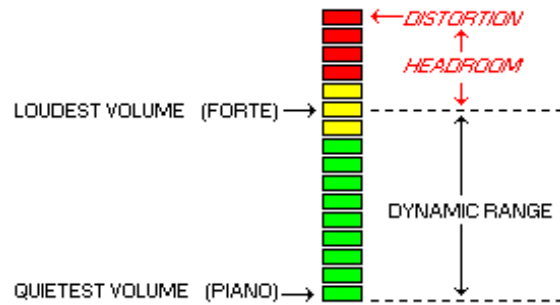




# Dynamic Processing

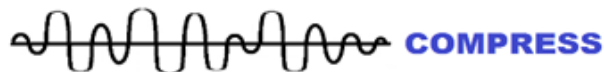
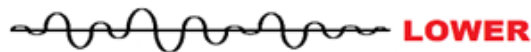
The **Dynamic Range** of a piece of music, or speech, is the distance between its quietest volume and its loudest volume. Musically-speaking, it is the distance between the piano and the forte.



The dynamic range of a signal on a Level Meter shouldn't bounce up and down more than 10dB (6 to 8dB is even better). This will allow you to hear the really quiet passages, but prevent the really loud passages from going up into distortion. Unfortunately, a live musician can deliver up to 100dB.

In the case of signals that have particularly high electrical movement, we need to use a Dynamic Processor to reduce (compress) the distance between the loudest (forte) and the quietest (piano). A gentle compression will improve the Headroom, which is the safety space you keep on top for unexpected volume leaps, and reduce the risk of distortion.

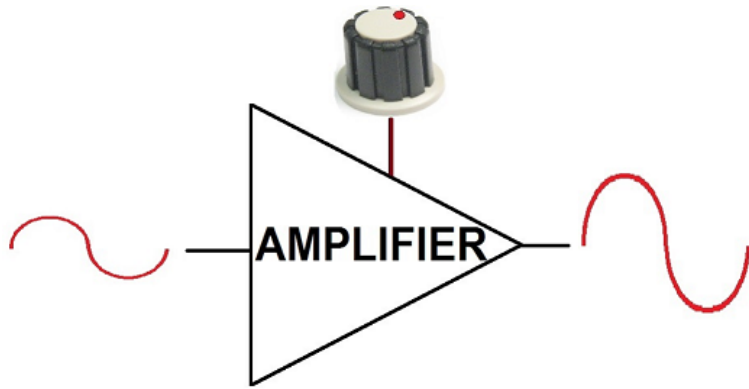
Never compress a signal to the point where the signal on the Level Meter is only moving one or two notches. This is the reason many amateurs say they don't like Compressors. They didn't know what they were doing, and they squashed the sound to death. A Compressor is a Sound Technician's best friend, used discretely.



Why isn't it enough to just lower the Fader, instead of compressing?

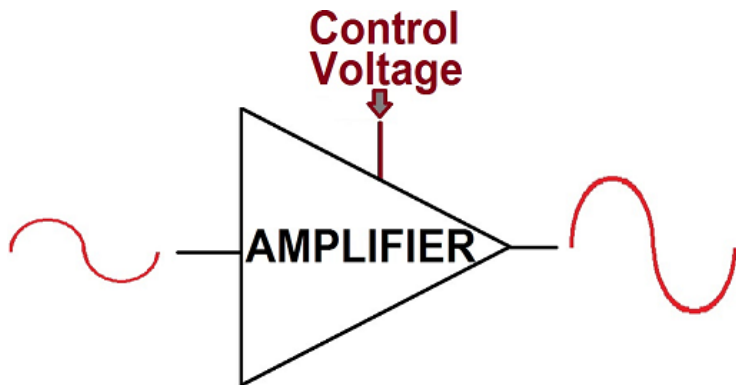
If you lower a highly dynamic signal with a **Fader**, the distance between the loudest and quietest level remains the same (because you lowered everything) and now the quiet sounds won't be heard anymore.

If you lower a highly dynamic signal with a **Compressor**, you only compress the levels that go up high, and the lower levels are left untouched. This means that all quiet passages are heard normally, but any time the signal tries to go too loud, it will be gently lowered.



### Normal Amplifier

The standard Amplifier has a dial to adjust the amount you want to amplify your signal. You choose a value, and the Amplifier responds as you would expect.

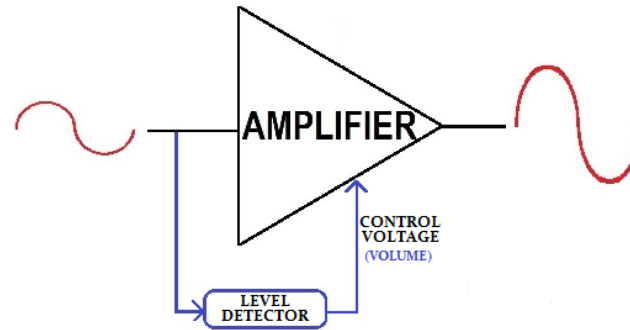


### Voltage Controlled Amplifier (V.C.A.)

This kind of Amplifier requires an external (**control**) voltage to tell it how much to amplify. When you vary the controls on a Digital Mixer, they send a voltage to their particular VCA.

You can also use the incoming signal as the voltage to control the Amplifier. This way the Amplifier responds to it's own incoming level.

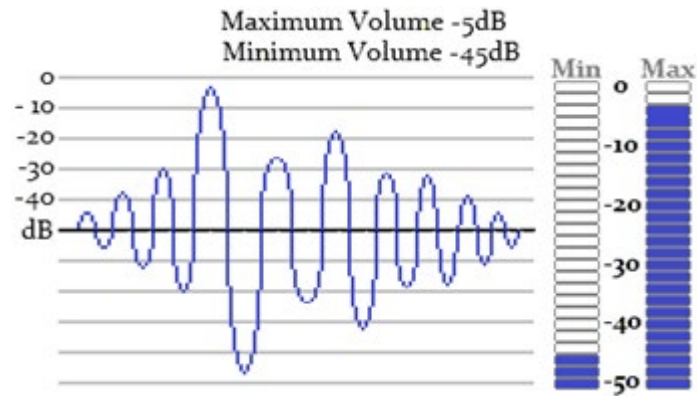
## THE DYNAMIC COMPRESSOR



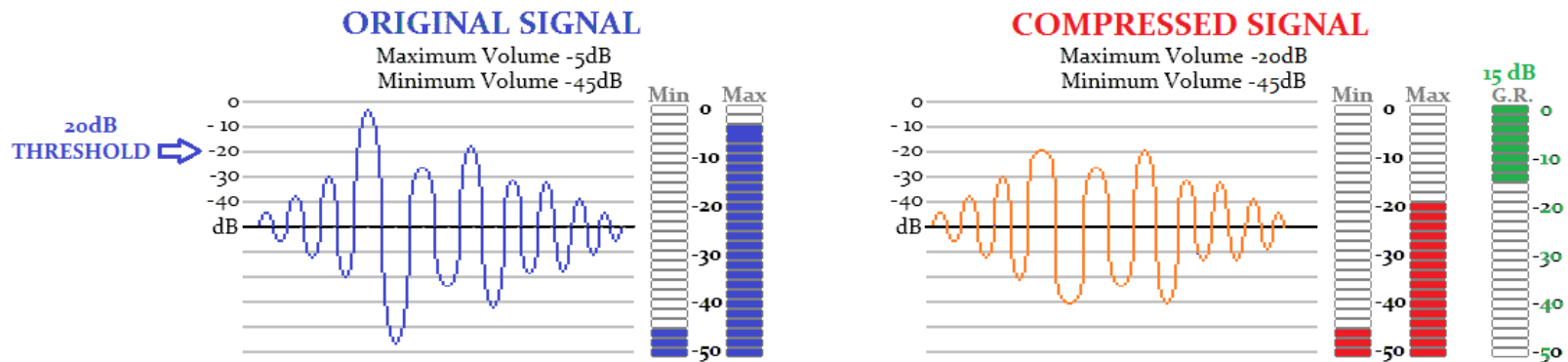
At the heart of a **Compressor** (*Dynamic Compressor*) is the **V.C.A.** (voltage-controlled amplifier) or more recently the **D.C.A.** (digitally-controlled amplifier) which is the digital version of the same thing.

A Compressor monitors the incoming signal (Level Detector).

- If the incoming signal is below the threshold, then it doesn't amplify. The output volume will be the same as the input volume. The ratio will be 1:1 (*one volt in will get you one volt out*).
- If the input volume rises above the "**threshold**" voltage that you set, then the '**control**' voltage will take over, turning down the amplification of the output. Now the output will start being less than the input, until the input volume falls below the threshold again, when the output will return to 1:1



Let's look at some examples. We'll start with our original signal... in its loudest moments it is -5dB, in its quietest it is -45dB, so it has a dynamic range of 40dB.



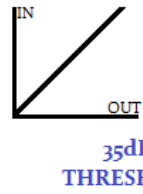
If we set the **Threshold** dial on the Compressor to -20dB, then all signal peaks that rise above -20dB will be compressed.

We can see a difference on the **Level Meters** of the 'Compressed Signal'. The output 'Max' level doesn't rise as far as the 'Original Signal' level 'Max' did.

The loudest moments in the output are now -20dB, in its quietest it is still -45dB, so the dynamic range has reduced to 25dB.

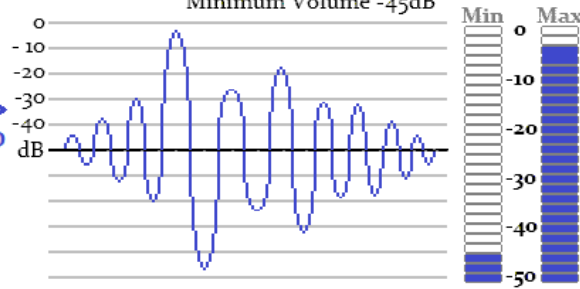
Most Compressors have a **G.R Meter** (Gain Reduction Meter). It works in the opposite direction to Level Meters. The lower it goes, the more it is compressing... easy to see without having to think! *6dB compression is plenty, 10dB is a lot, 20dB is worrying!*

### Ratio 1:1



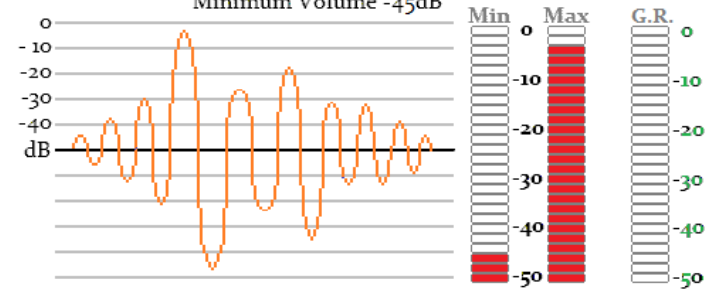
### ORIGINAL SIGNAL

Maximum Volume -5dB  
Minimum Volume -45dB



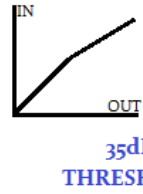
### COMPRESSED SIGNAL

Maximum Volume -5dB  
Minimum Volume -45dB



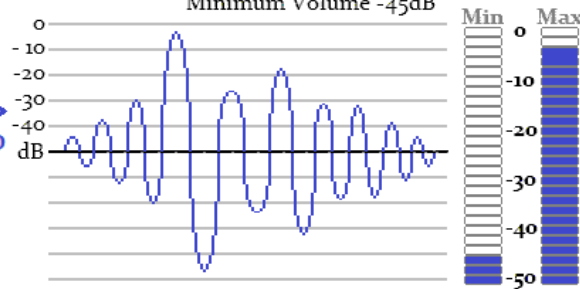
Once we set the Threshold, we decide how much the rate of compression will be by selecting a **Ratio**. This is where we say how hard we want to compress the peaks that rise above our threshold. If we set the Ratio at 1:1 (*1 in :1 out*) then the output will always be the same as the input, regardless of the signal crossing the threshold or not.

### Ratio 2:1



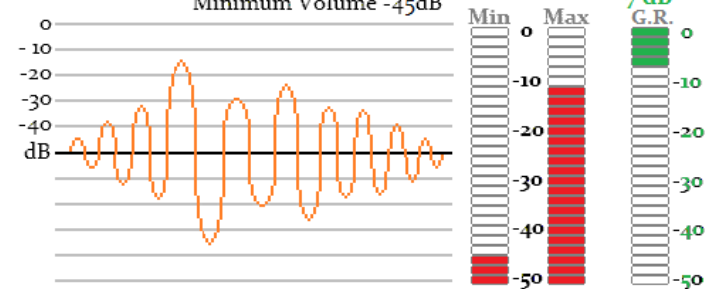
### ORIGINAL SIGNAL

Maximum Volume -5dB  
Minimum Volume -45dB



### COMPRESSED SIGNAL

Maximum Volume -12dB  
Minimum Volume -45dB



If we set the Ratio to 2:1 then everything above the threshold will become half of the input. This is a very light compression and is sometimes all that is needed to bring levels under control. The signal below the threshold will pass through the Compressor untouched, and only the peaks that cross the threshold will be reduced.

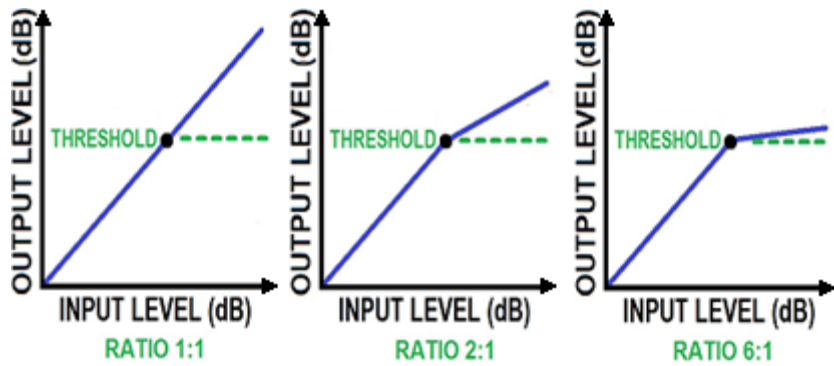


**Threshold Indicators** show if the signal is below or above the threshold you set. If the “Above” light (+) is on, the signal has risen above the threshold (compressing). If the “Below” light (-) is on, the signal is below the threshold (not compressing). They are very helpful when it comes to setting the volume threshold. Adjust the **Threshold** dial until it is flashing more below than above. Now you know you’re only compressing the higher peaks.



... every now and then, glance at the **Gain Reduction (G.R.)** meter which always shows exactly how much you are squishing.

*Note: Because sound levels change depending on the moment in the service and the type of song, make it your habit to occasionally glance at the Threshold and GR meters. Properly compressed sounds are normally “nicer” sounding (because all the peaks are compacted into the body of the sound) often removing any need there might have been to equalise.*



A typical way we show the behaviour of a Dynamic Processor is using a simple line graph. We call it a **Hinge Graph** for obvious reasons.

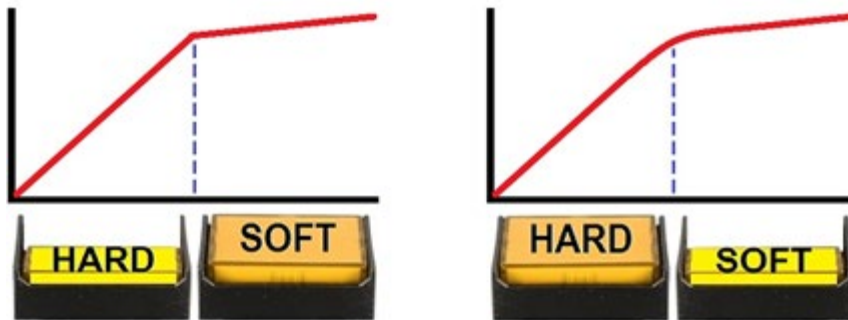
As the input level increases we can see what the output level will do.

Once a signal crosses the threshold...

a ratio of 1:1 (1v in will give 1v out) on a hinge graph is a straight line.

a ratio of 2:1 (it will take 2v in to get 1v out) means the output is compressed.

a ratio of 6:1 (it will take 6v in to get 1v out) is an even stronger compression.

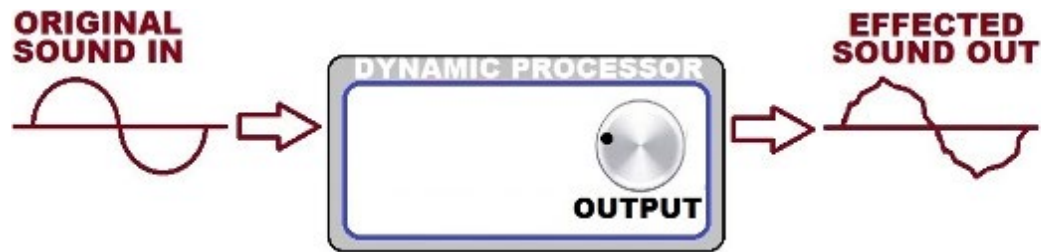


In order to make a smooth transition between the compressed and the non-compressed parts of the signal there is sometimes the opportunity to select the type of Knee (Hinge) you want to use.

A **Hard Knee** will start or stop compressing from the instant the signal crosses the threshold. It is the best choice if you are trying to catch every electrical peak.

A **Soft Knee** will slowly move in to, or out of, compression. This makes the transition more inaudible, especially important if you are compressing voice or instruments. A well-known brand, **dbx**, call their soft knee function '**Over-easy**'. Americans cook eggs that way too.





Whenever you are dealing with a Dynamic Processor, you will be changing volumes. As a result, the output level may be quite different to the input level. There is often a parameter called “**Output Gain**” or “**Make-up Gain**” to let you adjust the level before it returns to the Mixer.



Compressors have two advanced parameters that allow you to take tighter control of the transition in to, and out of, compression. These are **Attack** and **Release**. They are quite difficult for inexperienced operators, and the best solution is to press the button ‘**AUTO**’ which means the Compressor will do its own calculations on what the **Attack** and **Release** should be. *Attack/Release is on a separate lesson.* As digital compressors can delay a signal for a few milliseconds if you wish (completely inaudible) some offer a **Look-Ahead Period, or Integration Period**. This allows the “Auto” feature to see more signal coming in, and adjust itself even better, before playing it back out.

## APPLICATION: “How to Compress a Voice or a Musical Instrument”



### A summary:

- 1 Set the Ratio to around to 2.5 or 3
- 2 Press 'Auto' Attack/Release (so the machine looks after all that stuff).
- 3 Check that you have a healthy signal coming in to the Effect Unit. Electronics won't work properly (linearly) if there is a weak input signal.
- 4 Check that the “Above Threshold (+)” indicator flashing periodically, but not all the time. This assures you that you are only compressing the loudest parts.
- 5 Watch the Gain Reduction (GR) meter. Tweak things to keep a reduction that averages around 6 to 8 dB (so you aren't squishing the life out of your sound).

## CREDITS

*This material is offered freely to the Christian Churches; downloadable at [Pietango.com](http://Pietango.com)*

**Text:** *Original, by the Author, a Christian Recording Engineer.*

**Images:** *Designed by the Author. Some photographs were sourced from the Internet, then re-worked.*

Ever since the creation of the world, God's invisible attributes and divine nature have been evident. They are clearly understood through his workmanship, and all the wonderful things that he has made. Therefore, those who fail to believe and trust in him are without excuse, or defence. **Romans 1:20**

All of us have sinned and fallen short of God's glory, but God treats us much better than we deserve.

Because of Christ Jesus, he freely accepts us and sets us free from our sins. God sent Christ to be our sacrifice. Christ offered his life's blood, so that by faith in him we could come to God. **Romans 3:23**

If you declare with your mouth, "Jesus is lord," and believe in your heart that God raised him from the dead, you will be saved. For it is with your heart that you believe and are justified, and it is with your mouth that you profess your faith and are saved. **Romans 10:9**

For the Scripture (*Isaiah 28:16*) says, "Whoever believes in Him will not be disappointed." **Romans 10:11**

These things have been written so that you may believe that Jesus is the Christ, the son of God; and that by believing, and relying on him, you may have new life in his name. **John 20:31**