FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A= A-PASS, B-PASS, C-PASS
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC 812797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE IF EE MODE SET TO AUTO.	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE. WORST CASE ---------- UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE CREW ACTION REQUIRED. ANNUNCIATED. REDUNDANT PATHS REMAINING --------------- N/A 1) EE MODE SWITCH (FOR SAVING THE SYSTEM) 2) END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)	2/1R	**DESIGN FEATURES** --------------- EEE PARTS HAVE BEEN SELECTED AND CONTROLLED IN ACCORDANCE WITH SPAR-RMS-PA.003. THIS DOCUMENT DEFINES THE PROGRAM REQUIREMENTS FOR MONITORING AND CONTROLLING EEE PARTS. THE REQUIREMENTS INCLUDE PART SELECTION TO AT LEAST "ESTABLISHED RELIABILITY" LEVELS, AND ADEQUATE DERATING OF PART STRESS LEVELS. PROCEDURES AND ACTIVITIES ARE SPECIFIED TO ENSURE AT LEAST EQUIVALENT QUALITY FOR NONSTANDARD AND IRREGULAR PARTS. RELIABILITY ANALYSIS HAS CONFIRMED NO PARTS WITH GENERICALLY HIGH FAILURE RATES. AEROSPACE DESIGN STANDARDS FOR DETAILING ELECTRONIC PARTS PACKAGING, MOUNTING AND STRUCTURAL/MECHANICAL/INTEGRITY OF ASSEMBLIES ARE APPLIED. SUCH DESIGN HAS BEEN REVIEWED AND FOUND SATISFACTORY THROUGH THE DESIGN AUDIT PROCESS, INCLUDING THE USE OF RELIABILITY, MAINTAINABILITY AND SAFETY CHECKLISTS. MATERIAL SELECTION AND USAGE CONFORMS TO SPAR-SG.368 WHICH IS EQUIVALENT TO THE NASA MATERIALS USAGE REQUIREMENTS. WORST CASE ANALYSIS HAS BEEN CONDUCTED TO ENSURE THAT PERFORMANCE CAN BE MET UNDER WORST CASE TEMPERATURE AND AGING EFFECTS. EEE PARTS STRESS ANALYSIS HAS BEEN COMPLETED AND CONFIRMS THAT THE PARTS MEET THE DERATING REQUIREMENTS. PRINTED CIRCUIT BOARD DESIGNS HAVE BEEN REVIEWED TO ENSURE ADEQUATE CIRCUIT PATH WIDTH AND SEPARATION AND TO CONFIRM APPROPRIATE DIMENSIONS OF CIRCUIT SOLDER PADS AND OF COMPONENT HOLE PROVISIONS. PARTS MOUNTING METHODS ARE CONTROLLED IN ACCORDANCE WITH MSFC-STD-136 WHICH DEFINES APPROVED-MOUNTING METHODS, STRESS RELIEF, AND COMPONENT SECURITY. WHERE APPLICABLE, DESIGN DRAWINGS AND DOCUMENTATION GIVE CLEAR IDENTIFICATION OF HANDLING PRECAUTIONS FOR ESD SENSITIVE PARTS. BOARD ASSEMBLY DRAWINGS INCLUDE THE REQUIREMENTS FOR SOLDERING STANDARDS IN ACCORDANCE WITH NHB 5300.4(3) AND JSC 08800. 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. THE DIODE AND TRANSISTOR, WHICH COMPRISE AN OPTO-ISOLATOR, ARE SUBJECTED TO THE SAME QUALITY AND APPLICATION CONTROLS AS APPLIED TO DISCRETE SEMICONDUCTORS.

PROJECT: SRMS (-5 MCIU INSTALLED)
ASS'Y NOMENCLATURE: MCIU

SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y P/N: 51155F160-5   SHEET: 2

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: N/A A-PASS, B-PASS, C-PASS
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC 812797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE. WORST CASE ---------- UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE IF EE CREW ACTION REQUIRED. ANNUNCIATED. REDUNDANT PATHS REMAINING ------------- N/A 1) EE MODE SWITCH (FOR SAFING THE SYSTEM) 2) END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)	MODE SET TO AUTO.	ACCEPTANCE TESTS ---------------- THE MCIU IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTING AS AN LRU. O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 3.2 O THERMAL: +40 DEGREES C TO -16 DEGREES C (2 CYCLES) QUALIFICATION TESTS ------------------- THE MCIU IS SUBJECTED TO THE FOLLOWING LRU QUALIFICATION ENVIRONMENTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 3.2 O SHOCK: BY SIMILARITY TO -3 MCIU O THERMAL: +51 DEGREES C TO -27 DEGREES C (10 CYCLES) O HUMIDITY: BY SIMILARITY TO -3 MCIU O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TESTS CE01, CE03, CS01, CS02, CS06, RE02 (N/B), RS01, RS02 O LIFE: 630 OPERATING HOURS 1000 POWER ON/OFF CYCLES FLIGHT CHECKOUT --------------- PORS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY: MFWG   SUPERCEDING DATE: NONE

RMS/ELEC - 155   DATE: 11 JUL 91   CIL REV: 0

PROJECT: SRMS (-5 MCIU INSTALLED)
ASS'Y NOMENCLATURE: MCIU

SYSTEM: ELECTRICAL SUBSYSTEM
ASS'Y P/N: S1155F160-5   SHEET: 3

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. CRITICALITY	RATIONALE FOR ACCEPTANCE
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC 812797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE. WORST CASE ---------- UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE IF EE CREW ACTION REQUIRED. ANNUNCIATED. REDUNDANT PATHS REMAINING --------------- N/A 1) EE MODE SWITCH (FOR SAFING THE SYSTEM) 2) END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)	1R1 2/1R MODE SET TO AUTO.	QA/INSPECTIONS --------------- DOCUMENTED QUALITY CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, RECEIVING, PROCESSING FABRICATION, ASSEMBLY, TESTING AND SHIPPING OF THE MCIU. GOVERNMENT SOURCE INSPECTION IS INVOKED AT VARIOUS LEVELS OF COMPONENT ASSEMBLY AND TEST OPERATIONS. MANDATORY INSPECTION POINTS ARE EMPLOYED AT VARIOUS LEVELS OF ASSEMBLY AND TEST. 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, INSPECTED, AND TESTED TO SPAR-RMS-PA.003. 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-1) STANDARD. 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). A TEST READINESS REVIEW (TRR) WHICH INCLUDES VERIFICATION OF TEST PERSONNEL, TEST DOCUMENTS, TEST EQUIPMENT CALIBRATION/ VALIDATION STATUS AND HARDWARE CONFIGURATION IS CONVENED BY

SCREENS: N/A A-PASS, B-PASS, C-PASS

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

CRITICAL ITEMS LIST

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: HW A-PASS, B-PASS, C-PASS
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC 012797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE. WORST CASE --------- UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE IF EE CREW ACTION REQUIRED. ANNUNCIATED. REDUNDANT PATHS REMAINING --------------- N/A 1)EE MODE SWITCH (FOR SAFING THE SYSTEM) 2)END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)	1FF 2/1R MODE SET TO AUTO.	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, VIBRATION, AND THERMAL TESTING (SPAR/GOVERNMENT REP. - MANDITORY INSPECTION POINT).

PREPARED BY: MFWG   SUPERCEDING DATE: NONE

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FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. CRITICALITY	RATIONALE FOR ACCEPTANCE SCREENS: N/A A-PASS, B-PASS, C-PASS
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC 812797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE. WORST CASE ---------- UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE IF EE MODE SET TO AUTO. CREW ACTION REQUIRED. ANNUNCIATED. REDUNDANT PATHS REMAINING ------------- N/A 1) EE MODE SWITCH (FOR SAFING THE SYSTEM) 2) END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)	3/F 2/1R	FAILURE HISTORY --------------- THERE HAVE BEEN NO FAILURES ASSOCIATED WITH THIS FAILURE MODE ON THE SRMS PROGRAM.

PREPARED BY: MFWG   SUPERCEDING DATE: NONE

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DATE: 11 JUL 91   CIL REV: 0

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CRITICAL ITEMS LIST

FMEA REF.	FMEA REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDWR / FUNC. -4/+ 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
2255	0	FAILURE DETECTOR. QTY. 1. SCHEMATIC B12797	MODE: CORRUPT EE AUTO FUNCTIONS-- ONE OR MORE EE COMMANDS FAIL ON. CAUSE(S): 1) OPTO ISOLATORS FAIL SHORTED 2) COMMAND DRIVE CIRCUIT EEE PARTS FAILURE	ERRONEOUS COMMAND APPLIED TO END EFFECTOR AS SOON AS EE AUTO MODE IS SELECTED. MOTOR WILL STALL OR SLIP CLUTCH UPON REACHING HARDSTOP. EE MANUAL MODE IS STILL AVAILABLE.		SCREENS: N/A A-PASS, B-PASS, C-PASS

OPERATIONAL EFFECT

WHEN EE AUTO MODE IS SELECTED, ERRONEOUS EE COMMANDS WILL BE ISSUED AND MAY RESULTS IN UNWANTED PAYLOAD MOTION. MOTOR STALL OR BURNOUT OR CLUTCH SLIP POSSIBLE. ARM MAY REMAIN LIMP UNTIL EE MODE SWITCH IS TURNED OFF.

CREW ACTION

SELECT EE MODE MANUAL

CREW TRAINING

CREW WILL BE TRAINED TO RECOGNIZE AND RESPOND TO ALL OFF-NOMINAL OPERATIONS OF THE END EFFECTOR.

MISSION CONSTRAINT

WORST CASE — CAPTURE AND RELEASE POSITIONS SHOULD BE FAR ENOUGH AWAY FROM STRUCTURE TO PROHIBIT CONTACT IF POSSIBLE OR AS FAR AWAY AS POSSIBLE IN THE CASE OF A LARGE PAYLOAD. UNDER NO CIRCUMSTANCE WOULD PAYLOAD ROTATIONS UP TO 15 DEGREES CAUSE CONTACT. EE MODE SWITCH SHOULD BE RETURNED TO THE OFF IMMEDIATELY AFTER SPEC DRIVE TIME HAS ELAPSED.

Column note (failure effect continued): UNEXPECTED PAYLOAD MOTION. UNCOMMANDED END EFFECTOR RELEASE OR DERIGIDIZE IF EE CREW ACTION REQUIRED. ANNUNCIATED. *(MODE IS RESET TO AUTO)*

SCREEN FAILURES

N/A

OMRSD OFFLINE

APPLY CAP/OFF/REL COMMANDS TO MCIU. VERIFY VOLTAGES AT MCIU OUTPUT.

OMRSD ONLINE INSTALLATION

NONE

OMRSD ONLINE TURNAROUND

VERIFY NO EE MOTION WHEN EE COMMANDS ARE ZERO.

REDUNDANT PATHS REMAINING

N/A
1) EE MODE SWITCH (FOR SAFING THE SYSTEM)
2) END EFFECTOR MANUAL MODE (FOR CONTINUING OPERATIONS)

PREPARED BY: MFWG   SUPERCEDING DATE: NONE

DATE: 11 JUL 91   CIL REV: 0