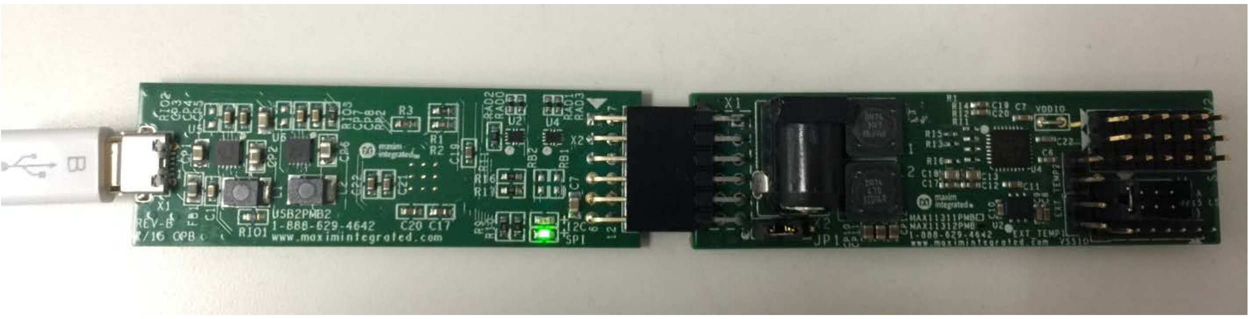


MAX11312PMB# Peripheral Module and Munich2 (USB2PMB2#) Adapter Board Quick Start Guide

UG6232; Rev 0; 3/16

Abstract

This document explains how the MAX11312PMB#, which features the MAX11312 12-port programmable mixed-signal I/O device, interfaces with the Munich2 (USB2PMB2#) adapter board and how to use the GUI.

Table of Contents

1. Required Equipment

- PC with Windows® OS (Windows XP®, Windows Vista®, Windows 7, Windows 8, and Windows 8.1) with one USB port
- MAX11312PMB# board
- Munich2 (USB2PMB2#) board
- USB Type A to Micro B Cable
- Munich2 Software GUI

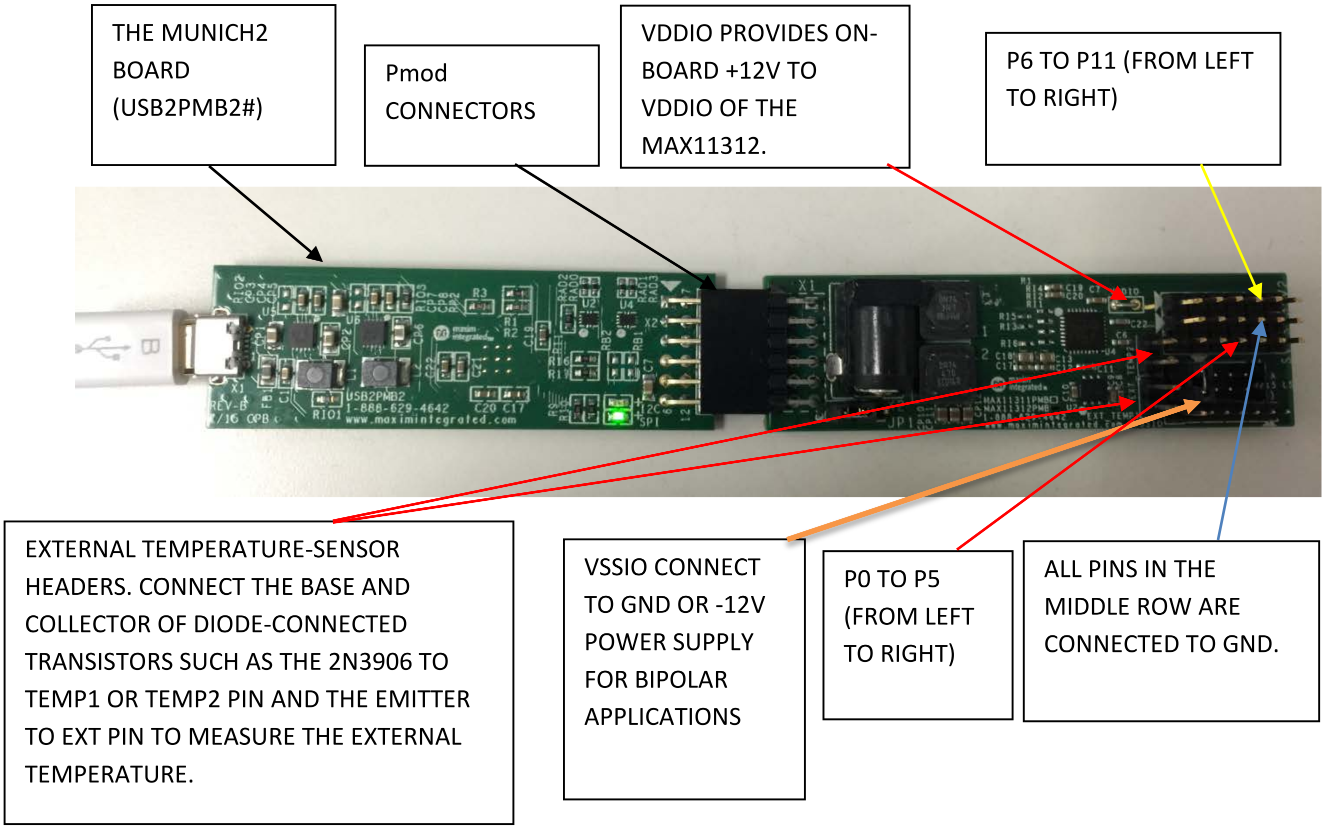
2. Overview

This document explains how the MAX11312PMB# featuring the MAX11312 12-port programmable mixed-signal I/O device interfaces with the Munich2 (USB2PMB2#) adapter board, and how to navigate through the tool.

The MAX11312PMB# peripheral module provides the necessary hardware to interface the MAX11312 12-port device to any system that utilizes Pmod™-compatible expansion ports configurable for I^2C communication (**Figure 1**). MAX11311/MAX11312 configuration software is a design tool to create the configuration bit stream, which is downloaded to the MAX11312 through the Munich2 adapter board (**Figure 2**).

Refer to the MAX11312 IC data sheet for detailed information regarding operation of the IC and to the USB2PMB2# adapter board data sheet for detailed information regarding the Munich2 board and GUI. Refer to the MAX11311/MAX11312 PIXI™ Configuration Software User Guide for detailed information using the design tool.

The Munich Software GUI and the USB2PMB2# adapter board are referred to as Munich2 throughout this document.



THE MUNICH2 BOARD (USB2PMB2#)

Pmod CONNECTORS

VDDIO PROVIDES ON-BOARD +12V TO VDDIO OF THE MAX11312.

P6 TO P11 (FROM LEFT TO RIGHT)

EXTERNAL TEMPERATURE-SENSOR HEADERS. CONNECT THE BASE AND COLLECTOR OF DIODE-CONNECTED TRANSISTORS SUCH AS THE 2N3906 TO TEMP1 OR TEMP2 PIN AND THE EMITTER TO EXT PIN TO MEASURE THE EXTERNAL TEMPERATURE.

VSSIO CONNECT TO GND OR -12V POWER SUPPLY FOR BIPOLAR APPLICATIONS

P0 TO P5 (FROM LEFT TO RIGHT)

ALL PINS IN THE MIDDLE ROW ARE CONNECTED TO GND.

Figure 1. MAX11312PMB# connected to Munich2 adapter board.

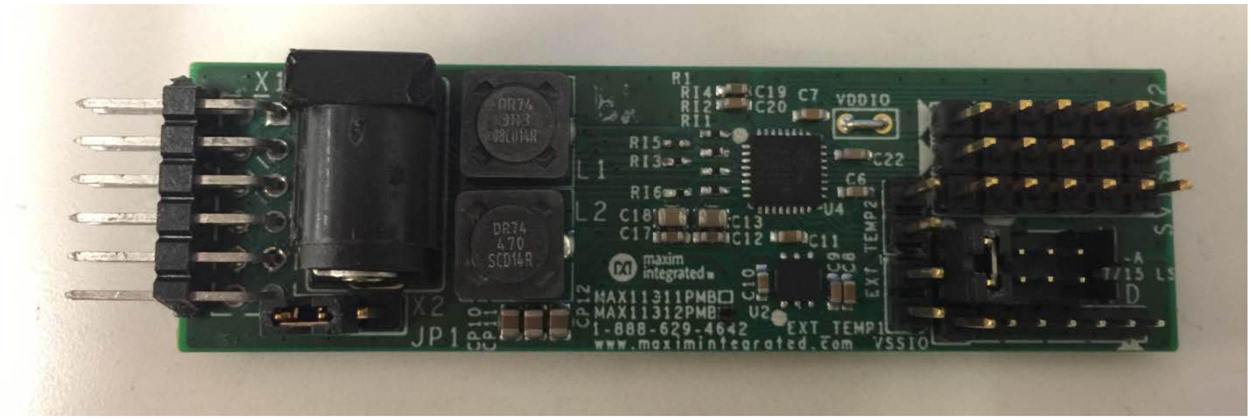


Figure 2. MAX11312PMB# Board.

The Munich2 adapter board is designed to supply power to external boards (i.e., MAX11300PMB1, MAX11311PMB, MAX11312PMB, Santa Fe, and many more) through the connector X2. It is intended to provide power supply to the interface circuitry present in the connected board.

Figure 3 shows the pin configuration for the I^{2}C-compatible connector at the MAX11312PMB# board. The MAX11312PMB# board itself generates positive voltages from 3.3V on pins 11 and 12 with an on-board DC-DC converter. The 3.3V supply is limited to ~1.5W, limiting power available for the MAX11312PMB# if a higher watt power supply is required and external power supply is used. Refer to the MAX11312PMB data sheet for details.

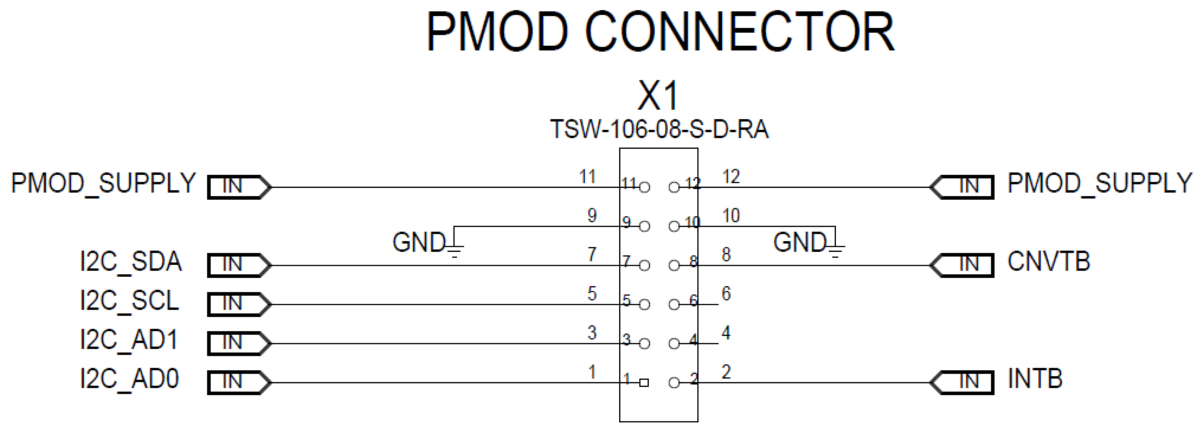
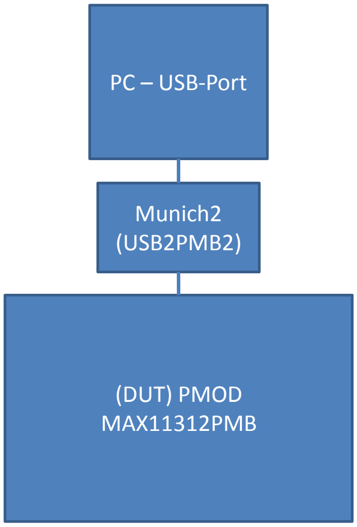


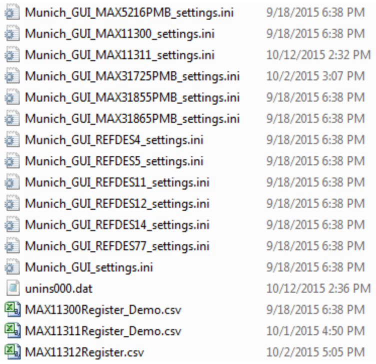
Figure 3. I^{2}C connector inputs found on the MAX11312PMB#.

3. Included Files

Included files are the MAX11311/MAX11312 configuration software and Munich GUI (see **Figure 4**). The Munich GUI evaluates this MAX11312PMB# and other Pmod designs from Maxim Integrated.



Included Files:
GUI and the configuration-File
for each Tab.
Driver installs automatically on
WinXP, Win7, Win8, and
Win8.1 if PC is Connected to
Internet .

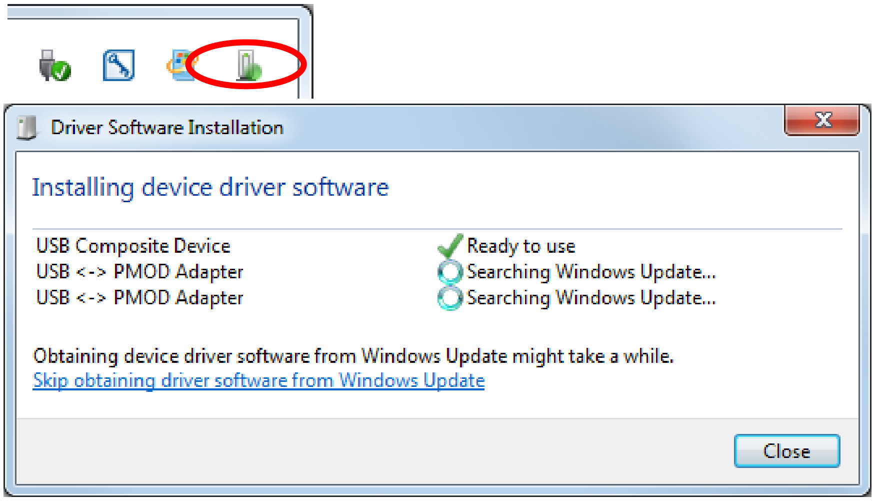


Munich_GUI_MAX5216PMB_settings.ini	9/18/2015 6:38 PM
Munich_GUI_MAX11300_settings.ini	9/18/2015 6:38 PM
Munich_GUI_MAX11311_settings.ini	10/12/2015 2:32 PM
Munich_GUI_MAX31725PMB_settings.ini	10/2/2015 3:07 PM
Munich_GUI_MAX31855PMB_settings.ini	9/18/2015 6:38 PM
Munich_GUI_MAX31865PMB_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES4_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES5_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES11_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES12_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES14_settings.ini	9/18/2015 6:38 PM
Munich_GUI_REFDES77_settings.ini	9/18/2015 6:38 PM
Munich_GUI_settings.ini	9/18/2015 6:38 PM
unins000.dat	10/12/2015 2:36 PM
MAX11300Register_Demo.csv	9/18/2015 6:38 PM
MAX11311Register_Demo.csv	10/1/2015 4:50 PM
MAX11312Register.csv	10/2/2015 5:05 PM

Figure 4. MAX11312PMB#/Munich2 included files.

4. Procedure

1) Go to www.maximintegrated.com/evkitsoftware to download the most recent version of the Munich board software, **Munich GUI**. Double-click on the installation file **Munich GUISetupV2.09.exe** to install the GUI.
2) Connect the USB cable between the Munich board and the PC; the USB driver is installed automatically (internet connection required). Alternately, install the FTDI driver by double-clicking on the **CDM V2.08.30 WHQL Certified.exe** application file in the **FTDI Driver.zip** folder. See **Figure 5**, **Figure 6**, and **Figure 7**.



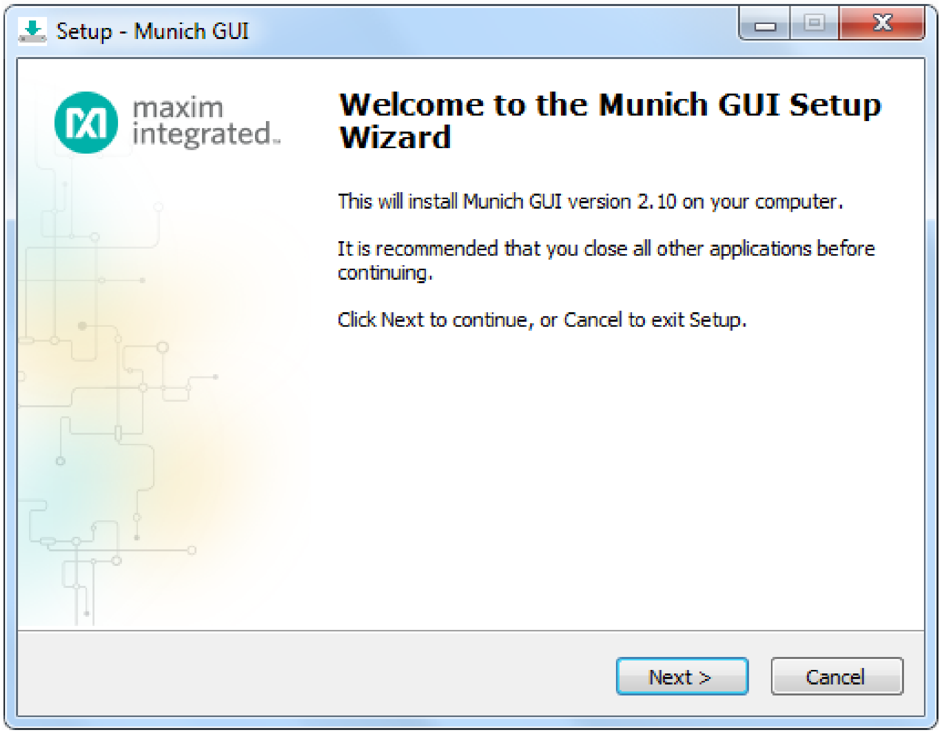
Driver Software Installation

Installing device driver software

USB Composite Device ✓ Ready to use
USB <-> PMOD Adapter ○ Searching Windows Update...
USB <-> PMOD Adapter ○ Searching Windows Update...

Obtaining device driver software from Windows Update might take a while.
Skip obtaining driver software from Windows Update

Figure 5. Driver installation for Munich board.



Setup - Munich GUI

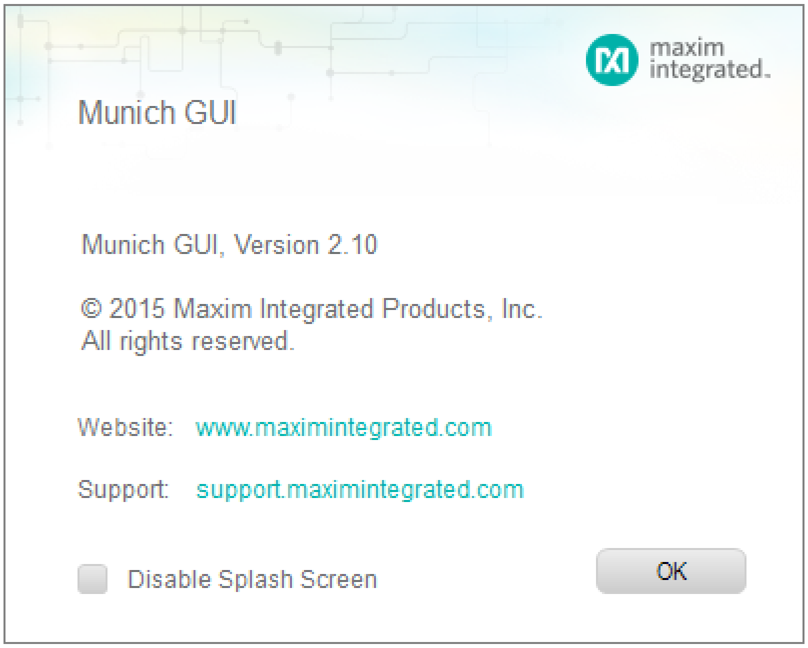
Welcome to the Munich GUI Setup Wizard

This will install Munich GUI version 2.10 on your computer.

It is recommended that you close all other applications before continuing.

Click Next to continue, or Cancel to exit Setup.

Figure 6. Munich GUI setup wizard.



Munich GUI

Munich GUI, Version 2.10

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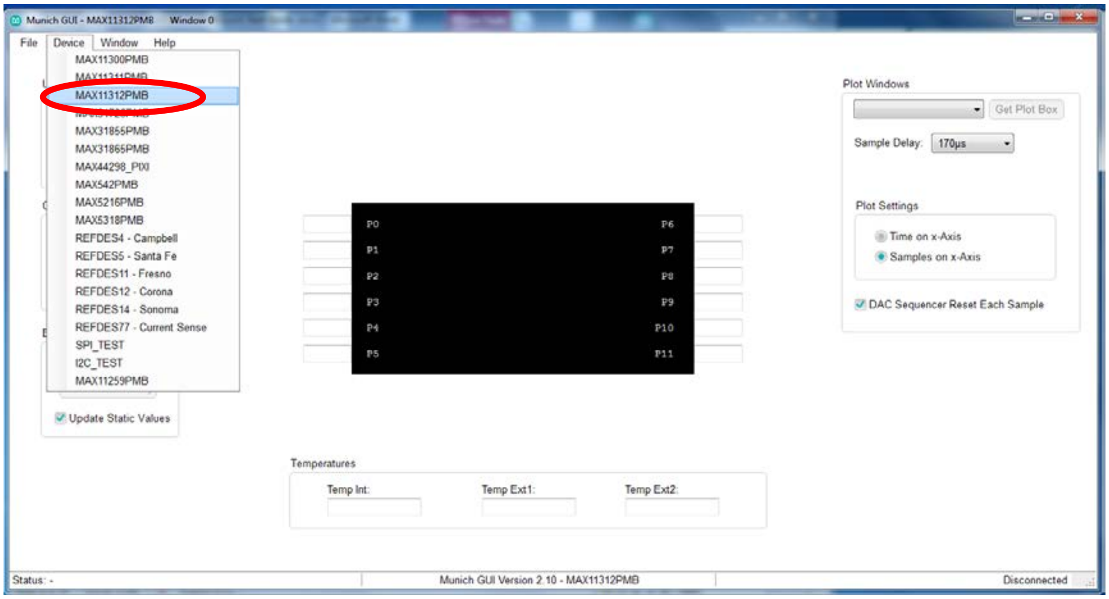
Website: www.maximintegrated.com

Support: support.maximintegrated.com

□ Disable Splash Screen

Figure 7. Munich GUI at startup.

3) Ensure that the jumper settings for JP1 and VSSIO power supplies are correct (JP1 and VSSIO jumpers are connected from pin 1 to pin 2). Refer to the MAX11312PMB# datasheet for further details.
4) Connect the Munich board's 2x6 pin right-angle connector to the MAX11312PMB#'s 2x6 pin right-angle header.
5) Once the Munich board is connected with the MAX11312PMB#, open the **Munich GUI.exe** (double-click) software.
6) Click on **Device** tab and select the **MAX11312PMB#** as shown in **Figure 8**, the Munich GUI.



Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

☑ Update Static Values

Status: - | Munich GUI Version 2.10 - MAX11312PMB | Disconnected

Figure 8. The Munich GUI.

7) Press the **Scan Adapters** pushbutton to scan the available Munich boards connected to the computer. This allows the user to test multiple companion driver boards at the same time. Each Munich board has a unique ID that the software determines.
   Scan and Select: Figure 9 depicts the scanning and available Munich devices connected. The software automatically identifies the device—PMOD806924A.

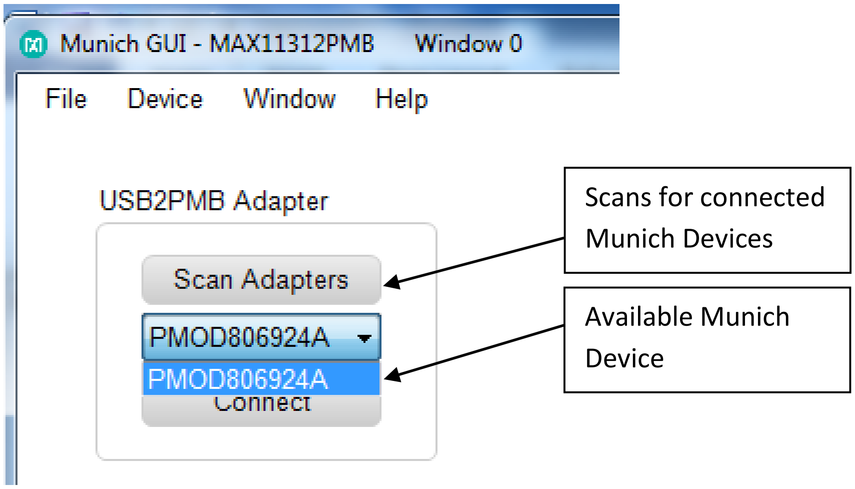
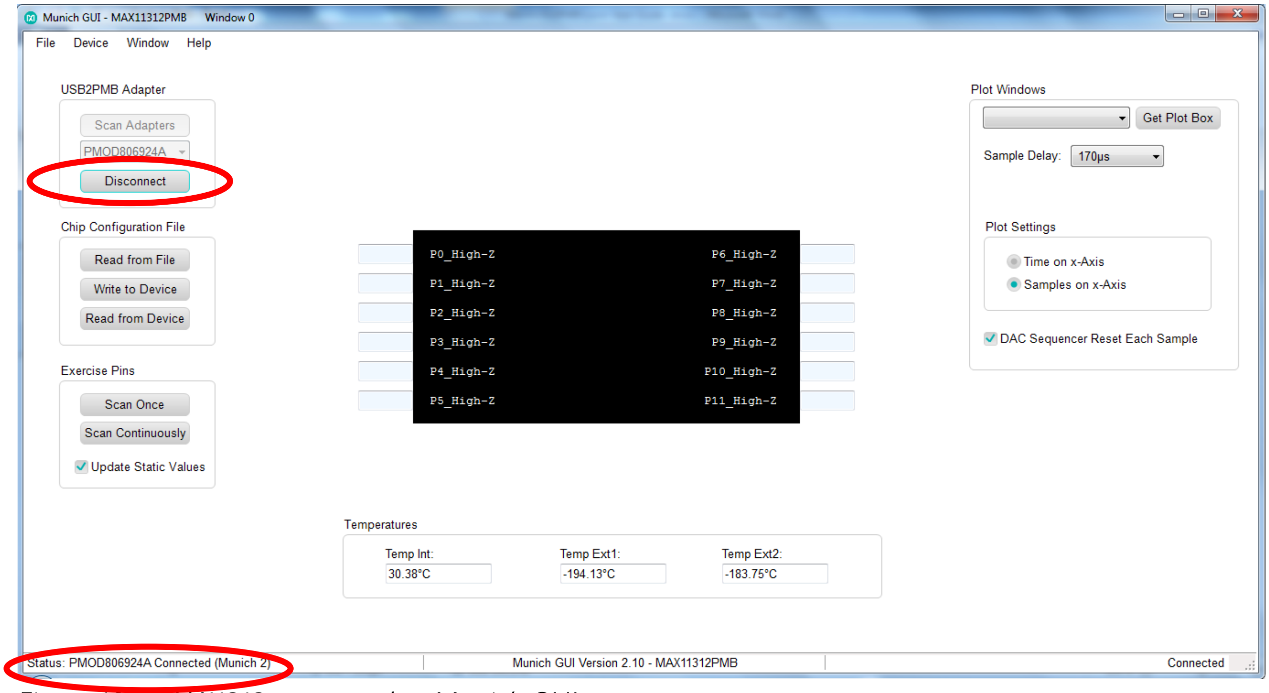


Figure 9. Connect PMOD adapter.

8) Within the tab sheet, press the **Connect** button and verify that the button changes its text to **Disconnect,** and the status bar at the bottom indicates that the companion board is connected. See **Figure 10**.



☑ Update Static Values

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

```
P0_High-Z        P6_High-Z
P1_High-Z        P7_High-Z
P2_High-Z        P8_High-Z
P3_High-Z        P9_High-Z
P4_High-Z        P10_High-Z
P5_High-Z        P11_High-Z
```

Temp Int: 30.38°C
Temp Ext1: -194.13°C
Temp Ext2: -183.75°C

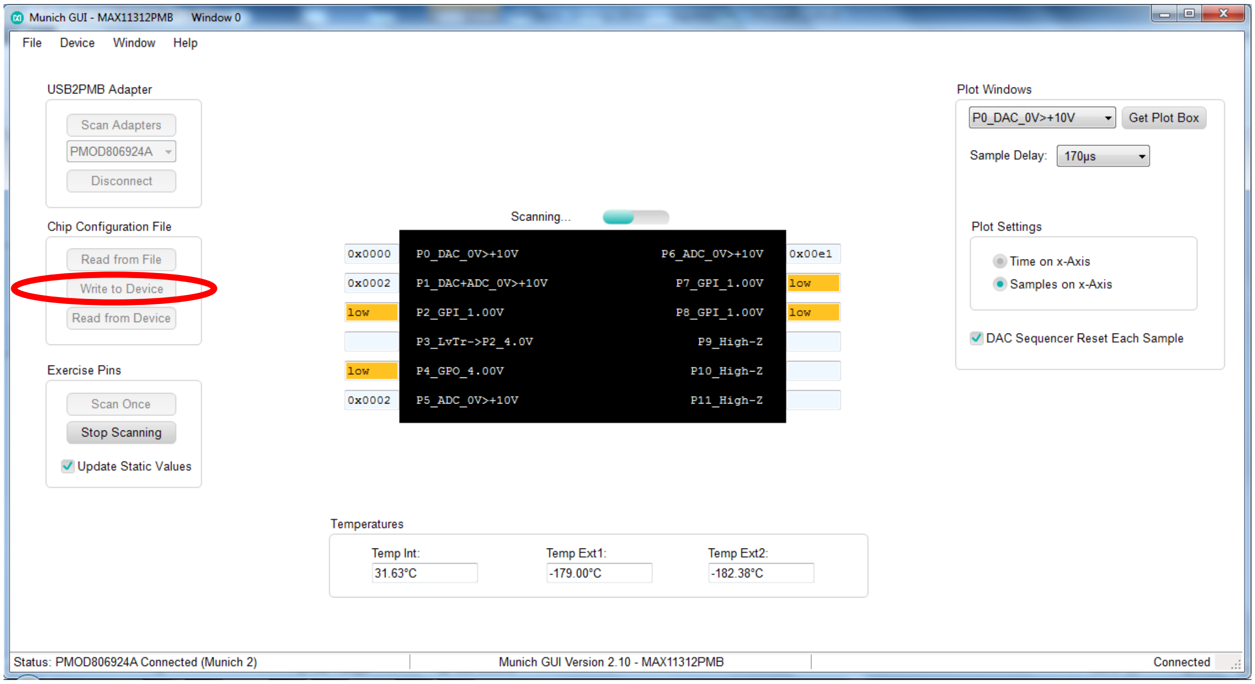
Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 10. MAX11312 connected to Munich GUI.

5. Munich GUI

The Munich GUI contains the internal block diagram of the MAX11312 device showing the 12 programmable I/Os with their programmed setting.

At startup, the MAX11312 device is un-programmed. To program the device, click on **Chip Configuration File | Read from File** and select a .csv file that was created with the MAX11312 Configuration Software tool. In the example provided, the **MAX11312Register_Demo.csv** was selected. Next, write this 'configuration bit stream' to the MAX11312 device by clicking on **Chip Configuration File | Write to Device** as shown in **Figure 11**.



PMOD806924A

☑ Update Static Values

Scanning...

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x00e1
0x0002	P1_DAC+ADC_0V>+10V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	P10_High-Z	
0x0002	P5_ADC_0V>+10V	P11_High-Z	

P0_DAC_0V>+10V

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

Temp Int: 31.63°C

Temp Ext1: -179.00°C

Temp Ext2: -182.38°C

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 11. Configuration example.

5.1 Write to Device

Click this button to transfer the configuration bit stream to the MAX11312. After updating the device, the port name is updated to reflect the configuration. Use the **Scan** command to read the status. In this case, **P5_ADC** shown in **Figure 11** denotes that Port 5 is configured as an ADC.

The functions supported by the Munich GUI are as follows:

- Configuration
- Get Predefined Waveform Files
- Choose Sample Delay and Single or Continue Scan Mode
- View/Save Plots
- Plot View Options

Once the MAX11312 device is configured, click on **Scan Continuously.** The GUI then exercises each port with the programmed function.

5.2 Part Configuration

If the port is configured as:

a. **General-Purpose Input Port (GPI):** The user-defined logic level is read from the port and written to the appropriate port box.

b. **General-Purpose Output Port (GPO):** The user-defined logic level defined in the port text box is written to the port (use either "0" / "1" or "high" / "low").

c. **DAC Analog Output:** The value written to the text box is applied to the port. For DAC analog outputs, it is also possible to apply a complete waveform. To do that, select a target DAC-port, and to apply a waveform, click on **Get Plot Box** on the top right. A separate window opens, and a comma separated file (.adc) that contains hex or decimal numbers can be read with up to 1024 samples (see **Figure 12**). There are a few waveform examples provided for sawtooth and sine and triangle waveforms; these files have the suffix .adc*. Note that once a plot box for the port is open, the text box in the GUI main window is ignored.

d. **ADC Analog Input:** the hexadecimal number in the text box corresponds to the voltage applied to the pin. Note that the ADC input type and the input range is selected in the configuration tool. As with the DAC configuration, you can also open a plot box by selecting the appropriate pin and clicking on **Get Plot Box** on the top right. If a plot box is open, the plot box shows the waveform applied to the ADC input pin.

e. **Differential ADC Input:** The MAX11312 can be configured for differential ADC mode using two ports. The operation of the GUI is the same as in step d.

f. **Level Translator:** The IC acts correctly, but the GUI would only show static values for the input and the output.

**Although the files have suffix .adc, the content is a simple hex value that can either be a file saved from an ADC analog input, or as a file that can be opened and written to a DAC to provide an analog output.*

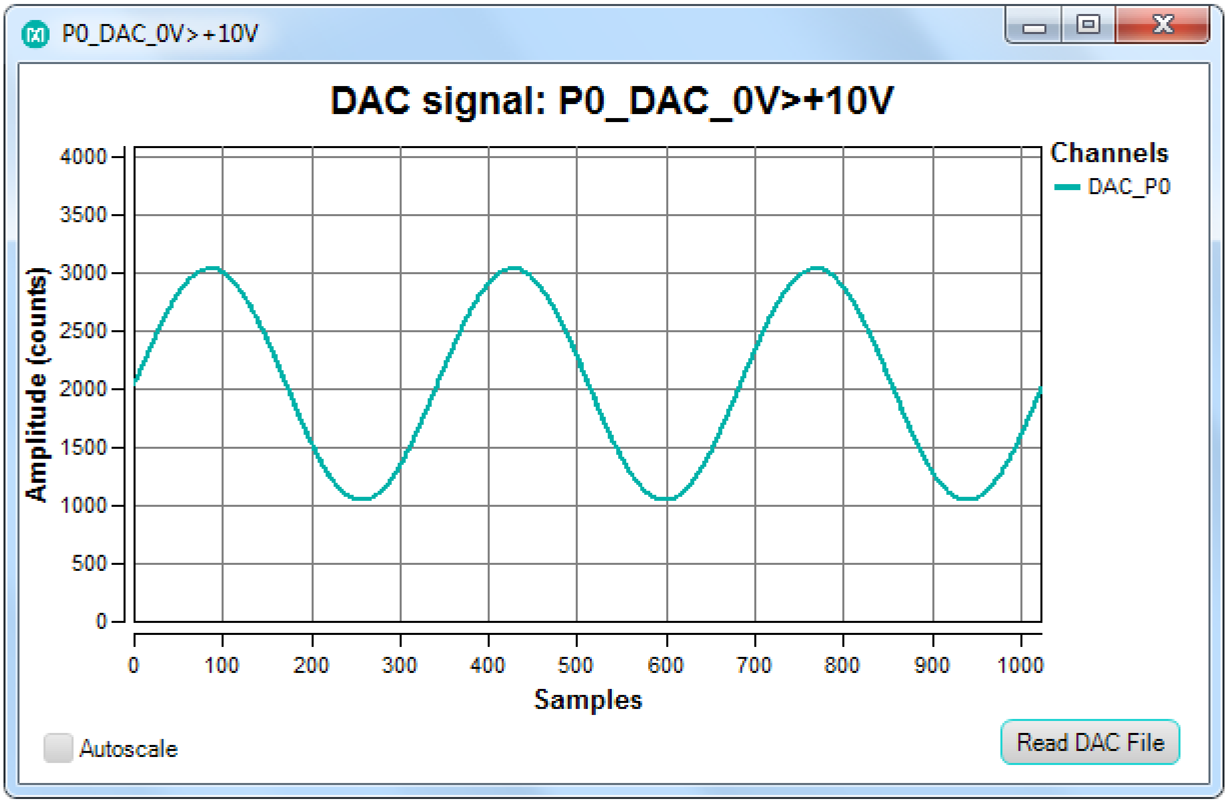


Figure 12. DAC plot box.

The GUI also displays the three temperature-sensor measurements in degrees Celsius (°C). The internal device temperature measures the IC die temperature. For the external temperature measurements, add diode-connected transistors sensors such as a 2N3906 to each channel.

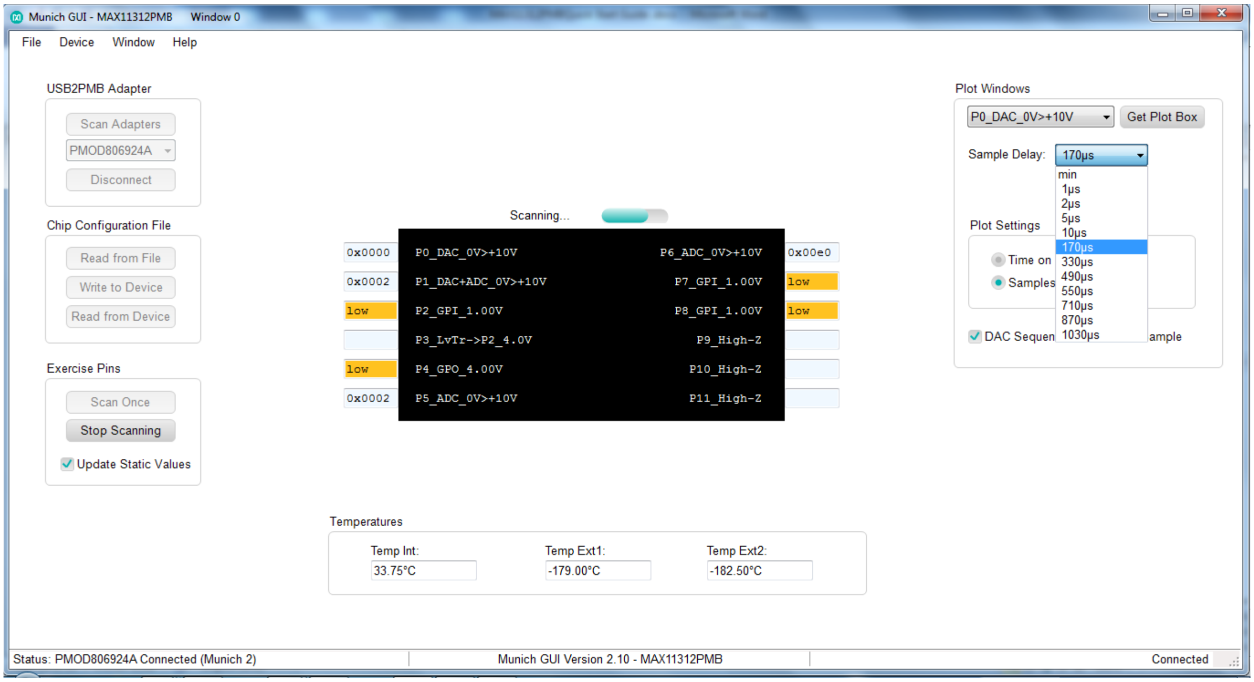
5.3 Sampling

The flexibility of MAX11312 supports different modes of operation including different sampling schemes:

a. **Scan Once:** In this mode the software reads the status of each input port a single time, and displays the value of each port.

b. **Scan Continuously:** In this mode the software continually loops, reading all input ports and updating the display to show the value of each port.

c. **Sample Delay:** This drop-down menu allows the user to select up to 1030µs delay. This delay is enabled by the GUI between each complete sequence of ADC read. See **Figure 13**.



PMOD806924A

☑ Update Static Values

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x00e0
0x0002	P1_DAC+ADC_0V>+10V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	P10_High-Z	
0x0002	P5_ADC_0V>+10V	P11_High-Z	

Temp Int: 33.75°C
Temp Ext1: -179.00°C
Temp Ext2: -182.50°C

P0_DAC_0V>+10V

Sample Delay: 170µs

○ Time on
● Samples

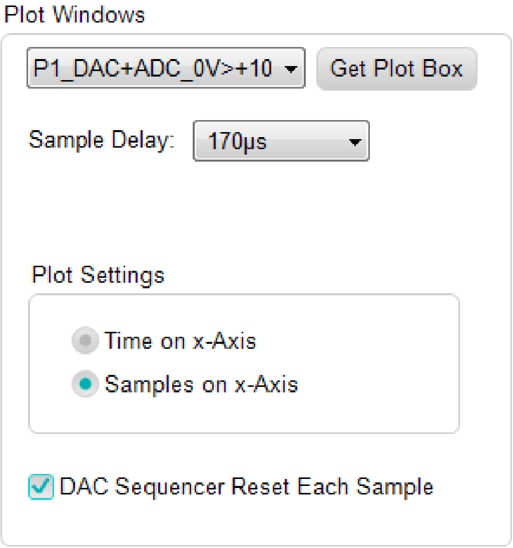
☑ DAC Sequen ... ample

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 13. Sample delay drop-down menu.

5.4 DAC Sequencer Reset Each Sample

The DAC ports can be updated in different ways, either following a default sequence, or as soon as new data is received, or using one of two data values, which can be programmed to all DAC ports. This button when selected enables the DAC to be updated as soon as new data is received at the DAC Data register. See **Figure 14**.



P1_DAC+ADC_0V>+10

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

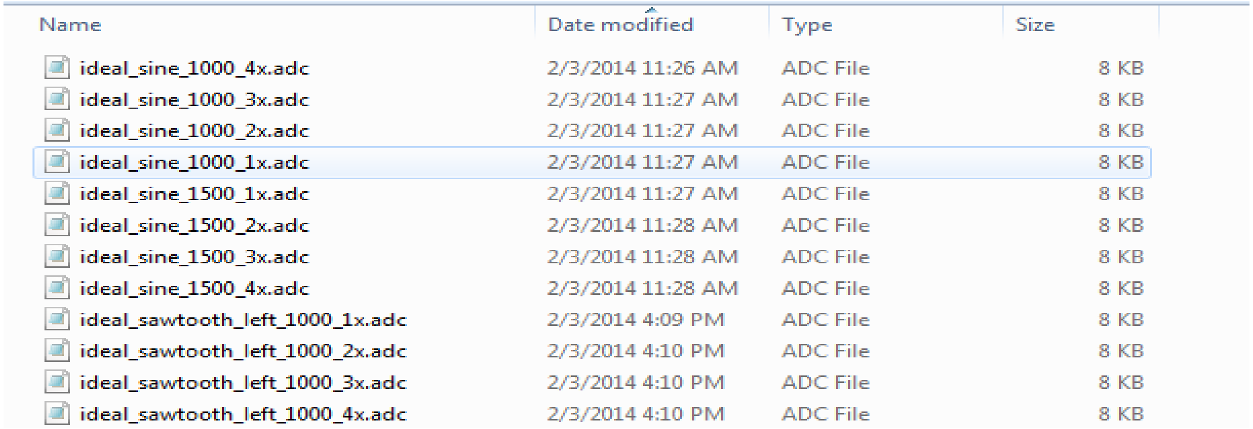
☑ DAC Sequencer Reset Each Sample

Figure 14. DAC sequencer reset.

6. Examples

The MAX11312PMB# software includes a number of waveform plots and examples for configuring and testing the MAX11312.

Figure 15 lists the files provided with the software tool. The files with suffix .ADC are predefined waveform plots that can be used as input values to ports configured in DAC mode. The files with suffix .csv are example configurations showing different ways the MAX11312 can be configured. The files with suffix .mpix are design files from MAX11312 configuration software.



Name	Date modified	Type	Size
ideal_sine_1000_4x.adc	2/3/2014 11:26 AM	ADC File	8 KB
ideal_sine_1000_3x.adc	2/3/2014 11:27 AM	ADC File	8 KB
ideal_sine_1000_2x.adc	2/3/2014 11:27 AM	ADC File	8 KB
ideal_sine_1000_1x.adc	2/3/2014 11:27 AM	ADC File	8 KB
ideal_sine_1500_1x.adc	2/3/2014 11:27 AM	ADC File	8 KB
ideal_sine_1500_2x.adc	2/3/2014 11:28 AM	ADC File	8 KB
ideal_sine_1500_3x.adc	2/3/2014 11:28 AM	ADC File	8 KB
ideal_sine_1500_4x.adc	2/3/2014 11:28 AM	ADC File	8 KB
ideal_sawtooth_left_1000_1x.adc	2/3/2014 4:09 PM	ADC File	8 KB
ideal_sawtooth_left_1000_2x.adc	2/3/2014 4:10 PM	ADC File	8 KB
ideal_sawtooth_left_1000_3x.adc	2/3/2014 4:10 PM	ADC File	8 KB
ideal_sawtooth_left_1000_4x.adc	2/3/2014 4:10 PM	ADC File	8 KB

Figure 15. MAX11312PMB# files.

The Munich GUI is provided with an example configuration file for the examples in **Figure 15**. To create a configuration file, a separate tool is needed: **MAX11311/MAX11312 Configuration Software**.

A step-by-step guide to use the example register file is as follows:

1. Ensure the Munich board is connected to the MAX11312PMB# board and the USB is connected to a PC through a USB Type A to Micro B Cable as shown in **Figure 16**.

2. Ensure the **MAX11312PMB#** tab is opened in the Munich GUI and the adapter number is shown in top-left corner. If you have multiple USB2PMB2 adapters, verify the serial numbers.

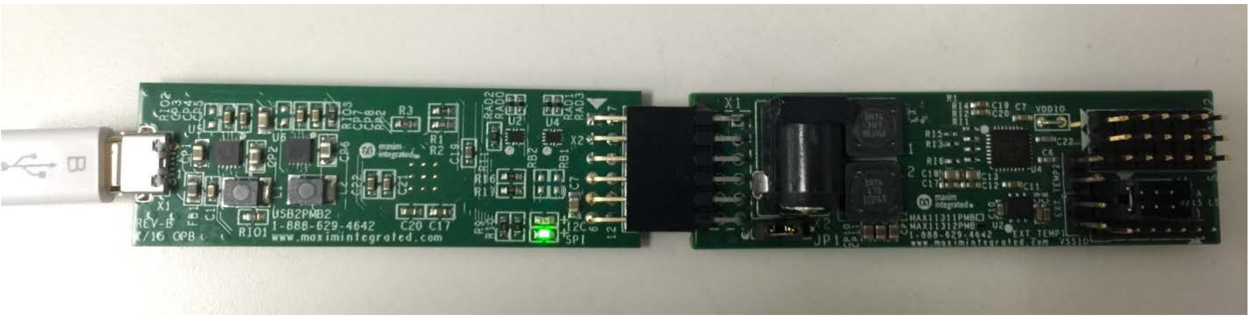
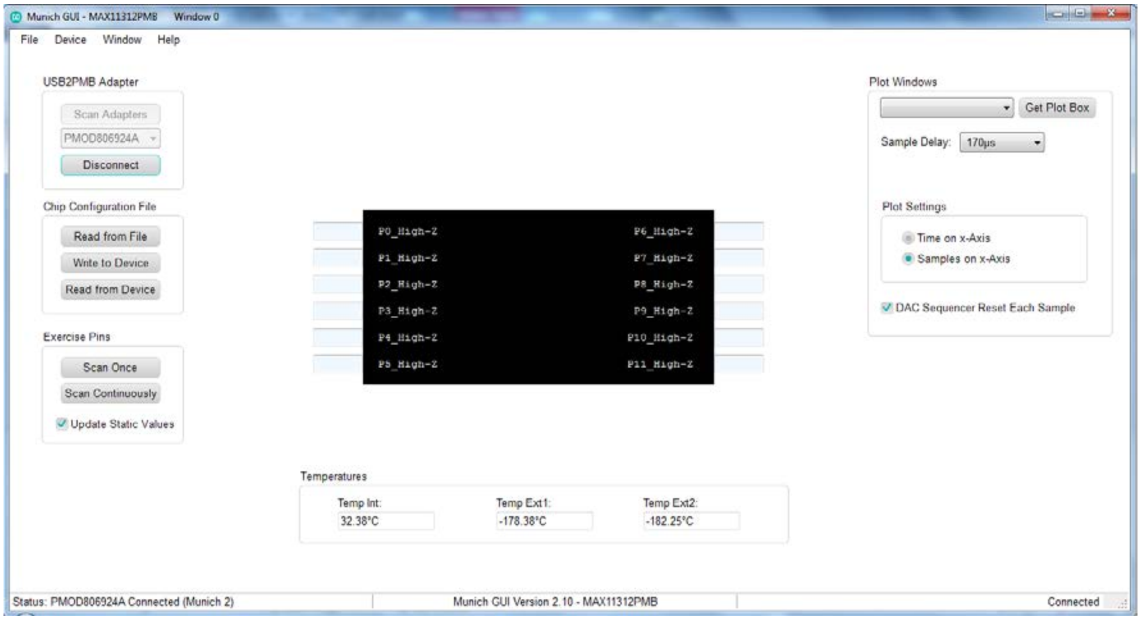


Figure 16. MAX11312PMB#/Munich2 connected to a PC through a USB cable.

3. Click the **Connect** button. The Munich GUI then reads the current configuration from the connected MAX11312PMB# and displays the pin description for each pin. If the device is powered up, every pin is high-Z (high impedance) as shown in **Figure 17**.



PMOD806924A

P0_High-Z	P6_High-Z
P1_High-Z	P7_High-Z
P2_High-Z	P8_High-Z
P3_High-Z	P9_High-Z
P4_High-Z	P10_High-Z
P5_High-Z	P11_High-Z

☑ Update Static Values

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

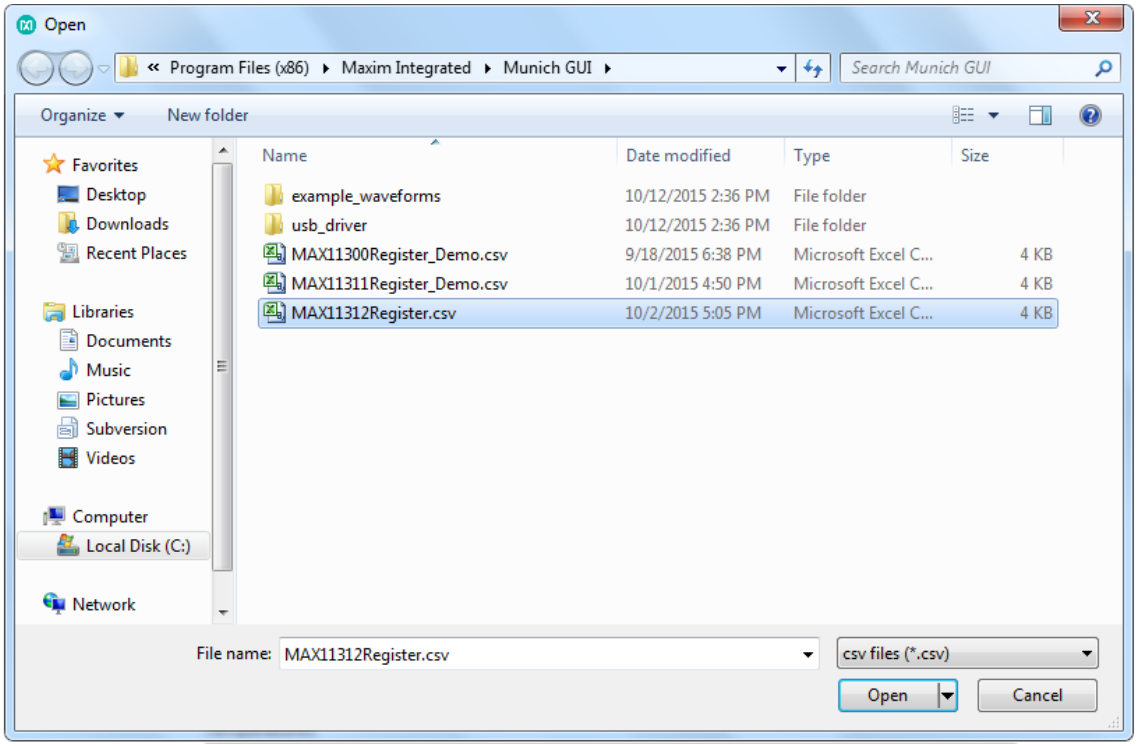
☑ DAC Sequencer Reset Each Sample

Temp Int: 32.38°C
Temp Ext1: -178.38°C
Temp Ext2: -182.25°C

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 17. Munich GUI at startup.

4. Under Configuration, click on **Read from File** and select the register file **MAX11312Register_Demo.csv** as shown in **Figure 18**.



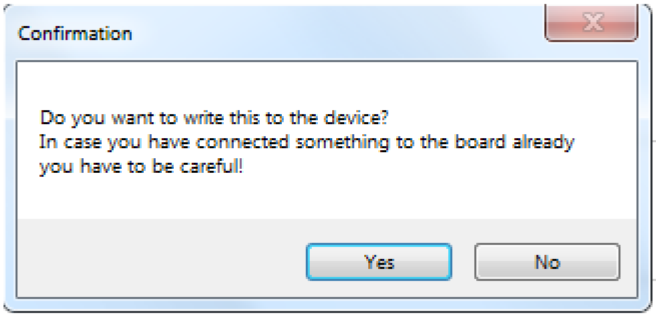
Name	Date modified	Type	Size
example_waveforms	10/12/2015 2:36 PM	File folder	
usb_driver	10/12/2015 2:36 PM	File folder	
MAX11300Register_Demo.csv	9/18/2015 6:38 PM	Microsoft Excel C...	4 KB
MAX11311Register_Demo.csv	10/1/2015 4:50 PM	Microsoft Excel C...	4 KB
MAX11312Register.csv	10/2/2015 5:05 PM	Microsoft Excel C...	4 KB

File name: MAX11312Register.csv

csv files (*.csv)

Figure 18. Register files.

5. The Munich GUI now shows all pin descriptions in the GUI according to the register file. But the GUI does not immediately write it to the device, allowing the user opportunity to double-check. This step is only important if something is already connected to the MAX11312 ports as a DAC can provide up to ±10V and potentially destroy the external circuitry. Also, do not connect 2-DAC ports together (shorted) and set to **different voltage levels. In addition, GPI ports can only support levels between 0V and 5V**. Therefore, do not connect a DAC to a GPI with a voltage outside of the allowed range. A **Confirmation** window appears as depicted in **Figure 19**.



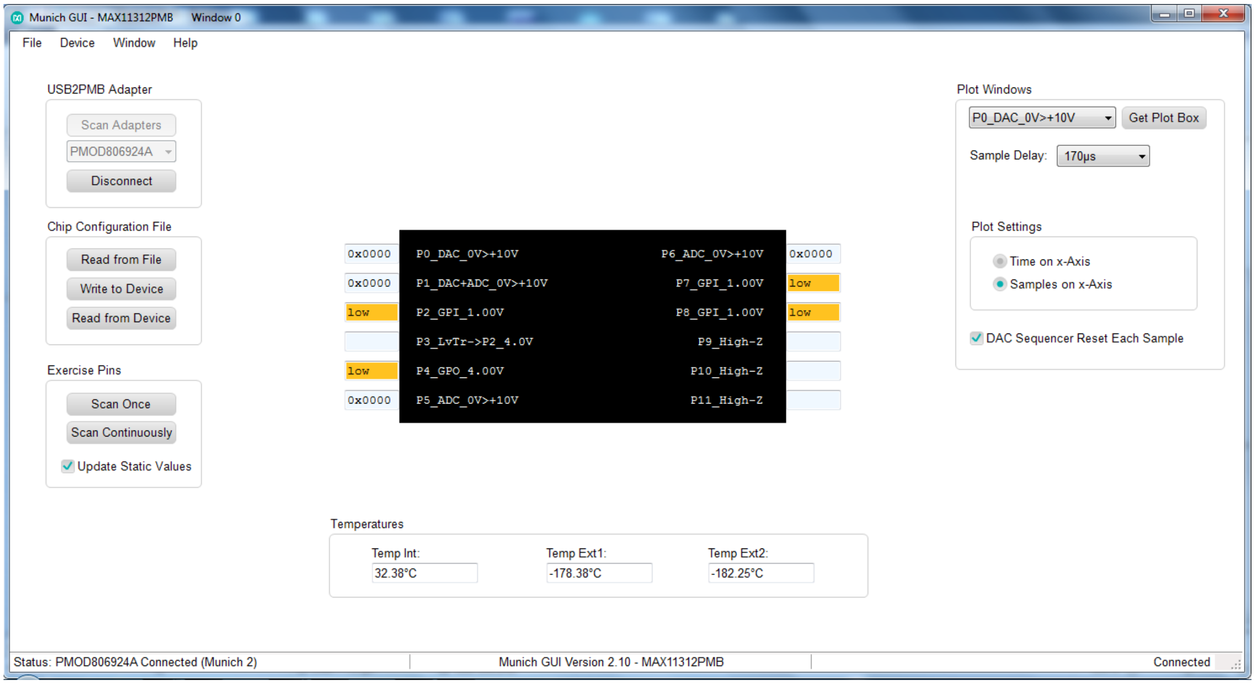
Confirmation

Do you want to write this to the device?
In case you have connected something to the board already
you have to be careful!

Figure 19. Confirmation Window

Select **Yes** to write the new configuration to the MAX11312. If **No** is chosen, the GUI does not write to the device, but reads the configuration from the device and displays that again.

6. After the Example Register File is written, the screen on the GUI appears as shown in **Figure 20**.



PMOD806924A

☑ Update Static Values

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x0000
0x0000	P1_DAC+ADC_0V>+10V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	P10_High-Z	
0x0000	P5_ADC_0V>+10V	P11_High-Z	

Temperatures

Temp Int: 32.38°C
Temp Ext1: -178.38°C
Temp Ext2: -182.25°C

P0_DAC_0V>+10V

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

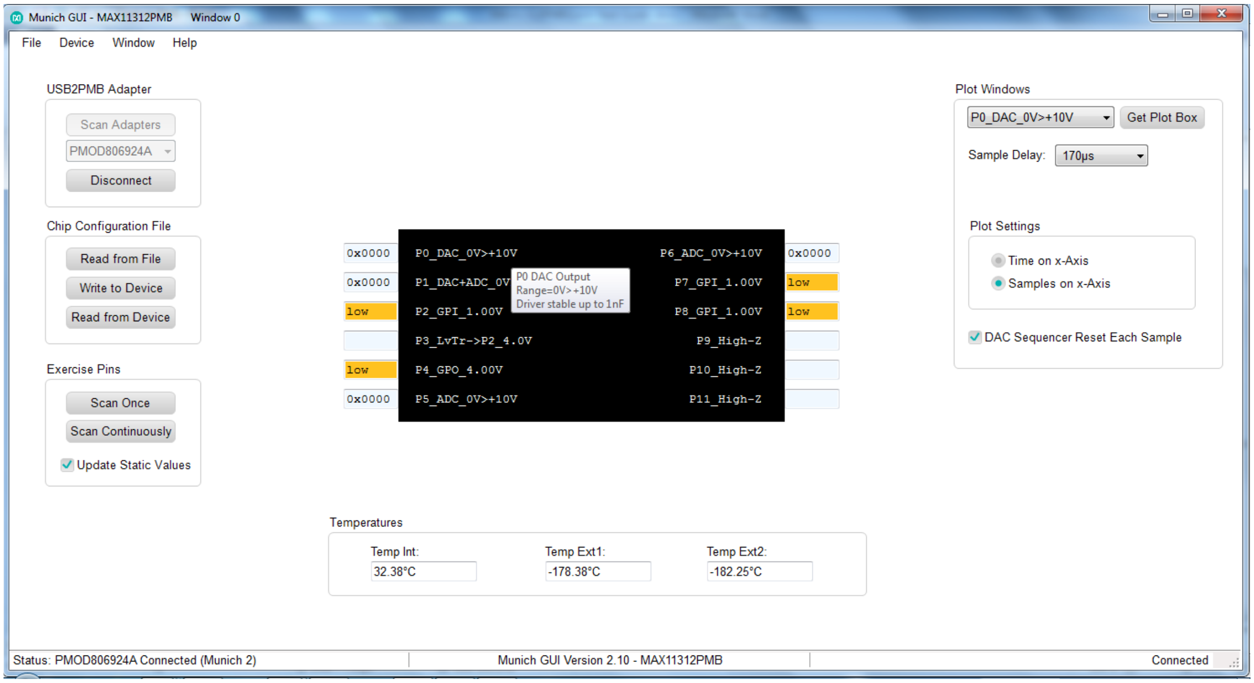
Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 20. Pin Configuration

Pin configurations in this example are as follows:

P0:DAC Range 0V to +10V
P1: DAC + ADC Monitoring Range 0V to +10V
P3: Unidirectional Level Translator Input from P2, Output Level 5.0V
P4: GPO General Purpose Digital Output, Level 4.0V
P5: ADC (Single-Ended ADC) Range 0V to +10V
P6: ADC (Single-Ended ADC) Range 0V to +10V
P7: GPI General-Purpose Digital Input, Threshold 1.0V
P8: GPI General-Purpose Digital Input, Threshold 1.0V
P9, P10, P11: High-Z (not used)

7. Hover the mouse cursor over the abbreviated pin description to obtain the detailed description as shown in **Figure 21**.



PMOD806924A

☑ Update Static Values

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x0000
0x0000	P1_DAC+ADC_0V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	P10_High-Z	
0x0000	P5_ADC_0V>+10V	P11_High-Z	

P0 DAC Output
Range=0V>+10V
Driver stable up to 1nF

P0_DAC_0V>+10V

Sample Delay: 170µs

○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

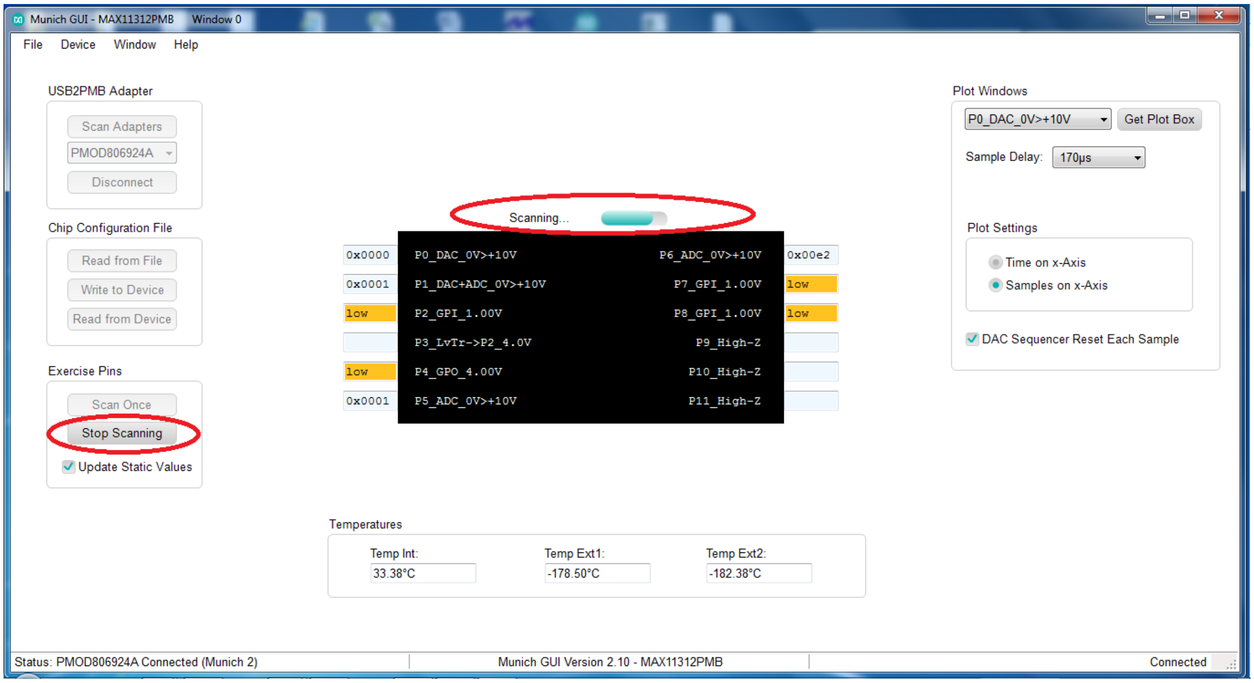
Temp Int: 32.38°C
Temp Ext1: -178.38°C
Temp Ext2: -182.25°C

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 21. Detailed port description.

8. Select the **Scan Once** button under **Exercise Pins**. The Munich GUI then scans through all 12 PIXI ports and executes its function. For DAC, it writes the value in the port box to the DAC; for ADC, it reads the ADC and displays the received value into the port box, similar to the GPIs and GPOs. Only switches and level translators are independent, and the Munich GUI does not make any changes to them. The **Scan continuously** button performs the same function as the **Scan Once** button, but it repeats the scanning process until **Stop Scanning** is pressed.

To see results in real time, click on **Scan Continuously**. The **Scan Continuously** button then changes to the **Stop Scanning** button, and the **Scanning Progress** bar appears. All inputs are continuously updated (i.e., GPIs, ADCs, temperature sensors). See **Figure 22**.



PMOD806924A

☑ Update Static Values

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x00e2
0x0001	P1_DAC+ADC_0V>+10V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	P10_High-Z	
0x0001	P5_ADC_0V>+10V	P11_High-Z	

P0_DAC_0V>+10V

Sample Delay: 170µs

○ Time on x-Axis

● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

Temp Int: 33.38°C

Temp Ext1: -178.50°C

Temp Ext2: -182.38°C

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 22. Continuous scanning mode.

The following examples illustrate step-by-step instructions to:

- Write a waveform to a DAC and sample it back with an ADC.
- Demonstrate the behavior of a DAC with ADC monitoring.
- Generate PWM with potentiometer-adjustable pulse width.

6.1 Writing a Waveform to a DAC and Sampling It Back with an ADC

1. Under **Plot Windows** in the drop-down menu at the top right, select **P0_DAC_0V>+10V** and **Get plot box**. A small plot window appears on the screen as shown in **Figure 23**. Click **Read DAC File** and select an analog data point file called **ideal_sine_1000_3x.adc**.

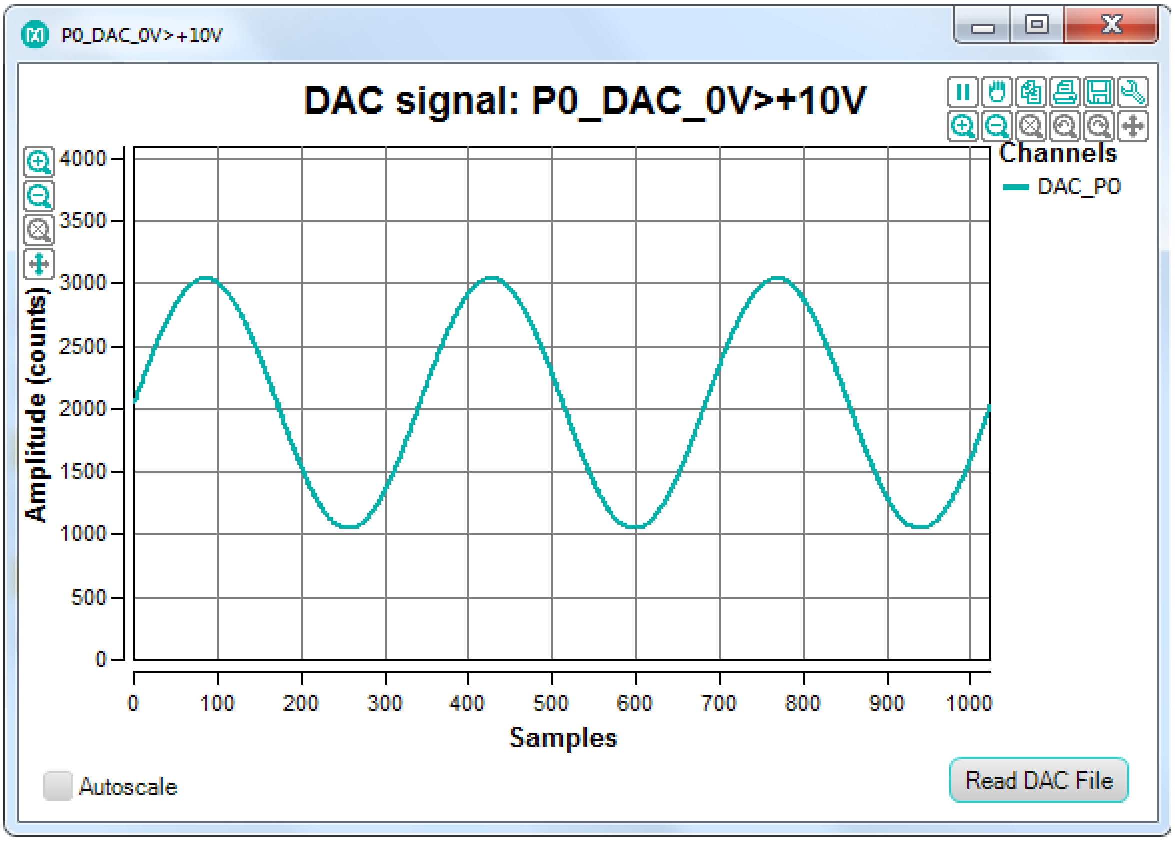


Figure 23. P0_DAC_0V>+10V plot window.

The plot window now shows a sine wave, and the entire plot has 1024 data points. While **Continuous Scan** is in progress, this waveform is written to the DAC and the speed depends on how many DAC and ADC pins are available and how many plot windows are open.

2. In the drop-down menu at the top right, select **P5_ADC_0>+10V** and click the **Get plot box** button. A plot window opens and shows the analog level on the ADC as shown in **Figure 24**.

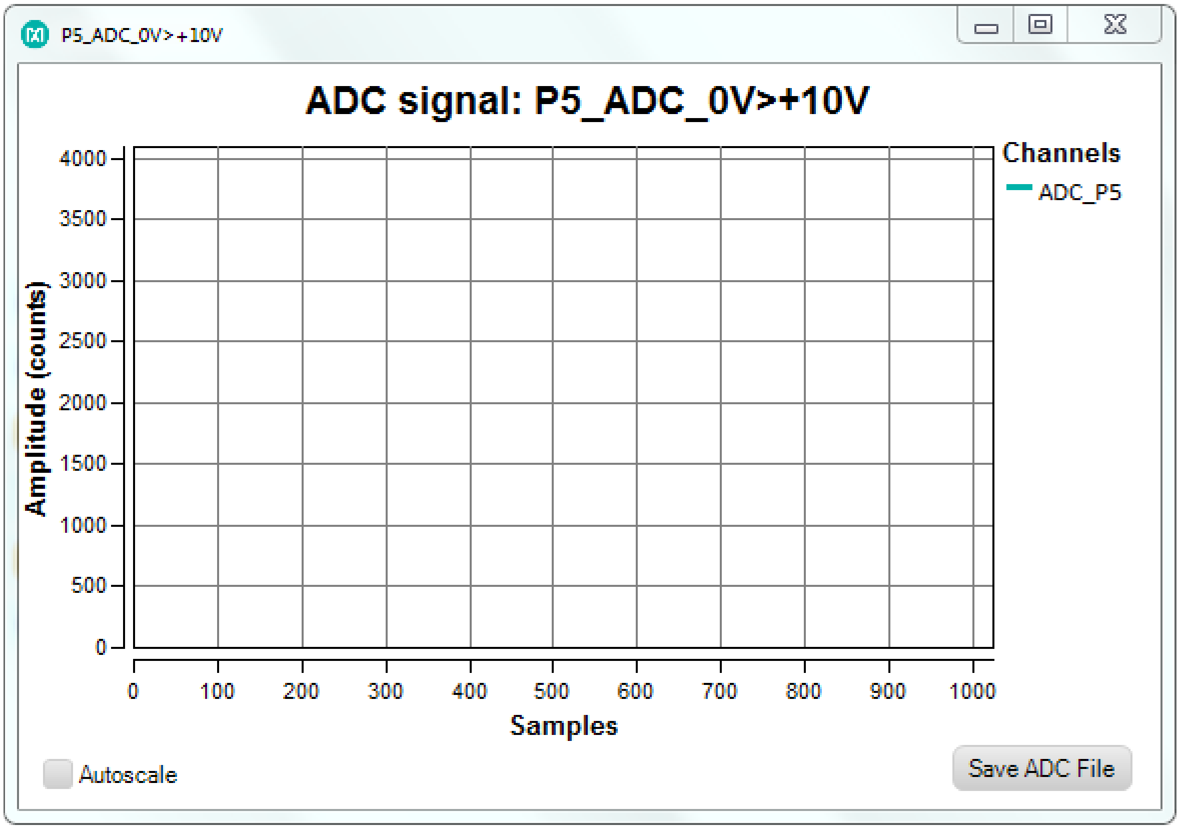


Figure 24. P5_ADC_0>+10V plot window.

3. Use a jumper wire to connect P0 to P5 as shown in **Figure 25**.

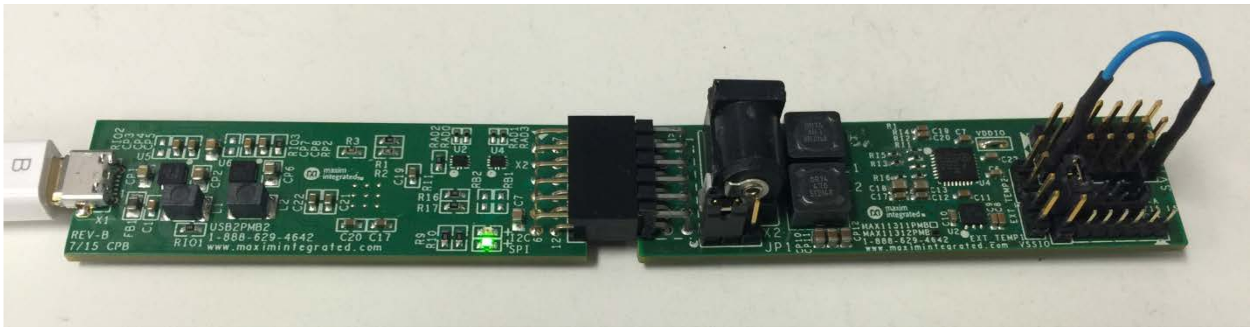


Figure 25. P0 connected to P5.

4. After connecting the DAC to the ADC, observe a sine wave in the ADC plot window as shown in **Figure 26**. Since the DAC can sample 20ksps only, but the ADC can sample 400ksps, the multiple data points are written to the DAC before the DAC can accept a new data point. To allow ample time for the DAC to settle before writing a new value, insert a sample delay between each sample by selecting 10µs or more in the **Sample delay** drop-down menu. We add 170µs sample delay here.

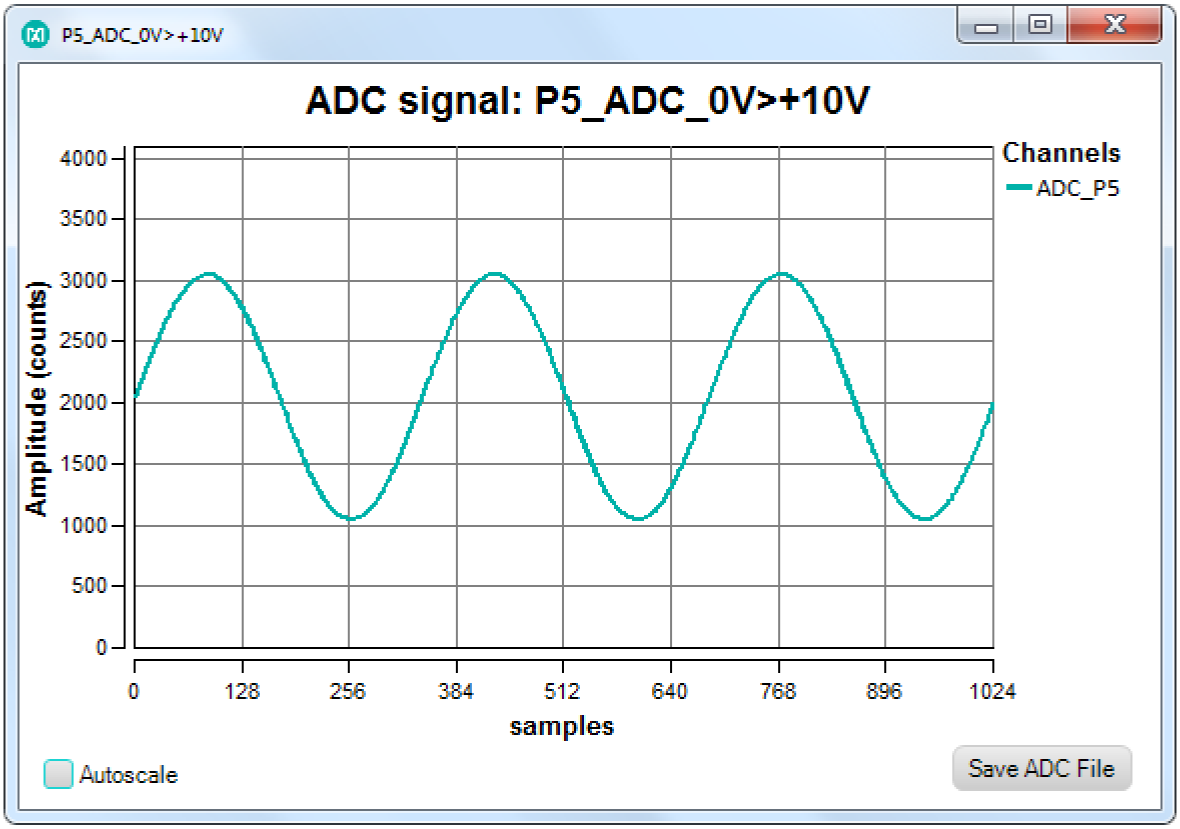


Figure 26. Sine wave with 170µs sample delay.

6.2 Demonstrate the Behavior of a DAC with ADC Monitoring

In this example, a potentiometer is connected between ADC and DAC to adjust the amplitude.

1. See **Figure 27** for the potentiometer schematic connection. Make sure that (1) is connected to the DAC output of the MAX11312 Port 0, (2) is connected to GND (middle row), and (3) is connected to the ADC MAX11312 Port 5. See **Figure 28** for the setup.

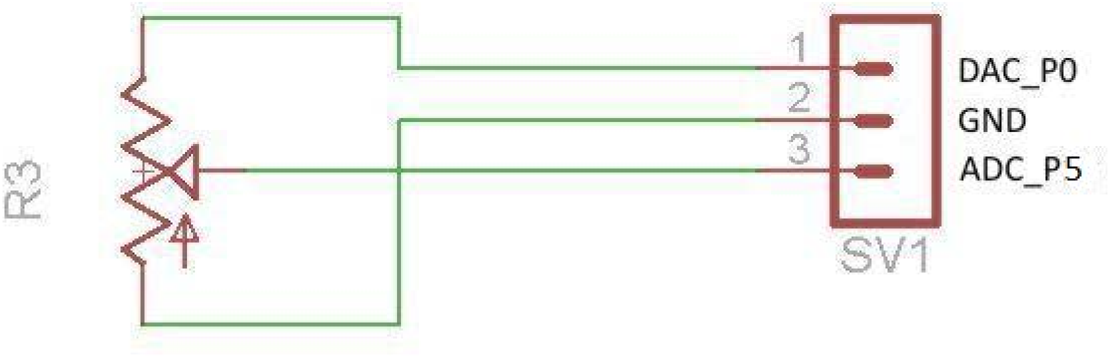


Figure 27. Potentiometer schematic connection to MAX11312PMB# ports.

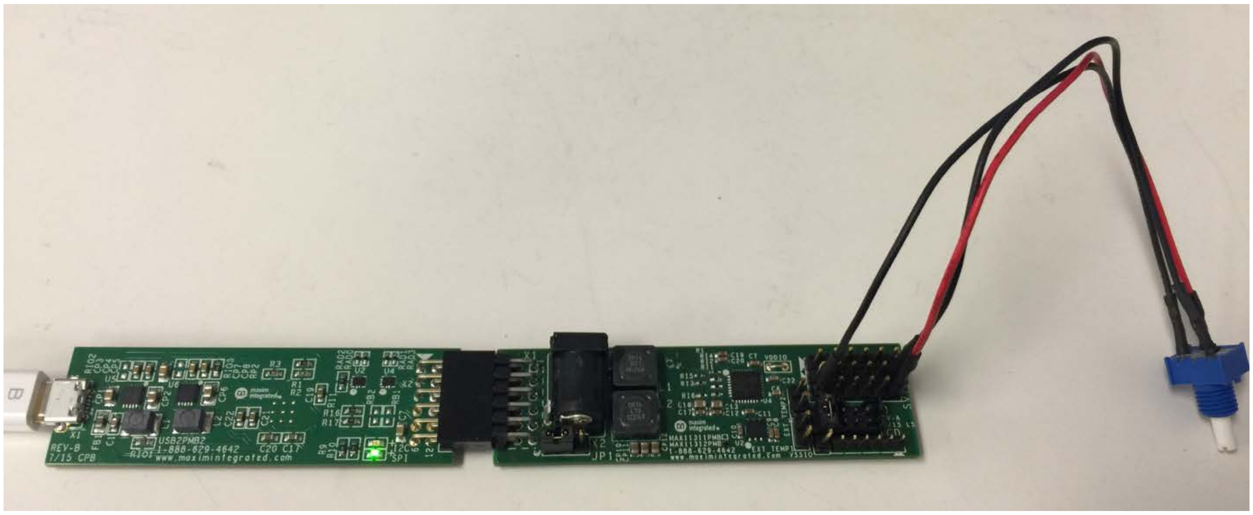


Figure 28. Potentiometer setup for demonstrating the behavior of a DAC with ADC monitoring.

2. Adjust the potentiometer and observe the amplitude received at the ADC changes as the potentiometer is varied.

3. In drop-down menu on the top right, select **P1_DAC+ADC_0>+10V** and select the **Get plot box** button. Another plot window opens and displays two waveforms: one in teal, and one in purple. The teal waveform is for ADC, and the purple waveform is for DAC. Click on **Read DAC File** and open the **ideal_triangle_1000_3x.adc** file. The purple DAC waveform shows a triangle as driven into the DAC. The teal plot shows the waveform as sampled with the ADC on that same pin. Zoom in or make the plot window full screen to see the difference between the ADC and DAC plots, which is mostly due to timing. DAC allows current up to ~20mA; if more current is drawn, the DAC voltage drops. This happens if the DAC has an output voltage of 10V with a load resistor of 500 Ω or less.

6.3. Generate PWM with Potentiometer-Adjustable Pulse-Width

In this example, a sawtooth waveform is generated and fed to a comparator (we use a level translator). The output of the comparator is high if the signal is above the threshold, or low if the signal is below the threshold (same case for a level translator). As the position of the sawtooth waveform is moved up or down when the potentiometer is adjusted, the width of the curve above the threshold is wider or thinner. See **Figure 29** and **Figure 30**.

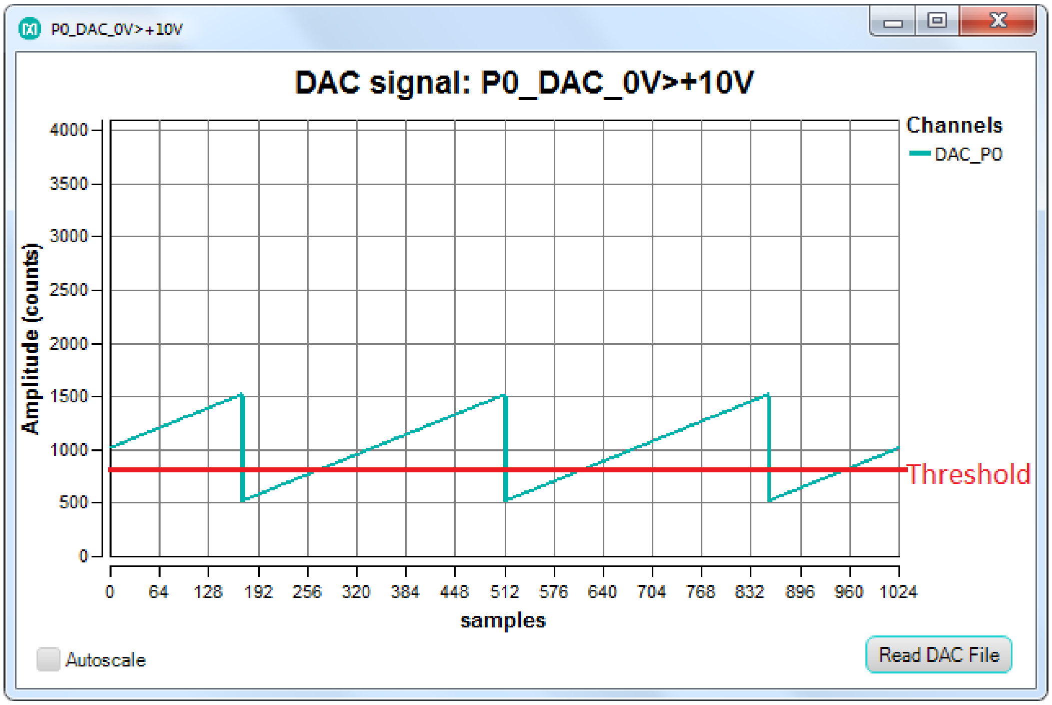


Figure 29. A sawtooth waveform shown is generated and applied to a level translator, resulting in a PWM.

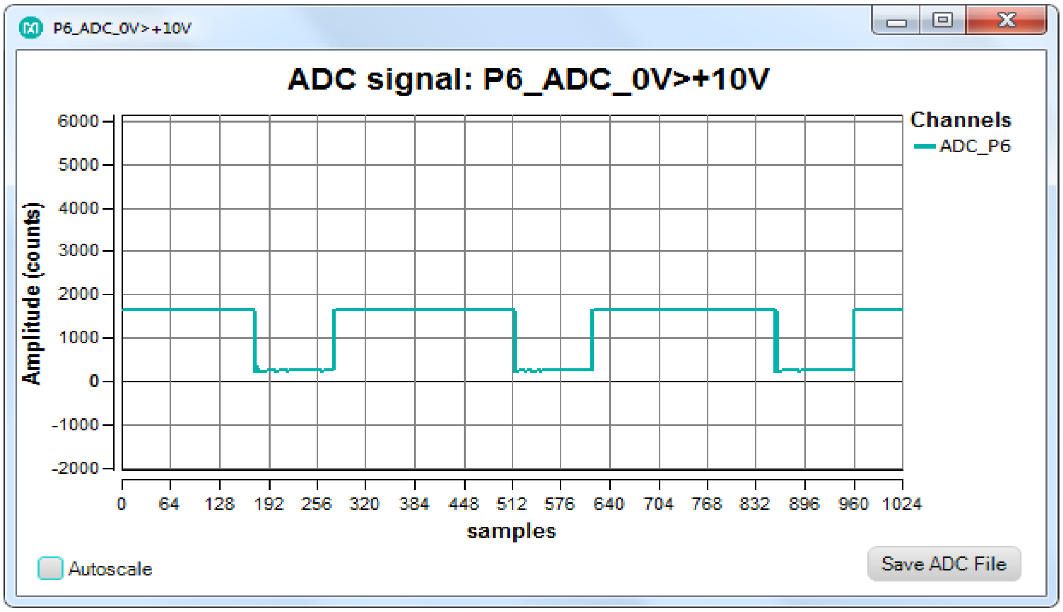


Figure 30. The width of a PWM is adjusted by a potentiometer.

1. In the drop-down menu on the top right, select **P0_DAC_0V>+10V** and click the Get plot box button. Another plot window opens for DAC on P0. Click on **Read DAC File** in the newly opened P0_DAC window and open the analog data point file **ideal_sawtooth_right_1000_3x.adc**.

2. Connect a potentiometer cable assembly to Port 0 (black jumper wire), Port 2 (red jumper wire), and GND (black jumper wire). Connect Port 3 to Port 6 (blue jumper wire) as shown in **Figure 31**.

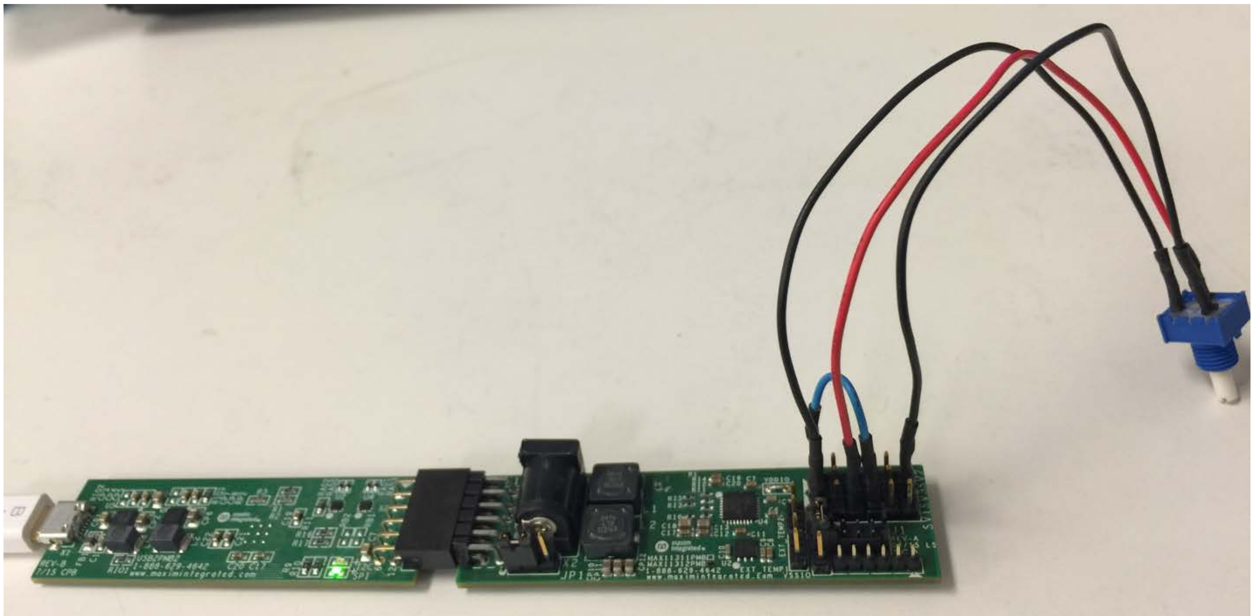
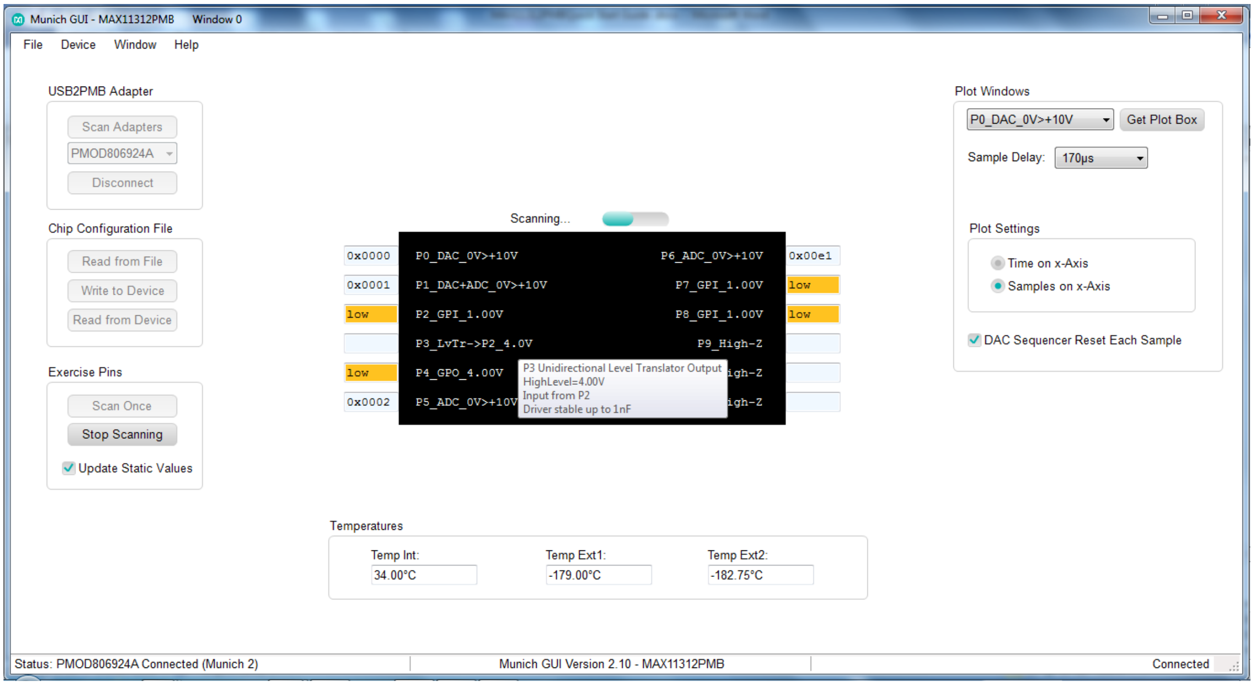


Figure 31. A potentiometer is connected to ports 0, 2, and GND.

3. Click P3_LvTr->P4_4.0V as shown in **Figure 32** below, a separate window of pin description for Pin3 pops up as shown in **Figure 33**, under the associated pin tap, choose P4 (this is due to the limitation of GUI). The real pin number is listed on the pin description.



PMOD806924A

☑ Update Static Values

Scanning...

0x0000	P0_DAC_0V>+10V	P6_ADC_0V>+10V	0x00e1
0x0001	P1_DAC+ADC_0V>+10V	P7_GPI_1.00V	low
low	P2_GPI_1.00V	P8_GPI_1.00V	low
	P3_LvTr->P2_4.0V	P9_High-Z	
low	P4_GPO_4.00V	igh-Z	
0x0002	P5_ADC_0V>+10V	igh-Z	

P3 Unidirectional Level Translator Output
HighLevel=4.00V
Input from P2
Driver stable up to 1nF

P0_DAC_0V>+10V

Sample Delay: 170µs

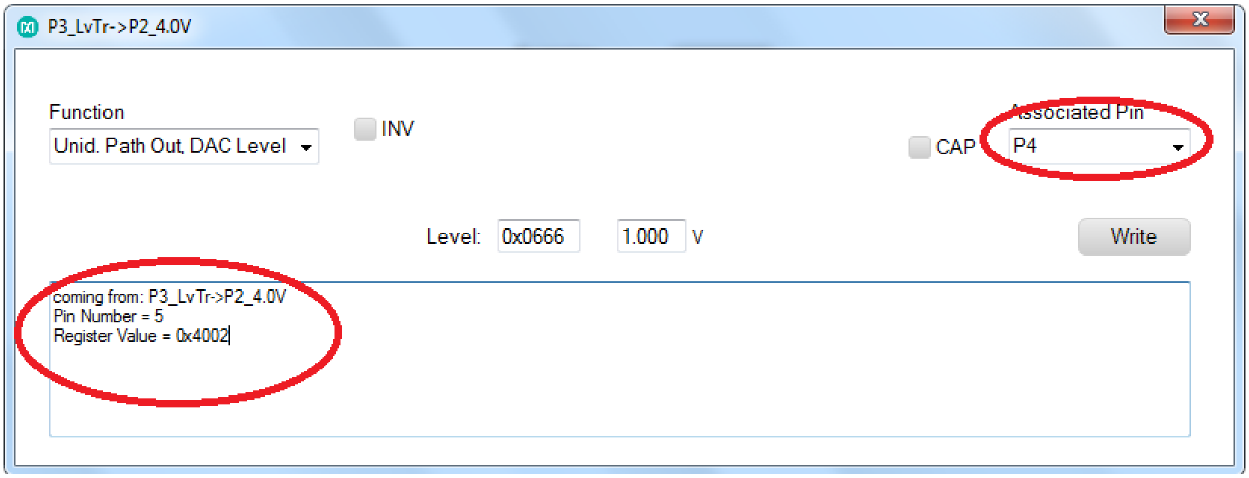
○ Time on x-Axis
● Samples on x-Axis

☑ DAC Sequencer Reset Each Sample

Temp Int: 34.00°C
Temp Ext1: -179.00°C
Temp Ext2: -182.75°C

Status: PMOD806924A Connected (Munich 2) | Munich GUI Version 2.10 - MAX11312PMB | Connected

Figure 32. Click on Output of level translator.



Function: Unid. Path Out, DAC Level

□ INV

□ CAP

Associated Pin: P4

Level: 0x0666 1.000 V

```
coming from: P3_LvTr->P2_4.0V
Pin Number = 5
Register Value = 0x4002
```

Figure 33. Pin description of P3.

4. In the drop-down menu on the top right, select P6_ADC_0V>+10V and click the Get plot box button. Another plot window opens for ADC on P6. Observe PWM signal in the ADC plot window. Adjust the pulse width by turning the potentiometer to the low and high positions and observe the width of the PWM waveform as shown in **Figure 34** and **Figure 35**.

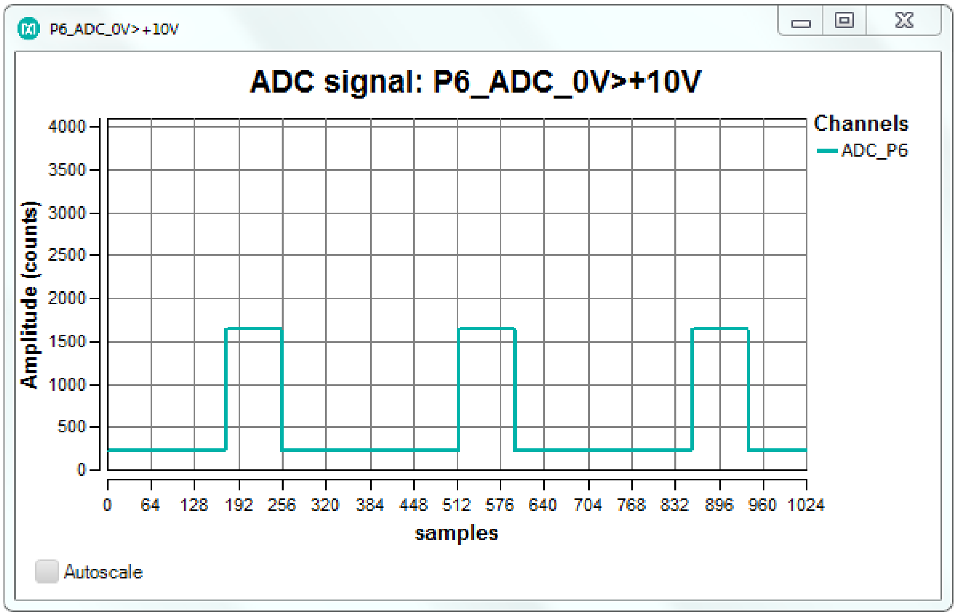


Figure 34. PWM Width as the potentiometer set to a low position.

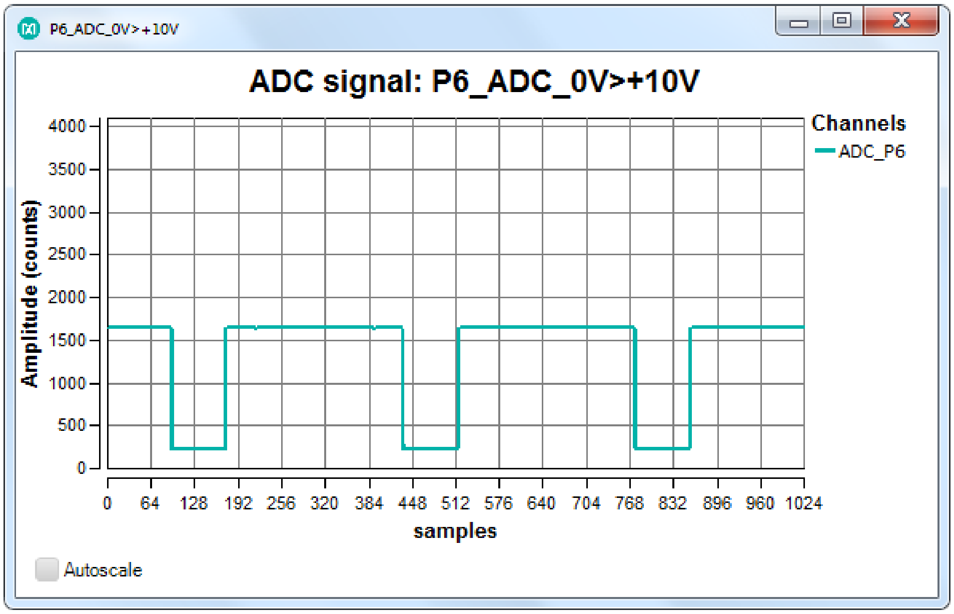


Figure 35. PWM Width as the potentiometer set to a high position.

Note that the input of the level translator can only handle up to 5V. The provided configuration file is set to deliver a max of 5V in 0V to 10V mode. If other files are used, be sure not to apply more than 5V at any digital inputs.

7. References

For further detailed information, refer to the following documents available online:

1. MAX11312 data sheet: www.maximintegrated.com/MAX11312
2. MAX11312PMB EV Kit data sheet: www.maximintegrated.com/MAX11312PMB
3. MAX11300 Configuration Software: https://www.maximintegrated.com/en/design/tools/applications/evkit-software/
4. USB2PMB2# Adapter Board(Munich) data sheet: www.maximintegrated.com/USB2PMB2
5. USB2PMB2(Munich) Adapter Board GUI: www.maximintegrated.com/en/design/tools/applications/evkit-software/index.mvp/id/1161
6. MAX11300PMB1 and Munich Adapter Board Quick Start Guide: http://pdfserv.maximintegrated.com/en/an/UG5795.pdf

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