CUBESPACE

Product Description

CubeStar CT M3.0E5.3

DOCUMENT NUMBER	CS-DEV.PD.CT-M3.0E5.3
VERSION	1.00
DATE	21/11/2025
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DISTRIBUTION LIST	External

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Revision History

Version	Authors	Date	Description
1.00	A. Scholtz	21/11/2025	First release of Product Description for CubeStar M3.0E5.3

Reference Documents

The following documents are referenced in this document.

[RD1] CS-DEV.ICD.CT-M3.0E5.3 CubeStar Interface Control Document, Ver.1.00 or later

List of Acronyms/Abbreviations

ADCS	Attitude Determination and Control System
API	Application Programming Interface
CAN	Controller Area Network
ECI	Earth-Centred Inertial
EMI	Electromagnetic Interference
FDIR	Fault Detection, Isolation, and Recovery
HMI	Human Machine Interface
ICD	Interface Control Document
OBC	On-board Computer
PCB	Printed Circuit Board
UART	Universal Asynchronous Receiver/Transmitter

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1. Introduction

This document presents and describes the CubeStar, shown in Figure 1, as a standalone product which can be integrated with a client satellite system.

This document serves as a prelude to the documentation pack described in Section 1.2.

Figure 1: CubeStar

1.1 Document applicability

This version of the Product Description 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)

1.2 Documentation Pack

The CubeStar is provided with a set of standard documents which are listed in Table 2.

Table 2: CubeStar Standard Documentation

Document	Description
Product Description (This Document)	Provides an overview of the CubeStar. It is typically supplied to prospective clients to allow a better understanding of the CubeStar.
Interface Control Document (ICD)	Detailed information about the physical aspects of the CubeStar addressing technical aspects of all interfaces. It is typically supplied to prospective clients to allow a better understanding of the CubeStar and how to interface to it.
User Manual	Describes all functions and features in more detail. It also guides the user to conduct a health check to confirm the CubeStar is “alive and well” after receipt of the shipment at the client. It is only supplied to clients after the purchase of a CubeProduct.

Document	Description
API User Manual	Describes the communication messages that the client ADCS/OBC will use to interface with the CubeStar in detail as well as where to find the API definitions and source files. It is only supplied to clients after the purchase of a CubeProduct.
Software Guide	Describes how to make use of provided software packages. It is only supplied to clients after the purchase of a CubeProduct.
CubeProduct Firmware Reference Manual	Provides a complete description of protocols used by communication transport layers. It is only supplied to clients after the purchase of a CubeProduct.
Bootloader Application Manual	Describes how to use the bootloader and make use of all features. It is only supplied to clients after the purchase of a CubeProduct.
Delivery Report	Report to indicate that quality assurance took place on the delivered unit/s and that a complete health check was performed at CubeSpace before shipment.

2. CubeStar Detailed Description

2.1 Overview

CubeStar is a medium to high accuracy star tracker designed for low power consumption, in a small form factor.

The main features of CubeStar include:

- Outputs full quaternions
- Lost-in-space and tracking modes
- Flight-proven algorithms
- Integrated baffle
- M2 threaded mounting holes
- Aluminium case with EMI filters
- CubeSpace common node design (shared across CubeProducts)
- In-orbit re-programmability

2.2 Subsystem Diagram

Figure 2 provides a high-level block diagram of CubeStar.

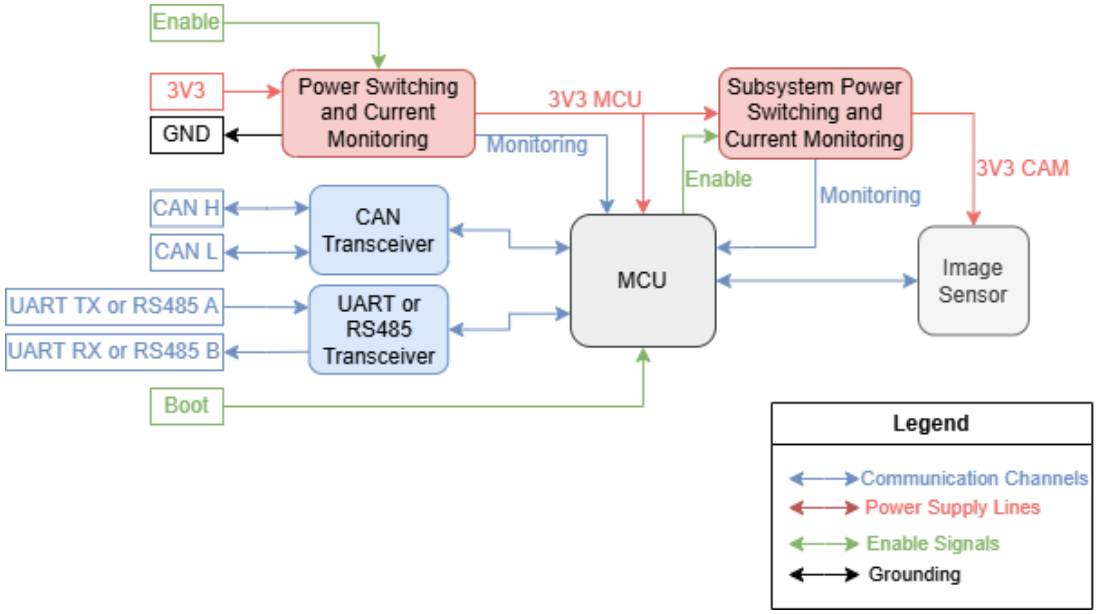

Figure 2: CubeStar Block Diagram

2.3 Performance Characteristics

Table 3: CubeStar Performance Characteristics

CubeStar		
Performance		
Accuracy ["] (Dependent on slew)	Cross-axis (3-sigma)	35
	Roll (3-sigma)	175
Max slew rate [°/s]	0.3	
Physical		
Mass [g]	70 ± 5 %	
Dimensions [WxHxL] [mm]	43x24x63.75	
Exclusion Angle [°] (total)	70	
Power and Data		
Data bus	CAN/UART/RS485	
Connector	Molex Micro-Lock Plus	
Update rate [Hz]	Up to 1	
Supply voltage [V]	3.3	
Maximum power [mW]	363	
Average power [mW]	192	
Qualification Levels		
Radiation	24 kRad	
Random vibration	14.16 g RMS (NASA GEVS)	
Thermal vacuum [°C]	-20 to 80	
Thermal cold and hot start [°C]	-35 to 70	

2.4 Interconnect

The CubeStar is designed to be connected to the CubeSpace ADCS Core or to the client ADCS/OBC by means of harnesses. These harnesses are based on the Molex Micro-Lock Plus family of wire-to-board connectors. These harnesses are made with low-outgassing insulated wires.

Each CubeStar is delivered with a ground support harness to be used for health checks, as well as a pigtail FM harness that can be used to assemble the final flight harness.

2.5 Pre-loaded Firmware Applications

The CubeStar is supplied with two pre-loaded applications, the bootloader and the control program.

2.5.1 Bootloader

The bootloader is the first application that will run when the CubeStar is powered on. It has the following features:

- Allows for quick identification through communications messages and protocol that is common across all CubeProducts
- Allows CubeStar control program and configuration to be updated
- Supports FDIR

- Exposes bootloader API to Host Device over communication channels

2.5.2 Control Program

The control program is the main program of the CubeStar. It has the following features:

- Supports FDIR
- Supports CubeStar management (e.g., power, status, setup, and configuration)
- Supports CubeStar sensor sampling
- Reports CubeStar measurement telemetry:
  - Image capture results
  - Image sensor information
  - Star detection results
  - Attitude quaternion results
  - Estimated angular rates
  - Best detected stars results
  - Current consumption
  - Temperature
- Exposes control program API to host device

2.6 CubeStar Coordinate Systems

CubeStar will output a measured attitude quaternion that will transform from J2000 ECI reference frame to the CubeStar's Measurement Coordinate System, defined in [RD1].

2.7 CubeStar Sensor Placement

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.

3. Ground Support Equipment

3.1 Support software (CubeSupport Application)

The user is provided with ground support software called CubeSupport. This allows the user to directly connect to CubeStar and to gain access to all telemetries and telecommands. The CubeSupport application also has convenient HMI elements for uploading and upgrading firmware, and downloading images, event logs, and telemetry logs.

3.2 Support hardware (CubeSupport PCB)

CubeSpace provides ground support equipment to allow the user to power and interface with the CubeStar out of the box. All required cables, harnesses and documentation are provided to allow the user to perform a health check of the CubeStar upon delivery to the client.