

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

| |
|---|
| To: SCHWEIGERT, JEREMY A. BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP 1279 OAKMEAD PARKWAY SUNNYVALE CA 94085 USA |
|---|

| |
|--|
| Date of mailing (day/month/year) 30 August 2017 (30.08.2017) |
|--|

| | |
|---|--|
| Applicant's or agent's file reference 42P110061PCT | FOR FURTHER ACTION See paragraph 2 below |
|---|--|

| | | |
|---|--|-------------------------------|
| International application No. PCT/US2016/066717 | International filing date (day/month/year) 14 December 2016 (14.12.2016) | Priority date(day/month/year) |
|---|--|-------------------------------|

| |
|--|
| International Patent Classification (IPC) or both national classification and IPC H01L 23/66(2006.01)i, H01L 23/522(2006.01)i, H01L 25/04(2006.01)i, H01L 23/538(2006.01)i, H01L 23/00(2006.01)i, H01Q 1/22(2006.01)i, H01Q 9/04(2006.01)i |
|--|

| |
|---------------------------------------|
| Applicant INTEL CORPORATION |
|---------------------------------------|

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

| | | |
|---|---|---|
| Name and mailing address of the ISA/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578 | Date of completion of this opinion 29 August 2017 (29.08.2017) | Authorized officer CHOI, Sang Won Telephone No. +82-42-481-8291 |
|---|---|---|

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2016/066717

Box No. 1 Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :
 - the international application in the language in which it was filed
 - a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2016/066717

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|--------|-------------|-----|
| Novelty (N) | Claims | <u>1-20</u> | YES |
| | Claims | <u>NONE</u> | NO |
| Inventive step (IS) | Claims | <u>NONE</u> | YES |
| | Claims | <u>1-20</u> | NO |
| Industrial applicability (IA) | Claims | <u>1-20</u> | YES |
| | Claims | <u>NONE</u> | NO |

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2016-0240495 A1 (INFINEON TECHNOLOGIES AG) 18 August 2016

D2: JP 5988004 B1 (TDK CORPORATION) 07 September 2016

1. Novelty and Inventive Step

1.1 Claims 1-7

1.1.1 Independent claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a semiconductor module (100) comprising: an integrated circuit (IC) chip (102) for wireless communication (see paragraph [0020] and figures 1b, 1d in D1); an interface layer (117) coupled to the IC chip (102) through a metallization layer (130), the interface layer (117) including an antenna structure (108) for transmitting and/or receiving wireless communication signals (see paragraphs [0024], [0027], [0032] and figures 1b, 1d in D1); and a package mold compound (112) formed on the interface layer (117), the package mold compound (112) including a region that is positioned between the antenna structure (108) and a parasitic antenna structure (136) with the package mold compound (112), the package mold compound (112) comprising an organic polymer such as an epoxy material that has an inorganic filling material, wherein the parasitic element (136) is a radio antenna element, which does not have any wired input, but instead absorbs radio waves radiated from the antenna structure (108) (see paragraphs [0027]-[0028], [0035]-[0036] and figures 1b, 1d in D1).

Claim 1 differs from D1 in an antenna unit for transmitting and receiving communications at a frequency of approximately 4 GHz or higher. However, this

Continued on Supplemental Box

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Box No. V

different feature is merely a variation of the disclosure of D1 considering the antenna structure (108) being suitable for applications and various frequencies of operation (see paragraph [0044] in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity. Accordingly, claim 1 would have been obvious over D1. Therefore, claim 1 lacks an inventive step under PCT Article 33(3).

1.1.2 Dependent claims 2-7

1.1.2.1 Claims 5-7

The additional feature of claim 5 can be easily conceived from the disclosure of D1 considering the antenna structure (108) coupled to a redistribution layer (121) through the metallization layer (130), the antenna structure (108) comprising a patch antenna or a coplanar patch antenna (see paragraphs [0025], [0032] and figures 1b, 3e-3f in D1).

The additional feature of claim 6 is merely a variation of the disclosure of D1 considering the interface layer (117) comprising the redistribution layer (121) and a dielectric coat (119) (see paragraph [0027] and figure 1b in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

The additional feature of claim 7 is merely a variation of the disclosure of D1 considering the semiconductor module (100) including an antenna structure (106), the antenna structures (106, 108) integrated to the IC chip (102) for microwave engineering processes (see paragraphs [0020]-[0021] and figure 1a in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

Accordingly, claims 5-7 would have been obvious over D1. Therefore, claims 5-7 lack an inventive step under PCT Article 33(3).

1.1.2.2 Claims 2-4

The additional features of claims 2-3 are merely variations of the disclosure of D2 considering a mold resin (40) comprising a first region (21A) having a recess

Continued on The Next Page

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Previous Page

portion (47) and a second region (21B), the second region (21B) thicker than the first region (21A) (see paragraph [0029] and figure 1 in D2), and a person skilled in the art would arrive at the claimed inventions by general experimentation alone without exercising any ingenuity.

The additional feature of claim 4 is virtually suggested by the feature of D2 considering an upper surface of an electronic component (31) exposed in the recess portion (47) so that a magnetic film (50) is in contact with the upper surface of the electronic component (31), wherein it is possible to enhance heat dissipation properties for the electronic component (31) if a material having a thermal conductivity higher than that of the mold resin (40) is used as a material of the magnetic film (50) (see paragraphs [0059]-[0060] and figure 12 in D2).

Accordingly, claims 2-4 would have been obvious over a combination of D1 and D2. Therefore, claims 2-4 lack an inventive step under PCT Article 33(3).

1.2 Claims 8-14

1.2.1 Independent claim 8

Independent claim 8, which relates to a microelectronic device, shares the same technical features with claim 1 except that a second substrate includes conductive layers and organic dielectric layers; and the microelectronic device comprises an electromagnetic interface (EMI) shield integrated with a mold material to shield radio frequency (RF) components from an EMI. However, in addition to the same reasoning as in claim 1, these different features of claim 8 are merely variations of the disclosures of D1 and D2 considering an interface layer (117) comprising a redistribution layer (121) and a dielectric coat (119) (see paragraph [0027] and figure 1b in D1) and a shield structure for an electronic component (31), the shield structure comprising a magnetic film (50) buried in a recess portion (47) formed in a mold resin (40) and a metal film (60), the metal film (60) being an electromagnetic shield (see paragraphs [0030], [0038], [0042] and figure 1 in D2), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity. In addition, D1 and D2 are in the related technical fields, and therefore it would not be particularly difficult for a person skilled in the art to combine D1 and D2. Accordingly, claim

Continued on The Next Page

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Previous Page

8 would have been obvious over a combination of D1 and D2. Therefore, claim 8 lacks an inventive step under PCT Article 33(3).

1.2.2 Dependent claims 9-14

The additional feature of claim 9 is merely a variation of the disclosure of D1 considering the interface layer (117) including an antenna structure (108) for transmitting and/or receiving wireless communication signals and a package mold compound (112) including a region that is positioned between the antenna structure (108) and a parasitic antenna structure (136) with the package mold compound (112), the package mold compound (112) comprising an organic polymer such as an epoxy material that has an inorganic filling material, wherein the parasitic element (136) is a radio antenna element, which does not have any wired input, but instead absorbs radio waves radiated from the antenna structure (108), and the antenna structure (108) is suitable for applications and various frequencies of operation (see paragraphs [0024], [0027]-[0028], [0035]-[0036], [0044] and figures 1b, 1d in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

The additional feature of claim 10 can be easily conceived from the disclosures of D1 and D2 considering an integrated circuit (IC) chip (102) for wireless communication (see paragraph [0020] and figures 1b, 1d in D1) and the shield structure comprising the magnetic film (50) buried in the recess portion (47) formed in the mold resin (40) and the metal film (60), the metal film (60) being the electromagnetic shield (see paragraphs [0030], [0038], [0042] and figure 1 in D2).

The additional feature of claim 11 can be easily conceived from the disclosure of D1 considering the antenna structure (108) comprising a patch antenna or a coplanar patch antenna (see paragraph [0025] and figures 1b, 1d, 3e-3f in D1).

The additional feature of claim 12 can be easily conceived from the disclosures of D1 and D2 considering the integrated circuit (IC) chip (102) (see paragraph [0020] and figures 1b, 1d in D1) and the shield structure for the electronic component (31) (see paragraphs [0030], [0038], [0042] and figure 1 in D2).

Continued on The Next Page

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Previous Page

The additional feature of claim 13 is merely a variation of the disclosure of D2 considering the metal film (60) connected to a power pattern (25G) such as a ground pattern (see paragraphs [0027], [0039] and figure 1 in D2), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

The additional feature of claim 14 is merely a variation of the disclosure of D1 considering a semiconductor module (100) integrally packaged with the IC chip (102) for the wireless communication (see paragraph [0020] in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

Accordingly, claims 9-14 would have been obvious over a combination of D1 and D2. Therefore, claims 9-14 lack an inventive step under PCT Article 33(3).

1.3 Claims 15-20

1.3.1 Independent claim 15

Independent claim 15, which relates to a computing device, shares the same technical features with claim 1 except for the computing device comprising: at least one processor to process data; and a communication module or chip coupled to the at least one processor; and an antenna unit for transmitting and receiving communications at a frequency of approximately 15 GHz or higher. However, in addition to the same reasoning as in claim 1, these different features of claim 15 are merely variations of the disclosure of D2 considering high-performance wireless communication circuits and digital chips adopted for electronic devices such as a smartphone, wherein an operating frequency of semiconductor ICs tends to increase (see paragraph [0002] in D2), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity. In addition, D1 and D2 are in the related technical fields, and therefore it would not be particularly difficult for a person skilled in the art to combine D1 and D2. Accordingly, claim 15 would have been obvious over a combination of D1 and D2. Therefore, claim 15 lacks an inventive step under PCT Article 33(3).

Continued on The Next Page

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Previous Page

1.3.2 Dependent claims 16-20

The additional features of claims 16-17 are merely variations of the disclosure of D2 considering a mold resin (40) comprising a first region (21A) having a recess portion (47) and a second region (21B), the second region (21B) thicker than the first region (21A) (see paragraph [0029] and figure 1 in D2), and a person skilled in the art would arrive at the claimed inventions by general experimentation alone without exercising any ingenuity.

The additional feature of claim 18 is virtually suggested by the feature of D2 considering an upper surface of an electronic component (31) exposed in the recess portion (47) so that a magnetic film (50) is in contact with the upper surface of the electronic component (31), wherein it is possible to enhance heat dissipation properties for the electronic component (31) if a material having a thermal conductivity higher than that of the mold resin (40) is used as a material of the magnetic film (50) (see paragraphs [0059]-[0060] and figure 12 in D2).

The additional feature of claim 19 can be easily conceived from the disclosure of D1 considering an antenna structure (108) comprising a patch antenna or a coplanar patch antenna (see paragraph [0025] and figures 1b, 1d, 3e-3f in D1).

The additional feature of claim 20 is merely a variation of the disclosure of D1 considering a semiconductor module (100) integrally packaged with an integrated circuit (IC) chip (102) for wireless communication, the semiconductor module (100) including an interface layer (117) comprising a redistribution layer (121) and a dielectric coat (119) (see paragraphs [0020], [0027] and figure 1b in D1), and a person skilled in the art would arrive at the claimed invention by general experimentation alone without exercising any ingenuity.

Accordingly, claims 16-20 would have been obvious over a combination of D1 and D2. Therefore, claims 16-20 lack an inventive step under PCT Article 33(3).

(NOTE: It is plausible that the phrase "the microelectronic device" mentioned in claim 20 is re-written as "the computing device".)

Continued on The Next Page

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2016/066717

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Previous Page

2. Industrial Applicability

Claims 1-20 are industrially applicable under PCT Article 33(4).