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**Datasheet for the decision
of 10 February 2022**

Case Number: T 2165/17 - 3.4.01

Application Number: 09777590.2

Publication Number: 2319121

IPC: H01Q1/24, H01Q9/02, H01Q5/00

Language of the proceedings: EN

Title of invention:

ANTENNALESS WIRELESS DEVICE CAPABLE OF OPERATION IN MULTIPLE
FREQUENCY REGIONS

Applicant:

Ignion, S.L.

Headword:

Multiband wireless device / Ignion

Relevant legal provisions:

EPC Art. 84, 56, 83, 123(2)

Keyword:

Sufficiency of disclosure - main request (yes)
Claims - clarity - main request (yes)
Inventive step - main request (yes)
Amendments - main request - added subject-matter (no)



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Case Number: T 2165/17 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 10 February 2022

Appellant: Ignion, S.L.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 24 March 2017
refusing European patent application No.
09777590.2 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman B. Noll
Members: T. Petelski
Y. Podbielski

Summary of Facts and Submissions

- I. The applicant appealed the Examining Division's decision to refuse the European patent application 09777590.
- II. The Examining Division held that claim 1 of the main request then on file lacked clarity and that its subject-matter did not involve an inventive step over

D6: US 2007/146212 A1.

The respective reasoning referred to the technical background documents

D8: J. Villanen et al.: "A coupling element-based quad-band antenna structure for mobile terminals", Microwave and Optical Technology Letters, Vol.49, No.6, 1 June 2007, pages 1277-1282;

D9: J. Villanen et al.: "Optimum dual-resonant impedance matching of coupling element based mobile terminal antenna structures", Microwave and Optical Technology Letters, Vol.49, No.10, 27 October 2007, pages 2472-2477; and

D10: J. Villanen et al.: "Coupling Element Based Mobile Terminal Antenna Structures", IEEE Transactions on Antennas and Propagation, Vol.54, No.7, 1 July 2006, pages 2142-2153.

- III. Further according to the decision, auxiliary requests 1 - 7 were not allowable for lack of clarity of their respective claims 1. In addition, the subject-matter of claim 1 of auxiliary request 3 also lacked an inventive step over D6.
- IV. In a passage named "Obiter dictum", the Examining Division raises an objection of insufficient disclosure that is not part of the decision. Although Article 82 EPC (Unity of invention) is also mentioned under that passage, no respective reasoning is present.
- V. In their statement setting out the grounds of appeal, the appellant requested that the decision be set aside and that a patent be granted on the basis of the main request then on file or of one of auxiliary requests I, II, IIa, III, IIIa, IV, V, VI, VII and VIII. Auxiliary requests II, IIa and IIIa were filed for the first time with the statement of grounds of appeal, the other requests were re-numbered copies of the requests underlying the decision under appeal. The appellant requested remittal to the Examining Division, should the Board consider the objections under Article 82 or 83 EPC relevant.
- VI. In a communication annexed to the summons to oral proceedings, the Board informed the applicant of its provisional opinion, according to which claim 1 of all auxiliary requests lacked clarity. Further, the subject-matter of claim 1 of the main request and of claims 1 of auxiliary requests II and IV lacked an inventive step over D6; and the subject-matter of claims 1 of auxiliary requests II, IIa and IIIa

extended beyond the content of the application as filed.

VII. In response, the applicant submitted, with its letter dated 10 January 2022, a new main request A, a main request B and auxiliary requests IIb, Va, Vb and Vc, along with amended description pages 30 and 32 for each of the total number of 17 requests.

VIII. Oral proceedings were held by video-link, during which the applicant submitted a new main request.

IX. Claim 1 of this main request is the sole independent claim and reads:

A wireless handheld or portable device (100) comprising:

- a user interface module (101),*
- a processing module (102),*
- a memory module (103),*
- a communication module (104) and,*
- a power management module (105);*

the communication module (104) including a radiating system capable of transmitting and receiving electromagnetic wave signals in a first frequency region and in a second frequency region, wherein the highest

frequency of the first frequency region is lower than the lowest frequency of the second frequency region;

said radiating system comprising a radiating structure comprising or consisting of at least one ground plane layer capable of supporting at least one radiation mode, the at least one ground plane layer including at least one connection point; at least a first and a second radiation booster to couple electromagnetic energy from/to the at least one ground plane layer, each radiation booster including a connection point; and at least two internal ports, wherein, for each booster, an internal port is defined between the connection point of the radiation booster and one of the at least one connection point of the at least one ground plane layer;

wherein the at least one ground plane layer has associated a ground plane rectangle (450),

wherein the ground plane layer is irregularly shaped compared to a rectangular ground plane layer, featuring a rectangular shape having a short edge and a long edge, which has been modified to include two cut-out portions in which metal has been removed from the ground plane layer, wherein a first cut-out portion has been provided where the ground plane layer had its first corner, while a second cut-

out portion has been provided where the ground plane layer had its second corner, and wherein the ground plane layer has a ground plane rectangle equal to the rectangular shape of the ground plane layer without the modification to include two cut-out portions,

wherein the first and second corner were at opposite ends of a short edge of the ground plane layer,

wherein the ratio between a long side of the ground plane rectangle (450), and the free-space wavelength corresponding to the lowest frequency of the first frequency region is larger than 0.2 and smaller than 1.0;

the radiating system further comprising a radiofrequency system, and an external port;

the radiofrequency system, for each of the at least two internal ports of the radiating structure, comprising a port connected to said internal port of the radiating structure, the radiofrequency system further comprising a port connected to the external port of the radiating system;

wherein the input impedance of the radiating structure at the/each internal port when disconnected from the radiofrequency system has an imaginary part

not equal to zero for any frequency of the first frequency region;

and wherein said radiofrequency system modifies the impedance of the radiating structure, providing impedance matching to the radiating system in the at least two frequency regions of operation of the radiating system,

wherein each radiation booster has a maximum size smaller than 1/30 times the free-space wavelength corresponding to the lowest frequency of the first frequency region,

wherein the first radiation booster is provided on the first cut-out portion, while the second radiation booster is provided on the second cut-out portion,

wherein the radiating structure is arranged within the wireless handheld or portable device such that there is no ground plane in the orthogonal projection of a radiation booster onto the plane containing the ground plane layer, and

wherein the orthogonal projection of the first and second radiation boosters on the plane containing the ground plane layer is completely inside the perimeter of the ground plane rectangle.

X. Dependent claim 6 reads:

The wireless device of any of claims 1 to 5, wherein the at least one radiation booster (401) comprises or is a conductive part which may take the form of, a conducting strip comprising one or more segments, a polygonal shape such as a triangle, a square, a rectangle, a hexagon, a circle, an ellipse, a polyhedral shape, a cylinder, a sphere or a combination thereof, wherein preferably the connection point of the at least one radiation booster is located substantially close to an end, or to a corner, of said conductive part.

- XI. The claims of the auxiliary requests are not relevant for the present decision.

Reasons for the Decision

The teaching of the application

1. The invention relates to mobile devices that are able to communicate in different radio frequency bands. Small capacitive patches of metal, called "boosters" in the application, are arranged with respect to the ground plate such that they efficiently couple radiation of different frequencies to and from the ground plate. The boosters need space, which is precious in mobile devices. The invention is aimed at an arrangement of boosters and ground plate that uses the available space effectively.

2. Commonly, an arrangement for emitting and receiving radio frequencies is called "antenna". The application, though, uses the unusual term "antennaless" in order to distinguish the non-radiating (and non-receiving) booster elements from conventional, self-radiating antenna elements (page 14, lines 16-23).

Main request - Amendments - Article 123(2) EPC

3. Claim 1 is based on claim 1 as originally filed, and comprises amendments that are based on original claims 2, 3 and 16, and on the following passages of the description:
 - (a) page 9, lines 26 - 28 (ports of radiofrequency system);
 - (b) page 13, lines 15 - 18 (1/30 wavelength);
 - (c) page 20, lines 6 - 9 (orthogonal projection);
 - (d) page 46, lines 34 - page 47, line 2;
 - (e) page 47, lines 18 - 32 (shape of ground plane and booster location); and
 - (f) page 47, lines 32 - page 48, line 3 (inside perimeter).
4. The dependent claims are based on original claims 4 - 8, 10, 20 - 23, 25, 26 and 28; and on the description page 11, lines 28 - 32.
5. Hence, there is a valid basis for the set of claims and the main request does not contain added subject-matter.

Main request - Sufficiency - Article 83 EPC

6. Claim 1 defines two boosters to be arranged in cut-out portions at the two corners of a short side of the ground plane rectangle. An example of such an arrangement is illustrated in Figure 11b. Realizations of suitable booster elements are described in relation to Figure 4 on page 36, lines 19 - 25, and on page 18, lines 15 - 22. It is common to these booster elements that they are conductive strips of metal with a size well below a quarter of the operating wavelength (see page 13, lines 15 - 33). Conductors of such small size couple capacitively with the ground plate and intrinsically have an input impedance with an imaginary part below zero, when considered in isolation.

7. The skilled person does not find a problem in realising such an arrangement, in which boosters in the form of capacitive patches of metal are placed in the cut-out portions of an otherwise rectangular ground plate. The Examining Division's objections (which were not part of the decision under appeal) relating to the nature, positioning and impedance of the boosters do, therefore, not apply to the invention as claimed in the main request.

8. Further according to the Examining Division, the skilled person did not learn from the application, how to design and implement the adaptation circuits (or "matching circuits"). D9 confirmed that it was problematic to provide adaptation circuits that matched the boosters to the ground plane, in order to excite the proper electro-magnetic modes.

9. The application describes one particular impedance matching circuit in relation to Figures 5, 6a, 7a-c and

8a-c (see page 41, line 6 to page 44, line 12). A suitable layout of a printed circuit board with pads 1807 for the impedance-matching circuit components (here with reference numbers 1811 and 1812) is shown in Figure 18. Although choosing the correct value of the capacitors and inductances of the circuits according to Figure 6a might require a certain level of experimentation, such a task is well within the knowledge and capability of a skilled person. Hence, the application discloses a workable example of how to realize a matching circuit.

10. Generally, impedance matching is a routine task for a person skilled in the field of radio frequency antennas. Therefore, it would have also been within her capability to design and use other impedance matching circuitries, such as those hinted at on page 24, line 7 to page 28, line 7 of the application. An exemplary process of how a skilled person would have determined the correct values for an impedance matching circuit by experimentation is described in D6 ([0036] - [0039] and Figure 2).
11. D9 refers to the difficulties of calculating the proper values for the components to be used in a matching circuit. This does not mean that the previously practised trial-and-error approaches (or complicated calculations) for finding suitable values for the electronic circuit-components were not feasible for the skilled person.
12. Hence, the invention as defined by the present set of claims is sufficiently disclosed.

Main request - Clarity - Article 84 EPC

13. The clarity objections that were raised against various versions of the claims in previous proceedings do not apply to any of the claims of the main request.
14. Claim 1 defines a wireless device, in which the ground plane layer has a basically rectangular shape with two cut-out portions at the two corners of a short edge. Two boosters are provided on these cut-out portions such that their projection lies completely inside the perimeter of the ground plane rectangle. Each booster is defined to have a certain maximum size, which implies that it has more than one size. For example, length, width and height are different sizes, and the largest of all could be the "maximum size". The claim does not hint at the narrower interpretation of the "maximum size" being a diameter of a minimal sphere enclosing the whole booster (and thereby equating to the size of the maximum cross-section), but does not exclude this interpretation, either.
15. The ground plane and the boosters in the wireless device of claim 1 are part of a radiating system. Claim 1 defines the radiating system as being connected, via two internal ports (the contacts between the boosters and the ground plane layer), to two ports of a radiofrequency system. It is also connected, via its external port, to a further port of the radiofrequency system.
16. Dependent claim 6 defines a booster as comprising or being a conductive part and lists examples of possible forms of the booster, while not excluding other forms. This is a restriction of the nature, but not of the form of the booster. Optionally, the connection point

of the booster is located "close to an end, or to a corner of said conductive part". The optional reference to a corner can only apply to forms that have a corner.

17. Hence, the nature, location, form and size of the boosters, as well as the nature of the ports of the radiofrequency system and the radiating system, are clearly defined. Since there are also no further clarity-related problems, the present set of claims is clear.

Main request - Inventive step - Article 56 EPC

18. D6 discloses a multi-band antenna for use in mobile wireless devices ([0028]). A rectangular ground plane 14 (see Figure 1) acts as main resonator for the radio frequency signals. The signals are coupled to and from the ground plane by two coupling-elements 12 and 18.
19. The coupling elements 12 and 18 are conductive patches which are "largely non-resonant at the desired operating frequencies" (the end of paragraph [0054]). They are, therefore, boosters in the sense of the application. The high-band coupling element 12 is cubic with a side length of 4 mm (see Figure 1). This is less than 1/30 times the wavelength of the lowest frequency of both the low-frequency band GSM850/900 (12 mm at 824 MHz) and the high-frequency band GSM1800/1900 (5.8 mm at 1710 MHz; see [0028] and the table in [0042]). The low-band coupling element 18 is of rectangular cuboid shape with a size of 4 mm by 4 mm by 39 mm (Figure 1). Its maximum size of 39 mm is more than three times larger than the maximum size as defined in claim 1.

20. The question of whether the skilled person, in consideration of the small size of the high-band coupling element, would have also shortened the low-band coupling element can be left unanswered, because the subject-matter of claim 1 involves an inventive step for another reason.

21. In D6, the coupling elements 12 and 18 are arranged outside the perimeter of the rectangular ground plane, facing its short side (Figures 1). Their positions and the locations of the connection points 16 and 20 with the ground plane are selected to optimize the capacitive coupling ([0033], [0034]). The strongest coupling is achieved in the areas of high electric field strength of the radio frequency modes, as is illustrated on the right-hand side of Figure 7. The corresponding paragraph [0054] highlights that the coupling elements 12 and 18 extend beyond the edges of the short side of the ground plane 14 but do not overlie the ground plane. Figures 6A-G illustrate an embodiment with arcuate coupling-elements, and also show the matching circuits 30 and 40 (for the latter see also Figure 2).

22. According to claim 1 of the main request, the boosters are arranged in cut-out portions of the ground plane rectangle and (their projections) are completely inside the perimeter of said rectangle. This arrangement differs from D6, in which the boosters 12 and 18 are positioned completely outside the ground plane rectangle 14.

23. The technical effect of this different arrangement lies in that it is more compact. In particular, the claimed arrangement does not necessitate a length and width of a mobile device beyond the dimensions of the ground

plate rectangle (see the application, page 48, lines 3 - 6).

24. The corresponding technical problem lies in achieving a more compact arrangement.
25. Starting from D6, the skilled person would not have acted contrary to its explicit teaching regarding the placement of the coupling elements 12 and 18 outside the ground plane rectangle. Rather, the skilled person might have considered slightly different shapes of the coupling elements, or - at the cost of efficiency - a smaller ground plate.
26. The only document on file that discloses a ground plane with a cut-out is D4. As illustrated in Figure 3, a single radiating antenna element 22 is placed in the centre of a triangular cut-out section at corner 30 of ground plane 18. In this case the cut-out is necessary to enable a proper emission and reception of the radiating antenna element 22, which employs ultra-wideband (UWB) technology for short-range communication (see [0031] - [0034]). The telecommunication antennas are not shown in the Figures and D4 contains no information about their placement (see [0031], lines 38 - 41).
27. The teaching of D4 cannot be transferred to D6, because in contrast to antenna element 22 in D4, the coupling elements 12 and 18 in D6 are non-radiating and do not require a cut-out for reasons of unimpeded radiation. In addition, they serve a different purpose, work in a different frequency range and need to be placed close to the short edge of the ground plane for a proper capacitive coupling with the latter. Therefore, the

skilled person would not have combined documents D4 and D6.

28. For these reasons, the subject-matter of claim 1 involves an inventive step over D6.

Conclusion

29. It follows from the above that the invention is disclosed in a manner sufficiently clear and complete for it to be carried out. Further, claim 1 of the main request is clear and its subject-matter involves an inventive step. This also applies to the dependent claims 1 - 10. The claims of the main request also comply with the other requirements of the EPC and are, therefore, allowable.

30. The compliance of the description with the EPC has not been examined during the appeal proceedings.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The case is remitted to the Examining Division with the order to grant a patent with the following claims and a description to be adapted thereto:

Claims 1-10 of the main request as filed during the oral proceedings before the Board on 10 February 2022.

The Registrar:

The Chairman:



C. Moser

B. Noll

Decision electronically authenticated