

AN INSIGHT VIEW OF CURRENT SEMICONDUCTOR DEVELOPMENTS

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Abstract: The Semiconductor market is a very cyclical market. For the last 40 years it has been characterized by two words: change and speed! The compound annual growth rate has averaged 15 percent, but business cycles have been far more extreme, with some increases of 50% and decreases of 35%. Like all other companies in this market, Infineon Technologies has to cope with these challenges and opportunities. One key factor in order to meet the requirements of the market is the permanent focus upon a wide range of products on a very innovative level. This characterizes Infineon: maintaining a very high level of R&D investment, even during the past recession, to retain technological leadership, bringing added customer value.

Pogled na trenutno stanje razvoja področja polprevodnikov

Ključne besede: polprevodniki, trg polprevodnikov, cikličnost trga, tehnološki primat, Infineon Technologies

Izveček: Trg polprevodnikov je zelo ciklični trg. V zadnjih štiridesetih letih ga lahko opišemo z dvema besedama: sprememba in hitrost! Skupna letna rast je bila v povprečju 15%, poslovni cikli pa so bili bolj izraziti, z maksimalno rastjo do 50% in padcem do 35%. Podobno kot druga podjetja na tem trgu, se je tudi Infineon Technologies moral kosati s temi izzivi in priložnostmi. Eden ključnih faktorjev pri naporih za zadovoljevanje takšnega trga je vzdrževanje visoke ravni inovativnosti pri širokem spektru proizvodov. Za Infineon je značilno: vzdrževanje visokega nivoja investicij v raziskave in razvoj, celo med zadnjim obdobjem recesije, z namenom obdržati tehnološki primat in povečevati dodano vrednost v izdelkih.

1. Cyclicity in the semiconductor market

The Semiconductor market is a very cyclical market. For the last 40 years it has been characterized by two words: change and speed! The compound annual growth rate has averaged 15 percent, but business cycles have been far more extreme, with some increases of 50% and decreases of 35%. Like all other companies in this market, Infineon Technologies has to cope with these challenges and opportunities. One key factor in order to meet the requirements of the market is the permanent focus upon a wide range of products on a very innovative level. This characterizes Infineon: maintaining a very high level of R&D investment, even during the past recession, to retain technological leadership, bringing added customer value.

2. Infineon in the market

Infineon Technologies AG, Munich, Germany, offers semiconductor and system solutions for the automotive and industrial sectors, with applications in wired communications markets, secure mobile solutions as well as memory products. With a global presence, Infineon operates in the U.S. from San Jose, CA, in the Asia-Pacific region from Singapore and in Japan from Tokyo. For the fiscal year 2003, the company achieved sales of Euro 6.15 billion

with about 32,900 employees (incl. 6,100 R&D staff) worldwide, as of Dec 31, 2003. Infineon is listed on the DAX index of Frankfurt Stock Exchange and on the New York Stock Exchange (ticker symbol: IFX).

Infineon Technologies Austria AG headquarters is in Villach with development centers in Villach, Graz and Linz. There is also a sales office in Vienna. Infineon Technologies Austria AG achieved sales of Euro 533 million with about 2,600 employees in the FY 2003. This fact of having manufacturing and R&D at one site is providing for very short feedback loops and improving time to market. To further strengthen this benefit, Infineon Technologies has decided to transfer the worldwide activities for Power Management & Supply from Munich to Villach, enlarging the current existing center of competence.

Infineon has jumped two positions in the ranking of worldwide semiconductor suppliers. According to the American market research institute, IC Insights, it is now number five. The figures are based on the first six months of 2004. Infineon is the only one of the ten leading semiconductor companies that managed to improve its position. With sales growth of 35 percent compared to the previous six months, we are actually two percentage points above the average growth of the ten U.S., Japan, Europe, Korea and Taiwan companies. In the first six months of FY 2004 we were able to achieve sales of around 4.4 billion dollars.

3. Current semiconductor developments

As already mentioned above, focus upon technology is very important during downturns. Thus, a wide range of new products and applications emerge. Among these Ambient Technology is playing a key roll for many forthcoming developments described as follows: Ambient Intelligence is the vision that technology will become invisible, embedded in our natural surroundings, present whenever we need it, enabled by simple and effortless interactions, attuned to all our senses, adaptive to users and context, and autonomously acting. High quality information access and personalized content must be available to everybody, anywhere, and at any time.

While in the 70's one computer served many users, and in the 90's the personal computer served humans on a one-to-one basis, today more than one computing device serves each user. This trend towards distributed electronic intelligence will likely prevail in the near future.

Infineon hopes to convert Ambient Intelligence applications, in the next 5 years, into the appropriate markets. As an example, a low-cost wireless network is presented for Ambient Intelligence environments (that creates the necessary link between the user and distributed electronics). Smart homes and hotel room infrastructures are among the first examples where this vision may become reality. We are presently investigating chances for applications of Smart RFID tags that represent possible solutions for distributed intelligence. An "edutainment" device for children has been developed as an innovation study for a natural and intuitive computer interface.

Infineon is working on a packaging and interconnect technology for deep textile integration of electronics. An interconnect and packaging technology is demonstrated using a polyester narrow fabric with several warp threads replaced by copper wires which are coated with silver and polyester. A thin flexible printed circuit board (PCB) is then attached to the polyester fabric. Then the module is encapsulated for mechanical protection. The complete unit is molded forming a hermetically sealed casing that protects it against mechanical and chemical stress.

Another example is a demonstration of a speech-controlled MP3 player system which is based on a DSP/ μ C-two-processor system. The user can control the music player either by speaker-independent voice recognition or by means of the keypad.

The Techtexil prize for innovation was written out on the occasion of the Techtexil 2003 for the 7th annual by the organizing committee of the Techtexil Symposium. Outstanding achievements were awarded in research, material and product development as well as new technologies.

"Fault-tolerant Integration Concept of Microelectronics in Smart Textiles" by Christl Lauterbach, Stefan Jung, Tho-

mas Sturm, Rupert Glaser, and Werner Weber, Infineon Technologies AG, Corporate Research, received the Tech-Textil Innovation award 2003 in the category "Integration of new technologies". The work is concerned with the direct installation of inexpensive Microsystems into textile structures.

On 26th April 2002, Infineon presented for the first time, prototypes of functional, durable and everyday life-suited implementations of microelectronics circuits in "smart" textiles and/or clothes. Thus, a smooth transition for, and reliable integration of electronic functionality into articles of clothing is now available - Wearable Electronics. Highly integrated chips and sensors with lowest capacity are inserted or interwoven directly into textile fabrics, making possible the complete integration of electronic applications into articles of clothing. Thus Infineon presented the basic technology to textile manufacturers and clothing designers who were able to convert it to visionary, innovative and inexpensive products.

The chips and very small sensors are applied in special frames on the textile fabric. Fine interwoven conductive strips provide for the electrical connections. The multiplicity of conceivable applications fields includes Infotainment and communications, in addition, logistics, medicine and security. Accordingly broadly is also the chip Portfolio of Infineon, which can be used for different textile-electronic applications. In addition, among other things, the Portfolio includes microcontroller and DSPs, Bluetooth, GPS and GSM solutions, memory cards, RFID solutions as well as biometric sensors.

The researchers of Infineon developed a self-contained embedded-microcontroller-net, which can be integrated into floor coverings. Together with sensors, it can be used with LEDs as signposts/guides or advertising media. "The electronic carpet" is also good for the control of air conditioning systems and fire signaling systems.

But that's not all: equipped with appropriate sensors, such a fabric can be built for instance into floors or walls and afterward, it can supply information about condition and load of materials. Thus the system makes possible early recognition of breaks and tears in building materials and fabrics.

The smart floor covering works through microelectronics modules which are embedded in braids of the carpet in the form of a "checkerboard". Each chip is connected to its four adjacent "neighbors" by electrically conductive threads, which creates a network that enables the flow of information. The more chips in a given square of smart carpet, the more sensitive it becomes.

Another interesting aspect of the technology is its self-organizing, or self-learning, nature. Though chips are pressure, water and heat resistant, if one fails the carpet can identify the failure and is able to compensate automatically and reorganizes all other chips on the grid so that data is

no longer set via paths that include the failing module. Not only does this help with faults, but it also offers the possibility to cut the "intelligent" carpeting to virtually any shape and size without damaging the electronic network within it. It still remains operational, which strains the "smart carpet" bears. However it is washable.

Example:

The demonstrator developed by Infineon incorporates robust encapsulated integrated capacitive sensors that act as touch detectors and LEDs as display elements. A carpet equipped with these chips and with this electronic architecture could thus be used as a motion or fire detector. The more densely the sensor elements are arranged, the more precise the results of measurement. At the same time, the integrated LEDs support use of the high-tech carpet as a control system that can be used in public buildings to mark walking routes and control the flow of visitors or to mark escape routes in an emergency.

In order to evaluate the information supplied by the micro-controllers, individually adapted programs can be written. Thanks to this flexible solution, the possible fields of application are virtually limitless.

The chips are interconnected by means of extremely fine signal and data conductors that are woven into a braided material that acts as the carrier. This interconnecting woven material can be the base layer or an intermediate layer of a carpet or of any other textile material. Each chip communicates via a self-learning and self-organizing network with its immediate neighbor and uses a software algorithm to ascertain its own position. If an element within the network is faulty, the chips automatically search for new ways in order to maintain the communication. Since the coordinates are stored in the chip and the entire carpet network is self-organizing, a faulty semiconductor element or a damaged connection does not impair the network's ability to function. The self-organizing nature of the material allows it to be cut to size in order to fit a specific area or a desired shape. Once it is cut and installed, the information network is connected via a data interface to existing systems, such as the alarm, air-conditioning or IT system.

Further Example:

Another potential field of application for the new high-tech textiles is the building industry, where sensors could be used as a means of detecting faults in concrete at an early stage. The water and heat-resistant chips could be integrated into columns, floors and walls, where they could collate information about the condition of the building material. Information gathered in this way could then be evaluated by means of a laptop computer connected to an interface of the concrete carrier. This would also allow static investigations to be performed faster and more cost-efficiently.

Application in the field of advertising and information is also conceivable for the concepts of "intelligent" textiles devel-

oped by Infineon. By way of example, when integrated into tent roofs or Zeppelin (airship) and balloon covers, the controllable LEDs as well as other display elements could be used to convey advertising messages.

Example:

The Hub (O'Neill's snowboard winter jacket with Infineon state-of-the-art technology).

For Infineon, the jacket marks its debut in the promising future "wearable electronics" market, which, according to forecasts, will bring in revenues of over one billion euros in the year 2007 alone.

This article of clothing targets the dynamic market segment of snowboarders and winter sports enthusiasts. The removable Infineon chip module is embedded in the inside of the high-tech jacket in a hard-shell holder, which protects it from physical damage and moisture. The mp3 files are loaded on the module via a USB connector. A textile keyboard built into the arm of the jacket is used for controlling the player. The player's electronics are connected via conductors sewn directly into the cloth of the jacket. The battery offers eight hours of playtime. The 128-megabyte memory provides enough space for all titles on a CD with outstanding sound quality. What is more, thanks to the Bluetooth module integrated in the jacket, cell phoning is even possible: The microphone is built into the collar; the headphones are tucked away in the helmet.

Infineon has already been in contact with over 200 companies in the textile industry regarding specific projects in the area of intelligent textiles.

The Hub will be available in retail stores along with the 2004/2005 winter collection.

Rosner mp3blue

The German clothing manufacturer Rosner from the Bavarian city of Ingolstadt and Infineon Technologies AG presented, on 26th July 2004, a jointly developed product: A men's jacket called "mp3blue" that features built-in functions such as "mobile telephony via Bluetooth" and "MP3 player". The electronics are an integral part of the clothing. The electronic features are controlled by a textile keyboard incorporated on the sleeve.

A new self-service library is yet another innovation that has been made possible by an Infineon complete solution using 300,000 radio chips. The my-d RFID (Radio Frequency Identification) chips have now been embedded in 240,000 books and 60,000 CDs and DVDs at a Vienna library. The library's users now only have to place their choices on the check-out table and insert their library card into a card reader. A radio system, built into the table, reads the content of the RFID chips and registers the details. This eliminates waiting periods, especially since the new process can register several library transactions at once. The chips, with up to ten kilobits of memory, can include

much more information than conventional barcodes. We developed the system together with ekz, a library provider from Reutlingen, Germany, and the Swiss company Bibliotheca Library Systems AG and have equipped further libraries in Austria, Switzerland, Belgium, and Germany.

4. An insight outlook about: What will be?

Generally, cyclicity in the market will continue, peaks of ups and downs will probably increase! Further strong focus in revenue forecasts is inescapable. Regional competition between Asia and Europe will increase, market pressure upon costs and productivity. One of the key factors is to meet the requirements of the customers. New consumer applications will shape and increase the worldwide market. A broad portfolio of new products will change everybody's life!

In this article various technology demonstrators were presented which consistently aim at improving the interaction between the human individual and information technology. Although we focused on the application-specific technologies to be explored and developed, at this point we want to emphasize the challenges mainstream Si-based

technology pose to technology innovation. Indeed the progress of the latter is not automatic. Major creativity and hard work are necessary to maintain a constant rate of progress in this field. It was the goal of this paper to show that this endeavor is worth the effort. The described projects may open the way to promising applications that may lead to completely new fields of application for micro-electronic technologies in just a few years' time.

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