FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506,508/
2294821-503
SHEET 1 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | DESIGN FEATURES<br><br>The TVC/Lens Assembly is comprised of 16 electrical subassemblies; 13 subassemblies are RCA Astro designed and fabricated using standard printed-circuit board type of construction. The remaining three assemblies, high voltage power supply, oscillator, and stepper motors, are vendor supplied components which have been specified and purchased according to RCA Specification Control Drawings (SCDs) prepared by engineering and reliability assurance. Specifications per the SCD are prepared to establish the design, performance, test, qualification, and acceptance requirements for a procured piece of equipment.<br><br>Parts, materials, processes, and design guidelines for the Shuttle CCTV program are specified in accordance with RCA 2295503. This document defines the program requirements for selection and control of EEE parts. To the maximum extent, and consistent with availability, all parts have been selected from military specifications at the JAN level, as a minimum. In addition to the overall selection criteria, a subset of general purpose preferred parts has been defined by this document and the RCA Government Systems Division Standard Parts List. In the case of the CMOS and TTL family of microcircuits, devices are screened and tested to the MIL-STD-883C equivalent and procured under the designations of HI-REL/3HQ and SNC 54LS from RCA-SSD and Texas Instruments Corp, respectively. Parts not included in the above documents have been used in the design only after a nonstandard item approval form (NSIAF) has been prepared, submitted to Reliability Assurance Engineering (RAE) and approved for use in the specific application(s) defined in the NSIAF by NASA-JSC.<br><br>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 minimum).<br><br>A component application 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 RCA 2295503.<br><br>In addition, an objective examination of the design was performed through a PDR and CDR to verify that the TVC/Lens assembly met specification and contractual requirements. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506.508/ 2294821-503
SHEET 2 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | DESIGN FEATURES (Continued)<br><br>BARE BOARD DESIGN (A3, A4, A5, A6, A7, A9, A10, A12)<br><br>The design of the associated boards A3, A4, A5, A6, A7, A9, A10, A12 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.<br><br>The thrd 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.<br><br>BOARD ASSEMBLY DESIGN (A3, A4, A5, A6, A7, A9, A12)<br><br>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. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 3 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | DESIGN FEATURES (Continued)<br><br>BARE BOARD CONSTRUCTION (A2)<br><br>The boards are of "welded wire" construction. At the bare board level this does not distinguish it from a normal PC board except that holes which will take weld pins generally are not connected to PC traces. Only those pins which bring power and ground potentials to the ICs are on PCs. An annular ring surrounds the hole in the board where each power and ground pin is located. These pins are then soldered to the trace like any other component lead. Aside from this feature, all design & construction techniques used in PC board layout apply.<br><br>BOARD ASSEMBLY (A2)<br><br>The drilled and etched boards are populated with several hundred solderable or weldable pins. Power and ground pins, as well as connector pins, are soldered in place. Discreet components (resistors, diodes, capacitors) are attached to bifurcated terminals, where they are soldered. Flatpack ICs are welded, lead-by-lead, to the tops of the weld pins. After welding, extra lead material is trimmed away. Circuit connections are made using #30 AWG nickel weld wire. The wire is welded to the pin surfaces on the board backside. All wire welds are done using a machine which is tape driven, thus eliminating the possibility of miswiring due to operator error. All wiring & circuit performance is tested prior to box-level installation. After successful testing, components are staked as required by drawing notes and the assembly is coated with urethane.<br><br>The board is inserted in the box on card-edge guides, in the same manner as the other PC boards.<br><br>BOARD PLACEMENT<br><br>The A7-A low voltage power supply board is bolted in place at 6 points around its perimeter. Four of these mounting screws also pass through and tie down the smaller A7-B board. These two boards are mounted face-to-face, separated by the standoffs. Electrical interconnections are achieved by jumper wires between the two boards. The A7-A houses a 34-pin connector which brings in power and signals from outside the module.<br><br>The A7 module includes these two boards as well as power transistor Q4. The module housing is bent aluminum sheet, comprised of two halves screwed together. The boards and Q4 are secured to the lower half, and wired together. Then the upper half is put in place. By mounting Q4 directly to the aluminum housing, good thermal performance is assured.<br><br>The A2, A3, A4, A5, A6, A12 boards are 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. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 4 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | DESIGN FEATURES (Continued)<br><br>A10 BOARD MOUNTING<br><br>Due to packaging constraints within the camera, the Aid TVC divider assembly is Built in "cordwood" fashion. Two PC boards, each 2.1 inches square, are mounted opposite each other, separated by 3/4 inch long standoffs. Biaxial components span the distance between the boards and are soldered in place, one lead to each board. Some jumper wires are also mounted this way. All solder joints are staked. The boards have a 1-inch diameter hole through the center. The vidicon tube socket fits through this hole and has its flying leads soldered to thru-holes in one of the boards. At camera-level installation, the entire A10 module is inserted in place around the stem, of the vidicon tube and bolted in four places to the housing. The socket is then engaged manually to the tube, completing the installation.<br><br>BOARD MOUNTING<br><br>The A9 board is mounted to the target preamp housing by 4 #4-40 screws. This provides ample support since the board is only 1.9 x 2.1 inches. Electrical correction is by jumper wires soldered to board terminals. A sheet metal cover is installed over the board to protect it during handling and installation of the target preamp assembly.<br><br>The high-voltage power supply is purchased to a performance specification that details the design, qualification, and production requirements for use in the TV Camera System. It is designed for a minimum operational life of 8000 hours and shall exhibit no evidence of arcing, corona, or any other intermittent or continuous failure when operated at any atmospheric pressure from sea level to $1 \times 10^{-6}$ torr. All electronic components and materials used in the power supply design are verified to conform with the reliability requirements of the Shuttle CCTV program as outlined by NASA-JSC. |

FMEA NO. 5.2.2

CRITICALITY: 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294839-506, 508/
2294821-503
SHEET 5 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>IVE<br>12 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>13 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>14 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>15 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>16 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>17 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>18 High Voltage Power Supply.<br>19 Target Preamplifier.<br>10 Beam Current Regulator.<br>Cathode Blanking.<br>12 Shading Waveform Generator.<br>14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | The SIT tube is a selected high-grade silicon-diode-array target vidicon with an attached image intensifier for operating at low light levels. Faceplate exposure is controlled by means of an Automatic Light Control (ALC) Function that restricts operation to $2 \times 10^{-2}$ foot-candles. This can provide an SIT life of more than 1000 hours according to the manufacturer's recommendations. By providing exposure control when using the SIT tube, life can be extended to the point where reduced thermionic cathode emission will end its life, as in other camera tubes. Because of its excellent characteristics many military, medical, and scientific applications, in addition to surveillance applications, have been developed for low-light-level television cameras employing the SIT tube.<br><br>QUALIFICATION TEST<br><br>For Qualification Test Flow, see Table 2 located at the front of this book. |

AREA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 6 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | ACCEPTANCE TEST<br><br>The CCTV systems' TVC/CLA is subjected directly, without vibration isolators which might be used in their normal installation, to the following testing:<br><br>• Vibration: 20-80Hz: 3 dB/Oct-rise from 0.01 $G^2$/Hz<br>80-350 Hz: 0.04 $G^2$/Hz<br>350-750 Hz: -3 dB/10 Oct-slope<br>Test Duration: 1 Minute per Axis<br>Test Level: 6.1 Grms<br><br>• Thermal Vacuum: In a pressure of $1X10^{-5}$ Torr, the temperature shall be as follows:<br><br>125° F: Time to stablize equipment plus 1 hour<br>25° F: Time to stablize equipment plus 1 hour<br>125° F: Time to stablize equipment plus 1 hour<br><br>The TVC/CLA may not have been subjected to the vacuum condition.<br><br>For Acceptance Test Flow, see Table 1 located at the front of this book.<br><br>OPERATIONAL TEST<br><br>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.<br><br>Pre-Launch on Orbiter Test/In-Flight Test<br><br>1. Power CCTV System.<br>2. Via the PHS panel, select a monitor as destination and the camera under test as source.<br>3. Send "Camera Power On" command from PHS panel.<br>4. Select "External Sync" on monitor.<br>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.<br>6. Send Pan, Tilt, Focus, Zoom, ALC, AND Gamma commands and visually (either via the monitor or direct observation) verify operation.<br>7. Select downlink as destination and camera under test as source.<br>8. Observe video routed to downlink.<br>9. Send "Camera Power Off" command via PHS panel.<br>10. Repeat Steps 3 through 9 except issue commands via the MDM command path. This proves that the CCTV equipment is operational. |

FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/ 2294821-503
SHEET 7 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | QA/INSPECTION<br><br>Procurement Control - The TVC/CLA 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).<br><br>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 that 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 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 fabrication is required. Non-conforming materials are held for Material Review Board (MRB) disposition. (PAI-307, PAI IQC-531).<br><br>Board Assembly & Test - Prior to the start of TVC or CLA 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.<br><br>TVC Boards<br><br>Specific TVC board assembly and test instructions are provided in drawing notes, and applicable documents are called out in the Fabrication Procedure and Record (FPR-2294819) and parts list PL2294819. These include shuttle TVC assembly notes 2593660, 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 0030035, Specification - Bonding and Staking 2280875. |

FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/ 2294821-503
SHEET 8 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | QA/INSPECTION (Continued)<br><br>TVC Assembly and Test - An open box test is performed per TP-IT-2294819, and an Acceptance Test per TP-AT-2294819, including vibration and 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 TVC button-up and critical torquing.<br><br>TVC/CLA Assembly and Test - After a TVC and an CLA have has been tested individually, they are mated and a final acceptance test is performed per TP-AT-2294819, including vibration and thermal vacuum environments. RCA and DCAS personnel monitor these tests and review the acceptance test data/results. These personnel also inspect for conformance after all repair, rework and retest.<br><br>Preparation for Shipment - The TVC and CLA are separated prior to shipment after fabrication and testing is complete. Each is packaged according to CCTV Letter 8011 and 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 EIOP is prepared for each assembly in accordance with the requirements of NS-2593176. RCA QC and DCAS personnel witness crating, packaging, packing, and marking, and review the EIOP for completeness and accuracy. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 9 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY<br><br>TDR - W2575 - Log #0400 - TVC S/N 005-501<br><br>Description: Acceptance Test Failure<br>Box Level<br>Vibration Environment<br>Video presentation rotated approximately 6° after vibration.<br><br>Cause: Vidicon Yoke nut became loose during vibration.<br><br>Corrective Action: Reposition yoke, tighten nut and add staking to sensor assy's yoke nut. ECN (B1073) issued.<br><br>TDR - W2576 -Log #0412 - TVC S/N 005-501<br><br>Description: Acceptance Test Failure<br>Box Level<br>Vibration Environment<br>CW rotation of picture after "Y axis vibration. (Retest of TVC per TDR W2575.)<br><br>Cause: Bending of yoke (A1) broke loose allowing yoke to rotate during vibration.<br><br>Corrective Action: Assembly procedure revised per ECN CCT 600 (B1073) to provide for better staking of yoke.<br><br>TDR - W2568 - Log #0414 - TVC S/N 006-501<br><br>Description: Acceptance Test Failure<br>Box Level<br>Vibration Environment<br>Input current increased by 180 mA from normal input current during vibration in "Y" Axis.<br><br>Cause: Defective capacitor C26 on A3 board. Analysis indicated manufacturing defect - capacitive element was loose inside metal case.<br><br>Corrective Action: Remove and replace part. Retested camera per PMD directive. Capacitors removed from stock and returned to vendor. Reference memo CCTV-(C)-243 for close out of TDR W2560. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 9A OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>IDR - W0988 - Log #0432 - TVC S/N 005-501<br>W0989 - Log #0428 - TVC S/N 005-501<br><br>Description: Acceptance Test Failure<br>Box Level<br>T/V Hot Environment<br>Cluster of white spots in lower left quadrant of display on black field. Crazing of cement securing cover glass to fiberoptics faceplate evident.<br><br>Cause: Stresses exerted by potting material during temp. extremes resulted in de-lamination of the cover glass to SIT tube bonding.<br><br>Corrective Action: Modified potting fixtues and technique used on SIT tube Dwg. #2295530 modified by ECN (B 2082). SIT tubes returned to manufacturer for rework of encapsulation. Vendor to perform temp tests on tube prior to shipment to insure cover glass does not shift. REF CCTV Directives CCTV - (D) - 054, CCTV - (D) - 070.<br><br>IDR - W2739 - Log #0485 TVC S/N 009-502<br><br>Description: Pre-Launch Failure<br>Box Level Test<br>Ambient Environment<br>Problem report VSCS-201-0093 visual inspection of unit at KSC revealed a recessed pin 31 in the J1 connector.<br>(Location code function pin)<br><br>Cause: Error in manufacturing of the connector pin. It is 0.035" shorter in length than other pins in connector.<br><br>Corrective Action: Remove and replace pin 31 in J1 connector. Test pins ability to lock into mating connector. Perform contact retention test to insure pin is locking as required. Inspect to insure pin is not pushed out of place.<br><br>IDR - W0401 - Log #0499 - TVC 013-502<br>IDR - W4278 - Log #0497 - TVC 013-502<br><br>Description: Qualification Test Failure<br>Box Level (Qual. Model)<br>Ambient Environment<br>Output video intermittent.<br><br>Cause: SIT has low G4 current. |

FMEA NO. 5.2.2.

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 98 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Corrective Action: Remove and replace SIT. Defective tube returned to Lancaster for evaluation, Results: Tube failure verified.<br><br>TDR - W4312 - Log #0506 - TVC S/N 014-502<br><br>Description: Acceptance Test Failure<br>Box Level<br>Thermal Vac-Hot Environment<br>Approx. 45 minutes into (T/V Hot) soak at +125°F video became distorted and TVC input current increased 710 mA to 800 mA.<br><br>Cause: Yoke deflection coil developed a short between horizontal and vertical deflection windings at 50°C. The short was eliminated when the temperature was reduced.<br><br>Corrective Action: Replaced defective yoke with new part. This is a random failure.<br><br>TDR - W4677 - Log #0529 - TVC S/N 009-502<br><br>Description: Integration Test Failure<br>Box Level<br>Ambient Environment<br>Center resolution measured 30% @ 300 TVL, should be 70% min. Amplitude appears appears to be intermittent.<br><br>Cause: Transformer T3 on the A7 Board had unusual interwinding capacity, causing ringing on the secondary resulting in a slightly higher output voltage.<br><br>Corrective Action: Interwinding capacity is not a parameter specified, nor can it be measured readily. Transmitter T3 removed & replaced. Acceptance Test screening will detect this problem if present on other units - This problem is considered a random failure.<br><br>TDR - Y1781 - Log #0577, TVC S/N 017-504<br><br>Description: Acceptance Test Failure<br>Box Level<br>Ambient Environment<br>Oscillations in video output.<br><br>Cause: Poor grounding in pre-amp. |

FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 9C OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Corrective Action: Unit reworked to ECN CCI 838 for ground problem.<br><br>TDR - N1729 - Log #0578 - TVC S/N 020-502<br>TDR - N1730 - Log #0579 - WLA S/N 006-501<br>TDR - Y1404 - Log #0565 - TVC S/N 011-502<br><br>Description: Flight Failure Spacecraft Level<br>TVC S/N 020, WLA S/N 006-STS-3<br>TVC S/N 011 - STS-2<br>Coherent noise in output video presentation.<br><br>Cause: Poor conductive path to ground caused by excessive conformal coating and oxidation of aluminum spacers.<br><br>Corrective Action: Removed excessive conformal coating. Spacers were cleaned and treated with alodine. Flow progress report has been modified to insure proper assembly of units.<br><br>TDR - Y6906 - Log #0630 - TVC S/N 019-504<br><br>Description: Flight Failure<br>STS-5<br>Problem report VJCS-024<br>Intermittent Pan/Tilt reset command.<br><br>Cause: Problem could not be verified thru extensive thermal testing.<br><br>Corrective Action: Unit updated from group 504 to group 506 configuration. Instructed test director to carefully monitor operation of this camera during retesting. failure still could not be verified.<br><br>TDR - N6859 - Log #0695 - TVC S/N 024-506<br><br>Description: Pre-Launch Test Failure<br>Box Level<br>Ambient Environment<br>Automatic Iris goes from open to close.<br><br>Cause: Problem could not be duplicated after extensive testing.<br><br>Corrective Action: None - unit returned to KSC. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 90 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| malfunction in the camera to cause ıtal loss of the active video sig- ıl or video information that will rovide degraded performance. Com- ɔsite sync and vertical blanking ignals are useable and not affected.<br><br>/C<br>2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Align- ment. Vertical Alignment.<br>4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>8 High Voltage Power Supply.<br>9 Target Preamplifier.<br>10 Beam Current Regulator.<br>Cathode Blanking.<br>12 Shading Waveform Generator.<br>14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of pic- ture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>TDR - W1735 - Log #0723 - TVC S/N N/A -506<br><br>Description: Acceptance Test Failure<br>Box level<br>Ambient Environment<br>High voltage power supply S/N 2046 exhibits internal arcing. This TDR was opened to investigate failure noted on TDR-W6870, Log #722.<br><br>Cause: Improper lead dress of high voltage terminal.<br><br>Corrective Action: HVPS S/N 2046 was one of eight units manufactured under purchse order G-T50999-4151-00F28 by Murata Erie. This problem is limited to units manufactured in 1982. All defective units have been screened and returned to Murata Erie for analysis and replacement.<br><br>TDR - W6870 - Log #0722 - TVC S/N 028-506<br><br>Description: Acceptance Test Failure<br>Ambient Environment<br>Box Level Test<br>Approximately 47 seconds after initial turn on, the iris close command would be generated by TVC.<br><br>Cause: Internal short in the high voltage power supply (S/N 2046), which generated spikes on the POR Line.<br><br>Corrective Action: H.V.P.S. removed from TVC and new H.V.P.S. installed. Tests indicated problem solved. Power supply returned to vendor for Evaluation. Refer to TDR W1735, Log #723.<br>The problem was attributed to improper lead dress of high voltage terminal. These leads have been rerouted and extra insulation added at the HV terminal for all new built units.<br><br>TDR - W-6875 - Log #0746 TVC S/N 014-506<br>TDR - W-6872 - Log #0742 TVC S/N 011-506<br><br>Cause: Resistor R6 on A10 board, failed.<br><br>Corrective Action: All flight cameras containing R6 resistor fabricated by ACI and dated with code 7813 will be replaced with new RNC60 type resistors from TRW. |

FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294021-503
SHEET 9E OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>TDR - W6917 - Log #0748 - TVC S/N 030-506<br><br>Description: Acceptance Test Failure<br>Box Level<br>Ambient Environment<br>Video presentation very noisy when J4 cable is connected.<br><br>Cause: Sensor assembly clamp sleeve shorted to chassis. Insufficient insulation coating on clamp sleeve.<br><br>Corrective Action: New clamps were installed. All parts in controlled stores were inspected and all discrepant materal rejected.<br><br>TDR - W6925 - Log #0770 - TVC S/N 022-506<br><br>Description: Flight Failure (STS-8)<br>Spacecraft Level<br><br>Horizontal streaking in picture gamma when in black stretch.<br><br>Cause: Incorrect shim installed. Face plate shim shorted to ground.<br><br>Corrective Action: Shim removed and correct shim installed per ECN-CCIB59. All future TVC's will conform to this ECN.<br><br>TDR - A3249 - Log #0929 - TVC S/N 033-506<br><br>Description: Acceptance Test Failure<br>Box Level<br>Thermal Vac. Ambient Environment<br>Video locked in white clip mode.<br><br>Cause: Defective Transistor Q16 on A5 Board.<br><br>Corrective Action: Removed Q16 and replaced with new transistor. Q16 X-rayed and a dense particle was observed. Further analysis proved to be a loose and metallic particle. Considered to be random failure.<br><br>TDR - A4093 - Log #0973 TVC S/N 019-506<br><br>Description: Acceptance Test Failure<br>Box Level<br>Vibration Environment<br>Unit failed "Y" axis vibration, picture on monitor all white. |



CCN-DWG

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 9F OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| malfunction in the camera to cause otal loss of the active video signal or video information that will rovide degraded performance. Composite sync and vertical blanking ignals are useable and not affected.<br><br>VC<br>2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ filters (change of voltage or loss of filtering)<br>8 High Voltage Power Supply.<br>9 Target Preamplifier.<br>10 Beam Current Regulator.<br>Cathode Blanking.<br>12 Shading Waveform Generator.<br>14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Cause: Defective Q7 on the A4 board.<br><br>Corrective Action: Product Assurance analysis revealed an open transistor Q7. They found an extraneous gold bond wire positioned so as to cause a short between the base leads of the dual transistors. Transistors with the same date code, plus all transistors with different data codes were X-rayed and no anomalies were found. Concluded that this was a random failure.<br><br>TDR - W1746 - Log #1024, TVC S/N 011-506<br><br>Description: Pre-Launch Test Failure<br>Box Level<br>Ambient Environment<br>KSC DR.3C430012<br>ALC and Gamma controls intermittent. Pan and tilt operation intermittent.<br><br>Cause: Intermittent operation of ALC and Gamma commands could not be duplicated thru extensive thermal testing. Intermittent tilt motion due to improper position of right hand camera slide.<br><br>Corrective Action: Slides were re-positioned per ECN-CCT 1178. Retest indicated problem solved.<br>Returned TVC 011 to "JSC" for further evaluation of ALC/GAMMA analoaly.<br><br>TDR - B0146 - Log #1079 - TVC S/N 007-506<br><br>Description: Flight Failure<br>Flight #41D<br>Evaluation Test<br>TVC returned from KSC for evaluation of white streaks in video observed during orbiter Flight #41D.<br><br>Cause: Arcing in vicinity of ground tab of face plate of SIT tube S/N JB294.<br><br>Corrective Action: Removed tube S/N JB249 from sensor assembly, opened TDR-B0809, Log #1105 to track tube; tube returned to vendor.<br>Installed new tube into sensor.<br><br>TDR - B-0148 - Log #1885 - TVC S/N 044-506<br><br>Description: Acceptance Test Failure<br>Box Level<br>Thermal-Vac Ambient Environment<br>Distorted video seen on monitor. Distortion consisted of two types of noise, modulated and random. |

FMEA NO. 6.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/, 2294821-503
SHEET 96 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| malfunction in the camera to cause otal loss of the active video sig-al or video information that will rovide degraded performance. Com-osite sync and vertical blanking ignals are useable and not affected.<br><br>VC<br>2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Align-ment. Vertical Alignment.<br>4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>7 Primary Oscillator/ Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>8 High Voltage Power Supply.<br>9 Target Preamplifier.<br>10 Beam Current Regulator.<br>Cathode Blanking.<br>12 Shading Waveform Generator.<br>14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of pic-ture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Cause: Random noise is caused by poor grounding of the A9 pre-amp. Modulated noise is due to A5 board operation.<br><br>Corrective Action: Random noise problem was cured by cleaning the A9 ground connections and the incorporation of ECN 009485 - redundant wire ground connection to the A9 pre-amp. Modulated noise problem was cured by incorporating ECN E1773 to the A5 board which limits the control voltage to the A8 high voltage power supply. TVC Group number was changed from 2294819-506 to 2294819-508.<br><br>TDR - B-2352 - Log # 1123 TVC S/N 033-506<br><br>Description: Pre-Launch Test Failure<br>Box Level<br>Ambient Environment<br>(Ref) 3CA420062) Noisy video, vertical lines with low light level.<br><br>Cause: Poor A9 pre-amplifier ground.<br><br>Corrective Action: ECN CCT 1237. Written to add redundant ground lead.<br><br>TDR - B3451 - Log #1150 S/N 042-508<br><br>Description: Acceptance Test Failure<br>Box Level<br>Vibration Environment<br>Vertical noise pattern present in video.<br><br>Cause: Poor ground connection on A9 pre-amplifier board thru conductive washers.<br><br>Corrective Action: ECN D-9584 (Ground wire installation) was installed in sensor assembly. This ECN incorporated in all previous units presently located at RCA, and all new build units.<br><br>TDR - B3518 - Log #1174 - TVC S/N 020-506<br><br>Description: Pre-Launch Test Failure<br>Box Level<br>Ambient Environment<br>Problem report #DR.3C53001A<br>Evaluate video noise problem<br><br>Cause: Poor grounding for pre-amp. TVC depended on a mechanical ground connection. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 94 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| malfunction in the camera to cause otal loss of the active video sig-al or video information that will rovide degraded performance. Com-osite sync and vertical blanking ignals are useable and not affected.<br><br>VC<br>2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Align-ment. Vertical Alignment.<br>4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>8 High Voltage Power Supply.<br>9 Target Preamplifier.<br>10 Beam Current Regulator.<br>Cathode Blanking.<br>12 Shading Waveform Generator.<br>14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of pic-ture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Corrective Action: ECN CCT-1237 was prepared adding redundant hard wire ground. This ECN was incorporated into TVC S/N 020 and retest indicated problem resolved. This ECN will be incorporated into all TVC's in process.<br><br>TDR - C0751 - Log #2002 - TVC S/N 024-508<br>TDR - A3105 - Log #2097 - TVC S/N 024-508<br><br>Description: Acceptance Test Failure<br>Box Level<br>Ambient Environment<br>White ion spot visable in center of raster. Tube conditioning procedure operated in excess of 60 Hrs. which, reduced spot size to 20-25 IRE. Unit authorized to ship to NASA/JSC for further evaluation. The above unit returned from NASA (Ref. PR-DR 3C530032) with the 20-25 IRE spot.<br><br>Cause: TVC tube operated in an unathorized configuration or mode such as (1) extended exposure to bright light (2) loss of camera voltages, (3) exposed to light without lens assembly.<br><br>Corrective Action: SIT replaced with new tube. Old tube sent to RCA-Lancaster for analysis. Found silicon target burned. No corrective action possible on tube S/N 243886. Tube to be labeled as non-flight, but may be used in non-critical application such as for TVC trainer.<br><br>TDR - C4523 - Log #2039 - TVC 044-508<br><br>Description: Evaluation Test<br>Box Level<br>Ambient Environment<br>Output of high voltage power supply 0V with 6.0 Vdc control voltage, should be approximately 9 kv intermittant operation, slight rap on housing will produce 9 kV.<br><br>Cause: Analysis of failure under investigation.<br><br>Corrective Action: N/A<br><br>TDR - C0693 - Log #2042 - TVC S/N 042-508<br><br>Description: Flight Failure STS 51F (26). Spacecraft level<br>String like material on lens or TVC noticed in video presentation, also horizontal noise is present in output video. |

FMEA NO. 5.2.2

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 91 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic.<br>Command Execution Logic.<br>Camera Timing Logic.<br>A3 Horizontal Deflection.<br>Vertical Deflection.<br>Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper.<br>Gamma Correction.<br>Aperture Correction.<br>Shading Correction.<br>Video Output Driver.<br>A5 Automatic Light Control.<br>Automatic Gain Control.<br>Dark Current Compensation.<br>A6 Output Voltage Regulator.<br>Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/<br>Driver (sync loss)<br>Secondary Rectifiers/ Filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator.<br>Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | FAILURE HISTORY (Continued)<br><br>Cause: String like material was found on face of SIT tube and could not be determined where it came from. Horizontal noise could not be duplicated.<br><br>Corrective Action: String removed with small brush. This is the first reported instance of such contamination. Horizontal noise in video as reported could not be duplicated during 9 days of thermal cycling and thermal vacuum testing. The probable cause of the video noise was external to the TVC and unknown at this time. |

FMEA NO. 5.2.2.

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 10 OF 10

| FAILURE MODE AND CAUSE | FAILURE EFFECT ON END ITEM | RATIONALE FOR ACCEPTANCE |
|---|---|---|
| A malfunction in the camera to cause total loss of the active video signal or video information that will provide degraded performance. Composite sync and vertical blanking signals are useable and not affected.<br><br>TVC<br>A2 Command Decode Logic. Command Execution Logic. Camera Timing Logic.<br>A3 Horizontal Deflection. Vertical Deflection. Focus Current. Horizontal Alignment. Vertical Alignment.<br>A4 Black/White Clipper. Gamma Correction. Aperture Correction. Shading Correction. Video Output Driver.<br>A5 Automatic Light Control. Automatic Gain Control. Dark Current-Compensation.<br>A6 Output Voltage Regulator. Input Voltage Pre-Regulator.<br>A7 Primary Oscillator/ Driver (sync loss) Secondary Rectifiers/ filters (change of voltage or loss of filtering)<br>A8 High Voltage Power Supply.<br>A9 Target Preamplifier.<br>A10 Beam Current Regulator. Cathode Blanking.<br>A12 Shading Waveform Generator.<br>A14 SIT Tube | (1) Unable to open lens iris.<br>(2) Degradation of picture content.<br><br>Worst Case:<br>Loss of mission critical video. | OPERATIONAL EFFECTS<br><br>Loss of video. Possible loss of major mission objectives due to loss of RMS cameras or other required cameras.<br><br>CREW ACTIONS<br><br>If possible, continue RMS operations using alternative visual cues.<br><br>CREW TRAINING<br><br>Crew should be trained to use possible alternatives to CCTV.<br><br>MISSION CONSTRAINT<br><br>Where possible, procedures should be designed so they can be accomplished without CCTV. |