FMEA NO. 4.2.1

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/C1A
DWG NO. 2294819-506,508/
2294821-503
SHEET 1 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. TVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A11- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	DESIGN FEATURES 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. 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. 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). 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. 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.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506,508/
2294821-503
SHEET 2 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7 - DC-DC converter. Primary oscillator driver. Secondary Rectifiers/filters 2294886-503 A13 - Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	DESIGN FEATURES BARE BOARD DESIGN (A1, A4, A6, A7) The design for the associated boards A1, A4, A6, A7, are 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. 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, A4, A6, A7) 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.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 3 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video Output Drive 2294884-503 A6 - Power On/Off Switching Input Voltage Prerequlators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A11- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	DESIGN FEATURES BARE BOARD CONSTRUCTION (A2) 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. BOARD ASSEMBLY (A2) 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. The board is inserted in the box on card-edge guides, in the same manner as the other PC boards. BOARD PLACEMENT 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 14-pin connector which brings in power and signals from outside the module. 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. The A1, A2, A4, A6, 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.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 4 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A13- Master Oscillator 2295527-3	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	The A13 assembly is a temperature compensated voltage controlled crystal oscillator (TCVCXO) that is purchased to a specification controlled drawing that establishes the requirements for performance, design, test, and qualification of the unit. The product assurance provisions of the document contain the identical requirements for electronic parts and materials as the Shuttle CCTV program and must receive the approval of RCA and NASA-JSC. Mechanical and electrical integrity of the assembly is confirmed by both analysis (design review) and test (qualification and acceptance). QUALIFICATION TEST For Qualification Test Flow, see table 2 located at the front of this book.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506, 508/
2294821-501
SHEET 5 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Prereguiators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A11- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.

RATIONALE FOR ACCEPTANCE

ACCEPTANCE TEST

The CCTV systems' IVC/CLA is subjected directly, without vibration isolators which might be used in their normal installation, to the following testing:

- Vibration:
  - 20-80Hz: 3 dB/Oct-rise from 0.01 G^2/Hz
  - 80-350 Hz: 0.04 G^2/Hz
  - 350-750 Hz: -3 dB/Oct-slope
  - Test Duration: 1 Minute per Axis
  - Test Level: 6.1 Grms
- Thermal Vacuum: In a pressure of $1X10^{-5}$ Torr, the temperature shall be as follows:
  - 125° F: Time to stablize equipment plus 1 hour
  - 25° F: Time to stablize equipment plus 1 hour
  - 125° F: Time to stablize equipment plus 1 hour

The IVC/CLA may not have been subjected to the vacuum condition.

For Acceptance Test Flow, see Table I 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 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 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, OLR, 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 output to downlink.
9. Send "Camera Power Off" command via PHS panel.
10. Repeat Steps 4 through 9 except issue commands via the MDM command path.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 6 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-503 A3 - Sync Formatter. Video output drive 2294884-503 A4 - Power On/Off Switching Input Voltage Prerequlators Output Voltage Regulators 2294885-501 A5- DC DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A13- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	QA/INSPECTION Procurement Control - The IVC/CLA Ltt 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 ELE 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 1846604 - 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). Board Assembly & Test - Prior to the start of IVC 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. IVC Boards Specific IVC 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 IVC assembly notes 2597808, Process Standard NTV-566 2280881, Process Standard - Bonding Velcro Tape 2280689, Specification Soldering 2280749, Specification Name Plate Application 1960107, Specification - Crimping 2280800, Specification - Bonding and Staking 2280878, Specification - Urethane coating 2280877, Specification - Locking compound 2020116, Specification Epoxy Adhesive 2010985, Specification - Marking 2280876, Specification - Workmanship 80.80035, Specification - Bonding and Staking 2280875.

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CRITICALITY 2/2

SIMPLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CLA
DWG NO. 2294819-506, 5087
2294821-503
SHEET 7 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE QA/INSPECTION
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884 503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A15- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	IVC Assembly and Test - An open box test is performed per FP-IT-2294819, and an Acceptance Test per FP-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 FPA operations in accordance with PAI-204, PAI-205, PAI 206 and PAI 217. DCAS personnel witness IVC button-up and critical torquing. IVC/CLA Assembly and Test - After a IVC and an CLA have has been tested individually, they are mated and a final acceptance test is performed per FP-AI-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. Preparation for Shipment - The IVC and CLA are separated prior to shipment after fabrication and testing is complete. Each is packaged according to CCIV Letter 8011 and c280746, Process standard for Packaging and Handling guidelines. All related documentation including assembly drawings, Parts List, AUDI, 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 WS-2593176. RCA QC and DCAS personnel witness crating, packaging, packing, and marking, and review the EIDP for completeness and accuracy.

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CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CIA
ORG NO. 2294819-506, 508/
2294821-503
SHEET 8 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A13- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	FAILURE HISTORY TDR - M2644 - Log #0462, TVC S/N F003-502 TDR - M2640 - Log #0463, TVC S/N F003-502 Description: Integration Testing Failure Box Level Thermal-Vac Hot Environment No video from IVC. +28 volt current at 1.5 Amp limit. (30 minutes into thermal vac hot test cycle -105°F) Cause: Short in A7 low voltage power supply. (High voltage winding of transformer) Corrective Action: Removed and replaced transformer (sent to vendor for analysis). Short due to a pin-hole in magnet wire insulation. Future transformers to be purchased per revised spec control drawing ECN CCTV 649(83078). TDR - M2740 - Log #0486 - TVC S/N 008-502 Description: Pre-Launch Test Failure Box Level Ambient Environment REF: VDCS-2-01-0097 unit returned from KSC. Power was applied to wrong pins. (+28V). Cause: Incorrect wiring of shuttle craft harness, put +28V to J1-10 and RTN to J1-9. Corrective Action: Wiring of shuttle harness to be repaired by responsible organization. Failure analysis performed and corrective action taken on TVC S/N 008. A6 board-failure analysis indicated the following parts are to be changed. Q1, Q3, Q12, CR3, CR6, and R51 were replaced. TDR - M8024 - Log #0530 - TVC S/N 007-502 Description: Acceptance Test Failure Box Level Thermal Vac - Hot Environment. TVC drawing excessive current, >1.5A. Failure occurred at +125°F. Cause: Capacitor C10 on the A6 board was found to be shorted. A large quantity of solder flowed inside from sleeve thru header. Corrective Action: Capacitor C10 removed & replaced. (random part failure).

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SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT TVC/CIA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 8A OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. TVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-timing logic 2294881-501) A4 - Sync Formatter. Video output drive 2294804-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294085-501) A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294086-503 A13- Master Oscillator 229552)-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	FAILURE HISTORY TDR - W2644 - Log #0462, TVC S/N F003-502 TDR - W2640 - Log #0463, TVC S/N F003-502 Description: Integration Testing Failure Box Level Thermal-Vac Hot Environment No video from TVC. +28 volt current at 1.5 Amp limit. (30 minutes into thermal vac hot test cycle -105°F) Cause: Short in A7 low voltage power supply. (High voltage winding of transformer) Corrective Acting: Removed and replaced transformer (sent to vendor for analysis). Short due to a pin-hole in magnet wire insulation. Future transformers to be purchased per revised spec control drawing ECN CCTV 649(B3028). TDR - W2740 - Log #0486 - TVC S/N 008-502 Description: Pre-launch Test Failure Box Level Ambient Environment REF: VJC5-2-01-0097 unit returned from KSC. Power was applied to wrong pins. (+28V). Cause: Incorrect wiring of shuttle craft harness, put +28V to J1-10 and RTN to J1-9. Corrective Action: Wiring of shuttle harness to be repaired by responsible organization. Failure analysis performed and corrective action taken on TVC S/N 008. A6 board-failure analysis indicated the following parts are to be changed. Q1, Q3, Q12, CR3, CR6, and R51 were replaced. TDR - W8024 - Log #0530 - TVC S/N 007-502 Description: Acceptance Test Failure Box Level Thermal Vac - Hot Environment. TVC drawing excessive current, >1.5A. Failure occurred at +125°F. Cause: Capacitor C10 on the A6 board was found to be shorted. A large quantity of solder flowed inside from sleeve thru header. Corrective Action: Capacitor C10 removed & replaced. (random part failure).

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CRITICALITY 2/2

SINGLE CCTV
CRITICAL ITEMS LIST

UNIT IVC/CIA
DWG NO. 2294819-506, 508/
2294821-503
SHEET 80 OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A10- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	FAILURE HISTORY TDR - W6823 - Log #558 - IVC S/N 012-502 Y1771 - Log #568 - IVC S/N 009-502 Y1771 - Log #568 - IVC S/N 002-502 Y1771 - Log #568 - IVC S/N 009-502 Y1770 - Log #567 - IVC S/N 014-502 Y1770 - Log #567 - IVC S/N 010-502 Y1770 - Log #568 - IVC S/N 017-502 W1729 - Log #538 - IVC S/N 020-502 Description: Flight Failure, Spacecraft Level RMS TV Camera circuit breaker popped open during flight mission STS-3. Cause: Camera low voltage supply has erratic syncronization mode at low temperature. Corrective Action: All flight cameras were returned under CCA35 for rework and retest to ECN E-1881. ECN (E-1881) to the low voltage power supplies eliminates the erratic syncronization problem. IVC group part no. has been changed from 2294819-502 to 504 to denote cameras that contain low voltage power supply modification. TDR - Y1773 - Log #0570 - IVC S/N 008-502 Description: Flight Failure Spacecraft Level (STS-3) IVC not synchronized for approximately 38 minutes. This problem occured at cold temperature. Synchronization was regained at 2°C. Cause: Loss of phase lock due to thermal assymetry of the 3.58 MHz Phase detector. Corrective Action: CCA 39 has been issued directing RCA to incorporate the heater and synt modifications (ECN CCT 838) to all flight camera's. IVC 008 was modified accordingly. IVC group number has been updated from group 502 to 506. TDR - Y1779 - Log #57b - IVC S/N 014-502 Description: Flight Failure (STS-3) Spacecraft Level TDR was opened to follow relay K1 - contacts 5 and 8 failure on ass'y 2294885-501 S/N 1018.

FMEA NO. 4.2.1 CRITICALITY 2/2	SHUTTLE CCTV CRITICAL ITEMS LIST	UNIT TVC/CLA DHG NO. 2294B19-506, 508/ 2294B21-503 SHEET 8C OF 9

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. TVC A1 - Sync Generator. Clock Divider Chain 2294880-504. A2 - Camera-Timing Logic 2294881-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Prereguiators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294886-503 A13- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	FAILURE HISTORY TDR - B-3521 - Log #1165 - TVC S/N 038-508 Description: Acceptance Test Failure Box Level Thermal Vac - Hot Environment Excessive supply current, lost all DLR/camera lights and output video information. Cause: Shorted capacitor C14 on A6 board. Corrective Action: C14 removed and replaced with new capacitor. Product assurance lab could not find a cause for shorted cap. (Report # B5321A) Considered random failure.

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

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No output signal to the VSU. Neither video or synchronization information is present. IVC A1 - Sync Generator, Clock Divider Chain 2294080-504. A2 - Camera-Timing Logic 2294801-501 A4 - Sync Formatter. Video output drive 2294884-503 A6 - Power On/Off Switching Input Voltage Preregulators Output Voltage Regulators 2294885-501 A7- DC-DC converter. Primary oscillator driver. Secondary Rectifiers/Filters 2294806-503 A11- Master Oscillator 2295527-1	Loss of camera output depicting scene information within FOV of lens assembly. Worst Case: Loss of mission critical video.	OPERATIONAL EFFECTS Loss of video. Possible loss of major mission objectives if RMS elbow is required. CREW ACTIONS If possible, continue RMS operations using alternative visual cues. CREW TRAINING Crew should be trained to use possible alternatives to CCTV. MISSION CONSTRAINT Where possible, procedures should be designed so they can be accomplished without CCTV.