

Crocus Magnetic Switch

Reed Switch Replacement

Relevant Crocus Devices

The concepts and examples in this application note are applicable to all of the following Crocus devices:

CTSR420C-IS2, CTSR440-IS2, CTSR460-IS2

Introduction

Magnetic reed switches are simple switches that change state in the presence of a magnetic field. Reed switches are available in a variety of shapes and sizes as well as with different functionality: Normally Open (NO) and Normally Closed (NC) switches, Single Pole Single Throw (SPST) as well a Single Pole Double Throw (SPDT), just to name a few. Figure 1 shows a few of the typical read switch varieties.

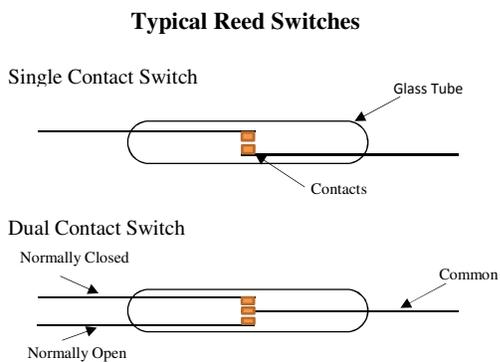


Figure 1

There is one very serious DOWN-SIDE with designing with reed switches: THEY BREAK

EASILY!!! The casing of the reed switch body is typically made of glass and is very fragile. The Crocus Magnetic Switch is a suitable replacement for the reed switch in many applications. The Crocus Magnetic Switch offers the same electrical functionality as the reed switch with additional advantages:

1. **Reliability:** The Crocus Magnetic Switch is much more robust than the reed switch. Since the Crocus Magnetic Switch is a solid state device, it has no moving parts and certainly has no parts made of glass.
2. **Speed:** The frequency response of the Crocus Magnetic Switch is very high compared to the mechanical reed switch. The switch on-time and switch off-time for the Crocus Magnetic Switch is on the order of nanoseconds.
3. **Size:** The physical size of the Crocus Magnetic Switch compared to even the smallest reed switch is much smaller. There are also multiple package options for the Crocus Magnetic Switch that are more robust and not as fragile as glass package . It is available in a 16-pin QFN that is 3x3 mm and also a standard SOT23 package that is even smaller.
4. **Cost:** The Crocus Magnetic Switch solution has a lower cost than more expensive reed switch solution. The

reason for this is the much smaller dimension of the Crocus TMR switch as well as the low manufacturing costs compared to the reed switch.

Crocus Magnetic Switch

The Crocus Magnetic Switch is a solid state, magnetic switch that changes state in the presence of a magnetic field. The functionality is very similar to a magnetic reed switch. The output of the Crocus Magnetic Switch is a simple resistor output that shows a high resistance (Rh) when there is no magnetic field present and assumes a low resistance (RI) when a magnetic field with a sufficient magnitude is present near the device.

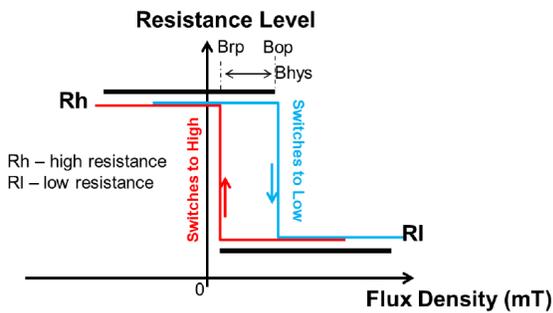


FIGURE 2

Figure 2 shows the output resistance of the Crocus Magnetic Switch as function of magnetic field (Flux Density [mT]) near the switch. The operating point (Bop) shows the threshold of the switch where the output will transition for Rh to RI. This threshold value is in the range of mT depending on the Crocus Switch device design. The release point (Brp) in the Figure 2 shows the release point threshold of the switch where the device transitions back to the Rh value when the external magnetic field is reduced below the release point of threshold value.

Crocus Magnetic Switch Circuit Implementation

The Circuit implementation of the Crocus Magnetic Switch and the typical magnetic reed switch circuit is nearly identical. Both devices are simple switches that require completion resistors to convert the switch resistance of the device to a voltage to be sensed by a sensing circuitry, typically microcontroller or analog circuitry.

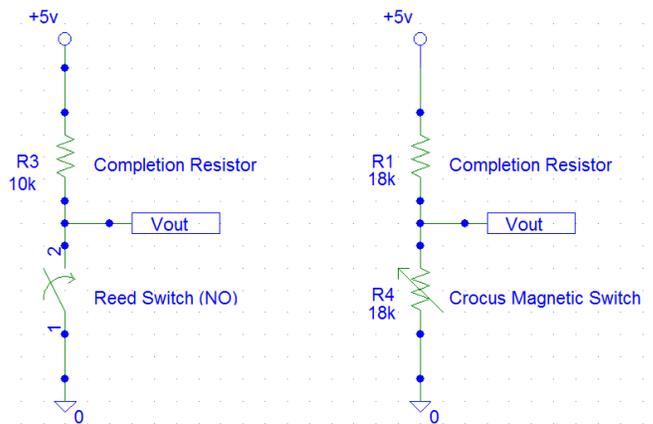


FIGURE 3

In the case when a microcontroller is used to monitor the voltage Vout of the switch circuit, the circuit in Figure 3 can be used as-is. One should note that the Vout of the Crocus circuit on the right side in Figure 3 will not transition from rail to rail. The output of the Crocus Magnetic Switch will transition from 20K ohms when there is no magnetic field present to 10K ohms when a magnetic field is present (please see CTSR4xxC datasheet).

If a microcontroller is not directly monitoring the output of the switch circuit or a rail to rail Vout transition is required, a comparator can be used to set the threshold of the circuit and to

provide full rail to rail Vout swing. The circuit in Figure 4 shows a generic comparator circuit interface to the sensor circuit. The Vthrsld value can be provided from a constant voltage source or a variable source from a DAC depending on the application. Many analog ICs are available with built-in reference voltages. These built-in voltage sources can also be used to set the threshold voltage.

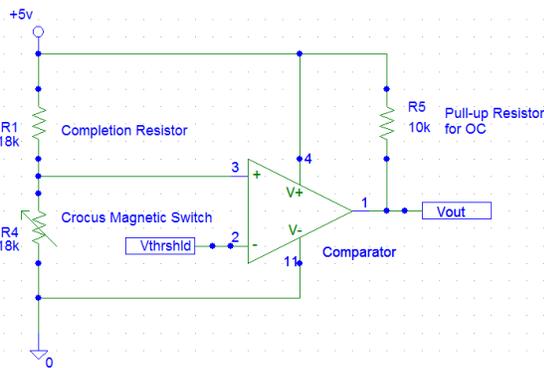


FIGURE 4

The optional pull-up resistor, R5, should be used if an open collector or open drain comparator is used. Also, a push-pull comparator can be used. An open drain or open collector comparator should be used if the output of the comparator is to be tied to another comparator's output.

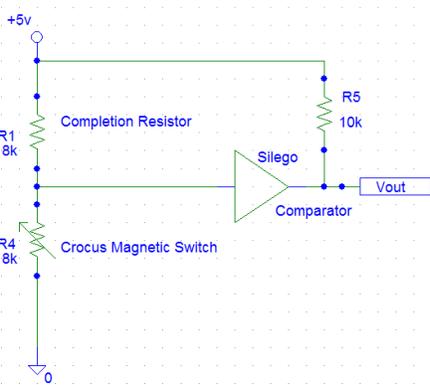


FIGURE 5

Figure 5 shows an implementation of the Crocus Magnetic Switch using a Silego (<http://www.silego.com/>) Analog IC that is very low-cost and that provides the threshold voltage as well as the open drain output of the comparator. The Silego analog IC can also be configured to provide both the source and the drain of the MOSFET as the output of the device as opposed to an open drain configuration where the source of the MOSFET is tied to GND. This configuration provides the application circuit with a MOSFET switch. Figure 6 shows this circuit application.

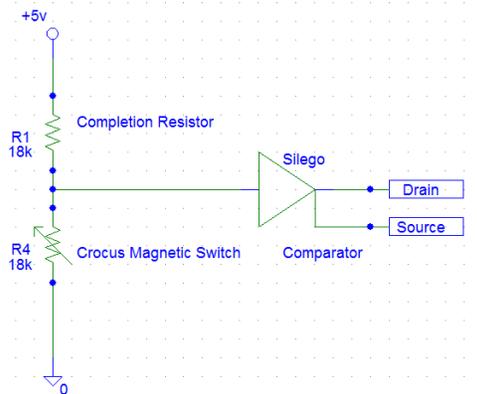


FIGURE 6

The output of the Silego comparator in Figure 6 could be used to directly control a load or other circuits of the system that aren't connected directly to GND. An example of this type of circuit might be a high-side driver used to control a load or to provide power to a circuit.

Summary

The Crocus Magnetic Switch can be used to directly replace a reed switch in many applications. The higher reliability, improved

frequency performance, smaller size, and lower cost are advantages that lead to more efficient system solutions.