

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2329 -2 REV:05/03/88

ASSEMBLY :AFT PCA-1 & 2	CRIT.FUNC: 1R
P/N RI :RBR56L15D01BR	CRIT. HDW: 3
P/N VENDOR:	VEHICLE 102 103 104
QUANTITY :4	EFFECTIVITY: X X X
:FOUR	PHASE(S): PL LO X OO DO LS
:	

PREPARED BY:		REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS	
DES R PHILLIPS	APPROVED BY:	APPROVED BY (NASA):	
REL M ROVE	DES <i>R. B...</i>	SSM <i>W.C. Stang 5/11/88</i>	
QE J COURSEN	REL <i>W. J. ... 5-6-88</i>	REL <i>W. J. ... 5/11/88</i>	
	QE <i>J. J. ... 5/6/88</i>	QE <i>W. J. ...</i>	

ITEM:  
RESISTOR, WIRE WOUND, 15K OHMS - ORB/SRB DC BUS POWER CONTROL

FUNCTION:  
LIMITS CURRENT AS PART OF A VOLTAGE DIVIDER NETWORK FOR SENSING SRB DC BUS VOLTAGE FOR CONTROL OF SWITCHING REDUNDANT ORBITER POWER SOURCE TO SRB DC BUS: 54V76A131A1R45, R46; 55V76A132A1R44, R45

FAILURE MODE:  
SHORTS

CAUSE(S):  
STRUCTURAL FAILURE, (MECHANICAL STRESS, VIBRATION), CONTAMINATION, THERMAL STRESS, ELECTRICAL STRESS, PROCESSING ANOMALY

EFFECT(S) ON:  
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE (E) FUNCTIONAL CRITICALITY EFFECT:

(A) FIRST FAILURE - NO EFFECT. LOSS OF VOLTAGE DIVIDER TO DETECT LOW VOLTAGE ON A SRB DC BUS.

(B) INCORRECT SENSING (INDICATES HIGHER THAN ACTUAL VOLTAGE) OF ASSOCIATED SRB DC BUS VOLTAGE. LOSS OF REDUNDANCY FOR ONE OF TWO SRB DC BUSES IF PRIMARY POWER FEED FROM THE ORBITER TO THE AFFECTED SRB DC BUS FAILS TO A LOW VOLTAGE CONDITION.

(C,D) FIRST FAILURE - NO EFFECT. THIS CONDITION WILL NOT RESULT IN INADVERTENT SWITCHING OF SRB DC BUS TO ALTERNATE SOURCE OR LOSS OF ANY SRB DC BUS.

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JBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2329 -2 REV:05/03/88

EFFECT(S) ON (CONTINUED):

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE (E)FUNCTIONAL  
CRITICALITY EFFECT:

(E) POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF TWO SRB DC BUSES  
DURING FIRST STAGE VIA THE FOLLOWING SCENARIO:

- (1) RESISTOR FAILS SHORTED.
- (2) LOW VOLTAGE ON ASSOCIATED PRIMARY ORB/SRB DC BUS SOURCE  
RESULTING IN LOSS OF THAT SRB DC BUS DUE TO LOSS OF SWITCH OVER  
CAPABILITY CAUSED BY IMPROPER SENSING.
- (3) LOSS OF SECOND DC BUS ON THE SAME SRB.

LOSS OF TWO SRB BUSES RESULTS IN LOSS OF THRUST VECTOR CONTROL FOR THE  
AFFECTED SRB AS WELL AS SRB RATE GYRO FLIGHT CONTROL DATA. FAILS "B"  
SCREEN BECAUSE IMPROPER SENSING WILL NOT BE MANIFESTED UNLESS THE  
ASSOCIATED PRIMARY SRB DC BUS FAILS.

DISPOSITION & RATIONALE:

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

(A,B,C,D) DISPOSITION AND RATIONALE:

(A) DESIGN

RESISTOR IS A 1/8 WATT FIXED RESISTOR WITH A WIRE WOUND  
ELEMENT. THE DEVICE IS AN "ACCURATE" (0.10% TOLERANCE) DEVICE WITH  
SOLDER LEADS CAPABLE OF FULL-LOAD OPERATION UP TO 125 °C AMBIENT  
TEMPERATURE AND DERATED LINEARLY TO ZERO LOAD AT 145 °C AMBIENT. THE  
RESISTORS HAVE A FAILURE RATE OF .01% PER 1,000 HOURS. THIS FAILURE  
RATE IS ESTABLISHED AT 50% CONFIDENCE ON THE BASIS OF LIFE TESTS  
(PERMISSIBLE RESISTANCE CHANGE IS +/- 0.2% + 0.01 OHMS). THE PART IS  
QUALIFIED TO MEET THE REQUIREMENTS OF MIL-R-39005/5. THE APPLICATION IS  
FULLY ANALYZED TO ASSURE COMPLIANCE WITH THE 50% DERATING CRITERIA OF THE  
ORBITER PROJECT PARTS LIST.

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SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2329 -2 REV:05/03/89

(B) TEST

THE FOLLOWING TESTS ARE PERFORMED ON A SAMPLE OF THE MANUFACTURER'S PRODUCT TO QUALIFY THE PRODUCT TO THE SPECIFICATION:

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
CONDITIONING		X			X
DC RESISTANCE		X			X
VISUAL AND MECHANICAL EXAMINATION	X				X
SHORT-TIME OVERLOAD			X		X
TEMPERATURE CYCLING		X		X	X
SOLDERABILITY		X			X
SALT WATER IMMERSION CYCLING	X				X
DIELECTRIC WITHSTANDING VOLTAGE		X	X		X
TERMINAL STRENGTH	X		X		X
INSULATION RESISTANCE		X	X		X
MOISTURE RESISTANCE	X				X
RESISTANCE TO SOLDERING HEAT	X			X	X
SHOCK	X				X
VIBRATION	X				X
RESISTANCE-TEMPERATURE CHARACTERISTIC		X		X	X
LOW TEMPERATURE STORAGE				X	X
LOW TEMPERATURE OPERATION			X	X	X
LIFE		X	X	X	X
FUNGUS	X				X
RESISTANCE TO SOLVENTS	X				X
HIGH TEMPERATURE EXPOSURE		X		X	X

QUALIFICATION TESTS

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2329 -2 REV:05/03/88

1) TEST (CONTINUED)

THE FOLLOWING TESTS ARE PERFORMED ON A SAMPLE OF PARTS FROM EACH LOT TO DEMONSTRATE QUALIFICATION.

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
VISUAL AND MECHANICAL INSPECTION	X				X
SHORT-TIME OVERLOAD			X		X
THERMAL SHOCK		X		X	X
RESISTANCE-TEMPERATURE CHARACTERISTIC		X		X	X
SOLDERABILITY		X			X
INSULATION RESISTANCE		X	X		X
MOISTURE RESISTANCE	X				X
DIELECTRIC WITHSTANDING VOLTAGE		X	X		X
TERMINAL STRENGTH	X				X
RESISTANCE TO SOLVENTS	X				X

QUALIFICATION TESTS (LOT SAMPLE)

TESTS AND INSPECTIONS PERFORMED ON A PERIODIC BASIS AS A PART OF QUALIFICATION ARE:

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
LIFE		X	X	X	X
LOW TEMPERATURE STORAGE				X	X
LOW TEMPERATURE OPERATION			X	X	X
RESISTANCE TO SOLVENTS	X				X
SALT WATER IMMERSION CYCLING	X				X
DIELECTRIC WITHSTANDING VOLTAGE		X	X		X
TERMINAL STRENGTH	X				X
DC RESISTANCE		X			X
VISUAL AND MECHANICAL INSPECTION	X				X
SHORT-TIME OVERLOAD			X		X
TEMPERATURE CYCLING		X		X	X
RESISTANCE TO SOLDERING HEAT	X			X	X
SHOCK	X				X
VIBRATION	X				X
HIGH TEMPERATURE EXPOSURE		X		X	X

QUALIFICATION TESTS (PERIODIC)

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SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2329 -2 REV:05/06/88

**(B) TEST (CONTINUED)**

CAUSES	CAUSE CONTROL				
	a	b	c	d	e
a Structural failure Mechanical stress Vibration					
b Contamination					
c Electrical stress					
d Thermal stress					
e Processing anomaly					
TEST / INSPECTION					
POWER CONDITIONING		X			X
DC RESISTANCE		X			X

**QUALITY ASSURANCE TESTS (ALL DEVICES)**

**GROUND TURNAROUND TEST**

NONE PERFORMED DUE TO RISK ASSOCIATED WITH REQUIRED TEST.

**(C) INSPECTION**

THE PART HAS REQUIRED INSPECTION DURING MANUFACTURING PROCESS IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-R-39005. IN ADDITION, THE PART SUPPLIER IS REQUIRED TO HAVE QUALITY AND PROCESS CONTROL PRACTICES IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-R-39005 AND IN ADDITION, THE PART SUPPLIER IS REQUIRED TO HAVE A RELIABILITY PROGRAM IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-STD-790. THE REQUIREMENTS ARE TO ASSURE ADEQUATE PROCESS CONTROLS ARE IMPOSED BY THE PART SUPPLIER ON THE PARTS MANUFACTURING PROCESS. THE PROCESSES AND CONTROLS ARE ROUTINELY REVIEWED AND APPROVED BY THE QUALIFYING AGENCY (DEFENSE ELECTRONIC SUPPLY CENTER).

**RECEIVING INSPECTION (FAILURE CAUSE a,b,e)**

INSPECTION OF INCOMING MATERIALS, UTILITIES AND IN-WORK PROCESSES (PACKAGES, WIRE, WATER PURIFICATION) IS REQUIRED OF THE PART SUPPLIER.

**CLEANLINESS CONTROL (FAILURE CAUSE b)**

THE PART SUPPLIER IS REQUIRED TO HAVE CLEANLINESS AND ATMOSPHERE CONTROL IN CRITICAL WORK AREAS TO THE REQUIREMENTS OF FED-STD-209.

**ASSEMBLY/INSTALLATION (FAILURE CAUSE a,b,e)**

THE PART SUPPLIER IS REQUIRED TO HAVE TRACEABILITY (DESCRIPTION OF PRODUCTION PROCESS AND CONTROLS, QUALITY CONTROL INSPECTION DOCUMENTATION, DATE OF SUBMISSION, INSPECTION CRITERIA, FINAL LOT DISPOSITION AND RECORDS RETENTION). THE MANUFACTURER IS ALSO REQUIRED TO SUBMIT A PROGRAM PLAN ESTABLISHING A MANUFACTURING FLOW CHART, A FUNCTIONAL ORGANIZATION CHART, INTERNAL AUDIT ACTIVITIES AND EXAMPLES OF DESIGN, MATERIAL EQUIPMENT STANDARDS AND PROCESS INSTRUCTIONS FOR APPROVAL BY THE QUALIFYING AGENCY.

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C) INSPECTION (CONTINUED)

CRITICAL PROCESSES (FAILURE CAUSE a,e)

THE PART SUPPLIER MUST HAVE REQUIREMENTS AND CONTROLS ON MATERIALS REPARATION; BONDING CRITERIA; REWORK CRITERIA; DESIGN, PROCESSING, MANUFACTURING, TESTING, AND INSPECTION DOCUMENTATION AND CHANGE CONTROL; PERSONNEL TRAINING; FAILURE/DEFECT ANALYSIS AND CORRECTIVE ACTION; AND INVENTORY CONTROL.

TESTING (FAILURE CAUSE a,b,c,d,e)

THE PART SUPPLIER MUST HAVE TEST EQUIPMENT MAINTENANCE AND CALIBRATION CONTROLS WHICH COMPLY WITH THE REQUIREMENTS OF MIL-STD-45662 AND HAVE BEEN APPROVED BY THE QUALIFYING AGENCY.

HANDLING/PACKAGING (FAILURE CAUSE a)

HANDLING PROCEDURES MUST PROVIDE PHYSICAL PROTECTION OF MATERIALS DURING ALL SEQUENCES OF PRODUCTION AND INSPECTION. ASSEMBLED PARTS ARE PHYSICALLY PROTECTED DURING TESTING AND QUALITY CONFORMANCE INSPECTIONS. STORAGE OF PARTS IS IN A CONTROLLED AREA, REQUIRING AUTHORIZATION FOR REMOVAL FROM THE AREA AND PREPARATION FOR SHIPMENT.

D) FAILURE HISTORY

FAILURE MODE: SHORT, LOW RESISTANCE

R'S AB0824 AND AB0851

IDENTIFIED NINE FAILURES OF DEFECTIVE RBR56 WIRE WOUND RESISTORS MANUFACTURED BY ULTRONIX. THE FAILURE CAUSE WAS IDENTIFIED TO BE IMPROPER WINDING WHICH ALLOWED INTRA-WINDING SHORTS. THE IMPROPER TECHNIQUE WAS CAUSED BY NOVICE OPERATORS WITH INADEQUATE SUPERVISION. ACCEPTANCE TESTING IS CONSIDERED TO BE AN EFFECTIVE SCREEN FOR THIS ITEM.

E) OPERATIONAL USE

NE