

Evaluating the **AD9832** 45 mW Power, 3 V to 5.0 V, 25 MHz Programmable Waveform Generator

FEATURES

- Full featured evaluation board for the **AD9832** evaluation board
- Graphic user interface software for board control and data analysis
- Connector to the **EVAL-SDP-CB1Z** system demonstration platform (SDP) board
- Various power supply and reference link options

APPLICATIONS

- DDS tuning
- Digital demodulation

GENERAL DESCRIPTION

The **AD9832** is a numerically controlled oscillator employing a phase accumulator, a sine lookup table, and a 10-bit digital-to-analog converter integrated on a single CMOS chip. Modulation capabilities are provided for phase modulation and frequency modulation.

The **EVAL-AD9832SDZ** board is used in conjunction with the **EVAL-SDP-CB1Z** board available from Analog Devices, Inc. The USB-to-SPI communication to the **AD9832** is completed using this Blackfin®-based development board.

A high performance, on-board 25 MHz trimmed general oscillator is available to use as the master clock for the **AD9832** system. Various links and SMB connectors are also available on the **EVAL-AD9832SDZ** board to maximize the usability.

Complete specifications for the **AD9832** are provided in the **AD9832** data sheet, available from Analog Devices, and should be consulted in conjunction with this user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

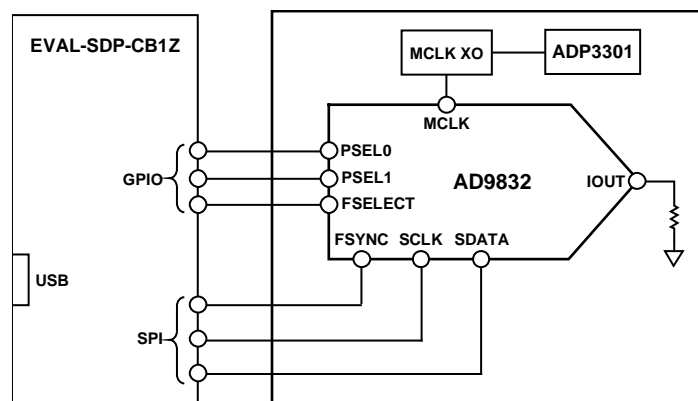


Figure 1.

10153-001

TABLE OF CONTENTS

Features	1	Select External MCLK Frequency.....	5
Applications.....	1	Select Frequency and Phase Registers	6
General Description	1	Loading Frequency and Phase Registers.....	6
Functional Block Diagram	1	Power Options	6
Revision History	2	Initialize, Reset, SYNC, Clear, and Sweep.....	6
Evaluation Board Software	3	Example of Operation.....	7
Installing the Software	3	Evaluation Board Schematics and Layout.....	8
Running the Software	4	Ordering Information.....	11
Setting Up the Digital Interface.....	5	Bill of Materials.....	11

REVISION HISTORY

11/11—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

The [EVAL-AD9832SDZ](#) 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-AD9832SDZ](#) evaluation kit CD.
3. Download the [EVAL-AD9832SDZ](#) LabVIEW™ software. The correct driver for the SDP board, SDPDriversNET, should download automatically after LabVIEW is downloaded,
4. After installation of the software and drivers is complete, plug the [EVAL-AD9832SDZ](#) into the SDP board and the SDP board into the PC using the USB cable included in the kit.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation (for example, **Found New Hardware Wizard** and **Install the Software Automatically**).

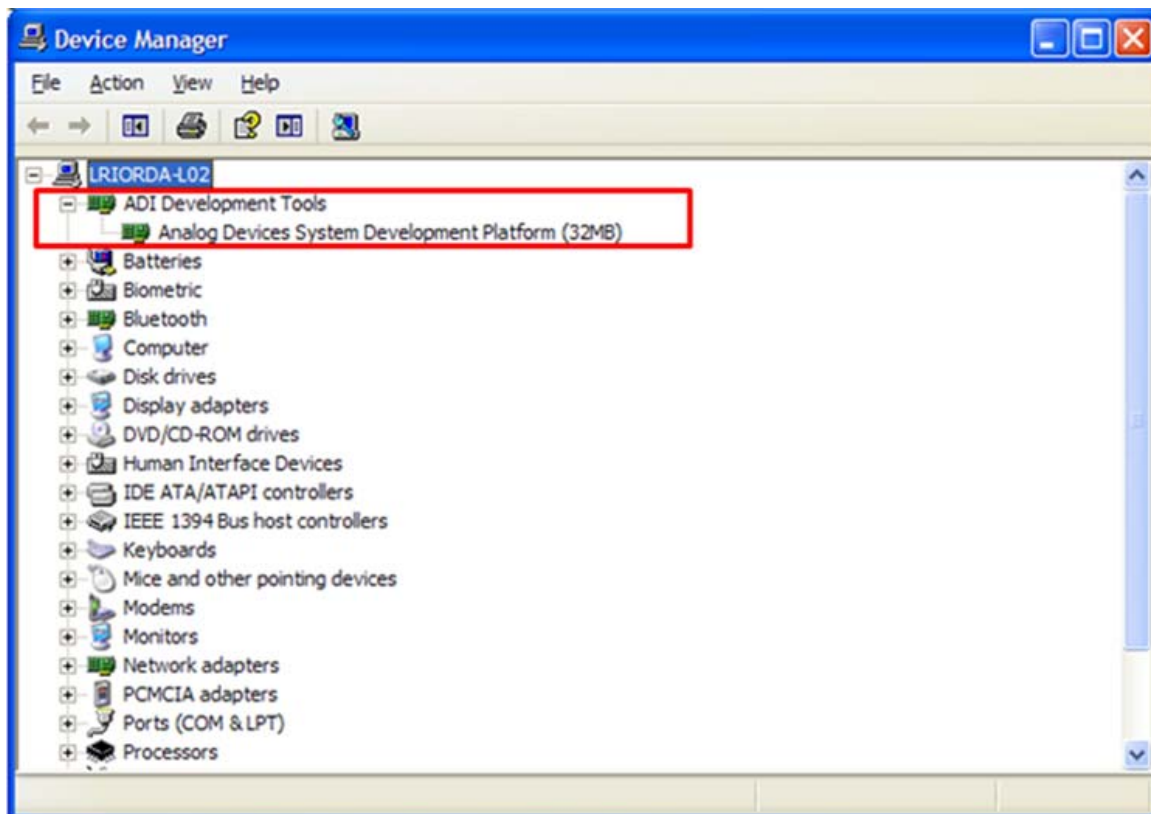


Figure 2. Hardware Device Manager Window with SDP Board Plugged In

RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/AD9832/AD9832 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 [AD9832](#) evaluation software then opens, as shown in Figure 4.

Table 1. Default Setup for Link Positions

Link No.	Position	Function
LK1	Connected	REFOUT is used as the reference to the DAC by connecting REFOUT to REFIN
LK3	B	3.3 V digital supply for the AD9832 supplied from the EVAL-SDP-CB1Z board.
LK5	B	3.3 V analog supply for the AD9832 supplied from the EVAL-SDP-CB1Z board.
LK6	A	On-board linear regulator selected to supply power to the general oscillator.

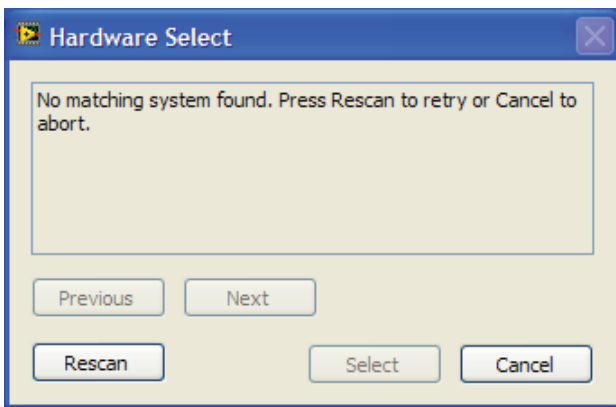


Figure 3. Pop-Up Window Error

10155-003

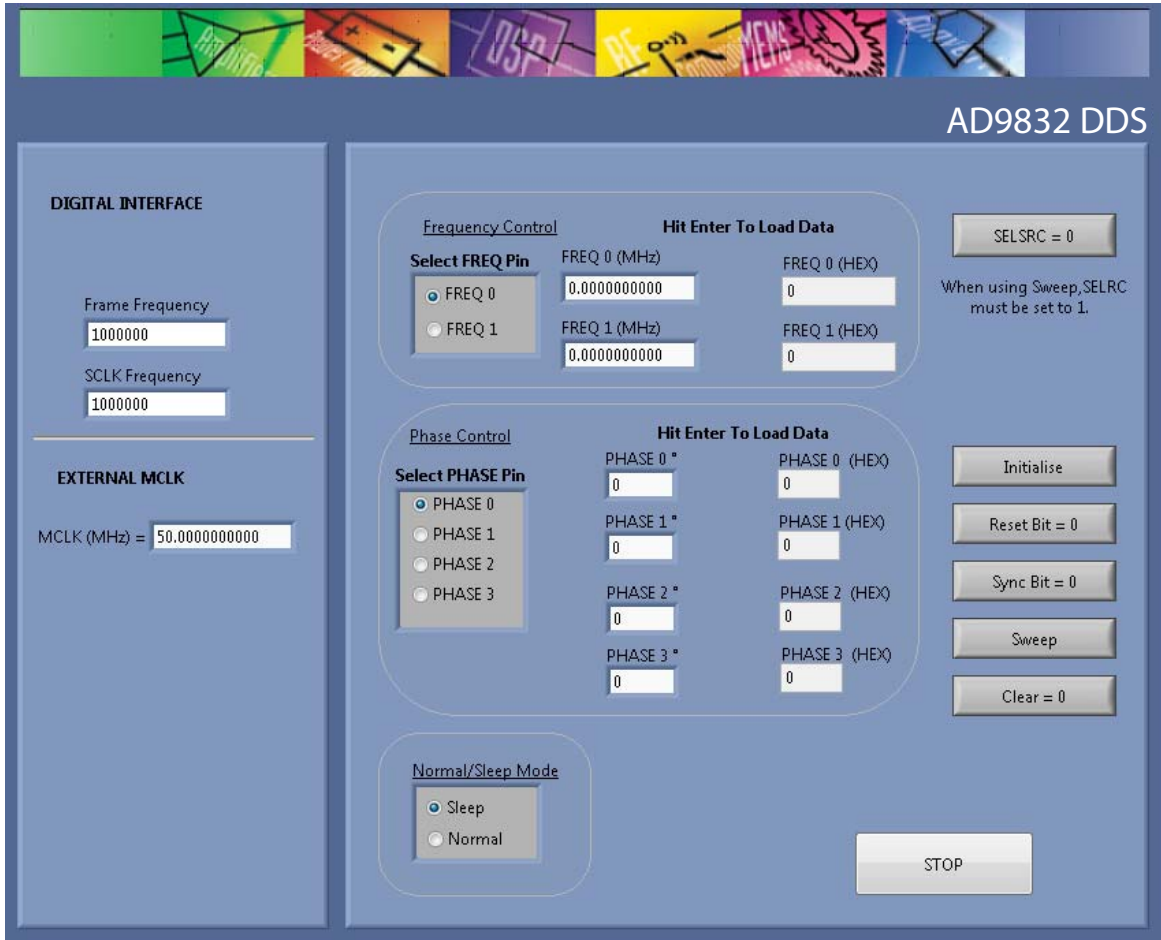


Figure 4. AD9832 Evaluation Board Software

SETTING UP THE DIGITAL INTERFACE

The first step in setting up the AD9832 to take measurements is to set the DIGITAL INTERFACE in the software window (see Figure 4).

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 as shown in Figure 5.

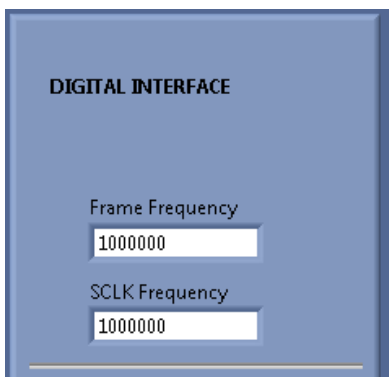


Figure 5. Digital Interface

SELECT EXTERNAL MCLK FREQUENCY

Having selected the digital interface specifics, next use the EXTERNAL MCLK box to select the frequency to use. The boards are supplied with a 25 MHz general oscillator. If a different clock source is required, the CLK SMB connector can be used to supply a different MCLK value.

The general oscillator includes the AEL301 oscillators from AEL Crystals.

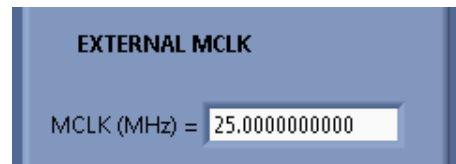


Figure 6. EXTERNAL MCLK Input

SELECT FREQUENCY AND PHASE REGISTERS

Frequency and phase registers can be selected using either software or hardware. Figure 7 shows how to select the source of control for the registers. To control the frequency and phase registers using the hardware pins, use **SELSRC = 0**. To control the frequency and phase registers using the software bits, use **SELSRC = 1**.



Figure 7. Selection method

LOADING FREQUENCY AND PHASE REGISTERS

The desired output frequency and output phase can be loaded using the inputs shown in Figure 8. Either the **FREQ0** register or the **FREQ1** register can be loaded with frequency data. The frequency data is loaded in megahertz, and the equivalent hexadecimal code is shown to the right after data is entered. After data is loaded, the output appears on the **IOUT** pin. Similarly, the **PHASE0** register, the **PHASE1** register, the **PHASE2** register, or the **PHASE3** register can be selected, and the phase data is loaded in degrees.

The analog output frequency from the **AD9832** is defined by

$$f_{CLK}/2^{32} \times \text{FREQ}$$

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

$$2\pi/4096 \times \text{PHASE}x$$

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

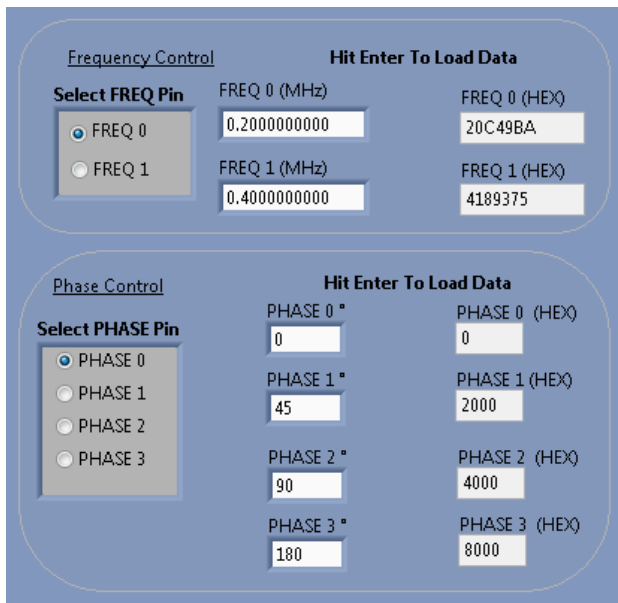


Figure 8. Frequency and Phase Load

POWER OPTIONS

When **Sleep** is selected, the sleep bit is set to 1. When this bit equals 1, the **AD9832** is powered down, internal clocks are disabled, and the current sources and **REFOUT** of the DAC are turned off.

When **Normal** is selected, the sleep bit is set to 0 and the **AD9832** is powered up.

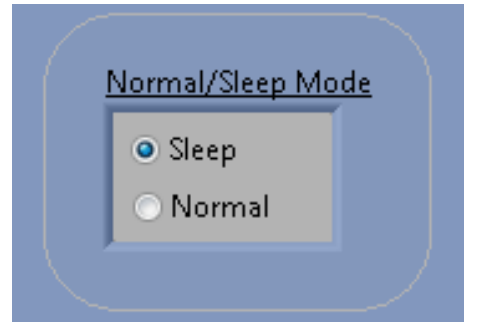


Figure 9. Power Options

INITIALIZE, RESET, SYNC, CLEAR, AND SWEEP

The initialize, reset, SYNC, and clear commands are set using the buttons shown in Figure 10. To set up a DDS sweep, click **Sweep**.

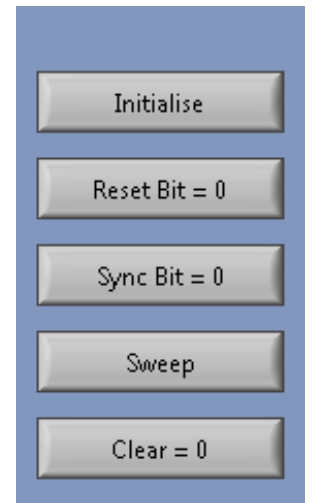


Figure 10. Commands

Initialise sets the frequency registers and the phase registers to the values chosen by users. It also sets SELSRC to 0. It is used in three different cases: when starting the program, after using reset and after switching from sleep to normal.

When the reset bit = 1, the phase accumulator is set to zero phase, which corresponds to an analog output of midscale. Setting reset to 1 sets the FSELECT, PSEL0, and PSEL1 pins to 0.

Selection of the frequency/phase registers using the FSELECT and PSELx pins is synchronized with the MCLK rising edge when SYNC = 1. When SYNC = 0, the loading of the data and the sampling of FSELECT and PSELx occurs asynchronously.

When CLR = 1, SYNC and SELSRC are set to zero so that the pins are the default source. CLR resets to zero automatically.

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. When using the sweep function, SELSRC must be set to 1.

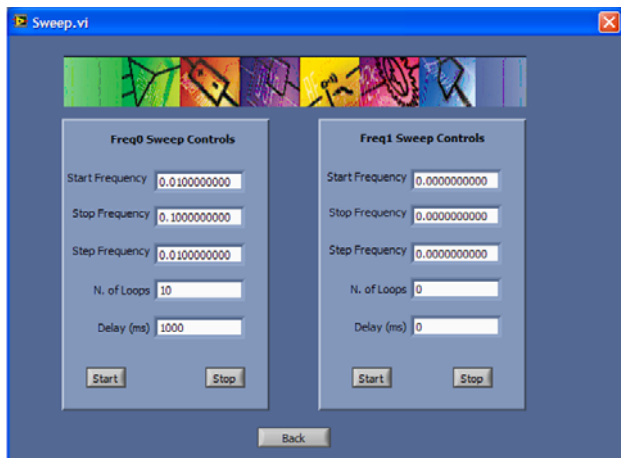


Figure 11. Sweep Functionality

EXAMPLE OF OPERATION

An example of configuring the AD9832 to output 1 MHz follows:

1. Plug the [EVAL-SDP-CB1Z](#) board into the [EVAL-AD9832SDZ](#) board and connect to the USB port.
2. Start up the software located at **Start/All Programs/Analog Devices/AD9832/AD9832 Eval Board**. Users should see the SDP board communicating with the PC.
3. Define MCLK; the default is an on-board 25 MHz oscillator.
4. Ensure that all links are in the correct locations (see Table 1).
5. Select the **FREQ1** register.
6. Load a 1 MHz excitation frequency and press the **ENTER** key.

The output should appear on the IOOUT output on the evaluation board.

For the **FREQ0** register,

1. Select the **FREQ0** register, and load the **FREQ0** register with 2 MHz.
2. Press the **ENTER** key.

For the **FREQ1** register,

1. Select the **FREQ1** register to load the 1 MHz associated with this register.
2. Press the **ENTER** key.

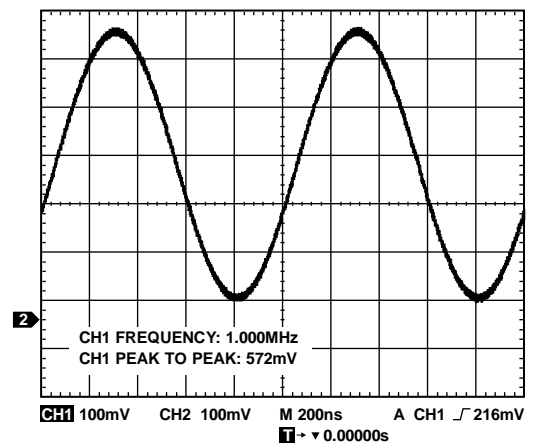


Figure 12. 1 MHz Output Signal on the IOOUT Test Point

EVALUATION BOARD SCHEMATICS AND LAYOUT

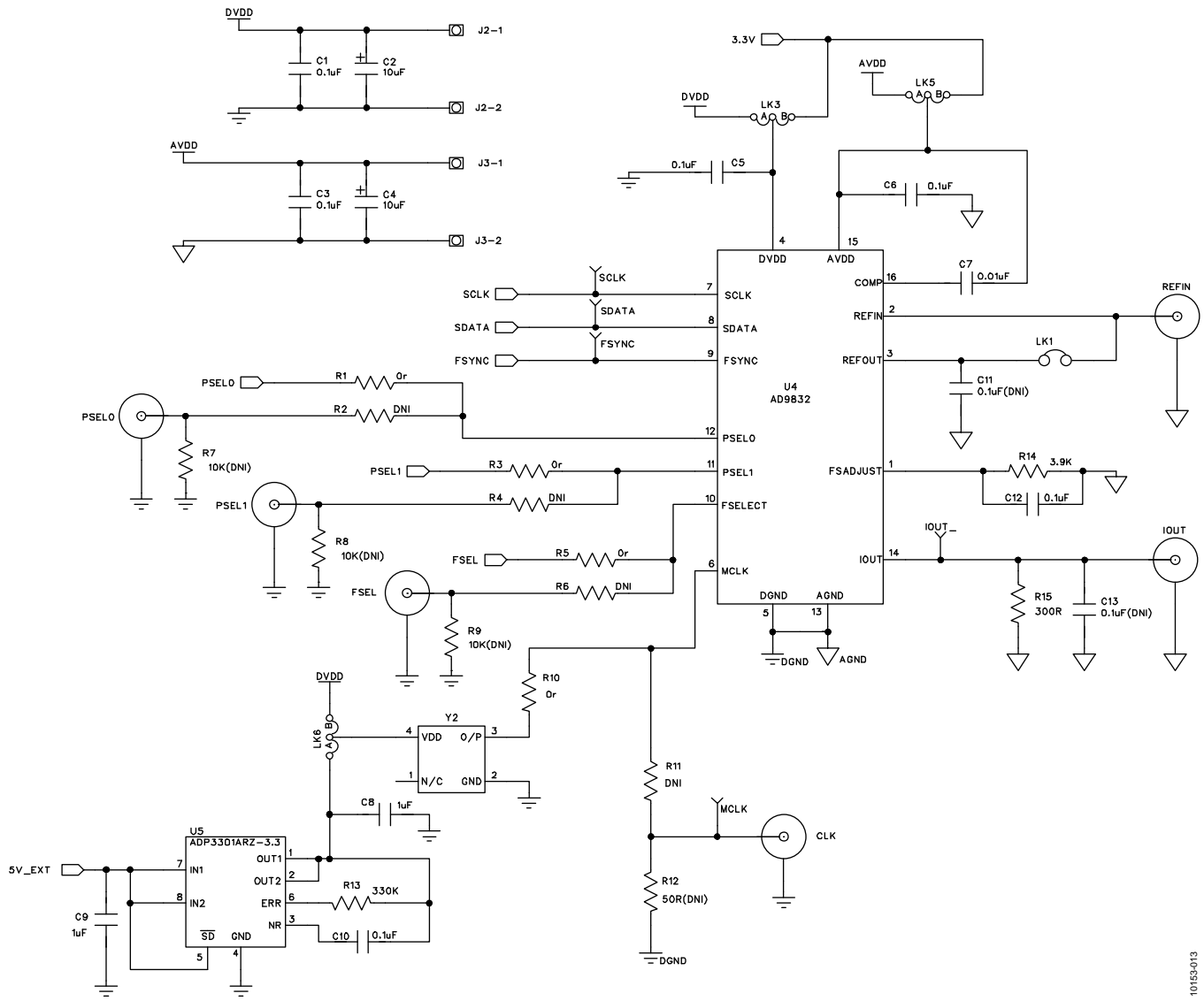


Figure 13. AD9832 Schematic Part A

10153-013

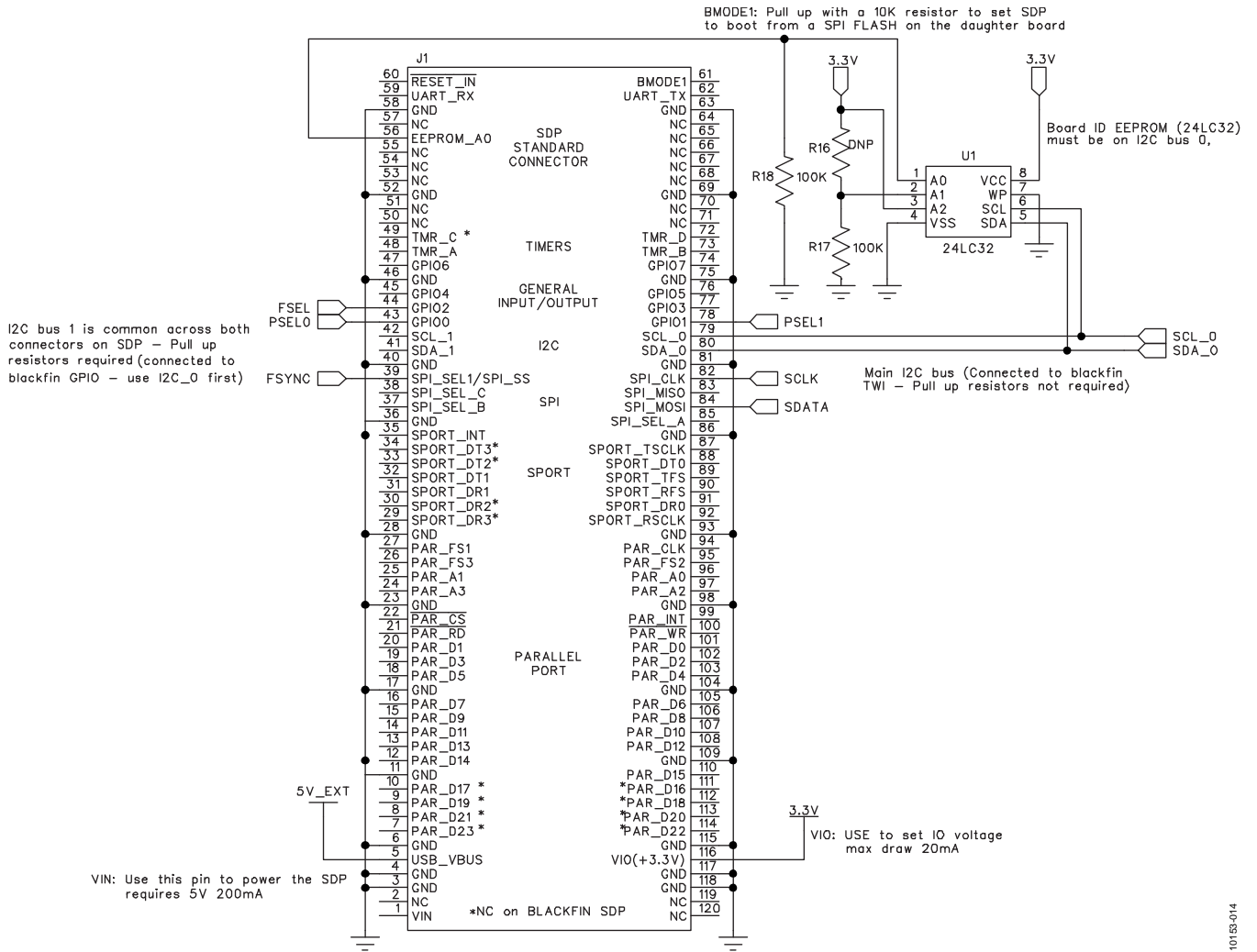


Figure 14. AD9832 Schematic Part B

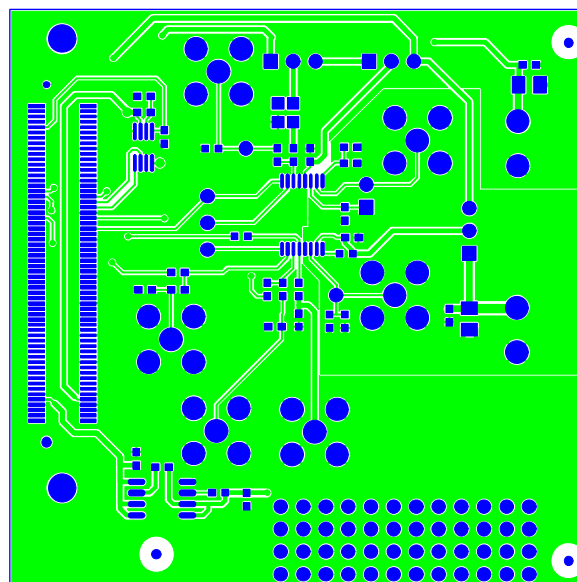


Figure 15. Component Side View Layer 1

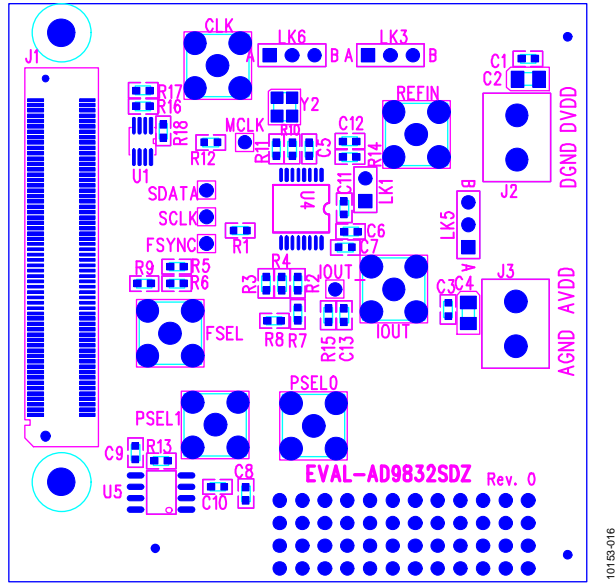


Figure 16. Component Side View Silkscreen

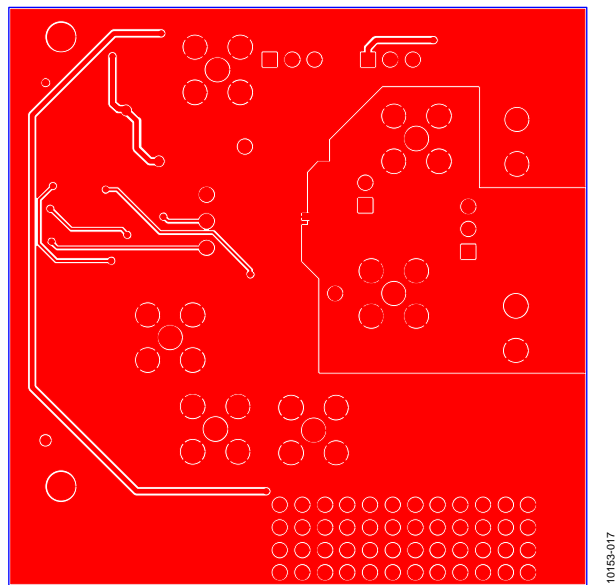


Figure 17. Component Side View Layer 2, Solder Side

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part Number
C1, C3, C5, C6, C11, C12, C13	0.1 μ F, \pm 10%, 50 V, X7R, ceramic capacitor	Murata	GRM188R71H104KA93D
C7	0.01 μ F, \pm 10%, 10 V, 0603, X5R, capacitor	Kemet	C0603C103K5RACTU
C2, C4	10 μ F, \pm 10%, 10 V, SMD tantalum capacitor	AVX	TAJA106K010R
C8,C9	1 μ F, \pm 10%, 10 V, Y5V, 0603, ceramic capacitor	Yageo	CC0603ZRY5V6BB105
C10	0.1 μ F, \pm 10%, 16 V, X7R, 0603, capacitor	Multicomp	B0603R104KCT
CLK ¹ , FSEL ¹ , IOUT, PSEL1 ¹ , REFIN, PSEL0 ¹	Straight PCB mount SMB jack, 50 Ω	Tyco	1-1337482-0
FSYNC, IOUT, MCLK, SCLK, SDATA	Red test point	Vero	20-313137
G2	Copper short	Not applicable	Not applicable
J1	120-way connector, 0.6 mm pitch receptacle	HRS (Hirose)	FX8-120S-SV(21)
J2, J3	2-pin terminal block (5 mm pitch)	Campden	CTB5000/2
LK3, LK5, LK6	3-pin SIL header and shorting link	Harwin	M20-9990345 and M7567-05
LK1	2-pin SIL header and shorting link	Harwin	M20-9990246
R7 ¹ , R8 ¹ , R9 ¹	10 k Ω , \pm 1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 10K
R12 ¹	50 Ω , \pm 1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 50r
R14	3.9 k Ω , \pm 1%, SMD resistor	Multicomp	MC 0.063W 0603 6K8
R15	300 Ω , \pm 1%, SMD resistor	Multicomp	MC 0.063W 0603 200r
R17,R18	100 k Ω , \pm 1%, SMD resistor	Multicomp	MC 0.063W 0603 1% 100K
R1, R2 ¹ , R3, R4 ¹ , R6 ¹ , R5, R11 ¹ , R10,R16 ²	0 Ω , \pm 1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 Or
R13	330 k Ω , \pm 5%, SMD resistor	Multicomp	MC 0.063W 0603 330KR
U4	45 mW power, 3 V to 5.5 V, 25 MHz complete DDS	Analog Devices	AD9832BRUZ
U1	32k I ² C serial EEPROM 8-lead MSOP	Micro Chip	24LC32A-I/MS
U5	3.3 V linear regulator	Analog Devices	ADP3301ARZ-3.3
Y2	50 MHz, 3 mm \times 2 mm SMD clock oscillator	AEL Crystals	AEL301series

¹ Do not install.² DNP

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.