FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 05-5-603-1 -X

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)
REVISION: 8 08/23/93

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MULTIPLEXER-DEMULTIPLEXER HONEYWELL	MC615-0004-5210 4020534-942
LRU	: MULTIPLEXER-DEMULTIPLEXER HONEYWELL	MC615-0004-5210 4020534-952

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FLIGHT AFT MDM: "FA1", "FA2", "FA3", AND "FA4".

REFERENCE DESIGNATORS: 54V72A7
55V72A8
56V72A9
56V72A10

QUANTITY OF LIKE ITEMS: 4
FOUR

FUNCTION:
PROVIDES MULTIPLEXED INTERFACE BETWEEN THE COMPUTER, ACTUATORS, AND SOME GUIDANCE NAVIGATION AND CONTROL (GN&C) SENSORS. CONVERTS ANALOG/DISCRETE SUBSYSTEM DATA TO A DIGITAL FORM FOR DATA BUS TRANSFER. PROVIDES DATA BUFFERING, FORMAT CONVERSION AND DISCRETE DATA CONDITIONING FOR COMMAND OUTPUTS TO CRITICAL FUNCTIONS SUCH AS AEROSURFACES ACTUATION, ENGINE GIMBALLING, ELECTRO MECHANICAL DEVICES, REACTION CONTROL SYSTEM (RCS) CONTROL, ETC. EACH MDM CONTAINS INTERNAL REDUNDANT POWER SUPPLY SECTION AND REDUNDANT DATA HANDLING SECTIONS (CORES).

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REVISION#: 9 03/27/96

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)
LRU: MULTIPLEXER-DEMULTIPLEXER CRITICALITY OF THIS
ITEM NAME: MULTIPLEXER-DEMULTIPLEXER FAILURE MODE: 1/1

FAILURE MODE:
ERRONEOUS OUTPUT

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
ADDRESS VALIDATION BY FAILED CHIP, FAILED ELEMENT IN DATA PATH, FAILED SELECTOR/DECODER CIRCUIT, ADDRESS CHECK FAILURE, DATA ERROR TO MDM MODULE, MDM MODULE/CHANNEL SELECT FAILURE, ANALOG/DIGITAL (A/D) CONVERTER FAILURE, PIECE PART FAILURE IN THE SEQUENCE CONTROL UNIT (SCU).

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ONE MDM

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(B) INTERFACING SUBSYSTEM(S):
DATA FOR ANOTHER LINE REPLACEABLE UNIT (LRU) EXECUTED, OR WRONG CHANNEL, TASK, OR MODULE BEING SELECTED.

(C) MISSION:
POSSIBLE EARLY MISSION TERMINATION DECISION DUE TO LOSS OF REDUNDANCY.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
CRITICALITY 1/1 BECAUSE OF THE FOLLOWING REASON:

ON ORBIT:
FA MDM ERRONEOUS OUTPUT COMMANDS TO ENABLE MAIN REACTION CONTROL SYSTEM (RCS, DURING PROXIMITY OPERATIONS CAN RESULT IN LOSS OF CREW/VEHICLE.

CRITICALITY 1R2 BECAUSE OF THE FOLLOWING REASONS:

ALL PHASES:
A SINGLE ANALOG OUTPUT PROBLEM TO THE GENERAL PURPOSE COMPUTER (GPC) HAS NO EFFECT. TWO LIKE ANALOG OUTPUT FAILURES TO THE GPC THAT PROVIDE A BIASED OUTPUT THAT IS BELOW THE SOFTWARE REDUNDANCY MANAGEMENT THRESHOLD CAN RESULT IN A LOSS OF VEHICLE IF IT OCCURS ON THE FOLLOWING SENSORS - ORBITER RATE GYRO ASSEMBLIES (RGA'S) AND ORBITER POSITION FEEDBACKS. THE TYPE OF MDM FAILURES THAT CAN PRODUCE THIS PROBLEM ARE A/D CONVERTER, MODULE SELECTOR, CHANNEL SELECTOR, AND DENDRITE GROWTHS IN INPUT FILTER CAPACITORS. CR79963C PROVIDES PARTIAL DETECTION OF ANALOG INPUT CARD FAILURES BY EXECUTING A/D BUILT IN TEST EQUIPMENT (BITE) TEST.

FOR ASCENT/ENTRY:
A FAILURE CONDITION SUCH THAT RESPONSE DATA FROM MDMS TO GPCS HAS LESS THAN 5 MICROSECOND GAPS BETWEEN CONSECUTIVE WORDS, CAN CAUSE A NON-UNIVERSAL I/O ERROR CONDITION DUE TO DIFFERING PERCEPTION OF ARRIVING DATA AMONG THE GPCS OF THE PASS REDUNDANT SET. DURING ASCENT AND ENTRY, ENGAGE OF THE BFS IS THEN REQUIRED. A SUBSEQUENT FAILURE CAUSING LOSS OF BFS CAN RESULT IN LOSS OF VEHICLE/CREW.

FOR ASCENT:
(1) UNVOTED EFFECTORS, NO EFFECT ON 1ST FAILURE. 2ND RELATED FAILURE COULD CAUSE EXTERNAL TANK (ET) SEPARATION DOORS TO CLOSE PREMATURELY, RESULTING IN BENT LINKAGE WHICH PREVENTS SUBSEQUENT DOOR CLOSING.
(2) MDM FA1, 2, 3, OR GPC 1, 2, OR 3 ERRONEOUS OUTPUT WHICH RESULTS IN BODY FLAP ENABLE AND UP COMMANDS ON THE SAME CHANNEL, COUPLED WITH LOSS OF OUTPUT ON ANOTHER CHANNEL (GPC, MDM, ACTUATOR, MOTOR OR AUXILIARY POWER UNIT (APU)), WILL CAUSE THE BODY FLAP TO DRIVE IN THE UP DIRECTION, CONTACTING AN ENGINE BELL. THIS CAN RESULT IN LOSS OF CREW/VEHICLE.

(3) IDENTICAL ERRONEOUS OUTPUTS FROM TWO FA MDM'S (FA1, 3 OR 4) CAN RESULT IN OPENING BOTH SERIES CONNECTED RTLS LH2 DUMP VALVES, DUMPING LH2 OVER ORBITER WING. IF LESS THAN 100,000 FEET, COULD RESULT IN EXPLOSION. SIMILAR ERRONEOUS OUTPUTS CAN OPEN TWO SERIES LH2 MANIFOLD REPRESSURIZATION VALVES WHICH CAN INJECT GASEOUS HE AND H2 INTO THE LH2 MANIFOLD RESULTING IN POSSIBLE SSME COMBUSTION INSTABILITY.
(4) TWO FA MDM FAILURES THAT CAUSE IMPROPER COMMANDS TO A SUFFICIENT NUMBER OF JETS CAN RESULT IN ORBITER ET CONTACT OR AN ORBITER OUT-OF-CONTROL CONDITION AT SEPARATION.

-DISPOSITION RATIONALE-

(A) DESIGN:
ALL PARTS SELECTED FROM MF0004-400 ORBITER PROJECT PARTS LIST (OPPL) WHICH CALLS FOR JANTXV LEVEL PARTS, OR HAVE ADEQUATE DERATING FACTORS OF 25-50% ON HYBRIDS & TRANSISTORS, 25-30% ON RESISTORS, CAPACITORS AND OTHER COMPONENTS. PARTS THAT DID NOT MEET ORBITER PROJECT PARTS LIST REQUIREMENTS FOR QUALIFICATION, TRACEABILITY SCREENING OR BURN-IN WERE REVIEWED AND WERE FOUND ACCEPTABLE FOR THEIR GIVEN FUNCTIONS. REDUNDANT COMMAND/SIGNALS FOR CRITICAL FUNCTIONS ROUTED THROUGH SEPARATE MDM'S. DESIGN ALSO INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGNS AND CONSTRUCTION PER SPECIFICATION MC615-0004.

(B) TEST:
EACH UNIT SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ATP) TEST (T4025545) AT HONEYWELL INCLUDING CONTINUITY, FULL FUNCTIONAL, ACCEPTANCE VIBRATIONAL TEST (AVT), ACCEPTANCE THERMAL TEST (ATT), EXAMINATION OF PRODUCT, INSULATION RESISTANCE TEST, DIELECTRIC STRENGTH TEST, PERFORMANCE, AND POWER VARIATION TEST

QUALIFICATION TEST (T4025763) COMPLETED AT HONEYWELL INCLUDING FULL FUNCTIONAL, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), HUMIDITY, THERMAL, VIBRATION, THERMAL VACUUM, LIGHTNING, SHOCK, SALT/FOG, 1000 ON/OFF CYCLE LIFE TEST, ACCELERATION, AND EXPLOSIVE/CORROSIVE ATMOSPHERE.

GROUND TURNAROUND TEST: ALL TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
CERTIFICATIONS & SOURCE INSPECTION TEST REPORTS ARE ON FILE. CASES AND FLATPACKS ARE ENVIRONMENTALLY SCREENED, INCLUDING LOOSE PARTICLE DETECTION IN RECEIVING INSPECTION. ALL HYBRID COMPONENTS ARE LOT SAMPLED IN RECEIVING INSPECTION.

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CONTAMINATION CONTROL
CLEANLINESS TO CLASS 100,000 LEVEL IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
VISUAL INSPECTION IS PERFORMED AT KIT RELEASE. PRINTED WIRING BOARD MICROSECTION ANALYSIS IS PERFORMED AND MONITORED BY INSPECTION. QUALITY CONTROL VERIFIES AND WITNESSES TORQUE OPERATIONS. QUALITY CONTROL VERIFIES SOLDERED CONNECTIONS AND ASSEMBLY OF PARTS. TOOL CERTIFICATION AND TENSILE TESTS ARE MAINTAINED. QUALITY CONTROL PERFORMS PRE-CAP VISUAL INSPECTION FOR CLEANLINESS. QUALITY CONTROL VERIFIES CONVEYOR FURNACE PROFILE/TEMPERATURE EVERY 90 DAYS. QUALITY CONTROL VERIFIES ALL FLATNESS & SURFACE ROUGHNESS FOR PROPER HEAT TRANSFER. THERMAL PROTECTION CONTROLS EXIST FOR ALL SOLDERED CONNECTIONS.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF SELECTED COMPONENTS, I.E., TANTALUM CAPACITORS, IS PERFORMED.

CRITICAL PROCESSES
INSPECTION VERIFIES CRIMPING OPERATIONS AND CERTIFICATION. SOLDERING REQUIREMENTS PER NHB5300.4(3A) ARE VERIFIED BY INSPECTION.

TESTING
ATP IS OBSERVED AND VERIFIED BY QUALITY CONTROL, INCLUDING AVT AND ATT.

HANDLING/PACKAGING
PROPER GROUNDING OF ELECTRICALLY STATIC SENSITIVE DEVICES WHEN HANDLING IS PERFORMED. PACKAGING AND PROTECTION VERIFIED BY INSPECTION.

(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 DATABASE

(E) OPERATIONAL USE:

PORT MODING TO RECOVER MDM FUNCTIONALITY IS AVAILABLE AS FOLLOWS:

A) MM102 - PORTMODING WILL NOT BE PERFORMED UNLESS IT IS NECESSARY FOR CRITICAL CAPABILITY.

B) POST MM102 TO PRE MECO - PORTMODING MAY BE PERFORMED TO REGAIN CRITICAL CAPABILITY OR AFTER ANY SECOND FAILURE. NON-CRITICAL RECOVERY WILL NOT BE PERFORMED FOR NON-UNIVERSAL I/O ERROR CASES.

C) POST MECO - PORTMODING MAY BE PERFORMED IN ANY VALID PHASE OR OPS, EXCEPT FOR NON-UNIVERSAL I/O ERROR CASES.

(REFERENCE FLIGHT RULE 7-31)

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- APPROVALS -

EDITORIALLY APPROVED	: RI	:
EDITORIALLY APPROVED	: JSC	: 5-1-96
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-013_05-5