



IMT Presentation 2022



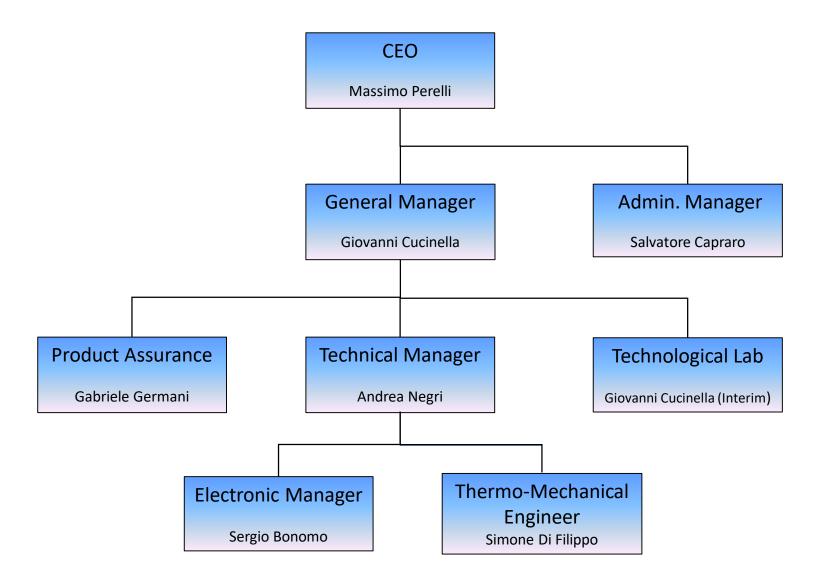
OVERVIEW

IMT Srl is a private company, founded in 1991 and active in the Space sector on three main types of activities:

Ingegneria Marketing Tecnologia

- Systems Engineering: Design and Development of Nano/Microsatellites and relevant On-board units for space commercial, scientific and defense applications.
- *Parts Engineering*: Characterization and Testing of EEE (Electrical, Electronic, Electro-Mechanical) parts.
- *IoT solutions*: Development of Iot Solutions for Smart Cities, Environmental Monitoring and Agriculture.





IMT ORGANIZATION

PLANTS







OPERATIONAL PLANT

Via C. B. Piazza, 30 00161 Roma – ITALY

TECHNOLOGICAL LAB.

c/o Tecnopolis Via per Casamassima Km 3 70010 Valenzano (BA)





Mission: System Engineering Activities for Space applications Characterization and Tests of EEE components.

<u>Tipology:</u> SME (20 in staff)

Space Space

Turnover: 2.5 MEuro



WHERE DO WE COME FROM



IMT HERITAGE

CUBESAT

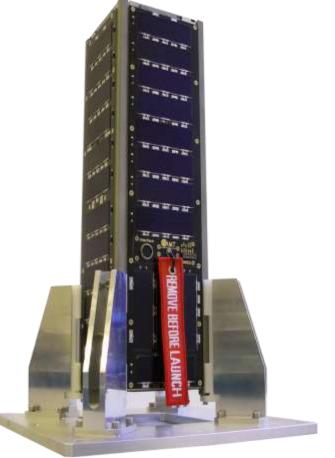


IMT has developed 3U Cubesat based on modular systems. Preliminary performances for 3U standard platforms:

- 1.5U available for Payload
- UHF/VHF (opt. S-Band) Communication
- NADIR Pointing (5° knowledge accuracy / 10° control accuracy)
- OAP (Orbit Average Power): 4W
- Applications: Education / Technology IoD / Science Missions

In-development Enhanced Performances 6U Cubesat

- Fine Pointing: <1° control accuracy
- Propulsion: Drag Compensation + Low Orbit Maneuvering
- High Data Rate: up to 10 Mbps
- Application: Earth Observation / TLC / Astronomy



CUBESAT 3U





CUBESAT UNITS

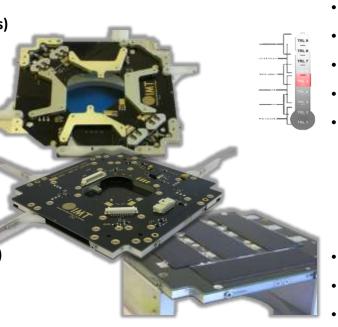


- IMT Cubesat Subsystems:
- Structure
- Antenna Deployment Mechanism
- Solar Arrays and Solar Array Drive Mechanism
- On Board Computer
- Power Distribution Unit
- Battery Pack

ADM FOR CUBESAT

Antenna Deployment Mechanism (ADM) Features:

- Cubesat Compatible (98 x 98 x 6 mm)
- Mass: 80 g
- Power Cons.: 50 mW (3,5W in operation 25 secs)
- Frequencies: VHF / UHF
- Max. Ptx: 2W (4W on request)
- Interfaces: SSMCX 50 Ohm (RF) / PicoBlade (data)
- Possible Configurations:
 - 4 monopoles in UHF or VHF
 - Turnstile in UHF / VHF
 - 2 dipoles in VHF / UHF
 - Other possible combinations (on demand)
- BUS:
 - electric: 3,3V / 5V
 - data: I2C
- OP. Temp. : -40°C / +125°C



CUBESAT OBDH



Features:

- Cubesat compatible (96 x 90 mm) + CSK (Cubesat Kit)
- Mass: 38 g
- Power consumption: < 400 mW
- Real Time OS (free RTOS)
- 2x CAN bus / 2x I2C / 2x SPI / 2x UART / JTAG / CAMERA
- 8 GB Payload Data / 128 MB Housekeeping Data / 16 MB RAM
- Triple modular redundancy (TMR) with Majority Voting
- Processor:
 - Up to 200 MHz / 330 DMIPS
 - AEC-Q100 (Grade 2)
 - Cryptography with RNG (AES, 3DES, SHA, MD5, and HMAC) FPU (IEEE 754)
- Double RTC (5 days without power supply)
- 4 dedicated anti-latchup protection circuits
- Op. Temp. : -20°C / +70°C
- Radiation tolerance: up to 25 Krad (Si)



BATTERY PACK FOR CUBESAT



Features:

- CubeSat compliant (96 x 90 mm) + CSKB (Cubesat Kit Bus)
- Mass: < 250 g
- Op. Temp. :
 - Charge: 0°C/+45°C
 - Discharge: -20°C / +60°C
- Capacity: > 40 Wh
- Configuration 4S / 2S2P / 4P
- Heaters / Temp. Sensors / Overcurrent Protection
- IMT Screening Procedure (for COTS Li-ion cells)
- IMT Acceptance lot procedure

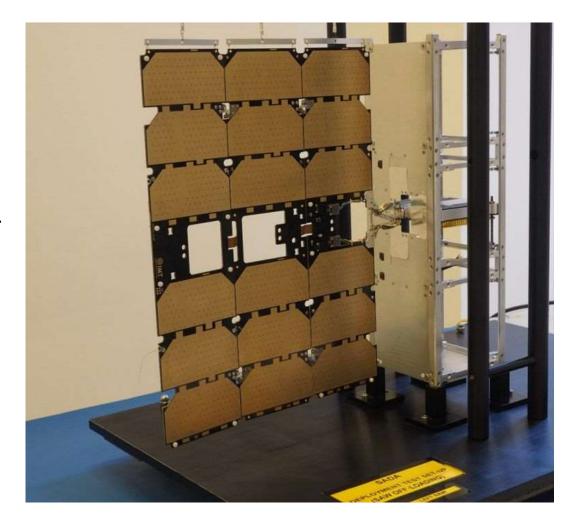






3U CUBESAT SADA

The IMT 3U CubeSat SADA project started in 2012 such as internal R&D program, later co-funded by Lazio Region (POR/FESR 2007-2013). Nowadays the TRL is 3/4. Modular and Scalable unit (3U CubeSat or upper) with no relevant re-design phase (only Solar Array Wings are affected).

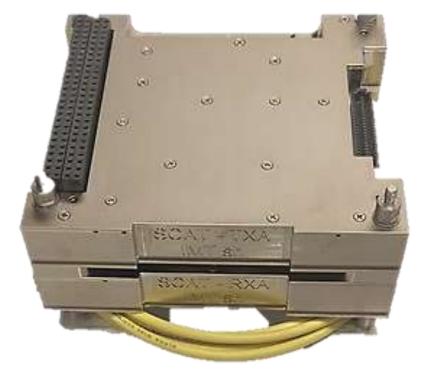




SCAT C-BAND TRANSPONDER (ESA Program - ARTES in progress)

SCAT C-BAND Transponder is compliant with CubeSat/Microsatellite spacecrafts and gives a new frequency band for microsatellite communication (both TT&C and Payload data).

The modular design allows to derive from the basic design a line of COTS-based products for LEO missions as transmitter for high data rate transmission and command receiver for various modulation formats and frequency bandwidths.

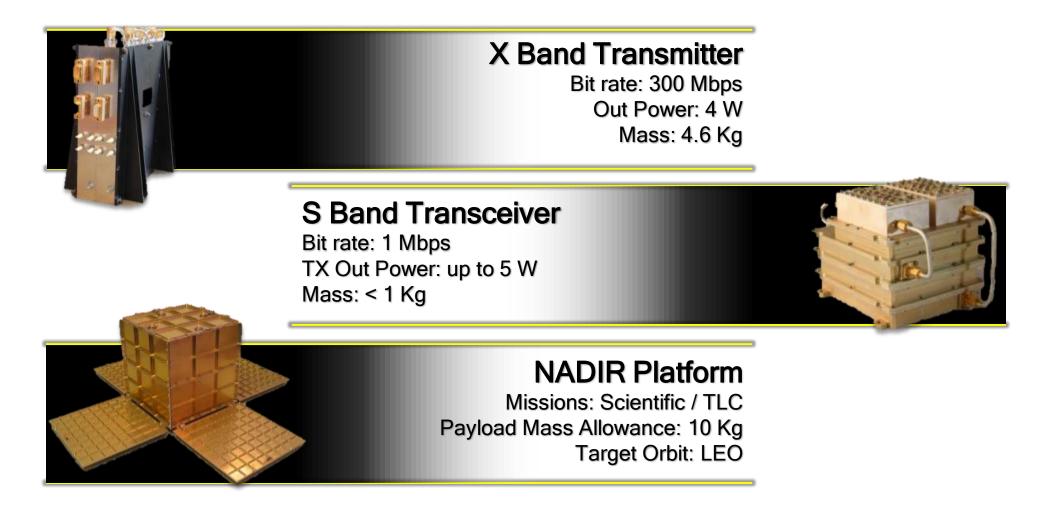






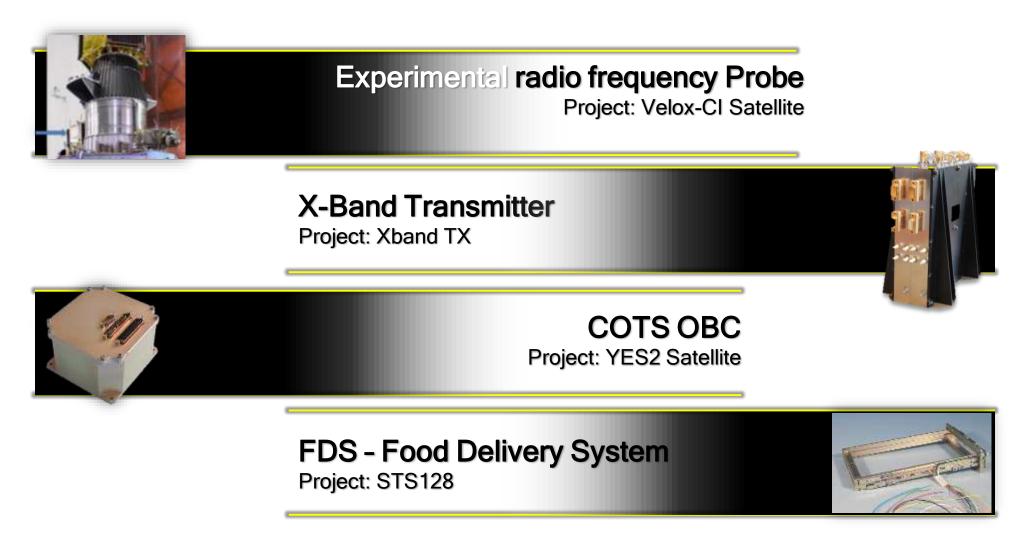
MICROSAT S/S





MAJOR FLIGHT HERITAGE





EDUCATIONAL ACTIVITIES



IMT participated in several projects on Educational Activities. EduSat, a joint activity with the Italian Space Agency, is a Satellite Trainer (Technological Satellite Demonstrator - DTS) for High Schools and Universities. It is composed by typical Cubesat Subsystems and thanks to a Plug&Play ground station is possible to send and receive TT&C data.

Over 30 Italian High Schools and 4 Universities has been involved in EDUSAT.



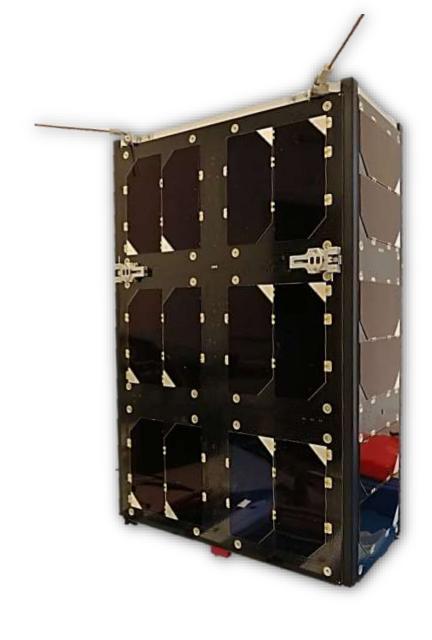
EDUSAT DTS

Satellite Training High School Students / Academics Only for Laboratory Use





IMT CUBESAT PROJECT



HORTA CUBESAT 6U (Regione Lazio Program)

Thanks to HORTA, a Regione Lazio program, IMT developed a CubeSat sized 6U for Earth Observation and Remote Sensing. The payload on board of satellite is a GNSS-R Passive Reflectometry, it will be used to analyze soil conditions, in particular humidity and biomass.

A Ka-Band transmitter on board of HORTA will send data from satellite to Earth. The main goals of this program are: the study and monitoring of soil conditions and the Precision Farming.







HORTA

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EOSS CUBESAT 6U (Apulia Region Program in progress)







Operazione coflonariziato con il Fondo Europeo d'Srilippe Ragionale Pagi POR Pagila 2014 - 2020 'Investimo nel rostro futaro' Asse III - Obertivo specifico 3 a Calvo Materialio - Azione 3.1. Asse I - Obiettivo specifico 1 a - Azione 1.1 (RdS) Procetto



EQUIPMENTS FOR CUBESAT



IMT µSADA (ESA Program - GSTP in progress)

Thanks to a contract with ESA, IMT SrI is developing a miniaturized Solar Array Drive Assembly for CubeSat sized 6U and 12U. The IMT μ SADA aims to increase the on-board available power energy, thanks to 6 solar panels (3 for each wing) that increase the active area needed for the power generation. The pointing and tracking of the solar arrays toward to the Sun allows to be very competitive on the market, with a product that can guarantee very high performances about:

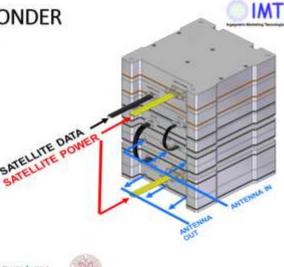
- High Transmission power
- Electric Propulsion
- High computational power

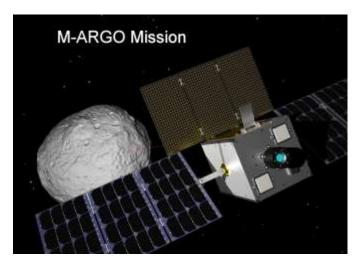


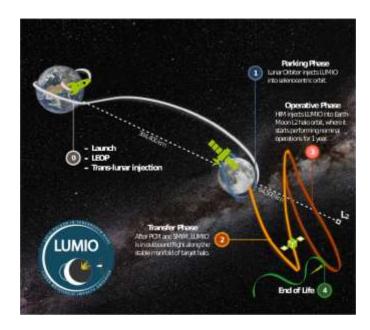


The C-DST X-BAND Transponder is compliant with CubeSat spacecrafts and can guarantee very high performances. This subsystem can be used for the Deep Space Exploration and it is a revolutionary equipment for CubeSat missions. C-DST will be compliant to the ESTRACK Stations. IMT <u>Srl</u> is the Prime Contractor of this project with the ESA (European Space Agency).









over Supply: Main / Release Mechanism 5V / 5V ower Consumption: Drive / Stand-By / Release 2W / 500 mW / 4.5W (Simultaneous Deployment) BE Interface CAN Bus / 12C / UART ID: >15 Krads EL: Latch-up protections for critical components Automotive Grade or Rad Tolerant: - • No Single Event Latch-up Below an LET Threshold of 60 MeV.cm2 /mg @125°C • Total lonizing Dose of 30 krad(Si) • Stepper Motor with redundant windings • Independent Drive mechanism for each Wing • Independent Drive mechanism for each Wing • No Single Event cation (endless rotation) • 10.3° with zero reference rive direction: Forward and reverse rotation (endless rotation) • 10.07 °/s (selectable by digital command) • 40.4 °/s ualification sequence: 38060 revolutions (3 years il LEO orbit) Motor Motor • 170 mNm Max are Slip Rings			
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Slip Rings			
umber of lines 15 for each Wing			
Nax. Current 0.5A for each contact			
Max Voltage 60V for each contact Ausian for each WINC Ausian for each WINC			
Powered Rings: 4 pairs for each WING			
Solar Wings			
enerated Power (BOL @ Tamb): 118W @ 25°C (Total)			
us Voltage @ Max Power 31V – 54V (Typ. 42V)			
urrent @ Max Power 2.6A – 3.0A (Typ. 2.8A) (Total)			
olar Cells per Panel: 18 (54 for each Wing)			





µSolar Array Drive Assembly

	MAIN F	PERFORMANCES			
Network Compatibility	ESTRACK	ESTRACK			
Design Lifetime	3 years	3 years			
Frequency Bands (Uplink)	7145 MHz -	7190 MHz (Cat. B missions)			
	7145 MHz -	7235 MHz (Cat. A missions)*			
Frequency Bands (Downlink)	8400 MHz -	8400 MHz -8450 MHz (Cat. B missions)			
		8400 MHz -8500 MHz (Cat. A missions)*			
Coherency	Coherent o	Coherent operations supported			
Turn-around rations	749/880	749 / 880			
Ranging	ESA STD rar				
		ative ranging			
Navigation Support	2-way Dopp	ller			
		Ranging			
	Delta-DOR	Delta-DOR <1,5U			
Volume Mass		< 1,50 1356g			
111055					
		CubeSat compliant. 3 separate assemblies:			
Form Factor		2 Lin () both big			
		HPA Assembly Internal OCXO			
Oscillator					
		External USO – Ultra Stable Oscillator (100 MHz) *			
TCXO Allan Deviation		< 2E^-11 at 1 sec			
TM/TC Interface	Redundant	Redundant CAN bus or CAN Bus (I2C as backup)			
Payload Data Interface	R5422	R\$422			
Operation Modes		5151			
		ist signal beteening earlier requisition, earlier racking and re racking			
	Operative N	Node	POWER		
Power Consumption	STBY		7.4 W		
	RX		12.9W		
	RX & TX		81.7W @ 15w Output Power		
Operative Temperature	-20°C + 50°C				
	-30°C + 60°C				





Cubesat Deep Space X-Band TT&C Transponder

C-DST

BISS Mission



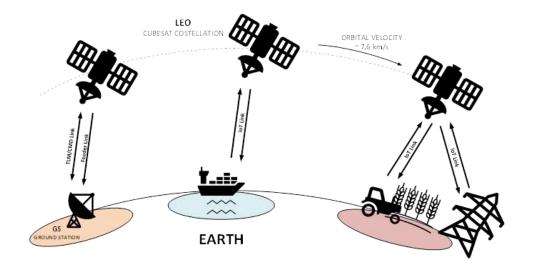
As result of the ASI call for tenders called "Future CubeSat missions" emanated in 2020, the BISS (BI-directional IoT Satellite Service) proposal by IMT resulted as the first classified by the Agency technical evaluation and it has been funded up to phase B completion.

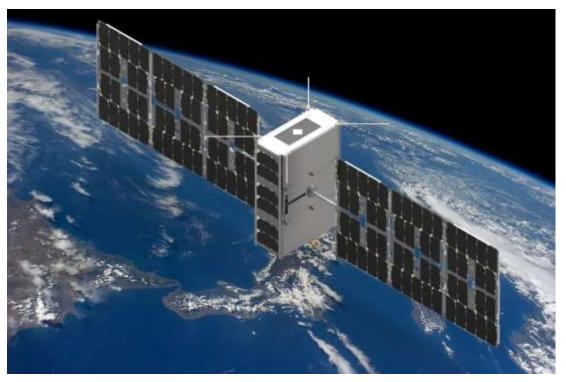
The main purpose of BISS (BiDirectional Satellite Service) is to provide IoT connectivity basing on the following key features:

- Lowest cost IoT communication proposition for massive quantity of users;
- Lowest Power or Lowest energy consumption footprint and device autonomy for several years;
- Global Coverage (Internet of Everything Everywhere), the scale of the IoT demands ubiquitous network coverage even in remote locations, which are best served by satellite networks.

The Direct Sat-IoT offers an IoT service in the area not covered by the terrestrial network. Thanks to this, the main applications involved are:

- Structural Health Monitoring
- Smart Agriculture
- Environmental Monitoring







TECHNOLOGY LABORATORY

EEE PARTS ENGINEERING



- Technical support to System Engineers and PM
- Technical analysis and preparation of DCL
- Specification Preparation and Review
- Technical Negotiation of Specification
- PAD Preparation
- Parts Reduction and Standardization
- Solutions to specific concerns about the use of COTS
- Evaluation / Qualification Plan and Test Plan
 Preparation
- Test Procedures Preparation
- Quality assurance

Part Type 28222	2A	Part Number MM8T2222ALT 1G	Flag IN PPL
PPL Application	Group 12	Sub Group 1	
Applicable Specification MNI I	95: MM0T2222LT1/D - October	,2016 - Rev. 11	
Quality Level COTS			Package S0123
Descrition TRANSISTOR - I	NPN - Vce 50V - 1c 0.8A		
Manufacturer ON SENICON DU	CTOR		
Manufacturer Country US			
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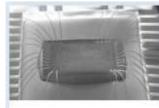
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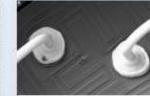
EEE PARTS TESTING





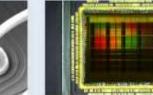
Destructive physical analysis

DPA is a detailed warmination of EEE components at various stages of physical disassembly. This last verifies that the component quality is in accordance with the detailed project requirements.



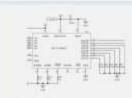
Failure analysys

FA is the process of analysing the component to Find out the reason for degradation or failure of a EEE component, during component manufacturing and testing, during incoming impertion ar after delivery to the client.



Construction analysis

the CA test can give informations about our for the construction of the component, component, identifying potential fragility, anomalies or ring and factors that should be improved, etion or



Burn In

Burn In is an electrical stress test that uses voltage and temperature to accelerate the appearance of latent reliability defects in a EEE component.



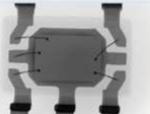
Thermal shock (airair/liquid-liquid)

Thermal Shock testing is performed to find out the capability of EEE components to function properly in an orwinonment with rapid extreme changes in temperature.



P.I.N.D. test

The aim of the P.I.N.D. (Particle Impact Noise Detection) test, is to detect free particles inside component cavities, that can affect the system.



X-Rays

X-Rays tests can detect internal physical defects which are not visible in EEE components.



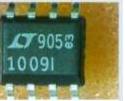
Re-life test

Re-life test consists in the assessment of the EEE component reliability when stored for a long period. Thanks to Re-life test is possible to discover if components are degraded or not.



Up-screening

Up-screening is a very complete test on EEE components about some types of leaves.



Humidity test

Humidity test has the purpose of evaluating the properties of materials used in components and the reliability of nonhermetic packaged devices in humid environments.



Die Shear test

Die Shear test has the target to determine the integrity of materials and procedures used to attach semiconductor die or surface mounted passive elements to packago headers or other substrates.



Bond pull test

The aim of this test is to measure bond strengths in discrete semiconductors and microcircoits wire bond



Life test

Life test is an electrical test that uses voltage and lemperature to increase the appearance of wear-out rebablity failures in a EEE component.



High stabilization bake

The aim of this test is to find out the effect on microelectronic devices of storage at wide temperatures without electrical stress request.



Electrical test characterization of EEE parts

Analogue, Digital and radiofrequency electrical tests on EEE parts.



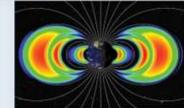
Hermeticity test

The aim of hermeticity tests is to determine the efficacy of the sealing of components with internal cavities and to test their hermeticity.



C-SAM (Sonoscan)

Thanks to this test is possible to have a quality control on EEE components.



Radiation test (TID - DD -SEE)

Radiations can reduce capability of equipments and systems operating in space.

APPLICABLE STANDARDS

All IMT laboratory activities are performed according to:

- ECSS standards as required by ESCC system
- ✓ *MIL-STD- 202*
- ✓ MIL-STD-750
- ✓ MIL-STD-883
- ✓ JEDEC Standards

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	NDARD	DEPARTMENT O TEST METHOD TEST METHODS FOR SEMA	STANDARD
AMSC N/A	FSC 5962	AMEC NIA	FSC 5961

TECHNOLOGY LABORATORY MEASUREMENT TEST EQUIPMENTS



Analogue. Digital and radiofrequency (up to 40 GHz) electrical tests (at ambient, low and high temperature; -65°C - +150°C) on EEE parts are performed with large number of automatic and PC controller test equipment.

Besides standard instrument, the following equipment are available:

HP4142B - Semiconductor Parameters DC Analyzer (3 units)

HP4085M - 48 Pins Switching Matrix

Thermostream - per High/Low Temperature Test

HP4275A - LCR Meter for passive components test

33250A - Agilent Function Generator

Spectrum Analyzer up to 43,5 GHz (3 units)

N5224A - AGILENT Network Analyzer (10 MHz - 43,5 GHz)

E4419B - Agilent Power Meter (4 units)

Signal Generator up to 43,5 GHz (3 units)

NI PIXIe - National Instruments ATE - Source / Monitor Unit

TECHNOLOGY LABORATORY Environmental Testing area





TECHNOLOGY LABORATORY Environmental Testing Chambers



IMT is equipped with a large number of Thermal chambers to perform various temperature tests, Thermal Cycles, Thermal Shocks and Humidity tests according to applicable MIL, NASA and ESA standards.

Equipment	Manufacturer	Model	Description
Heating oven	Binder	FD53 Cl.2	Temperature range from 5 °C above ambient temperature to 300 °C
Thermal Chamber	A.C.S.	CSTL12	Thermal Shocks liquid to liquid (-75;+200°C)
Thermal Chamber	A.C.S.	CST 110/3D3	Thermal Shocks air to air (-60;+175°C)
Climatic Chamber	A.C.S.	SYSTEM CNS 500	Salt spray test Chamber
Thermal Chamber	WEISS/MAZZAL	80/80 180 DU	Thermostatic chamber cold-hot (-70;+200°C)
Thermal Chamber	MAZZALI	A530H1	Thermostatic chamber cold-hot (-70;+125°C)
Thermal Chamber	MAZZALI	A530H1	Thermostatic chamber cold-hot (-70;+125°C)
Thermal Chamber	MAZZALI	A530Q1	Thermostatic chamber hot-hot (+40; +250°C)
Thermal Chamber	MAZZALI	A530Q1	Thermostatic chamber hot-hot (+40; +250°C)
Climatic Chamber	MAZZALI	C330G5	Climatic chamber hot-cold- humidity (-30;+100°C; 100%RH)
Climatic Chamber	MAZZALI	C330G5	Climatic chamber hot-cold- humidity (-30;+100°C; 100%RH)
Pressure cooker	MAZZALI/WEIS	PCK 75/155	Pressure cooker (95%RH up to 170°C)

TECHNOLOGY LABORATORY PROJECTS



PRAGAN - Preliminary Reliability Assessment of a European 0.25 μm GaN HEMT Process (ESA Program)

Contract as part of the General Support Technology Program (GSTP) supported by ASI. The objectives of this activity are:

- 1) To perform a preliminary performance and reliability assessment of the Contractor 0.25um gate GaN MMIC foundry process (Task 1) as it exists today.
- 2) To perform process optimization and validation of a commercial European episupplier (Task 2). Task 2 shall allow identification and correction of any process weaknesses (if any) in terms of space applicability and tuning of European epi-layer supplier.









Evaluation of LFoundry Mixed-Signal 150nm CMOS Process (LF15A) for Space Applications (ESA Program)

- Activity as part of the General Support Technology Programme (GSTP) supported by ASI
- The scope is to list, assess, select, characterize, and validate a European mixed-signal process technology
- Kick-off done on 23/03/2016





INDUSTRIALIZATION AND QUALIFICATION OF RAD-HARD POWER MOS-FET N-CHANNEL (ESA Program)

- > The objective of the activity is the development, qualification, and industrialization of Power MOSFET in answer to the strong demand from Space Industry.
- The introduction of this product family, supported by the ESCC qualification and EPPL listing, is expected from the industry as an advantage in procurement process, allowing the European non-dependence for European Space programs.
- > Target TRL: 8 (estimated)
- Partners: ST (IT), IMT (IT)
- Kick-off meeting 2019, Feb. 12th





Packaged Integrated photonics-based RF/Optical hybrid Transceiver key-elements for Sensing and communication (PIOTS) - SSSA-INPHOTEC/IMT as SUBCO (ESA Program)

PIOTS stems from recent state of the art achievements in photonics integration and advanced packaging solutions at Scuola Superiore Sant'Anna (SSSA-INPHOTEC) with its existing skills and facilities, aiming at the development of an innovative space-compliant packaged integrated photonics-based RF/optical hybrid transceiver for sensing and communication.

- The initial TRL is 5 using discrete components and 4 using photonic integration
- The final TRL will be 7
- It is part of GSTP 6 Element 2, AO7935.
- Kick-off meeting end of Jan 2019









IMT MAIN CUSTOMERS







Thank you for your kind attention!

- General Director: Giovanni Cucinella giovanni.cucinella@imtsrl.it
- CTO: Andrea Negri andrea.negri@imtsrl.it

