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# Datasheet for the decision of 24 July 2025

**Case Number:** T 1802/21 - 3.5.06

**Application Number:** 18193878.8

**Publication Number:** 3454167

**IPC:** G06F1/16, G06K9/00

**Language of the proceedings:** EN

**Title of invention:**
DISPLAY DEVICE AND MOBILE INFORMATION TERMINAL INCLUDING THE SAME

**Applicant:**
LG Display Co., Ltd.

**Headword:**
Moiré interference/LG DISPLAY

**Relevant legal provisions:**
EPC Art. 52(1), 56, 84
RPBA 2020 Art. 12(4), 12(6)

**Keyword:**
Main request - inventive step (no)
Auxiliary request 1 - clarity (no)
Auxiliary request 1 - inventive step (no)
Auxiliary requests 2 to 4 - not admitted

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**Boards of Appeal**

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**Case Number: T 1802/21 - 3.5.06**

# D E C I S I O N
# of Technical Board of Appeal 3.5.06
# of 24 July 2025

| | |
|---|---|
| **Appellant:** (Applicant) | LG Display Co., Ltd.<br>128, Yeoui-daero, Yeongdeungpo-gu<br>Seoul, 07336 (KR) |
| **Representative:** | Harden, Henry Simon<br>Kilburn & Strode LLP<br>Lacon London<br>84 Theobalds Road<br>London WC1X 8NL (GB) |
| **Decision under appeal:** | **Decision of the Examining Division of the European Patent Office posted on 21 April 2021 refusing European patent application No. 18193878.8 pursuant to Article 97(2) EPC.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | M. Müller |
| **Members:** | M. Domingo Vecchioni |
| | K. Kerber-Zubrzycka |

## Summary of Facts and Submissions

I. The appeal is directed against the decision of the examining division to refuse European patent application No. 18 193 878.8 on the grounds that the main request was found not to comply with the requirement of inventive step, Article 56 EPC, auxiliary request 1 with those of Articles 84, 123(2) and 56 EPC, auxiliary request 2 with those of Article 123(2) EPC and auxiliary request 3 with those of Article 56 EPC.

II. With the statement of grounds of appeal, the appellant requested that the decision of the examining division be set aside and that a patent be granted on the basis of the main request or, alternatively, on the basis of one of auxiliary requests 1 to 4, all filed with the statement of grounds of appeal.

The main request and auxiliary request 1 were identical to those considered in the decision under appeal.

III. In a communication pursuant to Article 15(1) RPBA, the board presented its preliminary opinion on the appeal.

The board first noted that the document identified as "D3" in the facts and submissions section of the contested decision did not correspond to the document that had been identified as such throughout the examination procedure, namely US 2004/0211960 A1 (Joo et al.), and that the appellant had also correctly referred to that latter document in the statement of grounds of appeal. The board thus adopted the following document designations:

D1: US 2017/220838 A1 (He et al.),
D3: US 2004/211960 A1 (Joo et al.),
D4: US 2016/140380 A1 (Carver et al.),

and noted that point 12.3 of the decision was to be understood as referring to D4.

Furthermore, the board introduced the following documents, in accordance with Article 114(1) EPC:

D5: Seok-Joo Byun et al., An efficient simulation and analysis method of moiré patterns in display systems, Optics Express, vol. 22, no. 3, February 2014, pages 3128-3136,

D6: J. Krumm et al., Sampled-grating and crossed-grating models of moire patterns from digital imaging, Optical Engineering, vol. 30, no. 2, February 1991, pages 195-206.

The board considered that claim 1 of the main request did not involve an inventive step, Articles 52(1) and 56 EPC, in view of D1 combined with D3. The board referred to D5 and D6 for common general knowledge.

In respect of auxiliary request 1, the board tended not to follow the examining division's objection under Article 123(2) EPC but raised an objection under Article 84 EPC against claim 1. Claim 1 was also considered not to involve an inventive step.

The board was not minded to admit auxiliary requests 2 to 4, Article 12(4) RPBA and Article 12(6), second sentence, RPBA.

IV. During the oral proceedings, the appellant maintained the requests filed with the statement of the grounds of appeal. At the end of the oral proceedings, the chair announced the decision of the board.

V. Claim 1 according to the main request reads:

"A display device comprising:

a rectangular display panel (DPNL) configured to receive a touch by a user's finger on a display area (16) of the rectangular display panel, wherein the rectangular display panel has a width and a length, the width being perpendicular to the length;

a transparent substrate (CP) disposed on the rectangular display panel to provide a surface contactable by a fingerprint of the user's finger; and

a fingerprint sensor (ISS) attached to a rear surface of the display panel such that the display panel is interposed between the transparent substrate and the fingerprint sensor, and configured to sense light reflected from the fingerprint of the user's finger, wherein the light reflected from the fingerprint is incident on the fingerprint sensor through the rectangular display panel and the fingerprint sensor has a length,

wherein the fingerprint sensor is attached on the rectangular display panel such that the length of the fingerprint sensor is at a predetermined angle oblique to a reference line (REF) parallel to the length of the rectangular display panel, and the fingerprint sensor and the rectangular display panel are in parallel planes."

VI. How claim 1 according to each of auxiliary requests 1 to 4 differs from claim 1 according to the main request is explained at points 13 and 17 to 19 of the reasons.

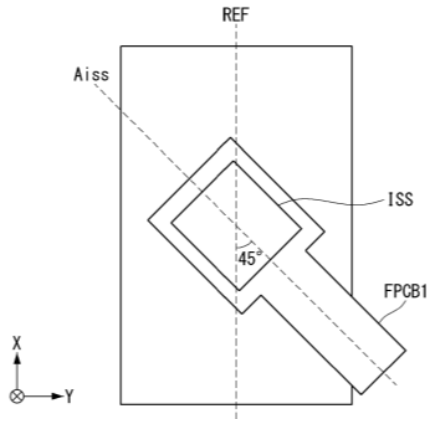
## Reasons for the Decision

*The application*

1. The application concerns a display device - such as that of a mobile phone - comprising a display panel (e.g. an OLED panel), a transparent substrate (e.g. a cover glass) disposed on top of the display panel, and a fingerprint sensor attached to the rear surface of the display panel (paragraphs [0049]-[0051], [0081]).

2. The fingerprint sensor (ISS) is attached to the rear surface of the display panel such that its "length" (longitudinal axis) is *at a predetermined angle oblique* to the "length" of the display panel, as shown in figures 10A and 11A. This angle may be between 20° and 45° (paragraphs [0073], [0103]).

**FIG. 10A**



3. According to the description, this oblique configuration serves to prevent *moiré interference* in the captured fingerprint images (shown in figure 9B). Such interference would otherwise result from the superposition of the periodic structures (plurality of lines, e.g. gate lines, spaced at regular intervals) of the display panel's pixel array and the fingerprint sensor's photosentitive array (paragraphs [0007], [0073], [0101], [0103]-[0107]).

*Main request - Article 56 EPC*

4. The main request is identical to the one considered in the decision under appeal.

5. The examining division found that claim 1 lacked an inventive step, Articles 52(1) and 56 EPC, starting from document D1. The display device of claim 1 differed from that of D1 in that the fingerprint sensor was attached to the display panel at a predetermined angle oblique to its length. Since claim 1 did not specify the pixel structures of either the display device or the fingerprint sensor, the technical effect of reducing moiré interference was not considered to be achieved over the whole scope of the claim. Consequently, claim 1 lacked an inventive step (contested decision, points 11 to 11.1.14).

Moreover, even assuming the technical effect were achieved, claim 1 still lacked an inventive step. The moiré effect and the circumstances under which it arises were well-known. The skilled person would thus have found document D3, which teaches that line patterns should be placed at an angle relative to one another to mitigate the moiré effect. Although D3 addressed a different structural configuration, the

skilled person would have applied its teaching to D1, thereby arriving at claim 1 (contested decision, points 11.1.15 to 11.1.16).

6. The appellant argued that the distinguishing feature of claim 1 over D1 produced the technical effect of "providing an improved combined display device and fingerprint sensor". This improvement was achieved through "an improved bonding method between a display panel and a fingerprint sensor[,] which method reduces moiré interference in an image obtained by the fingerprint sensor" (statement of grounds of appeal, page 2).

According to the appellant, a skilled person reading the claim, together with the description and drawings, would understand that it is *implicit* in claim 1 that the pixel matrix structure of the display panel is aligned with the "length" of the rectangular display panel, and that the pixel matrix structure of the fingerprint sensor is aligned with the "length" of the sensor, as shown in figure 22. Such alignment was the norm, and in absence of any indication to the contrary, it was to be presumed (statement of grounds of appeal, page 2).

Furthermore, the appellant submitted that irrespective of the specific pixel matrix structures, the invention "can reduce moiré [interference] and improve fingerprint recognition rate using any optical fingerprint sensor, by permitting optimisation of the attachment angle of the display panel and the sensor" (statement of grounds of appeal, page 2).

The display device of claim 1 therefore solved, over D1, the objective technical problem of "how to provide

an improved combined display device and fingerprint sensor" (statement of grounds of appeal, page 4).

D1 made no reference to image interference in the fingerprint sensor, let alone moiré interference. Accordingly, the skilled person starting from D1 would have had no motivation to consider moiré artefacts, nor to search for prior art addressing this issue, such as D3 (statement of grounds of appeal, page 4).

During the oral proceedings, the appellant further argued that even if the skilled person would have considered the possibility of moiré interference in the context of the system of D1, they would have provided a software solution to it, like the one disclosed in D1 for removing optical distortions in images captured by the fingerprint sensor.

D3, as a single patent document, did not constitute common general knowledge. Moreover, it did not teach a generally applicable principle. In D3, the fingerprint sensor was placed on top of an LCD panel. The type of interference described in D3 was not universal across all display devices. Thus, the skilled person would not have combined the teachings of D1 with D3 (statement of grounds of appeal, pages 3-5).

The proposed solution was also counter-intuitive, in that it sought to reduce moiré interference by deliberately misaligning the fingerprint sensor and the display matrix (statement of grounds of appeal, page 5).

In addition, this arrangement facilitated the separate manufacture of the display and sensor components, avoiding the need to integrate them in a single

manufacturing process to ensure precise geometric alignment (statement of grounds of appeal, page 5).

Accordingly, claim 1 involved an inventive step.

7. The board agrees with the conclusion of the examining division that claim 1 does not involve an inventive step, Articles 52(1) and 56 EPC, for the following reasons.

8. Document D1

8.1 D1 discloses a display screen that enables on-screen fingerprint sensing by means of an under-screen optical sensor module (paragraphs [0004], [0012]-[0013]; figures 2A and 2B). The display screen may be implemented in portable devices such as smartphones (paragraph [0053]).

8.2 The disclosed display screen comprises (see paragraphs [0055]-[0058] and [0061]-[0062]):
- a rectangular OLED display panel (figure 2B: "OLED Display Screen", part of the Device Screen Assembly; figures 2A and 2D confirm the rectangular shape),
- a top transparent layer through which the user touches the screen (figure 2C: Top Transparent Layer above the Device Screen Assembly), and
- an optical sensor module located below the display panel for capturing fingerprint images (figure 2B and 2C: Optical Sensor Module; see also figure 2D).

8.3 The OLED panel comprises an array of light-emitting pixels with associated electrodes and wiring (paragraphs [0057], [0071]; see also figure 3).

The optical sensor module includes a photodetector

array implemented as an optical imaging sensor array (paragraphs [0038], [0072]).

8.4 D1 acknowledges that optical distortions may arise in the fingerprint image process that would adversely affect the fingerprint sensing. It suggests to correct them during image reconstruction, for example via calibration using test patterns after assembly (paragraphs [0075], [0121]).

8.5 In one embodiment, the fingerprint sensor incorporates an array of optical collimators to guide the reflected light (carrying fingerprint information) toward the sensor array (paragraphs [0151]-[0154]), as shown in figure 21B:

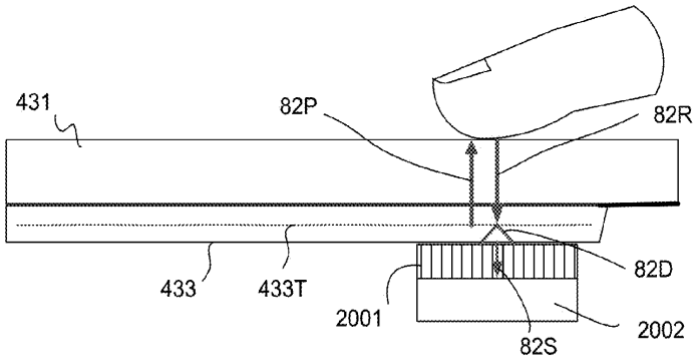



**FIG. 21B**

During operation, light (82P) emitted by the OLED pixels of the display panel (433) is reflected by the finger, passes back through the holes of the TFT layer (433T) of the OLED display panel and the holes of the collimator array (2001), and is then captured by the photosensitve pixels of the optical sensor array (2002) (paragraphs [0151]-[0154], [0158]-[0160]).

The optical collimator array exhibits a periodic

structure (shown in figure 22A) that matches the optical sensor array (paragraphs [0155], [0160]).

9. Comparison of claim 1 with D1

9.1 The display screen of D1 qualifies as a "display device" within the meaning of claim 1. It includes a "rectangular display panel" (the OLED display panel), a "transparent substrate" (the top transparent layer) and a "fingerprint sensor" (the optical sensor module).

9.2 It is undisputed that the sole distinguishing feature of claim 1 over D1 is:

**F1** the **fingerprint sensor is attached to the rectangular display panel** such that the length of the fingerprint sensor is **at a predetermined angle oblique** to a reference line parallel to the length of the rectangular display panel.

10. Objective technical problem

10.1 The board interprets "oblique" in feature F1 to mean that the "predetermined angle" is neither 0°, 90°, 180° nor 270°.

10.2 In its preliminary opinion, the board tended to agree with the examining division that, in the absence of any limitation in claim 1 regarding the presence and layout of pixel array in either the display panel or the fingerprint sensor, and given the undefined scope of the "predetermined angle", it was doubtful whether any technical effect - in particular a reduction of moiré interference - was achieved over the whole scope of the claim. However, in view of the reasons given below, this issue may be left open.

In the following, it is assumed - to the benefit of the appellant - that differentiating feature F1 produces the technical effect of reducing the occurrence of moiré interference in images captured by the fingerprint sensor.

10.3 However, even under this assumption, the board finds the objective technical problem as formulated by the appellant ("how to provide an improved combined display device and fingerprint sensor") to be overly broad. It fails to account for D1's explicit acknowledgement of the potential for optical distortions in fingerprint images (see point 8.4 above).

10.4 A more appropriate formulation of the objective technical problem is *"how to reduce the occurrence of optical distortions in the images captured by the optical sensor array"*. The skilled person starting from D1 would have considered this technical problem.

10.5 The board notes that, to avoid hindsight, the formulation of the objective technical problem refers generically to "optical distortions" and not specifically to moiré interference, as the former but not the latter are explicitly addressed in D1.

Furthermore, the board does not follow the appellant's argument that the skilled person starting from D1 would only have considered *removing* optical distortions arising in captured images rather than *preventing* them to occur in the first place. The board considers that the skilled person would always seek for ways to prevent optical distortions to occur in the first place, and given that D1 mentions that optical distortions occur in the disclosed system, it would not

have required any inventive activity for the skilled person to consider the technical problem as formulated above.

Finally, the board notes that the appellant was correct in observing that the formulation of the objective technical problem given in the preliminary opinion - "how to reduce optical distortions in the images captured by the optical sensor array" - could be misunderstood as referring to the correction of optical distortions already present in such images. This, however, had not been the board's intention. The formulation has been clarified above, as was already done during the oral proceedings.

11. Obviousness

11.1 The board considers that the skilled person - namely, a display and optical sensing engineer - would have been aware, from common general knowledge, that moiré interference can occur when light passes through superposed optical layers having periodic structures, and/or when light passing through such an optical layer is subsequently captured by a sensor array having a periodic structure (see e.g. D5, section 1, and D6, section 1, first to third paragraphs, referring to these two cases as "crossed-grating" and "sampled-grating"). Moreover, this phenomenon is familiar from everyday experience - for instance, when a mobile phone captures an image of a computer screen, moiré fringes are often observed in the image.

Reducing moiré interference is a known and commonly addressed issue in the design of display devices for mobile phones (see e.g. D5, section 1, third paragraph).

11.2 Accordingly, the board considers that, based on common general knowledge, the skilled person, confronted with the technical problem, would have recognised that the arrangement disclosed in D1 - particularly as illustrated in figure 21B - presents a risk of moiré interference in the fingerprint images captured by the optical sensor array. This is because the reflected light from the finger passes sequentially through two periodic layers (the OLED pixel array and the collimator array) before reaching the sensor array, which itself also has a periodic structure (see point 8.5 above).

11.3 In light of this, the skilled person would have been motivated to seek ways to specifically reduce the occurrence of *moiré interference* in the system of D1, and would have consulted relevant prior art, such as document D3.

11.4 Document D3

11.4.1 D3 discloses a display device, for use e.g. in mobile communication systems, comprising an optical fingerprint recognition device with a matrix configuration mounted on top of an LCD display panel. Illumination is provided by a backlight unit located beneath the LCD panel (paragraphs [0003]-[0009], [0031]-[0033], [0036]).

11.4.2 D3 explains that "when both pixel areas of the fingerprint recognition device and the LCD panel are not exactly aligned with each other while the fingerprint recognition device is disposed on the LCD panel, a moire image may appear thereon", due to the interaction of their respective periodic features such

as gate, data and output lines (paragraphs [0008]-[0010], figure 1).

11.4.3 To address this, D3 teaches that the appearance of a "moire image" may be prevented by pivoting the pixel area of the fingerprint recognition device with respect to the pixel area of the LCD panel by a "predetermined slope" when the fingerprint recognition device is combined with the LCD panel (paragraphs [0047]-[0050]). D3 notes that this effect is achieved even though the two units are "misaligned" (paragraphs [0050], [0070], [0076]).

11.4.4 D3 specifies that a suitable rotation angle is in the range "from about 22,5° to about 45°" (paragraphs [0067]-[0068]).

11.5 Combination of D1 with D3

11.5.1 The board considers that - although the arrangement in D3 places the fingerprint sensor above the display panel, whereas in D1 it is beneath - the skilled person would have derived from D3 the teaching that a moiré interference - here caused by light passing through the periodic structures of a display panel and a fingerprint sensor - can be reduced or avoided by orienting one of the layers at a predetermined angle (preferably between about 22,5° and about 45°) relative to the other, and that this can be implemented by attaching the fingerprint sensor to the display at that angle.

11.5.2 In view of this teaching, the skilled person seeking to reduce optical interference in the fingerprint sensing arrangement of D1 would have considered the approach disclosed in D3. Specifically, the skilled person would

have contemplated attaching the fingerprint sensor (including the collimator array) at a predetermined angle oblique with respect to the OLED display panel, thereby arriving at feature F1 and thus at claim 1.

11.6 Accordingly, the board considers that claim 1 lacks an inventive step, Articles 52(1) and 56 EPC.

*Auxiliary request 1*

12. Auxiliary request 1 is identical to the one considered in the decision under appeal.

13. Claim 1 of auxiliary request 1 differs from claim 1 of the main request in that it includes the following additional features:

F1.1 the fingerprint sensor is configured to "obtain an image of the fingerprint", and

F1.2 "a pixel array of the rectangular display panel and a pixel array of the fingerprint sensor each includes a plurality of lines spaced at regular intervals, such that when the fingerprint sensor is attached to the display panel such that the length of the fingerprint sensor is at an angle of 45° to the reference line, moiré interference in the image obtained by the fingerprint sensor, caused by the plurality of the lines, is at a minimum".

14. Article 84 EPC

The board notes that feature F1.2 does not require the fingerprint sensor to be attached at an angle of 45°, nor does it require the claimed display device to

produce minimal moiré interference in a captured image. Rather, the claim characterises *the pixel arrays of the display device and the fingerprint sensors* to be such that *if* the fingerprint sensor were attached at an angle of 45°, the resulting moiré interference in an image would be at a minimum.

Determining whether a given device falls within the scope of claim 1 would thus in principle require comparing moiré interference across multiple *hypothetical* configurations at different angles, to assess whether the 45° configuration indeed produces a minimum. Identification of the minimum may be even more complex if any of pixel arrays has a non-uniform layout, as the degree of moiré interference may then not follow a convex function of the alignment angle. Furthermore, it is unclear whether a reliable assessment of moiré interference can be made based on a single image. Accordingly, the board considers the scope of claim 1 to be not clearly defined, contrary to Article 84 EPC.

The appellant did not contest this objection, which had been raised in the board's preliminary opinion.

15. Article 56 EPC

15.1 The appellant submitted that claim 1 is inventive for the same reasons as provided for the main request.

15.2 The board notes that feature F1.1 is already disclosed in D1, as this is the basis function of an optical sensor array.

As for feature F1.2, the use of regular pixel arrays in both the OLED display panel and the fingerprint sensor

is either implicitly disclosed in D1 or, at the very least, constitutes a conventional design choice — as acknowledged by the appellant. To the extent that F1.2 can be understood, it encompasses such commonly used pixel structures.

Accordingly, claim 1 does not involve an inventive step, Articles 52(1) and 56 EPC.

*Auxiliary requests 2 to 4*

16. Auxiliary requests 2 to 4 were filed for the first time with the statement of grounds of appeal. Their admittance is therefore at the discretion of the board, Article 12(4) RPBA.

17. Claim 1 of auxiliary request 2 differs from claim 1 of the main request in that it is specified that

F2.1 "a pixel array of the rectangular display panel and a pixel array of the fingerprint sensor each includes a plurality of lines spaced at regular intervals, such that when the fingerprint sensor is attached to the display panel such that the length of the fingerprint sensor is at an angle of 45° to the reference line, a clearest image, in terms of not having moiré interference, is obtained by the fingerprint sensor".

18. Claim 1 of auxiliary request 3 differs from claim 1 of the main request in that it is specified that

F3.1 "a sensor attachment direction line (Aiss) passes through a centre of the fingerprint sensor and a centre of direction of a width of a flexible printed circuit board on which the

fingerprint sensor is mounted",

F3.2 "a pixel array of the rectangular display panel and a pixel array of the fingerprint sensor each includes a plurality of lines spaced at regular intervals such that when the sensor attachment direction line (Aiss) is at 90 degrees to a reference line (REFF) parallel to the length of the rectangular display panel then moiré interference can be seen in stripe form due to interference between the fingerprint sensor and the display panel",

and in that the last feature of claim 1 is modified as follows:

F3.3 "wherein the fingerprint sensor is attached on the rectangular display panel such that the sensor attachment direction line (Aiss) ~~length of the fingerprint sensor~~ is at a predetermined angle oblique to ~~a~~ the reference line (REF) ~~parallel to the length of the rectangular display panel~~, and the fingerprint sensor and the rectangular display panel are in parallel planes".

19. Claim 1 of auxiliary request 4 differs from claim 1 of auxiliary request 3 in that it is further specified that

F4.1 "the predetermined angle is 20°".

20. The appellant stated that
- the amendments made in auxiliary request 2 aimed to overcome the objections under Articles 84, 123(2) and 56 EPC raised against the first auxiliary request in

points 14 to 17 of the contested decision (statement of grounds of appeal, page 7),
- the amendments made in auxiliary requests 3 and 4 aimed to overcome the objection under Article 123(2) EPC raised against the former second auxiliary request in points 18 and 19 of the contested decision (statement of grounds of appeal, pages 9-11).

At the oral proceedings, the appellant relied on its written submissions.

21. The board observes that all these objections had already been raised in the examining division's communication dated 8 April 2021 (see points 5-10), which followed a telephone consultation between the first examiner and the appellant's representative on 6 April 2021, in preparation of the oral proceedings scheduled for 14 April 2021.

Hence, auxiliary requests 2 to 4 could - and should - have been filed during the first-instance proceedings.

Instead, the appellant neither responded in substance to these objections nor attended the oral proceedings, only indicating in a letter dated 9 April 2021 that it would not be represented at the oral proceedings.

22. Furthermore, the board considers, prima facie, that an objection under Article 84 EPC similar to that raised above against feature F1.2 in auxiliary request 1 would apply to feature F2.1 in auxiliary request 2.

23. It is also not apparent that claim 1 of any of auxiliary requests 2 to 4 overcomes the objection of lack of inventive step, Articles 52(1) and 56 EPC.

23.1 For features F2.1, F3.1 and F3.2, the reasoning is similar to that presented for feature F1.2.

23.2 Regarding feature F4.1, the board considers that an angle of 20° is close to value of "about 22,5°" disclosed in D3 as part of the known range ("from about 22,5° to about 45°"). Moreover, the present application does not attribute any particular advantage to the 20° value in terms of moiré reduction. Paragraph [0106] merely states that this angle reduces the Y-dimension length of the fingerprint sensor - an obvious geometric consequence.

The appellant's argument that the 20° attachment angle "reduces the total number of intersecting rows and columns of the display and the sensor, thereby reducing the area of the display that is potentially affected by interference" (statement of grounds of appeal, page 12) lacks support in the description, which does not mention a reduction of the area potentially affected by interference.

23.3 Given these circumstances, the board decided not to admit auxiliary requests 2 to 4, Article 12(4) RPBA and Article 12(6), second sentence, RPBA.

## Order

## For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Stridde Martin Müller

Decision electronically authenticated