REVISED 10-14-86

FMEA NO. 1.1.12.1

CRITICALITY 2/2

SHUTTLE CCTV
CRITICAL ITEMS LIST

UNIT Remote Control Unit (RCU)
DWG NO. 2294824-500, 507

SHEET 1 OF 8

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
lo power on reset (POR) pulse to he VSU at turn on. ause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	DESIGN FEATURES The RCU is a microprocessor-based command and control unit using an RCA 1802 CMOS microprocessor, CMOS RAM, and TTL PROM. Computer I/O circuitry is implemented in CMOS CD4000 series logic to minimize power dissipation. The design incorporates a dual master oscillator (one active, one cold backup). The master oscillator is a Temperature Compensated Crystal Oscillator (TCXO) purchased from Vectron to an RCA specification control drawing (SCD). Decode logic consists of Low Power Schottky TTL, and the sync amplifier design uses monolithic NE5539 wideband op amps. Parts were required to be JAN reliability level parts or their equivalent. Part selection falls into three categories: (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. BARE BOARD CONSTRUCTION (A6) 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 (A6) The drilled and etched board is 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.

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UNIT Remote Control Unit (RCU)
DWG NO. 2294824-504, 506

SHEET 3 OF 8

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No power on reset (POR) pulse to the VSU at turn on. Cause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	QUALIFICATION TEST For Qualification Test flow, see Table 2 located at the front of this book.

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SHEET 4 OF 8

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
lo power on reset (POR) pulse to .he VSU at turn on. .ause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2295865-504	Unpredictable VSU state at power turn on. Worst Case: loss of video from mission critical camera	ACCEPTANCE TEST The CCTV systems' RCU is subjected to the following testing: • Vibration: 20-80Hz: 3 dB/Oct-rise from 0.01 G^2/Hz to 0.04 G^2/Hz 80-350 Hz: 0.04 G^2/Hz 350-750 Hz: 3 dB/Oct-Fall to 0.018 G^2Hz 750-1000: 0.018 G^2/Hz 1000-2000: 3 dB/Oct-Fall to 0.009 G^2/Hz Test Duration: 1 Minute per Axis Test Level: 6.6 Grms • Thermal: 100° F: Time to stablize equipment plus 1 hour 0° F: Time to stablize equipment plus 1 hour 100° F: Time to stablize equipment plus 1 hour For Acceptance Test Flow, see Table 1 located at the Front of this book. OPERATIONAL TEST In order to verify that CCTV components are operational, a test must verify the health of all the command related components from the PHS (A/AI) 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, DLR, 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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SHEET 5 OF 8

FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
o power on reset (POR) pulse to he VSU at turn on. ause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	QA/INSPECTION Procurement Control – The RCU EEE parts and hardware items are procured from approved vendors and suppliers, which meet the requirements set forth in the CCTV contract and Quality Plan Work Statement (WS-2593176). Resident DCAS personnel review all procurement documents to establish the need for GSI on selected parts (PAI 517). Incoming Inspection and Storage – Incoming Quality inspections are made on all received materials and parts. Results are recorded by lot and retained in file by drawing and control numbers for future reference and traceability. All EEE parts are subjected to incoming acceptance tests as called for in PAI 315 – Incoming Inspection Test Instructions. Incoming flight parts are further processed in accordance with RCA 1846684 – Preconditioning and Acceptance Requirements for Electronic Parts, with the exception 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. Nonconforming materials are held for Material Review Board (MRB) disposition. (PAI-307, PAI IQC-531.) Board Assembly & Test – Prior to the start of RCU 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 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 RCU board assembly and test instructions are provided in drawing notes, and applicable documents are called out in the Fabrication Procedure and Record (FPR-2294824) and parts list PL-2294824. These include wire connection List 2295901, 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 2280875. RCU Assembly and Test – An open box test is performed per TP-IT-2294824, and an Acceptance Test per TP-AT-2294824, 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 RCU button-up and critical torquing. RCA and

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
a power on reset (POR) pulse to he VSU at turn on. ause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	QA/INSPECTION (Continued) OCAS personnel monitor acceptance tests and review the test data/results. These personnel also inspectfor conformance after all repair, rework and retest. Preparation for Shipment - The RCU is packaged according to 2280746, Process Standard for Packaging and Handling guidelines. All related documentation including assembly drawings, Parts List, ABPL, Test Data, etc., is gathered and held in a documentation folder assigned specifically to each assembly. This folder is retained for reference. An EIOP is prepared for each RCU in accordance with the requirements of WS-2593176. RCA QC and OCAS personnel witness crating, packaging, packing and marking, and review the EIOP for completeness and accuracy.

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
In power on reset (POR) pulse to the VSU at turn on. Cause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	FAILURE HISTORY NONE

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FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
No power on reset (POR) pulse to thee VSU at turn on. Cause: POR circuit on VSU Interface Assy A6, 2592386-501 or 2294865-504	Unpredictable VSU state at power turn on. Worst Case: Loss of video from mission critical camera	OPERATIONAL EFFECTS Loss of video. Possible loss of major mission objectives due to loss of RMS cameras or other required cameras. 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.