F&B Solution with **MELSEC iQ-F** series

Food & Beverage
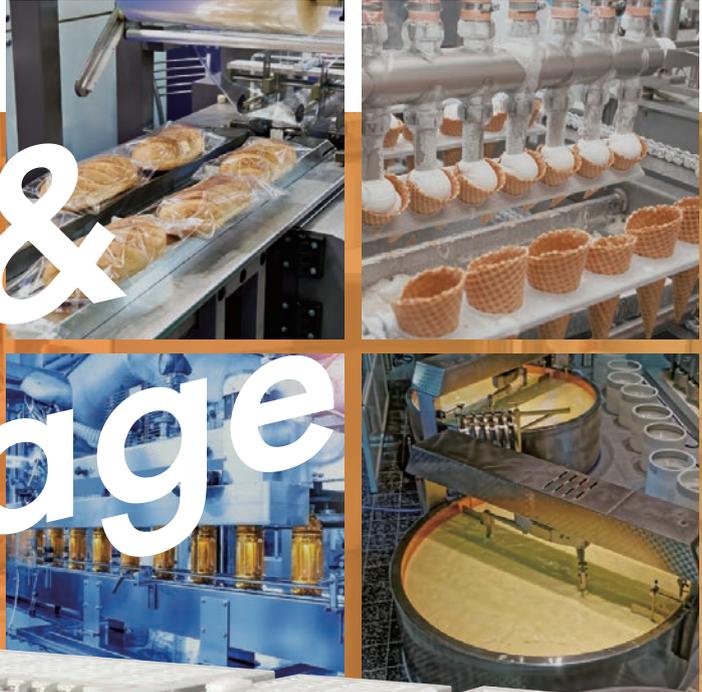
MELSEC iQ-F series

Our MELSEC iQ-F series offers the best solutions for your food processing machinery and food manufacturing lines.

Screw terminal block type

Maximum number of control points
512 * points

Program capacity
64 k/128 k steps

Pulse train
200 kpps

Up to
4 axes

FX5U
All-in-one model with advanced functions

As an all-rounder CPU, this module can help introducing IoT to facilities and equipments in any scenes.

High-speed counter function (Max. 8 ch)	Positioning function (Up to 4 axes)
Ethernet port	RS-485 port
SD memory card slot	Analog input/output

Screw terminal block type

Maximum number of control points
256 points

Program capacity
48 k steps

Pulse train
200 kpps

Up to
3 axes

FX5UJ
Entry model with advanced functions

Equipped with variety of built-in functions while demonstrating excellence in cost performance, this single module is recognized for its ease of use.

High-speed counter function (Max. 8 ch)	Positioning function (Up to 3 axes)
Ethernet port	USB (Mini-B) connector
SD memory card slot	

Spring clamp terminal block type

Connector type

Maximum number of control points
512 * points

Program capacity
64 k/128 k steps

Pulse train
200 kpps

Up to
4 axes

FX5UC
Compact model with advanced functions

Its slim body fits into tight space inside the control panel, allowing for flexible installation options. The use of spring clamp terminal blocks offers superior vibration isolation and reduces wiring work.

FX5UC
Compact model with advanced functions

Compact body with I/O connection to external terminal block allows for flexible installation options inside the control panel.

| High-speed counter function (Max. 8 ch)	Positioning function (Up to 4 axes)	Ethernet port	RS-485 port	SD memory card slot

*: It is the maximum number of control points including remote I/O points.

Start IoT with the advanced functions of MELSEC iQ-F series

Data collection

Data logging function

| FX5U | FX5UC | FX5UJ |

Trigger
Fault cause
NG signal from inspection machine
Trigger condition value
Temperature sensor
Pressure sensor
Inspection machine

Logging file (CSV file)

Collects data before and after occurrence of a trouble.

Data management can be performed using Microsoft® Excel®.
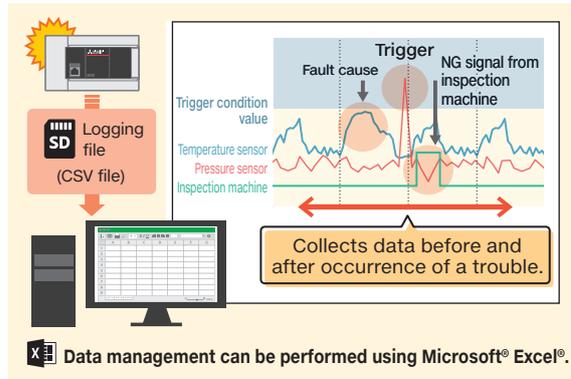
A maximum of 512 data points can be collected at the specified intervals or any desired timing. Store the collected data on an SD memory card in the CSV*1 or binary file format.

File transfer function

| FTP server | FX5U | FX5UC | FX5UJ |
| FTP client | FX5U | FX5UC | FX5UJ*2 |

Factory — Office
FTP server — File reading/writing — FTP client
Logging file — Ethernet
FTP client — File transfer — FTP server
Logging file — Ethernet
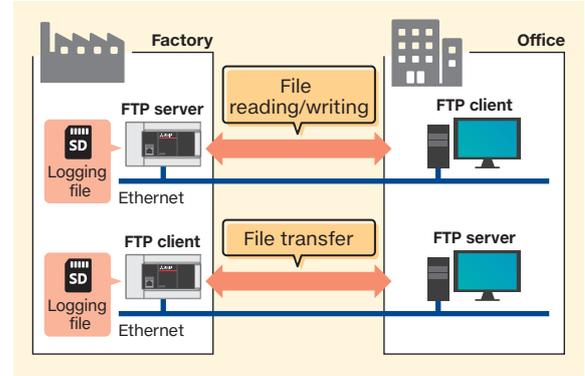
Remotely acquire factory logging files right from your office, and reduce travel and maintenance work.

Monitoring

Web server function

Factory — Office
Ethernet
Internet
VPN
Wireless LAN — VPN router — VPN router — Wireless LAN
Tablet
Displays on the system Web page. Displays on the user Web page.
or
Tablet
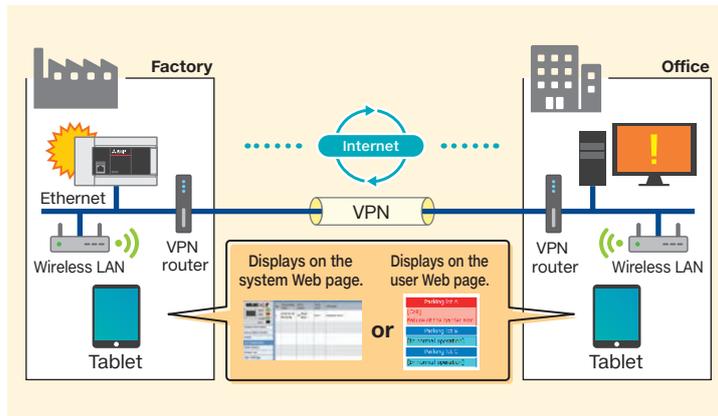
System Web page

| FX5U | FX5UC | FX5UJ |

Monitor and diagnose the CPU module from the Web browser on your personal computer or tablet.

User Web page*3

| FX5U | FX5UC | FX5UJ |

Customize the Web pages for easy viewing on your personal computer or tablet.

Maintenance

Memory dump function

| FX5U | FX5UC | FX5UJ |

Factory — Office
Collection of error information
Memory dump file read
Ethernet
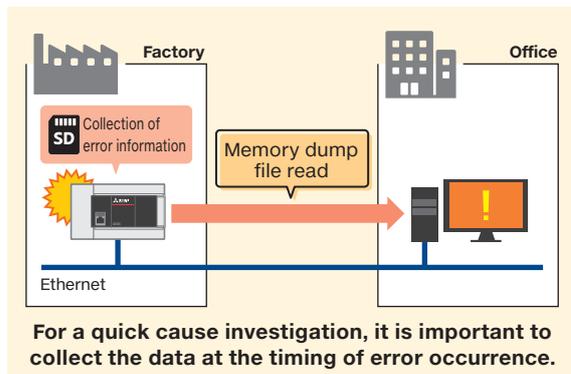
For a quick cause investigation, it is important to collect the data at the timing of error occurrence.

Store the device values of the CPU module to an SD memory card at your desired timing.

Real-time monitor function

| FX5U | FX5UC | FX5UJ |

Numerical verification
Numeric values at error occurrence can be checked immediately!

Graph verification
GX LogViewer
It changed here!
This is the cause!
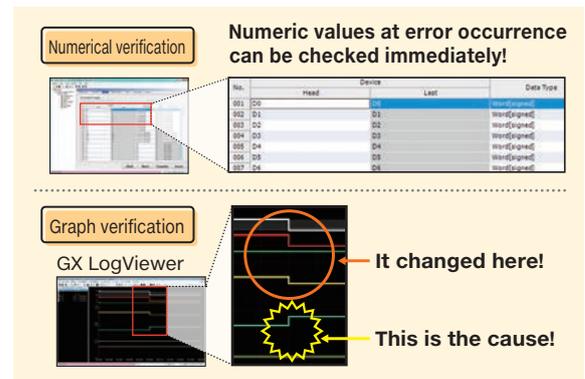
Monitor the status of the devices that are specified in GX LogViewer in real time to quickly start up the facility and improve the problem solving efficiency.

*1: FX5UJ CPU module is to be supported in the near future.
*2: To be supported in the near future.

*3: An SD memory card is required to use user Web page.

An accelerated adoption of HACCP in the food industry

HACCP stands for Hazard Analysis Critical Control Point and regulates food hygiene. It was established in the 1960's originally to ensure the safety of space food. HACCP is used to analyze possible hazardous factors in the food manufacturing process. It is a food hygiene control method that defines critical control points to monitor and record every step in the manufacturing process.
The use of PackML helps visualize the manufacturing process, prevents contamination, and prevents data tampering to ensure the safety of the food manufactured.

Constant monitoring and recording of the entire process prevents quality-related and manufacturing-process-related problems. HACCP helps visualize the food manufacturing process and increases the productivity as well as the trust in your company.

Example manufacturing process in bread baking	Action	HACCP method
Reception of ingredients	Receive ingredients → Store	**Control temperature/humidity** • Quality control of the ingredients in a hygienic environment
Preparation	Mix ingredients (flour, water, yeast, etc.) → Knead → Leaven (primary) → Add more ingredients and knead	**Monitor and record the process to ensure traceability** • Stability in product quality • Detection of contamination
Shaping	Divide the dough into specific weight with a divider → Roll the dough into shape with a roller	
Leavening	Leaven the dough (secondary)	
Baking	Fine-tune the baking time and bake in an oven	**Properly control baking temperature and process time** • Stability in product quality
Cooling	Slowly cool the bread to keep the steam from the bread from filling the package	
Packaging	Print/label	**Detect and remove contamination using a metal detector** • Prevention of outflows of contaminated products
Packing	Box	**Verify of labels** **Manage traceability**
Shipping	Store and ship	**Promptly ship in clean vehicles** **Record shipment**

Higher productivity and stable product quality

▌ Food manufacturing machine

P6 - 9

(1) Agitator/mixer   (3) Oven
(2) Paste filling machine (4) Packaging machine (horizontal pillow type)

Reduced the total costs including the production line launching, running costs, and maintenance. Increased productivity with an integrated process management.

▌ Solutions for food manufacturing process control

P10 - 11

(1) PackML
(2) Complies with FDA 21 CFR Part 11

Automated problem detection improves inspection accuracy

▌ Traceability control solutions

P12 - 13

(1) Machine Vision
(2) Code reader

GOT2000
Graphic Operation Terminal

Integrated control of all data with IoT

▌ Quality control and automation solution

P14 - 15

Partnership companies
(1) IO-Link sensor [Balluff Inc., OPTEX FA CO., LTD.]
(2) Label printer [SATO HOLDINGS CORPORATION, BROTHER INDUSTRIES, LTD.]

Preparation

Shaping

Leavening

Cooling

Baking

Packaging

Packing
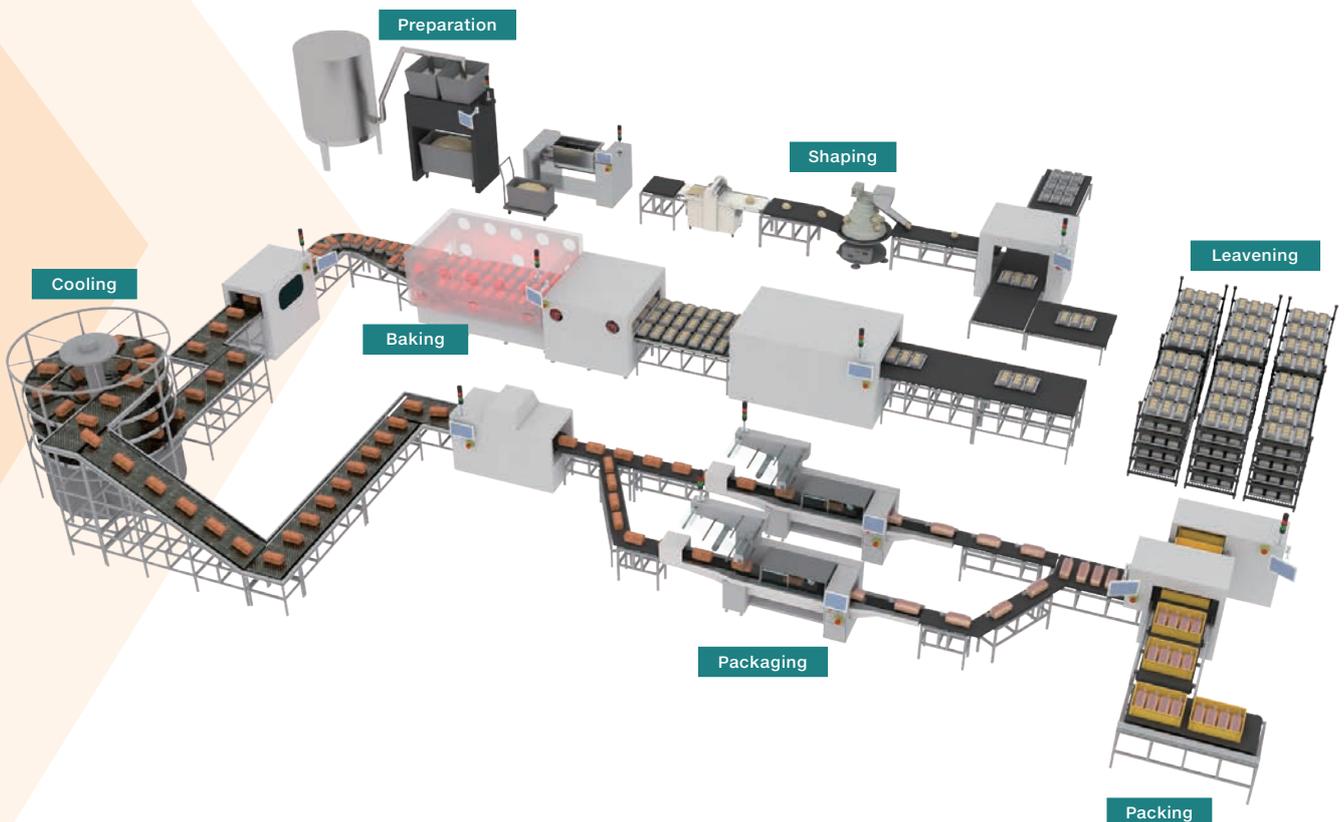
Application example
01

Agitator/mixer

System configuration example

Analog input

GOT

Flow sensor, pressure sensor, etc.

Ethernet

Built-in RS-485 port (MODBUS/RTU, inverter communication, etc.)

Inverter   Motor
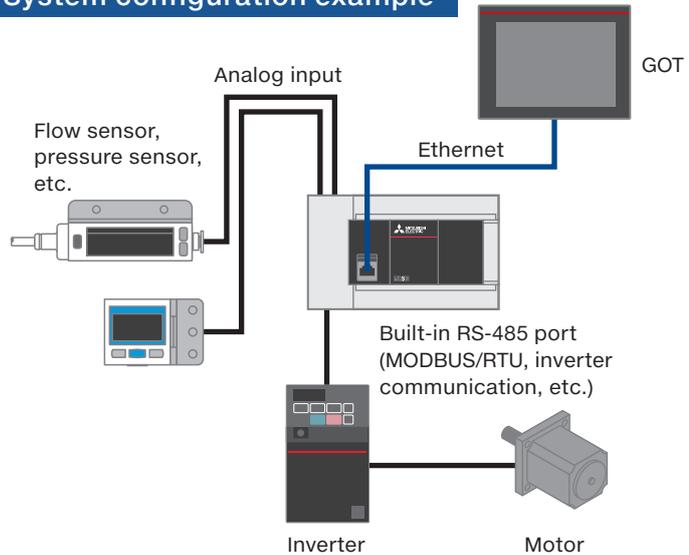
Device features

Agitators and mixers are food processing machinery that mix multiple ingredients, using impellers.
While maintaining the fluidity of the ingredients, they can uniformly mix the ingredients and are used for a variety of foods, such as breads and cakes. When making breads, the way the dough is mixed depends on the dough type. Uniform mixing of the dough is the key to achieving good taste and appearance.

What MELSEC iQ-F can do

Point 1
Recipe control that supports a variety of dough types

Preparation of recipe data for different types of doughs facilitates quick process changeover and allows for the use of the same equipment to handle multiple food recipes.

File operation instruction

Read/write in device data from/to the recipe files.

Recipe: French bread

Recipe: Loaf bread

Dough type
Loaf bread
French bread

SD
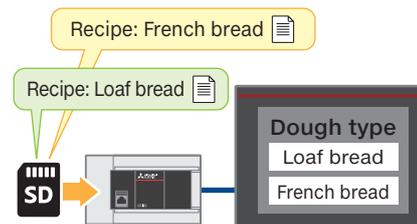
▌ **Reduce process changeover time**

Switch and edit the recipe files from iQ-F.

Recipe: French bread

Point 2
Smooth inverter controlled rotation

The operation of a maximum of 16 inverters can be controlled through RS-485 communication. The inverter-specific built-in instructions properly control the mixing speed for easy inverter control.
The type of control using MODBUS function or analog output function is also available.

Inverter-specific instruction

MELSEC iQ-F have built-in dedicated instructions for Mitsubishi Electric inverter protocols and communication control. The use of inverter-dedicated instructions facilitates programming.

6 types of **specific instructions**

IVCK: Operation monitor
IVDR: Operation control
IVRD: Parameter read
IVWR: Parameter write
IVBWR: Parameter batch write
IVMC: Multiple command

Paste filling machine

System configuration example

Motion module FX5-40SSC-G

Paste filling process

(1) Flattens the dough → (2) Places the paste → (3) Rolls the dough → (4) Seals and cuts the dough

CC-Link IE TSN

Servo amplifier MR-J5W2-G

Rolls the dough

Seals and cuts the dough
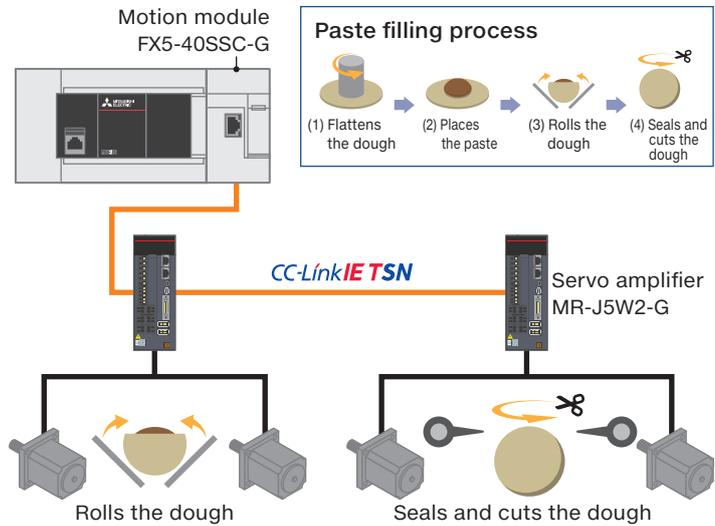
Device features

Paste filling machines are used to make pastries with pasty fillings.
They are designed to wrap the pasty fillings with the dough without damaging the dough, gently as if hand folded. Paste filling machines increase the productivity and maintains product quality.

What MELSEC iQ-F can do

Point 1 — **Advanced synchronization control that reduces the number of mechanical components required such as gears**

As a software-controlled manufacturing option, MELSEC iQ-F eliminates the need for gears, shafts, clutches, transmissions, and cams. Just set the parameters on MELSOFT GX Works3 to easily achieve synchronization control.

Advanced synchronization control of simple motions

Command generation axis

All axes can be synchronized.
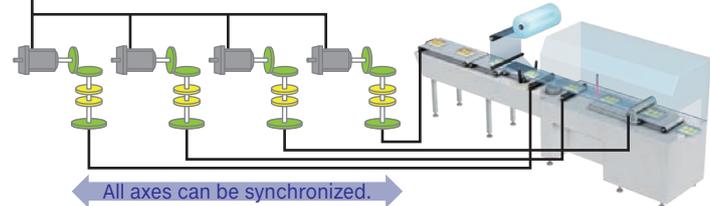
▍**What is command generation axis?**

A command generation axis is an axis that only generates commands. Command generation axis can be controlled independently of the axis to which servo amplifiers are connected (not counted as control axis).

Point 2 — **Monitoring of servo data to visualize device status**

Servo data can be changed and monitored during operation.
Operation status of the servo amplifier and servo motor acquired through CC-Link IE TSN can be transferred to and displayed on the high-level system or the GOT window you created.

Data monitoring

High-level system

Motion module FX5-40SSC-G

MR-J5-G

CC-Link IE TSN

GOT

Feedback of position information and peak load ratio, etc.

HK series

Oven

System configuration example

GOT

Temperature control module FX5-4LC

Ethernet

Temperature input

Temperature control

Heater

Temperature sensor

Solid state relay
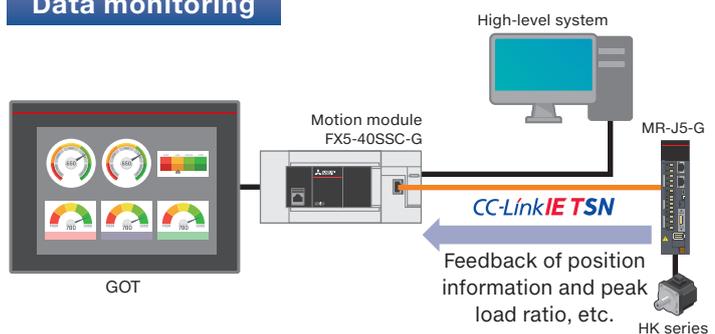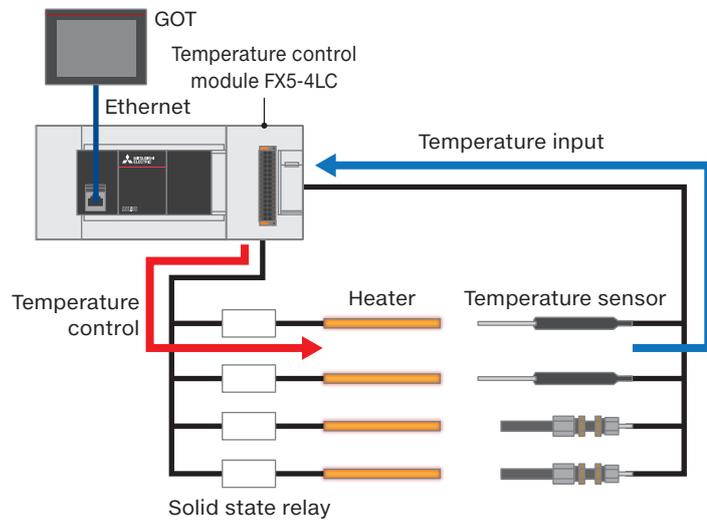
Device features

An oven that evenly bakes breads and cookies in appetizing brown.
Stable baking temperature control is important for bringing out the unique properties of different types of doughs. It is important to effectively produce high-quality goods without unnecessary loss.

What MELSEC iQ-F can do

Point 1

Temperature control for uniform baking

Baking temperatures are controlled based on the temperature information from the temperature control module (FX5-4LC) to avoid overshoot and hunching. Uniform baking ensures stability in product quality.
Temperature data are traceable and are useful for improving product quality.

Temperature control

Temperature

Time

Suppress overshoot!

Temperature

Time

Suppress hunting!
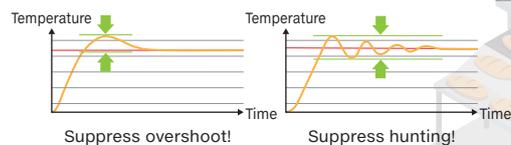
Supports the achievement of SDGs

Prevents uneven temperatures at the start of the oven and reduces food loss.

Point 2

Broken heater wire detection function to quickly identify device problems

Temperature control module (FX5-4LC) detects broken heater wire. Unnoticed broken heater wire can lead to insufficient baking and other quality-related problems.
Minimize food loss by detecting problems early.

Detection of broken heater wire

Detects abnormal temperature drop

Immediately displays the problem

Detection of insufficient baking problem Stops the assembly line

Packaging machine (horizontal pillow type)

System configuration example

GOT GT25

Servo amplifier MR-J5-G

Vertical sealing

Horizontal sealing/film cutting

Inverter FR-E800-E

Motion module FX5-40SSC-G

CC-Link IE TSN

External encoder
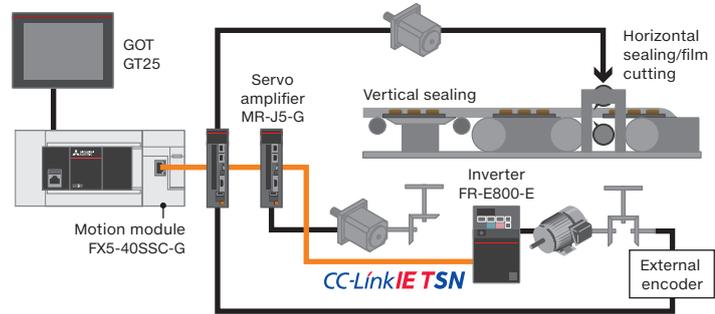
Horizontal pillow packaging process

Product conveying → Film wrapping → Vertical sealing → Horizontal sealing/film cutting
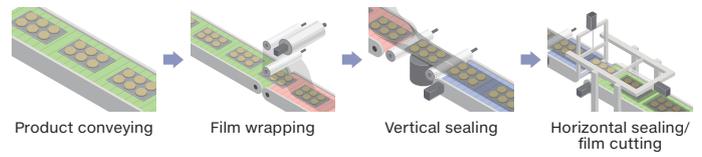
Device features

Horizontal pillow packaging machines are a type of machine that packages solid objects or products in trays in horizontal motion. They wrap belt-conveyed products with pillow-shaped packaging film, seal the ends, and cut the film. They safely package food and seal in the flavor.

What MELSEC iQ-F can do

Point 1

Advanced synchronization and cam control for rotary cutting precision

The synchronization and cam control functions speed up the job while maintaining precision. Use the cam data auto-generation function to easily create cam data of the rotary cutter axis and quickly design the assembly process.

Cam data auto-generation

User-created GOT screen

Parameter settings, including items like sheet length, etc.

Cam data

Synchronous axis length (synchronized axis circumference)

Sheet feeding

Sheet synchronizing width

Sheet length

Cam axis (Synchronized axis) speed

Sheet feeding speed

Stroke ratio

Sheet synchronizing width
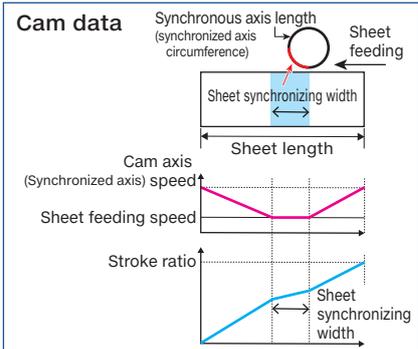
Point 2

The mark sensor corrects sheet length value to ensure precise sheet cutting.

Registration mark on the packaging sheet are read by the sensor to correct for displacement due to elongation, shrinkage, and slipping. Automatic sheet cutting at the registration mark ensure high-quality food packaging.

Mark detection function

Motion module FX5-40SSC-G

Mark sensor ON

Registration mark

CC-Link IE TSN

Mark sensor

Cutter
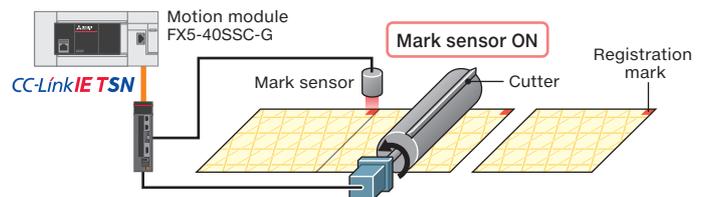
Increase your productivity

Combine iQ-F and a motion module to reduce defects and facilitate the inspection process.

Solutions for food manufacturing process control

PackML solution
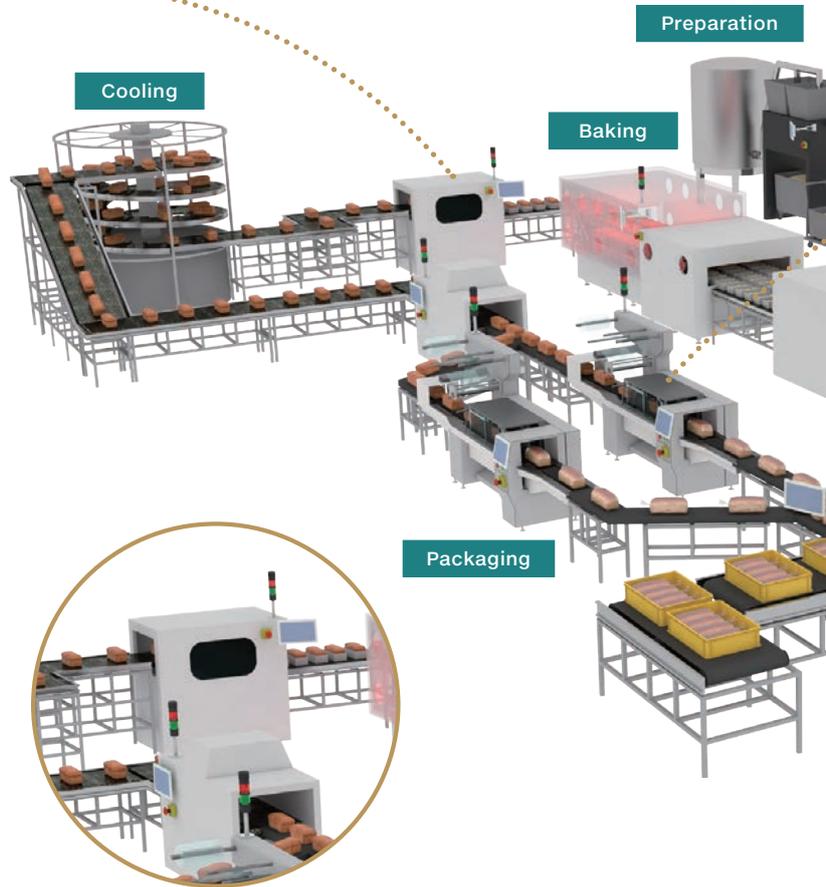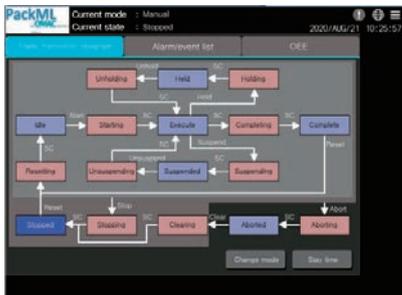
What is Packing Machine Language (PackML)?

Packing Machine Language (PackML) is an automation standard developed by OMAC* and has been used in food packaging and other industries. PackML helps build commonality between disparate equipment on the production line, such as the operation panels, using standardized data points called PackTag to seamlessly connect the high-level system and the equipment.

Preparation

Cooling

Baking

Packaging

Displays production line performance, capacity utilization ratio, and product quality

High-level system

PackTag Communication between high-level systems

Agitator

Bread shaping machine

Uniform window

Integrated project

Uniform window

Integrated project

PackTag
Communication between equipment
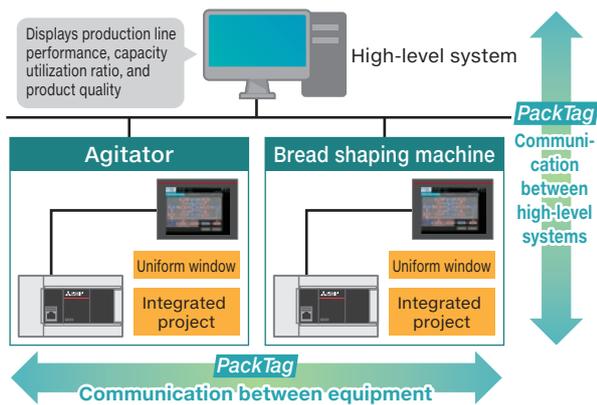
Benefits

Point 1

Supports an international standard PackML

Sample windows and projects in compliance with the international standard are available. These templates reduce the man-hours and the time it takes to design PackML-compliant processes. Equipment of different manufacturers on the manufacturing lines can be integratively controlled on common monitor/control windows and by using common operation, which cuts the operator training costs and the running costs, such as maintenance and facility engineering.
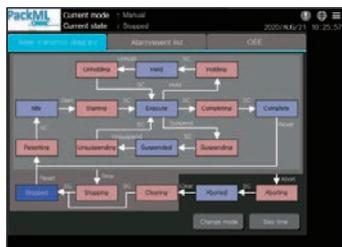
Monitor/control window	**Warning management/monitoring of total facility efficiency**	**PackTag communication**

Warning/event window

OEE window (monitors total facility efficiency)

FB

PackTag

Agitator

Bread shaping machine

PackTag

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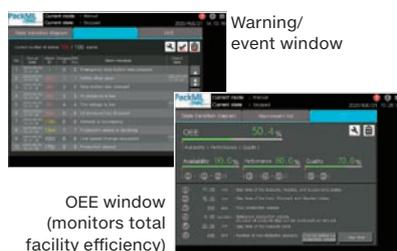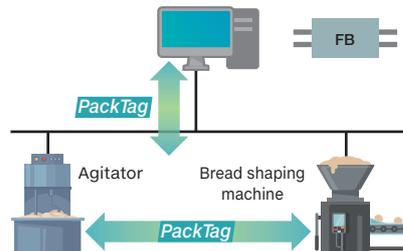
*: Stands for Organization for Machine Automation and Control. It is a consortium of packaging machine manufacturers and has established guidelines to improve machine flexibility and performance.

Shaping

Leavening

Packing

Bread manufacturing process
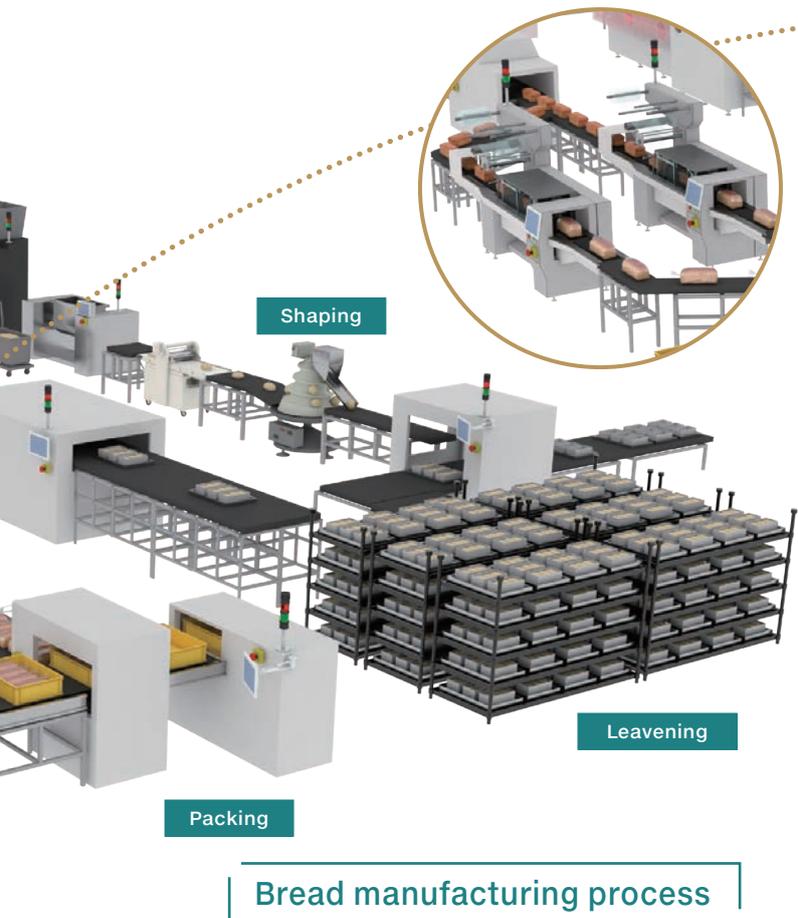
FDA 21 CFR Part 11

What is FDA?

FDA stands for Food and Drug Administration, an organization under the Department of Health and Human Services in the United States.

What is 21 CFR Part 11?

CFR Part 11 is a regulation of the FDA that applies to the use of electronic records and signatures, and requires data change logging and measures against data tampering. Medications and food sold in the United States of America are required to comply with FDA regulations.

Importance of manufacturing process visualization and establishment of traceability

Prompt response to claims of contamination is important to avoid a long manufacturing-line down time.
Poor traceability makes it difficult to identify the affected lots, leading to massive disposal of all stocked products and monetary loss. Visualization of the manufacturing process and establishment of traceability hold the key to ensure efficiency and quality.

Contamination, etc.
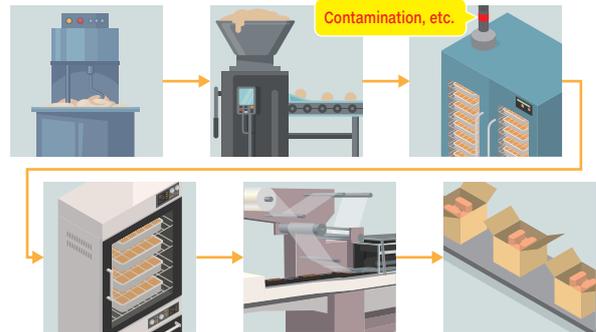
Benefits

Point 2

Compliance with FDA 21 CRF Part 11 ensures complete traceability.

On Mitsubishi Electric's Human-Machine Interfaces (HMIs)-GOT2000, system operators can be registered, and detailed access levels (e.g., for different operation windows or for entire script) can be set for the operators to prevent data tampering. Also, operator actions can be timestamped for record-keeping purposes. Log data and other data are stored in the binary format (which is less susceptible to data tampering), password-protected, and transferred to your personal computers.
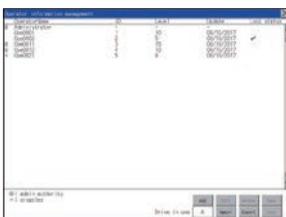
Operator information management window

Setup access authority window
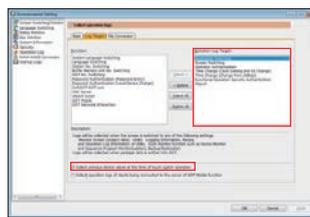
Operation log target setting window
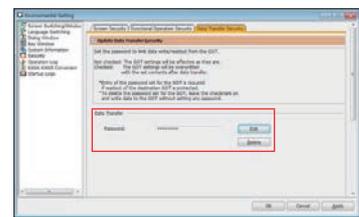
Data transfer security window

Traceability control solutions

Easy automation of inspection and measurement helps maintain product quality.

Useful features

Seamless connection of Machine Vision and GOT helps build an automated quality control system quickly. GOT automatically detects Machine Vision. Select the connection targets and set the parameters.

Machine Vision

HUB

GOT

CC-Link IE Field Basic

Composite Machine Vision monitor view window

In-Sight Explorer FTP settings window

Preparation

Cooling

Baking

Packaging
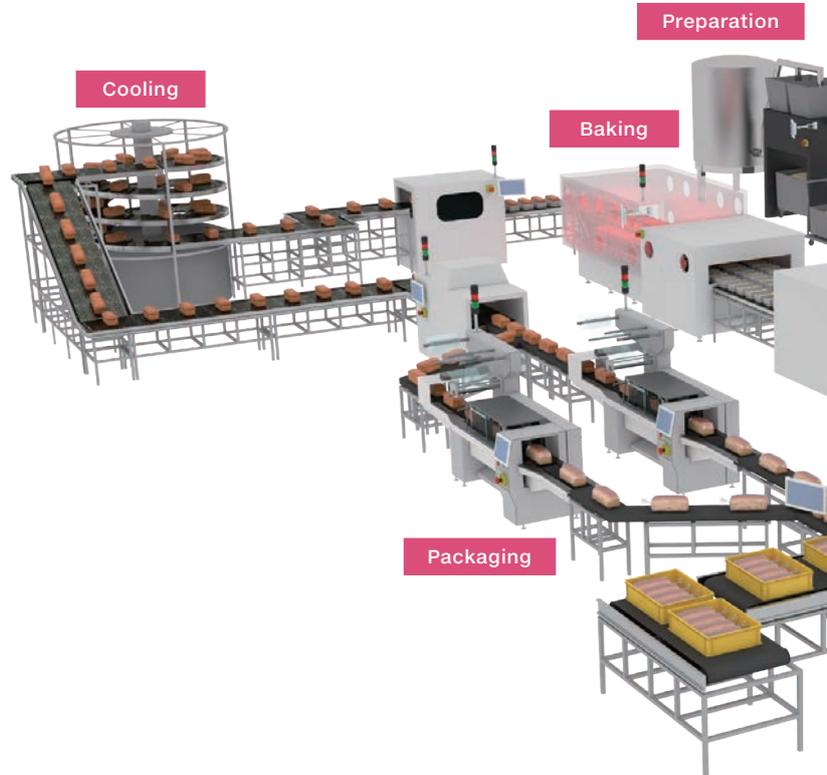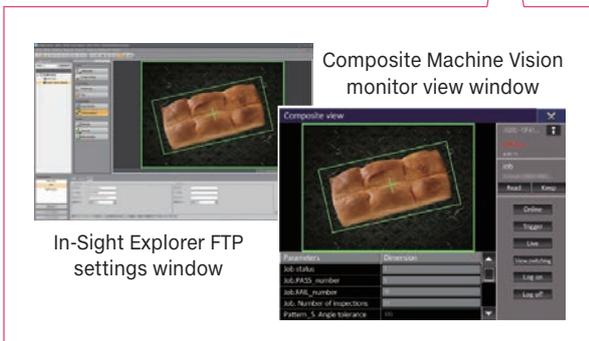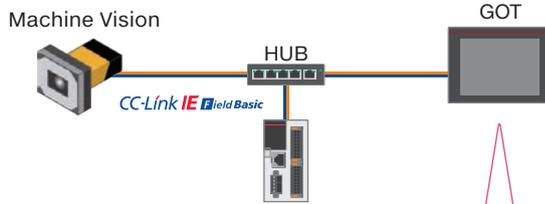
Machine Vision

COGNEX

Product features

- In-Sight 8000/7000 has a built-in PatMax RedLine®*1.
- In-Sight 8000 supports PoE. Connection with fewer cables.
- In-Sight 7000 supports IP67 and has superior environmental resistance.
- Extracts outline from hard-to-read images with high precision.
- In-Sight 2000 identifies basic existence/non-existence.
- Monochrome or color option for all models

Benefits

In-Sight 2000 scans for the presence or absence of expiration date and makes a simple identification of items. In-Sight 7000 and 8000 are capable of higher-level inspection of the expiration date with the use of OCR*2 and identification of package items with the use of PatMax RedLine®. Its built-in function to calculate accurate position-correction values eliminates the need for a function to align the objects to be scanned, reducing the costs and the facility size.

*1: High-speed high-precision pattern matching algorithm
*2: Optical Character Reader

Quickly reads a variety of codes to help with quality control
and traceability at a wide range of production sites.

Shaping

Leavening

Packing
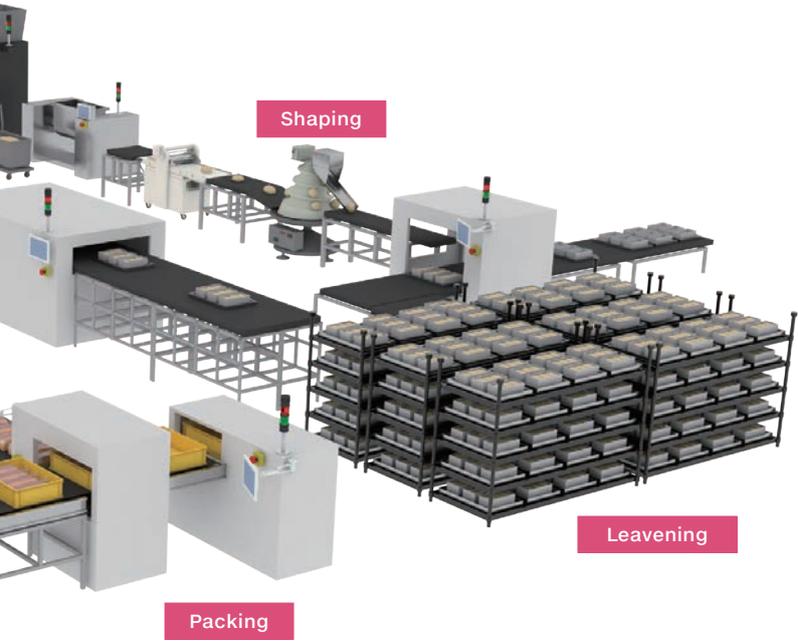
Bread manufacturing process

Useful features

Combined use of GOT and code readers that are
essential for ensuring traceability improves code reader
system usability. A variety of sample windows allows for
easy code-reader tuning and setting changes from GOT
without the need for a computer.

Code reader — FTP communication — GOT

HUB

SLMP communication — MELSOFT communication

Tuning window

Lighting setting window
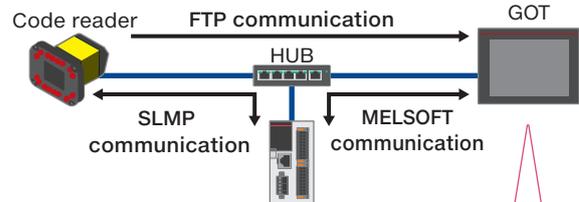
Other available settings: Symbols, code-reader read
setups, device logs

Code reader COGNEX

Codes on a curved surface   Codes on a shiny or glaring surface   Codes in fast motion

Product features

■ With 2D code reading algorithm PowerGrid and 1D code
image processing algorithm HotBars II
■ PowerGrid can read seriously damaged codes or 2D
code with missing quiet zone.
■ HotBars II can read partially missing codes.

Benefits

PowerGrid is capable of scanning wrinkled or glaring codes
on the packages. Because PowerGrid, which operates on
our original algorithms, covers a wide scanning area and
reads the codes in different positions or depths, code
labels on cardboard boxes of different heights on the
assembly line are easily read with PowerGrid.

Quality control and automation solution

Supported	Not supported

Balluff Inc.

▶ **IO-Link gateway BNI00E7**
(IP67 environmental resistance)

▶ **Laser light band sensor BLA**

CC-Link IE TSN	Ethernet	Serial communication	Ladder example*
CC-Link IEF Basic	SLMP	FB*	GOT window example

IP67 environmental resistance

BNI00E7

BLA

Product features

- The use of simple and accurate operating principle, light blocking
- Simultaneous measurements of a variety of properties, such as diameter, position, and gap width
- Object identification based on the measurement values, and object counting function
- A wide lineup of housing sizes
- Intuitive setting via IO-Link or on the built-in display and the buttons

Benefits

Laser light band sensor BLA features a variety of detection/ measurement modes. Products can be identified based on height and width, and missing plastic bottle caps can be detected based on edge positions.
The use of laser light band sensor BLA in combination with IO-Link gateway that supports CC-Link IE Field Network Basic enables the collection of device information from a programmable controller and remote configuration of the sensor settings.

∗: To be supported in the future

OPTEX FA CO., LTD.

▶ **IO-Link master UR series**

CC-Link IE TSN	Ethernet	Serial communication	Ladder example
CC-Link IEF Basic	SLMP	FB	GOT window example

IO-Link master

IO-Link sensor

Product features

- UR-MS16DT supports CC-Link IE TSN and CC-Link IE Field Network.
- UR-ES16DT supports CC-Link IE Field Network Basic.
- A single module handles systems with a mixture of IO-Link and NPN/PNP I/O devices. (Max. 16 ch)
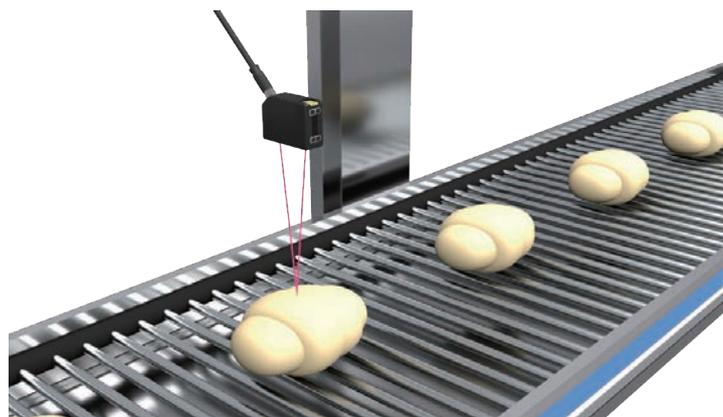
Benefits

A wide lineup of IO-link-compatible sensors, such as photoelectric sensors, are available. For example, some of our sensors measure the thickness of the dough to reduce variations in dough thickness. When used in combination with the IO-Link master UR series that supports CC-Link IE TSN or CC-Link IE Field Network Basic, information collected from the IO-Link-compatible sensors can be collected to the programmable controller.

With our close ties with our partnership companies,
Mitsubishi Electric will provide strong support for your manufacturing needs.

SATO HOLDINGS CORPORATION

▶ **Printer CL4NX-J Plus**
▶ **Automatic labeler LR4NX-FA**

LR4NX-FA

CC-Link IE TSN	Ethernet	Serial communication	Ladder example*1
CC-Link IEF Basic	SLMP	FB*1	GOT window example

Product features

■ Product concept: Universal printer that keeps the manufacturing lines moving
■ Produce high-quality high-precision labels for production processes.
■ Monitor printer job status through the Cloud.
■ Monitor the disposable parts replacement alert through the Cloud.

Benefits

Automatically calculates the weight of the packages and labels the packages. Packages are tagged with relevant information as they pass under the labeler. Package weights, number of labels used, date of labeling, and lot information can be sent to the programmable controller and used to ensure traceability. Labels for food manufacturing lines, which often requires water resistance, can be created on site, and the portability of the printer reduces the risk of food contamination.

*1: To be supported in the future

BROTHER INDUSTRIES, LTD.

▶ **Label printer TD-4550DNWB**

CC-Link IE TSN	Ethernet	Serial communication	Ladder example
CC-Link IEF Basic	SLMP	FB	GOT window example

Product features

■ A wide variety of interface options (USB/USB host/RS-232C/LAN)
■ Wi-Fi®/Bluetooth® compatible
■ Flagship model with an automatic cutter*2 and LCD
■ Self-maintaining thermal head/platen roller that do not require any tools reduce down time
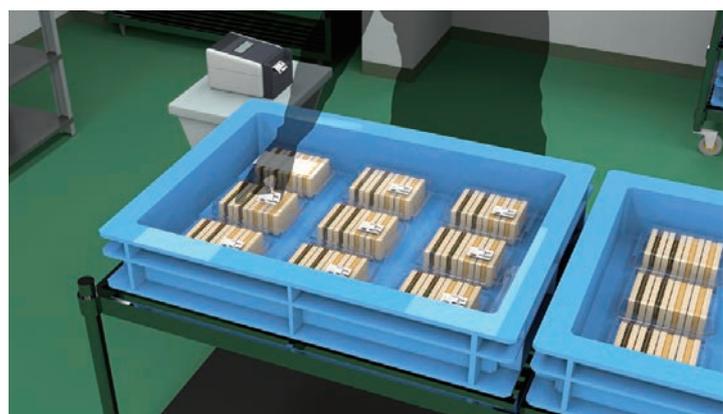
Benefits

The TD-4D series (thermal model) receives production lot and other necessary information from programmable controllers and automatically creates labels. Automation of labeling reduces the risk of mislabeling of production lot, and the portability of the printer eliminates the need to move the products to the printer, reducing the risk of contamination.

*2: The cutter (PA-CU-001) is sold separatery. Available models vary in different regions. Please consult your local Mitsubishi Electric representative.

Global FA Center

Mitsubishi Electric Corporation FA Centers support all our customers and users of MELSEC iQ-F Series all over the world.
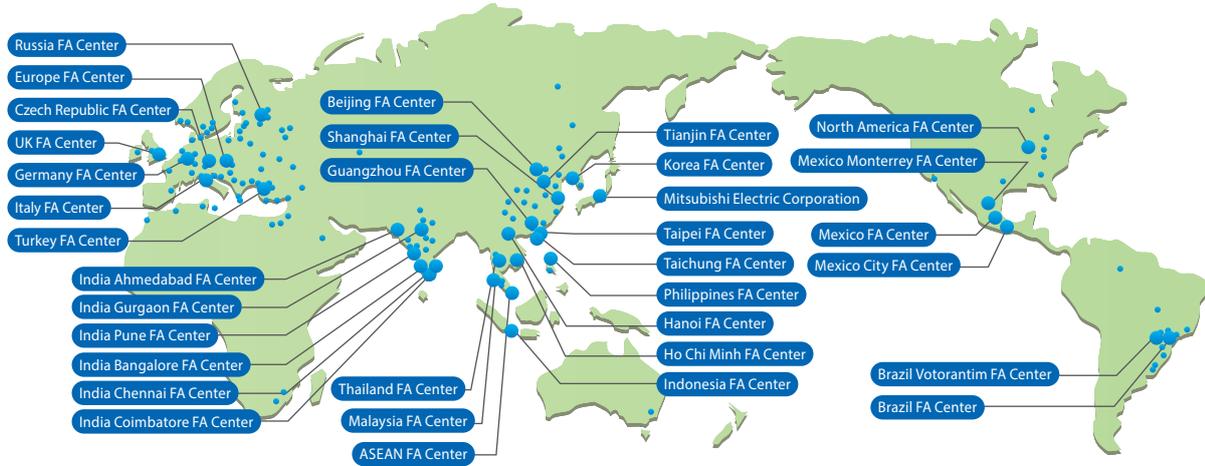
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