The NaoSat nanosatellite platform for in-flight radiation testing

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EMXYS – Spain

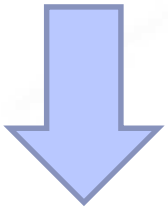
RADIATIONTEST WORKSHOP 2016
SEVILLE – SPAIN 31st MARCH – 1st APRIL

Presentation outline:

- Purpose and objectives of EMXYS NaoSat plattform
- The Platform: service module
- The platform: payload module and ICD
- NaoSat intended missions (so far)
- EMXYS RelTools

OBJECTIVE

- **Increased performance and features of both analogue and digital electronic** circuitry are **pushing designers** toward the fast adoption of components originated or widely used in the Commercial Off-The-Shelf (COTS) market.
- Any change in technology or new process introduction presumably leads to loss of radiation immunity (total dose effects and single event effects).
- **Low Earth orbits provide the ultimate environment to TRL9**, i.e. characterize the response of any system versus proton and electron fluences as well as proton, electron and other energetic particles (ions) generated at the Sun and cosmic radiation.



- **EMXYS Naosat platform** is nanosatellite specifically built as a test facility for, among others, study the response of several payloads to the action of the space environment

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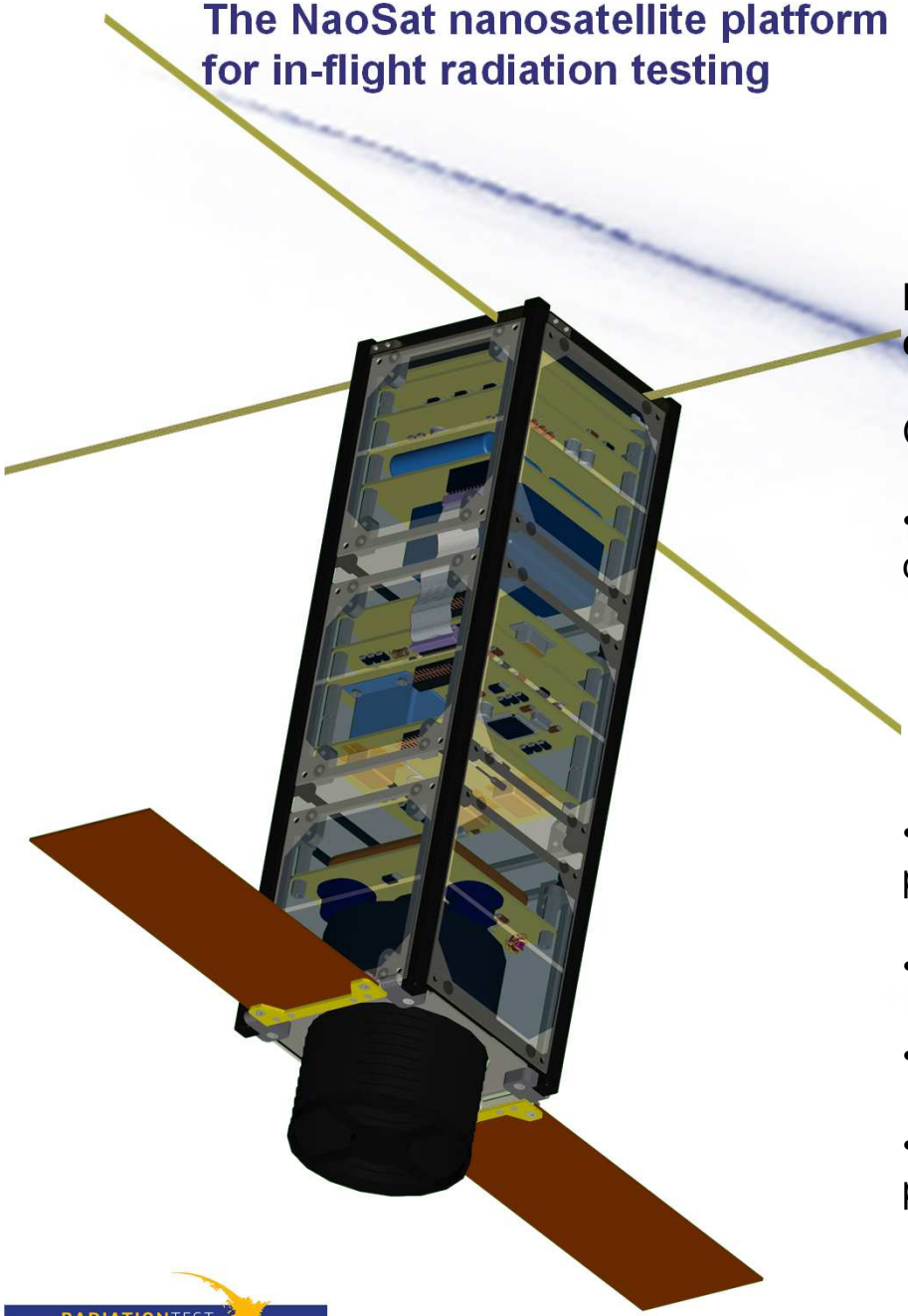

NAOSAT concept is developed over two platform concepts:

CUBESAT (10 x 10 x 30cm, 3.5Kg in 3U formats)

• Power = 3 W average for payload (10% battery pack capacity), providing :

Maximum Discharge current : 10 A (min.)
Peak Discharge current : 20 A (sec.)

• Volume starting with 80 x 80 x 15 mm per slot. 1U for platform subsystems + 2U for Payload (Earth-facing side)

• Payload Mass = 2.5 Kg

• TTC in VHF 140 MHz / UHF 430 MHz ISM band

• ADCS (Magnetorquers +Reaction Wheels (target 1º in pointing accuracy).

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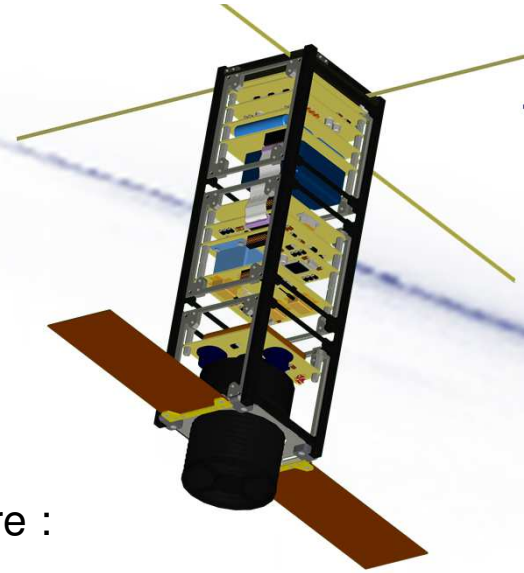

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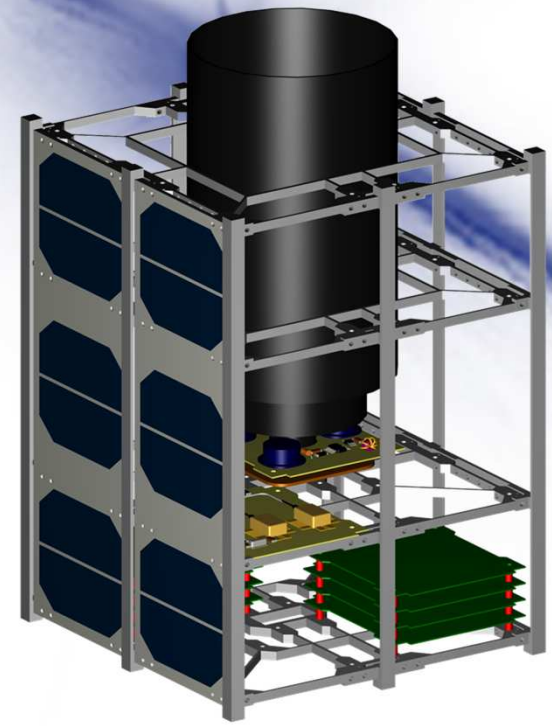
Hardware :

• On-Board computer (CORTEX 32 bits + FPGA)
• MPPT system, protected DC/DC converters, Two 2,5 A·h Li-Ion batteries in parallel plus protection stage.
• ADCS (magnetorquers, MEMS- based IMU, magnetometer, 4 miniature Reaction wheels).
• Flexible double-dipole TTC antenna.
• Redundant CAN network + I2C + RS485



XCUBE (Extended CUBE Satellite)

20x20x30 15 Kg Platform (Target 20Kg)

• Payload Power : 8 W average.
• Payload volume 170 x 130 x 80 mm 2kg /slot

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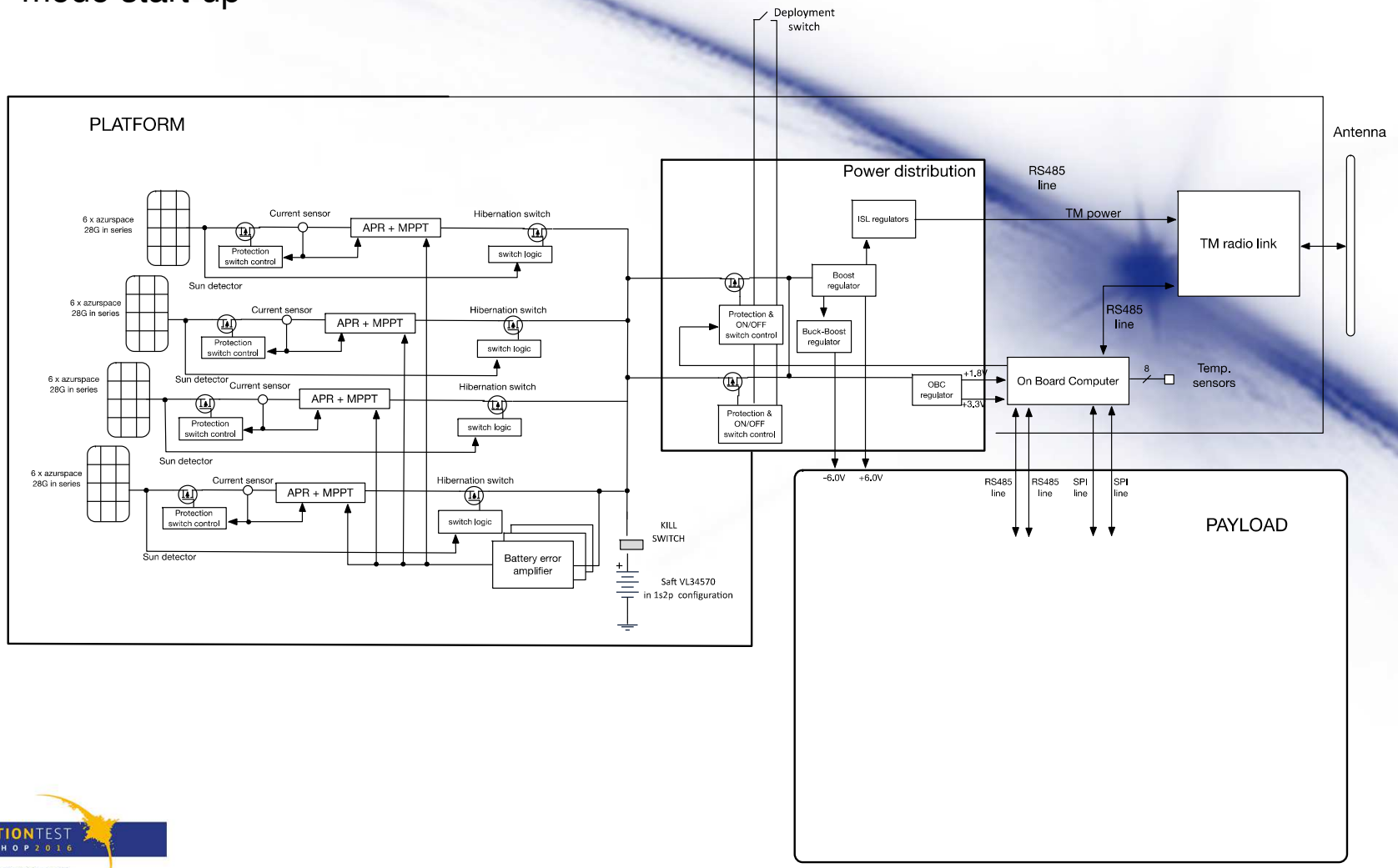
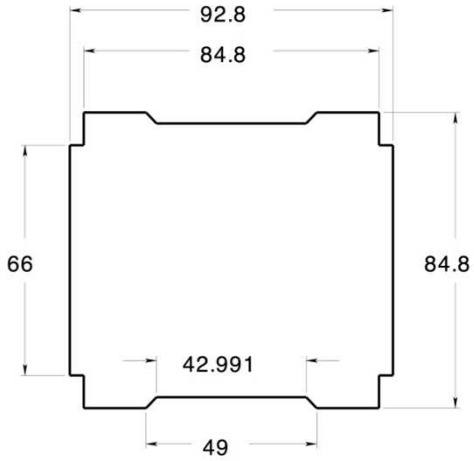
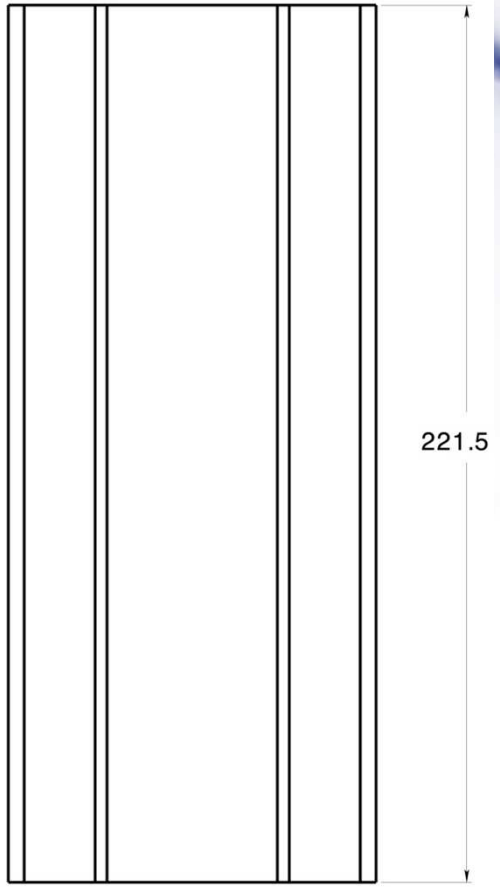
- Fully protected/redundant platform with auto-start upon Sun detection for safe mode start-up



The NaoSat nanosatellite platform for in-flight radiation testing

- Payload Bay with complete ICD for custom made payloads





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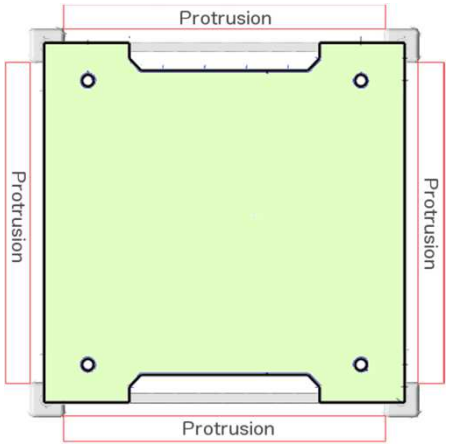
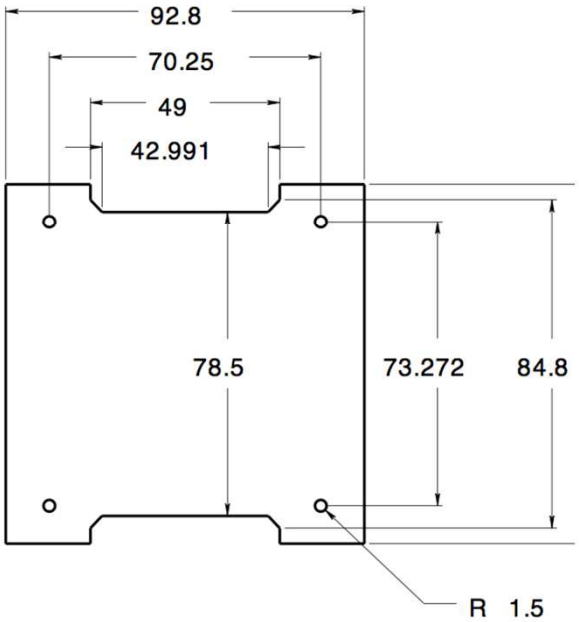
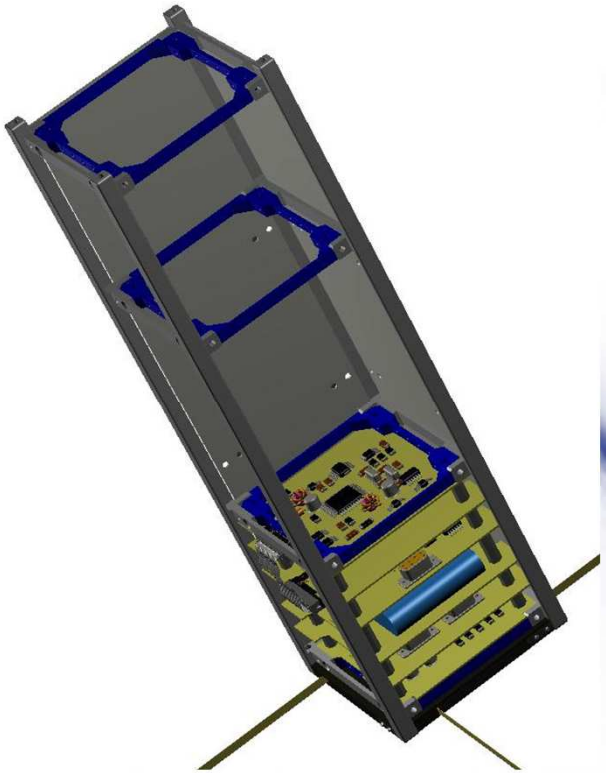
The NaoSat nanosatellite platform for in-flight radiation testing

- Payload Bay with complete ICD for custom made payloads: standard PCB sizes for ready integration







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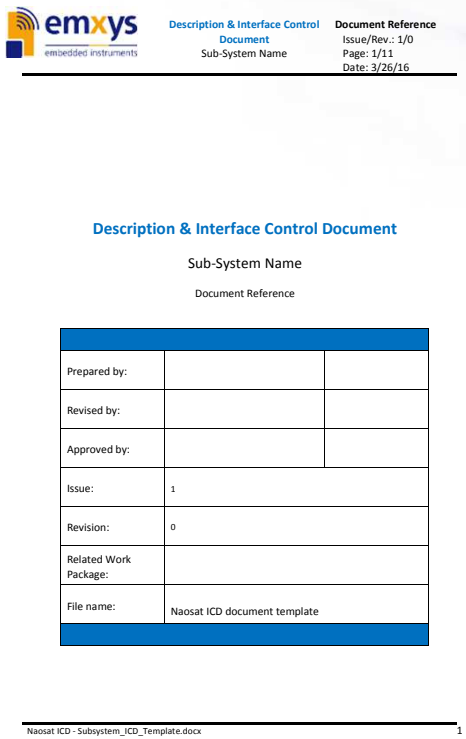
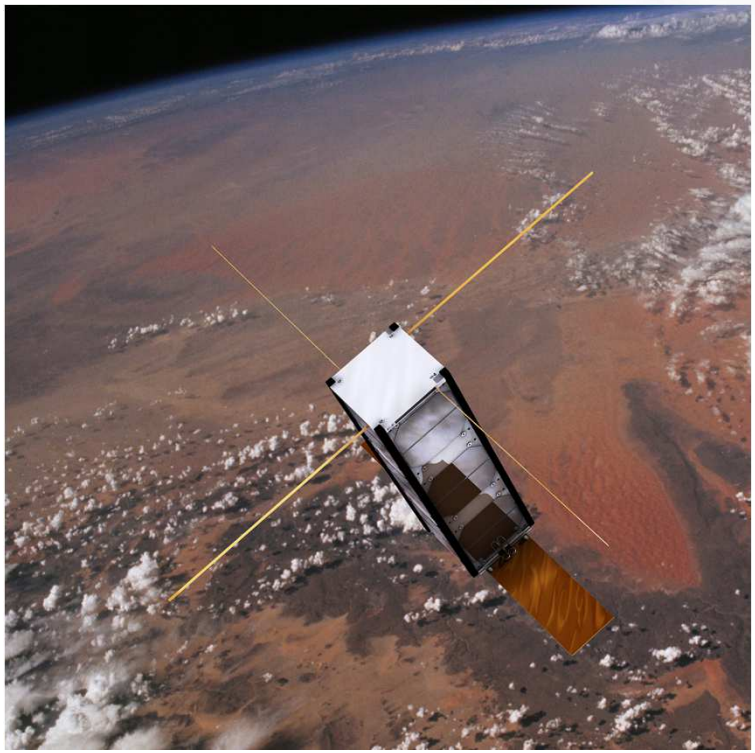
- Payload Bay with complete ICD for custom made payloads



- NaoSat OBC provides capabilities to perform **in orbit characterisation of components and sub-systems and radio it to Earth**

UPV Technology in Space



THE SCENARIO :

The U.P.V (Universidad Politécnica de Valencia) is featured by :

- Strategic interest in Aerospace technology.
- Broad technology research activity, in areas of strong interest for Space sector.
- No flight experience, which reduces impact on Space research fields.

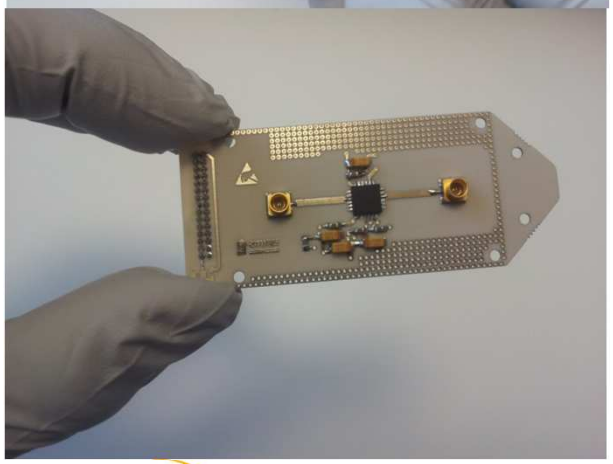
- VALSPACE Consortium is created to lobby for regional interests in Space industry sector:

Regional presidency + 2 public universities + Valencia city council.

It integrates the ESA Power Microwave Lab.

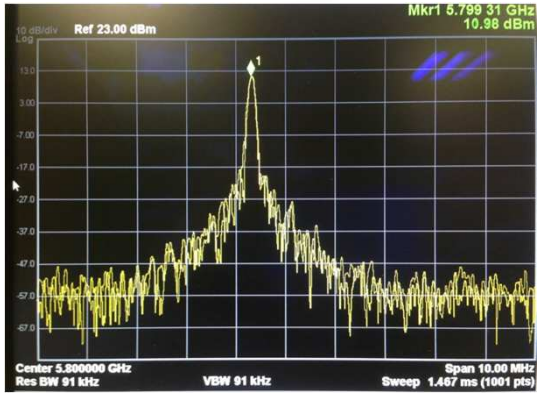
PoliTech.1

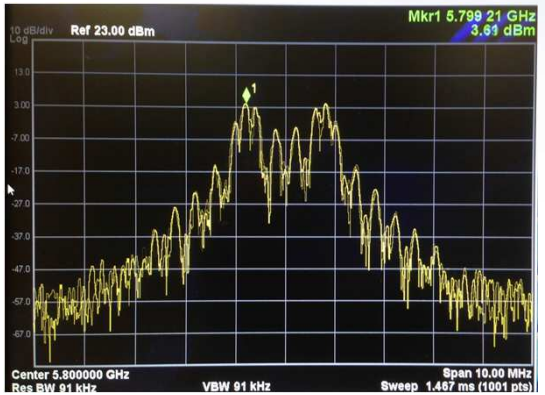
UPV Technology in Space



HiDAC includes a Half-Duplex C Band Transceiver with a Power Amplifying stage.

Operation Frequency : 5,8 GHz
Modulation : FSK-2
Data Rate : 400 KBps raw (40KBps 10 Chips/Bit).
Tx RF Power : 26 dBm (nominal)
Codification : DSSS (Turbo-codes / Convolutional codes).





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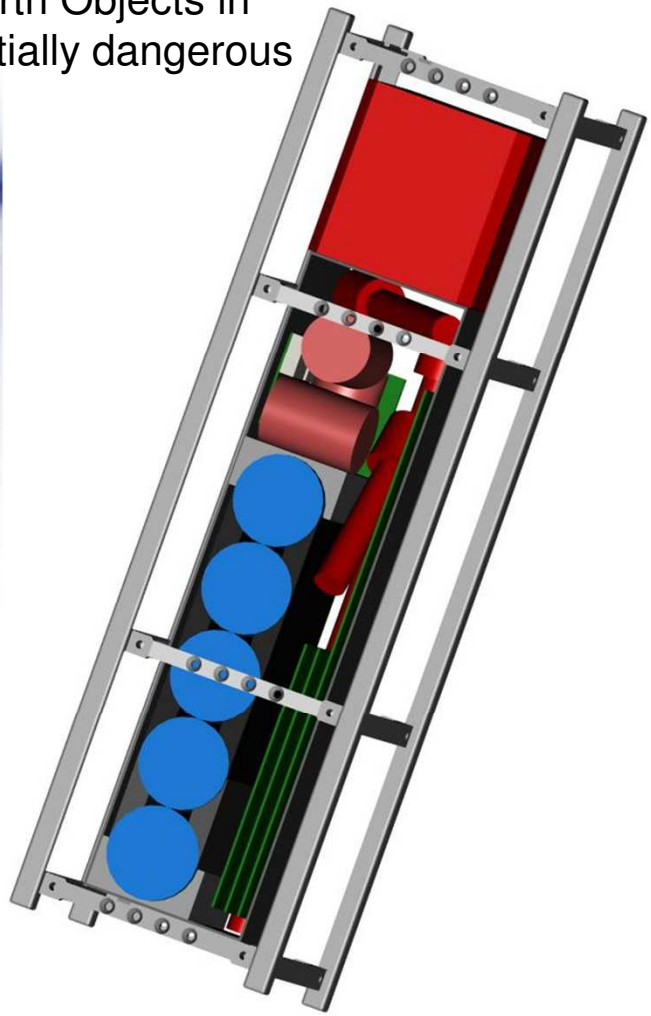
EMXYS *NAOsat Cubesat platform selected for phase study asteroid mission*

ESA's Asteroid Impact Mission is an European joint initiative with NASA to investigate the composition and physical properties of Near Earth Objects in order to protect the Earth of future collisions by diverting potentially dangerous asteroids.

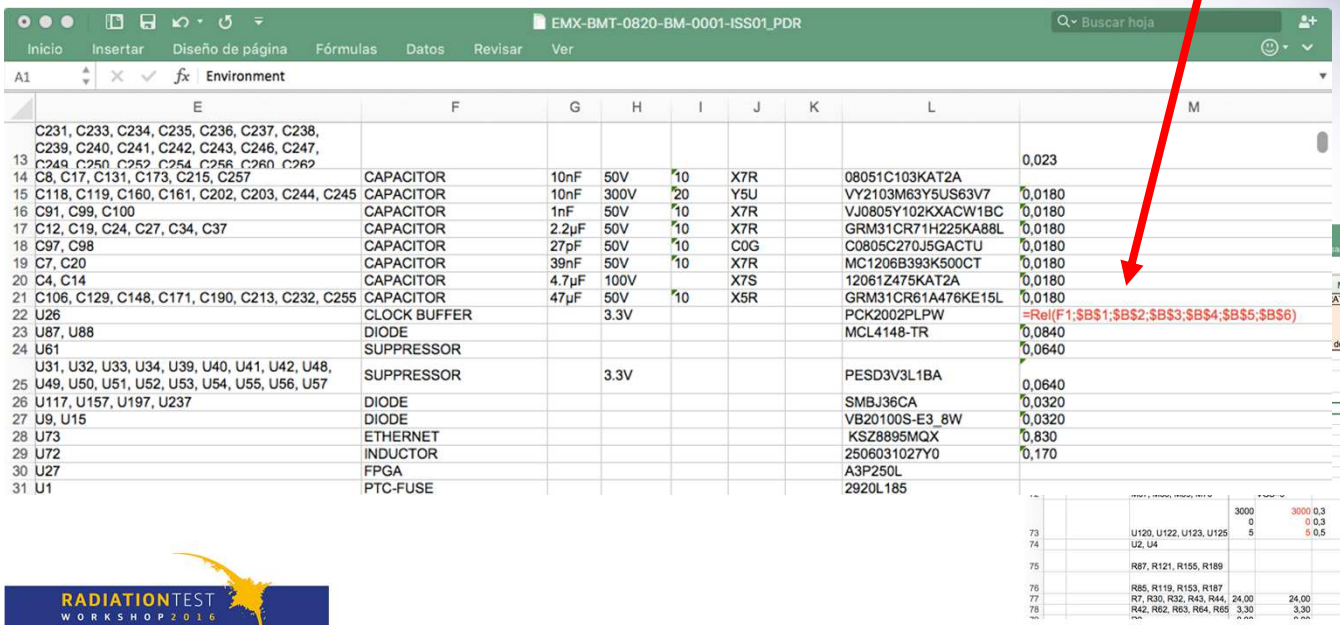


EMXYS *RelTools*

The final goal is to modify the major factors that affect failure rates under actual space conditions: Failure rates and MTBF and programmed as EXCEL functions with adjustable modifying factors

$$\lambda_a = \lambda_b \cdot \pi_p \rightarrow \pi_E \cdot \pi_Q \cdot \pi_T \cdot \pi_D \cdot \pi_v$$

Environment	LEO	
Operational Ta	10ºC	
Dormant Ta	-20oC	
Vibration	20rms	
Duty cycle/Cycles per year	80	330



	E	F	G	H	I	J	K	L	M
13	C231, C233, C234, C235, C236, C237, C238, C239, C240, C241, C242, C243, C246, C247, C249, C250, C252, C254, C256, C260, C262								0,023
14	C8, C17, C131, C173, C215, C257	CAPACITOR	10nF	50V	10	X7R		08051C103KAT2A	
15	C118, C119, C160, C161, C202, C203, C244, C245	CAPACITOR	10nF	300V	20	Y5U		VY2103M63Y5US63V7	0,0180
16	C91, C99, C100	CAPACITOR	1nF	50V	10	X7R		VJ0805Y102KXACW1BC	0,0180
17	C12, C19, C24, C27, C34, C37	CAPACITOR	2.2µF	50V	10	X7R		GRM31CR71H225KA88L	0,0180
18	C97, C98	CAPACITOR	27pF	50V	10	C0G		C0805C270J5GACTU	0,0180
19	C7, C20	CAPACITOR	39nF	50V	10	X7R		MC1206B393K500CT	0,0180
20	C4, C14	CAPACITOR	4.7µF	100V		X7S		12061Z475KAT2A	0,0180
21	C106, C129, C148, C171, C190, C213, C232, C255	CAPACITOR	47µF	50V	10	X5R		GRM31CR61A476KE15L	0,0180
22	U26	CLOCK BUFFER		3.3V				PCK2002PLPW	=Rel(F1;B1;B2;B3;B4;B5;B6)
23	U87, U88	DIODE						MCL4148-TR	0,0840
24	U61	SUPPRESSOR							0,0640
25	U31, U32, U33, U34, U39, U40, U41, U42, U48, U49, U50, U51, U52, U53, U54, U55, U56, U57	SUPPRESSOR		3.3V				PESD3V3L1BA	0,0640
26	U117, U157, U197, U237	DIODE						SMBJ36CA	0,0320
27	U9, U15	DIODE						VB20100S-E3_8W	0,0320
28	U73	ETHERNET						KSZ8895MQX	0,830
29	U72	INDUCTOR						2506031027Y0	0,170
30	U27	FPGA						A3P250L	
31	U1	PTC-FUSE						2920L185	

Thank you

for your attention

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http://www.naosat.com

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