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**Datasheet for the decision
of 19 October 2006**

Case Number: T 0105/05 - 3.5.03

Application Number: 98911767.6

Publication Number: 0978167

IPC: H04B 1/40

Language of the proceedings: EN

Title of invention:
Dual band radio receiver

Applicant:
INTEL CORPORATION

Opponent:
-

Headword:
Dual band radio receiver/INTEL

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step; new main request (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0105/05 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 19 October 2006

Appellant: INTEL CORPORATION
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Decision under appeal: Decision of the examining division of the
European Patent Office posted 19 July 2004
refusing European application No. 98911767.6
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: A. S. Clelland
Members: F. van der Voort
M.-B. Tardo-Dino

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division refusing European patent application No. 98 911 767.6 (EP 0978167), which was published as international application WO 98/44646 A pursuant to Article 158(1) EPC and which claims a priority date of 28 March 1997. The reasons for the refusal were that the subject-matter of two independent claims of a main request and two auxiliary requests did not involve an inventive step (Article 56 EPC).

II. The following documents were cited in the international search report and/or the supplementary European search report made up for the patent application in suit:

D1: US 5 437 051 A;
D2: US 4 132 952 A;
D3: EP 0 653 851 A;
D4: WO 97 30523 A;
D5: US 5 406 615 A;
D6: US 5 564 076 A;
D7: US 5 694 414 A;
D8: GB 2 312 108 A; and
D9: US 5 475 677 A.

No further documents were introduced by the examining division in the course of the examination procedure.

III. With the statement of grounds of appeal the appellant filed five sets of claims, corresponding to a main request and four auxiliary requests, and requested that the impugned decision be set aside and a patent be granted on the basis of any one of these sets of claims.

Arguments were submitted in support. Oral proceedings were conditionally requested.

- IV. In a communication accompanying a summons to oral proceedings, the board gave a preliminary opinion. In respect of the claims on file, objections under Articles 56, 84 and 123(2) EPC were raised.
- V. In response to the board's communication, the appellant filed an amended main request and four amended auxiliary requests and submitted arguments in support.
- VI. Oral proceedings were held on 19 October 2006 in the course of which the appellant withdrew all requests on file and filed a single set of claims replacing them. Further, amended pages of the description were filed. The appellant requested that the impugned decision be set aside and a patent be granted on the basis of the following documents:
- claims 1 to 10 as filed during the oral proceedings;
 - description pages 1, 4 to 6, 8 and 9 as originally filed, pages 2, 3 and 7 as filed during the oral proceedings, and pages 2A and 10 as filed with letter of 28 May 2002; and
 - drawing sheet 1/6 as filed with letter of 28 May 2002, sheet 2/6 as filed with letter of 27 February 2004 and sheets 3/6 to 6/6 as originally filed.

At the end of the oral proceedings the board's decision was announced.

VII. Independent claim 1 reads as follows:

"A dual band radio receiver (100) comprising:

 a local oscillator (122) configured to generate a Local Oscillator (LO) signal within a single band;

 a first two-way switching device (126) connected to be controlled by a base band controller device (127) and arranged to couple an RF signal intercepted by an antenna (102) to one of a first front end receiver (132) and a second front end receiver (134) dependent on whether the RF signal frequency is within a first band or a second band, respectively;

 a first mixer device (116) adapted to receive said LO signal in said single band and an output signal from the first front end receiver (132) and to output a first Intermediate Frequency signal (IF_1);

 a second mixer device (118) adapted to receive the same said LO signal within said single band and an output signal from the second front end receiver (134) and to output a second Intermediate Frequency signal (IF_2);

 a second two-way switching device (128) also connected to be controlled by said base band controller device (127) for switching between said first IF signal (IF_1) and second IF signal (IF_2); and

 said local oscillator (122) being connected to said base band controller device (127) and being adapted to provide said LO signal with an oscillation frequency that resides only within said single band which is a third band located substantially midway between centres of said first and second bands, and

between said first and second bands and wherein a lower limit of the third band is substantially equal to a lower limit of the first band plus half a difference between a respective lowest frequency of the first and second bands and an upper limit of the third band is substantially equal to an upper limit of the second band less half the difference between the respective lowest frequency of the first and second bands."

Independent claim 7 reads as follows:

"A method of converting a Radio Frequency signal into an Intermediate Frequency signal, comprising:

 providing in a dual band radio receiver (100) a local oscillator (122) configured to generate a Local Oscillator (LO) signal within a single band;

 coupling, by a first two-way switching device (126) connected to be controlled by a base band controller device (127), an RF signal intercepted by an antenna (102) to one of a first front end receiver (132) and a second front end receiver (134) dependent on whether the RF signal frequency is within a first band or a second band, respectively;

 mixing in a first mixer device (116) said LO signal in said single band and an output signal from the first front end receiver (132) and outputting a first Intermediate Frequency signal (IF_1);

 alternatively mixing in a second mixer device (118) the same said LO signal within said single band and an output signal from the second front end receiver (134) and outputting a second Intermediate Frequency signal (IF_2);

 switching between said first IF signal (IF_1) and second IF signal (IF_2) using a second two-way switching

device (128) also connected to be controlled by said base band controller device (127);

wherein said local oscillator (122) is connected to said base band controller device (127) and provides said LO signal with an oscillation frequency that resides only within said single band which is a third band located substantially midway between centres of said first and second bands and between said first and second bands and wherein a lower limit of the third band is substantially equal to a lower limit of the first band plus half a difference between a respective lowest frequency of the first and second bands and an upper limit of the third band is substantially equal to an upper limit of the second band less half the difference between the respective lowest frequency of the first and second bands."

Reasons for the Decision

1. *Articles 123(2), 83 and 84 EPC*
- 1.1 Claim 1 is based on a combination of claims 1 to 3 as originally filed. The board notes however that not all of the additional features of claim 2 as originally filed, which specifies that IF filters are coupled to the respective mixers and that a switching device is coupled to these filters, have been included in present claim 1. Only the switching device has been included, whereas the IF filters remain the subject of present claim 2. However, in the board's view, it is implicit to the skilled reader from reading the application as filed as a whole that, in view of their different, independent functions, the dual band radio receiver, when provided with the switching device, which is

illustrated in Fig. 1 as a two-way switching device 128, does not necessarily require the presence of the IF filters (IF filters 120 and 124 in Fig. 1) and that, alternatively, the switching device may, for example, be directly coupled to the outputs of the mixer devices (mixers 118 and 116 in Fig. 1). The application as originally filed thus provides a basis for the second switching device for switching between the first and second IF signals provided by the respective mixers, as specified in present claim 1.

The feature concerning the first two-way switching device in present claim 1 is based on page 4, lines 3 to 10, of the application as originally filed. Further, the definition of the third band and its upper and lower limits is based on page 5, penultimate line, to page 6, line 2, and page 6, lines 21 to 27, of the description, it being clear from page 3, line 17, to page 4, line 2, that the formulas at page 6, which define the lower and upper limits, are not limited to the specific frequency values used (cf. dependent claims 4 to 6 as originally filed). The wording "substantially equal" in the definition of the lower and upper limits is based on page 6, last line ("approximately equal").

Claims 3 to 5 and 8 to 10 are based on claims 4 to 6, 19 and 20 as originally filed. System claim 6 is based on independent claim 8 as originally filed, which was redrafted as a dependent claim without introducing any subject-matter which was not originally disclosed, and includes all the constructional features referred to in independent method claim 21 as originally filed. Claim 7 is based on claim 15 as originally filed and is

further limited by the inclusion of method steps which correspond to the apparatus features of present claim 1.

- 1.2 Description pages 2, 2A, 3, 7 and 10 and drawings 1/6 and 2/6 include a number of corrections of obvious errors as well as amendments which were made in view of the requirements of Rule 27 EPC. In the board's view they equally do not introduce any subject-matter which was not originally disclosed.
- 1.3 The board is thus satisfied that the application does not contain subject-matter which extends beyond the content of the application as filed. The amendments therefore meet the requirements of Article 123(2) EPC.
- 1.4 Further, the board is also satisfied that the claims do not give rise to objections under Articles 83 and 84 EPC.

Taking into account the common general knowledge of a person skilled in the art, in the board's view, the application as originally filed provides a sufficiently clear teaching to enable the skilled person to implement the claimed receiver and to carry out the claimed method, including the feature of coupling the RF signal to one of the front-end receivers dependent on whether the RF signal frequency is within the first or second band.

Further, the board judges that in claims 1 and 7 the definition of the third band as being "substantially" midway between centres of the first and second bands,

with lower and upper limits of the third band being "substantially" equal to ..., is adequately clear.

2. *Novelty*

2.1 None of the available prior art documents discloses all of the features of independent claim 1. In particular, none of them discloses a dual band receiver including two IF mixers supplied with the same signal generated by a local oscillator and a two-way switching device for selectively applying an incoming RF signal to one of two front-end receivers.

2.2 More specifically, D1 discloses a broadband tuning circuit including a signal splitter 52 (see Fig. 3) for splitting an incoming RF signal into two signals, i.e. a low and a high frequency signal. The splitter cannot be said to constitute the two-way switching device of the claimed receiver in view of the different function of the switching device, which passes the complete incoming signal at its input terminal to either one or the other of its two output terminals.

D2, see Figs 1 and 2, discloses a dual band receiver having a single LO 16 which provides its output signal to a single mixer 15. An antenna receives broadcast signals which are applied to both of two bandpass filters 12H and 12L, each covering a different frequency range (col. 2, lines 50 to 52).

D3 discloses a multi-band receiver for GSM, DSC1800 and DECT signals, which includes an oscillator 31 connected to a single common mixer 30 (see Fig. 1).

D4 constitutes prior art according to Articles 54(3) and 158(1), (2) EPC and describes a dual-mode radio architecture in which for each of two reception modes a respective mixer is adapted to receive an output signal from a respective front-end receiver and an oscillator signal from a common local oscillator. The two mixers are however not adapted to receive the respective front-end receiver output signal and the same oscillator signal, since, as a function of the selected reception mode, the oscillator signal is switched to a different frequency band, see, e.g., Fig. 2 and page 10, lines 9 to 15 and page 11, lines 34 to 37, relating to an embodiment which includes a switch 14, mixers 30, 32, front-end receivers 16, 22, 20, 24 and a dual-band local oscillator 34 and which is suitable for receiving either digital (PCS1900) or analog (AMPS) cellular radio signals. In an alternative embodiment, as illustrated in Fig. 6, which is suitable for receiving either satellite (ODYSSEY) or cellular (PCS1900) radio signals, two separate oscillators (1LO VCO and 208) are used, in which each oscillator generates a local oscillator signal in a different frequency band.

D5, see Fig. 12, discloses a dual-band receiver for a base station, which includes mixers 1230 and 1283 which are supplied with different oscillator signals provided directly from a local oscillator 1233 and via a frequency doubler 1286, respectively. Further, D5, see Fig. 3, discloses a handset which includes a receiver, in which in order to receive either cellular or ISM signals a different oscillator signal is applied by means of a synthesizer 326 to a common IF (45 MHz) mixer 324, see col. 5, lines 8 to 11 and 38 to 40. A

second IF mixer 322 is supplied with a different signal having a fixed frequency, namely 45 MHz +/- 455 kHz, see col. 5, lines 46 to 50.

D6 discloses a dual band receiver for receiving either GSM or satellite signals. The GSM signals are either directly mixed to baseband (see Fig. 2) or mixed at an IF mixer 31 with a local oscillator signal which is generated by a VCO 230 and which has a frequency which is different from, namely N times higher than, the oscillator signal used for mixing the satellite signal at mixer 241 (see Fig. 3).

D9, see Fig. 3, discloses a receiver, in which a frequency synthesizer 301 is tuned to a selected local oscillator (LO) frequency which is applied to a single IF-mixer 304 of the receive chain which supports both a time-division duplex mode and a frequency-division duplex mode.

2.3 D7 and D8 were published between the priority date and the filing date of the present application and do not constitute prior art in the sense of Article 54 EPC since the priority date of the present application is validly claimed (Article 89 EPC).

2.4 The board therefore concludes that the subject-matter of independent claim 1 is new having regard to the cited prior art (Articles 52(1) and 54 EPC). For the same reasons, applied *mutatis mutandis*, the subject-matter of method claim 7, which specifies method steps corresponding to the apparatus features of claim 1, is new. Further, since claims 2 to 6 and 8 to 10 include

all features of either claim 1 or 7, their subject-matter is new too.

3. *Inventive step*

3.1 The examining division considered D1 as representing the closest prior art. The board however disagrees for the following reasons.

3.2 The object of the invention disclosed in D1 is to provide a tuning circuit which is able to receive broadcasting RF signals over the "entire frequency range" of "a very broad frequency band", in which the tuning circuit is, nevertheless, of a simple construction (see col. 1, lines 7 to 10, col. 2, lines 62 to 65, and col. 3, lines 10 to 19). More specifically, D1 seeks to solve the difficulty which arises in the use of one or more voltage controlled oscillators (VCOs) for generating an oscillator signal within a frequency range which is as wide as that of the (very broad) frequency band to be received. The proposed solution consists in artificially splitting the (very broad) frequency band into two contiguous subbands and in using a voltage controlled oscillator (VCO) in combination with two mixers for respectively converting an incoming RF signal in the lower subband in an up-heterodyne fashion and an incoming RF signal in the higher subband in a down-heterodyne fashion (see col. 2, line 62 to col. 3, line 9, col. 3, lines 20 to 34, and col. 5, lines 25 to 33). The effect is that the bandwidth of the VCO is relatively narrow and, hence, the VCO can be easily constructed (see col. 5, lines 44 to 56, and Fig. 4). In the specific embodiment described with reference to Figs 3 and 4, the RF signal

is received in a multi-channel transmission band over a frequency range from 500 to 2500 MHz. This band is split in the receiver by a splitter 52 into a first subband from 500 to 1500 MHz ("a" in Fig. 4) and a second subband from 1500 to 2500 MHz ("b" in Fig. 4). The VCO 22 is configured to generate a local oscillator (LO) signal within a band which extends from 900 to 2100 MHz only (see "f" in Fig. 4).

The broadband tuning circuit of D1 is therefore in effect a single band receiver, see also claim 1 of D1: "*A broadband tuner for receiving information comprising: means for receiving an input signal, which carries the information, the input signal being within a predetermined frequency range ...*" (underlining by the board).

Since D1 is not concerned with a dual band receiver, it can not be considered as a reasonable starting point for a judgement as to whether the subject-matter of present claim 1 involves an inventive step.

- 3.3 If, for the sake of argument, D1 were nevertheless taken as the starting point, the board notes that in order to arrive at the subject-matter of claim 1 it would *inter alia* be necessary to modify the tuning circuit of D1 such that it includes the feature that the VCO band is between the first and second bands. This feature implies however that the first and second bands are not contiguous but separated over at least the width of the VCO band. In the board's view, even if this were known per se (cf., e.g., D3, Fig. 2), a person skilled in the art would not apply it to the tuning circuit of D1, since it would go against the aim

and teaching of D1, namely that of providing a broadband tuning circuit capable of receiving RF signals over an entire, very broad frequency range.

- 3.4 Instead, the board considers D3 to represent the closest prior art as it relates to a multi-band radio receiver for receiving RF signals in at least two bands: a first band for GSM signals (890 - 960 MHz) and a second band for DSC1800 and DECT signals (1710 - 1900 MHz), see Fig. 2.

Further, in D3, see Figs 1 and 2, the frequency band (1290 - 1500 MHz) of a local oscillator 31 is between the first and second bands and located substantially midway between the centres of the first and second bands. The lower limit of the oscillator band is substantially equal to the lower limit of the first band plus half of a difference between the respective lowest frequency of the first and second bands and the upper limit of the oscillator band is substantially equal to the upper limit of the second band less half the difference between the respective lowest frequency of the first and second bands.

Besides the local oscillator 31, the disclosed receiver includes a common mixer device 30 which is adapted to receive the local oscillator signal and an output signal from either a first front-end receiver 12 or a second front-end receiver 22 dependent on the position of a multi-way switch 32. The front-end receivers each include a filter for suppressing frequency components outside the first and second bands, respectively (col. 4, lines 32 to 36).

3.5 The subject-matter of present claim 1 differs from the receiver disclosed in D3 *inter alia* in that the claimed receiver includes a second mixer device adapted to receive the same LO signal and an output signal from the second front end receiver and to output a second intermediate frequency signal.

In other words, the claimed receiver includes two IF mixers, each being supplied with the same local oscillator signal which is generated by a common local oscillator. Since the second two-way switch is downstream of the mixers, it switches between two intermediate frequency signals, whereas in D3, see Fig. 1, switch 32 switches between radiofrequency signals.

The technical problem underlying the claimed receiver when starting out from D3 may therefore be seen in providing an alternative implementation of the multi-band receiver disclosed in D3.

3.6 No suggestion to include a second mixer can be found in D3. On the contrary, D3 teaches that a low number of receiver components is advantageous having regard to the size and costs of the multiband receiver (see col. 2, lines 20 to 23, col. 2, line 54, to col. 3, line 3, and claim 1 ("gemeinsamer Mischoszillator")). The inclusion of a further mixer would at least *prima facie* go against this teaching.

3.7 Starting out from D3 and faced with the problem of providing an alternative implementation of the multi-band receiver, a person skilled in the art would consider D1 since it also relates to a radio receiver.

However, there would be no reason to apply the teaching of D1 (see point 3.2 above) to the receiver of D3, since the problem of, and solution provided for, receiving signals over an entire, very broad frequency range, i.e. in the order of 2000 MHz, as described in D1 does not apply to D3, in which the bandwidths of the first and second band are merely 70 and 190 MHz, respectively.

- 3.8 Nor is the above-mentioned distinguishing feature (see point 3.5) disclosed in any of the prior art documents D2, D5, D6 and D9 referred above, see point 2.2:

The tuner of D2, see Figs 1 and 2, includes only one mixer 15 connected to the local oscillator 16.

In the dual band receiver for the base station according to D5, see Fig. 12, the two mixers 1230 and 1283 are supplied with different oscillator signals provided directly from the local oscillator 1233 and via the frequency doubler 1286, respectively. In the receiver of the handset (see Fig. 3) for receiving either cellular or ISM signals, a different oscillator signal is applied by means of a synthesizer 326 to a common IF mixer 324, see col. 5, lines 8 to 11 and 38 to 40.

In the dual band receiver of D6, see Fig. 3, the oscillator signal applied to IF mixer 241 has a frequency which is different from the oscillator signal applied to IF mixer 31.

The receive chain of the receiver disclosed in D9, see Fig. 3, includes a single frequency synthesizer 301 for

generating a local oscillator signal which is applied to a single IF-mixer 304.

Further, the board sees no reason to assume that the above-mentioned distinguishing feature is part of the common general knowledge of the person skilled in the art.

- 3.9 It follows that the subject-matter of claim 1 is not rendered obvious having regard to the available prior art documents and taking into account the common general knowledge of a person skilled in the art (Articles 52(1) and 56 EPC). The same applies to claim 7, which specifies method steps corresponding to the apparatus features of claim 1, and to the respective dependent claims 2 to 6 and 8 to 10.

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 on the basis of the following documents:
 - claims 1 to 10 as filed during the oral proceedings;
 - description pages 1, 4 to 6, 8 and 9 as originally filed, pages 2, 3 and 7 as filed during the oral proceedings, and pages 2A and 10 as filed with letter of 28 May 2002; and
 - drawing sheet 1/6 as filed with letter of 28 May 2002, sheet 2/6 as filed with letter of 27 February 2004 and sheets 3/6 to 6/6 as originally filed.

The Registrar:

The Chairman:

D. Magliano

A. S. Clelland