

Feature	Benefit
Significant spaceflight heritage	TRL9. More than 200 have flown.
Sealed, Sub-Miniature, Snap-Action	Rugged, metal-enclosed, sealed switches use the Butterfly® switch mechanism providing long-life, durability and reliability.
Meets MIL-PRF-8805 enclosure design symbol 3	Switch is watertight and controlled by rigid quality requirements.
Gold contacts	Provide corrosion protection, increased electrical conductivity and enhanced durability.
Test verified	Qualified to extreme temperature, vibration and shock.
Variable installation	Switch can be installed on either the space vehicle or launch vehicle side of the Motorized Lightband (MLB).

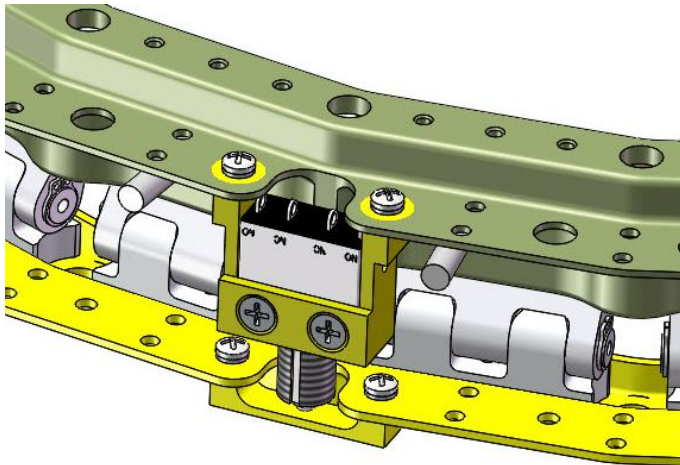


Figure 1: Separation Switch Assy. installed on a stowed MLB



Figure 2: Upper Switch Bracket (top) and Lower Switch Bracket (bottom)

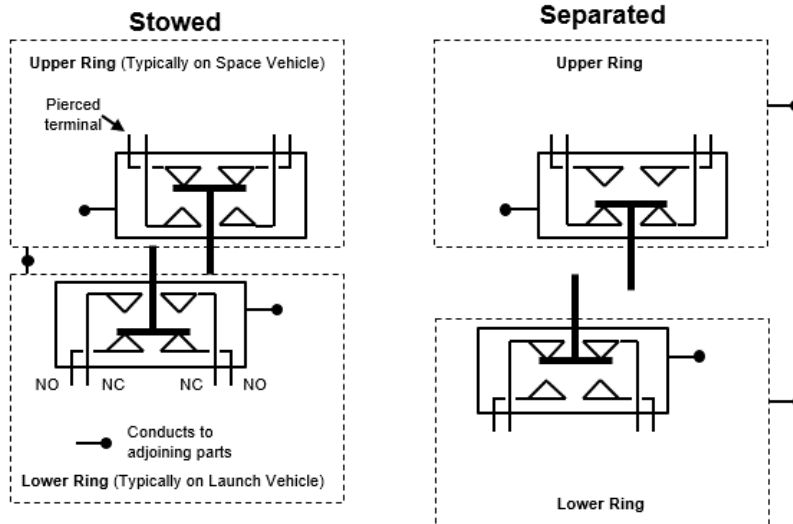


Figure 3: Schematic (switch shown installed on both MLB Lower Ring & Upper Ring). Switch is SPDT-DB (Form Z)

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1. PARAMETERS
Table 1: Parameters

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	Source Document
I	Current capability	Through NO or NC terminals, at pressure (P) and temperature (T) as specified in To	-	-	5.0	A	2002029, 2002204, and 2002309
Rms	Mated switch resistance	P = 760 Torr, T= +23 °C	-	0.0050	0.0075	Ω	2002204
Viso	Isolation: terminal to terminal, terminal to switch bracket, or terminal to switch housing	P= 760 Torr, T= +23 °C	-	-	1,500	V _{DC}	2002204
To	Operating temperature	P <10 ⁻⁴ Torr	-40	+23	+110	°C	2002029
Ts	Survival temperature	P <10 ⁻⁴ Torr	-54	-	+130	°C	2002029 and 2002309
ST	Soldering temperature	Duration ≤3.0 s	310.0	315.5	321.0	°C	NASA-STD-8739.3
-	Wire size		20	22	-	AWG	2002204
MI	Mass of Lower Switch Bracket	No attachment fasteners	-	0.004	-	lb _m	2002204
Mu	Mass of Upper Switch Bracket	No attachment fasteners	-	0.037	-	lb _m	2002204
Fc	Compressed switch plunger force	At height Ds	-	3.7	-	lb _f	2000785
Fe	Extended switch plunger force	At height Dms	-	0.9	-	lb _f	2000785
Dst	Height at state change during stowing	See Figure 4	-	1.54	-	inch	2002204
Ds	Height at stowed	See Figure 4	1.368	1.388	1.408	inch	2002204
Dse	Height at state change during separation	See Figure 4	-	1.58	-	inch	2002204
Dms	Height at mechanical separation	See Figure 4	-	1.59	-	inch	2002204
P	Life		-	5,000	-	cycles	2001025

2. DIMENSIONS, COMPONENTS AND IDENTIFICATION

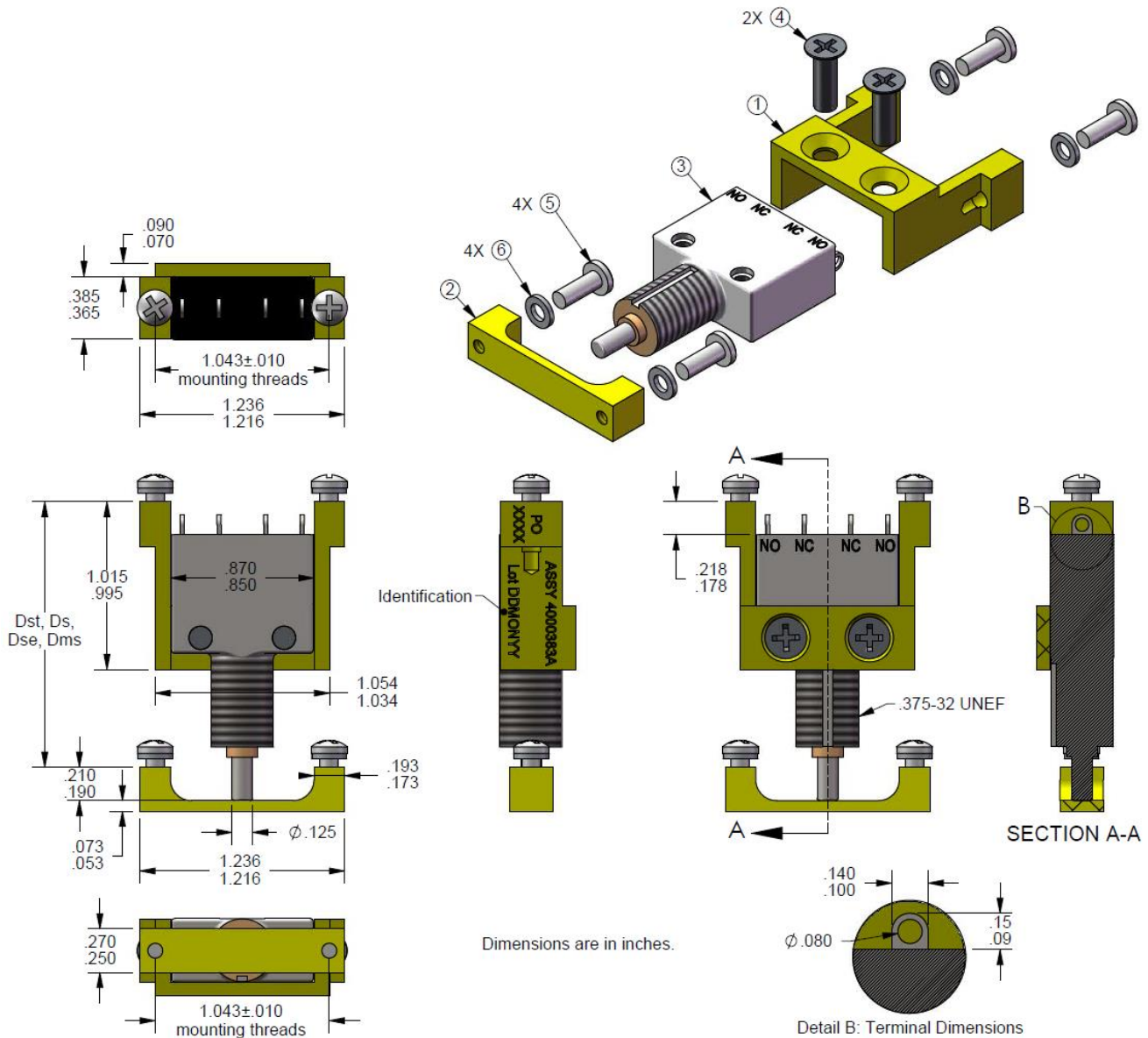


Figure 4: Dimensions

Identification: Upper Switch brackets are identified by either a serial number or lot number. Lower Switch Brackets may be identified with a serial number but are interchangeable with any Upper Switch Bracket.

Table 2: Bill of Materials

Item	Number & Description	Material & Surface Treatment	Comment
1	4000350, Upper Switch Bracket	6061 aluminum alloy w/ MIL-DTL-5541 Class 3	
2	4000351, Lower Switch Bracket	6061 aluminum alloy w/ MIL-DTL-5541 Class 3	
3	4000952, Sep Switch	-	
4	MS24693-C27, .138-32 UNC X .44 lg FLH Screw	Stainless steel	
5	MS51957-14, .112-40 UNC X .31 lg PNH Screw	Stainless steel	May be replaced with equivalent size hex head or socket head cap screw.
6	NAS620C4, .115 X .209 X .032 Washer	Stainless steel	
7	Arathane 5753 AB (LV), Two-Part Epoxy	-	Used between items 1 and 4 or items 3 and 4.

Note, the specification part numbers for items 4, 5, 6 and 7 may change without notice.

3. SUSCEPTIBILITY TO INTERMITTENCY AT EXTREMES OF VIBRATION

The switches were monitored for electrical intermittencies while stowed on an MLB. The random vibration profiles below are the MLB control input, on the interface structure adjoining the Lower Ring. See *2000785 MkII MLB User Manual* for more detail on the MLB.

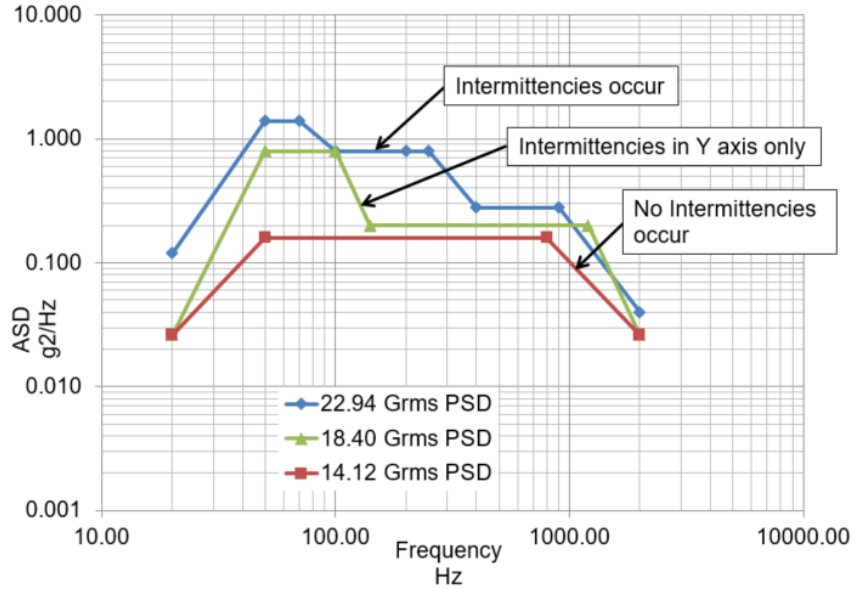
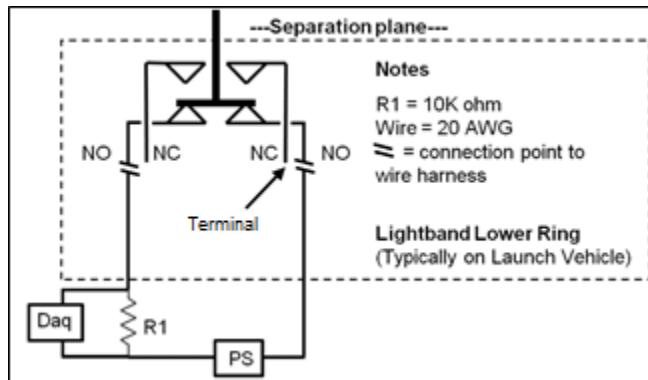


Figure 5: Random vibration profiles

Table 3: Random vibration levels and intermittencies

PSD Level [g _{rms}]	Tested Axes [-]	Sample Rate [samples/s]	Intermittency Duration, maximum [s]	Comments
14.1	X, Y, Z	100,000	0	No intermittencies detected
18.4	X, Y, Z	25,000	<0.00025	Intermittencies detected only in Y-axis testing
22.9	X, Y, Z	10,000	Unknown	Intermittencies detected but duration not measured

Intermittency may occur at vibration levels greater than 14.1 g_{rms}. After intermittency the switch always returns to its previous state. Use multiple switches or low pass filtering to reduce/eliminate intermittency if vibration levels exceed 14.1 g_{rms}.



Daq = Data Acquisition System, PS = DC Power Supply

Figure 6: Intermittency monitoring circuit

4. RELIABILITY

The table below shows total operations of all the switches produced by PSC (this data is not from a single unit).

Table 4: Reliability data

Data Set	No fail operations	Reliability at 95% confidence level ¹
Pre-assembly operations (switch 5A load)	39,600	0.99992
Tested while part of MLB (vibration, thermal vacuum, separation reliability)	192	0.98452
Successfully flown	96	0.96928

1. Source: Space Vehicle Mechanisms, Conley, Peter Wiley and Sons 1998

5. RECOMMENDED WIRING AND INSTALLATION PROCEDURE

Notes:

- 1) Practice this procedure, especially if access and/or volume is limited.
- 2) The interface openings on the MLB are rather small. Therefore the shield termination described here is designed to take a minimum of space around the opening.
- 3) Separation Switches may be added to the MLB before or after it has been stowed.
- 4) When attaching to structures other than the MLB this procedure may be used as a guideline for proper installation.
- 5) For all soldering, type RMA soldering flux and SN60PB40 solder is recommended.

Step 1 Tin the wire(s) and the switch pierced terminals. Set soldering iron temperature per 'ST' in Table 1. Apply heat no longer than 3 s. Form the tinned wire into a J shape as shown.

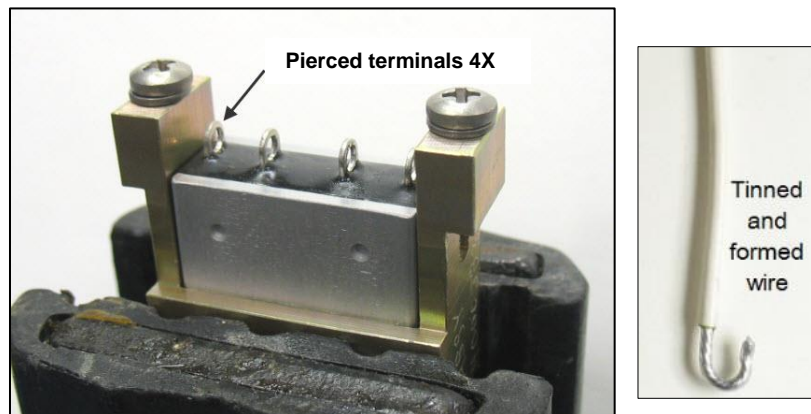


Figure 7: Tinning the hardware

Step 2 Install wire on switch pierced terminal and form wire to terminal. Solder wire to terminal. Note: It may be helpful to pre-form the wires to allow them to properly exit the switch bracket and MLB.

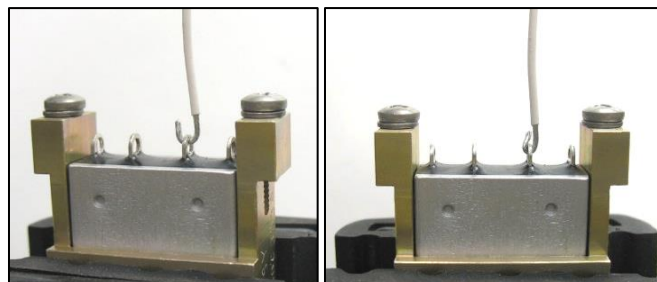


Figure 8: Installing the formed wire on the pierced terminal.

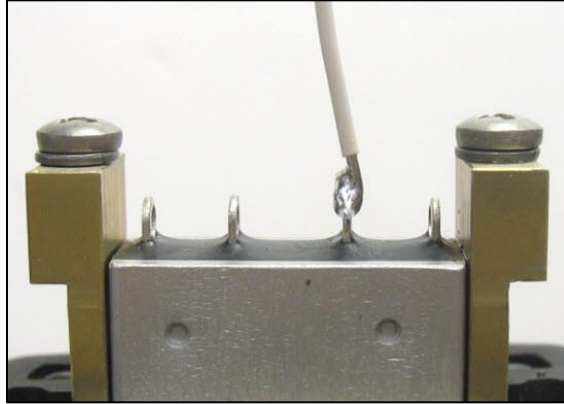


Figure 9: Typical solder fillet on installed wire (shown cleaned)

Step 3 Clean the solder flux, with 99% pure isopropyl alcohol. Repeat several times, ensuring no solder flux residue remains. While cleaning do not allow flux to seep onto the switch plunger as this could be detrimental to performance.

Step 4 Add clear heat-shrink (Kynar 3/32 or 1/8 inch diameter) and apply heat to shrink. The heat will tend to evaporate any retained alcohol.

If the user desires to add potting to the connections, do not allow it to seep onto the switch plunger as this could be detrimental to performance.

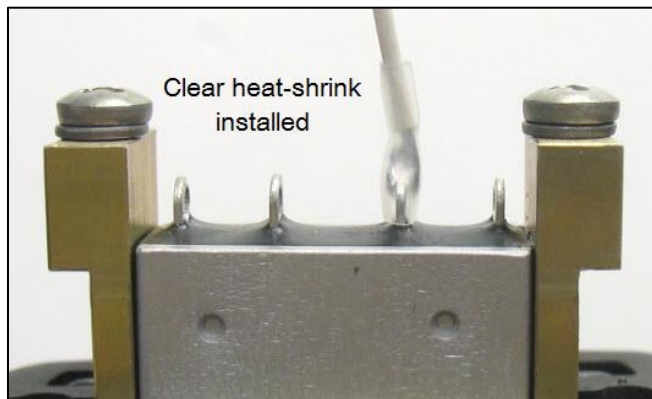


Figure 10: Heat shrink fully installed

Step 5 Wrap harness with tape to provide abrasion protection.



Figure 11: Taped wires exiting switch

Step 6 If required, attach shielding. Use 0.020 inch lock-wire. Several loops may be required. Trim excess. The shielding and lock-wire should not exceed the width or depth of the switch housing by more than 0.010 inch. Verify lock-wire is not degrading conductor insulation.

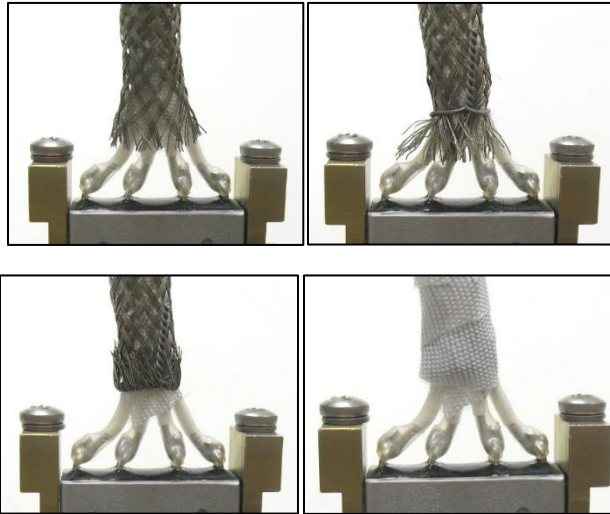


Figure 12: Shielding installation on switch

Step 7 Form wires at switch bracket exit to avoid interference with adjoining structure when harness is fastened to adjoining structure.



Figure 13: Completed harness

Step 8 If installing on a stowed MLB install the Lower Switch Bracket first. Depending on application this bracket can be installed on the MLB Upper Ring or MLB Lower Ring. Torque the .112-40 UNC fasteners 3 in-lb to 4 in-lb. Compress the switch plunger against the Lower Switch Bracket and slide the Upper Switch Bracket into the MLB. Align the Upper Switch Bracket accepting threads with the through holes on the MLB. Torque the .112-40 UNC fasteners 3 in-lb to 4 in-lb.

Step 9 If installing on a deployed MLB follow step 8 but omit compressing the switch plunger.

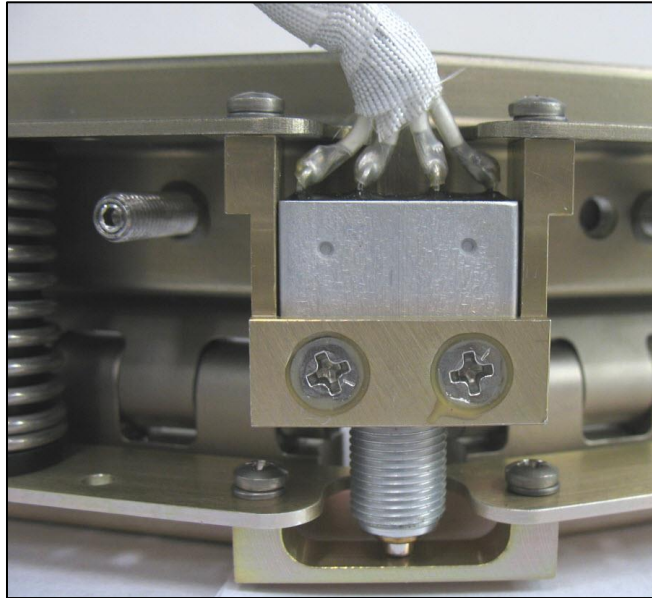


Figure 14: Upper Switch Bracket installed on Upper Ring. Lower Switch Bracket installed on Lower Ring. Harness is taped and formed.

Step 10 Fasten the harness to the adjoining structure. Ensure harness will not interfere with mating plane to adjoining structures.

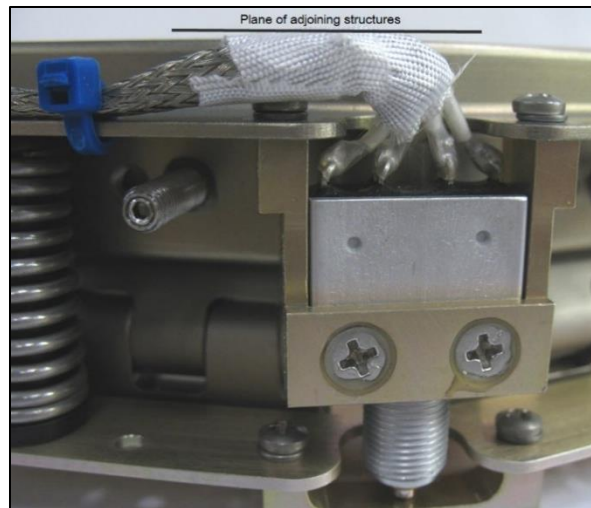


Figure 15: Separation Switch installed on MLB. Harness is constrained to adjoining structure with trimmed 4 inch Tefzel cable tie.

6. REVISION HISTORY

Revision	Release Date	Created By	Reviewed By
-	12-Jul-2012	RW	WH
A	22-Jun-2015	AZ	RW
B	19-Mar-2019	RW	RH

Changes from previous revision:

Section	Changes
All	<ul style="list-style-type: none"> • Changed format • Changed all instances of Lightband to MLB • Updated figures to maintain consistent switch orientation • Corrected numerous typos • Added section numbers • Removed Typical Applications section. • Changed all references of 'lug' to 'pierced terminal'
Cover Page	<ul style="list-style-type: none"> • Updated Features and Benefits • Figure 1: added • Figure 2: updated • Figure 3: updated with dual orientation and removed optional metal housing • Removed reference to EMI housing
1	<ul style="list-style-type: none"> • I: combined previous I_{ssv}, I_{ssa} and I_{pv} • T_o and T_s: updated conditions • S_T: was T_i • M_l and M_u: were W_l and W_u respectively • F_c: was F_i • F_e: added • D_{st}, D_s, D_{se} and D_{ms}: were D_{scj}, D_{ms}, D_{scd} and D_{md} respectively. Also updated values for D_s and D_{ms}.
2	<ul style="list-style-type: none"> • Figure 4: updated tolerances, removed typical cutout, consolidated previous mechanical interface figure and identification figure • Table 2: changed order and added Arathane
3	<ul style="list-style-type: none"> • Clarified control input location. • Figure 5: added 18.4 grms profile • Table 3: Updated mid-level results and added duration • Figure 6: updated
4	<ul style="list-style-type: none"> • New section
5	<ul style="list-style-type: none"> • Fixed error in step numbering • Corrected wording of various steps • Explained what "exceeding the switch housing" means • Increased minimum mounting torque • Clarified proper method to install switch on a stowed MLB • Deleted redundant figures