Interface Control Document

SatNOGS COMMS

Libre Space Foundation

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DRAFT

Contents

1. Introduction

1.1 Purpose

This Interface Control Document (ICD) defines the interface requirements for integrating SatNOGS COMMS into a Cubesat.

2. Mechanical interface

PCB dimensions, mounting holes, connector type and location follow LibreCube [1] standard. Interface connectors are SAMTEC ESQ-126–39–G-D. Mechanical drawing is shown in Figure 2.1

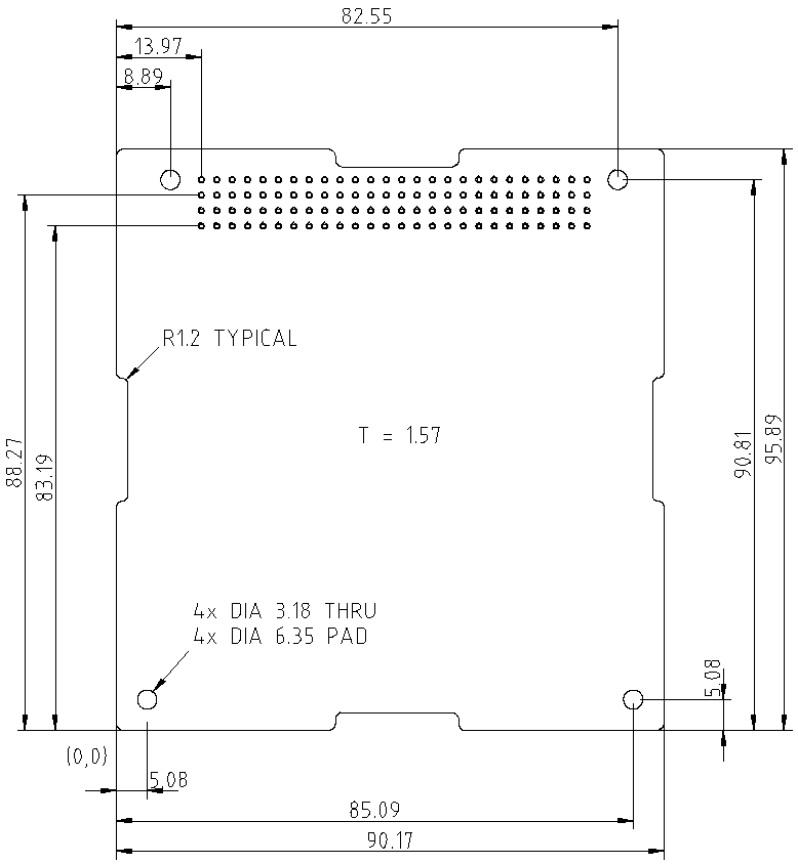

Figure 2.1: LibreCube mechanical drawing (dimensions in mm)

3. Subsystem interface

3.1 Subsystem Communication

For subsystem communication the following interfaces are available:

- Two CAN-FD interfaces backward compatible with CAN-2.0
- SPI Interface having maximum link speed of 8Mbps

CAN-FD fulfills interconnect link speed requirements. Subsystems only capable of CAN-2.0 can use SPI for data transfer and CAN-2.0 for control.

RF connectors will be either SMA or MCX

3.2 Antenna deployment

Antenna deployment interface exposes two closed loop control endpoints. Each endpoint consists of control signal and detection signal lines exposed via a Hirose DF11–8DP-2DS (52) with option of Hirose DF11–8DP-2DSA (01). Additionally these lines can be available on the main connector.

Control signal lines are software configurable as either 3.3V Push-Pull or Open-Drain. Maximum input voltage in Open-Drain configuration is restricted to 5V by protection diode. Control signal current is limited to 18mA via 270Ω resistor

Detection signal lines are 3.3V compatible and software configured as Pull-Up, Pull-Down or Floating. Pull-Up and Pull-Down resistor value is $40k\Omega \pm 10k\Omega$. Each detection line is protected from over-voltage via 3.3V Zener diode and 330Ω resistor.

Electrical connection of signal lines is provided via an 8 pin connector as shown in **??**

3.3 Power supply

COMMS transceiver accepts an input voltage range varying from 6V DC to 14V DC. Absolute maximum power consumption is estimated at 20W. This value should never be reached under normal operating conditions.

3.4 Ground Segment

3.4.1 Telemetry API

SatNOGS provides an API for receiving acquired telemetry as well as signal acquisition parameters. For non real-time operation, raw telemetry data is uploaded directly to SatNOGS DB servers by SatNOGS Client, on predefined intervals. This API endpoint accepts HDF5 formatted files which include additional information and metadata of the scheduled SatNOGS Network observation. The telemetry data are then processed and forward to the InfluxDB database of SatNOGS Dashboards in order to be visualized. For real-time operation, SatNOGS Client forwards the telemetry data to a SatNOGS Yamcs server. The SatNOGS Yamcs server receives the data through a data link plugin which provides a gRPC interface for telemetry. In this case, telemetry data is still eventually forwarded to SatNOGS DB via the Yamcs server and a SatNOGS DB API data link plugin.

3.4.2 Telecommand API

SatNOGS provides an API allowing telecommand data transmission. SatNOGS Client gRPC interface is used to receive telecommands. These commands are sent by the SatNOGS Yamcs server via a gRPC data link plugin. The client then forwards the telecommands to SatNOGS Radio in order to be encoded and transmitted via the SDR.

4. Connector Interface

4.1 BUS Connector

Connector type: SAMTEC ESQ-126–39–G-D
Pin assignment: Based on Librecube standard [1] Table 4.1

Pin	J102	J103
1	CAN A Low	CAN B Low
3	CAN A Low	CAN B Low
11	SPI MISO	-
13	SPI MOSI	-
15	SPI CLK	-
17	Antenna Detect 1	-
18	Antenna Deploy 1	-
19	Antenna Detect 2	-
20	Antenna Deploy 2	-
21	I2C SCL	-
23	I2C SDA	-
39	VIN	-
40	VIN	-

Table 4.1: Programming connector pin assignment

4.2 Antenna Deploy Connector

Connector type: Hirose DF11-6DP-2DS
Pin assignment: Table 4.2

Pin	Function
1	Deploy-1
2	Detect-1
3	Deploy-2
4	Detect-2
5	GND
6	GND

Table 4.2: Antenna Deploy connector pin assignment

4.3 Programming connector

Connector type: Hirose DF11-8DP-2DSA
Supported interfaces: SWD and JTAG
Pin assignment: Table 4.3

Pin	SWD	JTAG
1	3.3V Reference	3.3V Reference
2	Clock	Clock
3	GND	GND
4	IO	JTMS
5	RESET	RESET
6	SWO	JTDO
7	-	JTDI
8	-	-

Table 4.3: Programming connector pin assignment

4.4 RF Connectors

Antenna connectors can be SMA or MCX, straight or angled depending on user requirements

5. Interfaces Data Sheet

INTERFACE DATA SHEET				
	I/F Designation:	**DC Power interface**		
ID	**Source Circuit Specification**		Ver	Iss
-1	Bus voltage	6V-14V input range		
-2	Bus current	1.6A max @ 14V Bus voltage 3.5A max @ 6V Bus voltage		
-3	Response to bus undervoltage	All loads except MCU switch off automatically MCU is deactivated at 3.2V Bus voltage		
-4	Bus voltage (anomaly):	The load shall not be damaged when subjected to any bus voltage in the range 0V to 14V, steady-state or at any rate of change.		

Table 5.1: DC Power Interface characteristics

INTERFACE DATA SHEET				
	I/F Designation:	**SPI interface**		
ID	**Voltage, data rate and timing specification**		Ver	Iss
-1	Data rate	8 Mbps for 3m total bus length between devices		
-2	Voltage range	0V–3.3V		
-3	Voltage tolerance	-0.3V–5.5V		
-4	SPI clock frequency	Slave receiver mode: 100MHz max Slave mode transmitter/full duplex: 31MHz Slave mode transmitter/full duplex: 25MHz		
-5	NSS setup time	Min 2ns		
-6	NSS hold time	Min 1ns		
-7	Data input setup time	Min 2ns		
-8	Data input hold time	Min 1ns		
-9	Data input hold time	1ns		
-10	Data output access time	9ns–27ns		
-11	Data output disable time	Max 5ns		
-12	Data output valid time	Max 16ns		
-13	Data output hold time	Min 9ns		

Table 5.2: SPI Interface characteristics

INTERFACE DATA SHEET				
	I/F Designation:	**CAN interface**		
ID	**CAN Bus characteristics**		Ver	Iss
-1	Bus 1	compliant with ISO 11898–1[2] (CAN protocol specification version 2.0 part A, B) and CAN FD protocol specification version 1.0 Supports time triggered CAN (TT-FDCAN) specified in ISO 11898–4[3]		
-2	Bus 2	compliant with ISO 11898–1[2] (CAN protocol specification version 2.0 part A, B) and CAN FD protocol specification version 1.0		
-3	Receiver common mode input voltage	+/-12V		
-4	Bus fault protection	+/-58V		
-5	Max differential voltage between CANH and CANL	+/-45V		
-6	Bus termination	120 Ω at each end of the bus. Split termination is supported		

Table 5.3: CAN Interface characteristics

INTERFACE DATA SHEET				
	I/F Designation:	**Antenna interface**		
ID	**RF characteristics**		Ver	Iss
-1	UHF Impedance	50 Ω		
-2	S-Band impedance	50 Ω		
Deployment control				
-3	Output type	Push-pull or Open-drain		
-4	Output voltage	Push-pull: 3.3V Open-drain: 5V		
-5	Output current	Max 18mA		
Deployment detection				
-6	Input type	Pull-Up, Pull-Down or Floating		
-7	Input voltage	Nominal 3.3V Tolerant 5V		
-8	High threshold	2V		
-9	Low threshold	0.8V		
-10	Pull-up/Pull-down resistor	40kΩ±10kΩ		

Table 5.4: Antenna Interface characteristics

Bibliography

[1] LibreCube. LibreCube project.

[2] ISO/TC 22/SC 31. Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling, 2015.

[3] ISO/TC 22/SC 31. Road vehicles — Controller area network (CAN) — Part 4: Time-triggered communication, 2004.