

ICAL ITEMS LIST

PROJECT: SONS  
 ASS'Y NOMENCLATURE: SERVO 1 AMPLIFIER

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

SHEET: 1

AREA REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
2090	0	CURRENT LIMITER SCHEMATIC 2563710	<p>MODE: LOSS OF CURRENT SENSOR CIRCUIT.</p> <p>CAUSE(S):                      (1) PARTS FAILURE.                      (2) FAILURE OF PHASE SENSITIVE DETECTOR C46 FAILS S/C U160 FAILURE U160 FAILURE U10 FAILS O/C.</p>	<p>CURRENT LIMITING WILL BE INOPERATIVE. NOA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FWD/BKD FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.</p> <p>WORST CASE                      UNEXPECTED MOTION, JOINT RUNAWAY, UNANNUNCIATED, CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING                      N/A</p>		<p>DESIGN FEATURES</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>COMPARATORS AND OPERATIONAL AMPLIFIERS ARE STANDARD LINEAR INTEGRATED CIRCUITS WITH MATURE MANUFACTURING TECHNOLOGY. APPLICATION CONSTRAINTS ARE IN ACCORDANCE WITH SPAR-RMS-PA.003.</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 - 679

PREPARED BY: MFMG

SUPERSEDING DATE: 11 SEP 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 51140F1177

SHEET: 2

ITEM REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 1/1 CRITICALITY RATIONALE FOR ACCEPTANCE
2990	0	CURRENT LIMITER SCHEMATIC 2563718	<p>MODE: LOSS OF CURRENT SENSOR CIRCUIT.</p> <p>CAUSE(S): (1) PARTS FAILURE.  (2) FAILURE OF PHASE SENSITIVE DETECTOR C46 FAILS S/C U16D FAILURE U16D FAILURE U16 FAILS O/C.</p>	<p>CURRENT LIMITING WILL BE INOPERATIVE. MDA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FWD/BKD FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.</p> <p>WORST CASE UNEXPECTED MOTION, JOINT RUNAWAY, UNANNUNCIATED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING N/A</p>	<p>ACCEPTANCE TESTS                  THE SPA IS SUBJECTED TO THE FOLLOWING ENVIRONMENTAL TESTING AS AN SRU.</p> <ul style="list-style-type: none"> <li>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4</li> <li>O THERMAL: PLUS 70 DEGREES C TO -25 DEGREES C DURATION - 1 1/2 CYCLES</li> </ul> <p>THE SPA IS THEN TESTED AS PART OF THE JOINTS ACCEPTANCE TESTS (VIBRATION AND THERMAL VACUUM TEST).</p> <p>THE SPA'S/JOINTS UNDERGO RMS SYSTEM TESTS (TP518 RMS STRONGBACK AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.</p> <p>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.</p> <ul style="list-style-type: none"> <li>O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 4</li> <li>O SHOCK: 20G/11 MS/3 AXES (6 DIRECTIONS)</li> <li>O THERMAL VAC: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1X10<sup>-6</sup> TORR</li> <li>O HUMIDITY: TESTED WITH THE SHOULDER JOINT</li> <li>O ENC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE01, RE02 (N/O), RS01)</li> </ul> <p>FLIGHT CHECKOUT                  PDMS OPS CHECKLIST (ALL VEHICLES) JSC 16987</p>

RMS/ELEC - 680

CRITICAL ITEMS LIST

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO P. AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 511207177

SHEET: 3

ITEM REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HAZARD / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
2990	0	CURRENT LIMITER SCHEMATIC 2563710	<p>MODE: LOSS OF CURRENT SENSOR CIRCUIT.</p> <p>CAUSE(S): (1) PARTS FAILURE. (2) FAILURE OF PHASE SENSITIVE DETECTOR C46 FAILS S/C U160 FAILURE U10 FAILS O/C.</p>	<p>CURRENT LIMITING WILL BE INOPERATIVE. MOA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FWD/BRK FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.</p> <p>WORST CASE ..... UNEXPECTED MOTION. JOINT RUNAWAY. UNANNUNCIATED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING ..... N/A</p>	<p>HAZARD / FUNC. 1/1 CRITICALITY</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. OPA 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 JSCN0080 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(3A) 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 AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT).</p>

RMS/ELEC - 681

PREPARED BY: MFWG

SUPERSEDING DATE: 11 SEP 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
ASS'Y P/N: 5114DF1177

SHEET: 4

THEA REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. I/I CRITICALITY	RATIONALE FOR ACCEPTANCE
2990	0	CURRENT LIMITER SCHEMATIC 256371B	<p>MODE: LOSS OF CURRENT SENSOR CIRCUIT.</p> <p>CAUSE(S): (1) PARTS FAILURE.</p> <p>(2) FAILURE OF PHASE SENSITIVE DETECTION C46 FAILS S/C U16B FAILURE U16D FAILURE U18 FAILS O/C.</p>	<p>CURRENT LIMITING WILL BE INOPERATIVE. HOA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FLD/OKD FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.</p> <p>WORST CASE</p> <p>UNEXPECTED MOTION, JOINT RUNAWAY, UNANNOUNCED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING</p> <p>N/A</p>	<p>HOW / FUNC. I/I CRITICALITY</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 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 - 682

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO P/C AMPLIFIER

SYSTEM: ELECTRICAL SUBSYSTEM  
 ASS'Y P/N: 51140P1177

SHEET: 5

P/N REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOLD / FUNC. I / I CRITICALITY	RATIONALE FOR ACCEPTANCE
2090	0	CURRENT LIMITER SCHEMATIC 2563710	MODE: LOSS OF CURRENT SENSOR CIRCUIT.  CAUSE(S): (1) PARTS FAILURE.  (2) FAILURE OF PHASE SENSITIVE DETECTOR C46 FAILS S/C U168 FAILURE U16D FAILURE U10 FAILS O/C.	CURRENT LIMITING WILL BE INOPERATIVE. MDA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FWD/BKD FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.  WORST CASE ..... UNEXPECTED MOTION, JOINT RUNAWAY, UNANNUNCIATED. CREW ACTION REQUIRED.  REDUNDANT PATHS REMAINING ..... N/A		FAILURE HISTORY ..... THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

RMS/ELEC - 683

PREPARED BY: MFWG

SUPERSEDING DATE: 11 SEP 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: SERVO POWER AMPLIFIER

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

SHEET: 6

PREL REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE
2990	0	CURRENT LIMITER SCHEMATIC 2563718	<p>MODE: LOSS OF CURRENT SENSOR CIRCUIT.</p> <p>CAUSE(S): (1) PARIS FAILURE.  (2) FAILURE OF PHASE SENSITIVE DETECTOR C46 FAILS S/C U16B FAILURE U16D FAILURE U18 FAILS O/C.</p>	<p>CURRENT LIMITING WILL BE INOPERATIVE. MDA BITE WILL BE INOPERATIVE. MOTOR TORQUE MAY BE UP TO MAXIMUM POSSIBLE LEVEL. CONSISTENCY CHECK WILL NOT WORK FOR CERTAIN FAILURES. FWD/BKD FLAG DEPENDENT ONLY ON MOTOR DIRECTION, EXCEPT WHEN IN TEST MODE AND DURING EE CAPTURE SEQ WHERE ONLY BACKDRIVE IS INDICATED. JOINT RUNAWAY MAY OCCUR IN TEST MODE AND DURING EE CAPTURE SEQUENCE.</p> <p>WORST CASE UNEXPECTED MOTION, JOINT RUNAWAY, UNANNUNCIATED. CREW ACTION REQUIRED.</p> <p>REDUNDANT PATHS REMAINING N/A</p>	1/1	<p>OPERATIONAL EFFECTS</p> <p>IN TEST MODE OR DURING EE CAPTURE/RIGIDIZE SEQUENCE, JOINT MAY RUNAWAY. ARM WILL NOT STOP AUTOMATICALLY AFTER SUBSEQUENT FAILURE (FWD/BKD FLAG DIRECTION ONLY). UNANNUNCIATED. ALL OTHER JOINTS WILL BE IN LIMP CONDITION AND EXCESSIVE LOADS WILL NOT BE APPLIED. PERFORM CAPTURE SEQUENCE WHEN NOT IN COMPUTER SUPPORTED MODE.</p> <p>CREW ACTION</p> <p>APPLY BRAKES.</p> <p>CREW TRAINING</p> <p>CREW WILL BE TRAINED TO OBSERVE WHETHER ARM IS RESPONDING CORRECTLY TO COMMANDS. IF IT ISN'T APPLY BRAKES. CREW WILL BE TRAINED TO MINIMIZE ALIGNMENT ERRORS DURING CAPTURE OF PAYLOAD.</p> <p>MISSION CONSTRAINT</p> <p>DO NOT SELECT TEST MODE WITHIN 10 FT OF STRUCTURE. WHEN CAPTURING FREE FLYING PAYLOAD, THE EE MUST BE FAR ENOUGH AWAY FROM STRUCTURE TO PROHIBIT CONTACT REGARDLESS OF PAYLOAD ROTATIONS. SELECT TEST MODE IMMEDIATELY PRIOR TO CAPTURING PAYLOAD.</p> <p>SCREEN FAILURES</p> <p>N/A</p> <p>CMRSD OFFLINE</p> <p>IN COMPUTER CONTROLLED MODE FOR EACH JOINT VERIFY NO JOINT MOTION FOR ZERO CURRENT LIMIT SETTING</p> <p>CMRSD ONLINE INSTALLATION</p> <p>NONE</p> <p>CMRSD ONLINE TURNAROUND</p> <p>FOR EACH JOINT, IN TEST MODE VERIFY NO TACHOMETER MOTION</p>

RMS/ELEC - 684