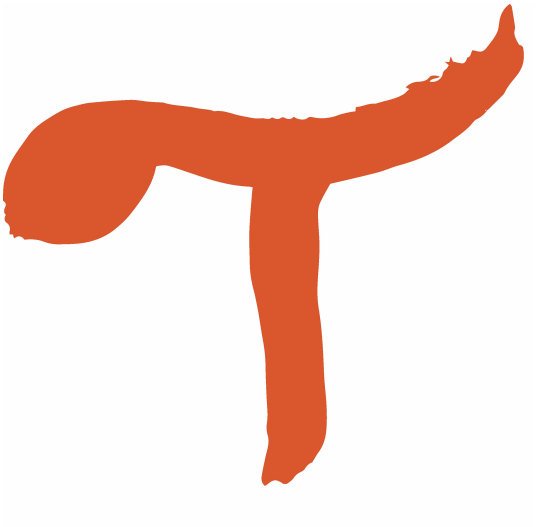

Terry Audio - CEQ
Dual Passive 6 Band Inductor Equalizer

*The CEQ is a 6 band inductor based discrete equalizer designed to be a transformative mastering and mix tool using a true passive EQ design for 5 bands. The sixth (mid cut) band is a combined active-passive midrange EQ that performs not only a frequency amplitude cut but also subtly adjusts the 'sonic reactivity' of the band. The makeup and active gain amplifiers are DC coupled internally for maximum bandwidth and punch. Ear-selected components are chosen at every position in the amplifier and equalizer.

*The CEQ approaches equalization at it's core using the tried and true filter design topologies developed by Bell Laboratories (these are famously used in the 'Lang' and 'Pultec' circuits) as well as other traditional 60's and 70's console and mastering equalizers. An amazingly wide variety of tone can be accomplished while tracking – with the main sonic footprint optimized for placing on the stereo buss for the 'essence of the record' while mixing, as well as being (as it was designed for) to offer a wide palate for critical and colorful mastering duties.

*Aside from the 6 band equalizer itself, the CEQ boasts the ability to operate fully single ended, without any input or output buffers or transformers. For both soundstage as well as function, a balanced input buffer amplifier is included on a switch, as well as an optional output transformer. Each of these serves a sonic footprint purpose, when selected along with function in cases of long cable runs or hard-to-interface equipment. Furthermore, a 'Shift' control is included, which effectively switches the filter bank build of the low controls of the equalizer entirely, yielding another completely different and unique soundstage and a 'shift' in overall equalizer character and imagery.

CEQ Specs and Controls

- 6 Bands (see CEQ Recall Sheet for full pictoral map, last page)
  Treble Boost:
  7 Bell: 2.5k, 4.2k, 8k, 10k (low inductance), 10k (high inductance), 13.9k, 18k.
  5 Shelf: 1k, 5k, 10k, 15k, 18k
  Treble Cut: 2.5k, 5k, 10k, 15k, 18k, 22k (shelf)
  Mid Boost: 310, 470, 680, 820, 1k, 1.8k, 2.5k, 3k, 4k, 6.3k, 8.2k, OUT (bell)
  Mid Cut: 260, 470, 820, 1k, 1.3k, 2.1k, 3k, 4.5k, 6.3k, 9.3k, OUT (bell, active/passive hybrid)
  Bass Boost: 47, 70, 100, 160, 200, 340 (shelf)
  Bass Cut: 27, 50, 80, 140, 220, 480 (shelf)
- True 'Hardwire' Bypass
- Fully discrete, through hole build design throughout – no surface mount or 'modern' transistor equivalents substituted. NOS transistors used where critical. Hand-soldered. Every part is highly specific to every voice and cannot be substituted without changes in tone and action.
- Design specific capacitors used throughout each band, including heritage paper-in-foil and metalized (sputtered/vacuum deposited) foil
- Input Impedance > 20k, passive, switchable single ended or balanced buffer enabled
- Outputs selectable as single ended (pin 3 ground) or output transformer coupled (floating)
- Linear power supply (transformer based, non switching, regulated), uses +/- 24v rails.
- Custom Options: Stepped (Metal Film Blend) or Non-Stepped (Carbon potentiometers)

<u>Suggested Listening Notes and Uses of the CEQ</u>

First, a running note: For each frequency, even if the level control for the band is at minimum, the audio is affected due to subtle loading at that band. This means that if you are evaluating the CEQ 'flat', you will notice subtle changes in the soundstage just by selecting different frequencies, even before adjusting the equalizer. For this reason, for the mid cut and mid boost bands, a 'blank' space can be selected which effectively turns that control completely OFF and OUT of the EQ. While this may seem desirable, in practice the last fine tuning of setting the EQ has a nice touch when selecting a frequency on the 'unused' control for best subtle euphonics for the recording and master.

The Low Boost control, and it's circuit configuration, has a real dynamic affect on not only bass but also the treble signature. When switching frequencies, slight soundstage differences also occur in the treble. This is one of the most desirable aspects of the low boost, and is part of the 'finished record' magic of Pultec-styled designs. Even just a few stops of boost adds the 'magic hint' of tonal transformation highly sought after in classic esoteric equalizers.

The 'Shift' control changes the capacitor filter bank of the Low Boost control. The tone of the low end changes, as well as a general 'bass energy' soundstage – and, last but not least – a treble dynamic and texture difference. With the Shift control 'down', the heritage Paper-In-Foil capacitors yield a well balanced, smooth and hi-fi tone. With the Shift control 'up', the more modern poly capacitors give a more active, woody bass tone and an enhanced, excited dynamic treble signature. Usually, after choosing which yields you the desired tone after using the Bass Boost control, the High Cut and Treble Boost controls can be dialed in for the desired treble signature.

The Treble Boost is either Bell (orange stops) or Shelf (light blue stops). The Q control has an audible effect regardless if Bell or Shelf is selected. A recommended 'nominal' position for the Q control is at 3 o'clock for both modes. The Treble Boost, along with the High Cut band, are great adjustments to toggle and refine along with auditioning both the Low Boost and Shift controls to set soundstage and treble texture.

The selection of the High Cut band, even if no high cut is dialed in, makes a very noticeable difference in the texture of the treble, and is a great 'last step' in treble refinement. The High Cut band has different capacitors in each stage, selected for the frequency shelf sonics needed. Furthermore, after selecting the high cut frequency, listen for about 5-10 seconds while the cap 'settles in'. This is at a high impedance part of the circuit, and treble refinements and extra detail comes out after the frequency selected starts reacting to audio for a few seconds. Also, the sonics of the band come alive even when dialing in even 2-5 level stops for the high cut. The reactive sonics come into play more more than an obvious reduction in treble at very low amounts of cut. Conversely, with larger amounts of cut dialed in, certain capacitor resonances were left in, giving character to work with – especially in tandem with the Boosts and the impact of the Shift control.

The Mid Cut band is the most transformative and most creative control of the equalizer. Due to this band being nestled around the gain stage itself, the frequency selected as well as the amount of cut dialed in (even at subtle amounts) creates a large soundstage and thick sculpted sound. The control also slightly smooths dynamics at the band that it cuts at, which is great for removing harshness and creating the ability to 'turn the mix louder' rather than reaching for compression due to overly 'shouty' midrange frequencies. Alternatively, if used for a low mid cut, it provides a specially voiced smooth weight and clarity when removing low mid frequencies that can be 'woofy' in a very musical way. Reminder – even if no Mid Cut is dialed in – the frequency selected is adding a subtle smooth loading to the sound. This was done on purpose for when no transformation is needed, but a character is desired. If no Mid Cut character is wanted, switch it to the last, blank position, which removes it from the circuit entirely.

The Mid Boost control is a gently wider control based on the slightly broader Q designs of vintage mastering consoles from the 60's and 70's. This 'secret weapon' is part of the stereo image 'pop' and voiced excitement of the chosen audio band. While suggested to be added in as one of the last adjustments for final mix sound, especially for vocals and acoustic instruments, the 'glowing' effect of the Mid Boost has been voiced to bring texture and 'largeness' for playback in cars and smaller speakers. Sometimes, only a few stops are needed. Other times, more is better. The stops are fine, and are about ¼ dB at the lowest end of the range. This control can be switched 'OUT' of the circuit by selecting the white blank space at the end of the frequency range.

The Buffer serves a major tone function as well as the electrical impedance buffer function: using NOS transistors and carbon components, a more colorful, large and vivid sound was found to be part of the classic sound of mastered records from the late 60's through mid 70's. Extra treble pop, texture and definition comes out with the Buffer. Additionally, a very slight high pass filter (at 7hz) is added into the buffer to help the final tone of the Equalizer when the Buffer is engaged. It is recommended to listen to the buffer after a few EQ moves are made, and then the sonic signature of buffering the single-ended input can be decided to be used. Toggle and decide at the 'end' as well.

The Low Cut control is a gentle -6db per octave cut. Due to the passive design, it helps to impart a rounded tonality to the soundstage as well as providing cuts either to just sub frequencies, or, when used at a higher stop than the Low Boost control, it provides a novel, clean low mid bell cut. This control is highly suggested to listen to and use in tandem with a parametric equalizer's low cut in order to get the desired blend of low energy tone desired in the music and master. Midrange becomes more forward and character comes out the more this control is used. For a more neural tone, lean on this control lightly and use an external parametric for a 'surgical' sound for the low sub frequencies. This is best described as a 'subtle yet broad brush' to use.

The output transformer was chosen for it's transformative effect (pun intended), rather than the approach to source and wind a 'neutral' transformer. The output transformer was voiced to be akin to an early 60's style transformer that offers a high pass perceived around 40hz and some low end saturation. This has a great advantage when using the low boost control – more low boost can be dialed in without excessive subsonics in the recording. The midrange excitement is a major sonic signature that delivers a vocal-forward mix and master while also managing low-mid muddiness. The transformer is a 50% nickel core to avoid strident treble signatures in higher nickel formulations, in heritage to the sounds of original recordings and LP's for the Atlantic and Stax labels.

The Mid Boost and Mid Cut controls are very close and subtly non-overlapping. It is also recommended to dial in a similar amount of Mid Boost and Cut at similar frequencies if you want to keep the sound 'the same' while changing the mix to just be 'bigger' and more polished.

The last suggestion to include here is the approach to mastering 'non-bookmarked', meaning, using different adjustments and different frequencies in dual mono, especially for the Treble Boost and Mid Boost controls. If a mix needs more excitement and separation, rather than a 'clean stereo picture', after getting EQ dialed where preferred, take a band for either the left or right channel and move it one frequency stop higher or lower, or even just one or two level amounts up or down. This approach was tuned in for the stops and is a hidden secret for bigger bolder tones for wide stereo mixes.

CEQ Design and Voicing

The input stage operates 'single ended' directly into 5 bands of fully passive EQ with frequency selections and level amounts for each band. This decided approach of using these bands WITHOUT additional buffers for the passive circuits creates open sonics with a very musical interactive nature, most specifically with the Bass Cut and Bass Treble controls, which leads to their shelving characteristics to be 'resonant shelves' the more they are used in tandem. This gives slight 'peaking' just below (or above) the given -3db frequency points in unique ways for enhanced low end character. This is the essence to the 'Pultec' design style control, except the CEQ lets the user select the Cut and Boost frequencies independently (and in reverse – cutting lower than the boost for mastering work!) for greater control and craft in the low registers of the mix.

The passive Mid Boost, Mid Cut and Treble Boost controls use the in-house designed heritage powder core toroidal inductors, wound and chosen to be the most euphonic by using classic 'Bell Laboratories' winding notes for both core strength (low permeability) and wire gauge. The 'low permeability' core is part of the essence of being able to boost large amounts of gain without being sharp. (Typical 'stronger cores' accentuate the dynamic peaks, and are a reason why most later EQ's sound too 'sharp' when boosting in comparison to the more desired classic circuits and inductors.) The Treble Boost selects as either bell (inductor) or shelf (no inductor), and the Q control works in both the bell (wide or narrow) and shelf (soft or hard shelf knee).

The 'cut' midrange circuit for the CEQ was found to be much more usable when made in a hybrid 'passive-active' configuration, and is placed in the feedback loop of the discrete amplifier in the makeup & driver amp stage. Active, gain adjusting controls not only adjust frequency boost and cut but also have a subtle smoothing sound imparted to the music. To describe this a bit more… a 'cut' frequency in a feedback amplifier gives a slightly smoother and perceptually 'recessed' tone due to reduced amplifier gain at the selected frequency - giving a smoother, lightly tighter signal band that is 'tucked in' sonically to the mix ever so slightly while cutting. This extra effect is the secret weapon in the classic console equalizers in the 1960's and 1970's, and does wonders for adding 'smooth weight' while tailoring low and mid frequencies while gently subduing harshness in the bands as well. During design listening, when the cut control was in configurations as a fully passive cut circuit (shunt to ground), it sounded great but didn't have the desired tone and effect that was needed for desired musicality and vividness. (Honestly, it was a bit bland and didn't have much exciting texture). Also, a more narrow Q was able to be obtained actively rather than passively due to circuit impedances at play.

The Mid Boost and Mid Cut controls are slightly redundant in their frequency selections yet are subtly non-overlapping, being voiced different from each other at these overlap points for added character and soundstage (rather than being just 'mirrors' of themselves.) This was yet another reason to use the circuit voicing approach for the Mid Cut described above.

Each frequency was listened to critically with a LARGE and WIDE VARIETY of different capacitors at each of the different stops. Variables such as capacitor makeup, material, different voltage ratings, capacitor polarity positioning (inner vs outer foil connected), impulse tonality and 'reaction' with the inductors would were evaluated. With this, two sets of capacitors were found to be vital to the tonalities desired, yet fundamentally different sounding to each other. These two sets are in the 'Shift' control denoted as the three 'scratch' marks, which selects one or the other as a full different set of filter capacitors for the low end section of the EQ. As you will be able to hear, this has a big 'shift' in the entire sonic presentation of the amplifier as well as the treble width perception in the stereo field. These two sets of capacitors highlight exactly how tedious and specific the right parts can be in creating musical equipment with the thousands of choices existing today. With the Shift control 'up', a “paper & metalized foil” is selected, which has a smoother sound and tight low end. With the shift control 'down', a 70's polypropylene type with accenting characteristics to the bass, treble and soundstage is used.

The make of resistors for each band's level controls and Q resistors also make a very noticeable difference in sound and tonal nuance. Some resistor types auditioned lead to a sterile yet 'clean' sound. Others were cloudy and dull. Even still, others imparted a strange sizzle or character to controls as they were used more (or sometimes less!). Only two different makes were found to be the desired voicing – one metal film type and one carbon type. Level controls are blended in each stage for the appropriate balance between film and carbon resistors for texture, soundstage, vividity and transformation.

The makeup gain signal goes through only one all discrete, DC coupled amplifier with just one output coupling capacitor. The amplifier was designed in house specifically to be a general fixed gain amplifier stage with a particular sweet tonality for the passive/active mid cut. It requires no external ultrasonic compensation capacitor and runs on slightly higher current and a balanced amount of open loop gain. The amplifier operates in small signal class A with large signals in push-pull class AB for dynamics and punch.

In amplifier development, four different amplifiers were ultimately built after experimenting with a variety of amp topologies and approaches. The 4 amplifiers were staggered in complexity and refinement, ranging from an early, simpler 'raw' design, 'evolving' through eras of components and equipment to a very 'refined' discrete design with many current sources and output drive situations. For the CEQ, the amps chosen most by most other engineers as well as in house was a mostly 'simpler, more elegant' amp design for some desired color when used in tandem with the EQ itself. Most notably, the CEQ amplifier uses only very light internal ultrasonic feedback compensation (and no global ultrasonic compensation) – a small amount of blended series resistance was needed only for stability for excessive capacitance in output cables and downstream equipment.

The switchable input buffer is included on all newer CEQ versions as an addition along with the Shift control. The input buffer is operated as a dual-mono gain stage, padded on it's output (which is found on many classic amp designs). The use of 'IC' chips is better in this regard but adds nothing exciting, while imparting the integrated circuit chip sound. The input buffer naturally incorporates a slight gentle high pass filter at 10hz for extra flexibility in use, as it is capacitor coupled in and out. The heritage tone of early LP cuts made at Sterling Sound from the late 60's to mid 70's are the honored voicings for the input buffer circuit, along with it's functionality.

Calibrations and Internal Trims

The only trims needed and included for the CEQ are in the two active stages: one, the output amplifier, and two, the input buffer amplifier. The EQ voicing (and furthermore, the action of the mid cut bell control) is very dependent on these calibrations and setup. So, really, don't go making tweaks here unless you have a good reason to.

Output Amplifier Unity Gain trim: It is important to set the CEQ so that the CEQ provides unity gain (or closest possible if trimpot is at the miminum) when fed from a true unbalanced source (600 ohms or less source impedance) and terminated into an unbalanced input (10k or greater). Set all EQ controls to OFF, all level controls to 1, High Boost to 18k (shelf), Transformer Out, Input Buffer Out, Shift Down and Bypass In. With a +4 signal, trim the left and right sides independently so that a +4 signal (or any signal the same level) is read when the EQ is bypassed or inserted.

Buffer Amplifier Trims: The buffer amplifier consists of two trim pots – one for adjusting unbalanced unity gain for unbalanced operation (Pin 2 only), and, after that is set, adding a true differential signal to Pin 3 and setting another trim. The factory procedure is as follows: Using the setup for the Output Amplifier Unity Gain Trim, switch in the Input Buffer and adjust R45 (left) and R58 (right) for unity gain for unbalanced signal. Toggle the switch in and out to verify. Next, input a true differential signal at +4 for the input. Toggle the Input Buffer and adjust R54 (left) and R65 (right) so that the signal is unity for the differential signal.

Contact:

Terry Audio

170 Simpson Ave

Cedar Creek, TX 78612

www.terryaudio.com

512-815-7274

marshall@terryaudio.com

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