

Tuner.

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The invention relates to a tuner.

European Patent Application 95 105 797.5-2211 describes a tuner comprising at least two signal-processing branches for frequency-selective reception, amplification and/or frequency conversion of RF signals. This tuner includes a switching
5 stage via which the RF signals, which can be supplied from an input, can optionally be passed through one of the signal processing branches. Each signal processing branch comprises a filter stage connected to the switching stage, a controllable amplifier stage arranged subsequent to the filter stage, and a mixer stage succeeding the amplifier stage. The outputs of the mixer stages are connected to a common output branch via a signal junction.

10 The tuner described allows a smaller volume at reduced manufacturing costs.

It has proved that, on the one hand, a further reduction of noise, i.e. an improvement of the signal-to-noise ratio, is desirable and that, on the other hand, the return loss in the signal-processing branches is reduced when the mixer stage is directly connected
15 to the (controllable) amplifier stage in the signal-processing branch. Via the input, the backscattered signals may reach an antenna connected to this input and thus lead to uncontrollable interferences.

It is an object of the invention to improve the return loss of the tuner with a small number of components and without losing the advantages of the tuner described in
20 European Patent Application 95 105 797.5-2211.

According to the invention, this object is solved by a tuner having at least one signal-processing branch for frequency-selective reception, amplification and/or frequency conversion of RF signals by means of a wideband input amplifier, a switching stage via which the RF signals, which can be supplied from an input via the input amplifier,
25 can optionally be passed through one of the signal-processing branches, each signal processing branch comprising a filter stage connected to the switching stage, a controllable amplifier stage arranged subsequent to the filter stage, and a mixer stage succeeding the amplifier stage, the outputs of the mixer stages being connected to a common output branch via the signal junction.

According to the invention, the afore-mentioned object is also solved by a tuner having at least one signal-processing branch for frequency-selective reception, amplification and/or frequency conversion of RF signals by means of a wideband, controllable input amplifier, a switching stage via which the RF signals, which can be
5 supplied from an input, can optionally be passed through one of the signal-processing branches, each signal-processing branch further comprising a filter stage connected to the switching stage and a mixer stage succeeding the amplifier stage, the output of the mixer stages being connected to a common output branch via a signal junction.

European Patent Application 95 105 797.5-2211 describes that, in
10 accordance with a hitherto conventional construction principle, each signal-processing branch comprises, in succession, a first filter stage, a controllable amplifier stage, subsequent filter stages and a mixer stage for downconverting the applied RF signals in frequency. The controllable amplifier stage is used for noise reduction of the RF signal before selection in the subsequent filter stages. In the subject matter of the present invention, this noise
15 reduction, i.e. an improvement of the S/N ratio is performed by the wideband input amplifier. Particularly when using a tuner according to the invention in a video recorder, this leads to a very simple and low-cost construction, because a wideband input amplifier of the type described is already present in the antenna input stage of the video recorder for looping through the RF signals to a subsequent television receiver (monitor). The desired noise
20 reduction is thus achieved without any additional components.

The wideband input amplifier also attenuates crosstalk of particularly a powerful oscillator signal for downconverting the RF signals in the mixer stages. Such a backscattering effect, particularly of the oscillator from the mixer stages to the antenna may be used to advantage if a filter stage is arranged not directly before the mixer stage in the
25 signal path for the RF signal in the signal-processing branch. The invention provides the possibility of attenuating this backscattering effect without any additional measures to an insignificant extent. Particularly, a semiconductor integration of the controllable amplifier stage and the mixer stage can then be realized without any drawbacks for the signal-processing operation.

30 In conventional tuners, the required impedance matching between an antenna terminal connected to the input and the filter stages in the tuner is ensured by the arrangement of the (controllable) amplifier stages at the head end of the signal-processing branches. Also this impedance matching may advantageously be performed without any additional components by the wideband input amplifier arranged in accordance with the





invention.

Moreover, in the tuner according to the invention, the separate first filter stage between the input and the (controllable) amplifier stage, which filter stage is to protect said stage from intermodulation, is dispensed with.

5 According to the invention, either the wideband input amplifier has a fixed gain factor, and the amplifier stage preceding the mixer stage in each signal-processing branch has a controllable gain factor, or the wideband input amplifier has an adjustable gain factor so that then separate amplifier stages preceding the mixer stages are dispensed with in the signal-processing branches, or, if necessary, may at best have a constant gain factor. The
10 solution using the wideband controllable input amplifier provides a very simple construction which is particularly suitable for standardized implementations of the tuner. The wideband controllable input amplifier may advantageously be utilized for amplitude or power control.

If the wideband input amplifier has a constant gain factor, the controllable amplifier stages in the signal-processing branches may be utilized for amplitude or power
15 control. This construction is favorable for a simple construction of an antenna input stage for a video recorder for an amplitude or power control to be performed in the signal-processing branches.

In a tuner according to the invention the mixer stages of all signal-processing branches are preferably connected to a common oscillation generator comprising a
20 common phase-locked loop and a separate oscillator stage for each signal-processing branch. Preferably, each signal-processing branch is implemented for a predetermined frequency range (band). For each band, an oscillator stage is provided but a phase-locked loop is provided for all bands combined. Consequently, the synchronization between the filter stages and the oscillators within each signal-processing branch can be simplified.

25 These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

The Figures, in which corresponding elements are denoted by the same reference numerals, show two embodiments of the tuner according to the invention.

The embodiment of the tuner shown in Fig. 1 comprises a wideband input
30 amplifier 1 which is connected at the input to an input 2 for the RF signals and at the output to a switching stage 3, as well as three signal-processing branches succeeding the switching stage 3, with a terminating signal junction. In Fig. 1, each signal-processing branch comprises filter stages 4, 5 and 6 connected to the switching stage 3, controllable amplifier stages 7, 8, 9 connected to the filter stages 4, 5 and 6, and mixer stages 10, 11, 12



connected to the associated controllable amplifier stages 7, 8, 9, respectively. The RF signals are applied from the input 2 via the wideband input amplifier and the switching stage 3 optionally to one of the signal-processing branches. In the signal-processing branch, the desired frequency band associated with the signal-processing branch is selected in the filter stage 4, 5, 6. The mixer stages 10, 11, 12 receive the RF signals, exclusive of the filtered frequency band, via the controllable amplifier stages 7, 8 and 9 and are downconverted in frequency in the mixer stages 10, 11 and 12. The signal junction, constituted in the arrangement of Fig. 1 by a node 13 and an output amplifier 14, provides the possibility of supplying the downconverted RF signals to a common output 15. Optionally, the signal junction may also comprise only the node; together with the output 15, the output amplifier 14 is then associated with an output branch which is common for all signal-processing branches.

To generate the oscillations required for downconverting the RF signals, a common oscillation generator comprising a phase-locked loop 16 which is common for all signal-processing branches and a separate oscillator stage 17, 18, 19 for each signal-processing branch is used in the arrangement shown in Fig. 1. The phase-locked loop 16 and the oscillator stages 17, 18 and 19 are connected together in known manner. To exclude interference between the signal-processing branches, the oscillator stages 17, 18, 19 may be optionally switched on and off via a data lead 20 so that only that oscillator stage 17, 18, 19 supplies an oscillation whose signal-processing branch is connected via the switching stage 3 to the input 2 (via the input amplifier 1). The data lead 20 may then be connected in the same manner to the switching stage 3 as well. Moreover, the frequency of the oscillation supplied by the oscillation generator 16 to 19 is adjustable via a data input 21 of the phase-locked loop 16. The oscillation generator 16 to 19 is further connected to a crystal oscillator 22 as a frequency reference.

The controllable amplifier stages 7, 8, 9 have a control input 23 via which the gain factor of the amplifier stages 7, 8, 9 is adjustable. The controllable amplifier stages 7, 8, 9 may then be taken up in a control loop for amplitude control or power control of the RF signals.

The data lead 20 and the data input 21 of the phase-locked loop 16 may be connected to a control (not shown) for the receiving operation of the tuner.

The filter stages 4, 5, 6 are connected via a lead 24 of the phase-locked loop 16. Via this lead 24, signals for the frequency selection by the oscillation generator 16 to 19 may be supplied in the conventional manner. Particularly, the tuning diodes in the filter

stages 4, 5, 6 are tuned in the same way as the oscillator stages 17, 18, 19.

Fig. 1 also shows the inclusion of the embodiment of the tuner described hereinbefore in an RF signal-processing unit of a video recorder. To this end, Fig. 1 shows a further input amplifier stage 25 which is connected at the input to an antenna input 26 of the video recorder and at the output to the input 2 of the tuner for the RF signals. The input 2 is further connected via a bridging amplifier 27 to an input of an RF signal superposition stage 28. Its output constitutes an antenna output 29 of the video recorder.

An input 30 for the baseband video signal constitutes a first input of a low-frequency signal superposition stage 31. An input 32 for an audio signal is connected to an audio signal modulation stage 33. This stage is connected to a second input of the low-frequency signal superposition stage 31. In the audio signal modulation stage 33, the audio signal supplied from the input 32 is modulated on a subcarrier oscillation and subsequently additively superposed in the low-frequency signal superposition stage 31 with the baseband video signal from the input 30. In this way, an FBAS signal is generated and supplied via an output 34 of the low-frequency superposition stage 31. The output 34 is connected to a modulation stage 35, in which the FBAS signal is upconverted with an oscillation from one of the oscillator stages, here the oscillator stage 19 for the third signal-processing branch. An RF signal is then produced, which is applied to the RF signal superposition stage 28 for further supply to the antenna output 29 of the video recorder.

In Fig. 1, the elements enclosed by the broken line 36 are advantageously combined to an integrated group of components. In a corresponding manner, the elements surrounded by the dot-and-dash line 37 may be combined to a further integrated group of components. These integrated groups may particularly be integrated on a semiconductor body.

Fig. 2 shows a second embodiment of the tuner according to the invention. As compared with the embodiment of Fig. 1, the wideband input amplifier 1 is replaced by a wideband controllable input amplifier 38 which is now connected to the control input 23 for amplitude and power control of the RF signals. On the other hand, the controllable amplifier stages 7, 8, 9 are dispensed with in the signal-processing branches and may be replaced in a modification of Fig. 2 by amplifier stages having constant gain factors in so far as a further signal amplification or return loss is desired at these positions in the circuit arrangement.

In other respects, the embodiments shown in Figs. 1 and 2 correspond to each other.

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These tuners are preferably suitable for use in RF processing stages of satellite tuners and video recorders.

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CLAIMS:

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1. A tuner having at least one signal-processing branch for frequency-selective reception, amplification and/or frequency conversion of RF signals by means of a wideband input amplifier, a switching stage via which the RF signals, which can be supplied from an input via the input amplifier, can optionally be passed through one of the signal-
5 processing branches, each signal-processing branch further comprising a filter stage connected to the switching stage, a controllable amplifier stage arranged subsequent to the filter stage, and a mixer stage succeeding the amplifier stage, the outputs of said mixer stages being connected to a common output branch via a signal junction.
2. A tuner having at least one signal-processing branch for frequency-
10 selective reception, amplification and/or frequency conversion of RF signals by means of a wideband, controllable input amplifier, a switching stage via which the RF signals, which can be supplied from an input, can optionally be passed through one of the signal-processing branches, each signal-processing branch further comprising a filter stage connected to the switching stage and a mixer stage succeeding the amplifier stage, the outputs of said mixer
15 stages being connected to a common output branch via a signal junction.
3. A tuner as claimed in Claim 1 or 2, characterized in that the mixer stages of all signal-processing branches are connected to a common oscillation generator.
4. A tuner as claimed in Claim 3, characterized in that the oscillation
20 generator comprises a common phase-locked loop and a separate oscillator stage for each signal-processing branch.
5. A tuner as claimed in Claim 4, where appendant to Claim 1, characterized in that, together with the oscillation generator, the controllable amplifier stages and the mixer stages of all signal-processing branches are combined in an integrated component.
6. A tuner as claimed in Claim 4 or 5, characterized in that the input
25 amplifier and the switching stage are combined in an integrated component.
7. A tuner as claimed in Claim 4, where appendant to Claim 2, characterized in that, together with the oscillation generator, the mixer stages of all signal-processing branches are combined in an integrated component.



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