

# X-CAM INSTRUMENT ONBOARD PROBA-2

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## ABSTRACT

The X-CAM instrument is one of the technology experiments carried onboard PROBA-2, an ESA mission dedicated to the demonstration of spacecraft technology and providing a flight opportunity for new technologies to promote their usage in future missions. X-CAM is an innovative concept of a very tiny observation system for generic monitoring purposes, that can monitor the spacecraft separation from the launcher, its attitude, devices deployment, solar panel degradation and so on. It includes a powerful micro-camera equipped with specific optics.

## 1. INSTRUMENT DESCRIPTION

The X-CAM Instrument is composed of two sub-units:

- The X-CAM Micro-Camera fitted with a 100° diagonal FOV optics;
- The UART Module to interface the X-CAM micro-camera with the Advanced Data and Power Management System (ADPMS) of the Proba-2 Spacecraft.

An overview of the instrument architecture is given Fig. 1.

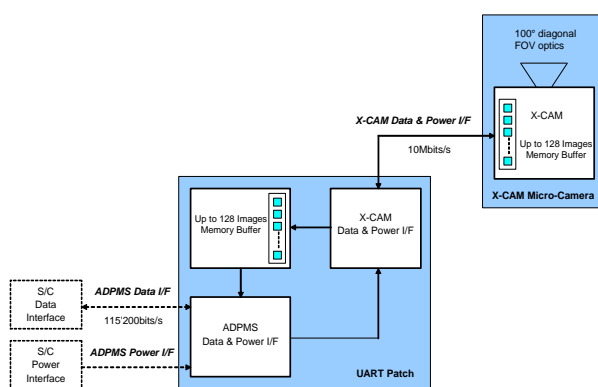


Figure 1: X-CAM Instrument architecture overview

The X-CAM Micro-Camera is composed of a camera head offering a storage capability of 32 uncompressed pictures with a resolution of 16-bits or 64 uncompressed pictures with a resolution of 8-bits or 128 lossless

compressed pictures with a resolution of 8-bits. The micro-camera is fitted with 100° FOV optics.

The UART Module is composed of the three main following parts:

- The X-CAM Data and Power I/F controls the data handling and the power management of the X-CAM Micro-Camera.
- The Image Memory Buffer allows the storage of 32 uncompressed pictures with a resolution of 16-bits or 64 uncompressed pictures with a resolution of 8-bits or 128 lossless compressed pictures with a resolution of 8-bits.
- The ADPMS Data and Power I/F ensures the link with the S/C.
- The data communication between the X-CAM Instrument and the S/C passes through a RS422 full duplex asynchronous serial bus with a fixed speed of 115'200 bits/s.

The X-CAM instrument is powered with a +28VDC voltage supplied by the ADPMS.

### 1.1. X-CAM Micro-Camera

The heart of the X-CAM Micro-Camera is composed of a CCD sensor of 1024 x 1024 pixels connected to an AD Converter with a conversion speed of 1 MSPs and a selectable resolution of 16-bits or 8-bits.

The embedded FPGA owns a dedicated data compression algorithm which allows a lossless compression of a picture taken by the camera with a minimum compression ratio of 2.

The micro-camera has a SDRAM memory of 512 Mbits offering a storage capability of 32 uncompressed pictures with a resolution of 16-bits or 64 uncompressed pictures with a resolution of 8-bits or 128 lossless compressed pictures with a resolution of 8-bits.

The micro-camera communicates with the UART Module through a RS422 full duplex synchronous serial bus with a fixed speed of 10 Mbits/s.

The X-CAM Micro-Camera, equipped with a 100° FOV rad-hard optics and its bracket for fixation to the spacecraft, is depicted Fig. 2.



Figure 2: X-CAM Micro-Camera

## 1.2. UART Module

The UART Module (Fig. 3) controls the data handling and the power management of the X-CAM Micro-Camera.

It communicates with the micro-camera through a RS422 full duplex synchronous serial bus with a fixed speed of 10 Mbits/s.

The UART Module has a SDRAM memory of 512 Mbits offering a storage capability of 32 uncompressed pictures with a resolution of 16-bits or 64 uncompressed pictures with a resolution of 8-bits or 128 lossless compressed pictures with a resolution of 8-bits.

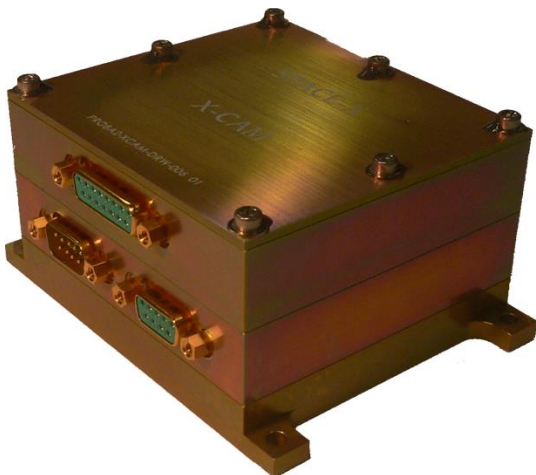


Figure 3: UART Module

The UART Module communicates with the S/C through a RS422 full duplex asynchronous serial bus with a

fixed speed of 115'200 bits/s.

## 2. PERFORMANCES SUMMARY

### 1.3. X-CAM Micro-Camera

- 100° diagonal FOV rad-hard optics
- 1024 x 1024 pixels CCD Image sensor
- 16 bits of A/D conversion
- Conversion rate of 1 image/s
- Storage capability of 32 images of 16 Mbits each (512 Mbits embedded memory)
- Dedicated data compression algorithm for lossless compression of pictures with a minimum compression ratio of 2
- Download at 10 Mbits/s from the Micro-Camera to the UART Module
- Local Temperature measurement
- Only +5V and +15V power supply inputs
- Power consumption: 1.8 W
- Mass: 221 g including bracket
- Volume: 77 x 82 x 75 mm<sup>3</sup>

### 1.4. X-CAM UART Module

- Conversion of the S/C +28V to +5V, +3.3V, +2.5V and +15V with input EMI filter
- Data communication with the S/C through the UART I/F
- Micro-Camera Power & data management
- Storage capability of 32 images of 16 Mbits each (512 Mbits embedded memory)
- Download at 115'200 bits/s from the UART Module to the S/C
- Signal conditioning of the temperature sensor (RTD) of the Micro-Camera
- Power consumption: 1 W
- Mass: 413 g
- Volume: 55 x 110 x 86 mm<sup>3</sup>

## 3. FLIGHT CONFIGURATION

The X-CAM Micro-Camera is mounted on the S/C panel external side whereas the UART Module is mounted on the same S/C panel internal side (Fig. 4).

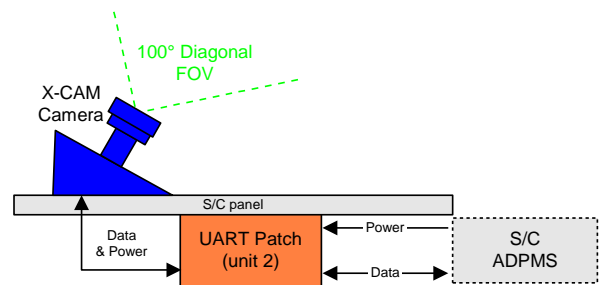


Figure 4: X-CAM flight configuration

The location of the 2 X-CAM Instrument units on the S/C is given in the Fig. 5.

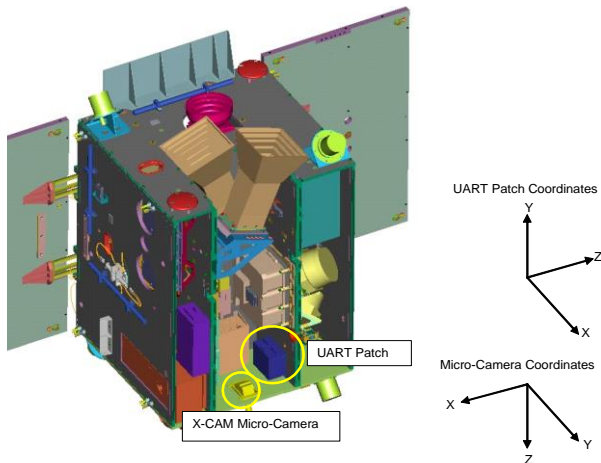


Figure 5: X-CAM Instrument on S/C

#### 4. INSTRUMENT OPERATION

The X-CAM Instrument has two operating modes, the idle mode and the task mode.

The X-CAM Instrument accepts one or several command(s) only when it has reached the idle mode after a switch-on setting time of 500 ms.

In the task mode, the instrument executes the current command after completion of the previous command.

The flow chart given Fig. 6 details the operating mode of the X-CAM Instrument.

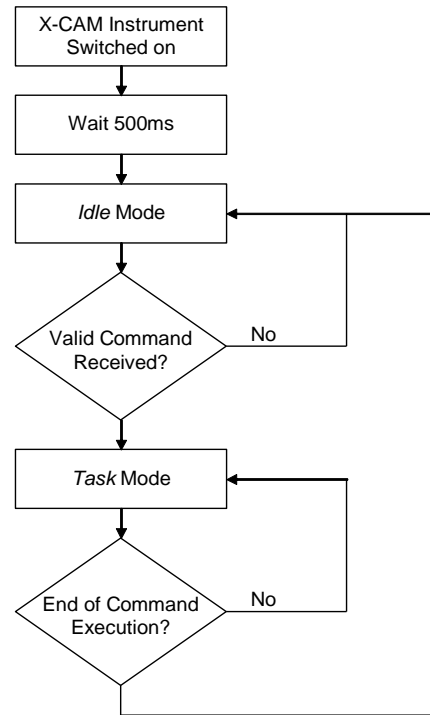


Figure 6: X-CAM Instrument Operating Mode

In order to increase the usage flexibility, the X-CAM Instrument can stack up to 64 commands sent by the S/C.

All the commands present in the stack are executed sequentially (FIFO operating mode). When the last command has been executed, the instrument stays in the idle mode until the next command is received from the S/C.

If a command is received when the stack is full, it is discarded by the instrument.