AEC C-39 Dynamic Processor Instruction Manual

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AEC C-39 Dynamic Processor

What happened to the Dynamic Range and How to Restore it

In concert, the sound level of a symphony orchestra's loudest fortissimos may be as much as 105 dB* sound pressure level, with peaks even above that. Rock groups in live performance often exceed 115 dB sound pressure level. By contrast, much essential musical information consists of higher harmonics heard at extremely low levels. The difference between the loudest and the quietest portions of the music is called dynamic range (expressed in dB). Ideally, to record the sound of live music without adding noise or distortion, the recording medium should accommodate dynamic range of at least 100 dB between the inherent background noise level of the equipment and the peak signal level at which distortion becomes audible. Unfortunately, even the best professional studio tape recorders are capable of only a 68 dB dynamic range. To prevent audible distortion, the highest signal level recorded on the studio master tape should have a safety margin of five to ten dB below the audible distortion level. This reduces the usable dynamic range to some 58 dB. The tape recorder is thus required to record a musical program with a dynamic range in dB of nearly twice its own capability. If music with 100 dB dynamic range is recorded on a tape recorder with 60 dB range, either the top 40 dB of the music will be horribly distorted, the bottom 40 dB of the music will be buried in the tape noise and thus masked, or there will be a combination of the two. The recording industry’s traditional solution to this problem has been to reduce intentionally the dynamic content of the music during recording. This restricts the dynamic range of the music to fall within the capabilities of the tape recorder, per- mitting most quiet sounds to be recorded above the tape noise level, while recording loud sounds at levels on the tape which are only slightly (although audibly) distorted. The dynamic range of a program can be intentionally reduced in several different ways. The conductor can instruct the orchestra not to play too loudly or too quietly and thus produce a limited dynamic range for the studio microphones to pick up In practice, this is almost always done to some degree, but the required reduction of 40 to 50 dB cannot be achieved without overly restricting the musicians, resulting in artistically poor performances. A more common method of reducing the dynamic range is for the recording engineer to modify the dynamic range through the use of manual and automatic gain controls.

A more common method of reducing the dynamic range is for the recording engineer to modify the dynamic range through the use of manual and automatic gain controls. studying the musical score that a quiet passage is coming, he slowly increases passan as the paste any increases an o prevent its being recorded below the level of the tape noise. If he knows that a loud passage is coming, he slowly reduces the gain as the passage approaches to prevent its overloading the tape and causing severe distortion. By “gain riding” in this manner, the engineer can make substantial changes in dynamics without the average listener perceiving them as such. As the dynamic range is reduced by this technique, how- ever, the recording will not have the excitement of the original live performance. Sensitive listeners can usually sense this deficiency, even though they may not be consciously aware of what is missing. The automatic gain controls consist of electronic signal processing systems called compressors and limiters that modify the signal level recorded on tape. A compressor reduces the dynamic range in a gradual manner by gently reducing the level of loud signals, and/or increasing the level of quieter signals. A limiter acts more drastic- ally to restrict any loud signal that exceeds some preset level. This prevents distortion due to the overloading of the tape on loud program peaks. Another dynamic range modifier is the magnetic tape itself. When tape is driven into saturation by high level signals, it tends to round off the peaks of the signals, and acts as its own limiter by restricting high level signals. This causes some distortion of the signal, but the gradual nature of tape saturation results in a type of distortion which is tolerable to the ear, so the record- ing engineer permits a certain amount of it to occur to keep the entire program as high above the tape noise level as possible and thus obtain a quieter recording. Tape satu- ration results in the loss of the sharp edge of percussive attacks, softening of the strong, biting overtones on instruments, and a loss of definition in loud passages when many instruments are playing together. The result of these various forms of dynamic range reduction through signal “tampering” is that the sounds are dis- placed from their original dynamic relation- ship. Crescendos and loudness variations containing vital musical information have been reduced in scale, compromising the presence and excitement of the live performance.

The widespread use of 16 or more track tape recording also contributes to dynamic range problems. When 16 tape tracks are mixed together, the additive tape noise increases by 12 dB, reducing the usable dynamic range of the recorder from 60 dB to 48 dB. As a result, the recording engineer strives to record each track at as high a level as possible to minimize the effects of the noise build-up.

Even if the finished master tape could provide full dynamic range, the music must ultimately, be transferred to a conventional disc which has, albest, a 65 dB dynamic range. Thus, we still have the problem of a musical dynamic range far too great to be cut on a commercially acceptable disc. Coupled with this problem is the desire of record companies and record producers to have records cut at as high a level as possible, to make their records louder than those of their competitors. If all other factors are held constant, a louder record generally sounds brighter (and “better”) overall than a quieter one. Radio stations also want records cut at high levels so that disc surface noise, pops and clicks will be less audible on the air.

The recorded program is transferred from the master tape to the master disc via a cutting stylus which moves from side to side and up and down as it inscribes the grooves of the master disc. The higher the signal level, the farther the stylus moves. If the stylus excursions are too great, adjacent grooves can cut into one another causing distortion, groove echo, and skipping on playback. To avoid this, the grooves must be spread farther apart when high level signals are cut, and this results in a shorter playing time for records cut at high levels. Even if the grooves do not actually touch each other, very high-level signals can cause distortion and skipping due to the inability of the playback stylus to follow very large groove excursions. While high-quality arms and cartridges will track large excursions, inexpensive "record players" will not, and the record manufac*) The dB or decibel is a unit of measure- ment for the relative loudness of sound. It is usually described as the smallest easily detectable change in loudness. The thresh- old of hearing (the faintest sound you can perceive) is about 0 dB, and the pain threshold (the point at which you instinctively cover your ears) is about 130 dB sound pressure level.

Expansion. The Need, the Fulfillment

The need for expansion in quality audio systems has long been recognized.

In the 1930's, when compressors first became available to the recording industry, their acceptance was inevitable. Compressors provided a ready solution to a major record- ing problem – how to fit onto discs, which could accept a maximum range of only 50 dB, program material where the dynamics ranged from a soft level of 40 dB to a loud level of 120 dB Where previously loud levels caused overload distortion (and soft levels were lost in background noise), the com- pressor now enabled the engineer to make loud passages softer and soft passages louder automatically. In effect, dynamic reality was altered to fit the limitations of the state of the art. It soon became obvious that realistic sound from these dynamically limited recordings demanded an inversion of the compression process – expansion – to restore the dynamic accuracy. That situation remains unchanged today. Over the past 40 years, many attempts have been made to develop expanders. These attempts have been imperfect, at best. The educated ear, it seems, is somewhat tolerant of errors that occur in compression; expansion faults, how- ever, are glaringly evident. They have included pumping, level instability and distortion – all of which are highly unacceptable. Thus designing a quality expander that eliminates these side effects has proved to be an elusive goal. That goal, however, has now been achieved. The reason we accept the loss of program dynamics without objection is due to an interesting psychoacoustic fact. Even though loud sounds and soft sounds have been compressed to similar levels, the ear still thinks it can detect a difference. It does – but, interestingly, the difference is not due to changes of level but to a change in harmonic structure Loud sounds are not just stronger versions of soft sounds. As volume increases, the amount and strength of the over- tones increase proportionately. In the listening experience, the ear interprets these differences as loudness changes. It is this process which makes compression acceptable. In fact we accept it so well that, after a long diet of compressed sound, live music is sometimes shocking in its impact. The AEC Dynamic Processor is unique in that, like our ear-brain system, it combines both harmonic structure information with amplitude change as a new and singularly effective approach to controlling expansion. The result is a design that overcomes previous annoying side effects to achieve a level of performance never before possible. The AEC C-39 inverts the compression and peak limiting present in almost all recordings to restore with remarkable fidelity the original program dynamics. Additionally, these improvements are accompanied by noticeable noise reduction – a marked decrease in hiss, rumble, hum and all background noise. The advantages of the AEC C-39 can make a truly significant difference to the listening experience. Dynamic contrasts are the core of much that is exciting and expressive in music. To realize the full impact of attacks and transients, to discover a wealth of fine detail you were unaware even existed in your recordings is to stimulate both new interest and new discovery in all of them.

Features

- Continuously variable expansion restores up to 16 dB of dynamics to any program source; records, tape, or oroadcast.
- Effectively reduces all low level background noise – hiss, rumble, and hum. Overall signal to noise improvements of up to 16 dB.
- Exceptionally low distortion.

- Combines upward and downward expansion with peak unlimiting to restore transients and fine details as well as more realistic dynamic contrasts.
- Easily set up and used. Expansion control is non-critical and calibration is not required.
- Fast responding LED display accurately tracks processing action.
- Improves stereo image and the listener's ability to distinguish each instrument or voice.
- Two-position slope switch controls expansion to match precisely both average and highly compressed recordings.
- Achieves remarkable restoration of older recordings.
- Reduces listening fatigue at high playback levels.

Specifications

AEC C-39 Dynamic Processor / Specifications

4 dB/16 dB	Total Expansion (Continuously variable)
−4 dB/ −7 dB	Downward Expansion
0/ + 9 dB	Upward Expansion
600 microseconds	Expansion Attack Rate
80 milliseconds	Expansion Decay Rate
6.5 V	Max. Output Voltage (at 0.5% distortion, 1 kHz; max. expansion into 50 kohm load)
1 V	Rated Output Voltage
50 millivolts	Minimum Sensitivity (level control maximum)
	Harmonic Distortion (at 1 kHz, max. expansion)
.08%	at 1.0 V out:
.04%	at 0.5 V out:
.1%	Intermodulation Distortion (60 and 2 kHz mixed 1 : 1, at 1 V output)
80 dB	Hum and Noise (referenced to 1 V output, expansion maximum)
80 kohms	Input Impedance
300 ohms	Output Impedance
120-240 V/50-60 Hz	Power Requirements
19" x 3½" x 11" 483 x 89 x 280 mm	Dimensions
5 Lbs. 2 oz./2,4 kg.	Weight
90 days/5 years with Service Contract	Warranty

Thank you for your interest in the AEC C-39 Dynamic Processor. We are proud of our product. We think it is undoubtedly the finest expander on the market today. Five years of intensive research went into developing it – research that not only produced a new technology in expander design but resulted in two patents granted, with a third pending. We urge you to compare the AEC C-39 with any other expander in the field. You will find it to be remarkably free of the pumping and distortion from which other units suffer. Instead you will hear a unique and accurate restoration of the original dynamics and fine detail which compression has removed. We would be pleased to hear your own reaction to our product and, if you have further questions, write us at any time.

Documents / Resources

AEC C-39 Dynamic Processor [pdf] Instruction Manual
C-39 Dynamic Processor, C-39, Dynamic Processor, Processor

References

- User Manual