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(71) Applicant: INFINEON TECHNOLOGIES NORTH AMERICA CORP. [US/US]; 1730 North First Street, San Jose, CA 95112-4508 (US).

(72) Inventor: CYRUSIAN, Sasan; 115 Flexis Street, Apt. #14, Santa Cruz, CA 95060 (US).

(74) Agent: BRADEN, Stanton, C.; Siemens Corporation - Intellectual property Dept., 186 Wood Ave. South, Iselin, NJ 08830 (US).

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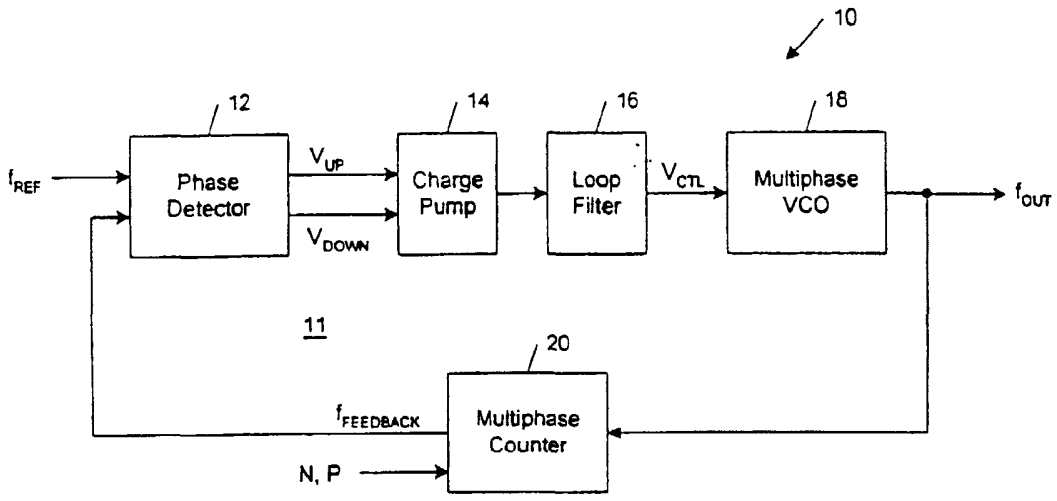
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HIGH RESOLUTION, LOW JITTER FREQUENCY SYNTHESIZER



(57) Abstract: Systems and methods for synthesizing frequencies with high solution and low jitter are described. In one aspect, a frequency synthesizer (10)for producing a series of output signal pulses spaced-apart by a characteristic period is described. The frequency synthesizer includes a phase-locked looped (11)having a multiphase counter (20) configured to produce a feedback signal pulse shifted in time by a programmable fraction of the output signal period relative to a period corresponding to a programmable number of output signal pulses. In another aspect, a hase shifter is configured to provide an over sampling clock signal with a frequency greater than the frequency of the output signal. In another aspect, the frequency synthesizer includes a phase-locked loop with a charge pump (14)having a pull up current source, a pull down current source, and an equalization circuit programmable to substantially offset mismatch between the pull up current source and the pull down current source.

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INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H03L7/18 H03L7/081 H03L7/089

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)
IPC 7 H03L

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, INSPEC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 889 436 A (WONG KERN WAI ET AL) 30 March 1999 (1999-03-30) column 6, line 26 -column 8, line 64; figures 8-13	1-10,13, 18-22
Y	---	14,15,23
X	US 6 114 914 A (MAR MONTE F) 5 September 2000 (2000-09-05) column 3, line 14 -column 5, line 26; figures 4,5	1-4,6,8, 18-21
Y	---	14,15,23
X	US 5 059 924 A (JENNINGSCHECK WILLIAM S) 22 October 1991 (1991-10-22) column 4, line 6 -column 7, line 66; claim 14; figures 1,2,6	1-10,13, 18-22
Y	---	14,15,23
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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

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"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

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"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
10 July 2002	17/07/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Balbinot, H

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/24648

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 111 468 A (TANISHIMA HIDEAKI) 29 August 2000 (2000-08-29) column 13, line 66 -column 20, line 7 column 23, line 35 -column 24, line 37 column 25, line 63 -column 27, line 15 figures 17,20,27,29,30	16,17
Y	-----	14,15,23

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

National application No.
PCT/US 01/24648

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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 fee, this Authority did not invite payment of any additional fee.

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.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ 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: 1-15,18-23

   Frequency synthesizer comprising a phase locked loop having a multiphase counter producing a feedback signal pulse shifted in time by a programmable fraction of the output signal period relative to a period corresponding to a programmable number of output signal pulses.

2. Claims: 16, 17

   Frequency synthesizer comprising a phase-locked loop having a charge pump provided with an equalization circuit programmable to substantially offset mismatch the up and down current sources of the charge pump.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 01/24648

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5889436 A	30-03-1999	NONE	
US 6114914 A	05-09-2000	NONE	
US 5059924 A	22-10-1991	CA 2002382 A1	07-05-1990
		WO 9006017 A1	31-05-1990
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