

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : COMMUNICATION & TRACKING FMEA NO 05-2G -23500 -3 REV: 01/05/88

ASSEMBLY : BAY 3A			CRIT. FUNC: 2
P/N RI : MC478-0106-4004			CRIT. HDW: 2
P/N VENDOR:	VEHICLE	102	103 104
QUANTITY : 1 (ONE)	EFFECTIVITY:	X	X X
: INTERNAL ELEC SW LOGIC	PHASE(S):	PL	LO X OO X DO X LS
: IS REDUNDANT			

PREPARED BY:	REDUNDANCY SCREEN:	A-	B-	C-
DES <i>M. Zelon</i> 1/5/8 M ZELON	APPROVED BY:	APPROVED BY (NASA):		
REL <i>M. Alvarez</i> 1-06 M ALVAREZ	DES <i>[Signature]</i> 1/7/8	SSM	<i>P.E.S.</i>	2/8/8
QE <i>D.M. Courseen</i> 1/18/8 J COURSEEN	REL <i>[Signature]</i> 1-12-8	REL	<i>[Signature]</i>	2/12/8
	QE <i>[Signature]</i>	QE	<i>[Signature]</i>	

ITEM:

SWITCH ASSEMBLY S-BAND (INCLUDES THE ELECTRONIC SWITCHING UNIT).

FUNCTION:

PROVIDES SWITCHING FUNCTIONS FOR ROUTING S-BAND RF SIGNALS TO AND FROM ELECTRONIC EQUIPMENT AND ANTENNAS (VIA FIVE INTERNAL TRANSFER SWITCHES). FOR THE S-BAND PHASE MODULATION (PM) SYSTEM THE SWITCH ASSEMBLY SELECTS ONE OF SIXTEEN POSSIBLE CONFIGURATIONS BY CONNECTING THE FOUR EQUIPMENT PORTS TO THE 4 QUAD ANTENNA PORTS ONE-ON-ONE. FOR THE S-BAND FREQUENCY MODULATION (FM) SYSTEM THE SWITCH ASSEMBLY SELECTS ONE OF TWO POSSIBLE CONFIGURATIONS BY CONNECTING TWO EQUIPMENT PORTS TO TWO HEMI ANTENNA PORTS. TWO REDUNDANT ELECTRONIC SYSTEMS PROVIDE CONTROL TO THE TRANSFER SWITCHES. 83V74A30.

FAILURE MODE:

RF TRANSFER SWITCH OPENS (4 REEDS) INADVERTENT OPEN, FAILS OPEN.

CAUSE(S):

VIBRATION, MECHANICAL SHOCK, TEMPERATURE, CONTAMINATION, MECHANICAL WEAR, PIECE-PART STRUCTURAL FAILURE.

EFFECT(S) ON:

(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A, B) FOR S1 OR S3 OPEN, LOSS OF USE OF BOTH UPPER QUAD ANTENNAS OR BOTH LOWER QUAD ANTENNAS. FOR S2 OR S4 OPEN, LOSS OF USE OF ONE PREAMP PORT AND ONE TRANSPONDER PORT. FOR S5 OPEN, LOSS OF USE OF HEMI ANTENNA SYSTEM (CRIT 3/3).

(C) FOR LOSS OF USE OF QUAD ANTENNAS (S1 OR S3) POTENTIAL LOSS OF PRIME MISSION OBJECTIVE SINCE VEHICLE ATTITUDE CONTROL IS REQUIRED TO MAINTAIN TORS COMMUNICATION. FOR S5 OPEN LOSS OF FM AND EVA TV.

(D) NO EFFECT.

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DISPOSITION & RATIONALE:

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

(A) DESIGN

THE SWITCH ASSEMBLY UNIT IS ENVIRONMENTALLY SEALED, INERT GAS FILLED. DESIGN IS INTERNALLY REDUNDANT EXCEPT FOR 5 RF COAXIAL SWITCHES. FOUR OF THESE SWITCHES ARE ASSOCIATED WITH THE FM SYSTEM WHICH PROVIDES THE CRITICALITY 2 (TDRS) FUNCTION. ALL PARTS ARE SELECTED FROM THE MF-0004-400 (OPPL) WITH ADEQUATE OPERATING OR EVALUATED FOR COMPLIANCE WITH DERATING. THE RF SWITCH TECHNOLOGY WAS DEVELOPED FOR THIS APPLICATION AND RECEIVED EXTENSIVE DEVELOPMENTAL TESTING (5 HIGH POWER LIFE TESTS). TEST # 5 INCLUDED A STRESS TEST (10,000 SWITCHING CYCLES AT 275 WATTS), A CYCLING LIFE TEST (50,000 CYCLES AT 200 WATTS). OPERATING LIFE IS 25,000 CYCLES WITH A SPECIFIED RF POWER IS 120 WATTS (NOMINALLY 90 WATTS).

(B) TEST

PERFORMED BY TELEDYNE MICROWAVE - ATP REF. NO. 9002084 M. ACCEPTANCE TESTING OF ALL SWITCH ASSEMBLY UNITS INCLUDES EXAMINATION OF PRODUCT, AVT, ATT, LEAK, AND FUNCTIONAL TESTS.

ACCEPTANCE VIBRATION TEST - RANDOM VIBRATION IN 3 ORTHO-AXES, SPECTRAL DENSITY IS 20 TO 80 HZ INCREASING AT 3 DB/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 - CYCLED FROM 70 TO 120, TO 0, TO 120, 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 INCLUDES: INPUT POWER, EMC, QATT, QAVT, RANDOM VIBRATION (FLIGHT), LEAKAGE, OPERATING LIFE, THERMAL VACUUM, SHOCK (BENCH HANDLING & DESIGN), AND FUNCTIONAL.

ELECTROMAGNETIC INTERFERENCE (EMI) AND ELECTROMAGNETIC COMPATIBILITY (EMC) - PER MF0004-002 CLASS 1A.

QUALIFICATION ACCEPTANCE VIBRATION TEST (QAVT) - SAME AS AVT IN THE 3 ORTHO-AXES, BUT DURATION IS 5 TIMES GREATER AT 0.067 G SQ/HZ.

QUALIFICATION 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 SUB-SYSTEM VERIFICATION WAS PERFORMED AT PALMDALE, KSC, AND IN-FLIGHT (OPT).

GROUND TURN AROUND TEST - COMMAND AND DATA ACCEPTANCE VERIFICATION AND POWER OUTPUT STDN HI AND STDN LO MEASUREMENT - PERFORMED EVERY FLIGHT.

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## (C) INSPECTION

## RECEIVING INSPECTION

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

## CONTAMINATION CONTROL

CLEANING OF ASSEMBLIES ON A LAMINAR FLOW BENCH IS PERFORMED PER PROCEDURE, AND CLEANLINESS IS VERIFIED BY INSPECTION. QUALITY CONTROL (QC) VERIFIES THAT REQUIRED PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL.

## ASSEMBLY/INSTALLATION

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

## CRITICAL PROCESSES

ALL CRITICAL PROCESSES FOR THE SWITCH BUILD-UP (SOLDERING) AND FOR THE SWITCH ASSEMBLY (SOLDERING AND TORQUING) ARE MONITORED AND VERIFIED BY INSPECTION.

## TESTING

ATP IS OBSERVED AND VERIFIED BY QC INCLUDING AVT, ATT, LEAK AND FUNCTIONAL TESTS.

## HANDLING/PACKAGING

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

## (D) FAILURE HISTORY

THERE ARE TWO FAILURES APPLICABLE TO THE RF SWITCH OPEN FAILURE MODE. THESE FAILURES HAVE OCCURRED DURING ORBITER SYSTEM CHECK-OUT, AND DURING VERIFICATION/ TROUBLESHOOTING.

FAILURE AD0579 OCCURRED DURING RETEST AFTER REPAIR FOR A PRIOR FAILURE; THE VSWR WAS OUT OF TOLERANCE. THE CAUSE FOR THIS FAILURE COULD NOT BE DETERMINED AND THE FAILURE IS CONSIDERED AN UNEXPLAINED ANOMALY. NO FURTHER INCIDENCES HAVE OCCURRED.

FAILURE AB8012 OCCURRED DURING VEHICLE SYSTEMS CHECK-OUT. THE STATUS INDICATORS WERE IN CONFLICT (BOTH INDICATED ON). THE PROBLEM WAS CAUSED BY PARTICLES WHICH CONTAMINATED THE ASSEMBLY. IT WAS CONCLUDED THAT THE CONTAMINATION WAS INTRODUCED DURING REPAIR. THE REMEDIAL ACTION WAS TO REPLACE THE RF SWITCH AND TO MONITOR ITS PERFORMANCE, NO FURTHER INCIDENCES HAVE OCCURRED.

## (E) OPERATIONAL USE

REORIENT VEHICLE. FOR S1 OR S3 OPEN - NO CREW CORRECTIVE ACTION AVAILABLE TO RECOVER USE OF LOST ANTENNAS.