

Introduction

This documentation explains how to start up MR-J3-□A-RJ158+MR-J3-T04 system. Beckhoff TwinCAT is used for the master controller as an example.

Need to prepare

Item	Product name	Remark
Servo amplifier	MR-J3-□A-RJ158	
EtherCAT comm. option	MR-J3-T04	
Servo motor	MR-J3 standard	e.g. KP, MP, SP series
Motor power cable	Depends on motor	
Encoder cable	Depends on motor	
PC for Master controller	OS such as Windows XP SP3 which TwinCAT supports	Because its energy saving function affect negatively, note PC may not be able to do synchronized communication.
LAN adapter	FC9011(Beckhoff) or same product	<Important!> TwinCAT supports particular Intel network controller integrated LAN adapters. Need to check.
Software PLC	TwinCAT (Beckhoff)	
LAN cable	Category 5e double shielded or better one is recommended.	
PC for MR Configurator	Universal Windows PC	Need to have USB port
USB cable		For MR Configurator
Device description file (xml file)	The file should match the slave component's product and revision.	

Master controller preparation

- Use Windows PC which has Intel network controller integrated LAN adapter as controller PC. Terminate the resident programs such as screen saver, energy saving functions, security software and etc. because they may cause the real time process.
- Download TwinCAT from Beckhoff website and Install in the PC. The package TwinCAT PLC or more is needed. Downloading TwinCAT PLC 30 days version is free of charge. You can re-download after 30 days.
- Put the device description file (xml file) for the slave component in the folder ¥TwinCAT¥IO¥EtherCAT (the folder address depends on where you install TwinCAT).
- Store PLC program for servo control under ¥TwinCAT¥Samples (the folder address depends on where you install TwinCAT). Though PLC program is configurable, we'd recommend the initial program until you get used how to use TwinCAT.

Servo amplifier connection

- Connect EtherCAT communication option MR-J3-T04 to the expansion connector CN7 of MR-J3-RJ158.
- Wire input and output signal to the amplifier, at least the power cable, EM1, LSP and LSN.
- Connect the amplifier and the motor as usual. (power and encoder cable)
- Connect between the master PC and slave (amplifier) by Ethernet cable. Be sure CN10A is going to the master.

Servo amplifier parameter set up

From the initial parameter setting, change the following parameters at least. Though the parameters can be changed via EtherCAT, we'd recommend using our MR-Configurator.

Parameter No.	Abbr.	Contents
PA03	*ABS	Set 0002h when absolute position detection system is used.
PO02	*ECAT	Set synchronous mode, control mode, and PDO communication cycle time. Example: Synchronous, position control mode, 1ms PDO comm.; 0180h Asynchronous, velocity control mode, 0.5ms PDO comm.; 0091h
PO03	*CPRO	Choose receive error 1, 2 detection valid/invalid Example: Synchronous, use incremental counter; 0001h Asynchronous, (hence incremental counter isn't available); 0200h

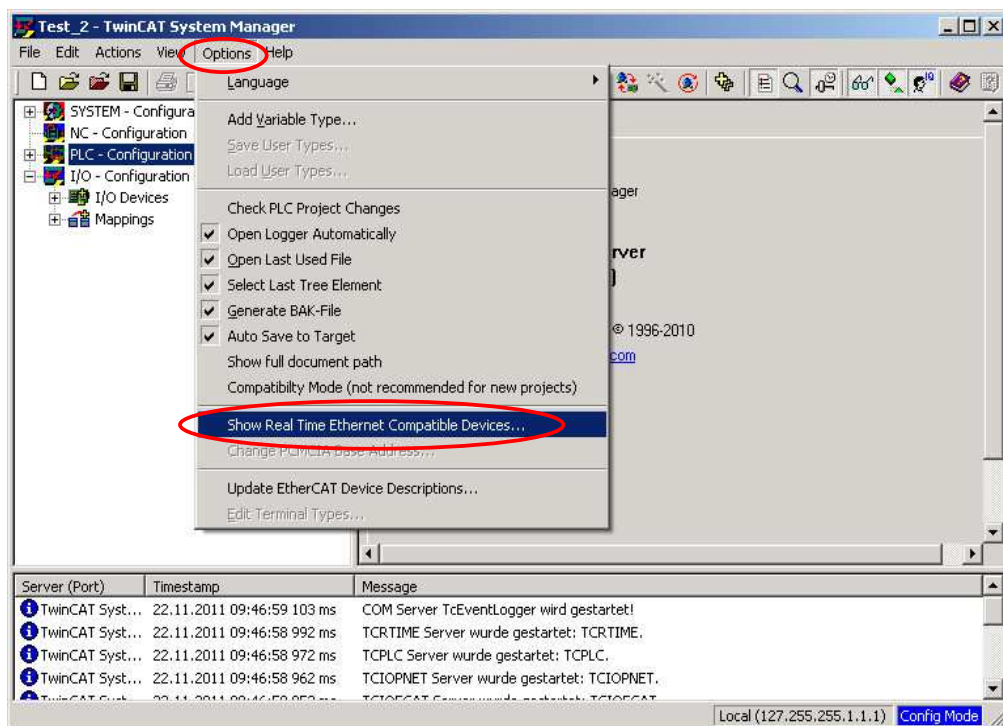
Notes: Switch off the power supply once after setting the parameter indicated with *. The setting will be completed after turning the power supply on again.

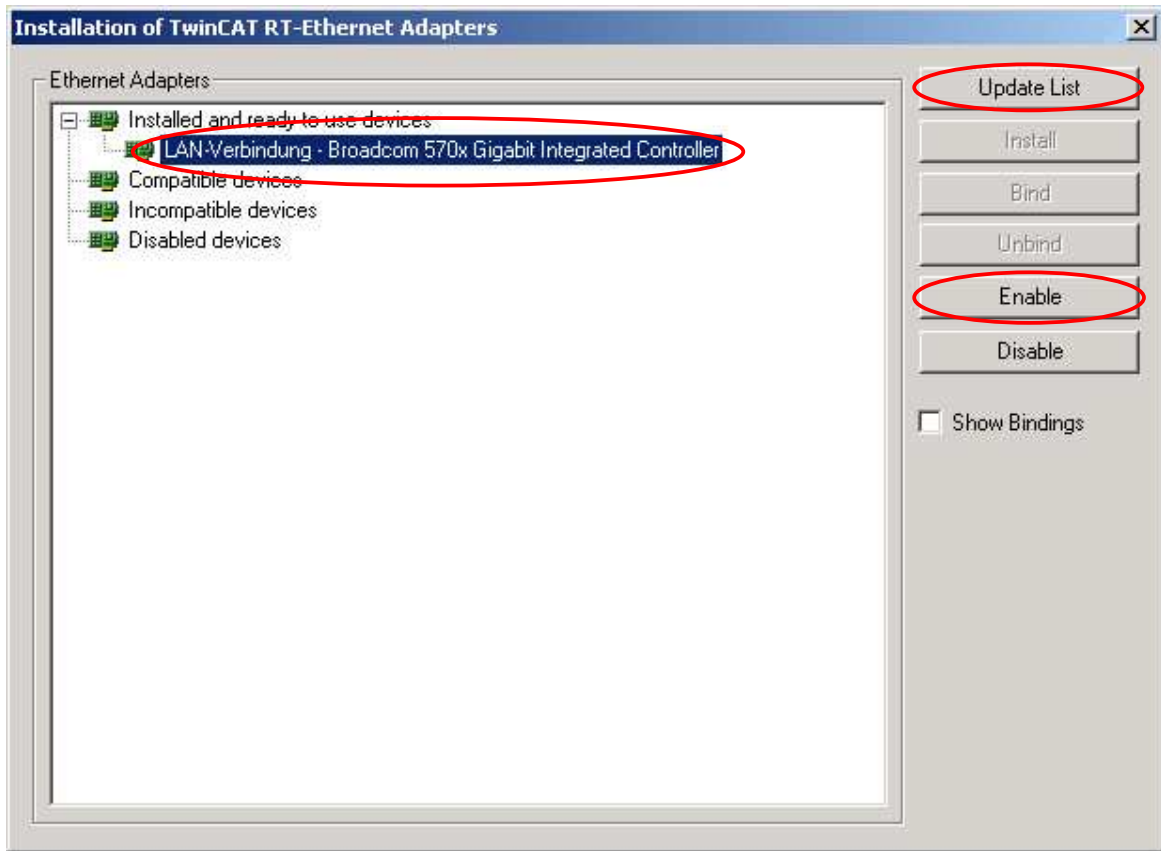
TwinCAT System Manager setup

1. Launch TwinCAT System Manager and choose "System"→"Config" to set up TwinCAT Config Mode.

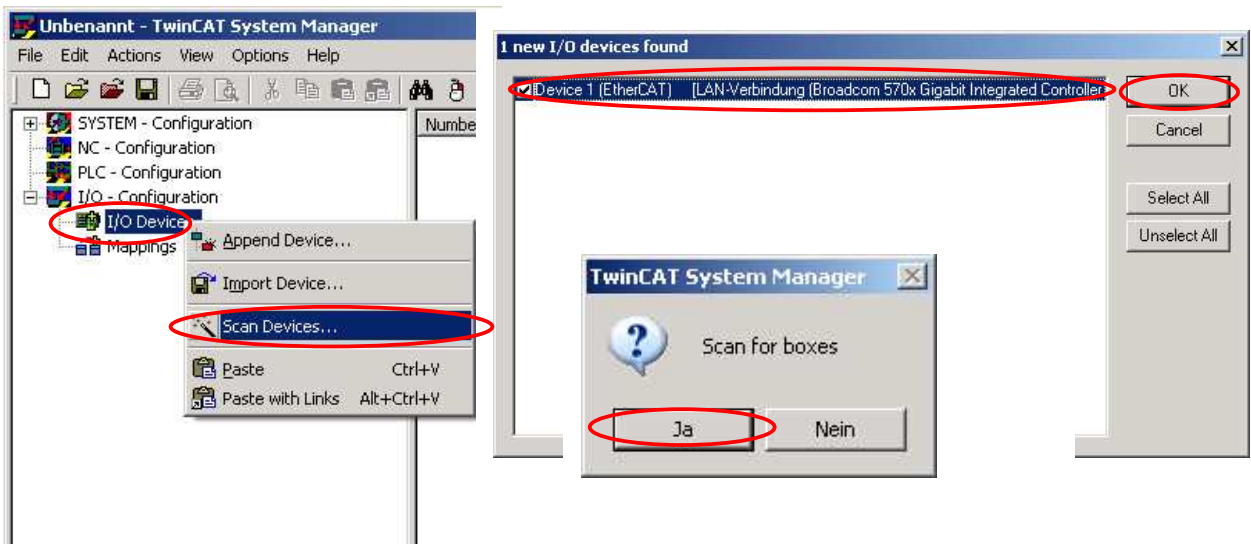


2. When the first time use of TwinCAT since installing, Selecting LAN adapter for EtherCAT communication is necessary to install the driver and to make valid. Click "Options" →"Show Real Time Ethernet Compatible Devices" . Then select one of the LAN adapters for EtherCAT communication in the window. Depends on LAN adapter, click "Install" or "Enable" so that the LAN adapter for EtherCAT communication is shown in "Installed and ready to use devices" column.

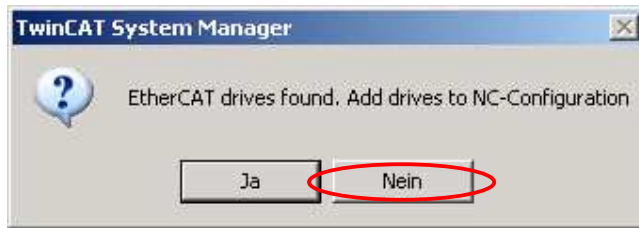




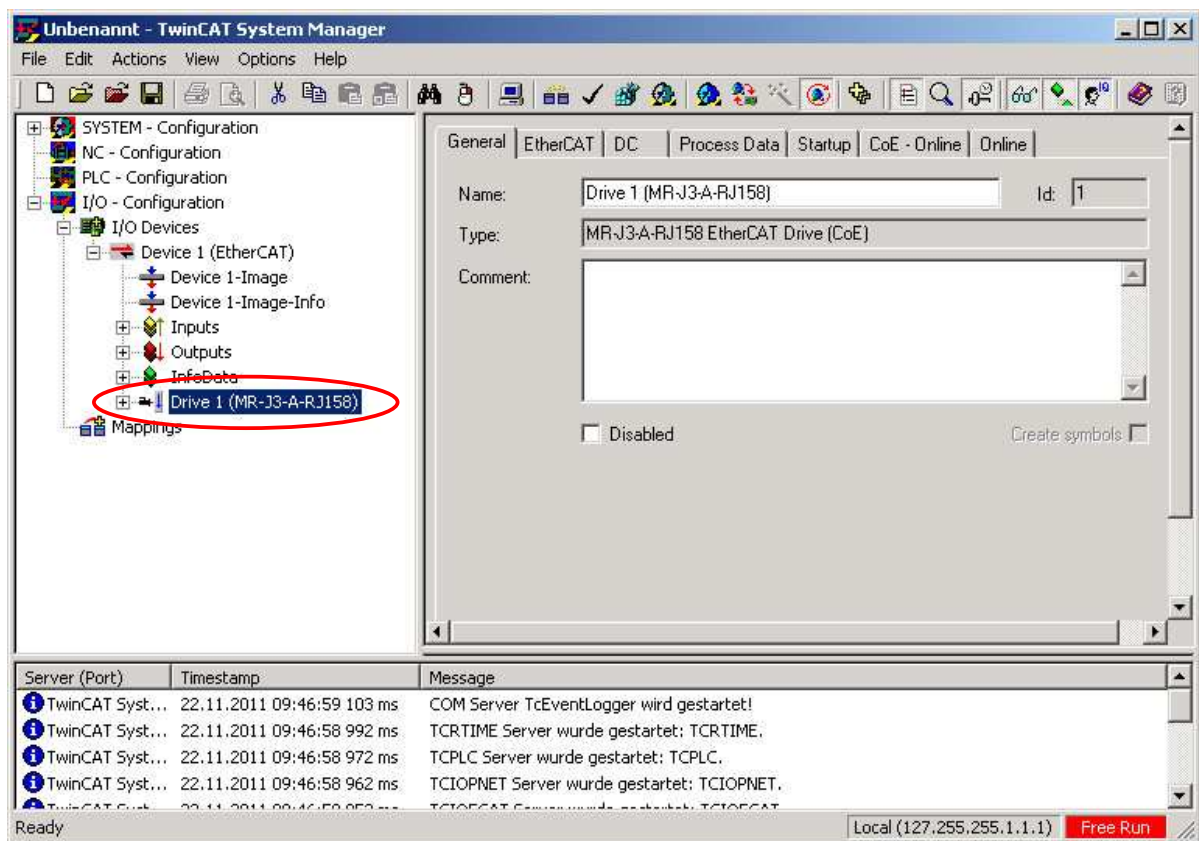
3. After the amplifier's power on, right click on "I/O – Configuration" → "I/O Devices", click "Scan Devices". Choose "Device1(EtherCAT)"(LAN adapter name for EtherCAT) and press "OK", then click "Yes" in "Scan for boxes".



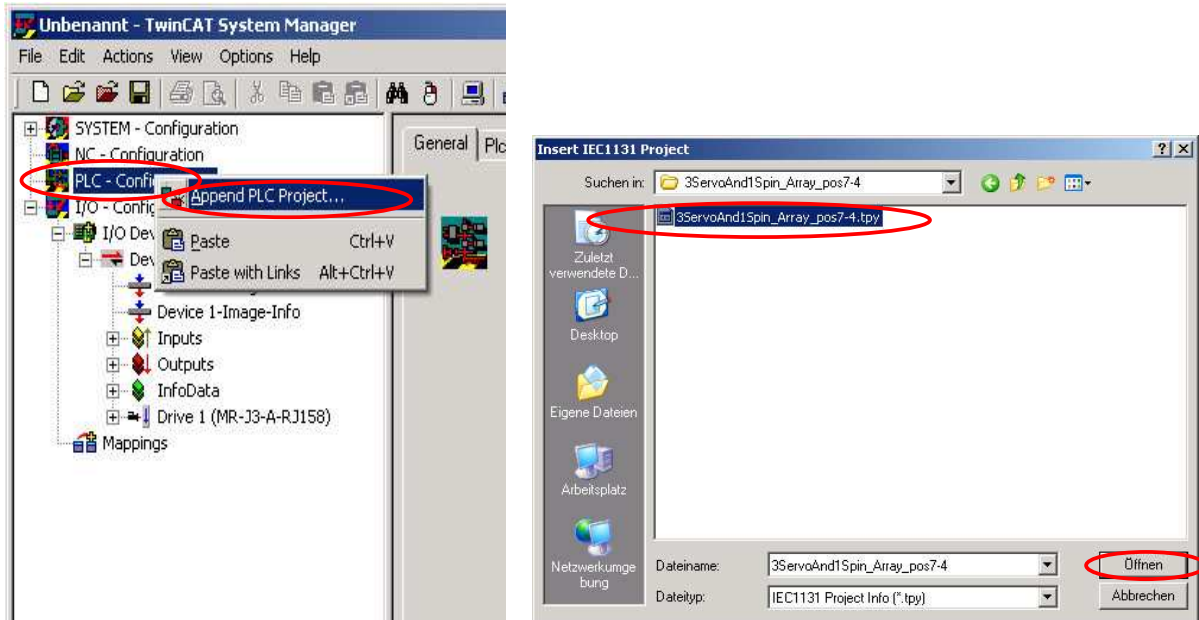
Then don't add drives to "NC-Configuration" (you may be asked depends on xml file), and choose "Yes" for "Active Free Run".



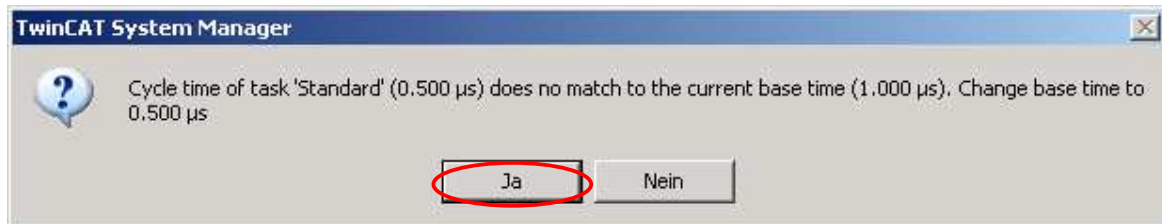
Now TwinCAT recognizes slaves connected. The picture below is 1 axis example.



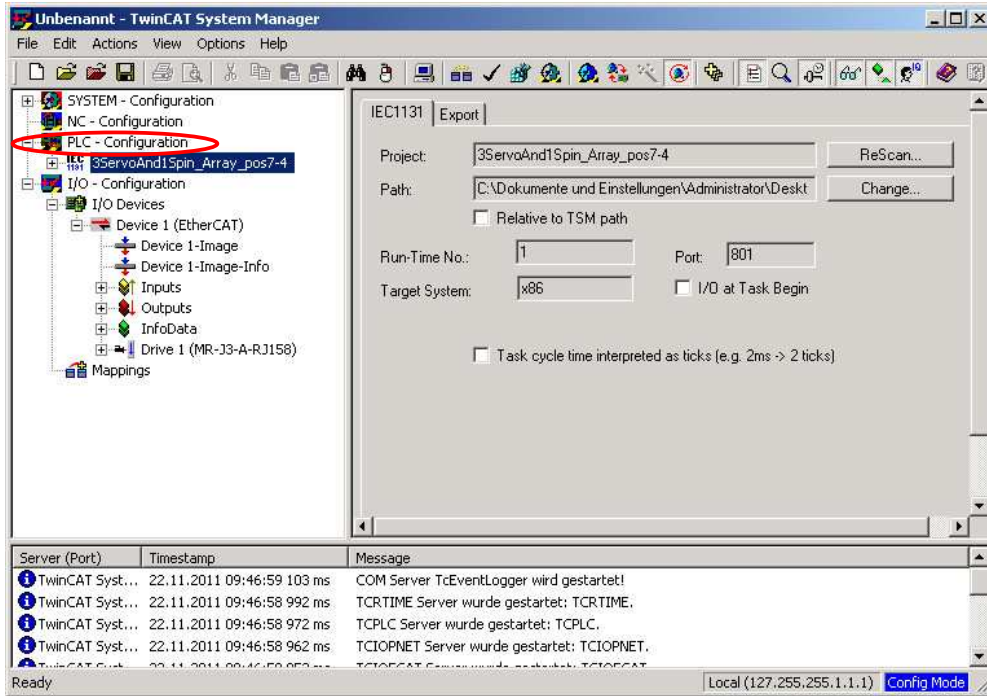
4. Right click on “PLC-Configuration” and open PLC project by clicking “Append PLC project”.



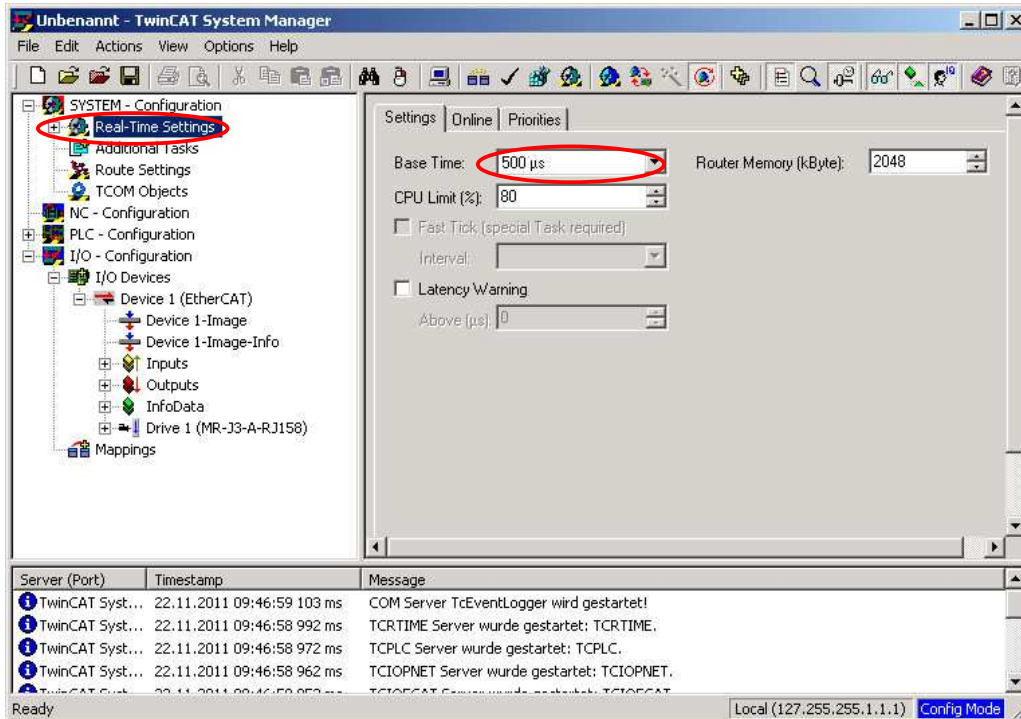
Depends on PLC project, the base time may have been saved as other than default value, 1ms. In this case you will be asked whether you change the base time, therefore choose “Yes”.



Now PLC program name which is chosen at “PLC – Configuration” column is recognized.

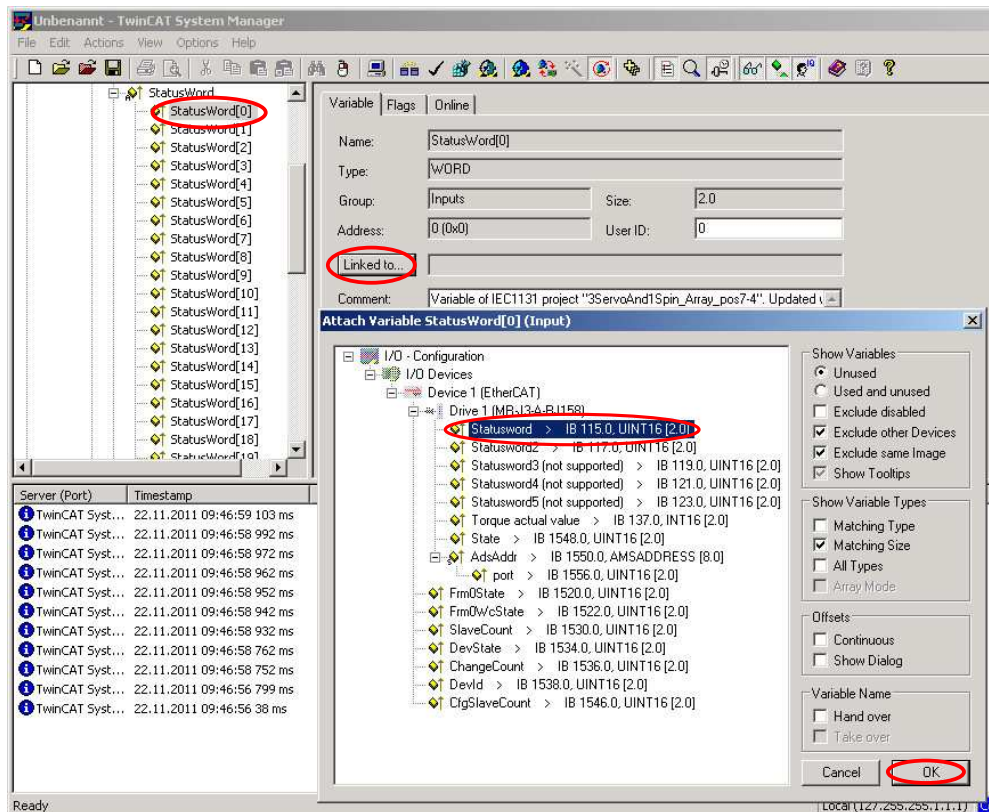


5. When you change the base time setting, go to “SYSTEM - Configuration”→”Real-Time Settings” and open “Settings” tab. The base time can be any divisor of PDO communication cycle time.



- In the window “PLC - Configuration” → (selected PLC program), click “Linked to ...” for the each item of “Inputs” and “Outputs” to link them to servo amplifier’s “Inputs” and “Outputs”. Inputs and outputs of all axes which are connected should be linked.

Following picture shows the example of linking PLC’s “StatusWord[0]” and Drive1(1st axis)’s “Statusword”.

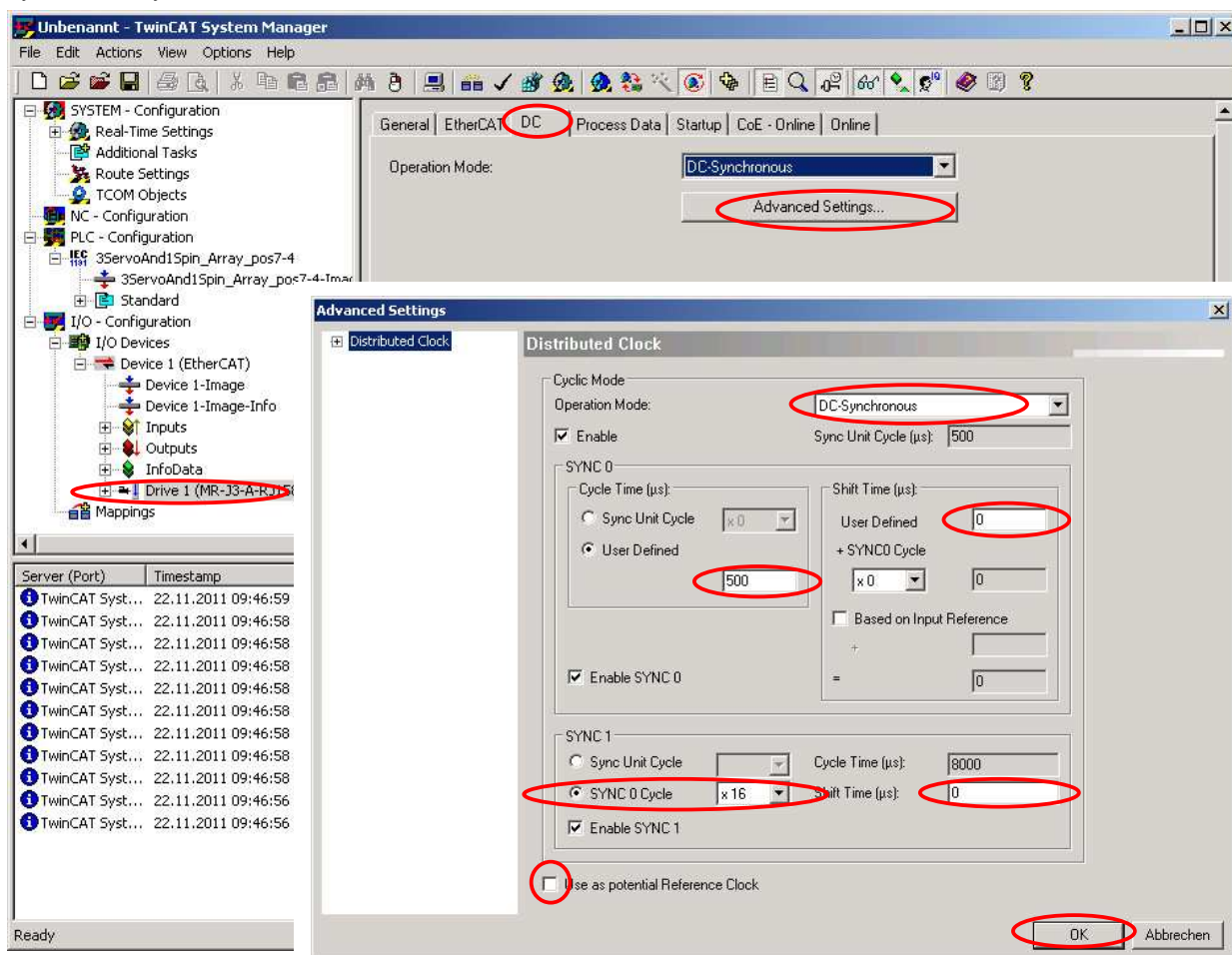


* The each element of PLC program’s “Inputs” and “Outputs” has 32 arrays. [0] corresponds to Servo A(1st axis), and [1] is Servo B(2nd axis), ..., [3] is Spindle(4th axis). This sample PLC cannot control 5th or later axis even it is linked due to GUI structure.

- Select each Drive connected and open "DC" tab. Choose "DC-Synchronous" in "Operation mode" and press "Advanced Setting". Then set "Cycle Time" of SYNC0 and SYNC1 so that it meets to PDO communication cycle time which is set in parameter PO02. Make sure to set all drives' DC setting.

	SYNC0	SYNC1
Cycle time	0.5ms: "500" us 1ms: "1000" us 2ms: "2000" us	0.5ms: SYNC 0 Cycle "x 16" 1ms: SYNC 0 Cycle "x 8" 2ms: SYNC 0 Cycle "x 4" *Set 8000 us at any cycle time
Shift time	"0" us	"0" us

The picture below is the example of DC setting when Drive1 is driven at 0.5ms PDO communication cycle time, synchronous mode.

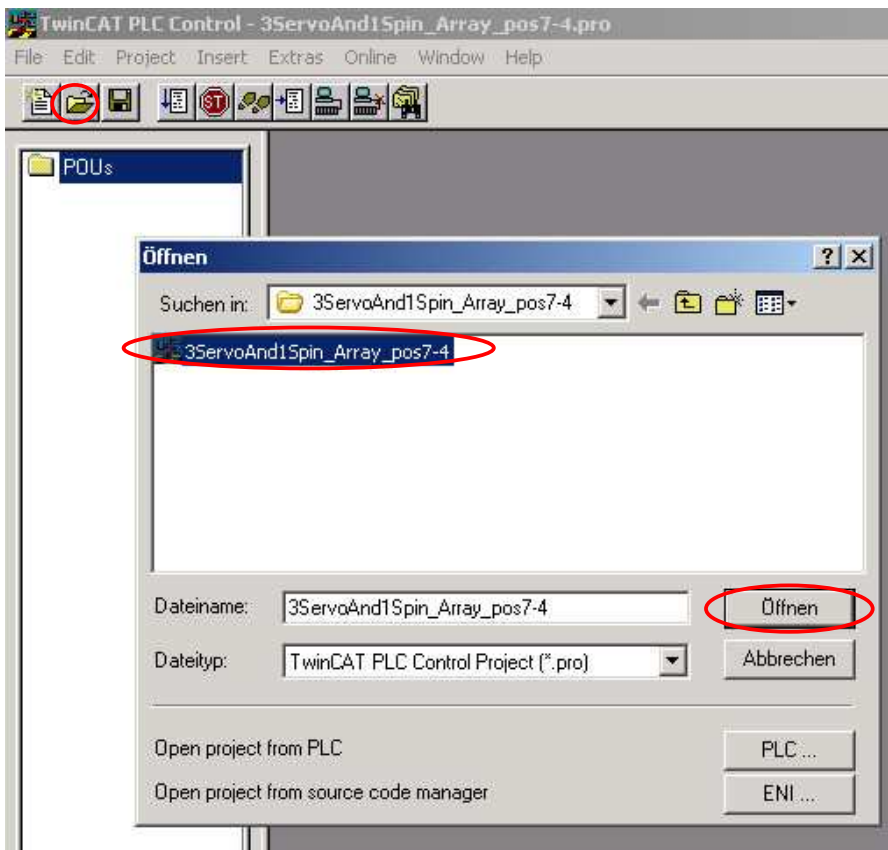


TwinCAT PLC Control set up

1. Right click TwinCAT on Windows task bar to launch TwinCAT PLC Control.

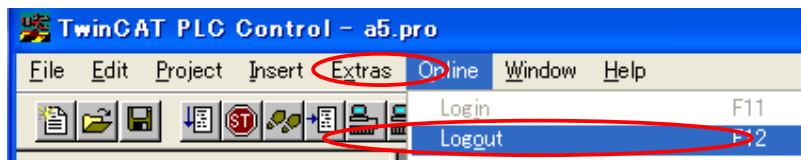


2. Click "File" → "Open" to open the PLC program which is selected TwinCAT System Manager.

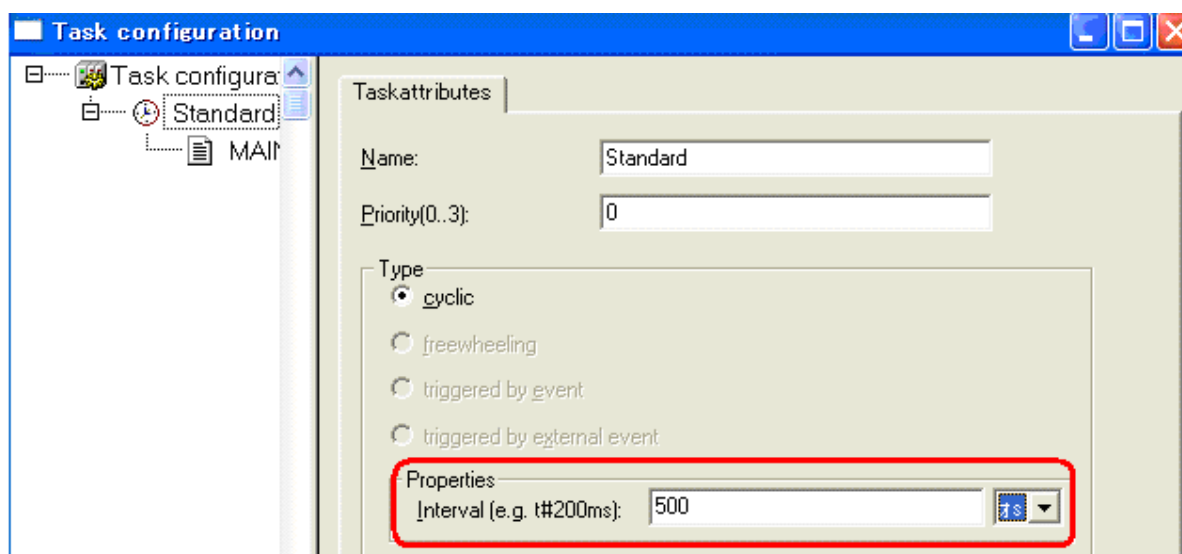


3. In case the Interval setting of PLC Control doesn't fit to PDO communication cycle time, change the setting as shown below.

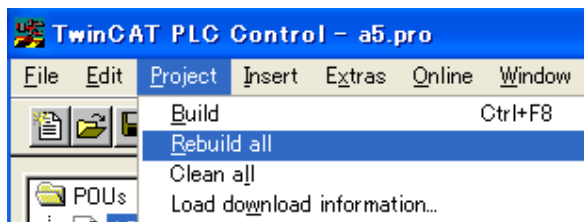
If "TwinCAT PLC Control" is Online, Logout it and make sure it's Offline.



Open "Task configuration" in "Resources" tab, and input the cycle time "Properties" "Interval" column. Following is the example of 0.5ms PDO communication cycle time.



4. When PLC program or setting is changed, execute "Project"→"Rebuild all" to save the file.

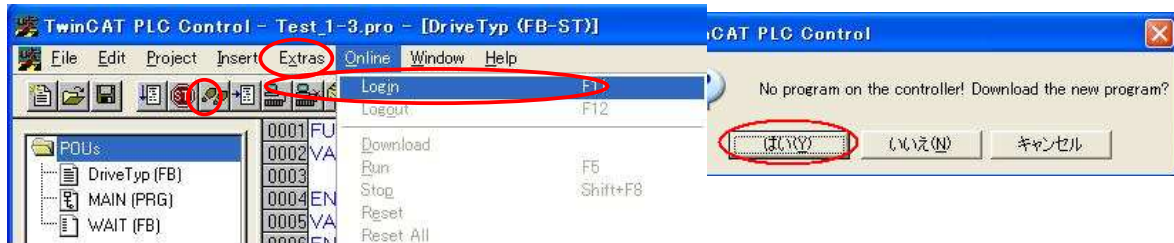


How to start PLC

1. In TwinCAT System Manager, press 1st “Generate Mappings”, 2nd “Check configuration” and 3rd “Activate configuration” in this order to activate “Run Mode”.



2. In TwinCAT PLC Control, click “Online”→“Login” and download the program.



3. Press “Run” button to start the PLC program. Now it turns to Run mode.



Major operation of PLC sample program

Following window shows up by opening “Visualizations” tab → “panel”.

The screenshot displays the TwinCAT PLC Control interface for a 3-axis servo and spindle array. The main visualization area is divided into columns for Servo A, Servo B, Servo C, and Spindle. The interface includes several key sections:

- Incremental Counter:** Shows PLC (Pre) and Amp (Post) counts for each drive, all set to 141.
- Inc. Counter Check:** Displays PDO Count, Inc. Count, Corrected Inc. Count, and Inc. Count Error for each drive.
- Actual Value:** Lists Velocity, Torque, and Position actual values for each drive.
- Control:** Shows Target Velocity, controlword, statusword, and torque limits.
- Positioning:** Includes Target Position, Start Position, FDTA, and POS START for each drive.
- Repeat Count:** Shows repeat counts for each drive (0, 5, 10).
- Timing:** Lists S1 (rpm), T1 (ms), T2 (ms), and dwell time (ms) for each drive.
- Control Parameters:** Includes 500us ERR FDT, Run Cnt, and various controlword and statusword settings.
- Graph:** A velocity profile graph at the bottom shows a trapezoidal acceleration and deceleration with dwell times T1 and T2.

Numbered callouts (1-18) highlight specific features and controls throughout the interface.

The main items are explained in the following table. If it's not written in there, do not touch because the functions are just for develop or test purpose.

	Item	Description
1	Incremental Counter	Upper: Incremental counter value which PLC send to amplifier Bottom: Incremental counter value which amplifier respond to PLC
2	Inc Counter Check	Upper: Total PDO communication times after "Count RESET" Middle: Correct incremental counter receive times of PLC Bottom: Incorrect incremental counter receive times of PLC
3	Count RESET button	Counter value in "Inc Counter Check" column is reset
4	Actual Value	Current value which amplifier send to PLC via PDO communication (Current speed, current torque, current position, droop pulse) Multi turn counter and position in one rotation which PLC calculated from current position
5	Velocity (rpm) button	Open dialog window to input command speed
6	controlword	Click to set the value of controlword and controlword2
7	statusword	The value of statusword, statusword2 which PLC receives
8	torque limit	Click to set the torque limitation value for CW/CCW
9	Target Position	After setting repeat count, S1, T1, T2, and dwell time, press "POS START" to calculate and send the command position for the trapezoidal operation.
10	Position control trapezoidal parameter	repeat count: repeat times of trapezoidal movement S1: Rotary speed at constant velocity T1: Acceleration and Deceleration T2: Constant velocity time, Dwell time: Dwell time
11	Follow up Stop	Set "Position Actual Value" in "Target Position"
12	CCW <-> CW	Press to change CCW/CW during position control trapezoidal operation
13	Cycle button	Set PDO communication cycle time to calculate the position command when position control trapezoidal operation
14	AGINGbutton	Update Target velocity by PLC as same as repeating CW/CCW acceleration and deceleration
15	STOP (Vel=0) button	Set 0 for all axes' Target velocity (all axes moving in speed control mode are stopped)
16	MULTI button	Update automatically all axes' Target position so that they make trapezoidal operation (all axes moving in position control mode become trapezoidal operation)
17	(Controlword) SET button	Change all axes' Controlword at once by pressing after input the value
18	(Controlword2) SET button	Change all axes' Controlword2 at once by pressing after input the value

How to drive in speed control mode

1. Click Controlword and set "15".
→ Enable Operation command is sent and the system turns servo on.
2. Press Velocity(rpm) button and input the speed in rpm in the dialog window.
→ Motor rotates at commanded speed. Positive command is CCW and vice versa, when POL is not available.
3. Press Velocity(rpm) button and input 0 in the dialog window.
→ Motor stops.
4. Click Controlword and set "0".
→ Disable Voltage command is sent and main power is off status. Shut off the power.

How to drive in position control mode

1. Click Repeat count, S1, T1, T2, and dwell time to trapezoidal operation parameters.
2. Click Controlword and set "15".
→ Enable Operation command is sent and the system turns servo on.
3. Press POS START button.
→ start the trapezoidal operation which is given in No.1.
4. Either finishing the number of the operation which is given or pressing POS START button stops the trapezoidal operation.
→ Motor stops.
5. Click Controlword and set "0".
→ Disable Voltage command is sent and main power is off status. Shut off the power.

Notes for TwinCAT operation

Even you stop or logout TwinCAT PLC, EtherCAT communication continues until System Manager communication stops. Meanwhile, amplifier power is off and on, the servo starts moving to follow the command. When you want to stop the operation, be sure not only to stop and logout TwinCAT PLC, but also to stop or reset TwinCAT System Manager to terminate the communication.