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**Datasheet for the decision  
of 9 September 2021**

**Case Number:** T 0347/18 - 3.4.03

**Application Number:** 09708988.2

**Publication Number:** 2253017

**IPC:** H01L27/146

**Language of the proceedings:** EN

**Title of invention:**

CIRCUIT AND PHOTO SENSOR OVERLAP FOR BACKSIDE ILLUMINATION  
IMAGE SENSOR

**Applicant:**

OmniVision Technologies, Inc.

**Headword:**

**Relevant legal provisions:**

EPC Art. 123(2), 84, 54(1), 56, 111(1)

**Keyword:**

Claims - clarity after amendment (yes) - added subject-matter  
after amendment (no)  
Novelty (yes)  
Inventive step (yes)

**Decisions cited:**

**Catchword:**



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Case Number: T 0347/18 - 3.4.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.4.03**  
**of 9 September 2021**

**Appellant:** OmniVision Technologies, Inc.  
(Applicant) 4275 Burton Drive  
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**Representative:** Mewburn Ellis LLP  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 28 September  
2017 refusing European patent application No.  
09708988.2 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** T. Häusser  
**Members:** M. Papastefanou  
G. Decker

## **Summary of Facts and Submissions**

- I. The appeal is against the decision of the examining division refusing European patent application No. 09 708 988.2 (published as WO 2009/100039 A1) on the grounds that neither the Main Request nor the Auxiliary Requests 1 to 3 before it fulfilled the requirements of Articles 123(2) and 84 EPC. In addition, the examining division, exercising its discretion pursuant to Rule 137(3) EPC, did not admit Auxiliary Requests 4 to 7 into the procedure.
- II. The appellant's (applicant's) final requests were that the decision under appeal be set aside and that a patent be granted on the basis of the Main Request or one of the First to Third Auxiliary Requests, all filed with the appellant's letter of 1 February 2021. In the alternative, the appellant requested the remittal of the case to the examining division for further prosecution (see points 1.1 and 10 of the statement of the grounds of appeal, as well as point 1 of the appellant's letter of 1 February 2021).
- III. The Main Request consists of the following application documents:
- description:
    - pages 1, 2a, filed with letter of 11 September 2017;
    - page 2, filed with letter of 8 September 2021;
    - pages 3 to 9 as published;
  - claims 1 to 10 according to the "NEW MAIN REQUEST" filed with letter of 1 February 2021;
  - drawings: sheets 1/6 to 6/6 as published.

IV. After the board issued summons to oral proceedings and its preliminary opinion, according to which the Main Request then on file did not meet the requirements of Articles 123(2) and 84 EPC, the appellant filed the above-mentioned requests with its letter of 1 February 2021, addressing the board's objections.

Thereafter, the board cancelled the oral proceedings and issues its decision in writing.

V. Reference is made to the following documents, cited during the examination procedure:

D1: US 2007/0091190 A1,

D2: US 2006/0023109 A1.

VI. Claim 1 of the Main Request has the following wording:

*A pixel array (205) including a backside illuminated ("BSI") imaging sensor pixel, the BSI imaging sensor pixel comprising:*

*a photodiode region (420) disposed within a semiconductor die for accumulating an image charge in response to light incident upon a backside of the BSI imaging sensor pixel, wherein the photodiode region (420) is an N or P type doped region within a substrate (405) having the opposite conductivity type; and pixel circuitry (430, 431) including transistor pixel circuitry disposed within the semiconductor die between a frontside of the semiconductor die and the photodiode region (420), wherein at least a portion of the pixel circuitry (430, 431) overlaps the photodiode region (420);*

*wherein a portion (431) of the pixel circuitry (430, 431) is shared with an adjacent pixel within the pixel array as shared pixel circuitry, wherein a first*

*portion of the shared pixel circuitry overlaps the photodiode the photodiode region (420) of the BSI imaging sensor pixel (400) and a second portion of the shared pixel circuitry overlaps a photodiode region of the adjacent pixel;*  
*wherein the shared pixel circuitry includes any one of: gain circuitry, ADC circuitry (305), gamma control circuitry, and exposure control circuitry.*

VII. The wording of the claims of the auxiliary requests is not relevant for the decision.

### **Reasons for the Decision**

1. The appeal is admissible.
2. The invention

The claimed invention relates to a pixel array of back side illuminated (BSI) sensor pixels and a corresponding imaging system.

- 2.1 A photo sensor pixel consists normally of a photodiode region, which is the region receiving the light and transforming it into electric charge, and a pixel circuitry region, which includes the necessary electronic circuits for transforming the electric charge of the photodiode region into a usable electric signal.

In conventional photo sensor pixels, the two regions are located next to each other. In an array of several pixels, these two regions are formed next to each other within a substrate (see for example Figure 1 of the application as published).

2.2 This disposition requires a relatively large space in the surface region of the substrate, leading to pixel arrays of large size.

The claimed invention seeks to provide a structure of the pixels of the array that saves space.

2.3 According to the claimed invention, the pixel circuitry region (430) is placed within the substrate in such a way as to overlap (at least) partially the photodiode region (420) of the pixel (see Figure 4). This measure allows for the photodiode region to occupy a larger area with respect to the surface of the substrate or correspondingly for the overall area of the pixel to be smaller.

2.4 In a array of such BSI sensor pixels, a portion of the pixel circuitry can be shared between adjacent pixels. In such a case, the shared pixel circuitry overlaps the corresponding photodiode regions of the adjacent pixels. This disposition saves even more space in the pixel array.

3. Main Request

3.1 Added subject-matter (Article 123(2) EPC)

3.1.1 According to the examining division's opinion, claim 1 of the Main Request before it comprised subject-matter going beyond the originally filed application. In particular, the examining division held that the originally filed application did not support the combination of the features that a portion of the pixel circuitry was shared with an adjacent pixel, that a first portion of the shared pixel circuitry overlapped the photodiode region of the BSI imaging sensor pixel

and a second portion of the shared pixel circuitry overlapped a photodiode region of the adjacent pixel and that the shared pixel circuitry included at least one of gain circuitry, ADC circuitry, gamma control circuitry, and exposure control circuitry (see point 2.1 of the reasons of the impugned decision).

- 3.1.2 In the board's view, the pixel circuitry region (430) consists of two parts/portions. The first portion comprises the basic or transistor pixel circuitry (e.g. 4T pixel circuitry). The second portion of the pixel circuitry comprises a region (431) which includes "other circuitry", such as gain circuitry, ADC, gamma control circuitry or exposure control circuitry (see paragraph [0025], the sentence bridging pages 5 and 6 of the published application).

In the board's understanding, it is this second portion (431) including the "other circuitry", which may overlap two or more photodiode regions (of adjacent pixels) and can be shared by one or more pixels (see paragraph [0027]).

- 3.1.3 According to the board's opinion, the skilled person reading the description as originally filed, in particular paragraphs [0025] and [0027], would directly and unambiguously derive that the portion of the pixel circuitry of the defined BSI imaging sensor pixel which is shared with an adjacent pixel is the one that overlaps the photodiode regions of the two adjacent pixels and includes any one of as gain circuitry, ADC, gamma control circuitry or exposure control circuitry, as defined in claim 1.

The skilled person would not contemplate any interpretations whereby the pixel circuitry is shared



by two specific adjacent pixels but overlaps the photodiode regions of different pixels, as the examining division argued (see point 2.1.2 of the reasons of the decision under appeal). The claimed definition does not leave room for such an interpretation because it defines only one shared pixel circuitry ("portion (431) of the pixel circuitry (430, 431)") that is shared with an adjacent pixel and it is the same shared pixel circuitry that overlaps the two photodiode regions (namely a "first portion" and a "second portion" of that shared pixel circuitry) and includes any one of gain circuitry, ADC, gamma control circuitry or exposure control circuitry (the board notes in particular the repeated use of the definite article "the" in "the shared pixel circuitry" of claim 1).

- 3.1.4 Finally, the board notes that the claim does not define that the specific elements (gain circuitry, ADC, gamma control circuitry or exposure control circuitry) are shared between the two adjacent pixels as the examining division argued (see point 2.1.1 of the reasons of the impugned decision). It rather defines that the shared circuitry includes any one of those elements, which corresponds to what is disclosed in the original description and claims.
- 3.1.5 The subject-matter of claim 1 is therefore directly and unambiguously derivable from the application as filed.
- 3.1.6 The deletion of the method claims 12 to 15 from the previous Main Request renders the examining division's (see point 2.4 of the reasons of the impugned decision) and the board's (see communication pursuant to Article 15(1) RPBA 2020, points 4.4.2 to 4.4.5) objections of added subject-matter against previous method claim 12

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3.1.7 The board is thus satisfied that the Main Request fulfils the requirements of Article 123(2) EPC.

3.2 Clarity (Article 84 EPC)

3.2.1 In point 3 of the reasons of the impugned decision, the examining division held that the expression "*a backside illuminated imaging sensor pixel within a pixel array*" in claim 1 of the Main Request then on file was not clear.

In claim 1 of the current Main Request this expression has been amended to read "*a pixel array (205) including a backside illuminated ('BSI') imaging sensor pixel*".

In the board's view this amendment overcomes the examining division's objection. The board also notes that the examining division was of the same opinion (see point 13.1 of the reasons of the impugned decision, which relates to Auxiliary Request 4 then on file).

3.2.2 With the amendments carried out in claims 2, 3, and 4, the objections for lack of clarity raised by the board in its preliminary opinion (see communication pursuant to Article 15(1) RPBA 2020, points 4.5.1 and 4.5.2) are considered to have been overcome. It is to be noted that claim 5 was mistakenly included in that preliminary objection by the board.

3.2.3 Finally, the board does not share the examining division's opinion that the terms "gain circuitry", "gamma control circuitry" and "exposure control circuitry" are vague and unclear (see point 3 of the

"Obiter dicta" of the impugned decision). In the board's view these terms are established terms in the art and the skilled person would not have any doubts as to their meaning.

3.2.4 The board is thus satisfied that the Main Request meets the requirements of Article 84 EPC.

3.3 Remittal to the examining division for further prosecution

The board notes that the Main Request overcomes the reasons for the refusal according to the decision under appeal. The board notes also that the disclosures of documents D1 and D2 were discussed during the first instance examination procedure, even if the impugned decision does not contain any opinion of the examining division regarding novelty and inventive step of the Main Request. The appellant also provided relevant arguments in its letter of 1 February 2021. The board, thus, considers it appropriate to assess novelty and inventive step of the claimed subject-matter with respect to D1 and D2. The discussion on novelty and inventive step and the introduction of two new prior art documents by the examining division after the oral proceedings (see Obiter dicta, points, 1, 2 and 4) refer to other previous requests (Auxiliary Requests 6, 7 and 5 then on file, respectively) and not to the previous Main Request.

Under these considerations and in view also of Article 11 RPBA 2020 the board decides to exercise the power conferred by Article 111(1) EPC and to proceed to decide the case without remitting it to the examining division.

### 3.4 Novelty (Article 54(1) EPC)

#### 3.4.1 With respect to D1:

D1 describes, like the application, a pixel array with back-illuminated sensor pixels (see for example paragraphs [0042] to [0047] and Figure 2) but the described pixel array does not comprise a pixel comprising a pixel circuitry, a portion of which is shared with an adjacent pixel, and a first portion of the shared pixel circuitry overlaps the photodiode region of the pixel and a second portion of the shared pixel circuitry overlaps the photodiode portion of the adjacent pixel, the shared pixel circuitry including any one of: gain circuitry, ADC circuitry, gamma control circuitry and exposure control circuitry.

In the pixel array of D1, adjacent pixels may share a portion of pixel circuitry, like the read-out circuit 50 (see paragraph [0048] or [0057] and Figure 3), but, as it is explicitly stated therein, the shared circuitry is placed in the area between the pixels (photodiodes) (see for example paragraphs [0060], [0072] and Figure 4). It is the wiring M1 that overlaps the photodiodes (photodiode regions) (see paragraph [0073]). In the board's view, the wiring cannot be considered to be a part of the shared circuitry, since a wiring connects two parts/components and is per definition "shared" between them, in the sense that it connects one to the other. In any case, the wiring M1 of D1 does not include any one of gain circuitry, ADC circuitry, gamma control circuitry and exposure control circuitry, as claim 1 defines.

In the board's view, therefore, the subject-matter of claim 1 of the Main Request is new over D1.

3.4.2 With respect to D2:

D2 describes a similar pixel array with BSI sensor pixels (see Figures 3A, 5 and paragraph [0089]). Adjacent pixels may share a portion of pixel circuitry (see Figure 7 and paragraph [0098]) but there is no indication in D2 about where this shared circuitry is located with respect to the photodiode regions ("PD", "PD1", ..., "PD4" in D2) of the adjacent pixels.

The board does not share the examining division's opinion that in Figure 7 the elements 611, 612, 613 and 614 are shared between the pixels (see first paragraph on page 15 of the impugned decision). These components are assigned to discrete, adjacent pixels. In any case, there is no indication in D2 about where these components are placed with respect to the photodiode regions of the pixels.

The board's conclusion is thus that the subject-matter of claim 1 of the Main Request is new over D2, as well.

3.5 Inventive Step (Article 56 EPC)

3.5.1 Taking any one of documents D1 or D2 as closest prior art, the pixel array of claim 1 of the Main Request differs essentially from the known devices in that:

- *a portion (431) of the pixel circuitry (430, 431) is shared with an adjacent pixel within the pixel array as shared pixel circuitry, wherein a first portion of the shared pixel circuitry overlaps the photodiode region (420) of the BSI imaging sensor pixel (400) and a second portion of the shared*

*pixel circuitry overlaps a photodiode region of the adjacent pixel; and*

- *the shared pixel circuitry includes any one of: gain circuitry, ADC circuitry (305), gamma control circuitry, and exposure control circuitry.*

### 3.5.2 Technical effect and technical problem

By having adjacent pixels share a portion of the pixel circuitry, the overall size of the pixel circuitry in the pixel array is diminished despite the implementation of relatively large circuitry such as gain circuitry, ADC circuitry, gamma control circuitry, or exposure control circuitry. Hence there is less space needed on the substrate, which thus may be of reduced size. Moreover, the overlapping of the photodiode regions of the pixels by the pixel circuitry implies that the pixel circuitry is located behind the photodiode regions and not next to them. This decreases even further the need for space on the substrate to place the pixel circuitry and leaves more space for the photodiode regions. The photodiode regions of the pixels thus cover a larger proportion of the overall surface of the substrate (increased fill factor). An increased fill factor increases the sensitivity of the sensor.

The overall technical effects of those differentiating features can therefore be identified as an increased sensitivity and a reduced size of the sensor.

The skilled person starting from D1 or D2 is thus faced with the technical problem of how to increase the sensitivity of the sensor, while, at the same time, saving space (reducing its size).

### 3.5.3 Obviousness

As explained above (see points 3.4.1 and 3.4.2) both D1 and D2 disclose that adjacent pixels may share a portion of the pixel circuitry. In D1, however, it is explicitly stated that the shared pixel circuitry is located between the pixels (photodiodes) and there is no indication of any overlapping of the photodiodes by the shared pixel circuitry (see for example paragraphs [0060], [0072] and Figure 4). In D2 there is no information about where the shared pixel circuitry may be placed. As a sole example, Figure 11 shows an A/D circuit ("ADC" in the terminology of the claims) placed in a signal processing chip 33 which is separate from the pixel/photodiode chip 32 (see also paragraph [110]).

In the board's opinion there is nothing in D1 or D2 that would incite the skilled person to solve, in an obvious manner, the identified technical problem in the way of the claimed invention.

3.5.4 The board's opinion is, hence, that the subject-matter of claim 1 of the Main Request involves an inventive step within the meaning of Article 56 EPC.

## 4. Conclusion

The board concludes, therefore, that the application and the invention to which it relates meet the requirements of the EPC and a European patent is to be granted according to Article 97(1) EPC.

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the examining division with the order to grant a patent in the following version:
  - description:
    - pages 1, 2a, filed with letter of 11 September 2017;
    - page 2, filed with letter of 8 September 2021;
    - pages 3 to 9 as published;
  - claims 1 to 10 according to the "NEW MAIN REQUEST" filed with letter of 1 February 2021;
  - drawings: sheets 1/6 to 6/6 as published.

The Registrar:

The Chairman:



S. Sánchez Chiquero

T. Häusser

Decision electronically authenticated