

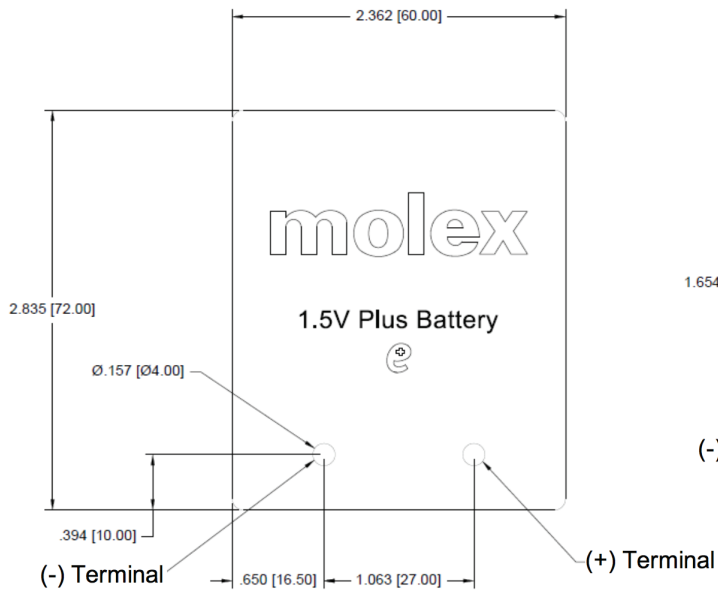
MOLEX THIN FILM BATTERIES

TABLE OF CONTENTS

Introduction	2
Battery Diagrams	2
Mechanical Integration	2
Recommended Attachment Method	2
Other Attachment Methods	3
Flexibility	3
Device Sealing	4
Battery Operation	4
Typical Discharge Behavior	4
Battery Capacity as a Function of Drain Current	4
Passivation Effects	4
Warning Against Abuse and Deep Discharge	4
Storage, Shelf Life and Environmental Concerns	4
Sealed-Package Shelf Life	4
Open-Package Shelf Life	5
Safety and Handling	5
Disposal	5

Introduction

Molex Thin Film Batteries are zinc-carbon primary cells (Zn anode / MnO₂ cathode) that nominally deliver either 1.5 or 3.0 volts. Typical applications include single-use or disposable sensing and monitoring devices where lightweight, 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 device.



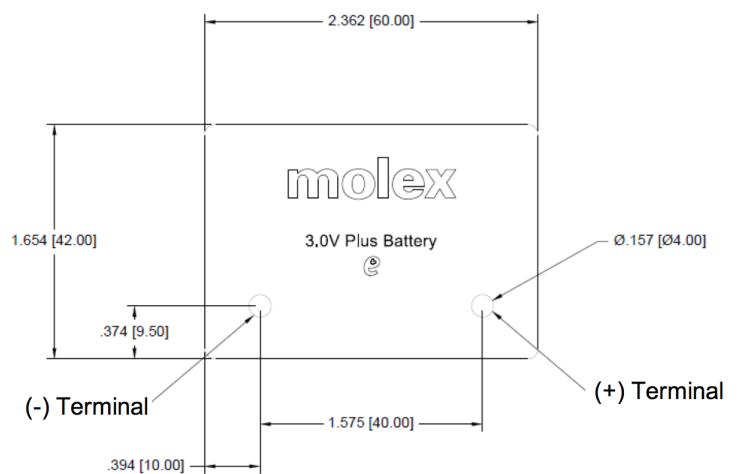
1U switch design

Mechanical Integration

While many thin batteries make use of protruding metal tabs for making electrical and mechanical connection, Molex Thin Film Batteries have terminals within the perimeter of the battery. The exposed surface of the terminals consists of a printed conductive carbon-based ink.

Battery Diagrams

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

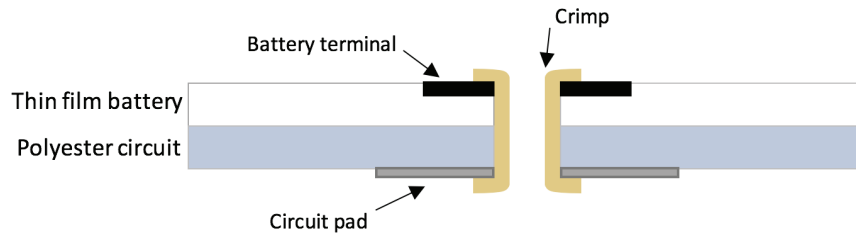


Recommended Attachment Method

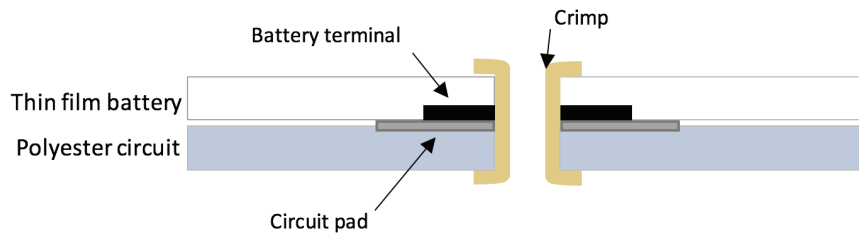
There are various options to attach the Molex Thin Film Battery. Depending on your application's requirements we can provide you with mechanical fastening including crimps and eyelets, or using conductive pastes, tapes or films.

One method of electrically attaching Molex Thin Film Batteries is the use of 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, and can be used with the battery either face-to-face or back-to-back with the circuit, as shown in the cross-sectional diagram on page 3.

“Back-to-back” attachment (cross-section view)



“Face-to-face” attachment (cross-section view)



When attached using this method, a contact resistance of $<10\Omega$ 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 battery not be exposed to elevated temperatures for more than brief periods.

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 using pressure sensitive tape or 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. We recommend 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 25mm for general use, however under optimal circumstances, a bend radius as low as 5mm can be achieved.

Device Sealing

For maximum battery lifetime (standby and active), Molex recommends that the exposed terminal areas be sealed after attachment to the circuit/device. This can be accomplished either by local sealing around the terminals, or by sealing the entire battery within the end device. Local sealing around the terminals can be accomplished by:

- Encapsulation with UV-curable adhesive, as described above
- Covering with adhesive tape, if battery is attached in the “back-to-back” configuration
- Use of an adhesive gasket, if battery is attached in the “face-to-face” configuration

As with all Zn/MnO₂ batteries, the potential for hydrogen gas generation exists. Under normal use, the amount of gas generated is negligible. However, under abusive conditions, the potential exists for a small volume of gas to be generated. Therefore, if the battery is to be entirely sealed within a device, Molex strongly recommends the user consider measures to prevent abusive conditions, and/or allow accumulated gas to be vented. See the Operation and Safety & Disposal sections for more detail.

BATTERY OPERATION

Passivation Effects

The chemistry and construction of Molex Thin Film Batteries is such that it is 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 Abuse and Deep Discharge

As mentioned previously, the chemistry used in Molex Thin Film Batteries has the potential to generate hydrogen gas when subjected to abusive conditions. In order to prevent gas generation, 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 2 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 are observed:

- Store batteries for extended periods at 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 use.
- If unit-level packaging must be opened (e.g., for inspection), reseal 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% 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 40-50% RH. In all cases, the best performance will be achieved by minimizing the time between opening the battery packaging and enclosing 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 no 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 is believed to have suffered abusive 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 of their original cartons they are mechanically robust against normal handling, but due to their thin flexible nature, care should be taken not to pinch or squeeze 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 you consult your local laws and regulations regarding disposal of batteries.