

## Si4010/Si4355 EZRADIO<sup>®</sup> REMOTE CONTROL DEMO KIT USER'S GUIDE

### 1. Purpose

Thank you for your interest in Silicon Laboratories' EZRadio Remote Control Demo Kit. The Silicon Laboratories EZRadio Remote Control Demo Kit (P/N EZR-LEDK1W-XXX) contains everything you need to familiarize yourself with and evaluate the Si4010 RF SoC transmitter and the Si4355 receiver. The kit has three versions: one for the 434 MHz band, one for the 868 MHz band, and one for the 915 MHz band. The key features of the demo kit are as follows:

- The key fob demo board has five push buttons and one LED output.
- The receiver demo board has four LEDs to display received key fob commands.
- The provided software pack contains all the documentation and files needed to develop a user application.
- The kit supports the use of the Silicon Laboratories Integrated Development Environment (IDE) for software debugging and the use of the Keil C compiler, assembler, and linker toolchain.
- Contains demo applications using API functions and the key fob demo application.

#### 1.1. Kit Content

**Table 1. Kit Content**

| Qty | Part Number           | Description                                    |
|-----|-----------------------|--|
|     | <b>EZR-LEDK1W-434</b> | <b>EZRadio Remote Control Demo Kit 434 MHz</b> |
| 1   | 4010-KFOB-434         | Si4010 Universal Key Fob 434 MHz               |
| 1   | 4355-LED-434-SRX      | Si4355 RFStick 434 MHz EZRadio receiver board  |
| 1   | MSC-PLPB_1            | Key Fob Plastic Case (translucent gray)        |
| 2   | AAA                   | AAA alkaline battery                           |
| 1   | CRD2032               | CR2032 3 V coin battery                        |
|     | <b>EZR-LEDK1W-868</b> | <b>EZRadio Remote Control Demo Kit 868 MHz</b> |
| 1   | 4010-KFOB-868         | Si4010 Universal Key Fob 868 MHz               |
| 1   | 4355-LED-868-SRX      | Si435 RFStick 868 MHz EZRadio receiver board   |
| 1   | MSC-PLPB_2            | Key Fob Plastic Case (translucent red)         |
| 2   | AAA                   | AAA alkaline battery                           |
| 1   | CRD2032               | CR2032 3 V coin battery                        |
|     | <b>EZR-LEDK1W-915</b> | <b>EZRadio Remote Control Demo Kit 915 MHz</b> |
| 1   | 4010-KFOB-915         | Si4010 Universal Key Fob 915 MHz               |
| 1   | 4355-LED-915-SRX      | Si4355 RFStick 915 MHz EZRadio receiver board  |
| 1   | MSC-PLPB_2            | Key Fob Plastic Case (translucent red)         |
| 2   | AAA                   | AAA alkaline battery                           |
| 1   | CRD2032               | CR2032 3 V coin battery                        |



**Figure 1. Si4010 Universal Key Fob Board and Plastic Case (P/N 4010-KFOB-434 and MSC-PLPB\_1)**



**Figure 2. Si4355 RFStick 434 MHz Receiver Board (P/N 4355-LED-434-SRX)**

## 2. Operating the Demo

The Si4010 key fob transmitter and the Si4355 RFStick receiver are the transmitter and receiver devices used in the one way link demo. This transmitter/receiver pair can be used to evaluate the capabilities of the Si4010 transmitter and the Si4355 receiver.

The first step is to insert the CR2032 battery in the battery holder on the 4010-KFOB-XXX demo board and then place the board into the plastic key fob case. Next, insert the two AAA batteries in the battery holder on the 4355-LED-XXX receiver board and turn it on by setting the S6 switch to the “Battery” position. LED4 will light continuously indicating that power is on and the SRX firmware is running.

When a button is pressed on the key fob, LEDs flash on the receiver board according to which button was pressed. In the next table, buttons are named according to their position when the key fob is held with its LED facing forward.

**Table 2. Key Fob Buttons and Resulting LEDs**

| Key Fob Button Pressed | RF Stick LED Flashed |
|------------------------|----------------------|
| Left Button            | LED1                 |
| Middle Button          | LED2                 |
| Right Button           | LED3                 |
| Rear Button            | LED1 + LED3          |
| Front Button           | LED1 + LED2 + LED3   |

## 3. RF Parameters

The demo kit uses the following RF parameters according to the kit's frequency band.

| Kit Part Number | Center Frequency | Deviation |
|-----------------|------------------|-----------|
| EZR-LEDK1W-434  | 433.92 MHz       | ± 59 kHz  |
| EZR-LEDK1W-868  | 868.30 MHz       | ± 119 kHz |
| EZR-LEDK1W-917  | 917.00 MHz       | ± 120 kHz |

The modulation is FSK.

## 4. Transmitter Side Program

The Si4010 in the key fob is factory programmed with the rke\_demo\_2 program. Since the program is burned in the NVM (OTP) memory of the Si4010, it cannot be changed. The whole rke\_demo\_2 software project can be found in the example programs package of the Si4010. It is available at the web page

<http://www.silabs.com/products/wireless/EZRadio/Pages/Si4010.aspx> on the Tools tab.

The key fob transmits an RF packet three times each time a button is pressed, and it also blinks the LED on the key fob. The packet structure is as follows:

| Number of Bytes | Field Name   | Description                                |
|-----------------|--------------|--|
| 13              | Preamble     | 0xaa                                       |
| 2               | Sync         | 0x2d, 0xd4                                 |
| 4               | Chip ID      | Unique, factory-burned chip ID             |
| 1               | Status       | Lower 5 bits are the button information    |
| 2               | Packet count | Rolling counter for PER measurement        |
| 2               | CRC-16       | Generator X16+X15+X2+1, start value 0xFFFF |

Symbol rate is 9.6 kBd.

Each packet contains 18 additional bytes that are not received by the receiver of this demo. These additional bytes are AES-encrypted and are used by the AES demo kit. See details in the user's guide of the AES demo kit (P/N 4010-AESK1W-434).

In the key fob program the frequency and deviation is pin-selected by the PCB layout. This operating frequency is indicated on a label on the back of the key fob PCB.

| GPIO8 | GPIO9 | Center Frequency | Deviation |
|-------|-------|------------------|-----------|
| High  | Low   | 316.66 MHz       | ± 43 kHz  |
| High  | High  | 433.92 MHz       | ± 59 kHz  |
| Low   | High  | 868.30 MHz       | ± 119 kHz |
| Low   | Low   | 917.00 MHz       | ± 120 kHz |

The 316.667 MHz key fob is available in the 4010-AESK1W-315 demo kit or separately from Silicon Labs.

The key fob's default modulation is FSK but if the middle button is pressed and held during battery insertion, the modulation will be OOK until the next powerdown (battery removal).

## 5. Receiver Side Program

The 8051F930 MCU on the RFStick receiver board is factory-programmed with the Si4355 Remote Control Demo Receiver program. Since the program is programmed in flash memory, it can be overwritten using a Silicon Labs Toolstick Base Adapter that is part of the Si4010 development kit or can be ordered separately as well (P/N Toolstick\_BA). The complete demo software project can be found on the Tools tab of the following web page: <http://www.silabs.com/products/wireless/EZRadio/Pages/Si4355.aspx>. The file name is Si4355\_RCdemo\_SW.zip.

The receiver program configures and controls the Si4355 receiver chip via the SPI bus. The Si4355 receives the packets transmitted by the keyfob, checks the preamble, the syn bytes and the CRC. If the packet is OK, the program flashes the LEDs according to the button information in the status byte of the received packet.

## 6. Schematics

Schematics of the transmitter and receiver boards of the kit can be seen on the following pages. Complete manufacturing file pack with CAD/CAM files and BOMs can be found at <http://www.silabs.com>.

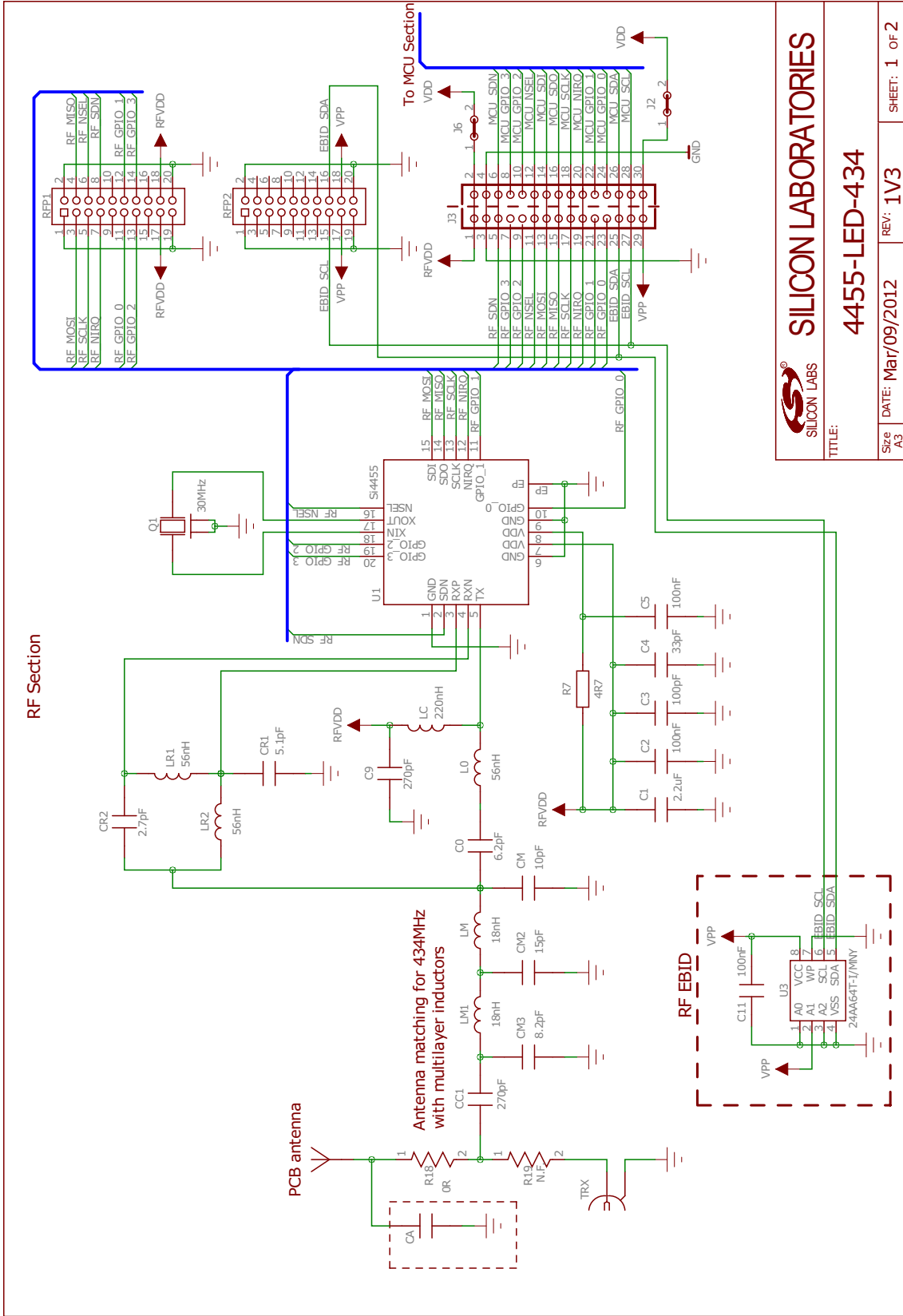


Figure 3. RF Section

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**4455-LED-434**

Size: A3    DATE: Mar/09/2012    REV: IV3    SHEET: 1 OF 2

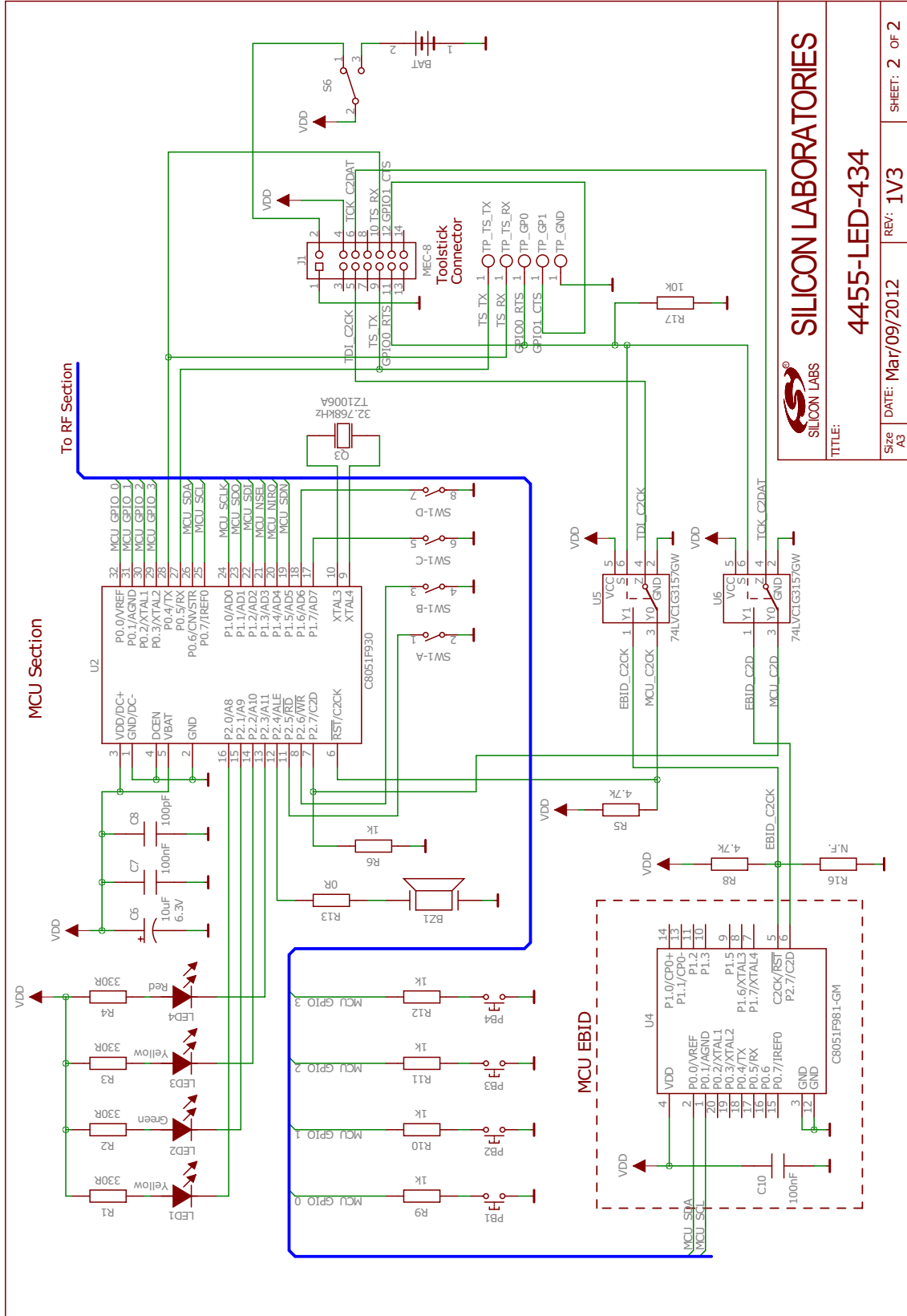


Figure 4. MCU Section

|   |                   |                             |               |
|---|-------------------|-----------------------------|---------------|
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| Size<br>A3  | DATE: Mar/09/2012 | REV: 1V3                    | SHEET: 2 OF 2 |

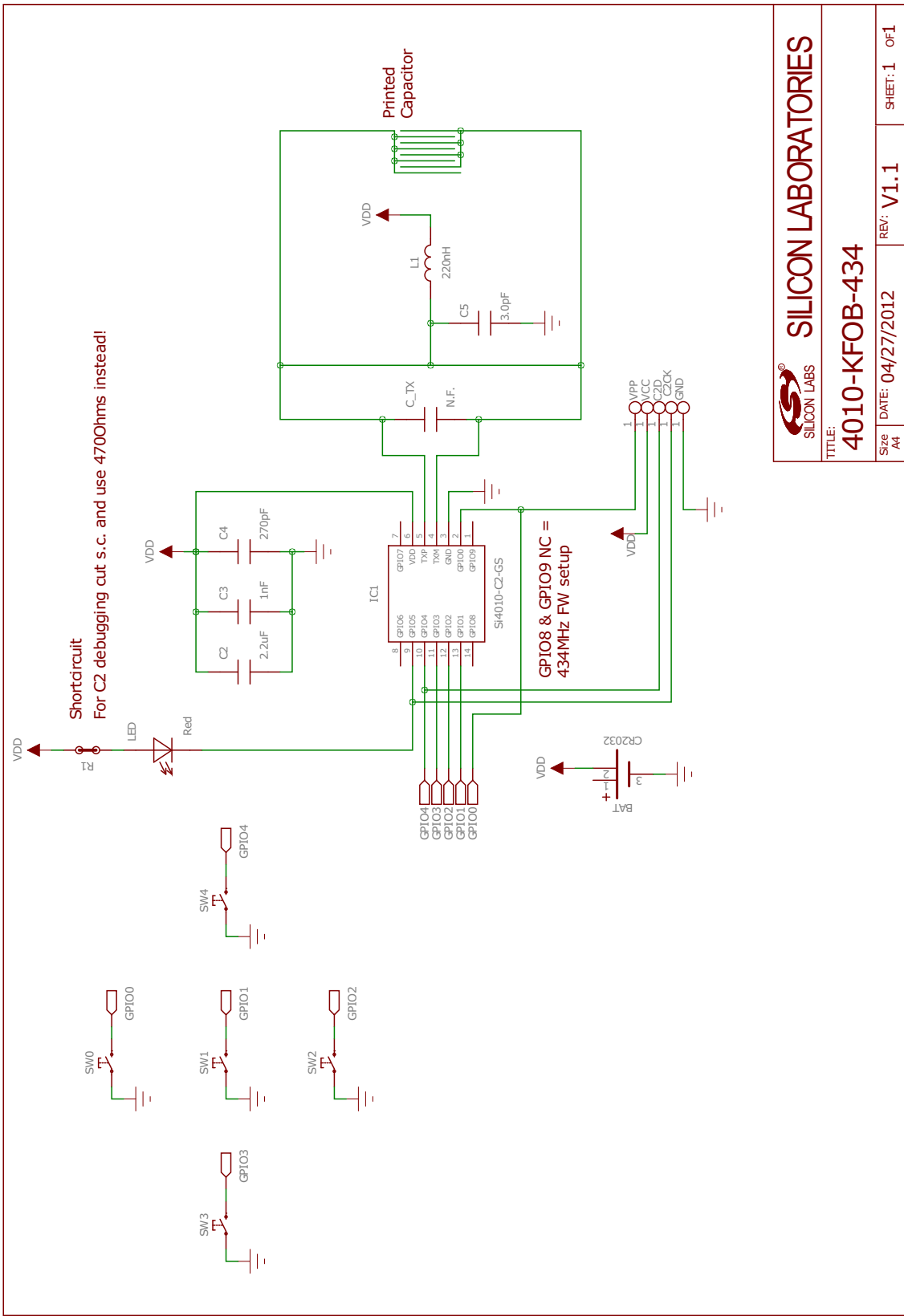


Figure 5. Key Fob

## DOCUMENT CHANGE LIST

### Revision 0.1 to Revision 0.2

- Updated "2. Operating the Demo" on page 2.
- Updated Table 2 on page 2.

### Revision 0.2 to Revision 0.3

- Updated Table 1, "Kit Content," on page 1.
- Updated name and filename of receiver-side program.



**NOTES:**



## Simplicity Studio

One-click access to MCU tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!

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