Introduction to Vibration Testing

Littelfuse tests sinusoidal vibration according to Mil. Std. 202G Method 204D, Test Condition G (10 – 2000 Hz frequency sweep at 30 G or 0.06 inch double amplitude, whichever is less). The test duration is 4 hours in each axis. Reed switches are tested with both the switch open and with the switch closed using a coil driven to 125% of switch pull-in. Any change of switch state is considered a failure, even if momentary. Most switch types will also pass this test with the switch held closed using coil drive of less than 100% of switch pull-in. Successful random vibration tests have also been conducted on most switches using Method 214A, Test Condition II, Letter D (15 minutes, 50 – 2000 Hz at 0.1 G2/Hz power spectral density and 13.89 Grms).

The mounting method chosen to test a reed switch with full length leads is critical for coupling the intended vibration into the reed switch without introducing unintended harmonic frequencies. The external reed switch leads must be soldered to terminals as close as possible to the glass to prevent them from breaking off at the glass / lead interface due to flexure-induced work hardening. Even with the best precautions, some work hardening of the external leads due to flexure occurs. Ideally, the switch should be used with the external leads cropped significantly or mechanically restrained if it will see a long term, high vibration environment.

The reed switch specification for vibration is based upon the above-described test. It does not imply the switch will survive continuous vibration at that level. It does not imply passing the test with any type of mounting method. However, when qualification tested according to the above test, Littelfuse switches at the rated pull-in have no false operations while either held closed or when open. The switches survive the tests without damage, other than a slight (approximately 5%) increase in pull-in due to flexure and work hardening of the external leads.

Successful tests have also been run at the above levels with switches mounted on a PCB by the external leads alone, with the leads soldered to the board 2.5 mm (0.1 inch) from the seal, with the glass body not held in place.

Precautions for High Vibration Environments

If a reed switch is going to be subjected to long term vibrations above 10 G, it should be firmly attached at all points to the mounting plane. Mounting a switch high from a circuit board by the leads alone is not recommended. An example of how to mount the switch would be to mount it close to the circuit board with a conformal coating or hot melt glue along the entire device. Operation through the resonant frequency of the switch should be avoided if possible. False operations may occur as low as 5 G at the resonant frequency.

Good mounting methods are even more critical in the case of reed relays, which are normally mounted by the external terminals alone. Compared to a reed switch, a reed relay has significantly more mass due to the copper coil, internal metal connections, and package encapsulation. This can result in the relay terminals breaking off due to metal fatigue at continuous vibration levels above 5 G. If they are to be subject to a high vibration environment, reed relays should be held to the PCB using a method such as hot melt glue to prevent the relay from rocking back and forth, flexing the terminals. Use of a socket for easy removal will greatly reduce the ability to survive a high vibration environment, especially for SIP relays.

Proximity sensors should have any wire leads secured to prevent them from flexing excessively and breaking off. If they are to extend from the vibrating surface to a non-vibrating surface, it is best to use a sensor with flexible fine-stranded wire, with a tapered clamp at each end.

Littelfuse, Inc.
8755 West Higgins Road, Suite 500
Chicago, IL 60631 USA
Phone: (773) 628-1000
Littelfuse.com