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HV2903
Analog Switch
Evaluation Board
User's Guide

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Preface

NOTICE TO CUSTOMERS

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Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the www.microchip.com on line help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the HV2903 Analog Switch Evaluation Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the HV2903 Analog Switch Evaluation Board as a development tool to evaluate the HV2903 No High-Voltage Bias, Low Harmonic Distortion, 32-Channel, High-Voltage Analog Switch IC. The user's guide layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the HV2903 Analog Switch Evaluation Board.

- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the demonstration board and instructions for how to begin using the HV2903 Analog Switch Evaluation Board.

- **Chapter 3. "PCB Design and Layout Notes"** – This chapter explains important points of the PCB design and layout of HV2903 Analog Switch Evaluation Board.

- **Appendix A. "Schematic & Layouts"** – Shows the schematic and PCB layout diagrams for the HV2903 Analog Switch Evaluation Board and the HV MUX Controller Board.

- **Appendix B. "Bill of Materials"** – Lists the parts used to build the HV2903 Analog Switch Evaluation Board and the HV MUX Controller Board.

- **Appendix C. "Demo Board Waveforms"** – Describes the various demo waveforms for the HV2903 Analog Switch Evaluation Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

HV2903 Analog Switch Evaluation Board User's Guide

RECOMMENDED READING

This user's guide describes how to use the HV2903 Analog Switch Evaluation Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **HV2903 Data Sheet –** *"HV2803/HV2903/HV2904 - No High-Voltage Bias, Low Harmonic Distortion, 32-Channel, High-Voltage Analog Switch.*

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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- Technical Support

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Technical support is available through the web site at: http://support.microchip.com.

DOCUMENT REVISION HISTORY

Revision A (December 2017)

- Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

HV2903 Analog Switch Evaluation Board (ADM00795) works with HV MUX Controller Board (ADM00825) to provide 32-Channel HV Analog Switches without HV Supplies, demonstration including basic switch ON/OFF operation, and 2:1 MUX operation with two built-in MD1822 and TC6320 pulser circuit.

1.2 HV2903 IC - DESCRIPTION

The HV2903 is 32-Channel HV Analog Switches without HV Supplies. It is designed for use in applications requiring high-voltage switching controlled by low-voltage control signals, such as medical ultrasound imaging, driving piezoelectric transducers and in printers. The typical 10Ω on resistance analog switch can pass the analog pulse signal up to ±3A of current at ±100V without high-voltage supplies such as ±100V. It requires only ±6V or ±5V for switch ON/OFF operation and 3.3V for logic operation.

The HV2903 has two modes of operation: individual switching mode and bank switching mode. The user can select the mode by MODE pin logic input. The 32 analog switches can be controlled individually through digital interface when MODE input is high (Individual switching mode). The digital interface clock operates up to 66 MHz. All 16 even switches and all 16 odd switches can be controlled together through simple 2 logic inputs when MODE input is low (bank switching mode).

The HV2903 has standby mode to decrease power consumption at idle state. When STBY logic input is low, it operates in standby mode and consumes very low current. When STBY logic input is high, it operates normally.

1.3 HV2903 ANALOG SWITCH EVALUATION BOARD - FEATURES

• One HV2903 32-Channel HV Analog Switches without HV Supplies
• Designed to work with Microchip HV MUX Controller Board
• Two 2:1MUX with built-in MD1822 + TC6320 pulsers
• 5 MHz 3 level voltage pulse waveform outputs
• On-board 330 pF//2.5 kΩ dummy load per SW8A, SW9A, SW24A, SW25A
• Mode selection and Switch ON/OFF control through PC GUI and controller board
• Pulser ON/OFF and time domain control through PC GUI and controller board

1.4 HV2903 ANALOG SWITCH EVALUATION BOARD - FUNCTIONAL DESCRIPTION

The HV2903 Analog Switch Evaluation Board can control the HV2903 operation and built-in pulsers that are connected to two 2:1 MUX switches for demonstration. Four switch output of two 2:1 MUX have SMA connectors, and the user can connect four transducer elements. The other side of the 2:1 MUX is connected to two built-in MD1822 + TC6320 pulsers. The HV2903 Analog Switch Evaluation Board can drive four transducer elements with 5 MHz ±100V pulse signals.

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The evaluation board features one HV2903/AHA 12x12x1.2 mm 132-lead TFBGA packaged integrated circuit, two MD1822K6-G 3x3x1 mm 16-lead QFN packaged integrated circuits and four TC6320K6-G 4x4x1 mm 8-lead DFN packaged NMOS and PMOS pair integrated circuits.

The board uses two high-speed 20 signal pair carrying capable right-angle backplane connector, which is designed to work with Microchip HV MUX Controller Board (ADM00825) as a control signal source.

The HV MUX Controller Board has an FPGA that generates pulser waveform and logic control signals and a USB-bridge IC that connects the control board to a PC. By means of a Microsoft Windows® driver and GUI, the user can control the HV2903 and two built-in pulsers.

Four switch terminals consisting two MUX configuration on the PCB have SMA connectors to which user can connect loads. Jumpers close to SMA connectors are for connecting the on-board dummy R-C load (330 pF//2.5 KΩ) optionally to the pulser output.

WARNING
Risk warning of electrical shock. This board uses **multiple hazardous high voltages**. Disconnect all high voltage supplies before working on it. **Electrical safety precautions** must be taken when working on or using this board.

1.5 HV2903 ANALOG SWITCH EVALUATION BOARD TECHNICAL KIT

Parameter	Value
HV2903 Modes of Operation	Individual Switching, Bank Switching and Standby modes
Pulser frequency	5 MHz
Number of pulses in the train	1 to 90
T_{OFF} time between pulse trains	5 to 30 msec
Pulse Peak Voltage & Current	0 to ±100V and ±3A typical
Interface of FPGA Control Signals & USB PC-GUI Software	J1 and J2 Connects to ADM00825 Controller Interface Board
Pulser R-C Test-Load & User's Transducer Interface	Built-in, 330 pF//2.5 KΩ per Channel with jumper and 50Ω SMA
PCB Board Dimension	115x110 mm (4.5x4.3 in.)
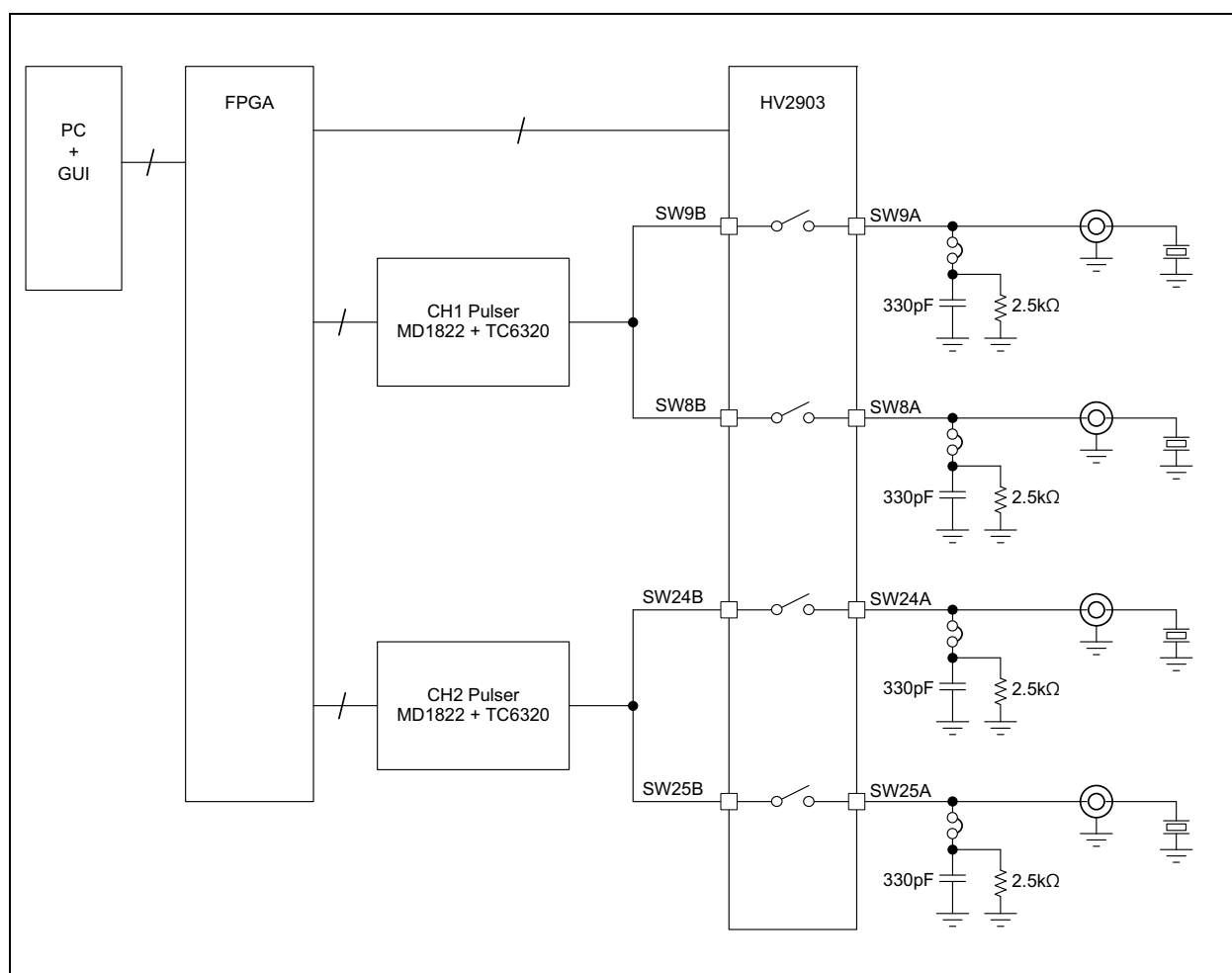
FIGURE 1-1: *HV2903 Analog Switch Evaluation Board Simplified Block Diagram.*

1.6 WHAT THE HV2903 ANALOG SWITCH EVALUATION BOARD KIT INCLUDES

The HV2903 Analog Switch Evaluation Board includes:

• HV2903 Analog Switch Evaluation Board (ADM00795)
• Important Information Sheet

Chapter 2. Installation and Operation

2.1 GETTING STARTED

The HV2903 Analog Switch Evaluation Board is fully assembled and tested. The board requires six power supply voltage rails of +3.3V, +10V, ±6.0V and ±100V.

2.1.1 Additional Tools Required for Operation

1. An oscilloscope with minimum 500 MHz bandwidth and two high-impedance probes
   - make sure the grounds of the power supply sources are correctly connected to the same ground as the testing oscilloscope ground
2. A Microchip HV MUX Controller (ADM00825)
3. A Microsoft Windows® 7 PC that has the HV MUX Controller GUI software installed and running.
   - connect J1 and J2 to the HV MUX Controller
   - connect the HV MUX Controller via USB to the Windows 7 PC

2.2 HV MUX GUI INSTALLATION

The HV MUX GUI software installer can be downloaded from the Microchip web site at www.mircochip.com. Search for the evaluation board on the web site by part number ADM000795.

1. Open the HVMUXGUI-v1.0.0-windows-installer.exe.
2. Initiate the HV MUX GUI software installer by launching the Application Install dialog box.
3. Click **Next** to start the installation.

FIGURE 2-1:   *HV MUX GUI - Application Install Dialog Box.*

4. Read the License Agreement and accept by checking the box corresponding to "I accept the agreement", then click **Next** to proceed with the installation.
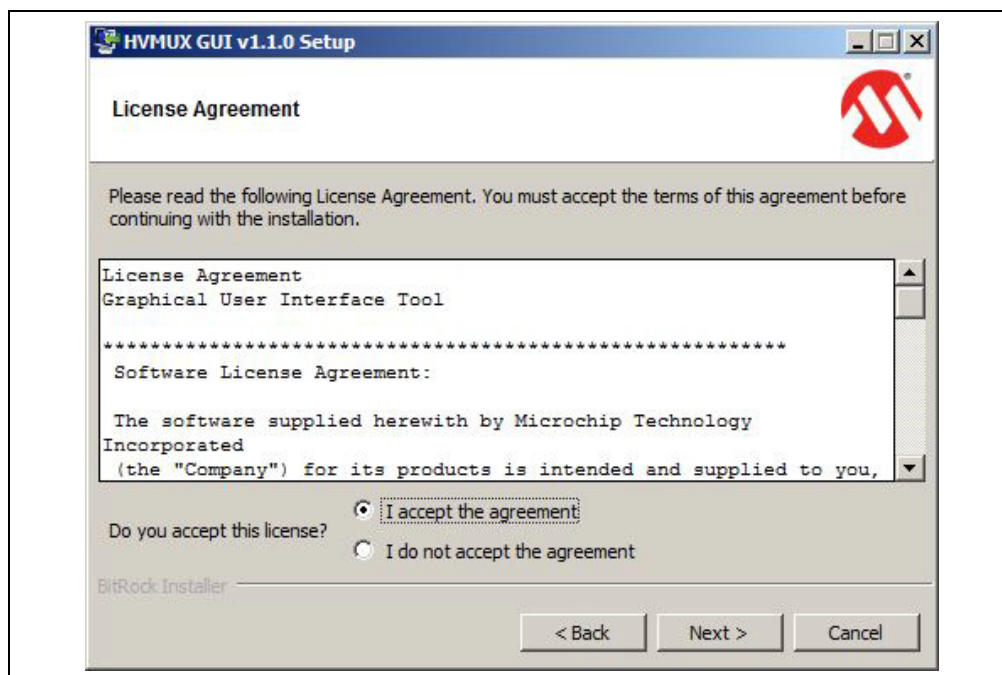
FIGURE 2-2: *HV MUX GUI - License Agreement Dialog Box.*

5. On the Installation Directory dialog box, browse for the desired location, or click **Next** to install in the default location.
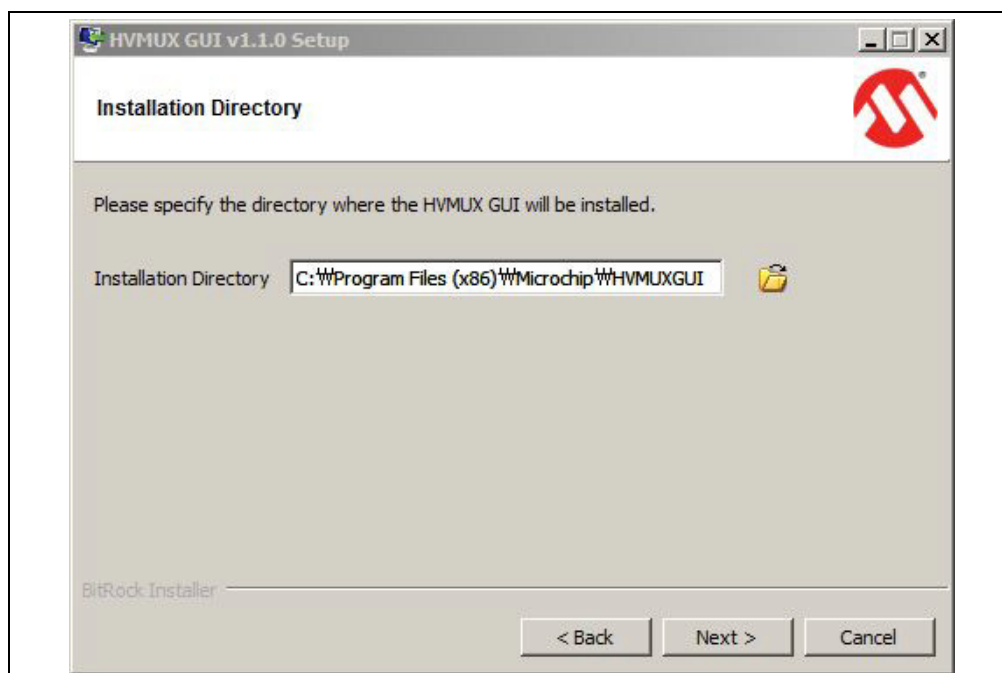
FIGURE 2-3: *HV MUX GUI - Installation Directory Dialog Box.*

6. Once the installation path is chosen, the software is ready to install. Click **Next.**
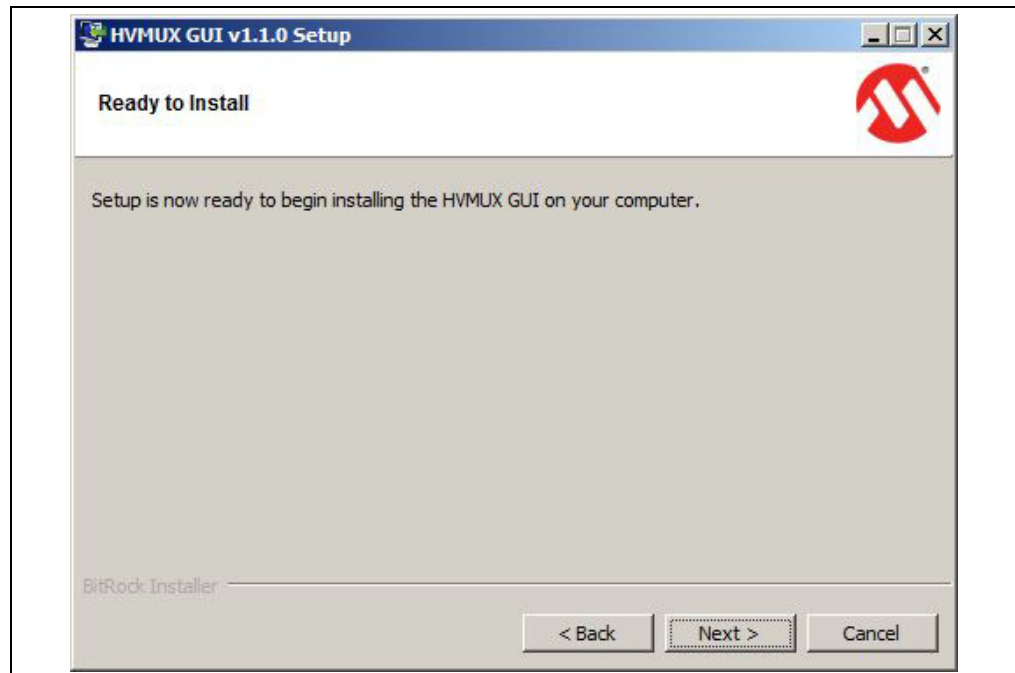
FIGURE 2-4: *HV MUX GUI - Ready to Install Dialog Box.*

7. The installation status window appears, showing the installation progress.
8. After the installation has completed, Click **Next** to continue.
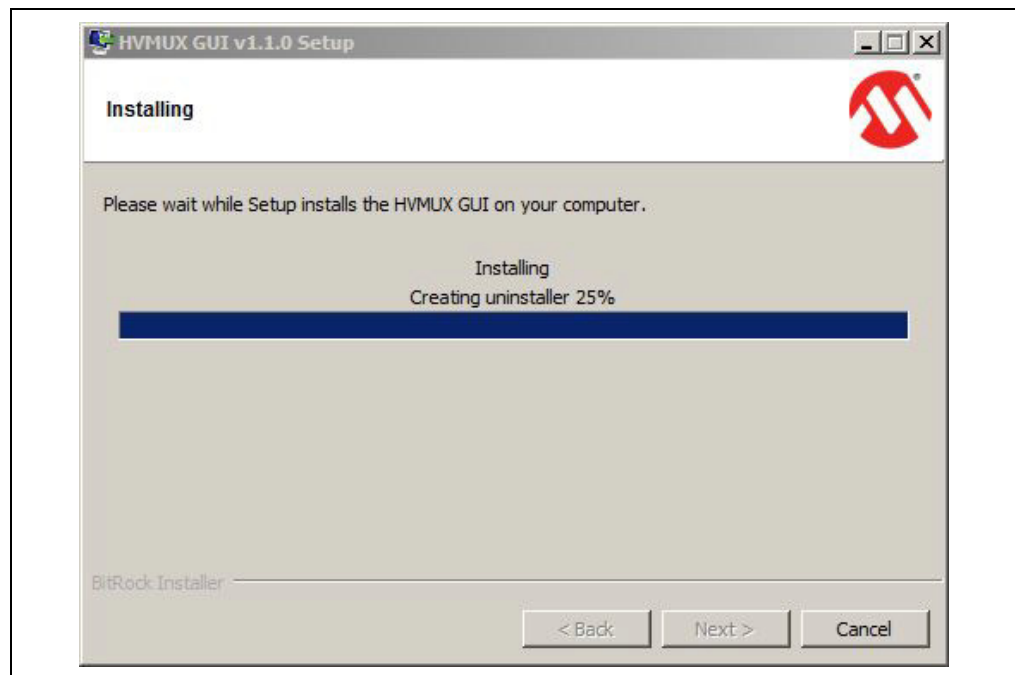
FIGURE 2-5: *HV MUX GUI - Installation Status Dialog Box.*

9. Once Installation Complete dialog box appears, click the **Finish** button to exit the installer.
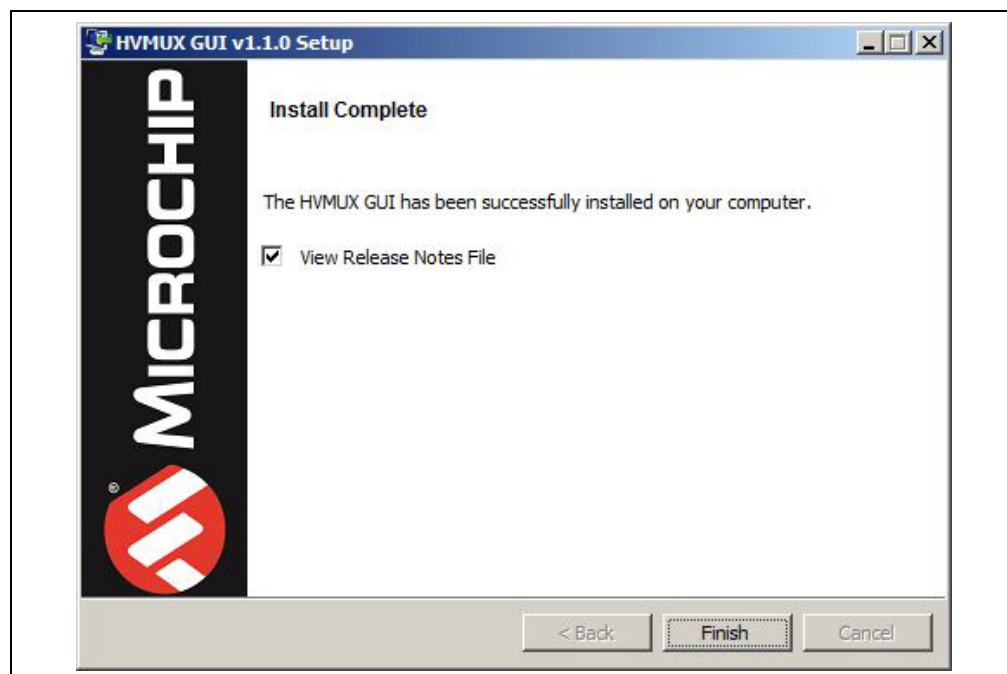
FIGURE 2-6:   *HV MUX GUI - Installation Complete Dialog Box.*

2.3   SETUP PROCEDURE

To operate the HV2903 Analog Switch Evaluation Board, the following steps must be completed:

1. Attach to the HV MUX Controller (ADM00825) with connector J1 and J2.
2. Connect all jumpers on J5, J6, J7 and J11 for the on-board R-C load.
3. Connect all power supplies to the voltage supply input connector J3 and J4, as indicated in Table 2-1 by observing the polarity.

WARNING
Please observe the polarity of each power supply rail and set the voltage and current limit carefully.

4. Turn on the V_{SS} first and then turn on the V_{DD}.
5. Turn on the V_{LL}.
6. Turn on the V_{GP} and V_{PP}/V_{NN}.
7. Connect a USB cable from the Controller Board to the PC.
8. Connect +12V/1A power to the Controller Board.
9. Run the HVMUX GUI software in the PC.
10. Click the **Initialize HV MUX Controller** button in the GUI and the status window in the bottom will show an "initialization complete" message.
11. Unselect the $\overline{STBY}$ check box to set HV2903 in normal operation and choose the switching mode by selecting/unselecting the MODE check box.
12. Click the **Set HV MUX** button. All digital control signals are applied to HV MUX.
13. Set the number of pulses and T_{OFF} time of the pulser.
14. Select CH1 or CH2 to set pulser ch1 or pulser ch2.
15. Click the **Start** button. Then, the selected pulser will start to generate pulse trains.

16. Click the Stop Button. Then, the selected pulser will stop generating the pulse train.

TABLE 2-1: POWER SUPPLY VOLTAGES AND CURRENT-LIMIT SETTINGS

Terminal	Rail Name	Voltage	Average-Current Limit
J3-1	V_{DD}	+6V	+20 mA
J3-2	GND	0V	—
J3-3	V_{SS}	–6V	–20 mA
J4-1	V_{LL}	+3.3V	+150 mA
J4-2	GND	0V	—
J4-3	V_{GP}	+5 to +11.5V	+10 mA
J4-4	V_{PP}	+100V	+5 mA
J11-2	V_{NN}	–100V	–5 mA
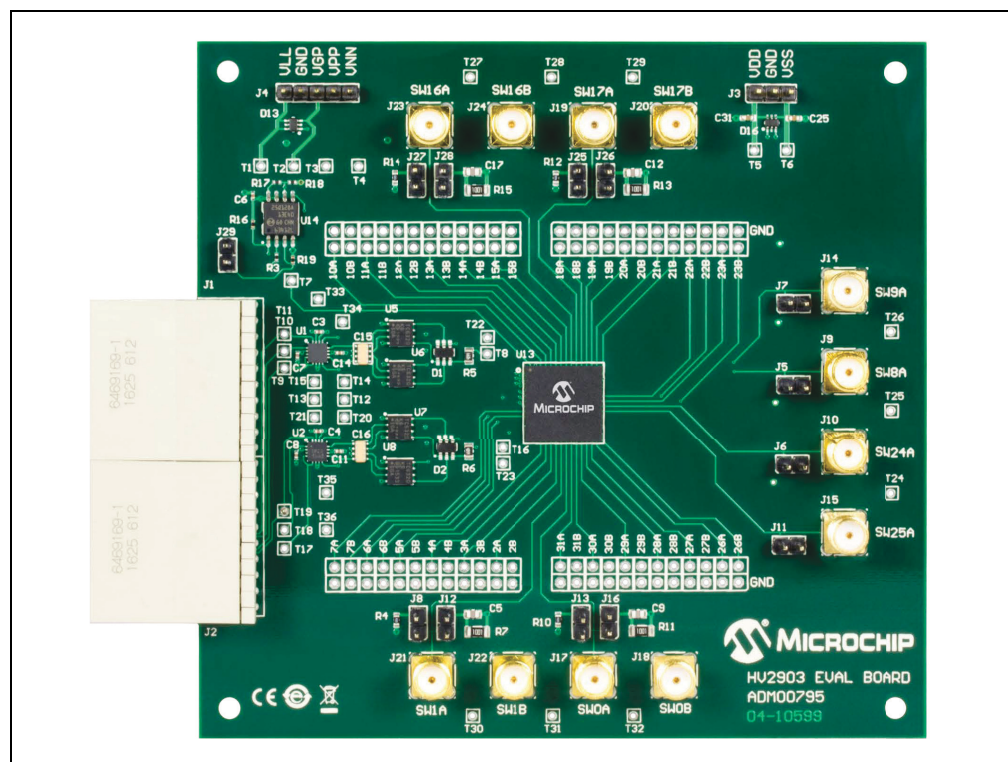
FIGURE 2-7: *HV2903 Analog Switch Evaluation Board - Front View.*

2.3.1 Recommended Power-Up and Power-Down Sequences

Table 2-2 shows the recommended power-up and power-down sequences of the HV2903 Analog Switch Evaluation Board.

TABLE 2-2: HV2903 ANALOG SWITCH EVALUATION BOARD POWER-UP AND POWER-DOWN SEQUENCES

Step	Power-Up Description	Step	Power-Down Description
1	V_{SS} on	1	V_{PP} and V_{NN} off
2	V_{DD} on	2	V_{GP} off
3	V_{LL} on with logic signal low	3	V_{LL} off with logic signal low
4	V_{GP} on	4	V_{DD} off
5	V_{PP} and V_{NN} on	5	V_{SS} off

WARNING

Powering HV2903 Evaluation Board up/down in an arbitrary sequence may cause damage to the device.

2.4 INTERFACE CONNECTIONS

TABLE 2-3: J2 CONTROL INTERFACE SIGNALS

PIN #	Name	Test Point	I/O Type	Signal Discretion
J2-A2	SCK	—	LVCMOS-2.5V Input	EEPROM Serial Clock Input
J2-B2	CSB	—	LVCMOS-2.5V Input	EEPROM Chip Select Input
J2-A3	MISO	—	LVCMOS-2.5V Output	EEPROM Serial Data Output
J2-B3	MOSI	—	LVCMOS-2.5V Input	EEPROM Serial Data input
J2-A5	CLR	TP15	LVCMOS-3.3V Input	HV2903 Latch Clear Logic Input
J2-B5	CLK	TP14	LVCMOS-3.3V Input	HV2903 Clock Logic Input
J2-C5	$\overline{\text{LE/EN}}$	TP12	LVCMOS-3.3V Input	HV2903 Latch Enable Logic Input
J2-D5	MODE	TP13	LVCMOS-3.3V Input	HV2903 Mode Logic Input
J2-A6	DIN/$\overline{\text{AB}}$	TP20	LVCMOS-3.3V Input	HV2903 Data In Logic Input
J2-B6	$\overline{\text{STBY}}$	TP21	LVCMOS-3.3V Input	HV2903 Standby Logic Input, Low active
J2-C6	1_A	TP11	LVCMOS-3.3V Input	Ch1 Pulser input for NMOS to V_{NN}
J2-D6	1_B	TP10	LVCMOS-3.3V Input	Ch1 Pulser input for PMOS to V_{PP}
J2-A7	1_DMP	TP9	LVCMOS-3.3V Input	Ch1 Pulser Damp Input for PMOS/NMOS to GND
J2-B7	2_A	TP19	LVCMOS-3.3V Input	Ch2 Pulser input for NMOS to V_{NN}
J2-C7	2_B	TP18	LVCMOS-3.3V Input	Ch2 Pulser input for PMOS to V_{PP}
J2-D7	2_DMP	TP17	LVCMOS-3.3V Input	Ch2 Pulser Damp Input for PMOS/NMOS to GND

Note 1: All the pins that are not included in this table are no-connect.

2.5 TESTING THE HV2903 ANALOG SWITCH EVALUATION BOARD

2.5.1 HV2903 Individual Switching Mode Operation ($\overline{STBY}$=1, MODE=1):

In the individual switching mode, the user can turn on/off 32 switches individually through the USB connected PC GUI software program:

1. Click the **Initialize HV MUX Controller** button at the top left corner.
2. Unselect $\overline{STBY}$ to set HV2903 in normal operation.
3. Select MODE to set HV2903 in individual switching mode.
4. Put 32 bit data in DIN to set switches ON and OFF. Data `1` means the switch is ON and data `0` means the switch is OFF.
5. Click the **Set HV MUX** button.
6. Then, the GUI and controller board generate 32-bit data and 32 clocks followed by one $\overline{LE}$ negative pulse, and switches are ON and OFF according to DIN in the GUI.
7. If the user selects CLR and then clicks the **Set HV MUX** button, all the switches are OFF.

2.5.2 HV2903 Bank Switching Mode Operation ($\overline{STBY}$=1, MODE=0):

In the bank switching mode, the user can turn on/off all the even switches (SW0, SW2,..., SW30) together and all the odd switches (SW1, SW3,..., SW31) together through the USB connected PC GUI software program:

1. Click the **Initialize HV MUX Controller** button at the top left corner.
2. Unselect $\overline{STBY}$ to set HV MUX in normal operation.
3. Unselect MODE to set HV2903 in bank switching mode.
4. Select EN to set HV2903 bank switching to active. If EN is not selected, all the switches are set to OFF.
5. Select A/$\overline{B}$ to set all the even switches ON and all the odd switches OFF.
6. Or, unselect A/$\overline{B}$ to set all the even switches OFF and all the odd switches ON.
7. Click the **Set HV MUX** button.
8. The GUI and the HV MUX Controller generate digital control signals according to the control data of the GUI that the user sets.

> **Note:** The typical voltage and waveforms are provided in **Appendix C. "Demo Board Waveforms"**.

2.6 HV MUX CONTROLLER AND GUI MANUAL

The HV MUX Controller generates control signals for HV2903 Analog Switch Evaluation Board. It features a Spartan-6 XC6SLX9 FPGA.

2.6.1 SETUP PROCEDURE

1. Before powering up the HV2903 Analog Switch Evaluation Board and the HV MUX Controller, please make sure that the latest GUI software is installed on the PC.
2. Start the GUI program. On the bottom left of the status bar, "Not Connected" will appear.
3. Connect the appropriate power supply and turn on the power switch to power-up the HV MUX Controller. The FPGA_OK(LD1) and DC_IN (LD2) on the HV MUX Controller should light up green. A "Connected" message should be displayed on the bottom left of the status bar of the GUI.

HV2903 Analog Switch Evaluation Board User's Guide

The HV MUX Controller is now ready to control the HV2903 Evaluation Board.
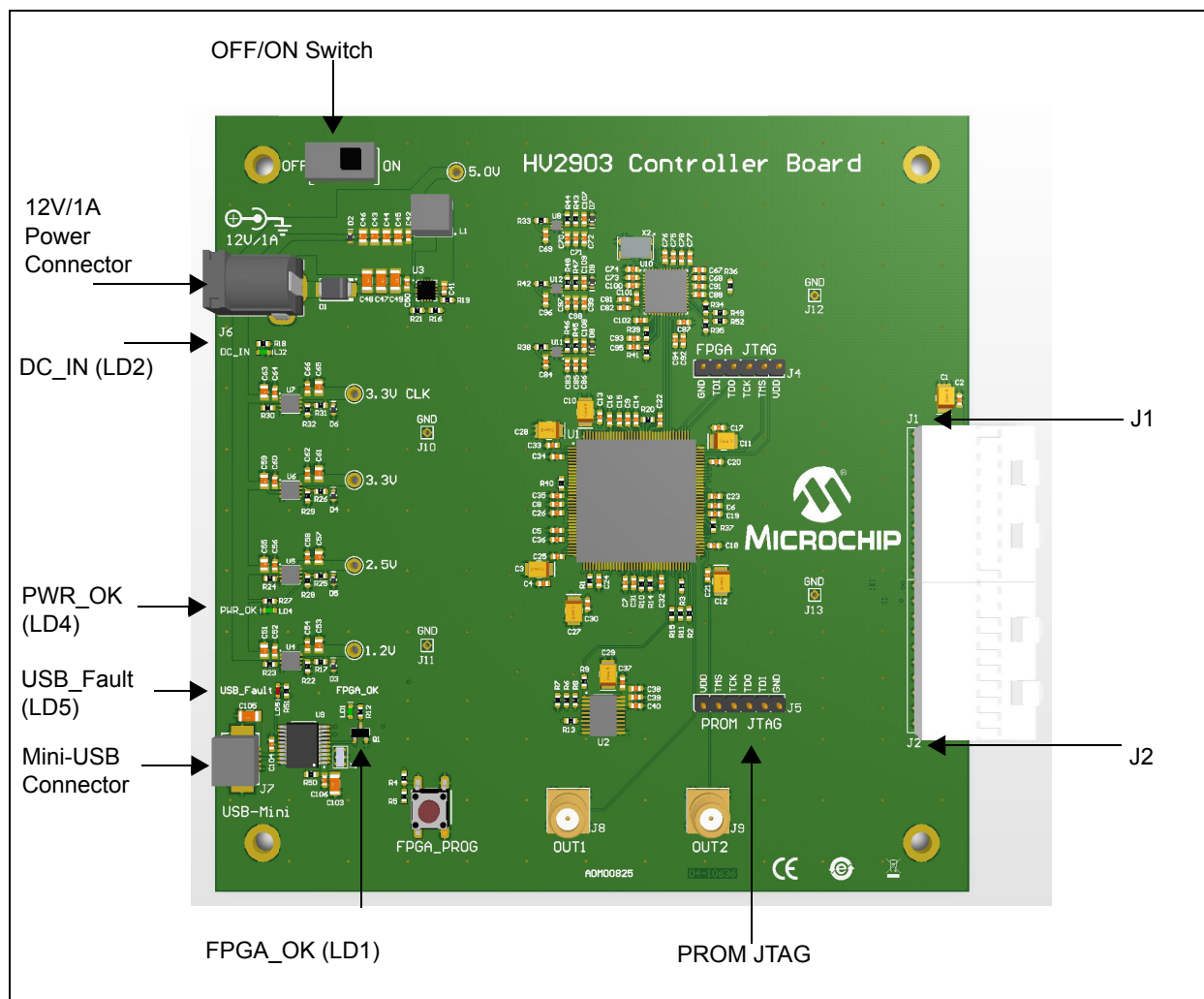
FIGURE 2-8: *HV MUX Controller(ADM00825) - Front View.*

2.6.2   HV2903 Analog Switch Evaluation Board GUI Description

Please see Figure 2-9 for a screen capture of the GUI. Every item indicated by circled numbers is explained after the figure. The selection of the check box, binary data in the DIN entry box and number in Pulses and T_{OFF} entry box are just settings, and do not change the operation of HV2903 and built-in pulsers immediately. By clicking **Set HV MUX**, **Start** and **Stop** buttons, the control data set by the user in the GUI changes operation of HV2903 and turn on/off the built-in pulsers in the HV2903 Analog Switch Evaluation Board. Please see the explanation for each corresponding item.
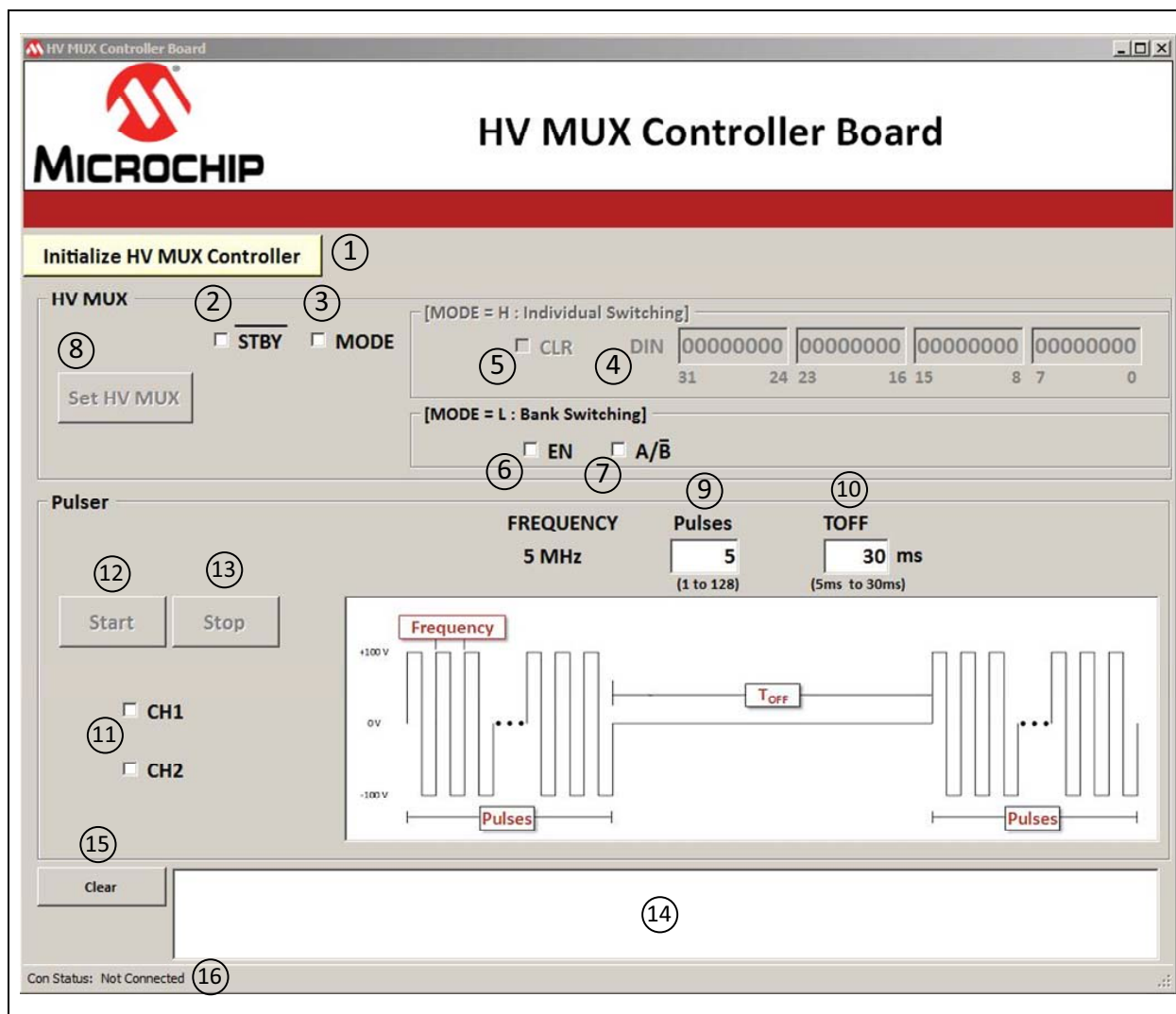
FIGURE 2-9:   *HV MUX Controller Board GUI Screen Capture.*

1. **Initialize HV MUX Controller:** when clicked, the GUI starts the initialization of FPGA on the HV MUX Controller and the communication between the GUI and the HV MUX Controller. If there is no error, the user will see "Initialization Complete" in the message window.

2. $\overline{STBY}$: when unselected, the $\overline{STBY}$ logic input is set to high and HV2903 is set to operate in normal mode. When selected, the $\overline{STBY}$ logic input is set to low and HV2903 is set to operate in standby mode to decrease power consumption.

3. MODE: when selected, the MODE logic input is set to high and HV2903 is set to operate in individual switching mode. When unselected, the MODE logic input is set to low and HV2903 is set to operate in bank switching mode.

4. DIN: 32-bit data entry boxes. Each bit in the boxes is related to each analog switch. If data entry is 1, the associated switch is set to ON. If data entry is 0, the associated switch is set to OFF.

5. CLR: when selected, the CLR logic input is set to high and all the switches of HV2903 are set to OFF. When unselected, the CLR logic input is set to low and the 32 switches of HV2903 are set to ON/OFF states, according to the DIN data entry.

6. EN: when selected, the EN logic input is set to high and HV2903 is set to active for bank switching mode. When unselected, the EN logic input is set to low and

all the switches are set to OFF.

7. A/$\overline{B}$: when selected, the A/$\overline{B}$ logic input is set to high, all the even switches are set to ON and all the odd switches are set to OFF. When unselected, the A/$\overline{B}$ logic input is set to low, all the even switches are set to OFF and all the odd switches are set to ON.

8. **Set HV MUX:** when clicked, the data that the user sets at steps 2 to 7 is applied to HV2903. Please note that the 32-bit DIN data, 32 clocks and one negative $\overline{LE}$ pulse are applied one time only at the individual switching mode.

9. Pulses: entry box to define the number of pulses in the pulse train generated by the selected pulser. A pulse is a half of the cycle and the pulse train always starts the positive pulse first.

10. TOFF: entry box to define the OFF time between pulse trains generated by the selected pulser.

11. CH1/CH2: when checked, the selected pulser is set to generate 5 MHz pulse trains defined at steps 9 and 10 by the user.

12. **Start:** when clicked, the selected pulser starts generating the pulse train.

13. **Stop:** when clicked, the selected pulser stops generating the pulse train.

14. Message window: shows information from the GUI program.

15. **Clear:** when clicked, the messages in the message window are cleared.

16. Connection Status window: shows status of the connection between the GUI and the HV MUX Controller.

2.7   GENERATION OF PULSER OUTPUT AT SW8A OF HV MUX

This section provides the simple step-by-step procedure to make the Ch1 pulser output at SW8A SMA connector by configuring the GUI.

1. Before powering up the HV2903 Analog Switch Evaluation Board, make sure that the latest GUI software is installed on the PC.

2. Start the GUI program. On the bottom left of the status bar, "Not Connected" will appear.

3. Power up the HV MUX Controller and HV2903 Analog Switch Evaluation Board as described in the previous section. The prompt "Connected" will appear in the status bar.

4. Click the **Initialize HV MUX Controller** button and check the message window to see "Initialization Complete".

5. Unselect $\overline{STBY}$ to set the HV2903 to operate normally.

6. Select MODE to set the HV2903 to individual switching mode.

7. Change the DIN to Bit 8 from 0 to 1 to set SW8 ON (DIN = 00000000 00000000 00000001 00000000).

8. Click the **Set HV MUX** button. HV2903 SW8 will turn on.

9. Change Pulses to 10.

10. Select CH1.

11. Click the **Start** button. The CH1 pulser will start to generate pulse trains with 10 pulses and 30 ms T_{OFF} time.

The Ch1 and Ch2 of the oscilloscope in Figure 2-10 show the SW8A and the SW9A.

CH1
50V/div

CH2
50V/div

| Ch1 | 50.0 V | Ch2 | 50.0 V | M | 200ns | A | Ch1 ʃ | 18.0 V |

20.20 %
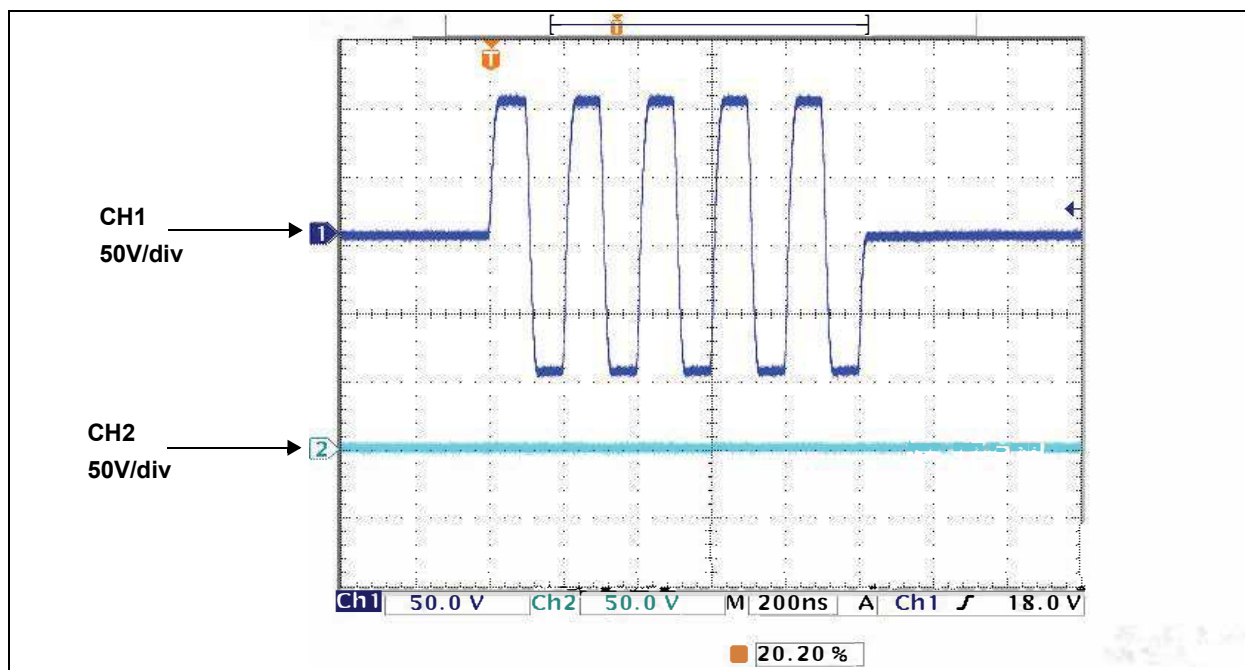
FIGURE 2-10:   *Typical Waveform of 2:1 MUX Connected to Pulser.*

NOTES:

Chapter 3. PCB Design and Layout Notes

3.1 PCB LAYOUT TECHNIQUES FOR HV2903

The HV2903 is an analog switch to pass high-voltage, high-current and high-frequency pulses. The PCB design and layout are important to ensure the success of the implementation.

3.1.1 High-Voltage & High-Speed Grounding and Layout Techniques

The center balls at the bottom of the HV2903 TFBGA package are internally connected to the IC's substrate (V_{SUB}). These balls should be connected to GND, externally on the PCB.

The designer must pay attention to the connecting traces, since the analog switches pass the high-voltage and high-speed signals. In particular, controlled impedance of 50Ω to the ground plane and more trace spacing needs to be applied in this situation.

High-speed PCB trace design practices are used for the HV2903 PCB layout. The internal circuitry of the HV2903 can operate at quite a high frequency, with the primary speed limitation being the load capacitance. Because of this high speed and the high transient currents that result from driving capacitive loads, the supply voltage bypass capacitors should be as close to the pins as possible.

All the GND pins should have low inductance feed-through via connections that are connected directly to a solid ground plane at the second layer of the PCB.

It is advisable to minimize the trace length to the ground plane, and to insert a ferrite bead in the power supply lead to the capacitor to prevent resonance in the power supply lines.

Pay particular attention to minimizing trace lengths and using sufficient trace width to reduce inductance. Surface mount components are highly recommended.

The use of a solid ground plane and good power and signal layout practices will prevent any possible parasitic capacitance coupling. The user should also ensure that the circulating ground return current from a capacitive load cannot react with common inductance to create noise voltages in the input logic circuitry.

3.1.2 Decoupling Capacitors Selection

The V_{LL}, V_{DD} and V_{SS} supply voltage rails can provide fast transient current. Therefore, they should have a low-impedance bypass capacitor at each of the chip's pins. Use a surface-mounted ceramic capacitor of 1.0 to 2.2 µF capacitance with an appropriate voltage rating.

The user needs to pay additional attention to what type of ceramic capacitor is selected for these bypass capacitors. The low impedance means low ESR/ESL impedance within the frequency bandwidth range of ultrasound pulses transmitted, including the very fast dV/dt of the pulse's rising and falling edges. A capacitor with low-temperature coefficient and low-voltage coefficient is also recommended. The type of X7R and X5R or other more advanced multilayer-ceramic types should be selected for these purposes.

Appendix A. Schematic & Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the HV2903 Analog Switch Evaluation Board (ADM00795) and the HV MUX Controller Board (ADM00825)

- HV2903 Analog Switch Evaluation Board (ADM00795):
  - ADM00795 - Schematic
  - ADM00795 - Top Silk
  - ADM00795 - Top Copper and Silk
  - ADM00795 - Top Copper
  - ADM00795 - Inner 1
  - ADM00795 - Inner 2
  - ADM00795 - Inner 3
  - ADM00795 - Bottom Copper
  - ADM00795 - Bottom Copper and Silk
  - ADM00795 - Bottom Silk
- HV MUX Controller Board (ADM00825):
  - ADM00825 - Schematic (Connection)
  - ADM00825 - Schematic (Power Supply)
  - ADM00825 - Schematic (USB to SPI)
  - ADM00825 - Schematic (Programmable Clock)
  - ADM00825 - Schematic (FPGA)
  - ADM00825 - Schematic (FPGA Decoupling Capacitors)
  - ADM00825 - Schematic (Connectors)
  - ADM00825 - Top Silk
  - ADM00825 - Top Copper and Silk
  - ADM00825 - Top Copper
  - ADM00825 - Inner 1
  - ADM00825 - Inner 2
  - ADM00825 - Inner 3
  - ADM00825 - Inner 4
  - ADM00825 - Bottom Copper
  - ADM00825 - Bottom Copper and Silk
  - ADM00825 - Bottom Silk