

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-1E-3

SHEET: 1

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: A-PASS, B-PASS, C-PASS
3610	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	<p>MODE: LOSS OF MOTOR DRIVE.</p> <p>CAUSE(S): (1) MOTOR WINDING SHORT CIRCUIT. (2) LOSS OF MOTOR DRIVE FROM EEEU. (3) COMMUTATION FAILURE/ MECHANICAL OR ELECTRICAL OR LOSS OF PLATING FROM CODE WHEEL. (4) SEIZURE OF MOTOR OR CLUTCH INPUT BEARINGS. (5) INPUT LEAD TO MOTOR OPEN CIRCUIT. (6) MOTOR SHAFT BREAKS.</p>	<p>MOTOR WILL NOT DRIVE. THEREFORE, SYSTEM WILL BE INOPERATIVE IN AUTO AND MANUAL END EFFECTOR MODES. LIMP ARM DURING AUTO CAP. SEQ. UNTIL EE MODE SW TO OFF.</p> <p>WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE CAPTURE/RELEASE SEQUENCE. UNABLE TO RELEASE PAYLOAD. CREW ACTION REQ.</p> <p>REDUNDANT PATHS REMAINING ----- BACKUP EE RELEASE.</p>		<p>DESIGN FEATURES -----</p> <p>THE END EFFECTOR MOTOR IS A MAJOR BOUGHT-OUT-PART WHICH IS SUPPLIED BY HONEYWELL SPERRY CORPORATION AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPECIFICATION SPAR-SG.446 FOR THE P/N 51140D575-1 AND SPAR-SG.1092 FOR P/N 51140D575-3 MOTORS</p> <p>THE MOTOR COMPRISES OF:-</p> <p>A MULTIPOLE ROTOR BUILT WITH "RARE EARTH" PERMANENT MAGNETS.</p> <p>A WOUND STATOR, CONSISTING OF 24 COILS WOUND IN GROUPS OF 8. THE 3 GROUPS ARE SYMMETRICALLY ARRANGED AND INSERTED IN 24 RADIAL SLOTS IN A LAMINATED STEEL CORE. THE ENDS OF THE 3 COIL GROUPS ARE JOINED AND CONNECTED TO TEFLON INSULATED LEAD WIRES TO FORM THE CONVENTIONAL "DELTA" CONFIGURATION.</p> <p>THE WINDING FEATURES THAT HELP PREVENT SHORT OR OPEN CIRCUITS ARE:-</p> <ul style="list-style-type: none"> - INSULATION IS TO CLASS 185 (H) - WIRE USED IN HEAVY ML MAGNET WIRE. - COILS ARE BAKED TO STRESS RELIEVE COPPER AND INSULATION. - SLOTS HAVE POLYIMIDE LINER. - END WINDINGS ARE ENCLOSED IN FIBREGLASS COVERS. - WINDING IS VACUUM IMPREGNATED USING 100% SOLID EPOXY, THIS IMPARTS GOOD THERMAL AND MECHANICAL PERFORMANCE. <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> <p>CONNECTOR USED ARE TO GSFC SPECIFICATION S.311.P.4/9.</p> <p>CONTACTS USED ARE TO GSF SPEC.S.311.P.4/9.</p> <p>CRIMPING IS CONTROLLED TO SPAR PPS 9:17 WHICH EMBODIES MSC-SPEC-Q-1A.</p> <p>THE END EFFECTOR COMMUTATION SCANNER ASSEMBLY (CSA) IS A MAJOR BOUGHT-OUT-PART WHICH IS SUPPLIED BY BEI MOTION SYSTEMS AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPAR-SG.454.</p> <p>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,</p>

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SHEET: 2

FMEA REF.	FMEA REV.	NAME, QTY. & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	NDWR / FUNC. 2/1R CRITICALITY RATIONALE FOR ACCEPTANCE SCREENS: A-PASS, B-PASS, C-PASS
3610	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	<p>MODE: LOSS OF MOTOR DRIVE.</p> <p>CAUSE(S): (1) MOTOR WINDING SHORT CIRCUIT. (2) LOSS OF MOTOR DRIVE FROM EEEU. (3) COMMUTATION FAILURE/ MECHANICAL OR ELECTRICAL OR LOSS OF PLATING FROM CODE WHEEL. (4) SEIZURE OF MOTOR OR CLUTCH INPUT BEARINGS. (5) INPUT LEAD TO MOTOR OPEN CIRCUIT. (6) MOTOR SHAFT BREAKS.</p>	<p>MOTOR WILL NOT DRIVE. THEREFORE, SYSTEM WILL BE INOPERATIVE IN AUTO AND MANUAL END EFFECTOR MODES. LIMP ARM DURING AUTO CAP. SEQ. UNTIL EE MODE SW TO OFF.</p> <p>WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE CAPTURE/RELEASE SEQUENCE. UNABLE TO RELEASE PAYLOAD. CREW ACTION REQ.</p> <p>REDUNDANT PATHS REMAINING ----- BACKUP EE RELEASE.</p>	<p>AND THE EXPECTED DEGRADATION IS VERY NOMINAL (2-5X, FOR 7 YEARS IN GEOSYNCHRONOUS ORBIT).</p> <p>THE LED IS ASSEMBLED INTO AN ALUMINUM MOUNTING RING, USING A THERMALLY CONDUCTIVE EPOXY.</p> <p>THE FIBER OPTICS USED ON THE RMS COMM SCANNERS ARE A CUSTOM DESIGN, MANUFACTURED BY GALILEO ELECTRO-OPTICS CORPORATION.</p> <p>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.</p> <p>ALL EEE PARTS ARE PROCURED TO MILITARY SPECIFICATIONS OR EQUIVALENT. THE CIRCUITS EMBODY THE USE OF MHB5300.4 (3A) SOLDERING, WITH NO PLATED-THRU HOLES (2 WIRES ARE USED WHERE NECESSARY) AND ALL LAP SOLDER JOINTS. THE EMI FILTER IS PURCHASED TO AN SCD (905-15181), WHICH INCORPORATES RESCREENING INCLUDING THERMAL SHOCK, BURN-IN, AND HERMETICITY TESTING, AS WELL AS X-RAY OF ALL UNITS.</p> <p>CERAMIC CAPACITORS ARE USED THROUGHOUT. THE BUS CAPACITORS ARE S LEVEL M39014.</p> <p>THE CURRENT LIMIT RESISTOR (LED 50MA) IS A TWO WATT RATING RWR80S TYPE DEVICE, OPERATING AT A STRESS LEVEL OF LESS THAN 0.1 TO GIVE A VERY LOW PROBABILITY OF FAILURE.</p> <p>THE CURRENT CONFIGURATION PHOTOCCELL IS ASSEMBLED AT BEI USING SPAR-APPROVED PROCEDURES. IT IS SCREENED AND QUALIFIED PER A BEI SCD (905-16816) TO STRESS LEVELS FAR IN EXCESS OF MISSION LIMITS.</p> <p>CODE WHEELS ARE MANUFACTURED PER BEI PROCEDURE 905A12224. THE BASE METAL WHEEL IS CHROME-PLATED BY AN OUTSIDE VENDOR, AND RETURNED TO BEI. PHOTO-RESIST IS USED TO MASK AREAS WHICH WILL REMAIN BLACK, WHILE AREAS WHICH ARE TO BE REFLECTIVE ARE STRIPPED OF BLACK CHROME TO EXPOSE THE GOLD SURFACE. THIS PROCESS INSURES GOOD ADHESION.</p> <p>THE END EFFECTOR PRIME AND BACK-UP RELEASE CLUTCH DESIGNS UTILIZE THREE BEARINGS, TWO OF WHICH ARE IDENTICAL. THE BEARINGS ARE PERMANENTLY LUBRICATED WITH WET LUBRICANT. THE TWO IDENTICAL BEARINGS ARE SEALED WITH TEFLON SEALS AND THE OTHER IS SEALED WITH TEFLON COATED FIBREGLASS SEALS, BOTH SIDES, TO PREVENT THE INGRESS OF DEBRIS.</p> <p>THE GREASE LUBRICANT USED IS BRAYCOTE 601 (FORMERLY 3L-38RP) WHICH HAS A PERFLUORINATED POLYETHER OIL BASE WHICH IS VERY STABLE UNDER VACUUM ENVIRONMENT.</p> <p>THE GREASE IS APPLIED IN PRECISE QUANTITY TO EACH BEARING.</p> <p>THE LIFE OF THE BEARING LUBRICATION HAS BEEN ANALYZED USING ULTIMATE LOADS TO EVALUATE HERTZIAN STRESSES. ULTIMATE LOAD = 1.4 X WORKING LOAD. THE LUBRICANT ON ALL BEARINGS IS GOOD FOR OVER 400 MISSIONS USING THE ULTIMATE LOADS.</p>

PREPARED BY:

MFNG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY:

RMS/MECH - 2

DATE: 24 JUL 91

CIL REV: 2

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-18-3

SHEET: 3

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PREPARED BY:

HFMG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

DATE: 26 JUL 91

CIL REV: 2

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SHEET: 5

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SHEET: 6

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: A-PASS, B-PASS, C-PASS
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PREPARED BY:

MFVG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

DATE: 24 JUL 91

CIL REV: 2

CRITICAL ITEMS LIST

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ASS'Y P/N: 51140E1470-1&-3

SHEET: 7

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SHEET: 8

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: A-PASS, B-PASS, C-PASS
3610	2	MOTOR MODULE ASSEMBLY QTY-1 P/N 51140E1473 OR 51140E2203	<p>MODE: LOSS OF MOTOR DRIVE.</p> <p>CAUSE(S): (1) MOTOR WINDING SHORT CIRCUIT. (2) LOSS OF MOTOR DRIVE FROM EEEU. (3) COMMUTATION FAILURE/ MECHANICAL OR ELECTRICAL OR LOSS OF PLATING FROM CODE WHEEL. (4) SEIZURE OF MOTOR OR CLUTCH INPUT BEARINGS. (5) INPUT LEAD TO MOTOR OPEN CIRCUIT. (6) MOTOR SHAFT BREAKS.</p>	<p>MOTOR WILL NOT DRIVE. THEREFORE, SYSTEM WILL BE INOPERATIVE IN AUTO AND MANUAL END EFFECTOR MODES. LIMP ARM DURING AUTO CAP. SEQ. UNTIL EE MODE SW TO OFF.</p> <p>WORST CASE ----- UNEXPECTED PAYLOAD MOTION. INCOMPLETE CAPTURE/RELEASE SEQUENCE. UNABLE TO RELEASE PAYLOAD. CREW ACTION REQ.</p> <p>REDUNDANT PATHS REMAINING ----- BACKUP EE RELEASE.</p>	<p>OPERATIONAL EFFECTS -----</p> <p>EE DOES NOT OPERATE NOMINALLY WHEN COMMANDED. ARM REMAINS LIMP UNTIL EE MODE SWITCH IS TURNED OFF DURING AN AUTO CAPTURE SEQUENCE.</p> <p>CREW ACTION -----</p> <p>FOR ANY OFF NOMINAL OPERATION OF THE EE, THE EE MODE SWITCH SHOULD BE TURNED OFF. ATTEMPT TO CAPTURE IN THE ALTERNATE MODE. IF THE SHARES REMAIN OPEN, MANEUVER ARM AWAY FROM PAYLOAD. IF THE SHARES ARE PARTIALLY CLOSED, ATTEMPT RELEASE USING A PRIMARY EE MODE. IF SHARES OPEN, MANEUVER THE ARM AWAY FROM THE PAYLOAD. IF SHARES DON'T OPEN, ATTEMPT TO RELEASE IN BACKUP MODE. IF SHARES OPEN, MANEUVER ARM AWAY FROM THE PAYLOAD. MANEUVER ORBITER AWAY FROM PAYLOAD. IF SHARES CANNOT BE OPENED, IN ANY MODE, EVA CAN BE USED TO RELEASE THE PAYLOAD OR THE ARM/PAYLOAD COMBINATION CAN BE JETTISONED.</p> <p>CREW TRAINING -----</p> <p>CREW WILL BE TRAINED TO RECOGNIZE OFF NOMINAL EE OPERATIONS AND TO MANEUVER THE ORBITER AWAY FROM A FREE FLYING PAYLOAD AT ANY TIME DURING ARM OPERATIONS.</p> <p>MISSION CONSTRAINT -----</p> <p>WHEN CAPTURING A FREE FLYING PAYLOAD, THE EE MUST BE FAR ENOUGH AWAY FROM STRUCTURE TO PROHIBIT CONTACT REGARDLESS OF PAYLOAD ROTATIONS. THE EE MODE SWITCH SHOULD BE PLACED BACK IN THE OFF POSITION IMMEDIATELY AFTER THE SPEC DRIVE TIME HAS ELAPSED.</p> <p>OMRSD OFFLINE -----</p> <p>PERFORM MANUAL CAPTURE/RELEASE. VERIFY CORRECT FLAG TIMING OPEN TO CLOSE.</p> <p>OMRSD ONLINE INSTALLATION -----</p> <p>NONE</p> <p>OMRSD ONLINE TURNAROUND -----</p> <p>PERFORM MANUAL CAPTURE/RELEASE. VERIFY CORRECT FLAG TIMING OPEN TO CLOSE.</p>

PREPARED BY: MFVG SUPERCEDING DATE: 06 OCT 87 APPROVED BY: _____ DATE: 24 JUL 91 CIL REV: 2