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**Datasheet for the decision
of 19 July 2012**

Case Number: T 1834/08 - 3.5.06

Application Number: 00972087.1

Publication Number: 1226507

IPC: G06F 13/42

Language of the proceedings: EN

Title of invention:

Bus System Optimization

Patentee:

Rambus Inc.

Opponent:

MICRON EUROPE Ltd

Headword:

Bus Signal Calibration/RAMBUS

Relevant legal provisions:

EPC Art. 123(2)

Relevant legal provisions (EPC 1973):

EPC Art. 56

Keyword:

"added subject matter (yes) - main request and auxiliary requests I-V and VII"

"inventive step (no) - auxiliary request VI"



Case Number: T 1834/08 - 3.5.06

D E C I S I O N
of the Technical Board of Appeal 3.5.06
of 19 July 2012

Appellant: MICRON EUROPE Ltd
(Opponent) Micron House
Wellington Business Park
Dukes Ride
Crowthorne Berkshire RG45 6LS

Representative: Tunstall, Christopher Stephen
Carpmaels & Ransford
One Southampton Row
London WC1B 5HA (GB)

Respondent: Rambus Inc.
(Patent Proprietor) 1050 Enterprise Way, Suite 700
Sunnyvale, CA 94089 (US)

Representative: Eisenführ, Speiser & Partner
Johannes-Brahms-Platz 1
D-20355 Hamburg (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 9 July 2008
rejecting the opposition filed against European
patent No. 1226507 pursuant to Article 101(2)
EPC.

Composition of the Board:

Chairman: D. H. Rees
Members: M. Müller
W. Sekretaruk

Summary of Facts and Submissions

- I. This appeal lies against the decision of the opposition division posted on 9 July 2008 to reject the opposition against European patent no. 1226507.
- II. The opponent filed a notice of appeal by telefax on 19 September 2008, the appeal fee being paid on the same day. A statement of grounds of appeal was received on 19 November 2008.
- III. In the grounds of appeal, the appellant (opponent) refers *inter alia* to the following documents.

OD1: US 5 254 883 A
OD2: WO 99/19876
OD3: WO 99/03106
OD4: US 5 666 078 A
OD5: US 5 457 407 A

Documents OD4 and OD5 had not been admitted into the procedure by the opposition division pursuant to Article 114(2) EPC 1973. The appellant challenged that decision and argued that they should be have been admitted. It also argued that the decision was contradictory in its arguments.

The appellant argued that the subject matter of granted claims 1 and 7 went beyond the application as originally filed, Article 100(c) EPC 1973, and was not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, Article 100(b) EPC 1973.

The appellant argued that claim 1 lacked novelty over OD1 and inventive step over OD1 in combination with any of OD4, OD5 or common knowledge, and that claim 7 lacked an inventive step over OD2 in view of common knowledge or over OD3 in combination with OD2, Article 100(a) EPC 1973.

- IV. In response to the grounds of appeal, with letter dated 6 April 2009, the respondent (proprietor) rejected each of these objections and requested that the appeal be dismissed or that, alternatively, the patent be maintained in amended form based on one of five sets of claims filed as auxiliary requests I to V.

- V. With a summons to oral proceedings, the board expressed the following preliminary opinion: The opposition division had exercised its discretion properly when deciding not to admit D4 and D5 into the proceedings, and the decision was sufficiently reasoned in this respect. Claim 7 as granted went beyond the contents of the application documents as originally filed, while claim 1 as granted did not. Claim 1 as granted was sufficiently disclosed for it to be carried out by the person skilled in the art but lacked an inventive step over OD1.

- VI. In response to the summons, with letter dated 18 June 2012, the respondent filed two additional sets of claims as further auxiliary requests VI and VII.

- VII. Claims 1 and 7 as granted read as follows:

"1. A method of determining a compensating driver current offset for a slave device (12a) transmitting

data to a master device (11) via a data bus (30), the method comprising:
driving data onto the data bus (30) at the slave device (12a);
receiving the data at the master device (11) in a comparator circuit;
comparing a voltage level of the data to a reference voltage;
generating a signal based on the comparison between the reference voltage and the voltage level of the data, wherein the signal is representative of a direction to adjust the voltage level of the data such that the voltage level of the data is adjusted toward the reference voltage;
communicating the signal from the master device (11) to the slave device (12a); and
adjusting a value in a register (321, 331) in accordance with the signal, wherein the register (321, 331) is in the slave device (12a) and the value in the register (321, 331) defines a driver current offset for the slave device (12a).

7. A method of operation in a system that includes a first integrated circuit device (11, 12a) to the second integrated circuit device (12a, 11), the method comprising:
transmitting a data sequence from the first integrated circuit device (11, 12a) to the second integrated circuit device (12a, 11);
sampling the data sequence by the second integrated circuit device (12a, 11) to produce receiver data;
transmitting the receiver data from the second integrated circuit device (12a, 11) to the first integrated circuit device (11, 12a);

performing a comparison between the data sequence and the receiver data; and based on the comparison, generating information representative of a calibrated timing offset; and using the information representative of the calibrated timing offset to adjust timing associated with transferring data from the first integrated circuit device (11, 12a) to the second integrated circuit device (12a, 11)."

VIII. In auxiliary requests I, II and VI, claim 1 is identical to claim 1 of the main request, in auxiliary requests III-V claim 1 and its dependent claims 2-5 have been deleted, and in auxiliary request VII claim 1 has been limited by addition of the following features at the end:

"... characterized in that driving data onto the bus (30) further comprises driving a high data value on a first signal line (335a) of the data bus (30) and driving a low data value on a second signal (335b) line of the data bus (30); and generating the voltage of the data from an intermediate voltage level of the high data value and low data value."

IX. Claim 1 of auxiliary request III and claim 5 of auxiliary request VII are identical to claim 7 of the main request. Claim 7 of auxiliary request I and claim 1 of auxiliary request IV are identical to claim 7 of the main request except for the addition of the following feature at the end:

"... wherein the timing offset is determined upon detection of a threshold number of bit errors."

Claim 7 of auxiliary request II and claim 1 of auxiliary request V are identical to claim 7 of the main request except for the addition of the following feature at the end:

"... wherein the data sequence has a balanced number of 0-1 and 1-0 transitions, and wherein the second integrated circuit device (12a) operates as a phase detector."

In auxiliary request VI, claim 7 is identical to claim 7 of the main request except for the following addition at the end:

"... characterized in that transmitting the data sequence from the first integrated circuit device (11, 12a) to the second integrating circuit device (12a, 11) includes transmitting a calibration clock signal that is shifted by about 90° with respect to the main clock signal; and transmitting data from the first integrated circuit device (11, 12a) to the second integrated circuit device (12a, 11) includes transmitting data in conjunction with transmitting the main clock signal."

- X. At the end of the oral proceedings, the chairman announced the decision of the board.

Reasons for the Decision

1. The appeal is admissible (see in particular points I and II above).

Admission of OD4 and OD5

2. In view of the outcome of the appeal the question whether OD4 and OD5 should have been or should be admitted is moot.

Admission of auxiliary requests VI and VII

3. Independent claims 7 and 18 of auxiliary request VI have been amended - over claims 7 and 19 as granted - by incorporating the features of claim 16 as granted, in particular a 90° clock shift. Independent claim 1 of auxiliary request VII has been amended over claim 1 as granted to incorporate the features of claims 2 and 3 as granted. Except for discarding the now redundant claims and renumbering the remaining ones, no further amendments have been made.
4. The filing of auxiliary requests VI and VII constitutes an amendment of the respondent's case which the board has discretion to admit under Article 13 (1) RPBA. Since both amendments are based on dependent claims as granted and are not particularly complex, and since therefore both the board and the appellant should be expected to deal with these requests without undue effort or delay during the oral proceedings, the board exercised its discretion to admit both requests.

Contradictions in the decision

5. The appellant argues that the decision contains contradictions that would "make it, as a whole, irrational (in the legal sense) and incomprehensible" (grounds of appeal, point 2.2). Specifically, the decision is alle-

gedly contradictory in its interpretation of "signal ... representative of direction" (grounds of appeal, point 3 ff.) While the appellant does not explicitly refer to any specific legal requirement, the board takes it that the appellant considers the decision therefore to be insufficiently reasoned in the sense of Rule 111(2) EPC.

- 5.1. The decision explicitly states the conclusions (see p. 3, esp. the last par.) that the original term "up/down signal" and the new term "signal ... representative of a direction" are "synonymous in the given context" of adjusting the voltage level towards the reference voltage, and that the K value of D1 is not considered to constitute such a signal. In the board's judgment, the decision also provides sufficient reasons for why the opposition division deemed this to be the case (*loc. cit.*).
- 5.2. The board therefore does not to share the appellant's perception that the decision is contradictory, let alone that it is insufficiently reasoned in this respect.

The invention

6. The invention generally relates to method and apparatus for adjusting timing and voltage characteristics of data signals exchanged between a master and a slave device (see application as published, p. 4, lines 2-4). In this context, independent claims 1, 5 and 6 of the patent relate to voltage adjustment, while claims 7 and 19 of the patent relate to timing adjustment. In the following, these groups of claims will be discussed separately, starting with claim 7 of the patent, *i.e.* claim 7 of the main request.

Main request

Article 100(c) EPC 1973, Article 123(2) EPC, Claim 7

7. Claim 7 of the patent as granted relates to the adjustment of the timing characteristics of data transmission between two integrated circuit devices (*viz.* master and slave). According to the claimed method, the first device transmits a data sequence to the second device which samples it to produce so-called "receiver data" which is transmitted back. At the first device, the original data sequence and the receiver data are compared and, based on the comparison, a calibrated timing offset is generated to be used for future data transmission between both devices.

7.1. The description discloses essentially two techniques to achieve timing calibration, called respectively "90° calibration" (p. 23, line 15 - p. 24, line 8, and original claim 43) and "scanning window" calibration (p. 25, lines 8-23, and original claim 49; cf. also grounds of appeal, points 5.1.2-5.1.4).

According to the 90° calibration technique, the sender shifts the internal transmit clock signal by 90° before sending the data sequence and the receiver will, depending on the phase difference between them, receive the sent data correctly, or will receive a "0" as a "1" or *vice versa* (cf. *e.g.* description, p. 24, lines 2-8). Depending on this result, the master will increment or decrement the read/write offset value until a centering offset value has been obtained (p. 24, lines 16-18). It is disclosed that the technique is symmetric in that sender and receiver can be master and slave, respective-

ly, or vice versa (p. 23, lines 20-22, and p. 24, lines 25-27).

According to the scanning window technique, a range of offset values is "scrolled through": That is, each of a range of offsets is applied to the read/write clock so that the clock transition moves in relation to the data eye. For each of these offsets the master will try to detect a 0-to-1 or 1-to-0 transition in order to locate the leading edge of the data eye at one offset value and the lagging edge at another one (cf. p. 25, lines 13-16). The centering offset is obtained as by averaging these offset values.

- 7.2. The appellant argues that claim 7 was broadened over the original disclosure "to such an extent that it no longer contains any of the essential integers of the original disclosed embodiments" (see grounds of appeal, point 5.1.6). In particular, as the appellant expressed during oral proceedings, both embodiments relied on some kind of clock shifting during the testing phase, in a single 90° shift or in a number of phase shifts, whereas claim 7 only requires a clock adjustment only as final timing adjustment, *i.e.* after the testing. This omission from claim 7 amounted to an impermissible generalisation of the disclosed invention. In the grounds of appeal (*loc. cit.*) more essential features were mentioned which claim 7 had to contain, in the appellant's view, in order to conform with Article 123 (2) EPC. With the summons to oral proceedings (see point 11 ff.), the board also raised the following issue: According to the respondent, claim 7 as granted was based on original claim 43 in combination with the description on pages 23 and 24 (see submission dated 6 April 2009, feature table on p. 17).

Original claim 43 contained the feature of "shifting the transmit clock in the master by 90°" and the description on pages 23 and 24 appeared to relate to the 90° calibration. In particular, the features of claim 7 relating to "data sequences" being transmitted, received and compared appeared not to appear to be disclosed in relation to the "scanning window" technique.

- 7.3. The respondent explained that the description disclosed three techniques for timing calibration, counting as two the alternatives of the 90° calibration (p. 23, line 15 - p. 24, line 24; vs. p. 24, line 25 - p. 25, line 1), of which only the first one was fully developed, whereas the others were disclosed in lesser detail. The skilled person would however understand that missing details from the scanning window technique had to be adapted from the detailed disclosure of the 90° calibration. In particular, the respondent referred to the description on page 26 (lines 6-7) which mentions that the "scanning window feedback mechanism is applied to voltages instead of timing", argued that the skilled person would understand this to refer to the 90° calibration technique, too, and suggested that the skilled person would take the term "feedback mechanism" to refer to the transmission, sampling, retransmission and comparison of data sequences according to the 90° calibration technique as disclosed on pages 24-25. Furthermore, the respondent, while conceding that original claim 43 covered the 90° calibration only, pointed out that original claim 49 covered the scanning window calibration and, as such, did not require a 90° clock shift: Claim 7 as granted was drafted to cover both embodiments so that the omission of the 90° clock shift feature was justified.

7.4. The board notes that the application as originally filed refers to, in the context of the 90° calibration, the transmission of a data sequence, a data pattern or a large block of data comprising several bits (p. 23, lines 22 and 30-31 and p. 24, line 13-14; claim 43) and its sampling into "receiver data", retransmission to the sending device, and comparison in order to detect a phase offset (p. 23, line 30 - p. 24, line 8; claim 43), in each step of the iteration which, as a whole, eventually produces the centering offset (p. 24, lines 16-18). In contrast, the description of scanning window calibration refers only to individual 0-to-1 or 1-to-0 transitions and neither to a transmission nor to the comparison of a data sequence as part of one iteration step. The board concedes that, as the respondent points out (submission of 18 June 2012), some data must be transmitted from the sender (e.g. the master) to the receiver (e.g. the slave) and back also in the scanning window approach. This does not imply, however, that a data sequence is transmitted in each iteration step. The board is also unable to accept that the skilled person would understand the mention of the "scanning window feedback mechanism" on page 26 (lines 6-7) as a reference to the transmit-sample-retransmit cycle disclosed as part of the 90° calibration technique disclosed on page 24.

7.5. The board therefore concludes that claim 7 of the patent as granted does not subsume the scanning window embodiment but is only supported by the 90° calibration embodiment. For the same reason, the board dismisses original claim 49 as a possible basis for claim 7 as granted.

7.6. In the context of the 90° calibration embodiment however the board is not aware of any statement in the applica-

tion which would justify the omission of the clock shifting feature. According to the description (p. 25, lines 2-7), the circuits in figures 25-27 require circuits "providing the 0° and 90° shifted clock signals" in the master - where they are "easily available in many DLL/PLL designs" and there is no disclosure to the effect that these circuits could be dispensed with. However their omission in the granted claims would be understood by the skilled reader to mean just that.

7.7. The board therefore concludes that claim 7 as granted extends beyond the application as originally filed, and that so does claim 19.

7.8. For this reason alone, the decision under appeal must be set aside.

Auxiliary requests I-V and VII

8. Since claim 7 of auxiliary requests I and II, claim 1 of auxiliary requests III-V and claim 5 of auxiliary request VII share the deficiency of claim 7 of the main request under Article 123 (2) EPC, auxiliary requests I-V and VII are not allowable for the same reason as the main request.

Auxiliary request VI

Article 100(b,c) and 83 EPC 1973, Article 123(2) EPC

9. The appellant argues (see grounds of appeal, point 4.1 ff.) that the replacement in claim 1 of the original term "up/down signal" by the new term "signal ... represent of a direction" goes beyond the application as originally filed and that the decision is wrong in finding

that it does not. The appellant further objects that, due to the replacement, amended claims 1-6 as granted are insufficiently disclosed because they are "fundamentally broader than the embodiments described in the description" (grounds of appeal, point 4.1.8). The respondent considers, in agreement with the decision, that the two expressions are synonymous in the given context.

9.1. The appellant argues that the patent would encompass two things that were not originally envisaged (see grounds of appeal, point 4.1.7) by stating that a signal ... representative of direction

a) "envisages far more complex arrangements than a simple up/down signal could ever have achieved", for example the use of "binary search algorithms" in addition to "simple linear searches" towards the reference voltage, and

b) covers the use of an "up/stop" or "down/stop" signal in addition to an "up/down signal".

9.2. During oral proceedings the appellant reiterated the objection according to which the term "signal ... representative of a direction" is more general than the term "up/down signal" but otherwise merely referred to its submissions in writing. The following argument is thus based on the board's preliminary opinion sent with the summons.

9.3. As regards a) the board considers that neither present claim 1 nor original claim 41 specify or imply what voltage level the calibration process has to start from nor how the "signal ... representative of direction" or the

"up/down signal" are to be used, respectively, for adjusting the voltage level towards the reference voltage, *i.e.* in what kinds of search algorithms. Thus the two expressions are equivalent in the "complex[ity of the] arrangements" which they might be taken to envisage. As regards b) the board agrees with the decision (p. 3, last par.) in considering that an "up/stop" or a "down/stop" signal are not "representative of direction": Rather, these signals merely represent the fact that the voltage level should be adjusted, whereas the direction and the amount of this adjustment are predetermined independent of the signal.

- 9.4. The board thus agrees with the decision under appeal and the respondent that the terms are synonymous in the claimed context, both defining a signal which indicates one of two possible directions (up or down) in which the reference voltage is to be adjusted but neither the adjustment step nor the target value of the adjustment.
- 9.5. In the board's judgement thus amended claim 1 does not extend beyond the application as originally filed and neither do, for the same reasons, claims 5 or 6. As a consequence of the board's position that the terms are synonymous, also the added matter objection to these claims fails.

Prior Art

10. Document OD1, undisputedly the most relevant piece of prior art at hand, addresses the problem of minimizing variations of voltage levels and current on a data bus between master and slave devices (see col. 2, lines 11-24 and 40-47; and fig. 1). To this end, circuitry is

provided in the slave device (col. 13, lines 8 ff. and fig. 7) for adjusting the current and voltage level under the control of a so-called K value held in a dedicated register (see e.g. col. 13, lines 45-60 and col. 15, lines 12-15) in the slave (see col. 15, lines 10-11). OD1 further discloses a calibration process during which the master device compares the voltage level on the bus and the reference voltage and determines an "updated K value" (see e.g. col. 15, line 22) which is sent to the slave device to set the register value accordingly (cf. e.g. col. 15, line 26-27).

11. The circuitry according to OD1 which eventually controls the voltage and current on the data transmission line (fig. 4, no. 111) has, as the respondent explains, two distinguished components, depicted respectively in figures 4 and 7.
 - 11.1. One is the current mode driver as disclosed in figure 4 and described in col. 7 ff.). It comprises an array of transistors (no. 101), which can be selectively "turned on" to control voltage and current on the data transmission line (cf. col. 9, lines 42-55). The transistors are controlled by a binary value which is received from the output lines of a "current controller" (see nos. 120 and 103; and col. 9, line 56 - col. 10, line 7) and via NAND gates and inverters (nos. 102 and 106).
 - 11.2. The other is the current controller itself. OD1 discloses two embodiments of the controller (figs. 6 and 7), the second of which is relevant for the case to hand. According to this embodiment, the controller provides an array of capacitors (no. 163) which can be selectively coupled to a line (no. 167) in accordance with the value

K held in register REG (cf. OD1, e.g. col. 13, lines 42-49; and col. 14, lines 17-22). Logic circuitry (esp. no. 157; col. 13, lines 50-68) is also provided to "translate" the resulting voltage into a binary value which is eventually used to control the transistor array as just discussed (see fig. 4).

- 11.3. The K value, which indirectly determines voltage and current on the data transmission line, can be set by the user (see OD1, col. 12, lines 66-68 and col. 14, lines 62-64). However, OD1 also discloses that the value of K may have to be calibrated, especially in order to compensate for manufacturing variance in the capacitance of the capacitors (fig. 7, no. 163; col. 14, line 65 - col. 15, line 2).
- 11.4. At every point during this calibration process, the voltage on the data transmission line is determined by the current value of K (col. 15, lines 12-15). The slave whose K value is being calibrated sends a data packet to the master (col. 15, lines 15-16) which compares the voltage level of the received data to a reference voltage (lines 16-20). Based on this comparison result, which must be represented by some signal, the K value is updated and sent to the slave to update the register accordingly (lines 22-23).
- 11.5. OD1 discloses that K may initially be set to zero and repeatedly increased during calibration (col. 15, lines 8-10 and 20-21). Alternatively, calibration may start with K set to a large value which is repeatedly decreased (lines 32-39) or that K can be found via a "binary search ... as part of the calibration process" (lines 29-31) in which case, as the board understands it,

K may be increased or decreased in response to the voltage comparison.

Inventive Step

12. Claim 1 of auxiliary request VI is identical with claim 1 as granted.
13. The respondent argues that the mentioned calibration process according to OD1 does not qualify as a "method of determining a compensating driver current offset" as required by the preamble of claim 1 and that the register REG of OD1 does not "[define] a driver current offset" as required by the last feature of claim 1. Rather, the process of OD1 has to be seen as a process of "calibrating the calibrator", as the respondent put it during oral proceedings, in a phase strictly preceding the current offset calibration as claimed. OD1 disclosed a second phase by discussing what "control logic 157" would do "during operation" (col. 15, lines 58-64).
14. The board cannot follow this argument. First, as discussed above, control logic 157 "translates" the voltage on line 167 (fig. 7) into a binary value which, if indirectly, determines voltage and current on data transmission line 111 (fig. 4). This translation is thus an integral part of the calibration process of OD1 rather than a separate phase. Moreover, since OD1 discloses calibration of each slave individually with respect to the master (col. 15, lines 10-11), the final K value in register REG constitutes, in the board's judgement, a "driver current offset for the slave device".

15. According to OD1, the updated K value is transmitted to the slave and there simply stored in the register. This K value is not "representative of direction" but represents the new target value directly.
- 15.1. The board thus concludes that claim 1 differs from OD1 in that it requires the transmission of a "signal representative of direction to adjust the voltage level" and the adjustment of the corresponding register at the slave "in accordance with this signal".
- 15.2. In the grounds of appeal (point 4.2.3), the appellant suggested that the objective technical problem is to avoid the "exchange of redundant information". In fact, while the entire K value consists of several bits (for instance five, as illustrated in figs. 4 and 7), the signal representative of direction could consist in as little as one or two bits. Therefore the board considers that in comparison with OD1, claim 1 solves the problem of reducing the amount of communication between master and slave.
- 15.3. The board agrees with the appellant that the skilled person would not need to exercise an inventive step in order to solve this problem by transmitting only the comparison result and leaving it to the slave to determine the new K value.
- 15.4. In the summons, the board presented this as its preliminary finding and invited the respondent to comment on it, specifically in view of the fact that the appellant's argument in the grounds of appeal had been brief and not been addressed by the respondent in its response. The respondent chose not to address this issue in its res-

ponse to the summons and stated during oral proceedings that it would not want to argue inventive step based on this difference.

15.5. The board thus concludes that claim 1 of auxiliary request VI lacks an inventive step over OD1, and that so do independent claims 5 and 6.

Summary

16. There being no further requests, the patent must be revoked.

Order

For these reasons it is decided that:

1. The decision is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

B. Atienza Vivancos

D. H. Rees