



# auSCOPE X

Smart Audio Oscilloscope AUv3

## User Guide

Version 1.0

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# Introduction

Thank you for purchasing auSCOPE X, auDSPr's Smart Audio Oscilloscope AUv3. auSCOPE X is designed to be a simple, yet powerful 2-Channel Oscilloscope that lets you easily see your audio signals in real-time. Its *main* feature is a big, clear, uncluttered fast rendering of your signal. Its *unique* feature is the smart way it shows this signal to you. You see, from the jump, our design intent for auSCOPE X was to focus just on audio signals - with special consideration for *musical* audio signals. So auSCOPE X is not trying to show every type of signal possible. In contrast, a traditional hardware or even software oscilloscope is a piece of engineering kit with lots of technical controls for analyzing *any* type of electrical signal - this makes a traditional o-scope powerful and versatile, but can also make it hard to use, especially for beginners. And most musicians aren't engineers. Focusing auSCOPE X just on audio and music means we could leave out controls that we audio folks don't need - keeping the user interface clean - and we could present our options in musician's terms. It also means we could add sweet features like a MIDI Input, so auSCOPE X can make smart, fast decisions about exactly how much of your signal to show... instantly. If you're playing a deep bass note, auSCOPE X auto-scales so you can see the whole cycle. If you're on a high note, auSCOPE X can immediately zoom in, so you can see the detail. Smart, right? auSCOPE X is your eyes and ears!

And like most other auDSPr audio apps, auSCOPE X is an AUv3 Audio Unit Extension, so you can run multiple instances in your favorite Audio Unit Host such as GarageBand, Cubasis, AUM, apeMatrix, or BeatMaker 3!

# What is an oscilloscope and why would I want one?

An oscilloscope is a tool for viewing signals as they change over time by showing a waveform graph with time going from left to right and amplitude varying top to bottom. They actually used to be called oscillographs, but now people just call them "scopes" or "o-scopes" for short. They are particularly good at showing repetitive signals - things that *oscillate* - like sound.

As for why someone would want an oscilloscope... well, first they're just cool and owning one makes us all cooler people. So, there's that. But really they let you zero in on and lock onto specific details of your sound, especially right at the start of the sound. Oscilloscopes let you see and then dial in your attack transients - very cool for percussive sound design. They help to see and understand what a compressor is doing to your sound's dynamics. When you want to design a synthesizer patch, an oscilloscope is your sonic microscope letting you see single cycles of your waveform as it evolves over time. You can literally watch a square wave get rounded and smoothed to a sine wave as its higher harmonics get taken out by a low-pass filter.

Lastly and most obviously oscilloscopes are super cool eye candy which catch everyone's attention.

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# Oscilloscope 101

Oscilloscopes can be tricky to understand at first, so I will attempt to explain how they work by using an analogy. Imagine yourself standing by the side of a stream with a camera on a short tripod focused on a section of the stream. The stream is flowing from right to left, so upstream is to your right and downstream is to your left. If you snap a quick picture, you'll capture a snapshot of the way the stream looked for that brief period of time. For the purposes of this analogy, I'm going to assume you've got a high quality camera that is fast enough to capture a sharply focused image of the stream. When you look at your snapshot, you can see the level of the stream varying higher and lower as you look from left to right. Think of this waveform as your signal level.

Next you set up your camera so it takes a burst of snapshots. As you would expect, each of these snapshots captures the stream's state at different points in time. If you were to stack up your snapshots and flip through them rapidly as if you were holding an animator's flip book, then you would see an animation of the stream flowing by.

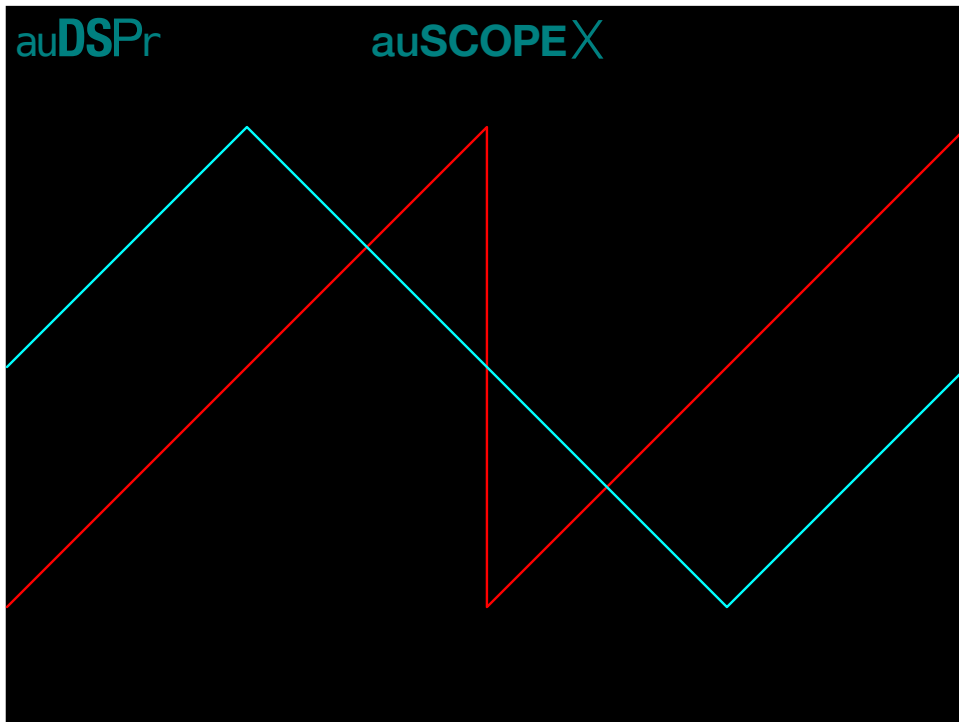
Now, by moving the camera closer to or further from the stream or by zooming in or out, you can capture shorter or longer sections of it. (This is your oscilloscope's Time Base.) By changing the rate of the snapshots in your burst, you get a different animation of the stream. And if you had awesome timing, you could even capture a picture of a leaf floating down the stream, or even an animation of the leaf at different points as it passes by. If you had a friend upstream dropping leaves in one by one at a steady rate, you conceivably could synchronize your camera so it always takes pictures with each leaf in the exact center of each shot. Think of each leaf as a trigger event.

In a nutshell, this is how your oscilloscope works. It's basically freeze framing sections of your signal (the stream) and animating those snapshots on the display. By synchronizing your snapshots to trigger events (the leaves), you can stabilize the waves that you see.

The power of the oscilloscope lies in just how dang fast and accurately it can take these snapshots of very fast moving things and still show them crystal clearly to you. Imagine now instead of being by a lazy stream, you are this time sitting across a large field trying to capture pictures of a distant bullet train zooming out of a tunnel - again moving from right to left. If your camera were as accurate as an oscilloscope, you'd be able to take a snapshot of each passenger in the third row of every car and be able to tell which book each person is reading. I exaggerate for dramatic effect, but you get my meaning.

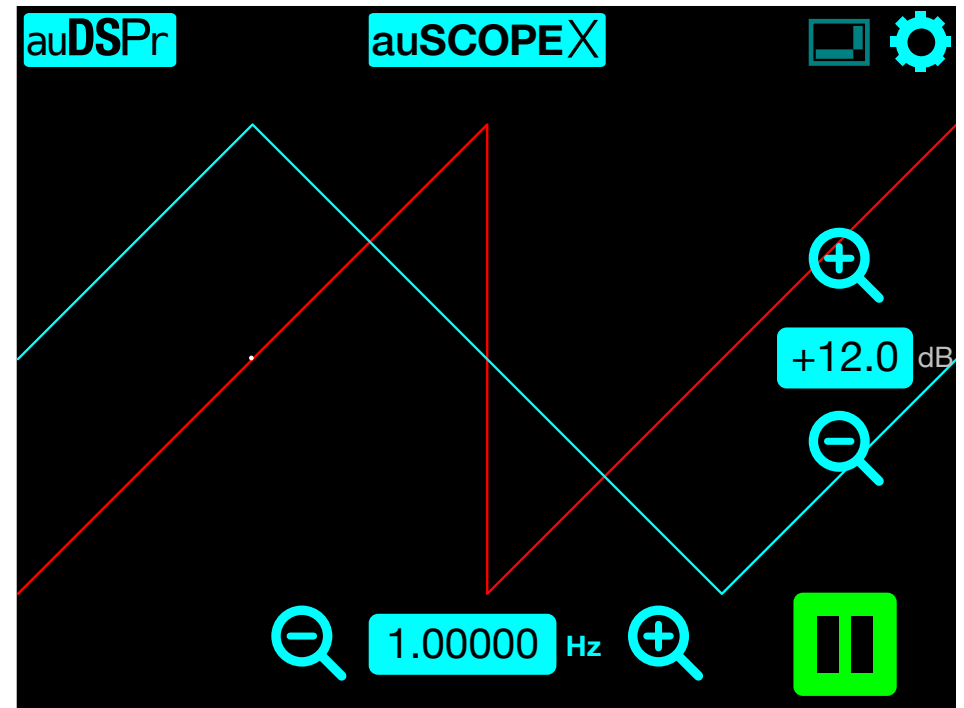
# The auSCOPE X Main Window




On auSCOPE X your audio traces are the **main attraction**, so we keep them front and center, big and bright. Most of the time, they're pretty much all that is showing on the screen.




As with any oscilloscope, auSCOPE X plots time on the horizontal axis and amplitude on the vertical axis.

If you want to customize how your traces look, simply tap anywhere in the Main Window and controls will fade in so you can dial in things just the way you want them.

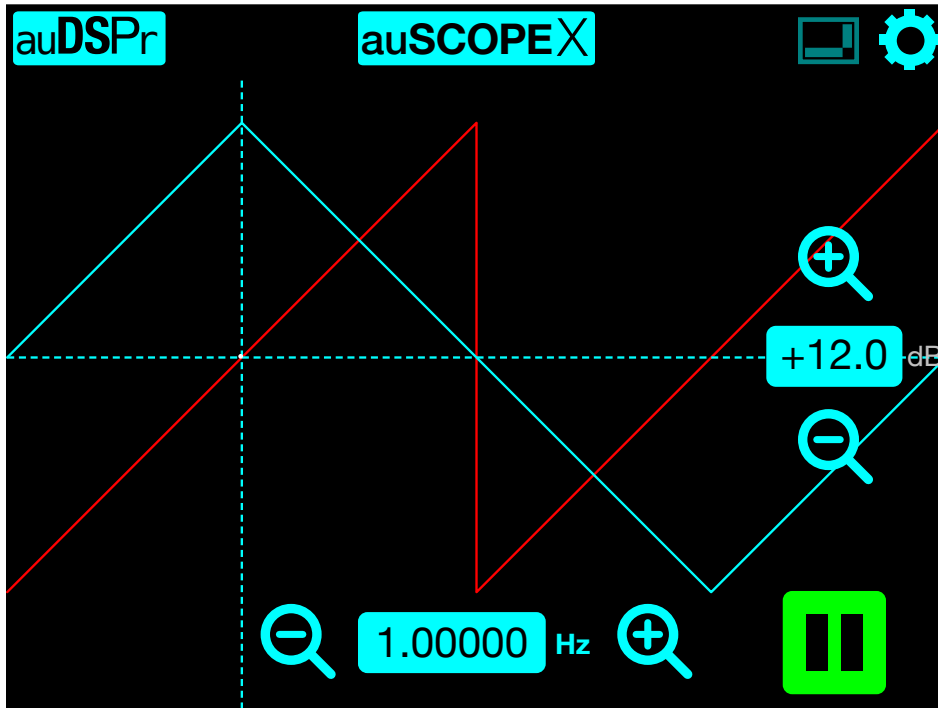


As musicians and audio creative types ourselves, we at auDSPr understand that things need to be fast and responsive so as not to lose creative flow. So we designed auSCOPE X's controls to be butt-simple - you can zoom in  or out  to make your traces Taller/Shorter or Wider/Thinner. And you can Pause  trace capturing. That's it.


Well... that's it *on the Main Window*. Of course, at auDSPr we *are* control freaks, so we've added plenty more options on the Settings Page  - described in detail below.

To avoid screen clutter, the controls will automatically fade back out a few seconds after you last touch the screen.

## The Touchable Trigger Dot







You might notice a small white dot on your trace. This indicates your Trigger Level and Horizontal Position. You can tap on the Dot and drag it to move your trace wherever you want. For tighter control, first only tap the Trigger Dot to bring up its horizontal and vertical guide lines. These guides divide the screen into 9 tappable zones. Tap *on* the vertical guide above or below the Dot to nudge just the Trigger Level in small steps. Similarly, tap on the horizontal guide to the right or left of the Dot to increment or decrement just the Trigger Horizontal Position. And tap anywhere *not on* either guide to step the Dot diagonally. Lastly, double-tap directly on the Dot to reset it to the center.

For finer control, tap  and your Trigger Sliders will, uhh... slide in. If you require even tighter control, you'll find more Trigger options on the Settings Page.

**!** Beware: On the Main Window, the Trigger controls (that is, Dot and/or Sliders) will only be visible if the Trigger Channel is the same as one of the Display Channels. Since auSCOPE X allows you to set the Trigger Channel independently from the Display Channel, it is possible for you to get yourself into a situation where what you are viewing is NOT what you are using for triggering. In this case, you'll need to set your Trigger controls from the Settings Page. With great power comes great responsibility.

## Pausing & Resuming the Trigger System

In the lower right corner you can tap  at any time to Pause the Trigger System. This freezes your current trace on the screen so you can admire it as long as you want. While Paused, you can use the Trace Height and Width controls to zoom in and out at your leisure. This is the perfect opportunity to take a screenshot.

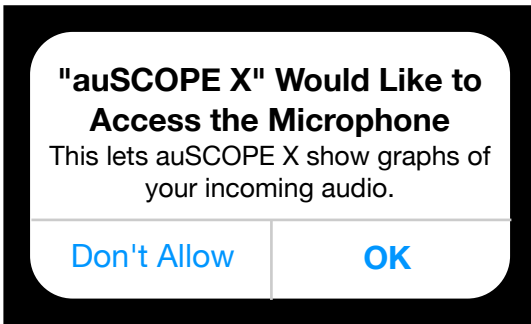
 or  or  Tap when you are ready to resume capturing new traces. Notice that this button gives you an indication of your current Trigger Mode (A for Auto, 1 for Single, or the simple red record spot for Normal capturing). Trigger Modes are very handy and they are described in detail below.

## Stand-Alone Mode

A lot of the times you'll be running auSCOPE X in an AUv3 Audio Unit Host such as AUM or apeMatrix so you can run as many instances of auSCOPE X as you want (up to the limit your device can handle, of course). Other times you might find it useful to run auSCOPE X as a single "stand-alone" app - nice for when you want to focus just on auSCOPE X functionality without the complexity of other apps. In Stand-Alone Mode,

auSCOPE X uses the device's audio input, whether this is the built-in microphone, a connected microphone, or a connected audio device.

Note that before auSCOPE X can use the audio input, you first need to grant it permission. (This step protects your privacy so apps can't use the microphone to spy on you. The operating system keeps track of which apps have access to the microphone, so at any time you can go into the Settings app under Privacy > Microphone and disable apps you might not trust.) The reason I'm telling you all this is because the first time you run auSCOPE X as a stand-alone app, you'll see this:



Note that the operating system will simply send silence to the audio inputs of apps which have not been granted access to the microphone/audio input.

On most iPhones and iPads, the microphone is a mono input, so in this case auSCOPE X will simply duplicate the Left Channel information to the Right Channel. To get a live stereo input, you'll need to connect an external audio interface that has two audio input channels.

## Drum Loop Demo Sound

In Stand-Alone Mode, auSCOPE X has a built-in Demo Sound which is a loop of a short drum pattern. This is useful for quick

system checks and is handy to play while you familiarize yourself with the app.

When the Main Window controls are showing, you'll see



or in the lower left corner. Tap to play or pause the Drum Loop Demo Sound.

## Fun with the Drum Loop Demo Sound


Let's use the Drum Loop to have some fun while we practice and get to know our cool new scope. I happen to know that the drum sample used for the loop is 4 beats long at a tempo of 90 BPM. Some simple math tells us that this sample is a total of 2.667 seconds long. I also know that the kick drum is the loudest sound in the loop and that the loop starts with a kick on count 1. Armed with these bits of information, let's try a few tricks:

### Trick 1: Get a look at the entire Drum Loop Sample


Settings:

Trigger Slope: Rising  
Trigger Level: ~ +0.45  
Exact value doesn't matter —  
it just needs to be higher than the snare.  
Trigger Mode: Single  
Trigger Horizontal Position: 0%  
Trace Width: 22.5 BPM (= 90 BPM / 4 beats)  
or, put another way  
2.66667 sec  
Trace Height: 0.0 dB



Start with the Drum Loop paused. Then tap  to ready the



scope for a capture. Then tap  to Play the Drum Loop. Let an entire pass of the loop play - it only takes a few seconds. The Trigger System will automatically pause after the one-shot. If all went as intended you should see a beautiful picture of the sample that we used for the Drum Loop.

## Trick 2: Watch each beat flash by

Settings:

Same as Trick 1 except change:


Trigger Level: ~ +0.19

Trigger Mode: Auto

Trigger Horizontal Position: 3%

Trace Width: 360 BPM

(= 90 BPM quadruple time to see 16th notes)

Tap  to ensure that the Trigger System is running. Play the Drum Loop. Watch and smile as the you see the waveform for each individual beat flash by. You can see that the kick sound was synthesized using a decaying, pitching down triangle wave, and you can see that the snare sound was built using filtered noise.

# Tips & Tricks

Oscilloscopes are essential tools for helping understand what complex systems are doing. When used as an AUv3, you can place auSCOPE X anywhere in your signal path to analyze the signal up to that point. You might find it useful to place an instance of auSCOPE X at the *end* of each channel's signal chain, so you can monitor the cumulative effects of all the plugins placed before it.

For capturing sounds that have a long time between trigger events (drum hits, rhythm patterns or even spoken words, for example), use Normal Trigger Mode. For sounds with fairly stable waveforms, Auto Trigger Mode might perform better for you.


Trigger Level is your friend. It lets you separate the signals that you want from the ones you don't want. If you set it to 0.0, your scope will trigger on every zero crossing. This is great when you *want* to capture everything, but not so great when you're trying to capture only certain things. For example, if you want to capture you snare hits but not hi-hat hits, you might first want to set your Trigger Level to something like +0.25 and then fine tune from there to grab the louder snare hits, but ignore the slightly softer hi-hat hits. auSCOPE X makes it very easy to do this so you can quickly, visually pick out specific aspects of your sounds.

Note that auSCOPE X does not alter your audio in any way.

# Settings Page

On auSCOPE X your audio traces are the most important thing, so most of the time, they are pretty much all that is showing on the screen. But if you tap the screen anywhere in the Main Window, Controls appear so you can customize how your traces look.



Tap  to display the Settings Page. This is where we've put controls for "set and forget" options that you might only change once in a while. Your settings are saved on a "Per Instance" basis, so if you have, say, 3 instances of auSCOPE X running in AUM, each one will remember its own settings.

## Trigger System




An oscilloscope's trigger system is one of its **most important** functions. Triggering is what enables the scope to display repetitive waveforms in a steady fashion - allowing us to see our audio in a clear and meaningful way. The trigger makes repetitive waveforms appear static by repeatedly displaying similar portions of the input signal. A trigger system also lets you capture single-shot waveforms.

## Trigger Level

The Trigger Level control sets the level at which the trigger fires. This allows you to lock onto signals that interest you, while ignoring signals that don't. If you set it at too high of a level and your signal is not strong enough, then auSCOPE X might not trigger and you will not be able to see any activity on your trace. On the other hand, if you set the Trigger Level too low, then the scope might trigger too often and you'll just be picking up too much low level noise.



*Top Tip:* Double-tap  on the Trigger Level slider to reset the level back to the default value of 0.0, which is a good starting point for capturing repetitive signals. If you want to capture drum sounds instead, start with the Trigger Level around +0.25 (which corresponds to -12 dBFS - a good level for capturing healthy drum hits) and then fine tune up or down from there to pick out your attack transients.

## Trigger Slope

The Trigger Slope control determines whether auSCOPE X triggers on a Rising or Falling edge of the input signal. Most of the time you can just leave it set to Rising and your trace will look fine.



or Tap to toggle the Trigger Slope.

## Trigger Horizontal Position

auSCOPE X's Trigger Horizontal Position allows you to place your trace anywhere along the horizontal axis. A common trigger position is 0% - all the way to the left. Changing the position to a different value will shift your trace to the right. This lets you capture what a signal did just *before* a trigger event, a feature known as Pre-Trigger Viewing.

## Trigger Channel





Similar to the *Display Channel Selection* described below, auSCOPE X lets you select the *Trigger Channel* - meaning, the Channel that it uses as the Trigger Source. Typically, you would just set this to a Channel that is currently showing, but the occasion might arise where, for example, you might want to Display the Left Channel while Triggering off the Right Channel. auSCOPE X gives you this flexibility.

## Trigger Mode





auSCOPE X has three simple Trigger Modes - each intended for a different specific purpose.

 **Auto:** In Auto Trigger Mode, auSCOPE X will automatically trigger and refresh the display - even if no signal is present or if the signal level is too low. This is useful to be able see where the trace is *wherever* it is. Most of the time, you can just leave auSCOPE X in Auto and your results will be fine.

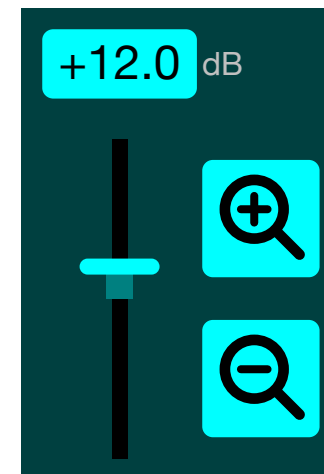
 **Normal:** In Normal Trigger Mode, auSCOPE X will *only* trigger and refresh the display when an actual trigger event is detected. This is useful because the waveform for the *last* trigger event will stay frozen on the screen. Normal Mode lets



you see just the signal of interest, even when triggers occur at a slow rate - for example, individual drum beats. Beware though, Normal Mode *can* fool you - if your Trigger Level is not adjusted properly (set too high, for example), you might not see *any* activity in your trace because trigger events are getting missed.

 **Single:** In Single Trigger Mode, on the first trigger event it sees, auSCOPE X will trigger and refresh the display in a one-shot fashion - and then stay frozen on that trace, pausing the Trigger System. This is useful if you want to capture just one note or just one percussion hit or just the attack of your sound.

When you are done looking at this trace, tap  on the Main Window to make auSCOPE X ready to capture your next trace. You can think of this as arming it to “Record One Time Only” or to put it more simply “Record Once”.

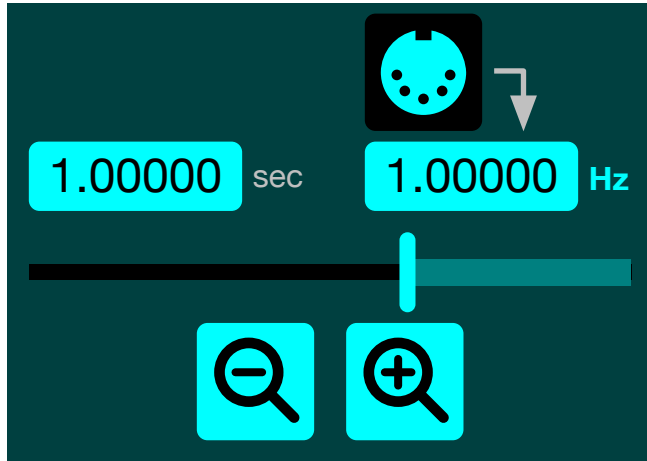
## Vertical - Set Your Trace Height




auSCOPE X lets you easily adjust the height of your traces. Tap  to make them twice as tall (+6.02 dB), or tap  to make them half as tall (-6.02 dB). If you want finer control, use the



vertical slider. For the ultimate in control, tap the number button and a keypad will appear so you can key in an exact value.

## Horizontal - Set Your Trace Width




It's just as easy to adjust the *width* of your traces. Tap  to

make them twice as wide, or tap  to make them half as wide. If you want finer control, use the horizontal slider. For ultra precise control, auSCOPE X gives you a few options for keying in exact values. Since period is mathematically the inverse of frequency (that is,  $\text{period} = 1 / \text{frequency}$ ), tapping the number button on the *left* lets you key in an exact period value *in seconds*, or tapping the one on the *right* lets you key in the desired frequency *in Hertz* (cycles per second) or *in BPM* (Beats per Minute). This might seem redundant, but really it is for speed and convenience. Sometimes it's easier to think in terms of seconds, and other times it makes sense to think in Hz or BPM.

*Top Tip:*  or  Tap to switch back and forth between Hz and BPM. auSCOPE X will convert the value for you.

But hold on... if you are running auSCOPE X as an AUv3 in an Audio Unit Host such as AUM, then we've got one more slick trick for you (and this is the super cool one because it's designed especially for musicians). Because of its unique MIDI Input feature, auSCOPE X can intelligently dynamically change its Time Base depending on what MIDI Note Number you are playing. So you can just ignore the last few paragraphs, and

instead, simply tap . auSCOPE X will automatically set your Trace Width for you! Of course you gotta remember to route your MIDI source to auSCOPE X's MIDI Input!

## Display Channel Selection & Layout

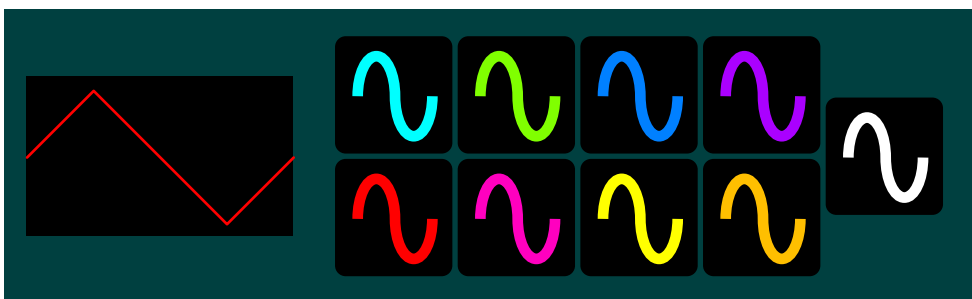


auSCOPE X is a 2-Channel Oscilloscope which means that you can show traces of the Left and Right Audio Channels independently. You also have the option of viewing a single trace which is a Mono averaged sum of Left + Right.



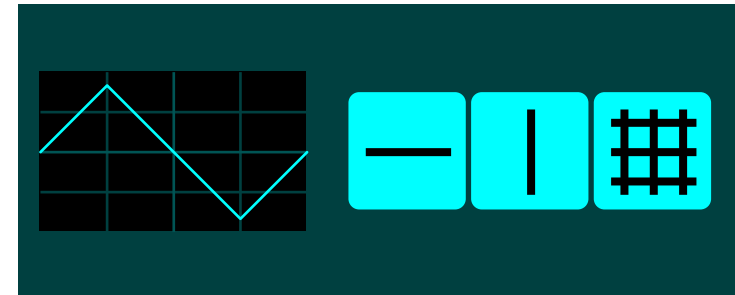
When both the Left and Right Channels are showing, you have the option of Overlapping them on top of each other, showing them Stacked top and bottom, or Side By Side left and right.

## Trace Color



For each Channel auSCOPE X lets you choose from a variety of trace colors. This comes in handy when you have several instances of auSCOPE X running at the same time and you want to color code each instance per track or per synth or per instrument group.

## Grid Lines



auSCOPE X lets you turn on or turn off the vertical and horizontal center reference lines independently. You also have control over whether to show or hide the grid.

## Controls Visibility



The default behavior for auSCOPE X is to Auto-Hide the Controls on the Main Window when you're not using them. This yields a clean, uncluttered look. However you can change it so auSCOPE X will Always Show the Controls.

## Audio Pass Through

auSCOPE X taps off your audio signal path and simply passively listens to the incoming audio. The audio that comes in is passed through untouched — sample for sample, bit for bit, so there is *zero* signal degradation.

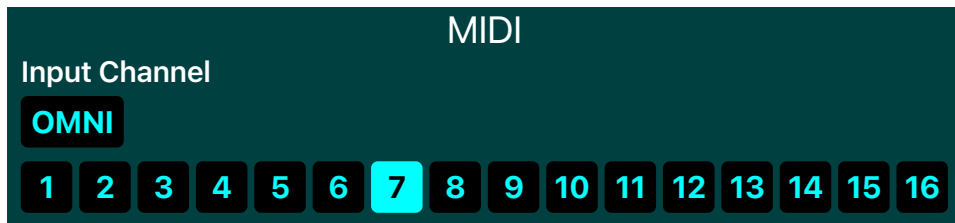
There are times however where you might actually *want* to disable Audio Pass Through. For example if you are using your iPad's built-in microphone as auSCOPE X's audio source, you'll

probably want to turn off Audio Pass Through so sound doesn't get passed through to the iPad's speakers which would cause an acoustic feedback loop and possibly result in weird high pitch squeals or whistles. (Fun Fact: This phenomenon is called the "Larsen Effect". It is named after the Danish physicist, Søren Absalon Larsen, who first discovered it.)



Tap to toggle Audio Pass Through to mute/unmute the outgoing audio.

## MIDI Input Channel



When an instance of auSCOPE X is running in an Audio Unit Host such as GarageBand, you'll see controls for setting up its MIDI Input. This allows you to select the MIDI Channel that this particular instance of auSCOPE X will use. Basically, auSCOPE X will simply ignore incoming MIDI messages that are not on this MIDI Channel. If you have OMNI selected, then auSCOPE X will respond to messages coming in on all MIDI Channels.

Keep scrolling down and you'll find the current **Sample Rate** at which the current instance is running. When running as a stand-alone app, auSCOPE X defaults to 44100 Hz (which is standard on most iOS devices) or 48000 Hz (supported by some newer devices like the iPad Pro). When running in an Audio Unit Host like AUM, auSCOPE X uses the sample rate set by the host. All auDSPr audio apps support the following sample rates: 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz. Our audio algorithms are designed to be "sample rate agile" which

means they scale themselves to run natively at the current sample rate. This way you get the best sound available for the current sample rate. To use the higher 88.2 and 96 kHz sample rates, your iPad, iPhone, or iPod touch will need to be connected to an iOS-compatible USB audio interface via the Lightning jack (or USB-C jack on some newer devices).

You'll also find here the maximum **Frame Rate** supported by your device's screen. Most devices support 60 fps (frames per second), but some Pro models support 120 fps.

When auSCOPE X is running as a stand-alone app (that is, not when it is running in an Audio Unit Host), two additional settings are available: Background Audio and Keep Screen On.

**Background Audio**

When Background Audio is enabled, auSCOPE X will continue to pass through audio even when running in the background (for example, when the screen is off). If Background Audio is not enabled, auSCOPE X will pause audio when it goes into the background. Pausing audio obviously will save battery life.

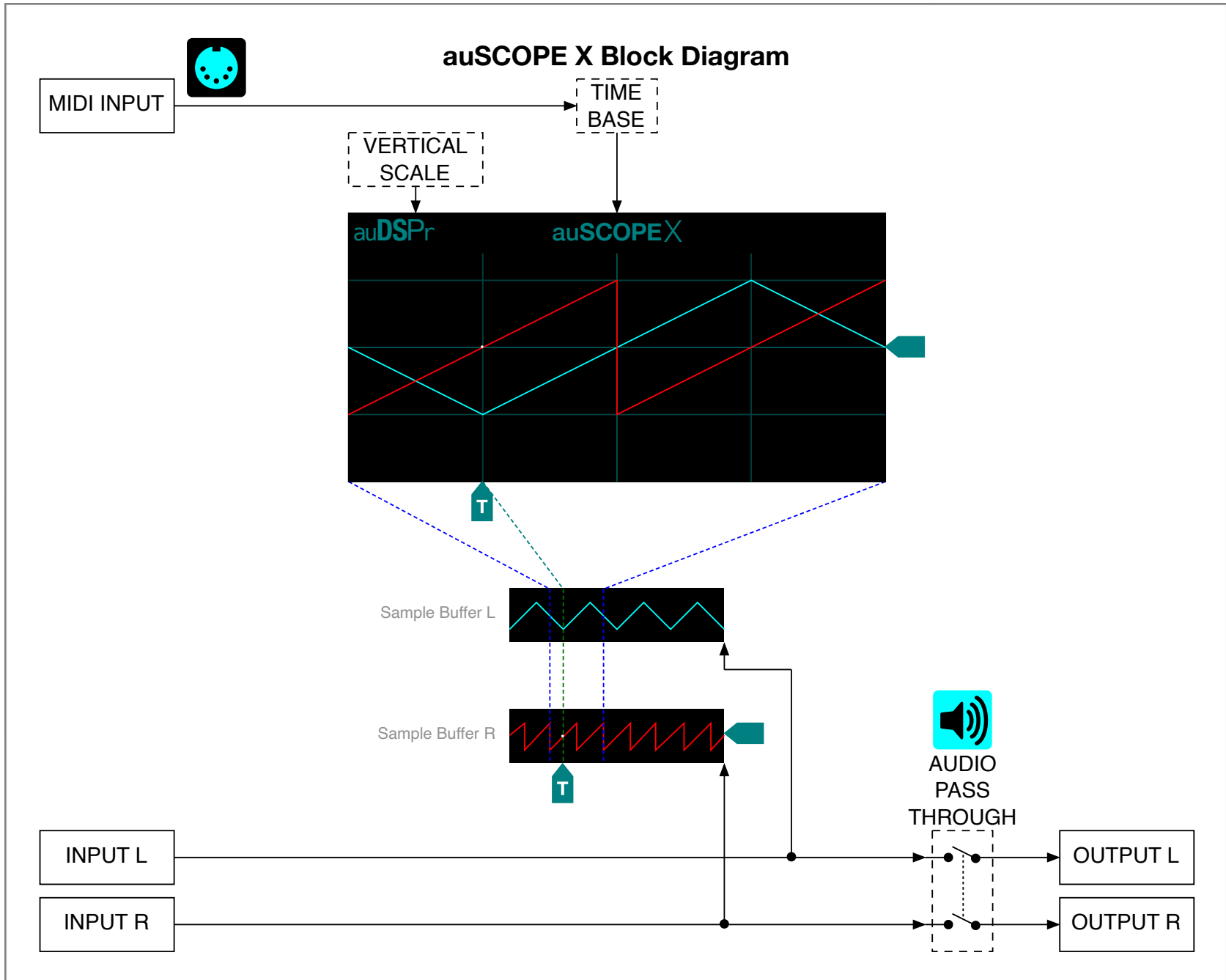
**Keep Screen On**

When Keep Screen On is enabled, auSCOPE X will prevent the screen from going to sleep. This is useful if you need to keep the traces available and visible for long periods (for example, during a live gig). Obviously disabling this option will allow the screen to sleep which saves battery life.

# Specifications

	Minimum	Maximum	Unit	Comment
Vertical Scale	-60.2	+60.2	dB	
Time Base	71 usec (1 cycle @ 14080 Hz)	9.309 sec (1 cycle @ 0.107 Hz)		
Sample Rate	44100	96000	Hz	

# Block Diagram





# Become an auDSPr Power User in Minutes

All auDSPr audio apps share common user interface features, so learn to be a power user *now* and you'll be a power user for all auDSPr audio apps!

First, each app consistently uses a specific key color to indicate interactive elements. This color is chosen to be eye-catching — a graphic designer might say that it “pops”. So when you see this color, the control is saying “See me! Touch me! Hear what I do!” Hint: The “pop” color is the color of the App icon.

## Getting the best performance

For optimum performance, when you are running any auDSPr audio app, you might want to consider first disabling Wi-Fi or activating Airplane Mode. Doing so will prevent any network activity or notifications from interrupting your session and competing for CPU and battery.

If you are running off battery, keep your charge above 50%. Otherwise the operating system might reduce CPU performance which can result in audio glitches or a sluggish user interface.

## Sliders

All auDSPr Sliders, in addition behaving just like typical sliders, have several added features designed so you can get to your desired setting quickly and accurately:

- Tapping a slider anywhere above or below the “thumb” (which you now know the thumb will be our “pop” color) will nudge the

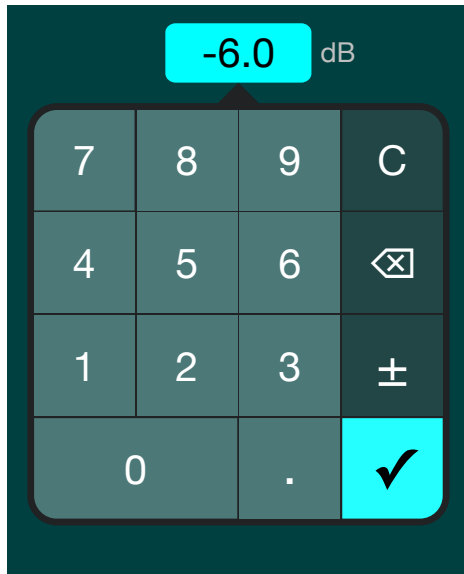
value in fine steps. (Obviously “above or below” is for vertical sliders — substitute “left or right” for horizontal sliders.) We have thoughtfully chosen step sizes for each parameter type. This allows you quickly to close in on your setting by first sliding to it, and then tapping up or down to fine tune accurately. (On other apps, I can't tell you how many times I've painstakingly made a setting only to have it nudge away as I lift my finger. Arrrgh! Our “Tap Slider Track To Step Value” Feature corrects this once and for all.) Furthermore, if you tap and hold, the value will keep stepping, just like key repeat on a computer.

- Double-tapping the slider thumb resets the value to a default setting which has been judiciously chosen.

## Range Sliders

- For sliders which control a range (for example, Frequency Range or Level Range), dragging from the middle of the range will move the entire range as a unit. The lower and upper values will move in lock step with each other so the range width stays the same. Tapping outside the range will nudge the entire range in fine steps.
- Sliding from either of the triangle-shaped controls at the lower left or upper right will change just the lower or upper value (depending on which one you touch, obviously). As with the simpler sliders, tapping will nudge the value in fine steps.
- Sliding from one of the dashed lines will change the width of the range.
- Double-tapping in the middle of the range resets both the lower and upper values to their default settings.

## Number Keypads



Lastly, all of the numeric parameter readouts are actually buttons. Tapping on one will bring up a convenient number keypad so you can directly enter in an *exact* value. And for parameters which are always negative (for example, Level), the minus sign is automatically entered for you, so you don't have to do it every time. (If you haven't figured it out already, I'm a control freak and efficiency freak. I'm hoping other control freaks like myself will appreciate these details and love auDSPr audio apps.)

## Product Info Page

Tap **auSCOPE X** to bring up the auSCOPE X product information page. Here, you'll find convenient buttons for visiting the auSCOPE X product page on our website, for viewing this informative User Guide, and for contacting us with a friendly e-mail. You'll also find the app version number.

## auDSPr Company Info Page

Tap **auDSPr** to bring up our company information page. Here, you'll find convenient buttons which link out to our website and to our social media. Earn brownie points by supporting us in public - we'll be your best friend!

In the future, the auDSPr Company Info Page is where you'll find information about our other sweet audio apps.

Knowing all this, you shouldn't ever need to crack another auDSPr manual, except to enjoy my quirky writing style.

Now go make something sound cool!

Dave Simpao  
auDSPr

P.S. If you enjoy our audio apps, **please write a favorable review** on the App Store. It really helps a lot! Thanks in advance!

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