

Using the AD7142 and a Capacitive Sensor to Develop a Single-Push Digital Shutter Button

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INTRODUCTION

This application note describes how the AD7142 can be combined with a capacitive sensor ring to implement a single-position digital camera shutter button similar to a traditional 35 mm SLR camera. In addition to easier control of the shutter button activation, other benefits include faster prefocus times and less expensive shutter buttons.

OPERATION

Figure 1 shows the block diagram of a single position shutter button encircled by a capacitive sensor ring connected to the AD7142 and HOST μ C. The combination of the capacitive sensor ring, which emits an electric field around the shutter button, and the AD7142 would provide early detection of a user's finger approaching the shutter button, and alert the HOST μ C by asserting the INT pin. The HOST controller could then begin the necessary processing to complete the prefocus steps before the user actually makes contact with the shutter button.

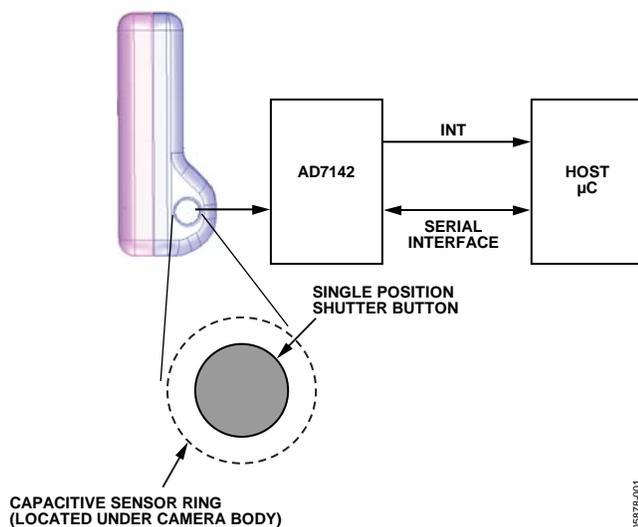


Figure 1. Capacitive Sensor Shutter Button Block Diagram

SHUTTER BUTTON AREA REQUIREMENTS

A 1.0 mm keep-out area must be maintained between the edge of the capacitive sensor ring and any metal object such as the metal camera casing, metal shutter button, or conductive metal paint. This ensures there is no false sensing due to the capacitive field being coupled to the metal casing at a virtual ground level when the camera is handled by the user. Figure 2 outlines the metal keep-out area where $d1 = d2 = 1.0$ mm minimum.

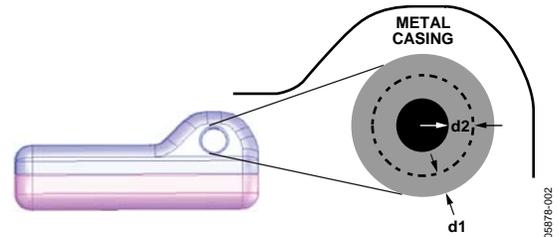


Figure 2. Metal Keep-Out Area

SHUTTER BUTTON SENSITIVITY

Figure 3 shows a user's finger hovering over the shutter button at a distance (D) above the capacitive sensor ring. The sensitivity of the capacitance sensor ring determines when the user's finger is detected as it approaches the shutter button. If the sensitivity level is set too high, the autofocus motor is enabled longer than necessary, thus creating extra drain on the battery. To avoid this, the sensitivity should be set at a low level, requiring the user to make partial contact with the shutter button prior to the AD7142 asserting the interrupt output.

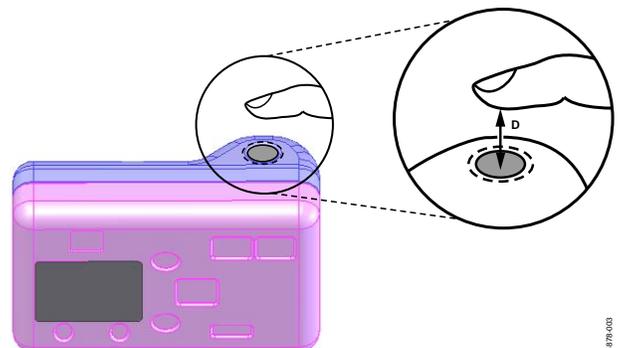


Figure 3. Finger Position "D" Above Shutter Button

The AD7142 can be configured for different threshold levels—that is, sensitivities. This feature can be used to set a very low sensitivity threshold level to meet the requirements previously described. Figure 4 shows an example of how the CDC output code changes when a user's finger is at various distances (D) from the shutter button. By setting a low interrupt threshold level, the user's finger has to make partial contact with the shutter button to cross the interrupt threshold level and assert the AD7142 interrupt output.

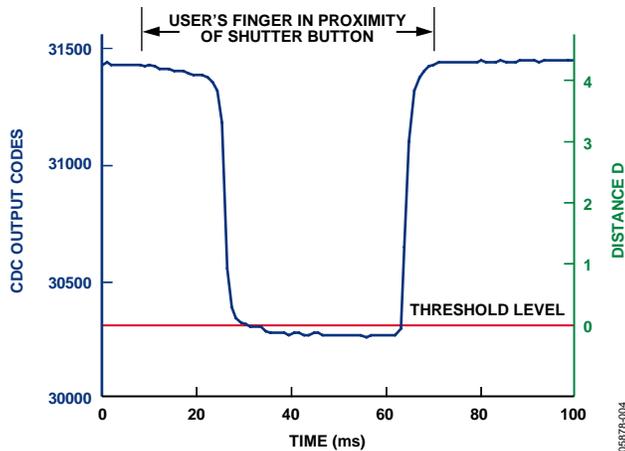


Figure 4. Example of CDC Output Code vs. Distance D

INTERRUPT OUTPUT TIMING

Figure 5 shows an example of the AD7142 interrupt timing when a user's finger hovers over the shutter button for an extended period of time. There are three asserted interrupts when the user's finger is close enough to the shutter button to cause the CDC output code level to go below the interrupt threshold level. Once the threshold level is exceeded, the AD7142 asserts the interrupt output, at which time the HOST μ C must read back the interrupt register to clear the interrupt. The interrupt output pin remains low until this register is read back.

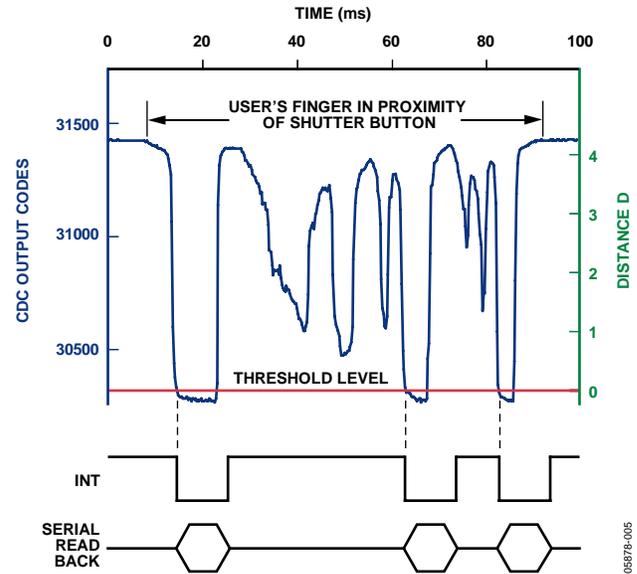


Figure 5. Example of Interrupt Output Timing for Multiple Shutter Button Contacts

COMMON QUESTIONS

Does the user have to contact the shutter button to assert the AD7142 INT output?

No. The AD7142 threshold levels for the capacitive sensor ring can be programmed for different sensitivity levels. For example, a high sensitivity level detects the user's finger a few millimeters away from the shutter button, whereas a lower sensitivity level requires the user to assert slight pressure on the shutter button.

The lens focus motor would be constantly operating if the user's finger was close to the shutter button while panning to focus on an object. This would draw unnecessary power and drain the battery. Is there a way to prevent this?

Yes. For this application, the sensitivity level and capacitive sensor would be configured to be under-sensitive. Lifting the finger slightly off the shutter button avoids detection.

Do the shutter buttons have to have a round form factor?

No. A capacitive filed ring can be custom designed to support different mechanical form factors such as square, rectangular, or round shutter buttons.