Application Note:
Extreme Temperature Reed Switch Operation

Introduction

Littelfuse reed switches are normally specified to operate in a temperature range of -40 °C to +125 °C. This application note will explain the reasons for these specifications, and give guidelines for use at temperatures beyond the specified limits. Although operating reed switches outside the specified range is possible, the amount of testing Littelfuse has done is limited. Suitability of the reed switch for the end product is the responsibility of the end product manufacturer, especially when exceeding published specifications.

Use Above the Rated Temperature

Littelfuse reed switches will operate at temperatures much higher than those specified by Littelfuse. Testing has been performed that indicates Littelfuse reed switches can operate up to 300 °C, but 200 °C is a realistic maximum for real-world applications. The contacts are largely unaffected by such temperatures because they consist of metals with high melting points and are hermetically sealed in an inert atmosphere. The coefficient of expansion of the metal and glass are closely matched, so there is no observed change in the hermetic seal at extreme temperatures.

The existing upper temperature limits are the result of two limitations. First, 125 °C is the point at which the majority of Littelfuse reed switches increase in pull-in approximately 10% when utilizing the higher pull-in ranges. Second, prolonged use above 125 °C can result in oxidation of the tin plating used on the external leads, and possible eventual rusting of the base metal underneath the tin plating.

High Temperature Guidelines

Lower pull-in switches have the advantage of less pull-in variation with temperature. For instance, at 200 °C, the pull-in of a 15 Ampere-turn MDCG-4 will increase less than 5%, but a 40 Ampere-turn MDCG-4 will increase approximately 30%. If a higher pull-in must be used, consider a larger switch, such as the MRPR series. Switches with larger diameter leads are more stable at the higher pull-in values.

If prolonged use at an extremely high temperature is expected, methods to prevent oxidation of the leads may be needed, such as encasing the leads in a high temperature capable material such as silicone rubber. Oxidation of the leads inside the reed switch's glass capsule should not be an issue because of the protective atmosphere sealed inside the switch.

Do not expect all switches to track identically with temperature. There will be variations in the amount of pull-in change with temperature.

Do not rely on a voltage driven coil to operate the switch accurately. The resistance of a relay coil will increase approximately 0.4 %/°C with temperature, resulting in less current. Less current causes less magnetism and could cause the switch to fail to operate.

Don't forget about the softening point of solder. At very high temperatures, either high temperature solder should be used, or the leads should be welded.

Use Below the Rated Temperature

There is generally not much change in the sensitivity of reed switches when operated at low temperatures. The major concern is ice crystal formation in the contacts, causing high resistance or an open circuit condition. The internal atmosphere of most Littelfuse reed switches is dry nitrogen at a reduced pressure. However, trace amounts of water vapor could theoretically produce ice crystals at very low temperatures.

How the Type of Switch Affects the Low Temperature Rating

Littelfuse reed switches are made in one of three ways: partial pressure (most common), pressurized, and vacuum. A vacuum switch really has no lower temperature limit. Littelfuse's -75 °C rating is because that is the lower limit of the environmental chambers used in testing. Littelfuse has actually immersed the MARR-5 in liquid nitrogen and operated it with a coil successfully. If any material is used to encase the switch, consideration of the coefficients of thermal expansion must be given to prevent stressing the switch.

A lower temperature limit of -40 °C has been established as a conservative specification for partial pressure switches such as the MDCG-4. Such switches have a reduced pressure atmosphere due to the gas inside cooling after the seals are made. Qualification tests at -65 °C are routinely performed on such switches with no observed problems, so -40 °C may be considered a relatively conservative number. One mitigating factor is that due to the dry atmosphere, any ice crystals formed will be so small they might not cause a problem other than possibly a slight increase in contact resistance.

A lower temperature limit of -20 °C has been established as a conservative specification for Littelfuse pressurized switches. The rating is not as low as for partial pressure switches because pressurizing the atmosphere increases the temperature at which trace amounts of water vapor will condense. We are not aware of any problems resulting from use at lower temperatures, and have found no problems in tests at -40 °C.

Temperature Effects by Switch Type

The following charts show the approximate effect of temperature upon pull-in for various switch types. This data should be considered an approximation of typical behavior. This data applies to uncut switches.

Chart 1.
Littelfuse MITI-3V1: Temperature Effect Upon Pull-In

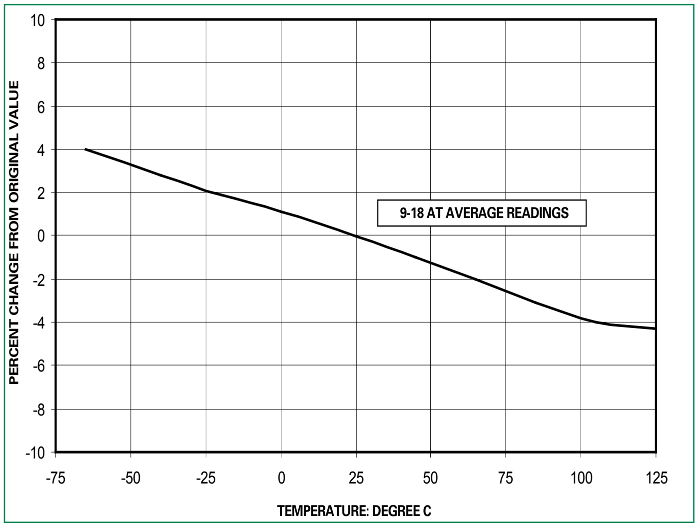


Chart 2.
Littelfuse MDSR-10: Temperature Effect Upon Pull-In

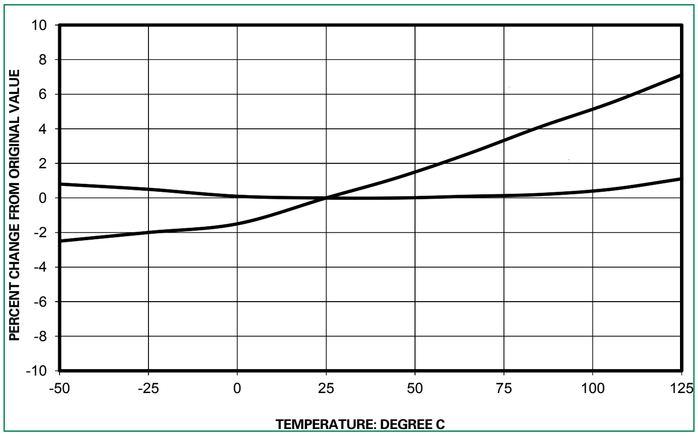


Chart 3.
Littelfuse MDSR-7: Temperature Effect Upon Pull-In

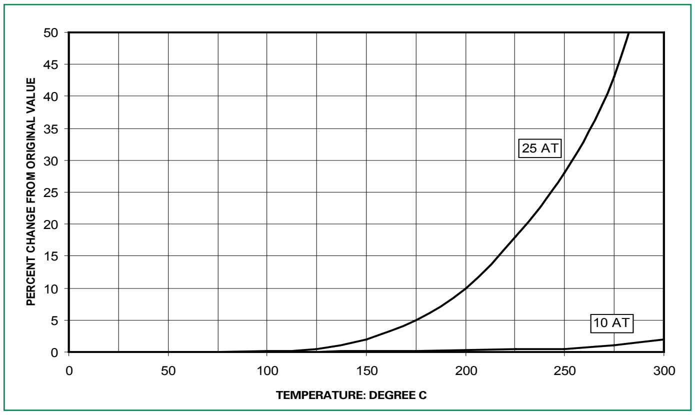


Chart 4.
Littelfuse MDCG-4 and MDRR-6: Temperature Effect Upon Pull-In

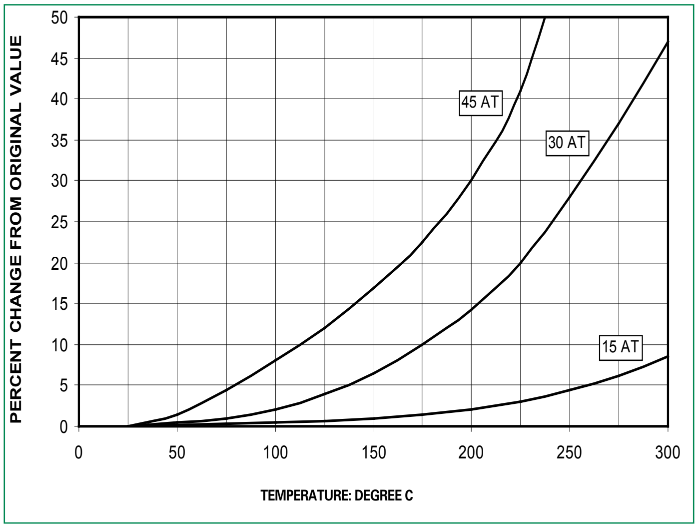


Chart 5.
Littelfuse MARR and MLRR: Temperature Effect Upon Pull-In

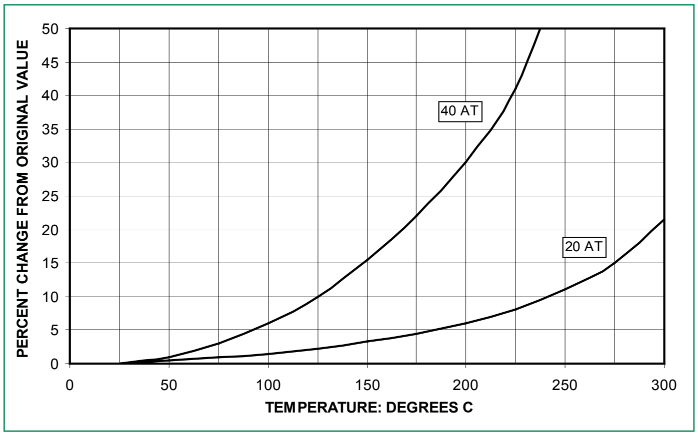


Chart 6.
Littelfuse MRPR: Temperature Effect Upon Pull-In

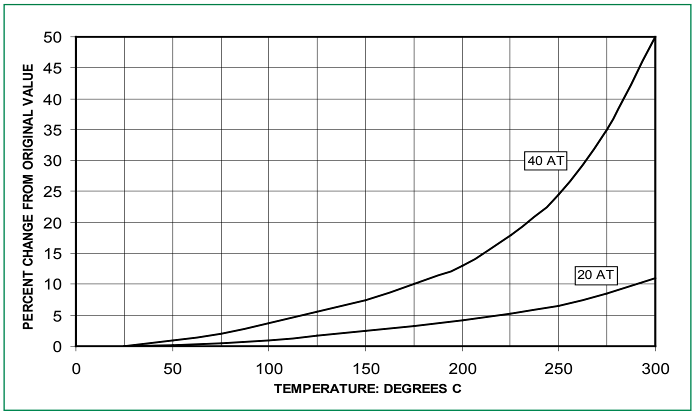


Chart 7.
Littelfuse MDRR-DT: Temperature Effect Upon Pull-In

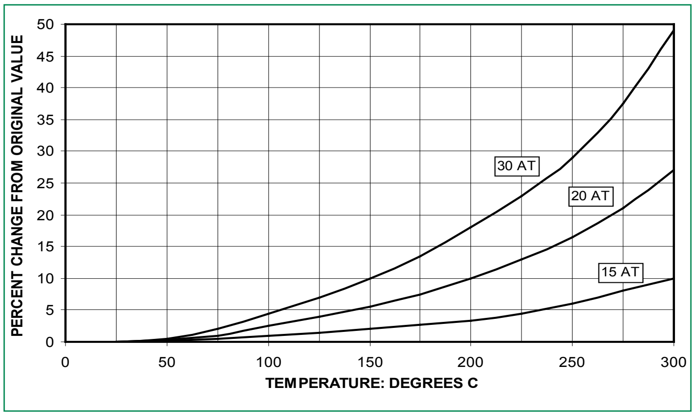


Chart 8.
Littelfuse DRR_DTH and DRT-DTH: Temperature Effect Upon Pull-In

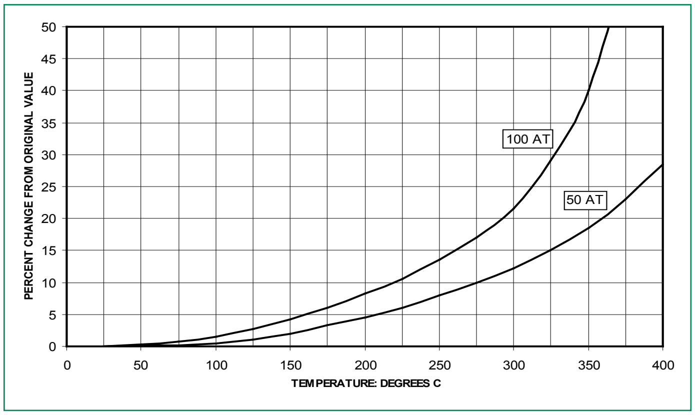
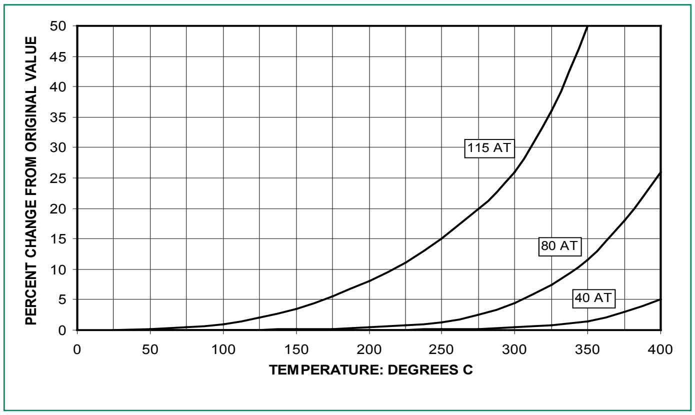


Chart 9.
Littelfuse DRR-129: Temperature Effect Upon Pull-In



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