

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : INSTRUMENTATION FMEA NO 05-4 -320201-1 REV: 9/7/85

ASSEMBLY : MULTIPLE
P/N RI : 1V070-751061, 755264, 265, 266, 267
P/N VENDOR: MC476-0131
QUANTITY : 5
: FIVE
:

VEHICLE 102 103 104
EFFECTIVITY: X X X
PHASE(S): PL X LO X OO X DO X LS X

CRIT. FUNC: 1R
CRIT. HDW: 3

PREPARED BY: W S MCKEE
DES R GREGORIAN
REL E GUTIERREZ
QE

REDUNDANCY SCREEN: A-PASS B-FAIL C-PASS

APPROVED BY: *A.C. Mendenhall 9/2/85*
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QE *A.C. Mendenhall 9/2/85*

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REL *C. K. ... 9/1/85*
QE *A.C. Mendenhall 9/2/85*

ITEM:
SIGNAL CONDITIONER, DEDICATED. (DSC)
OP04, OLO1, OLO2, OR01, OR02

FUNCTION:
CONDITIONS SIGNALS FROM TRANSDUCERS LOCATED THROUGHOUT THE VEHICLE AND PROVIDES ISOLATION TO BE COMPATIBLE WITH DEDICATED DISPLAYS AND MULTIPLEXER DEMULTIPLEXER (MDM) INPUT.
REFERENCE DESIGNATORS: 22V75A22, 51V75A25, 51V75A77, 52V75A24, 52V75A78.

FAILURE MODE:
LOSS OF POWER SUPPLY OUTPUT, POWER SUPPLY OUTPUT SHORTED TO GROUND, ERRONEOUS POWER SUPPLY OUTPUT

CAUSE(S):
PIECE-PART FAILURE, VIBRATION, TEMPERATURE, MECHANICAL SHOCK, CONTAMINATION.

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) NO EFFECT.

(B) NO EFFECT.

(C) NO EFFECT.

(D) FIRST FAILURE: LOSS OF ONE OF TWO REDUNDANT POWER SUPPLIES ON ONE OF THE DSC'S.

SECOND FAILURE: LOSS OF THE SECOND POWER SUPPLY OF THE SAME DSC RESULTS IN. LOSS OF UP TO 60 MEASUREMENTS.

THIRD FAILURE: LOSS OF THE DSC MEASUREMENTS MAY CONCEAL A CRITICAL SUBSYSTEM FAILURE WHICH MAY CAUSE LOSS OF CREW/VEHICLE.

FAILS SCREEN "B" BECAUSE FIRST POWER SUPPLY FAILURE IS NOT DETECTABLE. THE 15-MODULE DSC'S DO NOT CONTAIN BITE.

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DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE DSC ACCOMMODATES A FLEXIBLE MIX OF INPUT SIGNALS THROUGH THE INTERCHANGE OF PLUG-IN MODULES. THE DSC IS PACKAGED IN A SINGLE BOX. SPACE AND CONNECTORS ARE PROVIDED WITHIN THE DSC TO ACCEPT A MAXIMUM OF 30 MULTIPLE CONDITIONING MODULES. THESE FIVE DSC'S ARE HALF-SIZED CONTAINING ONLY 15 MODULES AND NO BUILT-IN-TEST EQUIPMENT. THE DSC INCLUDES ANY MIX OF THE FOLLOWING MODULES: DC AMPLIFIERS, ATTENUATORS, ANALOG BUFFERS, AC TO DC VOLTAGE CONVERTERS, VARIABLE RESISTANCE TO DC VOLTAGE CONVERTER, PULSE TO DC VOLTAGE CONVERTERS, AND DISCRETE BUFFERS. THE DSC OPERATES FROM 2 ORBITER REDUNDANT 28 VDC MAIN POWER SOURCES. THE CHASSIS - MOTHER INTERCONNECT BOARD CONTAINS CONNECTORS, WIRING, 2 POWER SUPPLIES AND OTHER COMPONENTS TO ACCOMMODATE A FLEXIBLE MIX OF MODULES. EACH DSC IS CONFIGURED TO MEASUREMENT LIST REQUIREMENTS. EEE PARTS ARE SELECTED FROM OR IN ACCORDANCE WITH MF0004-400(OPPL) REQUIREMENT. THE DSC HAS A MINIMUM DESIGN LIFE OF 25,000 HOURS, WHICH IS EQUIVALENT TO 100 ORBITAL MISSIONS AND CHECKOUT IN A 10 YEAR PERIOD.

(B) TEST

ACCEPTANCE REQUIREMENTS: EACH DSC ELEMENT IS SUBJECTED TO THE FOLLOWING: EXAMINATION OF PRODUCT, FUNCTIONAL AND PERFORMANCE TEST, ACCEPTANCE VIBRATION TESTS(AVT), ACCEPTANCE THERMAL TESTS(ATT), INSULATION RESISTANCE TESTS, DIELECTRIC STRENGTH TESTS.

A FUNCTIONAL TEST IS PERFORMED FOR EACH COMPLETE DSC ASSEMBLY.

QUALIFICATION TESTS INCLUDE:

ACCEPTANCE TEST, POWER TEST, EMC, SALT FOG, HUMIDITY, VIBRATION, ACCELERATION, THERMAL VACUUM, LIFE, EXPLOSIVE/ATMOSPHERE, SHOCK.

GROUND TURNAROUND TEST

POWER SUPPLIES ARE VERIFIED BY MONITORING PREDETERMINED AMBIENT ANALOG MEASUREMENTS WHILE THE DSC IS OPERATING FROM EITHER REDUNDANT BUS INDEPENDENTLY. INDIVIDUAL MEASUREMENTS DEEMED NECESSARY BY INTERFACING SUBSYSTEMS ARE VERIFIED WITH THAT SUBSYSTEM.

(C) INSPECTION

RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES PURCHASED MATERIALS TO THE EXTENT NECESSARY TO ASSURE CONFORMANCE TO THE APPLICABLE TECHNICAL REQUIREMENTS OF THE PURCHASE ORDER AND DRAWINGS PER DOCUMENTED POLICY. ENGINEERING SPECIFIES CRITICAL AND MAJOR PARAMETERS OF PURCHASED PARTS AND MATERIALS TO BE VERIFIED BY RECEIVING INSPECTION PER DOCUMENTED REQUIREMENTS. ALL CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED WITH THE ORIGINAL RECEIVING REPORT AND PACKING SLIP. COMPLETED RECEIVING REPORTS ARE MAINTAINED IN THE CLOSED PURCHASE ORDER FILE PER DOCUMENTED PROCEDURES.

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CONTAMINATION CONTROL

QUALITY ASSURANCE (QA) MONITORS AND AUDITS SHOP AREAS TO ENSURE THAT THE RESPONSIBLE PARTIES ARE IN COMPLIANCE WITH ALL SPECIFIED CONTAMINATION CONTROLS, PER DOCUMENTED INSTRUCTIONS.

ASSEMBLY/INSTALLATION

IN-PROCESS INSPECTION POINTS AND ESTABLISHED BY QA TO ENSURE ACCEPTABILITY OF ITEMS PRIOR TO SUBSEQUENT PROCESSING OR STOCKING, WHEN SUCH PROCESSING WOULD MAKE VERIFICATION OF ACCEPTABILITY OF PREVIOUS OPERATIONS IMPOSSIBLE, PER DOCUMENTED INSTRUCTIONS. A CRIMP LOG IS MAINTAINED, AND CRIMP TOOL CALIBRATION VERIFICATION COMPLIES WITH MSC-SPEC-Q-1A. ALL CRIMPS ARE VISUALLY INSPECTED.

CRITICAL PROCESSES

PROCESSING OPERATIONS ARE MONITORED FOR COMPLIANCE WITH QUALITY REQUIREMENTS, AND QA PERFORMS AUDITS TO VERIFY THAT PROCESSING REQUIREMENTS ARE MET. CRITICAL PROCESSES ARE CRIMPING, SOLDERING, SWAGING, COMPONENT BONDING, CONFORMAL COATING, SEALING AND ETCHING. CERTIFICATION OF OPERATORS IS VERIFIED FOR CRIMPING, SOLDERING, COMPONENT BONDING, CONFORMAL COATING, AND HARNESS/CABLE FABRICATION.

TESTING

QA REGULARLY CONDUCTS SURVEILLANCE OF PRODUCT TESTING IN ACCORDANCE WITH DOCUMENTED INSTRUCTIONS.

HANDLING/PACKAGING

PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS. SPECIAL HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED, TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING/TRANSPORTING/PACKAGING BETWEEN WORK STATIONS. CONTROLS ARE IMPLEMENTED TO PREVENT ELECTROSTATIC DISCHARGE, AND THE MAINTENANCE OF CONTROLS IS AUDITED BY QA.

(D) FAILURE HISTORY

THE "LOSS OF POWER OUTPUT", "POWER SUPPLY OUTPUT SHORTED TO GROUND", AND "ERRONEOUS POWER SUPPLY OUTPUT" FAILURES WILL BE ADDRESSED ON THIS CIL.

(1) CAR# 01F021, STS-1 FLIGHT, OV102, CMIB S/N 44, MC476-0147-3001, 4-12-81 A FAILURE OCCURRED WHICH WAS ATTRIBUTABLE TO AN INPUT SHORT IN THE POWER SUPPLY DURING STS 1. DURING ASCENT CB 2 ON PANEL 14 POPPED OPEN, RESULTING IN THE LOSS OF THE REDUNDANT POWER SUPPLY FOR DSC OF01 AND DSC OF04. BOTH DSC'S OPERATED THROUGHOUT THE FLIGHT FROM THE REDUNDANT POWER SUPPLY. DURING POST FLIGHT ANALYSIS, A SHORT WAS IDENTIFIED IN OF01. EXAMINATIONS REVEALED A PAPER CLIP HAD WORN THRU THE CONFORMAL COATING CAUSING A SHORT BETWEEN THE CHASSIS AND THE JUNCTION BETWEEN L5 AND R40 ON THE POWER SUPPLY CARD. THIS WAS A MANUFACTURING ESCAPE. ADDITIONAL INSPECTION POINTS WERE ADDED AND PERSONNEL HAVE BEEN INSTRUCTED.

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(2) CAR# AB6326, KSC, OV102, CMIB S/N 45, MC476-0147-3001, 03-06-80
DURING TESTING AT KSC THE DSC BITE INDICATED A POWER SUPPLY FAILURE.
FAILURE ANALYSIS REVEALED A LOW RESISTANCE SHORT (6000 OHM) RESULTING IN
LOSS OF 17VDC. THE CAUSE OF THE SHORT WAS IDENTIFIED AS CAPACITOR C7, PART
NUMBER 39014-2091, LOT DATE CODE 7434B IN THE POWER SUPPLY. ANALYSIS OF
THE PART REVEALED SLIGHT CRACKING AND DELAMINATION WHICH ALLOWED PARTIAL
SHORTING BETWEEN ELECTRODES. SEVERE ELECTRICAL OR MECHANICAL SHOCK ARE
THE PROBABLE CAUSE AND NO LOT OR GENERIC TREND IS INDICATED. THE UNIT HAD
BEEN SUCCESSFULLY ATP'D THREE TIMES. THE MOST LIKELY CAUSE WAS FROM
HANDLING DURING SEVERAL REWORK CYCLES THE CMIB EXPERIENCED IN JULY 1977
(UPGRADED TO RELOCATE TWO POWER CONNECTORS FROM INSIDE TO OUTSIDE THE
CHASSIS) AND JANUARY 1978 (CORRECTED A WIRING SHORT IN THE HARNESS). EACH
CMIB USES 6 OF THESE CAPACITORS.

(3) CAR# AC4871, KSC, OV102, CMIB S/N 38, MC476-0147-3001, 10-31-82
DURING TURNAROUND TESTING AFTER STS-4 THE DSC BITE INDICATED A POWER
SUPPLY FAILURE. FAILURE ANALYSIS REVEALED A LOW RESISTANCE SHORT (2000
OHMS) IN CAPACITOR C7 PART NUMBER 39014-2091, DATE CODE 7434B, WITHIN THE
BITE MODULE CAUSING LOSS OF 5 VDC. THE CAUSE OF THE SHORT WAS A CRACK IN
THE OUTER EDGE OF THE CERAMIC ALLOWING CONTAMINATION TO ENTER WHICH
RESULTED IN THE SHORT. THIS PART WAS PLACED IN USE IN 1975 AND FAILED AFTER
EIGHT YEARS. THIS IS CONSIDERED A RANDOM FAILURE. ONLY ONE OTHER PART
NUMBER 39014-2091 CERAMIC CAPACITOR HAS FAILED FROM THIS LOT DATE CODE. NO
TREND IS ESTABLISHED AND NO ADDITIONAL CORRECTIVE ACTION IS REQUIRED.

(4) CAR A00496, KSC, OV104, CMIB S/N 35, MC476-0147-3001, 11-11-85 DURING
BUS ISOLATION TESTING FOLLOWING STS-28/51-J, POWER SUPPLY NUMBER 2 OF DSC
0A2 INDICATED FAULTY OPERATION. ANALYSIS OF THE POWER SUPPLY INDICATED
THAT CAPACITOR C7, PART NUMBER 39014-2091, LOT DATE CODE 7434B WAS
DEFECTIVE. THE CAPACITOR WAS FOUND TO HAVE A COLD SOLDER JOINT UNDER
MICROSCOPIC EXAMINATION. THIS FAILURE RESULTED IN THE SUPPLY OUTPUT
VARYING FROM 2 TO 10 VDC WHEN IT SHOULD HAVE BEEN 17 VDC. MICROSECTIONING
OF THE PART REVEALED NO OTHER ANOMALIES. THIS IS THE FIRST FAILURE OF THIS
TYPE WITH THIS PART. TWO OTHER FAILURES OF THIS PART HAVE OCCURRED BUT WERE
FROM DIFFERENT FAILURE MECHANISMS. NO GENERIC TREND IS INDICATED AT THIS
TIME, HOWEVER CAPACITORS OF THIS DATE CODE WILL BE MONITORED FOR ADDITIONAL
FAILURE HISTORY.

(E) OPERATIONAL USE
NONE.