CROCUS Technology
Blossoming FUTURE

Application Note 109

Switch for Smart Locks

Relevant Products:

- CT510 Series Digital Switch

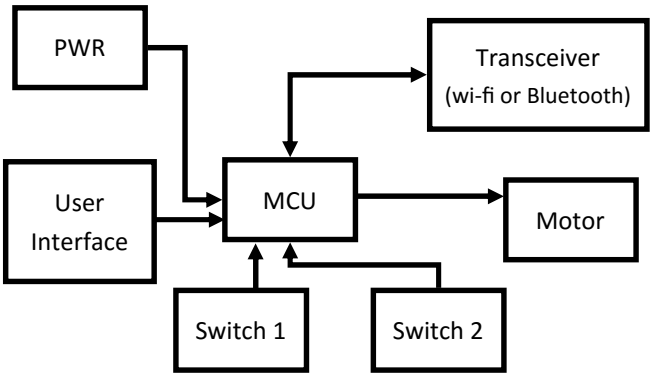
Introduction

New keyless, smart locks are emerging and replacing the traditional key deadbolt locks. With this new technology, the key is no longer used and the deadbolt position is now controlled by the smart lock itself and not the user with their key. Manufacturers of the new smart locks use various methods to determine the dead bolt position and travel. As with any security-based product, reliability and repeatability are a stringent requirement. The absolute position of the deadbolt needs to be known for the lock to accurately work with no issue. Hence, implementation of a sensor system to determine absolute position is the best solution. Crocus Technology offers switches that when used with a complementary magnet will provide absolute position feedback. This solution will be plug 'n play and does not require the user to run through a complicated calibration procedure for some smart locks. As the smart locks are batter operated, the CT510 Series will provide extended life drawing less than 300 nA of curent.

Also of note, an additional switch can be integrated into the smart lock design to determine if the door is open or closed. This is an added feature that can alert the user of any security issues.

Smart Lock System Diagram

A simplified smart lock system is comprised of a power source, MCU, communications, keypad and sensors:



Features and Benefits

- Accurate deadbolt position measurement
- Long battery life with less than 300 nA
- Plug and play implementation
- Digital output
- Cost competitive
- Stable temperature performance
- Small form factor SOT-23 package

Deadbolt Implementation

The deadbolt position sensing can be implemented in two different ways: 1) Sensing cylinder rotation position as shown in **Figure 1.** 2) Sensing actual travel of the deadbolt as shown in **Figure 2**.

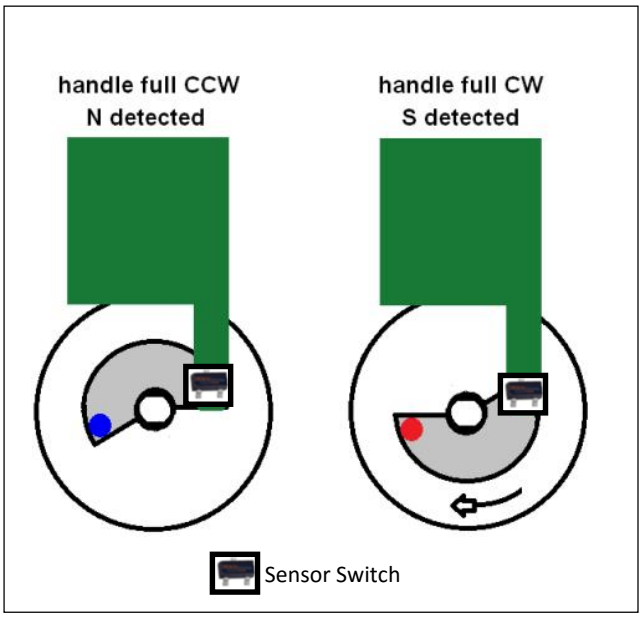


Figure 1: Cylinder Rotation Sensing Example

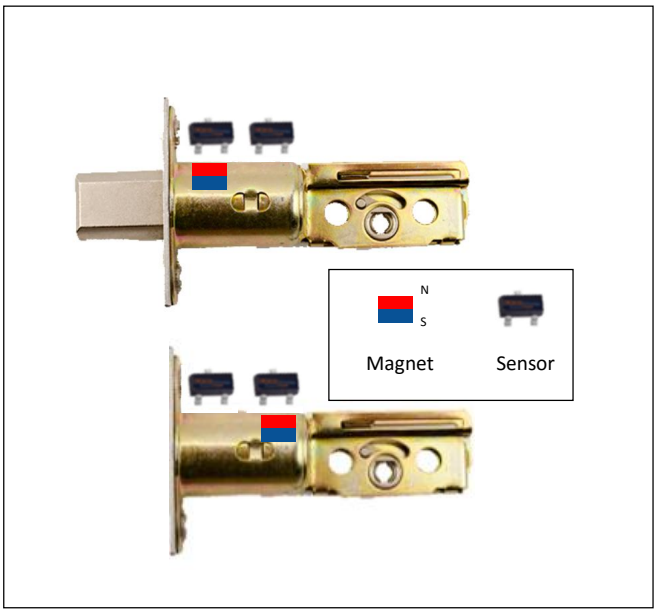


Figure 2: Deadbolt Travel Sensing Example

Cylinder Rotation Sensing

As the cylinder rotation is mechanically linked to the deadbolt position, knowing the cylinder location will correlate directly to the deadbolt position. As shown in Figure 2, by using two magnets to identify full travel of the cylinder in both the clockwise (CW) and counter-clockwise (CCW) position, the sensor will provide accurate information as to where the deadbolt position is, “locked” or “unlocked” position.

Deadbolt Position Sensing

Similarly, the deadbolt position can be determined by mounting a magnet to the deadbolt itself. A sensor switch is located at both the “locked” and “unlocked” position. When the magnet aligns with either switch, the switch will turn on and communicate the deadbolt’s position.

Door Security Feature

The smart lock can also incorporate the CT510 Series switch to signal an "open" or "closed" door condition. As shown in **Figure 3**, by aligning the switch and complementary magnet to the strike of the door, the sensor output will signal low for a closed door condition or high for an open door condition. It is important to note the polarity of the magnet and align the switch to the same polarity to ensure the magnetic flux is sensed.

For example, by mating the CT512 Switch with a ceramic magnet with surface magnetic field strength B = 220 Gauss, the sensor will perform as illustrated in **Figure 4** on the next page. In the closed door condition, the switch output will be in the low state. As the door opens, the switch will remain low until the Release Point, B_{RP}, is reached at about 1.3 cm of travel. At the BRP, the output will switch to high signaling an open door condition. The B_{RP} = 15 Gauss for the CT512 switch.

Conversely, as the door is closed, the sensor is in the high state until the Operating Point, B_{OP}, is reached at about the 1 cm point of travel from the closed door position. At the BOP, the output switches low and signals the close door condition. The B_{OP} = 60 Gauss for the CT512 switch. As shown in **Figure 5**, the application circuit is very user -friendly and can be easily integrated into the smart lock system design.

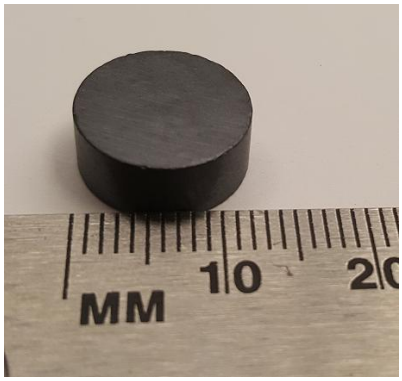
Figure 3: Door Sensing Example

Magnet Manufacturer: Ningo Magnetics Factory, Ltd.

Magnet Model #: 07002

Magnet Surface Field Strength: 220 Gauss

Disc Dimensions: Diameter = 12mm Height = 5 mm



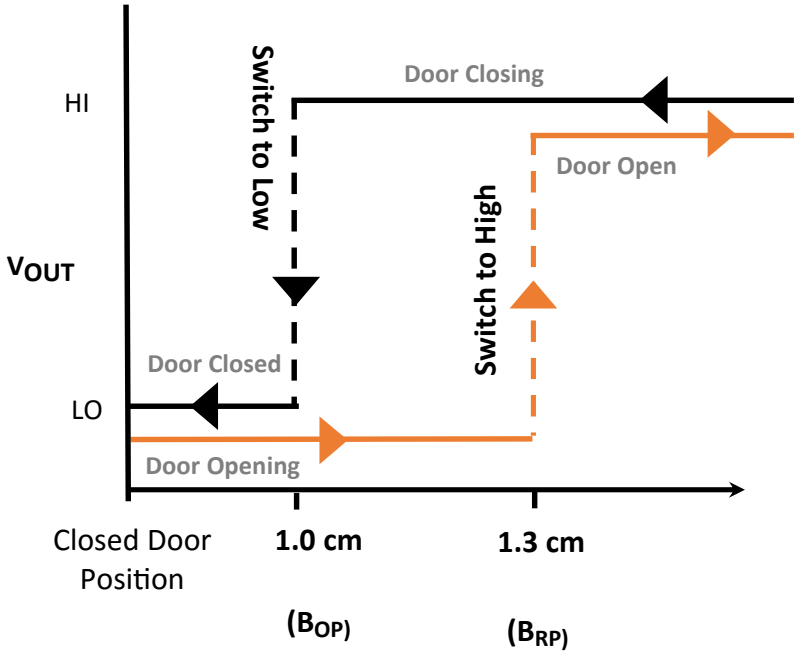


Figure 4: Magnet Distance Behavior

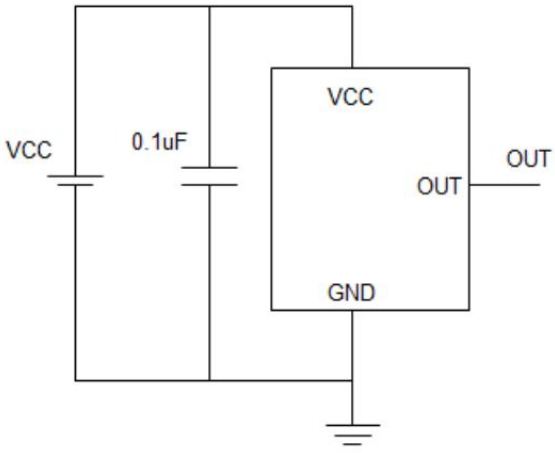


Figure 5: CT512 Application Circuit

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