MITSUBISHI ELECTRIC

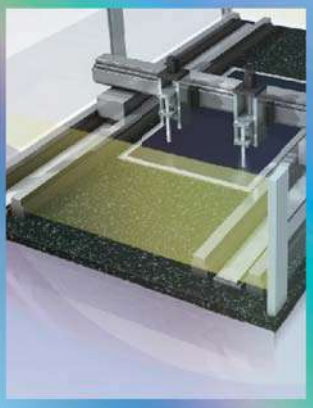
Changes for the Better

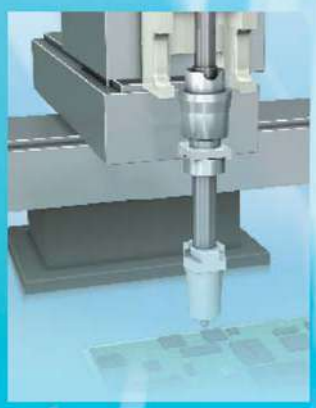
for a greener tomorrow eco Changes

Servo Amplifiers & Motors
Servo System Controllers

MELSERVO SOLUTIONS

For your all production needs





MITSUBISHI SERVO AMPLIFIERS & MOTORS

MELSERVO-J4 Solutions

Creating an ideal manufacturing environment

Exceptional Solutions for Your All Production Needs

Production sites are seeking to save more energy and resources as well as to create the safer and more user-friendly system. Mitsubishi helps you create these ideal manufacturing systems with our wide variety of products which offers various industry-leading basic and advanced functions.

Man

Functional safety and Easy to Use

[Compliant with functions of Safety standard]
The STO function is equipped as standard.

[Easy to Use]
Various functions, such as "One-touch tuning function", facilitates creating a better engineering environment.

[Preventive maintenance]
The machine diagnosis function is newly added for life diagnosis for mechanical parts.

Machine

Solutions for customers

[High response]
Speed frequency respond is increased to 2.5 kHz with the dedicated execution engine.

[High accuracy]
The high-resolution absolute encoder of 4,194,304 pulses/rev (22-bit) is equipped as standard.

[Vibration suppression]
Two types of low frequency can be suppressed automatically.

The Environment

Effort for energy and resource saving

[Energy saving]
Regenerative energy is utilized, and the "Power monitor function" is equipped.

[Reduced wiring and space-saving]
2/3-axis servo amplifier help reduce wiring and save space.

[International standard]
The MELSERVO-J4 amplifier is compliant with UL, CE and RoHS.

Man, Machine, Environment
in Perfect Harmony

System examples

Exceptional solutions for your all production needs

≫CASE 01 Vertical Form, Fill & Seal ····· P3

For food/beverage bag filling and packing

Issues

1. Stabilizing the packing quality
2. Shorter tack time without increasing shock to a machine
3. Creating a safety system

≫CASE 02 Rotary Knife ····· P7

For steel & paper cutting, stamping and labeling

Issues

1. Cam creation on HMI screen
2. Cutting the sheet using registration mark as a reference

≫CASE 03 Motion Alignment (X-Y-θ) ····· P11

For equipment requiring more accurate positioning

Issues

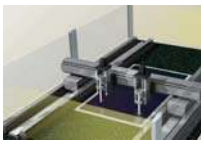
1. More accurate positioning
2. More precise drive operation
3. Shorter tact time

≫CASE 04 Gantry Application ····· P15

For material handling, automotive assembly and scanning

Issues

1. Less machine vibration
2. Simpler construction for multi-head
3. Axis 1 and 2 synchronized movement

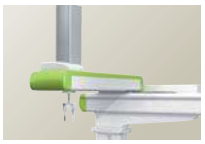


≫CASE 05 Pick and Place Robot ····· P19

For material loading/unloading and sealing

Issues

1. Suppression of the machine vibration
2. Simple setting of the suppression function
3. Smaller size machine



≫CASE 06 Press-fit Machine ····· P23

For pressing, bonding, clamping, and cap tightening

Issues

1. Pressing of the material with less shock to a machine
2. Monitoring of the machine movement

≫CASE 07 Conveyor System Utilizing Safety Observation Function ···· P27

For safety observation of printing, packing, and other lines

Issues

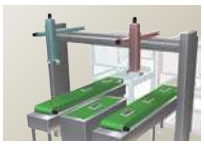
1. Safety measures in case of people entering in a restricted area
2. Ensuring safe speed for area where people works

≫CASE 08 Eco-friendly Conveyors and Product Handling Equipment ····· P31

For conveyors, Motion alignment, packing, and robots

Issues

1. Managing of total power consumption
2. Reduction of power consumption
3. Minimizing waste of power

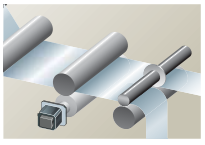


≫CASE 09 Film Slitting Machine ····· P35

For equipment with rollers

Issues

1. Sending film with a constant speed and tension
2. Utilizing regenerative energy



≫CASE 10 Screw Tightening Machine ···· P39

For tightening, pressing, and clamping

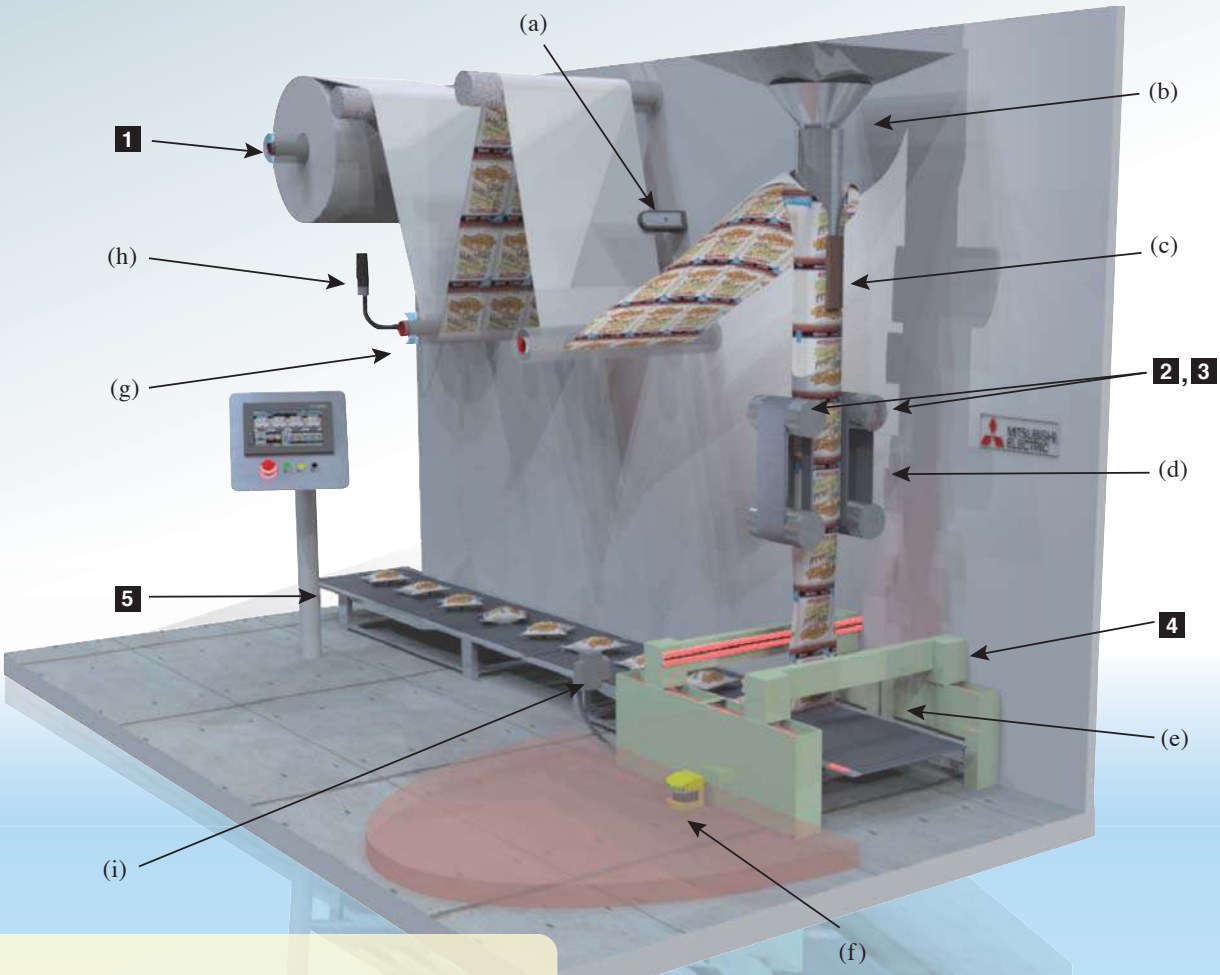
Issues

1. Tightening screws without using a torque sensor
2. Repeated accuracy in screw tightening operation

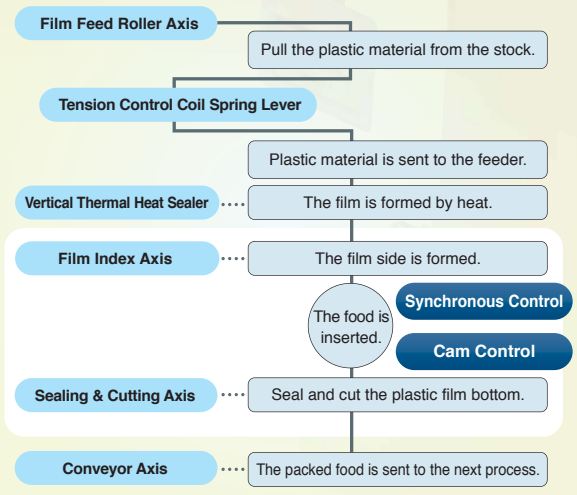
For food/beverage bag filling and packing

CASE | 01

Vertical Form, Fill & Seal



Control Flow



1 Film Feed Roller Axis
2 Film Index Axis
3 Film Index Axis
4 Sealing & Cutting Axis
5 Conveyor Axis

(a) Registration Mark Detection Sensor
(b) Feeder
(c) Vertical Thermal Heat Sealer
(d) Film Index Drives
(e) Sealing & Cutting Arms
(f) Proximity Safety Sensor
(g) Tension Control Coil Spring Lever
(h) Low Roll Detection Sensor
(i) Product Present Sensor

Q17nDSCPU Q170MSCPU QD77MS QD77GF (Note-1)

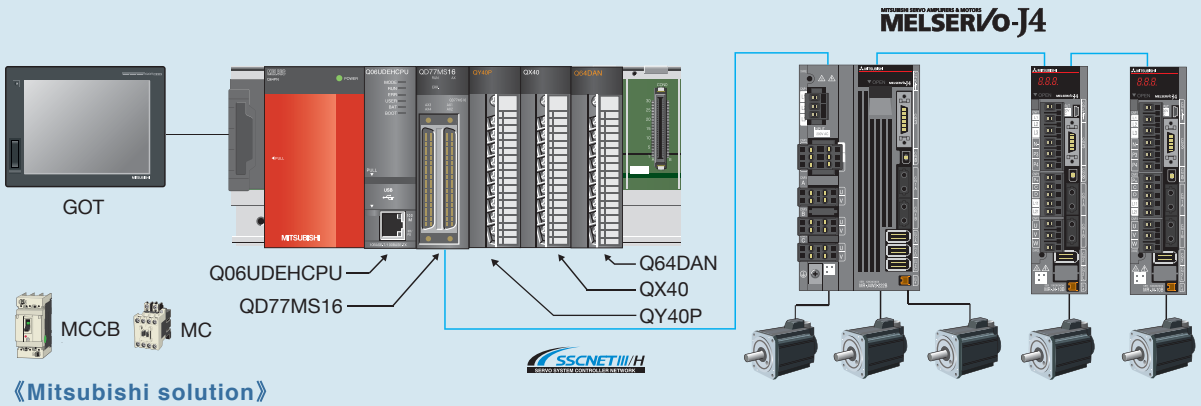
Issues at production sites

Issue 1 Stabilizing the packing quality
→ **Synchronous Control**

Issue 2 Shorter tact time without increasing shock to a machine
→ **Cam Control**

Issue 3 Creating a safety system
→ **Safety Observation Function**

System Example



《Mitsubishi solution》

Simple Motion	: QD77MS16	Servo amplifier	: MR-J4W3-B	Servo motor	: HG-KR,HG-SR
PLC CPU	: Q06UDEHCPU	GOT	: GOT1000 series	I/O module	: QX40,QY40P
Analog output module	: Q64DAN	Main base unit	: Q35DB		

Setup Procedure

Step1 System Structure Settings

Step2 Parameter Setting for Synchronous Control

Step3 Cam Data Creation

Step4 Creation of Sequence Program and Positioning Data

《Applications》

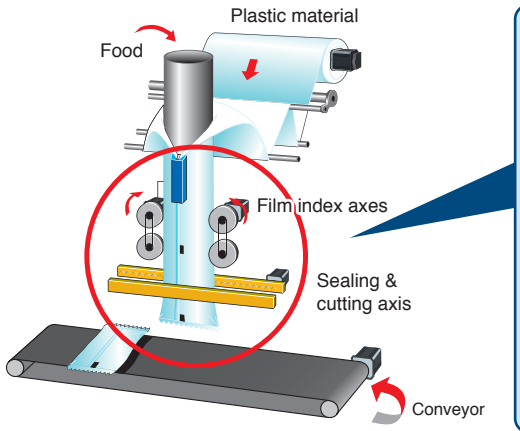
- Food/Beverage bag filling
- Pouch packing
- Powder filling

(Note-1): Use a 1-axis servo amplifier for QD77GF.

Solution 1 Synchronous Control

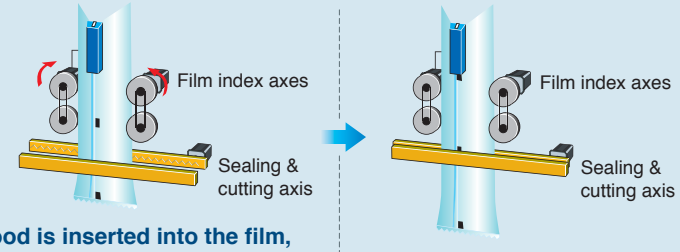
High Quality Production & Shorter Tact Time

High-quality production is achieved by improving the process accuracy with the 3-axis synchronous control (One sealing & cutting axis, two film index axes). Eliminating an interlock also enables shorter tact time.



Operation detail

The 3-axis synchronization (One sealing & cutting axis, two film index axes)



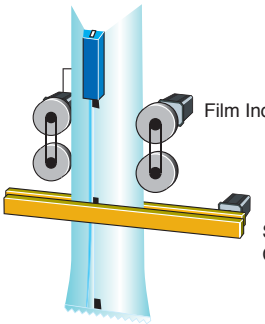
Food is inserted into the film, being sent by the film index axes.

Seal and cut the film.

Solution 2 Cam Control

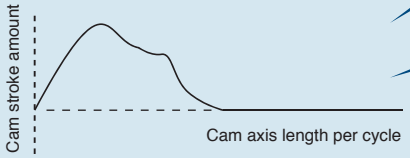
Smooth Sending & Stopping of the Film Material

Cam control enables the smooth sending and stopping of the film material. Thus high-speed operation and the shorter tact time are achieved.



Smooth waveform

Cam pattern of the film index axes



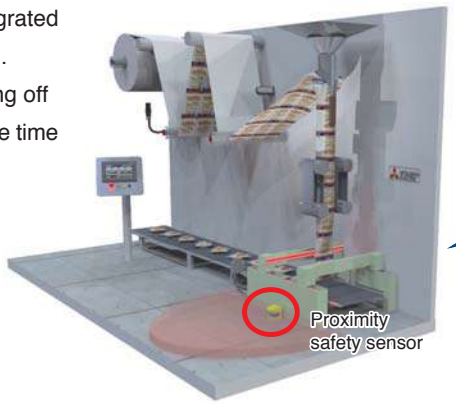
Possible to create the smooth pattern with the cam control.

Easily executes the cam control with the Simple Motion modules.

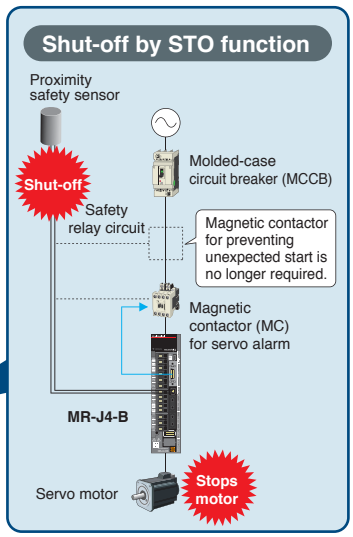
Solution 3 Safety Observation Function

Functions according to IEC/EN 61800-5-2

MR-J4-B series servo amplifiers have integrated STO (Safe torque off) function as standard. The machine can stop safely without turning off the main circuit power supply, cutting out the time for restart.



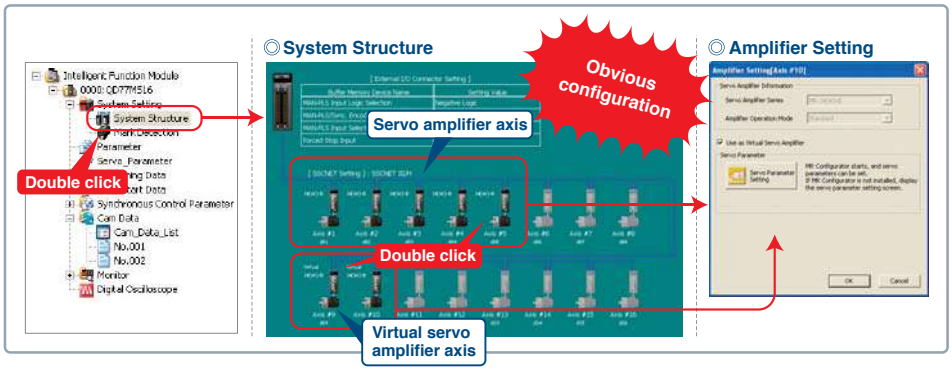
Shut-off by STO function



Setup Procedure

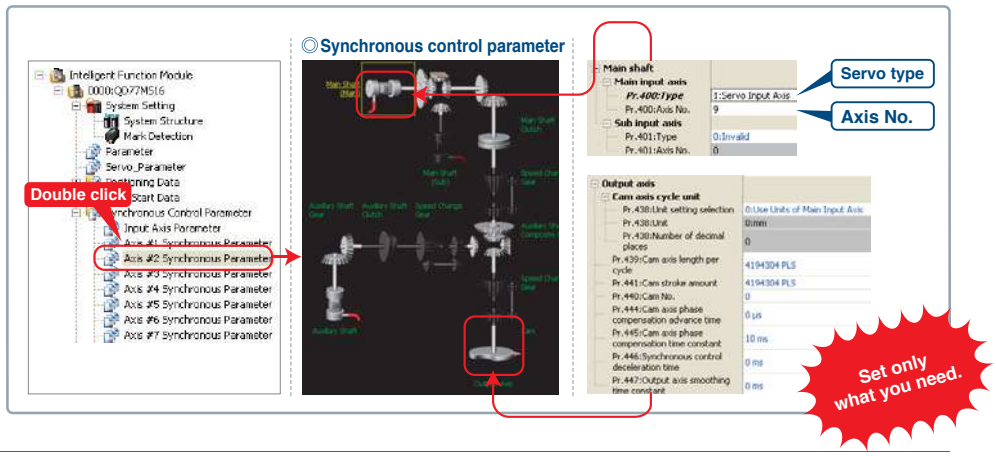
Step1 System Structure Settings

Set the servo amplifiers and virtual servo amplifiers.



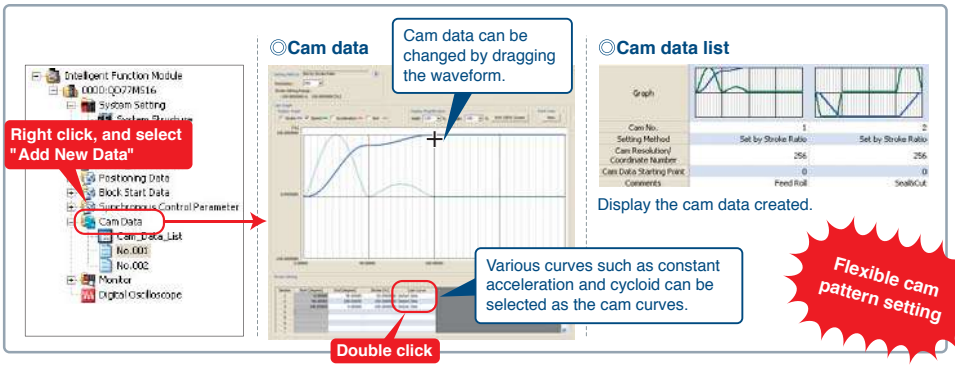
Step2 Parameter Settings for Synchronous Control

Set the axis-2 synchronous parameter for the axis-9 virtual servo amplifier.



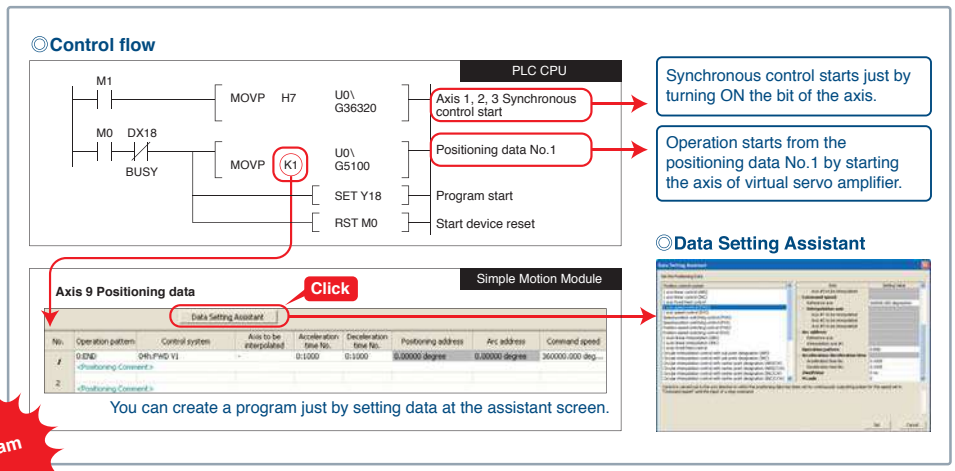
Step3 Cam Data Creation

Create the cam data for the film index axes and the sealing & cutting axis.



Step4 Creation of Sequence Program and Positioning Data

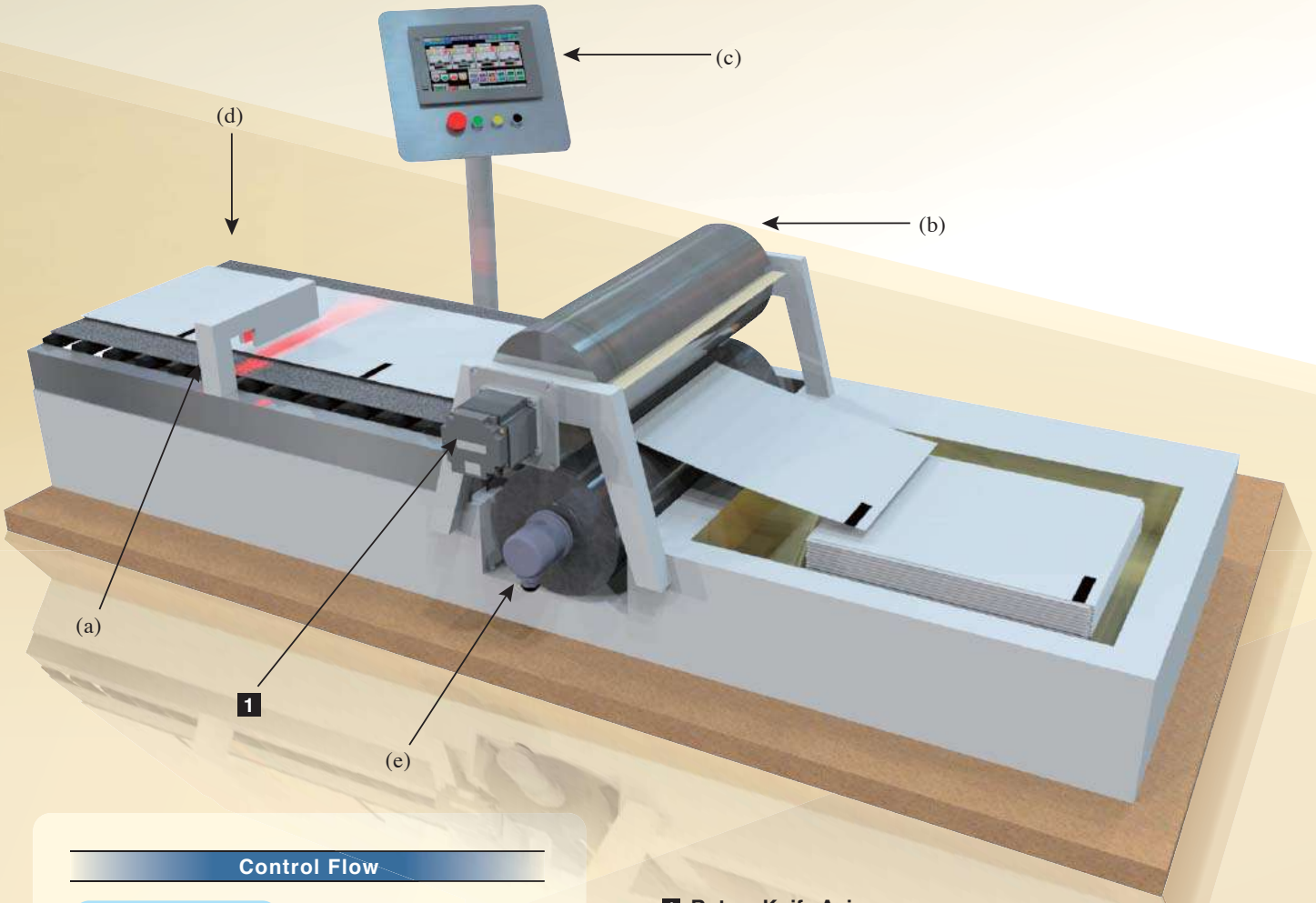
Create a program that starts the synchronous control of the three axes (1 to 3) and the positioning operation of the axis 9.



For steel & paper cutting, stamping and labeling

CASE | 02

Rotary Knife



Control Flow

Belt Conveyor

Feed the sheet.

Mark Detection Function

Capture the current feed value, etc. with the mark sensor ON.

Compensation readjustment of the rotary knife axis based on the registration mark.

Rotary Knife Axis

Cam Auto-generation Function

The axis rotates at the speed where the sheet feeding speed and the rotary knife speed are synchronized to cut the sheet.

The stock of the processed sheet.

1 Rotary Knife Axis

(a) Mark Sensor
(b) Rotary Knife
(c) HMI
(d) Belt Conveyor
(e) Synchronous Encoder

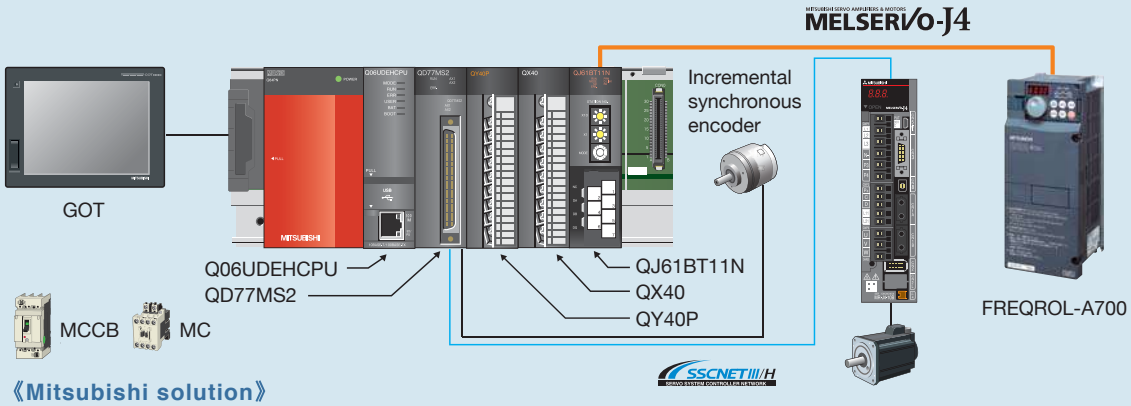
Q17nDSCPU | QD77MS
Q170MSCPU | QD77GF

Issues at production sites

Issue 1 Cam creation on HMI screen
→ **Cam Auto-generation Function**

Issue 2 Cutting the sheet using the registration mark as a reference
→ **Mark Detection Function**

System Example



《Mitsubishi solution》

Simple Motion : QD77MS2	Servo amplifier : MR-J4-B	Servo motor : HG-SR
PLC CPU : Q06UDEHCPU	GOT : GOT1000 series	I/O module : QX40,QY40P
Main base unit : Q35DB	Inverter : FREQROL-A700	CC-Link Module : QJ61BT11N

Setup Procedure

Step1 System Structure and Mark Detection Settings

Step2 Synchronous Control Parameter Setting

Step3 Sequence Program and Positioning Data Creation

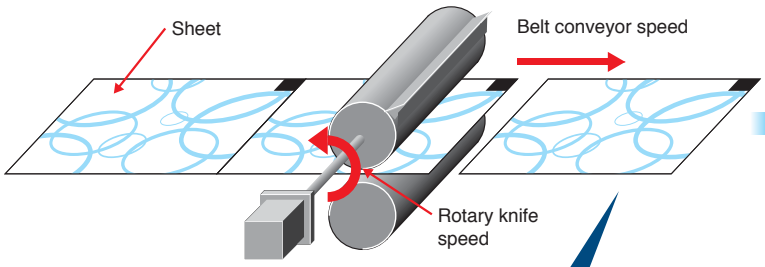
《Applications》

- Steel & paper cutting
- Perforation
- Labeling
- Stamping
- Scanning

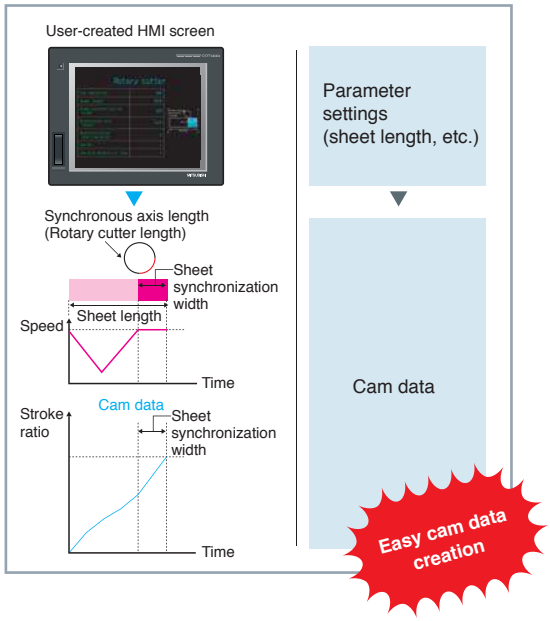
Solution 1 Cam Auto-generation Function

Reduced Designing and Programming Time and Increased Ease of Use

This function can create a cam automatically according to the sheet length and synchronization width, and the rotary knife axis dimension, which greatly reduces the designing and programming time.



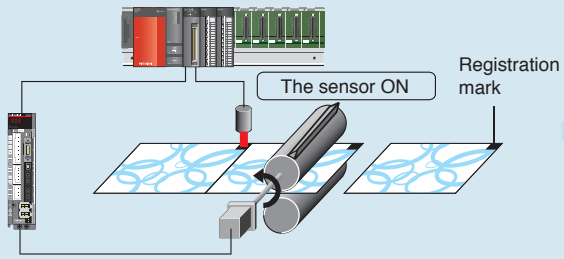
Auto-generated cam data for cutting the sheet:
Belt conveyor speed = Rotary knife speed



Solution 2 Mark Detection Function

Accurately Cutting by Responding Dynamically to Any Fluctuations

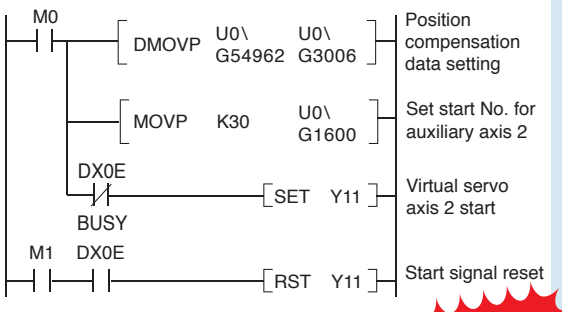
This function detects any fluctuations caused from the sheet tension or slippage when sending the sheet, and can cut the sheet at the set position by compensating these errors between the current sensed position and the standard position, referring to the registration mark.



Capture the current feed value, etc.with the mark sensor ON. (Mark Detection Function)

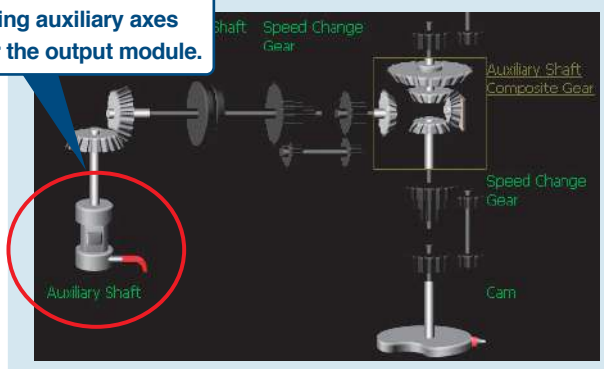
Calculate the error compensation length from the current feed value.

Start the auxiliary axis to compensate the error by adjusting the rotary knife.



Easy error compensation

Compensate the error using auxiliary axes for the output module.

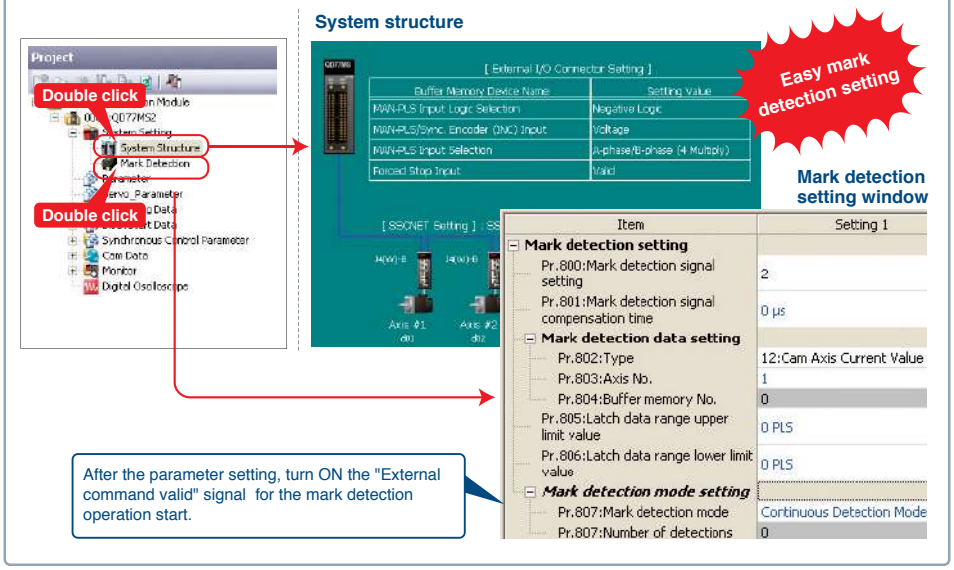


Setup Procedure

Step1

System Structure and Mark Detection Settings

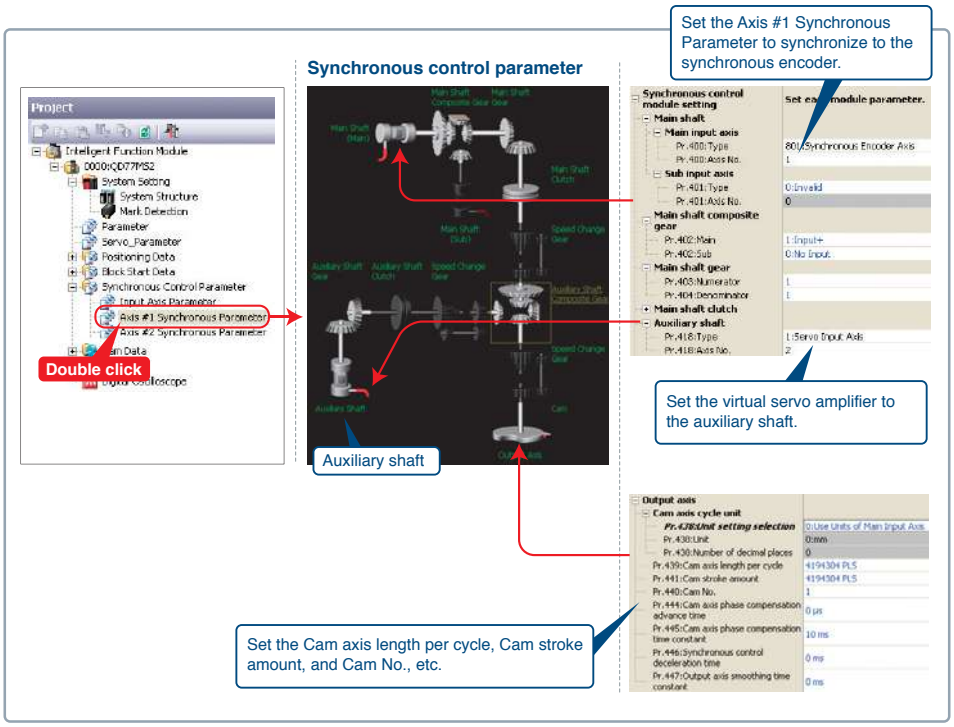
Set the system structure and mark detection.



Step2

Synchronous Control Parameter Setting

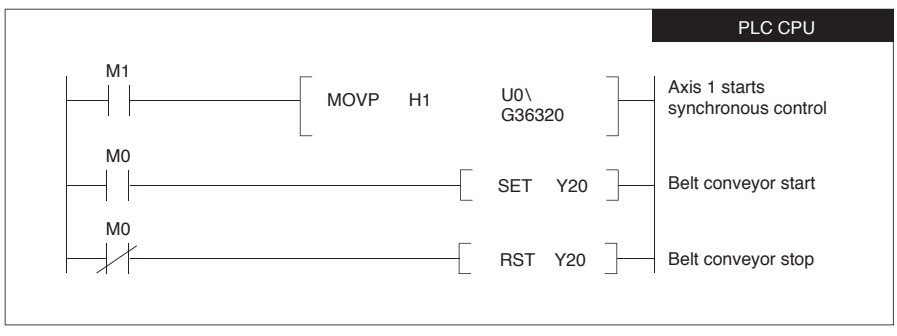
Set the parameter where the rotary knife speed (axis 1) is synchronized to the belt conveyor speed.



Step3

Sequence Program and Positioning Data Creation

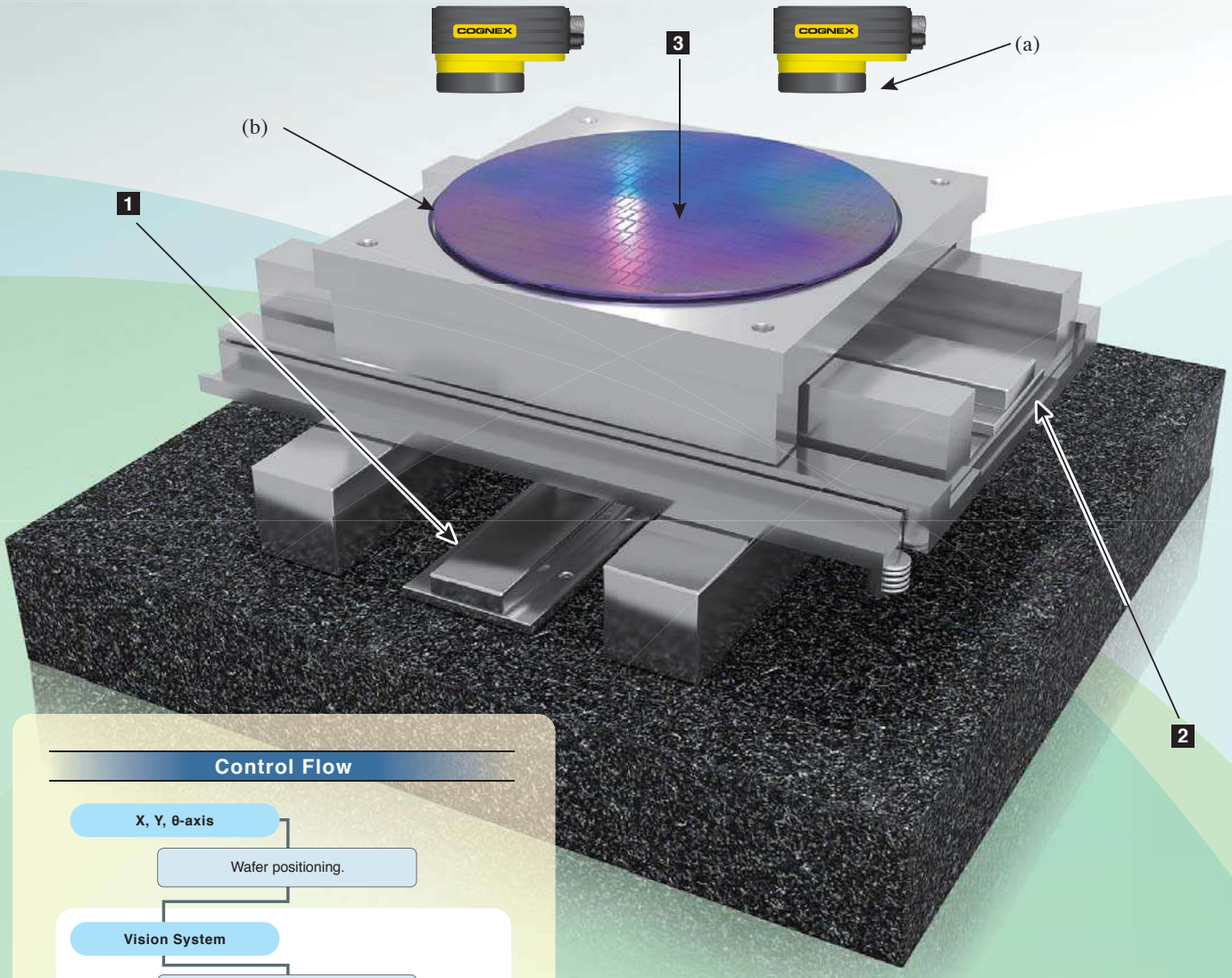
Create the program that starts the inverter which drives the belt conveyor after the rotary knife (axis 1) synchronization starts.



For equipment requiring more accurate positioning

CASE | 03

Motion Alignment (X-Y-θ)



1 X-axis
2 Y-axis
3 θ-axis

(a) COGNEX Vision System
(b) Wafer

Control Flow

X, Y, θ-axis
Wafer positioning.

Vision System
Measure the mark at the wafer's ends.
Calculate the difference between the target position and the position measured.

X, Y, θ-axis
Direct Drive Motor
Target Position Change Function
Correct the position.

Inspection Device
Inspect the material.

Q17nDSCPU
Q170MSCPU

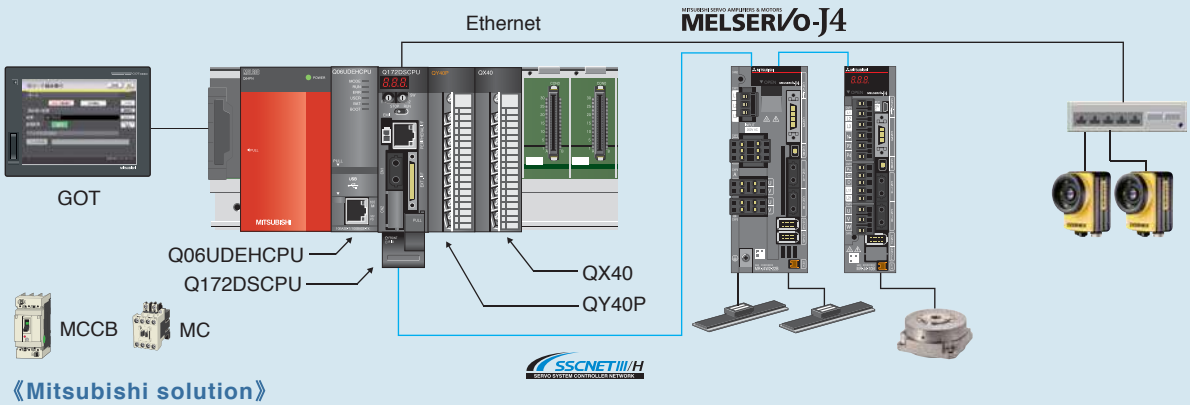
Issues at production sites

Issue 1 More accurate positioning
→ **COGNEX Vision System**

Issue 2 More precise drive operation
→ **Direct Drive Motor**

Issue 3 Shorter tact time
→ **Target Position Change Function**

System Example



《Mitsubishi solution》

Motion CPU	: Q172DSCPU	Servo amplifier	: MR-J4-B,MR-J4W2-B	Servo motor	: TM-RFM,LM-H3
PLC CPU	: Q06UDEHCPU	GOT	: GOT1000 series	I/O module	: QX40,QY40P
Main base unit	: Q35DB	Vision camera	: COGNEX Vision system		

Setup Procedure

Step1 System Structure Settings

Step2 Parameter Settings for Ethernet Connection

Step3 Vision System Connection Settings

Step4 Motion SFC Program Creation

《Applications》

- Pre/Post inspection system imaging
- Solar panel production
- FPD manufacturing
- 3D LCD manufacturing
- SEMI logic inspection

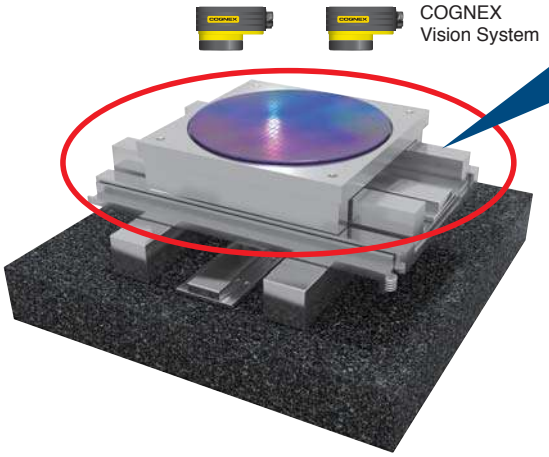
Solution 1 COGNEX Vision System

Accurate Position Reading and Quick Location Readjustment

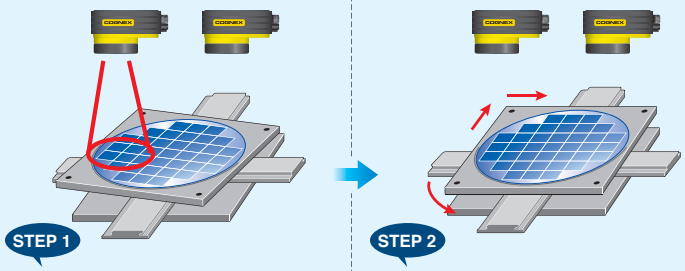
Quick position detection

The vision system can easily read the current position, and quickly moves the material (wafer) to the target position, calculating the correction amount.

[Example of using wafer (material)]



Material (Wafer) Detection



STEP 1 The vision system measures the current position.

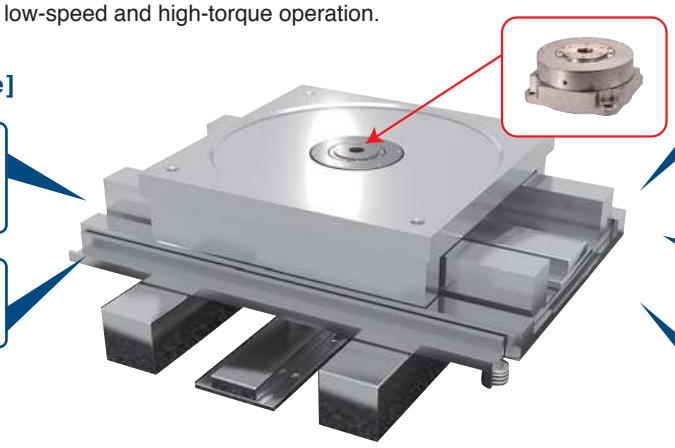
STEP 2 The system moves the wafer to the target position following the correction amount calculated.

Solution 2 Direct Drive Motor

Direct Connection to Drive Parts for High Response and Accuracy

High-response, high-accuracy, and stabilized positioning are achieved by using the direct drive motor.
This motor is also suitable for a low-speed and high-torque operation.

[Direct Drive Motor Example]



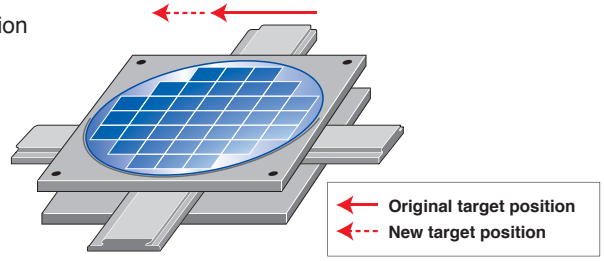
- This hollow construction enables cables and wires to go through inside.
- Elimination of transmission mechanical parts
- Suitable for a low-speed and high-torque operation.
- Smooth operation with low noise
- Clean system without dust coming from worn out

Solution 3 Target Position Change Function

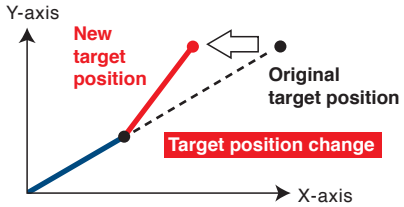
Flexibly Responding to Changes in the Target Position

Shorter tact time

Since performing a position correction using the vision system data during positioning operation, the system can move the wafer to a new target position directly without starting positioning again. Thus shorter tact time is achieved.



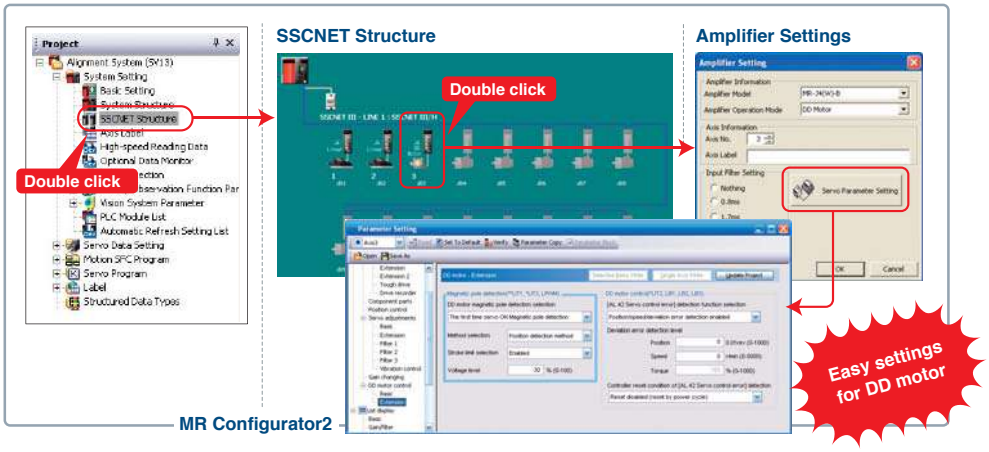
[Operation Example of Target Position Change Function]



Setup Procedure

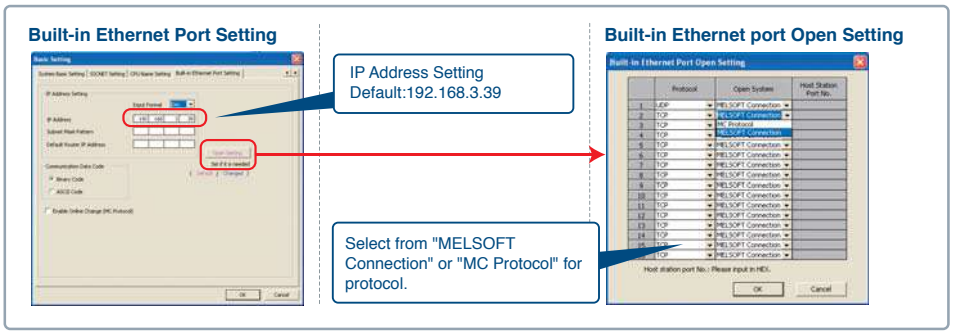
Step1
System Structure Settings

Set the servo amplifier.



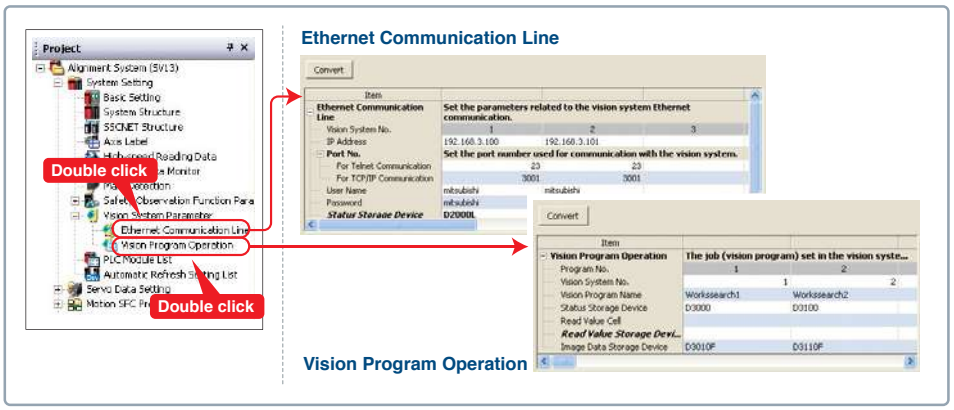
Step2
Parameter Settings for Ethernet Connection

Set the IP address of the Motion controller.



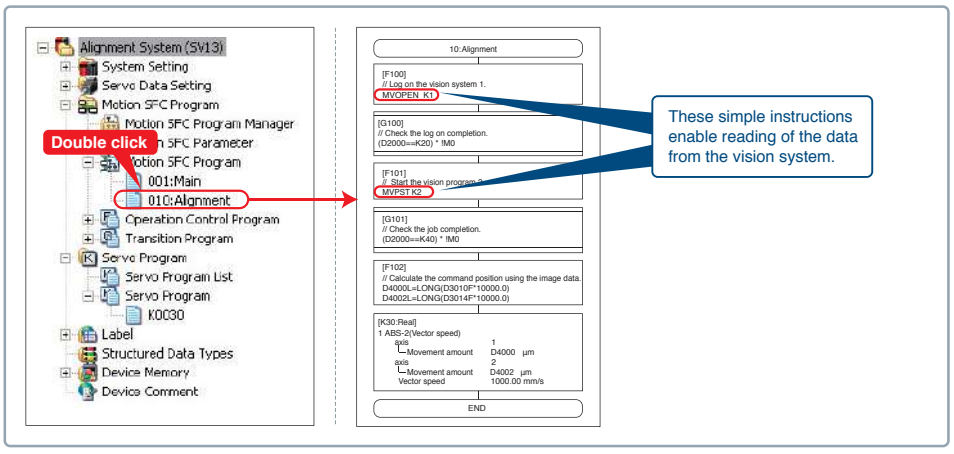
Step3
Vision System Connection Settings

Set the parameter concerning the Ethernet communication and the vision program operation.



Step4
Motion SFC Program Creation

Describe the vision system dedicated instructions, and then the positioning data from the vision system is possible to be read.

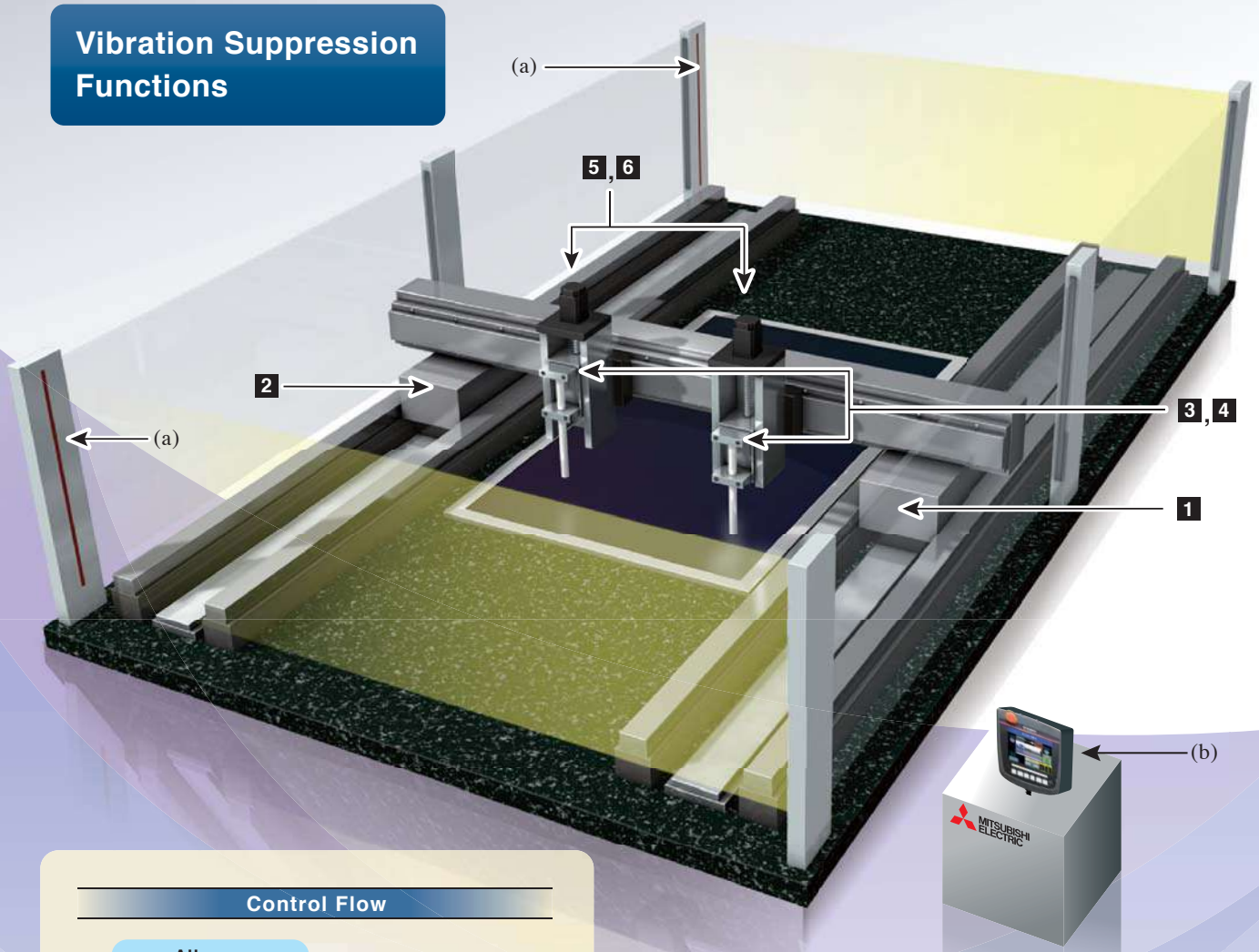


For material handling, automotive assembly and scanning

CASE | 04

Gantry Application

Vibration Suppression Functions



Control Flow

All axes

Move to the home position.

Y1, Y2, Z1, Z2-axis — Advanced Synchronous Control

Move to its wait point.

X1, X2-axis — Linear Servo Motor

Move to the target position from the home position. (for spraying, material handling)

Move back to its wait position.

1 X1-axis (Linear Servo Motor)
2 X2-axis (Linear Servo Motor)
3 Y1-axis (Linear Servo Motor)
4 Y2-axis (Linear Servo Motor)
5 Z1-axis (Vertical axis)
6 Z2-axis (Vertical axis)

(a) Light Curtain
(b) GOT (Graphical Operation Terminal)

Q17nDSCPU QD77MS
Q170MSCPU

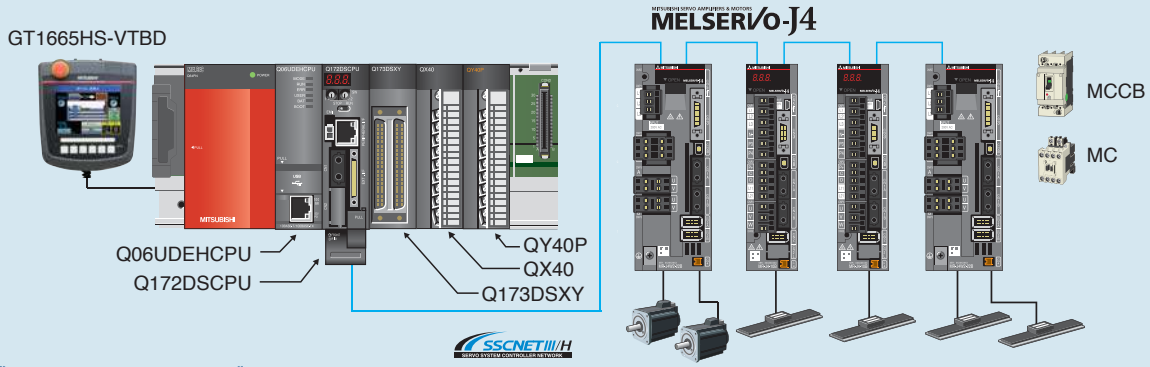
Issues at production sites

Issue 1 Suppression of machine vibration
→ **Vibration Suppression Functions**

Issue 2 Simpler multi-head configuration
→ **Linear Servo Motor**

Issue 3 Synchronized movement of axis-1 and axis-2
→ **Tandem Configuration**

System Example



《Mitsubishi solution》

Motion CPU	: Q172DSCPU	Servo amplifier	: MR-J4-B,MR-J4-W2-B	Servo motor	: HG-KR
Linear servo motor	: LM-H3	Safety signal module	: Q173DSXY	Main base unit	: Q35DB
PLC CPU	: Q06UDEHCPU	GOT	: GT1665HS-VTBD	I/O module	: QX40,QY40P

Setup Procedure

Step1 System Structure Settings

Step2 Parameter Settings for Linear Control

Step3 Parameter Settings for Vibration Suppression Control

Step4 Program Edit

《Applications》

- General material handling
- Automotive assembly
- Machine tool loading
- Aircraft assembly
- Scanning device

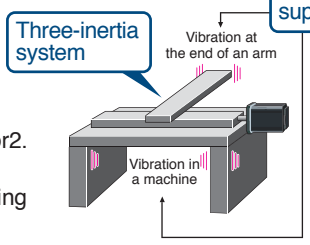
Solution 1 Vibration Suppression Functions

Advanced Servo Gain Adjustment Enables Precise Vibration Suppression Control with One-touch Ease

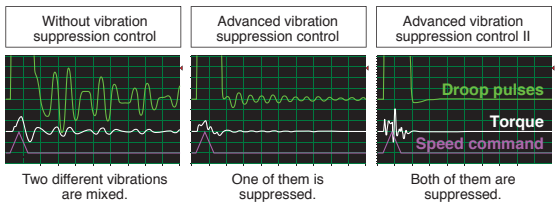
Advanced Vibration Suppression Control II

Patent Pending

Due to vibration suppression algorithm which supports three-inertia system, two types of low frequency vibrations are suppressed at the same time. Adjustment is performed on MR Configurator2. This function is effective in suppressing vibration at the end of an arm and in reducing residual vibration in a machine.



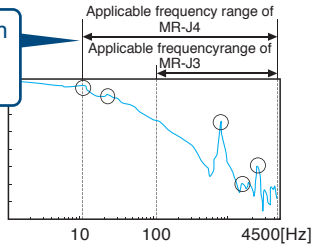
Two types of the vibrations are suppressed at the same time.



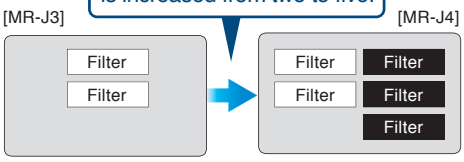
Machine Resonance Suppression Filter

With advanced filter structure, applicable frequency range is expanded from between 100Hz and 4500Hz to between 10Hz and 4500Hz. Additionally, the number of simultaneously applicable filters is increased from two to five, improving vibration suppression performance of machine.

Frequency at which filter is applied is expanded.



The number of notch filters is increased from two to five.

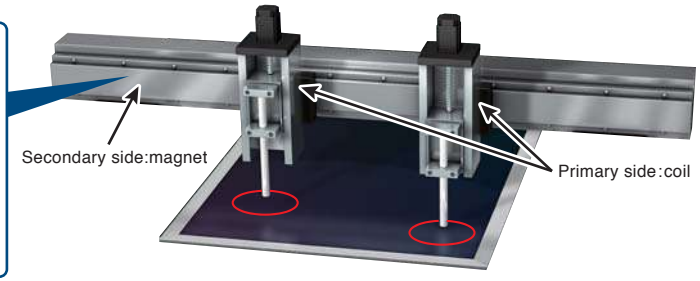


Solution 2 Linear Servo Motor

Controlling the Multi-head Freely and Dynamically

The multi-head system can be structured with the linear servo motor. (maximum speed: 3m/s (LM-H3 series), max. thrust: 150N to 18000N, compatible with a variety of serial interface linear encoders with resolution range from 0.005μm and up.)

Each of the motor coils can be controlled individually by different commands.
This simple structure is suitable best for the machines requiring shorter tact time.

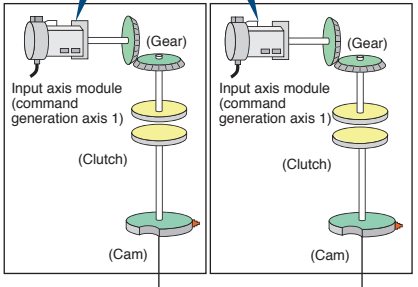


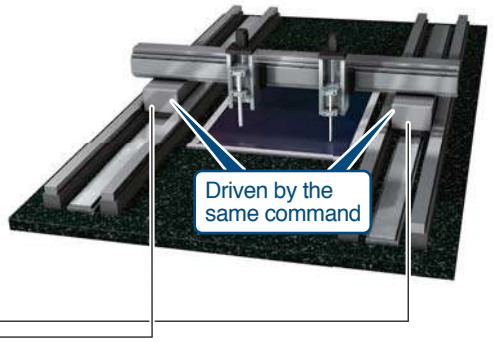
Solution 3 Tandem Configuration

Highly Synchronized Operation Between Two Axes

The parallel drive (tandem configuration) is achieved by outputting the same data to the cams using the advanced synchronous control.

The same axis No. for the input modules



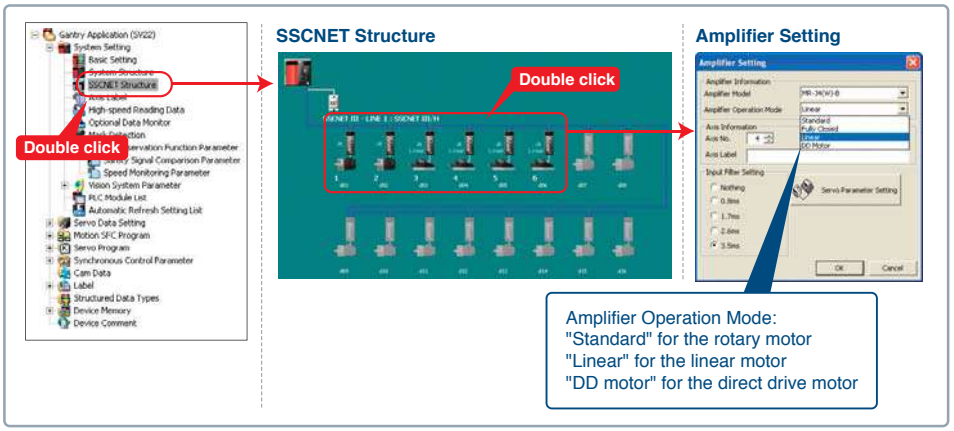


Setup Procedure

Step1

System Structure Settings

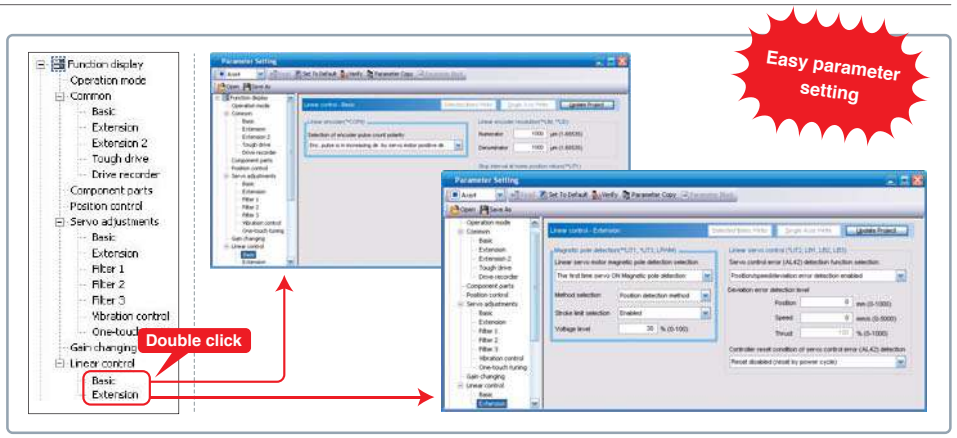
Set the servo amplifier and servo motor.



Step2

Parameter Settings for Linear Control

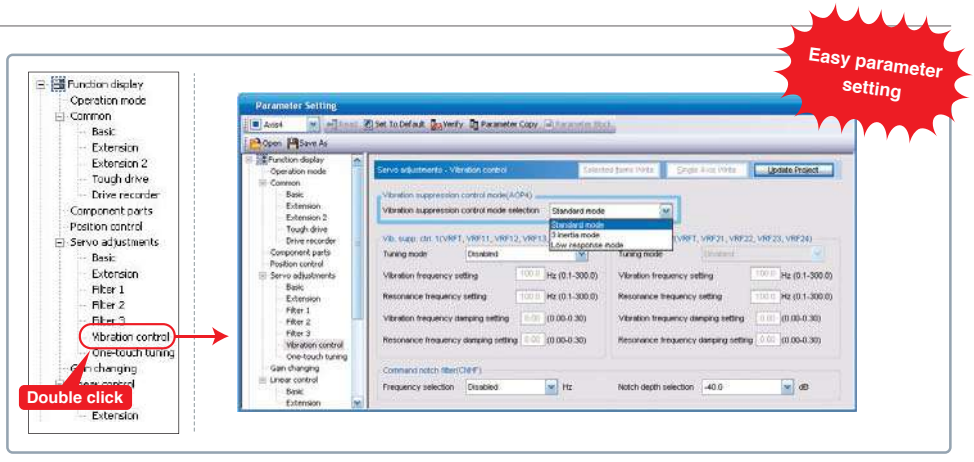
Set just the Basic and Extension settings for linear control.



Step3

Parameter Settings for Vibration Suppression Control

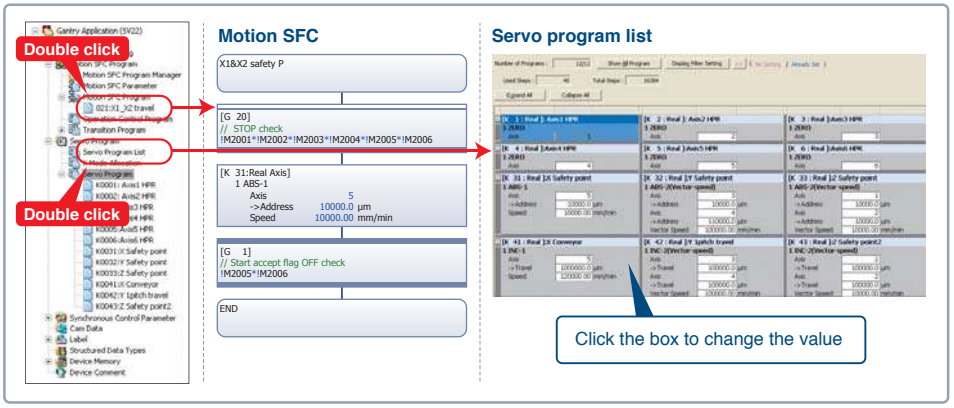
Select "3 inertia mode" in the "Vibration suppression control mode selection" to enable the "Advanced Vibration Suppression Control II".



Step4

Program Edit

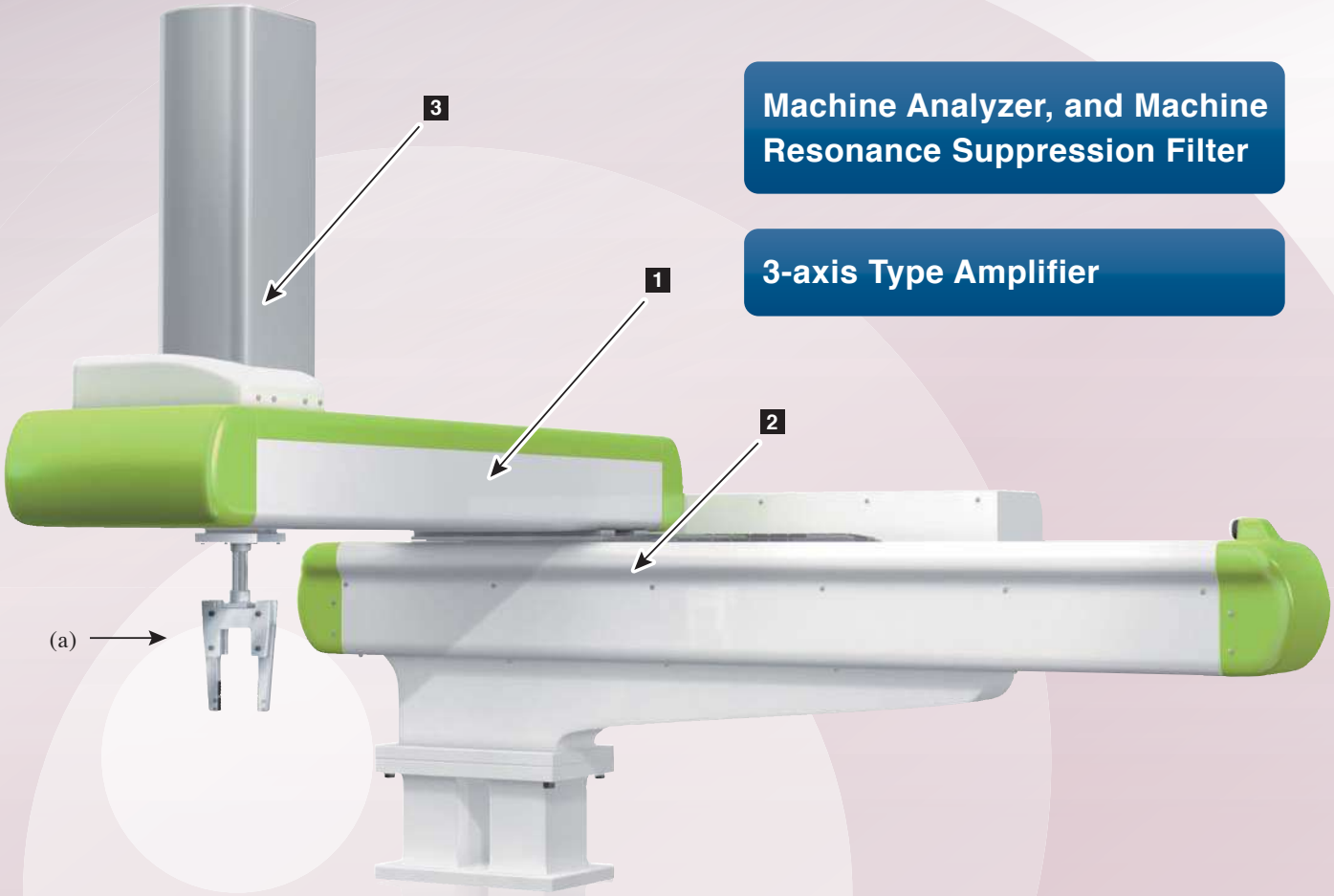
Create the Motion SFC program and the servo program.



For material loading/unloading and sealing

CASE | 05

Pick and Place Robot



Machine Analyzer, and Machine Resonance Suppression Filter

3-axis Type Amplifier

1 X-axis
2 Y-axis
3 Z-axis
(a) Hand

Control Flow

X, Y, Z axis

Move to the home position.

Advanced Vibration Suppression Control II

X, Y, Z axis

Move to above the workpiece from the home position.

Grab the workpiece.

Load the workpiece to the next location.

Q17nDSCPU Q170MSCPU QD77MS QD77GF (Note-1)

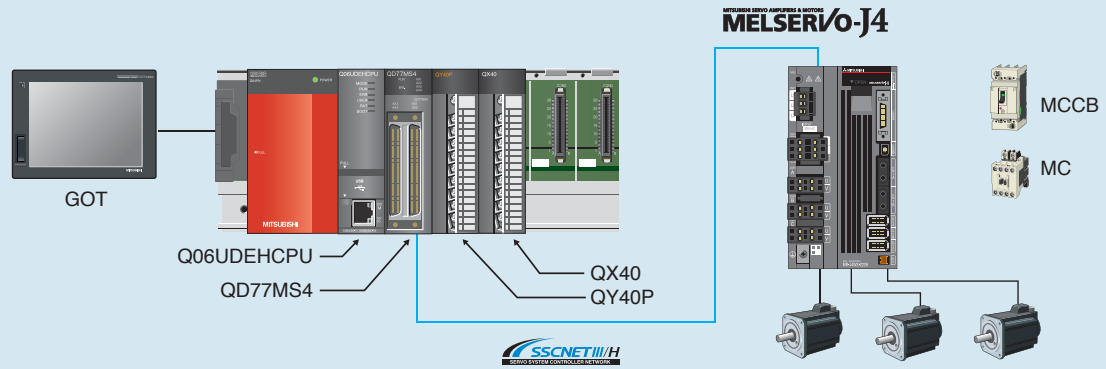
Issues at production sites

Issue 1 Suppression of the machine vibration
→ **Advanced Vibration Suppression Control II**

Issue 2 Simpler setting of the suppression function
→ **Machine Analyzer and Machine Resonance Suppression Filter**

Issue 3 Smaller size machine
→ **3-axis Type Amplifier**

System Example



《Mitsubishi solution》

PLC CPU	:Q06UDEHCPU	Simple Motion	:QD77MS4	Servo amplifier	:MR-J4W3-B
Main base unit	:Q35DB	I/O module	:QX40,QY40P	Servo motor	:HG-KR
GOT	:GOT 1000 series				

Setup Procedure

Step1 System Structure Settings
Step2 Parameter Settings
Step3 Parameter Settings for Vibration Suppression Control
Step4 Positioning Data Settings

《Applications》

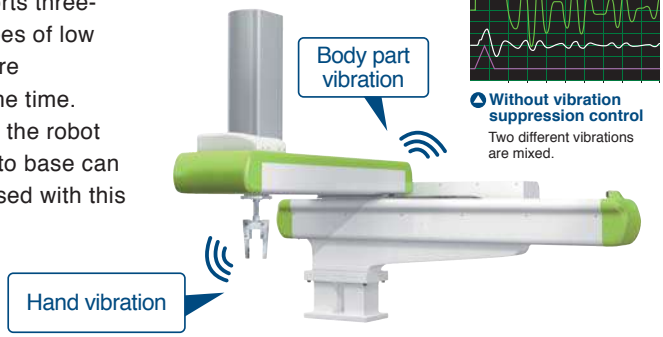
- X-Y table
- Sealing
- Material Loading/Unloading

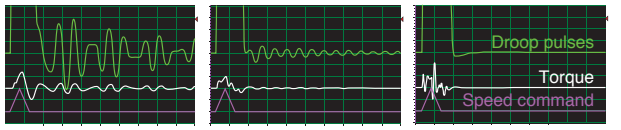
(Note-1): Use a 1-axis servo amplifier for QD77GF.

Solution 1 Advanced Vibration Suppression Control II

Effectively Suppressing Two Types of Low Frequency Vibrations

Due to vibration suppression algorithm which supports three-inertia system, two types of low frequency vibrations are suppressed at the same time. Thus, the vibrations of the robot existing from its hand to base can be effectively suppressed with this function.



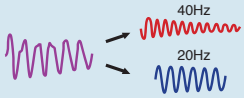


Without vibration suppression control
Two different vibrations are mixed.

Advanced vibration suppression control
One of them is suppressed.

Advanced vibration suppression control II
Both of them are suppressed.

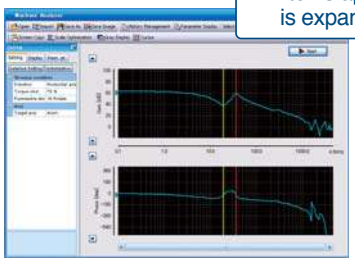
Two types of frequencies (20Hz and 40Hz) are generated.



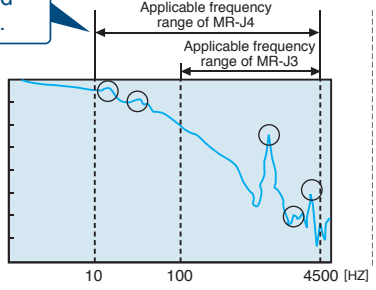
Solution 2 Machine Analyzer and Machine Resonance Suppression Filter

Easy Suppression of Multiple Vibrations with the Machine Analyzer and Filter Option

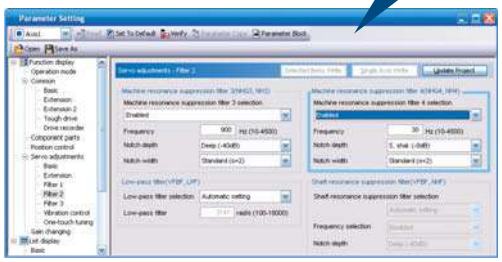
First, the ”Machine analyzer” function analyzes the machine frequency characteristics.
Then the five "Machine resonance suppression filters" suppress the vibration.



Frequency at which filter is applied is expanded.



The number of filters is now increased to five.



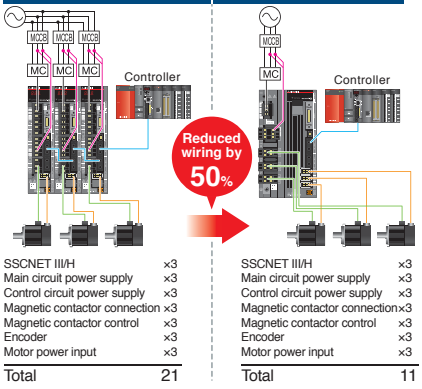
Solution 3 3-axis Type Amplifier

Designed to Cut Cost and Save on Space and Wiring

Reduced Wiring

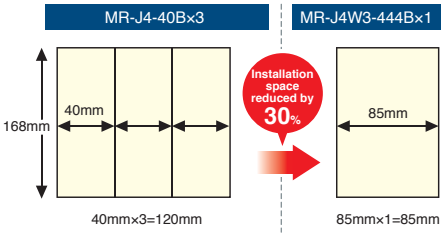
- SSCNET III/H compatible servo amplifier drastically reduces the wiring compared to the pulse train type.
- In 3-axis servo amplifier MR-J4W3-B, the three axes use the same connections for main and control circuit power, peripheral equipment, control signal wire, etc. Thus, the number of wirings and devices is greatly reduced.

Comparison of the number of wirings and devices



Space Saving

3-axis servo amplifier MR-J4W3-B requires 30% less installation space than three units of MR-J4-B.

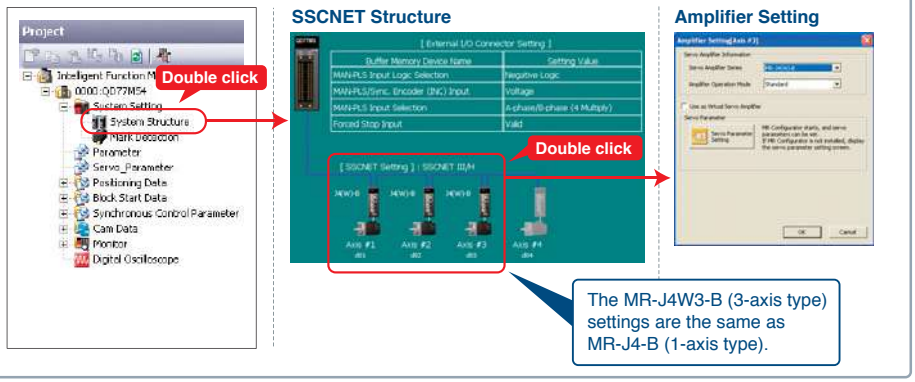


Setup Procedure

Step1

System Structure Settings

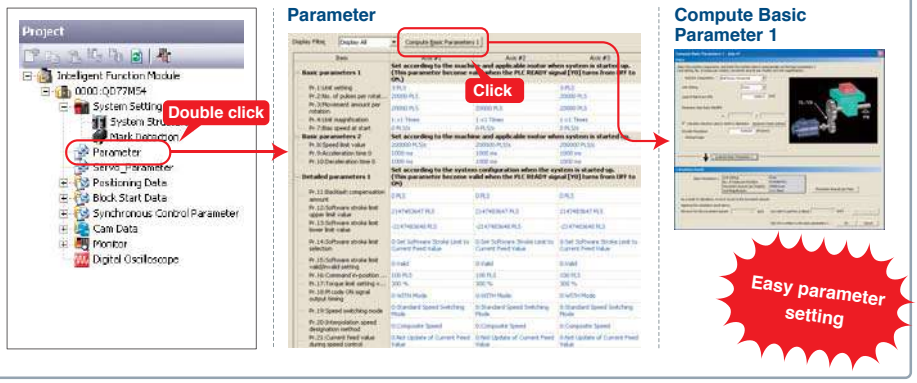
Set the servo amplifier.



Step2

Parameter Settings

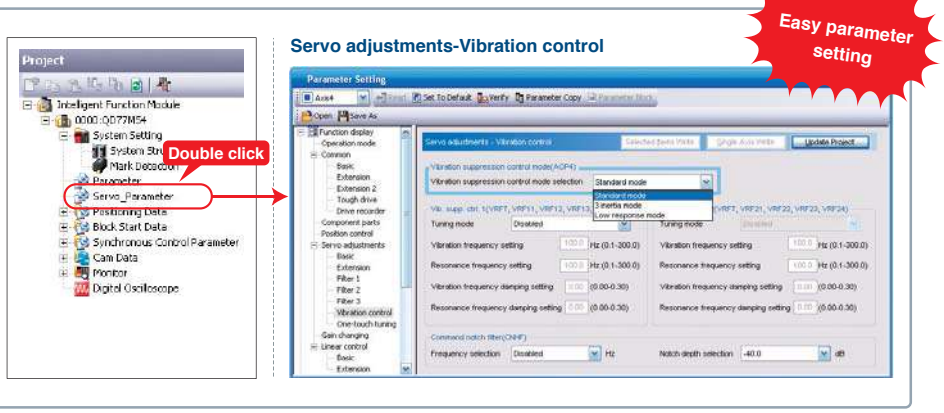
Open the "Compute Basic Parameter 1" screen and enter the mechanical data there. The parameter for electronic gear is calculated using the data automatically.



Step3

Parameter Settings for Vibration Suppression Control

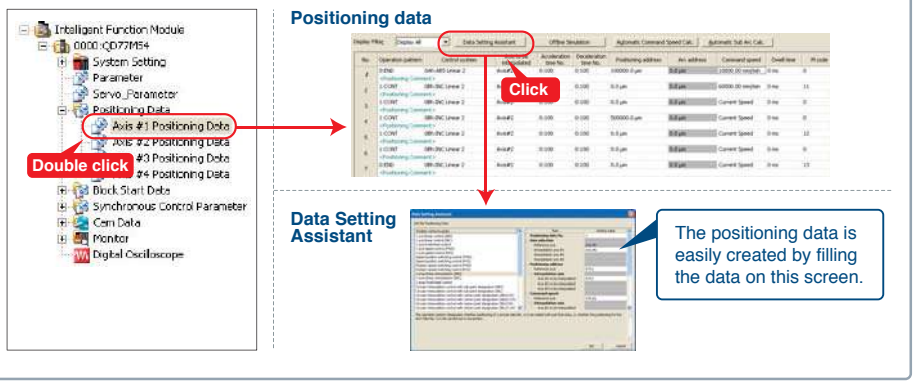
Select "Three-inertia mode" to start the "Advanced Vibration Suppression Control II".



Step4

Positioning Data Settings

Set the positioning data for each axis.



For pressing, bonding, clamping, and cap tightening

CASE 06

Press-fit Machine

1 Belt Conveyor Axis
2 Belt Conveyor Axis
3 Z-axis

(a) Ball Screw
(b) Presser
(c) Workpiece
(d) Support Table

Control Flow

Belt Conveyor Axis

Feed material to the machine.

Z-axis for Pressing — **Tightening & Press-fit control**

Operate in position control before pressing.

Switch to Tightening & Press-fit control, and press the workpiece.

Switch back to position control after pressing and go back to its wait position.

Proceed to the next workpiece.

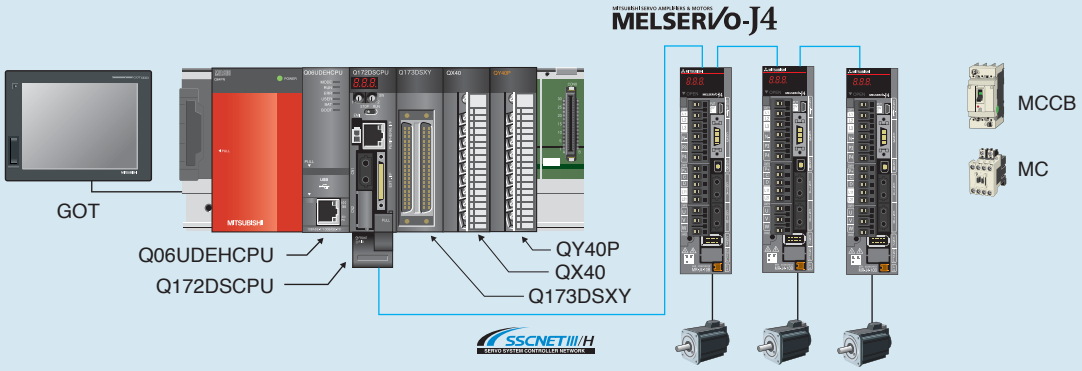
Q17nDSCPU Q170MSCPU QD77MS

Issues at production sites

Issue 1 Pressing of the material with less shock to a machine
→ **Tightening & Press-fit Control**

Issue 2 Monitoring of the machine movement
→ **Safety Signal Comparison Function**

System Example



《Mitsubishi solution》

Motion CPU	: Q172DSCPU	Servo amplifier	: MR-J4-B	Servo motor	: HG-SR
PLC CPU	: Q06UDEHCPU	GOT	: GOT 1000 series	I/O module	: QX40,QY40P
Safety signal module	: Q173DSXY	Main base unit	: Q35DB		

Setup Procedure

Step1 Speed-Torque Control Data Setting

Step2 Program Creation

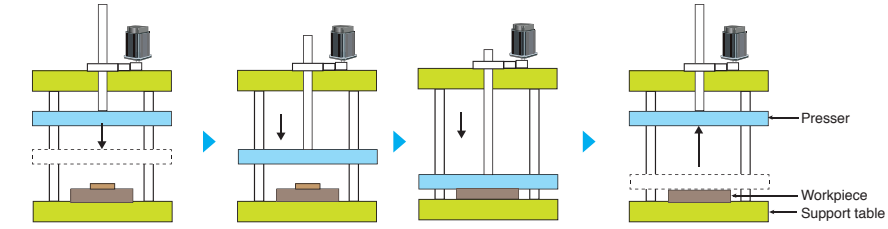
《Applications》

- Bonding
- Pressing
- Clamping
- Cap tightening

Solution 1 Tightening & Press-fit Control

Achieving Shorter Tact Time with Quick Mode Switching, and Less Shock with Smooth Movement

The system switches the control mode smoothly from position to Tightening & press-fit control without a stop.
The current position is being stored in the system during the Tightening & press-fit control to perform a quick positioning after switching back to the position control.
Thus shorter tact time is achieved.

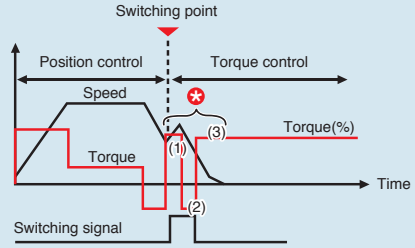


High-speed positioning using the position control.

The system is switched to the Tightening & press-fit control, and the workpiece is pressed with constant torque.

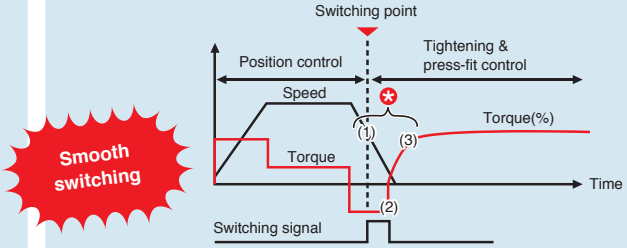
The system is switched back to position control, and the presser moves back to its wait position.

Torque control Sudden acceleration causes shock to the machine when switching control modes.



✪ (1) Switching to torque control, where specified torque(%) is forcibly generated, causes sudden motor acceleration, giving shock to the machine.
(2) System is forced into speed control when passing the speed limit, causing sudden deceleration.
(3) The system is switched to the torque control after the speed is below the required limit.

Tightening & press-fit control A smooth torque causes less shock to the machine when switching control modes.

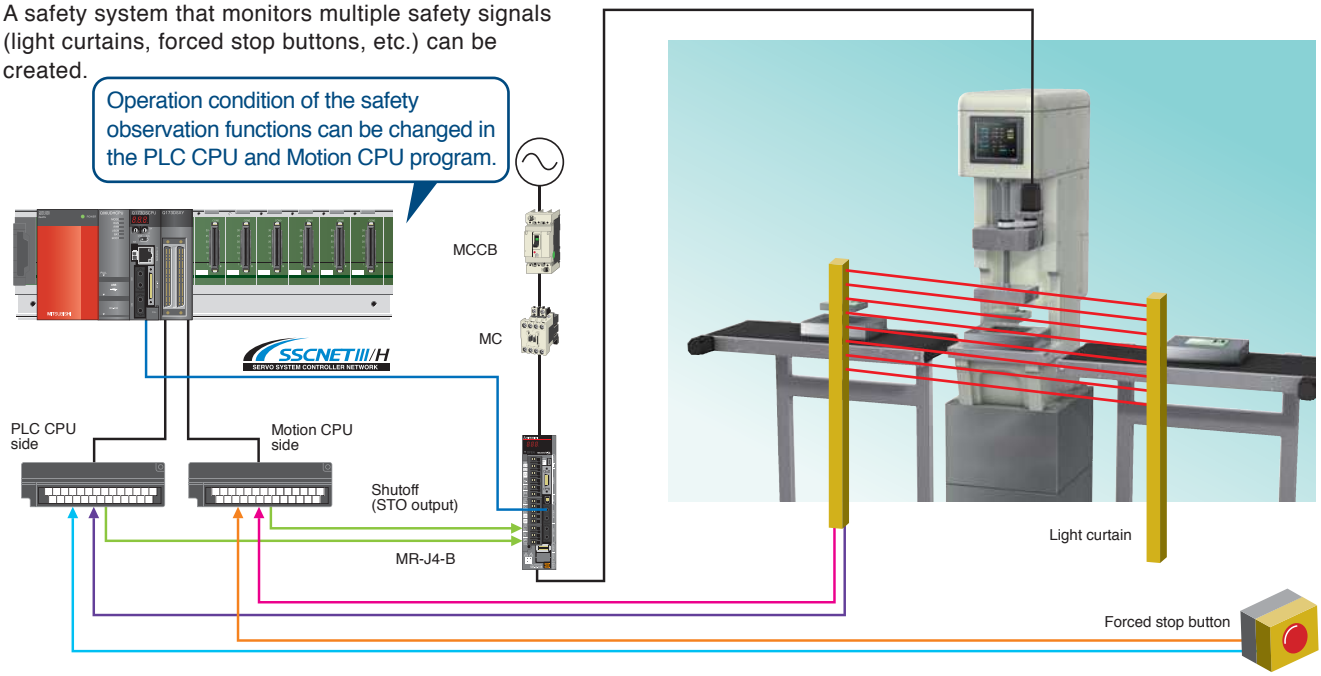


✪ (1) In Tightening & press-fit control, the motor keeps decelerating until passing the speed limit.
(2) The mode is switched to torque control when the speed passes the limit.
(3) The torque increases constantly to the specified value(%).

Solution 2 Safety Signal Comparison Function

Motion Controller and Servo Amplifier (MR-J4-B) Ensuring Your Safety with the Safety Observation Function, Equipped as Standard

A safety system that monitors multiple safety signals (light curtains, forced stop buttons, etc.) can be created.

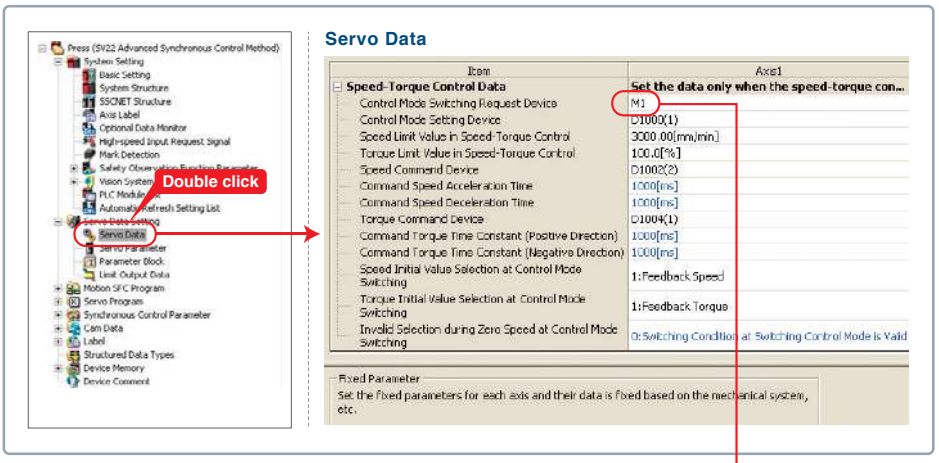


Setup Procedure

Step1

Speed-Torque Control Data Setting

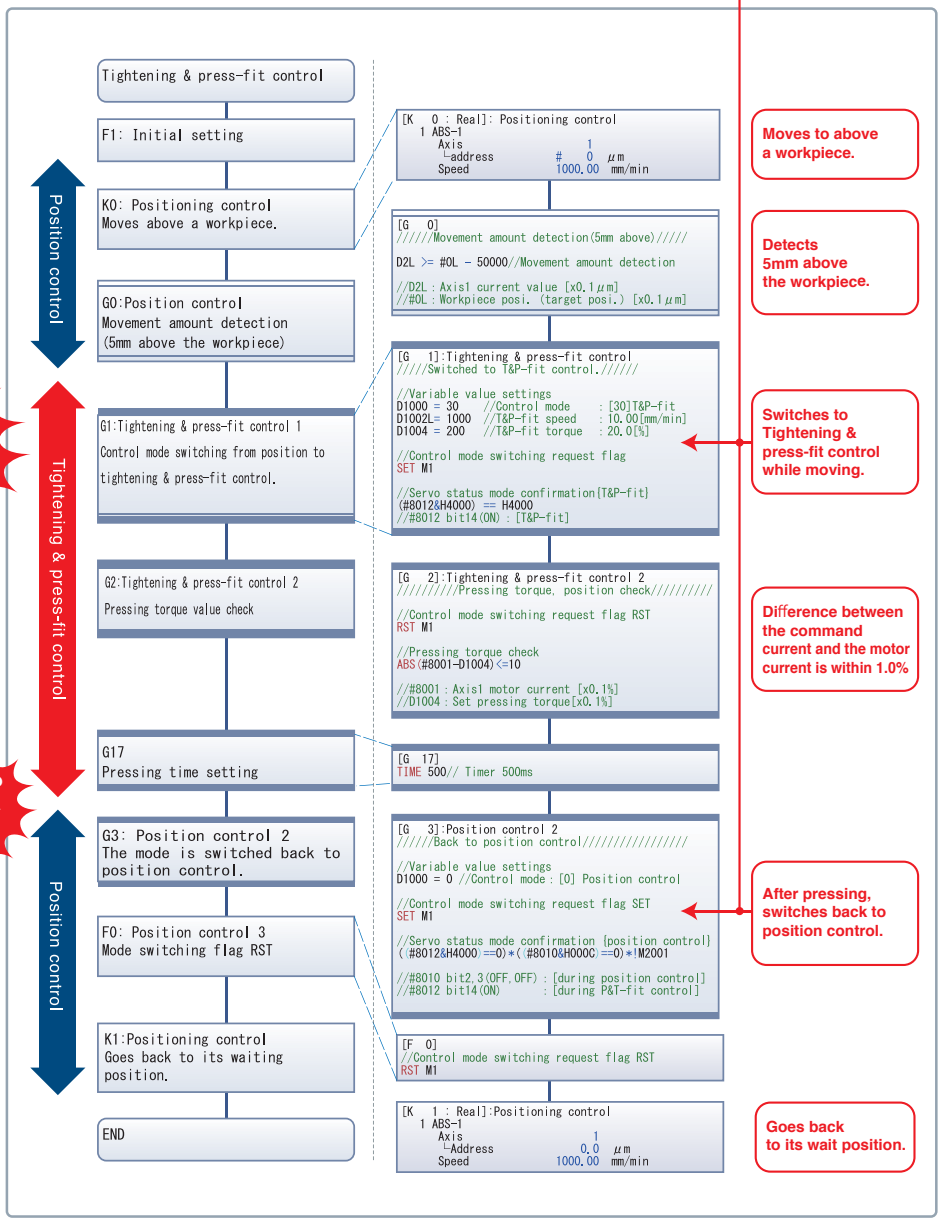
After completing the System Structure, set the Speed-Torque data in Servo Data screen.



Step2

Program Creation

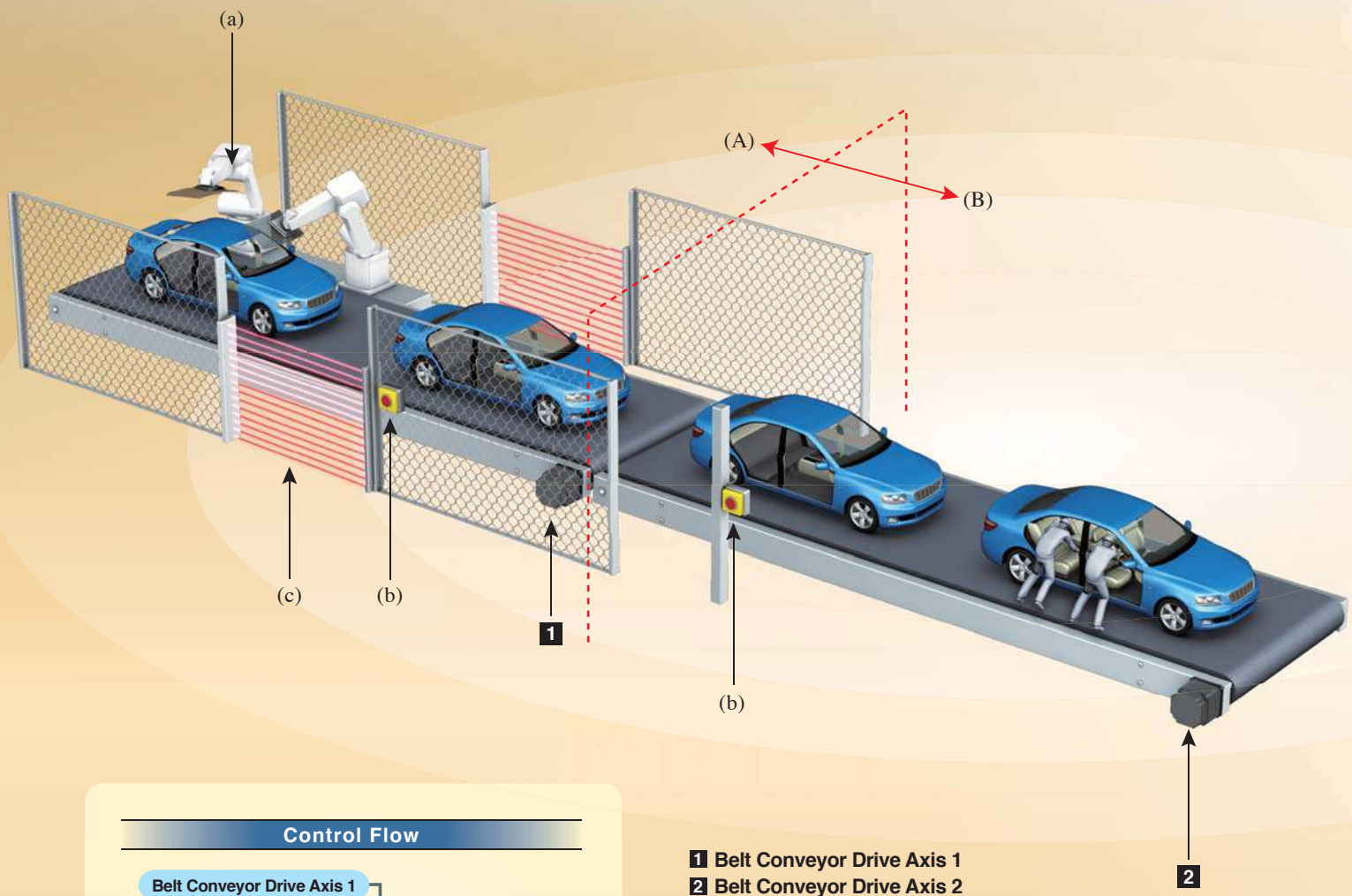
Create the Motion SFC program and servo program.



For safety observation of printing, packing, and other lines

CASE | 07

Conveyor System Utilizing Safety Observation Function



Control Flow

Belt Conveyor Drive Axis 1

- Car frames are moved on conveyor belt.
- Robots mount pane windows on cars.

Speed Monitoring Function

Belt Conveyor Drive Axis 2

- Car frames are moved on conveyor belt.
- Workers mount seats inside of car frames.
- To the next conveyor line.

1 Belt Conveyor Drive Axis 1
2 Belt Conveyor Drive Axis 2

(A) Glass Window Pane Mounting Line (Restricted Area)
(B) Car Seat Mounting Line (Non-restricted Area)
(a) Window Glass Mounting Robot
(b) Forced Stop Button
(c) Light Curtain

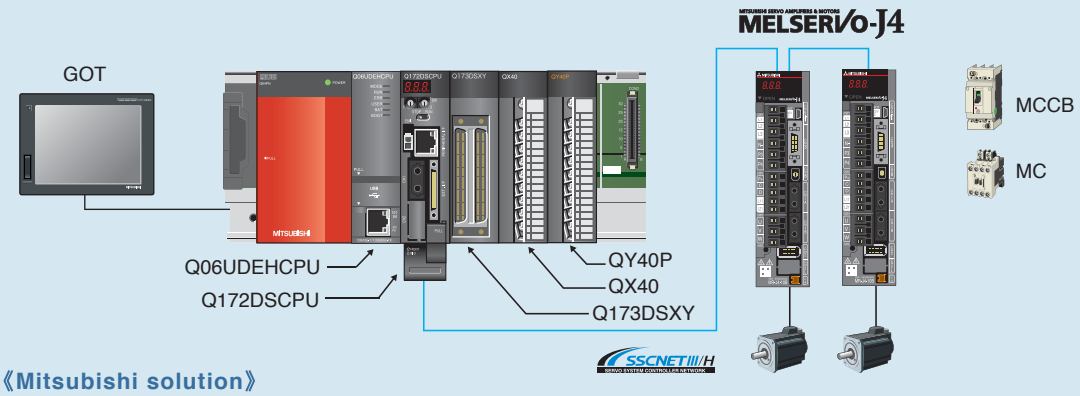
Q17nDSCPU

Issues at production sites

Issue 1 Safety measures in case of a person entering in a restricted area
→ **Shut-off Function**

Issue 2 Ensuring safe speed for manned assembly line
→ **Speed Monitoring Function (SLS)**

System Example



《Mitsubishi solution》

PLC CPU	: Q06UDEHCPU	Motion CPU	: Q172DSCPU	Servo amplifier	: MR-J4-B
GOT	: GOT 1000 series	Safety signal module	: Q173DSXY	Servo motor	: HG-SR
Main base unit	: Q35DB	I/O module	: QX40,QY40P		

Setup Procedure

Step1 Safety Signal Wiring

Step2 System Structure Settings

Step3 Parameter Settings for Safety Observation Function

《Applications》(Note-1)

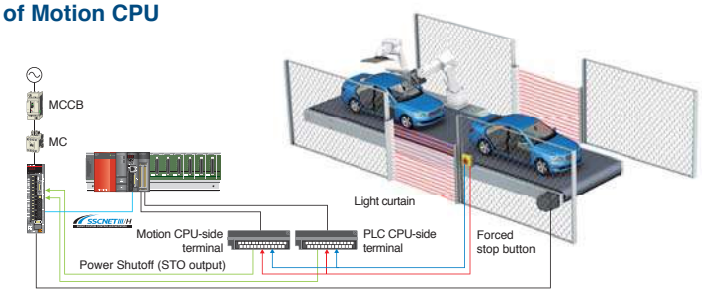
●Conveyor system	●Press-fit machine	●Press machine
●Printing machine	●Vertical form, fill & seal	●Horizontal form, fill & seal

(Note-1) Motion controllers and servo amplifiers attain "Safety category 3, SIL2". Take an additional safety measure or consider applicability based on the risk analysis.

Solution 1 Shut-off Function

Various Reliable Safety Systems Can Be Created with Safety Observation Function

System using "Safety signal comparison function" of Motion CPU



Each of the Motion and PLC CPU independently performs the safety monitoring functions at the same time (giving double CPU safety monitoring). Safety control can be combined with general control, which enables to create more flexible and simple safety systems. This is the best for a system monitoring multiple signals with safety monitoring equipment, such as forced stop buttons, light curtains, etc.

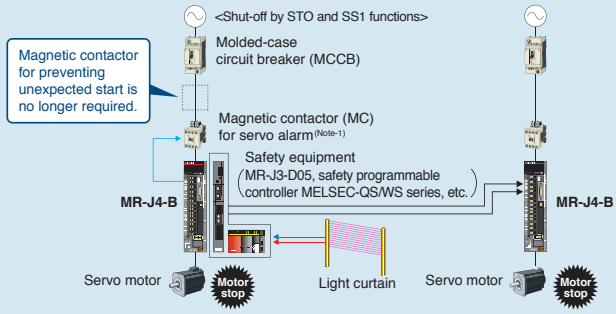
·Functions STO,SS1,SS2,SOS,SLS,SBC,SSM

·Specification of Q173DSXY Safety signal module

	Points	Purpose
Input signal	20 points × 2 systems	User safety signal
Output signal	1 point × 2 systems	Shut-off signal
	11 points × 2 systems	User safety signal

Functions achieved with the servo amplifier

· System using the Safety logic module MR-J3-D05



The MR-J3-D05 Safety logic module integrates the STO and SS1 functions, and has an equivalent number of safety I/O signals to that of two servo amplifiers.

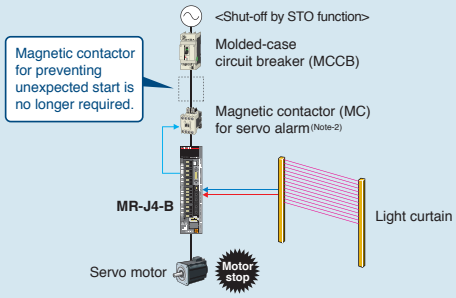
·Functions STO,SS1

·Specification of MR-J3-D05 Safety logic module

	Points	Purpose
Input signal	2 points × 2 systems	User safety signal
Output signal	4 points × 2 systems	Shut-off outputs

(Note-1): STO is not the electrical safety protection function but the function to turn off the output torque by shutting off the power supply inside the servo amplifier. For MR-J4 series servo amplifier, magnetic contactors are not required to meet the STO requirements. However, install a magnetic contactor to prevent the short circuit of servo amplifier or electric shock.

· System using the functions of the servo amplifier



The MR-J4-B Servo amplifier has integrated STO (Safe Torque Off) function as standard, being suitable for a system using only one piece of safety equipment.

·Functions STO

·Specification of MR-J4 Servo amplifier

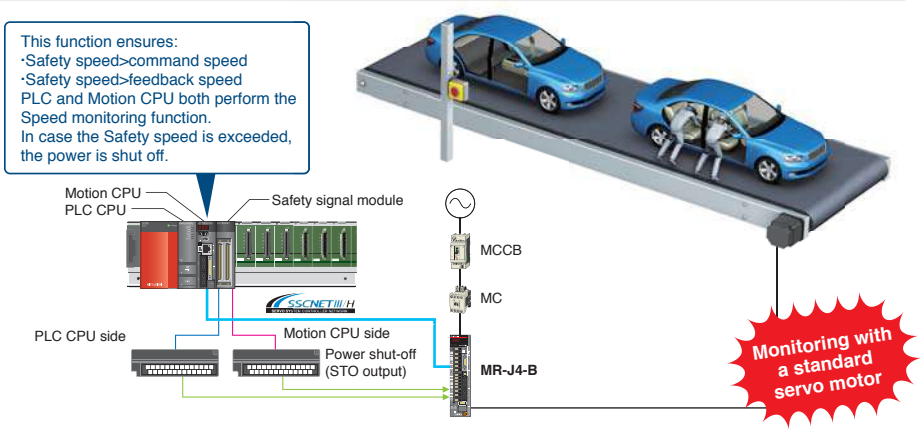
	Points	Purpose
Input signal	1 point × 2 systems	User safety signal
Output signal	1 point × 2 systems	Shut-off status

(Note-2): Refer to the (Note-1) above.

Solution 2 Speed Monitoring Function (SLS)

Securing Safe Speeds All the Time

This "Speed monitoring function" checks if the motor speed has exceeded the specified "Safety speed" or not.
A safe operation speed can be ensured by comparing the feedback and command speed with the "Safety speed".
When an error occurs, the STO and SS1 functions shut off the power.

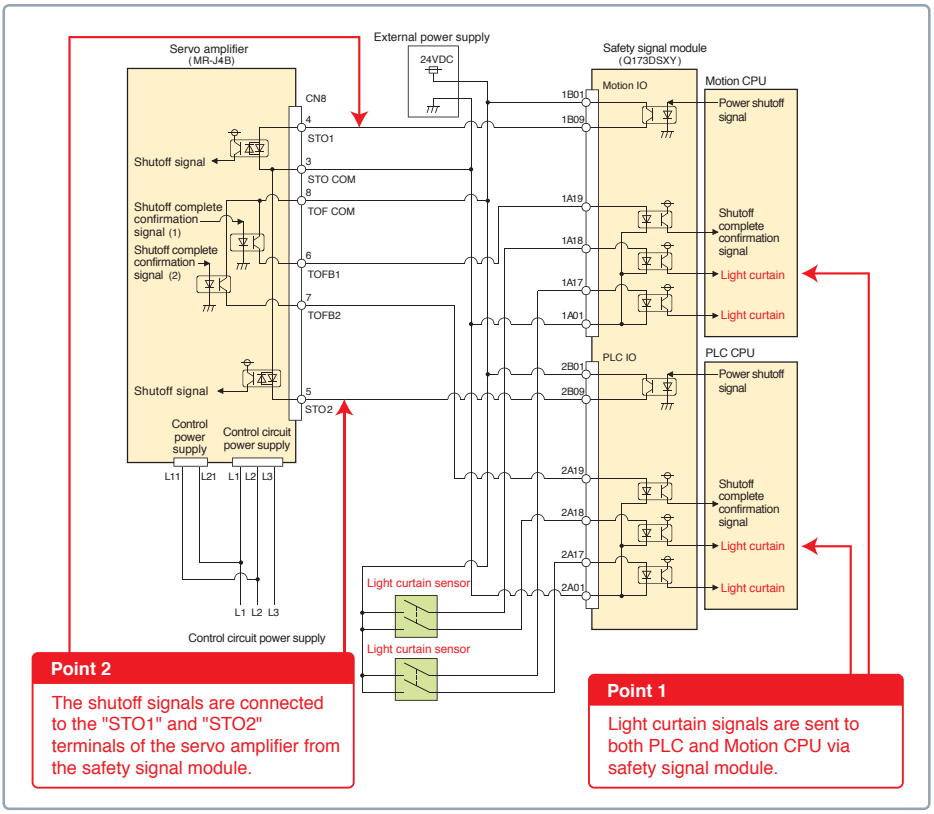


Setup Procedure

Step1 Safety Signal Wiring

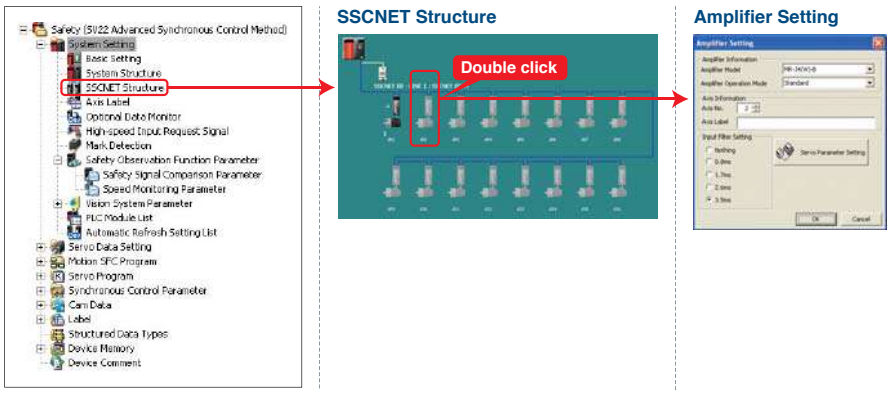
This diagram shows a wiring example of a safety system using a safety signal module. The light curtain signals are wired to the input terminals of the safety signal module, and the module's output terminals are to the STO terminal on the servo amplifier.

(Note) This example is compliant with EN ISO 13849-1 Category3 PLd.



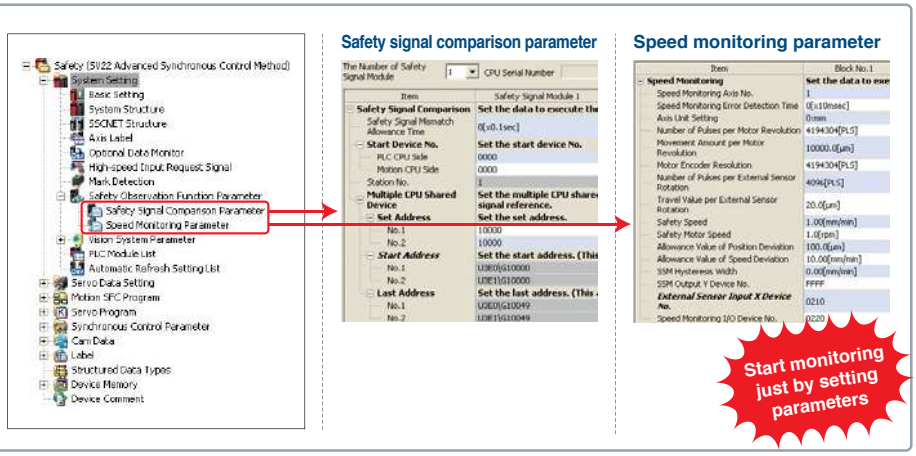
Step2 System Structure Settings

Set the servo amplifier and the servo motor on System Structure screen.



Step3 Parameter Settings for Safety Observation Function

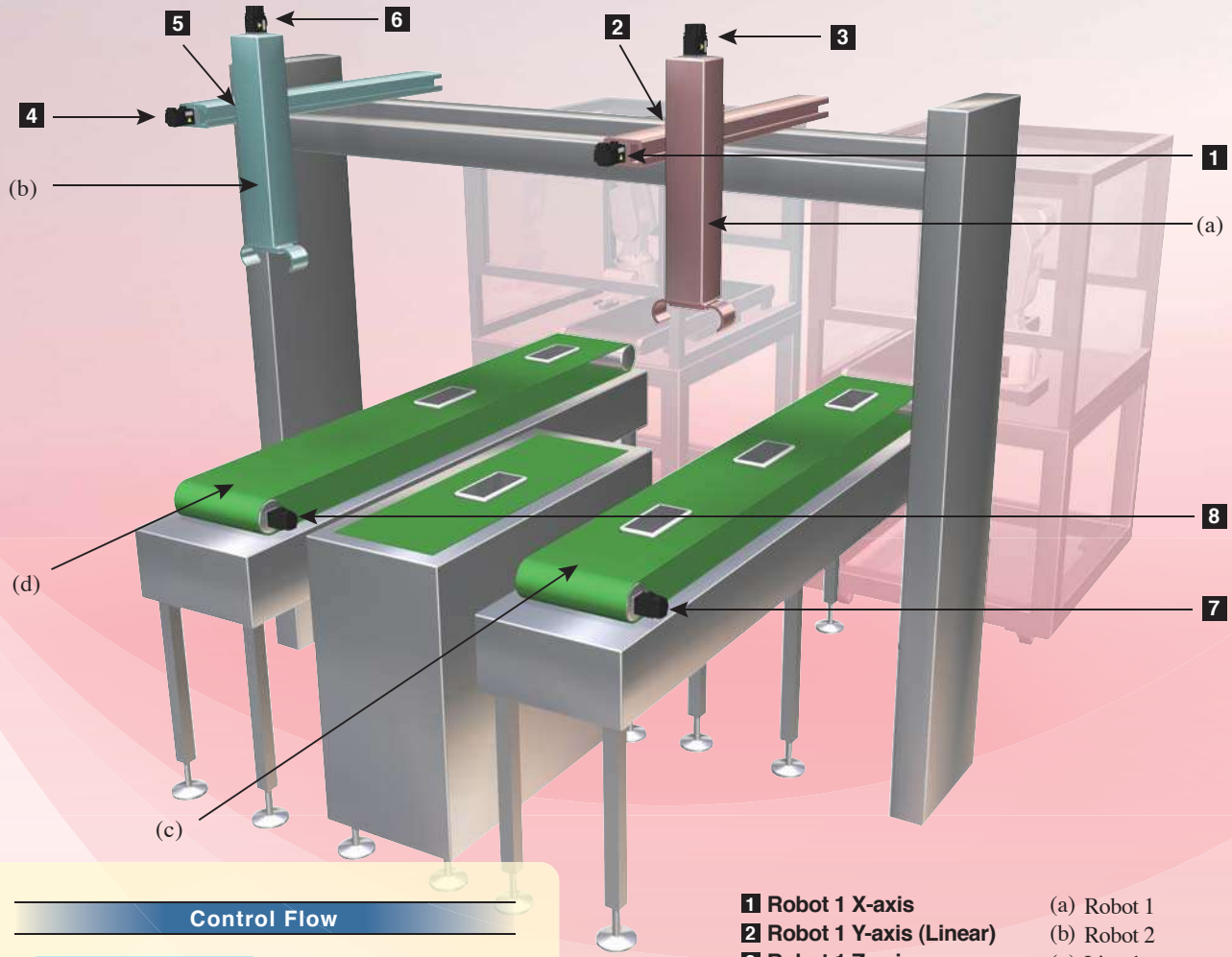
Set the Number of the safety signal modules, etc. with the Safety signal comparison parameter. Set the "Safety speed", Speed monitoring axis No., etc. with the Speed monitoring parameter.



For conveyors, Motion alignment, packing, and robots

CASE 08

Eco-friendly Conveyors and Product Handling Equipment



1 Robot 1 X-axis
2 Robot 1 Y-axis (Linear)
3 Robot 1 Z-axis
4 Robot 2 X-axis
5 Robot 2 Y-axis (Linear)
6 Robot 2 Z-axis
7 Line 1 Belt Conveyor Drive Axis
8 Line 2 Belt Conveyor Drive Axis

(a) Robot 1
(b) Robot 2
(c) Line 1
(d) Line 2

Control Flow

All axes

Robot 1 (X, Y, Z-axis) moves to its wait position.

Robot 2 (X, Y, Z-axis) moves to its wait position.

Robot 1 (X, Y, Z-axis)

Robot 1 grabs a workpiece and place it on the pallet.

Robot 2 (X, Y, Z-axis)

Robot 2 grabs the workpiece in the pallet and move it to Line 2.

Operation is then repeated.

Q17nDSCPU Q17nDSCPU Q170MSCPU Q170MSCPU QD77MS QD77MS QD77GF QD77GF (Note-1)

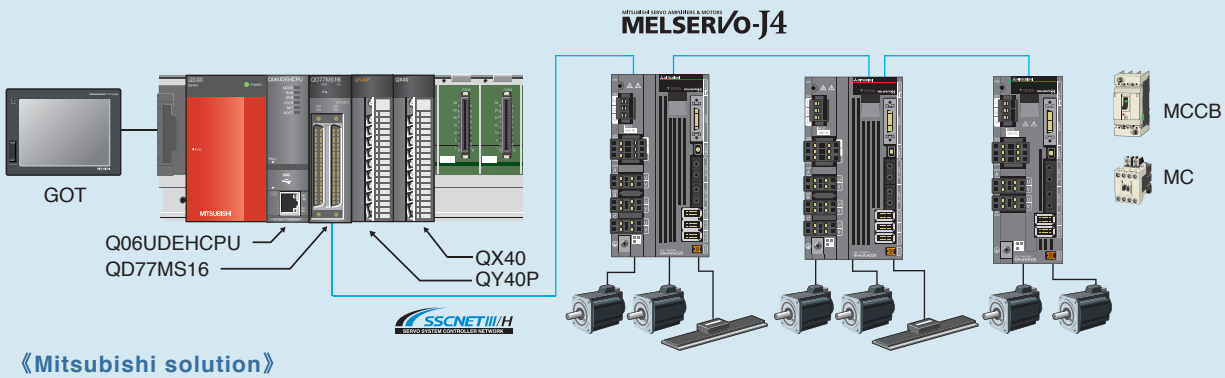
Issues at production sites

Issue 1 Managing of total power consumption
→ **Power Monitor Function**

Issue 2 Reduction of power consumption
→ **Multi-axis Servo Amplifier**

Issue 3 Minimizing waste of power
→ **Capacity Selection Software**

System Example



《Mitsubishi solution》

PLC CPU	: Q06UDEHCPU	Simple Motion	: QD77MS16	Servo amplifier	: MR-J4W3-B,MR-J4W2-B
GOT	: GOT 1000 series	I/O module	: QX40,QY40P	Servo motor	: HG-KR
Main base unit	: Q35DB			Linear servo motor	: LM-H3

Setup Procedure

Step1 System Structure Settings

Step2 Settings for Optional Data Monitor

Step3 Creation of a Sequence Program for GOT Display

《Applications》

- Conveyors and handling equipment
- Packing machine
- Motion alignment
- Pick and place robot

(Note-1): Create the system with one rotary servo motor when using QD77GF.

Solution 1 Power Monitor Function

Managing Power Consumption with a Visualization System

The MR-J4 series servo amplifiers can calculate power consumption itself without a power measuring instrument, and can send the data to controllers for monitoring.

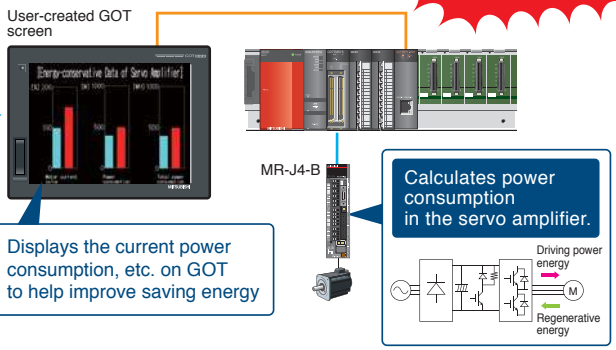
Calculating the data without a power measuring instrument

● **Parameter setting (Optional data selection)**

Data that can be Monitored		
The following are some examples of the data.		
· Effective load ratio	· Regenerative load ratio	· Peak load ratio
· Load to motor inertia ratio	· Position loop gain 1	· Equivalent disturbance torque
· Module power consumption	· Module integral power consumption	· Bus voltage

Optional data monitor: Data type setting with GX Works2
- **Module power consumption (W)**
- **Module integral power consumption (Wh)**

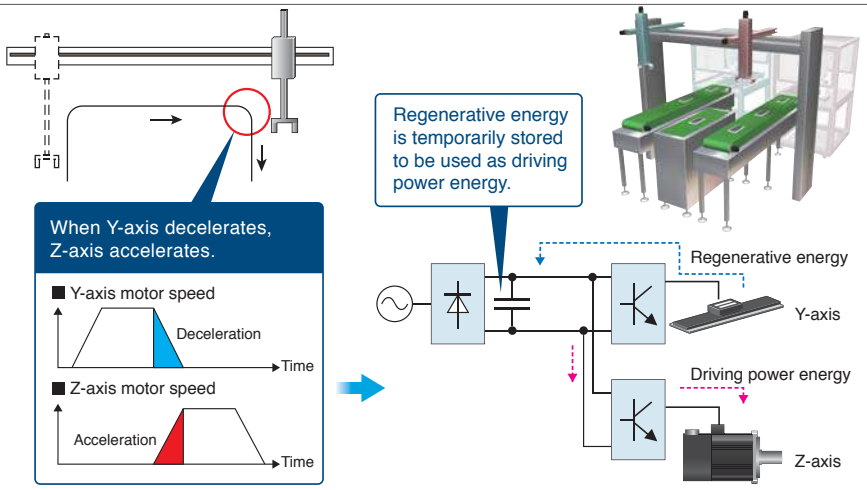
● **Displaying power consumption**



Solution 2 Multi-axis Servo Amplifier

Contributing Energy Conservation Using Regenerative Energy

The multi-axis servo amplifier can store regenerative energy when motors decelerate.
Those regenerative energy is used to drive another motor, contributing to energy conservation of the machine.
In this system, the regenerative energy from the Y-axis is used to accelerate the Z-axis.



Solution 3 Capacity Selection Software

Easy Selection of a Suitable Motor for Your Machine

Selecting motors easily

The "Capacity selection software" (free software) selects a suitable rotary servo motor, linear servo motor, and direct drive motor for your machine using various data, such as mass of the table and the load, the operation pattern, etc.
After the selection, it shows the calculation process and results.

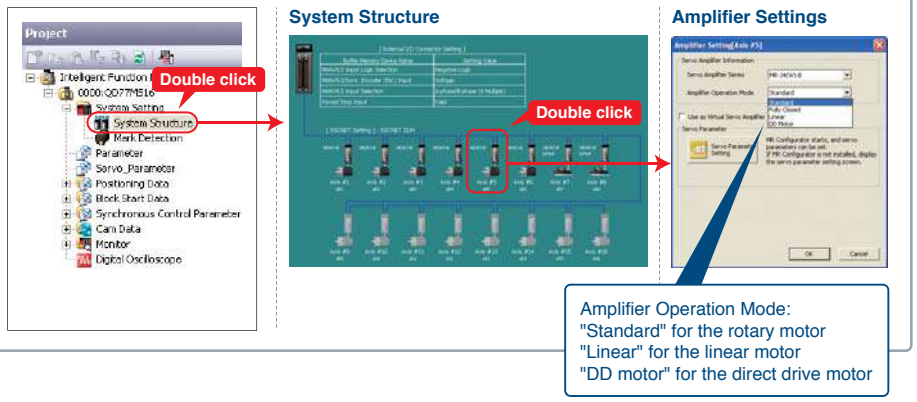
(Note): This software is available for free download.
Contact your local sales office for more details.

Setup Procedure

Step1

System Structure Settings

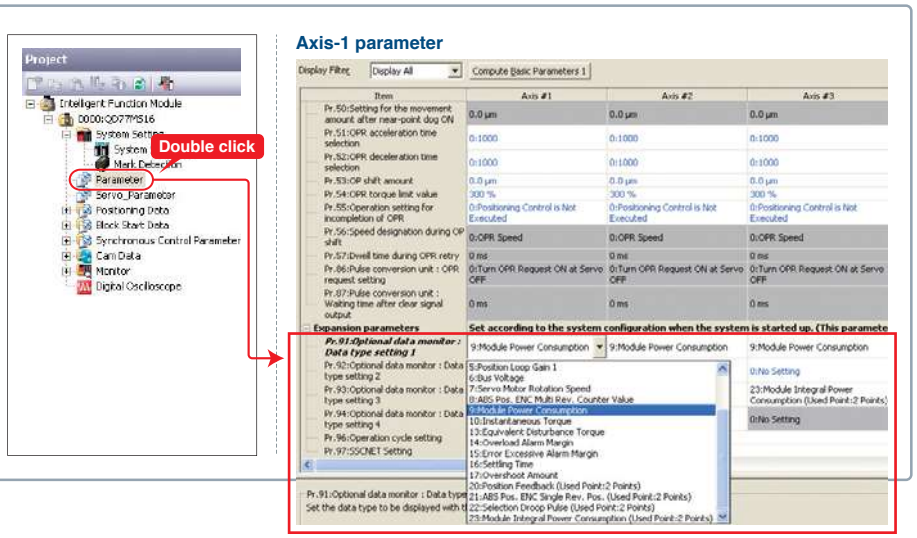
Set servo amplifier.



Step2

Settings for Optional Data Monitor

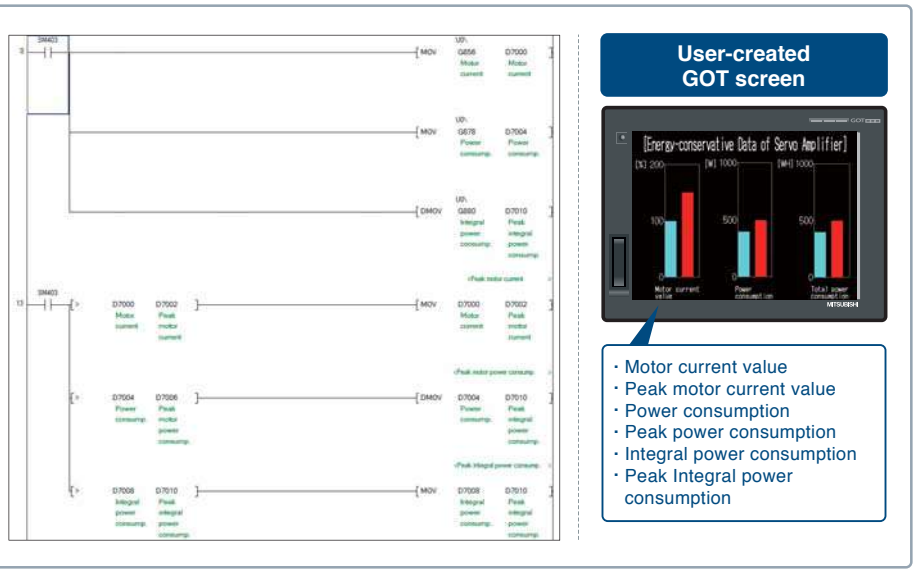
Set the "Optional data monitor" with the parameter. If you select "Module power consumption" or "Module integral power consumption", the amplifier power consumption is monitored.



Step3

Creation of a Sequence Program for GOT Display

Create a sequence program to calculate the data to be displayed on GOT, such as, "Peak power consumption", "Peak integral power consumption", and "Peak motor current".

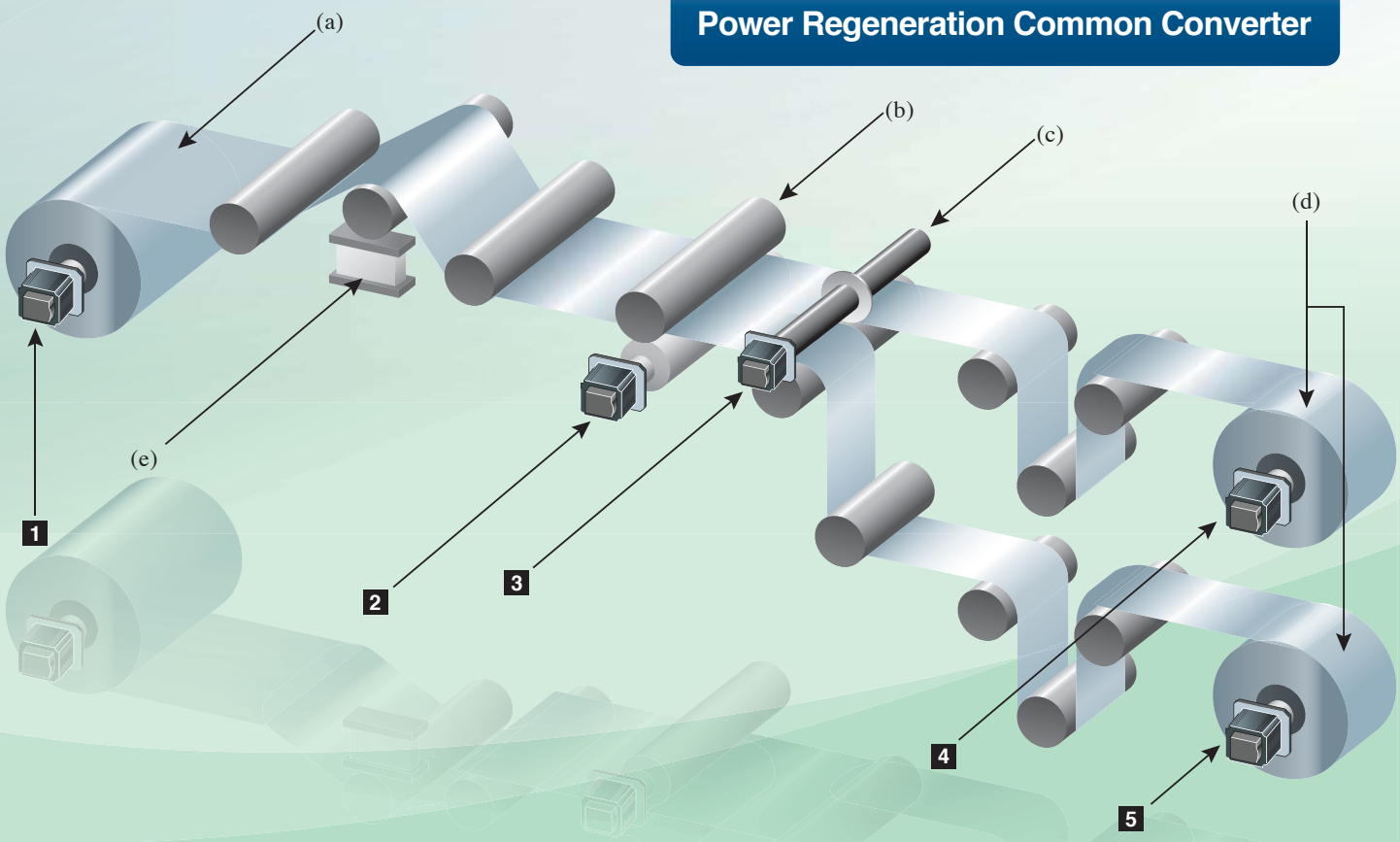


For equipment with rollers

CASE | 09

Film Slitting Machine

PN Bus Voltage Connection + Power Regeneration Common Converter



Control Flow

- **Unwinding Axis** — Torque Control
  - Unwind the film.
- **Roller Axis** — Speed Control
  - Send the film at a constant speed.
  - The cutter slits the film.
- **Rewinding Axes**
  - Rewind the cut film.

1 Unwinding Axis
2 Roller Axis
3 Cutter Axis
4 Rewinding Axis 1
5 Rewinding Axis 2

(a) Film Unwinder
(b) Film Sender
(c) Cutter
(d) Film Rewinder
(e) Tension Detector (sensor)

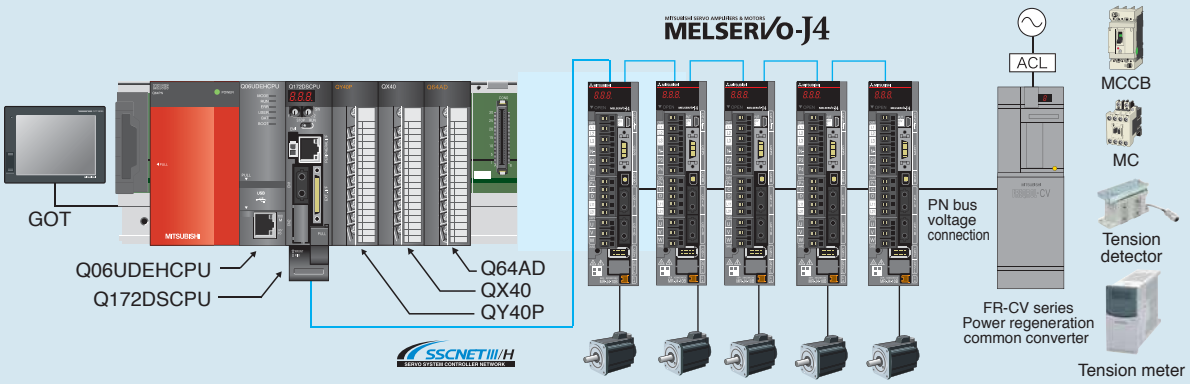
Q17nDSCPU
Q170MSCPU

Issues at production sites

Issue 1
Sending film with a constant speed or tension
→ **Speed Control, Torque Control**

Issue 2
Utilizing regenerative energy
→ **PN Bus Voltage Connection + Power Regeneration Common Converter**

System Example



《Mitsubishi solution》

PLC CPU	: Q06UDEHCPU	Motion CPU	: Q172DSCPU	Servo amplifier	: MR-J4-B
GOT	: GOT 1000 series	I/O module	: QX40,QY40P	Servo motor	: HG-SR, HG-KR
Main base unit	: Q35DB	Analog input module	: Q64AD	Power regeneration common converter	: FR-CV series
		Tension meter	: LM-10PD	Tension detector	: LX-050TD

Setup Procedure

Step1 Wiring of the Power Regeneration Common Converter

Step2 Servo Parameter Settings

Step3 Speed-Torque Control Data Settings

Step4 Control Mode Settings

《Applications》

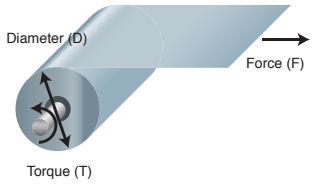
- Packing machine
- Printing machine
- Laminator
- Wire drawing machine
- Slitting machine

Solution 1 Speed Control, Torque Control

Various Controls Flexibly Applied for the Better Operation

Film needs to be sent with a constant tension, preventing from stretching or shrinking. To achieve that, as the equation below shows the relationship among force, torque, and diameter, the torque has to be changed according to the unwinding roll's diameter.
The current torque of the unwinding axis, taking the diameter into account, is measured with the tension detector and is used to compensate the difference from the original torque command, and the data for compensation is sent to the amplifiers.

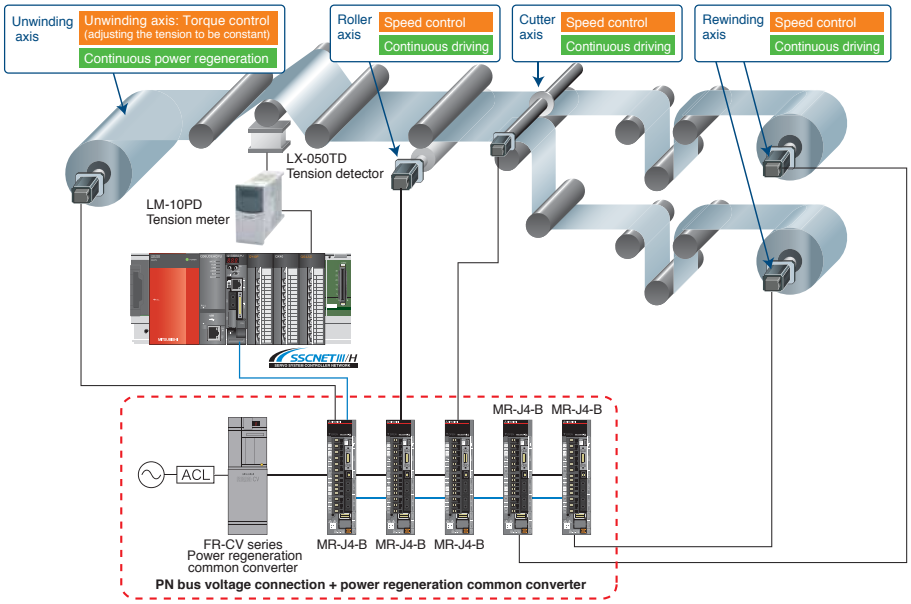
The relationship among force, torque, and diameter.



- Force(F) = Torque(T)/Radius (D/2)
  = (2 × T)/D

calculated according to

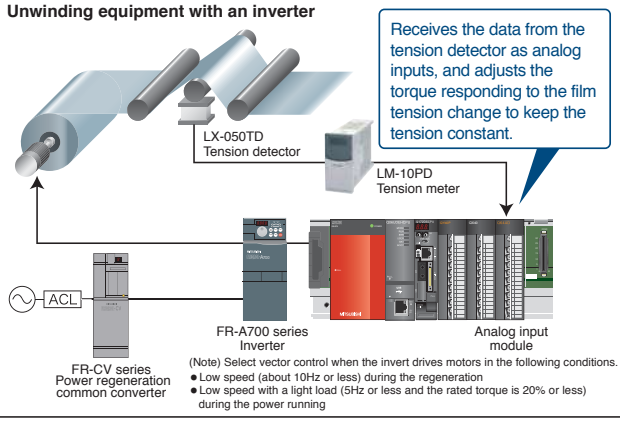
- Torque(T) = Force(F) × Radius (D/2)



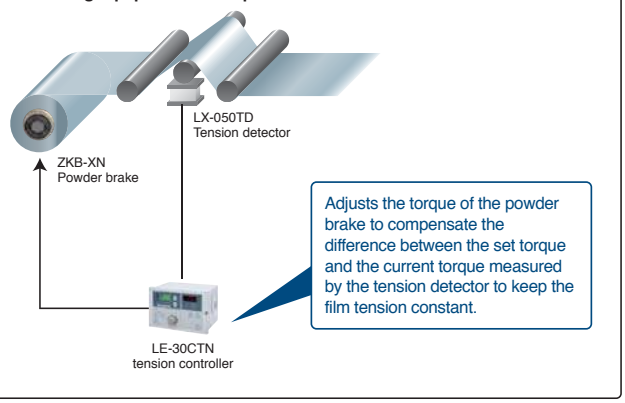
[Unwinding equipment]

An unwinding equipment can be created with an inverter or a powder brake.

Unwinding equipment with an inverter



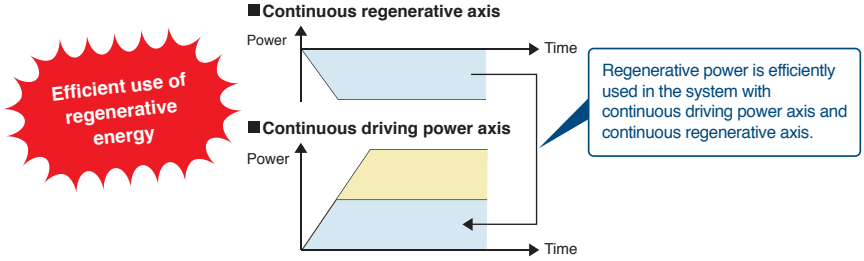
Unwinding equipment with a powder brake



Solution 2 PN Bus Voltage Connection + Power Regeneration Common Converter

Contributing Energy Conservation by Utilizing Regenerative Energy

Regenerative energy is used efficiently when multiple servo amplifiers are connected through common PN bus to the power regeneration common converter.



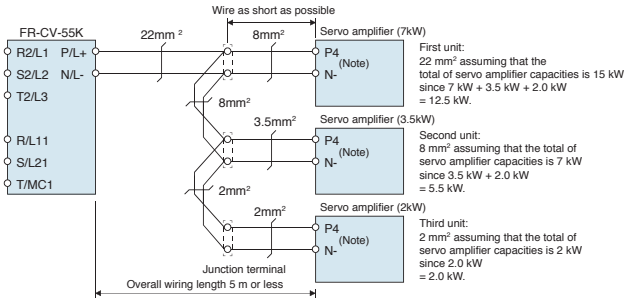
Setup Procedure

Step1 Wiring of the Power Regeneration Common Converter

Wire the Power regeneration common converter.

A wiring example of three servo amplifiers and Power regeneration common converter

When connecting multiple servo amplifiers, always use junction terminals for wiring the servo amplifier terminals P4, N-. Also, connect the servo amplifiers in the order of larger to smaller capacities.

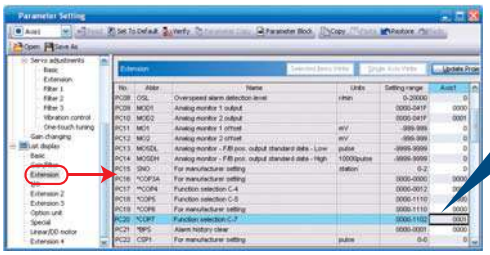


(Note) When using the servo amplifier of 7 kW or less, make sure to disconnect the wiring of built-in regenerative resistor (5 kW or less: P+ and D, 7 kW: P+ and C).

Step2 Servo Parameter Settings

Set the PC20 parameter when using the Power regeneration common converter.

Servo Parameter



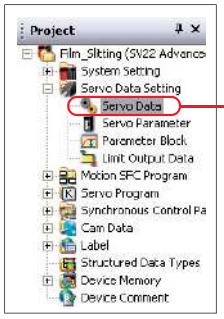
PC20

Undervoltage alarm detection method selection

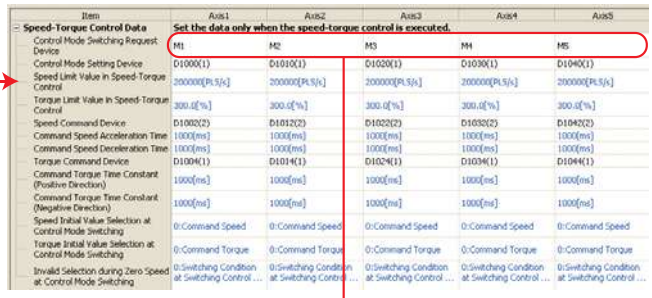
When you use FR-RC, FR-CV, or FR-BU2, select "Method 2 (_ _ _ 1)".
0: Method 1
1: Method 2

Step3 Speed-Torque Control Data Settings

Set the parameters for the unwinding axis, rewinding axis, and all of the roller axes to perform the Speed-Torque control.

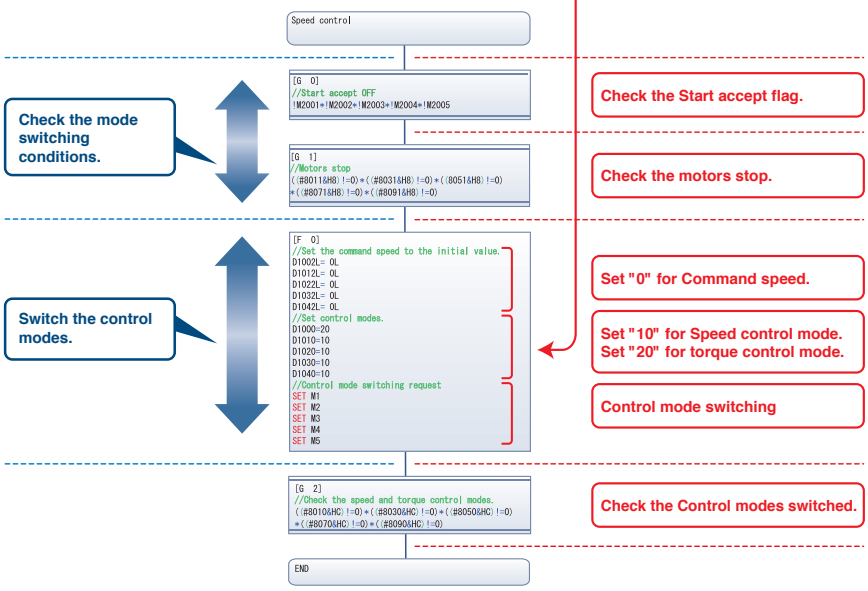


Speed-Torque control Data



Step4 Control Mode Settings

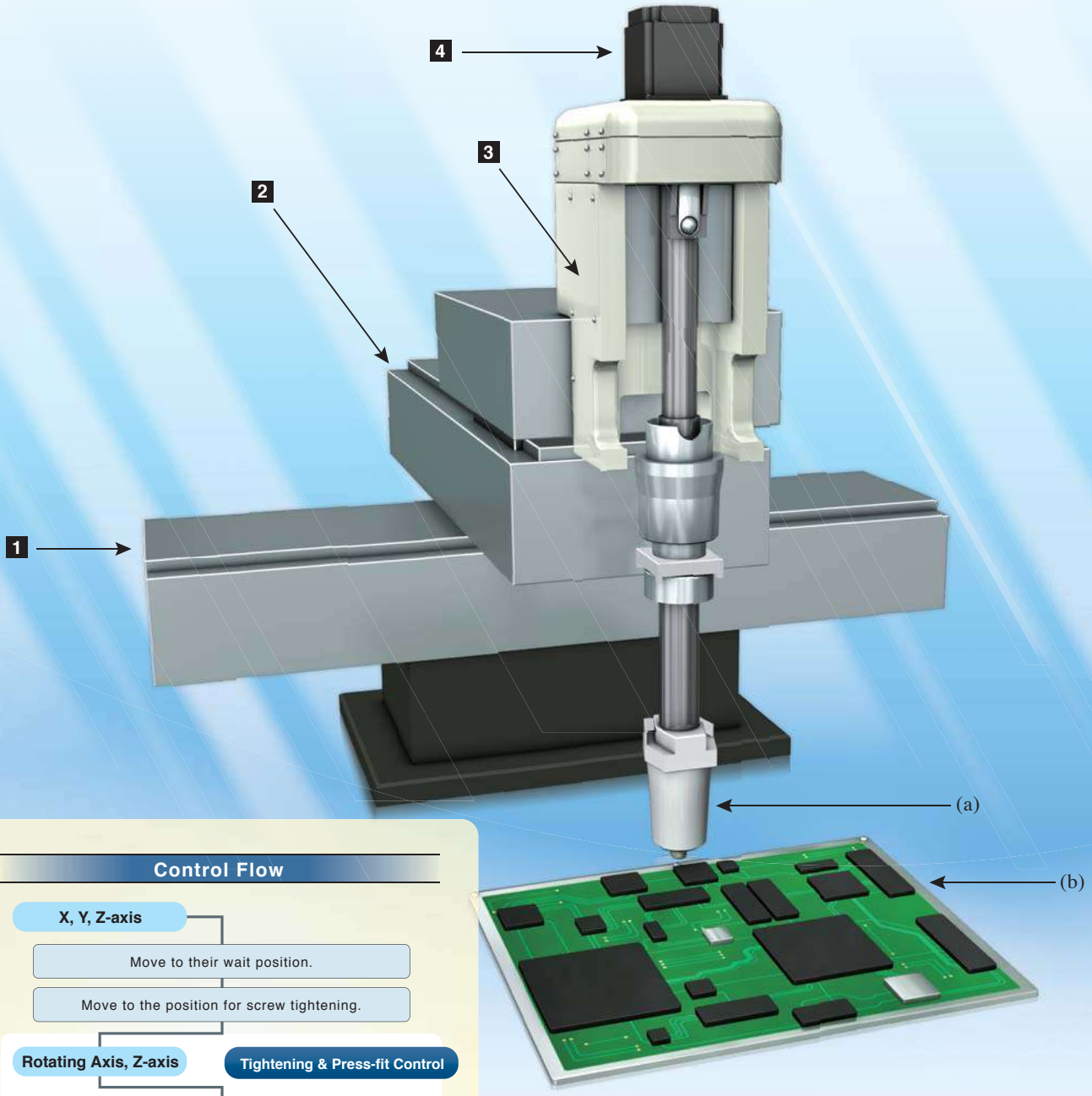
Create the Motion SFC program to switch the control mode of each axis to speed or torque control. Set each axis to "10" (Speed control) or "20" (Torque control) in the program, according to the application of each axis. The example on the right is a Motion SFC program switching the unwinding axis to torque control, and the other axes to speed control.



For tightening, pressing, and clamping

CASE | 10

Screw Tightening Machine



Control Flow

X, Y, Z-axis

Move to their wait position.

Move to the position for screw tightening.

Rotating Axis, Z-axis — **Tightening & Press-fit Control**

Tighten screws using Tightening & Press-fit control.

Z-axis goes down along with the Rotating axis.

Z-axis

Move back to its wait position.

1 X-axis
2 Y-axis
3 Vertical Axis (Z-axis)
4 Rotating Axis

(a) Screw Tightener
(b) Workpiece

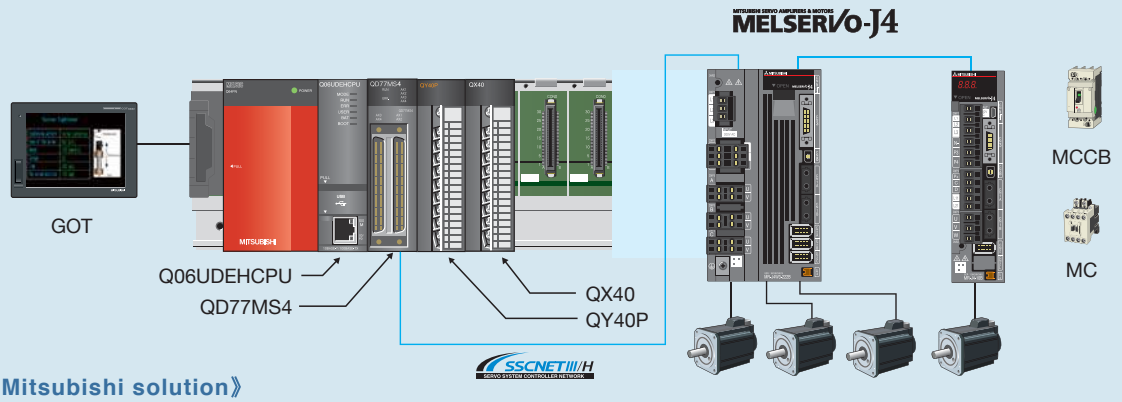
Q17nDSCPU Q170MSCPU QD77MS

Issues at production sites

Issue 1 Tightening screws without using a torque sensor
→ **Tightening & Press-fit Control**

Issue 2 Repeated accuracy in screw tightening operation
→ **Reduced Torque Ripple During Conduction**

System Example



《Mitsubishi solution》

PLC CPU	: Q06UDEHCPU	Simple Motion	: QD77MS4	Servo amplifier	: MR-J4(W3)-B
GOT	: GOT 1000 series	I/O module	: QX40,QY40P	Servo motor	: HG-SR, HG-KR
Main base unit	: Q35DB				

Setup Procedure

Step1 System Structure Settings

Step2 Servo Parameter settings

Step3 Creation of a Sequence Program for Tightening & Press-fit Control

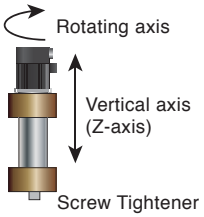
《Applications》

- Cap tightening
- Tightening machine for cylinder head
- Tightening machine for clutch tightening
- Press-fit machine
- Clamping

Solution 1 Tightening & Press-fit Control

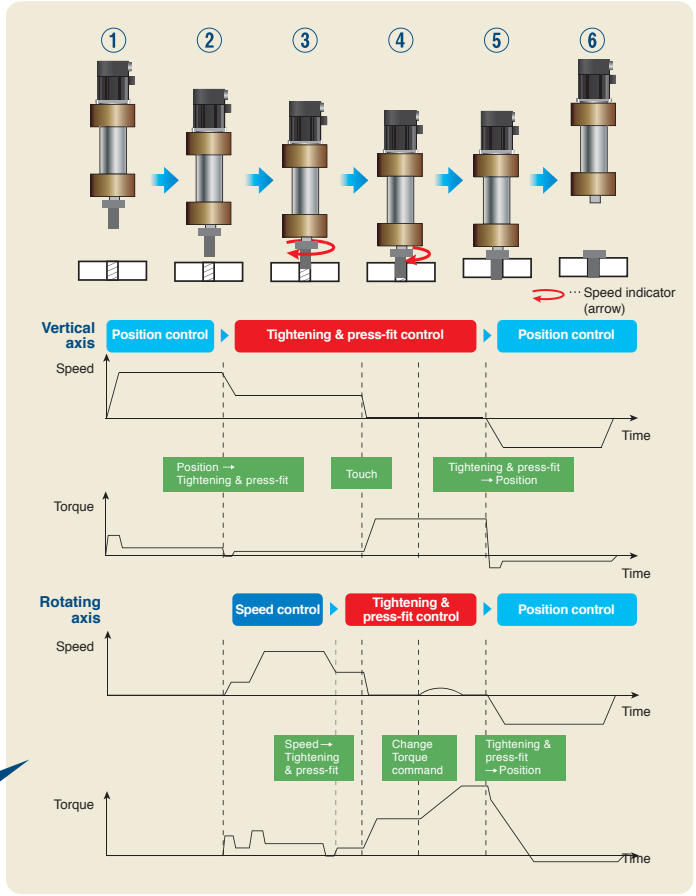
Open-Loop Control for Screw Tightening

The vertical (Z-axis) and rotating axis can be used to tighten screws by switching the control mode to "Tightening & press-fit control" which does not require a torque sensor.
"Tightening & Press-fit control" is a control mode where the motor does not have to stop when the system switches to this control mode from speed or positioning control.



<Operation Sequence>

①→②	Vertical axis	: Moves from its wait position to above the workpiece.
	Rotating axis	: No movement (Servo ON)
②	Vertical axis	: Switches to Tightening & press-fit control.
	Rotating axis	: Switches to speed control and starts operation at low speed
②→③	Vertical axis	: Starts pushing down the screw.
	Rotating axis	: Starts tightening after switching to mid-range speed operation.
③→④	Vertical axis	: Pushes down the screw with a constant torque.
	Rotating axis	: Switches to Tightening & press-fit control and tightens the screw.
④→⑤	Vertical axis	: Pushes the screw to its final position with a constant torque.
	Rotating axis	: Tightens the screw fully with a specified torque.
⑤→⑥	Vertical axis	: Switches back to position control and goes back to its wait position.
	Rotating axis	: Switches back to position control and goes back to its wait position.



<Tightening screws without a torque sensor>
Screws can be tightened without using a torque sensor (open-loop control), controlling the speed and torque of the rotating axis according to its operation sequence.

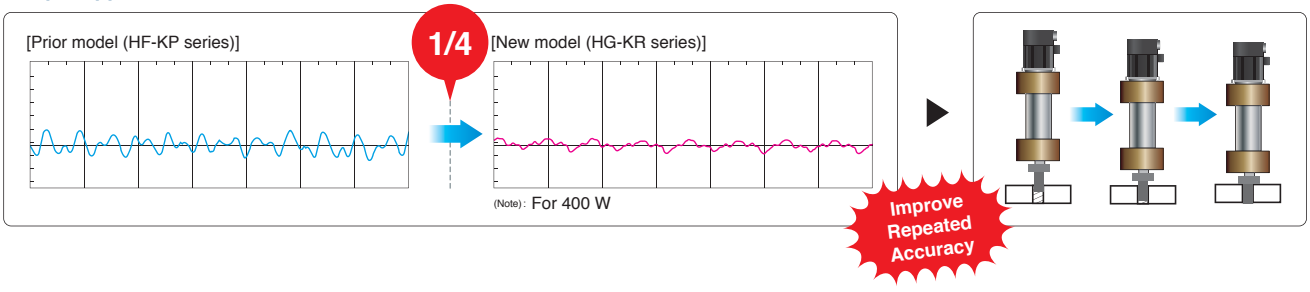
Solution 2 Reduced Torque Ripple During Conduction

Great Improvement in Repeated Accuracy of Screw Tightening

By optimizing the combination of the number of motor poles and the number of slots, torque ripple during conduction is greatly reduced, which helps improve the accuracy of repeated operation of tightening screws.

Torque ripple

(As compared to the prior series.)

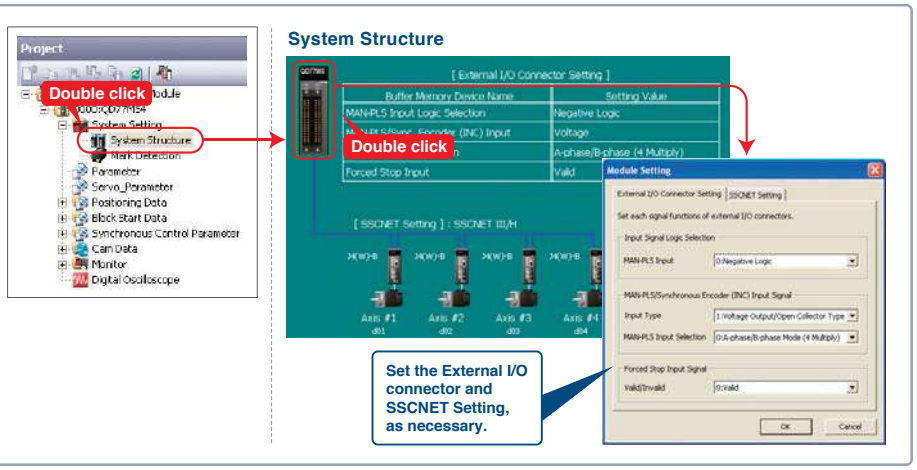


Setup Procedure

Step1

System Structure Settings

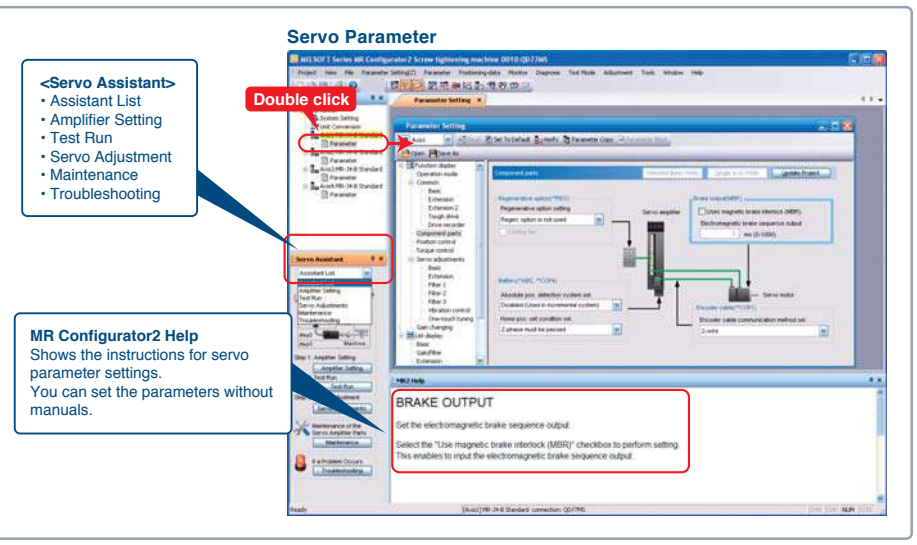
Set the servo amplifier in the System Structure.



Step2

Servo Parameter Settings

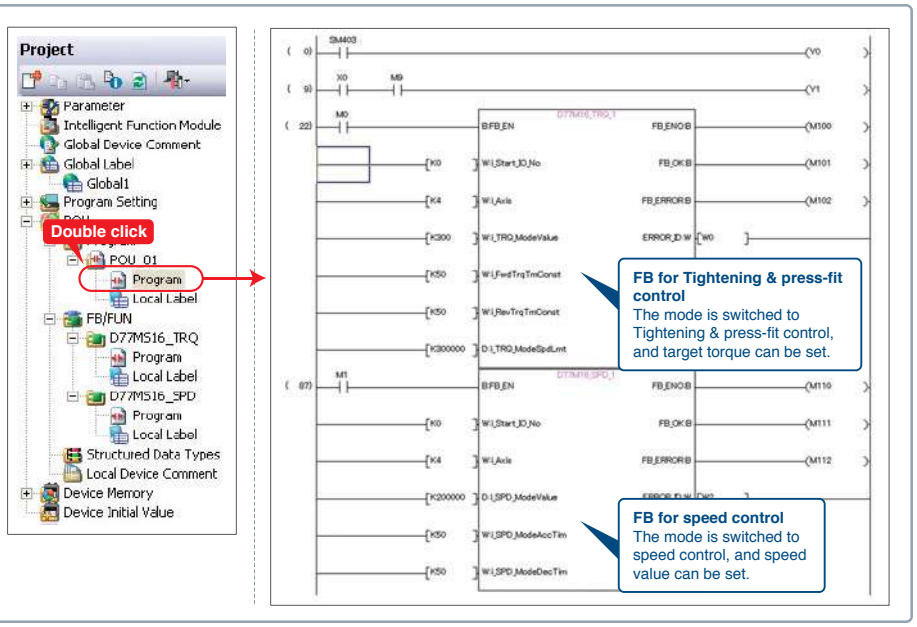
Set the servo amplifier of each axis. The parameters are easily set following the assistant function, including those set for the first time.



Step3

Creation of a Sequence Program for Tightening & Press-fit Control

Create a sequence program for control using Function Block (FB), such as a program for control mode switching.



Lineup

Features of the Motion Controllers and the Simple Motion Modules

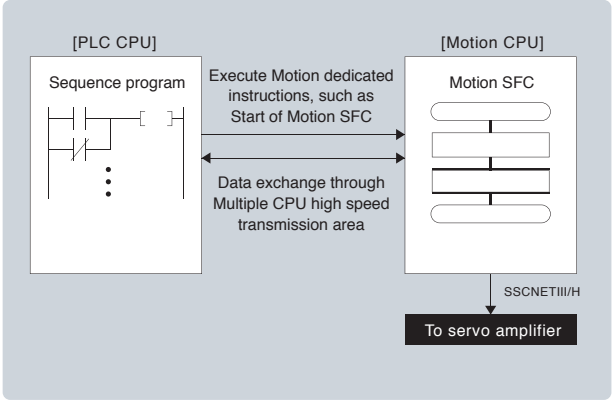
Harmony with a wide range of applications and controls

Most-advanced Motion controller

SSCNET III/H compatible Motion controller

Q173DSCPU
Q172DSCPU
Q170MSCPU
Q170MSCPU-S1

The Motion controller is a CPU module used with the PLC CPU for Motion control. Using Motion SFC program, the Motion controller separately controls I/O modules, etc.,from the PLC CPUs; therefore high speed control is achieved.
The Q170MSCPU is a CPU module integrating the Motion controller function, the PLC CPU function, and power supply all in one.



Advanced control but simple to use just like the positioning module

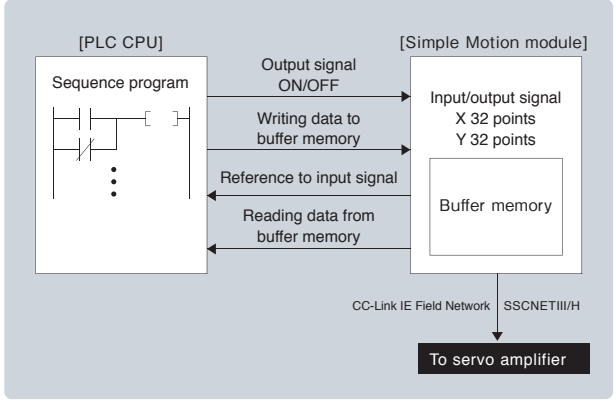
SSCNET III/H compatible Simple Motion module

QD77MS16
QD77MS4
QD77MS2

CC-Link IE Field Network Simple Motion Module

QD77GF16

The Simple Motion module is an intelligent function module performing positioning control following the PLC CPU's instructions. Synchronous control that was unavailable with the previous positioning module is now available with these new Simple Motion modules, while being simple to use just like the positioning module.
The positioning function of this Simple Motion module is used in the same way as the positioning module.



Function Comparison

Comparison of Motion controller and Simple Motion module

Superior

	Motion controller			Simple Motion module		
	Q173DSCPU	Q172DSCPU	Q170MSCPU(-S1) NEW	QD77MS16	QD77MS4/QD77MS2	QD77GF16 NEW
Module type	CPU module			Intelligent Function Module		
Servo amplifier interface	SSCNET III/H			SSCNET III/H		CC-Link IE Field Network
	2 systems	1 system		1 system		1 system
Servo amplifier type	MR-J4-B			MR-J4-B		MR-J4-B-RJ010+MR-J3-T10
Number of control axes	Up to 32 axes	Up to 16 axes		Up to 16 axes	Up to 4 axes / 2 axes	Up to 16 axes
Operation cycle	0.22 ms or more			0.88ms / 1.77ms	0.88ms	0.88ms / 1.77ms
PLC CPU	MELSEC-Q series		Q03UD/Q06UDH or equivalent	MELSEC-Q series		
Engineering environment	MT Woks2	MR Configurator2 (Note-1)		Simple Motion Module Setting Tool	MR Configurator2 (Note-2)	
Programming language	Motion SFC			—		
Control modes	Position control	Speed control	Torque control	Position control	Speed control (Note-5)	Torque control (Note-4)
	Tightening & Press-fit control	Synchronous control	Cam control	Tightening & Press-fit (Note-4)		Cam control
	Advanced synchronous control			Synchronous control		
Positioning control	Linear interpolation	Circular interpolation	Trajectory control	Linear interpolation	Circular interpolation	Trajectory control
	Helical interpolation	Position follow-up control	Speed control with fixed position stop			Speed/position switching control (ABS)
	High-speed oscillation control	Speed/position switching control			Speed/position switching control (INC)	Position/speed switching control
Acceleration/ deceleration control	Trapezoidal acceleration/deceleration	S-curve acceleration/deceleration	Advanced S-curve acceleration/deceleration	Trapezoidal acceleration/deceleration	S-curve acceleration/deceleration	
Manual control	JOG operation	Manual pulse generator operation		JOG operation	Manual pulse generator operation	
	JOG operation simultaneous start				Inching operation	
Functions to change the control details	Current value change	Target position change	Torque limit value change	Current value change	Target position change	Torque limit value change
	Speed change		Acceleration/deceleration time change	Speed change	Override	Acceleration/deceleration time change
Home position return type	Proximity dog type 1	Proximity dog type 2	Scale home position signal detection type	Proximity dog type		Scale home position signal detection type
	Count type 1	Count type 2	Count type 3	Count type 1	Count type 2	
	Data set type 1	Data set type 2	Dog cradle type	Data set type		
	Stopper type 1	Stopper type 2	Limit switch combined type			
	Dogless origin signal reference type					
Sub functions	Forced stop	Hardware stroke limit	Software stroke limit	Forced stop	Hardware stroke limit	Software stroke limit
	Absolute position system	Amplifier-less operation	Unlimited length feed	Absolute position system	Amplifier-less operation	Unlimited length feed
	Optional data monitor	Mark detection	ROM operation	Optional data monitor (Note-4)	Mark detection	Flash ROM backup
	M-code output	Error history	Digital oscilloscope	M-code output	Error history collection	Digital oscilloscope
	Safety observation (Note-3)	Vision system	Software security key			
	High-speed reading	Limit switch output	Cam auto-generation			Cam auto-generation

(Note-1) : MELSOFT MR Configurator2 is included in MELSOFT MT Works2.
(Note-2) : The Simple Motion module setting tool is included in MELSOFT GX Works2.
(Note-3) : The safety observation function is available with the Q173DSCPU/Q172DSCPU.
(Note-4) : Available only with the QD77MS.
(Note-5) : The QD77GF can perform only speed control with position loop, while QD77MS can perform speed control.

Engineering Environment

Comprehensibly supporting Motion controller design and maintenance

Motion Controller Engineering Software MELSOFT MT Works2

Motion SFC programming, parameter setting, digital oscilloscope function, and simulation function are available. All necessary setup steps for use of Motion controller are created with this software, from system designing, programming, debugging, to maintenance.

Supporting settings of simple Motion modules as well as sequence program creation

Programmable Controller Engineering Software MELSOFT GX Works2

This software supports sequence program creation and the necessary setup steps for use of Simple Motion modules, such as the creation, startup, debugging, and maintenance of parameters, positioning data, and cam data.

Start-up support tool for a suitable machine system, optimum control and short setup time

Servo Setup Software MELSOFT MR Configurator2

Tuning, monitor display, diagnosis, reading/writing parameters, and test operations are easily performed on a personal computer. This start-up support tool achieves a stable machine system, optimum control, and short setup time.

Easy to Use | Pursuing Easy-to-use and User-friendly Functions

System Design

MT Works2 GX Works2

◆System design

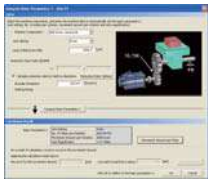
You can easily set servo amplifiers and modules with a graphical system setting screen.

◆Parameter settings

The one-point help is available to set parameters without the manual.

◆Electronic gear

You can easily set the complicated electronic gear just by inputting the machine specifications (reduction ratio, ball screw pitch, etc.).

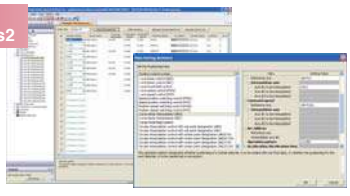


Programming

◆Positioning data setting

The Data Setting Assistant function simplifies the setting input process of the positioning data for the Simple Motion modules.

GX Works2



◆Advanced synchronous control

Synchronous control data is easily created with software by placing mechanical modules on screen, such as the gear, shaft, speed change gear and cam.

MT Works2 GX Works2

◆Programming

User-friendly functions are available for program development.

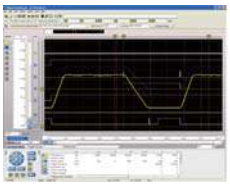
MT Works2

Monitor Function and Debugging

◆Digital oscilloscope function

Operation check and troubleshooting are powerfully supported with data collection and wave displays which are synchronized to the Motion operation cycle.

MT Works2 GX Works2



◆Monitor function

The Motion controller operation status is easily confirmed with the various monitoring functions.

MT Works2 GX Works2

◆Simulator

Program debugging can be executed without using Motion controller, which improves designing efficiency.

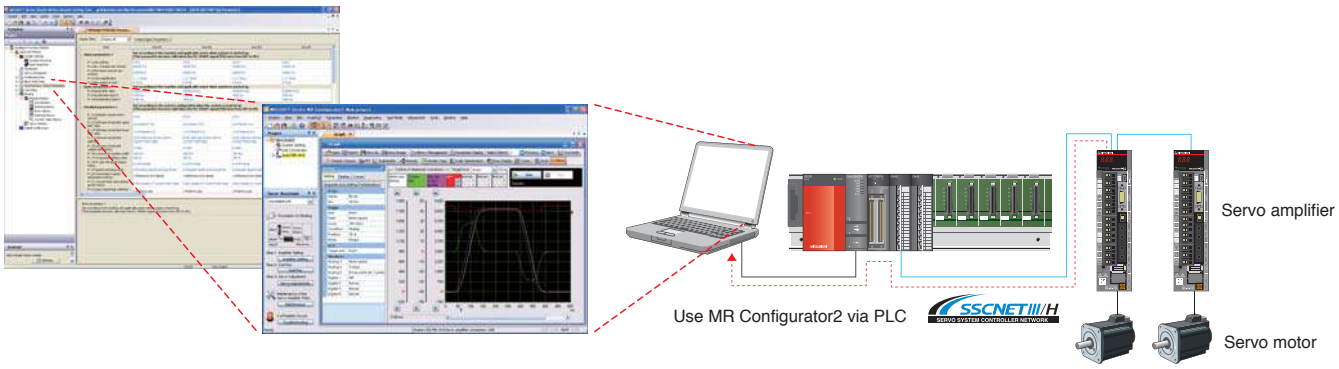
MT Works2

Easy to Use | User-friendly Software for Easy Setup, Tuning and Operation

◆Adjustment of servo amplifier parameters

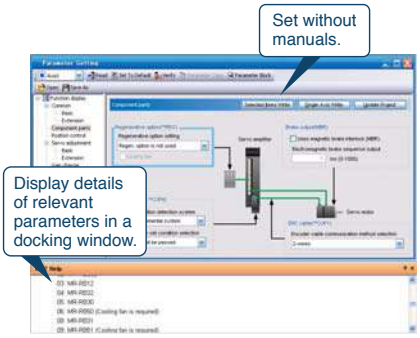
MR Configurator2

Collaboration with the MR Configurator2 increases the ease of servo installation. You can set and adjust servo amplifier parameters with the MR Configurator2, the software created with Mitsubishi servo know-how.



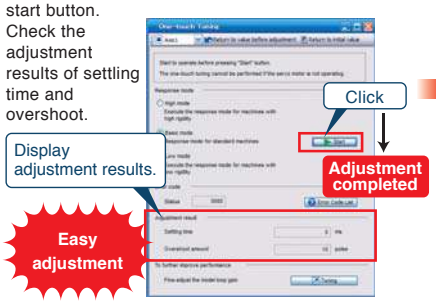
◆Parameter Setting Function

Display parameter setting in list or visual formats, and set parameters by selecting from the drop down list.



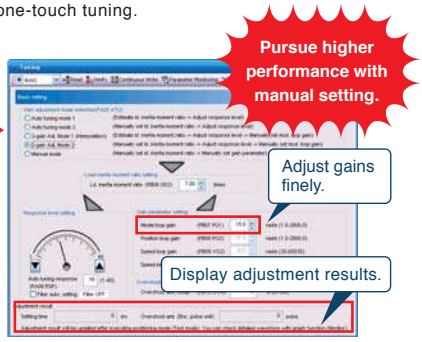
◆One-touch Tuning Function

Adjustments including estimating load to motor inertia ratio, adjusting gain, and suppressing machine resonance are automatically performed for the maximum servo performance just by clicking the start button.
Check the adjustment results of settling time and overshoot.



◆Tuning Function

Adjust model control gain finely on [Tuning] window manually for further performance after the one-touch tuning.

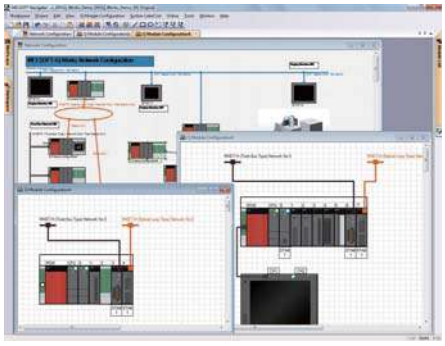


Easy to Use | Seamless Engineering Environment

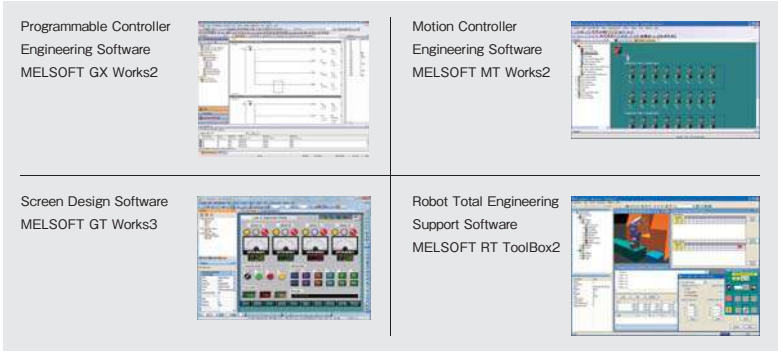
MELSOFT iQ Works is an integrated engineering software product, composing of GX Works2, MT Works2, GT Works3, and RT ToolBox2.
By sharing information such as system designs and programming as the entire control system, the system design and programming efficiency are improved and total cost reduction is achieved.

◆MELSOFT Navigator

In combination with GX Works2, MT Works2, GT Works3, and RT ToolBox2, this software performs upstream system design and inter-software operation.
It provides such convenient functions as system configuration design, batch setting of parameters, system labeling, and batch reading.



MELSOFT Navigator

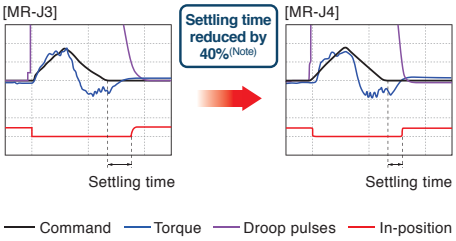


Industry-leading Basic Functions

High response | Speed Frequency Response Is Increased to 2.5 kHz

Our original servo control architecture is evolved from the conventional two-degrees-of-freedom model adaptive control and applied to the dedicated execution engine. Speed frequency response is increased to 2.5 kHz. Compatible servo motors are equipped with a high-resolution absolute encoder of 4,194,304 pulses/rev (22-bit), enabling high-speed and high-accuracy operation. The performance of the high-end machine is utilized to the fullest.

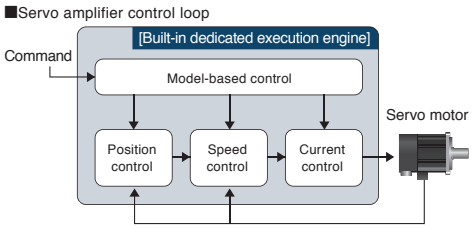
[Settling time comparison with the prior model]



(Note): The result is based on our evaluation condition.

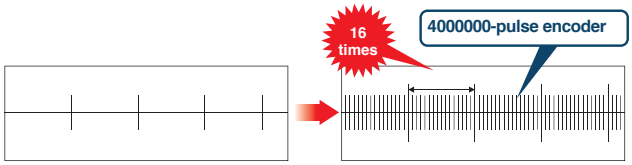
[Dedicated execution engine]

Equipped with the servo control engine with our original architecture.



High-accuracy | Improving Machine Performance with High-performance Motors

Rotary servo motors achieve high-accuracy positioning and smooth rotation with a high-resolution encoder and improved processing speed.



High Stability | Reduced Torque Ripple During Conduction

By optimizing the combination of the number of motor poles and the number of slots, torque ripple during conduction is greatly reduced. Smooth constant-velocity operation of machine is achieved.

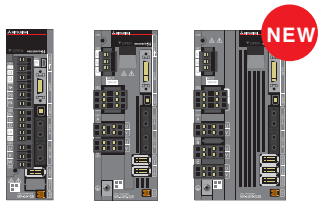
[Torque ripple]

(Note): For 400W

Flexible | Applicable for Various Control and Driving Systems

◆1-axis/2-axis/3-axis Servo Amplifiers

For SSCNET III/H compatible servo amplifiers, 2-axis and 3-axis types are available in addition to 1-axis type, enabling flexible systems based on the number of control axes.



MR-J4-B MR-J4W2-B MR-J4W3-B

◆Compatible Servo Motors

MR-J4 series servo amplifier operates rotary servo motors, linear servo motors, and direct drive motors as standard.

Rotary servo motor Linear servo motor Direct drive motor

◆Linear Servo Motor

Four series are available depending on applications.

LM-H3 series
(Core type)
Material handlings
Rated thrust: 70N to 960N
Max. thrust: 175N to 2400N

LM-U2 series
(Coreless type)
Screen printing systems
Scanning exposure systems
Rated thrust: 50N to 800N
Max. thrust: 150N to 3200N

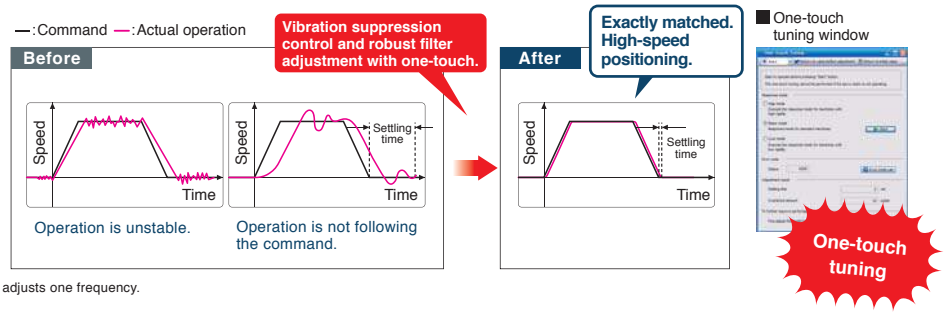
LM-F series
(Core type (natural/liquid cooling))
Material handlings
Press feeders
Rated thrust:
300N to 3000N (natural cooling)
600N to 6000N (liquid cooling)
Max. thrust:
1800N to 18000N (natural/liquid cooling)

LM-K2 series
(Core type with magnetic attraction counter-force)
LCD assembly systems
Semiconductor mounting systems
Rated thrust: 120N to 2400N
Max. thrust: 300N to 6000N

Advanced Servo Gain Adjustment

Advanced One-touch Tuning Function | Quick Setting by Just One Click

Servo gains including machine resonance suppression filter, advanced vibration suppression control II (Note), and robust filter are adjusted just by turning on the one-touch tuning function. Machine performance is utilized to the fullest using the advanced vibration suppression control function.



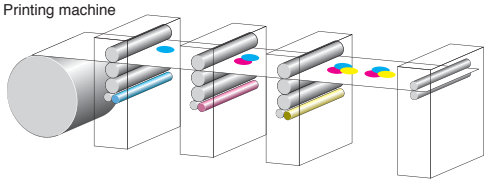
(Note): The advanced vibration suppression control II automatically adjusts one frequency.

High Stability | Robust Filter

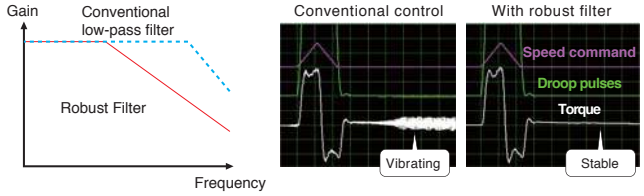
Achieving both high responsivity and stability was difficult with the conventional control in high-inertia systems with belts and gears such as printing and packaging machines. Now, this function enables the high responsivity and the stability at the same time without adjustment. The robust filter more gradually reduces the torque with wide frequency range and achieves more stability as compared to the prior model.

[Machine with a high-inertia ratio]

(Ex.) Printing machine



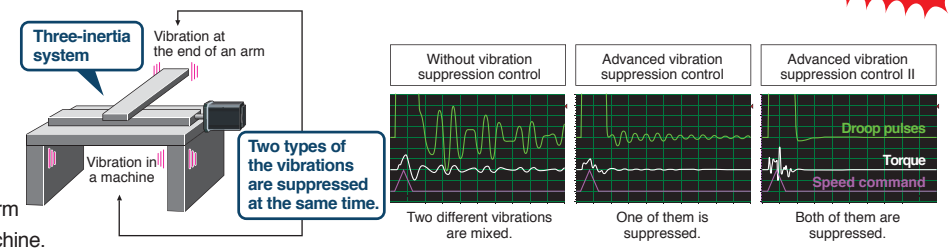
[Robust Filter]



High Stability | Advanced Vibration Suppression Control II

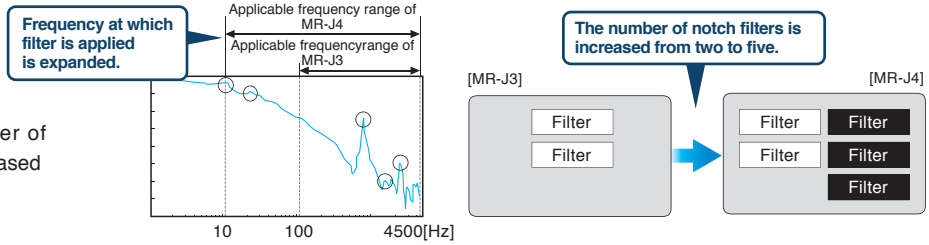
Patent Pending

Due to vibration suppression algorithm which supports three-inertia system, two types of low frequency vibrations are suppressed at the same time. Adjustment is performed on MR Configurator2. This function is effective in suppressing vibration at the end of an arm and in reducing residual vibration in a machine.



High Stability | Machine Resonance Suppression Filter

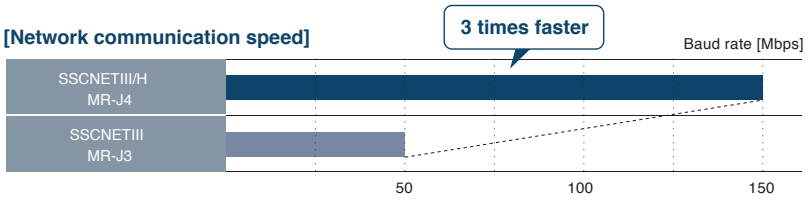
With advanced filter structure, applicable frequency range is expanded from between 100Hz and 4500Hz to between 10Hz and 4500Hz. Additionally, the number of simultaneously applicable filters is increased from two to five, improving vibration suppression performance of machine.



Achieving High-speed and High-accuracy Movement

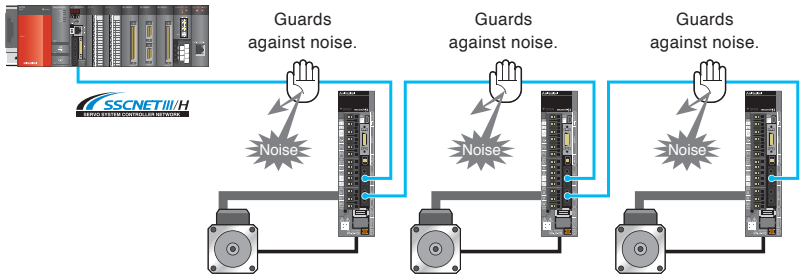
High response | Three times faster communication speed

Communication speed is increased to 150 Mbps full duplex (equivalent to 300 Mbps half duplex), three times faster than the conventional speed. System response is dramatically improved.



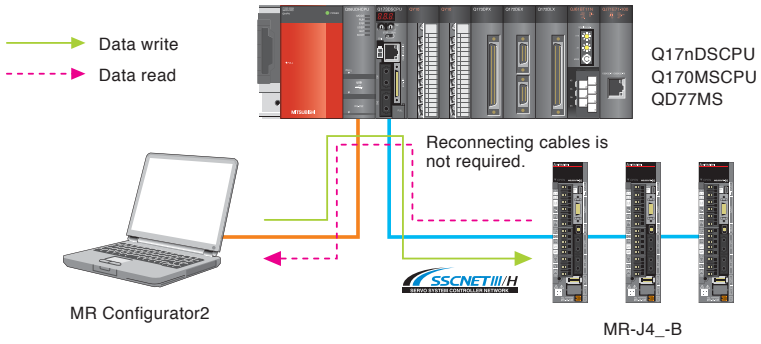
Low noise | No transmission collision

The fiber-optic cables thoroughly shut out noise that enters from the power cable or external devices. Noise immunity is dramatically improved as compared to metal cables.



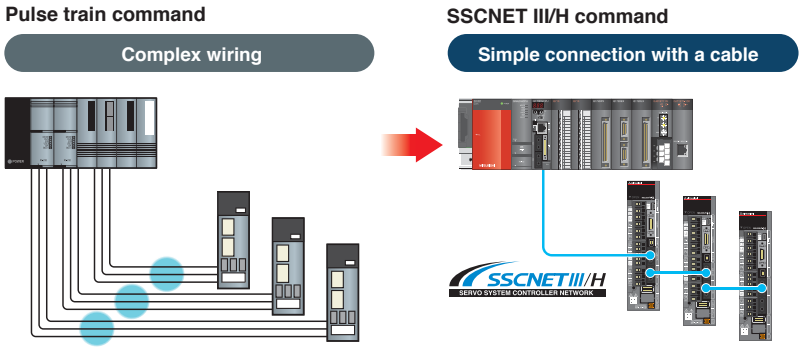
Easy to Use | Central control with network

Large amounts of servo data are exchanged in real-time between the controller and the servo amplifier.
Using MR Configurator2 on a personal computer that is connected to Q17nDSCPU, Q170MSCPU, or QD77MS helps consolidate information for the multiple servo amplifiers.



SSCNETIII/H | Dramatically Reduced Wiring

Simple connections with dedicated cables reduce both wiring time and chances of wiring errors. No more complicated wiring.



Compliant with Functional Safety of International Standard

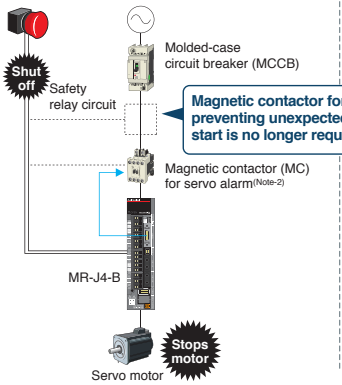
Functional Safety | Functions According to IEC/EN 61800-5-2

MELSERVO-J4 series servo amplifiers have integrated STO (Safe torque off) and SS1[(Note-1)] (Safe stop 1) functions as standard. Safety system is easily configured in the machine. (SIL 2)

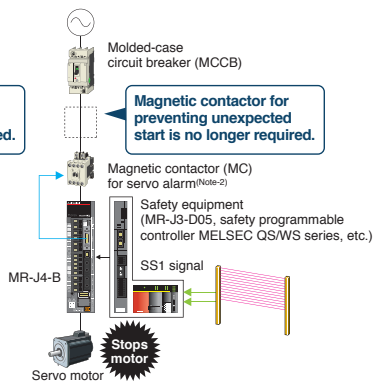
- Turning off the control power of servo amplifier is not required, cutting out the time for restart. Additionally, home position return is not required.
- Magnetic contactor for preventing unexpected motor start is not required.[(Note-2)]

(Note-1): Safety equipment (MR-J3-D05, safety programmable controller MELSEC QS/WS series, etc.) is required.
(Note-2): STO is not the electrical safety protection function but the function to turn off the output torque by shutting off the power supply inside the servo amplifier. For MR-J4 series servo amplifier, magnetic contactors are not required to meet the STO requirements. However, install a magnetic contactor to prevent the short circuit of servo amplifier or electric shock.

[Shut-off by STO function]

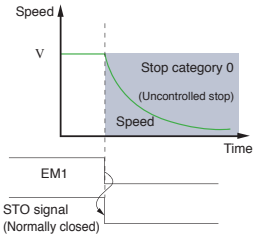
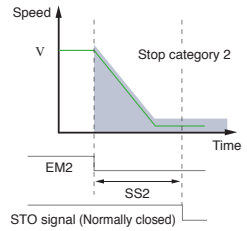
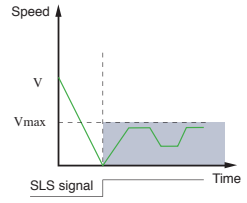
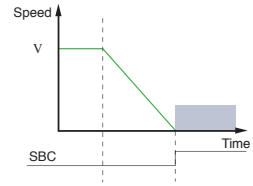


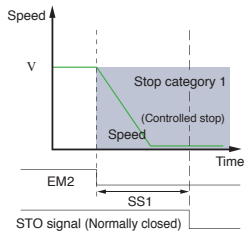
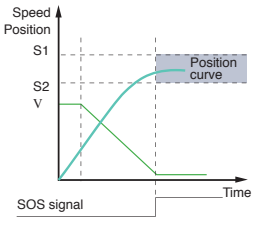
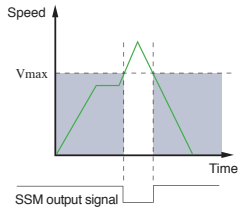
[Shut-off by STO and SS1 functions]



Safety Standard | Advanced Features for World-class Safety

(1) Amplifier + Motion controller "Safety Observation Function"
(2) Amplifier only
(3) Amplifier + Safety logic module "MR-J3-D05"

IEC61800-5-2 Safety standard		(1)	(2)	(3)
Safe torque off (STO) The STO function shuts off power to the motor electronically using the internal circuit by responding to the input signals (EM1) from external equipment (shuts off through secondary-side output). This function corresponds to the Stop category 0 of IEC 60204-1.		○	○	○
Safe stop 2 (SS2) Responding to the input signals from external equipment (EM2), the SS2 function initiates the motor deceleration. After a required time delay for motor stop is passed, the SS2 function initiates the SOS function. This function corresponds to the Stop category 2 of IEC 60204-1		○	—	—
Safely-limited speed (SLS) This function monitors the motor not to exceed the required speed limit. If the speed exceeds the limit, the motor power is shut off by the STO or SS1 function.		○	—	—
Safe brake control (SBC) This function outputs a safety output signals for external brake control.		○	—	—

IEC61800-5-2 Safety standard		(1)	(2)	(3)
Safe stop 1 (SS1) Responding to the input signals (EM2) from external equipment, the SS1 function initiates the motor deceleration. After a required time delay for motor stop is passed, the SS1 initiates the STO function. This function corresponds to the Stop category 1 of IEC 60204-1.		○	—	○
Safe operating stop (SOS) This function monitors the position of the motor not to deviate from the specified range. Power is still supplied to the motor during the SOS function.		○	—	—
Safe speed monitor (SSM) The SSM signal is outputted when the motor speed is below the specified speed limit.		○	—	—

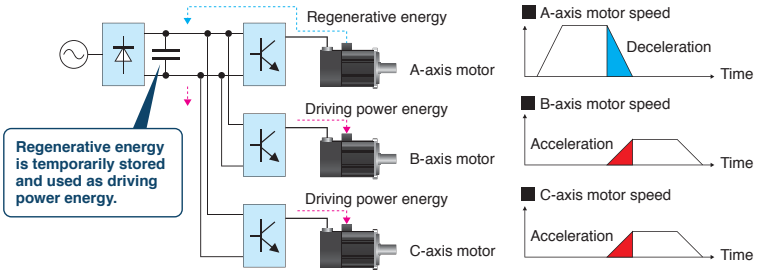
V: Speed
Vmax: User specified speed limit value
S1, S2: Specified stop position

Ensured safety range

A Wide Variety of Energy-conservation Functions

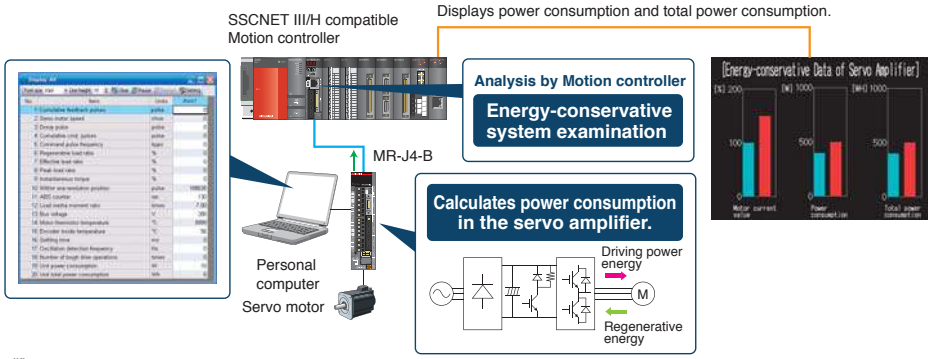
Energy Saving | Achieving Energy-conservative Machine Using Regenerative Energy

In the multi-axis servo amplifier, the regenerative energy of an axis is used as driving power energy for the other axes, contributing to energy-conservation of machine.
"Power Monitor function", which is available with the standard amplifier, enables the visualization of the power flow on screen.



Energy Saving | Power Monitor Function

Driving power and regenerative energy are calculated from the data in the servo amplifier such as speed and current. Motor current value, power consumption, and total power consumption are monitored with MR Configurator2. In SSCNET III/H system, data are transmitted to a Motion controller, and the power consumption is analyzed and displayed.



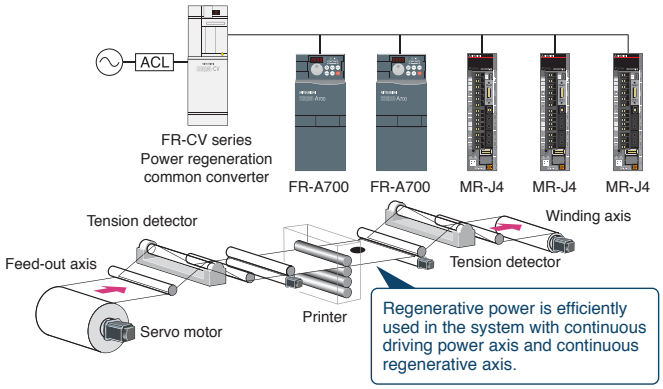
(Note): The diagram shows an example of using MR-J4-B servo amplifier.
Note that this function is available with any of MR-J4 series servo amplifiers.

Energy Saving | Optimal Energy-conservative Machine System

◆PN Bus Voltage Connection + Power Regeneration Common Converter

Regenerative energy is used efficiently when multiple servo amplifiers and inverters are connected through common PN bus to the power regeneration common converter.

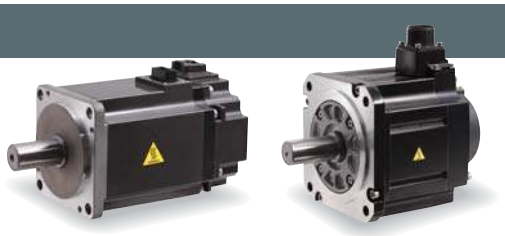
(Note): System only with common PN bus connection is also possible to be configured without using the power regeneration common converter.
However, there are restrictions depending on the system. Contact your local sales office for more details.
(Note): Refer to MR-J4-B(-RJ)/A(-RJ) Servo Amplifier Instruction Manual for selection of FR-CV series power regeneration common converter.



Resource Saving | Environment-friendly Servo Motors

The new environment-friendly HG rotary servo motor series uses 30% less permanent magnet than the prior HF series due to the optimized design of magnetic circuit.

(Note): For HG-KR43

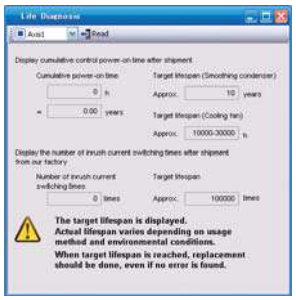


Maintenance Functions for TCO Reduction

Maintenance Function | Support the Preventive Maintenance for Safety Operation

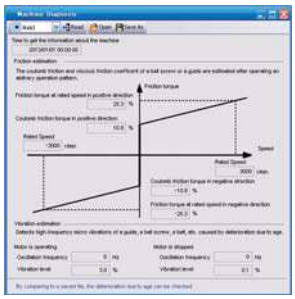
◆Servo Amplifier Life Diagnosis Function

Check cumulative operation time and on/off times of inrush relay. This function provides an indication of replacement time for servo amplifier parts such as capacitor and relays.



◆Machine Diagnosis Function

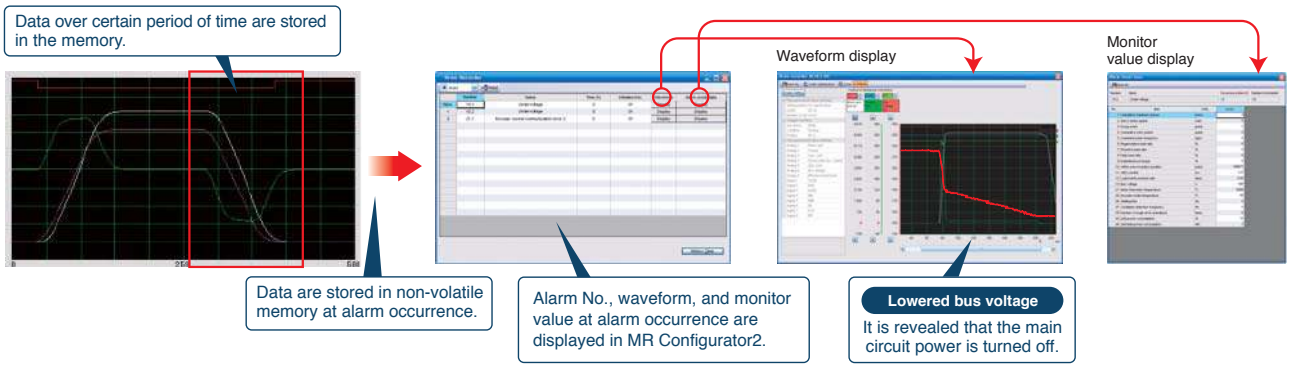
This function estimates and displays machine friction and vibration in normal operation without any special measurement. Comparing the data of the first operation and after years of operation helps to find out the aging deterioration of machine and is beneficial for preventive maintenance.



TCO Reduction | Large Capacity Drive Recorder

(Note): TCO: Total Cost Ownership

- Servo data such as motor current and position command before and after the alarm occurrence are stored in non-volatile memory of servo amplifier. The data read on MR Configurator2 during restoration are used for cause analysis.
- Check the waveform ((analog 16 bits × 7 channels + digital 8 channels) × 256 points) of 16 alarms in the alarm history and the monitor value.

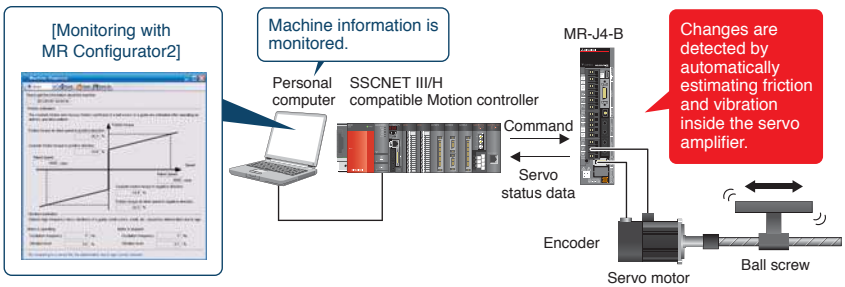


Maintenance Function | Powerful Maintenance Support with Machine Diagnosis Function

Patent pending NEW

This function detects changes of machine parts (ball screw, guide, bearing, belt, etc.) by analyzing machine friction, load moment of inertia, unbalanced torque, and changes in vibration component from the data inside the servo amplifier, supporting timely maintenance of the driving parts.

(Note): The diagram shows an example of using MR-J4-B servo amplifier. Note that this function is available with any of MR-J4 series servo amplifiers.



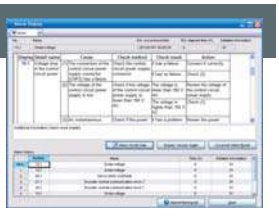
Maintenance Function | Easier Troubleshooting with 3-digit Alarm Display

In MR-J4 series, servo alarms are displayed in 3 digits.
Troubleshooting at alarm occurrence is easy.

[3-digit alarm display]

For the undervoltage alarm, whether the alarm occurred in the main or the control circuit is identified by the alarm No.

[Example of an alarm window on MR Configurator2]



FA Products

PLC — MELSEC-Q Series Universal Model

Introducing the high-speed QCPU (QnUDVCPU) for faster processing of large data volumes.

◎Realize high-speed, high-accuracy machine control with various iQ Platform compatible controllers and multiple CPUs.
◎Easily connect to GOTs and Programming tools using built-in Ethernet port.
◎25 models from 10 k step small capacity to 1000 k step large capacity, are available.
◎Seamless communication and flexible integration at any network level.

Product Specifications

Program capacity	10k steps to 1000k steps
Number of I/O points [X/Y], number of I/O device points [X/Y]	256 points to 4096 points/8192 points
Basic instruction processing speed (LD instruction)	120ns to 1.9ns
External connection interface	USB (all models equipped), Ethernet, RS-232, memory card, extended SRAM cassette
Function module	I/O, analog, high-speed counter, positioning, simple motion, temperature input, temperature control, network module
Module extension style	Building block type
Network	Ethernet, CC-Link IE controller network, CC-Link IE field network, CC-Link, CC-Link/LT, MELSECNET/H, SSCNETIII (/H), AnyWire, RS-232, RS-422

HMI — Graphic Operation Terminal GOT1000 Series GT16 Model

Full-flat face body integrating all the functions required of a HMI.

◎All models are equipped with Ethernet, RS-422/485 and RS-232 interfaces enabling a diverse range of communications.
◎A multimedia unit and a video/RGB unit (optional) are supported for smooth recording and playback of moving images.
◎USB host and device ports are provided as a standard on the front panel. Easily connect to a personal computer for data exchange.
◎Large 15MB memory capacity allows you to use optional functions and real parts, etc., without worrying about memory space.

Product Specifications

Screen size	15", 12.1", 10.4", 8.4", 5.7"
Resolution	XGA, SVGA, VGA
Intensity adjustment	8-step or 4-step adjustment
Touch panel type	Analog resistive film
Built-in interface	RS-232, RS-422/485, Ethernet, USB, CF card
Applicable software	GT Works3
Input power supply voltage	100 to 240VAC (+10%, -15%), 24VDC (+25%, -20%)

Inverter — FREQROL-A700 Series

High-function, high-performance inverter

◎High-accuracy, high-response speed control using real sensor-less vector control is possible with a general-purpose inverter having no PLG (encoder) (200% torque/0.3 Hz (3.7 K or less)).
◎Full-scale vector control is possible when used in combination with a motor with PLG (when using option).
◎The built-in noise filter (EMC filter) helps reduce noise generated from the inverter.
◎This series supports IPM motor operation. Use auto tuning to operate with the optimum motor characteristics.

Product Specifications

Inverter capacity	200V class: 0.4kW to 90kW, 400V class: 0.4kW to 500kW
Control method	IPM control, Soft-PWM control, high-carrier frequency PWM control (Select from V/F, advanced flux vector, or real sensor-less vector), vector control (when using options)
Output frequency range	0.2 to 400Hz (real sensor-less vector, upper frequency during vector control is 120Hz)
PM offline auto tuning	200V class: 0.4K to 1.5K (150%3%ED), 2.2K/3.7K (100%3%ED) When using the MM-CF Series, the motor constants, etc., are automatically measured for operation with the optimum motor characteristics (IPM motors other than the MM-CF Series, and other IPM motor brands are also supported)
Starting torque	200% 0.3Hz (3.7K or less), 150% 0.3Hz (5.5K or more) (when using real sensor-less vector, vector control)

Magnetic motor starters　MS-T Series

Collection large satisfaction in a small body.

◎The industry-leading smallest dimension＊ is achieved in a general purpose Magnetic Contactor.
＊ In general Magnetic Contactors of 10A frame class (our survey in September, 2012)
◎Standard terminal cover improves safety.
◎Wide range of operation coil ratings available. Reducing inventory types and supporting selections.
◎Supporting your overseas business with compliance to various International Standards.

Product Specifications

Frame	10 A to 32 A
Applicable standards	Certification to various standards including IEC, JIS, UL and CE (TÜV, CCC certification pending)
Terminal cover	Standard terminal cover improves safety, simplifies ordering, and reduces inventory, etc.
Improved wiring	Wiring and operability are improved with streamlining wiring terminal BC specifications.
Operation coil rating	Wide range of operation coil ratings reduces number of coil types from 14 (N Series) to seven types and simplifies selection.
Option units	Diverse lineup includes auxiliary contact blocks, surge absorber unit, and mechanical interlock unit.

Robot　MELFA　F Series

High speed, high precision and high reliability industrial robot

◎Compact body and slim arm design, allowing operating area to be expanded and load capacity increased.
◎The fastest in its class using high performance motors and unique driver control technology.
◎Improved flexibility for robot layout design considerations.
◎Optimal motor control tuning set automatically based on operating position, posture, and load conditions.

Product Specifications

Degrees of freedom	Vertical:6　Horizontal:4
Installation	Vertical:Floor-mount, ceiling mount, wall mount (Range of motion for J1 is limited) Horizontal:Floor-mount
Maximum load capacity	Vertical:2-20ｋｇ　Horizontal:3-20kg
Maximum reach radius	Vertical:504-1503ｍｍ　Horizontal:350-1,000mm

CNC　Mitsubishi Numerical Control Unit C70 Series

iQ Platform compatible CNC to provide TCO reduction effect.

◎A CNC structured in building block method on iQ Platform.
◎High performance CNC integrated with high-speed PLC offers high-speed control to reduce cycle time.
◎A wide variety of FA products helps construct flexible lines.

Product Specifications

Maximum number of control axes (NC axis + spindle + PLC axis)	16 axes
Maximum number of part system	Machining center system: 7 systems, Lathe system: 3 systems
Maximum number of NC axes per part system	8 axes
Maximum program capacity	2,000 kB (5,120 m)
Maximum number of files to store	124 files/252 files
Number of input/output points	4,096 points
Safety observation function	Safety signal comparison function, speed monitoring function, duplexed emergency stop

Check here for detailed information: http://www.mitsubishielectric.co.jp/fa/index.html

A global support network for MELSERVO users

Global FA Center

Across the globe, FA Centers provide customers with local assistance for purchasing Mitsubishi Electric products and with after-sales service. To enable national branch offices and local representatives to work together in responding to local needs, we have developed a service network throughout the world. We provide repairs, on-site engineering support, and sales of replacement parts. We also provide various services from technical consulting services by our expert engineers to practical training for equipment operations.

Ratingen, Germany
German FA Center/
Europe Development Center

Krakowska, Poland
European FA Center (Poland)

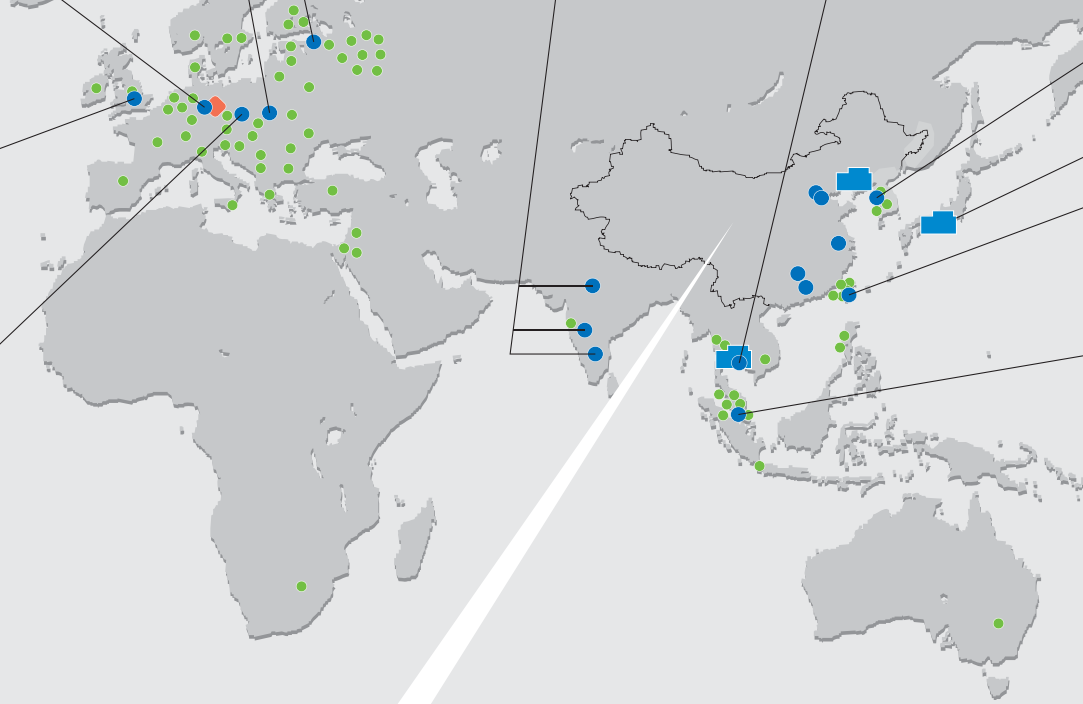
St. Petersburg, Russia
Russian FA Center

Pune/Gurgaon/Bangalore, India
India FA Center

Bangkok, Thailand
Thailand FA Center

Hatfield, U.K.
UK FA Center

Praha, Czech Republic
Czech Republic FA Center

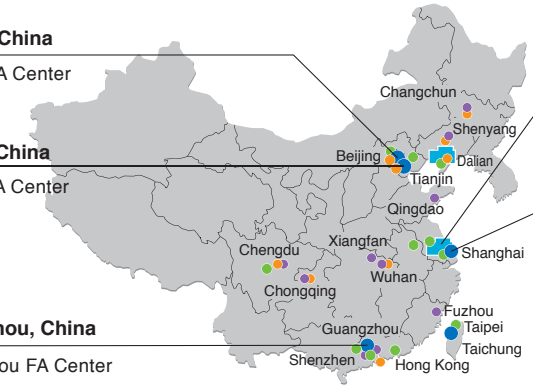


China (including Hong Kong District)

Beijing, China
Beijing FA Center

Tianjin, China
Tianjin FA Center

Guangzhou, China
Guangzhou FA Center



Changshu, China
China Local Factory
Mitsubishi Electric Automation Manufacturing (Changshu) Co., Ltd.

Shanghai, China
Shanghai FA Center

Complies with EN, UL, CSA (c-UL) standards, and Korea Radio Wave Law (KC).

MELSERVO-J4 series conforms to global standards.

* This product is not subject to China Compulsory Certification (CCC).
* Refer to "Servo Amplifier Instruction Manual" and "EMC Installation Guidelines" when your system needs to meet the EMC directive.
* Contact your local sales office for the corresponding models and standards.

● Global FA Center ● FA Center Satellite (China) ● Mechatronics Service Base (China) ● Mitsubishi Sales Offices
■ Production Facility ◆ Development Center

Seoul, Korea
Korea FA Center

Nagoya, Japan
Nagoya Works

Taiwan
Left: Taiwan FA Center (Taipei) /
Right: Taiwan FA Center (Taichung)

Chicago IL, U.S.A.
North America FA Center/
North American Development Center

Singapore
ASEAN FA Center

Sao Paulo SP, Brazil
Brazil FA Center

Complies with Restriction of Hazardous Substances Directive (RoHS).

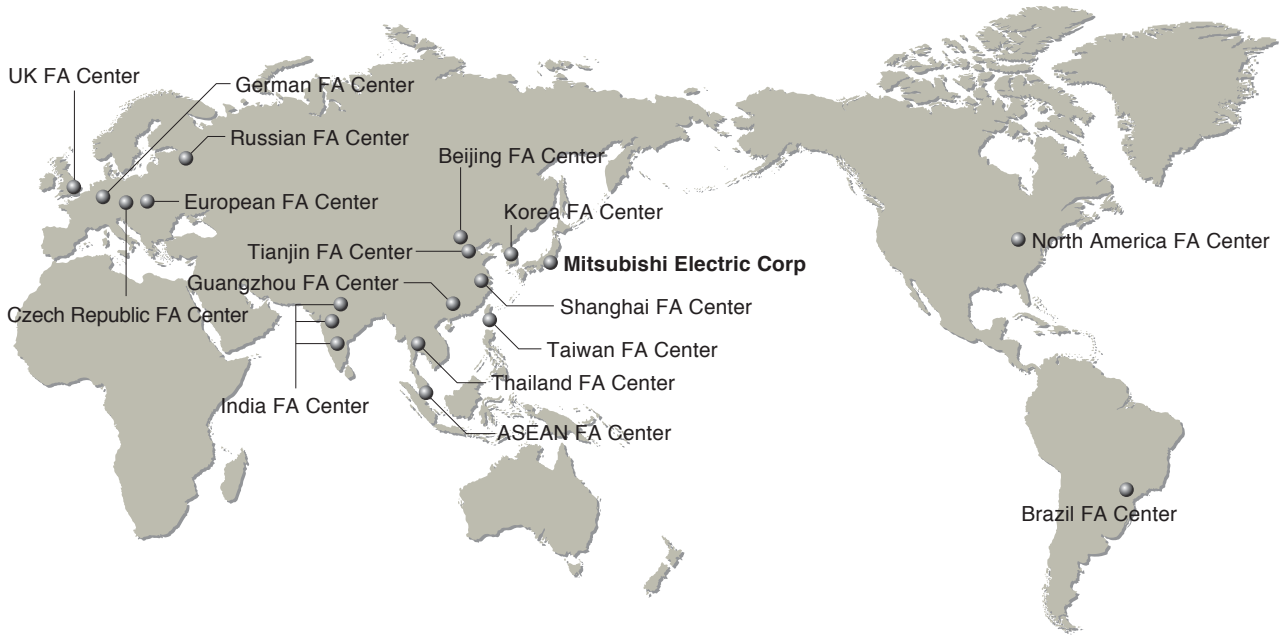
Human and environment-friendly MELSERVO-J4 series is compliant with RoHS Directive.

About RoHS directive
RoHS Directive requires member nations to guarantee that new electrical and electronic equipment sold in the market after July 1, 2006 do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants. <G> mark indicating RoHS Directive compliance is printed on the package.

* Refer to "Servo Amplifier Instruction Manual" and "EMC Installation Guidelines" when your system needs to meet the EMC directive.

Our optional cables and connectors comply with "Measures for Administration of the Pollution Control of Electronic Information Products" (Chinese RoHS).

Global FA Centers



China

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307 Alexandra Road, Mitsubishi Electric Building, Singapore 159943
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India

India FA Center
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Tel: 91-20-2710-2000 Fax: 91-20-2710-2100

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India Factory Automation Centre Bangalore Branch
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America

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MITSUBISHI ELECTRIC AUTOMATION, INC.
500 Corporate Woods Parkway, Vernon Hills, IL 60061, U.S.A.
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Brazil FA Center
MITSUBISHI ELECTRIC DO BRASIL COMÉRCIO E SERVIÇOS LTDA.
Rua Jussara, 1750- Bloco B Anexo, Jardim Santa Cecilia, CEP 06465-070, Barueri, San Paulo, Brazil
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German Branch
Gothaer Strasse 8, D-40880 Ratingen, Germany
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UK FA Center
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UK Branch
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Czech Republic FA Center
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Czech Branch
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Russian FA Center
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Russian Branch St. Petersburg office
Piskarevsky pr. 2, bld 2, lit "Sch", BC "Benua", office 720; 195027, St. Petersburg, Russia
Tel: 7-812-633-3497 Fax: 7-812-633-3499

Servo Amplifiers & Motors
Servo System Controllers

⚠ Safety Warning

To ensure proper use of the products listed in this catalog, please be sure to read the instruction manual prior to use.

Country/Region	Sales office	Tel/Fax
USA	MITSUBISHI ELECTRIC AUTOMATION, INC. 500 Corporate Woods Parkway, Vernon Hills, IL 60061, U.S.A.	Tel : +1-847-478-2100 Fax : +1-847-478-2253
Brazil	MITSUBISHI ELECTRIC DO BRASIL COMÉRCIO E SERVIÇOS LTDA. Rua Jussara, 1750- Bloco B Anexo, Jardim Santa Cecilia, CEP 06465-070, Barueri, San Paulo, Brazil	Tel : +55-11-4689-3000 Fax : +55-11-4689-3016
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