CRITICAL ITEMS LIST

ASSY. NOMENCLATURE CCTV/ITVC

ASSY. P/N 20007442G1

NAME, QTY & DRAWINGS REF. DESIGNATION	FUNCTION	FAILURE MODE AND CAUSE	END ITEM	FAILURE EFFECT			RATIONALE FOR ACCEPTANCE	DATE
				INTERFACE	MISSION	CREW/ VEHICLE		
ITVC, 1, Elbow Stack 20007442G1 ITVC 3.1	2/2	A malfunction in the Camera to cause total loss of the Video signal including sync. A1 Power Supply A5 TCVCXO/PLL A6 Video Proc. A10 CCD Drive	Loss of Camera Output Worst Case loss of mission critical video.	No Video	Loss of Mission Critical Video	None	See Sheet 2	

DESIGN FEATURES

The ITVC is comprised of 20 electrical subassemblies; 13 subassemblies are Lockheed Martin Astro Space designed and fabricated using standard printed circuit board type construction. The remaining six assemblies, 3 stepper motors, High Voltage Power Supply (HVPS), Intensified CCD (ICCD), and Lens assembly are vendor supplied components, which have been specified and purchased according to Lockheed Martin Specification Control Drawings (SCDs) prepared by Engineering and Product Assurance. Specifications per the SCD are performance, test, qualification, and acceptance requirements for a procured piece of equipment. Parts, materials, processes, and design guidelines for the ITVC program are specified in accordance with Lockheed Martin 3267828. This document defines the program requirements.

MIL-STD-975G will serve as the primary EEE parts selection document. If a suitable part cannot be found in MIL-STD-975G, equivalent EEE parts that meet the following criteria may be substituted.

Microcircuits are at least Class B Level, MIL-M-38510 devices. All microcircuits are subjected to Particle Impact Noise Detection (PIND) testing per MIL-STD-883C (except for devices with plastic epoxy-type package).

Diodes and transistors are at least JANTXV in accordance with MIL-S-19500. All semiconductors in cavity-type packages are subjected to PIND testing per MIL-STD-883C.

DESIGN FEATURES (Cont.)

Relays are procured to the highest military established reliability (MIL-ER) level as defined in MIL-R-39016. Relays are subject to PIND testing.

Switches are procured to at least the second highest level of the appropriate MIL-ER specification. Switches are subjected to either PIND testing or X-ray analysis as appropriate, for particle detection.

Other discrete parts are procured to at least the second highest level of the appropriate MIL-ER specification.

Parts not included in the above documents have been used in the design only after a non-standard parts acceptance request (NSPAR) has been prepared, submitted to Reliability Assurance Engineering and approved for use in the specific application(s) defined in the NSPAR by NASA-JSC.

Worst case circuit analyses have been performed and documented for all circuit designs to demonstrate that sufficient operating margins exist for all operating conditions. The analysis was worst case in that the value for each of the variable parameters was set to limits that will drive the output to a maximum (or min.)
A component approach review and analysis was conducted to verify that the applied stress on each piece part by the temperature extremes identified with environmental qualification testing does not exceed the stress derating values identified in Lockheed Martin 3267828.

DESIGN FEATURES (Cont.)

In addition, an objective examination of the design was performed through a Preliminary Design Review and Critical Design Review to verify that the ITVC met specification and contractual requirements.

BARE BOARD DESIGN
All boards are constructed from laminated copper-clad epoxy glass sheets per MIL-P-13949 Type GF Grade A. Circuit connections are made through printed traces which run from point to point on the board surfaces. Every trace terminates at an annular ring. The annular ring surrounds the hole in which a component lead or terminal is located. This ring provides a footing for the solder, ensuring good mechanical and electrical performance. Its size and shape are governed by MIL-P-55640 as are trace widths, spacing and routing. These requirements are reiterated specifically in drawing notes to further assure compliance. Variations between the artwork master and the final product (due to irregularities of the etching process) are also controlled by drawing notes. This prevents making defective boards from good artwork. Holes which house no lead or terminal, but serve only to electrically interconnect the different board layers, contain stitch bars for mechanical support and increased reliability.

The through holes are drilled from a drill tape thus eliminating the possibility of human error and allowing tight control over hole and annular ring concentricity, an important reliability criterion. After drilling and etching, all copper cladding

BARE BOARD DESIGN (Cont.)
is tin-lead plated per MIL-STD-1495. This provides for easy and reliable soldering at the time of board assembly, even after periods of prolonged storage.

BOARD ASSEMBLY DESIGN

All components are installed in a manner which assures maximum reliability. Component leads are pre-tinned, allowing total wetting of solder joints. All leads are formed to provide stress relief and the bodies of large components are staked. Special mounting and handling instructions are included in each drawing required after final assembly. The board is coated with urethane which protects against humidity and contamination.

ACCEPTANCE TEST

Each assembly is individually tested to a NASA approved Acceptance Test Procedure TP-AT-20007442. The Acceptance Test Flow is detailed in attached Table 1.

QUALIFICATION TEST

The Qualification unit is identical to the flight unit configuration in every respect and is used solely for the purpose of qualification testing. The Qual unit must successfully complete acceptance testing prior to entering qualification testing. The Qual unit has passed testing in accordance with NASA approved test plan PN-C-20007442. The Qualification Test Flow is detailed in attached Table 2.

OPERATIONAL TESTS

In order to verify that CCTV components are operational, a test must verify the health of all the command related components from the PHS (A7A1) panel switch, through the RCU, through the sync lines to the Camera/PIU, to the Camera/PIU command decoder. The test must also verify the camera's ability to produce video, the VSU's ability to route video, and the monitor's ability to display video. A similar test would be performed to verify the MDM command path.

Pre-Launch on Orbiter Test/In-Flight Test

1. Power CCTV System.
2. Via the PHS panel, select a monitor as destination and the camera under test as source.
3. Send "Camera Power On" command from the PHS panel.
4. Select "External Sync" on monitor.
5. Observe video displayed on monitor. Note that if video on monitor is synchronized (i.e., stable raster) then this indicates that the camera is receiving composite sync from the RCU and that the camera is producing synchronized video.
6. Send Pan, Tilt, Focus, Zoom, ALC, and Gamma commands and visually (either via the monitor or direct observation) verify operation.
7. Select downlink as destination and camera under test as source.
8. Observe video routed to downlink.
9. Send "Camera Power Off" command via PHS panel.
10. Repeat Steps 3 through 9 except issue commands via the MDM command path.

QA/INSPECTION

Procurement Control - The ITVC EEE Parts and hardware items are procured from approved vendors and suppliers, which meet the requirements set forth in the ITVC contract. Resident DPRO personnel review all procurement documents to establish the need for GSI on selected parts (PAI 517).

Incoming Inspection and Storage - Incoming Quality Inspections are made on all received materials and parts. Results are recorded by lot and retained in file by drawing and control numbers for future reference and traceability. All EEE parts are subjected to incoming acceptance tests as called for in PAP A4.14 - Incoming Inspection Test Instructions. Incoming flight parts are further processed in accordance with Lockheed Martin 3267B2B. Mechanical items are inspected per PAP A4.14 - Supplier Quality Assurance, and PAP E10.8.1 - Procedure for Processing Incoming or Purchased Parts Designated for Flight Use. Accepted items are delivered to Material Controlled Stores and retained under specified conditions until fabrication is required. Non-conforming materials are held for Material Review Board (MRB) disposition. (PAP A4.14.)

Board Assembly & Test - Prior to the start of TVC board assembly, all items are verified to be correct by stock room personnel, as the items are accumulated to form a kit. The items are verified again by the operator who assembles the kit by checking against the as-built-parts-list (ABPL). DPRO Mandatory Inspection Points are designed for all

QA/INSPECTION (Cont.)

printed circuit, plus harness connectors for soldering wiring, crimping, solder splices and quality workmanship prior to coating of the component side of boards and sleeving of harnesses.

QA/INSPECTION (Cont.)

ITVC Boards

Specific ITVC board assembly and test instructions are provided in drawing notes, and applicable documents are called out in the Fabrication Procedure and Record (FPR-20007442) and parts list PL20007442. These include Process Standard-Bonding RTV-566 2200081, Process Standard - Bonding Velcro Tape 2200089, Specification Soldering 2200749, Specification - Crimping 2200080, Specification - Bonding and Staking 2280078, Specification - Urethane coating 2200077, Specification - Marking 2280876, Specification - Workmanship 8030035, Specification Bonding and Staking 2280075. Specification-Wave Solder 2280821, Specification-Printed Wire Board Staking 2280851, Specification-Reflow Soldering 2200754, Specification-Soldering Surface Mount Components 20005710.

QA/INSPECTION (Cont.)

ITVC Assembly and Test

An open box test is performed per TP-IT-20007442 and an Acceptance Test per TP-AT-20007442, including vibration and thermal vacuum. Torques are specified and witnessed, traceability numbers are recorded and calibrated tools are checked prior to use. Lockheed Martin Quality and DPRO inspections are performed at the completion of specified FPR operations in accordance with PAP-2.6.1, PAP-2.9, PAP-2.11, PAP-E6.1, and PAP-8.5. DPRO personnel witness ITVC button-up and critical torquing.

The ITVC is packaged according to NASA documents NHB6000.1C and NHB5300.4(1D2) which defines packaging and handling requirements. All related documentation including assembly drawings, Parts List, ABPL, Test Data, etc., is gathered and held in a documentation folder assigned specifically to each assembly. This folder is retained for reference. An EIDP is prepared for each assembly in accordance with the requirements of PAP E2.3. Lockheed Martin QC and DPRO personnel witness crating, packaging, packing, and marking, and review the EIDP for completeness and accuracy.

TABLE 1. ACCEPTANCE TEST FLOW

1. ROOM AMBIENT PERFORMANCE TEST

Test conducted per the requirements of NASA approved TP-AT-20007442.

2. ACCEPTANCE VIBRATION EXPOSURE

20-80 Hz: 3 dB/octave rise from 0.01 g^2/Hz to 0.04 g^2/Hz
80-350 Hz: 0.04 g^2/Hz
350-2000 Hz: 3 dB/octave decrease to 0.006 g^2/Hz
Test Duration: 1 minute/axis, operating
Test Level: 6.1 grms

3. POST-VIBRATION FUNCTIONAL CHECK

Test conducted per the requirements of NASA approved TP-AT-20007442.

4. ACCEPTANCE THERMAL-VACUUM EXPOSURE

1.5 cycles total from +115 deg F to +14 deg F. After stabilization, one hour minimum duration at each plateau. In-spec functional tests performed at each plateau.

5. POST-ENVIRONMENTAL PERFORMANCE TEST

Room ambient performance tests conducted in accordance with NASA approved TP-AT-20007442.

TABLE 2. QUALIFICATION TEST FLOW

1. EMI

Conducted tests run in accordance with the requirements of SL-E-0002B, including CS01, CS02, CS06, TT01, CE01, and CE03. Radiated tests run in accordance with SL-E-0002B including RS02, RS03, and RE02 except that the test current for RS02 was 2 amps in lieu of 20 amps.

2. QUAL FOR ACCEPTANCE VIBRATION

20-80 Hz: 3 dB/octave increasing to 0.067 g^2/Hz
80-350 Hz: 0.067/octave
350-2000 Hz: 3 dB/octave decrease
Test Level: 7.8 grms
Test Duration: 5 minutes/axis operating

3. FLIGHT QUALIFICATION VIBRATION

20-70 Hz: 6 dB/octave increasing to 0.4 g^2/Hz
70-500 Hz: 0.4 g^2/Hz
500-2000 Hz: 6 dB/octave decrease
Test Level: 18.1 grms
Test Duration: 40 minutes/axis non-operating

4. THERMAL-VACUUM

7.5 cycles total from +120 deg F to +9 deg F. After stabilization, one hour minimum duration at each plateau. In-spec functional tests performed at each plateau.

5. THERMAL SIMULATION

Worst case hot and cold mission environments simulated in vacuum. During hot case, in-spec operation is required for 6 of 14 consecutive hours. During cold case, in-spec operation is required for 14 consecutive hours.

6. HUMIDITY

120 hours exposure to 85% RH including four 24 hour temperature cycles of +60 deg F to +125 deg F, non-operating.