

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-6-E2491 -X**

**SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL
REVISION: 2 04/30/99**

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:EMEC 1 AND 2	MC450-0016-0007 1640-507-1
LRU	:AMEC 1 AND 2	MC450-0016-0009 17850-507-101

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

ENHANCED MASTER EVENTS CONTROLLER (EMEC) OR ADVANCE MASTER EVENTS CONTROLLER (AMEC) NON-CRITICAL OUTPUTS AND INTERLOCK CIRCUITRY POST ARMING.

REFERENCE DESIGNATORS: 54V76A13
55V76A14

QUANTITY OF LIKE ITEMS: 2

TWO EMECS (OR AMECS) PER VEHICLE AND TWO CORES (A AND B) PER EMEC (OR AMEC)

FUNCTION:

DRIVERS USED TO ENABLE CRITICAL SRB/ET/ORB IGNITION/SEPARATION FUNCTIONS, ATVC DEADFACE, CONTROL SWITCHING OF SRB BUS POWER, AND COMMAND PYROTECHNIC INITIATOR CONTROLLER (PIC) TEST SIGNALS AS WELL AS PROCESS PIC RESPONSE DATA FOR PYRO CIRCUIT VERIFICATION (REFERENCE ASSOCIATED MEC/PIC CILS: 05-6-2509-01, 05-6-2509-02, 05-6-2510-01 AND 05-6-2510-02).

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LRU: EMEC 1 AND 2, AMEC 1 AND 2

CRITICALITY OF THIS

ITEM NAME: EMEC 1 AND 2, AMEC 1 AND 2

FAILURE MODE: 1R3

FAILURE MODE:

LOSS OF NON-CRITICAL OUTPUT (FIRE 3 COMMAND)

MISSION PHASE: PL PRE-LAUNCH
LO LIFT-OFFVEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS "B" SCREEN BECAUSE REDUNDANT CORE OUTPUT COMMANDS ARE NOT MONITORED.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF FUNCTION (FIRE 3 COMMAND) TO ENABLE OR CONTROL CRITICAL FUNCTIONS IN MEC CORE A OR CORE B.

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(B) INTERFACING SUBSYSTEM(S):

LOSS OF REDUNDANCY FOR COMPLETION OF CRITICAL FUNCTIONS. LOSS OF QUALIFIER FOR FIRE 2 COMMAND FOR CORE A OR B FOR ONE OF TWO MASTER EVENT CONTROLLERS. NO EFFECT - THE OTHER CORE OR THE OTHER MEC WILL COMPLETE THE FUNCTION.

(C) MISSION:

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER THE THIRD FAILURE DUE TO FAILURE TO PERFORM A CRITICAL FUNCTION SUCH AS SRB OR ET SEPARATION VIA THE FOLLOWING SCENARIO:

- (1) LOSS OF A FIRE 3 COMMAND OUTPUT.
- (2) LOSS OF THE SAME FIRE 3 COMMAND OUTPUT FOR THE OTHER CORE IN THE SAME EMEC (OR AMEC).
- (3) FAILURE OF THE PYRO INITIATOR WHICH IS FIRED BY THE OTHER EMEC(OR AMEC).

ALSO POTENTIAL LOSS OF CREW/VEHICLE AFTER FOUR FAILURES (1) LOSS OF ONE EMEC (OR AMEC) CORE OUTPUT TO A PIC COMMAND, (2) LOSS OF REDUNDANT CORE OUTPUT TO THE SAME PIC COMMAND AND (3) AND (4) LOSS OF CRITICAL PIC COMMANDS FROM BOTH CORES IN THE REDUNDANT EMEC (OR AMEC).

-DISPOSITION RATIONALE-

(A) DESIGN:

FUNCTIONAL DESCRIPTION

THE ENHANCED MASTER EVENTS CONTROLLER (EMEC) OR ADVANCE MASTER EVENTS CONTROLLER (AMEC) CONSISTS OF AN INTERFACE WHICH RECEIVES COMMANDS FROM THE GENERAL PURPOSE COMPUTER (GPC'S) VIA SEPARATE MULTIPLE INTERFACE ADAPTERS (MIA'S) AND WHICH TRANSMITS TEST AND MEASUREMENT DATA ON ONE

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CHANNEL TO ONE OF THE GPC'S. VALID COMMANDS ARE DECODED AND USED TO ENABLE THE REQUIRED PYRO INITIATOR CONTROLLER (PIC) INPUT COMMANDS. THERE ARE A MAXIMUM OF 57 CRITICAL COMMAND DATA WORDS AND ASSOCIATED DRIVERS TO THE INTERNAL AND REMOTE PIC'S. THE ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL (EEE) COMPONENTS FOR EMEC ARE SELECTED IN ACCORDANCE WITH ORBITER PREFERRED PARTS LIST (OPPL) REQUIREMENTS, EXCEPT WHERE THE USE OF NON-OPPL HAD BEEN AUTHORIZED. FOR THE AMEC, THE EEE COMPONENTS ARE SELECTED IN ACCORDANCE WITH ORBITER PROJECT PARTS REQUIREMENTS (OPPR), EXCEPT WHERE THE USE OF NON-OPPR HAD BEEN AUTHORIZED. COMPONENT APPLICATIONS ARE EVALUATED TO ASSURE COMPLIANCE WITH DERATING REQUIREMENTS.

PHYSICAL DESCRIPTION

THE DESIGN INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGN AND CONSTRUCTION PER SPECIFICATION MC450-0016.

THE CERTIFIED PART NUMBER FOR EMEC IS MC450-0016-0007, AND THE CERTIFIED PART NUMBER FOR AMEC IS MC450-0016-0009.

DESIGN EVOLUTION

THE -0007 (EMEC) CONFIGURATION INCORPORATED EXTENSIVE REDESIGN AND UTILIZED CURRENT TECHNOLOGY IN COMPONENTS AND ASSEMBLY WITH A NEW BOX MECHANICAL DESIGN WHICH WOULD BE PHYSICALLY INTERCHANGEABLE WITHOUT MODIFICATION WITH THE -0006 CONFIGURATION AND WOULD BE FUNCTIONALLY TRANSPARENT IN FLIGHT AND DURING GROUND TEST. THIS ENHANCED MEC (EMEC) WEIGHS LESS, REQUIRES LESS POWER, AND UTILIZES FEWER COMPONENTS THAN THE -0006 CONFIGURATION.

THE -0009 (AMEC) CONFIGURATION IS SIMILAR TO THE -0007 (EMEC) CONFIGURATION IN DESIGN REQUIREMENTS, MECHANICAL CONSTRUCTION, ELECTRICAL INTERFACES, MANUFACTURING PROCESSES, PRODUCTION TECHNIQUES & SEQUENCES, AND MATERIALS EXCEPT FOR CIRCUIT BOARD SOLDERING USING CONVECTION REFLOW RATHER THAN VAPOR PHASE REFLOW FOR THE EMEC. THE AMEC HAS SAME LOGIC AS EMEC, BUT PARTIONED IN FEWER HIGH-DENSITY ELECTRICAL PROGRAMABLE LOGIC DEVICES (EPLD'S).

**(B) TEST:
QUALIFICATION/CERTIFICATION**

CERTIFICATION TESTING AND ANALYSIS FOR THE EMEC'S ARE COMPLETED AND APPROVED. QUALIFICATION TESTING (QUAL TEST REPORT C90-682/701) INCLUDING FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), THERMAL VACUUM, AND LIFE HAS BEEN PERFORMED.

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CERTIFICATION TESTING FOR THE AMEC'S INCLUDED FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, AND ELECTROMAGNETIC COMPATIBILITY (EMC). THERMAL VACUUM AND LIFE ARE CERTIFIED BY SIMILARITY AND ANALYSIS.

ACCEPTANCE AND SCREENING

EACH UNIT IS SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ALO-5138) AT THE REPAIR CENTER INCLUDING VISUAL EXAMINATION, FULL FUNCTIONAL, ACCEPTANCE THERMAL TEST (ATT) AND ACCEPTANCE VIBRATION TEST (AVT).

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

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

CONTAMINATION CONTROL

A CONTROLLED WORK AREA IS UTILIZED FOR ASSEMBLY AND TEST. QUALITY CONTROL (QC) VERIFIES PROPER MAINTENANCE OF CLEANLINESS CONTROL.

ASSEMBLY/INSTALLATION

INSPECTION POINTS ARE DETERMINED BY QUALITY ENGINEERING IN ACCORDANCE WITH APPLICABLE REQUIREMENTS AND ARE DOCUMENTED ON INSPECTION PLANNING. WORK STATION DISCIPLINES ADHERED TO AND OBSERVED MORE THAN FIVE TIMES PER WEEK BY QC.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY QC AS PROCESS CONTROL SURVEILLANCE ACTIVITY (OPERATIONS AUDIT). THE CRITICAL PROCESSES ARE SOLDERING, BONDING OF COMPONENTS FOR MECHANICAL STABILITY/THERMAL CONDUCTIVITY, COMPONENT PLACEMENT, WIRE ROUTING, AND CRIMPING. FORMAL CERTIFICATION FOR SOLDERING AND QUALIFICATION FOR CRIMPING ARE MAINTAINED.

TESTING

ACCEPTANCE TESTS, INCLUDING VIBRATION, THERMAL AND INSULATION RESISTANCE (IR), ARE OBSERVED AND VERIFIED BY QC.

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HANDLING/PACKAGING

HANDLING OF CMOS/MOS DEVICES TO PRECLUDE ELECTROSTATIC DISCHARGE (ESD) VERIFIED BY QC. PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

MC450-0016-0007 CONFIGURATION

FAILURE MODE: LOSS OF OUTPUT

CAR AD7080

DURING MODULE LEVEL CONFIDENCE TESTING, A FAILURE WAS DETECTED THAT CAUSED THE MIA I/O MODULE TO RESPOND WITH ONLY ONE DATA WORD WHICH WAS DEFECTIVE REGARDLESS OF THE NUMBER OF WORDS THAT WAS COMMANDED TO TRANSMIT. THE PROBLEM WAS TRACED TO A POTENTIAL RACE CONDITION OF THE LOGIC IN THE ERASABLE PROGRAMMABLE LOGIC DEVICE (EPLD) THAT CREATED THE TDA SIGNAL. REPROGRAMMING THE EPLD REMOVED THE RACE CONDITION.

MC450-0016-0009 CONFIGURATION

FAILURE MODE: LOSS OF OUTPUT

FOR THE -0009 CONFIGURATION, THERE HAS BEEN NO FAILURE DOCUMENTED FOR THE FAILURE MODE OF LOSS OF OUTPUT.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

SS & PA ENGINEER	: T. AI	: <i>[Signature]</i> 4/30/99
SS & PAE MANAGER	: P. STENGER-NGUYEN	: <i>[Signature]</i> 4/30/99
EPD&C SUBSYSTEM MANAGER	: R. PHAN	: <i>[Signature]</i> 5/2/99
HARDWARE SSM	: P. VU	: <i>[Signature]</i> 4/30/99
USA SAM	:	: <i>[Signature]</i> 4/21/99
USA PROJECT MANAGER	:	: <i>[Signature]</i> 4/15/99

[Signature] 5/18/99

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NASA MOD

Henry G. Hill 5/18/99