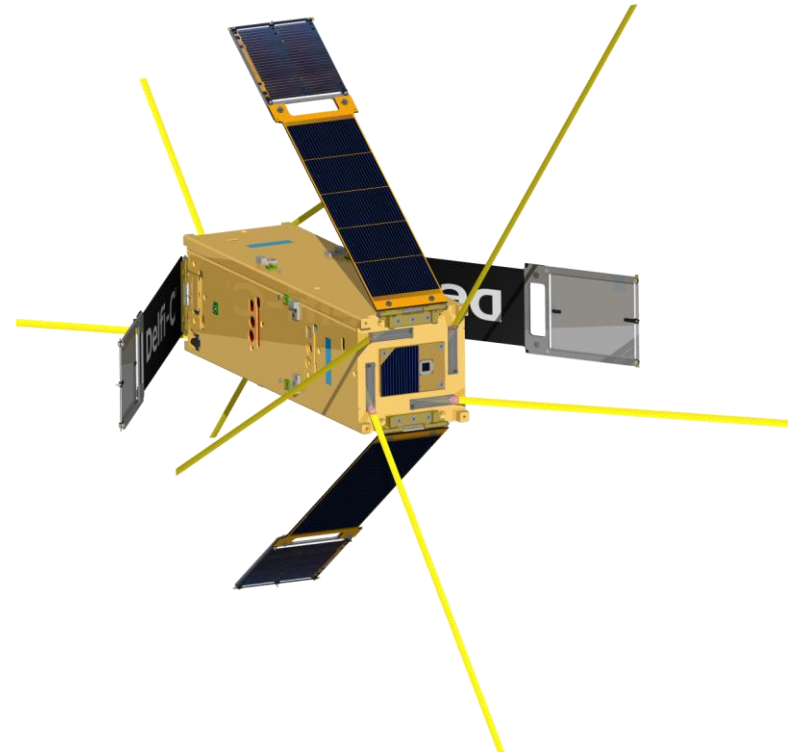
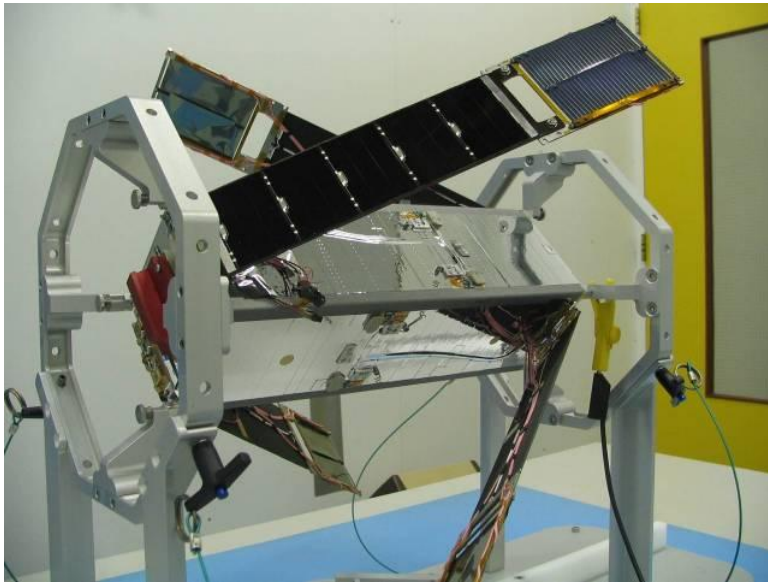


Delfi-C³

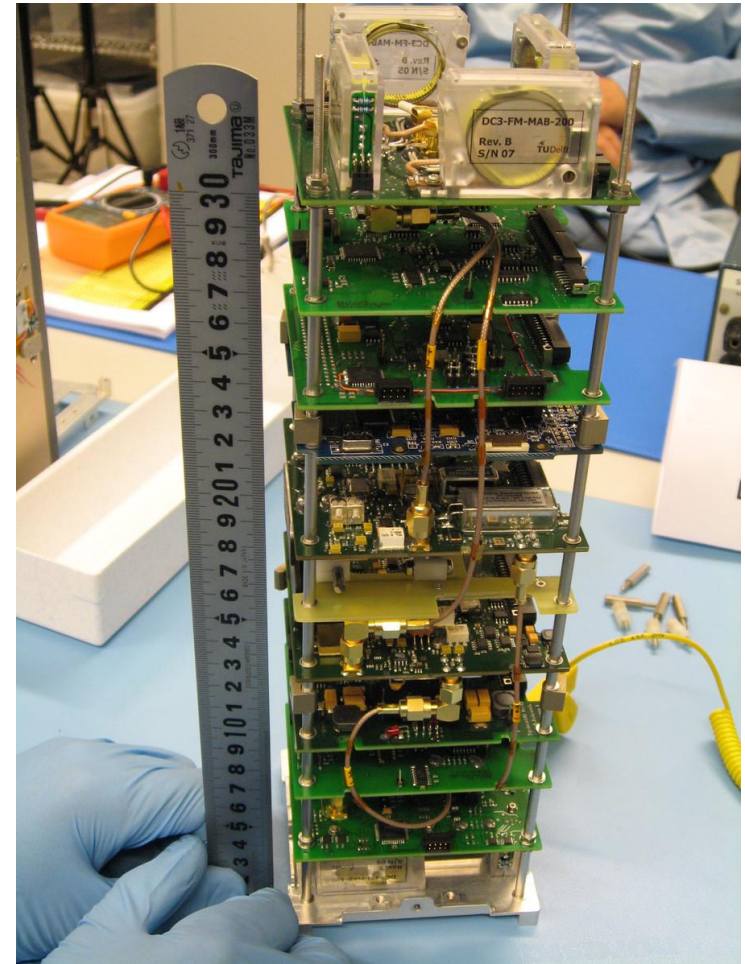


Update and Flight Results
Wouter Jan Ubbels PE4WJ



Delfi-C3 – quick facts

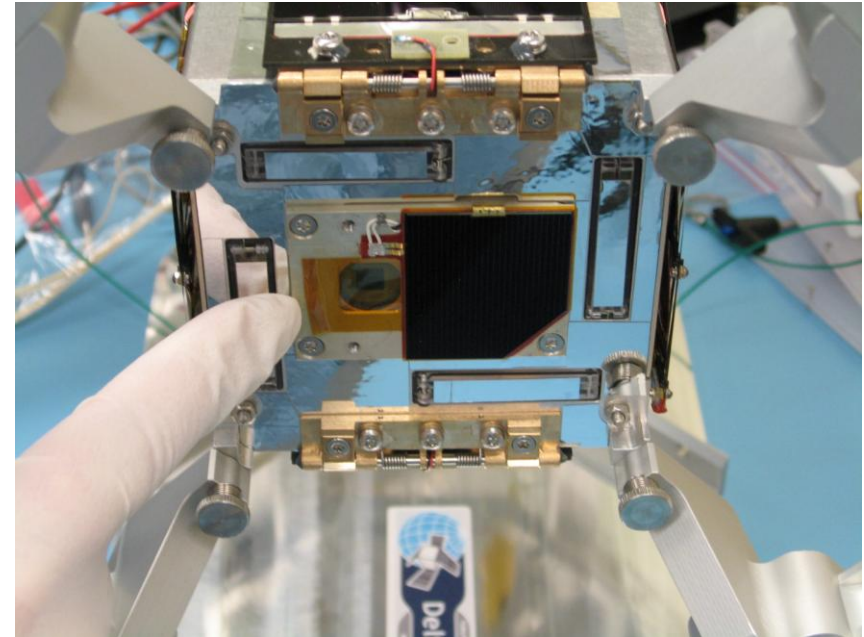
- 3U CubeSat
- NO Battery
- NO active attitude control
- 1200Bd BPSK VHF downlink
- Linear mode UV transponder
- Payloads:
 - Thin Film Solar Cells
 - Autonomous Wireless Sun Sensor
- Start project November 2004
- Launched 28th of April 2008
- > 60 student team



TFSC



AWSS

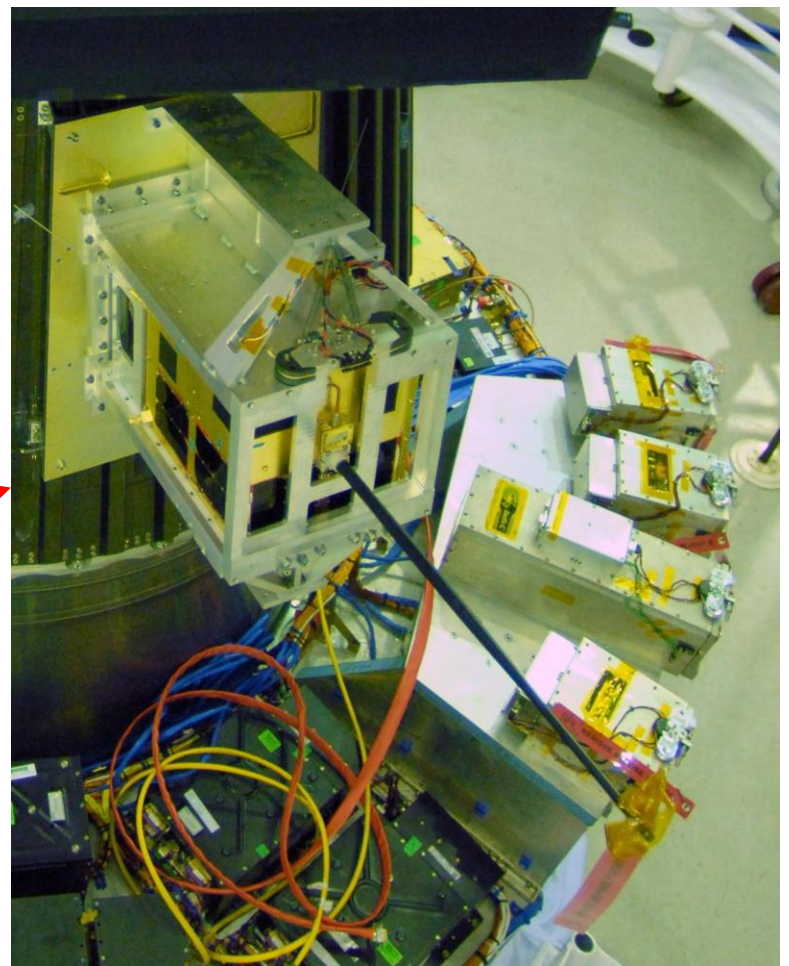


TFSC: Thin Film Solar Cell

AWSS: Autonomous Wireless Sun Sensor



PSLV-C9



Timeline

- 28 April 2008, 03:53 UTC Launch
- 06:39:08 UTC First received by Rick Mann (US)
- 11:49:51 UTC First reception in Delft
- 30 April 2008, 10:50:42 UTC Delfi-C³ CDHS set to Read-Only mode
- 15 May 2008 Designated DO-64
- 29 July 2008, 10:00 UTC Switch from Science Mode to Transponder
- End of September 2008 First signs of transponder degradation
- 14 October 2008, 11:00 UTC Switch to Basic Mode to investigate
- 29 January 2009, 09:33:17 UTC Switch to Science Mode



Frequencies

- **Primary** telemetry downlink
145.870MHz, 1200Bd BPSK AX.25 approx. 100mW
- **Backup** telemetry downlink
145.930MHz, 1200Bd BPSK AX.25 approx. 200mW
- **Transponder downlink:**
145.880-145.920MHz linear (inverting)
CW beacon 10mW at 145.870MHz (*Hi Hi de Delfi-C3 Delfi-C3*)
- **Transponder uplink:**
435.570-435.530MHz
40kHz passband, 400mW PEP
435.556MHz = 145.900MHz
- *Difference in downlink power caused by coupling capacitor having the wrong value of 10pF instead of 10nF*



- **Mission Success!**
- 468 days of operation as of today
- Radio Amateur Transponder degraded after a while, beyond normal useability
- All other subsystems fully operational
- Stability problems on I2C bus
- Issues with data analysis, hard to make conclusions on payload performance, lots of data still to be analyzed
- No critical problems or significant degradation to predict EOL



Radio amateur network

- Overwhelming response from the amateur radio community
- 328 amateurs (others on guest account)
- >3000 downloads of RASCAL
- Top submitters
 - JA0CAW
 - ZL2BX
 - PA0DLO
 - OH8MBN
 - PE1ITR



Delfi-C3 RASCAL

File Options

Audio level

SigmaTel Audio

Frequency

1400 1500 1600 1700 1800

1664 Hz

Sync

TUDELFT - DUTCH SPACE - TNO

Delfi-C³

WWW.DELFIC3.NL

Satellite		OBC		EPS		MeBo Z+	
Packet counter	36 packets	OBC temperature	27.885 deg. C	EMP op. mode	OBC	MEP Z+ op. mode	OBC
Bootcounter attempt	12 boots	System bus voltage	0.0 V	GaAs Z+ X+ current	0.0 mA	MDP Z+ op. mode	OBC
Bootcounter succes	12 boots	OBC current	2.765 mA	GaAs Z+ X- current	0.0 mA	MeBo Z+ current	2.765 mA
Operational mode	science	ComBo		GaAs Z- Y+ current	48.825 mA	MeBo Z-	
Last Rx Cmd RAP	RAP 1	CEP mode	OBC	GaAs Z- Y- current	273.42 mA	MEP Z- op. mode	OBC
		AWP mode	OBC			MDP Z- op. mode	OBC
		ComBo Current	5.9250 mA			MeBo Z- current	2.37 mA

RAP 1		RAP 2		ICB Z+		ICB Z-	
REP1 op. mode	OBC	REP2 op. mode	OBC	ADP 1 op. mode	OBM	ADP3 op. mode	OBC
RCP1 op. mode	OBC	RCP2 op. mode	OBM	ADP 2 op. mode	OBM	ADP4 op. mode	OBC
RBP1 op. mode	OBC	RBP2 op. mode	OBM	Solar Panel Z+ X+	undeployed	Solar Panel Z- Y+	deployed
RAP 1 temperature	30.945 deg. C	RAP 2 temperature	-68.1 deg. C	Solar Panel Z+ X-	undeployed	Solar Panel Z- Y-	deployed
RAP 1 Rx current	24.885 mA	RAP 2 Rx current	22.91 mA	Antenna Z+ X+	undeployed	Antenna Z- X+	deployed
RAP 1 Tx current	114.94 mA	RAP 2 Tx current	0.0 mA	Antenna Z+ X-	undeployed	Antenna Z- X-	undeployed
RAP 1 fwd. power	123.35 mW	RAP 2 fwd. power	0.0 mW	Antenna Z+ Y+	undeployed	Antenna Z- Y+	undeployed
RAP 1 refl. power	0.6194 mW	RAP 2 refl. power	0.0 mW	Antenna Z+ Y-	undeployed	Antenna Z- Y-	undeployed

Terminal

```

from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 01
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 01
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 01
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
from: DLFIC3 to: TLM  a8 98 9b 40 40 40 00 88 98 8c 92 86 66 01 03 f0 0c 00 02
                    
```

Status messages

Packets received: 7 Last packet received: 17/Apr/08 14:32:44

Primary repository		Secondary repository	
Disk:	7	Sent:	0
Disk:	7	Sent:	0

```

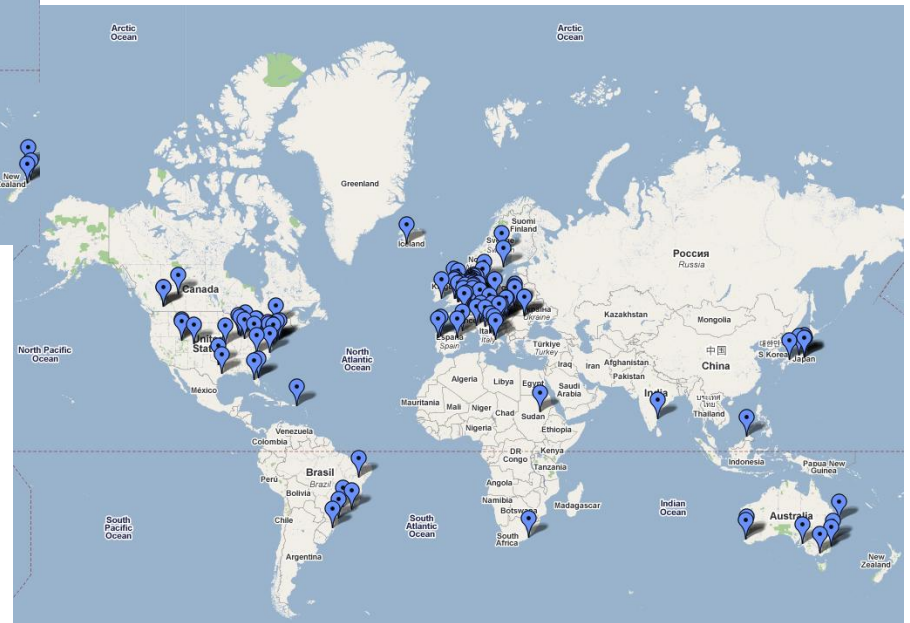
[14:32:11] Starting RASCAL
[14:32:12] Loaded primary repository data: 0 frames
[14:32:12] Loaded secondary repository data: 0 frames
[14:32:13] Sampling Primary Sound Capture Driver
[14:32:21] Sampling SigmaTel Audio
[14:32:44] Unable to connect to server 83.138.144.157
                    
```

CubeSat summer workshop 2009, Logan, UT

9

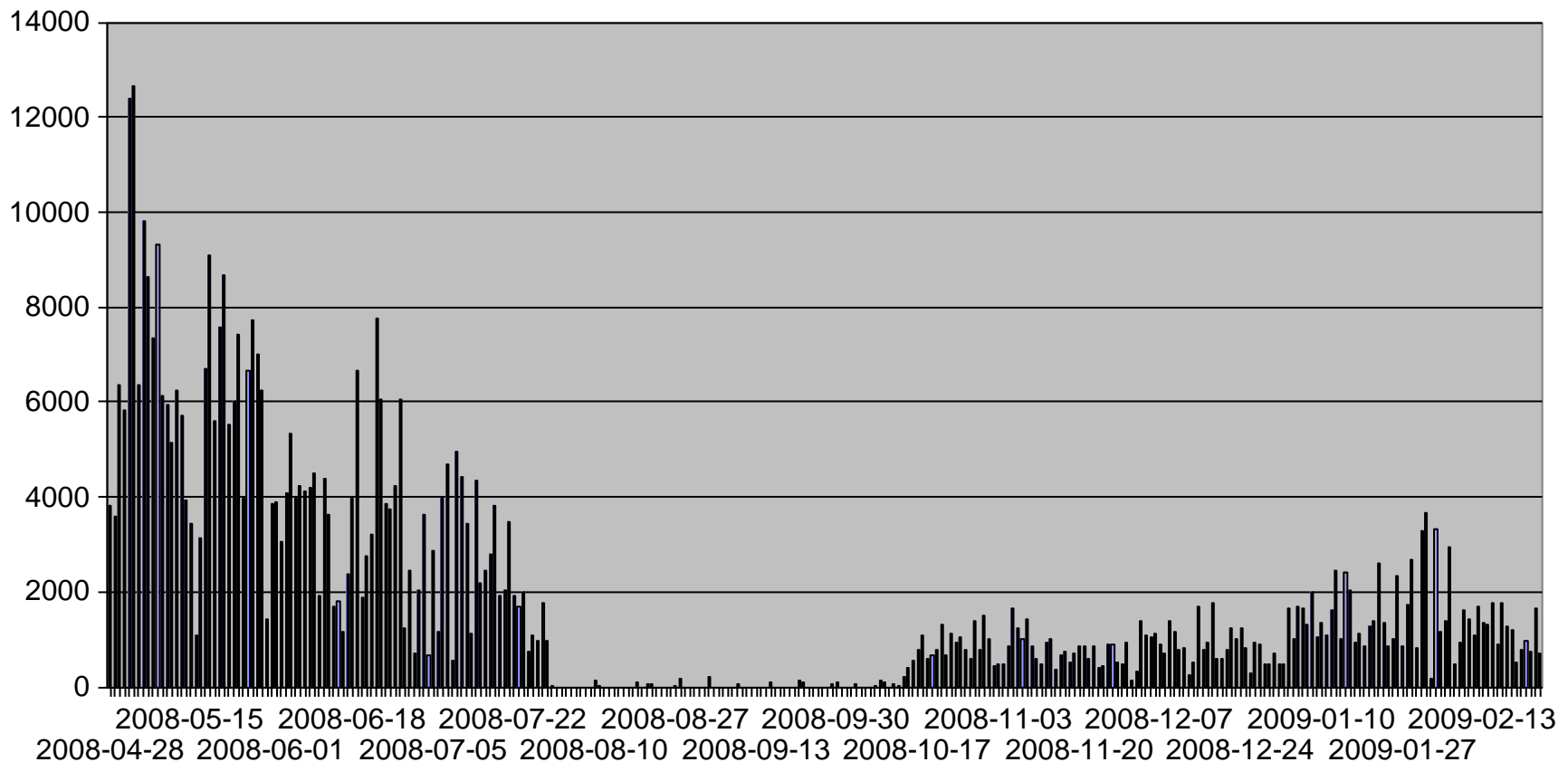
09 August 2009

Ground segment



Total number of packets: 699777
(approx. 100.1 MB)

Packets per day



Transponder issues

- Diagnostic test results:
 - Local oscillator and uplink frequency OK for both RHCP and LHCP polarization
 - Over 400 W uplink power required to get a marginal downlink
 - Not useful for radio amateurs
 - Transponder IF runs at full gain
- Conclusion:
 - Somewhere in the chain between antennas and power splitter there is a short or an open connection
 - Can be anything: Bad cable or solder joint, failed component, tin whisker, etc.
 - No further actions possible from ground
 - Unfortunately no AO-16 alike loopback due to time constraints



Performance of passive attitude control

Modelled performance of design:

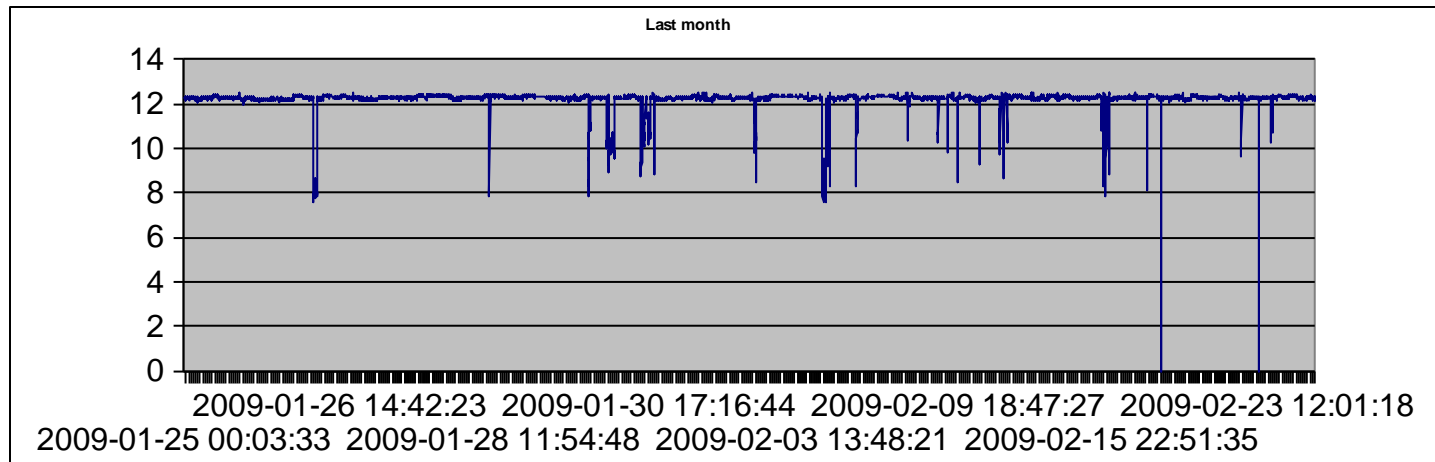
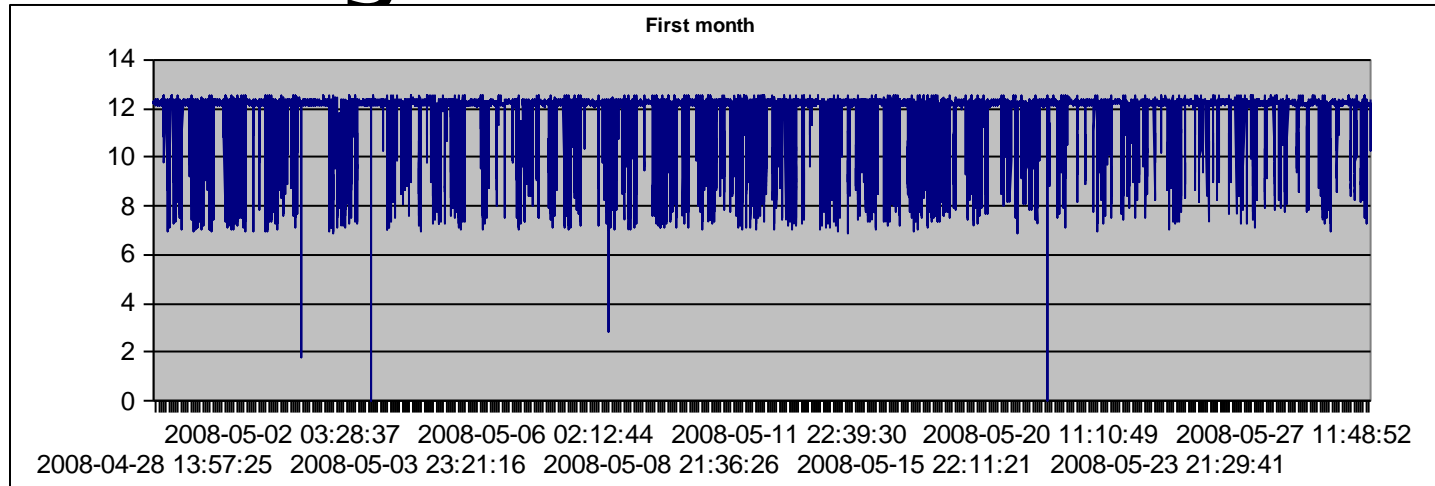
Rotation with passive magnetic (hysteresis) material within a few orbits to 0.2 - 2 °/s from a max. of 10 °/s after ejection from X-POD

Actual:

In the order of weeks before attitude gets from 9°/s to about 1°/s

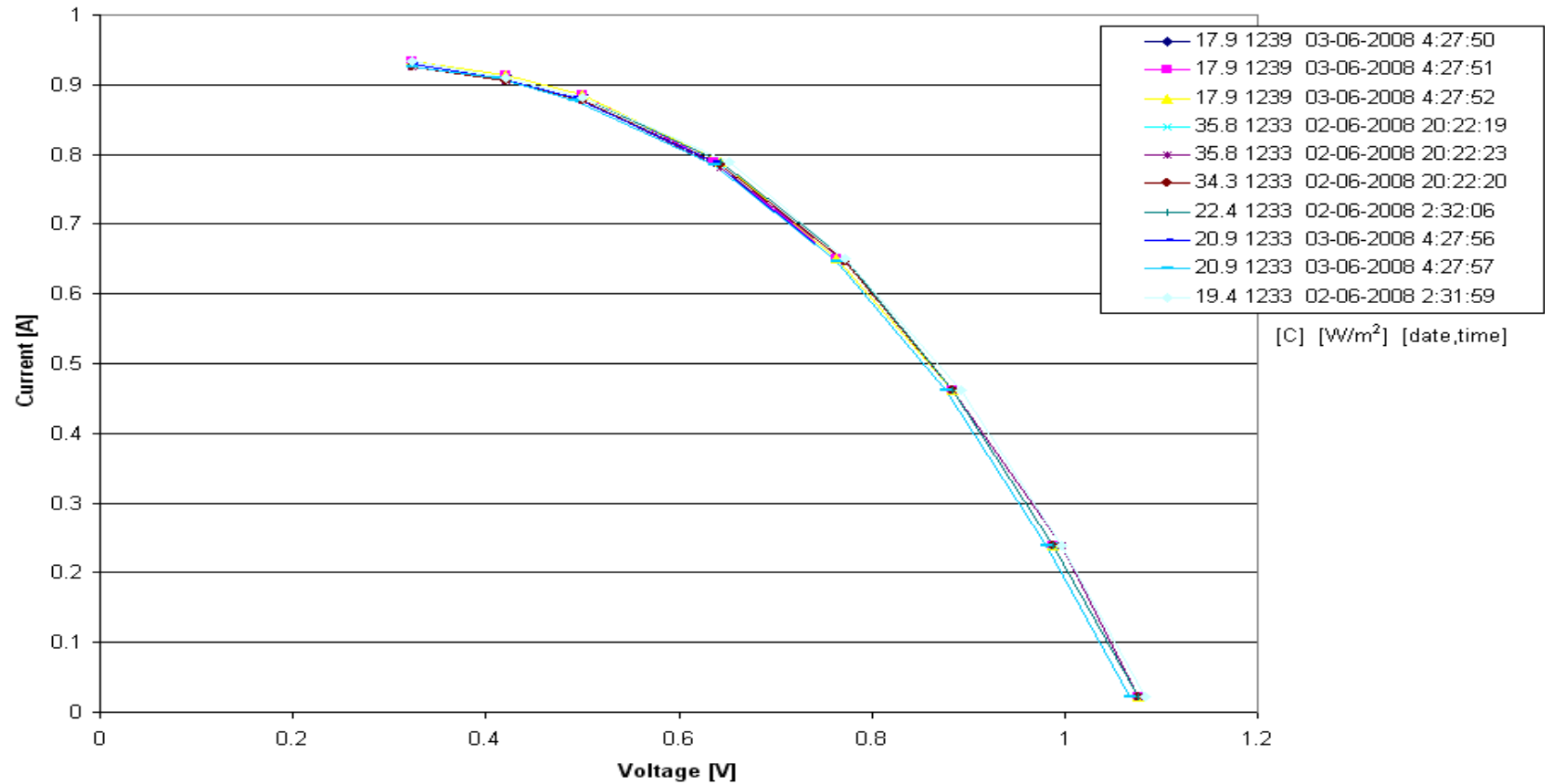


Bus voltage



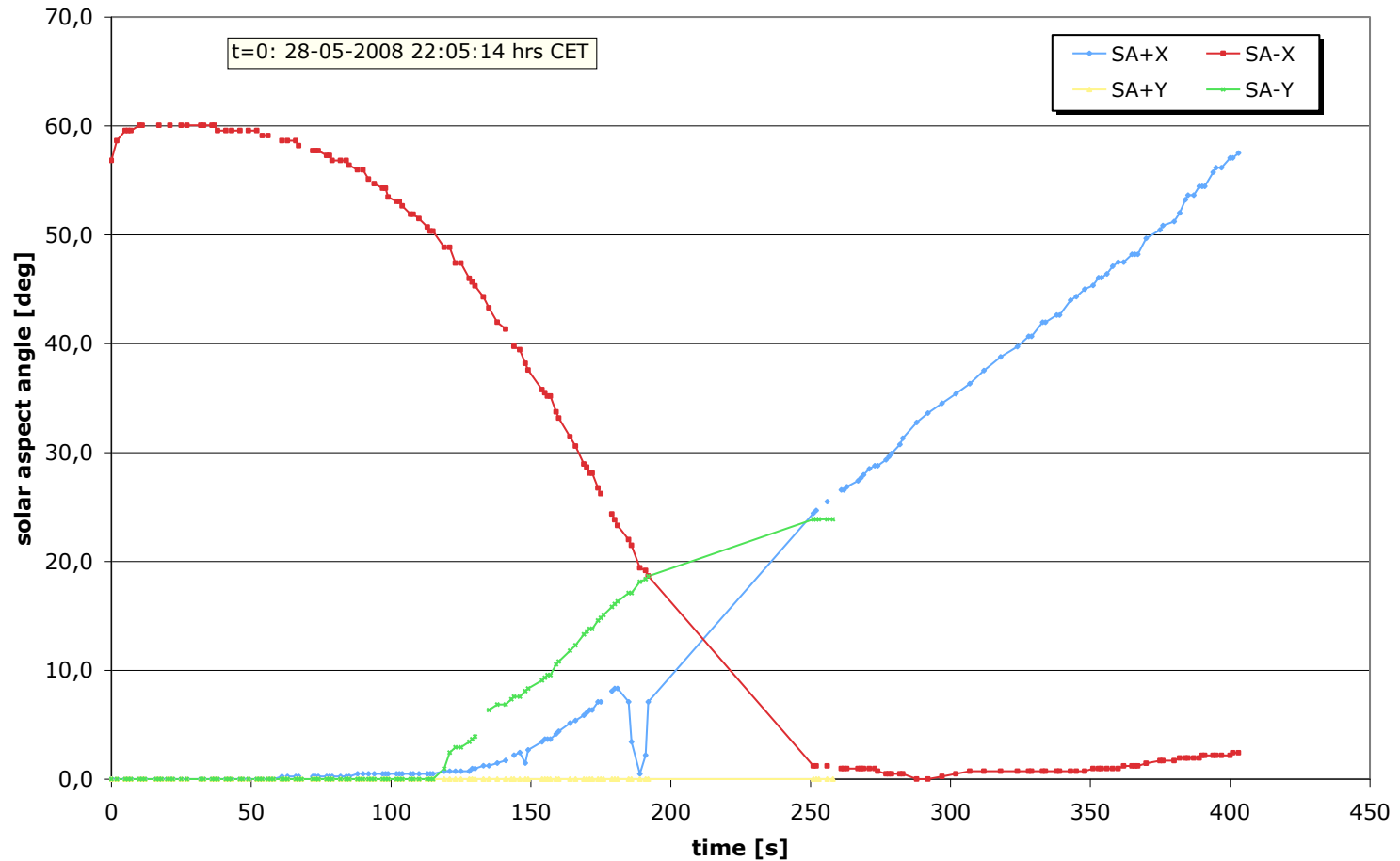
TFSC payload data

I-V Curve Panel -X



Antenna shading

reference diode output





www.delfic3.nl

