

Description

This invention relates to a receiver apparatus suitable for receiving, for example, a satellite broadcast and so on.

There has been known a satellite broadcast tuner (hereinafter referred to as "the BS tuner") which, for example, utilizes an AGC voltage of a tuner unit to calculate a received level and display the calculated received level on the screen of a television receiver connected thereto (or integrated therewith).

Since especially the BS tuner requires that a BS antenna be strictly set in an appropriate direction for receiving satisfactory images, it is quite useful to display a received level on the screen of a television receiver as a guide for determining an optimal setting direction of the antenna.

The received level calculated by the BS tuner is not a simple BS-IF level of a received channel but a value, for example, corresponding to a received C/N which is calculated by simultaneously measuring a received noise level at a predetermined frequency. This example will be described with reference to FIG. 1.

In that case, an IF level (carrier level) is calculated from an AGC voltage at an arbitrary channel (for example, BS channel 11), a received level or a noise level at a frequency out of the received frequency band of the satellite broadcast channels (1st - 15th channels), for example, a frequency corresponding to a channel 16.5 is similarly measured from the AGC voltage, and a received level L_{CN} is calculated, for example, by the following equation:

$$L_{CN} = K \times \frac{C_{f(x)}}{N_{f(16.5)}}$$

where K represents a correction coefficient, $C_{f(x)}$ a received level (carrier level) measured when it is received at a frequency of a channel x, and $N_{f(16.5)}$ a received level (noise level) measured when it is received at a frequency corresponding to the channel 16.5.

Measured values of the AGC voltages at the respective channels in a certain receiving condition present higher values as the channels are in a higher frequency region, for example, as indicated by solid lines illustrated in FIG. 1. This phenomenon is caused by the frequency characteristics of a BS converter, a BS cable, a bandpass filter used in a tuner unit, the AGC voltage and so on.

However, since the received levels of the respective channels derived by the prior art are calculated on the basis of a noise level (indicated by one-dot chain lines in FIG. 1) measured at a frequency outside the received frequency band, for example, at a frequency corresponding to the channel 16.5, the received levels of the respective channels are calculated as values corresponding to ℓ ($\ell 1 - \ell 15$) indicated by broken line arrows in FIG. 1.

That is, even if a received angle and a receiving condition of the antenna are identical, a large error may be produced in the received level L_{CN} calculated for certain channels, which results in confusing the user.

GB-A-1460513 (=DE-A-2523739) discloses an FDM communications system including a noise detector in accordance with the pre-characterizing portion of claim 1 and in which several quiet channels are provided in a broadcast band of interest and the noise level in those quiet bands is measured using respective local oscillators to shift frequencies to obtain a measurement of the performance of the system. This document also refers to CCIR recommendation 398-2 of 1970 that noise levels can be measured above and below the band of interest with asymmetric noise loading.

EP-A1-0368581 discloses a noise power meter with a narrow input frequency band and a converter to convert the signal from a device-under-test to the pass frequency. Inaccuracies in the converter are detected by scanning the passed signal and an offset added to the converter so that the measurement of noise can be measured at the frequency of interest.

EP-A1-0181701 discusses the measurement of CN ratio in a TDMA satellite communications system and DE-A-2439141 also discusses noise measurement in communication systems.

It is an object of the present invention to provide a BS receiver apparatus which is capable of calculating a precise noise level for each channel to thereby eliminate large differences in the noise level among the respective channels in the same receiving condition.

According to the present invention, there is provided a device for use in a radio wave receiver for detecting a noise level in a predetermined range of the received signal comprising:

a local oscillator to generate a local oscillating signal;

a mixer to mix said local oscillating signal with a received signal;

a tuning device to control the frequency of said local oscillating signal generated by said local oscillator;

control means to control said tuning circuit; and

a noise level detector to detect noise levels of predetermined plural points in a received band, characterised by estimating means to estimate from said detected noise levels the noise at a desired point in the received band and to compare it to a received signal at said point to derive a received signal strength.

The radio wave receiver may be a satellite broadcast receiver.

The invention will be further described by way of non-limitative example with reference to the accompanying drawings, in which:-

FIG. 1 is a graph used for explaining the difference in a received level corresponding to the C/N which occurs in each receiving channel;

FIG. 2 is a block diagram illustrating an embodiment of a BS tuner according to the present invention; and

FIG. 3 is a flowchart illustrating the operation of a system controller employed in the embodiment shown in FIG. 2,

FIG. 2 is a block diagram illustrating an embodiment of a receiver apparatus according to the present invention or BS tuner 1. A BS antenna 20 receives and supplies a radio wave in a 12 GHz band to a BS converter 30 which in turn converts the supplied radio wave to a first intermediate frequency signal (1.03 - 1.33 GHz). A received signal converted to the first intermediate frequency signal by the BS converter 30 is supplied to the BS tuner 1 through a coaxial cable 40.

Reference numeral 2 designates a high frequency amplifier circuit, 3 a preselector circuit, 4 a mixer circuit, 5 a local oscillator, 6 a bandpass filter, and 7 a tuning circuit. Based on a tuning voltage generated from the tuning circuit 7 for controlling the oscillating frequency of the local oscillator 5, a desired channel is selected from the received signal supplied as the first intermediate frequency signal. The received signal is further converted to a second intermediate frequency signal at a frequency of 134.26 MHz or 402.78 MHz.

The received signal converted to the second intermediate frequency signal is amplified by an AGC amplifier circuit 8 and FM demodulated by an FM demodulator circuit 9. An AGC control voltage is supplied from the AGC amplifier circuit 8 to an AGC voltage detector circuit 10, whereby a received level can be measured by the AGC voltage detector circuit 10 as a carrier level of the second intermediate frequency signal converted from the received signal.

The FM demodulated signal is supplied to an audio signal processing circuit 11 composed of a four-phase DPSK demodulator circuit and a PCM demodulator circuit to produce L and R audio signals as well as to a video signal processing circuit 12 composed of a deemphasis circuit, an energy diffusion signal removing circuit, a video amplifier circuit and so on to extract a video signal. The L and R audio signals and the video signal are supplied to a TV (television) receiver, which may be integrated with the BS tuner 1 or may be separate one, to be outputted as sounds and an image.

A system controller 13 having a microcomputer composed of a CPU, a ROM, a RAM, and an interface controls a channel selection, an AGC voltage detection and processing of a variety of signals. A character generator 14, under the control of the system controller 13, supplies a character signal to the video signal processing circuit 12 for displaying a predetermined

character on the screen of the TV receiver.

The BS tuner 1 is composed of the circuit blocks as described above. The system controller 13, on the other hand, is also provided, as function means in the form of software, with a high-band noise level measuring means for controlling a received frequency to the frequency corresponding to the channel 16.5 of the BS channel so as to measure an AGC voltage $N_{R(16.5)}$ at that frequency, a low-band noise level measuring means for controlling the received frequency to a frequency corresponding to a channel -0.5 of the BS channel so as to measure an AGC voltage $N_{R(-0.5)}$ at that frequency, a received signal level measuring means for controlling so as to measure an AGC voltage $C_{R(x)}$ when an arbitrary channel specified by the user is being received, to measure this received signal level, a calculating means for calculating a noise level at the channel frequency at which the received signal level was measured from the received signal levels respectively measured in the high band and the low band and calculating a received level corresponding to C/N of the received channel from the calculated noise level and the measured received level, and a display control means for controlling the character generator 14 to display a value calculated by the calculating means on the screen of the TV receiver.

By virtue of the system controller 13 having the above-mentioned control means in the form of software, the system controller 13 can measure the received level corresponding to the C/N by performing the operations illustrated in the flowchart of FIG. 3.

More specifically, when the user operates the receiver apparatus to display a received level on the screen of a TV receiver (step F100), at first the tuning circuit 7 is controlled to receive the channel 16.5, and in this state an AGC voltage value is detected by the AGC voltage detector circuit (step F101). Since the channel 16.5 is not assigned to the satellite broadcast, the detected AGC voltage value can be measured as a noise level $N_{R(16.5)}$ as shown in FIG. 1. Next, an AGC voltage value at the channel -0.5 is detected, thereby measuring a noise level $N_{R(-0.5)}$ in a band lower than the broadcasting frequency band (step F102).

Then, a predetermined channel, for example, the BS channel 11 is received to detect an AGC voltage $C_{R(11)}$ by the AGC voltage detector circuit 10 as a carrier level of the received signal (step F103). Incidentally, the order of the steps F101 to F103 is interchangeable.

When the respective values $N_{R(16.5)}$, $N_{R(-0.5)}$ and $C_{R(11)}$ have been calculated, a received level L_{CN} corresponding to the C/N is calculated by a program as the calculating means (step F104) in accordance with the following equation (1):

$$L_{CN} = K \times \frac{C_{R(x)}}{N_{f(x)}} \quad (1)$$

where K represents a correction coefficient, $C_{R(x)}$ a

carrier level at a received frequency corresponding to a channel x , and $N_{f(x)}$ a noise level at a received frequency corresponding to the channel x .

When the received level L_{CN} is calculated for the BS channel 11, 11 is substituted for x ($x=11$). The value $C_{f(11)}$ has already been calculated at step F103.

Supposing that $N_{f(x)}$ can be linearly approximated as indicated by a dot line in FIG. 1, the following equation is satisfied:

$$N_{f(x)} = N_{f(-0.5)} + \frac{N_{f(16.5)} - N_{f(-0.5)}}{f_{(16.5)} - f_{(-0.5)}} x$$

$$(f_{(x)} - f_{(-0.5)}) \quad (2)$$

where $f_{(x)}$ designates the frequency corresponding to the channel x , and $f_{(16.5)}$, $f_{(-0.5)}$ frequencies corresponding to the channels 16.5, -0.5, respectively.

Since the values $N_{f(16.5)}$ and $N_{f(-0.5)}$ have been measured at steps F101, F102, the noise level $N_{f(11)}$ corresponding to the BS channel 11 is calculated by substituting $f_{(11)}$ for the $f_{(x)}$ in the equation (2). When the noise level $N_{f(11)}$ corresponding to the BS channel 11 thus derived is substituted for $N_{f(11)}$ in the equation (1), the received level L_{CN} corresponding to the C/N is calculated.

The received level L_{CN} thus calculated corresponds to a value indicated by a solid line arrow L of each channel (L1 - L15). In other words, it is possible to calculate correct received levels for the respective channels without remarkable difference due to the frequency characteristics of the channels.

When the received level L_{CN} corresponding to the C/N is calculated at step F104, the character generator 14 is controlled on the basis of a program as the display control means to display the received level L_{CN} on the screen of a TV receiver in a predetermined format, e.g., a numerical or bar display (step F105).

The above operations are repeated until the termination of the display of the received level L_{CN} is instructed by the user (step F106), whereby a setting direction of a BS antenna, when installed, can be adjusted such that the received level L_{CN} displayed on the screen becomes maximum.

As described above, the receiver apparatus of the present embodiment can calculate a noise level corresponding to each channel from the measured values $N_{f(16.5)}$ and $N_{f(-0.5)}$ in a linear approximation fashion, so that a received level can be displayed without differences among the respective channels, whereby the user will not be confused. In addition, since the received level measuring unit is composed of a system based on the AGC voltage detection and software for calculating the received level L_{CN} , it can be manufactured at a remarkably low cost.

It goes without saying that receivers to which the present invention can be applied are not limited to BS tuners.

The receiver apparatus of the present invention as described above derives a received signal level of

an arbitrary channel from an AGC voltage and calculates a noise level of the channel from noise levels measured in a high band and a low band in a linear approximation fashion to calculate a received level corresponding to the C/N, thereby eliminating differences in received levels among the respective channels and displaying a received level which is readily understood by the user.

While a single preferred embodiment of this invention has been described in detail hereinabove, many modifications and variations would be made by those skilled in the art without departing from the scope of the present invention, which is to be defined by the appended claims.

Claims

1. A device for use in a radio wave receiver for detecting a noise level in a predetermined range of the received signal comprising:
 - a local oscillator (5) to generate a local oscillating signal;
 - a mixer (4) to mix said local oscillating signal with a received signal;
 - a tuning device (7) to control the frequency of said local oscillating signal generated by said local oscillator (5);
 - control means (13) to control said tuning circuit (7); and
 - a noise level detector (10) to detect noise levels of predetermined plural points in a received band, characterised by estimating means (13) to estimate from said detected noise levels the noise at a desired point in the received band and to compare it to a received signal at said point to derive a received signal strength.
2. A device according to claim 1, wherein said predetermined plural points are a frequency higher than the broadcast band and a frequency lower than the broadcast band.
3. A device according to any one of the preceding claims wherein said noise level detector (10) is an AGC voltage detector.
4. A device according to any one of the preceding claims further comprising a video processor (14) for superimposing information on a signal level on a received image.
5. A device according to any one of the preceding claims wherein said radio wave receiver is a satellite broadcast receiver.
6. A satellite broadcast receiver or a radio receiver including a device according to any one of the



carrier level at a received frequency corresponding to a channel x , and $N_{f(x)}$ a noise level at a received frequency corresponding to the channel x .

When the received level L_{CN} is calculated for the BS channel 11, 11 is substituted for x ($x=11$). The value $C_{f(11)}$ has already been calculated at step F103.

Supposing that $N_{f(x)}$ can be linearly approximated as indicated by a dot line in FIG. 1, the following equation is satisfied:

$$N_{f(x)} = N_{f(-0.5)} + \frac{N_{f(16.5)} - N_{f(-0.5)}}{f_{(16.5)} - f_{(-0.5)}} \times (f_{(x)} - f_{(-0.5)}) \quad (2)$$

where $f_{(x)}$ designates the frequency corresponding to the channel x , and $f_{(16.5)}$, $f_{(-0.5)}$ frequencies corresponding to the channels 16.5, -0.5, respectively.

Since the values $N_{f(16.5)}$ and $N_{f(-0.5)}$ have been measured at steps F101, F102, the noise level $N_{f(11)}$ corresponding to the BS channel 11 is calculated by substituting $f_{(11)}$ for the $f_{(x)}$ in the equation (2). When the noise level $N_{f(11)}$ corresponding to the BS channel 11 thus derived is substituted for $N_{f(11)}$ in the equation (1), the received level L_{CN} corresponding to the C/N is calculated.

The received level L_{CN} thus calculated corresponds to a value indicated by a solid line arrow L of each channel (L1 - L15). In other words, it is possible to calculate correct received levels for the respective channels without remarkable difference due to the frequency characteristics of the channels.

When the received level L_{CN} corresponding to the C/N is calculated at step F104, the character generator 14 is controlled on the basis of a program as the display control means to display the received level L_{CN} on the screen of a TV receiver in a predetermined format, e.g., a numerical or bar display (step F105).

The above operations are repeated until the termination of the display of the received level L_{CN} is instructed by the user (step F106), whereby a setting direction of a BS antenna, when installed, can be adjusted such that the received level L_{CN} displayed on the screen becomes maximum.

As described above, the receiver apparatus of the present embodiment can calculate a noise level corresponding to each channel from the measured values $N_{f(16.5)}$ and $N_{f(-0.5)}$ in a linear approximation fashion, so that a received level can be displayed without differences among the respective channels, whereby the user will not be confused. In addition, since the received level measuring unit is composed of a system based on the AGC voltage detection and software for calculating the received level L_{CN} , it can be manufactured at a remarkably low cost.

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 - a local oscillator (5) to generate a local oscillating signal;
 - a mixer (4) to mix said local oscillating signal with a received signal;
 - a tuning device (7) to control the frequency of said local oscillating signal generated by said local oscillator (5);
 - control means (13) to control said tuning circuit (7); and
 - a noise level detector (10) to detect noise levels of predetermined plural points in a received band, characterised by estimating means (13) to estimate from said detected noise levels the noise at a desired point in the received band and to compare it to a received signal at said point to derive a received signal strength.
2. A device according to claim 1, wherein said predetermined plural points are a frequency higher than the broadcast band and a frequency lower than the broadcast band.
3. A device according to any one of the preceding claims wherein said noise level detector (10) is an AGC voltage detector.
4. A device according to any one of the preceding claims further comprising a video processor (14) for superimposing information on a signal level on a received image.
5. A device according to any one of the preceding claims wherein said radio wave receiver is a satellite broadcast receiver.
6. A satellite broadcast receiver or a radio receiver including a device according to any one of the



preceding claims.

Patentansprüche

1. Vorrichtung für einen Radiowellenempfänger zum Detektieren eines Rauschpegels in einem vorbestimmten Bereich des empfangenen Signals, bestehend aus einem Lokaloszillator (5) zur Erzeugung eines Lokaloszillatorsignals, einem Mischer (4) zum Mischen des Lokaloszillatorsignals mit einem empfangenen Signal, einer Abstimmereinrichtung (7) zum Steuern der Frequenz des vom Lokaloszillator (5) erzeugten Lokaloszillatorsignals, einer Steuereinrichtung (13) zum Steuern der Abstimmereinrichtung (7) und einem Rauschpegeldetektor (10) zum Detektieren von Rauschpegeln mehrerer vorbestimmter Punkte in einem empfangenen Band, gekennzeichnet durch eine Abschätzeinrichtung (13) zum Abschätzen des Rauschens an einem gewünschten Punkt im empfangenen Band aus den detektierten Rauschpegeln und seinem Vergleich mit einem empfangenen Signal an diesem Punkt zum Ableiten einer empfangenen Signalstärke.
2. Vorrichtung nach Anspruch 1, wobei die mehreren vorbestimmten Punkte eine Frequenz höher als das Rundfunkband und eine Frequenz niedriger als das Rundfunkband sind.
3. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Rauschpegeldetektor (10) ein Spannungsdetektor mit automatischer Verstärkungsregelung ist.
4. Vorrichtung nach einem der vorhergehenden Ansprüche, mit einem Videoprozessor (14) zum Überlagern von Information einem Signalpegel auf einem empfangenen Bild.
5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Radiowellenempfänger ein Satellitenübertragungsempfänger ist.
6. Satellitenübertragungsempfänger oder Radioempfänger mit einer Vorrichtung nach einem der vorhergehenden Ansprüche.

Revendications

1. Appareil destiné à être utilisé dans un récepteur radioélectrique pour la détection d'un niveau de bruit dans une plage prédéterminée du signal reçu, comprenant :

- un oscillateur local (5) destiné à créer un signal d'oscillation locale,
 un mélangeur (4) destiné à mélanger le signal d'oscillation locale à un signal reçu,
 un syntoniseur (7) destiné à régler la fréquence du signal d'oscillation locale créé par l'oscillateur local (5),
 un dispositif (13) de réglage du syntoniseur (7), et
 un détecteur (10) de niveau de bruit destiné à détecter les niveaux de bruit en plusieurs points prédéterminés dans une bande reçue, caractérisé par un dispositif (13) d'estimation, à partir des niveaux détectés de bruit, du bruit en un point voulu dans la bande reçue, et de comparaison de ce bruit à un signal reçu audit point pour la dérivation d'une intensité du signal reçu.
2. Appareil selon la revendication 1, dans lequel les divers points prédéterminés sont à une fréquence supérieure à la bande d'émission et une fréquence inférieure à la bande d'émission.
 3. Appareil selon l'une quelconque des revendications précédentes, dans lequel le détecteur (10) de niveau de bruit est un détecteur de tension de réglage automatique de gain AGC.
 4. Appareil selon l'une quelconque des revendications précédentes, comprenant en outre un processeur vidéo (14) destiné à superposer l'information au niveau d'un signal sur une image reçue.
 5. Appareil selon l'une quelconque des revendications précédentes, dans lequel le récepteur radioélectrique est un récepteur d'émission d'un satellite.
 6. Récepteur radioélectrique ou d'émission d'un satellite, comprenant un appareil selon l'une quelconque des revendications précédentes.