

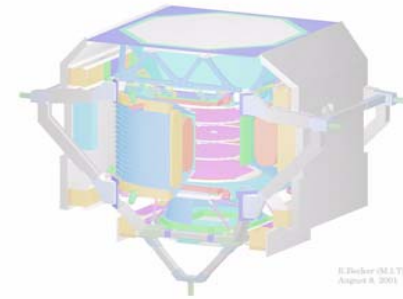
AMS-02 Functional Integration Test (FIT)

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R06

03-Oct-2003

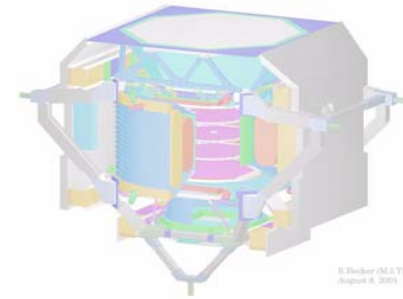
Introduction



The Functional Integration Test (FIT) for AMS-02 and ACOP is similar in purpose to the CDH portions of a Multi Element Integration Tests (MEIT).

- ❖ FIT will only use the AMS-02 avionics crates - Not the whole payload.
- ❖ To be performed at the Payload Test and Checkout System (PTCS) at KSC
- ❖ FIT will integrate the **flight segment** consisting of:
 - AMS-02 flight avionics hardware (J-Crate and JPD only)
 - ACOP/LFM
 - ISS primary CDH interfaces (Payload Multiplexer DeMultiplexer - PLMDM and High Rate Frame Multiplexer - HRFM, C&CMDM)
- ❖ FIT will integrate the **ground segment** consisting of:
 - Medium to high fidelity emulation of ISS ground handling systems (Payload Data Service System - PDSS and Enhanced Huntsville Operations Support Center Services - HOSC-EHS).
 - TReKGate and TReK for the PDSS to AMS-02 ground segment interface.
- ❖ The two integrated segments will be used to test all communications paths and command and data formats in the AMS-02 system.

Avionics Test Timeline



❖ Preliminary Interface Tests (PIT)

Completed June-2003.

Low level design validation tests for LRDL (1553) and HRDL hardware.

Functional test of HRDL via APS.

Low fidelity functional test of LRDL via STEP.

❖ Functional Integration Tests (FIT)

➤ Targeted for: Q4 2004 at KSC PTCS.

➤ Equivalent to ISS Program CDH "Multi Element Integration Tests" (MEIT).

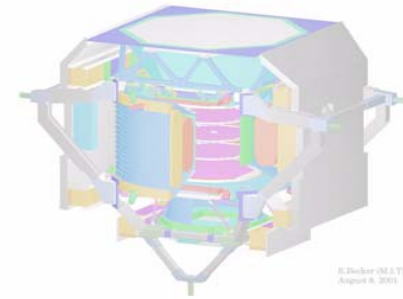
➤ Functional tests to verify the AMS-02 Command and Data Handling system, the AMS-02 ground segment, and their relationships to HOSC/POIC.

❖ Kennedy Integration Tests (KIT)

➤ L-3 months.

➤ Final integration tests perform in SSPF. ISS Program checkout of flight systems.

FIT Rational

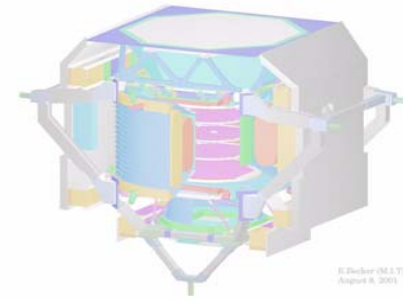


Well
Accepted

FIT, unlike PIT and KIT, is not part of the nominal ISS plan for a nominal payload. The rational for the extra FIT effort is:

- ❖ All large integrations for ISS have utilized Multi Element Integration Tests (MEIT).
- ❖ AMS-02 is a large and complex payload and should be fully tested early to improve the chances of mission success.
- ❖ Final assembly of AMS-02 is done in Europe. Extraction and repair of any electronics that do not meet test requirements during normal L-3 processing will likely force launch delay.
- ❖ The personnel who designed and built the avionics will be difficult to reassemble to correct any design defects detected during the launch processing.
- ❖ AMS-02 is the first attached payload.
- ❖ AMS-02 makes novel use of both the LRDL and HDRL interfaces.
- ❖ AMS-02 makes novel use of the ISS command and telemetry formats.
- ❖ AMS-02 represents a much larger data load/impact than ISS/POIC/HOSC has seen to date.
- ❖ The portable tools for payload testing (STEP and ScS) lack support for attached payloads.

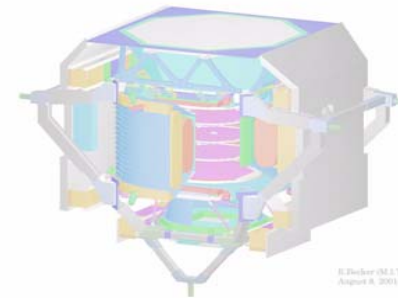
PIT Report



PIT was designed to provide low level interface tests of the HRDL and LRDL interfaces. Pit was executed in June 2003.

- ❖ Full 1553 RT Validation
 - ISS Interface
 - STS Interface
- ❖ HRDL Characterization for both AMS-02 J-Crate and ACOP
 - Light power measurements
 - Receiver sensitivity tests (**NOT** BER)
 - "TAXIScope" data quality" measurements
 - Low level protocol studies
 - Data throttling tests
- ❖ Payload to payload via APS engineering unit testing

PIT Test Setup



ACOP/LFM: Unit under test (UUT)

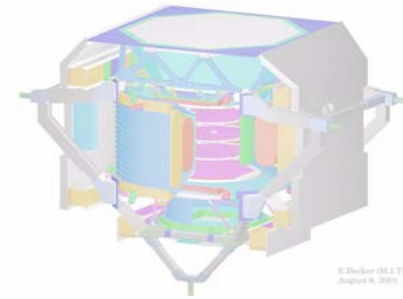
J-Crate: UUT

JPD: Flight power distribution

28v Power supplies

GSE Systems

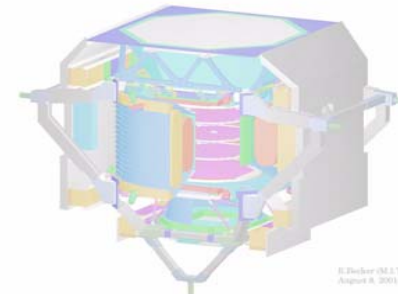
PIT Forward Issues



- ❖ Measurements of the extinsion ratio were marginal. These tests should be repeated using proper measurement tools. (Perhaps the Boeing personnel from PIT should be requested to perform this test.)

Seems to be
Measurement
issue

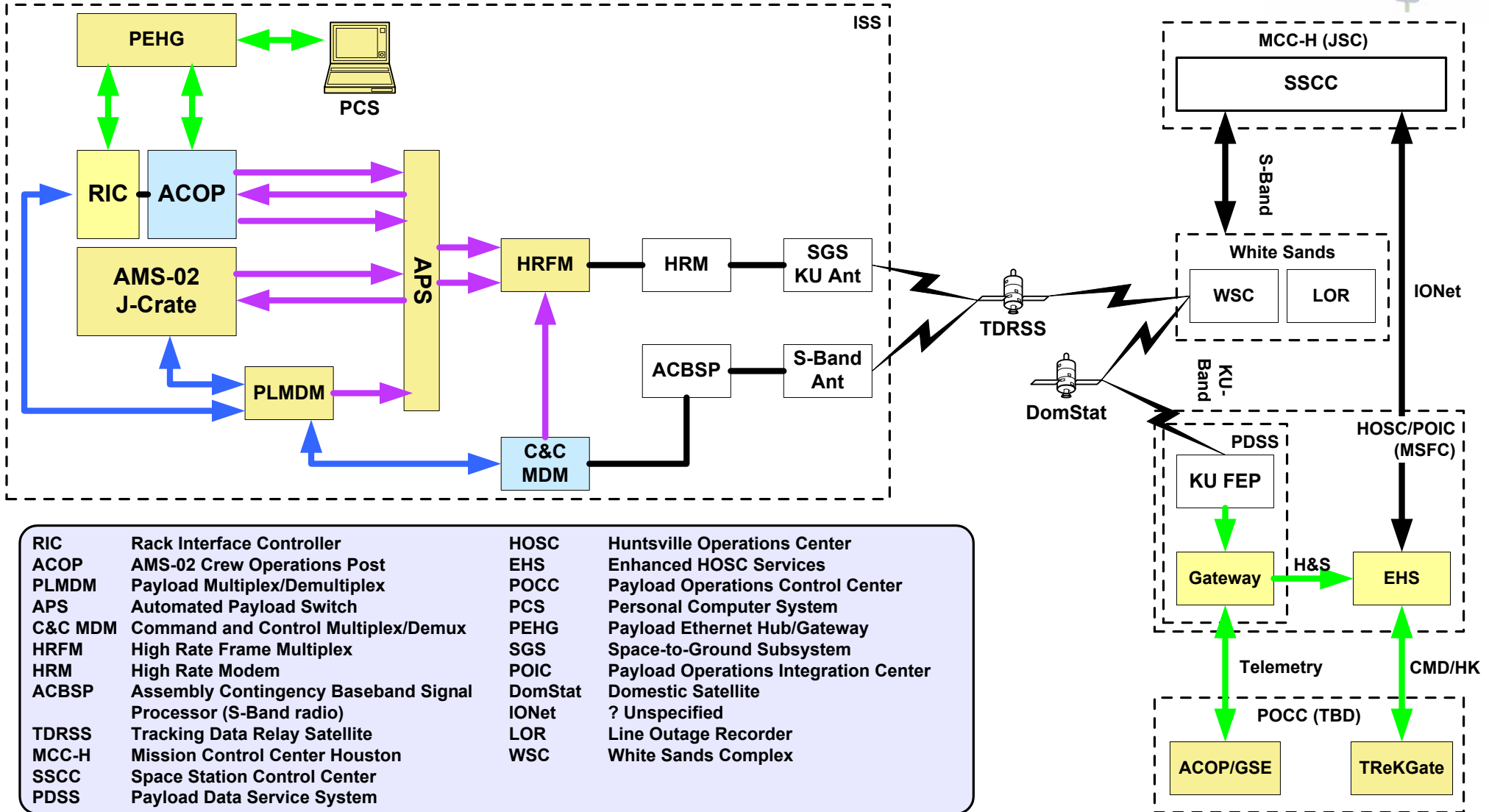
Fidelity Goals



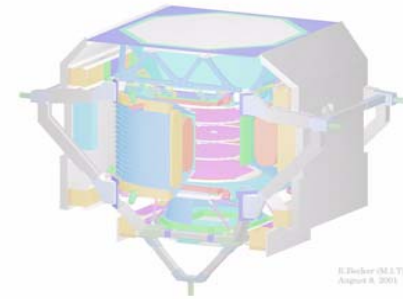
Fiber		Fidelity	High	
1553			Med/Low	
Copper				
Network				

NOTE: Color filled blocks have functional representation at FIT

ISS Flight C&DH



Site Selection

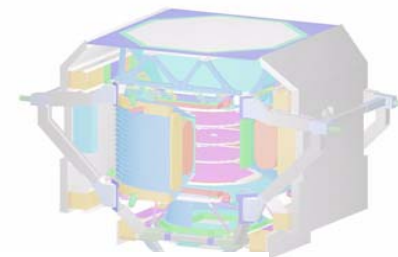


Locations considered to support FIT:

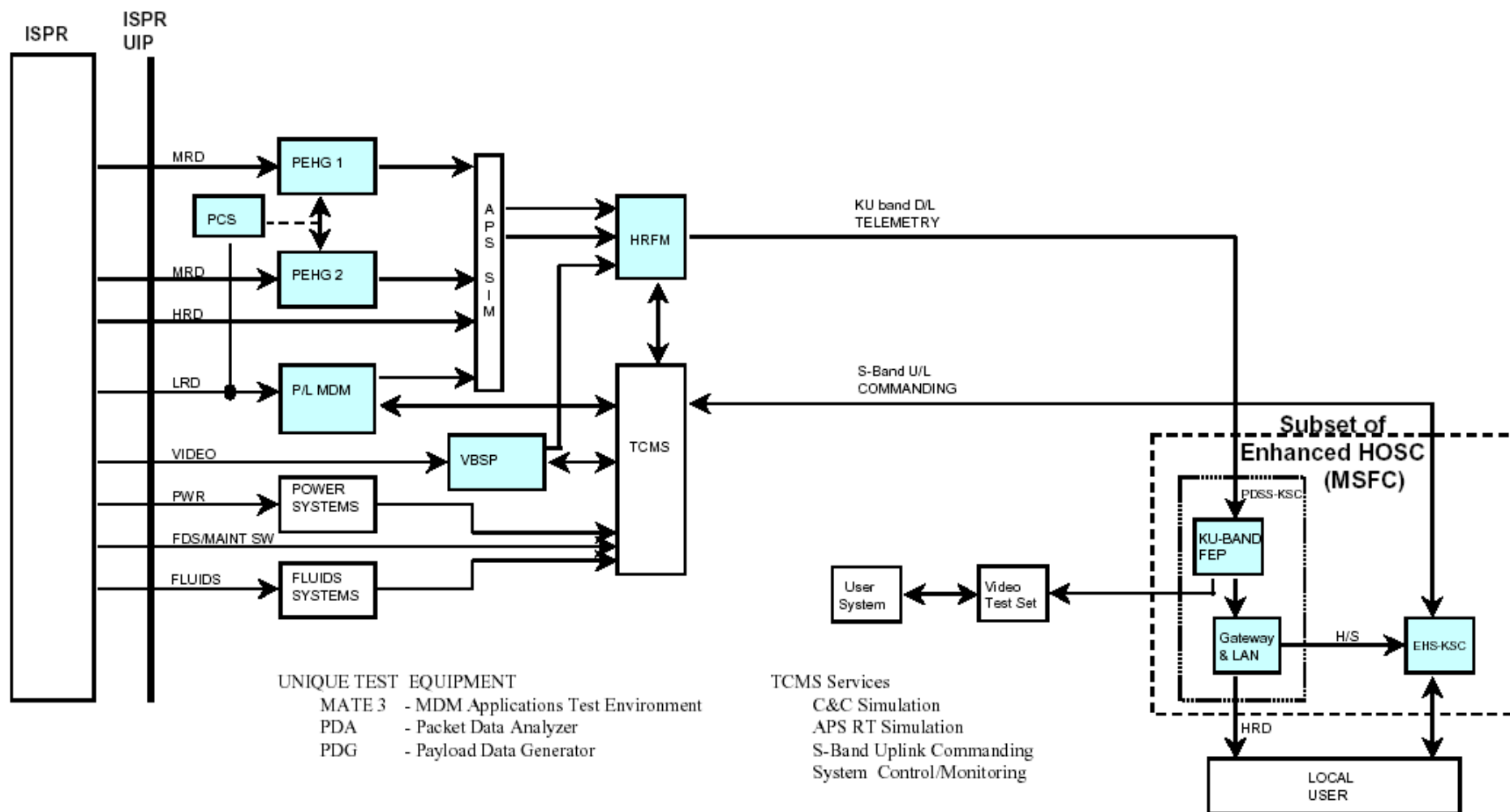
- ❖ ~~PRCU @ JSC~~ Payload Rack Checkout Unit at JSC utilized by Human Research Facility (HRF).
- ❖ ~~ISIL @ JSC Sonny Carter~~ ISS Systems Integration Lab. CDH development lab.
- ✓ ❖ PTCS @ KSC SSPF - Payload Test and Checkout System. (Used during payload processing for checkout (KIT).)

The PTCS was a clear winner - having all the systems needed to perform FIT. It also has the benefit of making FIT be a warm-up for the standard payload processing.

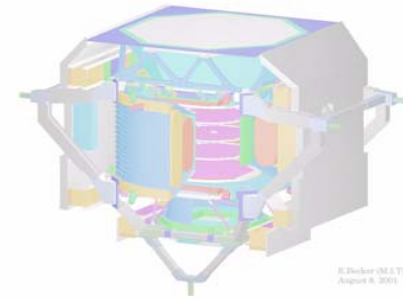
PTCS - KSC



K. Decker (M.I.T.)
August 8, 2003



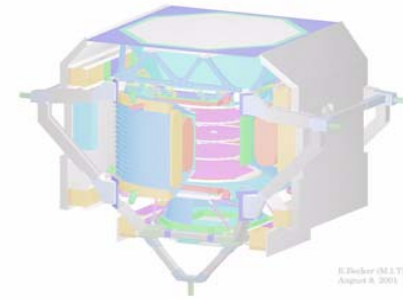
FIT Prep Schedule



- | | |
|---|------------------|
| ❖ Flight and Ground Segment Review at MSFC | 25-Sep-03 |
| ❖ FIT Site selection | 1-Nov-03 |
| ❖ PIA input for FIT needs | 1-Oct-03 |
| ❖ Kick off meeting at KSC (selected site) | 19-Jan-04 |
| ❖ Complete PDL C&DH section data entry | 15-Feb-03 |
| ❖ Promote PDL CDH section
(required to support generation of configuration
information for ISS test equipment). | 1-Mar-04 |
| ❖ Pre-FIT software checkout at CERN | 15-Jun-04 |
| ❖ ACOP ScS session at JSC | 15-May-04 |
| ❖ Perform FIT and FIT-STS (about 10 test days) | Q4-04 |

Looking
Good

FIT - STS



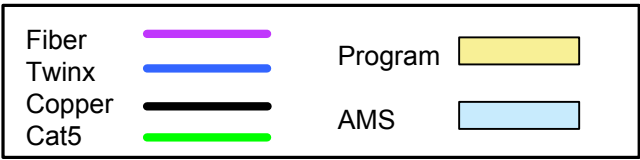
- ❖ During FIT it will be desirable to perform comparable tests for the STS systems (J-Crate, DDRS-02, KU, and OIU).

Site Selections:

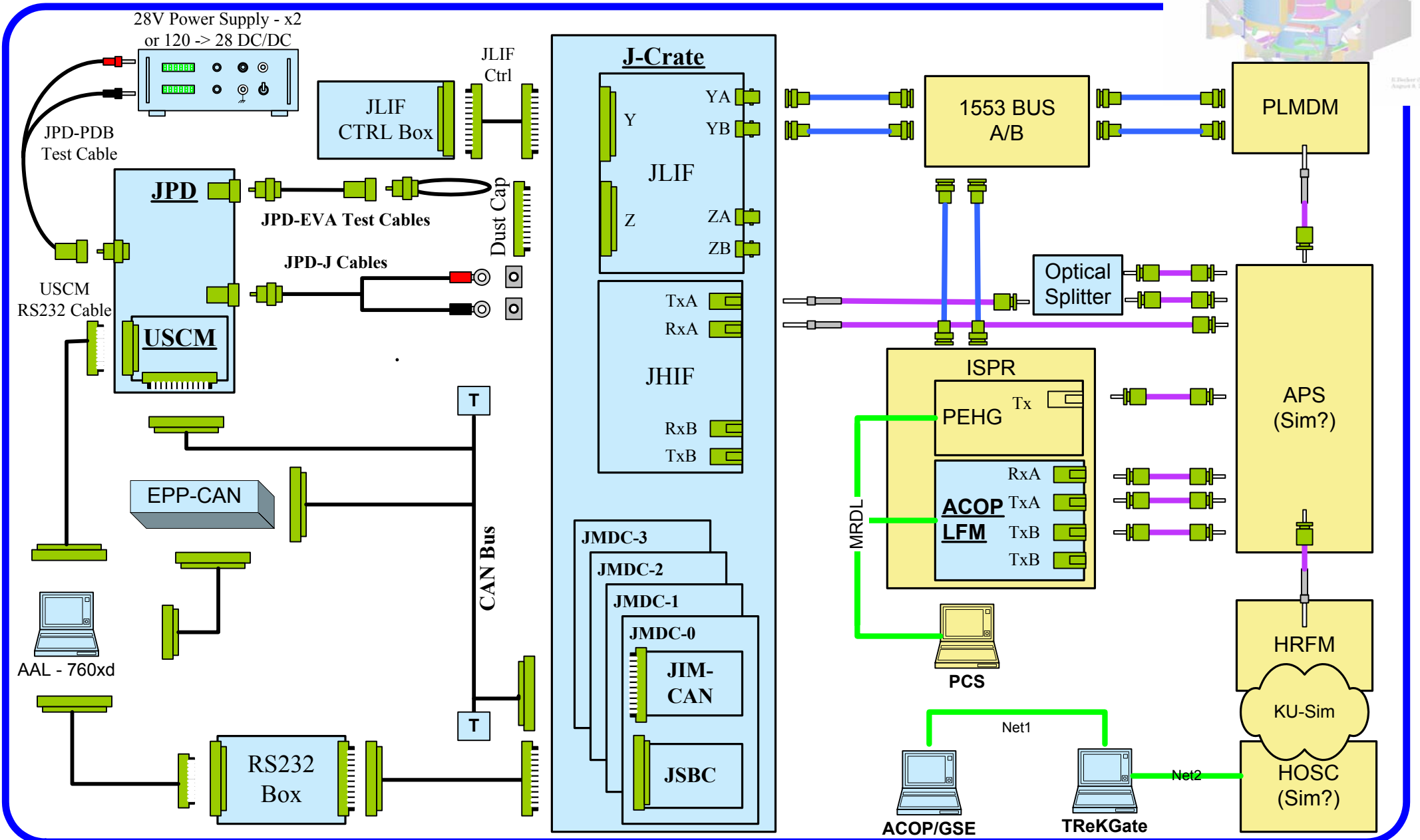
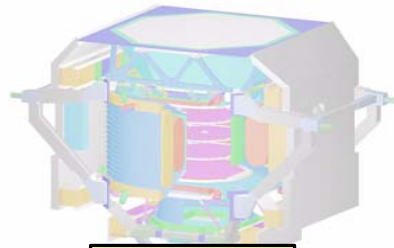
~~Electronic Systems Testing Lab (ESTL - JSC)~~

~~Shuttle Avionics Integration Lab (SAIL - JSC)~~

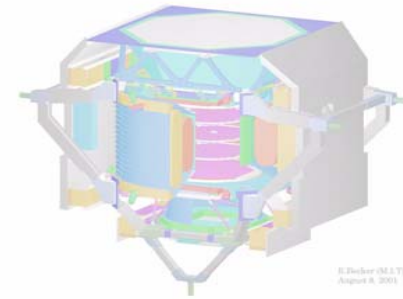
✓ Launch Package Integration Stand (LPIS - KSC)



Schematic



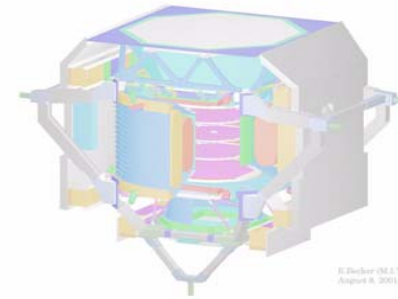
Test Plan



The following are major areas to be tested: (this list is growing...)

- ❖ Verify AMS-02 initial power up sequence is successful (several cycles)
- ❖ Verify AMS-02 PLMDM startup is handled correctly (particularly 1553 RT activation)
- ❖ Verify AMS-02 ground commands received and handled correctly
- ❖ Verify AMS-02 house keeping (ISS "Health and Status") data flows correctly
- ❖ Verify AMS-02 Critical Health Data (CHD) is process correctly
- ❖ Verify AMS-02 science data starts and flows correctly
- ❖ Complete PDL verification for commands (pre-defined and AMSBlock frames)
- ❖ Complete PDL verification for telemetry definitions (all PUIs)
- ❖ Repeat same tests for ACOP
- ❖ Verify ACOP MRDL link
- ❖ Verify ground segment house keeping data format
- ❖ Verify ground segment science data format
- ❖ Test LOS and AOS cases (several cycles)
- ❖ Test payload to payload communications over HRDL

PIRN 57003-NA-0046



The above PIRN clarifies testing for HRDL. Testing at FIT should be performed to assure AMS-02 meets all current HRDL requirements.

- ❖ Towel bar strain relief's should be in place for testing
- ❖ Bend limiters should be utilized
- ❖ BER testing should be used on J-Crate receiver and ACOP (assumes "program" provided BER generation).