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Case Number: T 1841/07 - 3.4.03

Application Number: 04012105.5

Publication Number: 1480194

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Language of the proceedings: EN

Title of invention:
Energy recovery circuit and driving method thereof

Applicant:
LG Electronices, Inc.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 123(2)

Relevant legal provisions (EPC 1973):
EPC Art. 54(1)(2), 84

Keyword:
"Novelty (no) - all requests"

Decisions cited:
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Case Number: T 1841/07 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 7 December 2010

Appellant: LG Electronics, Inc.
20, Yeoeuido-dong
Youngdungpo-gu
Seoul 150-721 (KR)

Representative: Trinks, Ole
Meissner, Bolte & Partner GbR
P.O. Box 102605
D-86016 Augsburg (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 22 June 2007 refusing European patent application No. 04012105.5 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: G. Eliasson
Members: R. Q. Bekkering
P. Mühlens

Summary of Facts and Submissions

I. This is an appeal against the refusal of application 04 012 105 for lack of novelty, Article 54(1) and (2) EPC 1973, over document

D1: EP 0 261 584 A.

II. With the statement setting out the grounds of appeal, the appellant requested that the decision under appeal be set aside and a patent granted on the basis of the following:

Main request: claims 1 to 11 filed with letter dated 18 January 2007, or

First auxiliary request: claims 1 to 11 filed with letter dated 21 May 2007,

Second auxiliary request: claims 1 to 10 filed with letter dated 21 May 2007,

Third auxiliary request: claims 1 to 8 filed with letter dated 21 May 2007,

Fourth auxiliary request: claims 1 to 6 filed with letter dated 21 May 2007.

III. The summons to oral proceedings requested by the appellant were provided with an annex in which a provisional opinion of the board on the matter was given, according to which, besides lacking clarity and support by the description on a number of points, the subject-matter of claim 1 of all requests appeared to

lack novelty, Article 54(1) and (2) EPC 1973, over document D1.

Thereupon the appellant requested in writing that in case the board could not accept the fourth auxiliary request a patent be granted on the basis of the following:

Fifth auxiliary request: claims 1 to 10 filed with letter dated 5 November 2010, or

Sixth auxiliary request: claims 1 to 10 filed with letter dated 5 November 2010.

Furthermore, the appellant informed the board that it would not attend the scheduled oral proceedings, cancelled its previous request to attend oral proceedings and instead requested that a decision according to the state of the file be submitted.

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

"*An energy recovery circuit, comprising:*
a panel capacitor (Cp);
a source capacitor (Cs) for recovering a voltage from the panel capacitor (Cp), and supplying the voltage charged to the source capacitor (Cs) to the panel capacitor (Cp);
an inductor (L) disposed between the source capacitor (Cs) and the panel capacitor (Cp);
characterized by
a reference voltage supply unit (30) for supplying a rising pulse rising to a predetermined reference voltage (Vs) to the panel capacitor (Cp) in an initial

period in which the panel capacitor (Cp) and the source capacitor (Cs) are not charged with a voltage and for supplying a reference voltage to the panel capacitor (Cp) in a period in which the panel capacitor (Cp) is charged with a first voltage and the source capacitor (Cs) is charged with a second voltage which is lower than the first voltage."

V. Claim 1 of the first auxiliary request corresponds to claim 1 of the main request, in which, however, the last feature reads as follows:

"*.. and the source capacitor (Cs) is charged with a second voltage which is lower than the first voltage in the initial period.*"

VI. Claim 1 of the second auxiliary request corresponds to claim 1 of the main request, in which, however, the characterising portion reads as follows:

"*characterized by*
a reference voltage supply unit (30) for supplying a rising pulse rising with a predetermined slope to a predetermined reference voltage (Vs) to the panel capacitor (Cp) in an initial period in which the panel capacitor (Cp) and the source capacitor (Cs) are not charged with a voltage and for supplying a reference voltage to the panel capacitor (Cp) when the energy recovery circuit normally operates."

VII. Claim 1 of the third auxiliary request corresponds to claim 1 of the second auxiliary request, in which, however, the last part reads as follows:

"*and for supplying a reference voltage to the panel capacitor (Cp) when the energy recovery circuit normally operates, wherein the source capacitor (Cs) is charged with a gradually rising voltage with a predetermined slope during the supply of the rising pulse.*"

VIII. Claim 1 of the fourth auxiliary request corresponds to claim 1 of the third auxiliary request, with the following additional feature:

"*wherein the voltage charged to the source capacitor (Cs) is increased until it reaches a voltage corresponding to approximately half the reference voltage (Vs).*"

IX. Claim 1 of the fifth auxiliary request corresponds to claim 1 of the main request, in which, however, the characterising portion reads as follows:

"*characterized by a reference voltage supply unit (30) for supplying a gradually rising pulse rising to a predetermined reference voltage (Vs) to the panel capacitor (Cp) and the source capacitor (Cs) in an initial period in which the panel capacitor (Cp) and the source capacitor (Cs) are not charged with a voltage and for supplying a reference voltage to the panel capacitor (Cp) in a period in which the panel capacitor (Cp) is charged with a first voltage and the source capacitor (Cs) is charged with a second voltage which is lower than the first voltage in the initial period, wherein the source capacitor (Cs) is gradually charged with a half of the reference voltage (Vs), while the reference voltage supply unit (30), supplies*

a voltage , gradually increasing from zero volt to the reference voltage (Vs), to the panel capacitor (Cp) in the initial period."

X. Finally, claim 1 of the sixth auxiliary request reads as follows:

"*An energy recovery circuit for a plasma display panel, comprising:*
a panel capacitor (Cp) representing an equivalent circuit of capacitance which is formed between a scan electrode (Y) and a sustain electrode (Z);
a source capacitor (Cs) for recovering a voltage from the panel capacitor (Cp), and supplying the voltage charged to the source capacitor (Cs) to the panel capacitor (Cp);
an inductor (L) disposed between the source capacitor (Cs) and the panel capacitor (Cp);
characterized by
a reference voltage supply unit (30) for supplying a gradually rising pulse rising to a predetermined reference voltage (Vs) to the panel capacitor (Cp) and the source capacitor (Cs) in an initial period in which the source capacitor (Cs) is not charged with a voltage Vs/2 and for supplying a reference voltage to the panel capacitor (Cp) in a period in which the panel capacitor (Cp) is charged with a first voltage and the source capacitor (Cs) is charged with a second voltage which is lower than the first voltage in the initial period, wherein the source capacitor (Cs) is gradually charged with a half of the reference voltage (Vs), while the reference voltage supply unit (30) supplies a voltage, gradually increasing from zero volt to the reference

voltage (Vs), to the panel capacitor (Cp) in the initial period."

XI. Furthermore, all requests include an independent claim for a corresponding method for driving an energy recovery circuit.

XII. The appellant in substance provided the following arguments:

The subject-matter of claim 1 of all requests differed from document D1 in that in an initial period the source capacitor was charged with a voltage gradually rising to Vcc/2 before the first one cycle of the energy recovery circuit, whereas D1 taught a power-up period with continuous switching through the four states until Vss would rise at Vcc/2. Furthermore, D1 was silent with respect to any information regarding the question how fast the voltage Vcc increased when the driver circuit switched through the four states. In case the voltage increase in one cycle was larger than Vcc/2, the switching elements had to be designed for a higher voltage compared with the operating voltage required in normal operation. Accordingly, the advantage of the application that in particular the voltage difference across the third switch S3 could be maintained to be less than approximately Vs/2, thereby reducing the manufacturing costs, could not be achieved in D1.

Accordingly, the subject-matter of claim 1, and of the respective method claim, of all requests was new and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 *Clarity, support by the description*

2.1.1 Claim 1 fails to specify that the energy recovery circuit pertains to a plasma display panel, although the description exclusively deals with an energy recovery circuit for this specific type of panel. Moreover, the reference in claim 1 to a panel capacitor is misleading as it suggests the provision of an additional component whereas in fact what is apparently intended is the capacitance formed between the scan electrode and the sustain electrode of the plasma display panel (cf original description, paragraph [12]).

2.1.2 Furthermore, the "*initial period*" in claim 1 is not clearly defined.

Claim 1 refers to the "*initial period*" as one "*in which the panel capacitor (Cp) and the source capacitor (Cs) are not charged*". However, as far as clear from the description and drawings, the "*initial period*" is the period during power-up of the energy recovery circuit (and the plasma display panel) in which the source capacitor Cs is charged from an initial condition in which the voltage across the capacitor is zero to a condition in which the voltage across the capacitor is about Vs/2, Vs being the voltage supplied by the reference voltage supply unit (30) in normal operation. Moreover, during this "*initial period*" the voltage

supplied by voltage supply unit (30) rises from zero to Vs (cf original description, paragraphs [22], [35] to [38], [52] to [54] and figures 5 and 6).

Accordingly, unlike what is defined in claim 1, only at the very beginning of the "*initial period*" both the panel and the source capacitor "*are not charged with a voltage*".

In fact, according to the appellant "*In the invention the initial period is a period in which the panel and source capacitors are at first not charged with a voltage but wherein Cs becomes charged over the length of the initial period*" (cf statement of grounds of appeal, page 2, third paragraph).

2.1.3 Furthermore, as far as clear from the description and drawings, in order for the source capacitor to be charged from an initial voltage of zero to a voltage of Vs/2 (more precisely, to half the voltage supplied by unit (30) as it rises to Vs), the process of T1 to T6 as shown in figure 3 is performed several times (cf original description, paragraphs [22], [51], [54] and figures 5 and 6).

Claim 1 fails to clearly define how the rising pulse rising to a predetermined reference voltage is supplied to the panel capacitor in the initial period.

It is noted in this respect that there is no basis in the application for the appellant's contention that according to the application the source capacitor is charged with Vcc/2 before the first one cycle of the energy recovery circuit, or in other words, that in the

initial period no switching through the steps T1 to T6 is provided (cf letter of 21 may 2007, point I; letter of 5 November 2010, page 4, fifth paragraph).

In fact, according to the description (see paragraph [22] referred to above), "*Practically, in order for the source capacitor Cs to be charged with a voltage of Vs/2, the processes of T1 to T6 as shown in FIG. 3 should be repeatedly performed several times. Also, during this processes a value of the voltage applied to across the third switch S3 gradually lowers from Vs to Vs/2, thus an internal voltage of the third switch S3 is set to about Vs*". This paragraph relates to the prior art energy recovery circuit referred to in the application, however "*As such, the operation timings of the first switch to fourth switch S1 to S4 according to an embodiment of the present invention are the same as the prior art shown in FIG. 3, thus it will be not explained here in detail*" (cf paragraph [51] referred to above). No other operation timings of the first to fourth switch during the "*initial period*" for charging the source capacitor are disclosed anywhere in the application.

2.1.4 Accordingly, claim 1 according to the main request lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973.

2.2 Novelty

2.2.1 *Document D1*

Document D1 discloses an energy recovery circuit for a plasma display panel having sustain and address

electrodes. As indicated in D1, the address electrodes of such a plasma panel display can be reasonably modelled as a simple capacitance. This panel capacitance needs to be charged and discharged for storing and erasing information and for sustaining stored information. The circuit uses inductors in charging and discharging the panel capacitance so as to recover 90% of the energy normally lost in driving the panel capacitance (cf page 3, lines 3 to 21).

In particular, the circuit includes a capacitor Css, an inductor L and a reference voltage supply unit Vcc (cf page 8, line 13 to page 12, line 29; figures 5 to 9).

Accordingly, document D1 discloses, using the terminology of claim 1, an energy recovery circuit, comprising
a panel capacitor (Cp);
a source capacitor (Css) for recovering a voltage from the panel capacitor (Cp), and supplying the voltage charged to the source capacitor (Css) to the panel capacitor (Cp); and
an inductor (L) disposed between the source capacitor (Css) and the panel capacitor (Cp), as defined in the pre-characterising portion of claim 1.

Furthermore, in D1 "*In fact, on power up, as Vcc rises, if the driver is continuously switched through the four states explained above, then Vss will rise with Vcc at Vcc/2*"(cf page 8, lines 39 to 40). Moreover, in the second of the four states of the switching operation, switch S3 is closed so as to clamp the voltage of the panel (Vp) to Vcc (cf page 8, lines 26-27).

Accordingly, document D1 discloses, using the terminology of claim 1, a reference voltage supply unit (Vcc) for supplying a rising pulse rising to a predetermined reference voltage (Vcc) to the panel capacitor (Cp) in an "*initial period*" in which the panel capacitor (Cp) and the source capacitor (Css) are (at first) not charged with a voltage and for supplying a reference voltage (Vcc) to the panel capacitor (Cp) in a period in which the panel capacitor (Cp) is charged with a first voltage (Vcc) and the source capacitor (Css) is charged with a second voltage (Vss=Vcc/2) which is lower than the first voltage.

2.2.2 The appellant argued that document D1 was silent with respect to any information regarding the question how fast the voltage Vcc increased when the driver circuit switched through the four states. Rather, document D1 only taught that, in case the voltage increase in one cycle was larger than Vcc/2, the switching elements had to be designed for a higher voltage compared with the operating voltage required in normal operation.

It is, however, noted that there is no basis in D1 for the appellant's contention that the voltage increase in one cycle would be larger than Vcc/2. D1 specifies that on power up, as Vcc rises, the driver is continuously switched through the four states, implying a gradual voltage increase over several cycles. Moreover, according to D1 "*Another advantage that this circuit has over prior proposed circuits is that T1, D1, T2 and D2 need only be 1/2 Vcc rather than the full Vcc voltage of prior circuits. Lower voltage switching devices, requiring lower breakdown voltages, are typically less costly to fabricate. This results in a*

lower parts cost for a discrete sustainer and lower integration costs for an integrated sustainer." (cf page 10, lines 34 to 37). A rapid increase of the output voltage of the power supply of D1 as suggested by the appellant would cause in particular a voltage of more than Vcc/2 across switch S2, which is what D1 explicitly wants to avoid.

The above advantage specified in D1 in fact corresponds to what the application seeks (cf original application, paragraphs [53], [54]).

The appellant argued, moreover, in this respect that the passage of D1 on page 10, lines 34 to 37 referred to above related to the normal operation of the energy recovery circuits explained in document D1 beginning on page 9, line 10, and not to the initial period.

It is, however, clear that the advantage of using lower voltage (Vcc/2) switching devices, with corresponding lower parts costs, implies that at no time during operation the voltage across the switches shall exceed Vcc/2. This evidently includes power-up, as otherwise the switches would fail at this point.

2.2.3 Accordingly, the subject-matter of claim 1 of the main request, as far as clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

2.3 The main request is, therefore, not allowable.

3. *First auxiliary request*

3.1 Claim 1 according to the first auxiliary request differs from that according to the main request in that it is specified that the source capacitor (Cs) is charged with a second voltage, which is lower than the first voltage **in the initial period**.

3.2 For the same reasons given above for the main request, claim 1 according to the first auxiliary request lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973.

3.3 Furthermore, it is unclear what is meant by "*the first voltage in the initial period*" (Article 84 EPC 1973).

According to claim 1, the "*first voltage*" is the voltage with which the panel capacitor is charged in a period in which the reference voltage supply unit supplies a reference voltage to the panel capacitor. As this period corresponds to normal operation, it remains undefined what the first voltage is in the "*initial period*" (Article 84 EPC 1973)

The paragraphs [35] and [52] of the original description referred to by the appellant (cf letter of 21 May 2007, point II) do not clarify the issue.

Moreover, insofar as the above feature requires the source capacitor to be charged with a voltage lower than that of the panel (capacitor), this is also the case in D1 (cf page 8, lines 13 to 40), so that as far as clear the additional feature does not provide any distinction over D1.

Accordingly, the subject-matter of claim 1 of the first auxiliary request, as far as clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

3.4 The first auxiliary request is, thus, not allowable.

4. *Second auxiliary request*

4.1 Claim 1 according to the second auxiliary request differs from that according to the main request in that it is specified that reference voltage supply unit is for supplying a rising pulse **rising with a predetermined slope**.

4.2 Claim 1 according to the second auxiliary request lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973, for the reasons given above for the main request.

4.3 Furthermore, the expression "*as Vcc rises*" in D1 (cf page 8, line 39) is considered to imply a rise with a predetermined slope.

The appellant's contention that in D1 this rise would be a "*square voltage waveform*" is unfounded. Rather, the specification in D1 that "*In fact, on power up, as Vcc rises, if the driver is continuously switched through the four states explained above, then Vss will rise with Vcc at Vcc/2*" (cf page 8, lines 39-40) implies a gradual increase of Vcc over several cycles.

Accordingly, the subject-matter of claim 1 of the second auxiliary request, as far a clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

4.4 The second auxiliary request is, thus, not allowable either.

5. *Third auxiliary request*

5.1 Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that the last part reads:

"*and for supplying a reference voltage to the panel capacitor (Cp) when the energy recovery circuit normally operates, wherein the source capacitor (Cs) is charged with a gradually rising voltage with a predetermined slope during the supply of the rising pulse.*"

5.2 Claim 1 according to the third auxiliary request lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973, for the reasons given above for the main request.

5.3 Furthermore, in D1 (in state 2 of the switching operation) a reference voltage (Vcc) is supplied to the panel capacitor (Cp) when the energy recovery circuit normally operates (cf page 8, lines 26-27). Moreover, as discussed above, in D1 the source capacitor (Css) is charged with a gradually rising voltage with a predetermined slope during the supply of the rising pulse, as defined in claim 1 (cf D1, page 8, lines 39-

40). The above additional features are, thus, also known from D1.

Accordingly, the subject-matter of claim 1 of the third auxiliary request, as far a clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

5.4 The third auxiliary request is, thus, not allowable either.

6. *Fourth auxiliary request*

6.1 Claim 1 of the fourth auxiliary request corresponds to claim 1 of the third auxiliary request, with the following additional feature:

"*wherein the voltage charged to the source capacitor (Cs) is increased until it reaches a voltage corresponding to approximately half the reference voltage (Vs).*"

6.2 Claim 1 according to the fourth auxiliary request also lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973, for the reasons given above for the main request.

6.3 Furthermore, in D1 the voltage (Vss) charged to the source capacitor (Css) is increased until it reaches a voltage ("*Vss will rise with Vcc at Vcc/2*") corresponding to approximately half the reference voltage (Vcc) (cf page 8, lines 39-40). The above additional features are, thus, also known from D1.

Accordingly, the subject-matter of claim 1 of the fourth auxiliary request, as far a clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

6.4 The fourth auxiliary request is, thus, not allowable either.

7. *Fifth and sixth auxiliary requests*

7.1 The appellant's fifth and sixth auxiliary requests for the grant of a patent on the basis of amended claims were filed after oral proceedings before the board were arranged.

Any such request entails *inter alia* an assessment by the board as to the conformity of the request with procedural requirements, the request being filed after the statement setting out the grounds of appeal have been submitted and thus its admission and consideration being subject to the board's discretion (Article 13(1) RPBA), and, if admitted, an assessment as to the conformity of the claimed subject-matter with the requirements of the EPC, notably clarity, added subject-matter novelty and inventive step, as a result of which grounds for a decision adversely affecting the appellant may arise. An appellant submitting such a request should, therefore, expect such grounds to be advanced.

An appellant renouncing to come to oral proceedings before the board to which it was duly summoned must be taken to waive its right to present comments on any such grounds (Article 113(1) EPC 1973).

It is noted that a different conclusion, ie that the appellant should be given the opportunity to comment, specifically on his request being held inadmissible or not allowable, would make a continuation of the proceedings in writing necessary and thus oblige the board to delay its decision in the proceedings by reason only of the absence at the oral proceedings of the party, contrary to Article 15(3) RPBA.

7.2 In view of the fact that the fifth and sixth auxiliary requests were filed in advance of the oral proceedings, constitute an attempt to overcome the objections raised and are provided with reasons in support thereof, and do not raise issues which the board cannot deal with without adjournment of the oral proceedings (Article 13(3) RPBA), the board exercises its discretionary powers under Article 13(1) RPBA so as to admit the requests into the proceedings.

8. *Fifth auxiliary request*

8.1 Claim 1 of the fifth auxiliary request essentially differs from claim 1 of the first auxiliary request in that in the initial period

- a gradually rising pulse is supplied,
- the pulse is supplied to the panel capacitor and the source capacitor,

and in that

- the source capacitor is gradually charged with a half of the reference voltage, while the reference voltage supply unit, supplies a voltage , gradually increasing from zero volt to the reference voltage, to the panel capacitor in the initial period.

8.2 Claim 1 according to the fifth auxiliary request still lacks clarity and support by the description, contrary to the requirements of Article 84 EPC 1973, for the reasons given above for the main request.

8.3 Furthermore, the application as originally filed does not disclose a reference voltage supply unit (30) for supplying a gradually rising pulse rising to a predetermined reference voltage (Vs) to the source capacitor (Cs). In the original application at no point in time the reference voltage supply unit (30) is connected to the source capacitor (Cs) (cf figures 3 and 4 with the corresponding description). In particular, as shown in figure 3, which is also applicable to the circuit of figure 4 (cf paragraph [51]), switch S2 is only closed in periods T2 and T3, in which no connection from node n2 to the source capacitor (switch S3 is open and diode D5 is blocking when switch S1 is closed) is provided. It is noted that, as discussed above, no other operation of the switches, in particular during an "*initial period*", is disclosed in the application as originally filed.

Accordingly, the amendments introduce subject-matter, which extends beyond the content of the application as originally filed, contrary to Article 123(2) EPC.

8.4 Moreover, at any rate, gradually charging the source capacitor as defined in the last feature of the claim is known from document D1 (cf page 8, lines 13 to 40), as discussed above in particular with respect to the third and fourth auxiliary requests.

Accordingly, the subject-matter of claim 1 of the fifth auxiliary request, as far as originally disclosed and clear, lacks novelty with respect to document D1 (Articles 54(1) and (2) EPC 1973).

8.5 The fifth auxiliary request is, thus, not allowable either.

9. *Sixth auxiliary request*

9.1 Claim 1 of the sixth auxiliary request essentially differs from claim 1 of the fifth auxiliary request in that the pre-characterising portion of the claim and the definition of the "*initial period*" have been amended.

9.2 However, the same objections under Article 123(2) EPC and 54(1) and (2) EPC 1973 raised above against the fifth auxiliary request apply.

9.3 The sixth auxiliary request is, thus, not allowable either.

Order

For these reasons it is decided that:

The appeal is dismissed.

Registrar | Chair

S. Sánchez Chiquero | G. Eliasson