CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: JOINT POWER CONDITIONER ASS'Y P/N: 5117OF1176 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 — RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
3165	0	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	FOR +/-15 AND 10V: MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND APPLY AUTOBRAKES TO THE ARM. FOR 5.1V: COMMUTATOR BITE WILL INITIATE AUTOBRAKES. ENCODER DATA FROZEN. IF FAILURE OCCURS BEFORE ARM SELECTED JOINT ANGLE DATA WILL BE INACCURATE FOR AFFECTED JOINTS. LOSS OF POWER TO POWER SWITCHES. FOR ALL CAUSES: ARM COMES TO REST. LOSS OF COMPUTER SUPPORTED MODES. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. IF WRIST JPC: END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION. FREE JOINT. AUTOBRAKES. REDUNDANT PATHS REMAINING	DESIGN FEATURES TRANSFORMERS AND INDUCTORS ARE DESIGNED SPECIFICALLY FOR THE APPLICATION. THESE ARE TOROID - WOUND AND UTILIZE A FERRITE CORE MATERIAL. CHOICE OF WIRE SIZE AND OF INSULATION MATERIALS ENSURE THAT THE DERATING REQUIREMENTS OF SPAR-RMS-PA.003 ARE MET. ALL RESISTORS AND CAPACITORS USED IN THE DESIGN ARE SELECTED FROM ESTABLISHED RELIABILITY (ER) TYPES. LIFE EXPECIANCY 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. 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. COMPARATORS AND OPERATIONAL AMPLIFIERS ARE STANDARD LINEAR INTEGRATED CIRCUITS WITH MATURE MANUFACTURING TECHNOLOGY. APPLICATION CONSTRAINTS ARE IN ACCORDANCE WITH SPAR-RMS-PA.003.

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

RMS/ELEC - 853

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: JOINT POWER CONDITIONER ASS'Y P/N: 51T20FT176 SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING B/O. 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
3165	0	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	1) AUTOBRAKES (FOR SAFING THE SYSTEM) 2) BACK-UP DRIVE AND END EFFECTOR MANUAL DRIVE MODES (TO SECURE ORBITER).		ACCEPTANCE TESTS THE JPC IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTING AS AN SRU. O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 5 O THERMAL: +70 DEGREES C TO -25 DEGREES C (1 1/2 CYCLES) THE JPC IS FURTHER EXPOSED TO THE JOINTS ACCEPTANCE TESTS VIBRATION THERMAL VACUUM. THE JPC INTEGRATED IN THE JOINT UNDERGOES AMBIENT RMS SYSTEM TESTING (TP 518 RMS STRONGBACK AND TP552 FLAT FLOOR TEST) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE. QUALIFICATION TESTS THE JPC IS SUBJECTED TO THE FOLLOWING SRU QUALIFICATION TEST ENVIRONMENTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 5 O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS) O THERMAL: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10**6 TORR. O HUMIDITY: TESTED ON THE SHOULDER JOINT HUMIDITY TEST. O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE01, RE02 (N/B, RS01). FLIGHT CHECKOUT PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

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: JOINT POWER CONDITIONER ASS'Y P/N: 511201176 SHEET: 3

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 SCREENS: A-PASS, B-PASS, C-PASS
3165	D	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	FOR +/-15 AND 10V: MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND APPLY AUTOBRAKES TO THE ARM. FOR 5.1V: COMMUTATOR BITE WILL INITIATE AUTOBRAKES. ENCODER DATA FROZEN. IF FAILURE OCCURS BEFORE ARM SELECTED JOINT ANGLE DATA WILL BE INACCURATE FOR AFFECTED JOINTS. LOSS OF POWER TO POWER SWITCHES. FOR ALL CAUSES: ARM COMES TO REST. LOSS OF COMPUTER SUPPORTED MODES. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. IF WRIST JPC: END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE --- UNEXPECTED MOTION. FREE JOINT. AUTOBRAKES. REDUNDANT PATHS REMAINING	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: MEWG SUPERCEDING DATE: NONE DATE: 11 JUL 91 CIL REV: D

RMS/ELEC - 855

SD402372
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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED)
ASS'Y NOMENCLATURE: JOINT POWER CONDITIONER
SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y P/N: 5114DF1176
SHEET: 4

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
3165	0	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	1) AUTOBRAKES (FOR SAFING THE SYSTEM) 2) BACK-UP DRIVE AND END EFFECTOR MANUAL DRIVE MODES (TO SECURE ORBITER).	SCREENS: A-PASS, B-PASS, C-PASS 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 (ITP) 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 AMBINET, 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 - 856

SCA2374
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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: JOINT POWER CONDITIONER ASS'Y P/N: 5114DF1176 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
3165	0	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	FOR +/-15 AND 10V: MCIU WILL DETECT ABE COMMUNICATIONS FAILURE AND APPLY AUTOBRAKES TO THE ARM. FOR 5.1V: COMMUTATOR BITE WILL INITIATE AUTOBRAKES. ENCODER DATA FROZEN. IF FAILURE OCCURS BEFORE ARM SELECTED JOINT ANGLE DATA WILL BE INACCURATE FOR AFFECTED JOINTS. LOSS OF POWER TO POWER SWITCHES. FOR ALL CAUSES: ARM COMES TO REST. LOSS OF COMPUTER SUPPORTED MODES. LOSS OF LIMPING DURING END EFFECTOR CAPTURE. IF WRIST JPC: END EFFECTOR AUTO DRIVE MODE MAY NOT FUNCTION CORRECTLY. WORST CASE UNEXPECTED MOTION. FREE JOINT. AUTOBRAKES. REDUNDANT PATHS REMAINING	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: MEWG SUPERCEDING DATE: NONE DATE: 11 JUL 91 CIL REV: 0

RMS/ELEC - 857

SCG0237A
ATTACHMENT
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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y NOMENCLATURE: JOINT POWER CONDITIONER ASS'Y P/N: 511C0F1176 SHEET: 6

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 SCREENS: A-PASS, B-PASS, C-PASS
3165	0	JOINT POWER CONDITIONER SCHEMATIC QTY-2 DIAGRAM 2563711	MODE: LOSS OF ONE OR MORE OUTPUTS FROM SHOULDER/ ELBOW OR WRIST JPC. CAUSE(S): (1) PARTS FAILURE OUTPUT FILTERS, TRANSFORMERS OR POWER TRANSISTORS FAIL OPEN OR SHORTED.	1) AUTOBRAKES (FOR SAFING THE SYSTEM) 2) BACK-UP DRIVE AND END EFFECTOR MANUAL DRIVE MODES (TO SECURE ORBITER).		OPERATIONAL EFFECTS COMPUTER SUPPORTED MODES CANNOT BE USED TO COMPLETE THE MISSION. DIRECT DRIVE AND BACKUP MODES REMAIN. IF PAYLOAD ATTACHED, THE ARM SHOULD BE MANOUVERED TO A SAFE POSITION FOR PAYLOAD RELEASE. LOSS OF NEXT REDUNDANT PATH RESULTS IN BEING ONE FAILURE AWAY FROM INABILITY TO CRADLE ARM. IF WITH SUBSEQUENT FAILURES ALL DRIVE MODES ARE LOST, THE ARM MAY BE JETTISONED. CREW ACTION APPLY BRAKES. SELECT BACKUP. CREW TRAINING THE CREW WILL BE TRAINED TO OBSERVE WHETHER THE ARM IS RESPONDING PROPERLY TO COMMANDS. MISSION CONSTRAINT OPERATE UNDER VERNIER RATES WITHIN 10 FT OF STRUCTURE. THE OPERATOR MUST BE ABLE TO DETECT THAT THE ARM IS RESPONDING PROPERLY TO COMMANDS VIA WINDOW AND/OR CCTV VIEWS DURING ALL ARM OPERATIONS. OMRSD OFFLINE VERIFY ABE DATA FOR WRAPAROUND. DRIVE EACH JOINT IN COMPUTER SUPPORTED MODE. VERIFY ENCODER CHANGES VALUE. OMRSD ONLINE INSTALLATION NONE OMRSD ONLINE TURNAROUND VERIFY THAT ABE WARNING IS NOT PRESENT DRIVE EACH JOINT IN SINGLE. VERIFY TACHO SIGNATURE AND ENCODER MOVEMENT (SMALL).

PREPARED BY: MFWG SUPERCEDING DATE: NONE

DATE: 11 JUL 91 CIL REV: 0

RMS/ELEC - 858

SS4C0237A
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