CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU [illegible]LLED) SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: ROTO[illegible]ULE ASS'Y P/N: 51140E1214 SHEET: 1

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	0	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A		DESIGN FEATURES --- THE JOINT COMMUTATION SCANNER ASSEMBLY (CSA) IS A MAJOR BOUGHT-OUT-PART WHICH IS SUPPLIED BY BEI MOTION SYSTEMS AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPECIFICATION SPAR-SG.467. TIES-13 TYPE LED IS PROCURED TO A JANTXV-EQUIVALENT LEVEL SPECIFICATION, THEN RESCREENED AGAIN TO INSURE THAT INFANT FAILURES ARE REMOVED. THE LED IS OPERATING AT A CURRENT STRESS RATIO OF 50/300, OR 0.2, WHICH IS A VERY LOW LEVEL. THIS MINIMIZES DEGRADATION OF THE LIGHT OUTPUT WITH TIME. THIS TYPE OF DEVICE HAS BEEN CHARACTERIZED WITH RESPECT TO RADIATION, AND THE EXPECTED DEGRADATION IS VERY NOMINAL (2-5%, FOR 7 YEARS IN GEOSYNCHRONOUS ORBIT). THE LED IS ASSEMBLED INTO AN ALUMINUM MOUNTING RING, USING A THERMALLY CONDUCTIVE EPOXY. THE FIBER OPTICS USED ON THE RMS COMM SCANNERS ARE A CUSTOM DESIGN, MANUFACTURED BY GALILEO ELECTRO-OPTICS CORPORATION. THE FIBRE OPTIC BUNDLES ARE SECURED AT EACH END BY METAL RINGS AND EPOXY. THE BUNDLE LENGTHS ARE SUPPORTED BY A FLEXIBLE WOVEN GLASS TUBE AND A STAINLESS STEEL SPRING. STRESS RELIEF ARE USED AT THE ANCHOR POINTS. CONNECTOR USED ARE TO GSFC SPECIFICATION S.311.P.4/9. CONTACTS USED ARE TO GSF SPEC.S.311.P.4/9. CRIMPING IS CONTROLLED TO SPAR PPS 9:17 WHICH EMBODIES MSC-SPEC-Q-1A. 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. 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 CIL REV: 0

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CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: MOTOR MODULE ASS'Y P/N: ST140E1214 SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	0	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A	ACCEPTANCE TESTS --- THE JOINTS MOTOR MODULE ASSEMBLY CONSIST OF THE BRAKE ASSEMBLY, MOTOR ASSEMBLY, TACHOMETER , COMM. SCANNER AND SCU ALL OF WHICH ARE EXPOSED TO AN ACCEPTANCE TEST BY THE VENDOR PRIOR TO ACCEPTANCE BY SPAR. THE MOTOR MODULE ASSEMBLY IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENT: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 8 O THERMAL VACUUM: +85 DEGREES C TO -25 DEGREES C (1.5 CYCLES) 1 X 10**5 TORR THE MOTOR MODULE IS INSTALLED IN THE JOINTS ASSEMBLY AND AGAIN IS EXPOSED TO ANOTHER ACCEPTANCE TEST, WHICH INCLUDES VIBRATION AND THERMAL VACUUM OF THE SAME APPROXIMATE LEVEL AND DURATION. QUALIFICATION TESTS --- A TYPICAL MOTOR MODULE ASSEMBLY WAS TOTALLY QUALIFIED BY SPAR FOR THE LISTED BELOW ENVIRONMENTS. FURTHER, THE BRAKE ASSEMBLY, MOTOR ASSEMBLY, TACHOMETER AND COMM. SCANNER, ARE SUBJECTED TO SOME DEGREE OF QUALIFICATION TESTING BY THE VENDOR. THE MOTOR MODULE TESTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 8 O THERMAL VACUUM: +96 DEGREE C TO -36 DEGREE C (8 CYCLES) 1 X 10**6 TORR O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS) O HUMIDITY: TESTED IN SHOULDER JOINT HUMIDITY TEST O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CS01, CS02, CS06, CE01, RE02(N/B), RS03, RS04) 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: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: MOTOR MODULE ASS'Y P/N: 51140E1214 SHEET: 3

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	0	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A		QA/INSPECTIONS --- UNITS ARE MAJOR BOUGHT OUT PARTS, MANUFACTURED, ASSEMBLED AND TESTED TO SPAR DRAWINGS AND SPECIFICATIONS UNDER DOCUMENTED QUALITY CONTROLS. THESE CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, PROCESSING, FABRICATION, ASSEMBLY QUALIFICATION AND ACCEPTANCE TESTING. MANDATORY INSPECTION POINTS ARE EMPLOYED AS APPROPRIATE AT VARIOUS LEVELS OF ASSEMBLY AND TEST. SPAR/GOVERNMENT SOURCE INSPECTION IS ENVOKED ON THE SUPPLIER. 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, DAMAGED OR LIFTING CIRCUIT PADS, CLEANLINESS ETC. 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. 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) UNITS ARE INSPECTED TO THE APPLICABLE SPAR INSPECTION TEST PROCEDURE (ITP) PRIOR TO MOTOR MODULE INTEGRATION. INSPECTIONS INCLUDE WORKMANSHIP, CLEANLINESS, DIMENSIONAL ETC.

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

CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: MOTOR MODUL ASS'Y P/N: 51140E1214 SHEET: 4

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	0	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A		INTEGRATION OF UNIT TO MOTOR MODULE - INSPECTIONS INCLUDE GROUNDING CHECKS, CONNECTOR FOR BENT PINS, VISUAL, CLEANLINESS, INTERCONNECT WIRING ETC. PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT). 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 GOVENMENT REPRESENTATIVE, PRIOR TO THE START OF ANY FORMAL TESTING (ACCEPTANCE OR QUALIFICATION). ACCEPTANCE TESTING (ATP) INCLUDES, AMBIENT, VIBRATION AND THERMAL-VAC 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

CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: MOTOR MODULE ASS'Y P/N: 51T40E1214 SHEET: 5

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	0	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A		FAILURE HISTORY --- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

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

CRITICAL ITEMS LIST

PROJECT: SRMS (-5 MCIU INSTALLED) SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y NOMENCLATURE: MOTOR MODULE ASS'Y P/N: 51140E1214 SHEET: 6

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. 1/1 CRITICALITY — RATIONALE FOR ACCEPTANCE SCREENS: N/A
4145	D	COMMUTATION SCANNER QTY-6 P/N 51140E1295	MODE: ALL THREE COMMUTATION OUTPUTS ARE UNDETERMINED CAUSE(S): (1) OPEN OR SHORT LED. (2) DAMAGED FIBRE OPTICS. (3) LOSS OF 10V SUPPLY. (4) LOSS OF 5.1V SUPPLY.	LOSS OF ABILITY TO DRIVE JOINT IN COMPUTER SUPPORTED AND DIRECT DRIVE MODES. ARM WILL TAKE AN UNEXPECTED TRAJECTORY. WORST CASE --- UNEXPECTED MOTION ELECTRICALLY FROZEN. UNANNUNCIATED. CREW ACTION REQ. REDUNDANT PATHS REMAINING --- N/A	OPERATIONAL EFFECTS --- ARM DOES NOT RESPOND PROPERLY TO HAND CONTROLLER COMMANDS OR AUTO SEQUENCES. CREW INHERENTLY COMPENSATES FOR ANY UNDESIRED ARM TRAJECTORY IN MANUAL AUGMENTED MODES. CREW ACTION --- APPLY BRAKES. SELECT BACKUP. CREW TRAINING --- THE CREW WILL BE TRAINED TO 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 OEPRATOR 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. OMRSD OFFLINE --- IN COMPUTER SUPPORTED MODE WITH ELBOW DEMATED DRIVE ALL JOINTS. VERIFY JOINT MOTION OMRSD ONLINE INSTALLATION --- NONE OMRSD ONLINE TURNAROUND --- IN SINGLE MODE DRIVE ALL JOINTS VERIFY TACHOMETER SIGNATURE

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