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G5C
G4H

(54) Forward and reflected power measurement and display

(57) A device for displaying forward and reflected RF power values simultaneously comprises a plurality of display segments 1–8 which are switched on in a predetermined sequence to display the forward power and switched off in a predetermined sequence to display the reflected power. Thus a simultaneous indication of the magnitudes of the two powers as well as their difference is displayed. The display segments may be LCDs or LEDs. The signals corresponding to the two parameters may be converted to digital signals and sampled. A microprocessor is used for signal processing and prevents large fluctuations in the display.

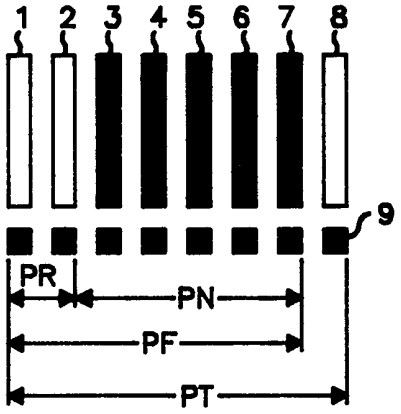

Fig. 1

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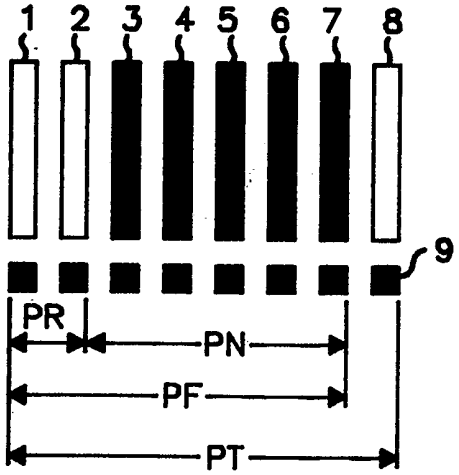

Fig. 1

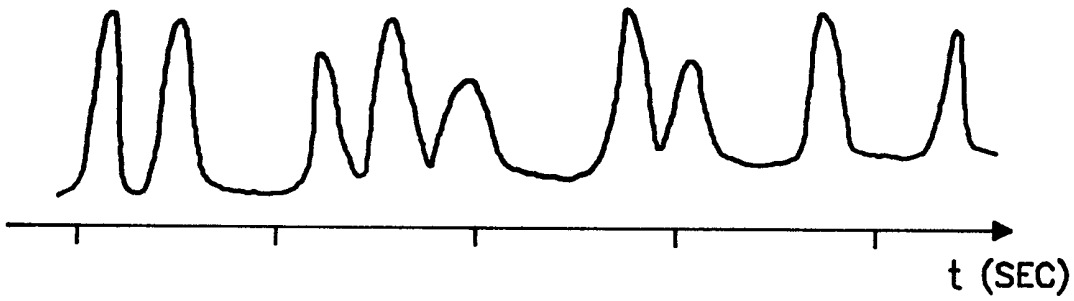

Fig. 2

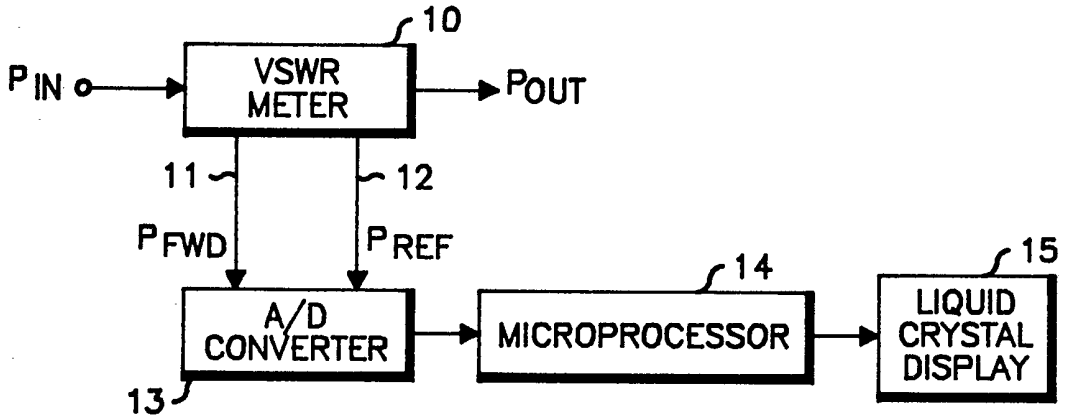

Fig. 3

SPECIFICATION

Forward and reflected power measure and display

FIELD OF INVENTION

This invention relates to a device for displaying the magnitude of two parameters, one of which is always less than or equal to the other, and more particularly for displaying the magnitude of forward and reflected radio frequency power at an antenna and to the measurement thereof.

BACKGROUND ART

It is known to measure the forward and reflected power at the aerial of a radio transmitter and to provide the operator with an indication of the appropriate values. However, it has been necessary to use either two separate displays to distinguish between forward and reflected power or to provide a single display and a switch for enabling an operator to switch the display between indications of forward and reflected power. These known methods therefore make it relatively difficult for an operator to obtain full information concerning the operational status of the radio, antenna tuner and antenna system in a convenient and self explanatory manner.

Furthermore, when the output includes a voice signal, the RF power envelope corresponding to the voice signal has maxima at syllables and minima at intervals between syllables or between words. Rapid changes in the peak envelope power can cause rapid changes in the display of the power value and this can make it difficult for the operator to see and/or understand the display.

BRIEF DESCRIPTION OF THE INVENTION

Thus, this invention seeks to provide a display for forward and reflected power values and measuring apparatus therefor in which the above mentioned disadvantages are mitigated.

In accordance with one aspect of the invention there is provided a display for displaying the magnitude of two parameters, a first one of which is always less than or equal to the second parameter, the device comprising a plurality of display segments each having a first and a second display state, the segments being changed from a first state to a second state in a pre-determined sequence in response to increasing values of said first parameter, a pre-determined sequence of segments being changed from the second to the first display state in response to increasing values of said second parameter whereby simultaneously to indicate the magnitude of both parameters.

In a preferred embodiment, the said first parameter is forward radio frequency power measured at the antenna of a radio transmitter and the said second parameter is reflected power measured at the antenna.

Conveniently, the display segments are liquid crystal display segments, although they may alternatively be light emitting diodes. The first display state is preferably the "off" state and the second display state is preferably the "on" state.

In accordance with a second aspect of the invention there is provied a measuring circuit for measuring the magnitude of a parameter whose value is to be displayed, comprising sampling means for sampling the value of the parameter at predetermined intervals, a first comparing means for comparing the sampled value with a currently displayed value to provide an indication of the change in value, a second comparing means comparing said change in value with a predetermined maximum change and for limiting changes in displayed values to not more than said predetermined maximum.

A preferred embodiment further includes means for measuring the parameter and providing an indication of its instantaneous value, these values then preferably being sampled to determine the maximum value from a group of said instantaneous values, the maximum value then being compared with the currently displayed value by said first comparing means.

The first comparing means preferably determines whether the sampled value is greater than, less than or equal to the currently displayed value. Preferably, the second comparing means then compares an increasing change with a predertermined maximum increasing change and a decreasing change with a predetermined maximum decreasing change. The predetermined maximum increasing change may be equal to the maximum decreasing change but need not be, if, for example, it is desired to have different attack and decay times.

Preferably a microprocessor constitutes one or more of said sampling means and said first and second comparing means.

The measuring circuit may also include an analogue-to-digital converter for converting the measurements of the parameter to digital values for passing to the microprocessor.

In a preferred embodiment the parameter is forward radio frequency power at the antenna of a radio transmitter and may, if desired, also include the reflected power.

If the values are displayed on a segmented display, then the predetermined maximum change may be a predetermined number of segments.

Preferably said predetermined maximum change level is one segment.

BRIEF DESCRIPTION OF DRAWINGS

An exemplary embodiment of the invention will now be described with reference to the drawings in which

Figure 1 illustrates a display in accordance

with a first aspect of the present invention,

Figure 2 shows the RF power envelope for a typical radio transmitter and

Figure 3 illustrates a block diagram of a measuring circuit in accordance with a second aspect of the present invention and suitable for driving the display of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

Refering to Fig. 1 there is shown an embodiment of a forward and reflected power display in accordance with the present invention and which is in the form of a liquid crystal bar chart display. The liquid crystal bar chart comprises eight equal rectangle segments 1 to 8 inclusive. A row of eight small square display segments 9 is located underneath the row of rectangular segments and indicates the full available power range.

When the PTT button of the radio transmitter is pressed all the square segments 9 turn ON ie change from a first to a second display state indicating both that the transmitter has been turned ON and also displaying the full power range PT.

As the value of the transmitter forward power PF increases a proportional number of the rectangular segments from left to right, as viewed, is turned ON ie is changed from a first to a second display state, while increasing reflected power PR turns OFF, ie changes from the second to the first display state, a proportional number of rectangular segments as viewed from left to right.

As shown in the drawing the segments referenced 1 to 7 inclusive are caused to be turned ON by the forward power PF whilst the segments 1 and 2 are turned OFF by the value PR of reflected power.

As a result the segments 3, 4, 5, 6 and 7 remain turned ON and provide an indication of the net power, PN delivered to the antenna, PN being the difference between the values of the forward power PF and the reflected power PR.

The output power of a radio transmitter which is fed to an antenna has an envelope which corresponds to the voice signal producing it. This envelope has maxima at syllables and minima at intervals between syllables or between words. This is illustrated in Fig. 2 of the drawings in which peak envelope power is shown plotted against time in seconds.

As already described, the display indicates the peak envelope power values for both forward and reflected power. With such an indication the transmitter operator can estimate the performance of the power amplifier of the transmitter and the matching between the radio and the antenna system. However in view of the typical envelope illustrated in Fig. 2 such rapid changes in output peak envelope power could cause rapid changes of the display. Consequently an operator may find it difficult to see and understand the fast moving display.

Thus, a measuring circuit such as that shown in fig. 3 is used for measuring forward and reflected power and for driving the display in such a manner as to prevent large rapid fluctuations in the display.

The measuring circuit comprises a voltage standing wave ratio meter 10 which is located in the power path between the harmonic filter and the antenna of the transmitter. The meter 10 measures the forward and the reflected power and these values are fed over lines 11 and 12 respectively to an analogue to digital converter 13 which converts the analogue measurements of forward and reflected power to digital values. The digital values provided by the analogue to digital converter 13 are fed to a microprocessor 14 which is coupled to drive the liquid crystal drive display 15.

The microprocessor goes through the following procedure for measuring the forward power:

Step 1: Sample the forward power at predetermined intervals, e.g. every 12 milliseconds.

Each sample constitutes a number of display segments proportional to the forward power.

Step 2: Successive samples e.g. eight samples, constitute a group.

Select the largest sample (MS) in the group.

Step 3: Compare this maximum sample (MS) with the maximum value (MD) currently being displayed (derived from the maximum of the previous group. This comparing operation occurs as follows:

a. If $MS > MD$ and $MS - MD \geq MRI$, where MRI is an arbitrarily selected maximum rate increase (e.g. 1 segment)

Then $MD' = MD + MRI$ where MD' is the new display

b. If $MS > MD$ and $MS - MD < MRI$

Then $MD' = MS$

c. If $MS < MD$ and $MD - MS \geq MRD$, where MRD is an arbitrarily selected maximum rate of decrease (e.g. 1 segment)

Then $MD' = MD - MRD$

d. If $MS < MD$ and $MD - MS < MRD$

Then $MD' = MS$

e. If $MS = MD$

Then $MD' = MD$

It will be appreciated that an exactly analogous procedure is followed for measuring the reflected power.

Thus, in the embodiment described the microprocessor samples the instantaneous values of forward and reflected power every 12 milliseconds and selects the maximum readings from a group of eight samples. This maximum reading corresponds to a number, in the present case from zero to eight, of rectangular segments of the display which are to be turned ON.

The microprocessor then compares this number to the previous number of turned ON segments. If the difference between the two

numbers is more than or equal to one segment the previous number is updated so as not to produce a change in the display of more than one segment and this new number becomes the new number of segments to be displayed.

Consequently the display is prevented from undergoing large fluctuations which would render it difficult to read.

The invention has been described by way of example and modifications may be made without departing from the scope of the invention. For example, the display need not necessarily be a liquid crystal display but could be any suitable display type and also the segments need not be rectagular in shape but could be of any suitable form, for example segments of a circular display. Also the particular sampling and updating method used by the microprocesser is exemplary and any suitable software programe for control of the updating could be utilised.

The use of the microprocessor to control the display performs slow smoothing of the power envelope and enables the easy controlling of the slope of the analogue to digital converter to provide much greater precision and if desired enables dual slope conversion with, for example fast attack and slow decay.

CLAIMS

1. A device for displaying the magnitude of two parameters, a first one of which is always less than or equal to the second parameter, the device comprising a plurality of display segments each having a first and a second display state, the segments being changed from a first state to a second state in a predetermined sequence in response to increasing values of said first parameter, a predetermined sequence of segments being changed form the second to the first display state in response to increasing values of said second parameter whereby simultaneously to indicate the magnitude of both parameters.

2. A display device according to claim 1 wherein said first parameter is forward radio frequency power measured at the antenna of a radio transmitter and said second parameter is reflected power measured at said antenna.

3. A display device according to either claim 1 or claim 2 wherein said first display state is an "off" state and said second display state is an "on" state.

4. A display device according to any preceding claim further including a set of segments for indicating the full power range available.

5. A display device according to any preceding claim which is a liquid crystal display.

6. A display device according to any one of claims 1 to 4 wherein said segments comprise light emitting diodes.

7. A measuring circuit for measuring the magnitude of a parameter whose value is to be displayed, comprising sampling means for sampling the value of the parameter at predetermined intervals, a first comparing means for comparing the sampled value with a currently displayed value to provide an indication of the change in value, a second-comparing means for comparing said change in value with a predetermined maximum change and for limiting changes in displayed values to not more than said predetermined maximum.

8. A measuring circuit according to claim 7 further including means for measuring the parameter and providing an indication of its instantaneous value.

9. A measuring circuit according to claim 8 wherein said sampling means samples said instantanous values and determines the maximum value from a group of a predetermined number of said instantaneous values, which maximum value constitutes said sampled value.

10. A measuring circuit according to any one of claims 7 to 9 wherein said first comparing means determines whether said sampled value is greater than, less than or equal to said currently displayed value thus indicating an increasing, decreasing or zero change.

11. A measuring circuit according to claim 10 wherein said second comparing means compares an increasing change with a predetermined maximum increasing change and a decreasing change with a predetermined maximum decreasing change.

12. A measuring circuit according to claim 11 wherein said predetermined maximum increasing change and said predetermined maximum decreasing change are equal.

13. A measuring circuit according to any one of claims 7 to 12 wherein a microprocessor constitutes one or more of said sampling means, and said first and second comparing means.

14. A measuring circuit according to any of claims 7 to 13 wherein said parameter is the forward radio frequency power at the antenna of a radio transmitter.

15. A measuring circuit according to claim 14 wherein said parameter also includes the reflected power at said antenna.

16. A measuring circuit according to any one of claims 7 to 15 wherein said values are displayed on a segmented display.

17. A measuring circuit according to claim 16 wherein said predetermined maximum change is a predetermined number of segments.

18. A measuring circuit according to claim 17 wherein said predetermined maximum change is one segment.

19. A measuring circuit substantially as hereinbefore described with reference to Fig. 3 of the drawings.

20. A display device substantially as hereinbefore described with reference to Fig. 1 of the drawings.

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