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GUVI

Global Ultraviolet Imager
Critical Design Review



Integration & Test

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Integration & Test Outline

- Instrument Integration & Test
- Spacecraft Integration & Test
- Contamination Control
- Early Orbit Operations
- Normal Operations



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Instrument Integration & Test

- Test Plan
- Subsystem Test Flow
- System Test Flow
- Test Matrix
- GSE Description



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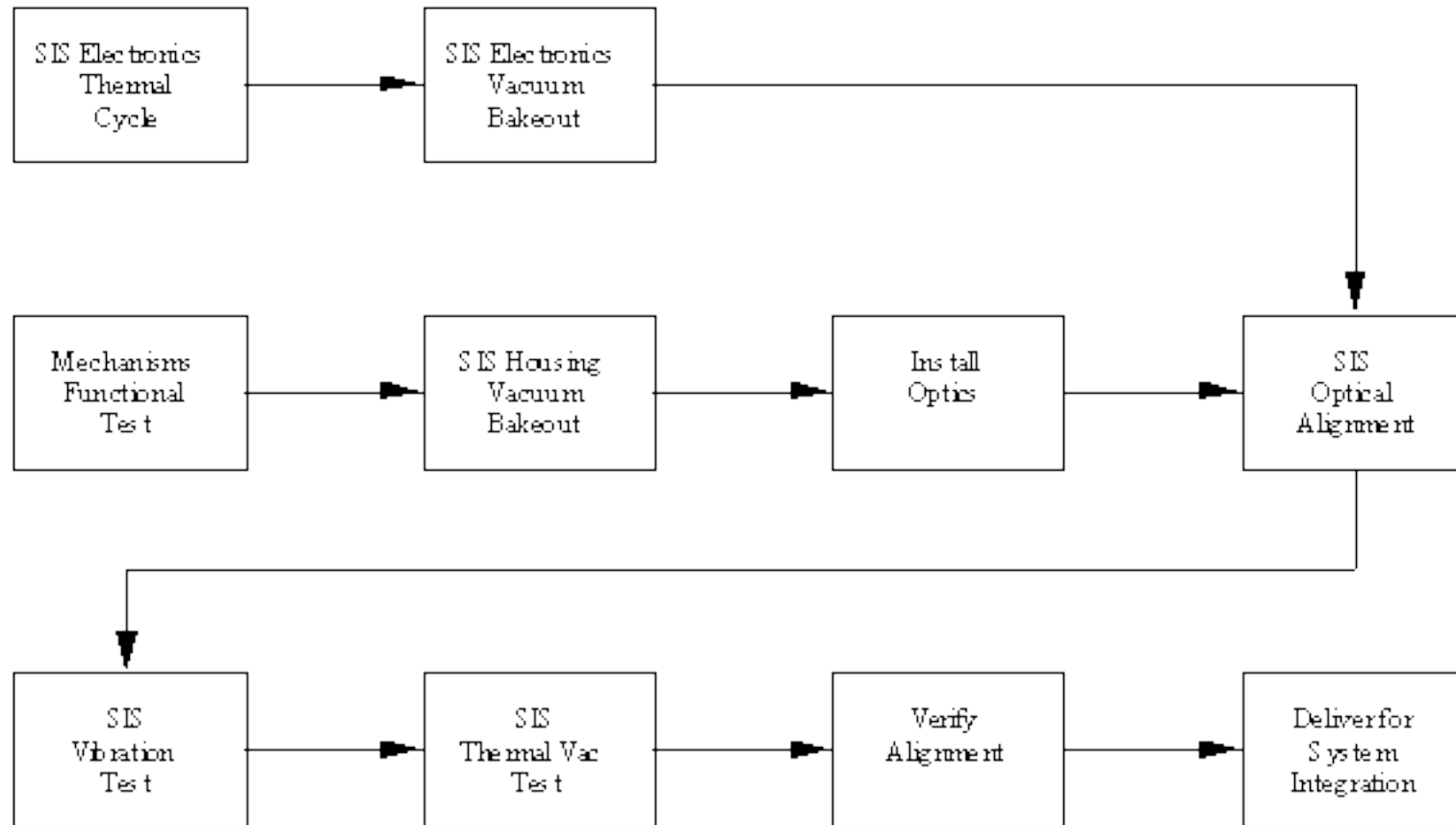


GUVI Test Plan

- **GUVI Acceptance Test Plan, 7366-9060**
- **SIS subsystem to be tested by SSG before delivery to APL**
- **All electronics packages to be thermal cycle tested in-air before system integration**
- **Board level thermal tests not required**
- **Vibration and thermal vacuum tests to be performed at system level**
- **System level integration and test to be performed at APL**
- **Optical calibration to be performed in APL OCF**
- **EMC test will not include SIS housing because of contamination concern**

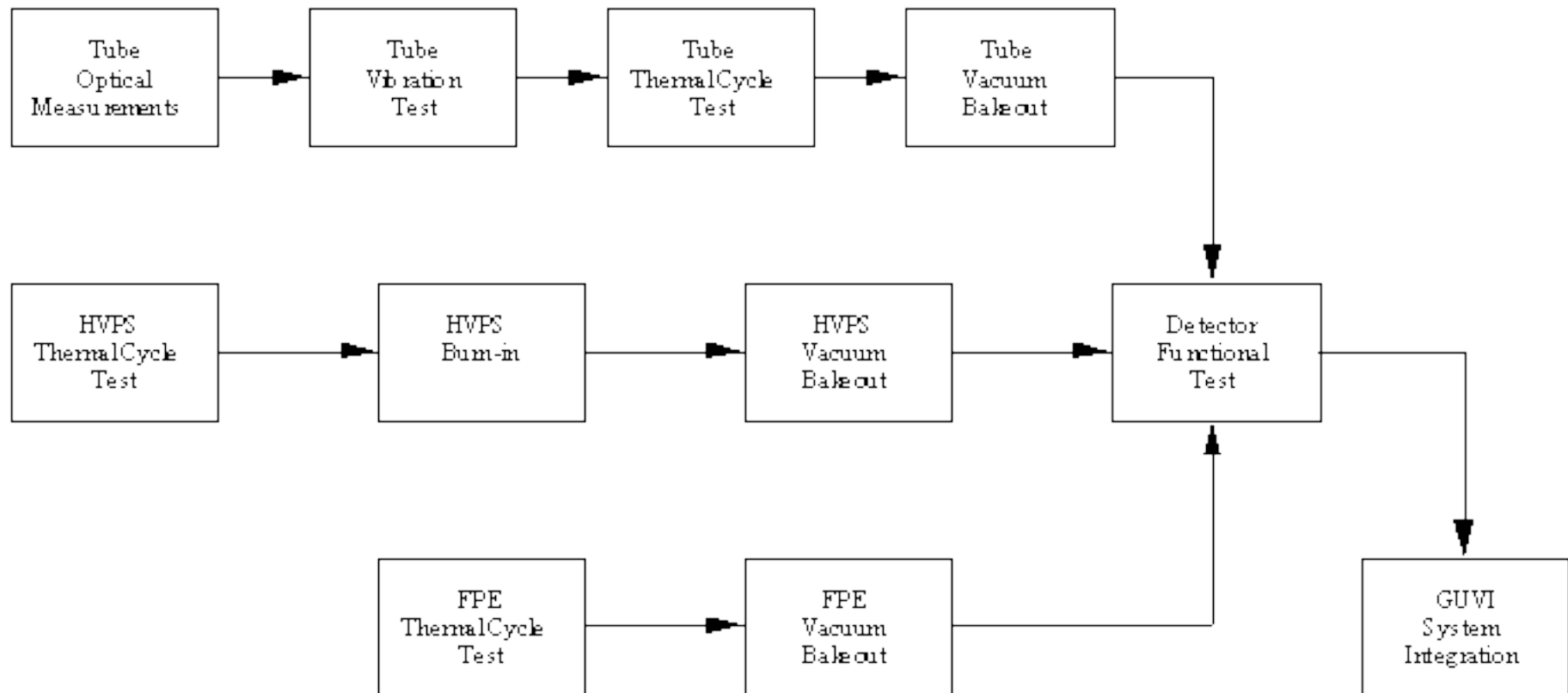


SIS Subsystem Test Flow



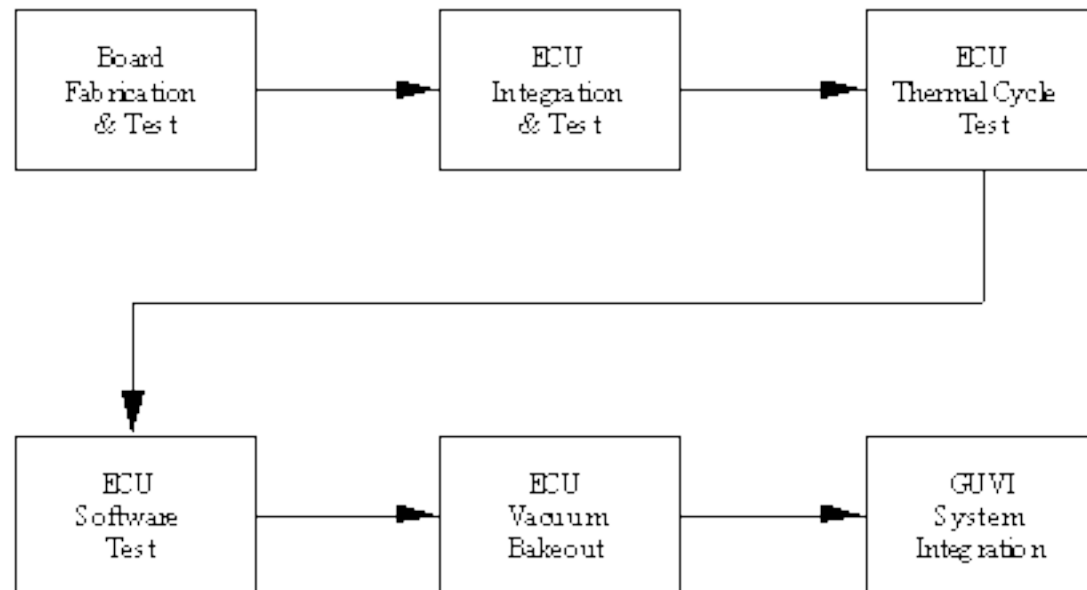


Detector Subsystem Test Flow



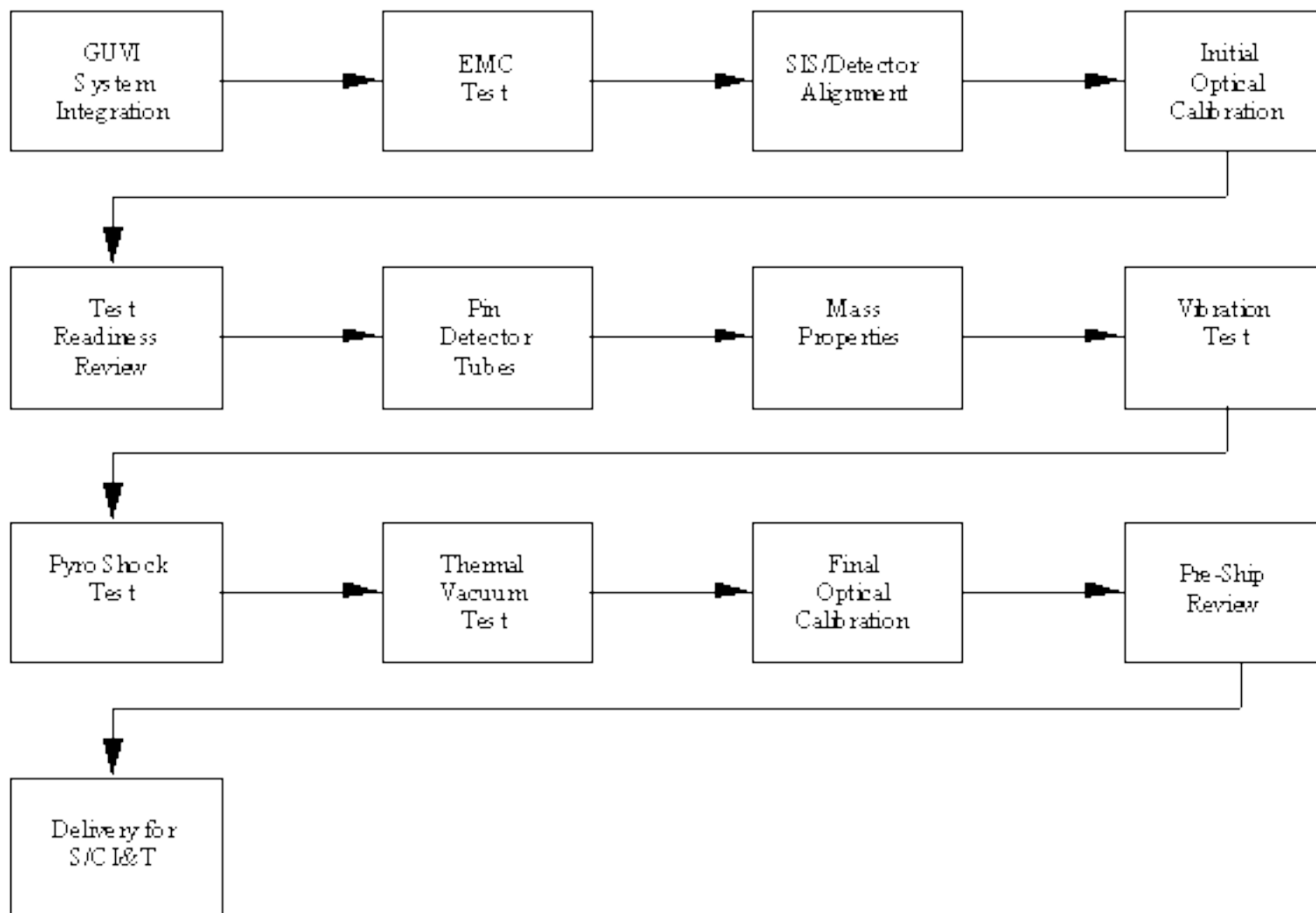


ECU Subsystem Test Flow





GUVI System Test Flow





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GUVI Test Matrix

GUVI Component	Subsystem Level Tests			System Level Tests			
		Thermal	Thermal	Optical			Thermal
	Vibration	Cycle	Vacuum	Calibration	EMC	Vibration	Vacuum
SIS Optics Housing	X		X	X		X	X
SIS Electronics	X	X	X	X		X	X
Detector Tube #1	X	X		X	X	X	X
Focal Plane Electronics #1		X		X	X	X	X
Detector HVPS #1		X		X	X	X	X
Detector Tube #2		X		X	X	X	X
Focal Plane Electronics #2		X		X	X	X	X
Detector HVPS #2		X		X	X	X	X
Electronics Control Unit		X		X	X	X	X



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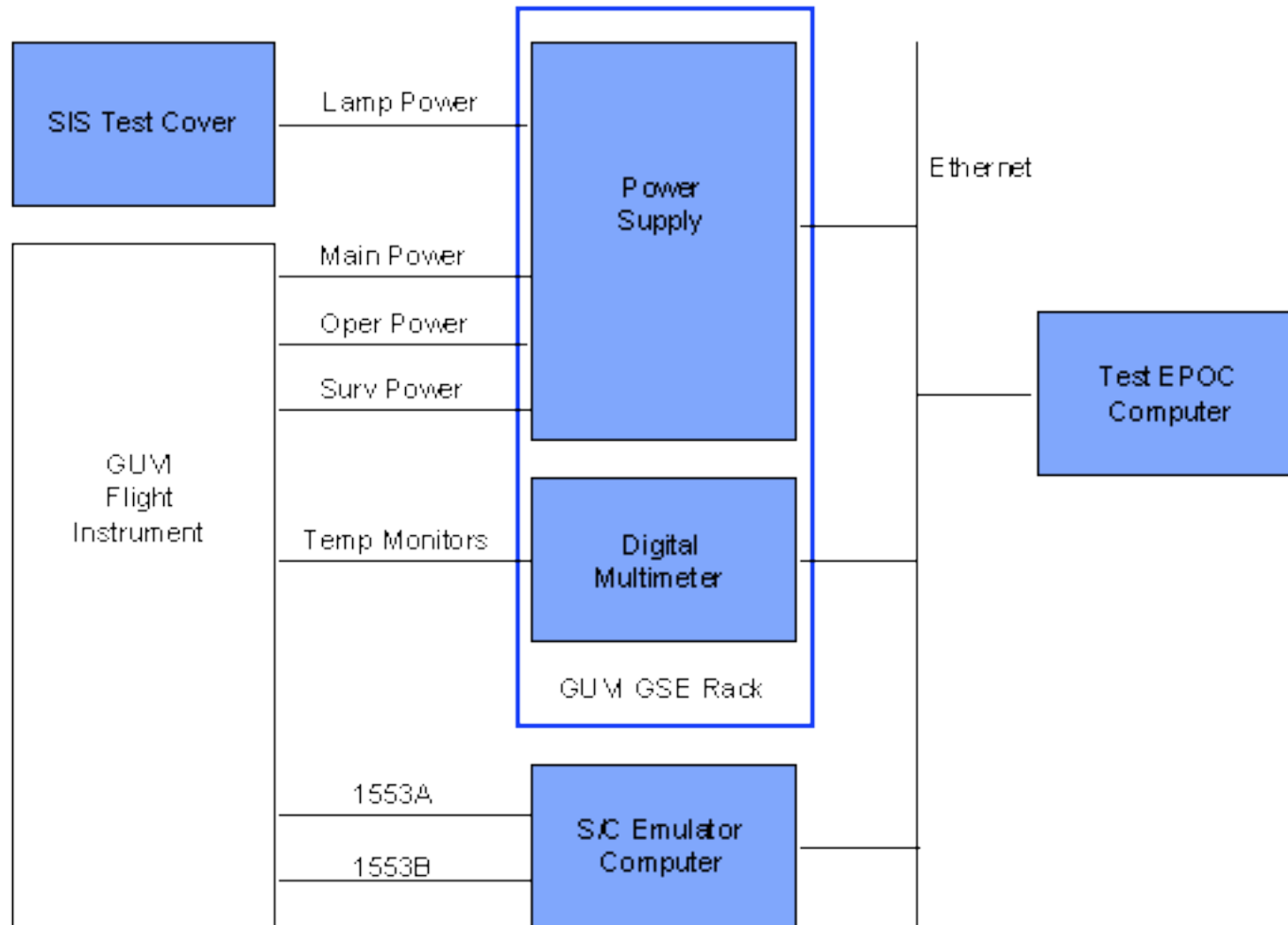
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GUM GSE During Stand-Alone Tests





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GUVI GSE Description

- **GUVI GSE Rack**
 - contains programmable power supply, digital multimeter, and ethernet to HPIB interface modules
 - provides instrument power and temperature monitor interface during stand-alone test
 - provides test lamp power during stand-alone test and spacecraft I&T
 - footprint 23 x 28 inch
 - height tbd (less than 4 feet)



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GUVI GSE Description

- **S/C Emulator Computer**
 - provides instrument 1553 interface during stand alone test
 - contained on computer cart of size 36 x 30 inch
 - not used during spacecraft I&T
 - can be stored in flexi-van



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GUVI GSE Description

- **SIS Test Cover**
 - installs onto GUVI spectrograph above scan mirror aperture using self-contained screws
 - scan mirror not caged when test cover installed
 - contains UV test lamp
 - receives 12 VDC power from GUVI GSE rack
 - used during stand-alone test and spacecraft I&T



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GUVI GSE Description

- **Test POC**
 - consists of engineering POC (EPOC) computer workstation
 - contained on computer cart of size 36 x 30 inch
- **Flight POC**
 - consists of engineering POC (EPOC) computer workstation and data processing POC (DPPOC) computer workstation
 - located at JHU/APL, room tbd



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Spacecraft Integration & Test

- GSE Configuration
- Facility Requirements
- Functional & Performance Tests
- Special Tests



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Spacecraft Integration & Test

- **GUVI Test/Flight POC will control instrument during I&T**
 - **GUVI personnel will be on site during all tests**
- **Non-flight test cover installed on SIS Housing during I&T**
 - **Protects scan mirror during testing**
 - **Contains UV test lamp**
 - **Remotely controlled by GUVI POC**
- **Nitrogen purge required on SIS Housing**
- **SIS cover closed during vibration test to cage scan mirror**



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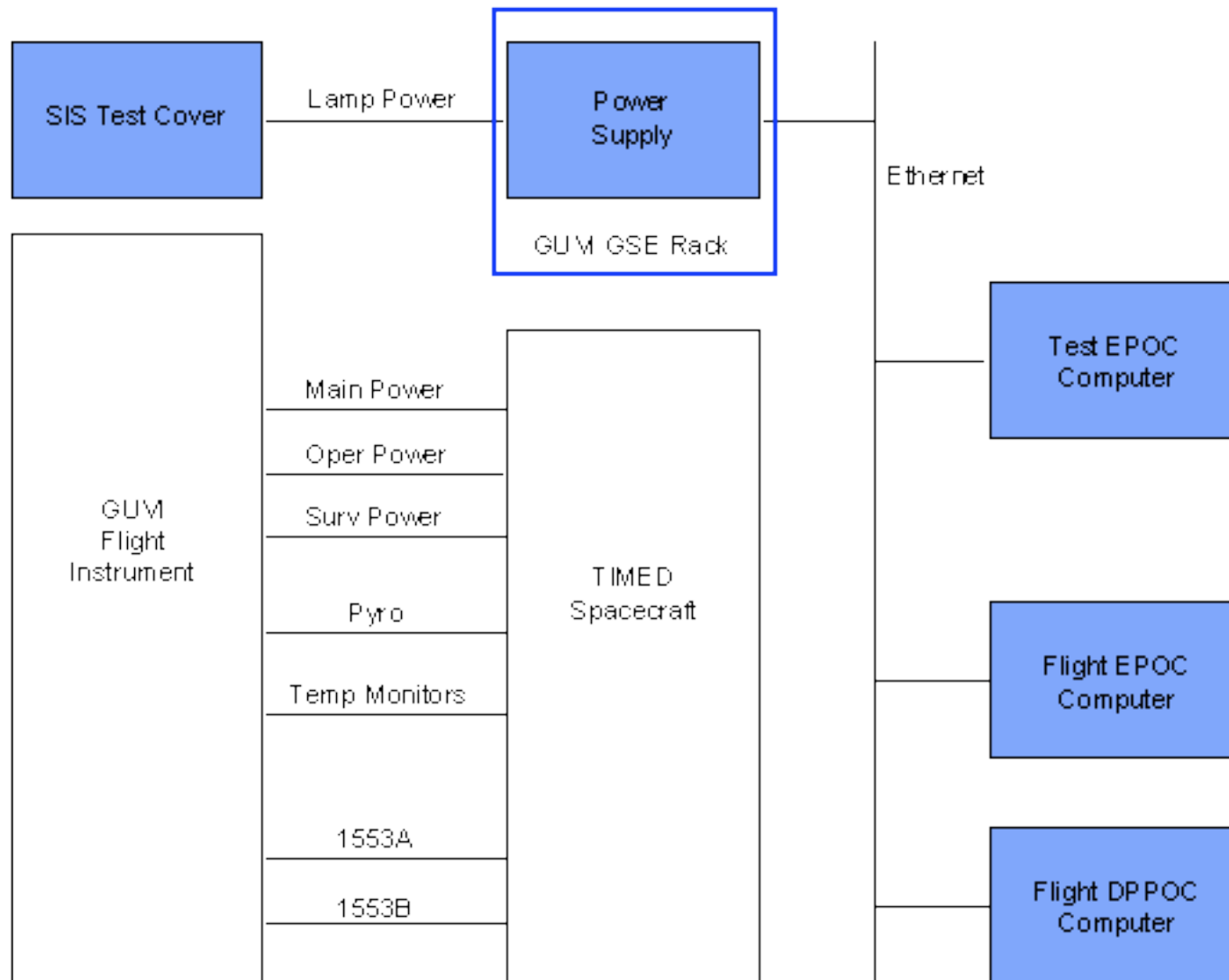
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GUM GSE During Spacecraft I&T





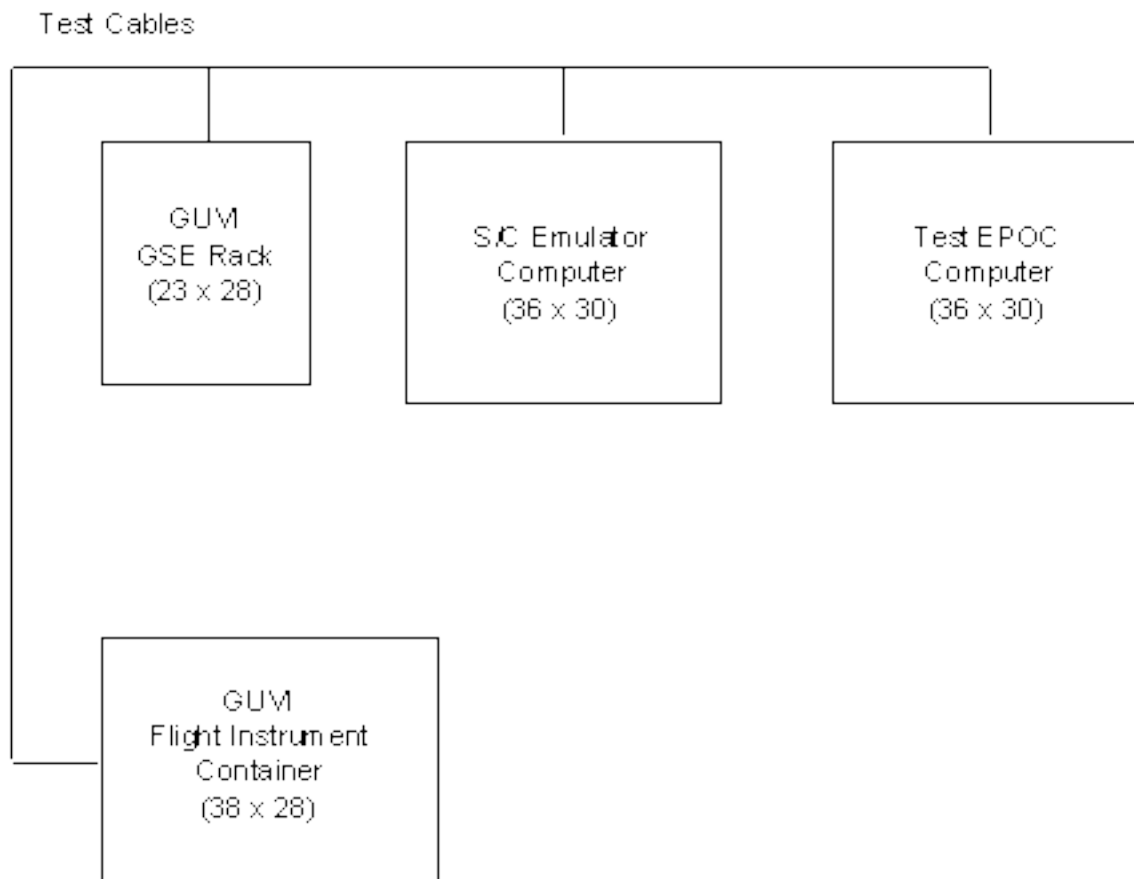
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GUVI Stand-Alone Test Facility Layout



Footprint of each item is shown in inches.

SIS Test Cover is installed on GUVI flight instrument.



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GUVI Facility Requirements

- **Stand-alone test**
 - test can be performed in an area of approximately 10 feet by 10 feet
 - flight instrument mounted in shipping container
 - we would like one table provided to serve as a general purpose work area
 - we can provide a nitrogen bottle and cart
 - no air conditioning is required
 - one 15 amp AC line can power the GUVI GSE
 - two GUVI team members will support the stand-alone test
 - test can be completed in one day, including set up time
 - no other special considerations



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GUVI Facility Requirements

- **GSE storage**
 - the S/C emulator computer is not required to support testing after spacecraft integration
 - can be stored in flexi-van
 - all other GUVI GSE items are used during spacecraft I&T



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GUVI Facility Requirements

- **Personnel**
 - on average, one person will operate the GUVI test POC during spacecraft I&T
 - a maximum of three people may be located at the GUVI test POC on occasion
 - since GUVI POC operators will be APL personnel, desks and phones are not required



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GUVI Facility Requirements

- **Facility layout**
 - **GUVI GSE rack will stay near the spacecraft**
 - **GSE rack footprint is 23 x 28 inch**
 - **one cable from GSE rack to GUVI test cover**
 - **GUVI test EPOC computer cart will reside in the test MOC**
 - **EPOC computer cart size is 36 x 30 inch**



GUVI Functional Test

- **Configuration: SIS test cover installed**
- **S/C events: No S/C events required**
- **Duration: 1 hour**
- **Test Outline**
 - **Maintenance mode**
 - short memory upload
 - **SIS mechanisms**
 - exercise slit and pop-up motors, primary and secondary drives
 - exercise scan motor, primary and secondary drive
 - **Detector test**
 - run test mode, detector #1, dark and test lamp on
 - run test mode, detector #2, dark and test lamp on



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GUVI Functional Test

- **Test Outline (continued)**
 - **Spectrograph mode test**
 - Spectrograph mode, detector #1, dark and test lamp on**
 - Spectrograph mode, detector #2, dark and test lamp on**
 - **Imaging mode test**
 - Imaging mode, detector #1, primary drive, test lamp on**
 - Imaging mode, detector #1, secondary drive, test lamp on**
 - **Shutdown sequence**



GUVI Performance Test

- **Configuration: SIS test cover installed**
- **S/C events: No S/C events required**
- **Duration: 2 hours**
- **Test Outline**
 - **Maintenance mode**
 - full memory upload
 - **SIS mechanisms**
 - exercise slit and pop-up motors, primary and secondary drives
 - exercise scan motor, primary and secondary drive
 - **Detector test (for longer duration than functional test)**
 - run test mode, detector #1, dark and test lamp on
 - run test mode, detector #2, dark and test lamp on



GUVI Performance Test

- **Test Outline (continued)**
 - **Spectrograph mode test (for longer duration than functional test)**
 - Spectrograph mode, detector #1, dark and test lamp on, 3 slits**
 - Spectrograph mode, detector #2, dark and test lamp on, 3 slits**
 - **Imaging mode test (for longer duration than functional test)**
 - Imaging mode, detector #1, primary drive, test lamp on**
 - Imaging mode, detector #1, secondary drive, test lamp on**
 - Imaging mode, detector #2, primary drive, test lamp on**
 - **Shutdown sequence**



GUVI Pad Test

- **Configuration: SIS flight cover closed**
- **S/C events: No S/C events required**
- **Duration: 30 minutes**
- **Test Outline**
 - **Maintenance mode**
 - short memory upload
 - **SIS mechanisms**
 - exercise slit and pop-up motors, primary and secondary drives
 - scan motor electrical check
 - **Detector test**
 - run test mode, detector #1, dark count
 - run test mode, detector #2, dark count



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GUVI Pad Test

- **Test Outline (continued)**
 - **Spectrograph mode test**
 - Spectrograph mode, detector #1, dark count**
 - Spectrograph mode, detector #2, dark count**
 - **Shutdown sequence**



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GUVI Special Tests

- **Detector Test**
 - If functional test is not run frequently, then we would like to perform the detector test about once per month
 - Same as detector test section of functional test
 - Checks pulse height distribution and dark count response for both detector tubes



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GUVI Special Tests

- **Mission Simulation Tests**
 - **During most mission simulations, GUVI will operate in the imaging mode. The secondary detector and secondary scan motor drive shall be selected occasionally.**
 - **Check GUVI response to yaw maneuver event. GUVI will go to safe mode for duration of yaw maneuver.**
 - **Test the GUVI star calibration sequence. Primarily a check of stored commands in the GUVI processor.**



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GUVI Contamination Control

- **GUVI Contamination Control Plan, 7366-9015**
- **Nitrogen purge required when feasible**
 - **grade C nitrogen or better**
 - **flow rate 1.0 to 4.0 liters per minute**
 - **maximum 8 hours without purge**
- **Total hydrocarbon count less than 15 parts per million**
- **Spacecraft surface cleanliness level less than 1000**
- **Must maintain GUVI scan mirror cleanliness level less than 500**
- **Bag SIS housing when on spacecraft**



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Early Orbit Operations (1)

- **Phase 1 Operations: Before SIS Cover Opened**
- **Enable survival heater during first available contact**
- **Remainder of phase 1 operation can be performed during first few days after launch**
- **Perform testing of processor communications, SIS mechanisms, and detector dark count**
- **Will take about 4 orbits to complete tests**
- **Would like real time control during first two orbits**



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Early Orbit Operations (2)

- **Open SIS cover at launch + 14 days**
 - Open cover real time
 - Require GUVI power on
 - Send scan mirror hold command before pyros fired
- **Phase 2 Operations: After SIS Cover Opened**
 - Test scan motor, detector response to airglow, imaging mode operation, star calibration
 - Will take about 10 orbits to complete tests
 - Real time testing not required
- **GUVI ready for normal operations after phase 2 testing completed**



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Normal Operations

- Routine Commanding
- Engineering Data Processing
- Science Data Processing
- On-orbit Calibration



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Routine Commanding

- **GUVI PI will originate or approve all GUVI mode changes**
- **GUVI Payload operations manager will implement mode changes into command file**
- **Commands will be uploaded once per week for all mode changes planned for that week**
- **Command upload will typically consist of less than 20 GUVI commands**
- **Only regularly scheduled mode change will be to transition from imaging mode to calibration mode once per month**
- **Planned timeline to be available two weeks before desired upload time**



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Engineering Data Processing

- **EPOC continuously polls MDC for new data**
- **Recorder data downlinked to MOC once per day**
- **Playback data available for POC 0 to 3 hours after downlink**
- **Engineering data processing complete 6 hours after data received at EPOC**
- **Alarms generated when out of limit parameters detected during engineering data processing**



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Science Data Processing

- DP POC continuously polls MDC for new data
- Recorder data downlinked to MOC once per day
- Playback data available for POC 1 to 3 hours after downlink
- Data products available on web server 24 hours after downlink
- Data products CD-ROMs mailed to GUVI Co-I's 14 days after data products available



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On-Orbit Calibration

- **Calibration to be performed once per month**
- **Calibration mode duration is 5 minutes per orbit for 3 to 5 orbits**
- **Calibration Sequence**
 - **At predetermined time, switch to spectrograph mode with scan mirror pointing at star, do for active detector only**
 - **After 5 minutes, return to imaging mode**
 - **Repeat for 3 to 5 consecutive orbits**
- **Time tagged commands to control sequence of events**