

Miniaturising transponders

The consolidated techniques used for fabricating integrated circuits have been successfully applied to the manufacturing of integrated transponders. Antenna coils are micro-structured onto the chip containing the transponder's electronic circuitry

The fundamental step of transponder manufacturing consists in soldering or bonding different components together. Most frequently, an integrated circuit is die and wire bonded to a small board, on which one or more capacitors and antennas are also soldered. More advanced and automated assembly technologies take advantage of on-silicon integration of capacitors and of the direct bonding of the antenna to the chip, thus reducing the number of joints, while increasing the reliability and lowering the cost of the device.

Coil on Chip technology

An innovative technique called "Coil on Chip" is now available, allowing the manufacture of very small, flat, reliable and low cost RF transponders. Coil on Chip is based on proven manufacturing processes of the IC industry and is conceived to respond to the demand for miniaturised transponders expressed by several markets, including both industrial and consumer applications. Its advantages are evident in the case of small sized products, for which brand protection and authentication would be impossible to ensure using common RFID labels or bar codes.

Micro-Sensys is the name behind Coil

on Chip. Since its beginning, the German company has focused its investments to develop fully integrated transponders without any external components such as capacitors or coils. By implementing leading edge micro-system technologies, the first Coil on Chip transponder with dimensions of 4 x 4 x 0.5mm and a read/write memory of 2 kbit was released in 1994. Since then this technology has been tested in many different applications, in combination with special low power closed coupling readers and software solutions.

More recently, Micro-Sensys extended its product portfolio with two new chips: a 64bit read only transponder and a 16 kbit read/write transponder with a micro controller. Moreover, a 64bit read only Tag has been created with dimensions of 1,6 x 1,0 x 0,45mm (see figure 1).

The manufacturing process

The current standard RF transponder consists of a silicon chip with the electronic circuitry and an external antenna in the form of a coil or of metal loops, designed for receiving data and for transmitting the information stored in the internal memory chip. In the case of Coil on Chip the antenna is

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integrated as a finely structured device on top of the basic silicon chip. The ends of the antenna windings are connected directly to the resonance capacitor of the electronic circuit through the passivation openings on the silicon chip (see figure 2).

One of the most important qualities for obtaining a high Q in the resonant LC circuit, and thus an acceptable reading distance, is the achievement of a very high ratio between the thickness of the coil metal layer and the dimensions of the horizontal structures. The micro structured coil for the 64bit read only transponder has a winding pitch of approximately 10 μm with a thickness of 20 μm . To protect the micro coil from mechanical abrasion a very thin polyimide layer is deposited on the surface of the antenna. With such configuration, the integrated transponder and its 13.56 MHz reader antenna, provide a reading distance of up to 3 mm.

The 64 bit Coil on Chip transponder manufactured by Micro-Sensys represents one of the smallest (1.6 x 1.0 x 0.4 mm) fully integrated passive radio frequency device in the world.

High performance specifications

The development of coil on chip micro

systems paves the road to many different RFID applications. The identification and tracking of tools, technical equipment, spare parts, medical probes, even with minute dimensions and odd shapes, will become easier. Moreover, the possibility of concealing the transponder into products will broaden the application opportunities in the area of brand protection.

Coil on Chip technology has the potential to be used for a wide range of applications which enable high performance tracking. End customers as well as manufacturers, will benefit from the coil on chip specifications:

- very small Tag size down to 1 mm square and thickness down to 150 μm ;
- extremely high reliability even at temperatures of up to 250 °C and at acceleration levels of up to 500 g;
- mass production capability, with up to 10,000 tags manufactured in a single process run;
- low cost wafer manufacturing technique;
- wide product portfolio: 64 bit read-only, 16 kbit read/write, etc.



Figure 1.
A standard 64bit read only silicon chip incorporated into a tag with dimensions of 1,6 x 1,0 x 0,45mm

Figure 2.
A cross section of a CoC transponder chip (in reality the thickness of the metal layer is 20 times greater than a CMOS standard metal layer)

