YASKAWA

A World of Automation Solutions™

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Yaskawa Electric America, Inc., November 2005

YEA-CHA-MSB-1A Printed in USA

Motion Solutions

YASKAWA

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Yaskawa Electric America, Inc. (YEA)

is responsible for customer satisfaction throughout North and South America. Established in 1967, the organization today consists of distributed R&D facilities, sales and service offices, training centers, and manufacturing operations. YEA, with a highly qualified distribution channel and OEM partners, has earned the reputation as the leading quality supplier of AC servo, inverter (variable frequency drives), and motion control solutions.

Motoman, Inc., a wholly owned subsidiary of YEA since 1994, is located in West Carrollton, Ohio. As a member of Yaskawa Electric Corporation's robotics group, Motoman has more than 100,000 robots installed worldwide with over 20,000 of them installed in North and South America. With the broadest product line (3 – 600kg) and unmatched multiple robot capability, Motoman delivers the highest level of Customer Satisfaction in the Robotics Industry.

Yaskawa Electric, via its global organization, supports local, national, multi-national, and global clients with high quality products, technical support, and innovation to insure maximum satisfaction.

Commitment to Quality

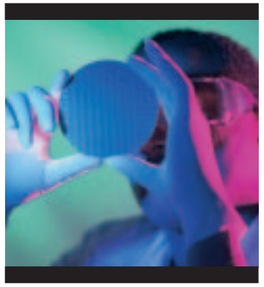
QUALITY IS OUR TRADITION FOR OVER 90 YEARS

YASKAWA'S MOTOR AND DRIVE PRODUCTS EXCEED 400,000 TO ONE MILLION HOURS MTBF.

During the production process, Yaskawa assures product quality by utilizing the techniques of statistical quality control (SQC). Because of its outstanding achievements in quality assurance, Yaskawa is the first manufacturer specializing in industrial electronic equipment to win the prestigious Deming Application Prize. Yaskawa consistently applies quality control (QC) and reliability control (RC) methods across the company's operations.

Performance Technology

Yaskawa's continued investment in development assures the highest level of technology and performance.



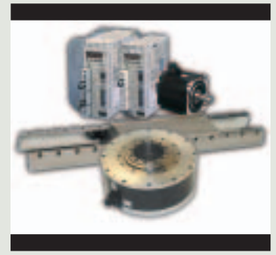
R&D Support facilites in Japan, America, and Israel are part of an organization dedicated to licensing agreements, joint ventures, cooperative business arrangements, and other instruments that make available a broad range of information and technology to augment the original work. This system, supporting the company's quality, growth, and customer satisfaction goals, enables Yaskawa to introduce a steady stream of leading edge products.

GLOBAL RESEARCH RESULTS

Yaskawa's core strength is its successful implementation of invention and innovation into the highest quality products available to provide new and better solutions for its customers.

System Flexibility, Product Expansion

Yaskawa machine controls and servo products are developed with flexible design to allow customers the ability to configure products to meet their specific needs.



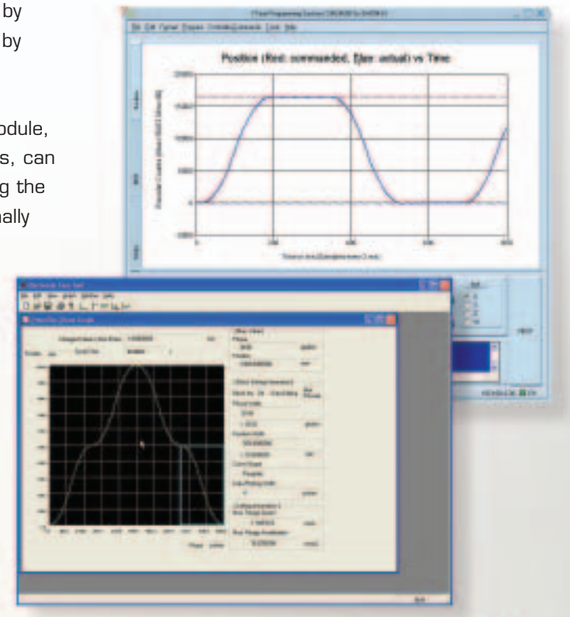
Yaskawa offers matched servo systems (motor and amplifier), ranging in power output from 10W up to 90kW. Up to 256 synchronized axes can be controlled with Yaskawa's motion control products.

Sigma II amplifiers are shipped from the factory preset to speed mode. Torque or position modes can easily be configured should system requirements change. Single-axis controllers and application modules that simply snap on to the side of the amplifier expand the range of possible control solutions with Sigma II. From a simple point-to-point indexer module to a network-specific module, the Sigma II system's all-in-one modular approach is easily adaptable to your system's needs.

Generation 7 AC inverter drives with MECHATROLINK™ communications provides the perfect solution for speed control applications and high performance networking requirements.

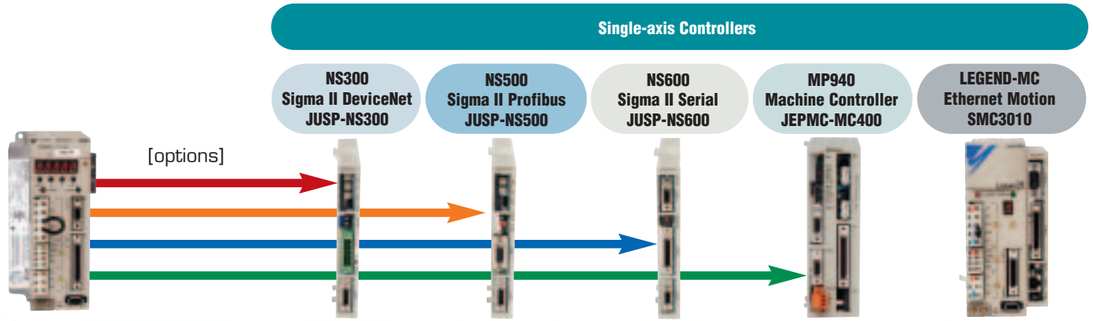
Economical Solutions

Adding a motion controller or communication module to a Yaskawa amplifier is literally a snap. Yaskawa's single-axis machine controller (MP940) and application modules (NS300, NS500, NS600) snap on to the side of any Sigma II amplifier (30W to 55kW). This modular approach reduces integration costs by eliminating amplifier to controller wiring and improves performance by distributing position control directly to the amplifier.



Using a set of simple motion commands, the NS600 application module, a point-to-point indexer featuring both registration and homing inputs, can create motion via a serially connected PLC, HMI, or even a PC using the built-in HyperTerminal program. The NS600 can also execute internally stored motion programs by triggering digital I/O.

NS300 and NS500 application modules allow DeviceNet and Profibus connectivity for distributed indexing applications. The MP940 single-axis machine controller easily handles advanced motion control functions like Cams, Programmable Limit Switch, Phase Adjustment, Digital Gearing, Registration, External Encoder Input, and more. The SMC-3010 is a single-axis motion controller that is used exclusively with the LEGEND series torque amplifier. Ethernet connectivity makes it a versatile single-axis controller also capable of non-coordinated multi-axis motion.



		NS300 Sigma II DeviceNet JUSP-NS300	NS500 Sigma II Profibus JUSP-NS500	NS600 Sigma II Serial JUSP-NS600	MP940 Machine Controller JEPMC-MC400	LEGEND-MC Ethernet Motion SMC3010
		Single-axis Controllers				
Configuration	Parameter Based Motion Routines	■	■	■		
	Full programmable				■	■
	Programming Method	Parameter Edit	Parameter Edit	Index Table	Text Graphical Ladder	Text
Communication	RS232/422/485	●	●	■	■	RS232
	DeviceNet	■			▼	
	Profibus		■			
	Mechatrolink (MLINK)				▼	
	Ethernet					Modbus TCP/IP
	Controller to Controller				Master/Slave	Multi-axis Programming
Hardware	Position Loop Update	250 µs	250 µs	250 µs	500 µs	250 µs
	Dedicated I/O	■	■	■	■	■
	Programmable Digital I/O			◆	11 in/8 out	8 in/4 out
	Programmable Analog I/O				1 in/1 out	2 in/1 out
	Expandable Network I/O				■	■
	Full Closed Loop Encoder	■	■			■
	Auxiliary Encoder Input				■	■
	Absolute Encoder Compatible	■	■	■	■	
	H. S. Position Latch Input	■	■	■	■	■
Motion	Table of Index Moves	50	50	128	Programmable	Programmable
	Point-to-Point Motion	■	■	■	■	■
	Electronic Gearing				■	■
	Electronic Camming				■	■
Amplifiers	SGDH Sigma II	■	■	■	■	
	SGDG LEGEND					■
Motors	SGMAH, SGMPH, SGMGH, SGMSH/UH, and Linear	■	■	■	■	▼
	SGMCS Direct Drive	■	■	■	■	
	SGMBH Large Capacity	■	■	■	■	

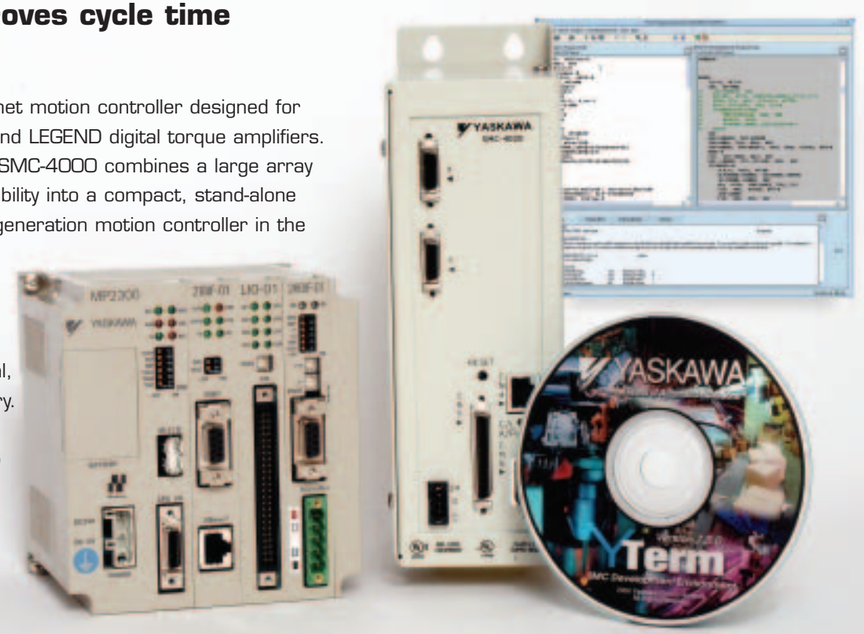
● RS232 communication for optional serial port setup
◆ Inputs select index table, outputs based on position
■ Applies to entire product line
▼ Applies to part of product line

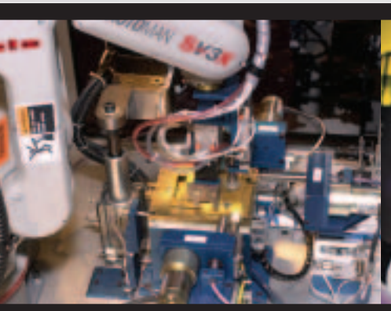
Simplified Control

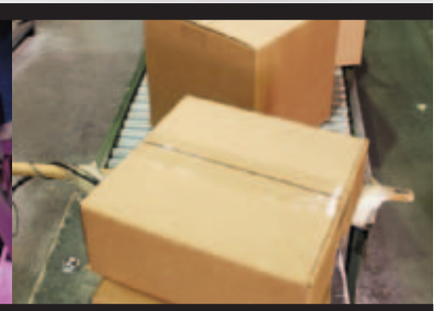
- **Multi-axis motion and machine control**
- **Yaskawa control-to-motor solution improves reliability**
- **Application templates reduce development time**
- **Tightly integrated motion, I/O, and network communication improves cycle time**

The SMC-4000 is a multi-axis Ethernet motion controller designed for use with Yaskawa's Sigma II series and LEGEND digital torque amplifiers. Available in 2 or 4 axis models, the SMC-4000 combines a large array of features with easy setup and reliability into a compact, stand-alone package. The SMC-4000 is a third generation motion controller in the SMC product line.

The MP2300 system provides integrated sequence and motion control for case-packing, form-fill-seal, labeling, and flow-wrapping machinery. Virtually unlimited electronic gearing and cam profiles are available for up to 48 axes of motion. Ethernet, DeviceNet, and Profibus connectivity are available with optional modules.







Multi-axis Controllers	SMC-4000	MP2300
		
Emphasis	General Motion Control, short development, fast start-up time	Machine Control, Packaging Machine Systems
Software	YTerm – 8 multi-tasking threads, input and fault interrupts, autotuning, system monitor, syntax checking, context sensitive help, real-time and historic oscilloscope	MotionWorks – Ladder with function blocks for process and motion, text based motion, 256 motion programs, 1 ms high scan synchronized to motion, low scan for machine I/O, full oscilloscope, system monitoring, cam tool
Motion	Homing, Jogging, Point-to-Point, Registration, Contouring, Gearing, Cam Profile, Linear, Circular, and Helical Interpolation	Homing, Jogging, Point-to-Point, Registration, Contouring, Gearing, Cam Profile, Linear, Circular, and Helical Interpolation
Electronic Cam Functionality	1024 points with interpolation, slave phase shifting, one virtual master, one cam master	Cam Tool software module, 25 selectable cam profiles, 4096 points with interpolation, phase shifting master or slave, unlimited virtual masters, unlimited cam masters, dynamic cam profile adjustment, dynamic cam profile curve fitting with position and velocity matching
Number of Axes	2 or 4*	up to 48
Servo Update	4 axes in 500 µs	8 axes in 1 µs, 16 axes in 2 µs
Motion Interface	Analog torque or speed mode, all tuning in the controller, pulse and direction	Mechatrolink-II high speed digital motion network, analog speed mode, pulse and direction
Network Connectivity	10base-T Ethernet Modbus TCP/IP master, TelNet (ASCII)	10-base Ethernet standard TCP/IP, Modbus TCP/IP, Melsec-A, Memobus Protocol, DeviceNet master/slave, Profibus slave
PC HMI Communication	RS232, Ethernet Modbus TCP/IP, TelNet, OCX driver	RS232/422/485, Ethernet, Third party OPC server via Modbus TCP/IP
Hardware Configuration	All-in-one, no software configuration required	Up to three modules, self configuration
On Board I/O	8 in / 8 out digital, overtravels, external encoder*	8 in / 4 out plus I/O modules
Expandable I/O	Modbus TCP/IP third party I/O module*	Up to 63 Mechatrolink-II nodes, Third party fieldbus I/O modules
Program Memory	2000 lines x 80 characters plus 15k array	120K steps of ladder or 24K lines of motion text plus registers, size may vary

* NOTE: For more axes or larger I/O counts, contact your sales representative.

Added Value

THE DEMAND FOR BETTER CONTROL INCREASES SALES GROWTH OF YASKAWA SERVOS – OVER 4 MILLION SERVOMOTORS SOLD

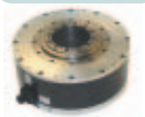
Identifying the growing need for servo control in a multitude of industrial machinery and equipment applications, Yaskawa developed and introduced its first family of AC servomotors in 1984. Since its introduction, the company has experienced incredible success and sales growth with its servo products. Within its first decade of production, the company achieved the one million sold mark.

In the next decade, Yaskawa pioneered segmented stator design which reduced size and cost of Sigma Series Servomotors and allowed us to reach sales of 4 million units.

Servo control systems have become an essential requirement to makers of machinery and equipment directly affecting the performance, capabilities, and value of their machines. Recognized for efficiency, precision, and accuracy, servos are used extensively in a variety of industries including packaging, machine tool, printing, food processing, robotics, textile, semiconductor processing, and assembly machinery.

All Sigma II and LEGEND amplifiers feature all digital architecture; high resolution, serial encoder feedback, automatic motor recognition, low torque ripple; and high bandwidth. These result in the benefits of smooth motion at low speed, higher load-to-rotor inertia ratios and decreased settling time.

All of Yaskawa's servo products are UL, cUL listed and CE compliant. In consideration of the environment, Yaskawa practices lead-free manufacturing processes and techniques.

		Rotary Servos								
		Small Capacity		Medium Capacity			Large Capacity	Direct Drive	Sigma Mini	
		SGMAH	SGMPH	SGMGH	SGMSH	SGMUH	SGMBH	SGMCS	SGMM	
										
Motor Parameters	Sizes Within Series	6	5	10	6	3	5	17	2	
	Rated Torque Range [lb-in]	0.8 – 21	2.8 – 42	25 – 845	28.2 – 140	14 – 43	1239 – 3100	17.7 – 1770	0.28 - 0.56	
	Peak Torque Range [lb-in]	2.5 – 63	8.4 – 126	79 – 1988	84.4 – 422	57.6 – 190	2478 – 6120	53 – 5310	0.84 - 1.68	
	Rated Speed [rpm]	3000	3000	1500	3000	6000	1500	150-200	3000	
	Max. Speed [rpm]	5000	5000	3000 [1]	5000	6000	2000	250-500	5000	
	Power Range [kW]	0.03 – 0.75	0.1 – 1.5	0.5 – 15	1 – 5	1 – 3	22 – 55	0.02 – 3	0.01 – 0.02	
	IP Rating [2]	IP55	IP67	IP67	IP67	IP67	IP67	IP42	IP42	
	Inertia	LOW	MEDIUM	MEDIUM	LOW	LOW	MEDIUM	HIGH	LOW	
	Flange Size [mm]	40-85	60-120	130-220	100-130	116-155	250-300	135-360	25	
Amplifier Voltage	24VDC								■	
	100VAC, 1-Phase	▼	▼							
	200VAC, 1-Phase	■	■	▼	▼			▼		
	200VAC, 3-Phase	▼	▼	■	■			▼		
	400VAC, 3-Phase [3]			■	■	■	■			
Encoder Options	Incremental	13-bit	13-bit	17-bit	17-bit	17-bit	17-bit		13-bit	
	Absolute	16-bit	16-bit	17-bit	17-bit	17-bit	17-bit	20-bit		
Misc. Options	Holding Brake	■	■	■	■	■	▼		■	
	Shaft Seal	■	■	■	■	■	■			
	Gearbox		■	▼						
	NEMA Flange	▼								
Amplifiers	SGDH Sigma II 	■	■	■	■	■	■	■		
	SGDG LEGEND 	■	■	▼	▼					
	SGDF Sigma Mini 								■	

[1] 11 & 15 kW have max speed of 2000 rpm [2] Excluding shaft [3] 380-480 VAC +10/-15% ■ Applies to entire product line ▼Applies to part of product line

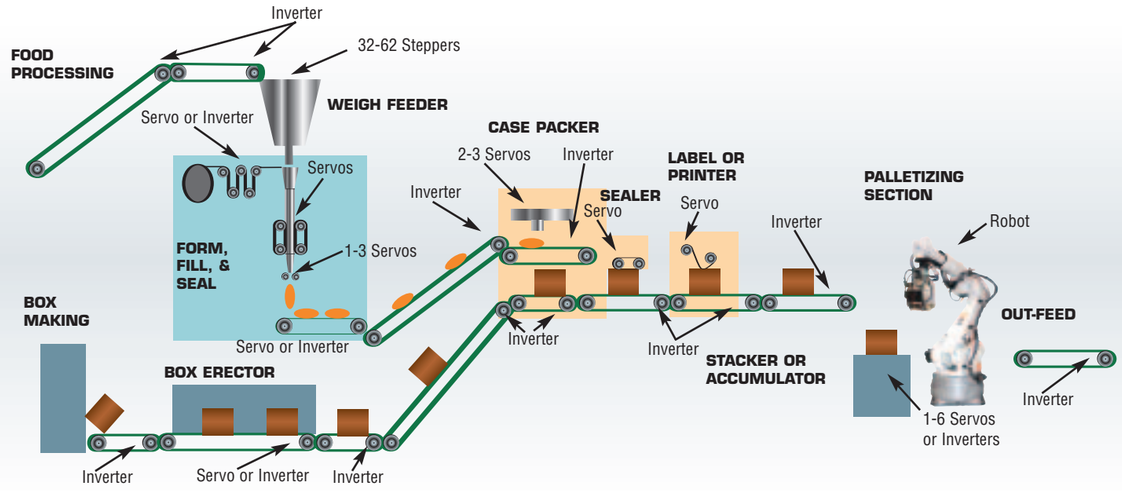
LINEAR SERVOMOTORS MEET THE DEMANDS OF THE EVER-CHANGING NEEDS OF OUR CUSTOMERS

All Yaskawa linear servomotors feature plug-and-work connection with Sigma II and LEGEND amplifiers through automatic motor recognition and serial encoder technology. Yaskawa's linear servomotors are supplied as components or as an integrated slide. The components include a coil that directly drives the load and modular magnet tracks that allow almost unlimited machine length. The Sigma Trac slide includes direct drive components, carriage, bearings, base, cable carrier, and linear encoder all integrated into a plug-and-work package.

			SGLGW	SGLFW	SGLTW	SIGMA TRAC
Motor Parameters	Sizes Within Series		6	8	10	6
	Rated Force Range	lbs [N]	10.5 – 49.5 [47 – 220]	5.6 – 180 [25 – 800]	29.2 – 450 [130 – 2000]	5.6 – 89.9 [25 – 400]
	Peak Force Range	lbs [N]	31.5 – 148 [140 – 660]	19.3 – 540 [86 – 2400]	85.4 – 1350 [380 – 6000]	19.3 – 270 [86 – 1200]
	Max. Speed	in/sec [m/sec]	197 [5]	197 [5]	197 [5]	197 [5]
	Coil Mass Range	lbs [kg]	0.86 – 2.5 [0.39 – 1.13]	1.5 – 25.3 [0.7 – 11.5]	5.7 – 94.7 [2.6 – 43]	Integrated
	Magnetic Attraction Force Range	lbs [N]	Zero	70.6 – 1863 [314 – 8289]	Zero	Integrated
Features	Coreless Coil		■			
	Iron-core Coil			■	■	■
	Coil and Magnet Track Components		■	■	■	
	Integrated Slide					■
Amplifier Voltage	100VAC, 1-Phase		▼	▼		
	200VAC, 1-Phase		■	▼	▼	▼
	200VAC, 3-Phase		▼	▼	▼	▼
Amplifiers	SGDH Sigma II		■	■	■	■
	SGDG LEGEND		■	▼	▼	■

■ Applies to entire product line ▼Applies to part of product line

Complex Applications



PROCESS LINE EXAMPLE

Process lines consist of a series of machines performing sequential steps of a process. The success of a line is often a function of how effectively the sections integrate. Yaskawa offers many solutions to maximize integration.

- A single Yaskawa controller can manage multiple machines, providing seamless integration.
  - High-end Yaskawa controllers are complete machine controllers capable of providing full process management
  - Yaskawa controllers can also interface with PLCs providing powerful motion engines to multiple machines
  - AC drives, servos, and robots can coordinate under a common controller platform offering a seamless interface
- Yaskawa offers a complete range of motion solutions allowing natural interoperability between various types of solutions.
  - Service, training, and support become easier due to Yaskawa's inherent interconnectivity
  - There are opportunities for combined product discounts and reduced spare inventory
- A wide variety of network connectivity options are available.
  - Networks for connecting between process stations and/or machines
  - Connectivity to process and enterprise level management
- Yaskawa offers many pre-engineered solutions designed to simplify and eliminate problems resulting from product transfer between machines. One example of this is the Synch-Belt application on page 12.

Our Experience

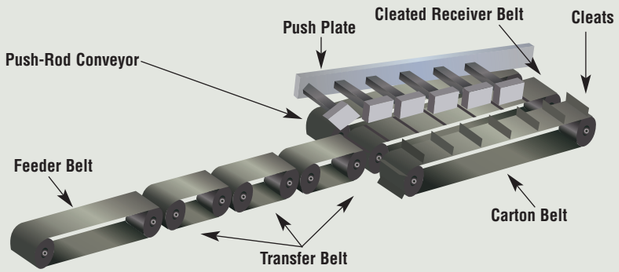
Yaskawa has extensive experience providing solutions for Factory Automation, Packaging, Semiconductor, Automotive, Machine Tool, Converting, Assembly, and more. This expertise allows Yaskawa to provide superior solutions for most applications. Examples of several applications are shown on the following pages.

ROTARY CAM

A Cam is defined as any application in which an axis moves in a predefined profile based on the position of another axis. Usually, there is a sensor to detect a product or a mark on a package. This sensor signal is used to determine where the rotary axis needs to be to perform its operation.

CARTONER

A Cartoning machine takes randomly spaced products from an upstream process and inserts them into cartons. These products typically come from another packaging machine, such as a Filler-Sealer or Wrapper. Transfer belts (Synch-Belts) are used to transfer product from random intervals to precisely spaced product locations on a receiving belt. The Synch-Belt accelerates or decelerates the product to position it at an exact sequence position on the receiving belt. These sequential positions are in exact phase with cartons on the carton belt running parallel to the receiving belt. The rear flaps are folded and glued to close the rear end of the carton. Products on the parallel receiving belt are pushed across into the cartons, which are precisely aligned with the products. After the product is in the carton, the front flaps of the carton are folded and glued.



VERTICAL FORM, FILL, AND SEAL MACHINES

Form, Fill and Seal is a continuous process where plastic film is formed around a mandrel into a tube. Digitally geared transport belts on each side of the filling tube pull the plastic tube down the filling tube to the exact desired bag length. An edge sealer seams the edges of the plastic together to complete the tube.

A feeder above the mandrel feeds the contents down the filling tube at timed intervals into the bags. The cyclic sealing bar seals and separates the bags. This cam action sealer uses registration to minimize material waste and align to printing on the film. The filled and sealed bags then drop onto a conveyor to exit the machine.

Auxiliary equipment may be used to perform secondary functions to the plastic web, such as printing, installing a plastic zipper, etc.

Yaskawa's ability to sculpt the motion profiles limits shock loading during acceleration and deceleration, decreasing wear and reducing the chance for web breakage.

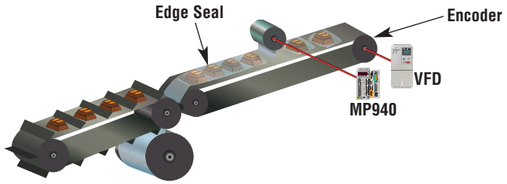
I/O control integrates related machine functions such as thermocouples where PID adjustments are performed at the controller.

All parity functions are done by the controller and automatically integrate into the process.

Solution Capabilities

Yaskawa offers powerful, pre-engineered solutions designed to make complex applications easy to program. These solution packages offer significant benefits to machinery manufacturers and their customers.

- Low risk – pre-tested to work
- Easy to use – drop-in code
- Less downtime – designed to maximize productivity
- Higher performance – unique features
- Can be modified – customized to application
- Protects process secrets – security provisions

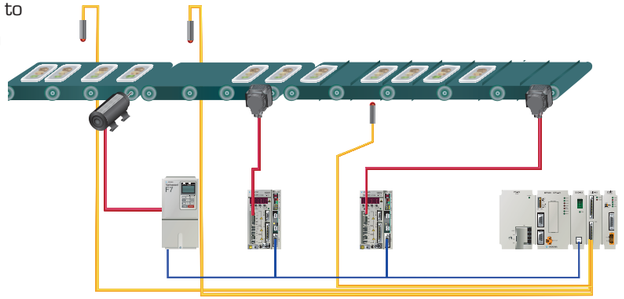


ROTARY KNIFE

A product (in this case, a candy bar) is fed by a conveyor. Packaging film, from a continuous roll, is formed into a tube around the product. The tube edge is sealed and the heated, rotating knife seals and separates the bars into individual packages. An encoder on the conveyor provides the master speed reference to the knife controller. This provides the position reference for the cam cut profile. A requirement of the cam profile is that the knife speed match the conveyor speed during a cut. Moving too fast or too slow will cause an inconsistent cut and may ruin the product. A sensor reads registration marks on the film. This allows the knife controller to make final position adjustments to compensate for any variation of product position.

SYNCH-BELT APPLICATION

A Synch-Belt is an intermediate conveyor that takes randomly spaced products from a feed conveyor and precisely positions them on a process conveyor. The Synch-Belt must accelerate or decelerate to exactly align the product to the target position on the receiving belt. Products precisely positioned onto the receiving belt can be easily sequenced into a process.



Multiple Servos and VFDs with Digital Network Option

The number of Synch-Belts required in an application is determined by the size of the product being moved and the relative speeds of the related conveyors. In this example, a single Synch-Belt is shown. Obviously, it is desirable to minimize the number of Synch-Belts in an application to reduce cost and size of the machine.

RANDOM ROTARY PLACER

This pre-engineered application template provides an adaptive cam profile (cam shift) to align products with randomly spaced targets.

In this example, CDs are stored in a magazine and a vacuum head on the placer picks up a CD as it passes the magazine.

Cases are randomly spaced on the conveyor and a sensor detects a case as it passes. When a case is present, the placer matches speed, aligns it with the case, and releases the CD.

This solution allows easy program development for various applications including:

- Rotary knives
- Rotary label machines
- Flying cut-off
- Continuous part placement

Technical Training

Trained individuals turn automation visions into reality. Yaskawa provides standard and customized courses on all products utilizing a “learn by doing” philosophy, emphasizing “hands-on” activities and demonstrations. Yaskawa has a variety of training programs ranging from factory training classes and customer site classes to live web classes and e-Learning Modules.

Yaskawa Product Training Engineers are degreed engineers with extensive industry experience and product expertise. Product Training Engineers work together with product engineering, service, and marketing to develop training classes for our customers that provide real world skills to enhance job performance.

Yaskawa offers comprehensive technical training programs emphasizing “hands-on” learning. Training on our products provides extensive application instruction to prepare for project implementation. Classes are held monthly at training locations across the country and are limited in size in order to provide personal attention to each student.

PRODUCT AVAILABILITY

To ensure product availability and support, Yaskawa has made a commitment to assemble and modify products at its manufacturing facility in North America. An extensive inventory including peripheral devices is maintained. The Yaskawa Asset Management program also gives customers the opportunity to store spare parts at their facilities. They are obligated only to purchase on an as-needed basis. These empowerment programs help maximize system up-time and factory productivity.

AMERICAN DISTRIBUTION SALES CHANNELS

Yaskawa uses a comprehensive network of highly qualified and highly trained channel partners to provide Total Customer Support. Our valuable channel acts to insure the correct application of Yaskawa products across a broad range of needs. This local channel provides the customer with service, knowledge, support, and inventory closest to where it is needed. Yaskawa’s channel partners maintain a rigorous certification standing with over 200 hours of classroom and field instruction at the highest certification level. Yaskawa’s own sales force and support center personnel participate in continuous training and provide ongoing support and enhancement services to all of our partners to ensure the highest level of customer satisfaction. Visit Yaskawa’s Web site at www.yaskawa.com to locate one in your area.

Worldwide Services

Yaskawa offers worldwide support with application assistance, start-up, maintenance, troubleshooting and repair, as well as internet tools and telephone support. With production facilites and offices in Asia, America, and Europe, Yaskawa provides a total global service and support network for its customers.

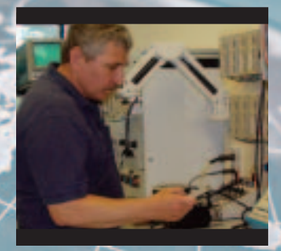
Through one web site address, www.yaskawa.com, customers can access several Yaskawa global web sites that best service their geographic area and language preference. Each web site has an extensive document and knowledge database. Customers can easily locate information and select products and available services.

In the Americas, telephone assistance is available 24/7 at 800-YASKAWA (800.927.5292). Our phone support group is product certified to assist you with current and legacy product requirements.

LOCAL APPLICATION SUPPORT AND FIELD SERVICE

Yaskawa’s network of field engineers is available nationwide to assist with installation and troubleshooting of complex applications. Our field service engineers are certified motion control specialists with many years of experience to assist with your application and technical needs. Users of servos, controllers, and networks are never more than a phone call away from reliable technical support at 1-800-YASKAWA.

REPAIR CENTER



Yaskawa Electric America, Inc. maintains a certified repair and modification center that uses approved parts, procedures, and testing to renew your equipment. Normal repair/return cycles (including burn-in) average six days.

48-hour emergency turn-around service is also available. Orders for new material requiring special modifications are processed through the same facility to provide the fastest response to customer needs. Electronic equipment is repairable as long as parts or economical modifications are available. Some electronic controls in the United States are over 30 years old and are still repairable. This commitment to customers and our products enhances the investment made in Yaskawa products.

YASKAWA FIELD ENGINEERING SERVICES

Yaskawa’s local resources have global depth whenever and wherever needs arise. Design, system integration, and field repair assistance are handled locally by degreed engineers and trained technicians. Yaskawa application engineers offer phone consulting as well as on-site assistance to get the maximum benefit from your installation. Multi-national projects with distributed design and build locations can depend on careful integration via the Yaskawa network. Customers are able to handle more projects or bring them online faster by utilizing Yaskawa’s resources. Whether the need is for emergency service or international project coordination, customers worldwide depend on Yaskawa.