USB Multifunction

Arbitrary Waveform Generator

AWG2300

User Guide

Contents

Safety information

Electrical Safety

- To prevent electric shock hazard, disconnect the power cable from the electric outlet before relocating the device.
- When adding or removing the device from the system, ensure that the power cables for the devices are unplugged before the signal cables are connected. If possible, disconnect all power cables from the existing system before you add a device.
- Before connecting or removing signal cables from the device, disconnect the power cables if possible.
- Seek professional assistance before using an adapter or extension cord. These devices could interrupt the grounding circuit.
- Ensure your power supply is set to the correct voltage in your area. If you are not sure about the voltage of the electrical outlet you are using, contact your local power company.
- If the power supply is broken, do not try to fix it by yourself. Contact a qualified service technician or your retailer.

Operation safety

- Before installing the instrument and adding it to your system, carefully read all the manuals that came with the package.
- Before using the product, ensure that all cables are correctly connected and the power cables are not damaged. If you detect any damage, contact your dealer immediately.
- To avoid short circuits, jeep paper clips, screws, staples and other metal parts away from connectors, slots, sockets and circuitry.
- Avoid dust, humidity and temperature extremes. Do not place the product in any area where it may become wet.
- Place the product on a stable surface.
- If you encounter technical problems with the product, contact a qualified service technician or your retailer.

About this guide

This user guide contains the information you need when installing and configuring the instrument or device.

How this guide is organized

This guide contains the following parts:

Chapter 1. Product introduction

This chapter describes the features of the instruments and functions it supports

Chapter 2. PC installation

This chapter describes the standard steps the user should follow to install the instrument on a PC running Windows operation system.

Chapter 3. Instrument Functions

This chapter demonstrates the main functions of the instrument. For first time users of this product, it is recommended that the user read or test the steps and see these working functions of the instrument.

Chapter 4. Programming Interface

This chapter provides a simple example of writing an application software to communicate with the instrument. The complete command set that is available for the user to control the instrument is also provided.

Chapter 5: Signal Expansion Board

This chapter describes how to install the signal expansion board on the instrument, to allow user access of other functional signals including digital IO, analog input and output.

More information

The SciCore Instrument website (www.scicoreinstruments.com) provides updated information on SCI hardware and software products. Refer to SCI contact information.

Specifications Summary

Waveform Generation	
Channels	2
Frequency Range	DC - 50MHz
Sample Rate	300 MS/s
Vertical Resolution	14 bit
Waveform Length	4,096 Samples/ channel
Amplitude	6.0 Vpp (into 1M Ohm), 3.5 Vpp (into 50 Ohm)
Output Current	50 mA
Output Connector	SMA (Female)
Standard Waveforms	Sine, Square, Pulse, Triangle, Saw-tooth, Sinc, ECG
Resolution	1 mHz
Analog Input	
Channels	8
Input Range	0 V - 3.3 V
A/D Resolution	10 bit
A/D Conversion rate	Software controlled
Digital IO	
Channels	8
Voltage Level	0 V - 3.3V
Update rate	Software controlled
Analog Output	
Channel	4
Voltage	0 V - 4.096 V
D/A Resolution	12 bit
D/A Conversion rate	Software controlled
PC Communication Interface	
Control Interfaces	USB
PC Communication Protocol	Virtual COM port (RS232 style text commands)
PC operating system	Windows 7, Windows 8
Power and Environment	
Power Supply Voltage	DC +5V
Power Consumption	1.5 W
Operating Temperature Range	0 °C - 50 °C
Non-Operating Temperature Range	-20 °C - 70 °C
Humidity Range	≤80% Relative Humidity
Mechanical Dimensions (L x W x H)	108 mm x 70 mm x 11 mm
Net Weight	90 g

Chapter 1: Product Introduction

Thank you for buying a SCI AWG2300 multifunction arbitrary waveform generator!

Before you start installing the instrument, check the items in your package with the list below.

1.1. Package contents

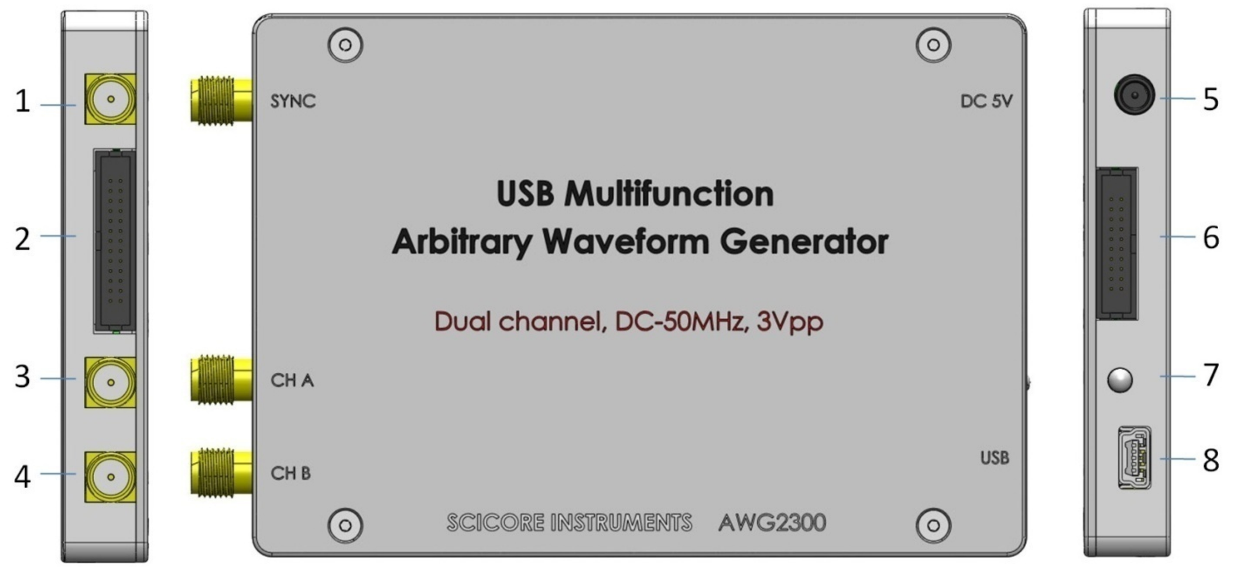
Check your package for following items.

STANDARD	
Instrument	AWG2300 arbitrary waveform generator
Cables	1x USB 2.0 Type A to Mini-B Cable 10 Feet
Installation media	SCI AWG software disk (USB flash drive)
OPTIONAL	
Accessories	AWG2300-SIG signal expansion board
Hardware	4x M2.5 stand-off screws; 4x M2.5 button head screws
Cables	1x 20 pin flat cable; 1x 26 pin flat cable
Power supply	+5V DC power supply

1-2. General Descriptions

AWG2300 is a dual-channel, 14 bit, 300MS/s simultaneously sampling arbitrary waveform generator capable of generating waveforms from DC to 50MHz. The maximum output voltage is 7Vpp when driving 1M Ohm load, and 3.5Vpp when driving 50 Ohm load. When connected to a PC via a standard USB cable, the AWG appears as a virtual RS232 COM port that can accept data and instructions from the PC. Various waveform parameters including the frequency, amplitude, offset and phase of the output waveform are adjustable by the AWG control software running on the PC. The designed waveform data is downloaded to the AWG via the USB cable by the same control software. After being programmed, the AWG can run on a +5V DC power supply without the PC in stand-alone mode, or remain USB powered.

In addition to the two fast waveform output and synchronization channels, AWG2300 also provides 8 analog input channels, 8 digital IO channels, and 4 analog control voltage output channels. All the user accessible signals are available on the three SMA connectors and two box-type extension connectors. The 8 digital IO channels can be configured individually as input or output, or be accessed as a group (1 byte). The analog input voltages across 8 analog input channels are measured at software controlled sampling rate. The 4 analog output channels generate analog control voltages at software defined values from 0V to 4.096V.



Product left, top and right views. Connectors and indicators are: (1) SYNC, (2) User Extension A, (3)CH A, (4) CH B, (5) DC 5V power input, (6) User Extension B, (7) LED indicator, and (8) USB.

1-3. Connectors and Indicators:

1. **SYNC**: The synchronization signal of generated waveforms that are present on channel A and channel B simultaneously. This signal uses a SMA female type connector and the output has a voltage swing from 0V to 2V when driving a 50 Ohm load, and from 0V to 4V when driving a 1MOhm load. The bandwidth of this signal is from DC to 50 MHz.

2. **User Extension A**: This connector provides some extension signals to the user, including the 4 analog control voltage output signals and the counted trigger output signal. For detailed information on the pin map and individual signal descriptions, please see section 1-2.

3. **CH A**: The waveform output for channel A. This signal uses a SMA female type connector and the output has a voltage swing from 0V to 3.5V when driving a 50 Ohm load, and from 0V to 7.0V when driving a 1MOhm load. The bandwidth of this signal is from DC to 50 MHz.

4. **CH B**: The waveform output for channel B. Other properties of this signal is the same as CH A.

5. **DC 5V**: The connector for an external 5V (> 500 mA) power supply with a 0.9 mm ID, 3.2 mm OD plug connector.

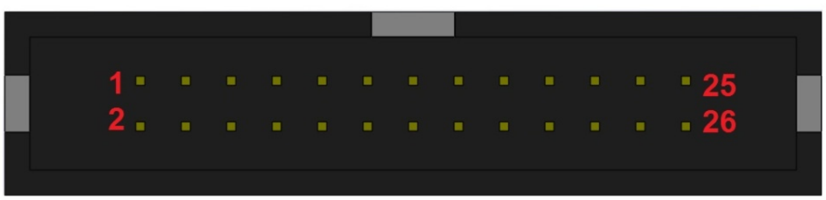
6. **User Extension B**: This 20-pin, 1.27 mm pitch box header connector provides additional extension signals to the user, including the 8 digital IO signals and the 8 analog input signals. For detailed information on the pin map and individual signal descriptions, please see chapter 1-3.

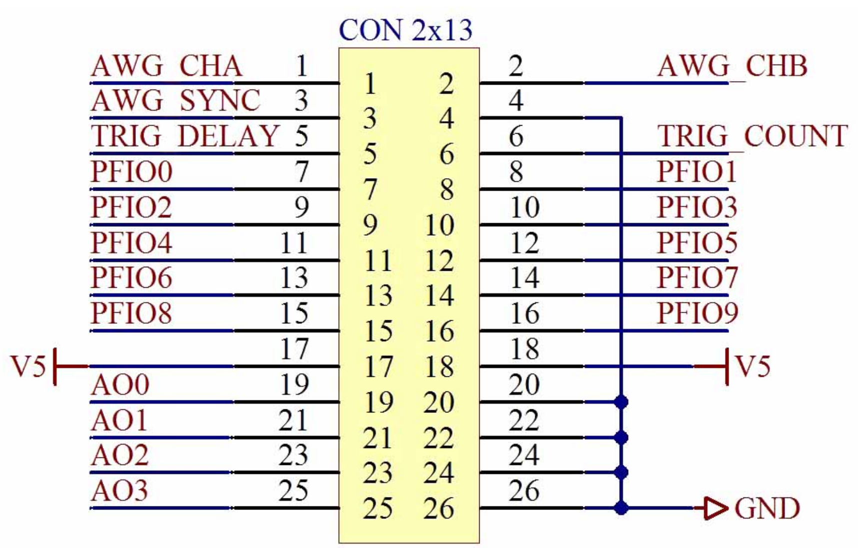
7. **LED indicator**: This three color (red, green and orange) LED provides device connection and status information to the user. When the instrument is powered by the USB cable, the orange LED blinks for two times and the green LED become steady on; When the instrument is powered by an external 5V power supply, the orange LED blinks for two times and the orange LED become steady on.

8. **USB**: This USB (mini B) connector provides the connection from PC to the AWG device. The AWG can also be powered by this USB cable. Various parameters of the AWG can be controlled and programmed using a control software running on the PC.

1-4. User Extension Connector A

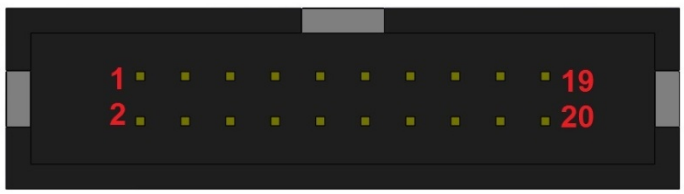
The User Extension Connector A is a 1.27 mm pitch, 26-pin box header type connector. The connector pin map is shown below. This connector contains the two waveform output channels (AWG CH A and CH B) and the trigger channel (AWG SYNC). A delayed trigger signal (TRIG DELAY)and a counted trigger signal (TRIG COUNT) are also provided on this connector. There are 4 channels of analog output signals (AO0 - AO3) available on this connector, and each channel is capable of generating control voltages between 0V and 4.096V, at software controlled update rate. This connector also provides 10 PFIO lines connected to the on-board FPGA chip controlling the waveform generation. Please see section 3-5 for application examples of the analog output signals.

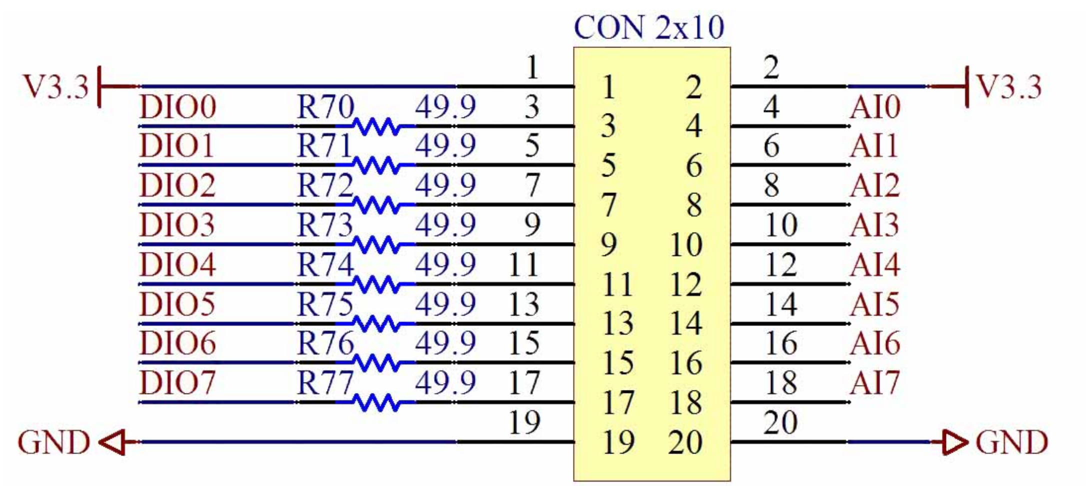




1-5. User Extension Connector B

The User Extension Connector B is a 1.27 mm pitch, 20-pin box header type connector. The connector pin map is shown below. This connector provides 8 digital IO (DIO) lines and 8 analog input (AI) channels. The 8 digital IO lines can be programmed individually as input or output, or be accessed together as one byte, at software controlled update rate. The voltage level of the DIO lines is between 0V and 3.3V. Please note there is a 50 Ohm resistor in each DIO line to limit its output current. The 8 analog input channels can sample external input voltages between 0V and 3.3V, at software controlled sampling rate. Please note there is a 1000 pF capacitor and a 10kOhm resistor connecting each analog input channel to the ground. Please see section 3-3 and 3-4 for application examples of these analog input and digital IO signals.





Chapter 2: PC installation

2-1. PC Requirements

	Minimum	Recommended
Operating system	Windows 7	Windows 7 (64 bit)
Processor	High-performance dual core CPU or quad core CPU	Intel Core I3/5/7 series
Memory	2 GB	4 GB
Screen resolution	800 x 600 pixels	1024 x 768 pixels
USB	USB 2.0	USB 2.0
Hard disk	20 GB	40 GB

2-2. PC Installation Steps

1. Install the "SCI AWG" software onto your PC using the provided USB disk drive. See section 2-3 for detailed steps of software installation. The software program icon with the name "SCI AWG" will be placed on the Windows desktop on your PC.

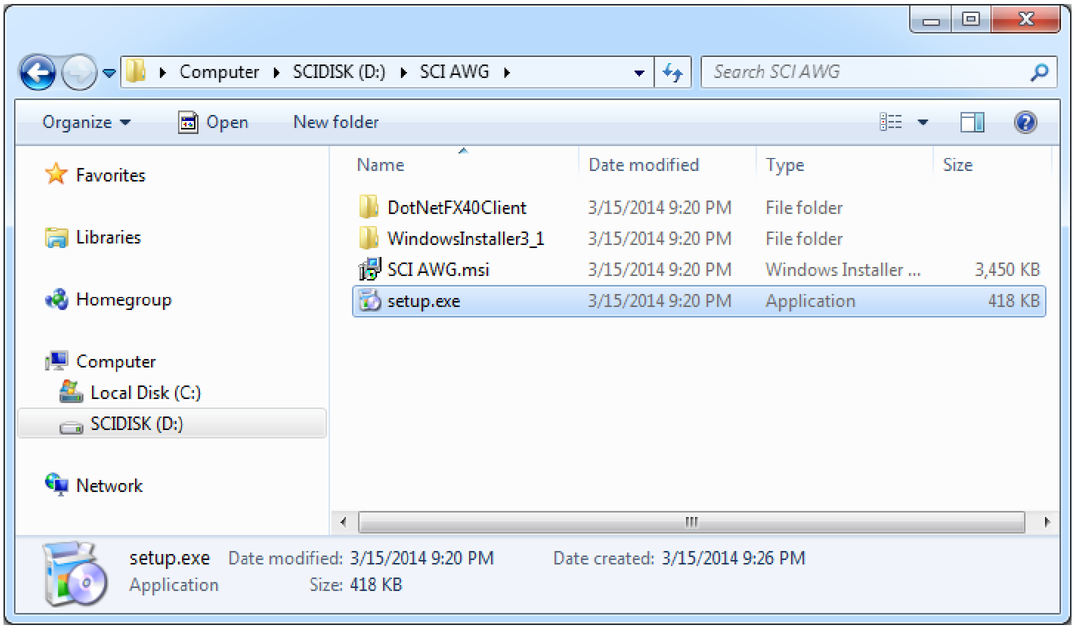
2. Connect the AWG2300 to a PC USB port using the provided USB cable. Configure the driver for AWG2300 following the steps described in section 2-4.

3. Launch the "SCI AWG" program on your PC desktop to test AWG2300 functions.

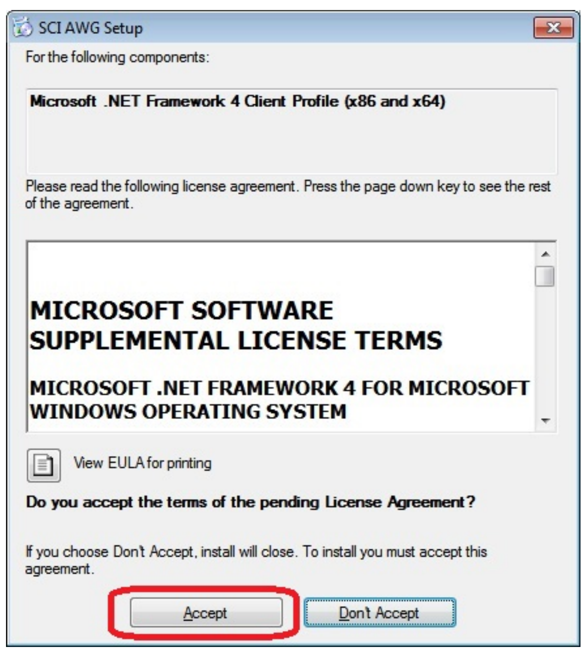
2-3. "SCI AWG" Software Installation

The following screens show the steps to install the "SCI AWG" on a PC with Windows 7 (64 bit) operating system.

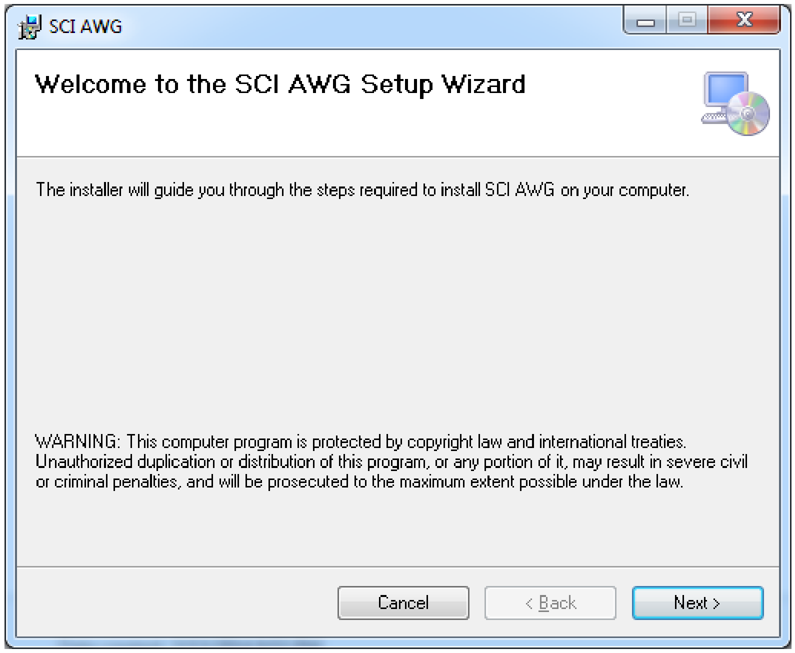
1. Launch the "Setup.exe" from the "SCI AWG" folder on the provided USB thumb drive.



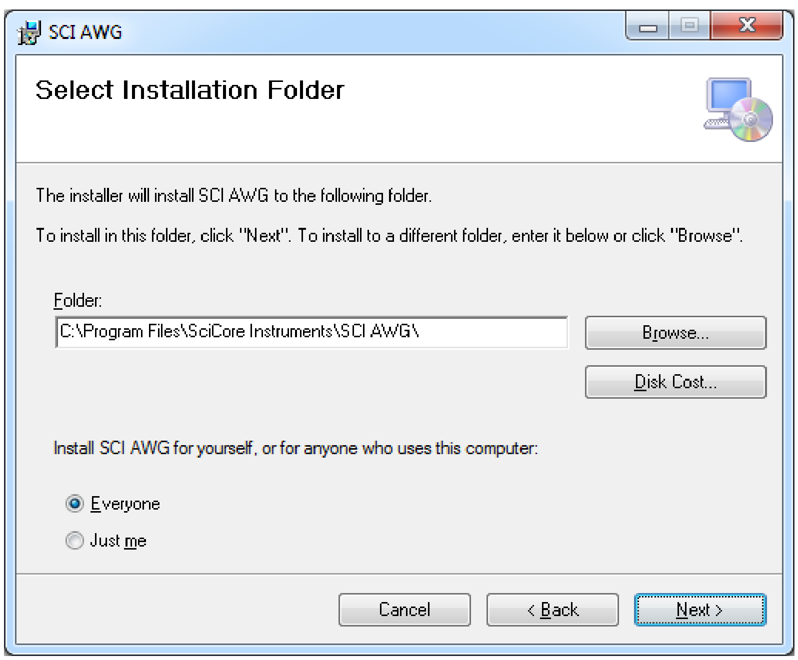
2. Click "Accept" button to install "Microsoft .NET framework" if it has not been installed on this PC.



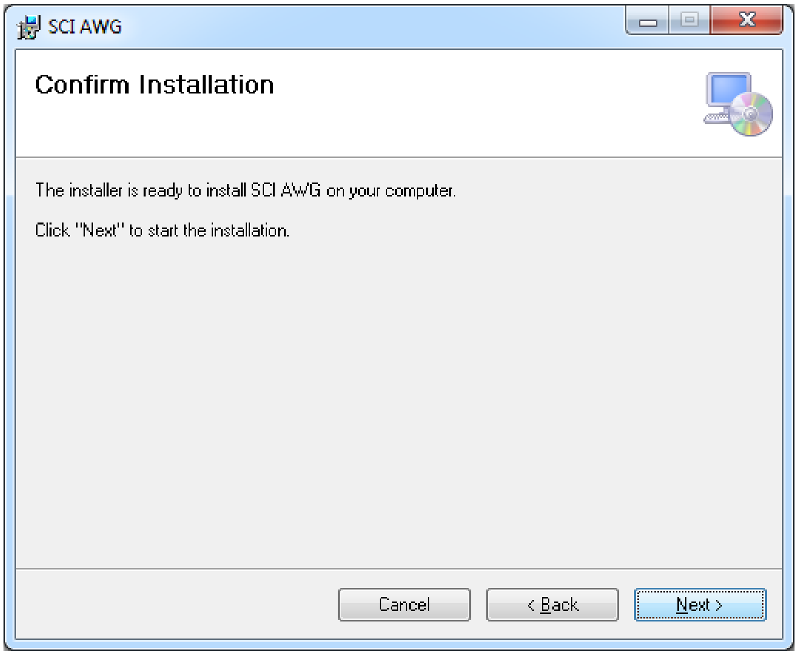
3. Click "Next".



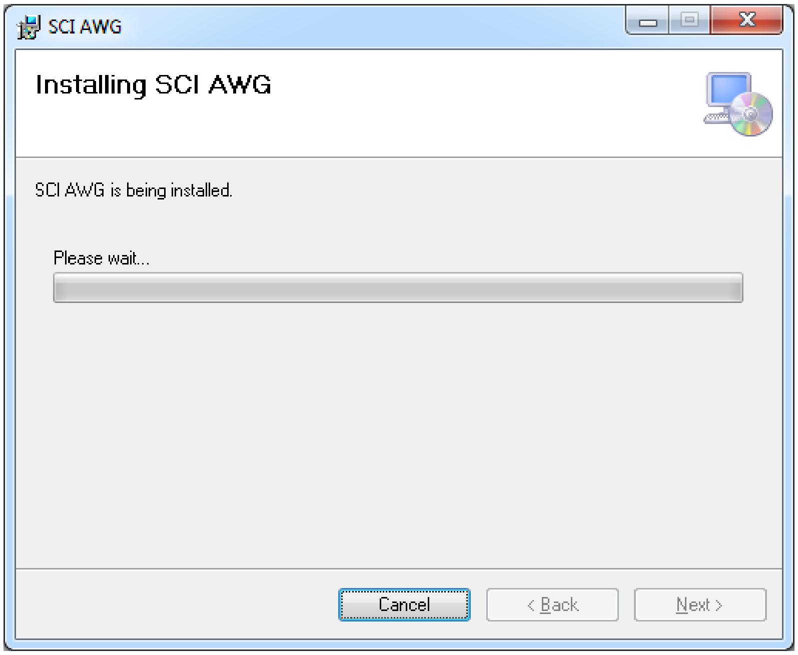
4. Click "Next".



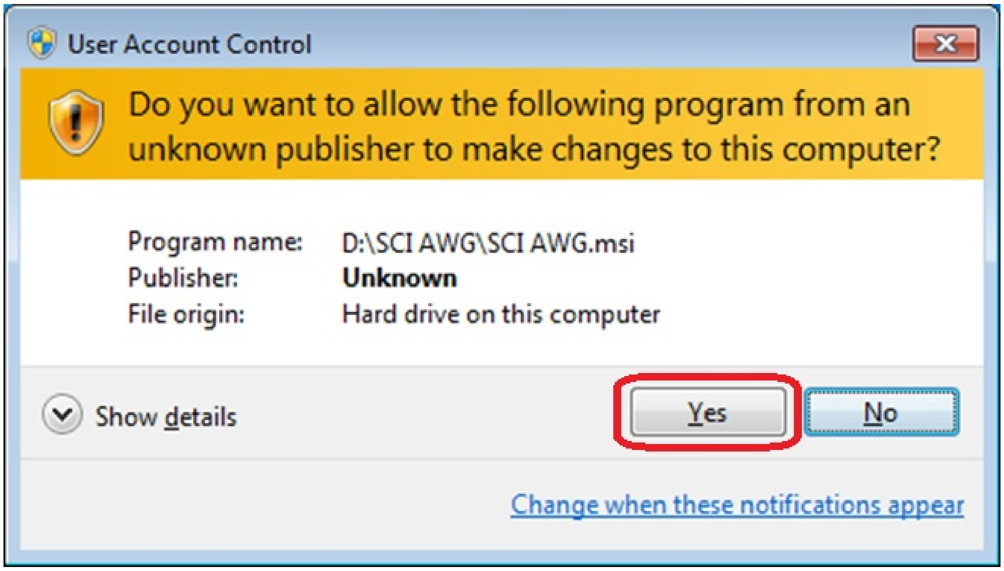
5. Click "Next".



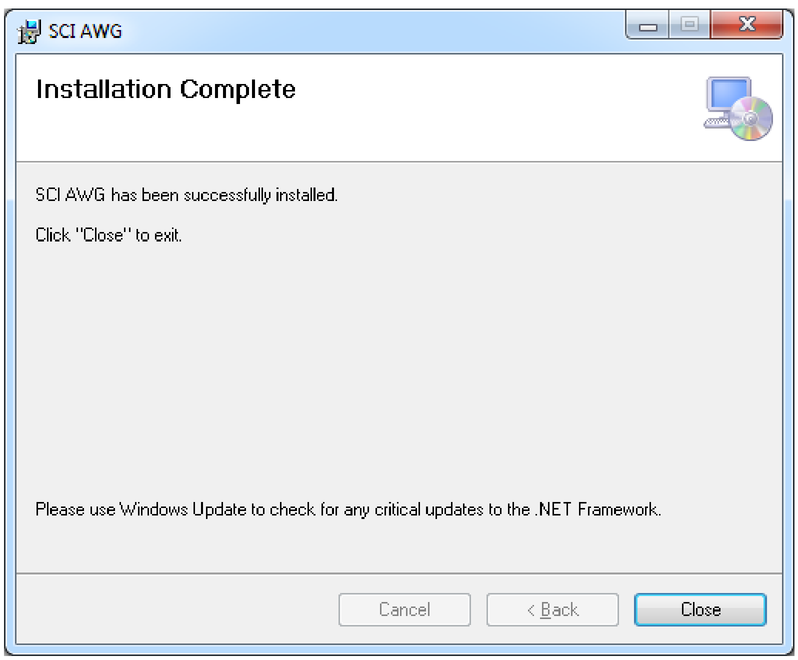
6. Wait a few seconds when the software is being installed.



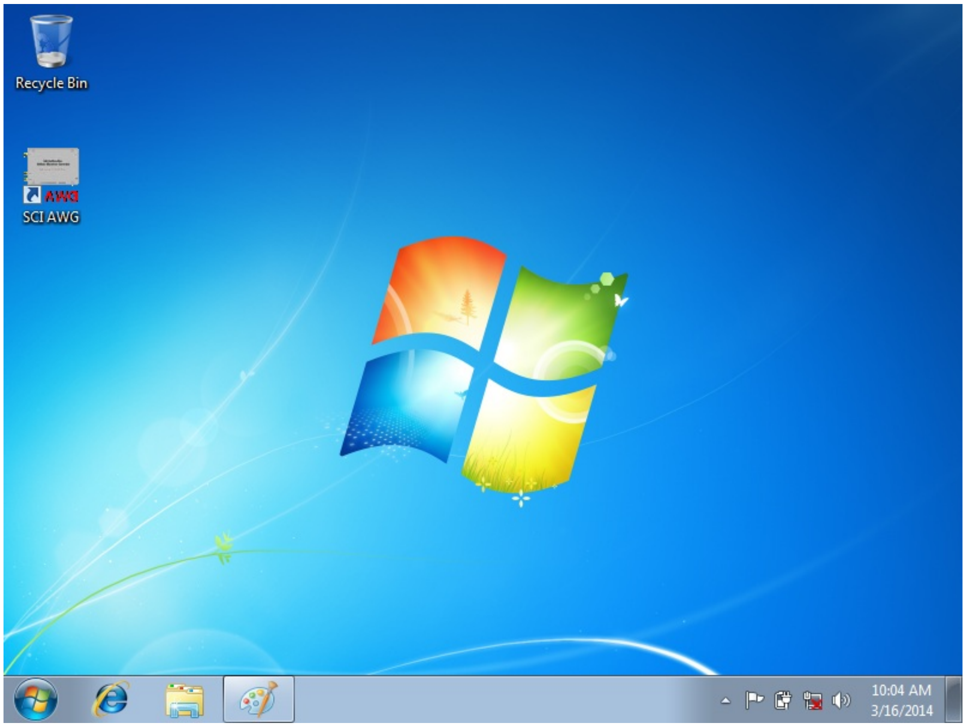
7. When following dialog appears, click "Yes".



8. Click "Close".



9. A software program icon named "SCI AWG" will be placed on the windows desktop. This is the software program to control the AWG2300 from the PC.



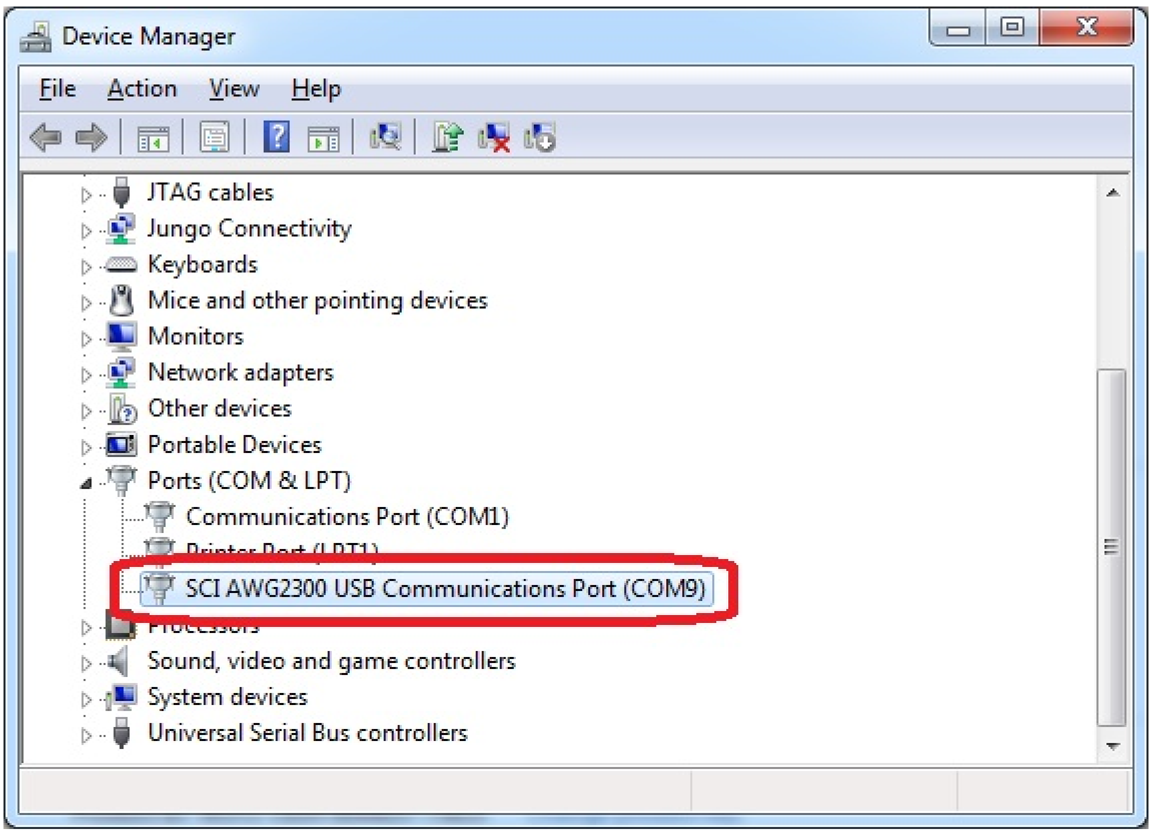
The next steps, as described in section 2-4, are to install the USB communication port driver for AWG2300 to be recognized by the PC.

2-4. Driver Software Installation

Section 2-3 shows the necessary steps to install the AWG control software "SCI AWG" on the PC. When the AWG2300 is connected to the PC using a USB cable, only for the first time use, it requires a software driver file or a hardware information file (*.inf) being registered with the Windows operating system.

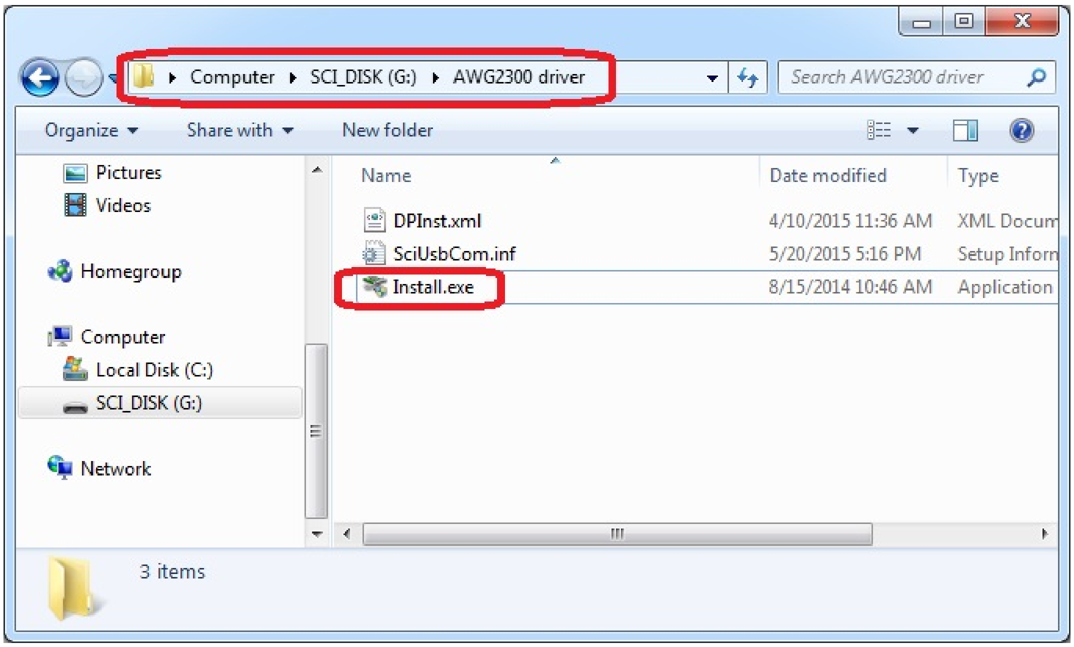
After installation of "SCI AWG" software, the following screen shots show the steps to register hardware information file "SCIUSBCOM.inf" on the same PC for the AWG2300 to work properly.

1. When it is the first time for the PC to connect to the AWG2300, the PC may be able to recognize the AWG2300 as a USB communication port automatically. In the example below a PC assigned COM9 to the AWG2300 automatically. If this is the case please skip all steps from 2 to 7 below which deal with un-successful automatic driver installation.

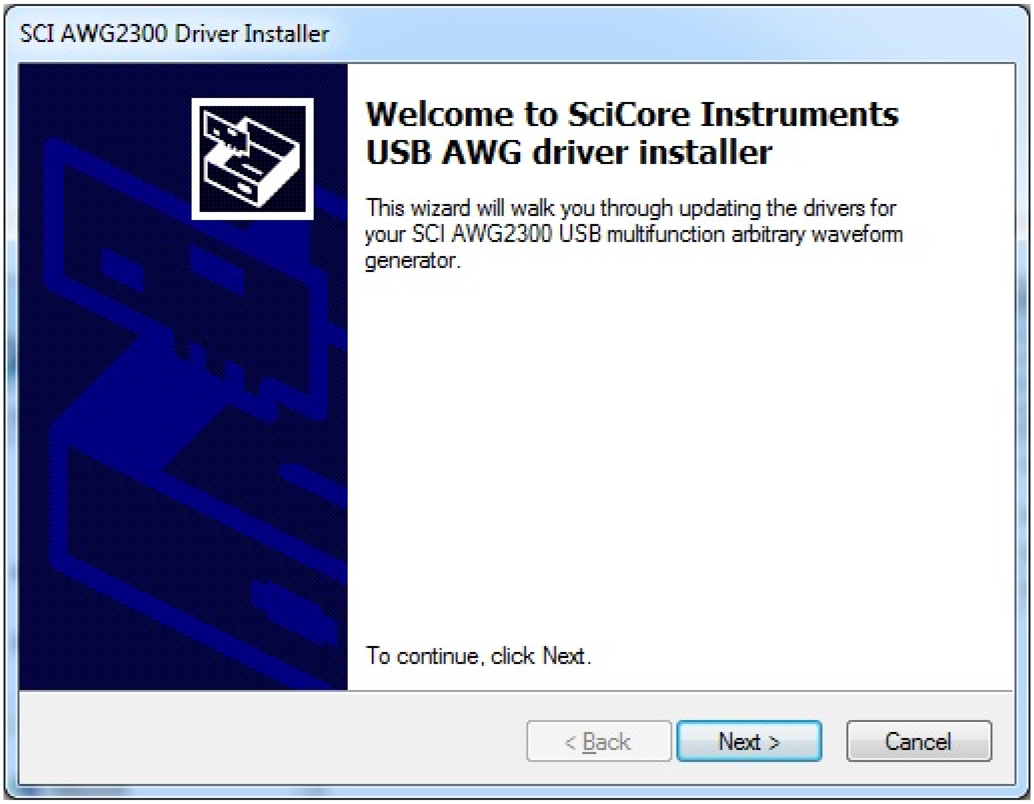


2. Depending on the drivers already installed on the PC, some PCs are not be able to recognize the AWG2300 as a USB communication port automatically. In this case a message will shown on the bottom right of the screen.

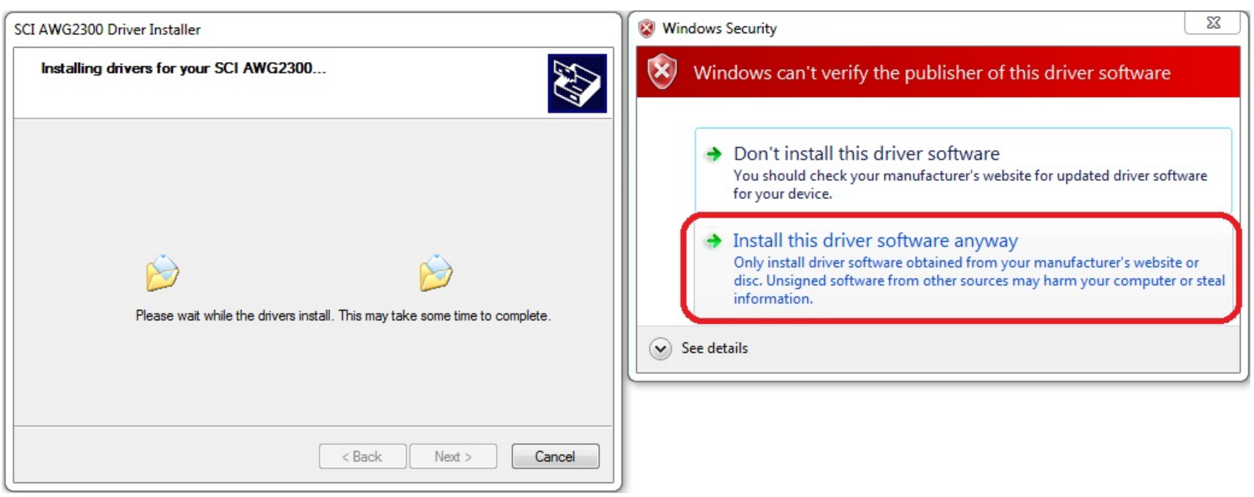
3. Launch the "install.exe" from the "AWG2300 driver" directory on the USB installation disk.



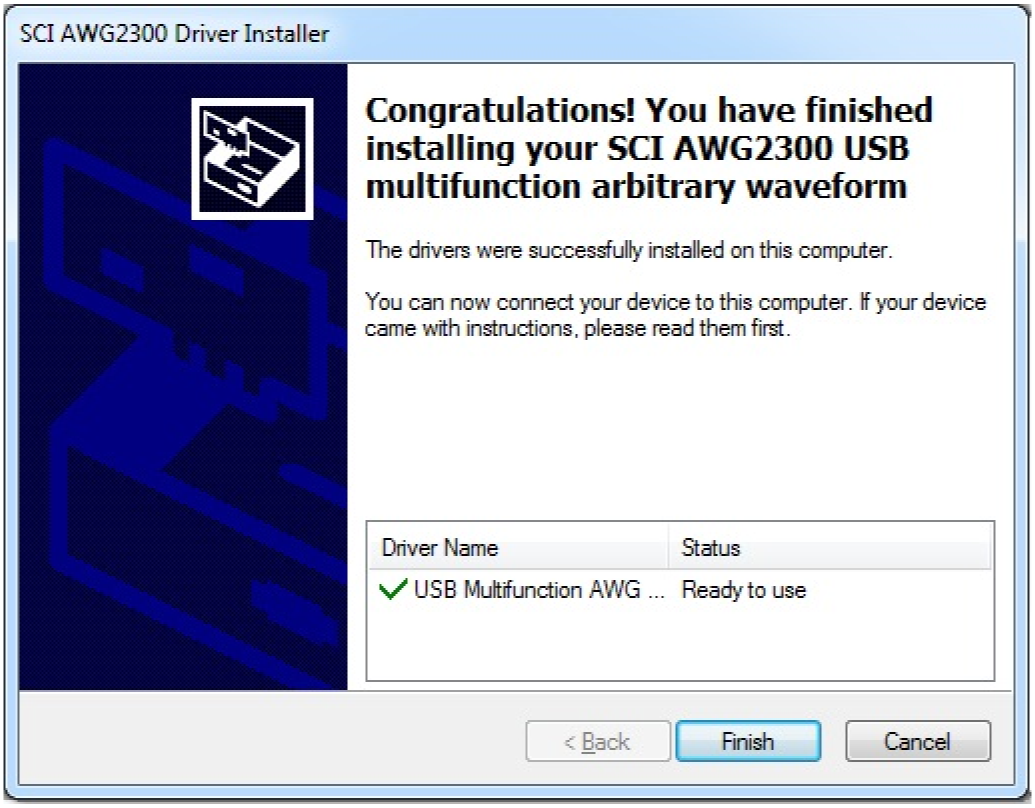
4. Click "Next" to continue the installation process.



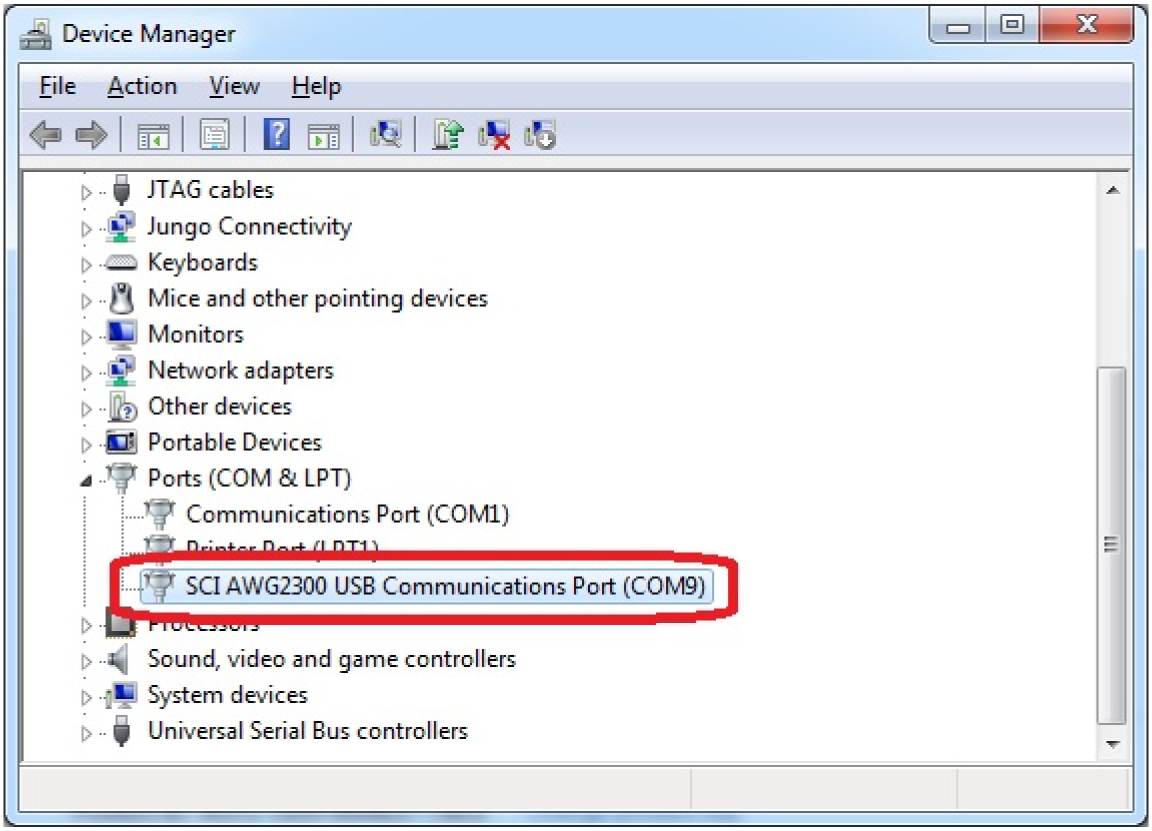
5. When the following dialog shows up, click "Install this driver software anyway ".



6. Please wait a few seconds and following dialog will show to indicate the driver installation is successful. Please click "Finish" and the driver installation process is complete.



After the driver installation, the AWG2300 connected to the PC now shows in the Device Manager as "SCI AWG2300 USB Communication Port (COMx)". The actual number assigned to the device depends on the number of communication ports already exist in this PC. In this example "COM9" is assigned to this particular AWG2300 connected to this PC.

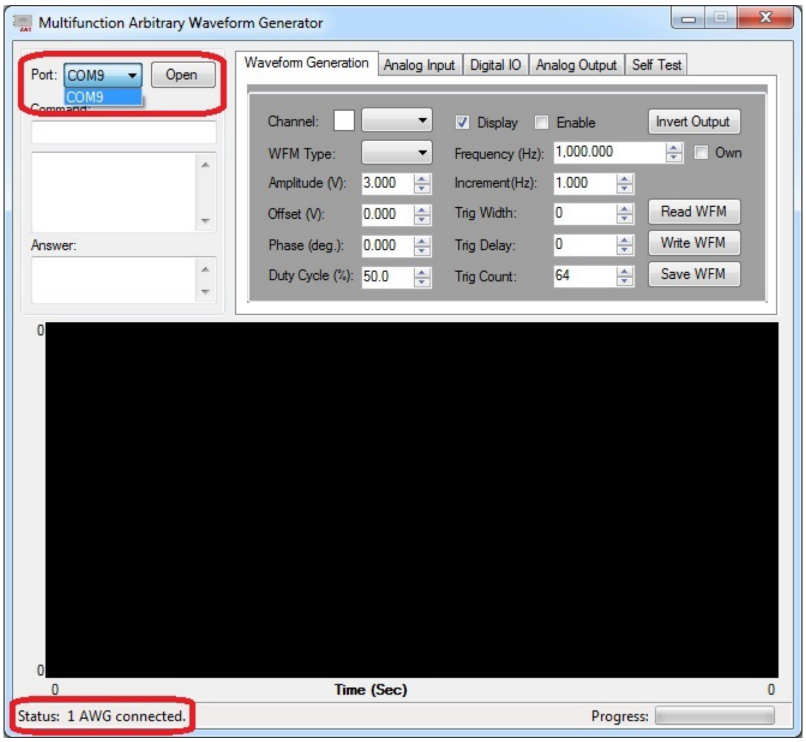

Device Manager
File
Action
View
Help
JTAG cables
Jungo Connectivity
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Other devices
Portable Devices
Ports (COM & LPT)
Communications Port (COM1)
SCI AWG2300 USB Communications Port (COM9)
Sound, video and game controllers
System devices
Universal Serial Bus controllers

Chapter 3: AWG Functions

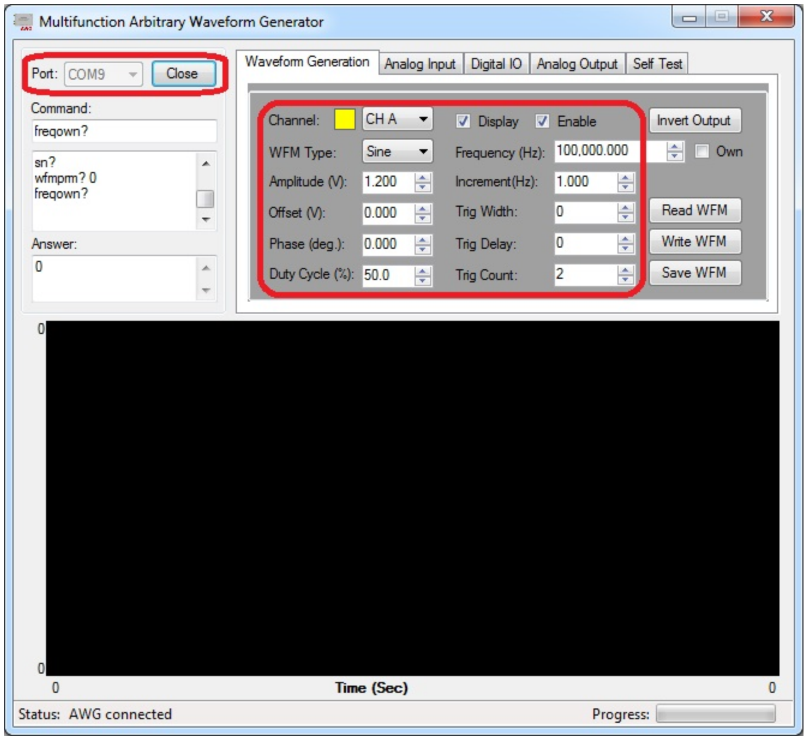
The AWG2300 can output two channels of waveform simultaneously, at fixed sampling rate of 300MS/s. The waveform of each channel is defined by 4096 data point with 14 bit D/A resolution.

3-1. Open Communication with AWG2300

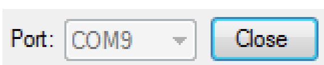
1. After installing software and driver on the PC, the user can click the "SCI AWG" software icon on Windows desktop to start the AWG control software. The software shows the number of detected AWGs that are connected to the PC, and its associated COM port number. Click the "Open" button to start using this AWG.



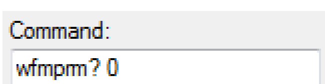
2. After the user clicks the "Open" button, the AWG is connected with the control software, as shown in below. Note the status bar now shows "AWG connected". The waveform parameters are also updated in the "Waveform Generation" control panel.



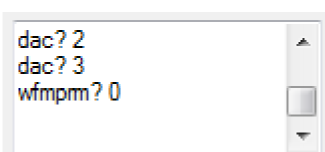
The useful software controls are:



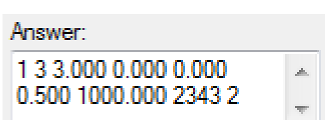
List of available communication port on this computer that can be opened or closed.



The latest command sent from the PC to the AWG.



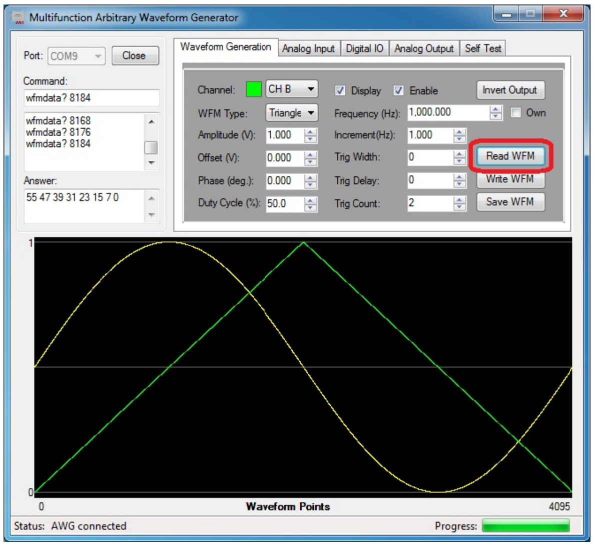
List of the command history

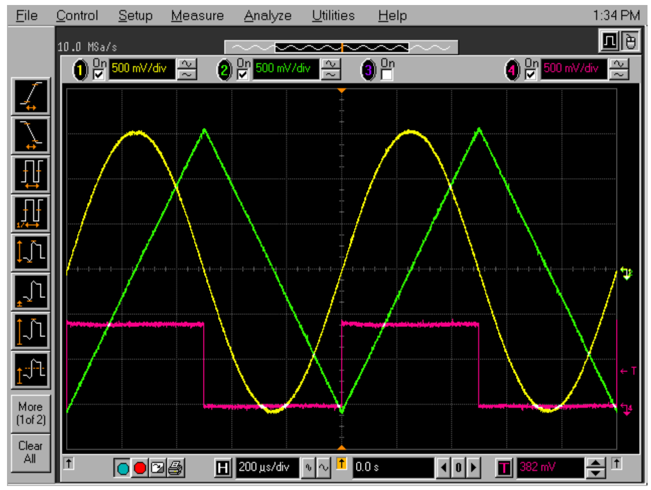


The newest answer received from the AWG.

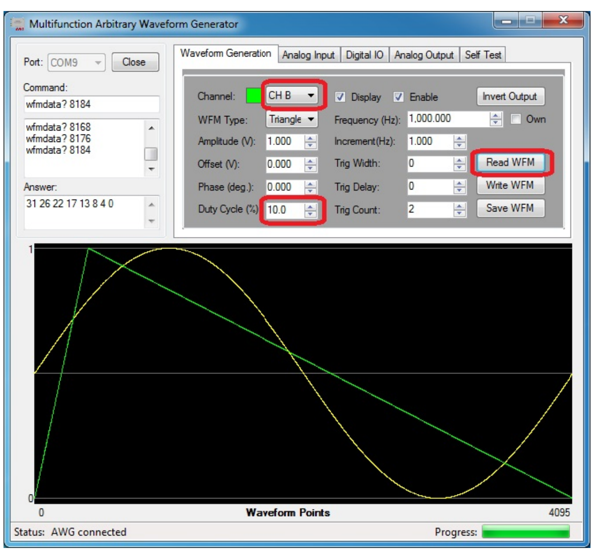
3-2. Arbitrary Waveform Generation

1. If the user click "Read WFM" button, the waveforms that are stored in the AWG are uploaded to the PC and displayed in the signal window. The control software user interface is shown in the left, and the AWG output signals monitored on an oscilloscope (not provided) is shown in the right.



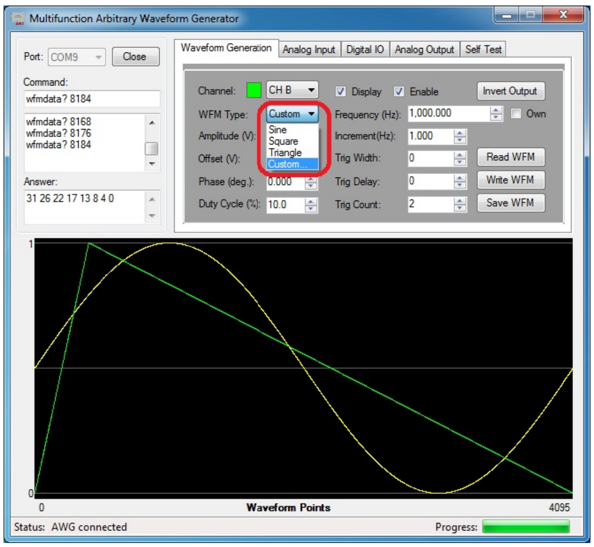


2. The user is free to adjust the waveform parameters include amplitude, offset, phase and duty cycle of the waveform in the control software. For example, if the user select "CH B", and change its duty cycle from 50% to 10%, and then clicks the "Read WFM" button again, the screens of the control software and oscilloscope are shown below.

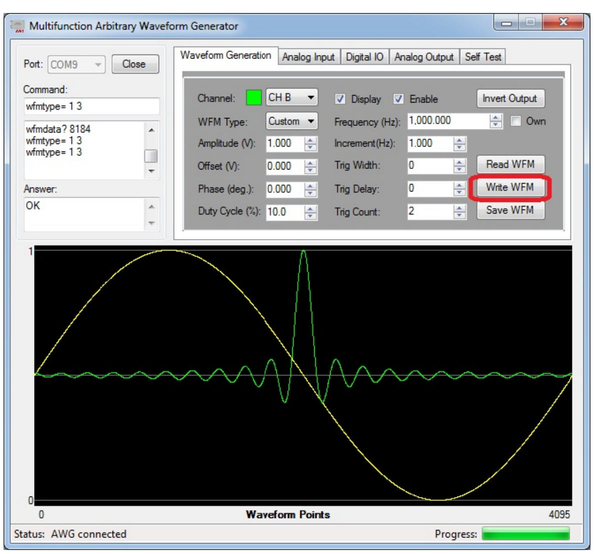


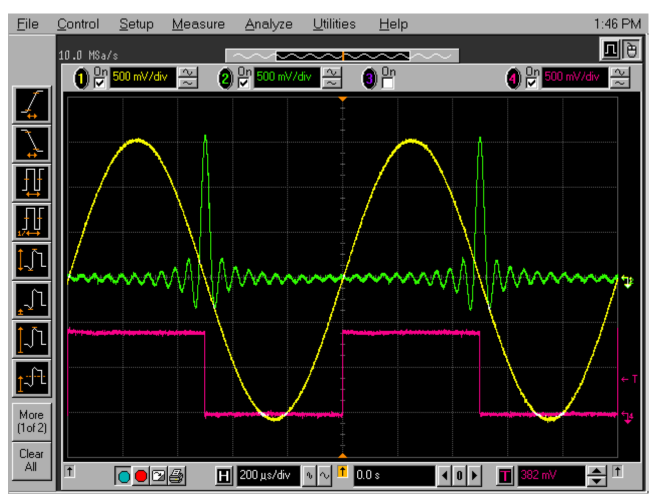
3. Please note that AWG2300 can generate three types of waveforms (sine, square, and triangle) internally. Other custom type waveform needs to be designed on the PC and downloaded to the AWG. This example shows how to download a pre-designed custom waveform to AWG2300.

After clicking the "WFM Type" drop-down menu, an "open file" dialog is shown to ask the user to select the pre-designed waveform file. For testing purpose please click "Sinc.wfm" file and then the "Open" button.

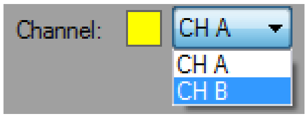


The waveform will be loaded to the control software as shown in the left screen below. After the user click the "Write WFM" button, the custom waveform is updated as AWG CH B output signal as shown on the oscilloscope.





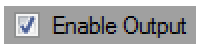
The useful software controls are:

1. 

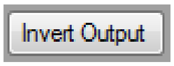
To select available waveform output channel and its parameters to be displayed in the software.

2. 

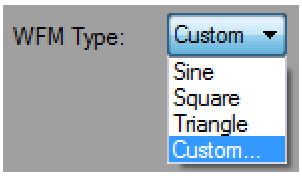
To enable/disable the display of this waveform channel signals in the software.

3. 

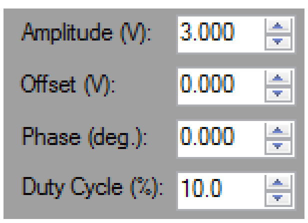
To enable/disable the output of this waveform channel in AWG output.

4. 

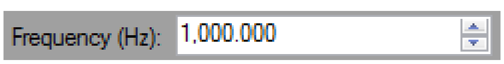
To invert the polarity of the waveform in the AWG output.

5. 

To select the output waveform type for this channel. Please note the three standard waveform types "Sine", "Square" and "Triangle" can be generated by the AWG internally. If the user select "Custom" type then the waveform data file needs to be provided to download to AWG.

6. 

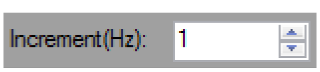
To adjust the Amplitude, Offset, Phase and Duty cycle of the waveform in the AWG output. Please note that the "Duty cycle" parameter does not apply to "Sine" waveform type.

7. 

To adjust the frequency of the output waveform. Valid range is from 0 Hz to 50 MHz.

8. 

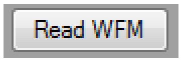
To enable individual frequency for each waveform channel, so the two waveforms have different frequencies.

9. 

To change the frequency increment when the up and down buttons of the frequency control is adjusted.

10. 

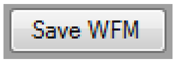
To change the number of triggers to counted in the counted trigger output (PFIO 1).

11. 

To transfer a copy of the waveform data from the AWG to the PC and displayed in the signal window.

12. 

To transfer a copy of the designed waveform data from the PC to the AWG.

13. 

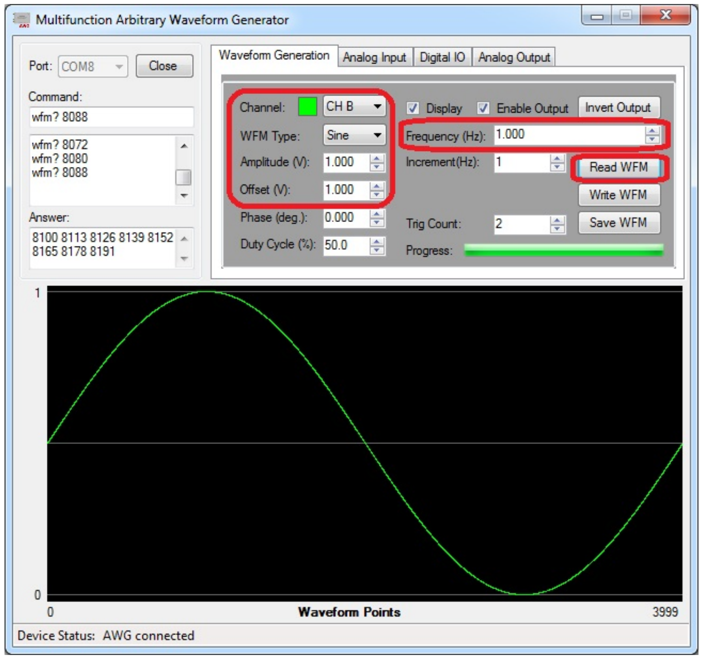
To save to waveform currently output from the AWG as its default waveform to output after a power cycling event.

13. 

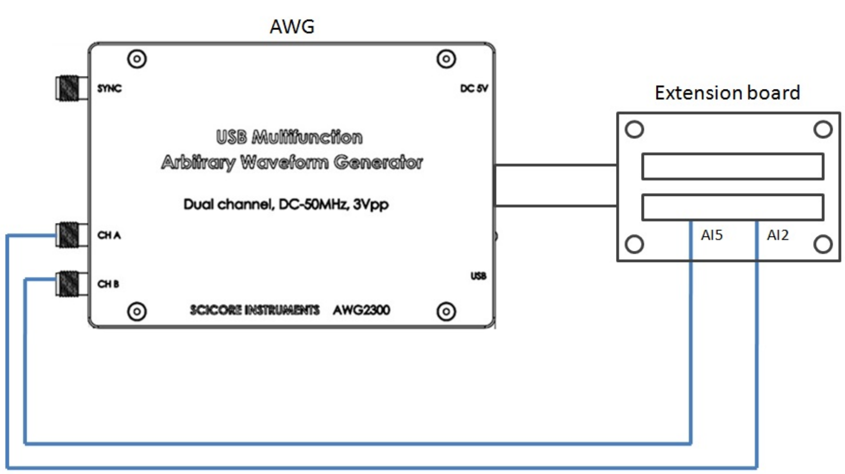
The progress indicator when the waveform data is transferred between the PC and AWG.

3-3. Analog Input

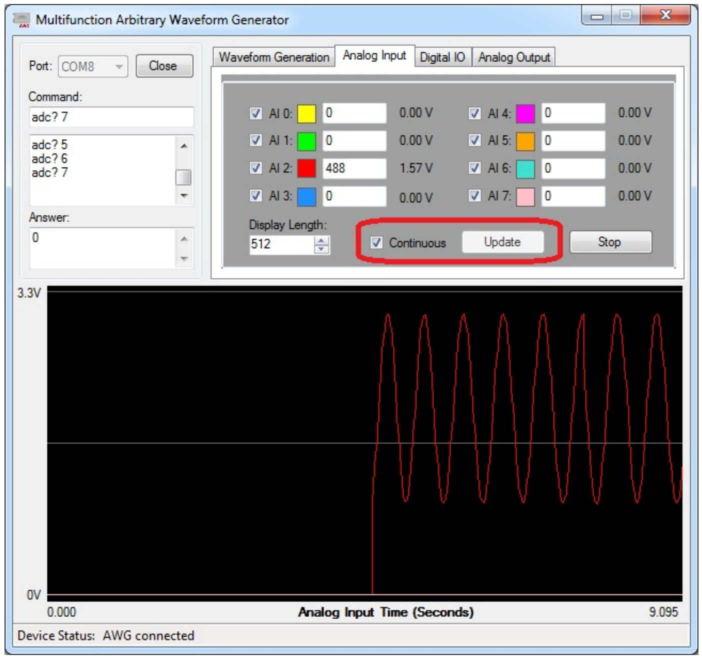
1. Setup the test sine waveform to be generated by the AWG channel B. Recommended settings are shown as below. Click the "Read WFM" button to check the waveform currently output from the AWG.



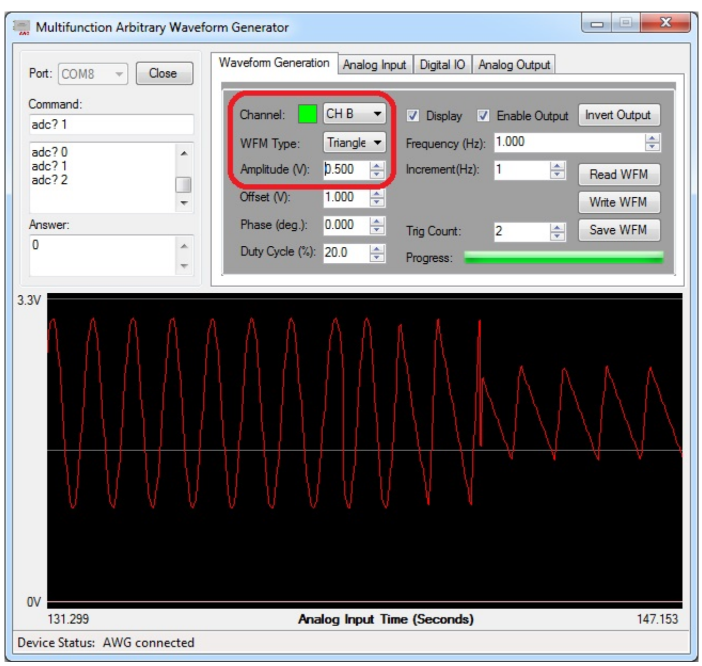
2. Use a conductive wire to connect the AWG channel B output signal to one of the analog input channel available on the "user extension B" connector. In this example the AI2 analog input channel is used.



3. Go to the "Analog Input" tab, check the "Continuous" check box, and click "Update" button. The signals appearing on AI2 will show on the signal monitoring window.



4. Keep the analog input channel measuring and updating, the user can go to the "Waveform Generation" tab to change the source waveform parameters. For example change the channel B output waveform to triangle waveform with 90% duty cycle and half of previous amplitude. The signals acquired from the analog input channel AI2 will change accordingly.



5. By connecting the other waveform output channel (AWG channel A) to another analog input channel (AI 6), the user can monitor the two analog input channels at the same time.

The valid analog input voltage range is 0V to 3.3V. Input signals outside of this range will appear saturated. The sampling rate is controlled by software (software polling mode). Limited by the data transfer speed of the communication port, the approximate maximum sample rate for single channel is measured about 100 Samples/second.

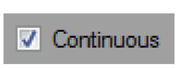
The useful software controls are:

1. 

Use the check box to enable/disable this analog input channel to be processed and displayed.

2. 

For each channel, the number of data points to display in the full window. The larger the number, the longer time of the acquired signals been displayed in the signal window.

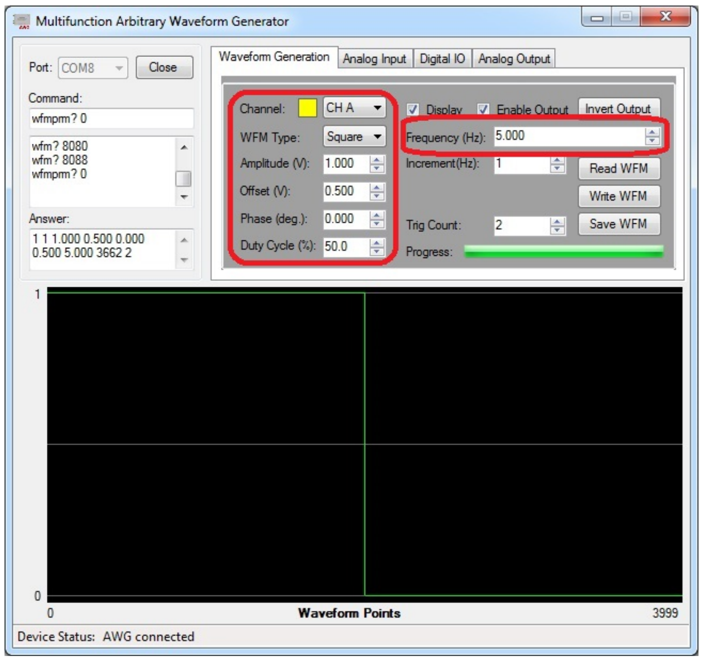
3. 

When checked, the selected analog input channels are sampled and displayed continuously.

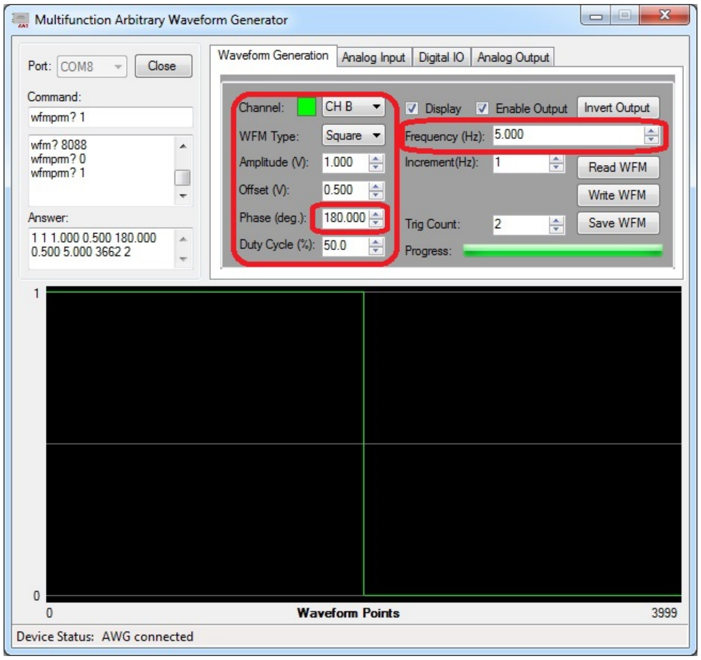
3-4. Digital Input / Output

AWG2300 supports digital IO in two operation modes, bit mode and byte mode. In the bit mode, all eight IO lines (IO0 to IO7) are configured as input or output individually. In the byte operation mode, all eight IO lines are configured as one byte and are accessed together.

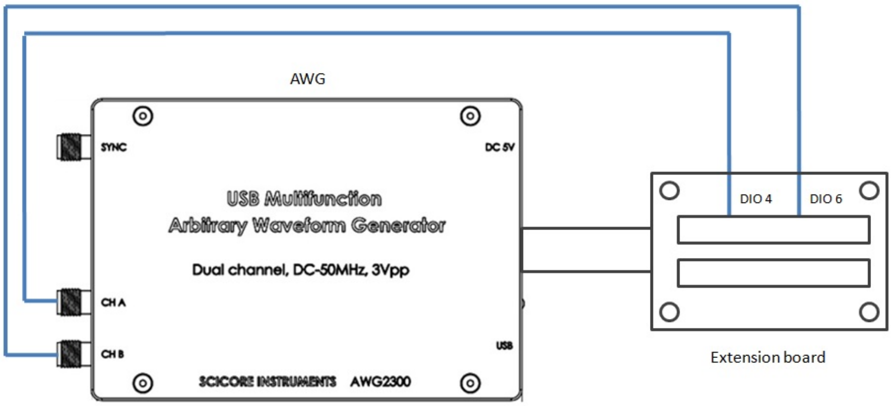
1. Setup the test waveform to be generated by the AWG channel A.



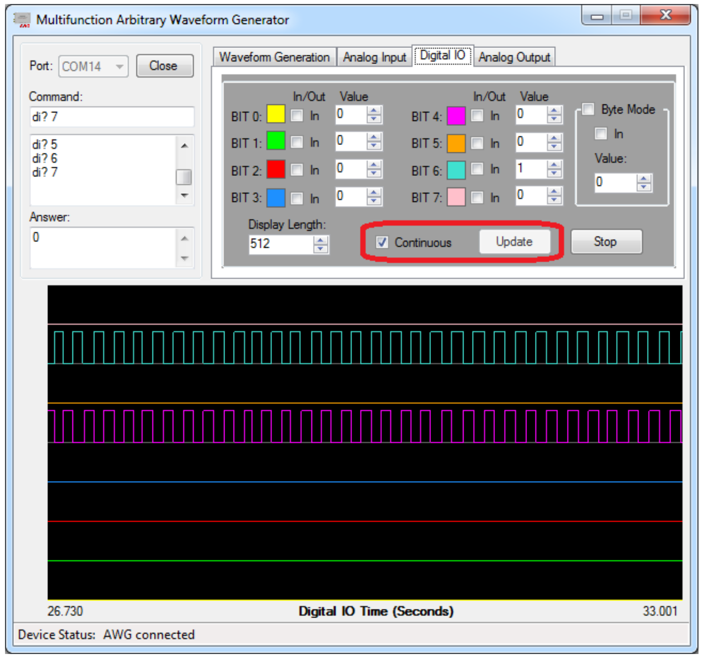
2. Setup the test waveform to be generated by the AWG channel B. Please note that the two channels are 180 degrees out of phase.



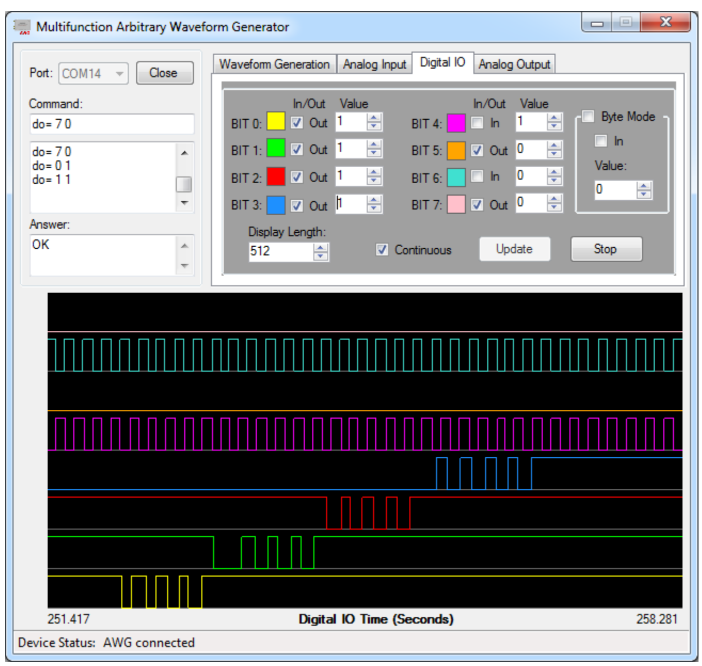
3. Use one conductive wire to connect the AWG channel A output signal to digital IO channel 4 (Bit 4), and use another conductive wire to connect the AWG channel B output signal to digital IO channel 6 (Bit 6).



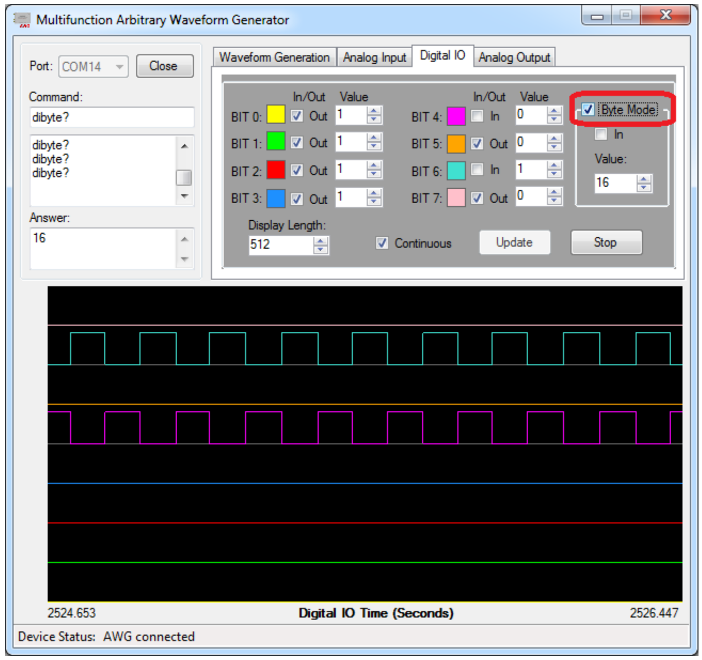
4. To test the digital IO in bit operation mode, go to "Digital IO" tab, check the "Continuous" check box, and click "Update" button. The two signals appear on the two digital input lines will show as below.



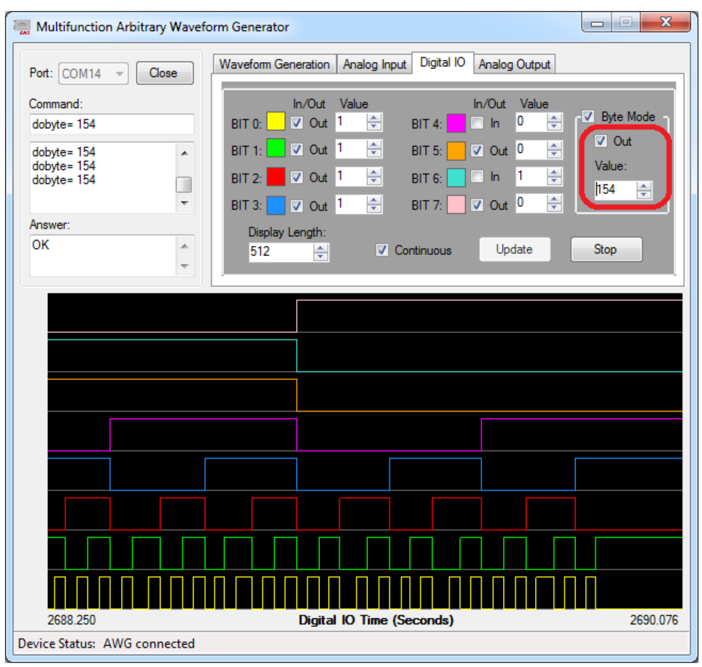
5. While Bit 4 and Bit 6 of the digital IO channels are configured as input, the user can change other digital IO channels as output by checking the IO direction check box for each channel. The value of each bit can be changed using the up-down button and appears on the output.



6. Click the "Byte Mode" check box to enable the digital IO in byte operation mode. The IO direction is input.



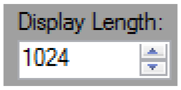
7. Click the IO direction check box to change it from "In" to "Out", and change the value of the using the up-down button. All eight IO lines are configured as one byte and each line corresponds to one bit in the binary code of the byte value.



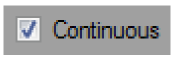
The useful software controls are:

1. 

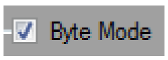
The check box defines this bit to be input or output. The up-down buttons set the value to be 0 or 1.

2. 

For each channel, the number of data points to display in the full window. The larger the number, the longer time of the IO signals been displayed in the signal window.

3. 

When checked, the digital IO signals are displayed continuously.

4. 

When checked, all digital IO lines (BIT 0 to BIT 7) are accessed as one byte.

5. 

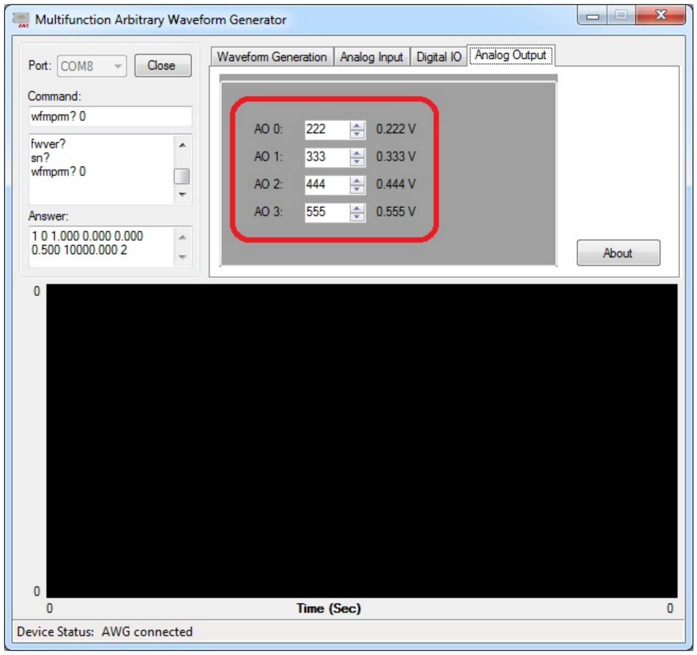
This check box defines the IO direction to be input or output.

6. 

The value of the byte when the digital IO is in input or output.

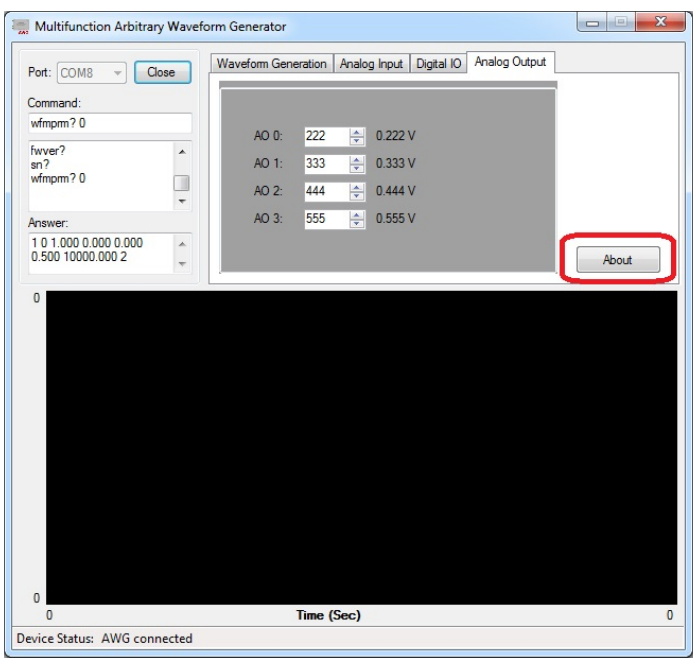
3-5. Analog Output

Go to "Analog Output" tab of the control software. Changing the value in the box will change the output voltage of each analog output channel accessible in the "user extension connector A". Please see section 1-3 for detailed pin map of the user connector to test the voltages.

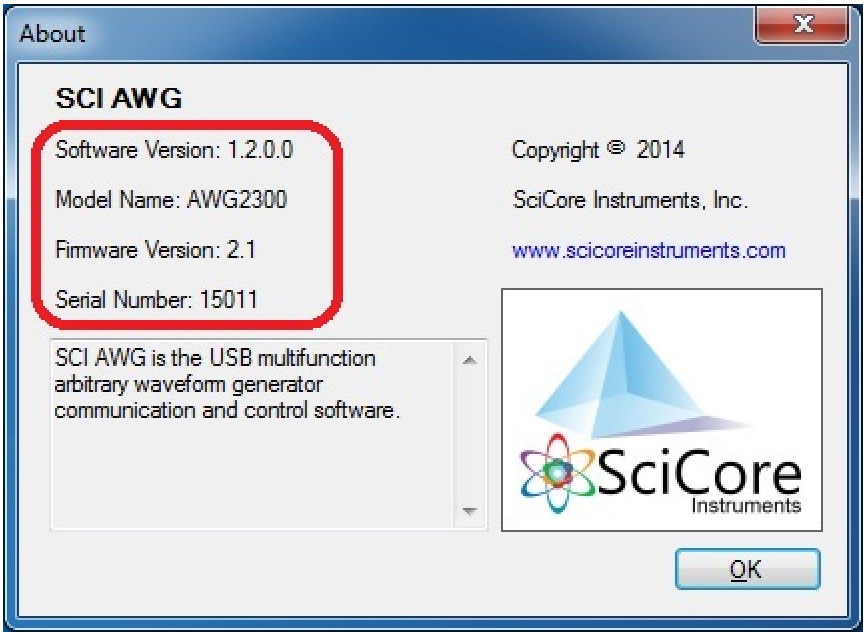


3-6. Check Device Information

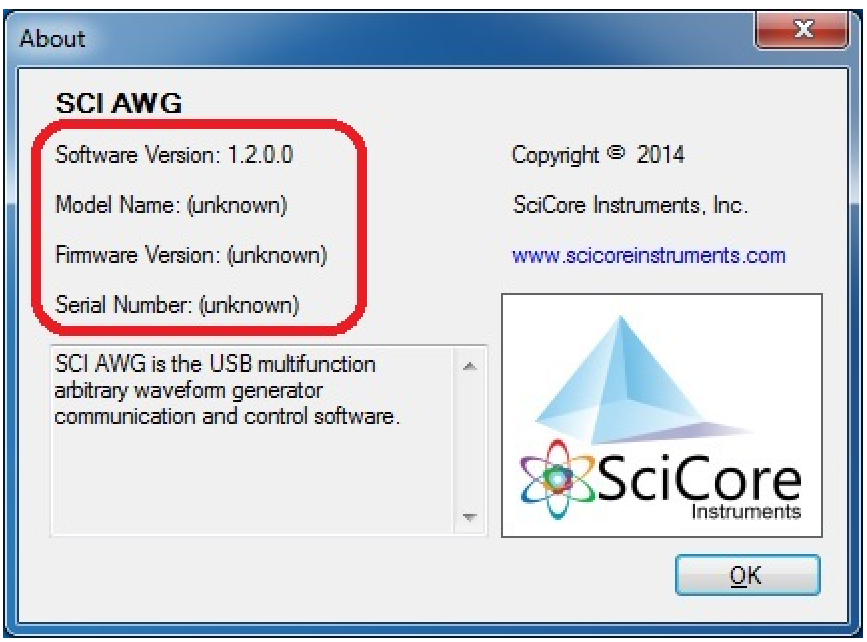
Go to "Analog Output" tab of the control software, and click the "About" button.



The information including model name, firmware version, and serial number of the instrument will show in the "About" dialog. The version information of the "SCI AWG" software is also shown.



If no instrument is connected to the PC, only the software version information is shown. Other information about the instrument is displayed as unknown.

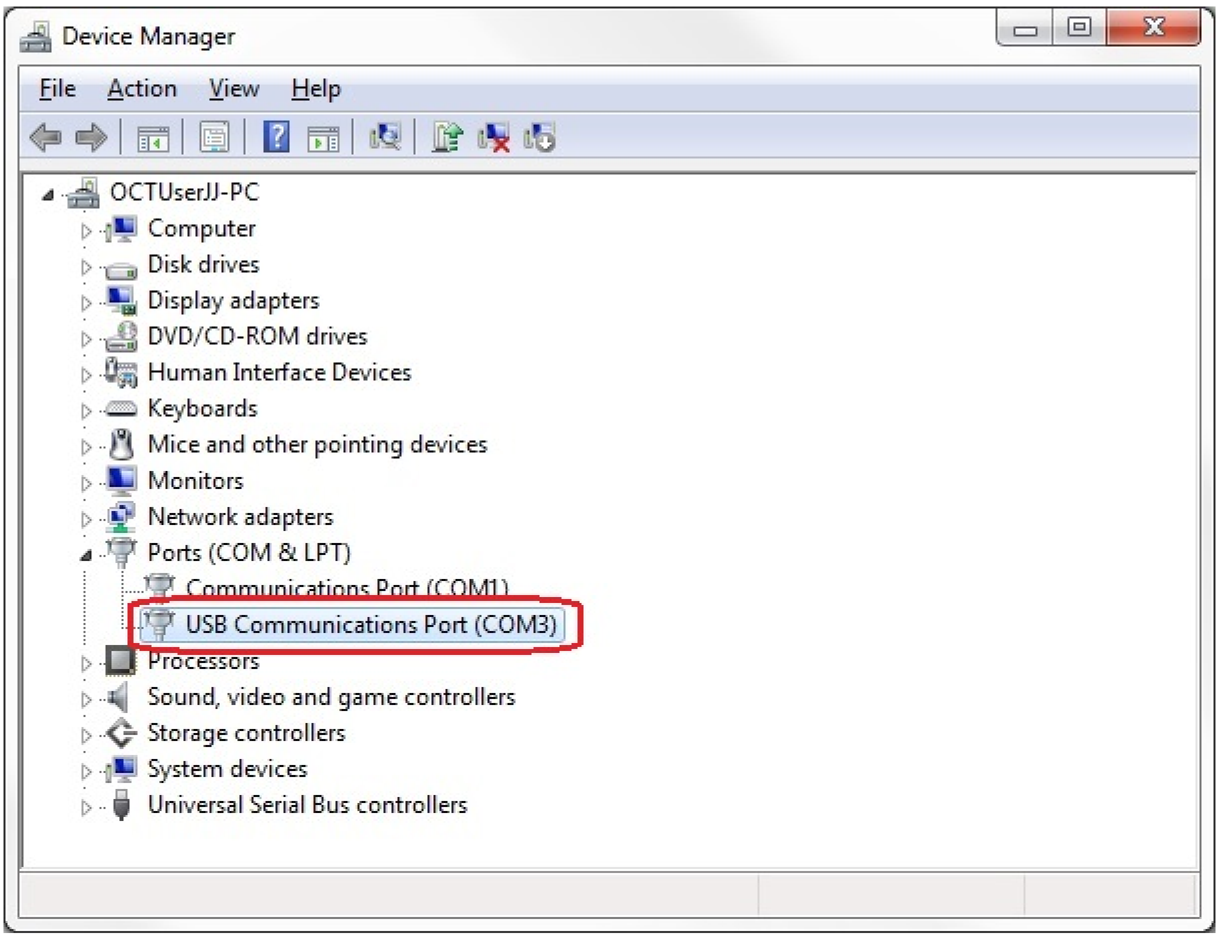


Chapter 4: Programming Interface

4-1. Programming requirements

After successful installation of the AWG driver and control software "SCI AWG", all designed functions of the AWG2300 can be tested using "SCI AWG" to work properly, as described in Chapter 3.

When connected to the PC using a USB cable, the AWG2300 appears as a standard COM port (i.e. COM3).

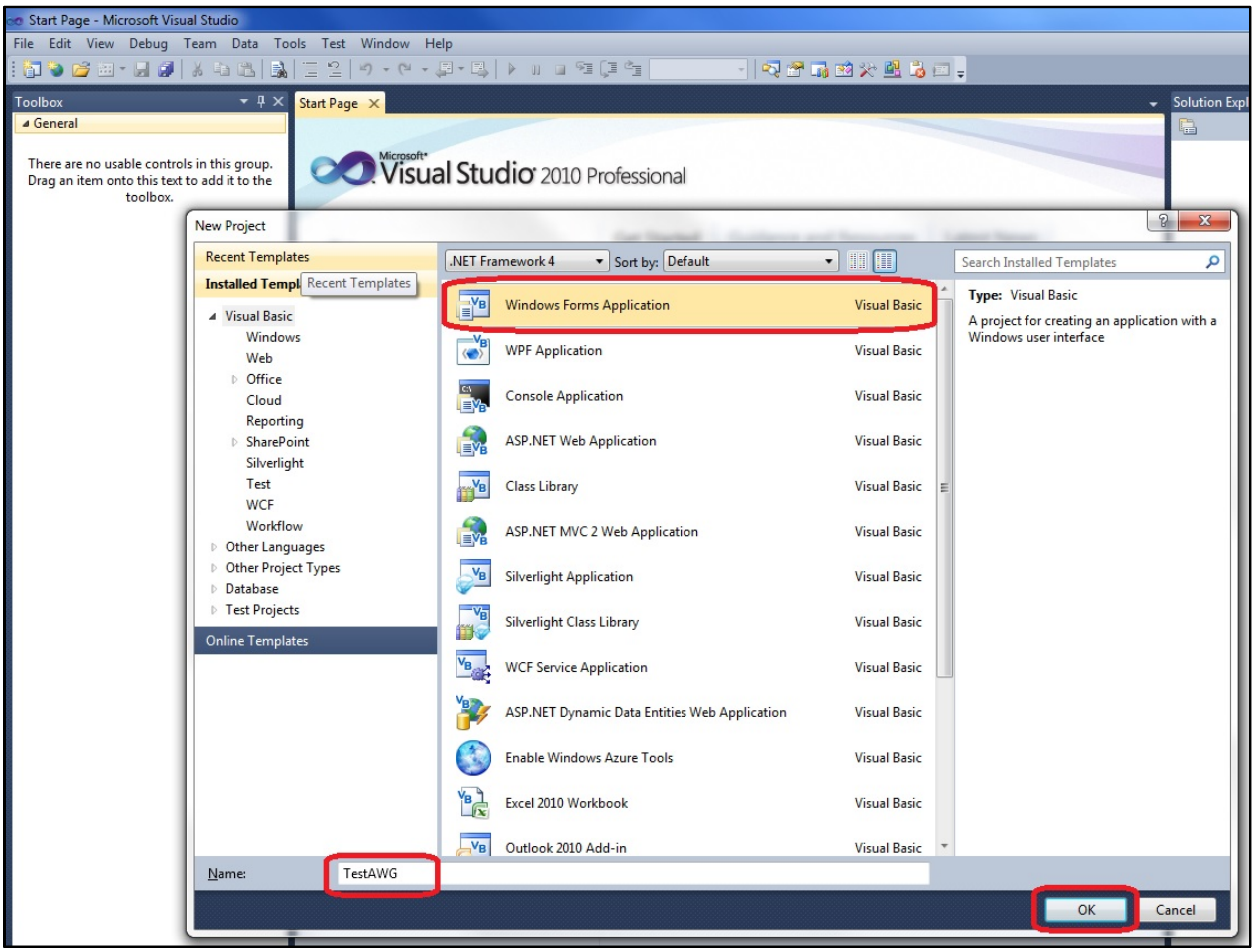


4-2. Communication software example

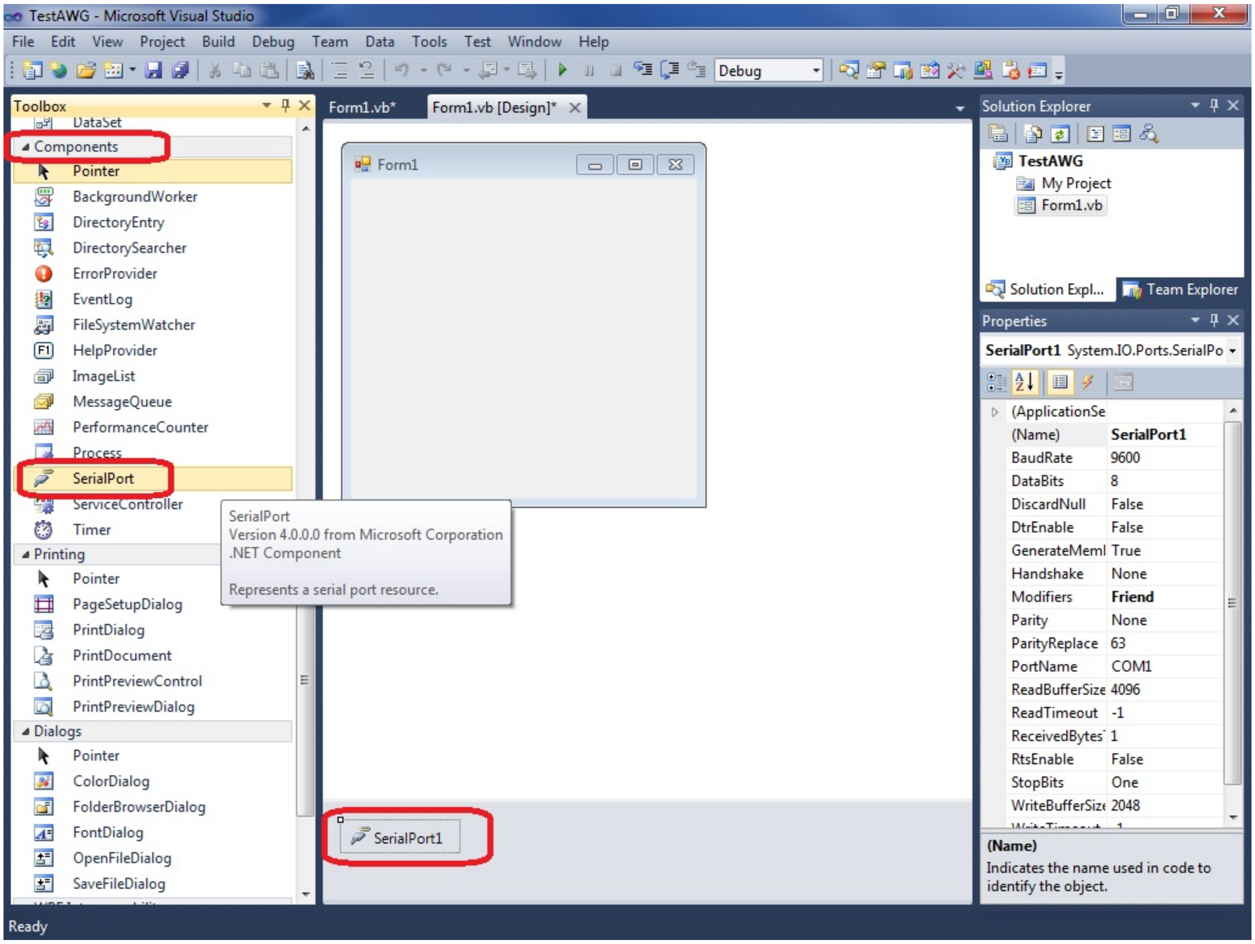
The following example shows how to write a software program to communicate with the instrument in Microsoft Visual Studio 2010, after all the preparation steps mentioned in section 4-1 is done.

1. Click "New Project ..." in Visual Studio 2010. For demonstration purposes, the Visual Studio is configured in Visual Basic development environment.

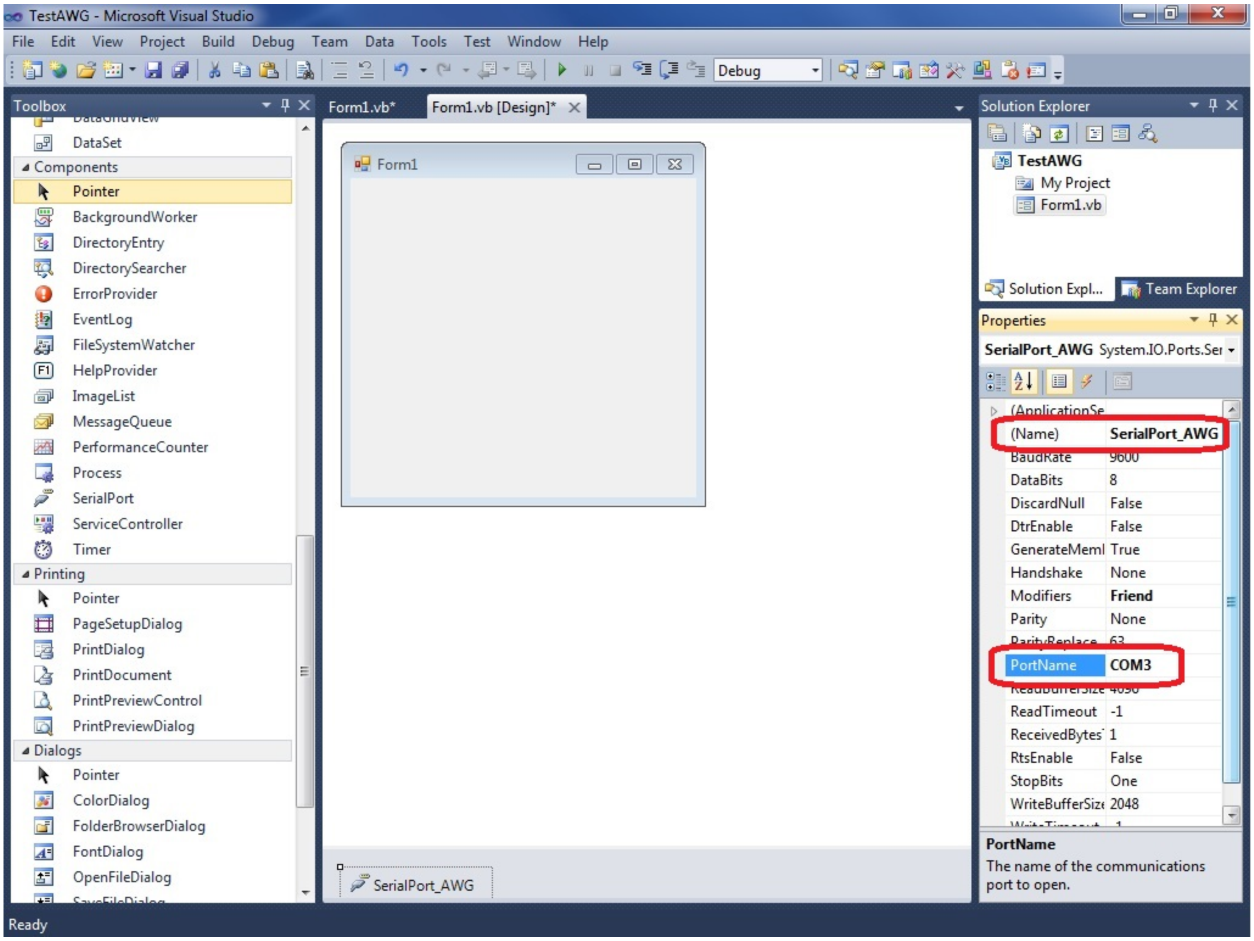
2. When following dialog is shown, select the "Windows Form Application" as project template; give the project the name "TestAWG" and click the "OK" button.



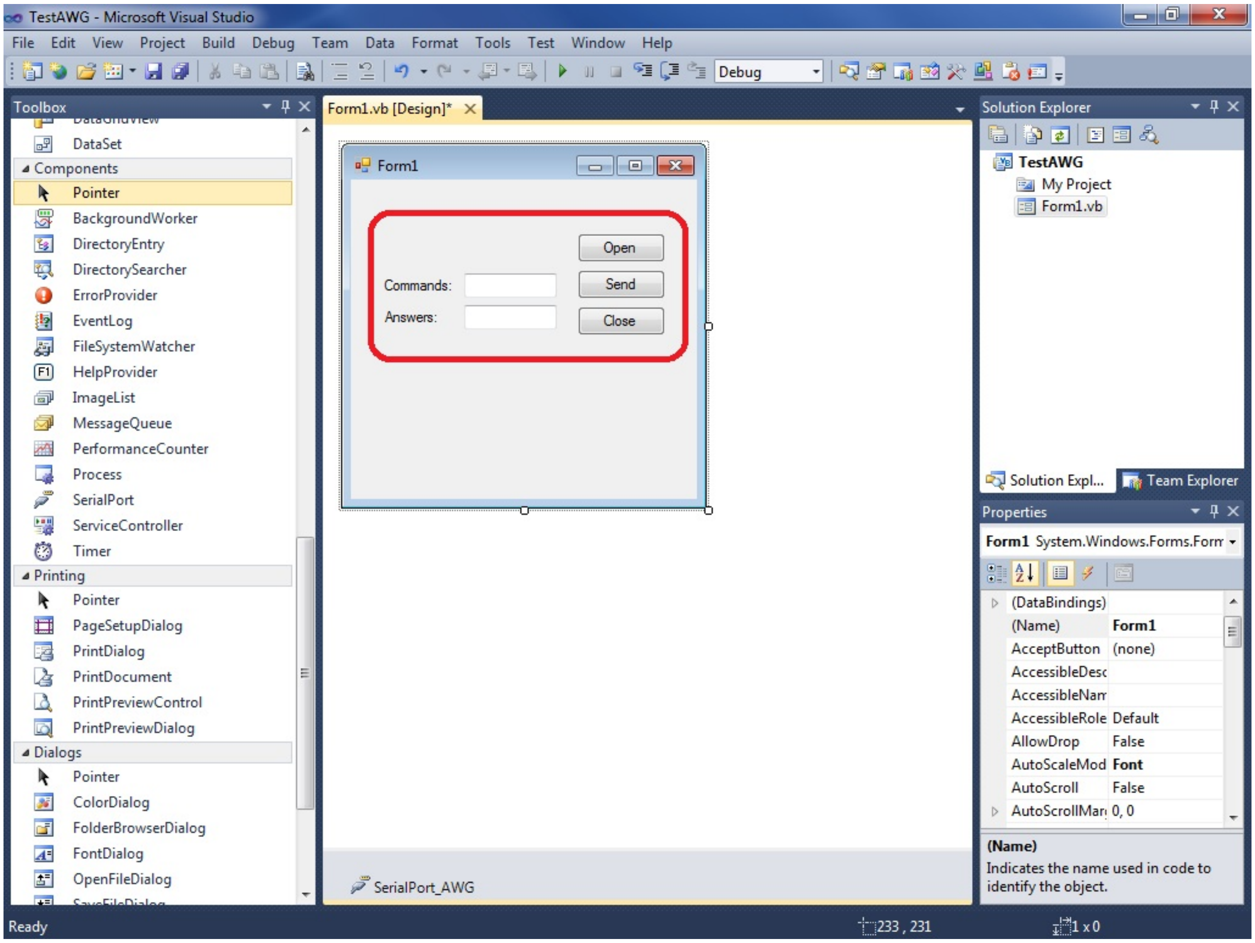
3. In the Toolbox Panel, double click "Components -> SerialPort" to add "SerialPort1" to the project.



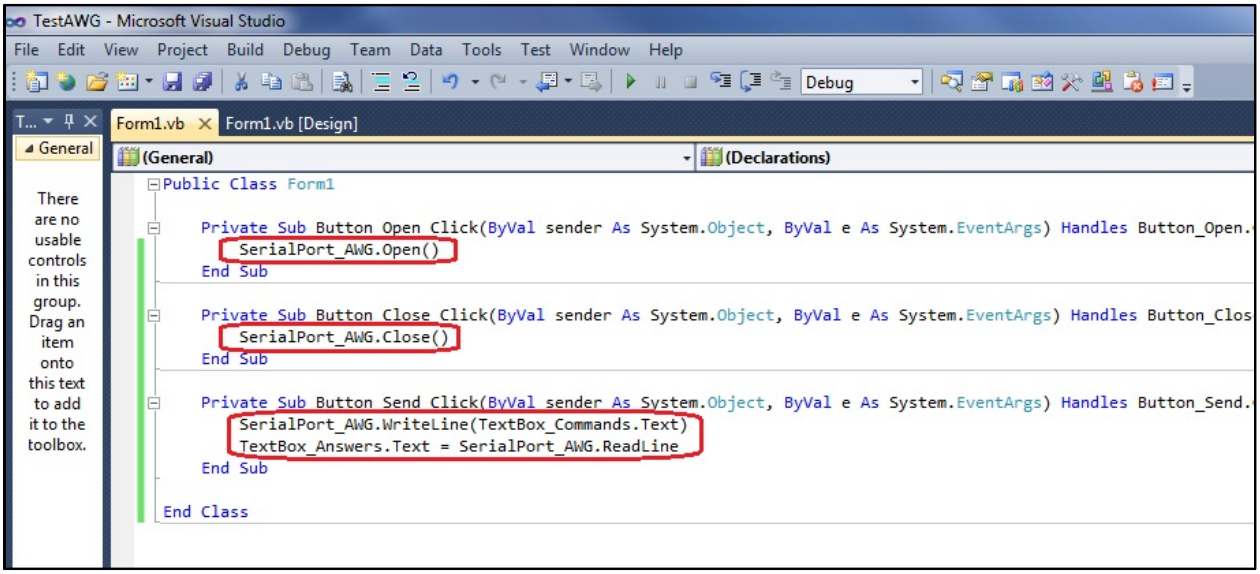
4. Rename " SerialPort1" to "SerialPort_AWG", and change the PortName to "COM3" **or the actual port number appears on the user's computer**.



5. Add a few standard controls of buttons and textboxes to the project.

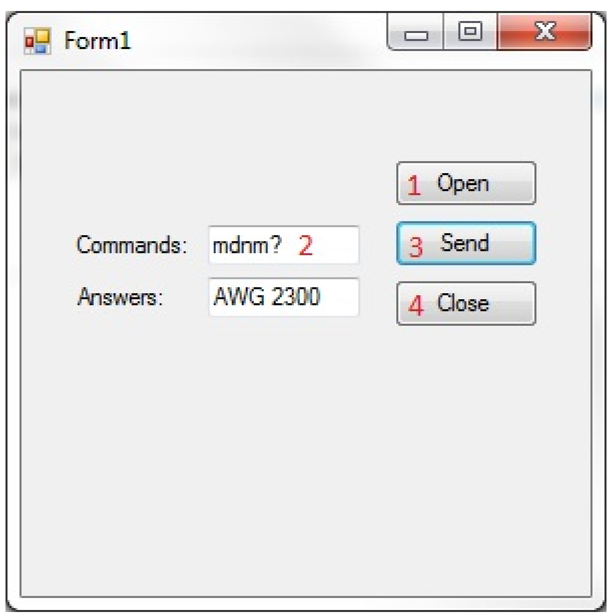


6. Add a few lines of code to handle when the buttons are clicked.



7. Press "F5" key on the keyboard to start testing this small program.

8. After click the "open" button once, input the first test command "mdnm?" and then click the "Send" button, the program will receive a response from the AWG as "AWG 2300" in the textbox named "answers". The user need click "Close" button before close the program. Note the "mdnm?" command is used to inquiry the device model name from a pre-defined command set as described in section 4.3.



4.3 AWG command Set

The list below is the complete command set supported by the instrument via the USB COM port.

4.3.1 Get Device Model Name

Description	Get device model name as string
Command	`mdnm?`
Parameters	none
Return Values	The string contains the model name of the device
Example	`mdnm?`
Example Answer	`AWG 2300`

4.3.2 Get Device Vendor Name

Description	Get device vendor name as string
Command	`vdnm?`
Parameters	none
Return Values	The string contains the manufacturer's name
Example	`vdnm?`
Example Answer	`SCI`

4.3.3 Get Waveform Channel Number

Description	Get number of waveform output channels supported by the device
Command	`wfmchnum?`
Parameters	None
Return Values	The number of waveform channels on the device
Example	`wfmchnum?`
Example Answer	`2`

4.3.4 Set Waveform Type

Description	Set output waveform type for the specified channel	
Command	`wfmtype= [value1] [value2]`	
Parameter	`[value1]`	`[value2]`
Type	Integer	Integer
Range	0: Channel A 1: Channel B	0: Sine waveform 1: Square waveform 2: Triangle waveform

		3: Custom waveform
Return Values	OK	
Example	`wfmtype= 1 2 (Set channel B to output triangle waveform)`	
Example Answer	`OK`	

4.3.5 Set Waveform Frequency

Description	Set output waveform frequency for all channels
Command	`wfmfreq= [value1]`
Parameter	`[value1]`
Type	Single
Range	0 - 50,000,000
Return Values	The new output frequency
Example	`wfmfreq= 100000 (Set waveform frequency to be 100kHz for all output channels)`
Example Answer	`100000.000000`

4.3.6 Set Individual Frequency Control

Description	Enable/disable each output channel to have its own frequency
Command	`freqown= [value1]`
Parameter	`[value1]`
Type	Integer
Range	0: All waveforms have the same output frequency as CH A 1: Each output waveform has its own output frequency
Return Values	OK
Example	`freqown= 1 (All waveforms have different output frequencies)`
Example Answer	`OK`

4.3.7 Set Individual Frequency

Description	Set individual output frequency for the specified channel	
Command	`wfmfreqown= [value1] [value2]`	
Parameter	`[value1]`	`[value1]`
Type	Integer	Single
Range	0: Channel A 1: Channel B	0 - 50,000,000
Return Values	The new output frequency	
Example	`wfmfreqown= 1 50000  (Waveform CH B will have`	

	a new frequency of 50kHz. Waveform CH A output frequency is unchanged)
Example Answer	OK

4.3.8 Set Waveform Amplitude

Description	Set output waveform amplitude (Vpp) for the specified channel	
Command	wfmamp= [value1] [value2]	
Parameter	[value1]	[value2]
Type	Integer	Single
Range	0: Channel A 1: Channel B	0 to 10.0
Return Values	OK	
Example	wfmamp= 0 3.2 (Set channel A output waveform amplitude to be 3.2V)	
Example Answer	OK	

4.3.9 Set Waveform Offset

Description	Set output waveform offset for the specified channel	
Command	wfmoffset= [value1] [value2]	
Parameter	[value1]	[value2]
Type	Integer	Single
Range	0: Channel A 1: Channel B	0 to 10.0
Return Values	OK	
Example	wfmoffset= 0 1.1 (Set channel A output waveform offset to be 1.1V)	
Example Answer	OK	

4.3.10 Set Waveform Phase

Description	Set output waveform phase for the specified channel	
Command	wfmphase= [value1] [value2]	
Parameter	[value1]	[value2]
Type	Integer	Single precision float
Range	0: Channel A 1: Channel B	-360.0 to 360.0
Return Values	OK	

Example	`wfmphase= 0 45.0 (Set channel A output waveform phase to be 45 degrees)`	
Example Answer	OK	

4.3.11 Set Waveform Duty-cycle

Description	Set output waveform duty-cycle for the specified channel	
Command	`wfmduty= [value1] [value2]`	
Parameter	`[value1]`	`[value2]`
Type	Integer	Single precision float
Range	0: Channel A 1: Channel B	0 to 100.0
Return Values	OK	
Example	`wfmphase= 0 90.0 (Set channel A output waveform duty-cycle to be 90%)`	
Example Answer	OK	
Note	`Duty-cycle only applies to square and triangle waveform types.`	

4.3.12 Enable/Disable Waveform Output

Description	Enable or disable waveform output for the specified channel. When a channel is disabled it will output 0V DC voltage.	
Command	`wfmon= [value1] [value2]`	
Parameter	`[value1]`	`[value2]`
Type	Integer	Integer
Range	0: Channel A 1: Channel B	0: output disabled 1: output enabled
Return Values	OK	
Example	`wfmon= 1 0 (Disable channel B output)`	
Example Answer	OK	

4.3.13 Invert Waveform Output

Description	Invert the voltage polarity of the waveform for the specified channel.
Command	`wfminv= [value1]`
Parameter	`[value1]`
Type	Integer
Range	0: Channel A

	1: Channel B
Example	`wfminv= 0 (Invert the waveform for CH A)`

4.3.14 Download Waveform Data To AWG

Description	Download waveform data from the PC to the AWG at the specified address. To reduce the data transfer overload, 8 data points are updated in one command.	
Command	`wfmdata= [address] [value1] [value2] [value3] [value4] [value5] [value6] [value7] [value8]`	
Parameter	`[address]`	`[value1] to [value8]`
Type	Integer	Integer
Range	0 to 3999: Channel A 4096 to 8095: Channel B	0 to 16383
Example	`wfmdata= 4096 0 1 2 3 4 5 6 7(Download the first eight waveform data for CH B)`	
Example Answer	`OK`	
Note	The downloaded waveform data is not applied to the output until the "wfmupdate=" command is sent.	

4.3.15 Update AWG Output

Description	Update AWG output using the downloaded waveform data for the specified channel. After this command the new waveform will appear on the AWG output.
Command	`wfmupdate= [value1]`
Parameter	`[value1]`
Type	Integer
Range	0: Channel A 1: Channel B
Example	`wfmupdate= 1` (Update CH B output using the latest waveform data)
Example Answer	`OK`

4.3.16 Read Waveform Parameters

Description	Read the waveform parameters for the specified AWG channel. These parameters include amplitude, offset, phase, dutycycle, etc.
Command	`wfmprm? [value1]`
Parameter	`[value1]`
Type	Integer

Range	0: Channel A 1: Channel B		
Answer	`[value1] [value2] [value3] [value4] [value5] [value6] [value7] [value8]`		
Parameters	`[value1]`	`[value2]`	`[value3]`
Type	Integer	Integer	Single precision float
Range	0: output is disabled 1: output is enabled	0: sine wave 1: square wave 2: triangle wave 3: custom wave	The output voltage amplitude of the specified channel
Parameters	`[value4]`	`[value5]`	`[value6]`
Type	Single precision float	Single precision float	Single precision float
Range	The offset voltage of the specified channel	The phase (in degrees) of the specified channel	The duty-cycle of the specified channel
Parameters	`[value7]`	`[value8]`	
Type	Single precision float	Integer	
Range	The frequency of the output waveform	The trigger counter number	
Example	`wfmprm? 1 (Checking CH B parameters)`		
Example Answer	`1 2 3.000 -0.500 90.000 0.200 200000.000 2` (CH B output is enabled, triangle wave at 200kHz, amplitude is 3.0V, offset is -0.5V, phase shift is 90 degree, duty cycle is 20%, and the trigger counter number is 2)		

4.3.17 Write Trigger Counter

Description	The number of the triggers to be counted as output on the PFIO 1 pin on the user connector 1
Command	`wfmtrgcnt=[value1]`
Parameter	`[value1]`
Type	Integer
Range	1 to 4095
Example	`wfmtrgcnt= 64` (every 64 triggers will be counted to output one pulse on PFIO 1 pin)
Example Answer	`OK`

4.3.18 Save Waveform As Default

Description	Save the current waveforms and parameters as default settings. The next time when the AWG is powered all default settings are applied.
Command	`wfmsave`

Parameter	None
Return Value	OK: Operation is Successful Err: Operation is Failed
Example	wfmsave
Example Answer	OK

4.3.19 Read Analog Input

Description	Read the analog input voltage on the specified input AI0 to AI7.
Command	ai? [value1]
Parameter	[value1]
Type	Integer
Range	0 to 7 corresponds to the analog input channel AI0 to AI7
Return Value	[result1]
Type	Single precision float
Range	0 to 3.30 (0V to 3.3V)
Example	ai? 5 (read AI5)
Example return	1.60 (1.6V)

4.3.20 Read Digital Input

Description	Read the specified digital input line DI0 to DI7.
Command	di? [value1]
Parameter	[value1]
Type	Integer
Range	0 to 7 corresponds to the digital input channel DI0 to DI7
Return	[result1]
Type	Integer
Range	0 or 1
Example	di? 3
Return	1

4.3.21 Write Digital Output

Description	Write specified digital output line DO0 to DO7.	
Command	do= [value1] [value2]	
Parameter	[value1]	[value2]
Type	Integer	Integer
Range	0 to 7 corresponds to DO0 to DO7	0 or 1
Example	do= 2 1 (output 1 on DO2 line)	

Example Answer	OK

4.3.22 Read Byte Digital Input

Description	Read a byte from DI7 to DI0.
Command	dibyte?
Parameter	None
Return	[result1]
Type	Integer
Range	0 to 255
Example	dibyte?
Return	128 (10000000 is read from DI7 to DI0)

4.3.23 Write Byte Digital Output

Description	Write a byte to DO7 to DO0.
Command	dobyte= [value1]
Parameter	[value1]
Type	Integer
Range	0 to 255
Example	dobyte= 128 (output 10000000 to DO7 to DO1)
Example Answer	OK

4.3.24 Read Analog Output

Description	Read the output voltage at the specified analog output channel AO0 to AO4.
Command	dac? [value1]
Parameter	[value1]
Type	Integer
Range	0 to 3 corresponds to AO0 to AO3
Return Value	[result1]
Type	Integer
Range	0 to 4095 corresponds to 0V to 4.095V
Example	dac? 1
Example Answer	OK

4.3.25 Write Analog Output

Description	Write a new output voltage at the specified analog output channel

	AO0 to AO4.	
Command	`dac= [value1] [value2]`	
Parameter	`[value1]`	`[value2]`
Type	Integer	Integer
Range	0 to 3 corresponds to AO0 to AO3	0 to 4095 corresponds to 0V to 4.095V
Example	`dac= 2 2048 (output 2.048V on AO2)`	
Example Answer	`OK`	

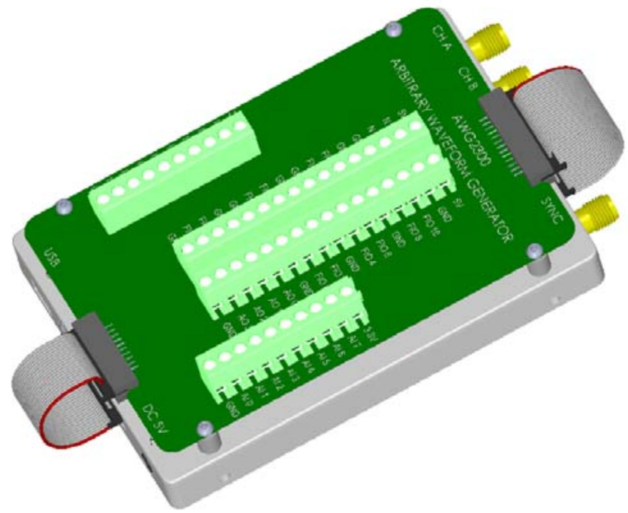
4.3.26 Check Firmware Version

Description	Write a new output voltage at the specified analog output channel AO0 to AO4.
Command	`fwver?`
Parameter	`None`
Return	`[result1]`
Type	Single precision float
Example	`fwver?`
Example Answer	`1.1`

Chapter 5: Signal Expansion Board

5-1. Signal Expansion Board

The AWG2300 only needs a USB cable or a 5V power supply to operate in stand-alone mode, and outputs the waveforms from the two SMA connectors. For convenient access of other signals including analog input, analog output and digital IO, a signal expansion board can be mounted on the AWG with two flat cables connections between the AWG and the signal expansion board.

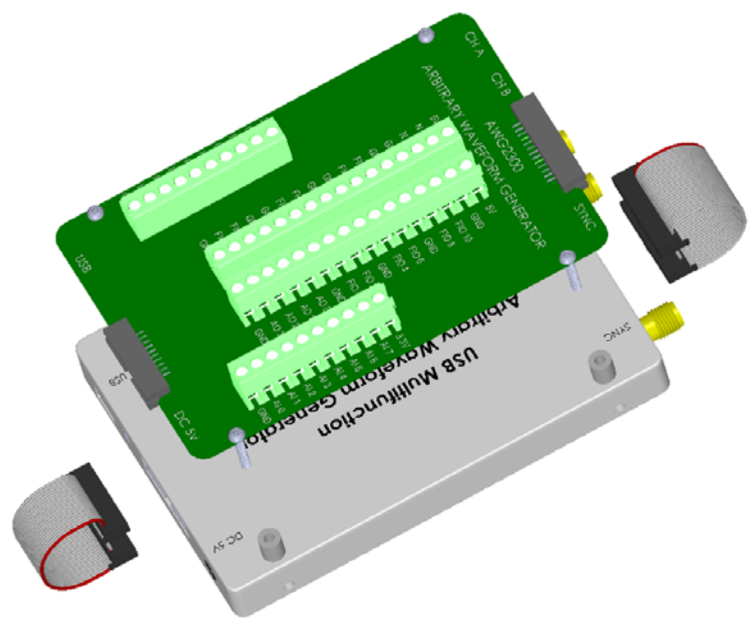


5-2 Signal expansion board installation

1. Disconnect the USB and power cable from the AWG2300, remove the four flat-head screws on the top cover with a Phillips #1 screwdriver.

2. Using four M2.5 stand-off screws to secure the AWG2300 top cover to the base.

3. Using a 1.5 mm hex key screw driver to tighten four M2.5 button-head screws to mount the signal expansion board on the four stand-offs already installed in previous step.

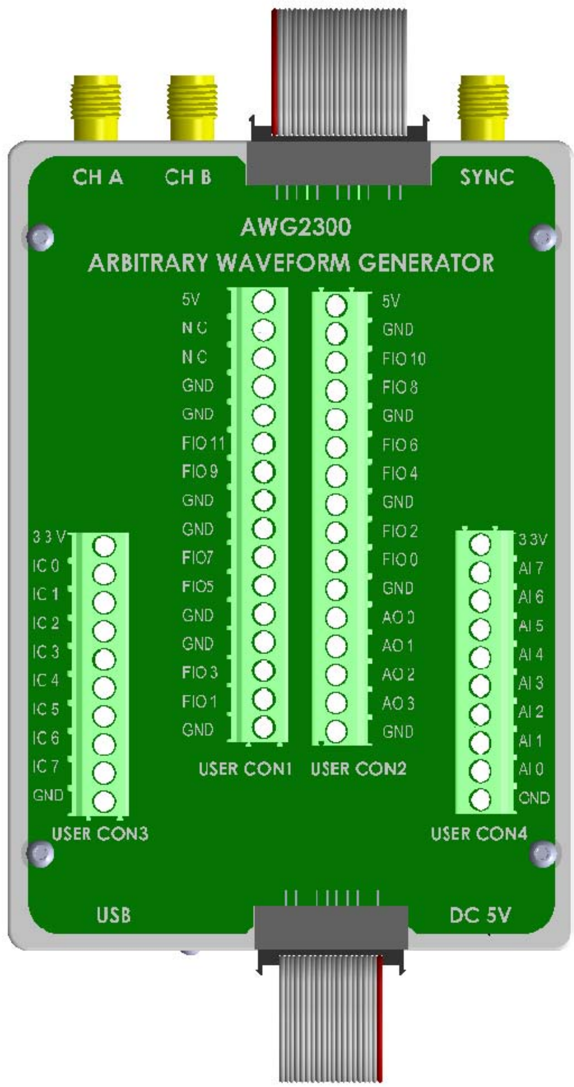


4. Connect the signal expansion board with the AWG using a 20 pin flat cable connector on one side and a 26 pin connector on the other side.

5-3. Available Signals

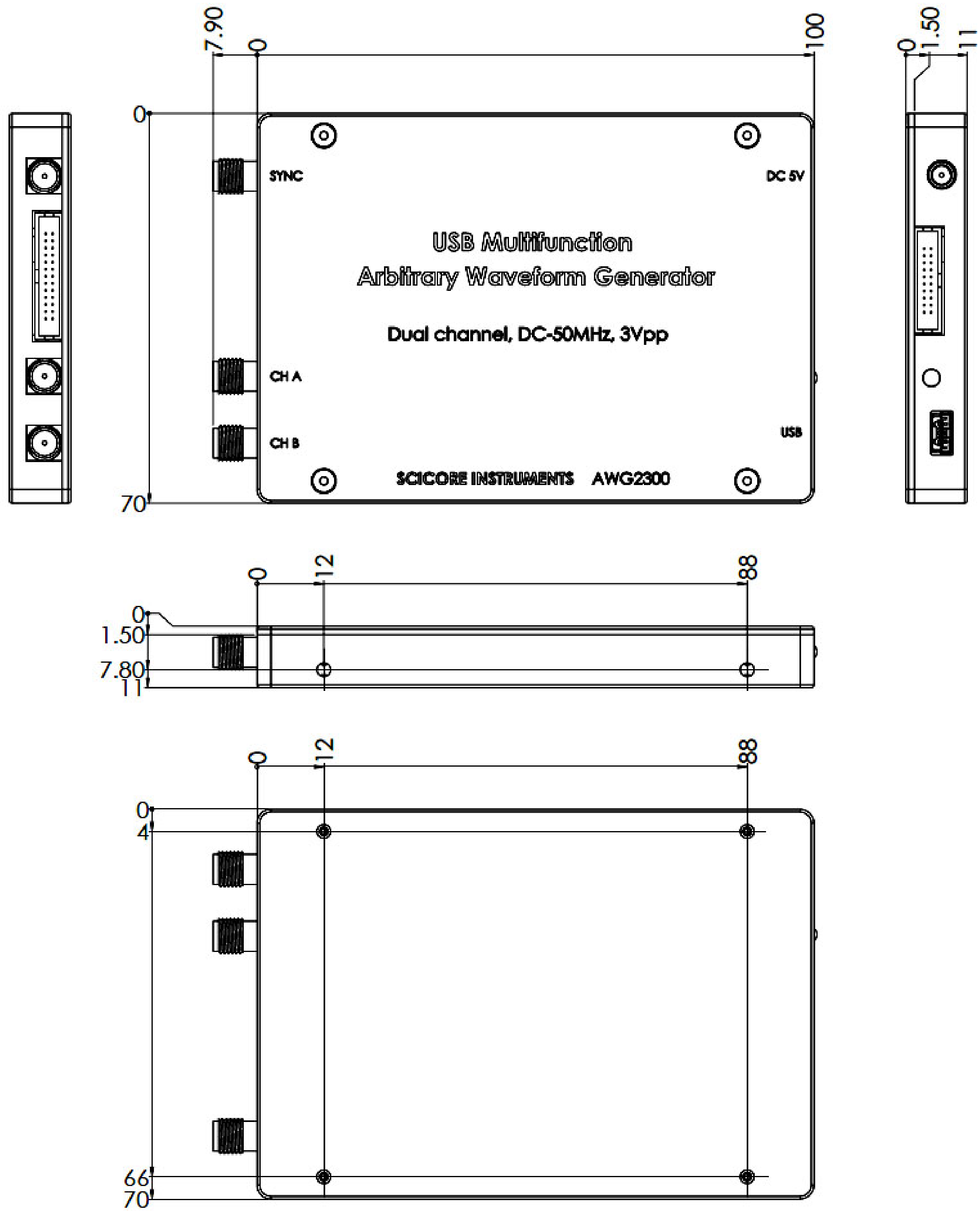
To connect a signal wire to a screw terminal, prepare the wire by stringing ~5mm of insulation, insert the wire into the screw terminal, and securely tightening the screws with a flathead screwdriver. The signals that can be accessed on the signal expansion board include:

Signal type	Name	Location
Power signals	+5V	USER CON1 and USER CON2
	+3.3V	USER CON3 and USER CON4
	GND	All connectors
Analog input signals	AI 0 - AI 7	USER CON4
Digital IO signals	IO 0 - IO 7	USER CON3
Analog output signals	AO 0 - AO 3	USER CON2
Functional IO signals	FIO 0 - FIO 11	USER CON1 and USER CON2

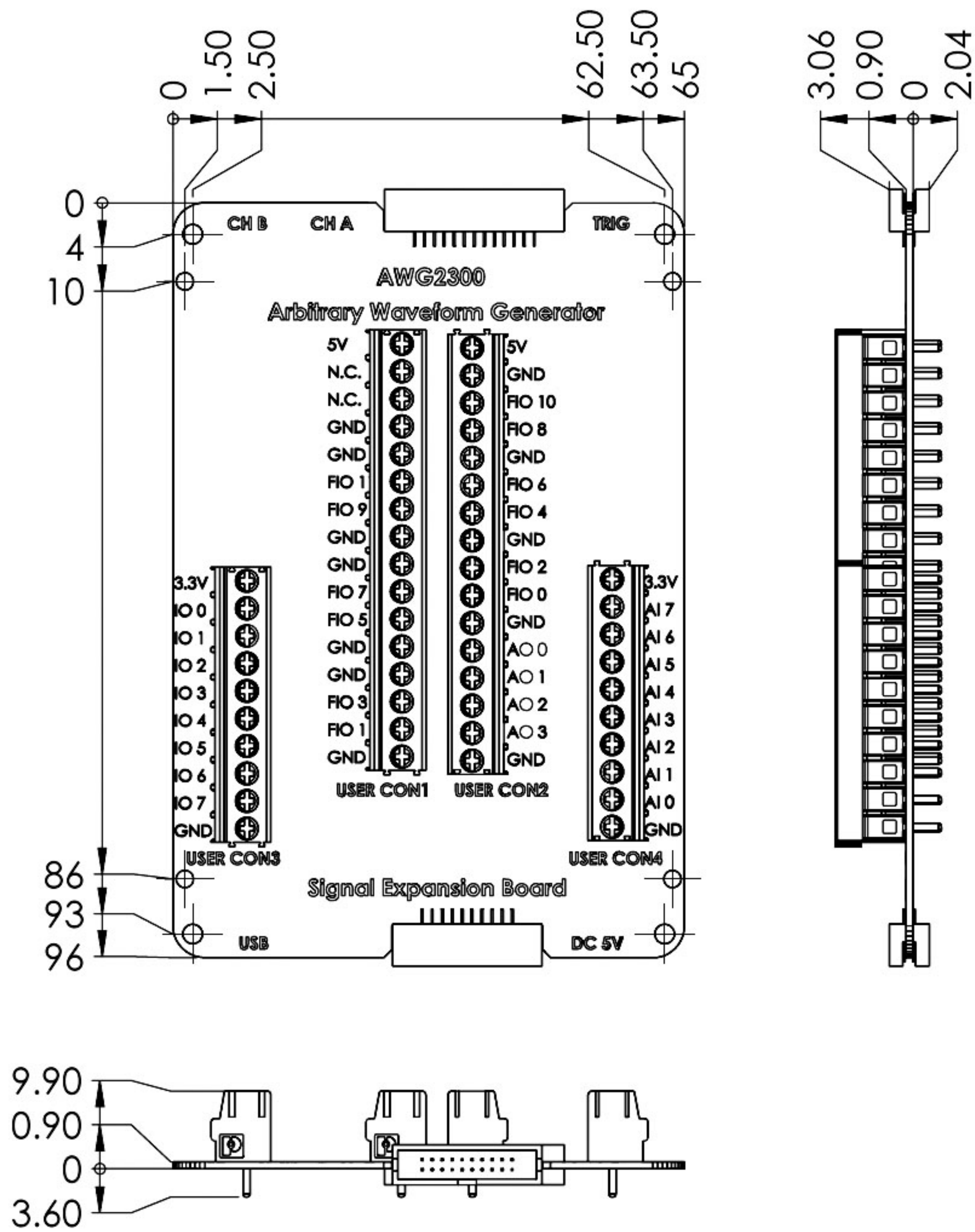


Chapter 6: Mechanic Drawings

6-1. AWG2300 dimensions (All units are in mm)



6-2. Signal expansion board dimensions (All units are in mm)



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