



## **China IGBT Industry Report, 2010**

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## 2. Status Quo of China IGBT Industry

### 2.2 Technological Evolution

In IGBT field, China lags far behind foreign countries when it comes to technology, equipment and talents. Although the Chinese Government attached more importance to realize the R&D and industrialization of IGBT during the 8th and 9th Five-Year Plan periods, the result was disappointing because of some reason or another. The IGBT production process consists of chip design, chip fabrication, chip module packaging and monotube packaging, every link of which has yet to be largely improved.

#### *Technology of Chinese IGBT Enterprises*

Manufacturers	Position in the Industry Chain	Strength of IGBT Technology	Remarks
Ke Da Semiconductor	chip design	production of IGBT chip with 600V/1200V independently	responsible for chip packaging and testing by themselves; SMIC, Beijing Yandong Microelectronics and , ASMC serve as OEM; as of Oct.31st, 2010, IGBT output reached 1,000 pcs/m, with the total order valuing RMB3 million; IGBT products are mainly used in induction cooker
Wuxi Phoenix Semiconductor	Chip design & fabrication	***	***
Shenzhen South Xinyuan Technology	***	***	***
MX Tronics Corporation	***	***	***
CNR Yongdian Electronics Technology	***	***	***
Xi'an Power Electronic Research Institute	***	***	***
Jilin Sino-Microelectronics	***	***	***
Tianjin Zhonghuan Semiconductor	***	***	***
BYD Microelectronics	***	***	***
Shanghai Belling	***	***	***

Manufacturers	***	***	***
Zhuzhou CSR Times Electric	***	***	***
Qianjiang Motor	***	***	***
Jiangyin Changdian Advanced Packaging	***	***	***
XIAN IR-PERI	***	***	***
Weihai Singa Electronics	***	***	***
Nanjing Silvermicro electronics	***	***	***
STARPOWER SEMICONDUCTOR	***	***	***
MacMic Science & Technology Co., Ltd.	***	***	***
Hubei TECH Semiconductors Co., Ltd. (TECHSEM)	***	***	***

Source: ResearchInChina

### Chip Design

In terms of chip design, domestic manufacturers are forced to make PT-based low-end products with 600V and 1200V due to the technological bottleneck.

By contrast, foreign IGBT design companies, such as Infineon, have marched into the mature application of the fourth-generation IGBT technology- Trench + Field-Stop. Moreover, the first-and second-generation are Punch Through (PT) and Non Punch Through (NPT) based, while the third generation refers to Trench technology. Alongside with the technology breakthrough, the junction temperature of silicon wafer changed from 125°C to 150°C and then to 175°C, improving the power density of IGBT wafer. That is to say, the power density is rising under the same condition of heat dissipation. The technology progress lowers down the voltage drop of IGBT chip and conduction losses of devices.

### Chip Fabrication

The front technology employed in the production of NPT chip is exactly the same with VDMOS. But there exist two major difficulties: thin wafer technology and back technology. At present, China lags behind its foreign counterparts when it comes to the technology, notably, thin wafer technology and back technology.

1. Thin wafer technology: IGBT device with special pressure-proof indicator features the given chip thickness which requires reducing to 200-100um or even 80um. When the chip thickness is reduced to 100~200um-grade, the follow-up treatment will become more difficult, especially for large-sized silicon wafer with the size exceeding 8 inches.

2. Back technology: it consists of back injection, annealing and activation, back metallization, etc. the back technology are only permitted to conduct at low temperatures (not beyond 450°C) because of the restriction of melting point of the front metal. This makes the annealing and activation process more difficult.

### Chip Packaging (Module Packaging & Monotube Packaging)

Only a few domestic enterprises are engaged in mid-and small-power IGBT packaging, which results in low added value and consistent technological reliance. Modules that employ foreign chips for packaging are mainly products below 400A and 1700V. In this sense, China's IGBT industrialization is in the initial stage, great efforts should be made to seek for further development such as preferential policies, vigorous investment of related enterprises and adequate talent pool.

## **2.3 Industrial Layout**

Only a minority of domestic enterprises is engaged in mid-and small-power IGBT packaging, and some of them make breakthroughs in chip design and module technology but not yet possess large-scale production capability. Although there is still a long way to go to catch up their foreign counterparts in terms of overall strength, homegrown enterprises are sparing no efforts to seek for breakthrough in every single link of the IGBT production chain.

Key enterprises in chip design: Ke Da Semiconductor, Xi'an Power Electronic Research Institute, Wuxi Phoenix Semiconductor and Shenzhen South Xinyuan Technology.

Key enterprises in chip manufacturing: Tianjin Zhonghuan Semiconductor, Jilin Sino-Microelectronics, Harbin Transistor Factory, Zhongyangtian Electronics Technology, Xi 'an Weiguang technology, Zhuzhou CSR Times Electric, Shanghai Belling, ASMC, FMIC, BYD Microelectronics, etc.

Key enterprises in module packaging: Weihai Singa Electronics, Nanjing Silvermicro electronics, MacMic Science & Technology, STARPOWER SEMICONDUCTOR, Zhuzhou CSR Times Electric, BYD Microelectronics, Xiamen Hongfa Electroacoustic, etc.

Key enterprises in monotube packaging: Xi 'an Weiguang Technology and Jiangyin Changdian Advanced Packaging.

**Layout of China IGBT Industry**



Source: MCC; ResearchInChina

### 3. Chinese IGBT market

#### 3.3 IGBT Application Market

Home appliance energy saving: low-power IGBT is primarily applied in inverter home appliances. China's inverter home appliance market characterizes low penetration rate but higher growth potentiality.

Motor energy saving: it turns out to be the main body of global and China IGBT market, with the major applications in low & medium-frequency inverters and high-voltage inverter.

High-speed railway, smart grid, new energy, high-voltage inverter, etc.: all the fields adopt above 6500V IGBT modes, with the highest technical barrier.

#### ***IGBT Application Market in China***

Item	Applications	Product Specification	Cost	Localization Difficulty
1	Home appliance, new energy vehicles	<1700V	Lowest	Relatively low entry threshold
2	Motor energy saving (UPS, inverter-driven motor, etc.)	**	**	**
3	**	**	**	**

Source: ResearchInChina

Currently, IGBT in Chinese market is mainly employed in such industrial control and consumer electronics as motor, convertor, inverter, UPS, EPS, wind power equipment, digital camera flash lamp charger, electromagnetic oven, and inverter home appliances.

## **4. International IGBT Enterprises**

### **4.1 Infineon**

#### **4.1.2 Business in China**

Infineon used to only attach importance to the consumer electronics market with huge demand. For example, Infineon's IGBT single tube accounts for\*\*of the application in China's induction cookers. Now Infineon starts to attach importance to the promotion of its separation devices in the industrial applications market. Infineon's IGBT module occupies the largest market share in China's industrial application area, holds over \*\* in the general inverter market, over \*\* in the medium and high voltage inverter market, over\*\* in the inverter welding machine market, over \*\*in the induction heating market, and over \*\* in the transportation market. Infineon/EUPEC IGBT module has established its leadership in the Chinese market through decades of selection and tests by Chinese customers.

Infineon Integrated Circuit (Beijing) Co., Ltd.

In January 2011, Infineon Integrated Circuit (Beijing) Co., Ltd., a new subsidiary of global chip maker Infineon Technologies, was officially established with registered capital of \*\* million.

Infineon Integrated Circuit (Beijing) Co., Ltd. will focus on three core areas: Automotive Electronics, Industrial and Multimarket, Smart Card and Security Chip. Its main businesses are sales, marketing and application engineering. IC design function is unavailable at present, but may be carried out with the market need in the future.

In 2009, China has surpassed Germany to become the world's largest solar energy market; smart grid is a key development objective during the Twelfth Five-Year Plan period. To this end, the company built a \*\*m2 of manufacturing plant, mainly providing wind, solar and high power energy storage applications with high power IGBT components, with an annual capacity of \*\*sets, and formally put into production in March 2011.

Each high power kit MOD Stack of wind turbine contains six 1700V (2400A) of IGBTs and one control panel that can support 1.3MW of power generating capacity. For 5MW wind turbine, a maximum of four MOD Stack kits can be used. IGBTs in each kit are connected in 2+2 parallel mode, and there are three IGBT controller driver boxes on the control panel in three-phase full-bridge mode. For the applications other than wind turbine, the number of IGBT can be determinate on demand.

New energy vehicles have become a development trend of automobile industry. In fact, the passive components and power modules used in an automobile can promote energy conservation and emission reduction through improving performance. The IGBT modules of Infineon's HybridPACK1 and HybridPACK2 are developed specifically for energy-saving HEV and EV. At present, Infineon and major domestic automakers have projects under way. Major HEV supporting plants, especially those engaged in motor drive, have adopted Infineon's power modules. As of January 2011, the IGBT of China's new energy vehicle hasn't achieved localized production, and all the products are imported.

Infineon developed and launched car-class IGBT modules, 650 volts 400 amperes and 800 amperes are two models available at present, and more models will be introduced in 2012.

Infineon is the Supplier of IGBT Stacker for Goldwind Science & Technology

Infineon has supplied IGBT stackers to Goldwind since 2007 for the development and manufacturing of inverters. Since Goldwind set up the first wind turbine in Beijing Guanting Reservoir in July 2009, the inverters adopting Infineon's IGBT has achieved an availability of over \*\*, and passed a number of tests under extreme conditions.

Goldwind has applied IGBT stackers to 1.5MW wind turbines and plans to further apply them to 2.5MW model and the 3.0MW model in mass production after increasing the self-production, and apply them to the 6MW offshore model under development in the future. Goldwind is expected to complete the prototype design of the first 6MW wind turbine in 2012.



### Main Agents of Infineon in China

Beijing Jingchuan Electronic Technology Development Co., Ltd. is a level 1 agent of Infineon IGBT in the Chinese market, and also the agent with the largest sales of Infineon IGBT in Asia Pacific region in recent years. It's been an agent of Siemens power electronic components since its establishment in 1996, and achieved good results in the Chinese market. It achieved IGBT sales of \*\*in 2007. It's now engaged in EUPEC power semiconductor devices and concept IGBT driver, Infineon IGBT separator devices and fast recovery diode, EPCOS (electrolysis, absorption, power) capacitors, has offices in Shanghai, Shenzhen, Chengdu, Qingdao and Wuhan, and has Scilicontron power electronics laboratory.

Eurotone Electric Co., Ltd. is the largest level 1 agent of Infineon/EUPEC in the Chinese market, and products involved include IGBT, SCR, diode and other power devices. It has offices in Hong Kong and Chinese mainland. Products are widely applied in various fields, such as inverter, power inverter, locomotive traction, electric vehicle, inverter welding machine, communication power, UPS/EPS, induction heating, medical equipment and switching power supply. Eurotone Electric achieved IGBT module sales of about RMB5 million in 2008 in China, occupies\*\* of China's inverter and welding machine IGBT market, and is a major supplier of IGBT modules for Shenzhen INVT Electric.

## **7. IGBT Module Packaging Enterprises**

### **7.1 CSR Times Electric**

#### **7.1.1 Profile**

Zhuzhou CSR Times Electric Co., Ltd was jointly set up by five companies including CSR Zhuzhou Electric Locomotive Research Institute Co., Ltd. in 2005 with the registered capital of RMB1084.26 million. It highlights the R&D, manufacture, sales, and technical service of such products as rail transit device electric drive system, network control, converter, transmission system, signal system, rail engineering machinery electric control system & whole machine set, passenger vehicle electric products, high-power semiconductor devices, universal inverter, PV inverter, sensor, PCB, laminated busbar, and urban smart transportation system, which are widely applied in various industries and fields like high-speed MU, electric locomotive, diesel locomotive, passenger vehicle, subway & LRV, large-scale track maintenance machinery, urban rail transit, power, and metallurgy. In December 2006, the company went public in Hong Kong H-shares.

#### **7.1.2 Operation**

IGBT is broadly used in vehicle traction and transmission field. IGBT turns out to be the vital component of converter and assistant converter, the dominating products of CSR Times Electric, and occupies 1/3 in the cost. The IGBT in China completely relies on import.

In 2008, CSR Times Electric purchased the UK based Dynex Company and held its 75% equity. The sales of high-power semiconductor devices of Dynex, one of the few companies worldwide that master the manufacturing technology of high-voltage IGBT, takes the 6th position across the world. After the purchasing, CSR Times Electric has been in possession of such products and technologies as high-power IGBT, and high-voltage electric & electronic components.

In May 2010, CSR Times Electric established the overseas R&D center of semiconductor devices in UK, which becomes the window of the company to absorb the domestic and abroad technical talents of semiconductor devices, will accelerate the technology improvement of new electric & electronic components, and will lead the enterprise to firstly acquire the breakthrough of IGBT manufacturing technology.

Subsidiary: Dynex

Listed in the GEB of Canada's Toronto Stock Exchange, Dynex is one of the global leading suppliers of high-power semiconductor products. Dynex Semiconductor Ltd, the sole operational entity of Dynex, enjoys a history of more than 50 years and mainly designs and produces bipolar power semiconductor devices, IGBT, power components, and sapphire dedicated silicon IC, mostly employed in such fields as power transmission & distribution, transmission, aviation, industrial automation and control. Up to December 2010, it had 286 employees.

The former two 4-inch IGBT production lines of Dynex were founded over 20 years ago for the production of CMOS chips at the beginning, and later for the production of IGBT and diode and the assembly of IGBT module. These two production lines expanded in 2009 and the project was implemented by Dynex Semiconductor Ltd, the British subsidiary of Dynex. At the end of 2010, the installation of the first 6-inch IGBT production line was accomplished and that of the second one was under way, the two new production lines will increase the company's capacity by tenfold. Promisingly, the demand will witness the evident growth in 2011, primarily fueled by the small batch utilization of IGBT module by the subway products of CSR Times Electric. The IGBT module of DYNEX will also replace the overseas products and tap into wider fields like MU and high-power locomotive, which will substantially raise the company's output. Up till January 2011, the maximum operation voltages of its IGBT device products can be \*\*, \*\*, \*\*, \*\*, and\*\*.

**Operating Income and Growth Rate of Dynex (a Subsidiary of CSR Times Electric), 2007-2010**

(Unit: US\$ mln, %)

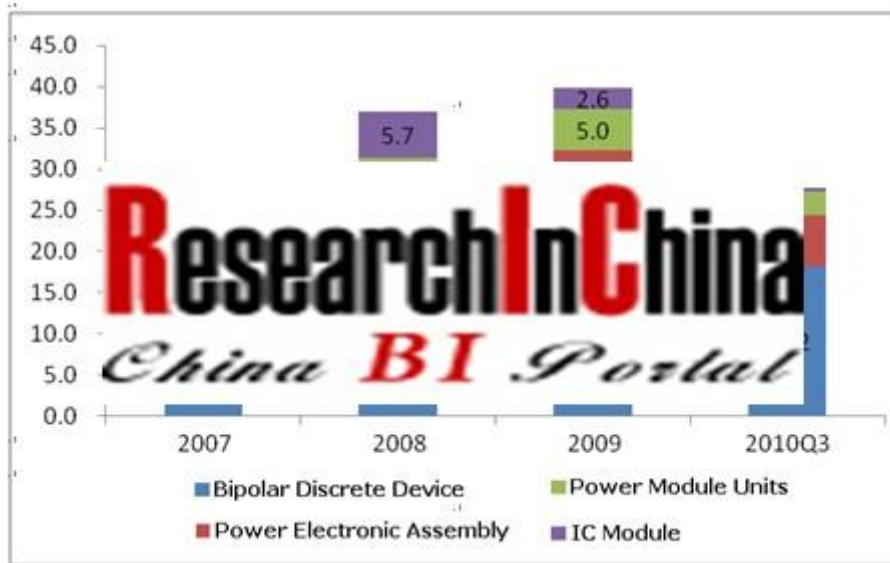


	2007	2008	2009	2010Q3
Operating Income	30.2	37.0	**	**
Growth Rate	27.2%	22.8%	**	**
Net Income	2.2	**	**	**
Growth Rate	894.1%	**	**	**

Source: Annual Report of Dynex; ResearchInChina

The power module business of Dynex acquired the revenue of US\$5 million in 2009, accounting for \*\* of the total. Power module business is mainly composed of IGBT module and diode module, with the applications of high-power electric locomotive and power management.

**Operating Income (by Product) of Dynex (a Subsidiary of CSR Times Electric), 2007-2010 (Unit: US\$ mln)**



Source: Annual Report of Dynex; ResearchInChina

**Operating Income (by Region) of Dynex (a Subsidiary of CSR Times Electric), 2007-2010 (Unit: US\$ mln)**



Source: Annual Report of Dynex; ResearchInChina

## → Related Reports

- **Global and China CMOS Camera Module Industry Report, 2009-2010**  
*<http://www.researchinchina.com/Htmls/Report/2010/5839.html>*
- **Global and China Passive Component Industry Report, 2009**  
*<http://www.researchinchina.com/htmls/Report/2010/5831.html>*
- **Global and China Digital STB (Set-top Box) Market Report, 2009**  
*<http://www.researchinchina.com/htmls/Report/2010/5809.html>*
- **Semiconductor Equipment Industry Report, 2009**  
*<http://www.researchinchina.com/htmls/Report/2009/5791.html>*
- **IC Advanced Packaging Industry Report, 2009**  
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**Address: Room 1008, A2, Tower A, Changyuan  
Tiandi Building, No. 18, Suzhou Street, Haidian  
District, Beijing, China 100080**

**Tel: 0086-10-82600828, 82600893**

**Fax: 00-86-10-82601570**

**Mail: report@researchinchina.com**

