OUR MISSION IS THAT YOU ACHIEVE YOURS

3D plus

a HEICO company

SPACE PRODUCT CATALOG

ABOUT **3D PLUS**

COMPANY OVERVIEW

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

Our patented technology portfolio starts with standard package scale upward to die-size and wafer-level stacking processes. It enables stacking heterogeneous active, passive and opto-electronic devices in a single highly miniaturized package. Comparing to other existing 2D traditional solutions, our technology allows gaining a factor of at least 10 on the weight and volume.

3D PLUS standard products and System-In-Package (SiP) solutions bring breakthrough advantages to our customers' electronic designs. They are used in diverse computer boards, data recorders boards and custom applications for buses and payloads. Our Flight Heritage is expanding continuously with products launched in Space every month in GEO, MEO and LEO orbits, for deep space exploration missions, for satellite constellation fleets, and for governmental missions.

Since our creation in 1995, we have been pursuing a constant growth with today customers spread over 30 countries.

3D PLUS MAIN BENEFITS

MINIATURIZATION

Size reduction for the PCB and weight savings for the application.

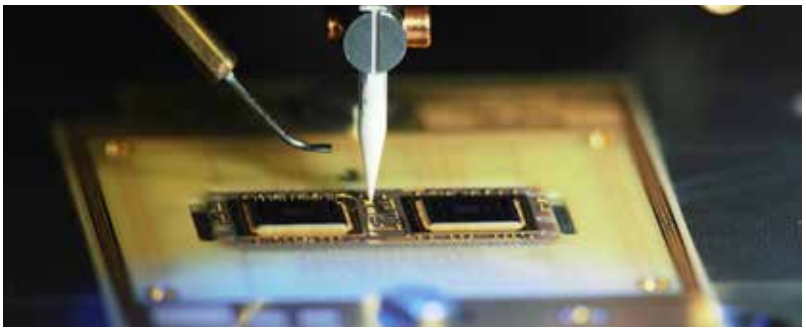
HIGH RELIABILITY

Proven technology combined with a unique design and manufacturing know-how developed for more than 20 years.

RADIATION EXPERTISE

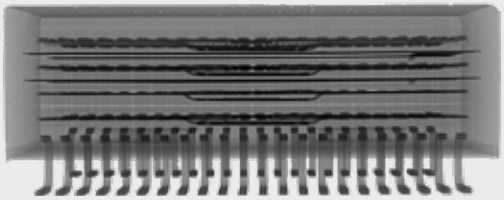
A strong space radiation expertise for high reliability products.

OUR UNIQUE KNOW-HOW

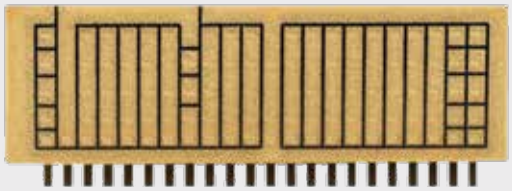


3D PLUS offers high reliability and high performance innovative products thanks to a strong design activity of complex electronic modules and a high level of technical capability in various areas such as digital, analog and IP cores. These abilities, combined with a strong Space Radiation expertise, enable us to bring key advantages for all kinds of space missions with a very high level of guarantee.

3D PLUS has been recognized for its innovation in design and manufacturing of miniaturized 3D modules for more than 25 years. With a capability of stacking up to 10 semiconductor devices up to 1 mm each, 3D PLUS ultra low profile modules are unique.



X-Ray inside view of the stacked layers



External view with vertical electrical interconnections

PROVEN TECHNOLOGY

Our proven patented technology brings high performance and small footprint for customer applications. The European Space Agency approved 3D PLUS manufacturing line.

HIGH PERFORMANCE

Extended thermal cycles - High mechanical resistance - High temperature - Space qualification.

LONG TERM AVAILABILITY

Expertise in obsolescence management and long term supply, we can guarantee availability of our products for very long term programs.

FLIGHT HERITAGE

"Design for Space" products definition. Space applications heritage upward to 20 years missions in geostationary orbit.

QUALITY **COMMITMENT**

3D PLUS' Quality and Reliability Organization is the executive arm of the quality assurance for the entire company. It is responsible for ensuring that 3D PLUS has the most competitive systems, processes, and programs in place to drive strategic quality improvements goals. To ensure that stringent product quality and reliability expectations are integrated throughout the company, 3D PLUS has established a global Quality Policy. 3D PLUS will provide a competitive advantage to its customers through timely, innovative, and defect-free products with outstanding service and specific customer support organization with systematic continuous improvement.

ISO 9001 CERTIFICATION

Certification to external standards is one example of how 3D PLUS strives to meet the needs of its worldwide customers. 3D PLUS Headquarter factory, Technical Center and Sales sites, as well as our major subcontractors, are certified to prestigious internationally recognized quality standards. 3D PLUS has continued its Quality excellence path by successful periodic renewal audits performed by third-party Lloyd's Register Quality Assurance.

ESA CERTIFICATION

The European Space Agency approved 3D PLUS manufacturing line for Space Applications.

ENVIRONMENTAL POLICY

3D PLUS as an ecoresponsible company is committed for several years to the environmental protection, of the goods and people. In its leading position of micro-electronic components manufacturer for space applications, the environment and the safety constitute major axes of improvement. 3D PLUS is engaged in the GREEN initiatives and committed to be in line with regulation providing statement concerning RoHS, REACH and Halogen Content.

CSR POLICY

Aware of the challenges related to the environment and concerned about the role we must play in our ecosystem, 3D PLUS obtained its Corporate Social Responsibility label at confirmed level in 2023 to meet the challenges of sustainable development of its activities, for its clients, with the involvement of its employees and its partners.

Our main objectives are to :

- Optimize our growth and sustain economic development
- Promote the well-being and professional development of our employees
- Preventing health and safety, quality, environmental and social responsibility risks
- Interact with our key stakeholders
- Respect the rules of conduct, ethics and regulations

SPACE **EXPERTISE**

3D PLUS products and SiPs are used by the major Aerospace Prime contractors, systems and equipments manufacturers and space agencies worldwide. Recognized for their electrical performance, miniaturization, quality, reliability and radiation assurance level, 3D PLUS space qualified products are used in all types of space applications:

- **Consumer Applications:** telecommunication, navigation, Internet
- **Sustainable Development**: environment and climate monitoring
- **Defense & Security:** Earth observation
- **Space transportation:** launch and manned space vehicles
- **Science**: astronomy, deep space exploration and interplanetary missions

RADIATION **ASSURANCE**

With more than 220,000 modules in space as of 2024, and with more than 25 years of flight heritage with no reported failure, 3D PLUS is the largest Hybrid space qualified catalog products and customer system-in-packages (SIPs) manufacturer in Europe. In space, electronic devices are subject to radiation environment, and 3D PLUS Radiation Assurance Policy has been initially set-up for its Radiation Tolerant Products to cover the effects induced by the space radiation environment:

TOTAL IONIZING DOSE (TID)

Ionization induced in semiconductor materials or associated insulators, such as silicon dioxide layers, can lead to charge trapping or the formation of interface states at the semiconductor-insulator boundary, affecting component behavior or material properties. In MOS devices, the trapped charge can lead to a shift in the gate threshold voltage, and for semiconductors in general, interface states can significantly increase device leakage currents. The device tolerance depends on the semiconductor technology, process, diffusion mask, and wafer fabrication facility. The device tolerance is expressed in krad(Si) based on wafer diffusion lot - batch code.

SINGLE EVENT EFFECTS (SEE)

Effect caused either by direct ionization from a single travelling particle or by recoiling nuclei emitted from a nuclear interaction. The device tolerance is dependent on the semiconductor technology, process, and diffusion mask. The device tolerance is expressed in Linear Energy Transfer (LET) (MeV.cm^2/mg) and cross section (cm^2/device or cm^2/bit) based on die mask revision. The SEE can be distinguished in three main categories:

- **Single Event Latch-up (SEL)**
  Potentially destructive triggering of a parasitic PNPN thyristor structure in a device.
- **Single Event Functional Interrupt (SEFI)**
  Interrupt caused by a single particle strike which leads to a temporary nonfunctionality (or interruption of normal operation) of the affected device.
- **Single Event Upset (SEU)**
  Single bit flip in a digital element that has been caused either by direct ionization from a traversing article or by a recoiling nuclei emitted from a nuclear interaction.
- **Single Event Transient (SET)**
  A momentary voltage excursion (voltage spike) at a node in an integrated circuit caused by a single energetic-particle strike.

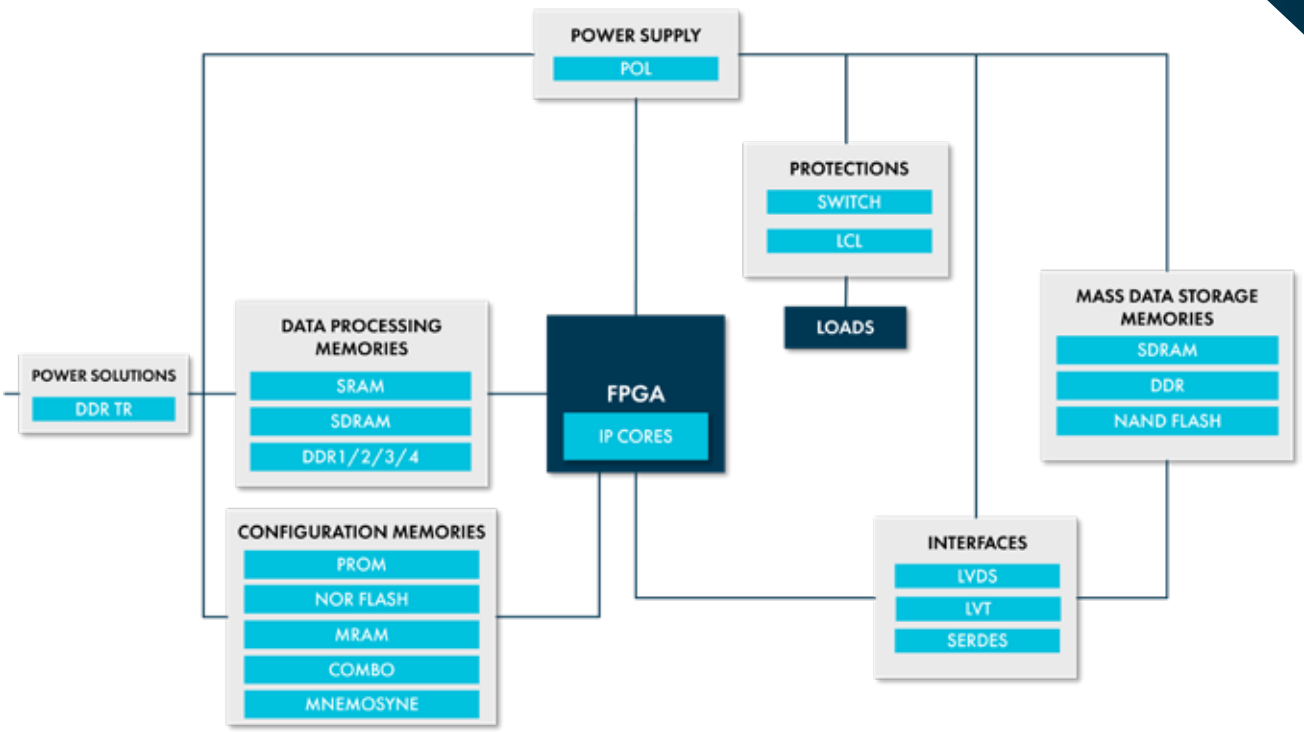
PRODUCT PORTFOLIO

3D PLUS standard product portfolio includes a large range of Volatile and Non Volatile Memories, Memory Controllers, Computer Cores, Camera Heads, Interfaces, Point-of-Loads, Latch-Up Protections and Termination Regulators.

3D PLUS products are fully space qualified and offer key advantages to our customers' electronic design:

- High reliability
- Excellent signal integrity
- High speed performance
- Radiation hardened by design
- Small form factor
- Flight proven solutions

COMPONENTS



MICRO-SYSTEMS

IMAGING SOLUTIONS

Opto-electronic modules:

- CAMERA HEAD
- CAMERA SYSTEMS
- CAMERA ROUTERS

FUSIO RT COMPUTER CORES

Modules embedding :

- FPGA
- TMR MEMORY
- ADDITIONAL MEMORY: Computing and mass data storage

RTIMS FLASH

Radiation Tolerant Intelligent Memory Stacks embedding :

- RHBD FMC ASIC
- NAND FLASH
- TMR, EDAC

FPGA COMPANION CHIP

COMBO embedding:

- RHBD COMPUTER CORE
- 64 Gbit NAND FLASH
- LOGICS FOR BOOT AND SCRUB FPGA

CUSTOM SOLUTIONS: **SYSTEM-IN-PACKAGE**

A System-In-Package consists of a number of dissimilar integrated circuits enclosed in a single highly miniaturized package. The SiP performs all or most of the functions of an electronic system, and, it can contain several silicon components (bare die or package) and passive components.

Thanks to the 3D PLUS stacking technology, from a customer's schematic or specification, the generated SiP allows gaining a factor of at least 10 times on weight and volume of the customer PCB. Our strong expertise in Digital, Analog and IP cores combined with our unique know-how in stacking technology for Space Radiation environment make our SiP your missions enablers. 3D PLUS provides a one-stop source for customer's concept analysis, feasibility study, design, manufacturing and test of high reliability and high performance SiP.

1

INITIAL CONCEPT ANALYSIS AND FEASIBILITY STUDY

- Initial requirements analysis
- Initial feasibility study and SiP technology selection
- Manufacturing line selection

2

REQUIREMENTS DETAILED ANALYSIS

- Detailed requirements specification analysis
- Final design trade-offs & feasibility studies
- Product Requirement Specification

3

PRELIMINARY DESIGN

- Functional and physical partitioning analysis
- Module physical architecture and layers' definition
- Preliminary mechanical outline
- Electrical analysis (power, critical signal paths, I/Os,...)
- Thermal and mechanical analysis
- Environmental compatibility analysis

4

DETAILED DESIGN

- Detailed design and lay-out of the module
- Electrical Analysis and simulation
- Final thermal and mechanical analysis
- Detailed design report
- Test equipment and procedure definition
- Product validation and qualification plan

5

PROTOTYPES MANUFACTURING AND TEST

- Design and manufacturing of the test specific tools
- Parts and materials procurement
- Manufacturing and test of prototypes
- Validation
- Final updated Product specification and data sheet

6

INDUSTRIALIZATION AND FLIGHT MODELS MANUFACTURING

- Procurement of the additional specific manufacturing and test tools
- Flight Models Manufacturing
- Qualification

Processing Memories
DDR4 Ecosystem

3D PLUS DDR4 memory modules are part of a complete DDR4 ecosystem, providing fully space qualified memory subsystem solutions and operating in a wide temperature range.

3D PLUS's DDR4 Ecosystem includes:

- A wide range of **DDR4 memories** to handle high speed computing data requirements;
- A **DDR4 Termination Regulator** to efficiently provide stable V_{TT} to DDR4 components;
- **DDR4 Radiation Intelligent Memory Controller** (RIMC) IP that allows enhanced protection and mitigation against SEUs/SEFIs.

DDR4 SDRAM MEMORY

KEY FEATURES

- Radiation tolerant and highly reliable DDR4
- High bandwidth: 2400 MT/s
- High density: up to 64 Gbit
- Large data bus width: x80 bits, x72 bits, x48 bits

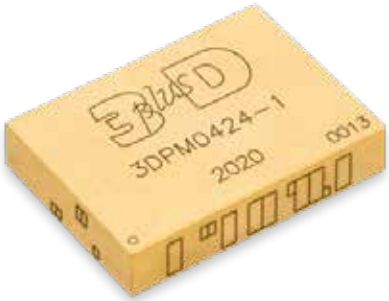
RADIATION DATA

- TID > 100 krad(Si)
- SEL immune up to LET > 62.8 MeV.cm²/mg
- SEU/SEFI protection / mitigation thanks to RIMC IP

DDR4 TERMINATION REGULATOR

KEY FEATURES

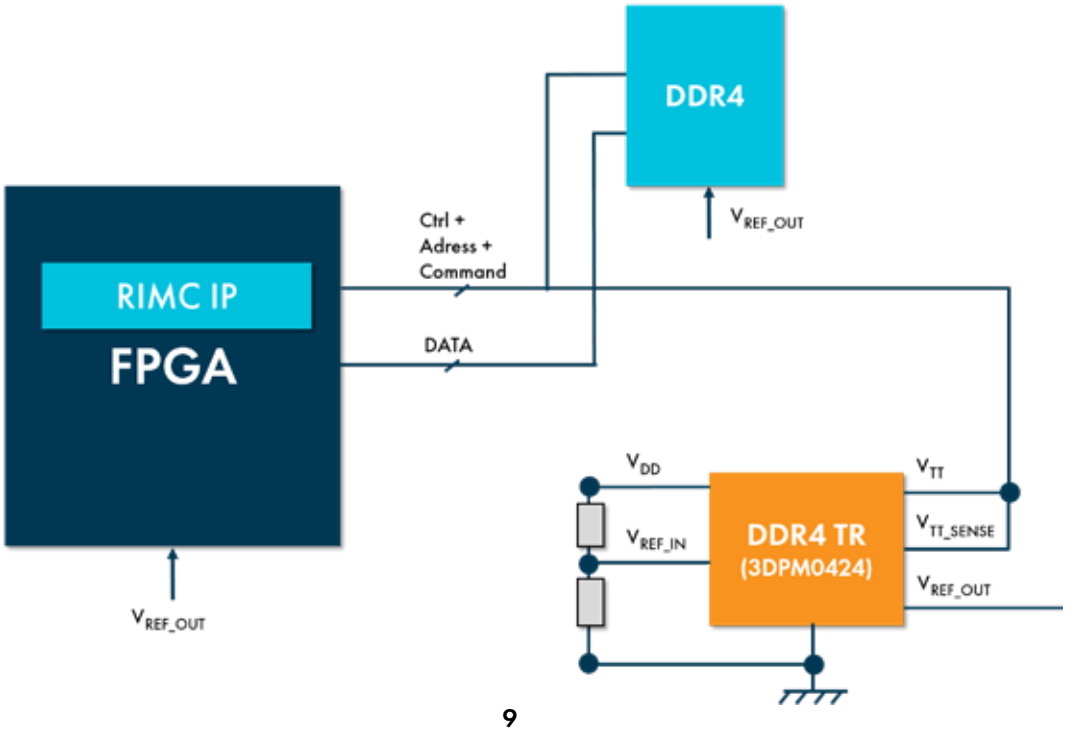
- Source and Sink current capability ±2 A
- JESD79-4C compliant solution
- Thermal protection
- Eliminates the need for external capacitors



RADIATION INTELLIGENT MEMORY CONTROLLER (RIMC)

KEY FEATURES

- High performance DDR4 controller
- Scrubbing mechanisms (user-definable)
- Configurable user interface AMBA compliant AXI/APB
- Enhanced SEU protection with ECC (Hamming or Reed Solomon)
- SEFI mitigation



80-BIT DDR4

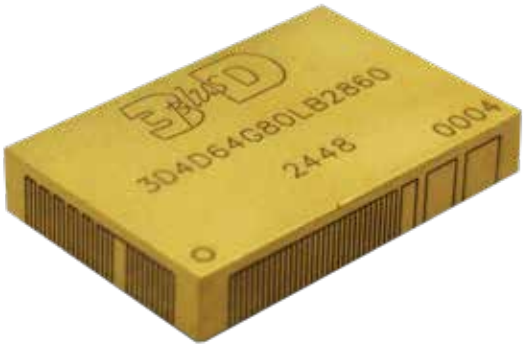
3D4D64G80LB2860

PRODUCT OVERVIEW

With a rich heritage in space electronics, 3D PLUS delivers cutting-edge, radiation-tolerant memory solutions, from SDRAM to DDR4. The latest in our DDR4 family is the 3D4D64G80LB2860, featuring an 80-bit bus width and designed specifically for space applications. This high-speed, integrated DDR4 Synchronous Dynamic RAM offers 64 Gbit of memory using 10 chips of 1G x8 bits each. It supports 64-bit data and 16-bit ECC for efficient Single Event Effect (SEE) management, significantly enhancing the reliability of systems using processors or FPGAs.

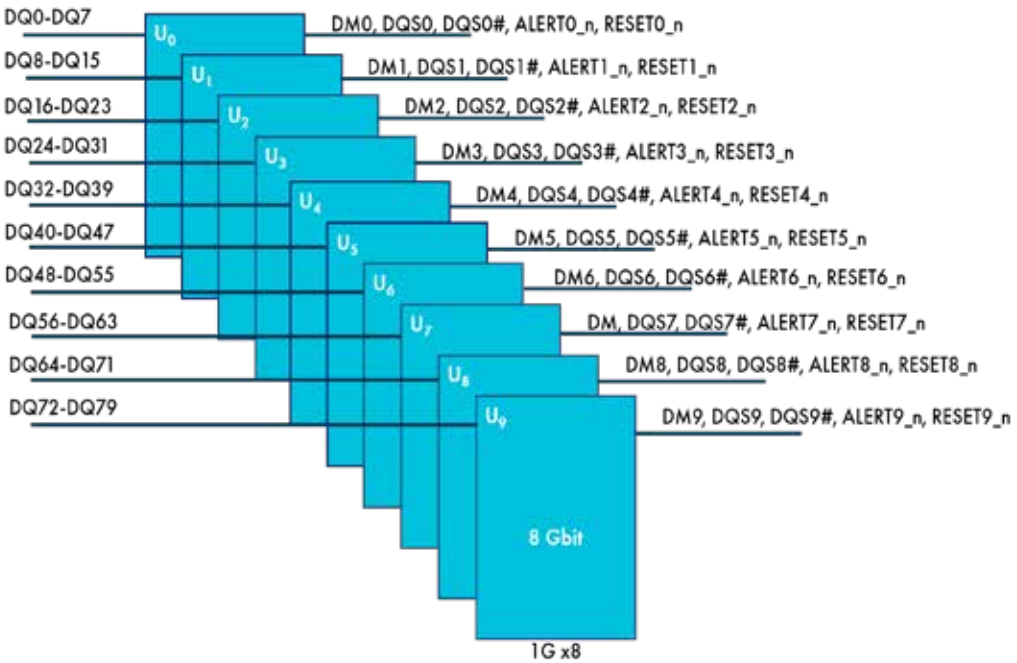
KEY FEATURES

- Up to 2400 MT/s data rate
- 64 Gbit overall density (+ 16 Gbit spare for ECC)
- 80-bit data bus
- Embedding 10x 8 Gb devices
- Independent RESET and ALERT



APPLICATIONS

Processing memory.



NEWEST **SDRAM**

3DSD1G48VB2820

PRODUCT OVERVIEW

Since their market debut in 2003, 3D PLUS space-qualified SDRAMs have been a cornerstone of high-performance computing in space. They serve as processor RAM in advanced computer boards and as high-density storage in Solid State Data Recorders. 3D PLUS is introducing 3DSD1G48VB2820, a new memory, to broaden the space SDRAMs portfolio. This module features 1.5 Gbit density with 48-bit data bus and 3.3V power supply.

KEY BENEFITS

- Small footprint
- Long life electronics: 15-18 years mission in space.

APPLICATIONS

- High density storage memory in SSD recorders boards.
- Processor's RAM for high performance computer boards.

RADIATION TOLERANCE

- TID > 50 krad(Si)
- SEL > 80 MeV.cm²/mg
- SEU: 7 MeV.cm²/mg

LARGEST FLIGHT HERITAGE

With a proven track record, 3D PLUS SDRAMs boast an impressive flight heritage across various space applications, including:

- **Science and Deep Space Missions:** Powering NASA's Juno mission since 2011.
- **Earth Observation:** Supporting COSMO-SkyMed satellites since 2007.
- **Launch Vehicles:** Integrated into Ariane 5 rockets.
- **Navigation Satellites:** Essential to the Galileo system.

Globally, these SDRAMs have been instrumental in missions like:

- **BepiColombo**: An ESA/JAXA collaboration launched in 2018.
- **EMM (Emirates Mars Mission)**: Launched by the UAE in 2020.
- **Chandrayaan-3**: Launched by ISRO in July 2023.

VOLATILE MEMORIES

DDR4	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3D4D16G72LB2832	16 Gbit	256M x 72	1.2	1200 MHz	100	62.8	2.6	$4x10^{-12}$ [3]	BGA 259	3DPA-8252
3D4D24G48LB2833	24 Gbit	512M x 48	1.2	1200 MHz	100	62.8	2.6	$4x10^{-12}$ [3]	BGA 259	3DPA-8256
3D4D32G72LB2805	32 Gbit	512M x 72	1.2	1200 MHz	100	62.8	2.6	$6x10^{-12}$ [3]	BGA 259	3DPA-8260
3D4D48G48LB2825	48 Gbit	1G x 48	1.2	1200 MHz	100	62.8	2.6	$6x10^{-12}$ [3]	BGA 259	3DPA-8246
3D4D64G80LB2860	64 Gbit	1G x 80	1.2	1200 MHz	100	62.8	2.6	$6x10^{-12}$ [3]	BGA 363	3DPA-8351

Temperature: C, I, S. Specific temperature range: -55 °C to +105 °C

DDR3	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3D3D16G16YB4751	16 Gbit	1G x 16	1.35 or 1.5	667 MHz	75	67	0.4	$1.05x10^{-11}$	BGA 95	3DPA-8172
3D3D16G72WB2723	16 Gbit	256M x 72	1.35 or 1.5	667 MHz	75	67	0.4	$1.05x10^{-11}$	BGA 199	3DPA-8173
3D3D24G48YB2732	24 Gbit	512M x 48	1.35 or 1.5	667 MHz	75	67	0.4	$1.05x10^{-11}$	BGA 259	3DPA-8250

Temperature: C, I, S. Specific temperature range: -40 °C to +105 °C

DDR2	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3D2D1G08US1285	1 Gbit	128M x 8	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	SOP 74	3DPA-8186
3D2D2G08US2662	2 Gbit	256M x 8	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	SOP 74	3DPA-8187
3D2D2G16UB2684	2 Gbit	128M x 16	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	BGA 95	3DPA-8188
3D2D4G08US4661	4 Gbit	512M x 8	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	SOP 74	3DPA-8189
3D2D4G72UB3652	4 Gbit	64M x 72	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	BGA 191	3DPA-8201
3D2D6G48UB3687	6 Gbit	128M x 48	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	BGA 143	3DPA-8190
3D2D6G48UQ3694	6 Gbit	128M x 48	1.8	125-333 MHz	100	68	2.3	$5.6x10^{-11}$	QFP 144	3DPA-8191
3D2D8G08US8663	8 Gbit	1G x 8	1.8	125-200 MHz	100	68	2.3	$5.6x10^{-11}$	SOP 88	3DPA-8192

Temperature: C, I, S. Specific temperature range: -40 °C to +105 °C

IP CORES	P/N[4]	DESCRIPTION	TARGET FPGAs
RIMC DDR2	3DIPMC0700	Configurable high performing DDR controller mitigating radiation effects to increase memories protection. Memories SEU and SEFI enhanced protection (ECC, scrubbing user definable).	Xilinx (V5QV, Series 7), Microchip (RTG4)
RIMC DDR3	3DIPMC0744		Xilinx (Series 7, Ultrascale), Microchip (Polarfire)
RIMC DDR4	3DIPMC0815		Xilinx (Ultrascale, Ultrascale+)
Reed Solomon 2 symbols 4 symbols	3DIPEC0725 3DIPEC0726	Reed Solomon Encoding and Decoding IP Core to provide protection for data storage in space application.	- -

(1) Minimum values.

(2) SEU saturated cross section.

(3) Including SBUs from SEFI.

(4) Refer to P/N Decoder 3DPI-0190-2

SDRAM	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DSD512M16VS1605	512 Mbit	32M x 16	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 54	3DPA-8152
3DSD1G08VS2685	1 Gbit	128M x 8	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 54	3DPA-8150
3DSD1G16VS2494	1 Gbit	64M x 16	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 58	3DPA-8155
3DSD1G32VS2490	1 Gbit	32M x 32	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 70	3DPA-8154
3DSD1G48VB2820	1.5 Gbit	32M x 48	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	BGA 215	3DPA-8352
3DSD2G08VS4686	2 Gbit	256M x 8	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 54	3DPA-8143
3DSD2G16VS4767	2 Gbit	128M x 16	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 54	3DPA-8147
3DSD2G32VS4484	2 Gbit	64M x 32	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 70	3DPA-8137
3DSD2G64VB4488	2 Gbit	32M x 64	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	BGA 119	3DPA-8156
3DSD2G40VS5493	2.56 Gbit	64M x 40	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 70	3DPA-8144
3DSD3G48VQ6486	3 Gbit	64M x 48	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	QFP 114	3DPA-8157
3DSD4G08VS8613	4 Gbit	512M x 8	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 58	3DPA-8145
3DSD4G16VS8483	4 Gbit	256M x 16	3.3	100-133 MHz	50	80	7	$2x10^{-10}$	SOP 62	3DPA-8158

Temperature: C, I, S. Specific temperature range: -40 °C to +105 °C

SRAM	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DSR4M08VS1520	4 Mbit	512k x 8	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 44	3DPA-7760
3DSR4M08CS1647	4 Mbit	512k x 8	5	12 ns	100	110	0.7	$6x10^{-8}$	SOP 44	3DPA-5610
3DSR4M16VS1690	4 Mbit	512k x 16	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 44	3DPA-8000
3DSR8M16VS2505	8 Mbit	512k x 16	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 54	3DPA-8040
3DSR8M16CS2510	8 Mbit	512k x 16	5	12 ns	100	110	0.7	$6x10^{-8}$	SOP 54	3DPA-8092
3DSR8M32VS2503	8 Mbit	256k x 32	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 64	3DPA-8050
3DSR16M08CS4660	16 Mbit	2M x 8	5	12 ns	100	110	0.7	$6x10^{-8}$	SOP 44	3DPA-7280
3DSR16M16VS4502	16 Mbit	1M x 16	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 54	3DPA-8060
3DSR16M16CS4512	16 Mbit	1M x 16	5	12 ns	100	110	0.7	$6x10^{-8}$	SOP 54	3DPA-8093
3DSR16M32VS4500	16 Mbit	512k x 32	3.3	12ns	100	110	0.7	$6x10^{-8}$	SOP 64	3DPA-8080
3DSR16M32CS4511	16 Mbit	512k x 32	5	12 ns	100	110	0.7	$6x10^{-8}$	SOP 64	3DPA-8094
3DSR20M40VS2708	20 Mbit	512k x 40	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 84	3DPA-6860
3DSR32M32VS8504	32 Mbit	1M x 32	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 68	3DPA-8020
3DSR32M16VS8506	32 Mbit	2M x 16	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 54	3DPA-8010
3DSR32M32VS8501	32 Mbit	1M x 32	3.3	12 ns	100	110	0.7	$6x10^{-8}$	SOP 68	3DPA-8070

Temperature: C, I, M

TEMPERATURE RANGE

C: Commercial (0 °C to +70 °C)

I: Industrial (-40 °C to +85 °C)

M: Military (-55 °C to +125 °C)

S: Product specific temperature range

SCREENING LEVEL

N: Commercial

B: Industrial

S: Space

ORDERING INFORMATION

Screening level

Part Number XX X00X

Temperature range

https://www.3d-plus.com/ordering-information

COnfiguration Memory BOot manager
COMBO

PRODUCT OVERVIEW

3DCO0849
SCD# 3DPA-8335

COMBO is a space grade configuration memory boot manager to configure SRAM based FPGAs requiring a large configuration memory.

3D PLUS's COMBO module provides a unique solution that combines all required hardware resources into a single module to boot the SRAM based FPGA in the smallest PCB footprint available in the market. COMBO is an all-in one smart space grade solution performing the following functions:

- Integrating a 16 Gbit RT NAND Flash capable of storing multiple large configuration images for the FPGAs and their embedded processors.
- Mitigating the different bitstreams against radiation effects.
- Booting the SRAM based FPGA from the required configuration image stored in the NAND Flash.
- Providing file protection.
- Supporting functionality to detect the errors of the SRAM based FPGA when needed.
- Allowing the in-flight reconfiguration of the bitstream.
- Allowing persistent file storage if needed.
- Supporting AMD Versal™.

KEY FEATURES

COMBO is a turnkey solution compatible with SRAM FPGAs to:

- Safely boot the SRAM-based FPGA requiring large configuration memory
- Monitor the SRAM based FPGA when needed

KEY BENEFITS

- High density full space grade solution to boot high end SRAM based FPGAs
- Multiple reliable bitstream images management with data integrity
- Enhance system's reliability by monitoring SRAM base FPGAs
- Key solution for on-orbit reconfiguration
- Smallest footprint on PCB
- Time and money savings

INTERFACES

For user ground support to store bitstreams and configuration files :

- SPI Ground Support interface:

  Bandwidth: up to 58 Mbps (Quad)

For in-flight use to boot SRAM FPGAs and MPSoCs:

- SPI Boot interface:

  Bandwidth: up to 116 Mbps (Dual Quad)

For in-flight use to Read and Write R&W bitstreams/files

- SPI R&W interface :

  Bandwidth: up to 58 Mbps (Quad)

RADIATION TOLERANCE

- TID > 50 krad
- SEL LET > 62.5 MeV.cm²/mg

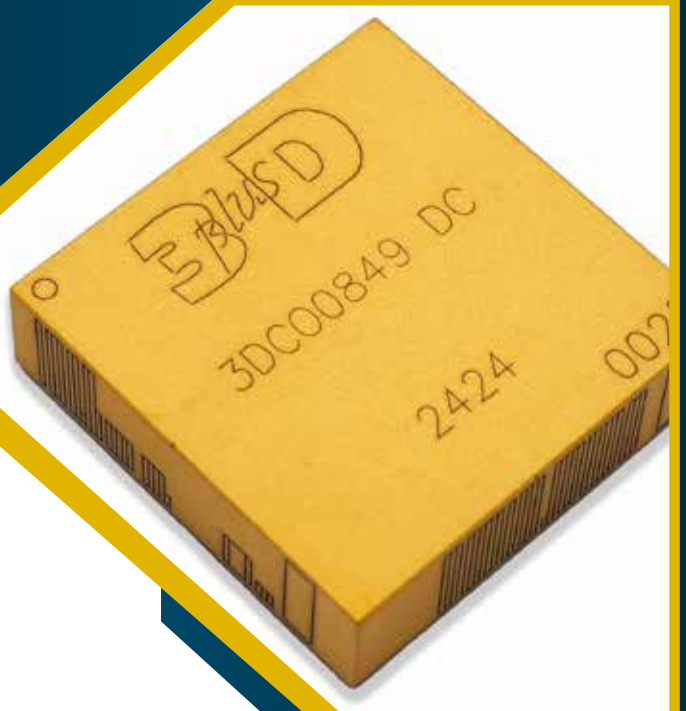
MODULE CONFIGURATION

- Power Supply: 1.2 V, 2.5 V, 3.3 V
- 483 BGA pins module
- BGA pitch = 1.27 mm

ENVIRONMENT PERFORMANCES

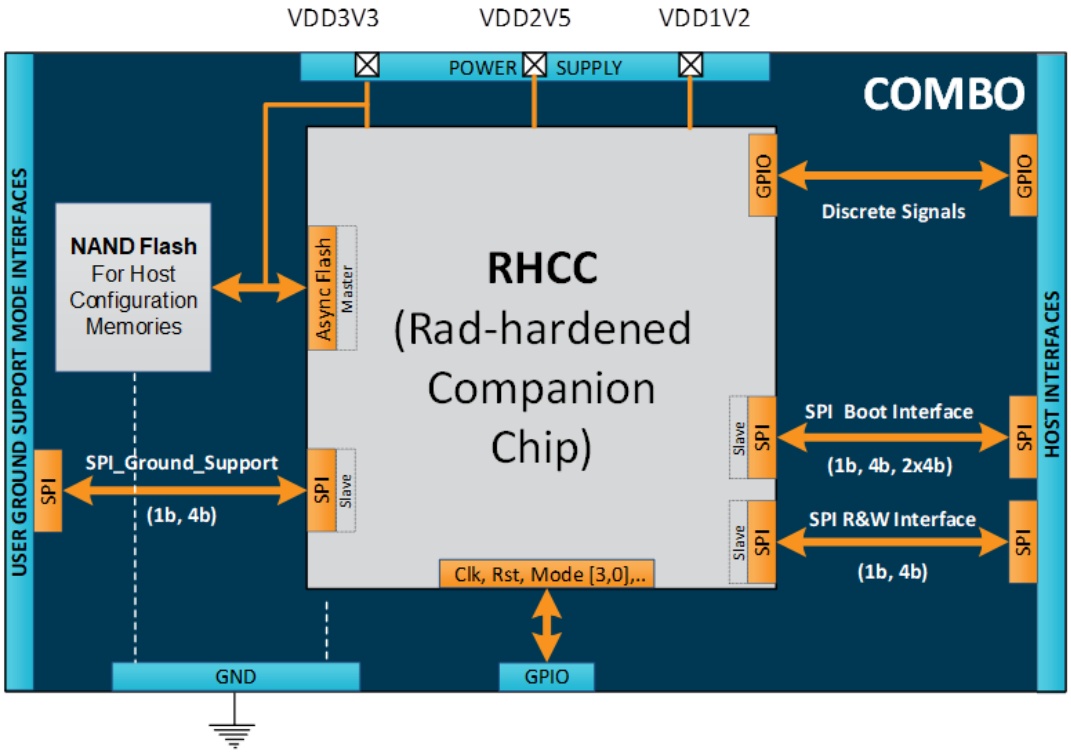
- -40 °C to +105 °C

COMBO **FUNCTIONALITIES**



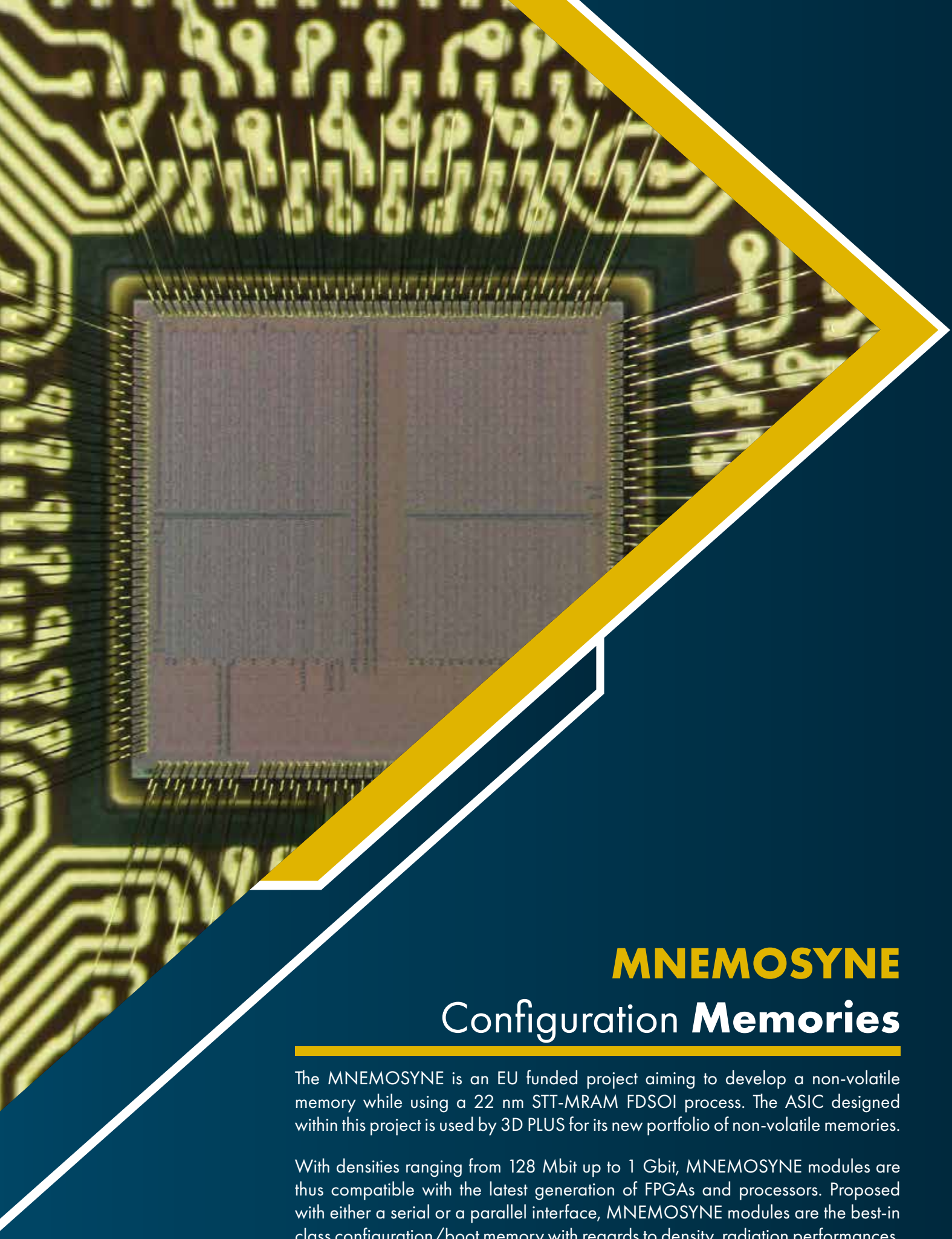
- To store bitstreams
- To guarantee data integrity
- To boot SRAM FPGAs
- To enhance internal memories protection
- To provide intelligent functionnalities to the system

FUNCTIONAL BLOCK DIAGRAM



COMPLETE ECOSYSTEM FOR IN-FLIGHT RECONFIGURATION

- DDR3/4 memory to buffer the new bitstream
- DDR3/4 TR to regulate the VTT of DDR3/4 memory
- RIMC DDR3/4 to mitigate new bitstream SEEs and to scrub DDR3/4 memory.
- COMBO to store multiple SRAM based FPGA images and to enable in-flight reconfiguration



MNEMOSYNE
Configuration **Memories**

The MNEMOSYNE is an EU funded project aiming to develop a non-volatile memory while using a 22 nm STT-MRAM FDSOI process. The ASIC designed within this project is used by 3D PLUS for its new portfolio of non-volatile memories.

With densities ranging from 128 Mbit up to 1 Gbit, MNEMOSYNE modules are thus compatible with the latest generation of FPGAs and processors. Proposed with either a serial or a parallel interface, MNEMOSYNE modules are the best-in class configuration/boot memory with regards to density, radiation performances, endurance, data retention and qualification.

KEY BENEFITS

- High density & SEE immune non volatile memory
- Help customers in error management strategy with specific features
- Small footprint

MNEMOSYNE 1.8 V SPI

KEY FEATURES

- 100,000 Program/erase cycles endurance
- 20 years data retention
- -55°C to +125 °C operating temperature range
- Embedded ECC

MNEMOSYNE 3.3 V SPI

RADIATION TOLERANCE

- TID > 100 krad (Si)
- SEL LET > 85 MeV.cm²/mg
- SEU LET > 85 MeV.cm²/mg
- SET LET > 85 MeV.cm²/mg
- SEFI LET > 85 MeV.cm²/mg

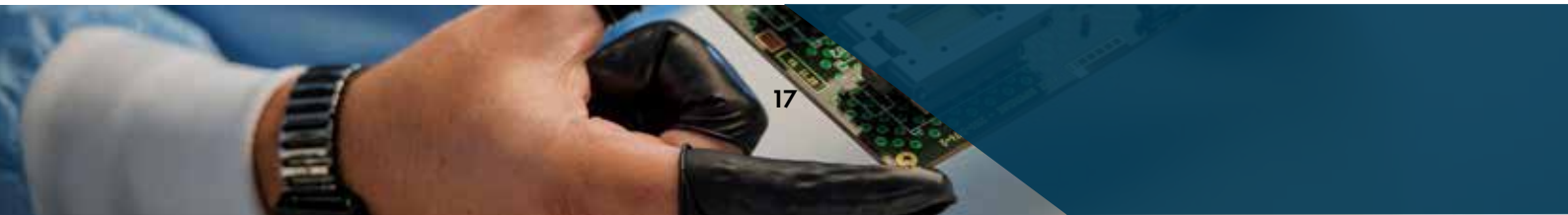
MNEMOSYNE 3.3 V EEPROM

APPLICATIONS

- FPGA configuration bitstream storage
- Boot code and program storage for microcontrollers and microprocessors

MNEMOSYNE	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE			PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg		
3DMN128M08VS1852	128 Mbit	EEPROM	3.3 & 1.8	250 ns	100	85	85	SOP 54	3DPA-8354
3DMN512M08US4853	512 Mbit	SPI/QSPI/OSPI	1.8	100 MHz	100	85	85	SOP 42	3DPA-8338
3DMN1G08US8854	1 Gbit	SPI/QSPI/OSPI	1.8	100 MHz	100	85	85	SOP 42	3DPA-8339
3DMN512M04VS4867	512 Mbit	SPI/QSPI	3.3 & 1.8	50 MHz	100	85	85(*)	SOP 42	3DPA-8362
3DMN1G04VS8868	1 Gbit	SPI/QSPI	3.3 & 1.8	50 MHz	100	85	85(*)	SOP 42	3DPA-8363

Temperature: C, I, M
(*)Frequency dependent



CONFIGURATION **MEMORIES**

PROM	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DPO32M08VS1419	32 Mbit	4M x 8	3.3	33 MHz	50	120	120	-	SOP 44	3DPA-5080
3DPO64M08VS2299	64 Mbit	8M x 8	3.3	33 MHz	50	120	120	-	SOP 44	3DPA-3450
3DPO128M08VS4667	128 Mbit	16M x 8	3.3	33 MHz	50	120	120	-	SOP 44	3DPA-5960

Temperature: C, I, M

MRAM	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DMR1M08VS1426	1 Mbit	128k x 8	3.3	40 ns	50	85	Immune	-	SOP 44	3DPA-8114
3DMR2M16VS2427	2 Mbit	128k x 16	3.3	40 ns	50	85	Immune	-	SOP 54	3DPA-8118
3DMR4M08VS4428	4 Mbit	512k x 8	3.3	40 ns	50	85	Immune	-	SOP 44	3DPA-8115
3DMR8M08VS8666	8 Mbit	1M x 8	3.3	40 ns	50	85	Immune	-	SOP 44	3DPA-8117
3DMR8M32VS8420	8 Mbit	256k x 32	3.3	40 ns	50	85	Immune	-	SOP 68	3DPA-8113
3DMR10M40VS5688	10 Mbit	256k x 40	3.3	40 ns	50	85	Immune	-	SOP 96	3DPA-8119
3DMR64M08VS4476	64 Mbit	8M x 8	3.3	40 ns	50	85[5]	Immune	-	SOP 54	3DPA-8116

Temperature: C, I, S. Specific temperature range: -55 °C to +105 °C

SPI NOR FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DFS256M04VS1740	256 Mbit	SPI/QSPI	3.0	50-133 MHz	20[3]	62.5	15	7.5×10^{-11}	SOP 18	3DPA-8122
3DFS512M04VS2722	512 Mbit	SPI/QSPI	3.0	50-133 MHz	20[3]	62.5	15	7.5×10^{-11}	SOP 18	3DPA-8121

Temperature: C, I, S. Specific temperature range: -55 °C to +105 °C.

TMR NOR FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE			TEMP.	PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg			
3DFS128M01VS2728	128 Mbit	TMR SPI	3.3	40 MHz	40	62.5	Immune[4]	C, I, M	SOP 20	3DPA-8229
3DFS256M04VS2801	256 Mbit	TMR SPI	3.3	50 MHz	40	62.5	Immune[4]	C, I, S	SOP 24	3DPA-8308

Specific temperature range: -55 °C to +105 °C

TEMPERATURE RANGE

C: Commercial (0 °C to +70 °C)

I: Industrial (-40 °C to +85 °C)

M: Military (-55 °C to +125 °C)

S: Product specific temperature range

SCREENING LEVEL

N: Commercial

B: Industrial

S: Space

ORDERING INFORMATION

Screening level — Options

Part Number XX X00X

Temperature range

https://www.3d-plus.com/ordering-information

(1) Minimum values.

(2) SEU saturated cross section.

(3) TID value under the condition of 50% duty cycle.

(4) Immune by Radiation Intelligent TMR design.

(5) Please refer to Application Note 3300-6674

MASS DATA STORAGE

MASS DATA STORAGE

64 Gbit RTIMS FLASH

PRODUCT OVERVIEW

The Radiation Tolerant Intelligent NAND Flash Memory Stack (RTIMS Flash) is a user-friendly, high density, plug-and-play, radiation-protected NAND Flash memory.

The 3DSS64G08US2818, latest addition in the RTIMS Flash family, embeds 64 Gbit (or 32 Gbit with EDAC) of NAND Flash memory and an intelligent Flash Memory Controller (FMC). The FMC provides the module with full protection against radiation effects such as SEL, SEFI and SEU.

KEY BENEFITS

- User friendly, plug-and-play module
- Release the computing resource in the system
- Reduce design load
- Highly reliable for space applications

APPLICATIONS

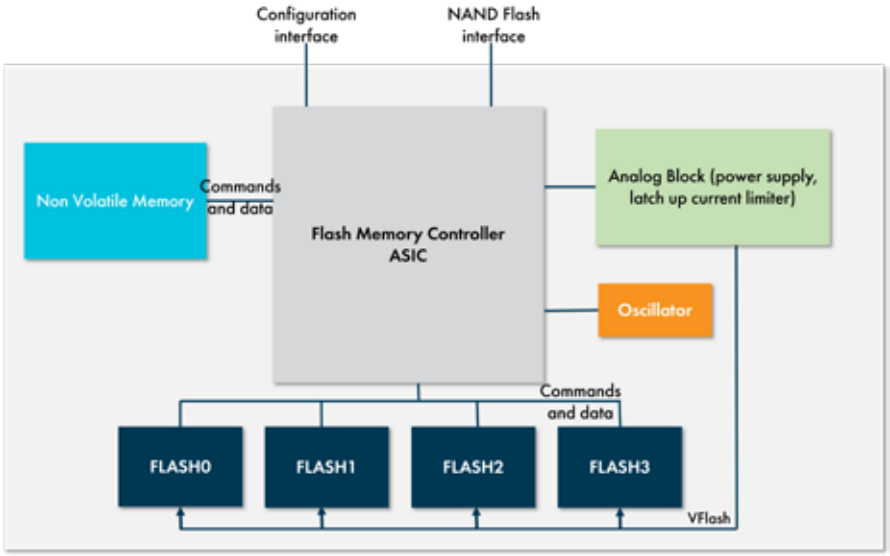
High density storage memory for solid state data recorder boards.

PERFORMANCES

- Voltage supply: 3.3 V and 1.8 V
- Asynchronous and synchronous modes supported
- 64 Gbit with no additional memory protection
- 32 Gbit with EDAC memory protection
- Up to 100 Kcycles Program/Erase endurance
- 10 years data retention
- Standard 8-bit NAND Flash Interface
- Write mode at 195 Mbps bandwidth
- Read mode at 617 Mbps bandwidth
- Operating Temperature Range: -55 °C/+85 °C

SPECIFIC FEATURES

- Error free guaranteed sector 0 for boot data storage
- Continuous logic sectors
- Embedded bad blocks management
- Embedded dynamic wear leveling
- Embedded format, sector logic generation commands for initialization
- Serial Port Interface for RTIMS Flash configuration, command and telemetry



RADIATION TOLERANCE

- TID > 50 krad (Si)
- SEL/SEB/SEGR > 60 MeV.cm²/mg
- SET Immune by design
- High Current SEFI Immune by design
- SEU Immune by design (Flash ECC and ASIC TMR)

NON VOLATILE **MEMORIES**

NAND FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DFN8G08VS1706	8 Gbit	1G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8105
3DFN16G08VS1712	16 Gbit	2G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8112
3DFN16G08VS2705	16 Gbit	2G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8104
3DFN32G08VS2711	32 Gbit	4G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8111
3DFN32G08VS4704	32 Gbit	4G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8103
3DFN32G08US2845	32 Gbit	4G x 8	1.8	12 ns	60	62.5	1.3	$2x10^{-10}$	SOP 54	3DPA-8284
3DFN64G08VS4309	64 Gbit	8G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8109
3DFN64G08VS8695	64 Gbit	8G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8102
3DFN64G16VS4679	64 Gbit	4G x 16	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 58	3DPA-8110
3DFN64G16VS8710	64 Gbit	4G x 16	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 58	3DPA-8101
3DFN128G08VS8308	128 Gbit	16G x 8	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8107
3DFN128G16VS8709	128 Gbit	8G x 16	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8108
3DFN128G16VS8810	128 Gbit	8G x 16	3.3	25 ns	60	62.5	1.3	$2x10^{-10}$	SOP 50	3DPA-8248
3DFN128G08US8761	128 Gbit	16G x 8	1.8 and 3.3	12 ns	60	62.5	1.3	$2x10^{-10}$	SOP 54	3DPA-7920

Temperature: C, I, M

NOR FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DFO64M16VS1281	64 Mbit	4M x 16	3.0	90 ns	20[3]	51.2	10	$1x10^{-11}$	SOP 54	3DPA-8235
3DFO128M16VS2282	128 Mbit	8M x 16	3.0	90 ns	20[3]	51.2	10	$1x10^{-11}$	SOP 54	3DPA-8233
3DFO256M16VS4105	256 Mbit	16M x 16	3.0	90 ns	20[3]	51.2	10	$1x10^{-11}$	SOP 54	3DPA-8234
3DFO256M16VS4269	256 Mbit	16M x 16	3.0	90 ns	20[3]	51.2	10	$1x10^{-11}$	SOP 54	3DPA-8231
3DFO512M16VS8492	512 Mbit	32M x 16	3.0	90 ns	20[3]	51.2	10	$1x10^{-11}$	SOP 56	3DPA-8232
3DFO2G16VS4214	2 Gbit	128M x 16	3.3	90 ns	25[3]	> 60	1.8	$8x10^{-11}$	SOP 60	3DPA-8240
3DFO2G08VS4215	2 Gbit	256M x 8	3.3	90 ns	25[3]	> 60	1.8	$8x10^{-11}$	SOP 60	3DPA-8239

Temperature: C, I, M

RTIMS FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DSS24G08VS3626	24 Gbit	3G x 8	3.3	25 ns	50	60	Immune[4]	-	SOP 38	3DPA-5780
3DSS48G08VS3772	48 Gbit	6G x 8	3.3	25 ns	50	60	Immune[4]	-	SOP 38	3DPA-8249
3DSS64G08US2818	64 Gbit	16 G x 8	1.8 and 3.3	12 ns	50	60	Immune[4]	-	SOP 52	3DPA-8327

Temperature: C, I

(1) Minimum values.

(2) SEU saturated cross section.

(3) Power Bias 50%

TEMPERATURE RANGE

C: Commercial (0 °C to +70 °C)

I: Industrial (-40 °C to +85 °C)

M: Military (-55 °C to +125 °C)

S: Product specific temperature range

SCREENING LEVEL

N: Commercial

B: Industrial

S: Space

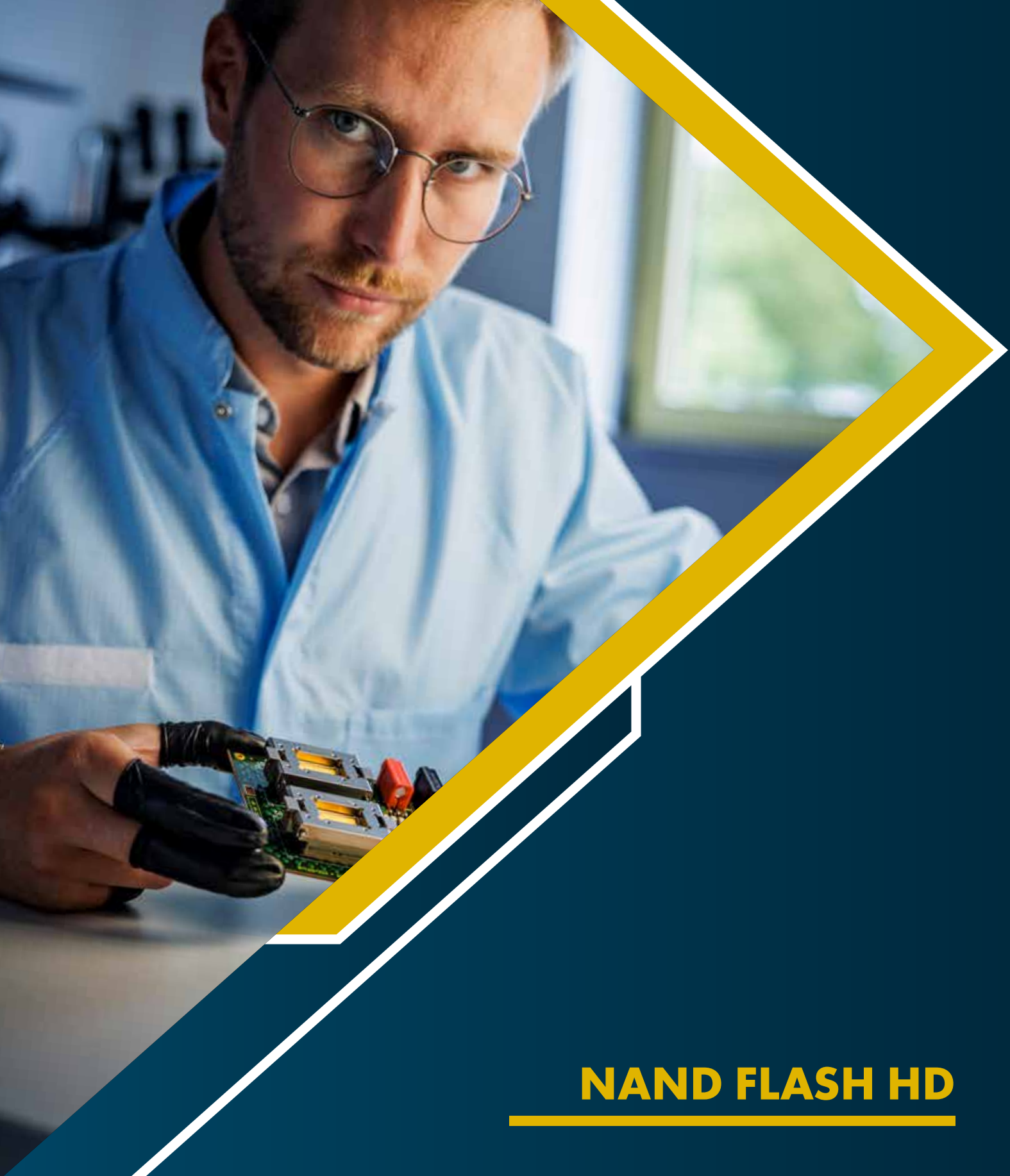
ORDERING INFORMATION

Screening level — Options

Part Number XX X00X

Temperature range

https://www.3d-plus.com/ordering-information



NAND FLASH HD

High Density NAND Flash

PRODUCT OVERVIEW

The 3DFN4T16LB1862 and 3DFN8T16LB2821 are advanced NAND Flash memories designed for high-density storage. The 3DFN4T16LB1862 offers 4 Tbit of capacity, operating as a 1.33 Tbit memory in p-SLC mode, with a 16-bit bidirectional data interface compliant with ONFI 4.2. The 3DFN8T16LB2821 provides 8 Tbit of storage (2.67 Tbit in p-SLC mode) and features two 4 Tbit banks that share data I/Os while maintaining separate control signals. Both devices utilize p-SLC mode and 3D PLUS stacking technology to ensure efficient performance and fast data transfer, and are available in a BGA package.

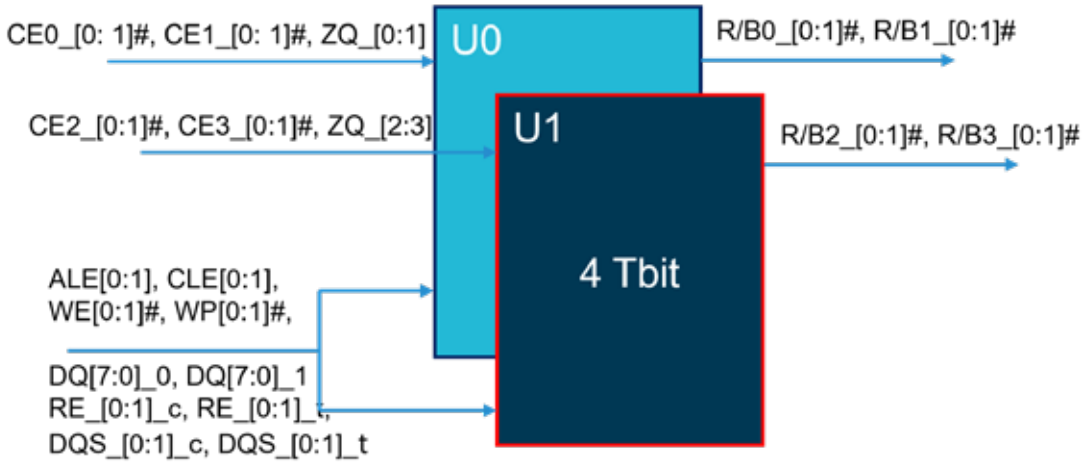
KEY FEATURES

- p-SLC mode supported
- ONFI 4.2 compliant
- Automatic Program and Erase
- 4 Tbit bank organization: 17,792 blocks
  - Page size x8: 18,352 bytes (16,384 + 1968 bytes)
  - Block size: 2112 pages (33,792K + 4059K bytes)
  - Plane size: 4 planes x 556 blocks
- Supply voltage: Vcc = 2.5 or 3.3 V, Vccq= 1.2 V
- Supporting NV-DDR3 interface up to mode 12 (F= 600 MHz)
- Array performance
- READ page time : 40 µs (TYP)
- Effecive Program page time: 170 µs (TYP)
- Erase block time: 8 ms (TYP)
- Endurance: 60,000 in p-SLC mode

RADIATION TOLERANCE

- TID > 25 krad(Si)*
- SEL > 62.5 MeV.cm²/mg
- SEFF LET threshold: > 45.8 and ≤ 55 MeV. cm²/mg, $\sigma_{sat} \approx 1 \cdot 10^{-3}$ cm²/dev.
- SEU LETth ≤1.5 MeV.cm²/mg; $\sigma_{sat} = 4.10^{-11}$ cm²/bit

BLOCK DIAGRAM



HD NAND FLASH	DENSITY	CONFIG.	VOLTAGE (V)	ACCESS / CLOCK	RADIATION TOLERANCE				PACKAGE	SCD#
					TID[1] krad (Si)	SEL[1] MeV.cm²/mg	SEU MeV.cm²/mg	SEU Xsection[2] cm²/bit		
3DFN4T16LB1862	4 Tbit	256Gx16	2.35 - 3.6 & 1.2	600 MHZ	25	62.5	1.5	4·10-11	BGA 215	3DPA-8371
3DFN8T16LB2821	8 Tbit	512Gx16	2.35 - 3.6 & 1.2	600 MHZ	25	62.5	1.5	4·10-11	BGA 215	3DPA-8372

* To be refined

MAJORITY VOTER

MAJORITY **VOTER**

PRODUCT OVERVIEW

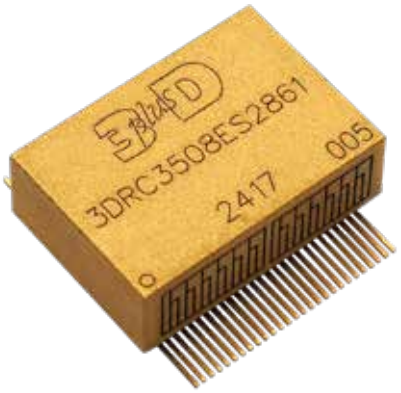
The 3DRC3508ES2861 is a 3-input, high-speed octal majority voter module with built-in triple redundancy. With the three 8-bit inputs used for majority voting, the module provides the result of the vote as an output, along with an error signal indicating if there is a difference between any of the input bits (also 8-bit).

Operating on a power supply range from 1.65 V to 5.5 V, the module can be used in any type of redundancy configuration, thanks to the cold protection function.

The 3DRC3508ES2861 is immune to SET and SEL by design, and insensitive to SEU/MBU by process (CMOS IC), qualifying its use in space environment. Its integration into digital systems improves reliability through the use of the TMR. This space-qualified module is ITAR-free.

KEY FEATURES

- 1.65 V to 5.5 V voltage supply
- Input voltage up to 5.5 V at any Vcc
- Provides logic-level down translation to Vcc
- Cold sparing capability
- Internal power-on reset (POR) circuitry
- 13 ns maximum propagation delay at 3.3 V

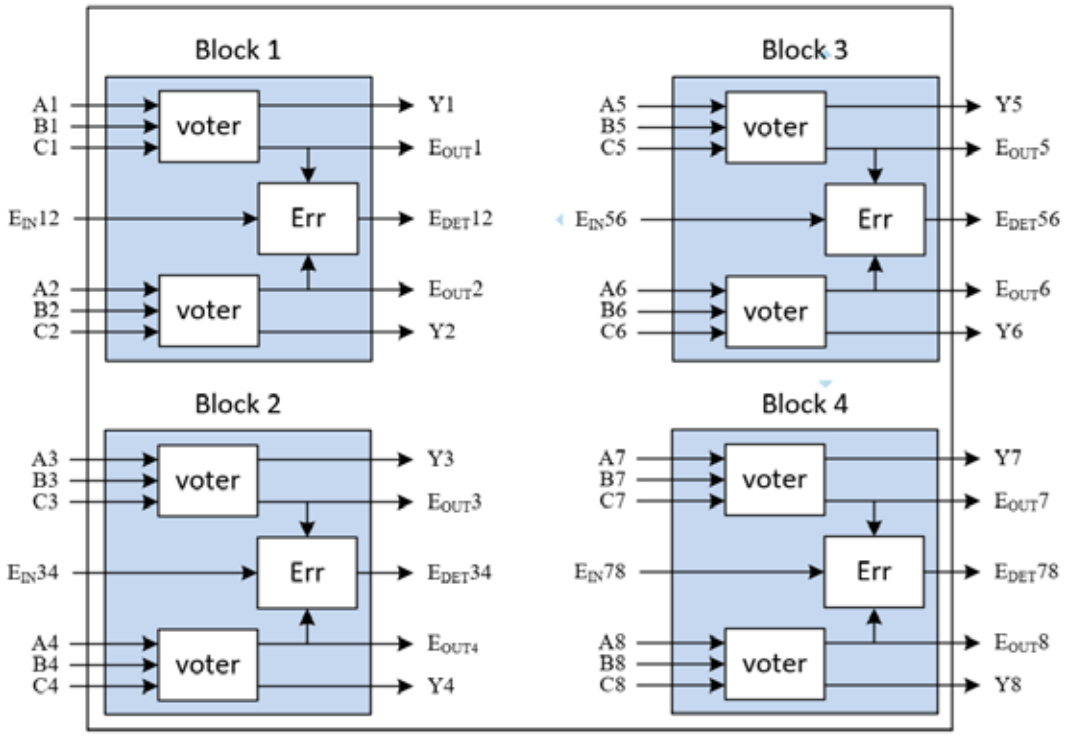


APPLICATIONS

- Mitigating SEE effects on non SEE-immune device.
- TMR on any digital system signal.

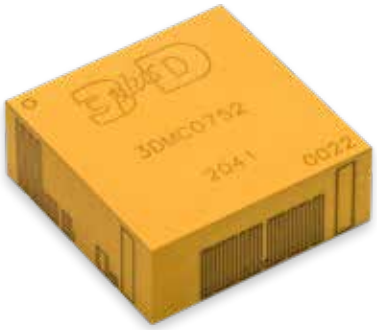
MAJORITY VOTER	VOLTAGE SUPPLY	CONFIG.	TID krad (Si)	SEL/SET MeV.cm²/mg	OPERATING TEMPERATURE	PACKAGE	SCD#
3DRC3508ES2861	1.65 V - 5.5 V	Octal 3-input	30	74.7	-55°C to +125°C	SOP 54	3DPA-8331

FUNCTIONAL BLOCK DIAGRAM



FUSIO RT
Computer Cores

FUSIO RT **COMPUTER CORES**



PRODUCT OVERVIEW

The FUSIO RT is a complete reconfigurable Computer Core integrating a space grade SRAM-based FPGA and its configuration memory, with additional computing and mass storage memory, in one miniaturized module.

KEY FEATURES

- Power Supply: 1.2 V, 2.5 V, 3.3 V
- NX1H35AS: Brave NG_Medium European FPGA
  - 550 k ASIC gates
  - Integrated space wire interface
  - 800 Mbit/s I/O support
- FPGA loading at 25 MHz (via internal Flash NOR)
- SPI NOR Characteristics:
  - Triple 128 Mbit / 16 M-Byte
  - Triple Modular Redundancy (TMR) integrated
  - Enhanced TID implementation
- Optional NAND and SDRAM memory integrated into module
- Operating temperature range: -40 °C to +105 °C
- Package: 483 balls BGA, 263 users I/Os
- Dimensions: 32 mm x 32 mm
- Weight: < 25 g

KEY BENEFITS

- Highly integrated Space Computer Core
- European FPGA
- Reduces significantly the board area
- Modular, easy to use
- Proven radiation hardened design
- Well suited for use in high reliability, high performance and high density system applications

RADIATION DATA

- TID > 40 krad(Si)
- SEL LET > 60 MeV.cm²/mg

	CONFIGURATION	PART NUMBER	DESCRIPTION	SCD#
FUSIO RT BASIC CONFIGURATION	2 LAYERS 	3DMC0753	FPGA TMR 128 Mbit SPI NOR Flash (triplicated)	3DPA-7940
FUSIO RT NAND FLASH	3 LAYERS 	3DMC0754	FPGA TMR 128 Mbit SPI NOR Flash (triplicated) 64 Gbit NAND Flash	3DPA-8176
FUSIO RT SDRAM	3 LAYERS 	3DMC0755	FPGA TMR 128 Mbit SPI NOR Flash (triplicated) 2 Gbit SDRAM	3DPA-8175
FUSIO RT FULL OPTIONS	4 LAYERS 	3DMC0752	FPGA TMR 128 Mbit SPI NOR Flash (triplicated) 64 Gbit NAND Flash 2 Gbit SDRAM	3DPA-8177

EVALUATION BOARD

The 3DEV075x FUSIO RT Development Kit is a ready to use development board integrating a FUSIO RT module (configuration of your choice). The FUSIO RT Development kit allows customers to get familiar with the FUSIO RT developments tools and allows for early prototyping of their application.

SPACE CAMERA PRODUCTS

CAMERA & CAMERA HEADS
APPLICATIVE CONTEXT

OVERVIEW

3D PLUS Space Camera products offers off-the-shelf solutions targeting a wide range of imaging applications designed for space environment. Based on high reliability and qualified parts, the CASPEX camera heads and the IRIS cameras are efficient and competitive choices for your space missions.

Platform and payload monitoring

3D PLUS space camera solutions are ideal for monitoring applications, ensuring the correct deployment of spacecraft solar panels and antennas, or overseeing the operation of instruments like drills or robotic arms. They also enable wide communication of mission operations through live imaging.

Guidance, navigation and control

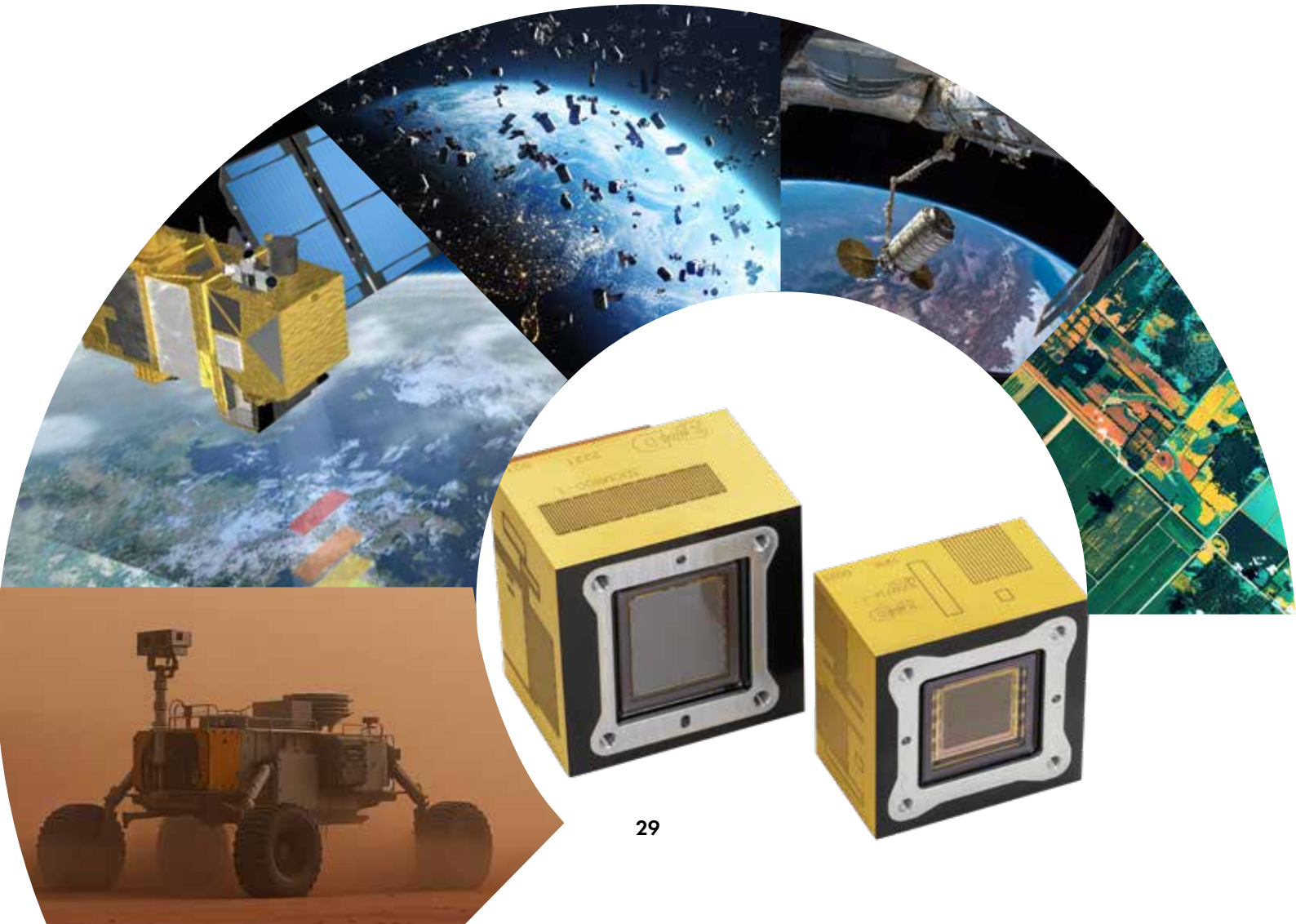
Our space camera systems offer efficient solutions for GN&C applications, serving as rover navigation cameras and main image sensors in orbit servicing. Their modularity allows to select the most suitable configuration for your specific needs.

Surveillance, observation, tracking

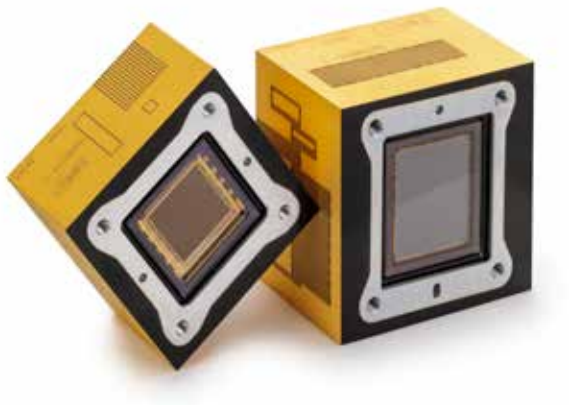
The expanding family of 3D PLUS cameras provides effective and straightforward solutions for observation applications, including Earth observation, debris detection and tracking, or spacecraft situational awareness (SSA).

Planetology, mineralogy, spectrometry

With highly miniaturized optoelectronic cores, 3D PLUS cameras are perfect for the size and mass constraints of instruments used in planetology, mineralogy, and spectrometry, whether on satellite platform or embedded in rovers and landers.



CASPEX Camera Heads



PRODUCT OVERVIEW

3D PLUS CASPEX (CAmera for SPace EXploration) Camera Heads offer high density, high performance and high resolution imaging solutions for space applications. CASPEX solutions combine a high-resolution image sensor with a FPGA-based electronic architecture integrating sensor control and interfacing and image processing. Power supplies, memories and protections are integrated into this miniaturized module to meet the constraints of space platforms and instruments.

KEY FEATURES

- Highly integrated all-in-one optoelectronic core
- Generic User-reconfigurable FPGA-based architecture with available Standard FPGA designs and IP cores
- Embedded processing and storage memories
- Embedded power supplies and protections
- Radiation hardened by design

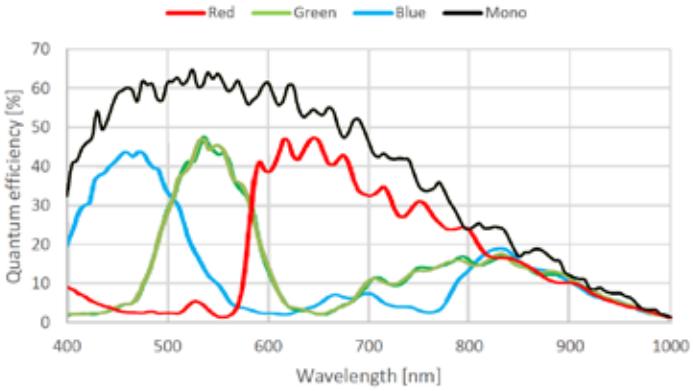
KEY BENEFITS

- Reduced development time with standardized, off-the-shelf and turn-key solutions
- High versatility and adaptability with user-reconfigurable FPGA-based architectures
- Mass and space saving with high degree on integration of all-in-one solutions
- Easy optics centering, focal plan alignment and system integration thanks to dedicated optical/mechanical references
- Enhanced mission reliability with fully qualified products and more than 20 years of 3D PLUS experience designing camera heads.

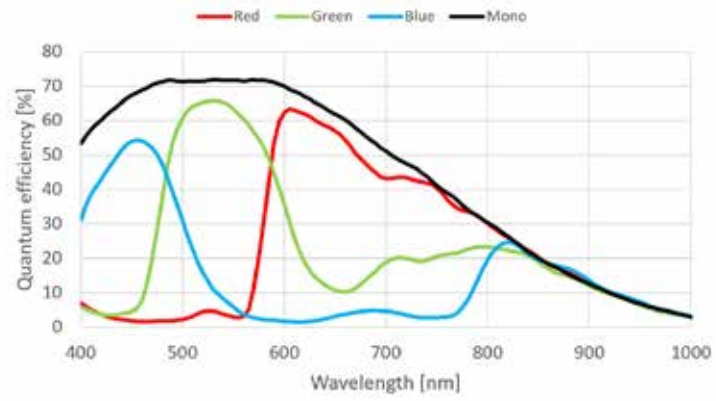
APPLICATIONS

- Earth observation, planetology
- Platform monitoring (equipment, payload, target)
- GNC sensor (tracking, RdV, Star-tracking)
- Spectroscopy

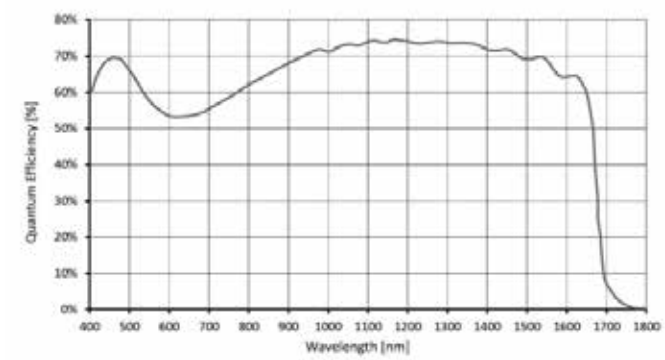
Spectral response for CASPEX 4 Mpx



Spectral response for CASPEX 12 Mpx



Spectral response for CASPEX 1.3 Mpx SWIR



	CASPEX 4M	CASPEX 12M	CASPEX SWIR
P/N	3DCM734 (Mono) /3DCM739 (RGB)	3DCM878 (Mono) / 3DCM879 (RGB)	3DCM880
SCD#	3DPA-7620 / 3DPA-7610	3DPA-8355 / 3DPA-8356	3DPA-8357
SENSOR	2048 x 2048 pixels VIS CMOS Global shutter (Mono/RGB)	4096 (H) x 3000 (V) pixels VIS CMOS Global shutter (Mono/RGB)	1280 (H) x 1024 (V) pixels VIS-NIR Global shutter InGaAs
SPECTRAL BANDWIDTH	400-1000 nm	400-1000 nm	400-1800 nm
READ NOISE	< 13 e-	< 2 e-	< 240 e-
DARK CURRENT (25°C)	< 125 e-/s	< 10 e-/s	< 30 ke-/s
FWC	13,5 ke-	15 ke-	170 ke-
ELECTRONIC ARCHITECTURE	Microchip ProASIC 3 1 Gbit SDRAM – 8 Gbit NAND Flash	AMD-Xilinx KU040 Ultrascale 8 Gbit DDR3 SDRAM – 48 Gbit Synchronous NAND Flash	AMD-Xilinx KU040 Ultrascale 8 Gbit DDR3 SDRAM – 48 Gbit Synchronous NAND Flash
MAXIMUM HARDWARE FRAME RATE (FULL RESOLUTION)	15 fps (10 bit/pixel) 7 fps (12 bit/pixel	68 fps (8 bit/pixel) 60 fps (10 bit/pixel) 46 fps (12 bit/pixel)	135 fps (8 bit/pixel) 125 fps (10 bit/pixel) 71 fps (12 bit/pixel)
POWER SUPPLY	4.5 to 9 V	4.5 to 5.5 V	4.5 to 5.5 V
POWER CONSUMPTION (25°C)	1.5 W	5 W	5 W
ELECTRICAL INTERFACE	55 pins PGA 12 LVDS pairs, 13 GPIO, JTAG	77 pins PGA 22 LVDS pairs, JTAG, Thermistor interface	77 pins PGA 22 LVDS pairs, JTAG, Thermistor interface
TEMPERATURE RANGE	-40 to +70 °C	-40 to +70 °C -55 to +70 °C (Extended)	-40 to +70 °C -55 to +70 °C (Extended)
RADIATION PERFORMANCES	30 krad SEL LET > 62.5 MeV.cm²/mg	40 krad SEL LET > 62.5 MeV.cm²/mg	40 krad SEL LET > 62.5 MeV.cm²/mg
SIZE	35x35x23 mm³	40x40x45 mm³	40x40x50 mm³
MASS	62 g	125 g	140 g

CASPEX DEVELOPMENT TOOLS AND OPTIONS

FPGA Design and IP Cores

- 3D PLUS CASPEX camera heads products come with several options for FPGA configuration and design development. FPGA designs and IP Cores are developed based on ECSS-Q-ST-60-02C ESA development standard.
- Standard FPGA Designs :
  - 3D PLUS offers for its CASPEX camera heads standard FPGA designs to provide a simple and efficient turn-key solution, allowing quick integration and reduced time-to-market. 3D PLUS standard FPGA designs for the CASPEX products allow a straightforward management of the sensor and internal memories of the camera head and provides a standard SpaceWire interface for easy interfacing with space equipments and platforms.
- IP Cores :
  - 3D PLUS offers for its CASPEX camera heads validated building blocks allowing users to have readily available controllers to develop their custom FPGA designs.

Evaluation kit

- 3D PLUS CASPEX camera heads products comes with several options for FPGA configuration and design development. FPGA designs and IP Cores are developed based on ECSS-Q-ST-60-02C ESA development standard.
  - CASPEX 4M Evaluation Kit: 3DEV0734
  - CASPEX 12M Evaluation Kit: 3DEV0800
  - CASPEX SWIR Evaluation Kit: 3DEV0880

IRIS Cameras

PRODUCT OVERVIEW

3D PLUS IRIS Space Cameras offer high resolution and high reliability turn-key solution for space applications requiring image capture and monitoring. The IRIS cameras bring together the space qualified CASPEX camera heads and their standard FPGA designs, with space grade optics and mechanical casing to provide a full space-grade camera, suitable for multiple monitoring and imaging applications.

KEY FEATURES

- Embeds CASPEX space camera heads with heritage in multiple missions
- Standard SpaceWire interface for easy and robust integration on space platforms
- Offers wide range of space grade optics to address multiple applications
- Designed for space environment, with high radiation, temperature and mechanical performances.

APPLICATIONS

- Platform and payload monitoring
- Guidance, navigation and control
- Detection, observation and tracking

KEY BENEFITS

- Reduced development time with standardized, off-the-shelf and turn-key camera solutions
- Versatile solution suitable for multiple applications
- Enhanced mission reliability with fully qualified products, based on CASPEX space-grade camera heads

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
P/N	3DCS04M080942 (Mono) 3DCS04M080943 (RGB)	3DCS04M110944 (Mono) 3DCS04M110945 (RGB)	3DCS04M250959 (Mono) 3DCS04M250960 (RGB)	3DCS04M500961 (Mono) 3DCS04M500962 (RGB)	3DCS12M080963 (Mono) 3DCS12M080964 (RGB)
FOCAL LENGTH	7.9 mm	11.6 mm	25 mm	50 mm	7.9 mm
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/6	F/4	F/8
OPTICAL ANGULAR RESOLUTION	<1.2 mrad	1.3 mrad	0.25 mrad o	0.125 mrad	<1.2 mrad
SPECTRAL BANDWIDTH	450-700 nm	450-700 nm	450-700 nm	450-700 nm	450-700 nm
CAMERA CORE	CASPEX 4M	CASPEX 4M	CASPEX 4M	CASPEX 4M	CASPEX 12M
SENSOR RESOLUTION	4 Mpixels 2048 x 2048	4 MPixels 2048 x 2048	4 Mpixels 2048 x 2048	4 MPixels 2048 x 2048	12 MPixels 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	< 400 g	< 400 g	< 400 g	< 400 g	< 800 g
VOLUME	86x72x69 mm³	86x72x76 mm³	86x72x80 mm³	86x72x120 mm³	90x84x92 mm³
POWER SUPPLY	4.5 to 9 V	4.5 to 9 V	4.5 to 9 V	4.5 to 9 V	4.5 to 5.5 V
AVERAGE POWER CONSUMPTION (25°C)	1.5 W	1.5 W	1.5 W	1.5 W	5 W
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

MCAM Multi Camera System

PRODUCT OVERVIEW

The MCAM Monitoring System is a space-grade multi-cameras monitoring system allowing the capture of images and low-rate color videos for monitoring purpose on complex space platform (solar panels and antenna deployment monitoring, parts separation, payload or specific events monitoring). 3D PLUS MCAM multi camera system offer the possibility to operate up to seven IRIS cameras through one control box.

KEY FEATURES

IRIS-C Camera controller unit :

- **SpaceWire router for cameras control and readout**
  - Two main SpaceWire ports for platform interfacing, one main, one redundant
  - Seven spacewire ports for IRIS cameras interfacing
  - RMAP compatible telecommands/telemetries
  - Video stream from cameras via SpaceWire interface up to 128 Mbps
- **Power conditioning and protections**
  - 28 V to 5 V primary DC-DC converter with input filter, for a maximum 25 W power consumption in full configuration
  - 3 independent power switches
    - One for 5 camera ports on one switch suitable for IRIS cameras
    - Two for 2 camera ports suitable for IRIS and IRIS-HD cameras
  - Overvoltage protection power switch on primary power converter
  - LVDS transceivers on both SpaceWire main ports
- **Dimensions :**
  - Volume : 190x128x54 mm3
  - Mass : 1060 g

MCAM Multi Camera System :

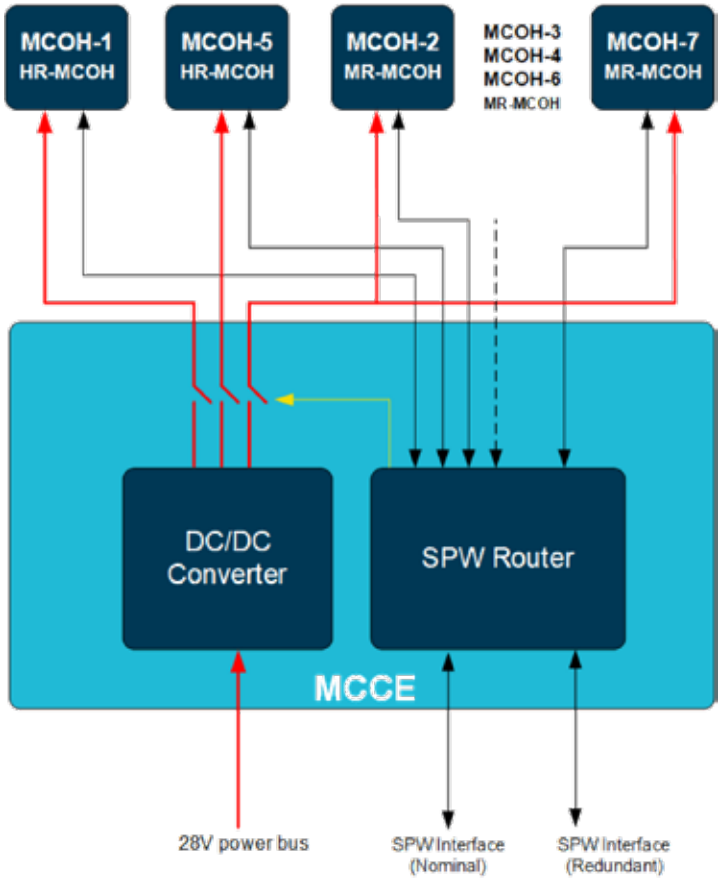
- **Multi configuration of IRIS-C**
  - Up to seven cameras
  - Up to two IRIS-HD cameras on dedicated ports
  - SpaceWire harness up to 10 m
- **System performances**
  - Up to two IRIS cameras streaming simultaneously at 2 frame/s
  - One IRIS-HD camera in snapshot mode full resolution at 1 frame/s or streaming at 30 frame/s in Full HD with h.264 compression
  - Configurable camera sensors parameters (exposure, gain, framerate)
  - Raw/binned mode, windowing mode on IRIS-HD cameras
- **Reliability :**
  - Class 1 missions, up to 15 years in GEO orbit
  - Suitable for GEO, LEO and deep space missions

APPLICATIONS

- Multi-platform compatibility with multiple cameras configurations possible operating from one interface
- Reduced development time with off-the-shelf and turn-key camera solutions
- Enhanced mission reliability with space grade IRIS cameras and IRIS-C controller

KEY BENEFITS

- Platform monitoring (solar panels and antennas deployments, parts jettisoning, payload monitoring)
- Spacecraft surrounding monitoring (SSA/SDA)
- Guidance, navigation and control



3D PLUS Space Cameras **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 optoelectronic head of the Remote MicroImager sub-equipment. It landed on Mars in early 2021.

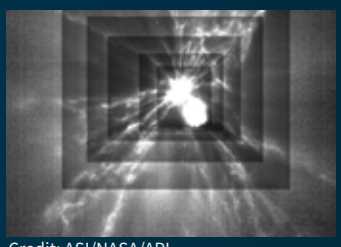

Credit:NASA/JPL-Caltech/LANL/CNES/CNRS

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

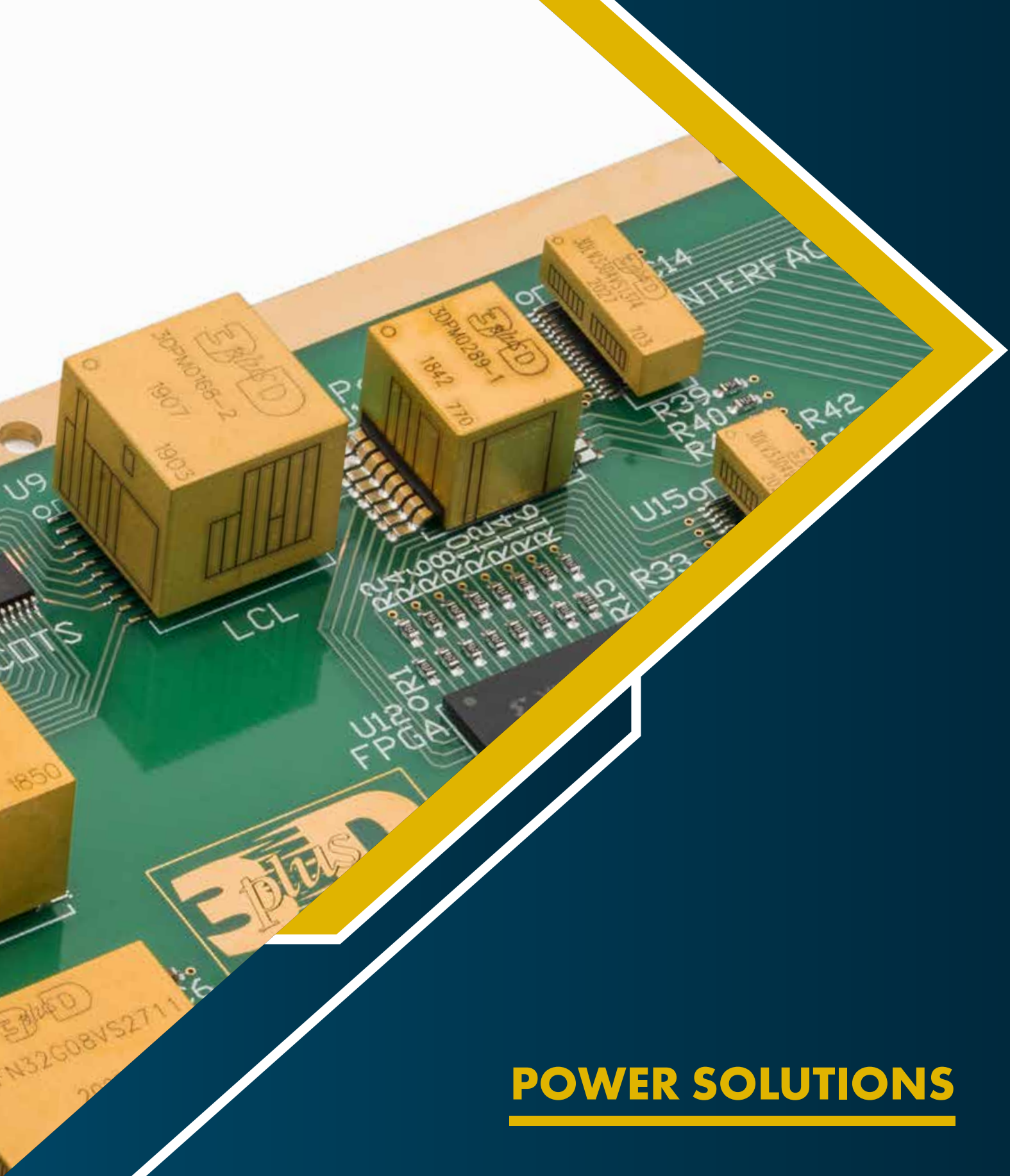
3D PLUS CASPEX 4M camera head is the optoelectronic head of the LEIA camera, that was used in 2022 to confirm the DART spacecraft impact with the Dimorphos asteroid.


Credit: ASI/NASA/APL

Mars Sample Return

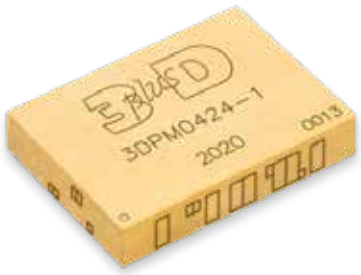
3D PLUS IRIS and IRIS HD Space cameras are part of the ongoing MSR program, providing imaging capability for both the Earth Return Orbiter (Multicamera monitoring system, especially martian sample capture monitoring) and Sample Return Lander robotic arm (Sample Transfer Arm, as critical sample detection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


Credit: ESA/NASA



POWER SOLUTIONS

DDR **TERMINATION REGULATOR**



PRODUCT OVERVIEW

One of the major challenges when using DDR memory system architectures is to ensure signal integrity during data accesses. Termination Regulator modules are compact, flexible and Rad Hard By Design. Able to sink and source current while regulating VTT voltage within the limits defined by JEDEC standards. As part of the DDR Ecosystem, they efficiently maintain fast transient response times; offer a remote sensing function; support control via Command pin and provide all power requirements for DDR VTT bus designs.

KEY FEATURES

- Source and sink current capabilities up to ±2 A
- JEDEC compliant solution
- Thermal protection
- Eliminate the need for external capacitors

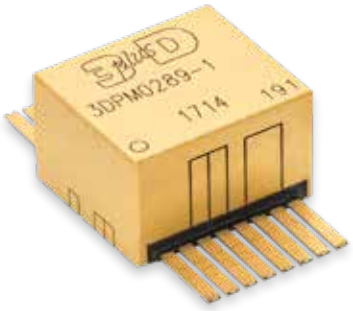
KEY BENEFITS

- Global radiation tolerant solution
- Highly integrated – All in one
- Significant board area savings

P/N	DDR Technology	Input voltage	Output current	TID krad(Si)	SEE MeV.cm²/mg	Package	SCD#
3DPM0237	DDR2	1.6 to 2.8 V	± 1A	50	80	SOP 24	3DPA-5930
3DPM0318	DDR2	1.6 to 2.8 V	± 1A	50	62.5	BGA 127	3DPA-6870
3DPM0385	DDR3	1.2 to 1.65 V	± 2A	100	62.5	BGA 259	3DPA-8140
3DPM0424	DDR4	1.1 to 1.3 V	± 2A	100	62.5	BGA 259	3DPA-8184

Temperature: C, I, S
Specific temperature range: -40 °C to 105 °C

POINT-OF-LOAD



PRODUCT OVERVIEW

PoL Converter modules provide high performances, high reliability, compact size and low weight for space applications. Based on a Buck topology, they are an excellent solution for low voltage power distribution systems designed around high-speed digital electronics such as ASICs, FPGAs (Microsemi, XILINX,...) and memories (SDRAM, DDR, DDR2, DDR3,...). All input and output filters come integrated within the module. Its output voltage can be adjusted by use of an external resistor.

KEY FEATURES

- Excellent dynamic performances
- High efficiency
- Integrated I/O filters
- Supports Current Sharing

KEY BENEFITS

- All-in-one component - all filters included
- Easy to use - Plug and Play intelligent power solution
- Modular design for distributed power architectures

APPLICATIONS

- Low power distributed power architectures
- Power supply for digital loads (FPGA, ASICs, memory banks...)

P/N	Input voltage	Output voltage	Output current	TID krad(Si)	SEL/SET MeV.cm²/mg	Operating Temperature	Package	SCD#
3DPM0211	5 V ±10%	1.2 V to 3.8 V	5 A	50	80	-40 °C to +95 °C	14-Gull-Wing	3DPA-5410
3DPM0289	4.5 V to 12 V	1 V to 5 V	1.9 A	40	60	-40 °C to +85 °C	16-Gull-Wing	3DPA-8307
3DPM0602	4.6 V to 13.2 V	0.8 V to 3.3 V	20 A	50	75	-40°C to +105°C	16-Gull-Wing	3DDS-0602

POL 20 A

NEW 20-A POINT-OF-LOAD

PRODUCT OVERVIEW

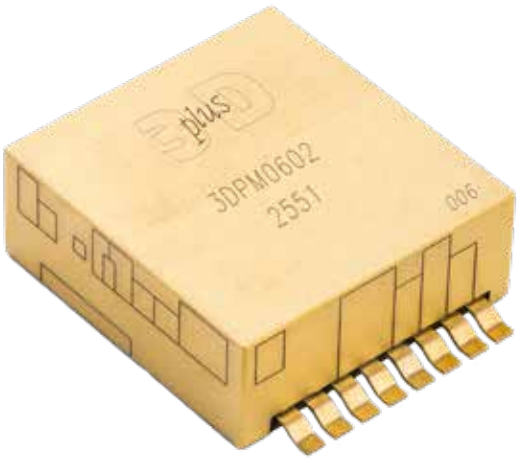
The 3DPM0602 is a highly integrated synchronous buck Point-of-Load (POL) power module designed for demanding space applications. It supports a wide input voltage range from 4.6 V to 13.2 V and provides an adjustable output voltage from 0.8 V to 3.3 V, delivering up to 20-A output current (20-W maximum output power).

The converter is engineered for high dynamic performance and ensures precise output voltage regulation, even under rapid load variations.

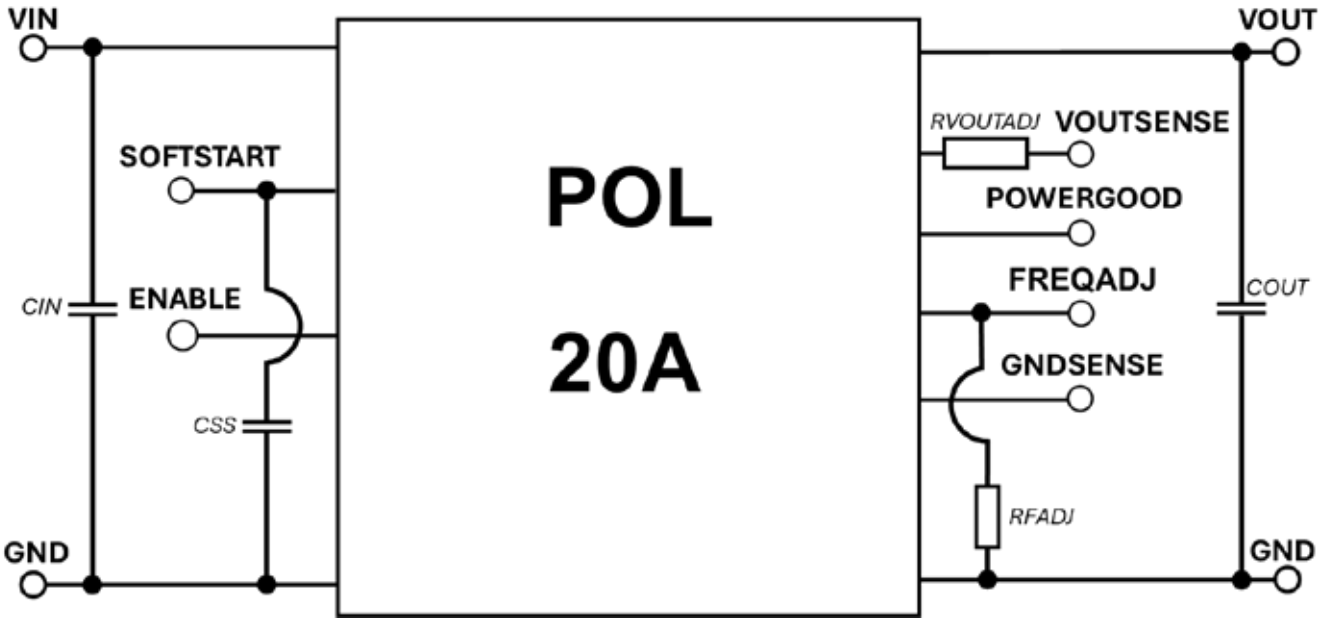
The 20-A Point-of-Load converter provides full protection against output short-circuit conditions. It also includes input under-voltage protection (UVP) and thermal shutdown circuitry, which disables operation when the internal temperature of the power module exceeds its specified thermal limit. This robust and efficient design makes it ideally suited for advanced space applications requiring high reliability and dependable power delivery.

KEY FEATURES

- Input Voltage: 4.6 V to 13.2 V
- Adjustable output voltage: 0.8 V to 3.3 V
- Output current: Up to 20 A
- Peak Efficiency 90%, full load efficiency above 80%
- Internal protections:
  - Input Undervoltage Protection
  - Output Short Circuit Protection
  - Thermal Protection
- Radiation performance:
  - Radiation-hardness-assured up to TID 50krad (Si)
  - SEL, SEB, and SEGR immune to LET = 75 MeV-cm^2 /mg
  - SET and SEFI characterized up to LET = 75 MeV-cm^2 /mg
- Size: 30 × 30 x 8 mm^3



BLOCK DIAGRAM

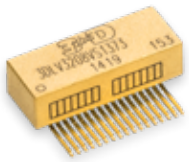


INTERFACES COMPONENTS

INTERFACES **COMPONENTS**

LVDS

- High speed performance: > 400 Mbit/s (200 MHz) switching rates
- Excellent differential skew and propagation delay
- compatible with IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards
- Very high density - small footprint
- Suitable for SpaceWire data links
- Cold sparing capability
- Ultra low power dissipation



LVDS	DESCRIPTION	I/Os	VOLTAGE (V)	SWITCHING RATE (Mbit/s)	RADIATION TOLERANCE			PACKAGE	SCD#
					TID krad (Si)	SEL MeV.cm²/mg	SEU MeV.cm²/mg		
3DLV3108VS1372	Octal Driver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 34	3DPA-8287
3DLV3208VS1373	Octal Receiver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 34	3DPA-8288
3DLV3304VS1374	Quad Driver & Receiver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 34	3DPA-8289
3DLV3104VS1617	Quad Driver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 16	3DPA-8290
3DLV3204VS1618	Quad Receiver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 16	3DPA-8291
3DLV3302VS1619	Dual Driver & Receiver	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 18	3DPA-8292
3DLV3408VS1715	Octal Repeater	LVTTL / LVCMOS	3.3	> 400	100	> 80	Immune	SOP 48	3DPA-8293

Temperature: C, I, M

LVT

- Extended voltage range
- High current driving capability
- High speed outputs
- Bus hold provided on both sides
- Cold spare function
- Space quality grade
- Compact size and low weight

LVT	DESCRIPTION	VOLTAGE (V)	PROPAGATION DELAY (ns)	RADIATION TOLERANCE			PACKAGE	SCD#
				TID krad (Si)	SEL MeV.cm²/mg	SEU MeV.cm²/mg		
3DLT162245VS1639	Dual 16-bit buffer Transceiver	1.8 - 3.6	3.2	100	Immune	Immune	SOP 82	3DPA-8303
3DLT164245VS1645	Dual 16-bit bidirectional Level Shifter 3.3 V to 5 V	2.7 - 5.5	8	100	Immune	Immune	SOP 82	3DPA-8305
3DLT163245US1696	Dual 16-bit bidirectional Level Shifter 1.8 V to 3.3 V	1.4 - 3.6	5.5	100	Immune	Immune	SOP 82	3DPA-8304

Temperature: C, I, M

SERDES

- Up to 1.428 Gbit/s data rate
- PLL frequency range 20 to 68 MHz
- Low power consumption
- Power-down mode
- Compact size and low weight
- Requires no external components
- Rising clock edge trigger
- Space qualified technology
- Compact size and low weight

SERDES	CONFIGURATION	VOLTAGE (V)	DATA THROUGHPUT (Gbit/s)	RADIATION TOLERANCE			PACKAGE	SCD#
				TID krad (Si)	SEL MeV.cm²/mg	SEU MeV.cm²/mg		
3DLV21721VS2622	21:3 Serializer	3.3	1.428	> 60	> 67	-	SOP 56	3DPA-5210
3DLV21821VS2623	3:21 Deserializer	3.3	1.428	> 60	> 67	-	SOP 56	3DPA-5220

Temperature: C, I, M

TEMPERATURE RANGES

C: Commercial (0 °C to +70 °C)

I: Industrial (-40 °C to +85 °C)

M: Military (-55 °C to +125 °C)

QUALITY GRADES

N: Commercial

B: Industrial

S: Space

ORDERING INFORMATION

Quality Grade — Options

Part Number XX XXX

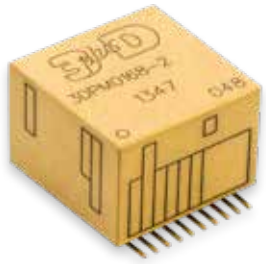
Temperature Range

https://www.3d-plus.com/ordering-information

PROTECTION ICS

PROTECTION **ICS**

LATCH-UP CURRENT LIMITER



3DPM0168

SCD# 3DPA-5090

PRODUCT OVERVIEW

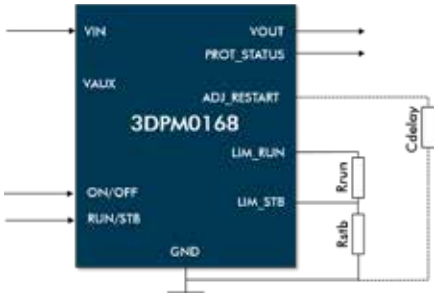
Advanced high performance semiconductor devices can be sensitive to Single Event Latch-Up (SEL) effects when exposed to radiation in the space environment. Even though SEL is a very rare event, it can lead to device destruction and therefore must be mitigated to ensure the reliability and success of the mission. The LCL is the best solution for power lines protection.

KEY FEATURES

- Latch-up protection from 0.8 V to 5.5 V and up to 2 A
- Very fast switch-off time (10 µs max)
- Very low Voltage drop across the LCL
- Adjustable Run & Standby threshold currents
- Automatic reconnection or through ON/OFF command
- Adjustable delay for automatic reconnection
- Protection Status signal for system supervision
- Operating temperature range: -40 °C to +115 °C
- Package: SOP 20 - Pitch: 1.27 mm
- Dimensions: 15 mm x 15 mm x 12 mm
- Weight: 6.5 g

KEY BENEFITS

- Highly integrated solution
- All-in-one component - two resistors needed
- Generic design to protect any type of load



RADIATION DATA

- TID > 50 krad(Si)
- SEL Immune
- SET Immune

SWITCH

3DPM0356

SCD# 3DPA-7670

PRODUCT OVERVIEW

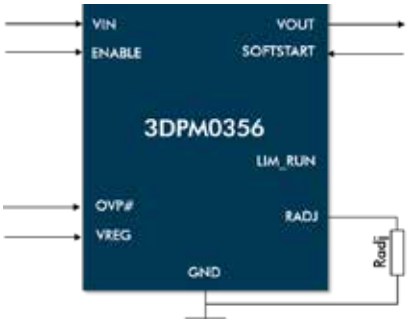
The 3DPM0356 switch module, has been designed for isolation purposes. This module is a mono-directional blocking Switch, configured to provide a fast response time against any kind of perturbation. The Switch represents a key element to guarantee a fault tolerant power supply architecture in Space applications.

KEY FEATURES

- Protection from 3 V to 12 V and up to 7 A
- Fast switch-off time (20 µs max for Over-current detection)
- Enable and OVP control inputs
- Current limitation threshold can be set through an external resistor
- Rise Time can be controlled through an external capacitor
- Operating temperature range: -40 °C to +105 °C
- Package: BGA 48 - Pitch: 1.27 mm
- Dimensions: 13 mm x 13 mm x 9.5 mm
- Weight: 4 g

KEY BENEFITS

- All-in-one component – one external resistor needed
- Simplified design – smallest footprint with OVC protection included
- Generic design to protect any type of load



RADIATION DATA

- TID > 50 krad(Si)
- SEL Immune
- SET Immune

Flight **HERITAGE**

More than 25 years in space

SUN

- **Parker solar Probe :** SDRAM
- **Solar Orbiter :** Caliste-SO, SRAM, NAND Flash, EEPROM, SDRAM, NOR Flash, LCL

EARTH

- **Cluster II:** MCCS SiP
- **One Web:** Auriga Camera
- **Pléiades** : SDRAM
- **KompSat-6:** LVDS, LVT, LCL, NAND Flash.
- **EMIT**: RIMC, DDR3, TMR NOR Flash
- **SAOCOM**: SPI NOR Flash
- **PACE**: CASPEX 4 Mpx

MOON

- **ARTEMIS I:** NAND Flash, SRAM,
- **SLS** : SDRAM
- **Chang'e 6:** FUSIO RT, RIMC, SDRAM, EEPROM, NAND Flash, SRAM, NOR Flash, POL Converter.
- **Lunar Flashlight** : NOR Flash, SRAM
- **Chandrayaan-3 :** EEPROM, SDRAM
- **IM-1 :** NAND Flash, RTIMS

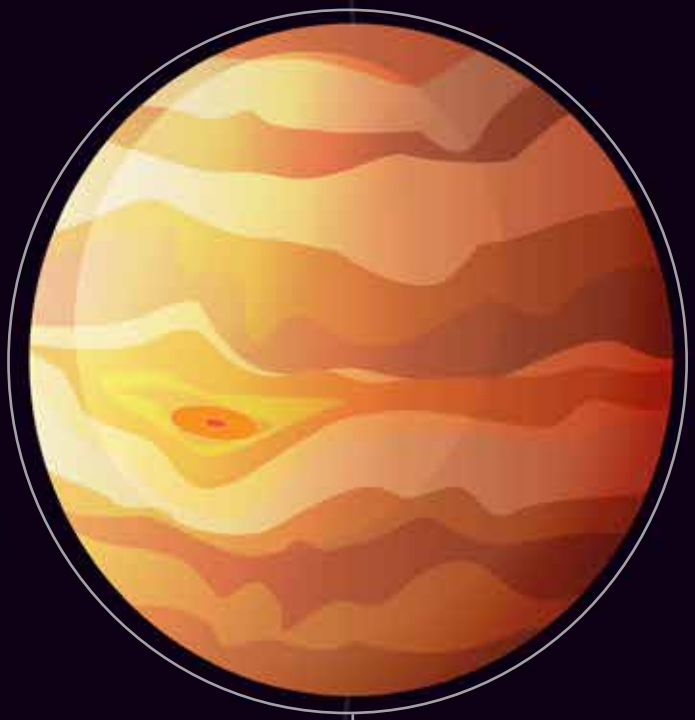
MERCURY

- **BepiColombo**: SRAM, EEPROM, SDRAM, PoL Converters

More than 225,000 modules in space

MARS

- **Mars Science laboratory:** SDRAM,NOR Flash, RTIMS SiP, CCD Camera SiP
- **EXOMARS 2016:** SDRAM, EEPROM, NAND Flash
- **Mars 2020:** CMOS Camera, SRAM, NOR Flash.



JUPITER

- **JUNO:** SDRAM

ASTEROID/COMET

- **DART:** CASPEX 4M in LICIACube
- **ROSETTA:** SRAM, EEPROM, SDRAM, CAMERA SiP

DEEP SPACE

- **HUBBLE TELESCOPE-(SM4):** SRAM, SDRAM, NAND Flash
- **GAIA:** SDRAM
- **EROSITA:** NOR Flash
- **EUCLID:** SRAM, SDRAM, EEPROM, LCL
- **NEW HORIZONS:** NAND Flash

WE ARE **EVERYWHERE** YOU ARE

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3D PLUS a HEICO company

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