

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-6BA-2584-IM -X**

SUBSYSTEM NAME: EPD&C - LANDING GEAR CONTROL

REVISION: 6 08/16/00

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: FWD PCA 1	VO70-763320
SRU	: RELAY, LATCHING	MC455-0128-0001

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
RELAY, LATCHING, LANDING GEAR DOWN CONTROL CIRCUIT (4P2P)

REFERENCE DESIGNATORS: 81V76A22K8

QUANTITY OF LIKE ITEMS: 1
ONE, FPCA-1

FUNCTION:
THE DOWN RELAY (K8) WITH TWO ARM RELAYS (K6 AND K7) ACTUATES THE CIRCUIT FOR THE LANDING GEAR EXTEND VALVE 1. PROTECTION AGAINST PREMATURES AND REDUNDANCY PROVIDED WITHIN LANDING GEAR CIRCUITS. COMMON RESET TO ALL LANDING GEAR DOWN AND ARM RELAYS.

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE

NUMBER: 05-6BA-2584-IM-02

REVISION#: 8 09/22/00

SUBSYSTEM NAME: EPD&C - LANDING GEAR CONTROL

LRU: FWD PCA 1

CRITICALITY OF THIS FAILURE MODE: 1/1

ITEM NAME: RELAY, LATCHING, K8

FAILURE MODE:

CLOSED, PREMATURELY CLOSES (TO SET POSITION), SHORT TO STRUCTURE (GROUND), SHORTS CONTACT-TO-CONTACT (TO SET POSITION)

MISSION PHASE: LS LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 103 DISCOVERY
104 ATLANTIS
EFFECTIVE FOR PRE LANDING GEAR MOD -
(K6 RELAY NOT CHG'D TO DOWN FUNCTION)

CAUSE:

FOR CLOSED, PREMATURELY CLOSES (TO SET POSITION), SHORTS CONTACT-TO-CONTACT (TO SET POSITION): PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS.
FOR SHORT TO STRUCTURE (GROUND): PIECE PART FAILURE, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY.

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:

FIRST FAILURE – LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) HAS FAILED CLOSED. THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

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(B) INTERFACING SUBSYSTEM(S):

FIRST FAILURE - LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) HAS FAILED CLOSED. THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

(C) MISSION:

FIRST FAILURE- LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) HAS FAILED CLOSED. THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

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

FIRST FAILURE- LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) HAS FAILED CLOSED. THIS MAY OCCUR AT AT TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1: SHORTS CONTACT-TO-CONTACT (TO SET POSITION), SHORT TO STRUCTURE (GROUND); CRITICALITY 1/1

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

1. K8 (DOWN) RELAY SHORTS CONTACT-TO-CONTACT (TO SET POSITION) OR SHORT TO STRUCTURE (GROUND).
LANDING GEARS WILL BE EXTENDED AS SOON AS ARM SWITCH IS ACTIVATED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) SINGLE CONTACT HAS FAILED CLOSED OR SHORTED TO STRUCTURE (GROUND). (THESE FAILURES ARE NOT DETECTABLE IN FLIGHT). THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

CASE 2: CLOSED, PREMATURELY CLOSES (TO SET POSITION); CRITICALITY 1/1

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

1. K8 (DOWN) RELAY FAILS CLOSED AFTER ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE.
LANDING GEARS WILL BE EXTENDED BECAUSE DOWN RELAY (NORMALLY CLOSED BY DOWN SWITCH) HAS FAILED CLOSED. THIS MAY OCCUR AT A TIME WHEN THERE IS A LIGHT VEHICLE, STRONG HEAD WIND AND LOW ENERGY WHICH COULD LAND

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VEHICLE SHORT OF RUNWAY AND MAY CAUSE VEHICLE DAMAGE RESULTING IN POSSIBLE LOSS OF CREW/VEHICLE.

CASE 3: CLOSED, PREMATURELY CLOSSES (TO SET POSITION); CRITICALITY 1R2, PPP

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

1. K8 (DOWN) RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE.
2. ARM SWITCH ACTIVATED.
IF DOWN RELAY (K8) FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION AT TWO THOUSAND FEET ALTITUDE, CREW CAN DETECT FAILURE AND DELAY "ARM" UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. (THIS IS A CRIT 1R2 SCENARIO PRIOR TO ARM SWITCH ACTIVATION.

-DISPOSITION RATIONALE-

(A) DESIGN:

REFER TO APPENDIX C, ITEM NO.3 - LATCHING RELAY

(B) TEST:

REFER TO APPENDIX C, ITEM NO. 3 - LATCHING RELAY

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

REFER TO APPENDIX C, ITEM NO. 3 - LATCHING RELAY

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND TURNAROUND PROCESSING CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:

CASE 1: SHORTS CONTACT-TO-CONTACT, SHORT TO STRUCTURE (GROUND); CRITICALITY 1/1

1. NONE.

CASE 2: CLOSED, PREMATURELY CLOSSES (TO SET POSITION); CRITICALITY 1/1

1. GEAR NORMALLY ARMED AT TWO THOUSAND FEET ALTITUDE WHICH ASSURES MAKING RUNWAY THRESHOLD EXCEPT FOR THE WORST CASE COMBINATION OF LIGHT WEIGHT VEHICLE, STRONG HEAD WIND AND LOW ON ENERGY. CREW TRAINS IN

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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SHUTTLE TRAINING AIRCRAFT AT TWO THOUSAND FEET ALTITUDE TO MAKE
ADJUSTMENTS TO COMPENSATE FOR INADVERTENT GEAR EXTENSION. IF DOWN
RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION, CREW WILL DELAY "ARM"
UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. CREW WILL SEE "DOWN" FBI LIGHT ON
AND GROUND WILL SEE THE ASSOCIATED TELEMETRY MEASUREMENT ON WHEN DOWN
RELAY FAILS.

- APPROVALS -

S & R ENGINEERING	:	M. D. DUMETZ / G. T. TATE:	<i>M. Dumetz</i> 9/27/00
S & R ENGINEERING ITM	:	P. A. STENGER	<i>P. A. Stenger</i> 9/28/00
DESIGN ENGINEERING	:	J. L. PECK	<i>J. L. Peck</i> 9/27/00
EPD&C SUBSYSTEM MANAGER:	:	R. L. PHAN	<i>R. L. Phan</i> 9/28/00
SR&QA	:		<i>[Signature]</i> 9/27/00
NASA DCE	:		<i>L. P. Phan for J. Norris</i> 24 Sep 00
MOD	:		<i>[Signature]</i>
USA SAM	:		<i>[Signature]</i> 10/3/00
USA ORBITER ELEMENT	:		

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PRINT DATE: 09/22/00

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- OIL FAILURE MODE
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SHUTTLE TRAINING AIRCRAFT AT TWO THOUSAND FEET ALTITUDE TO MAKE ADJUSTMENTS TO COMPENSATE FOR INADVERTENT GEAR EXTENSION. IF DOWN RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION, CREW WILL DELAY "ARM" UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. CREW WILL SEE "DOWN" PBI LIGHT ON AND GROUND WILL SEE THE ASSOCIATED TELEMETRY MEASUREMENT ON WHEN DOWN RELAY FAILS.

- APPROVALS -

S & R ENGINEERING	:	M. D. DUMETZ / G. T. TATE	:	<i>M. D. Dumetz</i> 9/21/00
S & R ENGINEERING ITM	:	P. A. STENGER	:	<i>P. A. Stenger</i> 9/29/00
DESIGN ENGINEERING	:	J. L. PECK	:	<i>J. L. Peck</i> 9/27/00
EPD&C SUBSYSTEM MANAGER	:	R. L. PHAN	:	<i>R. L. Phan</i> 9/28/00
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SHUTTLE TRAINING AIRCRAFT AT TWO THOUSAND FEET ALTITUDE TO MAKE ADJUSTMENTS TO COMPENSATE FOR INADVERTENT GEAR EXTENSION. IF DOWN RELAY FAILS CLOSED PRIOR TO ARM SWITCH ACTIVATION, CREW WILL DELAY "ARM" UNTIL IT IS SAFE TO DEPLOY LANDING GEAR. CREW WILL SEE "DOWN" PBI LIGHT ON AND GROUND WILL SEE THE ASSOCIATED TELEMETRY MEASUREMENT ON WHEN DOWN RELAY FAILS.

- APPROVALS -

S & R ENGINEERING	:	M. D. DUMETZ / G. T. TATE	: <u>M. D. Dumetz 9/21/00</u>
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EPD&C SUBSYSTEM MANAGER	:	R. L. PHAN	: <u>R. L. Phan 9/28/00</u>
SR&QA	:		: <u>J. P. Stenger 9/27/00</u>
NASA DCE	:		: <u>Z. P. Larson for J. Norris 28 Sep 00</u>
MOD	:		: <u>J. G. Gull</u>
USA SAM	:		:
USA ORBITER ELEMENT	:		: