

FEATURES

Evaluation board powered solely via the USB port
Easy to use Windows graphical user interface allowing software control of all AD9913 features
Flexible reference clock input accepts external crystal or external reference clock
DAC output easily accessible via SMA connector
SMA connectors provided for external reconstruction filter

PACKAGE CONTENTS

AD9913 evaluation board
USB cable
CD with the following contents:
 Evaluation software
 Schematics
 AD9913 data sheet
 EVAL-AD9913 instructions (this document)

GENERAL DESCRIPTION

This document serves as a guide to the setup and use of the AD9913 evaluation board. The AD9913 is a 250 MSPS DDS with a 10-bit DAC.

For easy communication with the device, the evaluation board software includes a graphical user interface that has many user-friendly features, including context-sensitive Help.

This document is intended for use in conjunction with the [AD9913](#) data sheet, which is available from Analog Devices, Inc., at www.analog.com.

EVALUATION BOARD BLOCK DIAGRAM

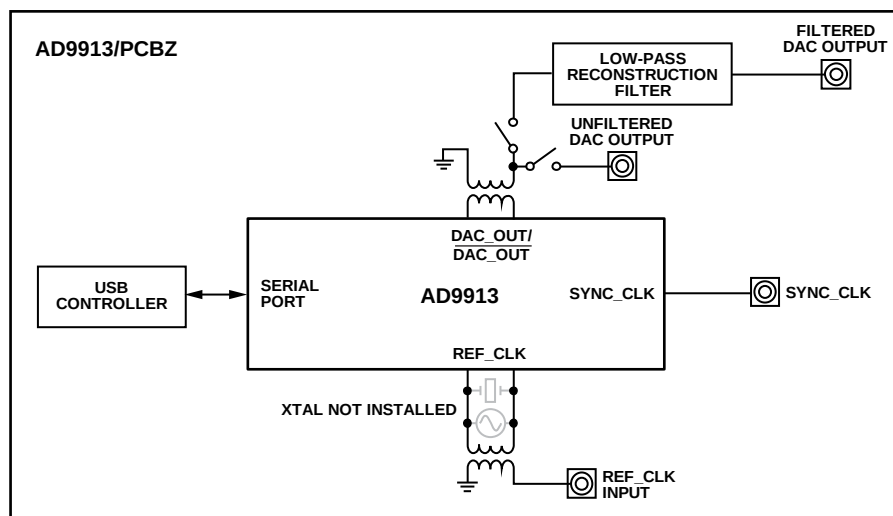


Figure 1.

Rev. 0

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REVISION HISTORY

9/08—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

PACKAGE CONTENTS

The EVAL-AD9913 kit contains the following items:

- AD9913 evaluation board
- Software CD
- USB cable

REQUIREMENTS

To use the evaluation board and run the software, the requirements listed in Table 1 must be met.

Table 1. EVAL-AD9913 Requirements

Item	Requirement
Operating System	Microsoft® Windows® 98/Me/2000/XP
Processor	Pentium® I or higher
Memory	128 MB minimum
Ports	One USB port
Clocking	Signal generator capable of generating sinusoidal waves of at least 0 dBm power, up to at least 10 MHz
Power Supplies	Capability to generate at least two independent dc voltages (1.8 V/3.3 V)
Measurement	Appropriate measurement device, such as a spectrum analyzer or a high bandwidth oscilloscope
Cables	USB 1.1/2.0 cable (supplied with the evaluation kit) and SMA-to-X cables (X = SMA or BNC, depending on the connector of the device interfacing with the board)

SETTING UP THE EVALUATION BOARD

DC Power Supply

The power supply to the AD9913 evaluation board is provided via the USB cable. The evaluation board draws the required power from the PC. Note that R10 (previously labeled C12) should be populated with a 0 Ω resistor.

Device Clock Oscillator Options

The AD9913 architecture supports three ways to provide an input signal to the part.

- Provide a differential input signal, connected to J1.
- Connect using a CMOS input reference frequency, which also connects through J1.
- Connect a crystal resonator on the back side of the board.

To enable the crystal resonator, remove C100 and C101. Place 0 Ω resistors at R160 and R161 on the back side of the board. Populate C158 and C159 with 39 pF capacitors. The crystal oscillates at 25 MHz.

All these options can be used with or without a built-in phase-locked loop (PLL) multiplier to multiply the reference signal. See the AD9913 data sheet for details on maximum input speeds and sensitivities.

Device Communication Requirements

Two interface standards are available on the evaluation board.

- USB 1.1/2.0
- Header row (P1), which places the part under the control of an external controller (such as a microprocessor, FPGA, or DSP)

Analog Devices provides a GUI for the PC; it does not provide control software for external controllers.

Use the jumper settings listed in Table 2 to enable different modes of communication.

Table 2. Jumper Settings for Communication Modes

Mode	Settings
PC Control, USB Port	Set Jumper JMP2 to PC. Set JMP1 to EEPROM ENABLE.
External Control	Set Jumper JMP2 to MANUAL.

Jumper JMP2 enables the USB circuitry to control the AD9913. Jumper JMP1 controls the EEPROM, used in starting up the USB circuitry.



Figure 2. AD9913 Evaluation Board

These pins provide the communication interface for the AD9913 when the part is under the control of an external controller (set Jumper JMP2 to MANUAL).

These connections represent the filtered or unfiltered (default) output of the DAC.

This connection is the input for the external reference clock signal.

The AD9913 evaluation board is preconfigured to be powered solely via the USB connection.

When the part is under PC control (the default mode), the evaluation board communicates with the AD9913 via this port.

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

Do not connect the AD9913 evaluation board to the PC until the AD9913 evaluation software has been installed.

To install the AD9913 evaluation software, follow these steps:

1. Log on to the PC with administrative privileges.
2. Uninstall any previous versions of the AD9913 evaluation software from the PC.
3. Insert the AD9913 evaluation software CD into the CD drive. Refer to the **Readme.txt** file located in the **Software** folder on the CD before you install the AD9913 evaluation board software.
4. Double-click the **setup.exe** file located in the **Software** folder and follow the on-screen installation instructions.

INSTALLING THE DRIVERS

After the software is installed on the PC, use the supplied USB cable to connect the AD9913 evaluation board to the USB port on the PC (see Figure 2).

For the evaluation board and the software to communicate properly, drivers must be installed on the PC. The following instructions describe how to install these drivers, depending on the Windows operating system running on the PC.

Windows 98/Me/2000

1. Power up the AD9913 evaluation board (see Table 2).
2. Connect the evaluation board to the PC using the supplied USB cable via the USB port. The VBUS LED (CR1 on the AD9913 evaluation board) lights.

The **Found New Hardware** window appears.

3. If the PC is running Windows 2000, click **Finish** in the **Found New Hardware** window.

After the window closes, the USB STATUS LED (CR2 on the AD9913 evaluation board) flashes, which indicates that the evaluation board is properly connected. If the LED does not flash, verify that all power and USB connections are properly connected.

Windows XP

1. Power up the AD9913 evaluation board (see Table 2).
2. Connect the evaluation board to the PC using the supplied USB cable via the USB port. The VBUS LED (CR1 on the AD9913 evaluation board) lights.

The **Found New Hardware Wizard** appears.

3. Click **Next** to display the **AD9913 Firmware Loader** window.
4. Click **Continue Anyway** when the **Hardware Installation** warning window appears.
5. Click **Finish** in the **Found New Hardware Wizard** when the installation is complete.
6. Click **Next** when the **Found New Hardware Wizard** appears to install the EZSSP device.
7. Click **Continue Anyway** when the **Hardware Installation** warning window appears.
8. Click **Finish** in the **Found New Hardware Wizard** when the installation is complete.

After the window closes, the USB STATUS LED (CR2 on the AD9913 evaluation board) flashes, which indicates that the evaluation board is properly connected. If the LED does not flash, verify that all power and USB connections are properly connected.

STARTING THE SOFTWARE

Before you start the software, make sure that the AD9913 evaluation board is powered up and connected to the PC, and that the USB STATUS LED is flashing.

To start the AD9913 evaluation software, follow these steps:

1. Click the **Start** button (located at the bottom left corner of your desktop).
2. Select **All Programs > Analog Devices > AD9913 Evaluation Software**.
3. Click **AD9913 Evaluation Software** to start the software.

A status message appears. These messages are described in the Status Messages upon Starting Software section.

EVAL-AD9913

Status Messages upon Starting Software

After you start the AD9913 evaluation software, a splash screen appears. The status box within the splash screen gives the status of the AD9913 evaluation software. Green text in the status box indicates that the software was successfully loaded. After a successful load, the splash screen disappears.

Red text in the status box indicates that an error occurred. You can click in the status box and scroll through the text to troubleshoot the cause of the error.

Most installation errors can be resolved by checking jumper settings, making sure that the evaluation board is powered up correctly, and inspecting the USB port and cable connections.

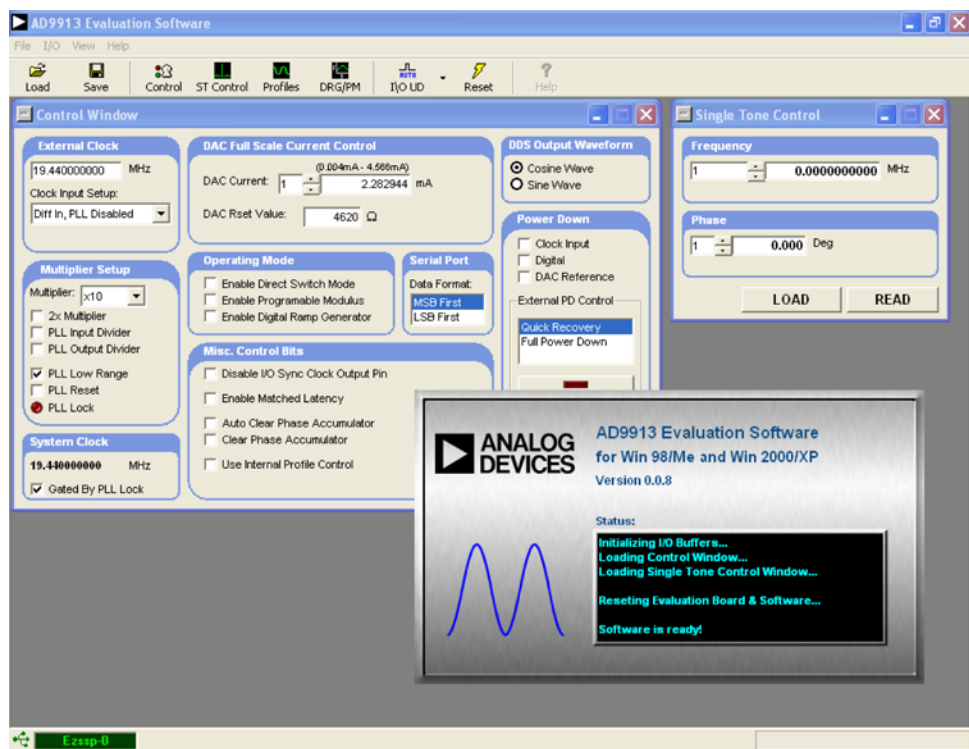


Figure 3. Screenshot Showing the Evaluation Software Successfully Loaded

FEATURE CONTROL WINDOWS

Control Window

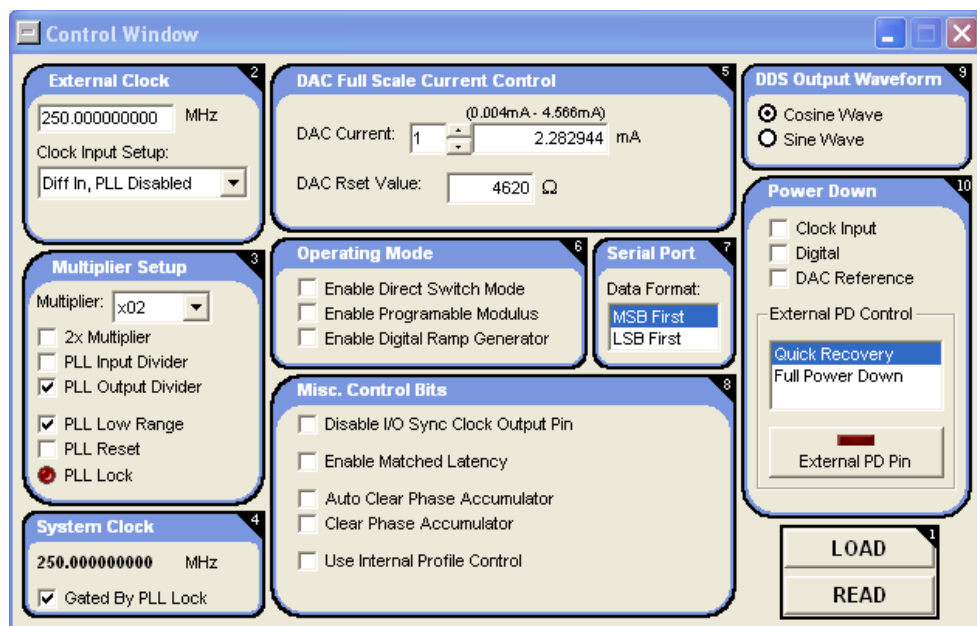


Figure 4. Control Window

The **Control Window** (see Figure 4) provides control of the clock input, clock multiplier, DAC current settings, operating modes, output waveform, and power-down functions of the AD9913. To open this window, select **View** from the menu bar and then select **Control Window** from the View menu (see Figure 10).

1—LOAD and READ Buttons

The **READ** button retrieves register settings from the AD9913.

The **LOAD** button is used to send data to the AD9913. All **LOAD** buttons found in the evaluation board GUI work the same way.

When new data is detected, **LOAD** flashes orange, indicating that you must click **LOAD** to send the updates to the serial I/O buffer where they are stored until an I/O update is issued.

The I/O update sends the contents of the serial I/O buffer to active registers. I/O updates can be sent manually (**Manual I/O Update**) or automatically (**Auto I/O Update**). By default, the AD9913 evaluation software is set to **Auto I/O Update**.

To manually send an I/O update, select **Manual I/O Update** from the **I/O UD** menu in the menu bar (see Figure 3) and then click the **I/O UD** button.

2—External Clock

The **External Clock** dialog box allows you to configure the reference clock signal for the AD9913. You can use this dialog box to enter the operating frequency of the external reference clock or crystal. The maximum reference clock frequency for the AD9913 is 250 MHz, which is the default setting in the MHz box. A red outline around the MHz box indicates that the value entered is out of range.

The **Clock Input Setup** box allows you to choose from six different clock input modes: three clock input configurations with the built-in PLL enabled, and the same three clock input configurations with the PLL disabled. The default setting of this box is **PLL Disabled**, indicating that the reference clock PLL circuitry is bypassed and that the reference clock/crystal input is piped directly to the DDS core. See the Clock Input (REF_CLK) section of the AD9913 data sheet for more information about the different clock modes.

3—Multiplier Setup

The **Multiplier Setup** dialog box allows you to configure the PLL for use as the system clock. To make changes to the multiplier setup, the **Clock Input Setup** box must have the PLL enabled.

Multiplier selects the PLL multiplication factor (1× to 32×) by which to scale the input frequency. The default setting is 10×.

2× Multiplier enables an additional 2× multiplication of the reference clock.

PLL Input Divider enables a divide by 2 for the signal entering the PLL.

PLL Output Divider enables a divide by 2 for the signal exiting the PLL.

PLL Low Range adjusts the PLL loop filter to allow low frequency reference clock inputs.

PLL Reset restarts the PLL.

PLL Lock indicates a frequency locked PLL. When this light is red, the PLL is locked and the chip is using the PLL as the system clock. If the PLL is not locked, the chip operates from the external clock frequency provided.

4—System Clock

System Clock displays the operating frequency of the DDS core (system). The value shown in this box is derived from the values entered in the **External Clock** and **Multiplier** boxes. If the PLL is used for the system clock, by default, the nonmultiplied external clock is used as a system clock until the PLL is locked. If the **Gated By PLL Lock** check box is selected, no system clock is used until the PLL is locked.

5—DAC Full Scale Current Control

The **DAC Current** box allows you to adjust the DAC current in increments proportional to the full-scale current range. The **mA** box displays the DAC current; the spin box for the DAC current is set to delta-1 increment adjustment.

DAC Rset Value allows you to adjust the variable resistance, which produces the reference current. The full-scale output current of the DAC is produced as a scaled version of the reference current according to the equation found in the 10-Bit DAC section of the AD9913 data sheet. Therefore, the resistance value determines the range of the DAC full-scale current. The DAC is designed to operate with full-scale current values up to 4.58 mA. As a result, the recommended value for the variable resistance is 4.62 k Ω . (For more information, see the 10-Bit DAC section of the AD9913 data sheet.)

6—Operating Mode

The **Operating Mode** dialog box allows you to choose the operating mode. These modes are Single Tone, Direct Switch, Programmable Modulus, and Digital Ramp Generator/Linear Sweep. For a description of the operating modes, see the AD9913 data sheet.

Single tone mode is the default mode of operation. The chip is in single tone mode when none of the check boxes are selected. In this mode, the **Single Tone Control** window is used to control the chip output (see Figure 5).

The chip is in direct switch mode when the **Enable Direct Switch Mode** check box is selected. In direct switch mode, the chip output is controlled via registers and profiles (see Figure 6).

The chip is in programmable modulus mode when the **Enable Programmable Modulus** check box is selected and the **Enable Direct Switch Mode** check box is not selected. In this mode, the **DRG \ Programmable Modulus** window is used to control the chip output (see Figure 8).

The chip is in digital ramp generator/linear sweep mode when the **Enable Digital Ramp Generator** check box is selected and neither the **Enable Direct Switch Mode** check box nor the **Enable Programmable Modulus** check box is selected. In this mode, the **DRG \ Programmable Modulus** window is used to control the chip output (see Figure 7).

7—Serial Port

Serial Port configures the information sent through the serial connection to either MSB first format or LSB first format.

8—Misc. Control Bits

Disable I/O Sync Clock Output Pin shuts down the pin drive, minimizing the noise generated by the digital circuitry.

Enable Matched Latency configures the auxiliary accumulator, the phase offset word, and the phase accumulator to have the same latency.

Auto Clear Phase Accumulator enables the phase accumulator to be synchronously cleared for one cycle upon receipt of the IO_UPDATE sequence indicator.

Clear Phase Accumulator creates an asynchronous, static reset of the DDS phase accumulator.

Use Internal Profile Control allows profiles to be controlled by Register CFR1, Bits [22:20] rather than by the profile pins.

9—DDS Output Waveform

DDS Output Waveform determines whether the DDS output is a sine or a cosine function.

10—Power Down

Power Down allows you to power down each specific circuit block individually.

Clock Input shuts down all clock generation, including the system clock signal going into the digital section.

Digital disables the digital core and places it in a low power dissipation state.

DAC Reference disables the DAC and places it in its lowest power dissipation state.

External PD Control allows you to control which power-down mode is used in conjunction with the **External PD Pin** button. The **Quick Recovery** mode powers down the digital logic and DAC digital logic, but the DAC bias circuitry, comparator, PLL, oscillator, and clock input circuitry are not powered down. **Full Power Down** powers down all functions.

The **External PD Pin** button allows you to control the external power-down pin without altering the evaluation board. See the AD9913 data sheet for more information about power-down conditions.

Single Tone Control Window

To open the **Single Tone Control** window, select **View** on the menu bar and then select **Single Tone Control** (see Figure 10).

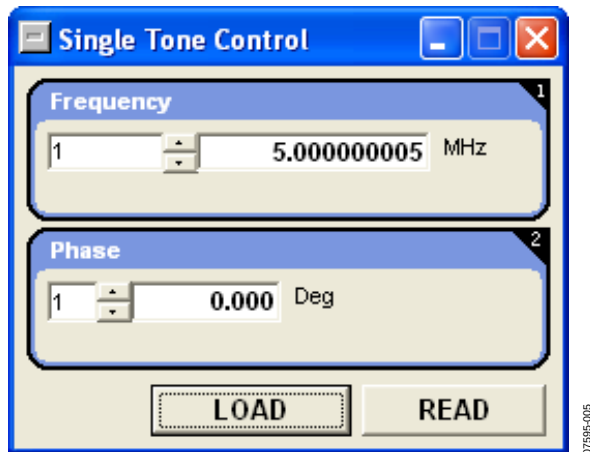


Figure 5. Single Tone Control Window

Single Tone is the default operating mode for the AD9913. To produce an output signal, you can type the desired output frequency into the **Frequency** box and click the **LOAD** button. When you enter a valid frequency, that is, a frequency that is less than half the frequency of the system clock (125 MHz maximum), the DDS produces a sinusoidal output.

1—Frequency

The **Frequency** box allows you to control the frequency tuning word and, therefore, the frequency of the output signal with a resolution of 0.058 Hz. The output frequency cannot exceed half the frequency of the system clock (125 MHz maximum). If you enter a value greater than 125 MHz, a warning appears on the screen and the maximum possible output frequency is entered.

The spin box for frequency increases and decreases the frequency tuning word in 1-bit increments, which is equivalent to 0.058 Hz. You can also change the frequency by typing a value into the **MHz** box.

2—Phase

The **Phase** box allows you to control the phase of the output signal with a resolution of 0.022 degrees. The phase can be changed from 0° to 360°. The spin box changes the phase offset in 1-bit increments. You can also change the phase by typing a value into the **Deg** box.

Direct Switch Profile Control Window

The AD9913 supports the use of profiles, which consist of a group of eight registers that contain parameters for a particular operating mode. Profiles enable rapid switching between parameter sets. Profile parameters are programmed via the I/O port. To open the **Profile** window, select **View** on the menu bar and then select **Profile Window** (see Figure 10).

1—Profile

The **Profile** dialog boxes allow you to program up to eight different profiles for use in Direct Switch mode. The output frequency and phase offset are controlled the same way as in the **Single Tone Control** window.

2—Control

The **Control** dialog box allows you to select the active profile. You can also manually select a profile by means of Register CFR1, Bits [22:20], or by using the three external profile select pins. The external profile pins option is available in serial mode only. See the AD9913 data sheet for more information about profile selection.

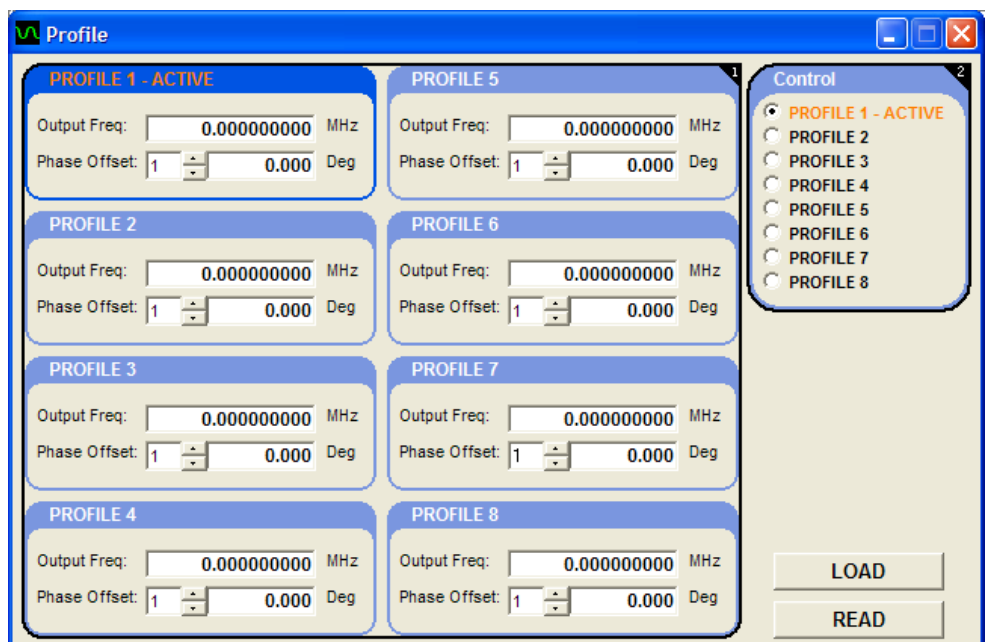


Figure 6. Profile Window

Digital Ramp Generator/Linear Sweep Control Window

To open this window, select **View** on the menu bar and then select **DRG \ Programmable Modulus Window** (see Figure 10). To view this window, the **Enable Digital Ramp Generator** check box must be the only check box selected in the **Operating Mode** section of the **Control Window** (see Figure 4).

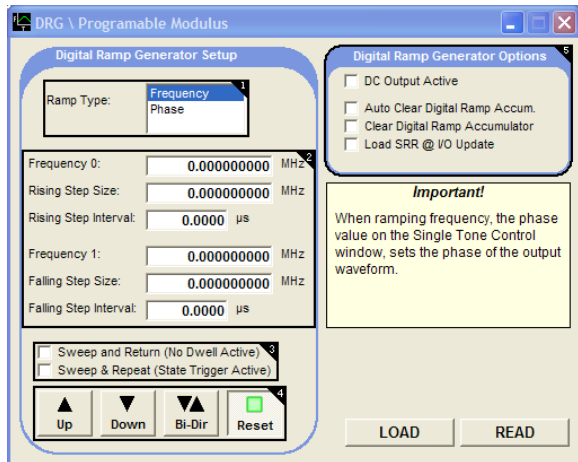


Figure 7. Digital Ramp Generator Setup Window

1—Ramp Type

The **Ramp Type** menu allows you to choose whether the DDS ramps the output by phase or by frequency. These options provide better bandwidth containment than Direct Switch mode by enabling more gradual, user-defined changes between a start point and an end point.

2—Frequency Programming

These boxes set the start and end points of the ramp. You enter a start point (phase or frequency, depending on the ramp type), a step size, and a step interval. For more information about choosing the appropriate step size and interval time, see the Modes of Operation section in the AD9913 data sheet.

3—Sweep Options

If **Sweep and Return (No Dwell Active)** is selected, the sweep takes place and, upon completion, the device reverts to its initial state. If this check box is not selected, the sweep takes place and, upon completion, the device holds at the final state.

Sweep & Repeat (State Trigger Active) determines the sweep triggering. If this option is not selected, the sweep is edge triggered and sweeps only once. If this option is selected, the sweep is level triggered. In level triggered mode, the sweep is automatically repeated as long as the appropriate profile pin is held high. A **Stop** button is also available in place of the **Reset** button.

4—Sweep Type

These options determine the type of sweep to be made: up, down, bidirectional, or no sweep (**Reset** button).

5—Digital Ramp Generator Options

DC Output Active causes the output of the DAC to be driven to full scale and disables the DDS output.

Auto Clear Digital Ramp Accum. synchronously clears the auxiliary accumulator for one cycle upon receipt of the **IO_UPDATE** sequence indicator.

Clear Digital Ramp Accumulator is an asynchronous, static reset of the auxiliary accumulator. The ramp accumulator remains reset as long as this bit remains set.

Load SRR @ I/O Update interrupts the timer immediately upon the assertion of **IO_UPDATE** and causes the value to be loaded.

Programmable Modulus Control Window

To open this window, select **View** on the menu bar and then select **DRG \ Programmable Modulus Window** (see Figure 10). To view this window, the **Enable Programmable Modulus** check box must be selected and the **Enable Direct Switch Mode** check box must not be selected in the **Operating Mode** section of the **Control Window** (see Figure 4).

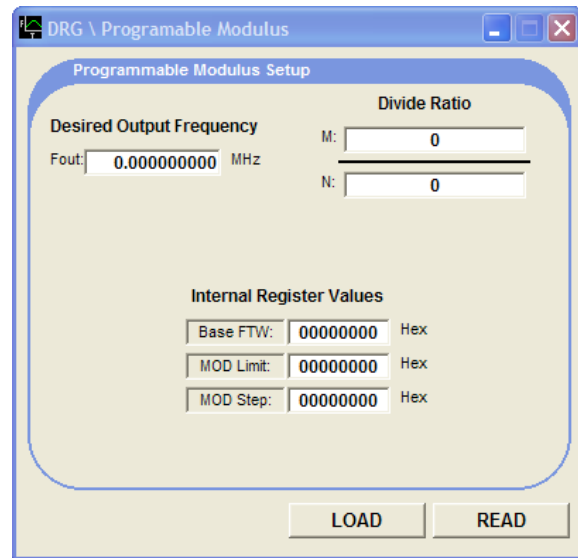


Figure 8. Programmable Modulus Setup Window

The **Programmable Modulus Setup** window is used to alter the frequency equation of the DDS core, making it possible to implement fractions that are not restricted to a power of 2 in the denominator.

When you enter the desired output frequency in the **F_{out}** box, the values in the **Internal Register Values** boxes and the **Divide Ratio** boxes are automatically updated. You can also directly enter a divide ratio; in this case, the **Internal Register Values** boxes and the **Desired Output Frequency** box are automatically updated.

Debug Window

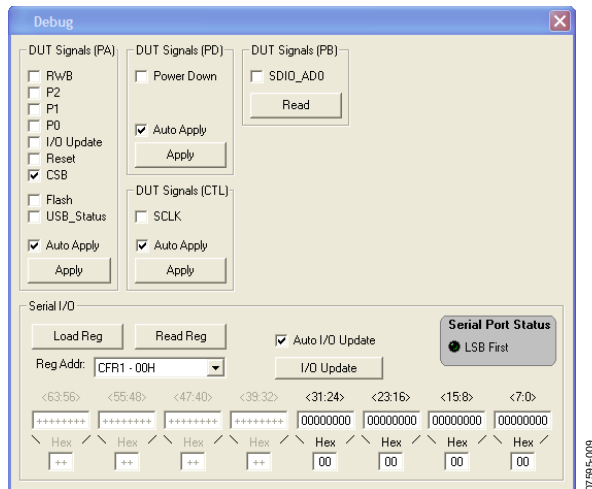


Figure 9. Debug Window

The **Debug** window gives you complete, direct access to the register map as well as control of many external pins. To open this window, select **View** from the menu bar and then select **Debug Window** from the **View** menu (see Figure 10). The **Debug** window is intended for debugging problems with the AD9913. It can be used for all programming, but it is not user friendly and, therefore, may result in improper programming of reserved bits.

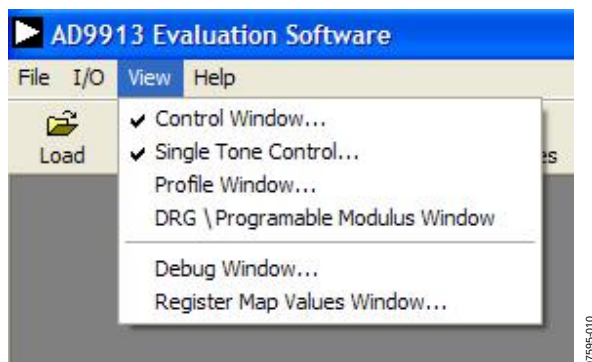


Figure 10. View Menu

DUT Signals (PA)

The **RWB**, **P2**, **P1**, **P0**, **I/O Update**, **Reset**, and **CSB** check boxes control the pins to which they correspond. The **P2**, **P1**, and **P0** pins control the profile registers. Note that the **RWB** check box corresponds to the **SDIO($\overline{W}$ R/RD)** pin (Pin 29) on the AD9913. See the AD9913 data sheet for the logic required to control these pins.

All these functions are available elsewhere in the software. A check in the box means that the pin is in its active state. Note that this does not mean that the pin is logic high or logic low. This is determined by the active state on that pin. See the AD9913 data sheet for information about the external pins.

The **Flash** and **USB_Status** check boxes are used to control the two LEDs on the AD9913 evaluation board.

Note that when the **Auto Apply** boxes are selected, the action that they apply to is automatically taken without the need to click the **Apply** button.

DUT Signals (PD)

The **Power Down** box controls the external power-down pin.

DUT Signals (CTL)

The **SCLK** (Serial Clock) check box allows you to toggle the external pin. This pin is used to synchronize data to and from the AD9913 and to run the internal state machines.

DUT Signals (PB)

Data is always written to and read from the AD9913 on the **SDIO_AD0** pin (serial data I/O pin).

Serial I/O

The **Serial I/O** portion of the **Debug** window allows direct access to the register map. You can use the **Reg Addr** menu to select the register of interest. The bit numbers are shown above each byte in the register. The maximum size of any selected register is eight bytes. For registers that are smaller than eight bytes, the unavailable bytes are dimmed. You can enter register values in either binary or hexadecimal notation.

The **Serial Port Status** flag displays the serial operating mode of the AD9913.

Register Map (Software Buffer) Values Window

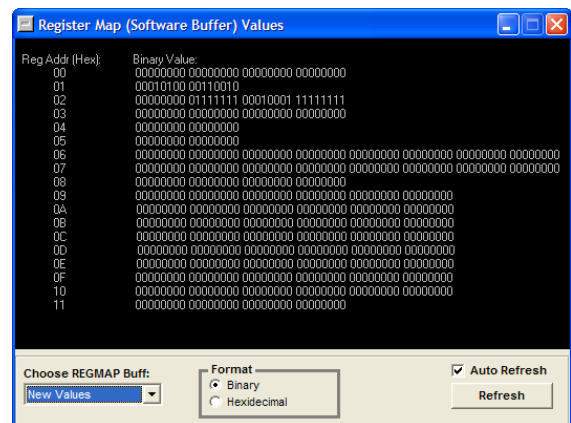


Figure 11. Register Map (Software Buffer) Values Window

The **Register Map (Software Buffer) Values** window allows you to toggle between the current values and the values that are loaded in the software buffer. To open this window, select **View** from the menu bar and then select **Register Map Values Window** from the **View** menu (see Figure 10). This window does not allow you to change the register map. However, you can use this window in conjunction with other control windows to observe register changes that will be written from the software buffer.

The **Choose REGMAP Buff** menu allows you to toggle between **Current Values** and **New Values**. You can use the **Format** box to view the registers in binary or hexadecimal format.

EVAL-AD9913

ORDERING INFORMATION

ORDERING GUIDE

Model	Description
AD9913/PCBZ ¹	Evaluation Board

¹ Z = RoHS Compliant Part.

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.