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**Datasheet for the decision
of 26 March 2014**

Case Number: T 1403/09 - 3.5.02

Application Number: 05251659.8

Publication Number: 1679792

IPC: H03G3/30

Language of the proceedings: EN

Title of invention:

System for dynamic control of automatic gain control-take-over-point and method of operation

Applicant:

Zoran Corporation

Headword:

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - auxiliary request (yes)

Decisions cited:

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 1403/09 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 26 March 2014

Appellant: Zoran Corporation
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 14 January 2009
refusing European patent application No.
05251659.8 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 appealed on 20 March 2009 against the decision of the Examining Division of the European Patent Office, posted on 14 January 2009, refusing European patent application No. 05251659.8 pursuant to Article 97(2) EPC. The statement setting out the grounds of appeal was received on 22 May 2009.

- II. The examining division held that the main request and the first request then on file did not meet the requirements following from Articles 83, 84 and 123(2) EPC, and that claim 1 of the second auxiliary request did not meet the requirements of Articles 83 and 84 EPC and that its subject-matter was not new in the sense of Article 52(1) and 54 EPC, having regard to each of documents
D1 : GB 2 371 690 A, and
D2 : EP 1 089 429 A.

- III. With the statement of grounds of appeal the appellant filed a new main request and three auxiliary requests.

- IV. In a communication dated 7 May 2013 the board expressed the preliminary opinion that none of the requests met the requirements of Article 84 EPC.

- V. The appellant responded with a letter dated 6 September 2013 and filed a new main request and three new auxiliary requests.

- VI. In an annex to the summons to oral proceedings dated 14 January 2014, the board expressed its opinion that claim 1 of the main request and claim 1 of the second auxiliary request were not clear (Article 84 EPC) and that none of the main request and the first, second and

third auxiliary requests did involve an inventive step (Article 52(1) and 56 EPC) having regard to document D2 and document Z1 (US 5 999 559 A).

- VII. In the oral proceedings which took place before the board as scheduled on 26 March 2014, the appellant filed a second auxiliary request that included amended description pages 2, 3 and 7 and amended claims 1 to 16.
- VIII. The applicant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main request or of the first auxiliary request filed with the letter dated 6 September 2013, or on the basis of the second auxiliary request filed in the oral proceedings of 26 March 2014.
- IX. Main request
Claim 1 of the main request reads as follows:
"A receiver (10) for processing a signal, comprising:
a first amplifier circuit (14) that is operated in association with first gain versus amplitude values and which is operable to receive an input signal (36); and
a second amplifier circuit (30) that is operated in association with second gain versus amplitude values and which is operable to transmit a modulated signal (34) associated with the input signal;
wherein the first and second gain versus amplitude values are such that there is a take-over-point which is an amplitude of the modulated signal at which gain control is changed from the first amplifier circuit to the second amplifier circuit;
and
a gain control circuit (32);

characterized in that the gain control circuit (32) is operable to:
determine a quality indicator of the modulated signal (34); and adjust the first gain versus amplitude values and the second gain versus amplitude values based at least in part upon the determined quality indicator."

Claims 2 to 13 are dependent on claim 1.

Claim 14 reads as follows:

"A method for processing a signal, comprising:
operating a first amplifier circuit (14) in association with first gain versus amplitude values and to receive an input signal (36); and
operating a second amplifier circuit (30) in association with second gain versus amplitude values and to transmit a modulated signal (34) associated with the input signal,
wherein the first and second gain versus amplitude values are such that there is a take-over-point which is an amplitude of the modulated signal at which gain control is changed from the first amplifier circuit to the second amplifier circuit;
characterized in that the method comprises:
determining a quality indicator of the modulated signal (34), and
adjusting the first gain versus amplitude values and the second gain versus amplitude values based at least in part upon the determined quality indicator."

Claims 15 to 26 are dependent on claim 1.

X. First auxiliary request

Claim 1 reads as follows:

"A receiver (10) for processing a signal, comprising:
a first amplifier circuit (14) that is operated in
association with a first gain and which is
operable to receive an input signal (36); and
a second amplifier circuit (30) that is operated in
association with a second gain and which is
operable to transmit a modulated signal (34)
associated with the input signal;
wherein the first and second gains are such that there
is a take-over-point which is an amplitude of the
modulated signal at which gain control is changed
from the first amplifier circuit to the second
amplifier circuit; and
a gain control circuit (32);
characterized in that the gain control circuit (32) is
operable to:
determine a quality indicator of the modulated signal
(34); and
adjust the take-over-point amplitude (60) based at
least in part upon the determined quality
indicator."

Claims 2 to 10 are dependent on claim 1.

Claim 11 reads as follows:

"A method for processing a signal, comprising:
operating a first amplifier circuit (14) in association
with a first gain and to receive an input signal
(36);
operating a second amplifier circuit (30) in
association with a second gain and to transmit a
modulated signal (34) associated with the input
signal,
wherein the first and second gains are such that there
is a take-over-point which is an amplitude of the
modulated signal at which gain control is changed

from the first amplifier circuit to the second amplifier circuit;
characterized in that the method comprises:
determining a quality indicator of the modulated signal (34), and
adjusting the take-over-point amplitude (60) based at least in part upon the determined quality indicator."

Claims 12 to 20 are dependent on claim 11.

XI. Second auxiliary request

Claim 1 reads as follows:

"A receiver (10) for processing a signal, comprising:
a first amplifier circuit (14) that is operated with a first gain and is arranged to amplify an input signal (36);
a second amplifier circuit (30) that is operated with a second gain and is arranged to output a modulated signal (34); and
a gain control circuit (32) arranged to control the first and second gains such that there is a take-over-point which is an amplitude (60) of the modulated signal (34) at which gain control is changed from the first amplifier circuit to the second amplifier circuit;
wherein the gain control circuit (32) is operable to determine an amplitude of the modulated signal (34) and to adjust at least one of the first and second gains based at least in part upon the determined amplitude of the modulated signal (34) characterized in that:
the gain control circuit (32) is further operable to:
demodulate the modulated signal (34) to generate a demodulated signal (102) and determine a quality

indicator (110) of the demodulated signal (102);
and

if the determined quality indicator (110) of the demodulated signal (102) exceeds a predetermined threshold, determine a quality indicator (108) of the modulated signal (34) and adjust the amplitude (60) of the take-over-point based at least in part upon the determined quality indicator (108) of the modulated signal (34)."

Claims 2 to 8 are dependent on claim 1.

Claim 9 reads as follows:

"A method for processing a signal, comprising:
operating a first amplifier circuit (14) with a first gain to amplify an input signal (36);
operating a second amplifier circuit (30) with a second gain to output a modulated signal (34),
operating a gain control circuit (32) to:
control the first and second gains such that there is a take-over-point which is an amplitude of the modulated signal (34) at which gain control is changed from the first amplifier circuit (14) to the second amplifier circuit (30);
determine an amplitude of the modulated signal (34);
and
adjust at least one of the first and second gains based at least in part on the determined amplitude of the modulated signal (34)
characterized in that the method comprises:
operating the gain control circuit (32) to demodulate the modulated signal (34) to generate a demodulated signal (102) and determine a quality indicator (110) of the demodulated signal (102);
and

if the determined quality indicator (110) of the demodulated signal (102) exceeds a predetermined threshold, determine a quality indicator (108) of the modulated signal (34) and adjust the amplitude (60) of the take-over-point based at least in part upon the determined quality indicator (108) of the modulated signal (34)."

Claims 10 to 16 are dependent on claim 9.

XII. The appellant essentially argued as follows:

An object of the invention was to provide a better and faster way of controlling the take-over-point which was an amplitude of the modulated signal at which gain control was changed from the first amplifier circuit to the second amplifier circuit.

D2 proposed to control the take-over-point on the basis of a demodulated signal and introduced further delays with LPFs (low pass filters) 16 and 17 (cf. figure 1). The invention allowed a faster gain control of the take-over-point based on the quality of the modulated signal.

Furthermore the invention controlled the gains according to the amplitude of the output of the second amplifier while D2 controlled the take-over-point amplitude and the gains of the amplifiers on the basis of the radio frequency signal, i.e. the input signal at the antenna.

With an arrangement according to the invention a single channel could be amplified rather than the whole frequency spectrum received at the antenna which included the adjacent channels.

Claim 1 of the second auxiliary request comprised the features of claims 1 and 3 of the main request and the

first auxiliary request, whereby claim 3 of these requests was based on original claim 5. This new request did not introduce any new consideration and should be admitted into the proceedings.

The subject-matter of independent claims of the second auxiliary request was limited to a receiver and a method wherein the adjustment of the take-over-point was based on the quality of the modulated signal and adjusted only if a determined quality indicator of the demodulated signal, e.g. the BER (bit error rate), exceeded a predetermined threshold. The combination of these features was not disclosed in any of documents D1, D2 and Z1.

Reasons for the Decision

1. The appeal is admissible.

2. *Main and first auxiliary requests*

2.1 The closest available prior art is considered as represented by D2 which concerns the adjustment of a take-over-point (TOP) (cf. D2, section [0008]) and the control of the gains of an RF circuit and an IF circuit.

D2 discloses a receiver for processing a signal, comprising:

- a first RF amplifier circuit 2 , 4 that is operated with a first gain and is arranged to amplify an RF input signal (cf. section [0029]), and
- a second IF amplifier circuit 10 (cf. section [0032]) that is operated with a second gain and is arranged to output a modulated signal.

The operation of the receiver is such that there is a take-over-point at which gain control is changed from

the first amplifier circuit to the second amplifier circuit (cf. sections [0039] and [0042]).

- 2.2 The gain control circuit of D2 is operable to:
- determine a quality indicator of the modulated signal (34); and
 - adjust the first gain and the second gain based at least in part upon the determined quality indicator.

Actually the adjustment of the gains of D2 depends on the signal issued by level detector 13 which is an image of the amplitude of the modulated signal and is used to maintain the receiving quality (cf. section [0041]).

Since the gains of amplifiers 2, 4 and 10 are adjusted based on this signal, the first and second gains (values) are considered as "adjusted based at least in part upon a determined quality factor of the modulated signal issued by the second amplifier" (claims 1 and 14 of the main request).

- 2.3 The independent claims of the main and first auxiliary requests recite further that:
- the first and second amplifier are operated in association with first and second gains or gain versus amplitude values which are such that there is a take-over-point.

The feature that first and second gains or first and second gain versus amplitude values are defined "such that there is a take-over-point" is not supported by the description.

In the present application, the take-over-point, i.e. the amplitude corresponding to the take-over-point, is first adjusted "from amplitude 60a to amplitude 60b in

small increments or decrements and in an iterative process with respect to the measurement of quality indicator 108" (cf. section [0026] of the published application). The first and second gains are then adjusted depending on the quality factor of the modulated signal and the comparison between the amplitude of the modulated signal and the amplitude of the take-over-point. It may be that two groups of gain values versus amplitude values would then be recalculated. Nevertheless the take-over-point does not result from a recalculation of new first and second gains or gains versus amplitude values of the modulated signal. The first and second gains do not even have to be related or to share a value at the take-over-point as the figures might suggest.

As such, the first and second gains are two isolated values. They are not "such that there is a take-over-point".

Hence, the feature mentioned above, which is not supported by the original application, is understood as a way to define that the gains are controlled such that there is a take-over-point which is an amplitude of the modulated signal at which gain control is changed from the first amplifier circuit to the second amplifier circuit. This feature which is incorporated in claims 1 and 9 of the second auxiliary request is known from D2.

- 2.3.1 The take-over-point amplitude (60) is adjusted based at least in part upon a determined quality factor of the modulated signal (claim 1, respectively claim 11 of the first auxiliary request).

This feature is considered as known from the receiver of D2 which comprises a gain control circuit operable to:

- determine a quality indicator (reception quality detector 20) of a signal (cf. section [0051] and figures 3A and 3B) and
- adjust the take-over-point based at least in part upon this determined quality indicator (cf. sections [0046] to [0049] and figures 2A to 2C).

Actually, according to D2, figures 3A and 3B and section [0040], the reception quality detector is for "detecting the reception quality based on outputs from the demodulator 19". Nevertheless, according to section [0051] of D2 "the reception quality detector 20 has a function for detecting the spread I-Q constellation after digital demodulation". An information taken out from an I-Q scheme is a symbol comprising a digital information, i.e. a group of bits, and several steps might be required before converting the received symbol into a sequence of individual bits, depending on the type of modulation and the algorithm used to estimate the quality and validate a symbol value. Thus, it appears that the reception quality detector 20 of D2 does not work on the basis of a completely demodulated signal.

In order to estimate the values of the bits of a sequence of bits represented by a symbol, the distance of the received symbol to the nearest points in the I-Q constellation is usually estimated. The quality of the reception depends on this distance and may be estimated using different well-known estimators like

- error vector magnitude, or receive constellation error;
- modulation error ratio; or

- mean-square error.

Figure 4 of the application shows clearly that the quality indicator 108 is issued from the demodulation circuit 100 which comprises an analog to digital converter 104. The quality indicator 108 of the present invention is based on signals available between the input of the demodulation circuit 100 receiving the modulated signal 34 and the output of the demodulation circuit 100 issuing the demodulated signal 102. Since the present application claims (cf. original claim 15) the same factors as the factors usually applied on symbols of an I-Q plane for assessing the quality of the received modulated signal, it should be concluded that the quality detector of the present application does not work directly on the modulated signal 34 but on values taken from the I-Q plane like the reception quality detector 20 of D2. If the quality indicator 108 of the present invention may be regarded as a quality indicator of a modulated signal, the quality indicator issued by the reception quality detector 20 of D2 has also to be regarded as a quality indicator of a modulated signal in the sense of the present invention.

Furthermore the receiver of D2 controls the gains such that there is a take-over-point (TOP), which implies gains versus amplitude values.

2.4 *Novelty (Article 54 EPC)*

The subject-matter of the independent claims of the main request and the first auxiliary request is new since it differs from D2 in that:

- there is a take-over-point which is an amplitude of the modulated signal (issued by the second amplifier).

2.5 *Inventive step (Article 56 EPC)*

In D2 the RF signal input is compared to the take-over-point value to make a choice between adjusting the gain of the first amplifier 2, 4 or the second amplifier 10 (cf. section [0042]). The take-over-point value of D2 is therefore implicitly an amplitude of the RF signal.

The adjustment of the gains is based on the signal issued by level detector 13 representing the difference between the input level of the A/D converter 12 and the optimal input level (cf. section [0041]). The input level of the A/D converter 12 which corresponds to the output level of the second amplifier 10, is thus necessarily estimated to estimate the difference with the optimal input level.

Since the amplitude of the modulated signal is available in D2, a comparison of the take-over-point to the modulated signal outputted by the second amplifier rather than to the RF input signal appears to be an obvious alternative.

The subject-matter of claim 1, respectively claim 14 of the main request and of claim 1, respectively claim 11 of the first auxiliary request does not therefore involve an inventive step (Article 56 EPC).

3. Second auxiliary request

3.1 *Admissibility*

The claims of the second auxiliary request, although filed at the oral proceedings, have been admitted by the board because they addressed the formal deficiencies that had become apparent in the claims filed with the letter dated 6 September 2013. On the

other hand, since the independent claims of the second auxiliary request are based on claims 3 and 5 as filed, which had been searched, they did not require any further investigative effort on the part of the board to assess novelty and inventive step.

3.2 *Article 83 EPC*

The examining division objected that "a skilled person is not able to correlate one defined gain value of the first and second amplifier, respectively, to a defined value of the modulated signal" (cf. penultimate paragraph of section 1.1 of the grounds of the decision). To remedy this objection, any correlation of the gain values to the modulated signal or any feature related thereto, like "gain profiles" or "gain versus amplitude values", have been suppressed from the claims of the second auxiliary request.

3.3 *Article 84 EPC*

The objected terms "prior to any demodulation" have been suppressed from the objected original feature "determine a quality indicator for the modulated signal (34) prior to any demodulation".

The term "association" in the original features "a first amplifier circuit (14) that is operated in association with a first gain" and "a second amplifier circuit (30) that is operated in association with a second gain" has been deleted for clarity. The modulated signal has been defined as outputted by the second amplifier and the definition of the take-over-point given in the original section "background of the invention" introduced (cf. also section [0019] of published application).

Consequently the unclear original expression "adjust the first gain and the second gain by adjusting the

default amplitude (60) from a first amplitude of the modulated signal to a second amplitude of the modulated signal based at least in part upon the determined quality indicator" could be replaced by features defining the take-over-point and its adjustment: "a gain control circuit (32) arranged to control the first and second gains such that there is a take-over-point which is an amplitude (60) of the modulated signal (34) at which gain control is changed from the first amplifier circuit to the second amplifier circuit" and "adjust the amplitude (60) of the take-over-point based at least in part upon the determined quality indicator (108) of the modulated signal (34)".

3.4 *Article 123(2) EPC*

Claim 1 of the second auxiliary request is based on clarified original claim 3 and part of original claim 5 and section [0017] of the published application. Claim 9 has been amended accordingly and new description pages 2 and 3 have been adapted to the new claims while a clerical error on page 7 has been corrected.

The requirements following from Article 123(2) EPC have been respected.

3.5 *Articles 54 and 56 EPC*

Claim 1, respectively claim 9 of the second auxiliary request adds the feature that the gain control circuit is operable "if the determined quality indicator (110) of the demodulated signal (102) exceeds a predetermined threshold, to determine a quality indicator (108) of the modulated signal (34) and adjust the amplitude (60) of the take-over-point based at least in part upon the determined quality indicator (108) of the modulated signal (34)".

This feature is not known from D2 wherein the take-over-point is adjusted on the basis of the quality indicator delivered by the reception quality detector 20 and derived from the I-Q plane values of the modulated signal, regardless of the quality of the fully demodulated signal.

The subject-matter of claim 1, respectively claim 9 of the second auxiliary request is therefore new (Article 54 EPC).

The condition defined by this feature might help reducing the frequency of adjustment of the take-over-point which might reduce the load on the processor of the receiver.

This feature is not considered as obvious in the light of the documents cited in the search report.

Claim 1, respectively claim 9, of the second auxiliary request does therefore involve an inventive step and claims 2 to 8, respectively claims 10 to 16, which depend on claim 1, respectively claim 9, do also meet the requirements of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description: pages 1, 4 to 6 and 8 to 13 as originally filed, and pages 2, 3, and 7 as filed during the oral proceedings of 26 March 2014;

Claims 1 to 16 of second auxiliary request filed during the oral proceedings of 26 March 2014;

Drawings: Sheets 1/3 to 3/3 as originally filed.

The Registrar:

The Chairman:



U. Bultmann

M. Ruggiu

Decision electronically authenticated