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D E C I S I O N
of 10 August 2001

Case Number: T 0441/97 - 3.4.1

Application Number: 91302607.6

Publication Number: 0450829

IPC: G01P 15/08

Language of the proceedings: EN

Title of invention:
Intelligent programmable sensor

Patentee:
TEXAS INSTRUMENTS INCORPORATED

Opponent:
Robert Bosch GmbH

Headword:

-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Inventive step - (yes)"

Decisions cited:

-

Catchword:

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Boards of Appeal

Chambres de recours

Case Number: T 0441/97 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 10 August 2001

Appellant: Robert Bosch GmbH
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Representative -

Respondent: TEXAS INSTRUMENTS INCORPORATED
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Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted
26 February 1997 concerning maintenance of
European patent No. 0 450 829 in amended form.

Composition of the Board:

Chairman: G. Davies
Members: U. G. O. Himmler
G. Assi

Summary of Facts and Submissions

- I. The appellant (opponent) lodged an appeal, received on 18 April 1997, against the interlocutory decision of the Opposition Division, dispatched on 26 February 1997, maintaining European Patent No. 0 450 829 (application number 91 302 607.6) in amended form. The fee for the appeal was paid on 18 April 1997. The statement setting out the grounds of appeal was received on 20 June 1997.

Opposition had been filed against the patent as a whole and was based on Article 100(a) EPC, in particular on the grounds that the subject-matter of the patent was not patentable within the terms of Articles 52(1) and 56 EPC.

The Opposition Division held that the grounds of the opposition did not prejudice the maintenance of the patent in amended form, having regard *inter alia* to the following documents:

D1= EP-A-0 277 006

D5= Electronics, July 1989, pages 54-59; W. Iversen:
"The vendors are betting their chips on Silicon sensors".

- II. Oral proceedings were held on 10 August 2001.
- III. The appellant requested that the decision under appeal be set aside and that the patent be revoked.

VI. The respondent (proprietor of the patent) requested that the appeal be dismissed and that the patent be maintained on the basis either of the documents as maintained by the opposition division (main request) or of further amended documents (first and second auxiliary request).

V. The wording of claim 1 reads as follows:

"An intelligent programmable sensing apparatus using elements mounted on a silicon base, said elements comprising:

a transducer (12) for sensing physical variables and generating a plurality of raw analog signals representing said sensed physical variables; and

a configurable analog signal conditioner (16) receiving said raw signals from said transducer (12), said configurable analog signal conditioner (16) conditioning said raw analog signals to transmit conditioned analog signals, said configurable analog signal conditioner (16) including:

a first configurable memory (18) for storing at least one signal conditioning instruction for directing said configurable analog signal conditioner (16), said first configurable memory (18) being reprogrammable to contain different sets of signal conditioning instructions at different times and being adapted for connection to an external programming device supplying the different sets of signal conditioning instructions."

The wording of claim 12 reads as follows:

"A method of sensing a physical variable using an intelligent programmable sensing apparatus according to any one of the preceding claims comprising the steps of:

sensing physical variables with said transducer and generating a plurality of raw signals representing said sensed physical variables;

receiving said raw signals from said transducer in said configurable analog signal conditioner;

conditioning said raw signals in said configurable analog signal conditioner;

transmitting a plurality of conditioned signals from said configurable analog signal conditioner; and

storing at least one signal conditioning instruction for directing operations of said analog configurable signal conditioner in said first configurable memory, said storing including reprogramming said first configurable memory to contain different sets of signal conditioning instructions at different times and said storing including receiving the different sets of signal conditioning instructions from an external programming device."

Claims 2 to 11 and 13 to 17 are dependent.

VI. The appellant's arguments may be summarized as follows:

The opposed patent essentially related to a smart sensor system including a transducer, a signal conditioner and a configurable memory. Such a system was disclosed in document D1, which was considered as the most relevant state of the art. The smart sensor system shown in Figure 1 of D1 comprised transducers (12) and adjustable gain low pass filters (44) which were configurable for conditioning the signals of the sensors, as disclosed in column 5, lines 1 to 3. According to this passage, the reconfiguration of the adjustable gain filters was by "digital control words". This fact implied that the information for the reconfiguration had to be memorized, which required the presence of a configurable memory, even if this was not explicitly mentioned in D1. Further evidence for the presence of a reconfigurable memory in the sensor processing modules (40) was that without such a memory all configuring of the adjustable gain filters would have to be carried out remotely by the central processing unit, which would be in contradiction with the teaching of D1 which relates to a **distributed** computing and processing system. The system disclosed in D1 comprised elements, for instance the integrated circuits which were mounted on a silicon base as required by claim 1. The claim did not require that all elements of the system should be mounted on the **same** silicon base. Therefore, the apparatus defined in claim 1 was anticipated by the system disclosed in D1. Even though the ground of lack of novelty could not be introduced as a fresh ground of opposition without the proprietor's consent (**see G7/95**), the Enlarged Board had pointed out that subject-matter fully anticipated

by a prior art document cannot involve an inventive step. Therefore, claim 1 was not allowable in view of D1 taken alone.

Furthermore, the subject-matter of this claim followed in an obvious way from the combination of D1 with document D5, because D5 disclosed that, in the field of distributed computing sensor solutions, smart sensors incorporating more intelligence, either in the package or integrated onto the sensor die itself, were favourable. In particular, D5 discussed that the signal processing components could be either integrated onto a companion silicon chip or onto the silicon sensor chip itself.

Since the sensor system defined in claim 1 did not involve an inventive step in the light of D1 alone, or the combination of D1 and D5, the subject-matter of claim 12, essentially defining the use of the system of claim 1, was also obvious having regard to D1 and/or D5.

VII. The arguments of the respondent may be summarized as follows:

The patent related to a sensing apparatus comprising, on a single silicon base, a sensor and integrated circuits. These circuits could be programmed for processing the sensor signals according to the user's specific needs. Therefore, the device was versatile in that it could be manufactured as a general-purpose sensing device and individually and dynamically adapted by the individual user. In contrast, document D1 was related to a central monitoring system of a plant with many sub-units, each sub-unit being monitored by a

plurality of sensors. The problem of such a system was that, if each sensor were connected to the central processor for data collection, the electrical wiring would be very costly; furthermore, the requirements on computing power of the central processor would be high. The solution proposed in D1 was to bundle the signals of a plurality of sensors (12) from each respective sub-unit of the plant (see Figure 1A), the signals being processed in a separate sensor preprocessing section (18) arranged between the sensors and the remote processor. This section included at least two modules (40) comprising adjustable gain low pass filters and multiplexers (42). Therefore, D1 did not disclose or suggest the feature of dynamically and individually configuring a sensor. Furthermore, the document did not suggest to integrate a sensor with a configurable analog signal conditioner, nor did it disclose a configurable memory for storing signal conditioning instructions to be integrated with one sensor.

Also a combination of the teachings of D1 and D5 was not obvious, because D1 did not address the possibility of integration of all components. Even if, starting from the system of D1, the skilled person would consider modifying the individual sensors (12) by integrating processing electronics onto these as disclosed in D5, there would no longer be a need for the gain adjustment of the filters (44) because each sensor would have its own built-in filter.

Reasons for the Decision

1. The appeal is admissible.

- 2.1 Document D1, which is considered to disclose the closest prior art, discloses, see Figures 1A, B and C, an intelligent programmable sensing apparatus (smart sensor system 10) comprising:
 - a transducer for sensing physical variables and generating a plurality of raw analog signals representing said sensed physical variables (sensors 12); and

 - a configurable analog signal conditioner (**sensor processing modules 40**) receiving said raw signals from said transducer (12), said configurable signal conditioner conditioning said raw analog signals (**column 4, line 56 to column 5, line 3**) to transmit conditioned analog signals.

- 2.2 With respect to the feature that the apparatus comprises a configurable memory, it is noted that, according to claim 1, this memory is included in the configurable analog signal conditioner. This requirement implies, that the memory is structurally **arranged** at or as part of the analog signal conditioner, as shown in the embodiments in Figures 2 and 3 of the patent. The sensor preprocessing modules (40) shown in Figure 1A of D1 do not include any configurable memory as part of the module.

The appellant submits that D1 implicitly discloses this feature, considering that the gain of the filters (44) is adjusted by "digital control words" (see column 5, lines 1 to 3). However, these control words are transmitted from the data acquisition section (20), which does not form part of the sensor preprocessing modules (40), because it sends the signals to all the processing modules. Therefore, the Board does not share the appellant's viewpoint that D1 would implicitly disclose that the conditioner includes a configurable memory.

2.3 In the opinion of the Board, the requirement in claim 1 that the transducer, the analog signal conditioner and the memory are "mounted on a silicon base" is to be understood as meaning that these elements are mounted on **the same** base, as it is clearly shown in Figures 2 and 3 (see the base at the right-hand side) otherwise for an embodiment comprising elements each with different bases the expression would read "...mounted on silicon bases".

2.4 Hence, the subject-matter of claim 1 differs from the sensing apparatus known from D1 by the following features:

- the signal conditioner includes a first configurable memory for storing at least one signal conditioning instruction, the memory being reprogrammable and adapted to be connected to an external programming device *and*
- the transducer, the signal conditioner and the configurable memory are mounted on a silicon base.

- 2.5 The claimed solution solves the technical problem of increasing the integration and miniaturization of the intelligent sensor device. Furthermore, the inclusion of the configurable memory in the signal conditioner enables an optimal adaptation of the device to the user's needs and the remote change of the operation settings by the user in dependence of the sensor signals and operation conditions.
- 2.6 In the Board's view, the skilled person does not have any incentive to modify the system disclosed in D1 by these measures. Although he learns from document D5 that for particular applications it might be advantageous to integrate electronic circuits onto a sensor die, he would not use this measure for the particular system of D1. Indeed the processing sections are designed to bundle and process the signals of a plurality of sensors in the vicinity of a component of the plant and to communicate the processed and multiplexed signals to a central computer. If a gain/filter circuit would be integrated onto each sensor, there would be the problem of having too many data lines to the central computer. Furthermore, the provision of a configurable memory in such integrated sensors would depart from the teaching of D1, because the configurable gain filters serving different types of sensors would no longer be necessary.
- 2.7 The remaining prior art documents cited during the opposition procedure do not contain any teaching which would make the claimed subject-matter obvious to the skilled person.

Therefore, the subject-matter of claim 1 is considered to involve an inventive step within the meaning of

Article 56 EPC.

2.8 Independent claim 12 essentially relates to the use of the sensing apparatus according to claim 1. Hence, the subject-matter of this claim also fulfils the requirements of Article 56 for the reasons given above.

2.8 Claims 2 to 11 and 13 to 17 are dependent on claims 1 and 12 and, therefore, their subject-matter involves an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

R. Schumacher

G. Davies