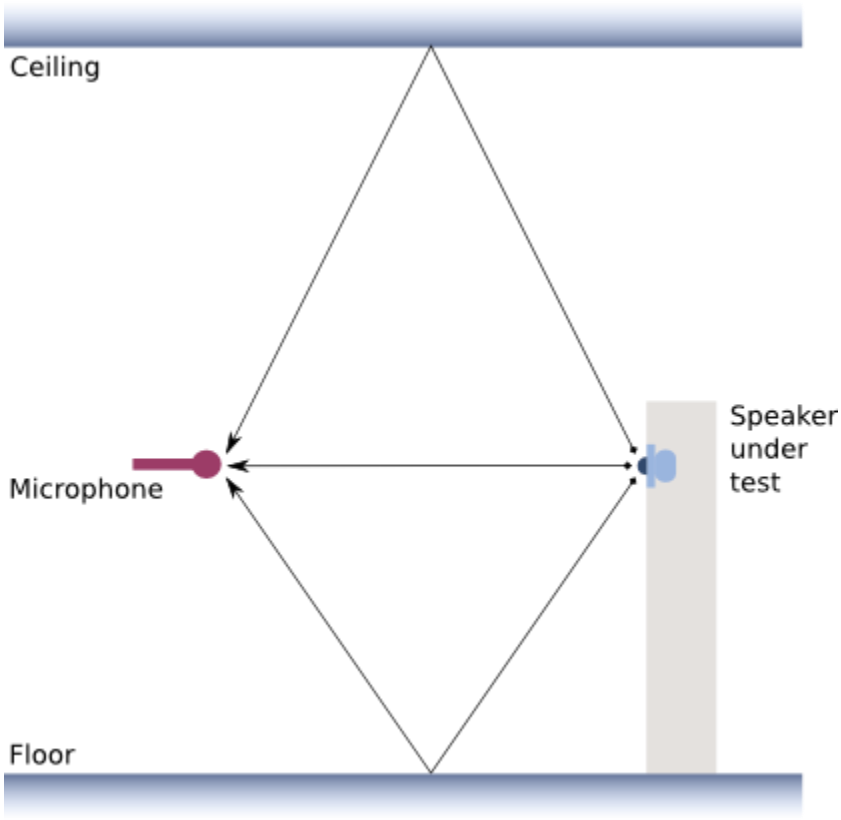
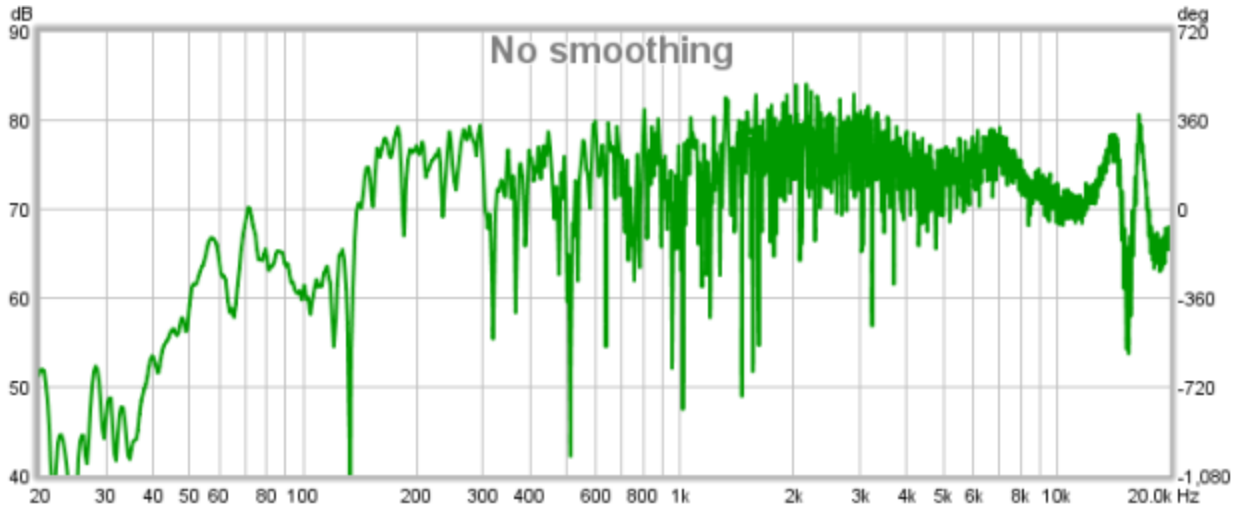
https://www.minidsp.com/applications/acoustic-measurements/loudspeaker-measurements#gated-measurements

Gated measurements

An acoustic measurement with the microphone at the listening position is generally referred to as an *in-room* measurement. You are measuring the combined effect of the loudspeakers (and/or subwoofers) and the acoustics of the listening room. That is fine for assessing room acoustics, but when doing **loudspeaker design**, you want to measure the loudspeaker only, without any effects from the room. This figure illustrates the problem:



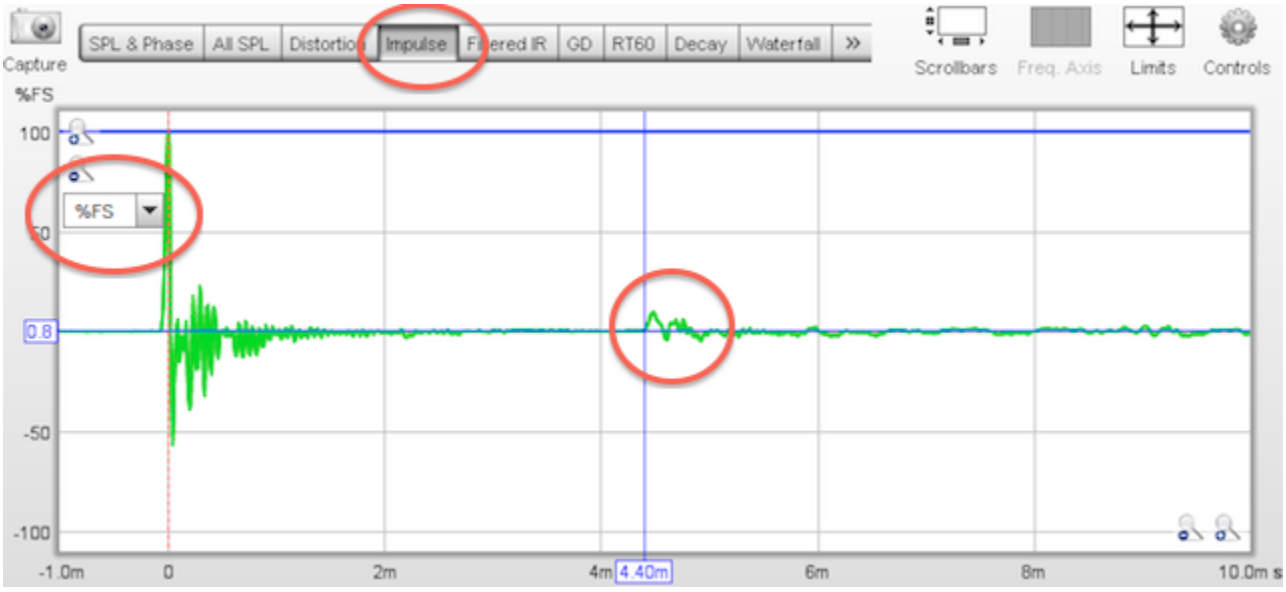
The sound from the speaker arrives at the microphone first, followed by a reflection from the floor, then from the ceiling, and somewhere along the way from the side walls. These reflections continue to bounce around the room for up to several hundred milliseconds. That is what we hear, but it makes it hard to get an accurate measurement of **just** the loudspeaker! To illustrate, here's a measurement of a 3-inch full-range driver taken with the UMIK-1 and REW in a typical domestic environment:



Obviously, without a little work, this is fairly hard to use! One way to address the problem is to use an anechoic chamber, which is a very large room with lots of acoustic absorption in it so there are almost no reflections. Most of us don't have one of those. Another technique is to use a *gated measurement*, where the reflections are simply removed from the measurement. We can do this in REW.

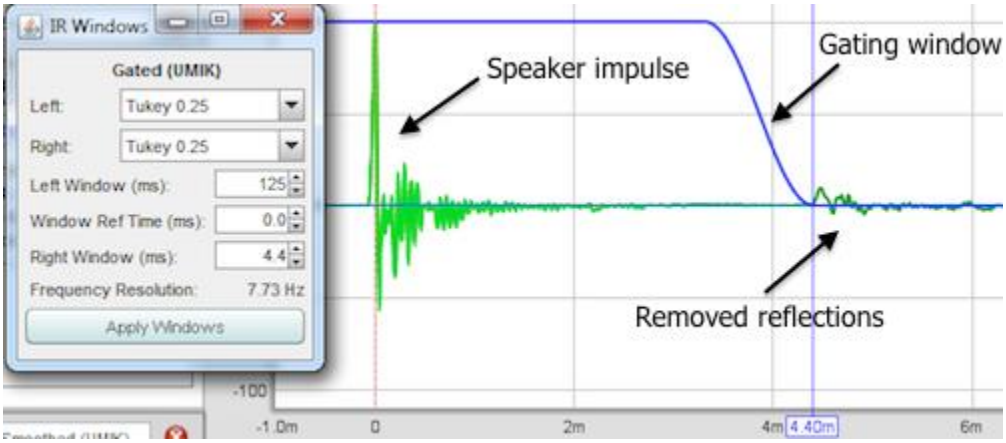
First, let's understand what we are looking for. The measurement was taken with the driver mid-way between the floor and ceiling at 120 cm from each, and the microphone level with the driver and 1 m distant. According to the floor-bounce calculator at mehlau.net, we would expect the first reflection to arrive at the microphone 4.65 ms after the direct signal.

Let's see if we can see this first reflection in our example measurement. In the main REW window, click on the "Impulse" button, and then hover the mouse over the display and select the "%FS" dropdown (you may need to adjust the graph limits to get a good view of the impulse response):

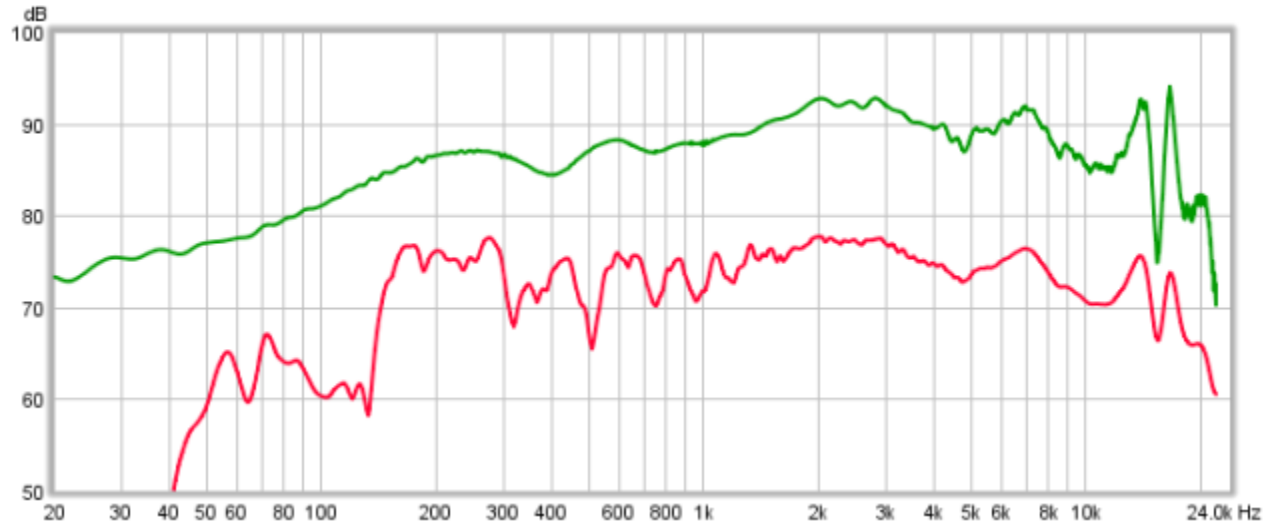


Yep! There it is... To eliminate this reflection (and all subsequent reflections), we will gate the signal at 4.4 ms as shown by the marker. Go to Tools→IR Windows, set the "Right Window" to 4.4 ms, and then click **Apply Windows**. The "window" is the region of time that REW uses to calculate the

frequency response. The display will update to show the new window, which reduces the signal so that it is zero by 4.4 ms (in blue):



Clicking back on the **SPL & Phase** button will now show the gated measurement — that is, with the reflections removed from the frequency response calculation. Here it is (shown on the **Overlay** screen) in green:



Another technique that can be used to make the raw measurement graph more usable is *smoothing*. This function is accessed from the Graph menu when viewing the main window, or from the Control dialog on the Overlays window. For example, the graph above shows, in red, the same measurement with 1/12 octave smoothing (and without gating). While smoothing can sometimes be used to give a similar effect as gating, this example shows that you must be careful: the peaks at 14 and 17 kHz have been smoothed over and now are not accurate.

Gating does have limitations. For one thing, the frequency resolution of the measurement is reduced—the IR Windows dialog shows this resolution. In addition, any frequency below about 1 / (window length) cannot be represented. In the case of the 4.4 ms window, the lowest frequency that can be represented correctly is 1/0.0044 or about 230 Hz - anything on the graph below this frequency must be ignored. So this technique works best at high frequencies and can't be used for low-frequency measurements at all.