

TOSHIBA

Kaga Toshiba Electronics factory tour
for analysts and institutional investors

Discrete Semiconductor Business Overview

Kenji Kishimoto

Director, Vice President of Discrete Semiconductor Div.
Toshiba Electronic Devices & Storage Corporation

December 17, 2019

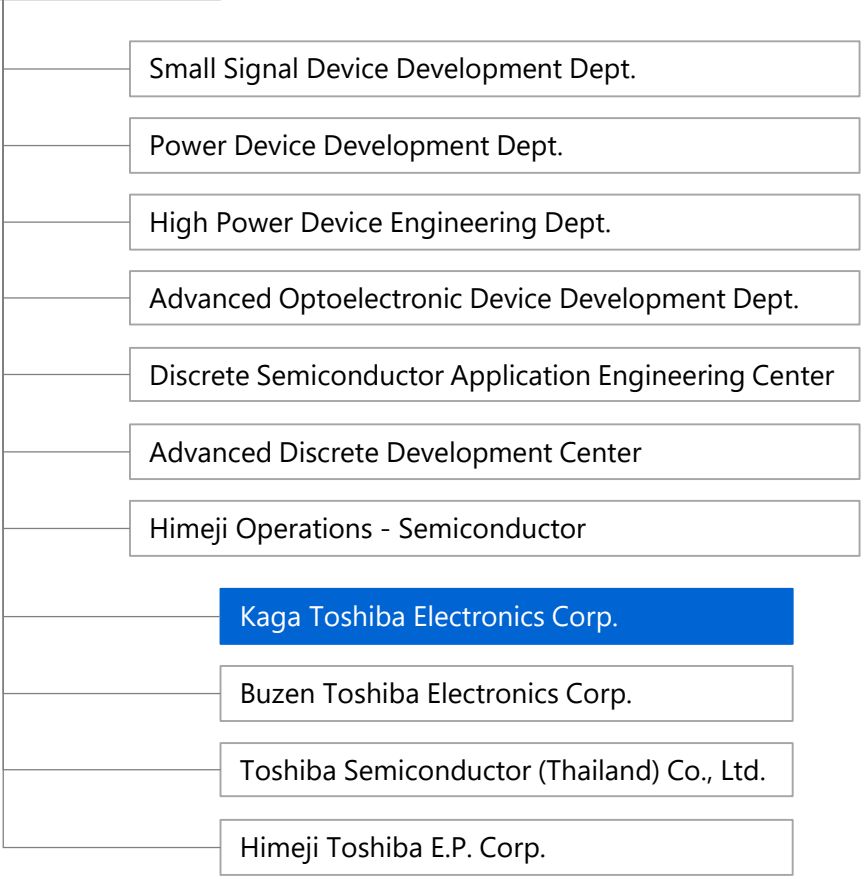
Forward-looking Statements

- This presentation contains forward-looking statements concerning future plans, strategies, and the performance of Toshiba Group.
- These statements are not historical facts; rather, they are based on assumptions and judgments formed by the management of Toshiba Group in light of currently available information. They include items that have not been finally decided at this point and future plans that are yet to be confirmed or that require further consideration.
- Since Toshiba Group promotes business in various market environments in many countries and regions, its activities are subject to a number of risks and uncertainties that are, without limitation, related to economic conditions, worldwide mega-competition in the electronics business, customer demand, foreign currency exchange rates, tax rules, regulations, geopolitical risk, natural disasters and other factors. Toshiba therefore wishes to caution readers that actual results might differ from expectations. Please refer to the annual securities report (*Yuukashoken houkokusho*) for FY2018 and the quarterly securities report (*shihanki houkokusho*) for the second quarter of FY2019 (both issued in Japanese only) for detailed information on Toshiba Group's business risk.
- Toshiba's fiscal year (FY) runs from April 1 to March 31. All figures are consolidated totals for 12 months, unless otherwise stated.
- Results in segments have been reclassified to reflect the current organizational structure, unless otherwise stated.

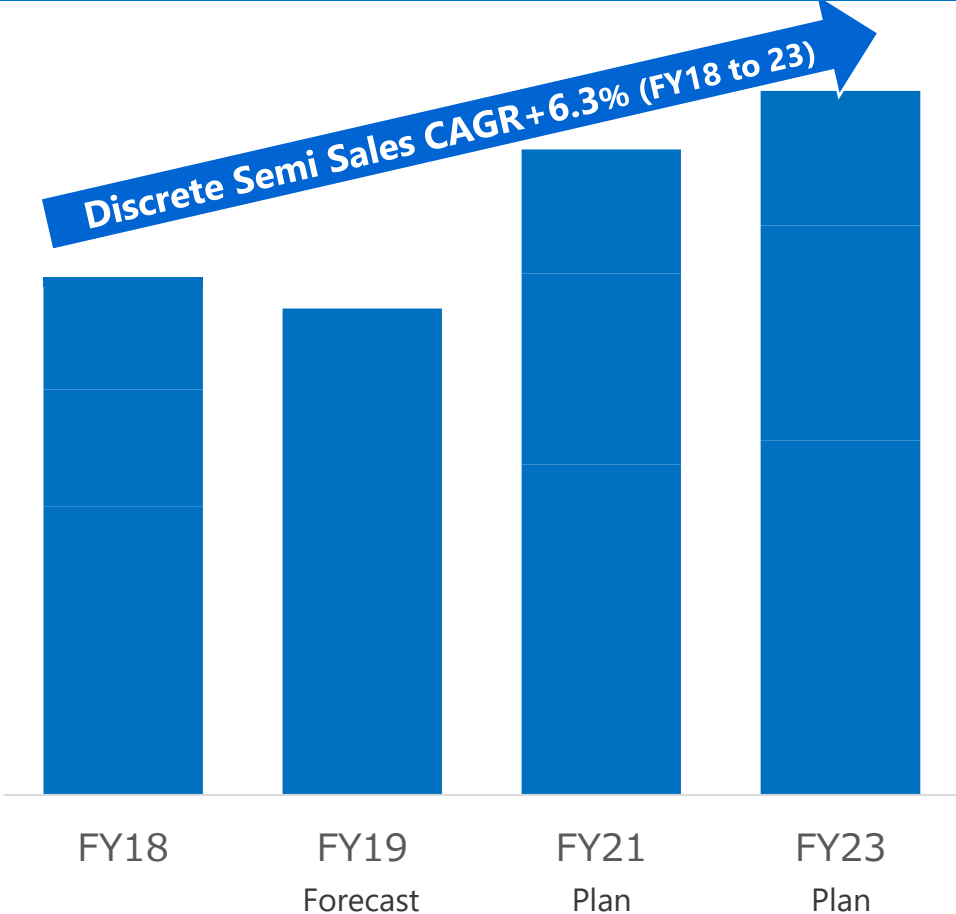
Overview

Aim for annual sales of 200 billion yen with three core products: power devices, our biggest focus, small signal, and opto devices

Discrete Semiconductor Div.
VP Kenji Kishimoto



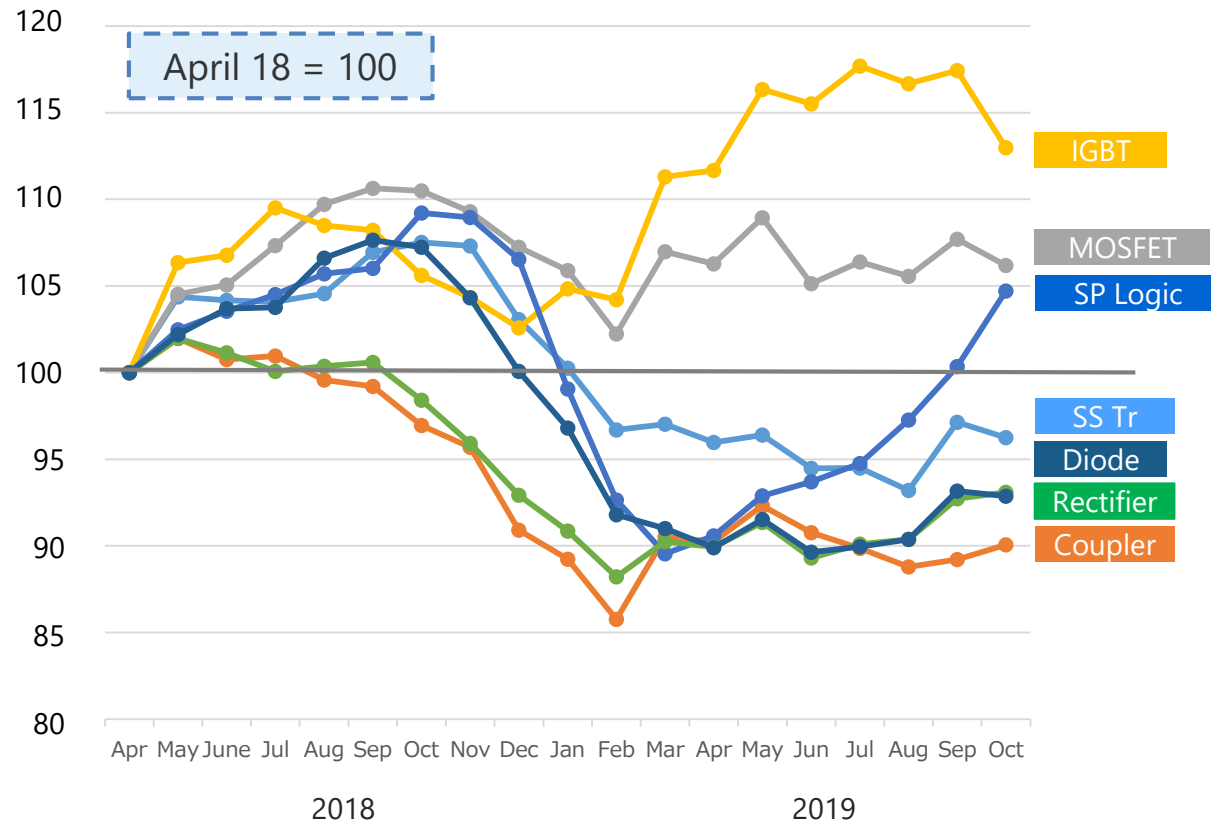
Discrete Semiconductor sales in the Toshiba Next Plan



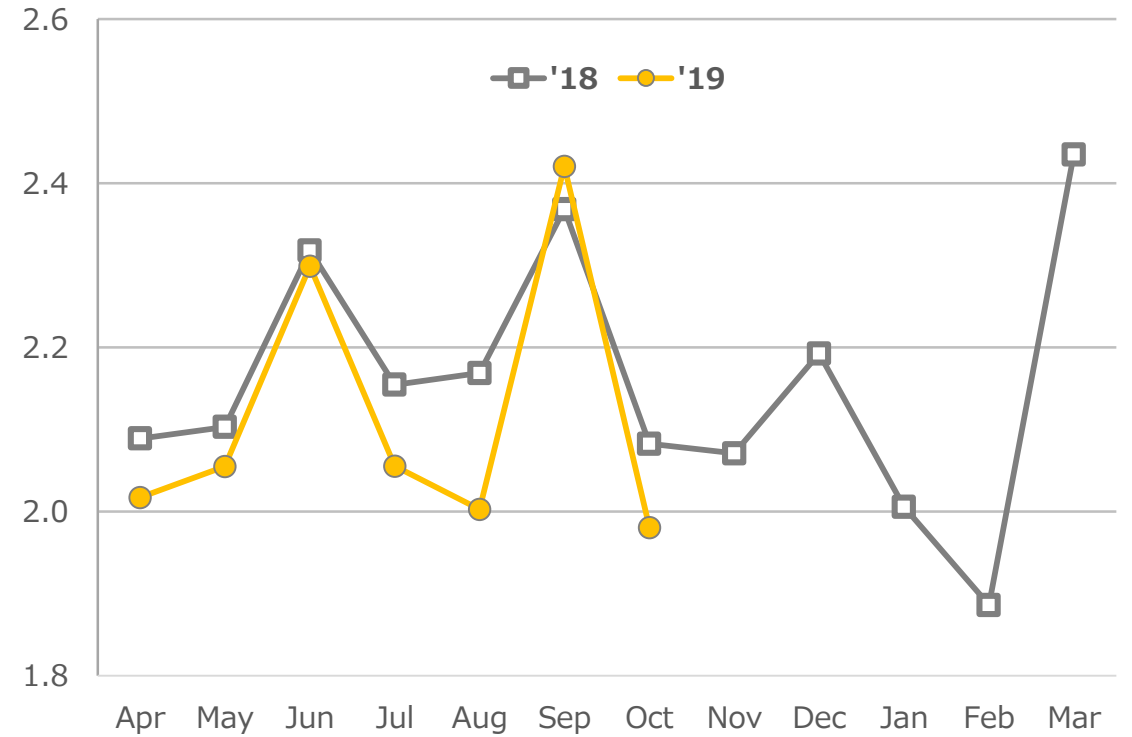
Market Trend

Demand remained very slow in CY19, except for certain power devices

Shipment actuals (3-month rolling average, amount-base)



CY18 and CY19 Shipment Actuals (discrete devices + opto couplers + standard logic ICs)

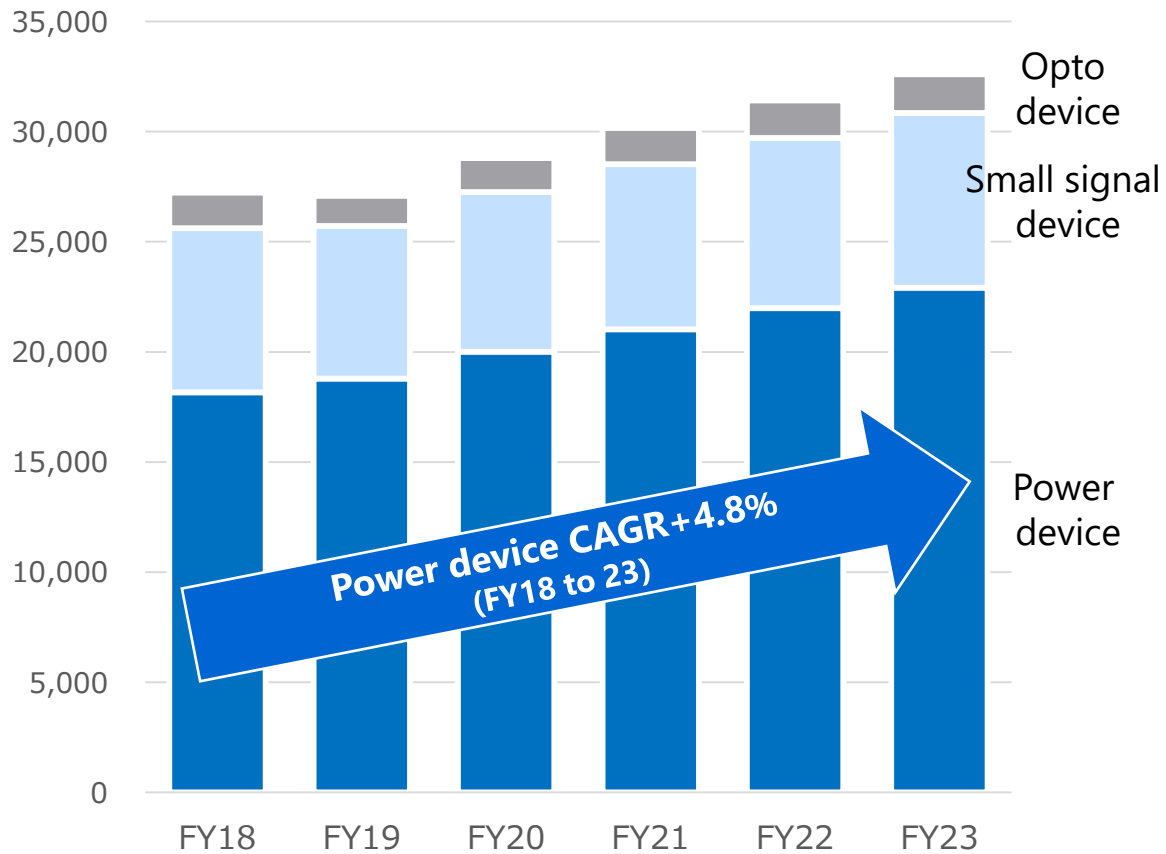


Source: Toshiba Electronic Devices & Storage Corp., based on WSTS data

The Market and Our Position

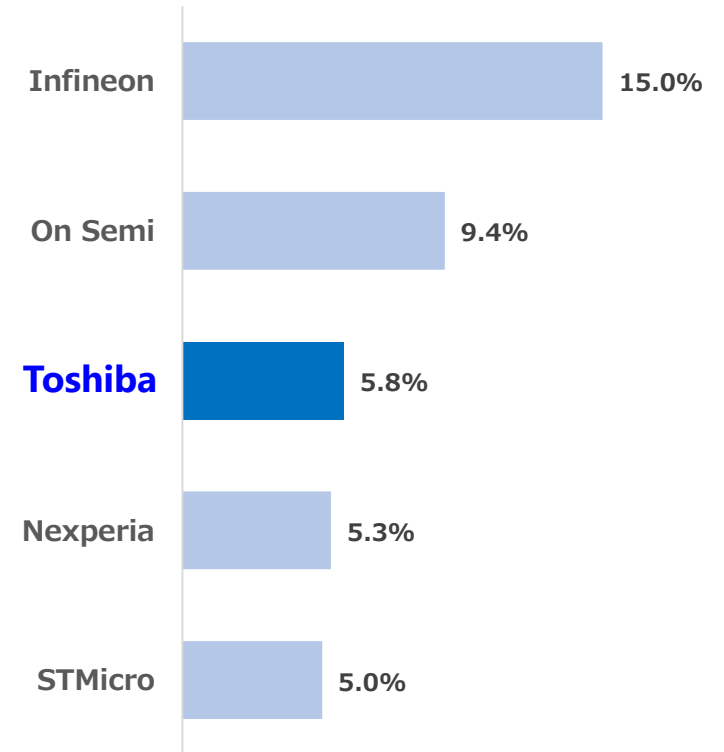
Expected to grow to a 3.6 trillion yen market by FY23

Discrete Semiconductor Market (\$M)



Source: Toshiba Electronic Devices & Storage Corp.

Our position (discrete devices + opto couplers + standard logic ICs)



Source: IHS Markit technology research, now part of Informa Tech. Competitive Landscaping Tool (CLT), Q3 2019. Market share in terms of revenue.

Results are not an endorsement of Toshiba. Any reliance on these results is at the third-party's own risk.

Core Technologies

Diverse core technologies deliver value to customers

Process/device technology

■ MOSFET

- Cutting-edge process development for highly efficient power supply
- Highly competitive switching performance

■ IGBT

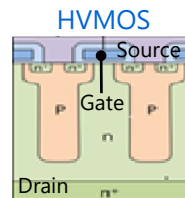
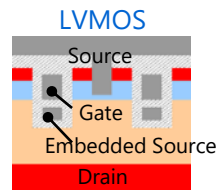
- Excellent performance high power module for automotive and industrial applications

■ RF SOI switch

- Tailored to wireless communications (TarfSOI™)

■ SiC/GaN

- Next generation power devices (based on new materials)

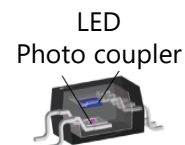


Quality

Increase AEC-compliant products

■ Long life photo coupler

125°C operating temperature

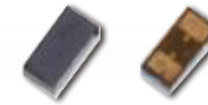


*1AEC: Automotive Electronics Council reliability requirements
AEC-Q100: for ICs; AEC-Q101: for discrete semiconductors

Assembly technology

Offer products in wide variety of packages suitable to any applications, from mobile equipment to power transmission equipment

0.4mm x 0.2mm



125mm diameter

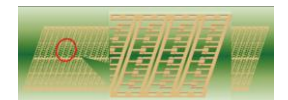


Mold packages suitable for ultra high density mounting

Press Pack IGBT/IEGT module)

Production technology

Cutting-edge, highly efficient "Matrix" assembly lines installed in factory in Thailand*2 (small signal devices and photo couplers)



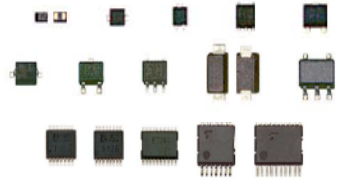
High density lead frames for "Matrix" assembly lines

1.7 times more efficient

*2 Discrete semiconductor assembly site for small signal devices and opto couplers

Product Portfolio

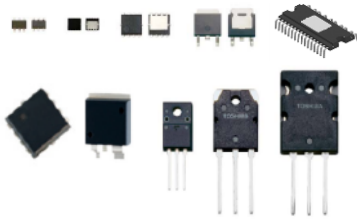
Small signal devices



Mainly for radio wave reception and signal processing

- Standard logic (L-MOS, C-MOS, etc.)
- Diode (switching, SBD, TVS, etc.)
- MOSFET (low voltage operation)
- Bipolar transistor
- General purpose linear IC (Op-Amp, comparator, LDO, load switch, etc.)
- SOI-Switch (RF switch IC) • RF transistor & diode

Power devices



Mainly for converting electricity to power, heat and energy

- MOSFET
- Power diode (SBD, zener, etc)
- Bipolar transistor
- Intelligent power device (IPD)
- Discrete IGBT
- Discrete SiC (Diode/MOSFET)
- GaN (under development)

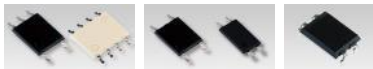
High power devices



Mainly for power conversion and industrial large scale motor control

- IGBT (Automotive IGBT)
- High power IGBT module for industrial application: PPI
- SiC module for train and industrial applications

Opto devices (Photo couplers)



Mainly for isolating switch applications that protects equipment from noise and short circuits

- IC coupler
- Transistor coupler
- Photo relay

Focus applications

Telecom equipment
OA equipment
Personal electronic equipment



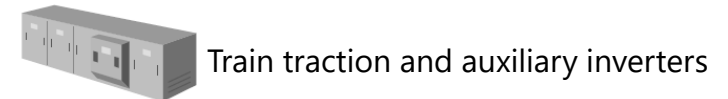
Automotive
(ECU to body control)



Power supply for data centers and servers



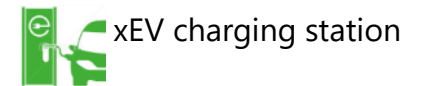
Eco-friendly cars Rolling mill Power transmission



Train traction and auxiliary inverters



Inverters for photovoltaic equipment



Consumer goods

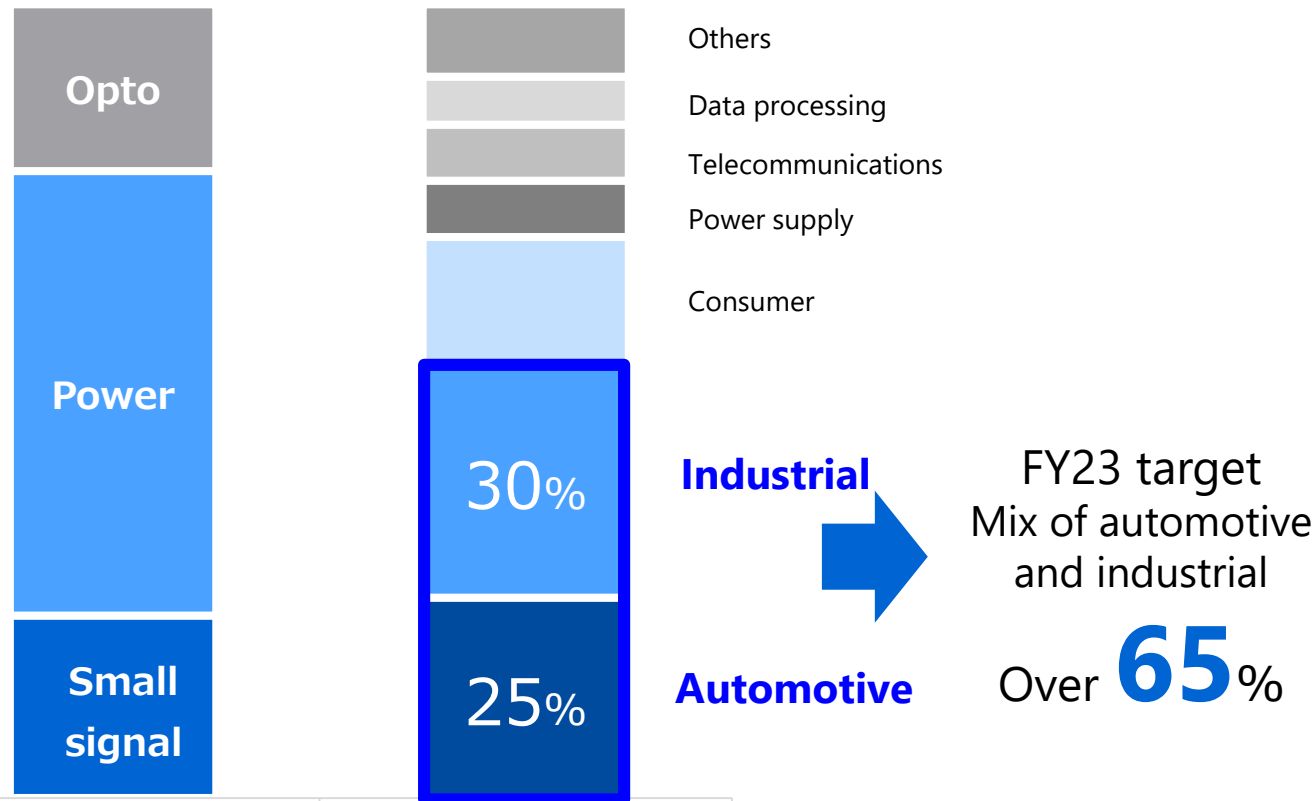


Industrial equipment
(testers, FA, etc.)

FY18 Sales Results

Over 2,200 customers* mainly in the automotive and industrial markets

Sales mix



Sales results

- Volume: **1.9 billion pcs/mo**
- Item #: 37,000

Applications

- Wide range of markets, especially **automotive and industrial**
- Automotive customers: over **200**
- Direct accounts: over **2,200**

* Excluding customers through business partners

Power Device Strategies, 1/2

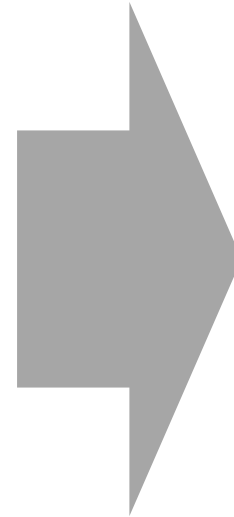
Provide value to industrial and automotive markets
making full use of our strengths

Wide variety of product offerings

Excellent technology and quality

Solid customer base

Strategic investments to increase
production capacity

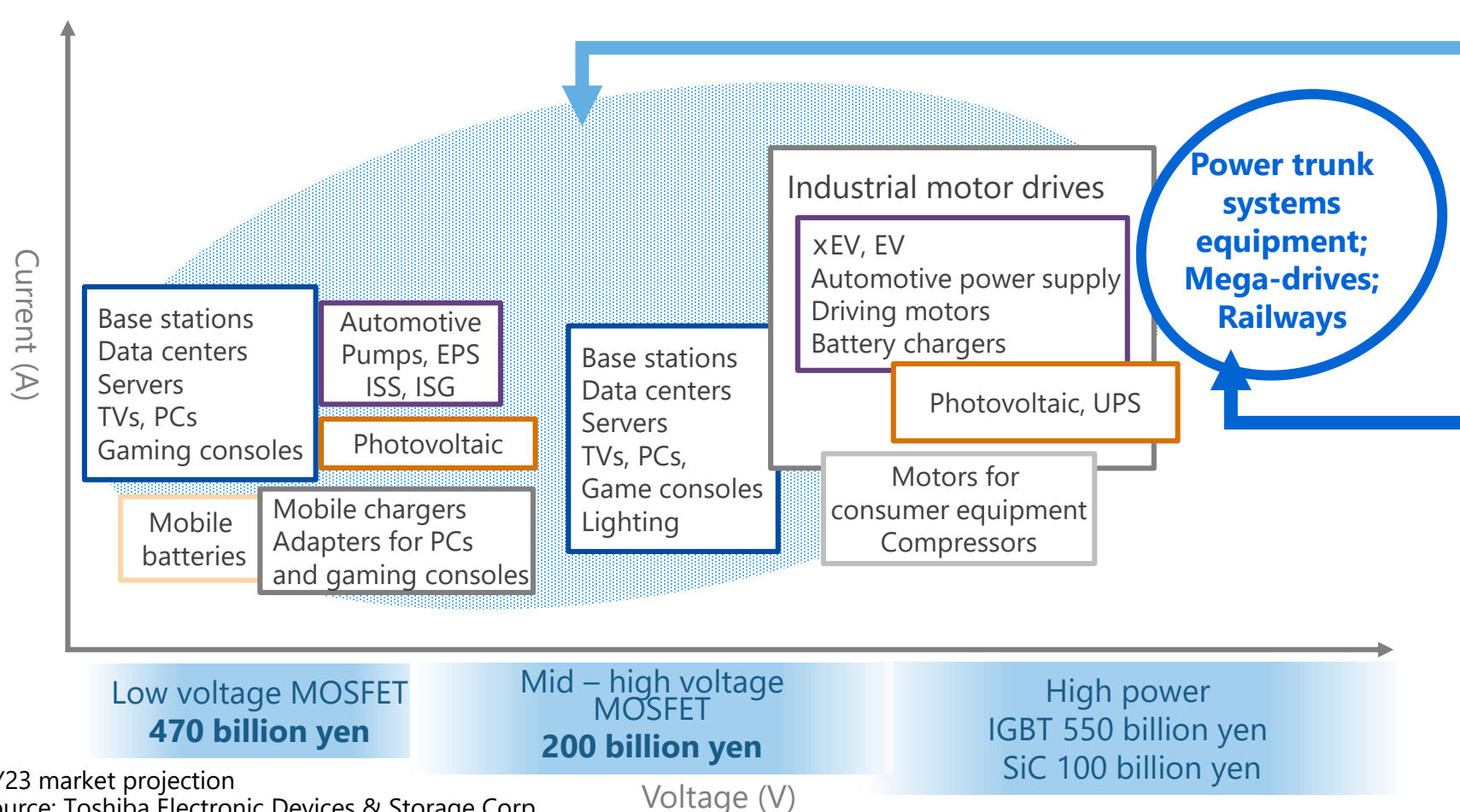


Value
for automotive market

Value
for industrial market

Power Device Strategies, 2/2

Offer diverse products for a wide variety of applications:
MOSFETs, IGBTs and SiC devices



Applications where Silicon remains dominant

- Increasing production capacity at Kaga
- Expanding production at Japan Semiconductor Corp.
- 300mm process development

Applications where SiC is preferred for making equipment size smaller, power consumption lower

- 6-inch production lines established at Himeji
- Expanding, mainly for railways

Value to the Automotive Market

Provide solutions for eco-friendly cars by contributing to electrification;
safe and secure cars



Environment

xEV motor drive & inverter
Electronic power steering
Battery management system
Engine control Electronic pump
Semiconductor relays Fan

Power MOSFET (LV, HV)
IGBT/FRD, Coupler
LV-IPD, Small signal device

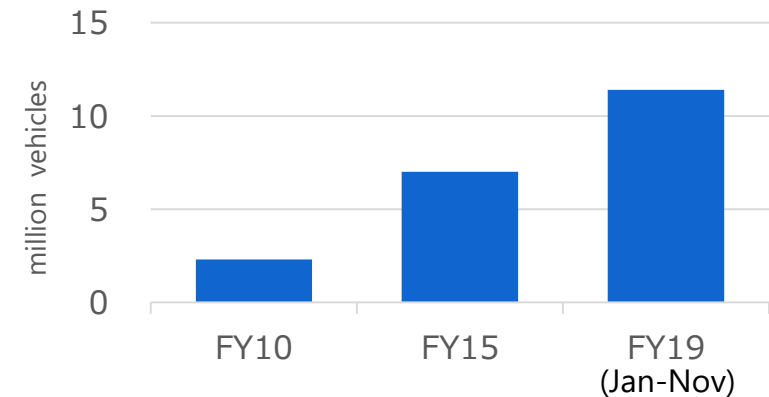
Safety

Electronic power steering
Brakes
LED headlights
Airbags
Autonomous driving, ADAS

Power MOSFET (LV)
LV-IPD
Small signal device

Results

- Have supplied devices for xEV motor drives for
over **10 million vehicles**



Source: Toshiba Electronic Devices & Storage

Future

- Strengthen relations with Japan-based customers;
penetrate overseas markets
- Further strengthen quality
- Expand product portfolio and focus applications
Lower loss, higher power and higher operating temperature

Value to the Industrial Market

Provide solutions for growth markets

Power transmission & distribution, drives

- Our cutting-edge PPIs are used in and out of Japan

PPI (Press Pack IEGT)

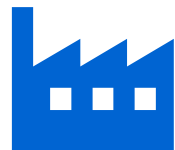


Press Pack:
Hermetically sealed, pressure contact module

IEGT:
The IEGT (Injection Enhanced Gate Transistor) improves IGBT emitter structure and control of high current voltage drive



High voltage DC transmission (HVDC)



Rolling mill

Trains

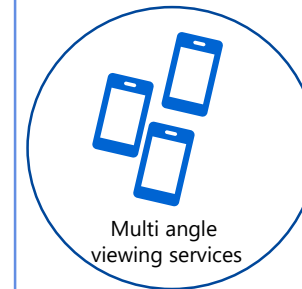
- Supply SiC modules in collaboration with Toshiba Group
- Inverters using our All-SiC devices, produced in Himeji, Japan, are supplied to various trains

Reference (example)

Toshiba Infrastructure Systems Corp' news release on October 11, 2018
"The supply of electric equipment to Tokyo Metro's cars" (in Japanese only)
<https://www.toshiba.co.jp/cs/topics/back-number/20181011.htm>

Servers, Telecommunications infrastructure

- Introducing new products to our portfolio
 - Low voltage UMOS X series
 - High voltage DTMOS VI series



Multi angle viewing services



5G base station



Outstanding realism live viewing services

Base stations using our MOSFETs contributed to 5G pre-service at Rugby World Cup 2019 in Japan

Securing Production and Supply Capability



Kaga Toshiba Electronics

- Increase 8-inch wafer fab capacity **1.5x times** from FY17 to FY20
- Consider 300mm fab to further enhance production capacity

Capital expenditure (commitment base) in the Toshiba Next Plan period (FY19 to FY23) total **100 billion yen**



Himeji Operations - Semiconductor

- **Increase** assembly capacity
- **Start** 6-inch SiC wafer fab operation
- Expand **DE/DX**



Prachin Buri, Thailand

- **Increase** assembly capacity for opto and small signal devices



Buzen Toshiba Electronics

- Assembly site for opto and small signal devices
- Technical & manufacturing support for Thai factory



Japan Semiconductor

- **Expand** Discrete semiconductor production

Our Semiconductor and Storage products will always be a driving force to change the world

Toshiba Electronic Devices and Storage, together with our customers, will accelerate our future journey.

We aim to be a company that will be chosen for our pioneering technology and spirit embedded in our products.