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Evaluation Board for the ADF9010 RF Front End

FEATURES

Tx baseband to RF, Rx RF to baseband operation
Flexibility for reference input, output frequency, phase-frequency detector (PFD) frequency, and loop bandwidth
Accompanying software allows complete control of part functions from a PC
Typical voltage controlled oscillator (VCO) phase noise performance of −120 dBc/Hz at 100 kHz offset
Typical spurious performance of −70 dBc at 250 kHz offset (900 MHz setup)

GENERAL DESCRIPTION

The ADF9010 evaluation board is designed to evaluate the performance of the ADF9010 RF front end, which consists of an integrated PLL, VCO, upconverter, and Rx filter. The board also contains an ADL5382 demodulator and an ADL5501 rms detector, as well as some ADP3334 power management devices. A photograph of the board is shown in Figure 1.

In addition to these parts, the board contains various connectors, including a 9-pin connector for the PC interface cable, power supply banana connectors, and several SMA connectors to access the RF ports on the board. The evaluation board can be modified as necessary for a customer's requirements.

The package also contains a USB adapter board, PC interface cables, and a CD with Windows®-based software to allow quick, user-friendly programming. The CD includes several PLL data sheets, technical notes, articles, and ADIsimPLL™ PLL simulation software from Analog Devices, Inc. More information is available at www.analog.com/pll.

DIGITAL PICTURE OF THE EVALUATION BOARD

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

6/12—Rev. 0 to Rev. A

Document Title Changed from EVAL-ADF9010 to UG-423 ..... Universal
Changes to General Description Section 1
Changes to Hardware Description Section 3
Changes to Software Description Section, Replaced Figure 6 5
Added Figure 7; Renumbered Sequentially 6
Added Related Links Section 10

4/09—Revision 0: Initial Version

HARDWARE DESCRIPTION

The evaluation board comes with a USB adapter board and cables for connecting the evaluation board to the USB port of a PC. The silkscreen and cable diagram for the evaluation board are shown in Figure 2 and Figure 3, and the board schematics are shown in Figure 8 and Figure 9.

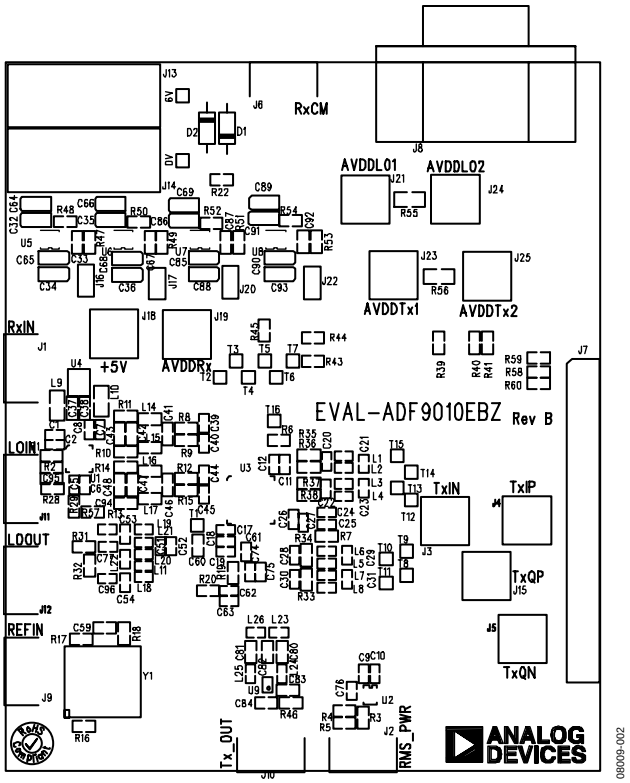

Figure 2. Evaluation Board Silkscreen—Top View

The evaluation board is powered from a single 6 V supply. All components necessary for the Tx upconversion of baseband signals and for the Rx downconversion and filtering of Rx signals are included on board. An external reference signal is necessary for PLL operation via J9. The PLL comprises the ADF9010 and a passive loop filter. Depending on the LO output options selected, the combined LO outputs or one LO output is available at J12. To measure this signal, the LO must be rerouted from the demodulator by desoldering R29 and inserting a 0 Ω link into R31.

The rms detector (ADL5501) measures the power level of the RF signal connected to J2.

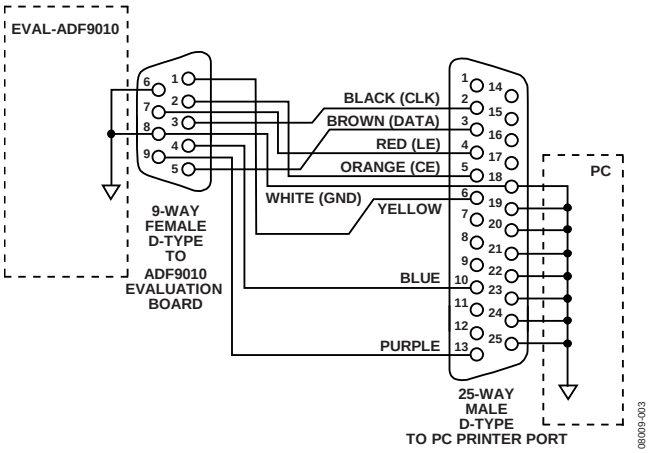

Figure 3. PC Cable Diagram

To use alternative power supplies for the 5 V power rail and the demodulator, use Connectors J18 and J19, respectively. In addition, J21, J23, J24, and J25 can be used to connect external supplies to the ADF9010, which may result in improved VCO phase noise. The on-board filter is a third-order, passive low-pass filter that contains three capacitors (C61, C62, and C63) and two resistors (R19 and R20).

The design parameters for the loop filter are for a center frequency of 900 MHz, a channel spacing of 250 kHz, and a low-pass filter bandwidth of 7 kHz. To design a filter for different frequency setups, use ADIsimPLL Version 3.1 or higher.

The latest revision of the board has been modified to allow the ADL5382 to be used in place of a different demodulator. Unlike the previous version, pull-up resistors on the baseband outputs are not required, so the regulator and the link to the 5 V supply voltage have been removed. The board schematics may indicate connections to a pull-up supply, but the pull-up supply is not used.

In addition, the schematics show all possible connections for the operation of the part, but not all components are populated. The bill of materials (Table 1) provides an accurate summary of the values and components used.

LO OUTPUT OPTIONS

Two options exist for connecting the LO output from the ADF9010 to the ADL5382 demodulator. Due to the differential nature of the ADF9010 VCO circuit, the differential outputs can be connected through a Series L (or 0 Ω) resistor, a Shunt L (~9 nH) inductor, and a dc bypass capacitor (100 pF); the relevant components are shown in red in Figure 4. Components shown in black in Figure 4 should be omitted.

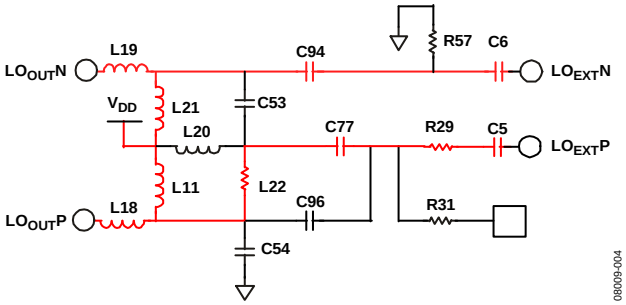

Figure 4. Differential LO Connection to ADL5382

If the user prefers to use a balun to drive one of the demodulator LO inputs, the two LO outputs from the ADF9010 can be combined as shown in Figure 5. The unused input to the ADF9010 is ac-coupled to ground using C6 and R57. Recommended circuit values for the balun are 0 Ω resistors for the Series L (L18, L19), 7.5 nH for the balun inductors (L21, L22), 47 nH for the RF choke at L20, and 3.3 pF for the balun capacitors. Capacitor C77 is a dc-blocking capacitor and should have a value of 100 pF. Resistor R29 requires a 0 Ω resistor to complete the circuit.

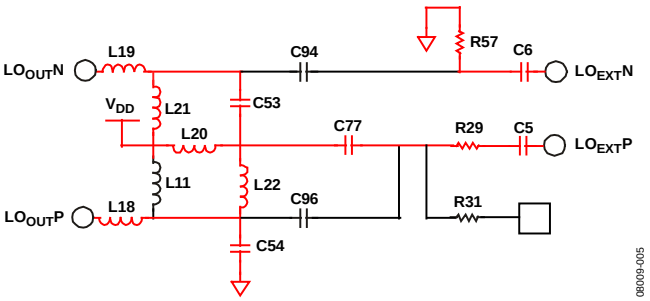

Figure 5. Single-Ended LO Connection to ADL5382

SOFTWARE DESCRIPTION

INSTALLING THE SOFTWARE

The control software for EVAL-ADF9010EBZ1 is provided on the CD included in the evaluation board kit. To set up the software, use the following steps:

1. Click **ADF9010_Setup.msi**.
2. The installation wizard appears. Follow the on-screen instructions.
3. The software is installed in a default directory called **C:/Program Files/Analog Devices/ADF9010**.

USING THE SOFTWARE

To run the software,

1. From the **Start** menu, navigate to the **ADF9010** item in the Analog Devices folder and double-click **ADF9010**.
2. In the first window, select **ADF9010** and **USB board (green)**; then click **Connect** (see Figure 6).
3. Click the **Main Controls** tab to view the main controls. The default values are set to lock the VCO to 900 MHz with a reference frequency of 10 MHz and a PFD frequency of 250 kHz.

Optimizing Operation

It may be necessary to adjust the Tx output power level and the LO output power level to optimize operation. These settings are displayed in the **Main Controls** tab (see Figure 7).

To optimize the evaluation board operation,

1. Ensure that the Rx filters are operating correctly. To accomplish this, the filter calibration must be set correctly, which involves setting the Rx calibration divider to divide the PLL reference (REFIN) to exactly 2 MHz and setting the correct timeout period for the high-pass filter boost. For more information, refer to the ADF9010 data sheet.
2. Select the desired Rx filter bandwidth and gain.
3. Ensure that all registers are programmed by clicking each update button at the bottom of the window. Follow the recommended sequence of buttons: **Update R1**, **Update R5**, **Update R0**, **Update R2**, and finally **Update R3**.

The part should now be set up, allowing you to modify other features. As stated in the ADF9010 data sheet, the correct sequence of register writes is as follows: R1, R5, R0, R2, and R3.

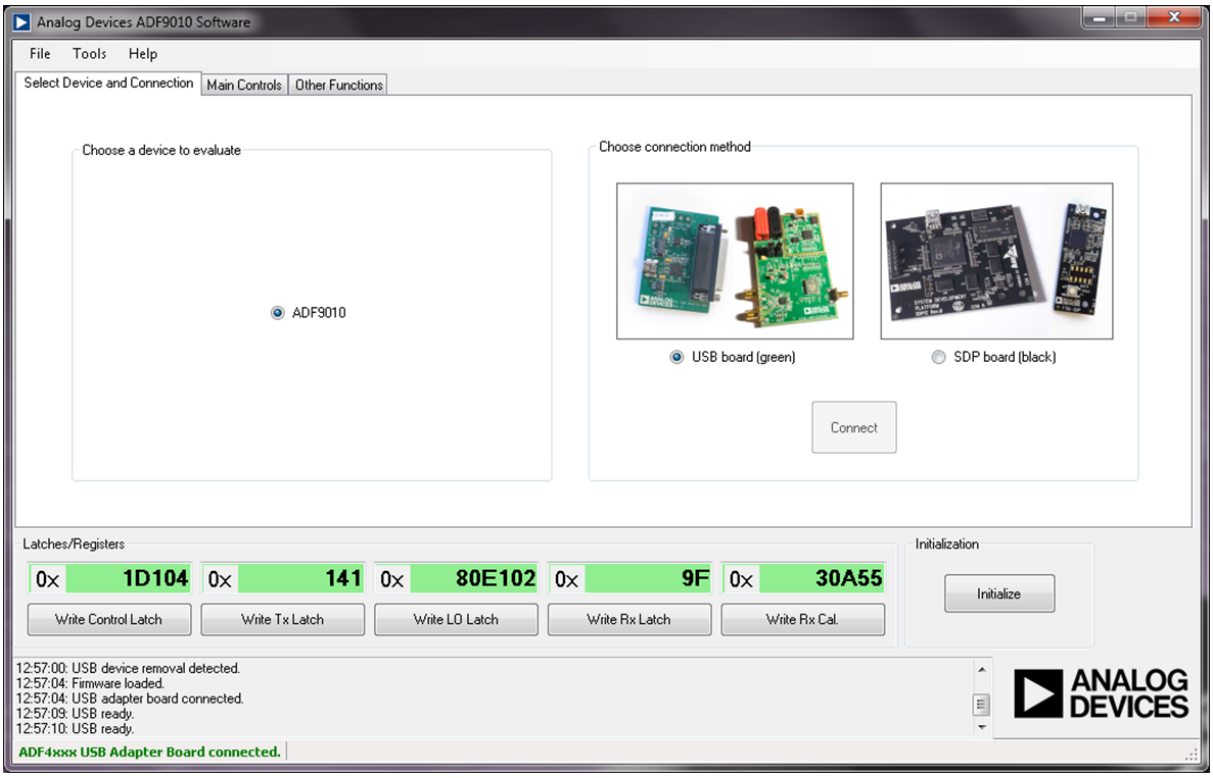

Figure 6. Software Device Selection

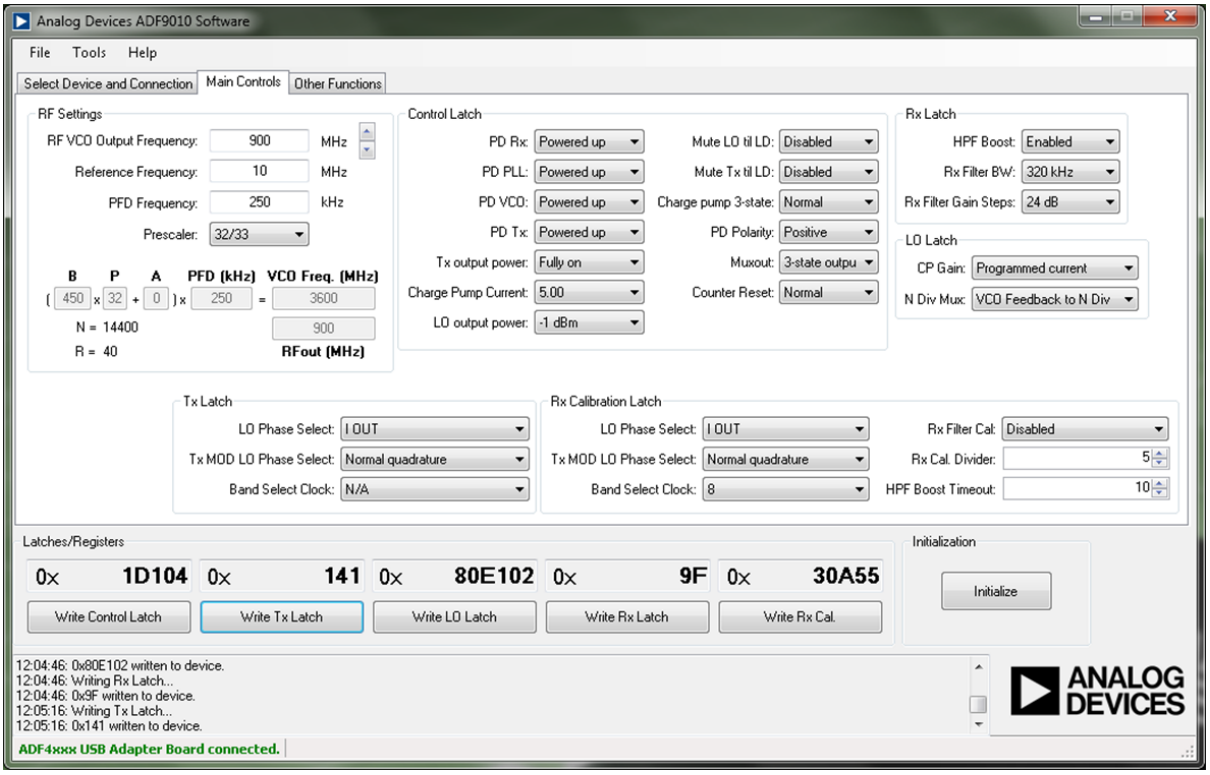

Figure 7. Software Main Controls Tab

SCHEMATICS

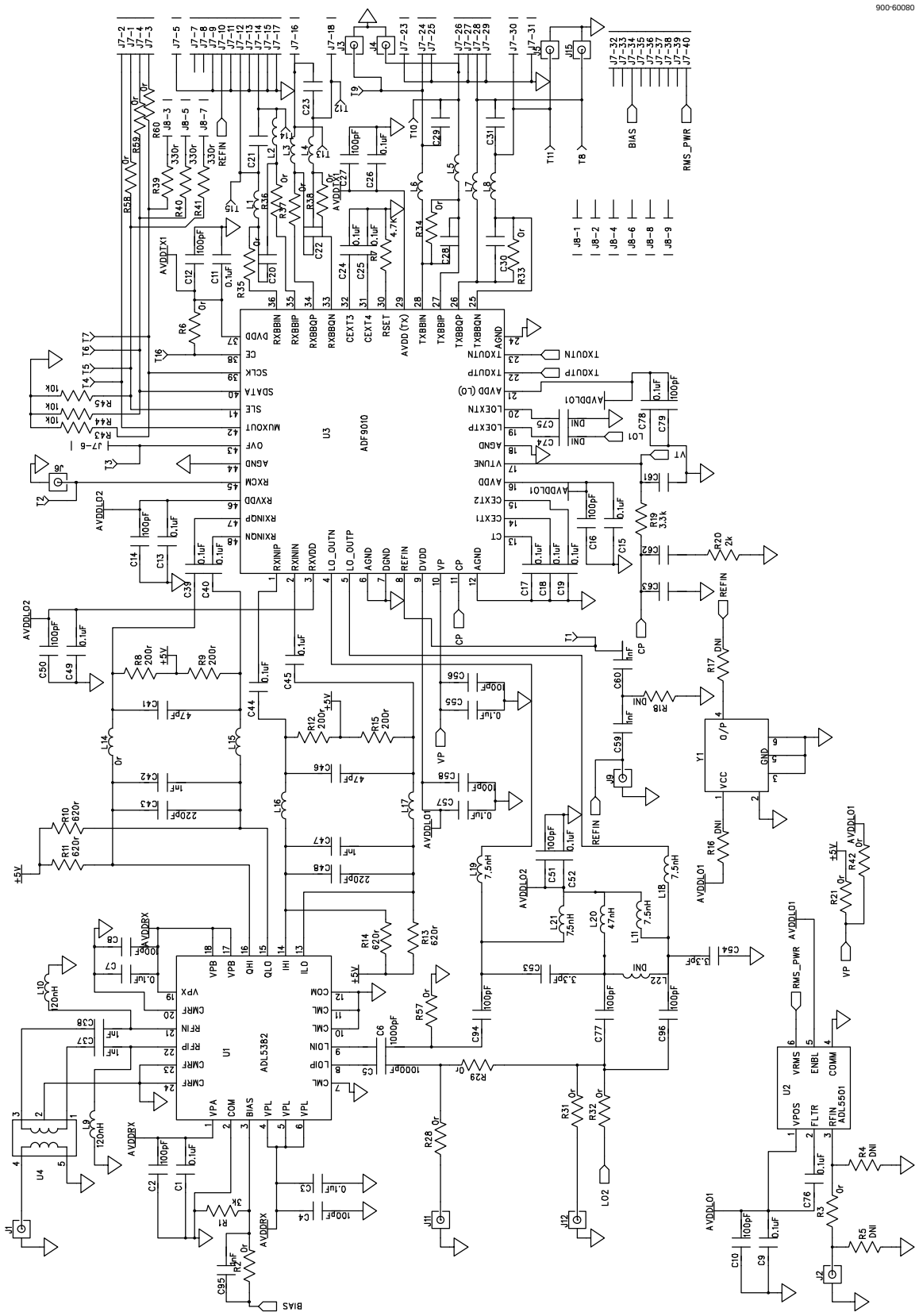

Figure 8. EVAL-ADF9010EBZ1 Circuit Diagram

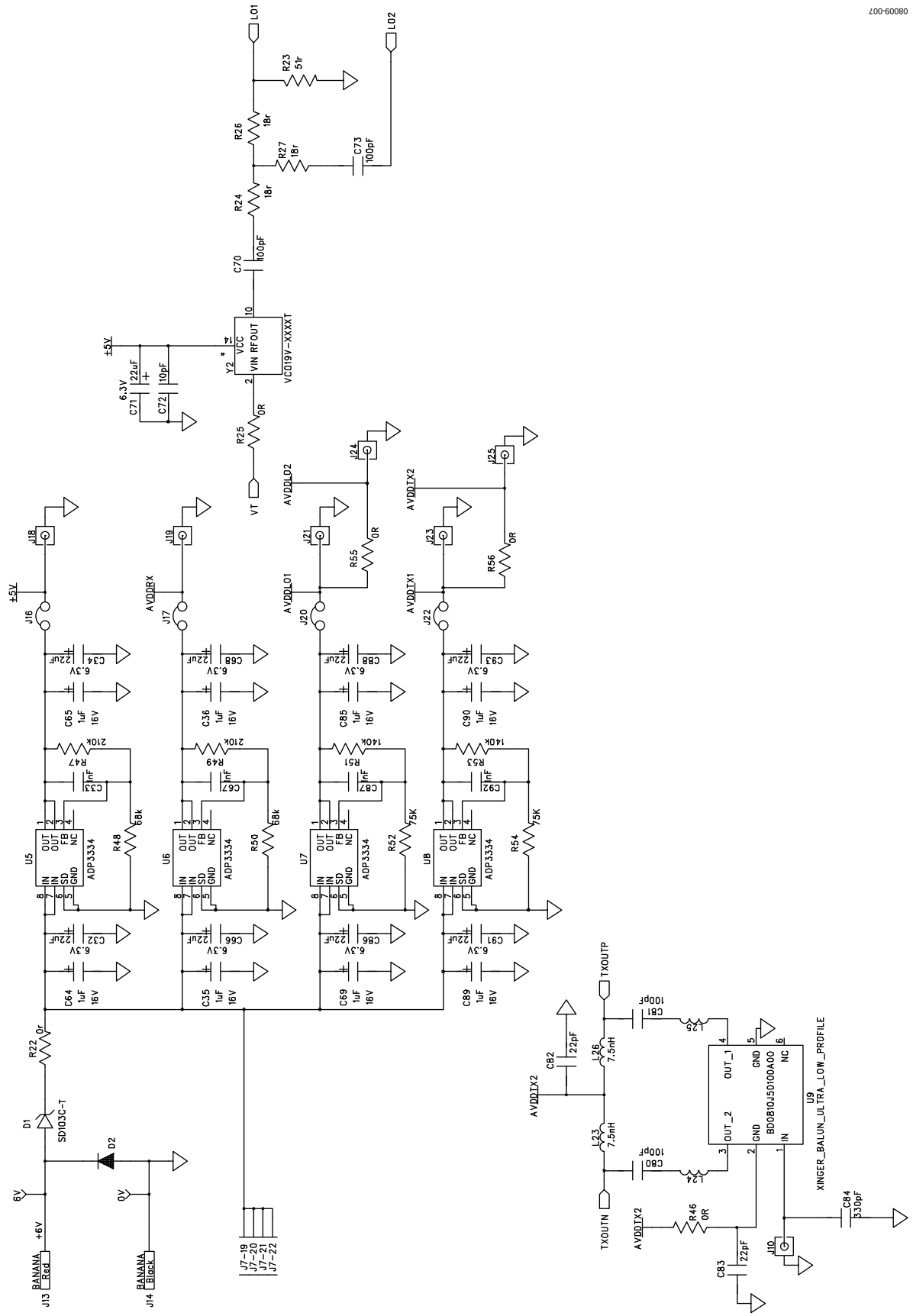

Figure 9. EVAL-ADF9010EBZ1 Circuit Diagram—Power Management Section

BILL OF MATERIALS

Table 1.

Qty	Reference Designator	Description	Supplier/Part Number
23	C1, C3, C7, C9, C11, C13, C15, C17, C18, C19, C24, C25, C26, C39, C40, C44, C45, C49, C52, C55, C57, C76, C78	0.1 µF, 0402 capacitor	Phycomp (Yageo) 2238 787 19849
13	C2, C4, C8, C10, C12, C14, C16, C27, C50, C51, C77, C79, C94	100 pF, 0402 capacitor	Murata GRM1555C1H101JD01D
3	C5, C6, C63	1000 pF, 0402 capacitor	Murata GRM1555C1H102JA01D
8	C20, C21, C22, C23, C28, C29, C30, C31	0402 capacitor	Do not insert
7	C32, C66, C68, C86, C88, C91, C93	22 µF, CAP\TAJ_A capacitor	AVX TAJA226K006R
1	C33	0603 capacitor	Do not insert
2	C34, C71	CAP\TAJ_A capacitor	Do not insert
7	C35, C36, C64, C69, C85, C89, C90	1 µF, CAP\TAJ_A capacitor	AVX TAJA105K016R
10	C37, C38, C42, C47, C59, C60, C67, C87, C92, C95	1 nF, 0603 capacitor	AVX 06035A102JAT2A
2	C41, C46	47 pF, 0603 capacitor	Murata GRM1885C1H470JA01D
2	C43, C48	220 pF, 0603 capacitor	Phycomp (Yageo) 2238 586 15614
2	C53, C54	0402 capacitor	Do not insert
2	C56, C58	100 pF, 0402 capacitor	Murata GRM1555C1H101JZ01D
1	C61	560 pF, 0603 capacitor	Phycomp (Yageo) 2238 867 15561
1	C62	12 nF, 0603 capacitor	Phycomp (Yageo) 2238 916 16637
1	C65	CAP\TAJ_A capacitor	Do not insert
2	C70, C73	0603 capacitor	Do not insert
1	C72	0603 capacitor	Do not insert
3	C74, C75, C96	0402 capacitor	Do not insert
2	C80, C81	100 pF, 0603 capacitor	Murata GRM1885C1H101JA01D
2	C82, C83	22 pF, 0603 capacitor	Murata GRM1885C1H220JA01D
1	C84	0603 capacitor	Do not insert
1	D1	20 V Schottky diode, DO-35	Diodes Inc. SD103C-T
1	D2	Diode, DO-41	Multicomp 1N4001
5	J1, J2, J9, J10, J12	SMA connector	Johnson (Emerson) 142-0701-851
4	J3, J4, J5, J15	SMA connector	Pasternack PE4118
2	J6, J11	SMA connector	Do not insert
1	J7	Header, 40-position	Samtec Inc. SSW-120-02-G-D-RA
1	J8	9-way D sub connector	ITW McMurdo SDEX9PNTD
1	J13	Banana socket	Del-Tron Precision 571-0500-01
1	J14	Banana socket	Del-Tron Precision 571-0100-01
4	J16, J17, J20, J22	Jumper, SIP-2P	Harwin M20-9990246, M7566-05
6	J18, J19, J21, J23, J24, J25	SMA	Do not insert
8	L1, L2, L3, L4, L5, L6, L7, L8	0 Ω, 0603 inductor (resistor)	Multicomp MC 0.063W 0603 0R
2	L9, L10	120 nH, 0805 inductor	Coilcraft 0603CS-R12X_LU
4	L11, L21, L23, L26	7.5 nH, 0402 inductor	Coilcraft 0603CS-7N5X_LU
6	L14, L15, L16, L17, L18, L19	0 Ω, 0603 inductor	Multicomp MC 0.063W 0603 0R
1	L20	0402 inductor	Do not insert
1	L22	0402 inductor	Do not insert
2	L24, L25	0 Ω, 0402 inductor	Phycomp (Yageo) 232270591001
1	R1	3 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 3K
11	R2, R4, R5, R16, R17, R18, R21, R57, R58, R59, R60	0603 resistor	Do not insert
10	R3, R6, R22, R29, R35, R36, R37, R38, R42, R46	0 Ω, 0603 resistor	Multicomp MC 0.063W 0603 0R
1	R7	4.7 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 4K7
4	R8, R9, R12, R15	200 Ω, 0603 resistor	Multicomp MC0603WGF2000T5E-TC

Qty	Reference Designator	Description	Supplier/Part Number
4	R10, R11, R13, R14	620 Ω, 0603 resistor	Multicomp MC0603WGF6200T5E-TC
1	R19	3.3 kΩ, 0603 resistor	Phycomp (Yageo) 232270463302
1	R20	2 kΩ, 0402 resistor	Welwyn PCF0402-R-2K-B-T1
1	R23	0603 resistor	Do not insert
3	R24, R26, R27	0603 resistor	Do not insert
1	R25	0805 resistor	Do not insert
5	R28, R31, R32, R33, R34	0603 resistor	Do not insert
3	R39, R40, R41	330 Ω, 0603 resistor	Multicomp MC 0.063W 0603 1% 330R
3	R43, R44, R45	10 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 5% 10K
2	R47, R49	210 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 210K
2	R48, R50	68 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 68K
2	R51, R53	140 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 140K
2	R52, R54	75 kΩ, 0603 resistor	Multicomp MC 0.063W 0603 1% 75K
2	R55, R56	0 Ω, 0805 resistor	Multicomp MC 0.1W 0805 0R
16	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16	Test point	Do not insert
1	U1	Quadrature demodulator, 24-lead LFCSP	Analog Devices ADL5382ACPZ-R7
1	U2	TruPwr™ detector, 6-lead SC-70	Analog Devices ADL5501AKSZ-R7
1	U3	Analog RF front end, 48-lead LFCSP	Analog Devices ADF9010BCPZ-RL7
1	U4	Transformer, SOT23-5	M/A-COM ETC1-1-13TR
1	U5	anyCap® adjustable low dropout regulator, 8-lead MSOP	Analog Devices ADP3334ARMZ-REEL (do not insert)
3	U6, U7, U8	anyCap adjustable low dropout regulator, 8-lead MSOP	Analog Devices ADP3334ARMZ-REEL
1	U9	Balun transformer, ultralow profile	Anaren BD0810J50100A00
1	Y1	Temperature controlled crystal oscillator	Do not insert
1	Y2	Optional external voltage controlled oscillator	Do not insert

RELATED LINKS

Resource	Description
ADF9010	Product Page: 900 MHz ISM Band Analog RF Front End
ADL5382	Product Page: 700 MHz to 2700 MHz Quadrature Demodulator
ADL5501	Product Page: 50 MHz to 6 GHz TruPwr Detector
ADP3334	Product Page: High Accuracy Low IQ, 500 mA anyCAP Adjustable Low Dropout Regulator

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.

UG08009-0-6/12(A)

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