

Compander with varying characteristics

The invention relates to a circuit for automatic compression and/or expansion of electrical signals. Such a circuit is known as a compander.

The block circuit diagram of such a compander is illustrated in the article "Der Telefunken-Kompander" in the journal "Rundfunktechnische Mitteilungen", Year 22 (1078), Volume 2, diagram 13 and described in paragraph 4.2. Since this compander effects a wideband treatment of the signals, a compatible reproduction of recordings which e.g. have been effected with a compressor according to the sliding band procedure is not possible. For the recording and reproduction of LF performances by this procedure a complete change-over of the compander could indeed be effected, so that the parameters introduced for a known sliding band procedure are accurately retained; the change-over would however be too expensive.

It is an object of the present invention to modify a known circuit so that sliding band parameters may selectively be obtained so accurately that remaining

deviations from ideal behaviour cannot be noticed.

According to the present invention there is provided a circuit for automatic dynamic compression and/or expansion of electrical signals having a signal path, including a first adjustable member for varying the transfer characteristic in the signal path and a low-pass circuit, and a branch path including a second adjustable member for varying the transfer characteristic in the branch path, the branch path serving to provide a control voltage which is applied to control inputs of the first and second adjustable members, wherein the first adjustable member constitutes part of a controllable highpass circuit, the limiting frequency of which is of the order of magnitude of the limiting frequency of the lowpass circuit.

For selective changing over from the characteristic of a wide-band compander to that of a sliding-band compander, the controllable highpass circuit may be switched between first and second configurations.

In the second switched configuration, a capacitor may be connected in series with the first adjustable member.

A preferred embodiment of the present invention will now be described by way of examples with reference to

the accompanying drawing.

Firstly the operating mode will be considered in which coupled switches 13, 14 and 28 are in the position shown. In this case the circuit operates as a wideband compander. For treating the signals in the sense of a compression the switch 7 is closed. The path for the useful signals then leads from an input terminal 1 via the non-inverting input 3 of an amplifier 2 to the output 5 of the amplifier and thence to an output terminal 37 at which the compressed signals can be taken off. The amplifier 2 has its output 5 coupled by a negative feedback path to its inverting input 4. The feedback path includes the series circuit comprising a damping member 8, a highpass 9, a controllable resistor 10, an inverter 16 and a lowpass circuit having the circuit elements 20 to 26. For obtaining the control voltage for the adjusting member of the controllable resistor 10 a branch path having a similar adjusting member 30 is provided. The compressed signals are fed to the branch path from the output of the highpass 9 and pass via an inverting amplifier arrangement 30, 32, 38 to the output 34 of this amplifier and thence via a highpass 35 to a rectifier 36. The control voltage obtainable at the output of this rectifier is applied to control inputs 11

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and 31 of the adjusting members 10 and 30. Since during compression the adjusting member 10 associated with the useful signal path is arranged in the negative feedback path of the amplifier 2, and the adjusting member 10 and the adjusting member 31 are both controlled in the same manner, the dynamic range of a useful signal applied to the input terminal 1 is regulated after the amplifier 2 to half the dynamic value, and at the input of the rectifier 36 is regulated to the dynamic value 0 dB.

If the switch 7 is opened to change over to the "expansion" mode of operation, the circuit elements located in the negative feedback path for the "compression" mode of operation are now located in the signal path. The expanded signals can be taken off at an output terminal 29. The amplifier 2 has the constant amplification "1" due to the provision of a negative feedback resistor 6 between its output 5 and its inverting input 4. In the "expansion" operating mode also the signals fed to the branch path are regulated to the stationary value 0 dB. Since, however, in contrast to the controllable resistor 30 in the branch path the controllable resistor 10 in the signal path is in series in relation to the useful signals, with the same control of the controllable resistors 30, 10 an expansion occurs in the signal path.

The damping member 8 serves for matching the level of the

the output signals of the amplifier 2 to the control range of the controllable resistors 10 and 30. On the output side this lowering of level is raised again by the amplification of the amplifiers 16 and 21. The highpass 9 as well as the highpass 35 have the task of effecting a reduction of level for high frequencies, in order to avoid tape over-loading effects in magnetic tape recording. The amplifier 21 has a lowpass character owing to its external connections. In the "compression" operating mode this lowpass is located in the negative feedback path of the amplifier 2, so that the circuit as a whole operates as a highpass. Owing to the re-arrangement of the lowpass circuit for compression and for expansion, pre-emphasis is effected during "compression" and de-emphasis during "expansion". This step is comparable to the band limit shift in accordance with the sliding band procedure. With the circuit described, however, the limiting frequencies are fixed.

For changing over the arrangement to a different compander characteristic, the coupled switches 13, 14 and 28 are brought into the position not shown; i.e. switches 13 and 28 are closed and switch 14 is opened. There results the most important feature that by the inclusion of a condenser 15 in series with the adjusting member 10 a controllable highpass is provided. The highpass function is limited in the direction of low frequencies by a resistor 12 in parallel with the adjusting

resistor 10 and the condenser 15. The connection of a condenser 27 in parallel with the condenser 26 already present represents an additional feature that assists optimal matching to the sliding band parameters. The limiting frequencies of the lowpass circuit 20...28 and of the highpass circuit 10...15 are of the same order of magnitude. The actions of the two circuits are thus oppositely directed. By varying the adjusting member 10 there is effected a shift of the limiting frequency as well as a change of the amplification in the upper frequency range. In contrast to the sliding band procedure, however, here only one limiting frequency is altered. The amplitude shifts therefore take place in particular spectral regions of the signals. However, these frequency errors are not noticeable in practice, in direct A-B comparison with an accurately operating sliding band circuit. Also, a measurement check shows that tolerances within a ± 3 dB field can be attained.

It is worth noting that for the control of the adjusting member 10 in the above arrangement the same voltage generator is used as in the "wideband" mode of operation. This is based on appreciation of the fact that the branch path with its adjusting member and the control voltage generator operates as a negative feedback rectifier and hence as a circuit which, independently of the type of signal, represents a reproducible quantity for the alternating voltage.

With the above arrangement, amplifiers, adjusting members and frequency-dependent networks already present are utilised in an advantageous manner. The principle of operation of the above circuit depends essentially on the fact that the influencing of the frequency of a lowpass circuit with fixed limiting frequency is partially compensated by a controllable highpass filter of variable limiting frequency in accordance with useful signals. As compared with an exact treatment of the LF signals by a sliding band circuit, the above circuit indeed effects an amplitude shift of individual parts of the spectrum; it has been found in practice, however, that these transmission errors are not noticed. Moreover, with a critical treatment of these transmission errors account must be taken of the fact that an accurately dimensioned and constructed sliding band circuit effects an amplitude shift of parts of the spectrum even if a magnetic tape storage device gives rise to a peak error between the compressor output signal and the expander input signal, owing e.g. to different types of tape.

The above arrangement provides a possible way of changing over to quasi-compatible Dolby ^(Registered Trade Mark) reproduction.

CLAIMS

1. A circuit for automatic dynamic compression and/or expansion of electrical signals having a signal path, including a first adjustable member for varying the transfer characteristic in the signal path and a low-pass circuit, and a branch path including a second adjustable member for varying the transfer characteristic in the branch path, the branch path serving to provide a control voltage which is applied to control inputs of the first and second adjustable members, wherein the first adjustable member constitutes part of a controllable highpass circuit, the limiting frequency of which is of the order of magnitude of the limiting frequency of the lowpass circuit.
2. A circuit according to claim 1, wherein, for selective changing over from the characteristic of a wide-band compander to the characteristic of a sliding-band compander, the controllable highpass circuit may be switched between first and second respective configurations.
3. A circuit according to claim 2 wherein, in the second switched configuration, of the controllable highpass circuit, a first capacitor is connected in series with the first adjustable member.
4. A circuit according to claim 3 wherein, in order to limit the highpass function at low frequencies, in the second

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switched configuration of the controllable highpass circuit a resistor is connected in parallel with the series connection of the first adjustable member and the first capacitor.

5. A circuit according to claim 2 wherein the lowpass circuit includes a first lowpass circuit capacitor, and, in order to reduce the limiting frequency of the lowpass circuit in the second switched configuration of the controllable highpass circuit, a second lowpass circuit capacitor is connected in parallel with the first lowpass circuit capacitor.

6. A circuit according to any of the preceding claims wherein a common control voltage generator is used to control the first adjusting member in both the first and second switched configuration of the controllable highpass circuit.

7. A circuit for automatic compression and/or expansion of electrical signals substantially as herein described with reference to the accompanying drawing.

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