

## CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR: SW1  
 NAME/QUANTITY: TOGGLE SWITCH/1  
 DRAWING REFERENCE: ME452-0102-7601

PROJECT: IFM BREAKOUT BOX  
 LRU NAME/QUANTITY: IFM BREAKOUT BOX/2  
 LRU PART NUMBER: SED39121772

SUBSYSTEM: NONE  
 EFFECTIVITY: All Orbiters

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FAILURE MODE NUMBER	CRITICALITY	FAILURE EFFECT	RETENTION RATIONALE
3	2/1R		
<b>FUNCTION</b> Switches power to auxiliary output connector P2, 28 Vdc continuous output		<b>END ITEM</b> Shorted switch will open circuit breaker at the dc utility outlet; unable to utilize remaining output circuits of box  <b>MISSION</b> None  <b>CREW / VEHICLE</b> Switch failure followed by failure of remaining Orbiter essential bus powering the C&W electronics would create an undetected fuel cell emergency due to loss of fuel cell coolant pump  <b>INTERFACE</b> See "End Item" and "Crew/Vehicle"	A. DESIGN - The toggle switch is hermetically sealed and has an inert gas backfill and a stainless steel case. There is a positive mechanical linkage between the toggle and moveable contacts. Detent spring ends have a double loop for positive retention in case of spring breakage. Application meets the Orbiter program parts list (OPPL) current derating requirements for a 15-A rating. The switch is designed to meet the requirements of the Space Shuttle program detailed by Rockwell International specification MC452-0102.  B. TESTS - The part is screened and qualified to the requirements of Rockwell International specification MC452-0102. Tests and inspections are done on the entire product to check radiographics, dielectric strength, insulation resistance, vibration, leakage (fine and gross), contact resistance, and run-in (250 actuations). A visual examination is also performed. Tests and inspections
<b>FAILURE MODE AND CAUSE</b> Mode: Switch 1 fails shorted to ground return or chassis Cause: • Mechanical failure • Manufacturing defect			
<b>REDUNDANCY SCREENS</b> A - Pass B - Pass C - Pass	<b>REMAINING PATHS</b> Use backup IFM breakout box		
<b>MISSION PHASE</b>	<b>TIME TO EFFECT</b>	<b>TIME TO CORRECT</b>	
Orbit	Minutes	Immediate	

PREPARED BY: Luis Marquez

REVISION: Basic

SUPERSEDING DATE: B/91

DATE: B/91

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## CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR: SW1  
NAME / QUANTITY: TOGGLE SWITCH / 1  
DRAWING REFERENCE: ME452-0102-7601

PROJECT: IFM BREAKOUT BOX  
LRU NAME / QUANTITY: IFM BREAKOUT BOX / 2  
LRU PART NUMBER: SED39121772

SUBSYSTEM: NONE  
EFFECTIVITY: All Orbiters

### RETENTION RATIONALE (Continued)

done to qualify the product check contact resistance at a rated current, vibration, endurance (5000 cycles at 15 A and 20,000 cycles at 10 A), short circuit (95 A), terminal strength, overload (10 cycles actuation at 23 A), toggle lever strength, leakage (fine and gross), and function.

To ensure the failure modes do not exist on the ground turnaround checkout tests and to also determine checkout frequency of these tests, see Functional Test Procedure.

- C. INSPECTION - Inspections verify that the part meets the Space Shuttle program requirements detailed by Rockwell International specification MC452-0102, which includes inspections, vibration tests, and screening tests as described in paragraph B. Receiving Inspection performs visual and dimensional examination of all incoming parts. Test reports are maintained certifying material and physical properties. Contamination Control/Quality Control verifies proper maintenance and procedures used for Clean Room operation. A detailed inspection on assembly installation is performed on all assemblies prior to their next operation. Inspection under magnification is performed prior to the closeout weld.

Nondestructive examination - Radiographic inspection is performed prior to the production run-in and subsequent to acceptance of the vibration test for evidence of solder migration, loose parts, and assembly anomalies.

Critical processes - All critical processes and certifications, including passivation, heat treating, plating, soldering, sandblasting, welding, brazing, and adhesive bonding, are monitored and verified by inspection.

Testing - Acceptance test procedures, including tests on run-in, performance, vibration, and hermetics, are observed and verified by Quality Control.

Handling/packaging - Parts are packaged, protected, and verified by inspection.

- D. FAILURE HISTORY - The most common toggle switch problem has been "teasing." Teasing occurs when the operator thinks the proper switch action has taken place when actually it hasn't. It is a function of the operator and the switch design and can be eliminated with proper switch operation.

1. Teasing is especially likely to happen for the following switches.

- a. Momentary switches: The initial contact of the roller and the contact shoe may be felt when switching a momentary switch. If movement of the switch handle is stopped at this point, positive contact will not be made. In a multiple pole

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PREPARED BY: Dave Crouch, Luis Vazquez

REVISION: Basic

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IFM BOX - 2

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REFERENCE DESIGNATOR: SW1  
NAME / QUANTITY: TOGGLE SWITCH / 1  
DRAWING REFERENCE: ME452-0102-7601

PROJECT: IFM BREAKOUT BOX  
LRU NAME / QUANTITY: IFM BREAKOUT BOX / 2  
IRL PART NUMBER: SED39121772

SUBSYSTEM: NONE  
EFFECTIVITY: All Orbiters

### RETENTION RATIONALE (Continued)

switch, some of the poles may or may not be making the circuit. In addition, a slight relaxation in holding force could allow one or more circuits to break contact. To eliminate teasing, operate these types of switches to the full extent of the handle (into a mechanical stop).

- b. Lever lock switch: In a three-position lever lock switch, this condition normally occurs when the lever lock handle is pulled, transfer action is started, and then the lever lock handle is released before the transfer action is completed. Under these conditions, the frictional drag force of the locking mechanism on the lock cam significantly affects the "feel" of the switch transfer action, and the center detent position is not felt or achieved by the operator. Internally, with the switch not in the center detent position, one or more of the pole rollers may be making contact with the associated shoe, while one or more are not yet touching the shoe. This is an inherent characteristic of the switch design and is more prevalent in the four-pole toggle switch configuration because of the basic tolerance structure and larger dimensions. To eliminate teasing, the handle must be placed into its groove in the bushing or be moved to the end of its travel.
2. The following examples describe switches that had teasing problems that are now resolved.
    - a. AC7521 - Problem: One pole intermittent. The metal ridge on the plunger caused uneven pressure of the roller on one set of contact shoes. This resulted in a decreased contact pressure until the contact resistance became erratic. This is considered an isolated incident.
    - b. AC8953 - Problem: Switch operating erratically on the Shuttle Avionics Integration Laboratory (SAIL). Excessive lubricant was found on contacts, and spring force was on low side of tolerance limits. This is considered an isolated incident.
    - c. A7791 - Problem: Unable to initial program load (IPL) the flight system from mass memory in SAIL. Failure resulted from a fatigue fracture of the retainer and was attributed to wearout. Data indicated that the switch operated more than 12,000 cycles, which exceeds life requirements by 2.5 times. The switch was an old design (- 6xxx switch) that is not used in flight vehicles. Design changes made to improve the switch include:
      - (1) Double loop detent spring
      - (2) Elimination of dimples from retainer
      - (3) Improved boot retention
      - (4) Cross-pinning of bat handle to shaft

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PROJECT: IFM BREAKOUT BOX  
LRU NAME / QUANTITY: IFM BREAKOUT BOX / 2  
LRU PART NUMBER: SED3912172

SUBSYSTEM: NONE  
EFFECTIVITY: All Orbits

### RETENTION RATIONALE (Concluded)

(5) Inspection of radiographics

(6) Added inspection of piece parts

- d. AC9012 – Problem: Knob missing. Application of the locking compound was not used to retain the knob when it was installed. Assembly personnel at John F. Kennedy Space Center (KSC) were instructed to follow installation procedures.
- e. AD1527 – Problem: Unable to transfer switch; lever lock actuator could not be pulled from its locked position. The external mechanism was found to be contaminated with Loc-tite. Assembly personnel at KSC were instructed to be more careful.

There are no known unresolved generic issues.

### E. OPERATIONAL USE –

1. Mission constraints: None
2. Crew action: Install backup IFM breakout box; reset circuit breaker
3. Protect against next failure: Use backup IFM breakout box
4. Special crew training: None

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PREPARED BY Dave Crouch, Luis Vazquez

REVISION: Basic

SUPERSEDING DATE: 3/91

DATE: 3/51

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