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Datasheet for the decision of 8 May 2015

Case Number: T 1688/11 - 3.5.03

Application Number: 06769805.0

Publication Number: 1867062

IPC: H04B1/52

Language of the proceedings: EN

Title of invention:
Tunable duplexer with common node notch filter

Applicant:
Qualcomm Incorporated

Headword:
Duplexer with notch filter/QUALCOMM

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
Inventive step - main request (no)
Novelty - first and second auxiliary request (no)

Decisions cited:

Catchword:

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Case Number: T 1688/11 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 8 May 2015

Appellant: (Applicant)	QUALCOMM INCORPORATED 5775 Morehouse Drive San Diego, CA 92121 (US)
Representative:	Catesby, Olivia Joanne Tomkins & Co. 5 Dartmouth Road Dublin 6 (IE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 11 February 2011 refusing European patent application No. 06769805.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	F. van der Voort
Members:	K. Schenkel
	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. 06769805.0 (publication number EP 1867062), which was originally filed as international application PCT/US2006/013120 (publication number WO 2006/121551).

II. The reasons given for the refusal were that:

- the subject-matter of claim 1 of a main request did not involve an inventive step (Articles 52(1) and 56 EPC) having regard to the disclosure of:

  D1: Saitou, K. et al., "Tunable Duplexer Having Multilayer Structure Using LTCC", June 2003, Microwave Symposium Digest, 2003 IEEE MTT-S International, Volume: 3, pages 1763-1766,

  and taking into account the common general knowledge of a person skilled in the art;

- the subject-matter of the independent claims (claims 1 and 11) of a first auxiliary request extended beyond the content of the application as originally filed (Article 123(2) EPC); and

- the independent claims (claims 1 and 11) of a second auxiliary request were not clear (Article 84 EPC).

III. In the statement of grounds of appeal, the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main request on file or, in the alternative, on the basis of

the claims of a first or a second auxiliary request, both as filed with the statement of grounds of appeal.

Oral proceedings were conditionally requested.

IV. In a communication accompanying a summons to the oral proceedings, the board, without prejudice to its final decision, raised objections concerning inter alia lack of inventive step of the subject-matter of all independent claims of each request having regard to the disclosure of document D1.

V. The appellant did not comment on the board's observations or file any further amendments.

VI. Oral proceedings were held on 8 May 2015.

At the oral proceedings, the appellant submitted an excerpt from *Federal Standard 1037C (Telecom Glossary 2000) - Telecommunications: Glossary of Telecommunications Terms* (in the following D4) in support of its interpretation of the term "band-reject filter" as used in each one of the independent claims.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 9 of a main request as filed on 13 December 2010 or, in the alternative, on the basis of claims 1 to 12 of a first or a second auxiliary request, both filed with the statement of grounds of appeal.

At the end of the oral proceedings, after due deliberation, the chairman announced the board's decision.

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

"A mobile station for use in a wireless communication system, the mobile station being operable to use a transmit frequency and a receive frequency, the mobile station comprising:

a receive path (606) comprising:

a tunable single-pole transmit band reject filter (612) adapted to receive signals from an antenna and tuned to the transmit frequency such that it rejects the transmit frequency, and having an output port connected to an input port of a tunable receive band pass filter tuned to the receive frequency such that it passes the receive frequency and adapted to receive filtered signals from the transmit band reject filter (612)

and a transmit path (608) comprising:

a tunable single-pole receive band reject filter (618) tuned to the receive frequency such that it rejects the receive frequency and adapted to provide signals to the antenna, wherein the tunable single-pole receive band reject filter (618) and the tunable single-pole transmit band reject filter (612) are coupled at a common node (610), and a tunable transmit band pass filter (620), tuned to the transmit frequency such that it passes the transit [sic] frequency, is adapted to provide filtered signals to the receive band reject filter, the transmit band pass filter (620) having an output port connected to an input port of the tunable single-pole receive band reject filter (618)."

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

"A mobile station for use in a wireless communication system, the mobile station being operable to use a transmit frequency and a receive frequency, the mobile station comprising:

a receive path (606) comprising:

a tunable transmit band reject filter (612) adapted to receive signals from an antenna and tuned to the transmit frequency such that it rejects the transmit frequency and a tunable receive band pass filter tuned to the receive frequency such that it passes the receive frequency and adapted to receive filtered signals from the transmit band reject filter; wherein the band reject filter (612) is a notch filter that is an open circuit at the transmit frequency

and a transmit path (608) comprising:

a tunable receive band reject filter (618) tuned to the receive frequency such that it rejects the receive frequency and adapted to provide signals to the antenna, wherein the tunable receive band reject filter (618) and the tunable transmit band reject filter (612) are coupled at a common node (610), and a tunable transmit band pass filter (620), tuned to the transmit frequency such that it passes the transit [sic] frequency, is adapted to provide filtered signals to the receive band reject filter wherein the band reject filter (618) is a notch filter that is an open circuit at the receive frequency."

IX. Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the wording "is a notch filter that" is twice deleted.

Reasons for the Decision

1. Main request - *inventive step*

1.1 D1 relates to a tunable duplexer (see the abstract) for use in a "handy terminal for cellular system of the fourth generation" (page 1763, left column, second paragraph) and therefore implicitly discloses that the tunable duplexer is part of a mobile station.

The duplexer comprises a receive path "Rx" with a high pass filter "HPF" and a bandpass filter "BPF" in series and a transmit path "Tx" with a low pass filter "LPF" and a band pass filter "BPF" in series (see Figure 1).

Table 1 on page 1764 lists the design parameters of the low pass filter "LPF" in the transmit path "Tx" and of the high pass filter "HPF" in the receive path "Rx". Further, on page 1765, Figure 5 shows the stopband attenuation in the transmit path "Tx" with and without the low pass filter "LPF", and Figure 6 shows the stopband attenuation in the receive path "Rx" with and without the high pass filter "HPF".

The duplexer of D1 makes it possible to control the passband and the stopband independently (see the abstract), the four filters being separately controllable (page 1764, beginning of the second paragraph). In the transmit path "Tx" and the receive path "Rx" the passband is controlled by tuning the band pass filters "BPF" and the stopband is controlled by tuning the low pass filter "LPF" and the high pass filter "HPF", respectively (cf. page 1766, left column, first paragraph).

Further, D1 on page 1766, second half of the first paragraph, states that in Figure 5, which relates to the transmit path "Tx", a notch, i.e. a stopband, is on the higher side of the passband. Since, as shown in Table 2 for both GSM modes, the passband of the receive path "Rx" is at higher frequencies than the passband of the transmit path "Tx" and since it is implicit that the passband in the transmit path "Tx" corresponds to the transmit frequency band and the passband in the receive path "Rx" corresponds to the receive frequency band, it follows that in the transmit path "Tx" the stopband is on the same side of the passband as the receive frequency band.

Thus, D1 discloses a low pass filter "LPF" in the transmit path "Tx", which is tuned such that it rejects the receive frequency band.

Likewise, D1 on page 1766, second half of the first paragraph, states that in Figure 6, which relates to the receive path, a notch, i.e. a stopband, is on the lower side of the passband. Thus, D1 discloses a high pass filter "HPF" in the receive path, which is tuned such that it rejects the transmit frequency band.

1.2 The appellant argued that the terms "transmit band reject filter" and "receive band reject filter" used in claim 1 were to be interpreted as meaning band rejection filters according to the definition given in D4.

The board notes, however, that the term "transmit band reject filter" may also be interpreted as meaning a filter for rejecting the transmit band. Hence, the term "single-pole transmit band reject filter" encompasses a filter that rejects the transmit frequency band,

without being necessarily a band reject filter, i.e. a filter which attenuates all frequencies between two non-zero limits (cf. the definition given in D4). This interpretation is also in accordance with the characteristic of the "single-pole transmit band reject filter" as cited in claim 1, namely that the filter is "tuned to the transmit frequency such that it rejects the transmit frequency". Hence, one frequency (the transmit frequency) is rejected (or, in practice, at least substantially attenuated), without it being necessary that this frequency is between two non-zero limits.

Further, the board notes that the "single-pole transmit band reject filter" (underlining added by the board) is part of the receive path and that the skilled reader would therefore relate the term "transmit" to the frequency band the filter rejects, i.e. the transmit band. The same applies, *vice versa*, to the "single-pole receive band reject filter" in the transmit path.

With the statement of grounds of appeal the appellant filed an annex which shows two filter circuits together with the frequency response simulations. These circuits were said to represent a single-pole notch filter and a second-order high pass filter. With reference to the frequency response simulations, the appellant argued that the frequency responses of the two circuits bare no resemblance to each other and that, consequently, the single pole filter of claim 1 could not be read on the high and low pass filters of D1. The board notes however that the high pass filter "HPF" of D1 has a circuit structure which substantially differs from the circuit structure of the high pass filter shown in the annex, and further that the application as filed does not provide any circuit structure details of the

single-pole filters of claim 1. Hence, the simulations described in the annex do not convincingly support an alleged difference between on the one hand the low and high pass filters of D1 and on the other hand the single-pole filters of claim 1.

1.3 Using the language of claim 1, D1 thus discloses a mobile station, for use in a wireless communication system, in which the mobile station is operable to use a transmit frequency and a receive frequency (page 1765, Table 2). The mobile station includes: a receive path (page 1763, Figure 1, "Rx") which includes a tunable transmit band reject filter (Figure 1, "HPF") which is adapted to receive signals from an antenna (Figure 1, "IN-OUT/ANT") and is tuned to the transmit frequency such that it rejects the transmit frequency, and having an output port connected to an input port of a tunable receive band pass filter (upper "BPF" in Figure 1) which is tuned to the receive frequency such that it passes the receive frequency and is adapted to receive filtered signals from the transmit band reject filter (the upper "BPF" is connected in series with the filter "HPF"), and a transmit path ("Tx" in Figure 1) which includes a tunable receive band reject filter ("LPF" in Figure 1) which is tuned to the receive frequency such that it rejects the receive frequency and is adapted to provide signals to the antenna, and a tunable transmit band pass filter (lower "BPF" in Figure 1) which is tuned to the transmit frequency such that it passes the transmit frequency and is adapted to provide filtered signals to the receive band reject filter "LPF", the transmit band pass filter having an output port connected to an input port of the tunable receive band reject filter "LPF" (the lower "BPF" is connected in series with the filter "LPF"). Further, the tunable receive band reject

filter "LPF" and the tunable transmit band reject filter "HPF" are coupled at a common node. The receive band reject filter "LPF" and the transmit band reject filter "HPF" are higher-order filters with multiple poles, each comprising a plurality of capacitors and inductors.

1.4 The subject-matter of claim 1 of the main request thus differs from the mobile station disclosed in D1 in that according to claim 1 the transmit band reject filter and the receive band reject filter are single-pole filters.

1.5 Starting from D1, the technical problem underlying the subject-matter of claim 1 may be seen as reducing the complexity of the transmit band reject filter and the receive band reject filter.

1.6 The formulation of this technical problem does not contribute to an inventive step, since it is fully in line with the common ongoing pursuit, in the field of electronics, of reducing the complexity of electronic devices. Further, at the priority date it was well-known to a skilled person that the complexity of a filter may be decreased by reducing its order, in particular the number of its poles, and that one pole is the minimum number of poles for a filter.

Consequently, it would have been obvious to the skilled person, starting from D1 and faced with the above-mentioned problem, to use single-pole filters for the reject filters.

1.7 The board concludes that, starting from D1 and taking into account his common general knowledge, the skilled person would have arrived at a mobile station which

includes all the features of claim 1 without the exercise of inventive skill.

1.8 The subject-matter of claim 1 does not therefore involve an inventive step (Articles 52(1) and 56 EPC).

1.9 The main request is therefore not allowable.

2. First auxiliary request - *novelty*

2.1 The board notes that claim 1 of the first auxiliary request is identical to claim 1 of the first auxiliary request decided on by the examining division.

2.2 Compared to claim 1 of the main request, claim 1 of the first auxiliary request removes the limitation that the transmit band reject filter and the receive band reject filter are single-pole filters and, instead, adds the feature that these filters are notch filters that are open circuits at the respective frequencies the filters are tuned to.

The board understands the term notch filter to be a synonym for the term band-stop or band-rejection filter (cf. D4).

Further, the board follows the appellant's argument that the skilled reader would not understand the term "open circuit" in an absolute sense, but as meaning a substantially open circuit.

2.3 In D1, page 1766, section V, in the second half of the first paragraph, reference is made to Figures 5 and 6 and it is stated that "when applied voltage to LPF is increased from 1 to 4V, the notch on the higher side of passband moves towards lower frequency" (underlining

added by the board). Further, at the end of the aforementioned paragraph of D1, it is stated that "After the passband is fixed, the stopband is tuned by controlling voltages to BPF so that the notch of HPF and LPF is adjusted to desired frequency range for Tx and Rx respectively".

Hence, the low pass filter "LPF" and the high pass filter "HPF" disclosed in D1 have a notch in their frequency response and thus can be regarded as constituting notch filters with a low pass and a high pass characteristic, respectively.

2.4 Regarding the feature according to which the transmit band reject filter and the receive band reject filter are substantially open circuits at their respective frequency, the board notes that in D1 the high pass filter "HPF" and the low pass filter "LPF" include resonators formed by parallel and serial combinations of inductors and capacitors. More specifically, the "HPF" filter includes twice a serial resonator consisting of an inductor L1 and a capacitor Cv1 between the input and ground, which means that at the resonance frequency the impedance has its minimum and, hence, that the signal is substantially shortened to ground and thus substantially prevented from being passed on. Likewise, the "LPF" filter includes a parallel resonator consisting of an inductor L3 and a capacitor Cv3 in the signal path, which means that at the resonance frequency the impedance has its maximum and, since the parallel resonator is in the signal path, the signal is substantially prevented from being passed on. The board further notes that a notch in the frequency response minimises the signal propagation through the filter by decoupling the output from the input. Thus, a notch filter at the notch frequency

constitutes a substantially open circuit. Since the low pass filter and the high pass filter in D1 are notch filters and D1 discloses implicitly that the receive band reject filter has its notch at the receive frequency and that the transmit band reject filter has its notch at the transmit frequency, D1 discloses that the receive band reject filter is an open circuit at the receive frequency and that the transmit band reject filter is an open circuit at the transmit frequency.

2.5 The subject-matter of claim 1 is therefore not new (Articles 52(1) and 54 EPC).

2.6 The first auxiliary request is therefore not allowable.

3. Second auxiliary request - *novelty*

3.1 The board notes that claim 1 of the second auxiliary request is identical to claim 1 of the second auxiliary request decided on by the examining division.

3.2 Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the wording "is a notch filter that" is twice deleted. Claim 1 of the second auxiliary request is therefore broader than claim 1 of the first auxiliary request.

The reasoning set out above in respect of claim 1 of the first auxiliary request thus applies, *mutatis mutandis*, to claim 1 of the second auxiliary request.

3.3 Hence, the subject-matter of claim 1 is not new (Articles 52(1) and 54 EPC).

3.4 The second auxiliary request is therefore not allowable.

4. There being no allowable request, it follows that the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Rauh F. van der Voort

Decision electronically authenticated