STEREO
IMPACT

FM2 IDPU Thermal Vacuum Test Report

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Distribution List

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1. Overview

1.1. *Introduction*

The Instrument Data Processing Unit (IDPU) is the part of the STEREO IMPACT instrument suite. It resides inside the spacecraft, hard-mounted (conductively coupled) to the deck.

This document describes the results of the thermal vacuum testing performed on the FM1 IDPU unit. This testing was performed at U.C. Berkeley following the test procedure called out in reference 1. There was no thermal balance test performed on the IDPU, as called out in reference 2.

The IDPU FM2 has satisfactorily completed its thermal vacuum test program and has met all of its requirements spelled out in reference 1 and 2.

1.2. *Applicable Documents*

The following documents are closely interrelated with this specification. All documents can be found on the Berkeley STEREO/IMPACT FTP site unless otherwise indicated:

http://sprg.ssl.berkeley.edu/impact/dwc/

1. IMPACT IDPU TVAC TEST PLAN
2. APL Document APL 7381-9003 Rev A – STEREO Environment Definition, Observatory and Instrument (on APL web site)
3. IMACT-IDPU-CPT

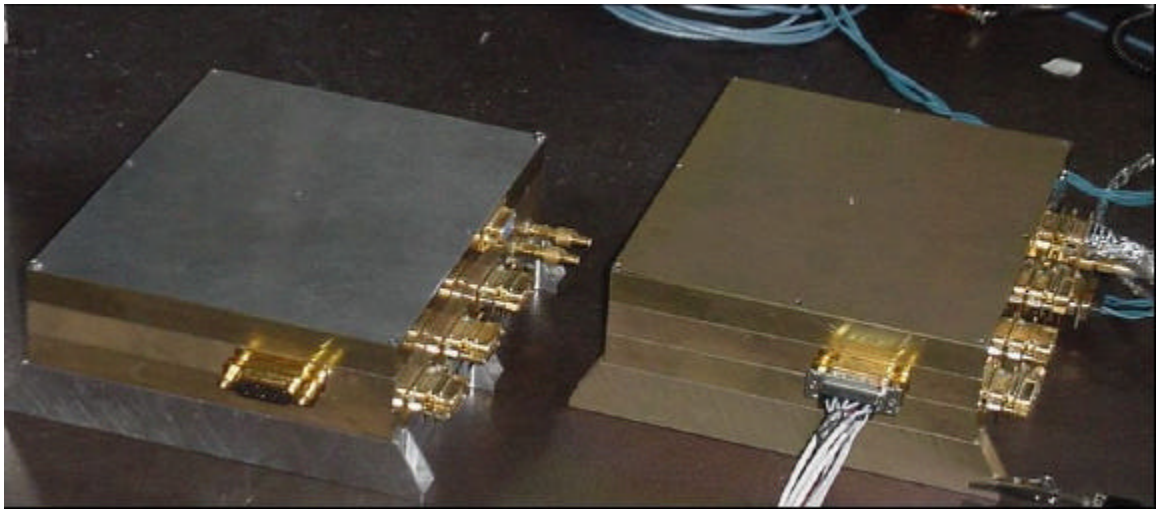


Fig 1. FM1 and FM2 IDPU

2. Test Setup

The "SNOUT" thermal vacuum chamber at U.C. Berkeley was used for the thermal vac of the FM2 IDPU. Final outgassing certification was completed in the "Jeffrey", since SNOUT is not certified for that purpose.

The FM2 boom, including the FM2 MAG and STE-U instruments were setup outside the chamber. SEP, SWEA, and PLASTIC were simulated by GSE (ISG).

In addition to chamber monitoring TCs (on the baseplate, and shroud), a number of chamber TCs were attached to the exterior of the instrument to monitor the temperature. These instrument-mounted TCs were used to determine when temperature soaks were met. The one internal temperature sensor tended to run 10-15C warmer when the instrument was powered due to power dissipation in the unit.

3. Test History

3.1. *First Run*

This test was first attempted starting on 2004-December-29, following vibration testing of the IDPU. Following a ~19 hour +60C bakeout / non op hot cycle, the instrument was transitioned to non-op cold. After non-op cold soak the instrument proceeded to the first operational cycle. The hot soak CPT passed fine, but at cold soak the instrument failed to start (PFR1031). Thermal vac was aborted and the problem was diagnosed – a part was missing on the power converter (it was determined that FM1 did not have this problem). This was fixed and thermal vac resumed.

The non-op cycle was not repeated, so cycling started at the first operational cycle, following a 15 hour bakeout. The instrument worked fine until the final cold soak CPT when the system failed to start at high bus voltage (PFR1032). Again thermal vac was aborted and the problem diagnosed. The problem was tracked down to some reverse-biased tantalum capacitor. This problem effected not only the FM1 IDPU (which had completed environments earlier), but also the SEP LVPS (which had not yet started environments). The problem was repaired on all units and both IDPU usnits were returned to test including a workmanship vibration and 4 more cycles of thermal vac (see the FM1 IDPU test reports for results of FM1 testing).

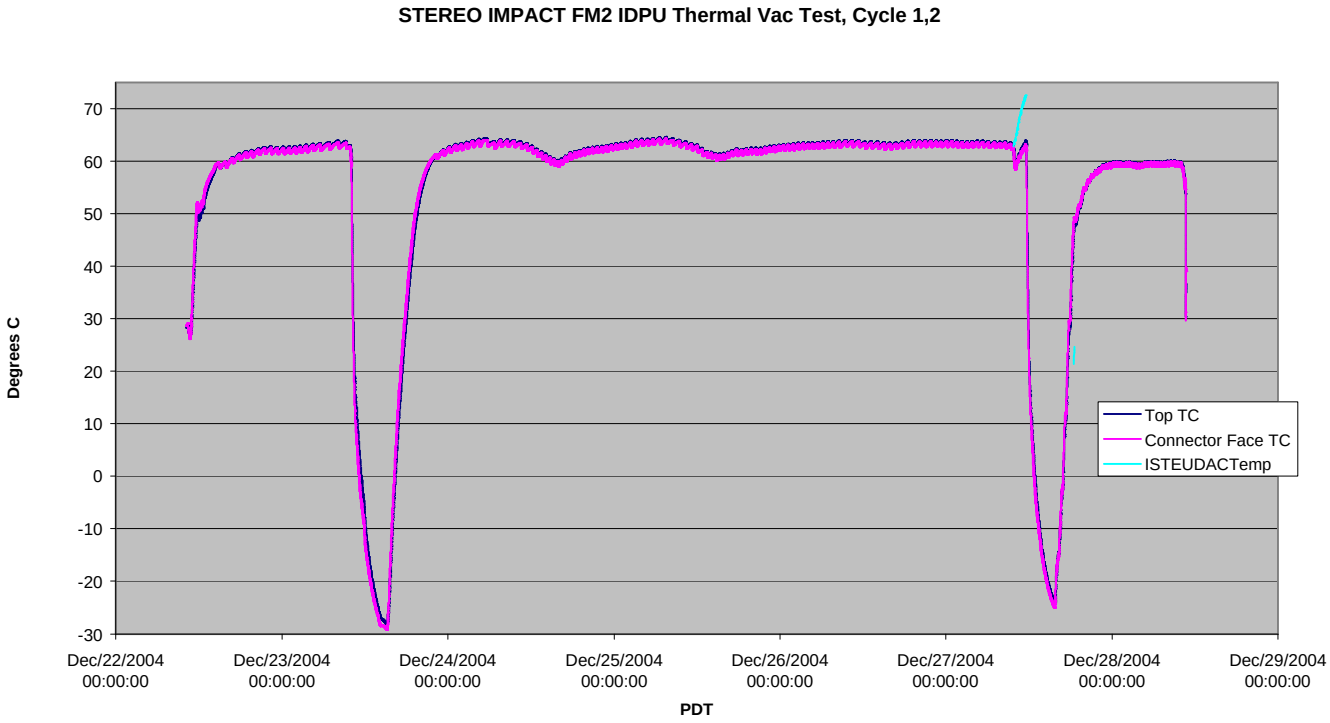
3.2. *Second Run*

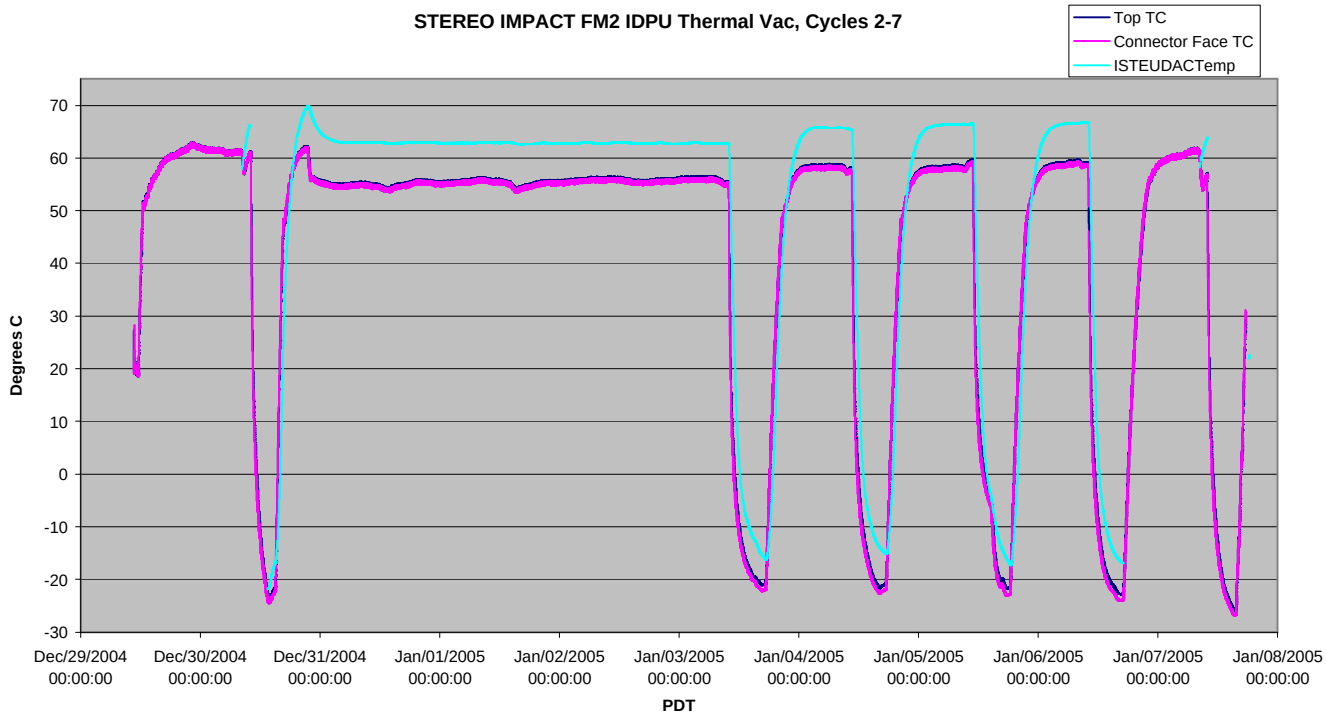
Starting on 2005-February-1 the FM2 IDPU was baked out at non-op hot for 16 hours. The unit was then cycled 4 times with CPTs at each plateau and cold start demonstrated at hot and cold of the first and last cycles at high and low bus voltage limits. The test completed 2005-February-8.

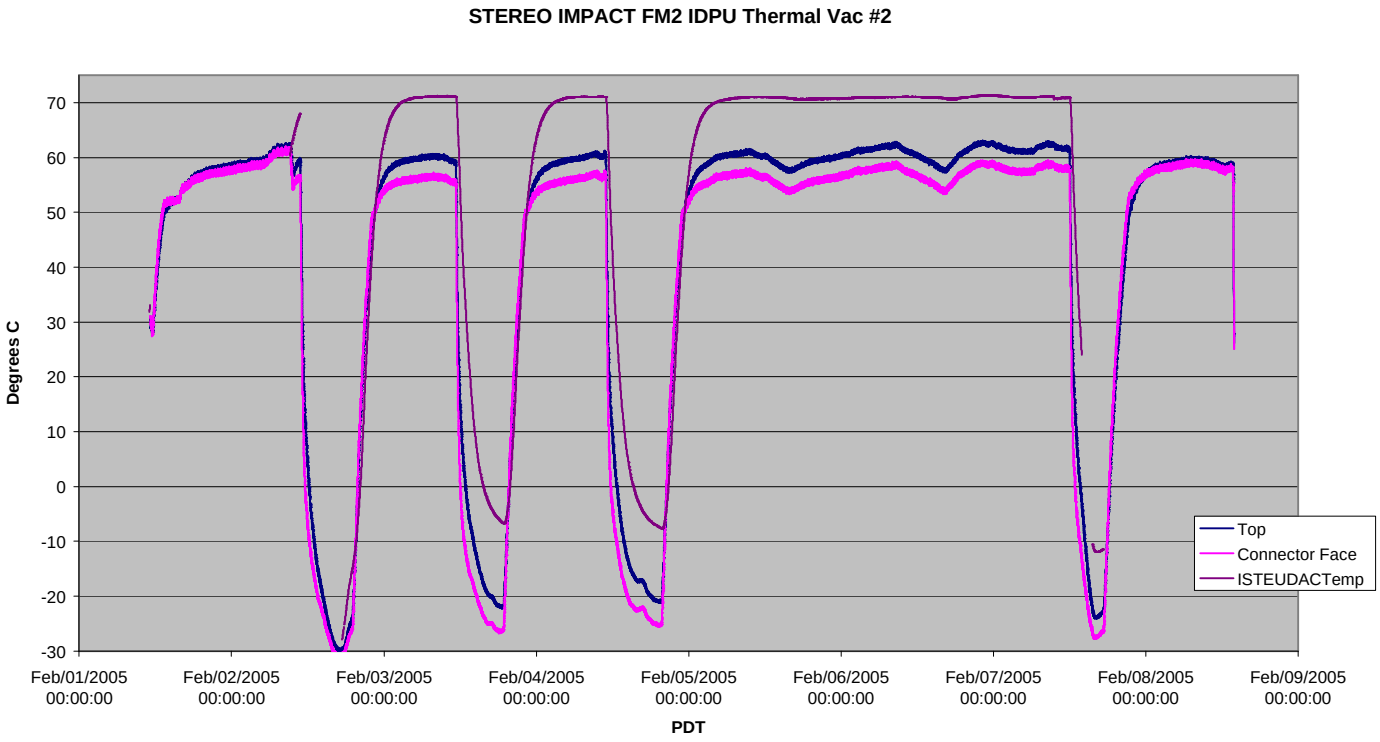
Following this second thermal vac run the unit complete a workmanship vibration and passed the subsequent CPT test. The unit then went back into the Jeffrey chamber for bakeout certification (see below)

4. Temperature Profile

IDPU Top is a chamber thermocouple taped to the top of the IDPU. Conn Face is a chamber TC taped to the connector face of the IDPU. ISTEUDACTemp is an instrument thermistor mounted to the STE-U interface board in the IDPU.






STEREO IMPACT FM2 IDPU Thermal Vac #2
Degrees C
70
60
50
40
30
20
10
0
-10
-20
-30
Feb/01/2005 00:00:00
Feb/02/2005 00:00:00
Feb/03/2005 00:00:00
Feb/04/2005 00:00:00
Feb/05/2005 00:00:00
Feb/06/2005 00:00:00
Feb/07/2005 00:00:00
Feb/08/2005 00:00:00
Feb/09/2005 00:00:00
PDT
Top
Connector Face
ISTEUDACTemp

5. Trending

5.1. *Trending Data Explanation*

The trending data on the previous pages is extracted from the trending file for the STE-U and Magnetometer instruments, plus the IDPU power trend. It is composed of values measured during the CPT, either directly, or from a post-processing fitting function which evaluates the data collected.

- The Door Open and Door Close columns show two times; from application of power to the time when the door comes off the first switch (starts moving), and the time from the application of power to the time when the door reaches the destination switch.
- Threshold values are DAC levels, corresponding to ~100eV per step. Requirement is <5keV.
- The test pulser fit data measures the electronic performance. Of particular interest is the FWHM, which measures the electronic noise in the system. Other values can be used to look for thermal drift and other trends in energy gain and offset.
- The "door source" fit data measures the calibration source on the STE door, and so is a end-to-end measurement (albeit using mostly photons rather than electrons). Again the FWHM is of interest (requirement < 2keV).

- Magnetometer RMS data is mostly influenced by noise sources in the vicinity of the sensor during the test (pretty bad in the clean room and close to the Jeffrey chamber, not so bad close to the Snout chamber)
- The IFC (In-Flight Calibration) data are parameters from a fit to the transition from IFC off to IFC on. This includes the measured amplitude of the stimulation (should be stable to a few percent), the relative timing (important for correlation of data timing with SWAVES, should be good to a few milliseconds), and the decay time of the signal (which indicates how the front end filtering is working; the fit is not great because only a few data points are taken during the transition).

- IDPU trends show the primary current (data logger) and secondary voltages (instrument housekeeping). There was a significant decrease in the instrument current when the soft start circuit was fixed. No other significant trends.

5.2. ***STE-U Trending Data***

STE-U FM2 Performance Trend

Date	File	Test	STE-U Temp	Preamp Temp	IDPU Temp	STE-U Cur (mA)	Door Open (sec)	Door Close (sec)	Bias	FlFlag	Det.	Thresh	Test Pulser: Offset (keV), Gain (keV/Ch), Curv. (1/keV), Test Gain, FWHM (keV)	Door Source: Offset (keV), Gain (keV/Ch), Curv. (1/keV), 60keV c/s, 20keV c/s, FWHM	AccTime (sec)	Long Integration Door Source (Door LUT): Offset (keV), Gain (keV/Ch), Curv. (1/keV), 60keV c/s, 20keV c/s, 60keV c/s, FWHM
Dec 14 2004	0412151815.tlm	IDPU Pre Vib CPT	22		26.3	16.5	3.38 / 0.50	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec 17 2004	[illegible]	IDPU Post Vib CPT	22.4		27.2	16.7	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec 27 2004	[illegible]	IDPU Tvac Hot #2	15.5		66.8	14	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec 20 2004	0412200000.tlm	IDPU Tvac Hot #2 again	13		20.6	16.6	3.60 / 0.50	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec 20 2004	0412200000.tlm	IDPU Tvac Cold #2	14.9		-21.1	15	3.60 / 0.50	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 3 2005	0501030000.tlm	IDPU Tvac Hot #3	12.1		62.7	16.8	3.60 / 0.50	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 3 2005	[illegible]	IDPU Tvac Cold #3	14.0		-14.9	20.6	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 4 2005	[illegible]	IDPU Tvac Hot #4	12.2		66.6	14.4	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 4 2005	0501040000.tlm	IDPU Tvac Cold #4	15.3		-13.6	20.5	3.60 / 0.50	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 5 2005	0501050000.tlm	IDPU Tvac Hot #5	12.5		66.6	14.4	3.60 / 0.75	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 6 2005	[illegible]	IDPU Tvac Cold #5	16.7		-15.3	20.7	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 6 2005	[illegible]	IDPU Tvac Hot #6	12.2		66.7	14	[illegible]	[illegible]	150	[illegible]	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 6 2005	0501060000.tlm	IDPU Tvac Cold #6	15.5		-15.8	21	3.60 / 0.62	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan 7 2005	0501070000.tlm	IDPU Tvac Hot #7	12.7		66	16.0	3.60 / 0.62	3.38 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 2 2005	0502020905.tlm	IDPU Tvac2 Hot #1	15.1		65.6	17	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 2 2005	0502021725.tlm	IDPU Tvac2 Cold #1	20.7		-22.9	21.5	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 3 2005	0502030000.tlm	IDPU Tvac2 Hot #2	16.9		71.2	14.5	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 3 2005	0502030000.tlm	IDPU Tvac2 Cold #2	20.7		-4.9	20.2	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 4 2005	0502040000.tlm	IDPU Tvac2 Hot #3	16.5		71.1	14.1	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 4 2005	0502040000.tlm	IDPU Tvac2 Cold #3	19.1		-6.0	16.5	3.60 / 0.75	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb 7 2005	0502070000.tlm	IDPU Tvac2 Hot #4	14.0		70.6	14.3	3.60 / 0.62	3.38 / 0.58	20	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
									150	21/60/305	0 1 2 3				[illegible]	[illegible]
Feb 7 2005	[illegible]	IDPU Tvac2 Cold #4	16.9		-11.6	20.6	[illegible]	[illegible]	20	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
									150	21/60/305	0 1 2 3				[illegible]	[illegible]
Feb 14 2005	0502141544.tlm	IDPU post-vib	22.5		31.7	16.5	3.60 / 0.50	3.25 / 0.58	150	21/60/305	0 1 2 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note: During IDPU FM2 Thermal vac, STE-U door seems to have been [illegible] during calibration [illegible] between [illegible] switch and [illegible] the stop

MAG Trending Data

MAG FM2 Performance Trend

Date	File	Test	MAG Temp	IDPU Temp	Heater On HKP	RMSx	RMSy	RMSz	IFC Fit Rev	IFC X Sample Time	IFC X Amplitude	IFC X Rate	IFC Y Sample Time	IFC Y Amplitude	IFC Y Rate	IFC Z Sample Time	IFC Z Amplitude	IFC Z Rate	
Dec 14 2004	0412151207.tlm	IDPU Pre vib CPT	24	26.3	10.4	6.0	2.0	9.0	2/18/2005	-22.4	8901	9.3	-22.6	8858	9.6	-21.3	9306	8.7	Clean Roo
Dec 17 2004	0412171124.tlm	IDPU Post vib CPT	23.3	27.2	10.3	8.0	5.0	9.0	2/18/2005	-22.6	8908	9.7	-23.8	8870	10.4	-21.5	9299	8.9	Clean Roo
Dec 27 2004	0412270938.tlm	IDPU Tvac Hot #2	17.6	65.8	14.5	1.4	1.4	1.2	2/18/2005	-21.5	8883	9.4	-18.9	8849	10.0	-23.1	9387	10.0	Snout
Dec 30 2004	0412300000.tlm	IDPU Tvac Hot #2	14.8	60.6	11.8	1.6	1.8	1.1	2/18/2005	-21.1	8883	9.3	-20.9	8852	9.6	-21.9	9383	9.5	Snout
Dec 30 2004	0412300000.tlm	IDPU Tvac Cold #2	15.1	-21.1	8.7	1.5	1.6	1.3	2/18/2005	-22.6	8858	10.8	-20.5	8826	10.1	-22.4	9372	10.3	Snout
Jan 3 2005	0501030000.tlm	IDPU Tvac Hot #3	13.9	62.7	15.1	1.3	3.4	1.8	2/18/2005	-19.1	8879	8.2	-20.5	8849	9.3	-22.3	9382	9.5	Snout
Jan 3 2005	0501030000.tlm	IDPU Tvac Cold #3	14.7	-14.9	9.2	1.5	4.6	1.2	2/18/2005	-22.3	8856	10.7	-20.9	8828	10.4	-22.5	9372	10.4	Snout
Jan 4 2005	0501040000.tlm	IDPU Tvac Hot #4	14.2	65.5	15.2	1.6	5.3	1.8	2/18/2005	-20.6	8881	9.0	-20.9	8850	9.5	-22.8	9384	9.8	Snout
Jan 4 2005	0501040000.tlm	IDPU Tvac Cold #4	16.4	-13.6	9.7	1.5	2.1	1.7	2/18/2005	-21.5	8854	10.3	-20.3	8826	10.1	-22.6	9370	10.5	Snout
Jan 5 2005	0501050000.tlm	IDPU Tvac Hot #5	16.2	66.5	16.1	2.0	2.3	1.5	2/18/2005	-18.2	8879	7.8	-20.6	8851	9.4	-23.0	9383	9.9	Snout
Jan 5 2005	0501050000.tlm	IDPU Tvac Cold #5	15.9	-15.3	9.6	2.0	1.7	1.5	2/18/2005	-21.7	8853	10.4	-21.1	8822	10.5	-21.9	9368	10.1	Snout
Jan 6 2005	0501060000.tlm	IDPU Tvac Hot #6	15.3	66.7	15.4	1.7	2.6	2.2	2/18/2005	-21.7	8879	9.5	-21.4	8848	9.8	-22.0	9385	9.5	Snout
Jan 6 2005	0501060000.tlm	IDPU Tvac Cold #6	16.6	-15.6	9.4	1.4	4.2	1.0	2/18/2005	-22.3	8855	10.7	-20.0	8822	9.9	-22.0	9366	10.2	Snout
Jan 7 2005	0501070000.tlm	IDPU Tvac Hot #7	14.5	60	14.7	1.9	1.8	1.3	2/18/2005	-20.0	8880	8.8	-20.5	8853	9.4	-22.1	9380	9.6	Snout
Feb 2 2005	0502020906.tlm	IDPU Tvac2 Hot #1	17.1	63.6	14.9	2.1	2.5	1.4	2/18/2005	-20.6	8882	9.0	-21.3	8849	9.7	-23.4	9386	10.1	Snout
Feb 2 2005	0502021725.tlm	IDPU Tvac2 Cold #1	21.2	-22.9	8.3	2.1	4.5	2.6	2/18/2005	-21.0	8852	9.8	-21.0	8818	10.3	-23.6	9370	10.9	Snout
Feb 3 2005	0502030000.tlm	IDPU TVac2 Hot #2	20.5	71.2	15.2	1.5	4.1	2.5	2/18/2005	-19.7	8880	8.5	-20.1	8849	9.1	-22.0	9383	9.4	Snout
Feb 3 2005	0502030000.tlm	IDPU TVac2 Cold #2	22.1	-4.8	10	2.0	5.4	1.7	2/18/2005	-21.7	8855	10.3	-20.4	8831	10.0	-22.2	9371	10.2	Snout
Feb 4 2005	0502040000.tlm	IDPU TVac2 Hot #3	20.1	71.1	15.2	1.4	5.5	2.6	2/18/2005	-20.5	8879	8.9	-20.4	8848	9.2	-21.9	9386	9.4	Snout
Feb 4 2005	0502040000.tlm	IDPU TVac2 Cold #3	20.3	-6.8	10	1.7	3.4	1.6	2/18/2005	-22.0	8858	10.4	-20.5	8825	10.1	-23.1	9371	10.7	Snout
Feb 7 2005	0502070000.tlm	IDPU TVac2 Hot #4	17.8	70.8	15.2	1.6	4.8	3.8	2/18/2005	-21.8	8879	9.5	-20.2	8848	9.1	-21.9	9383	9.4	Snout
Feb 7 2005	0502070000.tlm	IDPU TVac2 Cold #4	18.7	-11.6	9.3	1.4	3.5	1.7	2/18/2005	-22.3	8858	10.7	-20.7	8823	10.3	-22.8	9370	10.6	Snout
Feb 14 2005	0502141544.tlm	IDPU post-vib	23.3	31.7	8.7	6.5	8.1	7.3	2/18/2005	-20.6	8901	8.6	-15.2	8881	6.4	-23.0	9327	9.7	Clean Roo

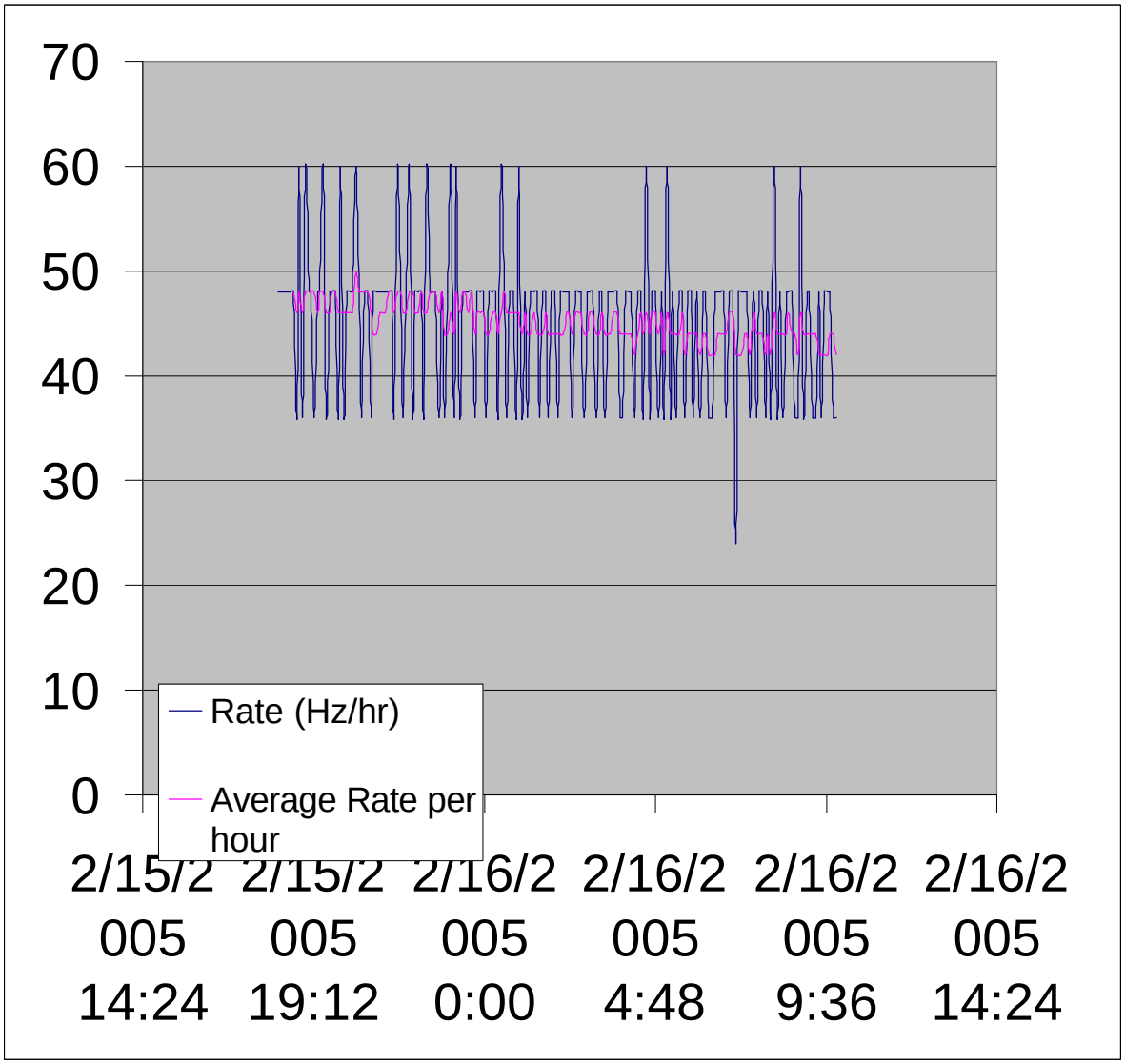
5.3. *IDPU Trending Data*

IDPU FM2 Performance Trend

Date	File	Test	S/W Version	IDPU Temp	Primary Current, mA	Bus Voltage	2.5V	5VD	5VA	12VA	STE-U?
Dec 14 2004	0412151207.tlm	Pre vib CPT	24	26.3	201	28	2.49	4.98	4.87	12.86	FM2
Dec 17 2004	0412171124.tlm	Post vib CPT	24	27.2	199	28	2.49	4.98	4.88	12.86	FM2
					200.5	28	2.48	4.98	4.84	12.97	
Dec 27 2004	0412270938.tlm	Tvac Hot #2	24	65.8	240.5	24	2.48	4.98	4.84	12.88	FM2
					162.7	35	2.48	4.98	4.84	12.97	
					199	28	2.49	4.97	4.83	12.94	
Dec 30 2004	0412300000.tlm	Tvac Hot #2, again	24	60.6	240	24	2.49	4.97	4.83	12.89	FM2
					164	35	2.49	4.97	4.83	12.98	
					198	28	2.51	5.00	4.92	12.86	
Dec 30 2004	0412300000.tlm	Tvac Cold #2	24	-21.1	246	24	2.50	5.00	4.92	12.80	FM2
					162	35	2.51	5.00	4.93	12.87	
Jan 3 2005	0501030000.tlm	Tvac Hot #3	24	62.7	201	28	2.49	4.97	4.84	12.95	FM2
Jan 3 2005	0501030000.tlm	Tvac Cold #3	24	-14.9	197	28	2.50	5.00	4.92	12.86	FM2
Jan 4 2005	0501040000.tlm	Tvac Hot #4	24	65.5	201	28	2.49	4.97	4.83	12.95	FM2
Jan 4 2005	0501040000.tlm	Tvac Cold #4	24	-13.6	197	28	2.50	5.00	4.92	12.87	FM2
Jan 5 2005	0501050000.tlm	Tvac Hot #5	24	66.5	201	28	2.49	4.97	4.83	12.95	FM2
Jan 5 2005	0501050000.tlm	Tvac Cold #5	24	-15.3	202	28	2.50	5.00	4.92	12.86	FM2
Jan 6 2005	0501060000.tlm	Tvac Hot #6	24	66.7	202	28	2.49	4.97	4.83	12.95	FM2
Jan 6 2005	0501060000.tlm	Tvac Cold #6	24	-15.6	199	28	2.51	5.00	4.92	12.86	FM2
					200	28	2.49	4.97	4.84	12.95	
Jan 7 2005	0501070000.tlm	Tvac Hot #7	24	60	240	24	2.48	4.98	4.84	12.87	FM2
					160	35	2.48	4.98	4.84	12.96	
					207	28	2.49	4.97	4.83	12.95	
Feb 2 2005	0502020906.tlm	TVac2 Hot #1	24	63.6	242	24	2.48	4.98	4.84	12.87	FM2
					162	35	2.49	4.98	4.84	12.96	
					200	28	2.51	5.00	4.92	12.87	
Feb 2 2005	0502021725.tlm	TVac2 Cold #1	24	-22.9	242	24	2.51	5.00	4.93	12.80	FM2
					167	35	2.51	5.00	4.93	12.86	
Feb 3 2005	0502030000.tlm	TVac2 Hot #2	24	71.2	203	28	2.49	4.97	4.83	12.94	FM2
Feb 3 2005	0502030000.tlm	TVac2 Cold #2	24	-4.8	199	28	2.50	4.99	4.90	12.89	FM2
Feb 4 2005	0502040000.tlm	TVac2 Hot #3	24	71.1	204	28	2.49	4.97	4.83	12.95	FM2
Feb 4 2005	0502040000.tlm	TVac2 Cold #3	24	-6.8	197.5	28	2.50	4.99	4.90	12.89	FM2
					200	28	2.49	4.97	4.83	12.95	
Feb 7 2005	0502070000.tlm	TVac2 Hot #4	24	70.8	243	24	2.49	4.97	4.83	12.89	FM2
					164	35	2.49	4.97	4.83	12.97	
					197	28	2.50	5.00	4.91	12.88	
Feb 7 2005	0502070000.tlm	TVac2 Cold #4	24	-11.6	239	24	2.50	5.00	4.91	12.79	FM2
					165	35	2.50	5.00	4.91	12.87	
					193	28	2.49	4.98	4.87	12.93	
Feb 14 2005	0502141544.tlm	Post-vib CPT	24	31.7	229	24	2.50	4.98	4.88	12.86	FM2
					160	35	2.49	4.98	4.88	12.86	

6. TQCM Data

Both flight IDPU units were placed in the Jeffrey chamber together. They had both spent a considerable amount of time in bakeout during thermal vac, so all that was required was certification, which involves measuring the TQCM rates while the chamber control surfaces are held at non-op hot for the IDPU (60C). The measured TQCM rate was steady at 45Hz/hour, not significantly above chamber background. The corresponding calculated outgassing rate is 3.4E-13 g/cm^2/sec per unit, compared to a requirement of 5e-11.


70
60
50
40
30
20
10
0
Rate (Hz/hr)
Average Rate per hour
2/15/2005 14:24
2/15/2005 19:12
2/16/2005 0:00
2/16/2005 4:48
2/16/2005 9:36
2/16/2005 14:24