

Evaluating the AD9837 Low Power, 8.5 mW, 2.3 V to 5.5 V, Programmable Waveform Generator

FEATURES

- Full featured evaluation board for the [AD9837](#) evaluation board
- Graphical user interface software for board control and data analysis
- Connector to [EVAL-SDP-CB1Z](#) system demonstration platform (SDP) board
- Various power supply and reference link options

APPLICATIONS

- Biomedical sensors
- Bioelectrical impedance analysis
- Electrochemical analysis
- Impedance spectroscopy
- Complex impedance measurement
- Nondestructive testing

GENERAL DESCRIPTION

The AD9837 is a 16 MHz low power DDS device capable of producing high performance sine and triangular outputs. It also has an on-board comparator that allows a square wave to be produced for clock generation. Consuming only 20 mW of power at 3 V makes the AD9837 an ideal candidate for power-sensitive applications.

The EVAL-AD9837SDZ board is used in conjunction with a EVAL-SDP-CB1Z SDP board available from Analog Devices, Inc. The USB-to-SPI communication to the AD9837 is completed using this Blackfin®-based development board.

A high performance, on-board 16 MHz trimmed general oscillator is available to use as the master clock for the AD9837 system. Various links and SMB connectors are also available on the EVAL-AD9837SDZ board to maximize usability.

Complete specifications for the AD9837 are provided in the AD9837 data sheet, available from Analog Devices, and should be consulted in conjunction with this user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

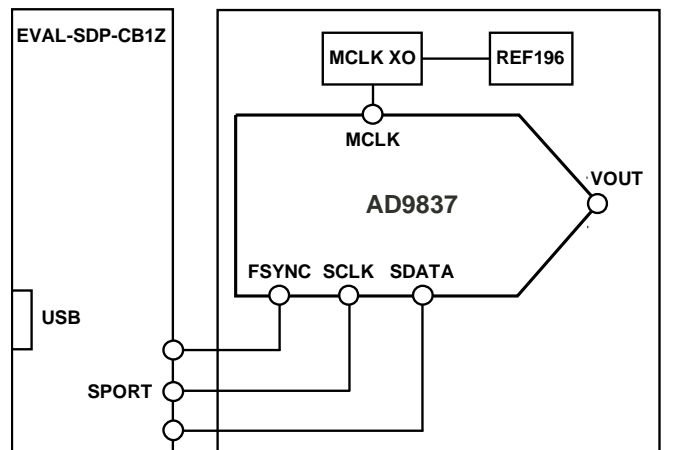


Figure 1.

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REVISION HISTORY

4/11—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

The EVAL-AD9837SDZ evaluation kit includes the software and drivers on CD. The software is compatible with Windows® XP, Windows Vista, and Windows 7.

To install the software, follow these steps:

1. Install the software before connecting the SDP board to the USB port of the PC.
2. Start the Windows operating system and insert the EVAL-AD9837SDZ evaluation kit CD.
3. Download the AD9837SDZ LabVIEW™ software. The correct driver, SDPDriversNET, for the SDP board should download automatically after LabVIEW is downloaded, supporting both 32- and 64-bit systems. However, if the drivers do not download automatically, the driver executable file can also be found in the **Program Files/Analog Devices** folder. Follow the on-screen prompts to install the SDPDriverNet Version 1.3.6.0.
4. After installation of the software and drivers is complete, plug the EVAL-AD9837SDZ into the SDP board and the SDP board into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation (**Found New Hardware Wizard/Install the Software Automatically** and so on).

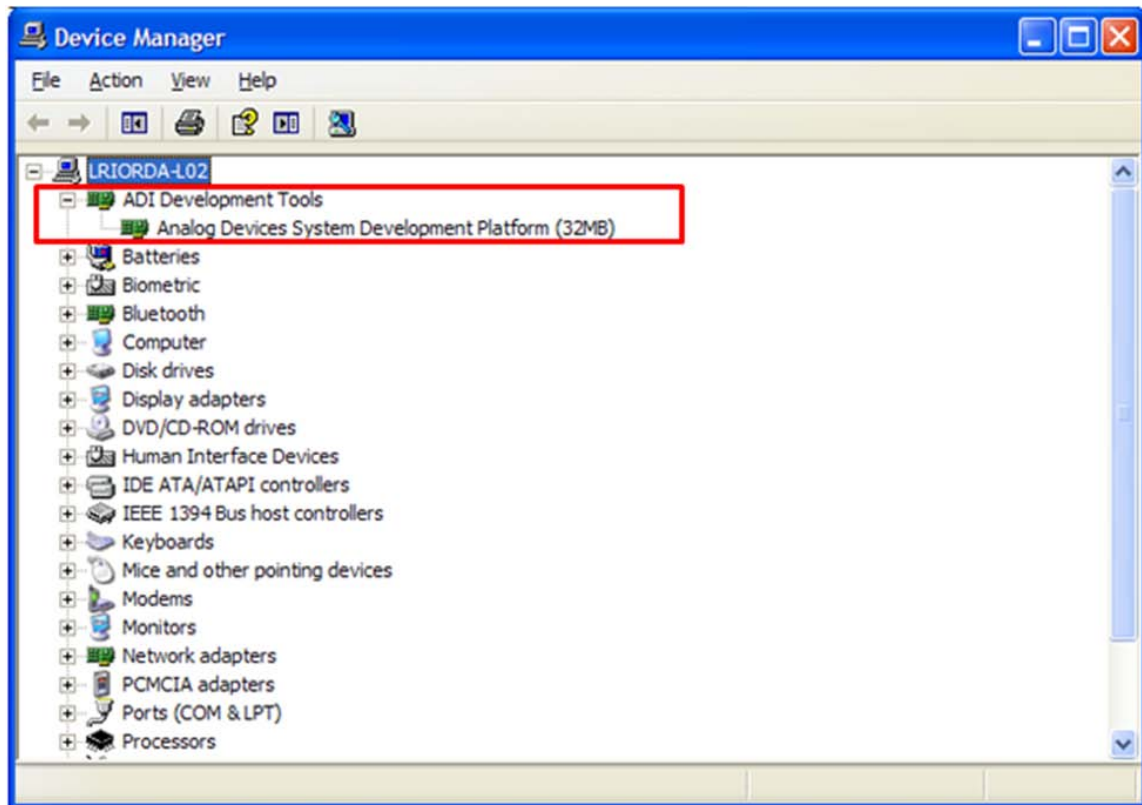


Figure 2. Hardware Device Manager Window with SDP Board Plugged In

RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/AD9837/AD9837 Eval Board**.
2. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 3). Simply connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.
3. Ensure that all links are in their correct locations (see Table 1). The main window of the AD9837DBZ evaluation software then opens, as shown in Figure 4.

Table 1. Default Setup for Link Positions

Link No.	Position	Function
LK1	In	Decouple the CAP/2.5V pin to ground because V_{DD} is >2.7 V.
LK2	A	On-board linear regulator selected to supply power to the general oscillator.
LK3	A	On-board crystal oscillator selected.
LK4	A	3.3 V digital supply for the AD9837 supplied from the EVAL-SDP-CB1Z SDP board.

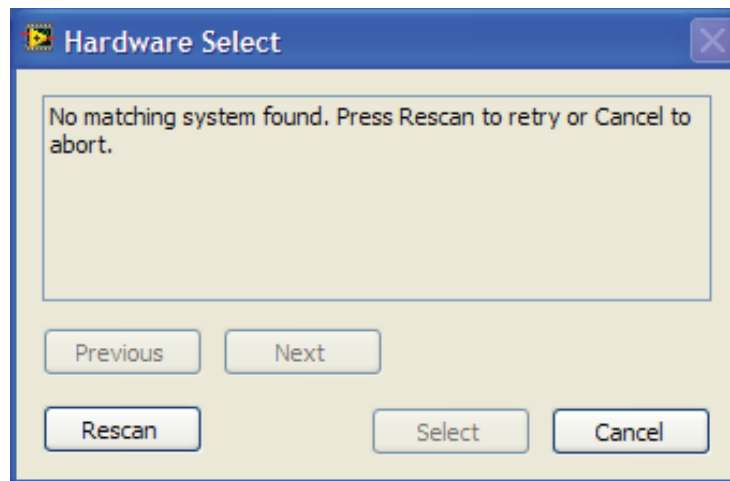


Figure 3. Pop-Up Window Error

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USING THE EVALUATION BOARD SOFTWARE

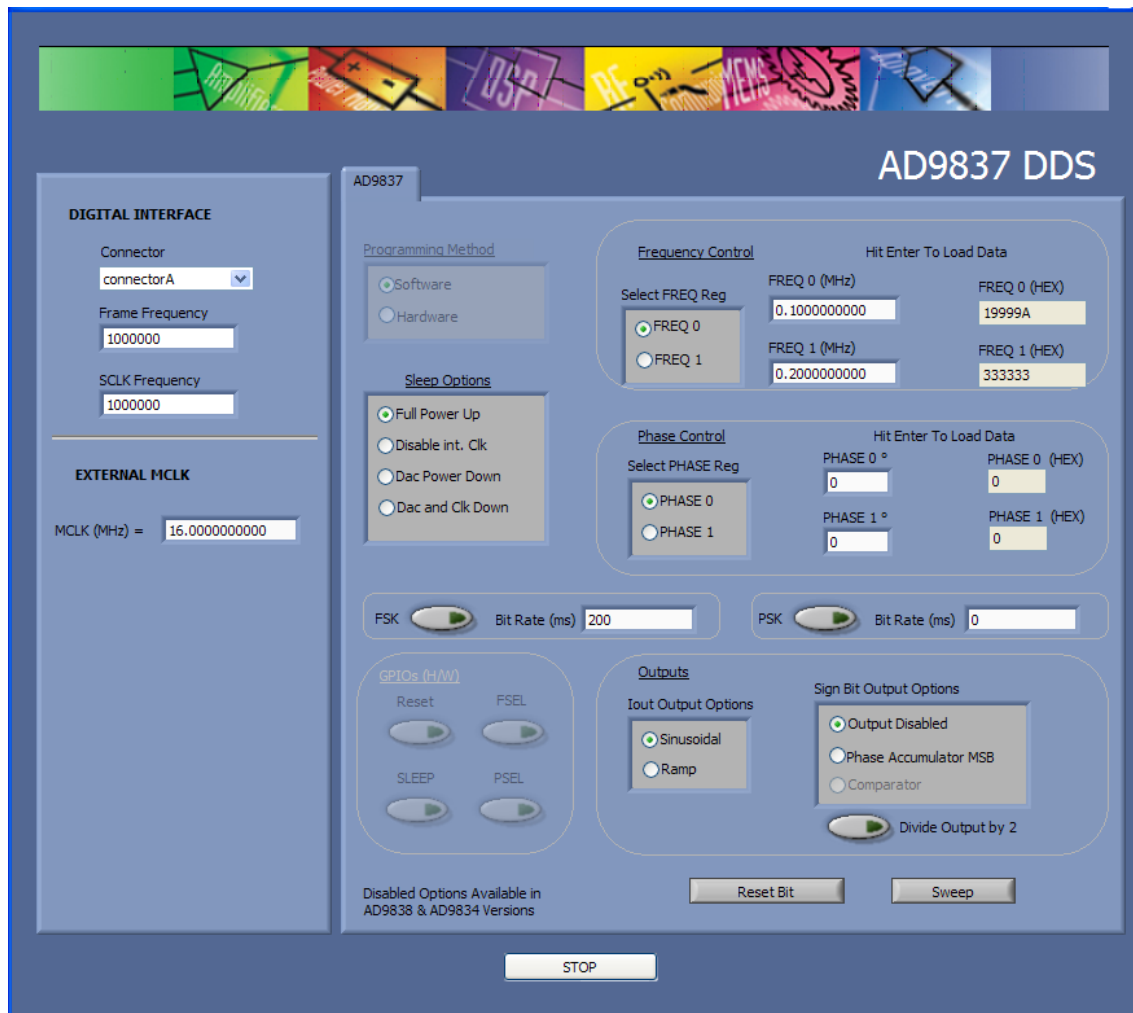


Figure 4. AD9837 DDS Evaluation Software

SETTING UP THE DIGITAL INTERFACE

The first software step in setting up the [AD9837](#) to make some measurements to set the **DIGITAL INTERFACE**. The [EVAL-SDP-CB1Z](#) has two connectors plugs: **connectorA** and **connectorB**. Select which connector you want to use with the AD9837 evaluation board from the drop-down menu.

The SPI **Frame Frequency** (/SYNC) box and **SCLK Frequency** box can also be set in this window. If the SPI interface speed has not been decided upon, leave the default values shown in Figure 5.

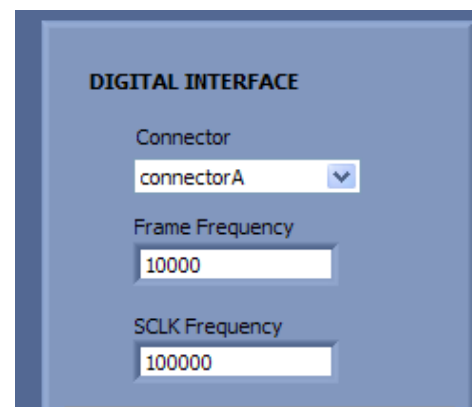


Figure 5. Digital Interface

SELECT EXTERNAL MCLK FREQUENCY

Having selected the digital interface specifics, next use the **EXTERNAL MCLK** box to choose which frequency to use. The boards are supplied with a 75 MHz general oscillator. If a different clock source is required, the CLK1 SMB connector can be used to supply a different MCLK value.

Two options for the general oscillator include the AEL3013 oscillators from AEL Crystals and the SG-310SCN oscillators from Epson Electronics.

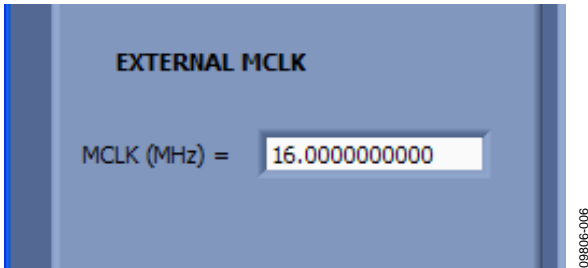


Figure 6. EXTERNAL MCLK Input

LOADING FREQUENCY AND PHASE REGISTERS

The desired output frequency and output phase can be loaded using the inputs shown in Figure 7. Either the **FREQ 0** register or the **FREQ 1** register can be loaded with frequency data. The frequency data is loaded in megahertz, and the equivalent hex code is shown to the right once data is entered; click **Enter** to load data. Once data is loaded, the output appears on the **IOUT1** and **IOUT2** pins. Similarly, either the **PHASE 0** register or **PHASE 1** register can be selected, and the phase data is loaded in degrees.

The analog output frequency from the **AD9837** is defined by

$$f_{MCLK}/2^{28} \times FREQREG$$

where **FREQREG** is the value loaded into the selected frequency register in decimals. This signal is phase shifted by

$$2\pi/4096 \times PHASEREG$$

where **PHASEREG** is the value contained in the selected phase register in decimals.

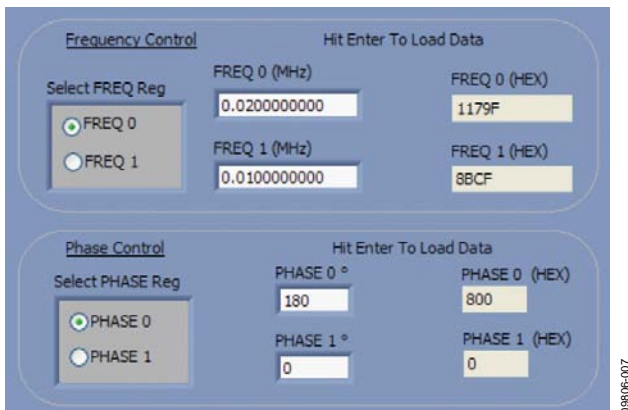


Figure 7. Frequency and Phase Load

FSK AND PSK FUNCTIONALITY

In software mode, the **AD9837** can be set up for **FSK** or **PSK** functionality by simply entering the bit rate in milliseconds and selecting the push-button option (see Figure 8).



Figure 8. FSK and PSK Functionality

WAVEFORM OPTIONS

The output waveform can be selected as a sinusoidal waveform or a ramp waveform. The internal comparator in the **AD9837** can be disabled or enabled (see Figure 9). The **MSB/2** of the phase accumulator can be selected as the output on the **SIGN BIT OUT** pin.

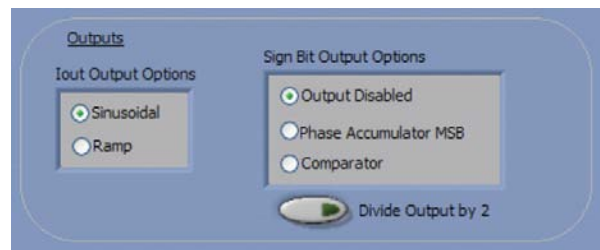


Figure 9. Waveform Profile and SIGN BIT OUT Pin

Power-Down Options

The **AD9837** has various power-down options selected through the control register. The part can disable the **MCLK** or disable the **DAC** if just the **MSB** output is used on the **SIGN BIT OUT** pin, or it can power down both sections for a lower power sleep mode (see Figure 10).

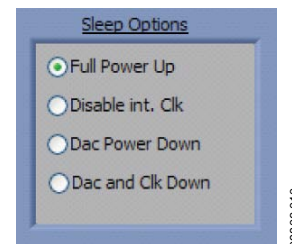


Figure 10. Power-Down Options

RESET AND SWEEP

The reset software command is set using the push-button shown in Figure 11. To setup a DDS sweep, click **Sweep**.



Figure 11. Software Reset and Sweep Select

The sweep function allows users to load a start frequency, stop frequency, increment size, number of loops, and delay between each frequency increment. These commands are then loaded to the part automatically from the EVAL-SDP-CB1Z board.

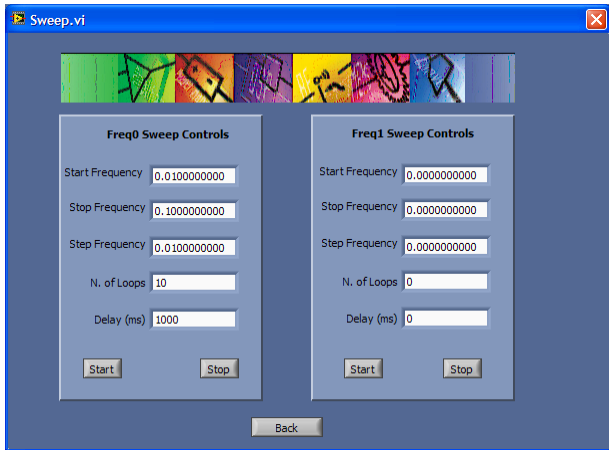


Figure 12. Sweep Functionality

EXAMPLE OF OPERATION

An example of configuring the AD9837 to output 10 kHz follows:

1. Plug the EVAL-SDP-CB1Z board into the EVAL-AD9837SDZ board and connect to the USB port.
2. Start up the software located at **Start/All Programs/ Analog Devices/AD9837/AD9837 Eval Board**. You should see the SDP board communicating with the PC.
3. Select **connectorA** or **connectorB**; this must match what the AD9837 test chip is connected to.
4. Define MCLK; the default is an on-board 16 MHz oscillator.
5. Ensure that all links are in the correct locations (see Table 1).
6. Select the **FREQ 1** register.
7. Load a 10 kHz excitation frequency and click **Enter**.

The output should appear on the IOOUT and IOOUTB outputs on the evaluation board.

For the FREQ 0 register,

- Select the FREQ 0 register.
- Load the FREQ 0 register with 20 kHz and click **Enter**.

For the FREQ 1 register,

- Select the FREQ 1 register to load the 10 kHz associated with this register.

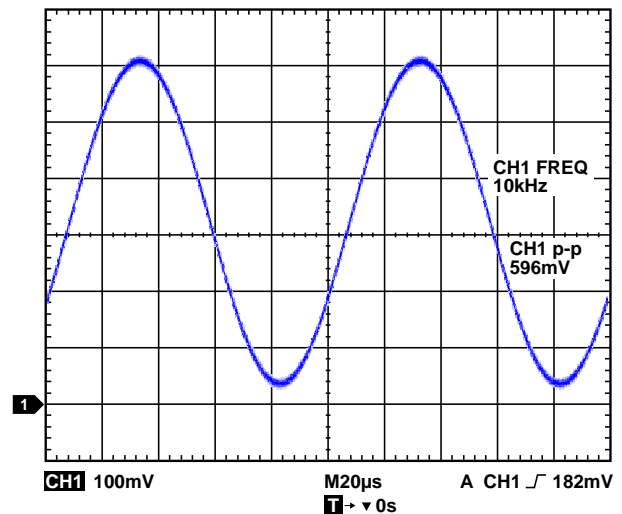


Figure 13. 10 kHz Output Signals on an IOOUT Test Point

EVALUATION BOARD SCHEMATICS AND LAYOUT

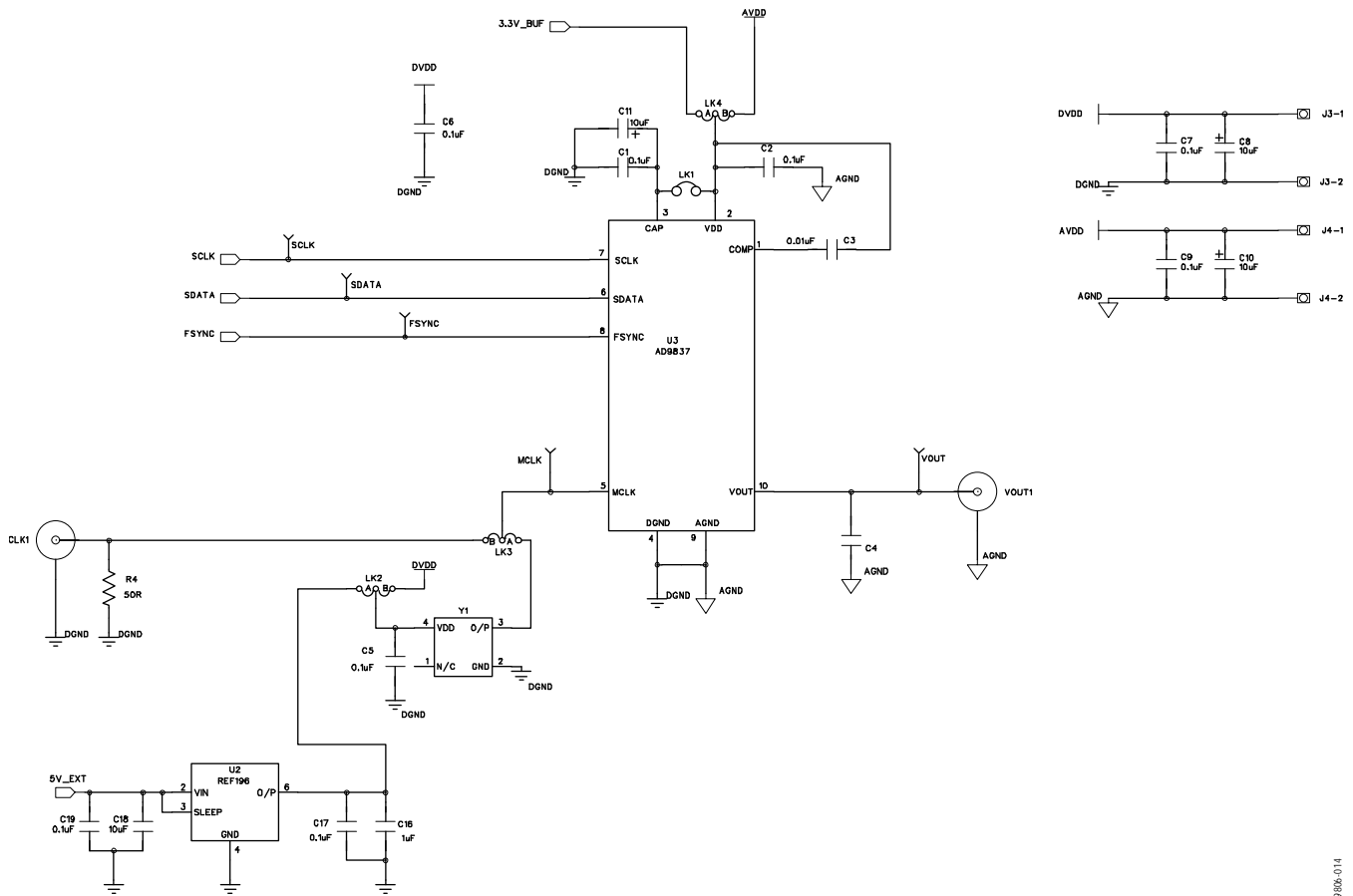


Figure 14. AD9837 Schematic Part A

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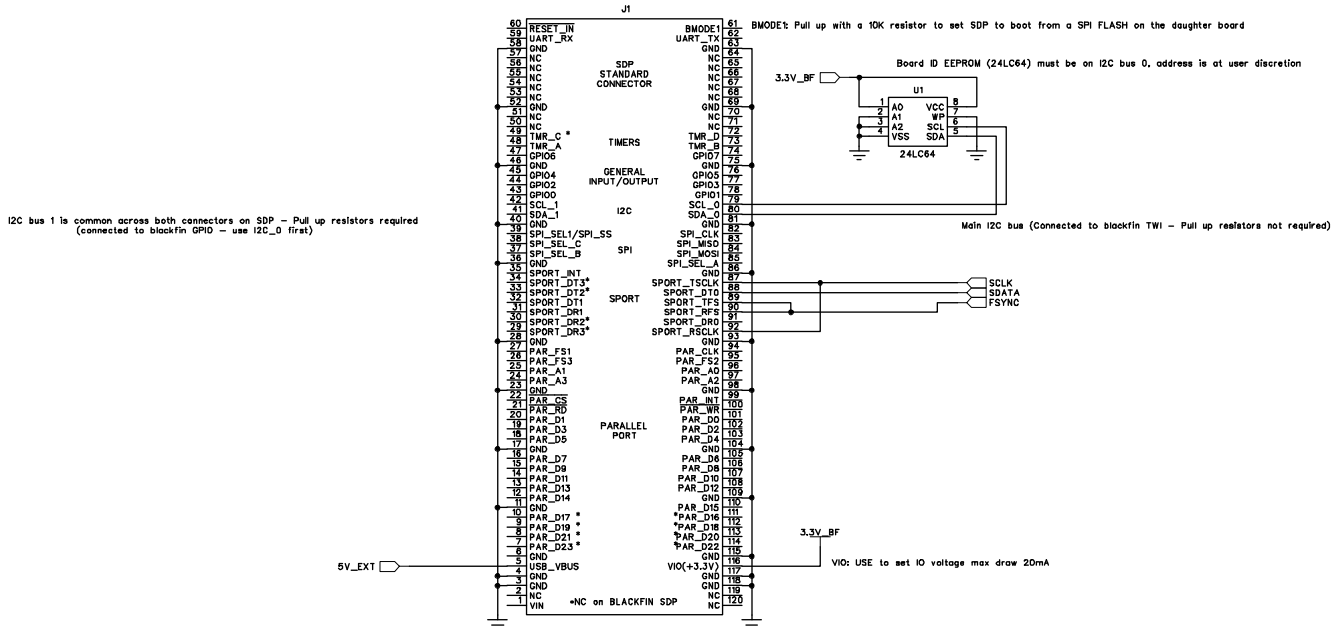
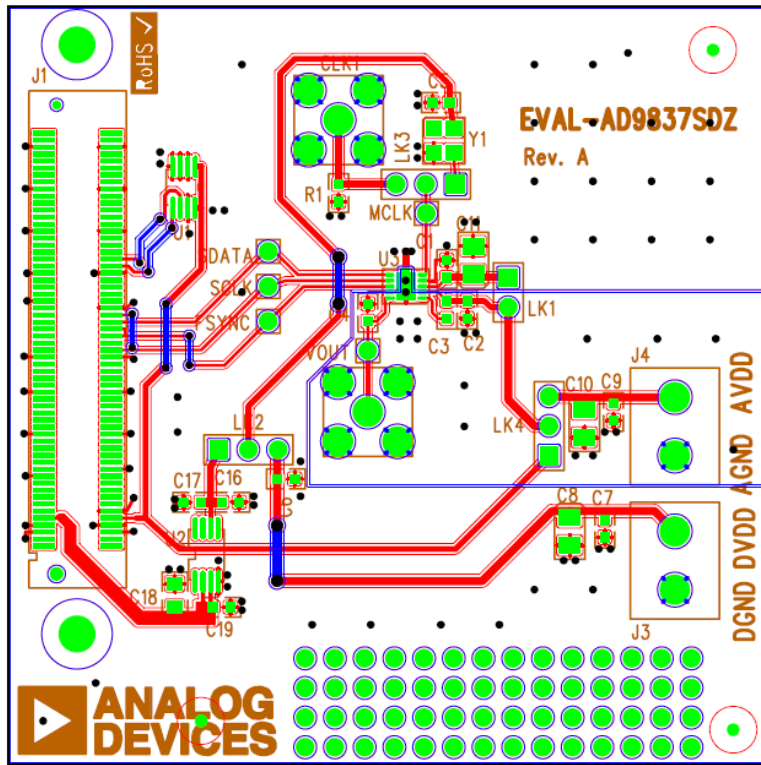


Figure 15. AD9837 Schematic Part B

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EVAL-AD9837SDZ (Rev. A) – Component Side View

Layer 1 – Component Side

Layer 2 – Solder Side

Silkscreen

Figure 16. Evaluation Board Layout

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ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part Number
C1, C2, C4 to C7, C9, C17, C19	0.1 μ F ceramic capacitor, 50 V, X7R, \pm 10%, 0603	Murata	GRM188R71H104KA93D
C3	0.01 μ F capacitor, 0603, 10 V, X5R, 10%	Kemet	C0603C103K5RACTU
C8, C10, C11	10 μ F, 10 V, SMD tantalum capacitor, \pm 10%, RTAJ_A	AVX	TAJA106K010R
C16	1 μ F capacitor, 10 V, Y5V, 0603, +80%, -20%	Yageo	CC0603ZRY5V6BB105
C18	10 μ F ceramic capacitor, 10 V, 10%, X5R, 0805	Murata	GRM21BR61A106KE19L
CLK1, VOUT1	Straight PCB mount SMB jack, 50 Ω	Tyco	1-1337482-0
FSYNC, MCLK, SCLK, SDATA	Red test point	Vero	20-313137
G1	Copper short, ground link, component link	Not applicable	Not applicable
J1	120-way connector, 0.6 mm pitch, receptacle	HRS (Hirose)	FX8-120S-SV(21)
J3, J4	2-pin terminal block (5 mm pitch)	Campden	CTB5000/2
LK1	2-pin SIL header and shorting link	Harwin	M20-9990246
LK2, LK3, LK4	3-pin SIL header and shorting link	Harwin	M20-9990345 and M7567-05
R1, R2	100 k Ω SMD resistor, 0603, 1%	Multicomp	MC 0.063W 0603 1% 100K
R3 ¹	SMD resistor, 0603, 1%	Multicomp	MC 0.063W 0603 0R
R4	50 Ω SMD resistor, 0603, 1%	Multicomp	MC 0.063W 0603 1% 50r
U1	32K I ² C serial EEPROM, MSOP-8	Microchip	24LC32A-I/MS
U2	Precision micropower, low dropout, low voltage references, 8-lead TSSOP	Analog Devices	REF196GRUZ
U3	Low power, 8.5 mW, 2.3 V to 5.5 V, programmable waveform generator, 10-lead LFCSP	Analog Devices	AD9837BCPZ
VOUT	Red test point	Vero	20-313137
X1, X2	3 mm NPTH hole	Not applicable	MTHOLE-3mm
Y1	16 MHz, 3 mm \times 2 mm SMD clock oscillator	Epson	SG-310 Series

¹ Do not install.

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.

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