

# GLAST Large Area Telescope:

## OUTLINE FOR CONNECTION PROCEDURES

Aug 19, 2004



# PRIME REQUIREMENT: GEVS-SE REV A

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- **2.3.1 Electrical Interface Tests**
  - Before the integration of an assembly, component, or subsystem into the next higher hardware assembly, electrical interface tests shall be performed to verify that all interface signals are within acceptable limits of applicable performance specifications.
  - Prior to mating with other hardware, electrical harnessing shall be tested to verify proper characteristics; such as, routing of electrical signals, impedance, isolation, and overall workmanship.



# CONNECTION PROCEDURES: NASA/JPL

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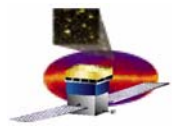
- **MATE – DEMATE PROCESS**
  - **Simple workmanship standard**
    - Verify connector savers are being used
    - Inspect both halves of a mate for reference designators, cleanliness, pin/socket characteristics
    - Verify power is off on all connected hardware (flight or EGSE)
    - Perform the ESD discharge
    - Perform the Mate or Demate with QA witness.
    - Process paperwork for mate (fill out mate log)
  - **Usage: Every mate**



# CONNECTION PROCEDURES: NASA GSFC

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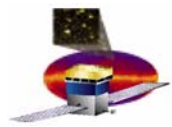
- **ELECTRICAL INTERFACE CONTINUITY AND ISOLATION TEST (EICIT or Cold Checks)**
  - **Electrical interface continuity and isolation test**
    - Verify like node continuity
    - Verify power and ground isolation
    - Verify signal isolation from power and ground
    - Verify controlled/expected impedances between signal pairs
  - **Usage:**
    - Performed when item is new
      - **Applies to subassemblies (CCA, unit, cable)**
    - Performed when item has undergone any re-work
    - Performed when I&T receives an item from a subsystem supplier
    - Performed when item has not been used for some period of time



# CONNECTION PROCEDURES: NASA GSFC

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- **INTERFACE VERIFICATION TEST (IVT or Hot Checks)**
  - **Initial Power On Measurements**
    - Test interface for stray voltages
      - Make power and ground connections and check signal pins for levels that could cause damage
  - **Test interface requirements**
    - **Power**
      - Conformance to voltage specification (operation at nominal, high, low, etc.)
      - In-rush current
      - Total consumption over input voltage range
      - Noise on power lines for general interest or spec verification
    - **Signaling characteristics**
      - Signaling meets specification (ex.: LVDS EIA-644)
        - » Voltage range, jitter, or just does it function
      - Noise on signaling lines
      - Signaling over input voltage range to simulate aging
  - **Usage: performed on each interface as part of first mate**
    - Performed when item is new
      - Applies to subassemblies (CCA, unit, cable)
    - Performed when item has undergone any re-work
    - Performed when I&T receives an item from a subsystem supplier
    - Performed when item has not been used for some period of time



# CONNECTION PROCEDURES: NASA GSFC

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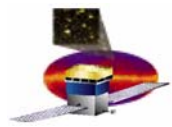
- **SAFE TO MATE**
  - **Procedure used to verify power and ground integrity on an un-powered interface**
    - Verify like node continuity
    - Verify power and ground isolation
  - **Usage: Every mate**



# RECOMMENDATION: TAILORED TEST METHODS

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- **MATE – DEMATE PROCESS**
  - Follow this per NASA / JPL for every mate
- **EICIT**
  - Perform once by the subsystem supplier on each component, subassembly, or flight unit prior to integration into next assembly
    - Not repeated by I&T
- **IVT**
  - Tests to demonstrate Interface conformance to ICD performed at subsystem level, but NOT a part of safe connection process
  - Safe Connection Process: Stray voltage checks performed on interfaces that supply power
    - IVT not required on control interfaces
    - Perform once by the subsystem supplier on each component, subassembly, or flight unit prior to first mate
    - Repeated by I&T to ensure safety

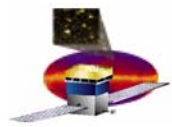


# AUTOMATED TEST SOLUTIONS

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- Follow the SLAC recommendations for connections
- Time to do EICIT and an IVT is about 2 hours (based on a 51 pin connector) per connector
  - Given the number of units and large number of high density connectors, automation can save both direct labor cost and schedule
- Two possible solutions
  - **RECOMMEND: Switch matrix followed by Digital Multi-Meter** – more expensive and can perform all the needed measurements for ELX and I&T
    - Using same tester for ELX and I&T saves on test software development
    - \$16,500 X 3 stations
  - **Data loggers** - inexpensive test equipment that can perform the basic tasks of safe connection, but can't do every test
    - \$5,000 X 3 stations





# ESTIMATED TEST TIMES- UNTAILORED METHODS

## ELX HOURS

Unit Under Test	MANUAL TESTS PERFORMED AT PROCESS STEP							FLIGHT QUANTITY	TOTALS (Hrs.)
	BOARD ASSY (Hrs.)	BOX ASSY (Hrs.)	AFTER TEMP CYCLE (Hrs.)	AFTER VIBE (Hrs.)	RVC. AT SLAC (Hrs.)	BEFORE EMI (Hrs.)	RTN. TO SLAC (Hrs.)		
TEM	35	35						19	1317
TPS	5	5						19	203
TEM/TPS Assy.			37	37	37	37	37	19	3547
GASU	133	133	133	133	133	133	133	3	2800
SIU*		13	13	13	13	13	13	4	310
EPU*		8	8	8	8	8	8	4	192
PDU*	66	66	66	66	66	66	66	3	1379
Heater Control Box									0
Productivity rate of 2.667 hrs. per connector have been measured in EM2, and well as ACD Test Stand testing									<b>9749</b>
* Increased productivity since connectors have fewer pins									

## I&T HOURS

Unit Under Test	RCV TKR (Hrs.)	FLT MATE / CAL (Hrs.)	TWR and FLT CBL (Hrs.)	RCV ACD (Hrs.)	SWAP GASU	SWAP PDU (Hrs.)	ACD I&T (Hrs.)	SIU / EPU I&T (Hrs.)	?	FLIGHT QUANTITY	TOTALS (Hrs.)
					Add FLT CBLs to LAT Shield (Hrs.)						
EM TEM/TPS Assy.	75									16	1195
TEM/TPS Assy.		37								16	597
EM GASU			43							1	43
GASU					120						0
ACD				67			67			1	133
SIU*								13		2	26
EPU*								13		3	39
EM PDU*			33								33
PDU*						75				1	75
Heater Control Box											0
Productivity rate of 2.667 hrs. per connector have been measured in EM2, and well as ACD Test Stand testing											<b>2141</b>
* Increased productivity since connectors have fewer pins											



# ESTIMATED TEST TIMES- USING TAILORED METHODS

## ELX HOURS

AUTOMATED TESTS PERFORMED AT PROCESS STEP									
Unit Under Test	BOARD ASSY (Hrs.)	BOX ASSY (Hrs.)	AFTER TEMP CYCLE (Hrs.)	AFTER VIBE (Hrs.)	RVC. AT SLAC (Hrs.)	BEFORE EMI (Hrs.)	RTN. TO SLAC (Hrs.)	FLIGHT QUANTITY	TOTALS (Hrs.)
TEM	7	7						19	247
TPS	1	1						19	38
TEM/TPS Assy.			7	7	7	7	7	19	618
GASU	25	25	25	25	25	25	25	3	525
SIU*		3	3	3	3	3	3	4	72
EPU*		3	3	3	3	3	3	4	72
PDU*	16	16	16	16	16	16	16	3	336
Heater Control Box									0
									<b>1908</b>

## I&T HOURS

AUTOMATED TESTS PERFORMED AT PROCESS STEP											
Unit Under Test	RCV TKR (Hrs.)	FLT MATE / CAL (Hrs.)	TWR and FLT CBL (Hrs.)	RCV ACD (Hrs.)	SWAP GASU Add FLT CBLs to LAT Shield (Hrs.)	SWAP PDU (Hrs.)	ACD I&T (Hrs.)	SIU / EPU I&T (Hrs.)	?	FLIGHT QUANTITY	TOTALS (Hrs.)
EM TEM/TPS Assy.	14									16	224
TEM/TPS Assy.		7								16	112
EM GASU			8							1	8
GASU					23						0
ACD				13			13			1	25
SIU*								2		2	5
EPU*								2		3	7
EM PDU*			6								6
PDU*						14				1	14
Heater Control Box											0
											<b>401</b>

\* Increased productivity since connectors have fewer pins