FMEA NO. 6.0.1

CRITICALITY 2/1R

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT Remote Video Switch (RVS)
DWG NO. 2293633-501

SHEET 1 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
Loss of power enable command to both elbow and wrist cameras. Cause: Component Board Assembly, A1, 2293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	DESIGN FEATURE BARE BOARD DESIGN (A1) The design of the associated A1 board is contsructed from laminated copper-clad epoxy glass sheets (NEMA G-10) Grade FR-4), PER MIL-P-55617A. 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 thru 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 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 (A1) 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. BOARD PLACEMENT The A1 board is secured in the electronics assembly by gold-plated beryllium copper card guides. Connections are made to the mother board with blind-mated connectors. Disengagement during launch is prevented by a cover which spans the board's free edge.

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SHEET 2 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
oss of power enable command to oth elbow and wrist cameras. ause: omponent Board Assembly, A1, 293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	QUALIFICATION TEST For Qualification Test Flow, see Table 2 located at the front of this book. ACCEPTANCE TEST The CCTV system's RVS is subjected directly, without vibration isolators which might be used in normal installation, to the following testing: • Vibration: 20-80 Hz: 3 dB/Oct-rise from 0.01 G^2/Hz 80-350 Hz: 0.04 G^2/Hz 350-750 Hz: -3 dB/10 Oct-slope Test Duration: 1 Minute per Axis Test Level: 6.1 Grms For Acceptance Test Flow, see Table 1 located at the front of this book. OPERATIONAL TEST 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/PTU, to the Camera/PTU 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 HDM 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 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 HDM command path. This proves that the CCTV equipment is operational.

FMEA NO. 6.8.1

CRITICALITY 2/1R

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT Remote Video Switch (RVS)
DWG NO. 2293633-501

SHEET 3 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
Loss of power enable command to both elbow and wrist cameras. Cause: Component Board Assembly, A1, 2293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	QA/INSPECTION Procurement Control - The RVS EEE Parts and hardware items are procured from approved vendors and suppliers, which meet the requirements set forth in the CCTV contract and Quality Plan Work Statement (WS-2593176). Resident DCAS 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 PAI 315 - Incoming Inspection Test Instructions. Incoming flight parts are further processed in accordance with RCA 1846684 - Preconditioning and Acceptance Requirements for Electronic Parts, with the exception the DPA and PIND testing is not performed. Mechanical items are inspected per PAI 316 - Incoming Inspection Instruction for mechanical items, PAI 305 - Incoming Quality Control Inspection Instruction, and PAI 612 - 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 cable fabrication is required. Non-conforming materials are held for Material Review Board (MRB) disposition. (PAI-307, PAI IQC-531.) Board Assembly & Test - Prior to the start of RVS 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). DCAS Mandatory Inspection Points are designated for all printed circuit, wire wrap and welded wire boards, 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. Specific RVS board assembly and test instructions are provided in drawing notes, and applicable documents are called out in the Fabrication Procedure and Record (FPR-2293633) and parts list PL 2293633. These include wire connection List 2295955, Process Standard RTV-566 2280881, Process Standard - Bonding Velcro Tape 2280889, Specification Soldering 2280749, Specification Name Plate Application 1960167, Specification - Crimping 2280800, Specification - Bonding and Staking 2280878, Specification - Urethane coating 2280877, Specification - Locking Compound 2026116, Specification Epoxy Adhesive 2018985, Specification - Marking 2280876, Specification - Workmanship 8030035, Specification Bonding and Staking 228075.

FMEA NO. 6.0.1
CRITICALITY 2/1R

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CRITICAL ITEMS LIST

UNIT Remote Video Switch (RVS)
DWG NO. 2293633-501
SHEET 4 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
Loss of power enable command to both elbow and wrist cameras. Cause: Component Board Assembly, A1, 2293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	QA/INSPECTION (Continued) RVS Assembly and Test Acceptance Tests are performed per TP-AT-2293633, including thermal vacuum. Torques are specified and witnessed, traceability numbers are recorded and calibrated tools are checked prior to use. RCA Quality and DCAS inspections are performed at the completion of specified FPR operations in accordance with PAI-204, PAI-205, PAI-206 and PAI-217. DCAS personnel witness RVS button-up and critical torquing. RCA and DCAS personnel monitor acceptance tests and review test data/results. These personnel also inspect after all repair, rework and retest. Preparation for Shipment - The RVS is packaged according to 2280746, Process standard for Packaging and Handling guidelines. 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 RVS in accordance with the requirements of NS-2593176. RCA QC and DCAS personnel witness crating, packaging, packing and marking, and review the EIDP for completeness and accuracy.

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DWG NO. 2293633-501

SHEET 5 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
Loss of power enable command to both elbow and wrist cameras. Cause: Component Board Assembly, AI, 2293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	FAILURE HISTORY NONE

FMEA NO. 6.D.1

CRITICALITY 2/1R

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT Remote Video Switch (RVS)
DWG NO. 2293633-501

SHEET 6 OF 6

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
Loss of power enable command to both elbow and wrist cameras. Cause: Component Board Assembly, A1, 2293218-501	No video signal, and no command and control capability at elbow and wrist locations. Worst Case: Loss of PTU control prevents RMS stowing.	OPERATIONAL EFFECTS Loss of ability to position the elbow camera. Possible inability to stow the RMS if the elbow camera physically interferes with a payload. If RMS cannot be stowed the port payload bay door cannot be closed. Loss of crew and vehicle. CREW ACTIONS Perform EVA to reposition the elbow camera, use RMS motion to reposition the camera, or jettison the RMS. CREW TRAINING Crew should be trained in contingency EVA and RMS operations procedures. MISSION CONSTRAINT Do not manifest elbow camera for any flight where the payload and the elbow camera can interfere with each other (for any pan or tilt angle). If the camera must be flown do not change the camera position until the interfering payload is deployed.