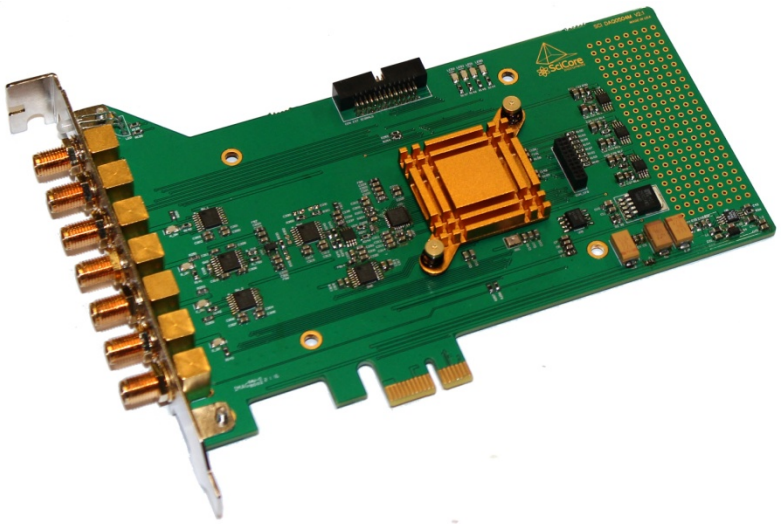
PCI-express data acquisition card

DAQ0504M

User Guide



SciCore Instruments

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: Mechanic drawings

This chapter provides the mechanic drawings for the product.

More information

The company's website (www.scicoreinstruments.com) provides updated information on SCI hardware and software products, and the contact information.

Specifications Summary

Product	**DAQ-0504M**
Descriptions	PCI express data acquisition card
Analog Input	
Channels	4 (time multiplexing)
Sampling Rate	50 MS/s, 40 MS/s, 30 MS/s, 25 MS/s, 24 MS/s, 20 MS/s, 15 MS/s, 12.5 MS/s, 12 MS/s, 10MS/s, 8.0 MS/s, 7.5 MS/s, 6.0 MS/s, 5.0 MS/s, 4.0 MS/s, 3.0 MS/s, 2.5 MS/s, 2.0 MS/s, 1.5 MS/s, 1.0 MS/s, 0.5 MS/s
Vertical Resolution	14 bit
Input Impedance	50 Ohm or 1M Ohm
Input Coupling	DC or AC
Input Bandwidth (-3 dB)	25 MHz
Input Attenuation	/1, /2
Input Amplifier Gain	x1, x10, x100
Input Connector	SMA (Female) x 4
SNR	60 dB
Channel switching time	1 millisecond
Channel crosstalk	-65 dB
Trigger Input	
Trigger Methods	rising edge, falling edge, line
Input Connector	SMA (Female) x 1
Synchronization output	
Sync signals	line sync, frame sync
Output connector	SMA (Female) x 2
Data Transfer (DMA)	
Record Length	32 – 16,384
Record Number	1 – 32,768
Maximum Data Transfer Rate	100 MB/s
PC Requirements	
Data Interface	PCI express x1
PC Operating System supported	Windows 7 64 bit, Windows 8, Windows 10
CPU	Quad-core, >1GHz
Memory	4GB
Power and Environment	
Power Supply Voltage	3.3V, 12V
Power Connector	PCI express x1 edge connector
Power Consumption	15 W
Mechanical Dimensions	162 mm x 121 mm x 21.5 mm (L x W xH)
Net Weight	350 g

*All specifications subject to change without notice

Chapter 1: Product Introduction

Thank you for choosing the DAQ0504M data acquisition card from SciCore Instruments!

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	DAQ0504M data acquisition card
Installation media	SCI DAQ software disk (USB flash drive)

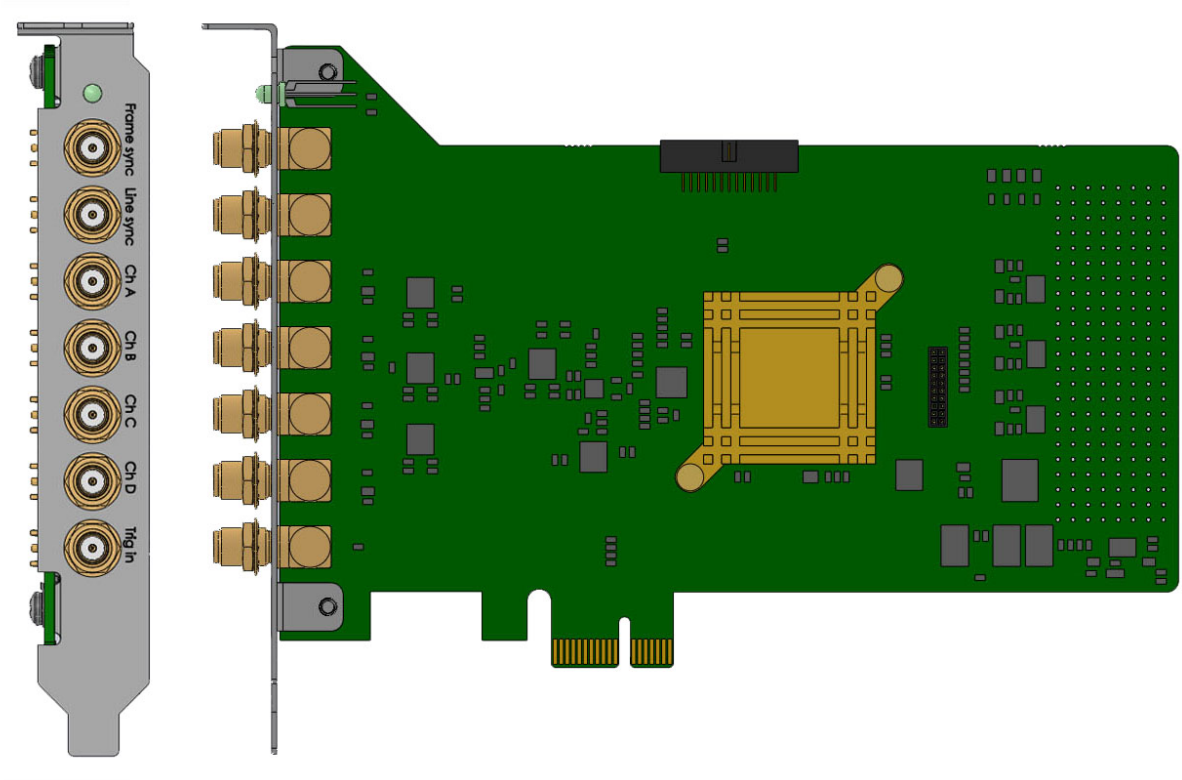
1-2. General Descriptions

DAQ0504M accepts analog input signals connected to any of the four input SMA connectors on the board, performs the A/D conversion with 14-bit vertical resolution at maximum sampling rate of 50MS/s, and transfers the digitized waveform data to application software via the PCI express bus inside a PC.

The four analog input channels are multiplexed to one A/D converter on the board. The channel switching is controlled by software commands with channel switching time less than 1 millisecond.

DAQ0504M supports high measurement duty cycle in continuous acquisition mode. When running at 50MS/s sampling rate with 14-bit A/D resolution, this board can achieve a sustained data transfer rate of 100MB/s to the PC memory, which corresponds to nearly 100% duty cycle and minimized dead time between transferred data records.

DAQ0504M has a simplified software programming interface. The digitized waveform data is transferred in the format of data frames. Each data frame consists of a number of data records and each data record consists of a number of data points. Both the number of data points per record and the number of records per frame can be programmed before the transfer starts. A fixed number of data frames can be grouped into one data volume. DAQ0504M supports various triggering methods including free run and edge (rising edge or falling edge) triggering mode. In the edge triggering mode, the data in every record is synchronized with the trigger event. After initialization, the application software only need to call one library function to get the latest data frame or data volume. This library function is non-blocking which means the application software can continue work on data processing and other important tasks, without waiting for the hardware to complete the data acquisition.



Product left and front views. There are total 7 SMA connectors on the PCI mounting bracket, and from top to bottom are: (1) Frame sync output, (2) Line sync output, (3) Channel A input, (4) Channel B input, (5) Channel C input, (6) Channel D input, (7) Trig input.

1-3. Connectors and Indicators:

1. **Frame sync:** The frame synchronization signal of acquired data frame. This is an output signal provided by the DAQ card. The rising edge of this signal indicates the start of acquiring a data frame defined by the user. 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. **Line sync**: The line synchronization signal for each data record in the acquired data frame. This is an output signal provided by the DAQ card. The rising edge of this signal indicates the start of acquiring a data record as defined by the user. A data frame consists of many data records and a data record consists of many data points. The first data point in each data record is synchronized with each the trigger event. 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.

3. **CH A**: The analog input for channel A. This signal uses a SMA female type connector.

4. **CH B**: The analog input for channel B. This signal uses a SMA female type connector.

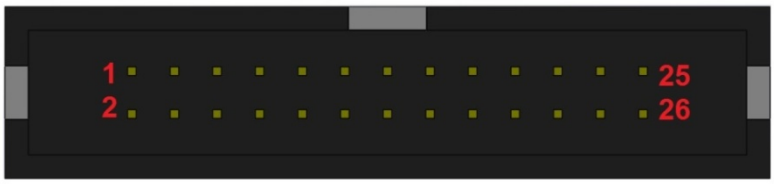
5. **CH C**: The analog input for channel C. This signal uses a SMA female type connector.

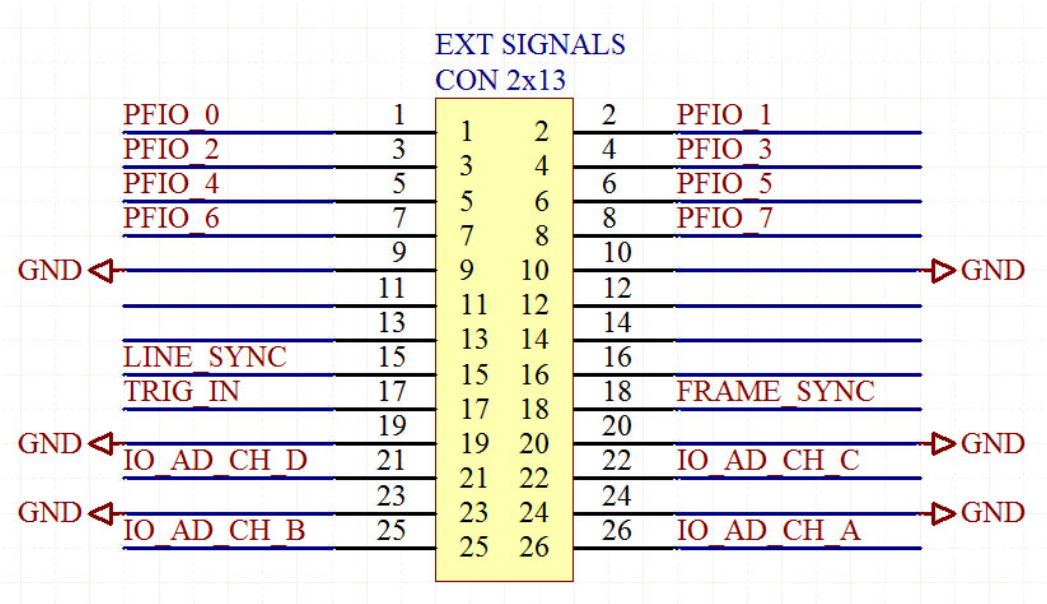
6. **CH D**: The analog input for channel D. This signal uses a SMA female type connector.

7. **Trig in**: The trigger input connector when the acquisition is configured in external trigger mode. The starting data point in every record is aligned with this trigger event.

8. **LED indicator**: This three color (red, green and orange) LED provides device status information to the user. The LED is in solid green color when the card is in normal status. The LED turns to orange color when the card is in active data acquisition process. The LED is in red color when an error is detected.

9. **User extension connector**: The User Extension Connector is a 1.27 mm pitch, 26-pin box header type connector. The connector pin map is shown below. This connector contains all the signals available on the PCI mounting bracket. This connector also provides 8 PFIO lines connected to the on-board FPGA chip that can be customized for particular applications, such as digital IO, counter and synchronization functions. Please contact SciCore Instruments if you have special requirements for this product.





Chapter 2: PC installation

2-1. PC Requirements

	Minimum	Recommended
Operating system	Windows 7 (64 bit)	Windows 7 (64 bit)
Processor	Dual core @ 2.0 GHz	Quad core @ 2.0 GHz
Memory	4 GB	8 GB
Screen resolution	1280 x 1024 pixels	1920 x 1080 pixels
PCI Express Interface	Gen 1 x1	Gen 1 x1
Hard disk	64 GB	128 GB

2-2. Hardware Installation Steps

Step 1. Turn off the power of the PC.

Step 2. Plug the data acquisition card into an available PCI express slot in the motherboard of the PC. Secure the card to the chassis of the PC.

Step 3. Turn-on the power of the PC.

2-3. Software installation steps

Step 1. Install the driver for the DAQ0504M card using the provided USB disk drive, as detailed in section 2-3-1. The driver is the software that allows the data acquisition card to be recognized by the PC, and to be used by other software including the "SCI DAQ" control software.

Step 2. Install the "SCI DAQ" control software onto your PC using the provided USB disk drive, as detailed in section 2-3-2. The software program icon with the name "SCI DAQ" will be placed on the Windows desktop on your PC.

After above installation steps, the user can launch the "SCI DAQ" program on your PC desktop to test DAQ0504M functions.

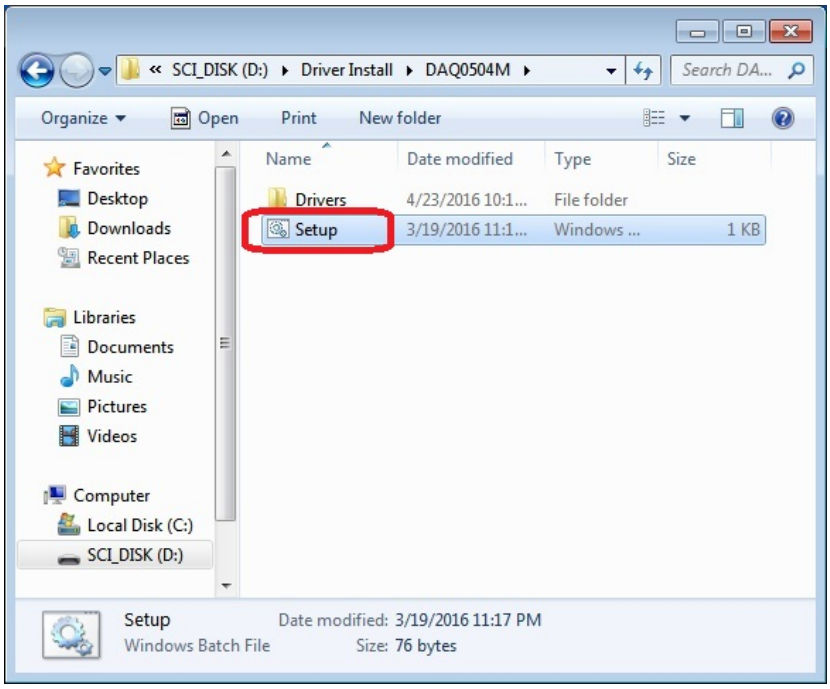
2-3-1. Driver Software Installation

When the data acquisition card is physically installed inside a PC, it requires a software driver installation so the card can be recognized by *Windows* operation system.

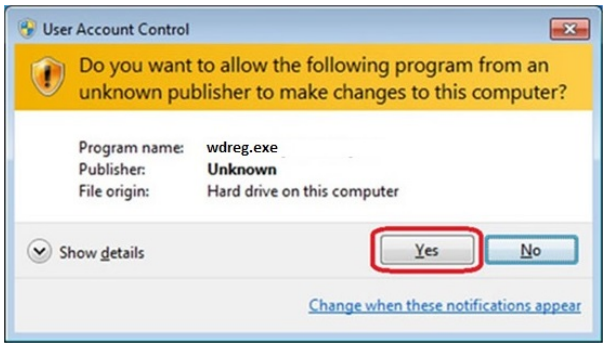
The following screen shots show the steps to install the software driver.

1. When it is the first time for the data acquisition card installed inside a PC, a message will show on the bottom right of the screen.

2. Launch the "Setup" file from the "Driver Install\DAQ0504M" directory on the USB installation disk.

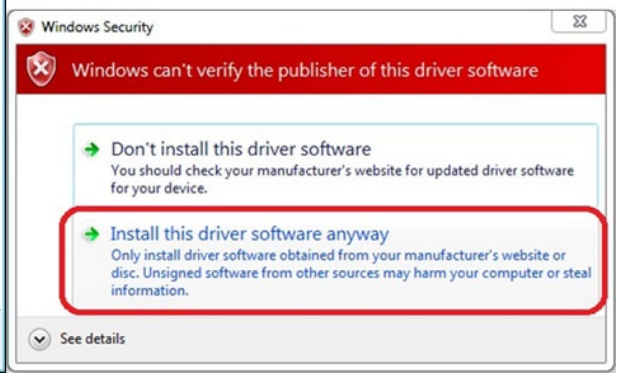


3. When the following screen appears click "Yes".

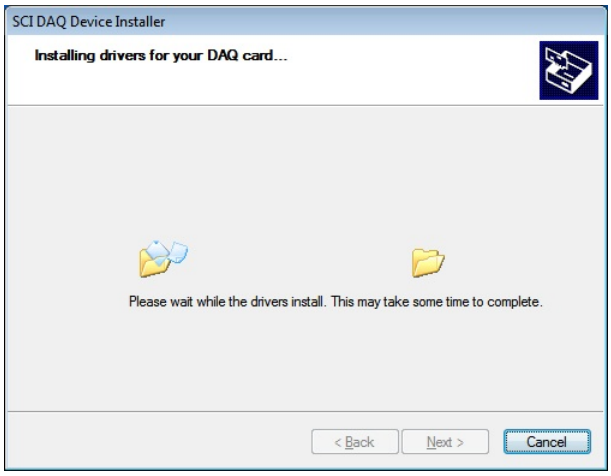


4. When the following screen appears click "Yes".

5. When the following dialogs show up, click "Next" and "Install this driver software anyway ".



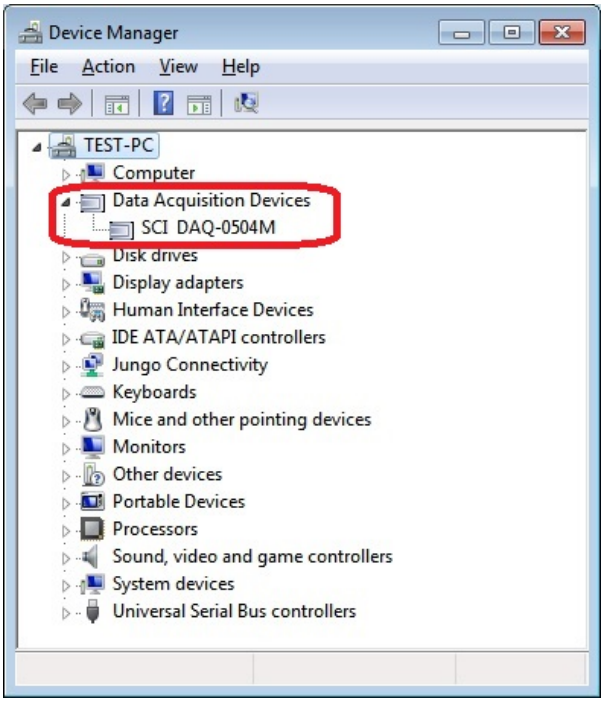
6. Please wait a few seconds when following dialog shows the installation is in process.



7. The following dialog indicates the driver installation is successful. Please click "Finish".

8. Please restart the computer for the newly installed driver files to take effect in the *Windows* operation system.

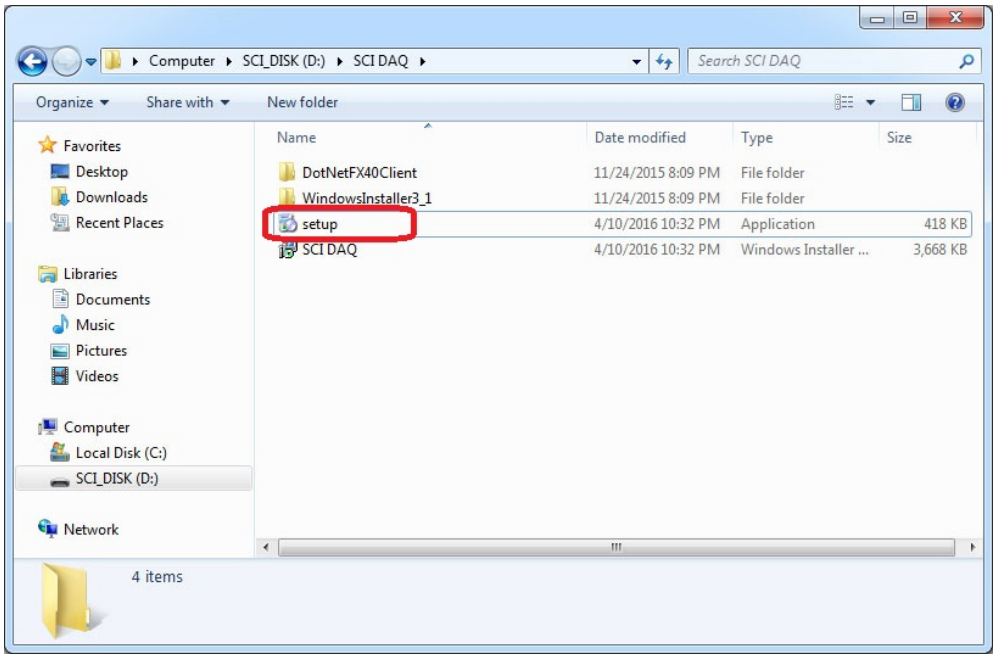
After the driver installation and restart of the computer, the DAQ card installed in the PC now shows in the Device Manager as "SCI DAQ-0504M" in the "Data Acquisition Devices" category, and is ready to use.



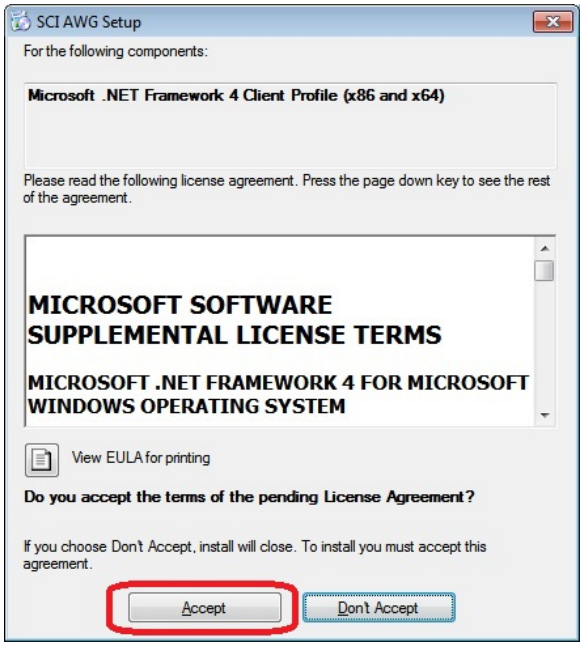
2-3-2. "SCI DAQ" Software Installation

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

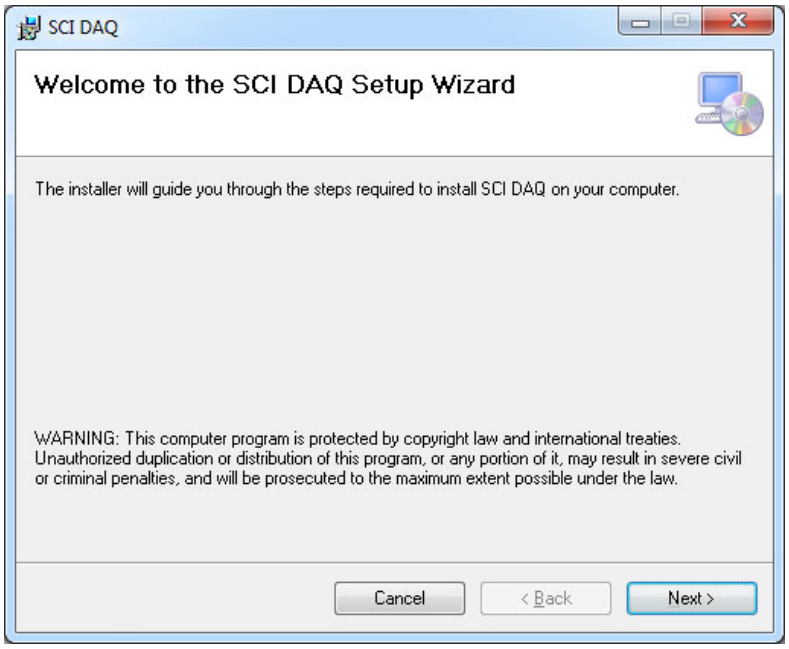
1. Launch the "Setup.exe" from the "SCI DAQ" folder on the provided USB disk.



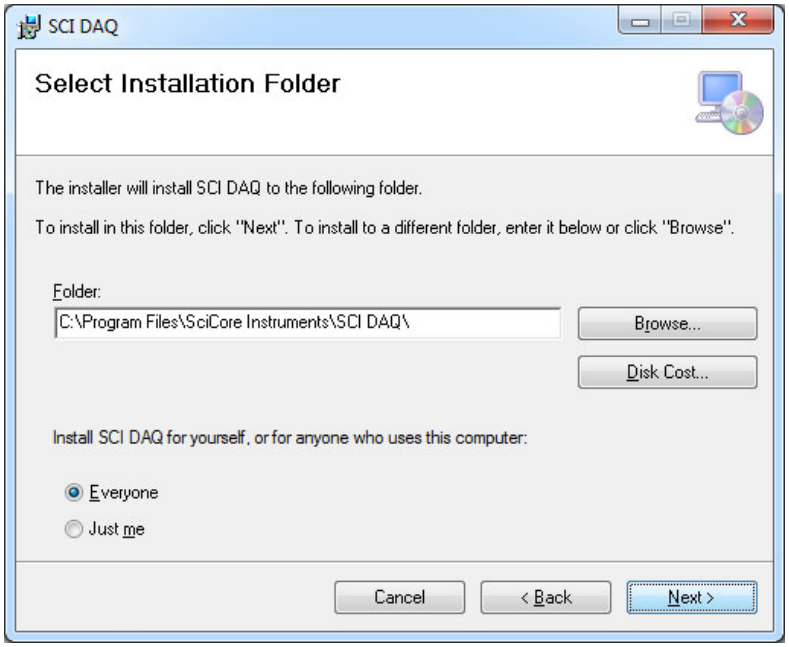
2. Click "Accept" button to install "Microsoft .NET framework" if it has not been installed on this PC.



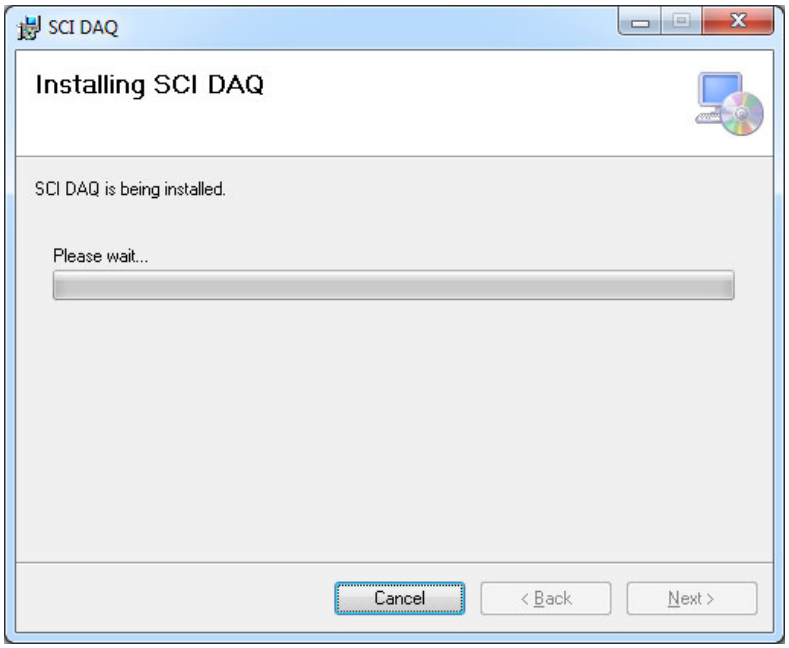
3. Click "Next".



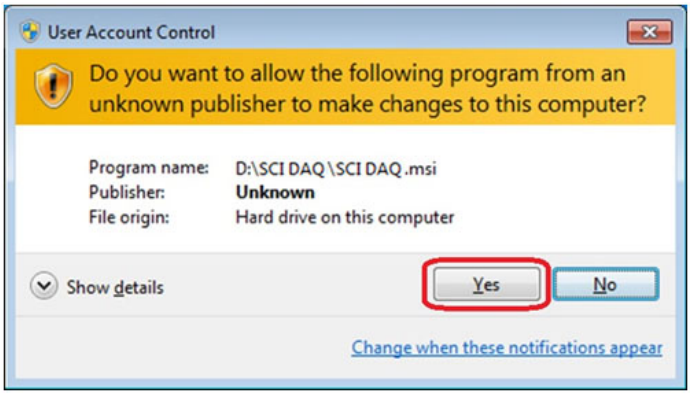
4. Click "Next".



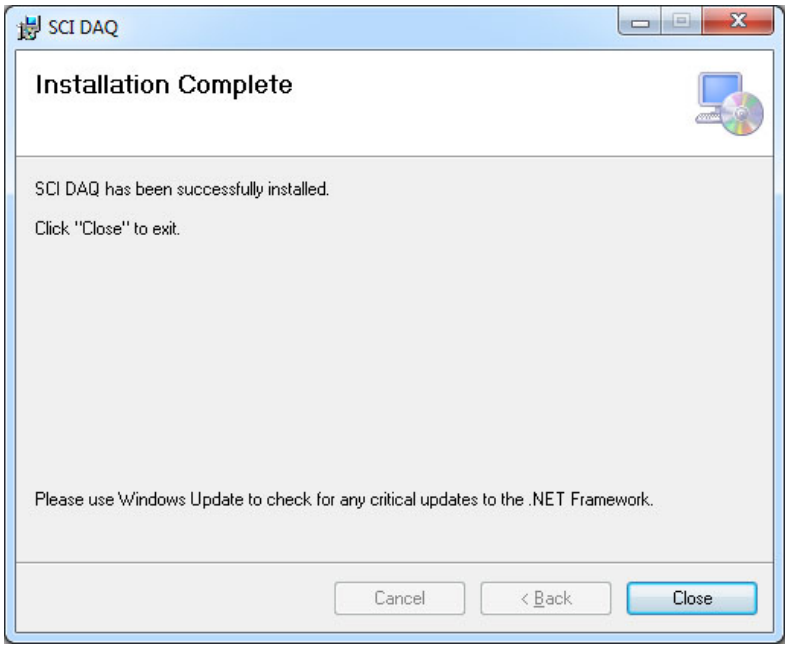
5. Wait a few seconds when the software is being installed.



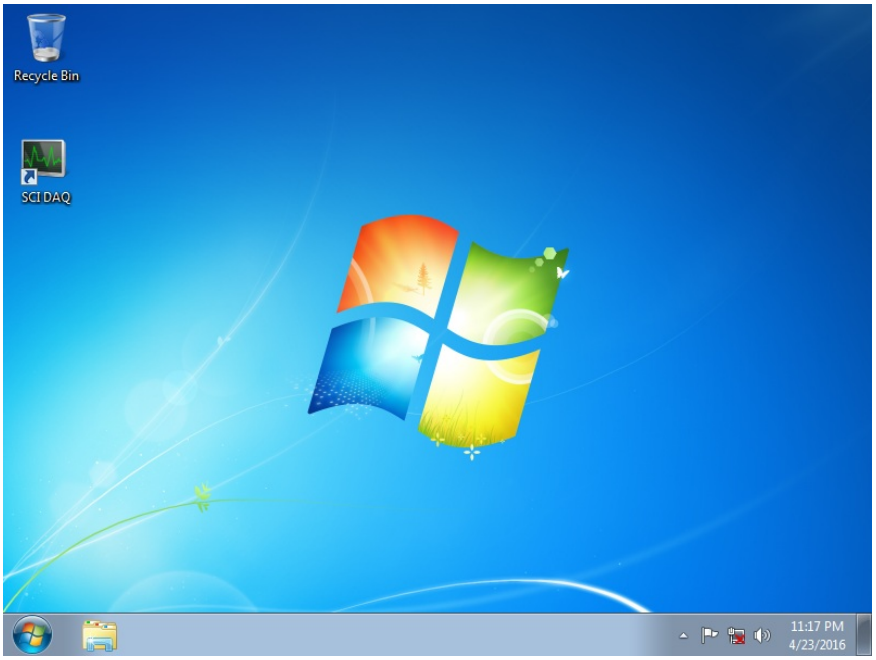
6. When following dialog appears, click "Yes".



7. Click "Close".



8. A software program icon named "SCI DAQ" will be placed on the windows desktop. This is the software program to control the data acquisition card.



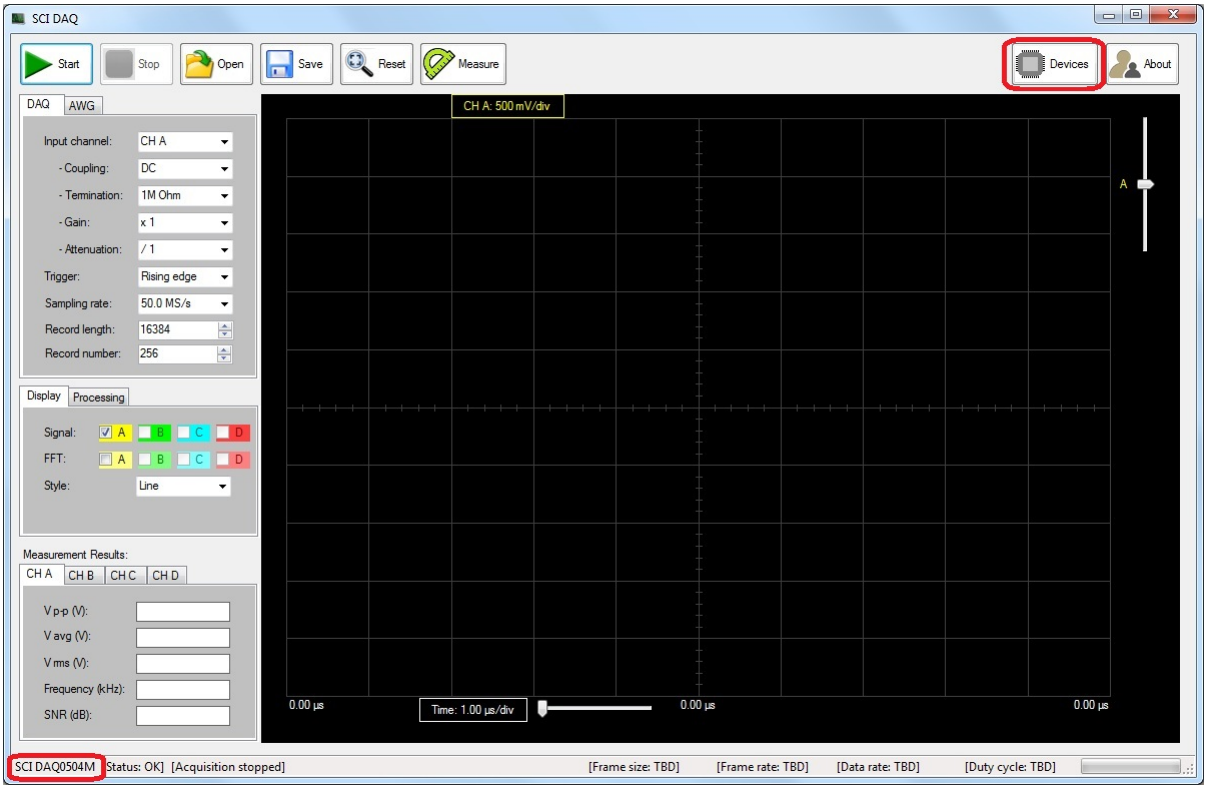
The next chapter describes how to use the "SCI DAQ" control software to test some basic functions of the DAQ0504M data acquisition card.

Chapter 3: Product Functions

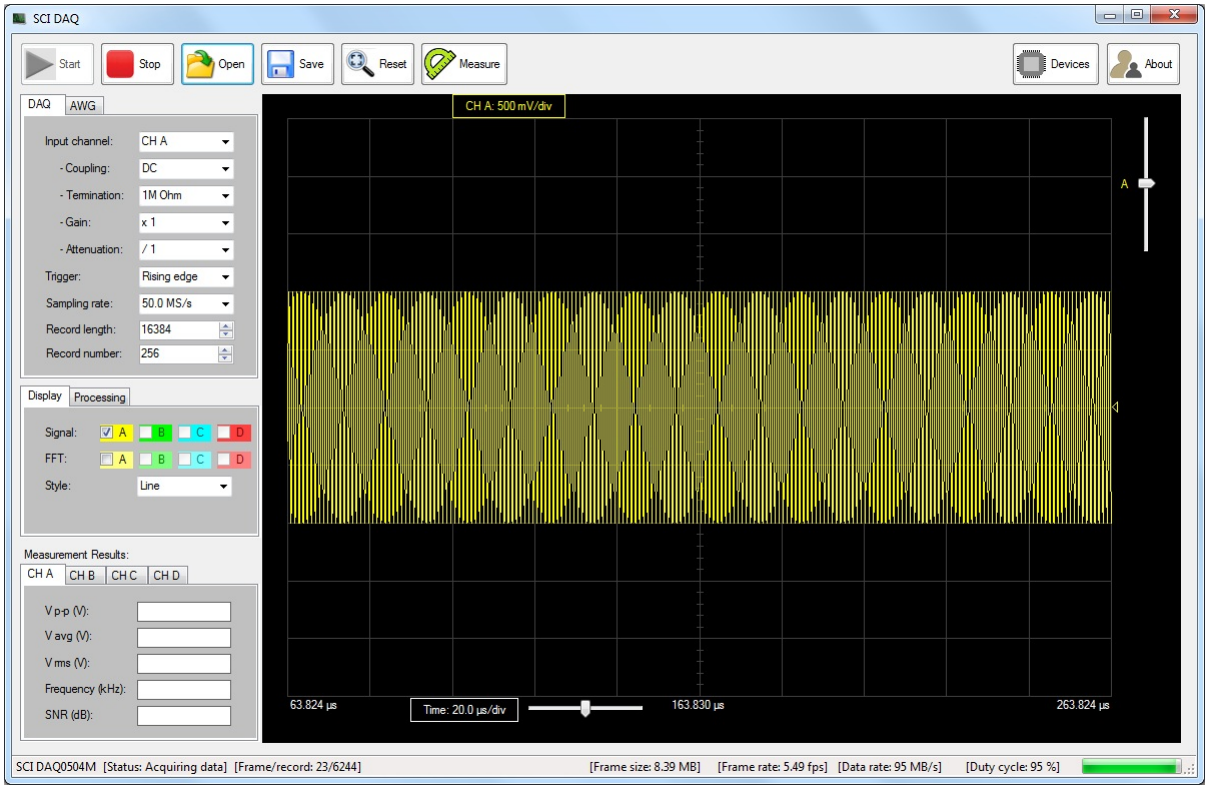
This chapter demonstrates some basic functions of the DAQ0504M data acquisition card, using the "SCI DAQ" software program, after the successfully installation of the DAQ hardware and software drivers on a PC.

3-1. Display acquired signals

1. After installing hardware and software driver on the PC, the user can click the "SCI DAQ" software icon on *Windows* desktop to start the DAQ control software. The software shows the detected DAQ card model number on the status panel in the bottom. Alternatively the user may click the "Devices" tool button which brings up a dialog showing the detected DAQ devices.

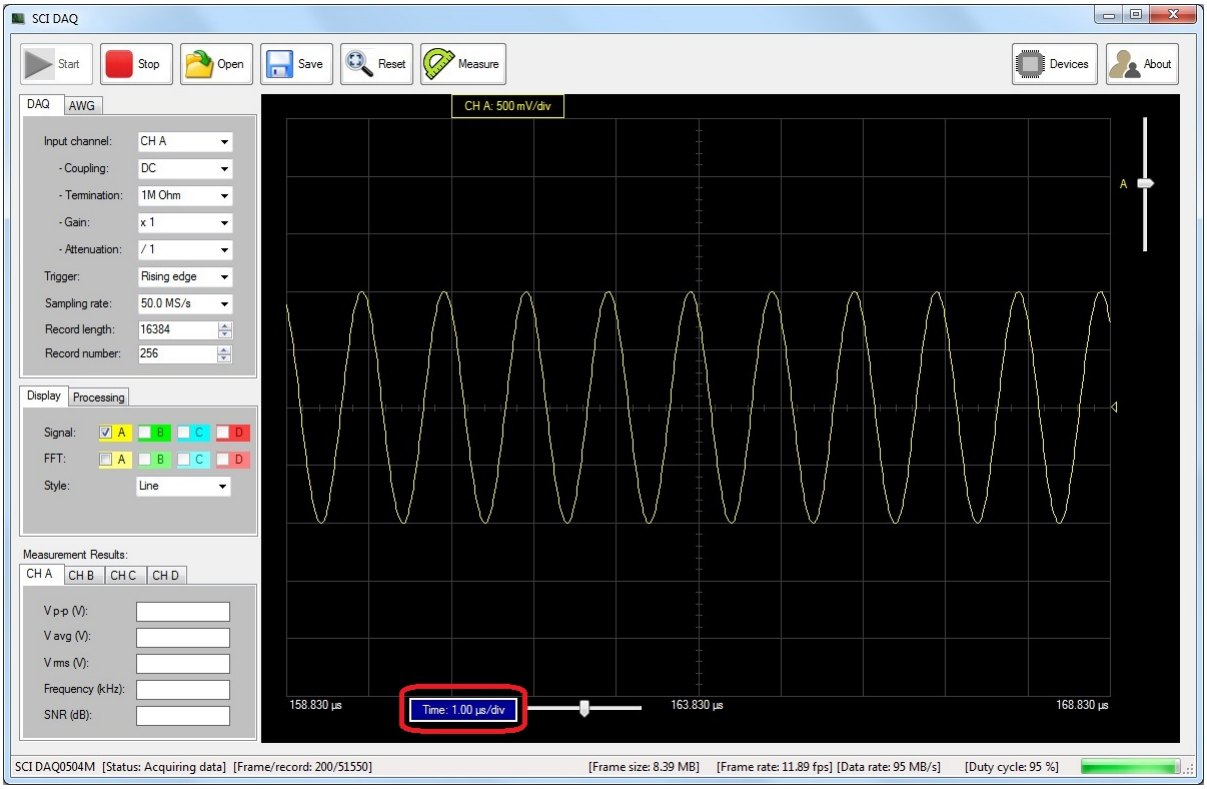


2. The user needs to provide a test signal to the DAQ card, such as from a function generator. In this demo example, a 1MHz, 2Vpp sine wave from a function generator (Rigol DG4162) is connected to DAQ card input channel A. After the user clicks the "Start" button, the acquired signals are showing on the software screen.



3. To change to horizontal time scale of the display, click the time scale control button and the button become highlighted in blue, then use mouse wheel to change the horizontal time display scale of the signal. The possible time scales are:

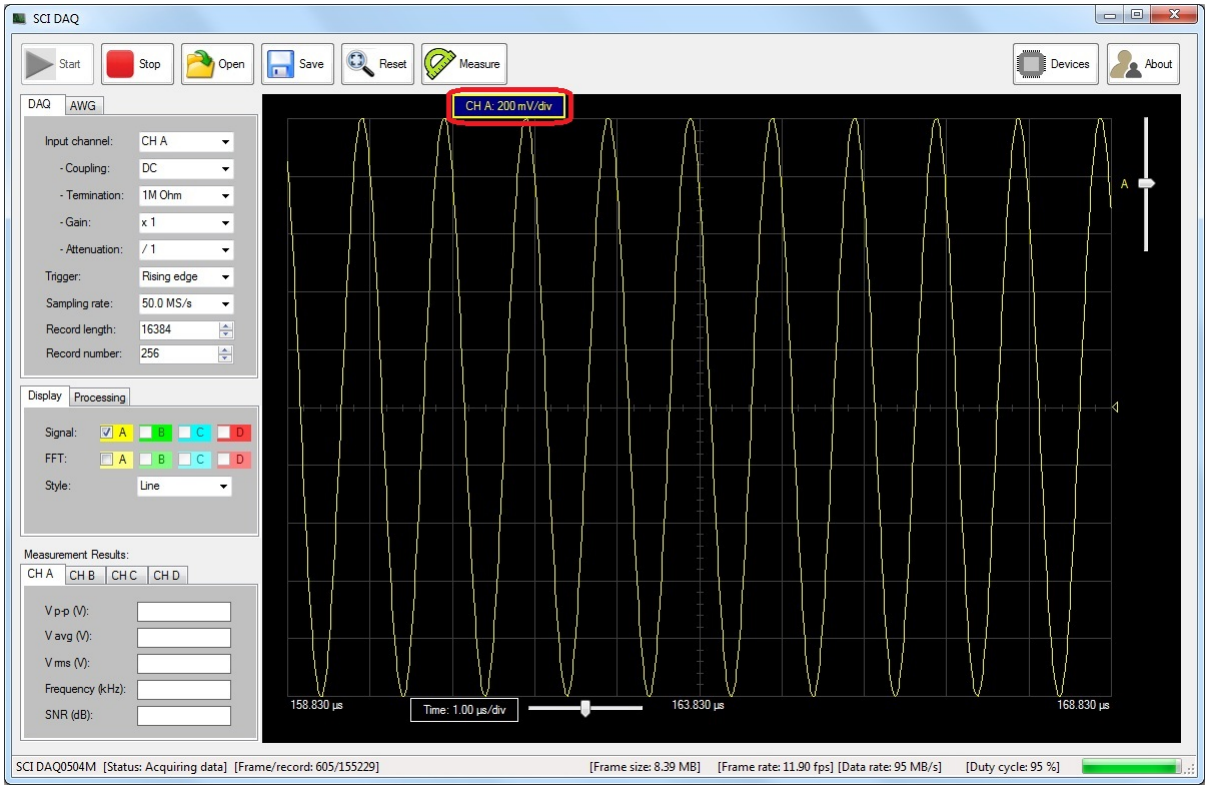
"1.00 ms/div", "500 µs/div", "200 µs/div", "100 µs/div", "50.0 µs/div", "20.0 µs/div", "10.0 µs/div", "5.00 µs/div", "2.00 µs/div", "1.00 µs/div", "500 ns/div", "200 ns/div", "100 ns/div", "50.0 ns/div", "20.0 ns/div", "10.0 ns/div", "5.00 ns/div", "2.00 ns/div", "1.00 ns/div"



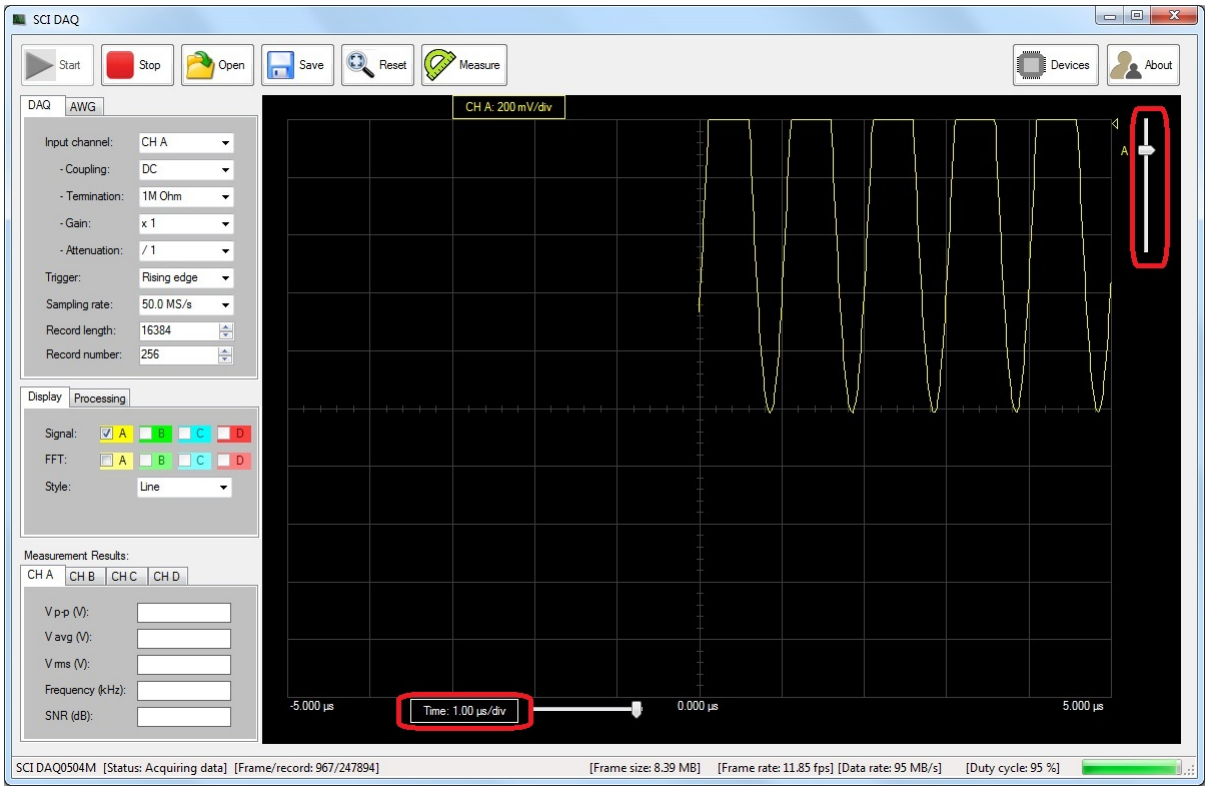
4. To change the vertical voltage scale of the display, click the voltage scale control button and the button become highlighted in blue, then use the mouse wheel to change the vertical time display scale of the signal. The possible vertical scales are:

```
"10.0 V/div", "5.00 V/div", "2.00 V/div", "1.00 V/div", "500 mV/div", "200 mV/div",
"100 mV/div", "50.0 mV/div", "20.0 mV/div", "10.0 mV/div", "5.00 mV/div", "2.00 mV/div",
"1.00 mV/div"
```

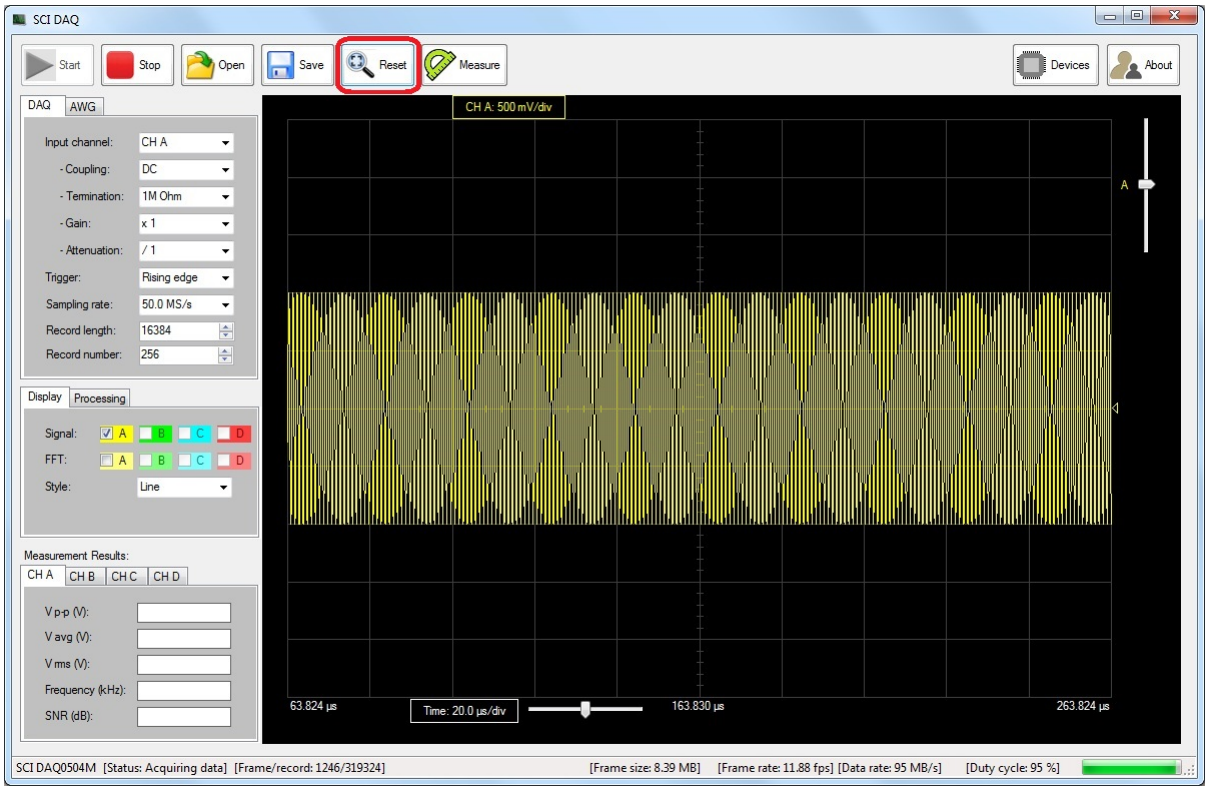
A small triangle shaped arrow on the right indicates the 0V voltage of the signals.



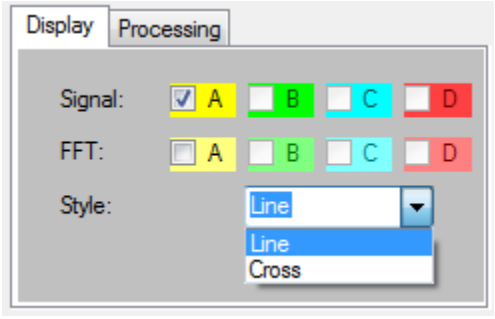
5. The horizontal and vertical positions of the signals on the screen can be changed by adjusting the slider positions on two track bars. The sliders represent the centers of the signals.



6. The user may click on the "Reset" menu button to fit the signals to the display screen at any time.



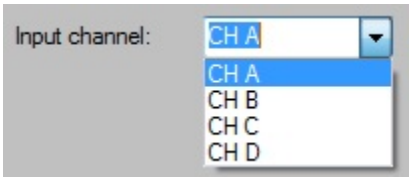
7. One the display tab, the user can select to display the raw signal, or the FFT of the signal, or both. The available display styles are line style and cross style.



3-2. Select signal input conditions

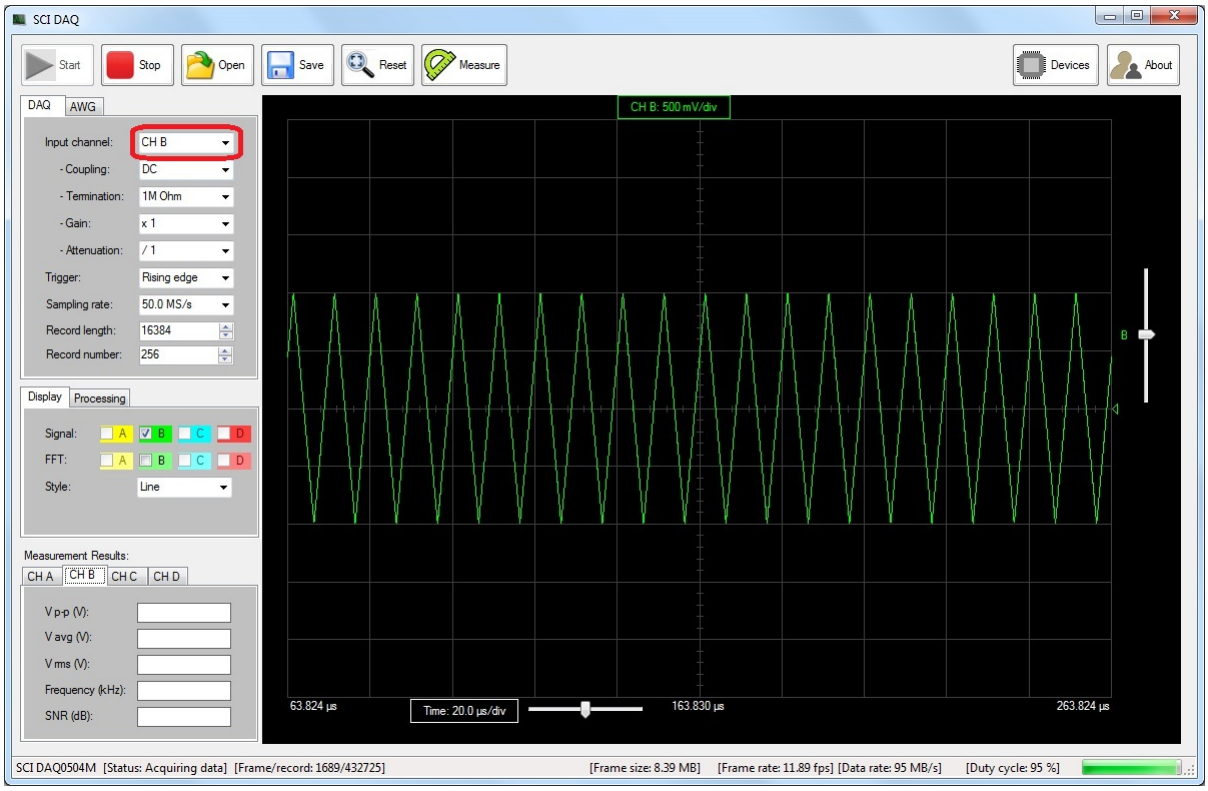
On the software control panel named "DAQ" on the left of the signal display window, the user can change the input conditions of the DAQ card to measure the signals. The useful controls for selecting the signal input conditions are:

Input channel

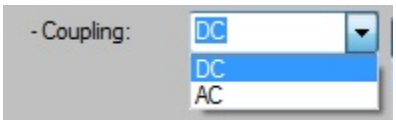


There are four available channels that the user can select as the input signals to be digitized.

For example when a 100kHz 2Vpp triangle wave is connected to channel B input, selecting the DAQ input channel to be channel B changes the displayed signals from the sine wave to the triangle wave.

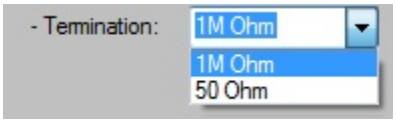


Input coupling



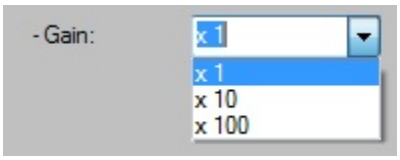
The available input coupling options are DC coupled and AC coupled.

Input termination



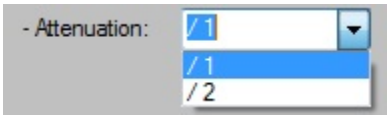
The available input termination options are 1M Ohm termination and 50 Ohm termination.

Input gain



The available input gain options are x1, x10, and x 100.

Input attenuation

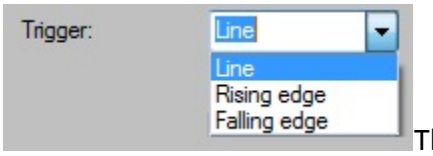


The available input attenuation options are divide by 1 and divide by 2.

3-3. Select acquisition conditions

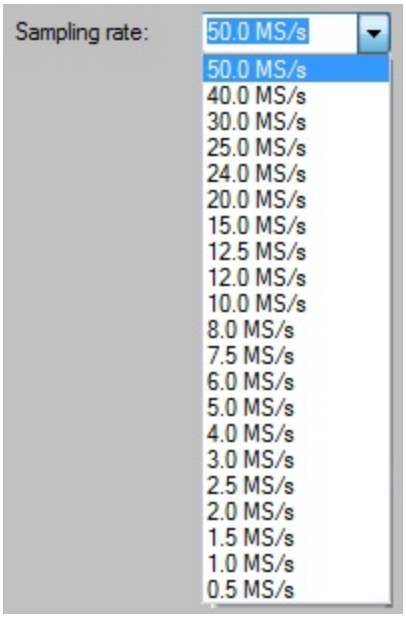
The acquisition conditions of the DAQ card include trigger method, sampling rate, data record length and data record number.

Trigger method



The available trigger methods are line trigger, rising edge trigger and falling edge trigger.

Sampling rate



The available sampling rates are listed.

Record length

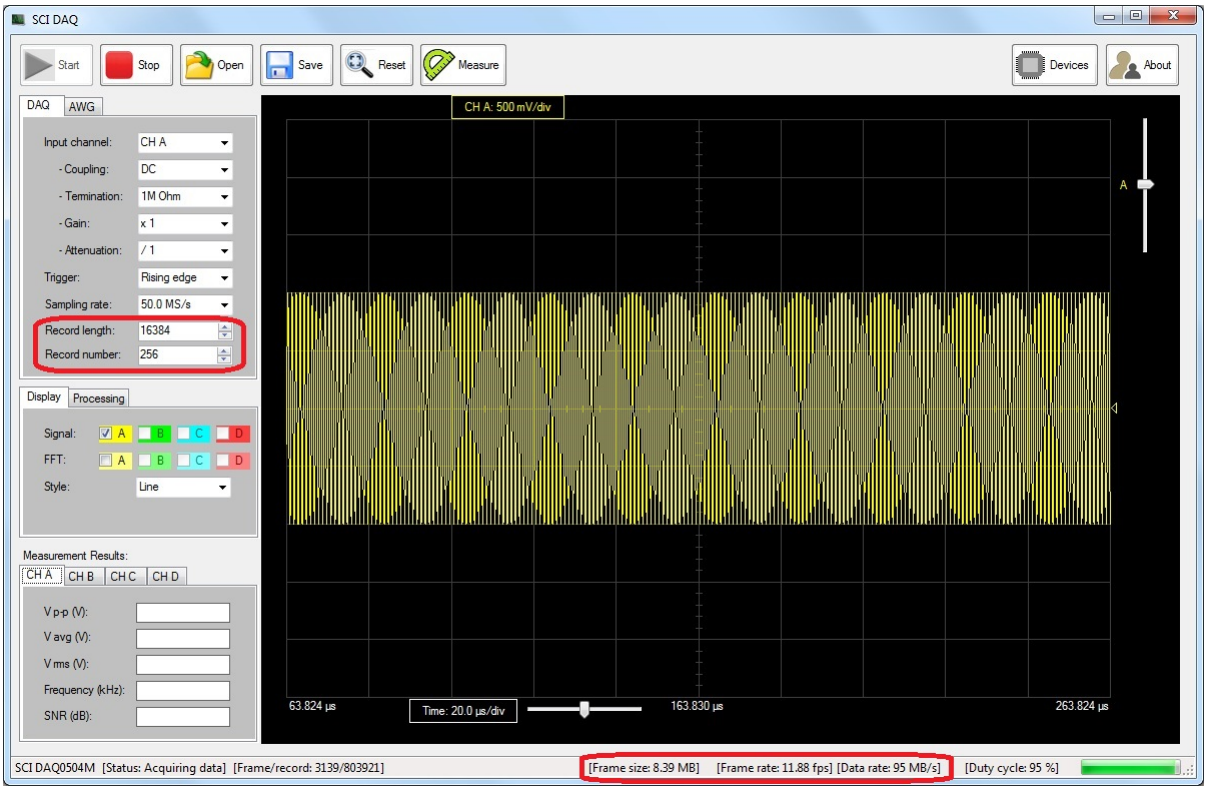
The record length is the number of data points to acquire and to form one data record. For DAQ0504M, the valid number for record length is between 32 and 16384. The first data point in a data record is always aligned with the trigger event specified by the trigger method, and no pre-trigger data points are acquired. For each data record, a rising edge in the "line sync" signal aligned with the first data point in the record is provided.

Record number

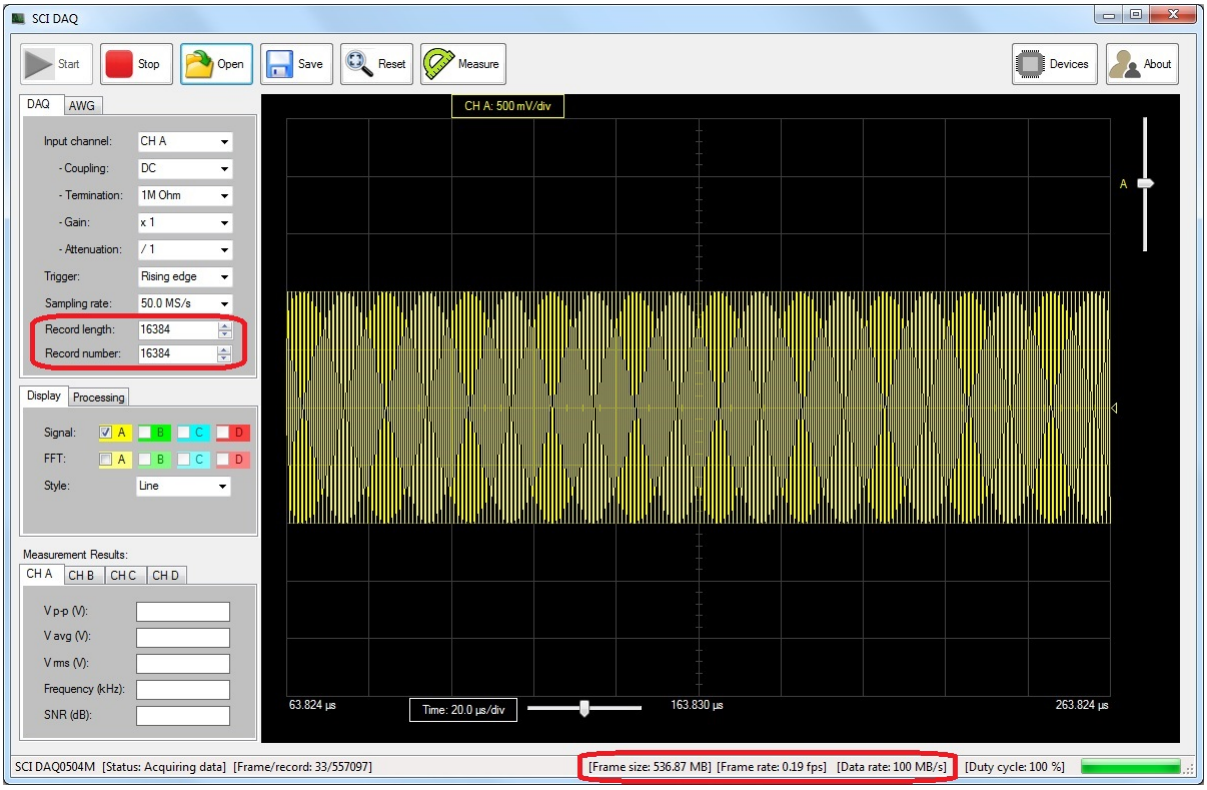
The record number is the number of records to acquired and form one data frame. For each data frame, a rising edge in the "frame sync" signal aligned with the first data point in the frame is provided. For DAQ0504M, because every data point is 2 bytes, the maximum valid record number depends on the available computer memory and data frame size which is calculated by:

Data frame size = Record length x Record number x 2 bytes

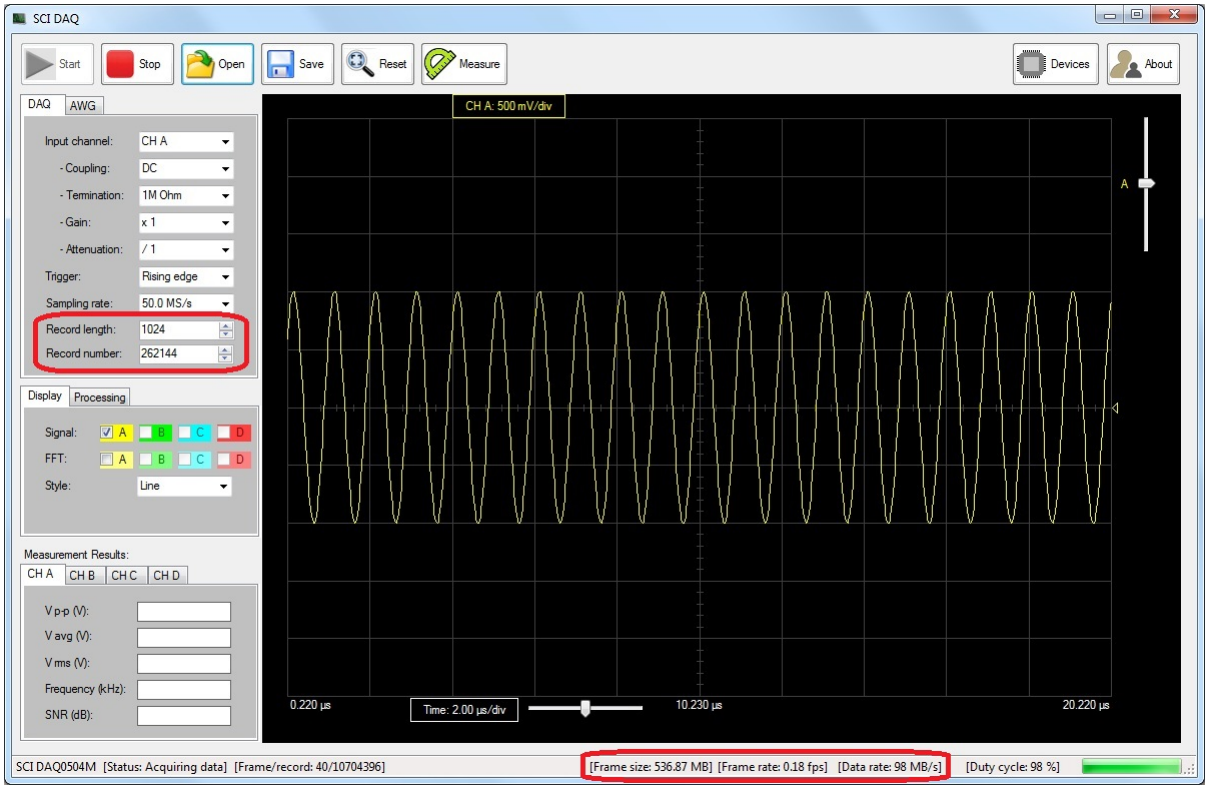
In one example below, the DAQ card can acquire one frame of 8.39MB data containing 256 records by 16384 points at 11.9 frames/second.



In another example below, the DAQ card can acquire one frame of 536.87MB data containing 16384 records by 16384 points at 0.19 frames/second.



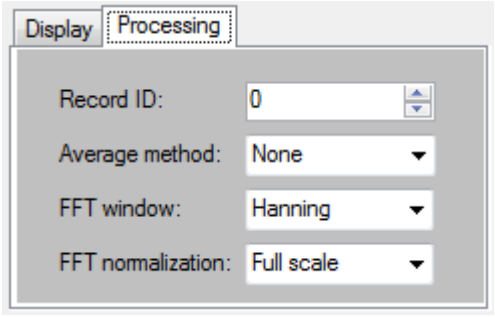
In another example below, the DAQ card can acquire one frame of 536.87MB data containing 262144 records by 1024 points at 0.19 frames/second.



The theoretic maximum data throughput of DAQ0504M card is 50MS/s x 2 bytes/sample = 100MB/s.

3-4. Select signal processing methods

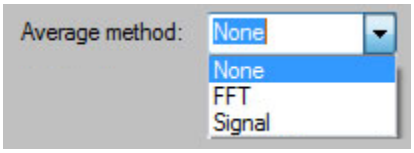
The "processing" tab shows a number of controls that affect the signal processing results.



Record ID

The ID number of the record in the current frame that is currently being processed and displayed. After the user stops the data acquisition, this number can be changed to review each record in the latest frame that has been acquired.

Average method



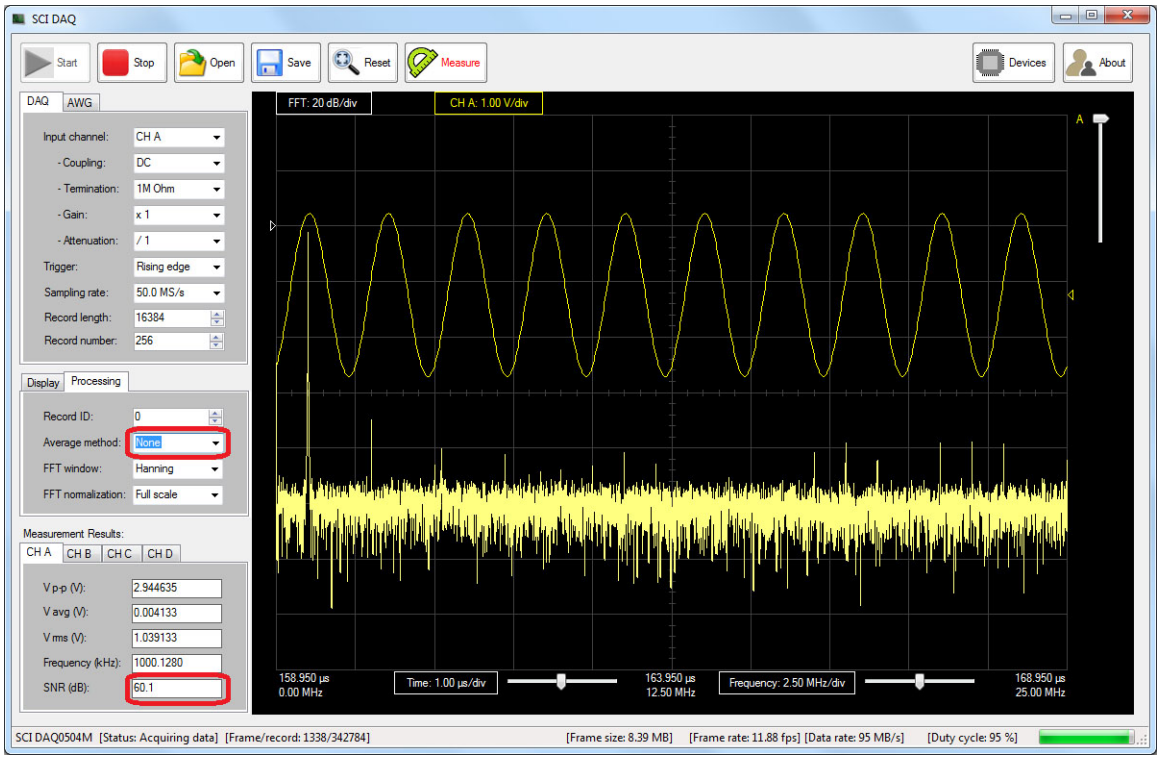
The available average methods are:

None: Only one record is processed and displayed, no average method applied.

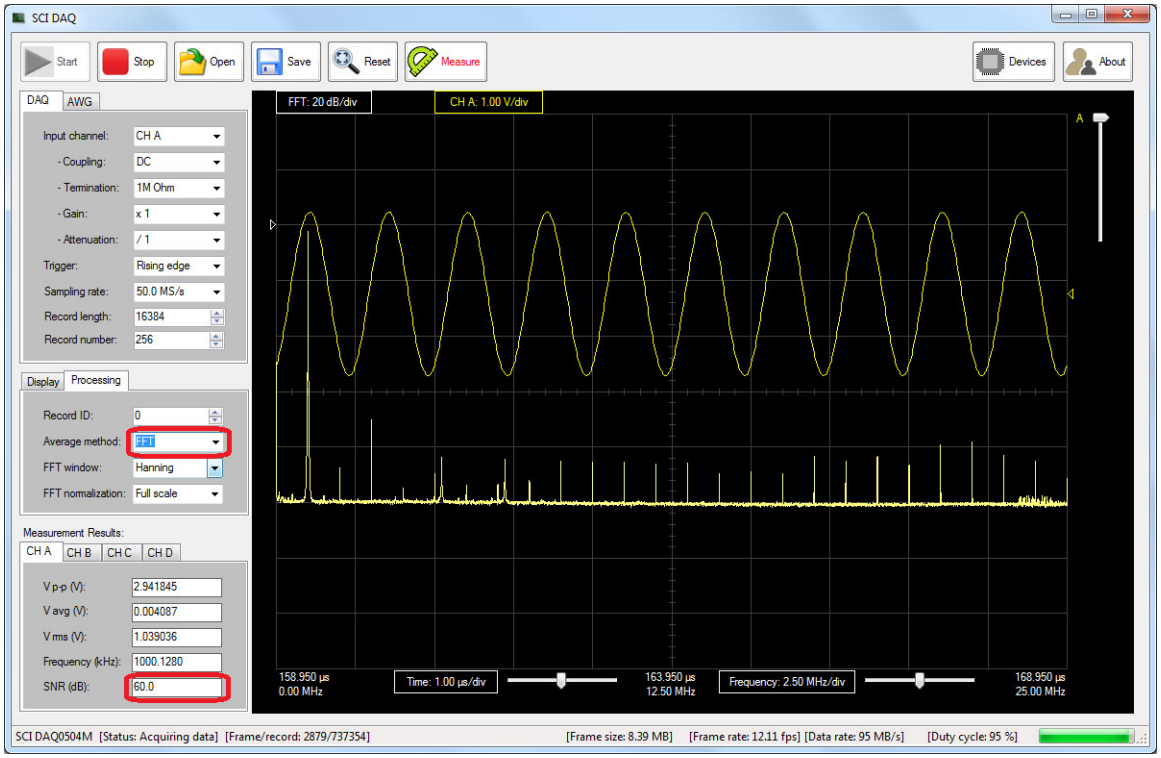
FFT: The FFT operation is applied to each record separately, and the FFT intensity signals are averaged for display.

Signal: The raw signals of all the records in one data frame are averaged into one record, and one FFT operation is applied to this average record.

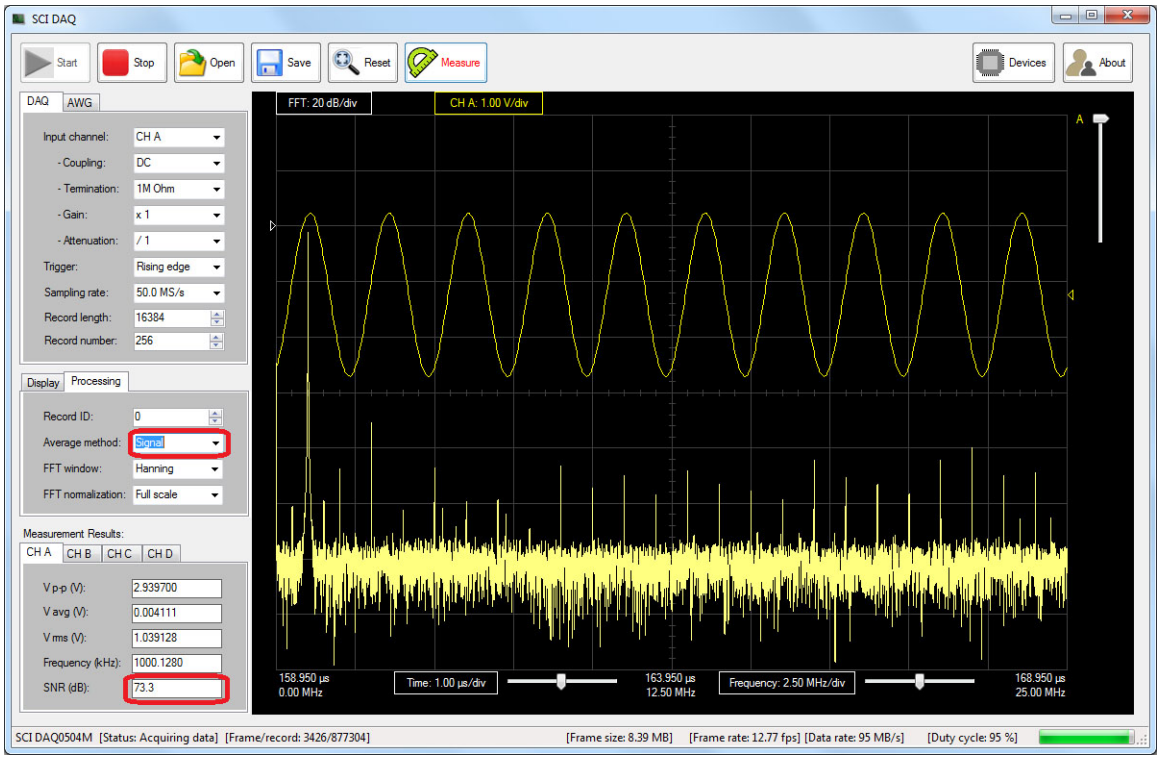
Using 1MHz input signals, the following screen shots compare the measured SNR using different average method. In triggered acquisition mode when the acquired signals are in phase, average the raw signals can significantly improve the measured SNR.



Average method: None

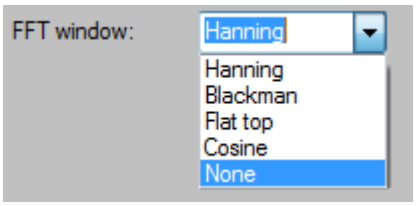


Average method: FFT



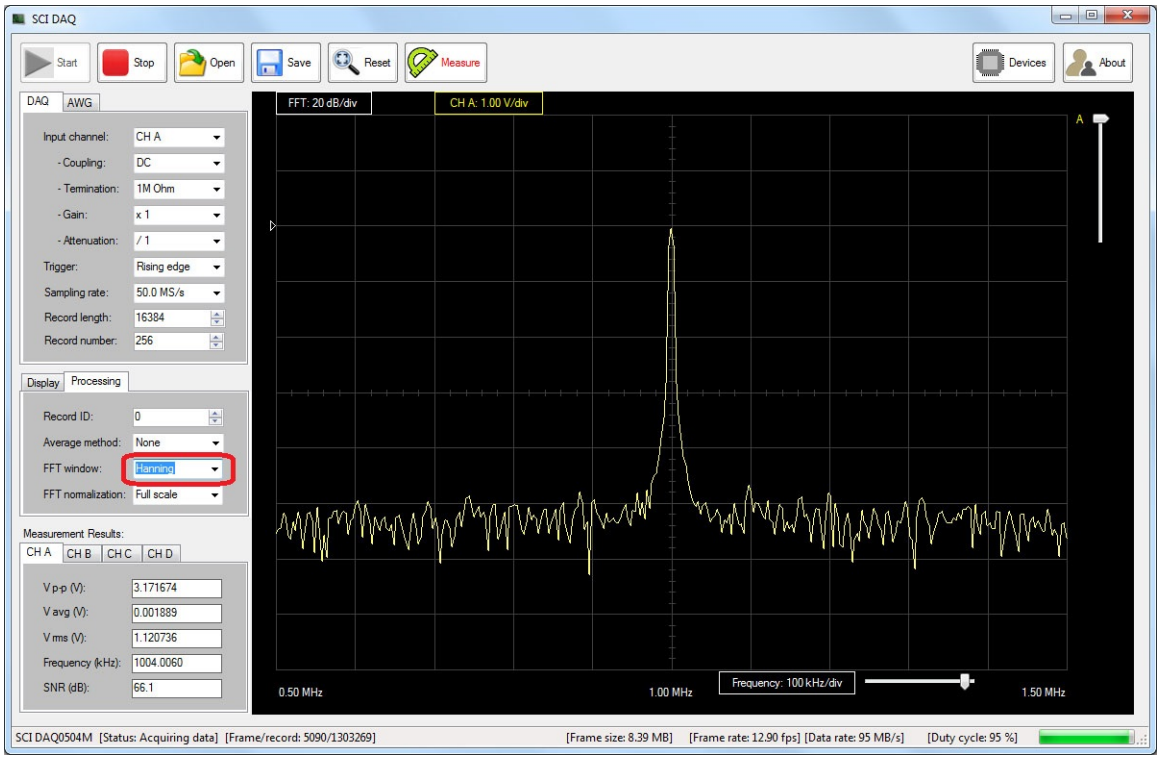
Average method: Signal

FFT Window

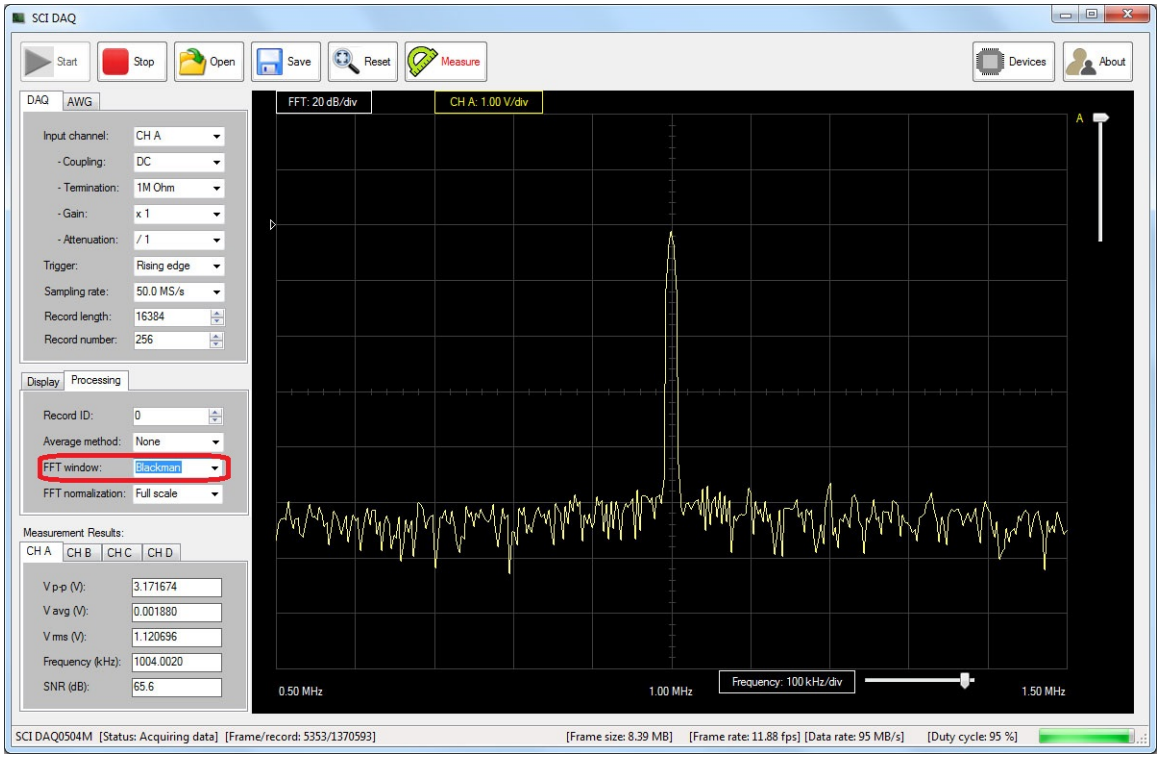


The available FFT window types are Hanning, Blackman, Flat top, Cosine, and no window.

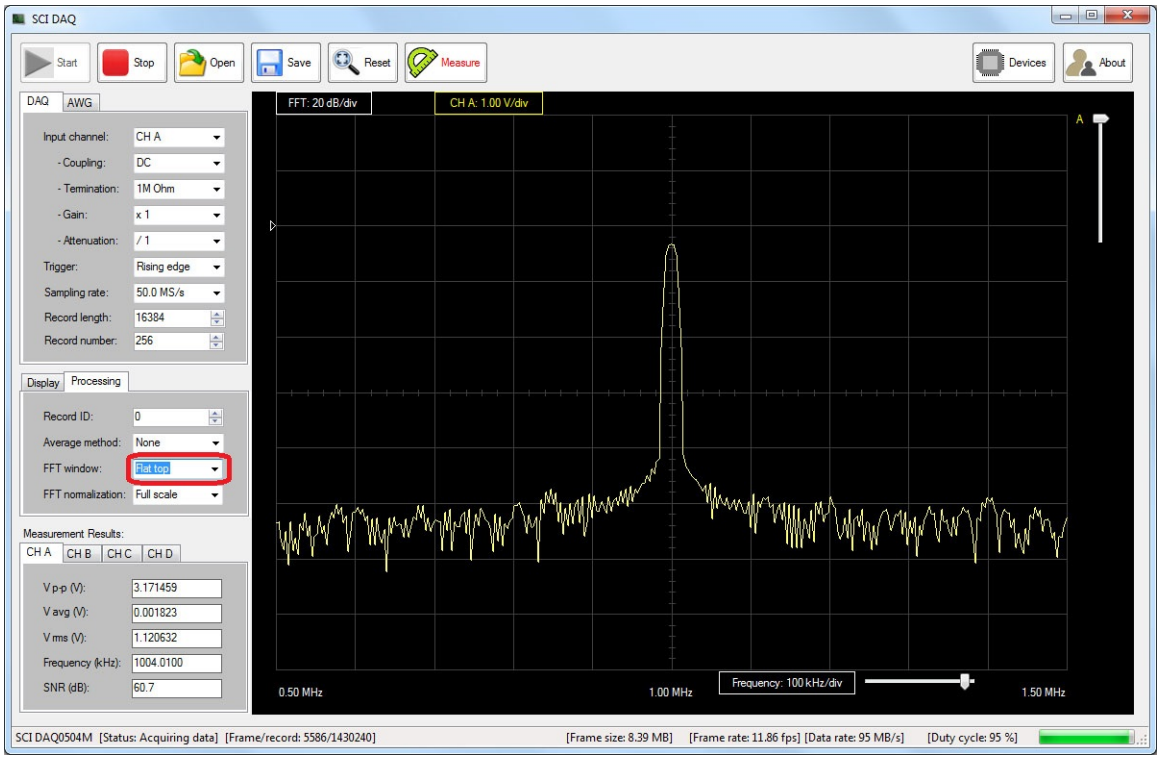
Using 1MHz input signals, the following screen shots compare the FFT output near the main peak using different window functions.



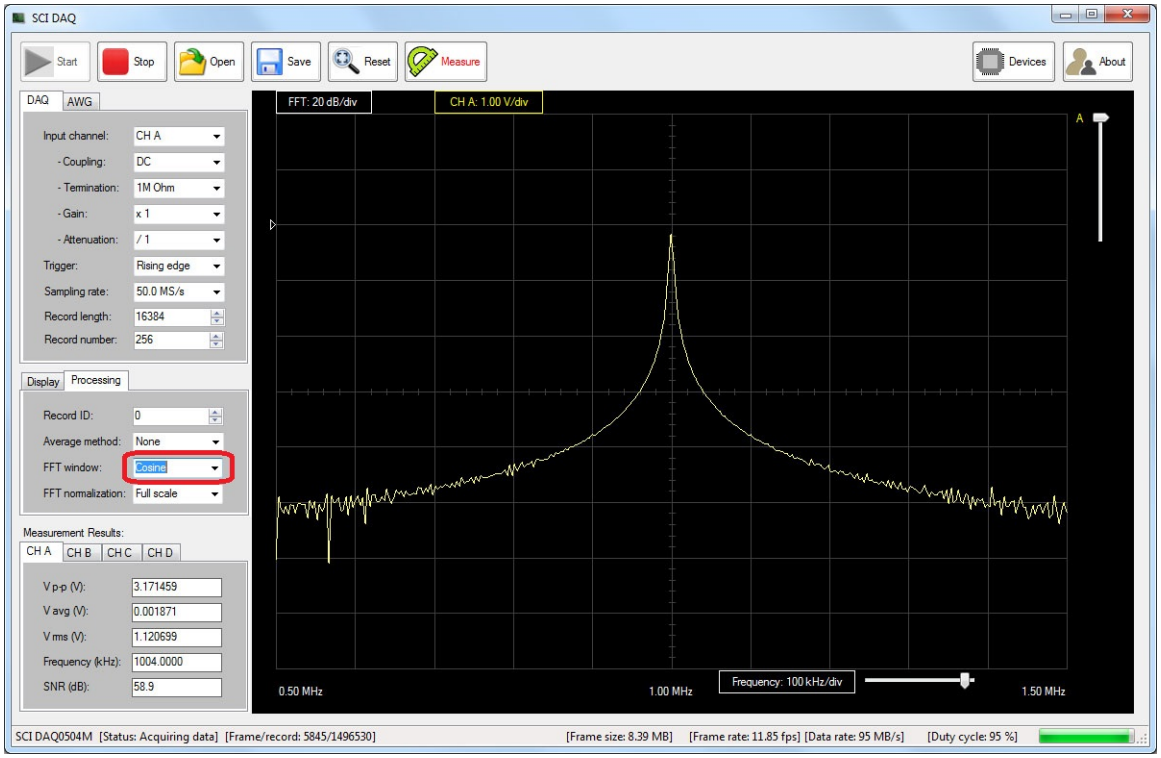
FFT Window: Hanning



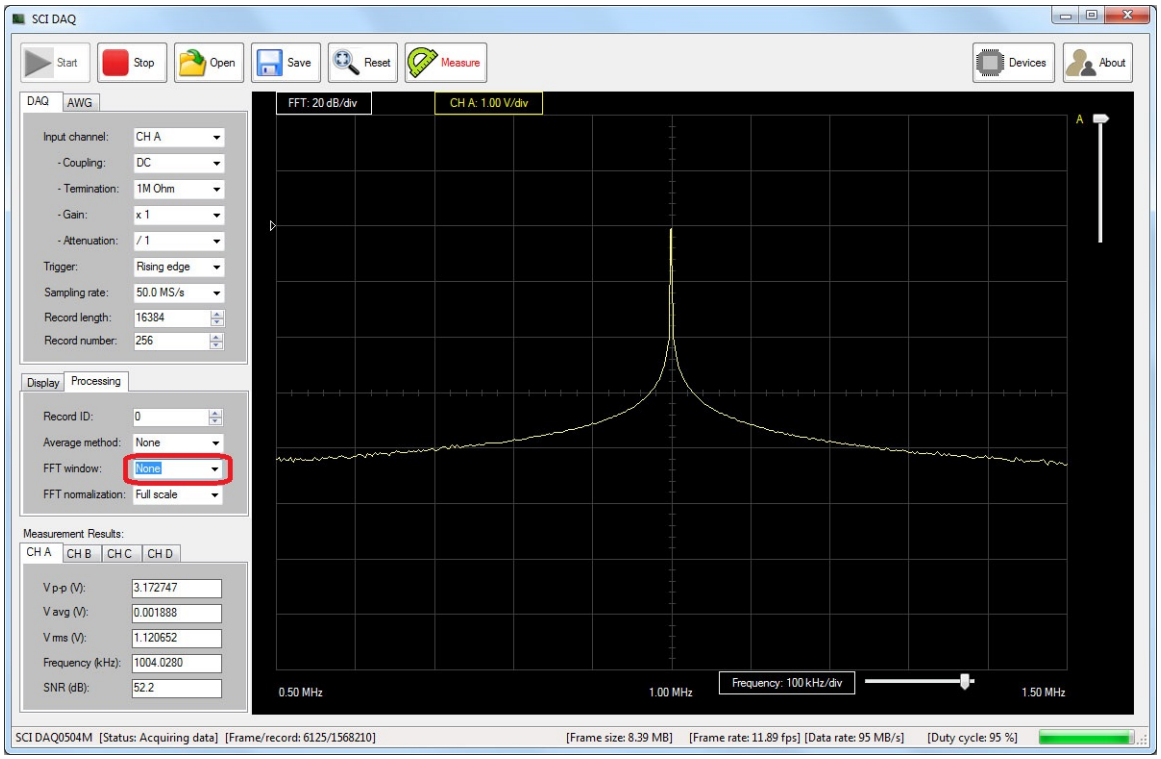
FFT Window: Blackman



FFT Window: Flat top

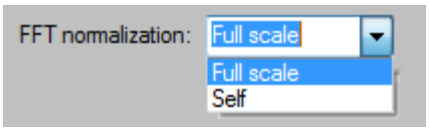


FFT Window: Cosine



FFT Window: None

FFT Normalization

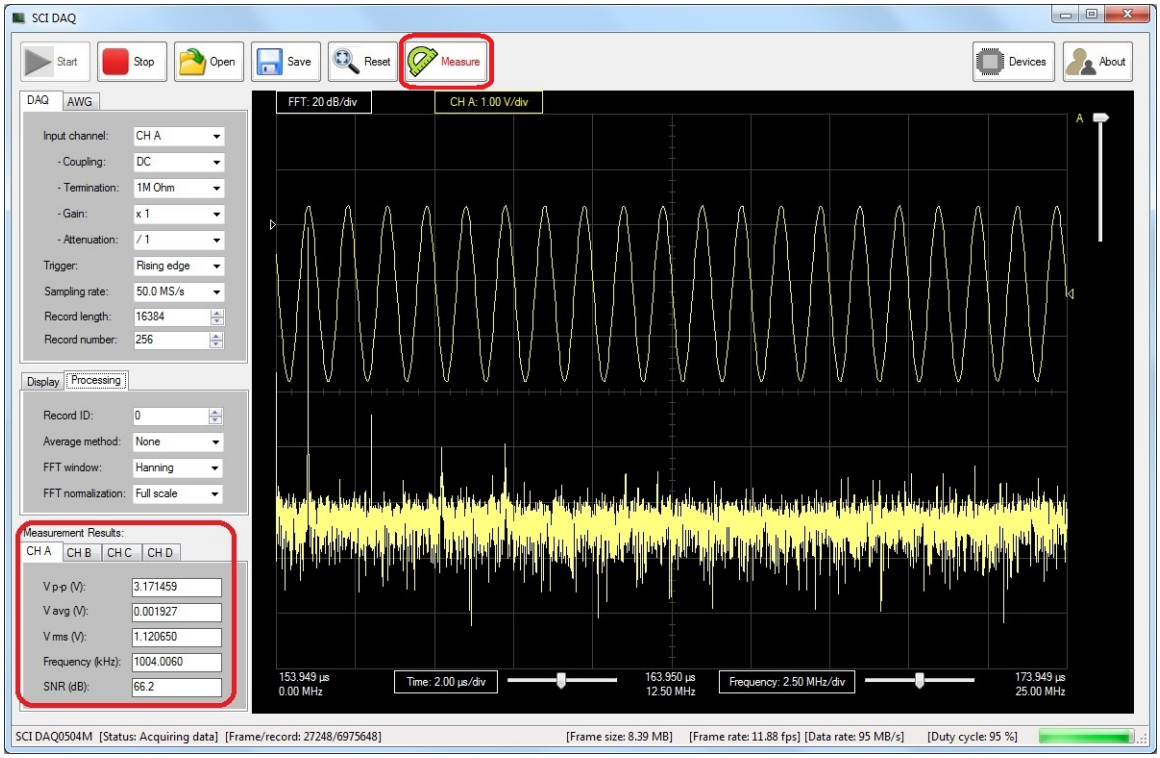


The available FFT normalization methods are full scale normalization and self normalization.

In the full scale normalization method, the 0 dB signal amplitude is the maximum full scale number which is a fixed number. In the self normalization method, the 0 dB signal amplitude is the maximum amplitude found in the Fourier transform.

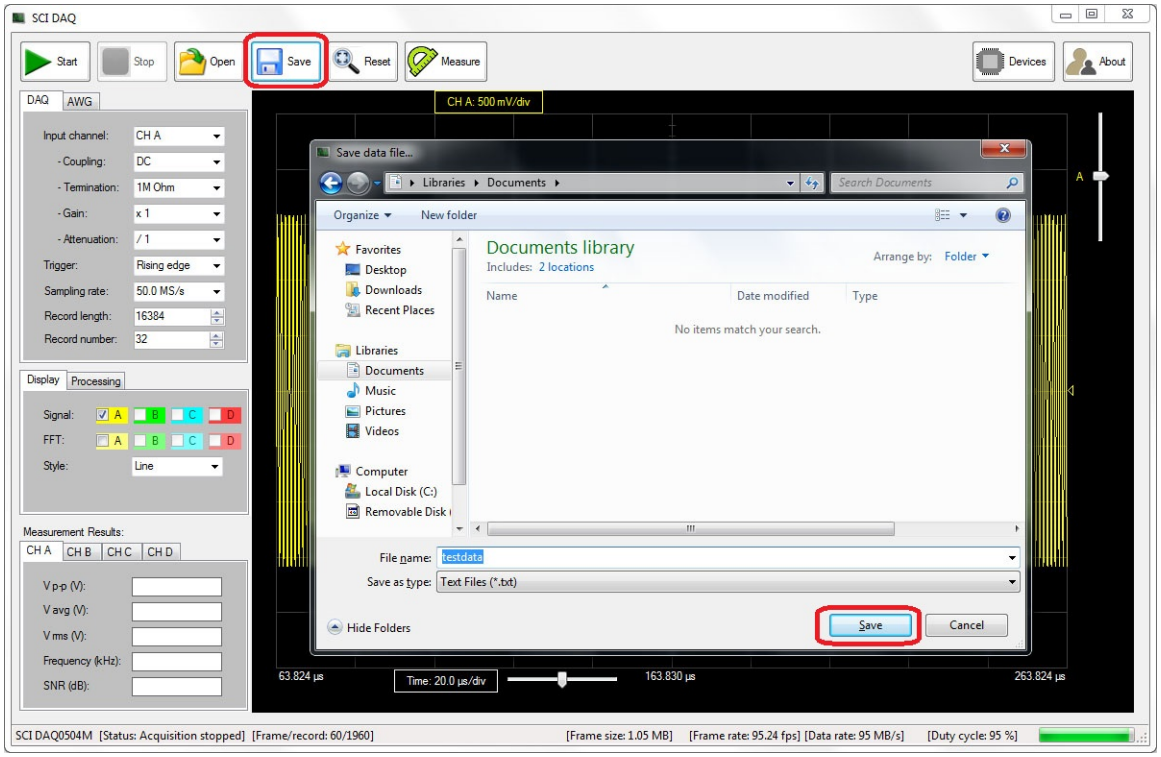
3-5. Signals measurement results

After the user clicking the "Measure" tool button, the software will display some signals measurment results including the peak-to-peak voltage (Vpp), average voltage (Vave), and root-mean-square voltage (Vrms) of the signals. The measured signal frequency and SNR are obtained from the Fourier transform of the signals.



3-6. Data saving

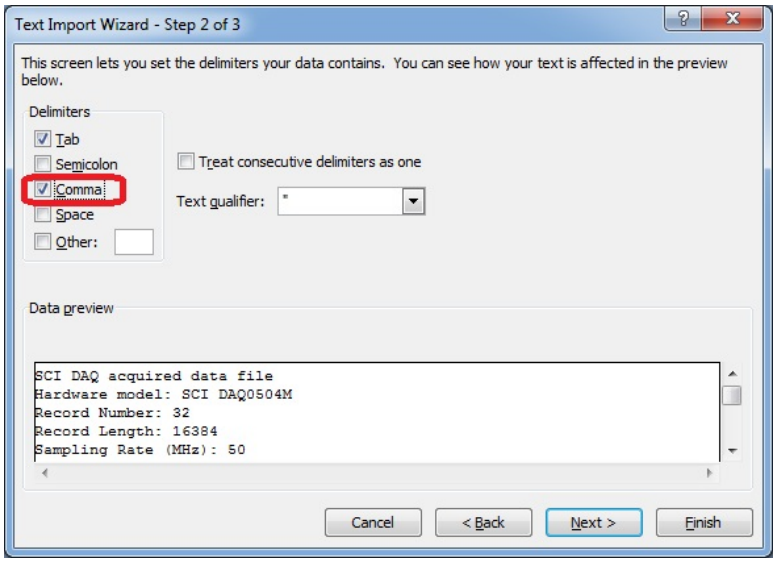
The "SCI DAQ" software also supports data file saving functions. After acquiring a data frame, the user can click the "Save" tool button to open a file saving dialog like below.



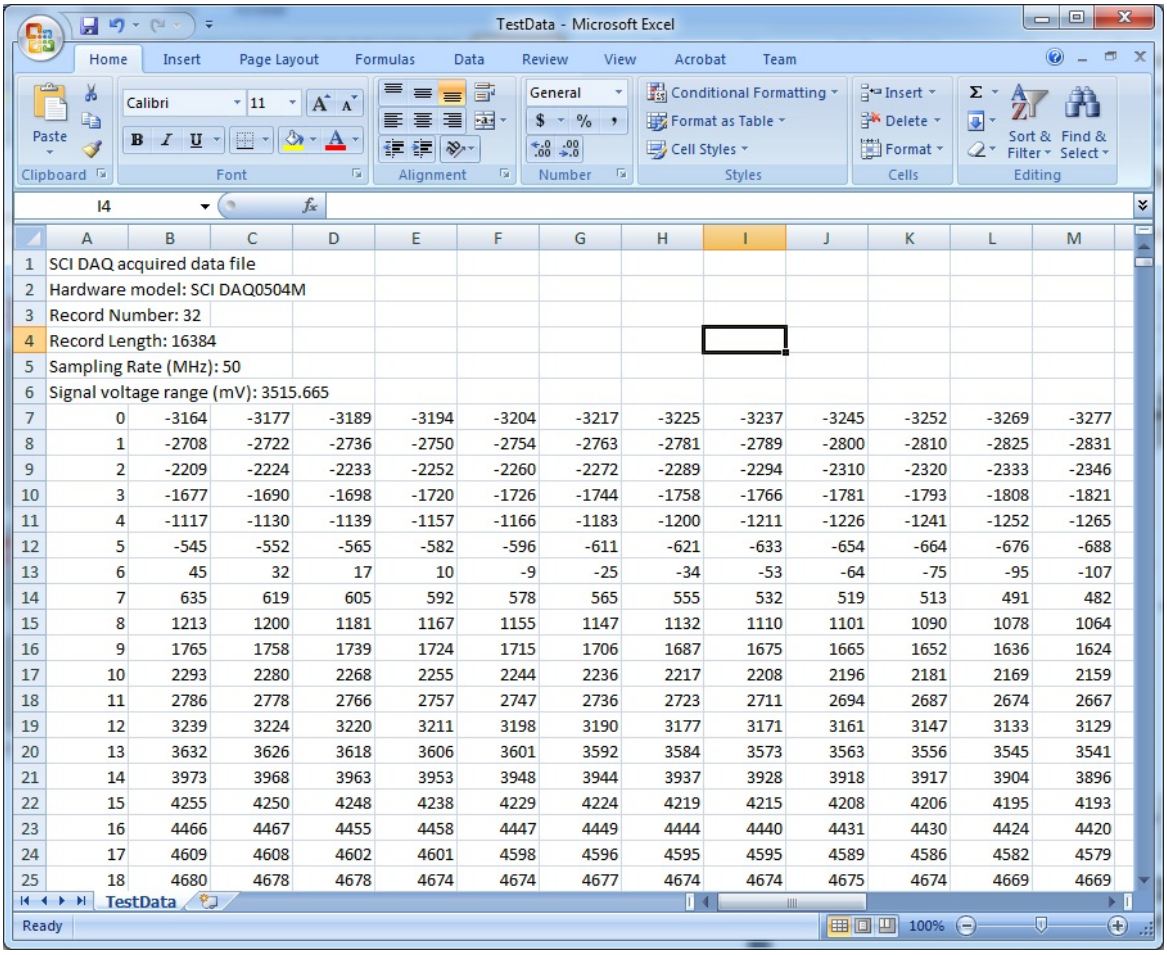
For data frames containing larger than 512 records, only the first 512 data records are saved. The saved data file is in text format and can be opened by other data processing software like Microsoft Excel. Please select text delimiter type to be "comma" when import the text data file.

In the text file, the first column is the data ID in a record, and the following columns are data for each record.

The user can also open the saved data file in the "SCI DAQ" software and browse all the data records.

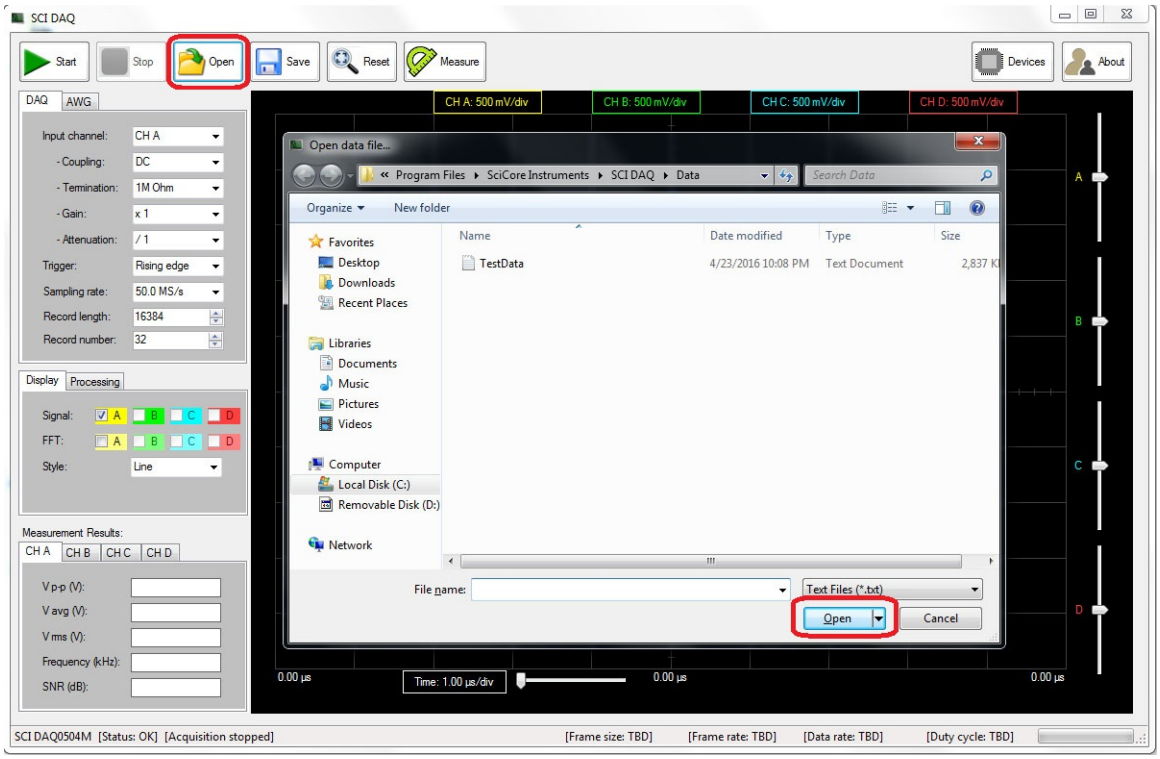


Select text delimiters when importing data to Microsoft Excel

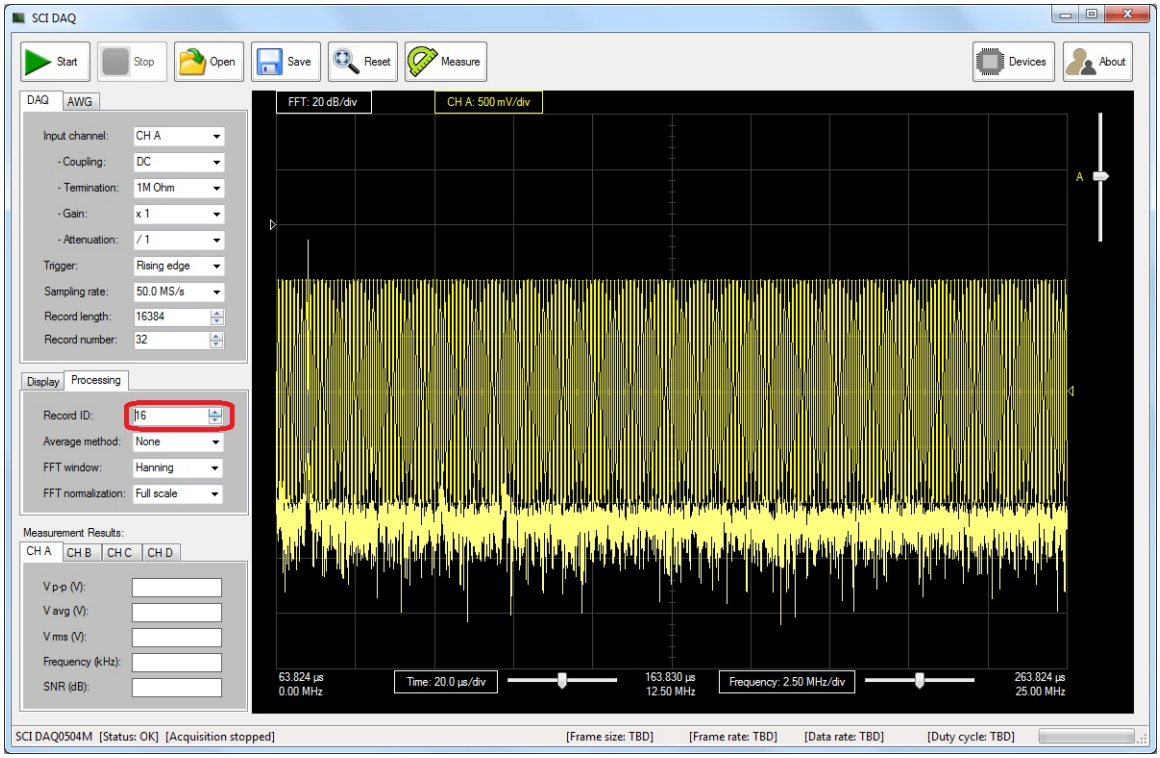


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	SCI DAQ acquired data file												
2	Hardware model: SCI DAQ0504M												
3	Record Number: 32												
4	Record Length: 16384												
5	Sampling Rate (MHz): 50												
6	Signal voltage range (mV): 3515.665												
7	0	-3164	-3177	-3189	-3194	-3204	-3217	-3225	-3237	-3245	-3252	-3269	-3277
8	1	-2708	-2722	-2736	-2750	-2754	-2763	-2781	-2789	-2800	-2810	-2825	-2831
9	2	-2209	-2224	-2233	-2252	-2260	-2272	-2289	-2294	-2310	-2320	-2333	-2346
10	3	-1677	-1690	-1698	-1720	-1726	-1744	-1758	-1766	-1781	-1793	-1808	-1821
11	4	-1117	-1130	-1139	-1157	-1166	-1183	-1200	-1211	-1226	-1241	-1252	-1265
12	5	-545	-552	-565	-582	-596	-611	-621	-633	-654	-664	-676	-688
13	6	45	32	17	10	-9	-25	-34	-53	-64	-75	-95	-107
14	7	635	619	605	592	578	565	555	532	519	513	491	482
15	8	1213	1200	1181	1167	1155	1147	1132	1110	1101	1090	1078	1064
16	9	1765	1758	1739	1724	1715	1706	1687	1675	1665	1652	1636	1624
17	10	2293	2280	2268	2255	2244	2236	2217	2208	2196	2181	2169	2159
18	11	2786	2778	2766	2757	2747	2736	2723	2711	2694	2687	2674	2667
19	12	3239	3224	3220	3211	3198	3190	3177	3171	3161	3147	3133	3129
20	13	3632	3626	3618	3606	3601	3592	3584	3573	3563	3556	3545	3541
21	14	3973	3968	3963	3953	3948	3944	3937	3928	3918	3917	3904	3896
22	15	4255	4250	4248	4238	4229	4224	4219	4215	4208	4206	4195	4193
23	16	4466	4467	4455	4458	4447	4449	4444	4440	4431	4430	4424	4420
24	17	4609	4608	4602	4601	4598	4596	4595	4595	4589	4586	4582	4579
25	18	4680	4678	4678	4674	4674	4677	4674	4674	4675	4674	4669	4669

Text data imported to Microsoft Excel



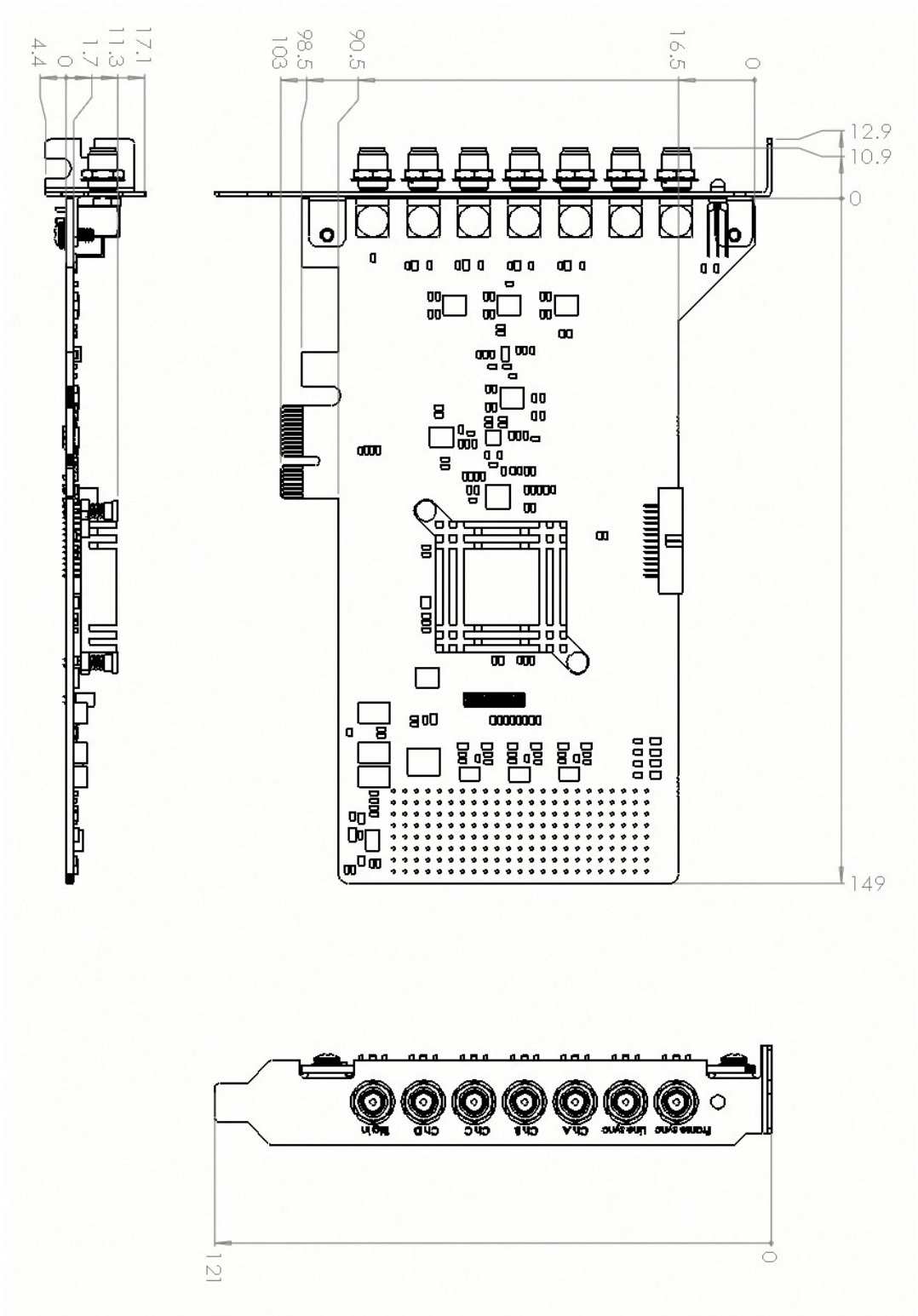
Open a data file in "SCI DAQ" software



Browse data records in a saved data file

Chapter 4: Mechanic Drawings

6-1. DAQ0504M dimensions (All units are in mm)



SciCore Instruments Contact Information

SciCore Instruments, Inc.

P. O. Box 135

Long Valley, New Jersey 07853

E-mail: info@scicoreinstruments.com

Web site: www.scicoreinstruments.com

For comments and technical questions regarding DAQ0504M, send e-mail to:

support@scicoreinstruments.com