

## Evaluation Board for ADF4360-9 Integrated PLL and VCO Frequency Synthesizer

### FEATURES

- Self-contained board for generating RF frequencies**
- Flexibility for reference input, PFD frequency, and loop bandwidth**
- Accompanying software allows complete control of synthesizer functions from a PC**
- Flexibility for changing external inductor to allow different VCO output frequency ranges**
- USB-/battery-operated 9 V supplies**
- Typical DIVOUT jitter performance of 1.4 ps**

### GENERAL DESCRIPTION

The [EV-ADF4360-9EB1Z](#) board is designed to allow the user to evaluate the performance of the [ADF4360-9](#) frequency synthesizer consisting of an integrated PLL and VCO (see Figure 1). It contains the [ADF4360-9BCPZ](#), a USB connector, and SMA connectors for the RF outputs. Unpopulated SMA footprints are available for the power supplies, lock detect, and the external reference input. The evaluation board also contains the loop filter to complete the PLL. It can be modified as necessary for the user's PLL requirements. A USB cable is included with the board to allow software programmability.

The package also contains a CD with Windows® software to allow quick, user-friendly programming of the synthesizer. The CD contains numerous other PLL data sheets, technical notes, articles, and ADIsimPLL™ V3.4, Analog Devices, Inc., PLL simulation software. More information is available at [www.analog.com/pll](http://www.analog.com/pll).

### EVALUATION BOARD PHOTOGRAPH



Figure 1.

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## REVISION HISTORY

### 2/12—Rev. B to Rev. C

|  |   |
|--|---|
| Changed EVAL-ADF4360-9EBZ1 to EV-ADF4360-9EB1Z<br>Throughout ..... | 1 |
|--|---|

### 11/11—Rev. A to Rev. B

|  |   |
|--|---|
| Changes to Features Section, General Description Section, and<br>Figure 1 .....                                  | 1 |
| Changes to Evaluation Board Hardware Section and Figure 2 ..   | 3 |
| Changes to Figure 3.....   | 4 |
| Replaced Evaluation Board Software Section with Evaluation<br>Board Software Quick Start Procedures Section..... | 5 |
| Added Figure 5, Figure 6, and Figure 7; Renumbered<br>Sequentially .....   | 5 |
| Added Figure 8 and Figure 9.....   | 6 |
| Replaced Programmable Software Settings Section with Using<br>the Evaluation Board Software Section .....        | 7 |
| Changes to Figure 10.....  | 8 |

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### 8/10—Rev. 0 to Rev. A

|   |           |
|---|-----------|
| Document Title Changed from EVAL-ADF4360-9 to<br>UG-106 .....     | Universal |
| Changes to Features and General Description Sections .....        | 1         |
| Changes to Programmable Software Settings Section.....            | 5         |
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| Changes to Table 1.....   | 9         |
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### 9/08—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

The evaluation board comes with a mini-USB cable to connect to the USB port of a PC. The silkscreen for the evaluation board is shown in Figure 2. It is important that the software be installed before connecting the board. If the user encounters any installation warning messages during connection, select **Continue Anyway**. If another **Install hardware procedure wizard** runs when the software is executed, allow it to install.

The board schematics are shown in Figure 11, Figure 12, and Figure 13.

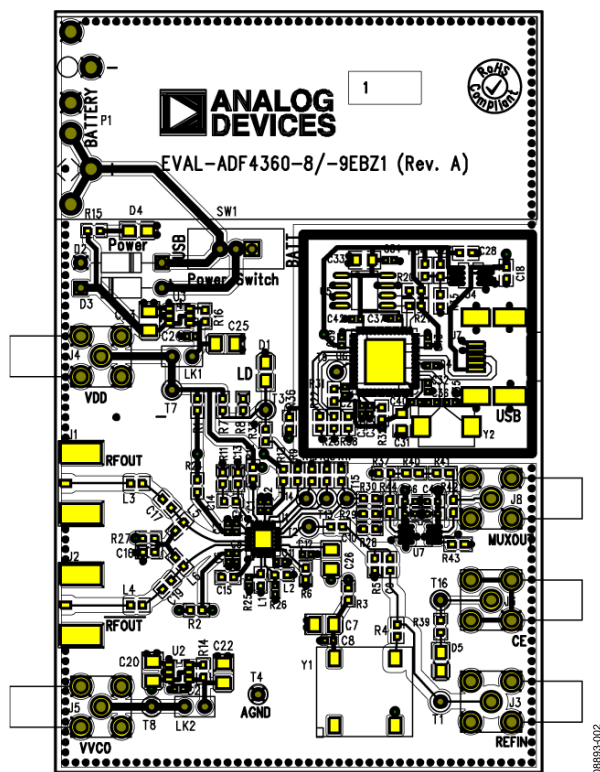


Figure 2. Evaluation Board Silkscreen—Top View

The board is powered from a single 9 V battery or USB connection. All components necessary for local oscillator (LO) or DIVOUT generation are available on board. A 19.2 MHz TCXO from Fox Electronics provides the necessary reference input. Otherwise, an external reference signal can be connected via J3 (to disable the TCXO, remove R3 and R4). The PLL is composed of the ADF4360-9 and a passive loop filter. The VCO output from RF<sub>OUT</sub>A is available through the standard SMA connector, J1, and the complementary output RF<sub>OUT</sub>B VCO output is available from J2. DIVOUT is available from J8. Digital lock detect is present on the SMA marked J6.

Users can provide their own power supplies using the J4 and J5 connectors, as shown in Figure 2.

The on-board filter is a third-order, passive low-pass filter. It contains three capacitors (C13, C14, and C15) and two resistors (R10 and R11). The footprint for R10 is located on the underside of the board. The design parameters for the loop filter are for a center frequency of 360 MHz, a PFD frequency of 1600 kHz, and a low-pass filter bandwidth of 40 kHz. To design a filter for different frequency setups, use the ADIsimPLL simulation software.

Note that only very high performance measurement equipment is capable of measuring good jitter performance below 180 MHz. The Agilent E5052A/E5052B and Rohde & Schwarz FSUP are both good instruments for this purpose.

### RF OUTPUT STAGE

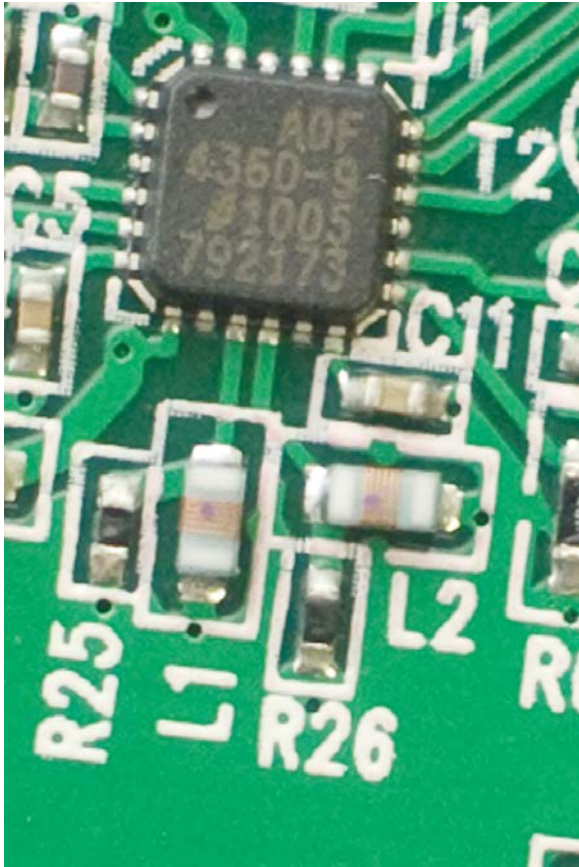
The RF output stage of the board allows the user to insert a tuned load for a particular frequency. The particular network inserted in the board is optimized for 360 MHz operation. For different frequencies, the output stage needs different component values. Consult the ADF4360-9 data sheet for further information. If in doubt, use a 50  $\Omega$  resistor instead of the shunt inductor and a 100 pF bypass capacitor and 0  $\Omega$  resistor instead of the series inductor.

It is very important that the same components be placed on the RF<sub>OUT</sub>A and RF<sub>OUT</sub>B lines. In addition, it is essential that both outputs be terminated with 50  $\Omega$  loads. Otherwise, the output power is not optimal, and, in some cases, the part may malfunction.

In applications that only use the divider, both RF outputs are best terminated with a shunt 50  $\Omega$  resistor to AV<sub>DD</sub>, a series 100 pF dc bypass capacitor, and a 50  $\Omega$  load to GND.

### EXTERNAL INDUCTOR OPTIONS

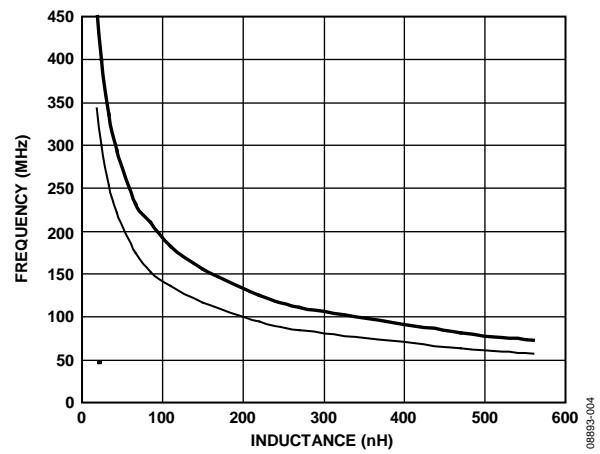
The ADF4360-9 uses external inductors (L1 and L2) to set up the LC tank circuit of the VCO. The evaluation board has a footprint for the placement of these. A value of 22 nH is inserted on the board giving a VCO center frequency of 360 MHz. Insert two 470  $\Omega$  resistors (R25 and R26) parallel to ground for both L1 and L2 (see Figure 3).



088893-003

Figure 3. External Inductors and Resistors for the ADF4360-9 Tank Circuit

To find the optimum frequency range for a given inductor, see Figure 4. Ensure that the desired frequency is between the two lines and determine the appropriate inductance needed.



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Figure 4. Output Center Frequency vs. External Inductor Value

## EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

The control software and USB drivers for [EV-ADF4360-9EB1Z](#) accompany the [EV-ADF4360-9EB1Z](#) on a CD.

To install the software, use the following steps:

1. Open **ADF4360\_setup.msi**.
2. The install wizard guides you through the installation process. The software is installed in a default directory called **C:/Program Files/Analog Devices/ADF4360**.

The software requires Microsoft's .NET Framework Version 2.0 or later to be installed on your machine. The installer automatically downloads the framework from the Microsoft website if you do not have this installed. If you do not have an Internet connection or have a slow connection on the PC, you can install the .NET framework directly from the CD. Do this by double-clicking **dotnetfx.exe**. Once installed, run **ADF4360\_Setup.msi** again.

### WINDOWS XP OS

After you have installed the software, install the USB drivers.

To do so, use the following steps:

1. Plug a USB cable into the USB connector on the evaluation board. The **Found New Hardware** box opens. See Figure 5.
2. Choose **Install from a list or specified location (Advanced)**.



Figure 5. New Hardware Wizard

3. Click **Continue Anyway** when asked about Windows Logo testing.

4. If the installation is successful, the message in Figure 6 appears.

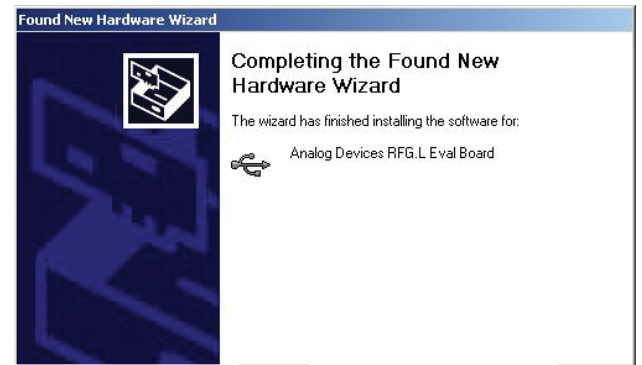


Figure 6. Successful Installation

### WINDOWS VISTA OS AND WINDOWS 7 (32-BIT) OS

For Windows Vista or Windows 7 (32-bit), you must manually install the drivers. To do so, use the following steps:

1. Find the new unknown device (the evaluation board) in **Device Manager** and double-click it to open the properties. The device should be **Unknown device**, under **Other devices** (see Figure 7).

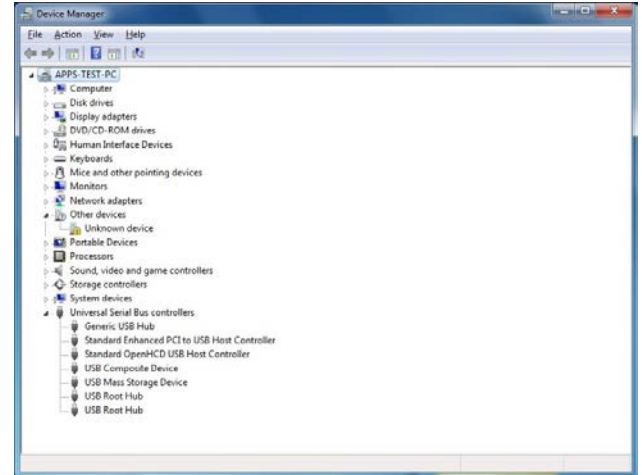


Figure 7. Device Manager

- Click **Update Driver** in the properties window (see Figure 8).

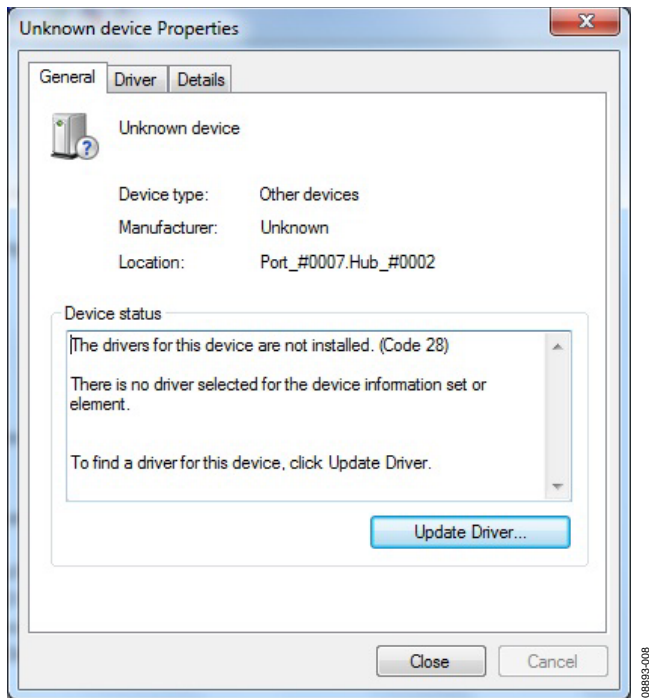


Figure 8. Unknown Device Properties

- In the **Update Driver Software** dialog box, choose **Browse my computer for driver software**.
- Browse to **C:\Program Files\Analog Devices\ADF4360**.
- Click **OK** or **Next**.
- If prompted by Windows Security, choose **Install this driver software anyway**.

- If the installation is successful, the message in Figure 9 appears.

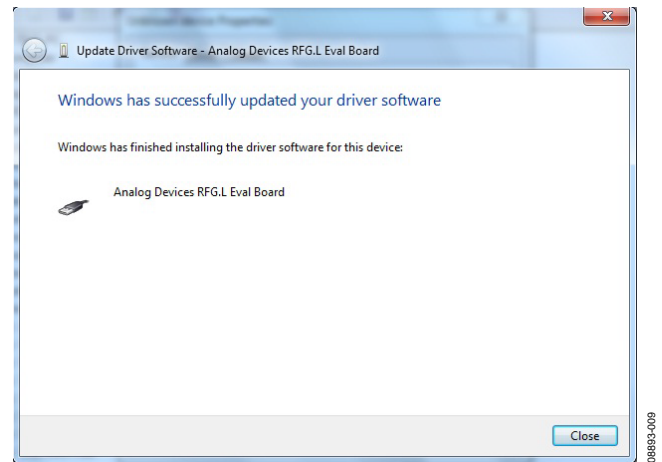


Figure 9. Successful Installation

## WINDOWS 7 (64-BIT) OS

Windows 7 64-bit uses a different driver than 32-bit systems. To install this driver:

- Disconnect the USB evaluation board.
- Open **ADF4360\_setup.msi**.
- The install wizard guides you through the installation process. The software is installed in a default directory called **C:\Program Files\Analog Devices\ADF4360**.
- Connect your USB evaluation board. The driver should be found automatically.

Note that installing this driver package disables older versions of Analog Devices PLL software; therefore, only install if needed.



## USING THE EVALUATION BOARD SOFTWARE

The control software for the [EV-ADF4360-9EB1Z](#) accompanies the [EV-ADF4360-9EB1Z](#) on a CD. To install the software, see the Evaluation Board Software Quick Start Procedures section.

To run the software, double-click the **ADF4360.exe** file on the desktop or from the **Start** menu.

The main interface window opens (see Figure 10). Confirm that **Analog Devices RFG.L Eval Board connected** is displayed at the top of the window. Otherwise, the software has no connection to the evaluation board.

The evaluation board can be connected and disconnected while the software is running. Note that when connecting the board, it takes about 5 seconds for the status label to change.

Under the **File** menu, the current settings can be saved to, and loaded from, a text file.

Use the **REF IN Frequency** text box to set the correct reference frequency and the reference frequency divider. The reference TCXO on the evaluation board runs at 19.2 MHz.

The **Settings** section controls the charge pump current setting, the output power setting, and the multiplexer output setting.

Use the **Frequency Settings** section to control the output frequency. You can input the desired output frequency in the **RF Output Frequency** text box (in megahertz). **Div Out Frequency** displays the VCO output frequency available from the output divider.

In the **Registers** tab, you can manually input the desired value to be written to the registers.

In the **Sweep and hop** tab, you can make the device sweep a range of frequencies or hop between two set frequencies.

In the **Latches to write** section at the bottom of the window, the values to be written to each register are displayed. If the background on the text box is green, the value displayed is different from the value actually on the device. Click **Write N counter Latch** or **Write R counter Latch** to write that value to the device.

Press the **F2**, **F3**, and **F4** keys to switch between the three tabs. **F12** increases the output frequency by one channel spacing and writes it to the device. **F11** decreases the output frequency by one channel spacing.

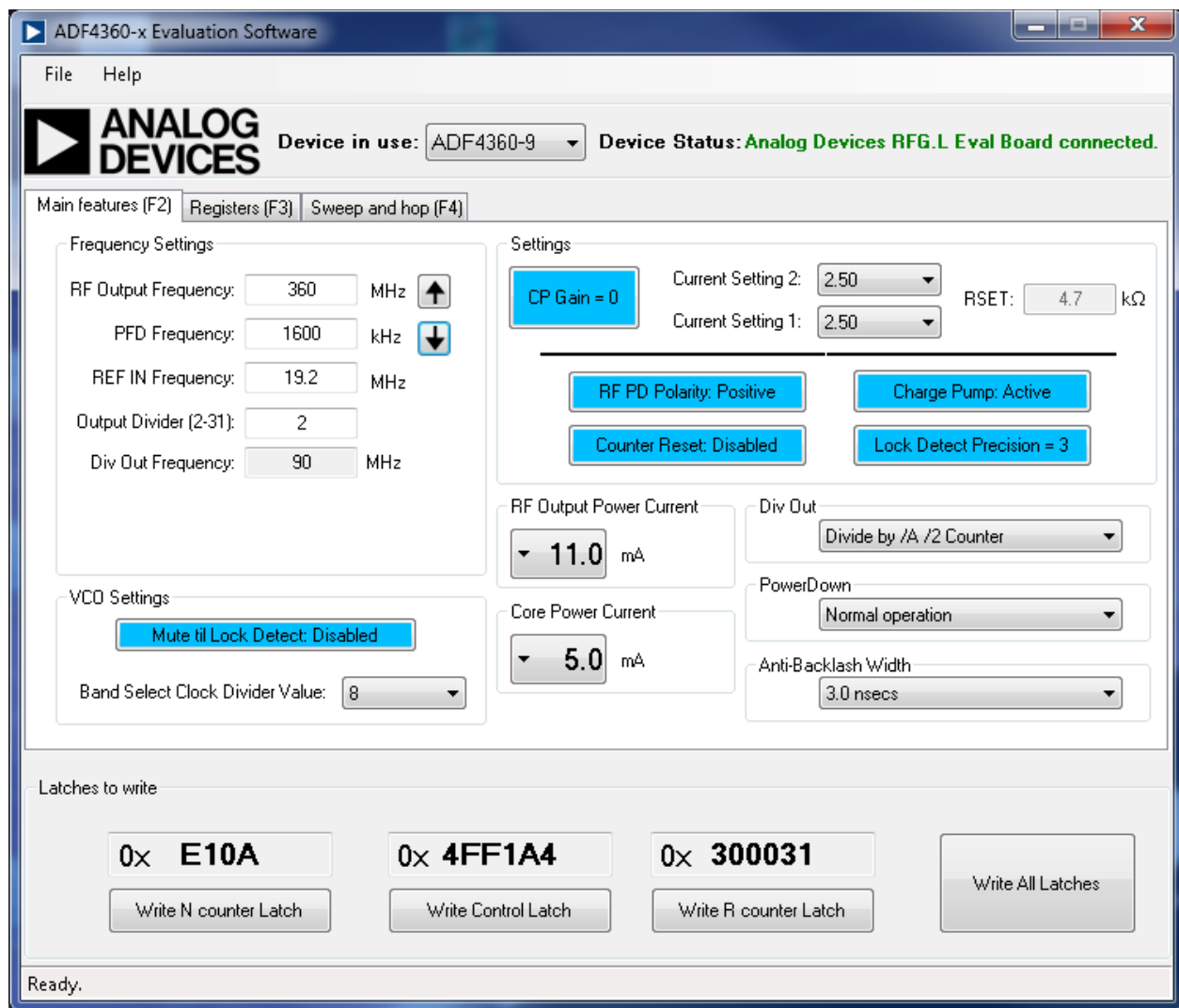


Figure 10. Software Main Interface Window



## EVALUATION BOARD SCHEMATICS

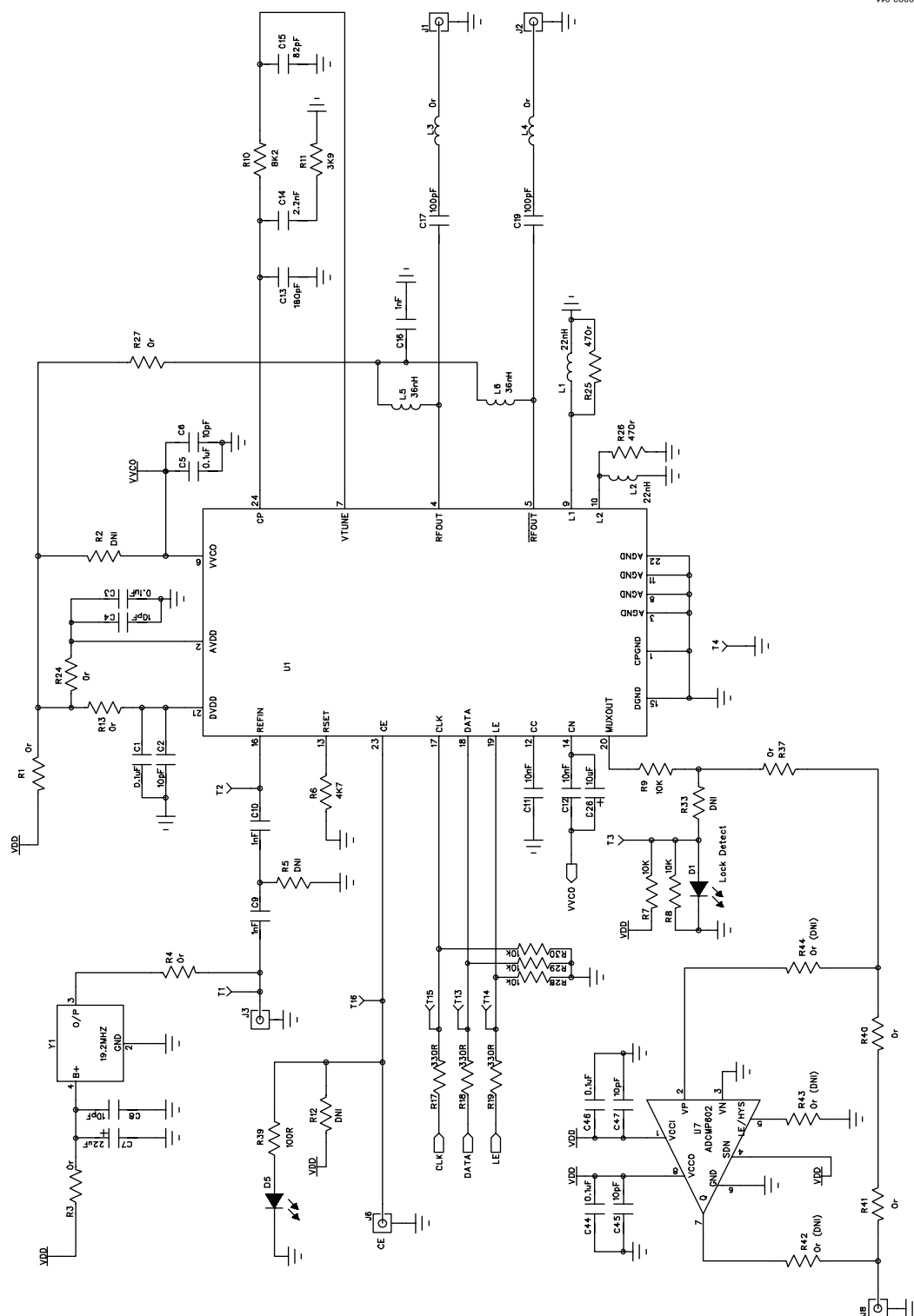


Figure 11. EV-ADF4360-9EB1Z Schematic



Figure 12. *EV-ADF4360-9EB1Z* Schematic (Continued)



## ORDERING INFORMATION

## BILL OF MATERIALS

Table 1.

| Reference Designator   | Part Description   | Manufacturer/Part No.                             |
|--|--|---|
| C1, C3, C5, C29, C30, C32, C37, C38, C39, C40, C41, C42, C43 | Capacitor, 0402, 0.1 $\mu$ F, 16 V                               | Kemet C0402C104K4RAC                              |
| C2, C4, C6, C8   | Capacitor, 0402, 10 pF, 50 V                                     | Kemet C0402C100J5GACTU                            |
| C7   | Capacitor, Case A, 22 $\mu$ F, 6.3 V                             | AVX TAJA226K006R                                  |
| C9, C10, C27   | Capacitor, 0603, 1 nF, 50 V                                      | AVX 06035A102JAT2A                                |
| C11, C12, C21, C24   | Capacitor, 0402, 10 nF, 16 V                                     | Yageo (Phycomp)<br>CC0402ZRY5V7BB103              |
| C13  | 2-pin capacitor, 180 pF, 0603, 50 V                              | Yageo (Phycomp)<br>CC0603KRX7R9BB181              |
| C14  | 2-pin capacitor, 2.2 nF, 0603, 50 V                              | Yageo (Phycomp)<br>CC0603KRX7R9BB222              |
| C15  | 2-pin capacitor, 82 pF, 0603, 50 V                               | Yageo (Phycomp)<br>CC0603JRNPO9BN820              |
| C16  | Multilayer ceramic capacitor, 50 V, X7R, 1 nF, $\pm 10\%$ , 0402 | Murata GRM155R71H102KA01D                         |
| C17, C19   | Capacitor, 0603, 100 pF, 50 V                                    | Phycomp 2238 867 15101                            |
| C18, C28   | Capacitor, 0603, 1 $\mu$ F, 25 V                                 | Taiyo Yuden TMK107BJ105KA-T                       |
| C20, C23   | Capacitor, Case A, 1 $\mu$ F, 16 V                               | AVX TAJA105K016R                                  |
| C22, C25   | Capacitor, Case A, 4.7 $\mu$ F, 10 V                             | AVX TPSA475K010R1400                              |
| C26  | Capacitor, Case A, 10 $\mu$ F, 6.3 V                             | Kemet T491A106M016AT                              |
| C31, C33   | Capacitor, 0805, 10 $\mu$ F, 6.3 V                               | Murata GRM21BR71A106KE51L                         |
| C34  | Capacitor, 0402, 22 pF, 50 V NPO                                 | Kemet C0402C220J5GACTU                            |
| C35, C36   | Capacitor 0402, 12 pF, 50V                                       | Kemet C0402C120J5GACTU                            |
| D1   | LED, SMD red   | Avago HSMS-C170                                   |
| D2   | Diode, 1 A, 50 V   | Multicomp 1N4001                                  |
| D3   | Schottky diode, 20 V   | Micro Commercial Components, Inc.,<br>SD103C-TP   |
| D4   | LED, SMD red   | Avago HSMS-C170                                   |
| D5   | LED, SMD red   | Avago HSMS-C170                                   |
| J1, J2   | Jack SMA end launch tab  | Johnson Components 142-0701-851                   |
| J3 to J6   | Jack SMA end launch tab (not inserted)                           |   |
| J7   | USB mini-B   | Molex 56579-0576                                  |
| L1, L2   | Ceramic chip inductor, 220 nH, 5%, 0603 for ADF4360-9 only       | Coilcraft 0603CS-22NX_LU                          |
| L3, L4   | Resistor, 0603, 0 $\Omega$                                       | Multicomp MC 0.063W 0603 0R                       |
| L5, L6   | Ceramic chip inductor, 240 nH, 5%, 0603                          | Coilcraft 0603LS-36NX_LU                          |
| LK1, LK2   | Header, 1-row, 2-way and jumper socket black                     | Harwin Plc M20-9990245 and<br>Harwin Plc M7567-05 |
| P1   | Battery clip, PCB mounting                                       | Keystone Electronics Corp. 593+594                |
| R1 to R4, R9, R13, R22 to R24, R27, R36, R37, R40, R41, R38  | Resistor, 0603, 0 $\Omega$                                       | Multicomp MC 0.063W 0603 0R                       |
| R5   | Resistor, 0603, 51 $\Omega$                                      | Multicomp MC 0.063W 0603 1% 51R                   |
| R6, R15  | Resistor, 0603, 4.7 k $\Omega$                                   | Multicomp MC 0.063W 0603 1% 4K7                   |
| R7, R8, R12, R28, R29, R30                                   | Resistor, 0603, 10 k $\Omega$                                    | Multicomp MC 0.063W 0603 1% 10K                   |
| R10  | 2-pin resistor, 12 k $\Omega$ , 0603, 1%                         | Multicomp MC 0.063W 0603 1% 8K2                   |
| R11  | 2-pin resistor, 5.1 k $\Omega$ , 0603, 1%                        | Multicomp MC 0.063W 0603 1% 3K9                   |
| R14, R16   | Resistor, 0603, 330 k $\Omega$                                   | Multicomp MC 0.063W 0603 1% 330K                  |
| R17 to R19   | Resistor, 0603, 330 $\Omega$                                     | Multicomp MC 0.063W 0603 1% 330R                  |
| R20, R21   | Resistor, 0603, 2.2 k $\Omega$                                   | Multicomp MC 0.063W 0603 1% 2K2                   |

| Reference Designator | Part Description                                 | Manufacturer/Part No.                        |
|----------------------|--|--|
| R25, R26             | Resistor, 0402, 470 $\Omega$                     | Multicomp MC 0.063W 0402 1% 470R             |
| R31, R32             | Resistor, 0603, 100 k $\Omega$                   | Multicomp MC 0.063W 0603 1% 100K             |
| R34                  | Resistor, 0603, 140 k $\Omega$                   | Multicomp MC 0.063W 0603 1% 140K             |
| R35                  | Resistor, 0603, 78.7 k $\Omega$                  | Multicomp MC 0.063W 0603 1% 78K7             |
| SW1                  | Switch, PCB SPDT                                 | APEM TL36P0050                               |
| T1 to T8, T13 to T16 | Terminal, PCB, red, PK100                        | Vero Technologies, Ltd. 20-313137            |
| T9 to T12            | Test point (not inserted)                        |  |
| U1                   | Integrated integer-N synthesizer                 | Analog Devices <a href="#">ADF4360-9BCPZ</a> |
| U2, U3               | High accuracy low dropout linear 3 V regulator   | Analog Devices <a href="#">ADP3300ARTZ-3</a> |
| U4                   | <a href="#">ADP3334</a> adjustable LDO regulator | Analog Devices <a href="#">ADP3334ARMZ</a>   |
| U5                   | IC serial EEPROM 8-SOIC                          | Microchip 24LC64-ISN                         |
| U6                   | USB microcontroller                              | Cypress CY7C68013A-56LFXC                    |
| U7                   | <a href="#">ADCMP602</a> comparator              | Not inserted                                 |
| Y1                   | 19.2 MHz TCXO (FOX801)                           | Fox Electronics FOX801-BELF                  |
| Y2                   | 24 MHz XTAL                                      | ECS ECS-240-12-20A-TR                        |

## RELATED LINKS

| Resource                  | Description  |
|---------------------------|--|
| <a href="#">ADF4360-9</a> | Product Page, Clock Generator PLL with Integrated VCO  |
| <a href="#">ADP3300</a>   | Product Page, High Accuracy anyCAP® 50 mA Low Dropout Linear Regulator   |
| <a href="#">ADP3334</a>   | Product Page, High Accuracy Low IQ, 500 mA anyCAP® Adjustable Low Dropout Regulator  |
| <a href="#">ADCMP602</a>  | Product Page, Rail-to-Rail, Very Fast, 2.5 V to 5.5 V, Single-Supply TTL/CMOS Comparator in 8-Lead MSOP and LSCFP Packages |

**NOTES**

## NOTES



## NOTES

**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.

**Legal Terms and Conditions**

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. **CONFIDENTIALITY.** This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. **ADDITIONAL RESTRICTIONS.** Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. **TERMINATION.** ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. **LIMITATION OF LIABILITY.** THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). **EXPORT.** Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.