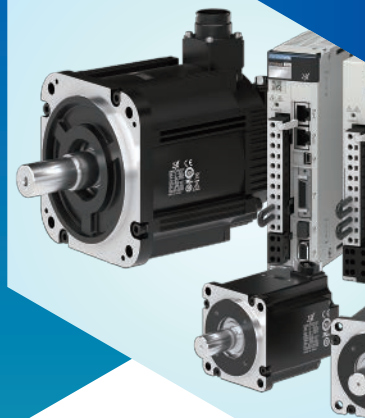
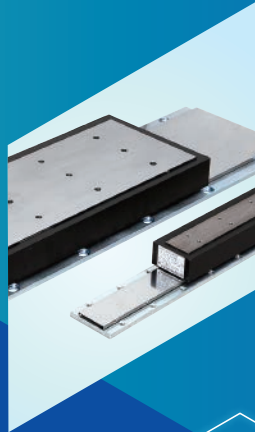


# YASKAWA

## YASKAWA Total Solutions for Secondary Battery Manufacturing



# “A Technology Company” YASKAWA

Our refined products and technologies support today’s most cutting-edge industries around the world.

Since our founding as Yaskawa Electric in 1915, we have made motors and their applications our sole expertise. We focus on developing innovative, world-class technologies and products while maintaining the highest level of quality management.

Our core technologies are motion control, robot technology, and power transformation.

These technologies and products are the result of our work to precisely control the movements of mechanisms, and every day they help promote manufacturing automation and improve production efficiency.

We have also expanded our business globally to offices in 30 countries (including Japan) and manufacturing operations in 13 countries.



## YASKAWA Strengths

By having all the servomotor, AC drive and robot components essential to manufacturing, we can provide comprehensive solutions for your needs.

### History of Products and Technology

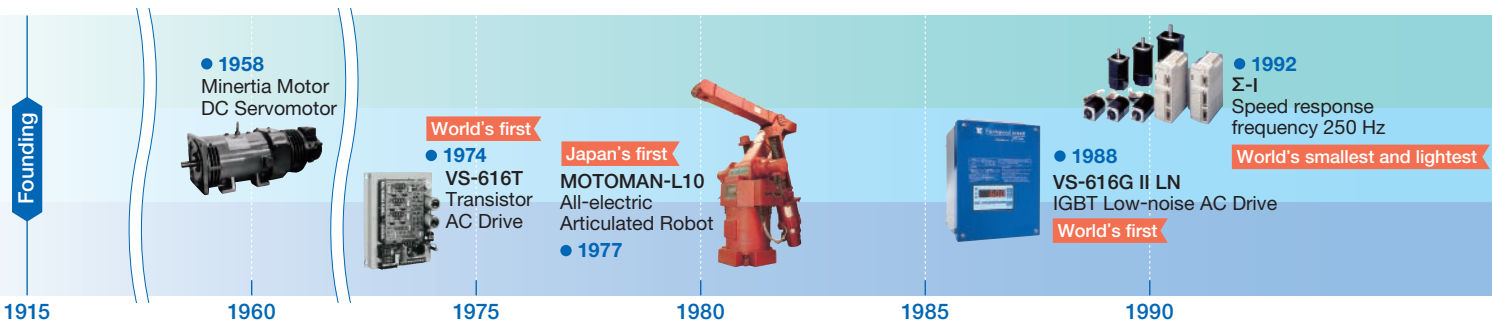
## 》 Servomotors

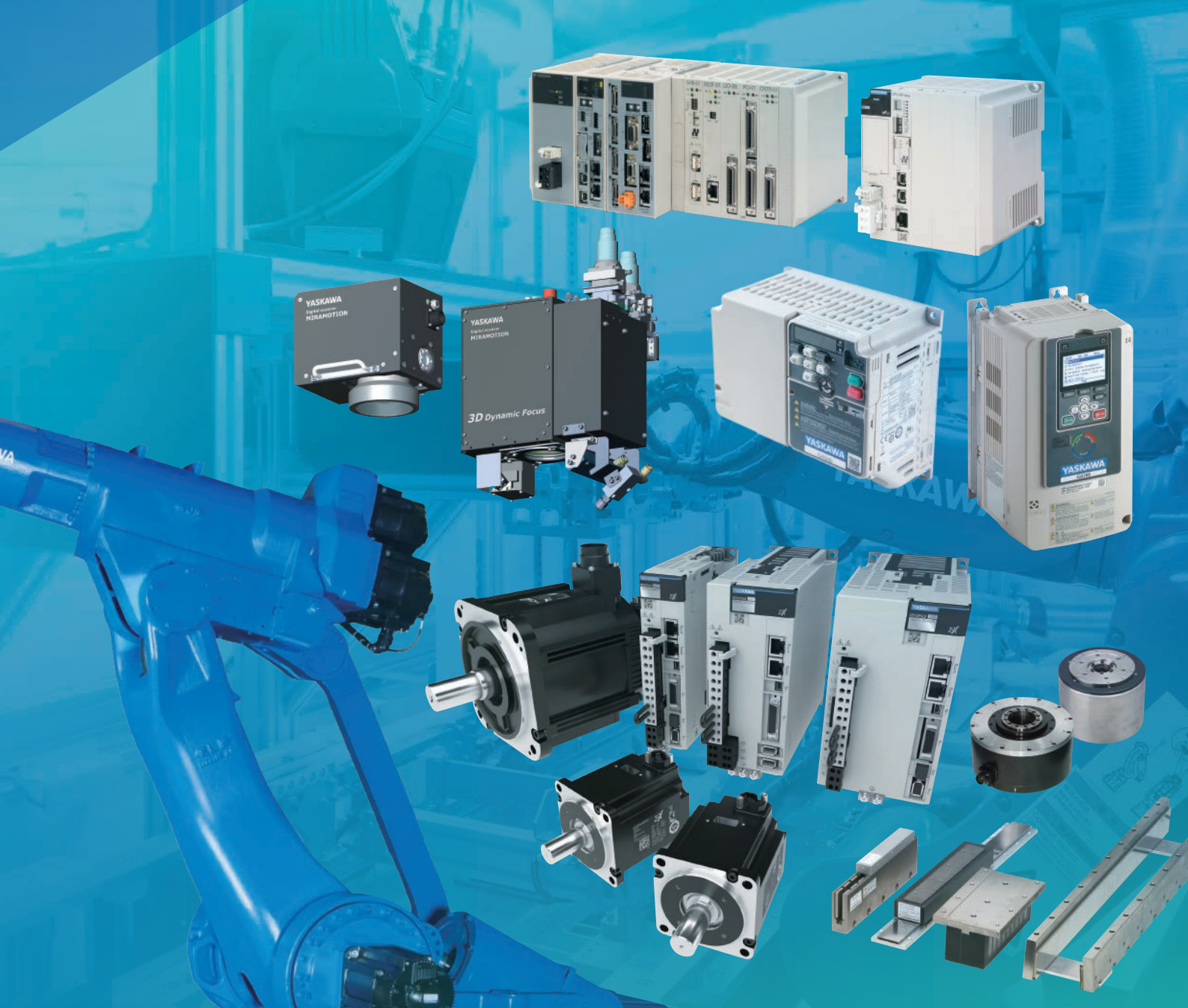
Invented the world’s first Minertia motor in 1958.

Total servomotors shipped

**20 million units**

(as of 2021)





## » AC Drives

Brought to market the world's first transistor inverter in 1974.

Total AC drives shipped

**30 million units**  
(as of 2021)



Our AC drives reduce annual global power consumption by about 4%.










## » Robots

Brought to market Japan's first fully electric vertically articulated industrial robot in 1977.

Total robots shipped

**500,000 units**  
(as of 2021)



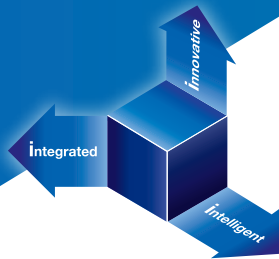
 <b>MOTOMAN-SK16</b> Multiple Robot Cooperative Control • 1995 <b>World's first</b>	 <b>VS-616G5</b> General-purpose Vector Control AC Drive • 1995 <b>World's first</b>   <b>World's first</b> Σ-II Serial encoder applied • 1997	 <b>MOTOMAN-DA20</b> Dual-arm Industrial Robot for Volume Production • 2005 <b>World's first</b>   <b>MOTOMAN-VA1400</b> Seven-axis Arc Welding Robot • 2008 <b>World's first</b>   <b>World's first</b> Varispeed AC IGBT Matrix Converter • 2005	 <b>World's first</b> U1000 Matrix Converter • 2014	 <b>MotoMINI</b> • 2017 <b>Smallest and lightest in industry</b>   <b>World's first</b> Σ-X Speed response frequency 3.5 kHz • 2021 <b>Industry-leading</b>	
1995	2000	2005	2010	2015	2020

# Quality-Focused YASKAWA

We reflect market needs in our technological development and earn the trust of our customers with solutions that merge products and data utilization.

We have achieved a new industrial revolution with i<sup>3</sup>-Mechatronics: a solution that adds value through digital data management of linked devices and cells incorporating Yaskawa products.

## » Solutions with i<sup>3</sup>-Mechatronics



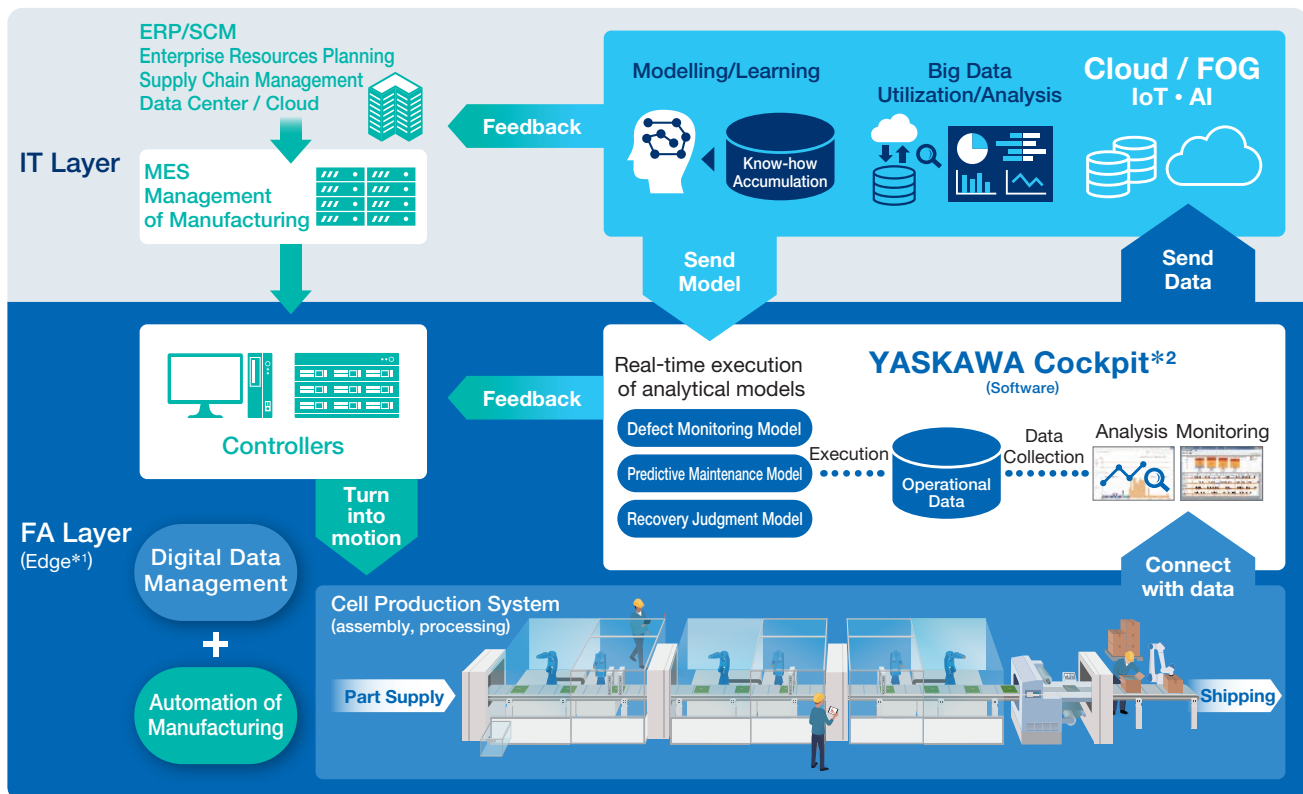
**i<sup>3</sup>-Mechatronics**  
New value with "i cube", digital data solution

Our i<sup>3</sup>-Mechatronics solutions concept, launched in 2017, provides solutions for systems that use Yaskawa servos, AC drives, and robots. It delivers productivity improvements and quality assurance/maintenance by using post-operation

data from the machinery and equipment in which those products are installed. It also provides digital data solutions with AI that achieve non-stop production by providing predictive maintenance alerts for machinery and equipment.



### Smart factory with i<sup>3</sup>-Mechatronics solutions



\*1: A location (close to a production site, such as a factory or within a production base) that performs data processing to provide real-time data analysis feedback.  
\*2: Software that can collect, store, and analyze data from production site facilities and equipment in real time.

# » YASKAWA ECO VISION Carbon Neutral Initiative

The Yaskawa Group undertakes environmental management with a two-pronged approach: we minimize environmental impact through production activities (green processes) and the supply of our product (green products).



[https://www.e-mechatronics.com/green\\_product/index.html](https://www.e-mechatronics.com/green_product/index.html)

## Green processes

By installing solar power panels that use our own PV inverters and updating production facilities to make them more efficient, we raise our CO<sub>2</sub>-free power usage ratio in factories and offices in Japan and abroad.

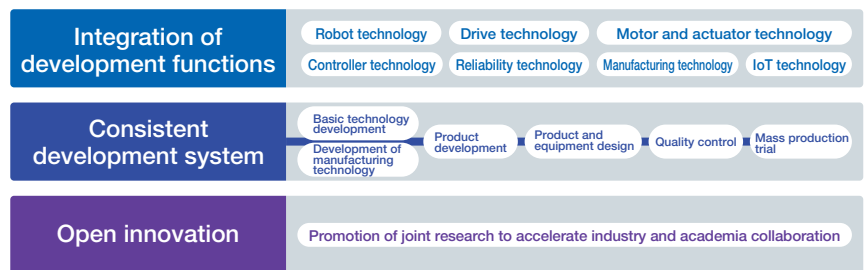
## Green products

We have introduced our own Green Products Certification System to develop products that help reduce CO<sub>2</sub> emissions, comply with the European RoHS Directive and REACH Regulation, and carefully manage chemical substances contained in the products that we supply.

# » Yaskawa Technology Center, a center of technical development supporting innovation

Established in September 2021, Yaskawa Technology Center brings together all Yaskawa development teams. Our activities are integrated; from basic technology development to mass production prototyping. In addition, we are engaged in open innovation with our partners. This has enabled significant improvements to our technical expertise and the pace of development, which allows timely provision of technologies and highly competitive products to meet customer needs.

## Consolidating a development system previously dispersed across different business divisions



Product development and control technology trials in a local 5G environment



Exterior of the Yaskawa Technology Center

## Exhibition space



## Environmentally friendly sustainable building



Interiors use eco-friendly materials made from recycled materials; entire building is barrier-free



Use of solar power generation to achieve net zero CO<sub>2</sub> emissions

# New controller concept actualizes i<sup>3</sup>-Mechatronics YRM-X

The YRM-X controller provides integrated control of equipment, robots, and data to automate and optimize secondary battery manufacturing processes.



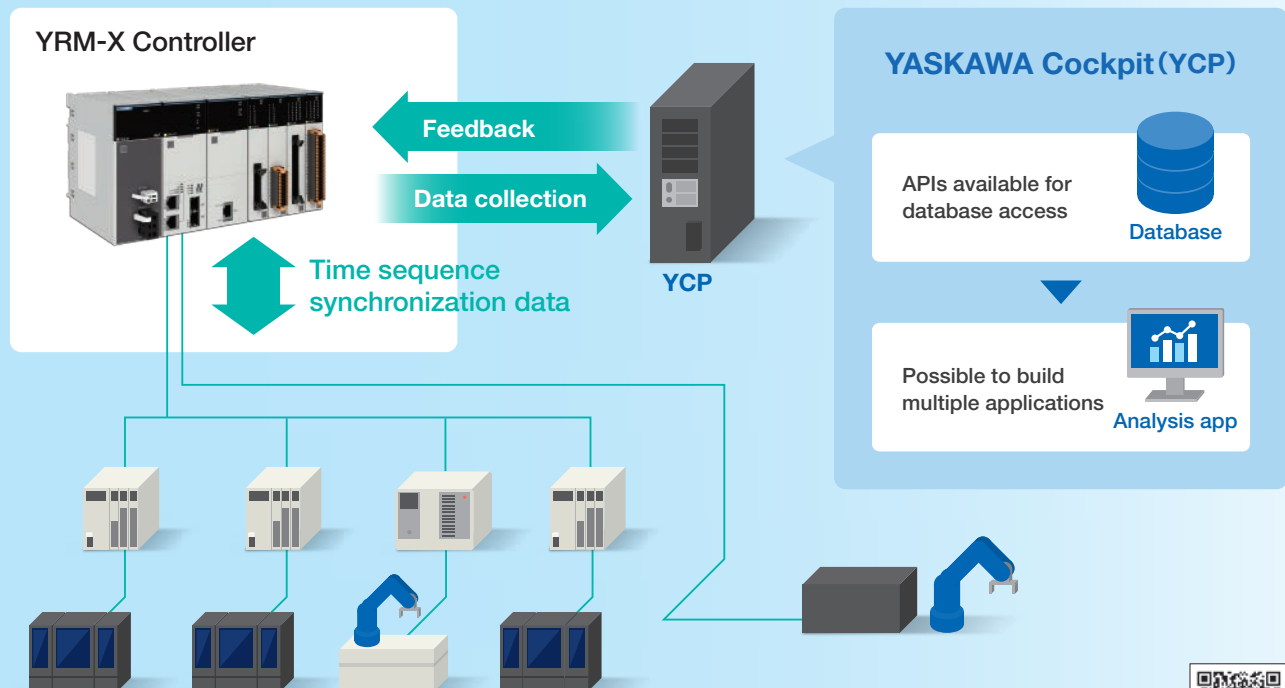
## » Optimized control of the entire cell with a single controller

A single YRM-X controller can provide optimized control of an entire cell consisting of multiple devices, devices and robots. By capturing a full picture of the cell's status, the controller improves production quality and productivity.

## » Automatic control by collecting/analyzing data while controlling devices and robots

While performing synchronous control of devices and robots, the controller can simultaneously gather data to capture and analyze the operating status of the entire cell. This makes it easier to improve processes. A high-performance, new-generation controller that continues to evolve.

Capturing "live, time-stamped data" from devices and robots enables operators to understand the status of the entire cell in real time. Feeding back motion process adjustments based on data analysis achieves Manufacturing Automation: stable operation, stable quality, and process improvement.

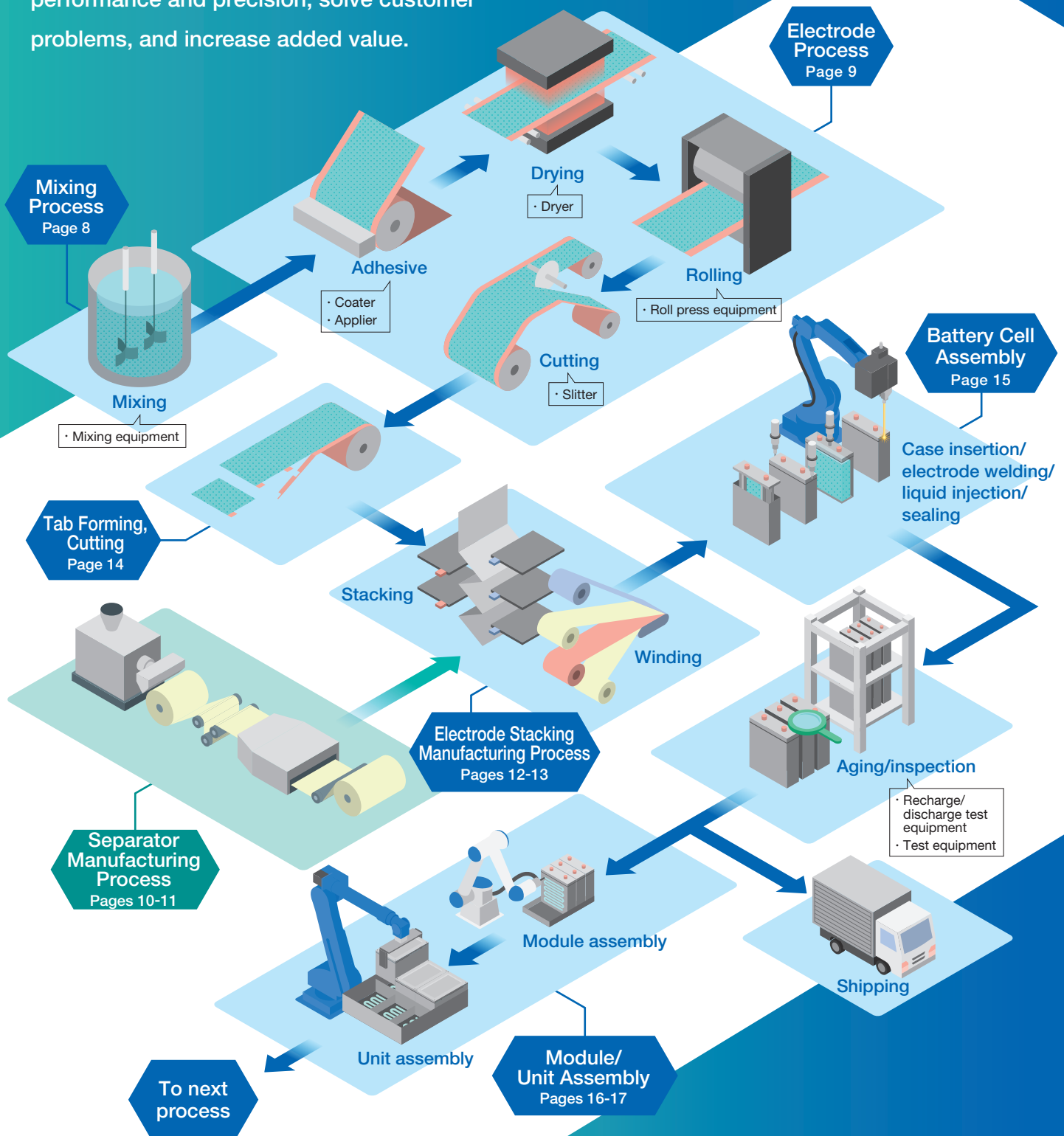


● More about i<sup>3</sup>-Mechatronics:  
<https://www.yaskawa-global.com/product/i3-mechatronics>



# YASKAWA Total Solutions for Secondary Battery Manufacturing Processes

By utilizing Yaskawa's wide range of technological capabilities such as AC drives, servo drives, robot components, high-speed/high-precision drives, laser welding, cutting, and multi-axis/synchronous control with galvano scanner motors, we promise to dramatically improve equipment performance and precision, solve customer problems, and increase added value.



# » Mixing Process



Yaskawa AC drives enable uniform and even mixing.

Yaskawa GA500 and GA700 AC drives enable uniform and even mixing. Motor torque monitoring and sensor feedback make it possible to manage viscosity. Plus, using real time data is easy.

## POINT 1

### Superior control performance

Yaskawa's proprietary sensor-less technology provides stable control regardless of the material's viscosity or volume. Plus, the maximum output frequency of 590 Hz (2P: 35,400 min<sup>-1</sup>) is an industry best for standard AC drives.

\*: Talk to a Yaskawa representative if you require 1000/2000 Hz.

## POINT 2

### Motors as sensors

The AC drive uses motors as sensors: extracting torque, current, rotation speed, and power consumption data. This information is gathered and analyzed by the host controller to help improve production management efficiency.

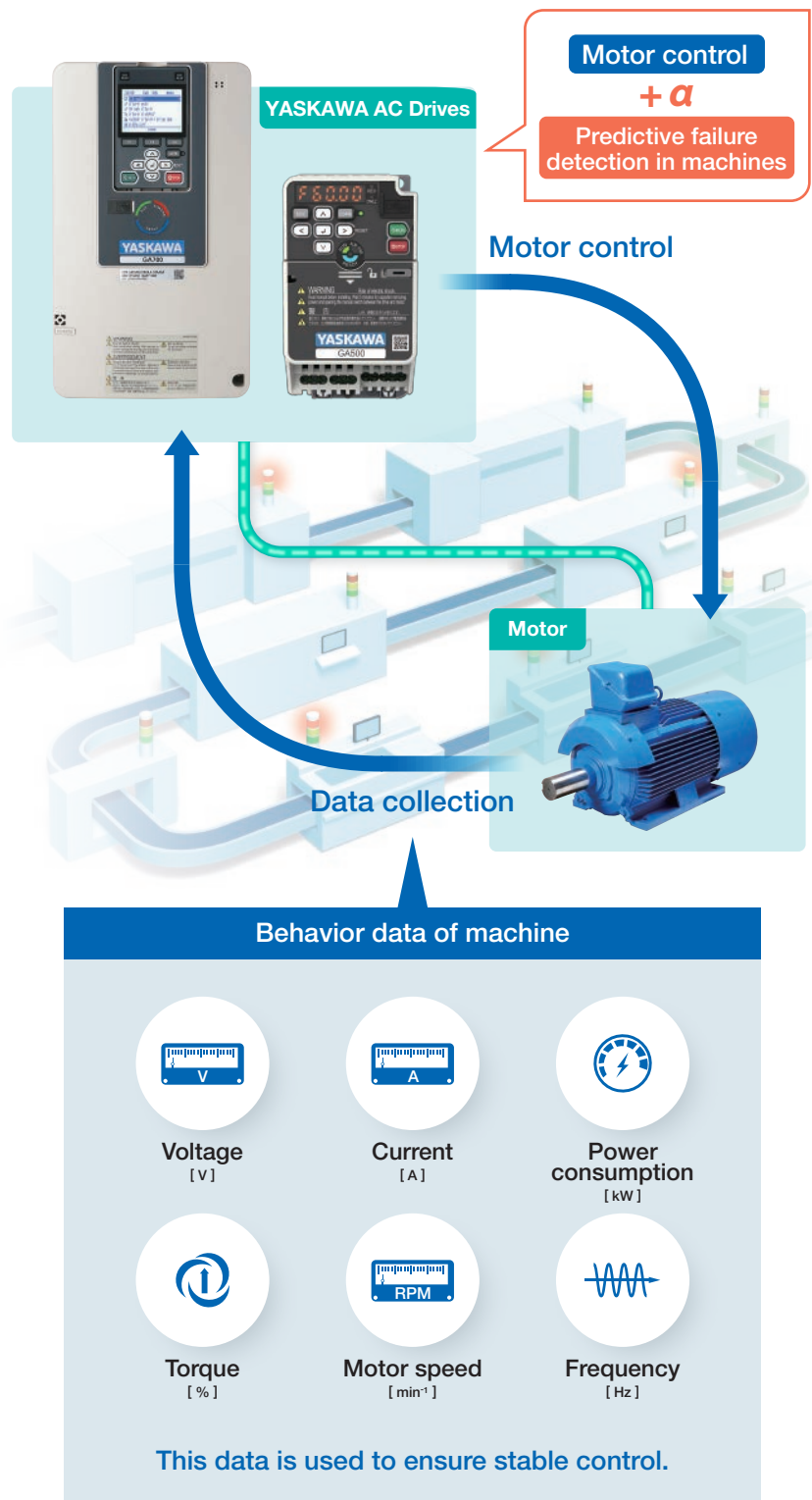
## POINT 3

### Fault warning signs detection

Detection of fault warning signs in machinery is made possible by using DriveWorksEZ, which makes it easy to write specialized programs in the AC drive. Equipment faults can be dealt with before line stoppages, enabling non-stop production.



Easily write programs to the AC drive from a PC with DriveWizard installed!



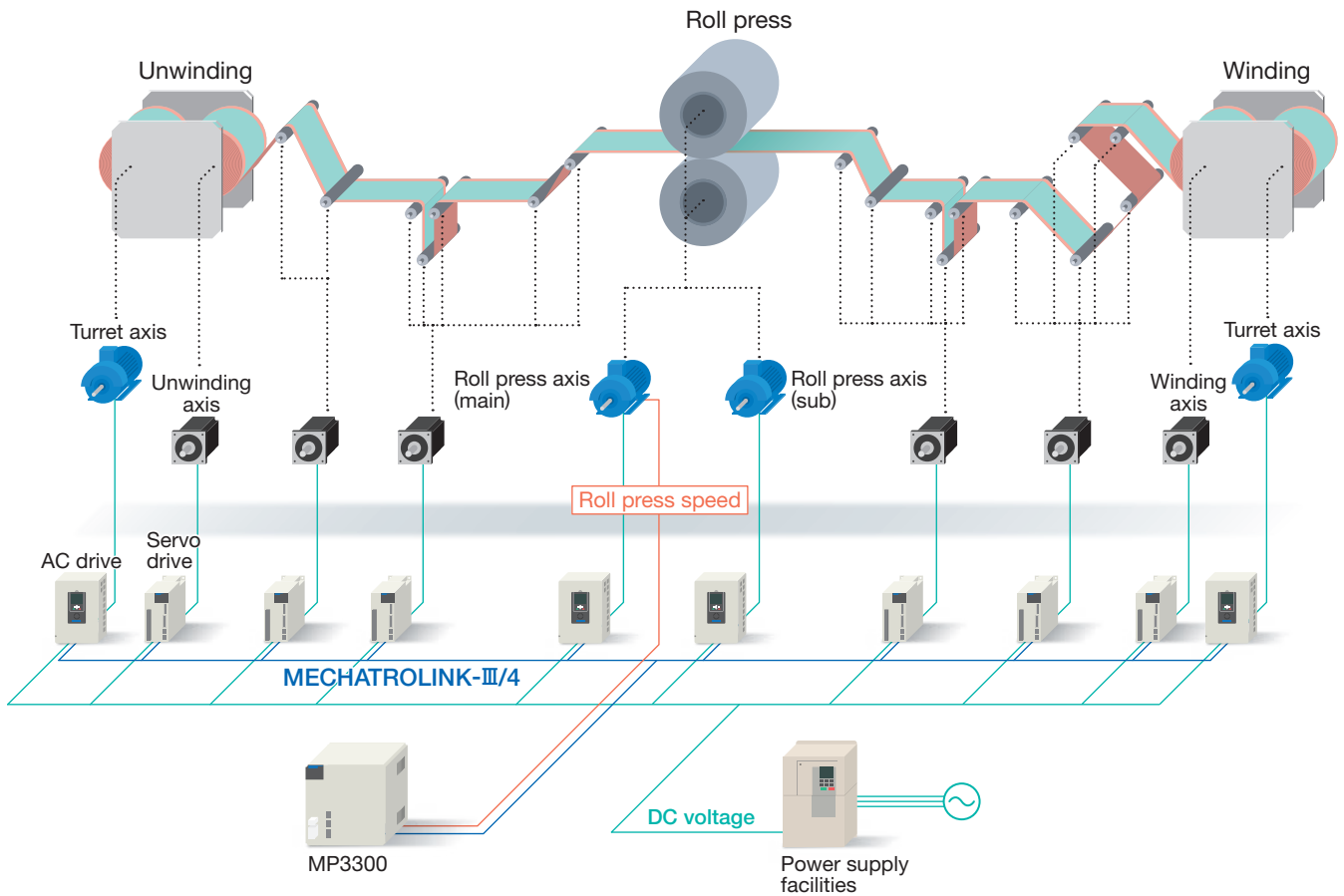


For stable electrode foil processing, we leverage the power supply technology and conveyor technology (Roll to Roll technology) that our company has developed over many years to help you build energy-saving equipment of higher quality. Please contact Yaskawa for details.



Our extensive motion control know-how contributes to creating flexible systems.

Pressing process (roll press device example)



POINT 1

Fully featured functionality supports systems development

Making use of MP3000 series features and user functions means you do not have to build complicated control processes from scratch.

Examples of user functions

- Draw roll control
- Winder diameter operations control
- Winder dancer control, etc.

\*: Consult with a Yaskawa representative about your user function requirements.

POINT 2

Providing centralized control and dispersed control solutions

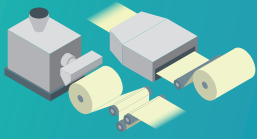
From controllers to servomotors and AC drives, we offer a broad lineup of products that achieve high-precision motion control without the restrictions of a host controller. We provide centralized and dispersed control solutions matched to your application and system.

POINT 3

Support for systems using regenerative energy

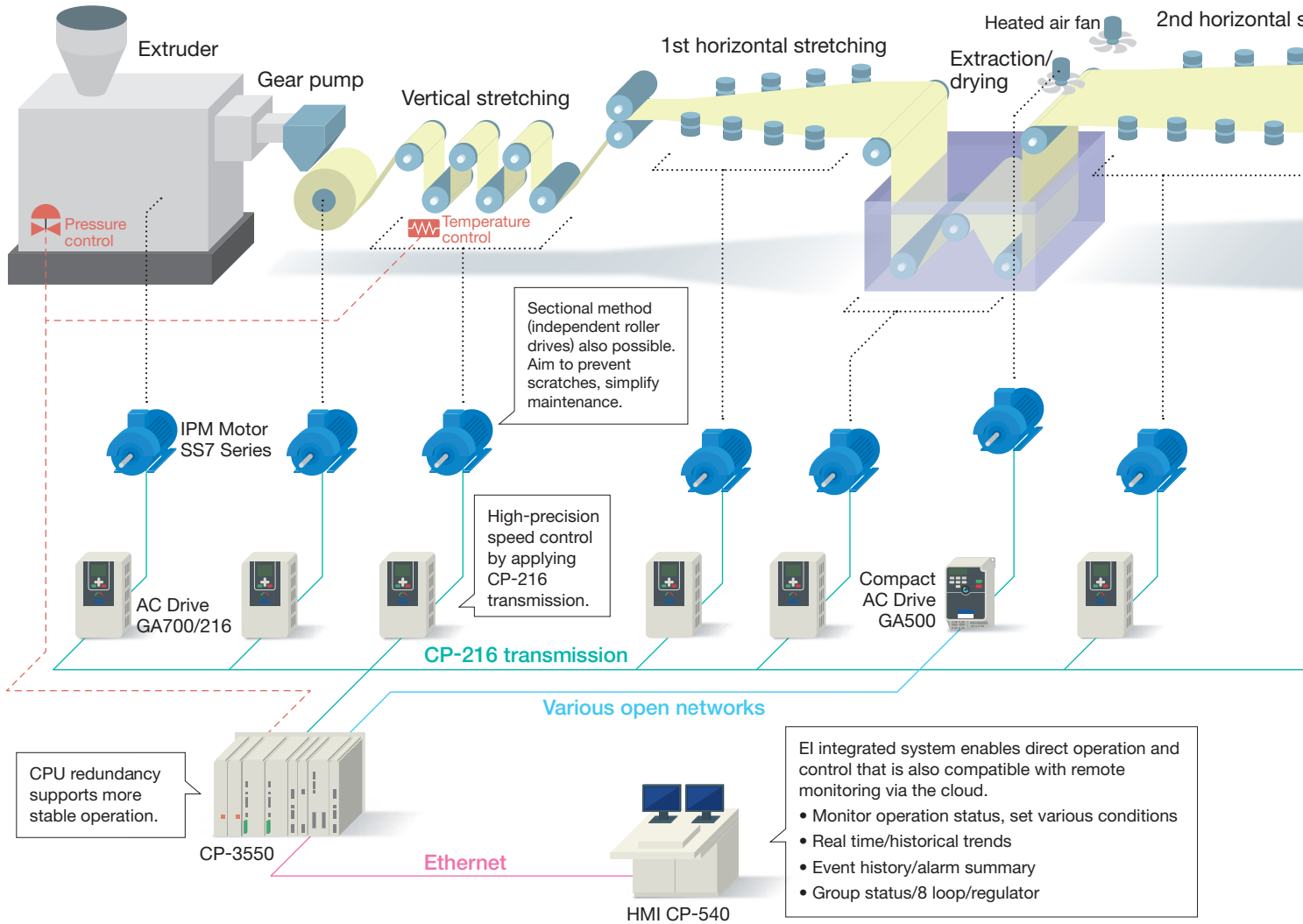
In addition to our motion technology, we are specialists in energy transformation, including regenerative energy technologies. We build energy-saving systems that use regeneration-related products\*, but we can also provide solutions for power factor improvements of power and power supply harmonics suppression.

\*: For details, see the Yaskawa Regenerative Energy-saving Unit Series (Catalog No. CHEPC71060015).



We help build optimized systems that maximize the performance of our products.

### Equipment configuration example using system products (film depositor + slitter)



## POINT 1

**We have diverse control technologies honed by extensive experience**

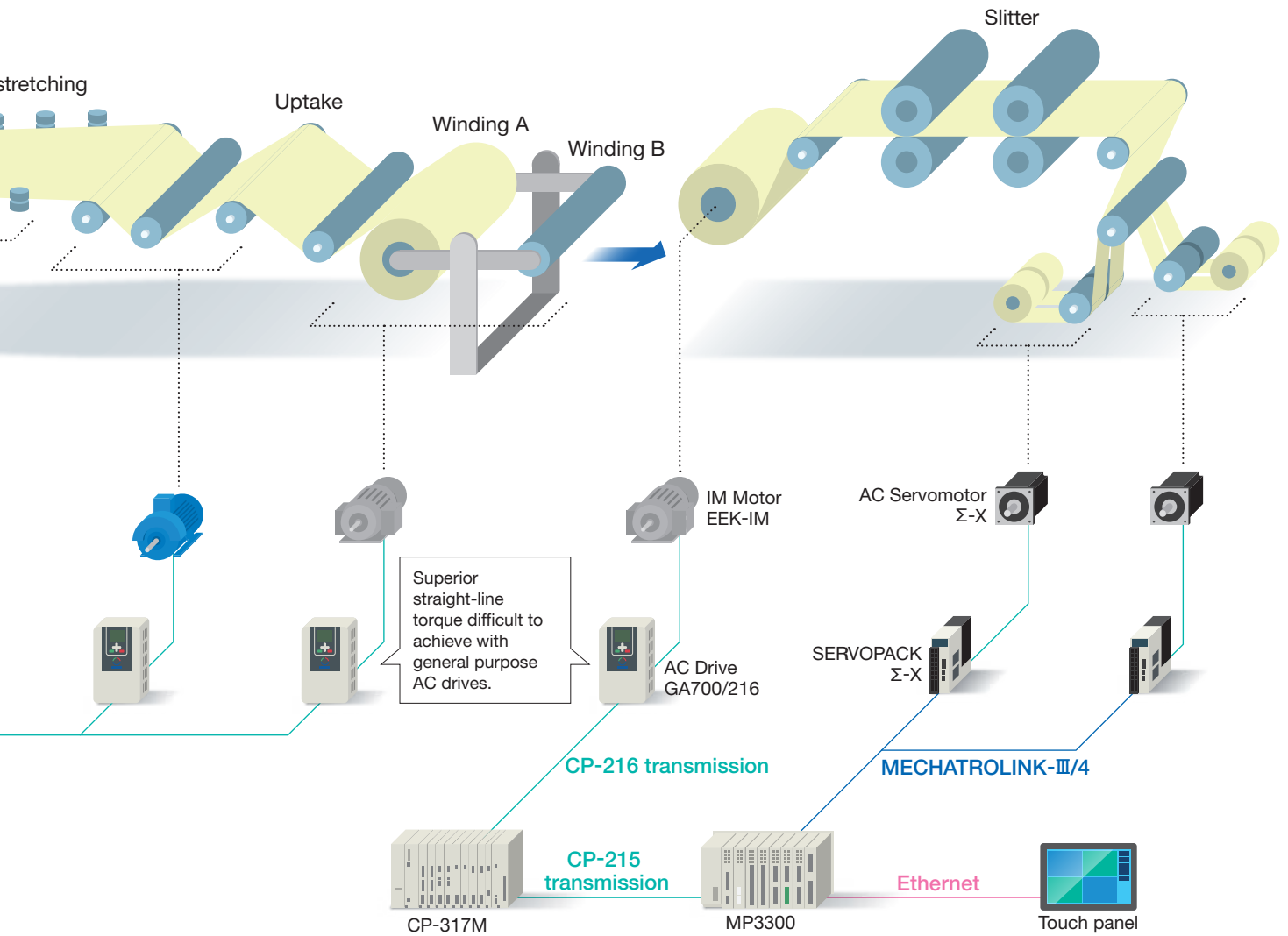
We use film conveyor control technologies and know-how honed by our extensive experience with films, coaters, and slitters to deliver the high-level precision customers demand. The HMI (CP-540) setting, operation, and maintenance screens are extremely easy to use and reduce operator workload.

## POINT 2

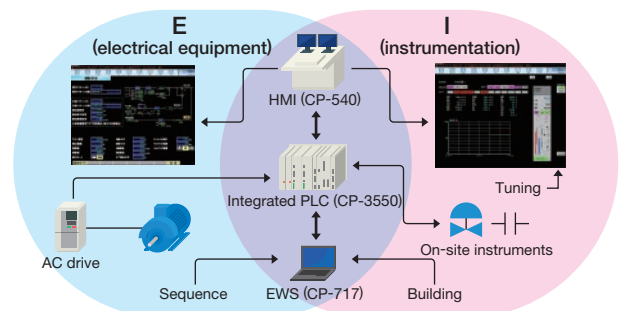
**Reduced startup and running costs**

We offer a broad lineup of standard drives from 100 W servo drives to 1000 kW-plus AC drives. Using IPM-compatible large motors provides power savings, integrated control including auxiliary equipment, and also reduces power consumption across the entire line drive due to the deployment of common converters.

To improve the quality and productivity of separator manufacturing equipment, it is necessary to further improve component performance, remotely monitor the operating status of facilities equipment, have functions that use data and prevent creases and scratches, and more. We meet the needs of our customers with an extensive product lineup that incorporates the latest technology combined with highly advanced engineering and support capabilities. Please contact Yaskawa for details. We can also propose single device solutions.



### Consolidated extruder pressure control, temperature control, etc. with PLC

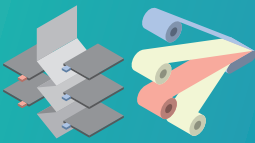


- Improved ease-of-use with 1WINDOW
- Fewer required devices, fewer spares
- Integration of the electrical equipment and instrumentation reduces customer workload

### POINT 3

#### Visualizing on-site information and enabling stable operation with remote monitoring

By using AC drives or servo drives as sensors, we can visualize on-site information and introduce machinery fault warning and diagnosis functions into the system. Centralized administration with HMI and cloud-based servers enables flexible remote monitoring to achieve stable operation.

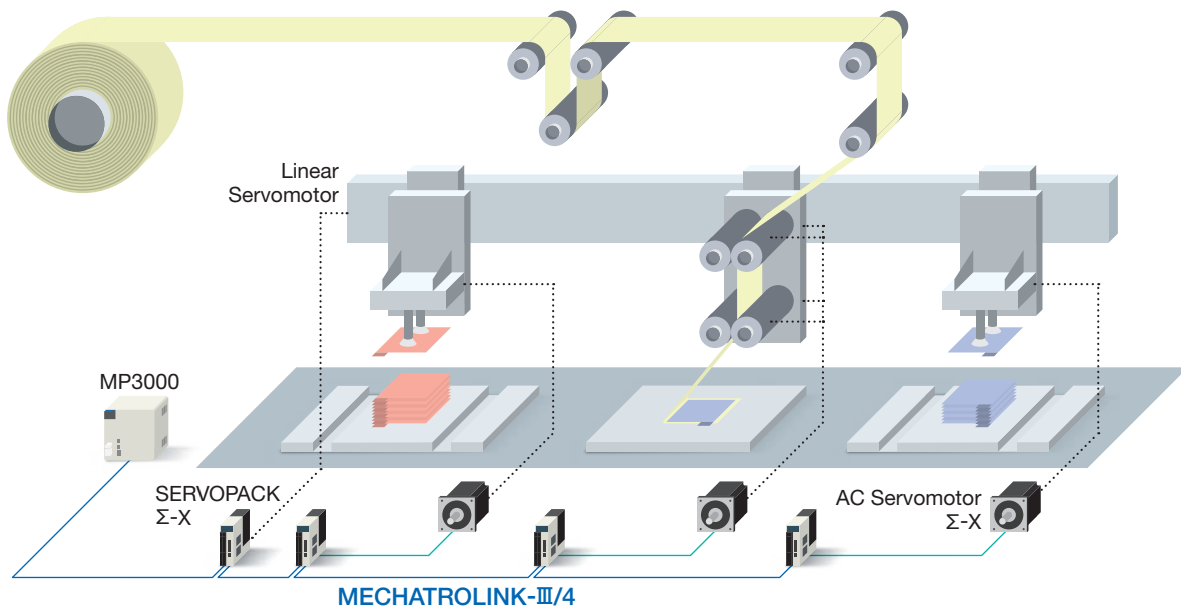


We leverage our company's specialized expertise in multi-axis, high-precision systems to help you develop and set up systems.

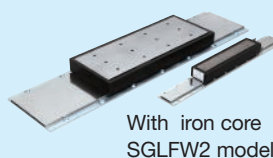
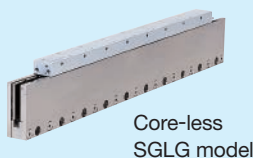
## » Stacking

Positive and negative electrode sheets are conveyed and stacked alternately over separators. To improve throughput and ensure stacking without misalignment, we have a lineup of optimized linear servomotors for high-speed, high-accuracy sheet conveyance.

### Stacking system configuration example



### Linear servomotors lineup



#### POINT 1

With overall synchronization, all motors are synchronized for waste-free stacking

As the positive and negative electrode sheets are assembled on long separators, the process requires optimized stacking with all motors operating synchronously. Our MP3000 Series Machine Controllers enable synchronous operation.

#### POINT 2

High-speed, high-precision sheet injection with linear servomotors

Linear servomotors provide high-speed, high-precision positioning, making them the optimal choice for sheet stacking processes that demand fast acceleration and high precision. You can choose from the non-magnetic attraction SGLG model, SGLFW2 model with improved force, and SGLT model with powerful force and magnetic attraction offset configuration.

#### POINT 3

Servo drives optimized for the application provide direct processing without a PLC

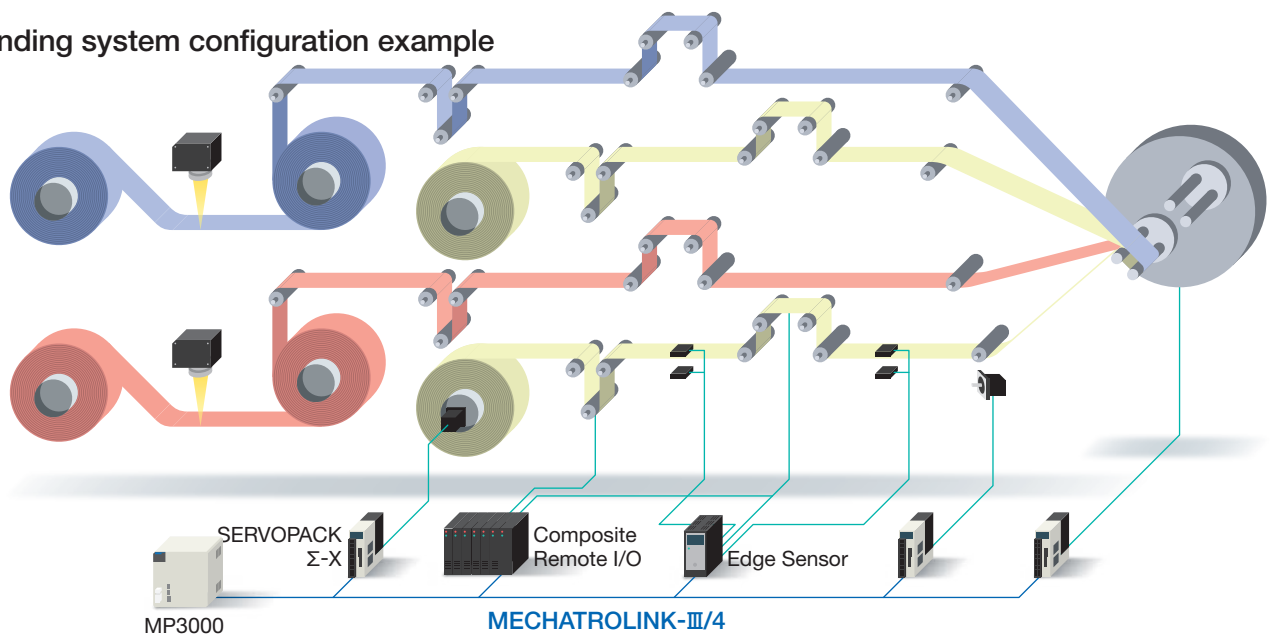
Σ-X/Σ-7 series servo drives optimized for the application (latch function, fixed point output function, etc.) enable high-speed processing that requires direct servo drive I/O signals, such as electrode sheet detection and operation synchronization trigger signals.

Cylindrical, square, and pouch-type cell shapes for secondary batteries are manufactured by varying the stacking or winding method. Yaskawa offers a large number of optimized components that enable high-level control of the technologies and functions required by each process. We also provide solutions for visualizing and using data collected from components.

## » Winding

Positive electrode material, negative electrode material, and separators are stacked and wound into cylindrical or angular shapes. Our motion components (MP3000 series,  $\Sigma$ -X series) enable a multi-axis/synchronous control winding system that can perform high-speed winding of electrodes and separators at a constant tension.

### Winding system configuration example



The system can be controlled with standard servo drives and controllers without the need for specialized tension controllers. You can program using functions optimized for tension control.



### POINT 1

#### Simple line control with electronic cams

Using our MP3000 Series Machine Controllers, we provide electronic cam control that moves the main axis of the line on a virtual axis, and the entire system tracks this axis. The MP3000 series makes it easy to create electronic cam data.

### POINT 2

#### Uses low-inertia motors

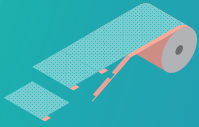
In the winding process, we use a low-moment of inertia model (SGMXA) from our  $\Sigma$ -X servomotor series on the winding axis. This enables tracking even on high-speed lines.

### POINT 3

#### User functions provided

Our MP3000 Series Machine Controllers comes standard with user functions for dancer roll control, tension feedback control, draw control, and more. Using these functions makes it easy to start up high-precision systems.

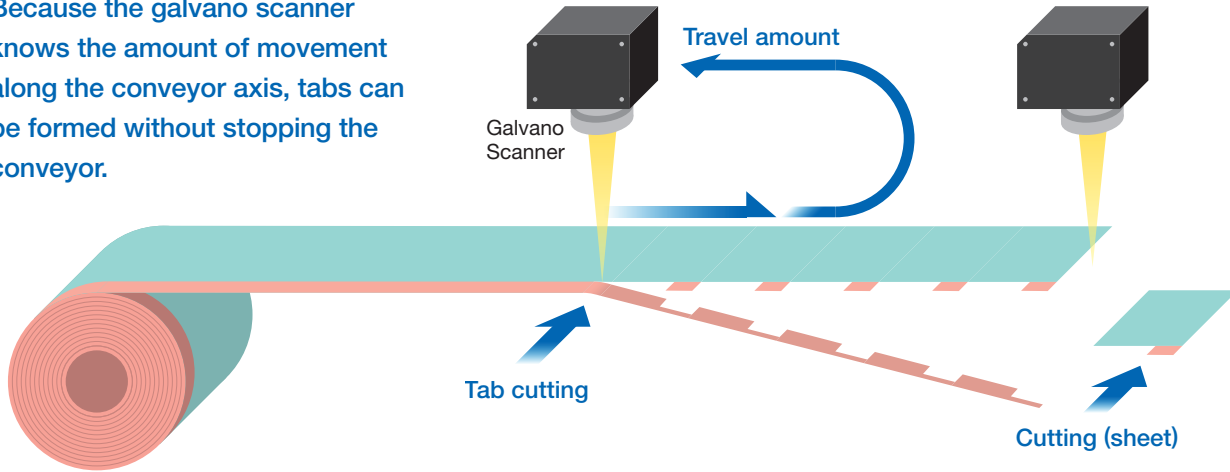
Our technologies and products track changing tab positions and sizes, enabling high-precision work while helping to solve issues in the manufacturing process.



Our MIRAMOTION galvano scanner enables tab cutting on multiple product types without the use of dies.

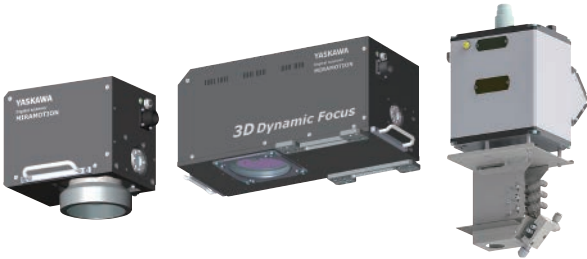
## » Synchronous operation of cutting axis and conveyor axis

Because the galvano scanner knows the amount of movement along the conveyor axis, tabs can be formed without stopping the conveyor.



### MIRAMOTION Galvano Scanner

Excels at high-speed scanning, high-precision positioning, and high-quality processing with blue lasers. Software optimized for program creation shortens start-up times.



### Σ-X Series AC Servo Drives

Our industry-leading motion performance and servo drives make it easy to use sensing data data to build build high-speed, high-precision systems.



#### POINT 1

**Maintenance free with no blades needed**

Laser cutting eliminates blades, which in turn eliminates the need for blade maintenance and blade die creation. It provides sharp cutting and prevents foreign matter adhering to the cut surface.

\*Customers can select the laser manufacturer.

#### POINT 2

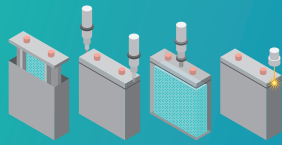
**Higher speeds, greater precision with conveyor axis synchronization**

By inputting the conveyor axis encoder signal to the galvano scanner, the galvano scanner and conveyor axis servo drives can operate synchronously. This enables high-speed, high-precision tab cutting without stopping the movement of the pole plates.

#### POINT 3

**More compact equipment with galvano heads**

Using 2D and 3D scanners, it is possible to design a device more compact than XY laser cutting devices. As long as they are in the same processing area, different types of tabs can be cut using the same equipment. The processing programs are stored on the galvano controller, meaning you are free to switch them at will.



Our extensive galvano scanner lineup makes it easy for you to perform the laser welding you need.

Our systems provide laser welding that delivers the quality and reliability required for the final process. Supports various materials as well as spatterless and deep penetration welding. Plus, welding can be done in combination with our Motoman robots.

## » Galvano head unit lineup to match your application



**YD-2000WM**  
Compact Galvano Head Unit (specialized wobbling unit)  
Laser welding conditions can be changed for plate thickness



**YD-3000M/ML**  
3D Galvano Head Unit (for multiple lasers)  
Thermal lens effect control  
On-the-fly processing

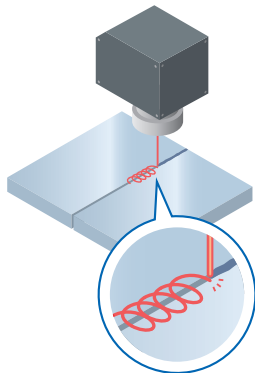


**YD-3000S**  
3D Galvano Head Unit (for single lasers)  
Deep penetration welding  
On-the-fly processing



**YD-3000-IRM-B**  
3D Hybrid Galvano (blue/IR support)  
Ideal for secondary battery busbar copper welding, etc.

### Built-in wobbling function



Flattening amount	Wobbling shape	Actual path
100%		
50%		
0%		

The wobbling command function\* enables welding with a high degree of tolerance for variations in workpiece precision.

\*: Command specification: Program can be created to specify diameter, flattening, and frequency only.

### Supports larger batteries

Combine with our MOTOMAN robot for compatibility with larger batteries.



#### POINT 1

#### High reliability of lasers

As well as high-speed welding, laser welding offers consistent welding quality and ensures the reliability of sealed cans and seals.

\*Customers can select the laser manufacturer.

#### POINT 2

#### Spatter control

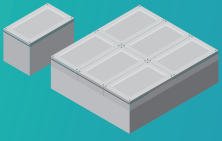
The MIRAMOTION's unique optical element insertion mechanism and welding spatter control from the hybrid laser work to produce high-quality welding.

#### POINT 3

#### Supports more compact equipment & large batteries

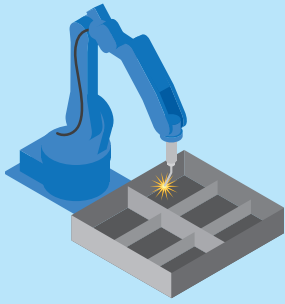
Using the galvano scanner makes it possible to design equipment that is more compact than laser torch equipment. The wide-area support of the 3D galvano enables seamless, high-quality welding of large batteries.

## » Module/Unit Assembly



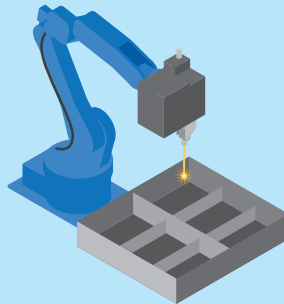
We offer a broad lineup of robots necessary for automating module and unit assembly. We also have a range of programming tools necessary for module/unit assembly, enabling you to perform high-difficulty jobs stably and efficiently.

### » Battery case manufacturing



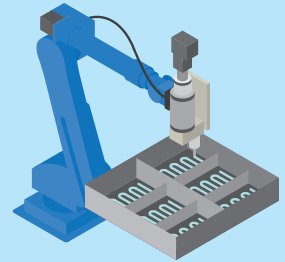
Frame welding (MIG welding)

or



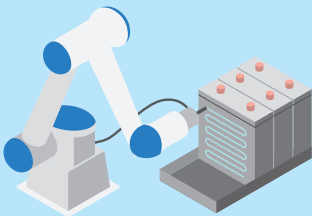
Frame welding (remote laser welding)

### » Unit assembly

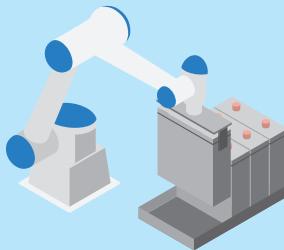


Applying gap filler

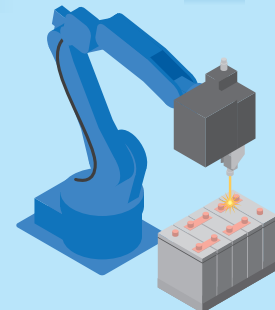
### » Module assembly



Applying adhesive



Cell stacking



Busbar welding (remote laser welding)

#### POINT 1

##### Support for various applications

Provides the functions and performance to perform tasks including arc welding, laser welding, bonding, sealing, mechanical joining, and more.

#### POINT 2

##### High speed, high precision

We are constantly working to improve the high-speed performance and precision of our individual robots. They make it possible to perform high-precision tasks at high speeds, such as uniform screw tightening that ensures precise start/end points and bead tracking.

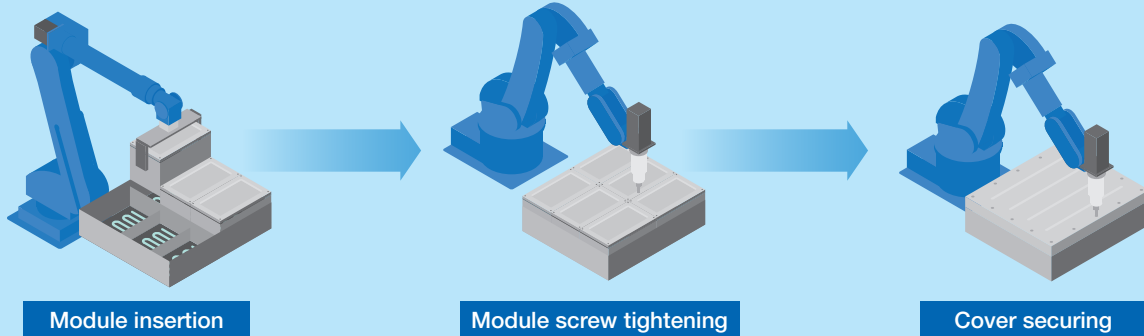
#### POINT 3

##### Broad lineup

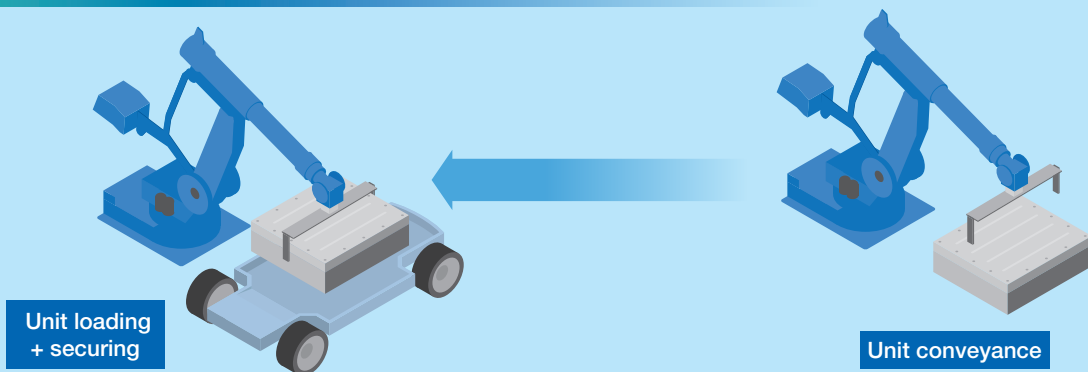
Our lineup features small to large robots with payload capacities ranging from 0.5 kg to 600 kg. We have many different models, including robots with cables routed through arms and collaborative robots that automatically stop when they sense an external force (contact).



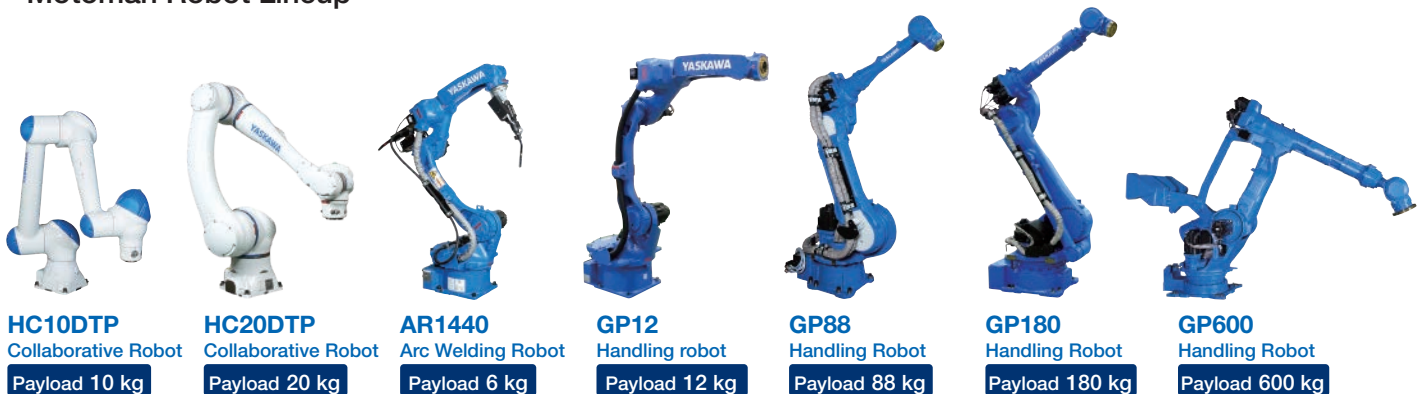
As a leading robot company, we can solve many problems with the use of robots, such as automating manufacturing industries, achieving multi-product, variable volume manufacturing, improving production efficiency and quality, and ensuring traceability. We draw on this experience and technology to provide solutions in secondary battery manufacturing processes that achieve automation of high-level work, improved efficiency, heavy goods conveyance, and more.



» Also supports cart loading



## Motoman Robot Lineup



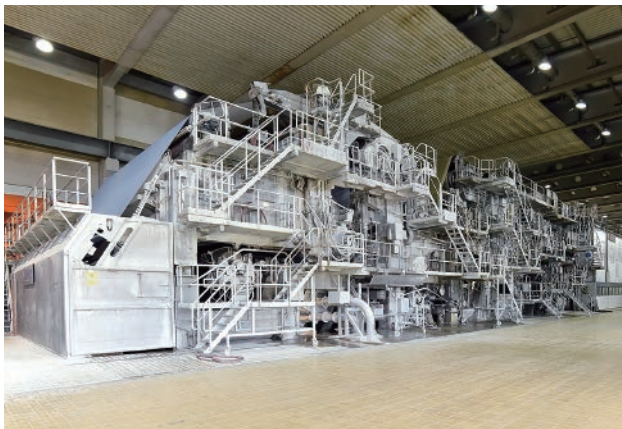
Complete support with superior technology from motors to system equipment and engineering.

With close links to the Yaskawa Group, we can draw on the group's strengths to provide comprehensive service and detailed support in Japan and abroad.

## Business Areas

### Industrial power business

In addition to business areas such as films, paper and pulp, fibers, rubber and tires, metals processing, and plastics in which we have built up extensive experience and trust, we also bring our outstanding continuous drive technology to a range of industrial engineering applications, irrespective of existing systems.



### Steel business

We provide optimized control systems for facilities within steel plants and contribute to stable, continuous operation with our high reliability.



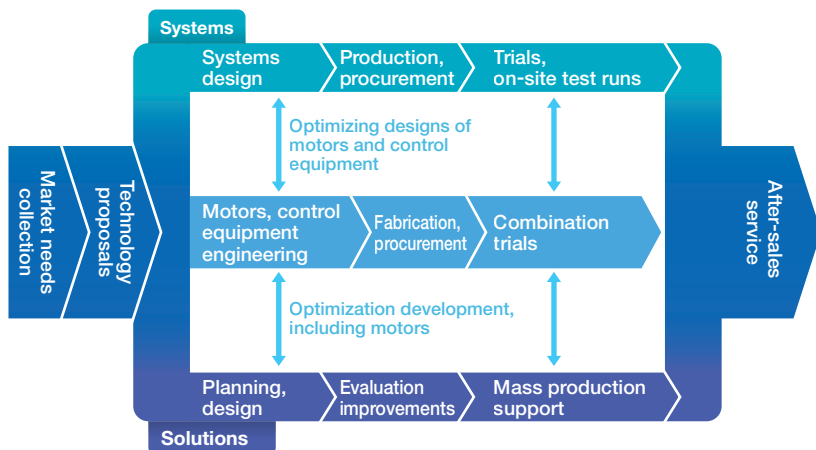
### Crane business

We provide electrical products containing new technology for all crane types to support work and energy efficiency.



## Systems Solutions

We make use of motors, drive equipment, and controllers to provide optimal engineering for a wide range of plants and facilities.



## Service & Support

We provide fast and reliable service and support, identifying problems at early stages that may lead to significant obstacles in production processes.

To handle inquiries about industrial electrical products whose systems were built by our company, we have set up a 24-hour/365-day help desk, "TRUST 365" and respond quickly to issues and technical inquiries. We provide robust support to keep customers' production facilities stable, working to minimize downtime in the event that machinery issues occur.

# Global Network Worldwide Yaskawa

Yaskawa's worldwide network includes business bases in 30 countries and production bases in 13 countries.

Our customers' global businesses are reliably supported by connecting our group companies and service bases throughout the world. We provide regionally-based, finely-tuned support.

## Europe



YASKAWA EUROPE GmbH

### Germany

- YASKAWA EUROPE GmbH

### Sweden

- YASKAWA NORDIC AB

### U.K.

- YASKAWA ELECTRIC UK LTD.
- YASKAWA UK LTD.

### Italy

- YASKAWA ITALIA S.R.L.

### France

- YASKAWA FRANCE SAS

### Spain

- YASKAWA IBERICA S.L.

### Finland

- YASKAWA FINLAND OY
- THE SWITCH ENGINEERING OY

### Norway

- THE SWITCH MARINE DRIVE NORWAY AS

### Netherlands

- YASKAWA BENELUX BV

### Slovenia

- YASKAWA EUROPE ROBOTICS D.O.O.
- YASKAWA SLOVENIJA D.O.O.
- YASKAWA RISTRO D.O.O.

### Czech Republic

- YASKAWA CZECH S.R.O

### Poland

- YASKAWA POLSKA SP. ZO. O.

## North America



YASKAWA AMERICA, INC.

### U.S.A.

- YASKAWA AMERICA, INC.
- SOLECTRIA RENEWABLES, LLC

### Canada

- YASKAWA CANADA INC.

### Mexico

- YASKAWA MEXICO S.A. DE C.V.

## Middle East • Africa

### Israel

- YASKAWA EUROPE TECHNOLOGY LTD.

### Turkey

- YASKAWA TURKEY ELEKTRIK TICARET LTD. STI.

### South Africa

- YASKAWA SOUTHERN AFRICA (PTY) LTD.

## South America

### Brazil

- YASKAWA ELECTRICO DO BRASIL LTDA.
- MOTOMAN ROBOTICA DO BRASIL, LTDA.

## Asia Pacific



YASKAWA ELECTRIC (CHINA) CO., LTD.

### China

- YASKAWA ELECTRIC (CHINA) CO., LTD.
- SHANGHAI YASKAWA DRIVE CO., LTD.
- YASKAWA TSUSHO (SHANGHAI) CO., LTD.
- YASKAWA ELECTRIC (SHENYANG) CO., LTD.
- YASKAWA SHOUGANG ROBOT CO., LTD.
- YASKAWA (CHINA) ROBOTICS CO., LTD.

### Korea

- YASKAWA ELECTRIC KOREA CORPORATION

### Taiwan

- YASKAWA ELECTRIC TAIWAN CORPORATION

### Singapore

- YASKAWA ASIA PACIFIC PTE. LTD.

### Thailand

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### Indonesia

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### Vietnam

- YASKAWA ELECTRIC VIETNAM CO., LTD.

### Malaysia

- YASKAWA MALAYSIA SDN. BHD.

### India

- YASKAWA INDIA PRIVATE LIMITED

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# YASKAWA

**YASKAWA ELECTRIC CORPORATION**

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply. Specifications are subject to change without notice for ongoing product modifications and improvements.

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