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D E C I S I O N
of 24 January 1995

Case Number: T 0998/93 - 3.4.1

Application Number: 87302707.2

Publication Number: 0240273

IPC: H01L 27/118

Language of the proceedings: EN

Title of invention:
Programmable transistors

Applicant:
Exar Corporation

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

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

Decisions cited:
T 0654/92 (unpublished)

Catchword:
-



Case Number: T 0998/93 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 24 January 1995

Appellant: Exar Corporation
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Decision under appeal: Decision of the Examining Division of the European Patent Office dated 5 July 1993 refusing European patent application No. 87 302 707.2 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G. D. Paterson
Members: H. J. Reich
R. K. Shukla

Summary of Facts and Submissions

- I. European patent application No. 87 302 707.2 (publication No. 0 240 273) was refused by a decision of the Examining Division.
- II. The reason given for the refusal was that the subject-matter of independent Claims 1 and 12 filed on 29 March 1993 did not satisfy the requirements of Articles 52(1) and 56 EPC having regard to document:

D1: Patent Abstracts of Japan, Vol. 8, No. 250 (E-279) [1687], 16 November 1984; & JP-A-59 126650,

and the device disclosed in Figure 1 of the present application representing background art indicated by the applicant in the introductory part of the description. The Examining Division took the following view: In the field of semicustom integrated circuits, compacting and optimising a cell in a semiconductor chip is a known fundamental problem. A skilled person would be able to derive from the cell in Figure 1 of the present application that by placing the first N-doped region in the gap between two second P-doped regions a more compact layout with good proximity between the first N- and the first P-doped region would be achieved. Therefore, he would also locate in the cell disclosed in Figure 9 of document D1 the first N-doped region in such a gap and thereby automatically provide the feature distinguishing the subject-matter of Claim 1 from its closest prior art according to document D1, i.e. "said first N-doped region being located immediately adjacent said first P-doped region at a portion where no part of any second P-doped region is between said first P-doped region and said first N-doped region". Method Claim 12 does not meet the requirements of Articles 52(1) and 56

EPC, since it merely comprises a list of process steps for forming the corresponding features of the device of Claim 1.

III. The Appellant lodged an appeal against this decision. In the Statement of Grounds of Appeal the Appellant maintained the claims underlying the appealed decision as his main request and filed first, second and third auxiliary requests based on further amended independent claims respectively.

IV. In a communication accompanying a summons to oral proceedings, the Board expressed its preliminary view essentially as follows:

- (a) The technically identical subject-matters of Claims 1 of the **main and first auxiliary requests** were apparently obvious, since reducing the surface area of second P-doped regions 26a and 26b in Figure 9 of document D1 in order to bring first N-doped region 25 nearer to first P-doped region 27, produced only foreseeable effects which did not contribute to the disclosed technical aims and thus represented a simple alternative falling within a skilled person's routine considerations.
- (b) A skilled person would know that provision of "a fourth N-doped region" in the device disclosed in Figure 9 of document D1 according to the feature distinguishing Claim 1 of the **second auxiliary request** from this prior art, increases the flexibility of the cell. Depending upon the practical requirements, he would, therefore, decide whether or not a fourth N-doped region should be provided. The provision of a fourth N-doped region was therefore obvious to a skilled person.

(c) Starting from Figure 9 of document D1 it was obvious, having regard to the outlay of the cell disclosed in Figure 7 of document D1 to arrive at the subject-matter of Claim 1 of the **third auxiliary request** by providing "a pair of spaced apart first N-doped regions" and by disposing the first P-doped region "between said first N-doped regions".

V. In reply, the Appellant withdrew his third auxiliary request and filed on 13 January 1995 a **fourth auxiliary request** wherein Claim 1 comprised in addition to the features defining the geometrical layout according to the cancelled third auxiliary request features concerning the layer structure in the interior of the cell. Furthermore, document:

D1': translation of JP-A-59 126650

was filed.

VI. Oral proceedings were held on 24 January 1995, during which the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of a **new main and sole request** filed at the oral proceedings. Claim 1 of this request comprises the subject-matter of Claims 1 and 6 of the former fourth auxiliary request, so that the location of a further first N-doped region was specified and the subject-matter of Claim 1 is narrowed to the geometrical form of the layout of the cell as disclosed in Figure 4 of the present application. Hence, it was requested that a patent be granted on the basis of the following request:

Claims: 1 to 4, filed during the oral proceedings on 24 January 1995,
with **description** to be adapted accordingly.

VII. Claim 1 of the request reads as follows:

"1. A semicustom semiconductor chip having a plurality of cells each cell being alternatively connectable to form either a bipolar PNP or one or more bipolar NPN transistors in an N-layer, characterised by each cell comprising an N-epitaxial layer (104) and being bounded by a P-doped isolation region (102), a plurality of doped regions being formed in said N-epitaxial layer and comprising an approximately centrally located first P-doped region (106), two second P-doped regions (108, 110) symmetrically placed with regard to the first P-doped region (106) and spaced therefrom and from each other whereby said two second P-doped regions (108, 110) partially surround said first P-doped region (106) forming first and second gaps where said first P-doped region (106) is not surrounded, two first N-doped regions (112, 114) symmetrically placed with regard to the first P-doped region (106) and aligned therewith and located in said first and second gaps separating the second P-doped regions (108, 110), two second N-doped regions (116, 118) respectively one within each of the second P-doped regions; a P-doped substrate (126) being provided beneath said epitaxial layer (104), and an N+ buried layer (120) extending into said P-doped substrate (126) in the area beneath said first and second N-doped regions and first and second P-doped regions, and a respective N+ diffused area (122) extending from each said first N-doped region (112, 114) to said buried layer (120)."

Claims 2 to 4 are dependent on the above Claim 1.

VIII. In support of this request the Appellant argued essentially as follows:

(a) The object of the present invention is to produce a standardised cell for a cell array which makes maximum use of the space of the silicon wafer for achieving an optimum cell flexibility and simplifies the routing of metallic contacts (see the description page 4, paragraph 3) for preventing interferences - which produce undesirable capacity and resistivity effects - without adversely affecting electron flow characteristics, and to provide a cell wherein dually formable transistors have identical characteristics.

(b) These objects are achieved by the constructional concept of a partial-enclosure and non-intrusion outlay concept as claimed in Claim 1.

(c) The practical importance of the claimed chip follows from document:

D3: "Electronic Design", 1 November 1986, page 3 and 1 May 1986, pages 171 to 174, 176 and 178.

In particular Figure 2 on page 173 of document D3 employs the symmetric and open structure of the embodiment of Figure 4 of the present application and demonstrates the advantageous routing of metal contacts into all directions.

(d) Document D1' describes cell outlays which do not disclose the partial enclosure of the first P-doped region by the second P-doped region, and that the second P-doped region does not intrude between the first P-doped region and the first N-doped region,

as in the present invention. Moreover, these conventional outlays have not been designed for achieving an optimum flexibility. The outlay disclosed in Figure 9 of document D1' does not allow to realize two NPN transistors, since only **one** first N-doped region is provided. Moreover, Figure 9 of document D1' hints only at the use of two second P-doped regions as dual collectors of one and the same PNP-transistors. Since the two first N-doped regions 25 disclosed in Figure 7 of document D1' are not part of a transistor but are used as contacts to a crossunder of one transistor, a skilled person sees no technical reason to make use of the teaching of Figure 7 to provide the cell of Figure 9 with a further first N-doped region. A combination of the teachings of Figures 7 and 9 of document D1' to arrive at the claimed subject-matter would clearly be the result of an unallowable ex post facto analysis.

- IX. At the conclusion of the oral proceedings, the decision was announced that the decision of the Examining Division is set aside and that the case is remitted to the first instance with the order to grant a patent on the basis of the request filed during oral proceedings on 24 January 1995, with description to be adapted accordingly.

Reasons for the Decision

1. The subject-matter of Claims 1 to 4 of the above request is disclosed in original Figures 4 and 4a and the corresponding original description on page 8, paragraph 2 to page 9, paragraph 1. There is, therefore, no objection to such amended claims under Article 123(2) EPC.

2. Document D1' discloses in the wording of Claim 1:

"A semicustom semiconductor chip having a plurality of cells (see document D1', 29a, b, c in Fig. 6; page 4, paragraph 4), each cell being alternatively connectable to form either a bipolar PNP or one ... bipolar NPN transistor (page 5, paragraph 1)....., comprising an approximately centrally located first P-doped region (27 in Fig. 9), two second P-doped regions (26a, 26b) symmetrically placed with regard to the first P-doped region and spaced therefrom and from each other, whereby said two second P-doped regions (26a, 26b) partially surround said first P-doped region (27) forming first and second gaps where said first P-doped region is not surrounded,".... and "two second N-doped regions (28a, 28b) respectively one within each of the second P-doped regions".

The conventional cell disclosed in Figure 9 of document D1' has only **one** first N-doped region (25) which is located **outside** the gap separating the second P-doped regions (26a, 26b). All other cells disclosed in the documents cited in the European Search Report, do not come closer to the subject-matter claimed in Claim 1.

Thus, the subject-matter of Claim 1 is considered new in the sense of Article 54 EPC.

3. *Inventive Step*

3.1 Starting from the closest prior art cell according to Figure 9 of document D1', the objective problem underlying the present invention is to provide a semicustom semiconductor chip, the cells of which have an increased flexibility in forming PNP or NPN transistors and allow a simple routing of metallic contacts.

- 3.2 This problem is solved in that each cell furthermore comprises:

"two first N-doped regions symmetrically placed with regard to the first P-doped region and aligned therewith and located in said first and second gaps separating the second P-doped regions."

The further features claimed in Claim 1 apparently do not contribute to the solution of the objective problem and are moreover conventional; see for instance document EP-A-O 056 571 (D2) mentioned by the Examining Division, with regard to a cell "comprising an N-epitaxial layer and being bounded by a P-doped isolation region and a P-doped substrate being provided beneath said epitaxial layer", and document D1', Figure 7B and page 5, paragraph 5 with regard to the "N⁺ buried layer... and a N⁺ diffused area extending from each said (two) first N-doped regions to said buried layer."

- 3.3 Document D1' is totally silent about the problem of an efficient routing of metal contacts. Hence, a skilled person would not see in any one of the geometrical layout structures disclosed in document D1' a means for simplifying routing.

- 3.4 The fact that in Figure 7 of document D1' the two first N-doped regions 25 are contacting a crossunder element 31, in the Board's view does not prevent a skilled person from recognising in the layout structure of Figure 7 a symmetrical placing of two first N-doped regions with regard to first P-doped region 27. Therefore, a mere **provision** of a further first N-doped region in the layout of Figure 9 of document D1' and thus of "two first N-doped regions symmetrically placed with regard to the first P-doped region" in the Board's view would be obvious in view of Figure 7 of document

D1', since it would increase in a foreseeable way the flexibility of the use of the cell and would not necessarily contribute to achieve an improvement in routing. (For this reason, the subject-matter of Claim 1 of the former fourth auxiliary request was regarded as the obvious result of an analogous use of a per se known layout structure.)

3.5 However, in the Board's view, neither document D1' nor any other document cited in the European Search Report suggests to a skilled person to **locate** a first N-doped region **in the gap** separating the second P-doped regions in order to simplify routing. A skilled person who considers the use of a second "first N-doped region" symmetrically to the present one 25 in Figure 9 of Document D1 would clearly maintain the conventional layout and provide a first rectangular first N-doped region extending - as the already existing one - parallel to the outer lateral sides of the two opposite U-shaped second P-doped regions and thus would provide the N-doped region completely **outside** the gap between the second P-doped regions 26a and 26b. Such an addition would moreover lead to a more complicated routing.

3.6 The background art disclosed in Figures 1 and 2 of the present application in the Board's view does not suggest to a skilled person to provide two first N-doped regions "symmetrically placed with regard to the first P-doped region and aligned therewith". This restrictive feature was not comprised in the subject-matter of Claim 1 as rejected by the first instance.

3.7 The remaining documents cited in the European Search Report are less relevant.

- 3.8 For the reasons set out above in paragraphs 3.1 to 3.7, the subject-matter of Claim 1 is considered to involve an inventive step in the sense of Article 56 EPC.
4. Thus, Claim 1 satisfies Article 52(1) EPC. Dependent Claims 2 to 4 concern particular embodiments of the device claimed in Claim 1 and are, therefore, allowable.
5. The case is remitted to the Examining Division in order that the description should be adapted to the above set of claims.

Order

For these reasons it is decided that:

1. The decision of the Examining Division is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of the request filed during oral proceedings on 24 January 1995, with description to be adapted accordingly.

The Registrar:

The Chairman:

M. Beer

G. D. Paterson