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**Datasheet for the decision  
of 14 October 2020**

**Case Number:** T 1877/14 - 3.5.04

**Application Number:** 06254480.4

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**IPC:** H04N5/32, H04N5/217,  
H01L27/146, H04N3/15

**Language of the proceedings:** EN

**Title of invention:**

Image sensor

**Applicant:**

Teledyne UK Limited

**Headword:**

**Relevant legal provisions:**

EPC 1973 Art. 56, 84

**Keyword:**

Claims - clarity - auxiliary request (yes)  
Inventive step - auxiliary request (yes)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
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Case Number: T 1877/14 - 3.5.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.04**  
**of 14 October 2020**

**Appellant:** Teledyne UK Limited  
(Applicant) 106 Waterhouse Lane,  
Chelmsford, Essex CM1 2QU (GB)

**Representative:** HGF  
1 City Walk  
Leeds LS11 9DX (GB)

**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 11 April 2014  
refusing European patent application No.  
06254480.4 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** B. Müller  
**Members:** A. Seeger  
B. Le Guen

## **Summary of Facts and Submissions**

- I. The appeal is against the decision of the examining division to refuse European patent application No. 06 254 480.4, published as EP 1 763 230 A1.
- II. The documents cited in the decision under appeal included the following:  
D1: EP 0 441 521 A1  
D4: US 2003/0111674 A1  
E1: DE 196 28 675 A1
- III. The application was refused on the grounds that independent claims 1 and 20 of the then sole request did not meet the requirements of Articles 84, 54(1) and (2), and 56 EPC.
- IV. The applicant ("appellant") filed notice of appeal. With the statement of grounds of appeal, the appellant maintained the sole request on which the decision was based as the main request and filed claims according to a first auxiliary request and a second auxiliary request. Alternatively, the appellant requested that oral proceedings be held before the board.
- V. The board issued a summons to oral proceedings. In a communication under Article 15(1) RPBA 2007 (Rules of Procedure of the Boards of Appeal in the version of 2007, OJ EPO 2007, 536) annexed to the summons, the board expressed its provisional opinion that claim 1 of all requests did not meet the requirements of Article 84 EPC 1973 and that its subject-matter did not involve an inventive step within the meaning of Article 56 EPC 1973.

- VI. By letter dated 23 March 2020, the appellant filed amended claims according to a third auxiliary request. The appellant provided arguments as to why the amended claims met the requirements of Article 123(2) EPC, Article 84 EPC and Article 52(1) EPC in combination with Article 56 EPC. The appellant maintained its request for oral proceedings in the event that none of the requests was considered allowable by the board.
- VII. In response, the board cancelled the oral proceedings and issued a communication pursuant to Rule 100(2) EPC indicating that it considered the claims of the third auxiliary request to be clear (Article 84 EPC 1973) and their subject-matter to involve an inventive step (Article 56 EPC 1973). However, the board objected that the description did not support these claims, as required by Article 84 EPC 1973, and did not acknowledge the prior-art documents E1 and D4, contrary to the requirement of Rule 27(1)(b) EPC 1973.
- VIII. By letter dated 25 June 2020, the appellant filed amended description pages 4, 4A, 5 to 8 and 8A to replace pages 4, 4A and 5 to 8 then on file.
- IX. During a consultation by telephone with the appellant on 21 July 2020, the rapporteur objected to several clerical errors in the description pages filed by letter dated 25 June 2020.
- X. By letter dated 7 August 2020, the appellant filed amended description pages 4, 4A, 5 and 6 to replace pages 4, 4A, 5 and 6 then on file.
- XI. Claim 1 of the main request reads as follows:

"A method of operating an image sensor including the steps of:

- a. providing an array of pixel structures (10, 20, 50) each having photodetector means (11, 21, 511) and dump drain means (12, 22, 52) controlled by dump gate means (121, 221, 521);
- b. exposing the photodetector means to radiation (111) to generate charge in the photodetector means; and
- c. alternately dumping charge to the dump drain means from the photodetector means and reading charge from the photodetector means in a duty cycle, within a single exposure or frame, at a frequency at least equal to a reciprocal of a decay time of the photodetector means."

XII. Claim 1 of the first auxiliary request reads as follows:

"A method of operating an image sensor including the steps of:

- a. providing an array of pixel structures (10, 20, 50) each having photodetector means (11, 21, 511) and dump drain means (12, 22, 52) controlled by dump gate means (121, 221, 521);
- b. exposing the photodetector means to radiation (111) to generate charge in the photodetector means; and
- c. alternately dumping charge to the dump drain means from the photodetector means and reading charge from the photodetector means in a duty cycle, multiple times within a single exposure or frame, at a frequency

greater than a reciprocal of a decay time of the photodetector means."

XIII. Claim 1 of the second auxiliary request reads as follows:

"A method of operating an image sensor including the steps of:

- a. providing an array of pixel structures (10, 20, 50) each having photodetector means (11, 21, 511) having a decay time period over which the output of the photodetector means decays and dump drain means (12, 22, 52) controlled by dump gate means (121, 221, 521);
- b. exposing the photodetector means to radiation (111) to generate charge in the photodetector means having a decay time period over which the output of the photodetector means decays; and
- c. alternately dumping charge to the dump drain means from the photodetector means and reading charge from the photodetector means in a duty cycle, multiple times within a single exposure or frame, at a frequency greater than a reciprocal of the decay time of the photodetector means."

XIV. Claim 1 of the third auxiliary request reads as follows:

"A method of operating an image sensor including the steps of:

- a. providing an array of pixel structures (10, 20, 50) each having photodetector means (11, 21, 511) and dump

drain means (12, 22, 52) controlled by dump gate means (121, 221, 521);

b. exposing the photodetector means to radiation (111) to generate charge in the photodetector means over a decay time period following exposure of the photodetector means to the radiation; and

c. alternately dumping charge generated in the photodetector means to the dump drain means from the photodetector means or reading charge generated in the photodetector means from the photodetector means in a duty cycle, multiple times within a single exposure or frame, at a frequency greater than a reciprocal of the decay time period of the photodetector means, such that charge generated in the photodetector means is either dumped to the dump drain or read."

Claim 20 of the third auxiliary request reads as follows:

"An image sensor comprising an array of pixel structures (10, 20, 50) each having photodetector means (11, 21, 511), wherein charge is generated in the photodetector means over a decay time period following exposure to radiation (111); dump drain means (12, 22, 52) controlled by dump gate means (121, 221, 521); and control circuitry arranged alternately, in a duty cycle, multiple times within a single exposure or frame, at a frequency greater than a reciprocal of the decay time of the photodetector means, to dump charge generated in the photodetector means to the dump drain means from the photodetector means or to transfer charge generated in the photodetector means from the photodetector means for reading, such that charge



generated in the photodetector means is either dumped to the dump drain or read."

Claims 2 to 19 and claims 21 to 40 of the third auxiliary request are dependent on claims 1 and 20, respectively.

XV. The appellant's arguments, where relevant to the present decision, may be summarised as follows:

(a) The appellant argued with respect to claim 1 of the first auxiliary request (see statement of grounds of appeal, page 3, second paragraph) that document E1 did not disclose that:

- charge was alternately dumped or read out from the photodetector means in a duty cycle multiple times within a single exposure
- the photodetector means had a decay time

(b) The appellant did not submit counter-arguments to the objections raised by the board in the communication annexed to the summons but argued that these objections were resolved by the amendments to the claims according to the third auxiliary request (see letter dated 23 March 2020, section "Third Auxiliary Request", headings "Clarity" and "Inventive Step").

### **Reasons for the Decision**

1. The appeal is admissible.
2. The invention

The application relates to an image sensor comprising an array of pixel structures each having photodetector means and to a corresponding method of operating such an image sensor.

In such a sensor, radiation quants are converted into an electrical signal. Since the radiation quants may have high energy, for example, in the case of x-rays or gamma-rays, a lot of electrons can be generated and a pixel can easily be driven into saturation. This reduces the achievable signal-to-noise ratio, which is limited by photon shot-noise. For a pixel not to be driven into saturation, it needs to have a larger surface. However, enlarging the surface of the pixels reduces spatial resolution (see description page 1, lines 7 to 14).

The application proposes to connect a photodetector in a pixel to either a dump gate or a sense gate. Hence, only a part of the generated charge is sensed and accumulated. By adjusting the ratio between dump and sense portions, the sensitivity of the photodetector can be regulated and pixel saturation avoided (see description, page 9, lines 13 to 20).

In addition, there are multiple read/dump cycles during a single exposure. The frequency of these read/dump cycles is set such that it is greater than a reciprocal of the decay time period during which charge is generated following exposure of the photodetector to radiation. This has the technical effect that a signal is received from every detected radiation quant and signals from all incident radiation quants are evenly reduced (see description page 11, lines 7 to 11).

3. Main request - clarity and support by the description (Article 84 EPC 1973)

3.1 According to Article 84 EPC 1973, the *"claims shall define the matter for which protection is sought. They shall be clear and concise and be supported by the description"*.

Moreover, according to the established case law of the boards, Article 84 EPC 1973 has to be interpreted as meaning not only that a claim must be comprehensible from a technical point of view, but also that it must define the object of the invention clearly, that is to say indicate all the essential features thereof. An independent claim should explicitly specify all essential features needed to define the invention, i.e. all the features necessary for solving the technical problem with which the application is concerned (see Case Law of the Boards of Appeal of the European Patent Office, 9th edition 2019, ("Case Law"), II.A.3.2).

3.2 Claim 1 specifies a "photodetector means" and furthermore a "decay time of the photodetector means".

3.3 The board finds that the feature in claim 1 reading "decay time of the photodetector means" can have different meanings.

It may mean a time after which an incident radiation quant has led to the generation of all or almost all resulting charge in the photodetector.

It may also mean a time after which charge generated in the photodetector has vanished.

3.4 If the feature "decay time of the photodetector means" is given the latter meaning, the "photodetector means" as specified in claim 1 may have no noticeable lag between an incident radiation quant and a generated charge.

3.5 However, the board holds that a noticeable lag between an incident radiation quant and a generated charge is an essential feature of the invention.

Otherwise, if charge is generated instantaneously and this charge is dumped, further read/dump cycles make no technical sense.

This is in line with the description on page 11, lines 5 to 6: "*In order for the duty cycle technique to be effective, the imager must have some lag*" (emphasis added by the board). Similar statements are contained in other passages of the description (page 14, lines 19 to 24, page 16, lines 4 to 8, and page 16, line 33, to page 17, line 2).

3.6 Since claim 1 does not include the feature of a photodetector means having a noticeable lag between an incident radiation quant and a generated charge, which is an essential feature of the invention, the board comes to the conclusion that claim 1 does not meet the requirements of Article 84 EPC 1973.

3.7 Claim 1 also specifies: "*alternately dumping charge .. and reading charge .. in a duty cycle, within a single exposure or frame, at a frequency at least equal to a reciprocal of a decay time of the photodetector means*".

3.8 The board holds that the term "frequency" in claim 1 implies a repetition. However, this frequency can have

values below one, e.g. 1/2 or 2/3, which would mean that there may be less than one cycle per single exposure or frame.

The board finds that this is not supported by the description on page 11, lines 17 to 23: "*there are always many cycles 31 per exposure period*" (emphasis added by the board).

3.9 Hence, the board comes to the conclusion that - also for this second reason - claim 1 of the main request does not meet the requirements of Article 84 EPC 1973.

4. Main request - inventive step (Article 56 EPC 1973)

4.1 According to Article 56 EPC 1973, an invention is to be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art.

4.2 It is common ground that document E1 may be considered the closest prior art for the subject-matter of claim 1 in the context of the established "problem and solution approach" for the assessment of whether an invention involves an inventive step (Case Law, I.D.2).

4.3 Document E1 discloses an image sensor comprising an array of pixel structures each having photodetector means in which charge is generated when exposed to radiation (see E1, column 1, lines 12 to 18). The restricted electron capacity per pixel limits a signal-to-noise ratio of the image sensor (see E1, column 1, lines 19 to 50). To improve the signal-to-noise ratio, document E1 discloses reading out a pixel signal during exposure, storing it and resetting the charge

accumulated in the pixel (see E1, column 1, lines 57 to 67). This process can occur multiple times during an exposure and finally all stored pixel signal contributions can be summed up (see E1, column 4, line 63 to column 5, line 31).

4.4 The appellant argued with respect to claim 1 (the board relies on the arguments submitted for the first auxiliary request - see point XV above - which the board finds to also apply to the main request) that document E1 did not disclose that:

- (a) charge was alternately dumped or read out from the photodetector means in a duty cycle within a single exposure
- (b) the photodetector means had a decay time

4.5 Concerning alleged difference (a), the board finds that this feature is disclosed in document E1, see column 2, lines 57 to 62: "*wenigstens eine weitere Vorabtastung mit Auslesen von Pixeln und Rücksetzen der Pixelladungsspeicher*"; column 3, lines 54 to 56: "*mehrere weitere Vorabtastungen in im wesentlichen konstanten Zeitabständen erfolgen*"; and column 4, line 65, to column 5, line 14: "*wird zu einem Zeitpunkt  $t = 2$  eine zweite Vorabtastung von Pixeln [...] durchgeführt. Auch hierbei werden, wie bereits im Rahmen der ersten Vorabtastung, die pixeleigenen Ladungsspeicher wieder zurückgesetzt, damit weitere Strahlung aufnehmbar und umsetzbar ist. [...] Von diesen Vorabtastungen können beliebig viele durchgeführt werden.*"

Document E1 explicitly discloses at least two charge reading and charge reset operations (see column 4, line 68, to column 5, line 2: "*Auch hierbei werden, wie bereits im Rahmen der ersten Vorabtastung, die*

*pixeleigenen Ladungsspeicher wieder zurückgesetzt" and column 2, lines 3 to 7: "wird zunächst eine Vorabtastung [...] kurz nach deren Beginn durchgeführt [...] Hierbei werden die Ladungsspeicher zurückgesetzt" in combination with column 2, lines 56 to 59: "nach Ermittlung der potentiellen Übersteuerungsgebiete wenigstens eine weitere Vorabtastung mit Auslesen von Pixeln und Rücksetzen der Pixelladungsspeicher [...] erfolgt").*

The board notes that in the application some charge is dumped and some other charge is sensed (see description page 9, lines 23 to 25). In document E1, the same charge is first sensed and then reset/dumped (see E1, column 1, lines 59 to 63). However, the board finds that both of these options are encompassed by the general feature of claim 1: *"alternately dumping charge [...] and reading charge [...] in a duty cycle"*.

Moreover, the board finds that this general feature of claim 1 does not specify a time order of dumping and reading.

- 4.6 Concerning alleged difference (b), the board holds that the existence of a decay time of the photodetector is implicit in document E1 (when adopting the interpretation of the term "decay time" as set out in points 3.3 to 3.4 above). It would have been evident to the person skilled in the art that any charge stored on a sensor would eventually decay.

As a consequence, the board arrives at the conclusion that document E1 discloses either explicitly or implicitly features (a) and (b) of claim 1 set out in point 4.4 above.

In points 4.7 and 4.8 below, the board will assess two other features in respect of their eligibility as distinguishing features.

- 4.7 In an image sensor according to document E1, there is apparently no significant drain current. Hence, the decay time is approaching infinity and thus a reciprocal of this decay time leads to a frequency of zero or slightly above zero. As a consequence, the board finds that the disclosure of document E1 (see column 3, lines 54 to 56: "*mehrere weitere Vorabtastungen in im wesentlichen konstanten Zeitabständen erfolgen*") anticipates the feature of claim 1 reading: "*at a frequency at least equal to a reciprocal of a decay time of the photodetector means*".

The board holds that this feature of claim 1 only specifies a lower limit of the charge dump/read duty cycle frequency (as a function of the decay time) and does not specify a step requiring that the decay time is obtained and based on which the duty cycle frequency is set.

- 4.8 The board observes that document E1 only sets out in a functional manner that a charge accumulated in an image sensor is reset at a certain moment (see column 2, lines 58 to 59: "*Vorabtastung mit Auslesen von Pixeln und Rücksetzen der Pixelladungsspeicher*").

Hence, the board finds that document E1 does not disclose a particular structure containing "*dump drain means controlled by dump gate means*" as specified in claim 1.



For this reason, the board holds that the subject-matter of claim 1 is new with respect to the disclosure of document E1.

4.9 The board considers that the technical problem to be solved is how to implement a reset of a charge storing element at certain times in a solid-state image sensor.

4.10 The board finds that, faced with this task, the person skilled in the art would have considered document D4 teaching electronic shuttering of a pixel sensor array in CMOS technology (see D4, title, paragraph [0003]).

Document D4 solves the problem formulated above by using a reset gate (see D4, Figure 3A: 45; paragraph [0040]: "*reset gate 45*") to switch a connection between a charge accumulating pixel (see D4, Figure 3A: 30) and a drain diffusion (see D4, Figure 3A: 50), as set out in D4, paragraph [0040]: "*This is accomplished by the reset signal RST temporarily increasing to a higher positive voltage to temporarily remove the potential barrier 90 and provide a downward potential staircase [...] to the drain diffusion*".

The board holds that it would have been obvious for the person skilled in the art to apply these features of document D4 to implement the switchable reset function set out in document E1 and thus arrive at the subject-matter of claim 1 in a straightforward manner.

4.11 Therefore, the board comes to the conclusion that claim 1 does not meet the requirements of Article 52(1) EPC 1973 because the claimed subject-matter lacks inventive step within the meaning of

Article 56 EPC 1973 over the combined disclosures of document E1 and document D4.

5. First auxiliary request - clarity and support by the description (Article 84 EPC 1973)

5.1 Claim 1 of the first auxiliary request specifies:  
"*reading charge from the photodetector means in a duty cycle, multiple times within a single exposure or frame*" (amendments with respect to claim 1 of the main request are underlined).

5.2 Claim 1 clarifies that there are multiple dump/read cycles within a single exposure or frame. Therefore, it resolves the objection under Article 84 EPC 1973 raised in point 3.8 above.

5.3 However, the board holds that the objection under Article 84 EPC 1973 raised in points 3.4 to 3.6 above still applies.

5.4 As a consequence, the board comes to the conclusion that claim 1 of the first auxiliary request does not meet the requirements of Article 84 EPC 1973.

6. First auxiliary request - inventive step (Article 56 EPC 1973)

6.1 Claim 1 of the first auxiliary request differs from claim 1 according to the main request by specifying (amendments with respect to claim 1 of the main request are underlined):

- (a) "reading charge from the photodetector means in a duty cycle, multiple times within a single exposure or frame"
- (b) "at a frequency greater than a reciprocal of a decay time of the photodetector means"

- 6.2 Document E1 discloses repeated read/dump cycles (see column 3, lines 54 to 56: "*mehrere weitere Vorabtastungen in im wesentlichen konstanten Zeitabständen*") and, as set out in point 4.5 above, at least two read/dump cycles.
- 6.3 Hence, the board holds that document E1 discloses feature (a) of claim 1 set out in point 6.1 above.
- 6.4 Since in document E1 the decay time is approaching infinity (see point 4.6 above), a reciprocal of this decay time leads to a frequency of zero or slightly above zero.
- 6.5 Hence, the board holds that the multiple read/dump cycles in document E1 anticipate feature (b) of claim 1 set out in point 6.1 above.
- 6.6 In view of the above, the board arrives at the conclusion that document E1 also discloses the additional features of claim 1 according to the first auxiliary request. Thus, the subject-matter of claim 1 of the first auxiliary request lacks inventive step within the meaning of Article 56 EPC 1973 for the same reasons as set out for claim 1 of the main request (see in particular points 4.8 to 4.10 above).
- 7. Second auxiliary request

7.1 Claim 1 of the second auxiliary request differs from claim 1 according to the first auxiliary request in that it further specifies that the photodetector means has "*a decay time period over which the output of the photodetector decays*".

7.2 The board finds that this is merely an editorial change which adds nothing of substance to the feature: "*decay time of the photodetector means*".

The board holds that this added feature does not further limit the technical meaning of the expression "decay time". Thus, it addresses neither the objection under Article 84 EPC 1973 raised in points 3.4 to 3.6 above nor the objection of lack of inventive step (Article 56 EPC 1973) raised in point 6.

7.3 As a consequence, the board arrives at the conclusion that these objections equally apply to claim 1 according to the second auxiliary request.

8. Third auxiliary request - amendments  
(Article 123(2) EPC)

8.1 Compared with claim 1 of the main request underlying the decision under appeal, claim 1 of the third auxiliary request contains the following amendments indicated by underlined text:

(a) to generate charge in the photodetector means over a decay time period following exposure of the photodetector means to the radiation

(b) alternately dumping charge generated in the photodetector means to the dump drain means from

the photodetector means or reading charge generated in the photodetector means from the photodetector means

- (c) multiple times within a single exposure or frame
- (d) at a frequency greater than a reciprocal of the decay time period of the photodetector means
- (e) such that charge generated in the photodetector means is either dumped to the dump drain or read

Corresponding amendments apply to independent claim 20.

8.2 A basis for feature (a) can be found in Figure 3 in combination with page 11, lines 7 to 11, of the application as filed.

Features (b) and (e) are disclosed on page 9, lines 23 to 25, and page 10, lines 29 to 31.

Features (c) and (d) are disclosed on page 11, lines 17 to 22.

8.3 Dependent claims 2 to 19 and 21 to 40 of the third auxiliary request correspond to dependent claims 2 to 19 and 21 to 40 of the main request underlying the decision under appeal, with claims 2 to 5, 9 and 11 amended to reflect the change of a conjunction in claim 1 (see feature (b): "or").

8.4 In view of the above, the board finds that the claims of the third auxiliary request do not contain subject-matter which extends beyond the content of the application as filed. Thus, they comply with Article 123(2) EPC.

9. Third auxiliary request - clarity and support by the description (Article 84 EPC 1973)

9.1 The feature of claim 1 reading "*generate charge in the photodetector means over a decay time period following exposure of the photodetector means to the radiation*" specifies that the decay time period relates to a process in which charge is generated over time and not to a process in which charge is decaying after it was generated.

Hence, it is clarified that there is a noticeable lag between an incident radiation quant and a generated charge.

As a consequence, the board finds that the objection under Article 84 EPC 1973 raised in points 3.4 to 3.6 above no longer applies.

9.2 The feature in claim 1 reading "*alternately dumping charge .. or reading charge .. in a duty cycle, multiple times within a single exposure or frame*" specifies that there are multiple duty cycles of dumping/reading within a single exposure or frame.

Hence, the board finds that the objection under Article 84 EPC 1973 raised in point 3.8 above is resolved.

9.3 The board considers there to be no other clarity objection.

9.4 In view of the amendments made on pages 4A and 5 to 8 of the description, the board holds that the claims of

the third auxiliary request are supported by the description.

9.5 Hence, the board arrives at the conclusion that the requirements of Article 84 EPC 1973 are met.

10. Third auxiliary request - inventive step  
(Article 56 EPC 1973)

10.1 The board finds that the subject-matter of claim 1 differs from the disclosure of the closest prior-art document E1 in that:

(a) the dump drain means is controlled by dump gate means

(b) the charge generated in the photodetector means is either dumped to the dump drain or read

(c) the frequency of the dump/read duty cycle is greater than a reciprocal of the decay time period following exposure of the photodetector means to the radiation

10.2 The board observes that in document E1 a saturation of a photodetector is avoided by reading the charge accumulated up to a certain period and then dumping the charge. This is repeated multiple times. Hence, all charge generated due to incident radiation is captured.

According to claim 1, only parts of the charge generated due to incident radiation are captured. Other parts are dumped. The board regards this as an alternative manner of avoiding saturation of a photodetector.

10.3 Hence, the board holds that the objective technical problem may be regarded as finding an alternative manner of avoiding saturation of a photodetector.

10.4 The board is of the opinion that the person skilled in the art faced with this problem would have considered electronic shuttering such as disclosed in document D4 (see D4, title) to avoid pixel saturation (D4, paragraph [0011]: "*to avoid saturating the pixels*").

The board holds that by applying this concept of electronic shuttering to an image sensor according to document E1, the person skilled in the art would have arrived at features (a) and (b) mentioned in point 10.1 above. In other words, the person skilled in the art would have arrived at a method of operating an image sensor in which a photodetector is connected to a dump drain during a first time period within a single exposure or frame and in which a charge accumulated in the photodetector is read during the remaining time period within the single exposure or frame.

10.5 However, the board holds that it would not have been obvious to arrive at feature (c).

The technical effect of feature (c) is that every incident radiation quant contributes to the generated charge, and signals from all incident radiation quants are evenly reduced (see description page 11, lines 7 to 11). For this effect to be achieved, it is essential that charge in the photodetector is not generated instantaneously but during a decay time period following exposure of the photodetector to radiation.

In document E1, there is no pointer towards this technical effect and the corresponding feature (c). In



particular, document E1 never mentions a decay time period of the photodetector.

Moreover, in document D4, there is no disclosure or suggestion to open and close an electronic shutter multiple times within a single exposure.

10.6 Hence, the board finds that the subject-matter of claim 1 would not have been obvious starting from document E1 as closest prior art.

10.7 The other documents cited during the examination proceedings are less pertinent because they do not address the same problem as in the application, i.e. to increase a shot-noise limited signal-to-noise ratio of an image sensor by avoiding charge saturation in a pixel.

For example, document D1 discloses several sensor readings during a charge decay time (see D1, column 11, lines 45 to 50) but with the aim of increasing a signal-to-noise ratio by averaging multiple measurements. Document D1 does not disclose charge dumping to avoid premature saturation of a pixel.

10.8 In view of the above, the board arrives at the conclusion that the subject-matter of claim 1 involves an inventive step (Article 56 EPC 1973).

10.9 The same holds for the subject-matter of claim 20 which specifies a corresponding image sensor.

10.10 Claims 2 to 19 and 21 to 40 are dependent claims. Therefore, their subject-matter also involves an inventive step.

11. Formulating the independent claims in the two-part form according to Rule 29(1) (a) and (b) EPC 1973 is not appropriate because it would distort the logical sequence of steps or the corresponding means.
  
12. Amended page 4 of the description cites prior-art documents E1 and D4, thus meeting the requirements of Rule 27(1) (b) EPC 1973.

## **Order**

### **For these reasons it is decided that:**

1. The decision under appeal is set aside.
  
2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

#### Description:

Pages 1 to 3 and 9 to 17 as originally filed  
Pages 4, 4A, 5 and 6 filed with the letter of  
7 August 2020

Pages 7, 8 and 8A filed with the letter of 25 June 2020

#### Claims:

Nos. 1 to 40 filed with the letter of 23 March 2020

#### Drawings:

Sheets 1/3 to 3/3 as originally filed.

The Registrar:

The Chairman:



K. Boelicke

B. Müller

Decision electronically authenticated