MITSUBISHI ELECTRIC

Changes for the Better

SERVO AMPLIFIERS & MOTORS

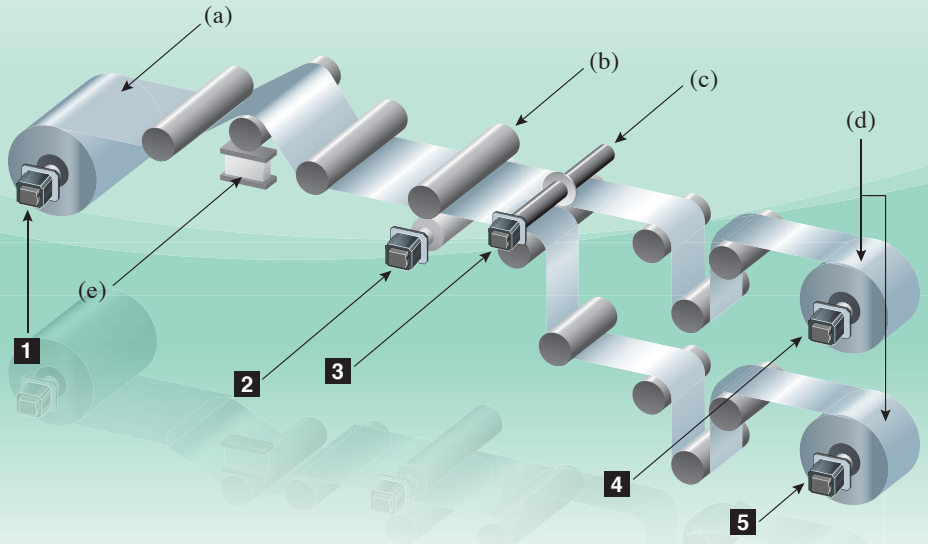
For your all production needs

MELSERVO-J4 Solutions

MELSERVO-J4

vol.09 Film Slitting Machine

PN Bus Voltage Connection + Power Regeneration Common Converter



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)

Control Flow

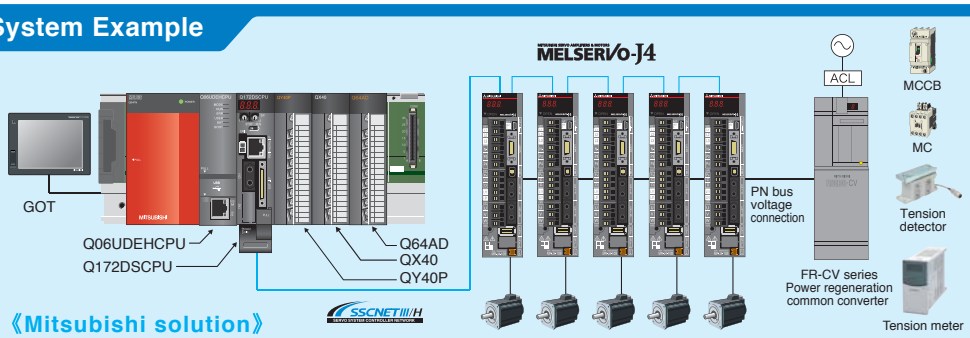
- Unwinding Axis — Torque Control
  - Unwind the film.
- Roller Axis — Speed Control
  - Send the film at a constant speed.
  - The cutter slits the film.
- Rewinding Axes
  - Rewind the cut film.

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

《Application》

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

Setup Procedure

Step1 Wiring of the Power Regeneration Common Converter

Step2 Servo Parameter Settings

Step3 Speed-Torque Control Data Settings

Step4 Control Mode Settings

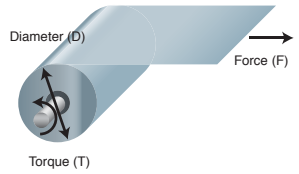
MELSERVO-J4 Offering the Best Solution

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.

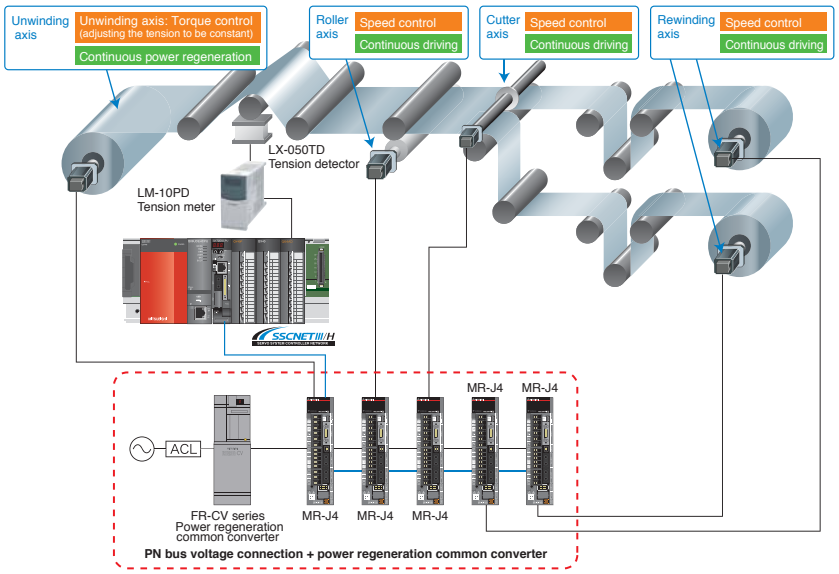
The relationship among force, torque, and diameter.



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

calculated according to

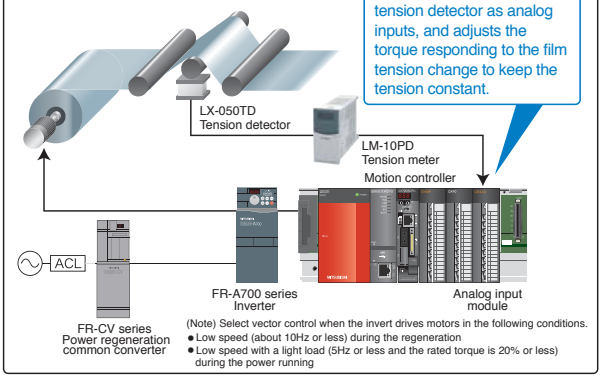
- Torque(T) = Force(F) × Radius (D/2)



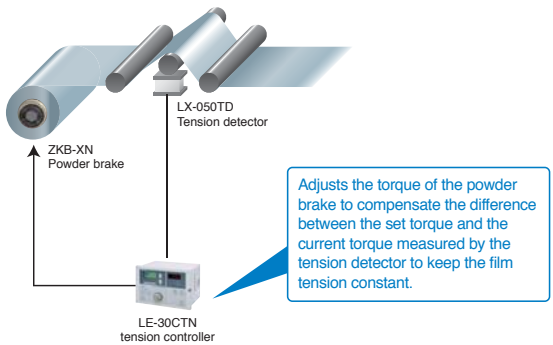
[Unwinding equipment]

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

Unwinding equipment with an inverter



Unwinding equipment with a powder brake

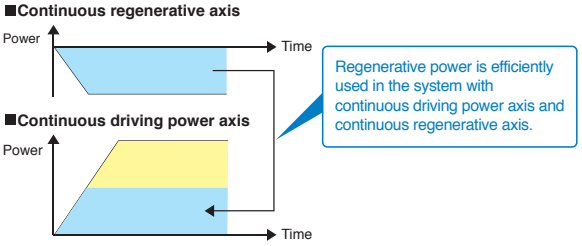


Solution 2 PN Bus Voltage Connection + Power Regeneration Common Converter

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.

Efficient use of regenerative energy



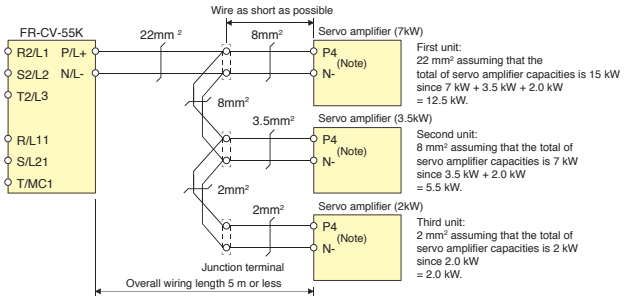
Setup Procedure

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.

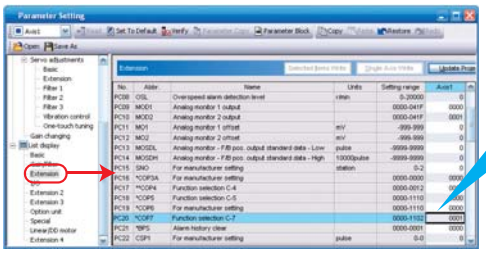


(Note) When using the servo amplifier of 7 kW or less, make sure to disconnect the wiring of built-in regenerative resistor (5 kW or less: P+ and D, 7 kW: P+ and C).

Step2 Servo Parameter Settings

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

Servo Parameter



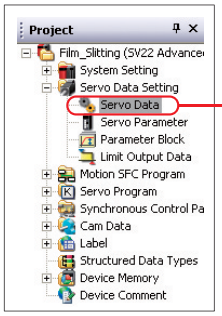
PC20

Undervoltage alarm detection method selection

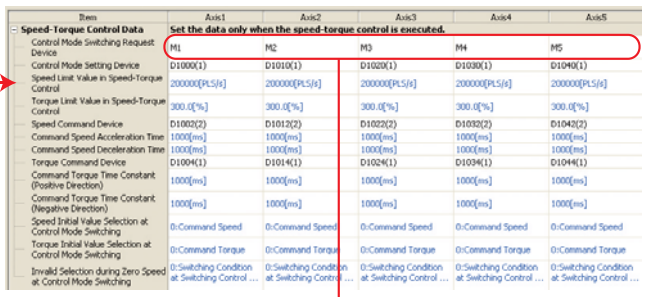
When you use FR-RC, FR-CV, or FR-BU2, select "Method 2 (_ _ _ 1)".
0: Method 1
1: Method 2

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.

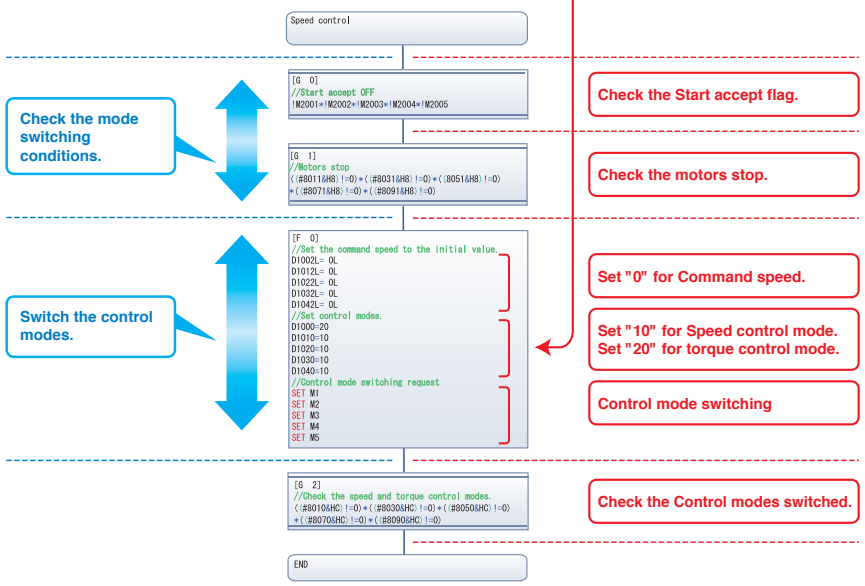


Speed-Torque control Data



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.



MELSERVO-J4 Features

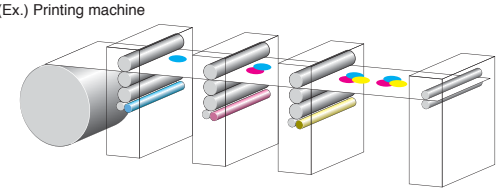
Achieving High Operation Stability and Reliability with a Wide Variety of Excellent Functions of Mitsubishi MR-J4

High Stability Robust Filter

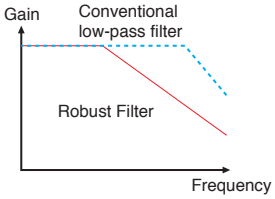
Achieving both high responsivity and stability was difficult with the conventional control in high-inertia systems with belts and gears such as printing and packaging machines. Now, this function enables the high responsivity and the stability at the same time without adjustment.
The robust filter more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

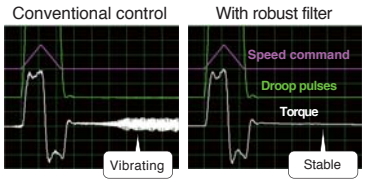
[Machine with a high-inertia ratio]

(Ex.) Printing machine



[Robust Filter]

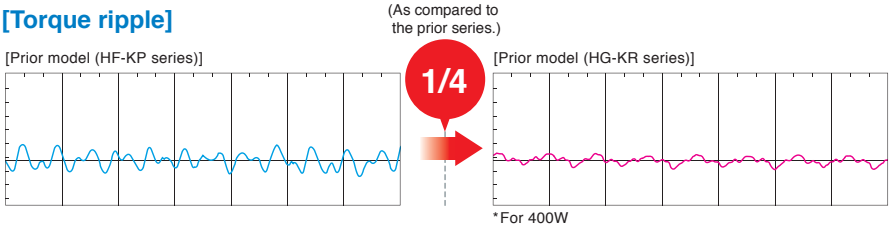




High Stability Reduced Torque Ripple During Conduction

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.

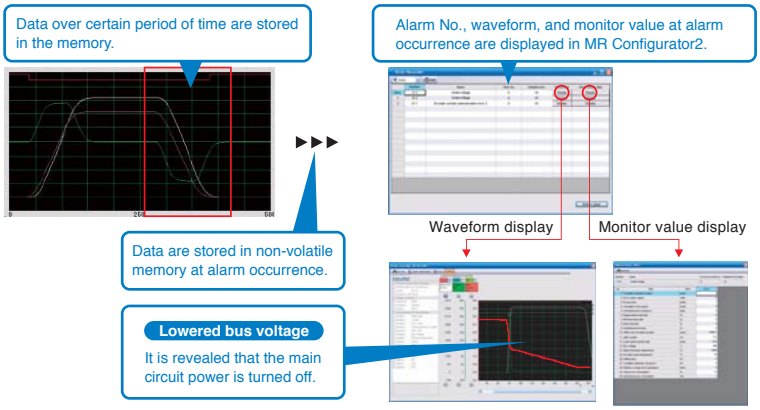
[Torque ripple]



TCO Reduction Large Capacity Drive Recorder

- 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 of 16 alarms in the alarm history ((analog 16 bits × 7 channels + digital 8 channels) × 256 points) and the monitor value.



Man, machine and environment in perfect harmony

Solution

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L(NA)03084-A 1303(IP)

New publication,effective March 2013.
Specifications are subject to change without notice.