GAIN STRUCTURE

Gain structure *is the sequence of inputs & outputs that a signal follows throughout an audio system.*

The building block of gain structure is called a **'gain stage'**. A Gain Stage has three parts – the Input, the Gain, and the Output. The signal arriving at the **Input** is boosted by the **Gain** control, and then sent to the **Output**.

Input => Gain => Output

Some devices need a lot of gain, others not so much. A microphone signal might need 30 or 40 dB of gain, whereas an electric piano might only need 3 or 4 dB of gain.
Gain on a preamp is controlled with the **gain** or **trim** control.

In a typical studio, you'll find many gain stages. Let's 'record' an electric guitar and see where the gain stages are:

- A guitar feeds a distortion pedal. The *input* is where you plug the guitar in to the pedal; the *gain* is happening inside the pedal (compression and distortion); and the distorted sound is *output* from the pedal.
- The pedal feeds a guitar amp. The *input* is on the front of the amp; the amp circuitry adds lots of *gain*; the *output* is connected to the amp speaker.
- The amp is being miked. The signal from the microphone is fed into a mixer. The *input* is on the rear of the mixer; the *gain* is created by a preamp; the *output* goes to the channel strip on the mixer.

Achieving Good Gain Structure

As you set up for a recording or performance, you're making several adjustments of the Gain controls to get the best levels and the cleanest sound. You have to carefully balance the inputs, gain settings, and outputs throughout the signal path.

- The Input is vulnerable to overload by incoming signals that are too loud. If you hear distortion, check your inputs to make sure they're not being overloaded.

- The Gain may add noise and some amount of harmonic distortion. If you hear a lot of noise, check your gain settings to make sure you're not adding more gain than should be necessary. If your gain is set very high, it might mean that the input isn't getting enough signal. If your gain is set very low, it might mean that the incoming signal is too hot for the input.
- The Output has to be compatible with the next input, or you'll have problems. Ask yourself how loud the output is, and how strong the signal should be for the next input.

The main reason for good gain structure is to *keep the noise from getting in*. The best way to do this is to ensure that the incoming SIGNAL is good and strong (though not so loud as to overload the input). For example, a synth may have a fairly weak output. If so, the keyboardist should be asked to turn up the volume as much as possible, in order to deliver a strong signal to the input of the mixer. Then the engineer doesn't have to add a lot of gain.

What is Unity?

If you look at a mixer, you'll notice the faders may 'notch' at a marking of 0dB, and that the meters have 0dB near the top, clearly marked. 0dB is a very important number. It represents the point where the system is working at its optimum levels. This point is called **unity.** It's understood to mean that whatever the voltage is coming in is also the voltage going out.

Here's how to set unity gain for a microphone. First, bring all your faders down to silence. Then turn up the Master fader and the microphone's channel fader to 0dB. Now, have the singer sing into the mic at a good level, and watch the meters. Adjust the Gain (Trim) control for the mic channel until the meters register around 0dB.