ADQ Digitizer

User's Guide

ADQ 108 - 8-bit, 7 GSPS Digitizer
ADQ 112 - 12-bit, 1100 MSPS Digitizer
ADQ 114 - 14-bit, 800 MSPS Digitizer
ADQ 212 - Dual-channel, 12-bit, 550 MSPS Digitizer
ADQ 214 - Dual-channel, 14-bit, 400 MSPS Digitizer
ADQ 412 – Dual/Quad-channel, 12-bit, 3.6/1.8 GSPS Digitizer

SP Devices
Signal Processing Devices

Document Number 09-0340
Rev F, Nov 2010

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1 INTRODUCTION

The ADQ series digitizers are portable high performance digitizers which incorporate one or more analog inputs, on-board DDR2 memory and USB or PXI Express interface. The analog inputs are sampled with high resolution and at data capture rates of up to several thousand mega samples per second (MSPS), and offers excellent analog input bandwidth.

With its combination of high speed, high resolution and high bandwidth the ADQ digitizers are ideal for broadband applications such as IF sampling of RF signals and high-speed data recording. They come with an easy-to-use API that allows for simple integration into any application. The digitizer connects to a host PC via a high-speed USB 2.0 cable or through an optional eight-lane PXI Express interface. The ADQ digitizer comes equipped with Xilinx FPGAs, and offers significant parts of the FPGA resources available for customized applications.

2 SPECIFICATIONS

2.1 Electrical Characteristics

See datasheet for respective ADQ product.

2.2 Front panel

The front of the device features connectors for signal input, external clock input, reference clock I/O, external trigger I/O and GPIO. The function of each connector is described in more detail throughout the user's guide.

The three LED indicators on the front of the device communicate the status of the device when turned on according to the following table.

Indicator	Description
Power (Green)	Constant green light indicates power and status OK.
Status (Red)	Constant red light indicates the device is waiting for PLL lock, this is the case until drivers and software has connected to the card. Short flashes of red light indicate the device is calibrating after startup or sample frequency change. Blinking red light in combination with green light off indicates overheat or power error.
Ready (Amber)	Amber light indicates that the trigger has been armed and is waiting to trig the device.

3 GETTING STARTED

3.1 What You Need to Get Started

To set up and use the ADQ digitizer, you must have the following items:

For USB version:

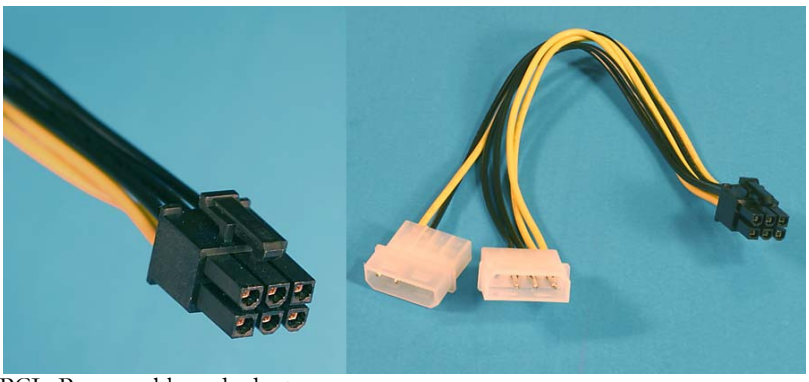
- Mains power supply, 12 V
- A host computer with USB 2.0 (also compatible with USB 1.1)
- USB cable

For PXIe version:

- A host computer with an available PXI Express or cPCI Express slot

For PCIe version

- A host computer with an available PCI Express slot and a PCIe Express 6-pin power connector as illustrated below. Please note that an adapter might be required for some systems. The adapter can be purchased from your favorite computer accessory supplier.



PCIe Power cable and adapter

It is also recommended to have:

- Signal generators
- Female SMA Connector Cables

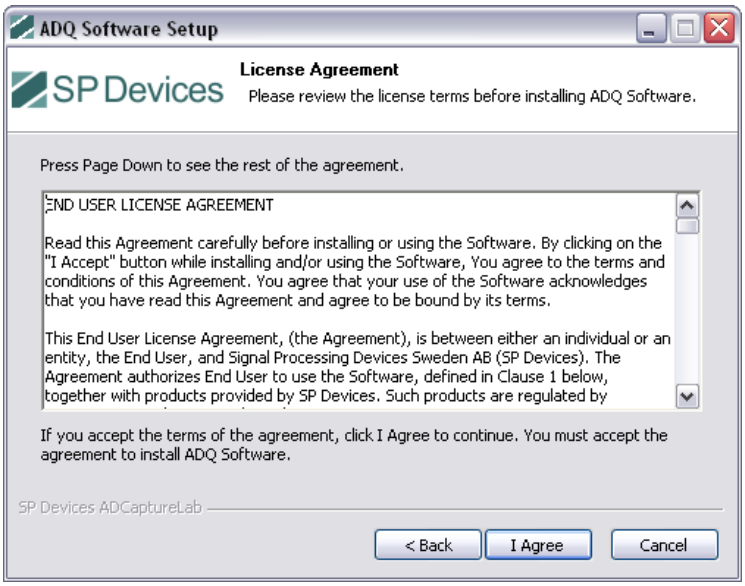
3.2 Software Installation

To install the software for the ADQ digitizer, run "ADQ-setup.exe" found on the CD delivered with the digitizer. This will cause all software to be installed and a shortcut to be added to the start menu. Currently the software package is only available for use with Microsoft Windows.

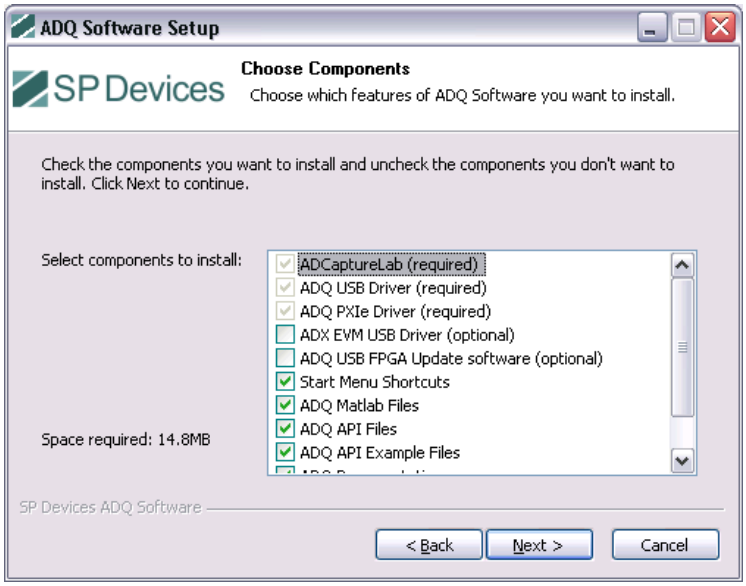
IMPORTANT: Install the software *before* you connect the ADQ digitizer.

1) To install the software, run ADQ-setup.exe which is included on the CD delivered with your digitizer. The window below will be shown.

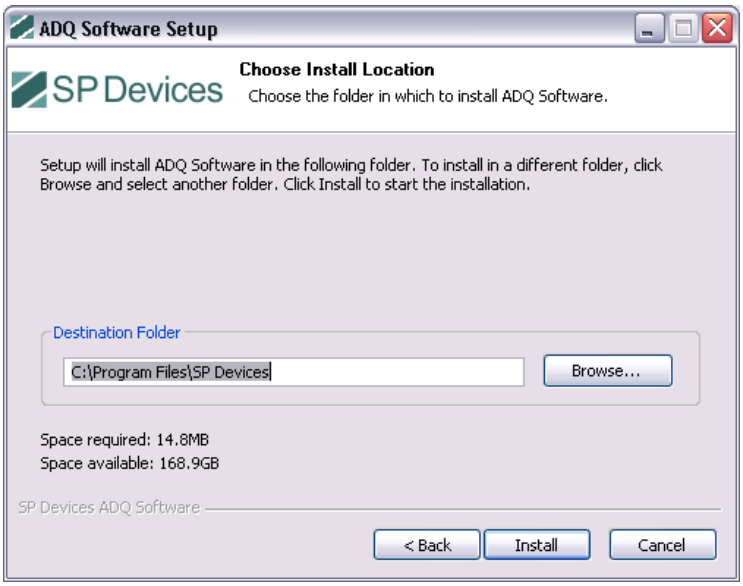
2) Press "Next >".



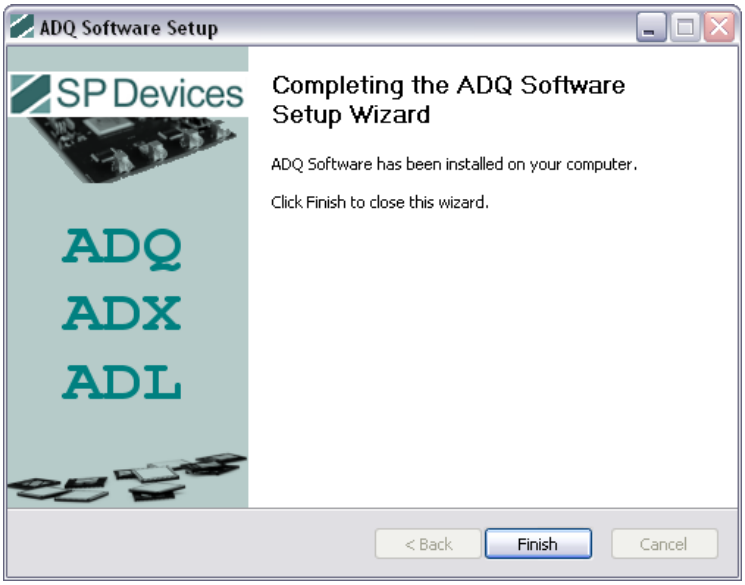
3) Read the license agreement, and then press "I Agree".



4) Choose the components to be installed and press "Next >".
SP Devices recommend installation of all suggested components.



5) If the suggested default installation location is not satisfactory, press "Browse" to choose another location. Then press "Install".



6) When all components have been installed the software is ready for use. Press "Finish" to complete the installation.

3.2.1 Installed Components

3.2.1.1 ADCapture Lab

ADCapture Lab is an easy-to-use standalone program which allows for configuration and operation of all ADQ series digitizers from SP Devices. It displays the collected data and calculates key performance metrics such as SNR and SFDR. Collected data can be stored on disk for later use so that comparison with previous measurements can be done. For more information on how to use ADCapture Lab, please refer to section "Using ADCapture Lab" on page 18.

3.2.1.2 MATLAB Interface

The MATLAB interface consists of a dynamic link library and a MATLAB function that together provide easy-to-use communication with your ADQ device. Example code included on the CD shows how to interact with the device.

3.2.1.3 ADQ API (C/C++ SDK)

The ADQ ADI consists of a number of C++ classes that can easily be integrated with existing source code. It comes with source code and example files. For more information about the ADQ API, please refer to the separate user's guide for the API.

3.2.1.4 Additional Software

There are several other software interfaces available. They include, but are not limited to, LabVIEW and a Dynamic Link Library (DLL) that can be used when not programming in C++, for example with Delphi or CVI. For further information please contact SP Devices.

3.3 Testing Your Device

After installing the relevant software according to the instructions in the previous section, the ADQ digitizer has to be configured when connected to the host PC for the first time. Once this has been done, the device will be ready for operation. An initial test as described in section "Data Acquisition using ADCapture Lab" will get you started with exploring the capabilities of your new device.

3.3.1 Connecting the device for the first time

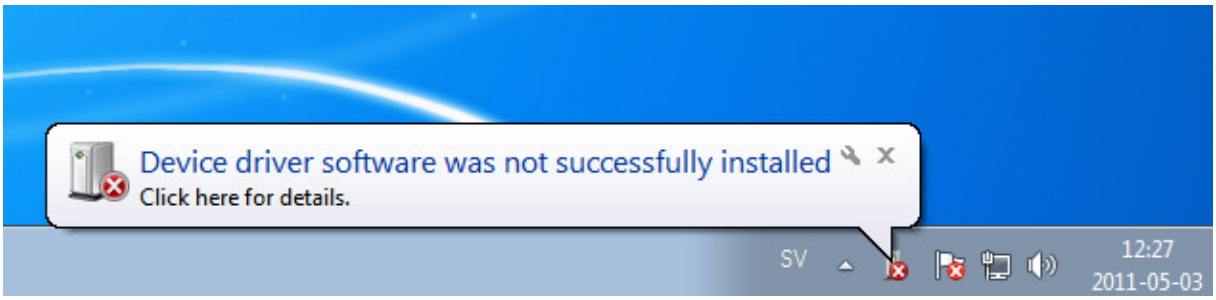
IMPORTANT: Install the software *before* you connect the ADQ digitizer.

Perform the following steps before moving on to acquiring the signal using any of the methods described in later sections.

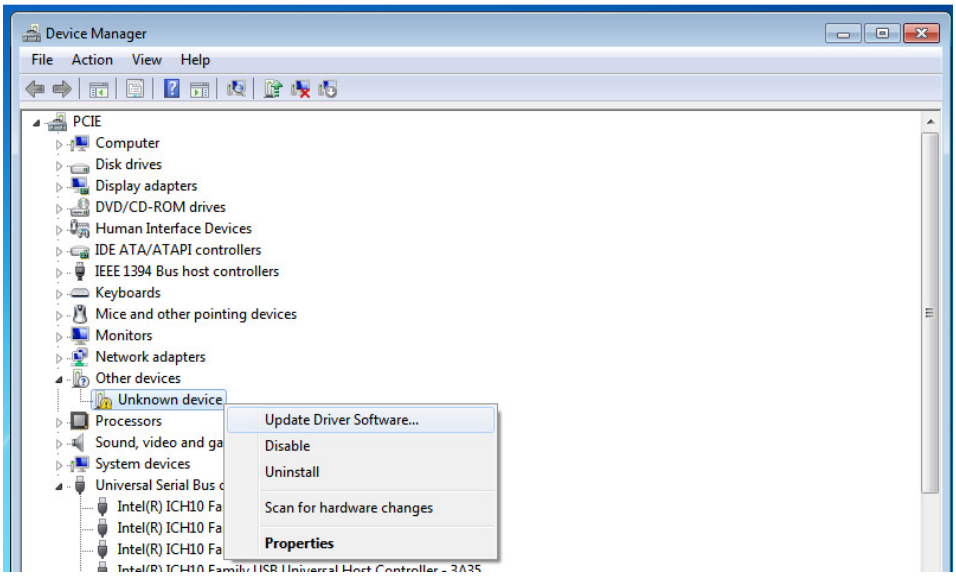
3.3.1.1 Windows 7

Note that the examples in this section are based on installation and operation of an ADQ 412 minor differences will occur when using other digitizers.

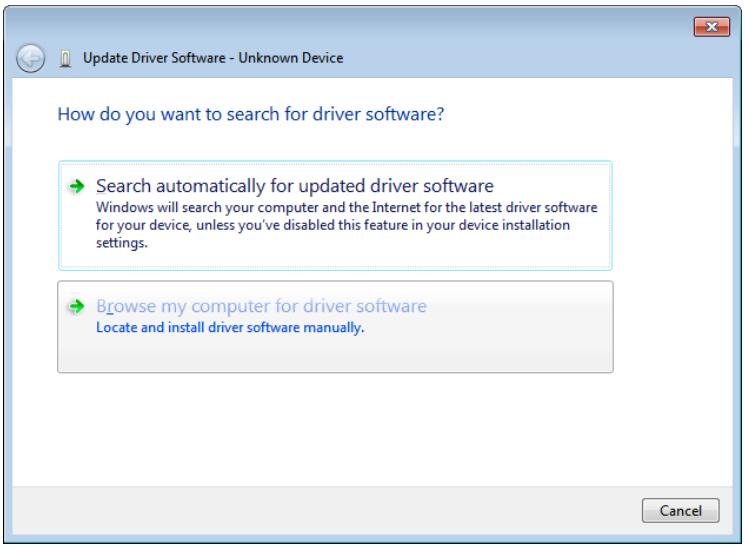
1) Switch on the ADQ digitizer and connect it to the host PC using the USB cable. The message below will be shown.



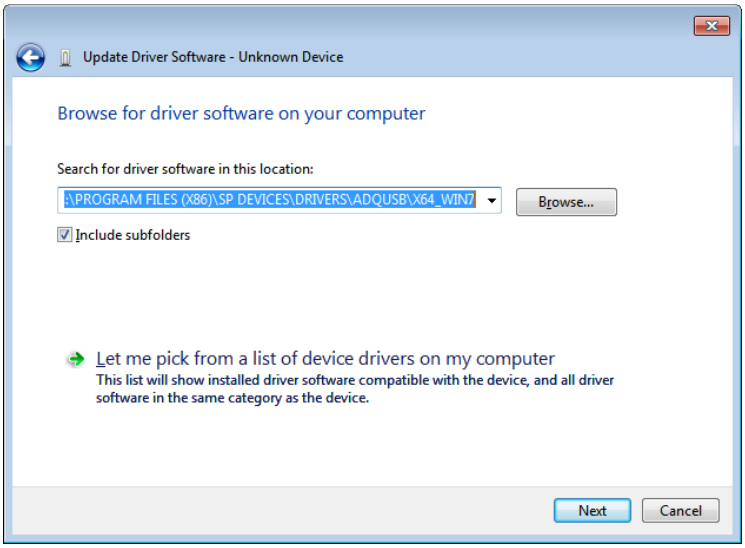
2) Open the Device Manager by typing "devices manager" in the search field of the start menu.



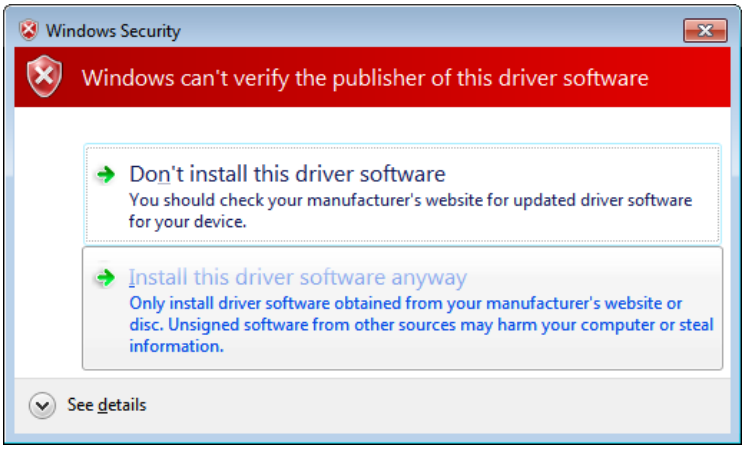
3) Locate "Unknown device" and right click. Select "Update Driver Software".



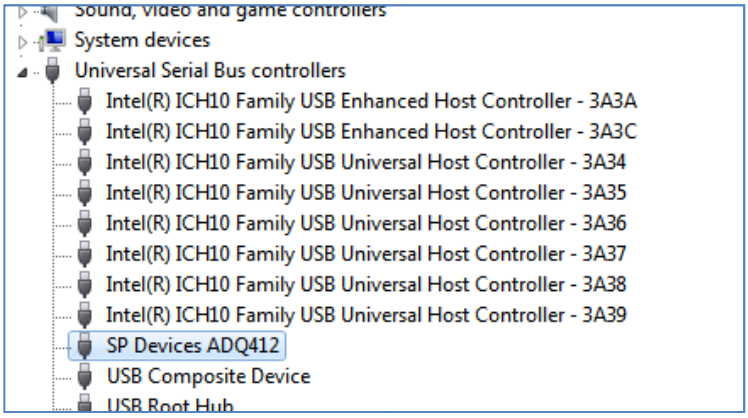
4) Select “Browse my computer for driver software”.



5) Press “Browse” and select “Drivers\ADQUSB\X64_WIN7” in the installation directory , then press “Next >”.
NOTE: If you are running 32-bit version select “Drivers\ADQUSB\x86_win7”.



6) Press “Install this driver software anyway”.



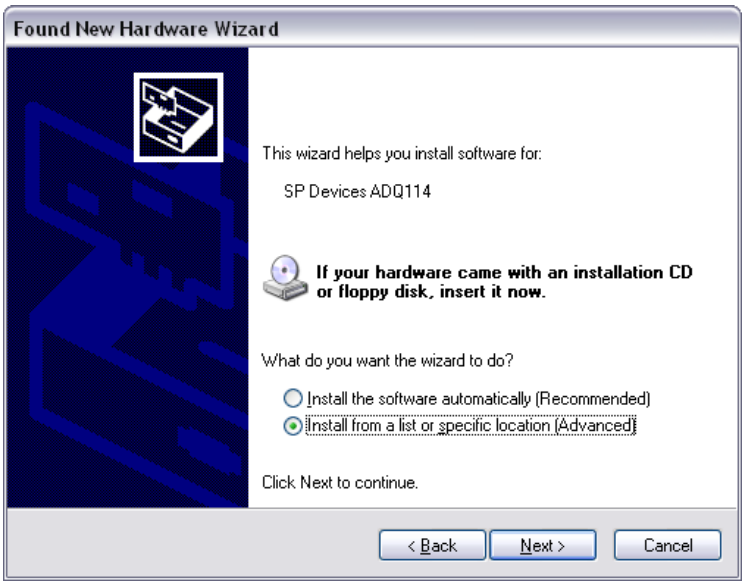
7) Your ADQ unit shall now appear under USB devices in the device manager.

3.3.1.2 Windows XP and Vista

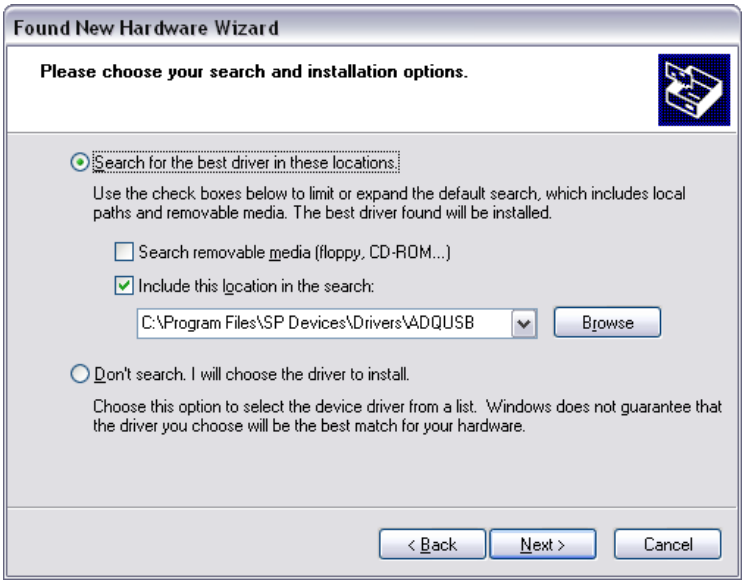
Note that the examples in this section are based on installation and operation of an ADQ 114, minor differences will occur when using other digitizers.

1) Switch on the ADQ digitizer and connect it to the host PC using the USB cable. The window below will be shown.

2) Select “No, not at this time” and press “Next >”.

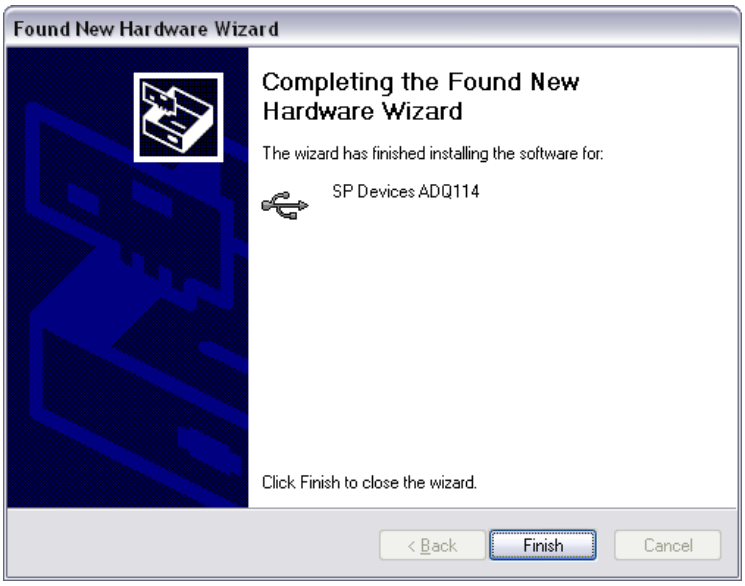


3) Select “Install from a list or specific location (Advanced)” and press “Next >”.



4) Select “Search for the best drivers in these locations”. Check “Include this location in the search”. Press “Browse” and select “Drivers\ADQUSB” in the installation directory, then press “Next >”

5) Press “Continue Anyway”.



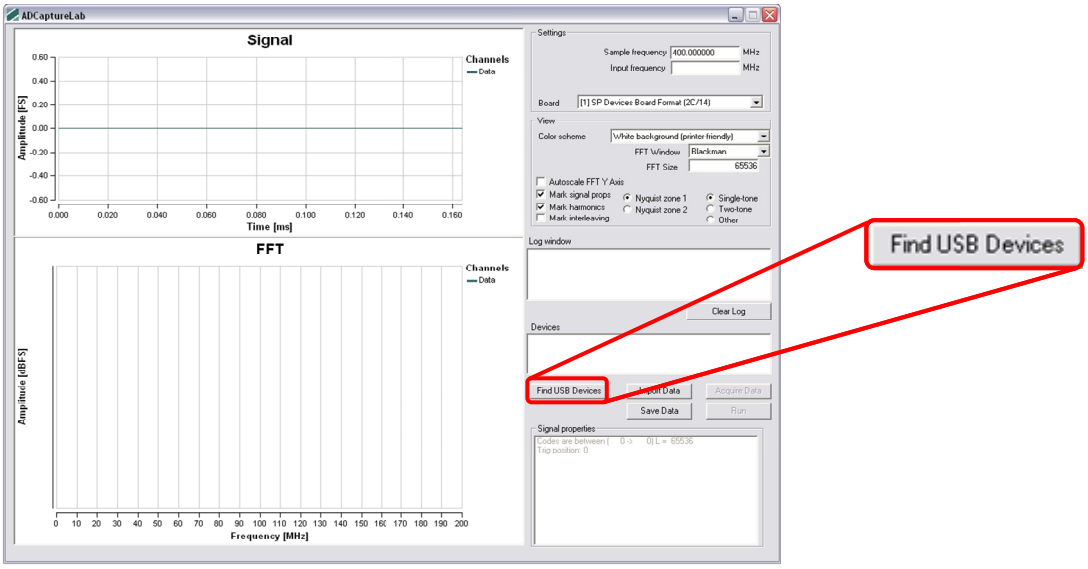
6) Press “Finish”.

3.3.2 Data Acquisition using ADCapture Lab

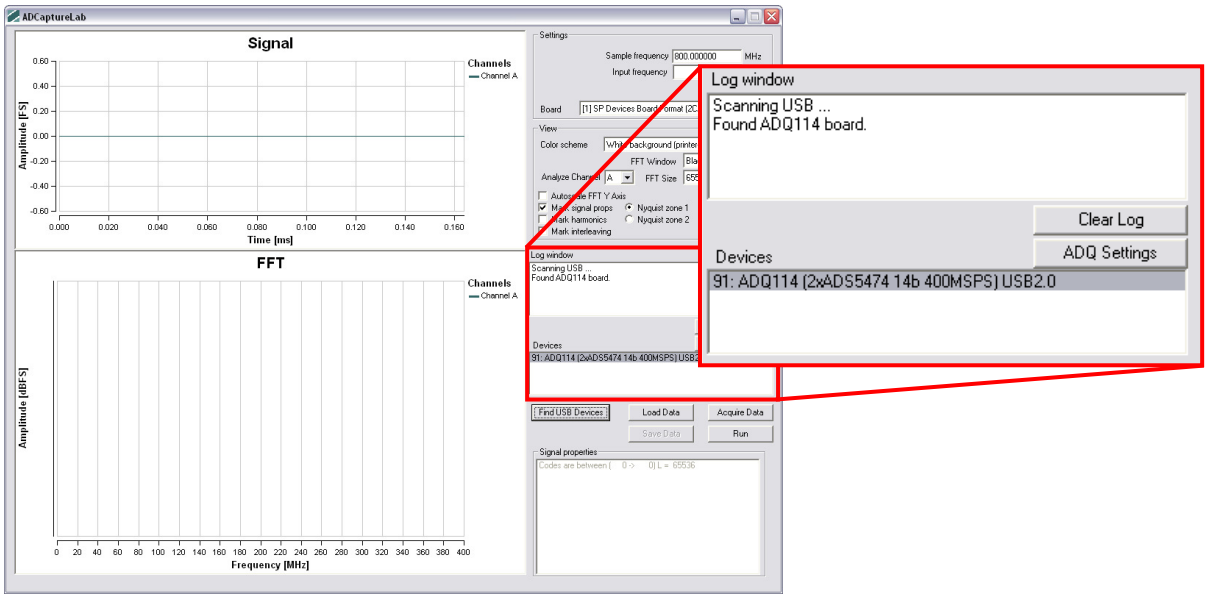
This section describes how to acquire a signal and save it to disk using ADCapture Lab. For a more detailed description of ADCapture Lab, please refer to section “Using ADCapture Lab”. Follow these steps to acquire a signal:

1) Make sure that the ADQ digitizer is switched on and connected to the host PC through USB.

2) Start ADCapture Lab.



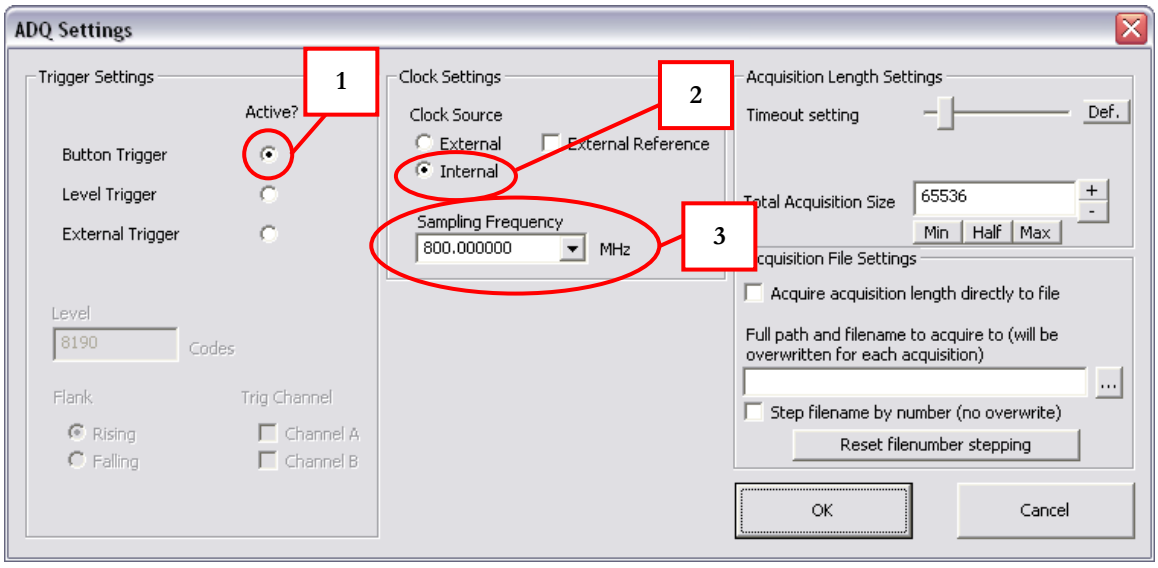
3) In ADCapture Lab, press “Find USB Devices”. All connected ADQ USB devices will be identified.



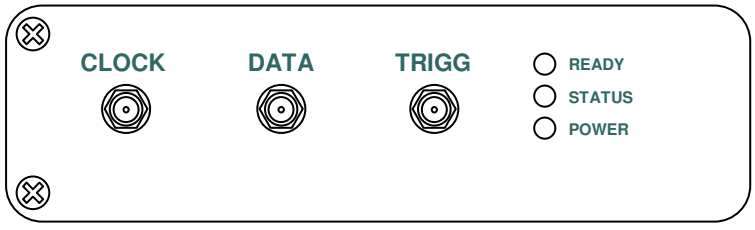
4) Once identified, all connected devices will be displayed in the Devices window.
Status information on the enumeration of devices shows in the Log window.

5) Select the device of your choice by clicking it in the Devices window.

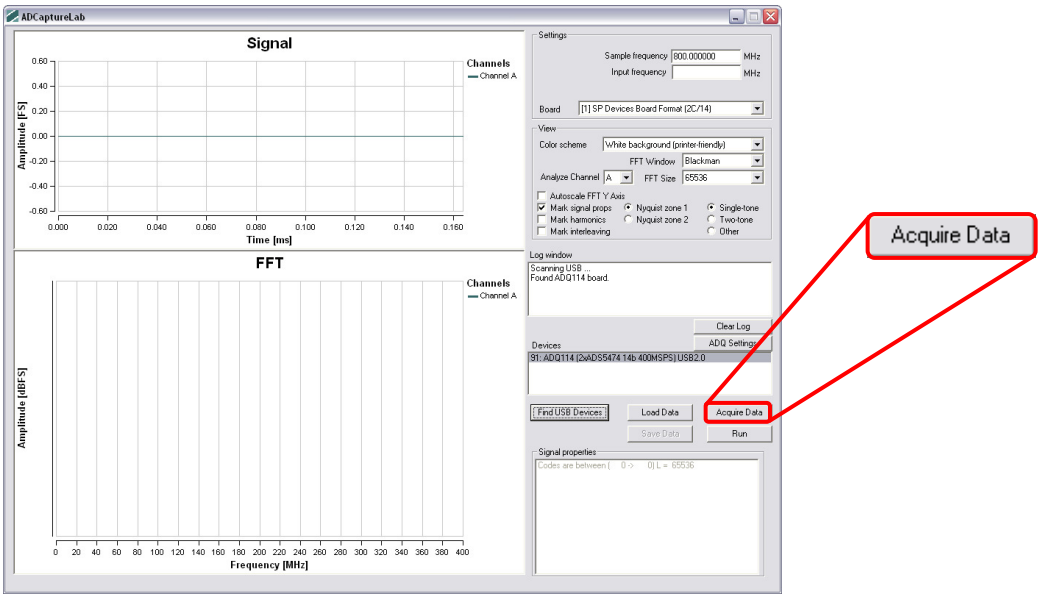
6) Press function key "F8" or the "ADQ Settings" button to enter the ADQ settings and bring up the settings dialog.



7) In Trigger settings, check "Button Trigger" so that acquisition will be triggered from inside ADCapture Lab.
In Clock settings, select internal clock by checking "Internal". This will eliminate the need of an external source.
Select sampling frequency "800 MHz".



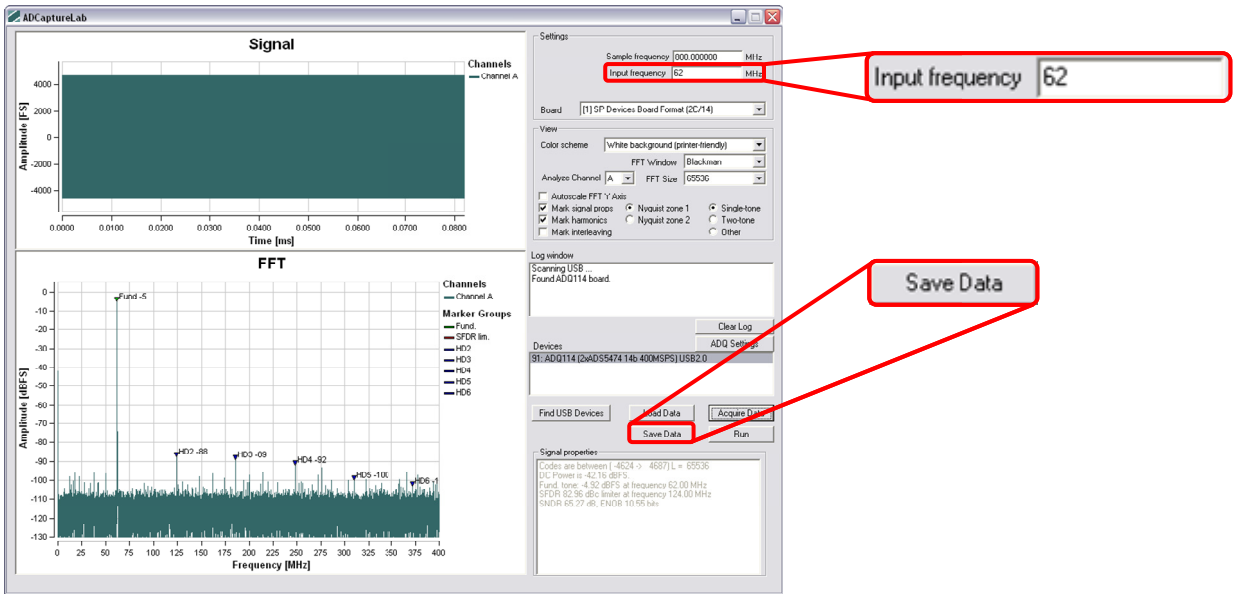
8) Connect a signal source set to 1.0 Volt amplitude and 62 MHz to the DATA[1] channel SMA input.
There is no need to connect a signal source to the clock input since we have chosen to use the internal clock.



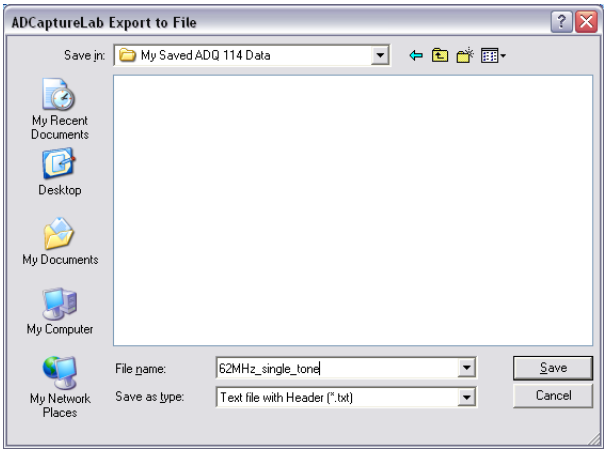
9) Press "Acquire Data" to collect one batch of samples.
The number of samples collected in the batch is determined by "Total acquisition size" which is found in the settings dialog. To open this dialog, press F8 or click the "ADQ Settings" button.

10) The acquired samples are displayed both in time and frequency domain (FFT).
For best performance, it is likely that the signal source have to be filtered so that harmonics are suppressed.

[1] Note that different ADQ digitizers might have different number of inputs and other designated names on the SMA inputs than what is shown in the picture.



11) Write 62 in the "Input Frequency" field to indicate the frequency of the sampled signal. This information will be saved to the data file so that the input frequency can be displayed again at a later time after data import.
Then press "Save Data".



12) Navigate to the target directory by clicking the drop-down box named "Save in".
Provide a file name, for example "62MHz_single_tone".
Choose file type "Text file with Header (*.txt)".
Press "Save".

Congratulations, you have now acquired and saved your first signal using your ADQ digitizer and ADCapture Lab!
For further information on how to use ADCapture Lab, please refer to section "Using ADCapture Lab" on page 18.

4 USING ADCAPTURE LAB

4.1 Overview

Figure 1 shows the main window of ADCapture Lab. A detailed description of each part shown in the main window is given in the section shown in the figure.

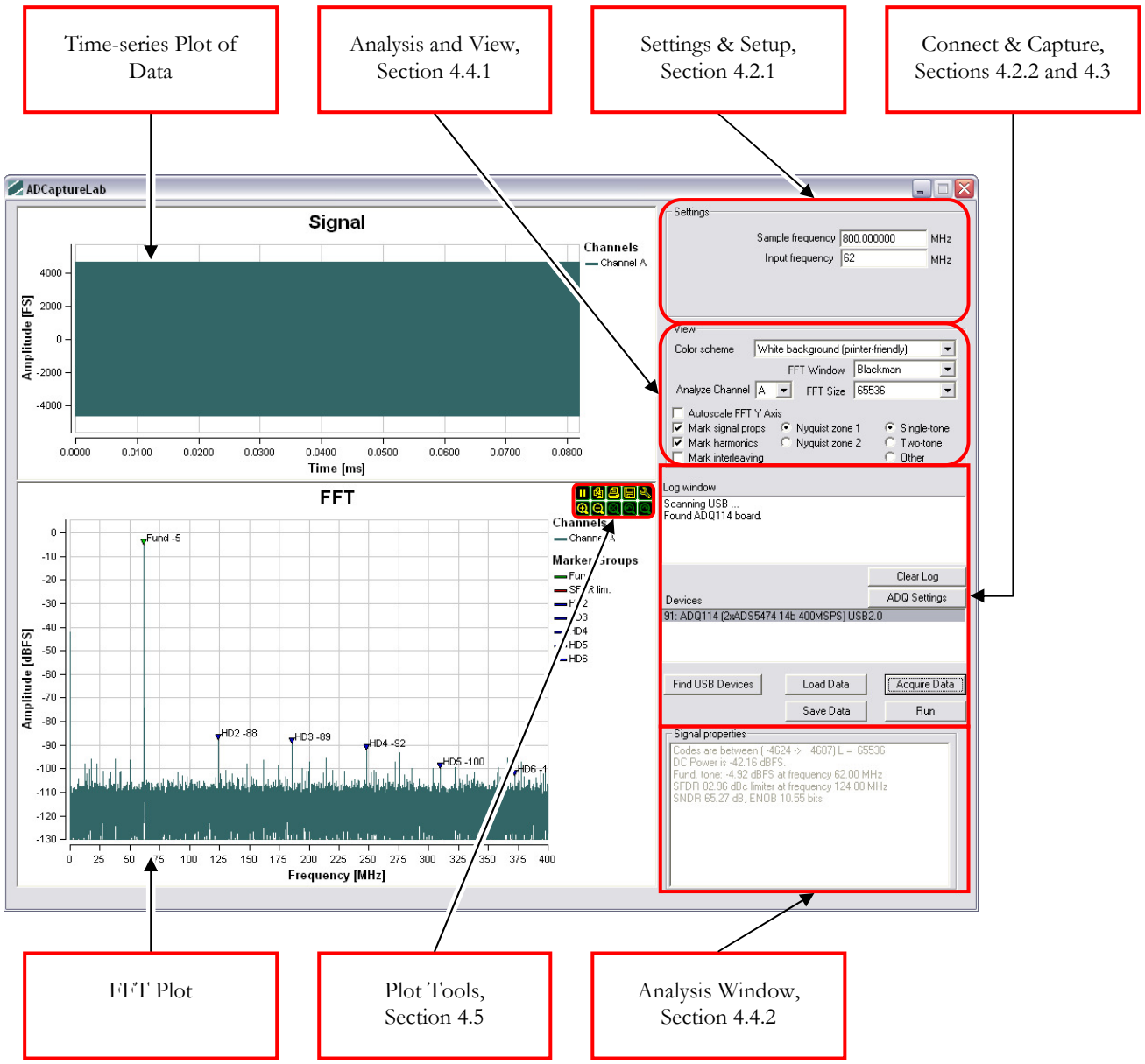


Figure 1. ADCapture Lab main window.

4.2 Capturing Data

4.2.1 Settings & Setup

Figure 2. Sample frequency when running with internal clock (left) and external clock (right).

Setting	Description
Sample frequency	Set the sampling frequency for the system. Frequency axis for FFT plot will be based on this and on Nyquist zone settings (see also section 4.4.1.2). The sample frequency can only be changed manually when running on external clock. If the ADQ digitizer is running on internal clock, this value will automatically be changed according to the frequency selected in the ADQ Settings dialog (which opens when pressing F8).
Input frequency	Set the input frequency. Only used for tagging when exporting data.

4.2.2 Connect & Capture

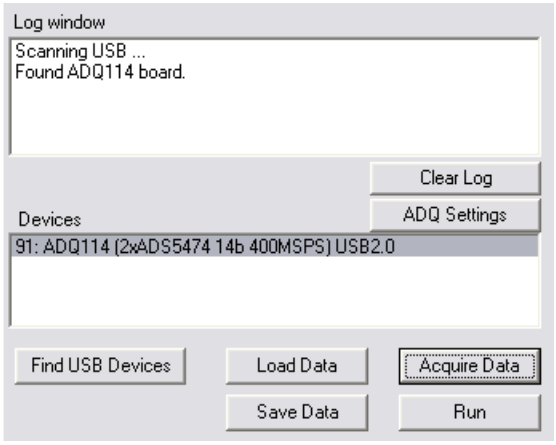


Figure 3. Buttons used for connect and capture.

4.2.2.1 Connecting to the digitizer

1) To find the digitizer – press button "Find USB Devices". The digitizers connected to the computer will then show up in the "Devices" box. Status information on the enumeration of devices will show in "Log window".
2) Select a compatible device digitizer from the "Devices" list. The buttons "Acquire data" and "Run" will then be activated.

4.2.2.2 Capture Single Batch

To capture a single batch from the digitizer, press "Acquire data". Trigger mode must be set to "Button trigger", see section 4.6 for further information on different trigger modes.

4.2.2.3 Continuous Capture

To capture continuously, press "Run". Button will change name to "Stop", and pressing it will stop the capturing. If plots are in "Play" mode (see section 4.5), plots will be updated continuously as new data arrives from the digitizer. Trigger mode must be set to "Button trigger" for continuous capture, see section 4.6 for further information on different trigger modes.

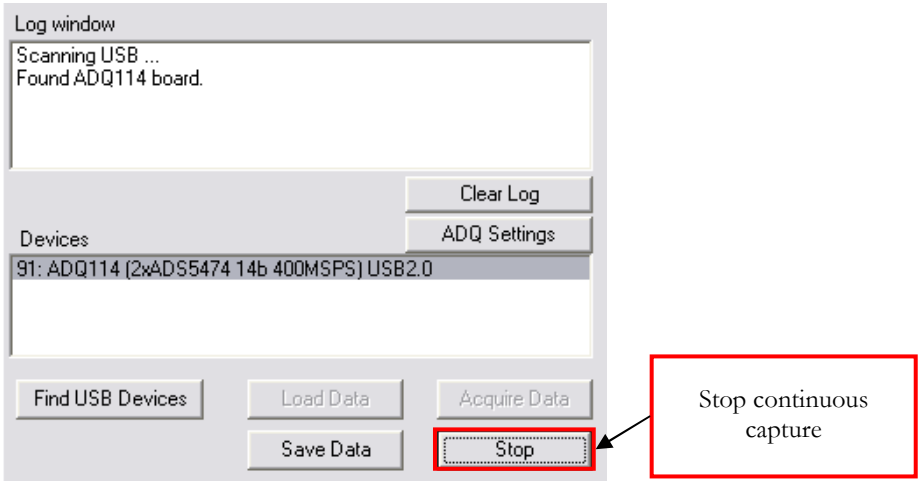


Figure 4. The appearance and functionality of the Start / Stop button changes during continuous capture.

4.3 Import and Export of Data

4.3.1 Import Data

Press "Import Data" to load previously saved results into ADCapture Lab. In the file dialog window that opens, select the target file and press "Open". File contents will be loaded into the plot windows (unless they are in "Pause" mode). To import, you may also drag & drop the file to the ADCapture Lab main window directly.

4.3.2 Export data

To save the results of a measurement, press "Save Data". Provide a filename in the file dialog window that opens, select a file format and press "Save". Data can be exported as a text file format with a header, binary format, or as a pure ASCII file for use with for example MATLAB.

4.4 Data Analysis

ADCapture Lab supports several data analysis functions that helps you interpret and evaluate the results of your measurements. The following sections explain the details about these functions.

4.4.1 Analysis and View Settings

The analysis and view settings determine which type of data analysis that is performed and how the result is displayed.

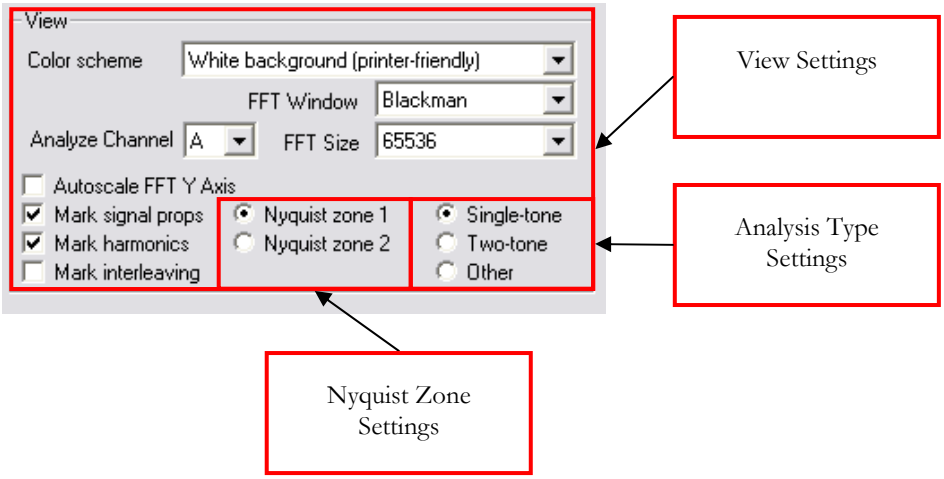


Figure 5. The analysis and view settings.

4.4.1.1 Analysis Type Settings

Analysis Type	Description
Single-tone	Check this to indicate that the current measurement is a single-tone test. Supports analysis of code range, fundamental, harmonics, SFDR, and SNDR (ENOB).
Two-tone	Check this to indicate that the current measurement is a two-tone test. Supports analysis of code range, fundamentals, SFDR and SNDR (ENOB).
Other	Check this to indicate that the current measurement is other than above mentioned test types. Supports analysis of code range only.

4.4.1.2 Nyquist Zone Settings

Nyquist Zone	Description
Nyquist zone 1	Check this to indicate that the input signal frequencies are in the first Nyquist zone, i.e. DC < fin < fs/2. Frequency axis of FFT plot will be based on this and on the current sample frequency setting.
Nyquist zone 2	See description above. FFT plot frequency axis will change to fs/2 < fin < fs.

4.4.1.3 View Settings

Setting	Description
Color scheme	Sets the color scheme of the plot routines. Available modes are: ▪ White background (printer-friendly) ▪ Black background ▪ Grey background
Window	Windowing function used for FFT and analysis functions. Available windows are: ▪ Blackman ▪ Blackman-Harris ▪ Hamming ▪ Hanning ▪ Rectangular

Setting	Description
Autoscale FFT Y Axis	When enabled, the y-axis of the FFT plot is automatically scaled. If disabled, the y-axis is locked between 0 and -130dBFS.
Mark signal props	When enabled, fundamental tone(s) and SFDR limiter are marked in the FFT plot.
Mark harmonics	When enabled, harmonics (2^{nd}-6^{th}) are marked in the FFT plot. Supported for single-tone tests only.
Mark interleaving	When enabled, interleaving errors are marked in the FFT plot. Supported for single-tone tests and two-tone tests only.

4.4.2 Analysis Window Output

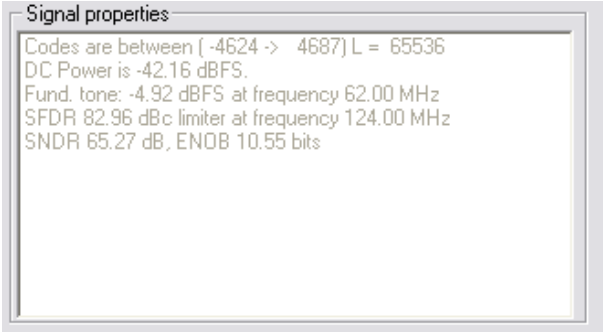


Figure 6. The result of the data analysis is displayed in the analysis window.

Analysis Item	Applicable to Analysis Type(s)	Description
Codes	All	Code range and number of samples in the current data batch.
DC Power	All	DC power in dBFS.
Fund. tone(s)	Single-tone Two-tone	Identified fundamental tones (power and frequency).
Power max	Other	Identified power maximum (power and frequency).
SFDR	Single-tone Two-tone	Spurious-Free Dynamic Range. Power relation between fundamental tone and largest distortion. For a two-tone test this is calculated as the relation between the largest fundamental tone and the largest distortion. Frequency position of limiting component is calculated.
SNDR	Single-tone Two-tone	Signal to Noise and Distortion Ratio. Power relation between fundamental tone and noise and distortion.
ENOB	Single-tone Two-tone	Effective Number Of Bits. Based directly on the SNDR value.

4.5 Plot Tools

Move the mouse cursor over any of the plot windows (time-series plot or FFT plot) to display the plot tools toolbar. When a plot tool is marked green, as for example the "Zoom to Fit" tool shown in Figure 7, it means that this

specific tool is currently not a valid choice. In the case of the "Zoom to Fit" tool, this happens when the plot is already zoomed to show the full signal plot.

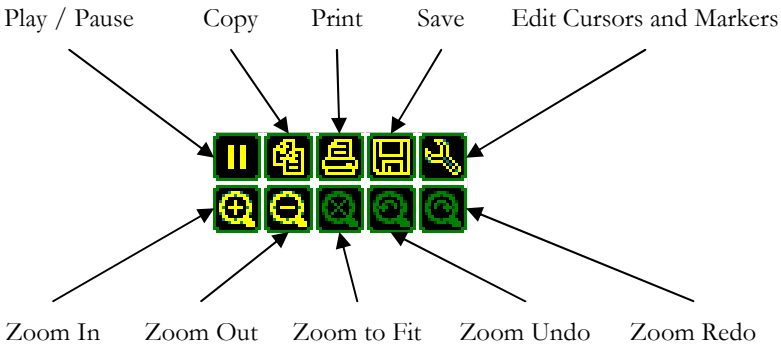


Figure 7. The plot tools appear when placing the mouse over any of the plot windows.

Plot Tool	Description
Play/Pause	To put plot in Play/Pause mode. In play mode, plot will display new data as it arrives either by acquiring or by import from file. In pause mode, plot will not update.
Copy	Copies plot window to the clipboard. The result can for example be pasted into a document or similar.
Print	Prints plot window to printer.
Save	Exports plot window to bitmap or jpeg image file.
Edit Cursors and Markers	Edits the cursors & markers of the plot window. When pressed a dialog window will open which will allow for changing properties such as channel name and visibility, display color for the channel and marker shapes and colors.
Zoom In	Zooms in.
Zoom Out	Zooms out.
Zoom to Fit	Zooms to the original setting.
Zoom Undo	Returns to previous zoom setting.
Zoom Redo	Returns to zoom setting before undo press.

4.6 Trigger Settings

The ADQ digitizers supports several trigger types which are explained in further detail in the following sections. Press F8, or the "ADQ Settings" button to open the ADQ settings dialog from which the trigger settings can be changed.

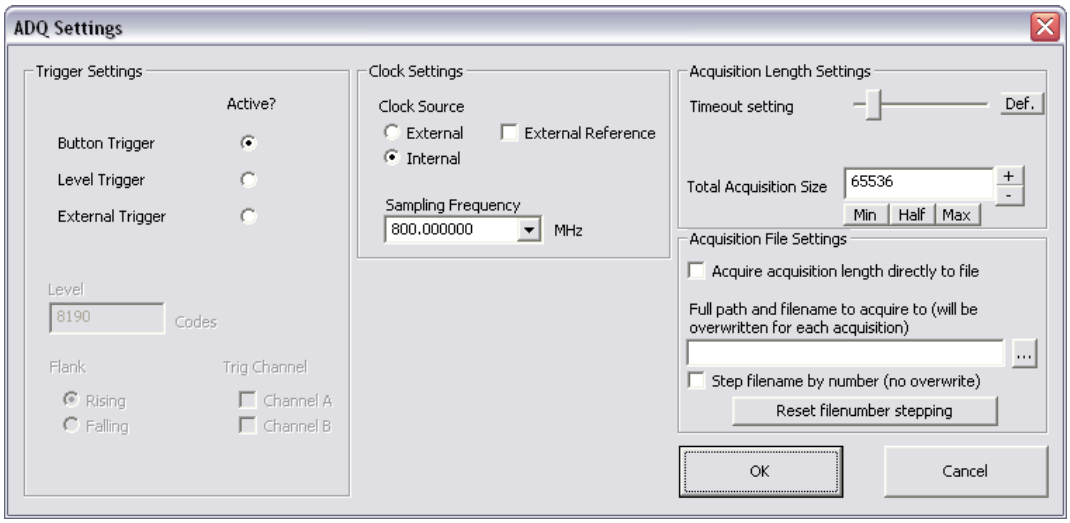


Figure 8. The ADQ settings dialog allows for modification of trigger settings.

4.6.1 Button Trigger

When the button trigger is activated, the ADQ digitizer will acquire data whenever any of the buttons "Acquire Data" or "Run" is pressed in the main window of ADCapture Lab (see sections 4.2.2.2 and 4.2.2.3 for more information). The button trigger mode is activated by checking the "Button Trigger" checkbox in the ADQ settings dialog. See Figure 8 for an example of where the button trigger mode is active.

4.6.2 Level Trigger

When the level trigger is activated, the ADQ will monitor the input(s) and wait for a level trigger condition to occur. The specified trigger level, chosen flank (or slope) and selected input channel are all monitored to determine whether or not the trigger condition is fulfilled. Open the settings (F8) to activate and configure a level trigger:

1) Activate the level trigger by checking the "Level Trigger" checkbox.
   Note that rest of the level trigger settings becomes enabled.

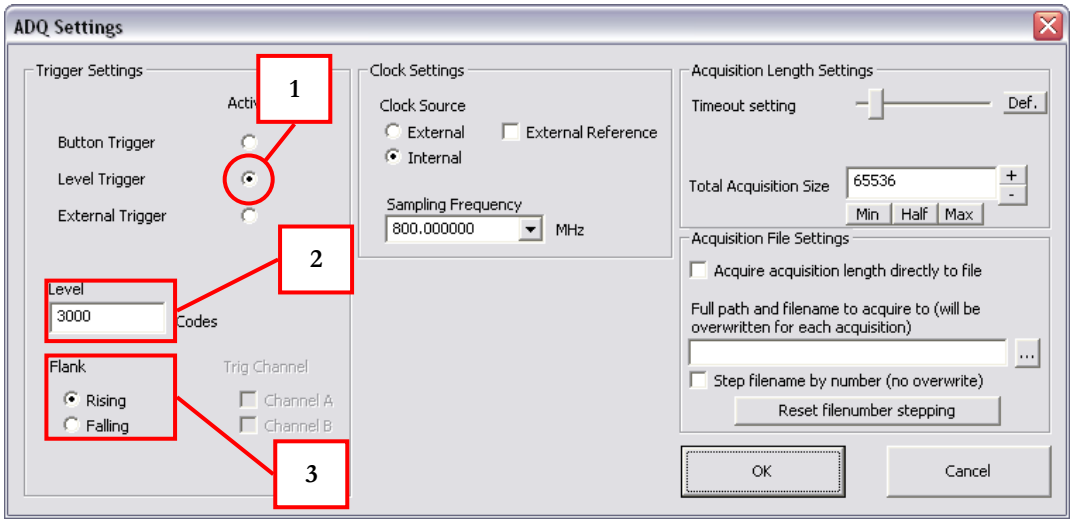


Figure 9. Level trigger activated from the ADQ settings dialog window.

2) Specify a trigger level (code) by writing the value into the "Level" field.
   As an example, the ADQ 114 has 2^{14} = 16 384 different codes, which gives a valid level trigger range between -8192 to 8191.

3) Choose a flank by clicking either "Rising" or "Falling".

4) For digitizers with several channels, such as the ADQ 214, the trigger can be assigned to a specific channel. This is done by clicking the checkboxes for Channel A or Channel B.

5) Press "OK" when the trigger has been configured to return to the main window.

The example settings shown in Figure 9 illustrate a level trigger armed for acquiring data starting on a transition from an input level (code) below 3000 to a level above 3000.

4.6.2.1 Capture Single Batch with Level Trigger

Press the button "Acquire Data" in the main window of ADCapture Lab to arm the trigger. While armed, and as long as no trigger event occurs, the text of the button changes to "Cancel" to indicate that the button can be used to disarm the trigger and return to normal operation.

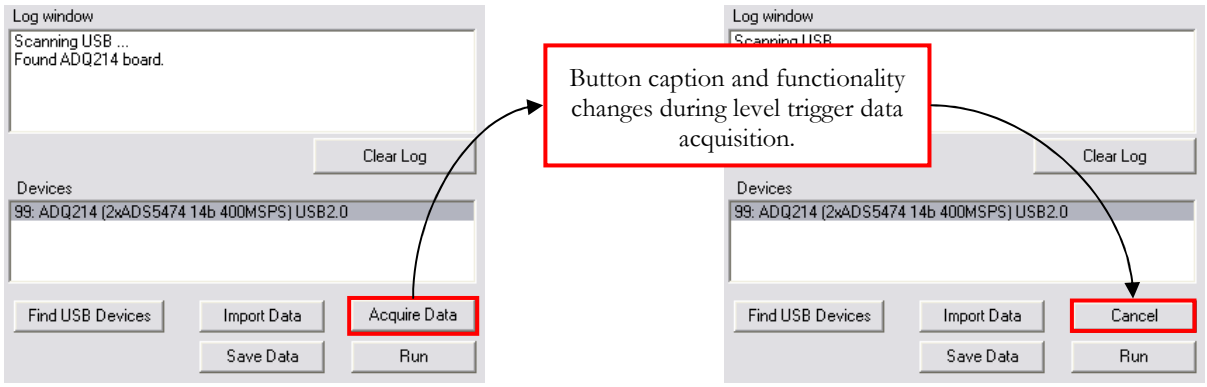


Figure 10. With level trigger, press "Acquire Data" to arm and "Cancel" to disarm the trigger.

If, instead, the trigger event occurs, the time-series and FFT plots will be updated with the captured data. The placement of the occurring trigger event will be shown in the time-series plot window. To ensure proper operation of the plot updating, make sure that the time-series plot is in play mode (see section 4.5) and that the view setting "Mark signal props" (see section 4.4.1.3) is checked.

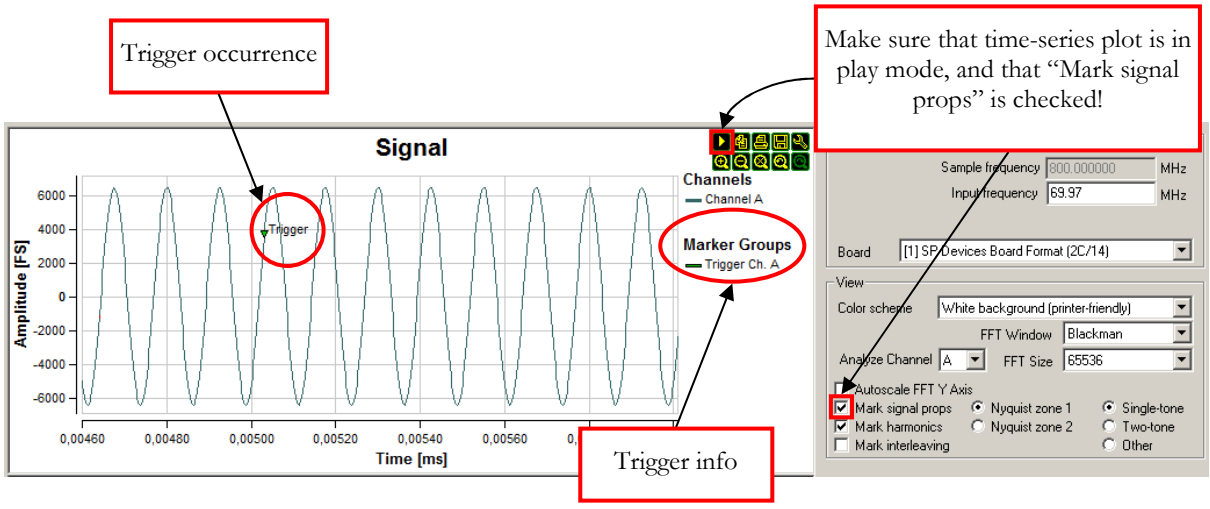


Figure 11. A level trigger event shown in the time-series plot.

4.6.3 External Trigger

When the external trigger is activated, the ADQ digitizer will monitor the input signal at the "TRIGG"[2] SMA connector. The trigger input port operates on LVTTL signal levels, and a trigger event will occur on a logic low-to-

[2] This input is marked "External Trigger" on some of the ADQ digitizers.

high transition (rising edge flank). To activate the external trigger, enter the ADQ settings by pressing F8 and click the checkbox marked "External Trigger.

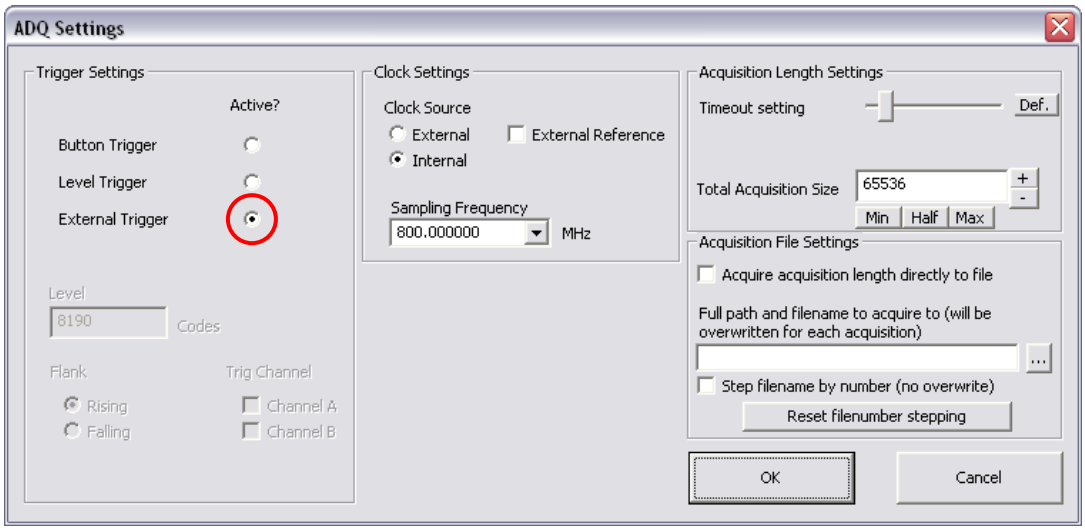


Figure 12. Activate the external trigger in the ADQ settings dialog.

4.6.3.1 Capture Single Batch with External Trigger

Data acquisition using external trigger is performed in the same way as with level trigger. Therefore, please refer to section 4.6.2.1, "Capture Single Batch with Level Trigger" for an overview of the acquisition procedure.

4.7 Clock Settings

There are three basic clock configurations that can be used with the ADQ digitizers:

- Internal Clock Source with Internal Reference (default clock setting)
- Internal Clock Source with External Reference
- External Clock Source

The clock settings are configured in the ADQ settings dialog.

4.7.1 Internal Clock Source with Internal Reference

This is the default clock setting. The frequency of the internal clock source, and hence the sampling frequency, can be changed to a number of pre-defined frequencies. Open the settings dialog (F8) to activate and configure this clock setting:

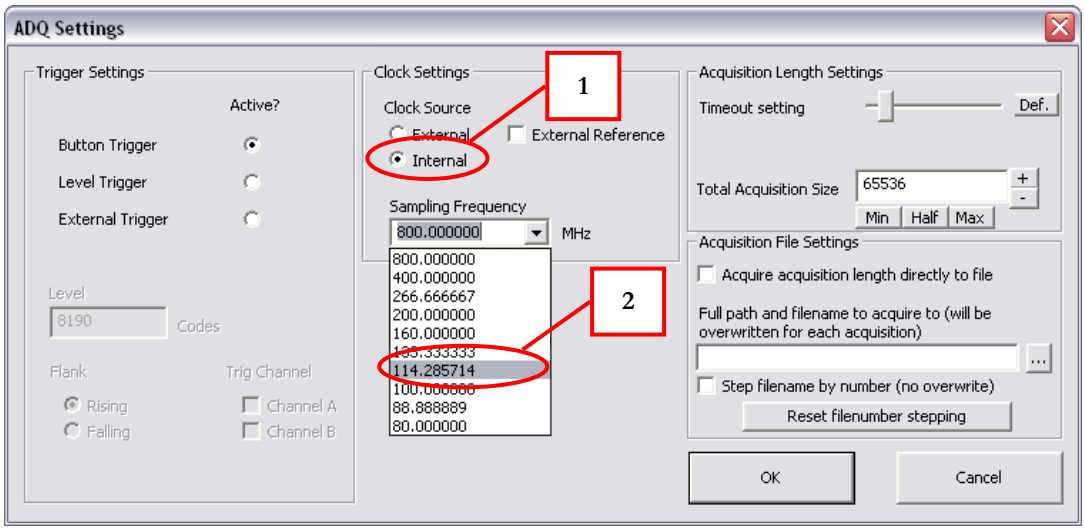


Figure 13. Internal clock source with internal reference and 114.28 MHz sampling frequency.

1) Click "Internal" in the clock settings to choose internal clock source (the internal clock reference is implied).
2) Use the sampling frequency drop-down box to select any of the pre-defined sample frequencies.
3) Press "OK" to apply the setting.

4.7.2 Internal Clock Source with External Reference

Use this clock setting to synchronize the ADQ digitizer with another instrument. The other instrument must provide an output clock reference of 10 MHz that should be connected to the "CLOCK"[3] SMA input on the ADQ.

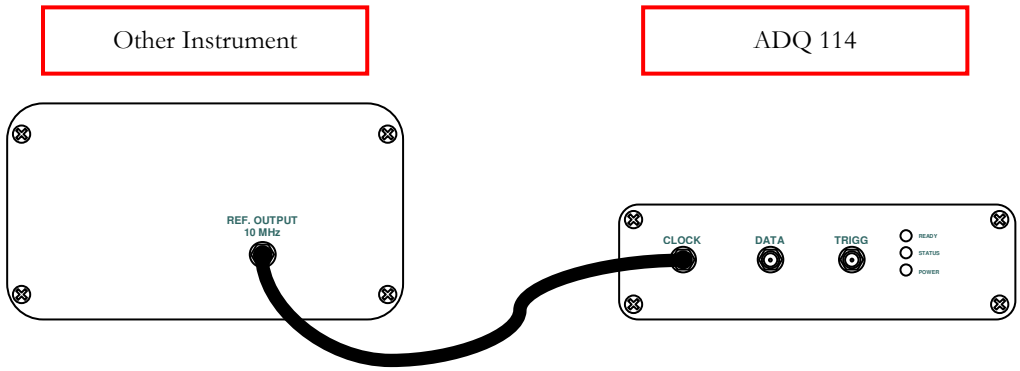


Figure 14. Start by connecting the 10 MHz reference output clock from the other instrument to the clock input of the ADQ digitizer.

To configure ADCapture Lab for use of internal clock source with external reference, follow the same procedure as explained in section 4.7.1, "Internal Clock Source with Internal Reference", but make sure to also click the "External Reference" checkbox. See Figure 15.

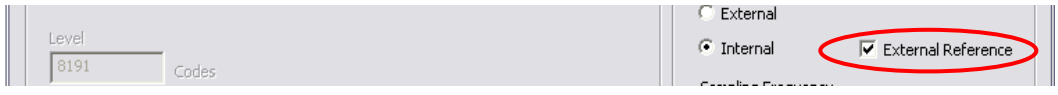


Figure 15. Make sure to click the External Reference checkbox when synchronizing with another instrument.

[3] This input is marked "External clock/reference" on some of the ADQ digitizers.

4.7.3 External Clock Source

Use this clock setting when the sample frequency is entirely provided by an external signal source. Connect the output of the signal source to the "CLOCK"[4] SMA input on the ADQ digitizer. This clock setting allows for a more flexible choice of sampling frequency than internal clocking. Make sure to keep the provided frequency within the specifications listed in section 2.1, "Electrical Characteristics" on page 5. Note that signal source jitter will have a significant impact on system performance. The jitter specifications of the internal clock given in section 2.1 indicate suitable performance.

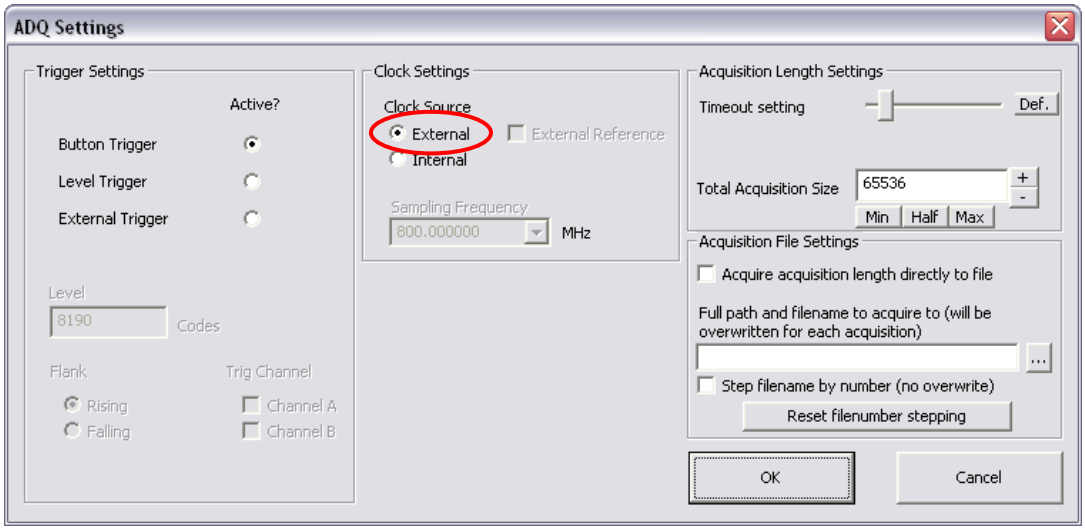


Figure 16. Set clock source to "External" when using a signal generator to provide the sampling frequency.

4.8 Keyboard Shortcuts

Key	Description
F1	Show version information for ADCapture Lab software.
F2	Show version information for FPGA firmware and FPGA firmware status.
F3	Show digitizer status.
F4	Show FFT Analysis Options.
F5	Refresh plots.
F6	Clear plots.
F8	Launch ADQ settings to modify things such as trigger type, acquisition length etc. Note that this dialog will only appear when connected to a digitizer (i.e. after pressing "Find USB Devices").
CTRL+F	Find USB
CTRL+A	Acquire Data
CTRL+R	Run/Stop

[4] This input is marked "External clock/reference" on some of the ADQ digitizers.

CTRL+S	Save Data
CTRL+I	Import Data

4.9 Troubleshooting

Problem	Remedy
"No devices found" is displayed in the log window when pressing "Find USB Devices".	Check if a compatible digitizer is plugged in via USB. Check if digitizer is powered. Try to turn the power off and on again. Press "Find USB Devices" again. Restart the software and try again.
Digitizer is connected and found in list, but when trying to acquire digitizer does not respond correctly.	Check if digitizer is powered. Check that correct digitizer format is selected (see section 4.2.1). Try to turn the power off and on again. Press "Find USB Devices" again, select digitizer and retry.
Time-series plot or FFT plot does not update when acquiring or importing data.	The plot which is not updating may be in "Pause" mode. Move the mouse over the plot to bring up the plot tools. If in "Pause" mode, press the pause symbol so that it changes into a play symbol. See figure below. Press here… … to change to play mode. 
The "ADQ Settings" dialog does not appear when pressing F8.	Make sure that "Find USB Devices" have been pressed, and that the digitizer has been found.

5 USING MATLAB

5.1 Files

The MATLAB interface consists of a mex_ADQ.dll which gives access to the functions in the ADQ API. The calls to the to the mex file is listed in the interface_ADQ.m file. The format for calling interface_ADQ is

>> interface_ADQ('name_of_the_function',[parameter list])

The names of the functions are found in the ADQ API reference documentation. The parameter list is found by looking in the interface_ADQ.m source code.

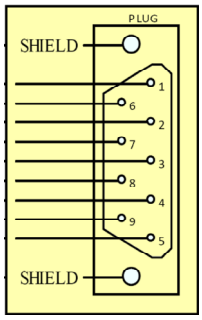
At set-up, the MATLAB files are located in the folder C:\Program Files\SP Devices\Matlab. It also includes example files for getting started.

6 FUNCTIONS REFERENCE

6.1 GPIO

6.1.1 GPIO Micro-D connector

The Micro-D connector has

Pin1	In	Read GPIO out (code)	
Pin 2	In	Read GPIO out (code)	
Pin 3	Out	Set GPIO out (code)	
Pin 4	Out	Set GPIO out (code)	
Pin 5	GPIO	Set GPIO direction out/in (code)	

Set GPIO

6.1.2 Trigger as GPIO

Set-Trig direction out

Set trig value 1, 0

6.2 Time stamp

The ADQ has a running counter that enables the user to establish when a certain set of data was captured. The counter runs 4 times the speed of the sampling clock of one ADC.

6.2.1 Operation modes

There are two different modes of operation.

1. Sync Off
2. Sync On

The output from the timestamp depends on which mode the time stamp is in, more about the vector in section 6.2.3.

6.2.1.1 Sync Off

In this mode the full 64 bits are used to represent the number of tics that the counter has achieved.

6.2.1.2 Sync On

In this mode the lower 42 bits are used for the tic counter, while the upper 22 bits are used for the sync counter.

The GPIO Pin2 is used as start pulse input, to generate sync pulses.

6.2.2 Restart counter

The counter is started automatically upon power on. It is possible to reset the counter by a API command. The counter can be started in two ways, either by software or by sending a pulse into the GPIO Pin2, the same pin as the sync input. Default is to restart the counter by software upon resetting the counter.

6.2.3 Time stamp vector

Depending on if the sync mode is activated or not affects the time stamp vector, see Table 1 and Table 2.

63	0
Tic counter	

Table 1 Time stamp vector when sync is not active

63	42	41	0
Sync counter		Tic counter	

Table 2 Time stamp vector when sync is active

6.2.4 Translate time stamp to real time

To be able to relate the time stamp to real time one can use the following formulas

Sync off	$t = \frac{n_{tic}}{f_s * 2}$	ADQ214
	$t = \frac{n_{tic}}{f_s}$	ADQ112, ADQ114
Sync on	$t = \frac{n_{sync}}{f_{sync}} + \frac{n_{tic}}{f_s * 2}$	ADQ214
	$t = \frac{n_{sync}}{f_{sync}} + \frac{n_{tic}}{f_s}$	ADQ112, ADQ114

$t = real\ time, \quad n_{tic} = tic\ counter, \quad n_{sync} = sync\ counter$

$f_s = sampling\ frequency\ of\ the\ ADQ, \quad f_{sync} = sampling\ frequency\ of\ sync\ pulse$

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