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3plusD
a HEICO company

# SPACE CAMERAS

# SPACE CAMERAS FOR VIDEOS AND IMAGING

## Overview

3D PLUS Space Camera family offers standard products targeting a wide range of imaging applications and are designed for space environment. Using high reliability and qualified parts, and with widely used communication interfaces, IRIS Space Camera Family is an efficient and competitive choice for your space missions.

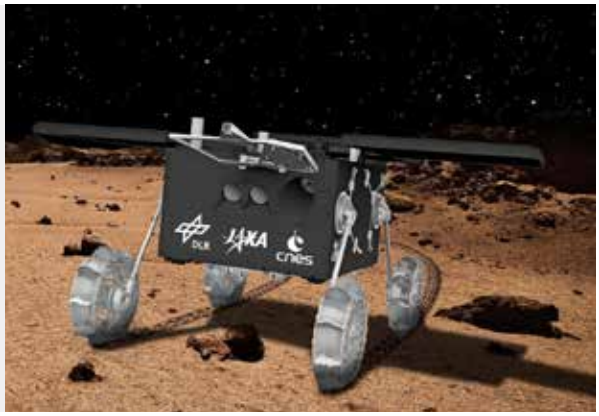
Credit: NASA

### PLATFORM AND PAYLOAD MONITORING

3D PLUS Space Cameras are perfectly suitable for monitoring applications, allowing to verify the correct deployment of your spacecraft's solar panels and antennas, or to watch over the operation of the instruments (drill monitor,robotic arm,...).They also allow to widely communicate on the mission's operations.

### GUIDANCE, NAVIGATION AND CONTROL

3D PLUS Space Cameras are efficient solutions for GN&C applications, and are used as rover navigation cameras and in-orbit servicing main imaging sensors. Their modularity allows to select the most suitable configuration for your application.




Credit: JAXA/CNES/DLR

### DETECTION, OBSERVATION AND TRACKING

3D PLUS Space Cameras expanding family provides efficient and simple solutions for observation applications, such as earth observation, debris detection and tracking, or spacecraft situational awareness (SSA).

## STANDARD SPACE CAMERAS LINE-UP

3D PLUS offers multiple off-the-shelf Space Camera configurations with its IRIS and IRIS HD line-up, based on its CASPEX 4M and CASPEX 12M Camera Heads and existing space qualified optics.

| | IRIS 8mm | IRIS 11mm | IRIS 25mm | IRIS 50mm | IRIS HD 8mm |
|---|---|---|---|---|---|
| **Focal Length** | 7.9mm | 11.6mm | 25mm | 50mm | 7.9mm |
| **FoV (Edge to Edge)** | 80° (H) x 80° (V) | 56° (H) x 56° (V) | 25° (H) x 25° (V) | 12.5° (H) x 12.5° (V) | 82° (H) x 74° (V) |
| **Aperture** | f/8 | f/9 | f/9 | f/7.5 | f/8 |
| **Optical angular resolution** | <1.2 mrad | 1.3 mrad | 0.25 mrad | 0.125 mrad | <1.2 mrad |
| **Spectral bandwidth** | 450-700nm | 450-700nm | 450-700nm | 450-700nm | 450-700nm |
| **Camera Core** | CASPEX 4M | CASPEX 4M | CASPEX 4M | CASPEX 4M | CASPEX 12M |
| **Sensor Resolution** | 4 Mpixels Global shutter 2048 x 2048 | 4MPixels Global shutter 2048 x 2048 | 4 Mpixels Global shutter 2048 x 2048 | 4MPixels Global shutter 2048 x 2048 | 12MPixels Global shutter 4096 x 3000 |
| **Integrated processing** | Binning, windowing mode | Binning, windowing mode | Binning, windowing mode | Binning, windowing mode | Binning, Windowing, H264 compression |
| **Performances** | 2 full frames per second | 2 full frames per second | 2 full frames per second | 2 full frames per second | 30 frames per second in Full HD |
| **Interface** | Space Wire | Space Wire | Space Wire | Space Wire | Space Wire |
| **Mass** | < 400g | < 400g | < 400g | < 400g | < 800g |
| **Volume** | 86x72x69 $mm^3$ | 86x72x76 $mm^3$ | 86x72x80 $mm^3$ | 86x72x120 $mm^3$ | 90x84x92 $mm^3$ |
| **Power supply** | 4.5 to 9V | 4.5 to 9V | 4.5 to 9V | 4.5 to 9V | 4.5 to 5.5V |
| **Average Power Consumption (25°C)** | 1.5W | 1.5W | 1.5W | 1.5W | 5W |
| **Operationnnal Temperature** | -40 to +55°C | -40 to +55°C | -40 to +55°C | -40 to +55°C | -55 to +55°C |
| **Environment** | LEO, GEO and Deep Space missions | LEO, GEO and Deep Space missions | LEO, GEO and Deep Space missions | LEO, GEO and Deep Space missions | LEO, GEO and Deep Space missions |

# SPACE CAMERAS RELATED PRODUCTS

## CASPEX Camera Heads

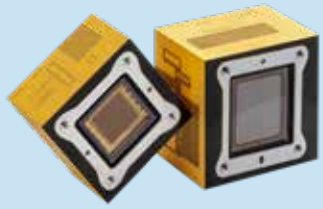
3D PLUS successful CASPEX camera heads product line offers multiple off-the-shelf solutions for your optical instruments. For specific applications not covered by our cameras, these camera heads bring the performances and miniaturization needed for highly constrained missions.

### APPLICATIONS

- Earth observation, Planetology
- Platform monitoring (equipment, payload)
- GN&C (Rendez-vous, navigation, tracking)
- Spectroscopy

### FEATURES

- Highly miniaturized All-in-one module
- Generic reconfigurable FPGA based architecture
- Radhard by design



| | CASPEX 4M Visible | CASPEX 12M Visible | CASPEX SWIR |
|---|---|---|---|
| **RESOLUTION** | 2048 x 2048 pixels, 5.5µm pitch, RGB or Mono | 4096x3000 pixels, 3.45µm pitch, RGB or Mono | 1280x1024 pixels, 5µm pitch |
| **OPTOELECTRONIC PERFORMANCES** | Read Noise : 13e-<br>Dark Current : 125e-/s<br>FWC: 13.5ke- | Read Noise : 2.5e-<br>Dark Current : 10e-/s<br>FWC: 11ke- | Read Noise : 240e-<br>Dark Current : 28ke-/s<br>FWC: 170ke- |
| **SPECTRAL RESPONSE** | 400-1000 nm | 400-1000 nm | 400-1700nm |
| **INTERFACES** | 12 LVDS pairs, 13 GPIO<br>4.5 to 9V power supply, average consumption 1.5W at 25°C | 12 LVDS pairs, 13 GPIO<br>4.5 to 9V power supply, average consumption 5W at 25°C | 22 configurable LVDS pairs 4.5 to 5.5 power supply, average consumption 5W at 25°C |
| **OPERATING TEMPERATURE RANGE** | -40°C to +70°C | -55°C to +70°C | -55°C to +70°C |
| **RELIABILITY** | TID > 30 krad(Si)<br>SEL immune | TID > 40 krad(Si)<br>SEL immune | TID > 40 krad(Si)<br>SEL immune |
| **DIMENSIONS** | 35x35x23 $mm^3$,<br>62g | 40x40x45$mm^3$,<br>125g | 40x40x50$mm^3$,<br>140g |

## FPGA Code and IPs

3D PLUS offers multiple IP products for its FPGA-based camera architecture. From full turn-key solutions with standard interface (ex: SpaceWire, CameraLink,...), Controller IP Cores, to fully custom FPGA designs, 3D PLUS Camera solutions can answer all your image processing needs.

## Evaluation Kit and GSE

3D PLUS offers ready-to-use prototyping solutions and ground support equipments for each of its Space Camera products. From electrical interface to acquisition software, the 3DEV evaluation kits allows you to easily characterize and integrate our camera solutions on your platform.

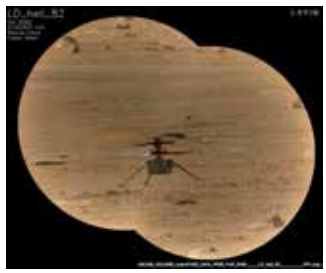
## Electronic Control Unit

3D PLUS developped an electronic control unit, integrating a 28V-5V DC-DC converter, communication interface protection, and Multi cameras router, able to operate up to seven IRIS Cameras, with a redundant spacewire connection to the platform, to provide a multi-camera monitoring system for spacecrafts.

# Flight **HERITAGE**

## SuperCam Perseverance Rover

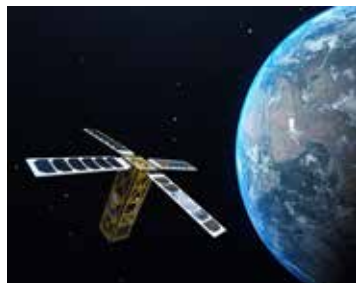
3D PLUS CASPEX 4M camera head is part of Perseverance's SuperCam instrument, providing imaging capability for soil monitoring and long distance imaging, as the opto-electronic head of the Remote MicroImager sub-equipment. It landed on Mars in early 2021.



Credit:NASA/JPL-Caltech/LANL/ CNES/CNRS

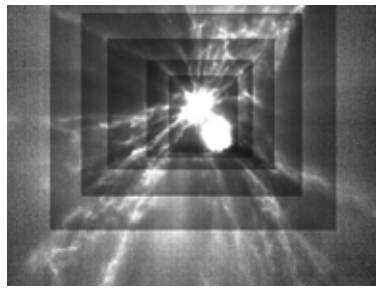
## EyeSat

3D PLUS CASPEX 4M camera head is the optoelectronic core of the Iris instrument, on EyeSat 3U nanosatellite. It was launched in 2019 in LEO and used for solar system study and zodiacal light analysis.



## Dart LICIACube

3D PLUS CASPEX 4M camera head is the optoelectronic head of the LEIA camera, that was used in 2022 to confirm the DART spacecraft impact with the Dimorphos asteroid.



Credit: ASI/NASA/APL

## Mars Sample Return

3D PLUS IRIS and IRIS HD Space cameras are part of the ongoing MSR program, providing imaging capability for both the Earth Return Orbiter (Multicamera monitoring system, especially martian sample capture monitoring) and Sample Return Lander robotic arm (Sample Transfer Arm, as critical sample detection and capture camera).

Credit: ESA/NASA

# AN INNOVATIVE COMPANY

## COMPANY OVERVIEW

3D PLUS is a world leading supplier of advanced high density 3D microelectronic products and Die/Wafer Level stacking technology meeting the demand for high reliability, high performance and very small size of today's and tomorrow's electronics.

We offer standard products and custom System-in-Package (SiP) solutions based on our patented technology. The company is ISO 9001 : 2015 certified and its stacking technologies is qualified by the European Space Agency for Space applications.

## SPACE EXPERTISE

Recognized for their electrical performances, miniaturization, quality, reliability and radiation assurance level, 3D PLUS's Space qualified products bring key advantages to all Space application fields:

- **Consumer Applications**: telecommunication, navigation, internet...
- **Durable Development**: environment and climate monitoring
- **Defense & Security**: Earth observation
- **Space Transportation**: launch and manned space vehicles
- **Science**: astronomy, space exploration and interplanetary missions

## FLIGHT PROVEN PRODUCTS

With more than 200.000 modules in orbit today and a failure-free flight heritage of more than 25years, 3D PLUS is the largest Space Qualified MCM manufacturer in Europe.

3D PLUS's products are used by all the major space agencies and customers worldwide. They are used in numerous missions: Dart LiciaCube, Mars 2020, Curiosity, New Horizons, Parker Solar Probe, Proba-1, ISS, Rosetta, Sentinel, Bepi-Colombo, Insight, OneWeb, Solar Orbiter and many more in the near future.

## 3D PLUS BENEFITS

- HIGH DENSITY
- HIGH SPEED PERFORMANCE
- SMALL FORM FACTOR
  75 % space and weight savings in the design
- HIGH RELIABILITY
- SPACE QUALIFIED TECHNOLOGY
- FLIGHT PROVEN PRODUCTS
- RADIATION HARDENED (TID, SEE)
- LONG TERM SUPPLY GUARANTY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