CUBESPACE

Interface Control Document

CubeStar CT M3.0E5.3

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Revision History

Version	Authors	Date	Description
1.00	A. Scholtz	26/11/2025	First release of ICD for CubeStar M3.

Reference Documents

The following documents are referenced in this document.

[RD1] CS-DEV.PD.CT-M3.0E5.3 CubeStar Product Description, Ver.1.00 or later

[RD2] CS-DEV.UM.CT-M3.0E5.3 CubeStar User Manual, Ver.1.00 or later

[RD3] CS-DEV.ETP.CA-01 Generic Environmental Test Plan, Ver.1.05 or later

[RD4] CS-DEV.FRM.CA-01 CubeProduct Firmware Reference Manual, Ver.7.04 or later

List of Acronyms/Abbreviations

ADCS	Attitude Determination and Control System
AWG	American Wire Gauge
CAN	Controller Area Network
CoM	Centre of Mass
CT	CubeStar
EM	Engineering Model
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESL	Equivalent Series Inductance
FM	Flight Model
ICD	Interface Control Document
MoI	Moments of Inertia
MCU	Microcontroller Unit
OBC	On-board Computer
PCB	Printed Circuit Board
RF	Radio Frequency
UART	Universal Asynchronous Receiver/Transmitter

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1. Introduction

The purpose of this document is to provide information on how to correctly interface with CubeStar. This includes communications, power requirements, mechanical mounting and axes definitions, as well as guidelines on EMI/EMC compatibility. It is assumed that the reader is already familiar with the relevant product description document [RD1]. Details regarding environmental qualification, and a declared materials list, are available to clients upon request.

CubeSpace cannot guarantee nominal operation of CubeStar if the specifications provided in this document are not adhered to.

1.1 Document applicability

This version of the ICD applies to the hardware- and electrical versions described in Table 1. For older product versions, please request the applicable documentation from CubeSpace.

Table 1: Document Applicability

Version	Notes
M3.0E5.3	Integrated baffle SurTec 650 conversion coating (silver)

2. Electrical Interface

2.1 Communication Interfaces

2.1.1 CAN Characteristics

Table 2: CAN Bus Characteristics

Parameter	Value
Supported CAN standard	V2.0B
Supported bit rate	1 Mbit/s
Supported protocols	CubeSpace CAN Protocol, CubeSat Space Protocol (CSP)
Default CAN address	4 (configurable)
CAN termination	2 kΩ

2.1.2 UART and RS485 Characteristics

Table 3: UART/RS485 Characteristics

Parameter	Value
Maximum supported baud rate	921600 (configurable)
Data bits	8
Parity	None
Stop bits	1
RS485 address	1 (configurable)
RS485 termination	1 kΩ

RS485 communication can be selected as a custom option and must be specified by the client when placing the order.

When RS485 is selected, the UART interface will not be available.

2.1.3 Boot Line

CubeStar implements a boot line to enable access to the MCU's low-level ROM bootloader. It is used by CubeSpace to initially flash the CubeSpace software bootloader to the MCU, which is thereafter used for uploading flight software. This boot line pin may be left unconnected, however it is recommended to connect it to the ADCS/OBC as a recovery method in case the software bootloader needs to be updated or re-flashed.

Due to hardware restrictions, the software bootloader cannot be upgraded or re-flashed over RS485.

2.2 Power Interface

Typical power consumption characteristics for CubeStar are independent of satellite size or the ADCS mode being used.

Table 4: Power Consumption on 3.3 V Line

Parameter	Value	Notes
Average current	58 mA	Measured over a 1-second loop in tracking mode.
Average power	192 mW	
Maximum current	110 mA	
Maximum power	363 mW	
Inrush current peak	176 mA	
Inrush current duration	~2.35 ms	

2.2.1 Enable Line

CubeStar implements an externally controlled enable line to power on the device. The enable line is active-high and should be controlled by the client ADCS/OBC.

2.2.2 3.3 V Power Switch

CubeStar implements an input power switch on the 3.3 V line that is enabled by pulling the enable line high. The power switch also provides a current limit of ~700 mA to protect against latch-up events. Under- and overvoltage protection is also implemented, with a range of 2.5 V – 3.9 V depending on thermal conditions.

2.2.3 Client ADCS/OBC Power Protection Requirements

The CubeSpace ADCS Core implements voltage and current monitoring on the 3.3 V line to CubeStar to ensure that the supply voltage is always within range and to mitigate the effects of latch-up in the event of a fault. If CubeStar is not used as part of a CubeSpace ADCS bundle, it is recommended that the client ADCS/OBC implements the same protection.

2.2.4 Power and Signal Ground

CubeStar does not have separate power and signal ground, all circuits share the same ground.

2.3 Header Pinout and Electrical Characteristics

The pinout designation of the header is shown in Figure 1 below.

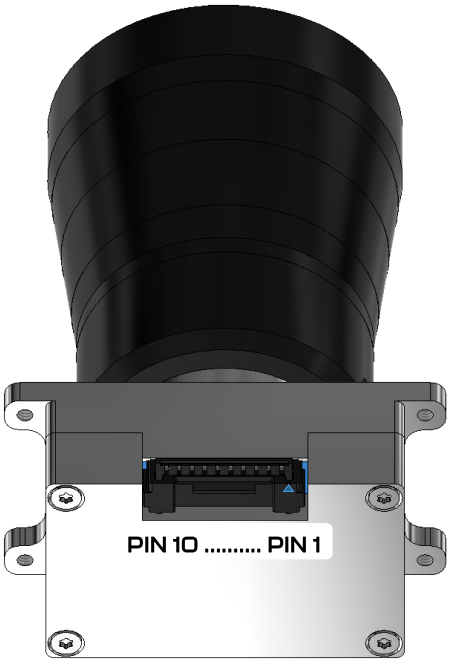

Figure 1: CubeStar Pinout Designation

Table 5: Header Details

Part	Description	Part Number
Header	Molex Micro-Lock Plus PCB Header	5055671081
Mating housing	Molex Micro-Lock Plus Receptacle Crimp Housing	5055651001
Housing terminal	Molex Micro-Lock Female Crimp Terminal	5054311100

Table 6: Header Pinout and Electrical Characteristics

Pin #	Pin Name	Pin Description	IO Type	Voltage Range [V]
1	Boot	Toggle ROM bootloader on startup Active-high Leave disconnected if unused	Input	0 to 3.4
2	GND	Power and signal ground	Power	0
3	3V3	Supply voltage	Power	3.2 to 3.4
4	UART Tx	UART data transmit line (default)	Output	0 to 3.4
	RS485 A	RS485 A (alternative)	Bidirectional	
5	CAN P	High level CAN bus line	Bidirectional	0 to 3.4
6	CAN N	Low level CAN bus line	Bidirectional	0 to 3.4
7	UART Rx	UART data receive line (default)	Input	0 to 3.4
	RS485 B	RS485 B (alternative)	Bidirectional	
8	GND	Power and signal ground	Power	0
9	GND	Power and signal ground	Power	0
10	Enable	Toggle power on Active-high	Input	0 to 3.4

2.4 Harness Details

A standalone CubeStar ships with two harnesses: an EM harness as part of the ground support equipment package to allow for immediate testing and health checks, and a standard FM pigtail harness that can be used by the client to assemble a flight harness. The standard FM pigtail harness specifications are described in Table 7. The standard length can be cut shorter, and longer (custom) lengths can be arranged during order placement but may affect lead time.

Table 7: Harness Details

Harness	Std. Length [mm]	No. Wires	Wire Gauge [AWG]	Wire Mass [g/m]	Housing Mass [mg]	Terminal Mass [mg]	Total[1] Mass [g]
FM pigtail	800	10	26	1.96	198.8	35.434	16.2

Harness lengths longer than 800mm have shown unsafe voltage changes over the 3.3V and GND wires depending on the ADCS bundle architecture. If harness lengths over 800mm are required, please contact CubeSpace.

The Molex Micro-Lock Plus 1.25mm Pitch connectors are rated for a maximum of thirty (30) mating cycles only. Care must be taken with flight harnesses to not exceed this threshold.

CubeSpace GSE test harnesses with all-black insulation, or without twisted pairs and braiding, are not safe for spaceflight or for use in a vacuum.

During satellite assembly and integration, take note of the minimum bending radius of the harnesses of 10 mm.

[1] Weight of the supplied pigtail harness only, excludes ADCS/OBC mating parts.

3. Mechanical Interface

CubeStar's electronics are enclosed in a 6082-T6 aluminium enclosure, treated with a chromate conversion coating. The baffle and lens assembly consist of black anodized 6068-T6 aluminium, and 17-4PH stainless steel. The baffle is internally coated with black low-outgassing, low reflectivity and high absorptivity paint.

The dimensions given in this chapter are indicative only. The mechanical CAD files with the latest dimensions are supplied to customers and must be used for final design and fitment verification.

3.1 Outer Dimensions

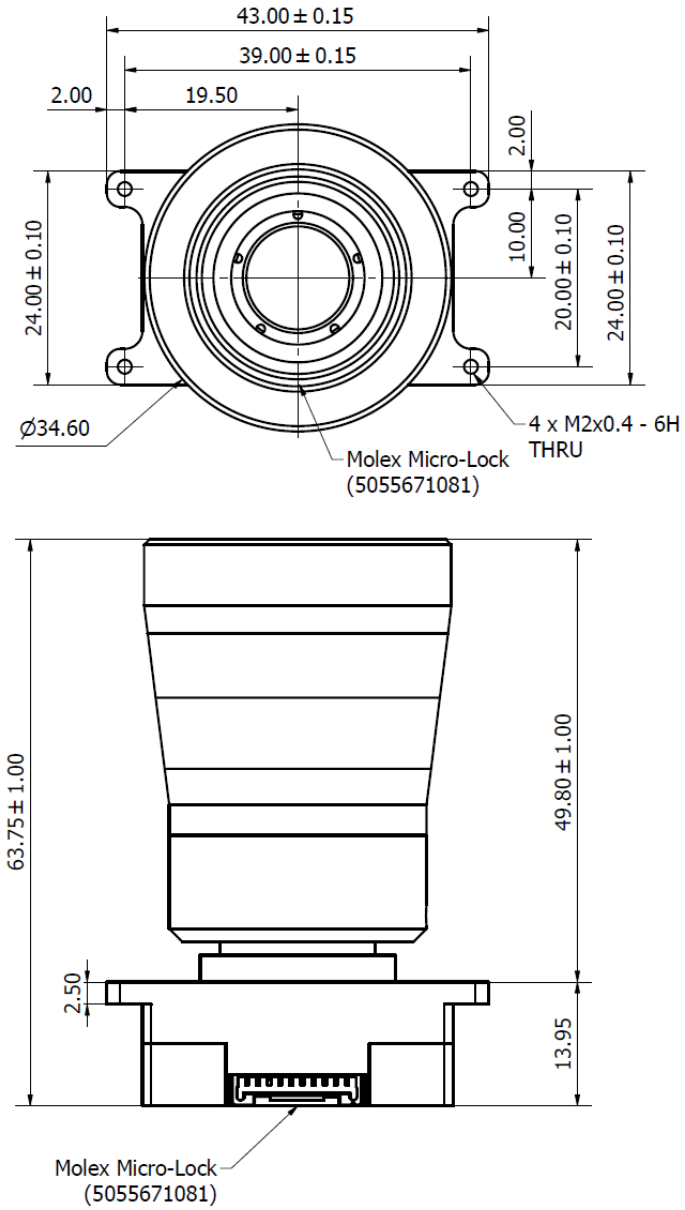

Figure 2: Indicative Dimensions of CubeStar

3.2 Mounting Definition

Mounting of CubeStar is performed via 4 x M2x0.4 mm threaded through holes as shown in Figure 2, that must be accessed from the face (lens side) of the enclosure. The lens of CubeStar is sufficiently supported by the enclosure and does not require additional external support.

3.2.1 Mounting Restrictions

CubeStar has an exclusion angle of 70° total (35° from boresight). It is important to ensure that CubeStar is orientated such that no object, including the Sun, Earth, Moon, or any panels or deployable structures from the satellite, will enter this exclusion angle during operation. The preferred mounting location will be to ensure the boresight is pointing as much as possible towards the zenith direction and away from the sun during nominal flight orientation.

CubeStar should not be mounted on the same surface as reaction/momentum wheels.

3.3 Mass, CoM and Inertia

CubeStar has a mass of 70 g ± 5 % (excluding harness and lens cap). The centre of mass location is indicated in Figure 3 below.

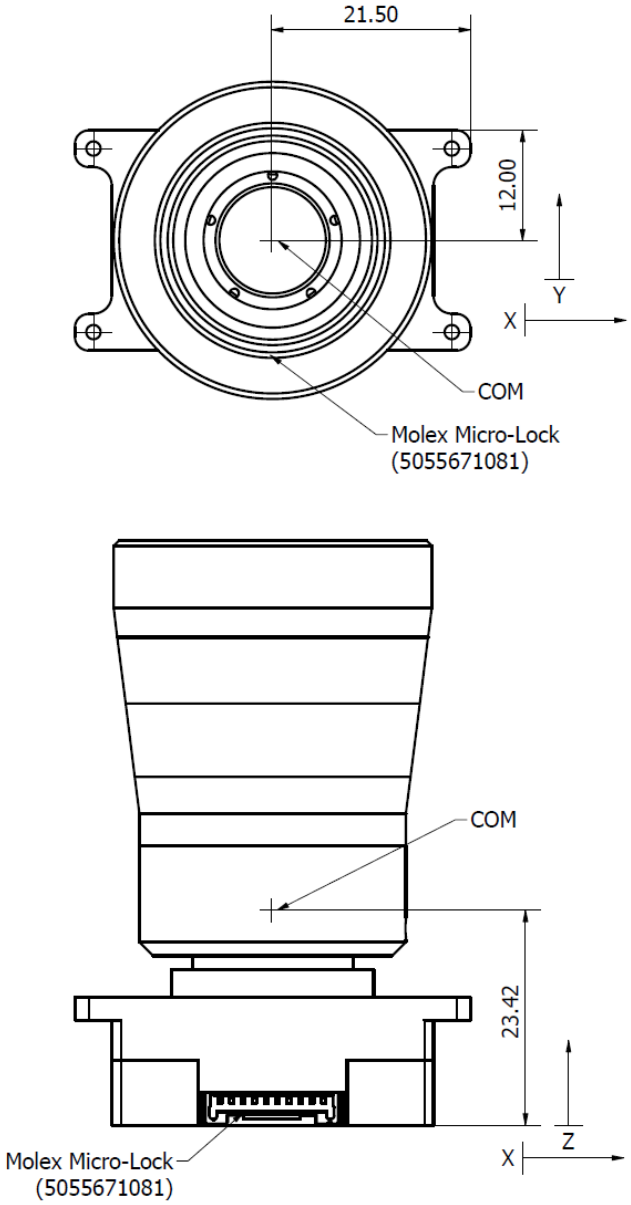

Figure 3: CoM Position of CubeStar without a Baffle

The MoI of CubeStar about its CoM are presented in Table 8, using the coordinate system definition shown in Figure 3. Please note the orientation of the Y-Axis with regards to the connector location.

Table 8: Moments of Inertia

Axis	Value [gmm²]
I_{xx}	20269
I_{yy}	20214
I_{zz}	5824

4. Software Interface

Each CubeProduct is accompanied by a user manual [RD2] that provides details regarding telemetry exchanges using ground support equipment. For further information regarding software interfacing and control, please refer to the firmware reference manual [RD4].

5. Measurement Coordinate System Definition

Vector and attitude outputs from CubeStar are referenced to the measurement coordinate system indicated in Figure 4. Note the orientation of the Y-Axis with regards to the connector location.

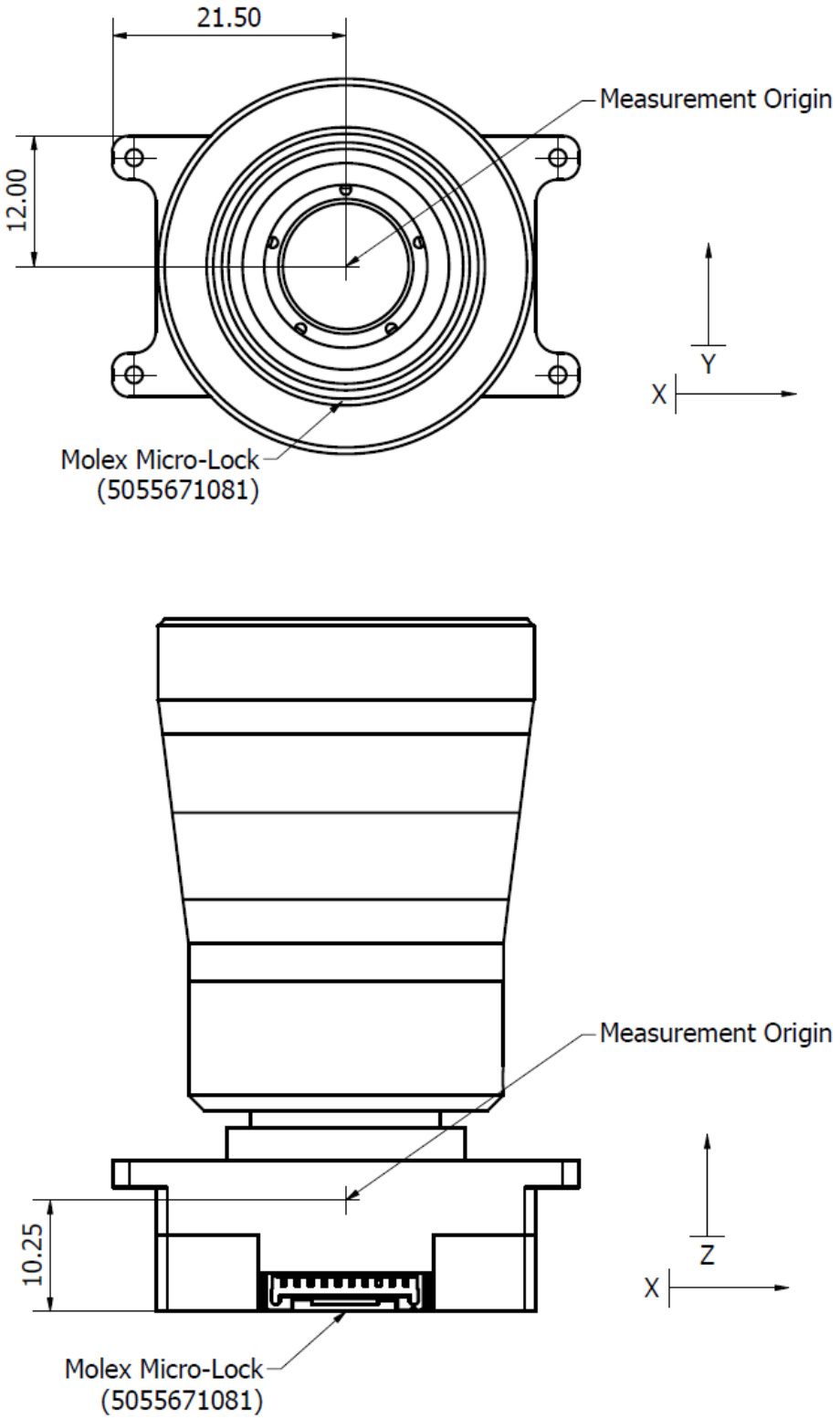

Figure 4: Measurement Coordinate System Definition

6. EMI/EMC

6.1 Potential RF Emitters

Table 9: Potential RF Emitters

Source	Frequency [MHz]	Frequency Stability [ppm]
MCU clock	24	± 50
Image sensor clock	20	± 50

6.2 EMI/EMC Cleanliness

6.2.1 Enclosure Grounding

The enclosure and mechanical parts of CubeStar are connected to the power and signal ground through a filter designed to minimise EMI, as illustrated in Figure 5. The enclosure of CubeStar can be grounded by the user if desired.

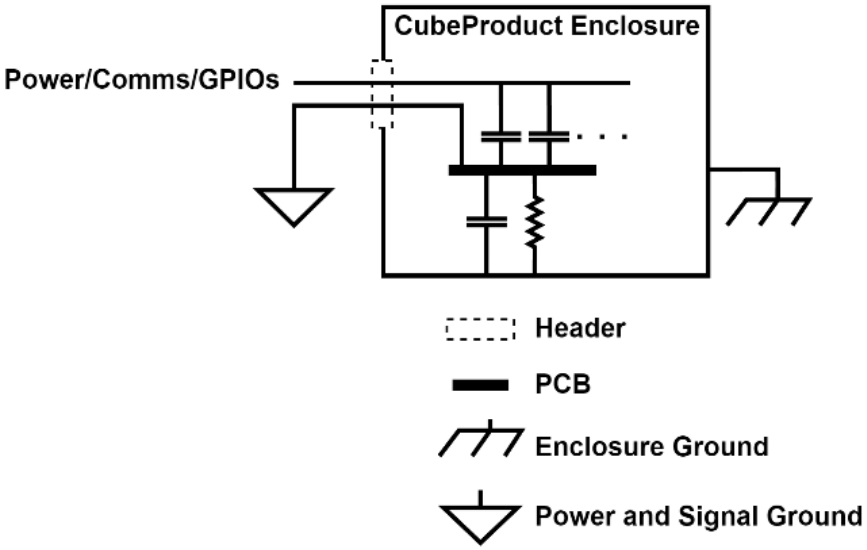

Figure 5: Enclosure Grounding

The enclosure's RC filter design consists of a high value resistor in parallel with a low ESL capacitor. This dissipates high frequency noise to ground and also conducts static buildup away from the enclosure. The commonly used alternative method where the enclosure is directly connected to the ground introduces the risk that a short circuit could occur during satellite integration.

In some cases a customer might require the enclosure of CubeStar to be completely isolated from the system ground by removing the EMI filters completely. In such a case, it should be specified as a custom option during order placement.

6.2.2 Shielding

Shielding of CubeStar electronics is accomplished by the mechanical enclosure as a Faraday cage. The enclosure makes contact to the chassis ground trace on each PCB. This chassis trace is connected to the PCB power and signal ground through the filter discussed in section 6.2.1.

6.2.3 Filtering and Suppression

The following noise filtering strategies are implemented on CubeStar:

- All pins that are externally exposed through headers are filtered by way of 100 pF decoupling capacitors to power and signal ground as shown in Figure 5.
- RC filtering is applied on the CAN and UART communication interfaces to minimize spurious frequencies above 1 MHz.

The following noise filtering strategies are recommended for consideration on the client ADCS/OBC side:

- LC filtering on the 3.3 V supply and the boot- and enable lines to CubeStar.
- Common-mode filtering on the CAN communication interface to CubeStar.