TRANSPONDERS ON SAW FOR RFID

S. Zabuzov
"Radar-MMC", Novoselcovska Street, 197439, St-Petersburg, RUSSIA
E-mail: zabuzov@mail.lanck.net

Now there is a plenty of radiodevices intended for identification of objects, including mobile, in which the radiochannel is used. For them standard there was a designation RFID – radio frequency identification devices. Areas of their application are the account and registration of automobiles and railway platforms, registration and payment of travel on highway and parking, marks of cargoes and luggage, to trace of routes of the important cargoes and objects, the control systems of access latent electronic marks of containers and automobiles, system of protection of the goods in warehouses and markets.

RFID is possible divide on active and passive devices. Active RFID contain in the structure power supplies. In systems with the large number of objects subject identification, the preference is given back passive RFID, in which the power supplies are absent. One of widely known realizations such RFID are the plastic maps Proximity. The basic lack of these maps is small radius of action not exceeding 50 – 70 centimeter

This RFID-system is based on application of devices which are working on surface acoustic waves(SAW)[1]. The principle of its functioning on use of SAW~re-radiation effect by strong piezoelectric. System structure includes:

-receiver-transmitter block;
-block of processing of the information;
-individual markers-SAW passive devices.

RFID passive marker is the sound-conductor from $LiNbO_3$ of the YZ-cut with entrance and outlet SAW-transducers marking on its working surface [2]. The entrance transducer is broadband unit, its extent defines the duration of an elementary impulse (τ). The outlet transducer is the phase-coded unit, being by pairs of electrodes connected to summing trunks according to beforehand-chosen code, and the distance between pairs gets out equal to extent of the entrance transducer. In this case, at submission on an input of the SAW-device of a radio-signal with a wide spectrum (shot radio-impulse), from the outlet there will be removed a generated phase-manipulated radio-signal with number of marks(N) equal to number of electrode pairs of the outlet transducer, and duration(T) equal $T=N\times\tau$. To SAW-transducer there is connected marker's antenna system which perceives an entrance signal from the transmitter of the stationary block and transfers into space re-radiated impulse response of a marker being by phase-manipulated radio-signal. The phase-manipulation connection to a code, which is incorporated into the law of electrode's connection to summing trunks of the outlet transducer. Each marker has an inherent individual code, which is realized an identification of marking object. The radiation of polling radioimpulses and the reception of re-radiated impulses is realized by the receiver-transmitter block, so the user receives the of information processing. The signals accepted from a marker and transformed in the block of processing, are transferred in PC for comparison with a database and acceptance of the decision.

In 2000 was developed and the demonstration sample of system is made.

The basic characteristics
Working frequency – 250 MHz
Kind of coding of a signal – phase manipulation
Number of marks – 16
Radius of action – 4 … 7m
Material of a marker – $LiNbO_3$
The size of a marker – 115 × 35 ×3mm
The size of the device on SAW – 10×6×1,5mm
The sample was demonstrated at the exhibition " Protection and safety – 2000 ", " MIPS – 2000 " in Moscow, information in Alive electronics, volume 2, with 79, 2000.
The patent of Russia № 2176092 " The marker for system radio frequency identification " is received.

The description of a demonstration sample.

For radiation and reception one aerial is used. With this purpose into structure of the receiver-transmitting block is entered aerial's switchboard.

The electronic part of system is executed on chips of the following firms: Analog Devace, Maxim, Motorolla. Most difficult has appeared a problem of performance of a receiver-transmitting path broadband. It was necessary to refuse a principle of formation re-radiated phase-manipulated signal (in a marker RFID) device on SAW, as its pulse response. In the demonstration sample the device on SAW carries out a role manitap of a line of a delay. The transmitting part of the block forms interrogation a pulse by duration 0,125mcs., being an elementary pulse re-radiated phase-manipulated signal. In the marker RFID is used 16-en marks a code, therefore duration re-radiated a signal has made ~ 2,0 mcs. Thus the requirements to stability of carrying frequency, duration of an elementary pulse, phase errors were transferred from a marker RFID on a transmitting part of system. On the other hand, the reduction of a passband of a receiver-transmitting path up to 15÷18MHz has allowed to reduce a level of noise, to raise a dynamic range of system (on tentative estimations a dynamic range of the demonstration sample RFID in a mode of definition of a code has made 51дБ) and, as a whole, to increase radius of action.

In the block of digital processing the algorithm of definition of a code re-radiated a signal was the following. In that case, when in a sequence from 16 accepted phase-manipulated pulses there are three following one after another of identical pulse, with the same code the given code is considered determined and is identified (for the given marker). The operative memory for recording beforehand of chosen codes with the subsequent comparison of the given codes with determined is stipulated. The interface of system allows to be connected to the personal computer through standard consecutive COM-port.

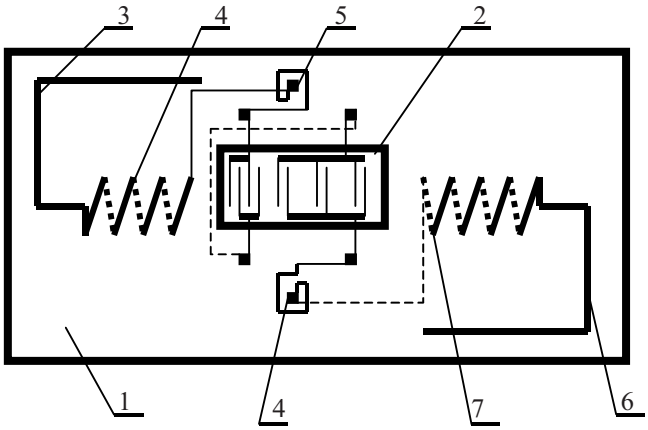

Fig. 1

Fig. 1
Here:
1 – payment
2 – reception vibrator
3 – reception coil
4 – agreeing coil
5 – device on surface acoustic waves (SAW)
6 – radiating vibrator
7 – radiating coil

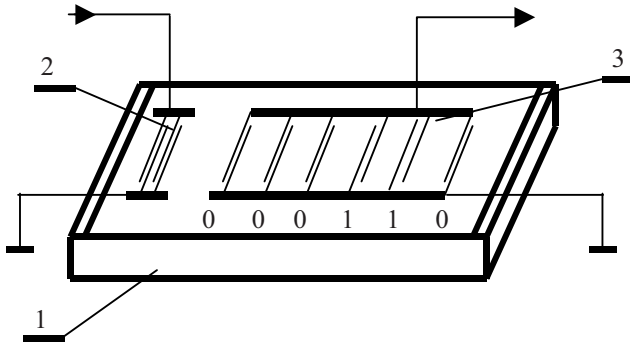

Fig. 2

Fig. 2
Here:
1 – sound-conductor from a piezoelectric material;
2 – entrance transducer;
3 – target transducer

Aerial's the part of a marker was two short quarter wave vibrators (reception and re-radiation) with coils of inductance connected consistently with entrance and target by transducers of the device on SAW. For indemnification of capacities of transducers it is consecutive with coils induction of vibrators are included agreeing of inductance. The structurally quarter wave vibrators, their coils of inductance and agreeing of inductance are executed together, as winding on flat a basis by thickness of 1 mm by a copper wire 0,3mm. The device on SAW, as it was already specified, represents manitap a line of a delay with phase-manipulated by the target transducer.

Dimensions of a marker RFID as a whole 120 x 40 x 3mm.

As the aerial of system RFID the coordinated horizontal quarter wave vibrator with the reflecting screen was used. The system from two vibrators with polarization in two mutual – perpendicular planes was applied.

In the demonstration sample RFID at use of the mentioned above aerials of a marker and receiver-transmitting block radius of action has made approximately 6-7 meters, and at use in a marker of the not short quarter wave vibrators radius of action has made about 12 meters.

The tests of a demonstration sample have confirmed its serviceability and reliability of the basic parameters. At the same time, the tests of the modernized sample of system RFID have shown expediency of increase of working frequency up to 900MHz. Thus approximately overall dimensions of a marker three times decrease, becomes to possible use of the directed properties of the aerial of the receiver-transmitting block, the increase of radius of action (is expected in case of necessity). In this frequency range probably wide use of element base of a radiotelephony (GSM, GPS etc.).

REFERENCES

1. G. Schimetta, F. Dollinger, R. Weigel, "A Wireless Pressure Measurement System Using a SAW Hybrid Sensor", IEEE Transactions on Microwave Theory and Techniques, Vol. MTT-48, NO.12,pp. 2730-2735, 2000.
2. The patent of Russia № 2176092 " The marker for system radio frequency identification ".