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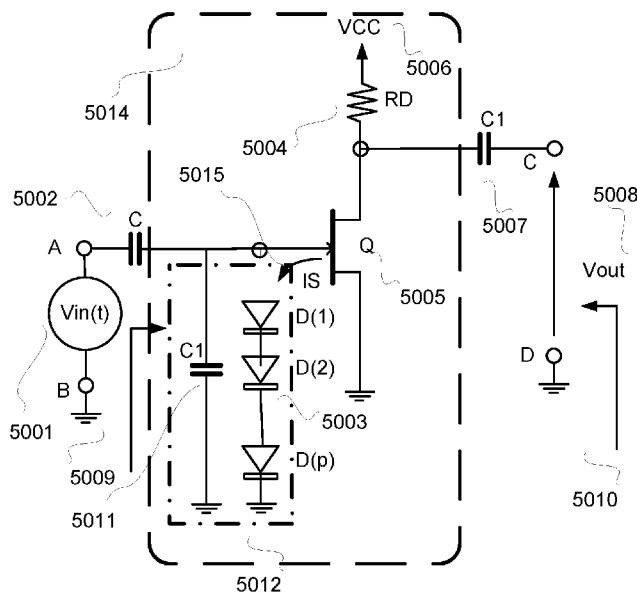
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[Continued on next page]

(54) Title: ADAPTIVE-SNR ULTRA-LOW-POWER ULTRA-LOW-NOISE MICROPHONE

FIG. 5



(57) Abstract: A microphone circuit including a JFET or MOSFET transistor, one input of an impedance network connected to the transistor's gate, a terminal of a source resistor connected to the transistor's source, another terminal of the source resistor connected to ground, a bypass capacitor connected in parallel to the source resistor, one terminal of a load resistor connected to the transistor's drain, VCC\_LOW connected to another terminal of the load resistor, an input of an op-amplifier connected to the transistor's source through a bi-directional low-pass-filter, another input of the op-amplifier connected to reference voltage, an output of the op-amplifier connected to another terminal of the input impedance network through an LPF, an energy detector connected to the transistor's drain via a coupling capacitor, an LPF connected to the energy detector output, and an LPF connected to the output of the energy detector, the input impedance network connected to a microphone.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**(88) Date of publication of the international search report:**  
23 March 2017

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB2016/054152

<p><b>A. CLASSIFICATION OF SUBJECT MATTER</b>                  IPC(8) - H04R 3/04; H04R 3/06; H04R 3/08; H04R 3/10; H04R 19/01 (2016.01)                  CPC - H04R 3/04; B81B 2201/00; B81B 2201/0257; H04R 3/06; H04R 3/08 (2016.11)                  According to International Patent Classification (IPC) or to both national classification and IPC</p>																				
<p><b>B. FIELDS SEARCHED</b></p> <p>Minimum documentation searched (classification system followed by classification symbols)                  IPC - H04R 3/00; H04R 3/04; H04R 3/06; H04R 3/08; H04R 3/10; H04R 19/00; H04R 19/01; H04R 19/04; H04R 23/00                  CPC - B81B 2201/00; B81B 2201/0257; H04R 3/00; H04R 3/04; H04R 3/06; H04R 3/08; H04R 3/10; H04R 19/00; H04R 23/00; H04R 29/004</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                  USPC - 324/686; 341/155; 381/111; 381/113; 381/114; 381/115; 381/116 (keyword delimited)</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                  Orbit, Google Patents, IEEE, Google Scholar                  Search terms used: microphone, MEMS, microelectromechanical, electret, transistor, JFET, MOSFET, field effect capacitor, amplifier, M2M, IOT, cloud of things, smart device, web of things, charge pump. low pass filter</p>																				
<p><b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b></p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>US 2011/0150243 A1 (ONISHI) 23 June 2011 (23.06.2011) entire document</td> <td>3, 5, 6, 9, 10, 17, 19</td> </tr> <tr> <td>A</td> <td>US 2015/0137834 A1 (AMS AG) 21 May 2015 (21.05.2015) entire document</td> <td>3, 5, 6, 9, 10, 17, 19</td> </tr> <tr> <td>A</td> <td>WO 2015/097681 A2 (WIZEDSP LTD) 02 July 2015 (02.07.2015) entire document</td> <td>1, 4, 6-15, 18</td> </tr> <tr> <td>A</td> <td>US 7,945,233 B2 (ARAD) 17 May 2011 (17.05.2011) entire document</td> <td>1, 3-15, 17-19</td> </tr> <tr> <td>A</td> <td>US 8,515,100 B2 (SHAJAAN et al) 20 August 2013 (20.08.2013) entire document</td> <td>1, 3-15, 17-19</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	US 2011/0150243 A1 (ONISHI) 23 June 2011 (23.06.2011) entire document	3, 5, 6, 9, 10, 17, 19	A	US 2015/0137834 A1 (AMS AG) 21 May 2015 (21.05.2015) entire document	3, 5, 6, 9, 10, 17, 19	A	WO 2015/097681 A2 (WIZEDSP LTD) 02 July 2015 (02.07.2015) entire document	1, 4, 6-15, 18	A	US 7,945,233 B2 (ARAD) 17 May 2011 (17.05.2011) entire document	1, 3-15, 17-19	A	US 8,515,100 B2 (SHAJAAN et al) 20 August 2013 (20.08.2013) entire document	1, 3-15, 17-19
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C.      <input type="checkbox"/> See patent family annex.</p>																				
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed									
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"P" document published prior to the international filing date but later than the priority date claimed																				
<p>Date of the actual completion of the international search 09 January 2017</p>		<p>Date of mailing of the international search report <b>14 FEB 2017</b></p>																		
<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300</p>		<p>Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>																		

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2016/054152

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

See supplemental page

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1, 3-15, 17-19

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2016/054152

Continued from Box No. III Observations where unity of invention is lacking

Note: Claims 6-7, 9-10 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim(s) 6-7, 9-10 is/are indefinite for the following reason: Claims 6-7, 9-10 recite the phrase "The microphone according to any of claims 1-4", which lacks antecedent basis in claim 2, which is drawn to an SNR monitor. For the purpose of the international opinion, claims 6-7, 9-10 are interpreted as "The microphone according to any of claims 1, 3-4" to provide proper antecedent basis.

Claims 8, 11-14 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim(s) 8, 11-14 is/are indefinite for the following reason: Claims 8, 11-14 recite the phrase "The microphone according to any of claims 2 and 4", which lacks antecedent basis in claim 2, which is drawn to an SNR monitor. For the purpose of the international opinion, claims 8, 11-14 are interpreted as "The microphone according claim 4" to provide proper antecedent basis.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1, 3-15, 17-19 drawn to detecting microphone and method for sensing an acoustic signal.  
Group II, claims 2, 16, drawn to an SNR monitor.

The inventions listed as Groups I or II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: a microphone or method for sensing an acoustic signal, comprising microphone comprising: a transistor comprising at least one of a JFET and MOSFET transistor; an impedance network, wherein a first input terminal of the impedance network is connected to a gate terminal of the transistor; a source resistor, wherein a first terminal of the source resistor is connected to a source terminal of the transistor, and a second terminal of the source resistor is connected to a ground terminal; a bypass capacitor (CS) connected in parallel to the source resistor; a load resistor (RD), wherein a first terminal of the load resistor is connected to a drain terminal of the transistor; a charge pump generating a low voltage power supply VCC\_LOW and an inverted voltage -VEE, wherein the low voltage is connected to a second terminal of the load resistor, and the inverted voltage -VEE is connected to a first power supply node of an op-amplifier as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: an SNR monitor comprising: a first input connected to a third low-pass-filter output; a second input connected to a fourth low-pass-filter output; one of: a third analog input, and a third digital input, that determines the required SNR: a first output connected to a control input of a controlled Vref, and an optional second output connected to a control input of an optional controlled charge pump as claimed therein is not present in the invention of Group I.

Groups I and II lack unity of invention because even though the inventions of these groups require the general technical features of connections to low pass filters and a connection to a charge pump and an output connected to a controlled reference voltage this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 7,945,233 B2 A1 (ARAD) 17 May 2011 (17.05.2011) teaches an SNR monitor (digital logic circuitry 104 measures the SNR, col 6 ln 15-20) which is connected to the output of a low pass filter 310 and to the output of a low pass filter 318 (col 5 ln 43, 48-53; fig 3, 4) and to a charge pump (VCO 326 connected to PLL 324, fig 3) and having an output 110 connected to a controlled reference voltage 332 (col 5 ln 17-22; fig 3).

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.