FM ACOUSTICS' Harmonic Linearizers allow adjusting the strength (or weakness) of critical frequencies. Thanks to this absolutely unique design, which only uses 5 easy to adjust controls, any frequency or group of frequencies in the entire audio band can be optimized without negative influence on the audio signal. The Linearizers do what producers, engineers and music enthusiasts the world over have been dreaming about for dozens of years. For the first time, obnoxious sounds in any music source can be attenuated (subtracted) and weaknesses of certain parts of the music spectrum can be strengthened. All this can be done whilst the characteristics and transparency of the original signal are kept intact.

The unique concept guarantees that all of the above is done without any negative influence on the signal path. In fact, the method of operation is rather intriguing as can be seen from Fig. C: the entire audio signal is directed straight through from input to output avoiding phase changes and all other negative influences.

The actual response improvement is done by a unique additive/subtractive phase accurate bank of 5 individual Linearizers that combined can correct any frequency aberration in the audio band. The signal always passes straight through from the input to the output even when the strength of a band is adjusted via the front panel controls.

While looking at the front panel one could be reminded of an equalizer. However, Linearizer's mode of operation is very different and avoids all the problems associated with equalizers. It's unique characteristic allow linearization of any source by only adding or subtracting critical areas of the audio signal to/from the direct through signal. The result is that there is no ripple in the pass band and no phase shift / discontinuity, which results in pristine signal coherence and superb transient response. Another singular characteristics is that when all level controls are in full boost position there is no change in frequency response; a linear gain over the entire frequency range is achieved; this is the sign of perfect linearization.

FM ACOUSTICS' Linearizers have been designed with optimal reproduction of musically relevant information in mind. Therefore, boost and cut levels are kept to an optimal but not excessive range.

Accurate selection and extremely tight component tolerances are required. No op-amps, IC's, transformers or hybrid circuits can be used. In the tradition of FM ACOUSTICS discrete enhanced Class A precision amplifiers are used so that no phase changes, non-linearity or other negative effect occur.

Thanks to their unique characteristics it is now possible to linearize audio signals with the assurance of only positive effects on the direct through audio signal. A good demonstration of the Linearizers inherent transparency is to first listen to the standard signal having all controls in the center detent position. Listen carefully to all the frequency ranges. Then turn one of the control, say the 800Hz control and while turning the control, concentrate on another frequency band, say the lower range of voices and low/mid based instruments. You will realize that when turning the 800 Hz control there is absolutely no change in the other frequency ranges! Only the one frequency that you are subtracting or adding is changing while the signal remains pristine and totally transparent, exactly like the original signal!

Do not try to work with the Linearizers like you would with an equalizer. It does not work that way. On the Linearizer section every control is dynamic, every movement of one control influences the other. So it is best to control the individual linearizers dynamically: move one control until you hear it is too much addition or subtraction, then move it back to the point where it becomes a realistic correction. Next, move the control adjacent to it (say the next lower frequency) by turning that control until again it becomes excessive. Turn it back until the setting becomes correct, then readjust the previously set control mildly until the optimum setting between these two controls is found. Then move to the next higher control and repeat the procedure.

Listeners "come to grips" rapidly with the Linearizer controls. An initial hesitation quickly reverses to enthusiasm as soon as a few recordings have been linearized. After a couple of hours practice users get rather comfortable with the controls and often adjust two controls simultaneously. This way they are able to control dynamically and find the optimum setting in seconds. Sometimes one needs to adjust during playing. The reason is that titles or movements of works were recorded on different dates and/or by different engineers and sometimes even in a different location. It is not uncommon to hear noticeable changes in sound from one title to another on the same recording.

While some great recordings may not need much of the linearizer function, others will become even greater; mediocre recordings will become very nice and some downright unlistenable recordings will become very listenable; an absolutely amazing feat.
**LINEARIZER SECTION**

To appreciate the massive difference between the Linearizers and equalizer/filter circuits some explanation is helpful. Fig. A shows a block schematic of a typical equalizer/filter and Fig. B shows a more detailed schematic of such a unit. It is obvious how the linear signal is tampered with, introducing all kinds of negative effects to the signal while trying to filter some - most often arbitrarily chosen - frequency bands. The filter circuits that contain resistors/capacitors/coils or - even worse - active reactance are connected in the feedback loop. By changing them the feedback configuration of the circuit is changed also! This is a poor solution as, if feedback is used, it must be linear and identical for all frequencies. With frequency-dependent feedback - as in such circuits - some of the music range will have higher distortion, intermodulation and other negative effects. It is obvious that such an equalizer configuration creates massive phase errors.

In contrast, Fig. C shows the block schematic of the FM 268C linearizer section. The input signal enters a Class A linear amplifier stage from which the signal goes 100% direct-through to a discrete Class A linear output amplifier. At the same time the input signal is routed to individual linearizer controls and then enters a bank of constant phase additive/subtractive Linearizers. These have the unique capability of either subtracting from or adding to the direct through signal without creating any negative influence! This allows very fine corrections without the usual drastic phase changes, frequency-dependent feedback distortion and other negative effects on the audio signal. The result: massive improvements in reproduction without any negative influence on the audio signal.

![Fig. A](image1)

![Fig. B](image2)

![Fig. C](image3)

**Fig. C:** Block schematic of the FM 268C Harmonic Linearizer showing the direct through signal and the constant phase linearizer bank that only ads to or subtracts from the direct through signal.
SYMMETRICAL / NON-SYMMETRICAL CORRECTION

On the left side of the FM 268C Linearizer section there are two switches. One allows activating or bypassing the entire Linearizer section (hardwire bypass!). The switch next to it is a special switch that allows selection of either symmetrical or non-symmetrical addition/subtraction of the audio signal.

Linearization must not be the same for boost and cut curves as the ear reacts differently when adding a certain band of frequencies than when subtracting it. In reality, the most objectionable sounds are resonances. Therefore, a different response is required when attenuating frequencies than when boosting frequencies (one does not really want to create a resonance!)

The function of the controls are best illustrated with a few actual frequency response curves.

Fig. 1 shows the response when the symmetrical/non-symmetrical switch is in the symmetrical position (out) and with a 6dB subtraction at 800Hz. The result is a mild, musically pleasing correction curve.

![Fig. 1](image_url)

The enclosed figures only show a few of the myriad possibilities of Linearizer settings. The simplicity of adjusting just five dynamic controls allows a literally unlimited number of musically relevant linearization correction curves to be created.

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**Fig. 2** shows the same setting of the linearizer section but this time with the non-symmetrical switch pushed in. As one can see the curve is quite distinctly different from that in Fig. 1 resulting in more concentrated correction in the non-symmetrical position.

![Fig. 2](image1)

**Fig. 3** shows signal addition at 800 Hz. This curve is identical for both the non-symmetrical as well as the symmetrical switch position. The reason for this is that the ear reacts different to a boost in frequency response than to an attenuation. Attenuated frequencies in music are often not sharp but rather soft and can be linearized by equally mild addition as Fig. 3 shows.

This is another characteristic that all existing frequency range correction circuits make wrong. It is a great feature of the FM 268C to have the possibility of linearizing the signal in a musically correct way.

![Fig. 3](image2)
The curves following below show a number of even more exiting possibilities:

**Fig. 4** shows - with the non-symmetrical switch pushed in - the response when the 800 Hz and the 3.2 kHz band are subtracted (each is set at -3.6). As these are unique additive/subtractive Linearizers the linearizer banks can be combined for an unlimited number of curves!

Because of this combining possibility the numbers printed on the front panel do not correspond to an absolute dB level but are changing with the settings of adjacent bands.

The smooth subtraction curve is centered exactly midway between the 800 Hz and the 3.2 kHz frequencies, at 1.6 kHz (in musical terms better explained as being precisely centered between the two octaves).

It is easy to see the absolutely smooth response with no ripple (valleys and hills) as is usually the case. Adjacent bands add perfectly without ripple or discontinuity and transient reproduction is superb.

Compare this with **Fig. 5**, which shows the frequency response of a typical equalizer. Apart from the non-desirable response curve and the ripple in the pass band that proves the existence of non-linearity, the phase response is terrible ruining much of what was on the original audio signal.
Fig. 6: Another great feature of the unique FM 268C is that one is not limited to the five centre frequencies at all! If one would like to correct a signal aberration at say 1000 Hz, the FM 268C allows to do this without resorting to any poor sounding parametric/state-variable filters or other musically non-satisfactory equalizing circuits. By simply decreasing the subtraction at 3.2 kHz and increasing the subtraction at 800 Hz the center frequency now moves down to any frequency requested, in this case the required 1000 Hz.

In this way it is possible to select any frequency in the audio band and at the same time continuously vary the addition or subtraction level of these frequencies to whatever is required. Remember, the attenuation can still be adjusted at the same time when moving the center frequency. This allows unlimited control of the frequency addition and subtraction over the entire audio range!

Fig. 7 shows again the attenuation centered on 1 kHz but this time with less attenuation than in Fig. 6, both controls having been moved to somewhat less subtraction the 800 Hz and 3.2 kHz.
Fig. 8 displays the attenuation curve when two of the controls, in this case 200 Hz and 800 Hz, are set to *full subtraction* and the non-symmetrical switch is pushed in. This way one is able to achieve very pronounced attenuation.

Note that as both controls are set to the same level of subtraction the centre frequency is at *exactly* the harmonic middle between the two controls (200 Hz and 800 Hz), in this case 400 Hz showing the musically correct function of the Linearizers.

Fig. 9 If, for instance, certain sharper resonances in a recording (e.g. horn resonances of early recordings) have to be subtracted from the original signal a good example is displayed in Fig. 9. Here the subtraction control is set to -6 at 800 Hz and -3.5 at both 200 Hz and 3.2 kHz. As can be seen a resonance that - in this case - would be centred at 800 Hz could be subtracted from the direct signal with a quite profound attenuation of - in this case - 32 dB! Of course this is an extreme value and almost never required in actual use.