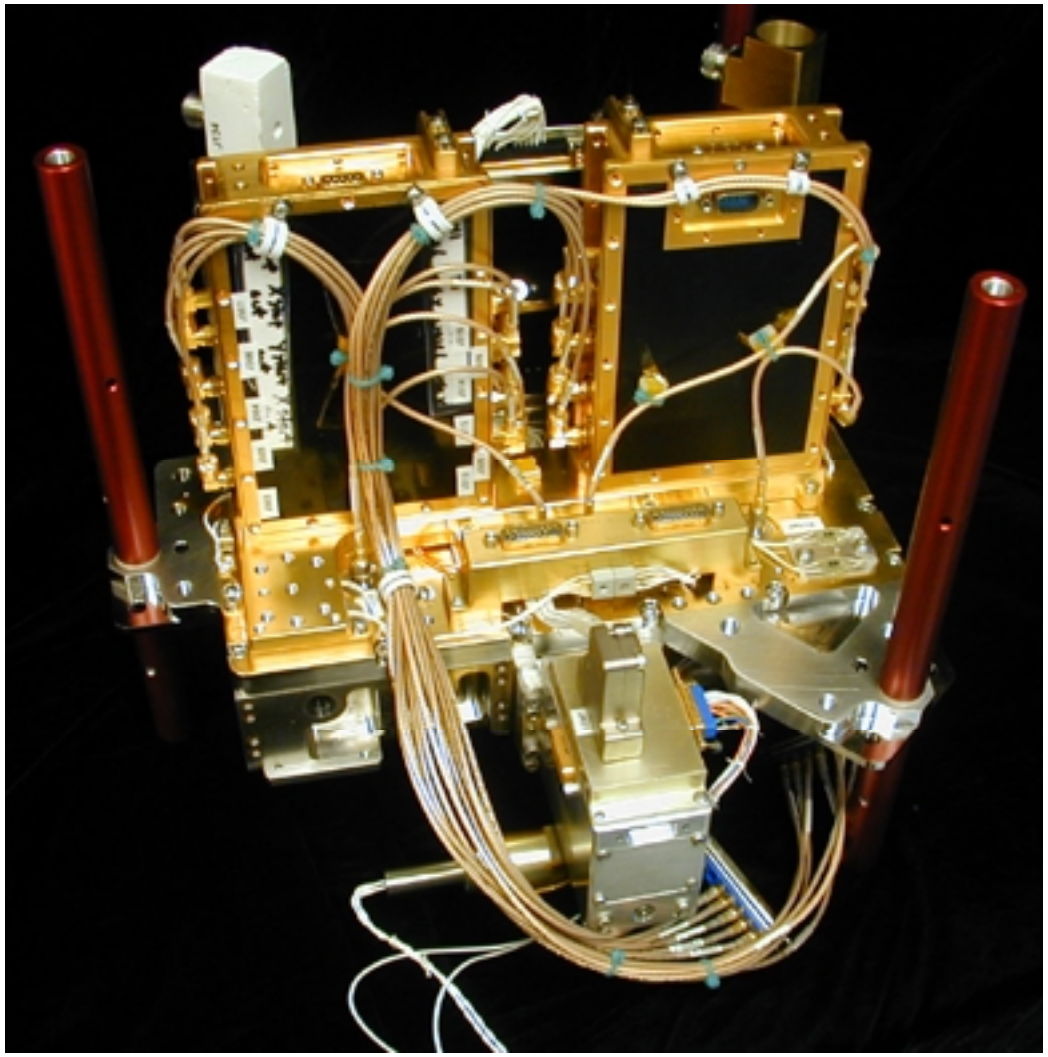
Center for Astrophysics and Space Astronomy



HST-COS

FUV Detector Pre-Environmental Review

November 8th 2000

Order of Presentation

Center for Astrophysics and Space Astronomy

Siegmund — PER Introduction/System Overview
- FUV System Specification/Description Overview
- FUV System Overview of Assemblies (DEB, DVA) + acronyms
- System Block Diagram
- Mass Budget Status
- Power Budget Status
- Power Application Matrix
- FUV Electronic Board Status
- DVA Status by sub-assembly:
  - BBA status
  - VHA status
  - HVFM Status
  - Amplifier Status
- DEB Status to-date by sub-assembly:
  - LVPC Status
  - HVPS Status
  - DCE Status — ACTEL Status
  - TDC Status — ACTEL Status — Thermal modelling Status

Gaines — Electronics Board Qualification Status
- Unit Test Summaries
  - Amplifiers
  - DCEs
  - TDCs
- Unit Cleanliness Status Matrix
  - Power Systems
  - Harnesses

Scholz — Quality Assurance
- Document Flowdown chart
- FUV Documentation Status
- CM Overview
  - ECs — Changes to System since Mission CDR
  - MOs
  - PFRs
  - Waivers
- Close-out/Open Items

Order of Presentation, ctd

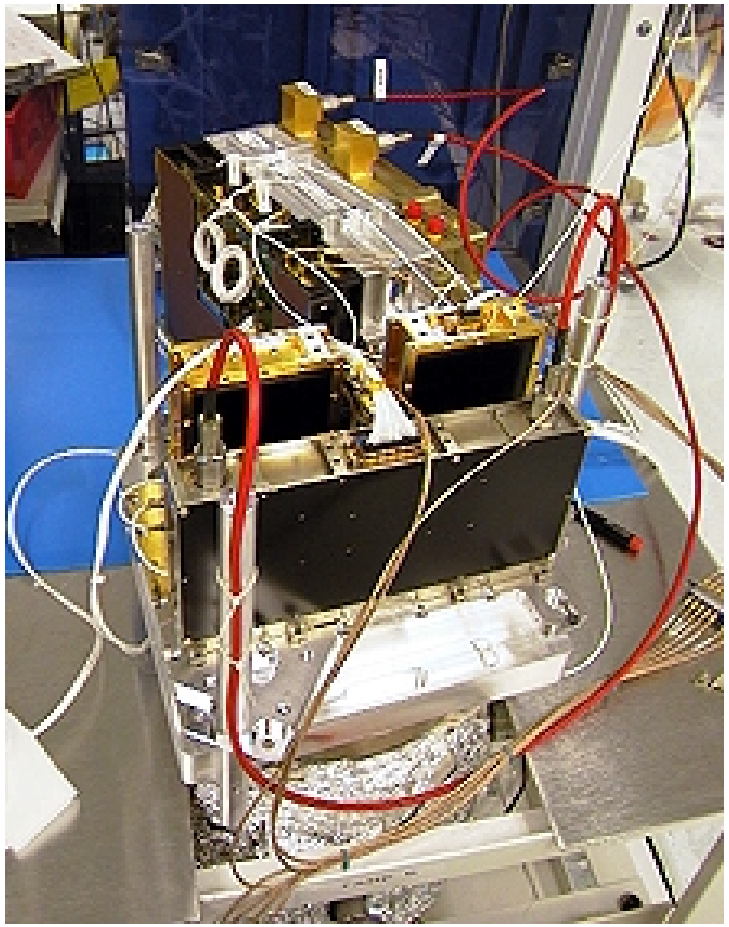
Donakowski — Mechanical Analysis
- Materials
- Fracture Control
- Stress analysis

McPhate — Performance Verification
- FUV Performance Verification Matrix
- FUV Detector Performance Requirements (SOR)
- Performance Test Flow
- Spatial Resolution
- Spatial Linearity
- Image Stability
- Deadtime
- Dark Count
- QE
- DVA Metrology Plan

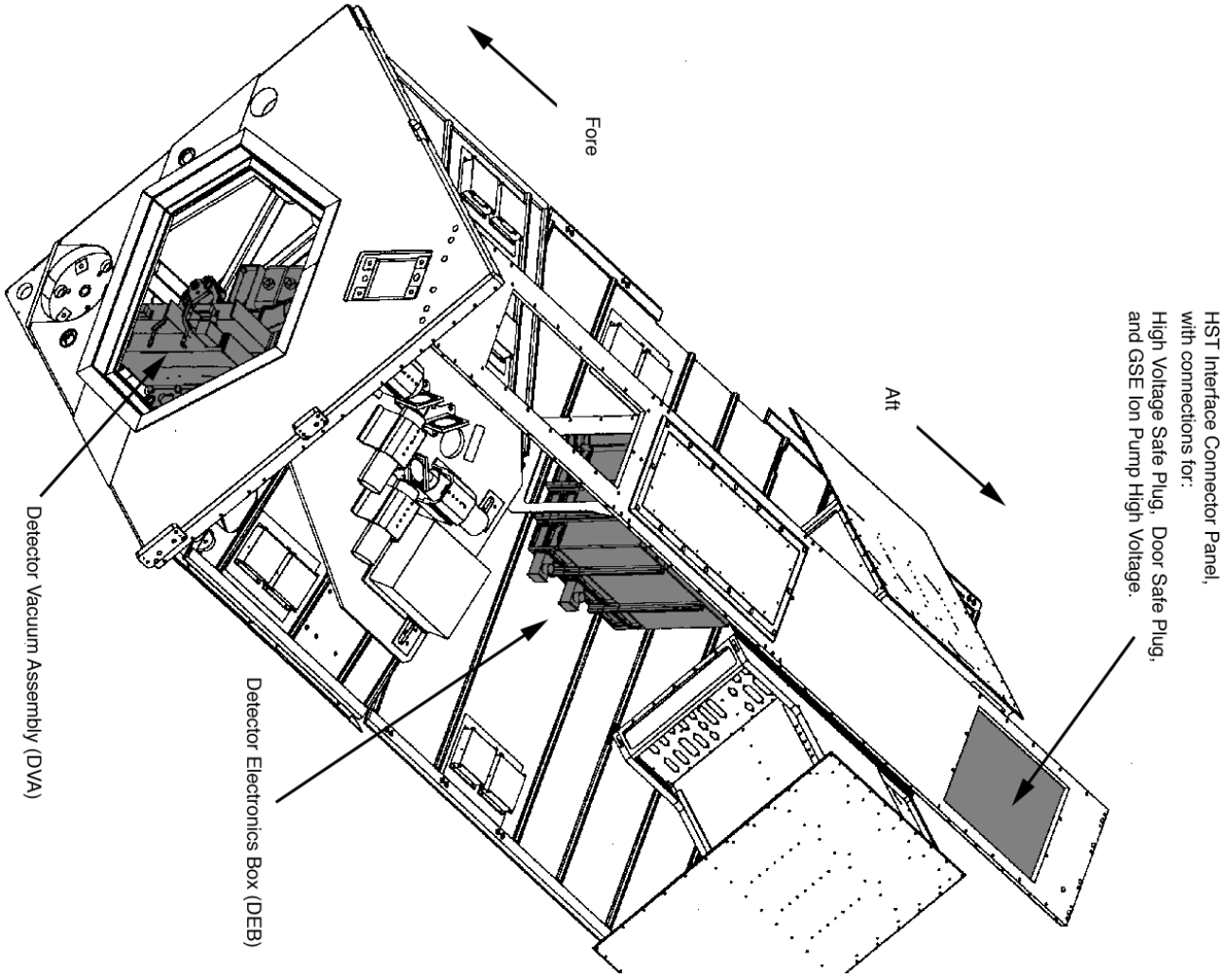
Welsh — FUV System Environmental Qualification Overview
- Overall FUV system test plan flow
- Detector Functional (short and long) test description
- Environmental Test Plan
  - Vibration Test Plan
  - EMI/EMC
  - Themal/Vacuum Testing
  - Cleanliness Cert
- Environmental Test Matrix
- FUV System Shipping Plan

FUV Detector System Introduction and Overview

Dr. Oswald Siegmund

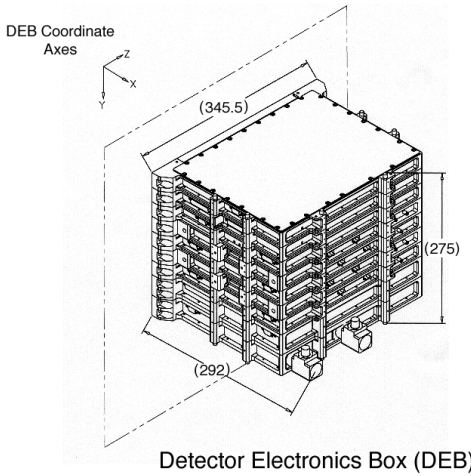


FUV DETECTOR IN COS SPECTROGRAPH



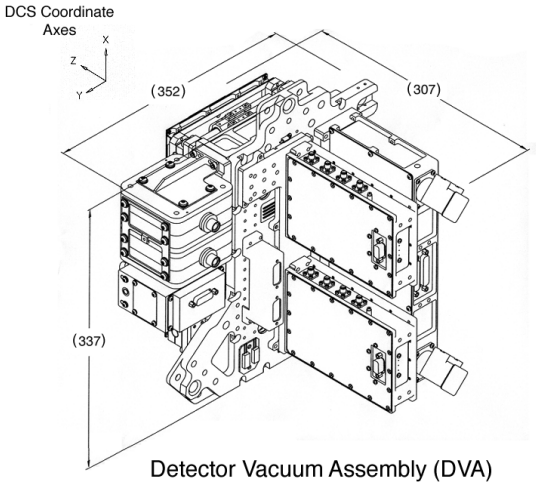
OVERVIEW OF FUV ASSEMBLIES

- **DEB** - (**D**etector **E**lectronics **B**ox)
  - **DCE** (**D**etector **C**ontrol **E**lectronics))
  - **TDCs** (**T**ime-**to-D**igital **C**onverters)
  - **HVPS** (**H**igh **V**oltage **P**ower **S**upply)
  - **LVPC**(**L**ow **V**oltage **P**ower **C**onverter)



Detector Electronics Box (DEB)

- **DVA** - (**D**etector **V**acuum **A**ssembly)
  - **VHA** (**V**acuum **H**ousing **A**ssembly)
  - **DBA** (**D**etector **B**ackplate **A**ssembly)
  - **Amplifiers**
  - **HVFM** (**H**igh **V**oltage **F**ilter **M**odule)

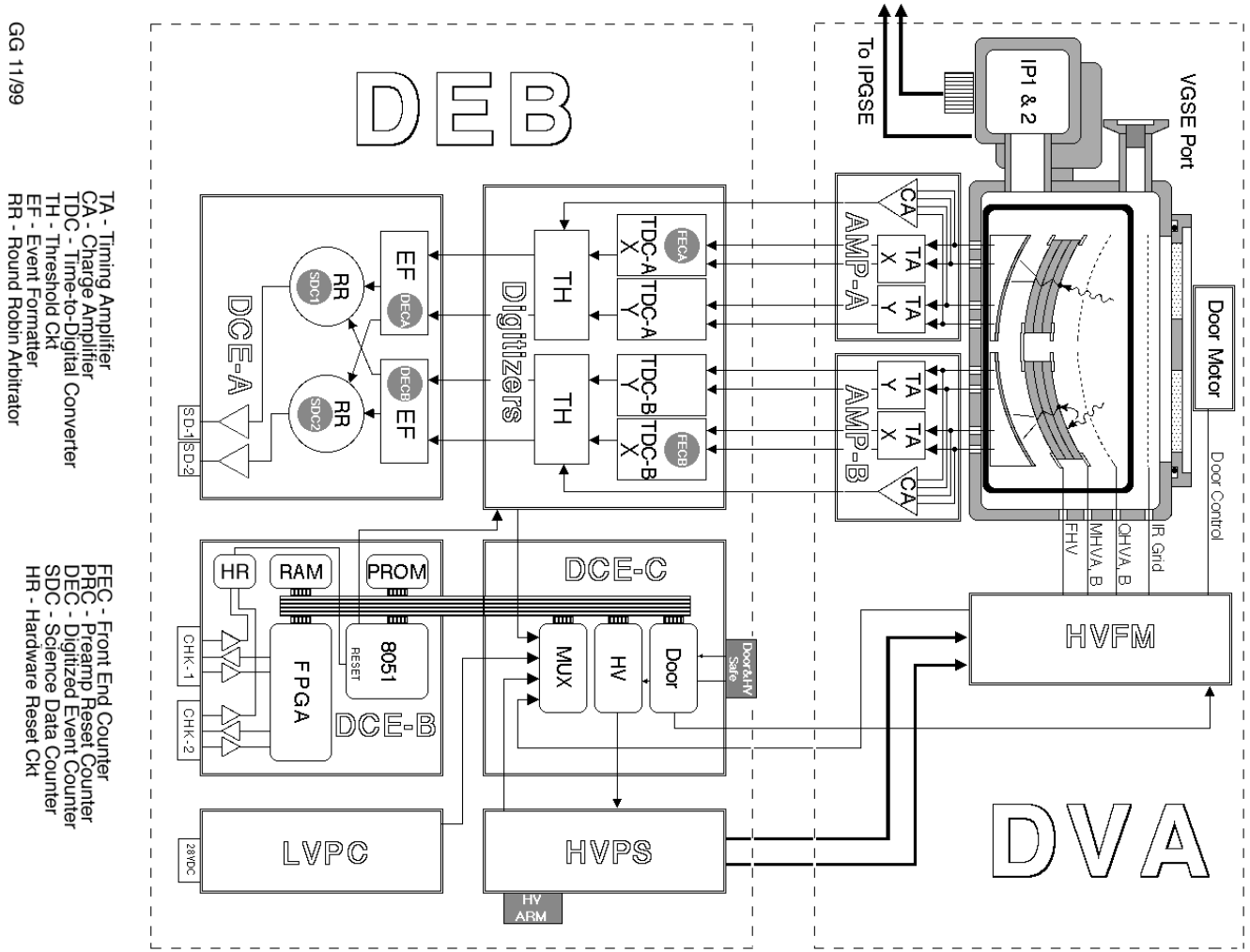


Detector Vacuum Assembly (DVA)

COS FUV System Configuration Features

- Dual segment, delay line microchannel plate detector scheme
  - 2 segments per detector, <9mm gap, 179 x 10mm overall active area
  - MCP front surface curved to 0.826m focal radius
  - Detection Efficiency optimized from 1000Å to 2500Å with CsI photocathode
- Self-contained vacuum system
  - Flight GSE Ion Pumps
  - Flight operable door with motor drive and backup actuator release mechanism
- 8051 Microcontroller
  - Automation and self-protection of HV and Door Operations
  - Global Count Rate Protection

FUV DETECTOR SYSTEM BLOCK DIAGRAM



FUV Detector Mass Budget

Center for Astrophysics and Space Astronomy

COS FUV Detector System Mass Budget Report
UCB-COS-RPT-1004
Revision C

REV	DATE	DESCRIPTION	APPROVAL
-	4/29/99	Baseline Release	Gaines
A	4/17/99	Update with measurements	Gaines
B	7/23/00	Updated DEB SOR Allocation from 12.7 to 15.3 kg	Gaines
C	11/4/00	Update with measurements, separate out covers	Gaines

DVA	Mass (Kg)	Notes
Vacuum Housing Assembly	10.13	Measured (Flight)
Detector Door & Mechanism	-	(Included in VHA)
Ion Pump Assembly	-	(Included in VHA)
Detector Backplane	5.04	Measured (Flight)
Heatsink Assembly	1.66	Measured (Flight)
Amplifier Units (2)	1.25	Measured (ETU)
HV Filter Modules	1.52	Measured (Flight)
Baffles, Magnetic Shield, etc.	0.8	Estimate
Total DVA	**20.43**	

DEB	Mass (Kg)	Notes
DCE	3.06	Measured (Flight)
TDCs (4)	4.96	Measured (Flight)
HVPS	2.08	Measured (Flight)
LVPC	2.14	Measured (Flight)
Interior Covers	1.20	Measured (Flight)
Exterior Covers	1.00	Estimate
Total DEB	**14.44**	

FUV System	Mass (Kg)	SOR Allocation[1] (Kg)	Margin (%)
DVA	20.43	21.5	5.2
DEB	14.44	15.3	6.0
Harness/Cabling	2.7 (est)	3.4	25.9
Total FUV Detector System	**37.57**	**40.2**	**7.0**

NOTES: 1. The SOR is COS-08-0008 Rev B *Statement of Requirements for the HST/COS FUV Detector*.

Changes to mass properties to be reported in COS monthlies, and revisions to this report.

FUV Power Budget

Center for Astrophysics and Space Astronomy

COS FUV Detectors System Power Budget Report
UC BCOS-RPT-1015
Revision D

REV	DATE	DESCRIPTION	REPORTER
-	4/29/99	Baseline Release	Gaines
A	4/17/00	Update with measured values	Gaines
B	10/19/00	Update with measured values	Gaines
C	10/24/00	Correct minor clerical error	Gaines
D	11/4//00	Reduce Power 2.7W by EC0052	Gaines

DVA	Operational Power (Watts)	Notes
Detector Door Mechanism	4.0	Measured (FUSE)
Amplifier Units (2)	3.88	Measured (COS Flight)
HV Filter Modules	0.71	Measured (COS Flight)
Total DVA	**4.59**[1]	

DHB	Operational Power (Watts)	Notes
DCE	4.09	Measured (COS Flight)
TDC (4)	28.32	Measured (COS Flight)[2]
HVPS	3.52	Measured (COS Flight)
LVPC	11.49[3]	Measured (COS Flight)
Total DEB	**47.42**	

FUV System	ICD Estimate (4/22/99)	Measured Power	SOR[4] Allocation (Watts)	Margin (%)
DVA	5.7	4.59		
DHB	43.7	47.42		
Total FUV Detectors System	**49.4**	**52.01**	**53.0**	**1.73**

NOTES:

1. Detector Door Mechanism power entries included since it is powered only on orbit flight.
2. Power reduced from measured value by .2W by EC0052.
3. Based on measured LVPC efficiency of 77% at nominal load.
4. The SOR is COS-0800-0903 *Space Segment Requirements for the HST/COS FUV Detector*.

Accumulated Run Times (hours)

Subassembly	Set 1	Set 2
Amplifiers	1026	985
DCE	807	728
LVPC	437	6
TDCs	232	1
HVPS	175	1
HVFM	6	1

Changes to System Since Mission CDR

- DCE
  - 8051 clock changed from 16 Mhz to 8 Mhz to add timing margin for (slower) flight ACTEL (per Baja)
  - Power-On-Reset circuit enhancement for extra margin, increased SEU tolerance (per I. Orlowski)
- TDC
  - Minor TDC-Y ACTEL modifications per Mark Voyton of GSFC
- Flight Software
  - 8051 controller BOOT code simplified, re-written
  - Flight OPERATE code currently being re-written and tested on ETU DEB. One week added to schedule for system test in vacuum prior to Vibration Test.
  - GSE OPERATE code mature and under Level II configuration control since June 2000. Environmental tests to be performed with this code.
  - FSW to be reviewed by the COS project in separate review

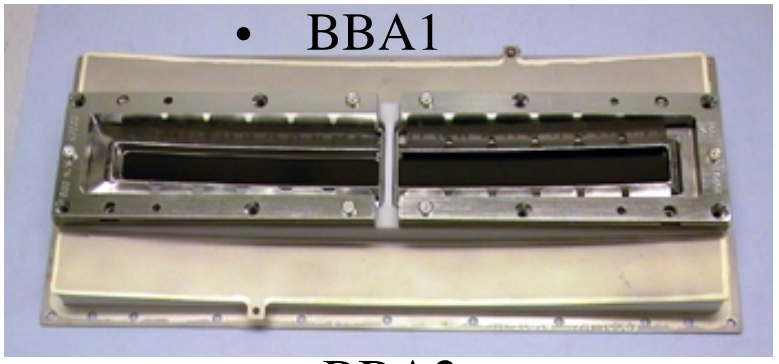
UCB FUV Detector - Flight BBA Status

- Brazed Body Assemblies - have 3 flight BBA units
- MC° P's - have 11 flight MCP sets
- Performance
  - Resolution, - is the primary selection criteria, ~ 25µm for most MCP stacks.
  - Flat field - MCP multifiber dominates, some small dead spots, & edge Moire
  - Background - almost all MCP sets have good background <0.5 events cm^{-2} s^{-1}
  - PHD - all MCP sets have good PHD's ~ 35% - 60% FWHM @ ~10^7 gain
  - Gain map - adjusted by shims to make uniform
  - Mini-scrub - extract 0.02 C cm^{-2} to assess gain stabilization effects
  - Metrology - need to match focus curve to ±100µm
- Repeatability
  - Repeated MCP stackings give very consistent results
  - BBA's give same results on different DBA's with different anodes

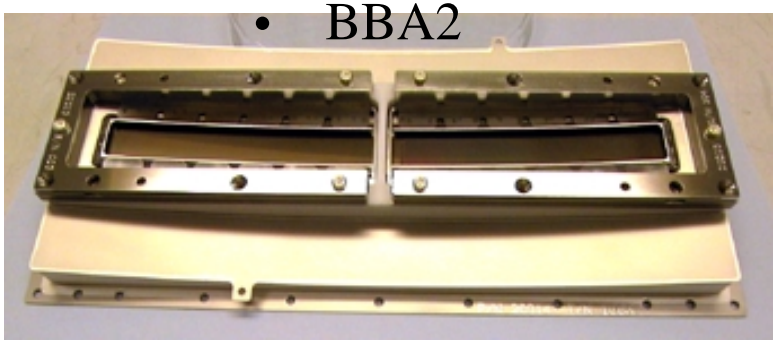
UCB FUV Detector - Flight BBA Status

- BBA #1 rebuilt with new MCP's. Resolution, tests show good (<25µm) performance. Doing gain map, flat field, background tests, mini-scrub next.
- BBA #2 mini scrub, background tests & gain trim done. Flight TDC flat field, resolution (<25µm) & functional tests are good. Selected for flight detector. Metrology with DBA#1 & shimming being completed. Formal verification tests imminent.
- BBA #3 assembled with new MCP's. Resolution, functional and background tests underway.

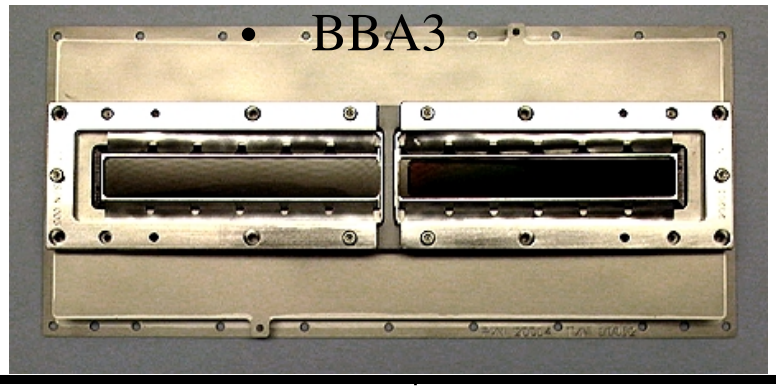
- BBA1



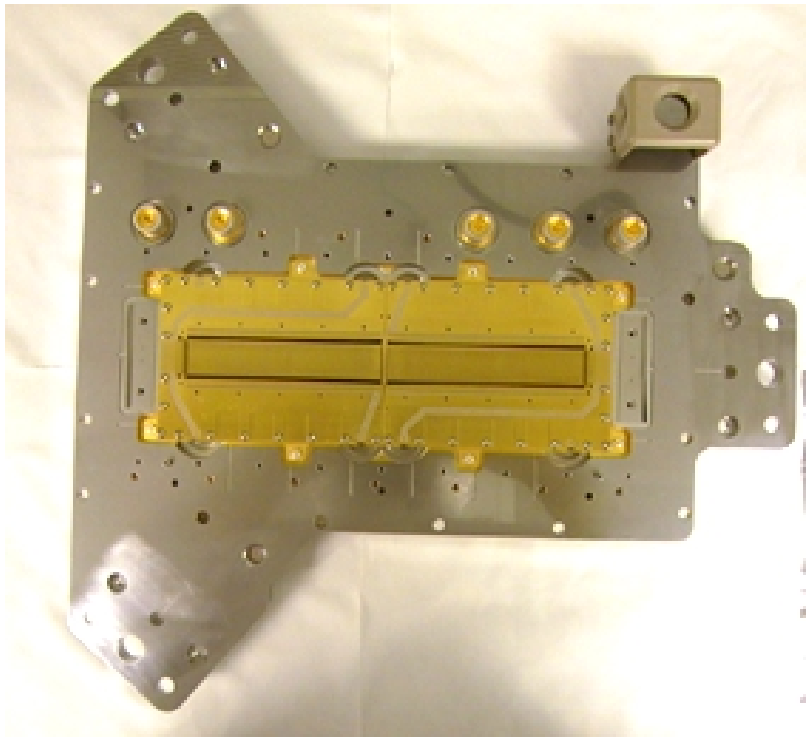
- BBA2



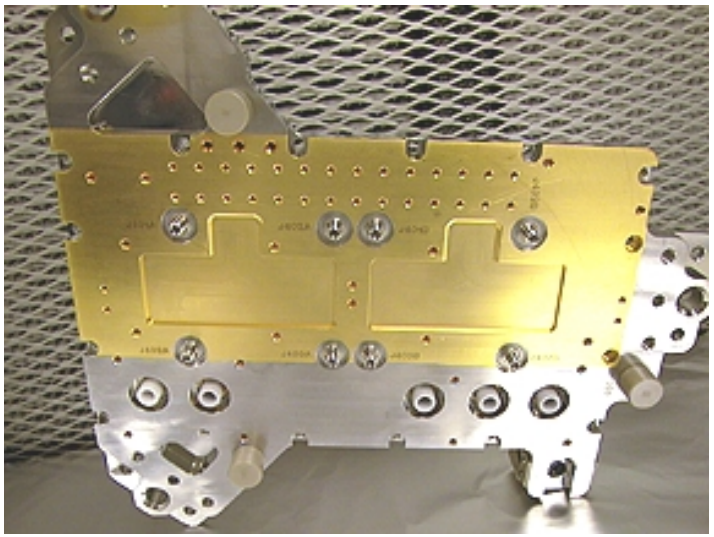
- BBA3



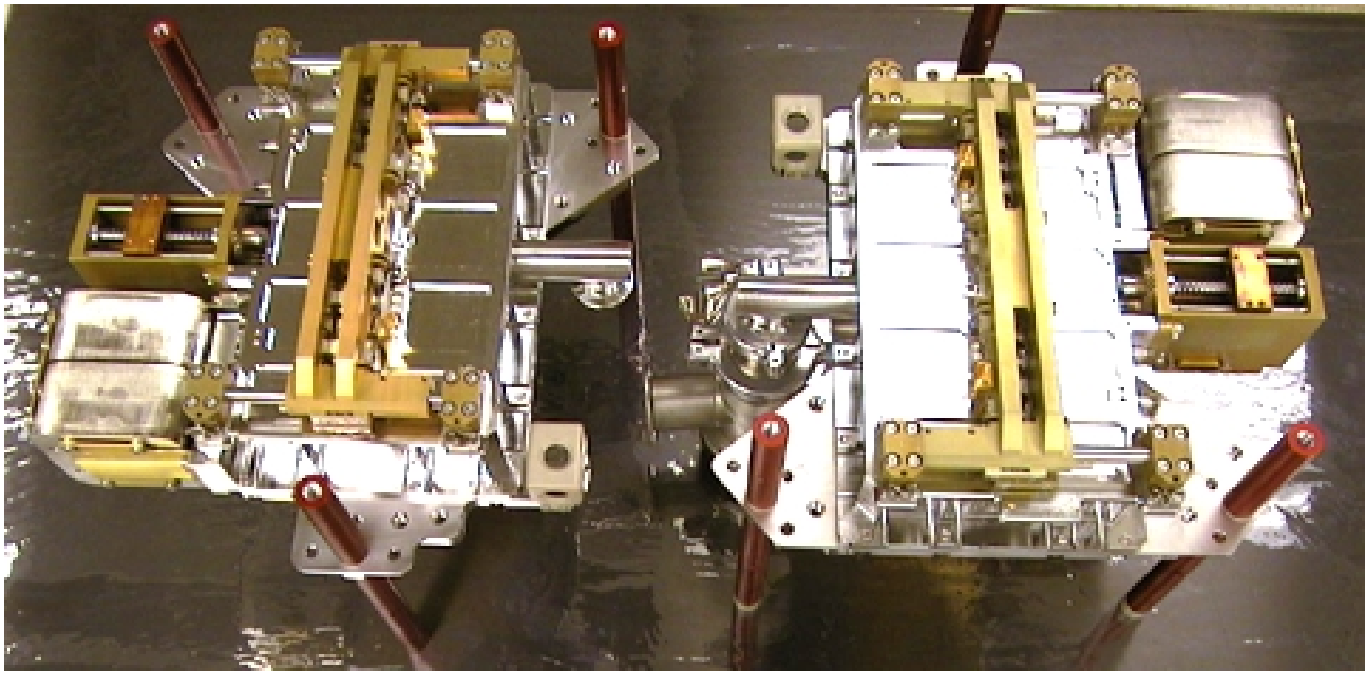
Backplate Status



- DBA #1 integrated with 2 flight anodes and BBA#2 in flight detector (in metrology)
- DBA #2 with 2 flight anodes & cradle ready to be integrated BBA#1
- DBA #3 in test on VHA



Detector Vacuum Assembly



- **Two VHA units assembled and attached to DBA's**
- **VHA #1 and #2 vacuum verified and operated with ion pumps**
- **VHA #1 and #2 door operation verified**
- **<u>VHA's ready for detector integration</u>**

FUV Electronic Board Status

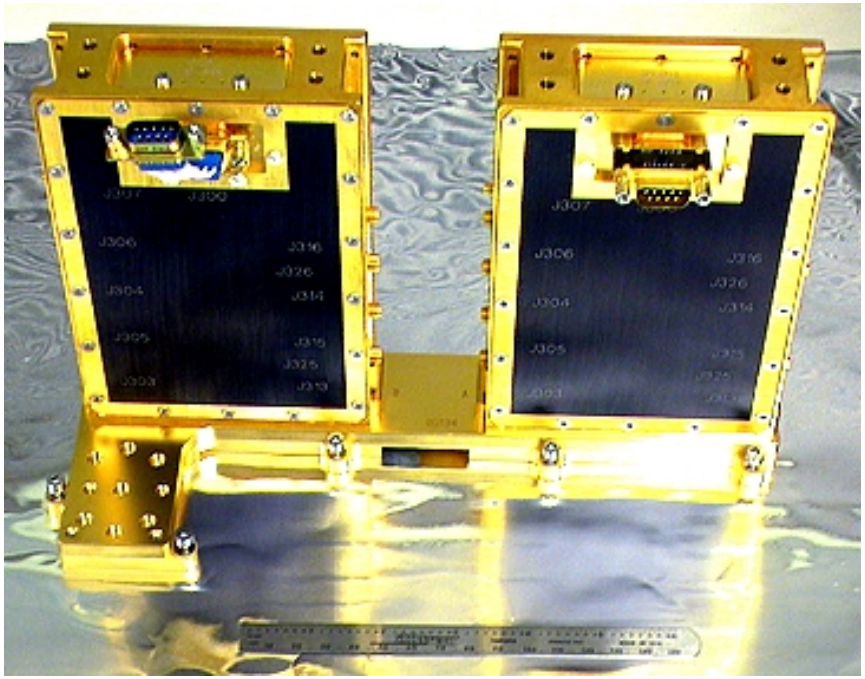
ACTIVITY	Amps	TDC-X	TDC-Y	HVFM	HVPS	LVPC	DCE-A	DCE-B	DCE-C
Parts List	C	C	C	C	C	C	C	C	C
Schematic	C	C	C	C	C	C	C	C	C
Actel Work	-	-	-	-	-	-	-	-	-
Initial Design	NA	C	C	NA	NA	NA	C	C	NA
Actel Peer Review	NA	C	C	NA	NA	NA	C	C	NA
End-to-End Simulation	NA	C	C	NA	NA	NA	C	C	NA
GSFC Review	NA	C	C	NA	NA	NA	C	C	NA
FPGA tests with ETU electronics	NA	C	C	NA	NA	NA	C	C	NA
Release ACTEL Schematic	NA	C	C	NA	NA	NA	C	C	NA
PC Board Layout	C	C	C	C	C	C	C	C	C
Parts Stress Analysis	C	C	C	NA	NA	NA	NA	C	C
Worst Case Analysis	NA	C	C	NA	NA	C	NA	C	C
Board Thermal Analysis	C	C	C	S	S	S	C	C	C
Release Layout	C	C	C	C	C	C	C	C	C
Board Fabrication	C	C	C	C	C	C	C	C	C
Kit Parts	C	C	C	C	C	C	C	C	C
Board Coupon Testing	C	C	C	C	C	C	C	C	C
Stuff PC Boards	C	C	C	C	C	C	C	C	C
Board Workmanship Acceptance	C	C	C	C	C	C	C	C	C
Board Engineering Acceptance	C	C	C	C	C	C	C	C	C
Engineering Test & Acceptance	C	C	C	C	C	C	C	C	C
Temperature Cycle Test	C	S	S	C	C	C	C	C	C
Voltage Margin Test	C	C	C	NA	NA	NA	C	C	C
Final Acceptance Test	C			C	C	C	C	C	C
Clean & Conformal Coat	C			C	C	C			

C = Complete NA = Not Applicable S= started

FUV Detector Electronics Verification & Status Summary

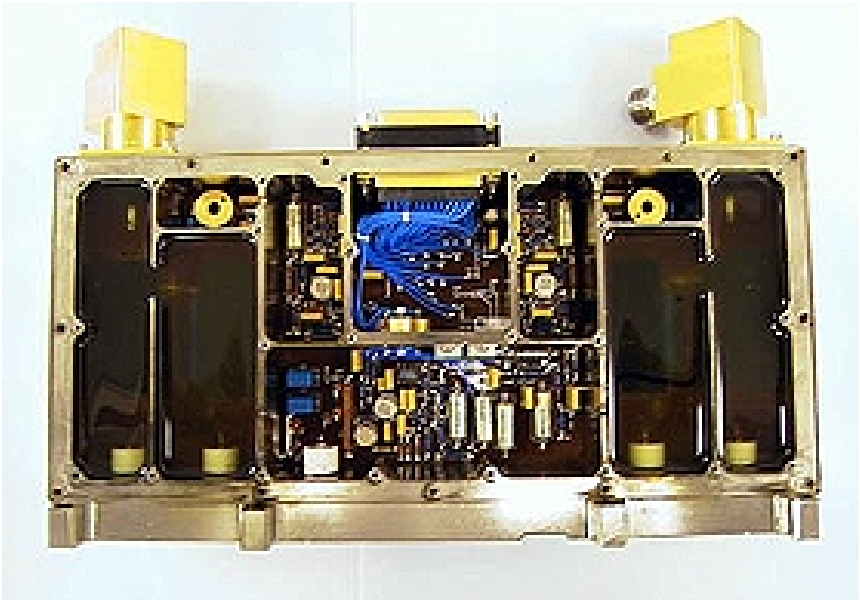
- Amplifiers - Ready for final integration
- HVFMs - Ready for final integration
- HVPS - conformally coated - ready for final integration
- LVPC - conformally coated - ready for final integration
- DCEs - POR enhancements under test, conformal coat pending PROM burn
- TDCs - in thermal testing

Amplifier Status



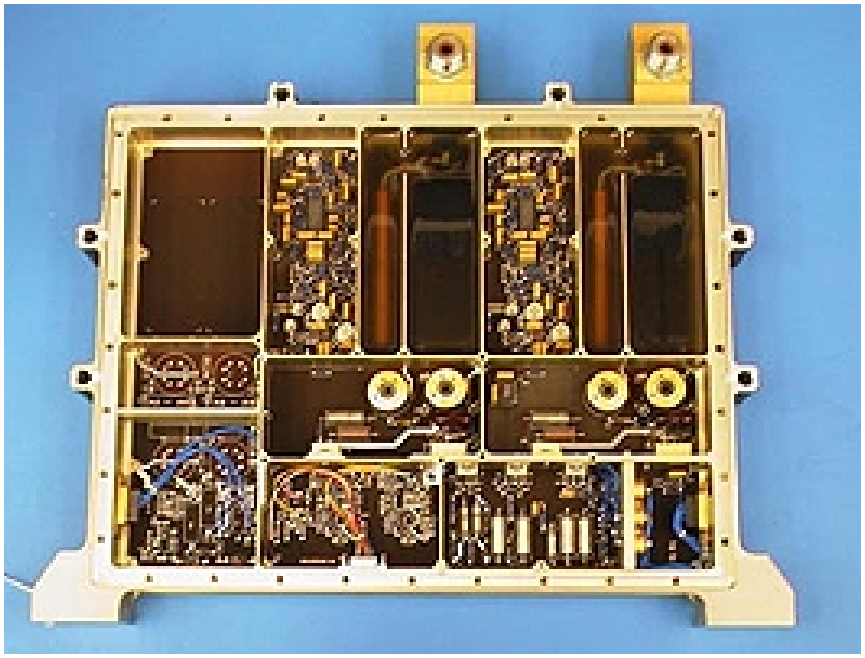
- Four Flight Amplifiers PCBs stuffed and mounted in frames.
- Stuffed by J&T and initial workmanship QA inspection done.
- Protection diodes and noise filters applied at UCB.
- Passed GSFC inspection
- Electronic performance verified
- Voltage margin testing completed
- Thermal cycle tests completed
- Cleaned, conformally coated, staked and baked.
- **Four units ready for integration**

HVFM Status



- 2 Flight HVFM units received from Battel Engineering
- Passed QA inspection by GSFC
- Engineering Acceptance done at UCB
- Electronic performance verified
- Thermal cycle tests completed
- Cleaned, conformally coated, potted
- Initial four day vacuum bake-out of EN-11 potting material at 60°C & TQCM measured
- **Two units ready for integration**

HVPS Status

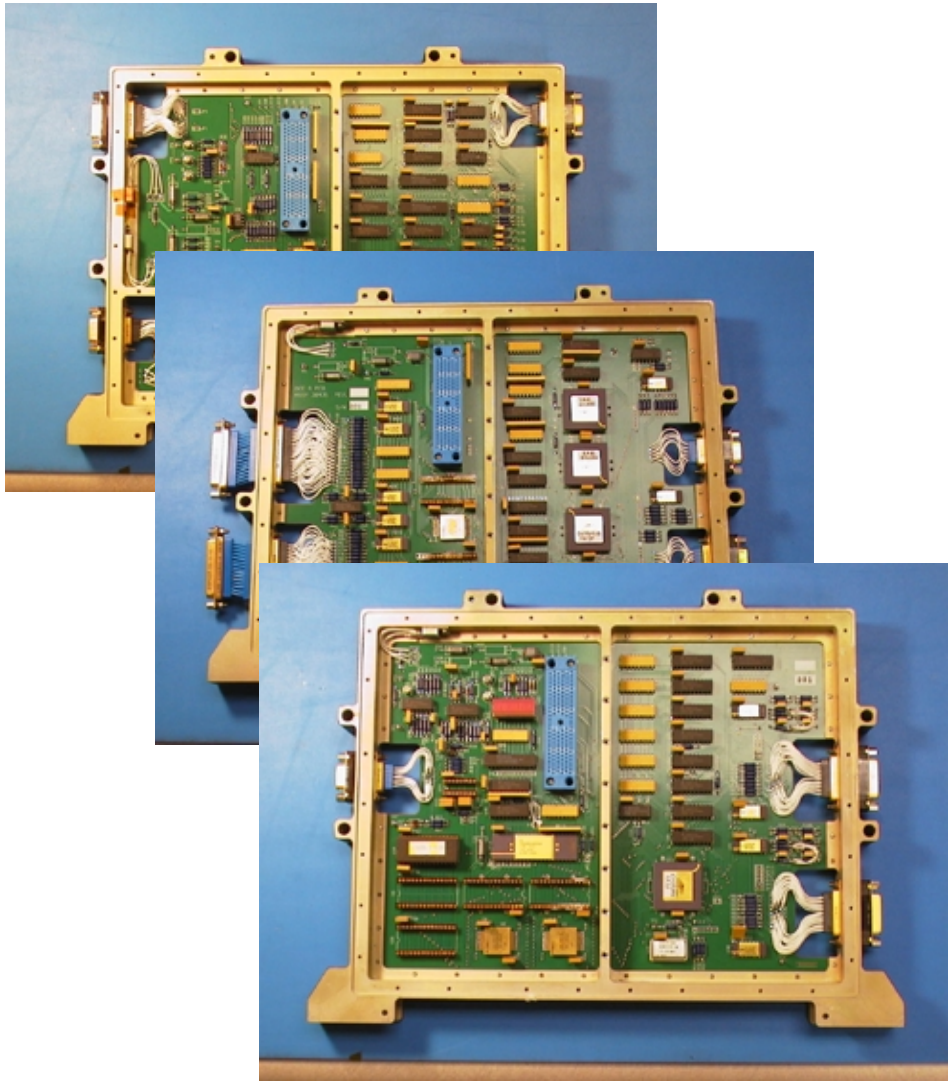


- 2 Flight HVPS units Received from Battel Engineering
- Passed by GSFC QA
- Passed UCB incoming inspection
- Engineering Acceptance tests done
- Electronic performance verified
- Thermal cycle tests completed
- Initial four day vacuum bake-out of EN-11 potting material at 60°C & TQCM measured
- One unit in use on flight detector
- One unit being cleaned, staked, and conformally coated at Lockheed

LVPC Status

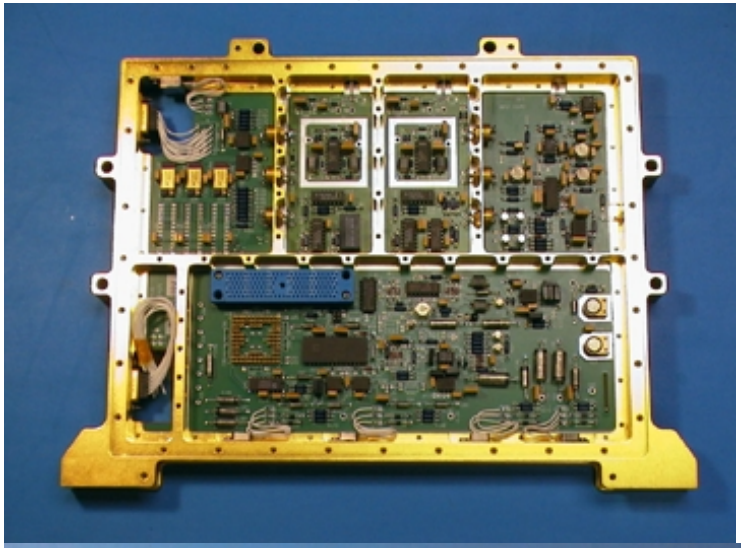
- Two flight LVPC units received from Battel Engineering
- Passed UCB incoming inspection
- Passed GSFC QA
- Engineering Acceptance tests completed
- Thermal tests performed by Battel Engineering
- Cleaning and conformal coating at Lockheed this week

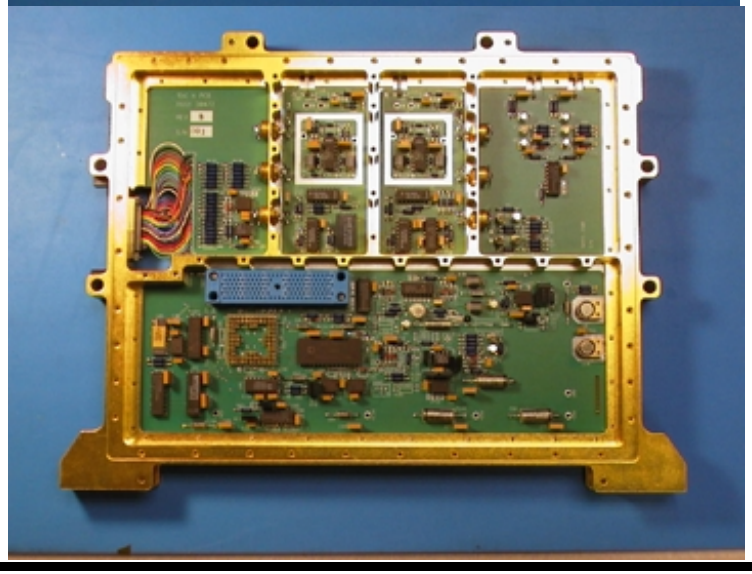
DCE Status



- Received flight DCE boards from J&T (2 sets of 3 (A, B, C.))
- Passed UCB inspection & GSFC QA
- Thermal analysis performed by BATC
- Engineering Acceptance tests done
- Electronic performance verified
- DCE ACTEL designs reviewed by GSFC.
- Voltage margin tests completed
- Frequency margin tests completed
- Thermal cycle tests completed
- One set in use on flight detector
- One set having POR modifications applied and tested.

TDC Status





- 4 sets of X & Y Flight TDC units received from J&T
- Passed QA inspection by GSFC
- Thermal analysis performed by BATC
- Engineering Acceptance done at UCB
- Electronic performance verified with BBA#2 flight detector
- TDC ACTEL designs under review
- One ACTEL set burned and under test
- Voltage margin tests complete
- Frequency margin tests complete
- Thermal cycle tests underway on 1st set
- One set in use on flight detector