

 GLAST LAT PROCUREMENT SPECIFICATION	Document # LAT-CR-00082-03	Date Effective 3rd Draft – 4/2/01
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	Subsystem/Office Tracker	
Document Title QA Provisions for the GLAST LAT SSD		

Gamma-ray Large Area Space Telescope

(GLAST)

Large Area Telescope (LAT)

Quality Assurance Provisions for the Silicon Strip Detectors (SSD)

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes

1. PURPOSE

These provisions will serve as the basis for the procurement, testing, handling, storage and shipping of the GLAST LAT silicon strip detectors.

2. SCOPE

The provisions give the environmental requirements for handling the GLAST LAT SSD, the tests required by the Seller and GLAST LAT institutions, and the details of packaging and shipping of the SSD.

3. DEFINITIONS**3.1 Acronyms**

GLAST	Gamma-ray Large Area Space Telescope
LAT	Large Area Telescope
SSD	Silicon Strip Detector
TBR	To Be Resolved

3.2 Definitions

AC Coupling	The Al metal electrode is covering almost the whole length of the p+ implant, separated from it by a dielectric material
AC Pad	Pad to access the Al metal electrode on the strips
Active Area	Area of the Volume from which charge is collected on the strips in $\ll 1\mu\text{s}$
Buyer	Institution procuring GLAST LAT SSD
C	Capacitance
Contract	Purchase agreement to procure GLAST LAT SSD's
Coupling Capacitor	Capacitor formed by Al metal electrode, dielectric and implant
Customer	Institution involved in the procurement and testing of GLAST LAT SSD's
C-V	Measurement of body capacitance (C) as a function of voltage (V)
DC coupling	Al metal electrode and implant in ohmic contact.
DC Pad	Pad to access the strip implant
Bias Resistor	Resistor connecting every implant to the bias ring
Bias Ring	Implant surrounding the active area, connects to bias resistors
Fiducial	Physical mark in the Al metal layers for alignment and metrology
Guard Ring	Implant ring outside the bias ring without bias connection ("floating")
I-V	Measurement of leakage current (I) as a function of voltage (V)
N-sub	Substrate contact on the detector front
Pad	Area of the Al metal layer accessible through the passivation The pad area is defined as the bondable area.
Pitch	Distance between strip centers
Passivation	Topmost layer covering of inert translucent material
Seller	SSD Manufacturer, Vendor,
Sensor	Silicon Strip Detector (SSD)
μm	Micro meter (10^{-6} meter)
μs	Micro second (10^{-6} second)
V	Voltage, Volt

4. REFERENCES

Hard copies of this document are for REFERENCE ONLY and should not be considered the latest revision beyond the date of printing.

GLAST LAT AO Response	P. Michelson <i>et al</i> , Nov 1999.
Strip Technology	T. Ohsugi <i>et al.</i> , NIM A, 383 (1996) 167.
BTEM prototype detectors	P. Allport <i>et al</i> , SLAC-Pub-8471, June 2000.
Flow-down of GLAST LAT SSD Spec's	H. Sadrozinski, SCIPP 00/33.
GLAST LAT SSD Specifications	LAT-DS-00011-09
Evaluation of LAT SSD Leakage Current Specification	LAT-TD-00122
GLAST LAT SSD Test procedures	LAT-TD-00085
GLAST LAT SSD Test Results	LAT-TD-00086
Drawings	SSD
	LAT-DS-00026
	Test structures
	LAT-DS-00027

5. QUALITY ASSURANCE PROVISIONS

a. General Instructions

I. QUALITY ASSURANCE AT THE SELLER

The Seller shall provide and maintain a quality program/system that compiles with any recognized U.S. Quality Program/System Standard in Effect on the contract date (e.g., ISO 9001, MIL-I-45208, ANSI N45.2) or equivalent.

The Seller shall require, in writing, subcontractors of all tiers to comply with all applicable quality program/system requirements.

The Seller shall tender for acceptance only those supplies or services that have been inspected and tested in accordance with its quality program/system and have been found to conform with contract requirements.

II. SUBMITTAL(S) REQUIRED AFTER CONTRACT DATE

Prior to the performance of any operations involving the following, but in no event later than 30 calendar days after the contract date, the Seller shall deliver for Buyer's review and approval:

- (1) a concise explanation of all manufacturing processes, including mask drawings,
- (2) a production and delivery schedule,
- (3) an Inspection and Test Plan. The plan shall specify, as a minimum: (1) what is to be inspected/tested (e.g., components, subassemblies, and assemblies), (2) the inspections/tests to be performed, and (3) the inspection/test methods or procedures to be used.
- (4) all proposed changes to the Customer's design or specifications.
- (5) evidence of its quality program/system. Such evidence may consist of a copy of the Seller's approved QA/QC plan, and shall specify the standard(s) upon which the system is based.

Buyer will notify the Seller of its approval or disapproval within 30 calendar days; provided, however, that if notice is not issued within such time, the Seller's procedure shall be deemed approved. For the purposes of this clause, an approval or disapproval notice is issued when it is sent.

III. FINAL ACCEPTANCE

Notwithstanding the inspection requirements at the Seller's facilities, final acceptance of all silicon strip detectors shall take place following delivery to and testing by the Buyer.

The buyer reserves the right to perform any or all test which would be required to verify that the silicon strip detectors conform to the requirements of the specifications supplied to the Supplier as part of this contract. Silicon strip detectors, which fail any of the tests performed, will be deemed unacceptable and returned to the Seller for replacement at no cost to the Buyer. Shipping cost of return and replacement shall also be borne by the Seller.

IV. SOURCE INSPECTION

The Buyer shall be permitted access to witness any phase of manufacturing, testing and conditioning of the silicon strip detectors. Upon request, the Seller shall make available to the Buyer all reports and data on materials and procurement, on tests, and manufacturing, or other operations, which pertain to the silicon strip detectors.

After a request for inspection, the Seller shall notify the Buyer no less than 7 working days in advance of any function or operation chosen to be witnessed or inspected by the Buyer's representative.

V. NONCONFORMANCE AND CORRECTIVE ACTION

Any departure from the requirements of the specification and drawings, which the Seller proposes to make, shall be documented and submitted to the Buyer for approval.

b. Delivery Schedule of SSD

Delivery of GLAST LAT SSD fabricated to the specifications of Specification (LAT-DS-00011), and tested according to Sec 5.c below shall be made according to the following monthly schedule (TBR at the time of the contract signing) (Table 5.1):

Table 5.1 Preliminary Monthly Delivery Schedule (TBR) of GLAST LAT SSD

Month	# of SSD
September 2001	500
October 2001	500
November 2001	500
December 2001	500
January 2002	500
February 2002	500
March 2002	500
April 2002	500
May 2002	500
June 2002	500
July 2002	500
August 2002	500
September 2002	500
October 2002	500
November 2002	500
December 2002	500
January 2003	600
February 2003	600
March 2003	600
April 2003	600
May 2003	500

c. Inspection Requirements at the Seller

The Seller shall perform or have performed all inspections and tests necessary to substantiate that the silicon strip detectors tendered for acceptance conform to the Technical Specifications (LAT-00011), and these Q/A Provisions (LAT-00082). Such inspections and tests shall include, but not be limited to the tests specified in Sec 5.e, 5.f, 5.h, 5.i, 5.k of the Technical Specification, and shall include:

- Dimensions of cut SSD (length, width, alignment to mask, thickness, quality of edge cut)
- Mask dimensions and alignment
- I-V, C-V on the full detector,
- Resistance value of bias resistor and Al electrode
- Capacitor breakdown up to 100V,
- Shorted and open metal electrodes and implants, disconnected bias resistors
- Bondability of bond pads
- Adhesion and electrical contact of the back plane when glued with a (TBD) glue to a Kapton substrate
- Visual inspection

d. Reporting by the Seller

The Seller shall submit for each silicon strip detector, Functional Test Report(s) of the actual test results, specifying what was tested, the requirements/parameters tested, and the acceptance criteria, all as required by Sec 5.k of the Technical Specification.

As specified in Sec 5.k.viii, the Seller shall submit for each batch both processing information and wafer QC information which allow the buyer to trace the process parameters.

The entire information shall be submitted for the SSD in each shipment. The submittal shall be made in form of an Excel file both in electronic form (by web, ftp and/or e-mail as specified by the Italian Institutions) and in diskette form within 2 week of completion of the tests. The electronic submittal shall be made to

T. Ohsugi, Hiroshima University	ohsugi@hirax6.hepl.hiroshima-u.ac.jp
R. Bellazzini, INFN-Pisa	Ronaldo.Bellazzini@Pi.infn.it
H. Sadrozinski, UC Santa Cruz	hartmut@scipp.ucsc.edu

The diskette with the test results mentioned above shall be included in the SSD shipment.

e. Packaging, Shipment and Delivery

The Seller shall package and ship the silicon strip detectors by a method that ensures that the silicon strip detectors are delivered to the Buyer free from any damage.

The packaging shall be similar to the one employed for the GLAST99 SSD delivered to SLAC for the BTEM. The SSD's shall be packaged individually in paper envelopes, in between two card board pieces. The SSD type, the ID# of the SSD and the batch number shall be written on the outside of the envelope. The envelope shall be inserted in order of their ID# into vertical slots in a lidded anti-static plastic box. The boxes shall be transported individually vacuum-sealed in Al foil and plastic wrapping.

The SSD shall be shipped via (carrier TBD) to INFN-Pisa (or an address specified by R. Bellazzini):

R.Bellazzini
INFN-Pisa
Via Livornese 1291
I-56010, San Piero a Grado
Pisa, Italy
E-MAIL Ronaldo.Bellazzini@Pi.infn.it
Phone +39/050/880286
Fax +39/050/880317

The shipment shall take place twice a month, or at longer intervals at the discretion of the Italian Tracker manager R. Bellazzini, and contain all the SSD produced according to the delivery schedule of Sec. 5. b.

R. Bellazzini shall be notified by fax and e-mail of the shipping, including the carrier name and the waybill number of the shipment. The shipment documents and the customs and insurance documents shall be filled out according to R. Bellazzini's directions.

Delivery shall be paid for by the Seller.

The "GLAST cut-off's" containing the test structures, identified by the corresponding SSD's ID#, shall be distributed in the following way. Within 1 week of completion of SSD testing at the Seller, the cut-offs of the accepted SSD, shall be shipped in equal parts (1/4 of the total) to

T. Ohsugi, Hiroshima University 1/4

R.Bellazzini, 1/4
INFN-Pisa at the above address

H. Sadrozinski 1/4
UC Santa Cruz, SCIPP, Nat Sci 2,
1160 High Str.,
Santa Cruz, CA 95064

The Seller will keep 1/4 of the cut-offs to be able make comparison measurements.

Details of the shipment documents for the cut-offs shall be specified by the recipients by April 15, 2001 (TBD).

f. Handling

The following provisions cover the handling of SSD during testing and assembly. Whenever more stringent provisions exist, the more stringent ones shall apply. The SSD shall be handled and stored in a clean room of a minimum classification of ISO 14644 CLASS 7 (occupied). Electrical discharge should be avoided.

Air atmosphere	Temperature > 20 deg C, Humidity <60%, >40% positive pressure of filtered air
Floor	tacky mats at the entrance
SSD Storage	Nitrogen atmosphere, flow < 1 volume change/hour
Garb procedures	Coats, hats, booties, masks when working with SSD
Gloves	LATEX (or equivalent) when contacting equipment
Ground straps	Wear ground straps when handling SSD
Surfaces / Tools	No metallic surface contact, suggest plastics or Teflon coating
Cleaning of surfaces and tools	daily with alcohol before they contact SSD
Handling	No touching, lifting, transporting detectors with fingers (even when gloved). Use vacuum tools and jigs.
Cleaning of SSD	If needed, SSD shall be cleaned with de-ionized water
Surface charge	should be removed before encapsulation, if needed
Use of pads	Bonding shall be done on the outer pads first.
Do not use detectors with	obvious surface blemishes, scratches etc excessive warping irregular edges (>50microns)

g. Testing Instructions at GLAST Institutions

GLAST LAT SSD Test procedures are documented in LAT-TD-00085.
The following testing will be done at GLAST LAT Institutions.

I. ACCEPTANCE TESTING

Italian Institutions will perform acceptance testing of SSD after delivery by the Seller. This will consist of I-V curves and, (in case it has not been done by the manufacturer,) checking of the saw cut dimensions and orientation.

II. PRODUCTION MONITORING

Production monitoring will be performed by Hiroshima University. It will consist of tracking the process parameters submitted by the Seller and of measurement on the test structures contained on "GLAST cut-offs" (see LAT-DS-00027-01). From every shipment (TBR), one cut-off of from a wafers of a delivered SSD will be tested both for long-term stability and for radiation hardness (see Sec 5.g.III below). The parameters to be tested will be the leakage current, the interstrip capacitance and isolation, and breakdown characteristics.

III. RADIATION TESTING

Hiroshima U. will conduct tests on the test structures mentioned in Sec 5.g.II above after irradiation with Cobalt 60 to total dose of 100Gy. If the irradiated sample detector does not satisfy the requirements, the acceptance of the detectors by GLAST LAT is immediately stopped, and only resumed after diagnosis and elimination of the problem.

IV. MECHANICAL TESTING

Testing of bonding, gluing and (TBD) other mechanical and electrical properties will be conducted at Italian Institutions and SLAC / UCSC.

V. SPACE QUALIFICATION

Space Qualification might require adherence to a "Qualification Test Plan", which will be developed before delivery of the flight SSD.

h. Data Base

A data base shall be maintained by an Italian Institution. It will allow to enter data from the following inputs and allows to monitor the performance of the SSD including statistical analysis of all parameters:

- data from testing of SSD at the Seller and GLAST institutions
- data from ladder / tray / tower assembly
- data from testing during assembly

Test data entry shall be done within 3 business days of the day when the data is acquired or received.