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**Datasheet for the decision
of 21 January 2011**

Case Number: T 2241/08 - 3.4.01

Application Number: 05257072.8

Publication Number: 1662612

IPC: H01Q 3/46

Language of the proceedings: EN

Title of invention:

A device for reflecting electromagnetic radiation

Applicant:

Agilent Technologies, Inc.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 123(2)

RPBA Art. 13

Relevant legal provisions (EPC 1973):

EPC Art. 83

Keyword:

"Enabling disclosure (no; all requests)"

Decisions cited:

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Catchword:

-



Case Number: T 2241/08 - 3.4.01

DECISION
of the Technical Board of Appeal 3.4.01
of 21 January 2011

Appellant:

Agilent Technologies, Inc.
- a Delaware Corporation -
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Representative:

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Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted 16 July 2008
refusing European patent application
No. 05257072.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: B. Schachenmann
Members: H. Wolfrum
F. Neumann

Summary of Facts and Submissions

I. European patent application 05 257 072.8 (publication No. EP-A-1 662 612) was refused by a decision of the examining division dispatched on 16 July 2008, *inter alia* for the reason of insufficiency of disclosure (Article 83 EPC 1973) of the subject-matter of claim 1 of a main request, being the only request which was admitted into the proceedings at the time.

II. The applicant lodged an appeal against the decision and paid the prescribed fee on 16 September 2008. On 18 November 2008 a statement of grounds of appeal was filed. The appellant requested the grant of a patent on the basis of sets of claims 1 to 6 according to a main request and an auxiliary request.

An auxiliary request for oral proceedings was made.

III. On 27 October 2010 the appellant was summoned to oral proceedings.

In a communication annexed to the summons, the Board gave a preliminary opinion on relevant issues, pointing *inter alia* to problems regarding added subject-matter and sufficiency of disclosure. As to the latter, the Board raised doubts as to whether the impedances of an antenna and a switching device could be established according to a claimed mathematical relationship within the whole ambit of the claims, given the broad ranges of possible impedances and frequencies of operation.

IV. In response to the objection as to added subject-matter, the appellant filed by letter of 21 December 2010 a new

set of claims 1 to 6, according to a main request, and a set of claims 1 to 4 according to an auxiliary request.

V. Oral proceedings were held on 21 January 2011.

As a result of the discussion, the appellant requested that the decision under appeal be set aside and a patent be granted, by way of a main request, on the basis of the set of claims 1 to 6 filed with the letter of 21 December 2010, or, according to a first auxiliary request, on the basis of a set of claims 1 to 6 filed at the oral proceedings, or, according to a second auxiliary request, on the basis of the set of claims 1 to 4 filed as auxiliary request with the letter of 21 December 2010.

VI. Claim 1 of the **main request** reads as follows :

"1. A device for reflecting electromagnetic radiation, the device including:

an array (10) of reflecting elements (12), each reflecting element comprising:

an antenna (20); and

a switching device (22) in electrical signal communication with the antenna,

wherein the switching device (22) has values of an on state impedance (Z_{on}) where $Z_{on} > 0$ and $Z_{on} < \infty$ and an off state impedance (Z_{off}) where $Z_{off} < \infty$ and $Z_{off} > 0$ for a radio frequency range, and

wherein physical attributes, which physical attributes have an effect on the impedance of the antennas, of the antennas (20) are configured such that the impedance ($Z_{antenna}$) of the antennas is conjugate to the square root

of the impedance of the switching devices (22) when in an on state (Z_{on}) multiplied by the impedance of the switching devices (22) when in an off state (Z_{off})."

Claims 2 to 6 are dependent claims.

Claim 1 of the **first auxiliary request** reads:

"1. A device for reflecting electromagnetic radiation, the device including:

an array (10) of reflecting elements (12), each reflecting element comprising:

an antenna (20); and

a switching device (22) in electrical signal communication with the antenna,

wherein the switching device (22) has values of an on state impedance (Z_{on}) where $Z_{on} > 0$ and $Z_{on} < \infty$ and an off state impedance (Z_{off}) where $Z_{off} < \infty$ and $Z_{off} > 0$ at a radio frequency $> 20\text{GHz}$, and

wherein physical attributes, which physical attributes have an effect on the impedance of the antennas, of the antennas (20) are configured such that the impedance ($Z_{antenna}$) of the antennas, at the frequency, is conjugate to the square root of the impedance, at the frequency, of the switching devices (22) when in an on state (Z_{on}) multiplied by the impedance of the switching devices (22) when in an off state (Z_{off})."

Claims 2 to 6 are dependent claims.

Claim 1 of the **second auxiliary request** reads :

"1. A device for reflecting electromagnetic radiation, the device including:

an array (10) of reflecting elements (12), each reflecting element comprising:

an antenna (20); and

a switching device comprising a solid state FET transistor (22) in electrical signal communication with the antenna,

wherein the solid state FET transistor (22) has values of an on state impedance (Z_{on}) where $Z_{on} > 0$ and $Z_{on} < \infty$ and an off state impedance (Z_{off}) where $Z_{off} < \infty$ and $Z_{off} > 0$ for a radio frequency range,

wherein physical attributes, which physical attributes have an effect on the impedance of the antennas, of the antennas (20) are configured such that the impedance ($Z_{antenna}$) of the antennas is conjugate to the square root of the impedance of the solid state FET transistors (22) when in an on state (Z_{on}) multiplied by the impedance of the solid state transistors (22) when in an off state (Z_{off}), and

wherein the sources of the solid state FET transistors (22) are DC grounded and the drains are either DC-grounded or floating, the source and drain of each solid state FET transistor (22) being connected to opposite terminals of the antenna (20) of the reflecting element (12) and gates of the solid state FET transistors (22) being connected to driver electronics."

Claims 2 to 4 are dependent claims.

Reasons for the Decision

1. In the following, reference is made to the provisions of the EPC 2000, which entered into force as of 13 December 2007, unless the former provisions of the EPC 1973 still apply to pending applications.
2. The appeal complies with the requirements of Articles 106 to 108 EPC and Rule 99 EPC and is, therefore, admissible.
3. Admissibility of the requests

The main request and the second auxiliary request were filed one month before the date of the oral proceedings. The first auxiliary request was filed during the oral proceedings. Thus, the present requests were filed in fairly late stages of the appeal proceedings, notably after the oral proceedings had been arranged.

Article 13 of the Rules of Procedure of the Boards of Appeal (RPBA) stipulates that requests of an appellant which are filed after filing the grounds of appeal may be admitted and considered at the Board's discretion.

In the present case, the amendments made to the main request and the second auxiliary request address an objection as to added subject-matter raised in the Board's communication that was annexed to the summons to oral proceedings. The amendments made to the first auxiliary request attempt to mitigate a particular aspect of insufficiency of disclosure that was discussed in detail during the oral proceedings.

For reasons of fairness, the appellant was given a chance to react to objections with which it was confronted for the first time by the Board's communication as well as to a particular line of reasoning which surfaced in the oral proceedings. Moreover, none of the amendments made raised issues which were surprising to the Board or which the Board could not be reasonably expected to deal with without adjournment of the oral proceedings. Therefore, the Board exercised its discretion in favour of the appellant and admitted all three requests into the proceedings.

4. Main request - sufficiency of disclosure (Article 83 EPC 1973)

4.1 Claim 1 requires a certain mathematical relationship to be met between the impedances of the antennas of an array of reflecting elements (reflectarray) and the impedances of switching devices which are, respectively, in electrical signal communication with the antennas. In particular, the claim definition requires physical attributes of each antenna to be configured such that each antenna's impedance (Z_{antenna}) is conjugate to the square root of the product formed by the impedance of the respective switching device when in an on state (Z_{on}) and the impedance of the switching device when in an off state (Z_{off}).

4.2 As is explained on page 6, second paragraph of the description as originally filed, designing an antenna of a reflecting element that exhibits optimal phase-amplitude performance involves a determination of the

on and off impedances, Z_{on} and Z_{off} of the respective non-ideal switching device that is used with the antenna and a subsequent manipulation of design parameters of the antenna to produce an antenna with an impedance that matches the claimed relationship.

According to page 4, first full paragraph of the description as filed, examples of antenna types that can be incorporated into a reflectarray include patch, dipole, monopole, loop, and dielectric resonator type antennas. Antennas have an impedance characteristic that is a function of their design parameters. Depending on the type of antenna, the design parameters include physical attributes such as the dielectric material of construction, the thickness of the dielectric material, shape of the antenna, length and width of the antenna, feed location, and thickness of the antenna metal layer. According to page 6, lines 13 to 16, of the originally-filed description, suitable switching devices are surface-mount field-effect transistors (FETs) and surface-mount diodes.

Figures 5 to 7 and the corresponding description illustrate a planar patch antenna in electrical signal communication with a switching device in the form of a surface mount FET.

- 4.3 One of the major problems with the claim definition arises from the claimed breadth of the impedance ranges for the (complex) impedances Z_{on} and Z_{off} of the switching device. The claim definition covers any numerical value for the square root of the impedances Z_{on} and Z_{off} between zero and infinity.

In distinction thereto, the impedances of existing antenna types can be varied by proper choices of the physical attributes of an antenna only in certain, limited ranges. Therefore, it is not technically feasible to modify the impedance of any type of antenna so as to meet the claimed relationship over the whole breadth of the specified ranges " $\infty > Z_{\text{on}} > 0$ " and " $\infty > Z_{\text{off}} > 0$ ".

4.3.1 The appellant has argued that the claimed ranges for the impedances Z_{on} and Z_{off} of the switching devices only signify that these devices were non-ideal switches, since it was the aim of the present invention to replace expensive ideal switching devices having $Z_{\text{on}} = 0$ and $Z_{\text{off}} = \infty$ by low-cost switches. It was the inventors' achievement to realize that an ideal switching behaviour which led to a phase change of 180° of the reflected radiation could be achieved just as well with inexpensive non-ideal switching devices, as long as the mutual impedances of the antennas and the switching devices satisfied the condition which was set out in claim 1.

Thus, the indications "0" and " ∞ " should be understood as approximations to the real world of existing switching devices. In practice, the skilled person would pick a non-ideal switching device and readily determine the impedances Z_{on} and Z_{off} thereof. Based on his common general knowledge, he would then choose a suitable type of antenna and adapt its impedance by properly modifying the antenna's physical attributes so as to match the claimed relationship. On occasion, this work could involve some amount of trial and error but would, nevertheless, be performed without undue burden.

4.3.2 This argumentation is found unconvincing.

First of all, it does not address the fact that claim 1 under consideration does not include any limitation as to the impedance ranges which are actually implementable, in particular for switching devices.

Apart from that, given the fact that there is a large number of diverse antenna types as well as of non-ideal switching devices, the claim definitions cover a vast number of possible combinations of such elements. It is improbable that each and every one of these combinations would be able to fulfil the claimed impedance relationship.

In this context, the application documents as filed do not provide any reliable information which would allow the skilled person to foresee which combinations of antenna type and switching element would be likely to succeed. Moreover, the application documents lack any teaching which would help lead the skilled person to establish which of a number of conceivable changes should be made in case of failure of a tested combination. Thus, in the absence of any form of guidance from the application documents as filed as to the kind of selections to be made, the extent of trial and error work to be executed for finding a working combination of elements imposes an undue burden on the skilled person.

As a matter of fact, the application documents as filed do not contain a single concrete embodiment which would provide at least one numerical example for an antenna

impedance (Z_{antenna}) and matching values of Z_{on} and Z_{off} . The example of Figures 5 to 7, which refers to a planar patch antenna in electrical signal communication with a surface-mounted FET as switching device, cannot cure this deficiency because it only sketches the basic structure of a reflecting element but does not disclose concrete figures for the impedances involved.

Due to the absence of a specific embodiment, even the notion of the impedance of an antenna remains obscure. Thus, on the basis of the application documents the skilled person cannot ascertain whether reactances (inductances and/or capacitances) of fixed value which are associated with the antenna should be considered to form part of the impedance of the antenna or not.

4.4 A further fundamental problem concerns the lack of information as regards the choice of the frequency at which the claimed relationship is to be met. The only information given in claim 1 is the indication "for a radio frequency range". Conventionally, radio frequencies range from about 30 kHz to 300 GHz, ie over 7 orders of magnitude.

4.4.1 Given the fact that complex impedances are frequency-dependent and that these dependencies differ for antennas and switching devices, the application should contain some indication as to the frequency at which the claimed relationship should be met. Moreover, without knowledge of this frequency, it is actually impossible to ascertain the impedance values to be used for the claimed relationship.

4.4.2 The appellant argued that the skilled person was familiar with the fact that impedances depended on the frequency of operation. Thus, it was readily apparent to him that the claimed relationship could only be valid at a specific frequency.

On the basis of this common knowledge, it was inherent to the teaching provided by the application documents as filed that a device for reflecting electromagnetic radiation within the meaning of the present invention was operated at a specific predetermined frequency and that it was this frequency for which the claimed relationship had to be met.

4.4.3 These arguments cannot convince the Board for the simple reason that it is by no means apparent from the application documents as filed that a device for reflecting electromagnetic radiation according to the present invention was intended to be operable at a single frequency (or within a single narrow frequency band) only.

In view of the lack of respective information in the application documents as filed, the skilled person can only speculate whether it would suffice for the purposes of the present invention if the claimed relationship was met for just one arbitrary frequency, which he could freely choose, or for a specific frequency out of an operating band of the antenna, or whether it was intended that the relationship was somehow met for all potential operating frequencies of the claimed device.

As an aside, it is noted that it was the amendment "at a frequency" which was introduced into the claims that were filed together with the statement of the grounds of appeal which had provoked an objection as to added subject-matter and was consequently removed from the definitions of claim 1 of the present main request. It is only logical that technical information which lacks a basis of disclosure cannot be relied upon as support for sufficiency of disclosure.

- 4.5 In summary, it is found that the application documents lack vital information which the notional skilled person would require in order to devise without undue burden a device for reflecting electromagnetic radiation, the reflecting elements of which would meet the mathematical relationship defined in claim 1.

Therefore, the Board has arrived at the conclusion that the technical information provided by the application documents as a whole does not enable a skilled person to practically implement the claimed subject-matter.

Thus, the main request does not meet the requirement of Article 83 EPC 1973.

5. First auxiliary request

- 5.1 The amendments to claim 1 concern a limitation of the feature "for a radio frequency range" to a range of frequencies larger than 20 GHz and the introduction of two references "at the frequency" in the subsequent wording of claim 1.

A basis of disclosure for the limitation "> 20GHz" is found in original claim 10 as well as on page 1, third paragraph and page 5, first paragraph of the description as originally filed.

Interpreting the amendments as referring to an operability of the claimed device in the specified frequency range "> 20 GHz" as a whole, the amendments are considered, for the purpose of the decision, to comply with the requirement of Article 123(2) EPC.

5.2 However, amended claim 1 is not limited to subject-matter for which the application documents as filed would provide an enabling disclosure, either.

First of all, the amendments do not address the problem set out in paragraph 4.3 above so that the respective reasoning given there applies with equal force to the subject-matter of claim 1 of the first auxiliary request.

Moreover, notwithstanding the limitation to radio frequencies at the high frequency end of the radio spectrum, the claimed range is still so broad that the problem of insufficiency of disclosure addressed in paragraph 4.4 above is not overcome.

For these reasons, the first auxiliary request does not meet the requirement of Article 83 EPC 1973 either.

6. Second auxiliary request

Claim 1 specifies the switching device of a reflecting element to comprise a solid state "FET transistor" [sic!].

Although this amendment limits to some extent the number of possible combinations of antennas and switching devices that is encompassed by the claim definitions, it does not overcome any of the problems addressed in paragraphs 4.3 and 4.4 above.

Therefore, the reasoning as to a lack of an enabling disclosure (Article 83 EPC 1973) for the claimed subject-matter of the main request applies to the subject-matter of claim 1 of the second auxiliary request as well.

7. In conclusion, it is found that none of the appellant's requests on file is allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

R. Schumacher

B. Schachenmann