

Space Applications Experience and Flight Heritage

March 2009



Reliable Miniaturization Technologies For Electronics

[INTRODUCTION]

With more than 30 000 modules in Space at the end of 2008, and, with 9 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 18 years missions in Space
- 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,
- 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 three main chapters:

- Quality Assurance, Certification and Qualification
- Projects and Products Design-in References
- Flight Heritage – Flight Proven Data
- Customers References

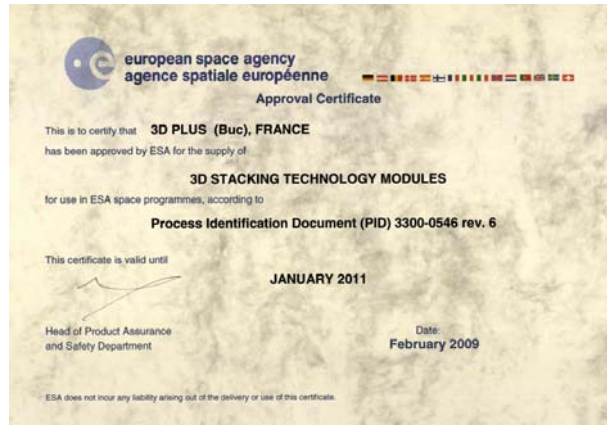


[QUALITY ASSURANCE, CERTIFICATION AND QUALIFICATION]

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.



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. 3300-0546-6.

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).

The 3D Plus stacking technology Capability Approval Program was implemented by ESA and CNES (Centre National d'Etude Spatiale - French National Space Agency). The results presentation was performed by 3D Plus in ESA-ESTEC - Noordwijk - The Netherlands - on April 2004, 28th. It included the description of the technology, the evaluation test vehicle, the qualification test products and the tests plans.

Links to the Technical Presentations on ESA/ESTEC website:

<https://escies.org/ReadArticle?docId=226>

<https://escies.org/GetFile?rsrId=1888>

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?rsrId=23167>

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 CNES representatives can be contacted:

- Mr Marc Billot, e-mail: marc.billot@cnes.fr

- Mr Aleberto Boetti, e-mail: alberto.boetti@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?rsrclid=7327>

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/index_nasa.cfm/619/64CB4357-A232-4136-A4EAE5AA219AD1A7/

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



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 ISO9001:2000 Quality System for the Design, Manufacturing and Sales of Microelectronic modules.

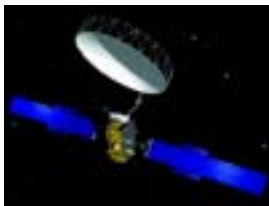


[PROJECTS DESIGN-IN REFERENCES]

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



Galileo (Giove-A and Giove-B)

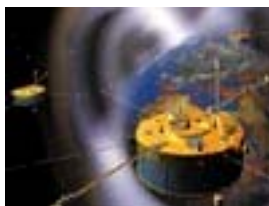


GPS

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



Envisat



Cluster II



Cryosat



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



Chandrayan



Goce



New Horizon



Dawn



Mars Science Laboratory



LRO



Bepi-Colombo



Corot



Kepler



Mars Express



Herschel



MRO



SDO



Juno

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 30 000 modules in space at the beginning of 2009.

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.



[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
THALES ALENIA SPACE	France, Italy
ASTRIUM	France, Germany, Spain
BALL AEROSPACE	USA
BRISTOL AEROSPACE	Canada
CNES	France
CEA	France
CARLO GAVAZZI	Italy
BOEING SATELLITE SYSTEMS	USA
CNRS (diverse Labs)	France
CONAE	Argentina
OERLIKON	Switzerland
COMDEV	Canada
DASSAULT	France
DGA (French MoD)	France
DLR	Germany
EADS SPACE TRANSPORTATION	France, Germany
ELTA	Israel
EUROPEAN SPACE AGENCY (ESA)	Eu
GALILEO AVIONICA	Italy
GENERAL DYNAMICS	USA
HONEYWELL SPACE SYSTEMS	USA
IAI	Israel
INVAP	Argentina
INPE	Brazil
ISRO	India
JAXA	Japan
JET PROPULSION LABORATORY (JPL)	
KAIST	Korea
KARI	Korea
LOCKHEED MARTIN	USA
MBT	Israel
MDA	Canada
NASA (GSFC, LANGLEY, MARSHALL)	USA
NT SPACE	Japan
MHI	Japan
ORBITAL SCIENCES	USA
OHB SYSTEMS	Germany
RUAG AEROSPACE	Sweden, Austria
SWRI	USA
SATRECI	Korea
SSTL	UK
THALES AIRBORNE SYSTEMS	UK, France
TUBITAK	Turkey

