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Datasheet for the decision of 3 February 2016

Case Number: T 2503/11 - 3.5.03

Application Number: 07817067.7

Publication Number: 1994655

IPC: H04B10/06, G02B6/293

Language of the proceedings: EN

Title of invention:
Method and system for integrated DWDM receivers

Applicant:
Huawei Technologies Co., Ltd.

Headword:
Integrated DWDM receivers/HUAWEI

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
Inventive step - main and auxiliary requests (no)

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Case Number: T 2503/11 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 3 February 2016

Appellant: (Applicant)	Huawei Technologies Co., Ltd. Huawei Administration Building Bantian Longgang District Shenzhen, Guangdong 518129 (CN)
Representative:	Casalonga, Axel Casalonga & Partners Bayerstrasse 73 80335 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 6 July 2011 refusing European patent application No. 07817067.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	F. van der Voort
Members:	A. Madenach
	O. Loizou

Summary of Facts and Submissions

I. The present appeal arises from the decision of the examining division refusing European patent application No. 07817067.7, published as WO 2008/043318 A1, on the ground that the subject-matter of independent claims 1 and 11 of a main request and of claim 1 of a first auxiliary request did not involve an inventive step (Articles 52(1) and 56 EPC). A second auxiliary request was not admitted into the proceedings (Rule 137(3) EPC). Reference was made *inter alia* to

D1: F. Tong et al.: "A 32-Channel Tunable Receiver Module for Wavelength-Division Multiple-Access Networks", IEEE PHOTONICS TECHNOLOGY LETTERS, vol. 9, no. 11, 1 November 1997, pages 1523 to 1525.

II. In the statement of grounds of appeal, the appellant requested that the decision under appeal be set aside and that a European patent be granted on the basis of the independent claims of a main request or of a first or a second auxiliary request, all filed with the statement of grounds of appeal, together with the remaining application documents on file, these requests being identical to those considered by the examining division in its decision. As an auxiliary measure, oral proceedings were requested.

III. In a communication pursuant to Article 15(1) RPBA accompanying a summons to oral proceedings, the board gave its preliminary opinion, *inter alia* raising objections under Articles 52(1) and 56 EPC, and of its own motion introduced documents including:

D3: F. Tong et al.: "Characterization of a 16-Channel Optical/Electronic Selector for Fast Packet-

Switched WDMA Networks", IEEE Photonics Technology Letters, vol. 6, no. 8, August 1994, pages 971 to 974,

which it considered as representing the closest prior art, and

D5: US 2005/0259910 A1 (which was cited in the international search report).

IV. With a letter dated 28 January 2016, the appellant submitted claims 1 and 11 of a main request and a claim 1 of an auxiliary request to replace the respective claims of the previous requests, and withdrew the second auxiliary request.

V. Oral proceedings were held on 28 January 2016.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims of a main request, including amended claims 1 and 11 as filed with letter dated 28 January 2016, or in the alternative on the basis of claims of an auxiliary request, including claim 1 as filed with the same letter.

After deliberation, the board gave its decision.

VI. Claim 1 of the main request reads:

"An integrated dense wavelength division multiplexing (DWDM) receiver apparatus that converts a multiple-channel DWDM signal to multiple electrical signals, the apparatus comprising:
a support component;

a silica-on-silicon substrate overlying the support component, the silica-on-silicon substrate including a silica layer overlying a silicon layer, the silica-on-silicon substrate including a first surface region and a second surface region;
an optical demultiplexer within the silica layer, the optical demultiplexer being located under the first surface region and overlying the silicon layer, the optical demultiplexer including at least an input waveguide for receiving the multiple-channel DWDM signal characterized in that it comprises a plurality of output waveguides for outputting several optical signals;
several reflecting structures located in the silica layer underlying the second surface region, each of said reflecting structures being optically coupled to a corresponding one of the plurality of output waveguides;
several semiconductor photodetector array chips overlying the second surface region of the silica-on-silicon substrate, each of said photodetector array chips including several photodetectors for converting an optical signal into a corresponding electrical signal, each of said photodetectors overlying and being optically coupled to a corresponding one of the reflecting structures;
several output terminals to output the converted electrical signals by the photodetectors, and each said reflecting structure is at an angle of approximately 45° with respect to the corresponding one of said plurality of output waveguides and formed at a terminal of the corresponding one of said plurality of output waveguides."

Claim 1 of the the auxiliary request comprises the additional features:

"the silica layer including
a first un-doped silica sub-layer on the silicon layer;
a doped silica sub-layer on the first un-doped silica sub-layer;
a second un-doped silica sub-layer deposited on the doped silica sub-layer;
each said reflecting structure having been formed in the silica layer by etching to form a recess in the silica layer and a sloped reflecting surface"

and, after "and each said reflecting structure is at an angle of approximately 45° with respect to the corresponding one of said plurality of output waveguides", the feature:

"so as to receive an optical output reflected at 90°".

Reasons for the Decision

1. Claim 1 of the main request: inventive step (Articles 52(1) and 56 EPC)

1.1 Document D3 discloses an integrated wavelength division multiplexing (WDM) receiver apparatus which has a wavelength channel spacing of 0.78 nm (page 971, left column, third paragraph) and hence is a dense WDM (DWDM) receiver. The receiver converts a multiple DWDM signal to multiple electrical signals (page 971, left column, first to third paragraphs and Figure 1).

The skilled person would have understood the reference to a SiO_2/Si planar waveguide grating (page 971, left column, second paragraph in chapter I.) as implying a silicon substrate with an overlying silica layer. The silica-on-silicon substrate includes a first surface

region and a second surface region, and an optical demultiplexer within the silica layer including at least an input waveguide for receiving the multiple-channel DWDM signal (page 971, left column, third paragraph and Figure 1). The board considers the whole of the planar waveguide grating minus the polished end face as corresponding to the claimed demultiplexer, since the end face itself does not contribute to the demultiplexing, and the end face as acting as a reflecting structure, since it does indeed direct the demultiplexed waves onto the photodetectors. These two sections (the demultiplexer and the polished end face) underlie first and second surface regions of the silica-on-silicon substrate, respectively.

The apparatus further comprises a plurality of output waveguides for outputting several optical signals and a mirror formed by the reflecting structure located in the silica layer, said mirror being optically coupled to the plurality of output waveguides at an angle of approximately 45° with respect to the corresponding one of said plurality of waveguides and formed at a terminal of the corresponding one of the plurality of output waveguides (page 971, left column, third paragraph and Figure 1).

The apparatus further comprises several semiconductor photodetector array chips underlying the second surface region of the silica-on-silicon substrate, each of said photodetector array chips including several photodetectors for converting an optical signal into a corresponding electrical signal, each of said photodetectors underlying and being coupled to the mirror (page 971, left column, third paragraph and Figure 1).

The apparatus further comprises output terminals to output the converted electrical signals by the photodetectors (page 971, left column, third paragraph and Figure 1).

1.2 The claimed apparatus differs from the apparatus disclosed in D3 in that according to claim 1

(i) it comprises a support component,

(ii) the photodetector array **over**lies the second surface instead of underlying it, and

(iii) several reflecting structures are used instead of a mirror.

1.3 With respect to feature (i), the board notes that it was common general knowledge at the priority date to use a heat sink as a support component (*e.g.* D1, page 1523, right column, second paragraph) in order to avoid temperature shifts (see also the paragraph bridging pages 9 and 10 of the present application). Hence, the use of a heat sink as a support component would have been obvious to the skilled person when implementing the apparatus disclosed in D3. This was not contested by the appellant.

1.4 With respect to feature (ii), arranging the photodetector array above instead of underneath the second surface is an obvious design alternative which the skilled person would consider according to the specific requirements (e.g. packaging requirements) without the exercise of inventive skill. This was likewise not contested by the appellant.

1.5 With respect to feature (iii), the board assumes for the sake of the present argument that a single mirror which reflects several incoming light beams as in D3 does not form "several reflecting structures" in the sense of the present claim. In other words, the board assumes that the "several reflecting structures" consist of separate elements, e.g. separate mirrors. The board considers the technical problem solved by this feature as providing an alternative way of reflecting light beams coming from the plurality of output waveguides. The skilled person, being aware of the technical equivalence of a reflecting structure in the form of a mirror and several reflecting structures, e.g. separate mirrors, for the purpose of reflecting light from a plurality of output waveguides to several photodetectors in photodetector array chips, would have chosen one or more reflecting structures in accordance with the circumstances without the exercise of inventive skill.

1.6 The appellant essentially argued that the objective technical problem to be solved by feature (iii) resided in creating the possibility of having a further degree of freedom as compared to a single reflecting structure, which would allow for a minimisation of interference among the reflected signals, since the positions of the several reflecting structures could be optimised in such a way as to achieve the best light reception at the corresponding ones of the plurality of photosensors. None of the cited prior-art documents would address and solve this problem. It would therefore not have been obvious to the skilled person to provide a solution to this problem, neither on the basis of the available prior art nor on the basis of the common general knowledge.

The board is however of the view that feature (iii) does not solve the technical problem as suggested by the appellant for the following reasons:

First of all, the board notes that the application is silent about any specific problem being solved by providing several reflecting structures instead of a single reflecting structure. Instead, in the application as filed several reflecting structures and a single reflecting structure are referred to as mere alternatives with no particular technical effect related to the provision of several reflecting structures (cf. claim 1 as filed: "one or more reflecting structures" in the same way as "one or more semiconductor photodetector array chips" and "one or more output terminals").

Further, in order to solve the suggested problem, it would have been necessary for the claimed apparatus to define constructional features which would at least imply the purported further degree of freedom. The claim and, in fact, the whole application as filed are silent about the possibility of such an effect .

In this respect, the board also notes that the feature "several reflecting structures" encompasses adjacent reflecting structures which are all arranged at the same angle with respect to the corresponding one of the plurality of output waveguides and are adjacent to each other. It follows that the alleged technical problem is not solved, since several reflecting structures formed in this way would exhibit the same reflecting behaviour as a single reflecting structure.

Consequently, the problem solved by feature (iii) is merely to provide an alternative way of reflecting

light beams coming from the plurality of output waveguides, the solution of which would have been obvious to the skilled person for the reasons given above at point 1.5.

The board further notes that no interaction between the above-mentioned features (i) to (iii) is apparent which could contribute to an inventive step. Nor did the applicant argue otherwise.

1.7 For the above reasons, the subject-matter of claim 1 of the main request does not involve an inventive step (Articles 52(1) and 56 EPC).

2. *Claim 1 of the first auxiliary request: inventive step (Articles 52(1) and 56 EPC)*

2.1 Claim 1 of the first auxiliary request differs from claim 1 of the main request in that it additionally includes:

(iv) features relating to the silica-on-silicon technology and specifying that the silica layer includes a first un-doped silica sub-layer on the silicon layer; a doped silica sub-layer on the first un-doped silica sub-layer; a second un-doped silica sub-layer deposited on the doped silica sub-layer; and

(v) a feature according to which each reflecting structure is formed in the silica layer by etching to form a recess in the silica layer and a sloped reflecting surface.

2.2 In the board's view, feature (iv) represents the standard technology at the priority date, which underlay the prior art of D3. Reference is made to the

SiO_2/Si planar waveguide grating (D3, page 971, left column, second paragraph in chapter I.), which the skilled person would have understood as referring to a silicon substrate onto which silica layers with various doped optically active layers are formed. Further, reference is made to D5, which shows in Figure 1 an optical component formed upon a silicon substrate 18 and comprised of lower and upper claddings 12 and 16 and a waveguide core 16. The common technology for forming optical components on a silicon substrate involved forming undoped cladding layers with doped, optically active components. Hence, the skilled person would, on the basis of his common general knowledge, consider features (iv) to be the technology underlying the devices of D3 and of Figure 1 of D5.

2.3 Feature (v), in comparison with the mirror obtained by polishing an end face as in D3, allows for diverting the light beam independently of the position of the end face, thereby providing an increased degree of freedom as to where the various components, in particular the photodetectors, of the apparatus can be placed.

2.4 The skilled person working in the field of integrated optics using silica-on-silicon technology would however have been aware of the possibility of forming a mirror in a trench. An example is illustrated in D5, which relates generally to integrating optical components and more specifically to adding and removing additional light signals (paragraph [0003]). Various examples of devices are shown, all employing a trench. In the specific example of Figure 1, a first trench is formed through cladding layers 12 and 14 and (implicitly) through the waveguide 16. The trench has an angled wall with a mirrored surface 22 acting as a mirror

(paragraph [0014]) and, hence, as a reflecting structure.

2.5 In the board's view, the skilled person, on the basis of his common general knowledge, would thus have been aware of the possibility of forming reflecting structures by etching a recess into cladding layers and the waveguide and would have chosen this option whenever needed, e.g. in a situation where the light beam has to be deflected at a place remote from the end face of the waveguide, in order to allow further components to be formed between the end face and the reflecting structures. Hence, feature (v) does not contribute to an inventive step.

2.6 The appellant referred to Figure 5 and paragraph [0022] of D5 and argued that the waveguides 60 and 62 shown in this figure did not optically couple to a corresponding one of several trenches. This argument is, however, irrelevant, since it concerns an integrated optical component which differs from the one shown in Figure 1 of D5.

2.7 The board further notes that no interaction between the above features (i) to (v) is apparent which could contribute to an inventive step. Nor did the appellant argue otherwise.

2.8 For the above reasons, the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC).

3. As there is no allowable request, the appeal is to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Rauh F. van der Voort

Decision electronically authenticated