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# Application Information

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## Acronyms:

CP:            SERCOS Communication Phase
NC:            Numerical Controller

## Introduction:

This application note describes how to setup the Beckhoff ™ TwinCAT™ PC based NC to act as the SERCOS master for Yaskawa SGDH drives. The TwinCAT NC runs in software on the PC, within a real-time kernel designed to ensure deterministic behaviour from a PC based platform. This application note describes system setup using Beckhoff TwinCAT version 2.9.

## System Requirements:

PC with Windows NT
Beckhoff TwinCAT software
Beckhoff FC7501 SERCOS Interface (PCI card)
Yaskawa SGDH Drive, motor & cabling.
Trio P730 SERCOS interface option module
SERCOS fiber optic cables

The TwinCAT software runs on the PC and acts as the SERCOS NC ring master, communicating with the SERCOS ring via the FC7501 SERCOS PCI interface card.  One or more Yaskawa drives are connected to the ring via Trio's P730 SERCOS option modules. The TwinCAT System Manager application is used to write a configuration file for the specific network. It contains a tree view and associated property tabs which provide access to the NC and SERCOS parameters. The system manager can also be used to issue move commands and monitor the current motor position.

This application note describes how the system manager file should be configured for a SERCOS ring containing a single drive. In this example the drive has an encoder with 65536 counts per rev, and a motor with a maximum rated speed of 3000 rpm. The actual values for such a system are shown in brackets below.


## TwinCAT System Configuration:

Run the TwinCAT System Manager, create a new system manager file, and setup the following parameters:


**NC - Configuration**

Create (Append) an NC task, and create (Append) an Axis (Axis 1). We will now use the various property tabs for this axis to initialise it. Critical parameters include the encoder scaling factor to ensure accurate feedback, and drive output scaling to ensure accurate position control.

**<NC–Configuration><NC Task><Axes><Axis 1 Property Tabs>**

**Settings Tab**
Set the Axis Type to 'SERCOS Drive', and Unit to 'mm'. Save all changes.

**Global Tab**
Set parameters as labelled, in particular set the 'Maximum Velocity' (50), 'Acceleration' and 'Deceleration' (200). Ensure the 'Position Lag Monitoring', 'Position Range Monitoring', and 'Target Position Monitoring' enables are set TRUE.

**<NC–Configuration><NC Task><Axes><Axis 1><Encoder Property Tabs>**

**NC Encoder Tab**
Set the Type to 'Encoder connected to SERCOS (position)'.

**Global Tab**
The critical value to set here is 'Scaling Factor', which is set to 1/number of encoder counts per rev (mm/INC) (1/65536 = 0.0000152587890625). Now, one turn of the motor should increment (or decrement) the position value displayed by the <Online> tab by 1.

**SERCOS Tab**
This tab contains the modulo value which is used by the encoder (default value is 3599999). Set as appropriate.

**<NC–Configuration><NC Task><Axes><Axis 1><Drive Property Tabs>**

**Analog Tab**
Set the appropriate 'Reference Velocity' based on the maximum speed of the motor (50).

**Sercos Tab**
Set the output scale to an appropriate value to ensure accurate position and velocity control (0.0025).

The value can be calculated empirically, by setting the factor to 1 and then running several moves at a very slow speed. Calculate the ratio of the actual move position:setpoint position, and the actual velocity:setpoint velocity (these ratios should be the same). The parameters can be observed using the <Axis 1><Online> tab. Set the output scale to the ratio calculated. Now, the actual and demanded moves and velocity should be the same.

### <NC–Configuration><NC Task><Axes><Axis 1><Control Property Tabs>

**NC Controller Tab**
Set the type to 'Position Controller P'.

**Global Tab**
Set the 'ENABLE: Position Lag Monitoring' to TRUE, and set an appropriate 'Maximum Position Lag Value'.

**PID Tab**
Set the 'Position Control: Proportional Factor Kv' to an appropriate value (30). This value is subsequently displayed on the <Axis 1><Online> tab.

### I/0 - Configuration

Create (Append) a new I/O Device, and select the <SERCOS Interface><SERCOS Master/Slave FC750x PCI> option. You can now link the NC Axis 1 to this drive, via the <NC – Configuration><Axes><Axis 1><Settings> tab, click the 'link to' button and select the I/O box (axis) just created.

### <I/O Configuration><I/O Devices><Device 1 Property Tabs>

**Device Tab (second Tab)**
Click the 'Search' button to initiate a search for the SERCOS card's PCI slot. Click the appropriate radio buttons to select the SERCOS ring 'Data Rate' (baud rate) and transmitter 'Send Power' level. Select the 'Startup to phase 4' option.

**Online Tab**
The online tab is useful because it enables the user to set the required SERCOS ring communication phase.

Create (Append) a new 'box' , and select the <miscellaneous><generic drive SERCOS>.

### <I/O Configuration><I/O Device><Device 1><Axis 1 Property Tabs>

**Sercos Tab**
Set the drive address, operation mode and telegram type as appropriate. If the drive is to be

controlled over SERCOS in velocity mode, then we can set 'Velocity' and 'Telegram 3 (36/51)' for the latter two parameters. In position mode, we would use 'Position 1' and 'Telegram 4 (47/51)'.

**Startup Tab**
This tab contains the SERCOS IDN values which are written to the drive during startup. As a minimum, it should contain values for the primary mode of operation (IDN 00032), the velocity data scaling type (IDN00044), the position data scaling type (IDN00076), and the modulo value (IDN000103).

| Mode Of Operation | Velocity Control Mode | Position Control Mode |
|---|---|---|
| IDN 00032 | 2 | |
| IDN 00044 | 1 | |
| IDN 00045 | 129 | |
| IDN 00103 | 3600000 | |

**Inputs Tab**
This tab contains the SERCOS IDN used as input to the NC, and should be set to IDN 00051 (position feedback 1 value).

**Outputs Tab**
This tab contains the SERCOS IDN used as output from the NC, and should be set to IDN 00036 (velocity command value) when in velocity control mode. It should be set to IDN 00051 (position 1 command value) when in position control mode.

**Online Tab**
This tab is used to readback and display all the SERCOS IDNs supported by the drive.

## TwinCAT System Operation:

Having completed the configuration, the values are saved and written to the drive by clicking inturn the toolbar buttons 'Generate Mappings', 'Check Configuration' and 'Activate Configuration'. This should cause the ring to move to CP4. If it does not, the error can be identified via the messages which will be displayed and should be rectified before repeating the process.

Having move the SERCOS ring to phase 4, now select the <NC–Configuration><NC Task><Axes><Axis 1><Online> Tab. Set the reference velocity based on the drive speed possible, and a target velocity based on the speed required. Click the 'set' button, and set the 'override' to 100%, and select the 'Controller', 'Feed Fw' and 'Feed Bw' options on the popup dialog which appears. Close the dialog, and the drive will enable.

Set the required move distance in the 'Target Position', and click the green button labelled 'F5' to move the motor to this setpoint.

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