



GOLDS-UFSC Documentation

GOLDS-UFSC Documentation

SpaceLab, Universidade Federal de Santa Catarina, Florianópolis - Brazil

GOLDS-UFSC Documentation
January, 2021

Project Chief:
Eduardo Augusto Bezerra

Authors:
Gabriel Mariano Marcelino
André Martins Pio de Mattos
Eduardo Augusto Bezerra

Contributing Authors:

Revision Control:

Version	Author	Changes	Date
0.1	Gabriel M. Marcelino	Document creation	2020/06/05



© 2021 by SpaceLab. GOLDS-UFSC Documentation. This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0/>.

List of Figures

4.1	Reference diagram of the PC-104 bus.	9
-----	--	---

List of Tables

3.1	Mission schedule.	5
4.1	PC-104 bus pinout.	10
4.2	PC-104 bus signal description.	11

Nomenclature

ADCS	<i>Attitude Determination and Control System.</i>
EDC	<i>Environmental Data Collection.</i>
EPS	<i>Electrical Power System.</i>
OBDH	<i>On-Board Data Handling.</i>
TTC	<i>Telemetry, Tracking and Command Module.</i>

Contents

List of Figures	v
List of Tables	vii
Nomenclature	ix
1 Introduction	1
1.1 Mission Description	1
1.2 Mission Objectives	1
2 Mission Requirements	3
3 Mission Schedule	5
4 Overall Description	7
4.1 General Diagrams	7
4.2 General Behaviour	7
4.3 Orbit Parameters	7
4.4 Power Budget	7
4.5 Link Budget	7
4.5.1 VHF Link	7
4.5.2 UHF Links	8
4.6 PC-104 Bus	8
5 Subsystems	13
5.1 On-Board Data Handling	13
5.2 Telemetry, Tracking and Command Module	13
5.3 Electrical Power System	13
5.3.1 Battery Module	13
5.4 Attitude Determination and Control System	13
5.5 Mechanical Structure	13
5.6 Interconnection Modules	13
5.6.1 PC-104 Interconnection Boards	13
5.6.2 External Connection Boards	14
5.7 Payloads	14
5.7.1 Environmental Data Collection	14
6 Ground Segment	15

7 Operation Planning	17
References	19

CHAPTER 1

Introduction

1.1 Mission Description

1.2 Mission Objectives

1. To serve as a host platform for the EDC payload.
2. Validate the EDC payload in orbit.
3. Validate EDC functionality in orbit.
4. Validate core-satellite functions in orbit.
5. Evaluate the behavior of the core modules.
6. Perform experiments on radiation effects in electronic components in orbit.
7. Serve as relay for amateur radio communications.

CHAPTER 2

Mission Requirements

1. The power system shall be able to harvest solar energy.
2. The power system shall be able to store energy for use when GOLDS-UFSC is eclipsed.
3. The power system shall supply energy to all other modules.
4. The data handling system shall communicate with the other modules and store their data.
5. The communications system shall send a beacon signal periodically using VHF radio.
6. The communications system shall send the CubeSat telemetry using UHF radio.
7. The communications system shall be able to receive telecommands and respond to them accordingly.
8. The attitude system shall be able to perform a 1-axis stabilization of the CubeSat.
9. GOLDS-UFSC shall have the capability to receive and execute a shutdown telecommand, therefore ceasing all transmissions.
10. The downlink transmissions shall be done once at a time, either telemetry or beacon.
11. The ground station shall operate under the proper radio frequency communication licenses.
12. GOLDS-UFSC shall comply with international and Brazilian radio license agreements and restrictions.
13. The team shall build and operate a ground station for full communication with GOLDS-UFSC.

CHAPTER 3

Mission Schedule

Phase/Activity	Period													
	2020												2021	
	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Flatsat test OBDH + EDC	■	■												
Protoflight - Design	■	■	■	■	■	■	■	■	■	■	■	■	■	■
GS & RF regulation procedures	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Critical Design Review (CDR)		■	■	■	■	■	■	■	■	■	■	■	■	■
Protoflight - Procurement			■	■	■	■	■	■	■	■	■	■	■	■
Protoflight - Boards fabrication				■	■	■	■	■	■	■	■	■	■	■
Flatsat test - Subsystems + EDC					■	■	■	■	■	■	■	■	■	■
Protoflight - Stack integration						■	■	■	■	■	■	■	■	■
Fit check							■	■	■	■	■	■	■	■
Verification & validation	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Environmental tests (LIT	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Acceptance Review (AR)										■	■	■	■	■
Export to launch country											■	■	■	■
Flight Readiness Review (FRR)												■	■	■
Integration to launch vehicle													■	■
Launch														■
Start commissioning														■
End commissioning														■
Start operation														■

Table 3.1: Mission schedule.

CHAPTER 4

Overall Description

4.1 General Diagrams

4.2 General Behaviour

4.3 Orbit Parameters

4.4 Power Budget

4.5 Link Budget

4.5.1 VHF Link

- Direction: Downlink
- Frequency: 145,97 MHz
- Modulation: MSK
- Datarate: 1200 bps
- Output Power: 30 dBm (1 W)
- Protocol: NGHam

4.5.2 UHF Links

Main UHF Link

- Direction: **Downlink and uplink**
- Frequency: **436,9 MHz**
- Modulation: **MSK**
- Datarate: **4800 bps**
- Output power: **30 dBm (1 W)**
- Protocol: **NGHam**

EDC UHF Link

- Direction: **Uplink**
- Frequency: **401.635 MHz**
- Modulation: **????**
- Datarate: **???? bps**

4.6 PC-104 Bus

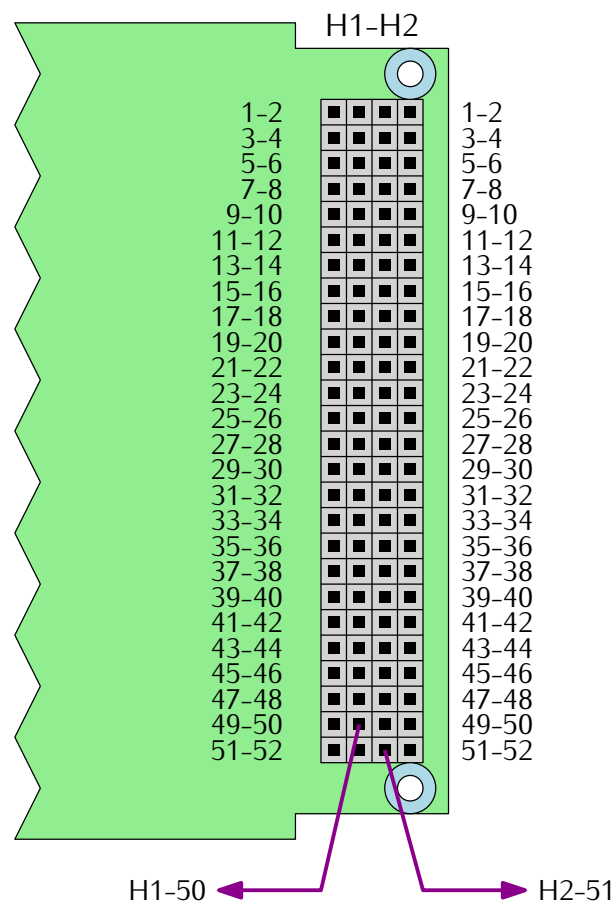


Figure 4.1: Reference diagram of the PC-104 bus.

Pin Row	H1 Odd	H1 Even	H2 Odd	H2 Even
1-2	-	-	-	-
3-4	-	-	EDC_1_EN	EDC_2_EN
5-6	-	-	BE_UART_RX	-
7-8	RA_GPIO_0	RA_GPIO_1	BE_UART_TX	GPIO_0
9-10	RA_GPIO_2	-	-	-
11-12	RA_RESET	RA_EN	BE_SPI_MOSI	BE_SPI_CLK
13-14	-	-	BE_SPI_CS	BE_SPI_MISO
15-16	-	-	-	-
17-18	EDC_UART_RX/TX	PLX_EN	-	GPIO_1
19-20	EDC_UART_TX/RX	GPIO_2	-	GPIO_3
21-22	-	-	-	GPIO_4
23-24	-	-	-	-
25-26	-	-	-	-
27-28	-	-	-	-
29-30	GND	GND	GND	GND
31-32	GND	GND	GND	GND
33-34	-	-	-	-
35-36	RD_SPI_CLK	-	ANT_VCC	ANT_VCC
37-38	RD_SPI_MISO	-	-	-
39-40	RD_SPI_MOSI	RD_SPI_CS	-	-
41-42	PL_I2C_SDA	-	-	GPIO_5
43-44	PL_I2C_SCL	-	-	-
45-46	OBDH_VCC	OBDH_VCC	BAT_VCC	BAT_VCC
47-48	EDC_VCC	EDC_VCC	-	-
49-50	RD_VCC	RD_VCC	EPS_I2C_SDA	-
51-52	BE_VCC	BE_VCC	EPS_I2C_SCL	-

Table 4.1: PC-104 bus pinout.

Signal	Pin(s)	Used By	Description
GND	H1-29, H1-30, H1-31, H1-32, H2-29, H2-30, H2-31, H2-32	All	Ground reference
BAT_VCC	H2-45, H2-46	EPS	Battery terminals (+)
ANT_VCC	H2-35, H2-36	EPS, ANT	Antenna power supply (3.3 V)
OBDH_VCC	H1-45, H1-46	EPS, OBDH	OBDH power supply (3.3 V)
EDC_VCC	H1-47, H1-48	EPS, EDC 1, EDC 2	EDC power supply (5 V)
RD_VCC	H1-49, H1-50	EPS, TTC	Main radio power supply (5 V)
BE_VCC	H1-51, H1-52	EPS, TTC	Beacon power supply (6 V)
RD_SPI_CLK	H1-35	OBDH, TTC	CLK signal of the main radio SPI bus
RD_SPI_MISO	H1-37	OBDH, TTC	MISO signal of the main radio SPI bus
RD_SPI_MOSI	H1-39	OBDH, TTC	MOS signal of the main radio SPI bus
RD_SPI_CS	H1-40	OBDH, TTC	CS signal of the main radio SPI bus
EPS_I2C_SDA	H2-49	OBDH, EPS	SDA signal of the EPS I2C bus
EPS_I2C_SCL	H2-51	OBDH, EPS	SCL signal of the EPS I2C bus
BE_UART_RX	H2-5	EPS, TTC	EPS TX, Beacon RX (UART bus)
BE_UART_TX	H2-7	EPS, TTC	EPS RX, Beacon TX (UART bus)
EDC_UART_TX/RX	H1-25	OBDH, EDC 1, EDC 2	OBDH TX, EDCs RX (UART bus)
EDC_UART_RX/TX	H1-27	OBDH, EDC 1, EDC 2	OBDH RX, EDCs TX (UART bus)
EDC_1_EN	H2-3	OBDH, EDC 1	EDC 1 enable signal
EDC_2_EN	H2-4	OBDH, EDC 2	EDC 2 enable signal
PLX_EN	H1-18	OBDH, Payload X	Payload X enable (GPIO)
PL_I2C_SDA	H1-41	OBDH, Payload X	SDA signal of the payload I2C bus
PL_I2C_SCL	H1-43	OBDH, Payload X	SCL signal of the payload I2C bus
GPIO_N	H2-8, H2-18, H1-20, H2-20, H2-22, H2-42	OBDH	GPIO pin (not used)

Table 4.2: PC-104 bus signal description.

CHAPTER 5

Subsystems

5.1 On-Board Data Handling

OBDH [1]

5.2 Telemetry, Tracking and Command Module

TTC [2]

5.3 Electrical Power System

EPS [3]

5.3.1 Battery Module

[4]

5.4 Attitude Determination and Control System

ADCS

5.5 Mechanical Structure

.

5.6 Interconnection Modules

5.6.1 PC-104 Interconnection Boards

[5]

5.6.2 External Connection Boards

[6]

5.7 Payloads

5.7.1 Environmental Data Collection

EDC [7]

CHAPTER 6

Ground Segment

.

CHAPTER 7

Operation Planning

Bibliography

- [1] Space Technology Research Laboratory (SpaceLab). *OBDH 2.0 Documentation*, 2020. Available at <<https://github.com/spacelab-ufsc/obdh2>>.
- [2] Space Technology Research Laboratory (SpaceLab). *TTC Documentation*, 2021. Available at <<https://github.com/spacelab-ufsc/ttc>>.
- [3] Space Technology Research Laboratory (SpaceLab). *EPS 2.0 Documentation*, 2021. Available at <<https://github.com/spacelab-ufsc/eps2>>.
- [4] Space Technology Research Laboratory (SpaceLab). *Battery Module 4C Documentation*, 2021. Available at <<https://github.com/spacelab-ufsc/battery-module-4c>>.
- [5] Space Technology Research Laboratory (SpaceLab). *PC-104 Adapter Documentation*, 2021. Available at <<https://github.com/spacelab-ufsc/pc104-adapter>>.
- [6] Space Technology Research Laboratory (SpaceLab). *Documentation of Interstage Interface Panels*, 2021. Available at <<https://github.com/spacelab-ufsc/interface-board>>.
- [7] Instituto Nacional de Pesquisas Espaciais (INPE). *Environmental Data Collector User Guide*, October 2019. CNS-MNL-PY-00-002-V01.