Electronic Devices
Business Strategies

May 31, 2018
Fuji Electric Co., Ltd.
Electronic Devices Business Group
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- Review of FY2017
- FY2018 Management Plan
  - Business Policy
  - Business Plan
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## Electronic Devices Business Overview

### Businesses
- **Semi-conductors**
  - Power semiconductors

### Major products
- **Photoconductors**
- **Aluminum substrate magnetic disks**
- **Glass substrate magnetic disks**

### Application
- **Inverters**
- **UPS**
- **PCS**
- **Air conditioners**
- **Automobiles**
- **Power supplies**

### Production bases
- **[Front-end processes]**
  - Fuji Electric Matsumoto Factory
  - Fuji Electric Yamanashi Factory
  - Fuji Electric Tsugaru Semiconductor Co., Ltd.
  - Fuji Electric (Malaysia) Sdn. Bhd.
- **[Back-end processes]**
  - Fuji Electric Power Semiconductor Co., Ltd.
  - Fuji Electric (Shenzhen) Co., Ltd.
  - Fuji Electric Philippines, Inc.
  - Fuji Electric (Malaysia) Sdn. Bhd.

* UPS: Uninterruptible power systems
* PCS: Power conditioning sub-systems

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# Semiconductors Business Overview

## Industrial field [ % of total sales: 73% ]

- **48%**

Inverters, NC machine tools, elevators, UPS, PCS (wind/solar power generation), air conditioners, etc.

## Automotive field [ % of total sales: 27% ]

- **25%**

HEV motor controls, Engine controls, transmission controls, brake controls, steering controls, etc.

## Features

- Unique devices that greatly improve power conversion efficiency (**SiC, RB-IGBT**) and packaging technologies that realize high reliability

## Products

- **Modules**
  - IGBT modules
  - SiC modules
  - RB-IGBT modules

- **Discrete devices**
  - Power supply control ICs
  - Diodes
  - Photoconductors
  - MOSFETs

- **Automotive IGBT IPMs**
  - Pressure sensors
  - Igniters
  - Power ICs

## Applications

- **Industrial field**
  - Industrial equipment, communication equipment, servers, PCs, flat-screen TVs, video game consoles, copiers, printers, etc.

- **Automotive field**
  - HEV motor controls, Engine controls, transmission controls, brake controls, steering controls, etc.

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* RB-IGBT: Reverse Blocking IGBT  SJ-MOS: Super Junction MOSFET
Review of FY2017
Review of FY2017

Higher sales and income as strong growth of semiconductor sales counteracted decrease in magnetic disk demand

**Semiconductors**
- Achieved higher sales and operating results due to demand growth centered on the industrial field
- Worked to have our proposed automotive IGBT modules specification accepted for use in new xEV models and commenced mass-production of 3rd-generation direct liquid-cooling IGBTs
- Increased production capacity of 8-inch wafers
- Approved approximately ¥20.0 billion worth of investments (to commence in 2019) aimed at increasing IGBT sales in FY2019 and beyond

**Magnetic Disks**
- Posted lower sales, despite recovery of demand seen in the second half of the fiscal year, but achieved improved operating results following cost reductions
- Advanced development of new products together with a customer
FY2018 Management Plan
Business Policy

◆ Increase sales and income through proactive investment in growth markets
◆ Solidify industry position with world-leading technologies and products

【Semiconductors】
● Accelerate development of new products and bolster production capacity to facilitate future business growth

【Magnetic Disks】
● Accelerate development of new products for nearline models and secure sales and profits
Business Plan

- Increase sales and income centered on semiconductors
- Target YoY growth of approximately 5% in sales and 12% in income from semiconductors by growing sales in Japan and overseas
- Project increase of approximately 5% YoY in sales of magnetic disks

### Net Sales by Business

<table>
<thead>
<tr>
<th></th>
<th>FY2017 Results</th>
<th>FY2018 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Disks</td>
<td>126.9</td>
<td>133.0</td>
</tr>
<tr>
<td></td>
<td>19.4</td>
<td>20.3</td>
</tr>
<tr>
<td>Semi-conductors</td>
<td>107.5</td>
<td>112.7</td>
</tr>
</tbody>
</table>

### Net Sales in Japan / Overseas

<table>
<thead>
<tr>
<th></th>
<th>FY2017 Results</th>
<th>FY2018 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>49.1</td>
<td>51.5</td>
</tr>
<tr>
<td></td>
<td>5.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Overseas</td>
<td>77.8</td>
<td>81.5</td>
</tr>
<tr>
<td></td>
<td>+6.1</td>
<td>+3.7</td>
</tr>
</tbody>
</table>

### Operating Income / Operating Margin

<table>
<thead>
<tr>
<th></th>
<th>FY2017 Results</th>
<th>FY2018 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Disks</td>
<td>13.7</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>(10.8%)</td>
<td>(11.4%)</td>
</tr>
<tr>
<td>Semi-conductors</td>
<td>77.8</td>
<td>81.5</td>
</tr>
<tr>
<td></td>
<td>+6.1</td>
<td>+12%</td>
</tr>
</tbody>
</table>
Semiconductors
Market Trends—Power Semiconductor Market Forecasts (Market Segments Targeted by Fuji Electric)

- Overall power semiconductor market growth of 5.5% YoY, CAGR of approximately 7% forecast for period from CY2017 to CY2020
- Strong conditions in industrial market to be supported by consistent automation and labor-saving needs
- High CAGR of approximately 14% projected in automotive product market in period from CY2017 to CY2020

**CY2017-CY2020 CAGR**
- **Semiconductors**: 6.7%
- **Industrial discrete devices**: 3.2%
- **Industrial Modules**: 4.1%
- **Automobiles**: 13.5%

*Company’s estimation based on market data released by IHS 2017 and on WSTS fall 2017*
Semiconductors—Business Plan

- Commence full-fledged mass-production of 7th-generation IGBTs to achieve increase of 6% YoY in sales of industrial modules
- Grow automotive field sales by roughly 10%, centered on overseas markets, to represent 29% of total semiconductors sales
- Project YoY decrease in sales of industrial discrete devices due to impacts of discontinued products

**Net Sales by Business Fields** (Billion yen)

<table>
<thead>
<tr>
<th></th>
<th>FY2017 Results</th>
<th>FY2018 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrete devices</td>
<td>107.5 (24%)</td>
<td>112.7 (22%)</td>
</tr>
<tr>
<td></td>
<td>73% (48%)</td>
<td>71% (49%)</td>
</tr>
<tr>
<td>Modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27% (27%)</td>
<td>29% (29%)</td>
</tr>
</tbody>
</table>

**Net Sales in Japan / Overseas** (Billion yen)

<table>
<thead>
<tr>
<th></th>
<th>FY2017 Results</th>
<th>FY2018 Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of Overseas Sales</td>
<td>54%</td>
<td>54%</td>
</tr>
<tr>
<td>Japan</td>
<td>107.5 (46%)</td>
<td>112.7 (46%)</td>
</tr>
<tr>
<td>Overseas</td>
<td>54%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Change

- Net Sales by Business Fields:
  - Discrete devices: +5.2
  - Modules: +3.2
  - Industrial: +3.1

- Net Sales in Japan / Overseas:
  - Japan: +2.3
  - Overseas: +2.9
  - Total: +5.2

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Semiconductors—Priority Measures

● Industrial field:
  - Promote sales of 7th-generation IGBTs
    (Take advantage of strong market conditions for NC machine tools, industrial robots, and other motor-drive products, and air conditioners)
  - Bolster back-end production capacity ahead of schedule to respond to demand growth

● Automotive field: Step up development of IGBTs for EVs
  - Enhance development resources
  - Accelerate development of 4th-generation direct liquid-cooling IGBTs (mass-production scheduled to commence in 2019)

● Proactive investment and acceleration of development to facilitate future business growth
  - Front-end: Bolster 8-inch wafer production capacity at Matsumoto Factory and Yamanashi Factory (achieve double 2017 level by 2020)
  - Back-end: Prepare for mass-production of 4th-generation direct liquid-cooling IGBTs
  - Commence mass-production of All-SiC devices (1st-generation trench MOSFETs) and accelerate development of 2nd-generation trench MOSFETs

● Stable component procurement
  - Promote long-term contracts and purchasing from multiple suppliers
Plans for Production Capacity Expansion

Increase ratio of large-diameter wafer fabrication and improve productivity

- Increase 8-inch wafer production capacity
- Move to full-fledged mass production as SiC device production base
- Function as mother base

Japan (Matsumoto)

- Increase ratio of power semiconductor production to 80% (up 5 ppts. YoY)
- Expand range of IGBT (FWD)*, power IC, and MOSFET series manufactured
- Transfer production of products for automotive applications

Japan (Tsugaru)

- Increase 8-inch wafer production capacity (achieve double 2017 level by 2020)
- Expand range of IGBTs for automotive and 7th-generation IGBT series manufactured

Japan (Yamanashi)

- Expand range of 6th-generation IGBT series manufactured

Malaysia

Expand range of models produced overseas

- Bolster production capacity for automotive products
- Manufacture products for domestic customers
- Function as mother bases

Japan (3 bases)

- Expand range of IGBT module models manufactured (Commence production of industrial-use IPMs)

China (Shenzhen)

- Increase air conditioner IPM production capacity (by 70% YoY)
- Bolster production capacity of products for power supplies and pressure sensors for automotive applications

Philippines

- Expand range of IGBT module models manufactured (Commence production of 7th-generation IGBTs)

Malaysia

*Free Wheel Diode
Expansion of Automotive Field Sales

- Commence mass-production of 3rd-generation liquid-cooling IGBTs
- Expand sales by developing 4th-generation IGBTs with higher levels of output electric power density by utilizing cutting-edge chip (RC-IGBT), package, and cooling technologies

**xEV Units and EV Ratio**

- Millions of units
- Source: IHS2017

**Plan for Enhancing Performance of Modules for xEV Power Trains**

- Output electric power density ratio:
  - Competitor ①
  - Competitor ②

**Ratio of Sales from Automotive Products**

- FY17 Result
- FY20 Target
- FY23 Target

*Target announced at business strategy meeting held on May 25, 2017 ©2018 Fuji Electric Co., Ltd. All rights reserved.
Redoubling of Development Efforts for Increasing SiC Sales

- Focus on development of All-SiC modules for module fields expected to see demand growth going forward
- Improve performance and bolster product series of SiC trench MOSFET chips (new + existing compatible packages)

SiC Market Trends and Fuji Electric’s Target Fields

Performance and Market Position of Fuji Electric’s SiC Chips

- Focus on development of All-SiC modules for module fields expected to see demand growth going forward
- Improve performance and bolster product series of SiC trench MOSFET chips (new + existing compatible packages)

SiC Market Trends and Fuji Electric’s Target Fields

Performance and Market Position of Fuji Electric’s SiC Chips
Growth of Air Conditioner IPM Sales

- Grow sales and **expand market shares** in conjunction with increasing ratio of inverter adoption
- Move ahead with underway development of large package models for addressing needs to replace coal-powered heating systems in China

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**Fuji Electric’s Strengths**

- **Increased energy savings realized with 7th-generation IGBTs**
  - Approx. 10% lower loss than competitors offerings (based on trial calculations by Fuji Electric)
  - Grow sales and expand market shares in conjunction with increasing ratio of inverter adoption
  - Move ahead with underway development of large package models for addressing needs to replace coal-powered heating systems in China

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**Market**

Global Inverter Room Air Conditioner Production Volumes (Forecast)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production volumes</th>
<th>Ratio of inverter adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CY21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Super mini type** (10-30A)
- **Large type** (50-75A)

**Sales**

Sales of Fuji Electric’s Air Conditioner IPMs and Global Market Share

- Fuji Electric’s sales
- Fuji Electric’s market share

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales of Fuji Electric’s Air Conditioner IPMs</th>
<th>Global Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY15</td>
<td>100</td>
<td>15%</td>
</tr>
<tr>
<td>FY16</td>
<td>220</td>
<td>9%</td>
</tr>
<tr>
<td>FY17</td>
<td>500</td>
<td>830</td>
</tr>
<tr>
<td>FY18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:** FUJI KEIZAI CO., LTD., and Fuji Electric Co., Ltd.
Magnetic Disks
Total Shipped Data Volumes

- Overall data volume to continue to increase, HDD expected to cover majority of data demand
- Large growth in data volume from nearline storage models for cloud servers and models for surveillance cameras in HDD field

Data shipment volumes as HDD, SSD and NAND Memory

### HDD Data Shipment Volumes

<table>
<thead>
<tr>
<th>Year</th>
<th>Nearline Storage</th>
<th>High-end Servers</th>
<th>2.5&quot; Consumer (mobile, etc.)</th>
<th>3.5&quot; Consumer (surveillance cameras, etc.)</th>
<th>3.5&quot; Desktop</th>
<th>Total CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>606</td>
<td>195</td>
<td>77</td>
<td>17</td>
<td>15</td>
<td>+24.4%</td>
</tr>
<tr>
<td>CY2017</td>
<td>689</td>
<td>244</td>
<td>94</td>
<td>222</td>
<td>245</td>
<td>+24.4%</td>
</tr>
<tr>
<td>CY2018</td>
<td>860</td>
<td>379</td>
<td>135</td>
<td>206</td>
<td>245</td>
<td>+24.4%</td>
</tr>
<tr>
<td>CY2019</td>
<td>1,091</td>
<td>507</td>
<td>143</td>
<td>222</td>
<td>507</td>
<td>+24.4%</td>
</tr>
<tr>
<td>CY2020</td>
<td>1,325</td>
<td>646</td>
<td>167</td>
<td>224</td>
<td>1,325</td>
<td>+24.4%</td>
</tr>
</tbody>
</table>

Source: Trend Focus 2018

### NAND (non-SSD) Data Shipment Volumes

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall NAND</th>
<th>2.5&quot; Consumer (mobile, etc.)</th>
<th>3.5&quot; Consumer (surveillance cameras, etc.)</th>
<th>3.5&quot; Desktop</th>
<th>Total CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>732</td>
<td>606</td>
<td>195</td>
<td>15</td>
<td>+26.1%</td>
</tr>
<tr>
<td>CY2017</td>
<td>864</td>
<td>689</td>
<td>244</td>
<td>245</td>
<td>+26.1%</td>
</tr>
<tr>
<td>CY2018</td>
<td>1,100</td>
<td>860</td>
<td>379</td>
<td>245</td>
<td>+26.1%</td>
</tr>
<tr>
<td>CY2019</td>
<td>1,401</td>
<td>1,091</td>
<td>507</td>
<td>507</td>
<td>+26.1%</td>
</tr>
<tr>
<td>CY2020</td>
<td>1,733</td>
<td>1,325</td>
<td>646</td>
<td>1,325</td>
<td>+26.1%</td>
</tr>
</tbody>
</table>

Source: Trend Focus 2018

### Volume of Data Per 1 HDD

<table>
<thead>
<tr>
<th>Year</th>
<th>TB/unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>1.4</td>
</tr>
<tr>
<td>CY2017</td>
<td>1.7</td>
</tr>
<tr>
<td>CY2018</td>
<td>2.2</td>
</tr>
<tr>
<td>CY2019</td>
<td>2.9</td>
</tr>
<tr>
<td>CY2020</td>
<td>3.8</td>
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</table>

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Magnetic Disks—Market Trends

- Lower HDD shipment volumes, but higher average capacity per unit
- Recovery of magnetic disk demand anticipated in conjunction with increase in number of disks used nearline storage models

**HDD Shipment Volumes (Millions of units)**

<table>
<thead>
<tr>
<th>Year</th>
<th>TB</th>
<th>WD</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>424</td>
<td>172</td>
<td>153</td>
</tr>
<tr>
<td>CY2017</td>
<td>404</td>
<td>162</td>
<td>153</td>
</tr>
<tr>
<td>CY2018</td>
<td>396</td>
<td>166</td>
<td>154</td>
</tr>
<tr>
<td>CY2019</td>
<td>377</td>
<td>162</td>
<td>151</td>
</tr>
<tr>
<td>CY2020</td>
<td>352</td>
<td>155</td>
<td>144</td>
</tr>
</tbody>
</table>

**Average Disks (disks/unit)**

<table>
<thead>
<tr>
<th>Year</th>
<th>TB</th>
<th>WD</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>2.03</td>
<td>2.13</td>
<td>2.33</td>
</tr>
<tr>
<td>CY2017</td>
<td>2.60</td>
<td>2.21</td>
<td>2.33</td>
</tr>
<tr>
<td>CY2018</td>
<td>2.93</td>
<td>2.60</td>
<td>2.73</td>
</tr>
</tbody>
</table>

**Magnetic Disk Demand (Millions of units)**

<table>
<thead>
<tr>
<th>Year</th>
<th>TB</th>
<th>WD</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>860</td>
<td>370</td>
<td>327</td>
</tr>
<tr>
<td>CY2017</td>
<td>861</td>
<td>370</td>
<td>336</td>
</tr>
<tr>
<td>CY2018</td>
<td>923</td>
<td>396</td>
<td>376</td>
</tr>
<tr>
<td>CY2019</td>
<td>981</td>
<td>432</td>
<td>402</td>
</tr>
<tr>
<td>CY2020</td>
<td>1,032</td>
<td>465</td>
<td>434</td>
</tr>
</tbody>
</table>

**Average Capacity (TB/disk)**

<table>
<thead>
<tr>
<th>Year</th>
<th>TB</th>
<th>WD</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY2016</td>
<td>0.70</td>
<td>0.80</td>
<td>0.93</td>
</tr>
<tr>
<td>CY2017</td>
<td>0.80</td>
<td>0.80</td>
<td>0.93</td>
</tr>
<tr>
<td>CY2018</td>
<td>0.93</td>
<td>0.93</td>
<td>1.11</td>
</tr>
<tr>
<td>CY2019</td>
<td>1.11</td>
<td>1.11</td>
<td>1.28</td>
</tr>
<tr>
<td>CY2020</td>
<td>1.28</td>
<td>1.28</td>
<td>1.46</td>
</tr>
</tbody>
</table>

※Trend Focus, 2018 and Company’s estimation

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Secure profits by addressing increased demand for products for nearline storage models

Priority Measures
- Secure sales and income
  - Secure sales with new products for nearline storage models
  - Step up efforts to reduce costs
- Advance research and development
  - Secure future sales by promoting joint-development with a customer
Capital Investment / Research and Development
Semiconductors
- Rationalization and production capacity increases
  - Front-end: Expansion of 8-inch wafer production
  - Back-end: Industrial and air-conditioning IPMs and automotive IGBTs and discrete devices
- Equipment for new products
  - Back-end: 4th-generation direct liquid-cooling automotive modules

Semiconductors
- SiC devices and modules
- Automotive IGBTs and discrete devices
- Expansion of 7th-generation IGBT series

* R&D expenditure figures above represent expenditures that have been allocated to segments based on theme and may therefore differ from figures contained in consolidated financial reports.
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