FY2015 Medium-Term Management Plan
Power Semiconductors Business

August 26, 2013
Fuji Electric Co., Ltd.
Electronic Devices Business Group
■ Business Overview
■ Market Trends / Business Targets
■ Business Strategies / Priority Measures
■ R&D Expenditures / Plant and Equipment Investment
Business Overview
Electronic Devices Segment

Realize operating income margin of 7% in FY2015

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<tr>
<th>Subsegments</th>
<th>Major products</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Semi-conductors</td>
<td>Power semiconductors</td>
<td>Inverters</td>
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<tr>
<td></td>
<td></td>
<td>PCSs</td>
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<td></td>
<td></td>
<td>Air conditioners</td>
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<td></td>
<td></td>
<td>Automobiles</td>
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<td></td>
<td></td>
<td>Power supplies</td>
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<td>Photoconductors</td>
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<td>Copiers</td>
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<td></td>
<td></td>
<td>Printers</td>
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<td>Solar cells</td>
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<td>Solar power generation</td>
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<td>Magnetic disks</td>
<td>Aluminum substrate</td>
<td>Magnetic disks</td>
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<td></td>
<td>magnetic disks</td>
<td>Photoconductors / Solar cells</td>
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<tr>
<td></td>
<td>Glass substrate</td>
<td>Power semiconductors</td>
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<td></td>
<td>magnetic disks</td>
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<td>HDDs</td>
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Net Sales (Billion yen)

<table>
<thead>
<tr>
<th>FY2012</th>
<th>FY2015 Medium-term management plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>113.6</td>
<td>130.0</td>
</tr>
<tr>
<td>28.9</td>
<td>9.2</td>
</tr>
<tr>
<td>9.2</td>
<td>99.6</td>
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</table>

Operating Income (Billion yen)

<table>
<thead>
<tr>
<th>FY2012</th>
<th>FY2015 Medium-term management plan</th>
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<tbody>
<tr>
<td>-1.4</td>
<td>9.0 (6.9%)</td>
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</tbody>
</table>
Power Semiconductors Overview

**Industrial field**
- (45% 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**
- (20% of total sales)
- Industrial equipment, information equipment, communications, servers, PCs, flat-screen TVs, video game consoles, copiers, printers, etc.

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**Application**
- **Industrial field**
- **Automotive field**
- **Power supply field**

**Products**
- **IGBT modules**
- **SiC modules**
- **RB-IGBT modules**

**Discrete products**
- **Pressure sensors**
- **Power ICs**
- **Power supply control ICs**
- **Power MOSFETs**
- **Diodes**

**Characteristics**
- 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

*1) SJ-MOS ; Superjunction MOSFET
Market Trends / Business Targets
**Power Semiconductors Market Trends**

*Market in which Fuji Electric Participates*

- Market contraction in FY2012, average growth rate of 10% 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

![Graph showing market trends](image)

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

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Basic Policies

- Shift management focus from sales expansion to profitability
- Strengthen business resilience to changes in market conditions (selectively enhance benefits of business restructuring measures instituted in FY2012)
- Expand sales in new energy, energy savings, and environmental markets centered on industrial and automotive IGBTs
- Strengthen development capabilities and create new products to win out against global competition
Business Strategies / Priority Measures
Business Strategies / Priority Measures

Business Strategies

● Develop new products for new energy, energy-saving, and environmental markets
● Optimize global operations and improve cost competitiveness

Priority Measures

● Accelerate development of new products for new energy, energy-saving, and environmental markets
  ▪ Develop IGBTs for new energy, industrial equipment, consumer electronics, and EVs and HEVs
  ▪ Develop products for the energy-saving power supply market
  ▪ Develop and commence production of 6-inch SiC devices (October 2013)

● Optimize global operations
  ▪ Increase overseas sales through local design (Europe, Taiwan, China) and local production for local consumption
  ▪ Pursue cost reductions
    - Expand overseas production (overseas production ratio 35% → 60%)
    - Step up overseas parts procurement (overseas procurement ratio 31% → 60%)

● Commence operations and expand production of new strategic bases
  ▪ Start up 8-inch front-end-process production line in Yamanashi Factory (October 2013)
  ▪ Expand portion of production for Fuji Electric’s products at Tsugaru Factory
  ▪ Establish back-end process system to increase production in Shenzhen, China
## Market Trends

- **Rise in supply of clean energy**
  - Expanded use of wind power, solar power, and other forms of new energy

- **Energy saving, automation, and stabilization of power supplies**
  - Rise in energy efficient equipment
  - Expanded use of inverters

## Fuji Electric’s Initiatives:
Create series of new products that realize high power conversion efficiency

- **High power modules**
- **SiC modules**
- **RB-IGBT modules (new 3-level)**

- **Develop new products compatible with high capacity and high power conversion efficiency**

- **Develop products with the necessary functions to support various applications (V-Series chips, protective circuits, rectification circuits, etc.)**
  - **IPMs**
  - **Small IPMs**
  - **PIMs**

*2) IPM; Intelligent Power Module  
*3) PIM; Power Integrated Module
New Products Compatible with High Capacity and High Power Conversion Efficiency

**■ SiC modules (6 inch)**

- Low-loss / Small size

- **Si-IGBT modules**
  - Compared with Si-IGBT modules (1200V/100A/2in1)
    - Loss: -60 to -80%
    - Area: -50% (footprint)
    - Volume: -80%

- **SiC modules**

- **New structured package**
  - Sealing resin
  - Implant pin
  - Thick Cu plate DCB substrate
  - Solder / metal particles

- **Back-end processes**
  - Install automated assembly line in Matsumoto Factory

**■ RB-IGBT modules (new 3-level)**

- Halved elements (4 → 2)
- Competitors’ 3-level products
  - IGBT: 2
  - FWD: 2

- **RB-IGBT: 2 (Reverse-Blocking)**
  - Fuji Electric’s products

- **IGBT/FWD structure**
  - Halved loss

- **RB-IGBT structure**

- **Halved loss**
  - 20kVA inverter
  - $f = 7$ kHz, $V_{V扫} = 700$, $I_{rms} = 30$ A
  - Competitors’ 3-level products
  - Fuji Electric’s 3-level products

- Power dissipation per phase (W)
  - Fuji Electric’s 2-level products: 73.7 W
  - Competitors’ 3-level products: 54.0 W
  - Fuji Electric’s 3-level products: 36.1 W

- Switching loss
  - 76.6% (73.7 W)
  - 61.8% (54.0 W)
  - 71.8% (36.1 W)

- Conduction loss
  - 23.4% (73.7 W)
  - 38.2% (54.0 W)
  - 28.2% (36.1 W)

- **-51%**
- **-33%**

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Automotive Field
- Market Trends and Fuji Electric’s Initiatives

**Market Trends**

- Regulation of exhaust gas
  (European emission standards, CO₂ emission standards, etc.)
- Increased incentives for eco-friendly vehicle purchasing
  - Spread of EVs and HEVs
  - Improvement of fuel efficiency and reduction of exhaust

- Efforts to improve safety
  - Safe driving

**Fuji Electric’s Initiatives:**

Develop small, light-weight, reliable products using unique technologies (direct water cooling technology, single chip power IC technology)

★ Realize high current density by utilizing direct water cooling technology

♦ IPMs for PHEVs

★ Develop single chip products that comply with stricter environmental and fuel regulations

♦ Pressure sensors
  ♦ Igniters

★ Develop high current density products for driver safety systems (equipped with more electrical components)

♦ Power ICs, IPDs*4

*4) IPD: Intelligent Power Device

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Market Trends

- Need to respond to stricter standards for power supplies
  Regulation of power conversion efficiency and harmonics
  (Energy Star, 80PLUS, etc.)

- Increased demand for high-efficiency power supplies for data center servers

- Stronger drive toward energy savings

  - Spread of energy-saving consumer electronics and lighting
    Increased demand for specialized circuits for power supplies

Fuji Electric’s Initiatives:
Create series of new products that realize energy savings by utilizing unique high-voltage, low-loss device technologies

- Control ICs compatible with power supply standards
  - Power supply control ICs for realizing high power conversion efficiency
  - Power factor control ICs

- High-voltage, low-loss discrete devices for power supplies
  - SJ-MOSFETs
  - SiC SBDs*5

*5) SBD: Schottky Barrier Diode

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Globalization (Sales, Development, and Design)

- Strengthen the Company’s world-leading design and development systems (consolidate engineering bases)
- Accelerate development of products that meet needs of overseas markets and promote local procurement of parts (establish design centers in Europe, China, and Taiwan)

- New! Europe design center (Frankfurt) Established in October 2013
- New! China design center (Shenzhen) Established in January 2013
- New! Taiwan design center (Taiwan) Established in October 2013
- New! Strengthen development systems (Matsumoto) Construct new building in FY2014

Map showing locations of sales and design bases globally.
Front-end processes: Improve productivity by reorganizing clean rooms
Back-end processes: Increase overseas production ratio (35% → 60%), commence mass production of automotive products overseas

Realize stable supply by utilizing multiple production bases
Front-end processes: Increase ratio of overseas production by operating Malaysian factory at full capacity and utilizing overseas wafer fabrication foundries

Back-end processes: Substantially raise overseas production ratio by commencing operation of Shenzhen factory and starting mass production of automotive products

Front-End Processes
(Monthly production converted to 6-inch base)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overseas</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2012</td>
<td>10</td>
<td>86</td>
</tr>
<tr>
<td>FY2015 Medium-term management plan</td>
<td>31 (20%)</td>
<td>122</td>
</tr>
</tbody>
</table>

Back-End Processes
(Billion yen)

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>Philippines</th>
<th>Malaysia</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2012</td>
<td>11.0</td>
<td>10.0</td>
<td>17.0</td>
<td>28.0</td>
</tr>
<tr>
<td>FY2015 Medium-term management plan</td>
<td>64.0</td>
<td>60%</td>
<td>26.0</td>
<td>55.0</td>
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R&D Expenditures / Plant and Equipment Investment

- **R&D expenditures**: Concentrate expenditures in growth markets, accelerate development of new products.
- **Plant and equipment investment**: Limit investment (shift focus from capacity expansion to new products and R&D).

### R&D Expenditures

<table>
<thead>
<tr>
<th>FY2010-FY2012</th>
<th>FY2013-FY2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of net sales</td>
<td>(10%)</td>
</tr>
<tr>
<td>Cumulative total</td>
<td>(11%)</td>
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<table>
<thead>
<tr>
<th>(Billion yen)</th>
<th>(Billion yen)</th>
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<tbody>
<tr>
<td>23.0</td>
<td>30.0</td>
</tr>
<tr>
<td><strong>Ratio of net sales</strong>: (10%)</td>
<td><strong>Ratio of net sales</strong>: (11%)</td>
</tr>
</tbody>
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### Plant and Equipment Investment

<table>
<thead>
<tr>
<th>FY2010-FY2012</th>
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<tr>
<td>Cumulative total</td>
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<table>
<thead>
<tr>
<th>(Billion yen)</th>
<th>(Billion yen)</th>
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<tbody>
<tr>
<td>35.0</td>
<td>33.0</td>
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### Major themes for FY2013–2015
- SiC devices
- Next-generation power semiconductors (develop high value added products)

### Major projects for FY2013–2015
- Introduction of SiC device production facilities
- Introduction of IGBT production facilities (Tsugaru Factory)
- Construction of new building at Matsumoto Factory
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