FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 05-5-B03-2 -X

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)
REVISION: 9 01/10/94

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MULTIPLEXER-DEMULTIPLEXER HONEYWELL	MC615-0004-5110 4020534-941
LRU	: MULTIPLEXER-DEMULTIPLEXER HONEYWELL	MC615-0004-6110 4020534-961

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FLIGHT FORWARD MDM: "FF1", "FF2", "FF3", AND "FF4".

REFERENCE DESIGNATORS: 81V72A3
82V72A4
83V72A5
82V72A6

QUANTITY OF LIKE ITEMS: 4
FOUR

FUNCTION:
PROVIDES MULTIPLEXED INTERFACE BETWEEN THE GUIDANCE NAVIGATION AND CONTROL (GN&C) SENSORS AND THE DATA PROCESSING SUBSYSTEM (DPS) COMPUTER COMPLEX. CONVERTS ANALOG/SUBSYSTEM DATA TO A DIGITAL FORM FOR DATA BUS TRANSFER. PROVIDES DATA BUFFERING, FORMAT CONVERSION AND DISCRETE DATA CONDITIONING FOR TRANSFERRING REQUEST/RESPOND DATA BETWEEN THE COMPUTER AND THE GN&C SENSORS. MDM'S ALSO PROVIDE LOGIC SIGNALS FOR OPENING/CLOSING ELECTRO MECHANICAL DEVICES. PROVIDES HANDOVER OF THE STATE VECTOR UPDATES AND COMMANDS FROM THE NETWORK SIGNAL PROCESSORS (NSP) TO THE DPS VIA MDM'S FF1 AND FF3. MDM FF3 INTERFACES THE GN&C GENERAL PURPOSE COMPUTER'S (GPC) WITH THE KU-BAND RADAR. EACH MDM CONTAINS INTERNAL REDUNDANT POWER SUPPLY SECTIONS AND REDUNDANT DATA HANDLING SECTIONS (PORTS).

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 05-5-B03-2-02

REVISION#: 10 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, ANALOG/DIGITAL (A/D), DENDRITE GROWTHS, MODULE AND CHANNEL SELECTS, ADDRESS CHECK FAILURE, DATA ERROR TO MDM MODULE, MDM MODULE/CHANNEL SELECT FAILURE, 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 MDM.

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: 05-S-B03-2-02

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

ON-ORBIT:
FF3 FAILURE WILL LOSE (VALID) RENDEZVOUS RADAR INPUT DATA TO GN&C. BACKUP PROCEDURES ARE IN PLACE TO ALLOW A RENDEZVOUS WITHOUT THE DATA.

FOR ENTRY:

FF1/FF2 FAILURE WILL LOSE NOSE WHEEL STEERING 1 (NWS1) CAPABILITY.
FF3/FF4 FAILURE WILL LOSE NOSE WHEEL STEERING 2 (NWS2) CAPABILITY.

(C) MISSION:
LOSS OF ONE FF MDM RESULTS IN POSSIBLE EARLY MISSION TERMINATION 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:
FF MDM ERRONEOUS OUTPUT COMMANDS TO ENABLED MAIN REACTION CONTROL SYSTEM (RCS) DURING PROXIMITY OPERATIONS CAN RESULT IN LOSS OF CREW/VEHICLE.

CRITICALITY 1R2 BECAUSE OF THE FOLLOWING REASONS:

ALL PHASES:
(1) A SINGLE ANALOG OUTPUT PROBLEM TO THE GPC HAS NO EFFECT. TWO LIKE ANALOG OUTPUT FAILURES TO THE GPC THAT PRODUCES A BIASED OUTPUT THAT IS BELOW THE SOFTWARE REDUNDANCY MANAGEMENT THRESHOLD CAN RESULT IN A LOSS OF VEHICLE DUE TO ERRONEOUS DATA INPUT TO THE GPC FOR NUMEROUS SUBSYSTEMS (AA, RHC, SBTC, RPTA, ETC). CR79993C PROVIDES PARTIAL DETECTION OF ANALOG INPUT CARD FAILURES BY EXECUTING INPUT OUTPUT MODULE (IOM) BUILT IN TEST EQUIPMENT (BITE) TEST.
(2) LOSS OF OUTPUT FROM ONE INERTIAL MEASUREMENT UNIT (IMU) OR A FF MDM CHANNEL PROCESSING IMU DATA, FOLLOWED BY FAILURE OF ANOTHER IMU OR A FF MDM WITH ERRONEOUS OUTPUT SUCH THAT THE AVERAGE OF THE TWO REMAINING CHANNELS IS CORRUPTED, WILL LEAD TO INCORPORATION OF FAULTY IMU DATA BY ALL COMPUTERS AND POSSIBLE LOSS OF VEHICLE/CREW

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-

FAILURE MODES EFFECTS ANALYSIS (FMEA) CIL FAILURE MODE
NUMBER: 05-5-B03-2-02

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 SECOND FAILURE CAUSING LOSS OF BFS CAN RESULT IN LOSS OF VEHICLE/CREW.

FOR ASCENT:
TWO FF MDM FAILURES THAT CAUSE IMPROPER COMMANDS OF A SUFFICIENT NUMBER OF JETS CAN RESULT IN ORBITER EXTERNAL TANK (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.

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: 05-5-B03-2- 02

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)

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: 05-5-B03-2-02

- APPROVALS -

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