

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 1

(Part 1 of this tutorial answers the "What", "Why", "Who" and "Where". Part 2 answers the remaining "How", "How Much", and "When".)

"What's The Story...Why Do I Need to Demaster?"

I recently bought a new/old stock (NOS) CD originally recorded on analog tape in 1976, released on vinyl then much later re-released on CD. The [CD](#) from which this music track originates dates from 1990, just before the wide distribution and use in 1991 of [multi-band music compressors](#), and with it the Loudness War on popular music.

When this particular CD arrived it was basically unlistenable, i.e., it sounded exceptionally strident and devoid of bass, but retained its music dynamics. At this point, I decided to investigate the reasons why it sounded so bad. My tool of choice: the freeware tool [Audacity](#).

When looking at the frequency spectrum averaged across most of this music track, it's easy to see a few characteristics:

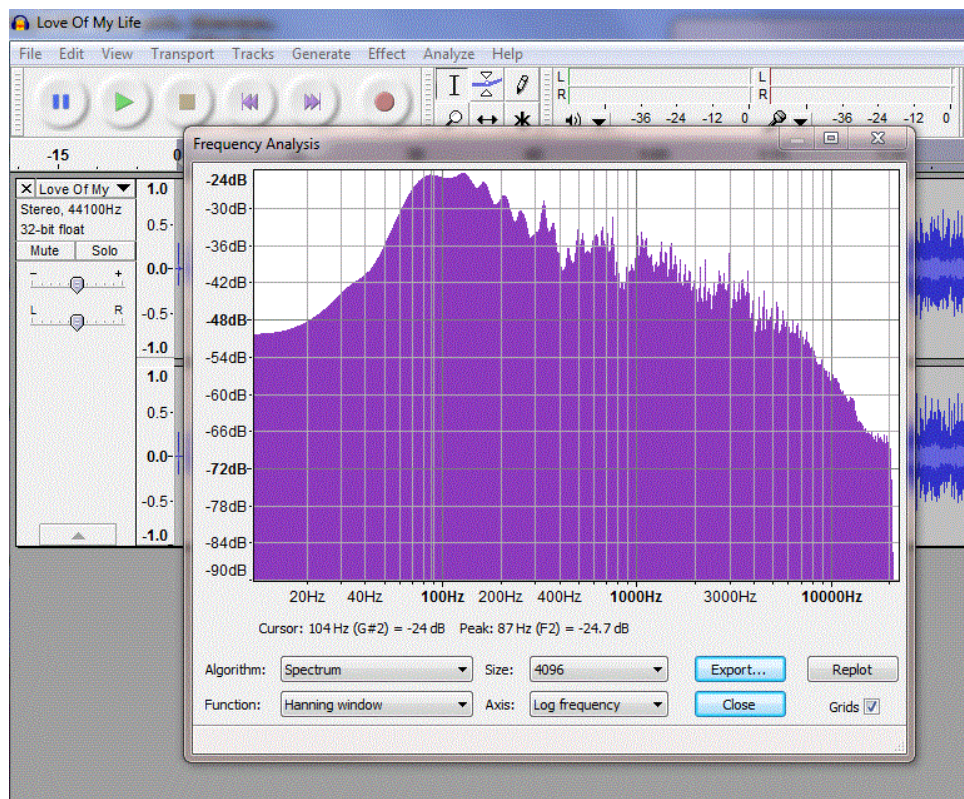


Figure 1 Incoming Audacity "Plot Spectrum" View for First Example

- The decreasing slope with frequency across its full spectrum (more on the reason for this later)
- Frequency spikes of narrow width across certain areas of the spectrum

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 2

- A slight "hump" or rounded spectrum from 1000 Hz to about 13 kHz
- A steep roll-off of low frequencies below about 80 Hz

Questions from the above plot spectrum view:

- Is the roll-off toward higher frequencies normal (i.e., is it there in the original master recording before any changes are made to it)?
- Are the frequency spikes normal?
- Is the frequency hump from 1-10kHz normal?
- Is the much steeper roll-off of low frequencies below 80 Hz reflective of what the musicians played?

Some answers:

- Roll-off of frequencies from low to high is normal, since the frequencies themselves double in their inherent energy for each increase of an octave - i.e., a -5.5 dB/octave or -16 dB/decade is present in all typical recordings (note: don't confuse this effect with the Fletcher-Munson curves of [equal perceived loudness](#)). In fact, any departures in the averaged frequency spectrum from this linearly decreasing amplitude behavior with logarithmic frequency should signal the need for further investigation.
- The frequency spikes typically correspond to certain types of musical instruments that do not change frequency each time they are played (i.e., piano, percussion, and especially electronic instruments, etc.). These spikes are almost always generated by the musicians themselves, not the recording/mixing/mastering processes.
- The frequency hump from 1-10 kHz isn't really typical of most live music. There is typically a straight line of decreasing slope tendency for averaged unamplified/unmixed music if the musicians onstage playing together get to adjust their loudness of the various music parts (assuming a multiplicity of instruments including percussion/drums, double bass, and treble instrumentation, like wind and string instruments of the band or orchestra, and voices. (This is probably the most useful observation that I found.)
- The roll-off in bass below 80 Hz is neither normal nor desirable, unless perhaps you don't actually have to listen to the reproduced music, but only to get the music impressed onto phonograph records or CDs without having to decrease its overall loudness/gain to accommodate the very large bass/kick drum transients that are actually there in real, live music.

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 3

"Prove it."

To check the last statement to assure myself that what my ears were telling me was correct, I looked up the frequency range of electric bass guitars. Here is what I found:

	B String	E String	A String	D String	G String	C String
Open	B - 30.8hz	E - 41.2hz	A - 55.0hz	D - 73.2hz	G - 98.0hz	C - 130.8hz
1st Fret	C - 32.7hz	F - 43.7hz	A#- 58.3hz	D#- 77.8hz	G#- 103.8hz	C#- 138.6hz
2nd Fret	C#- 34.6hz	F#- 46.2hz	B - 61.7hz	E - 82.4hz	A - 110hz	D - 146.8hz
3rd Fret	D - 36.7hz	G - 49.0hz	C - 65.4hz	F - 87.3hz	A#- 116.5hz	D# - 155.6hz
4th Fret	D#- 38.9hz	G#-51.9hz	C#- 69.3hz	F#- 92.5hz	B - 123.5hz	E - 164.8hz

Figure 2 Double Bass/Electric Bass String Frequencies

I also checked on the frequency spectrum of kick drums. Here is what I found for the time/frequency graph of a typical kick drum:

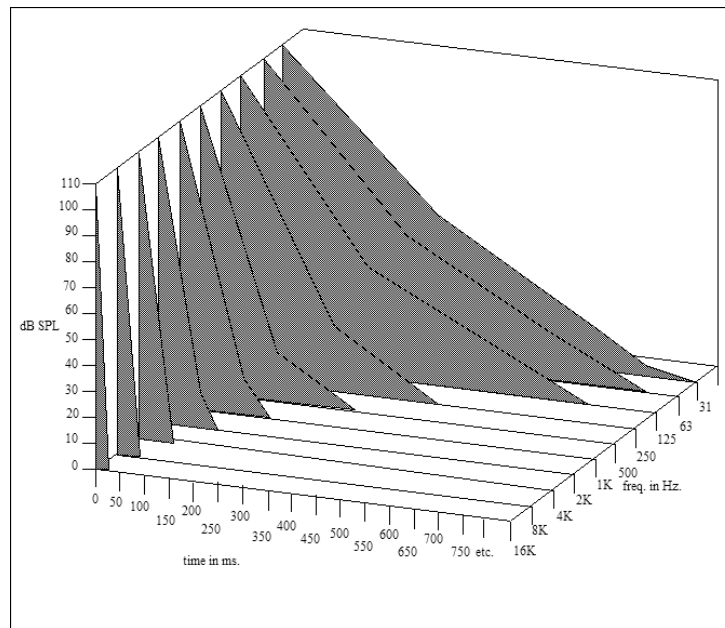


Figure 3 Bass Drum Frequency-Amplitude Curves versus Time

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 4

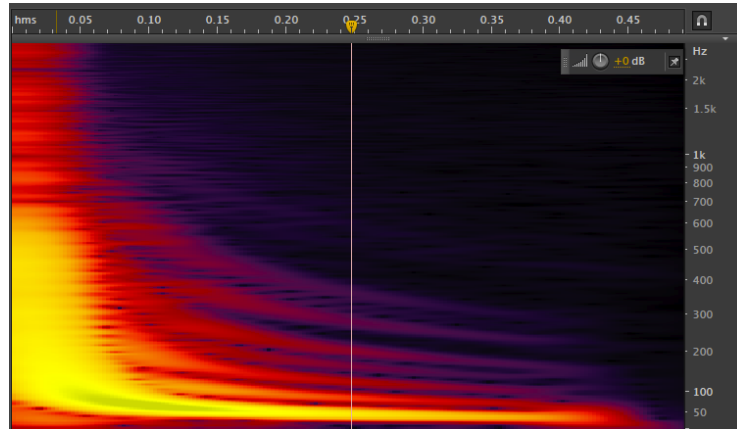


Figure 4 Kick Drum Frequency Amplitude Spectrum versus Time

As you can see just based on investigation of these two instrument types, the fundamental frequencies of the recorded music to accurately reproduce instrumental performance is **more than an octave lower** than the 80 Hz roll-off found in the example recording.

Why Has This Happened?

Questions arise from the information above:

1. why would a mixing or mastering engineer attenuate and thereby remove these frequencies from our recordings, especially in light of the information that 25% of the importance of loudspeaker performance in subjective ratings is due to its bass performance (notably bass performance well below 80 Hz)? (See [Floyd Toole's book](#), pgs. 197 and pgs. 463-464)
2. Is this why many CD releases made before 1991 (and I suspect many phonograph records) sound strident and bass shy when played back on high fidelity sound reproduction systems--like the ones that many forum members own?
3. How many recordings, and of what date released and type are affected by this "mixing feature"?

On What Recordings Is This An Issue?

I've found many, many more examples of this type of mastering frequency response profile, especially from pre-1991 recordings. Most of these recordings cut the bass below 100 Hz, not 80 Hz. This is the "missing octave". For pipe organ performance, real fundamental frequencies in concert as low as 17 Hz are typical for many large instruments with 32' fundamental stops.

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 5

Why Would the Mastering Process Remove Bass Below 100 Hz?

This is where the story gets interesting.

I've found through my now-many demasterings of different FLAC and WAV files with this characteristic is that the bass frequencies are inherently high in amplitude relative to all other frequencies (remember the decreasing slope of a typical music track, above).

This means that any mixing or mastering engineer worried about compressing tracks for the sake of maintaining a "loud" sounding mix, will have to roll off the amplitude of bass track, either by using equalization filters to cut the output extremely steeply below 100 Hz, or use equalization roll-off and a multi-band compressor that further compresses the bass track disproportionately to the higher frequencies on the compressed recordings...

If you're feeling as though you can't trust a mastering engineer as far as you can throw him/her, you've got the message. [Loudness War techniques have been in existence for many years now.](#)

Why would someone buy loudspeakers that can reproduce sub-80 Hz music content with great fidelity, but then turn around and find that their music has been intentionally blanked out for 3 of the 5 strings of an electric bass or the most energetic octaves of a kick drum (in fact rendering the drums on the music track for tom-toms and kick drums indistinguishable)? If you hear bass on these recordings, what you are hearing is actually the second harmonic of the bass player or the upper harmonics of the kick drum - not the fundamental frequencies.

Can Anything Be Done To Recover The Fidelity in These Albums?

Fortunately, the answer to this question is "yes", if the recording that you have hasn't been compressed using a multi-band compressor, like the Loudness War tracks made from 1991 to the present typically have.

So here's the situation: if you have a CD made before 1991 (or certain other CDs made after 1991 but not using compression techniques--which I'm finding are increasingly rare, but they do exist)--excellent results can be had by re-equalizing your CD tracks. How much re-equalization? See the below Audacity filter that I use as the initial starting curve for these bass-deficient tracks (followed immediately with the "Normalize" filter in the Effects menu to re-level the output before saving the new equalized track). Note decreasing gain above 100 Hz, which I find is needed for most (but not all) tracks. I also find that there are favorite EQ curves used by the various artists that seem to run from album to album:

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 6

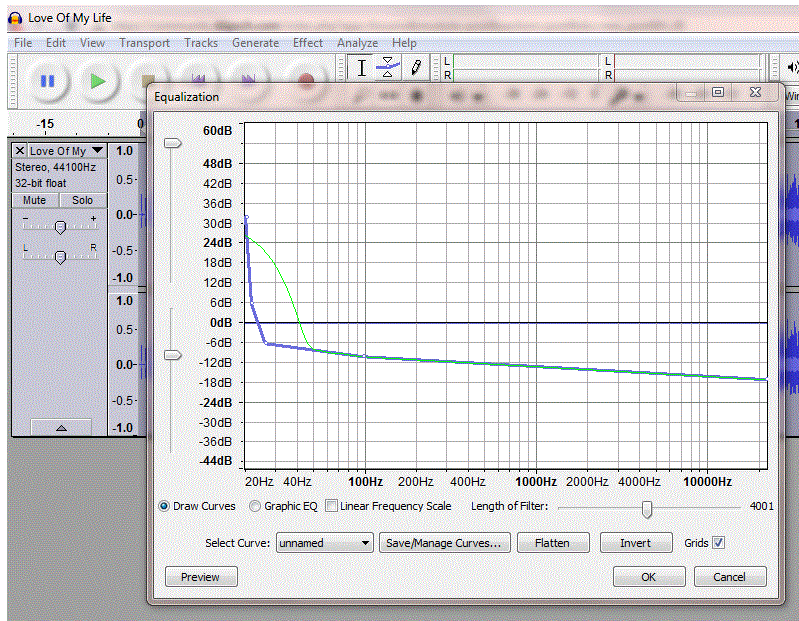


Figure 5 Bass Equalization Correction Curve for First Example

And the "after equalization" curve:

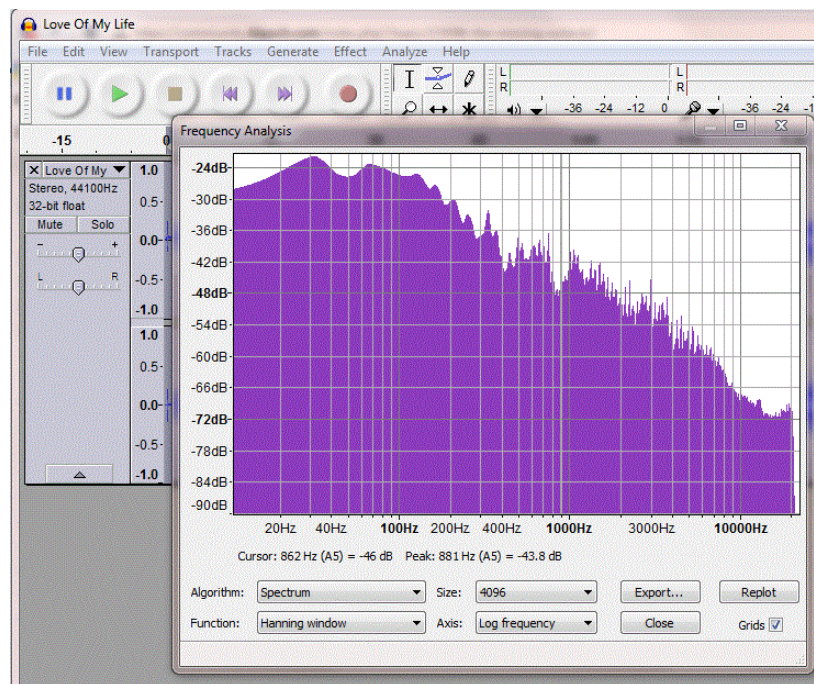


Figure 6 Finished "Plot Spectrum" View for First Example

To prove to myself that the restored bass octave tracks were originally rolled-off due to Loudness War compression techniques by mastering engineers, I subjected my now-

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 7

restored music tracks to both DR Database tool application sweeps and "ReplayGain" average level recalculation.

In every case of using restored bass tracks, the "ReplayGain" levels became more positive (i.e., they require more gain to play back than the original tracks), indicating that bass transients were suppressed in the original tracks in order to make the tracks louder.

Most tracks using impulsive bass and kick drums increased in their overall DR ratings - sometimes by as much as 4 DR ratings points. In tracks where the bass plays more-or-less continuous bass lines, there is a slight decrease in the DR ratings measured. This can be explained by the fact that the restored bass lines increased the overall track loudness levels, but did not materially increase the cresting transients in the recording. This would lead to slightly lower DR ratings (usually one DR point at most). But the listening quality of the tracks significantly improves, due to restoration of the original bass lines that the percussionists/drummers and bass players played in real life.

a.1 Why not use an equalizer or tone controls at playback time to fill in the bass? What's wrong with that approach?

Every time that you play a music track, you have to correct it, and worse than that, you have neither the control flexibility nor the visibility to correct the track properly. If you instead demaster the music track, it's fixed forever. You never have to worry about it again.

a.2 Why hasn't this been used elsewhere? What makes this new? Why hasn't someone already done this in the past? (IOW: I don't believe this is something significant)

Well, the Big Music corporations aren't interested in acknowledging what they have been doing for decades. Also, the software and computing power to demaster your stereo recordings were pricey in the past, but are now quite easy to acquire (the software is free). Demastering tracks really shouldn't be a new thing—and in fact when you read carefully, notable audiophiles (Dick Burwin, et al.) have been doing this for a couple of decades. It's just that he hasn't published a "how to" on the subject for the common audiophile to follow in his footsteps. If those guys are doing it, there must be a payoff. My experience is that there is a large payoff for doing it.

Basically all music is mastered for poor audio systems—(really poor, in fact). Almost all stereo recordings have these mastering issues. Some music genres have more limited equalization and clipping applied. Notably classical and avant-garde audiophile recordings have less mastering equalization applied--but not across the board.

On what type of CDs is this found? A high percentage of these CDs have "Mastering For Loudness" (MFL) applied, such as (but clearly not limited to):

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 8

- Doobie Brothers
- Steely Dan
- Pat Benatar
- Dave Brubeck
- Tears for Fears
- The Doors
- Grand Funk
- Mannheim Steamroller
- Jackson Browne
- Rolling Stones
- early Eagles
- The Who
- Linda Ronstadt
- Billy Cobham
- Stacey Kent
- Diana Krall
- The Alan Parsons Project
- etc.

On the flip side, here is a list of known CDs requiring minimal demastering:

- The Yellowjackets SACDs (three discs) (no demastering required)
- Many DVD-As with 5.1 recorded in the last 15 years (no demastering required)
- Diana Krall - Stepping Out (except low bass below 50 Hz, which is rolled off)
- Paquito D'Rivera - Portraits of Cuba
- Lyle Lovett - Joshua Judges Ruth, Lyle Lovett and His Large Band
- David Chesky - Club Del Sol
- (Virtually any Linn SACD)
- Steely Dan - Aja (MFSL) (some LF attenuation below 40 Hz)
- Any DVD from Gordon Goodwin's Big Phat Band
- Ana Caram - The Other Side of Jobim
- Peter White - Promenade
- Thelonius Monk - Monk's Dream
- James Taylor – That's Why I'm Here, Never Die Young
- Grover Washington - Winelight
- James Newton Howard and Friends
- Don Harriss - Elevations
- Stereophile Test Discs 1-3 (most tracks)
- Jerry Junkin - Dallas Wind Symphony - Holidays and Epiphanies ... The Music of Ron Nelson
- Dunedin Consort - The Messiah (Linn records)
- Leo Kottke - 1971-1976 Did You Hear Me?
- Redbird - Redbird
- Erick Leinsdorf and the LA Philharmonic, The Leinsdorf Sessions Vol. 1 (Sheffield Lab)

Demastering Your Music (Part 1)

Version 0.14 June 2017

Page | 9

When I look at artists from this time period that benefit greatly from demastering, virtually all of them that haven't already been classified as "audiophile quality are usually sporting these properties and which respond significantly to this treatment.

Some of the most startling results are CDs of bass players, such as Marcus Miller, Brian Bromberg (**Wood** series), Esperanza Spalding, and some jazz artists--notably early Jean-Luc Ponty, etc. I've demastered thousands of music tracks (about 10K) and I can tell you that out of those, perhaps two dozen tracks really didn't need much demastering help.

For popular music recordings made after 1991, the story is much more hit-or-miss in terms of how much fidelity can be recovered, but by judicious use of the [DR-Database](#), recordings with some dynamics left in them after the "mastering process", they can be de-clipped, re-EQed, and any remaining bass noise (50/60, 100-120 Hz line noise) can be removed to significantly reduce modulation distortion that arises in the process of restoring the "missing octaves" of bass. I've seen as much as 10 dB (that's 10 points on the DR Database scale) of recovery, with resulting listening improvement being as spectacular as any stereo album that I've demastered.

It's amazing how little stereo music is actually mastered for good full-range stereo systems. In fact, this issue is so pervasive that it is wise to assume that every CD that you own has mastering issues that have been introduced into them.

One of the apparent standard practices of the mastering industry is to take the mix-down two-channel (stereo) tracks and listen to them on small near-field monitors of dubious capability, thus making EQ and limiting/compression decisions based on loudspeakers that are most definitely not the best quality available. The term used in mastering circles is "translation", which means that the music is mastered to sound good on cheap nearfield monitors. A good explanation of the mind set used by mastering individuals:

"Ninety-five percent of people listen to music in their car or on a cheap home stereo; 5 percent may have better systems; and maybe 1 percent have a \$20,000 stereo. So if it doesn't sound good on something small, what's the point? You can mix in front of these huge, beautiful, pristine, \$10,000 powered monitors all you want. But no one else has these monitors, so you're more likely to end up with a translation problem."

Not only is this not true, but it also leaves people with good home sound reproduction systems out in the cold. What does typical released music sound like? A table radio... The first noticeable thing is no bass. The next noticeable thing is too much treble.

The purpose of this article is to chart a path forward for those that have good sound systems to repair their music tracks so that they more closely reflect the sound that was present in the recording venue before mixing and mastering EQ was applied using small, lower quality studio monitors to make equalization decisions.