(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 November 2009 (05.11.2009)

PCT

(10) International Publication Number
WO 2009/134372 A3

(51) International Patent Classification:
H03L 1/00 (2006.01) *H03H 9/24* (2006.01)

(21) International Application Number:
PCT/US2009/002612

(22) International Filing Date:
29 April 2009 (29.04.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/111,544 29 April 2008 (29.04.2008) US
12/111,535 29 April 2008 (29.04.2008) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *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:
24 June 2010

(54) Title: TIMING OSCILLATORS AND RELATED METHODS

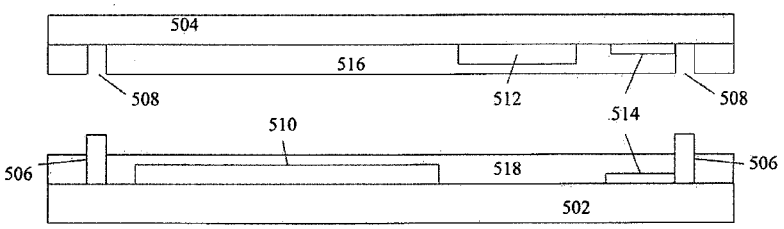


FIGURE 5

(57) Abstract: Timing oscillators as well as related methods and devices are described. A timing oscillator may include a mechanical resonating structure with major elements and minor elements coupled to the major element. The timing oscillator can generate stable signals with low phase noise at very high frequencies which allows a timing oscillator to be used effectively in a number of devices including computers and mobile phones for time and data synchronization purposes. The signal generated by the timing oscillator can be tuned using a driver circuit and a compensation circuit.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/002612

A. CLASSIFICATION OF SUBJECT MATTER
INV. H03L1/00 H03H9/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H03L H03H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/188254 A1 (SUTARDJA SEHAT [US]) 16 August 2007 (2007-08-16) paragraph [0235] - paragraph [0237] paragraph [0179]	1,2
X	WO 2006/000611 A (NOKIA CORP [FI]; MATTILA TOMI [FI]; JAAKKOLA OLLI [FI]; KAAJAKARI VILL) 5 January 2006 (2006-01-05) page 2, line 28 - page 2, column 35 page 5, line 7 - page 5, line 14	1,2

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 July 2009	11/05/2010
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Kahn, Klaus-Dieter

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/002612

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 additional sheet

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 an 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.:

see annex

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-2

Invention 1 set out in claims 1 and 2 defines a packaged integrated circuit.
The problem to be solved is environmental protection.
This is achieved by a package surrounding the timing oscillator and the filter.
No such filter surrounded by a package is defined in inventions 2, 3, 4, 5, 6 or 7.

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2. claim: 7

Invention 2 set out in claim 7 defines an integrated circuit.
The problem to be solved is to ease manufacturing.
This is achieved by integrating the timing oscillator and the device within the same package.
No such integrated circuit package is defined in inventions 1 or 3 - 7.

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3. claims: 8 - 16

Invention 3 set out in claim 8 defines a timing oscillator.
The problem to be solved is to decouple the mechanical resonating structure from the circuit .
This is achieved by forming each of the elements on a different substrate.
No such first and second substrates are defined in inventions 1, 2, or 4 - 7.

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4. claims: 17 - 19

Invention 4 set out in claim 17 defines a timing oscillator.
The problem to be solved is to reduce the height of the oscillator.
This is achieved by a total height of the timing oscillator to be less than 0.5 mm.
No such total height is defined in invention 1 - 3 or 5 - 7.

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5. claims: 20 - 25

Invention 5 set out in claim 20 defines a timing oscillator.
The problem to be solved is to generate a large amplitude.
This is achieved by a mechanical resonating structure including a major element and a minor element.
No such two elements are defined in inventions 1 - 4 or 6 or 7.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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6. claims: 26 - 34, 35 and 46 - 53

Invention 6 set out in claims 26, 35 and 46 defines a timing oscillator, a device and a method.
The problem to be solved is to generate low output frequencies.
This is achieved by processing the signal generated by the oscillator.
No such processing is defined in inventions 1 - 5 or 7.

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7. claims: 36 - 45

Invention 7 set out in claim 36 defines a timing oscillator.
The problem to be solved is to select the output frequency.
This is achieved by a switch to select a signal from a bank of micromechanical resonating structures.
No such switch or bank of micromechanical resonating structures is defined in inventions 1 - 6.

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8. claim: 3

Sub-invention 1.1 set out in claim 3 defines a packaged integrated circuit comprising a timing oscillator and a device associated with the timing oscillator surrounded by a package.
The problem to be solved is decoupling.
This is achieved in that the oscillator and the device are formed on different substrates.
No such different substrates are defined in invention 1.0 or in sub-inventions 1.2, 1.3 or 1.4.

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9. claim: 4

Sub-invention 1.2 set out in claim 4 defines a packaged integrated circuit comprising a timing oscillator and a device associated with the timing oscillator surrounded by a package.
The problem to be solved is to ease manufacturing.
This is achieved by forming the timing oscillator and the device on the same substrate.
No such single substrate is defined in invention 1.0 or sub-inventions 1.1 or 1.3 or 1.4.

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10. claim: 5

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Sub-invention 1.3 set out in claim 6 defines a packaged integrated circuit comprising a timing oscillator and a device associated with the timing oscillator surrounded by a package.
The problem to be solved is to generate plural output frequencies.
This is achieved in that the packaged integrated circuit comprises a second timing oscillator.
No such two timing oscillators are defined in invention 1.0 or in sub-inventions 1.1, 1.2 or 1.4.

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11. claim: 6

Sub-invention 1.4 set out in claim 6 defines a packaged integrated circuit comprising a timing oscillator and a device associated with the timing oscillator surrounded by a package.
The problem to be solved is to generate a large amplitude.
This is achieved by a mechanical resonating structure including a major element and a minor element.
No such two elements are defined in invention 1.0 or in sub-inventions 1.1, 1.2 or 1.3.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/002612

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007188254 A1	16-08-2007	WO 2008048624 A2	24-04-2008
WO 2006000611 A	05-01-2006	CN 1993890 A	04-07-2007
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