BxB Demo 1 Quickstart

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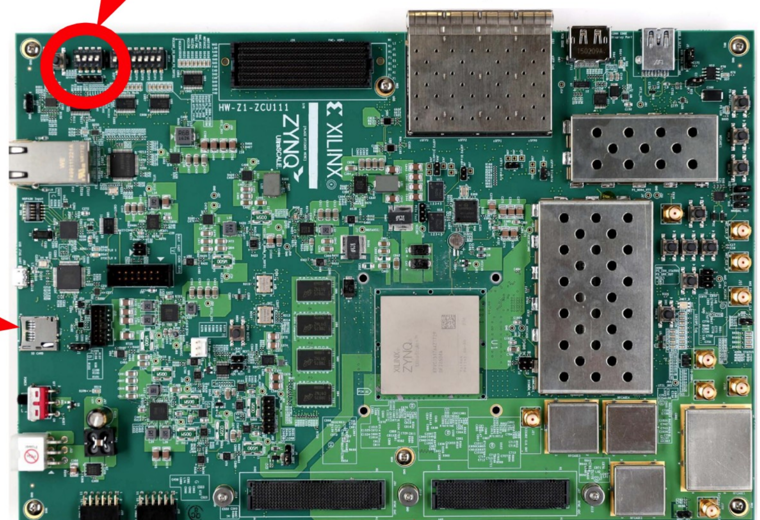
Hardware Setup

1. Get a ZCU111 board.

2. Select Boot Mode to UP-DOWN-DOWN-DOWN (Boot from microSD card)

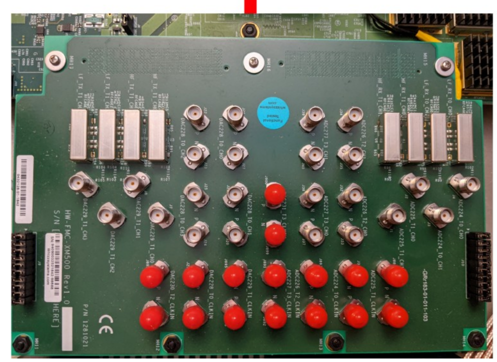


BOOT.BIN

image.ub

3. Get a microSD card. Delete all files on it, and put the two supplied boot files onto it. Insert it into the ZCU111. (It's usually unnecessary to format the card, but if you do use Microsoft "VFAT" format.)

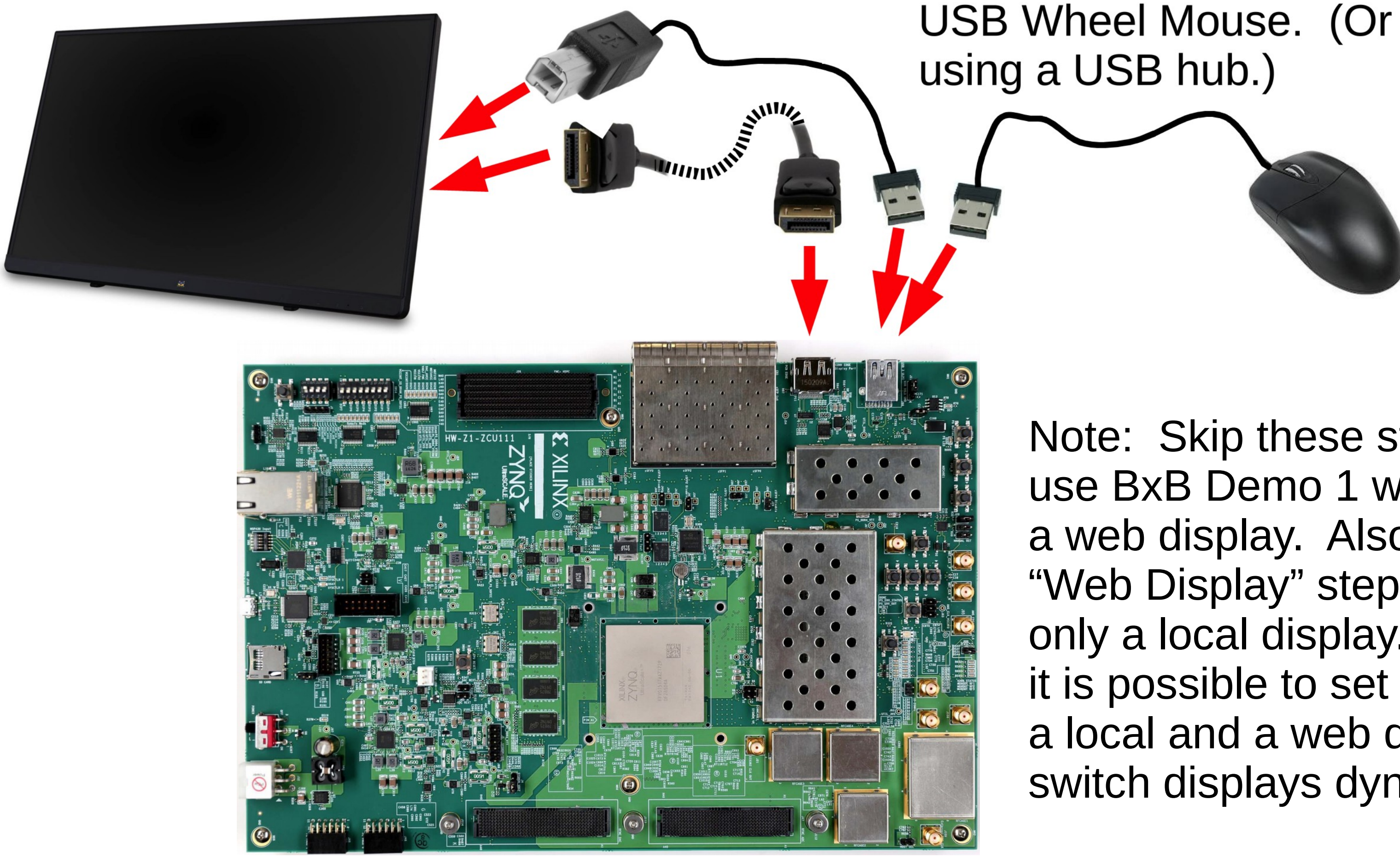
4. Attach an XM500 board to the ZCU111. Other analog boards will work, but their features may not fully match the software.



Recommended: Local Display

5. Attach a DisplayPort monitor to the ZCU111. A monitor supporting DisplayPort audio is best. Most monitors should work. Particularly recommended is a multipoint touchscreen monitor, such as the ViewSonic TD2230.

6. Attach the USB of your multipoint touchscreen monitor to the ZCU111 USB port. As a fallback, attach a USB Wheel Mouse. (Or attach both, using a USB hub.)

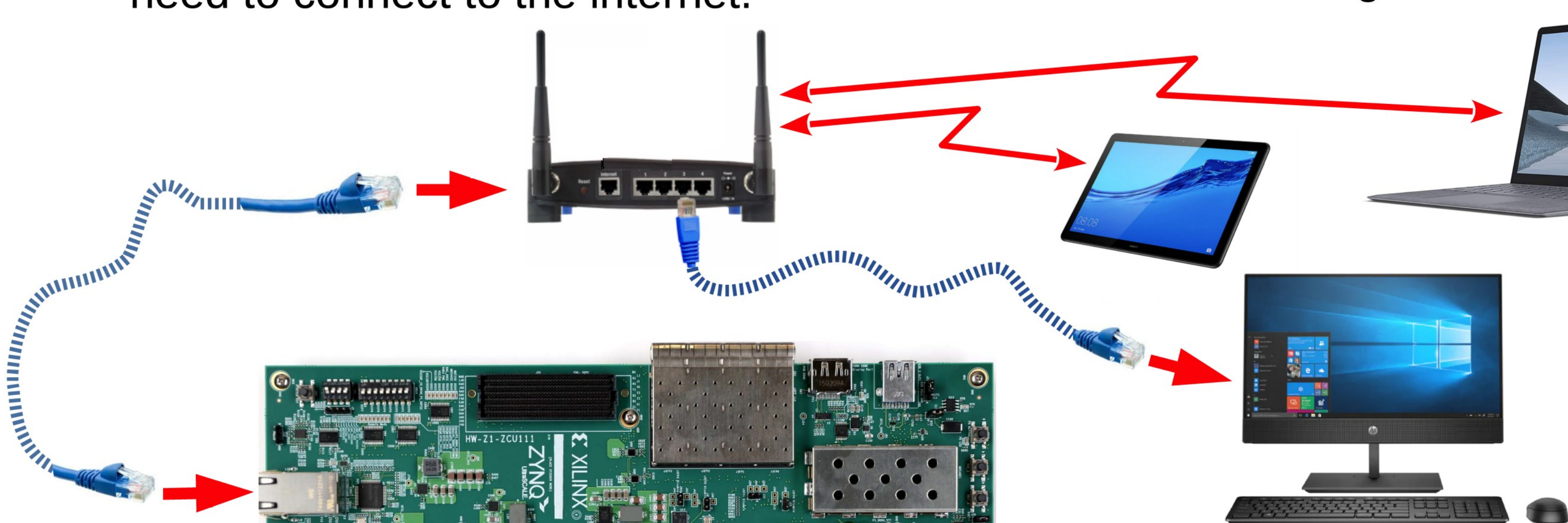


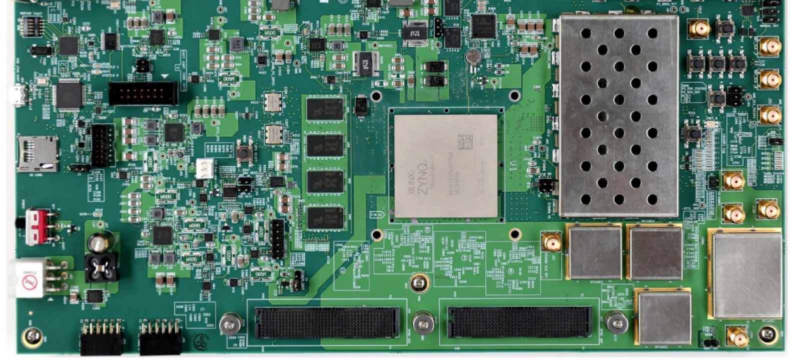
Note: Skip these steps to use BxB Demo 1 with only a web display. Also, skip the “Web Display” steps next for only a local display. If desired, it is possible to set up both a local and a web display, and switch displays dynamically.

Web Display

7. Use an ethernet cable to attach the ZCU111 to a router serving DHCP. The router may also be a WiFi Access Point. Note: the router may set up an isolated private network. It doesn't need to connect to the internet.

8. Connect a desktop computer, laptop, or tablet to the router to use as a display device. Devices connect to the ZCU111 using a web browser.



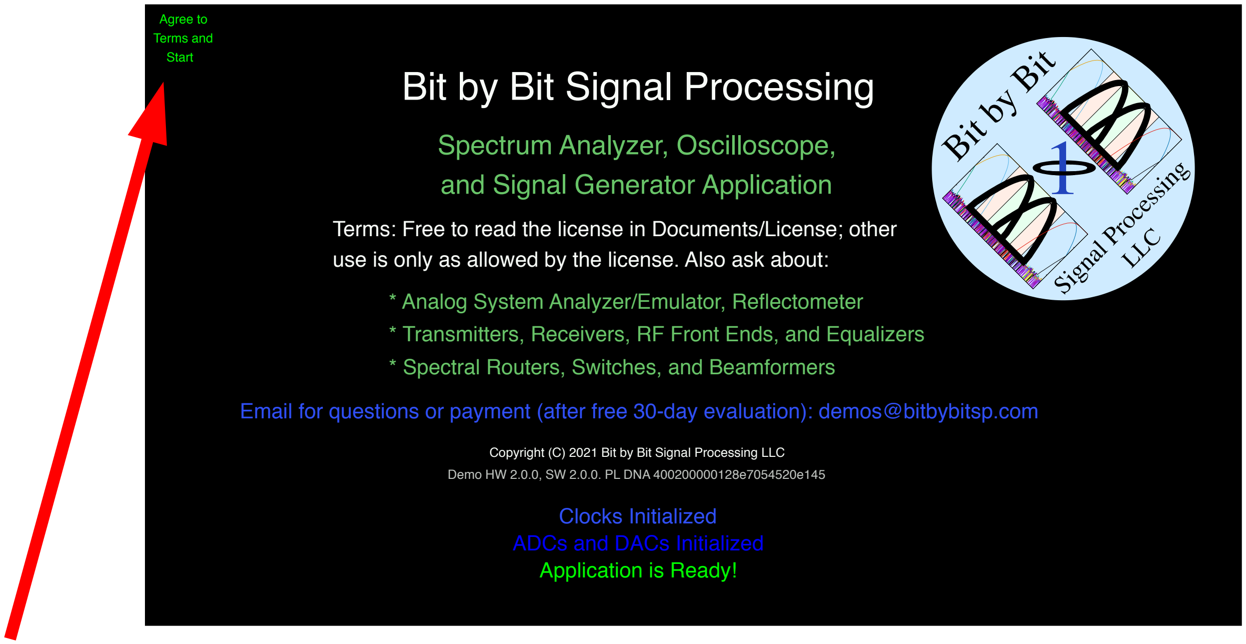


Ctrl-D on a Web Display will download a snapshot of the display.

For a web display, a browser must connect to BxB Demo 1 after it boots. BxB Demo 1 requests the hostname "rf", so "http://rf" may work. Alternately, check the DHCP server logs for the IP address and connect to the IP address.

BxB Demo 1 Startup

9. Turn everything on. Wait for it to boot. For a web display, also start a browser and connect it to the ZCU111 via HTTP. After some initialization steps, you should see the demo startup screen below.



BxB Demo 1 is now ready for use!

10. Press in the top left corner to agree to the license terms and go to the main menu. Read the license terms, but in a nutshell they are:

    1. BxB will be paid for the demo if it's used after the evaluation period.
    2. The user is responsible for using the demo safely and wisely, not BxB.

    Whenever you're not at the main menu, pressing in the top left corner will go to the main menu.

Examples

The following sections give examples of how to use BxB Demo 1

Example 1: BPSK generation and spectrum measurement.

Example 2: Sine generation and time measurement.

Example 3: Swept sine generation and time/frequency measurement.

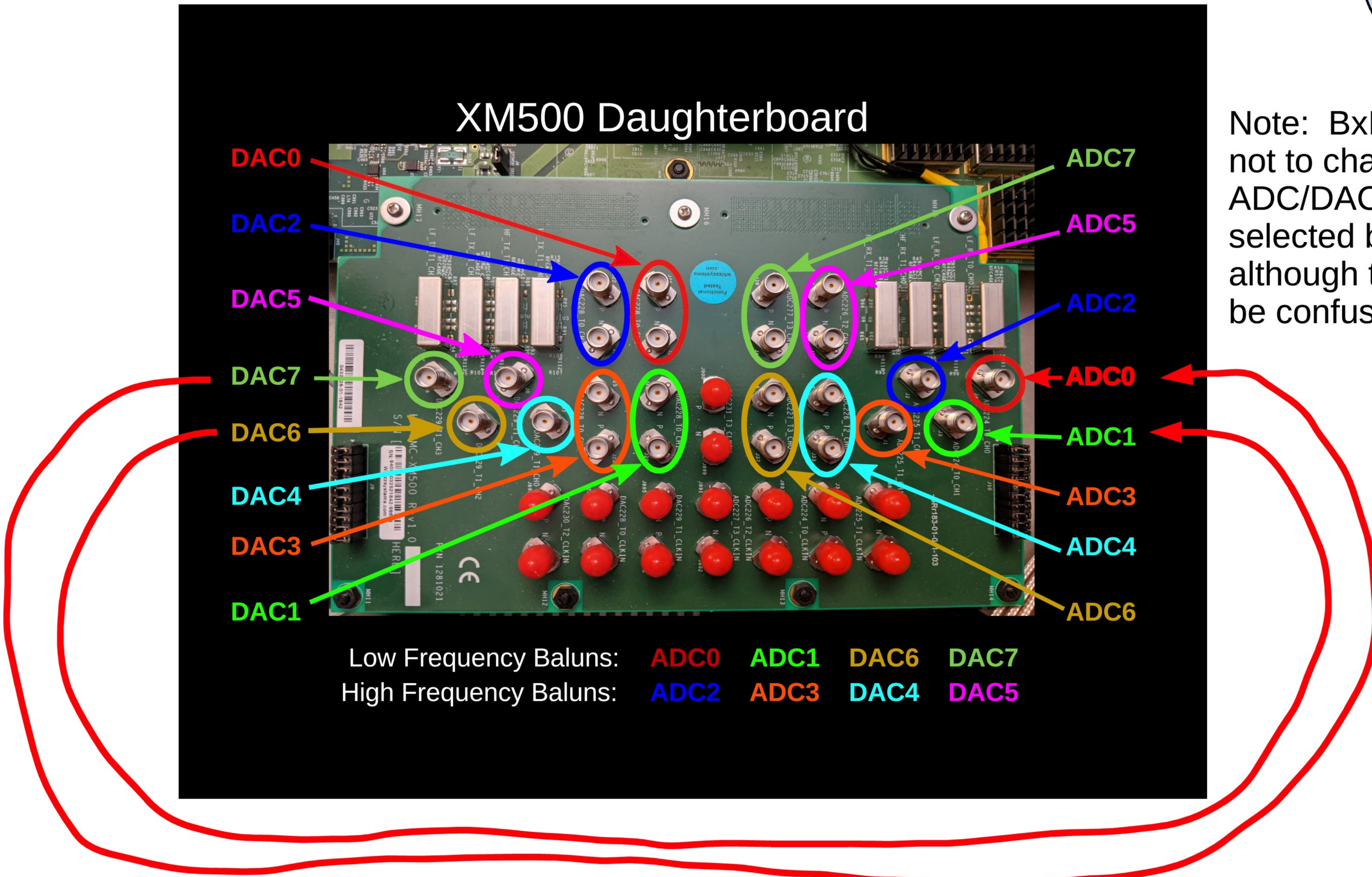
Example 4: White noise generation and cable delay measurement.

Example 5: Bandpass filter transfer function measurement.

Example 6: ADC Channel imbalance measurement.

Example 7: In-app documentation.

Loopbacks for Examples 1-3



Note: BxB chose not to change the ADC/DAC numbers selected by Xilinx, although they can be confusing.

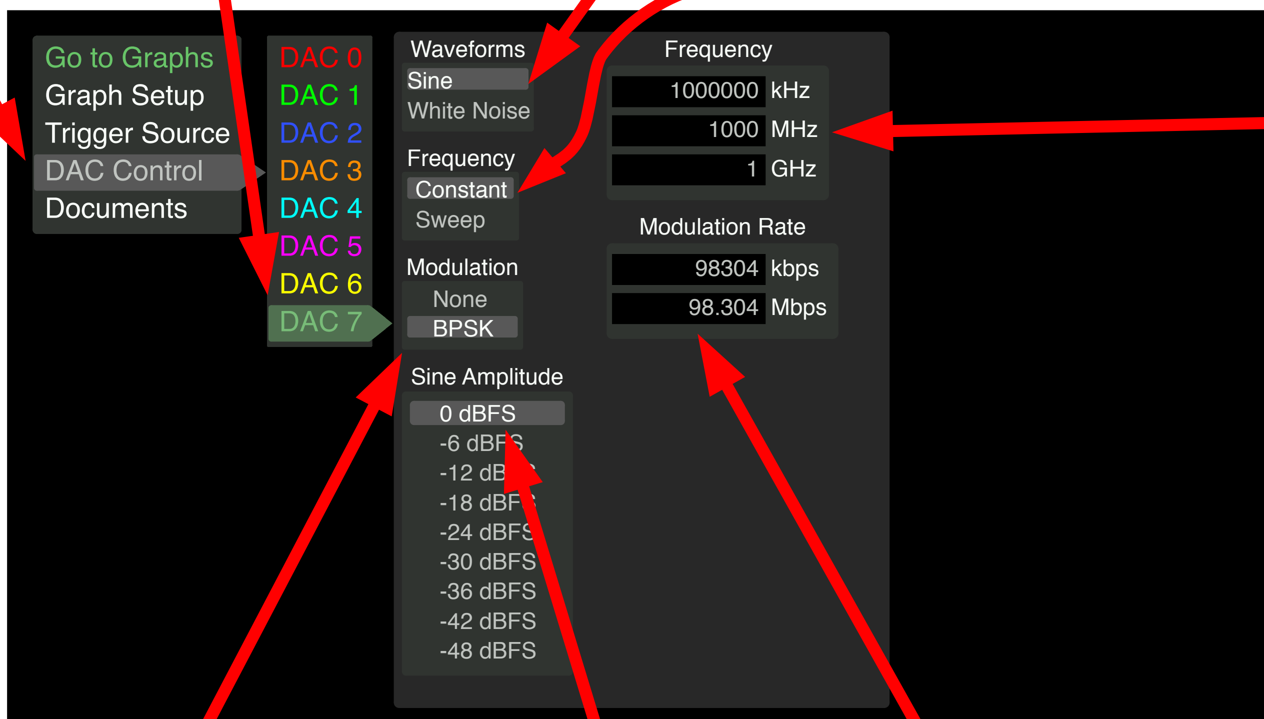
Examples 1-3 for BxB Demo 1 assume two loopbacks:

DAC7 → ADC0 and DAC6 → ADC1

Example 1, Step 1

This example shows how to generate and view a BPSK waveform. The first step is to set up the BPSK waveform on DAC 7. Go to the main menu by clicking in the upper left corner, then make these selections:

1. "DAC Control"
2. "DAC 7"
3. "Sine"
4. "Constant" Frequency
5. 1 GHz Center



6. "BPSK" Modulation
7. "0 dBFS" Amplitude
8. 100Mbps Modulation Rate. Demo shows nearest supported value.

Example 1, Step 2

The next step is to set up a Graph of ADC 0. Make these selections, in numerical order:

2. "New Graph"

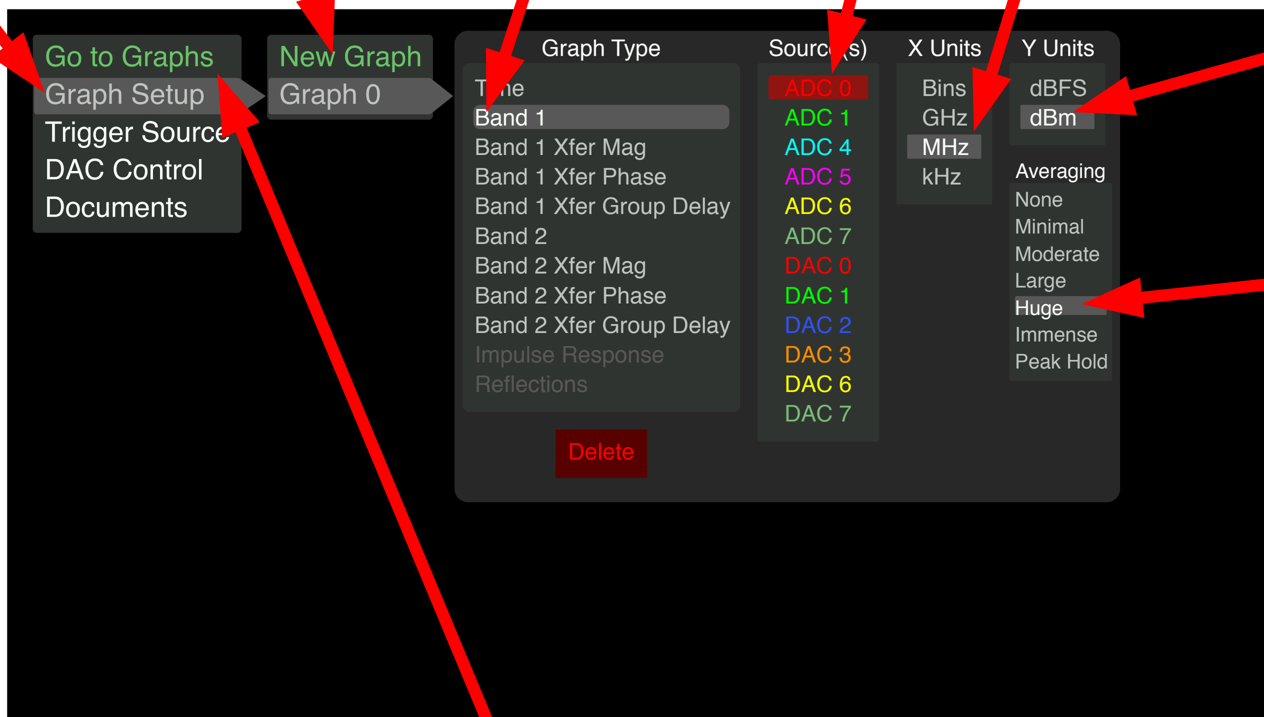
4. "ADC 0"

1. "Graph Setup"

3. "Band 1"

5. "MHz"

6. "dBm"



NOTE: Y Units are at the ADC inputs; they do not represent levels prior to the baluns.

7. "Huge". This waveform is steady, so averaging helps make it clearer.

8. "Go to Graphs"

Note: "Band 1" is the 1st Nyquist zone, 0.0MHz to 1966.08MHz

Example 1, Last Step

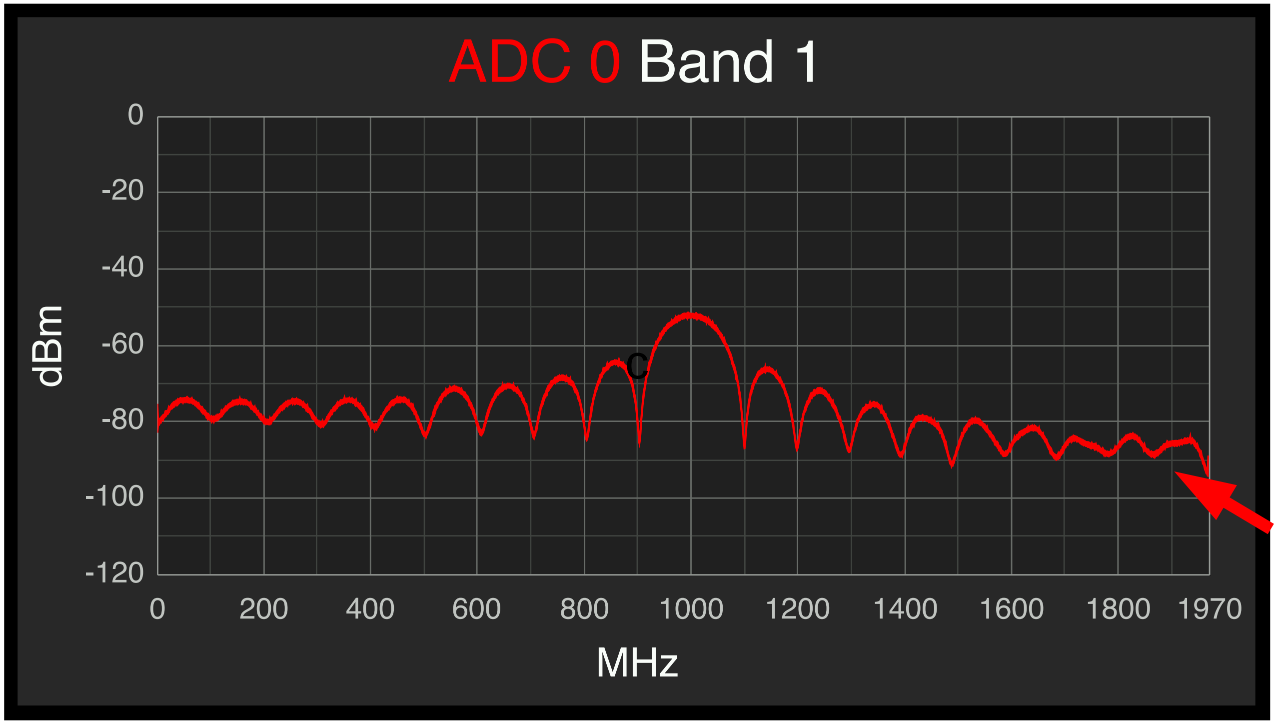
The previous steps will give a Graph of the spectrum of ADC 0, as shown below. The graph can be adjusted to see desired features by zooming and panning.

Touchscreen controls:

Two fingers Horizontally:	Zoom/pan X
Two fingers Vertically:	Zoom/pan Y
Two fingers Diagonally:	Zoom/pan X & Y

Mouse controls:

Middle Mouse hold & move:	pan X & Y
Wheel on graph near X Axis:	Zoom X
Wheel on graph near Y axis:	Zoom Y



Touch gestures with one finger or three fingers are reserved for later expansions.

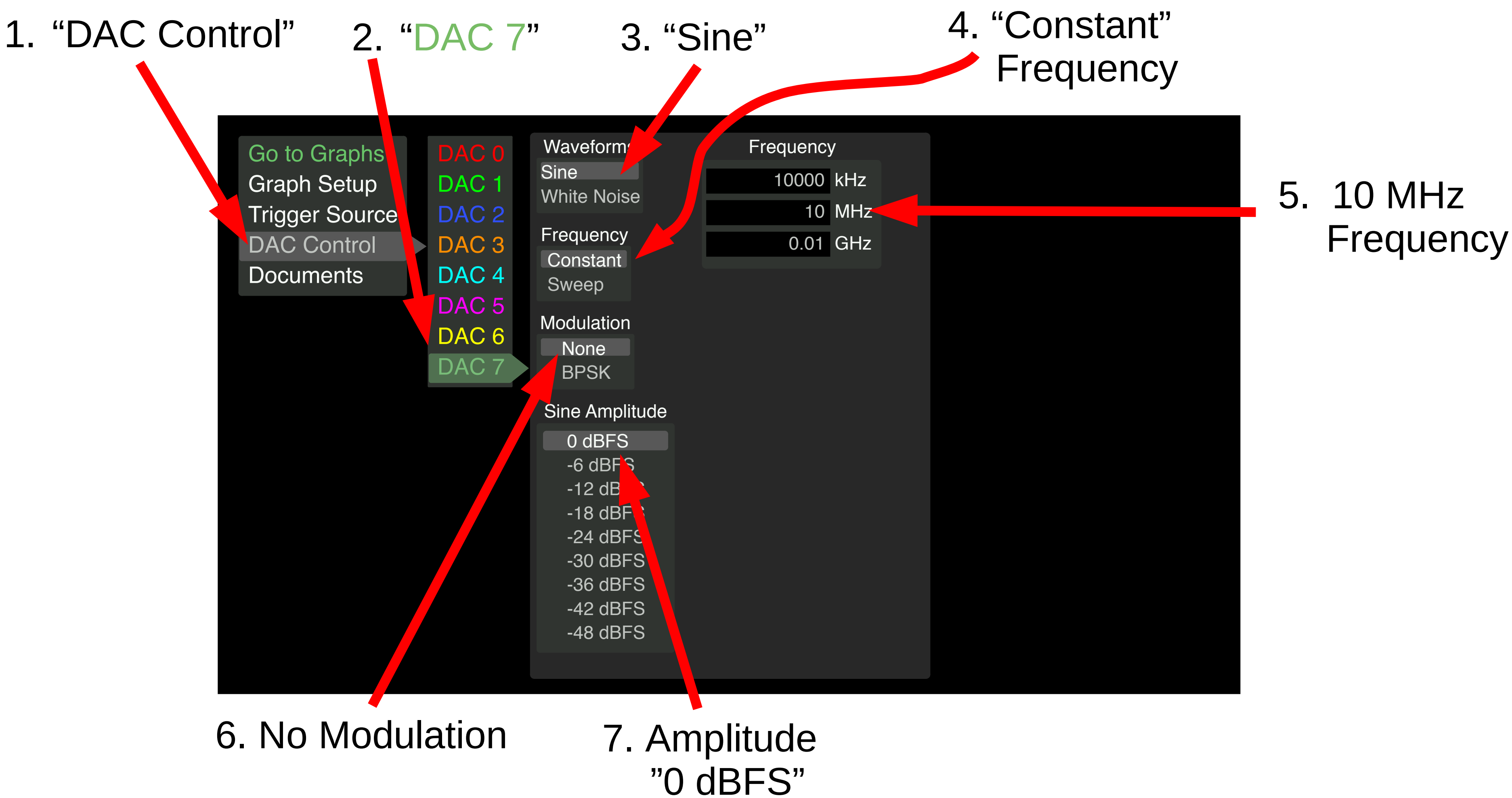
Mouse gestures with left or right mouse buttons are reserved for later expansions.

Note: waveform corruption at top frequencies is due to "folding" down of energy from 2nd Nyquist. To fix, use a lowpass filter to cut off high frequencies.

If you do not see this waveform, check previous steps. Also, check that the loopback cable is in place from DAC 7 to ADC 0.

Example 2, Step 1

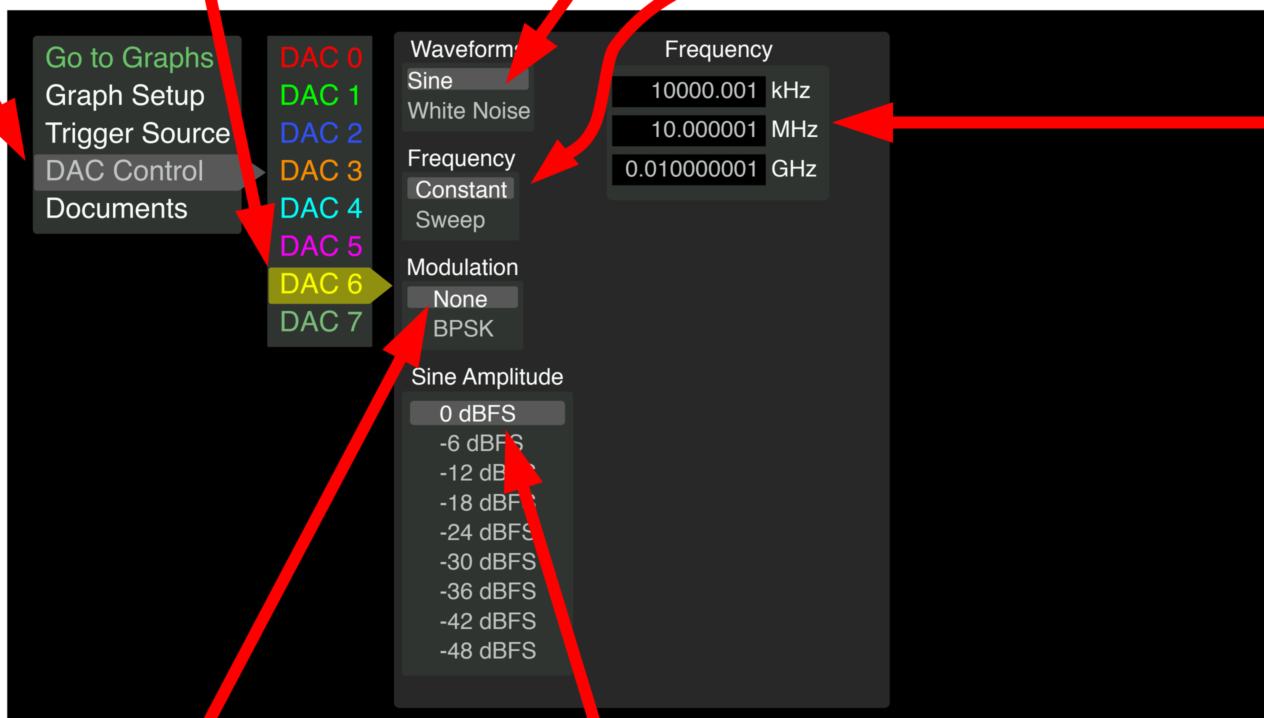
This example shows how to display time waveforms. The first step is to set up a sine wave on DAC 7. Go to the main menu by clicking in the upper left corner, then make these selections:



Example 2, Step 2

The second step is to set up a sine wave on DAC 6. Make these selections:

1. "DAC Control"
2. "DAC 6"
3. "Sine"
4. "Constant" Frequency
5. 10.000001 MHz Frequency. This is 1 Hz more than on DAC 7.

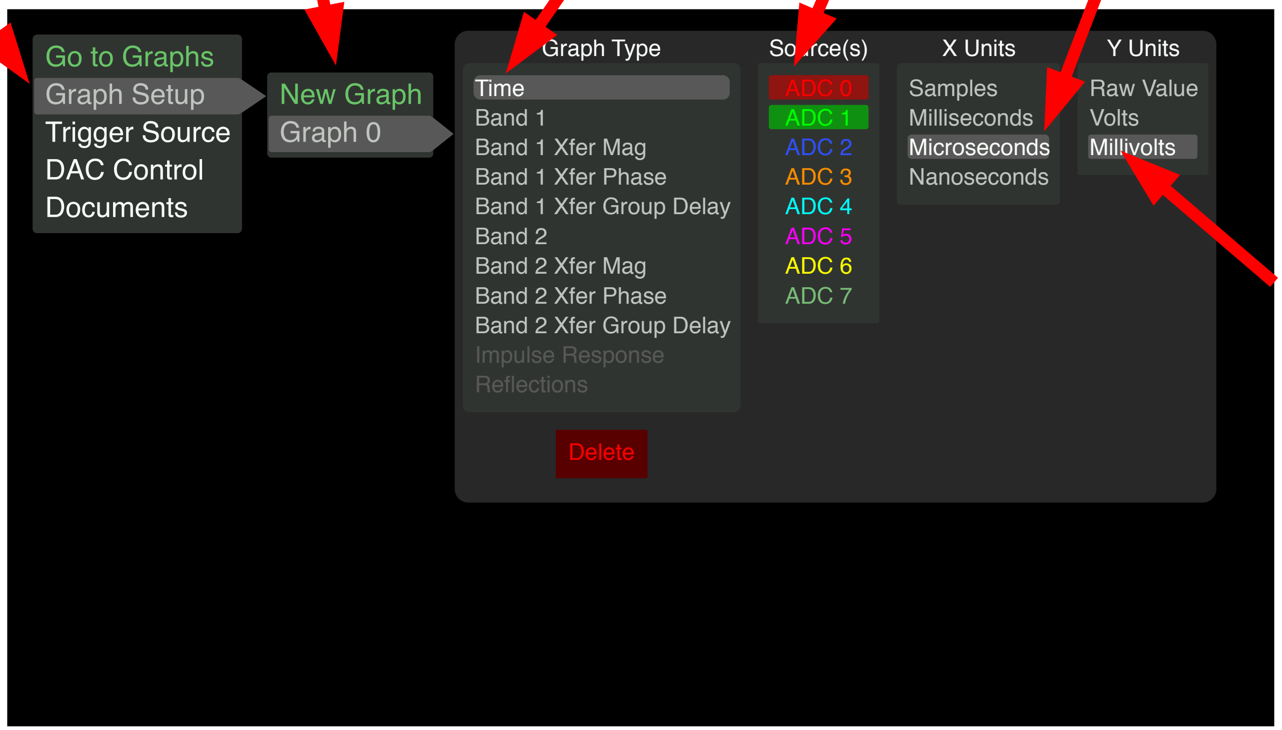


6. No Modulation
7. Amplitude "0 dBFS"

Example 2, Step 3

This step sets up a time display of ADC 0 and ADC 1. Make these selections:

1. "Graph Setup"
2. Select "Graph 0" if it already exists, or "New Graph"
3. "Time"
4. "ADC 0" and "ADC 1"
5. "Microseconds"
6. "Millivolts"

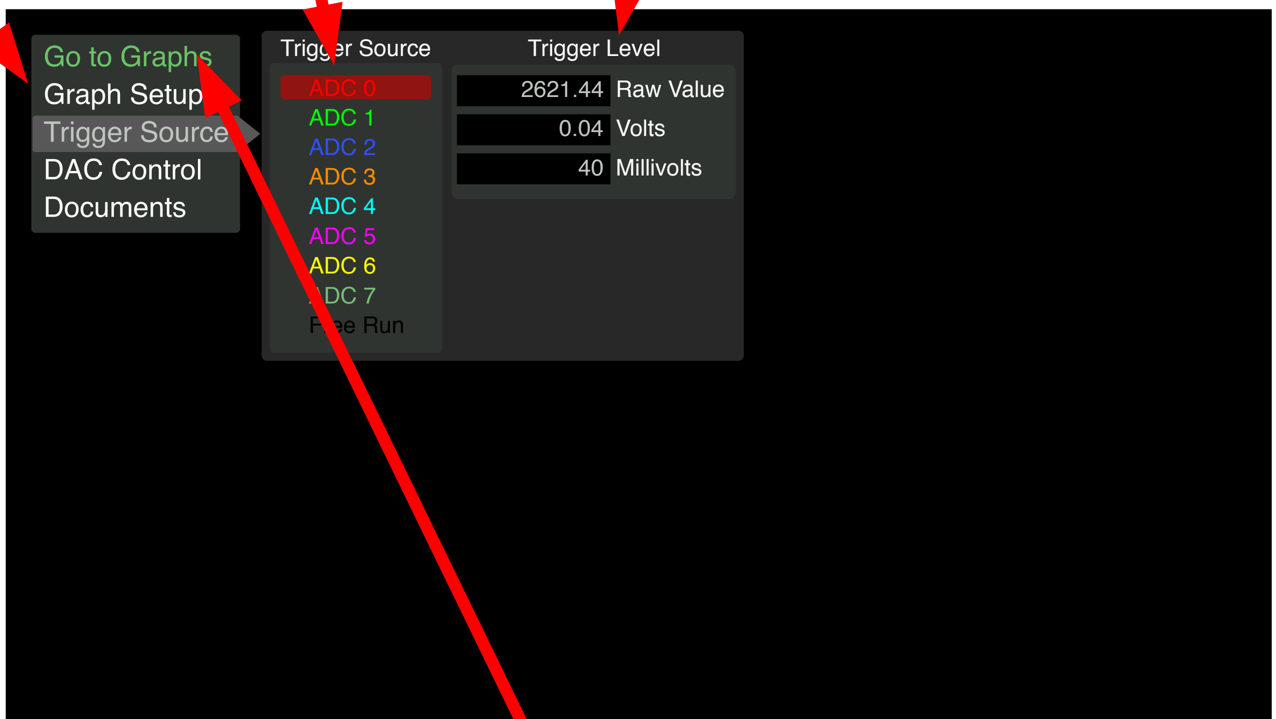


NOTE: Y Units are at the ADC inputs; they do not represent levels prior to the baluns.

Example 2, Step 4

This step sets up a trigger on ADC 0. Make these selections:

1. “Trigger Source”
2. “ADC 0”
3. “Trigger Level” of 40.0 mV

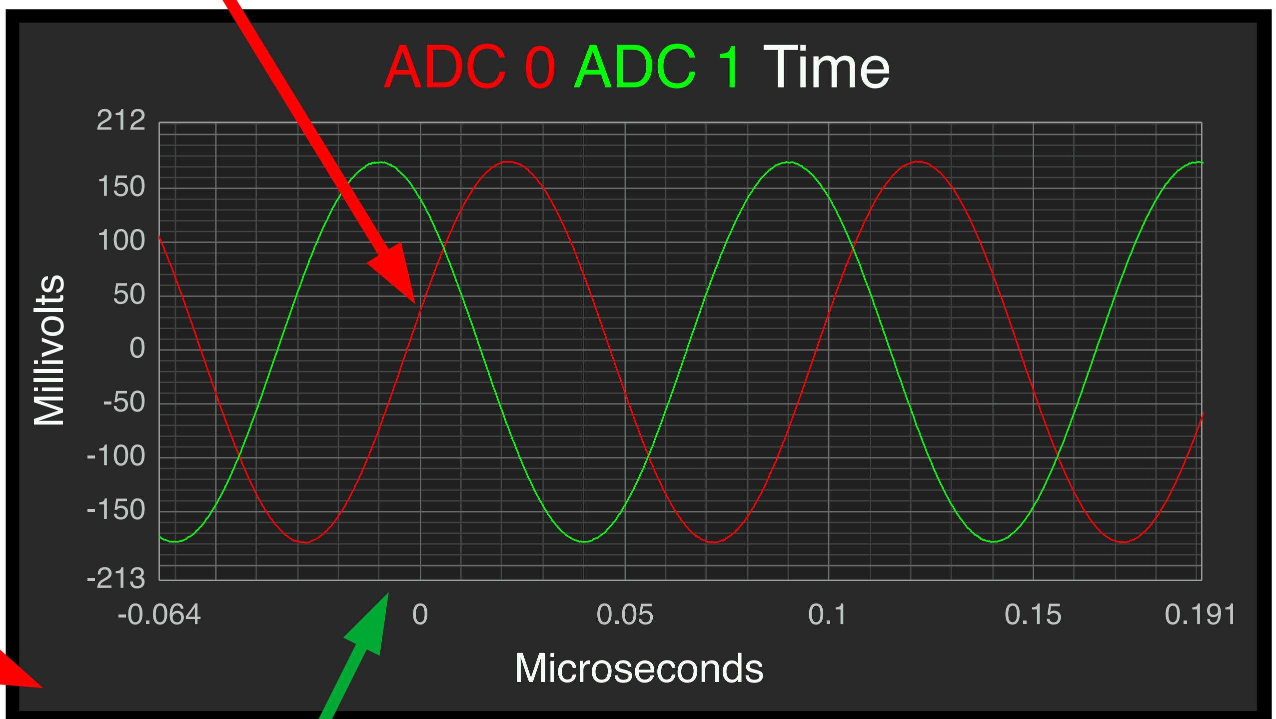


4. “Go to Graphs”

Example 2, Last Step

The ADC 0 waveform from DAC 7 is captured as it passes the trigger level (set to 40.0 mV). Data before and after the trigger point is collected. Zero on the time axis is the time of the triggering event.

Pressing in the lower left corner will pause the graphs.



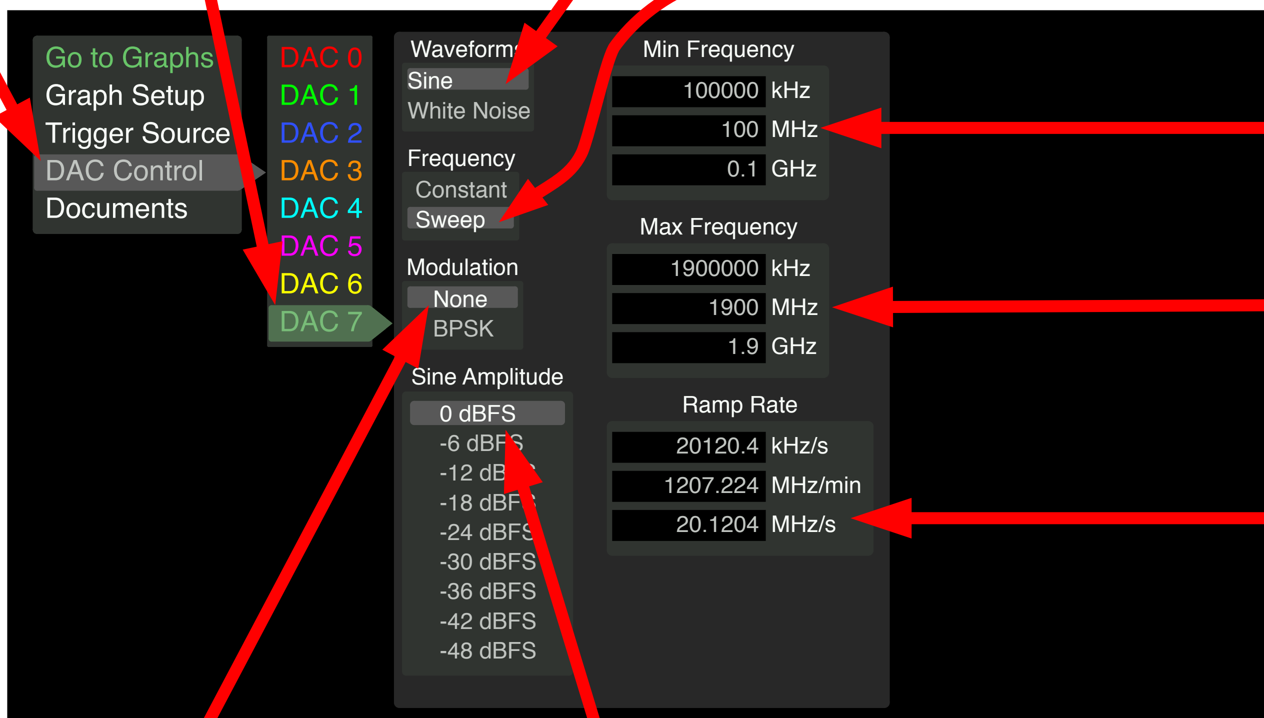
Significantly more data is collected than is shown. To see the rest, zoom out – as described in Example 1.

The ADC 1 sine wave from DAC 6 is 1Hz higher in frequency than the ADC 0 sine wave from DAC 7. Thus it continually slides past the ADC 0 sine wave at a 1Hz rate.

Example 3, Step 1

This example shows how to display useful time and frequency waveforms simultaneously. The first step is to set up a sine wave on DAC 7. Go to the main menu by clicking in the upper left corner, then make these selections:

1. “DAC Control”
2. “DAC 7”
3. “Sine”
4. “Sweep” Frequency



5. “Min Frequency” 100MHz
6. “Max Frequency” 1900MHz
7. “Ramp Rate” 20MHz/second. (The nearest supported value is displayed.)
8. No Modulation
9. “0 dBFS” Amplitude

Example 3, Step 2

The next step is to set up a Frequency Graph of ADC 0. Make these selections:

1. "Graph Setup"

2. Select "Graph 0" if it already exists, or "New Graph"

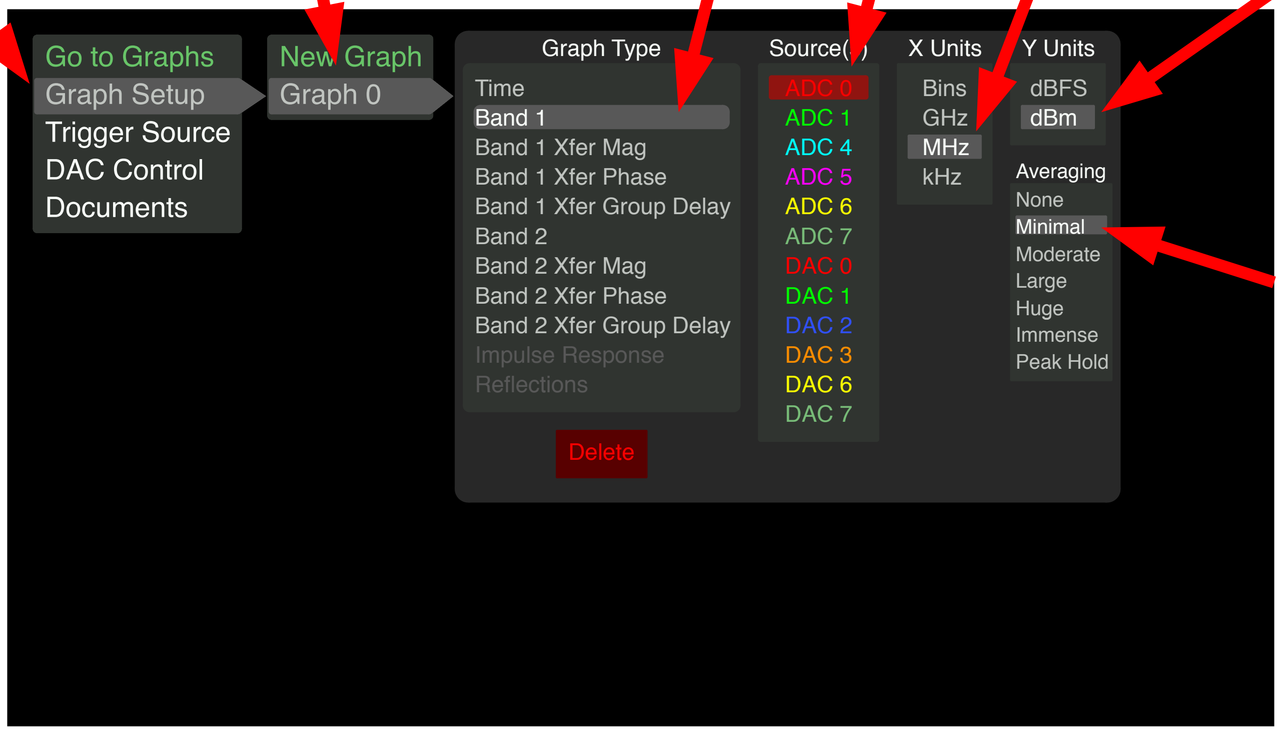
3. "Band 1"

4. "ADC 0"

5. "MHz"

6. "dBm"

7. "Minimal". This waveform is time-varying, so large values of averaging will distort it.



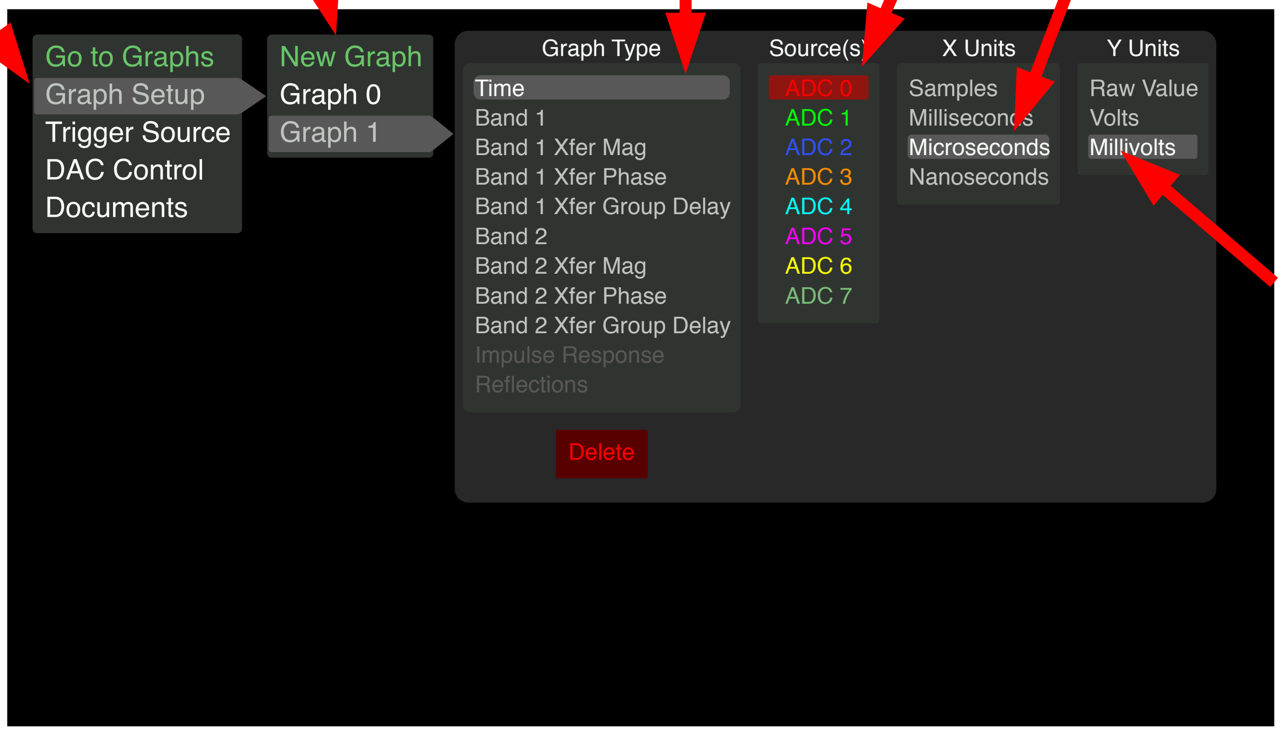
NOTE: Y Units are at the ADC inputs; they do not represent levels prior to the baluns.

"Band 1" is the 1st Nyquist zone, 0.0MHz to 1966.08MHz

Example 3, Step 3

This step sets up a Time Graph of ADC 0. Make these selections:

1. “Graph Setup”
2. Select “Graph 1” if it already exists, or “New Graph”
3. “Time”
4. “ADC 0”
5. “Microseconds”
6. “Millivolts”

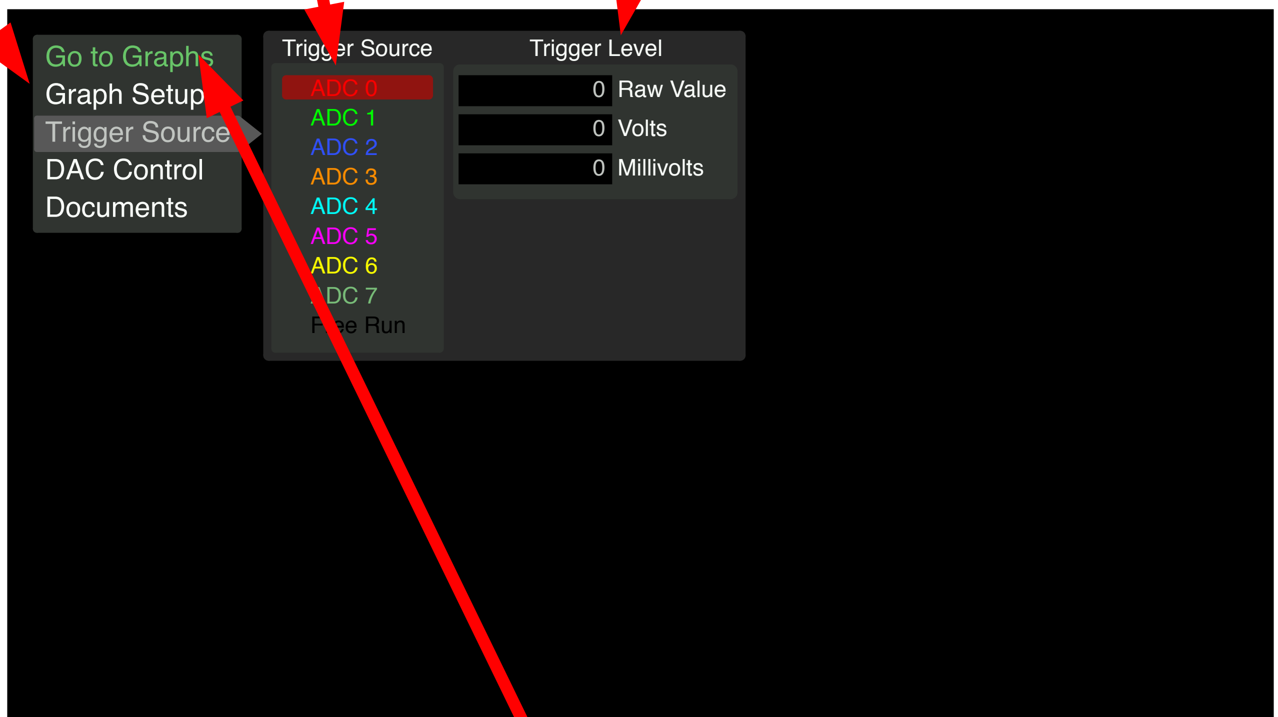


NOTE: Y Units are at the ADC inputs; they do not represent levels prior to the baluns.

Example 3, Step 4

This step sets up a trigger on ADC 0. Go to the main menu by clicking in the upper left corner, then make these selections:

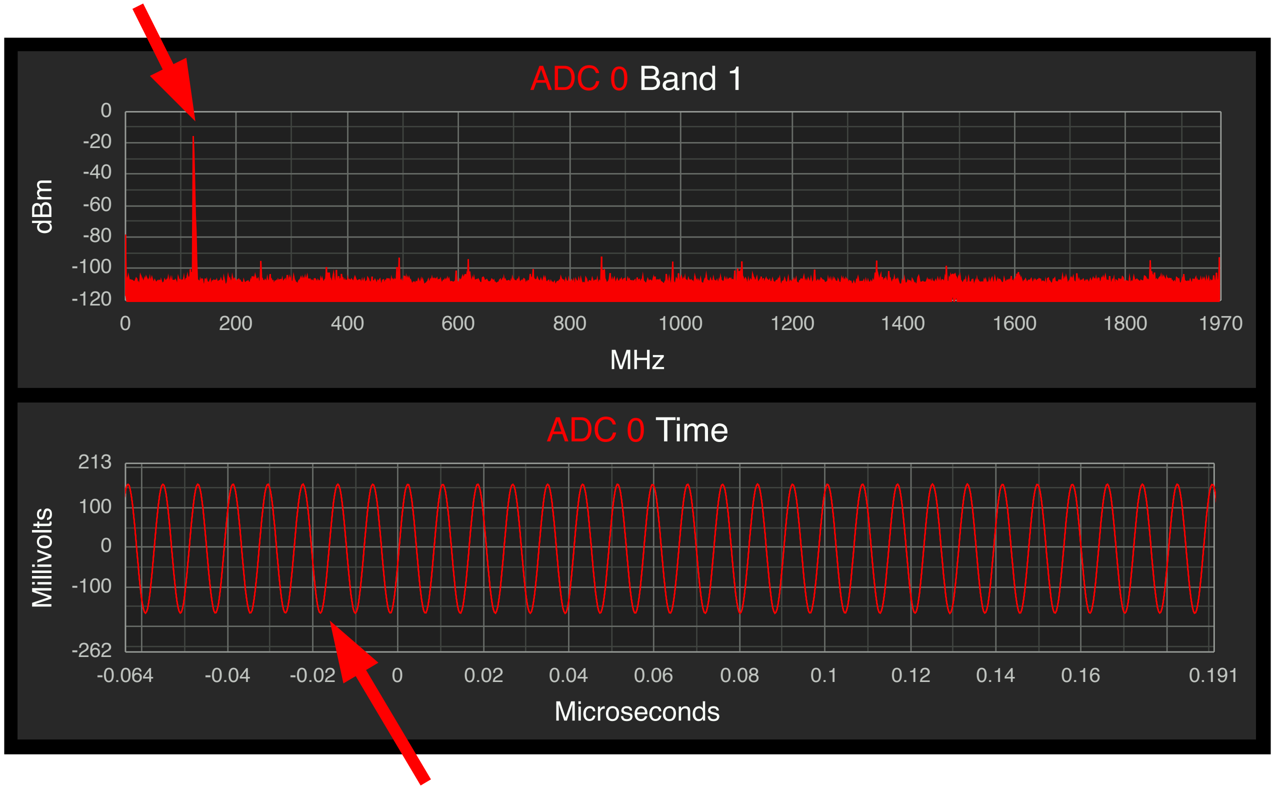
1. “Trigger Source”
2. “ADC 0”
3. “Trigger Level” of 0.0 mV



4. “Go to Graphs”

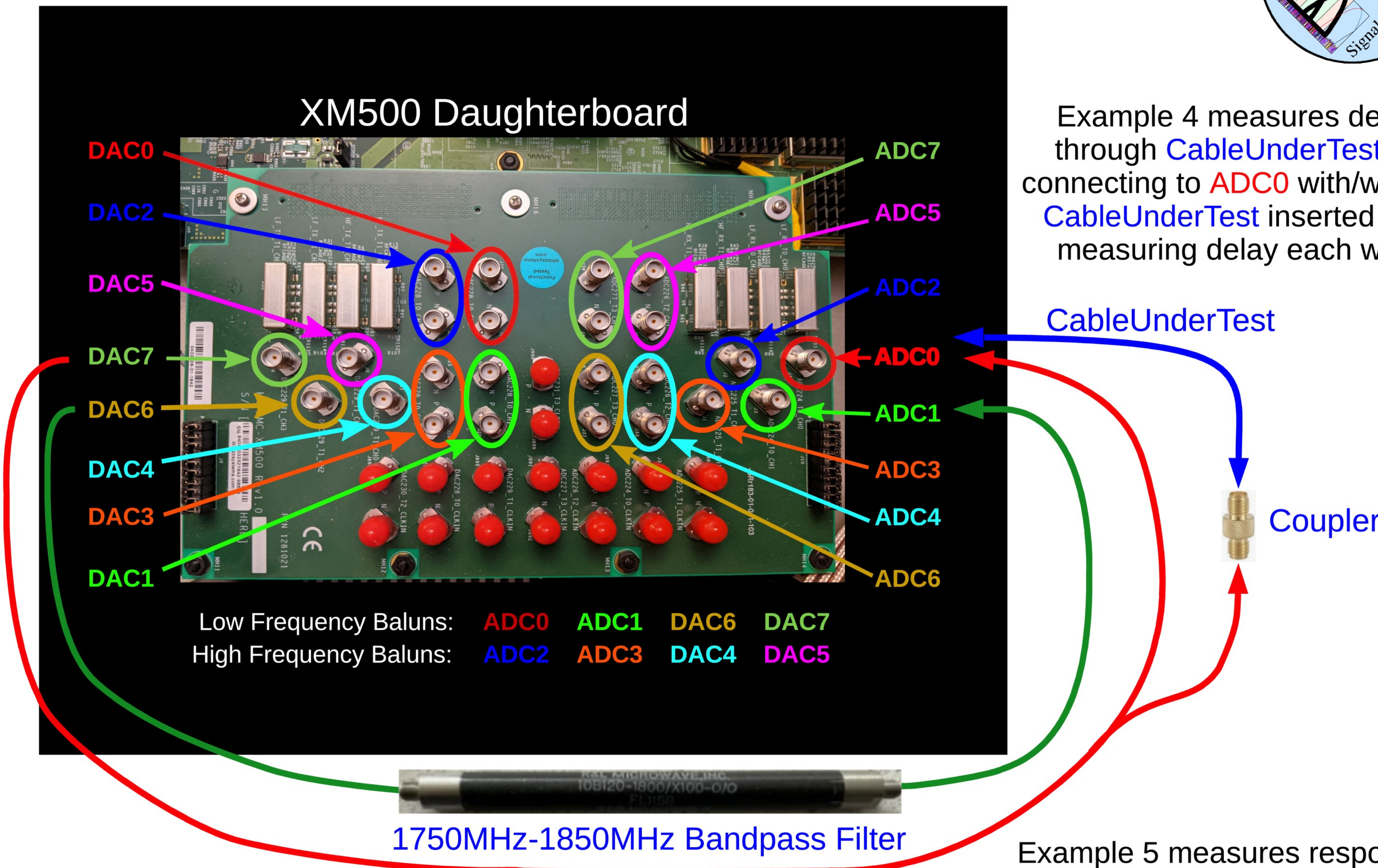
Example 3, Last Step

The swept sine waveform from DAC 7 is seen on ADC 0. Its spectrum is a single peak, with various forms of interference. Some spikes are ADC artifacts that are independent of the signal. More are from harmonics of the input sine wave or mixer products between the input sine wave and ADC/DAC sampling frequencies. The error source can often be identified by how each peak moves as the input sine wave changes frequency. The ADC noise floor is also seen.



The ADC 0 time waveform expands in and out like an accordion about its trigger point. This is especially visible at low frequencies. At higher frequencies, Moiré patterns between the input sine frequency and the sampling frequency can be seen.

Loopbacks for Examples 4 & 5



Example 4 measures delay through CableUnderTest by connecting to ADC0 with/without CableUnderTest inserted and measuring delay each way.

Example 5 measures response of a Bandpass Filter.

Example 4, Step 1

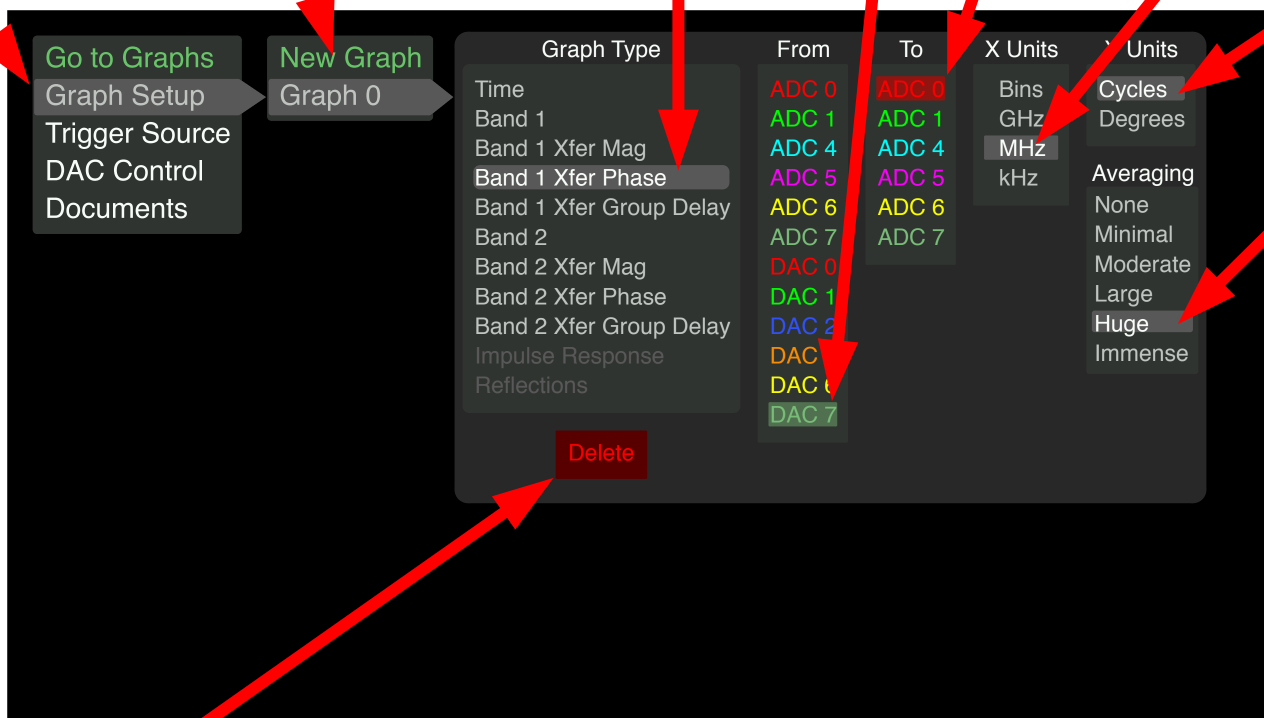
This example shows how to generate white noise and measure cable delays. The first step is to set up white noise on DAC 7. Go to the main menu by clicking in the upper left corner, then make these selections:

1. “DAC Control” 2. “DAC 7” 3. “White Noise” 4. “+3dBFS Max Amp”

Example 4, Step 2

The next step is to set up a Transfer Function Phase Graph from DAC 7 to ADC 0. Make these selections in numerical order:

1. “Graph Setup”
2. If there are existing graphs, delete them by pressing “Delete” repeatedly.
3. Select “New Graph”
4. “Band 1 Xfer Phase”
5. From “DAC 7”
6. To “ADC 0”
7. “MHz”
8. “Cycles”
9. “Huge”. A balance between the most accurate reading and convergence time.

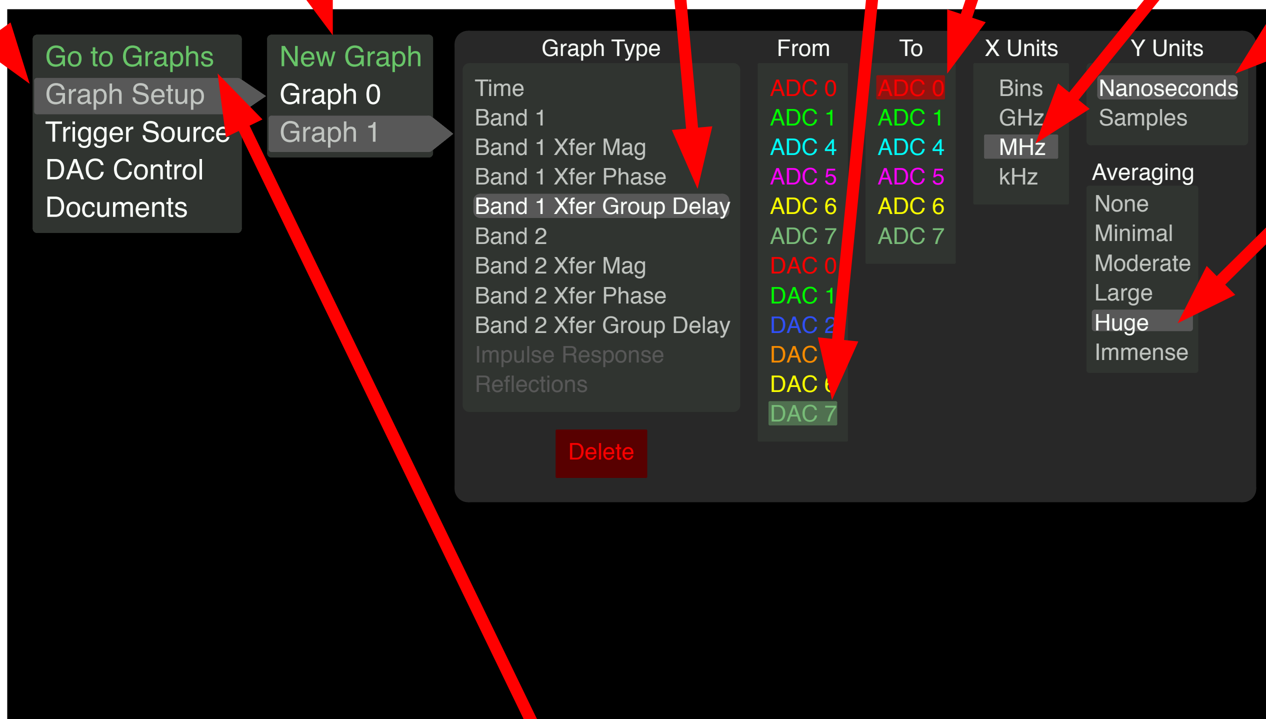


“Band 1” is the 1st Nyquist zone, 0.0MHz to 1966.08MHz

Example 4, Step 3

The next step is to set up a Transfer Function Group Delay Graph from DAC 7 to ADC 0. Make these selections in numerical order:

1. “Graph Setup”
2. Select “New Graph”
3. “Band 1 Xfer Group Delay”
4. From “DAC 7”
5. To “ADC 0”
6. “MHz”
7. “Nanoseconds”
8. “Huge”. A balance between the most accurate reading and convergence time.

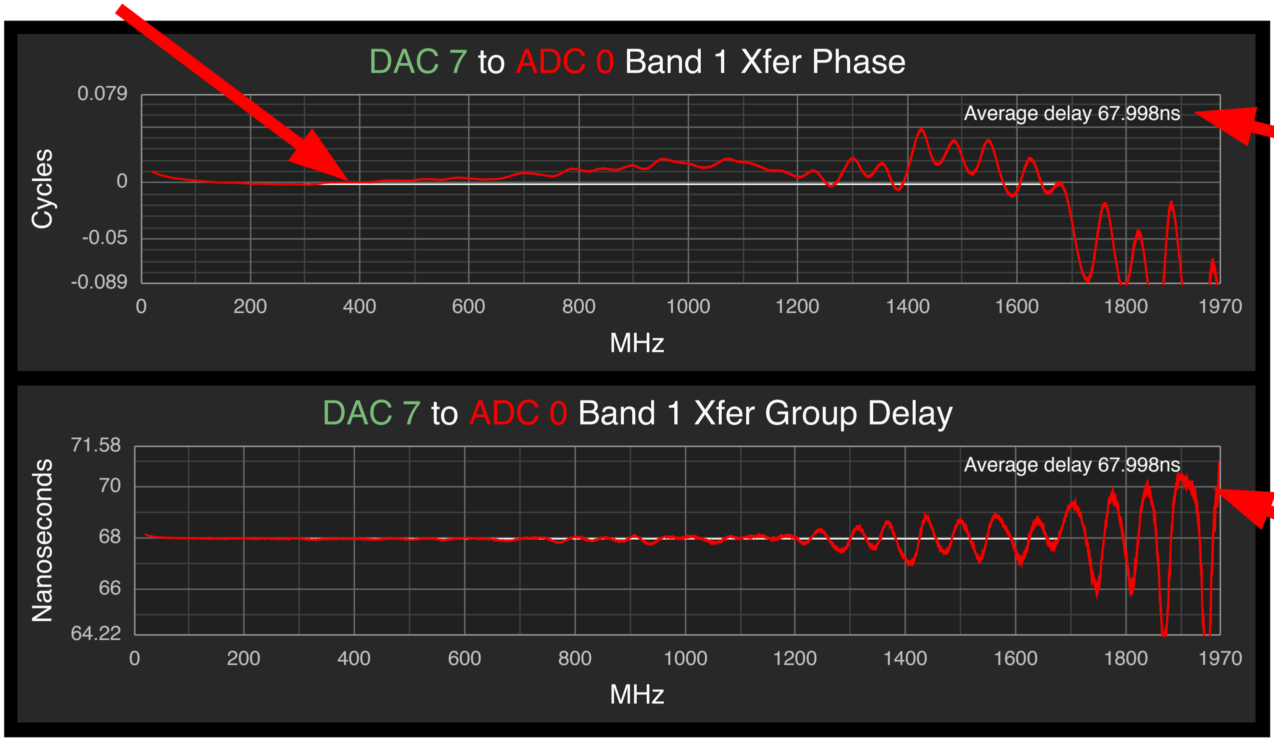


9. “Go to Graphs”

Example 4, Step 4

The previous steps will give graphs of the phase and group delay from DAC 7 to ADC 0. This measurement is without the CableUnderTest inserted, and it is repeated in Step 5 with the CableUnderTest inserted.

The white line shows the x-axis extent of the group delay measurement. The measurement is displayed in the top right; this matches the time shown on the y-axis of the Group Delay plot. For best measurements, zoom in on the y axis, then zoom and position the x-axis so that the measurement is in a large region of relative flatness..



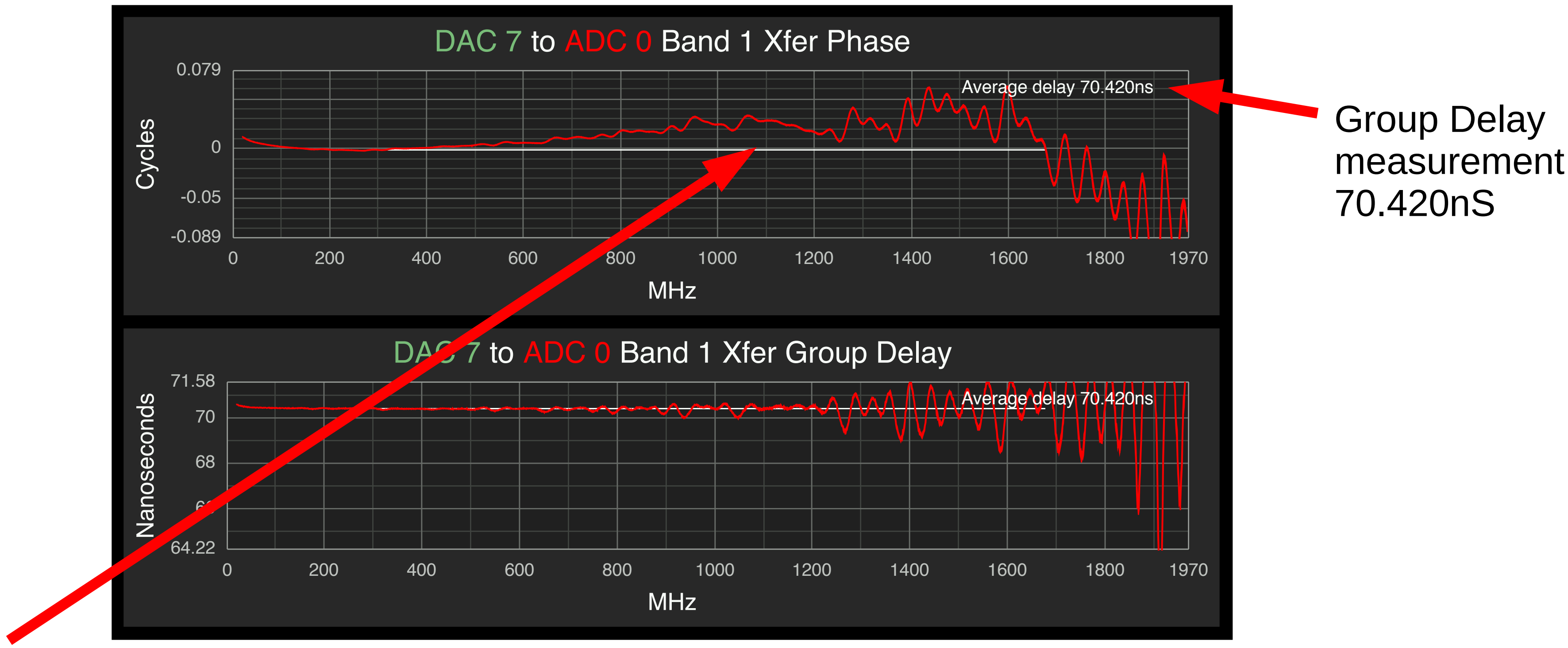
Group Delay measurement 67.998nS

A small Loss of linearity at high frequencies is due to multiple effects, such as “folding” of energy from 2nd Nyquist and uncorrected reflections in the cables. 2nd Nyquist issues can be eliminated by adding a lowpass filter to DAC output in the test setup.

Example 4, Step 5

Step 4 is repeated with CableUnderTest inserted, to measure the increased delay caused by CableUnderTest and the additional required Coupler.

If the connections are changed, the measurements converge faster if you enter the main menu and exit again. This engages an algorithm that speeds convergence. This may make for a faster second measurement after CableUnderTest is inserted.

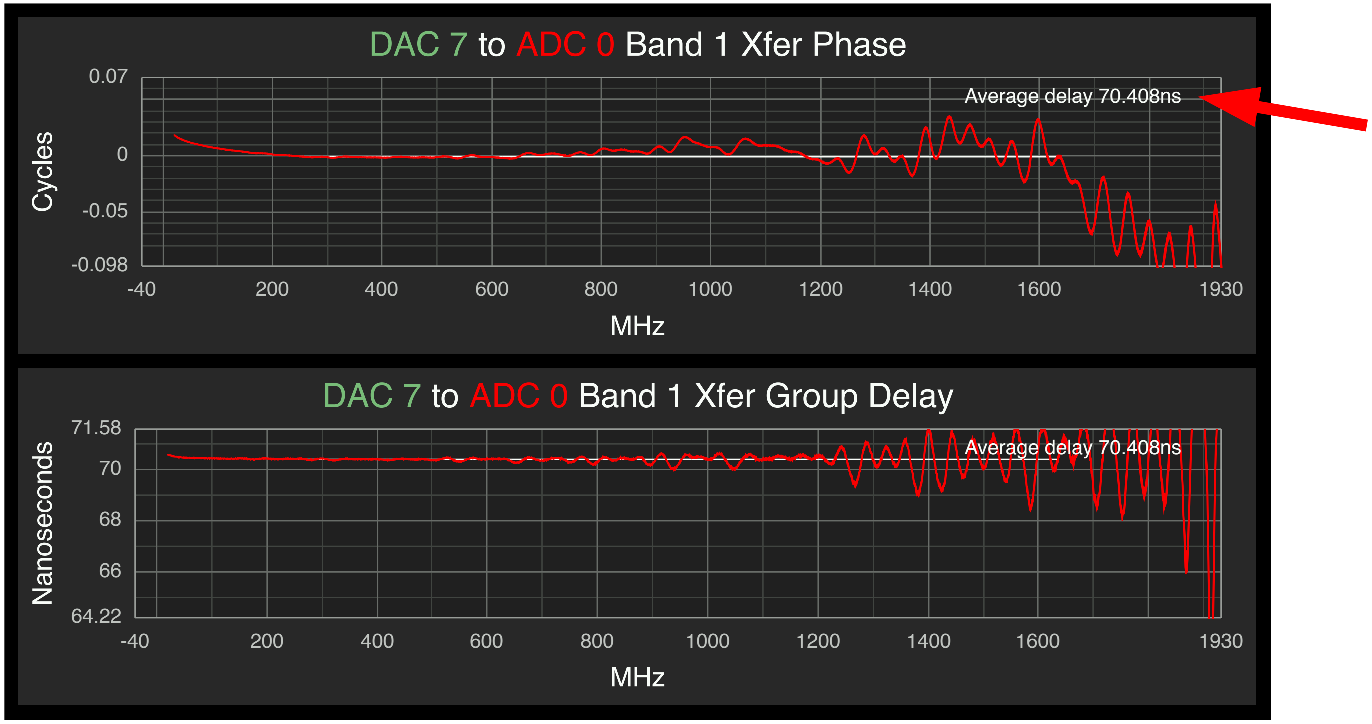


Note that on the Phase plot, the white measurement line diverges from the measured phase at the lower frequencies where the measurement is most accurate. To get a better measurement, move the graph to the right, so the measurement line is better positioned.

Example 4, Last Step

After adjusting the graph position, the white line more closely matches the phase plot. This gives a more accurate measurement.

Note that these plots are also capable of showing deviations from linear phase that may indicate issues with cables or connectors.



Group Delay measurement 70.408nS

The measurement with CableUnderTest + Coupler is 70.408nS, and the measurement without them is 67.998nS (from Step 4). So this particular cable and coupler together have a delay of 70.408nS – 67.998nS = 2.41nS.

Example 5, Step 1

This example measures the magnitude, phase linearity, and group delay of a bandpass filter. The first step is to set up white noise on DAC6. Make the required cable connections for Example 5 that were shown on an earlier slide. Then go to the main menu and make these selections:

1. "DAC Control" 2. "DAC6" 3. "White Noise" 4. "+3dBFS Max Amp"

Example 5, Step 2

The next step is to set up a graph of the spectrum of ADC 1 and DAC 6 .
Make these selections in numerical order:

1. “Graph Setup”

3. Select “New Graph”

4. “Band 1”

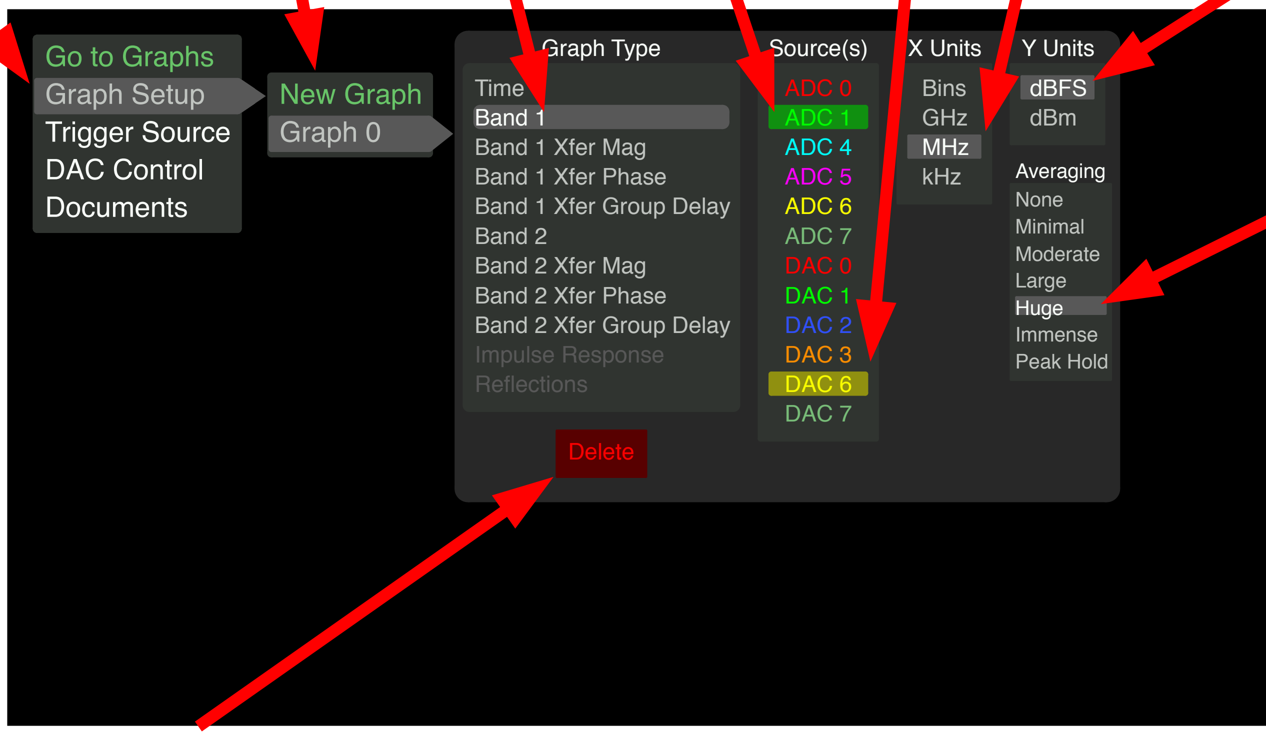
5. “ADC 1”

6. “DAC 6”

7. “MHz”

8. “dBFS”

9. “Huge”.
A balance between the most accurate reading and convergence time.

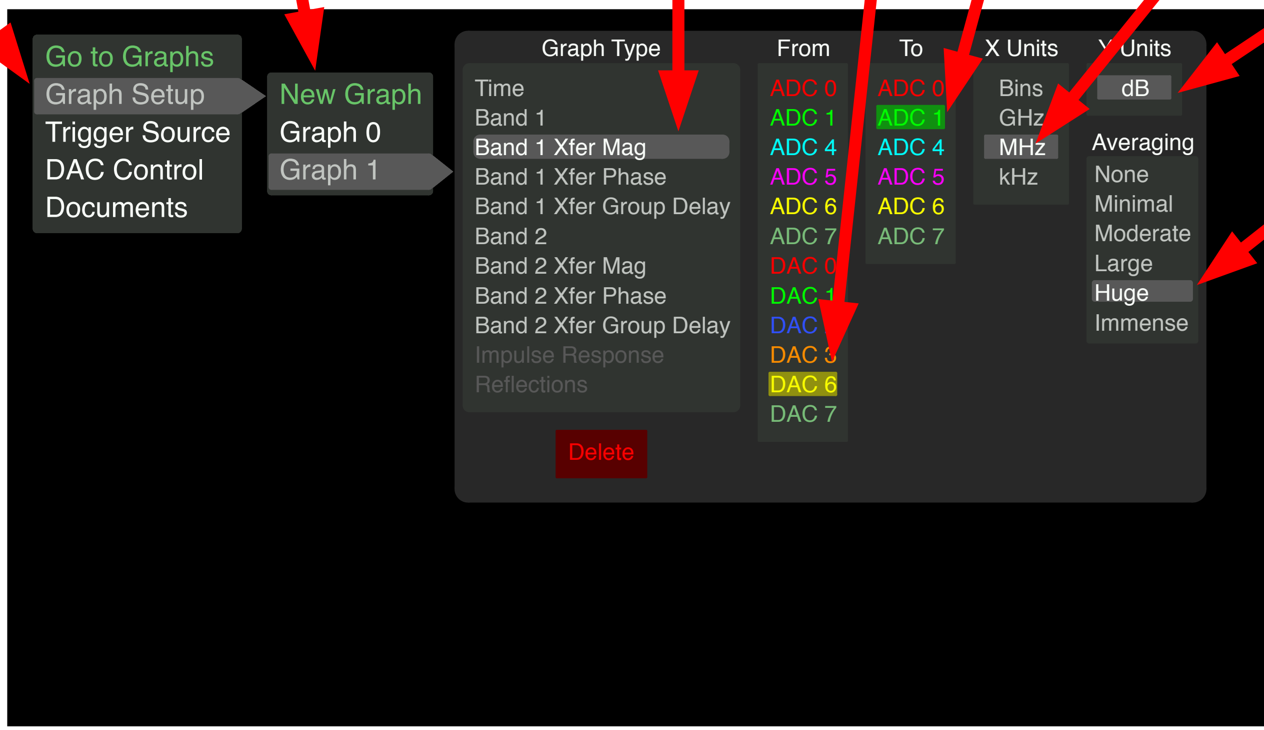


2. If there are existing graphs, delete them by pressing “Delete” repeatedly.

Example 5, Step 3

The next step is to set up a Transfer Function Magnitude Graph from DAC 6 to ADC 1. Make these selections in numerical order:

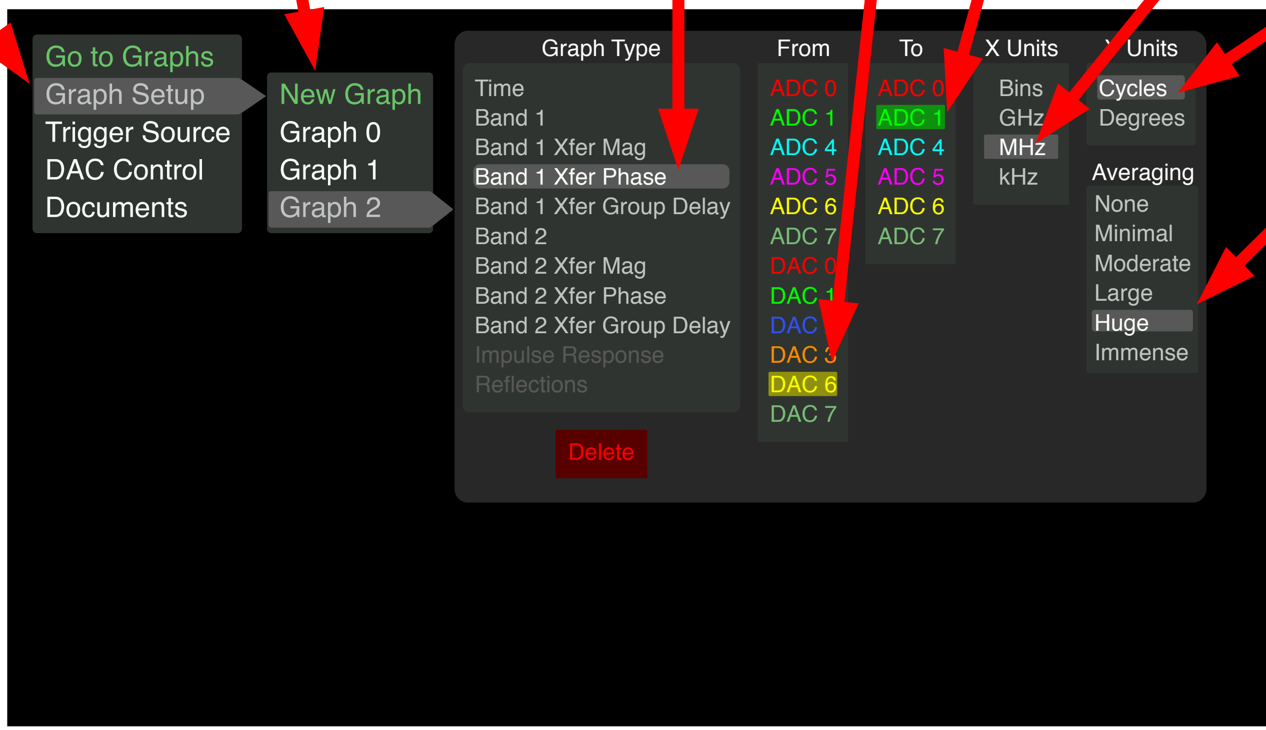
1. “Graph Setup”
2. Select “New Graph”
3. “Band 1 Xfer Mag”
4. From “DAC 6”
5. To “ADC 1”
6. “MHz”
7. “dB”
8. “Huge”.
A balance between the most accurate reading and convergence time.



Example 5, Step 4

The next step is to set up a Transfer Function Phase Graph from DAC 6 to ADC 1. Make these selections in numerical order:

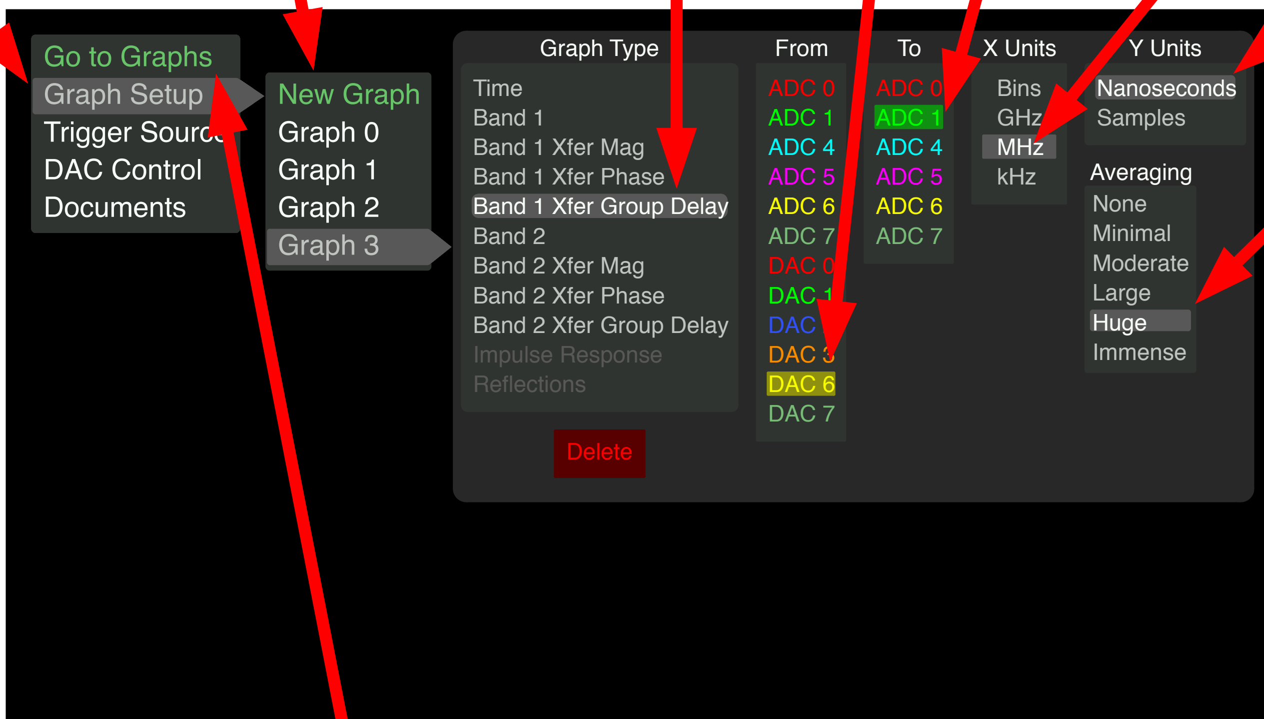
1. “Graph Setup”
2. Select “New Graph”
3. “Band 1 Xfer Phase”
4. From “DAC 6”
5. To “ADC 1”
6. “MHz”
7. “Cycles”
8. “Huge”.
A balance between the most accurate reading and convergence time.



Example 5, Step 5

The next step is to set up a Transfer Function Group Delay Graph from DAC 6 to ADC 1. Make these selections in numerical order:

1. “Graph Setup”
2. Select “New Graph”
3. “Band 1 Xfer Group Delay”
4. From “DAC 6”
5. To “ADC 1”
6. “MHz”
7. “Nanoseconds”
8. “Huge”. A balance between the most accurate reading and convergence time.



9. “Go to Graphs”

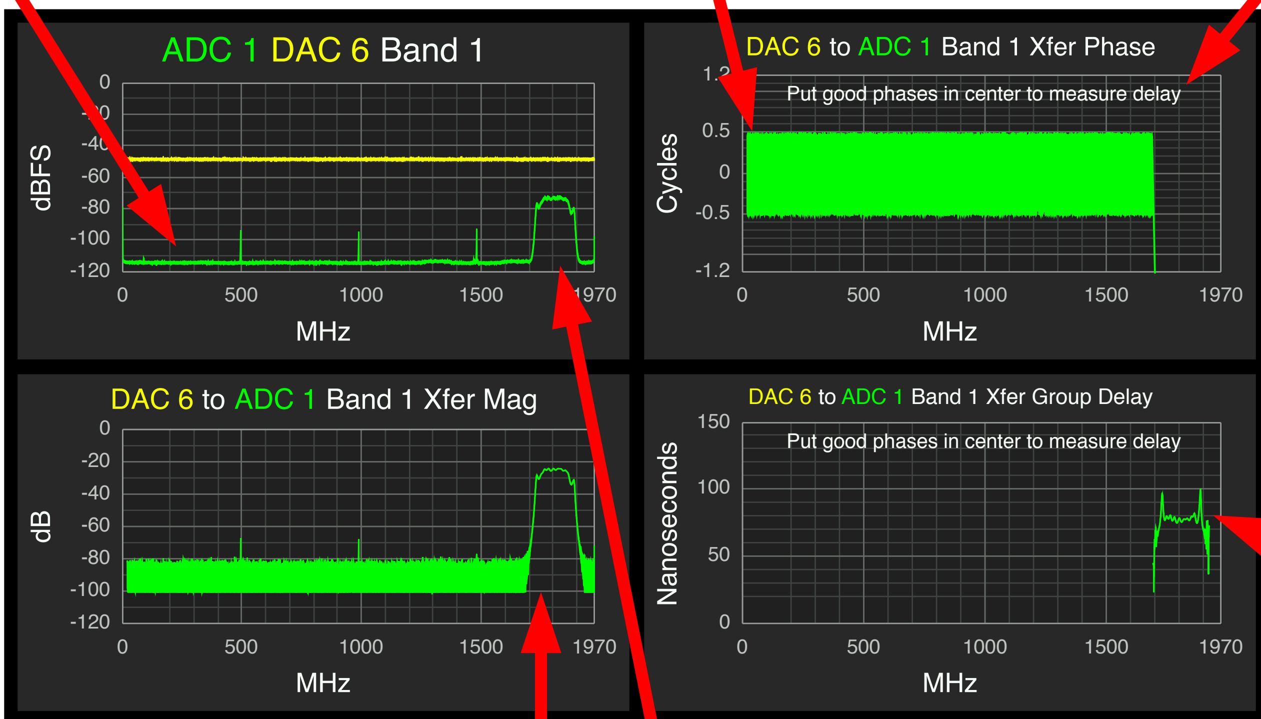
Example 5, Step 6

The previous steps will give the graphs shown below. Yours may vary if you have a different bandpass filter.

Measurement amplitudes at some frequencies are below -110dBFS. Amplitude/phase measurement of the filter is unreliable at these amplitudes.

Measured phases at low frequencies are detected to be random due to noise, and thus are unwrapped and not used for measurements.

No Group Delay measurement because it is only made in the center ¾ of the graph window and the only good values from the filter are off center.



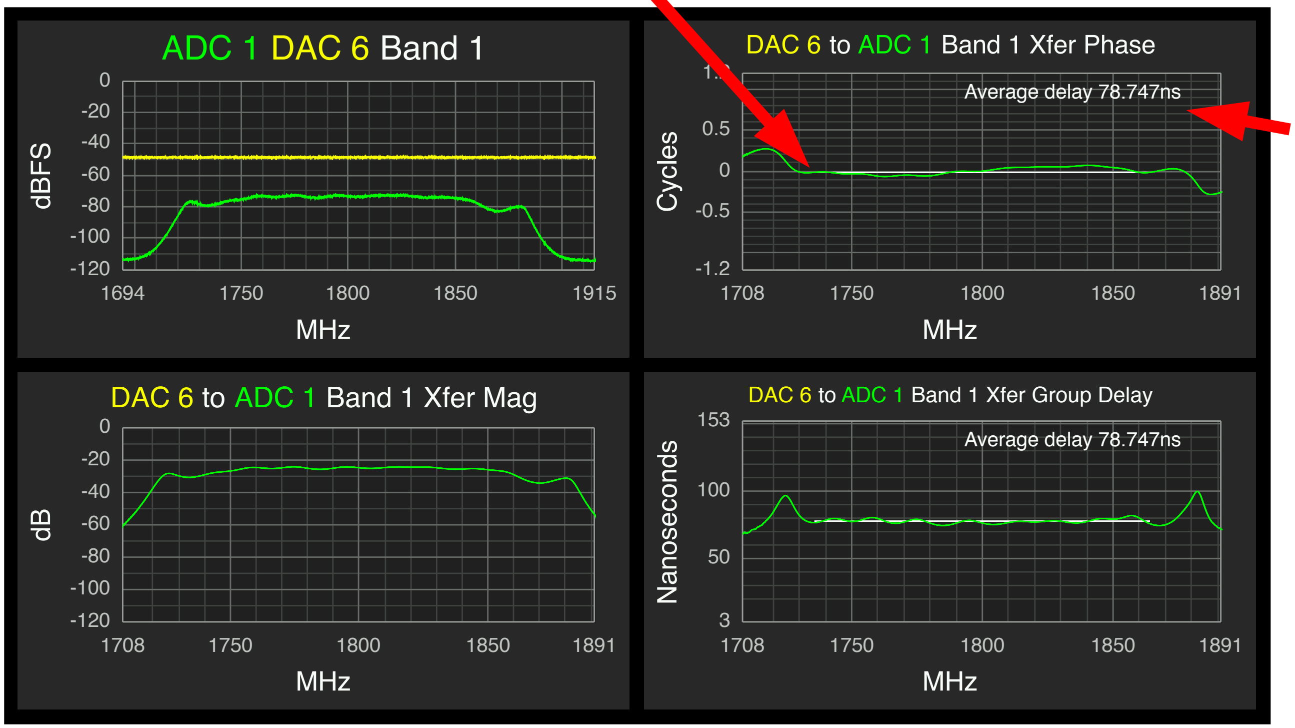
Filter group delay is shown. There is no white line for the measurement and the measurement isn't shown because the filter is off center in the plot. Also, frequencies where no good value could be measured are omitted from the graph.

The transfer magnitude plot is similar to subtracting the DAC 6 from the ADC 1 spectrum. However, the transfer measurement suppresses interference and extends dynamic range. Note that in the "Band 1" spectrum plot the filter amplitude varies from -70dBFS to -115dBFS, which is a difference of 45dB. The "Band 1 Xfer Mag" plot shows filter amplitude from -25dB to -80dB, a difference of 55dB. So an extra 10dB of measurement range was gained.

Example 5, Step 7

Zooming in allows the white measurement line to be positioned in the passband of the filter, for a measurement of the group delay through the filter in its passband.

Putting the filter passband in the graph center makes the measurement line appear with a corresponding Group Delay measurement.



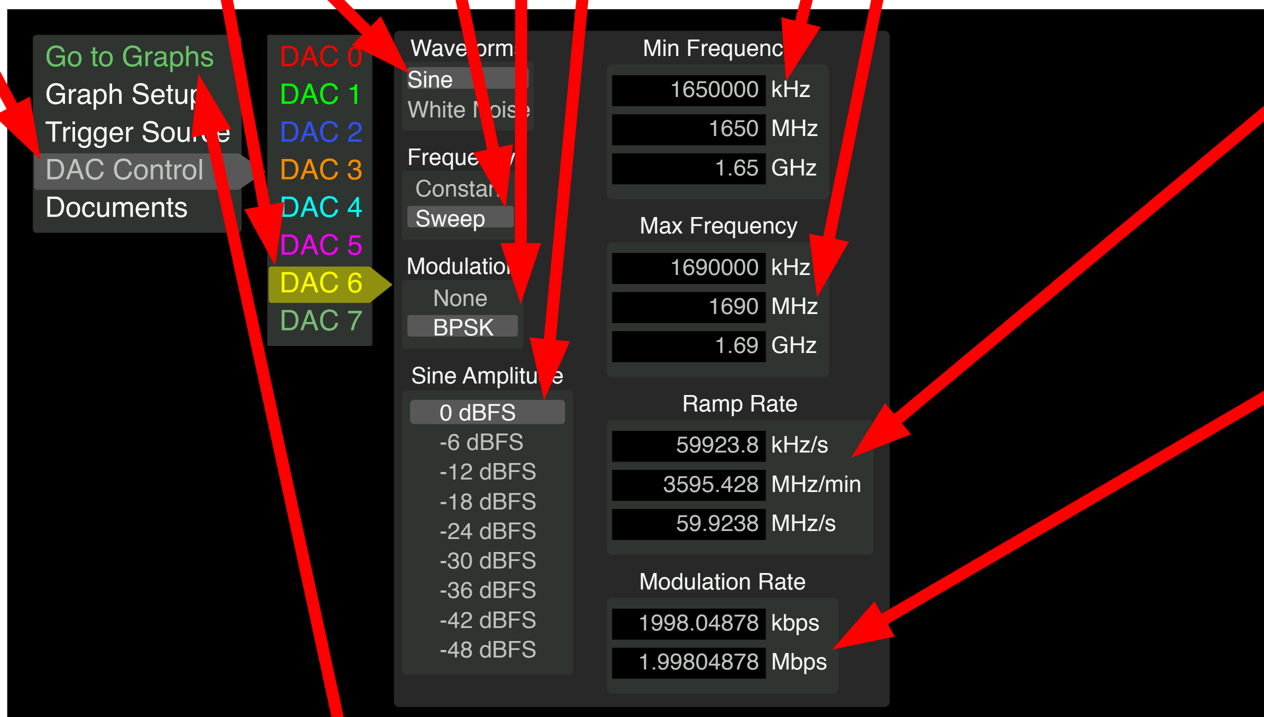
Measured group delay is approximately 78.747nS. ADC → DAC delay must be measured and subtracted from this to obtain the filter delay. This can be done by repeating the measurement after removing the filter from the line.

This filter provides at least 55dB of stopband attenuation (from the last slide). It may provide more attenuation, but that is beyond the measurement range with this setup. To measure further, higher signal amplitude could be generated using amplifiers (being careful to not exceed ADC input ranges) or by concentrating the DAC energy in a smaller range of frequencies.

Example 5, Step 8

To explore the filter response at its lower edge, you can put more energy at the lower edge using these selections:

1. "DAC Control"
2. "DAC6"
3. "Sine"
4. "Sweep"
5. "BPSK"
6. "0dBFS"
7. Min Freq 1650MHz
8. Max Freq 1690MHz
9. Ramp Rate 60Mbps (closest available value is shown)
10. Modulation Rate 2Mbps (closest available value is shown)
11. "Go to Graphs"



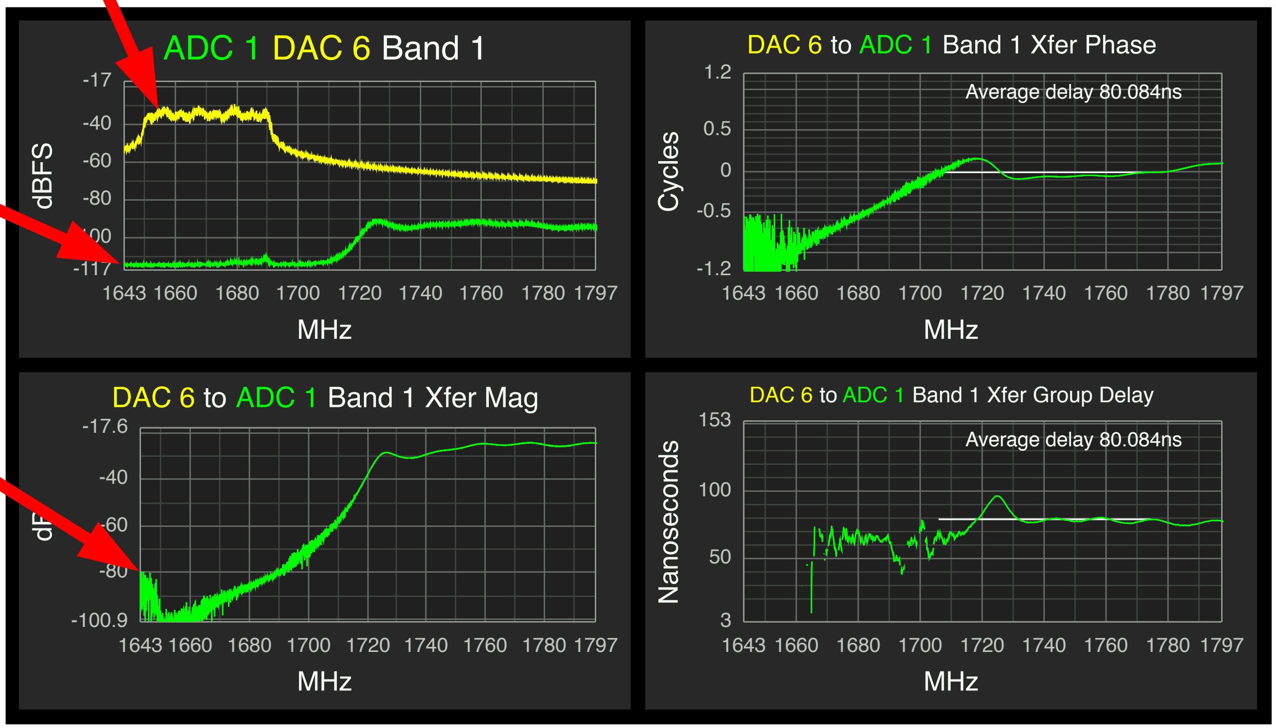
Example 5, Last Step

Changing from white noise to a swept BPSK signal allows more energy to be put in desired places to explore the filter response in regions of high cutoff.

DAC energy is now concentrated in a frequency region for which the filter is difficult to measure.

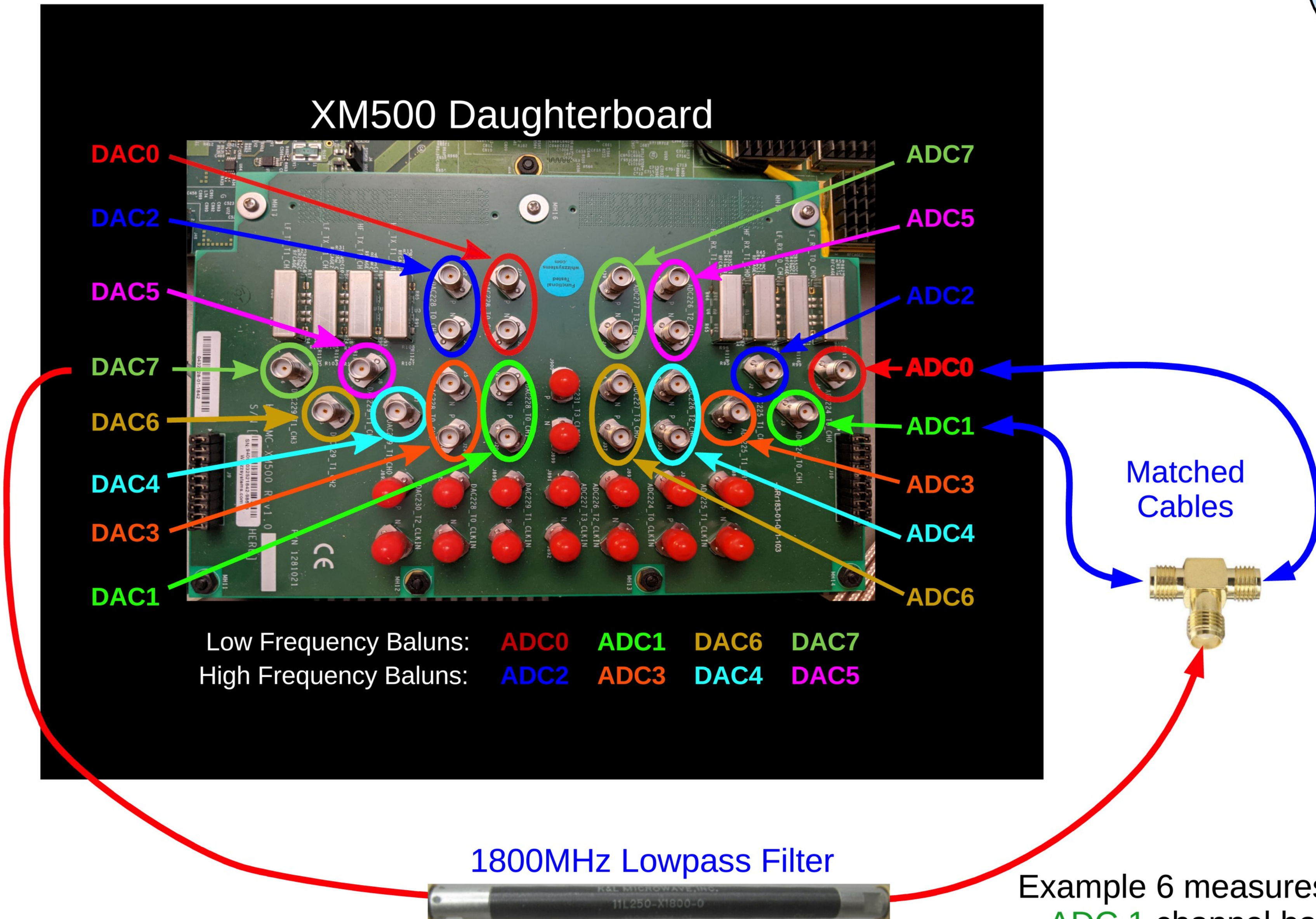
Response is below the noise threshold.

Processing pulls a useful result out of the noise.



By concentrating the energy, the filter response can be explored in regions of high attenuation. Here we see a passband response of around -23dB, with a stopband response at the lower edge of the filter of around -100dB. So it can now be seen that this filter attenuates by nearly 80dB at stopband frequencies, to the limit of the measurement capability without amplification.

Loopbacks for Example 6

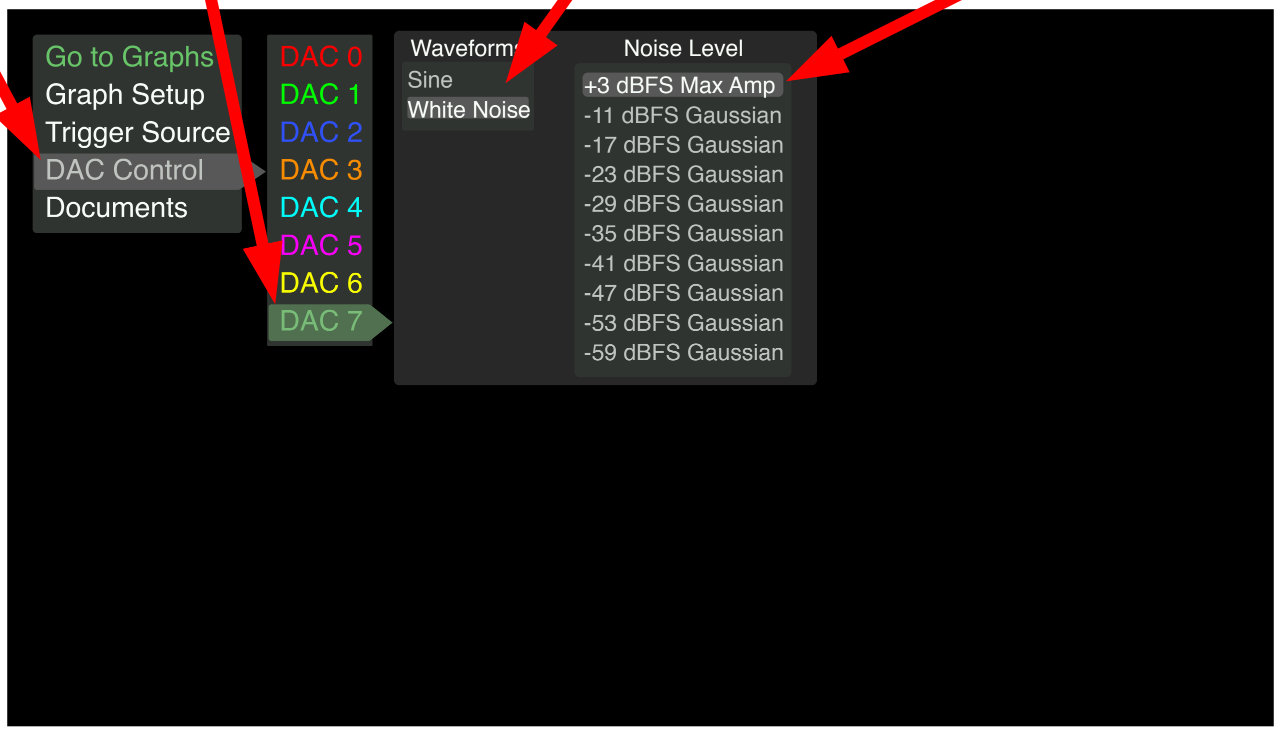


Example 6 measures ADC 0 / ADC 1 channel balance.

Example 6, Step 1

This example shows how to measure ADC balance. After setting up the cables as shown in the last slide, the first step is to set up white noise on DAC 7. Go to the main menu by clicking in the upper left corner, then make these selections:

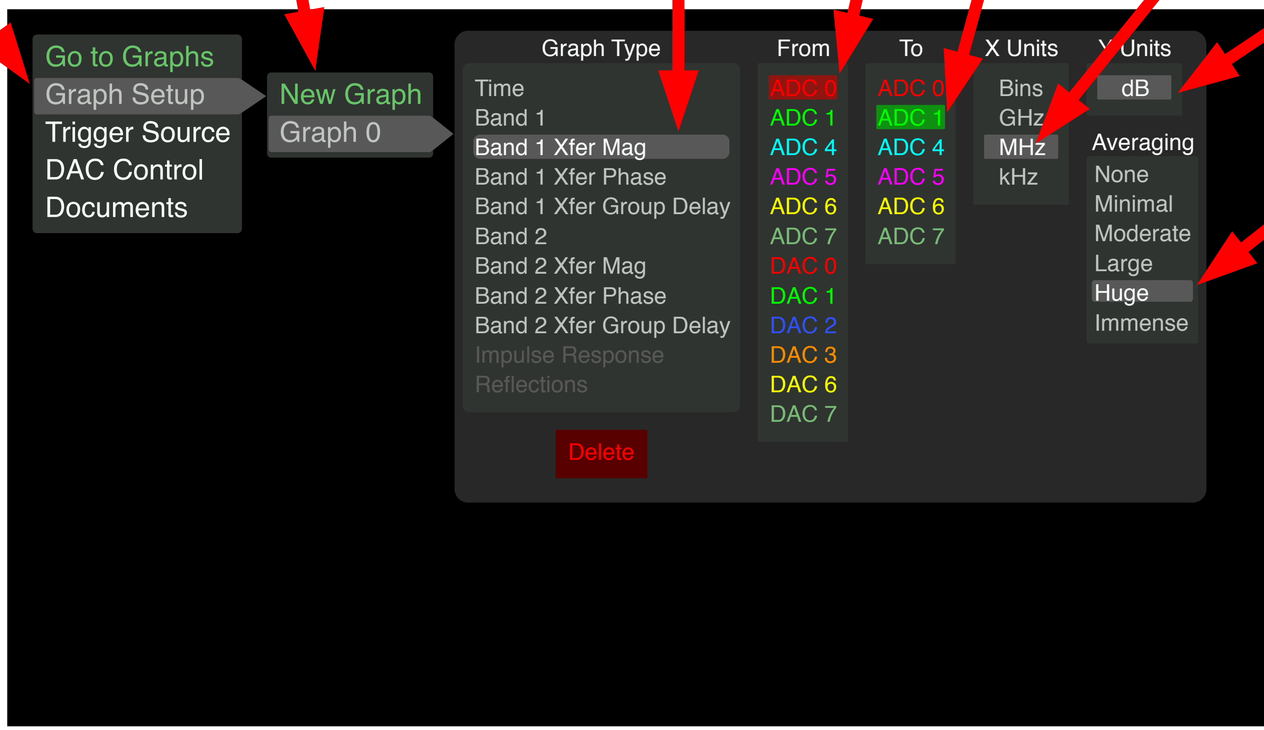
1. “DAC Control”
2. “DAC 7”
3. “White Noise”
4. “+3dBFS Max Amp”



Example 6, Step 2

The next step is to set up a Transfer Function Magnitude Graph from ADC 0 to ADC 1. Make these selections in numerical order:

1. "Graph Setup"
2. Delete other graphs, then select "New Graph"
3. "Band 1 Xfer Mag"
4. From "ADC 0"
5. To "ADC 1"
6. "MHz"
7. "dB"
8. "Huge". A balance between the most accurate reading and convergence time.

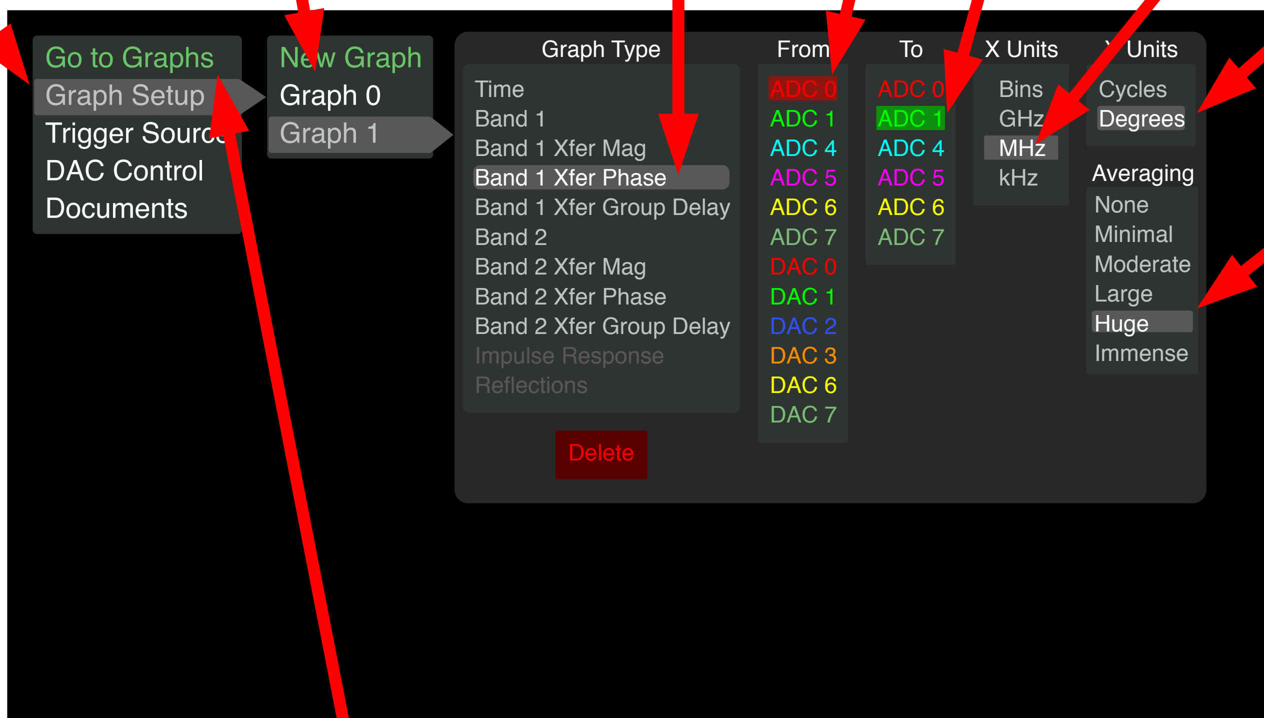


Note: A transfer function from ADC 0 to ADC 1 only works because they are driven by the same source (DAC 7).

Example 6, Step 3

The next step is to set up a Transfer Function Phase Graph from ADC 0 to ADC 1. Make these selections in numerical order:

1. “Graph Setup”
2. Select “New Graph”
3. “Band 1 Xfer Phase”
4. From “ADC 0”
5. To “ADC 1”
6. “MHz”
7. “Degrees”
8. “Huge”. A balance between the most accurate reading and convergence time.

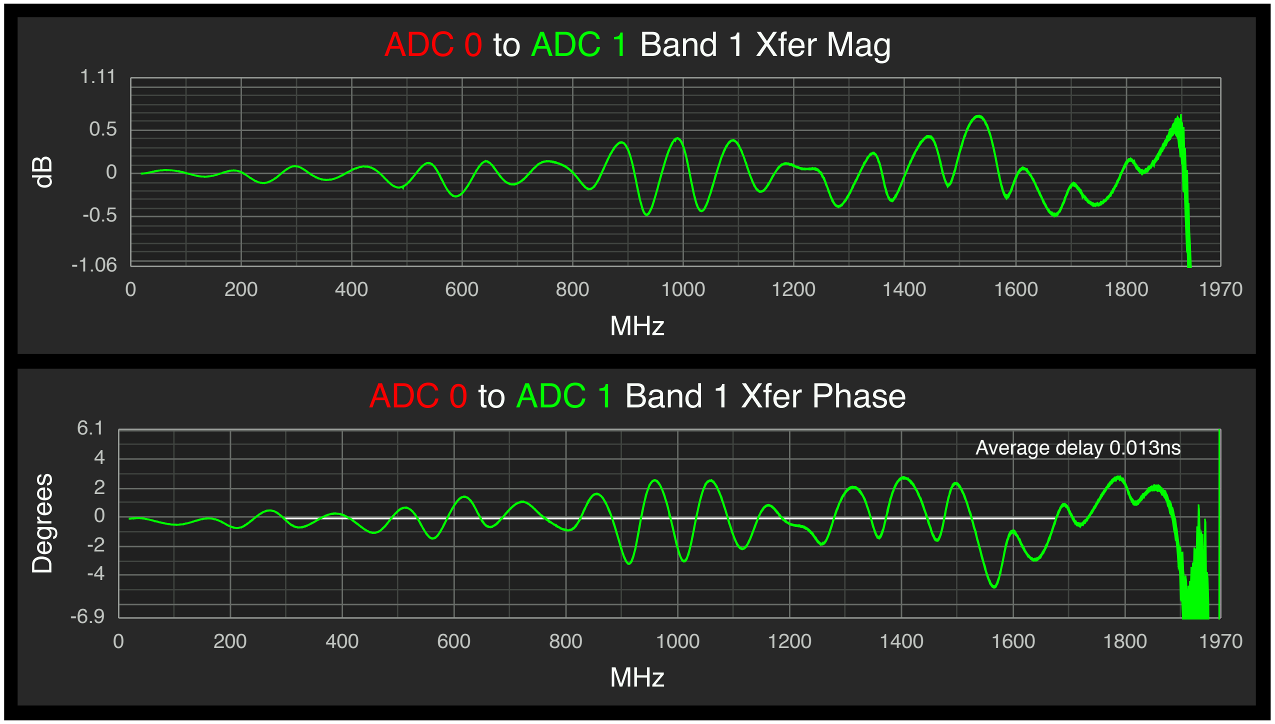


9. “Go to Graphs”

Example 6, Step 4

The graph shows the response of ADC 1 relative to ADC 0.

Zooming in on the y-axis shows differences between channels of up to 0.7dB in magnitude, 5 degrees in phase, and 0.013nS in group delay. These differences are small but possibly significant. For example, assume ADC 0 was at 0dBm = 1mW which corresponds to 223.6mV in a 50Ω system. Then a +0.7dB difference on ADC 1 puts it at 223.6 * 10^(0.7/20) = 242.4mV. The error signal has a level of 242.4-223.6 = 18.8mV. In dBm, the error is at 20log10(18.8mV/223.6mV) = -21.5dBm. Not very low at all!

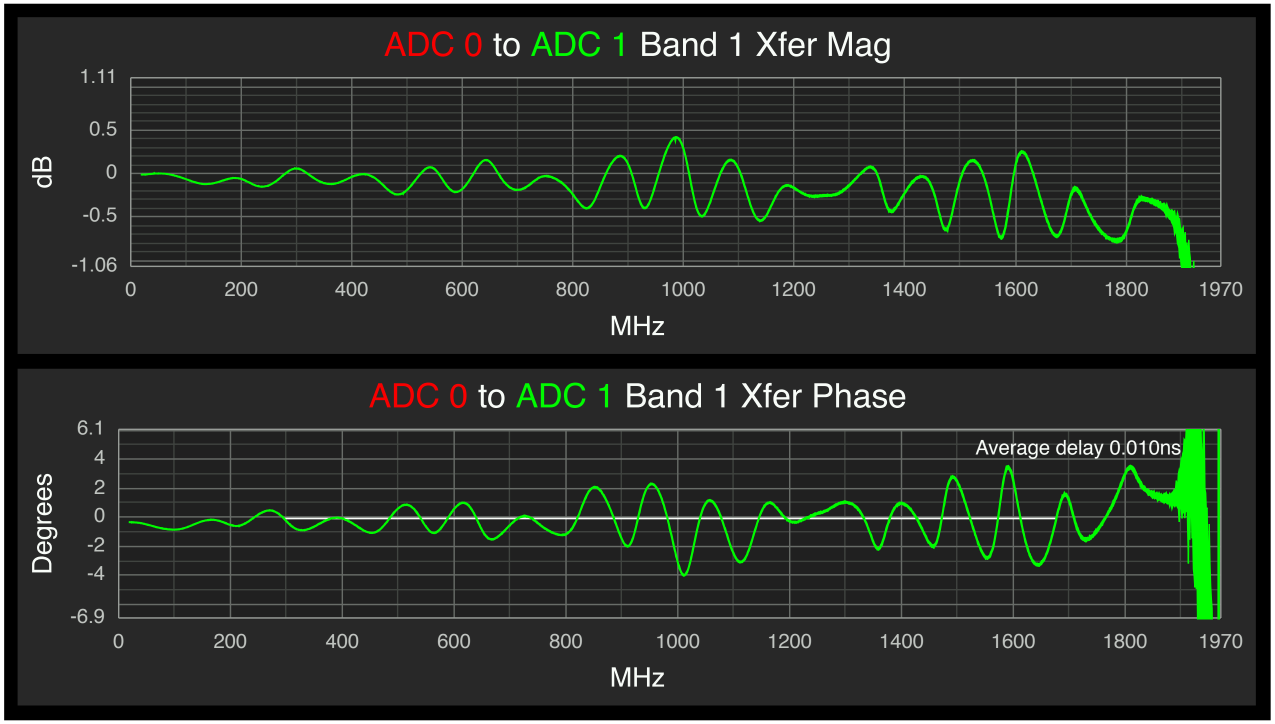


Beamforming and interleaved sampling are affected by the magnitude, phase, and group delay imbalances seen here. It's important to understand the level of imbalance to know whether the effect can be ignored for the target application or whether it must be corrected for.

Example 6, Last Step

The graph shows the response of ADC 1 relative to ADC 0, with the ADC 1 and ADC 0 inputs swapped from the previous graph.

The graphs with inputs swapped should be the same if all deviations are in the XM500/ZCU111 rather than in the test apparatus. Flipping back and forth with the previous slide, one can see that some things change, such as ripple amplitude. These changes are likely the effect of splitter imbalance. Other things are reasonably consistent, such as group delay and ripple peak location. These likely indicate real channel imbalances.



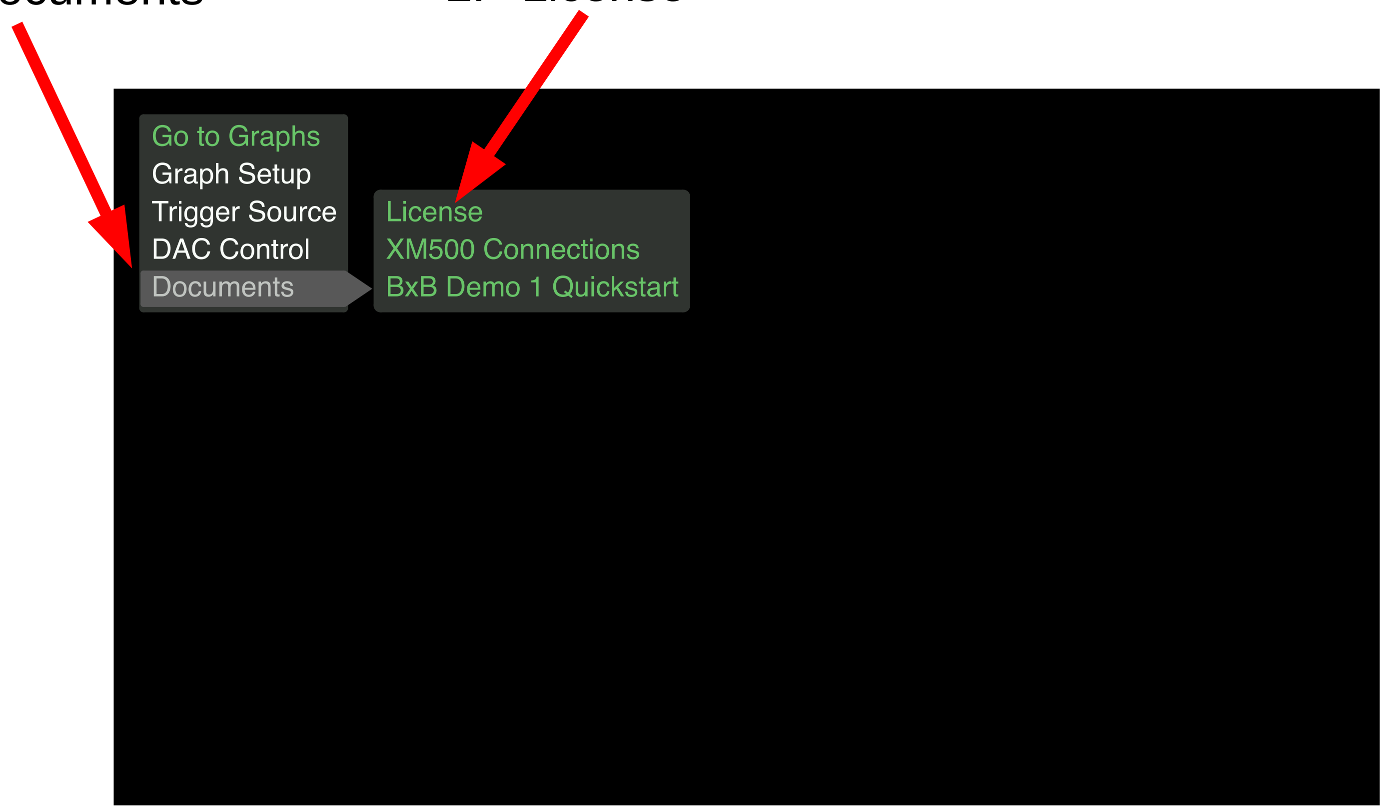
0.010nS delay between channels is reasonably consistent, and thus is unlikely to be in the splitter. It appears there is a small time delay difference in the analog chain between the two ADCs. This could also be due to slightly different sampling times.

An unequal split in the splitter degrades the usefulness of this method. However, it still gives a good indication of ADC imbalance. When the split between channels is part of what is being tested, such as a channel that is split in two to be sampled by different interleaved ADCs, then this is a great test.

Example 7, Step 1

This example shows how to access the built-in documentation. Make the following selections from the main menu:

1. “Documents”
2. “License”

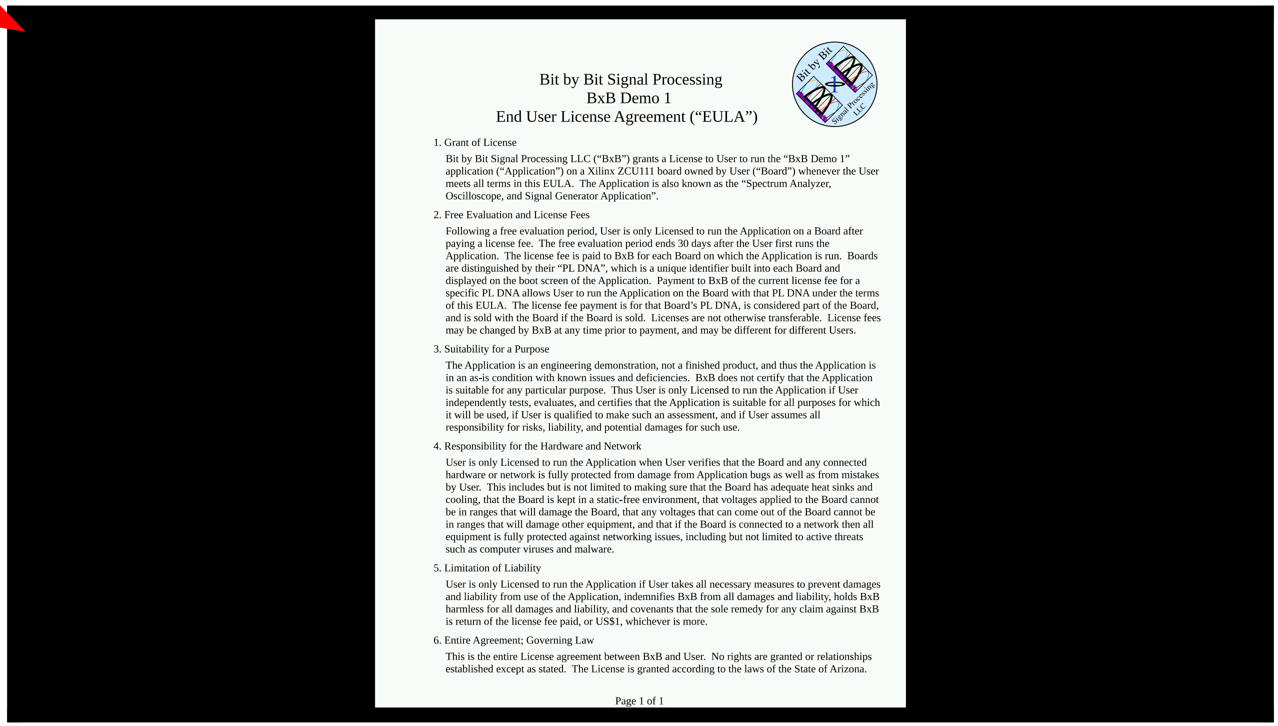


Example 7, Step 2

You should now see a copy of the License for BxB Demo 1, presented directly on the screen from BxB Demo 1.

Click on the top left to return to the main menu.

Click/touch on the left side of the screen to go back one page.
Click/touch on the right side of the screen to go forward one page.
(Doesn’t work for the License, since it is a 1-page document.)



Bit by Bit Signal Processing
BxB Demo 1
End User License Agreement (“EULA”)

1. Grant of License

Bit by Bit Signal Processing LLC (“BxB”) grants a License to User to run the “BxB Demo 1” application (“Application”) on a Xilinx ZCU111 board owned by User (“Board”) whenever the User meets all terms in this EULA. The Application is also known as the “Spectrum Analyzer, Oscilloscope, and Signal Generator Application”.

2. Free Evaluation and License Fees

Following a free evaluation period, User is only Licensed to run the Application on a Board after paying a license fee. The free evaluation period ends 30 days after the User first runs the Application. The license fee is paid to BxB for each Board on which the Application is run. Boards are distinguished by their “PL DNA”, which is a unique identifier built into each Board and displayed on the boot screen of the Application. Payment to BxB of the current license fee for a specific PL DNA allows User to run the Application on the Board with that PL DNA under the terms of this EULA. The license fee payment is for that Board’s PL DNA, is considered part of the Board, and is sold with the Board if the Board is sold. Licenses are not otherwise transferable. License fees may be changed by BxB at any time prior to payment, and may be different for different Users.

3. Suitability for a Purpose

The Application is an engineering demonstration, not a finished product, and thus the Application is in an as-is condition with known issues and deficiencies. BxB does not certify that the Application is suitable for any particular purpose. Thus User is only Licensed to run the Application if User independently tests, evaluates, and certifies that the Application is suitable for all purposes for which it will be used, if User is qualified to make such an assessment, and if User assumes all responsibility for risks, liability, and potential damages for such use.

4. Responsibility for the Hardware and Network

User is only Licensed to run the Application when User verifies that the Board and any connected hardware or network is fully protected from damage from Application bugs as well as from mistakes by User. This includes but is not limited to making sure that the Board has adequate heat sinks and cooling, that the Board is kept in a static-free environment, that voltages applied to the Board cannot be in ranges that will damage the Board, that any voltages that can come out of the Board cannot be in ranges that will damage other equipment, and that if the Board is connected to a network then all equipment is fully protected against networking issues, including but not limited to active threats such as computer viruses and malware.

5. Limitation of Liability

User is only Licensed to run the Application if User takes all necessary measures to prevent damages and liability from use of the Application, indemnifies BxB from all damages and liability, holds BxB harmless for all damages and liability, and covenants that the sole remedy for any claim against BxB is return of the license fee paid, or US$1, whichever is more.

6. Entire Agreement; Governing Law

This is the entire License agreement between BxB and User. No rights are granted or relationships established except as stated. The License is granted according to the laws of the State of Arizona.

Page 1 of 1

Middle mouse button or two-fingered touch: zoom/pan the same way graphs do.

Note: X and Y can’t be zoomed independently: document aspect ratio is always maintained.

Click/touch on the screen, then hold and move to go to a page in the document proportional to the screen x position.
(Doesn’t work for the License, since it is a 1-page document.)

End of Examples

- This is the end of prepared examples
- The examples showed BxB Demo 1 operation
  - How to generate signals and make measurements
- BxB Demo 1 is a useful lab instrument

No ZCU111 need ever be shelved from obsolescence!

BxB Demo 1 Features

Display Types and Features:
- Local DisplayPort monitor
- Remote web browser
- Connect local plus multiple web displays
- Switch between active displays
- Hotplug displays

Input Types and Features:
- Multitouch touchscreen
- Single touch touchscreen
- Wheel/Scroll Mouse
- Connect and use multiple input devices
- Hotplug input devices

Network Types:
- Ethernet with external router and DHCP
- WiFi sourced from BxB Demo 1 ZCU111
  - Requires Netgear WNDA4100
  - WiFi “BxB_Demo”, PW bitbybit, http://rf

Functions:
- Spectrum Analyzer; 1.96608GHz BW
  - Nyquist Zone 1 or Zone 2
- Network Analyzer
  - Transfer functions, filter shapes
  - Phase and group delay
- Oscilloscope; 16 μsecond time capture
- Function Generator: Sine; Random Noise
- Documentation Viewer

Graph Features:
- Time and frequency graphs
- Multiple graphs, automatic arrangement
- Multiple signals on each graph

Graph Selections:
- Source
- Reference (Xfer functions only)
- X Axis Units
- Y Axis Units
- Averaging mode (Spectrums only)
- Peak Hold (Spectrums only)

Oscilloscope Triggering Selections:
- Source (or Free Run)
- Trigger Level

Function Generator Selections:
- DAC number (all 8 work simultaneously)
- Enable/Disable
- Constant Frequency / Sweep
- BPSK Modulation / None
- Amplitude (in 6dB steps)
- Frequency (two for sweep mode)
- Ramp Rate (sweep only)
- Modulation Rate (BPSK only)

Graph Actions:
- Zoom / Pan
- Pause
- Doodle (Local Display only)
- Download SVG (ctrl-D; Web Display only)

Document Actions:
- Select document to view
- Zoom / Pan
- Page Forward / Reverse / Select

About the Author

Ross Martin received his PhD in Electrical Engineering from Arizona State University in December, 1994, under Doug Cochran. He worked in Hardware Acceleration for Radar systems, Optical processing, and Communication systems at Lockheed Martin, beginning in 1996 and ending in 2017. His final task was design of the digital switch for the JCSAT-17 communication satellite, based on PFB channelization and beamforming. He started Bit by Bit Signal Processing in 2017 to advance PFB channelization and beamforming technology.