Microphone Frequency Response

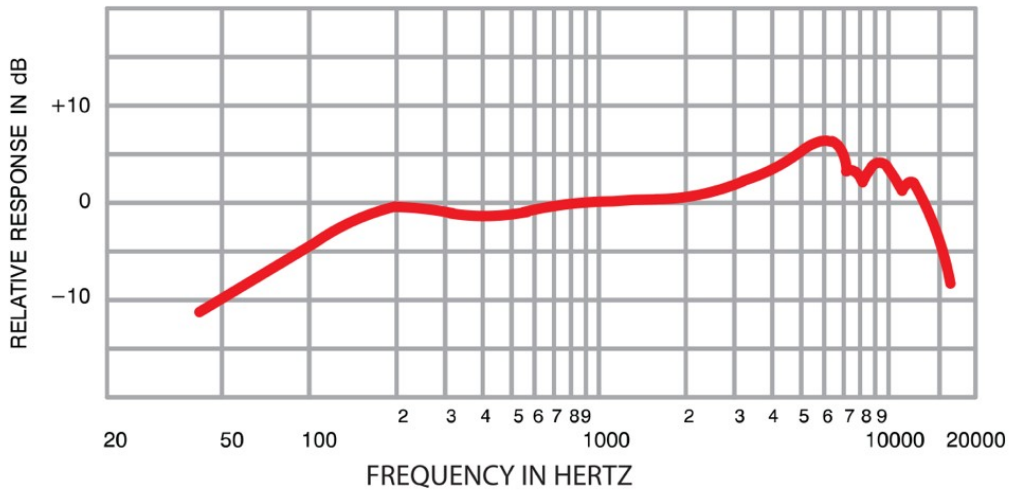
(From Shure Company)
A microphone only does one thing. It converts sound into an electrical signal that can be amplified, recorded, or transmitted. But, there are a number of different characteristics that make microphones sound different. These characteristics determine a mic's suitability for a particular application.

In this post, we'll talk about frequency response.

What is frequency response?

Frequency response defines the range of sound that a microphone can reproduce and how its output varies within that range. The frequency response is the most significant factor in determining the sound signature of a microphone. The frequency response of a mic is represented graphically by a response curve. The two most common types are flat response and shaped, or tailored, response.

Below is an example of a frequency response chart.



What's the difference between flat and shaped frequency response?

A **flat response microphone** is equally sensitive to all frequency ranges, so its response curve is in fact nearly a flat line. A flat response microphone reproduces the sound source accurately with little or no variation from the original sound. That's good if you're recording musical instruments or sound effects, but a mic with a flat response usually doesn't sound good on voices.

A **shaped response microphone** is more sensitive to some frequency ranges than others. Its response curve has peaks and valleys. Many microphones that have a shaped response are less sensitive to low frequencies, which reduces the pickup of both handling noise and the rumble from the stage when the mic is mounted on a stand. A shaped response microphone also typically has a boost in the upper mid-range, usually between 3,000 and 6,000 Hz. This is called a *presence rise*, and it enhances the clarity, or "punch," of voices and instruments.

Ideally, whether a microphone has a flat or shaped frequency response, a frequency response curve should be a fairly smooth line. If it has a lot of abrupt peaks and valleys, the microphone probably won't sound very natural, and it may have a greater tendency to cause feedback with a PA system.

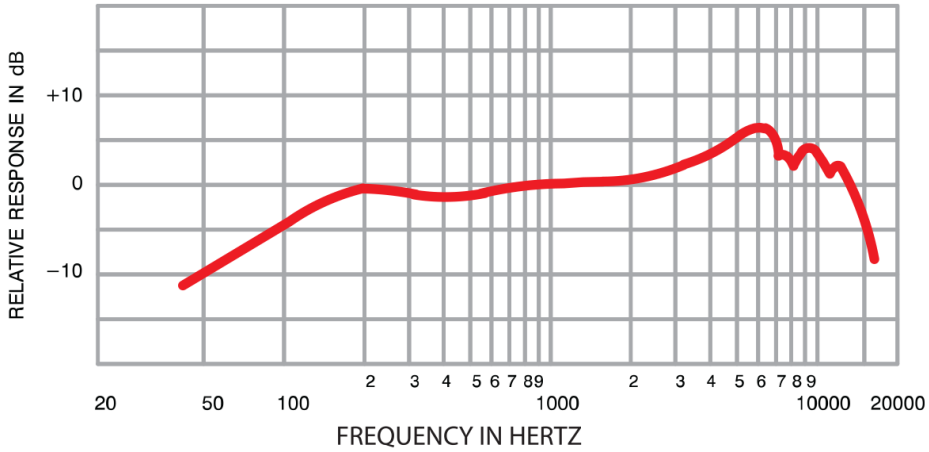
Some microphones allow their frequency response to be adjusted to suit different applications. The most common adjustments are a low frequency roll-off control to reduce pickup of room rumble and a boost in the upper mid-range to enhance voice intelligibility.

Reading the Chart

The chart is usually over the 20 Hz to 20 kHz range, which is the range of human hearing. So, how do you read it? The horizontal numbers in a microphone frequency response chart indicate frequencies (again, usually over the 20 Hz to 20 kHz range), and the vertical numbers represent relative output level in dB (decibels). As you look at a frequency chart, you can tell how a given microphone performs at certain frequencies.

Comparing Two Popular Shure Microphones

How is this information helpful? Let's look at a couple of examples.
Here's the ubiquitous Shure **SM57's** frequency chart:



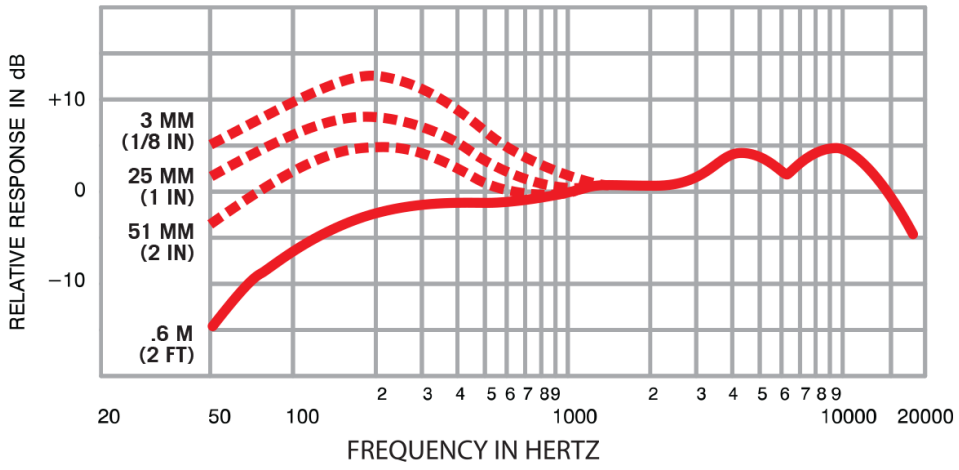
SM57 Frequency Response Chart

The frequency response of the SM57 makes it especially good for certain instruments such as a snare drum because the fundamental frequency of the snare resides in the 150 Hz to 250 Hz range, right where the SM57 frequency chart shows that the SM57 response is flat or neutral.

In other words, at this frequency, what you hear going into the microphone is what you will tend to hear coming out: nothing more, nothing less.

The presence bump on the right of the chart is just where the frequency of the "snap" of the snare resides. In addition, its rolled off low-end makes it great for downplaying the kick drum, which is often very close to the snare. This combination is what most engineers are looking for in a great snare drum mic: the ability to capture the true sound of the snare, accentuate its snap, and reject other instruments in close proximity.

Now, let's look at another popular Shure mic: the **BETA 58A®**.



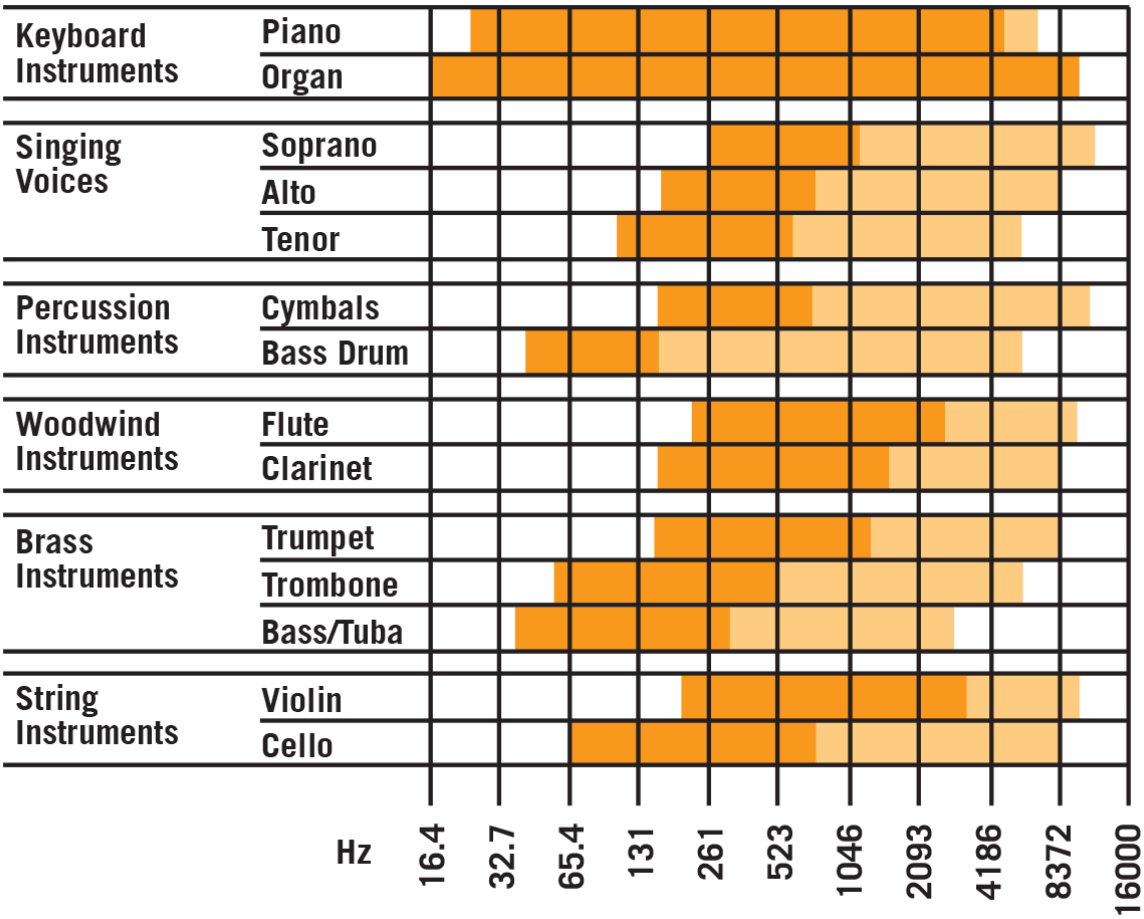
Beta 58A Frequency Response Chart
The BETA 58A is a popular model for vocals. The rising frequency response from 2,000 to 10,000 Hz adds brightness

and intelligibility to the voice. The bass emphasis (proximity effect) when used close to the mouth—see the dotted lines in the graph—adds warmth and fullness to the voice.

Pairing the Mic with the Sound Source

Next, let's look at what you're planning to mic. Musical instruments and voices have frequency ranges as indicated on the chart below. The darker orange indicates the range of fundamental frequencies, and the lighter shade represents the range of the highest harmonics or overtones of the sound source.

A mic that responds evenly to the full range of an instrument will reproduce the most natural sound.



Vocal and Instrument Frequency Response Chart

When you compare the frequency range of the SM57 to this chart, it's easy to understand why it's a staple in most mic lockers. Often called "the industry workhorse," it does a very good job of capturing the natural sound of most instruments across their frequencies.