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Datasheet for the decision of 3 July 2013

Case Number: T 2062/09 - 3.5.02

Application Number: 00309807.6

Publication Number: 1102394

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Language of the proceedings: EN

Title of invention:
System and method for producing amplified signals

Applicant:
Alcatel Lucent

Headword:
-

Relevant legal provisions:
RPBA Art. 13(3)
EPC Art. 54

Keyword:
"Late-filed requests - Sixth auxiliary request not admitted"
"Novelty - main request and first to fifth auxiliary requests (no)"

Decisions cited:
-

Catchword:
See point 6 of the reasons

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Case Number: T 2062/09 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 3 July 2013

Appellant: (Applicant)
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 7 May 2009 refusing European patent application No. 00309807.6 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: M. Ruggiu
Members: M. Léouffre
W. Ungler

Summary of Facts and Submissions

I. The applicant lodged an appeal, received on 24 June 2009, against the decision of the examining division, posted on 7 May 2009, on refusal of application no. 00 309 807.6.

II. The examining division held that the subject-matter of claim 1 filed with letter of 3 April 2009 was not new having regard to D3 (= US 5 287 069 A).

III. With the statement setting out the grounds of appeal, received on 4 September 2009, the appellant filed a first auxiliary request.

IV. In a communication annexed to the summons to oral proceedings, the board expressed the preliminary opinion that the application might not meet the requirements following from Articles 83 and 123(2) EPC, and that the invention might not be new (Article 54 EPC) and not involve an inventive step (Article 56 EPC) having regard to the prior art disclosed in D3, D4 (=US 5 365 187 A) or D7 (=US 5 201 071 A).

V. In reply to the summons to oral proceedings, with letter dated 3 June 2013, the appellant filed five further auxiliary requests.

VI. Oral proceedings before the board were held on 3 July 2013. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 10 of the main request filed with letter of 3 April 2009 or if this is not possible on the basis of claims 1 to 10 of auxiliary request 1

filed with letter of 4 September 2009, or on the basis of the claims of one of the auxiliary requests 2 to 6 filed with letter of 3 June 2013.

VII. Claim 1 of the main request reads as follows:

"A method of producing at least one signal, comprising:

splitting an original signal to be amplified to produce first and second versions (72, 74);

wherein said method is CHARACTERIZED BY:

delaying the second version within a delay circuit (76, 112, 134, 136, 168, 170, 396, 394) to produce a time-delayed version;

combining the first version and the time-delayed version within a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal and second transformed signal having reduced peak-to-average power ratios (PARs); and

amplifying (84, 86, 102, 104, 142, 144, 180, 182, 210-216, 274, 276, 304-306, 334, 336, 364, 404, 406, 454, 456) said first and second transformed signals."

Claims 2 to 7 are dependent on claim 1.

Claim 8 of the main request reads:

"An apparatus for producing a signal, comprising:

a splitter for receiving a signal (S(t)) and splitting the signal into first and second versions on first and second paths (72, 74);

wherein said apparatus is CHARACTERIZED BY:

a delay circuit (76, 112, 134, 136, 168, 170, 396, 394) positioned on the second path for delaying the second version to produce a delayed in time version of the first version;

a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) for receiving the first version and second delayed in time version and producing at least one transformed signal having a reduced peak-to-average power ratio;
an amplifier circuit (84, 86, 102, 104, 142, 144, 180, 182, 210-216, 274, 276, 304-306, 334, 336, 364, 404, 406, 454, 456) for receiving and amplifying the first version and second delayed in time version."

Claims 9 and 10 are dependent on claim 8.

VIII. Claim 1 of the first auxiliary request reads as follows:

"A method of producing at least one signal, comprising:

splitting an original signal to be amplified to produce first and second versions (72, 74);

wherein said method is CHARACTERIZED BY:

delaying the second version within a delay circuit (76, 112, 134, 136, 168, 170, 396, 394) to produce a time-delayed version;

combining the first version and the time-delayed version, by adding the first version and the time-delayed version and subtracting the first version and the time-delayed version within a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal and second transformed signal having reduced peak-to-average power ratios (PARs) relative to the original signal, the first transformed signal and the second transformed signal retaining amplitude and phase information of the original signal; and

amplifying (84, 86, 102, 104, 142, 144, 180, 182, 210-216, 274, 276, 304-306, 334, 336, 364, 404, 406, 454, 456) said first and second transformed signals."

Claims 2 to 7 are dependent on claim 1.

Claim 8 of the first auxiliary request reads:

"An apparatus for producing a signal, comprising:

a splitter for receiving an original signal (S(t)) and splitting the original signal into first and second versions on first and second paths (72, 74);

wherein said apparatus is CHARACTERIZED BY:

a delay circuit (76, 112, 134, 136, 168, 170, 396, 394) positioned on the second path for delaying the second version to produce a delayed in time version of the first version;

a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) for receiving the first version and second delayed in time version, by adding the first version and the second delayed in time version, and producing at least one transformed signal having a reduced peak-to-average power ratio relative to the original signal, the at least one transformed signal retaining amplitude and phase information of the original signal;

an amplifier circuit (84, 86, 102, 104, 142, 144, 180, 182, 210-216, 274, 276, 304-306, 334, 336, 364, 404, 406, 454, 456) for receiving and amplifying the at least one transformed signal."

Claims 9 and 10 are dependent on claim 8.

IX. Claim 1 of the second auxiliary request corresponds to claim 1 of the first auxiliary request wherein the

expression "relative to the original signal" has been deleted.

Claim 8 of the second auxiliary request corresponds to claim 8 of the first auxiliary request wherein the term "original" has been deleted from the first feature and wherein the last feature has been amended as follows: "an amplifier circuit (84, 86, 102, 104, 142, 144, 180, 182, 210-216, 274, 276, 304-306, 334, 336, 364, 404, 406, 454, 456) for receiving and amplifying the first version and second delayed in time version".

X. Claim 1 of the third auxiliary request reads as follows

"A method of producing at least one signal, comprising:

splitting an original signal to be amplified to produce a first version of the signal onto a first path (72) and a second version on a second path (74); and

combining the first version and the second version in a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal to a first amplifier path (80) and a second transformed signal on a second amplifier path (82),

wherein said method is CHARACTERIZED BY:

delaying the second version in the second path (74) within a delay (76, 112, 134, 136, 168, 170, 396, 394) to produce a time delayed version".

Claim 2 to 8 are dependent on claim 1

Claims 9 to 11 correspond to claims 8 to 10 of the second auxiliary request.

XI. Claim 1 of the fourth auxiliary request reads as follows:

"A method of producing at least one signal, comprising:

splitting an original signal to be amplified to produce a first version of the signal onto a first path (72) and a second version on a second path (74); and

combining the first version and the second version in a combiner (76, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal to a first amplifier path (80) and a second transformed signal on a second amplifier path (82),

wherein said method is CHARACTERIZED BY:

combining the first version and the second version, by adding the first version and the second version and subtracting the first version and the second version within a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal and second transformed signal having reduced peak-to-average power ratios (PARs), the first transformed signal and the second transformed signal retaining amplitude and phase information of the original signal."

Claim 2 to 8 are dependent on claim 1.
Claims 9 to 11 of the fourth auxiliary request correspond to claims 8 to 10 of the second auxiliary request.

XII. Claim 1 of the fifth auxiliary request adds the following feature to claim 1 of the fourth auxiliary request "delaying the second version in the second path (74) within a delay (76, 112, 134, 136, 168, 170, 396, 394) to produce a time-delayed version."

Claims 2 to 7 are dependent on claim 1.
Claims 8 to 10 correspond to claims 8 to 10 of the second auxiliary request.

XIII. Claim 1 of the sixth auxiliary request reads as follows:

"A method of producing at least one signal, comprising:

splitting an original signal to be amplified to produce a first version of the signal onto a first path (72) and a second version on a second path (74); and

combining the first version and the second version in a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal to a first amplifier path (80) and a second transformed signal on a second amplifier path (82),

reconstructing the amplified signal,

wherein said method is CHARACTERIZED BY:

delaying the second version in the second path (74) within a delay (76, 112, 134, 136, 168, 170, 396, 394) to produce a time-delayed version;

combining the first version and the time-delayed version, by adding the first version and the second version and subtracting the first version and the second version within a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) to produce a first transformed signal and second transformed signal having reduced peak-to-average power ratios (PARs), the first transformed signal and the second transformed signal retaining amplitude and phase information of the original signal;

performing an inverse transformation (54, 146, 184, 218, 284, 338, 366, 408, 468) on said first and second amplified transformed signals to produce first

and second inverse transformed signals, respectively, whereby the first inversed transformed signal is delayed by a delay to produce a delayed version according to the second inversed transformed signal, before combining the first and second inverse transformed signal."

Claims 2 to 7 are dependent on claim 1.
Claims 8 to 10 correspond to claims 8 to 10 of the second auxiliary request.

XIV. The appellant essentially argued as follows:
The present application teaches to combine a signal with a delayed version of itself to reduce the peak-to-average ratio of the signal in order to render possible the use of cheap amplifiers. The person skilled in the art is therefore taught to choose a delay in accordance with the circumstances i.e. adapted to the signal to be amplified, which may be any signal, analog or digital. The application proposes for example, a time delay of 200ns for a 2.1 to 2.17 GHz signal, which is a signal for a telecommunication apparatus. Thus, a signal affected by noise could be delayed to fall in a time period less subject to noisy environment. The peak-to-average ratio would thereby be improved.
The present application discloses the invention with the same level of precision as D3, D4 and D7, which do not specify the characteristics of the amplified signal and its field of application in a more precise way.

The subject-matter of the claims is novel having regard to D3 which
(a) - does not teach or suggest combining the first version of an original signal and a time-delayed

version of the original signal within a combiner as recited in claim 1. Rather, D3 combines a first version and an approximated/time-delayed version of an original signal, whereas in the application a delay is applied to the signal shifting the envelope of the signal and causing a shift in the location of amplitude peaks of the second version as compared to the first version, whereby when the first version and the second version of the signal are combined, amplitude peaks of these versions of the signal are no longer added together;

(b) - does not produce a first transformed signal and a second transformed signal having reduced peak-to-average power ratio (PARs);

(c) - does not combine the fist version and the time-delayed version, by adding the first version and the time-delayed version and subtracting the first version and the time-delayed version within a combiner; and

(d) - does not teach that the first transformed signal and second transformed signal retain the amplitude and phase information of the original signal.

Reasons for the Decision

1. *Article 83 EPC*

The invention should provide "a more efficient power amplifier architecture which can amplify signals having potentially high peak powers in a linear fashion" (cf. published application, section [0007], lines 9 and 10).

Therefore an input signal is transformed into signals which have lower peak to average power ratio (PAR) but retain amplitude and phase information of the original signal (cf. e.g. sections [0012], [0013], [0015], [0022], [0051], [0054], [0055] and [0056]). The transformed signals are amplified in efficient power amplifiers and combined to reconstruct an amplified original signal. The present invention proposes different solutions to obtain the transformed signals.

Figure 1 shows an amplification system according to the principles of the present invention (cf. published application at page 3, line 37), and according to which, "the transformed signal(s) can be formed by combining versions of the original signal(s) having a relative offset, for example a relative time and/or phase shift, by converting amplitude information of the original signal(s) into angle information in the transformed signal(s), or by combining the different original signals, for example to produce transformed signals having reduced PARs" (cf. section [0010]). The features "delaying the second version within a delay circuit (76, 112, 134, 136, 168, 170, 396, 394) to produce a time-delayed version" and "combining the first version and the time-delayed version (of a signal)" found in claim 1 according to the main request are two steps of a method to reduce the PAR of a signal to be amplified. These features are however not sufficient to reduce the PAR in every condition of frequencies and delays.

The appellant admits that the delay applied to the second version of the signal to be amplified should be adapted to the signal to be amplified and that the

person skilled in the art is taught to look for an adapted delay.
The possibility to reduce the peak to average ratio of a signal by combining it with an offset version of itself is known (cf. D7, column 4, lines 56 to 64).
A teaching about how to choose the right delay to reduce the peak to average ratio is however not given in the application.
Two embodiments of the invention could be identified wherein a delay is given in relation to the original signal. On the one hand, a delay of apparently less than a period is suggested in combination with the embodiment described in figure 14 and corresponding sections [0033] to [0035] of the description, and on the other hand, a delay of more than 400 times the period of the input signal is proposed for use in combination with the circuit of figure 6 (cf. section [0021]: 200ns and a signal of 2.1 to 2.17 GHz). In both cases the signals apply to wireless communications. Hence similar signals can be subjected to delays which differ greatly. A teaching cannot therefore be derived from the application, which would be sufficiently clear and complete to allow the skilled person to carry out the invention without undue burden. In these circumstances, the conditions of Article 83 EPC appear not to be met.

2. *Novelty (Article 54 EPC) with respect to D3*

2.1 D3 discloses (cf. figure 19) an amplifier receiving at least one signal (input wave 2X) and splitting (at node 75) the signal to be amplified to produce two signals that are identical to the original signal 2X on first

and second paths (connected to input 201 and input 202 of the combiner shown in figure 19).

The first signal can be regarded as being a first version of the original signal 2X. The second signal is first transformed into a signal 2Y having an amplitude approximating the amplitude of the orthogonal wave which when delayed and combined with the original signal would lead to a constant amplitude signal wave (cf. column 10, lines 21 to 26). Signal 2Y can be regarded as being a second version of the original signal 2X, since the term "version" (of a signal) mentioned in the independent claims of the application does not define exclusively a copy or a replica of the original signal. In this respect, the board observes that the delay circuit mentioned in the independent claims of all requests can be implemented by a variety of different means for producing a time-delayed version of the original signal (cf. figures 6, 15, 17, 18 and 26 of the application), among which are delay means but also filter means which modify the signal.

According to the embodiment shown in figure 20 of D3, which is a variation of the configuration shown in figure 19, the second version of the signal is delayed by a 90° phase shifter 155 before being inputted to the combiner 135 (cf. column 13, lines 7 to 26).
The combiner 135 is an hybrid circuit that combines the first version and the second version to produce a first transformed signal A and a second transformed signal B (cf. column 12, lines 10 to 25) having constant amplitudes. The first and second transformed signals have thus reduced peak-to-average power ratios (PARs).

The transformed signals A and B are then amplified in amplifiers 140 and 150.
The apparatus of claim 8 of the main request is therefore known from D3 and the method of claim 1 which is implemented by the amplifier of D3 is also not new.

3. Claim 1 of the first auxiliary request adds "combining the first version and the time-delayed version, by adding the first version and the time-delayed version and subtracting the first version and the time-delayed version within a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398)" and "the first transformed signal and the second transformed signal retaining amplitude and phase information of the original signal." Claim 8 of the first auxiliary request adds "a combiner (78, 116, 140, 176, 202, 204, 272, 302, 332, 362, 398) for receiving the first version and second delayed in time version, by adding the first version and the second delayed in time version, and producing at least one transformed signal having a reduced peak-to-average ratio relative to the original signal, the at least one transformed signal retaining amplitude and phase information of the original signal."

The first transformed signal A and the second transformed signal B of D3 (cf. column 12, lines 10 to 25) have constant amplitudes and are obtained by combining a first version with a delayed second version of the original signal. They have thus reduced peak-to-average power ratios (PARs) relative to the original signal.
The transformed signals A and B are respectively equal to the vector sum and difference of the first version (which is identical to the original signal) and the

second version (cf. figure 19) and, as is well know to the person of ordinary skill, the thus calculated couple of transformed signals A and B inherently retain amplitude and phase signal information of the original signal.

Claims 1 and 8 of the first auxiliary request are therefore known from D3.

4. Claim 1 of auxiliary request 2 differs from claim 1 of auxiliary request 1 in that the terms "relative to the original signal" have been cancelled. This amendment cannot render the subject-matter of claim 1 of auxiliary request 2 novel over D3.

5. Claim 1 of auxiliary requests 3, 4 and 5 adds that the first version and the second version of the received signal are on a first path and a second path.
This feature is clearly shown in figures 19 and 20 of D3. The first path is connected to input 201 of hybrid combiner 120 or 135 and the second path to the input 202.
The independent claims 1 of auxiliary requests 2 to 5 are therefore known from D3 (Article 54 EPC).

6. Admissibility of the sixth auxiliary request

Claim 1 of the sixth auxiliary request comprises the feature of
"performing an inverse transformation (54, 146, 184, 218, 284, 338, 366, 408, 468) on said first and second amplified transformed signals to produce first and second inverse transformed signals, respectively, whereby the first inversed transformed signal is

delayed by a delay to produce a delayed version according to the second inversed transformed signal, before combining the first and second inverse transformed signal."

This claim contains further features with respect to original claim 12.
The subject-matter of claim 1 of the sixth auxiliary request adds thereto that two signals are reconstructed and combined. The basis for these additional features may only be found in the description and in particular in figure 6 and paragraph [0024] of the published application. These features have apparently not been subject to any search or examination and, since they do not seem to be shown in D3, raise issues which the board cannot reasonably be expected to deal with without adjournment of the oral proceedings. The sixth auxiliary request cannot therefore be admitted into the proceedings (cf. RPBA Article 13(3)).

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

U. Bultmann M. Ruggiu