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Printhead Business

March 31, 2020

Seiko Epson Corporation

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Micro Piezo Technology

Minoru Usui
President

Printhead Business

Yasunori Ogawa
Managing Executive Officer

Micro Piezo Technology

Optimizing printing processes with piezo inkjet

Technology development

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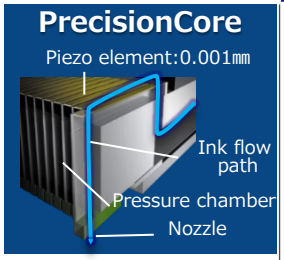
Higher speed
More precise
Smaller

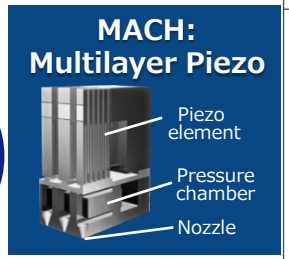
3rd Generation (2013)
Output resolution 600- dpi
(4 colors)

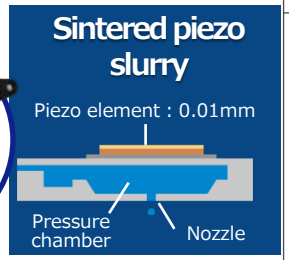
2nd Generation
Output resolution 360- dpi
(4 colors)

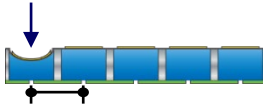
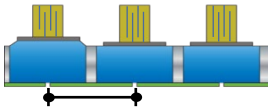
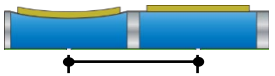
1st Generation
Output resolution 180- dpi
(4 colors)

dpi: dots per inch







Production technology	Head cross-section nozzle pitch	Piezo distortion (ratio)
Thin-film + MEMS MEMS: Micro Electro Mechanical Systems	Piezo distortion  300 npi＝0.08 ㎜ npi: nozzles per inch	**2.5**
Precision Machining + MEMS	 180 npi＝0.14 ㎜	**1.5**
Precision Machining	 120 npi＝0.21 ㎜	**1**

Keys for technology development

- Precise / Compact
- Support multiple ink types
- Durable

Precise | Ink ejection (Movie Capture)

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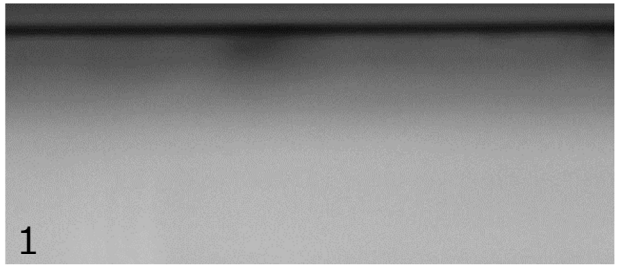

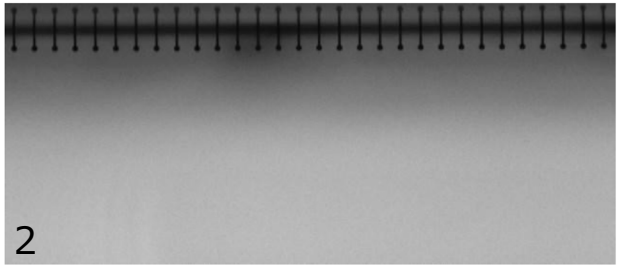

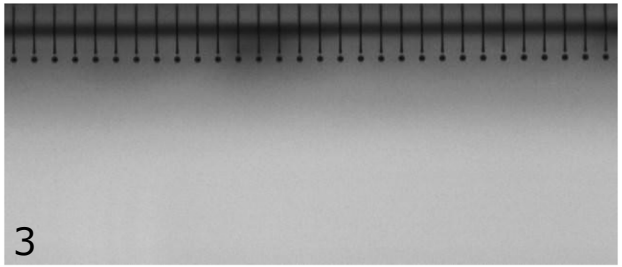

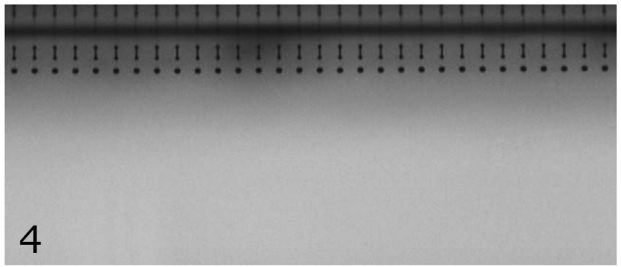

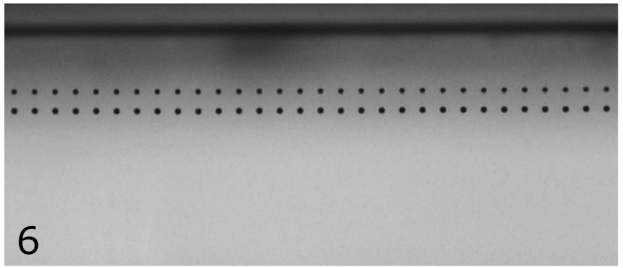

Precise | Ink ejection

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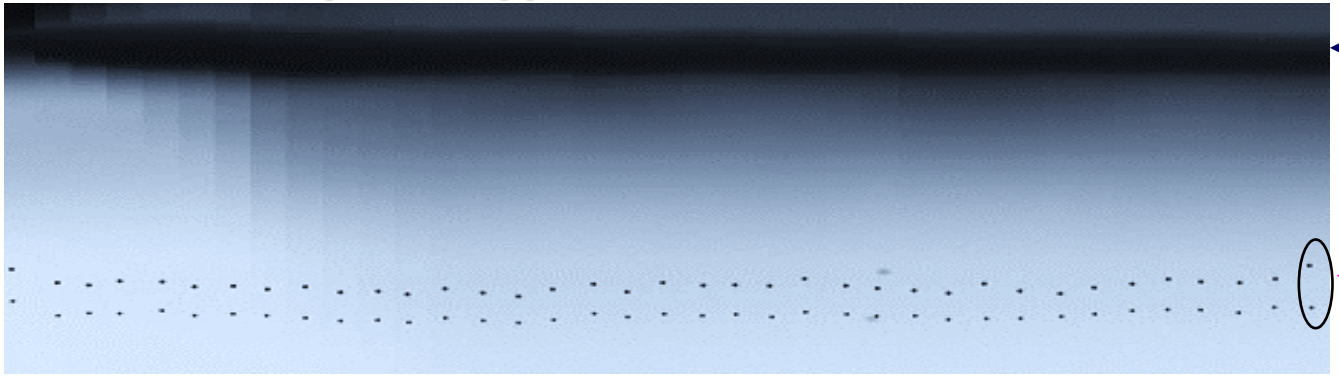
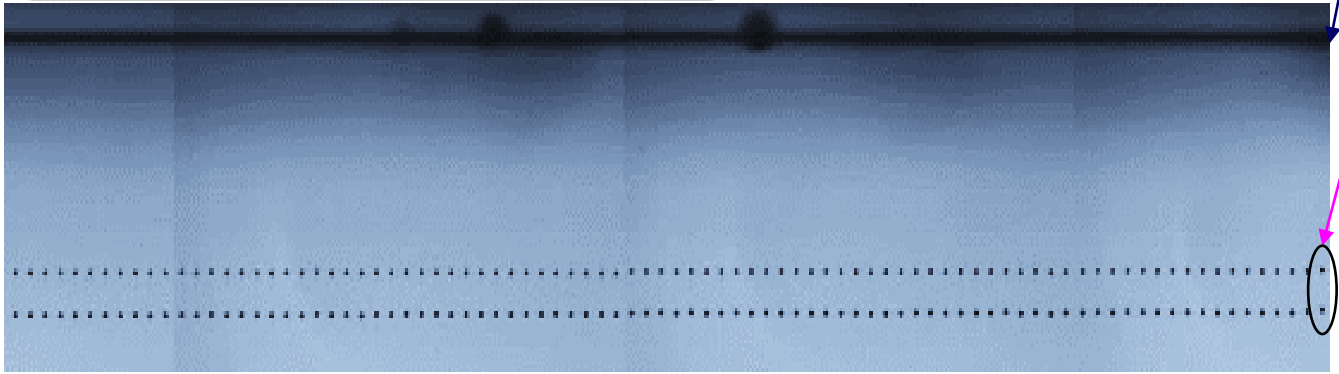
Other piezo type



PrecisionCore



- High density
- Low variance in dot size
- Very precise landing

Ejection frequency: 1KHz

Precise | Nozzle shape

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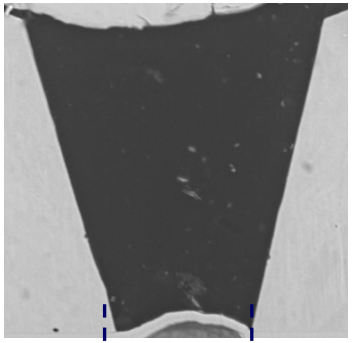
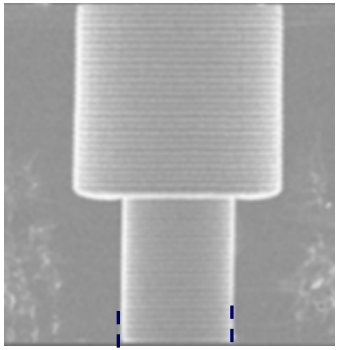
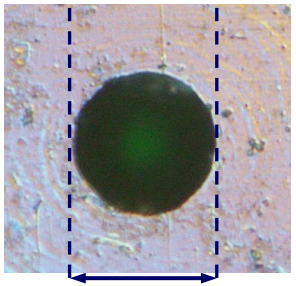
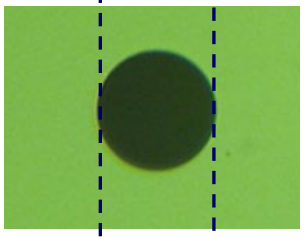
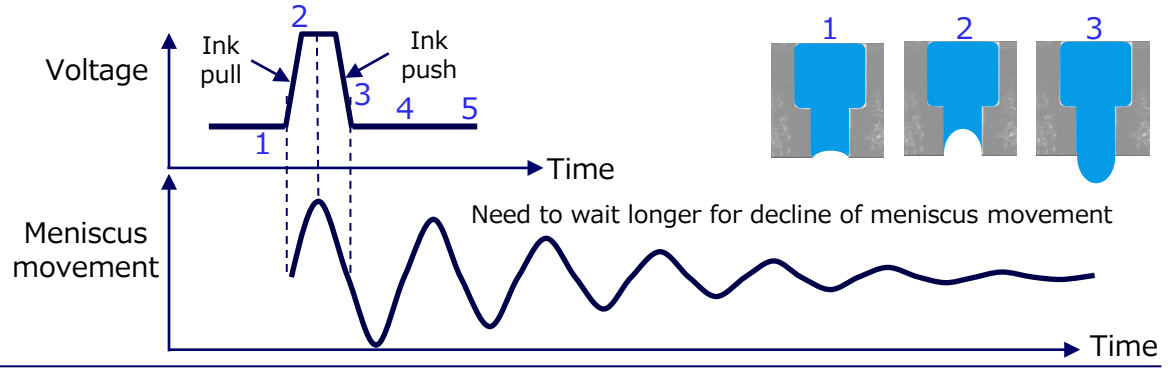
Exact circle / straight nozzle shape created by MEMS processing (silicon etching)

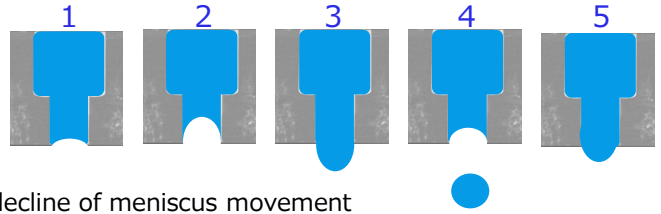
	Machining	PrecisionCore MEMS
Nozzle cross-section		
Nozzle surface	 0.025 mm	 0.02 mm

Precise | Meniscus control

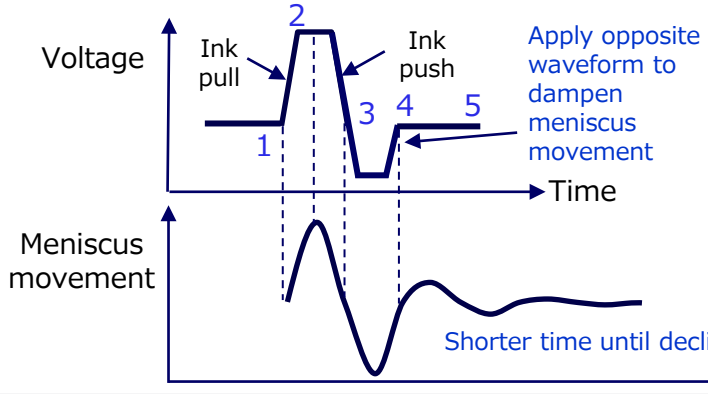
Precisely adjusting the waveform driving the piezo allows us to freely control ink ejection, and ensures stable ejection of minute droplets varying in viscosity

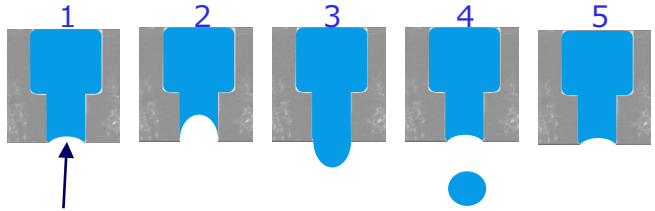
Without Meniscus Control





With Meniscus Control





Meniscus
(ink vapor-liquid interface at the nozzle end)

Precise | Image quality and higher speed

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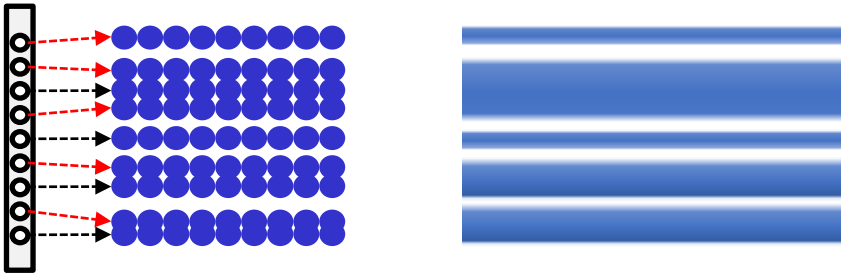
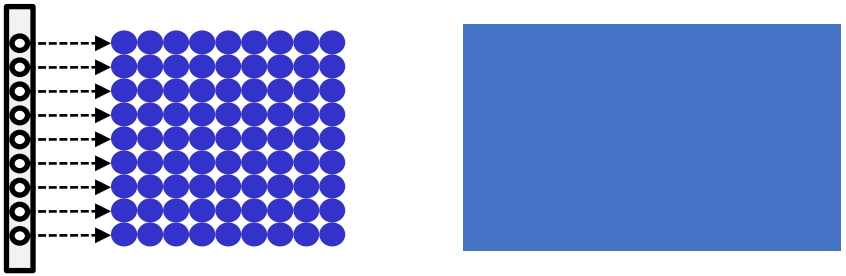
Increasing ink landing accuracy ensures uniform print output (no lines and/or uneven spots) and fewer print passes for higher print speed

Low
Accuracy



Uneven ink landing causes lines/uneven spots
Multiple passes are necessary for correction

High
Accuracy



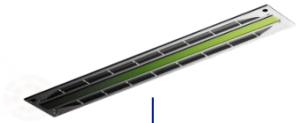
Head
(Nozzle)

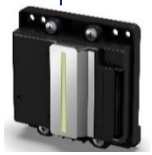
Even ink landing and print output, better print quality

Compact | Printhead expandability

Wide lineup of printheads with PrecisionCore print chips configured vertically and horizontally to meet customer needs

- Increase color / print width





I800 1 chip

I1600 2 chip horizontal

I3200 4 chip horizontal

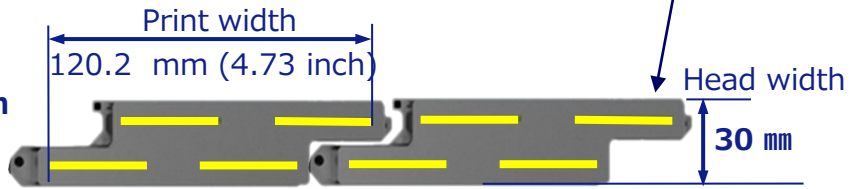
S1600 2 chip vertical

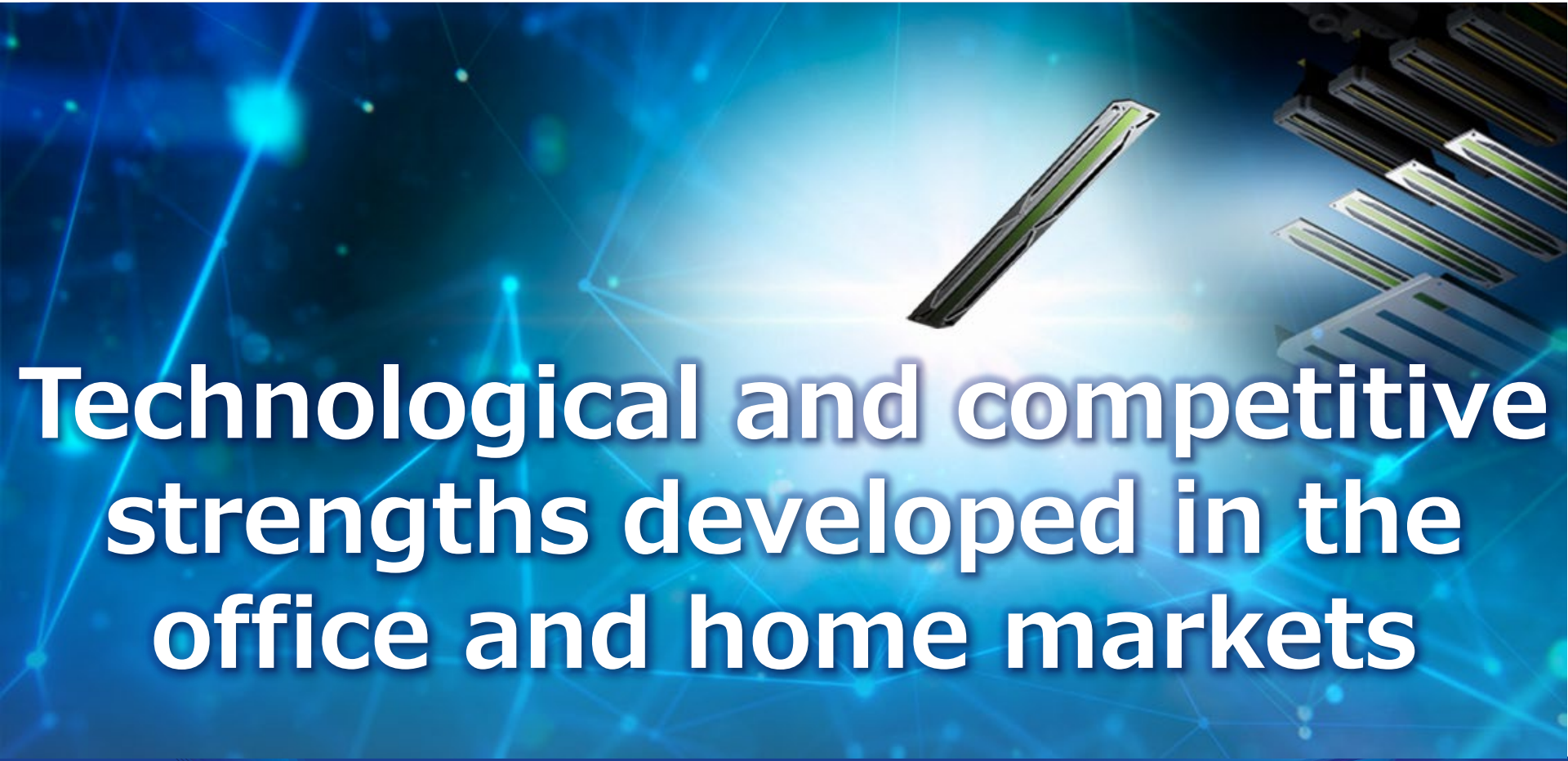
S3200 4 chip vertical

- Use “S” series to form compact lineheads

Previous Epson printhead

Linehead using S3200





Technological and competitive strengths developed in the office and home markets

Printhead market size | Comparison with Epson brand printers

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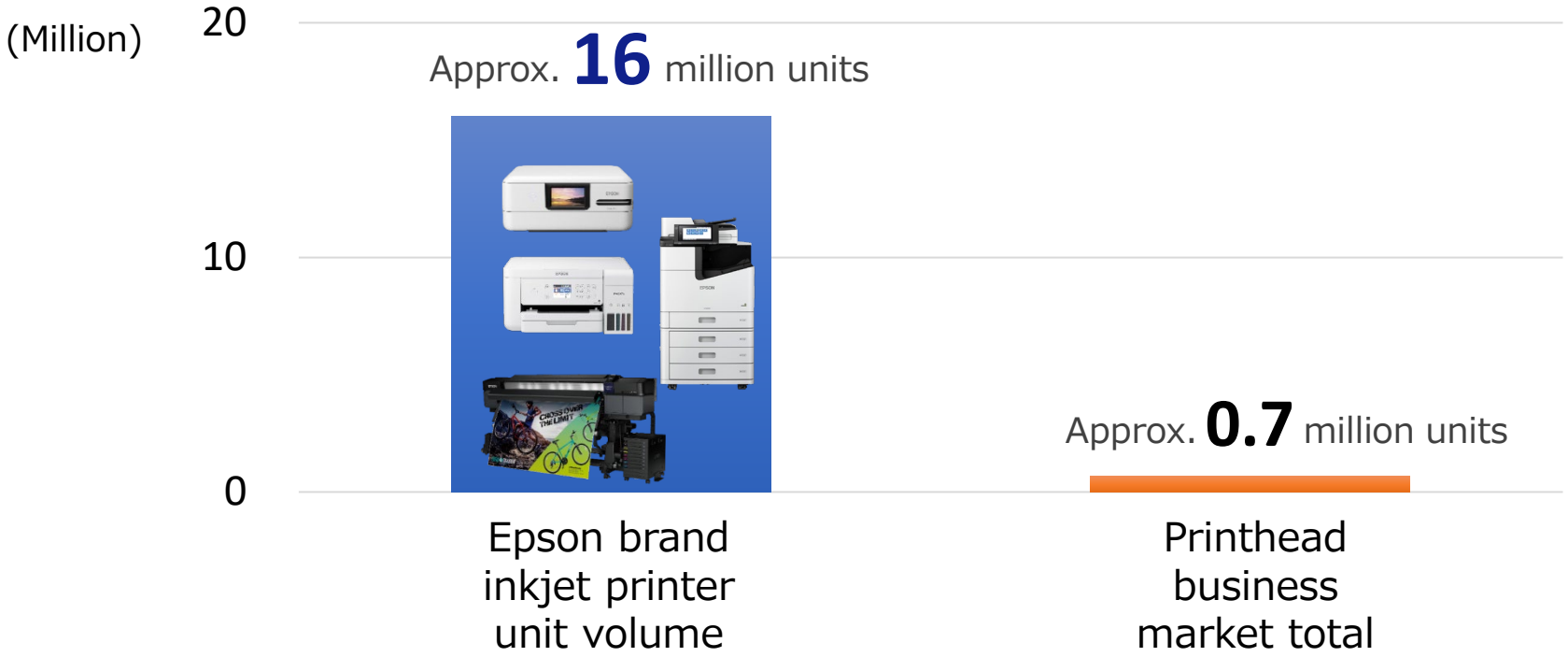
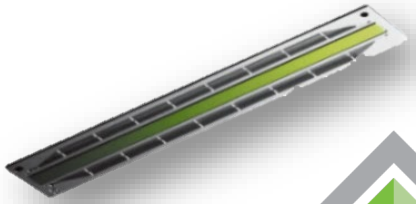
Annual production volume comparison



Printhead business market: Epson estimates for FY2018

PrecisionCore print chip (front-end) process capacity

Staged capital expenditure to meet necessary demand



PRECISIONCORE

Hirooka Plant

Suwa Minami Plant

Started Production

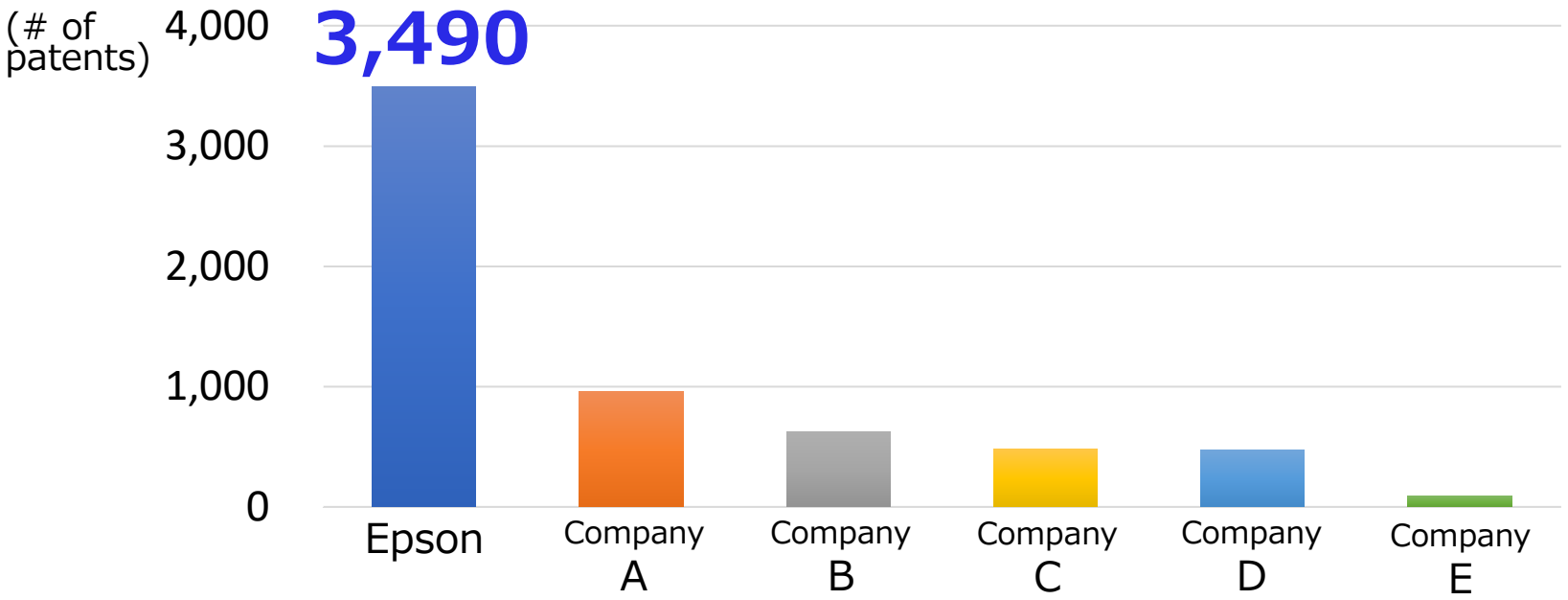
FY13

FY18

FY19

IP | Piezo printhead registered patents

Wide variety of patents, including head architecture, driving method, material, and production process



Epson data as of March 10, 2020
Registered patents for piezo print heads in Japan, US, China, and Europe filed after April 1, 2000

Micro Piezo Technology

Minoru Usui
President

Printhead Business

Yasunori Ogawa
Managing Executive Officer

Epson value creation story

Value creation story

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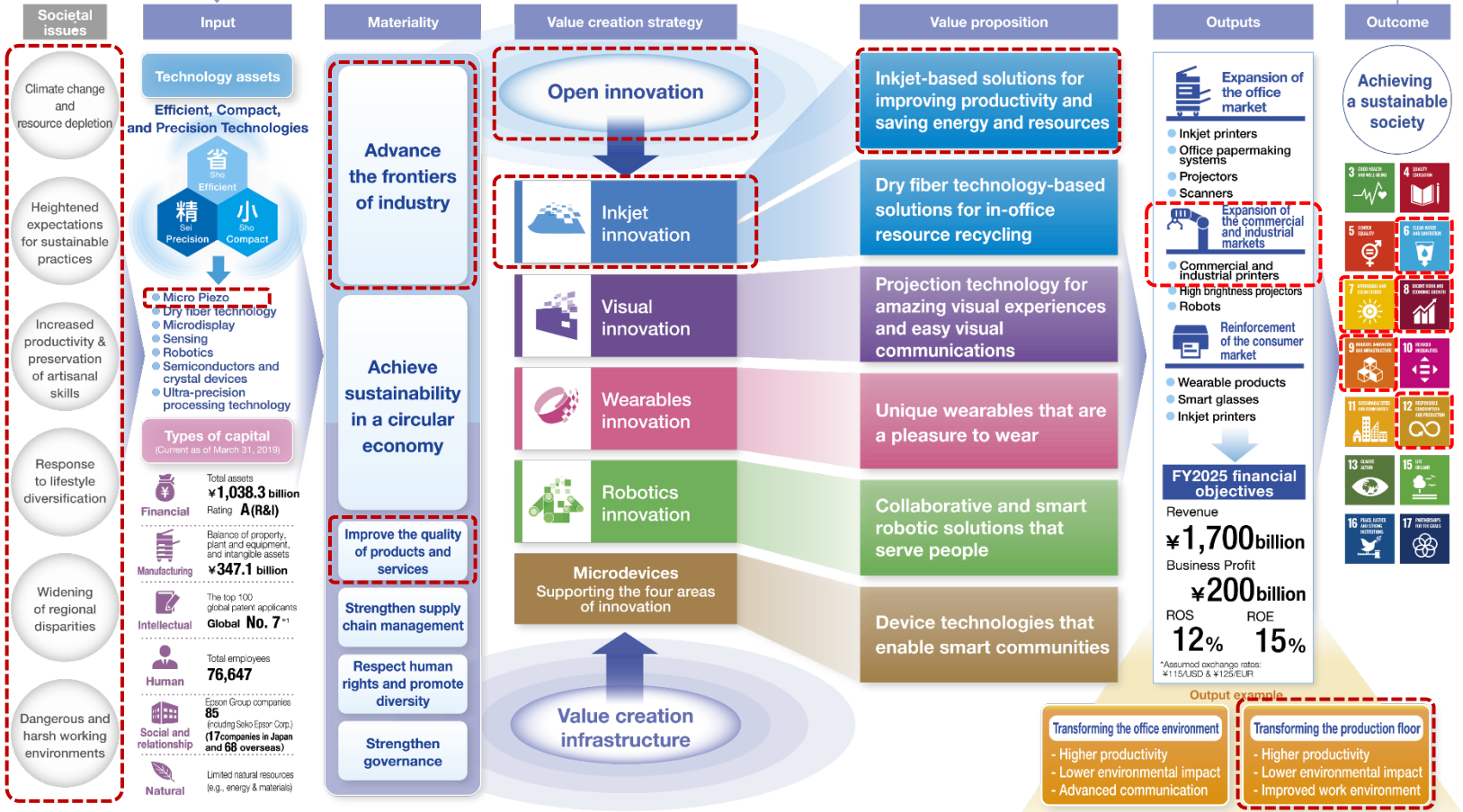


Value creation story | Social issues

Climate change and resource depletion

Heightened expectations for achieving sustainability

Increased productivity & preservation of artisanal skills

Response to lifestyle diversification

Growth in geographical inequities in infrastructure, education, and services

Dangerous and harsh working environments

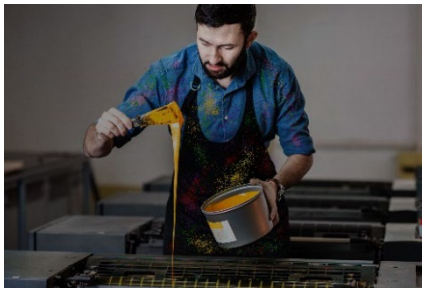
Value creation story | Output example: Digital textile printing

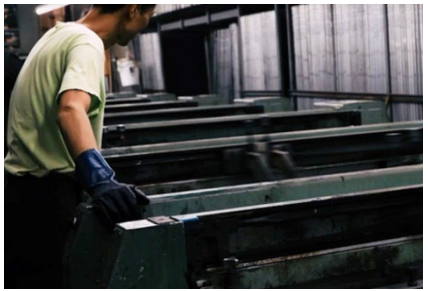
Achieving low-resource, high-efficiency production

- Balancing productivity and sustainability with inkjet solutions

Complex, wasteful work process

Analog textile printing





- Image arrangement
- Plate making
- Ink mixing
- Sample printing
- Plate cleaning & storage
- Mass production ink manufacturing
- Mass production printing
- Plate cleaning & storage
- Disposal of unneeded ink
- Post-processing

45 – 60 days

Simple process, lower environmental impact

3 – 14 days

- Conditioning
- Image arrangement
- Sample printing
- Mass production printing
- Post-processing

Digital textile printing

Value provided

- Faster turnaround. Less dead stock and disposal losses
- Reduces water use (no plate cleaning) and waste ink
- Saves plate and WIP storage space
- Offer a clean and safe printing environment

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Commercial & industrial printing

Digitization of commercial & industrial printing and growth potential

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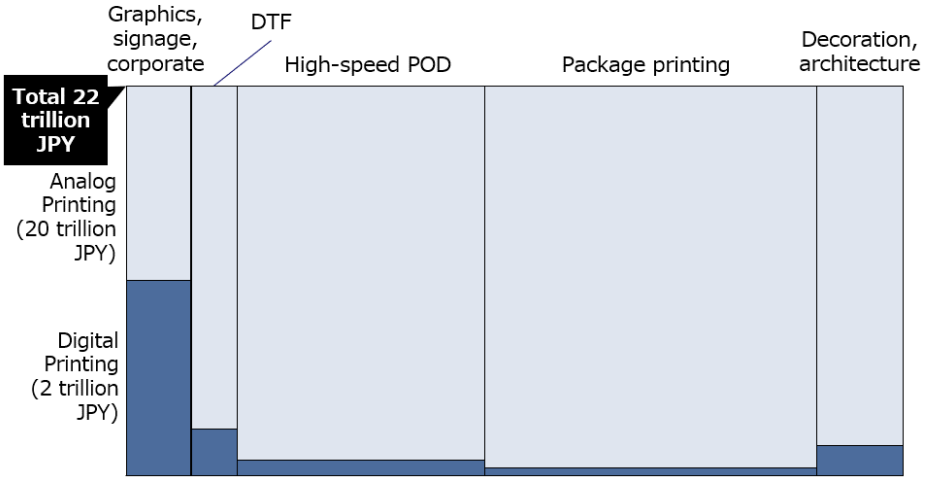
Commercial & industrial printing market including printhead and consumables

Growth potential in the existing market

- Market size including head and consumables: 22 trillion JPY
- Stable growth in digitization for graphics, sign, corporate
- Huge potential in digitization for packaging and POD

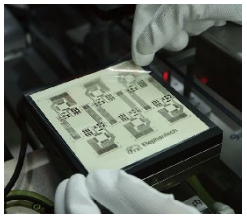


*Epson estimate 1USD=110円 y-axis: digital/analog ratio x-axis market volume
*POD: Print On Demand *DTF: Print Direct to Fabric

Growth potential (examples)

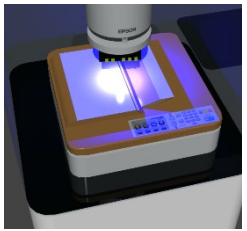
Growth potential from production process transformation

*Product image for illustration purposes only

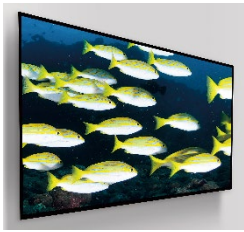

Circuits


Cosmetics


Food decoration


3D Printing


Body tissue


OLED

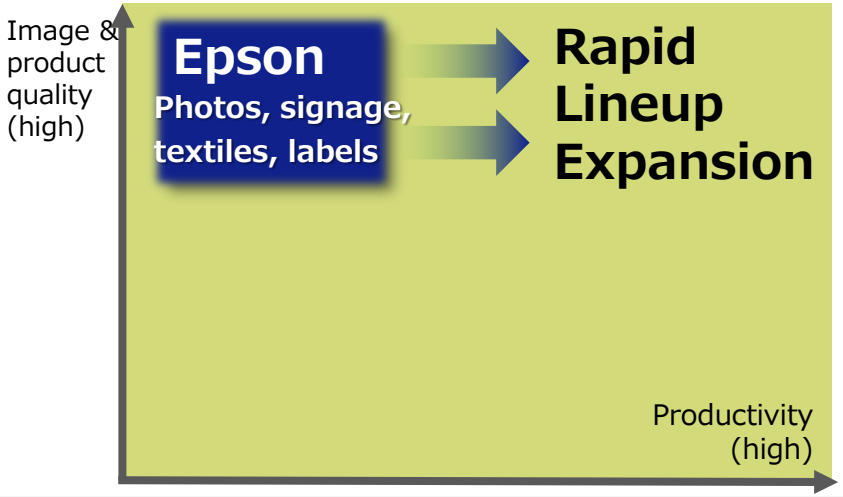
*OLED: Organic Light Emitting Diode

Epson brand commercial & industrial printing products

Completed preparation for accelerated growth in commercial & industrial printing

- Utilize new platform to rapidly increase lineup of high productivity products
  - ✓ Launch new products with differentiating technology fostered in office and home printing
- Deploy software solutions such as Color Control
  - ✓ Accelerate the switch from analog printing and competitors, and offer dispersed printing

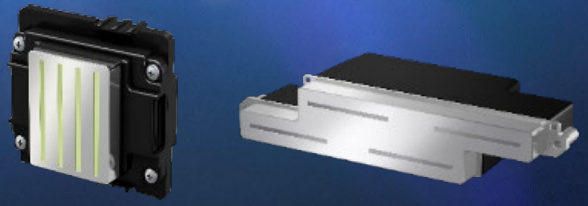
Expand lineup



Color Control Technology

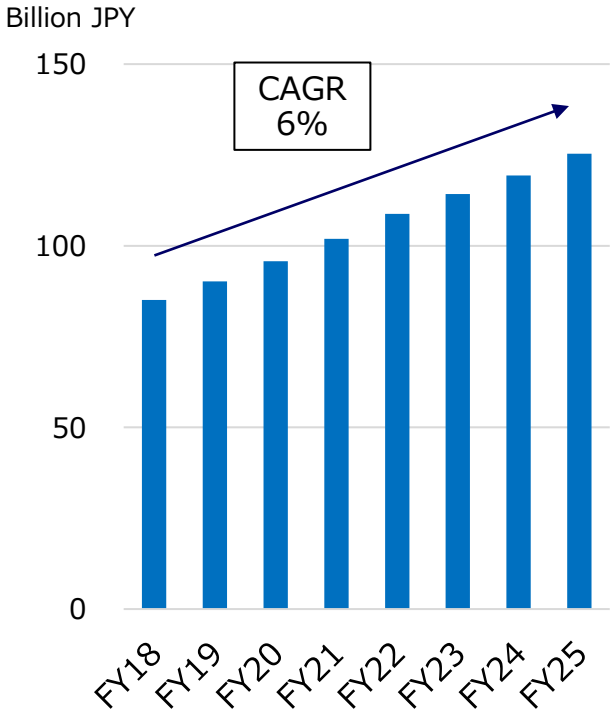
*Color management technology to increase reproducibility in commercial & industrial printing

Printhead business

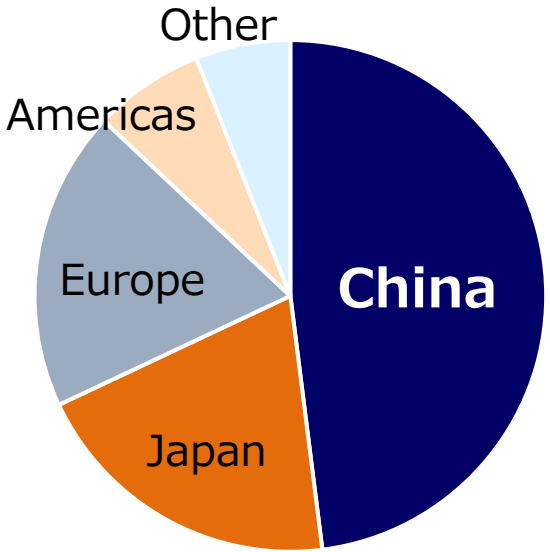


Printhead business market

Printhead market size

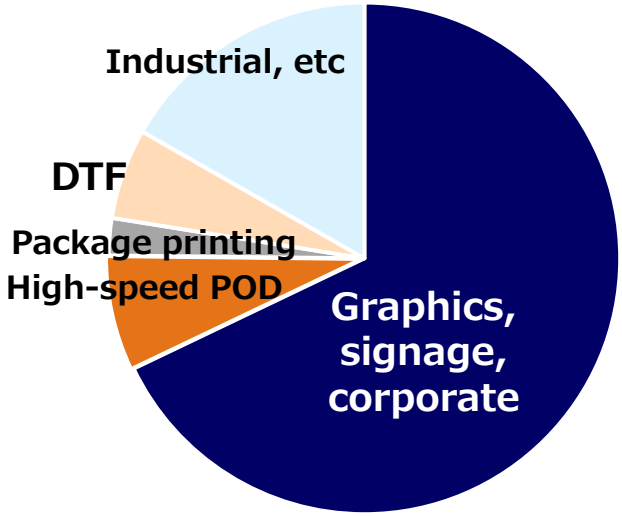


By region



FY18

By application



FY18

*DTF: Print Direct to Fabric
*POD: Print On Demand

Performance targets

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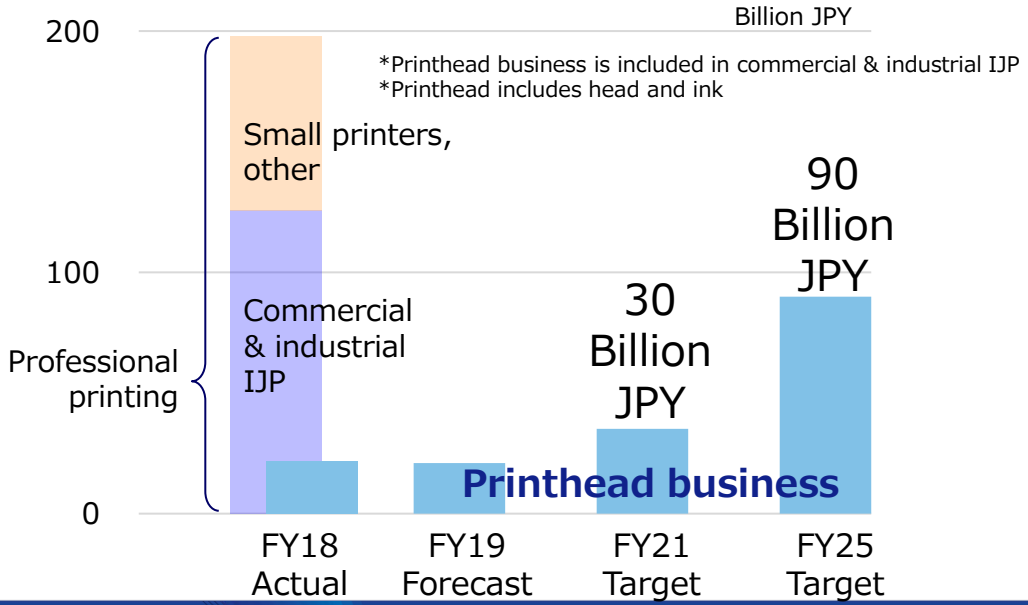
Contribute to large profit growth by increasing share in the existing market

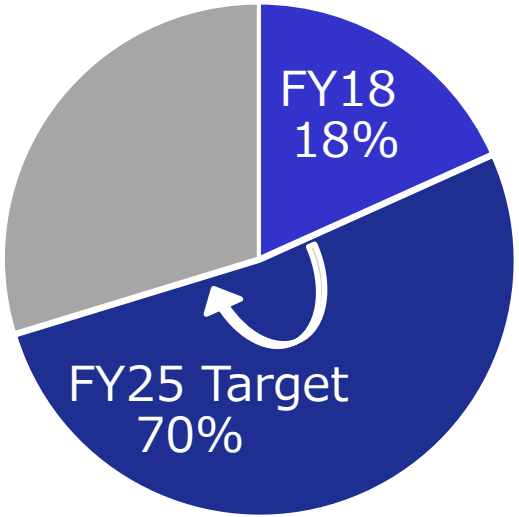
- Expand customer base from Japan to China and Europe/Americas

Further growth from new markets

Revenue target



Market share (printheads)



Epson Share

Actions to expand printhead business sales

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Completed preparations to expand printhead business

- New PrecisionCore print chip production facility completed
- Increased competitiveness in Epson brand printers

Started actions to expand sales

Market status	Actions	Targets
Competitors have 2- and 4-inch head lineup	● Increase lineup utilizing expandability of Epson print chips ● Increase awareness of business launch ● Collaborate with board/ink suppliers ● Strengthen sales/support	Revenue (graphics, signage, corporate) FY21 30 billion JPY FY25 60 billion JPY
Uncertified 1-inch head channels in China	● Offer direct sales and certified solutions where customers can use Epson heads without risk	
Progression of digitization is only seen in some applications	● Expand applications through collaboration and open innovation ✓ High productivity: POD, box printing, package printing, etc. ✓ New application: Circuit printing, 3D, cell printing, etc.	Revenue (new applications) FY25 30 billion JPY

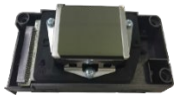
Printhead lineup

UV: Ultra Violet type ink
FB: Flat Bed
LFP: Large Format Printer
DTF: Print Direct To Fabric
POD: Print On Demand

PrecisionCore print head

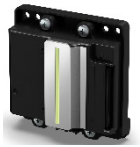
MACH print head

F1080



F1440

L1440



I800

I1600

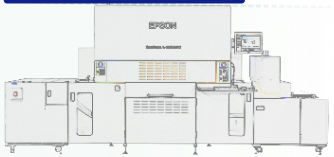
I3200

S1600

2-inch
2019-

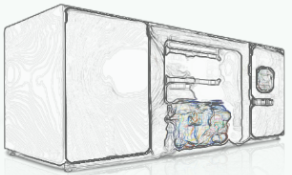
S3200

4-inch
2019-



Labels, package printing, POD

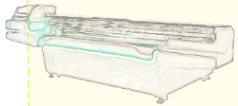
Dye-sublimation LFP



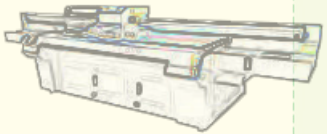
DTF

Small UV-FB

Low cost LFP



Mid-size UV-FB



Large UV

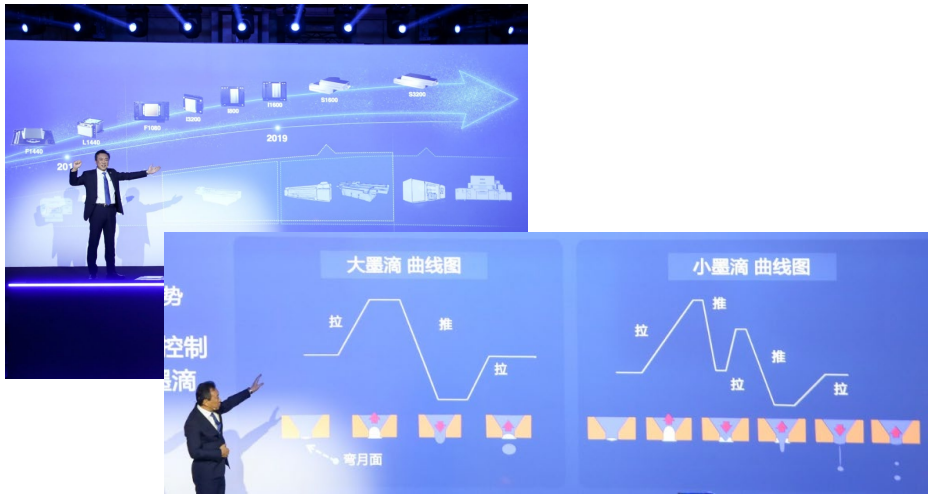
Small — Commercial printing — Large

Industrial printing

PrecisionCore business launch recognition

Activities to increase awareness of business launch in China

Events



September 2019 Shanghai Sign Show

- Communicated about Epson's full lineup and competitive strengths
- Participation from LFP makers and media

Customer Tour

October 2019 Invited LFP makers to print head factory

- Cleanroom tour wearing bunny suit
- Communicated QA control and production capacity

Collaboration with board and ink suppliers

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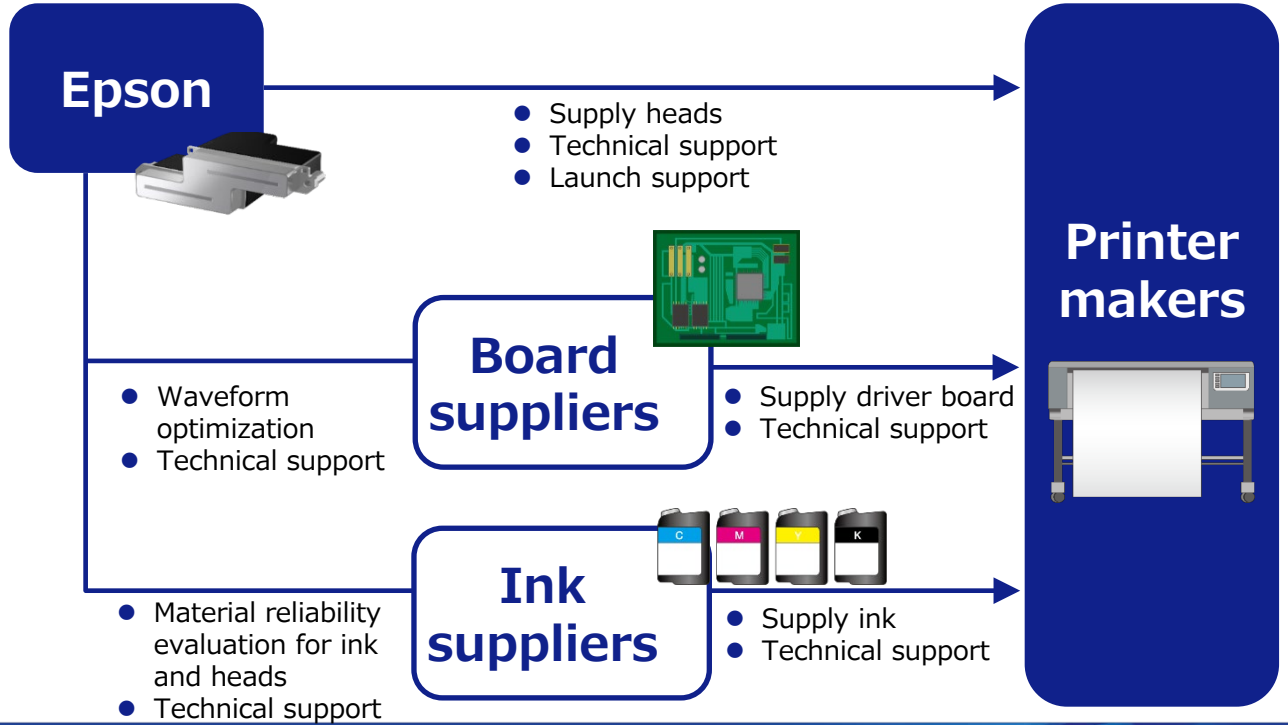
Specialization and division of manufacturing is a major trend in LFP.

By collaborating with board and ink makers, Epson offers risk-free solutions for customers using certified Epson printheads.

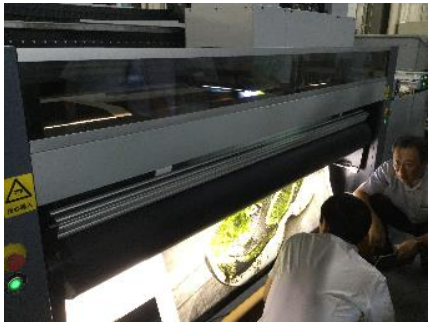


Sales / support

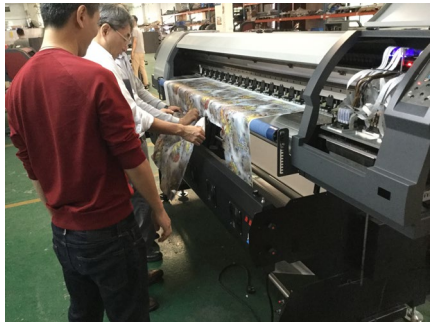
Created customer support structure in China, the largest market

- Utilize existing sales offices and deploy sales engineering staff
- Utilize expertise of head engineers in production facilities (Shenzhen: ESL), and facilitate communication among local engineers for fast launch support

Docan (Shanghai)
UV-FB



JHF (Beijing)
UV-R2R



Titanjet (Guangdong)
Dye-sublimation

Flora (Shenzhen)
Direct textile printer

ESL: Epson Engineering (Shenzhen) Ltd. UV: Ultra Violet type ink FB: Flat Bed R2R: Roll to Roll

Chinese LFP customers

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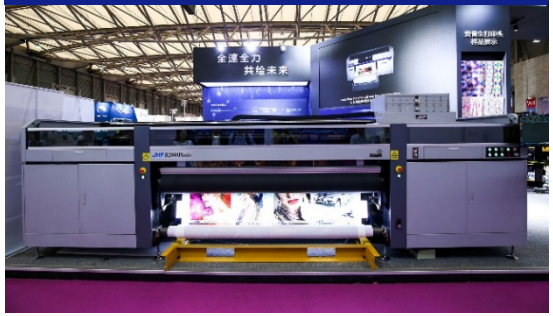
Shanghai sign show (Sep. 2019)

Gongzheng

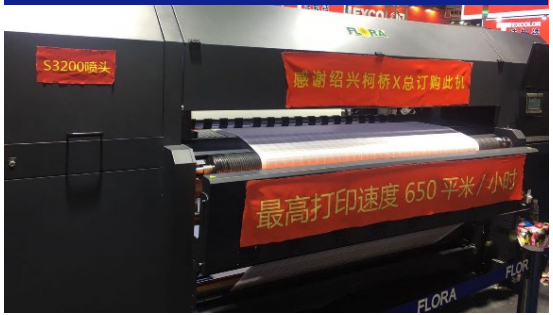
JHF



- Small type words are very sharp
- Increased productivity with wide head (JHF)

Shanghai Tex (Nov. 2019)

Flora



- Increased productivity with 1-pass printing (Flora)

Human Digital

Expanding applications

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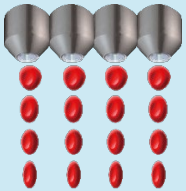
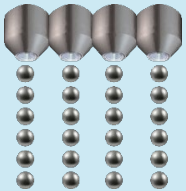
Print cells

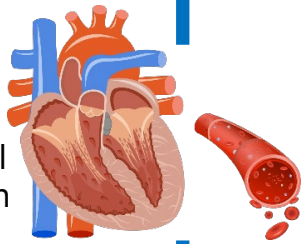


Inkjet printheads

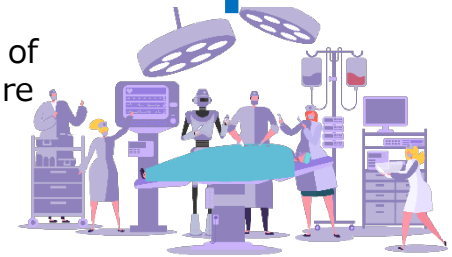
Print metals



Heart & blood vessel regeneration



Surgery of the future



Flexible circuits

Products of the future

Expanding applications | Open innovation

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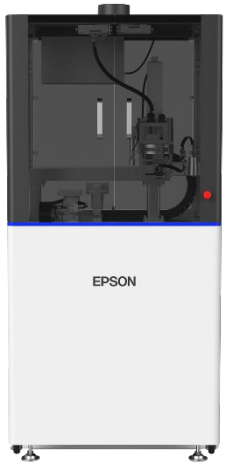
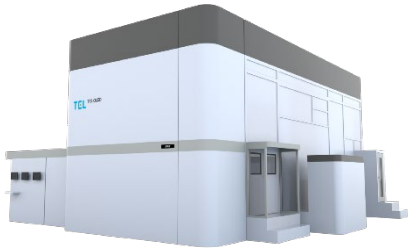
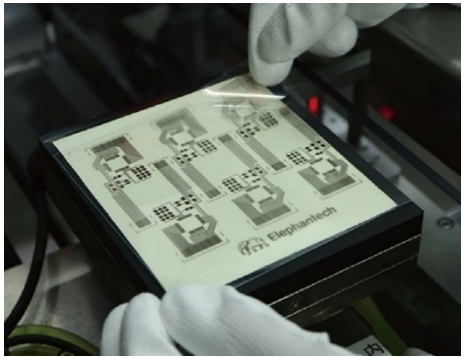
Conduct experiments and validation with customers in new applications such as flexible printed circuits, 3D printing, OLED printing, and biotechnology printing

R&D inkjet machine	Fujimi inkjet innovation lab	OLED inkjet system joint development: Tokyo Electron	Partnership: Elephantech







Source: Tokyo Electron Ltd. **Elius™500 Pro**
Elius is registered trademark or trademark of Tokyo Electron Limited in Japan and/or other countries.

Epson's vision

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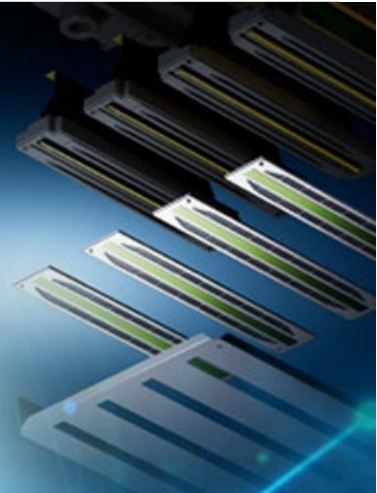

Solve social issues by revolutionizing manufacturing with PrecisionCore


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