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(72) Inventors:
• **Bitzer, Thomas**
73614 Schorndorf (DE)
• **Pascht, Andreas**
73635 Rudersberg (DE)

(71) Applicant: **Alcatel Lucent**
75007 Paris (FR)

(74) Representative: **Michalski Hüttermann & Partner**
Patentanwälte
Neuer Zollhof 2
40221 Düsseldorf (DE)

(54) **Wireless communication antenna devices and method for heat dissipation in such devices**

(57) The invention proposes a wireless communication antenna device (10) comprising:
a base element (12);
at least one antenna unit (14) mounted on one side (16) of the base element (12), the antenna unit (14) comprising an antenna structure (18) and a transceiver and/or amplifier device; and

at least one heat transfer element (26) assigned to the antenna unit (14) and extending from said assigned antenna unit (14) to the base element (12) being part of a heat sink (28) or to a heat sink (28) located on the opposite side of the base element.

The invention further proposes a corresponding method for heat dissipation in a wireless communication antenna device (10).

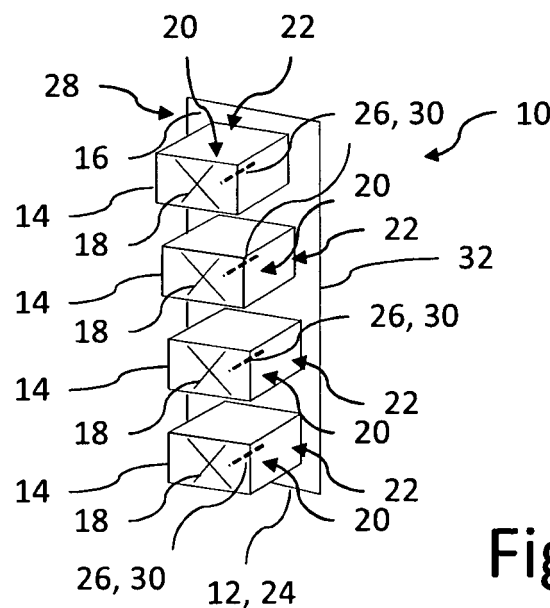


Fig. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless communication antenna device and a method for heat dissipation in such a device.

BACKGROUND

[0002] In the field of networks for wireless telecommunication, different wireless communication antenna devices are known. There is a trend to shorten the distance between the antenna structures and the transceiver and/or amplifier units. While macro base stations are typically installed on the ground or below a roof of a building and thus lossy feeder cables to the antenna structures are needed, the radio remote heads are installed directly at the mast close to the antenna structures. This saves power losses due to shorter feeder cables but still does not allow new and energy-saving features like individual beam forming for the single users.

SUMMARY

[0003] Various embodiments provide a wireless communication antenna device comprising: (i) a base element; (ii) at least one antenna unit comprising an antenna structure and a transceiver and/or amplifier device and being mounted on one side of the base element; and (iii) at least one heat transfer element assigned to the antenna unit and extending from the transceiver and/or amplifier device of said assigned antenna unit to at least one heat sink. The base element is a carrier for the at least one antenna unit. The heat transfer element thermally connects the transceiver and/or amplifier device to the heat sink. The complete heat sink or at least a part of the heat sink is arranged on the opposite side of the base element. This opposite side of the base element is the opposite side of the one side (with the at least one antenna unit).

[0004] The antenna device comprises one antenna unit or a plurality of antenna units, each unit with an antenna structure and a transceiver and/or amplifier device. Therefore, the antenna device is an active antenna device with active antenna unit(s).

[0005] This at least one active antenna device is the next step in miniaturization of the wireless communication antenna device. With said wireless communication active antenna device, the disadvantage of a high signal attenuation due to lossy cables can be overcome. On the other hand, said active antenna device is a new approach for higher flexibility and energy-saving in mobile telecommunication. The principle is that each antenna structure (or antenna element) is directly connected with a transceiver and/or amplifier device in the corresponding active antenna unit. That means that the transceiver and/or amplifier device can be located within a common antenna

radome covering the one side of the base element.

[0006] For the individual antenna units, the idea is to implement the transceiver together with the passive antenna structure in a compact unit. Several of these units can then be mounted in the antenna radome, depending on the wanted total output power, overall radiation characteristic, etc.

[0007] A resulting challenge of these kinds of active antenna devices is that the heat occurring due to the transceiver losses (due to the digital and analog hardware and due to the limited final amplifier efficiency) must be dissipated from the antenna unit(s) to the environment outside of the active antenna device. According to these embodiments, the at least one heat transfer element and the heat sink are used for the necessary heat dissipation. This heat transfer element conducts the heat generated within the corresponding antenna unit to the base element of the antenna device or directly to the opposite side of the base element, which is the side opposite to the side with the antenna unit(s).

[0008] If the wireless communication antenna device comprises a plurality of these antenna units, each antenna unit (comprising an antenna structure and a transceiver and/or amplifier device) is assigned to at least one corresponding heat transfer element.

[0009] The heat transfer element can transport at least as much thermal output (in the sense of a power P) by conductive heat transfer from the transceiver and/or amplifier device to the heat sink as said transceiver and/or amplifier device produces due to its power loss (P_{loss}) in its operating state (defined by operating temperature, etc.). In some embodiments, the heat transfer element can transport even more thermal output by conductive heat transfer than a maximum thermal output produced by the transceiver and/or amplifier device due to its power loss (P_{loss}) in its operating state.

[0010] According to a further embodiment, the base element is a heat conducting base element. This heat conducting base element especially is a metal base element. A metal base element is known from the passive wireless communication antenna devices of macro base stations. In these passive devices, the metal base element is a metal panel.

[0011] In some embodiments, the heat sink comprises the heat conducting base element. The heat transfer element contacts the heat sink thermally at its heat conducting base element.

[0012] In another embodiment, the at least one heat transfer element extends from the corresponding antenna unit through the base element to the heat sink. The heat transfer element or each of the heat transfer elements thermally connects the corresponding antenna unit with the heat sink directly.

[0013] In some embodiments, the heat transfer element comprises at least one thermally conducting pin (or rod). The pin or rod especially is a metal pin or metal rod. Preferably, the heat transfer element is a thermally conducting pin or thermally conducting rod.

[0014] In some embodiments, the heat transfer element comprises at least one thermally conducting panel unit forming a casing part of the transceiver and/or amplifier device. This casing part can be composed frame-like. The thermally conducting panel unit(s) preferably is/are (a) metal panel unit(s).

[0015] In further embodiments, said heat sink comprises a cooling element and/or, a heat pipe and/or, a liquid cooler and/or an air cooler and/or a fan. Preferably, all these kind of elements are arranged on the opposite side of the base element. The cooling element can comprise cooling fins.

[0016] In another embodiment, the antenna device comprises a plurality of antenna units and a plurality of corresponding heat transfer elements. Especially, the heat transfer elements thermally connect the corresponding transceiver and/or amplifier devices with only one common heat sink.

[0017] According to yet another embodiment, the antenna device further comprises an antenna radome covering the at least one antenna unit on the one side of the base element.

[0018] Various embodiments of the invention provide a method for heat dissipation in a wireless communication antenna device. The corresponding antenna device comprises a base element and at least one antenna unit mounted on one side of the base element. Said antenna unit comprises an antenna structure and a transceiver and/or amplifier device. The waste heat of the transceiver and/or amplifier device is dissipated from the antenna device by means of at least one heat sink and at least one heat transfer element. The heat transfer element extends from the corresponding antenna unit to the heat sink, wherein the heat sink is at least partially arranged on the opposite side of the base element. Thus, the heat transfer element extends from the corresponding antenna unit to (a) the base element, wherein the base element is part of the heat sink or to (b) the heat sink located on the opposite side of the base element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Various embodiments are illustrated in the accompanying drawings, in which:

Fig. 1 shows a side view of a wireless communication antenna device according to a first preferred embodiment of the invention,

Fig. 2 shows a semi-transparent presentation of the antenna device shown in Fig. 1, and

Fig. 3 shows a side view of a wireless communication antenna device according to a second preferred embodiment of the invention.

[0020] In the following, the invention will be described with respect to the figures.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0021] In Fig. 1 a wireless communication antenna device 10 for a mobile communication device is shown. Said mobile communication device (not shown in its entirety) can be a base station, a mobile telephone, a handheld computer, etc. The wireless communication antenna device 10 comprises a base element 12 and a plurality of antenna units 14 mounted on one side 16 of said base element 12. The base element 12 shown in Figs. 1 to 3 is a base panel. Each of the antenna units 14 is formed as an antenna block and comprises an antenna structure 18 and a transceiver and/or amplifier device (not shown). Each antenna structure 18 is provided on one side 20 of the corresponding antenna unit 14 facing away from the base element 12. This antenna structure 18 is the non-active part of the antenna unit 14. The transceiver and/or amplifier device is provided on the opposite side 22 of the corresponding antenna unit 14 facing towards the base element 12. This transceiver and/or amplifier device is the active part of the antenna unit 14.

[0022] The base element 12 is a heat conducting base element 24, preferably made of metal (a metal base element). The heat conducting base element 24 is formed as a metal strip, whereby the antenna units 14 are mounted in a line along the longitudinal axis of said metal strip.

[0023] The wireless communication device 10 further comprises a plurality of heat transfer elements 26 (shown in Fig. 2), each corresponding to one of the antenna units 14 and extending from the transceiver and/or amplifier device of the corresponding antenna unit 14 to the heat conducting base element 24. The heat transfer elements 26 thermally connect the transceiver and/or amplifier device of the corresponding antenna unit 14 with the common base element 12, 24. This base element 12, 24 itself is a heat sink 28 or at least part of a heat sink 28 of all active antenna units 14. The heat transfer elements 26 of the embodiment shown in Fig. 2 are formed as thermally conducting pins 30. These thermally conductive pins 30 shown in Fig. 2 are preferably metal pins.

[0024] The opposite side 32 of the base element 12 and/or a margin area of other heat sink 28 elements build an outer surface of the antenna device 10. Possible other heat sink elements are a cooling element comprising cooling fins (not shown), a heat pipe system (not shown), etc.

[0025] Fig. 3 shows another preferred embodiment of the antenna device 10. The heat transfer element 26 is a casing part 34 of the transceiver and/or amplifier device comprising heat conducting panel units (preferably made of metal) surrounding the opposite side 22 of the corresponding antenna unit 14 with the transceiver and/or amplifier device.

[0026] The waste heat of the antenna unit 14, especially of the transceiver and/or amplifier device, is dissipated from the antenna device 10 by means of a heat sink 28 and at least one heat transfer element 26. The

heat transfer element 26 extends from the transceiver and/or amplifier device of the antenna unit 14, to the base element 12. The base element 12 is part of the heat sink 28.

[0027] In some embodiments, the heat sink 28 further comprises a cooling element with cooling fins mounted on the base element 12 and a fan. In other embodiments, the heat sink 28 further comprises a heat pipe and an external liquid cooler or air cooler. All these kind of elements are arranged on the opposite side of the base element 12. Therefore, these elements are not visible in Figs. 1 - 3.

[0028] Independently from the external shape of the heat transfer element 26, each of the heat transfer elements 26 is able to transport at least as much heat by conductive heat transfer from the transceiver and/or amplifier device to the heat sink 28 as the maximum thermal output produced by the transceiver and/or amplifier device due to its power loss.

[0029] The heat transfer element 26 is a thermal bridge from the single antenna unit 14 to the base element 12 (or directly to the heat sink 28). It is made of a material with low thermal resistance, favorably some metal, on which the lossy components of the transceiver and/or amplifier device are directly mounted so that an optimal heat transfer to the heat transfer element 26 and the heat sink 28 is possible. Since the amplifier part may be the component that generates the highest amount of waste heat, this part is preferably mounted on the heat transfer element 26. But all other parts that generate heat, either due to active operation or due to resistive losses, can be mounted on the heat transfer element 26 as well.

[0030] For the shape of the heat transfer element 26, there is a high degree of freedom. However, it is important that it does not influence the radiation pattern of the antenna structure(s) 18 in a negative way.

[0031] With the proposed invention, it is possible to dissipate waste heat from an array of active antenna units 14 while keeping an antenna radome (not shown) covering the one side 16 of the base elements 12 and the antenna units 14 mounted on this one side 16 water and humidity proof. This is one prerequisite to enable the feasibility of active antenna units 14 in a wireless communication antenna device 10, which allows more flexible and energy-saving mobile telecommunication.

[0032] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

[0033] Other variations to be disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent

claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting scope.

Claims

1. Wireless communication antenna device (10) comprising:

a base element (12);
at least one antenna unit (14) mounted on one side (16) of the base element (12), the antenna unit (14) comprising an antenna structure (18) and a transceiver and/or amplifier device; and
at least one heat transfer element (26) assigned to the antenna unit (14) and extending from the transceiver and/or amplifier device of said assigned antenna unit (14) to at least one heat sink (28), wherein said heat sink (28) is at least partially arranged on the opposite side (32) of the base element (12).

2. Antenna device according to claim 1, wherein the heat transfer element (26) can transport at least as much heat by conductive heat transfer from the transceiver and/or amplifier device to the heat sink (28) as the maximum thermal output produced by the transceiver and/or amplifier device due to its power loss in its operating state.

3. Antenna device according to claim 1 or 2, wherein the base element (12) is a heat conducting base element (24), especially a metal base element.

4. Antenna device according to claim 3, wherein the heat sink (28) comprises the heat conducting base element (24).

5. Antenna device according to claim 4, wherein the heat transfer element (26) contacts the heat sink (28) thermally at its heat conducting base element (24).

6. Antenna device according to one of claims 1 to 4, wherein the at least one heat transfer element (26) extends from the corresponding antenna unit (14) through the base element (12) to the heat sink (28).

7. Antenna device according to one of claims 1 to 6, wherein the heat transfer element (26) comprises at least one thermally conducting pin (30).

8. Antenna device according to one of claims 1 to 6, wherein the heat transfer element (26) comprises at least one thermally conducting panel unit forming a casing part (34) of the transceiver and/or amplifier device.

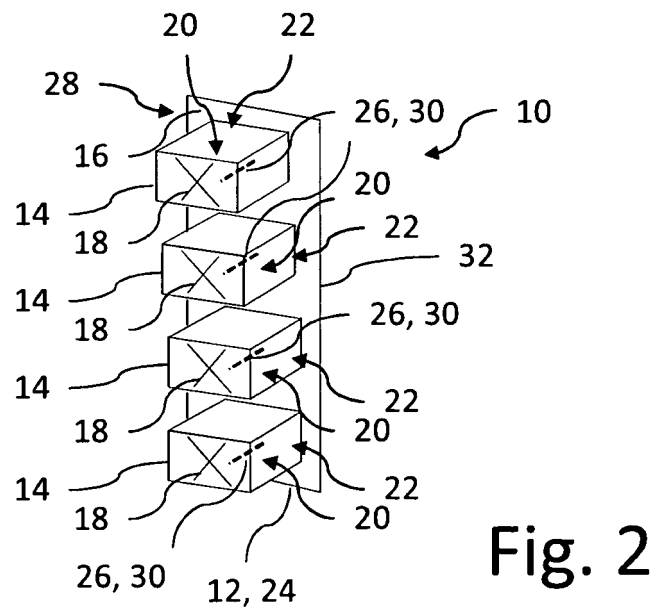
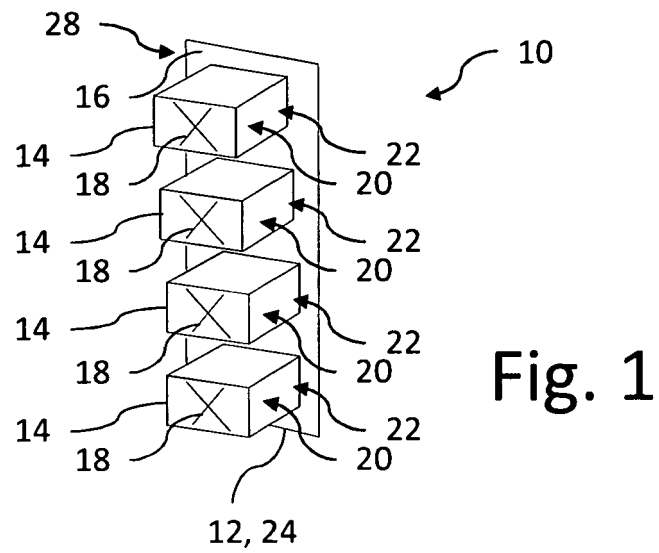
9. Antenna device according to one of claims 1 to 8,
wherein the heat sink (28) comprises at least one
element of the group of
a cooling element,
a heat pipe, 5
a liquid cooler
an air cooler and
a fan.
10. Antenna device according to one of claims 1 to 9, 10
comprising a plurality of antenna units (14) and a
plurality of corresponding heat transfer elements
(26).
11. Antenna device according to claim 10, wherein the 15
heat transfer elements (26) thermally connect the
corresponding transceiver and/or amplifier devices
with one common heat sink (28).
12. Antenna device according to one of claims 1 to 11, 20
further comprising an antenna radome covering the
at least one antenna unit (14) on the one side (16)
of the base element (12).
13. Method for heat dissipation in an wireless commu- 25
nication antenna device (10), the antenna device
(10) comprising a base element (12) and at least one
antenna unit (14) mounted on one side (16) of the
base element (12), wherein the antenna unit (14)
comprises an antenna structure (18) and a trans- 30
ceiver and/or amplifier device, wherein the waste
heat of the transceiver and/or amplifier device is dis-
sipated from the antenna device (10) by means of
at least one heat sink (28) and at least one heat trans- 35
fer element (26) extending from the corresponding
antenna unit (14) to the heat sink (28), wherein said
heat sink (28) is at least partially arranged on the
opposite side (32) of the base element (12).

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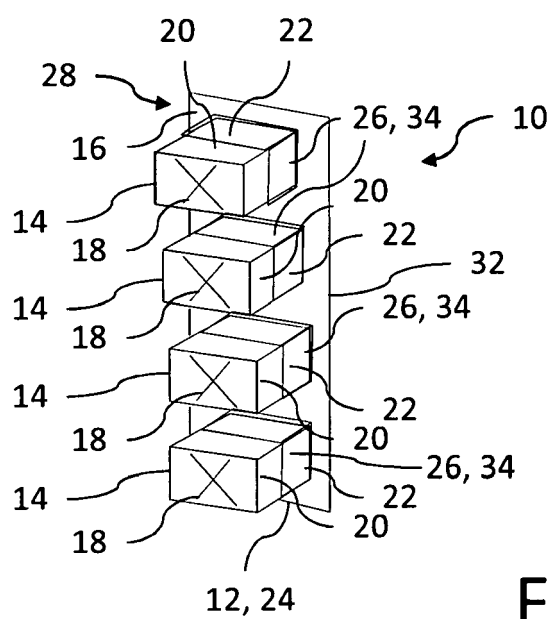


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 11 29 0332

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 328 042 A1 (EADS DEUTSCHLAND GMBH [DE]) 16 July 2003 (2003-07-16) * paragraphs [0034] - [0039]; figures 1-4 *	1-13	INV. H01Q23/00 H01Q21/00 H01Q21/06 H01Q1/02 H01Q1/42
X	US 6 184 832 B1 (GEYH EDWARD A [US] ET AL) 6 February 2001 (2001-02-06) * column 3, line 36 - column 7, line 46; claims 1,3,9,10,18,19; figures 1-3,9 * -----	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01Q
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 December 2011	Examiner Fredj, Aziz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 29 0332

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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07-12-2011

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