Philips Unveils Low-Cost Chip Plans

The chip maker recently spelled out its plans for producing billions of low-cost chips that can be used in RFID labels.

Nov. 18, 2002 - Philips Semiconductor has been a major player in the RFID market, and it clearly wants to remain one. This week, at the Auto-ID Center's board meeting in Cambridge, Mass., Philips' Christoph Kauer laid out a road map showing how Philips will produce billions of low-cost microchips for RFID tags and labels in a few years.

The roadmap calls for the use of a new packaging technique, which will enable Philips to boost production using existing technologies. The company is also working on new assembly technology that could enable it to produce billions of low-cost chips per year within five years.

Today, most semiconductor companies, including Philips, use expensive robots to pick a microchip off of a silicon wafer, and then flip it over, and carefully place it on an antenna. Two tiny metal pads on the chip have to touch the ends of the antenna to make an electrical connection. (There are a variety of ways of bonding the antenna to the pads.)

Just the process of connecting the chip to the antenna can make up 10 percent of the total cost of a smart label. Another problem with today's technique is that robots are slow because they must move the chip a foot or more and place it with incredible precision (usually to within 10 to 20 micrometers of the target). And picking and placing chips is becoming more difficult as chip sizes shrink.

Philips has developed a new process called I-connect that solves many of the current problems with assembling chips for RFID labels. I-connect is a package for the chip -- a small strip with metal connectors. Instead of moving the chip across a coiled antenna, the robot has to move it only into a narrow strip that's part of a long roll.

The I-connect strip has metal connectors that are bonded to the microchip using existing flip-chip techniques, but since the pads on the strip are large, its much easier to attach the strip to an antenna. It's a bit like placing a single piece of glitter on a strip of tape and taping it to a piece of paper, rather than trying to glue the tiny square directly onto the paper.

Philips plans to put chips with different frequencies and storage capacities into the same package. That way, a company making 13.56 MHz or 915 MHz RFID labels could use the same reel-to-reel machine.

"We will supply the I-connect packages in rolls," says Kauer, GM of Philips' tags and labels business line. "You simply stamp a chip out onto the antenna. The chip changes, but the package always stays the same."

The idea is to create a very cheap chip in a package that can be mounted to an antenna either by a label manufacturer or a packaging company. Philips envisions a day, for instance, when an antenna is printed directly on a cardboard box and the I-connect package is stamped on top as the box rolls down the production line.

Philips has been using a similar assembly technique with other types of discrete semiconductors. The company has a plant in Hong Kong that produces 6 billion units per year, with three operators per shift. The company is now adapting the existing technology to produce I-connect packages for RFID chips. One big benefit, Kauer says, is the system will be able to handle chips as small as 200 by 200 microns (about the size of the period at the end of this sentence).

Philips expects to have the first machine online by the fourth quarter of next year. Kauer says that this new technique should reduce the cost of assembly from 10 percent of the total RFID label cost to just 1 percent. The technique would be used when demand for RFID chips reaches 1 to 10 billion units per year.

Philips is working on an even more advanced assembly technique for when demand soars beyond 10 billion per year. Instead of pick-and-place robots, Philips is developing a mass assembly technique that it calls vibratory assembly. A drum will vibrate until chips slide into cavities on a substrate, where they can be connected to nodes on packages and then bonded to an antenna.

The system is somewhat similar to fluidic self-assembly, the technique Alien Technology, a Morgan Hill, Calif., startup, developed for assembling chips in massive numbers. Kauer says the assembly costs of the two techniques are comparable, but Philips wants to develop a system that can be brought online in stages.

"As an industrial company, we need to have a concept that is more modular and flexible," Kauer says. "We need to be able to add more machines as demand grows."

Vibratory assembly will be introduced in three or four years, if the expected demand for low-cost chips materializes. The development effort is already well under way.

"We are proving the concepts and working on how the principals can best be applied," Kauer says. "We need to start now, because if we wait until the demand is there, we won't be ready with the equipment."

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