

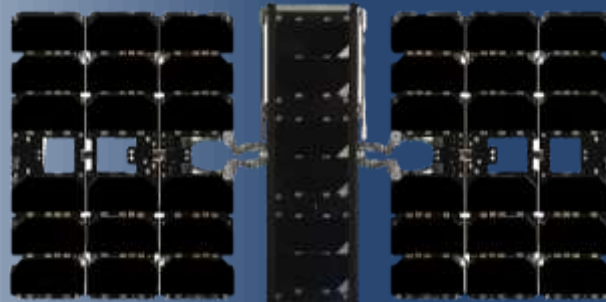
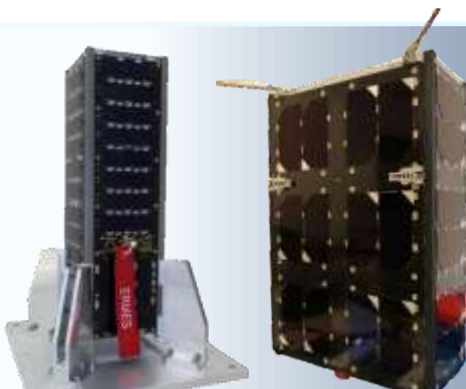
μ SADA

Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

(ESA Contract No 4000121485/17/NL/PS)

Final Review

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AGENDA

- Introduction (ESA)
- Summary presentation of the activity (IMT) - 0.5 hrs
- Discussion (ESA/IMT) - time as needed
- Potential follow-on
- Administrative issues
- AoB



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Programmatic 1

- The ESA Contract No 4000121485/17/NL/PS has been issued by ESA on 29/08/2017
- CCN1 has been authorised on 17/07/2020
- Total amount of the contract is Euro 460,000.00
- Objective of the contract was the “development and testing of a miniaturised Solar array Drive Assembly (SADA) suitable for future utilisation on 6U/12U CUBESAT platforms in order to enable deployable and steerable solar arrays generating significantly increased power for RF payloads, high-speed downlink and electric propulsion (from para 1.4.2 of SOW)



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Programmatic 2 - Deliverables

Doc ID	Title	Milestone	IMT code
D1	(TN - 1) Analysis of requirements for a SADA for both 6U and 12 U constellations	End of Task 1	TNO/762/17/IMT Issue 2 - Requirements Definition
D2	(TN - 2) SADA design concept trade off	End of Task 2	RPT/856/17/IMT Issue 1 – Evaluation Criteria RPT/861/17/IMT Issue 1 – Preliminary Tribology Assessment
D3	(TN - 3) Design justification file	End of Task 2	RPT/940/18/IMT Issue 1 – Reference Frame RPT/145/18/IMT Issue 1 - SADE Preliminary Design RPT/159/18/IMT Issue 1 - HDRM Design RPT/160/18/IMT Issue 1- SAWA Design TNO/069/18/IMT Issue 1 – Rotary Encoder TNO/074/18/IMT Issue 1 – Stepper Motor Dimensioning TNO/075/18/IMT Issue 1 – SADM Preliminary Design TNO/844/17/IMT Issue 1 – Bus Voltage Trade-Off TNO/943/18/IMT Issue 1 – Sun Sensor TNO/984/18/IMT Issue 1 – Slip Ring Preliminary Design TNO/060/18/IMT Issue 1 – HDRM Architecture on SADA 3U Cubesat TNO/762/17/IMT Issue 4 - Requirements Definition PLN/129/18/ IMT Issue 2 - Characterization Test Plan
D4	(TN - 4) Technical data package for DDR	End of Task 3	RPT/980/20/IMT Issue 2 – TN4 - Technical data package for DDR
D5	(TN - 5) Draft test plan	End of Task 3	RPT/981/20/IMT Issue 2 - TN5 - Draft Test Plan for DDR
D6	(TN - 6) Test procedure	End of Task 4	RPT/270/21/IMT Issue 3 - TN6 - Test Procedure
D7	(TN - 7) Design definition file	End of Task 4	RPT/246/21/IMT Issue 1 - TN7 - Design Definition Fil
D8	(TN - 8) Test report	End of Task 5	RPT/345/21/IMT Issue 1 - TN8A - Test Report RPT/699/22/IMT Issue 1 - TN8B - Accelerated Life Test Report RPT/791/22/IMT Issue 1 - TN8C - Vibration Test Report
D9	(TN - 9) Results of the inspection	End of Task 5	RPT/700/22/IMT/Issue 1 - TN9 - Results of the inspection
FR	Final Report	Final Review	RPT/895/23/IMT Issue 1 - TN10 - Final Report



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Programmatic 3 - Progress Reports

IMT code	Title	Date
RPT/833/17/IMT	uSADA Progress Report #1	13/11/2017
RPT/894/18/IMT	uSADA Progress Report #2	12/01/2018
RPT/952/18/IMT	uSADA Progress Report #3	21/03/2018
RPT/068/18/IMT	uSADA Progress Report #4	13/07/2018
RPT/343/19/IMT	uSADA Progress Report #5	30/05/2019
RPT/440/19/IMT	uSADA Progress Report #6	06/09/2019
RPT/603/20/IMT	uSADA Progress Report #7	14/02/2020
RPT/761/20/IMT	uSADA Progress Report #8	19/06/2020
RPT/891/20/IMT	uSADA Progress Report #9	16/09/2020
RPT/138/21/IMT	uSADA Progress Report #10	26/03/2021
RPT/648/22/IMT	uSADA Progress Report #11	26/04/2022



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Programmatic 4 - Reviews

IMT MoM code	Milestone	Subject	Date
	KOM	Kick-off Meeting	06/09/2017
MoM/909/18/IMT	RDR	Requirements Definition Review	26/01/2018
MoM/095/18/IMT	PDR	Preliminary Design Review	30/08/2018
MoM/259/19/IMT		Delta Preliminary Design Review	06/02/2019
MoM/998/20/IMT	DDR	Detail Design Review	17/12/2020
MoM/804/22/IMT	PTR	Post Test Review	11/10/2022
	TRB	Completion of the Test Campaign	24/01/2023



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Programmatic 4 - NCR (Major)

IMT code	Subject	Date	NCR Board
NCR/521/21/IMT	NCR HDRM - Lateral hook damage	22/12/2021	MoM/558/22/IMT
NCR/528/21/IMT	NCR HDRM - Lateral panel	29/12/2021	MoM/558/22/IMT



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uSADA in Brief

Aim of μ SADA is to increase the generated power in the CubeSat 6U and 12U, thanks to:

- The deployment of 6 solar foils (3 for each wing) that increases the active area needed for the power generation.
- Point the solar arrays towards the Sun to reduce the “cosine loss”.

The unit is composed by two deployable solar array wings and the control unit. μ SADA is able to turn around 1 gimbal axis, which is 1 dof (degree of freedom).



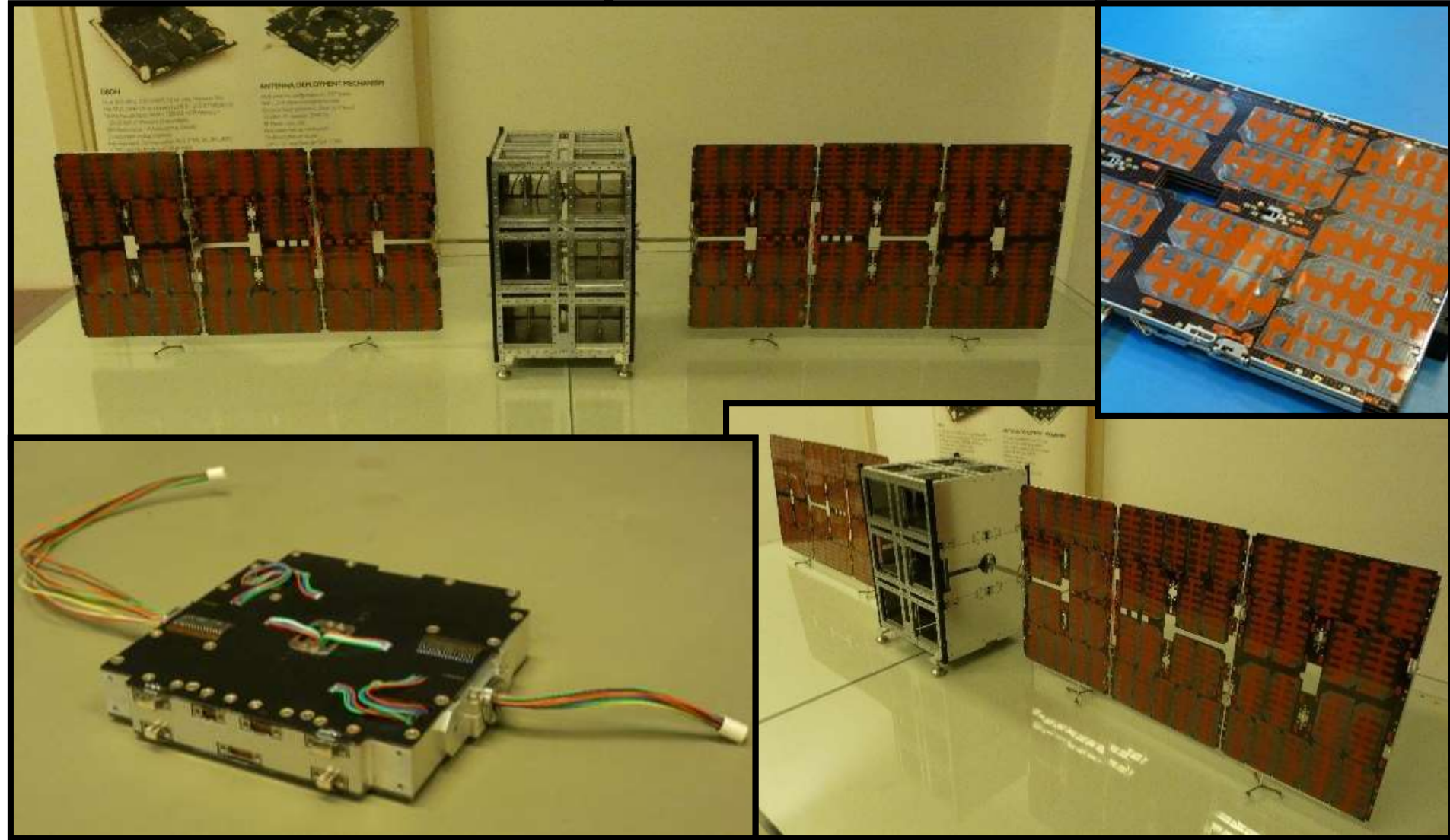
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μSADA



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μSADA Performances

SADU Main Performances

Power Supply:

- Main
- Release Mechanism

5V

5V

Power Consumption:

- Drive
- Stand-By
- During the Release Phase

2W

500 mW

4.5W (Simultaneous Deployment)

OBC Interface

CAN Bus (I2C as redundant **)

I2C **

UART **

Connectors:

- Main Data
- Main Power
- PV OUT (Wing 1)
- PV OUT (Wing 2)

OMNETICS MICRO-D MNSO-15-AA-N-ETH-M

OMNETICS MICRO-D MNSO-09-AA-N-ETH-M

OMNETICS MICRO-D MNPO-15-AA-N-ETH-M

OMNETICS MICRO-D MNPO-15-AA-N-ETH-M

Mechanical I/Fs:

Fully compliant with:

- ISIS 6U Structure **
- ISIS 12U Structure
- GomSpace 6U Structure **
- GomSpace 12U Structure **

** not implemented in the EM model



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μSADA Performances

Pointing Mechanism

Pointing Accuracy:	±0.3° with zero reference
Drive direction:	Forward and reverse rotation (endless rotation)
Nominal Speed Range:	± 0,07 °/s (selectable by digital command)
Max. Rotation Speed:	± 0,4 °/s
Qualification sequence:	38060 revolutions (3 years il LEO orbit)

Motor

Steps	Full to 1/16 μsteps (suggested 1/8 and 1/16 μsteps for long life e.g., 17000 cycles and low vibration disturbance)
Continuous Torque	>170 mNm
Maximum Backlash	Max 3°

Slip Rings

Number of lines	15 for each Wing
Max. Current	0.5A for each contact
Max Voltage	60V for each contact
Powered Rings:	4 pairs for each WING



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μSADA Performances

Hold Down and Release Mechanism

Burn Voltage:	5V
Burn Current:	0.4A for each HDRM
Burn Time:	Digital Selectable (max. 250s)
Burn Strategy:	Simultaneous Burn for both HDRM Sequentially Burn
Release sensors:	Wire cut sensor Unlocking mechanism sensor Release detection Pads



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μSADA Performances

Solar Wings

Generated Power (BOL @ Tamb):	118W @ 25°C (Total)
Bus Voltage @ Max Power	31V – 54V (Typ. 42V)
Current @ Max Power	2.6A – 3.0A (Typ. 2.8A) (Total)
Solar Cells per Panel:	18 (54 for each Wing)
Solar Cell type:	Triple Junction Solar Cells InGaP/GaAs/Ge Space Qualified + Bypass diode on each cell
Coverglass:	Yes, 100 μm
Array Configuration	18S3P (each Wing)
Locking mechanism:	<ul style="list-style-type: none">- For Adjacent panels- Between Wing and Structure
Power Lines:	Two configurations available: <ul style="list-style-type: none">- 6 independent power lines (3 for each wing) **- 2 independent power lines (1 for each wing)
Sensors:	<ul style="list-style-type: none">- Temperature sensor- Deployment and Wing Alignment switch sensor- Photodiodes **
First Resonance Frequency:	<ul style="list-style-type: none">- 56 Hz stowed configuration

** not implemented in the EM model



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μSADA Performances

Radiation and Redundancy

TID:	>15 Krads
SEL:	Latch-up protections for critical components
Microcontroller:	Automotive Grade or Rad Tolerant: ** <ul style="list-style-type: none">- No Single Event Latch-up Below an LET Threshold of 60 MeV.cm² /mg @125°C- Total Ionizing Dose of 30 krad (Si)
Redundancy:	<ul style="list-style-type: none">- Stepper Motor with redundant windings- Independent Drive mechanism for each Wing- Two burn resistors for each release mechanism

** not implemented in the EM model



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Absolute Maximum Rating

PARAMETER	DESCRIPTION	MIN.	TYPICAL	MAX.	UNIT
Top					
- SADU		-20°C	-	+50°C	°C
- HDRM		-25°C	-	+85°C	°C
- SAWA		-40°C	-	+85°C	°C
Tnon-op					
- SADU		-35°C		+65°C	°C
SUPPLY					
- VCC	Power Supply Input	4.5	5.0	5.5	V
- CURRENT		0.08	0.1	0.5	A
DEPLOY					
- VOLTAGE		4.5	5.0	5.5	V
- CURRENT		0.7A	0.8A	1.0	A
PV Output @25°C	Photo-voltaic output (Typ. @ Tamb)				
- VOLTAGE	Max refers to the OC conditions	-	42	60	V
- CURRENT	Max refers to the CC conditions	-	2.8	3.2	A
- POWER	Max refers to the BOL @ Low Temp	-	118	140	W



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Physical Characteristics

PARAMETER	DESCRIPTION	VALUE	UNIT
MASS	Subassembly Mass		
- SADU	For 6U/12U CubeSAT	210	g
- HDRM	For each SAWA	90	g
- SAWA	For each SAWA	950	g
- 12U SHAFT	Transmission shaft for 12U CubeSAT when Q. ty 1 SADU is used	26	g
SIZE	Subassembly Dimensions		
- SADU	For 6U and 12U CubeSAT	88 x 101 x 15	mm
- HDRM	For each hold down mechanism	215 x 12 x 19	mm
- SAWA	Deployed	209 x 324 x 10	mm
	Stowed	710 x 324 x 11	mm
- 12U SHAFT	Transmission shaft for 12U CubeSAT when Q. ty 1 SADU is used	123 x ϕ 12	mm



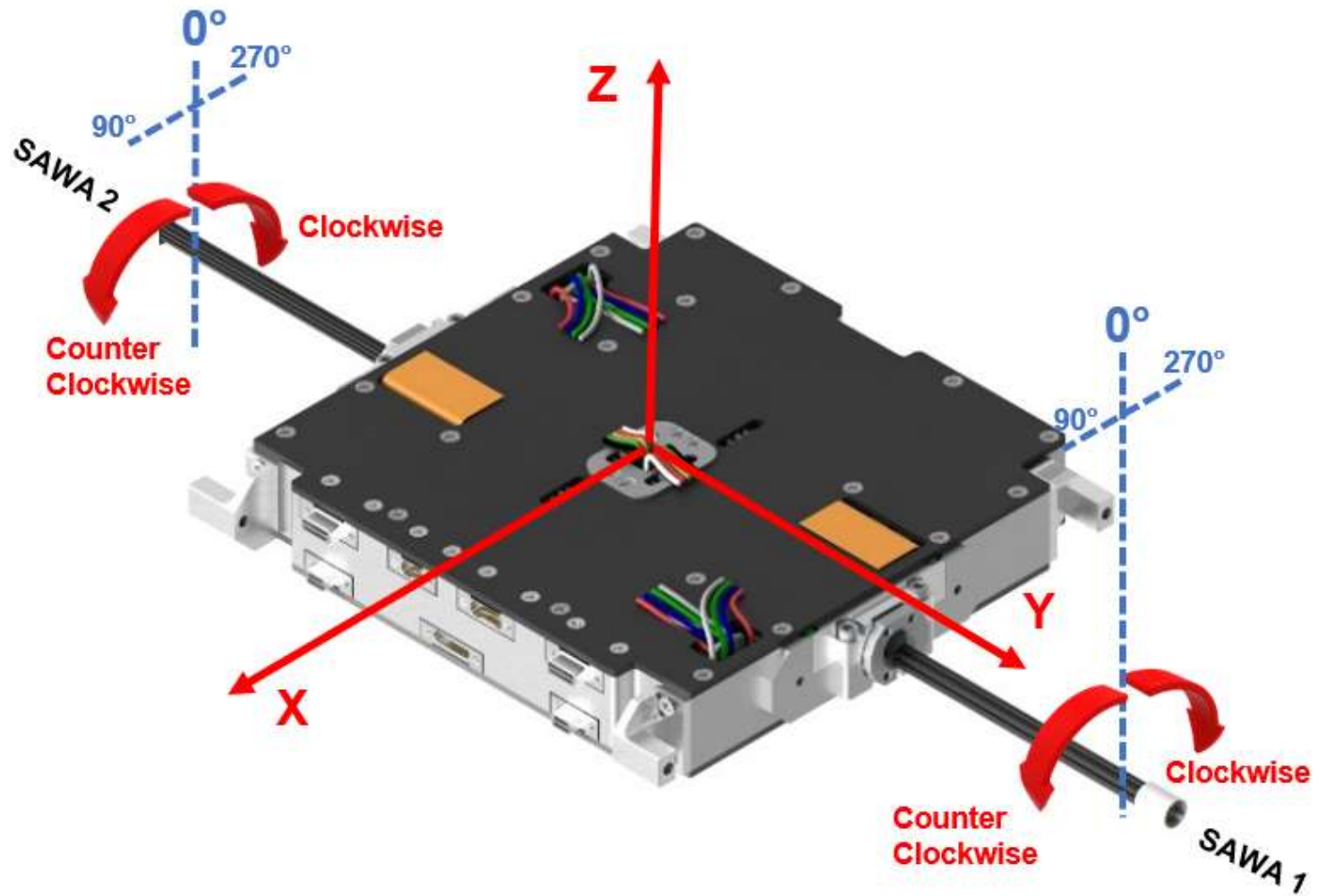
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Reference Frame



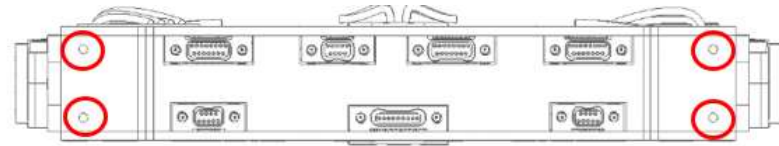
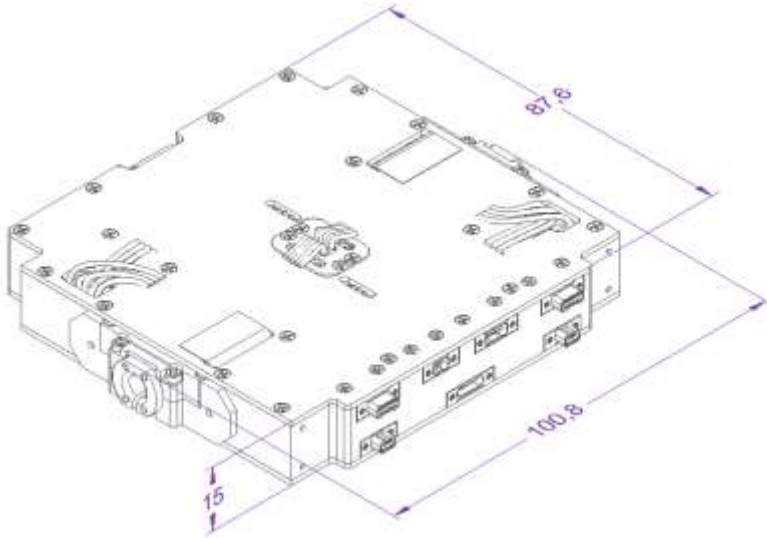
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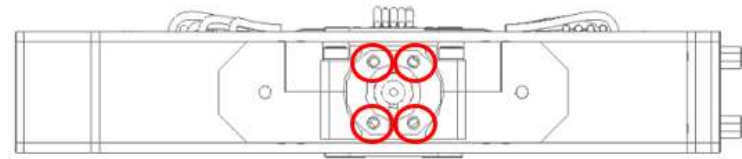
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Slide N°17

SADU - ICD



6U-12U Structure I/F – M1.6 x 2 (x 4 cornes)



SAWA I/F – M1.6 x 4 (x 2 SAWA)

The MAIN DATA INTERFACE provides the data connection both digital and discrete I/O lines. In particular, the following lines are provided:

- CAN BUS
- I2C BUS
- UART BUS
- Discrete I/O



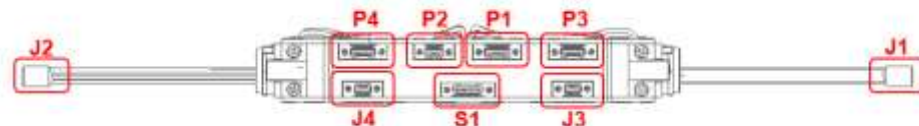
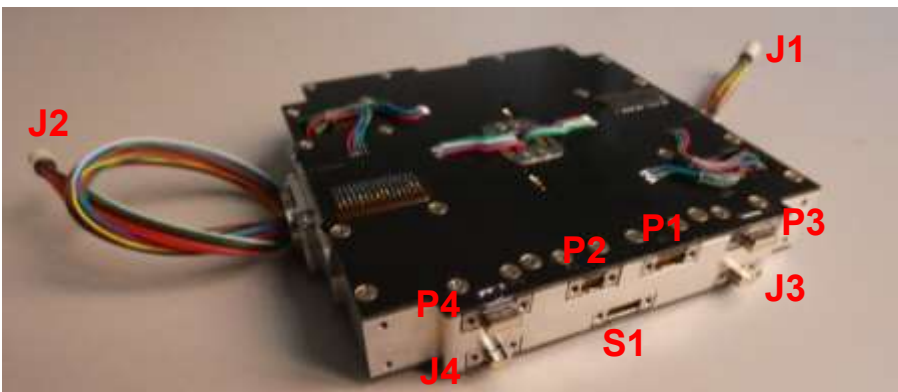
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SADU - ICD



MNEMONICS	DESCRIPTION	LOCATION	MANUFACTURER	MODEL	PN	NOTE
P1	MAIN DATA	SADU	OMNETICS	MICRO-D	MNSO-15-AA-N-ETH-M	A29100-015
P2	MAIN POWER	SADU	OMNETICS	MICRO-D	MNSO-09-AA-N-ETH-M	A29100-009
P3	PV OUT 1	SADU	OMNETICS	MICRO-D	MNPO-15-AA-N-ETH-M	A28100-015
P4	PV OUT 2	SADU	OMNETICS	MICRO-D	MNPO-15-AA-N-ETH-M	A28100-015
J1	SAWA 1	SADU	OMNETICS	NANO-CIRCULAR	NCS-16-WD-18.0-C	A79105-001
J2	SAWA 2	SADU	OMNETICS	NANO-CIRCULAR	NCS-16-WD-18.0-C	A79105-001
J3	RELEASE 1	SADU	OMNETICS	MICRO-D	MNPO-09-AA-N-ETH-M	A28100-009
J4	RELEASE 2	SADU	OMNETICS	MICRO-D	MNPO-09-AA-N-ETH-M	A28100-009
S1	SERVICE	SADU	OMNETICS	MICRO-D	MBSS-09-AA-M-ETH	A55100-009



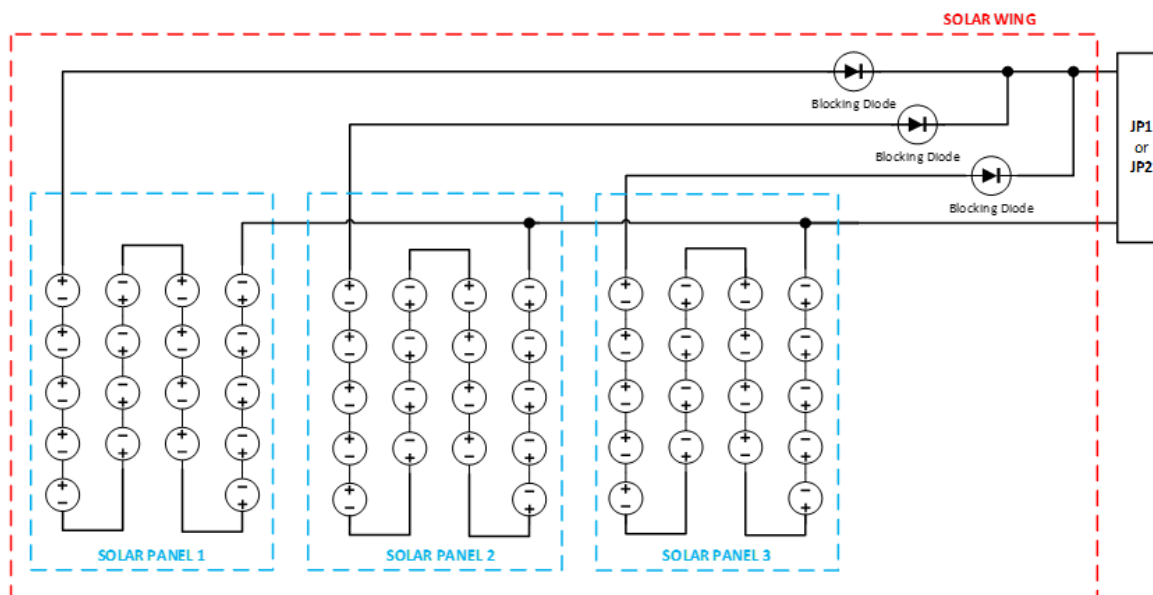
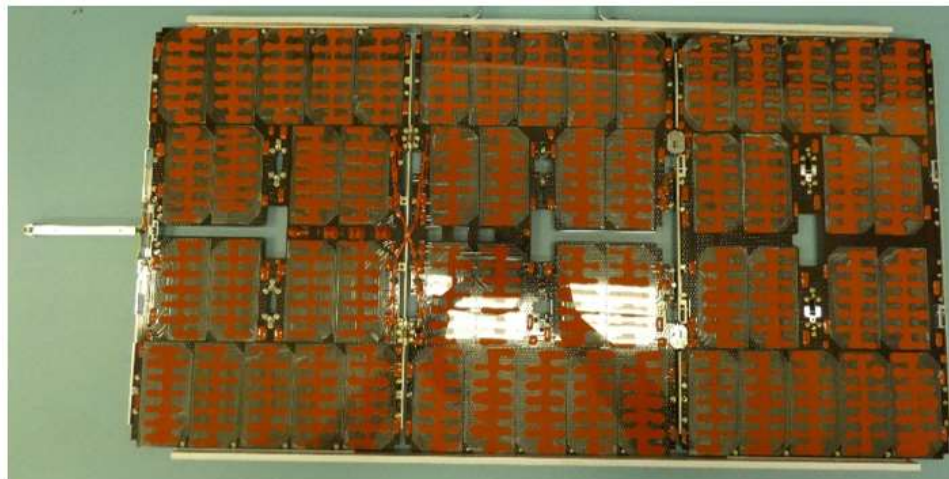
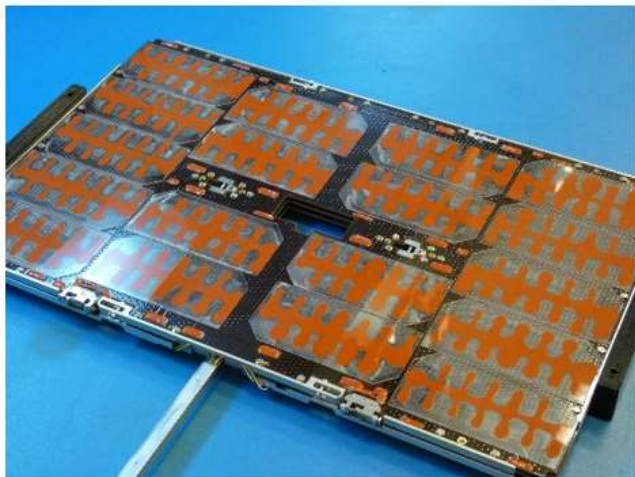
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SAWA - ICD



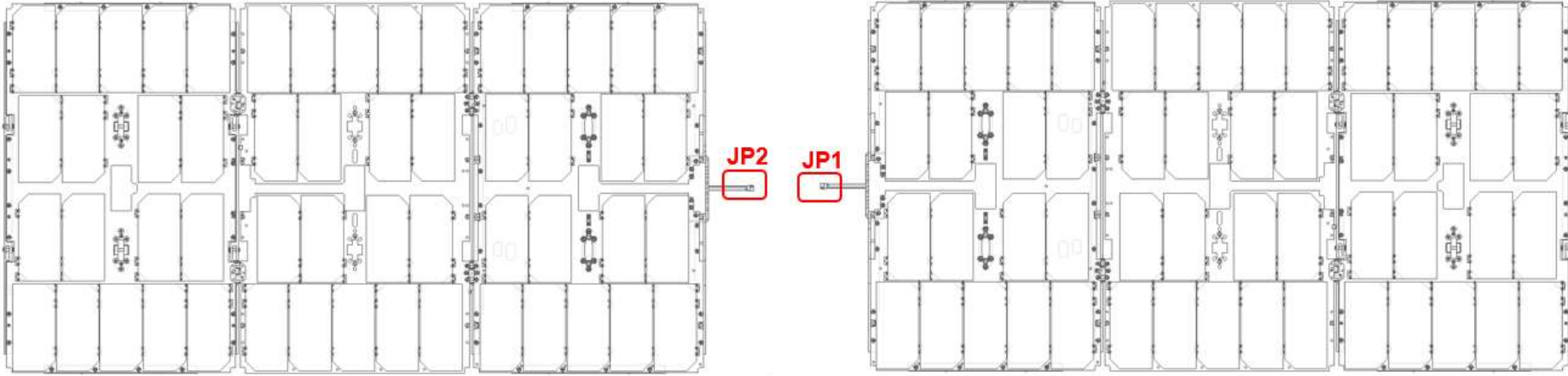
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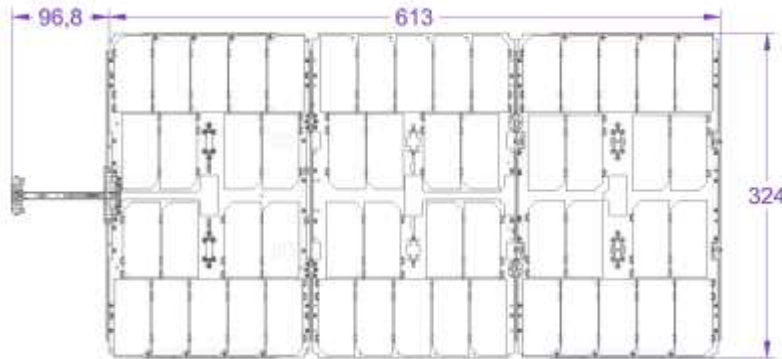
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SAWA - ICD



Mnemonics	Description	Location	Manufacturer	Model	PN	Note
JP1	SAWA 1	SAWA	OMNETICS	NANO-CIRCULAR	NCP-16-WD-18.0-C	A79104-001
JP2	SAWA 2	SAWA	OMNETICS	NANO-CIRCULAR	NCP-16-WD-18.0-C	A79104-001



SAWA I/F - M1-6 x 4 (x2 SAWA)



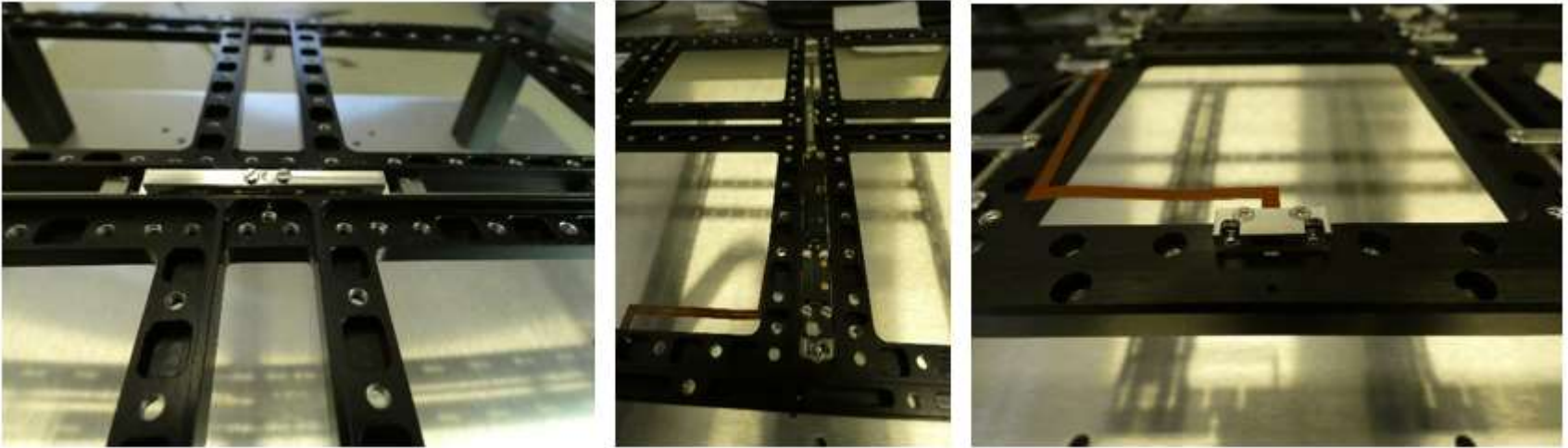
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HDRM - ICD



Feedback Sensors:

- Wire cut detection: to detect if the wire has been burned after the proper DEPLOYMENT COMMAND.
- Mechanism unlock detection: to detect if the locking mechanism has been released after the wire cutting.
- Release panel detection: to detect if the solar panels are separated from the structure.



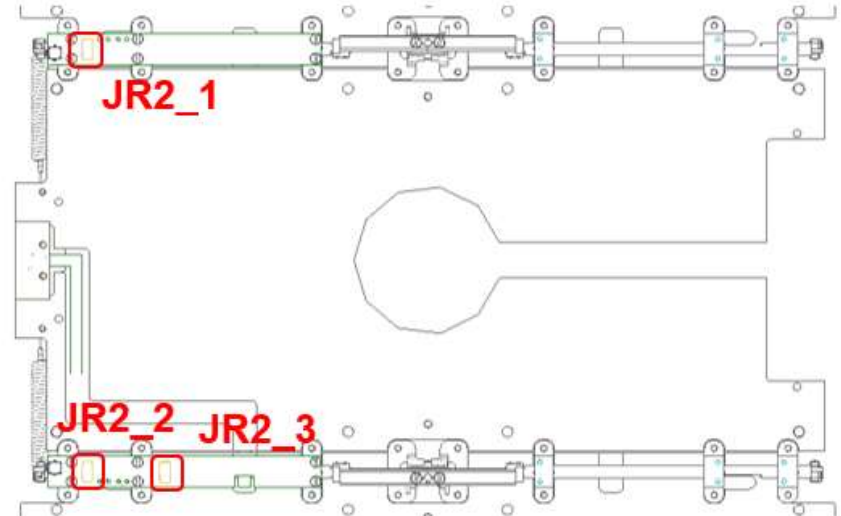
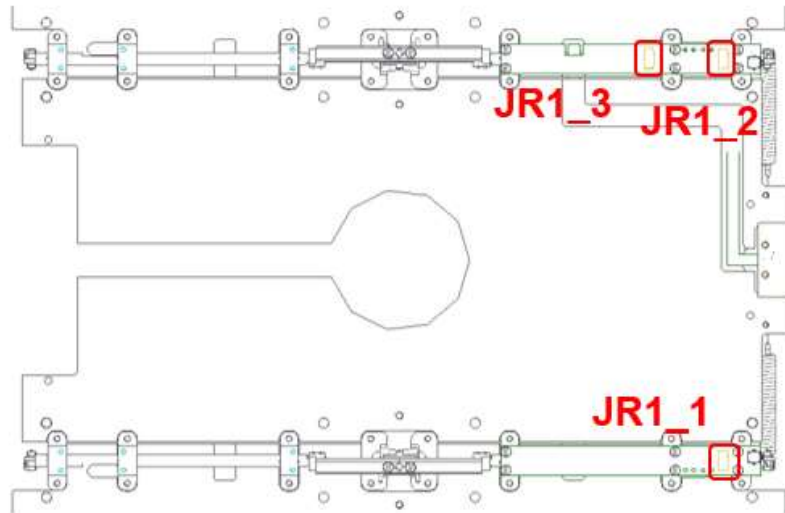
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HDRM - ICD



Mnemonics	Description	Location	Manufacturer	Model	PN	Note
JR1_1	HDRM 1	HDRM	HIROSE	DF52	DF52-4P-0.8C	/
JR1_2	HDRM 1	HDRM	HIROSE	DF52	DF52-4P-0.8C	/
JR1_3	HDRM 1	HDRM	HIROSE	DF52	DF52-4P-0.8C	/
JR2_1	HDRM 2	HDRM	HIROSE	DF52	DF52-4P-0.8C	/
JR2_2	HDRM 2	HDRM	HIROSE	DF52	DF52-4P-0.8C	/
JR2_3	HDRM 2	HDRM	HIROSE	DF52	DF52-4P-0.8C	/



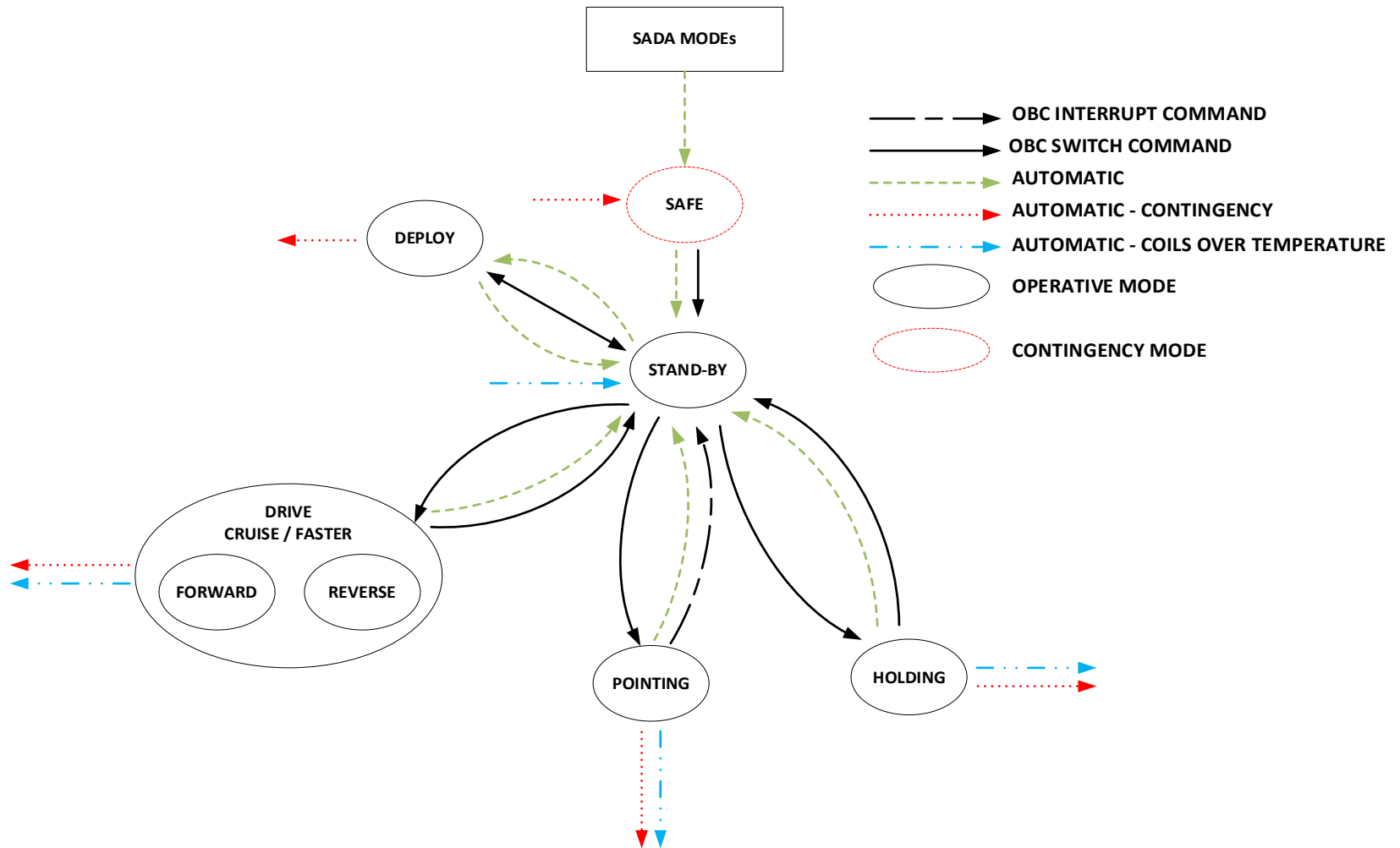
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μSADA Software



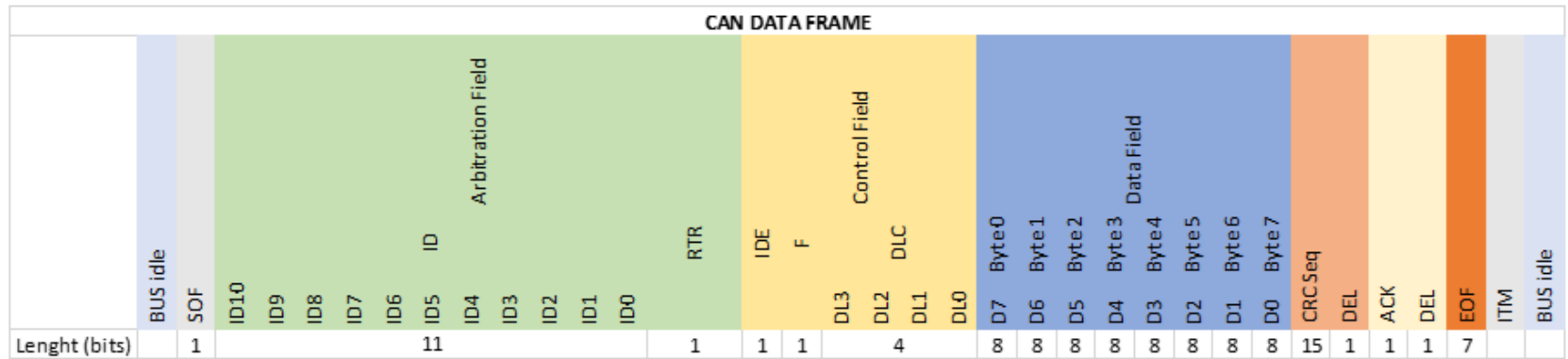
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μSADA CAN BUS



Field Name	Length (bits)	Function
Start-of-frame	1	Denotes the start of frame transmission
ID	11 (8 used)	A (unique) identifier which also represents the message priority
Remote TX req. (RTR)	1	Must be dominant (0) for data frames and recessive (1) for remote request frames
ID extension bit (IDE)	1	Must be dominant (0) for base frame format with 11-bit identifiers
Reserved bit (r0)	1	Reserved bit. Must be dominant (0)
Data length code (DLC)	4	Number of bytes of data (0–8 bytes)
Data field	0-8 byte	Data to be transmitted (length in bytes dictated by DLC field), it contains the uSADA Protocol
CRC	15	Cyclic redundancy check
CRC delimiter	1	Must be recessive (1)
ACK slot	1	Transmitter sends recessive (1) and any receiver can assert a dominant (0)
ACK delimiter	1	Must be recessive (1)
End-of-frame (EOF)	7	Must be recessive (1)



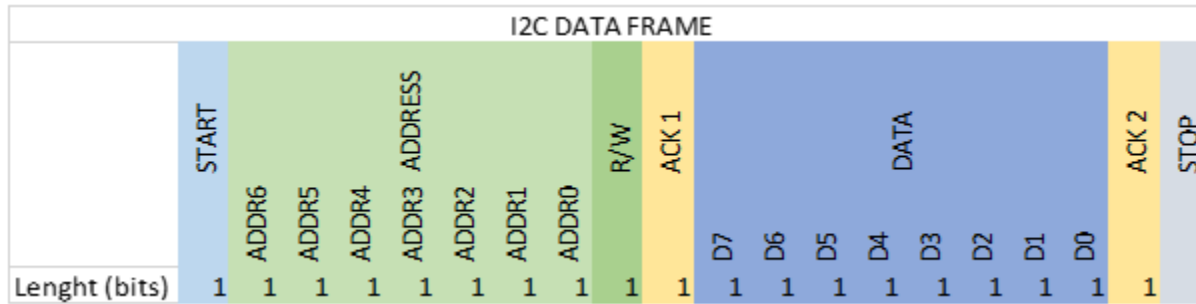
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μSADA I2C BUS



Field Name	length (bits)	Function
START	1	Denotes the start of transmission sequence
ADDRESS	7	Identifier
R/W	1	1 master requests data 0 master sends data
ACK1	1	1 NACK (Slave address not present) 0 ACK (Slave address present and ACK set by slave)
DATA	8	Data Byte, with ACK2 can be repeated for many Data bytes, it contains the μSADA Protocol
ACK 2 SEND	1	1 NACK (Data not received by Slave) 0 ACK (Data received by Slave)
ACK 2 RECEIVE	1	1 NACK (Slave shall stop transmit Data) 0 ACK (Slave shall continue transmit Data)
STOP	1	Denotes the END of transmission sequence



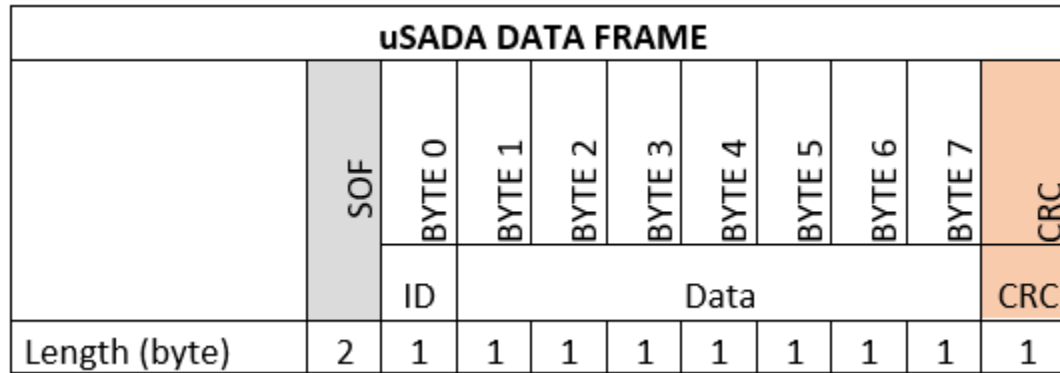
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μSADA Protocol



Field Name	Length (Bytes)	Function
Start-of-Frame	2	UART USE ONLY (
ID	1	A (unique) identifier
Data field	0-7 byte	Data to be transmitted, length is fixed and ID dependant
CRC	1	Cyclic redundancy check



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μSADA Protocol

The following command types are possible:

- OC: Operation Mode Commands (SET Commands)
 - MASTER: Sends Command ID (1 byte) with parameters (up to 7 bytes - DATA)
 - SLAVE: Answer with Command ID (1 byte) as ACK or with an error (EM Message)
- CC: Configuration Commands (SET Commands)
 - MASTER: Sends Command ID (1 byte) with parameters (up to 7 bytes - DATA)
 - SLAVE: Answer with Command ID (1 byte) as ACK or with an error (EM Message)Or (GET Commands)
 - MASTER: Sends Command ID (1 byte)
 - SLAVE: Answer with Command ID (1 byte) with parameters (up to 7 bytes - DATA) or with an error (EM Message)
- TM: Telemetries (GET Commands)
 - MASTER: Sends Command
 - SLAVE: Answer with a command repetition with parameters or with an error
- EM: Error Messages



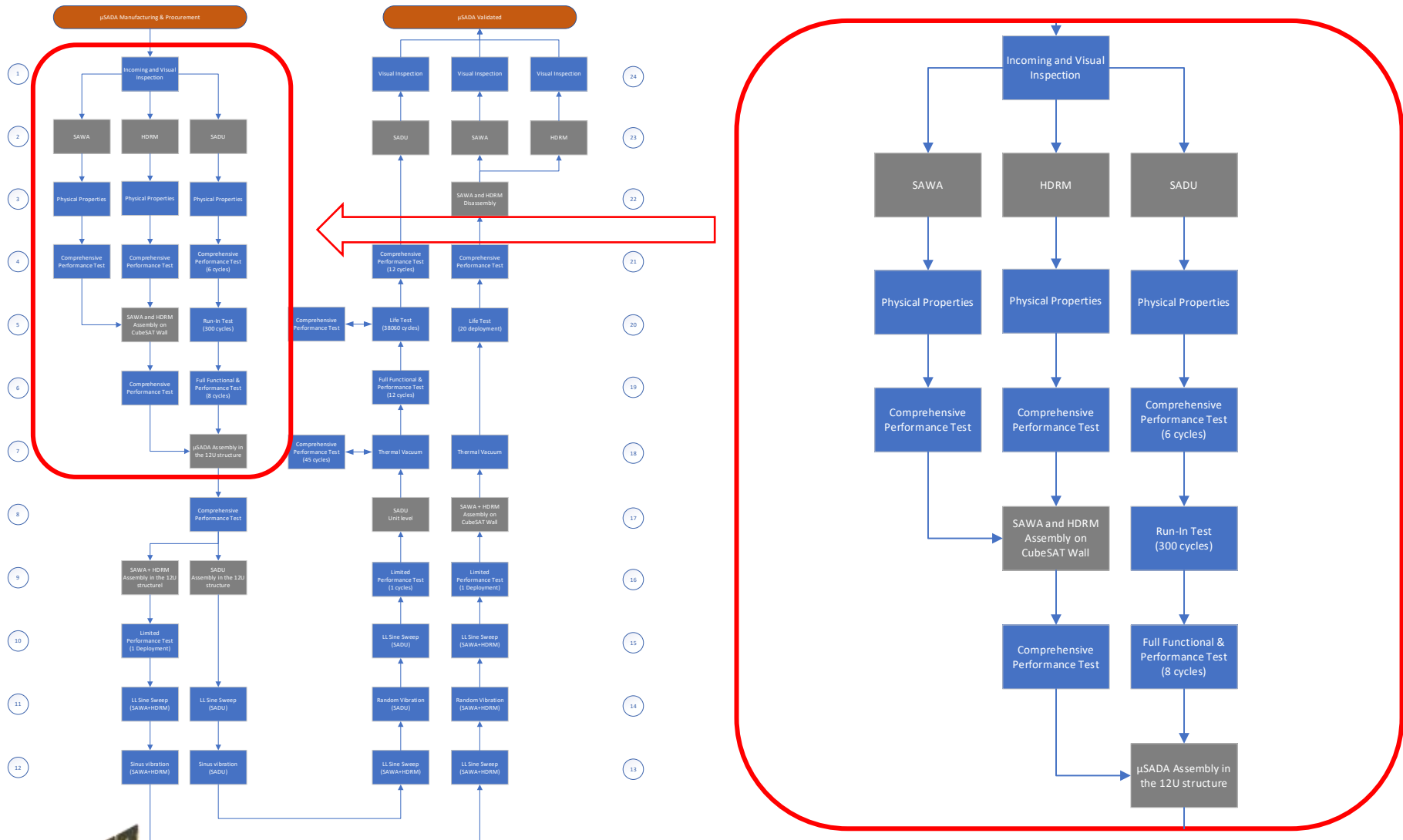
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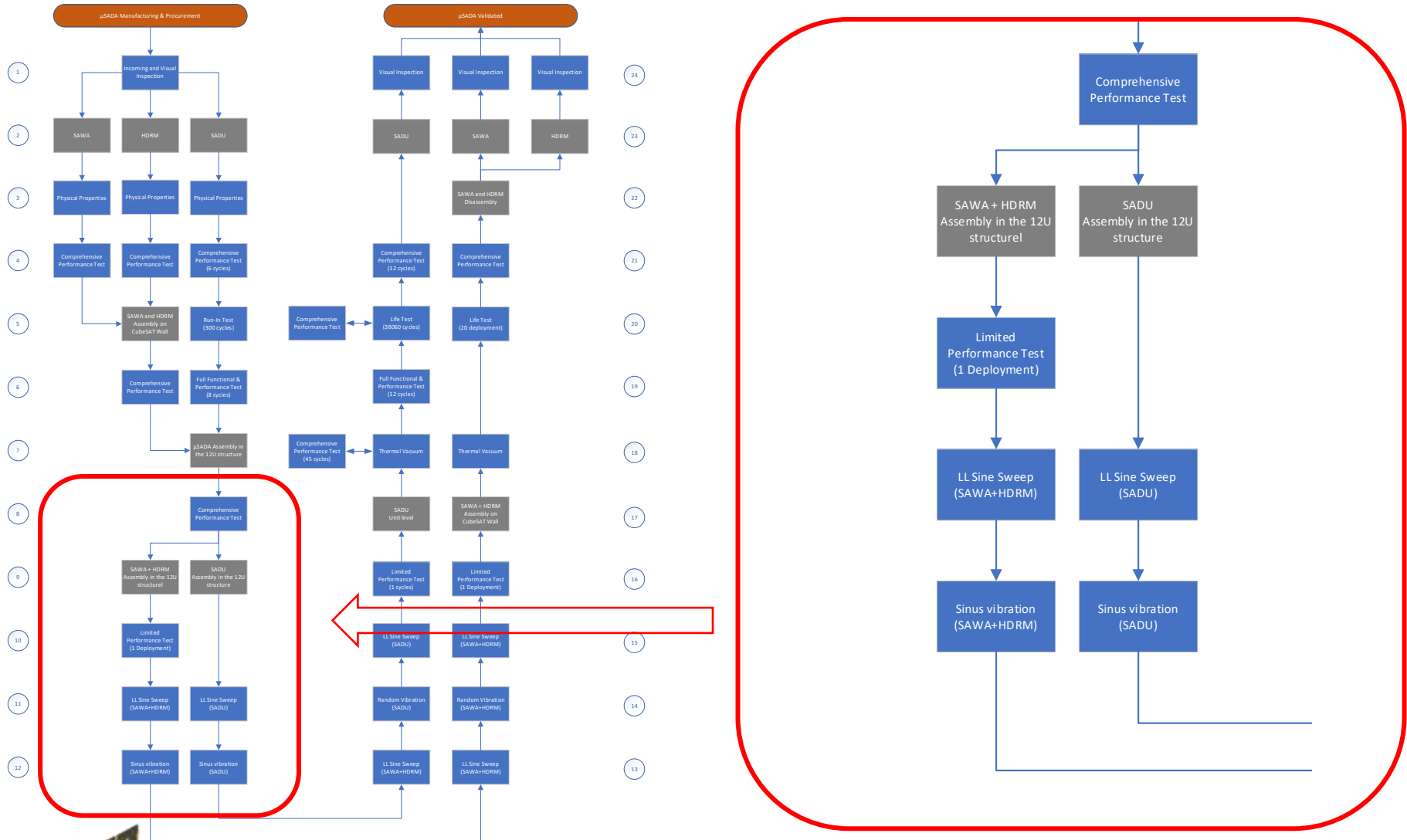
Test Plan



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Slide N°29

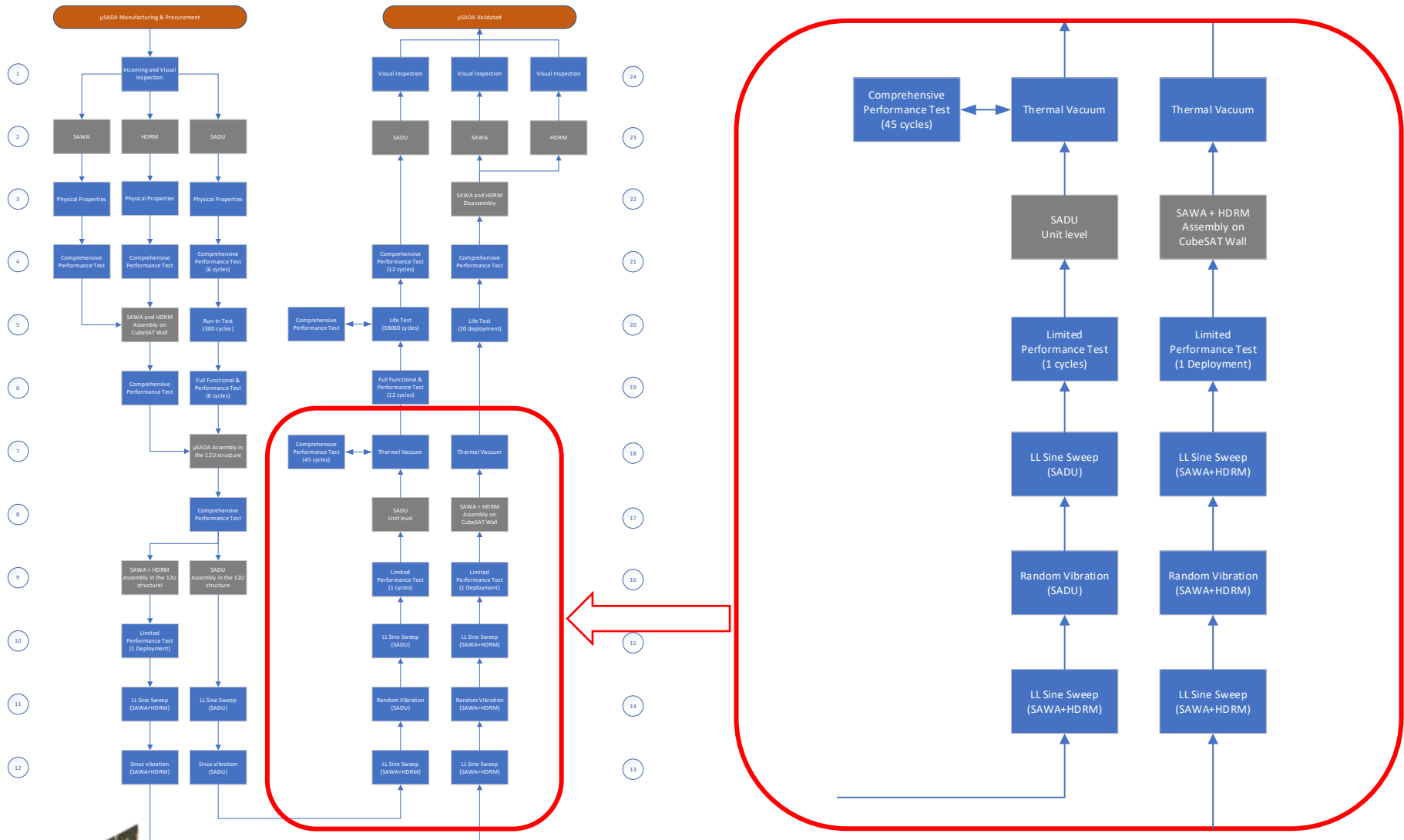
Test Plan



μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

IMT srl
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Slide N°30

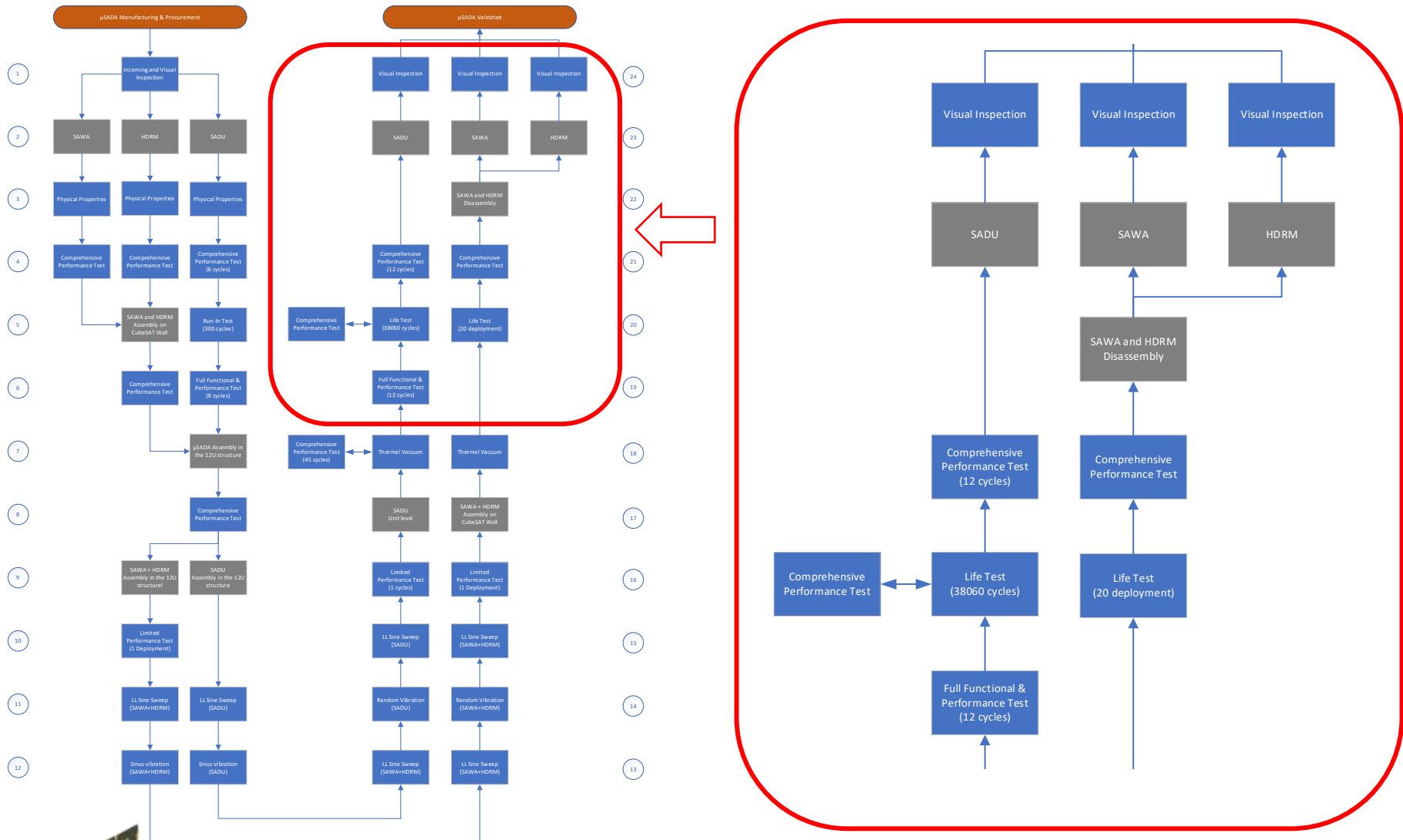
Test Plan



μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

IMT srl
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Slide N°31

Test Plan



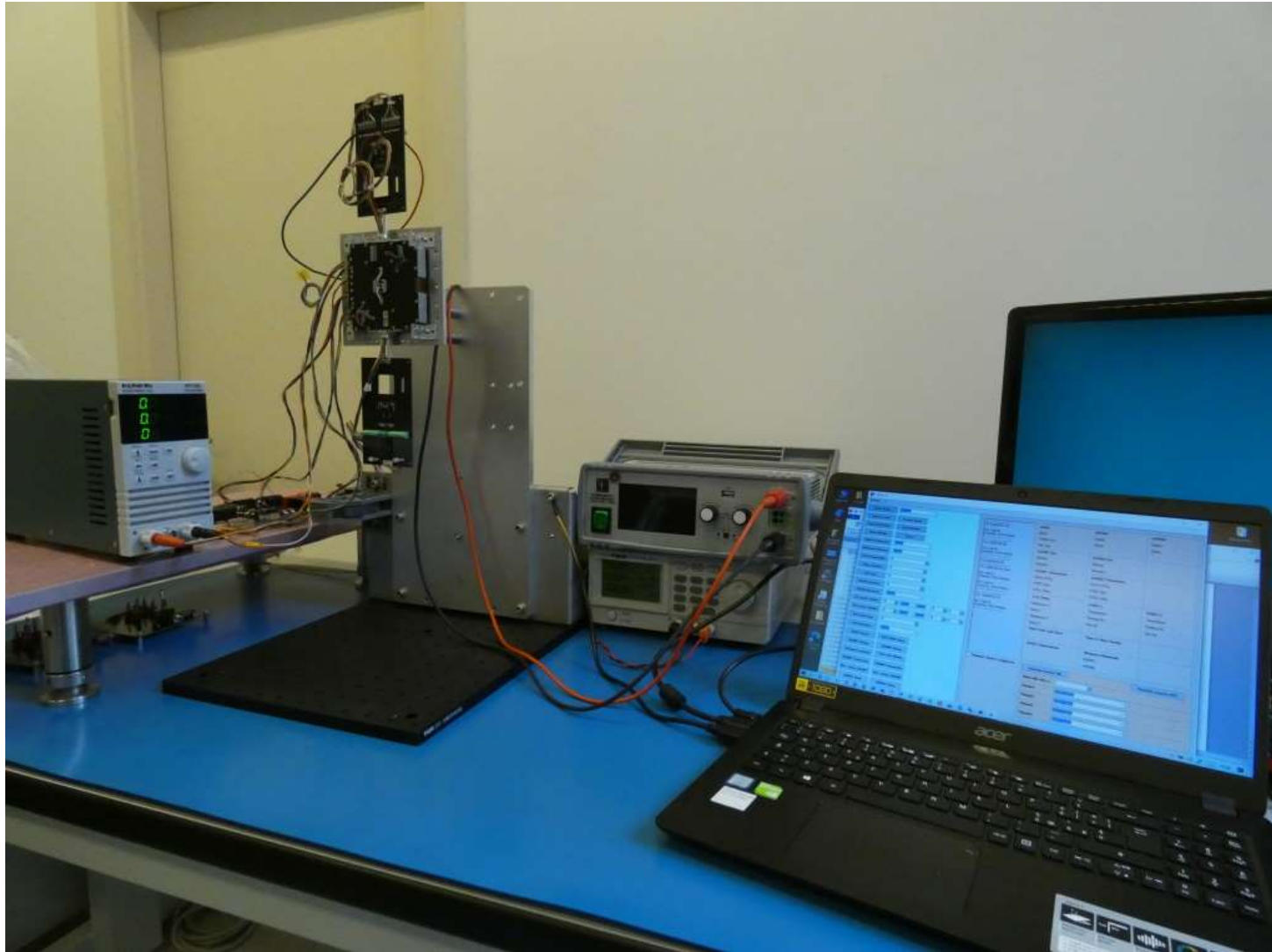
μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

IMT srl

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Slide N°32

SADU Verification



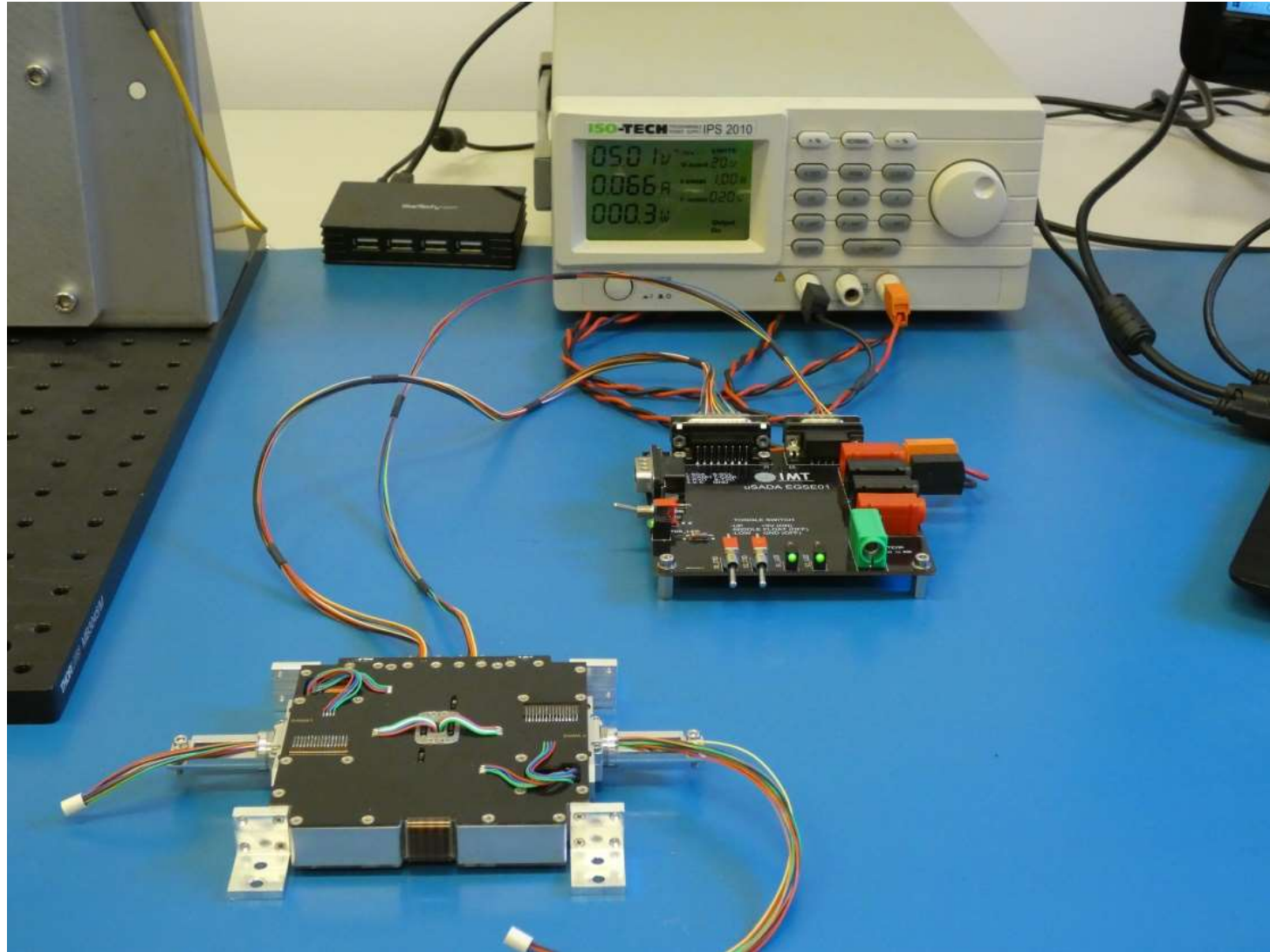
μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°33

SADU Verification



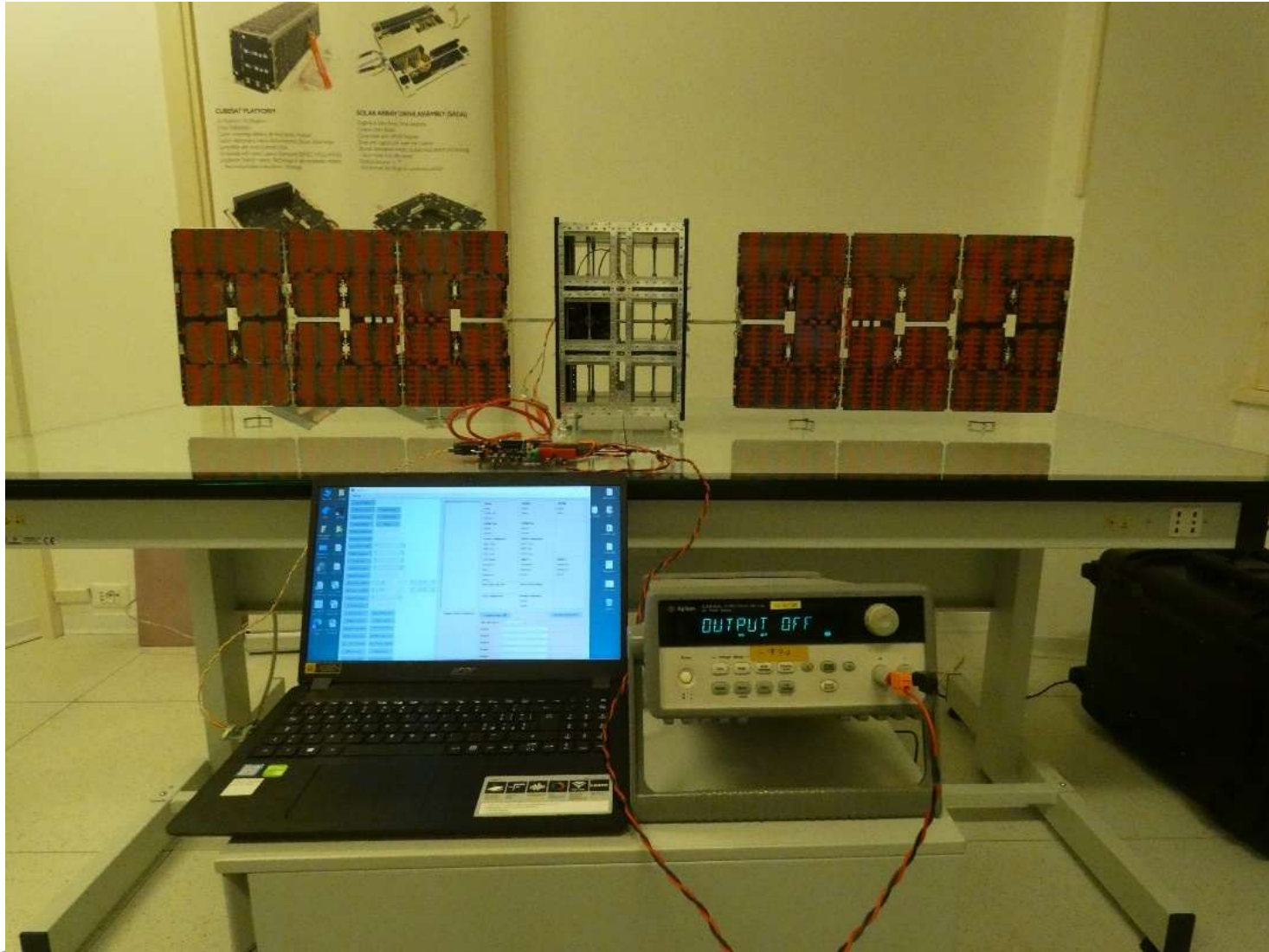
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Slide N°34

μSADA Verification



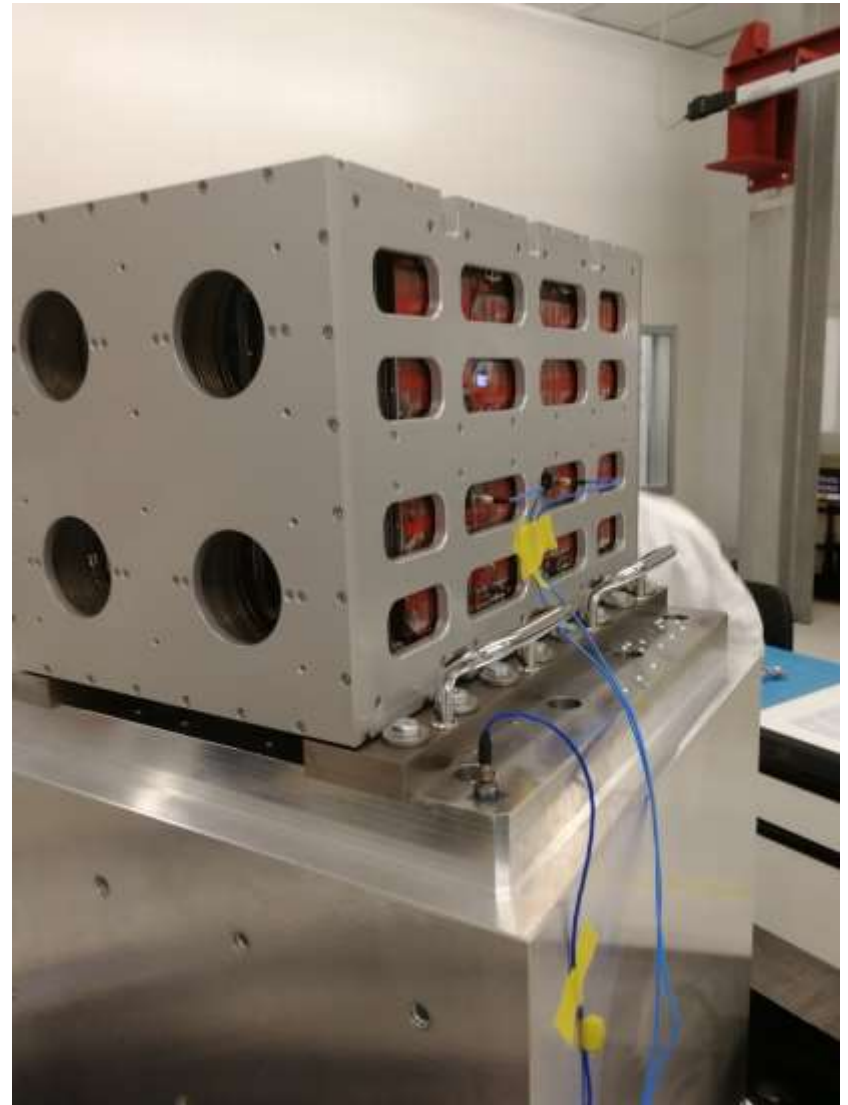
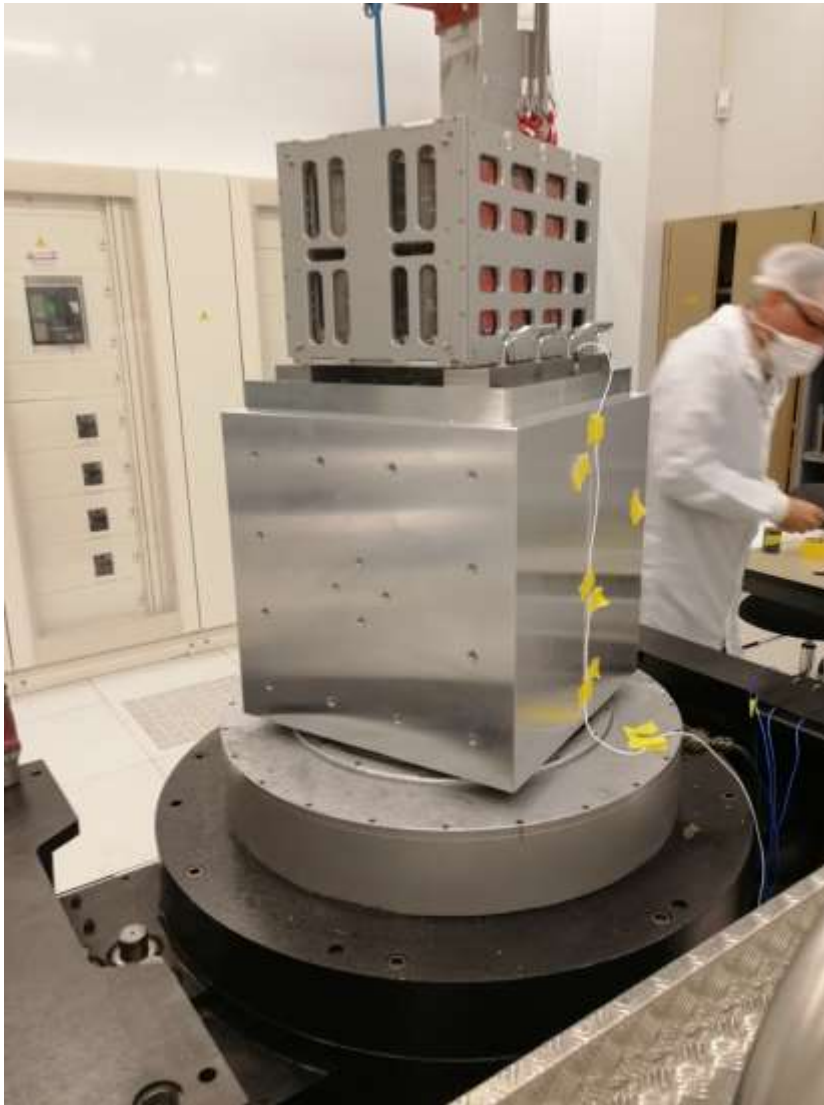
μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°35

Vibration tests μ SADA



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Slide N°36

Vibration tests μ SADA

As discussed, a Failure occurred during the vibration test (see the NCR/521/21/IMT and the NCR/528/21/IMT)

Corrective actions have been taken into account and the design has been updated basing on these.

The vibration tests have been developed considering the new mechanical parts. The units SADU and SAWA+HDRM has been tested separately. No other failures are discovered



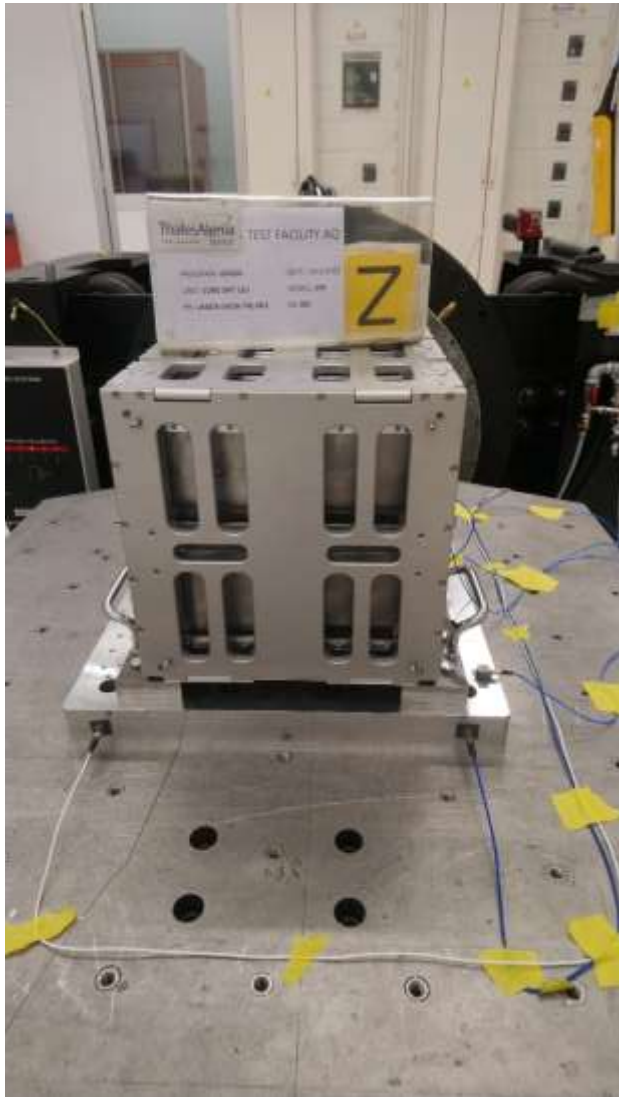
μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°37

Vibration tests SADU



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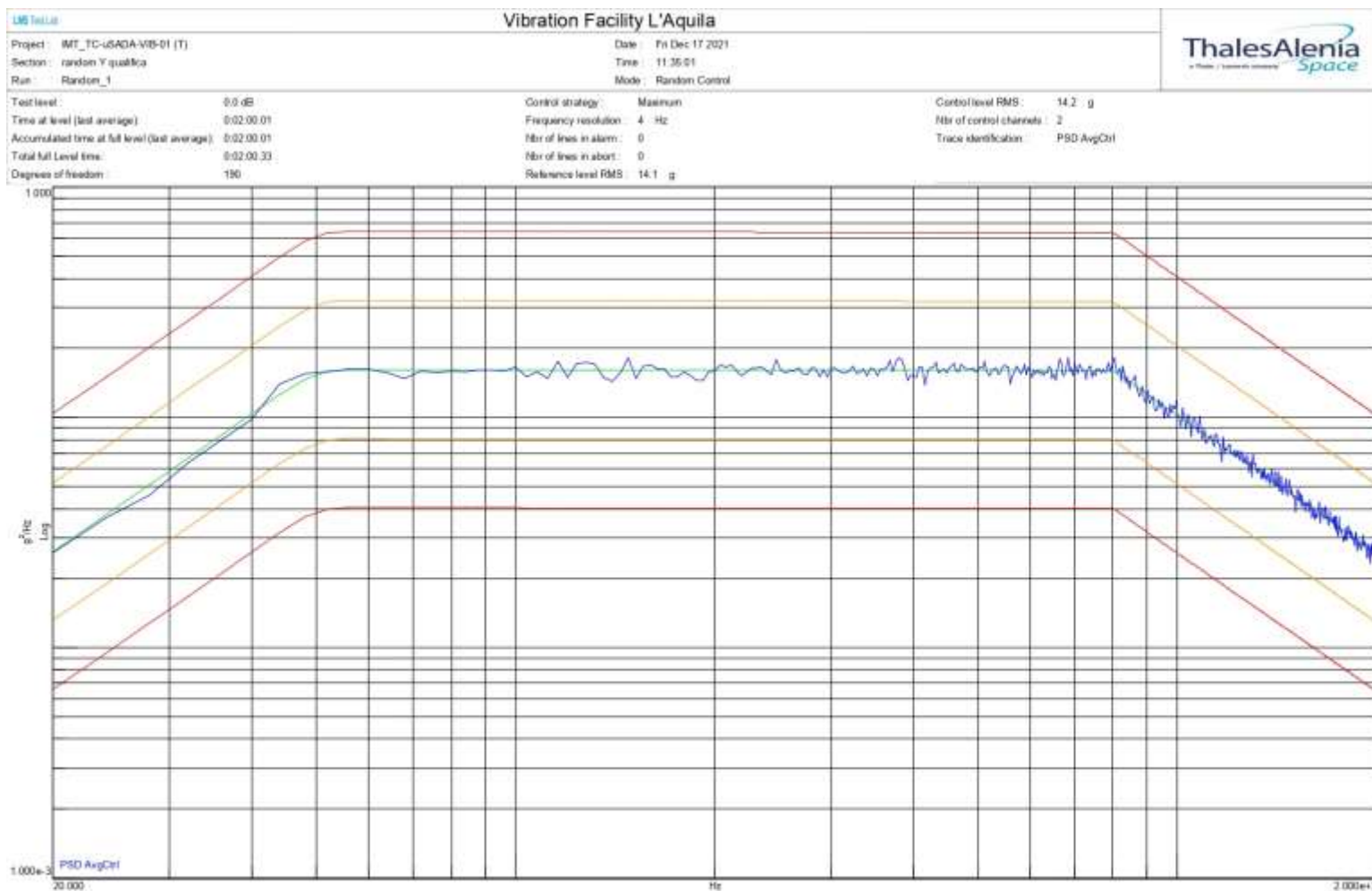
IMT srl

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Slide N°38

Vibration tests SADU

Input shaker Random Y



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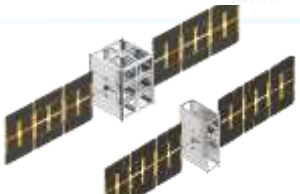
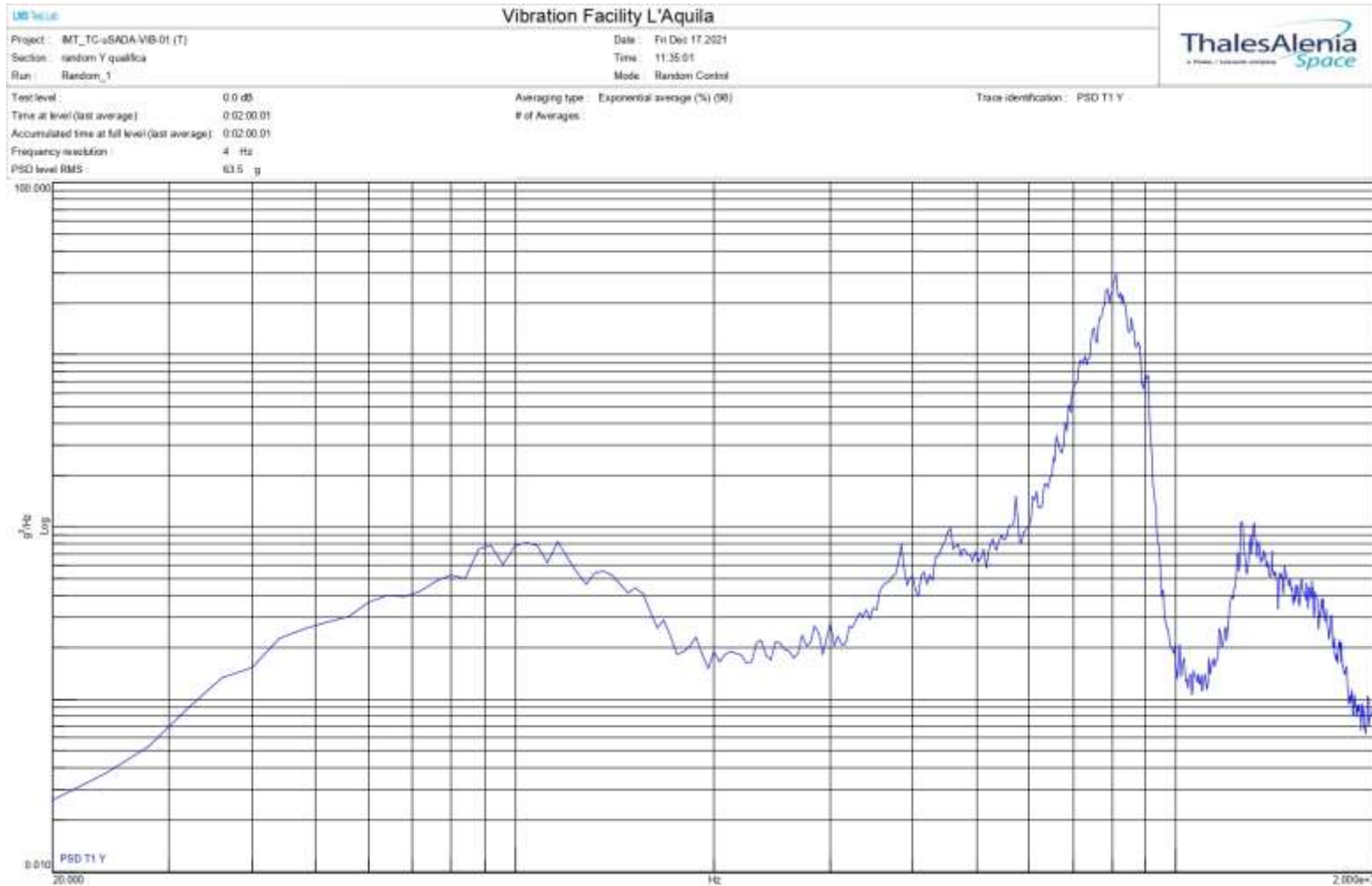
IMT srl

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Slide N°41

Vibration tests SADU

Random Y



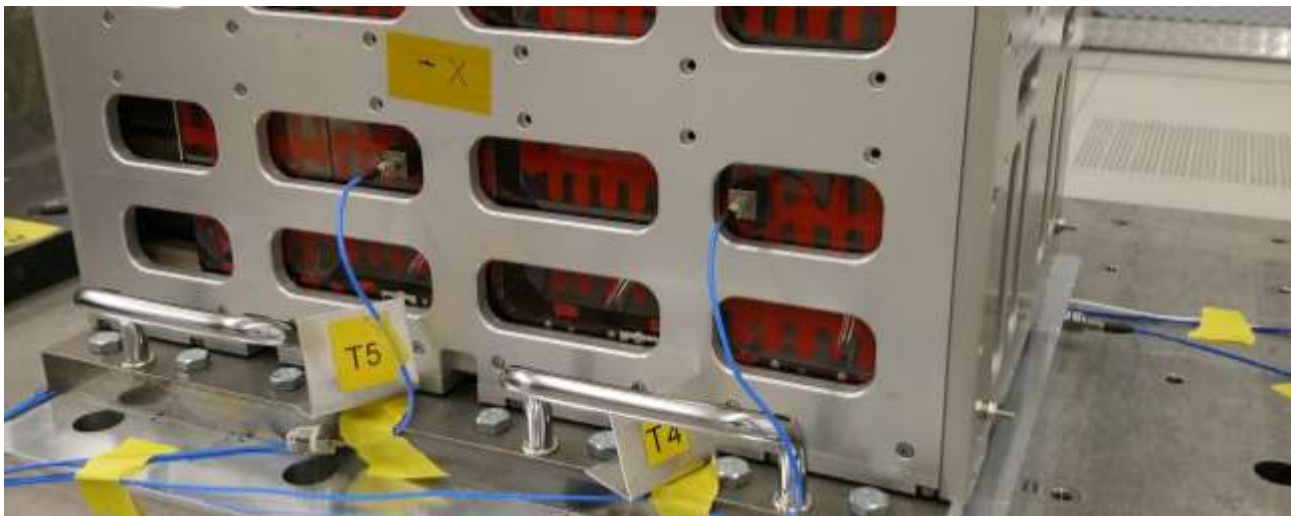
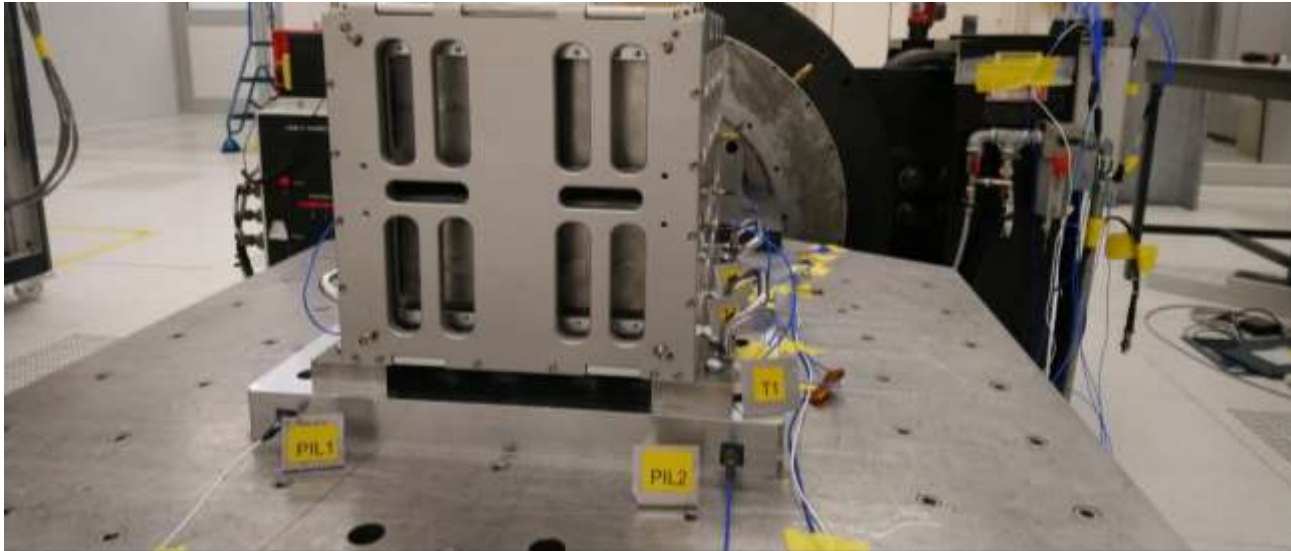
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Slide N°42

Vibration tests SAWA+HDRM



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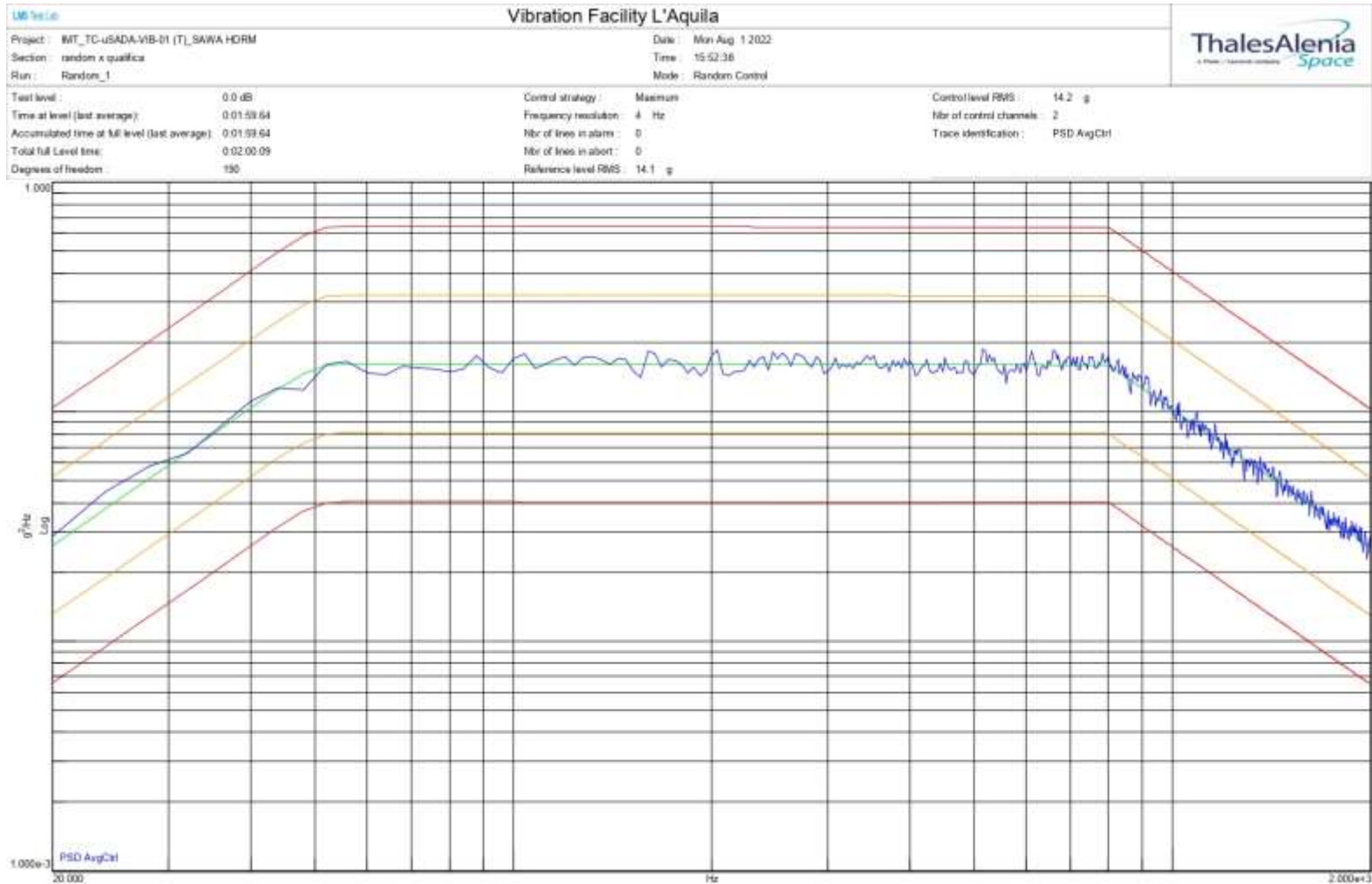
IMT srl

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Slide N°44

Vibration tests SAWA+HDRM

Input shaker Random X axis



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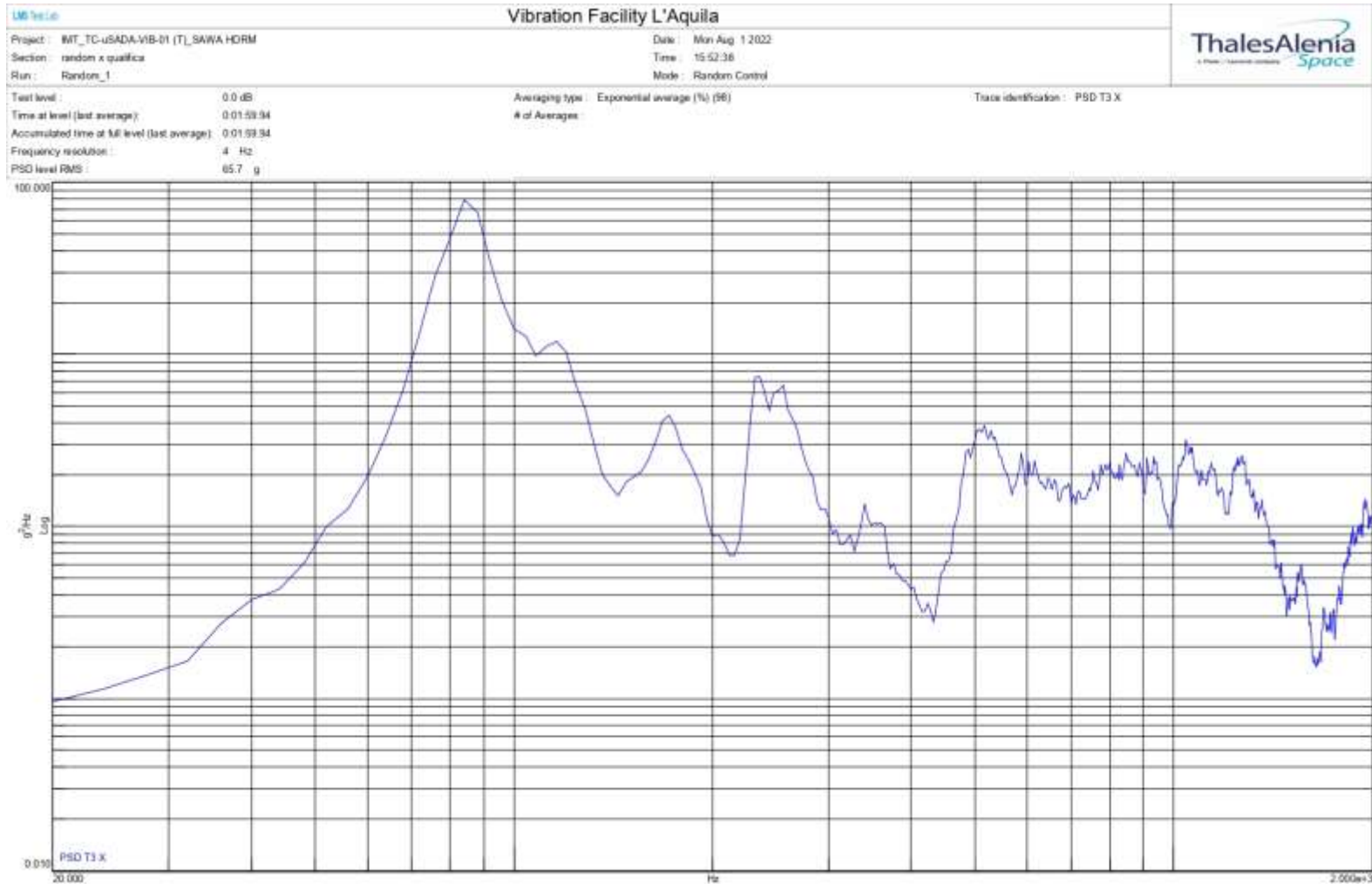
IMT srl

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Slide N°47

Vibration tests SAWA+HDRM

Random X



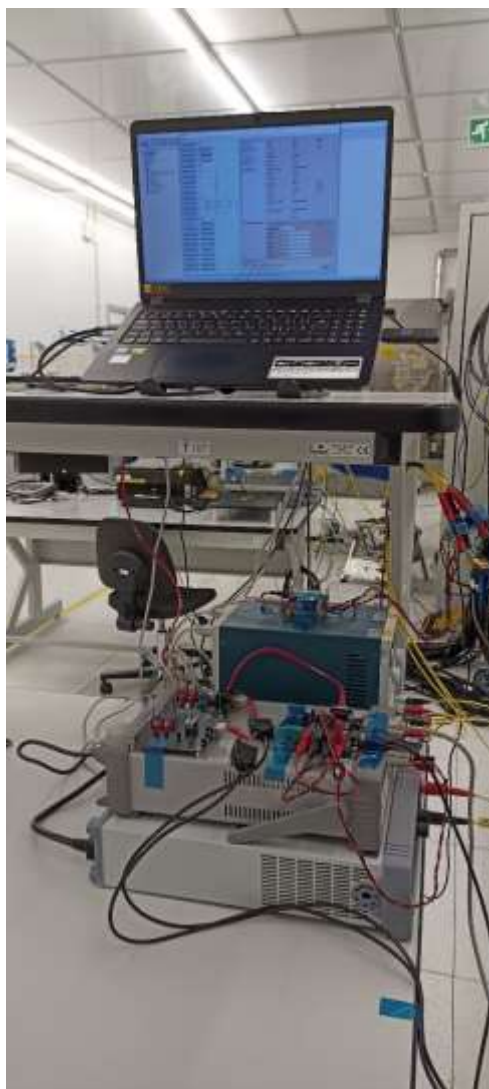
μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

IMT srl

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Slide N°48

TVAC SADU



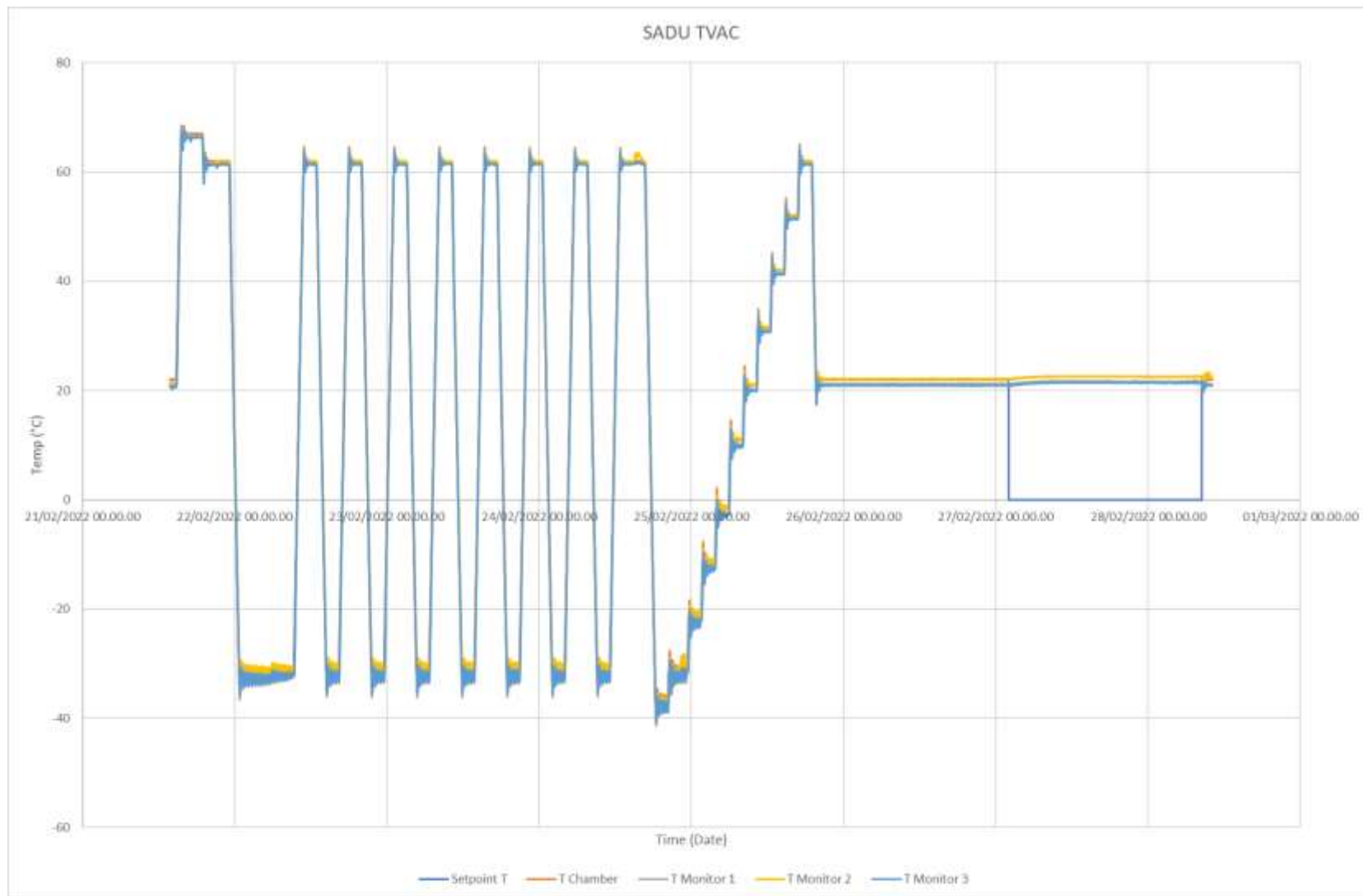
μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°49

TVAC SADU



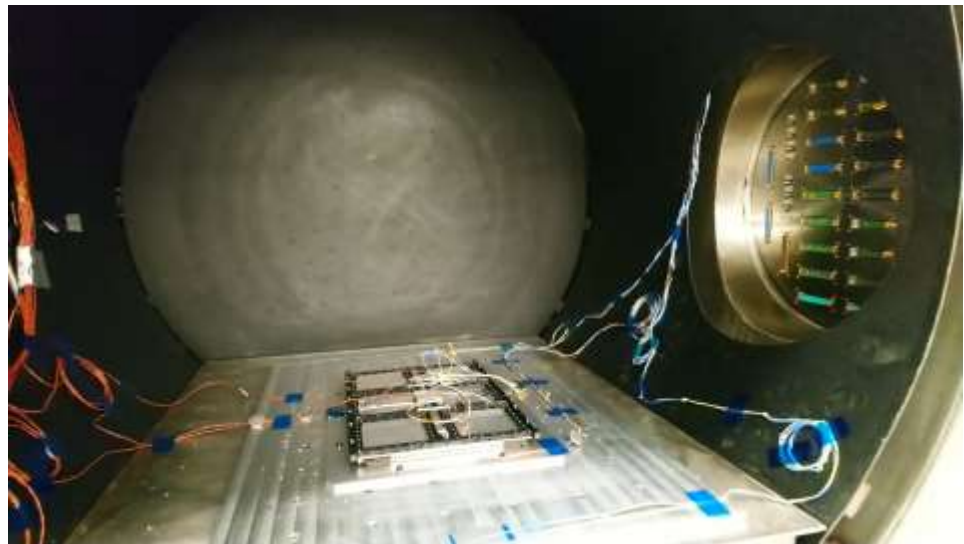
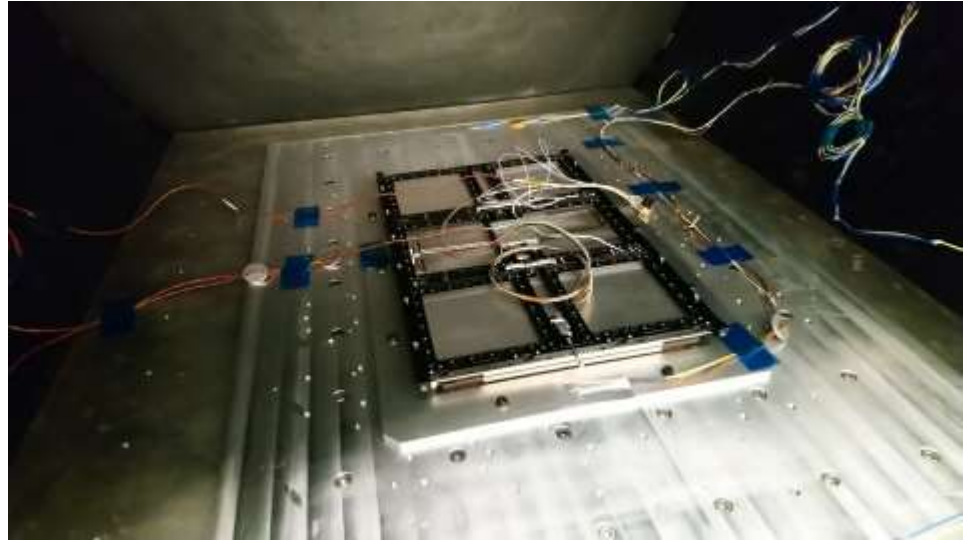
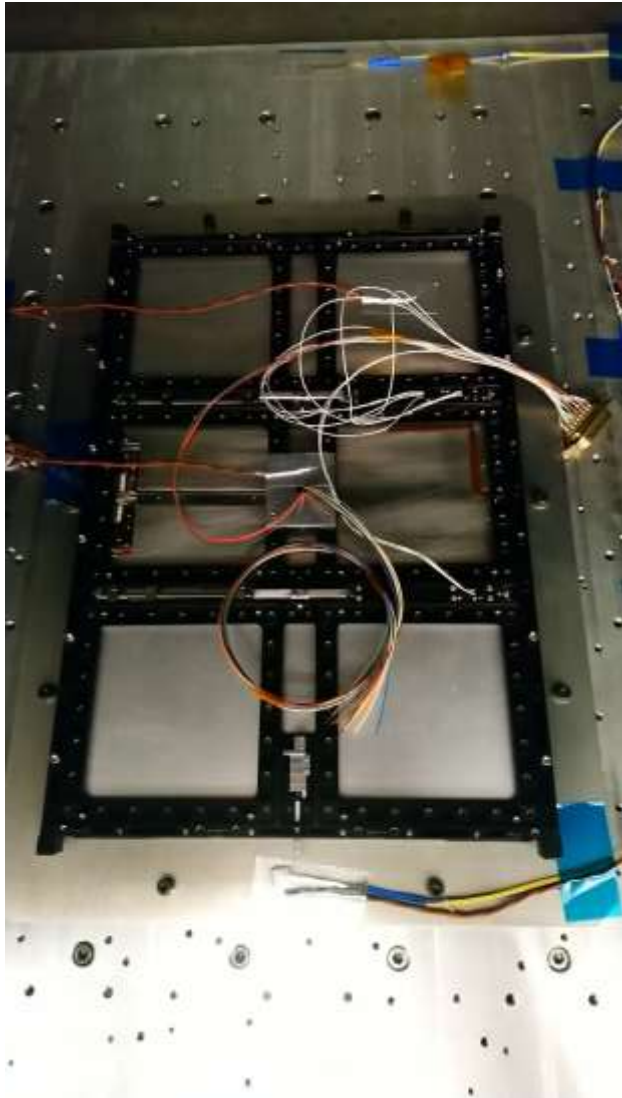
μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

IMT srl

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Slide N°50

TVAC SAWA+HDRM



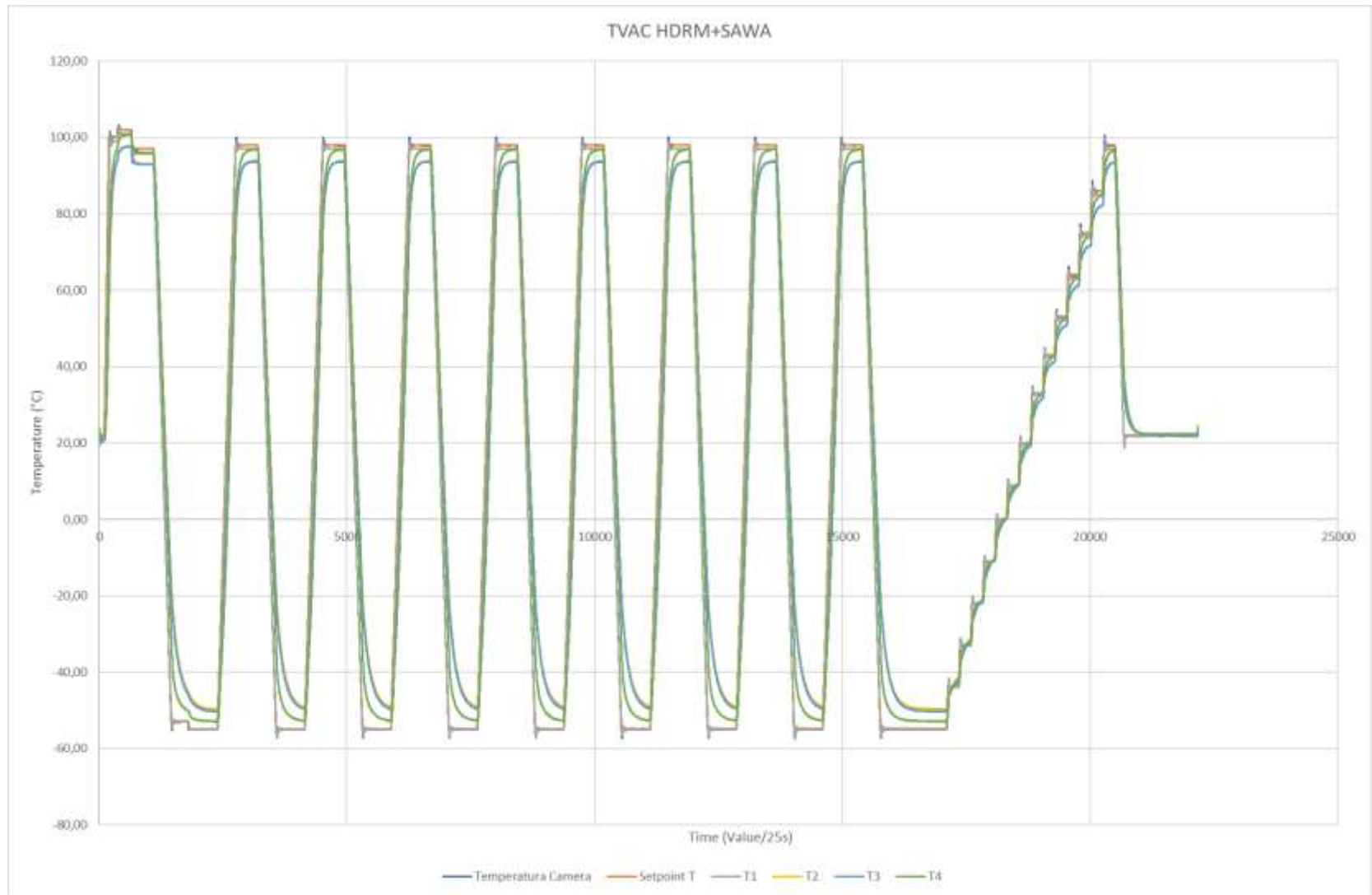
μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°51

TVAC SAWA+HDRM



μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

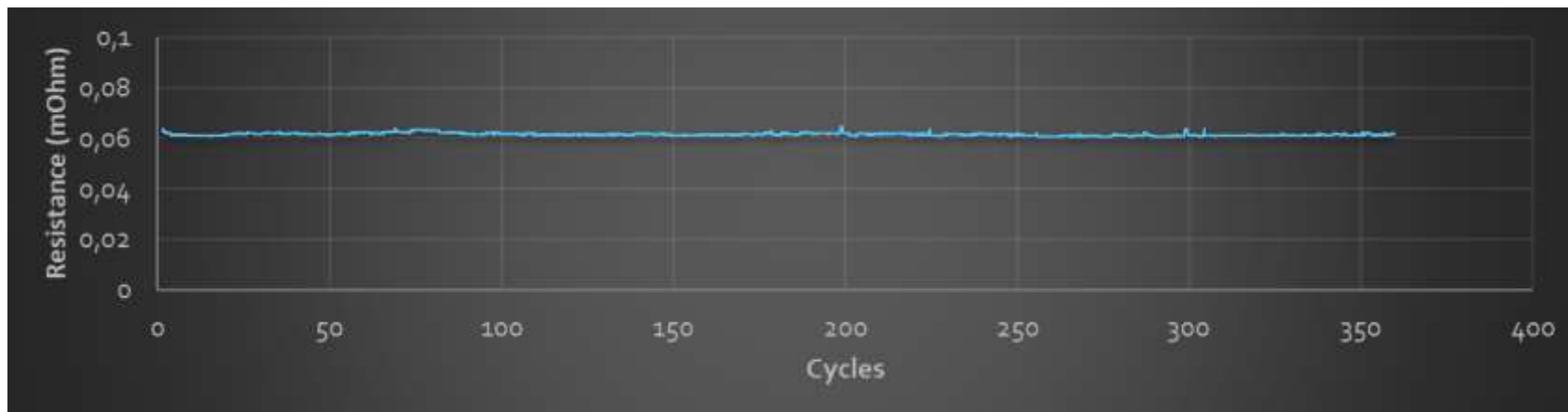
IMT srl

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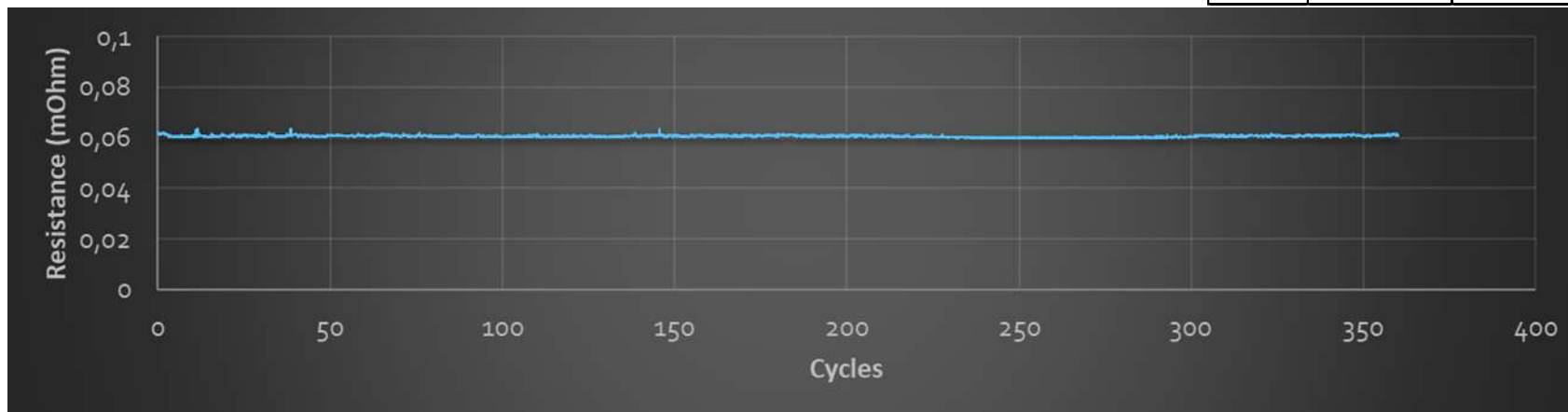
Slide N°52

Run-in (Side 1)

Before run-in [ohm/deg]



After run-in [ohm/deg]



	BEFORE R.I.	AFTER R.I.
	R (mohm)	R (ohm)
SIDE1	61,55	60,63
SIDE2	76,37	74,29



μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

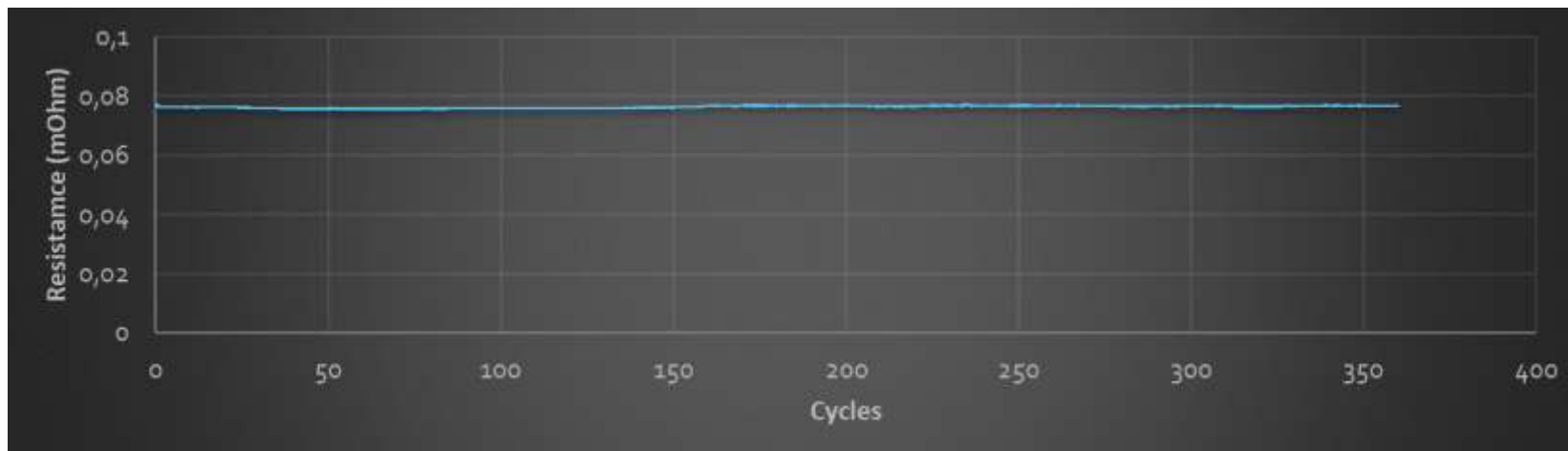
IMT srl

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Slide N°53

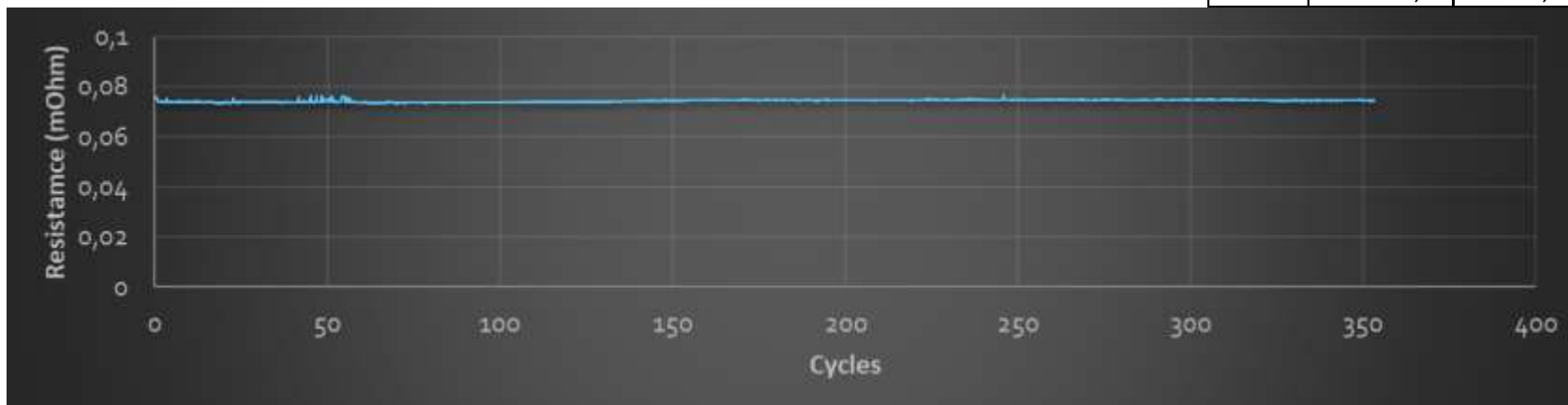
Run-in (Side 2)

Before run-in [ohm/deg]



After run-in [ohm/deg]

	BEFORE R.I.	AFTER R.I.
	R (mohm)	R (ohm)
SIDE1	61,55	60,63
SIDE2	76,37	74,29



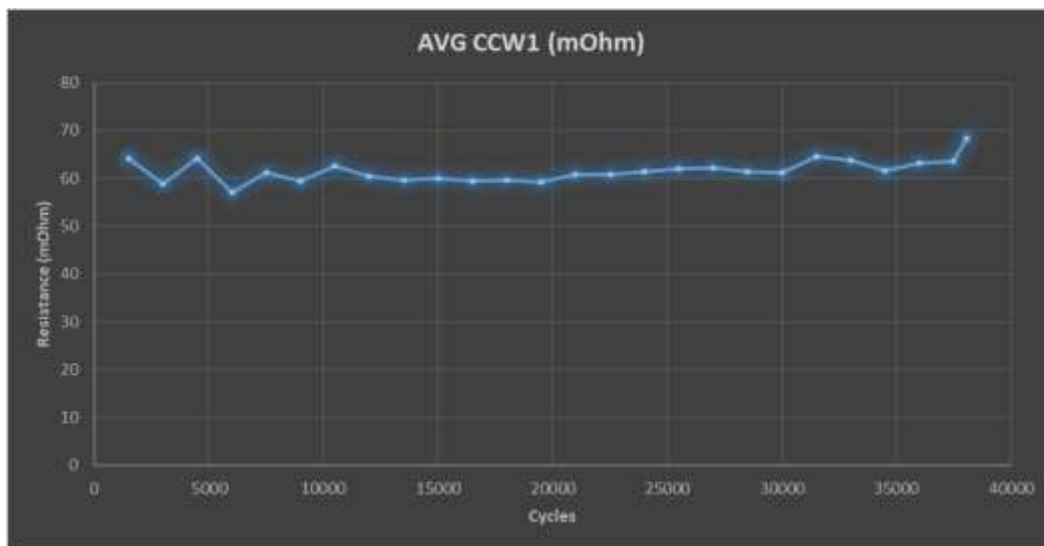
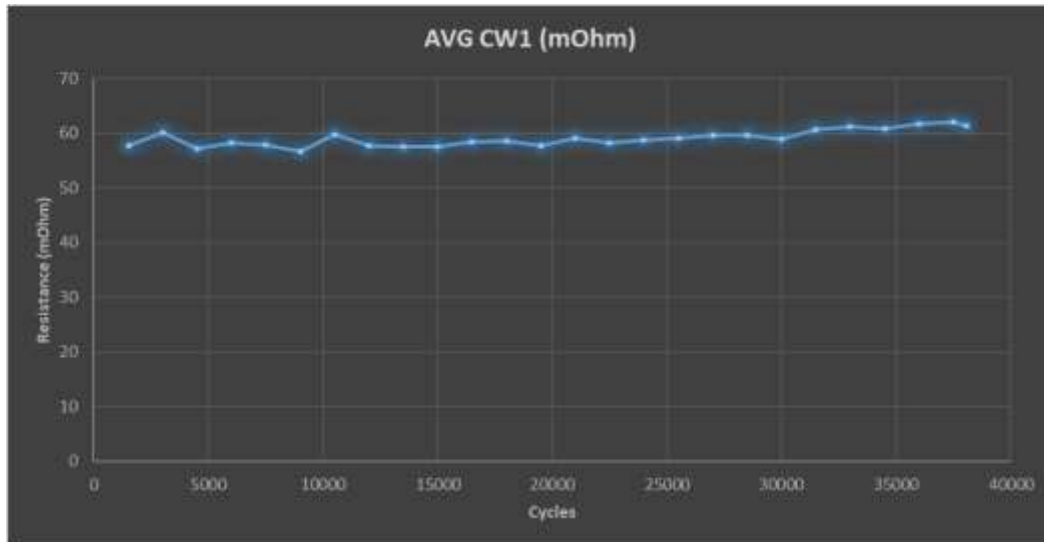
μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°54

Life-Test (summary)



REVS	CW	CCW
	AVG (mohm)	AVG (mohm)
1500	57,73	64,12
3000	60,07	58,91
4500	57,23	64,22
6000	58,13	57,12
7500	57,87	61,18
9000	56,73	59,49
10500	59,84	62,59
12000	57,75	60,38
13500	57,54	59,63
15000	57,57	60,07
16500	58,40	59,45
18000	58,58	59,55
19500	57,67	59,24
21000	59,01	60,82
22500	58,26	60,92
24000	58,68	61,35
25500	59,10	61,98
27000	59,52	62,15
28500	59,63	61,42
30000	58,97	61,25
31500	60,70	64,51
33000	61,10	63,81
34500	60,84	61,53
36000	61,64	63,17
37500	62,05	63,55
38060	61,32	68,39



μSADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

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Slide N°55

Life-Test (summary)



REVS	CW	CCW
	AVG (mohm)	AVG (mohm)
1500	76,41	78,69
3000	81,51	76,53
4500	75,56	78,39
6000	76,34	74,90
7500	75,50	76,58
9000	84,04	76,65
10500	90,19	75,62
12000	80,77	76,17
13500	79,27	76,14
15000	78,16	75,49
16500	77,99	79,46
18000	77,31	77,41
19500	76,87	77,04
21000	79,80	83,86
22500	79,97	77,04
24000	79,99	77,53
25500	78,89	77,06
27000	77,90	76,55
28500	79,10	77,63
30000	75,29	74,69
31500	77,82	77,71
33000	79,12	78,17
34500	77,65	77,31
36000	76,71	77,83
37500	78,95	78,35
38060	77,09	77,40



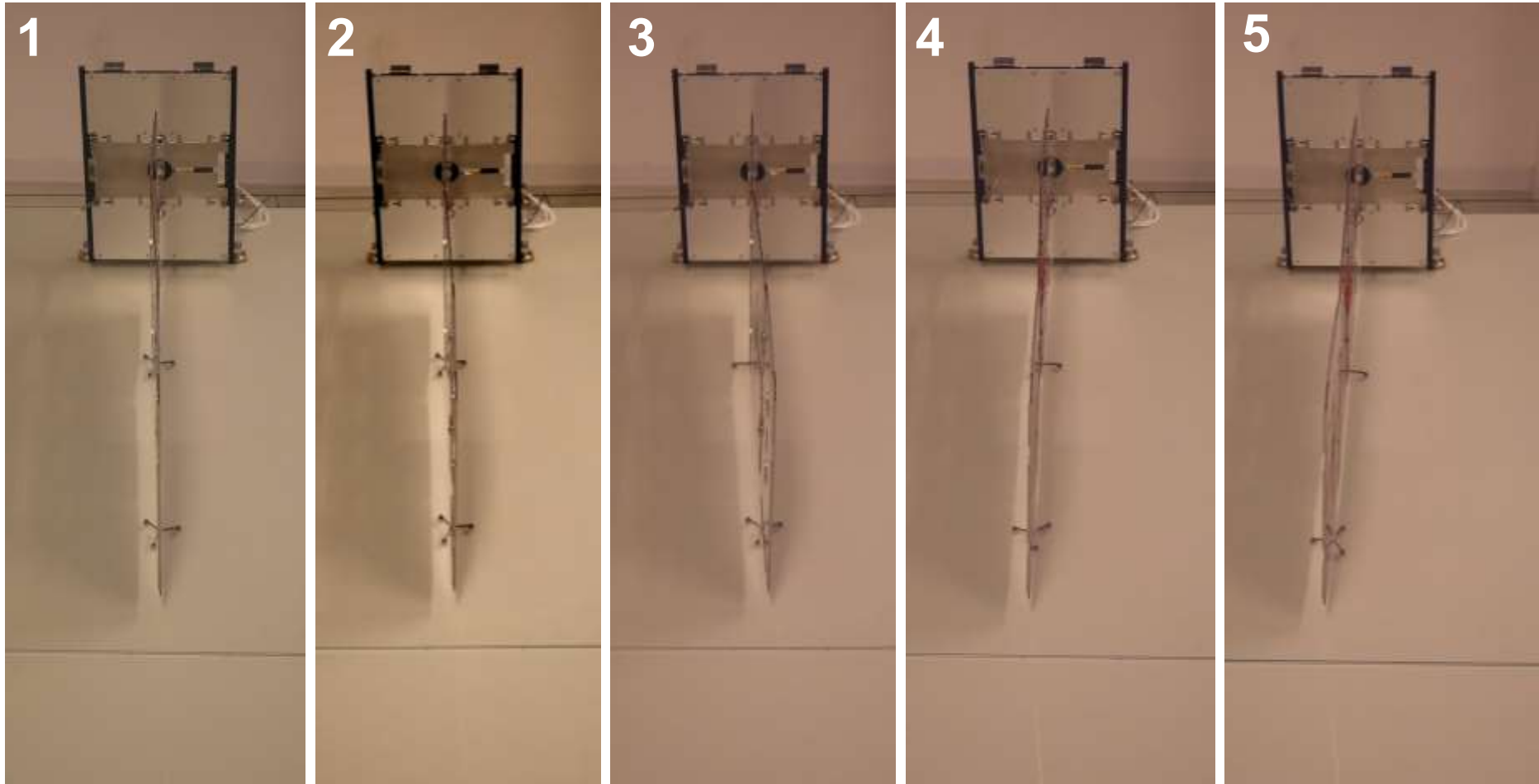
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Slide N°56

Deployment Life Test



All latching systems are engaged at each deployment



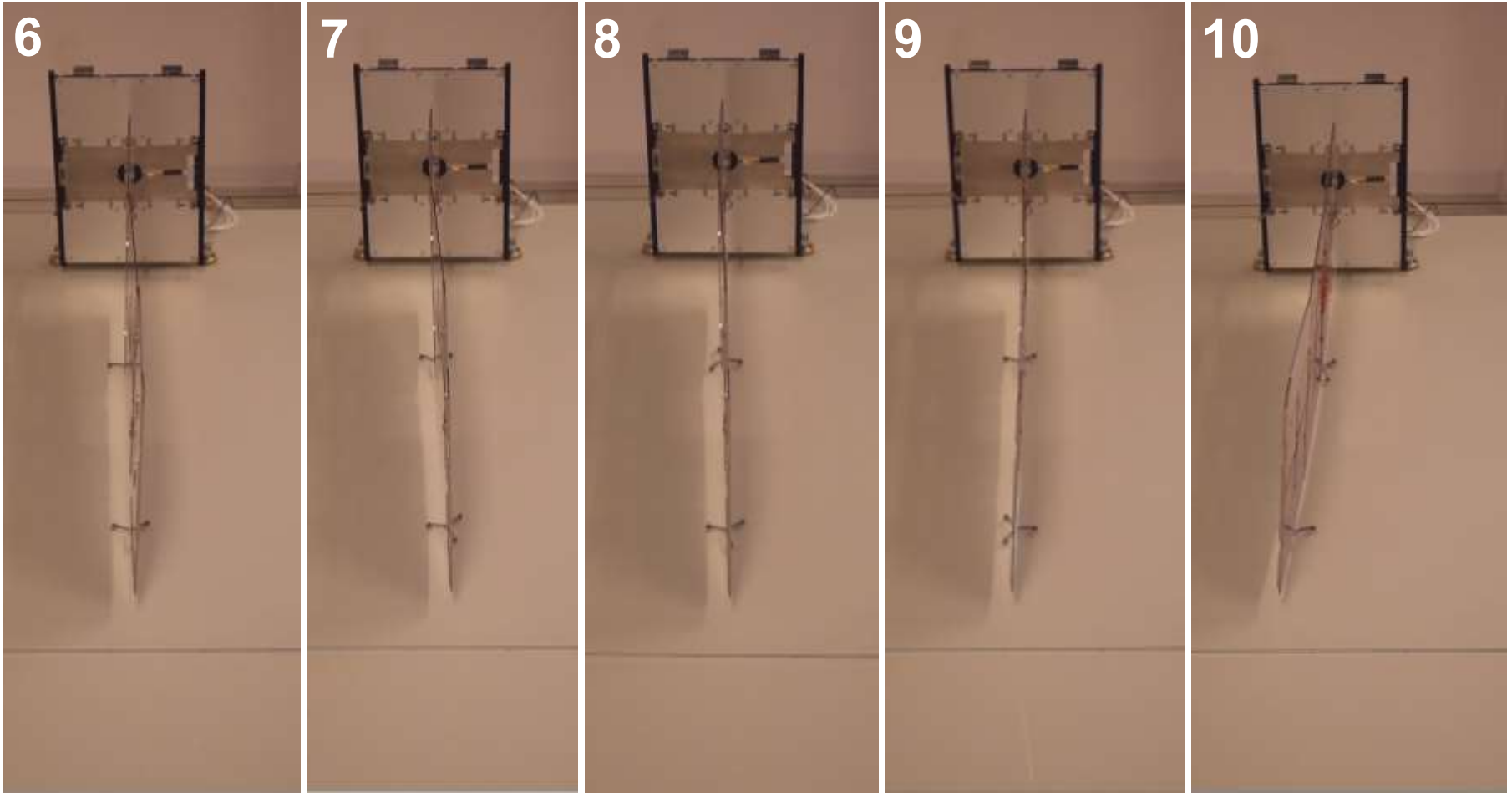
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Slide N°57

Deployment Life Test



All latching systems are engaged at each deployment



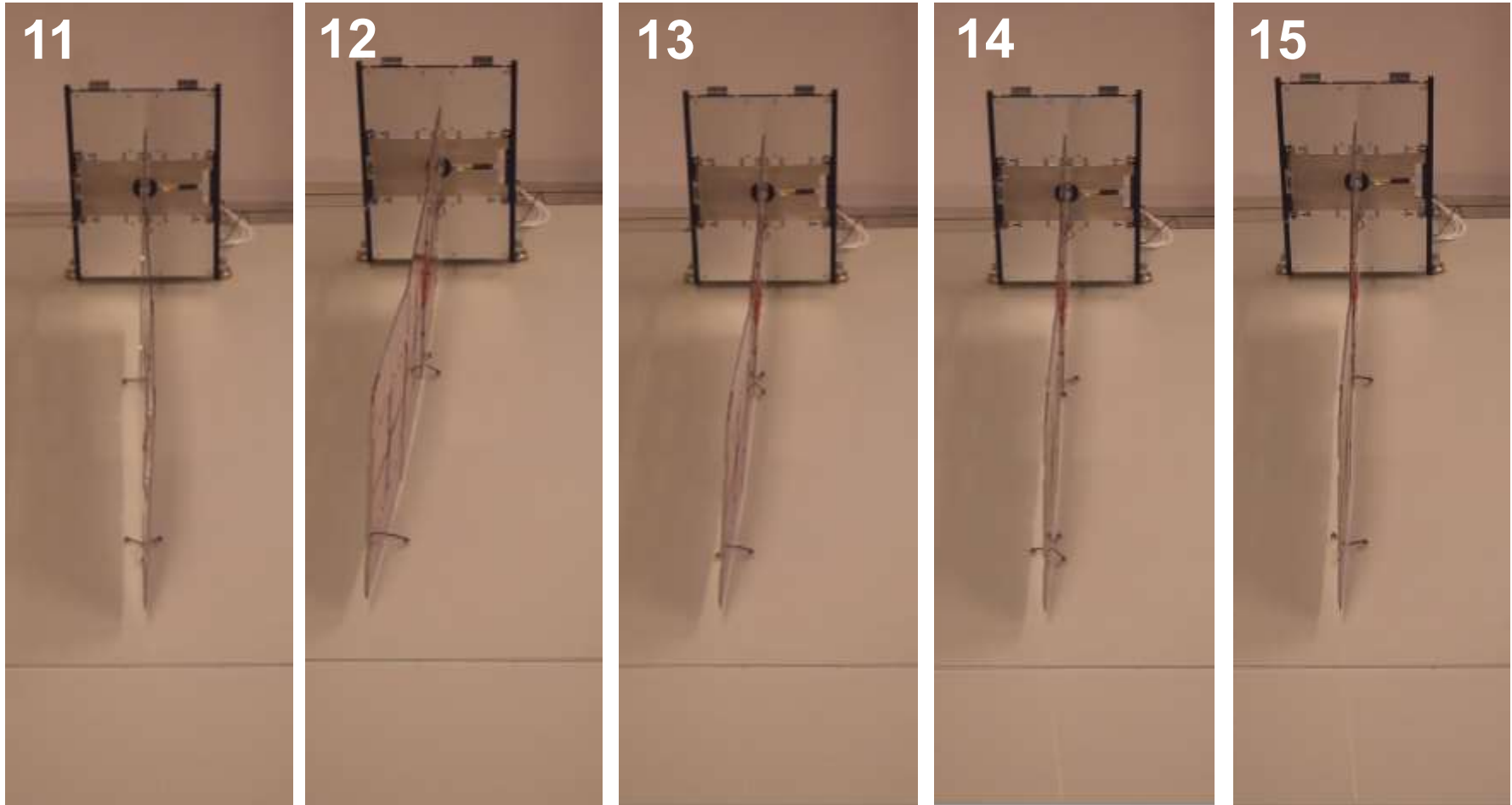
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Slide N°58

Deployment Life Test



All latching systems are engaged at each deployment



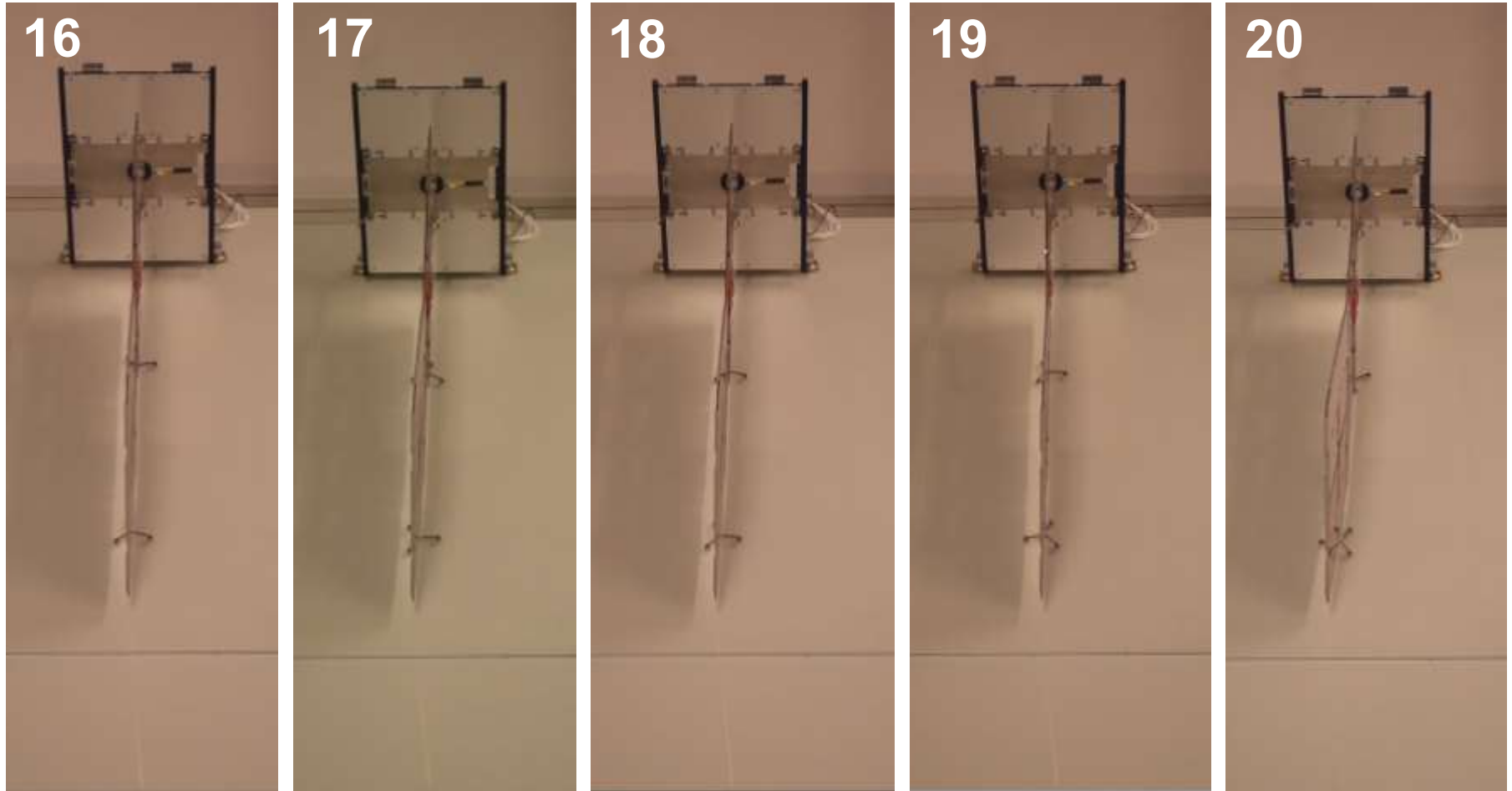
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Slide N°59

Deployment Life Test



All latching systems are engaged at each deployment



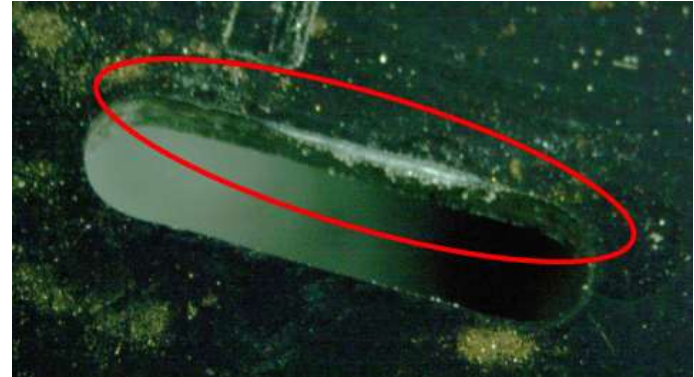
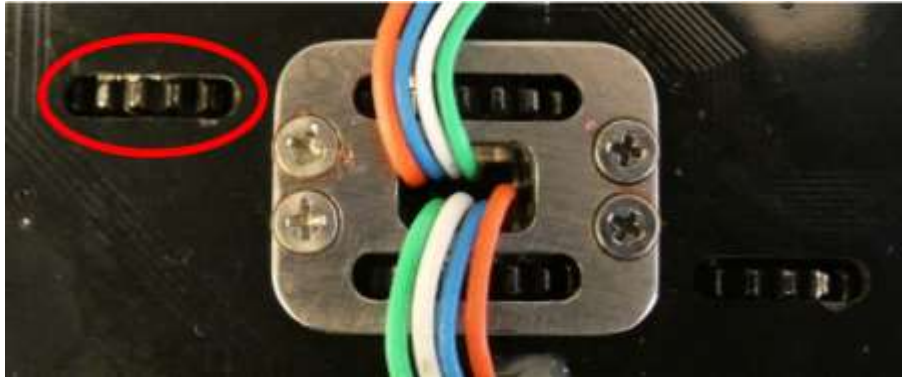
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Slide N°60

Visual Inspection



Wear between the gear and the PCB

Action: Increase the size of the PCB cutted area



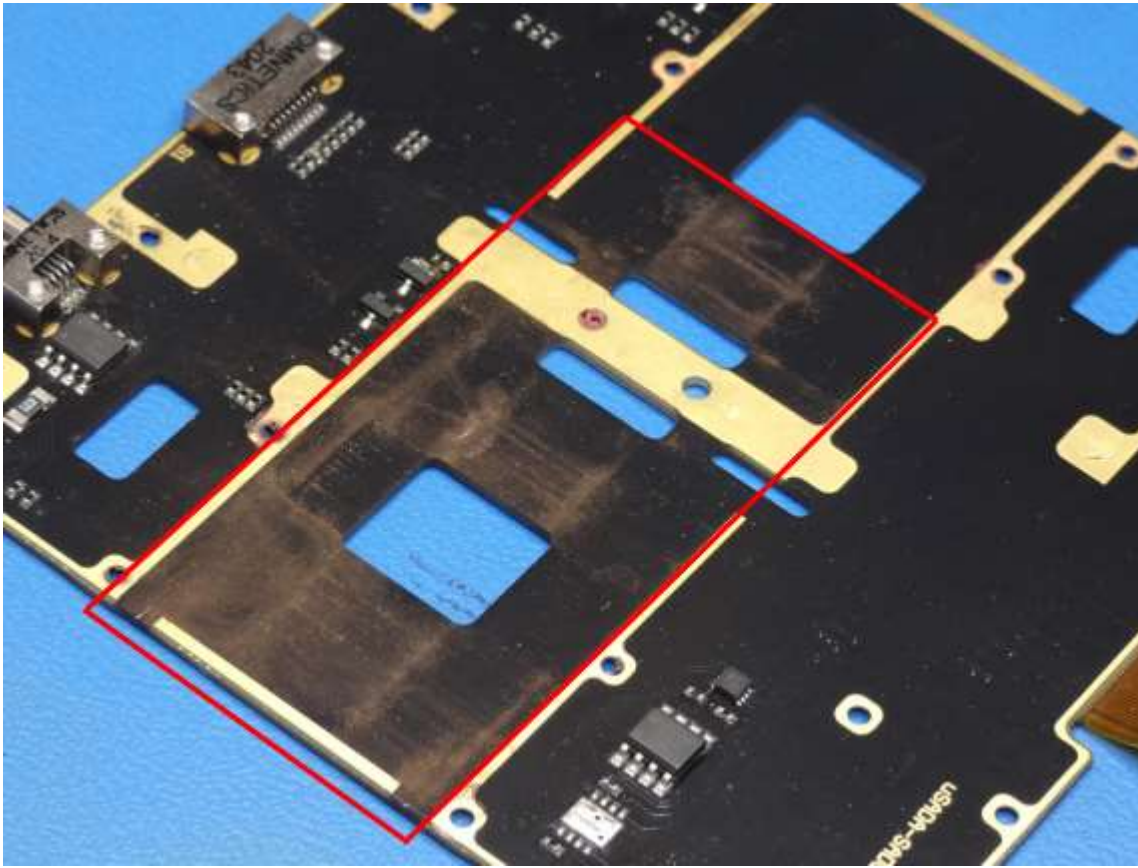
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Slide N°61

Visual Inspection



Pollution due to wear between pin/slip-rings contacts



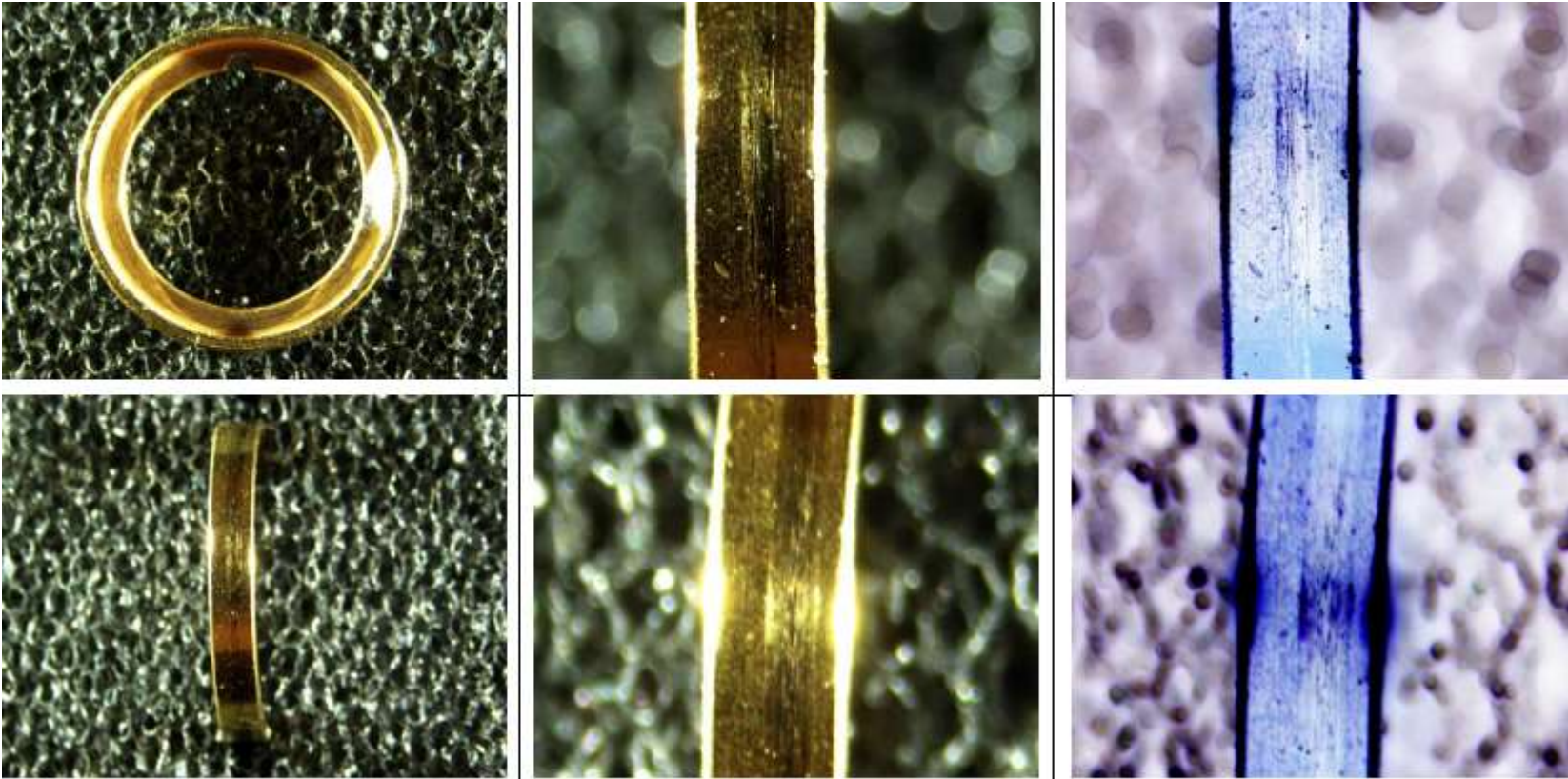
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Slide N°62

Visual Inspection



μ SADA - Miniaturised Solar Array Drive Assembly for 6U/12U CubeSAT

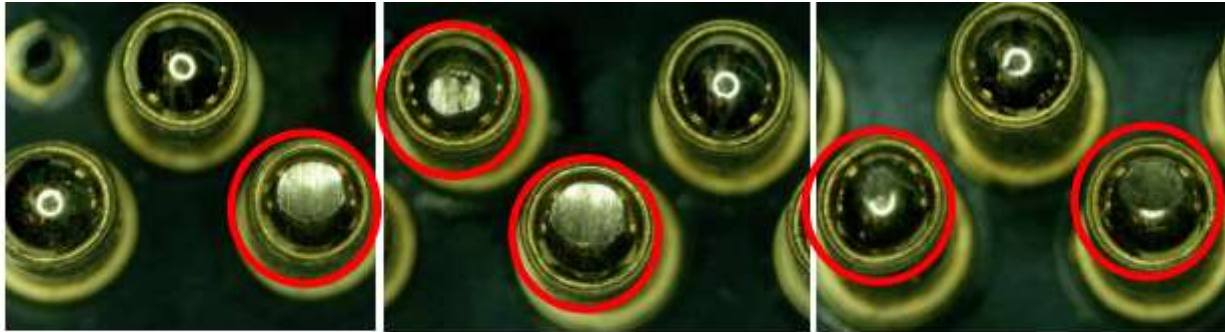
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Slide N°63

Visual Inspection

1



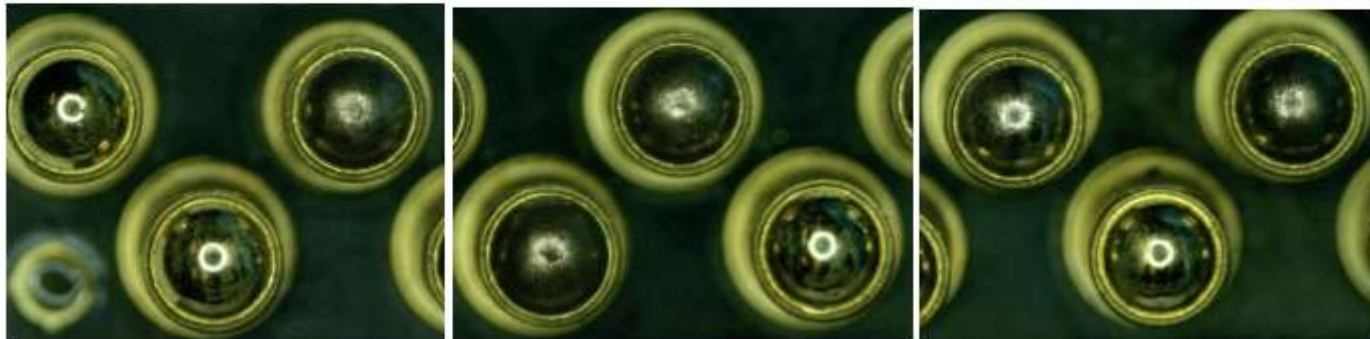
9

10



15

16



24



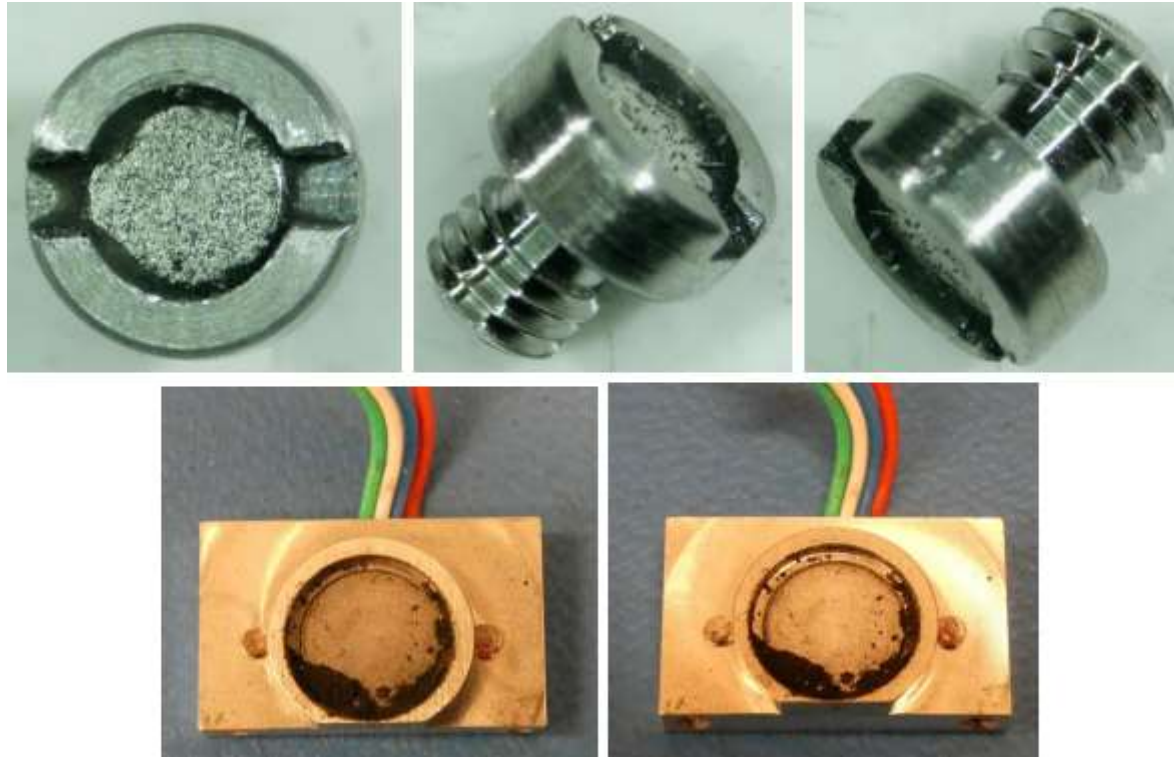
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Slide N°64

Visual Inspection



Pollution due to wear between Encoder Bracket and Ball bearing (SAWA 2)

Action: Change the tolerance between ball bearing and housing



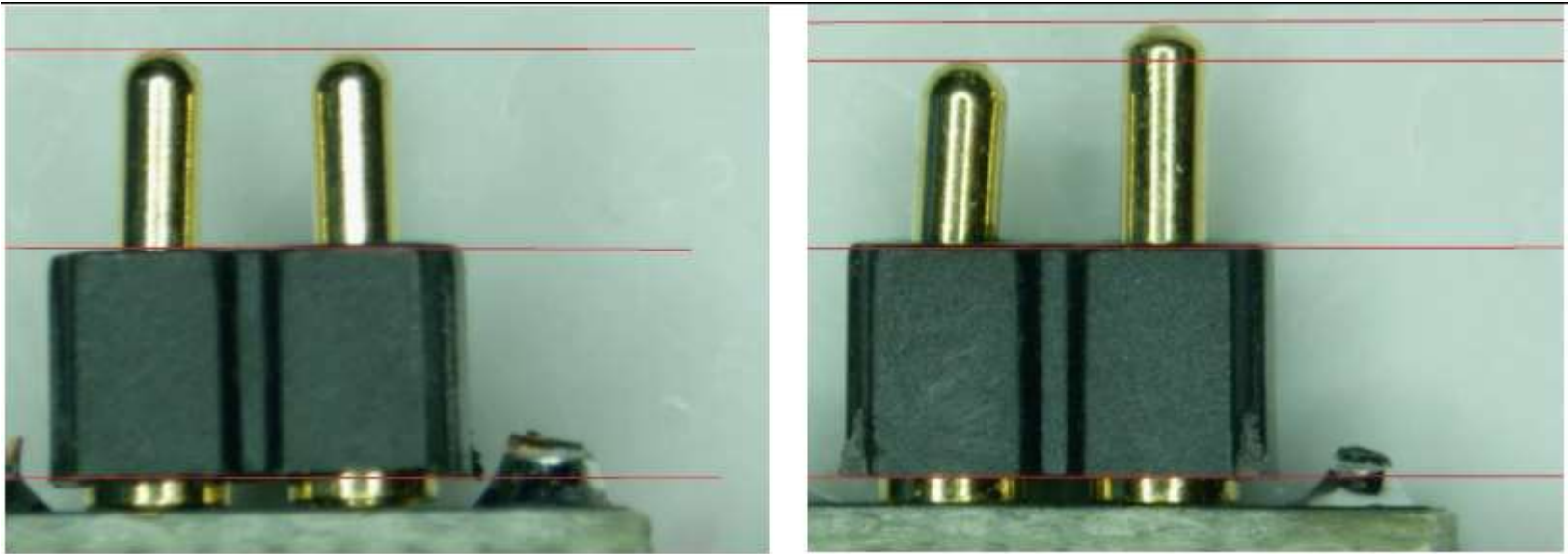
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Slide N°65

Visual Inspection



The deployment switches have light wear on the tip due to vibration tests and deployment tests. There is a static deformation of a pin, in extension stroke and direction. This deformation has not affected the pins functions.



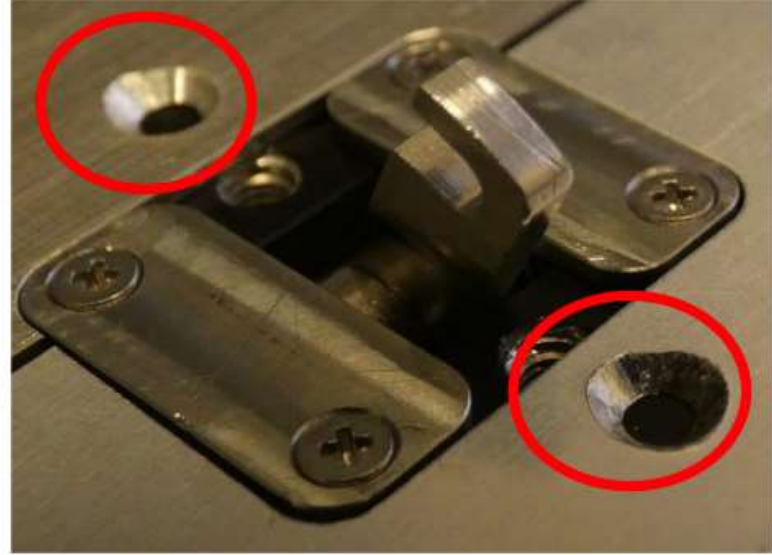
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Slide N°66

Visual Inspection



There are signs of wear on contact surfaces between reinforcing parts (rod and plate) and panels. This wear is due to vibrations tests (inox on aluminium) and deployments during life test of SAWA. Highlighted in red circles the wear zones



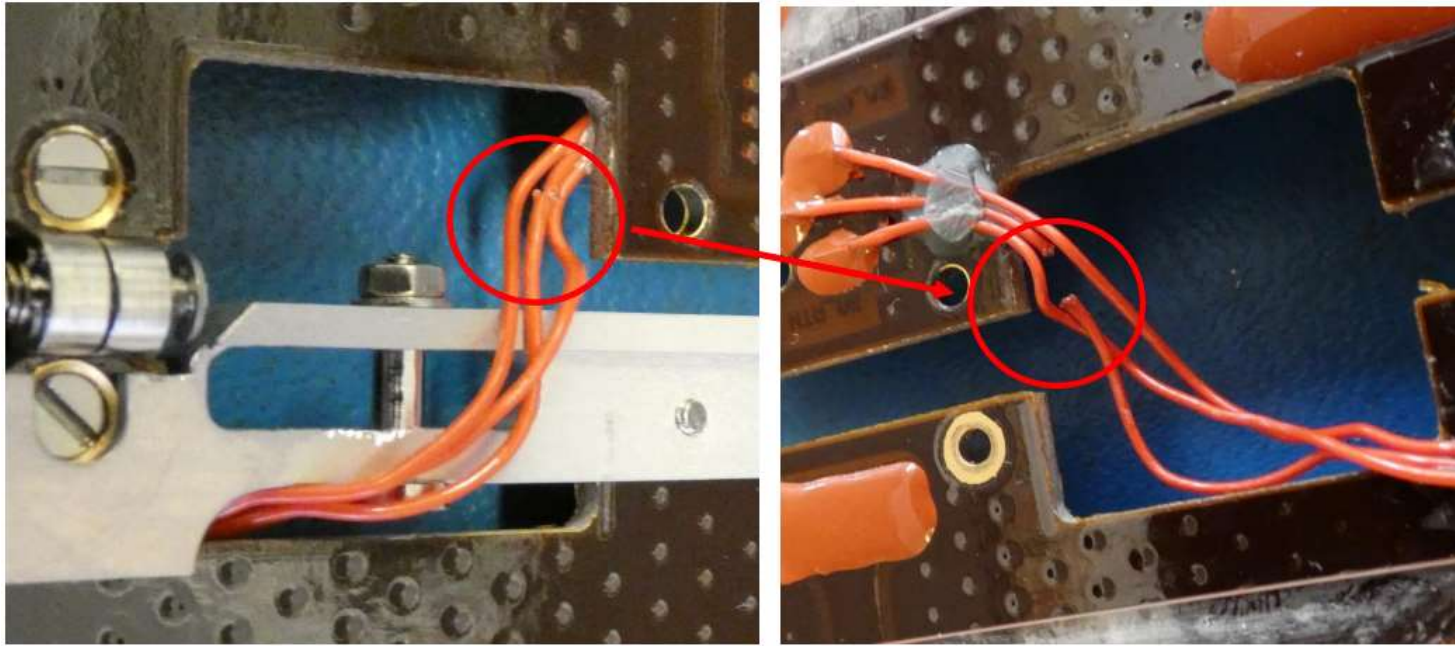
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Slide N°67

Visual Inspection



Only one wire in the bundle connection between Panel 3 and Panel 2 has a failure. After an investigation, it was discovered that the broken wire is the same mentioned in the NCR/206/21/IMT. There are no further damages.



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Follow-on activities

- Develop the Flight Software
- Implement the Coarse Sun Sensor and the Autonomous Mode
- Update the SADU electrical design to include an EPROM MEMORY (MR25H10CDC)
- Update the SADU mechanical design to reduce:
 - the wear between the ball bearing and the Encoder bracket
 - the wear between the gear and the PCB
- Update the SADU mechanical design to reduce the compression force of the Slip Rings pins



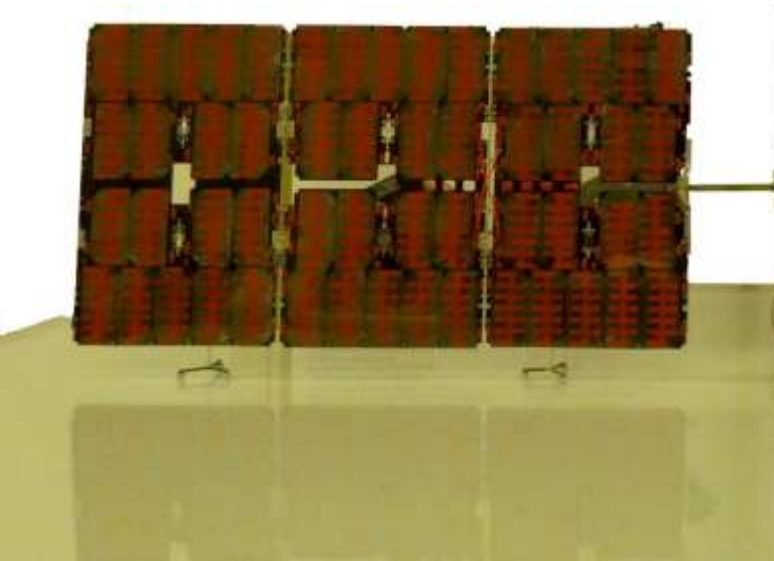
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Slide N°69

Thank You for your attention



**μ SADA
Miniaturised Solar Array
Drive Assembly for 6U/12U**

(ESA Contract No 4000121485/17/NL/PS)

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