Power Semiconductors Business Strategies

May 26, 2014

Fuji Electric Co., Ltd.
Electronic Devices Business Group
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■ Business Targets
■ Priority Measures
Business Overview
Electronic Devices Segment

Subsegments
- Semiconductors
  - Power semiconductors
  - Photoconductive drums
- Magnetic disks
  - Aluminum substrate magnetic disks
  - Glass substrate magnetic disks
- Copiers
- Printers

Major products
- Power semiconductors
- Inverters
- PCSs
- Air conditioners
- Automobiles
- Power supplies
- Photoconductive drums

Application

Net Sales (Billion yen)

<table>
<thead>
<tr>
<th>Subsegments</th>
<th>FY2012 Results</th>
<th>FY2013 Results</th>
<th>FY2014 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic disks</td>
<td>113.6</td>
<td>123.9</td>
<td>118.4</td>
</tr>
<tr>
<td>Photoconductive drums</td>
<td>28.9</td>
<td>23.5</td>
<td>15.0</td>
</tr>
<tr>
<td>Power semiconductors</td>
<td>75.5</td>
<td>90.4</td>
<td>94.4</td>
</tr>
</tbody>
</table>

Operating Income (Billion yen)

<table>
<thead>
<tr>
<th>Subsegments</th>
<th>FY2012 Results</th>
<th>FY2013 Results</th>
<th>FY2014 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic disks</td>
<td>-1.4</td>
<td>6.3</td>
<td>7.6 (6.4%)</td>
</tr>
<tr>
<td>Photoconductive drums</td>
<td>(-5.1%)</td>
<td>6.3</td>
<td>7.6 (6.4%)</td>
</tr>
<tr>
<td>Power semiconductors</td>
<td>9.2</td>
<td>10.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

※ PCSs: Power conditioner

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# Power Semiconductors

## Business Overview

### Industrial field

- **(47% of total sales)**
- Inverters, NC machine tools, elevators, UPSs, PCSs (wind / solar power generation), air conditioners, etc.

### Automotive field

- **(35% of total sales)**
- Engine controls, transmission controls, brake controls, steering controls, HEV motor controls, etc.

### Power supply field

- **(18% of total sales)**
- Industrial equipment, communication equipment, servers, PCs, flat-screen TVs, video game consoles, copiers, printers, etc.

## Products

- **IGBT modules**
- **SiC modules**
- **Automotive IGBT IPMs**
- **Discrete products**
  - Pressure sensors
  - Power ICs
  - Igniters

## Features

- Unique devices that greatly improve power conversion efficiency (SiC, RB-IGBT) and packaging technologies that realize high reliability
- Small, light-weight, and reliable devices critical for driving, turning, and stopping created by utilizing unique technologies (direct water cooling technology, single chip power IC technology)
- High-voltage, low-loss power supply IC and SJ-MOS*1 technologies that respond to ever stricter energy saving standards for power supplies

※ SJ-MOS: Superjunction MOSFET
Market Trends
■ Market contraction in FY2012, average growth rate of 12% projected for FY2013 onward
■ Expansion in domestic markets for EVs, HEVs, and industrial equipment and overseas markets for industrial equipment, consumer electronics, new energy, and eco-friendly vehicles

*Projections by Fuji Electric based on market data from IHS and other sources

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Business Targets
### Net Sales by Business Fields

<table>
<thead>
<tr>
<th></th>
<th>Industrial</th>
<th>Automobiles</th>
<th>Power supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2012</td>
<td>34.2</td>
<td>25.8</td>
<td>15.5</td>
</tr>
<tr>
<td>FY2013</td>
<td>42.5</td>
<td>32.0</td>
<td>15.9</td>
</tr>
<tr>
<td>FY2014</td>
<td>47.5</td>
<td>30.2</td>
<td>16.7</td>
</tr>
</tbody>
</table>

- **CAGR Entire Market**: 12%
- **Net Sales (Billion yen)**: 75.5, 90.4, 94.4

### Net Sales in Japan / Overseas

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>Overseas</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2012</td>
<td>31.6</td>
<td>43.9</td>
</tr>
<tr>
<td>FY2013</td>
<td>39.3</td>
<td>51.1</td>
</tr>
<tr>
<td>FY2014</td>
<td>42.7</td>
<td>51.7</td>
</tr>
</tbody>
</table>

- **Net Sales (Billion yen)**: 75.5, 90.4, 94.4
- **CAGR**: 1.9%

### Operating Income / Operating Income Margin

<table>
<thead>
<tr>
<th></th>
<th>FY2012 Results</th>
<th>FY2013 Results</th>
<th>FY2014 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>6.0</td>
<td>6.6%</td>
<td>6.5%</td>
</tr>
<tr>
<td>2013</td>
<td>6.5</td>
<td>6.9%</td>
<td>6.9%</td>
</tr>
<tr>
<td>2014</td>
<td>6.9</td>
<td>6.9%</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

- **Management Plan**: ▲2.5%, ▲1.9%
Priority Measures
Power Semiconductor Priority Measures

Basic Policy

● Development of foundation for Accomplishing Goals "Sales Target 100 billion yen" of FY2015 Medium-Term Management Plan
● Realization of 7% operating margin
● Accelerate development and Strengthen R&D structure
● Optimize global operations and improve cost competitiveness

Priority Measures

● Expand sales
  - Increase sales and expand market share by launching new products (⇒ Accelerate development)
  - Increase sales through the enhanced local design in the Design Center (China / Taiwan / Europe)
● Accelerate development of next-generation power semiconductors
  - Accelerate development of SiC product (commence mass production)
  - Accelerate development of 7th generation IGBT (X-Series)
● Establish the optimal production structure to increase production
  - Expand production on front-end process
  - Expand overseas production on back-end process
    (overseas production ratio 39% (FY2013), 47% (FY2014))
  - Step up overseas parts procurement
    (overseas procurement ratio 32% (FY2013), 40% (FY2014))
● Strengthen R&D structure
  - Aggregation of technology and development department
    by the construction of the Development Center (Matsumoto Factory)
    (Completion of new building in March 2015)
Begin market launch of new products (including newly derived products) that achieve increasing levels of power conversion efficiency

By taking advantage of their individual features, aim to boost market share in target fields
- Use RB-IGBT and SiC devices employing our proprietary technologies to achieve low loss levels
- Enable easy application in compact and high-radiation packages

<table>
<thead>
<tr>
<th>Target</th>
<th>New Products</th>
<th>Features</th>
<th>Mass Production Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCSs for Solar Power generation systems, UPSs</td>
<td>AT-NPC modules (RB-IGBT)</td>
<td>Simple external wiring, low surge voltage, low loss</td>
<td>Two models under mass production, series expansion from November 2014</td>
</tr>
<tr>
<td>General-purpose Inverters, General-purpose Servo systems, Industrial air-conditioner, Motor drive in General</td>
<td>Small PIMs (V-Series)</td>
<td>Compact and lightweight package, solderless mounting available</td>
<td>Under mass production</td>
</tr>
<tr>
<td></td>
<td>Small IPMs (V-Series)</td>
<td>Ultracompact package, includes drive IC and protection function</td>
<td>Under mass production for air conditioners, for industrial use from June 2014</td>
</tr>
<tr>
<td></td>
<td>SiC Hybrid modules (V-Series + SiC-SBD)</td>
<td>Substantially reduced switching losses (such as 35%)</td>
<td>Under mass production</td>
</tr>
<tr>
<td>NC machine tools, General-purpose servo systems, injection molding machine</td>
<td>Medium capacity IPM, High heat dissipation type (V series)</td>
<td>Increased overload tolerance, extended life, more compact (down 25% from previous models)</td>
<td>600V from September 2014, 1200V from November 2014</td>
</tr>
</tbody>
</table>

*AT-NPC: Advanced T-type Neutral Point Clamped  PIM: Power Integrated Modules  IPM: Intelligent Power Modules
Automotive Field  Overview of New Products

- Begin market launch of new products (including newly derived products) that are more compact, lightweight and reliable
  - Achieve low loss levels by employing next-generation trench IPS technology
  - Employ enhanced protection function to achieve high levels of reliability
  - Meet diverse customer design needs by providing low-voltage sensors as series
  - By increasing sensor sensitivity, extend application to fuel tanks

<table>
<thead>
<tr>
<th>Target</th>
<th>New Products</th>
<th>Features</th>
<th>Mass Production Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of relays, solenoids, lamps, etc.</td>
<td>High-side IPS</td>
<td>Enhanced protection function, low on resistance, highly sensitive current detection</td>
<td>from October 2014</td>
</tr>
<tr>
<td>Control of motors, etc., relay substitute</td>
<td>High-current IPS</td>
<td>High L load tolerance, low on resistance, battery reverse-connection protection, auto-protection function</td>
<td>from January 2015</td>
</tr>
<tr>
<td>Control of solenoids, stepping motors, etc.</td>
<td>Low-side IPS</td>
<td>Low resistance, high functionality, auto-protection function</td>
<td>Under mass production</td>
</tr>
<tr>
<td>Sensing of intake pressure, overpressure</td>
<td>Intake pressure, overpressure sensor</td>
<td>Compact, lightweight, freeze-resistant</td>
<td>from August 2015</td>
</tr>
<tr>
<td>Sensing of fuel tank pressure</td>
<td>Fuel leak detection sensor</td>
<td>Highly sensitive, increased fuel resistance</td>
<td>from June 2014</td>
</tr>
</tbody>
</table>
## Power Supply Field  
Overview of New Products

- Begin market launch of new products (including newly derived products) that achieve **energy savings**
  - Low-loss, low standby power
  - Product lineup capable of responding to diverse customer designs

<table>
<thead>
<tr>
<th>Target</th>
<th>New Products</th>
<th>Features</th>
<th>Mass Production Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LCD TV</strong></td>
<td><strong>Power factor control ICs</strong></td>
<td>Improved efficiency in Low-load Enhanced protection function</td>
<td>from January 2014</td>
</tr>
<tr>
<td></td>
<td><strong>PWM control ICs</strong></td>
<td>Low standby power Output current stabilization</td>
<td>from April 2013</td>
</tr>
<tr>
<td><strong>Printers</strong></td>
<td><strong>Quasi-resonant ICs</strong></td>
<td>Sound prevention Low standby power</td>
<td>Under mass production</td>
</tr>
<tr>
<td><strong>PC power supplies</strong></td>
<td><strong>Current resonance ICs</strong></td>
<td>Low standby power, High efficiency MOS crash prevention</td>
<td>from October 2013</td>
</tr>
<tr>
<td><strong>LED lighting</strong></td>
<td><strong>SJ-MOSFET (600V)</strong></td>
<td>Low on resistance Low switching loss Low noise</td>
<td>Under mass production</td>
</tr>
<tr>
<td><strong>Servers</strong></td>
<td><strong>SiC SBD (650V, 1200V)</strong></td>
<td>Low Vf* High avalanche tolerance Low switching loss</td>
<td>from 3Q 2014</td>
</tr>
<tr>
<td><strong>Standard power supplies</strong></td>
<td><strong>RB-IGBT (600V)</strong></td>
<td>1-chip reverse blocking characteristic Low VCE(sat)* Ideal for AC switches</td>
<td>Under mass production</td>
</tr>
</tbody>
</table>

* Vf: Forward voltage on a diode; VCE(sat): IGBT on voltage
### SiC Products

- **Begin market launch of products** that leverage features of SiC devices
- **Accelerate development of application-specific SiC products**

#### Features of SiC-Semiconductors

<table>
<thead>
<tr>
<th>Merit</th>
<th>Power Source Applications</th>
<th>Drive Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General-purpose power supplies, industrial power sources</td>
<td>Inverters</td>
</tr>
<tr>
<td></td>
<td>UPSs</td>
<td>Fans/ Pumps</td>
</tr>
<tr>
<td></td>
<td>PCSs</td>
<td>Conveyors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Servo systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EV/ HEV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric Power Infrastructure</td>
</tr>
</tbody>
</table>

- **Low-loss**
- **High-speed switching**
- **High-heat resistant / High-voltage**

#### Merit

- **High-efficiency**
- **Small / light-weight**
- **Highly accurate control**

#### Device voltage

- 600V/1.2kV/1.7kV
- 1.7/3.3kV >3.3kV

#### Product

<table>
<thead>
<tr>
<th>Low capacity</th>
<th>Medium / large capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBD</td>
<td>All SiC</td>
</tr>
<tr>
<td>discrete</td>
<td>Highly reliable new power modules that are easy to connect in parallel</td>
</tr>
<tr>
<td>Si IGBT+SiC Hybrid</td>
<td>6in1 7in1 modules</td>
</tr>
<tr>
<td></td>
<td>From the second half of FY2014</td>
</tr>
</tbody>
</table>

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Strengthen network of local bases that are design centers (China, Taiwan, Europe), accelerate product development to meet local needs, and work to increase local materials and component procurement ratios.

Establish the Development Center as the core global base for R&D.

Boost Sales through Localization (Overseas Design Centers)

- **Design base**
  - Europe design center (Frankfurt/Established in October 2013)
  - Local Design of industrial IGBT

- **Sales base**
  - Frankfurt
  - Mumbai
  - Hong Kong
  - Singapore
  - Shanghai
  - Taiwan
  - New Jersey

- **Development Center**
  - Matsumoto
  - Completion of new building in March 2015 (Plan)

- **China design center**
  - Shenzhen (Established in January 2013)
  - Local Design of industrial IGBT
  - and promote cost reductions

- **Taiwan design center**
  - Taipei (Established in October 2013)
  - Local Design of Power supply control ICs
Plans for Production Bases in FY2014

- **Front-end processes**: Increase scale of production and promote larger diameters
- **Back-end processes**: Boost overseas production ratio, expand mass production of automotive products overseas

**Core global base for front-end processes**
- Shift to larger diameters (6, 8 inch)
- Move to full-fledged mass production of SiC devices
- Increase production of 8-inch IGBT series (full operation by fiscal year-end)

**Core global base for back-end processes**
- In power semiconductors, accelerate production transfer of Fuji’s products to Tsugaru (raise production ratio of power semiconductors to more than 50% by fiscal year-end)
- Expand IGBT series under production (boost overseas production ratio)

**Production base (front-end processes)**
- Matsumoto, Japan
- Tsugaru, Japan
- Yamanashi, Japan

**Production base (back-end processes)**
- Japan (3 bases)
- Malaysia
- Philippines
- China (Shenzhen)

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Plant and Equipment Investment / R&D Expenditures

- Plant and equipment investment: shift focus from capacity expansion to R&D investment for new products and Next-generation products
- R&D expenditures: Next-generation products (SiC / 7th generation IGBT), accelerate development of new products

Plant and Equipment Investment:

<table>
<thead>
<tr>
<th>Year</th>
<th>Results</th>
<th>Management</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2013</td>
<td>11.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FY2014</td>
<td>11.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R&D Expenditures:

<table>
<thead>
<tr>
<th>Year</th>
<th>Results</th>
<th>Management</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2013</td>
<td>9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FY2014</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ratio of net sales:

<table>
<thead>
<tr>
<th>Year</th>
<th>FY2013</th>
<th>FY2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Major themes in FY2014:

- Construction of Matsumoto development center (¥4.8 billion)
- Introduce 7th generation IGBT module development facility
- Introduce SiC device development facility
- Develop SiC device mass production technology
- Develop 7th generation IGBT modules
- Expand series of industrial IGBT and power IC products

Note: R&D expenses are classified into segments according to theme. Consequently, the figures differ from the numerical values indicated in the Consolidated Financial Report for the fiscal year ended March 31, 2014.
【Development Center】Overview

Construct the Development Center at the Matsumoto Factory, our core global base for power semiconductor R&D and production technologies

[Structural overview]
- Location: Matsumoto, Nagano Prefecture, Japan (within Fuji Electric’s Matsumoto Factory)
- Structure: Steel frame, seismically isolated structure, six floors above ground
- Building area: Approximately 2,700 m² (40m x 67m)
- Site area: 12,500 m²
- Investment: Approximately ¥4.8 billion
- Completion: March 2015 (plan)

Combine into this factory the technology and development divisions that are currently dispersed (enhance information sharing and collaboration)

[Accelerate product and technology development]
- Develop next-generation power semiconductors
- Develop high-value-added products
- Develop revolutionary production technologies

Display leading-edge technologies and products

Enhance our presence with customers
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