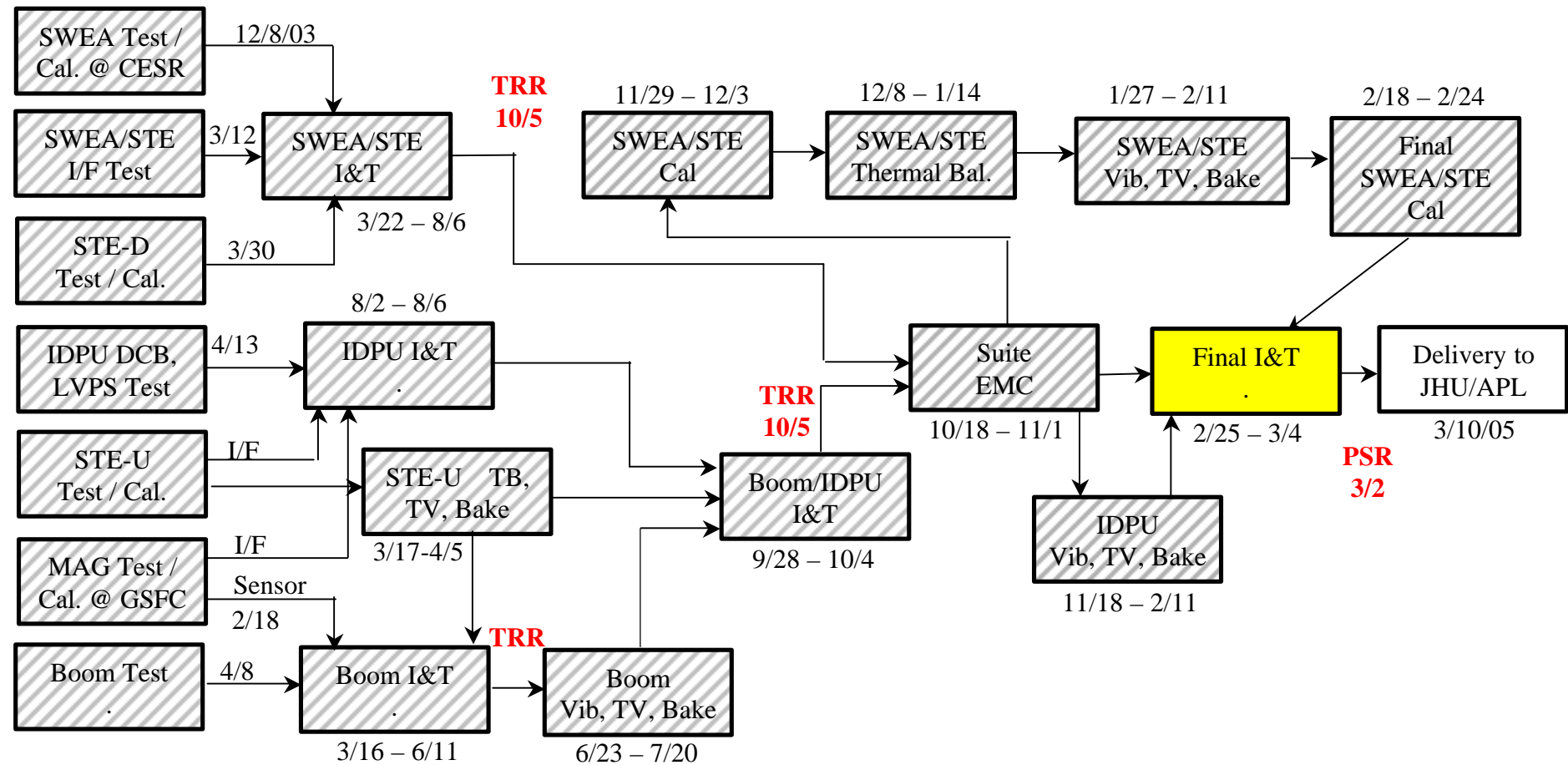




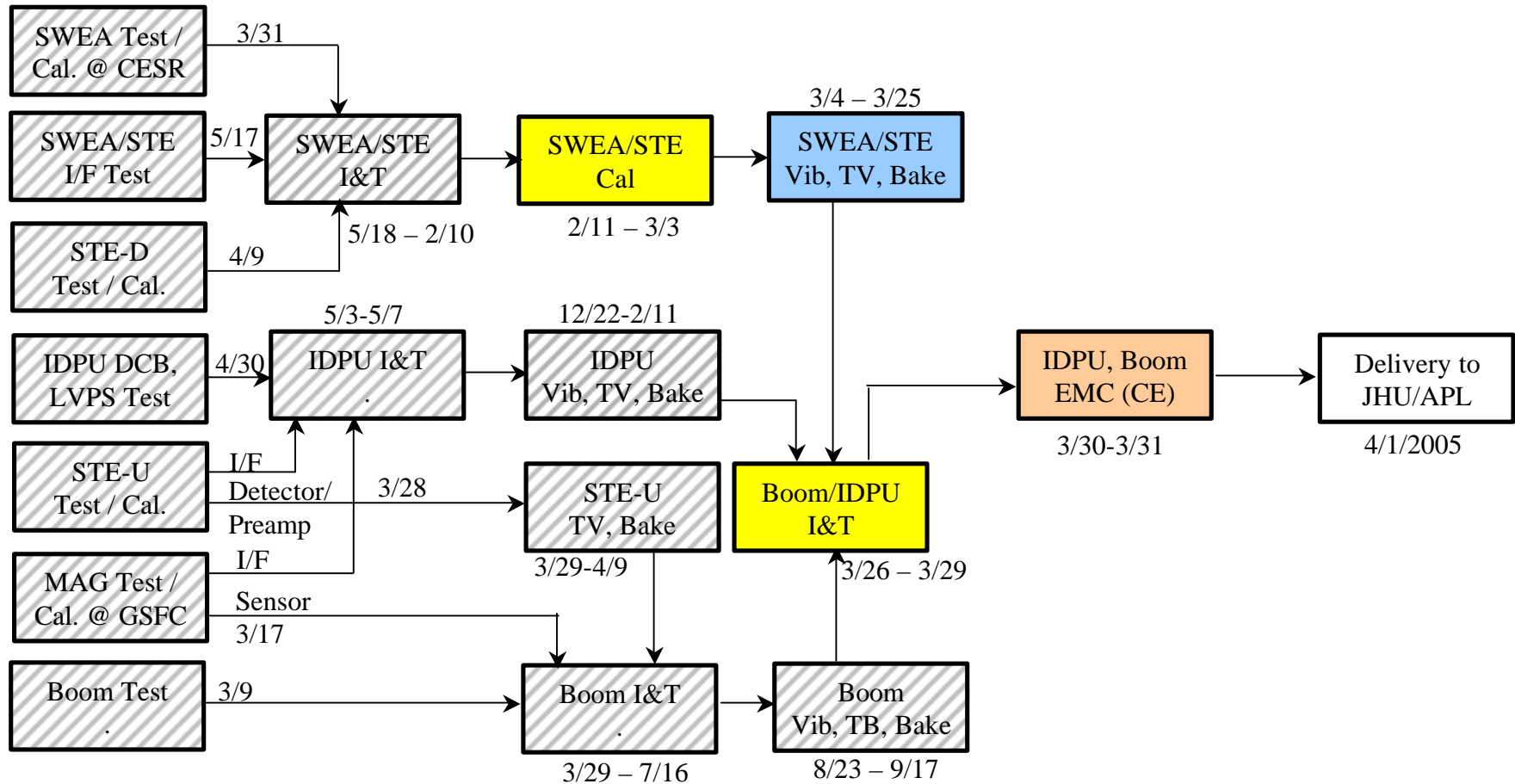
Review History

- **IMPACT held a suite-level PER in January 2004 to cover general plans and the detailed plans of the first instruments (SEPT)**
- **A more detailed Technical Readiness Review was held for each IMPACT subsystem as it became ready to start environmental tests**
 - **The TRR for the IMPACT Instrument Data Processing Unit (IDPU) was held on October 5 2004**
- **This PSR covers just the FM1 IDPU, which has completed testing and is ready to ship to APL for integration with the spacecraft starting March 10.**
 - **Other IMPACT hardware has also completed testing but the spacecraft is not yet ready to install it**
 - **This PSR also covers the FM1 IDPU to Boom and IDPU to SEP harnesses which will be delivered with the FM1 IDPU**
- **Subsequent PSRs will be held for the remaining hardware when it is through testing and the spacecraft is ready to install it.**

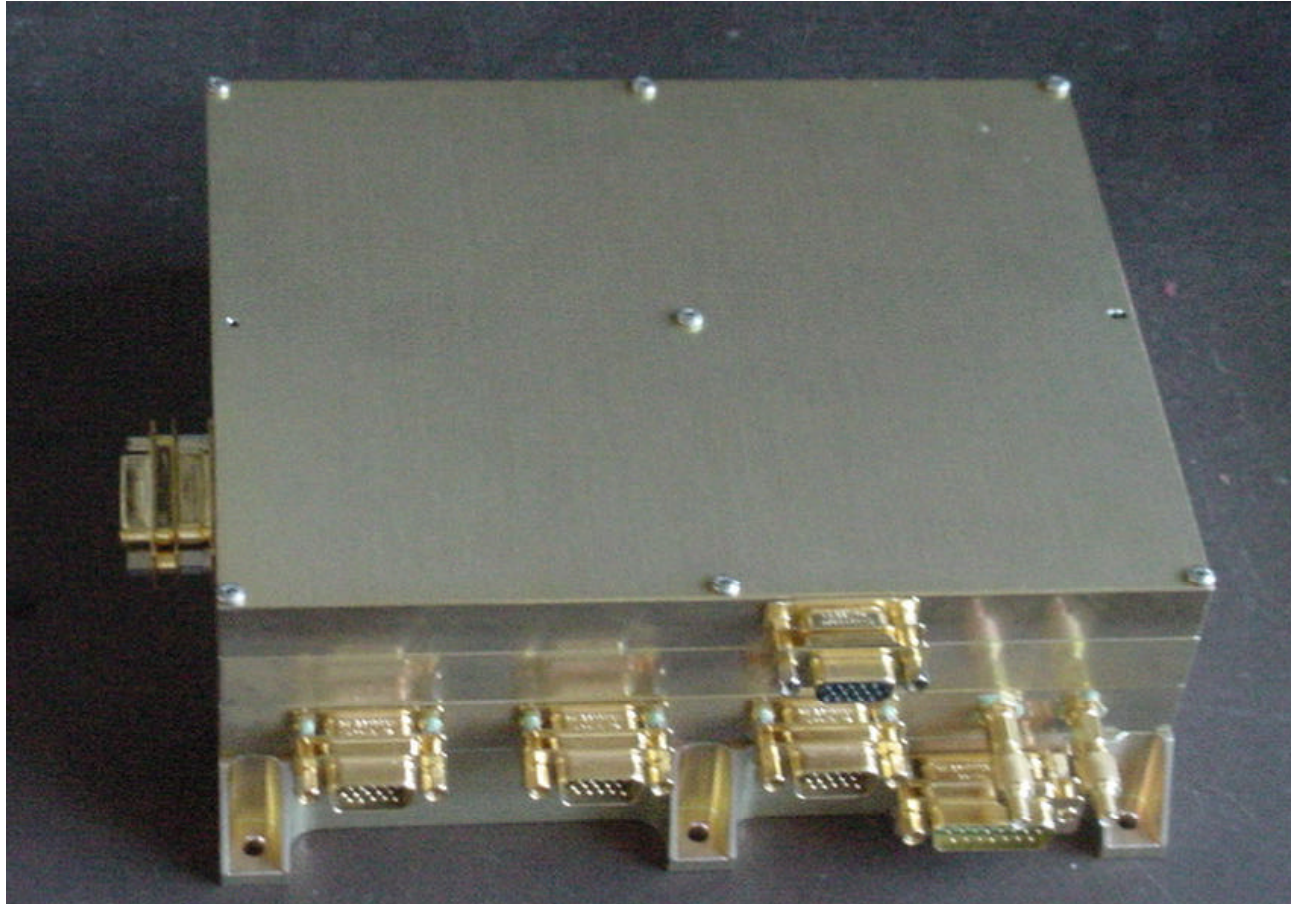
Boom Suite FM1 Test Flow (2/23/05)



Boom Suite FM2 Test Flow (2/23/05)



IMPACT FM1 IDPU



FM1 IDPU Test History

- **10/18 – 11/1 EMC test with the full IMPACT Suite**
 - Excess CE in MAG Heater resulted in minor modifications to the heater input filter after the EMC test, followed by a CE test on the MAG Heater
 - EMC test exceedances have been accepted by the EMC committee; the official waiver is in process.
- **11/18 Vibration test. No problems.**
- **11/19 – 11/23 Thermal Vac cycles 1,2**
 - Failed to start at low bus voltage (PFR1027). Failed diode. Replaced, returned to test
- **11/24 – 12/4 Thermal Vac cycles 3-5**
 - Decided to replace replacement diode with one from a new lot
- **12/18 – 12/22 Thermal Vac cycles 6,7. No problems**
- **1/14 Replace reverse-biased capacitors**
 - discovered in FM2 testing, PFR 1032
- **1/21 – 1/31 Repeat Thermal Vac, 4 cycles, no problems**
- **2/14 Workmanship vibration, passed**
- **2/15 – 2/16 Qualification Bakeout, Passed**
- **2/23 Magnetics test, passed**
- **2/24-2/25 Load new software (v25), software acceptance test**
- **2/28 –3/8 Integrate with Boom Suite, Collect Operating Hours**

IDPU Verification Matrix

		Verification Matrix for STEREO/IMPACT/IDPU																		
Hardware Description		Test																		
Level of Assembly	Item	Elect. test, rm. Temp	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Pressure change	Voltage margins	Thermal Vacuum	Thermal balance	>100 hours Operation	EMC/EMI	Magnetics	Leak	Bakeout	Mass Properties	Outgassing	Contamination
C	PWB, EM	C	C	C						C			C							
I	IDPU EM	C								C			C	C						
C	PWB, F	C	C	C						C			C							
I	IDPU, FM1	C	C	C	C	C			A	C	C		C	C	C		C	X	C	X
I	IDPU, FM2	C	C	C	C	C			A	C	C		C	X	X		C	X	C	X
Legend:																				
	Level of Assembly	Unit Type				X = Test required														
	C = Component	BB =	Breadboard			A = Analysis														
	I = Instrument	EM =	Engineering Model			H = at higher level of assembly														
		PT =	Prototype			C = Test Completed														
		PF =	Protoflight																	
		F =	Flight																	

Full IMPACT Verification Matrix at:

http://sprg.ssl.berkeley.edu/impact/dwc/Verification/IMPACTVerificationMatrix_2005-3-1.pdf

IDPU FM1 Problem/Failures, pre-PER

- **All power converters had a problem with the LTC1877 regulator used to generate 2.5V (PFR1007)**
 - Part was over-stressed in screening
 - Some parts failed in circuit
 - The burn-in fixture used by the screening house was reworked and a new lot of parts was screened
 - All flight parts have been replaced with parts from this new lot.
- **A second part in the FM1 IDPU LVPS was damaged due to a layout error (PFR1012)**
 - The failed part and all potentially stressed parts were replaced
- **These PFRs have been signed-off and closed (not “Red-Flag” PFRs)**

IDPU FM1 Problem/Failures since PER

- **PFR1027:**
 - The FM1 IDPU failed to turn on at bus voltages below 26V
 - Discovered in the first cycle of thermal vac.
 - Problem caused by a shorted diode
 - Failure analysis of diode was inconclusive as to cause
 - No other parts were stressed by the shorted diode
 - Diode was replaced and cycling continued
 - Later the diode was replaced again with a part from a newer lot date code
 - Between Thermal Vac cycles 5 and 6
- **PFR1032:**
 - The FM2 IDPU failed cold-start in Thermal Vac in the last cycle
 - Root cause tracked to a reverse-biased Tantalum capacitor
 - Silk screen on PWB was wrong
 - Increased leakage cause the circuit to fail
 - No other parts were stressed by the increased leakage
 - An investigation found another instance of this problem in the SEP supply
 - All effected units had the reverse-biased capacitors replaced
 - Both IDPU units had 4 more cycles of thermal vac and a workmanship vibration
- **These PFRs have been signed-off and closed (not “Red-Flag” PFRs)**

Waivers

- **Pre-environmental waivers related to the IDPU involve waivers to the EMC requirements, including:**
 - **CCR460-26 and CCR460-41 regarding single-ended interfaces to instruments**
 - **EMC committee approved IMPACT design**
 - **CCR460-40 regarding IDPU to STE distributed secondary power**
 - **EMC committee approved IMPACT design**
 - **CCR463-132 regarding harness shielding thickness (deep dielectric discharge)**
 - **EMC committee approved IMPACT design**
 - **CCR462-9, 19, 66, 134 regarding IMPACT Suite power consumption**
- **Waivers can be found at:**
 - **<http://sprg.ssl.berkeley.edu/impact/dwc/Waivers/>**
- **All Waivers approved by CCB**

Environmental Tests

- Test Plans/Procedures can be found at:
 - <http://sprg.ssl.berkeley.edu/impact/dwc/TestProcs/>
 - EMC: http://sprg.ssl.berkeley.edu/impact/dwc/TestProcs/IMPACT-EMC_C.pdf
 - CPT: http://sprg.ssl.berkeley.edu/impact/dwc/TestProcs/IMPACT-IDPU-CPT_G.pdf
 - Vibration: <http://sprg.ssl.berkeley.edu/impact/dwc/TestProcs/IMP-585-DOC--%20IDPU%20Vibration%20Test%20Procedure.pdf>
 - Tvac: http://sprg.ssl.berkeley.edu/impact/dwc/TestProcs/IMPACT-IDPU_TvacProc_A.pdf
- Test Reports can be found at:
 - <http://sprg.ssl.berkeley.edu/impact/dwc/TestReports/>
 - EMC: <http://sprg.ssl.berkeley.edu/impact/dwc/TestReports/02-15-05%20UCBerkeley%20Stereo%20Impact%20Prep%20TR.pdf>
 - Tvac: <http://sprg.ssl.berkeley.edu/impact/dwc/TestReports/IMPACT-IDPU-FM1-TVac-Report-B.pdf>
 - Magnetics: <http://sprg.ssl.berkeley.edu/impact/dwc/TestReports/IMPACT-IDPU-FM1-Magnetics-Report.pdf>
 - Vibration: <http://sprg.ssl.berkeley.edu/impact/dwc/TestReports/IMP-595-DOC%20STEREO%20IDPU%20FM1%20Vibration%20Report%20R-.pdf>

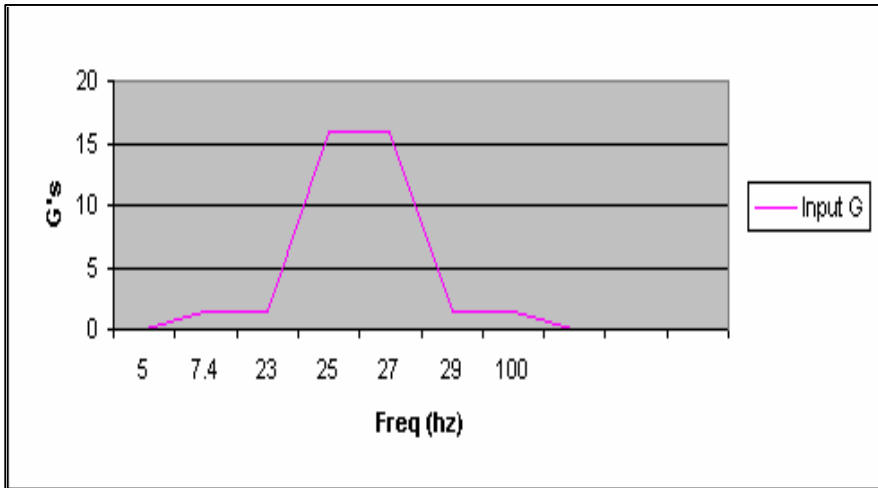
IMPACT Suite EMC Tests

- **The IMPACT Suite was integrated and completed EMC tests per the Project EMC Requirements document (7381-9030C) and the IMPACT EMC Test Plan (Rev C)**
 - **Bonding & Isolation**
 - **CE01, CE03, CE07 (5 power services)**
 - **CS01, CS02, CS06 (5 power services)**
 - **RE01, RE02**
 - **RS03**
- **One pre-test waiver involving some hardware that was not quite in flight configuration was approved by Project (CCR 463-179A)**
- **Testing completed at EMC Tempest in Anaheim**
 - **Detailed Facility Test Report provided**

EMC Test Results

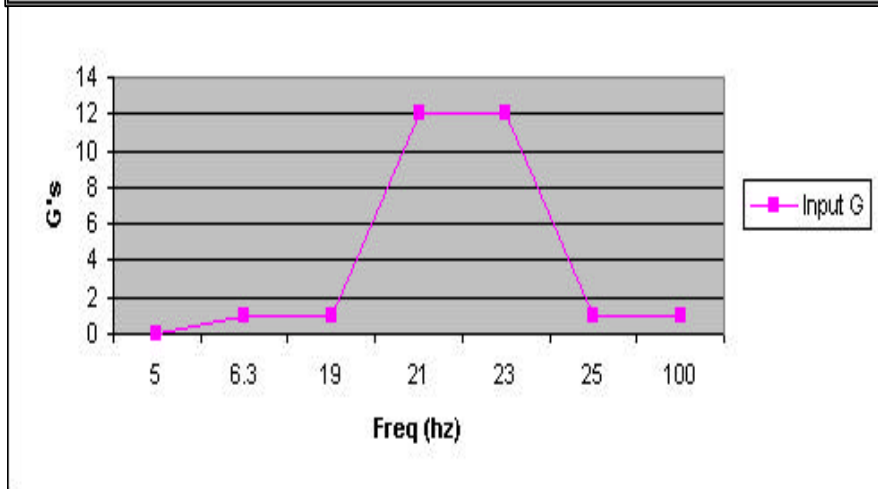
- **A number of exceedances and sensitivities were found and worked with the EMC committee in real time**
 - **RE01**
 - **MAG drive frequency & harmonics**
 - **SEP serial interface clock**
 - **RE02**
 - **IDPU, SEP Clock harmonics, 24MHz-1.4GHz, all crystal controlled**
 - **RS – some detector noise 100MHz-4GHz, eliminated when amplitude was lowered -6dB**
 - **No damage**
 - **STE was sensitive near the spacecraft transponder frequency (8.5GHz)**
 - **only to severe AM modulation, not FM**
 - **CE**
 - **MAG and SEP Converter Harmonics**
 - **Fixed after the test (harness routing); passed retest**
 - **A few other exceedances seen (clocks)**
 - **CS - Some detector noise, eliminated when amplitude drops -6dB**
 - **Some 1553 errors (CS06), handled correctly**
 - **No damage**
- **EMC Committee agrees no serious issues. Official waiver in progress.**

IDPU Vibration Testing – Sine Strength Levels



Thrust Axis (X-axis)

Freq	G
5-7.4	[.5" DA]
7.4	1.4
23	1.4
25	16
27	16
29	1.4
100	1.4



Lateral Axes (Y- and Z-axes)

Freq	G
5-6.3	[.5" DA]
6.3	1
19	1
21	12
23	12
25	1
100	1

IDPU Vibration Testing – Random Levels

Random Vibration Specification

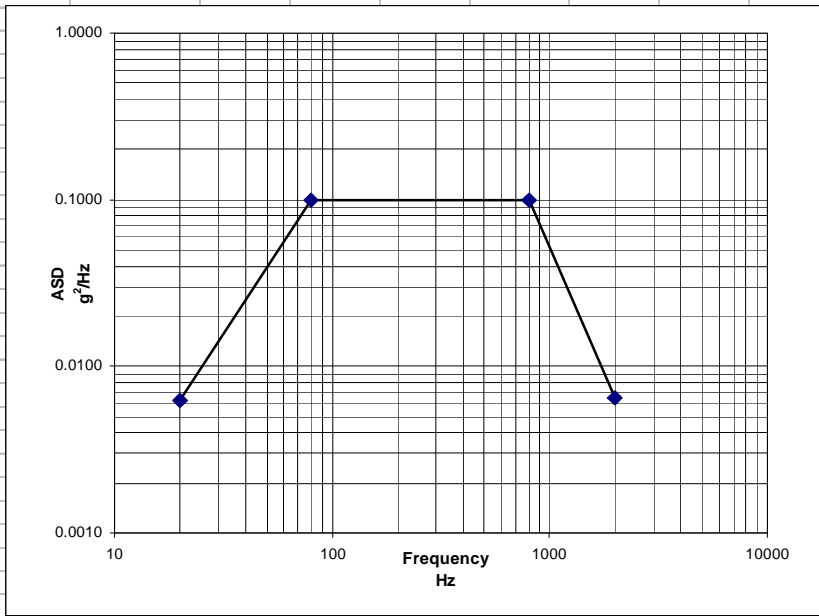
STEREO BOOM

REF: APL 7381-9003 REV A

Duration: 60 Seconds

Axis: Perpendicular to S/C Mounting Panel

FREQ(Hz)	ASD(G ² /Hz)	dB	OCT	Slope		Acceleration	
				dB/OCT	AREA	Grms	
20	0.0063	*	*	*	*	*	*
80	0.1000	12.01	2.00	6.00	2.63	1.62	
800	0.1000	0.00	3.32	0.00	74.63	8.64	
2000	0.0065	-11.87	1.32	-8.98	108.42	10.41	



Thrust Axis (X-axis)

Random Vibration Specification

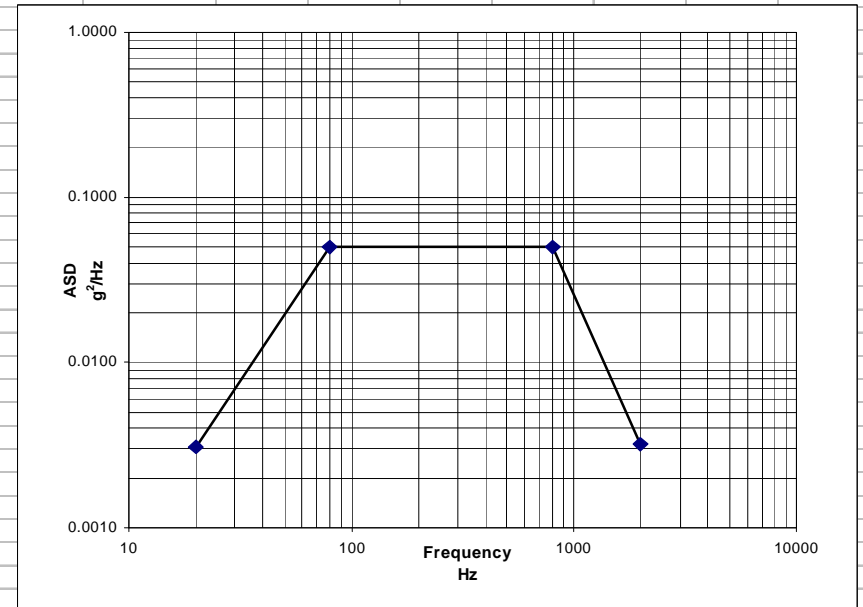
STEREO BOOM

REF: APL 7381-9003 REV A

Duration: 60 Seconds

Axis: Parallel to S/C Mounting Panel

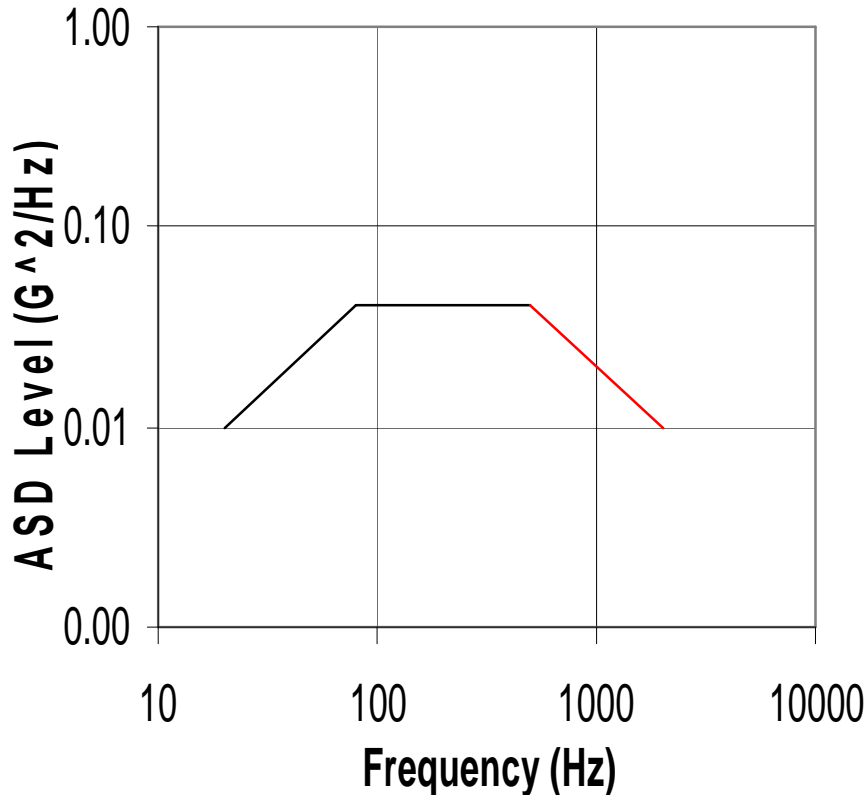
FREQ(Hz)	ASD(G ² /Hz)	dB	OCT	Slope		Acceleration	
				dB/OCT	AREA	Grms	
20	0.0031	*	*	*	*	*	*
80	0.0500	12.08	2.00	6.04	1.31	1.14	
800	0.0500	0.00	3.32	0.00	37.31	6.11	
2000	0.0032	-11.94	1.32	-9.03	54.11	7.36	



Lateral Axes (Y- and Z-axes)

IDPU Vibration Testing – Retest Levels

X-AXIS ACCELERATION SPECTRAL
DENSITY PLOT



GEVS Minimum Workmanship Levels

- Overall Amplitude = 6.8 g rms
- Duration = 60 seconds

Frequency (Hz)	PSD Level
20	0.01 g ² /Hz
20 to 80	+3.0 dB/oct
80 to 500	0.04 g ² /Hz
500 to 2000	-3.0 dB/oct
2000	0.01 g ² /Hz

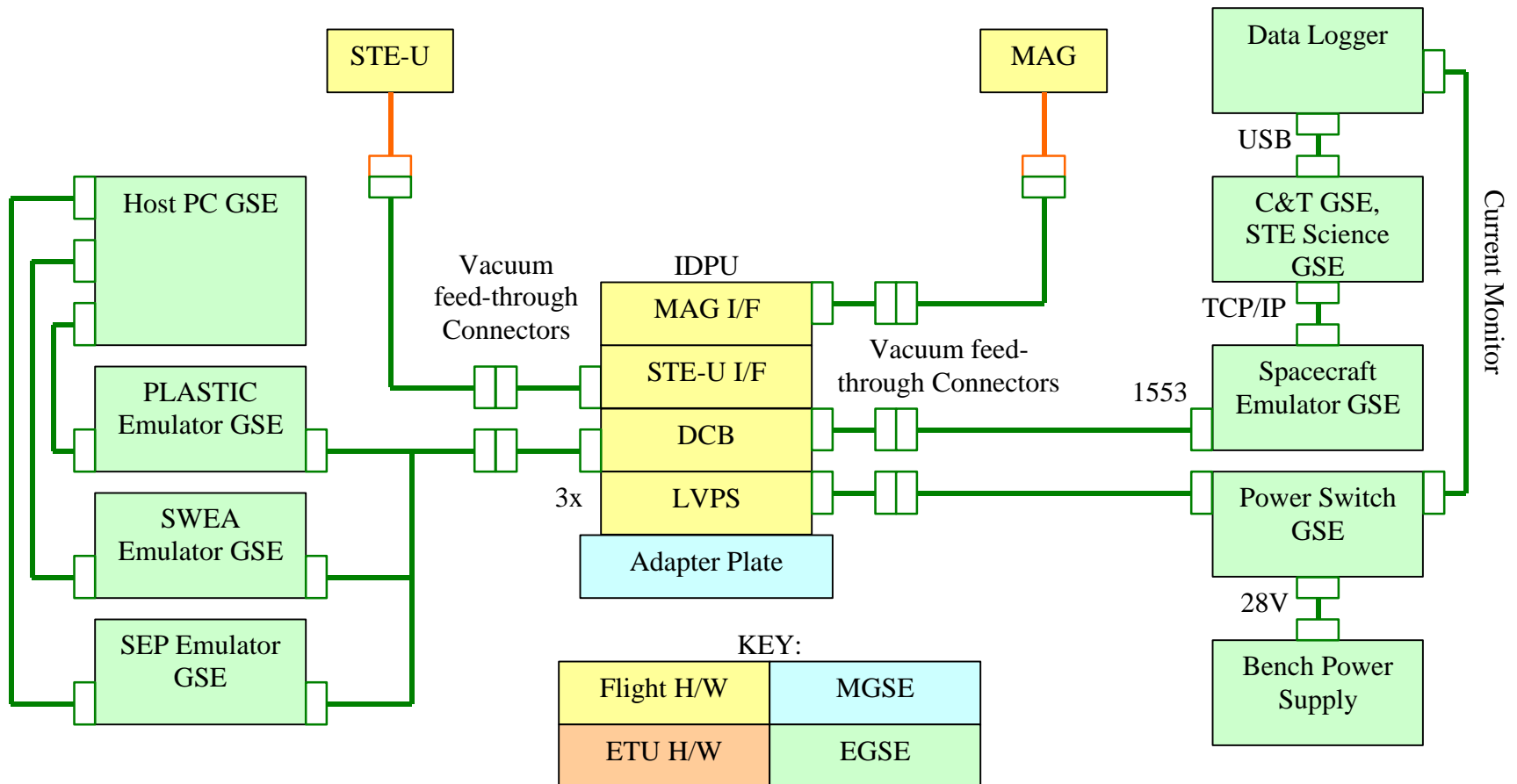
IDPU Vibration Testing – Results

- **All axes performed**
- **No notching performed**
- **Retest performed**
- **No structural degradation or loss of functionality**

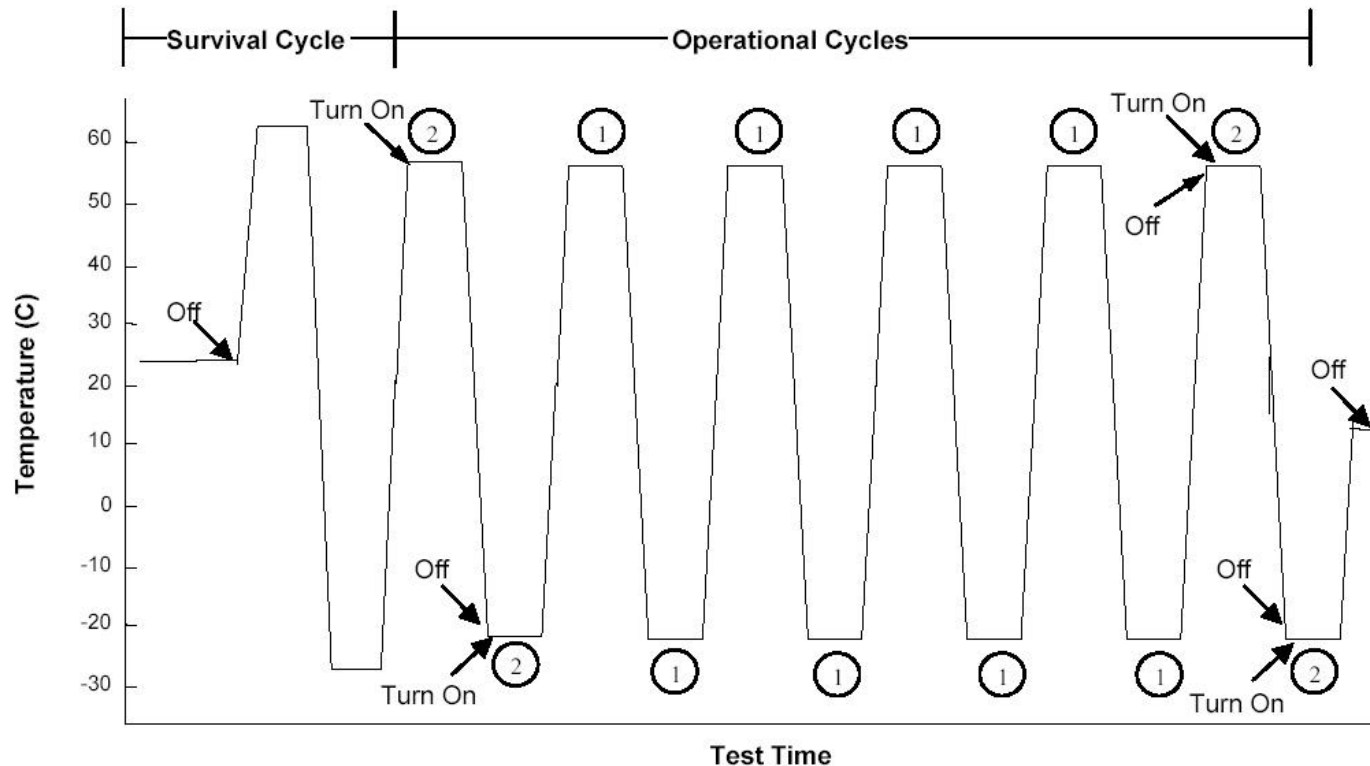
IDPU Thermal Vacuum Test

- **Test Plan:**
 - **Preliminary bakeout, up to 48 hours at +60C**
 - **Thermal vac, 6 op cycles (-23 to +55C) plus one non-op cycle (-28 to +60C)**
 - **Temperatures from APL requirements; IDPU is inside spacecraft and thermally coupled to it.**
 - **CPT on each operational cycle, cold-start in first and last cycles**
 - **Qualification bakeout**

IDPU CPT / Thermal Vacuum Setup



IDPU Thermal Cycling



See Table 2.3-1 for component dependant test temperatures.

Stabilization Criteria: Within 3°C Of Plateau And Changing < 1°C/Hr

See Fig 2.3.3.2-2 and -3 for detailed hot and cold transition definitions, resp.

① = Stabilize, Print T/C's, Soak 1Hour
and Test Concurrently, Print T/C's

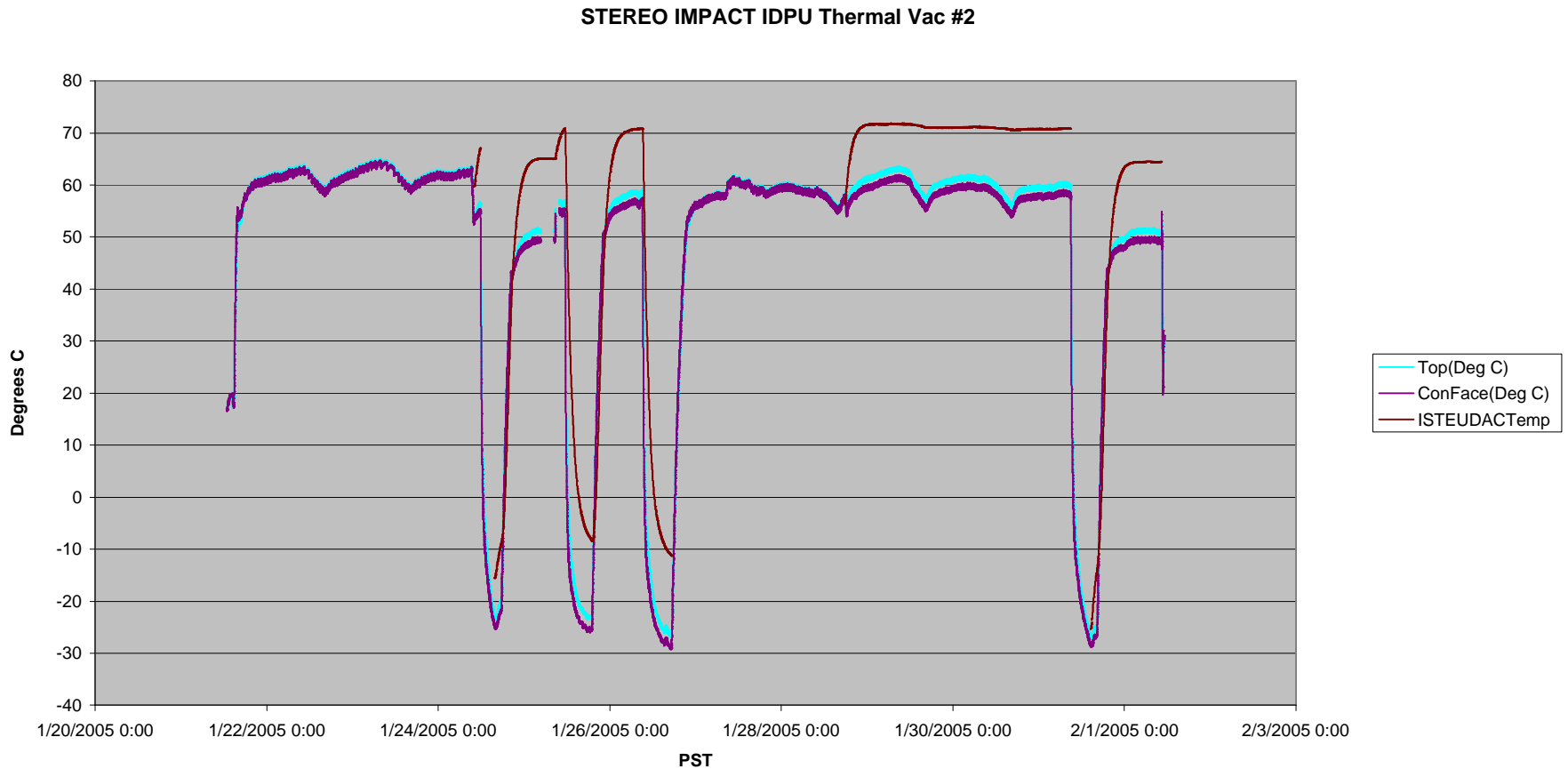
Six Operational Cycles Required

② = Stabilize, Turn On, Soak 1Hour and Test
Concurrently, Print T/C's at End of Soak

FM1 IDPU Thermal Vacuum Test Results

- **As mentioned above, the test was interrupted twice to deal with PFR1027**
- **A later failure in the FM2 unit (PFR1032) required a repair to the FM1 unit followed by a 4-cycle retest**
 - **All operational cycles, with cold-start demonstration on first and last cycles, CPTs at each soak.**
- **There were no other problems encountered**
- **Temperatures were controlled with Thermocouples attached to the outside of the instrument**
 - **Internal temperature sensor ran 10-15C warmer than the outside when IDPU was operational**
- **No significant trends or adverse temperature dependencies were seen**

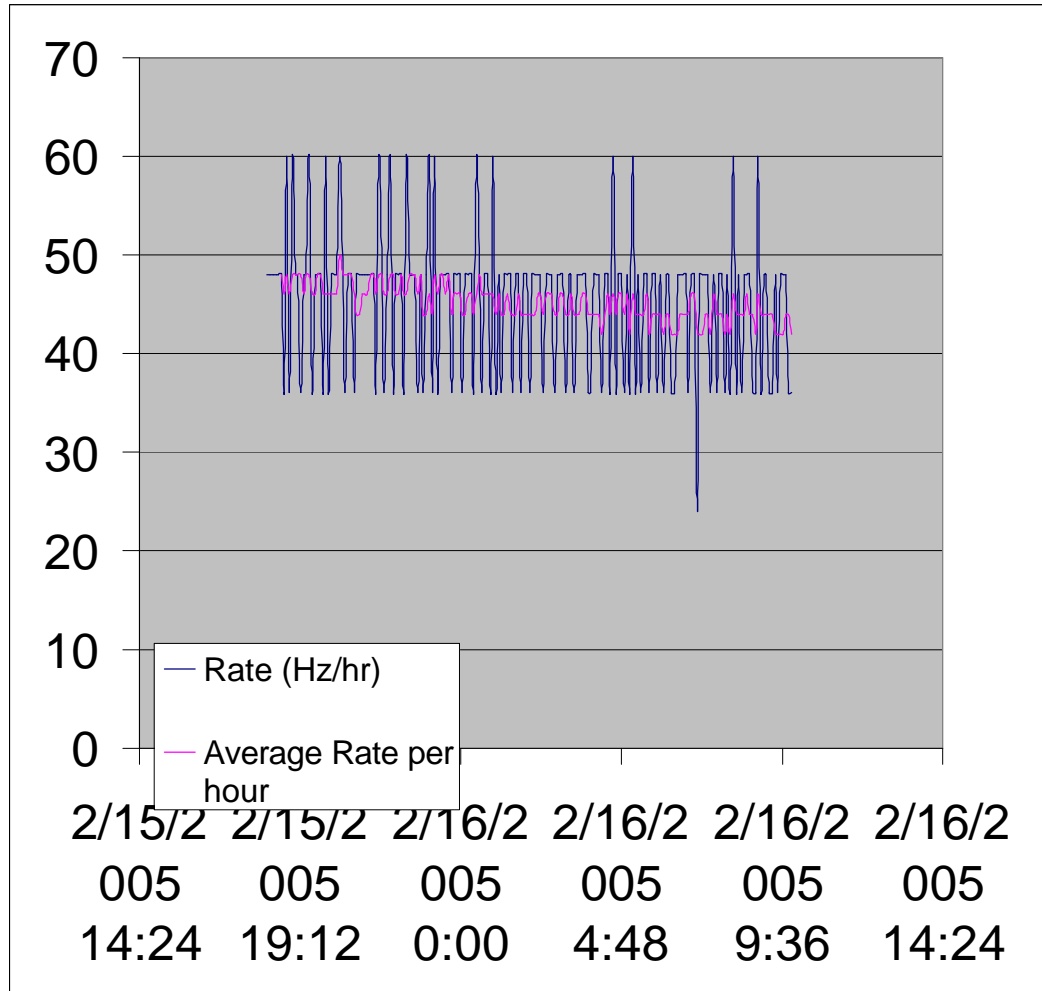
Last 4 Cycles of FM1 IDPU Thermal Vac



IDPU Bakeout Results

- **Following thermal vac, a bakeout of the two IDPU units was performed using a TQCM-monitored chamber**
- **Rates seen were 45Hz/hour, corresponding to an outgassing rate of 3.4E-13 g/cm²/sec (per unit), compared to a requirement of < 5e-11.**

IDPU Bakeout TQCM data



FM1 IDPU Magnetics Test

- **The IDPU was rotated while monitoring the magnetic field 60cm away.**
 - Repeated for each of 3 axes
 - Measured field was ~20nT peak to peak, corresponding to a magnetic moment of 5-10nT-m³, and a worst case field at the Magnetometer sensor of ~0.08nT (full spacecraft objective is 1nT DC).
 - MAG Col finds the level acceptable.
- **The IDPU was power cycled while monitoring the field 30cm away**
 - No signature was detectable, meaning less than 5nT, corresponding to an upper limit on the AC field at the sensor of <.005nT, compared to a spacecraft-level objective of <0.05nT.

Performance Data

- **Mag, STE-U and Power Supply measurements were trended throughout testing**
 - **MAG and STE-U analog interfaces included In the IDPU**
 - **No significant trends were found**
- **All performance measurements met or exceeded the requirements**
 - **Current processor load is 58%, code space is 54% of available memory**
 - **Anticipate no problems accommodating remaining PLASTIC software tasks**
- **MAG and STE-U performance details to be reported at the boom Pre-Ship review**

Sample Trend Data

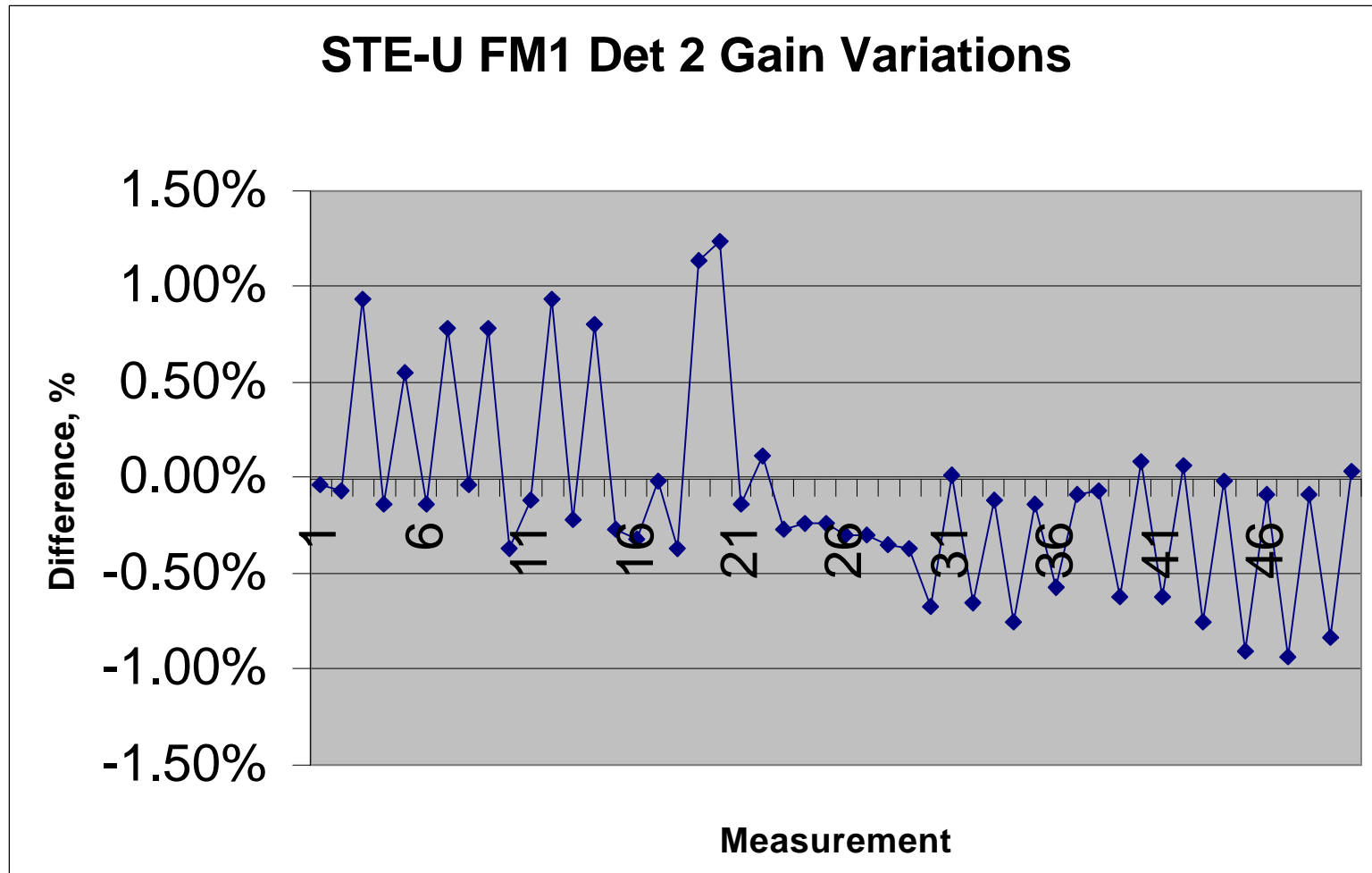
IDPU FM1 Performance Trend

Date	File	Test	S/W Version	IDPU Temp	Primary Current, mA	2.5V	5VD	5VA	12VA	STE-U?
Oct 1 2004	0410011640.tlm	Boom I&T, less SWEA	24	Ambient	222	2.50	4.98	4.87	12.84	FM1
Oct 16 2004	0410160000.tlm	Suite I&T, pre EMC	24	Ambient	238	2.48	4.98	4.86	12.81	FM1
Nov 3 2004	0411031353.tlm	Post EMC @ UCB	24	Ambient	223	2.49	4.98	4.85	12.84	FM1
Nov 17 2004	0411171046.tlm	Pre IDPU Vib	24	Ambient	215	2.49	4.98	4.86	12.85	FM1
Nov 18 2004	0411181804.tlm	Post IDPU Vib	24	Ambient	216	2.49	4.98	4.86	12.86	FM1
Nov 22 2004	0411221349.tlm	IDPU Tvac Hot 2	24	54.9	222	2.49	4.97	4.83	12.89	FM1
Nov 22 2004	0411221349.tlm	IDPU Tvac Cold 2	24	-33.3	222	2.51	4.99	4.91	12.82	FM1
Nov 29 2004	0411290000.tlm	IDPU Tvac Hot 3	24	64.2	196	2.49	4.97	4.82	12.90	FM1
Nov 29 2004	0411290000.tlm	IDPU Tvac Cold 3	24	-27.9	194	2.51	4.99	4.91	12.81	FM1
Nov 30 2004	0411300000.tlm	IDPU Tvac Hot 4	24	64.7	198	2.49	4.97	4.83	12.90	FM1
Nov 30 2004	0411300000.tlm	IDPU Tvac Cold 4	24	-20.7	193	2.50	4.99	4.90	12.82	FM1
Dec 1 2004	0412010000.tlm	IDPU Tvac Hot 5	24	65	199	2.49	4.97	4.82	12.90	FM1
Dec 1 2004	0412010000.tlm	IDPU Tvac Cold 5	24	-13	193	2.50	4.99	4.90	12.82	FM1
Dec 17 2004	0412171330.tlm	IDPU post-vib	24	24	190	2.49	4.98	4.86	12.84	FM1
Dec 20 2004	0412201426.tlm	IDPU Tvac Hot 6	24	58.2	198	2.49	4.97	4.83	12.89	FM1
Dec 20 2004	0412201426.tlm	IDPU Tvac Cold 6	24	-15.9	194	2.50	4.99	4.90	12.81	FM1
Dec 21 2004	0412210000.tlm	IDPU Tvac Hot 7	24	69.6	197	2.49	4.97	4.82	12.87	FM1
Dec 21 2004	0412210000.tlm	IDPU Tvac Cold 7	24	-7.5	196	2.50	4.99	4.89	12.81	FM1
Jan 24 2005	0501240956.tlm	IDPU Tvac2 Hot 1	24	61.1	195	2.49	4.97	4.82	12.88	FM1
Jan 24 2005	0501240956.tlm	IDPU Tvac2 Cold 1	24	-14.2	195	2.50	4.99	4.90	12.81	FM1
Jan 25 2005	0501250000.tlm	IDPU Tvac2 Hot 2	24	69.9	200	2.49	4.97	4.82	12.88	FM1
Jan 25 2005	0501250000.tlm	IDPU Tvac2 Cold 2	24	-6.6	201	2.50	4.99	4.89	12.80	FM1
Jan 26 2005	0501260000.tlm	IDPU Tvac2 Hot 3	24	70.8	197	2.49	4.97	4.82	12.88	FM1
Jan 26 2005	0501260000.tlm	IDPU Tvac2 Cold 3	24	-10.4	193	2.50	4.99	4.89	12.81	FM1
Jan 29 2005	0501290000.tlm	IDPU Tvac2 Hot 4	24	71.6	196	2.49	4.97	4.82	12.88	FM1
Jan 31 2005	0501310000.tlm	IDPU Tvac2 Cold 4	24	-22.5	195	2.51	4.99	4.90	12.80	FM1
Feb 14 2005	0502150000.tlm	IDPU Post-vib	24	31.5	192	2.49	4.98	4.85	12.85	FM1

Fix soft start

Fix reverse biased tantalum

Sample Trend Data



IDPU Flight Software

- **PROM boot code (Rev 0, 2004-10-14) is complete, passed Acceptance Tests, and has been in place for ~1 year. No issues.**
- **IMPACT Instrument code (Rev 25, 2005-02-25) is complete and passed acceptance tests. No outstanding issues**
- **PLASTIC Instrument code is still in progress**
 - **Current version includes PLASTIC rev 2.6**
 - **Stable but missing several functions**
 - **Once PLASTIC code is complete, acceptance tests will be repeated**
- **Instrument code is held in EEPROM (4 copies), and can be easily loaded from the POC by commands**
 - **Takes ~ 5 minutes/copy**

Operating Hours

- **Most of the FM1 IDPU has operated for over 1,000 hours trouble free**
- **Since the last change (reverse biased capacitor, PFR1032)**
 - **Thermal Vac #2: 135.6 Hours**
 - **Post Vib CPT: 2.4 Hours**
 - **Software Load, Test: 34.5 Hours**
 - **Boom Suite I&T: ~48 hours so far, expect ~200 before shipping**

Quality Assurance

- **IMPACT Suite QA Issues worked through Ron Jackson at UCB**
 - UCB Independent Inspections by Jeremiah Tolbert
 - Supported by GSFC QA
 - Signs off on work orders, inspections, parts & materials lists, etc.
- **Parts Lists**
 - All IDPU Parts Lists approved except MAG
 - Pending final approval
 - Parts qualification, screening (including radiation) completed
- **IDPU Materials Lists Approved**
- **IDPU FM1 PFRs Closed**
 - PFRs can be found at: <http://sprg.ssl.berkeley.edu/impact/dwc/Problems/>
- **IDPU-related Waivers Closed**
 - Except FM1 Suite EMC Test Results waiver
 - Waivers can be found at: <http://sprg.ssl.berkeley.edu/impact/dwc/Waivers/>

Outstanding Issues

- **IMPACT FM1 EMC Waiver not signed off**
 - Official waiver should be into approval cycle shortly
- **IDPU Flight Software is not complete**
 - Will be loaded from the POC via the commanding system when it is complete and passed acceptance tests
 - Should be in place prior to PLASTIC integration on the spacecraft
- **IDPU does not currently have the required connector identifiers attached**
 - Will be kapton-taped to the box to avoid violating outgassing certification
- **Final mass properties and surface contamination screening still to be performed.**

FM1 Flight Harness

- **We plan to deliver the harnesses that go between the IDPU and the rest of the IMPACT suite along with the IDPU**
- **The FM1 flight harnesses passed:**
 - **Continuity test**
 - **Mass properties (just mass)**
 - **Hi-Pot test**
 - **Suite EMC Test**
 - **Outgassing test**
 - **Requirement $<5E-11\text{g/cm}^2/\text{sec}$, Measured = $1.1E-12\text{ g/cm}^2/\text{sec}$**
- **There have been no PFRs or other issues with the flight harness**
- **The only open issue with the harness is that the part of the harness that is inside the spacecraft needs a non-conductive over-wrap to avoid shorting the harness ground to spacecraft chassis ground in an unpredictable manner**
 - **To be performed at APL**
- **Harness is currently wrapped in lumalloy to keep it clean.**

GSE Status

- **IDPU GSE includes:**
 - **APL Spacecraft Emulator computer and software, used during bench tests**
 - **POC Command and Telemetry GSE and Science GSE computer and software**
 - **Includes Command and Telemetry Database**
 - **Displays all housekeeping, sends all commands**
 - **Has been in use for more than a year**
 - **Software & Database passed acceptance tests and under configuration control**
 - **Data Logger, power switching for bench testing**
 - **Simulates spacecraft functions**
 - **ETU MAG sensor and cable**
 - **Must be connected to IDPU when IDPU is powered until flight MAG is attached.**
- **All this GSE will be shipped to APL prior to delivery**
 - **Use in bench tests**
 - **Use POC (connected to Spacecraft ground system) after integration**

Immediate Plans

- **FM1 Boom Suite is currently integrated and collecting operating hours**
- **Kelly Henderson will come to UCB March 8 to do final contamination inspection**
- **While the instrument is de-bagged we will do final FM1 IDPU Mass Properties**
 - **Measured Mass is 1.90kg, Not to Exceed = 2.25kg**
 - **Still need CG**
- **Deliver to APL March 10**
 - **Hand-carried**
 - **Triple-bagged in lumalloy**
 - **Connector savers extend through inner bag**
 - **Outer bags are sealed, dry N2 back-filled.**
 - **All inside an Aluminum briefcase packed with bubble-wrap**
 - **Shock and humidity monitors will be included**
 - **Project to provide paperwork and advance warning to TSA, Airlines**

Post-Delivery Plans

- **On arrival at APL, FM1 IDPU will go through a bench CPT and contamination inspection prior to mating with the spacecraft**
- **An APL procedure will be used for spacecraft mating**
- **A safe-to-mate will be performed prior to electrical mating**
- **A post-mating functional will be run using the POC/MOC/Spacecraft/IDPU**
- **The SEP and Boom instruments will be shipped and integrated at a later date**
 - **SEP Suite is still in environmental tests**
 - **The FM1 Boom is ready, but cannot be installed on the spacecraft yet**
- **Other than loading software, there are no other post-delivery operations required on this unit and no safety issues.**