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D E C I S I O N
of 19 April 2005

Case Number: T 1179/01 - 3.5.3

Application Number: 95925901.1

Publication Number: 0838037

IPC: G01S 7/03

Language of the proceedings: EN

Title of invention:

Circuit module for a phased array radar

Applicant:

QinetiQ Limited

Opponent:

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Headword:

Phased array radar/QINETIQ

Relevant legal provisions:

EPC Art. 56, 123(2)

Keyword:

"Amendments - added subject-matter (no) "

"Inventive step - yes (after amendment) "

Decisions cited:

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Catchword:

-



Case Number: T 1179/01 - 3.5.3

D E C I S I O N
of the Technical Board of Appeal 3.5.3
of 19 April 2005

Appellant:

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Decision under appeal:

Decision of the examining division of the
European Patent Office posted 29 May 2001
refusing European application No. 95925901.1
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 to refuse European patent application 95 925 901.1, which was published as international application WO 97/03367 A.
- II. The following documents were referred to in the decision:
- D1: A. Garrod, "Digital Modules for Phased Array Radar", IEEE International Radar Conference, Virginia, USA, 8 May 1995, pages 726 - 731; and
- D2: US 5 019 793 A.
- III. The reasons for the refusal were that the claims of the main request contravened Article 123(2) EPC and that the subject-matter of claims 1 and 8 of the auxiliary request lacked an inventive step with respect to the disclosure of D2 and common general knowledge in the art.
- IV. With the statement of grounds of appeal, the appellant filed two sets of claims according to a main and an auxiliary request and submitted arguments in support of these requests. Oral proceedings were conditionally requested.
- V. The appellant was summoned by the board to oral proceedings. In a communication accompanying the summons, the board gave a preliminary opinion.

VI. In response to the board's communication, the appellant filed a further set of claims by way of a second auxiliary request and submitted arguments in support of the request.

VII. Oral proceedings were held on 19 April 2005 during which the appellant withdrew the main and first auxiliary requests. An amended version of the claims of the second auxiliary request was made the subject of a new main request and a further set of claims by way of a new auxiliary request was filed. The appellant requested that the decision of the examining division be set aside and a patent be granted on the basis of the set of claims of the main request or, failing that, on the basis of the set of claims of the auxiliary request as filed during the oral proceedings. At the end of the oral proceedings the board's decision was announced.

VIII. Independent claims 1 and 6 of the main request read as follows:

"1. A circuit module for a phased array radar for digitally controlling a phase associated with a microwave signal received by the module, the module including frequency conversion means (514, 516; 522; 648; 656) for down-converting the received signal to produce an intermediate frequency (IF) received signal, characterised in that the module also includes digital to analogue converters (538I, 538Q; 638I, 638Q) (DACs) for deriving analogue phase-control signals from digital phase-control signals, a silicon vector modulator integrated circuit (526, 642) for producing a digitally phase-controlled IF signal in response to

input of the analogue phase-control signals and an IF reference signal, and an IF mixer (524; 646) for mixing the digitally phase-controlled IF signal with the IF received signal for production of a digitally phase-controlled baseband signal."

"6. A method of beamforming for radar using a phased array of circuit modules (502), the method including in each module (502) implementing the step of down-converting a microwave-frequency received signal to produce an IF received signal, characterised in that the method also includes in each module (502) implementing the steps of:

(a) deriving analogue phase-control signals by digital to analogue conversion of digital phase-control signals,

(b) applying the analogue phase-control signals and an IF reference signal to an *[sic]* silicon vector modulator integrated circuit (526, 642) for generation of a digitally phase-controlled IF signal, and

(c) mixing the IF received signal with the digitally phase-controlled IF signal for production of a digitally phase-controlled baseband signal."

Reasons for the Decision

1. *Amendments (main request)*

1.1 Claim 1 is based on subject-matter of claims 1, 8 and 9 as filed and defines a circuit module, specific examples of which are illustrated in Figures 9 and 10 and described in the description as filed (see, in particular, page 19, last three paragraphs). The

additional features defined in claims 2 to 4 are based on Figure 10 and page 20, 2nd and 3rd paragraphs, whereas those of claim 5 are based on Figure 9. Claim 6 defines a method including method steps corresponding to the constructional features of claim 1.

1.2 The board is therefore satisfied that the amendments according to the main request do not give rise to objections under Article 123(2) EPC. Neither do the claims in the board's view give rise to objections under Article 84 EPC.

2. *Inventive step (main request)*

2.1 D2 (see, in particular, Figure 6) discloses a circuit module, i.e. a variable phase shifter and amplitude weighting device (VPSAW) 70, for digitally controlling a phase associated with a microwave (RF) signal received by the module (cf. column 7, lines 27 to 32 in conjunction with column 3, lines 62 to 67, which shows that the device may be a "microwave" device). The circuit module is suitable for use in a phased array radar (column 1, lines 13 to 17 and column 9, lines 9 to 52). It includes frequency conversion means (mixers 78, 80) for down-converting the received RF signal RF_{in} in order to produce intermediate frequency (IF) received signals. Further, it includes direct digital synthesizers (DDSs) 82, 84 for producing digitally phase-controlled RF signals Φ_{DDSA} and Φ_{DDSB} to be mixed at the mixers 78, 80 with signal components A, B of the received RF signal, resulting in a digitally phase-controlled IF received signal at the output of a summer 122 (column 9, lines 5 to 13). The signal components A, B may be out-of-phase (column 5, lines 19 to 23). Each

DDS includes a digital-to-analogue converter 110 for deriving an analogue phase-control signal from a digital phase-control signal S_{CA} (Figure 7).

2.2 The circuit module according to claim 1 particularly differs from the circuit module of D2 in that the claimed module includes a silicon vector modulator integrated circuit for producing a digitally phase-controlled IF signal in response to input of analogue phase-control signals and an IF reference signal, and an IF mixer for mixing the digitally phase-controlled IF signal with the IF received signal for production of a digitally phase-controlled baseband signal.

2.3 Hence, whereas in D2 a DDS operating at RF is used for producing a digitally phase-controlled RF signal, the claimed module includes a vector modulator operating at IF and producing a digitally phase-controlled IF signal. The operation at IF renders it possible to use commercially available mass-produced components, in particular a silicon bipolar MMIC vector modulator chip as manufactured for cellular telephone systems (see the application as filed, page 3, last paragraph and page 18, lines 12 to 15).

2.4 If, starting out from the teaching of D2, it were assumed that a person skilled in the art would be aware of the frequency limitations of a DDS (see, e.g., D1, page 728, left column, last paragraph) and would therefore consider modifying the circuit module of D2 in order to have it operate at a more convenient frequency, e.g. IF, it is arguable that, without the exercise of any inventive skill, he would either, on the basis of his common general knowledge, down-convert

the incoming RF signal RF_{in} to the preferred frequency range or, following the teaching of D1, Figure 2, up-convert the output signal of a DDS operating at IF before mixing it in the corresponding mixer 78, 80 of the circuit module according to Figure 6 of D2. Following either approach, however, he would not be led to use a vector modulator (together with or instead of the DDS) for generating the digitally phase-controlled IF signal. Further, if, for the sake of argument, the circuit formed by the components 72, 78, 80 and 120 in Figure 6 of D2 were interpreted as together forming a vector modulator, as the examining division did in their decision, this vector modulator would not only operate at RF instead of IF but would also have the received signal at its input instead of a reference signal, as defined in claim 1. In the board's view, even if taking into account the common general knowledge in the art, only with the benefit of hindsight would the skilled person modify the circuit module such that circuit formed by the components 72, 78, 80 and 120 in Figure 6 of D2 is supplied with a reference signal instead of the received signal and such that the output thereof is subsequently mixed with a down-converted version of the received signal, as defined in claim 1.

2.5 The subject-matter of claim 1 is therefore not rendered obvious having regard to the disclosure of D2 and taking into account the teaching of D1 and the common general knowledge in the art.

2.6 The same conclusion is arrived at when taking D1 as the starting point: D1 (see Figure 2) discloses a circuit module, in which a digitally-phase controlled RF

reference signal is mixed with a received RF signal in order to obtain a digitally phase-controlled version of the received signal at IF (see page 728, paragraph bridging left- and right-hand columns). The RF reference signal is obtained by up-converting the output signal of a DDS.

Assuming that a skilled person were faced with the problem of operating the module at a more convenient frequency, i.e. IF, it is arguable that, starting from D1 and having regard to the common general knowledge in the art, he would do away with the up-conversion of the DDS output and, instead, would down-convert the received signal to IF before mixing in order to perform mixing at IF, which would produce a baseband output signal. However, there would be no reason to use a vector modulator.

- 2.7 It follows that, starting out from the teaching of D1, the subject-matter of claim 1 involves an inventive step having regard to the common general knowledge in the art. The remaining documents cited in the international search report are less pertinent than D1 and D2 and do not in the board's view put the conclusion that the subject-matter of claim 1 involves an inventive step into question.
- 2.8 The above applies *mutatis mutandis* to independent claim 6, which defines method steps corresponding to the constructional features of claim 1.
- 2.9 Since the subject-matter of claim 1 has been found to involve an inventive step, the same applies to claims 2

to 5, each of which defines additional features of the circuit module according to claim 1.

2.10 The board therefore concludes that the subject-matter of claims 1 to 6 of the main request meets the requirements of Articles 52(1) and 56 EPC.

3. Since the main request is allowable it has not proved necessary to consider the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of claims 1 to 6 of the main request filed during the oral proceedings and a description to be adapted accordingly.

The Registrar:

The Chairman:

D. Magliano

A. S. Clelland