

## Evaluation Board for Fractional-N PLL Frequency Synthesizer

### FEATURES

**Self-contained board including synthesizer, VCO, 10 MHz TCXO reference, USB interface, voltage regulators, and loop filter (5.8 GHz)**

**Designed for 10 MHz PFD frequency, minimum charge pump current, and 20 kHz loop bandwidth**

**Accompanying software allows control of synthesizer functions from a PC (via USB interface)**

**Battery operated: choice of 3 V or 5 V supplies**

### GENERAL DESCRIPTION

The EVAL-ADF4158EB1Z evaluates the performance of the ADF4158 frequency synthesizer for phase locked loops (PLL). A digital picture is shown in Figure 1. It contains the ADF4158 synthesizer, a PC connector, SMA connectors for the power supplies, and an RF output. There is also a low pass loop filter (20 kHz) and a VCO (Z Communications, Inc., VCO940ME03

5.8 GHz) on board. The evaluation board is set up for a 10 MHz PFD comparison frequency. An on-board TCXO provides the 10 MHz reference frequency. A USB cable is included with the board to connect to a PC USB port.

The package also contains Windows® software (XP, Vista, and 7 compatible) to allow easy programming of the synthesizer.

### EVALUATION KIT CONTENTS

**Antistatic bag with USB warning label (free issue by Analog Devices, Inc.)**

**Fractional-N synthesizer CD (with USB control) (issue by Analog Devices)**

**Evaluation board box (Europaks K-645/1) with EVAL-ADF4158EB1Z barcode label**

**Wrapping material (antistatic bubble wrap)**

### DIGITAL PICTURE OF THE EVALUATION BOARD



Figure 1.

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REVISION HISTORY

10/12—Rev. 0 to Rev. A

|                                                    |   |
|----------------------------------------------------|---|
| Changes to General Description Section .....       | 1 |
| Changes to Evaluation Board Software Section ..... | 5 |
| Added Figure 7; Renumbered Sequentially .....      | 8 |

5/10—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

### OVERVIEW

The EVAL-ADF4158EB1Z is supplied with a cable for connecting to the USB port of a PC. The silk screen for the evaluation board is shown in Figure 2. The board schematic is shown in Figure 8, Figure 9, and Figure 10.

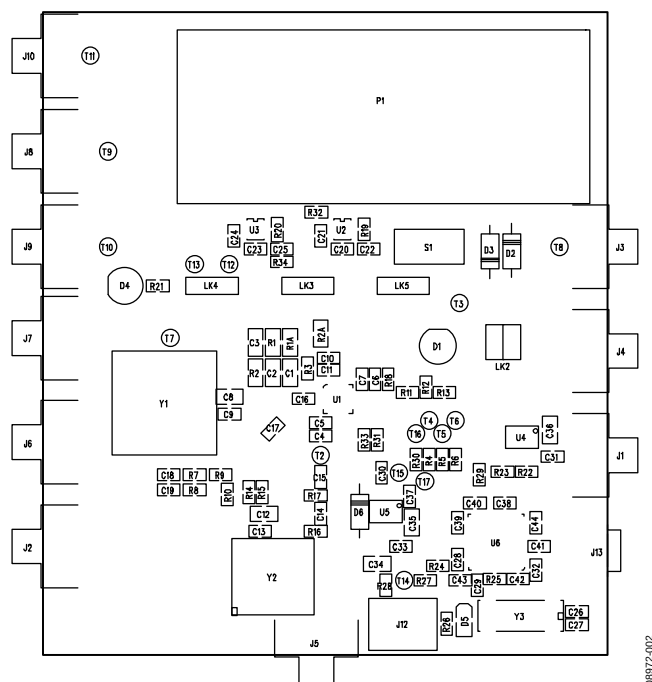


Figure 2. Evaluation Board Silk Screen

### POWER SUPPLIES

The board is powered from a single 9 V battery. The power supply circuitry allows the user to choose 3 V for the  $AV_{DD}$ ,  $DV_{DD}$ , and  $SDV_{DD}$  pins of the ADF4158 and either 3 V or 5 V for the  $V_P$  pin of the ADF4158 and for the VCO supply. The default settings are 3 V for  $AV_{DD}$ ,  $DV_{DD}$ , and  $SDV_{DD}$  and 5 V for  $V_P$ .

It is very important to note that the  $AV_{DD}$ ,  $DV_{DD}$ , and  $SDV_{DD}$  pins of the ADF4158 should never exceed the  $V_P$  pin of the ADF4158. This can cause damage to the device.

If the user wishes, external power supplies can be used. In this case, insert SMA connectors as shown on the silk screen (see Figure 2) and the digital picture (see Figure 1) of the evaluation board.

### LOOP FILTER

The loop filter schematic is included in the board schematic in Figure 8, Figure 9, and Figure 10. The loop filter component placements are clarified in Figure 3.

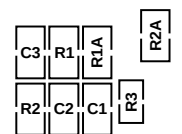


Figure 3. Loop Filter Placement

### LOCAL OSCILLATOR COMPONENTS

The 10 MHz TCXO provides the reference frequency. The on-chip R divider should be set to 1 so that the PFD frequency is also 10 MHz. The PLL is made up of the 10 MHz TCXO, the ADF4158, a passive loop filter (20 kHz bandwidth), and the VCO V940ME03 VCO from Z Communications. The output is available at  $RF_{OUT}$  through a standard SMA connector.

The on-board loop filter has been designed for a charge pump current of 0.3125 mA. ADIsimPLL, a free download available at [www.analog.com/pll](http://www.analog.com/pll), can be used to design other loop filters.

## EVALUATION SETUP

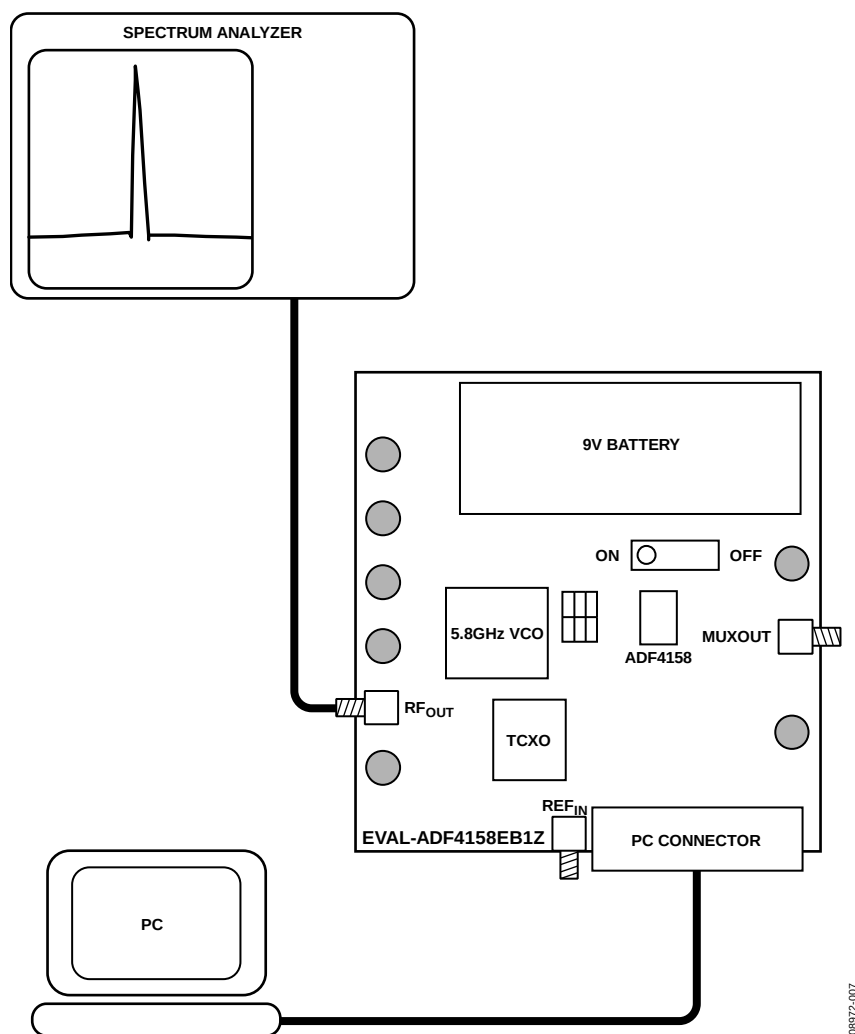


Figure 4. Evaluation Setup

08972-007

## EVALUATION BOARD SOFTWARE

The control software for EVAL-ADF4158EB1Z is on the CD that accompanies the board. For the software installation procedure, see [UG-476](#).

### SELECT DEVICE AND CONNECTION

In the **Select Device and Connection** tab (see Figure 5), choose **ADF4158**, choose **USB board (green)**, and click **Connect**. The software connects to the evaluation board.

### MAIN CONTROLS

In the **Main Controls** tab (see Figure 6), the basic PLL settings can be selected. When a register value is changed, the relevant register box at the bottom of the screen turns green. To write

the value to the evaluation board, click the associated button. The box returns to a grey color once the value has been written.

See the **RF Synthesizer: A Worked Example** section of the [ADF4158](#) data sheet for more information.

### RAMPS AND SHIFT-KEYING

In the **Ramps and Shift-keying** tab (see Figure 7), ramp parameters can be set and then programmed to the evaluation board.

See the **FMCW Radar Ramp Settings Worked Example** section of the [ADF4158](#) data sheet for more information.

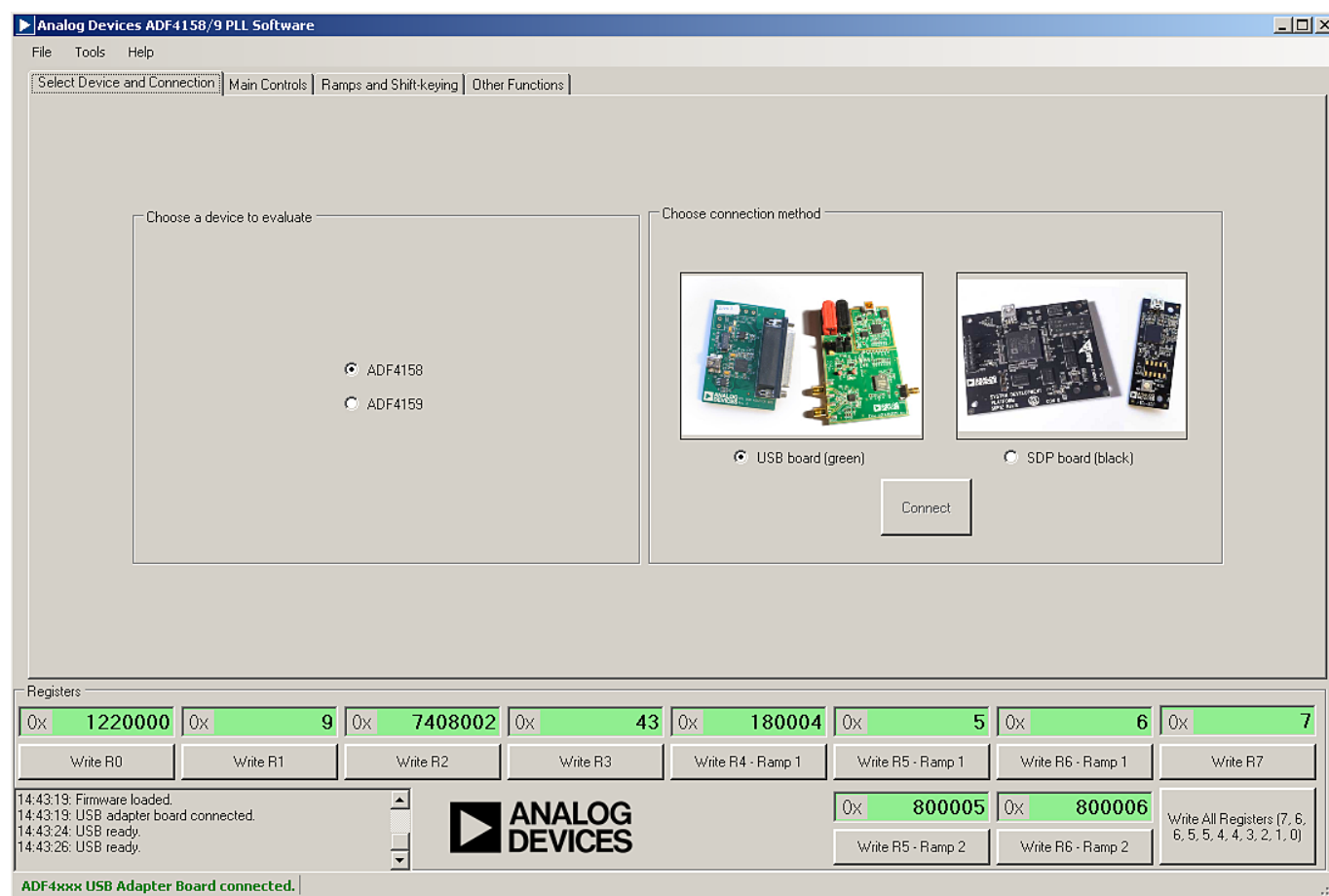


Figure 5. Select Device and Connection Tab

**Analog Devices ADF4158/9 PLL Software**

File Tools Help

Select Device and Connection: **Main Controls** | Ramps and Shift-keying | Other Functions

---

**RF Settings**

RF VCO Output Frequency:  MHz

Reference Frequency:  MHz

R counter:  Ref Doubler: ☐ Ref /2: ☐

PFD Frequency:  MHz

Channel spacing:  kHz

Prescaler:

INT:  +  $\frac{\text{FRAC}}{\text{MOD}}$  =  MHz

FRAC:  MOD:

N = 580

**PLL Settings**

Register 0: Muxout:

Register 2: CSR:  Charge Pump Setting:  mA

Register 3: Counter Reset:  Charge Pump Tri-State:  Phase Detector Polarity:  Lock Detect Precision:  Power Down:  SD Reset:  N SEL:

Register 4: CLK Div Mode:  FastLock Timer/CLK Div:

---

**Registers**

|                                         |                                         |                                         |                                         |                                                  |                                                  |                                                  |                                         |
|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|-----------------------------------------|
| 0x <b>1220000</b>                       | 0x <b>9</b>                             | 0x <b>7408002</b>                       | 0x <b>43</b>                            | 0x <b>180004</b>                                 | 0x <b>5</b>                                      | 0x <b>6</b>                                      | 0x <b>7</b>                             |
| <input type="button" value="Write R0"/> | <input type="button" value="Write R1"/> | <input type="button" value="Write R2"/> | <input type="button" value="Write R3"/> | <input type="button" value="Write R4 - Ramp 1"/> | <input type="button" value="Write R5 - Ramp 1"/> | <input type="button" value="Write R6 - Ramp 1"/> | <input type="button" value="Write R7"/> |

14:43:19: Firmware loaded.  
 14:43:19: USB adapter board connected.  
 14:43:24: USB ready.  
 14:43:26: USB ready.

**ADF4xxx USB Adapter Board connected.**

**ANALOG DEVICES**

0x **800005**

0x **800006**

Figure 6. Main Controls Tab

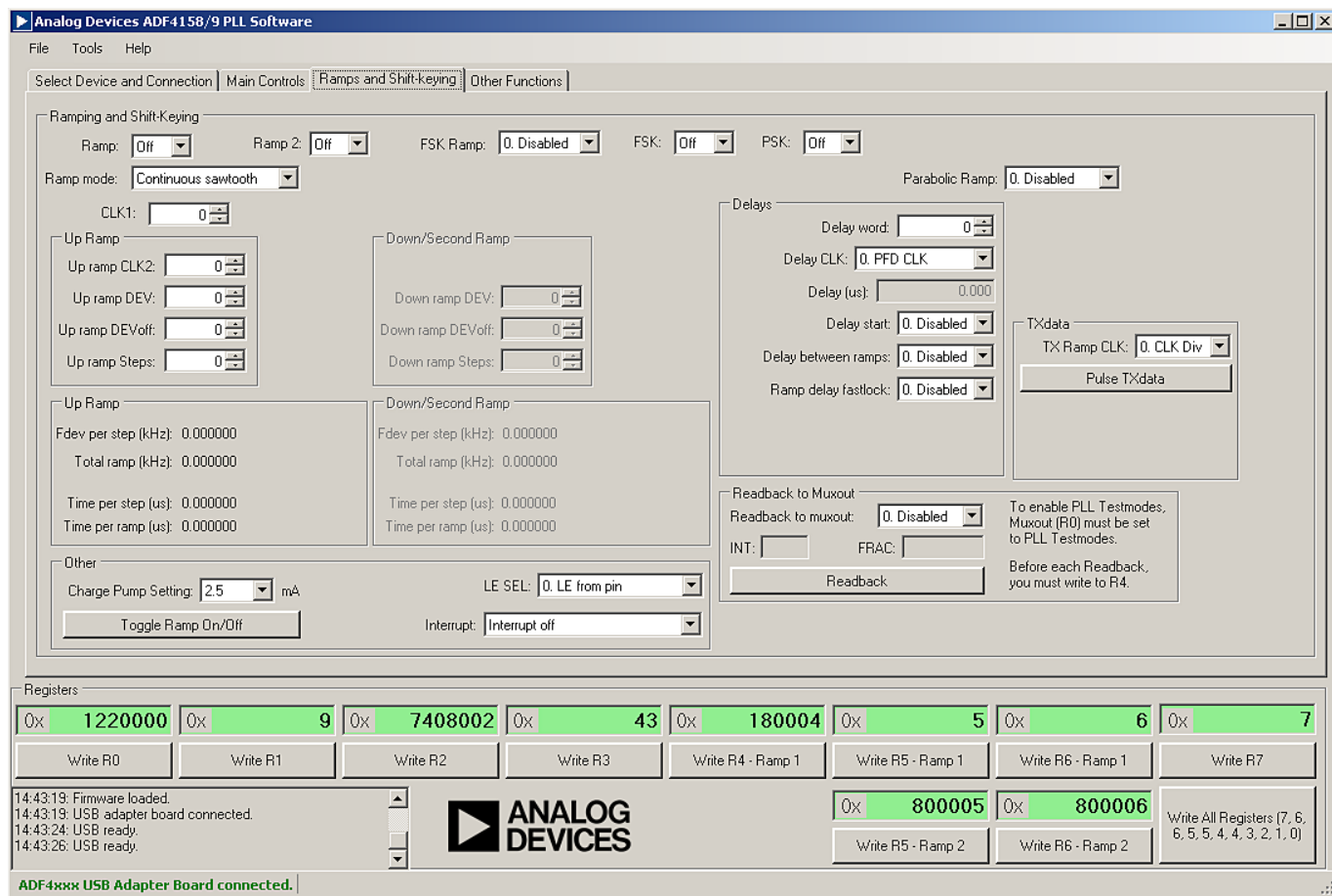
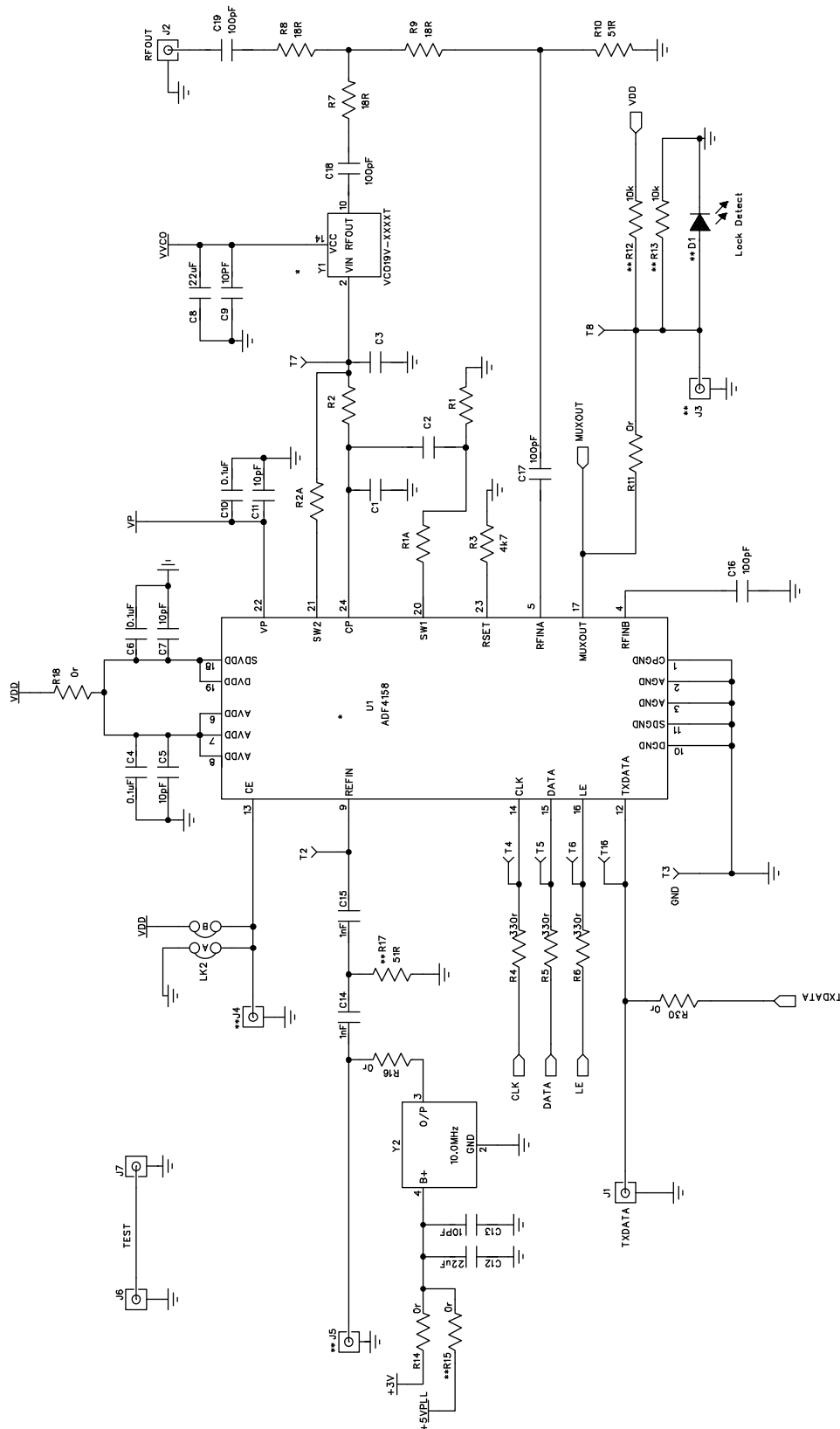


Figure 7. Ramps and Shift-Keying Tab

## EVALUATION BOARD SCHEMATIC



08972-004

Note on non-inserted components.  
 \*\* - These components can be inserted by the user for expansion purposes.

Figure 8. Evaluation Board Schematic (Page 1)



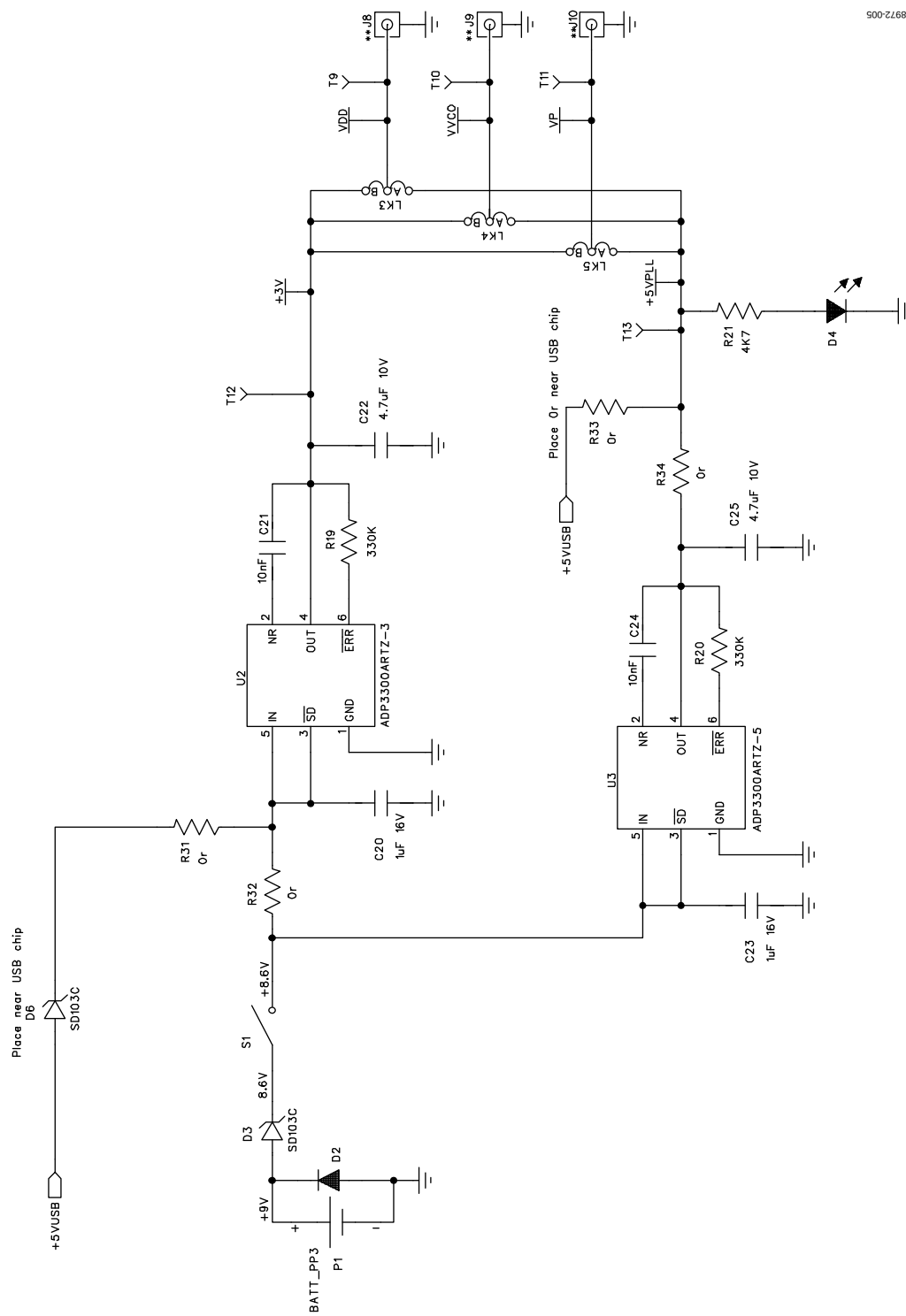
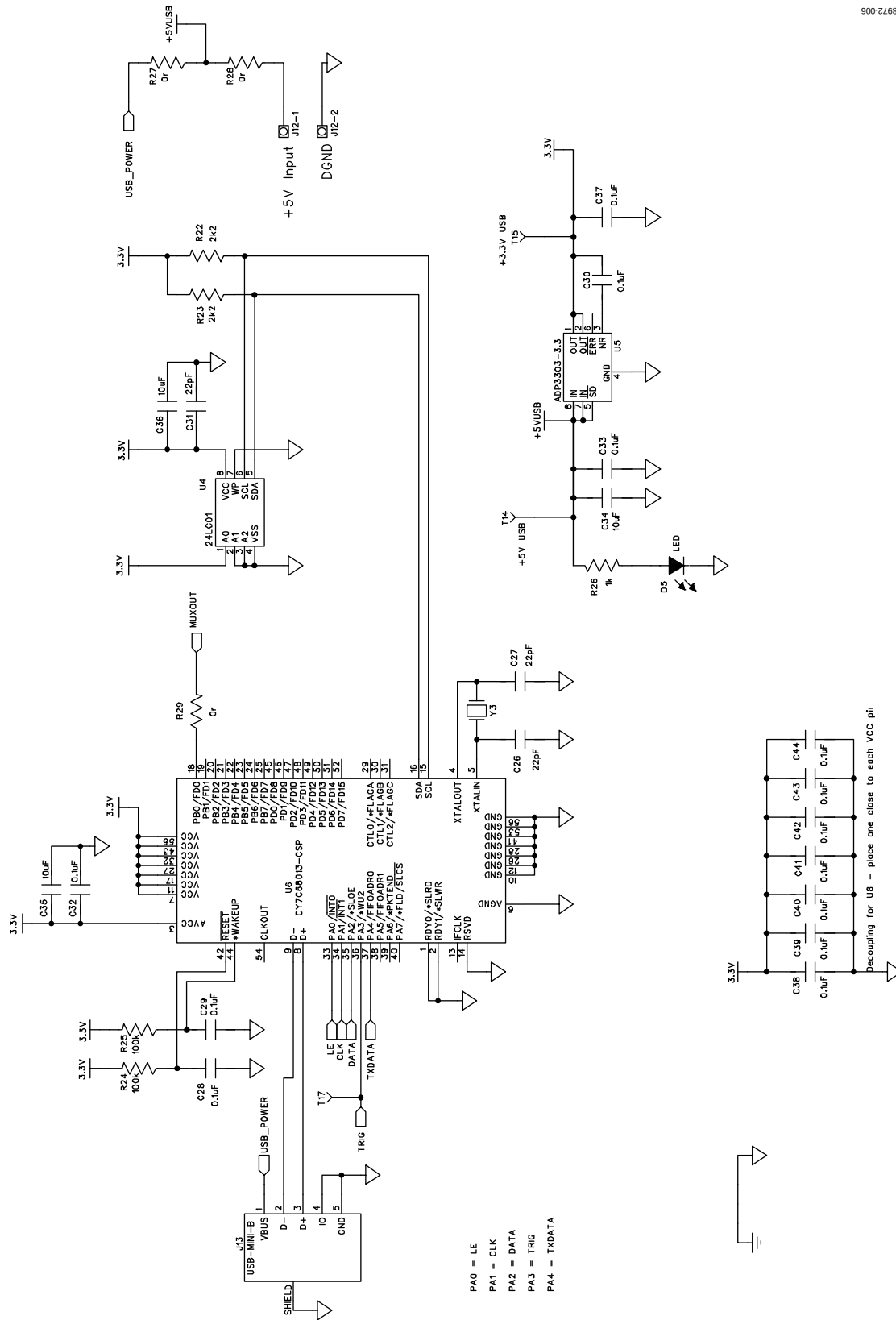


Figure 9. Evaluation Board Schematic (Page 2)



## ORDERING INFORMATION

## BILL OF MATERIALS

Table 1.

| Reference Designator                     | Description                     | Manufacturer/Part Number | Supplier Stock Code        |
|------------------------------------------|---------------------------------|--------------------------|----------------------------|
| C1                                       | Capacitor 680 pF 0603           | MCCA000220               | FEC 1759083                |
| C2                                       | Capacitor 8.2 nF 0603           | MCCA000236               | FEC 1759101                |
| C3                                       | Capacitor 330 pF 0603           | MCCA000212               | FEC 1759075                |
| C4, C6, C10, C28 to C30, C37 to C44      | Capacitor 0.1 $\mu$ F 0603      | CM105X7R104K16AT         | FEC 1216538                |
| C5, C7, C9, C11, C13                     | Capacitor 10 pF 0603            | 06035A100JAT2A           | FEC 499110                 |
| C8, C12                                  | Capacitor 22 $\mu$ F 0805       | GRM21BR60J226ME39L       | Digi-Key 490-1719-1-ND     |
| C14, C15                                 | Capacitor 1 nF 0603             | 06035A102JAT2A           | FEC 317202                 |
| C16 to C19                               | Capacitor 100 pF 0603           | 06035A101JAT2A           | FEC 499122                 |
| C20, C23                                 | Capacitor 1 $\mu$ F 16 V 0603   | GRM188R71C105KA12D       | Digi-Key 490-3900-1-ND     |
| C21                                      | Capacitor 10 nF 0603            | CC0603KRX7R8BB103        | FEC 3019561                |
| C22, 25                                  | Capacitor 4.7 $\mu$ F 10 V 0603 | LMK107BJ475KA-T          | Digi-Key 587-1441-1-ND     |
| C24                                      | Capacitor 10 nF 0603            | CC0603KRX7R8BB103        | FEC 3019561                |
| C26, C27, C31                            | Capacitor 22 pF 0603            | 06035A220JAT2A           | FEC 498543                 |
| C32, C33                                 | Capacitor 0.1 $\mu$ F 0603      | CM105X7R104K16AT         | FEC 1216538                |
| C34 to C36                               | Capacitor 10 $\mu$ F 0805       | GRM21BR71A106KE51L       | Digi-Key 490-3905-1-ND     |
| D1                                       | LED                             | DNI                      | DNI                        |
| D2                                       | Diode 1N4001 DO-41              | 1N4001                   | FEC 9564993                |
| D3, D6                                   | SD103C 20 V DO35                | SD103C-TP                | Digi-Key SD103CTPMSCT-ND   |
| D4                                       | Red LED                         | TLLR4401                 | FEC 1045504                |
| D5                                       | Green LED 0805                  | HSMG-C170                | FEC 579-0852               |
| J1 to J10                                | SMA SMA_CARD_EDGE_RF_VIAS       | 142-0701-851             | FEC 1019325                |
| J12                                      | CON\POWER                       | CTB5000/2                | FEC 151789                 |
| J13                                      | USB-MINI-B                      | 56579-0576               | FEC 9786490                |
| LK2                                      | JUMPER_2_INVTEXT                | M20-9980345 and M7567-05 | FEC 1022230 and FEC 150410 |
| LK3 to LK5                               | JUMPER2\SIP3, LINK-3P-NOTEXT    | M20-9980345 and M7567-05 | FEC 1022248 and FEC 150410 |
| P1                                       | BATT_PP3                        | 593+594                  | FEC 723988                 |
| R1                                       | Resistor 2.4 k $\Omega$ 0805    | MC 0.1W 0805 1% 2K4      | FEC 9332880                |
| R1A                                      | Resistor DNI 0805               | DNI                      | DNI                        |
| R2                                       | Resistor 5.1 k $\Omega$ 0805    | MC 0.1W 0805 1% 5K1      | FEC 9333320                |
| R2A                                      | Resistor DNI 0805               | DNI                      | DNI                        |
| R3, R21                                  | Resistor 4.7 k $\Omega$ 0603    | MC 0.063W 0603 4K7       | FEC 9331247                |
| R4, R5, R6                               | Resistor 330 $\Omega$ 0603      | MC 0.063W 0603 330R      | FEC 9331018                |
| R7, R8, R9                               | Resistor 18 $\Omega$ 0603       | MC 0.063W 0603 18R       | FEC 9330747                |
| R10, R17                                 | Resistor 51 $\Omega$ 0603       | MC 0.063W 0603 51R       | FEC 9331336                |
| R11                                      | Resistor 0 $\Omega$ 0603        | MC 0.063W 0603 0R        | FEC 9331662                |
| R12, R13                                 | Resistor 10 $\Omega$ 0603       | MC 0.063W 0603 10K       | FEC 9330399                |
| R14, R15, R16, R18, R27, R28, R30 to R34 | Resistor 0 $\Omega$ 0603        | MC 0.063W 0603 0R        | FEC 9331662                |
| R19, R20                                 | Resistor 330 $\Omega$ 0603      | MC 0.063W 0603 330K      | FEC 9331042                |
| R22, R23                                 | Resistor 2.2 k $\Omega$ 0603    | MC 0.063W 0603 2K2       | FEC 9330810                |
| R24, R25                                 | Resistor 100 $\Omega$ 0603      | MC 0.063W 0603 100K      | FEC 9330402                |
| R26, R29                                 | Resistor 1 $\Omega$ 0603        | MC 0.063W 0603 1K        | FEC 9330380                |
| S1                                       | SW_POWER, SW_SIP-3P             | TL36P0050                | FEC 1082496                |
| T2, T4 to T17                            | Test point                      | 20-313137                | FEC 8731144                |
| T3                                       | Test point                      | 20-2137                  | FEC 8731128                |

| Reference Designator | Description                        | Manufacturer/Part Number                           | Supplier Stock Code       |
|----------------------|------------------------------------|----------------------------------------------------|---------------------------|
| U1                   | Fractional-N frequency synthesizer | Analog Devices ADF4158BCPZ                         | ADF4158BCPZ               |
| U2                   | Low dropout linear regulator       | Analog Devices ADP3300ARTZ-3                       | ADP3300ARTZ-3             |
| U3                   | Low drop out linear regulator      | Analog Devices ADP3300ARTZ-5                       | ADP3300ARTZ-5             |
| U4                   | IC EEPROM 64 kB 400 KHz            | Microchip Technologies24LC64-ISN                   | Digi-Key 24LC64-I/SN-ND   |
| U5                   | Low drop out linear regulator      | Analog Devices ADP3303ARZ-3.3                      | ADP3303ARZ-3.3            |
| U6                   | USB microcontroller                | Cypress Semiconductor<br>CY7C68013A-56LFXC         | Digi-Key 428-1669-ND      |
| Y1                   | Voltage controlled oscillator      | Z Communication VCO V940ME03                       | VCO V940ME03              |
| Y2                   | OSC_TCXO 10.0 MHz OSC_TCXO         | 801-BELF-100                                       | Fox 801-BELF-100 (10 MHz) |
| Y3                   | XTAL-CM309S 24 MHz                 | X24M000000S244                                     | FEC 9509658               |
|                      | 9 V PP3 battery                    | GP1604-10                                          | FEC 5057050               |
|                      | Rubber stick-on feet 4x            | SJ5076BLACK                                        | FEC 1165061               |
|                      | Bare PCB                           | Analog Devices EVAL-ADF4158EB1Z                    | EVAL-ADF4158EB1Z          |
|                      | Cable MINI-USB A to MINI-B 1M      | Hirose Electric Co., Ltd.<br>UX40-MB-5PA-1000-2003 | Digi-Key H2957-ND         |

**ESD Caution**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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