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(54) **CABLE RECEIVER HAVING IN-BAND AND OUT-OF-BAND TUNERS**

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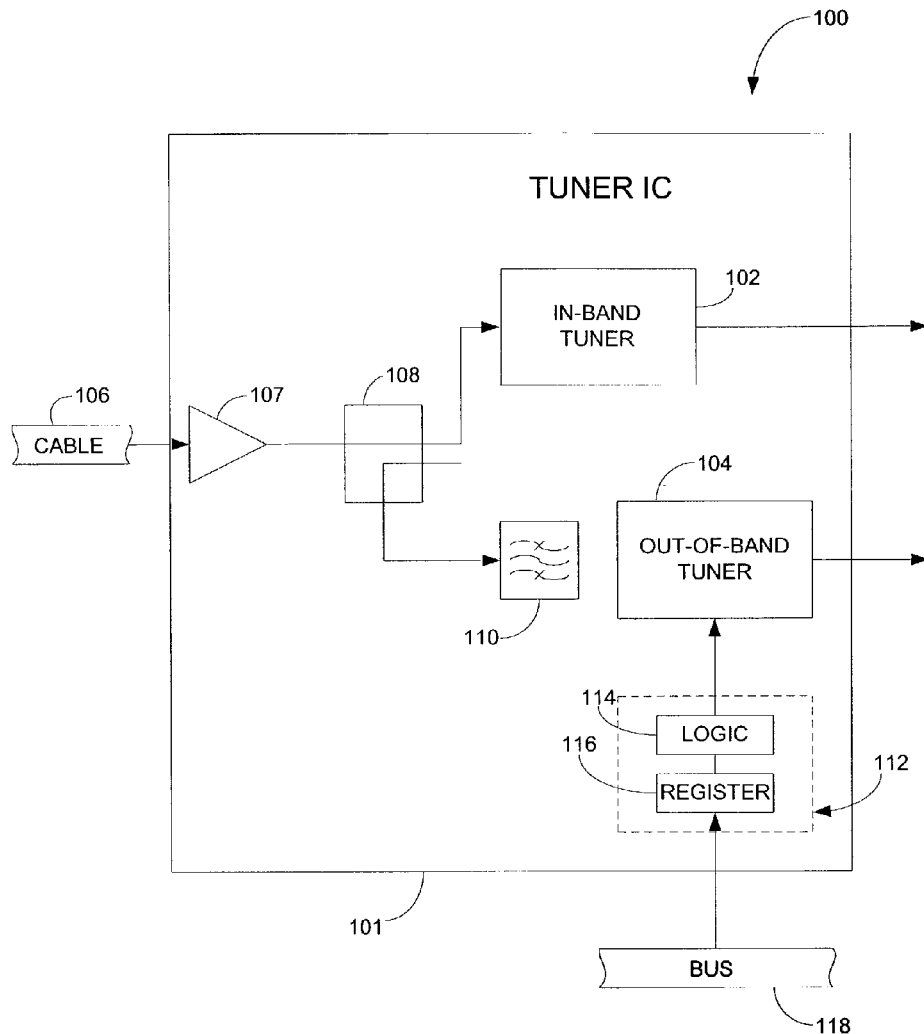
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(57) **ABSTRACT**

A cable television receiver includes in-band and out-of-band tuners integrated on a single IC. A mode controller determines whether an out-of-band signal is being received and powers the out-of-band tuner off when no out-of-band signal is present. A signal divider divides the signals between the in-band and out-of-band tuners and may be an asymmetric coupler in order to provide a higher power signal to the in-band tuner and a lower power signal to the out-of-band tuner.

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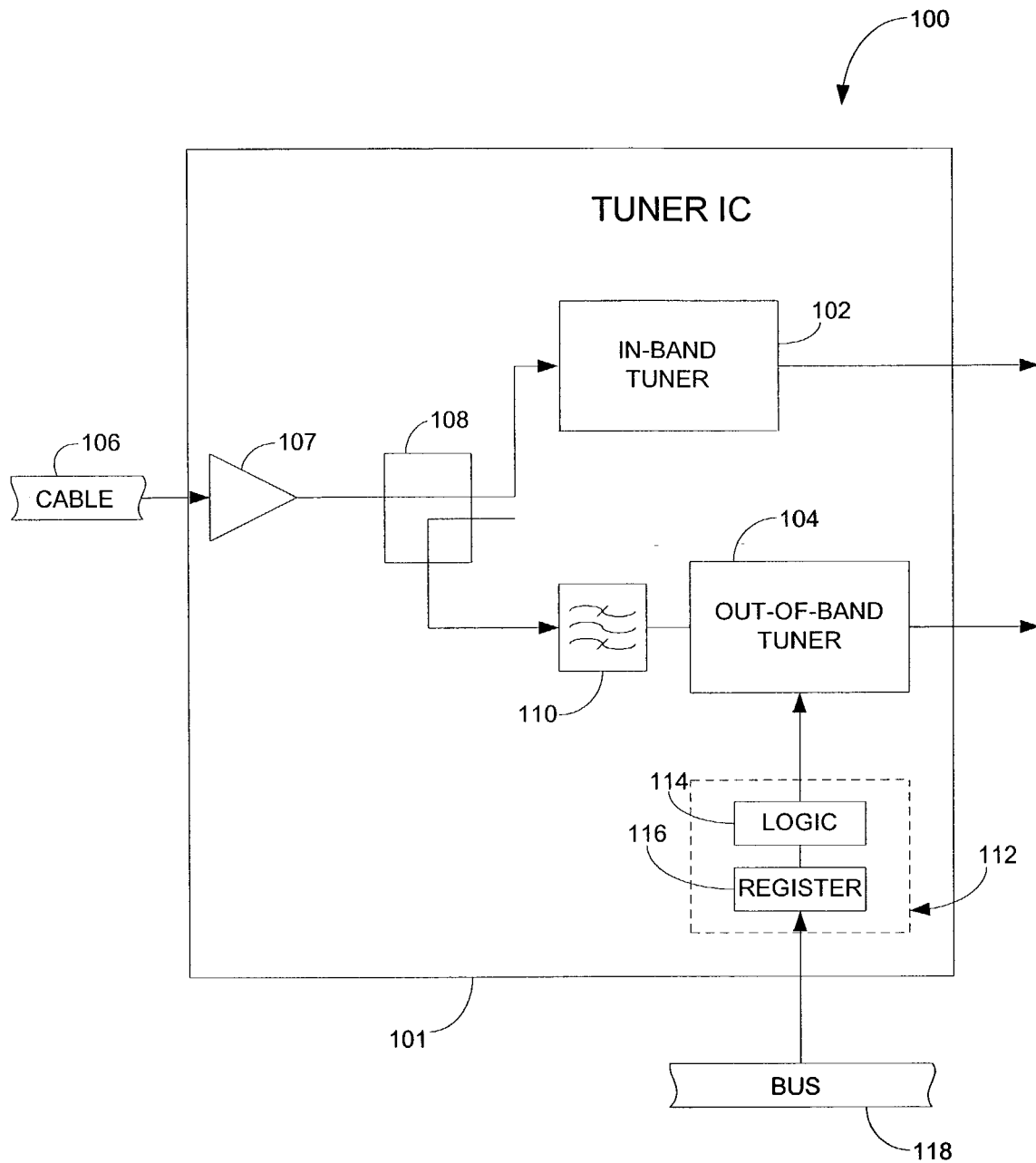


Figure 1

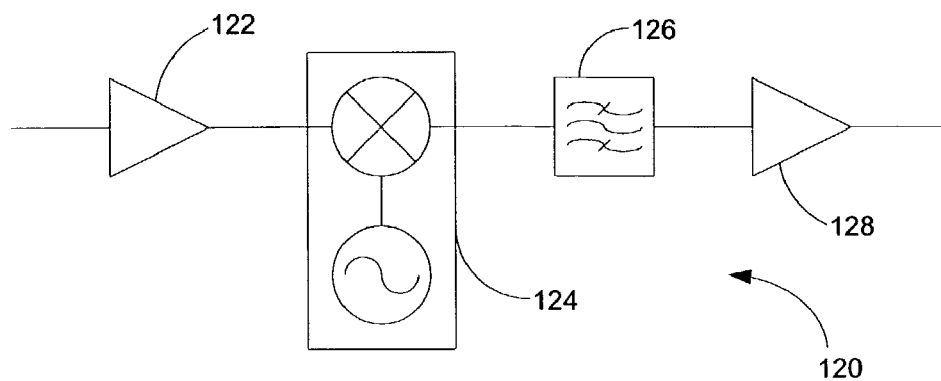


Figure 2

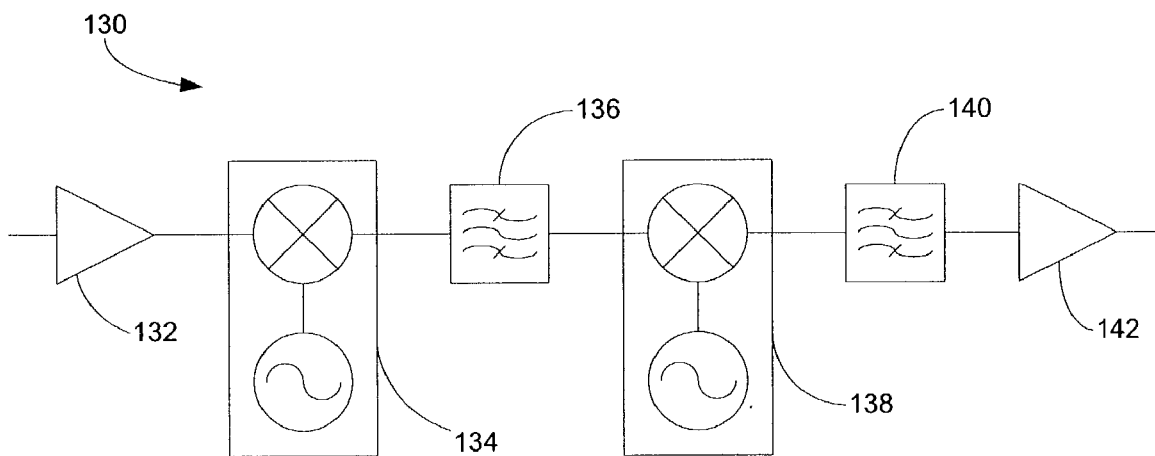


Figure 3

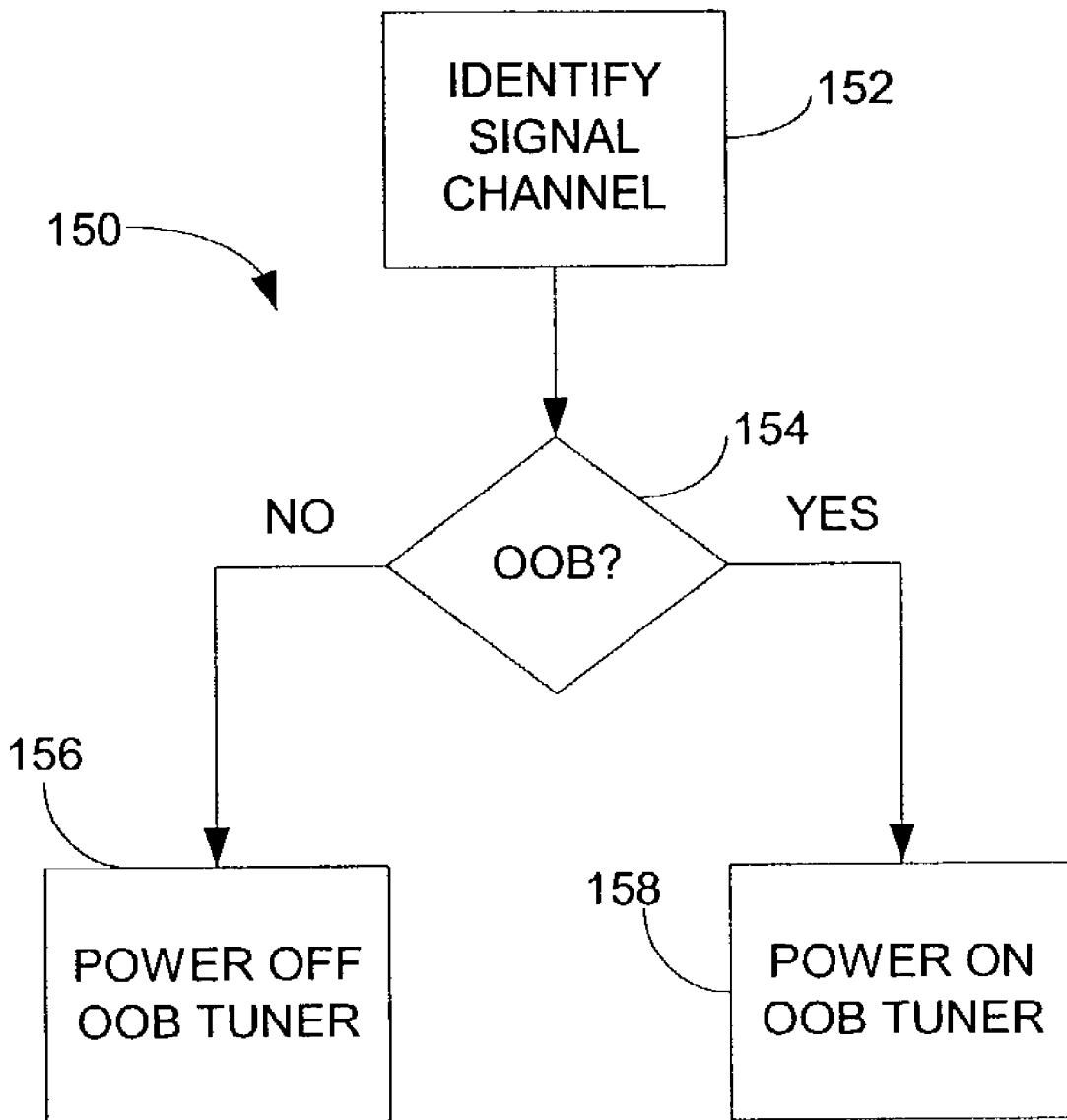


Figure 4

CABLE RECEIVER HAVING IN-BAND AND OUT-OF-BAND TUNERS

FIELD OF THE INVENTION

[0001] The present invention relates to a cable television receiver and, more particularly, relates to a cable television receiver having in-band and out-of-band tuners on a single integrated circuit.

BACKGROUND OF THE INVENTION

[0002] The recent advent of subscriber home terminals, such as digital set top boxes, has enabled cable operators to offer subscribers a wide array of broadband content beyond the usual cable television programming. Electronic and interactive programming guides can be received and displayed on the subscriber's television via the set top box. Pay-per-view and video-on-demand programming may be directly purchased via the subscriber's interface with the set top box. High speed Internet access and email services may be provided. Numerous other applications such as interactive games, IP telephony and videophone services are envisioned.

[0003] In order to support the receipt and display of this multitude of broadband content, the set top box receiver typically includes at least two separate tuners. A first type of tuner, designated an "in-band" (IB) tuner, has the primary function of receiving and tuning cable television channels. Each channel typically has a fixed width of 6 or 8 MHz and is located in the 50-850 MHz frequency band. A second type of tuner, designated an "out-of-band" (OOB) tuner is used to receive data and digital content. This content may include programming guides, video-on-demand and pay-per-view programming, Internet data and so on. The presence of multiple tuners permits simultaneous display of cable television programming along with other digital content. Internet data received over the out-of-band tuner may be displayed on one portion of the television display, for example, while a selected television channel is displayed on another portion of the display.

[0004] Modern subscriber home terminals employ separate out-of-band and in-band tuners in order to receive both in-band and out-of-band channels. These separate tuners are a costly part of such receivers. Cost advantages could be obtained by combining the in-band and out-of-band tuner functionality on a single integrated circuit.

SUMMARY OF THE INVENTION

[0005] The present invention provides a receiver having an in-band tuner and an out-of-band tuner integrated on a single IC. In one implementation of the invention, the receiver is a cable television receiver and a mode controller is provided for powering the out-of-band tuner on when an out-of-band signal is present and powering the out-of-band tuner off when no out-of-band signal is present. In a further implementation, a signal divider is provided to divide the received RF signal either symmetrically or asymmetrically between the two tuners.

[0006] In another embodiment of the invention, a cable set top box is provided. The set top box includes an in-band tuner and an out-of-band tuner integrated on a single IC. A mode controller powers the out-of-band tuner on when an

input RF signal on an out-of-band channel is received, and powers the out-of-band tuner off when an input RF signal on an out-of-band channel is not received. In one implementation, a coupler divides the input RF signal asymmetrically between the in-band tuner and the out-of-band tuner, providing a relatively higher power signal to the in-band tuner and a relatively lower power signal to the out-of-band tuner.

[0007] The present invention also provides a method for tuning in-band and out-of-band cable channels on a single IC. An input RF signal is received and provided to both an in-band and an out-of-band tuner. If the input signal is on an out-of-band channel, the out-of-band tuner is powered on and, if the input signal is not on an out-of-band channel, the out-of-band tuner is powered off.

[0008] A further embodiment of the invention is a cable television receiver having in-band and out-of-band tuning means. Mode control means powers the out-of-band tuning means on when RF signals on out-of-band channels are received, and powers the out-of-band tuning means off when RF signals on the out-of-band channels are not received. Signal divider means divides the RF signals between the in-band tuning means and the out-of-band tuning means.

[0009] Other systems, methods, features and advantages of the invention will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. In the figures, like reference numerals designate corresponding parts throughout the different views.

[0011] FIG. 1 is a block diagram illustrates a tuner IC having integrated in-band and out-of-band tuners according to the present invention.

[0012] FIG. 2 is a schematic diagram of a typical single-conversion tuner architecture.

[0013] FIG. 3 is a schematic diagram of a typical dual-conversion tuner architecture.

[0014] FIG. 4 is a flow chart illustrating a method for switching a tuner between in-band and out-of-band modes according to the present invention.

DETAILED DESCRIPTION

[0015] FIG. 1 is a block diagram of a first embodiment of the present invention. Tuner integrated circuit (IC) 100 is integrated on a single semiconductor chip 101 and comprises an in-band (IB) tuner 102 and an out-of-band (OOB) tuner 104. In one implementation, tuner IC 100 is contained in a subscriber home terminal such as a cable set top box. Functionally, tuner IC 100 is a single component or module mountable on a printed circuit board with its signal inputs and outputs coupled to the appropriate signal lines within the set top box or other receiving system in which it is incorporated. Tuners 102 and 104 are appropriately isolated from each other by being placed as remotely as feasible from each

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