

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP
ASS'Y P/N:

SHEET: 1

P/N REF.	REV.	NAME, QTY. & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	<p>MODE: NO. ON CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES.</p> <p>CAUSE(S): (1) LOSS OF 15V CONTROL.</p> <p>(2) OPEN OR SHORTED DIODES.</p> <p>(3) SHORT /OPEN PWR SWITCH.</p> <p>(4) TRANSFORMER FAILURE.</p>	<p>JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST.</p> <p>WORST CASE ----- BACKUP INOPERATIVE.</p> <p>REDUNDANT PATHS REMAINING ----- SINGLE AND DIRECT</p>	<p>DESIGN FEATURES -----</p> <p>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.</p> <p>TRANSFORMERS AND INDUCTORS ARE DESIGNED SPECIFICALLY FOR THE APPLICATION. THESE ARE TOROID - MOUNTED AND UTILIZE A FERRO CORE MATERIAL. CHOICE OF WIRE SIZE AND OF INSULATION MATERIALS ENSURE THAT THE DERATING REQUIREMENTS OF SPAR RMS-PA.003 ARE MET.</p> <p>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.</p> <p>FOR BETTER HEAT DISSIPATION THE POWER TRANSISTORS ARE BASE MOUNTED, AND THE POWER SWITCH IS COMPARTMENTALIZED FOR EMC PROTECTION.</p>	

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SHEET: 2

FREA REF.	REV.	NAME, QTY. & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	NODE: NO. OR CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES. CAUSE(S): (1) LOSS OF ISV CONTROL. (2) OPEN OR SHORTED DIODES. (3) SHORT /OPEN PWM SWITCH. (4) TRANSFORMER FAILURE.	JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST. WORST CASE BACKUP INOPERATIVE. REDUNDANT PATHS REMAINING SINGLE AND DIRECT		<p>ACCEPTANCE TESTS</p> <p>-----</p> <p>THE BDA IS ACCEPTANCE TESTED FOR THE FOLLOWING ENVIRONMENTS AS AN SRU.</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4</p> <p>O THERMAL: +70 DEGREES C TO - 25 DEGREES C (1 1/2 CYCLES)</p> <p>THE BDA IS INTEGRATED INTO THE SHOULDER JOINT AND EXPOSED TO THE JOINT ACCEPTANCE ENVIRONMENTS (VIBRATION AND THERMAL VACUUM).</p> <p>THE SHOULDER JOINT IS THEREAFTER TESTED AS PART OF THE RMS SYSTEM TESTS (TP518 RMS STRONGBACK AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.</p> <p>QUALIFICATION TESTS</p> <p>-----</p> <p>THE BDA HAS BEEN QUALIFICATION TESTED TO THE FOLLOWING ENVIRONMENTS AS AN SRU. THE BDA IS FURTHER TESTED ON THE SHOULDER JOINT QUALIFICATION TESTING.</p> <p>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4</p> <p>O SHOCK: 20G/11MS - 3 AXES (6 DIRECTIONS)</p> <p>O THERMAL: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10**6 TORR.</p> <p>O HUMIDITY: TEST IN SHOULDER JOINT HUMIDITY TEST</p> <p>O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CE01, CE03, CS01, CS02, CS06, RE01, RE02 (M/B), RS01)</p> <p>FLIGHT CHECKOUT</p> <p>-----</p> <p>PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987</p>

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SHEET: 3

FREA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDMR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	<p>MODE: NO. OR CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES.</p> <p>CAUSE(S): (1) LOSS OF 15V CONTROL (2) OPEN OR SHORTED DIODES. (3) SHORT /OPEN PWM SWITCH. (4) TRANSFORMER FAILURE.</p>	<p>JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST.</p> <p>WORST CASE ----- BACKUP INOPERATIVE. ----- REDUNDANT PAINS REMAINING ----- SINGLE AND DIRECT</p>	QA/INSPECTIONS	<p>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.</p> <p>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.</p> <p>WIRE IS PROCURED TO SPECIFICATION MIL-W-22759 OR MIL-W-81381 AND INSPECTED AND TESTED TO NASA JSCN8080 STANDARD NUMBER 95A.</p> <p>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.</p> <p>PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE:</p> <p>PRINTED CIRCUIT BOARD INSPECTION FOR TRACK SEPARATION, DAMAGE AND ADEQUACY OF PLATED THROUGH HOLES.</p> <p>COMPONENT MOUNTING INSPECTION FOR CORRECT SOLDERING, WIRE LOOPING, STRAPPING, ETC. OPERATORS AND INSPECTORS ARE TRAINED AND CERTIFIED TO NASA MHB 5300.4(3A) STANDARD, AS MODIFIED BY JSC 08800A.</p> <p>CONFORMAL COATING INSPECTION FOR ADEQUATE PROCESSING IS PERFORMED USING ULTRAVIOLET LIGHT TECHNIQUES.</p> <p>POST P.C. BD. INSTALLATION INSPECTION, CLEANLINESS AND WORKMANSHIP (SPAR/GOVERNMENT REP. MANDATORY INSPECTION POINT)</p> <p>P.C. BD. INSTALLATION INSPECTION, CHECK FOR CORRECT BOARD INSTALLATION, ALIGNMENT OF BOARDS, PROPER CONNECTOR CONTACT MATING, WIRE ROUTING, STRAPPING OF WIRES ETC.</p> <p>PRE-CLOSURE INSPECTION, WORKMANSHIP AND CLEANLINESS (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p> <p>PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC. (MANDATORY INSPECTION POINT).</p>

PREPARED BY: RMG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

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SHEET: 4

P/N REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	<p>MODE: NO. OR CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES.</p> <p>CAUSE(S): (1) LOSS OF 15V CONTROL.</p> <p>(2) OPEN OR SHORTED DIODES.</p> <p>(3) SHORT /OPEN PWM SWITCH.</p> <p>(4) TRANSFORMER FAILURE.</p>	<p>JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST.</p> <p>WORST CASE ----- BACKUP INOPERATIVE.</p> <p>REDUNDANT PATHS REMAINING ----- SINGLE AND DIRECT</p>		<p>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).</p> <p>ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT PERFORMANCE, THERMAL AND VIBRATION TESTING. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT).</p> <p>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.</p> <p>JOINT LEVEL PRE-ACCEPTANCE TEST INSPECTION, INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC.</p> <p>JOINT LEVEL ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT, VIBRATION AND THERMAL-VAC TESTING. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT).</p> <p>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.</p> <p>SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p>

PREPARED BY: MWG

SUPERSEDING DATE: 06 OCT 87

APPROVED BY:

DATE:

CRITICAL ITEMS LIST

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SHEET: 5

FREA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDMR / FUNC. 2/IR CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	MODE: NO. OR CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES. CAUSE(S): (1) LOSS OF 15V CONTROL. (2) OPEN OR SHORTED DIODES. (3) SHORT /OPEN PNM SWITCH. (4) TRANSFORMER FAILURE.	JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST. WORST CASE BACKUP INOPERATIVE. REDUNDANT PARTS REMAINING SINGLE AND DIRECT		FAILURE HISTORY ----- THE FOLLOWING FAILURE ANALYSIS REPORT(S) ARE RELEVANT: FAR 2328: S/N 301 JUL 82 DESCRIPTION FITCH BACK-UP DRIVE FAILED, LOOSE TERMINAL IN DEUTSCH BLOCK. CORRECTIVE ACTION ----- INSPECTED ALL DEUTSCH BLOCKS. FAR 3022: S/N 201 DEC 78 DESCRIPTION MDA OUTPUT DROPPED TO ZERO AT COLD DUE TO CRYSTAL OSCILLATOR FAILURE. CORRECTIVE ACTION ----- REPLACED OSCILLATOR, SCREENED OTHER OSCILLATORS.

PREPARED BY: WMC

SUPERSEDING DATE: 06 OCT 87

APPROVED BY: _____

RMS/BACK-UP 86

CRITICAL ITEMS LIST

PROJECT: SRMS
 ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP
 ASS'Y P/N:

SHEET: 6

P/N REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HWR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4580	4	ELECTRICAL POWER SWITCHES QTY-6 SCHEMATIC 2563712	MODE: NO. OR CONTINUOUS OUTPUT FROM ONE OR MORE SWITCHES. CAUSE(S): (1) LOSS OF ISV CONTROL. (2) OPEN OR SHORTE DIODES. (3) SHORT /OPEN PWM SWITCH. (4) TRANSFORMER FAILURE.	JOINT MOTOR WILL NOT DRIVE AND IF IT IS IN MOTION IT WILL SLOWLY COME TO REST. WORST CASE ----- BACKUP INOPERATIVE. REDUNDANT PATHS REMAINING ----- SINGLE AND DIRECT		OPERATIONAL EFFECTS ----- LOSS OF NEXT REDUNDANT PATH RESULTS IN BEING ONE FAILURE AWAY FROM INABILITY TO CRADLE ARM. JOINT WILL NOT DRIVE IN BACKUP ONCE PRIMARY MODES HAVE FAILED. THE BACKUP STANDBY SYSTEM WILL NOT PROVIDE THE CAPABILITY TO CRADLE THE ARM. ARM CAN BE JETTISONED. CREW ACTION ----- PERFORM AN EVA TO STOW THE ARM OR JETTISON. CREW TRAINING ----- NONE MISSION CONSTRAINT ----- ARM SHOULD NOT BE MANEUVERED TO POSITION WHERE JETTISON CANNOT BE SAFELY PERFORMED. SCREEN FAILURES ----- B: N/A (STANDBY REDUNDANT) OMRSD OFFLINE ----- OPERATE WRIST ROLL IN BACKUP. VERIFY THAT JOINT DRIVES. OMRSD ONLINE INSTALLATION ----- NONE OMRSD ONLINE TURNAROUND ----- OPERATE WRIST ROLL IN BACKUP. VERIFY THAT JOINT DRIVES.