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(54) **Communication device incorporating embedded frequency selective device**

(57) The present invention relates to a head worn communication device comprising a oscillation circuit or filtering circuit, where the circuit comprises a frequency selective element embedded in or with an integrated cir-

cuit. Furthermore the invention relates to an integrated circuit incorporating such frequency selective element for the application in a head-worn communication device.

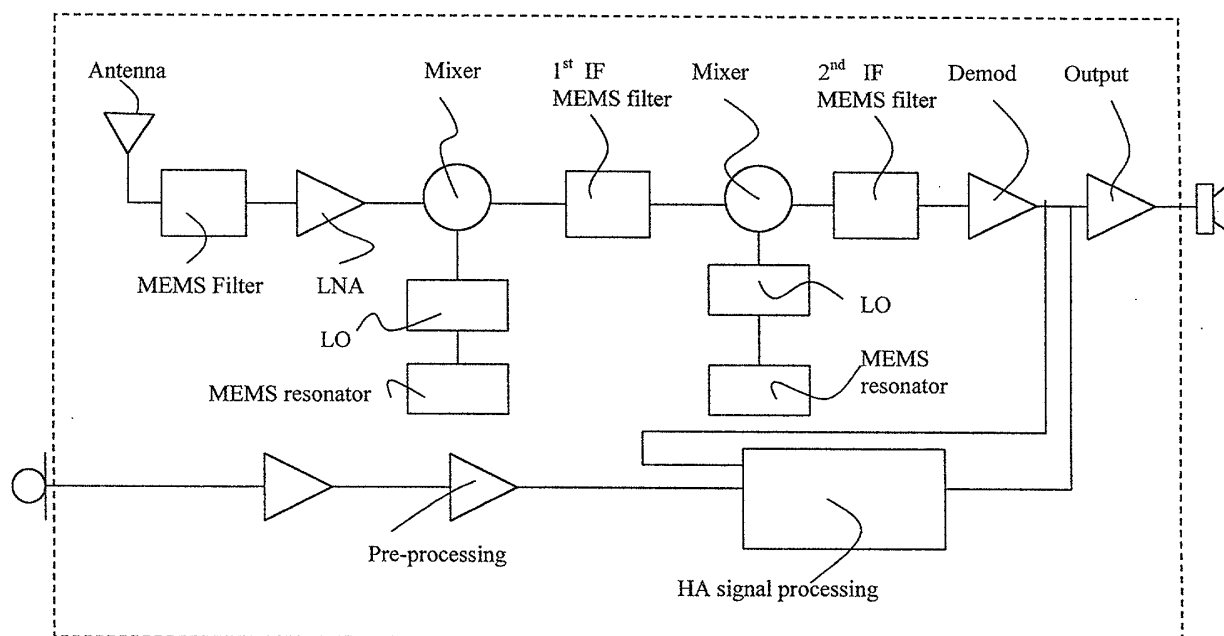


FIG. 1

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Description

AREA OF THE INVENTION

[0001] The invention relates to the area of personal communication devices incorporating an oscillation circuit, e.g. a part of radio receiver and/or a radio transmitter. More specifically the invention relates to communication devices to be worn on or in the ear and even inside the head and intended for use in personal communication. Such devices will generally be designated head-worn communication devices. These inherently requires relatively small size devices as well as low power consumption.

BACKGROUND OF THE INVENTION

[0002] One type of these communication devices is a hearing aid. Hearing aids are becoming more sophisticated and smaller. In-The-Ear and In-The-Canal type hearing aids are now possible due to changes in technology that permit miniaturization. Another type of device is a headset, e.g. for telecommunication use, and further implantable hearing devices, such as middle ear implants and cochlea implants may be mentioned.

[0003] Radio technology has lagged due to complexities in the RF circuits, power consumption and size. Presently, radio's can operate over a range of 30 meters consuming less than 1 mA of current from a 1 V battery source, such as Zinc Air. The size and power requirements of the radio make it possible to operate with larger Behind-The-Ear type hearing aids but are too large and consume too much power for In-The-Ear type hearing aids as well as smaller BTE hearing aids.

[0004] Due to this the communication devices today still are relatively bulky and the handling and especially carrying of these is often the main reason for not using these communication devices to a wider degree than it is the case today.

[0005] The objective of the present invention is to provide a communication device and an integrated circuit for such communication device that enables miniaturization of RF receiver and/or transmitters so as to enable the production of even smaller communication devices with RF receivers and/or transmitters built in, hence animating the users to a more intensive use of such devices.

SUMMARY OF THE INVENTION

[0006] According to the invention the first objective is achieved by means of a communication device as defined in claim 1.

[0007] The present invention relates to a head worn communication device incorporating an oscillation circuit, e.g. a radio frequency receiver and also to radio frequency receiver communication systems including such a receiver. Although other high Q devices, which

are traditionally incorporated in such devices may be replaced with MEMS based components, the invention is described with reference to a RF receiver incorporating an MEMS resonator. The radio frequency receiver consists of traditional electronic RF circuits integrated with MEMS based circuits to form a very low power, very small package density radio that can be integrated into a hearing aid circuit or built-into an in-the-ear hearing aid and provide reception of a radio transmission over a range of 30 meters and at different and selectable radio channels. The crystal normally used is a relatively bulky external component that need to be connected to the circuitry. Having now enabled the embedded resonator in the integrated circuit the large external component has become obsolete and the size of the radio receiver has been reduced dramatically and hereby enabled the production of small communication devices. The previously mentioned aversion against use due to the size of such prior communication devices has hereby been reduced dramatically.

[0008] Preferred embodiments are set forth in the dependent claims 2-4.

[0009] In a preferred embodiment the frequency selective element is embedded with a signalprocessing chip of a hearing aid or a headset. In this connection embedded should be understood as comprising the situation where the frequency selective element is a separate element incorporated into a packaging incorporating other integrated circuits as well as the situation where the frequency selective element forms a part of the integrated circuit that performs the signal processing. Other necessary parts may in the same manner be embedded with or in the same package as the frequency selective element.

[0010] The objective relating to the integrated circuit aspect has been achieved by means of the integrated circuit defined in claim 5.

[0011] As mentioned above the embedded resonator in the integrated circuit has made the large external component obsolete and the size of the radio receiver may be reduced dramatically. This enables the production of small communication devices. The previously mentioned aversion against use due to the size of such prior communication devices has hereby been reduced dramatically.

[0012] The invention will be explained more detailed in the following description of a preferred embodiment with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a schematic diagram showing a first implementation of the invention in a hearing aid;
FIG. 2 is a schematic diagram showing a second implementation of the invention;
FIG. 3 is a schematic diagram showing a second

implementation of the invention;

FIG. 4 is schematic diagram showing a second implementation of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0014] A new form of technology, Micro-Electro-Mechanical Systems (MEMS), is emerging that according to the invention will make it possible to reduce the size of the radio receiver and antenna to fit into an In-The-Ear hearing aid and consume very little power. In addition the radio's complexity can be expanded to include multi-channel and multifrequency operation with performance equivalent to a crystal controlled radio. MEMS based circuits can be integrated into silicon die and reside with traditional electronic circuits.

[0015] This invention describes a MEMS based wireless radio receiver comprised of traditional electronic radio circuits integrated with MEMS technology resulting in a device that occupies very little area and consumes very little battery power but provides wireless reception for voice and/or data communications.

[0016] The RF radio receiver consists of traditional radio circuits such as Low Noise Amplifiers, Mixers and Demodulators. Many of these circuits can, however, be replaced with MEMS based technology to create a radio with equivalent performance but consuming lower battery power and higher density. This invention relates to radios consisting of one and/or several circuits using MEMS technology. One of the most space consuming components is the oscillation circuitry, which normally comprises a crystal or a coil as the preferred frequency selective component. These components are relatively large, especially in the applications, which are the subject of this application. According to the invention the traditional crystal oscillator is replaced by an embedded resonator based on MEMS technology or the frequency selective element may form part of a filtering circuit.

[0017] From FIG. 1 a first embodiment of the invention appears implemented in a hearing aid. It appears that the in a preferred embodiment the solution containing the hearing aid processing and amplifying circuitry and the RF receiver are formed in a single die. The hearing aid part comprises an input transducer, a preprocessing part, an amplifier and an output transducer. The elements are given their designations in the drawing. In this the elements forming the radio receiver depicted comprises generally the same elements as indicated in connection with FIG. 4, where the elements are formed as an integrated part of the hearing aid die indicated by the dotted line.

[0018] From FIG. 2 a second embodiment of the invention appears. The radio receiver depicted comprises a power system and a MEMS oscillator. The relevant components appear from the blocks in the drawing.

[0019] From FIG. 3 a second embodiment of the invention appears. The relevant blocks are indicated in the drawing by the normal designations.

[0020] FIG. 4 shows a RF receiver incorporating a RF Filter, a LNA, an Image Rejection Filter, a 1st IF Filter, a 2nd IF Filter, a 1st LO Resonator, a 2nd LO Resonator, mixers, a Resonator, and a quadrature detector. In these several of the known building blocks, (those highlighted), may be replaced by microstructures as mentioned above.

[0021] One promising way of manufacturing such silicon embedded resonator is a so-called comb microstructure or comb resonator, which over time has been introduced in several different embodiments. Other ways of designing a resonator may evolve, however this will not change the intended scope of the present invention.

Claims

1. A head worn communication device comprising a oscillation circuit or filtering circuit, where the circuit comprises a frequency selective element embedded in or with an integrated circuit.
2. A communication device according to claim 1, where the frequency selective element is embedded in or with an integrated circuit.
3. A communication device according to claim 1, where the oscillation circuit is a component in a RF receiver.
4. A communication device according to claim 1 or 2, where the communication device comprises an input transducer, an output transducer and possibly an amplifier, these elements being configured and connected so as to form signal path(s) in either a headset or a hearing aid.
5. An integrated circuit for an ear worn communication device, where a frequency selective element for an oscillation circuit is embedded in the integrated circuit.

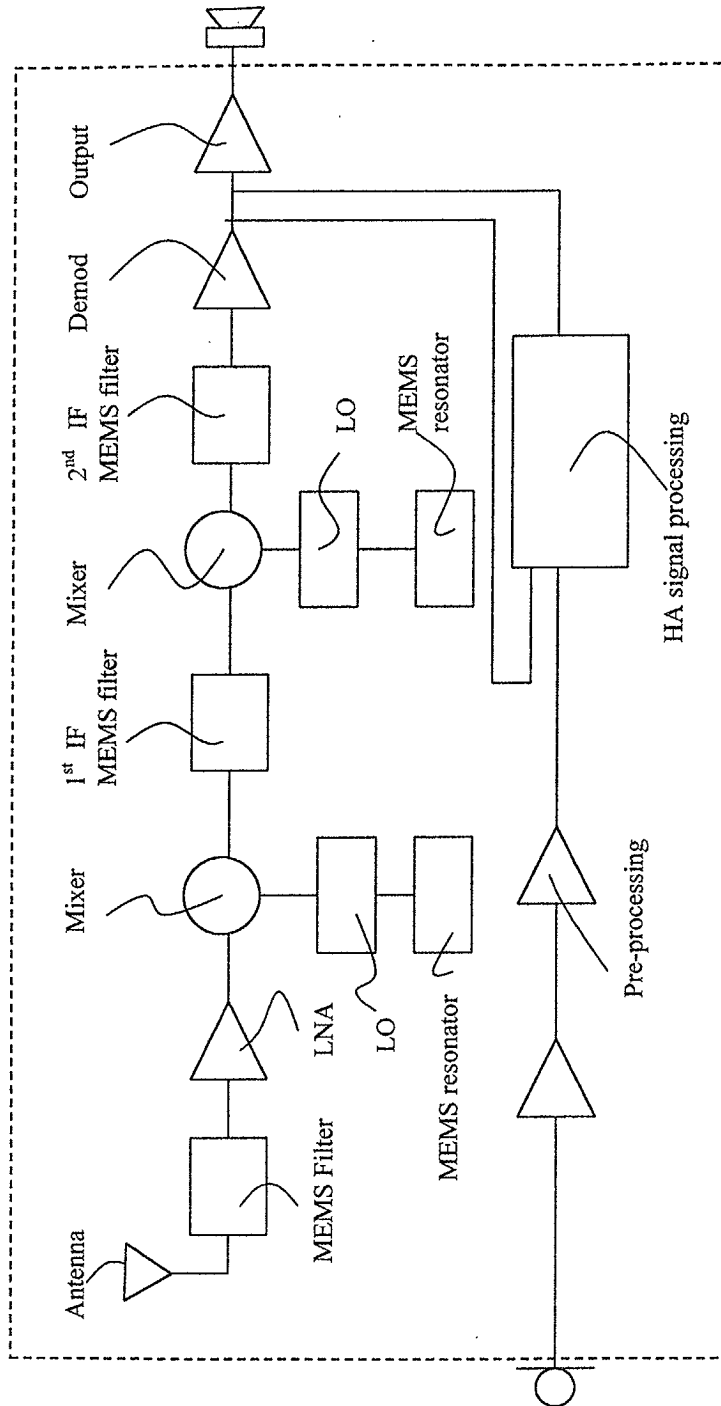


FIG. 1

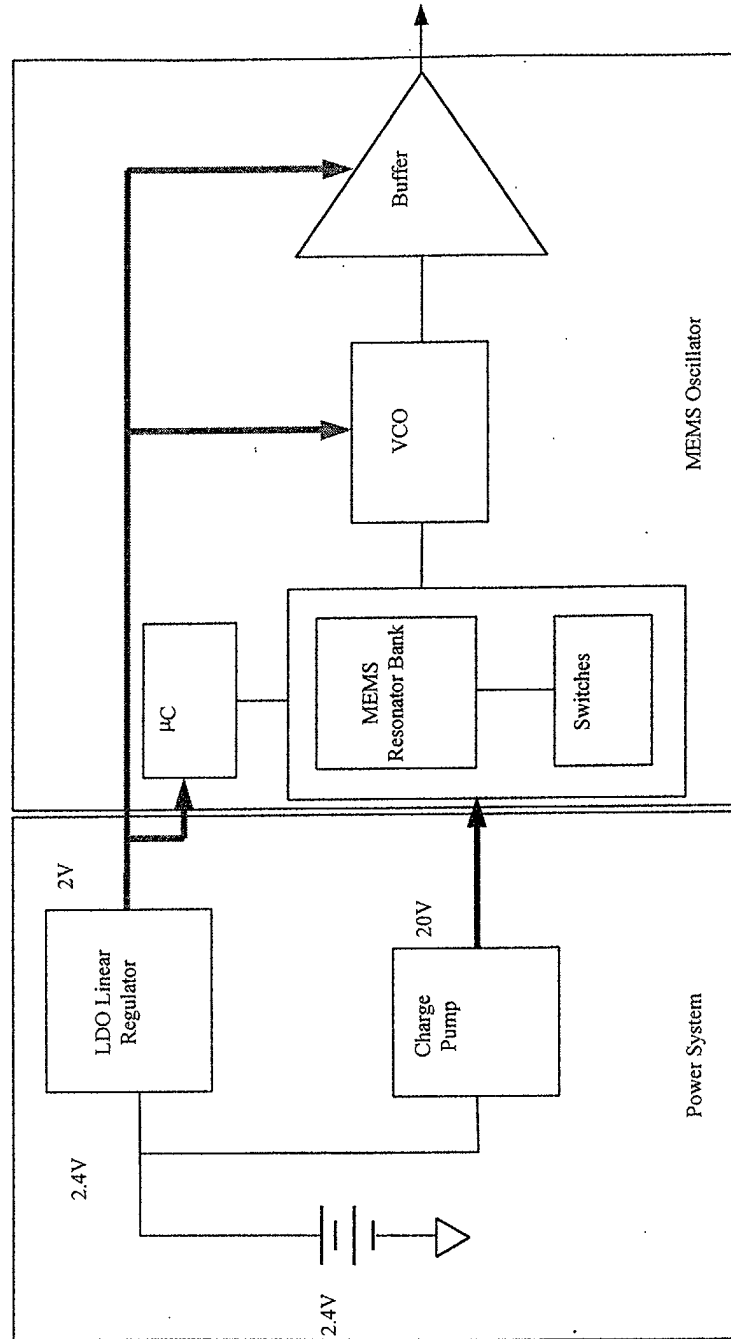


FIG. 2

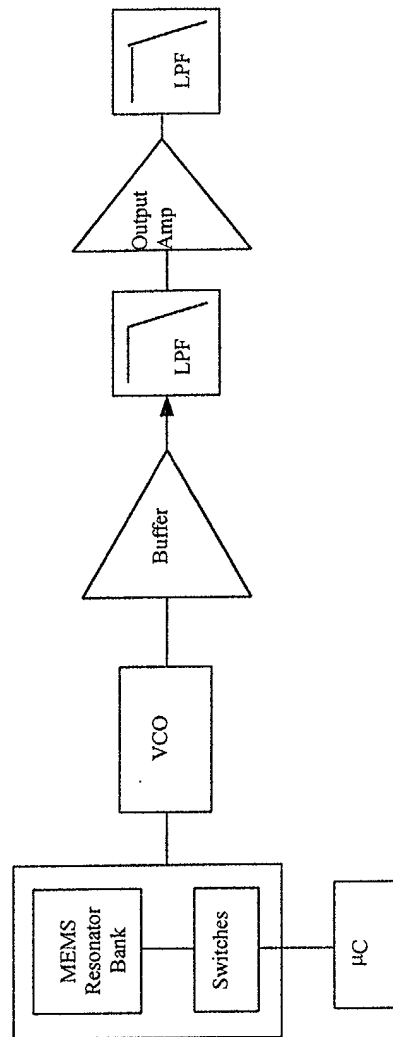


FIG. 3

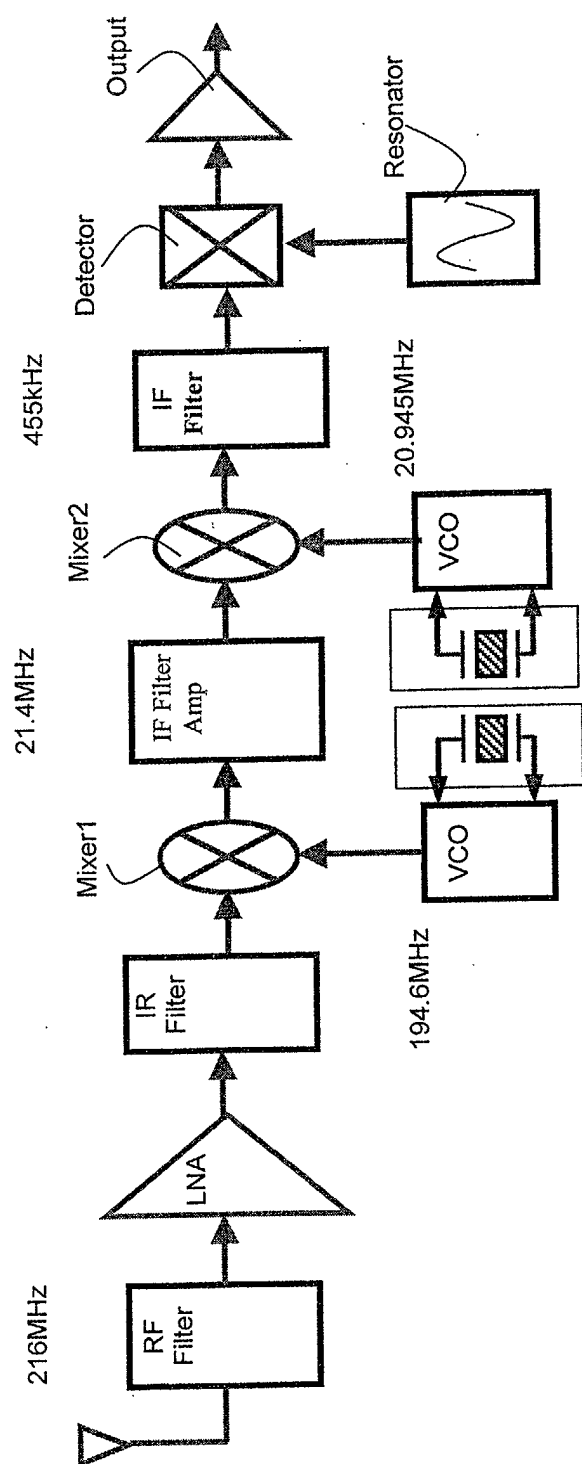


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 01 61 0083

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 491 980 A (ICHIKAWA TERUO) 1 January 1985 (1985-01-01) * column 1, line 6-13 * * column 1, line 43-47 * * column 2, line 25 - column 5, line 58 *	1-5	H04R25/00
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04R H03H H04B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		2 July 2002	Zanti, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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