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Datasheet for the decision of 2 June 2017

Case Number: T 2297/12 - 3.5.02

Application Number: 01300507.9

Publication Number: 1126606

IPC: H03H11/48

Language of the proceedings: EN

Title of invention:
Active inductor

Applicant:
Alcatel Lucent

Relevant legal provisions:
EPC Art. 123(2), 84, 83

Keyword:
Amendments - extension beyond the content of the application as filed (no)
Claims - clarity - main request (yes)
Sufficiency of disclosure - (yes)

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Case Number: T 2297/12 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 2 June 2017

Appellant: (Applicant)	ALCATEL LUCENT 148/152 route de la Reine 92100 Boulogne-Billancourt (FR)
Representative:	MERH-IP Matias Erny Reichl Hoffmann Patentanwälte PartG mbB Paul-Heyse-Strasse 29 80336 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 18 May 2012 refusing European patent application No. 01300507.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Lord
Members:	M. Léouffre
	W. Ungler

Summary of Facts and Submissions

I. On 27 July 2012 the applicant appealed against the decision of the examining division to refuse the European patent application No. 01 300 507.9.

II. The examining division held that the application did not meet the requirements of Articles 83 and 84 EPC, and that the subject-matter of claims 1 and 14 had been amended so as to extend beyond the content of the application as filed, thus contravening Article 123(2) EPC.
The examining division was of the opinion that active inductors comprised at least two transistors to comply with the gyrator principle, and objected essentially that the disclosure of the patent application was not sufficient for a person skilled in the art to simulate an inductor on the basis of a circuit comprising only one MOS-transistor.

The division also cited the following document:

D1: Jin-So Ko et al, "Low power, tunable active inductor and its applications to monolithic VCO and BPF", Microwave Symposium Digest, 1997, IEEE MTT-S International, Denver, CO, 8 to 13 June 1997, pages 929 to 932.

III. In response to the board's summons to oral proceedings, in a letter dated 19 April 2017, the appellant filed new arguments, a corrected main request and two auxiliary requests.

IV. On 18 May 2017, following a further communication from the board dated 10 May 2017, the appellant faxed a new set of claims of a main request and description pages 2

to 4 taking account of the clarity objections raised by the board in the said further communication.

V. With a communication dated 18 May 2017, the board cancelled the oral proceedings scheduled for 19 May 2017.

VI. The board understands that the appellant requests that the decision be set aside and that a patent be granted on the basis of the set of claims 1 to 13 of the main request as filed with the fax dated 18 May 2017, together with the description pages 2 to 4, filed with the same fax, and pages 1 and 5 as originally filed, and drawings sheets 1/2 and 2/2 as originally filed.

VII. Claim 1 reads as follows:

"A circuit for use as an active inductor on an integrated circuit having a power supply voltage supplied at a first power supply terminal, comprising:

a metal oxide semiconductor (MOS) transistor (101) having a gate terminal (103), a drain terminal (105), and a source terminal (107), said drain terminal being coupled to said power supply voltage (V_{dd}) and said source terminal being one of the terminals of said active inductor;

the circuit being CHARACTERIZED by

a resistor (113) having a first terminal coupled to said gate terminal and a second terminal coupled to a voltage that is derived from said power supply voltage and has a larger absolute value than said power supply voltage supplied at said first power supply terminal and the same sign as said power supply voltage; and

said circuit being adapted so that when said circuit is operating said circuit behaves as an active inductor between said source terminal and said first power supply terminal on said integrated circuit."

Claims 2 to 11 are dependent on claim 1.

Claim 12 reads as follows:
"A method for use of a circuit according to claim 1, the method comprising the steps of:
generating a beyond voltage that is either greater than the highest voltage or less than the lowest voltage being supplied to said integrated circuit by a power supply;
the method being CHARACTERIZED by the step of
supplying said beyond voltage to said MOS transistor so as to bias said MOS transistor with said beyond voltage thereby causing said MOS transistor to operate as said active inductor."

Claim 13 is dependent on claim 12.

VIII. The appellant argued essentially as follows:

In the decision under appeal, the scope of claim 1, which defined "a circuit for use as an active inductor", had been held to be broader than that of claim 1 as filed, which defined "an active inductor". Claim 1 was alleged to cover other circuits which were not necessarily active inductors, but could be used as active inductors.
An active inductor was not a coil-type one but a circuit that emulated an inductor. Embodiments of such circuits were disclosed in the application as an explicit support (e.g. figure 1). It was apparent that original claim 1 was already directed to a “circuit”, and that the amendment did not go beyond the original disclosure. The subset of all the circuits that were suitable to be used as an active inductor as claimed by

the amended claim 1 was specified by the features disclosed therein.
In particular, it was incorrect to say that the amended claim 1 was directed to a “circuit” in general, as was asserted on page 5, lines 1 and 2 of the decision.

In the decision, the amended claim 1 had also been held to be unclear because it attempted to define the invention by the result to be achieved, based on the last three lines: “said circuit being adapted so that when said circuit is operating said circuit behaves as an active inductor between said source terminal and said first power supply terminal on said integrated circuit".
This feature was descriptive of the natural result and simply reflected the fact that, unlike an ordinary inductor, which was an inductor whether it was operating or not, an active inductor had to be operating, i.e. be powered, to function as an inductor. In other words, the last feature described what happened when the circuit was operating. Features of this type were not completely excluded, as is explained in the Guidelines, Part F, IV, 4.10.

The present application dealt with circuits that behaved as an active inductor and that did not require two or more transistors.
At the priority date of the present application it was known to the skilled person how to realise active inductors by circuits comprising a single transistor. Incidentally, a summary of an example operation of such circuits was given in the publication by Prof. Dr.-lng. U, L. Rohde, section 4.4.1.4, Figure 4-32. The circuits shown there in Figure 4-32 were equivalent (at least for small signals) to Hara active inductor circuits.

The examining division's view that no active inductor with only one transistor had been disclosed in the general context of the claims and that therefore the application as a whole lacked sufficiency of disclosure, was thus incorrect. The examining division had not provided any proof that the circuits disclosed in the present application did not work; instead, it merely argued that some types of known active inductor circuits comprised a plurality of transistors.

A skilled person having studied the present application and availing himself of general technical knowledge was not unduly burdened to put into practice the present invention defined by claim 1 according to the main request. Based on the teaching of the present application, the skilled person would have had easily fabricated and used "active inductors" as described in the claims and shown in the figures. It was possible to reproduce the claimed circuit using the original application documents without any inventive effort over and above the ordinary skills of a practitioner (see Case Law of the Boards of Appeal, 8th edition, Chapter II.C.4.1, page 333). Thus, the application as a whole provided sufficient disclosure enabling the skilled person to carry out the present invention defined by claim 1 according to the main request, as required by Article 83 EPC. Analogous or similar arguments applied to claim 12 of the main request.

D1 did not disclose the feature that the second terminal was "coupled to a voltage that is derived from said power supply voltage and has a larger absolute value than said power supply voltage supplied at said first power supply terminal and the same sign as said power supply voltage".

Reasons for the Decision

1. The appeal is admissible.

2. Article 123(2) EPC

2.1 Claim 1 is based on original claim 1 wherein the feature "an active inductor for use on an integrated circuit" has been replaced by the feature "A circuit for use as an active inductor on an integrated circuit", and the following feature has been added: "said circuit being adapted so that when said circuit is operating said circuit behaves as an active inductor between said source terminal and said first power supply terminal on said integrated circuit."

2.2 The examining division considered that the scope of claim 1 had been broadened by the introduction of the feature "A circuit for use as an active inductor on an integrated circuit". The examining division alleged in particular that "the conversion of the specific "active inductor" into a general "circuit" does not comply with the requirements of Article 123(2) EPC".

2.3 An active inductor is not a single electrical element but a circuit which presents the characteristics of an inductor when energised or operated. A circuit according to claim 1, which is characterised as being "adapted so that when said circuit is operating said circuit behaves as an active inductor between said source terminal and said first power supply terminal on said integrated circuit" (last feature of claim 1) is a circuit necessarily simulating an inductor when operated. Hence, considering the addition of the last feature of claim 1, any circuit falling under the scope

of claim 1 is a circuit falling under the definition of an active inductor. Therefore the replacement of the feature "an active inductor for use on an integrated circuit" by the feature "A circuit for use as an active inductor on an integrated circuit" does not infringe Article 123(2) EPC.

3. Article 83 EPC

3.1 The examining division was of the opinion that active inductors comprised at least two transistors to comply with the gyrator principle, and objected that the circuit disclosed in the application comprised only one MOS-transistor.

3.2 The prior art cited in paragraph [0015] of the published application is a document from S.Hara. The board agrees with the appellant that, while so-called Hara active inductor circuits simulating inductors were usually based on two GaAs transistors (MESFET) connected in a cascode arrangement, simulating an inductor is also possible with a circuit comprising a single metal oxide semiconductor transistor (MOSFET), as shown for example in the habilitation thesis of Prof.Dr.-Ing. U.L. Rohde dated 8 June 2011 (see page 137). The fact that this document was published after the priority date of the present application does not mean that it is not relevant to this argument, because it merely provides evidence that the circuit disclosed in the application would indeed function in the manner described in the application.

3.3 The circuit discussed and shown in figure 4.32 of that thesis is the same as the circuit shown in figure 2 of the present invention. It follows that the circuit

shown in figure 2 of the application simulates an active inductor, even if its operation is not explained in detail in the description. The invention indeed does not relate to the transistor arrangement as such, but solely to the fact that the resistor 113 has "a second terminal coupled to a voltage that is derived from said power supply voltage and has a larger absolute value than said power supply voltage supplied at said first power supply terminal and the same sign as said power supply voltage". Connecting the resistor to a voltage having a larger absolute value than the power supply voltage enables compensation for the trend of using lower power supply voltages (see paragraphs [0002] and [0003] of the published application). A person skilled in the art is not unduly burdened to connect a MOS transistor with a resistor and a supply voltage in order to arrive at a circuit for use as an active inductor according to claim 1. Consequently the objection according to Article 83 EPC has no basis.

4. Article 84 EPC

4.1 The feature added to claim 1 is written in functional terms but does not imply any more features than the features already mentioned in the original claim 1. As indicated in item 3 above, a circuit comprising only a single metal oxide semiconductor transistor and a resistor can behave as an active inductor between said source terminal (of the MOS transistor) and the first power supply terminal. Thus it cannot be objected that the feature added to claim 1 defines a result to be achieved. As indicated under item 2 above, the feature added to claim 1 helps to clarify and delimit the scope of the claim.

4.2 Furthermore, the unclear original claim 2 has been deleted; the MOS transistor mentioned in claims 5 and 6 (former claims 6 and 7) has been specified as being a negative or a positive MOS transistor respectively; the former redundant claim 12 has been deleted; the method claimed in former claim 14 and dependent claim 15 (now claims 12 and 13) has been specified as "a method for use of a circuit according to claim 1"; and the unclear expressions "and are included within its spirit and scope" and "which is incorporated by reference as if fully set forth herein" found in the description at page 2, line 16 and page 4, lines 29 and 30, as well as the irrelevant passage from page 2, line 24 to page 3, line 26, have been removed.
Thus the claims and the description comply with requirements following from Article 84 EPC.

5. Articles 54 and 56 EPC

5.1 The board agrees with the appellant that the document D1 does not disclose that the second terminal of the transistor is "coupled to a voltage that is derived from said power supply voltage and has a larger absolute value than said power supply voltage supplied at said first power supply terminal and the same sign as said power supply voltage". The board notes also that D1 does not disclose that the transistor is a MOSFET, since the circuit described in that document makes use of GaAs MESFETs. The subject-matter of the independent claims 1 and 12 is therefore new over D1. These features also establish novelty over the prior art cited in paragraph [0015] of the present application.

5.2 The board is also of the opinion that the first of these features results in the presence of an inventive step in the claimed subject-matter, since it addresses the technical problem of operating with lower power supply voltages discussed in section 3.3 above, and since none of the available prior art documents contains any suggestion of this development.

5.3 Thus the subject-matter of the independent claims 1 and 12, and of claims 2 to 11 and 13 which are dependent on them, is new and involves an inventive step. Since the appellant has also with the submissions of 18 May 2017 addressed the remaining objections to the application, the board has to accede to the appellant's request to grant a patent on the basis of the main request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

   Description: pages 1 and 5 as originally filed,
   pages 2 to 4 filed with letter dated 18 May 2017,

   Claims: nos. 1 to 13 filed with letter dated 18 May 2017

   Drawings: sheets 1/2 and 2/2 as originally filed.

The Registrar: The Chairman:

U. Bultmann R. Lord

Decision electronically authenticated