

FMEA NO. <u>1.2.2</u> CRITICALITY <u>2/2</u>	SHUTTLE CCTV CRITICAL ITEMS LIST	UNIT <u>Video Switching Unit (VSU)</u> DWG NO. <u>2294823-502, 504</u> SHEET <u>1</u> OF <u>7</u>
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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
<p>No video output</p> <p>Causes:</p> <ul style="list-style-type: none"> (1) Command failure on microprocessor, I/O, A1-2592389-501 or 2294889-502 (2) Timing logic, Logic board (VSU A3) 2592392-504 or 2294891-502 (3) Switch matrix short on output Amplifier A6, A7, or A8, 2294894-502 (4) Power bus short, all VSU boards 	<p>No video signal to any destination including on-board monitors and downlink.</p> <p><u>Worst Case:</u> Loss of mission critical video.</p>	<p>DESIGN FEATURES</p> <p>The VSU is a microprocessor-based video switching unit using an RCA 1802 microprocessor, CMOS RAM, and TTL PROM. Computer I/O, decoding logic, digital audio and switch control circuitry are implemented in CMOS CD4000 series logic to minimize power dissipation. The design incorporates DMOS FET devices (SD211s) purchased to an RCA spec control drawing (SCD) as the basic video switch element. Video split-screen capability incorporates glass delay line modules procured from Microsonics (originally Corning) to an RCA SCD. The video amplifier design uses monolithic NE5539 wideband op amps in a fashion similar to the sync amp design employed in the RCU.</p> <p>Parts were required to be JAN reliability level parts of their equivalent. Part selection falls into three categories:</p> <ul style="list-style-type: none"> (1) JAN or better parts from the Military QPL, (2) Parts demonstrated to NASA to be equivalent to JAN level via test data (e.g., CD4000/3W series parts), or (3) Parts procured to an RCA spec control drawing which calls out tests and screening to effect JAN equivalency. <p>BARE BOARD DESIGN (A6, A7, A8)</p> <p>The design of the associated A6, A7, and A8 boards is constructed 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.</p> <p>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.</p>

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE	
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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
<p>No video output</p> <p>Causes:</p> <ul style="list-style-type: none"> (1) Command failure on microprocessor, I/O, A1-2592389-501 or 2294889-502 (2) Timing logic, Logic board (VSU A3) 2592392-504 or 2294891-502 (3) Switch matrix short on output Amplifier A6, A7, or A8, 2294894-502 (4) Power bus short, all VSU boards 	<p>No video signal to any destination including on-board monitors and downlink.</p> <p><u>Worst Case:</u> Loss of mission critical video.</p>	<p><u>QUALIFICATION TEST</u></p> <p>For Qualification Test Flow, see Table 2 located at the front of this book.</p> <p><u>ACCEPTANCE TEST</u></p> <p>The CCTV systems' VSU is subjected to the following testing:</p> <ul style="list-style-type: none"> • Vibration: <ul style="list-style-type: none"> 20-80Hz: 3 dB/Oct-rise from 0.01 G²/Hz to 0.04 G²/Hz 80-350 Hz: 0.04 G²/Hz 350-750 Hz: 3 dB/Oct-Fall to 0.018 G²/Hz 750-1000: 0.018 G²/Hz 1000-2000: 3 dB/Oct-Fall to 0.009 G²/Hz Test Duration: 1 Minute per Axis Test Level: 6.6 Grms • Thermal: <ul style="list-style-type: none"> 100° F: Time to stabilize equipment plus 1 hour 0° F: Time to stabilize equipment plus 1 hour 100° F: Time to stabilize equipment plus 1 hour <p>For Acceptance Test Flow, see Table 1 located at the front of this book.</p> <p>The VSU may not have been subjected to the vacuum condition.</p> <p><u>OPERATIONAL TEST</u></p> <p>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 MDM command path.</p> <p style="text-align: center;"><u>Pre-Launch on Orbiter Test/In-Flight Test</u></p> <ol style="list-style-type: none"> 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 MDM command path. This proves that the CCTV equipment is operational.

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No video output Causes: (1) Command failure on microprocessor, I/O, A1-2592389-501 or 2294889-502 (2) Timing logic, Logic board (VSU A3) 2592392-504 or 2294891-502 (3) Switch matrix short on output Amplifier A6, A7, or A8, 2294894-502 (4) Power bus short, all VSU boards	No video signal to any destination including on-board monitors and downlink. <u>Worst Case:</u> Loss of mission critical video.	<u>QA/INSPECTION</u> <u>Procurement Control</u> - The VSU 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). <u>Incoming Inspection and Storage</u> - 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 Instructions for mechanical items, PAI 305 - Incoming Quality Control Inspection Instructions, 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 fabrication is required. Non-conforming materials are held for Material Review Board (MRB) disposition. (PAI-307, PAI IQC-531). <u>Board Assembly & Test</u> - Prior to the start of VSU 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 VSU board assembly and test instructions are provided in drawing notes, and applicable documents are called out in the Fabrication Procedure and Record (FPR-2294823) and parts list PL 2294823. These include wire connection List 2295906, 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 2010985, Specification - Marking 2280876, Specification - Workmanship 8030035, Specification Bonding and Staking 228075.

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE	
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