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Datasheet for the decision of 24 April 2007

Case Number: T 0890/06 - 3.4.01

Application Number: 97925422.4

Publication Number: 0896743

IPC: H01P 1/20

Language of the proceedings: EN

Title of invention:
Odd order mesfet frequency multiplier

Applicant:
RAYTHEON COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Inventive step - no"

Decisions cited:
-

Catchword:
-

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Case Number: T 0890/06 - 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 24 April 2007

Appellant: RAYTHEON COMPANY
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Representative: UEXKÜLL & STOLBERG
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 3 January 2006 refusing European application No. 97925422.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: B. Schachenmann
Members: R. Bekkering
H. Wolfrum

Summary of Facts and Submissions

I. European patent application 97925422.4 (publication nos. WO-A-97 41613 and EP-A-0 896 743) was refused pursuant to Article 97(1) EPC by a decision of the examining division dispatched on 3 January 2006. The decision was based on the state of the file, as requested.

II. The applicant (appellant) lodged an appeal against the decision on 3 March 2006 and paid the appeal fee on the same day. The statement setting out the grounds of appeal was received on 3 May 2006.

III. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

Claims:	no. 1 to 15 filed with the grounds of appeal on 3 May 2006;
Description:	pages 1 to 6, 8, 10, 12 to 15 as published; pages 7, 9, 11 filed with letter of 23 October 2003;
Drawings:	Sheets 1/7 to 7/7 as published.

IV. Oral proceedings, requested as an auxiliary measure by the appellant, were scheduled to be held on 24 April 2007. By fax received on 23 April 2007, the appellant withdrew his request for oral proceedings and requested to decide the case as it stands.

V. In the annex to the summons to the oral proceedings pursuant to Article 11(1) RPBA, the board made

observations concerning *inter alia* lack of inventive step.

VI. Reference is made to the following documents:

D1: US-A-4 176 332

D2: J. Henkus et al. "A Wideband Tripler for X-band in Microstrip", Microwave Journal, vol. 36, no. 3, 1 March 1993, pages 106, 108, 109, 111

VII. Oral proceedings were held on 24 April 2007 as scheduled, in the absence of the appellant.

VIII. Claim 1 reads as follows:

"*1. An odd order MESFET frequency multiplier (100) generating an output frequency at a desired odd harmonic, comprising:*
an input port (14);
a MESFET (16) having a harmonic response varying with applied bias conditions and an input RF power level, the MESFET (16) coupled to the input port (14) and including a drain port (32);
an output matching network (30) coupled to the drain port (32), the output matching network (32) being sized and configured for a predetermined load at the output frequency, the output matching network (30) including a first impedance for reflecting energy from undesired even harmonics associated with the output frequency to the MESFET (16); and
a bandpass filter (36) coupled to the output matching network (30) and operable to produce the output frequency at the desired odd harmonic, the bandpass

filter (36) being sized and configured for the predetermined load, the bandpass filter (36) including a second impedance for reflecting energy from undesired odd harmonics to the MESFET (16), wherein the reflected energy from the undesired even and odd harmonics combine at the MESFET (16) to produce increased energy at the desired odd harmonic."

Independent claim 11 is directed to a corresponding "*method for generating an output frequency at a desired odd harmonic*".

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. In the annex to the summons to the oral proceedings pursuant to Article 11(1) RPBA, the board observed in particular that the subject-matter of claim 1 appeared to lack an inventive step.

2.1 As in substance indicated in the above annex, having regard to claim 1, from document D2 a MESFET frequency tripler is known (ie generating an output at the third harmonic of the input frequency) comprising:

- an input port;
- a MESFET having a harmonic response dependent on applied bias conditions (see figure 2, box 2 and corresponding text) and an input RF power level, coupled to the input port, and including a drain port (see figure 3 and corresponding text);

– an output matching network including a bandpass filter (BPF1) coupled to the drain port and sized and configured for a predetermined load (50 Ω, see figure 3 and corresponding text) at the output frequency, the output matching network including an impedance (ie "commensurate line length transmission lines in microstrip technology", see page 109, right-hand column, lines 13 to 17 and 30 to 38) apparently reflecting energy from undesired (even and odd) harmonics.

As in substance argued by the appellant in the grounds of appeal, in the multiplier according to document D2 the reflected energy of bandpass filter BPF1 is not combined at the MESFET, but rather passes bandpass filter BPF2 and is absorbed in the dummy load (see page 109, right-hand column, lines 6 to 13 and figure 3).

Novelty is, thus, provided over document D2.

2.2 The effect of the aforementioned difference is an increased production of energy at the desired third harmonic at the MESFET. Accordingly, having regard to document D2, the objective problem to be solved underlying the present application may be seen in increasing the efficiency of the generation of the desired odd harmonic.

The problem as such is generally obvious and addressed specifically in document D1 (see column 1, line 17 to column 2, line 12).

In particular, document D1 discloses a frequency doubler ($2xf_0$) including a transistor stage (bipolar) and an output coupling circuit providing a high load impedance at undesired frequencies $(2n-1)xf_0$ where n=1,2,3.... As stated, "*this high impedance loading causes circulating currents to be contained within the transistor 22 thereby increasing its generation of harmonics, and in particular, generation of the harmonic at frequency* $2xf_0$" (see column 3, lines 61 to 65).

Contrary to what is argued by the appellant in the grounds of appeal, this corresponds to the solution offered in claim 1 according to which, by reflecting the energy of the undesired frequencies back to the transistor stage where it is combined, the energy at the desired harmonic is increased.

Remains the consideration of how the skilled person would have configured the output coupling circuit suggested in document D1 in case of an odd order multiplier.

Document D1 suggests, in order to reflect the undesired odd harmonics, to include an open stub impedance (54) of one half wavelength at $2xf_0$. This stub will be equivalent to a quarter wavelength at all odd frequencies $(2n-1)xf_0$ where n=1,2,3... providing a very high load impedance and thus reflection at these frequencies (see column 3, lines 51 to 56).

By analogy, for an odd order multiplier, quarter wavelength open stub impedances would have to be provided for the undesired even harmonics, as would be

readily apparent to a skilled person working in the field of high frequency technology at issue.

Furthermore, since such an output matching network would not reflect the fundamental frequency f_0, additional measures would be required in order to prevent outputting the fundamental frequency. The provision of a bandpass filter to this end is as such already suggested in document D2 and would, thus, be obvious to the skilled person.

2.3 No submissions were made by the appellant in response to the board's observations provided in the annex to the summons to oral proceedings referred to above.

2.4 For these reasons, the subject-matter of claim 1 is obvious to the person skilled in the art and, therefore, lacks an inventive step (Article 52(1) and 56 EPC).

2.5 The subject-matter of independent claim 11 lacks an inventive step for in substance the same reasons.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

R. Schumacher B. Schachenmann