

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : COMMUNICATION & TRACKING FMEA NO 05-2G -21210 -2 REV: 01/05/88

ASSEMBLY : BAY 3A		CRIT. FUNC: 2
P/N RI : MC478-0106-2001		CRIT. HDW: 2
P/N VENDOR:	VEHICLE	102 103 104
QUANTITY : 1	EFFECTIVITY:	X X X
: ONE	PHASE(S):	PL LO X OO X DO X LS
: (INTERNALLY REDUNDANT)		

PREPARED BY:	REDUNDANCY SCREEN:	A-	B-	C-
DES <i>M. Zelon</i> 1/5/88 M ZELON	APPROVED BY:	APPROVED BY (NASA):		
REL <i>M. Alvarez</i> 1/10/88 M ALVAREZ	DES <i>[Signature]</i> 1/7/88	SSM	<i>P. E. S. L.</i>	<i>0/5/88</i>
QE <i>[Signature]</i> COURSE	REL <i>[Signature]</i> 1-12-88	REL <i>[Signature]</i>		<i>1/2</i>
	QE <i>[Signature]</i>	QE <i>[Signature]</i>		

ITEM:
PREAMPLIFIER ASSEMBLY S-BAND.

FUNCTION:
IN THE HIGH POWER S-BAND MODES PROVIDES LOW NOISE AMPLIFICATION OF THE UPLINK SIGNAL. ALSO PROVIDES THE DIPLEXING FUNCTION FOR THE DOWNLINK SIGNAL. 2 TRANSFER SWITCHES PROVIDE INTERNAL ROUTING OF THE UPLINK SIGNAL FROM EITHER DIPLEXER (FREQ HI & FREQ LO) THROUGH THE SELECTED AMPLIFIER TO EITHER OF 2 TRANSPONDER RECEIVER PORTS. ANOTHER TRANSFER SWITCH PROVIDES INTERNAL ROUTING OF THE DOWNLINK SIGNAL FROM EITHER OF 2 INPUT PORTS TO EITHER DIPLEXER. 83V74A7.

FAILURE MODE:
LOSS OF ALL UPLINK OR ALL DOWNLINK PATHS. TRANSFER SWITCH FAILS OPEN (STUCK IN MID-POSITION).

CAUSE(S):
CONTAMINATION, MECHANICAL SHOCK, MISEHANDLING, VIBRATION, TEMPERATURE, PIECE-PART STRUCTURAL FAILURE.

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A, B) LOSS OF UPLINK OR DOWNLINK IN THE HIGH POWER PM MODES.
(C) POSSIBLE LOSS OF PRIME MISSION OBJECTIVES DUE TO LOSS OF TDRS COMMUNICATIONS.
(D) NO EFFECT.

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DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE S-BAND PREAMPLIFIER UNIT IS ENVIRONMENTALLY SEALED, INERT GAS FILLED. THE DESIGN IS INTERNALLY REDUNDANT EXCEPT FOR 3 RF COAXIAL SWITCHES. THESE SWITCHES AND THE RF PRE AMP ASSEMBLY ARE ASSOCIATED WITH THE PM SYSTEM WHICH PROVIDES THE CRITICALITY 2 (TDRS) FUNCTION. ALL PARTS ARE SELECTED FROM MF-0004-400 (OPPL) WITH ADEQUATE DERATING OR EVALUATED FOR COMPLIANCE WITH DERATING. THE RF SWITCHES USED ARE REPRESENTATIVE OF THE MANUFACTURER'S STANDARD PRODUCT LINE WHICH HAS BEEN USED IN NUMEROUS MILITARY AND SPACE APPLICATIONS. THIS APPLICATION IS LOW STRESS IN THAT THE RF POWER IS REMOVED PRIOR TO SWITCHING. FOR THE RF SWITCHES, THE SUPPRESSION DIODES ARE SELECTED FROM MF-0004-400 (OPPL), WHICH CALLS FOR JANTXV LEVEL, AND HAVE ADEQUATE DERATING FACTORS OF AT LEAST 50 PERCENT - ALL NON-OPPL PARTS ARE EVALUATED FOR COMPLIANCE WITH OPPL DERATING REQUIREMENTS. ALL 3 RF SWITCHES ARE HIGH RELIABILITY AND QUALIFIED BY TESTS. THE S3 HIGH-POWER RF SWITCH WAS SUBJECTED TO ALL REQUIRED QUALIFICATION TESTS IN ADDITION TO QUALIFICATION TESTS PERFORMED IN OTHER SPACE PROGRAMS. (E.G., NAVSTAR, CLASSIFIED PROJECT (SANDERS.)

(B) TEST

PERFORMED BY AIL - ATP REF. NO. 557545 REV. R. ACCEPTANCE TESTING OF ALL UNITS INCLUDES EXAMINATION OF PRODUCT, AVT, ATT, LEAK AND FUNCTIONAL TESTS.

ACCEPTANCE VIBRATION TEST (AVT) - RANDOM VIBRATION IN 3 ORTHO-AXES - SPECTRAL DENSITY 20 TO 80 HZ, INCREASING AT 3DB/OCTAVE TO 0.04 G SQ/HZ AT 80 HZ. 80 TO 350 HZ CONSTANT AT 0.04 G SQ/HZ. 350 TO 2000 HZ DECREASING AT 3 DB/OCTAVE FROM 0.04 G SQ/HZ AT 350 HZ.

ACCEPTANCE THERMAL TEST (ATT) - CYCLED FROM 70 (55 TO 80 DEG F BASEPLATE) TO 100 (123 DEG F BASEPLATE), TO 0 (36 DEG F BASEPLATE) TO 100, TO 70 DEG F - THERMAL RATE SHALL NOT EXCEED (4 DEG F)/MINUTE OR NO LESS THAN (1 DEG F)/MINUTE.

LEAK TEST - PER SE-G-0020 SECTION 3.

QUALIFICATION TESTING INCLUDED: INPUT POWER, EMC, QATT, QAVT, RANDOM VIBRATION (FLIGHT), LEAKAGE, OPERATIONAL LIFE, THERMAL VACUUM, SHOCK (DESIGN) AND FUNCTIONAL.

EMI AND EMC - PER MF0004-002 CLASS IA. QAVT - SAME AS AVT IN THE 3 ORTHO-AXES, BUT DURATION IS 5 TIMES GREATER @ 0.067 G SQ/HZ.

THERMAL VACUUM TEST - CHAMBER AIR @ 80 DEG F PRESSURE REDUCED FROM AMBIENT TO 8.0 PSIA AT A RATE OF 0.15 PSIA/MINUTE. THIS LEVEL MAINTAINED FOR 2 HOURS AND RETURNED TO AMBIENT AT A RATE OF 9.0 PSIA/MINUTE.

CERTIFICATION BY ANALYSIS WAS DONE FOR ACCELERATION, CABIN ATMOSPHERE, OZONE, FUNGUS, PRESSURE AND SHOCK (CRASH SAFETY). INTEGRATED AND SUBSYSTEM VERIFICATION WAS PERFORMED AT PALMDALE, KSC, AND IN-FLIGHT.

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THE HIGH-POWER RF TRANSFER SWITCH (S3) ACCEPTANCE TESTING INCLUDES - EXAMINATION OF PRODUCT, FUNCTIONAL, THERMAL SHOCK (5 CYCLES - +100 DEG C TO -25 DEG C), ACCEPTANCE VIBRATION TEST (AVE 20 TO 2000 HZ @ 24.4 G RMS). RUN-IN TEST (500 CYCLES AT +100 DEG C AND 500 CYCLES AT -25 DEG C), FINAL FUNCTIONAL AND LEAKAGE ON J1 AND J4 CONNECTORS.

THE HIGH-POWER RF TRANSFER SWITCH (S3) QUALIFICATION TEST INCLUDES - THERMAL (-65 DEG C TO +125 DEG C, 5 CYCLES), VIBRATION (SINE AND RANDOM), SHOCK (NON-OPERATIONAL - 50 G, 11 MSEC SIX APPLICATION/AXIS AND OPERATIONAL - 10 G PEAK FOR 300 MSEC, TEN APPLICATIONS/AXIS, EMC/RFI AND OPERATING LIFE (50,000 CYCLES I.E., 100,000 OPERATIONS).

IN ADDITION A DELTA QUALIFICATION TEST FOR 300 WATTS S-BAND CONTINUOUS WAVE WAS PERFORMED FOR AIL WITH A MAXIMUM ALLOWED ATTENUATION OF 0.17 DB. THE QUALIFICATION TEST RESULTS ARE DOCUMENTED IN TRANSCO'S QTR 1973 PER SANDERS SPECIFICATION BZE-1000 WITH TRANSCO'S AMENDMENT TO AIL.

THE ACCEPTANCE TEST IS PERFORMED IN COMPLIANCE WITH AIL AUTOMATED TEST PROCEDURE "SPECIFICATION FOR SWITCH RF, COAXIAL, HI-POWER" 00752-55753.

GROUND TURNAROUND TEST - COMMAND AND DATA ACCEPTANCE VERIFICATION. ALSO, POWER AMP OUTPUT STDN HI MEASUREMENT. PERFORMED EVERY FLIGHT.

(C) INSPECTION

RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES ALL INCOMING PARTS AND MATERIALS, INCLUDING PERFORMANCE OF VISUAL AND DIMENSIONAL EXAMINATIONS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

QUALITY CONTROL (QC) VERIFIES THAT REQUIRED PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. FOR THE DUAL TRIPLEXER ASSEMBLY A CLASS 100 LAMINAR FLOW BENCH LOCATED WITHIN A CLASS 100,000 CLEAN ROOM IS USED.

ASSEMBLY/INSTALLATION

DETAILED INSPECTION PERFORMED ON ALL ASSEMBLIES AND DETAIL PARTS PRIOR TO NEXT ASSEMBLY.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATION ARE MONITORED AND VERIFIED BY QC. FOR THE DUAL TRIPLEXER ASSEMBLY, SOLDERING PER NASA CERTIFICATION IS VERIFIED; PLATING PROCESSES PERFORMED AT THE SUB-TIER LEVEL ARE VERIFIED THROUGH PERIODIC SURVEILLANCE AND AT RECEIVING INSPECTION.

TESTING

ALL PARTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING

IN-PROCESS OPERATIONS ARE VERIFIED BY QC TO PROTECT PARTS AND PRECLUDE MISHANDLING. PARTS PACKAGING IS VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

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HANDLING/PACKAGING (CONT'D)

CONTROLS TO PREVENT ELECTROSTATIC DISCHARGE ARE VERIFIED FOR THE DUAL TRIPLEXER ASSEMBLY.

(D) FAILURE HISTORY

THERE IS ONE FAILURE THAT OCCURRED DURING ACCEPTANCE TESTING THAT IS APPLICABLE TO THIS FAILURE MODE.

FAILURE ADO704 TOOK PLACE DURING ACCEPTANCE VIBRATION TEST AFTER REPAIR FOR A PRIOR FAILURE; INSERTION LOSS JUMPED BETWEEN 1 AND 3 DB DUE TO RF SWITCH #3 (S/N 110). THE SWITCH WAS DAMAGED FROM AN OUT-OF-SEQUENCE BRAZING OPERATION DURING MANUFACTURING, CAUSING THE CLAPPER ASSEMBLY TO FAIL. THIS FAILURE WAS UNIQUE TO THIS SWITCH, NEVERTHELESS, THE MANUFACTURING PERSONNEL WERE CAUTIONED TO ADHERE TO ASSEMBLY TECHNIQUES. NO FURTHER INSTANCES HAVE OCCURRED.

(E) OPERATIONAL USE

NO CREW CORRECTIVE ACTION AVAILABLE TO RECOVER S-BAND TDRS COMMUNICATIONS. STDN-LO/SGLS MAY BE USED TO COMMUNICATE WITH THE GROUND STATION.