

Proba-V QWG#11 Flight & GS status



24 – 25 June 2020
Teleconference



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Orbit Status

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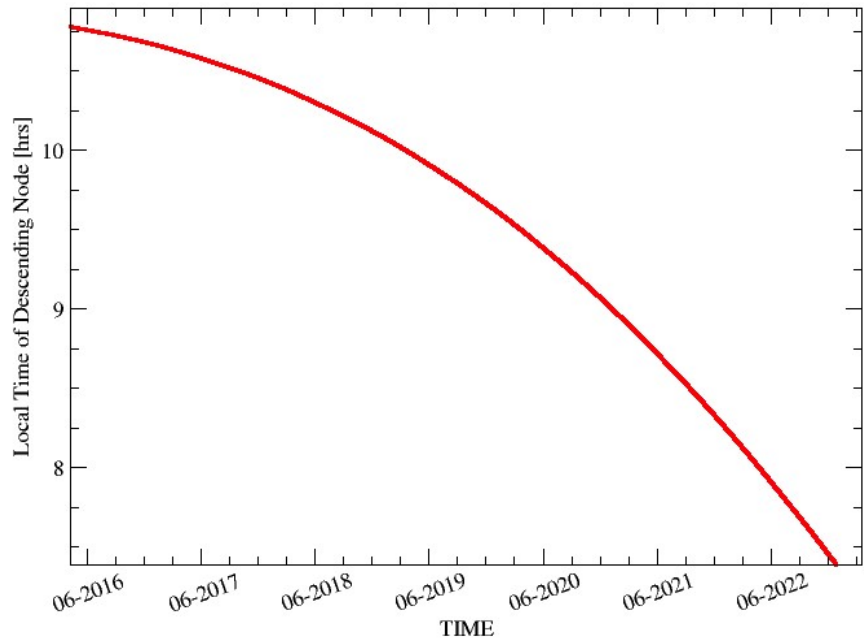


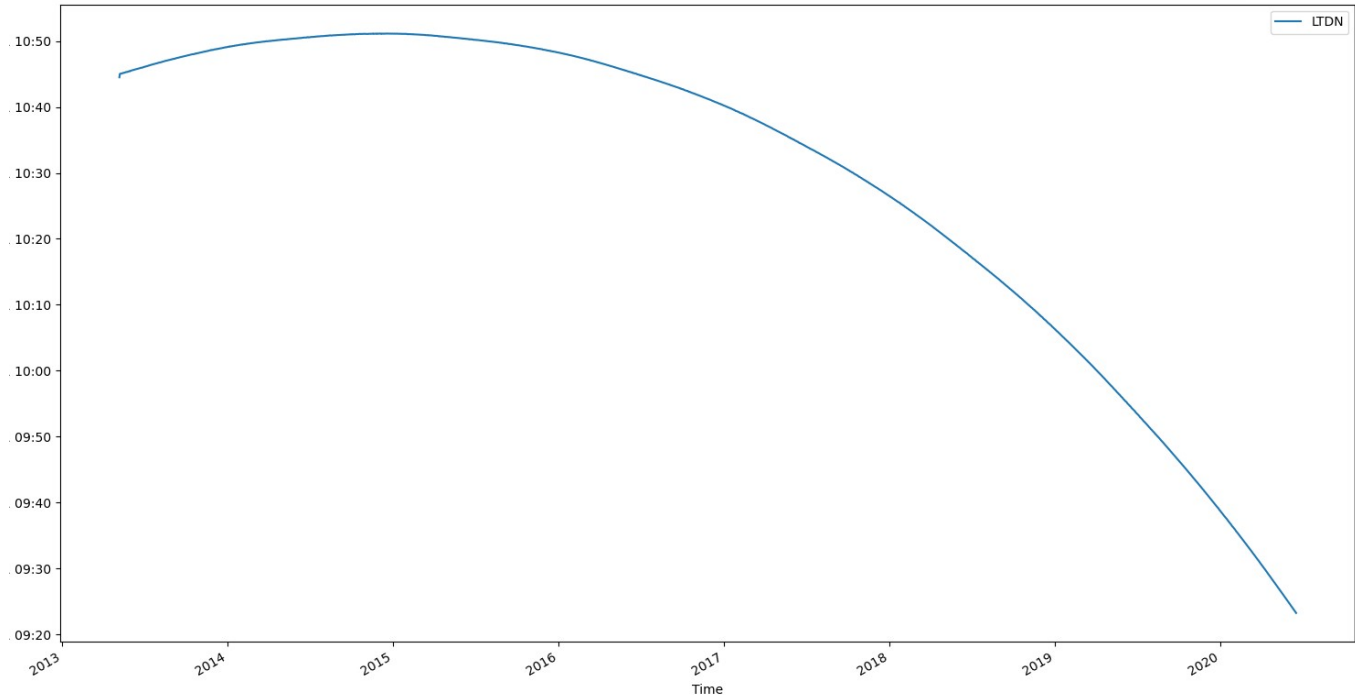
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Orbit Status

Proba-V - Predicted Evolution of LTDN

LTDN evolution:
7 May 2013: 10:44:30
1 Dec. 2014: 10:51:08
26 Apr. 2017: 10:36:26
1 Oct 2017: 10:30:28
1 May 2018: 10:20:29
1 June 2018: 10:18:54
1 Nov. 2018: 10:10:06
15 Apr. 2019: 09:59:07
15 Oct. 2019: 09:45:14
31 Dec 2019: 09:38:47
16 Jun 2020: 09:23:15





Platform Status

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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).

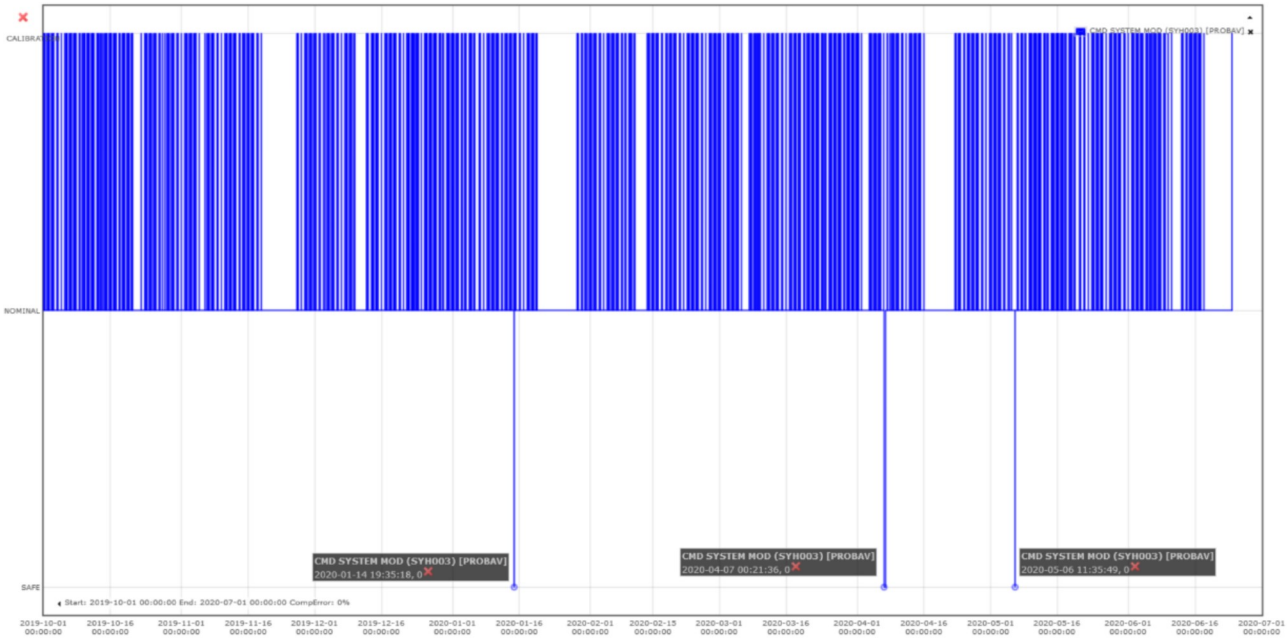
During this period the system was very stable:

- Monthly platform availability between 99.1% and 99.9% for the last 9 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.
- On 2020-03-29 from 01:03:26z to 03:11:28z: Wrong GPS data leads to TLE selection by ACNS with possible impact on the mission.
- On 2020-04-07 from 00:21:36z to 08:53:59z: Orbital filter FDI error leads to Safe Mode with impact on the mission.
- From 2020-05-05 at 16:49:21z to 2020-05-06 at 11:47:35z: Corrupted GPS almanac leads to TLE selection by ACNS with impact on the mission.

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Geometric Error Investigation

- 08/11/2019: VITO reports an increased amount of geometric errors which impact the user products.
- Extensive analysis leads to updates of Star Tracker S/W on 14/01/2020 and 03/03/2020.
 - Fast BBO centroiding (reduces CPU usage when BBOs are present)
 - Image clipping (reduces CPU usage when stray light is present)
 - Edge stars suppression (improves accuracy)
- In March 2020 VITO reported that the “actual reported missing percentage of pixels was estimated too high and a refactoring of this algorithm and scripting was done to reflect values that are closer to reality. <http://www.vito-eodata.be/missingpixels/> contains now a split between the impact of geometric and decompression errors on the daily products. The missing % of pixels contains the other categories.”
- Monthly dumps of Star Tracker images are now performed to continuously monitor performance and hot spot annealing.

Preparation of Proba-V Experimental Phase

- Start on 01/07/2020
- 3 X-band contacts per day
- New LSM to be provided by VITO
- Until the launch of PV-CC (planned for April 2021) focus on Europe and Africa data acquisitions with emphasis on 100m data and cal/val activities sensing of the moon, yaw manoeuvres.

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- On Thu. 02/01/2020 at 12:18:19z, close approach with "SCC #29531" (CRRES DEB Canister) with overall miss distance of 63m.

	Imaging APE at 95% confidence [arcsec]	3-axis APE at 95% confidence [arcsec]
Q4 2019	30.1	34.9
Q1 2020	27.2	31.5
Q2 2020	22.2	27.7

- 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).

Unit	Status	Remark
Star Tracker	nominal	Nominal head temp.: <0°C For previous 9 months <ul style="list-style-type: none">• Maximum: -2.76°C & -3.48°C• Average: -7.71°C & -13.15°C
GPS receiver	nominal	99.4% fix availability in Q2 2020 (ADS-B known interference on the GPS)
Magnetometer	nominal	
Reaction Wheels	nominal	No wear detected so far
Magneto-torquers	nominal	
AOCS IF	nominal	

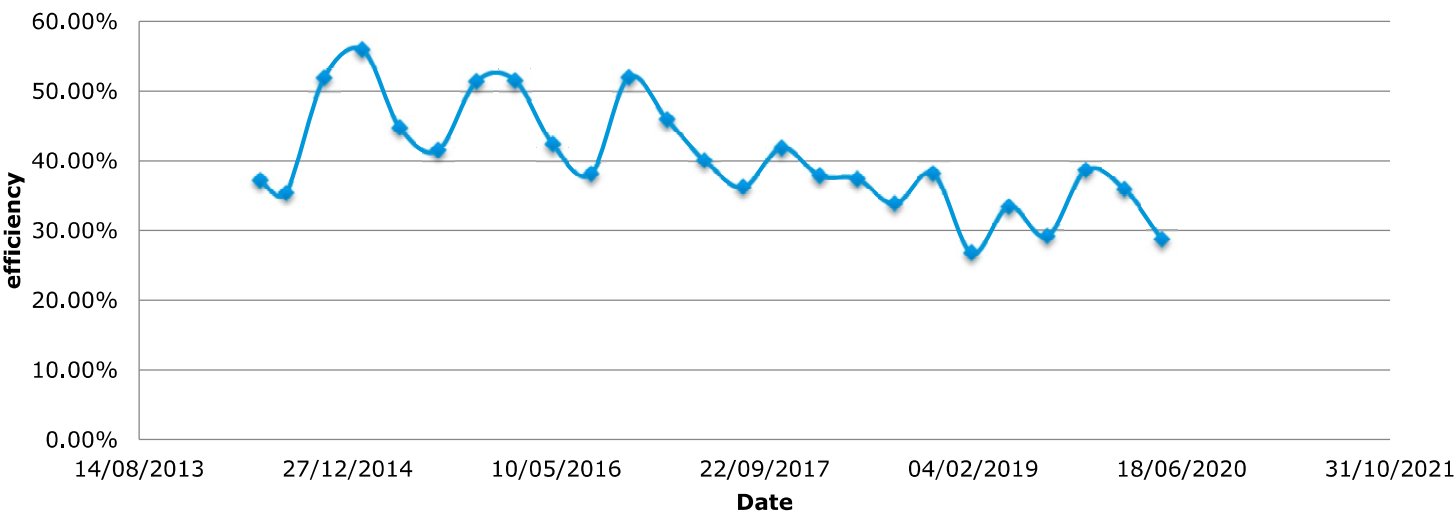
→ AOCS overall status: all is nominal and performances met by far

Power summary (Q2 2020):

- Mode: nominal mode
- Bus average consumption: 70.19W
- S/A average generation: 97.88W
- Energy budget margin: 25.85W (35.95%)
- Minimum battery voltage (max = 29.2V): 27.86V

→ **Power budget largely positive**

power margin



Unit	In-orbit Status	Remark
Battery	nominal	Battery voltage nominal. Temperature nominal. <ul style="list-style-type: none">• For 10/2019 to 06/2020: average 17.68°C, min 13.20°C• When >6°C no heater required
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	Single MPM SDRAM EDAC errors (trap 0x11) automatically corrected since launch : <ul style="list-style-type: none">Primary lane: 65Secondary lane: 9 Full flash dump monthly execution for bit-by-bit comparison purpose.
Mass Memory	nominal with work-around	<ul style="list-style-type: none">Latch-up behaviour detected in orbit.On-board S/W work around in place.Sector 1351 (primary) shows an increased amount of bitflips.57 bad blocks replaced by the MMM FPGA on the primary lane.4 bad blocks on the redundant ADPMS lane.Function fully autonomous within the MMM.

Mass memory anomaly statistics

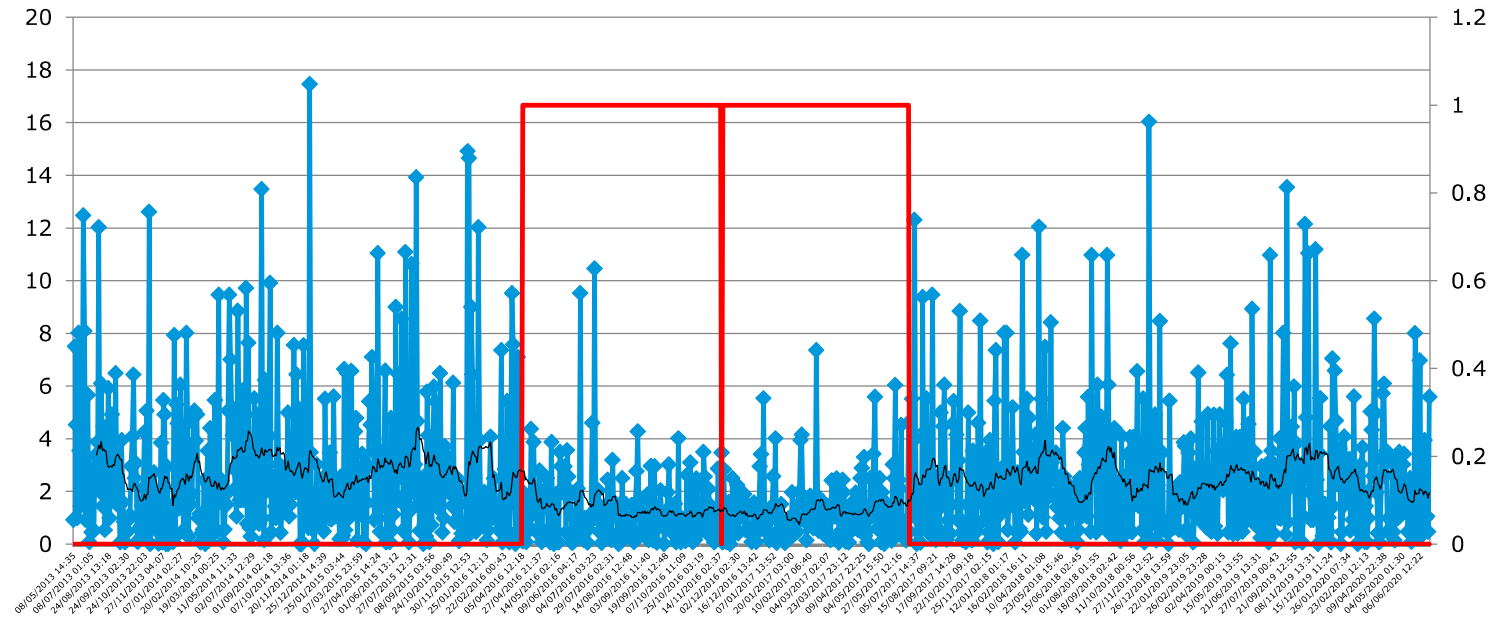
- Location: Generally SAA
- Occurrences on average once per
 - 48:41 hours for 06/2020 for lane 1
 - Average over entire mission 54:58h
- Potential data gap: 3 minutes per occurrence (when over land)



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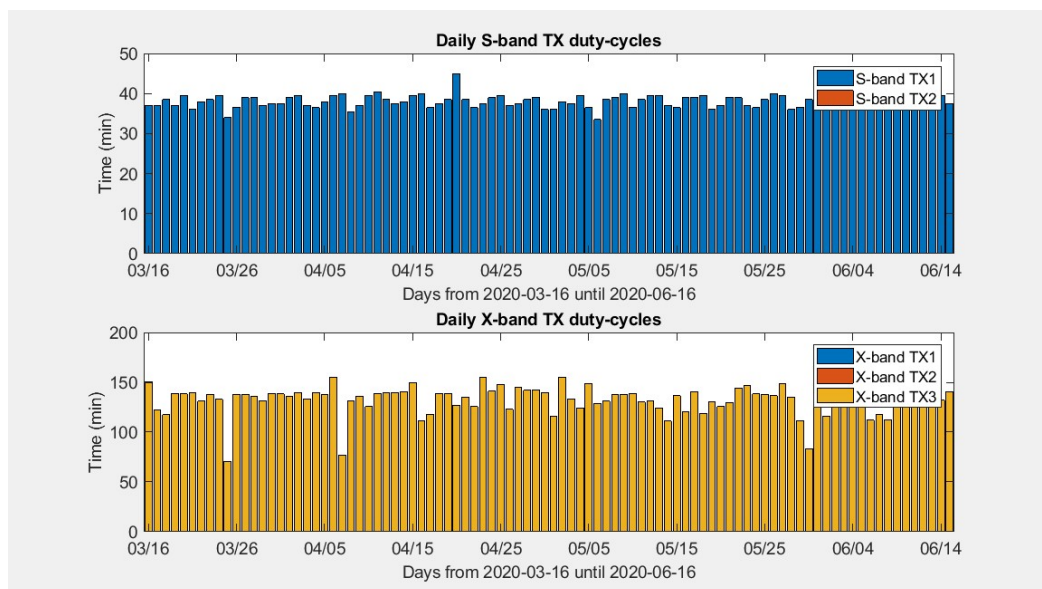


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MMM SRAM latchup event interval + moving average over last 20 occurrences [days]. The red line shows the ADPMS lane (0 is primary, 1 is redundant)

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



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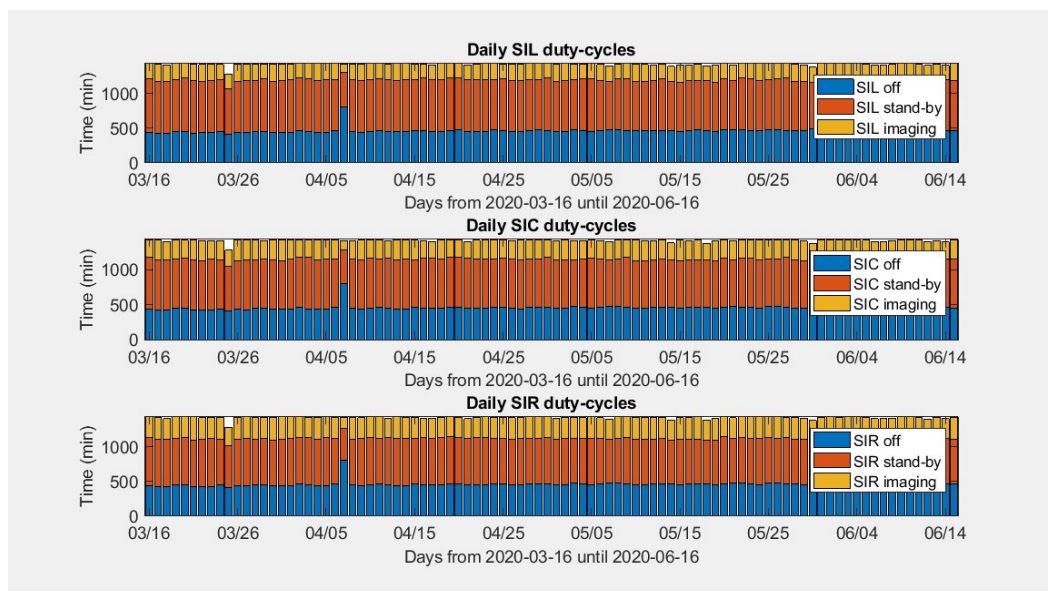
Instrument Status

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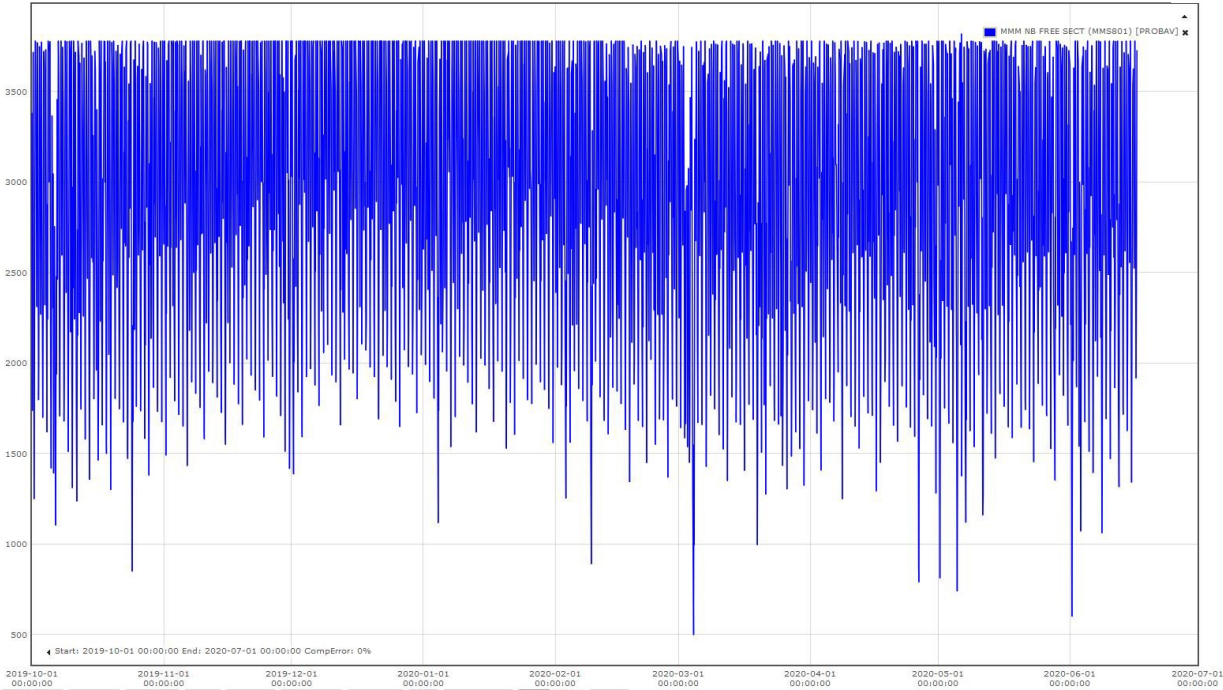
- Fully functional
- All calibration requests were executed correctly.



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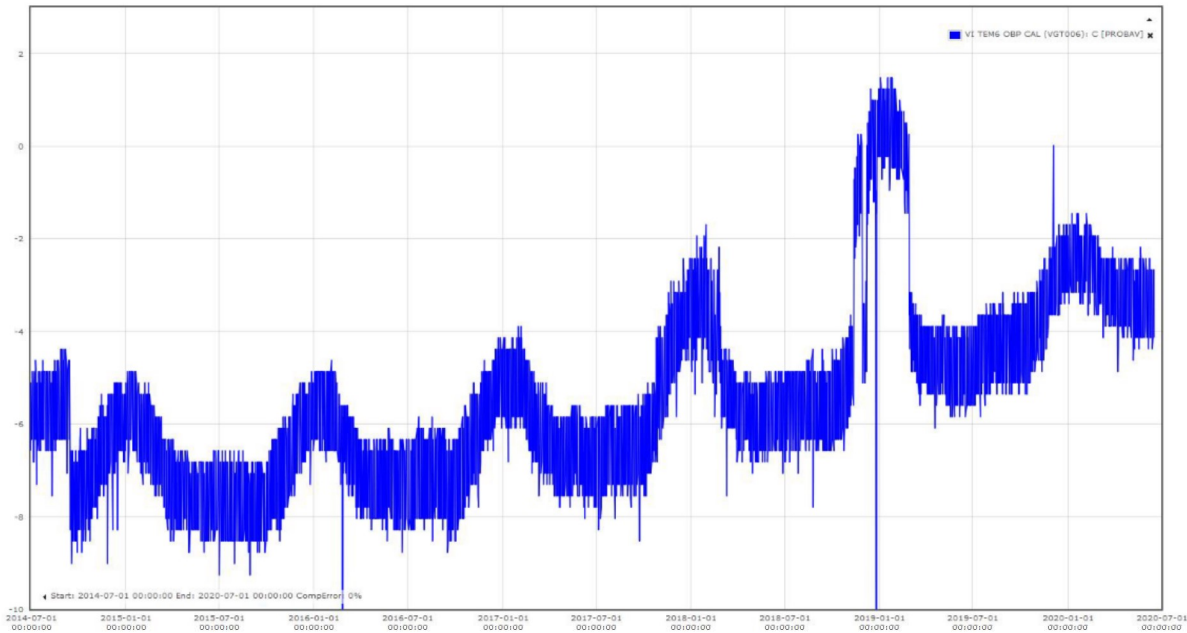
Optical bench thermal variation

~ 1°C variation per orbit

~ 1.5°C variation per day

→ **Confirming excellent thermal performances of radiator and bench**

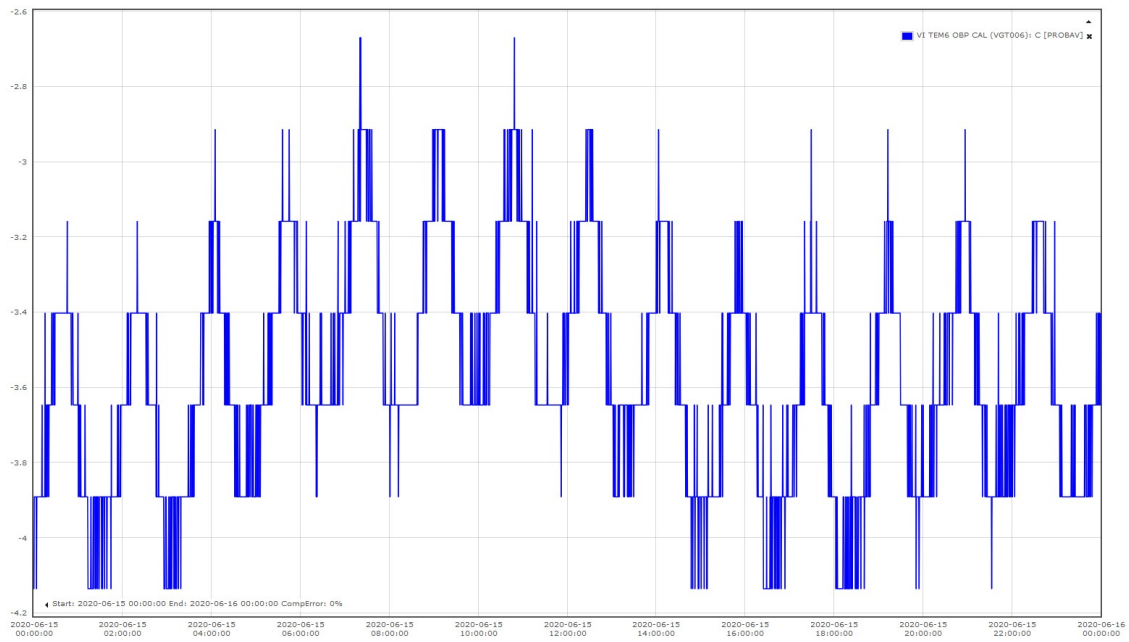
Optical bench thermal variation since beginning of exploitation phase



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Optical bench thermal variation 16 June 2020



S/C Anomalies

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Overview:

- 7 anomaly reports with status not closed (6 open, 1 pending)
- 3 new anomaly reports
- 1 new occurrence of SAT_AR_10 (see below) recorded in this reporting period

New Anomalies:

- SAT_AR27/20200505: GPS corrupted data leading to GPS restart forced by cold reboot (Almanac corruption). Open
- SAT_AR26/20200407: Event 254 and SAFE mode caused by orbital filter FDI flag. Open
- SAT_AR25/20200329: Wrong GPS data leading to automatic selection of TLEs. Open
- SAT_AR10_12/20200613: Wheel TC verification error. Kept pending for further recording.

Decompression errors

- The number of decompression errors is currently low.
- VITO to put in place a better classification of decompression errors in order to exclude, e.g., errors related to bad RF signal causing TM frame/packet drops (?).
- 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.

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 and the GPS patch.

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.

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.

Further analysis by Industry is required to understand the observed GPS behaviour.

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.

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.

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

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- Overall status: Nominal
- 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 with 10 X-band passes per day; from 01/07/2020 onwards only 3 X-band passes per day.
 - The selection of the best passes needs **to be discussed** in order to ensure a complete dump of the MMM.
 - Proposed passes: 2 passes after the Redu morning passes and 1 before the Redu evening pass.

	Total	Successful	Failed	Degraded Signal / data delay	Cancelled
October	310	306	1	3	0
November	300	298	0	2	0
December	310	304	4	6	0
January	310	305	0	6	0
February	289	285	2	2	0
March	309	300	2	7	0
April	300	285	1	14	0
May	311	304	1	6	0

- Acquisition performance is very stable with only very few frame gaps.
- 11 failed:
 - 2 equipment & 2 data files extraction/transfer problems & 2 bad tracking prediction in Inuvik,
 - 1 antenna & 1 data files transfer problems in Kiruna,
 - 1 equipment & 2 data files transfer problems in Kiruna problem in Alaska.
- The passes classified as degraded due to
 - signal degradation (signal drop during the pass above 5 deg., RF I/F, wind)
 - data file transfer delay.

7 new REDU GS AR were opened; none blocking.

- 29/05/2020 GS AR0980: BBE UNIT10_IMBU_config_failed_by_telnet. Open (To be closed)
- 27/05/2020 GS AR0979: EMCS2_RAID Disk Alarm. Closed
- 19/05/2020 GS AR0977: GSC PC RED3_POWER_SUPPLY_FAN. Closed
- 08/03/2020 GS AR0967: BBE UNIT12_TMA_Data_Link_Error. Closed
 - Backup equipment failed configuration for pass 31450. No impact on the mission.
- 21/02/2020 GS AR0966: RED-4 FEED_Water in feed. Closed
 - This is the 3rd occurrence of the problem: AR0669, AR0636
- 19/01/2020 GS AR0955: GS_ISP_LINE_OUTAGE. Open (To be closed)
- 21/10/2019 GS AR0938: MDS_SLOW_DOWN_SEARCH_REQUEST. Closed

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

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Thank you!

