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Bezeichnung der Erfindung: Sample and hold circuit  
Title of invention:  
Titre de l'invention :

Klassifikation / Classification / Classement : G11C 27/02

### ENTSCHEIDUNG / DECISION

vom / of / du 26 March 1990

Anmelder / Applicant / Demandeur : SONY CORPORATION

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : Inventive step (yes)

Leitsatz / Headnote / Sommaire



Case Number : T 220/88

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.1  
of 26 March 1990

**Appellant :** SONY CORPORATION  
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**Representative :** Ayers, Martyn Lewis Stanley et al,  
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**Decision under appeal :** Decision of Examining Division 067  
of the European Patent Office  
dated 8 December 1987 refusing  
European patent application  
No. 82 306 935.6 pursuant to  
Article 97(1) EPC

**Composition of the Board :**

**Chairman :** P.K.J. van den Berg  
**Members :** W. Riewald  
F. Benussi

## Summary of Facts and Submissions

- I. European patent application No. 82 306 935.6, claiming priority of an application in Japan of 28 December 1981, filed on 23 December 1982 and published on 27 July 1983, was refused by a decision of the Examining Division 067 dated 8 December 1987.
- II. The reason given for the refusal was that, whilst the subject-matter of Claim 1 was novel, it did not involve an inventive step.
- III. Whereas the applicant had disclosed his invention starting from a prior art depicted in Figures 1 and 2 of the application, the Examining Division based its decision on the document

US-A-3 584 920.

- IV. On 11 February 1988 the Applicant lodged an appeal against the decision of the Examining Division, the appeal fee having been paid on 9 February 1988. A Statement of Grounds of Appeal was received on 8 April 1988 by telefax and confirmed by letter on 13 April 1988.

The Appellant amended, during the ensuing proceedings, the claims and the description several times by way of main and auxiliary requests.

Oral proceedings were held on 15 December 1989 at which the Appellant requested to set the decision under appeal aside and to grant a patent on the basis of the claims according to the alternative submission 4 received 28 June 1989. At the conclusion of the oral proceedings,

the Appellant was, by setting a time limit of two months, offered the opportunity to file a set of new claims taking due account of the requirements which these claims should satisfy according to the Board, as discussed in the oral proceedings, plus a description adapted accordingly.

V. With amendments filed with letter of 13 February 1990, received on 14 February 1990, the Appellant now requests, by way of a main request, to grant a patent on the basis of the following application documents:

- description, pages 1 to 4 and 10 as published,  
pages 5, 5a and 6 to 9 filed with letter of  
13 February 1990;

- Claims 1 to 3, filed with letter of 13 February 1990;

- drawings, sheet 1/2 as published,  
sheet 2/2 filed with letter of 13 February  
1990.

VI. As an "Alternative Submission No. 5", the Appellant filed in addition

- pages 5, 5a and

- Claims 1 and 2

replacing the pages 5 and 5a and the Claims 1 to 3 of the main request.

VII. Claim 1 according to the main request reads as follows:

"A sample and hold circuit of the bridge type,  
comprising:

a diode bridge (1), having an input terminal (10) and an output terminal (11);

first and second drive terminals on said bridge;

first and second capacitors (17, 18) having first plates thereof coupled to said first and second drive terminals respectively;

first switching means (S3) constituted by at least one diode (D<sub>5</sub>, D<sub>6</sub>) and coupled between the drive terminals of the bridge in anti-parallel relation to the bridge diodes;

second and third switching means (S1, S2) for applying control signals of opposite phase to respective second plates of said capacitors (17, 18) for turning said bridge ON by a current flow in a first direction through the bridge diodes to produce at said output terminal a sample of a signal applied to said input terminal, and re-establishing the charge on said capacitors (17, 18) by a current flow in the opposite direction through the at least one diode (D<sub>5</sub>, D<sub>6</sub>) constituting the first switching means (S3) while said bridge is turned OFF; characterised in that: said circuit is implemented as an integrated circuit; the second and third switching means (S1, S2) are operative to connect the second plates of the first and second capacitors (17, 18) in alternation between opposite ones of two predetermined voltage levels, said sample being produced by the action of said second and third switching means changing over in a sense such as to place the diodes (D<sub>1</sub>-D<sub>4</sub>) of the bridge into conduction; and in that the first switching means (S3) consists of either:  
(a) said at least one rectifying diode (D<sub>5</sub>, D<sub>6</sub>) only; or  
(b) said at least one rectifying diode (D<sub>5</sub>, D<sub>6</sub>) and one or

more resistors (19, 20) in series or parallel combination therewith only."

VIII. The Appellant's submission in support of the inventive step can be summarised as follows:

- The prior art sample and hold circuit according to US-A-3 584 920 is not suitable for implementation as an integrated circuit for two reasons.

First, the transmission line for the control signals comprises two electromagnetically coupled inductor windings. In this respect, this prior art is not better than the example given in Figure 1 of the present application which requires a transformer. Secondly, the circuit of what is called in the present Claim 1 "the first switching means" comprises a Zener diode 76 and a relatively large capacitor 75, which are also unsuitable for implementation on an IC chip. These elements of the prior art provide a back bias voltage during the OFF-condition of the bridge. The present invention makes only use of at least one diode (contingently in combination with resistors) as the said "first switching means". This novel embodiment of a sample and hold circuit will function correctly, subject to the limitation that the change in the voltage difference between input and output of the diode bridge between sampling intervals must be sufficiently small to avoid placing the bridge diodes into conduction via the said diodes.

- The absence of inductor windings in the transmission line entails a T-attenuator configuration of the sample and hold circuit during the OFF-condition of the bridge as depicted in the equivalent circuit of Figure 5 of the amended application. This prevents the level change of

the input signal from appearing through the stray capacities of the bridge diodes at the output terminal during the holding interval of the sample and hold circuit. The known inductor windings would be placed in the equivalent circuit of Figure 5 between the capacitors 17 and 18 respectively and earth and thus make any T-attenuation ineffective.

- The outer plates of the capacitors 17 and 18 of the claimed sample and hold circuit are connected in alternation between opposite ones of two predetermined voltage levels. This is different from the control signals in US-A-3 584 920 which have the same value between sampling intervals and opposite values during such intervals.

#### Reasons for the Decision

1. The appeal is admissible.
2. Admissibility of the amendments.

Present Claim 1 constitutes a closer specification of the features of the original Claim 1, in substance based on Figure 3 of the drawings in combination with the description. The feature "implemented as an integrated circuit" was disclosed on the original page 10, lines 10 to 12. The specification of the "first switching means" according to the last five lines of Claim 1 corresponds to the different embodiments depicted in the Figures 3, 6A and 6B (original Figures 3, 7A and 7B) of the application (see also the original Claims 2 and 3).

Temporarily, the Appellant had incorporated in Claim 1 the feature that the control signals applied by the second and

third switching means had a 50% duty ratio. This feature was based on the waveform diagram of the original Figure 5 now deleted from the application. Since the originally claimed scope of protection was not restricted in any form to a particular duty ratio, no objection arises under Article 123(2) in this respect.

The transistorised embodiment of the second and third switching means according to the dependent Claims 2 and 3 is clearly based on the details of Figure 3.

3. Novelty.

The precharacterising part of Claim 1 is based on the disclosure of US-A-3 584 920.

No teaching is derivable from this document, either explicitly or implicitly, to implement this known circuit as an integrated circuit.

The inductor 55, as well as the Zener diode 76, in combination with the capacitor 75, suggest an arrangement composed from discrete circuit elements.

In contrast to the positive and negative going sampling voltage pulses in respect of a neutral voltage level, as depicted in US-A-3 584 920, the application provides only two predetermined voltage levels connected in alternation via the capacitors to the drive terminals of the bridge.

Whereas US-A-3 584 920 makes use of a backbias voltage being stored on the capacitor 75 and limited by the breakdown voltage of the Zener diode 76, the present Claim 1 provides only passive circuit elements in the form of at least one rectifying diode and, contingently, resistors in the driving diagonal of the bridge.

The prior art sample and hold circuits according to the Figures 1 and 2 of the present application differ already in respect of the precharacterising part of Claim 1, since the sampling pulses are not applied via capacitors to the drive terminals of the bridge.

The subject-matter of Claim 1 is, therefore, deemed to be novel.

4. Sufficient disclosure of the invention (Article 83 EPC) and clarity of Claim 1 (Article 84 EPC).

The question was raised during the proceedings whether the sample and hold circuit disclosed in the present application allows a correct function: the signal to be sampled might find a current path during the "OFF"-interval of the bridge from the signal input to the signal output via two diodes of the bridge and the diode(s) of the drive diagonal (communication of 24.11.88, section 6.2).

It is, however, common knowledge of the expert that diodes provide a specific threshold voltage so that the said signal path is only open if the sum of the threshold voltages involved in the signal path is overcome. The Appellant has, in addition, submitted that it is not necessary that the actual signal voltage is less than these threshold voltages because it is only the level change of the signal voltage during a sampling period that is to be blocked in the "OFF" interval (letter of 26.06.89, page 2, last paragraph).

Despite the fact that this explanation was not part of the original disclosure of the present application, the Board is satisfied that the Appellant's comments are

sufficiently based on what a skilled person will take into account when endeavouring to make use of the teaching disclosed and that therefore the present invention must be deemed to be disclosed in a manner sufficiently clear and complete in order to carry it out in a feasible way (Article 83 EPC). The necessary features are specified in Claim 1 so that also the requirements of Article 84 EPC are met.

5. Inventive step.

The Board agrees with the Examining Division's opinion that the wish to implement a sample and hold circuit found in US-A-3 584 920 as an integrated circuit is only in accordance with the general trend to carry out electronic circuits as integrated devices (decision of 08.12.87, page 5, point 4).

The Board is, however, satisfied that, with the amendments made, the solution found according to the present Claim 1 was not obvious to a skilled man.

The prior art solution of a sample and hold circuit suitable for implementation as an integrated circuit, presented in Figure 2 of the present application, is quite different from the Appellant's proposal. Instead of short current pulses generated by the provision of capacitors, as in accordance with the present Claim 1, the circuit of Figure 2 provides a constant current source (4) whose current path is switched by transistors 2 and 3 so that the diode bridge (1) is made conductive or bypassed, respectively, which leads to a higher power consumption. The voltage drop caused by the current flowing through the resistor 8 during the OFF-period of the circuit serves as a backbias voltage. Therefore, this document could not provide the information as to how to implement the sample

and hold circuit of US-A-3 584 920 as an integrated circuit.

In order to arrive at an integrated circuit, when starting from US-A-3 584 920, a first step to be made would be the removal of the inductors 55 from the circuit. It appears that the prior art inductor was regarded necessary in order to ensure a balanced pulse input to the bridge (column 2, lines 56 to 62). The Appellant has realised that his disclosed circuit does not require such a balancing means. With the inductors removed, the second plates of the first and second capacitors would be directly connected to the predetermined voltage levels. The Board is satisfied by the Appellant's conclusive submission that the envisaged cancellation of the adverse effects of the stray capacitances across the bridge diodes is only effective with the inductors being omitted from the bridge control circuit, so that a T-attenuator configuration according to Figure 6 of the application, now Figure 5, is achieved.

A further feature by which the claimed circuit differs from US-A-3 584 920 is the use of control signals applied to the drive inputs at the first and second capacitors, which are provided from only two predetermined voltage levels instead of three voltage levels consisting of a positive and a negative going voltage against a neutral voltage.

The Board is not satisfied that the features summed up so far, by which the claimed circuit differs from the circuits disclosed in said US patent, could establish an inventive step with regard to the contents of that document.

However, the Board regards the omission of the known backbias voltage source, capacitor 75, as a contribution to the envisaged implementation as an integrated circuit that is certainly not obvious from the prior art. The Board has checked on its own motion all the other documents available on the file, but could not find any document which makes only use of the inherent threshold voltages of rectifier diodes as means for blocking the bridge for the input signal between sampling pulses, without a capacitor performing as capacitor 75 according to US-A-3 584 920.

The Board notes that it seems that the first and second capacitors (17, 18) according to the invention are in fact performing the function of providing a backbias voltage in that they are unloaded via the first switching means (D5, D6) only down to the threshold voltage of those switching means. Although a similar function seems to be performed by capacitors 51 and 52 according to the cited US-A-3 584 920 in that they are unloaded via Zenerdiode 76 only down to the threshold voltage of that Zenerdiode, these known circuits use an extra capacitor 75 to generate the backbias voltage.

The merit of the present invention lies in the omission of that extra capacitor as noted hereinbefore.

It also seems to the Board that such an "extra" capacitor cannot be omitted in the absence of first and second capacitors (17, 18 of the invention, 51 and 52 of US-A-3 584 920).

Apart from this, the invention as claimed no longer uses the threshold voltage of a Zenerdiode in the first switching means as according to the US document.

6. Claim 1 meeting the requirements of Articles 52(1) and 84 EPC is, therefore, allowable.
7. Claims 2 and 3 are dependent on Claim 1, specify embodiments in respect of the second and third switching means and are thus also allowable.
8. Since a patent can be granted on the basis of the main request, there is no need to deal with the alternative submission mentioned in section VI of this decision.

#### 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 European patent with the documents specified in section V with the following amendments of clerical errors:

page 3, line 3: replace "lowered" by "lower";

line 6: insert a comma after "3";

line 21: replace "R8" by "8";

page 5a, line 13: insert "in" after "taken";

page 9, line 22: insert "of" after "example".

The Registrar:

The Chairman:

M. Beer

P.K.J. van den Berg