

Welcome To The Vox Production Team!

We are so excited you have chosen to jump on our Production Team and are interested in learning more about Audio Engineering here at Vox Church. Our desire is to empower you to feel comfortable and confident when serving and give you the tools to create a truly incredible worship environment at your campus.

While we hope this curriculum will guide you, it by no means covers all aspects of audio engineering. We've included some links to videos from MxU to really help you dive deeper into the practical applications of this training and we encourage you to reach out to your Production Lead if you would like recommendations for even more resources.

In this training we will cover:

- 1) Signal Flow
- 2) Gain Structure
- 3) EQ, HPF, and LPF
- 4) Compression
- 5) Gating
- 6) Monitor Mixing

Section 1. Signal Flow

In this first section, we will be covering signal flow. Understanding the signal flow (or audio chain) will help you to not only set up and tear down your audio equipment and mixing console, but also help you in troubleshooting any issues you may have. The first component of your signal flow is the audio being produced, whether from a voice singing or an instrument, that audio is then converted into an electrical signal by way of a transducer (a microphone is a transducer). That electrical signal then hits the input of your mixing console, through your console and audio processing, then out to your FOH Mains (speakers). An easy way to think of it is:

Signal flow is the path of the audio signal from its source to its output.

A few simple examples of signal flow at Vox may be:

-Worship Leader's Voice > Microphone > Mixing Console (Digico S21) > FOH Mains

-Acoustic Guitar > DI Box > Mixing Console (Digico S21) > FOH Mains

-Drums > Drums Mics > Snake > Mixing Console (Digico S21) > FOH Mains

In addition to the physical signal flow examples above, you also have a digital signal flow happening inside of your Digico S21. This signal flow can easily be viewed right on your console and will often include such audio processing tools as EQ, compression, gates, effects like delay and reverb, and more before sending the processed signal to the FOH Mains. We'll cover each of those separately in upcoming sections. For now, just remember that understanding your signal flow **from its source to its output** is crucial for an audio engineer.

Section 2. Gain Structure

Next, we will cover the concept of gain structuring. As stated earlier, your audio source gets converted to an electrical signal via a transducer. Gain is the measure of the ability of a circuit to increase the power or amplitude of a signal from the input to the output. Practically, when a vocalist's singing gets converted to an electrical signal, the voltage of that signal is very low, using gain we have the ability to increase the voltage in which the source is hitting the console to better control and mix that source.

Structuring gain first is one of the most important ways in which to achieve a clean, great sounding mix. Remember, since gain is the first stop in your chain once you hit the board, everything after will be affected by changes to the gain. This is just one reason as to why we want to set the gain appropriately right off the bat. For our systems, we recommend setting your gain so that your audio sits around –12dB to start, hitting –3dB when the band is at full. Generally, you'll want your audio signal to live in the green about 70% of the time with peaks to yellow the other 30%.

Take a look at this video from MxU where they cover the basic concept of gain structure:

MxU Basics of Gain Structure

https://app.mxu.rocks/now/lessons/c6dfcb26

Section 3. EQ, HPF, and LPF

Now that you understand your signal flow and have set your gain structure, the next step will be to set your EQ (or equalizer) and your High- and Low-Pass Filters. Let's start with your High- and Low-pass filters.

These filters do exactly what the name suggests, allows a certain frequency range to "pass" through, while the rest gets completely cut out. A high-pass filter will cut low end out, allowing the "highs" to pass, and a low-pass filter does the exact opposite. We use these in a variety of applications to help clean up and tighten our sound. For instance, let's say our acoustic player has a lot of bass and sub-bass coming through making the guitar sound muddy and maybe even causing some low-end feedback. We can activate our high-pass filter at 120Hz and cut out all the low frequencies below 120Hz, resulting in less low-end on the acoustic but a more workable tone that fits nicely in the mix. The same can be done with the low-pass on maybe an electric guitar tone with too much presence that make it sound shrill. Play around with these and try to set them in the ballpark of where you may want to cut. Think about each instrument or vocal and how they could benefit from these, then try it out!

MxU Intro to HPF and LPF

https://app.mxu.rocks/now/lessons/30824cb9/topic/67

Let's continue with our EQ now. EQ is a tool to help us shape some of the tonality of our audio source. As the video below states, this should be treated more as a musical tool than to hack away at problems. By cutting or boosting a certain frequency or frequency range we can dramatically change the overall tone of the audio. It is always preferred to cut rather than boost, however, there may be times when a slight boost is necessary. You'll want to make sure you are using your ears more than your eyes when EQing. If there is a frequency that is bothersome and you aren't sure where it is, try a narrow Q (width that you are cutting or boosting) boosted drastically and sweep it across the frequency spectrum until you hear what is bothersome and then cut it. This is a great way for you to learn a little bit more about what frequencies can be problematic and where each instrument lives. Just remember to do this only during a run-through or when practicing by yourself.

Watch this video from MxU to better understand some of the ways to utilize EQ at Vox Church:

MxU Intro to EQ

https://app.mxu.rocks/now/lessons/0de22653/topic/67

While we always want to be using our ears and not our eyes, use this chart as a starting point and to learn the correct names of each region and frequency range.

Region Name	Frequency Range
Sub-Bass	20 Hz - 60 Hz
Bass	60 Hz - 250 Hz
Low Mids	250 Hz - 500 Hz
Midrange	500 Hz - 2 KHz
Upper Mids	2 Khz - 4 kHz
Presence	4 kHz - 6 kHz
Brilliance	6 kHz - 20 kHz

Section 4. Compression

Let's take a look at another valuable tool for the audio engineer, compression. Compression controls the minimum and maximum dynamics of an audio signal using four primary settings: threshold, ratio, attack, and release. Many compressors also include an input and output gain setting for even more fine tuning. Let's take a quick look at what each one of these settings controls.

<u>Threshold</u> controls the minimum level at which the compression will kick in and apply. Audio signals below this threshold (represented as dB) will be ignored by the compressor, while audio signals above the threshold will be affected by the compressor.

<u>Ratio</u> essentially tells us how much of the affected signal will be compressed by. A ratio of 1:1 means that nothing will be changed, what comes in goes out. A ratio of 10:1, on the other hand, means that the incoming signal that is 10dB higher than the threshold will only be 1dB louder at the output.

<u>Attack and Release</u> adjust how quickly the compressor is applied and for how long. A shorter attack time means the audio signal will be compressed quickly when it passes the threshold. A longer release time will hold the compression on the audio signal longer before it goes back to its natural state.

As stated before, we want to always be using our ears when mixing live sound. Take a look on the next page for some good starting points with compression. Talk with your Production Lead about setting up a time to practice with a recorded source and hear the difference yourself as you experiment with different compression settings.

Compression starting suggestions:

Instrument	Threshold	Ratio	Attack	Release
Acoustic Guitar	-10dB to -15dB	4:1 to 10:1	5-10ms	10-30ms

Bass Guitar	-5dB to -10dB	4:1 to 12:1	2-10ms	5-30ms
Drums	-15dB (varies per drum)	10:1 (varies)	0-5ms	0-5ms
Vocals	-3dB to 4dB (varies per vocalist)	2:1	0-5ms	30-50ms

Watch this video from MxU to better understand some of the ways to utilize compression at Vox Church:

MxU Intro to Compression

https://app.mxu.rocks/now/lessons/9c7e4b6d

Section 5. Gating

Gating is a fairly simple concept, but is another great tool to dial in your sound. Essentially, a gate sets an audio level threshold and then mutes all signal below that threshold while allowing the signal above that threshold to pass through. Using a gate allows us to capture certain sounds or instruments while muting the background noise picked up by the microphone.

One of the most common uses of a gate in live sound is on drums. Let's use the example of a snare drum. Your snare mic is picking up nearby drums and cymbals, we want to isolate the snare so that we can mix it appropriately without bringing up all the excess noise as well. By using a gate, we can isolate the snare drum hits to more effectively mix.

Watch this video from MxU to better understand some of the ways to utilize gating at Vox Church:

MxU Intro to Gating

https://app.mxu.rocks/now/lessons/be165f13

Section 6. Monitor Mixing

At Vox Church, we understand the importance of a good monitor mix for our worship team members. We utilize In-Ear monitor systems not only so we can accommodate personal mixes for our musicians, but also to reduce overall stage volume, allowing us to have more control over the mix in the room.

Monitor mixing is a team effort between the musician and the audio engineer. We want to effectively and humbly communicate with each other to achieve the desired results. On occasion, we may even need to graciously educate the musician on some of the system or phrasing without overwhelming them to make the process even smoother in the future.

Practically speaking, what the musician hears is often far different than what you are mixing for FOH. One thing to note is that our monitor mixes at Vox are pre-fader. This means that volume changes with the fader (I.e. bringing up a second vocal when they are leading) won't change for them either. The only changes the musician will hear are that to Gain Structure, EQ, Compression, and Gating. Using the headphone out of the board will allow you to cycle through the monitor mixes to give you a better idea of what they are hearing.

Watch this video from MxU for some tips on mixing monitors from FOH:

MxU Mixing Monitors from FOH

https://app.mxu.rocks/now/lessons/694d79e4