

# Proba-V QWG#12 Flight & GS status

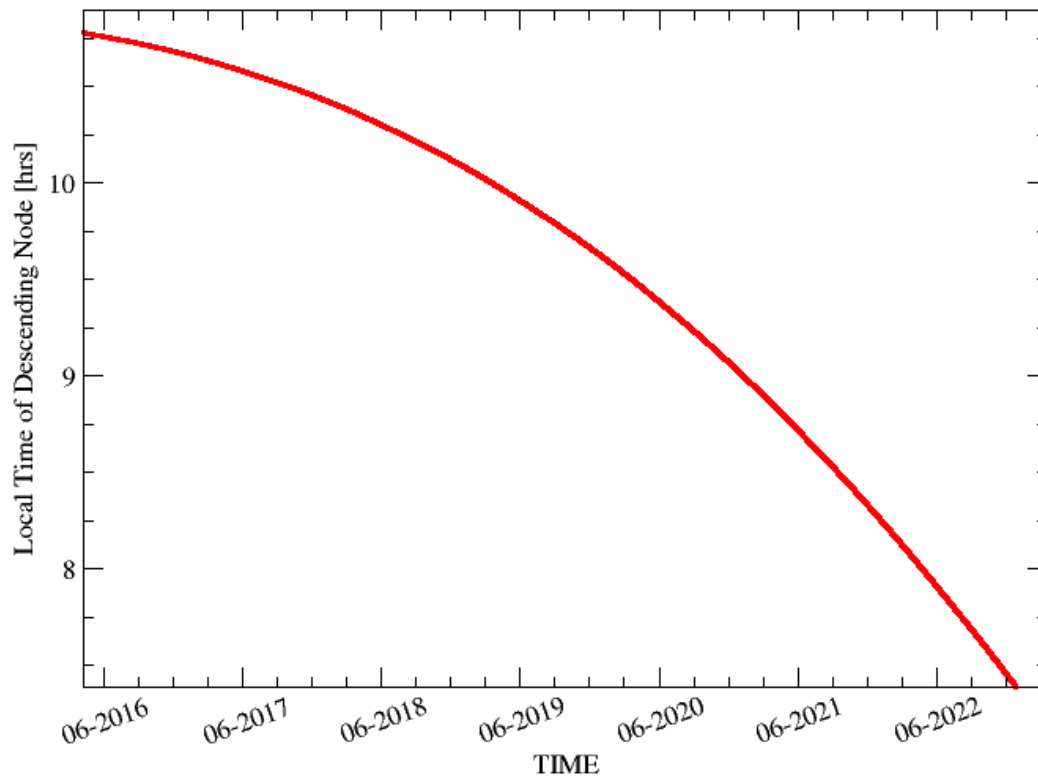


27 – 28 October 2020  
Teleconference

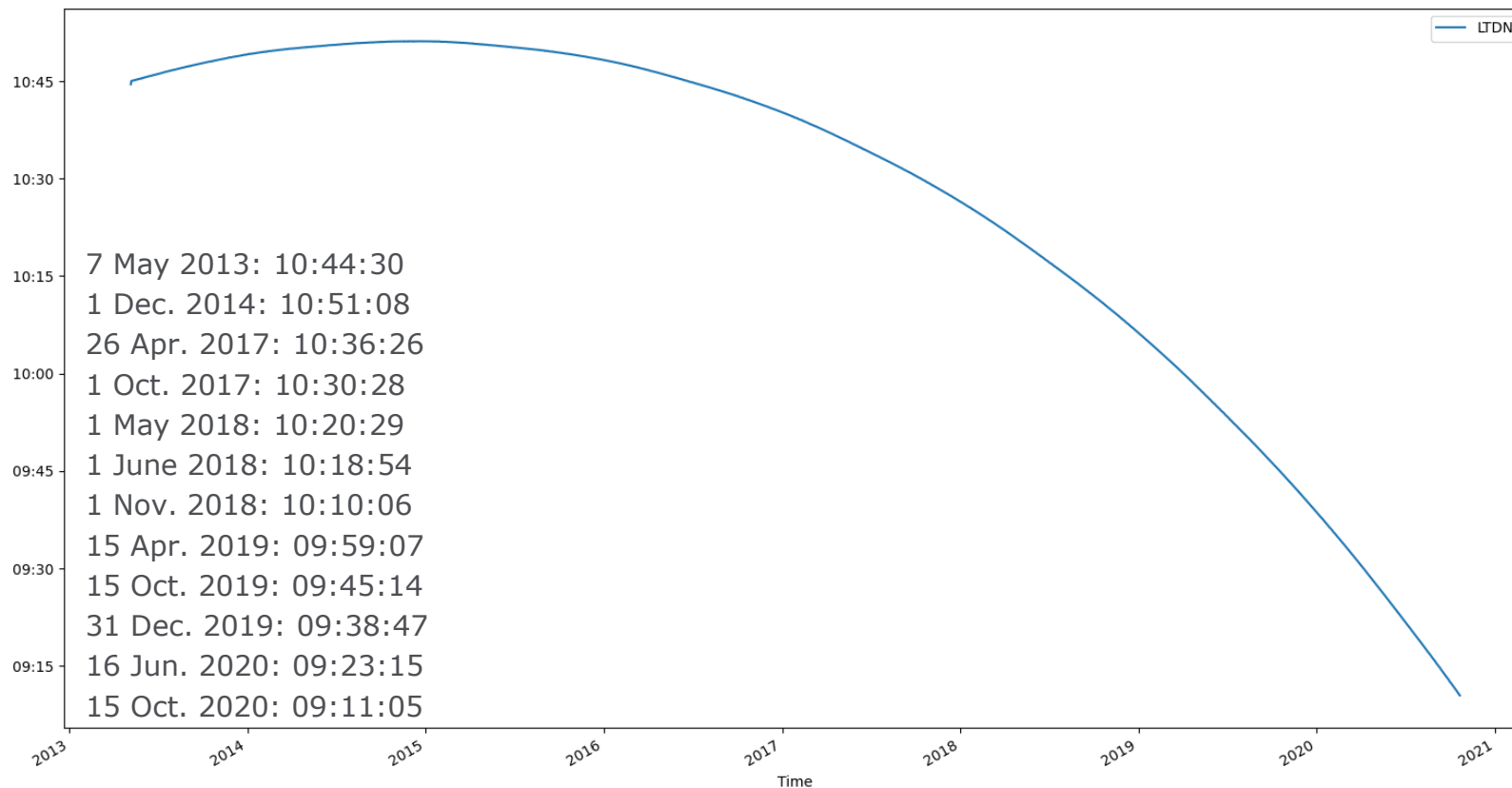


# Orbit Status





# Orbit Status – Measured LTDN



# Platform Status

Since QWG#11: 25/26 June 2020



# Platform Key Parameters



Satellite System mode : Nominal Observation with automatic transition to Calibration mode.

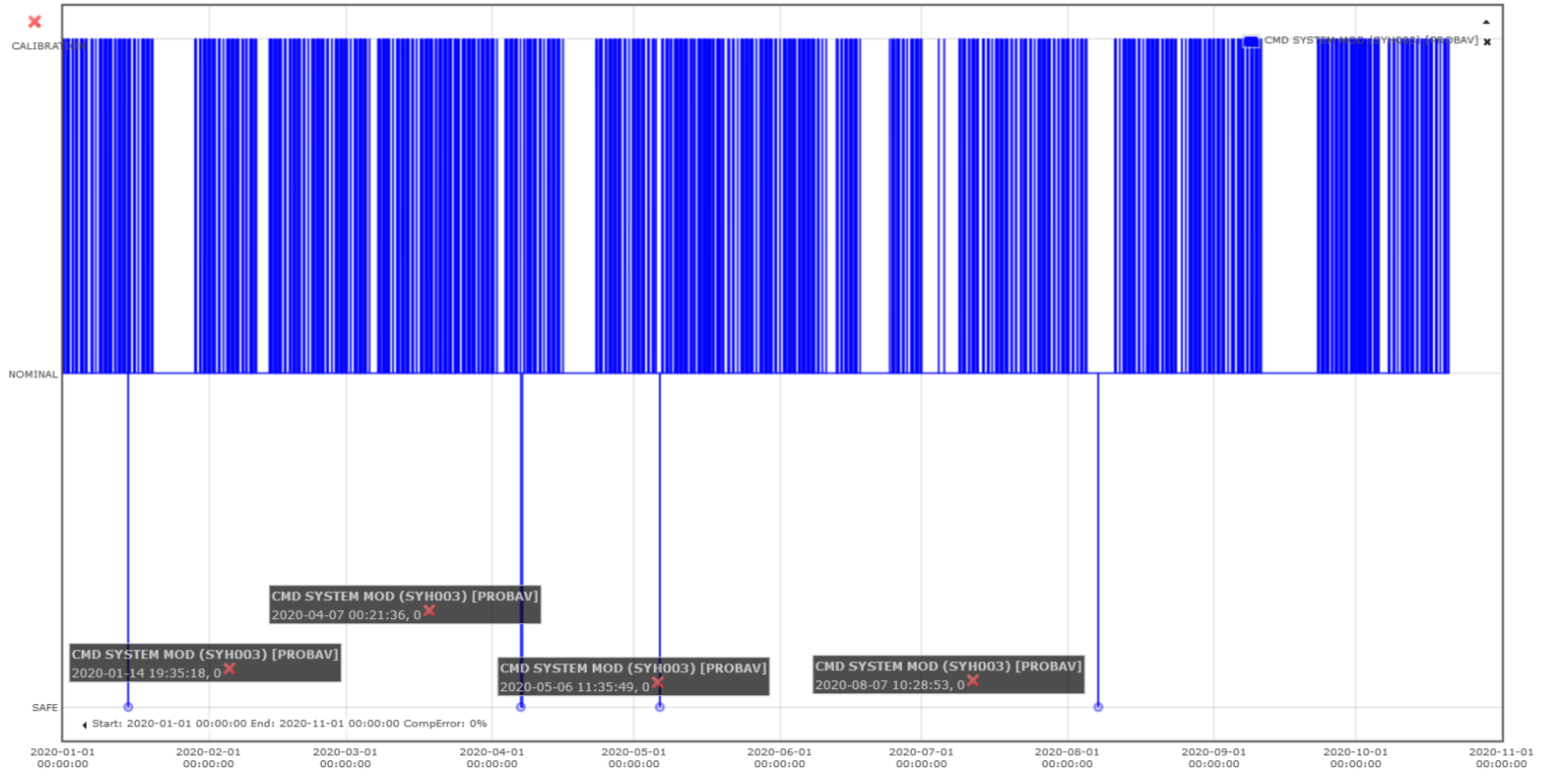
AOCS mode: Geodetic with all the units available. Primary lane selected with the use of associated units (AOCS IF 1, GPS 1, MM 1, XTX 3) and of the wheels 1, 3 and 4. Sun bathing mode enabled (with GPS ON).

During this period the system was very stable:

- Monthly platform availability between 98.1% and 99.9% over the last 3 months based on QS reporting.
- Pointing performances well within requirements.
- Power budget largely positive and stable.
- Thermal subsystem stable.
- No on-board failure, both primary and redundant chains available.



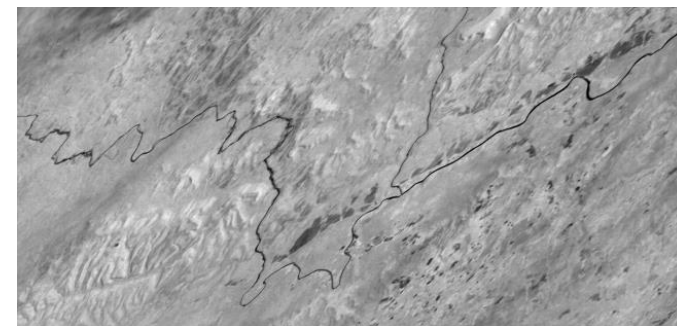
# Platform Key Parameters: System Mode



# Platform Key Activities

## Transition to Proba-V Experimental Phase

- Start on 01/07/2020
- New LSM uploaded on 30/06/2020
- Corrected LSM uploaded on 13/07/2020 (removal of poles)
- Until the launch of PV-CC (planned for August 2021) focus on Europe and Africa data acquisitions with emphasis on 100m data and cal/val activities sensing of the moon, super-resolution experiments.
- 3 X-band contacts per day
  - 11 new occurrences of the event 260 between Thu. 09/07 and Mon. 13/07, indicating that data from the MMM have been erased before being transmitted.
  - Adaptation of the X-band pass selection strategy & LSM.
- First Super-Resolution experiment performed on 22/10 over AMAZONIA.
- First Moon-Imaging campaign from 23/10 to 03/11.
  - Modification of the MCT required by QS to automate the calculation of moon calibrations above 30deg after the full moon.





# Close Approach Notifications

(ESA Space Debris Office)



- None



# Status AOCS: Pointing Performance



	Imaging APE at 95% confidence [arcsec]	3-axis APE at 95% confidence [arcsec]
Q1 2020	27.2	31.5
Q2 2020	22.2	27.7
Q3 2020	23.0	30.5

- Imaging APE: Only imaging periods considered.
- 3-axis APE: Includes imaging and momentum offload periods but not large-angle-rotations related to sun-bathing.

→ **The AOCS pointing performance is far better than the requirements (360 arcsec).**



# Status AOCS: Units

Unit	Status	Remark
Star Tracker	nominal	Nominal head temp.: <math><0^{\circ}\text{C}</math> <ul style="list-style-type: none"><li>• Maximum: <math>-2.76^{\circ}\text{C}</math> &amp; <math>-3.48^{\circ}\text{C}</math></li><li>• Average: <math>-8.65^{\circ}\text{C}</math> &amp; <math>-14.44^{\circ}\text{C}</math></li></ul>
GPS receiver	nominal	99.9% fix availability in Q3 2020 (ADS-B known interference on the GPS)
Magnetometer	nominal	
Reaction Wheels	nominal	No wear detected so far
Magneto-torquers	nominal	
AOCS IF	nominal	

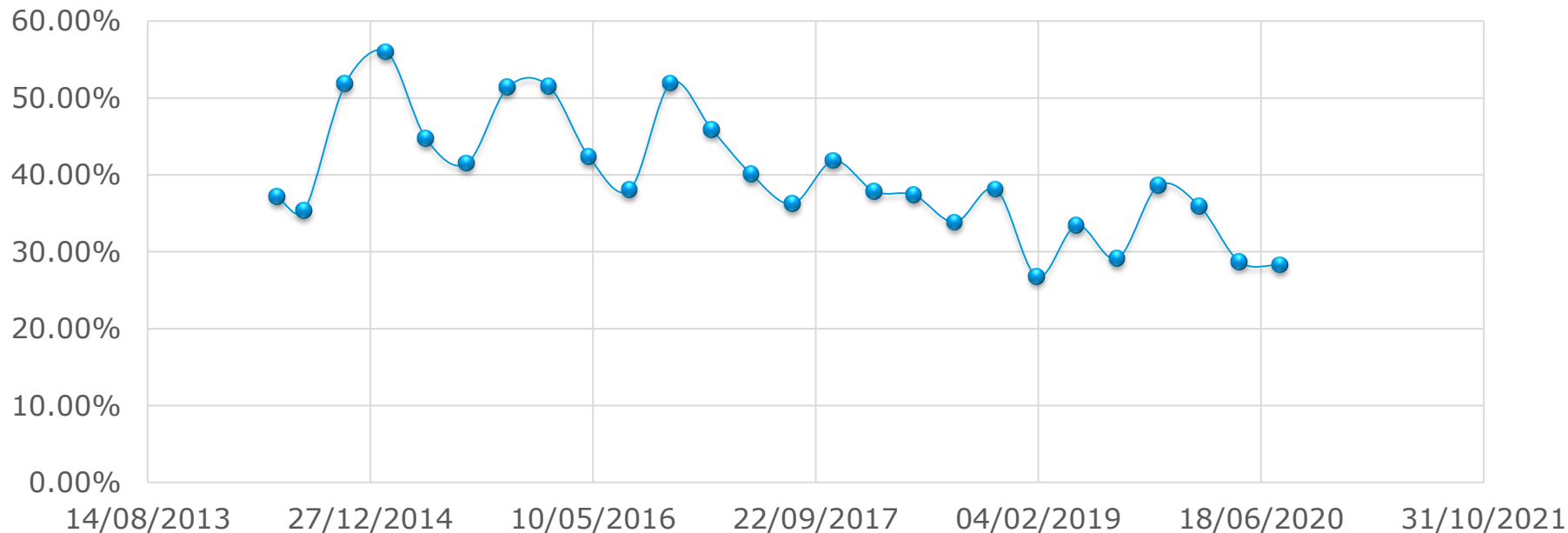
→ AOCS overall status: all is nominal and performances met by far

## Power summary (Q3 2020):

- Mode: nominal mode
- Bus average consumption: 69.23W
- S/A average generation: 88.76W
- Energy budget margin: 19.54W (28.28%)
- Minimum battery voltage (max = 29.2V): 27.93V

→ **Power budget largely positive**

## Power Margin



# Status Power Units



Unit	In-orbit Status	Remark
Battery	nominal	Battery voltage nominal. Temperature nominal. <ul style="list-style-type: none"><li>• Average 16.58°C</li><li>• Minimum 13.20°C</li><li>• When &gt;6°C no heater required</li></ul>
Solar Arrays	nominal	No degradation of the solar cells can be observed.
Power Conditioning (ADPMS)	nominal	Power conditioning (efficiencies) as expected

**All units within power budget**

**The power situation is very stable, showing no apparent degradation of the solar arrays, battery, nor power distribution system**



Unit	In-orbit Status	Remark
ADPMS	nominal	<p>Single MPM SDRAM EDAC errors (trap 0x11) automatically corrected since launch:</p> <ul style="list-style-type: none"> <li>• Primary lane: 68</li> <li>• Secondary lane: 9</li> </ul> <p>Full flash dump monthly execution for bit-by-bit comparison purpose.</p>
Mass Memory	nominal with work-around	<ul style="list-style-type: none"> <li>• Latch-up behaviour detected in orbit.</li> <li>• On-board S/W work around in place.</li> <li>• Sectors 5, 1351 &amp; 3302 (primary) show an increased amount of bitflips.</li> <li>• 64 bad blocks replaced by the MMM FPGA on the primary lane.</li> <li>• 4 bad blocks on the redundant ADPMS lane.</li> <li>• Function fully autonomous within the MMM.</li> </ul>

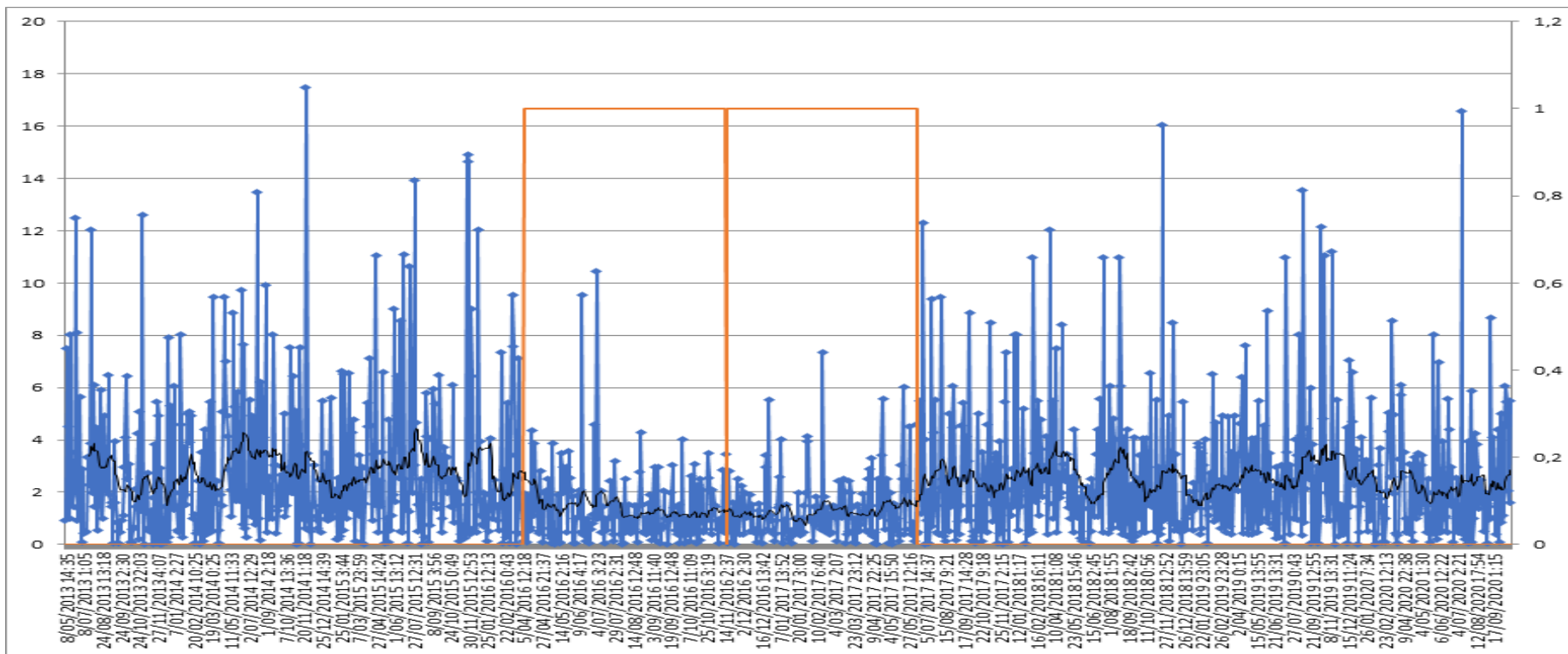
## Mass memory anomaly statistics

- Location: Generally SAA
- Occurrences on average once per
  - 48:41 hours for 06/2020 for lane 1
  - Average over entire mission 54:58h
- Potential data gap: 3 minutes per occurrence (when over land)





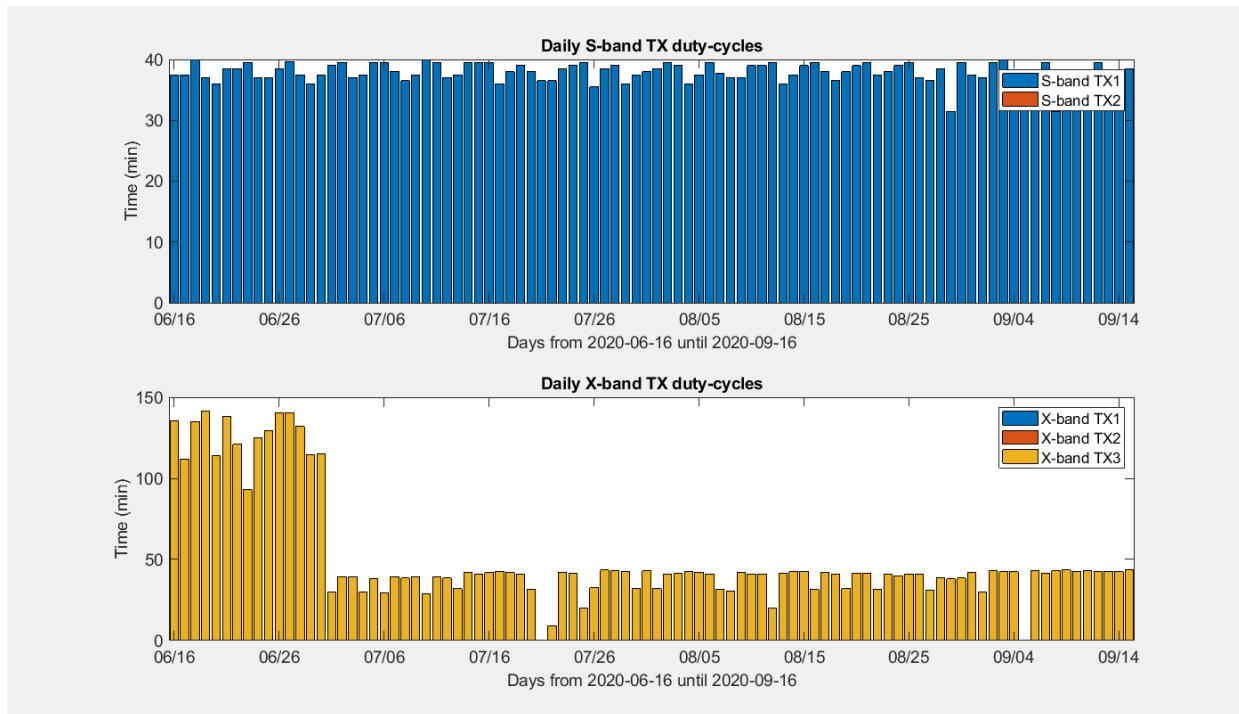
# Data Handling: Mass Memory Anomaly



MMM SRAM latchup event interval + moving average over last 20 occurrences [days]. The red line shows the ADPMS lane (0 is primary, 1 is redundant)

# RF S- and X-band Duty Cycle

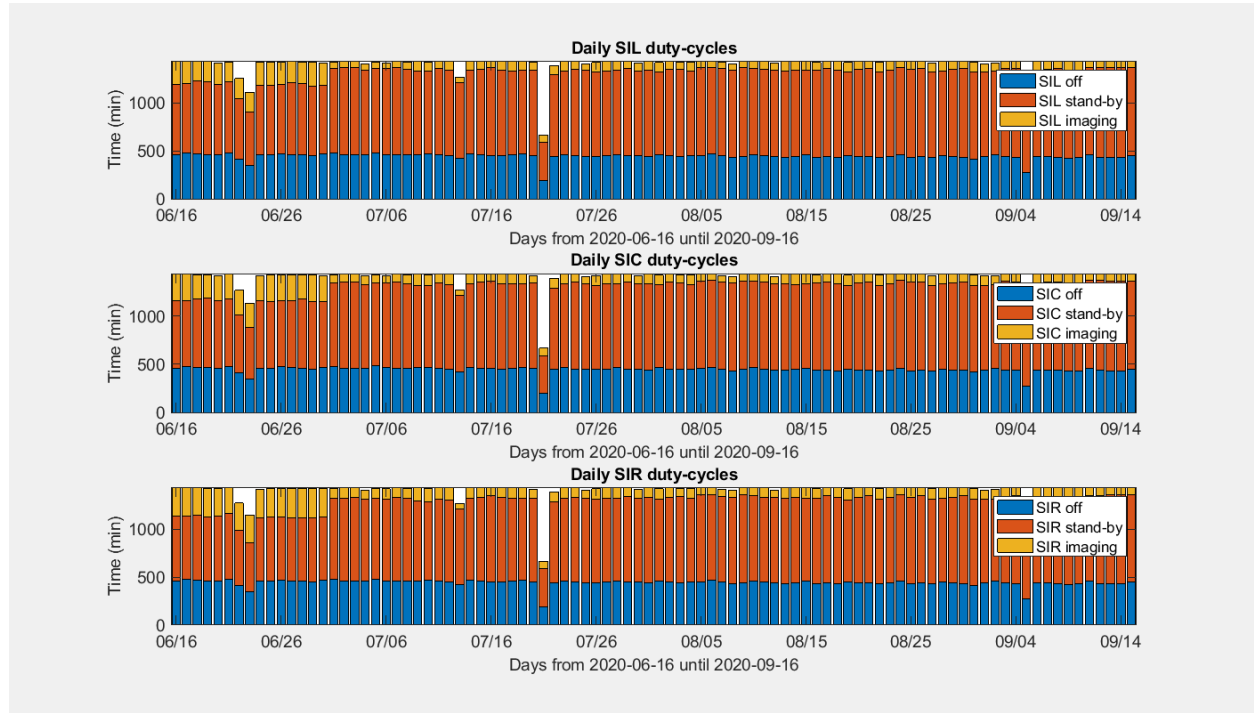
At the request of Project, since March 15 2017, only the experimental GaN X-band transmitter is used for the X-band passes.



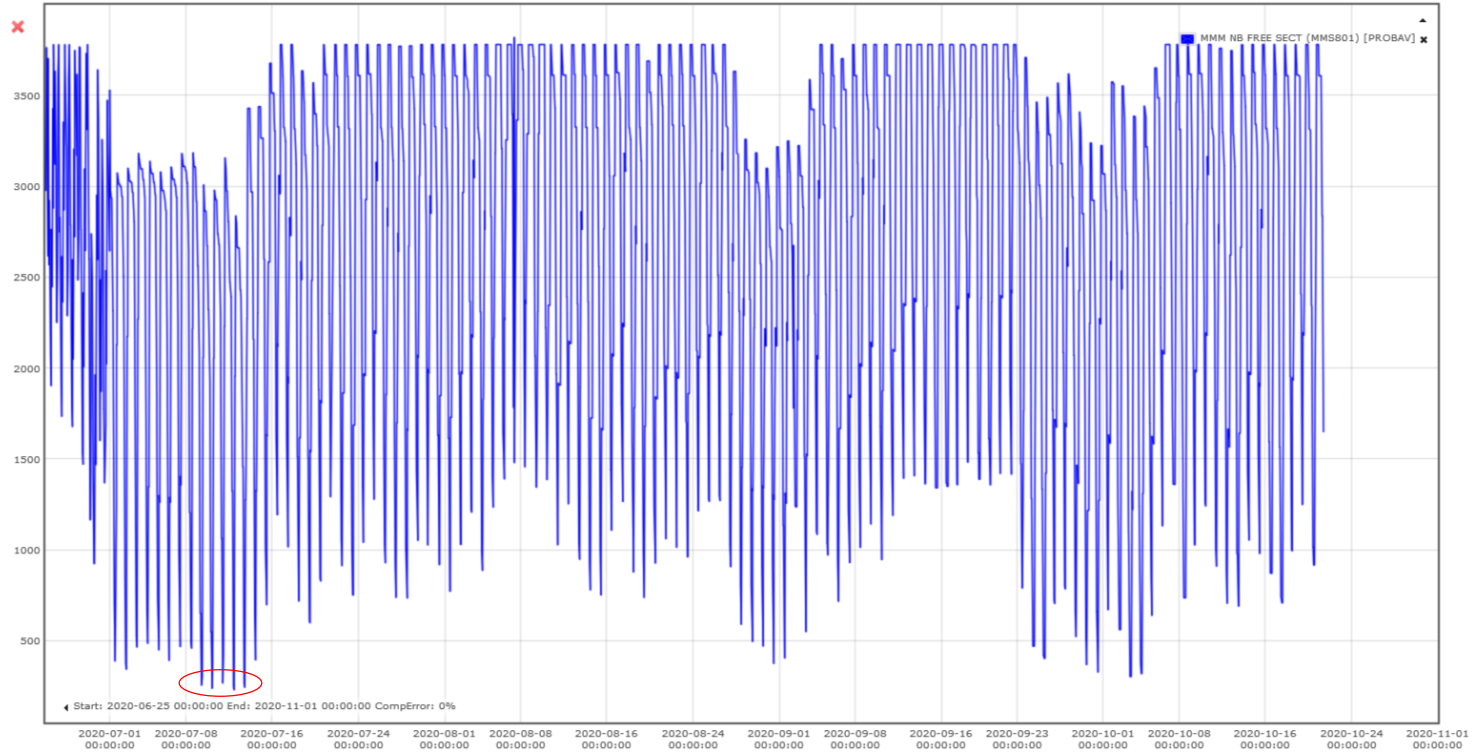
# Instrument Status

# Instrument Status

- Fully functional
- All calibration requests were executed correctly.



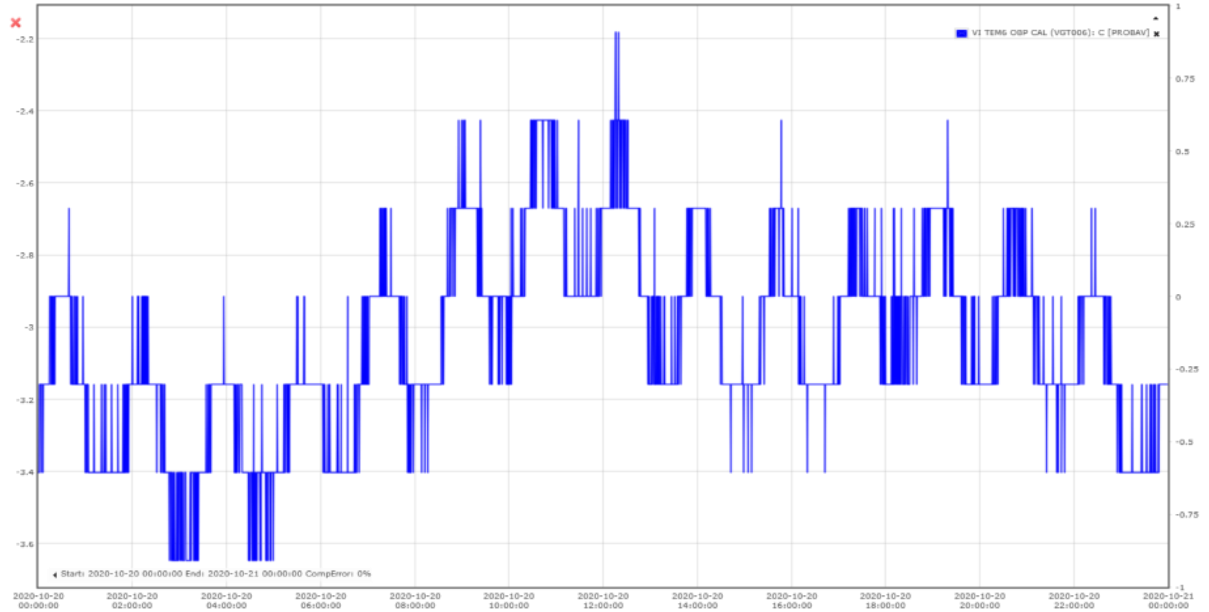
# MMM usage MMM NB FREE SECT (always > 237, no overwriting)



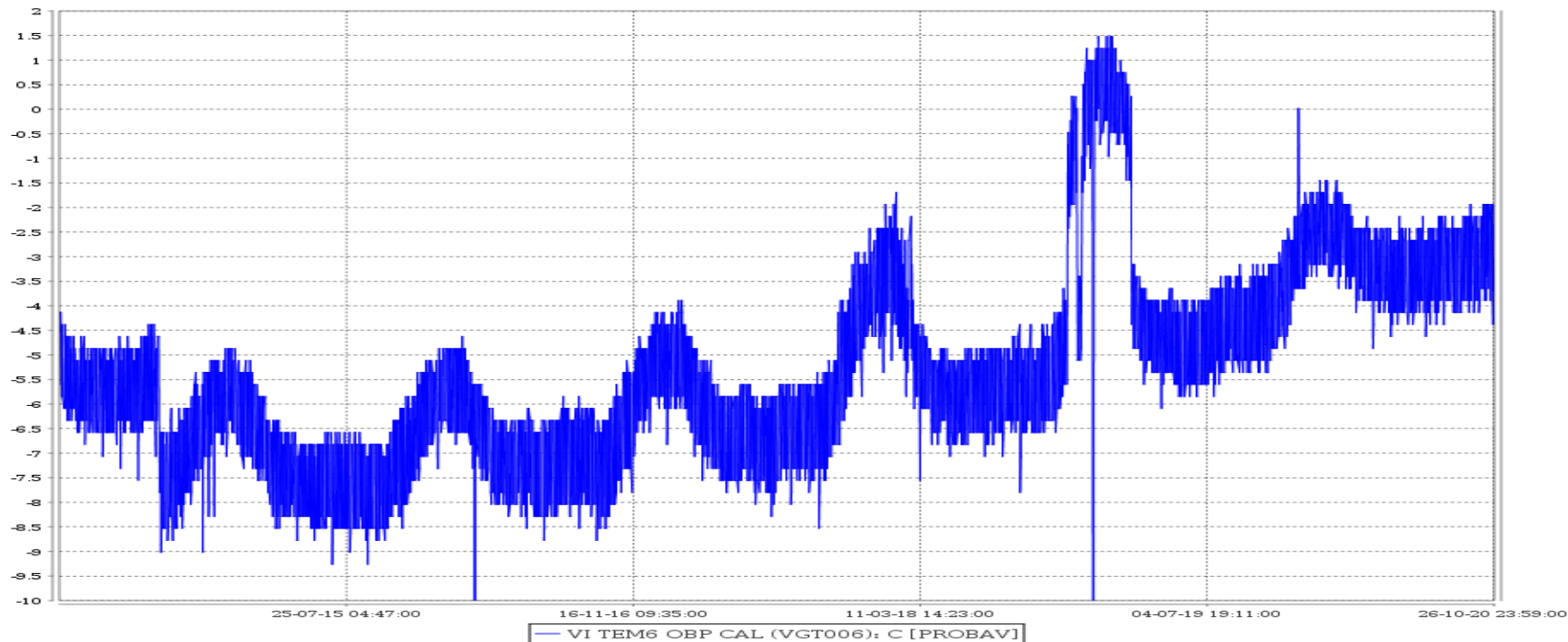
## Optical bench thermal variation

- ~ 1°C variation per orbit
- ~ 1.5°C variation per day
- **Confirming excellent thermal performances of radiator and bench**

Optical bench thermal variation 20 October 2020



## Optical bench thermal variation since beginning of exploitation phase



# S/C Anomalies



## Overview:

- 7 anomaly reports with status not closed (6 open, 1 pending)
- 0 new anomaly reports
- Proposed to call for an ARB (Project, QS, Redu, ESRIN) to progress on the analyses required for the open ARs.

## New Anomalies:

- None.



## Decompression errors

- The number of decompression errors is currently low.
- VITO has put in place a better classification of errors that now contains a split between the impact of geometric and decompression errors on the daily products. The missing % of pixels contains the other categories.
- The page <https://www.vito-eodata.be/missingpixels/> is not yet updated to take into account the experimental phase with reduced LSM; therefore, the reported numbers are too high (~65%).

# S/C Anomalies: SAT\_AR23/20181224



Title: Event 315 MMM\_DUMP\_WITHOUT\_TRANSMITTER repeated every minute.

Status: Open, corrected OBSW to be delivered.

When we confirm that the GPS patch of PROBA-2 applied on 27/03/2019 and related to PROBA2\_SAT\_AR43\_20181207 GPS time jump leading to AOCS no control and safe mode can also be applied for PROBA-V, Spacebel can then generate a PROBA-V software with the correction of the MMM full (PV\_AR23) and the GPS (P2\_AR43) patches.



# S/C Anomalies: SAT\_AR24/20190628



Title: Event 316 triggered every minute after S/C autonomous reconfiguration

Status: Open

- On 28/06/2019 after an autonomous S/C reconfiguration which occurred at 10:57:05z, the Event 316 (EVT\_MMM\_STATUS\_ERROR with parameters: Flash bad block table reconstruction error) was triggered every minute.
- This error is raised when there is a jump in the bad block replacement.
- On 17/09/2019 a small patch was uploaded to mask this bit of the MMM error register and made permanent via the StartUp TC 108 on 23/09/2019.

QS is analysing how to correct this “jump” easily to avoid the error and make the “jumped” spare blocks available again. This problem report is thus raised accordingly for recording and follow-on.



# S/C Anomalies: SAT\_AR25/20200329



Title: Wrong GPS data leading to automatic selection of TLEs

Status: Open

- On 2020-03-29 from 01:36:26z onwards on-board orbit propagator by TLE.
  - At 03:11:28z return to use of GPS data due to autonomous on-board reconfiguration.
  - DLR suspects a radiation-induced memory corruption in the “sprintf” routine.
- Ask QS to analyse a possible work-around for the encountered problem.



# S/C Anomalies: SAT\_AR26/20200407



Title: Event 254 and SAFE mode caused by orbital filter fdi flag

Status: Open

- On 2020-04-07 from 00:11:34z onwards many ephemerides parameters computed by the on-board software showed abnormal values and were followed by EKF orbital filter FDI errors.
  - At 00:21:19z the event 254 EVT\_AOCS\_NO\_CONTROL triggered Bdot mode.
  - At 08:54:19z return to nominal observation mode by ground TC.
- Further analysis by Industry is required to understand the cause of the observed on-board Orbital Filter behaviour.

# S/C Anomalies: SAT\_AR27/20200505



Title: GPS corrupted data leading to GPS restart forced by cold reboot (Almanac corruption)

Status: Open

- On 2020-05-05 at 16:49z the GPS started to deliver corrupted data while the GPS NAVIGATION STATUS remained equal to 2 (3D fix).
- From 16:54z onwards the TLE were selected by the ACNS.
- During morning passes of 2020-05-06, activation of the GPS units 1 and 2 in "assisted boot" mode (default) and a complete satellite reconfiguration w/o success.
- At 11:38z restart of GPS unit 1 in "cold boot" mode (no almanac assistance).
- At 11:47z the GPS starts to deliver good data.
- Problem could not be reproduced by DLR.
- Redu proposed to implement a ground-based procedure to verify the correctness of the almanac.

This is the first occurrence of this type of problem and the period with the selection of the TLE due to invalid GPS data had an impact on the Vegetation data products.

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# Ground Segment Status





# Ground Segment & Operations Status



- Overall status: Nominal
  - Covid-19: Minimum presence of PROBA operations personnel on site to perform the operations activities that are not designed for remote operations.
- The satellite and ground segment operations, including its Vegetation Instrument acquisition and calibration requests, are running nominally.
- The Mission Operations Centre is fully operational. ESA/Redu centre supports all planned passes (3 S-band passes per day).
- The data downlink is shared between the SSC stations located in Kiruna, Alaska and Inuvik; due to Redu's downlink strategy Kiruna is the most used station.



# X-band Status



	Total	Successful	Failed	Signal Degradation / Data Delay	Cancelled
June	293	285	1	7	0
July	93	92	0	1	0
August	93	93	0	0	0
September	91	89	0	2	0



# Ground Segment Anomalies



2 new REDU GS AR were opened; all without impact on operations.

- 01/07/2020 GS AR1001: PROBA COMMON\_GS\_QUICKLOOK 1 PC\_FAN\_NOISE. Closed.
- 20/10/2020 GS AR1018: PROBA COMMON\_GS\_GSMS\_Critical GSMS RAID-1 status. Closed.

(Managed via Redu Anomaly/Ticketing system (TANOR) and reported in the Weekly Reports)



Thank you!

