INTRODUCTION TO APPENDIX E

ITEM 1 - RESISTOR - FILM - RLR42
ITEM 2 - RESISTOR - FILMED FILM - RLR07
ITEM 3 - RESISTOR - WIRE WOUND - RWR80
ITEM 4 - RESISTOR - FIXED, POWER WIRE WOUND - RE77
ITEM 5 - RESISTOR - FIXED, POWER WIRE WOUND - RER65
ITEM 6 - RESISTOR - FIXED FILM - RLR20

THE FOLLOWING TABLE LISTS FAILURE MODES AND CAUSES WHICH WERE CONSIDERED IN DERIVING THE FAILURE MODES AND EFFECTS ANALYSIS (FMEA'S).

FAILURE MODE / Failure Cause	RLR42	RLR07	RWR80	RE77	RER65	RLR20
OPEN (a) Structural Failure Mechanical Stress Vibration (c) Electrical Stress (d) Thermal Stress (e) Processing Anomaly	X	X	X	X	X	X
SHORT (END TO END) (a) Structural Failure Mechanical Stress Vibration (b) Contamination (c) Electrical Stress (d) Thermal Stress (e) Processing Anomaly			X	X	X	
SHORT TO STRUCTURE (GROUND) (a) Structural Failure Mechanical Stress Vibration (b) Contamination (c) Electrical Stress (d) Thermal Stress (e) Processing Anomaly				X	X	

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APPENDIX E ITEM 5 - RESISTOR - FIXED WIRE WOUND - CHASSIS MOUNTING
RER65E2150M

RETENTION RATIONALE:
(A) DESIGN, (B) TEST, (C) INSPECTION, (D) FAILURE HISTORY

(A) DESIGN

THE DEVICE IS A 6 WATT FIXED RESISTOR WITH A WIRE WOUND ELEMENT. THE RESISTOR IS PACKAGED IN A CHASSIS MOUNTED, POWER TYPE CASE. THE PART DISSIPATES HEAT THROUGH A METAL MOUNTING SURFACE. THIS RESISTOR IS SUITABLE FOR CONTINUOUS FULL LOAD OPERATION AT AN AMBIENT TEMPERATURE OF 25 °C AND, WHEN DERATED, UP TO 275 °C. THE PART IS NOT SUITABLE FOR APPLICATIONS WHERE THE ALTERNATING CURRENT CHARACTERISTICS ARE OF IMPORTANCE: HOWEVER, INDUCTANCE EFFECTS HAVE BEEN MINIMIZED WHERE FEASIBLE. THE RESISTORS HAVE LIFE FAILURE RATE LEVEL OF .01% PER 1,000 HOURS. THIS FAILURE RATE LEVEL IS ESTABLISHED AT A 60% CONFIDENCE LEVEL ON THE BASIS OF LIFE TESTS. THE FAILURE RATE LEVEL IS REFERRED TO OPERATION AT FULL RATED WATTAGE AT 25 °C WITH PERMISSIBLE CHANGE IN RESISTANCE OF ±2% AT THE CRITERIA FOR FAILURE. THE PART IS DESIGNED TO MEET THE REQUIREMENTS OF MIL-R-39009/1. THE APPLICATION IS ALSO ANALYZED TO ASSURE COMPLIANCE WITH THE 25% DERATING CRITERIA OF THE ORBITER PROJECT PARTS LIST.

(B) TEST

THE PART IS SCREENED AND QUALIFIED TO THE REQUIREMENTS OF MIL-R-39009/1. THE DESIGN HAS BEEN QUALIFIED TO THE SPECIFICATION BY HAVING THE FOLLOWING TESTS AND INSPECTIONS PERFORMED:

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
CONDITIONING (RATED CURRENT, 96 HRS)		X			X
DC RESISTANCE		X			X
VISUAL AND MECHANICAL EXAMINATION	X				X
RESISTANCE-TEMPERATURE CHARACTERISTIC		X			X
TEMPERATURE (275 °C)				X	X
LOW TEMPERATURE STORAGE (-65 °C, 24 HRS)				X	X
DIELECTRIC WITHSTANDING VOLTAGE (4.5k V)		X	X		X
INSULATION RESISTANCE		X	X		X
LOW TEMPERATURE OPERATION (-55 °C, 30 MIN)				X	X

QUALIFICATION TESTS

APPENDIX E ITEM 5 CONT'D

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
MOMENTARY OVERLOAD (5X RATED WATTAGE)			X		X
MOISTURE RESISTANCE	X				X
TERMINAL STRENGTH	X				X
SHOCK (100G)	X				X
VIBRATION (20G)	X				X
LIFE (RATED POWER, 25 °C, 10,000 HRS)		X			X
HIGH TEMPERATURE EXPOSURE (275 °C,72 HR)				X	X
SOLDERABILITY		X			X

QUALIFICATION TESTS (CONT'D)

TESTS AND INSPECTIONS PERFORMED ON A SAMPLE OF PARTS FROM EACH LOT AS A PART OF QUALIFICATION ARE:

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
VISUAL AND MECHANICAL INSPECTION	X				X
MATERIAL					
DIMENSIONS					
DESIGN					
CONSTRUCTION					
MARKING					
WORKMANSHIP					
SOLDERABILITY		X			X
RESISTANCE-TEMPERATURE CHARACTERISTIC		X			X
TEMPERATURE				X	X
DIELECTRIC WITHSTANDING VOLTAGE		X	X		X
INSULATION RESISTANCE		X	X		X
LOW TEMPERATURE OPERATION				X	X
MOMENTARY OVERLOAD			X		X

QUALIFICATION TESTS (LOT SAMPLE)

APPENDIX E ITEM 5 CONT'D

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
LOW TEMPERATURE STORAGE	X			X	X
MOISTURE RESISTANCE			X		X
TERMINAL STRENGTH	X				X
SHOCK	X				X
VIBRATION	X				X
SOLDERABILITY		X			X
HIGH TEMPERATURE EXPOSURE				X	X

QUALIFICATION TESTS (PERIODIC)

TESTS OR INSPECTIONS PERFORMED ON ALL PARTS TO ASSURE ADEQUATE QUALITY CONTROL OF THE SUPPLIERS PROCESSES ARE:

TEST / INSPECTION	CAUSE CONTROL				
	a	b	c	d	e
POWER CONDITIONING (2 WATTS, 100 HRS)		X			X
DC RESISTANCE		X			X

QUALITY ASSURANCE TESTS (ALL DEVICES)

(C) INSPECTION

THE PART HAS REQUIRED INSPECTION DURING MANUFACTURING PROCESS IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-R-39009/1. IN ADDITION, THE PART SUPPLIER IS REQUIRED TO HAVE QUALITY CONTROL (QC) PRACTICES IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-R-39009 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).

APPENDIX E ITEM 5 CONT'D

RECEIVING INSPECTION (FAILURE CAUSE a,b,e)

INSPECTION OF INCOMING MATERIALS, UTILITIES AND WORK-IN 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 INSPECTION CRITERIA, FINAL LOT DISPOSITION AND RECORDS RETENTION. THE MANUFACTURER IS ALSO REQUIRED TO SUBMIT A PROGRAM PLAN ESTABLISHING A MANUFACTURING FLOW CHART, INTERNAL AUDIT ACTIVITIES AND EXAMPLES OF DESIGN, MATERIAL EQUIPMENT STANDARDS AND PROCESS INSTRUCTIONS FOR APPROVAL BY THE QUALIFYING AGENCY.

CRITICAL PROCESSES (FAILURE CAUSE a,e)

THE PART SUPPLIER MUST HAVE REQUIREMENTS AND CONTROLS ON MATERIALS PREPARATION; 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 MATERIAL 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.

APPENDIX E ITEM 5 CONT'D

(D) FAILURE HISTORY

SHUTTLE PROGRAM PART FAILURE HISTORY INDICATES NO REPORTED FAILURES FOR THIS DEVICE TYPE. A REVIEW OF GIDEP PRIOR MILITARY PART FAILURE HISTORY REVEALS NO UNCORRECTED GENERIC ISSUES EXIST.

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
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