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 current.

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:

- PWR
- User Interface
- MCU
- Transceiver (wi-fi or Bluetooth)
- Motor
- Switch 1
- Switch 2

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

Relevant Products:

- CT510 Series Digital Switch
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.

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](image-url)
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
Disclaimer: The contents of this document are provided in connection with products of Crocus Technology (Crocus). CROCUS TECHNOLOGY MAKES NO REPRESENTATIONS OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS HEREIN, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND RESERVES THE RIGHT TO MAKE CHANGES TO THE SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. Crocus reserves the right to discontinue or make changes to its products at any time without notice. Crocus's products have not been designed, tested, or manufactured for use and should not be used in applications where the failure, malfunction or inaccuracy of the Products carries a risk of death or serious bodily injury or damage to tangible property, including, but not limited to, life support systems, nuclear facilities, military, aircraft navigation or communication, emergency systems, harsh environments, or other applications with a similar degree of potential hazard.

ATTRIBUTION

© 2015 Crocus Technology, Inc. and Crocus Technology SA. All rights reserved. Crocus Technology, Blossoming Future, MLU, and combinations thereof are trademarks of Crocus Technology, Inc. and Crocus Technology SA.