APPLICATION NOTE

molex

THIN-FILM BATTERIES

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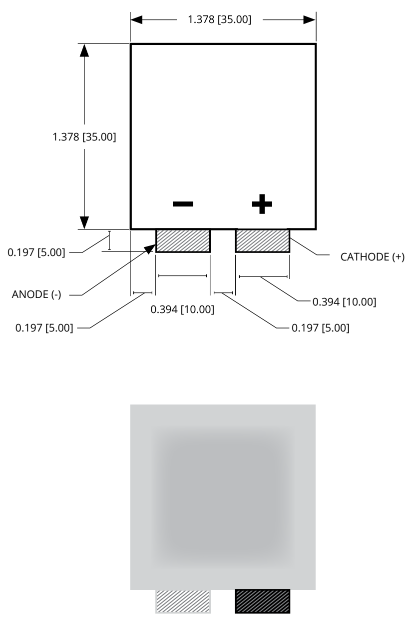
INTRODUCTION

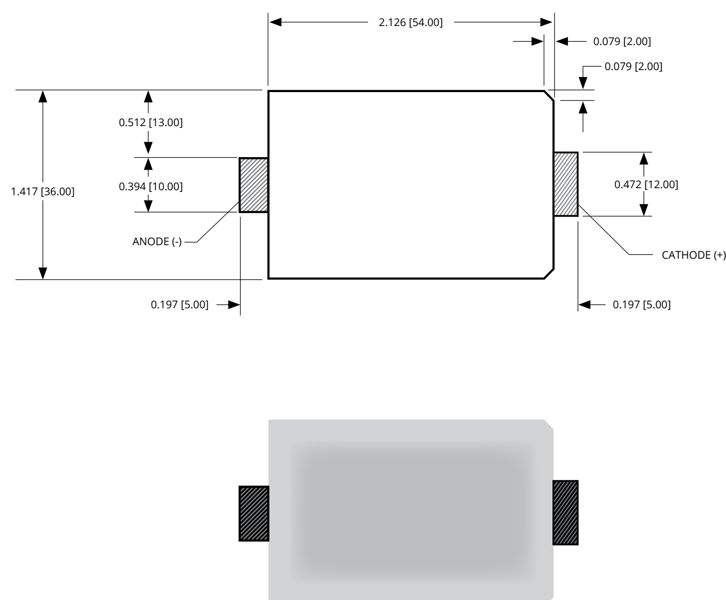
Molex Thin-Film Batteries are zinc-carbon primary cells (zinc anode, manganese dioxide cathode) that nominally deliver either 1.5 or 3.0V. Typical applications include single-use or disposable sensing and monitoring devices where light weight, a thin form factor and flexibility are desired. This application note is intended to serve as a starting point for electrical and mechanical engineers who wish to integrate Molex Thin-Film Batteries into their devices.

BATTERY DIAGRAMS

The diagrams below show the overall battery sizes and locations of the (+) and (-) terminals on the 1.5 and 3.0V battery models.



1.5V Battery



3.0V Battery
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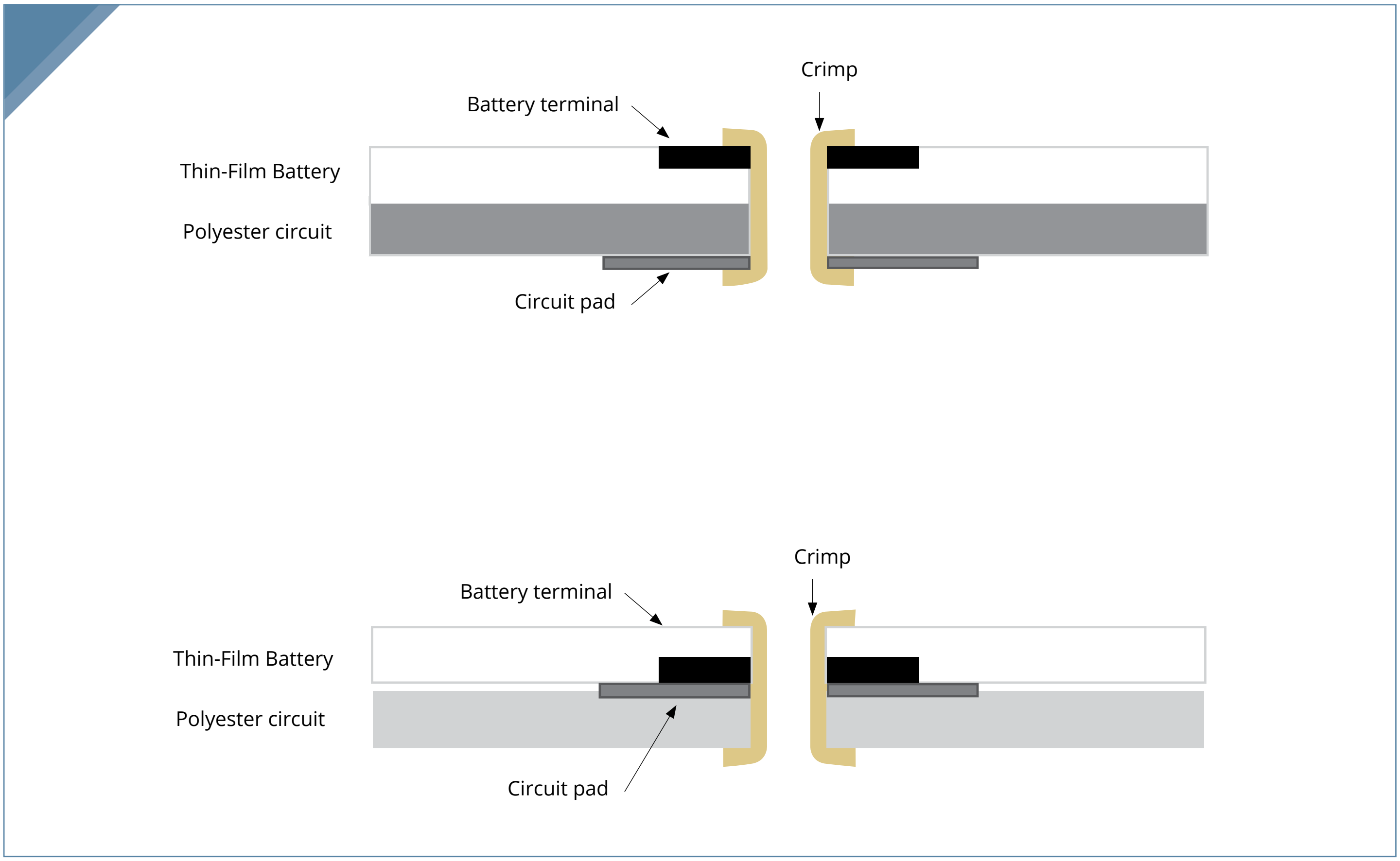
Recommended Attachment Methods

There are various options to attach the Molex Thin-Film Battery. Depending on the application's requirements, Molex can provide mechanical fastening, including crimps and eyelets, or conductive pastes, tapes or films.

Mechanical Integration

While many thin batteries use protruding metal tabs for making electrical and mechanical connections, Molex Thin-Film Batteries have tabs consisting of thin polyester film coated in conductive carbon, which improves durability.



One method of electrically attaching Molex Thin-Film Batteries is using a metallic crimp to secure the battery and circuit together. This method has been shown to be electrically and mechanically robust for attachment to circuits consisting of printed silver ink on a polyester film substrate. It can be used with the battery in either a face-to-face or back-to-back position with the circuit, as shown in the cross-sectional diagram on page three.

When attached using this method, a contact resistance of <10 Ohms from the battery terminal to the circuit can be expected.

Other Attachment Methods

The following methods may also be used, depending on the circuit materials and/or application:

- Conductive epoxy
- Anisotropic conductive adhesive/film (heat and pressure cure)
- XYZ-axis conductive pressure-sensitive adhesive tape
- Ultrasonic welding

For any methods involving heat curing, it is important that the body of the battery not be exposed to elevated temperatures for more than brief periods. Localized heating of the terminals (e.g., hot-bar bonding) is acceptable as long as the battery itself is not subjected to extreme heat.

In addition to the above methods for making a mechanical and electrical connection between the battery terminals and the circuit, it may be necessary to secure the body of the battery by using pressure-sensitive tape or a transfer adhesive.

Flexibility

Molex Thin-Film Batteries can be flexed as part of the installation or assembly process, but repeated flexing may have an impact on performance. It is recommended that flexing/bending cycles be kept to a minimum. Molex Thin-Film Batteries are not suitable for applications where they will be subjected to repeated flexing during use.

Molex recommends maintaining a minimum bend radius of 25.00mm for general use; however, under optimal circumstances, a bend radius as low as 5.00mm can be achieved.

Device Sealing

For maximum battery lifetime (standby and active), Molex recommends that the battery be sealed within the end device. Complete encapsulation is not necessary, but using an adhesive, gasketing or other means of enclosing the battery within an air-tight space will prolong the useful life.

As with all zinc/manganese dioxide batteries, there is potential for hydrogen gas generation. Under normal use, the amount of gas is negligible. However, under harsh conditions, a small volume of gas may be produced. Therefore, if the battery is to be entirely sealed within a device, Molex strongly recommends the user consider measures to prevent harsh conditions and/or allow accumulated gas to be vented. See the Battery Operation, Safety and Handling, and Disposal sections for more detail.

BATTERY OPERATION

Passivation Effects

The chemistry and construction of Molex Thin-Film Batteries make it possible for a temporary passivation to form on the anode and/or cathode materials after extended storage. This passivation has been found to be reversible and will appear as an apparent increase in internal resistance during the initial period of discharge. After a short period (typically minutes, depending on discharge current), the internal resistance will return to its normal value, with no effect on battery capacity.

Warning Against Harsh Use and Deep Discharge

As mentioned previously, the chemistry used in Molex Thin-Film Batteries has the potential to generate hydrogen gas when subjected to harsh conditions. To prevent gas production, the following precautions should be observed:

- Do not subject the batteries to any charging voltage.
- Do not discharge the batteries past their fully discharged state.

Note: Complete discharge is defined as the open-circuit voltage being less than 1.1V for the 1.5V battery and less than 2.2V for the 3.0V battery.

STORAGE, SHELF LIFE AND ENVIRONMENTAL CONCERNS

Sealed-Package Shelf Life

Molex Thin-Film Batteries will retain up to 70% of their initial capacity for two years when stored in their original, sealed packaging at normal room temperature conditions. For maximum shelf life and performance, Molex recommends the following best practices:

- Store batteries for extended periods at approximately +4°C.
- Avoid storing batteries at temperatures above +25°C.
- Do not store batteries near heat sources or in areas where direct sunlight could heat up batteries.
- Store batteries in the original packaging only, and do not open unit-level packaging until immediately before using it.
- If unit-level packaging must be opened (e.g., for inspection), reseal it as quickly as possible.

Open-Package Shelf Life

Once the unit-level packaging is opened, degradation in battery performance is exacerbated by dry ambient conditions. While batteries can survive indefinitely at ambient conditions of 50% relative humidity (RH), measurable loss in capacity will begin to occur within 48 hours at 20% RH. Therefore, Molex recommends that any handling, inspection, testing and attachment of batteries be conducted in a humidity-controlled environment at 40 to 50% RH. In all cases, the best performance will be achieved by minimizing the time between opening the battery packaging and enclosing the product in the end device.

SAFETY AND HANDLING

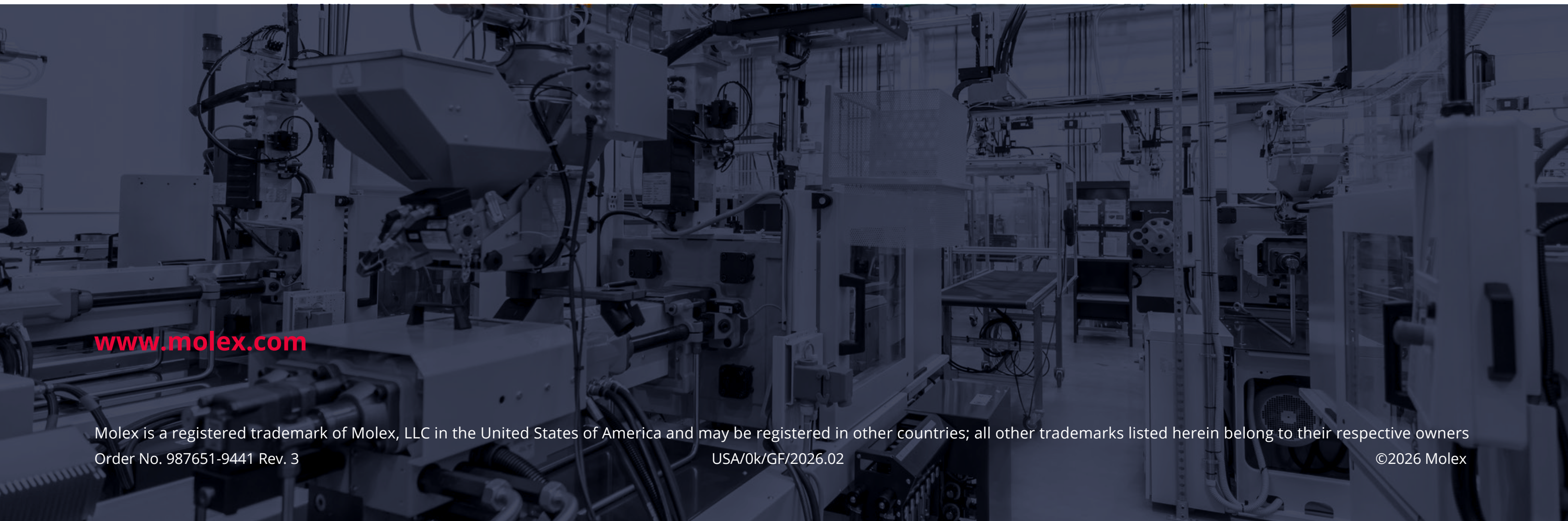
Under normal usage conditions as recommended by this application note and other documentation, Molex Thin-Film Batteries should present minimal opportunity for hazard or harm.

- Batteries contain no liquids that may leak out.
- Under short-circuit conditions, the internal resistance of the battery is such that no significant thermal or electrical hazards are created.
- Hydrogen gas generation is negligible when batteries are used and stored properly. If a battery has been subjected to harsh conditions, avoid storing it in a sealed container.

Molex Thin-Film Batteries can be safely stored, transported and shipped in their original packaging cartons. When handled outside their original packaging, they are mechanically robust under normal operation, but due to their thin, flexible nature, care should be taken not to pinch or squeeze the batteries.

DISPOSAL

Molex Thin Film Batteries are compliant with EU directives 2006/66/EC and 2002/95/EC. While they can generally be disposed of in the same waste stream as standard alkaline batteries, we recommend users consult local laws and regulations regarding disposal of batteries.



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