



Description

Identification or sensor arrangement - SAW arrangement - operating with surface acoustic waves

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The present invention relates to an identification or sensor arrangement - SAW arrangement - operating with surface acoustic waves, [lacuna] to the precharacterizing clause of Patent Claim 1.

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Identification marks - called an ID tag for short in the following text - are identification arrangements of the generic type and are used in identification systems for non-touching automatic identification of objects; they are disclosed, for example, in DE-OS
15 44 05 647. Such ID tags are components in which an electrical signal is converted by means of a transducer into a surface acoustic wave which is reflected on a sequence of reflectors, the reflected surface acoustic wave being converted back to an electrical signal by a
20 transducer which may be identical to the transducer which converts the electrical input signal. Depending on the configuration of the reflectors, a predetermined code is produced which represents this ID tag. The electrical signal which represents the code is sent back to a system
25 which emits the interrogation signal, as a result of which it is possible to identify the point at which the ID tag is arranged. Such identification systems can be used in a wide range of applications.

As stated above, the information content of the
30 response signal coming from the ID tag is determined by the configuration of the reflectors contained in it. The information may be defined, for example, in binary form by providing a reflector configuration for a predetermined number of information bits, in which configuration
35 a 1-bit corresponds to an existing reflector and a 0-bit corresponds to a commanding reflector, that is to say reflection back to the output transducer takes place on an existing reflector, while no bit produced by reflection is present in the case of a commanding reflector.



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Such a coding corresponds to amplitude modulation.

The information content can also correspond to phase modulation if, in a sequence of reflectors, the individual reflectors are shifted from a predetermined position, which corresponds to a 0-phase angle.

For example, SAW sensors which are disclosed in EP-PS 0 619 906 and can be interrogated without wires are sensor arrangements of the generic type. They contain first SAW structures as sensor elements and second SAW structures as reference elements, it being possible to interrogate measurements which are formed by comparing the output signals from the sensor and reference elements in response to interrogation signals.

Arrangements of the type explained above must, however, be physically designed such that pulses in the response or measurement signal can be reliably separated in order that it is possible to resolve the information in the response signal reliably. Since the resolvable time pulse interval or bit interval is inversely proportional to the bandwidth, if the available bandwidth of the interrogation signal is small, this results in a long time bit interval, from which it follows, in turn, that the distance between the SAW structures in identification or sensor arrangements must be correspondingly large. Particularly if the SAW structures are arranged in a single acoustic track, this means that a correspondingly long piezoelectric substrate is required for the arrangement. This in turn will result in a high level of physical complexity, especially for SAW arrangement housings.

The present invention is thus based on the object of specifying a less complex, and thus cost-effective, arrangement of the type under discussion.

In the case of an SAW arrangement of the type mentioned initially, this object is achieved according to the invention by the features of the characterizing part of Patent Claim 1.

Developments of the invention are the subject matter of the subclaims.

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The invention will be explained in more detail in the following text with reference to exemplary embodiments according to the figures of the drawing, in which:

- 5 Figure 1 shows a schematic illustration of an arrangement according to the invention in the form of an SAW ID tag;
- Figure 2 shows an embodiment of an interdigital transducer in the form of a so-called SPUDT for an ID tag
- 10 according to Figure 1;
- Figure 3 shows a first embodiment of a diverter which can be used in the ID tag according to Figure 1;
- Figure 4 shows a second embodiment of a diverter which can be used in the ID tag according to Figure 1;
- 15 Figure 5 shows a schematic illustration of a housing part for the acoustically active parts of an ID tag according to Figure 1;
- Figure 6 shows a schematic illustration of a closed housing corresponding to Figure 5 for the acoustically active parts of the ID tag according to Figure
- 20 1;
- Figure 7 shows a schematic, perspective illustration of an ID tag according to Figure 1 provided with a housing according to Figures 5 and 6;
- 25 Figure 8 shows a schematic, perspective illustration of an ID tag integrated in a chip card; and
- Figure 9 shows a detail of the ID tag according to Figure 1.

30 First of all, it should be mentioned that the following description relates to embodiments of ID tags. However, it also applies in a manner which is evident to the person skilled in the art to sensor arrangements for example according to EP-PS 0 619 906, mentioned above.

35 According to the schematic illustration in Figure 1, an interdigital transducer 2, which in this case acts as an input/output transducer, as well as reflectors 3 are provided in an ID tag, in a manner known per se, on a piezoelectric substrate 1. As mentioned initially, the

interdigital transducer 2 converts an electrical interrogation signal into an acoustic wave which is reflected on the reflectors 3 and is converted back to an electrical response signal in the interdigital transducer 2.

5 However, according to the invention, the interdigital transducer 2 and the reflectors 3 are not arranged one behind the other in one or more parallel acoustic tracks, but in different tracks which are connected acoustically in series, and, in order to pass the acoustic wave coming from the interdigital transducer 2 to the
10 reflectors 3, a diverter 4 is provided which in turn feeds the wave elements reflected from the reflectors 3 back to the interdigital transducer 2. The profile of the acoustic wave elements is indicated by arrows 5 in Figure
15 1.

 The design of an ID tag according to the invention explained above has the advantage that, by arranging the interdigital transducer 2 and reflectors 3 in a plurality of acoustic tracks connected in series, the
20 acoustic path can be folded a number of times. Increasing the size of the substrate in the direction at right angles to the propagation direction of the acoustic wave elements is far more than compensated for by reducing the length in the direction of propagation of the acoustic
25 wave elements, since the acoustic track is normally considerably faster than the substrate width. In addition, this makes it possible to achieve a substrate shape which has a considerably more favourable length-to-width ratio for a housing technique or for insertion into a
30 chip card.

 In a development of the invention, according to Figure 1, a structure 6 for injecting an electrical interrogation signal into the interdigital transducer 2 is provided on the substrate 1 and, in this embodiment,
35 is designed as an inductive coupling loop in the form of a frame. Instead of such an inductively coupling antenna, a capacitively coupling structure according to Figure 9 can also be provided, this figure illustrating a detail from Figure 1. To this end, two flat coupling pads 91, 92

- metallizations - can be used on the substrate 1, these being electrically coupled to the interdigital transducer 2.

A reduced insertion loss for the ID tag and thus
5 an increased range for an identification system can be achieved by using a Single Phase Unidirectional Transducer (SPUDT). Such a unidirectional transducer has electrode fingers 23, 24, 25 which are connected by means of two busbars 21, 22, two electrode fingers 23, 24 of
10 different width in each case being interleaved on the busbar 21 with an electrode finger 25 on the busbar 22. The acoustic wave emission direction is indicated by an arrow 26. Using such a unidirectional transducer makes it possible to achieve a reduction in the insertion loss of
15 3 dB for injection and extraction, that is to say a total of 6 dB. The maximum range of an identification system using an ID tag containing such a unidirectional transducer is increased by the factor root 2.

Figure 2 shows a first embodiment of the diverter
20 4 according to Figure 1 in the form of a reflector multistrip coupler 30. Such a reflector multistrip coupler is formed by two busbars 31 and 32 which are connected to one another by an electrode connection 33 and to which electrode fingers 34, 35 are in each case
25 connected. Non-connected electrode finger pairs 36, 37 are in each case arranged between these connected electrode fingers 34, 35. The width of two acoustic tracks formed by such a reflector multistrip coupler 30 is designated W, while the two opposing propagation direc-
30 tions of an acoustic wave are designated A and B, respectively.

A further embodiment of a diverter is illustrated in Figure 4 and is designated, in general, 40. This diverter is formed by a multistrip coupler 42 and a
35 multistrip reflector 41 which has a structure in the form of an arena. The propagation directions of acoustic waves are in this case indicated by arrows 43, while two acoustic tracks are designated A and B.

Figures 5 to 7 show a possible embodiment of a

housing for an ID tag according to the invention, which covers at least the acousto-electric components, it being possible to regard the piezoelectric substrate of the ID tag as a housing part.

5 According to Figure 5, a piezoelectric substrate 5 has laminated onto it a sheet which can be structured photolithographically and is structured in such a manner that a frame sheet 52 remains only on acoustically non-active regions of the substrate 50, while acousto-
10 electric components remain free of the frame sheet 52 in regions 51. An exception may comprise the diverter 4 still being covered in its central region, as a result of which the structural stability is increased and, at the same time, acoustic crosstalk by diffraction between the
15 acoustic tracks can be eliminated.

 According to Figure 6, a further sheet is then laminated onto the arrangement according to Figure 5 in such a manner that a covering sheet 53 is produced, by which means a micro-cavity, which protects the acoustics,
20 is produced above the acousto-electric components.

 Such an arrangement is illustrated schematically and in perspective in Figure 7.

 Housings for arrangements according to the invention are not limited to the physical form explained
25 above.

 Thus, for example, a housing termination can be formed by a cover which is structured to accommodate the acousto-electrically active components of the arrangement. The cover can be connected to the piezoelectric
30 substrate by bonding, glass solder and directly by wafer bonding.

 Furthermore, for example, a glass grating which surrounds the acousto-electrically active components of the arrangement can also be applied to the piezoelectric
35 substrate, on which a cover is mounted in a suitable manner.

 Figure 8 shows schematically one option illustrating how an ID tag according to the invention and of the type described above can be integrated in a chip

card. The ID tag, which is designated 81 in Figure 8, is placed onto a chip card 80 in a suitable manner, and its coupling structure 6 according to Figure 1, or its coupling pads 91, 92 according to Figure 9, are coupled
5 to a card antenna 82. If required, electrical matching can be carried out if the ID tag coupling structure is inductively coupled to the card antenna. Such matching is indicated schematically in Figure 8 by a matching element 83. In addition, it should be mentioned that the coupling
10 need not be inductive or capacitive. A direct connection - bonded connection - may also be used, for which purpose bonding pads corresponding to the pads 91, 92 are provided.



Patent Claims

1. Identification or sensor arrangement - SAW arrangement - operating with surface acoustic waves for
5 identification or sensor systems, in which an interrogation/evaluation device interrogates identification or sensor arrangements by means of an interrogation signal transmitted without wires and evaluates a response signal sent back from said arrangement, having acousto-
10 electrically active components (2, 3; 20, 3) on a piezo-electric substrate (1; 50), characterized in that the acousto-electrically active components (2, 3; 20, 3) are arranged in different acoustic tracks on the substrate (1; 50), and in that a diverter (4; 30; 40) is provided
15 for their acoustic coupling.
2. Arrangement according to Claim 1 in the form of an identification mark - SAW ID tag having at least one interdigital transducer (2; 20) and a predetermined number of reflectors (3), a coding in an identification
20 system being produced by the number and the position of the reflectors (3), characterized in that the interdigital transducer (2; 20) and at least some of the reflectors (3) are arranged in different acoustic tracks, and a diverter (4; 30; 40) is provided for acoustic
25 coupling of the tracks.
3. Arrangement according to Claim 2, characterized in that a unidirectional transducer is provided as the interdigital transducer (20).
4. Arrangement according to one of Claims 1 to 3,
30 characterized in that the diverter is formed by a reflector multistrip coupler (30).
5. Arrangement according to one of Claims 1 to 3, characterized in that the diverter (40) is formed by a multistrip coupler (42) and a multistrip reflector (41).
- 35 6. Arrangement according to one of Claims 1 to 5, characterized in that the reflectors (3) are arranged in a single acoustic track.
7. Arrangement according to one of Claims 1 to 6, characterized in that the reflectors (3) for coding the





response signal are shifted geometrically from a pre-determined 0-phase angle so as to produce phase modulation coding of the response signal.

8. Arrangement according to one of Claims 1 to 7, characterized in that a structure (6; 90, 91) which injects the interrogation signal is provided on the substrate.

9. Arrangement according to Claim 8, characterized in that the structure (6) is designed as a coupling loop in the form of a frame for inductive injection of the interrogation signal.

10. Arrangement according to Claim 8, characterized in that the structure (90, 91) is formed by coupling pads for capacitive or direct injection of the interrogation signal.

11. Arrangement according to one of Claims 1 to 10, characterized by a housing (52, 53) which contains at least the acousto-electric components (2, 3, 4) and is provided on the piezoelectric substrate (50).

12. Arrangement according to Claim 11, characterized in that the housing (52, 53) is formed by a frame sheet (52) which surrounds the electro-acoustic components (2, 3, 4), and by a covering sheet (53) which is located on the frame sheet (52).

13. Use of an identification mark according to one of Claims 2 to 12 in a chip card, characterized in that the identification mark (81) is integrated into the card (80), which has a card antenna (82), in such a manner that the identification mark coupling structure (6; 90, 91) is coupled to the card antenna (82).

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