EV-ADF5902SD1Z Evaluation Board User Guide
UG-1432

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Evaluating the ADF5902 24 GHz, ISM Band, Multichannel FMCW Radar Transmitter

FEATURES

- Self contained board, including the ADF5902 24 GHz VCO PGA, with integrated 2-channel PA output and fractional-N frequency synthesizer with ramp generation
- Windows-based software allows control of the ADF5902 functions from a PC
- Externally powered by a 5 V power supply

EVALUATION KIT CONTENTS

- EV-ADF5902SD1Z evaluation board

EQUIPMENT NEEDED

- PC with Windows XP (or more recent version) and USB port for evaluation software
- Analog Devices, Inc., EVAL-SDP-CS1Z SDP-S controller board
- Spectrum analyzer
- 5 V power supply

DOCUMENTS NEEDED

- ADF5902 data sheet
- PLL Software Installation Guide

SOFTWARE NEEDED

- PLL software

GENERAL DESCRIPTION

The EV-ADF5902SD1Z evaluation board allows the user to evaluate the performance of the ADF5902 24 GHz voltage controlled oscillator (VCO) programmable gain amplifier (PGA) with a 2-channel power amplifier (PA) output and ramping phase-locked loop (PLL). Figure 1 shows the EV-ADF5902SD1Z evaluation board, which contains the ADF5902, three high frequency K type Subminiature Version A (SMA) connectors for the local oscillator (LO) output, two transceiver outputs, banana connectors for the power supply, and a connector for the serial interface.

The EV-ADF5902SD1Z evaluation board requires an EVAL-SDP-CS1Z system demonstration platform serial (SDP-S) controller board, which the kit does not include. The EVAL-SDP-CS1Z SDP-S allows software programming of the ADF5902 device.

Full specifications on the ADF5902 are available in the ADF5902 data sheet. Consult the data sheet in conjunction with this user guide when working with the EV-ADF5902SDIZ evaluation board.

The Windows®-based PLL software provides easy programming of the synthesizer.

EVALUATION BOARD PHOTOGRAPHY

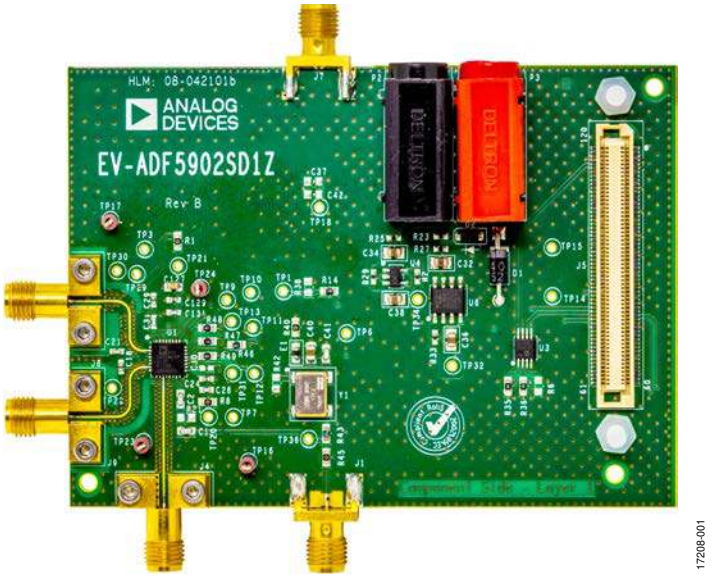

Figure 1.

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REVISION HISTORY

12/2018—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

The EV-ADF5902SD1Z evaluation board requires the use of an EVAL-SDP-CS1Z SDP-S controller board to program the device. Purchase the EVAL-SDP-CS1Z SDP-S separately because it is not included in the evaluation kit. See the Evaluation Board Schematics and Artwork section for the detailed schematics (Figure 6 to Figure 12) and layout (Figure 13 and Figure 14) of the EV-ADF5902SD1Z evaluation board.

POWER SUPPLIES

The EV-ADF5902SD1Z evaluation board is powered by a 5 V external power supply that must be connected as described in the Evaluation Board Test section.

INPUT SIGNALS

The 100 MHz temperature controlled crystal oscillator (TCXO), or an external REF input, provides the necessary reference signal. Either are acceptable to use.

Connect an external TX_DATA signal to the TPI test point to control some of the ramping functionality. Use the external REF input synchronized to TX_DATA when using the TX_DATA signal. Remove Resistor R40 when using an external REF input.

OUTPUT SIGNALS

The TX1, TX2, and LO outputs from the ADF5902 contain dc bias voltages, and are available on the J8 (TXOUT1), J9 (TXOUT2), and J4 (LOOUT) output SMAs.

DEFAULT OPERATION

All hardware components necessary to operate the ADF5902 are included on the EV-ADF5902SD1Z.

EVALUATION BOARD TESTING

To evaluate and test the performance of the ADF5902, use the following procedure and reference Figure 2 throughout the process:

1. Install the PLL software (see the PLL Software Installation Guide)
2. Follow the hardware driver installation procedure (see the PLL software Installation Guide for Windows XP only).
3. Connect the EVAL-SDP-CS1Z SDP-S board to the EV-ADF5902SD1Z evaluation board.
4. Connect the 5 V power supply to the red and black banana connectors of the EV-ADF5902SD1Z evaluation board.
5. Connect the USB cable from the EVAL-SDP-CS1Z SDP-S board to the PC.
6. Connect an ac-coupled signal source analyzer to the Transmitter 2 J9 output SMA.
7. Run the PLL software.
8. Click the **Select Device and Connection** tab in the PLL software window. Select **SDP board (black)**, the ADF5902 device, and click **Connect** (see Figure 3).
9. Click the **ADF5902 Controls** tab, and then click **Initialize ADF5902** in the bottom right corner of the window (see Figure 4).
10. Measure the TXOUT2 output signal on the J9 output SMA using the spectrum analyzer.

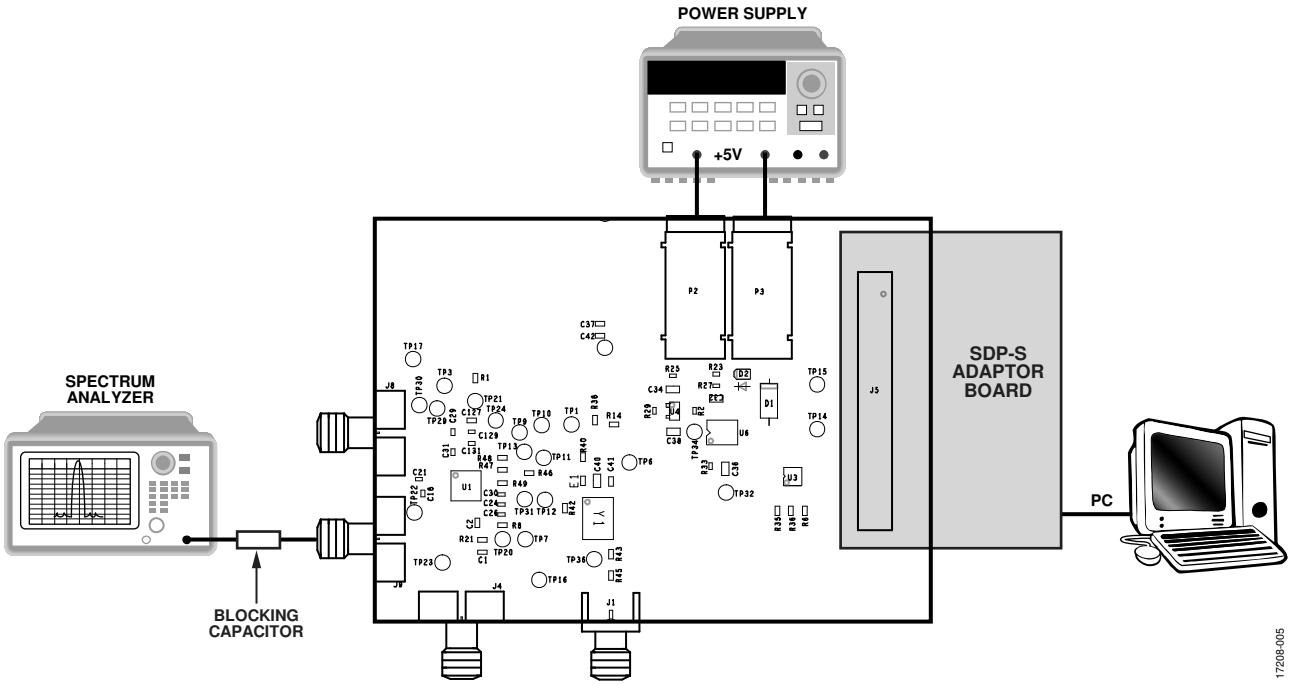

Figure 2. Typical EV-ADF5902SD1Z Evaluation Board Setup

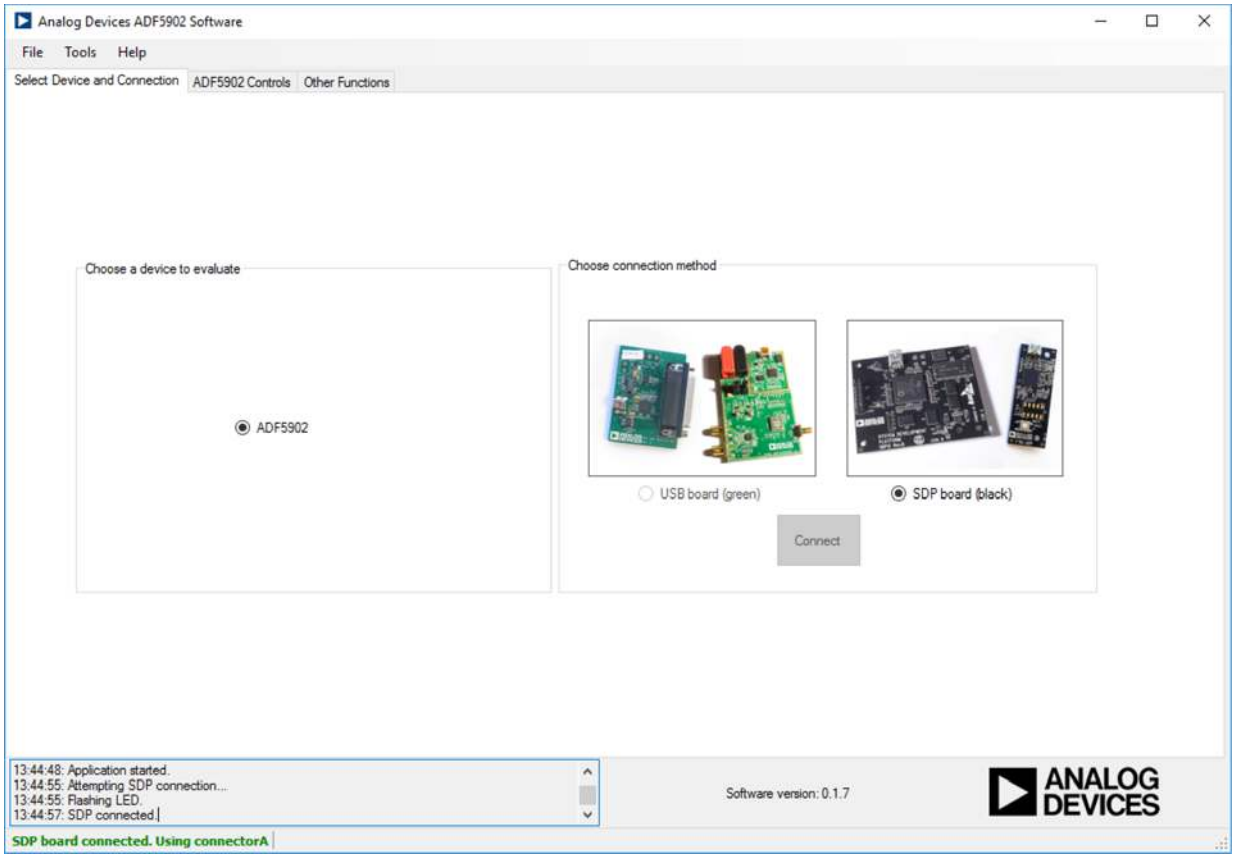

Figure 3. PLL Software Front Panel Display, Select Device and Connection

EVALUATION BOARD SOFTWARE

ADF5902 CONTROLS

Click the **ADF5902 Controls** tab in the PLL software window (see Figure 4) to select the user configurable register settings. Consult the register descriptions of the ADF5902 data sheet for details. Default settings are recommended for most registers.

After powering up the board, click the **Initialize ADF5902** box in the bottom right of the PLL software window to perform the initialization sequence (as described in the ADF5902 data sheet). Following this sequence, the ADF5902 transmitter powers up and all ADF5902 blocks calibrate.

The **ADF5902 Controls** tab allows access to the **PLL Setup** tab and the **Ramp Generation** tab.

PLL SETUP

To configure the PLL functionality of the ADF5902, take the following steps:

1. In the **PLL Setup** tab (see Figure 4), set the reference frequency (RF) settings for the PLL in the **RF Settings** section, and the required settings for the TX2, TX1, and LO outputs in the **Register 0** section.
2. In the **RF Settings** section, type the reference frequency in the **Reference Frequency** box. The PFD frequency is calculated from the **Reference Frequency** value, the **R counter** value, the **Ref Doubler** (reference doubler option), and the **Ref/2** (reference divided by 2 option).
3. Ensure that the value in the **PFD Frequency** box matches the value specified when designing the loop filter for the ADF5902.
4. Program the charge pump setting in the **Register 12** section to match the loop filter design by clicking the **Charge Pump Setting** dropdown menu and selecting a value.
5. Click the **Muxout** dropdown menu in the **Register 3** section, and then select the signal connected to the output of the MUXOUT pin.

To program any of the ADF5902 registers, click the button under each register value in the **Registers** section at the bottom of Figure 4 to write that value to the device. For example, to write the value for Register R0, click the **Write R0** button.

A green background of a register value indicates that the register value has changed in the **PLL Setup** tab, and that a write of this register to the device is required.

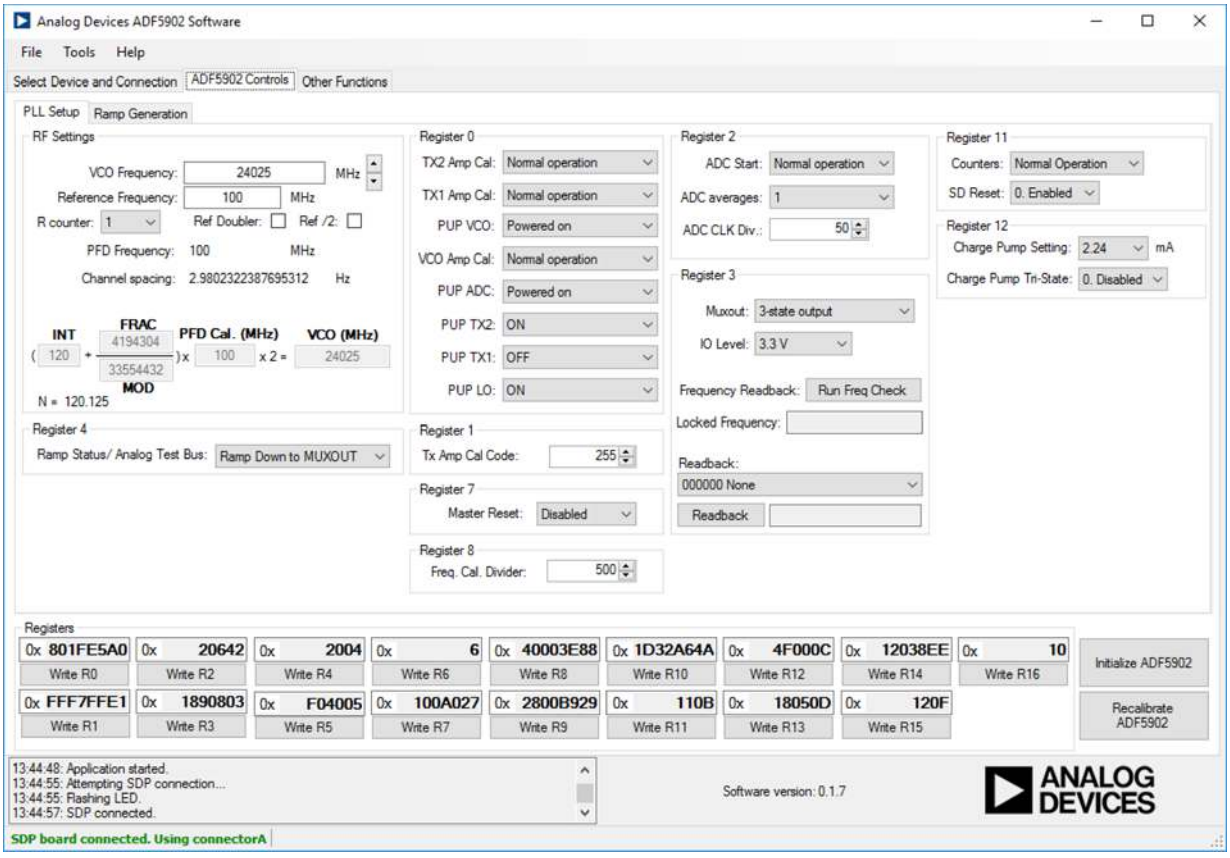

Figure 4. PLL Software Window Display, ADF5902 Controls

RAMP GENERATION

To configure the ramp functionality of the ADF5902,

1. Click the **Ramp Generation** tab in the PLL software window (see Figure 5).
2. Select the ramp type from the **Ramp mode** dropdown menu in the **Modulation Type** section, and set the various ramp parameters in the **CLK1**, **Slope 0**, **Slope 1, Slope 2, Slope 3**, and **Timing Parameters** sections.

Figure 5 shows an example of the ramping settings for a continuous triangular ramp of 144 ramp steps over 200 MHz at the ADF5902 transceiver output, with a ramp time of 5 ms. For 200 MHz, the PLL is programmed for a 100 MHz ramp because the feedback to the PLL is divided by two.

3. After each parameter is set in the PLL software, write it to the device by clicking the corresponding register write button.

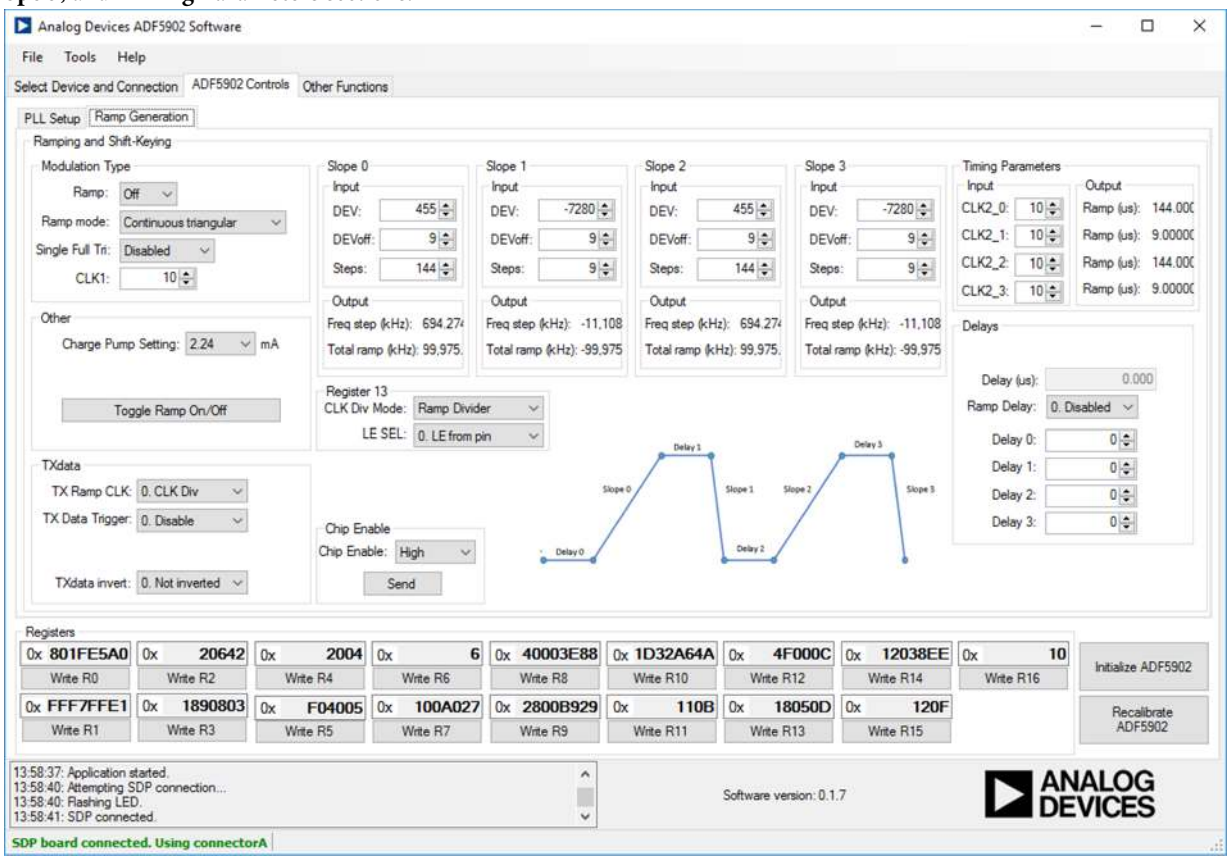

Figure 5. PLL Software Window Display, ADF5902 Ramps Generation

EVALUATION BOARD SCHEMATICS AND ARTWORK

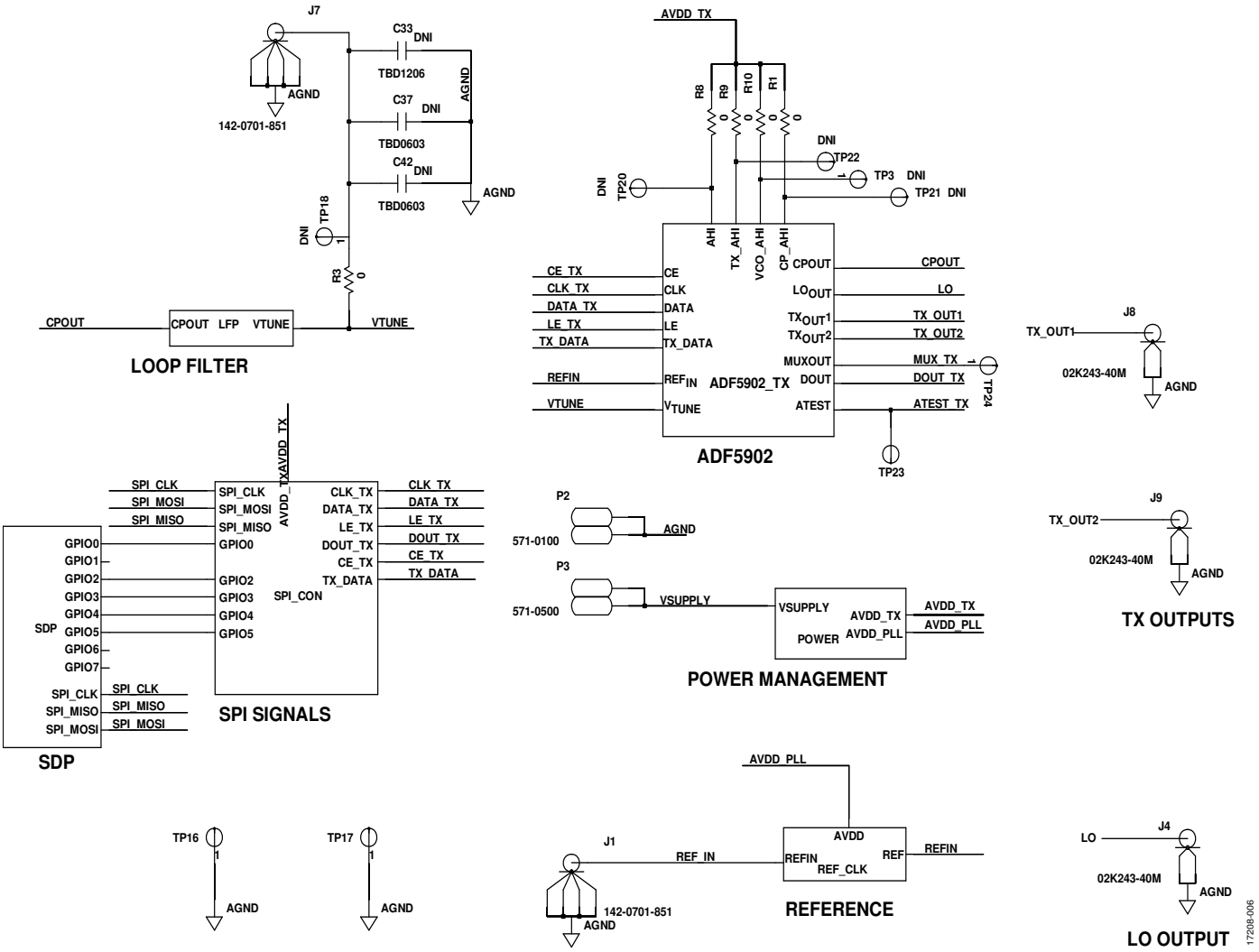

Figure 6. EV-ADF5902SD1Z Evaluation Board Schematic (Page 1)

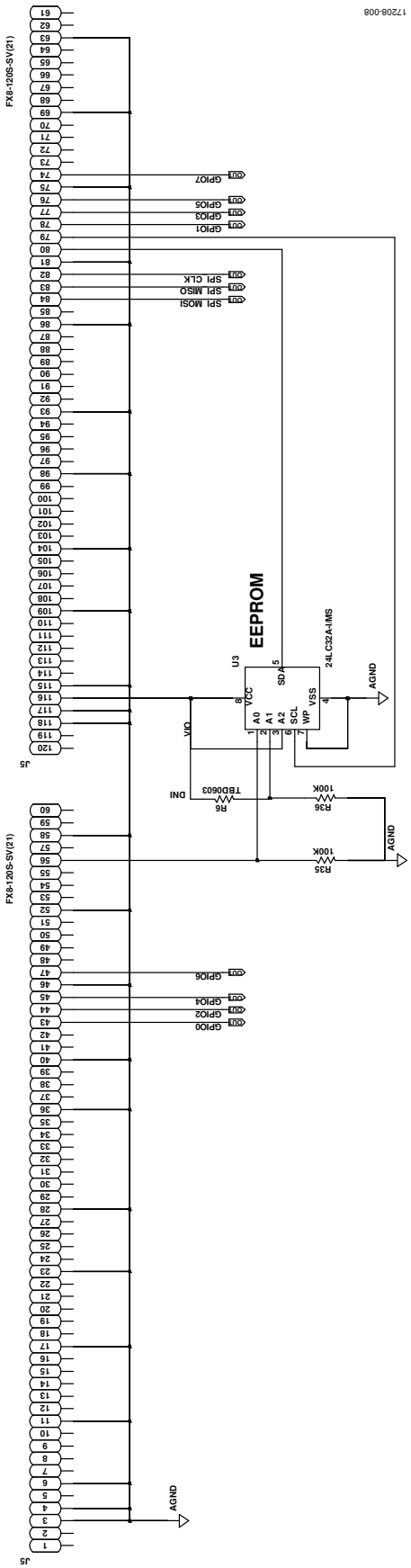

Figure 7. EV-ADF5902SD1Z Evaluation Board Schematic (Page 2)

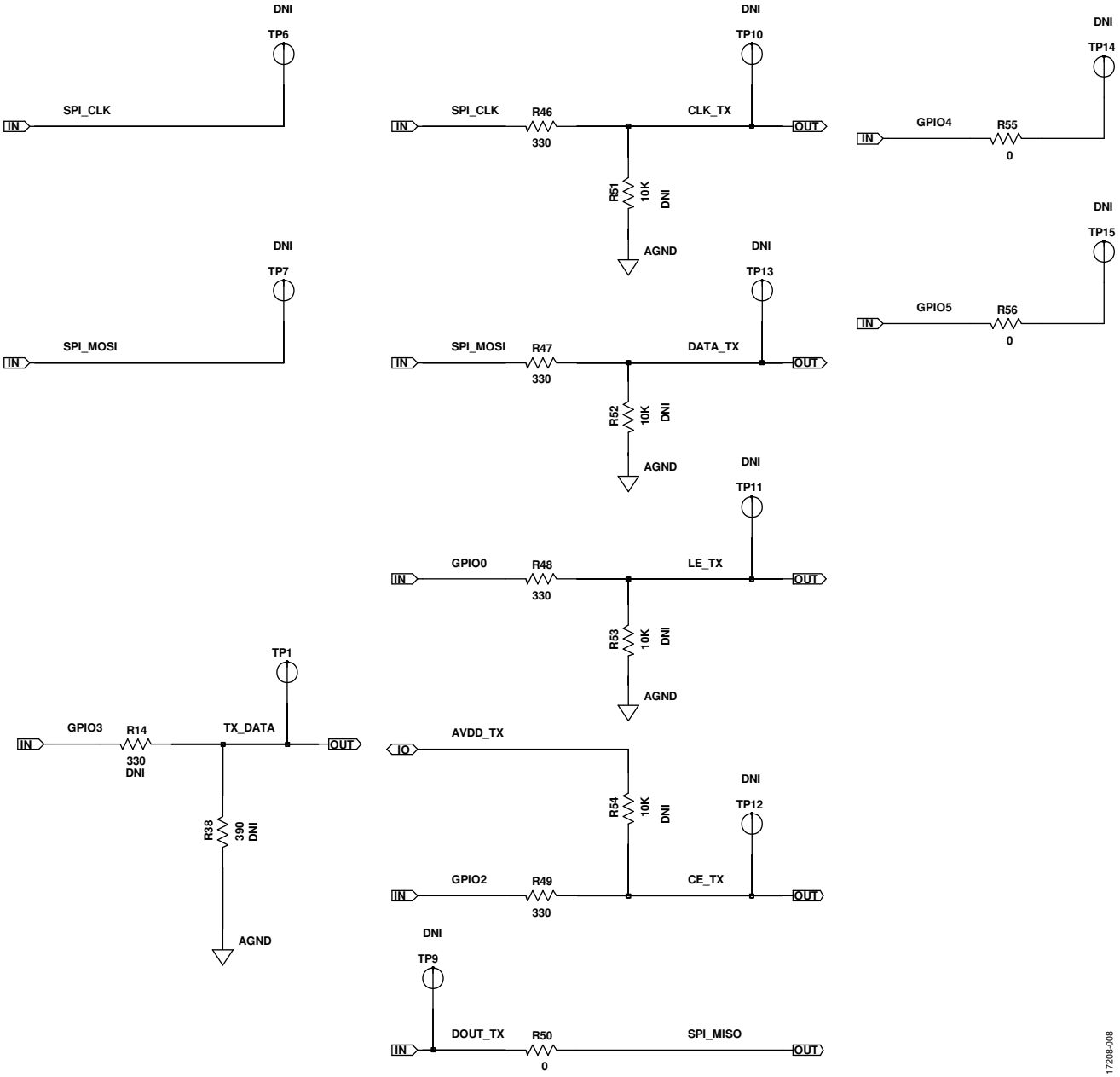

Figure 8. EV-ADF5902SD1Z Evaluation Board Schematic (Page 3)

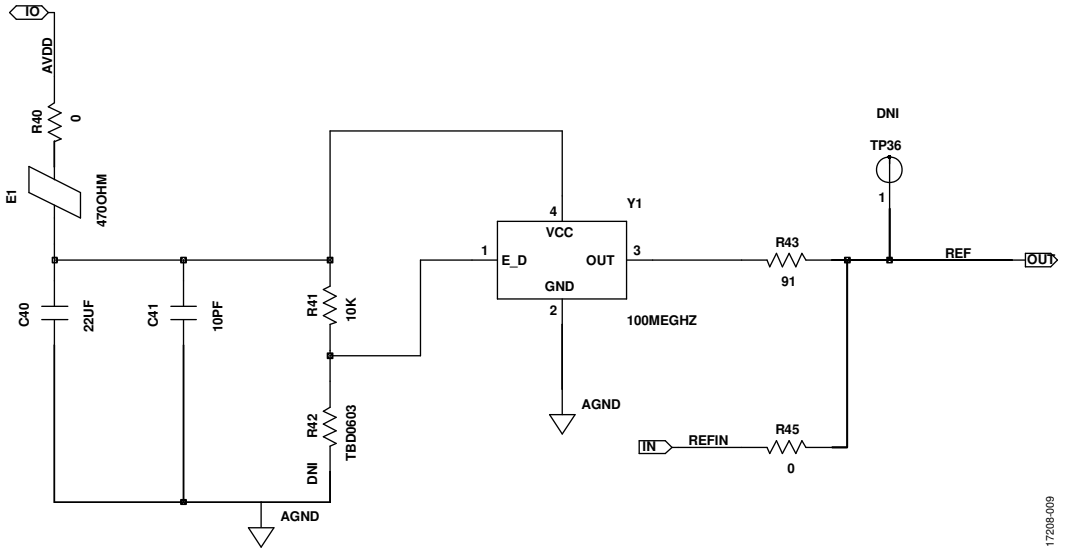

Figure 9. EV-ADF5902SD1Z Evaluation Board Schematic (Page 4)

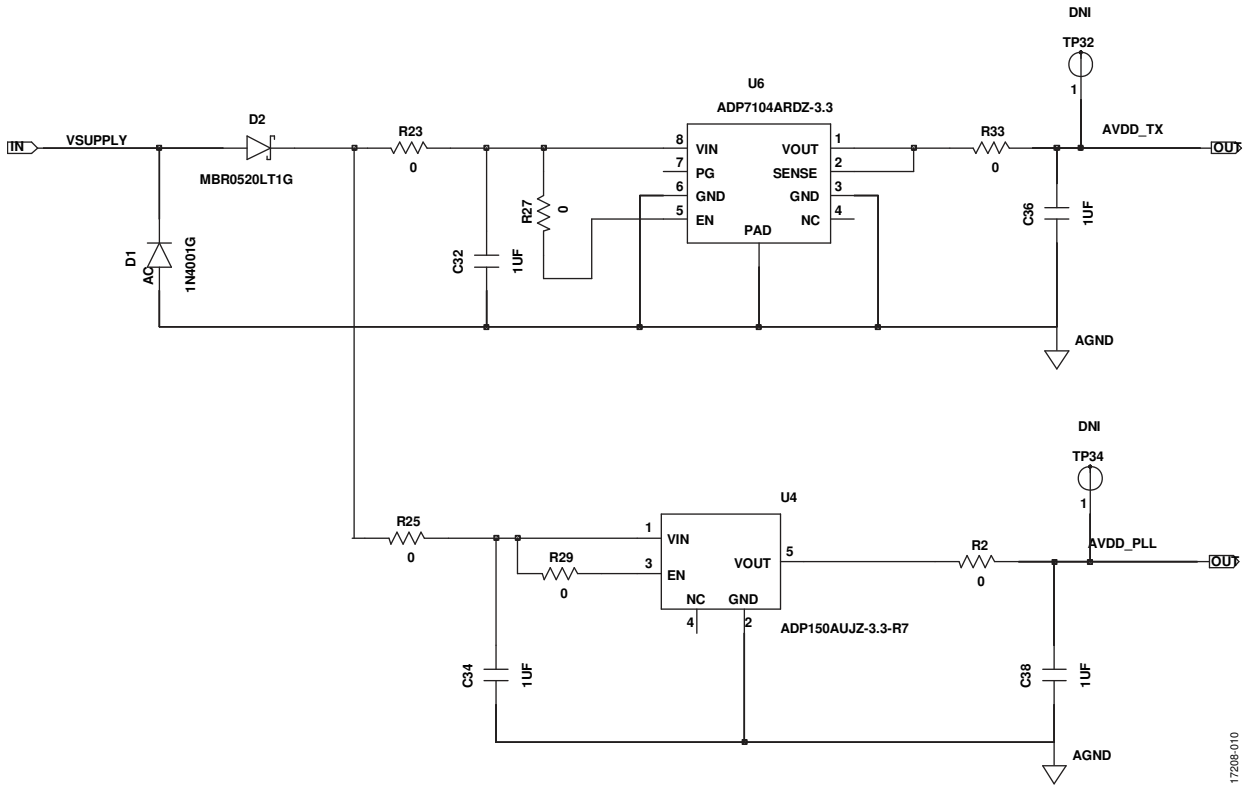

Figure 10. EV-ADF5902SD1Z Evaluation Board Schematic (Page 5)

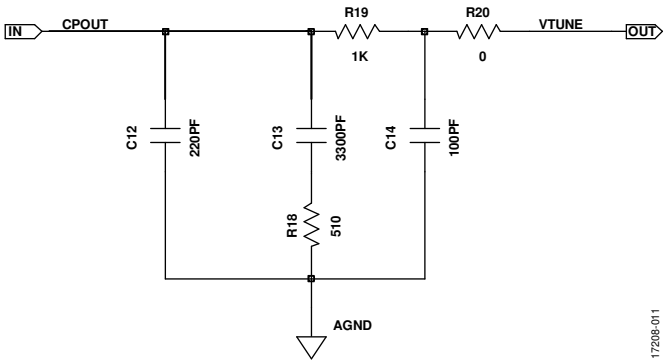

Figure 11. EV-ADF5902SD1Z Evaluation Board Schematic (Page 6)

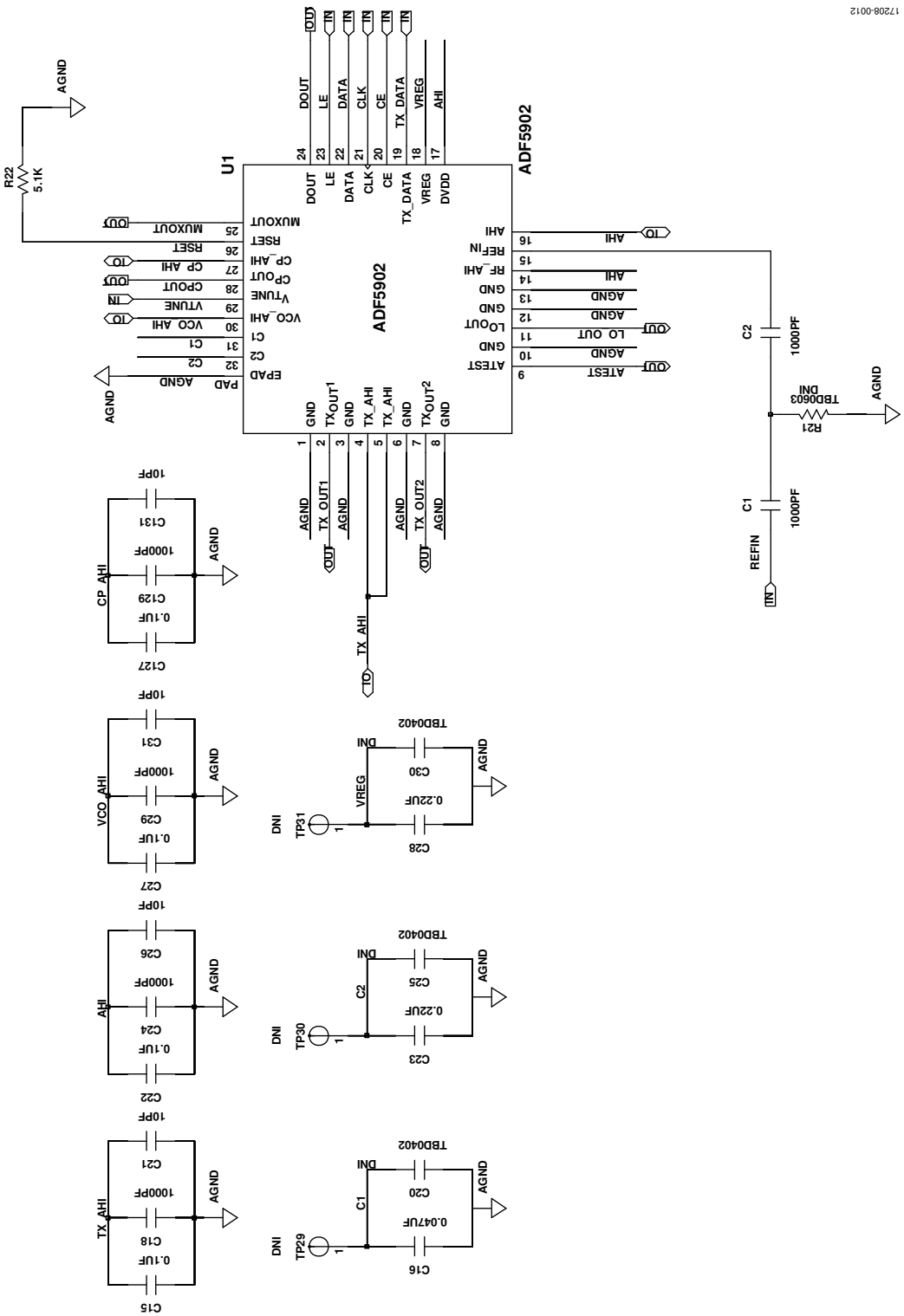

Figure 12. EV-ADF5902SD1Z Evaluation Board Schematic (Page 7)

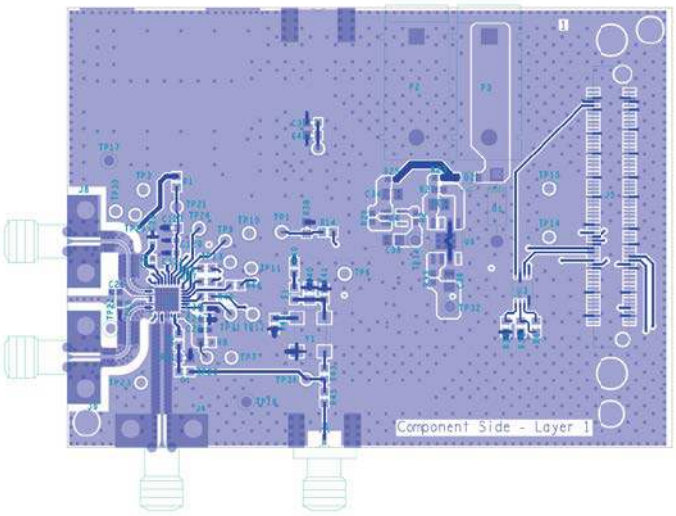

Figure 13. EV-ADF5902SD1Z Evaluation Board Layer 1 Top Side

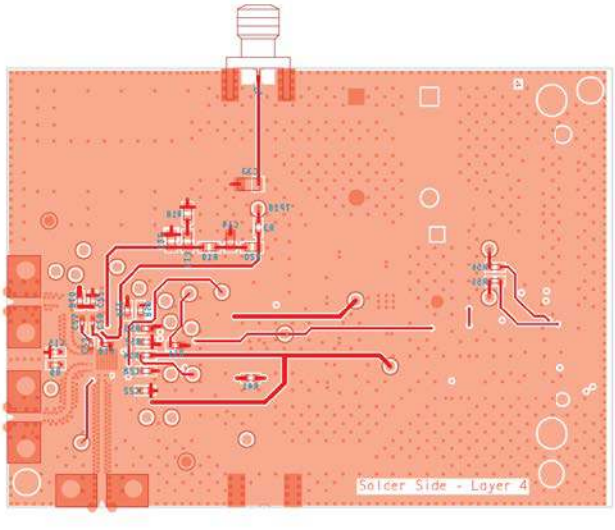

Figure 14. EV-ADF5902SD1Z Evaluation Board Layer 4 Bottom Side

ORDERING INFORMATION

BILL OF MATERIALS

Table 1. Bill of Materials

Quantity	Reference Designator	Part Description	Manufacturer	Part Number
2	C1, C2	1 nF, 0603 capacitors	Murata	GRM1885C1H102JA01D
1	C12	220 pF, 0805 capacitor	Phycomp (Yageo)	CC0805JRNPO9BN221
4	C15, C22, C27, C127	100 nF, 0603 capacitors	AVX	06035C104KAT2A
4	C18, C24, C29, C129	1 nF, 0402 capacitors	MurataA	GRM1555C1H102JA01
1	C13	3.3 nF, 0805 capacitor	TDK	C2012C0G1H332J
4	C21, C26, C31, C131	10 pF, 0402 capacitors	Phycomp (Yageo)	CC0402JRNP09BN100
1	C14	100 pF, 0805 capacitor	Yageo	CC0805FRNPO9BN101
1	C16	47 nF, 0402 capacitor	AVX	0402YD473KAT2A
1	C23	220 nF, 0402 capacitor	TDK	C1005X5R0J224K
1	C28	220 nF, 0603 capacitor	Murata	GCM188R71H224KA64D
4	C32, C34, C36, C38	1 µF, 0805 capacitors	Murata	GRM21BR71H105KA12L
1	C40	22 µF, 0805 capacitor	Taiyo Yuden	LMK212BJ226MG-T
1	C41	10 pF, 0603 capacitor	Murata	GRM1885C1H100JA01D
1	D1	Diode, standard, 1 A, 50 V	ON Semiconductor	1N4001G
1	D2	Diode, Schottky, 0.5 A, 20 V	ON Semiconductor	MBR0520LT1G
1	E1	Ferrite bead	Wurth Elektronik	7427-92642
2	J1, J7	Connector PCB end launch jack	Cinch	142-0701-851
3	J4, J8, J9	Connector PCB SMA right angle jack	Rosenberger	02K243-40M
1	J5	Connector PCB vertical type receptable SMD	Hirose	FX8-120S-SV(21)
1	P2	Connector PCB single socket black	Deltron	571-0100
1	P3	Connector PCB single socket red	Deltron	571-0500
10	R1, R3, R8 to R10, R40, R45, R50, R55, R56	0 Ω, 0603 resistors	Multicomp	MC0603WG00000T5E-TC
4	R46 to R49	330 Ω, 0603 resistors	Multicomp	MC 0.063W 0603 330R
1	R14	Do not install	Do not install	Do not install
1	R18	510 Ω, 0805 resistor	Yageo	RC0805JR-07510RL
1	R19	1 kΩ, 0805 resistor	Panasonic	ERJ-6ENF1001V
6	R2, R23, R25, R27, R29, R33	0 Ω, 0402 resistors	Panasonic	ERJ-2GE0R00X
1	R20	0 Ω, 0805 resistor	Panasonic	ERJ-6GEY0R00V
1	R22	5.1 kΩ, 0603 resistor	BOURNS	CR0603-FX-5101ELF
2	R35, R36	100 kΩ ,0603 resistors	Panasonic	ERJ-3EKF1003V
1	R41	10 kΩ, 0603 resistor	Panasonic	ERJ-3EKF1002V
1	R43	91 Ω, 0603 resistor	Yageo	9C06031A91R0FKHFT
1	TP1	Yellow test point	Keystone Electronics	5000
4	TP16, TP17, TP23, TP24	Red test point	Keystone Electronics	5000
1	U1	ADF5902 24 GHz Tx MMIC	Analog Devices	ADF5902WWCPZ-U1
1	U3	IC 32 kB serial EEPROM	Microchip	24LC32A-I/MS
1	U4	3.3 V complimentary metal-oxide semiconductor (CMOS) linear regulator	Analog Devices	ADP150AUJZ-3.3-R7
1	U6	3.3 V CMOS linear regulator	Analog Devices	ADP7104ARDZ-3.3
1	Y1	100 MHz crystal clock oscillator	Connor-Winfield	CWX113-100.0M
3	C20, C25, C30	Do not install	Not applicable	Not applicable
1	C33	Do not install	Not applicable	Not applicable
2	C37, C42	Do not install	Not applicable	Not applicable
3	R6, R21, R42	Do not install	Not applicable	Not applicable
1	R38	Do not install	Not applicable	Not applicable

Quantity	Reference Designator	Part Description	Manufacturer	Part Number
4	R51 to R54	Do not install	Not applicable	Not applicable
20	TP3, TP6, TP7, TP9 to TP15, TP18, TP20 to TP22, TP29 to TP32, TP34, TP36	Do not install	Not applicable	Not applicable
2	SCREW1, SCREW2	Screw, cheese, nylon, M3×10, PK100	Allthread Plastics Limited	119030010
2	NUT1, NUT2	Nut and washer, nylon, M3, PK100	Duratool	119030011

RELATED LINKS

Resource	Description
ADF5902	Product Page, 24 GHz VCO and PGA with 2-Channel PA Output
ADP7104	Product Page, 20 V, 500 mA, Low Noise, CMOS LDO

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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