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PRINT DATE: 01/13/94

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
NUMBER: 05-6N-2078-X**

SUBSYSTEM NAME: EPD&C - AUXILIARY POWER UNIT

REVISION: 3 01/13/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MODULAR ASSEMBLY	V070-765455
SRU	: CAPACITOR	M39003/01-5644

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

CAPACITOR, 6.8 MICROFARAD, 35 VDC - AUXILIARY POWER UNIT (APU) 1, 2, AND 3
OVERSPEED AND UNDERSPEED TIME DELAY FOR THE FUEL ISOLATION VALVE
CIRCUIT

REFERENCE DESIGNATORS: 54V76A226C1

54V76A226C2

55V76A227C1

55V76A227C2

56V76A228C1

50V76A228C2

QUANTITY OF LIKE ITEMS: 6

TWO PER APU

FUNCTION:

PROVIDES THE CAPACITANCE REQUIRED FOR THE OVERSPEED AND UNDERSPEED
TIME DELAY CIRCUIT.

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
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SUBSYSTEM NAME: EPD&C - AUXILIARY POWER UNIT

LRU: MODULAR ASSEMBLY

ITEM NAME: CAPACITOR

CRITICALITY OF THIS
FAILURE MODE: 1R3

FAILURE MODE:

OPEN

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 ALANTIS
 105 ENDEAVOUR

CAUSE:

STRUCTURAL FAILURE (MECHANICAL STRESS, VIBRATION), ELECTRICAL STRESS,
 THERMAL STRESS, PROCESSING ANOMALY

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
 B) FAIL
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

REDUNDANCY SCREEN "B" FAILS IN FLIGHT BECAUSE A FAILED OPEN CAPACITOR
 CANNOT BE DETECTED UNTIL IT ALLOWS THE (NADVERTENT CLOSING OF A FUEL
 ISOLATION VALVE TRIGGERED BY AN ERRONEOUS SIGNAL FROM THE APU
 CONTROLLER.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF ABILITY OF THE CIRCUIT TO PROVIDE A PROPER TIME DELAY IN RESPONSE
 TO THE OVERSPEED OR UNDERSPEED SIGNAL FROM THE APU CONTROLLER.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT - FIRST FAILURE

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NO EFFECT - FIRST FAILURE

(D) CREW, VEHICLE, AND ELEMENT(S):

NO EFFECT - FIRST FAILURE

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER THREE OTHER FAILURES (INADVERTENT OUTPUT PULSE INDUCED BY AN UNDERVOLTAGE CONDITION INSIDE THE APU CONTROLLER WHICH CLOSES ONE FUEL ISOLATION VALVE, HYBRID DRIVER FAILS OPEN CAUSING THE ASSOCIATED PARALLEL FUEL ISOLATION VALVE TO CLOSE RESULTING IN THE LOSS OF ONE APU, AND LOSS OF A SECOND APU) DUE TO LOSS OF TWO OF THREE APUS.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE PART IS A 6.8 MICROFARAD ± 5 PERCENT, 35 VDC, SOLID SLUG TANTALUM CAPACITOR. THE CAPACITOR IS POLARIZED, HAS SOLID ELECTROLYTE, IS HERMETICALLY SEALED WITH GLASS IN A METAL CASE WITH AXIAL LEADS WHERE THE CASE IS CONNECTED TO THE NEGATIVE TERMINAL AND IS DESIGNED FOR FULL RATED VOLTAGE BETWEEN -55 DEGREE C AND 85 DEGREE C. FOR OPERATION BETWEEN 85 DEGREE C AND 125 DEGREE C, THE RATED VOLTAGE IS LINEARLY DERATED. THE CAPACITOR LIFE FAILURE RATE IS 0.001 PERCENT FOR 1000 HOURS (FAILURE RATE LEVEL 'S'). THIS FAILURE RATE LEVEL IS ESTABLISHED AT A 60 PERCENT CONFIDENCE LEVEL ON THE BASIS OF LIFE TESTS. THE PART IS DESIGNED TO MEET THE REQUIREMENTS OF MIL-C-39003. THE PART APPLICATION WAS ALSO ANALYZED TO ASSURE COMPLIANCE WITH THE 60 PERCENT DERATING CRITERIA OF THE ORBITER PROJECT PARTS LIST.

THE CERTIFIED PART NUMBER IS M39003/01-5644.

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(B) TEST:

THE PART IS SCREENED AND QUALIFIED TO THE REQUIREMENTS OF MIL-C-39003.

TESTS AND INSPECTIONS PERFORMED ON 100 PERCENT OF THE UNITS PRODUCED WITH EQUIPMENT AND PROCEDURES NORMALLY USED IN PRODUCTION ARE:

TEST	cause control				
	a	b	c	d	e
THERMAL CYCLE (-65 DEGREE C TO 125 DEGREE C)				X	
VOLTAGE AGING (35 VDC, 85 DEGREE C, 40 HOURS)		X		X	X
HERMETIC SEAL (1X10 TO MINUS 5 CC/SEC)	X	X			X
RADIOGRAPHIC INSPECTION	X	X			X

QUALIFICATION TESTS (ALL UNITS)

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TESTS AND INSPECTIONS PERFORMED ON A SAMPLE OF UNITS AS A PART OF
QUALIFICATION ARE:

TEST	cause control				
	a	b	c	d	e
CAUSES					
a Structural failure mechanical stress vibration			c Electrical Stress d Thermal stress		
b Contamination			e Processing anomaly		
VISUAL AND MECHANICAL INSPECTION	X				X
DC LEAKAGE		X			X
CAPACITANCE (6.8 MICROFARAD +/- 5 PERCENT, 120 +/- 5 HZ TEST FREQUENCY, 25 DEGREE C)		X			X
DISSIPATION FACTOR (6 PERCENT, 120 +/- 5 HZ TEST FREQUENCY)		X			X
SHOCK (SAWTOOTH, 100G PEAK, 6 MILLISECOND)	X				X
VIBRATION, HIGH FREQUENCY (20G PEAK, 4 HOURS IN EACH OF 2 SETS OF PERPENDICULAR AXIS)	X				X
SALT SPRAY (5 PERCENT SALT FOG, 48 HOURS)		X			X
THERMAL SHOCK (-65 DEGREE C TO 125 DEGREE C, 15 MINUTES, 5 CYCLES)	X			X	
IMMERSION (25/65 DEGREE C, 15 MINUTES, 2 CYCLES)	X			X	
SOLDERABILITY		X			X
TERMINAL STRENGTH (3 LBS PULL)	X				X
FUNGUS		X			X
RESISTANCE TO SOLVENTS					X
RESISTANCE TO SOLDERING HEAT				X	X
MOISTURE RESISTANCE	X	X			X
LOW AND HIGH TEMPERATURE STABILITY (-55 DEGREE C TO 125 DEGREE C)				X	X
SURGE VOLTAGE (46 VDC, 85 DEGREE C, 1000 CYCLE)			X	X	X
LIFE (85 DEGREE C & 125 DEGREE C, 2000 HOURS)		X	X	X	X

QUALIFICATION TESTS (LOT SAMPLE)

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ACCEPTANCE AND SCREENING

ALL PRODUCTION UNITS ARE SUBJECTED TO A 100 PERCENT ACCEPTANCE TESTING WHICH INCLUDE THE FOLLOWING:

TEST	cause control				
	a	b	c	d	e
CAUSES					
a Structural failure					
mechanical stress					
vibration					
b Contamination					
c Electrical Stress					
d Thermal stress					
e Processing anomaly					
THERMAL CYCLE (-65 DEGREE C TO 125 DEGREE C)				X	
VOLTAGE AGING (35 VDC, 85 DEGREE C, 40 HOURS)		X		X	X
HERMETIC SEAL (1X10 TO MINUS 5 CC/SEC)	X	X			X
RADIOGRAPHIC INSPECTION	X	X			X

ACCEPTANCE TESTS (ALL UNITS)

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
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TESTS AND INSPECTIONS PERFORMED ON A SAMPLE OF PRODUCTION UNITS AS PART OF ACCEPTANCE ARE:

TEST	cause control				
	a	b	c	d	e
CAUSES					
a Structural failure mechanical stress vibration			c Electrical Stress d Thermal stress		
b Contamination			e Processing anomaly		
DC LEAKAGE		X			X
CAPACITANCE (6.8 MICROFARAD +/-5 PERCENT, 120 +/-5 HZ TEST FREQUENCY, 25 DEGREE C)		X			X
DISSIPATION FACTOR (6 PERCENT, 120 +/-5 HZ TEST FREQUENCY)		X			X
VISUAL AND MECHANICAL INSPECTION	X				X
MATERIALS		X			X
PHYSICAL DIMENSIONS					X
MARKING					X
WORKMANSHIP					X
LOW AND HIGH TEMPERATURE STABILITY (-55 DEGREE C TO 125 DEGREE C)				X	X
SURGE VOLTAGE (46 VDC, 85 DEGREE C, 1000 CYCLES)			X	X	X
SOLDERABILITY		X			X
LIFE (85 DEGREE C, 240 HOURS)		X	X	X	X
SHOCK (SAWTOOTH, 100G PEAK, 8 MILLISECOND)	X				X
VIBRATION, HIGH FREQUENCY (20G PEAK, 4 HOURS IN EACH OF 2 SETS OF PERPENDICULAR AXIS)	X				X
SALT SPRAY (5 PERCENT SALT FOG, 48 HOURS)		X			X
THERMAL SHOCK (-65 DEGREE C TO 125 DEGREE C, 15 MINUTES, 5 CYCLES)	X			X	
IMMERSION (25/65 DEGREE C, 15 MINUTES, 2 CYCLES)	X			X	
TERMINAL STRENGTH (3 LBS PULL)	X				X
RESISTANCE TO SOLVENTS					X
RESISTANCE TO SOLDERING HEAT				X	X
MOISTURE RESISTANCE	X	X			X
EXTENDED LIFE (125 DEGREE C, 10000 HOURS)		X	X	X	X

ACCEPTANCE TESTS (LOT SAMPLE)

OMRSD: ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

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THE PART HAS REQUIRED INSPECTION DURING THE MANUFACTURING PROCESS IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-C-39003. IN ADDITION, THE PART SUPPLIER IS REQUIRED TO HAVE QUALITY CONTROL (QC) PRACTICES IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-C-39003 AND 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)

MATERIAL AND PROCESS CERTIFICATION DOCUMENTS ARE REVIEWED FOR COMPLIANCE WITH PROGRAM REQUIREMENTS BY INSPECTION.

CONTAMINATION CONTROL (FAILURE CAUSE b)

A CONTROLLED WORK AREA IS UTILIZED FOR ASSEMBLY AND TEST. PROPER MAINTENANCE OF CLEANLINESS CONTROL IS VERIFIED BY INSPECTION.

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

DETAILED INSPECTION PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY. PROPER CONNECTIONS, ALIGNMENT OF SLUGS AND SEALS, STRUCTURAL INTEGRITY, SOLDERING AND WELDS ARE VERIFIED BY RADIOGRAPHIC INSPECTION.

CRITICAL PROCESSES (FAILURE CAUSE a,b,e)

ALL CRITICAL PROCESSES AND CERTIFICATION, INCLUDING WELDING AND SOLDERING ARE MONITORED AND VERIFIED BY INSPECTION.

TESTING (FAILURE CAUSE a,b,e)

ACCEPTANCE TESTS INCLUDING THERMAL SHOCK, VOLTAGE AGING, HERMETIC SEAL AND RADIOGRAPHIC TESTS ARE MONITORED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING (FAILURE CAUSE a,b)

HANDLING, PACKAGING, STORAGE AND SHIPPING PROVISIONS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

FAILURE HISTORY IS TRACKED IN THE PRACA SYSTEM.

(E) OPERATIONAL USE:

FUEL TANK VALVE CLOSED BY INADVERTENT CONTROLLER OUTPUT PULSE (SINGLE PULSE THAT DOESN'T REPEAT) CAN BE REGAINED ONCE THE APU WAS SHUTDOWN BY CYCLING THE FUEL TANK ISO VALVE SWITCH AND PERFORMING AN APU RESTART. THE VALVE CAN BE REGAINED DURING APU OPERATION BY CYCLING THE AUTO SHUTDOWN SWITCH OR THE APPROPRIATE CIRCUIT BREAKER.

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- APPROVALS -

EDITORIALLY APPROVED
EDITORIALLY APPROVED
TECHNICAL APPROVED

: RI
: JSC
: VIA CR

Handwritten signature and date:
1/20/94
550230AF