CRITICAL ITEMS LIST

PROJECT: SRMS (5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER ASS'Y P/N: 51T20T177 SHEET: 1

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY
2495	0	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2569722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRONEOUS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE-BITE MAY BE ANNUNCIATED IF RETURN DATA ARE 1'S. IF 0'S RETURNED FEEL BITE FLAG WILL BE ANNUNCIATED. CK CRT-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE --- UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING --- 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B PASS, C-PASS DESIGN FEATURES --- COMPARATORS AND OPERATIONAL AMPLIFIERS ARE STANDARD LINEAR INTEGRATED CIRCUITS WITH MATURE MANUFACTURING TECHNOLOGY. APPLICATION CONSTRAINTS ARE IN ACCORDANCE WITH SPAR RMS PA.003. THE DIODE AND TRANSISTOR, WHICH COMPRISE AN OPTO-ISOLATOR, ARE SUBJECTED TO THE SAME QUALITY AND APPLICATION CONTROLS AS APPLIED TO DISCRETE SEMICONDUCTORS. DISCRETE SEMICONDUCTOR DEVICES SPECIFIED TO AT LEAST THE TX LEVEL OF MIL-S-19500. ALL DEVICES ARE SUBJECTED TO RE-SCREENING BY AN INDEPENDANT TEST HOUSE. SAMPLES OF ALL PROCURED LOTS/DATE CODES ARE SUBJECTED TO DESTRUCTIVE PHYSICAL ANALYSIS (DPA) TO VERIFY THE INTEGRITY OF THE MANUFACTURING PROCESSES. DEVICE STRESS LEVELS ARE, DERATED IN ACCORDANCE WITH SPAR-RMS-PA.003 AND VERIFIED BY DESIGN REVIEW. ALL RESISTORS AND CAPACITORS USED IN THE DESIGN ARE SELECTED FROM ESTABLISHED RELIABILITY (ER) TYPES. LIFE EXPECTANCY IS INCREASED BY ENSURING THAT ALL ALLOWABLE STRESS LEVELS ARE DERATED IN ACCORDANCE WITH SPAR-RMS-PA.003. ALL CERAMIC AND ELECTROLYTIC CAPACITORS ARE ROUTINELY SUBJECTED TO RADIOGRAPHIC INSPECTION.

PREPARED BY: MWG SUPERCEDING DATE: NONE

DATE: 11 JUN 91 CEI REV: 0

RMS/ELEC - 421

CRITICAL ITEMS LIST

PROJECT: SRMS (5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER ASS'Y P/N: 51T4DF1177 SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. CRITICALITY 2/1R	RATIONALE FOR ACCEPTANCE
2695	B	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2561722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRONEOUS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE-BITE MAY BE ANNUNCIATED IF RETURN DATA ARE 1'S. IF 0'S RETURNED EEEU BITE FLAG WILL BE ANNUNCIATED. CK CR1-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION, JOINT RUNAWAY, AUTO BRAKES. REDUNDANT PATHS REMAINING 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).	SCREENS: A PASS, B PASS, C PASS ACCEPTANCE TESTS THE SPA IS SUBJECTED TO THE FOLLOWING ENVIRONMENTAL TESTING AS AN SRU. O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4 O THERMAL: PLUS 70 DEGREES C TO -25 DEGREES C DURATION - 1 1/2 CYCLES THE SPA IS THEN TESTED AS PART OF THE JOINTS ACCEPTANCE TESTS (VIBRATION AND THERMAL VACUUM TEST). THE SPA'S/JOINTS UNDERGO RMS SYSTEM TESTS (IPS1B RMS STRONGBACK AND IPS52 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE. QUALIFICATION TESTS THE SPA IS SUBJECTED TO THE FOLLOWING SRU QUALIFICATION TEST ENVIRONMENTS. THE SPA WAS ALSO TESTED AS PART OF THE JOINT QUALIFICATION TESTS. O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4 O SHOCK: 20G/11 MS/3 AXES (6 DIRECTIONS) O THERMAL VAC: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1X10**6 TORR O HUMIDITY: TESTED WITH THE SHOULDER JOINT O EMC: MIL-STD-461 AS MODIFIED BY SL-E 0002 (TEST CE01, CE03, CS01, CS02, CS06, RE01, RE02 (H/B), RS01) FLIGHT CHECKOUT PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY: MEMG SUPERSEDING DATE: NONE

DATE: 11 JUN 91 CEI REV: B

RMS/ELEC - 422

CRITICAL ITEMS LIST

PROJECT: SAMS (5 MCIU INSTALLED)
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER
SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y P/N: 51T20F1177
SHEET: 1

FMEA REF	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. CRITICALITY 2/1R	RATIONALE FOR ACCEPTANCE
2695	0	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2563722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRONEOUS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE-BITE MAY BE ANNUNCIATED IF RETURN DATA ARE 1'S. IF 0'S RETURNED EEEU BITE FLAG WILL BE ANNUNCIATED. CK CRT-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION, JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).	SCREENS: A-PASS, B PASS, C-PASS QA/INSPECTIONS UNITS ARE MANUFACTURED UNDER DOCUMENTED QUALITY CONTROLS. THESE CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, RECEIVING, PROCESSING, FABRICATION, ASSEMBLY, TESTING AND SHIPPING OF THE UNITS. MANDATORY INSPECTION POINTS ARE EMPLOYED AT VARIOUS STAGES OF FABRICATION ASSEMBLY AND TEST. GOVERNMENT SOURCE INSPECTION IS INVOKED AT VARIOUS CONTROL LEVELS. EEE PARTS INSPECTION IS PERFORMED AS REQUIRED BY SPAR-RMS-PA.003. EACH EEE PART IS QUALIFIED AT THE PART LEVEL TO THE REQUIREMENTS OF THE APPLICABLE SPECIFICATION. ALL EEE PARTS ARE 100% SCREENED AND BURNED IN, AS A MINIMUM, AS REQUIRED BY SPAR-RMS-PA.003, BY THE SUPPLIER. ADDITIONALLY, EEE PARTS ARE 100% RE SCREENED IN ACCORDANCE WITH REQUIREMENTS, BY AN INDEPENDENT SPAR APPROVED TESTING FACILITY. DPA IS PERFORMED AS REQUIRED BY PA.003 ON A RANDOMLY SELECTED 5% OF PARTS, MAXIMUM 5 PIECES, MINIMUM 3 PIECES FOR EACH LOT NUMBER/DATE CODE OF PARTS RECEIVED. WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCM8080 STANDARD NUMBER 95A. RECEIVING INSPECTION VERIFIES THAT ALL PARTS RECEIVED ARE AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO PHYSICAL DAMAGE HAS OCCURRED TO PARTS DURING SHIPMENT, THAT THE RECEIVING DOCUMENTS PROVIDE ADEQUATE TRACEABILITY INFORMATION AND SCREENING DATA CLEARLY IDENTIFIES ACCEPTABLE PARTS. PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE, PRINTED CIRCUIT BOARD INSPECTION FOR TRACK SEPARATION, DAMAGE AND ADEQUACY OF PLATED THROUGH HOLES, COMPONENT MOUNTING INSPECTION FOR CORRECT SOLDERING, WIRE LOOPING, STRAPPING, ETC. OPERATORS AND INSPECTORS ARE TRAINED AND CERTIFIED TO NASA NHB 5300.4(3A) STANDARD, AS MODIFIED BY JSC 08800A. CONFORMAL COATING INSPECTION FOR ADEQUATE PROCESSING IS PERFORMED USING ULTRAVIOLET LIGHT TECHNIQUES. POST P.C. BD. INSTALLATION INSPECTION, CLEANLINESS AND WORKMANSHIP (SPAR/GOVERNMENT REP. MANDATORY INSPECTION POINT) P.C. BD. INSTALLATION INSPECTION, CHECK FOR CORRECT BOARD INSTALLATION, ALIGNMENT OF BOARDS, PROPER CONNECTOR CONTACT MATING, WIRE ROUTING, STRAPPING OF WIRES ETC., PRE-CLOSURE INSPECTION, WORKMANSHIP AND CLEANLINESS (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT) PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT).

PREPARED BY: MEUG
SUPERCEDING DATE: NONE
DATE: 11 JUL 91
CIL REV: 0

RMS/ELEC - 423

CRITICAL ITEMS LIST

PROJECT: SRMS (5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER ASS'Y P/N: 51150F1177 SHEET: 4

FMEA SEQ	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
2695	0	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2563722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRINETRIS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE BITE MAY BE ANNUNCIATED IF RETURN DATA ARE 1'S. IF 0'S RETURNED EEEU BITE FLAG WILL BE ANNUNCIATED. CK CRT-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION, JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).		A TEST READINESS REVIEW (TRR) WHICH INCLUDES VERIFICATION OF TEST PERSONNEL, TEST DOCUMENTS, TEST EQUIPMENT CALIBRATION/ VALIDATION STATUS AND HARDWARE CONFIGURATION IS CONVENED BY QUALITY ASSURANCE IN CONJUNCTION WITH ENGINEERING, RELIABILITY, CONFIGURATION CONTROL, SUPPLIER AS APPLICABLE, AND THE GOVERNMENT REPRESENTATIVE, PRIOR TO THE START OF ANY FORMAL TESTING (ACCEPTANCE OR QUALIFICATION). ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT PERFORMANCE, THERMAL AND VIBRATION TESTING, (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT). INTEGRATION OF UNIT TO JOINT SRU - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTORS FOR BENT OR PUSHBACK CONTACTS, VISUAL, CLEANLINESS, INTERCONNECT WIRING AND POWER UP TEST TO THE APPROPRIATE JOINT INSPECTION TEST PROCEDURE (TIP) ETC. JOINT LEVEL PRE-ACCEPTANCE TEST INSPECTION, INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC. JOINT LEVEL ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT, VIBRATION AND THERMAL-VAC TESTING. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT). SRMS SYSTEMS INTEGRATION, THE INTEGRATION OF MECHANICAL ARM SUBASSEMBLIES AND THE FLIGHT CABIN EQUIPMENT TO FORM THE SRMS. INSPECTIONS ARE PERFORMED AT EACH PHASE OF INTEGRATION WHICH INCLUDES GROUNDING CHECKS, THRU WIRING CHECKS, WIRING ROUTING, INTERFACE CONNECTORS FOR BENT OR PUSH BACK CONTACTS ETC. SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)

PREPARED BY: MFWG SUPERCEDING DATE: NONE DATE: 11 JUL 91 CIL REV: 0

RMS/ELEC - 424

CRITICAL ITEMS LIST

PROJECT: SRMS (5 MCIU INSTALLED)
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER
SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y P/N: 51T20F1177
SHEET: 5

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
2695	0	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2561722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRONEOUS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE-BITE MAY BE ANNUNCIATED IF RETURN DATA ARE 1'S. IF 0'S RETURNED EEEU BITE FLAG WILL BE ANNUNCIATED. CK CRT-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).	2/1R	SCREENS: A PASS, B PASS, C PASS FAILURE HISTORY THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

PREPARED BY: MFWG
SUPERCEDING DATE: NONE
DATE: 11 JUL 91
CIL REV: 0

CRITICAL ITEMS LIST

PROJECT: SRMS (5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER ASS'Y P/N: 511E0F1177 SHEET: 6

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	MDWR / FUNC. 2/1R CRITICALITY — RATIONALE FOR ACCEPTANCE — SCREENS: A-PASS, B PASS, C-PASS
7695	D	CLOCK AND SYNC PULSE CIRCUITS QTY 6 SCHEMATIC 2563722	MODE: LOSS OF CLOCK PULSE SUCH THAT MCIU TO SPA DATA TRANSFER IS LOST. CAUSE(S): (1) ISOLATOR OR AMPLIFIER FAILURE.	ERRONEOUS COMMAND AND INPUTS TO SPA. JOINT WILL RUNAWAY. MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND INITIATE AUTOBRAKING. ARM WILL STOP. OTHER ABE-BITE MAY BE ANNUNCIATED IF RTURN DATA ARE 0'S. IF 0'S RETURNED EEEU BITE FLAG WILL BE ANNUNCIATED. CK CRT-EE FAILURE. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION. JOINT RUNAWAY. AUTO BRAKES. REDUNDANT PATHS REMAINING 1) AUTOBRAKES (FOR SAFING THE SYSTEM). 2) DIRECT DRIVE AND END EFFECTOR MANUAL DRIVE MODES (FOR CONTINUING OPERATIONS).	OPERATIONAL EFFECTS JOINT RUNAWAY. AUTOBRAKES. CANNOT USE COMPUTER SUPPORTED MODES. DIRECT DRIVE AND BACKUP AVAILABLE. ARM WILL NOT STOP AUTOMATICALLY IF AN UNDETECTED FAILURE OF THE AUTO BRAKES SYSTEM HAS PREVIOUSLY OCCURRED, BRAKES CAN BE APPLIED MANUALLY. CREW ACTION APPLY BRAKES. USE DIRECT DRIVE. CREW TRAINING THE CREW WILL BE TRAINED TO ALWAYS OBSERVE WHETHER THE ARM IS RESPONDING PROPERLY TO COMMANDS. IF IT ISN'T, APPLY BRAKES. MISSION CONSTRAINT OPERATE UNDER VERNIER RATES WITHIN 10 FT OF STRUCTURE. THE OPERATOR MUST BE ABLE TO DETECT THAT THE ARM/PAYLOAD IS RESPONDING PROPERLY TO COMMANDS VIA WINDOW AND/OR CCTV VIEWS DURING ALL ARM OPERATIONS. OMRSD OFFLINE VERIFY ABE COMMUNICATION. OMRSD ONLINE INSTALLATION NONE OMRSD ONLINE TURNAROUND VERIFY NO ABE COMMUNICATION FAILURE.

PREPARED BY: MFWG SUPERCEDING DATE: NONE DATE: 11 JUL 91 CIL REV: D

RMS/ELEC - 426

SCAC237A
ATTACHMENT
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