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Evaluating the AD9835 200 mW Power, 5 V,50 MHz CMOS Complete DDS

FEATURES

Full featured evaluation board for the AD9835 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 AD9835 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-AD9835SDZ board is used in conjunction with a EVAL-SDP-CB1Z board available from Analog Devices, Inc. The USB-to-SPI communication to the AD9835 is completed using this Blackfin®-based development board.

A high performance, on-board 50 MHz trimmed general oscillator is available to use as the master clock for the AD9835 system. Various links and SMB connectors are also available on the EVAL-AD9835SDZ board to maximize the usability.

Complete specifications for the AD9835 are provided in the AD9835 data sheet, available from Analog Devices, and should be consulted in conjunction with this user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

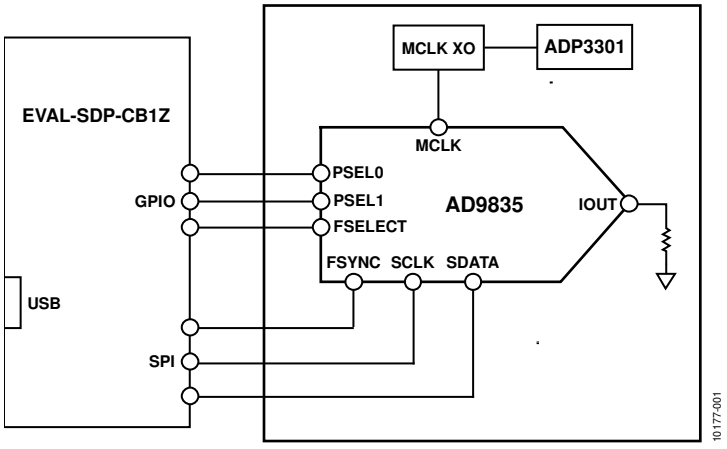

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

9/11—Rev. A to Rev. B

Document Title Changed from EVAL-AD9835EB to UG-319 ..... Universal
Updated Format ..... Universal
Changes to Features Section 1
Replaced Figure 1 1
Deleted Introduction Section and Operating the AD9835 Evaluation Board Section 1
Added Applications Section and General Description Section . 1
Deleted Link and Switch Options Section and Set-Up Conditions Section 2
Deleted Evaluation Board Interfacing Section, Sockets Section, Connectors Section, and Switches Section 3
Replaced Software Description Section with Evaluation Board Software Section 3
Replaced Figure 2 3
Deleted Table 2, Table 3, and Table 4; Renumbered Sequentially 3
Added Figure 3; Renumbered Sequentially 4
Changes to Table 1 4
Changes to Figure 4 5
Added Figure 5 and Figure 6 5
Added Figure 7 to Figure 10 6
Added Figure 11 and Figure 12 7
Added Evaluation Board Schematics and Layout Section 8
Changes to Figure 13 8
Added Figure 14 9
Changes to Figure 15 9
Changes to Figure 16 and Figure 17 10
Added Ordering Information Section 11
Changes to Table 2 11

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

The EVAL-AD9835SDZ 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-AD9835SDZ evaluation kit CD.
3. Download the EVAL-AD9835SDZ LabVIEW™ software. The correct driver for the SDP board, SDPDriversNET, should download automatically after LabVIEW is downloaded, supporting both 32-bit 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 SDPDriverNet Version 1.3.6.0.
4. After installation of the software and drivers is complete, plug the EVAL-AD9835SDZ 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**).

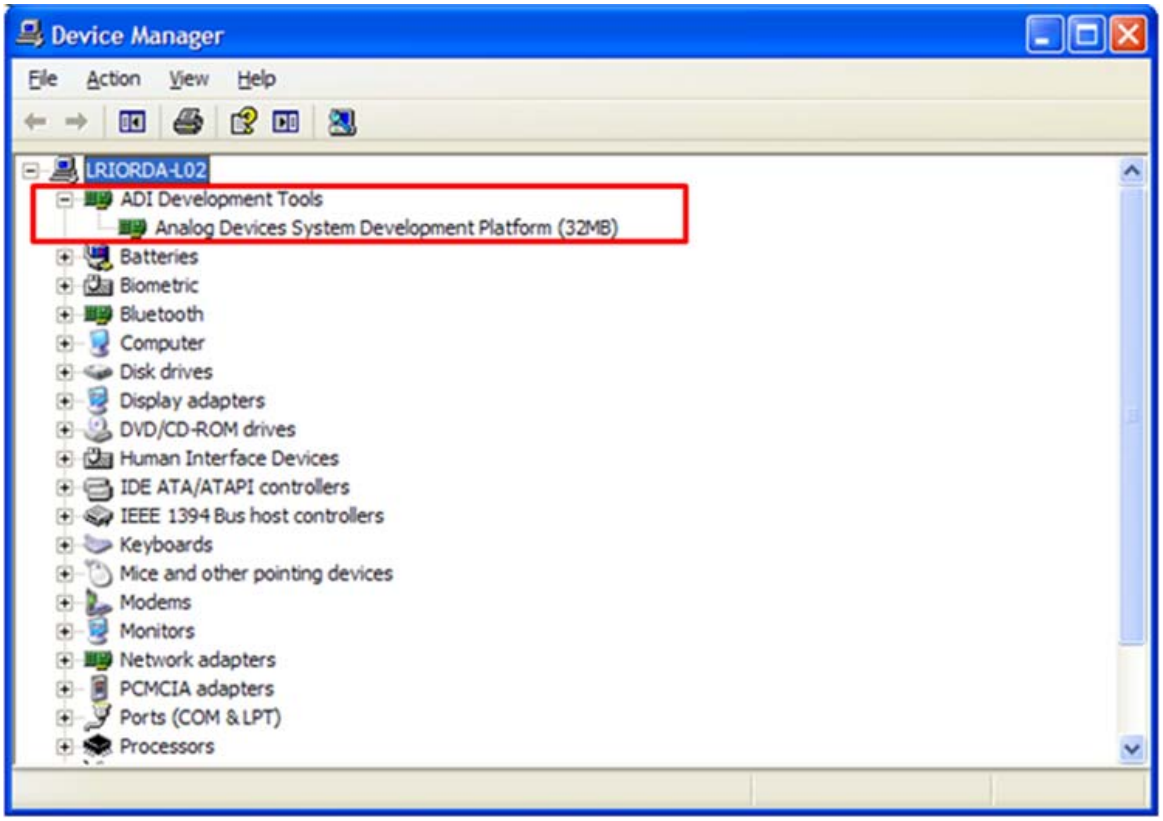

Figure 2. Hardware Device Manager Window with SDP Board Plugged In

RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/AD9835/ AD9835 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 AD9835 evaluation software then opens, as shown in Figure 4.

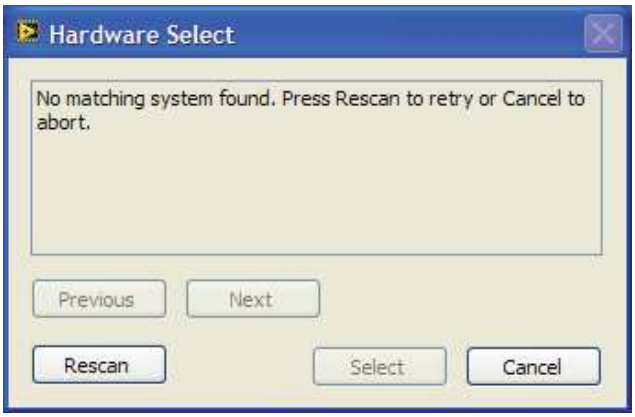

Figure 3. Pop-Up Window Error

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 AD9835 supplied from the EVAL-SDP-CB1Z board.
LK5	B	3.3 V analog supply for the AD9835 supplied from the EVAL-SDP-CB1Z board.
LK6	A	On-board linear regulator selected to supply power to the general oscillator.

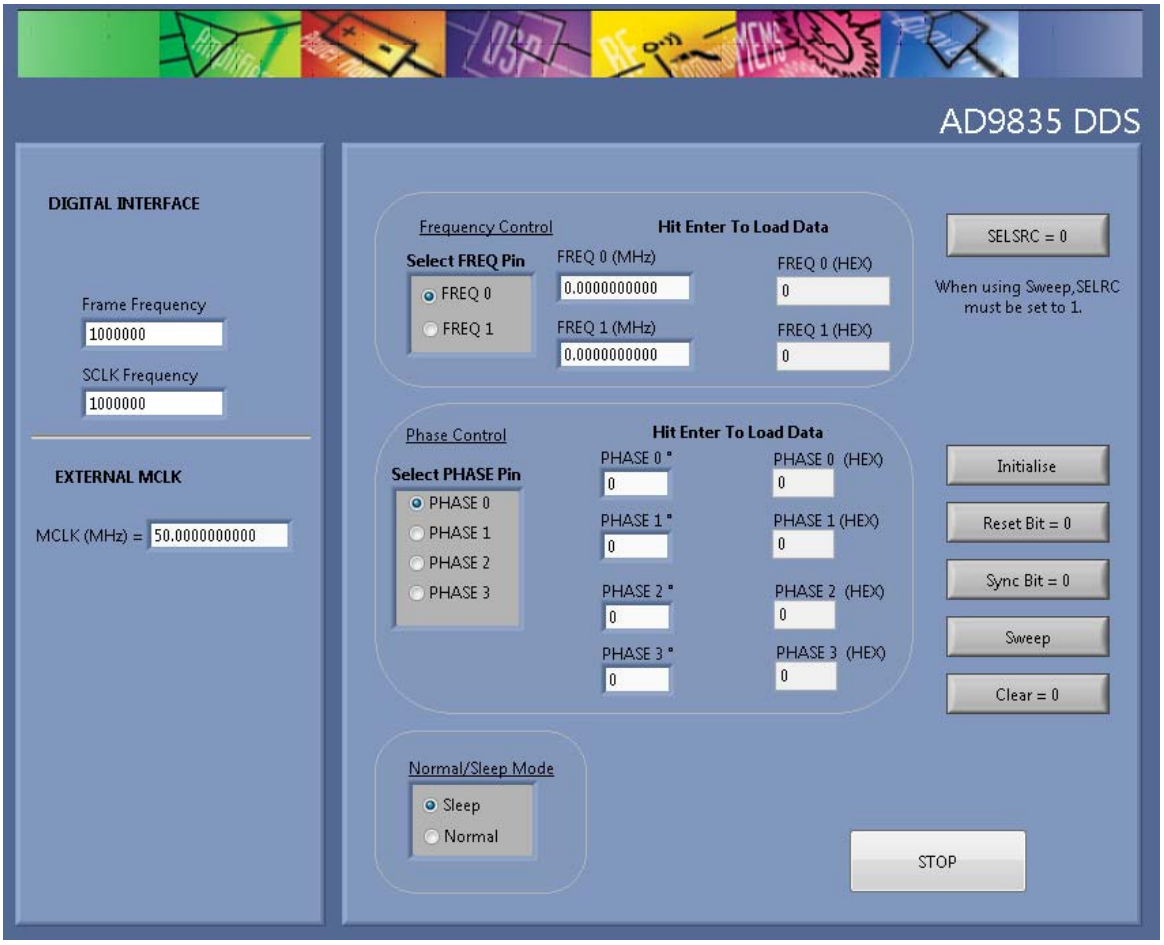

Figure 4. AD9835 Evaluation Board Software

SETTING UP THE DIGITAL INTERFACE

The first step in setting up the AD9835 to take measurements is to set the **DIGITAL INTERFACE** in the software window (see Figure 4).

The SPI **Frame Frequency** ($\overline{\text{SYNC}}$) 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.

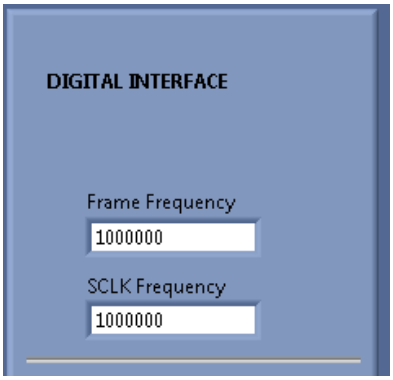

Figure 5. Digital Interface

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 50 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.

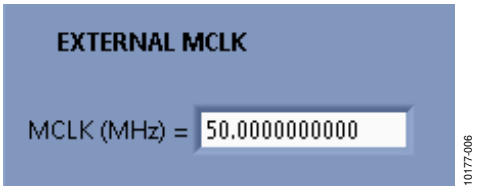

Figure 6. EXTERNAL MCLK Input

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.**

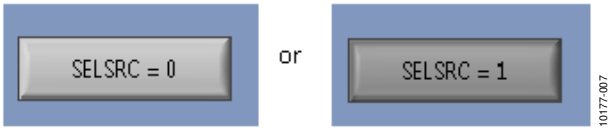

Figure 7. Selection Method

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 AD9835 is defined by

$$f_{MCLK}/2^{32} \times FREQ$$

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

$$2\pi/4096 \times PHASEx$$

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

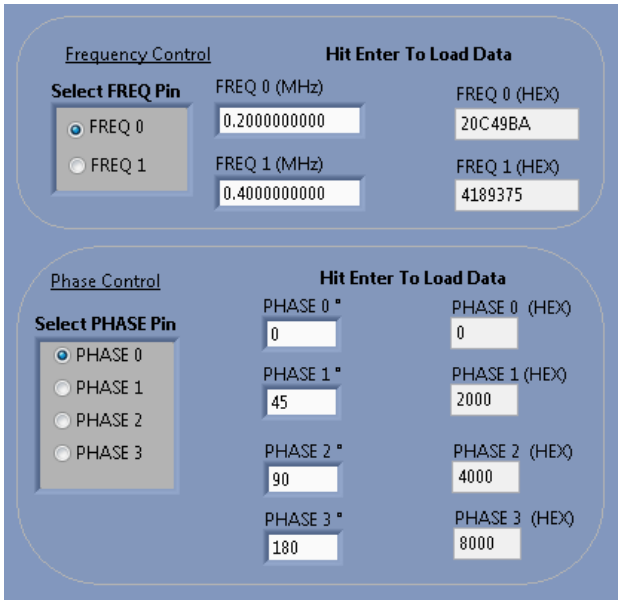

Figure 8. Frequency and Phase Load

POWER OPTIONS

When **Sleep** is selected, the sleep bit is set to1. When this bit equals 1, the AD9835 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 AD9835 is powered up.

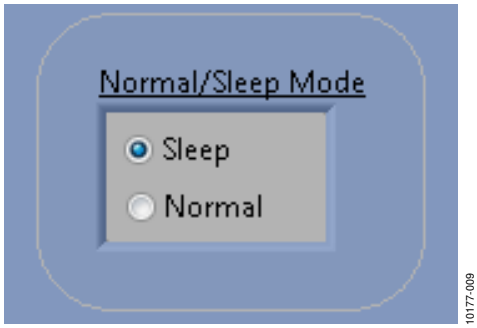

Figure 9. Power Options

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**.

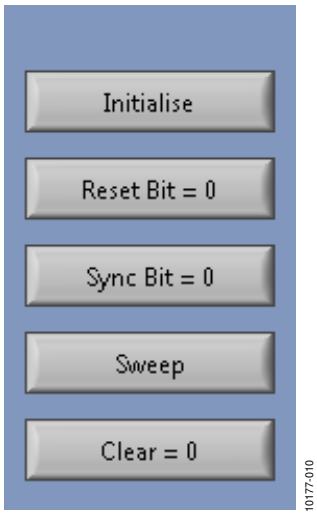

Figure 10. Commands

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.

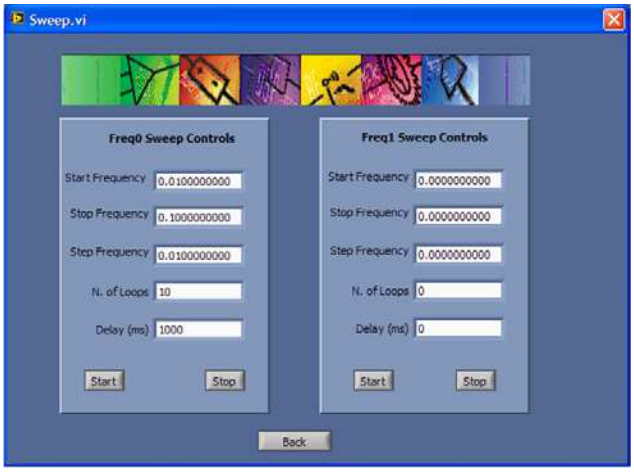

Figure 11. Sweep Functionality

EXAMPLE OF OPERATION

An example of configuring the AD9835 to output 1 MHz follows:

1. Plug the EVAL-SDP-CB1Z board into the EVAL-AD9835SDZ board and connect to the USB port.
2. Start up the software located at **Start/All Programs/Analog Devices/AD9835/AD9835 Eval Board**. Users should see the SDP board communicating with the PC.
3. Define MCLK; the default is an on-board 50 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 IOUT 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.

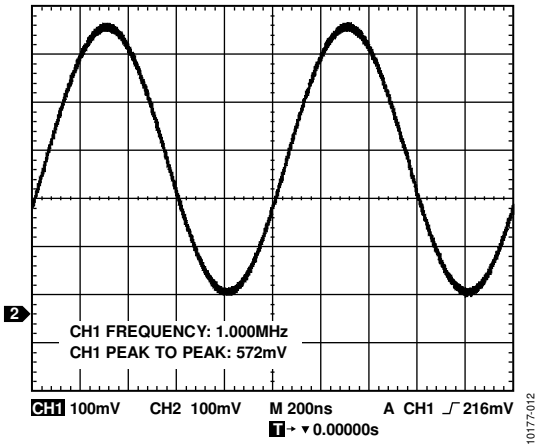

Figure 12. 1 MHz Output Signal on the IOUT Test Point

EVALUATION BOARD SCHEMATICS AND LAYOUT

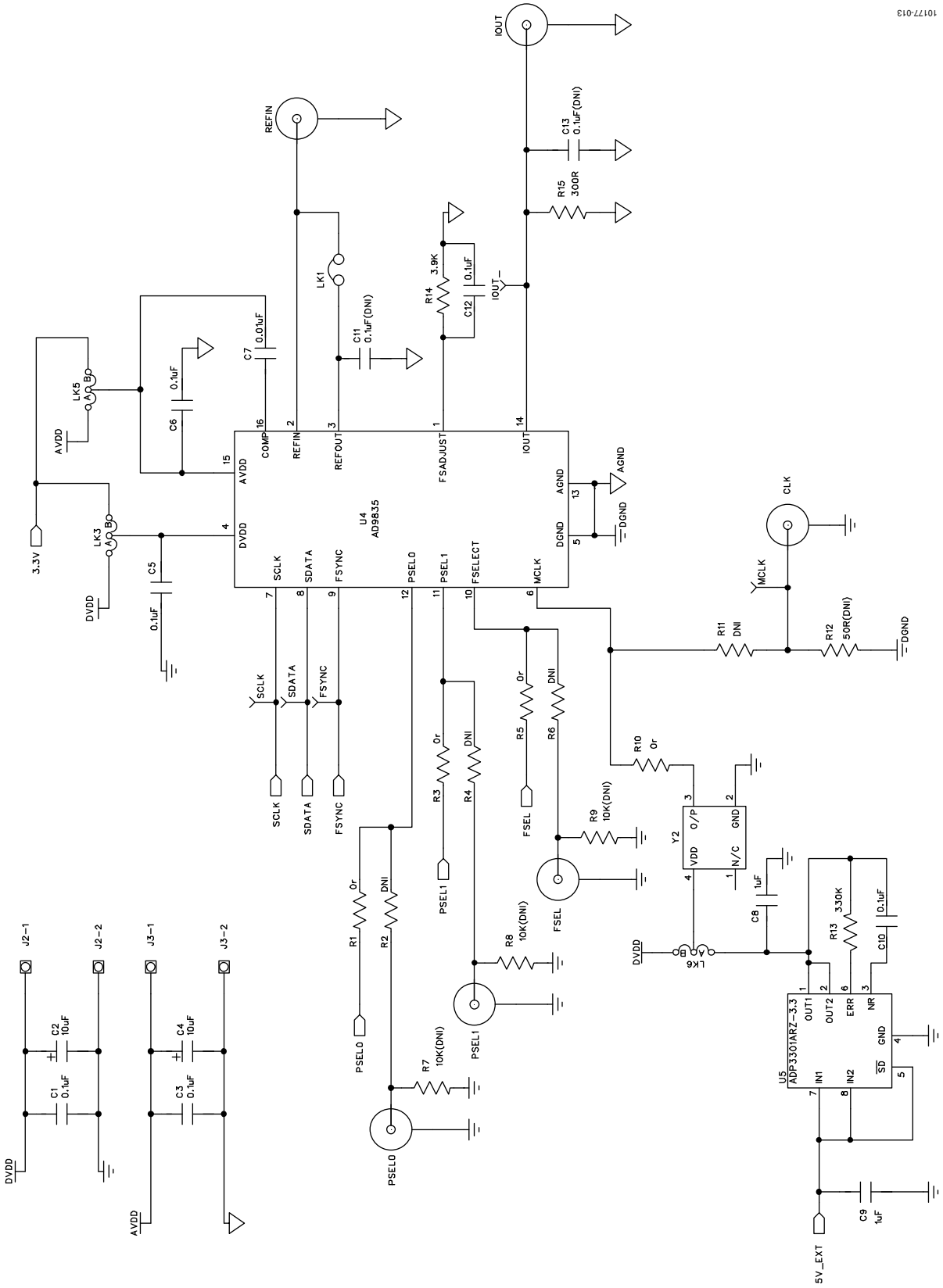

Figure 13. AD9835 Schematic Part A

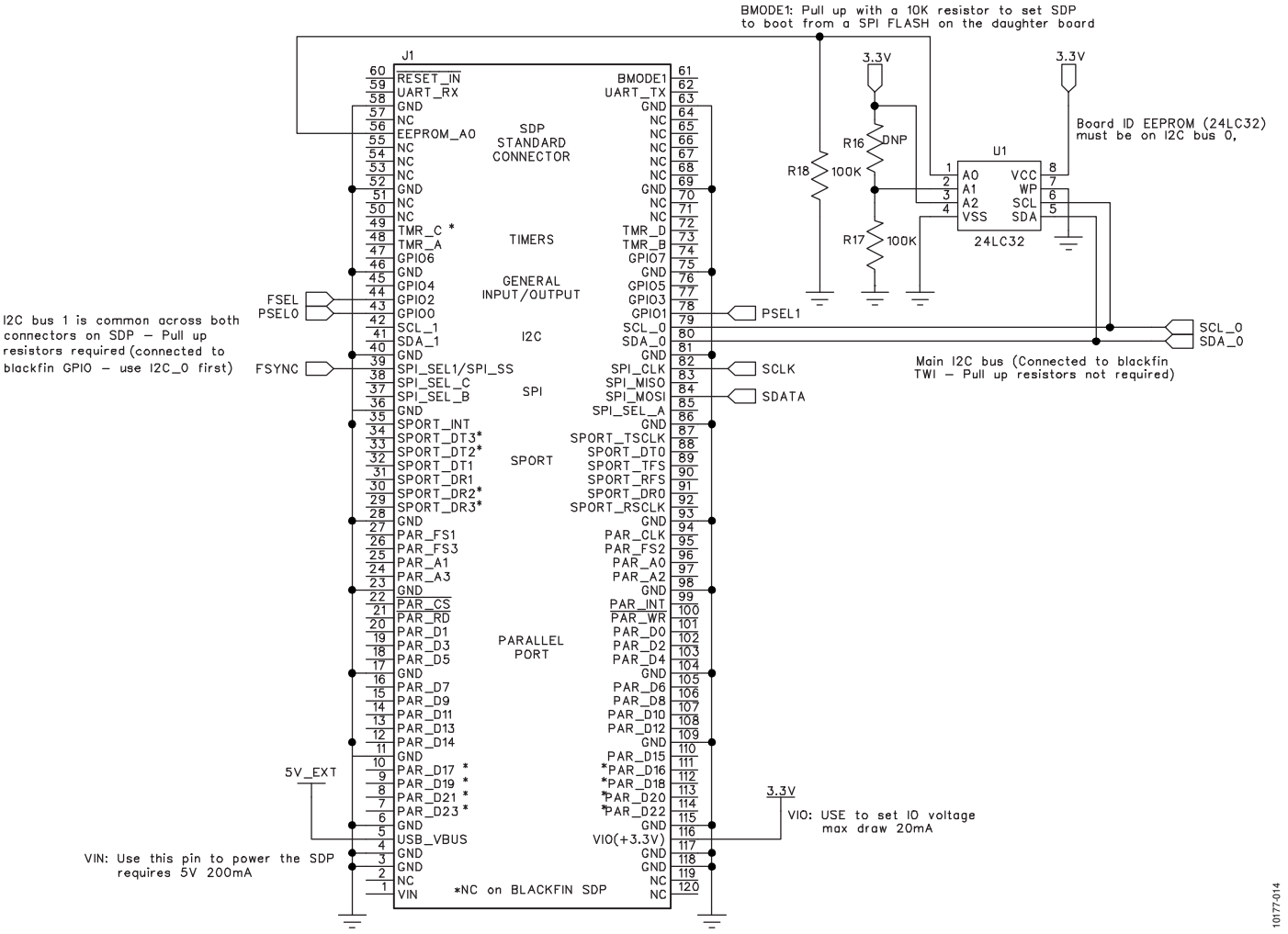

Figure 14. AD9835 Schematic Part B

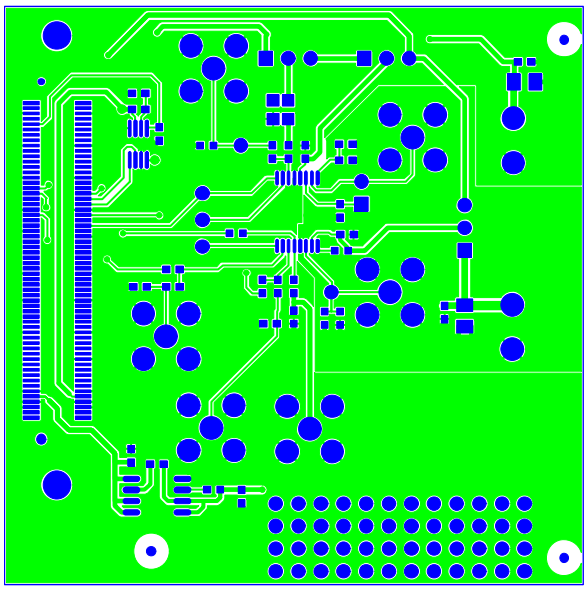

Figure 15. Component Side View Layer 1

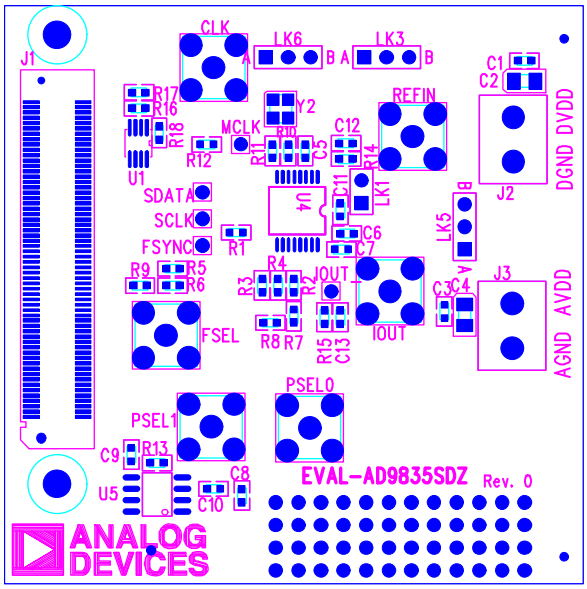

Figure 16. Component Side View Silkscreen

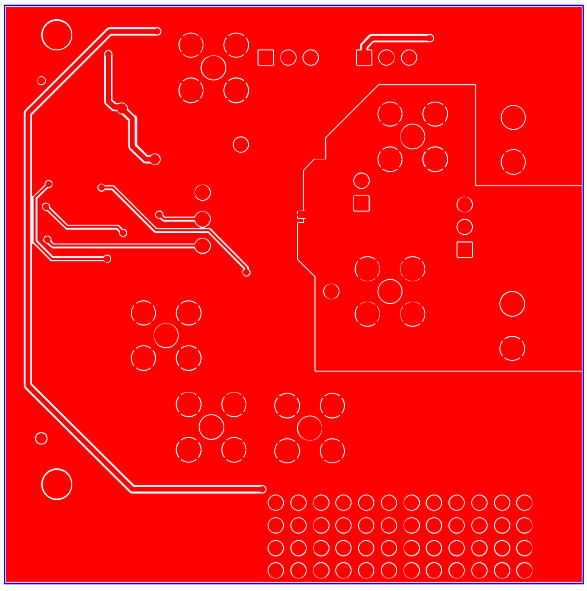

Figure 17. Component Side View Layer 2, Solder Side

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part Number
C1, C3, C5, C6, C11[1], C12, C13[1]	0.1 µF, ±10%, 50 V, X7R, ceramic capacitor	Murata	GRM188R71H104KA93D
C7	0.01 µF, ±10%, 10 V, 0603, X5R, capacitor	Kemet	C0603C103K5RACTU
C2, C4	10 µF, ±10%,10 V, SMD tantalum capacitor	AVX	TAJA106K010R
C8,C9	1 µF, ±10%,10 V,Y5V, 0603, ceramic capacitor	Yageo	CC0603ZRY5V6BB105
C10	0.1 µF, ±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 kΩ, ±1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 10K
R12[1]	50 Ω, ±1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 50r
R14	3.9 kΩ, ±1%, SMD resistor	Multicomp	MC 0.063W 0603 6K8
R15	300 Ω, ±1%, SMD resistor	Multicomp	MC 0.063W 0603 200r
R17, R18	100 kΩ, ±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, ±1%, 0603, SMD resistor	Multicomp	MC 0.063W 0603 0r
R13	330 kΩ, ±5%, SMD resistor	Multicomp	MC 0.063W 0603 330KR
U4	200 mW power 5 V, 50 MHz complete DDS	Analog Devices	AD9835BRUZ
U1	32k I^2C 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 × 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.

UG10177-0-9/11(B)

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