PRINT DATE: 06/01/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 05-2B-22100 -X

SUBSYSTEM NAME:

REVISION: 1 6/1/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	UHF TRANSCEIVER	6379452

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
(1) PROVIDES RF DUPLEX VOICE COMM BETWEEN EMU AND ORBITER FOR EVA AND RECEIVES BIOMED DATA FOR RELAY TO GROUND.

(2) PROVIDES UHF SIMPLEX VOICE COMM BETWEEN ORBITER AND GROUND FOR PRELAUNCH, ASCENT, ON-ORBIT, DESCENT, LANDING, AND POST-LANDING. UHF SYSTEM IS BACKUP TO S-BAND AND KU-BAND FOR AIR/GROUND COMM.

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 05-2B-22100- 01

REVISION# 1 06/1/94
SUBSYSTEM NAME: COMM & TRACK: ULTRA HIGH FREQ COMM (UHF)
LRU: UHF TRANSCEIVER
ITEM NAME: UHF TRANSCEIVER
CRITICALITY OF THIS FAILURE MODE: 2/2

FAILURE MODE:
LOSS OF RF OR AUDIO OUTPUT

MISSION PHASE:

PL	PRELAUNCH
LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT
LS	LANDING SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
SHOCK, VIBRATION, TEMPERATURE, CONTAMINATION, EEE PARTS FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
(1) 2/2 EVA - LOSS OF TRANSMIT/RECEIVE OF UHF VOICE.

(2) 1R/3 ALL OTHER MISSION PHASES - LOSS OF TRANSMIT/RECEIVE OF UHF VOICE.

(B) INTERFACING SUBSYSTEM(S):
(1) 2/2 EVA - LOSS OF TRANSMIT/RECEIVE OF UHF VOICE.

(2) 1R/3 ALL OTHER MISSION PHASES - LOSS OF TRANSMIT/RECEIVE OF UHF VOICE.

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(C) MISSION:
(1) 2/2 EVA - LOSS OF EVA COMM, TERMINATE EVA.

(2) 1R/3 ALL OTHER MISSION PHASES - NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):
(1) 2/2 EVA - NO EFFECT.

(2) 1R/3 ALL OTHER MISSION PHASES - NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECTS:
(1) 2/2 EVA - LOSS OF EVA COMM, TERMINATE EVA.

(2) 1R/3 ALL OTHER MISSION PHASES - AFTER THREE FAILURES (THIS TRANSCEIVER AND 2 S-BAND), POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF STATE VECTOR UPDATE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE UHF TRANSCEIVER (XCVR) CONSISTS OF INDEPENDENT TRANSMITTER AND RECEIVER SUBASSEMBLIES OPERATING ON FIXED FREQUENCIES, WITH COMMON RF AND AUDIO INPUT/OUTPUTS, COMMON CONTROL LOGIC AND INTERFACES, AND SHARED POWER SUPPLIES, IN A COMMON ENCLOSURE.

THE EQUIPMENT DESIGN IS BASED ON THE RF MODULES WHICH WERE MANUFACTURED BY RCA FOR THE APOLLO LUNAR EMU COMMUNICATIONS EQUIPMENT, AND ON POWER AMPLIFIERS AND DC-DC CONVERTERS WHICH WERE DEVELOPED FOR MILITARY AVIONICS PROGRAMS.

PARTS ARE SELECTED FROM MIL-STD QPL WHERE POSSIBLE. NON-STANDARD PARTS WERE APPROVED BY JSC RELIABILITY IN ACCORDANCE WITH CONTRACT NAS 9-15472.

(B) TEST:
(1) CERTIFICATION TEST - ONE-TIME TEST ON QUAL MODEL TRANSCEIVER.
TEMPERATURE - 5 CYCLES FROM 15 DEG F TO 155 DEG F OPERATING AND ONE EXCURSION TO -65 DEG F NON-OPERATING.

SHOCK - TERMINAL PEAK SAWTOOTH WITH 20 G PEAK AND 11 MSEC DURATION APPLIED 3 TIMES FOR EACH AXIS IN BOTH + AND - DIRECTIONS. TOTAL OF 18 SHOCKS. LANDING SHOCK AND ACCELERATION ENVIRONMENTS CERTIFIED BY ANALYSIS.

VIBRATION - TEST-INDUCED (QAVT) 5 MIN PER AXIS. 20 TO 80 HZ - INCREASING 3 DB/OCT, 80 TO 350 HZ - CONSTANT 0.067 G2/HZ, 350 TO 2000 HZ - DECREASING 3 DB/OCT. FLIGHT-INDUCED - 48 MINUTES PER AXIS. 20 TO 150 HZ - INCREASING 6 DB/OCT, 150 TO 1000 HZ - CONSTANT 0.03 G2/HZ, 1000 TO 2000 HZ - DECREASING 6 DB/OCT.

VACUUM - UNIT OPERATED IN CHAMBER EVACUATED TO 10 TO THE MINUS 5 TORR FOR FOUR HOURS.

SALT-FOG, HUMIDITY AND FUNGUS - CERTIFIED BY ANALYSIS.

(2) MANUFACTURING ACCEPTANCE TEST - ENVIRONMENTAL SCREEN AND COMPLETE ELECTRICAL PERFORMANCE TEST PERFORMED ON EACH END-ITEM PRIOR TO DELIVERY TO JSC.

TEMPERATURE - ONE AND ONE-HALF CYCLES FROM 20 DEG F TO 135 DEG F.

VIBRATION - ONE MINUTE PER AXIS. 20 TO 80 HZ - INCREASING 3 DB/OCT, 80 TO 150 HZ - CONSTANT 0.04 G2/HZ, 150 TO 2000 HZ - DECREASING 3 DB/OCT.

(3) PREINSTALLATION ACCEPTANCE TEST (PIA) - PERFORMED PERIODICALLY AT JSC PRIOR TO DELIVERY OF END-ITEM FOR VEHICLE INSTALLATION. INCLUDES COMPLETE ELECTRICAL PERFORMANCE VERIFICATION.

GROUND TURNAROUND TEST AIR/GROUND COMMUNICATIONS FUNCTION IS VERIFIED DURING COUNTDOWN.

(C) INSPECTION:
THE UHF TRANSCEIVER WAS MANUFACTURED IN ACCORDANCE WITH AN APPROVED QUALITY ASSURANCE PLAN USING RCA STANDARD WORKMANSHIP CRITERIA. MANDATORY INSPECTION POINTS WERE ESTABLISHED AT LEVELS OF SUBASSEMBLY, FABRICATION, TEST, INTEGRATION, AND FINAL ASSEMBLY. SUBASSEMBLIES ARE INSPECTED FOR CONFORMANCE WITH RELEASED DRAWINGS AND STANDARDS FOR PARTS PLACEMENT, SOLDERING, AND CLEANLINESS. FINAL PRECLOSE INSPECTION INCLUDES VACUUM CLEANING OF DEBRIS.

(D) FAILURE HISTORY:
THERE HAVE BEEN SEVEN ATP FAILURES AND ONE POST-ATP FAILURE OF THE UHF TRANSCEIVER RELATED TO THIS CIL.

THERE WERE TWO FAILURES DURING ATP VIBRATION TESTS FROM SHORTS DUE TO WIRE CLIPPINGS (RCAEA171, RCAEA173). THE CORRECTIVE ACTION WAS THAT ASSEMBLY PERSONNEL WERE CAUTIONED TO INSPECT FOR WIRE CLIPPINGS MORE DILIGENTLY.

THERE WAS A FAILURE DURING ATP VIBRATION TEST DUE TO A SHORT FROM A LOOSE SCREW (RCAEA166). THE CORRECTIVE ACTION WAS THAT ASSEMBLY PERSONNEL WERE CAUTIONED TO CHECK SCREWS BEFORE FINAL BUTTONING.

THERE WAS A FAILURE OF A TRANSFORMER IN A POWER SUPPLY WHICH WAS DETECTED DURING ATP (RCAEA170). THERE WAS NO CORRECTIVE ACTION, SINCE IT WAS ASSUMED TO BE A RANDOM PARTS FAILURE, DETECTABLE IN ATP.

CRACKED SOLDER JOINTS IN THE QUADRIPLEXER CAUSED THE FAILURE OF ATP VIBRATION TEST SIGNAL TO NOISE RATIO MEASUREMENT (RCAEA176). THE CORRECTIVE ACTION WAS THAT INSPECTION POINTS FOR SOLDER JOINTS WERE ADDED.

THE ISOLATION RESISTANCE OF A POWER SUPPLY DID NOT MEET SPEC DUE TO FAULTY INSULATION ON A WIRE (RCAEA180). THE CORRECTIVE ACTION WAS THAT INSULATION TUBING WAS PLACED OVER THE WIRE.

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THERE WAS A SHORT TO GROUND OF A BIAS LINE BETWEEN T/R SWITCH AND THE 243 MHZ TRANSMITTER, CAUSING FAILURE OF THE ATP TEMPERATURE CYCLE TEST (RCAEA:81). THE CORRECTIVE ACTION WAS THAT THE WIRE WAS REPLACED, AND THE ATP SUCCESSFULLY COMPLETED.

THERE WAS A SHORT ON A PC BOARD, CAUSING LOSS OF BIOMED DATA DURING A PIA (JSCEE466). THE CORRECTIVE ACTION WAS THAT A TRANSISTOR WAS REPLACED, AND BIOMED DATA RETURNED. PART WAS NOT DEFECTIVE. A SOLDER SHORT ON THE PC BOARD WAS ASSUMED.

(E) OPERATIONAL USE:
NO CREW ACTION AVAILABLE TO RESTORE UHF COMMUNICATIONS. FOR AIR/GROUND COMM S-BAND IS PRIMARY SYSTEM. FOR EVA COMM, CREW IS TRAINED TO SAFELY TERMINATE EVA IF MINIMUM REQUIRED COMMUNICATIONS IS LOST.

- APPROVALS -

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