

REED SWITCH OPERATION OVER TEMPERATURE RANGE

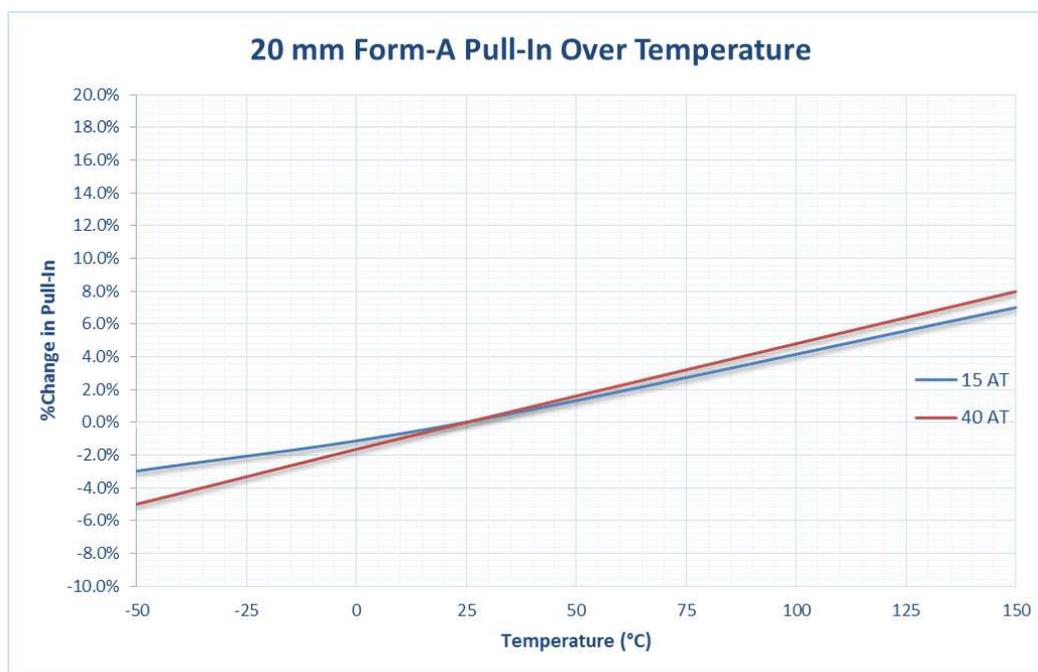
1.0 SCOPE:

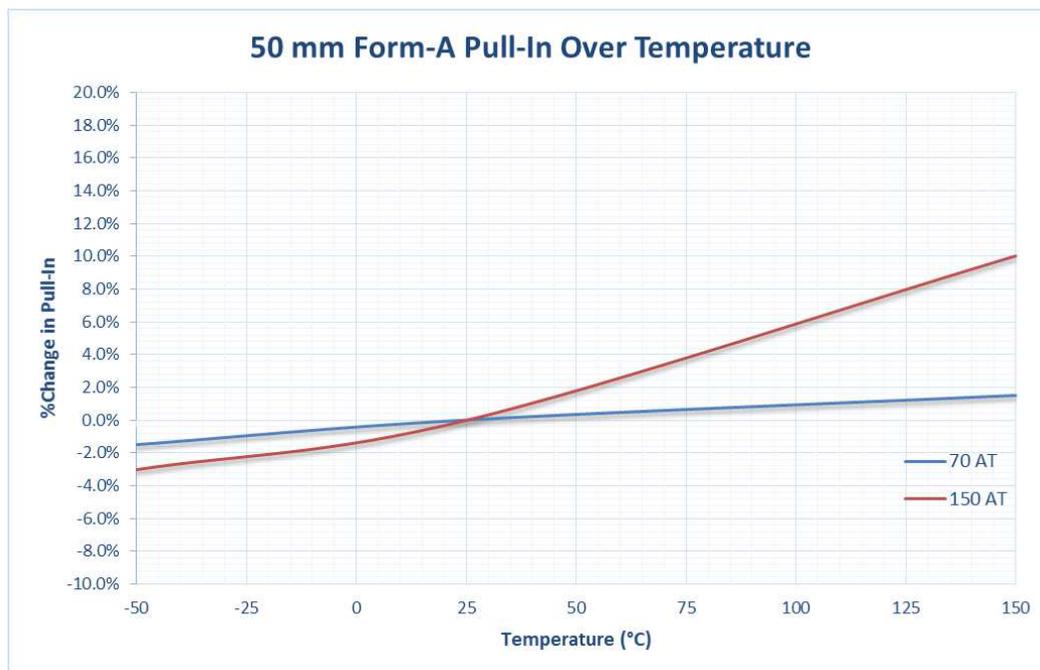
The typical operating range for HSI Sensing reed switches is -40°C to 125°C . Reed switches are quite capable of operating above and below this temperature range due to the nature and design of the device. The information herein will serve as a guideline for use outside the standard range. The suitability of the reed switch (or reed based proximity sensor) for a specific application is the responsibility of the final product manufacturer.

2.0 ABOVE THE TEMPERATURE RANGE:

HSI reed switches will operate well above the specified temperature range. The coefficient of expansion of the glass and reed blades are closely matched and thusly expand and contract at the same rate. Operation at 300°C or even 400°C is not out of the possible range. HSI has conducted application specific testing on some models as high as 350°C . It must be understood that the reed blades slowly become less efficient at conducting magnetism as temperature rises. The relative change is a low percentage, therefore low ampere turn switches are affected less than higher ampere turn switches. Typically, as the temperature rises above 200°C the shift or increase in required magnetism is more dramatic.

Switches with physically larger diameter leads in higher ampere turn sensitivity ranges are less susceptible to change than switches with smaller diameter leads in the same sensitivity range. All switches will not behave exactly the same over these elevated temperature ranges.





The effect of temperature on the **magnetic source** that is activating the reed switch or sensor must also be considered. Typically, magnetic materials get weaker with increases in temperature and some materials can vary greatly in performance over wide temperature ranges. Therefore, selection of the most suitable material is critical at elevated temperatures, often more so than the effect on the reed switch.

3.0 BELOW THE TEMPERATURE RANGE:

Typically, the change in performance at extremely low temperatures is very small. HSI Sensing manufactures switches with either an internal vacuum atmosphere or an inert gas mixture of 97% nitrogen and 3% hydrogen with a very low dew point. Because the sealing process heats the glass to melting points beyond 2000°F, surface moisture is virtually nonexistent, and any ice crystal formation in the contact area is insignificant. HSI Sensing has tested parts at -60°C on all atmospheric models and no sign of ice crystals in the contact areas has ever been detected.

The effect of temperature on the **magnetic source** that is activating the reed switch or sensor must also be considered. Typically, magnetic materials grow stronger as temperature decreases and some materials can vary greatly in performance over wide temperature ranges. Therefore, selection of the most suitable material is important at reduced temperatures, often more so than the effect on the reed switch.

4.0 SWITCH ACTIVATION – MAGNETISM SOURCE:

Reed switches are typically operated by one of two sources, coils or magnets. Electromagnetic coils have a limited temperature range depending on the coil bobbin material and the coil wire type. The resistance of the relay coil will increase with

temperature. Application of a fixed voltage to a coil will result in less current through the coil at an approximate rate of 0.4% per degree C. In the case of magnets, the gauss output will vary with temperature depending on the raw material of the magnet. HSI Sensing manufactures proximity sensor actuators with various magnetic materials depending on application requirements. The typical magnet materials used are Alnico 5, Samarium Cobalt 22, Neodymium, and Ceramic 5 or 8. HSI is certainly available to provide assistance in magnet selection or to provide magnet supplier information.

5.0 ELECTRICAL RATINGS:

The published electrical ratings of reed switches are at 'room temperature', approximately 25°C. The reed switch is a small mechanical device with rhodium or tungsten contacts sealed in an inert atmosphere. The performance is relative to the dissipation of heat so the contact materials do not suffer damage.

In elevated temperature applications consideration must be given to the power level of the electrical load versus the temperature. If the rated product is insufficient, the following options should be considered:

- Select a larger switch model
- Utilize a tungsten contact switch model
- Contact HSI Engineers to discuss contact material specifications

6.0 PRODUCT SELECTION:

The selection of 'the best' reed switch model is important when temperature is a design consideration. Contact material, internal atmosphere, switch lead wire diameter and glass diameter are all parameters to consider in applications of high temperature or applications with broad temperature ranges. Some switches are more resilient than others.

Form-A, SPST switches, that feature only one lead exiting the glass seal are stronger than Form-C SPDT switches. In a Form-C switch there are two leads exiting one end of the switch; this seal is typically weaker than the single lead seal. When a reed switch is installed in a device, on a PCB, encapsulated in epoxy, or mounted to another component, the coefficient of expansion of those adjacent materials can affect the switch. As they expand or contract they can stress, or in extreme cases, break the switch, thereby affecting operation. In temperature extreme applications, the components in contact with the switch must always be taken into consideration.

Switches with a higher glass diameter to lead wire diameter ratio are typically stronger. The HSR-069R with a glass to lead diameter ratio greater than 6, was deemed "the strongest switch in the world" by an independent laboratory.

The external coating of the reed switch leads is also important in maximizing performance. Typically reed switch leads are electroplated with pure tin for solderability. This tin will oxidize and discolor at higher than rated temperature. The solder employed for the electrical connection could also fail. Consider welding electrical connection to the switch lead in elevated temperature applications. HSI Sensing offers two different external preparations for welding leads, either cleaning of the bare alloy base metal or

gold plating.

7.0 CONCLUSION:

The reed switch is an excellent device to operate over a broad temperature range. Whether in an electromagnetic coil, or operated by a magnet, its performance is relatively predictable when all application parameters are known. HSI Sensing welcomes the opportunity to review your requirements and assist in selection of the best switch and components to achieve the desired performance. The effect on the switch and all relative components must be considered and we can help in this endeavor.

HSI Sensing Engineering
February, 2016