Space Applications Experience and Flight Heritage

March 2011

Reliable Miniaturization Technologies For Electronics

[INTRODUCTION]

With more than 45 000 modules in Space at the end of 2010, and, with 12 years of Flight Heritage with no failure, 3D Plus is the largest Space qualified catalog products and custom System-In-Packages (SiPs) manufacturer in Europe.

3D Plus catalog products and SiPs solutions realize key features and benefits for Space applications:

- High density
- Electrical performance – high speed
- Miniaturization (very small form factors, very low weight)
- High reliability
- Radiation Tolerant (TID, SEL, SEU)
- Space qualified technology and Very large Flight Heritage worldwide
- No pure Tin Guaranty (less than 97% tin guaranty)
- Very Long Life Time Electronics - Technology proven for 20 years geostationary missions
- Worldwide delivery guarantee

3D Plus Manufacturing line and capability domain are qualified by the European Space Agency (ESA) and the French Space Agency (CNES) for Space applications, and our most-used catalog products are listed in the ESA EPPL (European Preferred Parts List). 3D Plus is also Approved Supplier for NASA centers and Jet Propulsion Laboratory (JPL) in the United States of America.

Our products and SiP Solutions are used in diverse computer boards, data recorders boards and custom applications for bus, payloads and instruments. They are used for both digital and analog designs, and, for frequency ranges from few Hz to several GHz.

Our products and SiPs are used by the major Aerospace Prime Contractors, Systems and Equipments manufacturers, and Space Agencies worldwide. Our Flight Heritage is expanding continuously with products launched in Space almost every month and in all application fields:

- Consumer Applications: Telecommunications, Navigation, Internet,…

- Durable development: Environment and Climate monitoring,

- Defense and Security: Earth observation, Disaster advanced warning and monitoring,

- Space Transportation: Launchers and Manned Space vehicles,

- Sciences: Astronomy, Space exploration and interplanetary missions.

This document gives an overview of 3D Plus Experience and Flight Heritage in Space applications. It is organized in four main chapters:

- Quality Assurance, Certification and Qualification

- Projects and Products Design-in References

- Flight Heritage – Flight Proven Data

- Customers References

[QUALITY ASSURANCE, CERTIFICATION AND QUALIFICATION]

ESA/CNES Qualification

3D Plus has now more than 10 years of experience as supplier of Radiation Tolerant components for Space Applications, and has been granted with a generic European Space Agency (ESA) Capability Approval Certification for the 3D stacking technology and its manufacturing facility in BUC, France.

This is the only 3D stacking technology qualified for Space Applications in the world.

european space agency
agence spatiale européenne

Approval Certificate

This is to certify that 3D PLUS (Buc), FRANCE
has been approved by ESA for the supply of

3D STACKING TECHNOLOGY MODULES

for use in ESA space programmes, according to

Process Identification Document (PID) 3300-0546 rev. 7

This certificate is valid until

JANUARY 2013

Head of Product Assurance
and Safety Department

Date:
March 2011

ESA does not incur any liability arising out of the delivery or use of this certificate.

3D Plus has been Capability Approved by European Space Agency (ESA) for the manufacturing of 3D stacked modules to the rules of the applicable ESA PSS Standard (PSS-01-606 and ESA PSS-01-608). Based on the requirements of these standards, 3D Plus capability domain for the 3D technology and components was defined and qualified in a Process Identification Document (PID) ref. 3300-0546.

The products manufactured on the qualified manufacturing line, with the technology of the PID and whose design are validated with the relevant Circuit Type Approval are intended for use in any ESA and other European spacecraft and Space segment hardware in accordance with the procurement requirements defined in the ECSS-Q-ST-60-05C, Generic procurement requirements for hybrid microcircuits.

3D Plus is qualified as a category 1 Manufacturer with Capability Domain formally approved by ESA.

The qualification and the capability domain approval are formally reviewed by ESA and CNES every two years with full renewal audits and space quality grades products construction analysis (DPAs).

Link to the ESA List of Hybrid, MCM and 3D Stacking manufacturers which have been Capability Approved to ESA PSS requirements (ESA/ESTEC website):
https://escies.org/GetFile?rsrcid=49034

Link to the CNES Capability Approval List with 3D Plus on page 6 on CNES website:
http://biancaweb.cnes.fr/Standard_CNES_public/List/ListeASF.pdf

Moreover, whenever complementary information is requested, the following Agency representatives can be contacted:

- CNES, France: Mr. Marc Billot, e-mail: marc.billot@cnes.fr
- ESA, The Netherlands: Mr. Liam Murphy, e-mail: liam.murphy@esa.int

ESA EPPL Products

3D Plus Products are also listed in the ESA European Preferred Parts List (EPPL). The EPPL is a list of components preferred by the ESA Space Component Steering Board of the European Space Components Coordination. It can be used both as a project PPL and as a reference list for users and designers.

Link to the ESA Preferred Parts List (EPPL) for Space Applications on ESA Website:
https://escies.org/GetFile?rsrcid=49076

NASA Qualification - USA

In 2001, NASA started an Evaluation/Qualification of the 3D PLUS technology and products for use in their Space Applications.

The resulting qualification report **"Evaluation on 3D PLUS Test Structures"** performed by NASA GSFC and covering the main results of the 3D PLUS stacking technology Capability Approval Programme at NASA.

Link to the Evaluation Report on NASA web site:
http://nepp.nasa.gov/DocUploads/64CB4357-A232-4136-A4EAE5AA219AD1A7/FinalReport_Eval_of_3Dplus_CESAR_Cube_121201.pdf

Moreover, whenever complementary information is requested, the following NASA representative can be contacted:

- Mrs. Jeannette Plante, e-mail: jfplante@pop500.gsfc.nasa.gov

Jet Propulsion Laboratory (JPL) Qualification - USA

JPL
Jet Propulsion Laboratory
California Institute of Technology

3D Plus has been Approved in JPL's Approved Supplier List after successful Audit of its Quality Management System, Process/Product for Stacked Memory Devices, and Electrostatic Discharge (ESD) Control System.

3D Plus Approved Supplier reference is JPL-PQA-2006-679.

ISO 9001 Certification

3D Plus SA and 3D Plus USA, Inc. have been certified by Lloyd's Register Quality Assurance as being in full compliance with the requirements of the ISO9001:2008 Quality System for the Design, Manufacturing and Sales of Microelectronic modules.


CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

3D PLUS
Buc
France

has been approved by Lloyd's Register Quality Assurance France SAS to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

Design, manufacturing and sales of microelectronic modules.


CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

3D PLUS
McKinney, Texas
USA

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

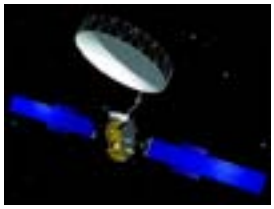
Sales of microelectronic modules.

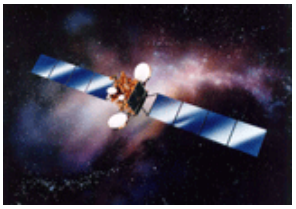
[PROJECTS DESIGN-IN REFERENCES]

3D Plus is involved in many space projects for more than 10 years and has Projects Design-in references for its Space Qualified and Radiation Tolerant product lines in all Space application fields. An overview of this experience is given in the following section.

Remote Sensing and Earth Observation Environment and Climate monitoring Defense and Security 5 to 8 years LEO and MEO missions	**Telecommunications** Telecom., Broadcasting and High-speed Internet **15 to 18 years GEO missions**	**Navigation** 5 to 8 years LEO and MEO missions	**Space Transportation** Launchers Manned Vehicles	**Sciences** Astronomy - Astrophysic Interplanetary missions Space Exploration 3 to 12 years missions
SRAM	SRAM	SRAM	SRAM	SRAM
EEPROM	EEPROM	EEPROM	EEPROM	EEPROM
SDRAM	SDRAM	SDRAM	SDRAM	SDRAM
DDR SDRAM		FLASH	FLASH	DDR SDRAM
FLASH		System-In-Packages	System-In-Packages	FLASH
Nv-RAM				POL Converters
POL Converters				System-In-Packages
System-In-Packages				

- **Consumer Applications: Telecommunications, Navigation, Internet,…**


AlphaSat


W3C


Galileo


GPS

- **Durable development: Environment and Climate monitoring**


Envisat


Cluster II

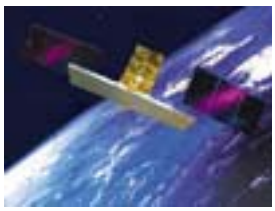

GOES-R


Themis

- **Defense and Security: Earth observation, Disaster Monitoring**


TerraSAR


Pleiades


Cosmo/Skymed


LandSat

- **Space Transportation: Launchers and Manned Space vehicles**


Ariane 5


H2A

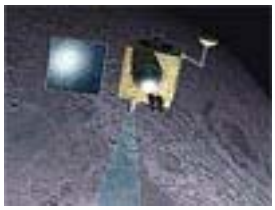

ISS

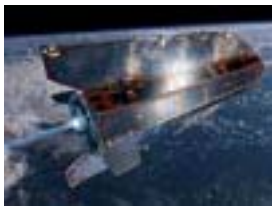

CEV-Orion

- **Sciences: Astronomy, Astrophysics, Space exploration and interplanetary missions.**


Rosetta


Smart-1


Chandarayan / L3


Goce


New Horizon


Dawn


Mars Science Laboratory


LRO


Bepi-Colombo

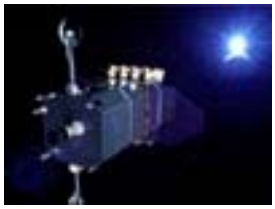

Corot


Kepler

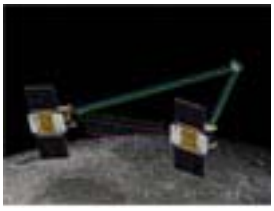

Mars Express


Hershel


MRO

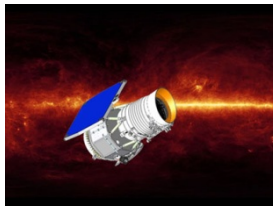

SDO


Juno


GRAIL


Gosat


SMOS


Wise

3D PLUS is present in many other missions and projects for institutional organisms as well as private companies.

[FLIGHT HERITAGE – FLIGHT PROVEN DATA]

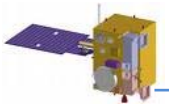
3D Plus is involved in many Space projects for more than 10 years and is therefore “flight proven” many times with more than 45 000 modules in space at the beginning of 2011.

Our products and SiPs are used by the major Aerospace Prime Contractors, Systems and Equipments manufacturers, and Space Agencies worldwide.

Our Flight Heritage is expanding continuously with products launched in Space almost every month.

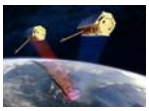
The recent ‘public’ launch schedule is presented hereafter. More flight heritage information is available on demand.

06.11.2010 COSMO 4 - Thales Alenia Space, Italy

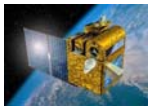


04.11.2010 FY - CAST, China

01.10.2010 Chang'e 2 - CAST, China



21.06.2010 TanDEM-X (TDX) - ASTRIUM, Germany

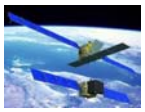


15.06.2010 Picard - CNES, France
PRISMA - Swedish Space Agency, Sweden

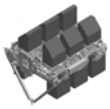
20.05.2010 Planet C (Akatsuki) - NT SPace, Japan

08.04.2010 CryoSat 2 - ASTRIUM, Germany

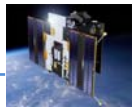
11.02.2010 SDO - NASA GSFC, USA



28.11.2009 IGS - MELCO, Japan

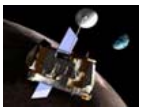


16.11.2009 Atlantis F31 (STS-129) ELC 1, ELC 2 - NASA, USA



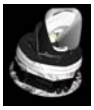
02.11.2009 Proba 2 - ESA, Europe
SMOS - ASTRIUM, France

29.07.2009 DubaiSat 1 - Satreci, Korea

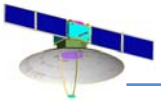


14.07.2009 RazakSat - ATSB-Satreci, Malaysia-Korea

18.06.2009 LRO - NASA GSFC, USA



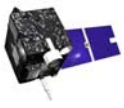
14.05.2009 Herschel - Thales Alenia Space, Europe
Planck - Thales Alenia Space, Europe



20.04.2009 RISAT 2 - ISRO, India

17.03.2009 GOCE - Thales Alenia Space, Italy

07.03.2009 Kepler (Discovery 10) - BALL Aerospace, USA



12.02.2009 SPIRALE A,B - ASTRIUM, France

23.01.2009 GOSAT (Ibuki) - NT Space, Japan

[SOME SPACE CUSTOMERS REFERENCES]

The following institutional organisms or private companies use 3D Plus Products and Technology to meet their needs in terms of Hi-Reliability electronics:

	COMPANY	COUNTRY
EUROPE & MEA	EUROPEAN SPACE AGENCY (ESA)	The Netherlands - Europe
	CEA	France
	CNES	France
	CNRS (diverse Labs)	France
	DASSAULT	France
	DGA (French MoD)	France
	SODERN	France
	EADS SPACE TRANSPORTATION	France, Germany
	ASTRIUM	France, Germany, Spain
	THALES ALENIA SPACE	France, Italy
	DLR	Germany
	JENA OPTRONICS	Germany
	OHB SYSTEMS	Germany
	ELTA	Israel
	IAI	Israel
	MBT	Israel
	ROKAR	Israel
	CARLO GAVAZZI	Italy
	GALILEO AVIONICA	Italy
	RUAG AEROSPACE	Sweden, Switzerland, Austria
	ASELSAN	Turkey
	TUBITAK	Turkey
	BAE SYSTEMS	UK
	SSTL	UK
	THALES AIRBORNE SYSTEMS	UK, France
ASIA & PACIFIC	ANURAG	India
	ISRO	India
	JAXA	Japan
	MELCO	Japan
	MHI	Japan
	NT SPACE	Japan
	KAIST	Korea
	KARI	Korea
	SATRECI	Korea
	NTU / DSO	Singapore
SOUTH AMERICA	CONAE	Argentina
	INVAP	Argentina
	INPE	Brazil
	MECTRON	Brazil
NORTH AMERICA	BRISTOL AEROSPACE	Canada
	COMDEV	Canada
	MDA	Canada
	APL	USA
	BALL AEROSPACE	USA
	BOEING SATELLITE SYSTEMS	USA
	GENERAL DYNAMICS	USA
	HONEYWELL SPACE SYSTEMS	USA
	JET PROPULSION LABORATORY (JPL)	USA
	L3-COMMUNICATIONS	USA
	LOCKHEED MARTIN	USA
	NASA (GSFC, LANGLEY, MARSHALL)	USA
	ORBITAL SCIENCES	USA
	SWRI	USA