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Gravity Probe B Relativity Mission

ATC(ACE) ADP Review – Final Issue Close Out

(Attitude Control Electronics)

S0840, Rev. -

March 28, 2003

Close Out Certification

The ACE data package* has been reviewed by Stanford University. MSFC and the IRT have been requested to identify any flight risks from any review to the Stanford University review chairman. The chairman, having assessed all inputs received as of the review date of 28 March 2003, finds the ACE component reviewed acceptable for the GP-B flight mission contingent on the acceptable closure of the action items and acceptable system level testing.

* the following items were reviewed: Attitude Control Electronics

ADP Review Chairman:

Bill Bencze — 18 APR 03 — Date

GP-B Program Manager:

Gaylord Green — 24 APR 03 — Date

Concurrence:

Systems Engineering — 4/24/2003 — Date

Concurrence:

Quality Assurance — Apr. 21, 03 — Date

ITAR Assessment Performed — Tom Langenstein — 4.25.03

ITAR Control Req'd? ☐ Yes ☒ No

ATC(ACE) ADP Data Review (telecon) and Issues Resolution Meeting Minutes:

Location: Lockheed Martin, Building 255 Room OA235, 1 pm, March 28, 2003
Minutes prepared by: Steve Young

References:

LM EM SYS 277, Response to MSFC issues for SPRU, PDU, Battery and SSR, Rich Whelan, March 27, 2003
[note: references are ITAR / U.S. Export Controlled documents]

Attendees:

MSFC: ..... Howard Estes, Albert Froelich, Morris Hammer, Ralph Kissel, Brian Mulac
SU: ..... Bill Bencze, Dorrene Ross, Steve Young
LM: ..... Rich Whelan, Mike Sisley, Mike Miranda, Dave Steele

Background:

Acceptance Data Packages for all Spacecraft and Space Vehicle components were sent to Marshall Space Flight Center for review. MSFC responded with questions and issues raised by the ADPs. A series of Issue Resolution Meetings were scheduled to address those questions and achieve issue closure based on appropriate discussions, clarifications, or actions. The issue closure process began when several ATC component issues were addressed in January 2003. Meetings scheduled for March and April (2003) will address other subsystems and their components.

The March 28, 2003 meeting focused on the Attitude Control Electronics (ACE), a component of the ATC subsystem.

Overview / Summary:

Review of the MSFC questions regarding the ACE ADP was divided into two sections. First, those issues not included in EM SYS 277 were discussed and brought to closure pending appropriate clarifications and/or provisions. All issues reviewed and further discussion regarding these items are included below. Next, the ACE component questions included in EM SYS 277 were discussed, along with the "Standard Questions" listed in the referenced document. The complete results of this discussion are not included below. However, several clarifications of the issue resolutions were added and are noted in this document. The remainder of the ACE component issues were closed as stated in the EM.

ACE Questions / Issues from MSFC:

	Sybsystem	MSFC Reviewer	Findings/issues	Finding resolution
1	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	It appears as though the ADP package submitted for the ACE is actually the ADP representing the effort conducted by SpectrumAstro in response to LM purchase order to remove and replace Interpoint DC/DC converters identified by GIDEP Alert; MSFC No. 7332. The ADP for the original build and test of the ACE was not available or reviewed. Data reviewed: 1162-ED-E24761_I.pdf 2. 1162-ED-E24761_II.pdf 3. 1162-ED-E24761_III.pdf 4. 1162-ED-E24761_IV.pdf 5. 1162-ED-E24761_V.pdf 6. 1162-ED-E24761_VI.pdf 7. 8A02482_E Drawing for AFT TIV Bracket 8. LMMS_P086880F.pdf LMMS Specification for the Attitude Control Electronics – March 21, 1999	Mike Miranda (2/17/03) Other ADP Documents have been identified and can be sent to the customer: Top assembly, EMC/EMI, Initial CFT, Post ship AFT, Vibe, Shock. See clarification below [1] All information is on the VRC. CLOSED
2			~~1. Although the primary reason for this effort was the removal and replacement of the DC/DC converters it was not clear from the process traveler (0000-EN-K065159a) what the part number/lot date code was for the part removed from location U062 on the two ACI boards impacted. The part number for the replacement part was identified as 5962-9307201HZA but the lot date code was not clear.~~	withdrawn by MSFC Previous RL answered this Mike Sisley - (3/12/03) The DC/DC converters replaced are on the baseplate (p/n AE-504836) and are at locations PS001 thru PS004. They all carry a Lot Date Code of 0302. The caps changed were also on the baseplate at locations C102, C106, C202 & C206. They are part number CDR04BX104AKUS with a Lot Date Code of 0043RA.
3			~~2. There was a discrepancy between the ACI board SNs on the ACE Assembly traveler and the ACI board "as run" post rework test procedures. The ACE assembly traveler identified the SN for the two ACI boards as SN 01480 and SN4. 01481. There were three (?) SN's identified in the ACI board "as run" post rework tests. They were SN 01840, SN 01841, and SN 01842.~~	withdrawn by MSFC Only 2 ACIs Mike Sisley (3/11/03) RL 574 states there are only two S/N 01840 and 01841.
4			5. There were no parts list (below PWBs) included in the ADP.	Mike Miranda (2/17/03) Build Documents have been sent to the customer (2/11/03): backplane assembly, attitude control interface, TIV, mass trim drive, thruster drive board. All information is on the VRC. CLOSED
5			6. The Thermal Cycle Test performed was run with one (1) cycle with functional tests only performed at +28 V vs the normal +35V, +28V, and +22V. This precluded as assessment of the linearity of the ACE.	Question references data in rework package -- see clarification below [1] CLOSED

6			7. The ACE box level TVAC utilized 4 test cycles vs the normal 8 cycles per LM TRR direction. No explanation provided for this change.	Penalty test is 4 cycles only. (3/6/03) Question references data in rework package -- see clarification below (1) CLOSED
7			8. Vol IV of the ACE ADP included an "As Run" test procedure for Unpowered Z Axis Vibration test. This procedure included a cover sheet for an appendix titled "Relay Discrepancies" with no contents.	Mike Miranda - Content was "none" (2/17/03), Mark Anderson - concur (3/6/03) CLOSED
8			9. QAR 11621873 makes mention of questionable EGSE performance and references to anomalous states with non-conclusive investigations.	See EM SYS 277
9			10. At least four (4) out of tolerance conditions were explained as caused by test environment noise. QAR 11621815A was one of these. The investigation report provided with this QAR raises concern over the ability of the ACE to meet CS01 and CS02 requirements.	See EM SYS 277 Section 6.2.2 of the EMI test procedure (SAI99018) confirms that the test was performed on the flight unit (not the engineering unit).
10			11. The EMI test procedure and report was not found in the ADP although there was reference to a SpectrumAstro document 1079-ET-E01665 titled ACE EMI test procedure found referenced in the ACE TVAC test procedure (1079-ET-E01663).	Mike Miranda (2/17/03) Other ADP Documents have been identified and can be sent to the customer: Top assembly, EMC/EMI, Initial CFT, Post ship AFT, Vibe, Shock. See clarification below (1) All information is on the VRC. CLOSED
11			12. The test procedures provided in the ADP make reference to a Rev D version of the ACE Specification while the ACE Specification provided, as part of the ADP is a Rev F. Other than the Record of Revisions page of LMMS/P086880F it is not possible to clearly identify the extent of the Rev E and Rev F changes.	Mike Miranda (3/10/03) Line by line D/F difference document ("Changes Between ACE SPEC – P086880 REV D and REV F") delivered to MSFC review team (4/15/03). CLOSED
12			~~13. The ACE Specification provided is missing page 46. There is no objective evidence of requirements for an EEE Parts program.~~	withdrawn by MSFC Mike Miranda - Rev. F rescanned. (2/17/03)
13			14. No data was found in the ADP to verify compliance with the radiation requirements. There also was no traceability between the ACE Specification radiation requirements and EMI requirements and the Space requirements of P0149.	See EM SYS 277
14			QAR 11621869 identifies bent pins, which were not replaced.	See EM SYS 277
15			16. The SpectrumAstro TVAC CFT "as run" procedure (1079-ET-E01661) indicated that the following Section 6 tests were not run per Op #530. a. 6.1 QA Review b. 6.2 Physical Measurements c. 6.3 Enclosure Bonding d. 6.4 Continuity and Isolation e. 6.5 Setup f. 6.6 40V Input Power g. 6.7 Turn On Time h. 6.8 Hot-Swap i. 6.9 Thruster Noise Density j. 6.10 Sixteen Channel Thruster Closed Loop k. 6.11 Telemetry Cross Talk l. 6.12 Power Modes m. 6.13 Torque Rod Step Response n. 6.14 In Rush Current	See EM SYS 277 Question references data in rework package -- see clarification below (1)

			o. 6.15 BasePlate Flatness p. 6.16 RAV Current Limit	
16			Either not found or incomplete: . Drawing Tree 1. Subsystem, assembly, and subassembly hardware (to lowest p/n) 2. Parts procured to a source control drawing 3. Parts procured to a specification control drawing f. List of loose or separate hardware g. Weight and balance Log h. List of authorized deviations and waivers (found only for rebuild effort) j. As designed (Qual) versus as-built (Flight) with explanation of resolution k. Class 1 Discrepancy Reports (found only for rebuild effort) l. Comparison with NASA Alert m. Limited Life Items List n. As-Measured Mass Properties Report o. Verification Requirements Compliance Document p. Deviation/Waiver Approval Requests	See EM SYS 277 Question references data in rework package -- see clarification below [1]
17			. Since it is probable that an ADP package for the initial delivery of the ACE exists it would probably be prudent to request this from the supplier.	Mike Miranda (2/17/03) Other ADP Documents have been identified and can be sent to the customer: Top assembly, EMC/EMI, Initial CFT, Post ship AFT, Vibe, Shock. See clarification below [1] All information is on the VRC. CLOSED
18			~~Since the primary reason for the rework effort performed by SpectrumAstro on the ACE was the removal and replacement of the Interpoint DC/DC converters it would probably be prudent to resolve the SN conflicts identified above to obtain confirmation that the as-built ACE is utilizing the desired Interpoint DC/DC converters.~~	withdrawn by MSFC Mike Sisley - S/N used are 0269, 0270, 0271, 0273 (3/11/03)
19			~~If the Interpoint part number 5962-9307201HZA is confirmed as utilized in the as-built configuration it may be prudent to perform a reliability engineering assessment of the risk of any additional thermal cycles on this part before any additional test cycles are performed. The differences between the HZA configuration of this part from the HXC configuration mentioned in the GIDEP alert may not be significant enough to preclude a repeat of the creep problem.~~	withdrawn by MSFC
20	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	Comments to follow refer to LM Part # 8A00318. 1. The parts list and schematics included in the ADP do not reflect all design changes and modifications that have occurred. Developer is requested to provide updates to documents impacted.	See EM SYS 277 Delta ADP in delivery process (4/7/03) CLOSED

21	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	2. All box level test data, Items 1 thru 4 above, are no longer valid due to design changes.	See EM SYS 277 Delta ADP in delivery process (4/7/03) CLOSED
22	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	3. Selected board level test data are no longer valid and should be resubmitted.	See EM SYS 277 Delta ADP in delivery process (4/7/03) CLOSED
23	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	4. The ACE Specification, Item 21 above, paragraph 3.3.1.1.1 states "derating requirements are not required". This statement requires clarification.	See EM SYS 277 Details of vendor standard practice unavailable -- parts purchased from qualified aerospace vendor (Spectrum Astro / ISO9000 certified)
24	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	5. No data were found in the ADP to verify compliance with the radiation requirements. There also was no traceability between the ACE Specification radiation requirements and EMI requirements and the Space requirements of P0149.	repeat from above See EM SYS 277
25	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	6. QAR 11621869 identifies bent pins, which were not replaced. Explain.	repeat from above See EM SYS 277
26	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	7. No Non-Standard Parts Approval Requests (NSPAR) were found in the ADP. Provide.	See EM SYS 277 Mike Miranda (3/25/03) Contained in SAI99017 document -- on VRC.
27	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	8. The reliability prediction for the ACE required by the specification was not found in the ADP. RL response on this was incomplete.	Drew Costantino (3/11/03) Provided by ACE/PDU Failure Review Action Item #6. (4/13/03) - Data converted to Excel format; delivery to MSFC underway. CLOSED
28	Attitude Control Electronics (ACE) (1162-ED-E24761)	Feltner	The following requirements of Appendix A from Reference 1 were either not found or incomplete: d. Drawing Tree; 1. Parts procured to a source control drawing; 2. Parts procured to a specification control drawing; f. List of loose or separate hardware; g. Weight and balance Log; h. List of authorized deviations and waivers (found only for rebuild effort); j. As designed (Qual) versus as-built (Flight) with explanation of resolution; l. Comparison with NASA Alert; m. Limited Life Items List; n. As-Measured Mass Properties Report; o. Verification Requirements Compliance Document; p. Deviation/Waiver Approval Requests	repeat from above See EM SYS 277

Additional Notes:

(1) Response to questions regarding data in rework package, Steve Young (3/31/03)

The first data package provided to MSFC reviewers represented testing performed by the vendor after a rework to remove and replace DC/DC converters. The second data package provided to reviewers represented the original component ADP (prior to the rework) and contains the data in question. Subsequent rework data packages will be provided as available.