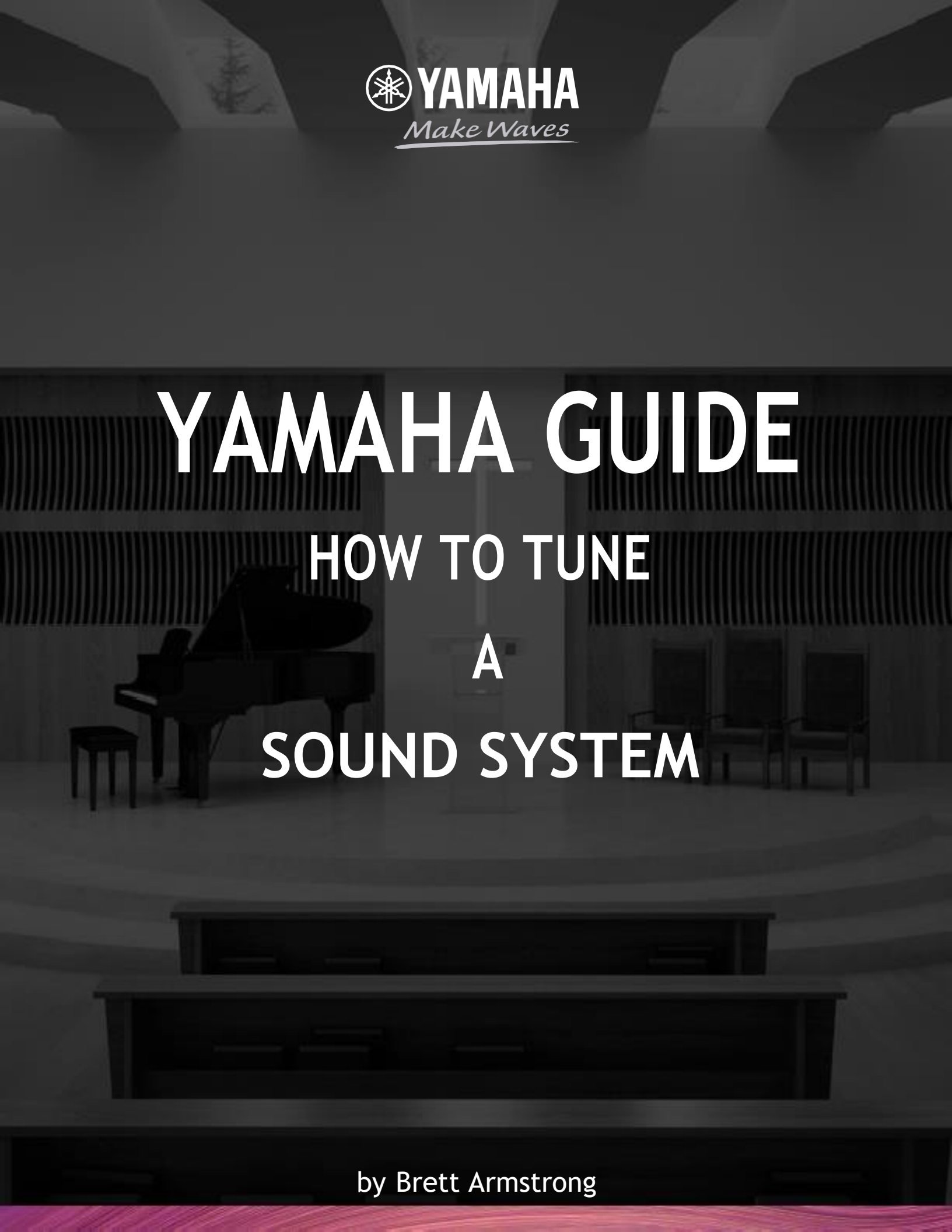


YAMAHA GUIDE

HOW TO TUNE

A

SOUND SYSTEM

by Brett Armstrong

HOW TO TUNE A SOUND SYSTEM FOR LIVE SOUND

Every church is different. Some are mega-churches with worship centers that look and sound like concert halls with ornate architecture and elaborate acoustical considerations. Others are small rooms with a half-working PA and no acoustic treatment whatsoever.

Either way, the service must go on, and it's your job to make it sound as good as possible.

Now, if you're mixing in a 1,000+ capacity church, you're most likely using a state-of-the-art digital console with full parametric EQs to fine-tune your mix. The room itself has probably already been tuned by a trained acoustician as well. We should all be so lucky.

Unfortunately, most of us will be working in small spaces with minimal to no acoustic treatment, a bargain basement analog console and a rack of graphic EQs.

The key to a good-sounding mix is a good-sounding room, but if you don't have one, you can still fix a not-so-good-sounding room by using a graphic EQ to "tune" the PA system.

REFERENCE MATERIAL

Start by testing the system with a few high-quality tracks you know well.

It's beneficial if the tracks are like the type of music, you will be mixing for the service. When mixing the latest CCM songs, it doesn't do you much good to check the system with an AC/DC tune. It should be a very familiar track to you.

Get a feel for what your reference tracks sound like in the room compared to your studio, home stereo, car, etc. Walk around and see what it sounds like up front, way in the back and on the far sides. Is the low-end overpowering? Do any particular frequency ranges stick out? Is there anything missing from the mix?

If you're lucky, the person who tuned the PA last did a good job, and you won't need to make

any adjustments. Or the person might have had no idea what they were doing and just made a smiley face on the EQ.

Either way, it's best to listen first and spin knobs second. As someone else once said, "Never judge an engineer by the curve of their graphic equalizer."

It's far more important that you use reference tracks that you're familiar with rather than the tracks other engineers use.

GRAPHIC EQUALIZERS

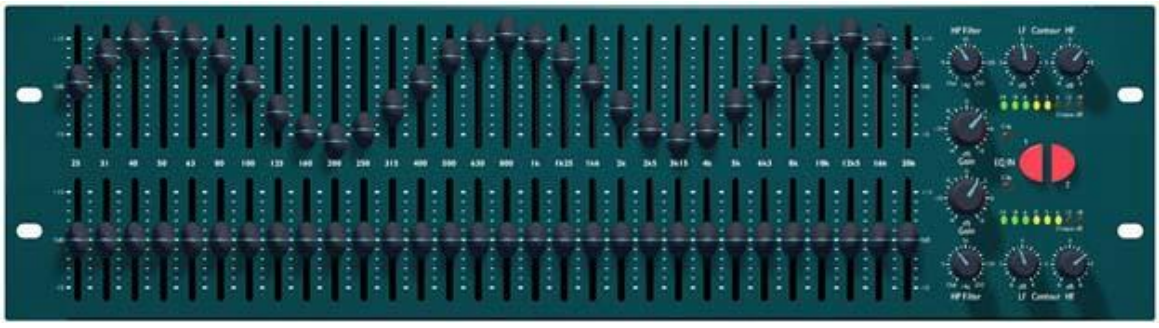
Most GEQs have 31 bands. That might seem shocking if you're used to the typical 4-band semi-parametric EQs on most live sound consoles, but GEQs have a very different purpose.

Each of the 31 bands has only one control — gain. Instead of knobs, there are 31 tiny faders that you can use to add or subtract gain for each band.

The bands themselves have fixed frequencies. At first glance, they seem to have little rhyme or reason as to which frequencies the bands control, but they're broken down into 1/3 octave increments starting at 20Hz up to 20kHz.

When using an analog GEQ, each band has a Q-value of about 4 (quality factor, aka resonance) relatively narrow notches meant for subtractive EQ. GEQs are mostly used to remove problem frequencies caused by the room.

When cutting frequencies on a GEQ, start small. There's no need to kill a band over a bit of feedback completely. Most GEQs have a dynamic range of +/- 15dB, which is a drastic cut. Start with something small, like a 2-3dB cut, and slowly increase it if needed.



It's not very common to add frequencies using a GEQ, but if you need to boost a specific frequency range, it's better to do it with small boosts across multiple bands. Don't push 80Hz up to 12dB. That's just going to create a new feedback problem. You're better off making small boosts at 63Hz, 80Hz and 100Hz.

It's important to periodically bypass the GEQ and see what it sounded like before you made any changes. It's very easy to make your mix sound worse by over-correcting, and you'll never know if you don't do some A/B testing and compare your new settings against the original.

After making the necessary adjustments and confirming that you've improved the mix, give your

reference tracks another listen. If they sound better, you did things correctly. If they sound worse, it's probably from over-correcting. Try to reduce the cuts you made and see if your mix improves.

PLAYING IT BY EAR

The most challenging part of tuning a sound system is identifying frequencies that are feeding back. It's not hard to hear the feedback. It's just tricky to find which of the 31 bands on your graphic EQ will fix the problem.

At the end of the day, the only thing that will make that process any easier is some good old-fashioned ear training. Luckily, several downloadable apps will help you train your ears to hear frequencies better. Some good examples are:

- Tenuto
- Teoria
- Good-Ear.com
- EarMaster
- Quiztones

In the meantime, as you work to improve your hearing, you can use a Real-Time Analyzer (RTA) to help you identify frequencies that are causing problems. Many digital consoles include RTAs, but you can also find apps for most smartphones, tablets, and laptops. Some good examples of these are:

- Audio Analyzer
- Ultrasonic Analyzer
- Audio RTA
- Audio Spectrum
- Audio Tools

RTAs are spectrum analyzers that graph the frequency response of whatever space you're in. Louder frequencies will display more prominent peaks on the graph, giving you a visual cue for problem areas.

If you're having difficulty identifying frequencies, start by figuring out if this one is higher or lower than the last one and narrow it down from there.

To properly use an RTA to tune the room, you need to generate a "Pink Noise" signal through the sound system. Most RTA apps will have a pink noise generator that you can connect to a channel on the console.

Start by setting your master fader to unity and the channel fader to unity. Set the 4-channel semi-parametric EQ on the console to zero db. Then, using a db level meter, bring the channel gain up until you are at the overall db level you will be running at for live services. It's important to take readings in several room settings: front, back, center, back-left, back-right, center-left, and center-right.

The RTA will show you the frequency level at each place you take a sample. The purpose is to see where each frequency is in relation to the "flat" line on the GEQ (0db).

The goal is to create as flat of an EQ response as possible, which will go a long way in preventing feedback issues and give you an overall "tuned" sound system.

Some frequencies will need to be boosted, and some will need to be cut. After you make your adjustments, go back, and repeat the procedure, you may have to do this several times to get the EQ settings at the correct levels to achieve a flat response.

Now play your tracks back and listen to see if the adjustments have helped improve the overall sound. You can now use the 4-band semi-parametric EQ on the console to add more depth to the track if needed.

FEEDBACK TEST

Now you can move on to your live mics. You need to test them to reduce the possibility of feedback from them as much as possible:

- Start by setting up your vocal mics downstage.
- Bring the master fader on your console up to unity.
- Bring the channel faders for the vocal mics up to unity.
- Slowly increase the gain of each mic until it starts feeding back, then turn it down just enough to make it stop.
- With all the mics "live," slowly turn up the gain on each vocal mic and identify the frequencies that cause feedback.
- Find the band for that frequency (or the closest one to it) on the GEQ, and slowly lower the fader until the feedback stops.

Remember, this is a "feedback" test. You are not "gain staging" the console here. You are identifying frequencies that can cause possible feedback issues.

One of the most common mistakes FOH techs make when tuning a sound system is over-EQing. Don't go crazy! Cutting a frequency more than you need to isn't going to make it any less likely to cause feedback. It's just going to make your mix sound worse.

Remember, your goal is to identify problem frequencies in the room. If a mic causes feedback, one of the frequencies is likely causing problems in your room. Make a note of it and adjust accordingly on your GEQ. To prevent the mic from feeding back, cut that frequency on the GEQ.

RINGING OUT THE STAGE MONITORS

The mains aren't the only speakers in the room. The stage monitors also have the potential to cause feedback. Thankfully, the process for eliminating offending frequencies or "ringing out" is very similar.

One key difference is the positioning of the stage monitors. You have control over the relationship between the mic and the monitor, so make sure they're working together to prevent feedback by pointing the rejection area of your vocal mic toward the center of the stage monitor driver. If possible, try to ensure the monitors aren't so far back that the audio signal bounces off the stage's back wall.

Start by setting up at least one vocal mic in front of each stage monitor. Turn the AUX Masters up to unity.

Turn the AUX sent to each monitor up to unity for each vocal mic. Ensure the console's semi-parametric EQ channels are set at zero db.

Slowly increase the gain of each mic until it starts feeding back, then turn it down just enough to make it stop.

With all the mics "live," slowly turn up the gain on each vocal mic and identify any frequencies causing the feedback.

Find the band for that frequency (or the closest one to it) on the GEQ, and slowly lower the fader until the feedback stops.

WRAPPING IT UP

Hopefully, these techniques will help you get the best sound you can for your church.

One thing to consider is that bringing in an acoustician is highly recommended if you have many hard surfaces, wood or tile floors, and windows. Acoustical treatments can sometimes make all the difference in the world.

Set aside a whole day so you will have the time you'll need to get the best sound response you can. One thing to remember, once you have the global settings locked in, write them down, save them somewhere and try to lock that part of your system to prevent anyone else from coming along and changing the settings on you.

Good luck and happy mixing!

GLOSSARY OF TERMS

ACTIVE SPEAKERS:

Powered speakers, also known as self-powered or active speakers, are loudspeakers with built-in amplifiers. They can be connected directly to a mixing console or other low-level audio signal sources without needing an external amplifier.

AUX:

An AUX send is an output used on most live sound and recording mixers. It allows you to create an "auxiliary" mix in which you have individual-level control over each input channel on your mixer to your AUX send output. This will enable you to add those effects to an output or channel on your mixer.

DAW:

A digital audio workstation is an electronic device or application software for recording, editing, and producing audio files.

DI:

Direct boxes are often referred to as DI, or direct injection, boxes. Their primary purpose is to convert unbalanced and/or high-impedance instrument signals into a format suitable for direct connection to a mixing console's mic input — without using a microphone.

GEQ:

A graphic equalizer is used to alter the frequency response of an audio system using linear filters. Since equalizers "adjust the amplitude of audio signals at particular frequencies," they are, "in other words, frequency-specific volume knobs."

IEM:

An in-ear monitor is used in place of monitor speakers that are usually placed on the stage in front of the band.

INSERT:

In audio processing and sound reinforcement, an insert is an access point built into the mixing console, allowing the audio engineer to add external line-level devices into the signal flow between the microphone preamplifier and the mix bus.

PASSIVE SEPAKERS:

A passive speaker has no built-in amplifier; it must be connected to an amplifier through an ordinary speaker wire.

PRE/POST:

Pre and Post Sends are AUX sends. They control the sound sent to objects like nursery speakers, stage monitors or anything other than the main house speakers. A pre-AUX send delivers the signal out of the mixer BEFORE it passes through the channel fader, pre-fader.

PREAMP:

A preamp is a "preamplifier." As the name suggests, it prepares the signal from a pickup or microphone for further amplification.

SEMI-PARAMETRIC EQ:

Sometimes called pseudo or quasi-parametric EQ, a semi-parametric EQ is a parametric equalizer with one or more missing features. This term is sometimes used to describe a single band of equalization, which generally means a parametric EQ that does not have a Q control (the Q is fixed).

SIGNAL-TO-NOISE RATIO:

The signal-to-noise ratio (abbreviated SNR or S/N) is a measure used in science and engineering that compares the level of the desired signal to the level of background noise. SNR is defined as the ratio of signal power to noise power, often expressed in decibels.

SPEAKON:

Speakon is a trademarked name for an electrical cable/connector. Initially manufactured by Neutrik, it is mainly used in professional audio systems for connecting loudspeakers to amplifiers. Other manufacturers make compatible products, often under the name "speaker twist connector."

SUBGROUPS:

Subgroups are a way to "pre-mix" several channels on a sound console before sending them to the master output mix.

TRS:

Tip-Ring-Sleeve refers to the parts of the jack plug that the different conductors are connected to. A TRS cable has three conductors vs. the two on a standard guitar cable. A guitar cable is a TS or Tip Sleeve cable.

UNITY:

Unity gain is a term used when establishing the balance between pieces of audio equipment. The idea is that input should equal output level-wise. Audio that goes into a device at one level and comes out of that device at the same level is said to be at unity gain.

GAIN STAGE:

Gain staging is the process of managing the relative levels in each step of an audio signal flow to prevent the introduction of noise and distortion.

PINK NOISE:

Pink noise definition is - a mixture of sound waves with an intensity that diminishes proportionally with frequency to yield approximately equal energy per octave.

Q-VALUE:

Stands for “Quality Factor,” defining the bandwidth of frequencies that will be affected by an equalizer.

XLR:

XLR refers to a three-pin locking connector that is used in audio applications.

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