**Screw Tightening Machine**

### System Example

**Issue 1** Tightening screws without using a torque sensor

**Issue 2** Repeated accuracy in screw tightening operation

**Control Flow**

- **X, Y, Z-axis**
  - Move to their wait position.
  - Move to the position for screw tightening.

- **Rotating Axis, Z-axis**
  - Tighten screws using Tightening & Press-fit control.
  - Z-axis goes down along with the Rotating axis.

- **Z-axis**
  - Move back to its wait position.

**System Configuration**

- **GOT**
  - Q06UDEHCPU
  - QD77M84

- **PLC CPU**
  - Q06UDEHCPU
  - QD77M84

- **I/O module**
  - QX40, QY40P

- **Servo amplifier**
  - MR-J4(W3)-B

- **Servo motor**
  - HG-SR, HG-KR

**Setup Procedure**

1. **Step 1** Setup
   - System Configuration Settings
2. **Step 2** Servo Parameter settings
3. **Step 3** Creation of a Sequence Program for Tightening & Press-fit Control

**Application**

- Cap tightening
- Tightening machine for cylinder head
- Tightening machine for clutch tightening
- Press-fit machine
- Clamping
**Solution 1: Tightening & Press-fit Control**

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 → 3: 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**

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

[Prior model (HF-KP series)]

1/4

[New model (HG-KR series)]

*For 400 W*
Setup Procedure

**Step 1**

**System Configuration Settings**

Set the servo amplifier in the System Structure.

**System Structure**

- Set the External I/O connector and SSCNET Setting, as necessary.

**Step 2**

**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.

**Servo Parameter**

- Double click

**MR Configurator2 Help**

Shows the instructions for servo parameter settings. You can set the parameters without manuals.

**Step 3**

**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.

**Sequence Program**

- Double click

**FB for Tightening & press-fit control**

The mode is switched to Tightening & press-fit control, and target torque can be set.

**FB for speed control**

The mode is switched to speed control, and speed value can be set.
The High Accuracy and Response Have Changed the "Standard" of Machine Operation

**Features**

**SSCNET II/H**  
**Advanced Drive Control is Possible with Higher Speed Communication**

**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 Motion controller, or QD77MS simple Motion module helps consolidate information such as parameter settings and monitoring for the multiple servo amplifiers, etc.

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

**Space-saving**  
**Designed to Reduce the Number of Wirings and Devices**

The number of wirings and devices is greatly reduced by using MR-J4 series 2-axis/3-axis servo amplifiers. For example, 3-axis servo amplifier MR-J4W3-B requires 30% less installation space than three units of MR-J4-B.

**Maintenance**  
**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.