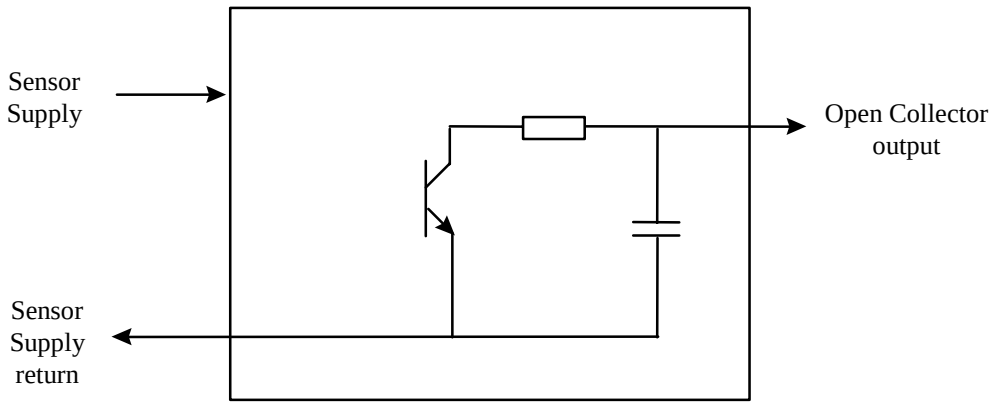


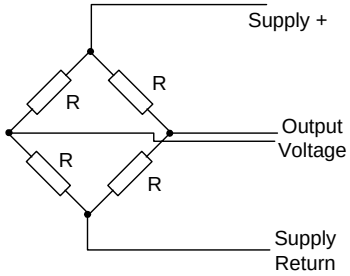

**Figure 12: Optical switch electrical interface**

# *

### 6.10.3.4 Strain gauge

Two types of strain gauge exists :

- one type for deployment
- two types for battery




#### *6.10.3.4.1 Deployment strain gauge*

# Reference **SB4-SAT-AD1-P4-REQ-380 c**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, POWER**]**

The deployment strain gauge interface shall comply with the following characteristics :

| Code | PARAMETERS | SOURCE SIDE (Strain gauge) | Pcb SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Floating | | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Supply voltage | | 13.6 ± 10% | between strain gauge and SDMP : 6m of #26 |
| Req-2 | Output voltage (differential mode) | -30mV<Vo<+30mV | | |
| Req-3 | Output voltage (common mode) | 6.8 ± 10% | | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | gauge impedance (R ) | 700 Ω or 350 Ω | | Wheaston bridge |

**Table 46: Deployment strain gauge characteristics**

# *

*6.10.3.4.2 Battery NiH2 Strain Gauge*

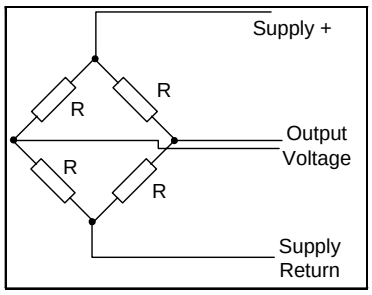



**Figure 13: Battery strain gauge type 1**

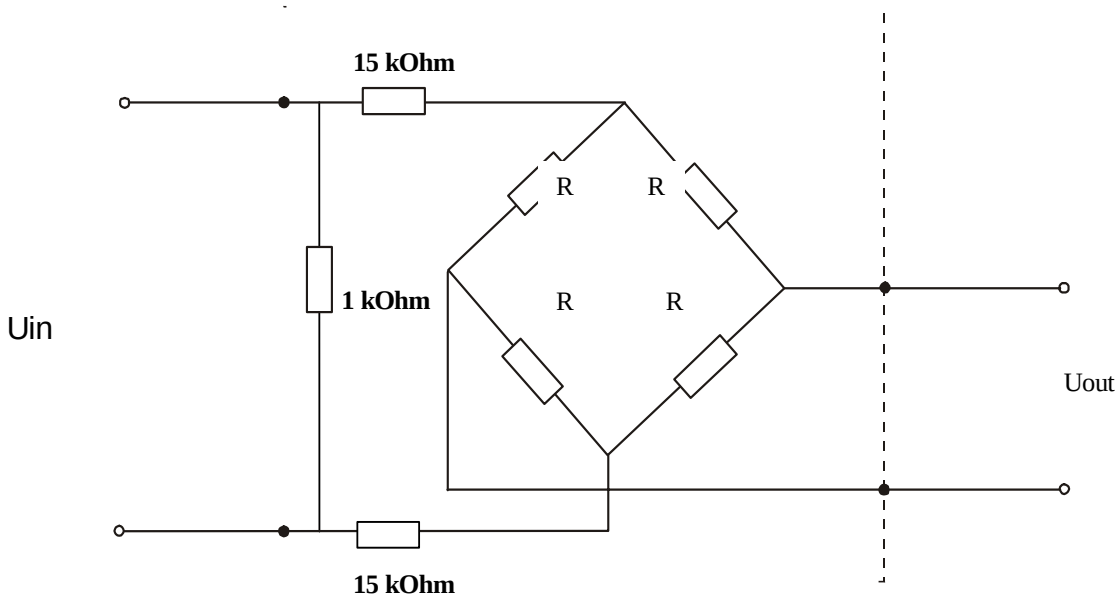



**Figure 14: Battery strain gauge type 2**

# Reference **SB4-SAT-AD1-P4-REQ-381 b**

**[FC Applicability:** ANTRACK, DATAM, MECHANISMS, POWER**]**

The battery strain gauge interface (type1 and type2) shall comply with the following characteristics :

| Code | PARAMETERS | Strain Gauge | Pcb SIDE | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | floating | | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Supply voltage | 10 V+/- 1% | 10V, +1%, -0.9% | between strain gauge and BMP : 8m of #26 |
| Req-2 | Output voltage | <+30mV | | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Gauge type1 impedance (R ) | 350 Ω or 1000 Ω ± 10% | | Wheaston bridge - See figure Type1<br>Including Temperature range |
| Req-2 | Gauge type2 impedance (R ) | 3000 Ω < R < 3500 Ω | | Wheaston bridge - See figure Type2<br>Including Temperature range |

**Table 47: Battery strain gauge characteristics**

# *

## 6.11 PYRO Interfaces

# Reference **SB4-SAT-AD1-P4-REQ-597**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

All inactive wires in connection with the EED circuits shall be grounded and static discharge resistors of 100 KΩ shall be connected from the wires of the EED to the satellite structure.

# *

# Reference **SB4-SAT-AD1-P4-REQ-598**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

Firing circuits between the power source and the EEDs shall be broken in both the positive and return lines at a safe/arm switch.

# *

# Reference **SB4-SAT-AD1-P4-REQ-599**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

The PYRO interfaces (EED / PYPGP Pcb) shall comply with the following characteristics:

| Code | PARAMETERS | SOURCE SIDE (PYPGP) | USER SIDE (Initiator) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Current source | Differential | |
| **B** | ***CURRENT*** | | | |
| Req-1 | Minimum firing current | 4.1A | 4.1 A | |
| Req-2 | Max no-fire current | <1A | 1A-5min | |
| Req-3 | Check out current | | 10mA | |
| Req-4 | Max firing current | 5.2A | | during 250ms max |
| Req-5 | Max battery input current in OFF state | <1mA | | For one battery input (among 2) |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Bridge wire resistance | | 1.05 Ω +/- 0.1 Ω | |
| Req-2 | Line resistance | ≤ 5 Ω | | Total (harness + EED) resistance between Source and User (Return included) |
| **E** | ***TIME*** | | | |
| Req-1 | Firing duration | 0.015s < T < 0.1s | 15ms min. @4.1A | |
| **F** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to the chassis | <1 MΩ | ≥1 MΩ | User side: R between shorted bridge wire and case |
| **G** | ***POWER SOURCE VOLTAGE*** | | | |
| Req-1 | Voltage range with LiIon battery | 28V < V < 37V | N/A | at PYPGP connector level, with or without firing current and with PYPGP=ON or OFF |
| Req-2 | Voltage range with NiH2 battery, PYPGP=ON (firing or not) | 28V < V < 40V | N/A | at PYPGP connector level |
| Req-3 | Voltage range with NiH2 battery, PYPGP=OFF | 28V < V < 44V | N/A | at PYPGP connector level |

**Table 48: PYRO interfaces characteristics**

# *

# Reference **SB4-SAT-AD1-P4-REQ-633**

**[FC Applicability:** ANTRACK, DATAM, HARNESS, MECHANISMS, POWER, PROP, ANTENNA**]**

The PYRO interfaces shall comply with the following characteristics with by-pass configuration:

| Code | PARAMETERS | SOURCE SIDE (PYPGP) | USER SIDE (bypass + LMU) | COMMENT |
|---|---|---|---|---|
| **A** | ***TYPE*** | | | |
| Req-1 | Output | Current source | Differential | |
| **B** | ***CURRENT*** | | | |
| Req-1 | Minimum firing current | 3.5A | 3 A* | *considering a 100ms pulse |
| Req-2 | Max no-fire current | <1mA | <1mA | |
| Req-4 | Max firing current | 5.2A | | during 250ms max |
| Req-5 | Max battery input current in OFF state | <1mA | | For one battery input (among 2) |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Bypass Resistance | | < 1 Ω | |
| Req-2 | LMU switch (+ return) resistance | | < 1 Ω | |
| Req-3 | Total resistance | ≤ 5 Ω | | Total (harness +LMU +bypass) resistance between Source and User (Return included) |
| **E** | ***TIME*** | | | |
| Req-1 | Firing duration | 0.1s < T < 0.25s | 0.1s < T* < 0.25s | * with Firing current = 3A |
| **F** | ***GROUDING AND ISOLATION*** | | | |
| Req-1 | Insulation resistance to the chassis | <1 MΩ | ≥1 MΩ | |
| **G** | ***POWER SOURCE VOLTAGE*** | | | |
| Req-1 | Voltage range with LiIon battery | 28V < V < 37V | N/A | at PYPGP connector level, with or without firing current and with PYPGP=ON or OFF |
| **H** | ***OUTPUT VOLTAGE*** | | | |
| Req-1 | Maximum dV/dt | <4V/µs | N/A | at PYPGP connector level, |

**Table 49: PYRO interfaces characteristics in by-pass configuration.**

# *

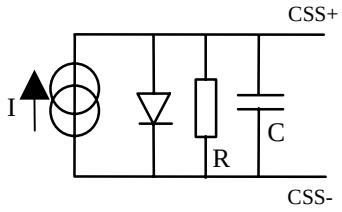
## 6.12 AOCS Interfaces

### *6.12.1 Coarse Sun Sensor interface*

#### 6.12.1.1 CSS current source

One CSS delivers 4 coarse analog detectors.

Schematic :




# Reference **SB4-SAT-AD1-P4-REQ-385 c**

**[FC Applicability:** AOCS, DATAM**]**

The CSS current source interfaces (AOCSP/AOCSP_NG) shall be compliant to these characteristics :

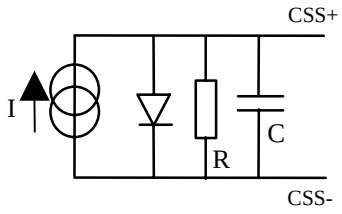
| Code | PARAMETERS | SOURCE SIDE Analog detector | USER SIDE (AOCSP/AOCSP_NG) | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Maximum fault voltage emission | | ±5 V | |
| Req-2 | Permanent Fault voltage tolerance | ±5 V | | |
| **B** | ***CURRENT*** | | | |
| Req-1 | Operating current range | 0<I<1mA | | |
| Req-2 | Maximum current | 10mA | | |
| Req-3 | Permanent current tolerance | | 10mA | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Resistance ( R ) | >10 KΩ | | |
| Req-2 | Capacitance ( C ) | 5 nF ≤ C ≤ 17 nF | | |
| **D** | ***FAILURE MODE*** | | | |
| Req-1 | Failure Mode | ▪ Short circuit<br>▪ Open circuit<br>▪ Short circuit between wire + and structure<br>▪ Short circuit between wire - and structure | Fail safe | |

**Table 50: CSS current source interfaces characteristics**

# *

### 6.12.1.2 CSS voltage source

Schematic :




# Reference **SB4-SAT-AD1-P4-REQ-605**

**[FC Applicability:** AOCS, DATAM**]**

The CSS voltage source interfaces (AOCSP_NG) shall be compliant to these characteristics:

| Code | PARAMETERS | SOURCE SIDE Analog detector | USER SIDE AOCSP_NG | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Maximum fault voltage emission | | ±15 V | |
| Req-2 | Permanent Fault voltage tolerance | ±15 V | | |
| Req-3 | Operating voltage range | 0<V<100mV | | |
| Req-4 | Maximum voltage including failure | 1V | | |
| Req-5 | Permanent failure voltage tolerance | | 1 V | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | Source Impedance (R ) | < 10Ω | | Differential |
| Req-2 | Load impedance | | >75 KΩ | Differential |
| Req-3 | Capacitance (C ) | 50 pF ≤ C ≤ 17 nF | | |
| **C** | ***FAILURE MODE*** | | | |
| Req-1 | Failure Mode | ▪ Short circuit<br>▪ Open circuit<br>▪ Short circuit between wire + and structure<br>▪ Short circuit between wire - and structure | Fail safe | |

**Table 51: CSS voltage source interfaces characteristics**

### *6.12.2 Reaction Wheel interface*

Each reaction wheel have 3 commands and 4 telemetries :

Commands :

- Torque command and Torque direction (interfaced by AOCSP) : PWM format
- ON/OFF command ( 2 ON and 2 OFF commands) : Low level Command

Telemetries :

- Tachometer (interfaced by AOCSP) : Frequency format
- Speed direction (interfaced by AOCSP) : Bi-level format
- Motor current (interfaced by AOCSP) : PWM format
- ON/OFF status : Switch closure
- Wheel NOGO (interfaced by AOCSP) : Bi-level format

Simplified schematic :

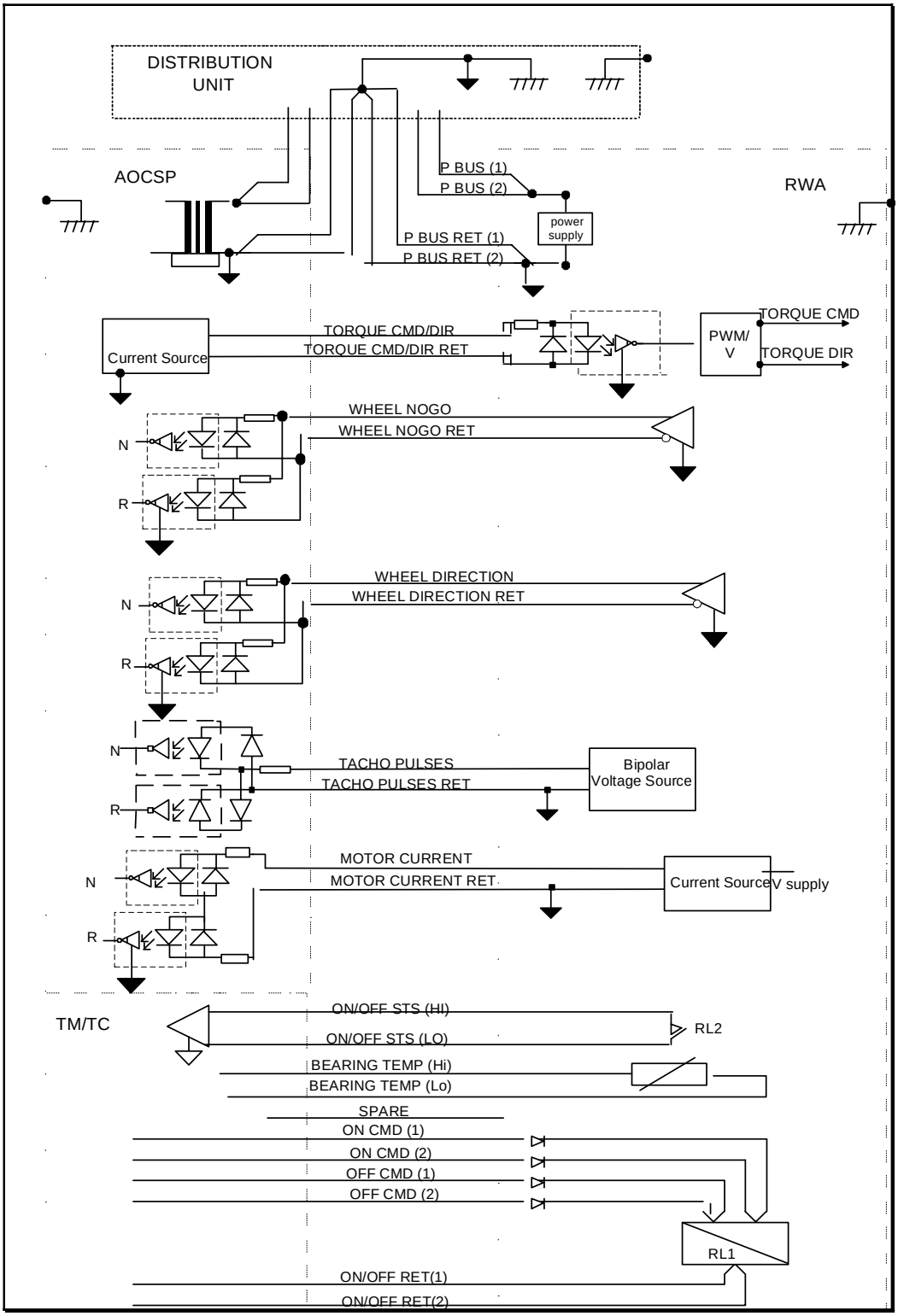



**Figure 15: Reaction Wheel interfaces**

### 6.12.2.1 Torque command

The torque command useful range is 10% (= - torque max.) to 90% (= + torque max.).

# Reference **SB4-SAT-AD1-P4-REQ-386 c**

**[FC Applicability:** AOCS, DATAM**]**

The torque command shall comply with the following table:

| Code | PARAMETERS | SOURCE SIDE AOCSP | USER SIDE WHEEL | COMMENT |
|---|---|---|---|---|
| **A** | ***CURRENT*** | | | |
| Req-1 | Low level current (discrete ''0'') | 0mA ±0.25mA | | |
| Req-2 | High level current (discrete ''1'') | 7mA<Ihl<13mA | | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Maximum Voltage drop | | <1.9V at 13mA | |
| Req-2 | Maximum differential Voltage | -1.5V<Vdiff<15V | | |
| **C** | ***FREQUENCY*** | | | |
| Req-1 | Operational frequency range | 400 Hz≤ f ≤ 600 Hz | | |
| **D** | ***TIME*** | | | |
| Req-1 | Rise/Fall time | <50ns | | 150 Ω ; 600 pF |
| **E** | ***ISOLATION*** | | | |
| Req-1 | from primary ground (0Vp) | connected | isolated ≥ 1 MΩ // ≤ 50 nF | |
| Req-2 | chassis | | isolated ≥ 1 MΩ // ≤ 50 nF | |

**Table 52: Torque telecommand characteristics**

# *

### 6.12.2.2 Wheel direction and Wheel NOGO Telemetry

# Reference **SB4-SAT-AD1-P4-REQ-387 c**

**[FC Applicability:** AOCS, DATAM**]**

The torque direction shall comply with these electrical characteristics :

| Code | PARAMETERS | SOURCE SIDE WHEEL (1) | USER SIDE AOCSP | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Low level differential voltage | 0V to 1.5V | | |
| Req-2 | High level differential voltage | 3.5V to 5.5V | | |
| Req-3 | Max Fault voltage emission | -5V to +5V | | |
| **B** | ***CURRENT*** | | | |
| Req-1 | Current capacity | >10mA | | |
| Req-2 | Load current | | <10mA | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Series resistor | | >700 Ω | |
| **D** | ***ISOLATION*** | | | |
| Req-1 | from primary ground (0Vp) | connected | isolated<br>≥ 1 MΩ // ≤ 50 nF | |
| Req-2 | chassis | | isolated<br>≥ 1 MΩ // ≤ 50 nF | |

**Table 53 :Wheel NOGO / direction telemetry characteristics**

Signal Logic :

Hi=''0'' and Lo=''1'' (NOGO State // negative direction)

Hi=''1'' and Lo=''0'' (GO State // positive direction)

The interface definition is set up so that current must flow through the optocoupler in order to establish a GO state (positive direction).

# *

### 6.12.2.3 Tachometer telemetry

# Reference **SB4-SAT-AD1-P4-REQ-388 b**

**[FC Applicability:** AOCS, DATAM**]**

The Tachometer interface shall be compliant with the following table :

| Code | PARAMETERS | SOURCE SIDE WHEEL | USER SIDE AOCSP | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Low level voltage | -12V ±2V | | Current capacity :>15mA |
| Req-2 | High level voltage | +12V ±2V | | |
| Req-2 | Fault voltage emission | ± 15V | | |
| **B** | ***IMPEDANCE*** | | | |
| Req-1 | Load impedance | | >400 Ω | |
| Req-2 | Source impedance | < 200 Ω | | |
| **C** | ***TIME*** | | | |
| Req-1 | Minimum Pulse duration | <10 μs | | |
| **D** | ***FREQUENCY*** | | | |
| Req-1 | Operating frequency range | | 0 Hz ≤ f ≤ 3200 Hz | The wheel tachometer generates 24 pulses per revolution and the maximum speed is 8000 revolution per minute |
| **E** | ***ISOLATION*** | | | |
| Req-1 | from primary ground (0Vp) | connected | isolated ≥ 1 MΩ // ≤ 50 nF | |
| Req-2 | chassis | | isolated ≥ 1 MΩ // ≤ 50 nF | |

**Table 54 :Tachometer telemetry characteristics**

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### 6.12.2.4 Motor current telemetry : PWM

The motor current is a PWM signal. 10% modulation corresponds to no current, while 90% modulation corresponds to maximum current.

# Reference **SB4-SAT-AD1-P4-REQ-390 c**

**[FC Applicability:** AOCS, DATAM**]**

The motor current AOCSP interface shall be compliant with the following table :

| Code | PARAMETERS | SOURCE SIDE WHEEL | USER SIDE AOCSP | COMMENT |
|---|---|---|---|---|
| **A** | ***VOLTAGE*** | | | |
| Req-1 | Low level voltage | 0 ±1.5V | | |
| Req-2 | High level voltage | 12V ± 2V | | |
| **B** | ***VOLTAGE*** | | | |
| Req-1 | Maximum Voltage drop | | 2 * 1.9V at 13mA | |
| **C** | ***IMPEDANCE*** | | | |
| Req-1 | Load impedance | | >400 Ω | |
| Req-2 | Source impedance | < 400 Ω | | |
| **D** | ***FREQUENCY*** | | | |
| Req-1 | Nominal frequency | 10 kHz ±2kHz | | |
| **E** | ***TIME*** | | | |
| Req-1 | Rise/Fall Time | <500 ns | | 150Ω ; 600pF |
| **F** | ***ISOLATION*** | | | |
| Req-1 | from primary ground (0Vp) | connected | isolated<br>≥ 1 MΩ // ≤ 50 nF | |
| Req-2 | chassis | | isolated<br>≥ 1 MΩ // ≤ 50 nF | |

**Table 55 :Motor current characteristics**

# *

## 6.13 Data Bus interfaces

Two types of Data bus are available on SB4000 :

- OBDH - 485
- 1553

The nominal bus is OBDH - 485.

The use of 1553 bus is limited to AOCS equipments :

- Startracker
- Gyro
- IRES

### *6.13.1 OBDH - 485*

The "Data Bus Network Electrical and Protocol Specification" (SBF 6AV2 AS SP 338) document comprises the requirements to be satisfied by the OBDH-485.
(See chapter "Applicable documents")

### *6.13.2 1553 BUS INTERFACE*

The Bus 1553 Applicable documents comprise the requirements to be satisfied by the bus 1553.
(See chapter "Applicable documents")

## ANNEX 1: CHANGE TRACEABILITY

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-001 b]** | AD-AV4-AD01_Part4-3.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-638 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-002 b]** | AD-AV4-AD01_Part4-3.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-003 b]** | AD-AV4-AD01_Part4-3.2.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-004 b]** | AD-AV4-AD01_Part4-3.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-005 b]** | AD-AV4-AD01_Part4-3.5-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-006 b]** | AD-AV4-AD01_Part4-3.6-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-610 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-007 c]** | AD-AV4-AD01_Part4-3.8.1.1-001/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-008 b]** | AD-AV4-AD01_Part4-3.8.1.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-544 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-009 b]** | AD-AV4-AD01_Part4-3.8.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-400 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-010 b]** | AD-AV4-AD01_Part4-3.8.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-011 b]** | AD-AV4-AD01_Part4-3.8.2-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-012 b]** | AD-AV4-AD01_Part4-3.8.2-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-013 b]** | AD-AV4-AD01_Part4-3.8.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-014 b]** | AD-AV4-AD01_Part4-3.8.3-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-401 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-015 b]** | AD-AV4-AD01_Part4-3.9.1.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-016 c]** | AD-AV4-AD01_Part4-3.9.1.2-001/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-017 b]** | AD-AV4-AD01_Part4-3.10-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-018 b]** | AD-AV4-AD01_Part4-3.10-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-019 b]** | AD-AV4-AD01_Part4-3.11.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-020 b]** | AD-AV4-AD01_Part4-3.11.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-021 b]** | AD-AV4-AD01_Part4-3.11.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-022 b]** | AD-AV4-AD01_Part4-3.12.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-023 b]** | AD-AV4-AD01_Part4-3.14.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-024 b]** | AD-AV4-AD01_Part4-3.14.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-025 b]** | AD-AV4-AD01_Part4-3.14.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-026 b]** | AD-AV4-AD01_Part4-3.14.2-003/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-027 b]** | AD-AV4-AD01_Part4-3.14.2-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-028 b]** | AD-AV4-AD01_Part4-3.14.2-005/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-029 b]** | AD-AV4-AD01_Part4-3.14.2-006/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-030 b]** | AD-AV4-AD01_Part4-3.14.2-007/a | Deleted in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-031 b]** | AD-AV4-AD01_Part4-3.14.2-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-032 b]** | AD-AV4-AD01_Part4-3.14.2-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-033 b]** | AD-AV4-AD01_Part4-3.15.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-034 b]** | AD-AV4-AD01_Part4-3.15.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-035 b]** | AD-AV4-AD01_Part4-3.15.2-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-036 b]** | AD-AV4-AD01_Part4-3.15.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-037 b]** | AD-AV4-AD01_Part4-4.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-038 b]** | AD-AV4-AD01_Part4-4.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-039 b]** | AD-AV4-AD01_Part4-4.2-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-040 b]** | AD-AV4-AD01_Part4-4.2.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-041 b]** | AD-AV4-AD01_Part4-4.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-042 b]** | AD-AV4-AD01_Part4-4.2.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-043 b]** | AD-AV4-AD01_Part4-4.2.1-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-044 b]** | AD-AV4-AD01_Part4-4.2.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-045 b]** | AD-AV4-AD01_Part4-4.2.1-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-046 c]** | AD-AV4-AD01_Part4-4.2.1-007/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-048 b]** | AD-AV4-AD01_Part4-4.2.1-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-049 b]** | AD-AV4-AD01_Part4-4.2.1-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-050 b]** | AD-AV4-AD01_Part4-4.2.1-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-051 b]** | AD-AV4-AD01_Part4-4.2.1-012/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-052 b]** | AD-AV4-AD01_Part4-4.2.1-013/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-053 b]** | AD-AV4-AD01_Part4-4.2.1-014/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-054 b]** | AD-AV4-AD01_Part4-4.2.1-015/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-055 b]** | AD-AV4-AD01_Part4-4.2.1-016/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-056 b]** | AD-AV4-AD01_Part4-4.2.1-017/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-057 b]** | AD-AV4-AD01_Part4-4.2.1-018/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-058 b]** | AD-AV4-AD01_Part4-4.2.1-019/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-059 c]** | AD-AV4-AD01_Part4-4.2.1-020/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-060 b]** | AD-AV4-AD01_Part4-4.2.1-021/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-061 b]** | AD-AV4-AD01_Part4-4.2.1-022/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-062 b]** | AD-AV4-AD01_Part4-4.2.1-023/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-063 b]** | AD-AV4-AD01_Part4-4.2.1-024/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-064 b]** | AD-AV4-AD01_Part4-4.2.2.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-065 b]** | AD-AV4-AD01_Part4-4.2.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-066 b]** | AD-AV4-AD01_Part4-4.2.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-067 b]** | AD-AV4-AD01_Part4-4.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-068 b]** | AD-AV4-AD01_Part4-4.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-069 b]** | AD-AV4-AD01_Part4-4.3-003/a | Deleted in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-070 b]** | AD-AV4-AD01_Part4-4.3.1.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-071 b]** | AD-AV4-AD01_Part4-4.3.1.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-072 b]** | AD-AV4-AD01_Part4-4.3.1.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-073 b]** | AD-AV4-AD01_Part4-4.3.1.1-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-074 b]** | AD-AV4-AD01_Part4-4.3.1.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-075 b]** | AD-AV4-AD01_Part4-4.3.1.1-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-076 b]** | AD-AV4-AD01_Part4-4.3.1.1-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-077 b]** | AD-AV4-AD01_Part4-4.3.1.1-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-078 b]** | AD-AV4-AD01_Part4-4.3.1.1-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-079 b]** | AD-AV4-AD01_Part4-4.3.1.1-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-080 b]** | AD-AV4-AD01_Part4-4.3.1.1-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-081 b]** | AD-AV4-AD01_Part4-4.3.1.1-012/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-082 b]** | AD-AV4-AD01_Part4-4.3.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-083 b]** | AD-AV4-AD01_Part4-4.3.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-084 b]** | AD-AV4-AD01_Part4-4.3.2-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-085 b]** | AD-AV4-AD01_Part4-4.3.2-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-086 b]** | AD-AV4-AD01_Part4-4.3.2.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-087 b]** | AD-AV4-AD01_Part4-4.3.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-088 b]** | AD-AV4-AD01_Part4-4.3.2.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-089 b]** | AD-AV4-AD01_Part4-4.3.2.1-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-090 b]** | AD-AV4-AD01_Part4-4.3.2.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-091 b]** | AD-AV4-AD01_Part4-4.3.2.1-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-092 b]** | AD-AV4-AD01_Part4-4.3.2.1-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-093 b]** | AD-AV4-AD01_Part4-4.3.2.1-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-094 b]** | AD-AV4-AD01_Part4-4.3.2.1-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-095 b]** | AD-AV4-AD01_Part4-4.3.2.1-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-096 b]** | AD-AV4-AD01_Part4-4.3.2.1-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-097 b]** | AD-AV4-AD01_Part4-4.3.2.1-012/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-098 b]** | AD-AV4-AD01_Part4-4.3.2.1-013/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-099 b]** | AD-AV4-AD01_Part4-4.3.2.1-014/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-100 b]** | AD-AV4-AD01_Part4-4.3.2.1-015/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-101 b]** | AD-AV4-AD01_Part4-4.3.2.1-016/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-102 b]** | AD-AV4-AD01_Part4-4.3.2.1-017/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-103 b]** | AD-AV4-AD01_Part4-4.3.2.1-018/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-104 b]** | AD-AV4-AD01_Part4-4.3.2.1-019/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-105 b]** | AD-AV4-AD01_Part4-4.3.2.1-020/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-106 b]** | AD-AV4-AD01_Part4-4.3.2.1-021/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-107 b]** | AD-AV4-AD01_Part4-4.3.2.1-022/a | Deleted in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-108 b]** | AD-AV4-AD01_Part4-4.3.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-109 b]** | AD-AV4-AD01_Part4-4.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-110 b]** | AD-AV4-AD01_Part4-4.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-111 b]** | AD-AV4-AD01_Part4-4.4-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-112 b]** | AD-AV4-AD01_Part4-4.4-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-113 b]** | AD-AV4-AD01_Part4-4.4-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-114 b]** | AD-AV4-AD01_Part4-4.5.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-115 b]** | AD-AV4-AD01_Part4-4.5.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-116 b]** | AD-AV4-AD01_Part4-4.5.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-117 b]** | AD-AV4-AD01_Part4-4.5.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-118 b]** | AD-AV4-AD01_Part4-4.6-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-119 b]** | AD-AV4-AD01_Part4-4.6-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-120 b]** | AD-AV4-AD01_Part4-4.6-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-121 b]** | AD-AV4-AD01_Part4-4.6.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-122 b]** | AD-AV4-AD01_Part4-4.6.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-123 b]** | AD-AV4-AD01_Part4-4.6.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-124 b]** | AD-AV4-AD01_Part4-4.6.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-125 b]** | AD-AV4-AD01_Part4-4.6.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-126 b]** | AD-AV4-AD01_Part4-4.7-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-127 b]** | AD-AV4-AD01_Part4-4.7-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-128 b]** | AD-AV4-AD01_Part4-4.8-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-129 c]** | AD-AV4-AD01_Part4-4.8-002/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-406 ]** | SB-AD01.3-4.03-010 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-407 ]** | SB-AD01.3-4.03-011 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-410 ]** | SB-AD01.3-4.03-014 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-411 ]** | SB-AD01.3-4.03-015 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-412 ]** | SB-AD01.3-4.02-006 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-415 ]** | SB-AD01.3-4.02-011 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-417 ]** | SB-AD01.3-4.02-012 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-418 ]** | SB-AD01.3-4.02-013 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-419 ]** | SB-AD01.3-4.02-013 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-611 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-420 ]** | SB-AD01.3-4.02-015 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-421 ]** | SB-AD01.3-4.02-015 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-425 ]** | SB-AD01.3-4.02-019 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-423 ]** | SB-AD01.3-4.02-018 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-424 ]** | SB-AD01.3-4.02-018 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-426 ]** | SB-AD01.3-4.02-020 | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-427 ]** | SB-AD01.3-4.02-021 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-428 ]** | SB-AD01.3-4.02-021 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-429 ]** | SB-AD01.3-4.02-004 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-430 ]** | SB-AD01.3-4.02-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-431 ]** | SB-AD01.3-4.02-022 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-433 ]** | SB-AD01.3-4.02-023 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-435 ]** | SB-AD01.3-4.02-026 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-436 ]** | SB-AD01.3-4.02-027 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-631 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-438 ]** | SB-AD01.3-4.02-029 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-439 ]** | SB-AD01.3-4.02-030 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-440 ]** | SB-AD01.3-4.02-031 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-624 ]** | SB-AD01.3-4.02-048 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-488 ]** | SB-AD01.3-4.03-046 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-454 ]** | SB-AD01.3-4.03-035 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-459 ]** | SB-AD01.3-4.03-040 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-460 ]** | SB-AD01.3-4.03-041 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-449 ]** | SB-AD01.3-4.03-006 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-450 ]** | SB-AD01.3-4.03-008 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-451 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-456 ]** | SB-AD01.3-4.03-037 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-596 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-409 ]** | SB-AD01.3-4.03-013 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-461 ]** | SB-AD01.3-4.03-042 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-462 ]** | SB-AD01.3-4.03-043 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-475 ]** | SB-AD01.3-4.03-019 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-476 ]** | SB-AD01.3-4.03-020 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-477 ]** | SB-AD01.3-4.03-021 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-479 ]** | SB-AD01.3-4.03-023 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-481 ]** | SB-AD01.3-4.03-025 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-482 ]** | SB-AD01.3-4.03-026 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-483 ]** | SB-AD01.3-4.03-027 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-484 ]** | SB-AD01.3-4.03-028 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-485 ]** | SB-AD01.3-4.03-029 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-489 ]** | SB-AD01.3-4.03-047 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-492 ]** | SB-AD01.3-4.03-050 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-493 ]** | SB-AD01.3-4.03-051 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-494 ]** | SB-AD01.3-4.03-052 | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-495 ]** | SB-AD01.3-4.03-053 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-606 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-497 ]** | SB-AD01.3-4.03-056 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-582 ]** | SB-AD01.3-4.03-059 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-490 ]** | SB-AD01.3-4.03-048 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-491 ]** | SB-AD01.3-4.03-049 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-498 ]** | SB-AD01.3-4.04-002 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-499 ]** | SB-AD01.3-4.04-002 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-507 ]** | SB-AD01.3-4.04-007 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-508 ]** | SB-AD01.3-4.04-007 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-506 ]** | SB-AD01.3-4.04-006 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-510 ]** | SB-AD01.3-4.04-015 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-614 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-511 ]** | SB-AD01.3-4.04-024 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-512 ]** | SB-AD01.3-4.04-025 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-615 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-518 ]** | SB-AD01.3-4.04-033 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-513 ]** | SB-AD01.3-4.04-015 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-515 ]** | SB-AD01.3-4.04-029 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-517 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-501 ]** | SB-AD01.3-4.04-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-502 ]** | SB-AD01.3-4.04-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-503 ]** | SB-AD01.3-4.04-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-504 ]** | SB-AD01.3-4.04-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-505 ]** | SB-AD01.3-4.04-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-394 b]** | AD-AV4-AD01_Part4-6.15.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-395 b]** | AD-AV4-AD01_Part4-6.15.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-396 b]** | AD-AV4-AD01_Part4-6.16.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-519 ]** | SB-AD01.3-4.05-001 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-520 ]** | SB-AD01.3-4.05-002 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-521 ]** | SB-AD01.3-4.05-003 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-522 ]** | SB-AD01.3-4.05-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-523 ]** | SB-AD01.3-4.05-005 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-524 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-525 ]** | SB-AD01.3-4.05-007 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-526 ]** | SB-AD01.3-4.05-008 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-539 ]** | SB-AD01.3-4.05-044 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-540 ]** | SB-AD01.3-4.05-045 | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-541 ]** | SB-AD01.3-4.05-047 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-509 ]** | SB-AD01.3-4.04-009 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-514 ]** | SB-AD01.3-4.04-028 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-623 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-639 ]** | SB-AD01.3-4.04-019 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-619 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-537 ]** | SB-AD01.3-4.05-041 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-538 ]** | SB-AD01.3-4.05-042 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-528 ]** | SB-AD01.3-4.05-017 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-529 ]** | SB-AD01.3-4.05-018 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-600 ]** | SB-AD01.3-4.05-033 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-640 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-641 ]** | SB-AD01.3-4.05-034 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-533 ]** | SB-AD01.3-4.05-027 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-534 ]** | SB-AD01.3-4.05-028 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-535 ]** | SB-AD01.3-4.05-031 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-545 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-532 ]** | SB-AD01.3-4.05-026 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-542 ]** | SB-AD01.3-4.05-053 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-205 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-011/a | Modified in, Moved in | 3 |
| **[SB4-SAT-AD1-P4-REQ-206 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-012/a | Modified in, Moved in | 3 |
| **[SB4-SAT-AD1-P4-REQ-208 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-209 c]** | AD-AV4-AD01_Part4-6.1.6.1.4-002/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-536 ]** | SB-AD01.3-4.05-036 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-543 ]** | SB-AD01.3-4.05-054 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-130 b]** | AD-AV4-AD01_Part4-5.1.1.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-132 c]** | AD-AV4-AD01_Part4-5.1.2.1-001/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-133 c]** | AD-AV4-AD01_Part4-5.1.2.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-134 b]** | AD-AV4-AD01_Part4-5.1.3-001/aAD-AV4-AD01_Part4-5.1.3-001/a : | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-135 c]** | AD-AV4-AD01_Part4-5.1.3-002/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-138 c]** | AD-AV4-AD01_Part4-5.1.4-003/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-145 b]** | AD-AV4-AD01_Part4-5.1.5-007/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-140 b]** | AD-AV4-AD01_Part4-5.1.5-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-616 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-464 ]** | SB-AD01.3-4.05-039 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-617 ]** | | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-618 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-465 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-141 b]** | AD-AV4-AD01_Part4-5.1.5-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-142 b]** | AD-AV4-AD01_Part4-5.1.5-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-143 b]** | AD-AV4-AD01_Part4-5.1.5-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-144 b]** | AD-AV4-AD01_Part4-5.1.5-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-146 c]** | AD-AV4-AD01_Part4-5.1.5-008/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-147 b]** | AD-AV4-AD01_Part4-5.1.5-009/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-148 c]** | AD-AV4-AD01_Part4-5.1.5-010/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-149 c]** | AD-AV4-AD01_Part4-5.1.5-011/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-603 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-150 b]** | AD-AV4-AD01_Part4-5.2.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-151 b]** | AD-AV4-AD01_Part4-5.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-152 b]** | AD-AV4-AD01_Part4-5.2.1-003/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-153 b]** | AD-AV4-AD01_Part4-5.2.1-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-154 b]** | AD-AV4-AD01_Part4-5.2.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-155 b]** | AD-AV4-AD01_Part4-5.2.1-006/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-156 b]** | AD-AV4-AD01_Part4-5.2.1-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-157 b]** | AD-AV4-AD01_Part4-5.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-158 b]** | AD-AV4-AD01_Part4-5.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-159 b]** | AD-AV4-AD01_Part4-5.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-160 b]** | AD-AV4-AD01_Part4-5.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-161 b]** | AD-AV4-AD01_Part4-5.5-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-162 b]** | AD-AV4-AD01_Part4-5.6.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-163 b]** | AD-AV4-AD01_Part4-5.6.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-164 b]** | AD-AV4-AD01_Part4-5.7-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-165 b]** | AD-AV4-AD01_Part4-5.7-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-166 b]** | AD-AV4-AD01_Part4-5.7-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-167 b]** | AD-AV4-AD01_Part4-5.7-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-168 b]** | AD-AV4-AD01_Part4-5.8.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-169 b]** | AD-AV4-AD01_Part4-5.8.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-171 b]** | AD-AV4-AD01_Part4-5.8.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-172 b]** | AD-AV4-AD01_Part4-5.8.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-442 ]** | SB-AD01.3-4.02-033 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-173 b]** | AD-AV4-AD01_Part4-6.1.2.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-174 b]** | AD-AV4-AD01_Part4-6.1.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-175 b]** | AD-AV4-AD01_Part4-6.1.2.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-176 b]** | AD-AV4-AD01_Part4-6.1.2.3-002/a | Deleted in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-177 b]** | AD-AV4-AD01_Part4-6.1.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-178 b]** | AD-AV4-AD01_Part4-6.1.5-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-210 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-211 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-212 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-213 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-214 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-215 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-216 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-217 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-218 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-219 b]** | AD-AV4-AD01_Part4-6.1.6.1.4-012/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-220 c]** | AD-AV4-AD01_Part4-6.1.6.1.4-013/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-179 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-180 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-181 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-182 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-004/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-183 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-185 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-186 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-187 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-188 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-189 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-190 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-012/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-191 b]** | AD-AV4-AD01_Part4-6.1.6.1.1-013/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-621 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-622 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-196 c]** | AD-AV4-AD01_Part4-6.1.6.1.2-002/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-637 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-197 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-198 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-199 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-200 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-201 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-007/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-203 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-204 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-207 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-013/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-221 b]** | AD-AV4-AD01_Part4-6.1.6.2.1-001/a | Deleted in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-222 b]** | AD-AV4-AD01_Part4-6.1.6.2.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-223 b]** | AD-AV4-AD01_Part4-6.1.6.2.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-224 b]** | AD-AV4-AD01_Part4-6.1.6.2.1-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-225 b]** | AD-AV4-AD01_Part4-6.1.6.2.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-226 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-001/a: | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-227 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-228 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-229 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-230 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-231 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-232 b]** | AD-AV4-AD01_Part4-6.1.6.2.2-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-202 b]** | AD-AV4-AD01_Part4-6.1.6.1.2-008/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-235 b]** | AD-AV4-AD01_Part4-6.1.6.3-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-236 b]** | AD-AV4-AD01_Part4-6.1.6.3-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-237 b]** | AD-AV4-AD01_Part4-6.1.6.3-003/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-630 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-233 b]** | AD-AV4-AD01_Part4-6.1.6.2.5-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-234 b]** | AD-AV4-AD01_Part4-6.1.6.2.5-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-238 c]** | AD-AV4-AD01_Part4-6.1.6.4.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-587 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-588 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-239 c]** | AD-AV4-AD01_Part4-6.1.6.4.3-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-589 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-590 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-626 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-241 b]** | AD-AV4-AD01_Part4-6.1.7.4-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-559 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-560 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-627 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-243 c]** | AD-AV4- AD01_Part4-6.1.8-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-548 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-550 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-551 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-552 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-553 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-240 b]** | AD-AV4-AD01_Part4-6.1.7.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-628 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-554 ]** | | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-555 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-557 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-242 b]** | AD-AV4-AD01_Part4-6.1.7.4-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-561 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-604 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-244 b]** | AD-AV4-AD01_Part4-6.2.3.3-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-613 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-245 b]** | AD-AV4-AD01_Part4-6.2.3.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-246 c]** | AD-AV4-AD01_Part4-6.2.3.5-001/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-247 b]** | AD-AV4-AD01_Part4-6.2.3.5-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-248 c]** | AD-AV4-AD01_Part4-6.2.3.6-001/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-250 c]** | AD-AV4-AD01_Part4-6.2.3.8-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-251 b]** | AD-AV4-AD01_Part4-6.2.3.9.1.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-252 b]** | AD-AV4-AD01_Part4-6.2.3.9.1.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-253 b]** | AD-AV4-AD01_Part4-6.2.3.9.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-254 b]** | AD-AV4-AD01_Part4-6.2.3.9.3.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-255 b]** | AD-AV4-AD01_Part4-6.2.3.9.3.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-562 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-256 b]** | AD-AV4-AD01_Part4-6.2.4.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-257 b]** | AD-AV4-AD01_Part4-6.2.4.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-259 b]** | AD-AV4-AD01_Part4-6.2.4.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-258 b]** | AD-AV4-AD01_Part4-6.2.4.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-260 c]** | AD-AV4-AD01_Part4-6.2.4.6-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-261 b]** | AD-AV4-AD01_Part4-6.2.4.7.1.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-262 b]** | AD-AV4-AD01_Part4-6.2.4.7.1.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-263 b]** | AD-AV4-AD01_Part4-6.2.4.7.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-264 b]** | AD-AV4-AD01_Part4-6.2.4.7.3.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-265 b]** | AD-AV4-AD01_Part4-6.2.5.1.1-001/aAD-AV4-AD01_Part4-6.2.5.1.1-001/a : | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-266 b]** | AD-AV4-AD01_Part4-6.2.5.3.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-269 b]** | AD-AV4-AD01_Part4-6.2.5.3.1-004/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-270 b]** | AD-AV4-AD01_Part4-6.2.5.3.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-563 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-564 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-271 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-272 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-565 ]** | AD-AV4-AD01_Part4-6.2.5.3.2-002/a | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-273 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-003/a | Deleted in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-274 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-004/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-275 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-005/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-277 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-278 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-279 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-280 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-566 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-283 b]** | AD-AV4-AD01_Part4-6.2.5.3.2-013/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-284 c]** | AD-AV4-AD01_Part4-6.2.5.3.2-014/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-286 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-287 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-288 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-289 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-290 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-291 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-292 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-007/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-293 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-008/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-294 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-009/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-295 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-010/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-296 b]** | AD-AV4-AD01_Part4-6.2.5.3.4-011/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-297 c]** | AD-AV4-AD01_Part4-6.2.5.3.4-012/b | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-298 b]** | AD-AV4-AD01_Part4-6.2.5.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-299 b]** | AD-AV4-AD01_Part4-6.2.5.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-300 b]** | AD-AV4-AD01_Part4-6.2.5.4-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-567 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-568 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-304 b]** | AD-AV4-AD01_Part4-6.2.5.4.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-305 b]** | AD-AV4-AD01_Part4-6.2.5.4.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-306 b]** | AD-AV4-AD01_Part4-6.2.5.4.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-307 b]** | AD-AV4-AD01_Part4-6.2.5.4.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-308 c]** | AD-AV4-AD01_Part4-6.2.5.5-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-632 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-591 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-570 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-571 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-572 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-573 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-575 ]** | | New in | 3 |

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|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-309 b]** | AD-AV4-AD01_Part4-6.2.6.1-001/aAD-AV4-AD01_Part4-6.2.6.1-001/a : | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-629 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-576 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-578 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-310 b]** | AD-AV4-AD01_Part4-6.2.6.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-311 b]** | AD-AV4-AD01_Part4-6.2.6.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-312 b]** | AD-AV4-AD01_Part4-6.2.6.5-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-313 b]** | AD-AV4-AD01_Part4-6.2.6.5-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-580 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-314 b]** | AD-AV4-AD01_Part4-6.2.6.6.1.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-315 b]** | AD-AV4-AD01_Part4-6.2.6.6.1.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-316 b]** | AD-AV4-AD01_Part4-6.2.6.6.2.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-317 b]** | AD-AV4-AD01_Part4-6.2.6.6.3.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-636 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-318 b]** | AD-AV4-AD01_Part4-6.2.7.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-319 b]** | AD-AV4-AD01_Part4-6.2.7.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-601 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-592 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-593 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-620 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-323 b]** | AD-AV4-AD01_Part4-6.3-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-324 b]** | AD-AV4-AD01_Part4-6.4.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-583 ]** | | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-584 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-326 b]** | AD-AV4-AD01_Part4-6.4.1-003/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-328 b]** | AD-AV4-AD01_Part4-6.4.1-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-329 b]** | AD-AV4-AD01_Part4-6.4.1-006/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-330 c]** | AD-AV4-AD01_Part4-6.4.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-635 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-634 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-333 b]** | AD-AV4-AD01_Part4-6.6.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-334 d]** | AD-AV4-AD01_Part4-6.6.2-001/c | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-335 b]** | AD-AV4-AD01_Part4-6.6.2-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-585 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-336 b]** | AD-AV4-AD01_Part4-6.6.3.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-337 b]** | AD-AV4-AD01_Part4-6.6.3.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-338 b]** | AD-AV4-AD01_Part4-6.6.4.1-001/a | Deleted in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-339 b]** | AD-AV4-AD01_Part4-6.6.4.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-340 b]** | AD-AV4-AD01_Part4-6.6.5.1.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-341 b]** | AD-AV4-AD01_Part4-6.6.5.1.4-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-342 b]** | AD-AV4-AD01_Part4-6.6.5.2.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-343 c]** | AD-AV4-AD01_Part4-6.7-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-344 b]** | AD-AV4-AD01_Part4-6.7-002/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-345 c]** | AD-AV4-AD01_Part4-6.7-003/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-612 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-346 b]** | AD-AV4-AD01_Part4-6.7-004/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-347 b]** | AD-AV4-AD01_Part4-6.7-005/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-356 c]** | AD-AV4-AD01_Part4-6.9.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-594 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-357 d]** | AD-AV4-AD01_Part4-6.9.3.1.1-001/c | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-358 c]** | AD-AV4-AD01_Part4-6.9.3.1.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-359 b]** | AD-AV4-AD01_Part4-6.9.4-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-362 d]** | AD-AV4-AD01_Part4-6.9.4.1.1-001/c | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-367 b]** | AD-AV4-AD01_Part4-6.9.6-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-363 c]** | AD-AV4-AD01_Part4-6.9.5.1.1-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-364 c]** | AD-AV4-AD01_Part4-6.9.5.1.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-365 c]** | AD-AV4-AD01_Part4-6.9.5.2.1-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-366 b]** | AD-AV4-AD01_Part4-6.9.5.2.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-602 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-368 b]** | AD-AV4-AD01_Part4-6.11.1.1.1-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-607 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-369 b]** | AD-AV4-AD01_Part4-6.11.1.1.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-625 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-370 b]** | AD-AV4-AD01_Part4-6.11.1.1.3-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-371 b]** | AD-AV4-AD01_Part4-6.11.1.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-372 c]** | AD-AV4-AD01_Part4-6.11.2.1-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-608 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-373 b]** | AD-AV4-AD01_Part4-6.11.2.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-374 b]** | AD-AV4-AD01_Part4-6.11.2.2-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-375 b]** | AD-AV4-AD01_Part4-6.11.2.3-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-376 b]** | AD-AV4-AD01_Part4-6.11.2.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-377 c]** | AD-AV4-AD01_Part4-6.11.2.4-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-378 b]** | AD-AV4-AD01_Part4-6.11.2.4-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-379 b]** | AD-AV4-AD01_Part4-6.11.2.4-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-380 c]** | AD-AV4-AD01_Part4-6.11.2.5.1-001/b | Modified in | 3 |

| PUID | PUID in AD01-P4 issue 2.2 and AD01-P3 issue 3.0 | Change Status | Doc Issue |
|---|---|---|---|
| **[SB4-SAT-AD1-P4-REQ-381 b]** | AD-AV4-Ad01_Part4-6.11.2.5.2-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-382 b]** | AD-AV4-AD01_Part4-6.12.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-383 b]** | AD-AV4-AD01_Part4-6.12.1-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-384 b]** | AD-AV4-AD01_Part4-6.12.1-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-597 ]** | SB-AD01.3-4.02-036 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-598 ]** | SB-AD01.3-4.02-037 | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-599 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-633 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-385 c]** | AD-AV4-AD01_Part4-6.13.1-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-605 ]** | | New in | 3 |
| **[SB4-SAT-AD1-P4-REQ-386 c]** | AD-AV4-AD01_Part4-6.13.2.1-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-387 c]** | AD-AV4-AD01_Part4-6.13.2.2-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-388 b]** | AD-AV4-AD01_Part4-6.13.2.3-001/a | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-389 b]** | AD-AV4-AD01_Part4-6.13.2.3-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-390 c]** | AD-AV4-AD01_Part4-6.13.2.4-001/b | Modified in | 3 |
| **[SB4-SAT-AD1-P4-REQ-391 b]** | AD-AV4-AD01_Part4-6.14-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-392 b]** | AD-AV4-AD01_Part4-6.14-002/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-393 b]** | AD-AV4-AD01_Part4-6.14-003/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-397 b]** | AD-AV4-AD01_Part4-6.17.1-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-398 b]** | AD-AV4-AD01_Part4-6.17.2-001/a | Deleted in | 3 |
| **[SB4-SAT-AD1-P4-REQ-399 c]** | AD-AV4-AD01_Part4-6.17.2-002/b | Deleted in | 3 |

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