PLC-Based Multi-Axis Position Controllers

Solve 2-, 4- and 16-axis position control applications using Omron servos and programmable controllers

» Simple to Program
» Single point connection and software for controller and Servo drives
» Powerful, High Precision Motion
» PLC Open motion control function blocks

Automation...simple...powerful.
Powerful Position Controller units with Motion Control Network Capabilities

- Control 2, 4 and 16 axes over a single network.
- Simplified wiring and programming.
Motion Controller Lineup

Wide selection of Controllers to match applications ranging from position control to synchronization control.

Position Controller Capabilities

- **Multi-Axis**: 1 to 16 axes supported over the motion network.

- **Multi-turn Absolute Encoder**: Absolute encoders eliminate homing routines though a battery backed encoder.

- **Position Control**: Can command absolute positions and relative distance moves with MoveAbsolute and MoveRelative function blocks.

- **Speed Control**: Can set continuous velocity commands that can be changed on the fly with specified acceleration and deceleration ramps. Uses MoveVelocity function block.

- **Linear Interpolation**: Easy coordinated motion with up to 4 axes is simple with the MoveLinear function block. All axes will start and stop at the same time and maintain tightly coordinated motion.
Motion Network Compatibility Means...Less time spent on wiring!

**Before**

- Routing wires was difficult because of the number of wires involved.
- Expanding or modifying equipment was complicated because the number of axes dictated the number of Units.
- Settings took time because Controllers and Servo Drivers had to be set separately.

**After**

- Easy parameter management using a Support Software connected to the PLC.
- All parameters can be set from one location.

### Single Point Communication
- One cable and software package to communicate to controller and servo drives.

### Motion Control Network
- Single motion bus reduces labor costs and wiring mistakes
- Fewer wires to label and track
- Easier to troubleshoot problems
- Constant access to drive parameters and real-time data
- Digital communication is highly noise immune, ensuring precise closed loop control.
GN Series Motion Network Servos Overview

The New GN Servo Drives and G-Series motors provide a large variety of functions featuring high-precision positioning with improved response and vibration control, making it suitable for a wide range of applications.

- **Network capabilities, single bus connection**, simplifies wiring and troubleshooting reduces installation cost.

- **Parameter back up stored in the controller**, simplifies drive replacement and reduces down time.

GN Series Advantages

- **Improved real-time auto tuning** simplifies the startup time.

- **Small footprint** reduces control panel space required saves on installation costs.

- **Better frequency response** improves machine performance and reduces cycle times (compared to previous models).

- **Adaptive vibration suppression filter** automatically reduces the effect of vibration improves machine performance and overall product quality.

- **Position, Speed and Torque control modes** provide higher flexibility in simplifying the production of complex parts.

Servo Motor Features:

- **Wide selection of speeds**, available in 1000, 1500, 2000 and 3000 RPM.

- **High encoder resolution**, all Servomotors with absolute encoder have 17 bit resolution for increased accuracy.

Additional new Control input signals

- Three external latch signals
- Three external general purpose inputs
- Origin Proximity input
**Modular Design Flexibility**

With the Position Controllers, the PLC can communicate with a subset of devices. This allows users the option to modularize their design. Operational status can be checked on connected drives without changing the program, even when all axes to be used are not connected.

**Robust Error Handling**

In case of an error on one axis, the properly functioning axes can continue to operate, if desired. Machines can continue to run a subset of axes while diagnostics are performed and problems are corrected.

**Industry Standard Motion Control Function Blocks**

Motion control is simple to program using PLC Open function blocks.

**Supported functions blocks include:**

- **MoveAbsolute** – Absolute move to a specified position with a set acceleration, velocity and deceleration rate.
- **MoveRelative** – Relative move of a specified distance with a set acceleration, velocity and deceleration rate.
- **MoveLinear** – Coordinated linear interpolation between up to 4 axes.
- **Stop** – Stop any move in progress with a specified deceleration rate.
- **MoveVelocity** – Start motion at a fixed velocity and acceleration rate.
- **Home** – Perform 1 of 11 supported routines.
- **ReadParameter** – Read a parameter or value from a specified axis.
- **WriteParameter** – Write a parameter or value to a specified axis.

**Motion Network Advantages**

**Monitor + Update Drive Parameters on the Fly:**

- **Following Error** – Jam Detection. Not just a fault, but can make an intelligent recovery plan depending on where fault occurred. Example: Move part back to a station for re-inspection instead of just rejecting it.
- **Torque** – Can alert operator to perform lubrication maintenance because torque is above a specified value.
- **Velocity** – Monitor servo speed in real time on a display and convert to useful units for diagnostics like feet / minute.
- **Position** – Monitor position even with the servo disabled. Move the axes into position by hand and then store those positions as teach points.

**Change Tuning Parameters on the Fly or Upon Specified Condition:**

- Gains can be adjusted as inertia changes.
- Filters.

**Noise Immune Communication from NC to Drive:**

- No lost feedback counts between the NC and drive.

**Single Communication Point:**

- Single location for troubleshooting controller and drives.
Key Applications

Cap Tightening

Machine Description
- Bottle moves into machine fixture and is clamped into place with pneumatics.
- Torque limit is set over motion network based on recipe.
- Servo motor twists cap on bottle.
- Bottle and cap are removed and process is repeated.

Technical Reference
The machine operator loads a recipe through an NS HMI with a part-specific twisting speed and twisting torque limit for a specific bottle and cap. The CJ1 PLC then sets a current limit in the drive over the motion bus with the NCF card with the WriteParameter function block. When the machine sequence starts, the CJ1 waits for an external signal the bottle is properly locked into the clamp. The capping mechanism then slides down and grips the cap from above. A MoveRelative function blocks starts a position move to turn the gripper. The motor’s following error is monitored from the drive with the ReadParameter function block until it exceeds a specified amount. The final position of the motor is recorded for quality control purposes, along with the lot code.

Customer Benefits
- Flexible design allows for a variety of caps and bottles to use the same machine.
- Quality control can guarantee 100% of caps were tightened to specification.

Vision Inspection of PCB Solder Joints

Machine Description
- A recipe of X, Y & Z points is loaded into the PLC from touch screen.
- Camera analyses joint image.
- Serial communication gives pass or fail data to PLC.

Technical Reference
The machine consists of an NS touch screen, CJ1 PLC and 3 axes of motion. At startup, the machine is homed using the Home function block on all three axes. The PLC program uses the MoveLinear function blocks to tightly coordinate the speed and position of the axes and move from position to position. A brake integrated into the motor on the vertical Z axis ensures the camera unit cannot fall and be damaged in case of power loss. The customer used vibration suppression to ensure the image could be captured almost immediately after the moves were completed.

Customer Benefits
- Reduced settling time at each inspection location because of the G-Series vibration suppression technology improves overall throughput of machine by allowing pictures to be taken within 5 ms after the move was complete, as opposed to 50 ms with a previous design.
Solar / Wafer Handling Machine

Machine Description
- Part is picked up from a process and placed into a series of chemical baths.

Technical Reference
The X-Z robot starts out by doing a homing routine to a pair of proximity switches with the Home function block. The wafers are picked up off a supply station and moved to a series of chemical baths. The length of time in the baths are recalled from a recipe sent over DeviceNet from an upstream process into the CJ1. A combination of MoveAbsolute and MoveLinear function blocks makes the motion programming very quick to implement.

Customer Benefits
- The time in each chemical process can be changed from a remote location using DeviceNet.
- The velocity of dipping the parts into the bath can be changed on the fly to improve throughput.

Cavity Inspection System

Machine Description
- Part is placed into clamp of machine.
- 4 axis Cartesian inspection machine moves laser distance sensor into part to inspect for cracks.

Technical Reference
A part is loaded into the inspecting machine and a recipe is loaded with coordinates of cavities within the part. A laser distance sensor attached to the end of the Z axis detects cracks within the cavities. The sensor is rotated around the Z axis throughout the cavity. An analog output from the sensor is monitored within the PLC. The Z axis moves the sensor down a fixed distance with the MoveLinear function block and then a 360-degree sweep is performed with the sensor using the MoveRelative function block. The Z axis then moves down further and another 360-degree sweep occurs at the new height. This process is repeated until the cavity is completely inspected. In case of power loss, absolute encoders are used so this very involved process does not need to be completely restarted from scratch.

Customer Benefits
- Inspection of products improves quality of products and allows a premium to be charged because products are “100% machine inspected.”