ANALOG DEVICES

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ADuCRF101 Evaluation Board User Guide

FEATURES

4-layer PCB (33mm x 55mm form factor)
Two power supply options:
- **2.2V to 3.6V from an external power supply**
- **5V from interface board USB-UART/SWD-CONVZ**

Power indicator/general purpose LEDs
Reset/Download push buttons
8-pin connector to the interface board USB-UART/SWD-CONVZ or to RS-232 interface cable (top row)
Access to ADuCRF101 pins on the two footprints for through-hole connectors on the edge of the board
32.768 kHz watch crystal footprint to drive the wakeup timer
Matching network and SMA connector for wireless communication

The Development System also includes:
- **A DVD containing evaluation software, user manuals, datasheets, example code, and get started videos.**
- **Antenna**

GENERAL DESCRIPTION

The ADuCRF101 is a fully integrated data acquisition solution designed for low power wireless applications. It features a 14-bit ADC, a low power Cortex™-M3 core from ARM®, a 431MHz to 464 MHz and 862 MHz to 928 MHz RF transceiver, and Flash/EE memory, in a 9 mm × 9 mm LFCSP package.

The ADuCRF101 mini board allows a user to program, debug and evaluate the performance of the ADuCRF101.

The mini board should be used in conjunction with the USB-SWD/UART-CONVZ kit as shown in Figure 1. The USB-SWD/UART-CONVZ kit includes an interface board and a JLINK Lite emulator.

Figure 1 ADuCRF101 Mini Board and Interface Board

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REVISION HISTORY

03/12—Rev. PrA, Initial Version

05/12—Rev. PrA to Rev. PrB

Changed external power supply voltage range from 1.8 V to 3.6 V to 2.2 V to 3.6 V .... Universal

Changed P1.2 to P4.2 in power indicator/ general purpose LEDs section 3

Changes to table 2 4

Removed EV-ADUCRF101MK4Z-U2 model .... Universal

Added table 11 11

EVALUATION BOARD FEATURES

POWER SUPPLY

The user has two options to power the board:

1. Using the interface board: (Available in the USB-SWD/UART-CONVZ kit)
   The 5V USB supply on J3.7 is regulated via the linear voltage regulator U2. The 3.3 V regulator output powers the red power LED, D2. When LK1 is in place, the regulator output is connected back to the interface board on J3.8.
   The regulator powers the ADuCRF101 only when LK1 and LK2 are in place.

2. External power supply applied to IOVDD on J1.3.
   In order to measure the ADuCRF101 current consumption only, the supply should be applied directly to IOVDD, LK1 and LK2 should be removed, and the interface board disconnected.
   It is also possible to power the device from an external supply (2.2V to 3.6V) while using the interface board for debugging. LK1 should be de-inserted and LK2 be inserted for the emulator to monitor the ADuCRF101 supply.

Each device supply pins of the ADuCRF101 is decoupled with 0.1 μF and 100pF capacitors. A 68μF capacitor is used on the supply line for the radio.

POWER INDICATOR/GENERAL PURPOSE LEDS

A power LED (D2) is used to indicate that the interface board is providing the supply to the board. Note that LK1 and LK2 must be inserted for the ADuCRF101 to be powered.

A general purpose LED (D1) is connected to P4.2 of the ADUCRF101. When P4.2 is cleared, the LED is turned on. When P4.2 is set, the LED is turned off.

CRYSTAL CIRCUITS

Footprints for a through-hole 32.768 kHz watch crystal (Y2) and its two capacitors are included on the board. This crystal can be selected by software as clock source of the wake up timer (T2).

EMULATION INTERFACE

Nonintrusive emulation and download are possible on the ADuCRF101 via Serial Wire by connecting the interface board USB-SWD/UART-CONVZ to the J3 connector. Only two signals are required for debug purposes: SWDIO and SWCLK. The Reset signal is also connected and can be used to provide a reset from the PC if required.

USB-SWD/UART-CONVZ includes an interface board and a JLINK Lite emulator. Other emulator supporting Serial Wire Debug (e.g. JLINK version 6 onwards) can be used. The connections between the mini board and the 20-pin JTAG connector are available in Table 1.

Table 1. Mini Board/Emulator Connections

Signal	J3 connector (Mini Board)	20-pin JTAG connector (emulator)
GND	J3.2	pins 4, 6, 8, 10, 12, 14, 16, 18, 20
VDD	J3.8	pins 1 and 2
SWDIO	J3.3	pin 7
SWCLK	J3.5	pin 9
RESET	J3.1	pin 15

Note that the internal pull ups on SWDIO and SWCLK are sufficient and no external resistors are required.

RESET/DOWNLOAD PUSH BUTTONS

A reset push button is available to allow the user to reset the part manually. When pressed, the reset pin of the ADUCRF101 is pulled to ground. Because the RESET pin on the ADUCRF101 is Schmidt-triggered internally, there is no need to use an external Schmidt trigger on this pin.

A second push button, BOOT, is connected to P0.6/IRQ2 and facilitates serial download mode entry.

RS-232 INTERFACE

To interface the ADuCRF101 UART pins to a PC, the USB UART interface on the USB-SWD/UART-CONV is the first option to consider.

The ADUCRF101 P1.0 and P1.1 lines are available on the top row of the J3 connector and can be directly connected to EVAL-ADUC-CABLE1, as shown in Figure 2, or similar adaptor that includes an RS232 interface device providing the required level shifting or a USB UART interface. Supply should be provided on J1.3 (IOVDD) and LK2 inserted when using an RS232 interface.
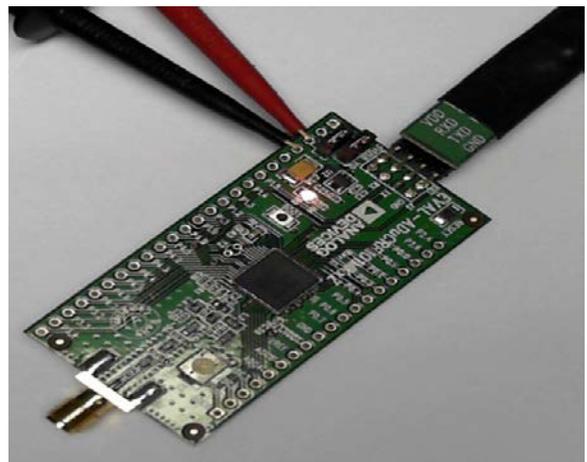

Figure 2. Mini board connected to EVAL-ADUC-CABLE1

Note: To communicate via UART using a UART cable EVAL-ADUC-CABLE1, supply should be between 3V and 3.6V as the

cable is only operational in this supply range. The EVAL-ADUC-CABLE1 is available for purchase on the ADI web site.

RF MATCHING NETWORK

An RF matching network is available to match the LNA input impedance and PA output with the 50Ohm SMA connector (J4) for ADUCRF101 at different frequencies depending on the board used.

Different boards are available based on the UHF transceiver ISM band required. See Table 2 for the relevant model numbers.

Table 2: ADuCRF01 evaluation kits: model numbers

Frequency	Topology	Model
868/915MHz	Differential PA	EV-ADUCRF101MK1Z-U2
433.92MHz	Differential and Single Ended PA	EV-ADUCRF101MK3Z-U2

The list of components for the two models available is available in Table 7 to Table 10.

The EV-ADUCRF101MK1Z-U2 contains the matching network components for differential PA.

The EV-ADUCRF101MK1Z-U2 matching network components can be modified to evaluate the single ended PA. The list of components for single ended PA operating at 868/915MHz is available in Table 11.

SENSITIVITY MEASUREMENTS

To perform the BER test on the UHF transceiver the internal clock and data signals of the transceiver can be brought to the ADuCRF101 GPIO pins

- The CLOCK signal can be brought out to P0.6.
- The DATA signal can be brought out to P2.6.

User code is available on the DVD to measure the performance of the radio on the mini board.

EXTERNAL CONNECTORS

EDGE CONNECTORS J1 AND J2

ADuCRF101 signals, such as GPIOs and analog inputs are available on the edge of the board, on two unpopulated through-hole connectors. These two connectors can be used to plug the Mini Board into a prototype board.

The pin out of the two edge connectors is shown in Table 3 and in Table 4.

Table 3: Pin Functions for Edge Connector J1

Pin Number	Pin Function
J1-1	5VOUT
J1-2	VDDOUT
J1-3	IOVDD
J1-4	GND
J1-5	RESET
J1-6	NC
J1-7	P1.5
J1-8	P1.4
J1-9	P1.3
J1-10	P1.2
J1-11	P1.1
J1-12	P1.0
J1-13	P4.0
J1-14	P4.1
J1-15	P4.2
J1-16	P4.3
J1-17	P4.4
J1-18	P4.5
J1-19	P4.6
J1-20	P4.7
J1-21	P3.2
J1-22	P3.3
J1-23	P3.4
J1-24	P3.5

Table 4: Pin Functions for Edge Connector J2

Pin No.	Pin Function
J2-1	ADC0
J2-2	ADC1
J2-3	ADC2
J2-4	ADC3
J2-5	ADC4
J2-6	ADC5
J2-7	VREF
J2-8	LVDD1
J2-9	GND
J2-10	P0.7
J2-11	P0.6
J2-12	P0.5
J2-13	P0.4
J2-14	P0.3
J2-15	P0.2
J2-16	P0.1
J2-17	P0.0
J2-18	P2.6
J2-19	P2.4

EMULATION AND SERIAL INTERFACE CONNECTOR J3

Connector J3 provides a connection with the interface board. The pin out for J3 connector is described in Table 5.

Table 5: Pin Functions for Edge Connector J3

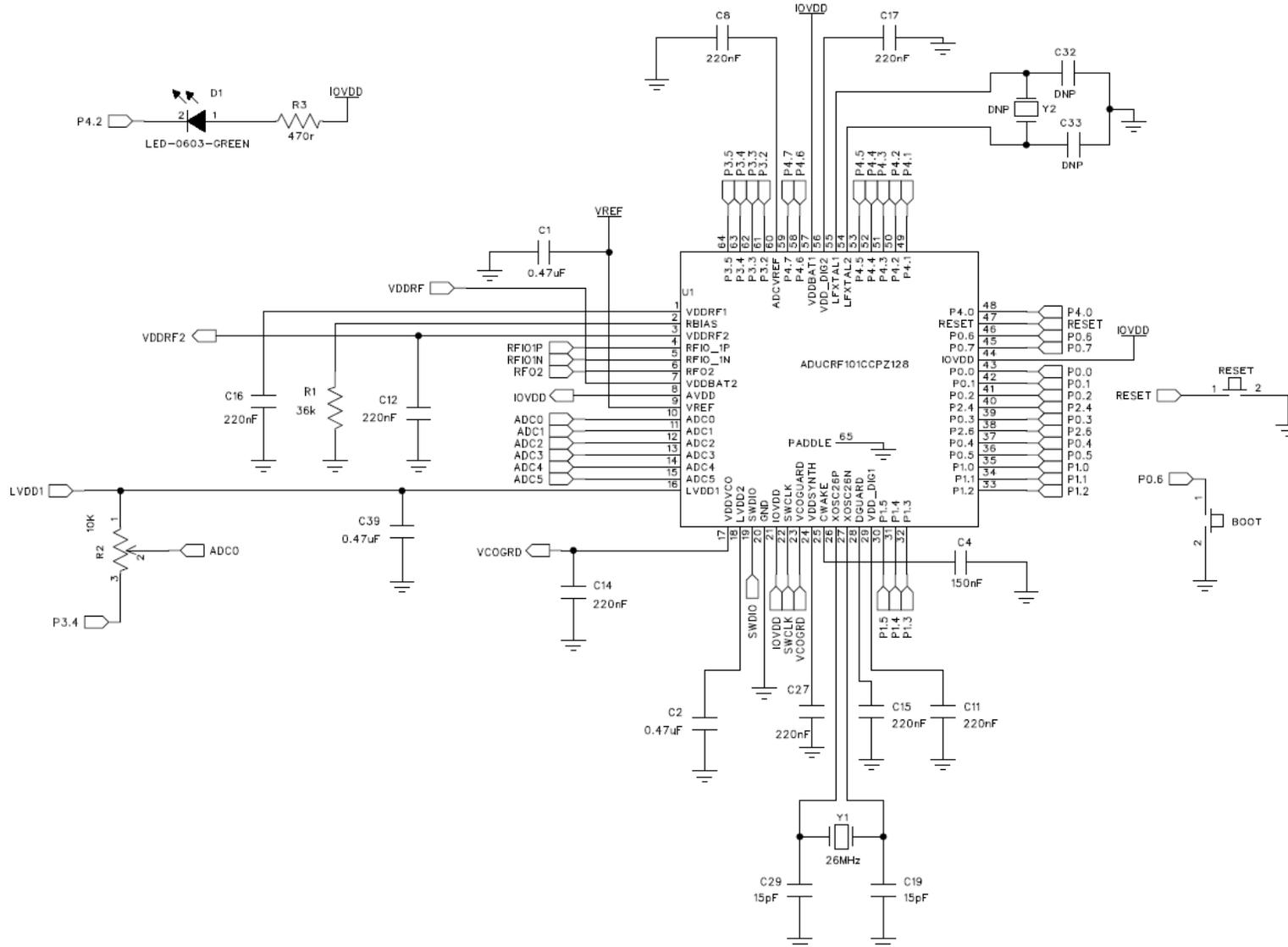| Pin No.	Pin Function
J3-1	RESET
J3-2	GND
J3-3	SWDIO
J3-4	TX
J3-5	SWCLK
J3-6	RX
J3-7	5VUSB
J3-8	VDDOUT

EVALUATION BOARD SCHEMATIC AND ARTWORK
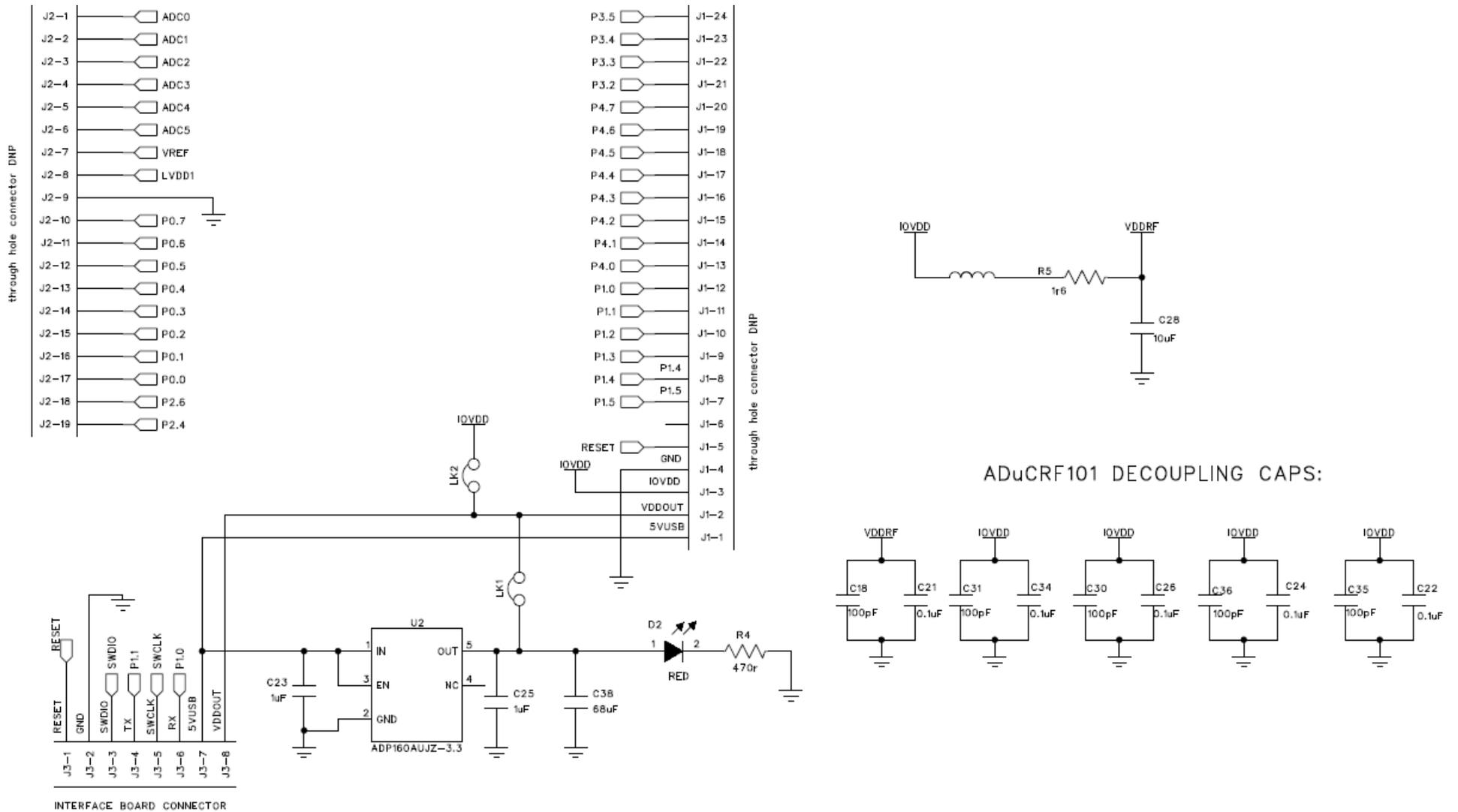

Figure 3: ADuCRF101 Section
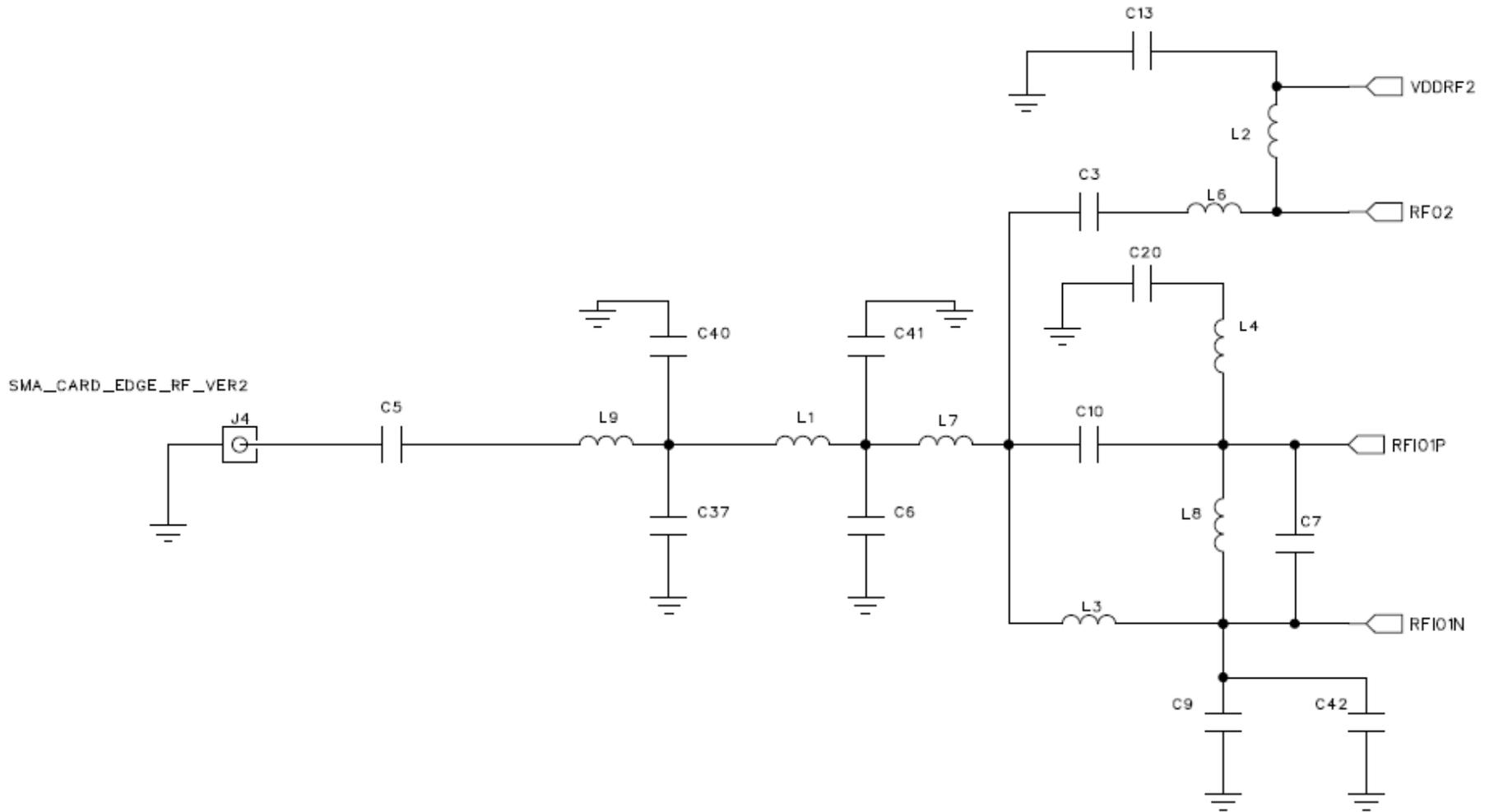
Figure 4: Connectors.
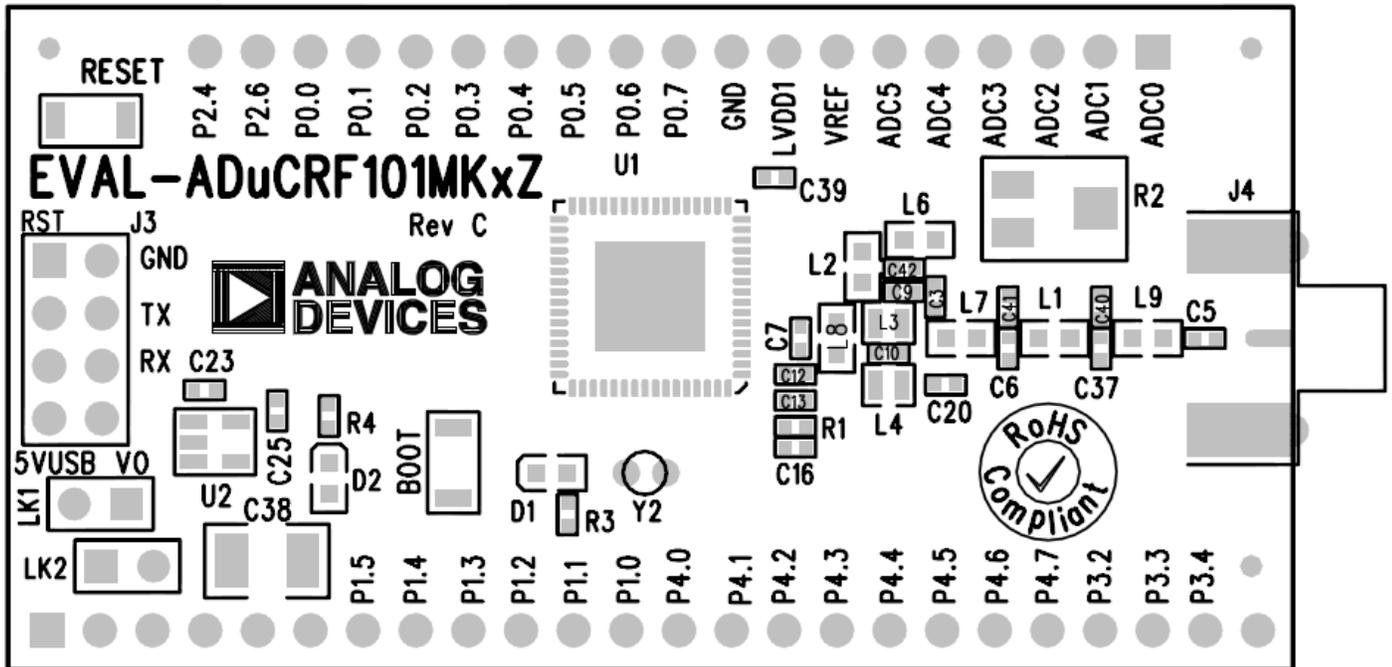
Figure 5: Matching Network Section
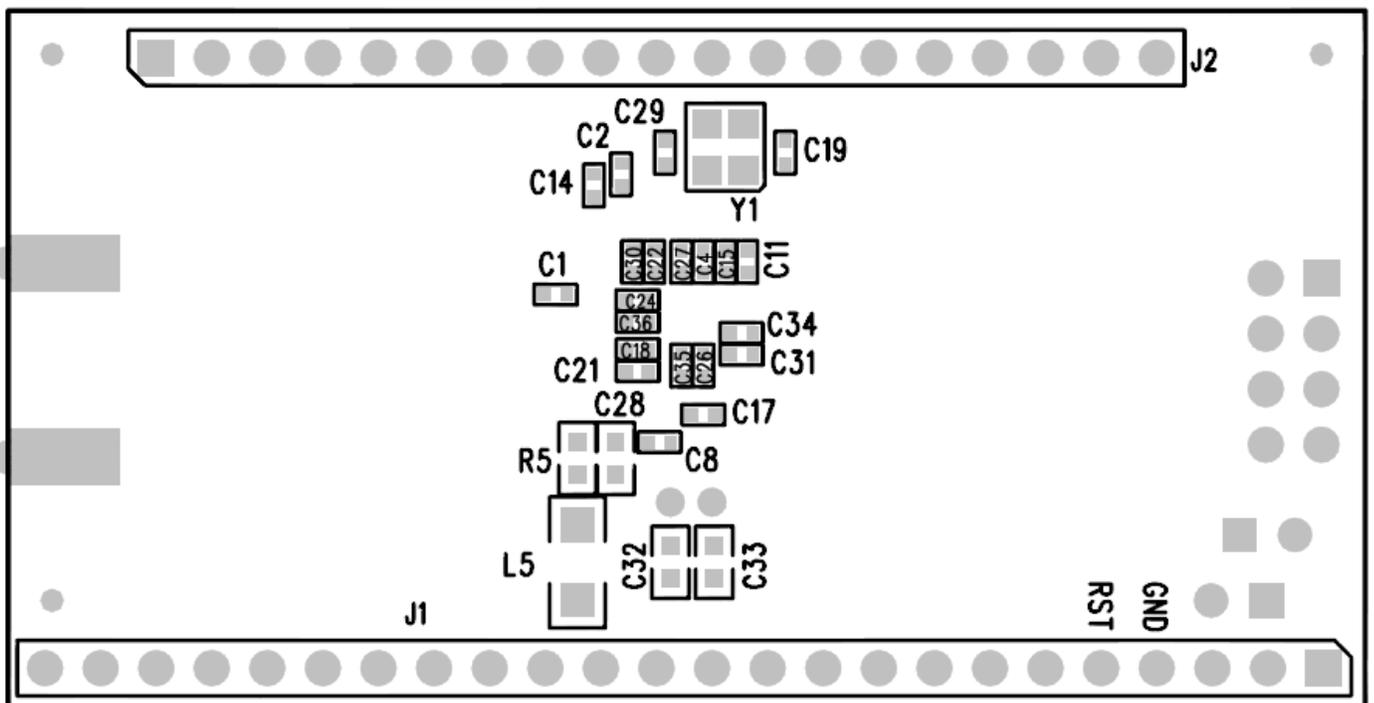
Figure 6: Top Side Silkscreen

Figure 7: Bottom Side Silkscreen

BILL OF MATERIALS

Table 6.

Qty	Component	Description	Order No.	Supplier
1	EVAL-ADUCRF101MKxZ RevC PCB	Two sided surface mount PSB-1		
1	U1	Precision Analog Microcontroller with ISM band transceiver	ADUCRF101CCPZ128U2	Analog Devices Inc.
1	U2	Low Quiescent Current, 3.3V Linear Regulator	ADP121-AUJZ33R7	Analog Devices Inc.
2	BOOT, RESET	SMD Push Button Switch	B3U-1000P	Farnell
1	D1	LED, SMD Green	LGQ971	Digikey
1	D2	LED, 0603 Red	LSQ976-Z	Farnell
3	C1, C2, C39	0.47uF Capacitor, 16V Y5V Ceramic 0402	GRM155F51C474ZA01D	Digikey
1	C4	150nF, CAPACITOR, 10%, 10V 0402	GRM155R61A154KE19D	Digikey
7	C8, C11, C12, C14, C15, C16, C17	220nF, 10V X5R Ceramic Capacitor	LMK105BJ224KV-F	Digikey
5	C18, C30, C31, C35, C36	100PF CAPACITOR, 5%, 50V 0402	GRM1555C1H101JD01D	Farnell
2	C19, C29	15PF CAPACITOR, 50V 5% C0G 0402	GRM1555C1H150JZ01D	Digikey
5	C21, C22, C24, C26, C34	.1UF CAP CER 16V X7R 0402	GRM155R71C104KA88D	Digikey
2	C23, C25	1UF CAPACITOR 10% 6.3V X5R 0402	C0402C105K9PACTU	Digikey
1	C27	220nF, 10V X5R Ceramic Capacitor	LMK105BJ224KV-F	Digikey
1	C28	10uF, Capacitor, 6.3V 20% X5R Ceramic 0603	GRM188R60J106ME47D	Digikey
2	C32, C33	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	C38	68UF CAP TANT 6.3V 20% 1210	TCJB686M006R0070	Digikey
2	J1, J2	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	J3	8 Pin R/A Header	9-103324-0	Farnell
1	J4	CONN JACK END LAUNCH PC GOLD SMA	142-0701-851	Digikey
1	L5	Ferrite Bead, 600 ohms @ 100MHz	BLM18BD102SN1D	Digikey
2	LK1, LK2	2 Pin (0.1" Pitch) Header & Shorting Shunt	M20-9990246	Farnell
1	R1	RESISTOR 36k OHM 1/16W 1% 0402 SMD	RC0402FR-0736KL	Digikey
1	R2	POT 10K OHM 4MM SQ CERM SMT	TS53YJ 10K 20% TR (Lead Free)	Digikey
2	R3, R4	RES 470 OHM 1/16W 1% 0402 SMD	MCR01MZPF4700	Digikey
1	R5	RES 1.6 OHM 1/10W 5% 0603 SMD	RC0603JR-071R6L	Digikey
1	Y1	CRYSTAL 26MHZ 10PF 3.2 X 2.5 SMD	NX3225SA-26.000000MHZ-G2	Digikey
1	Y2	32kHz Crystal	**NOT INSERTED**	**NOT INSERTED**
1	antenna	433MHz range antenna	SMAMFDRA433	VW Badland
		868MHz/915MHz range antenna	ANT-916-CW-HWR-SMA	Digikey

Table 7. Matching Network Bill of Material for MK1 Model (868/915MHz operation, differential PA)

Qty	Component	Description	Order No.	Supplier
4	C3, C7, C13, C42	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
2	C9, C10	CAP CER 2.7PF 50V C0G 0402	GRM1555C1H2R7CZ01D	Digikey
1	C20	CAPACITOR, 100PF, 5%, 50V 0402	GRM1555C1H101JD01D	Farnell
3	L2, L6, L8	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
2	L3, L4	10.4nH	0604HQ-10NXJL	Coilcraft

Table 8. Harmonic Filter Bill of Material for MK1 Model (868/915MHz operation, differential PA)

Qty	Component	Description	Order No.	Supplier
1	C5	CAP CER 270PF 50V 5% C0G 0402	GRM1555C1H271JA01D	Digikey
2	C6, C37	CAP CERAMIC 3.6PF 50V C0G 0402	GJM1555C1H3R6CB01D	Digikey
2	C40, C41	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	L1	15nH	0603HP-15NXJL	Coilcraft
2	L7, L9	7.5nH	0603HP-7N5XJL	Coilcraft

Table 9. Matching Network Bill of Material for MK3 Model (433MHz operation)

Qty	Component	Description	Order No.	Supplier
1	C3	CAPACITOR, 270PF, 5%, 50V 0402	GRM1555C1H271JA01D	Digikey
2	C9, C10	CAP CER 5.6PF 50V C0G 0402	GRM1555C1H5R6DZ01D	Digikey
1	C13, C20	CAPACITOR, 100PF, 5%, 50V 0402	GRM1555C1H101JD01D	Digikey
2	C7, C42	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	L2	100nH 0603 Inductor	0603HP-R10XJL	Coilcraft
1	L8	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	L6	15nH 0603 Inductor	0603HP-15NXJL	Coilcraft
2	L3, L4	27nH 0603 Inductor	0603HP-27NXJL	Coilcraft

Table 10. Harmonic Filter Bill of Material for MK3 Model (433MHz operation)

Qty	Component	Description	Order No.	Supplier
1	C5	CAP CER 270PF 50V 5% C0G 0402	GRM1555C1H271JA01D	Digikey
2	C6, C37	CAP CERAMIC 8.2PF 50V C0G 0402	GJM1555C1H8R2DB01D	Digikey
2	C40, C41	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	L1	30nH 0603 Inductor	0603HP-30NXJL	Coilcraft
2	L7, L9	18nH 0603 Inductor	0603HP-18NXJL	Coilcraft

Table 11. Matching Network Bill of Material for single ended PA topology at 868/915MHz operation

Qty	Component	Description	Order No.	Supplier
1	C3	150pF	GRM1555C1H102JA01	Digikey
2	C9, C10	CAP CER 1.5PF 50V C0G 0402	GJM1555C1H1R5CB01	Digikey
1	C13	CAPACITOR, 100PF, 5%, 50V 0402	GRM1555C1H101JD01D	Digikey
2	C7, C42	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	C20	CAPACITOR, 100PF, 5%, 50V 0402	GRM1555C1H101JD01D	Digikey
1	L2	47nH 0603 Inductor	0603HP-47NXJL	Coilcraft
1	L8	**NOT INSERTED**	**NOT INSERTED**	**NOT INSERTED**
1	L6	1.8nH 0603 Inductor	0603HP-1N8XJL	Coilcraft
2	L3, L4	10nH 0603 Inductor	0604HQ-10NXJL	Coilcraft

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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