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Datasheet for the decision of 24 October 2017

Case Number: T 0171/13 - 3.4.03

Application Number: 08155004.8

Publication Number: 1986179

IPC: G09G3/32

Language of the proceedings: EN

Title of invention:
Organic light emitting display and driving method thereof

Applicant:
Samsung Display Co., Ltd.

Headword:

Relevant legal provisions:
EPC Art. 83

Keyword:
Sufficiency of disclosure - (no)

Decisions cited:

Catchword:

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Case Number: T 0171/13 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 24 October 2017

Appellant: (Applicant)	Samsung Display Co., Ltd. 17113, 1, Samsung-ro Giheung-Gu Yongin-si Gyeonggi-do (KR)
Representative:	Gulde & Partner Patent- und Rechtsanwaltskanzlei mbB Wallstraße 58/59 10179 Berlin (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 26 October 2012 refusing European patent application No. 08155004.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	S. Ward
	W. Van der Eijk

Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division refusing European patent application No. 08 155 004 on the grounds that the claimed subject-matter did not fulfil the requirements of Article 84 and 56 EPC.

II. At the end of the oral proceedings held before the Board the appellant requested that the decision under appeal be set aside and that a patent be granted according to claims 1-11 as filed with the letter of 19 September 2017.

III. Claim 1 of the main request reads as follows:

"An organic light emitting display using the digital driving method of any of claims 6 to 11, comprising:
an organic light emitting display panel including a plurality of pixel circuits;
a data driver adapted to receive a data signal and to provide a driving signal corresponding to a data value of the data signal to the organic light emitting display panel;
a power supplier adapted to supply a supply voltage to the organic light emitting display panel;
a voltage detecting unit electrically coupled to the organic light emitting display panel and adapted to detect a voltage supplied from the power supplier; and
a controller electrically coupled to the voltage detecting unit and adapted to output a control signal to one of the power supplier and the data driver based on the detected voltage,
wherein

(variant I) the power supplier is adapted to select a voltage level of the supply voltage corresponding to the control signal; or
(variant Il) the data driver is adapted to adjust the data value of the data signal corresponding to the control signal,
characterised in that the controller further comprises an accumulative addition unit adapted to determine an accumulated data value by accumulating data values applied by the data driver at a respective period of time to the plurality of pixel circuits and to thereby determine a number of pixels that emit light at said respective period of time;
a frame memory being electrically coupled to the accumulative addition unit and adapted to store a table of voltage reference values, each voltage reference value being voltage value to be output by the power supply when a number of pixels emit light, and to output the voltage reference value corresponding to the accumulated data value to a comparison unit, the comparison unit being electrically coupled to the frame memory and adapted to compare a voltage reference value output from the frame memory depending on the number of pixels that emit light at the respective period of time determined by the accumulative addition unit with the detected voltage value supplied from the voltage detecting unit,
wherein
(variant I) the controller is adapted to output a control signal to the power supplier that causes the power supplier to reduce the supply voltage if the detected voltage value is larger than a reference voltage value and to increase the supply voltage if the detected voltage value is smaller than the reference voltage value or

(variant II) the controller is adapted to output a control signal to the data driver that causes the data driver to output a driving signal that decreases a brightness of organic light emitting diodes included in the pixel circuits if the detected voltage value is larger than a reference voltage value and to increase the brightness of the organic light emitting diodes included in the pixel circuits if the detected voltage value is smaller than the reference voltage value."

IV. The Board issued a communication under Article 15(1) RPBA giving its provisional opinions. It was stated *inter alia* that the determination of the number of pixels that emit light only appeared to be disclosed in the original application in combination with a digital driving method, and that as claim 1 was not thus limited, the requirements of Article 123(2) EPC appeared not to be met.

Moreover there was a doubt whether "variant II" satisfied the requirements of Article 83 EPC, as it was questionable whether there was a clear and unambiguous disclosure in the description and drawings how this variant might be made to work, in particular how to adapt the "data value of the data signal" in order to output a driving signal that decreased or increased a brightness of the OLEDs.

The explanation of variant II appeared to be in the flowchart of Fig. 7 and in paragraphs [0109]-[0118]. According to paragraph [0116], when employing a digital driving method the organic light emitting display "may increase or decrease a data voltage value so as to calibrate brightness". However, in paragraph [0068], in the digital driving method, OLED "brightness adjustments might be made based on a turn-on time per

each frame", and not by increasing or decreasing a data voltage value.

V. With a letter dated 19 September 2017 the appellant filed a new set of claims (those on which the present decision is based) in which independent claims 1 and 6 were restricted to a digital driving method.

In relation to Article 83 EPC, the appellant argued essentially as follows:

As stated in paragraph [0068] of the original description, in the digital driving method "the organic light emitting diode OLED may be turned on and off based on the digital signal, and brightness adjustments may be made based on a turn-on time per each frame". The longer the OLED was switched on, the brighter the light (timing diagrams A-F of exemplary driving modes with an 8 bit data signal resulting in different brightness levels were provided). Switching the OLED on and off fast at different rates of on and off influenced the brightness of the OLED due to persistence of human vision.

VI. At the oral proceedings, the Board noted that the claimed invention was now restricted to a digital driving method, and that according to the appellant's submissions (although not defined in the claims), the brightness of a respective OLED was controlled by a light emission turn-on time per each frame. Similarly the brightness adjustments (of variant II) might be made based on adjusting a turn-on time per frame. The Board expressed doubts whether, in the light of these submissions, the invention as claimed was sufficiently disclosed within the meaning of Article 83 EPC.

VII. The appellant responded at oral proceedings essentially as follows:

The skilled person would arrive at a suitable way of putting the invention into practice on the basis of the teaching of the application and common general knowledge in the art.

The claimed "number of pixels that emit light at [a] respective period of time", meant the number of pixels that emit light at any point during the period, e.g. the frame period. Hence only those pixels which were off for the entire duration of the frame were excluded. The parameter I_{OLED} was an instantaneous current defined at a point in time. A fixed relationship between these parameters (such as could be stored in a look up table) could be established in a number of ways which would readily occur to the skilled person, for example according to one of the following three proposals for implementing the invention:

(i) *First Proposal*
Even if all pixels to be turned on during a frame were not activated at the same time, this number could be determined over the course of the frame, and the currents flowing through the individual pixels during activation might also be determined (or were known). This would allow a reference current to be determined which could be compared with a measured current drawn by the panel.

(ii) *Second Proposal*
The application disclosed a digital driving method by which pixel brightness is "based on a turn-on time", and the timing diagrams A-F (in the appellant's letter of 19 September 2017) demonstrated an exemplary type of

pulse width modulation by which this could be achieved. The frame period was divided into 8 equal sub-periods corresponding to an 8 bit data signal. As seen in the figures, there were numerous ways of achieving a given brightness.

To implement the invention it would be an obvious measure to ensure that all pixels which are to be switched on in a given frame were simultaneously on for one particular sub-period, for example, the first (left-most) sub-period. A pixel to be illuminated for only one sub-period would be on during the first sub-period and off for the rest of the frame; a pixel to be illuminated for two sub-periods would be on during the first sub-period and one other sub-period (e.g. the second) etc.

In this way, the number of pixels that emit light at any point during the frame period would be identical to the number of pixels emitting light during the first sub-period, and provided both the reference current I_{OLED} and the measured current supplied to the panel were defined in relation to this first sub-period, the claimed invention could be consistently carried out.

(iii) *Third Proposal*

The statement in paragraph [0020] "for each period of at least one frame" was to be interpreted as referring to fractional periods of the frame. Thus, with respect to the diagrams A-F, "accumulating data values applied by the data driver at a respective period of time" meant that the accumulation was carried out for each of the 8 "periods" into which the frame had been subdivided.

Reasons for the Decision

1. The appeal is admissible.

2. *Terminology: Reference Voltage and I_{OLED}*

2.1 Claim 1 defines a "voltage detecting unit ... adapted to detect a voltage supplied from the power supplier". At first sight it might be imagined that what is measured is the total voltage applied to the panel. However, in the only passages disclosing the operation of the voltage detecting unit (paragraphs [0076] and [0077]), it is clear that what is actually measured is the voltage at both ends of a (low resistance) resistor located within the unit. The total current drawn by the panel can then be calculated using Ohm's law.

2.2 According to claim 1, this measured voltage is then compared with a "voltage reference value" stored in a table. This can only make sense if the "voltage reference value" refers to the voltage which would be measured across the same resistor in the voltage detecting unit for a given number of pixels emitting light and with the panel functioning correctly, i.e. with no deterioration of the organic light emitting diodes and at the normal operating temperature.

2.3 Knowing the resistance of the resistor, this reference voltage can be converted into a reference current using Ohm's law, and the Board's understanding is that this is what is referred to as "I_{OLED}" in Fig. 5 and the associated text.

In the discussion below, much of which focuses on the interpretation of Fig. 5, the Board will refer to the

current I_{OLED} as shown in the figure. However, it is to be understood that this could equally be translated into the vocabulary of reference voltages.

3. *Sufficiency of Disclosure*

3.1 According to Article 83 EPC, a European patent application "shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art." Rule 42(1)(e) EPC requires that the description shall "describe in detail at least one way of carrying out the invention claimed".

3.2 In the present case, the "invention claimed" relates to an organic light emitting display using a digital driving method. In order to implement the invention it would at least be necessary for the skilled person to be able to attach an unambiguous meaning to the following claimed features:

- "number of pixels that emit light at [a] respective period of time", and
- "voltage reference values" (or currents, "I_{OLED}" as noted above).

Moreover, there must be a fixed relationship between these two parameters which a skilled person could determine and arrange as a "table of voltage reference values" to be stored in the frame memory as defined in claim 1 (for example, in the form of a lookup table reflecting a relationship of the type shown in the graph of Fig. 5).

3.3 The "number of pixels that emit light at [a] respective period of time", clearly defines that this number is not determined instantaneously at a point in time, but rather with respect to a period of time.

In the application as filed, a suitable period is only indicated in paragraph [0020] and in original claim 8 (now claim 5), namely: "for each period of at least one frame". Hence, the single disclosed example of the claimed "period of time" is "one frame".

For the claimed digital driving method, the only disclosed arrangement for setting (and adjusting) the brightness of a pixel is a time-ratio method, i.e. based on a turn-on time per frame (see paragraphs [0068], [0071] and [0082]). According to this method, all pixels - apart from those which remain switched off for the entire frame - will emit light for at least some part of the frame. Similarly, all pixels - apart from those which remain switched on for the entire frame - will remain dark for at least some part of the frame.

During the oral proceedings the appellant stated that the number of pixels that emit light "at" a period of one frame means the number of pixels that emit light at any point during the frame period, hence excluding only those pixels which are off for the entire duration of the frame. Given the definitions of claim 1, and the disclosed time ratio method for setting the brightness (or grayscale), the Board accepts that this is probably the only reasonable interpretation.

3.4 According to paragraph [0082], the parameter I_{OLED} is an instantaneous current defined "at a point in time". The instantaneous nature of I_{OLED} was also accepted by the appellant.

3.5 The question is therefore how a fixed relationship (such as could be stored in a look up table) could be

defined between the number of pixels that emit light at any point during the frame period, and an instantaneous current defined at "a point in time".

For example, one could determine the current I_{OLED} at a time $t=t_1$ within a frame period T, and also the number of pixels emitting light at time t_1. However, the number of pixels that emit light at any point during the frame period also includes pixels which do not emit light at $t=t_1$, but which previously emitted light in the interval $0<t<t_1$, or which will subsequently emit light in the interval $t_1<t<T$, dependent on the image data to be displayed, and having no apparent relationship with the current I_{OLED} determined at time $t=t_1$.

3.6 The Board can see no explicit disclosure in the application explaining how this relationship is to be defined, and the appellant did not argue the contrary. It was the appellant's position that, starting from the teaching of the application, the common general knowledge possessed by the skilled person would allow him to arrive at a suitable way of putting the invention into practice without any undue burden.

In particular, the appellant proposed the three schemes referred to above (points VII(i), VII(ii) and VII(iii)) which, it was said, would readily occur to the skilled person, and which would resolve the above difficulties.

3.7 In the opinion of the Board, for this line of argument to be successful, at least the following two criteria would need to be satisfied. Firstly, it would have to be manifestly clear that a proposed scheme would actually work, that is to say, that it would allow a unambiguous relationship to be defined between the

number of pixels that emit light at any point during the frame period and an instantaneous current defined at "a point in time". Secondly, the proposed scheme must involve nothing more than the application of the common general knowledge in the art.

3.8 *First Proposal*

3.8.1 According to the appellant's first proposal (point V(i), above) the number of pixels activated at any time during the frame could be determined, and the currents flowing through the individual pixels during activation might also be determined.

3.8.2 The Board does not see any straightforward way in which currents flowing through the individual pixels when they are activated (perhaps several times per frame, depending on the image) could be linked in a fixed and unambiguous relationship with a reference current I_{OLED} which could be meaningfully compared with a measured instantaneous current supplied to the panel. As it is not apparent how this proposal represents a workable solution, it fails to meet the first of the above criteria.

Since the Board sees no reason to believe that this proposal represents common general knowledge in the art, it fails to meet the second criteria also.

3.9 *Second Proposal*

3.9.1 According to the second proposal (point VII(ii), above) the frame is divided into equal sub-periods, and all pixels which are to be switched on in a given frame are simultaneously on for one particular sub-period. In this way, the number of pixels that emit light at any

point during the frame period is identical to the number of pixels emitting light during the particular sub-period. The reference current I_{OLED} and the measured current supplied to the panel are also defined in relation to this sub-period.

3.9.2 The Board sees no reason why such a scheme could not, in principle, be carried out, and it could also be seen as resolving an apparent contradiction between claim 1 (which refers to a number of pixels that emit light in a period of time) and paragraph [0082] of the description (in which the important quantity for determining the current I_{OLED} is said to be the number of pixels that emit light at a "point in time"). If the "point in time" is a point within the particular sub-period referred to above, the two definitions of the number of pixels that emit light would give the same result. The relationship shown in Fig. 5 between I_{OLED} and the "number of light emitting pixels" would make sense and be consistent with the invention as defined in claim 1. The Board therefore considers that the first criterion mentioned above is fulfilled.

3.9.3 The fact remains, however, that not one of the features of this scheme is explicitly disclosed in the application as filed. In particular, the basic underlying idea of using pulse width modulation with the frame period divided into equal sub-periods is not disclosed, nor is having all pixels which are to be switched on during the frame simultaneously switched on for a particular sub-period, nor is defining the reference current I_{OLED} and the measured current supplied to the panel in relation to this particular sub-period. Hence, this argument of the appellant could only serve to establish compliance with Article 83 EPC

if all of these features were commonly known in the art.

3.9.4 The Board does not, however, believe that such an addressing scheme is commonly or routinely used in the art as a means for providing grayscale to an OLED display. This conclusion is based firstly on the absence of any evidence supporting this assertion, and secondly on the Board's view that there are strong reasons for believing that such a scheme would in fact represent an unusual and unlikely choice.

3.10 As explained during oral proceedings, it is the Board's view that conventional grayscale rendering using time domain modulation generally employs some form of binary weighted pulse width modulation, in which the frame is divided into 8 *unequal* sub-periods. For example, for an 8 bit data signal, the frame is divided into 8 sub-periods, and if the shortest of these is considered to define one unit of time, the durations of the other 7 sub-periods are 2, 4, 8, 16, 32, 64 and 128 units of time. A first bit of the data signal ("the least significant bit") controls the sub-period of one unit duration, a second bit ("the second least significant bit") controls the sub-period of two units duration, and so on until the 8th bit of the data signal ("the most significant bit"), which controls the sub-period of a duration of 128 units.

If the data signal is such that pixel is controlled to be on during all sub-periods (11111111), it emits light for 255 units of time; if it is off during all sub-periods (00000000), it emits light for zero units of time. Thus, the 8 bit signal is capable of rendering 256 (2^8) distinct grayscales.

It is, however, a feature of such weighted pulse width modulation that it is generally not possible to identify any sub-period in which all pixels which emit light at any point during the frame period will be simultaneously on during that sub-period, as required by this proposal of the appellant. Thus the second proposal of the appellant could not be carried out using this conventional and commonly used grayscale rendering method.

3.10.1 Instead the appellant proposes a form of linear pulse width modulation, in which the frame is split into sub-periods of *equal* duration, such that the total length of time a pixel is on during a frame is directly proportional to the number of sub-periods for which a pixel is on. In such a scheme, it would be possible to ensure that all pixels which are to emit light during the frame period are simultaneously on during a particular sub-period, thus making the appellant's proposed way of carrying out the invention possible.

However, if each sub-period has a duration defined as one unit of time, the total time the pixel is illuminated in a frame may be 0, 1, 2, 3, 4, 5, 6, 7 or 8 units, and therefore an 8 bit data signal would correspond to just 9 distinct grayscales.

3.10.2 The appellant effectively suggests that, having read the application and using common general knowledge, the skilled person would immediately appreciate that conventional weighted pulse width modulation should be abandoned in favour of a linear pulse width modulation technique which has not been shown to be common in the art and which, for a given data signal, would offer a palette of grayscale levels reduced by orders of magnitude (e.g. 9 instead of 256). Moreover, the

motivation for this would be to achieve a particular result (all pixels which are turned on at any point in a given frame being simultaneously turned on for one particular sub-period) which is nowhere disclosed in the application and which also has not been shown to be a commonly known measure.

The second criterion mentioned above is not considered to be fulfilled, and the appellant's arguments with respect to the second proposal do not, therefore, persuade the Board that the requirements of Article 83 EPC are met.

3.11 *Third Proposal*

3.11.1 The appellant's third proposal requires that the statement in paragraph [0020]: "for each period of at least one frame", be reinterpreted as referring to fractional periods of the frame. Thus, with respect to the diagrams A-F, "accumulating data values applied by the data driver at a respective period of time" would mean for each of the 8 "periods" into which the frame had been subdivided.

3.11.2 The Board finds no support in the application that the invention is to be understood in terms of such periodic operations within one frame. Moreover, as with the first scheme, the Board does not believe that it has been satisfactorily explained how accumulating data at multiple points in time would lead to a reference voltage or current (I_{OLED}) which could be meaningfully compared with a measured instantaneous current supplied to the panel, and which had a well-defined relationship with the number of pixels that emit light at any point during the frame period.

3.11.3 Since there is also no evidence that this proposal reflects common knowledge in the art, it fails to satisfy either of the criteria mentioned above.

3.12 The Board therefore concludes that the claimed invention has not been sufficiently disclosed in the application, and that it is not plausible that the common general knowledge of the skilled person could remedy this insufficiency. The requirements of Article 83 EPC are therefore not met.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

B. Atienza Vivancos G. Eliasson

Decision electronically authenticated