

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 5112071177

SHEET: 1

FMEA REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FINE Z/TRAB CRITICALITY RATIONALE FOR ACCEPTANCE
2890	1	MDA INHIBIT CIRCUITRY QTY: 6 SCHEMATIC 2563717	<p>MODE: LOSS OF BRAKE INHIBIT TO MDA.</p> <p>CAUSE(S): (1) INTERNAL PARTS FAILURE.</p>	<p>NONE UNTIL SECOND FAILURE OCCURS.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNUNCIATED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE JOINT RUNAWAY FAILURE</p>	<p>DESIGN FEATURES</p> <p>THE DIODE AND TRANSISTOR, WHICH COMPRISE AN OPTO-ISOLATOR, ARE SUBJECTED TO THE SAME QUALITY AND APPLICATION CONTROLS AS APPLIED TO DISCRETE SEMICONDUCTORS.</p> <p>DISCRETE SEMICONDUCTOR DEVICES SPECIFIED TO AT LEAST THE 1X 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>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>THE DESIGN UTILIZES PROVEN CIRCUIT TECHNIQUES AND IS IMPLEMENTED USING CMOS LOGIC DEVICES.</p> <p>CMOS DEVICES OPERATE AT LOW POWER AND HENCE DO NOT EXPERIENCE SIGNIFICANT OPERATING STRESSES. THE TECHNOLOGY IS MATURE, AND DEVICE RELIABILITY HISTORY IS WELL DOCUMENTED. ALL STRESSES ARE ADDITIONALLY REDUCED BY DERATING THE APPROPRIATE PARAMETERS IN ACCORDANCE WITH SPAR-RMS-PA.003. SPECIAL HANDLING PRECAUTIONS ARE USED AT ALL STAGES OF MANUFACTURE TO PRECLUDE DAMAGE/STRESS DUE TO ELECTROSTATIC DISCHARGE.</p>

RMS/ELEC - 559

PREPARED BY: MING

SUPERSEDING DATE: 11 DEC 86

APPROVED BY:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 5114071177

SHEET: 2

ITER REF.	REV.	NAME QTY & DRAWING OFF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	MLWR / FUNC. / IRAB / CRITICALITY	RATIONALE FOR ACCEPTANCE
2090	1	M/A INHIBIT CIRCUITRY QTY 6 S. NEMATIC 2563717	MODE: LOSS OF BRAKE INHIBIT TO MDA.  CAUSE(S): (1) INTERNAL PARTS FAILURE.	MODE UNTIL SECOND FAILURE OCCURS.  WORST CASE ..... LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNUNCIATED. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ..... SINGLE JOINT RINAWAY FAILURE		ACCEPTANCE TESTS. ..... THE SPA IS SUBJECTED TO THE FOLLOWING ENVIRONMENTAL TESTING AS AN SRI.  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 (TP510 RMS STRONGBACK AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.  QUALIFICATION TESTS ..... THE SPA IS SUBJECTED TO THE FOLLOWING SRI 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 SI-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE01, RE02 (H/B), RS01)  FLIGHT CHECKOUT ..... PDRS OPS CHECKLIST (ALL VEHICLES) JSC 169B7

RMS/ELEC - 560

PREPARED BY: HENG

SUPRECEDING DATE: 11 DEC 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS

ASS'Y NOMENCLATURE: SEAWO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM

ASS'Y P/N: 5114071177

SHEET: 3

P/N & REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW? FUNC. 2/1RAB CRITICALITY RATIONALE FOR ACCEPTANCE
2090	1	MOA INHIBIT CIRCUITRY QTY 6 SCHEMATIC 2563717	<p>MODE: LOSS OF BRAKE INHIBIT TO MOA.</p> <p>CAUSE(S): (1) INTERNAL PARTS FAILURE.</p>	<p>NONE UNTIL SECOND FAILURE OCCURS.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNOUNCED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE JOINT RUNAWAY FAILURE</p>	<p>QA/INSPECTIONS</p> <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 JSC8000 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 NHB 5300.4(JA) STANDARD, AS MODIFIED BY JSC 0800A.</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 AMBIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT)</p>

RMS/ELEC - 561

PREPARED BY: MEUG

SUPERSEDING DATE: 11 DEC 86

APPROVED BY:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
ASS'Y P/N: 2114071177

SHEET: 4

THER REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
2890	1	MDA INHIBIT CIRCUITRY QTY: 6 SCHEMATIC 2563717	<p>MODE: LOSS OF BRAKE INHIBIT TO MDA.</p> <p>CAUSE(S): (1) INTERNAL PARIS FAILURE.</p>	<p>NONE UNTIL SECOND FAILURE OCCURS.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNUNCIATED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE JOINT RUNAWAY FAILURE</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>

RMS/ELEC - 562

PREPARED BY: HMG

SUPPLEMENTING DATE: 11 DEC 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 51720F1177

SHEET: 5

ITEM REF.	REV.	PART QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT IN END ITEM	RDR / FUNC. 2/IRAD CRITICALITY	RATIONALE FOR ACCEPTANCE
2890	1	MDA INHIBIT CIRCUITRY QTY 8 SCHEMATIC 2563717	MODE: LOSS OF BRAKE INHIBIT TO MDA.  CAUSE(S): (1) INTERNAL PARTS FAILURE.	NONE UNTIL SECOND FAILURE OCCURS.  WORST CASE ..... LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNUNCIATED. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ..... SINGLE JOINT RUNAWAY FAILURE		FAILURE HISTORY ..... THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

RMS/ELEC - 563

**CRITICAL ITEMS LIST**

PROJECT: RMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 51120F1177

SHEET: 6

ITEM REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	IMPR / FUNC. 2/TRAB CRITICALITY RATIONALE FOR ACCEPTANCE
2890	1	NDA INHIBIT CIRCUITRY QTY-6 SCHEMATIC 2563717	MODE: LOSS OF BRAKE INHIBIT TO NDA.  CAUSE(S): (1) INTERNAL PARTS FAILURE.	NONE UNTIL SECOND FAILURE OCCURS.  WORST CASE  LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNEXPECTED MOTION. UNANNUNCIATED. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING  SINGLE JOINT RUNAWAY FAILURE	OPERATIONAL EFFECTS ..... NONE. ARM WILL NOT STOP AUTOMATICALLY AFTER A SUBSEQUENT FAILURE. BUT FAILURE WILL BE ANNUNCIATED. BACKUP AVAILABLE.  CREW ACTION ..... TURN RMS POWER SW TO OFF TO APPLY BRAKES.  CREW TRAINING ..... THE CREW WILL BE TRAINED TO TURN RMS POWER TO OFF IF BRAKES FAIL TO STOP ARM.  MISSION CONSTRAINT ..... IF A FAILURE OF THE FUNCTION IS DETECTED, PRIMARY MODES SHOULD NOT BE USED. OPERATE AT LESS THAN VERNIER RATES WITHIN 10 FT OF STRUCTURE BY CYCLING DIRECT DRIVE SWITCH. 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. AUTO-TRAJECTORIES MUST BE DESIGNED TO COME NO CLOSER THAN 5 FT FROM STRUCTURE.  SCREEN FAILURES ..... A: INDEPENDENT PATHS NOT INSTRUMENTED. B: NO ORBITER ANNUNCIATION OR DISPLAY.  CMRSD OFFLINE ..... WITH BRAKES APPLIED, DRIVE EACH JOINT IN COMPUTER SUPPORTED MODE. VERIFY NO TACHOMETER RESPONSE.  CMRSD ONLINE INSTALLATION ..... NONE  CMRSD ONLINE TURNAROUND ..... NONE

RMS/ELEC - 564

PREPARED BY: HFMG

SUPERSEDING DATE: 11 DEC 86

APPROVED BY:

DATE: