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D E C I S I O N
of 7 October 1994

Case Number: T 0808/93 - 3.5.2

Application Number: 88102283.4

Publication Number: 0280170

IPC: H03K 4/08

Language of the proceedings: EN

Title of invention:
Generator of periodic signals, in particular for switch-mode power supplies

Applicant:
SGS-THOMSON MICROELECTRONICS s.r.l.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes, after amendment)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0808/93 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 7 October 1994

Appellant: SGS-THOMSON MICROELECTRONICS s.r.l.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 1 April 1993 refusing European patent application No. 88 102 283.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: A. G. Hagenbucher
C. Holtz

Summary of Facts and Submissions

I. The present appeal contests the decision of the Examining Division refusing the Appellant's European patent application No. 88 102 283.4.

II. The reason given for the refusal was that the subject-matter of Claims 1 according to the main and two auxiliary requests then on file did not involve an inventive step having regard to

D1: US-A-4 413 237,

D2: J. Markus, "Modern Electronic Circuits Reference Manual", McGraw-Hill 1980, page 432, circuit "Sine - Square - Triangle with Lin/Log Sweep",

D3: J. Markus, "Sourcebook of Electronic Circuits", McGraw-Hill, 1968, page 14, circuit "Broadband Impedance Transformer", and

general knowledge.

III. In response to objections raised by the Board, the Appellant filed new claims and amendments to the description.

IV. Independent Claim 1 is now worded as follows:

1. A generator of periodic signals with exponential edges, in particular for switch-mode power supplies, comprising:

at least one capacitive element (11) and a resistive element (12);

current source means (13) connected to said capacitive element (11) and to said resistive element (12) and supplying them with currents having mutually proportional amplitudes;

a switch device (15) connected in parallel to said capacitive element (11) for charging said capacitor element (11) according to a trigger signal and for allowing discharge of said capacitive element (11) therethrough; and

amplifier means (14), interposed between said capacitive element (11) and said resistive element (12), for maintaining the voltage drop on said resistive element (12) proportional to the voltage drop on said capacitive element (11), CHARACTERIZED IN THAT

said generator is an integrated circuit; in that

said switch device (15) is arranged such as to allow periodical switching by an external trigger signal; and in that

said amplifier means (14) comprises a first (27) and a second (25) transistor alternately of the PNP type and of the NPN type, said first transistor (27) being connected with its base terminal to a terminal (17) of said capacitive element (11), and said second transistor (25) being connected with its base terminal to the emitter terminal of said first transistor (27), with its emitter terminal to a terminal of said resistive element (12), and with its collector terminal to a terminal of said current source (13).

V. The Appellant argued that the "Sine - Square - Triangle with Lin/Log Sweep" circuit shown in D2 was an internally triggered discrete oscillator, the circuit of the present application an externally triggered integrated pulse generator. In contrast to the present application the amplifier means of D2 was not compensated and its current mirror included resistor means. An impedance converter such as known from D3 was normally used for loadless measurements or decoupling two circuits by providing a high impedance interface but not for the compensation of voltage deviations or drifts, as in the present invention.

VI. The Appellant requested that the decision of the Examining Division be set aside and a patent be granted on the basis of the following documents:

Claims: 1 to 5 received on 22 August 1994
Description: pages 1, 3 to 7 as originally filed
pages 2, 2A received on 22 August 1994
Drawings: Figures 1 to 3, 4a and 4b (1 sheet) as originally filed.

Reasons for the Decision

1. The appeal is admissible.

2. The amendments made to the documents (claims and description) comply with the requirements of Article 123(2) EPC. All the features in present Claim 1 can be found in original Claims 1 and 4 and on pages 2 and 4 to 6 of the originally filed description.

3. None of the cited documents D1 to D3 nor the prior art shown in Figure 1 of the present application discloses all the features of the subject-matter defined in present Claim 1. Since novelty is not in dispute, the issue to be decided is whether the subject-matter of Claim 1 is objectionable for lack of inventive step.

4. *Closest prior art and problem*

The closest prior art is the Sine - Square - Triangle circuit shown in D2 when operated in its Log - mode. This generator has all the features indicated in the preamble of Claim 1. It is internally triggered and has no input terminal for an external trigger signal. Those parts of the circuit corresponding to the preamble of

Claim 1 are not integrated. The amplifier means comprises only a single transistor (Tr_4), so that voltage drops across the capacitive element (C_1) and the resistive element (R_6) are not strictly balanced. Because of the base emitter voltage of transistor TR_4 and tolerances of the resistor R_6 and capacitor C11 the desired shape of the output signal of the circuit of D2 may not always be reliably generated. D2 does not mention this problem, let alone suggest a solution to it.

The problem underlying the subject-matter of Claim 1 may be seen as the provision of a generator with the features in the preamble of Claim 1 which, in integrated circuit form, can be triggered externally and produces a more accurate output waveform.

5. This problem is solved by providing the features specified in the characterising part of Claim 1. As explained by the Appellant it is the external triggering and the compensation brought about by the amplifier means according to the last paragraphed section of Claim 1 which make it possible to achieve a satisfactory integrated circuit.

6. A person skilled in the art may be able to integrate generators as known from D2 and provide an input for external trigger signals instead of internal triggering means in view of D1. However, there is no hint in the prior art to use the Broadband Impedance Transformer of D3 in the circuit of D2 for compensation purposes. As explained by the Appellant, impedance Transformers are normally used for providing a high impedance interface between two circuit stages or for loadless measurements as shown by the Appellant with reference to the standard handbook Tietze-Schenk. D3 does not hint at the fact

that the base-emitter voltage drops of transistor Q_1 and Q_2 substantially cancel each other.

The Board, therefore, comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the documents cited by the Examining Division and general knowledge. It must accordingly be seen as involving an inventive step as required under Article 52(1) and 56 EPC.

7. In the opinion of the Board, independent Claim 1, together with dependent Claims 2 to 5 are allowable. The description has been adapted to the wording of these claims and meets the requirements of Rule 27 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the form requested by the Appellant (see paragraph VI above).

The Registrar:

M. Kiehl

The Chairman:

W. J. L. Wheeler