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Evaluating the AD9838 11 mW Power, 2.3 V to 5.5 V, 16 MHz Complete DDS

FEATURES

Full featured evaluation board for the AD9838
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 AD9838 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 AD9838 an ideal candidate for power-sensitive applications.

The EVAL-AD9838SDZ board is used in conjunction with an EVAL-SDP-CB1Z SDP board, available from Analog Devices, Inc. The USB-to-SPI communication to the AD9838 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 AD9838 system. Various links and SMB connectors are also available on the EVAL-AD9838SDZ board to maximize usability.

Complete specifications for the AD9838 are provided in the AD9838 data sheet, available from Analog Devices, and should be consulted in conjunction with this user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

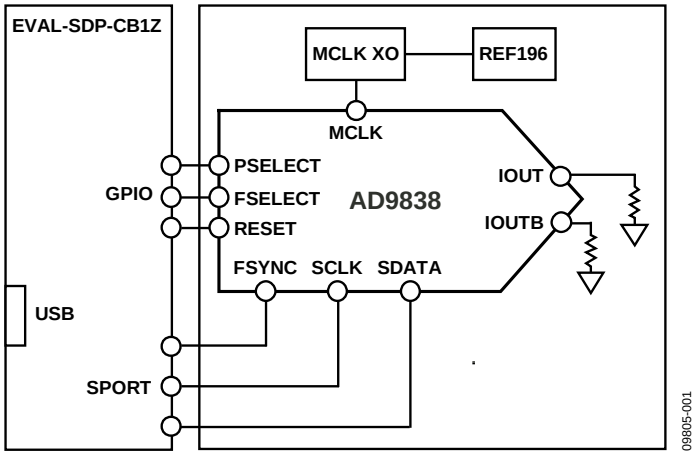

Figure 1.

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REVISION HISTORY

3/13—Rev. A to Rev. B

Changed 75 MHz to 16 MHz, Title 1
Changes to Setting Up the Digital Interface Section 5
Changes to Select External MCLK Frequency Section, Programming Method: Hardware or Software Section, and Loading Frequency and Phase Registers Section 6
Changes to Example of Operation Section 8
Changes to Figure 16 9

8/12—Rev. 0 to Rev. A

Changed LK3 Position from In to Out, Table 1 4

4/11—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

The EVAL-AD9838SDZ evaluation kit includes the software and drivers on a 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-AD9838SDZ evaluation kit CD.
3. Download the AD9838SDZ 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-AD9838SDZ 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).

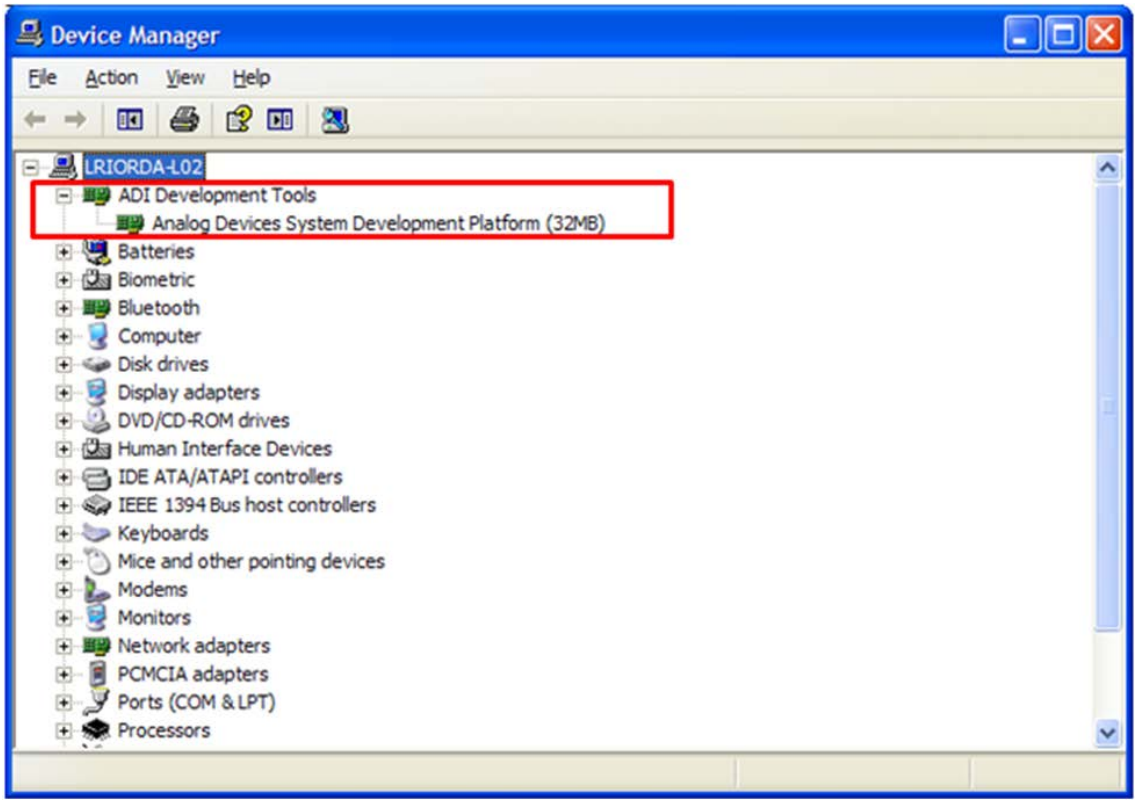


Figure 2. Hardware Device Manager Window with SDP Board Plugged In

RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/AD9838/ AD9838 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 the correct positions (see Table 1). The main window of the AD9838DBZ evaluation software then opens, as shown in Figure 4.

Table 1. Default Setup for Link Positions

Link No.	Position	Function
LK1	A	On-board linear regulator selected to supply power to the general oscillator.
LK2	B	3.3 V digital supply for the AD9838 supplied from the EVAL-SDP-CB1Z board.
LK3	Out	Decouple the CAP/2.5V pin to ground because V_{DD} is >2.7 V.
LK4	B	3.3 V analog supply for the AD9838 supplied from the EVAL-SDP-CB1Z board.

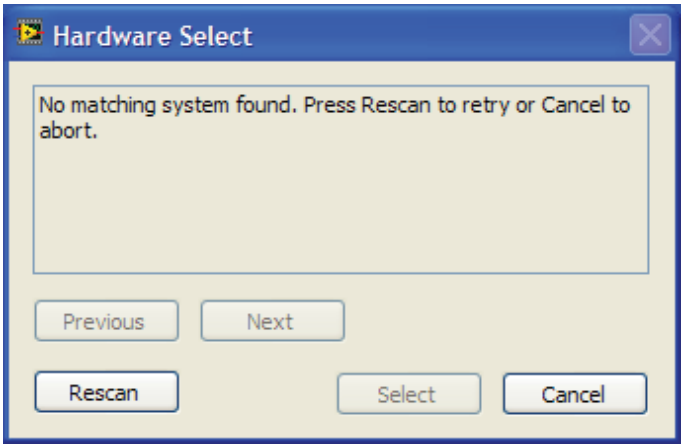


Figure 3. Pop-Up Window Error

USING THE EVALUATION BOARD SOFTWARE

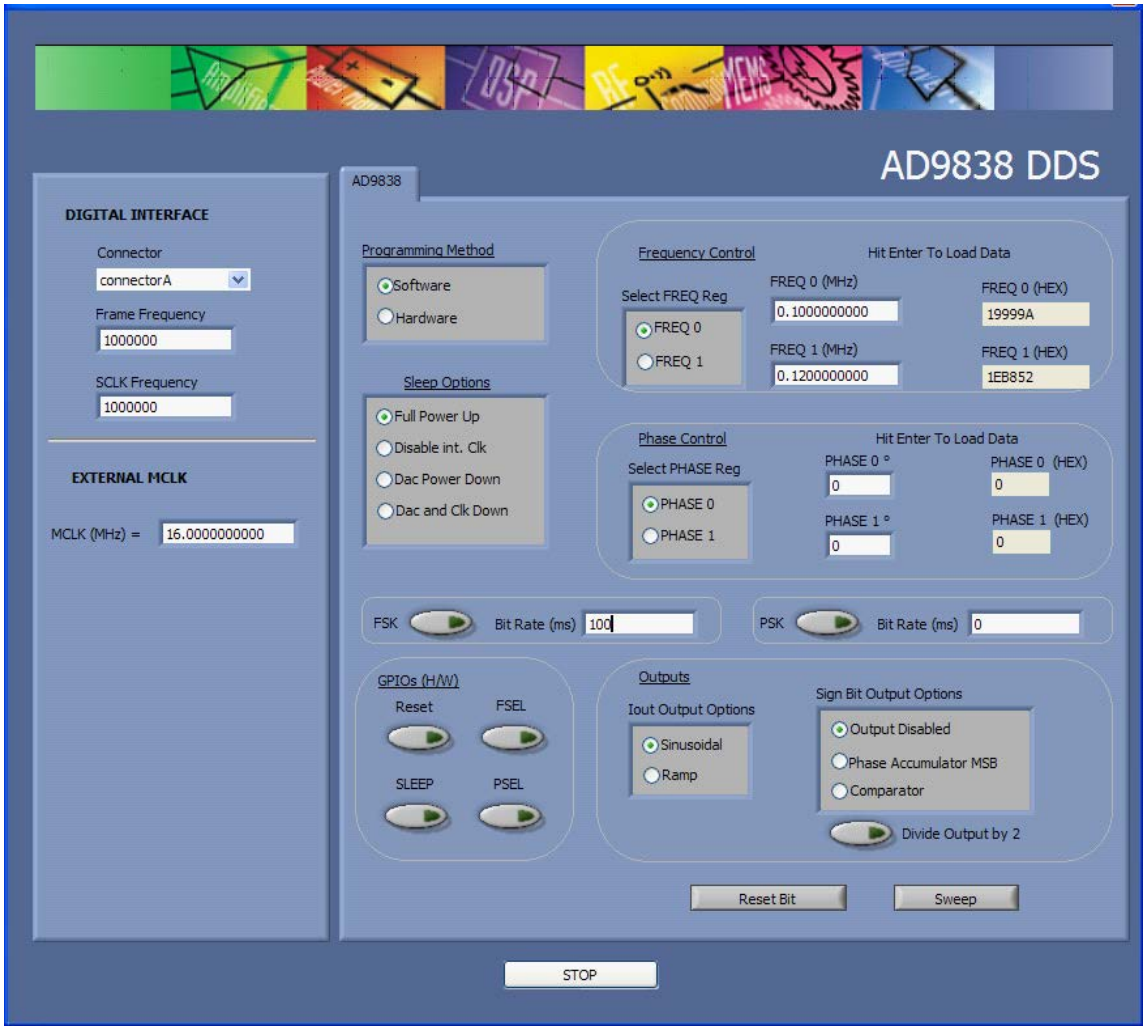


Figure 4. AD9838 DDS Evaluation Software

SETTING UP THE DIGITAL INTERFACE

To set up the AD9838 to perform measurements, first plug the EVAL-SDP-CB1Z board into the EVAL-AD9838SDZ board and connect the system to the USB port of a PC. Then launch the evaluation software and set the **DIGITAL INTERFACE**. The EVAL-SDP-CB1Z has two connector plugs: **connectorA** and **connectorB**. Select which connector you want to use with the AD9838 evaluation board from the **Connector** drop-down menu.

The SPI **Frame Frequency** and **SCLK Frequency** boxes 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.

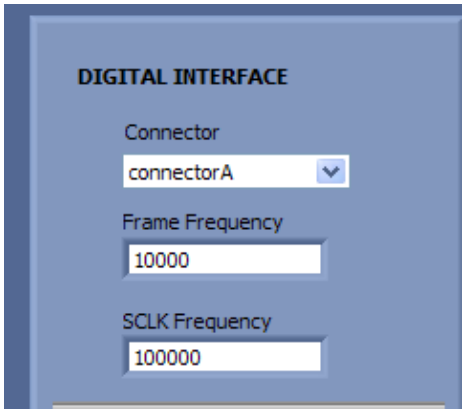


Figure 5. Digital Interface

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 16 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.

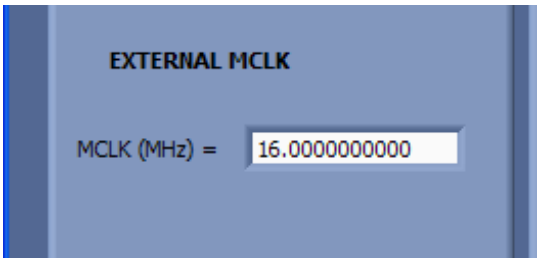


Figure 6. EXTERNAL MCLK Input

PROGRAMMING METHOD: HARDWARE OR SOFTWARE

Functions that select frequency and phase registers, reset internal registers, and power down the DAC can be implemented using either software or hardware. Figure 7 shows how to select the source of control for these functions. Alternatively, you can set the PIN/SW bit to 1 to select that these functions be controlled using the appropriate hardware control pins, or you can set the PIN/SW bit to 0 to select that these functions be controlled using the appropriate software control bits.

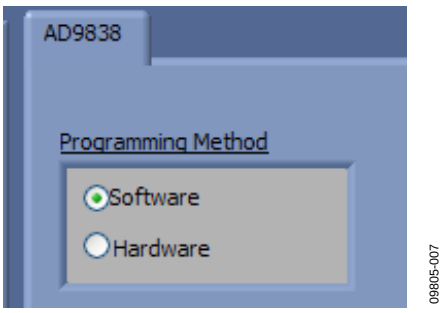


Figure 7. Programming Method

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; press the ENTER key to load data. After data is loaded, the output appears on the IOUT and IOUTB pins. Similarly, either the PHASE0 register or PHASE1 register can be selected, and the phase data is loaded in degrees.

The analog output frequency from the AD9838 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.

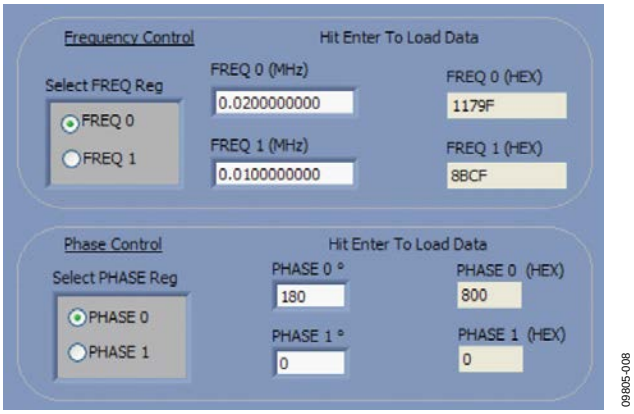


Figure 8. Frequency and Phase Load

FSK AND PSK FUNCTIONALITY

In software mode, the AD9838 can be set up for FSK or PSK functionality by simply entering the bit rate in milliseconds and clicking **FSK** or **PSK** (see Figure 9).

Figure 9. 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 AD9838 can be disabled or enabled (see Figure 10). The MSB or the MSB/2 of the phase accumulator can be selected as the output on the SIGN BIT OUT pin.

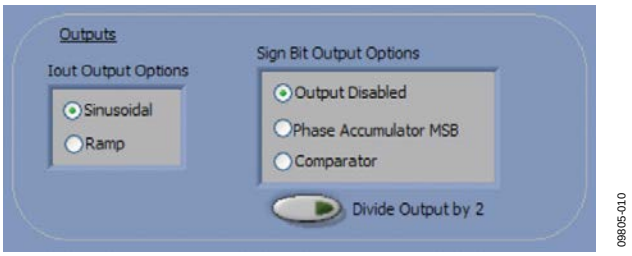


Figure 10. Waveform Profile and SIGN BIT OUT Pin

Power-Down Options

The AD9838 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 11).

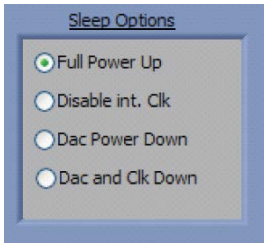


Figure 11. Power-Down Options

HARDWARE OPTIONS

If the hardware programming method is selected as shown in Figure 7, the following pin functions can be toggled: FSELECT, PSELECT, RESET, and SLEEP (by clicking **FSEL**, **PSEL**, **Reset**, and **SLEEP**, respectively; see Figure 12). These functions are controlled by the GPIO outputs on the EVAL-SDP-CB1Z board. For example, frequency data can be loaded to the FREQ0 register and the FREQ1 register, and the output can be toggled by the FSELECT pin, that is, 2FSK functionality.

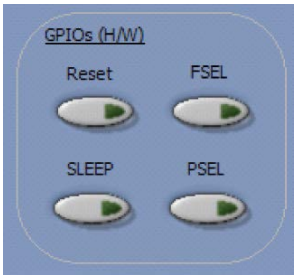


Figure 12. GPIO Hardware Pin Control

RESET AND SWEEP

The reset software command is set using the buttons shown in Figure 13. To set up a DDS sweep, click **Sweep**.

Figure 13. 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.

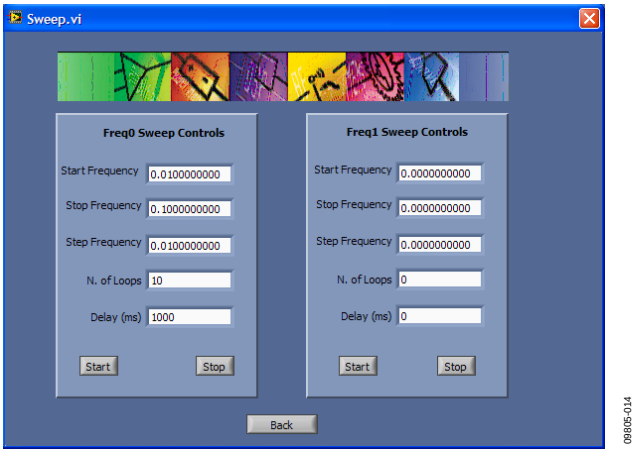


Figure 14. Sweep Functionality

EXAMPLE OF OPERATION

An example of configuring the AD9838 to output 10 kHz follows:

1. Plug the EVAL-SDP-CB1Z board into the EVAL-AD9838SDZ board and connect to the USB port.
2. Start up the software located at **Start/All Programs/ Analog Devices/AD9838/AD9838 Eval Board**. You should see the SDP board communicating with the PC.
3. Select **connectorA** or **connectorB**; this must match what the AD9838 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 positions (see Table 1).
6. Select the FREQ1 register.
7. Load a 10 kHz excitation frequency and press ENTER.

The output should appear on the IOUT and IOUTB outputs on the evaluation board.

For the FREQ0 register, follow the steps in the example operation, but with the following exceptions:

- In Step 6, select the FREQ0 register.
- In Step 7, load the FREQ0 register with 20 kHz and press ENTER.

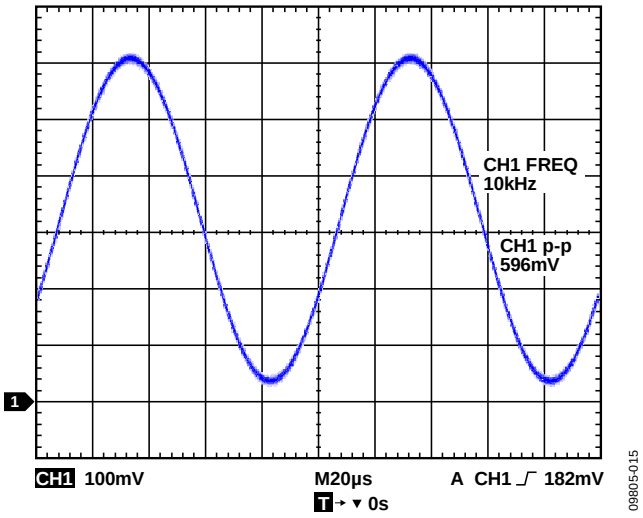


Figure 15. 10 kHz Output Signals on an IOUT Test Point

EVALUATION BOARD SCHEMATICS AND LAYOUT

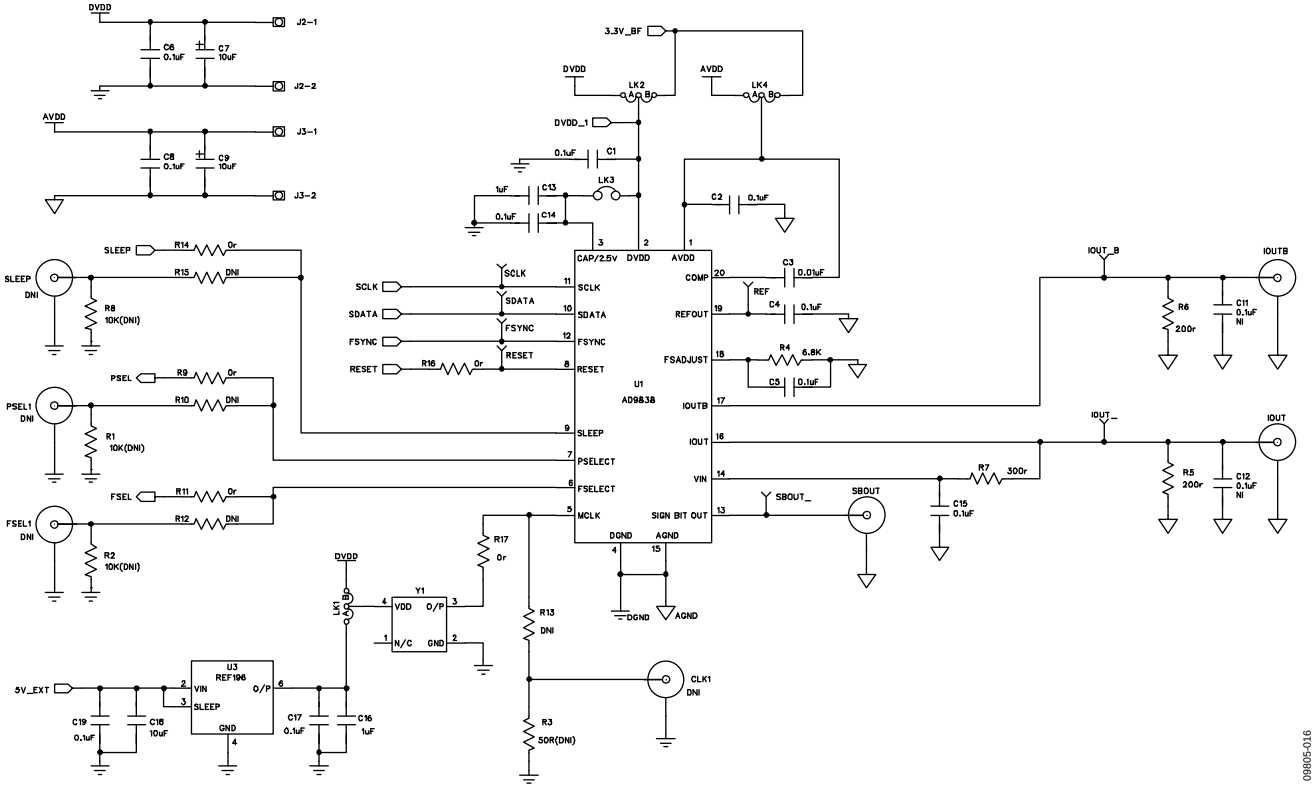


Figure 16. AD9838 Schematic Part A

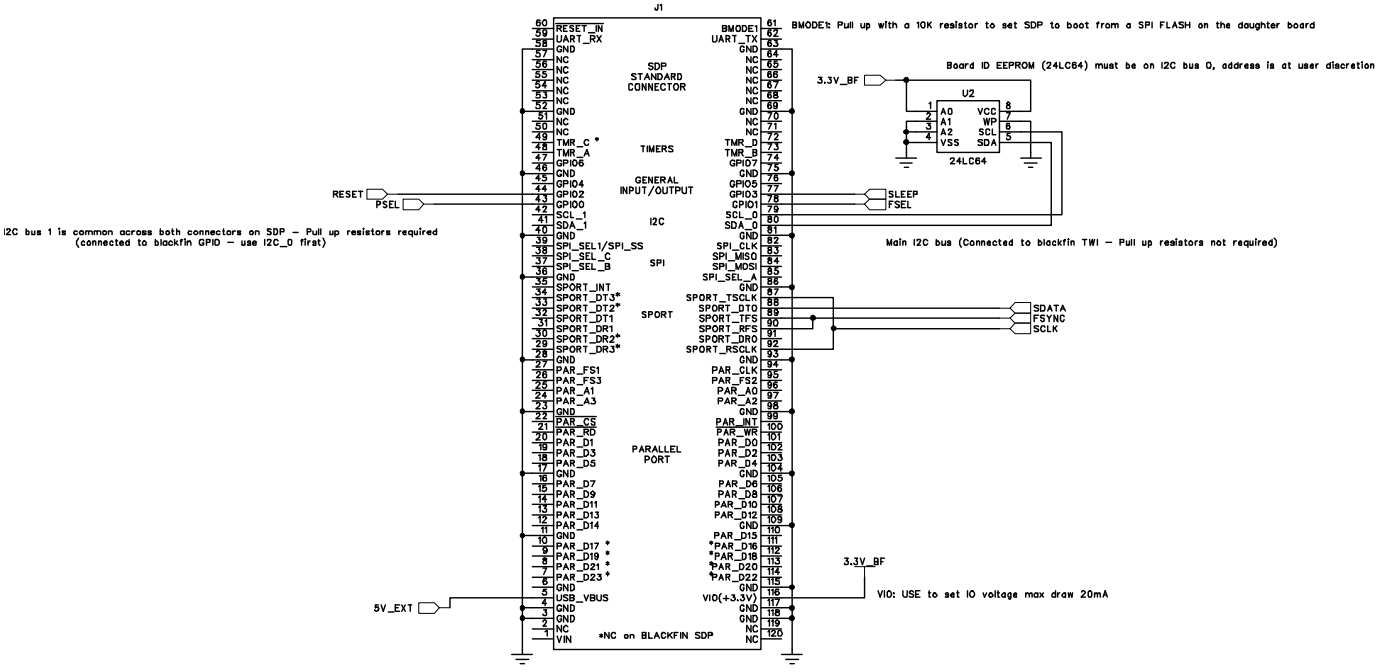
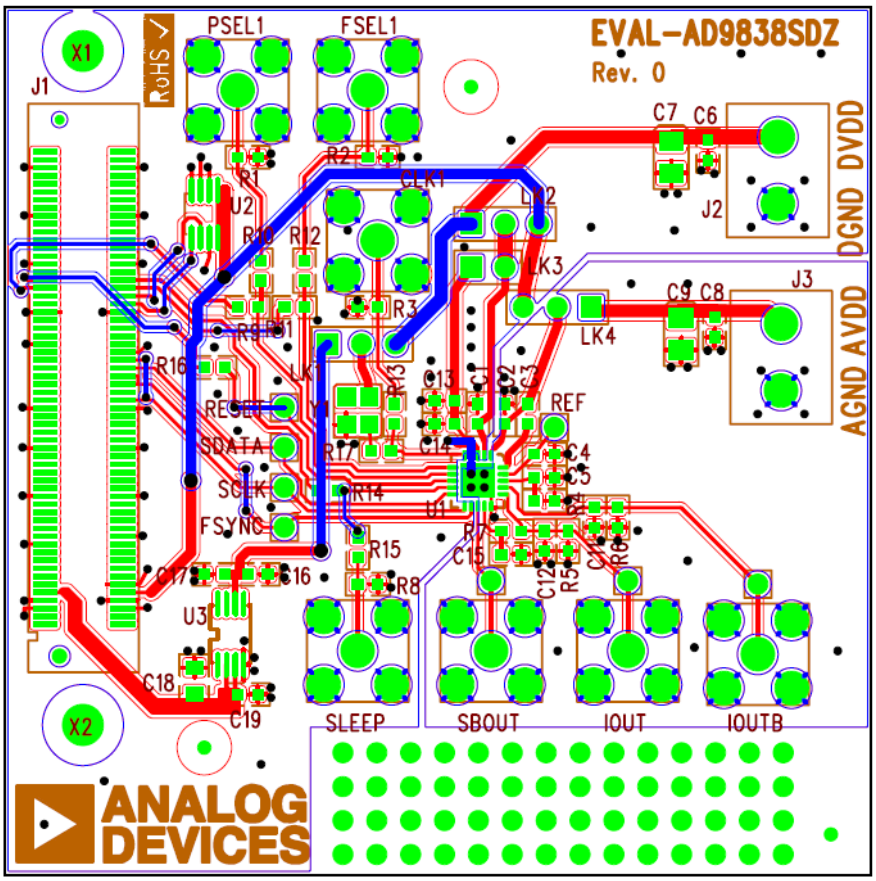


Figure 17. AD9838 Schematic Part B



EVAL-AD9838SDZ (Rev. 0) – Component Side View

Layer 1 – Component Side
Layer 2 – Solder Side
Silkscreen

09805-018

Figure 18. Component Side View Layer 1

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part Number
C1, C2, C4 to C6, C8, C11, C12, C14, C15	0.1 µF ceramic capacitor, 50 V, X7R, ±10%, 0603	Murata	GRM188R71H104KA93D
C3	0.01 µF capacitor, 0603, 10 V, X5R, 10%	Kemet	C0603C103K5RACTU
C7, C9	10 µF tantalum capacitor, ±10%, 10 V, SMD, RTAJ_A	AVX	TAJA106K010R
C13, C16	1 µF capacitor, 10 V, Y5V, 0603, +80%, −20%	Yageo	CC0603ZRY5V6BB105
C17, C19	0.1 µF capacitor, 0603, 16 V, X7R, ±10%	Multicomp	B0603R104KCT
C18	10 µF ceramic capacitor, 10 V, 10%, X5R, 0805	Murata	GRM21BR61A106KE19L
CLK1,[1] F SEL1,[1] IOUT, IOUTB, PSEL1,[1] SBOUT, SLEEP	Straight PCB mount SMB jack, 50 Ω	Tyco	1-1337482-0
FSYNC, IOUT_, IOUT_B, REF, RESET, SBOUT_, SCLK, SDATA	Red test point	Vero	20-313137
G1	Ground link, 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
LK1, LK2, LK4	3-pin SIL header and shorting link	Harwin	M20-9990345 and M7567-05
LK3	2-pin SIL header and shorting link, SIP-2P	Harwin	M20-9990246
R1,[1] R2,[1] R8[1]	10 kΩ SMD resistor, 0603	Multicomp	MC 0.063W 0603 10K
R3[1]	50 Ω SMD resistor, 0603	Multicomp	MC 0.063W 0603 50r
R4	6.8 kΩ SMD resistor, 0603	Multicomp	MC 0.063W 0603 6K8
R5, R6	200 Ω SMD resistor, 0603	Multicomp	MC 0.063W 0603 200R
R7	300 Ω SMD resistor, 0603	Multicomp	MC 0.063W 0603 300R
R9, R10,[1] R11, R12,[1] R13,[1] R14, R15,[1] R16, R17	0 Ω, 0603, SMD resistor	Multicomp	MC 0.063W 0603 0R
U1	11 mW power, 2.3 V to 5.5 V, 16 MHz complete DDS, 20-lead LFCSP	Analog Devices	AD9838BCPZ
U2	64k I^2C serial EEPROM, MSOP-8	Microchip	24LC64-I/MS
U3	Precision micropower, low dropout, low voltage references, 8-lead TSSOP	Analog Devices	REF196GRUZ
X1, X2	3 mm NPTH hole	Not applicable	MTHOLE-3mm
Y1	16 MHz, 3 mm × 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.

UG09805-0-3/13(B)

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