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**Datasheet for the decision  
of 29 June 2007**

**Case Number:** T 1324/05 - 3.5.03

**Application Number:** 99919729.6

**Publication Number:** 1068685

**IPC:** H04B 10/17

**Language of the proceedings:** EN

**Title of invention:**

Optical Fibre amplifier having a controlled gain

**Patentee:**

TELEFONAKTIEBOLAGET LM ERICSSON (publ)

**Opponent:**

-

**Headword:**

Optical Fibre Amplifier/ERICSSON

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step - no"

**Decisions cited:**

G 0003/99

**Catchword:**

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Case Number: T 1324/05 - 3.5.03

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.03  
of 29 June 2007

**Appellant:** TELEFONAKTIEBOLAGET LM ERICSSON (publ)  
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**Representative:** Holmberg, Martin Tor  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 27 April 2005  
refusing European application No. 99919729.6  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** D. H. Rees  
**Members:** A. Madenach  
M.-B. Tardo-Dino

## Summary of Facts and Submissions

I. The present appeal is against the decision of the examining division to refuse the application on the basis of Article 56 EPC considering

D1: EP 0 777 346 A

as the closest prior art.

II. In the notice of appeal of 29 June 2005, the appellant requested that the decision be set aside. Grounds of appeal were filed via facsimile of 5 September 2005. After the board issued a communication under Rule 36(3) EPC, a properly signed copy of the grounds of appeal was re-submitted with a letter of 29 May 2006.

III. In a communication of 21 March 2007 the board summoned the appellant to oral proceedings and gave its preliminary opinion on the case under appeal.

IV. In a letter of 7 June 2007 the appellant filed amended claims 1 to 7 and announced that it would not take part in the scheduled oral proceedings. No explicit request was made.

V. Oral proceedings took place in the absence of the appellant on 29 June 2007.

After deliberation, the chairman announced the board's decision.

VI. Independent claim 1 as submitted with the letter of 7 June 2007 reads as follows:

"An optical fiber amplifier for amplifying light signals of signal channels having distinct wavelengths in a wavelength band, the amplifier including

- an active optical fiber (1, 3) having an input end adapted to receive light signals to be amplified having wavelengths in a wavelength region and an output end adapted to forward the light signals amplified during the propagation thereof in the active optical fiber by gain factors specific to the wavelengths of the light signals,
- a pump source (17) connected to inject pumping light into the active optical fiber,
- an output power measurement device (23) connected (21) to the output end of the active optical fiber, and
- a light source (29) for injecting light into the active optical fiber, the injected light having a wavelength outside the wavelength region and selected not to be capable of causing an amplifying or pumping effect in the active optical fiber and selected to be capable of being amplified by the optical fiber amplifier,

characterized in

- that the output measurement device (23) is arranged to measure the presence and absence of the signal channels in said wavelength band,
- that the light source (29) is connected to the output power measurement device (23) in order to control the intensity of the injected light injected by the light source to maintain the gain factors constant in time, and
- that the light source (29) is so connected that the power of the light injected by the light source saturates the active optical fiber at said constant

gain factors irrespectively of the number of signal channels present in said wavelength band, i.e. of the total power of the input light signals."

Claim 7 relates to a fiber optical network comprising at least one optical amplifier according to claim 1.

### **Reasons for the Decision**

#### 1. *Procedural questions*

- 1.1 The appellant filed within the time limit set by the board in accordance with Rule 36(3) EPC a properly signed statement of grounds of appeal. In accordance with G 3/99 (OJ EPO 2002, 347; see point 18 of the reasons) only the present board is competent to issue a communication under Rule 36(3) EPC.

As the appellant provided a duly signed copy of the grounds of appeal within the set time limit, the appeal is admissible.

- 1.2 The appellant announced that it would not take part in the scheduled oral proceedings. According to Article 116(1) EPC, oral proceedings shall take place either at the instance of the European Patent Office if it considers this to be expedient or at the request of any party to the proceedings. Oral proceedings are an effective way to discuss cases mature for decision, since the appellant is given the opportunity to present its concluding comments on the outstanding issues

(Article 113(1) EPC), and a decision can be made at the end of the oral proceedings (Rule 68(1) EPC).

The board considers that, despite the appellant's announced intention not to attend, the twin requirements of fairness and procedural economy were still best served by holding the oral proceedings as scheduled.

1.3 The appellant has not made a clear request in the submission of 7 June 2007, but given the filing of new claims and arguments relating only to those claims the board assumes that the appellant's request is for grant of a patent based on the set of claims filed with this letter.

1.4 The set of claims filed with the letter dated 7 June 2007 and received on the same day were received after expiry of the four week time limit set by the board for amendments and new evidence to be filed prior to the oral proceedings of 29 June 2007. However, given that the amendments to claim 1 simply clarify features which were already considered in the board's communication of 21 March 2007 the amended claims are admitted into the procedure.

2. *Original disclosure (Article 123(2) EPC) and interpretation of the claims (Article 84 EPC)*

2.1 The board is satisfied that the features of present claim 1 derive from original claims 1 and 2 and additionally from page 6, lines 29-31, page 2, lines 34-37 and page 3, lines 36-39 of the original disclosure.

2.2 The expression "saturates the active optical fiber at said constant gain factors" is misleading. The usual interpretation of the term "saturation" as used in the relevant art is related to a working regime with a constant output power independent of the input power provided the input pump power is sufficient (page 5, lines 36-38 of the application). In other words, if the input power increases the output power is about constant resulting in a decreasing gain.

The board's understanding of the operation of the device according to the present invention, as confirmed by the appellant in his letter of 7 June 2007, is that it is generally operated in the saturation regime, which is common in the art (loc. cit.: "an erbium doped fiber amplifier is **usually** operated in the saturated state"). In addition, the light emanating from the additional light source is so controlled as to keep the gain constant, irrespective of the number of signal channels used. Operation in the saturation regime is, however, determined by the power of the pump light (loc. cit.) and is independent of the additional light and indeed also of the total power of input light signals.

3. *Inventive step (Article 56 EPC):*

3.1 The present invention relates to an optical amplifier of the kind used for amplifying optical signals transmitted over a long distance in optical fiber transmission. Optical amplifiers typically consist of an erbium doped section within the optical fiber. The erbium ions are pumped into higher energy states by an optical pump light source and release the acquired

energy into the optical signals, resulting in their amplification. This kind of amplification does however give rise to a problem which the present invention aims to solve, namely that the amplification gain depends on the number of active wavelength channels. This problem arises whether or not the amplifier is operating in the saturation regime (see D1, column 2, lines 3-6). A further problem exists in that the amplification gain differs for the various signal wavelengths.

The problems as such are well known in the technical field. Reference is made in particular to D1 (column 2, lines 3-6) and the references cited in the present application (page 2, lines 12-20).

- 3.2 The board concurs with the examining division and the appellant in that D1, which discusses both of these problems, can be considered to represent the closest prior art.
- 3.3 Three features of claim 1 are not explicitly and unambiguously disclosed in D1: (1) an output power measurement device is arranged to measure the presence and absence of the signal channels in said wavelength band, (2), the light source is connected to the output power measurement device in order to control the intensity of the injected light injected by the light source to maintain the gain factors constant in time, and (3) the light injected by the light source saturates the optical fiber amplifier.

The remaining features of claim 1 are known from D1. This finding was not contended by the appellant.



3.4 Before discussing the above differences, it is helpful to study the working principle of the optical amplifier disclosed in D1.

The object of D1 is to provide an optical amplifier which can reduce the wavelength dependence of the gain irrespective of a change in input power and number of input channels (col. 2, lines 3-6). This object is achieved by two means: firstly the power of a probe light is controlled in such a way as to maintain the wavelength dependence (i.e. the waveform) of the gain constant (col. 8, l. 33-35), the control being performed by measuring the input power of the optical amplifier (see Figure 7) and by keeping the sum of the powers of the signal light and the probe light to be supplied to the optical amplifier medium substantially constant (col. 9, lines 27-29 and col. 10, lines 49-51); secondly the power of the pump light is controlled so as to maintain the gain characteristics flat (col. 8, lines 48-51).

In comparison, the present invention aims at maintaining a constant gain irrespective of the number of signal channels (claim 1). This corresponds to the first part of the object of D1 and is achieved by controlling the power of an additional light source using the output power measurement device of the optical amplifier. As in D1, the total input power of the signal light and the probe light together is maintained constant (page 6, lines 11-14). Achieving a wavelength independent gain, i.e. the second part of the object of D1, is not contemplated by the present invention.

3.5 With respect to the above features (1) and (2), the board notes that D1 describes in connection with the basic configuration of an optical amplifier according to the first aspect of the invention shown in Figure 7a probe light source, which corresponds to the light source (29) of claim 1, being exclusively controlled by the input power of the optical amplifier. This control is performed in such a way as to offset any change in the power of the input signal by a corresponding change in the power of the probe light (column 8, lines 17-25 and column 9, lines 14-17). Since the power of the input signal is obviously proportional to the number of signal channels being used, in the optical fiber amplifier of D1 the presence and absence of signal channels is measured by an input power measurement device, and the light source is connected to this input power measurement device in order to control the intensity of the injected light by the light source to maintain the gain factors constant in time, the constancy of the gain factors being an inevitable result of the constancy of the input power.

The detailed embodiments of this aspect shown in Figures 10 and 11 show a connection of the controlling microprocessor to an output power measurement device (58, 59, 60) at the output of the optical amplifier. Therefore, a control of the probe light (or light source in the wording of claim 1 of the application) via the output power measurement device (58, 59, 60) **could** have been performed. Since D1 does not indicate explicitly that such a control is to be used the question is, whether the skilled person **would** have used such a control.

No particular object is solved by controlling the probe light via the output power measurement device. In fact, it is not the output power as such which is used for control, but rather a measure for the presence or absence of all the WDM-channels obtained at this device (page 6, lines 28-31). In view of the fact that D1 discloses a connection between the output power measurement device and the device (microprocessor) controlling the optical amplifier including the probe light, the skilled person would be aware of the fact that this particular measure could be obtained either at the input or at the output of the optical amplifier, possibly using further known means (see page 6, lines 31, 32 of the present application), and would use the most appropriate alternative according to the circumstances without the exercise of an inventive step.

- 3.6 With respect to feature (3), the board notes that it is common in the art to operate optical amplifiers in the saturation regime as indicated at point 2.2 above. This is done in order to reduce noise caused by amplified stimulated emission and to achieve the highest possible output power. In this respect, the board disagrees with the appellant's analysis that operating the amplifier in the saturation region would result in having as large a gain factor as possible. This is contradicted by Figure 3 of D1, which shows that the gain in the saturated region (indicated by SR) actually decreases. It is, however, true that the total achievable output power is maximum in the saturated region.

The board concurs with the appellant that D1 does not explicitly mention whether the optical amplifier is operated in the saturation regime or not. The fact that

the gain characteristics are kept flat (col. 8, l. 48-51) suggests, however, that the optical amplifier is actually operated in the non-saturated regime (compare with Figure 3 of D1). This appears to be a consequence of the desire to maintain a flat gain waveform as shown in Figure 5. Obviously, the price to pay for a flat gain waveform is an increased noise level as well as having an amplification below the maximum achievable.

In the device according to the present application, the board is not aware that operating the optical amplifier in saturation achieves any effect apart from the above mentioned improved noise and amplification performance. In particular it does not achieve any effect which would be uncommon in the art or otherwise surprising.

Thus, the problem to be solved by operating the amplifier in the saturation regime is to optimise the noise and amplification performance.

Starting out from D1, in order to achieve a reduced noise level and an improved amplification performance the skilled person would have had to trade off the specific way of maintaining a flat gain waveform disclosed in this document while still keeping the total input power of signal light and probe light constant and, thus, the gain independent of the number of active channels. A flat gain waveform could have been achieved by other means, e.g. by specially adapted filters (D1, col. 1, lines 44-53).

It would have been part of the skilled person's routine work to modify the system of D1 in order to respond to given noise or output power requirements along the

lines outlined above without exercising an inventive skill.

- 3.7 The combination of the above features (1) and (2) on the one side, and (3) on the other side solve different and independent objects and does not lead to an unexpected combinatorial effect which would go beyond a mere superposition of their individual effects.

Therefore, the claimed invention consists merely in the juxtaposition of these obvious features. For this reason, the subject-matter of claim 1 is not based on an inventive step contrary to the requirements of Article 56 EPC.

4. As claim 1 of the only request does not meet the requirements of the EPC, the application has to be refused.

## **Order**

### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar

The Chairman

D. Magliano

D. Rees