



Application Note

Yaskawa CANopen over EtherCAT Servo Drives with TwinCAT

Applicable Products:

Sigma-5 CANopen over EtherCAT



Product: Sigma-5 CANopen over EtherCAT	Doc#: ENG.09.126.MTN
Title: Yaskawa CANopen over EtherCAT Servo Drives with TwinCAT	

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1. About This Document

This document contains the setup procedure of hardware and software to perform basic operation of Yaskawa CANopen over EtherCAT Servo Drives with Beckhoff TwinCAT, with additional setup options.



Yaskawa SGD
with EtherCAT
option module
(Ex: SGDV with
CoE module)



Computer
(Ex: Beckhoff IPC
C6920-0040)



TwinCAT
(Ex: v.2.11 R3, Build 2220)

This document's purposes are as follows:

- Provide additional setup options beyond the setup described in the quick start guide (document number AN.MTN.03).
- Provide procedures in TwinCAT to utilize Yaskawa Drive features
- Provide additional details and purposes for selection of settings that are not addressed in the quick start guide.

This document's purpose does not include:

- How to create and run a sample TwinCAT PLC program.
 - An eLearning Module (Document eLM.Sigma5.01.CoE) is available with that purpose.

The intended audience for this document is as follows:

- Master Developers who desire additional setup options for setting up a TwinCAT system beyond the setup described in the quick start guide.





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- Machine builders using TwinCAT with Yaskawa Drives.

TwinCAT screenshots in this document may vary for different versions of TwinCAT.



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2. Abbreviations

- **CoE** - CANopen over EtherCAT - *Profile for motion control*
- **ECAT** - EtherCAT - *Industrial communication protocol*
- **ESI** - EtherCAT Slave Information - *File with slave device descriptions, utilized by masters*
- **GUI** - Graphical User Interface - *Screen that allows interaction*
- **IPC** - Industrial PC - *Computer designed for industrial use*
- **NIC** - Network Interface Card - *(EtherCAT) Ethernet PC card*
- **OS** - Operating System - *Examples: Windows 7, Linux, Mac OS X*
- **RAM** - Random-Access Memory - *PC Hardware for computer data storage*
- **USB** - Universal Serial Bus - *PC Hardware communication interface*
- **XML** - Extended Markup Language - *(EtherCAT) File containing device info. Same as ESI*



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3. Prerequisites

3.1. Hardware

- Yaskawa CANopen over EtherCAT Servo Drive
 - SGDV with SGDV-OCA01A
- USB Communications Cable
 - Use Yaskawa USB cable to avoid communication issues
 - Yaskawa Part number JZSP-CVS06-02-E
 - Industrial cable that includes 2 ferrite cores and is shielded
 - Connects Yaskawa drive to host PC running SigmaWin+, which allows:
 - Verification of Target Position each EtherCAT cycle
 - Setting drive parameters
 - Issuing drive functions
- For SGDV drives, Digital Operator (optional but recommended, otherwise use CoE or SigmaWin):
 - Part number JUSP-OP05A-1-E
 - Use to set parameters and perform functions quickly
 - Cannot be used to verify Target Position each EtherCAT cycle.
- Ethernet cable
 - Cat5e Shielded Twisted-Pair is recommended
 - Unshielded Ethernet cables may result in A.A12 and A.A11 alarms due to noise interference
- Windows PC:
 - TwinCAT-compatible NIC
 - See “Appendix B: TwinCAT Compatible NICs” for NIC specifications
 - The NIC can be onboard or an add-on (PCI, PCI-Express, etc.)
 - Processor Type & RAM
 - Depends on the following factors:
 - Number of axes (more axes requires faster processor)
 - Cycle time (faster cycle time requires faster processors)
 - Load on processor from other programs
 - TwinCAT 2 or TwinCAT 3 (TwinCAT 2 requires less processing power)
 - Beckhoff specifies “TwinCAT 3 performance class” for all their IPCs.



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- This rating gives users a rough quantitative comparison of performance between Beckhoff IPCs.
 - More information:
 - <http://www.beckhoff.com/english.asp?twincat/twincat-3-platform-classification.htm>
- Example: For 1 axis at 1ms cycle time using TwinCAT 2 on Windows XP 32-bit, this system has been successfully run on a PC with Intel Celeron M, 800MHz, 480MB RAM.
- To determine if a more powerful processor is necessary, while running the system, check TwinCAT's runtime %.
 - See "Appendix M: TwinCAT Real Time Usage".
- Any one of the following types of PC:
 - Beckhoff IPC
 - Not required to run TwinCAT
 - Guaranteed to run TwinCAT
 - Not commercially available (Longer lead time than commercially available PCs)
 - Rated by Beckhoff using "TwinCAT 3 performance class"
 - Non-Beckhoff IPC
 - Many IPCs contain an Intel NIC. Check the IPC's specifications.
 - Example Non-Beckhoff IPC: Advantech
 - Desktop PC
 - Expansion slot for Intel NIC or built-in Intel NIC
 - Laptop PC
 - Not recommended
 - Onboard Intel NIC
 - See "Appendix A: TwinCAT on Laptops" for details about using a Laptop





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3.2. Software

- ESI file for Yaskawa CANopen over EtherCAT Servo Drive
 - The Yaskawa ESI file has a *.xml extension.
 - Available on Yaskawa.com (search term: **Yaskawa_CoE_XML_File**)
 - Example: **Yaskawa SGDV-E1_CoE rev5.00.xml**
 - Files can co-exist, so the recommendation is to download them all.
 - See “Appendix D: Yaskawa ESI Files” for details about individual ESI files.
- OS compatible with TwinCAT version
 - Windows 8 might not run TwinCAT in realtime.
 - Virtual machines cannot be used.
 - See Beckhoff’s website for TwinCAT OS compatibility
- Beckhoff TwinCAT
 - Decide TwinCAT major version (2 or 3)
 - See “Appendix C: TwinCAT 2 and TwinCAT 3” for comparisons.
 - Decide TwinCAT minor version
 - Typically considered when duplicating another setup to verify functionality.
 - Select bit version (32 or 64) compatible with OS on Windows Desktop PC
 - For TwinCAT 2, the 64-bit versions do not run the Realtime Mode.
 - For TwinCAT 3, the 64-bit versions can run the Realtime Mode.
 - Request download from Beckhoff’s website.
 - Previously released versions (lower minor revisions) are also available.



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4. Software Configuration

Note: Steps in this section are shown in the eLearning module: eLM.Sigma5.01.CoE.

This document is more up to date than the eLearning module.

For any differences, steps in this document should be followed rather than the eLearning module.

4.1. Install TwinCAT

- For the TwinCAT Installation Level, select “TwinCAT NC I - Interpolation”
 - This level contains the most features that might be used.
- For the Components, select at least “TwinCAT Scope View”
 - Other items may be selected if desired.

4.2. ESI File Installation

- Close the TwinCAT System Manager application if it is running.
 - TwinCAT will re-read the XML directory to import the devices.
 - Without closing TwinCAT System Manager, the slave device will not be found.
- Place all ESI files into the TwinCAT directory.
 - For TwinCAT 2, typical location is: C:\TwinCAT\Io\EtherCAT
 - For TwinCAT 3, see TwinCAT help files from Beckhoff.
- If TwinCAT System Manager is open, close it and reopen it.
 - TwinCAT will re-read the XML directory to import the devices.
 - Without closing TwinCAT System Manager, the slave device will not be found.

4.3. TwinCAT Ethernet Adapter Setup

- This step is only required one time.
- See “Appendix E: TwinCAT Ethernet Adapter Setup” for step-by-step instructions.



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5. Hardware Configuration: Yaskawa Drive

5.1. Sigma-5 SGDV

Clear all alarms and warnings on the Yaskawa Drive before connecting with EtherCAT.

- The most common alarms are addressed in this section.
- For alarms not addressed in this document, refer to the user’s manuals for corrective actions:
 - Σ -V Series User’s Manual Design and Maintenance Command Option Attachable Type
 - Yaskawa.com document number: SIEPS80000060
 - Σ -V Series User’s Manual EtherCAT (CoE) Network Module
 - Yaskawa.com document number: SIEPC72082904

5.1.1. Parameter Reset

- The parameters should be reset to start with the default parameters.
- Execute Fn005 using the Digital Operator or Parameter Initialize using SigmaWin.

5.1.2. Absolute Encoder Setup

- Clears alarm “Encoder backup error” (A.081)
- Possible solutions:
 - Configure absolute encoder for incremental operation.
 - Set Pn002.2 = 1
 - Use digital operator, SigmaWin+, or set through EtherCAT
 - Use a digital operator (JUSP-OP05A-1-E) to reset the absolute encoder.
 - See “Appendix F: Reset Absolute Encoder Using a Digital Operator”
 - Use SigmaWin+ to reset the absolute encoder.
 - See “Appendix G: Reset Absolute Encoder Using SigmaWin+”
 - Use CoE to reset the absolute encoder.
 - See “Appendix H: Reset Absolute Encoder Using CoE”



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5.1.3. Overtravel Setup

- Clears “Forward/reverse run prohibited”
 - This is indicated with the 7-segment LED status display flashing “P”/“n”
- Possible solutions:
 - Connect the inputs to a switch that changes state.
 - Use a digital operator to disable the inputs.
 - See “Appendix I: Disable Overtravels Using a Digital Operator”
 - Use SigmaWin+ to disable the inputs.
 - See “Appendix J: Disable Overtravels Using SigmaWin+”
 - Use CoE to disable the inputs.
 - See “Appendix K: Disable Overtravels Using CoE”

5.1.4. Configure Motor

- Detach all load from motor shaft
- Execute motor jog through digital operator or SigmaWin+
 - Checks motor wiring
- Tune motor using digital operator or SigmaWin+
 - Tuningless mode enabled by default
 - Jog motor back and forth 10 times.
 - If audibly noisy, execute Easy FFT function (Fn203 on DigiOp) to enable notch filter.
 - Refer to the drive’s user’s manual for the tuning procedure





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5.1.5. Configure Amplifier

- DIP switches
 - Do not set for basic testing
 - TwinCAT by default uses “Auto Increment” addressing (ignores address DIP switches)
 - This assigns node addresses incrementally on the network.
 - See “Appendix N: Manual Axis Addressing” for information about manual axis addressing.
- Set up only 1 axis for testing
 - Reduces possibility for other errors like wiring
 - Multiple axes can be added during testing



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6. Hardware Configuration: Master Combination With Slave

6.1. Topology

- Connect a single Ethernet cable between Master Ethernet port and Slave “IN” port.
 - Diagram: Master ----- Slave
 - Line connection from Master Ethernet port to Slave Ethernet Port
 - No other devices on Network
 - No network hubs/switches
 - Add devices one by one during testing, in Line topology

6.2. Yaskawa Drive Port

- Use IN port of Yaskawa Drive as best practice
 - Port does not matter on some drives but use labeled IN and OUT ports as best practice

6.3. Power Up

- Supply control and main power to the Yaskawa drive
 - TwinCAT cannot detect the drive on the network if the drive is not powered on.



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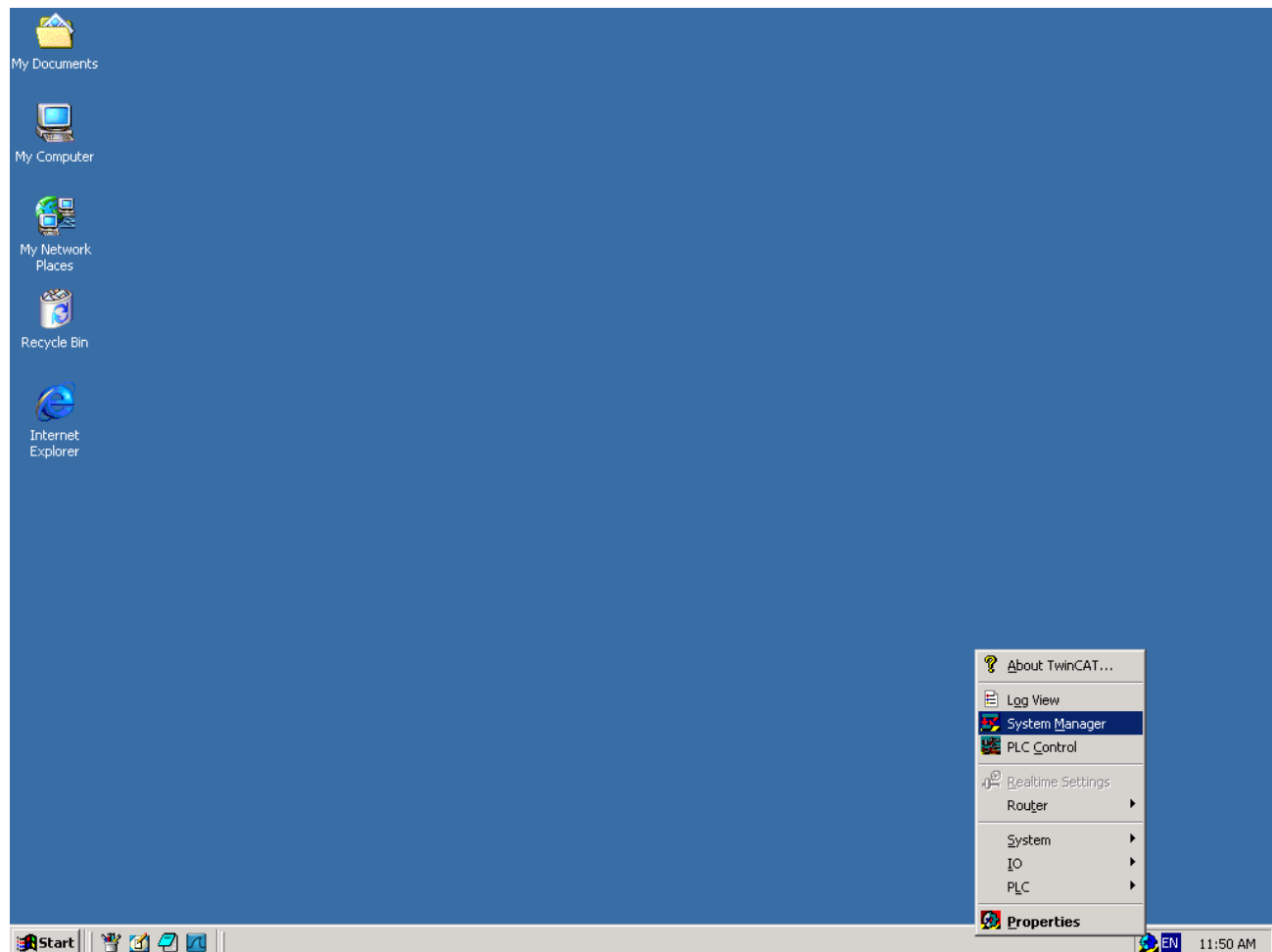
7. Trial Motion Operation Using TwinCAT

A step-by-step guide is shown here, which is similar to the eLearning module (eLM.Sigma5.01.CoE).

A video is also available at: <http://youtu.be/NgHKjHeHxOw>

7.1. Start TwinCAT System Manager

- Right-click the TwinCAT icon in the Windows System Tray.
- Select “System Manager”





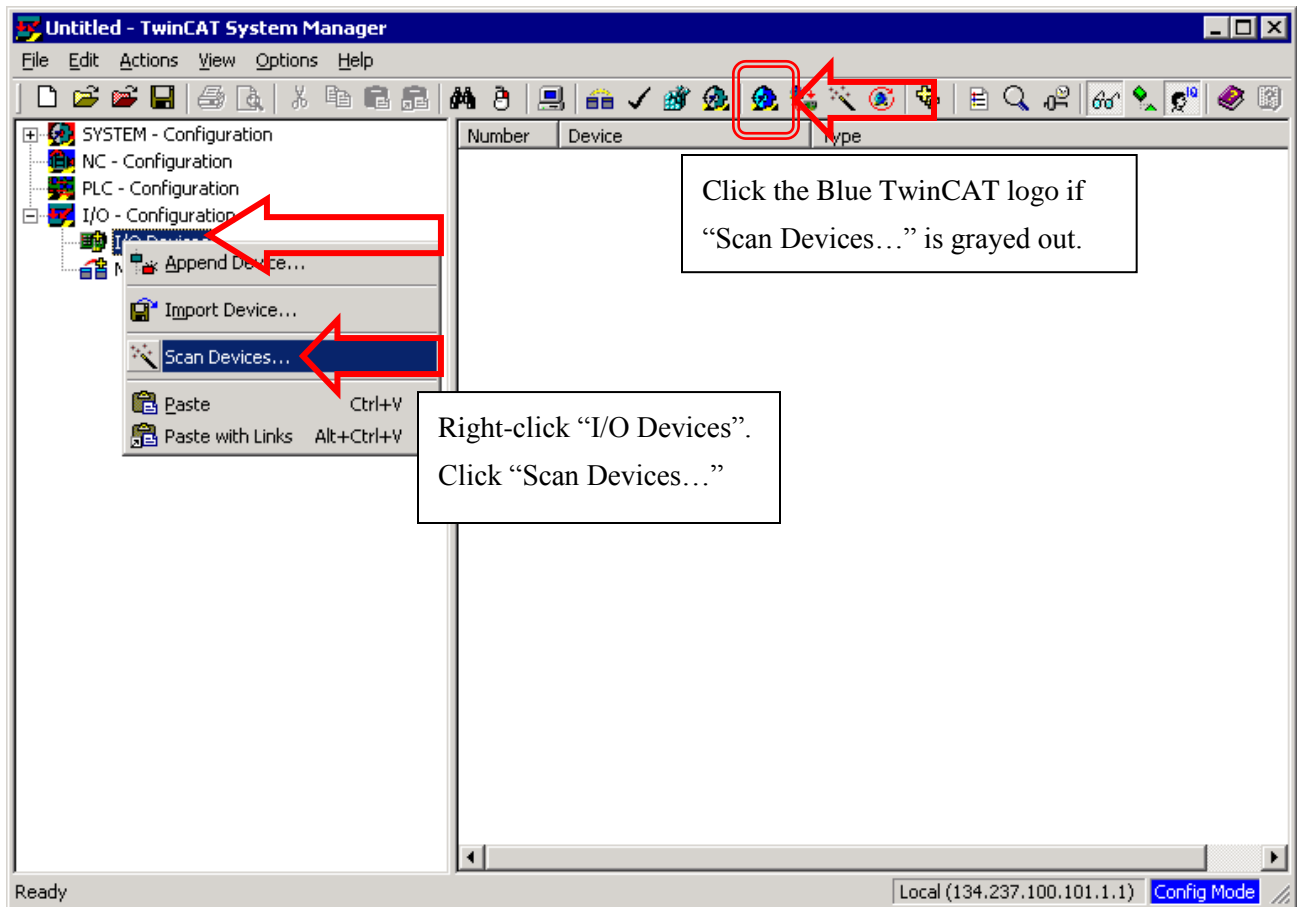
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7.2. Scan PC For EtherCAT Master Devices

- Right-click “I/O Devices”
- Click “Scan Devices...”
 - If “Scan Devices...” is grayed out:
 - Click the Blue TwinCAT logo to put TwinCAT into Config Mode

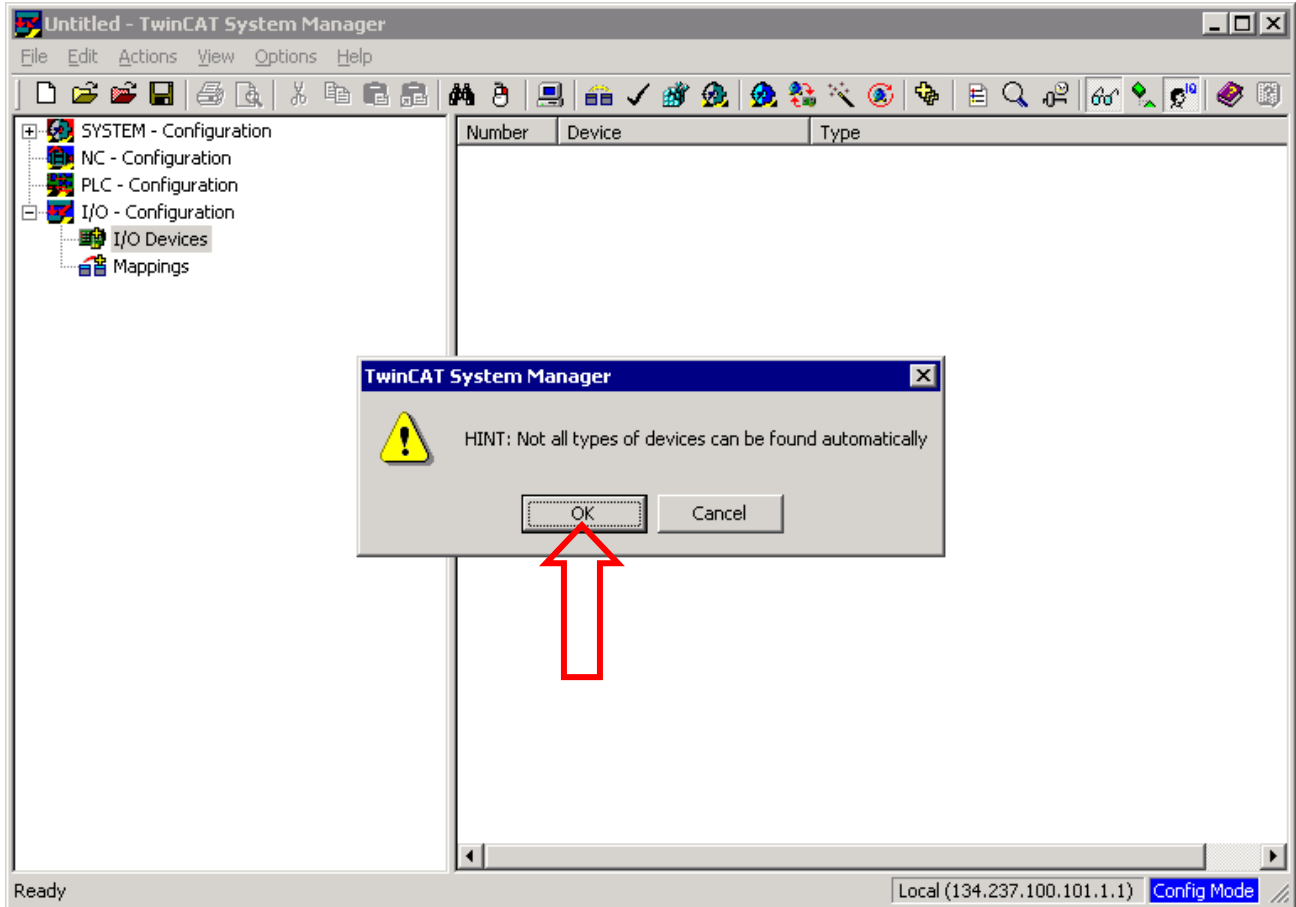


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- Click “OK”



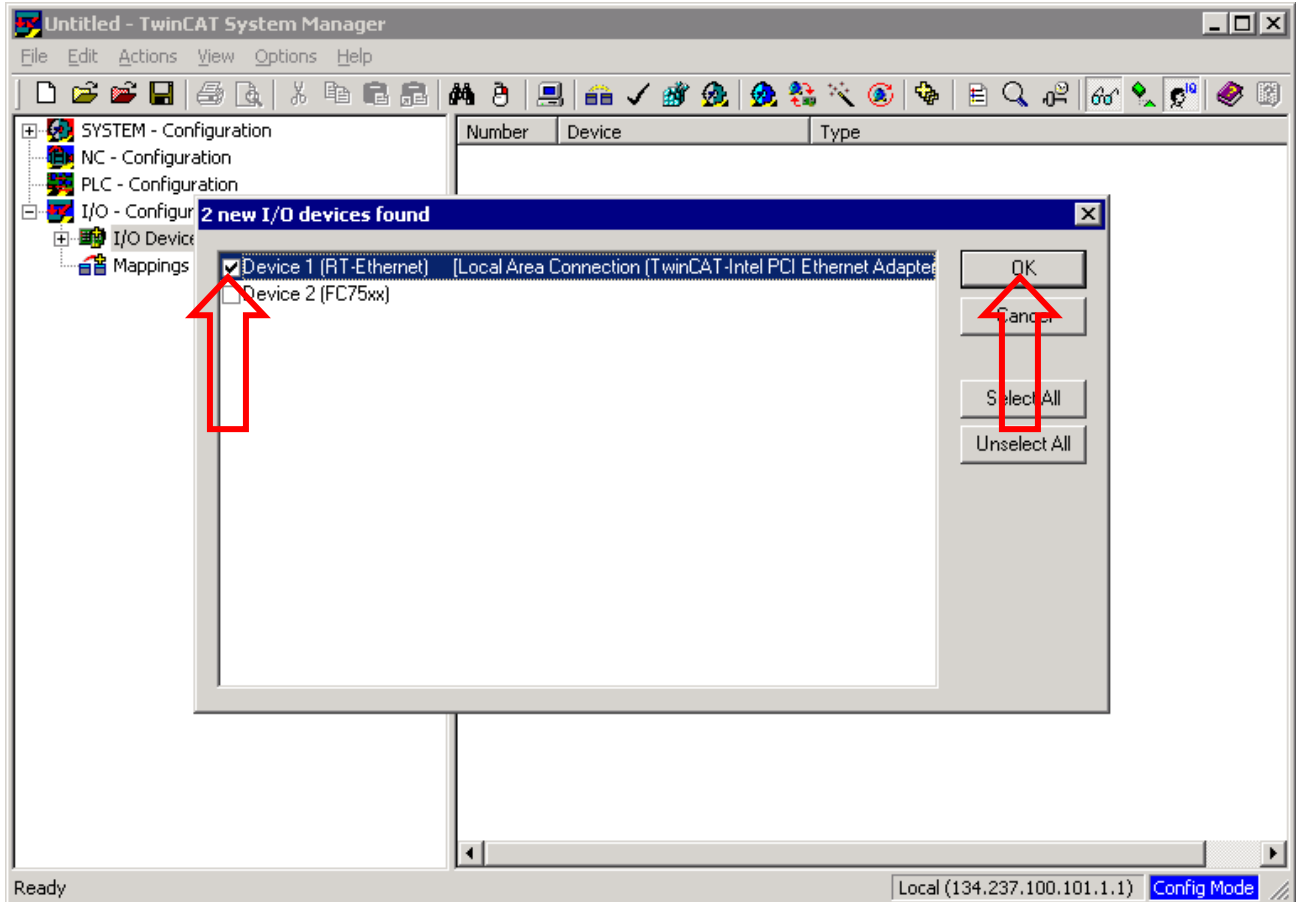


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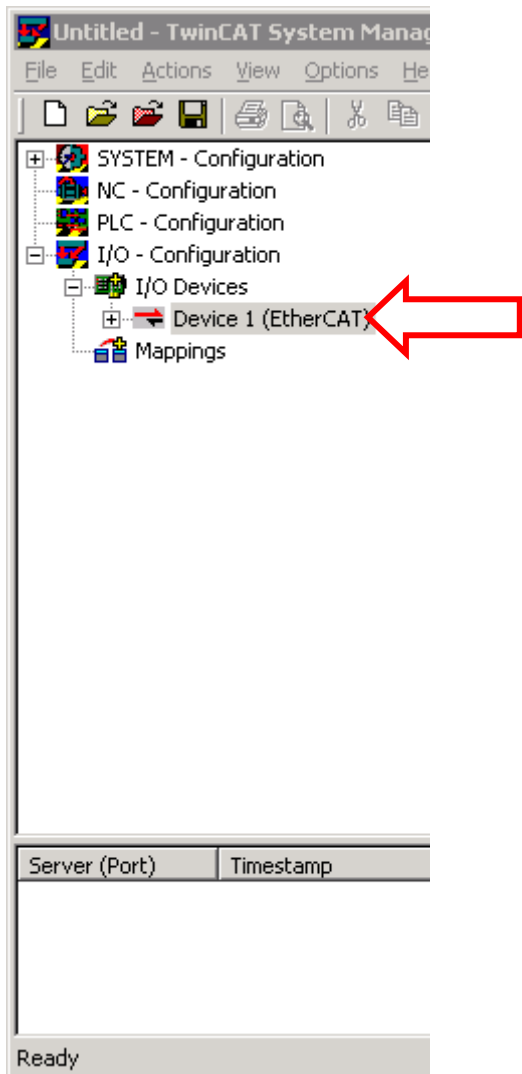
- Deselect all items except the Ethernet adapter, then click “OK”
 - If an Ethernet adapter does not appear here, the Ethernet adapter must be set up.
 - See section 4.3. TwinCAT Ethernet Adapter Setup above





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- The EtherCAT adapter should now appear on the left side of TwinCAT System Manager (below).
 - If the EtherCAT adapter does not appear as shown in the image (Example: “RT Ethernet” appears instead), either of the following might be true:
 - Slave device not connected to Master
 - Check cabling and that slave is powered on
 - Autoscan could not find the EtherCAT adapter, so it must be added manually
 - See “Appendix L: Adding EtherCAT Adapter Manually”





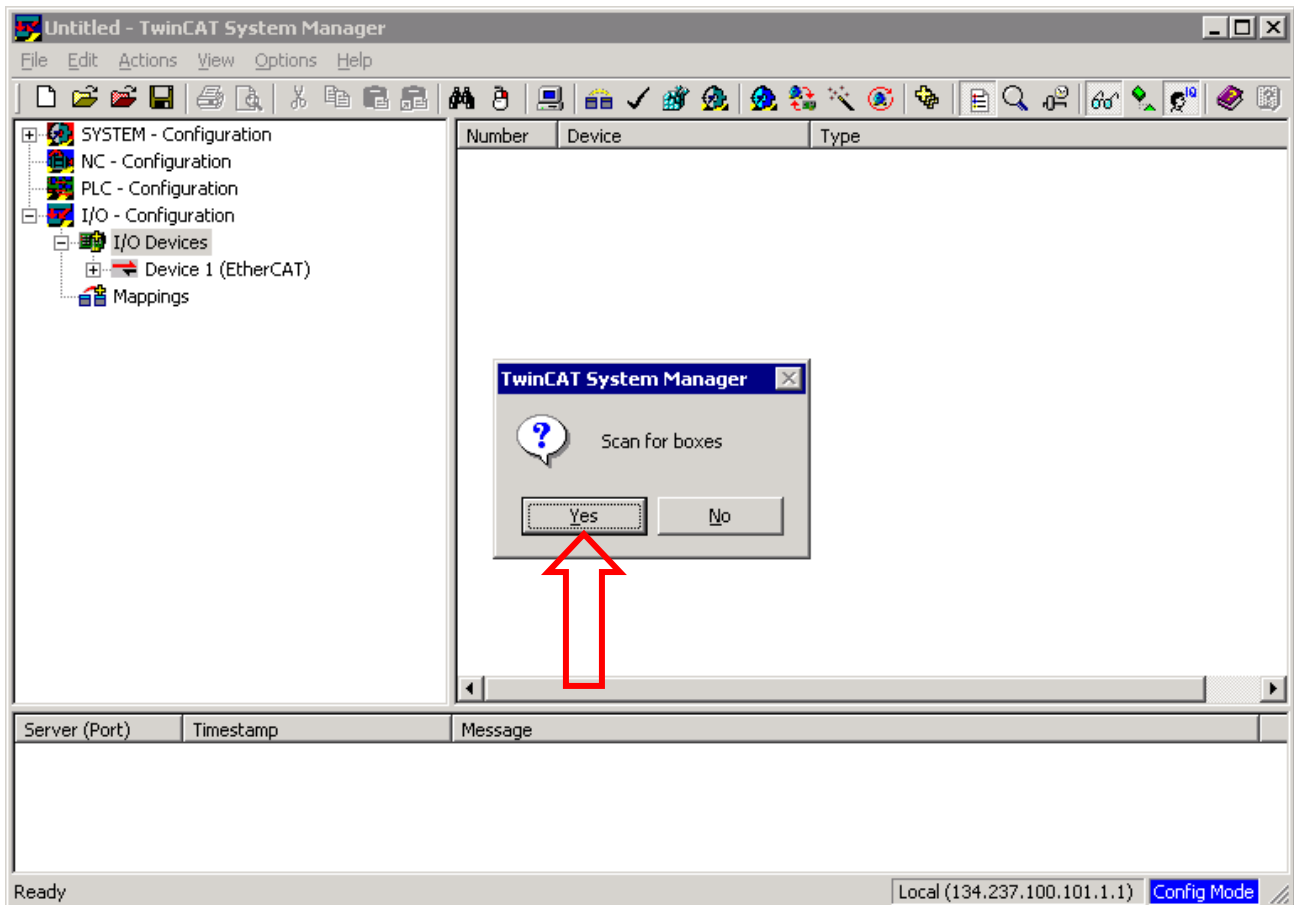
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7.3. Scan Network For EtherCAT Slave Devices

- Click “Yes”
 - If the EtherCAT adapter was added manually, right click on “Device 1 (EtherCAT)”
 - Select “Scan Boxes...” (not pictured)
 - Then proceed to click “Yes”.

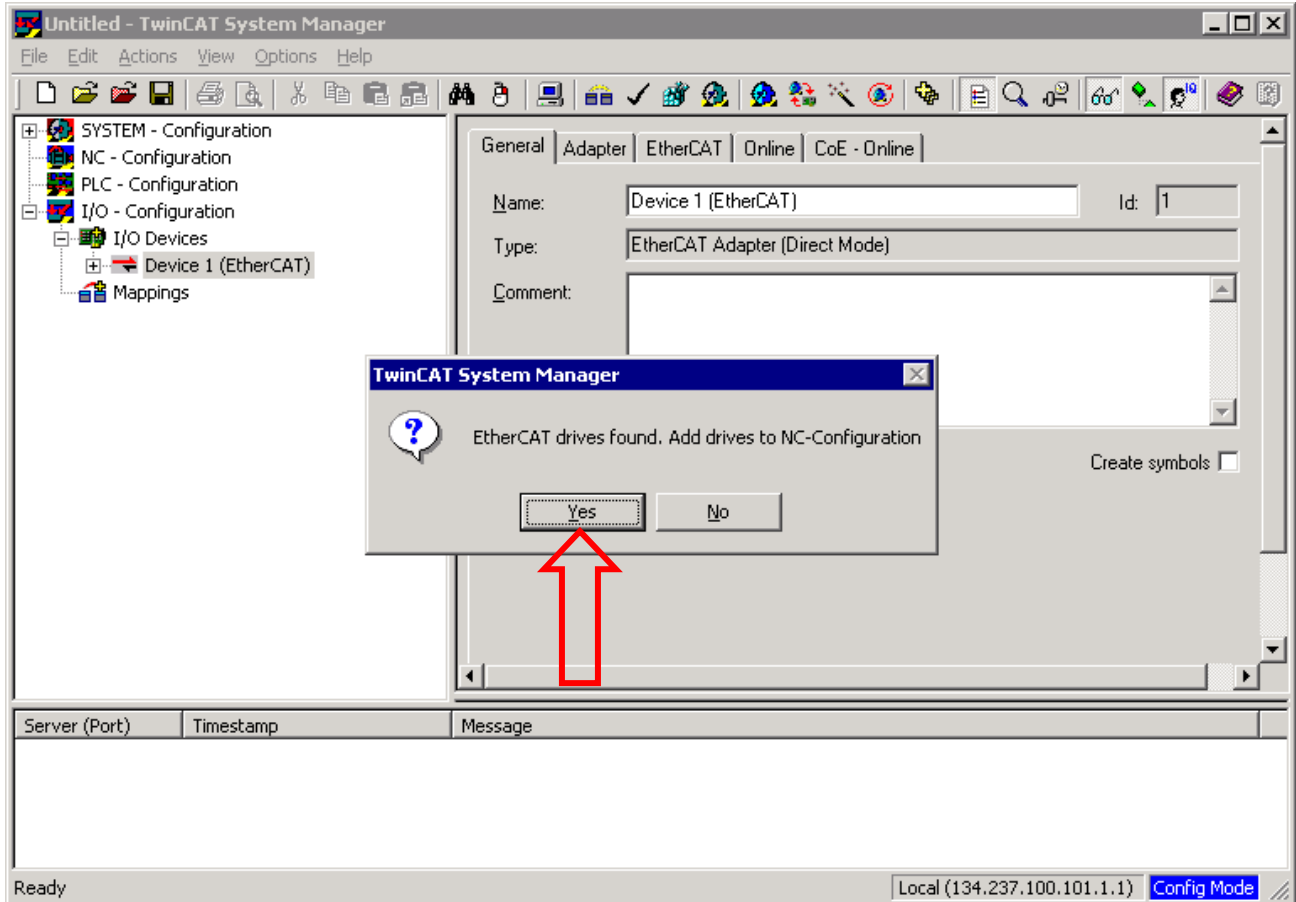


Product: Sigma-5 CANopen over EtherCAT

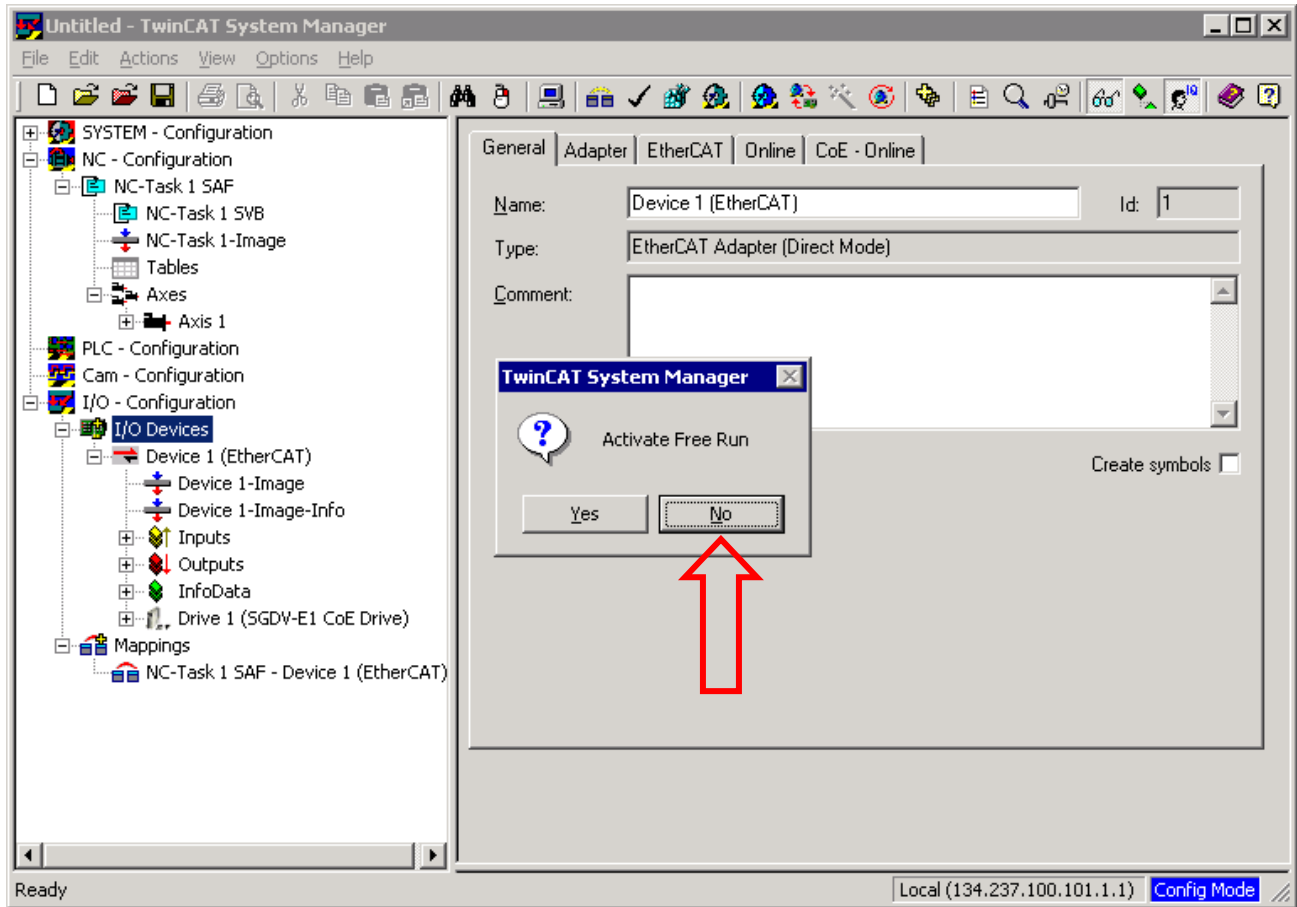
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- Click “Yes”
 - NC-Configuration is the “Numeric Control” function of TwinCAT.
 - This allows basic drive functions using the TwinCAT GUI like Jog.

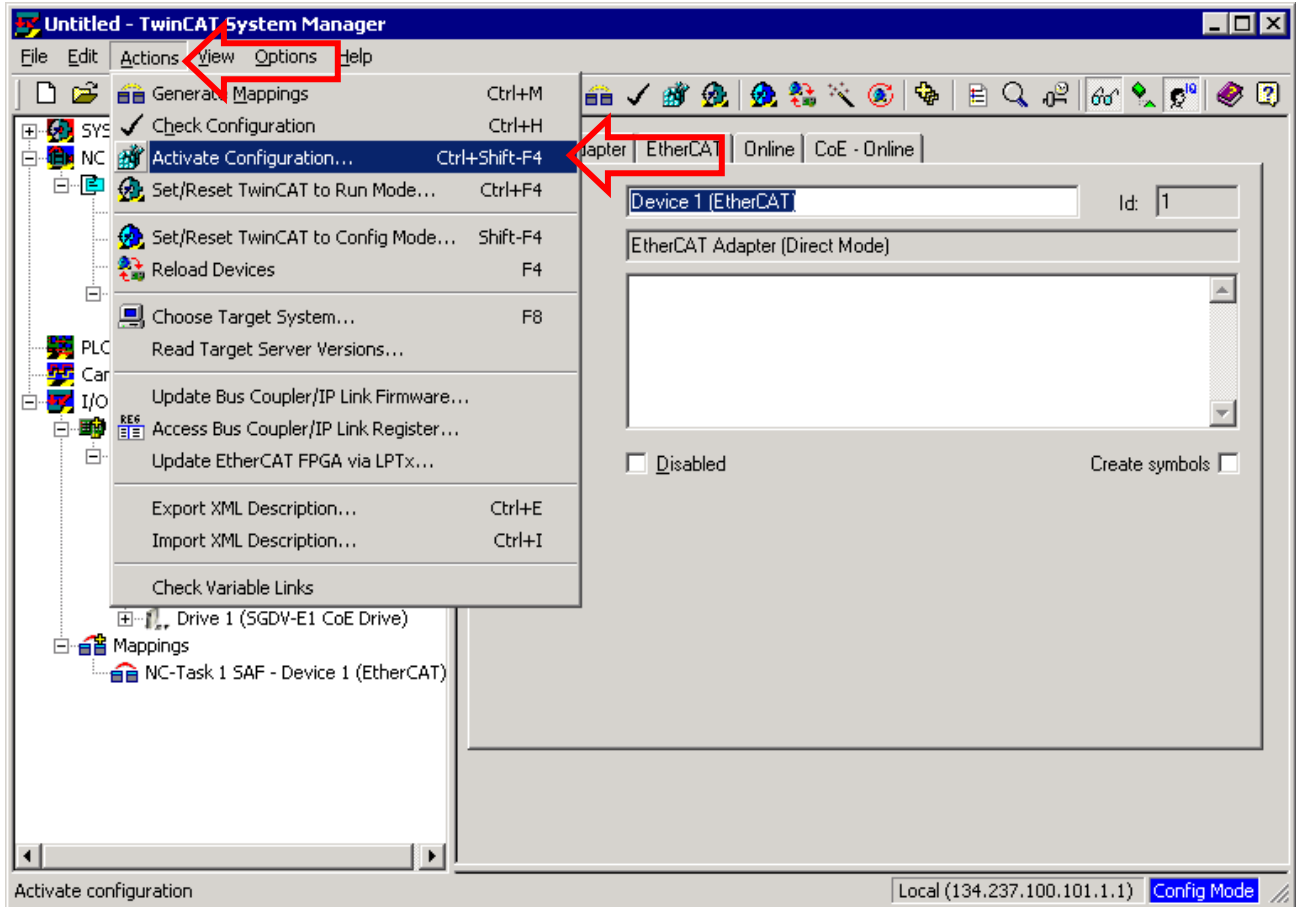


- Click “No”
 - Clicking “Yes” will not cause any problems, but the program performs additional unnecessary functions (delay occurs) for motion control.
 - Free Run is a mode that is used to control I/O, which is not necessary for motion control.

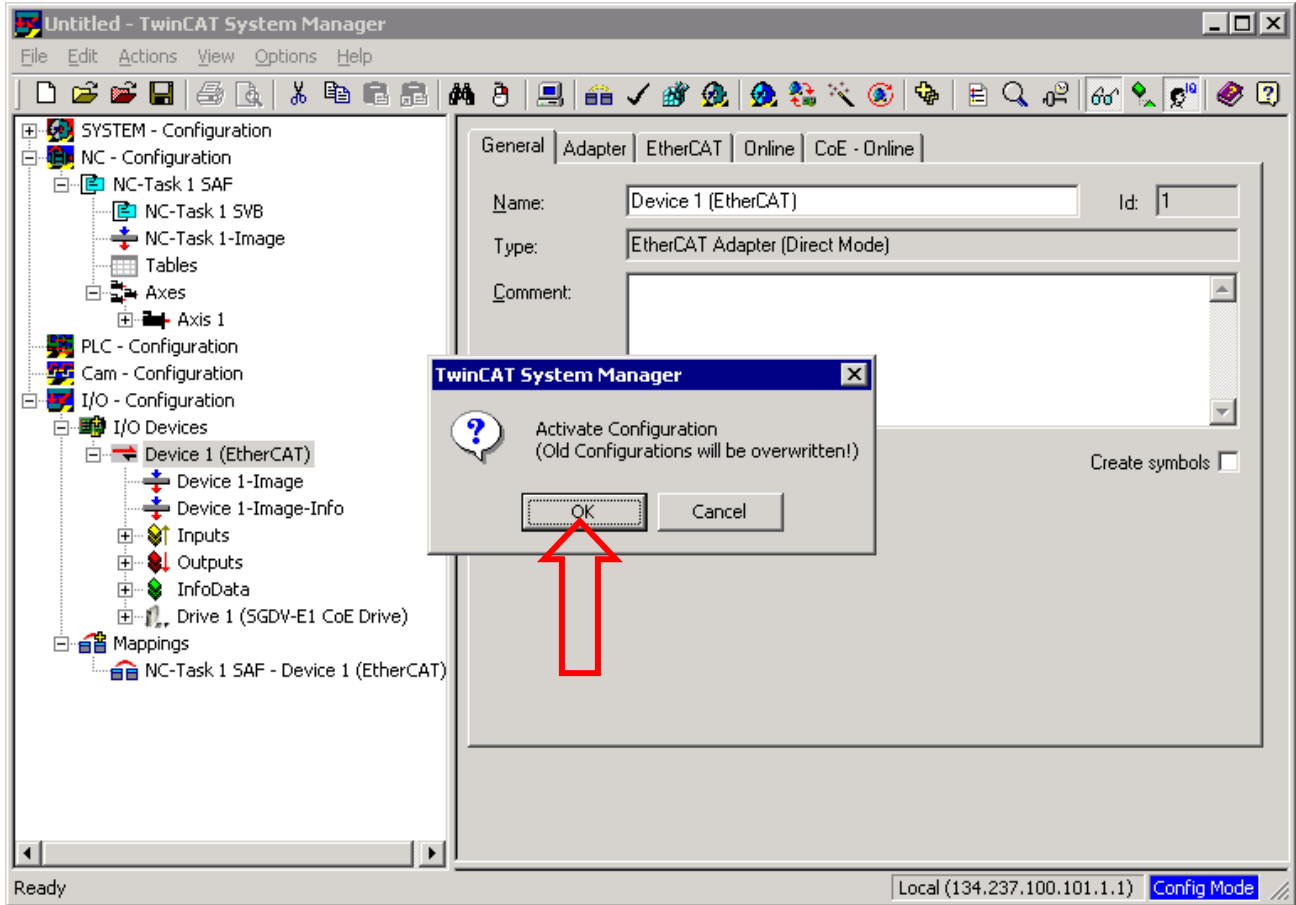


7.4. Start Communications

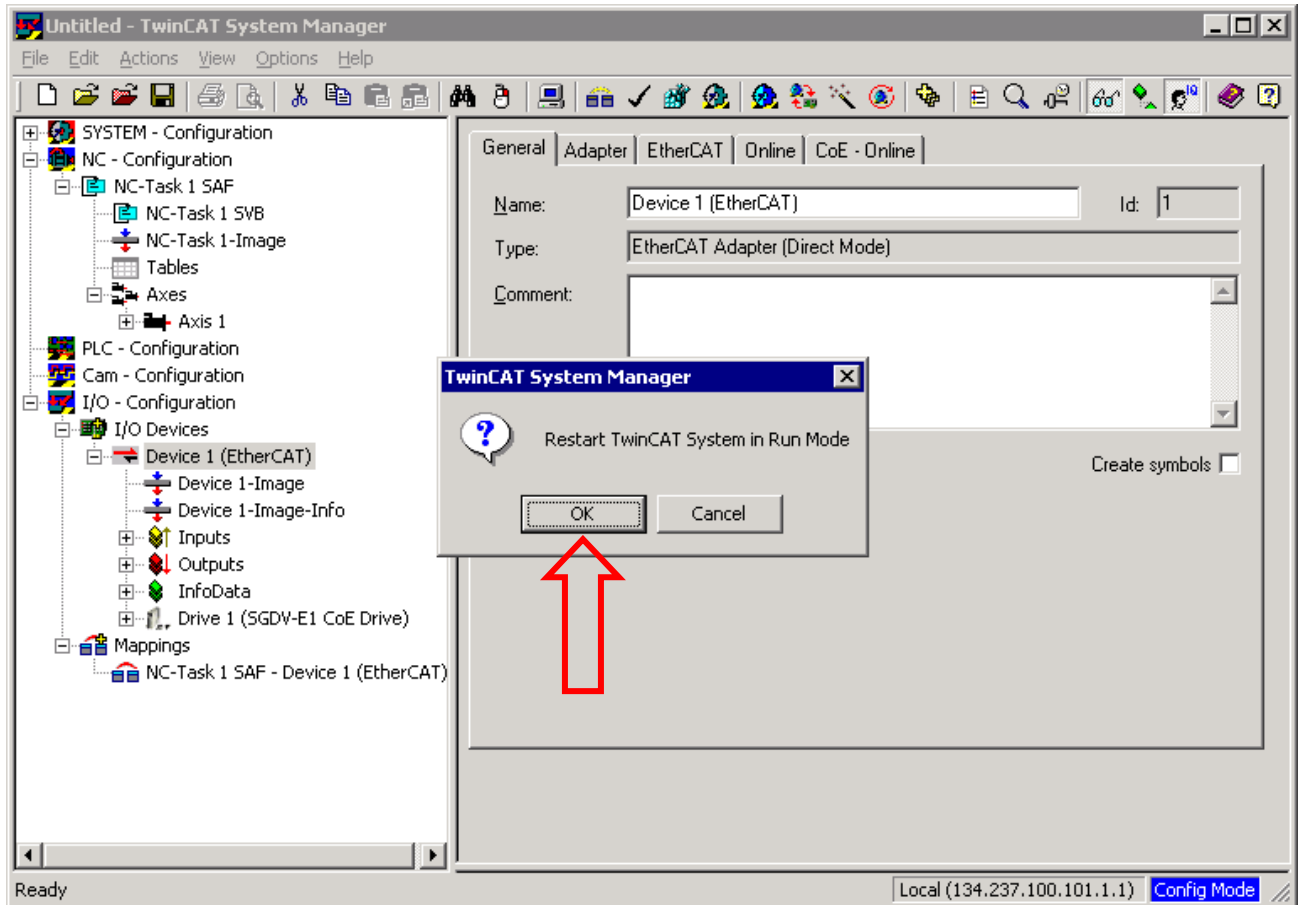
- From the Actions menu, select “Activate Configuration...”
 - This step must be performed every time after the configuration is modified.



- Click “OK”

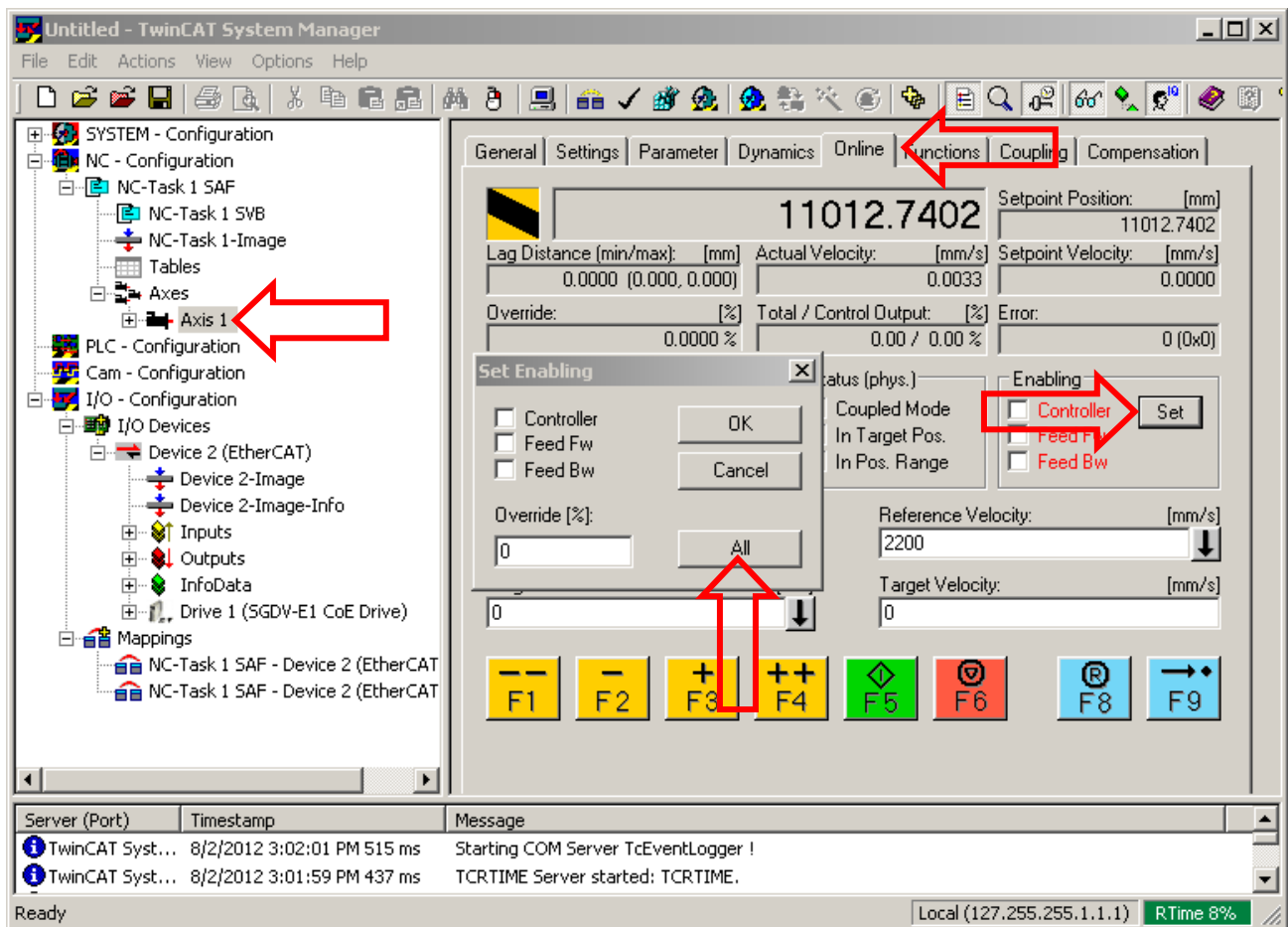


- Click “OK”
 - This will start the realtime communications.

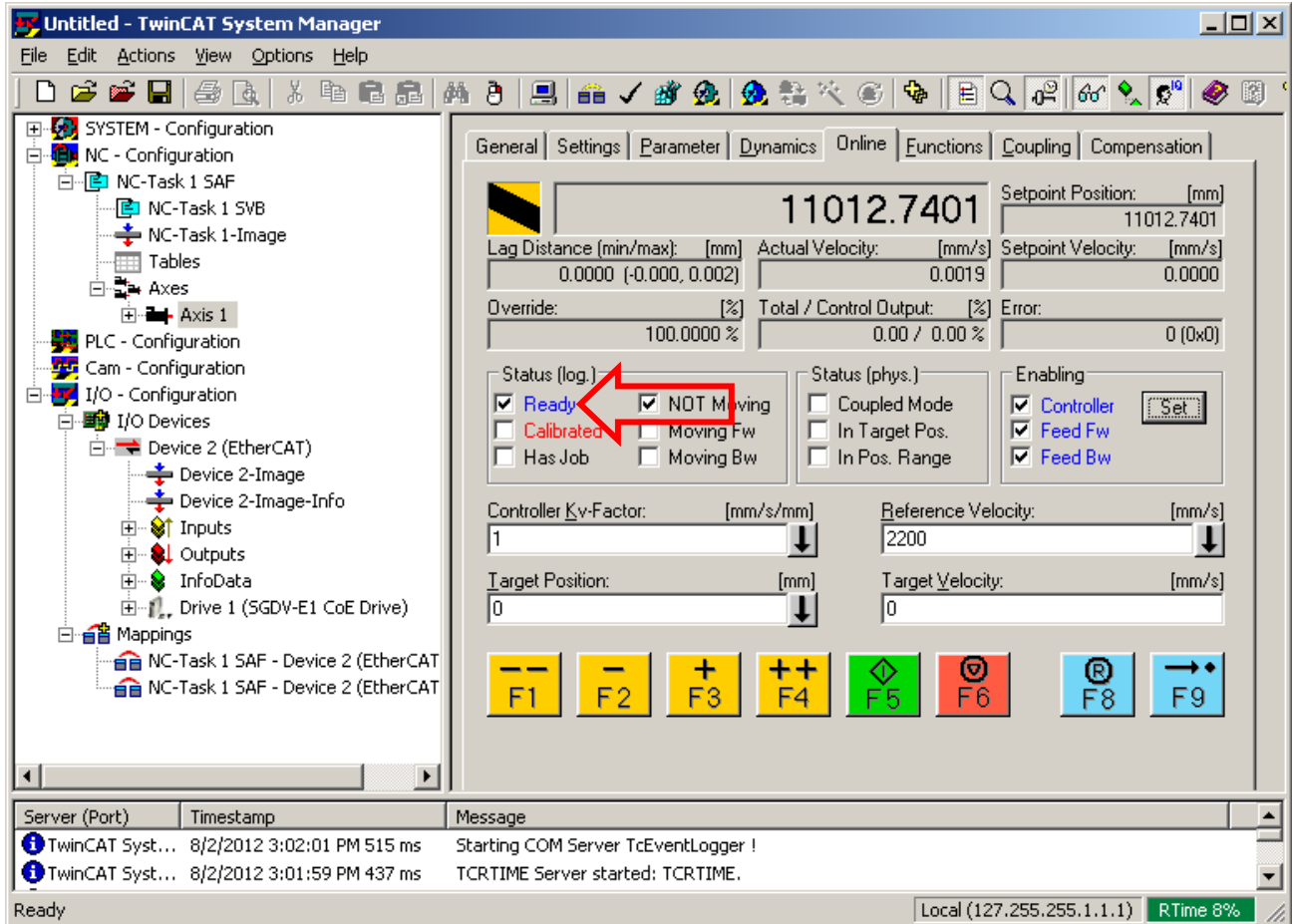


7.5. Test Motion

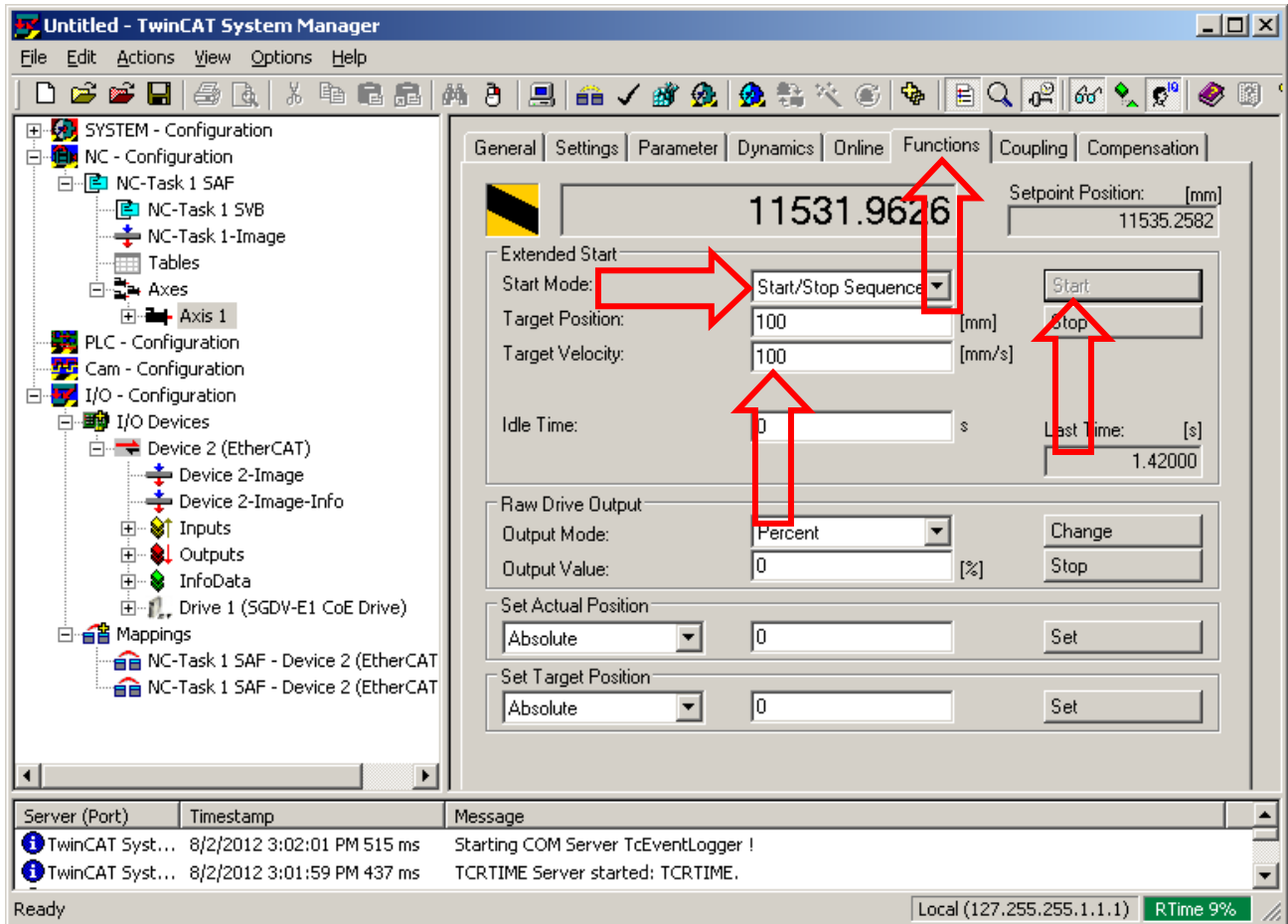
- In “NC – Configuration”, select “Axis 1”.
- Select the “Online” tab.
- Press the “Set” button.
- Press the “All” button.



- The “Ready” box will automatically change to a checked box, and the servo enables.

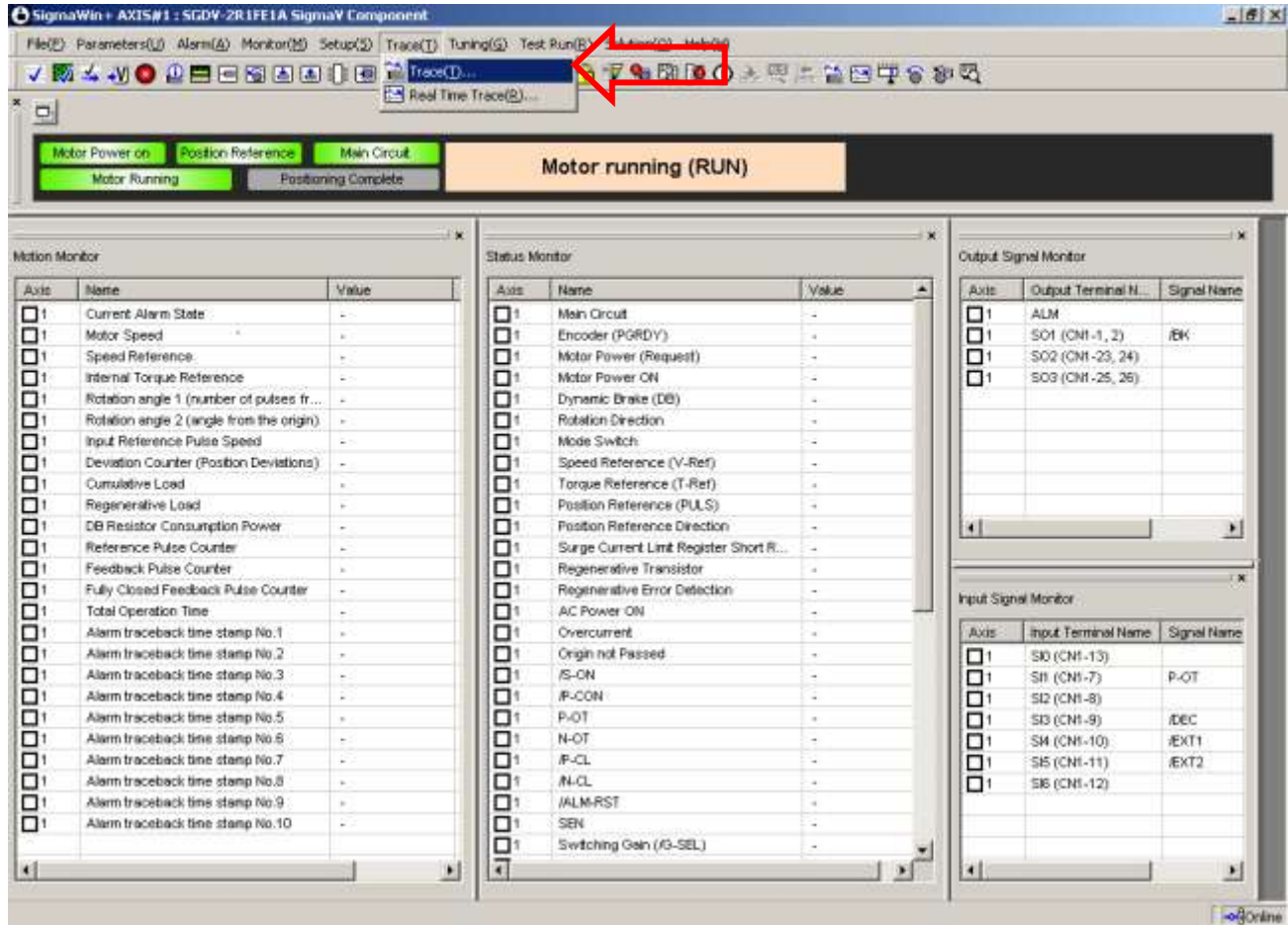


- Select the “Functions” tab.
- Select the “Start/Stop Sequence” Start Mode.
- Enter “100” for “Target Position” and “Target Velocity”.
- Press the “Start” button.
 - The motor will move, stop, repeat.



7.6. Verify Motion

- Connect to the Yaskawa Drive with SigmaWin
- Select “Trace(T)...” from the “Trace(T)” menu option



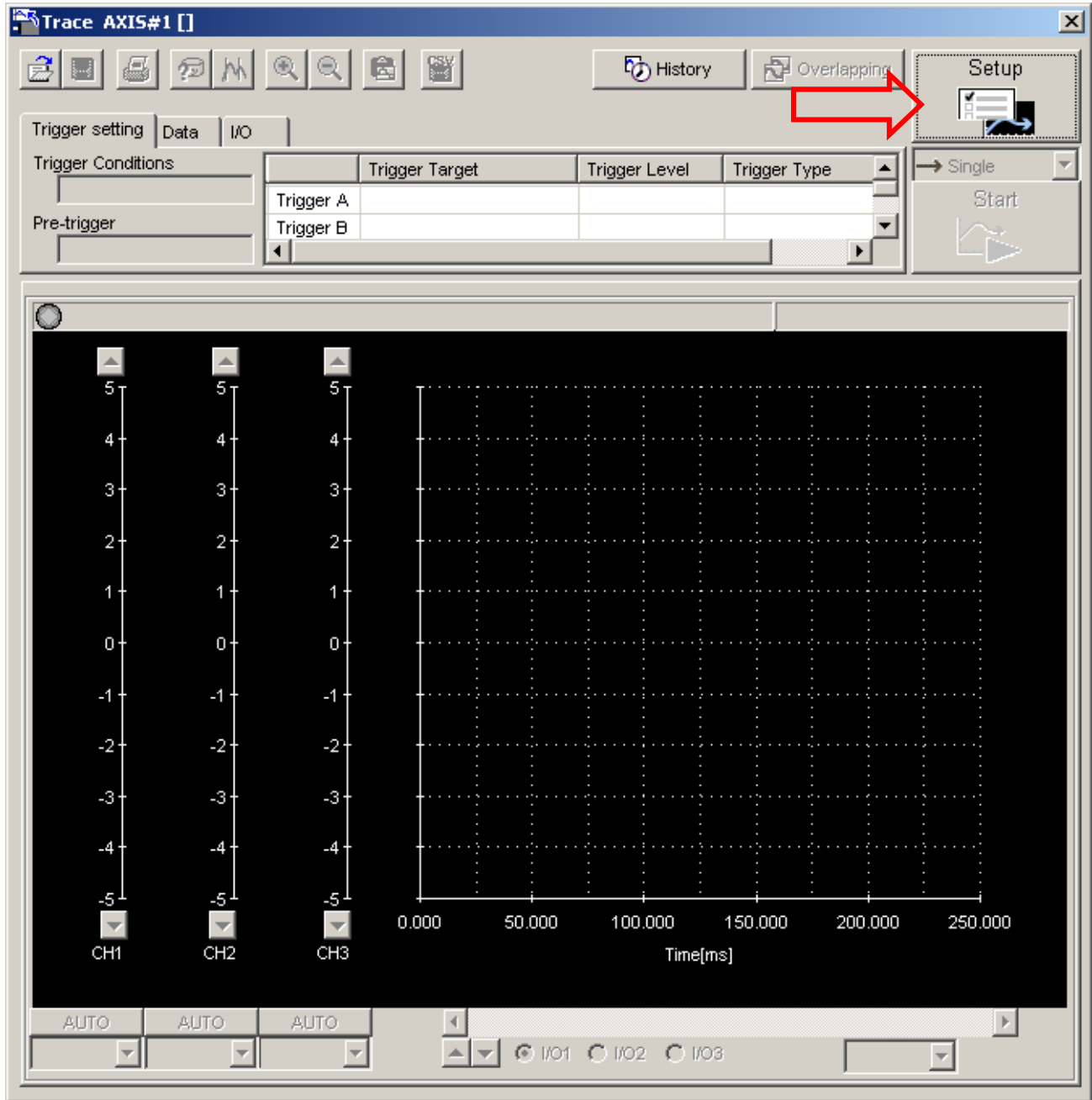


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- Press “Setup”



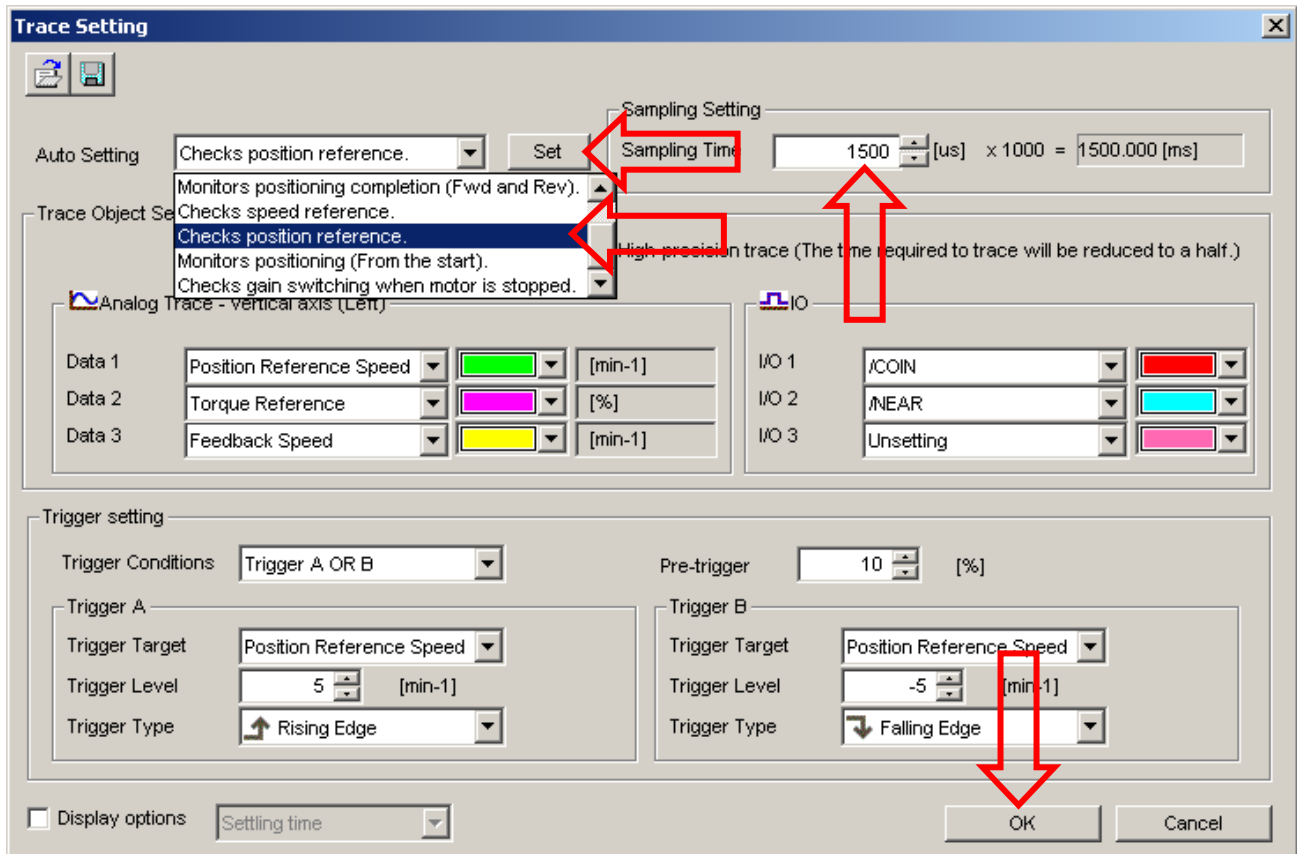


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- From the “Auto Setting” dropdown, select “Checks position reference.”
- Press the “Set” button.
- Change “Sampling Time” to 1500.
- Check other items as seen in the image below.
- Press “OK”.



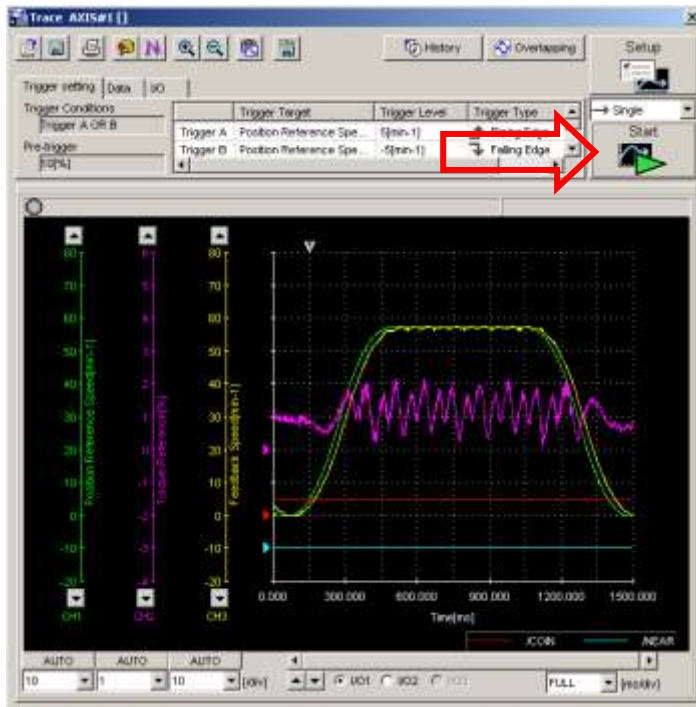


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- Press “Start”
- Wait for acquisition to complete.
 - If acquisition does not complete after 10 seconds, change trigger conditions.
- Check for “Position Reference Speed” (green line) is uniform.
 - “Position Reference Speed” is the difference between 2 position commands received by the Yaskawa Drive.
 - This will be updated every EtherCAT communication cycle.
 - Example: If EtherCAT communication cycle is 2ms, the Position Reference Speed will show new data every 2ms.
 - A discontinuity would appear as:
 - Position Reference Speed dropping from a non-zero value to zero for an EtherCAT communication cycle
 - Torque Reference spiking not related to accel/decel, for an EtherCAT communication cycle.
 - If discontinuities are apparent, see “Appendix Q: Discontinuities During Motion” for troubleshooting.





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7.7. Conclusion

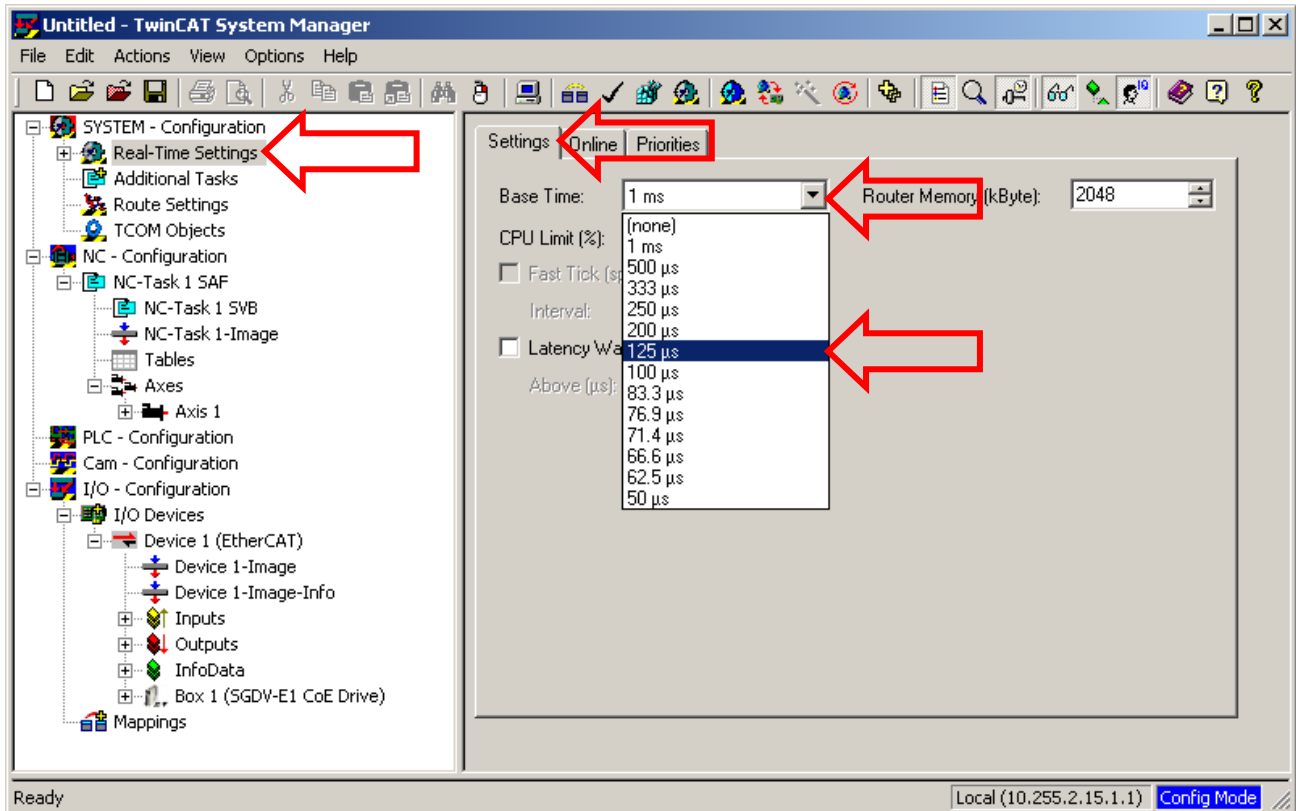
If interrupted motion is suspected due to audible noise, verify by capturing additional SigmaWin traces.

- If interrupted motion is captured, see “Appendix Q: Discontinuities During Motion” for troubleshooting.

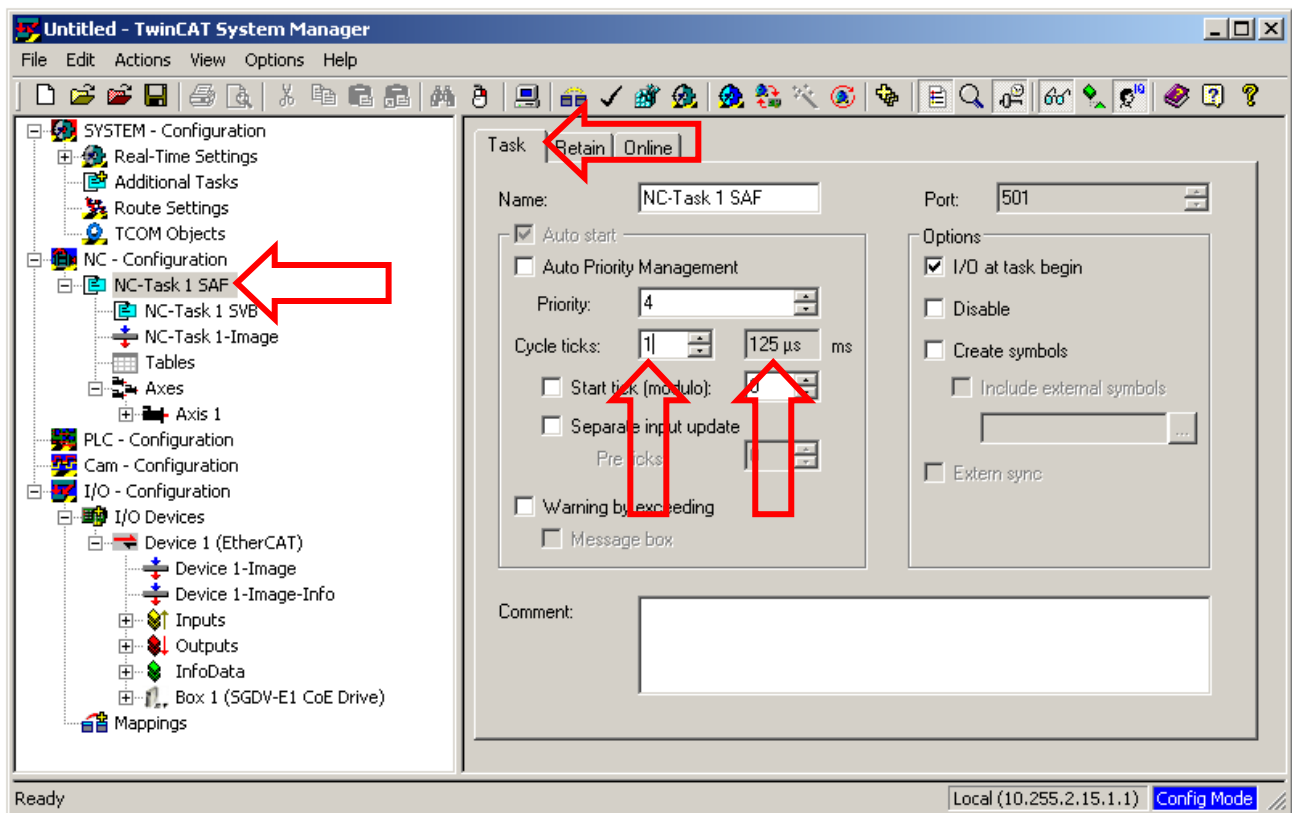
If discontinuities are not apparent in the SigmaWin trace, the setup of the Yaskawa Drive with Beckhoff TwinCAT is successful.

7.8. Additional Test Motion: Modified Cycle Time

- To change the EtherCAT communication cycle time:
 - Select “Real-Time Settings” under “SYSTEM – Configuration”
 - Select the “Settings” tab
 - Select the “Base Time” dropdown
 - Select “125 us”
 - Or select the fastest cycle time the device can operate



- Select “NC-Task 1 SAF”
- Select the “Task” tab
- Modify the “Cycle ticks:” such that the resulting value (box to the right of the Cycle ticks) is the desired test value.
 - The desired value must be a multiple of the “Base Time”.
 - If the desired value cannot be set, then modify the “Base Time”.



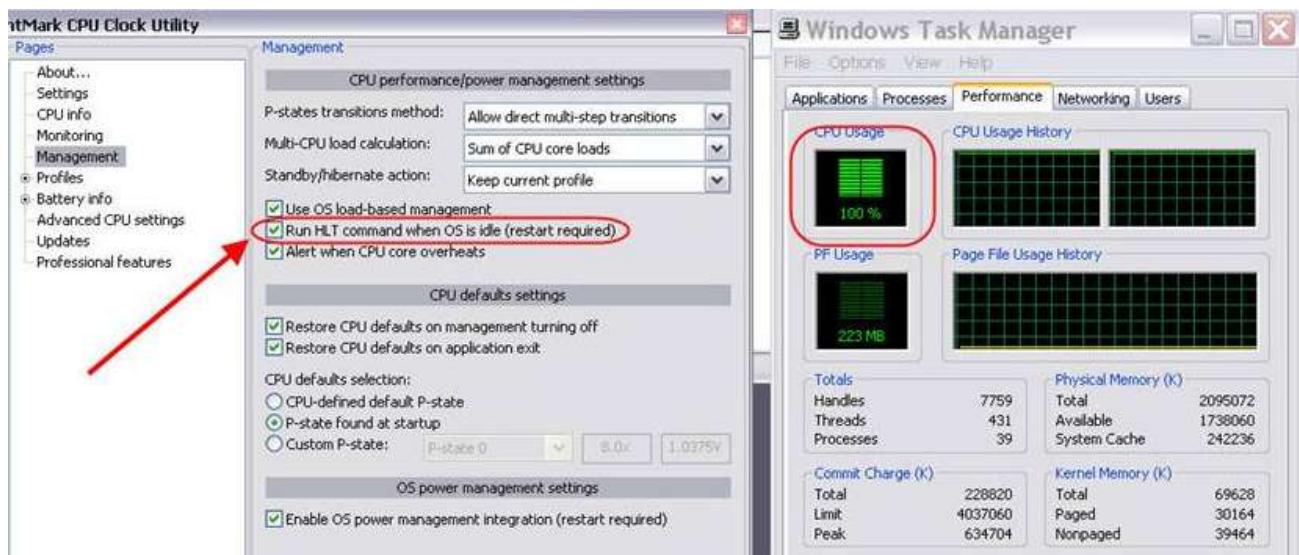
Appendix A: TwinCAT on Laptops

Laptops do not work well with TwinCAT due to:

- Power management
 - Laptops underclock the processor.
 - This can be disabled with the RightMark CPU Clock Utility
 - Non-Intel NIC
 - Intel NICs are less common on laptops
 - Higher hardware jitter than Desktop PCs
 - Causes issues with the real-time clock and Distributed Clocks
 - Causes missed frames

The RightMark CPU Clock Utility is described below

- Run “RightMark CPU Clock Utility”
 - <http://cpu.rightmark.org/download.shtml>
- Disable CPU clocking by selecting “Run HLT command when OS is idle (restart required)”.



- Restart the PC



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Appendix B: **TwinCAT Compatible NICs**

- TwinCAT typically functions properly on Intel NICs
- Without considering the Beckhoff Compatible NICs list, consider a trial operation as follows:
 - Complete the sections above, but when completing 4.3...
 - If the Ethernet Adapter appears under the “Compatible Devices”, then the NIC is compatible, and Beckhoff’s Compatible NICs list does not need to be considered.
 - Typically Intel NICs are compatible.
- Beckhoff Compatible NICs list:
 - http://infosys.beckhoff.com/english.php?content=content/1033/tcssystemmanager/reference/ethercat/html/ethercat_supnetworkcontroller.htm
- Alternatively: <http://infosys.beckhoff.com> > TwinCAT 2 > TwinCAT System Manager > Reference > I/O Devices > EtherCAT (Direct Mode) > Supported network controller
- Alternatively: Search Google for: **Supported Network Controller by Beckhoff Ethernet Driver**





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Appendix C: **TwinCAT 2 and TwinCAT 3**

Compatibility:

- All versions of Yaskawa EtherCAT drives operate with both TwinCAT 2 and TwinCAT 3.

Yaskawa's experience with TwinCAT 2 and TwinCAT 3 are below.

- Beckhoff does not necessarily disclose these differences.

Comparison:

- Licensing
 - TwinCAT 2: Has 30 days evaluation, then realtime will not start (will give error message)
 - There are at least 2 possible workarounds (choose either method):
 - Reinstall TwinCAT for another 30 days (Beckhoff tells users to do this)
 - Set clock back to within 30 days but not farther back or it will not work
 - TwinCAT 3: A code pops up and you type the same code into the box below the code to keep using the software as evaluation.
- TSM from 3 not able to open in 2.
 - If the file may be used on other PC's with TwinCAT, consider using TwinCAT 2 instead of TwinCAT 3.
- TwinCAT 2 is smaller file size, installs faster.
- TwinCAT 2 requires less processor power → better for lower end PCs.
- TwinCAT 2 may work for older OS's like Windows 2000, where TwinCAT 3 does not.
- TwinCAT 3 64-bit can run the Realtime mode, but TwinCAT 2 64-bit version cannot.
- Beckhoff has stopped implementing new features in TwinCAT 2.





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Appendix D: Yaskawa ESI Files

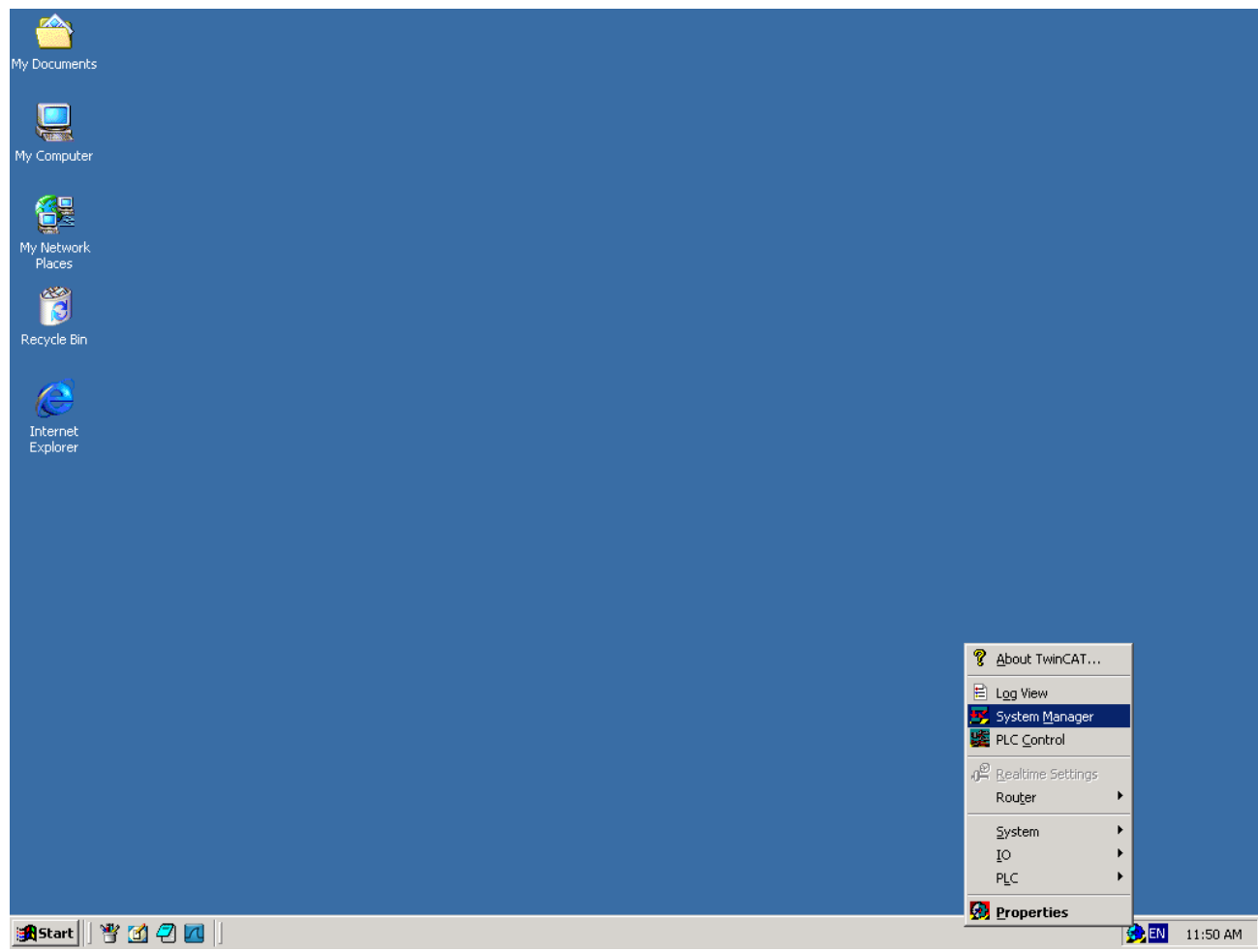
- The XML file (also known as ESI file) is available for download from Yaskawa.com.
 - For Sigma-5 SGD V, the Document number is: **Yaskawa_CoE_XML_Files** (use Search)
- ESI files can contain device descriptions of many different versions or one version.
 - Sigma-5 SGD V
 - **Yaskawa SGD V-E1_CoE rev5.00.xml & Yaskawa SGD V-E5_CoE rev5.00.xml** contain device descriptions for:
 - FW 1.00
 - FW 2.00
 - FW 3.01
 - FW 3.05
 - FW 4.00
 - FW 5.00
 - **Yaskawa_SGD V-E1_CoE_rev5.04.xml & Yaskawa_SGD V-E1_CoE_rev5.04.xml** contain the device description for:
 - FW 5.04



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Appendix E: TwinCAT Ethernet Adapter Setup

- Start TwinCAT System Manager
 - Right-click the TwinCAT icon in the Windows System Tray.
 - Select “System Manager”



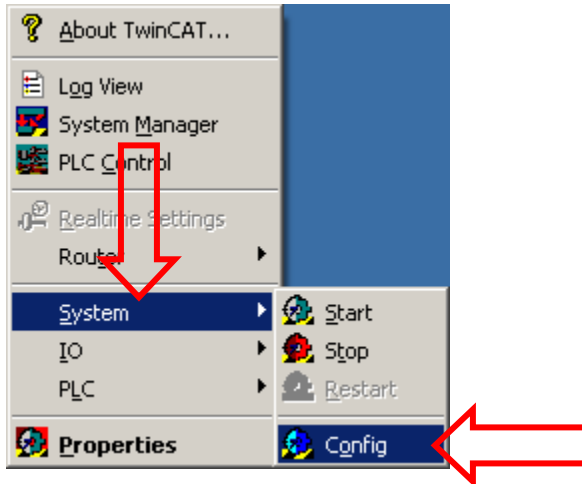


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- If the icon is not blue, change TwinCAT to Config mode:
 - Select “System”
 - Select “Config mode”

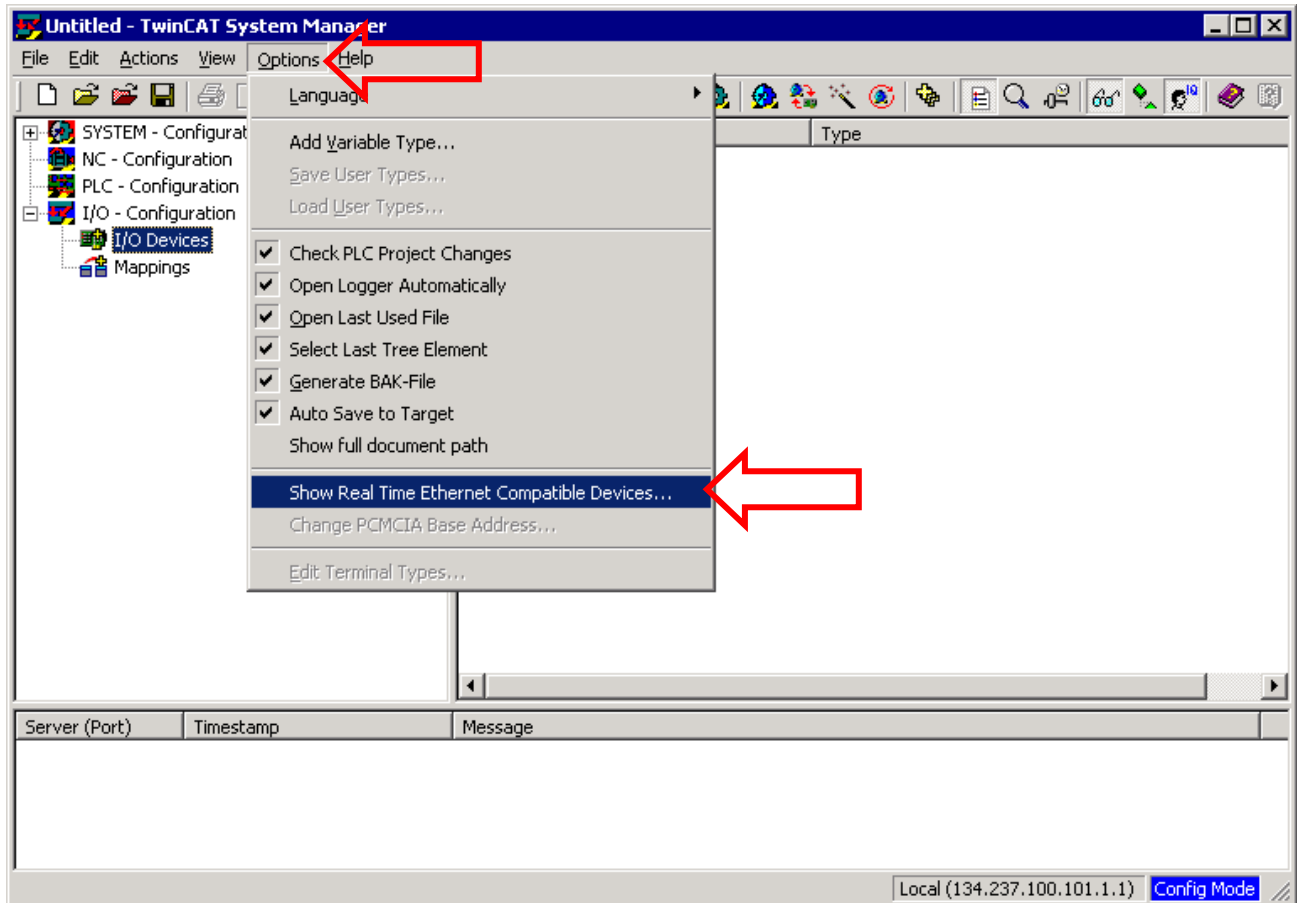


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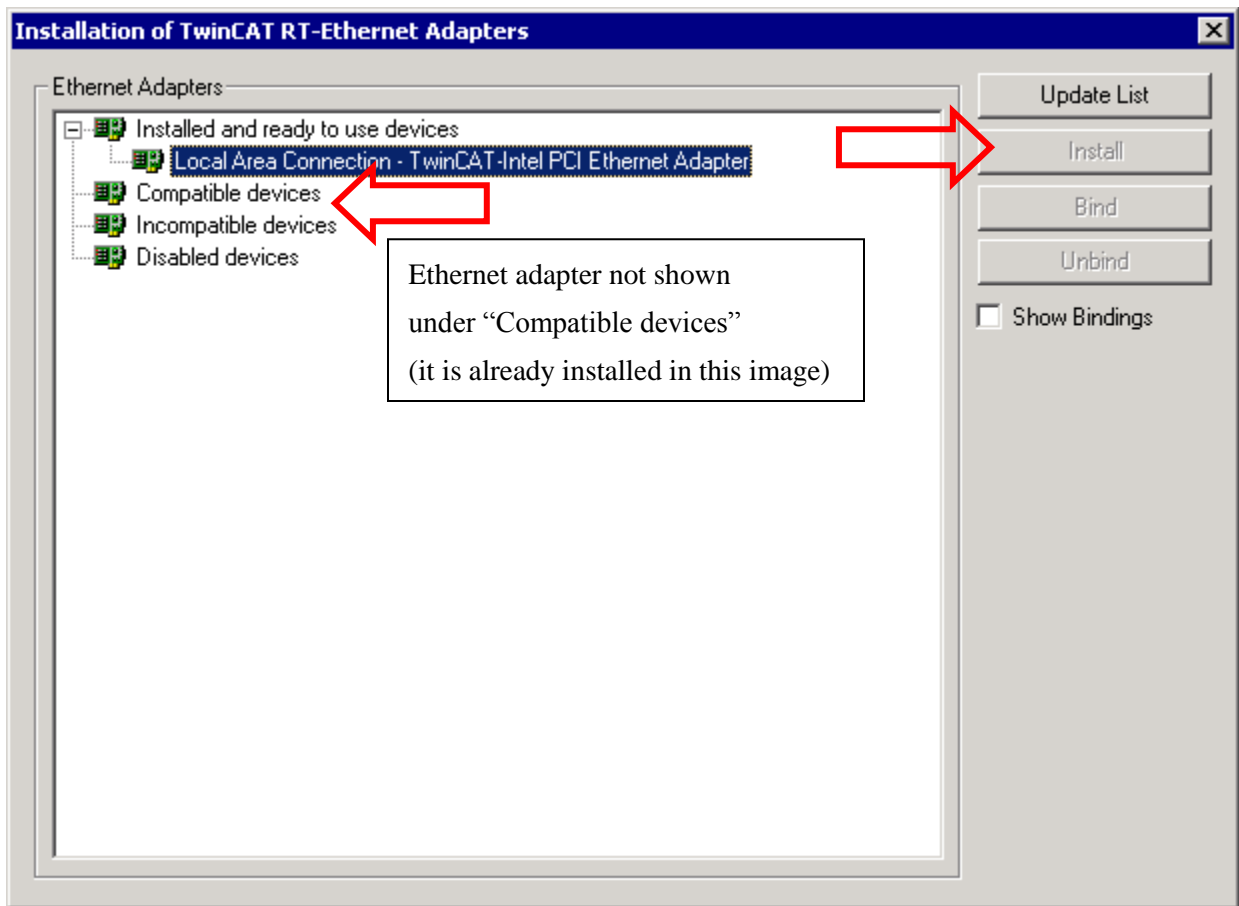
- Select “Options”
- Select “Show Real Time Ethernet Compatible Devices...”





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- Select the Ethernet adapter listed under “Compatible devices”
 - Incompatible devices may be selected, but likely results in undesired performance such as motion that is not smooth.
- Press the “Install” button.
 - When installation is complete, the Ethernet adapter will appear under “Installed and ready to use devices” as shown below.





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Appendix F: Reset Absolute Encoder Using a Digital Operator

The below information is found in:

- Σ-V Series User’s Manual Design and Maintenance Command Option Attachable Type
 - Yaskawa.com document number: SIEPS80000060
 - Section 4.5.4

4.5.4 Absolute Encoder Setup (Initialization)

 CAUTION
<ul style="list-style-type: none"> • The rotational data will be a value between -2 and +2 rotations when the absolute encoder setup is executed. The reference position of the machine system will change. Set the reference position of the host controller to the position after setup. If the machine is started without adjusting the position of the host controller, unexpected operation may cause injury or damage to the machine. Take sufficient care when operating the machine.

Setting up the absolute encoder is necessary in the following cases.

- When starting the machine for the first time
- When an encoder backup error (A.810) is generated
- When an encoder checksum error (A.820) is generated
- To set the absolute encoder rotational serial data to 0














Setup the absolute encoder with Fn008.

(1) Precautions on Setup

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- Setup the encoder when the servomotor power is OFF.
- The encoder backup error (A.810) and the encoder checksum error (A.820) cannot be reset by using the SERVOPACK alarm reset. Be sure to perform setup using Fn008.
- Any other alarms that monitor the inside of the encoder (A.8□□) should be canceled by turning OFF the power, then canceling the alarm.

(2) Procedure for Setup

Follow the steps below to setup the absolute encoder.

Step	Display after Operation	Keys	Description
1	<pre>BB --FUNCTION-- Fn008: AlmHlst Clr Fn008: Mturn Clr Fn009: Ref Adj Fn00A: Vel Adj</pre>	  	Press the  key and select Fn008.
2	<pre>BB Multiturn Clear PGCL1</pre>		Press the  key to view the execution display of Fn008. Note: If the display is not switched and "NO_OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the status and reset.
3	<pre>BB Multiturn Clear PGCL5</pre>	 	Keep pressing the  Key until "PGCL1" is changed to "PGCL5."
4	<pre>DONE Multiturn Clear PGCL5</pre>		Press the  Key to setup the absolute encoder. After completing the setup, "BB" in the status display changes to "DONE."
5	<pre>BB --FUNCTION-- Fn008: AlmHlst Clr Fn008: Mturn Clr Fn009: Ref Adj Fn00A: Vel Adj</pre>		Press the  Key to return to the display of the procedure 1.
6	Turn OFF the power and then turn it ON again to make the setting valid.		



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Appendix G: Reset Absolute Encoder Using SigmaWin+

The below information is in:

- SigmaWin+ Σ -V Component Online Manual
 - File name: SigmaWinFV.pdf
 - This is installed with SigmaWin+
 - Section 4.4.2

4.4.2 Setting the Absolute Encoder

■ Initializing the Absolute Encoder

 **WARNING**

The absolute encoder setup function resets the multi-turn counter and the encoder alarms for a connected serial absolute encoder.

If the absolute encoder's multi-turn counter is reset to zero, the previously defined mechanical system will change to a different coordinate system.

Operating the machine in this state is extremely dangerous. Failure to observe this warning may result in personal injury and/or damage to the machine. Be sure to reset the zero point for the mechanical system after the encoder has been successfully set up.

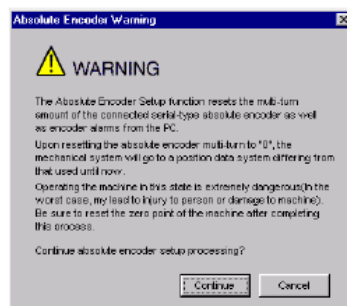
Set up the absolute encoder in the following cases:

- At initial machine startup
- When an "Encoder Backup Alarm" has occurred
- When the SERVOPACK power has been turned off, and the encoder cable removed.

The absolute encoder can only be set up while the servo is off. Turn the power back on after the encoder has been successfully set up.

Set up the absolute encoder using the following procedure.

1. In the SigmaWin+ Σ -V component main window, click **Setup**, point to **Set Absolute Encoder** and click **Reset Absolute Encoder**. A warning message appears confirming if you want to continue the processing.



Click **Cancel** to return to the main window without resetting the absolute encoder.



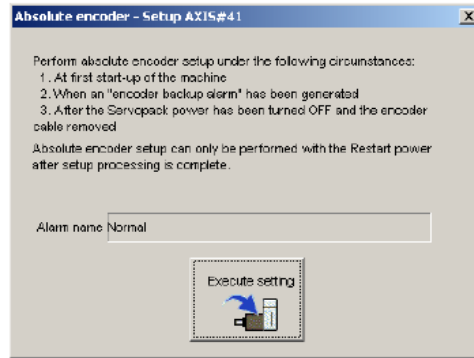


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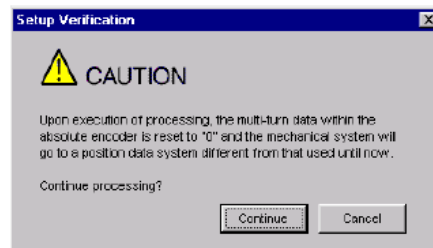
Title: Yaskawa CANopen over EtherCAT Servo Drives with TwinCAT

2. Click **Continue**, and the Absolute encoder Setup box appears.



The Alarm Name box displays the code and name of the alarm that is occurring now.

3. Click **Execute setting**, and a verification message appears confirming if you want to continue although the coordinate system will change.

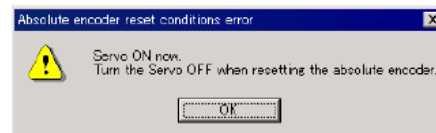


Click **Cancel** to return to the previous window without resetting the absolute encoder.

4. Click **Continue** to set up the encoder.

<If Setup is Unsuccessful>

If setting up is attempted with the servo ON, a reset conditions error occurs, and the processing is aborted.



Click **OK** to return to the main window.





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<If Setup Completes Normally>

If the encoder is set up successfully, a warning message will appear reminding you that the coordinate system has changed and must also be reset.



5. Click **OK** to return to the main window. Restart the servo, and perform an origin search for the upper-level controller.





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Appendix H: Reset Absolute Encoder Using CoE

The below information is in:

- Σ-V Series User’s Manual EtherCAT (CoE) Network Module

- Yaskawa.com document number: SIEPC72082904
- Section 8.5 Part (7)

(7) SERVOPACK Adjusting Command (2710h)

This object should be used for SERVOPACK adjusting services (e.g., Encoder setup, Multi-turn reset and so on). Writes the data into the Sub-Index 1 to start the command execution. Also, reads the Sub-Index 3 to accept the response. If the response is not available when reading Sub-Index 3, the first byte of the reply data could give information about the progress.

Index	Sub	Name	Data Type	Access	PDO Mapping	Value	EEPROM
2710h	0	Number of entries	USINT	RO	No	3	No
	1	Command	STRING [16]	RW	No	Byte 0 to n: Service Request Data A write access to the command data will execute the command	No
	2	Status	USINT	RO	No	0: last command completed, no errors, no reply 1: last command completed, no errors, reply there 2: last command completed, error, no reply 3: last command completed, error, reply there 255: command is executing	No
	3	Reply	STRING [16]	RO	No	Byte 0: as Subindex 2 Byte 1: unused 2 to n: Service Response Data	No

■ Command/Reply data format

Command data (Service Request data)	
Byte	Description
0	Reserved
1	Reserved
2	CCMD (Command code) 00: Read request 01: Write request
3	CSIZE (CDATA length in byte)
4 to 7	CADDRESS (Address)
8 to 15	CDATA (Writing data)

Reply data (Service Response data)	
Byte	Description
0	Status (As Subindex 2)
1	Reserved
2	RCMD (Echo back of CCMD)
3	RSIZE (R_DATA length in byte)
4 to 7	RADDRESS (Echo back of CADDRESS)
8 to 15	RDATA (Read data) /ERROCODE





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■ Executable Adjustments

Adjustment	Request Code	Preparation before execution	Processing Time	Execution Conditions
Absolute encoder reset	1008H	Required	5 s max.	When using an incremental encoder, impossible to reset the encoder while the servo is ON.
Automatic offset adjustment of motor current detection signals	100EH	None	5 s max.	Adjustment is disabled: <ul style="list-style-type: none"> • While the main circuit power supply is OFF • While the servo is ON • While the servomotor is running
Multiturn limit setting	1013H	Required	5 s max.	When using an incremental encoder, the setting is disabled unless A.CC0 (Multiturn limit disagreement) occurs.

■ How to Send an Command for Adjustment

1. Send the following data and set the request code of the adjustment to be executed.
 - CCMD = 0001H
 - CADDRESS = 2000H
 - CSIZE = 0002H
 - CDATA = Request code of the adjustment to be executed
 When the slave station receives the command normally, status field will be returned to 1.
 If an error occurs, carry out the operation in step 4 to abort execution.
2. For adjustment that requires a preparation process, send the following data.
 - If the preparation before execution is not required, carry out the operation in step 3.
 - CCMD = 0001H
 - CADDRESS = 2001H
 - CSIZE = 0002H
 - CDATA = 0002H
 When the slave station receives the command normally, status field will be returned to 1.
 If an error occurs, carry out the operation in step 4 to abort execution.
3. Send the following data to execute adjustment.
 - CCMD = 0001H
 - CADDRESS = 2001H
 - CSIZE = 0002H
 - CDATA = 0001H
 When the slave station receives the command normally, status field will be returned to 1.
 If an error occurs, carry out the operation in step 4 to abort execution.
4. Send the following data to abort the execution.
 - CCMD = 0001H
 - CADDRESS = 2000H
 - CSIZE = 0002H
 - CDATA = 0000H
 When the slave station receives the command normally, status field will be returned to 1.

Note: If no command can be received in 10 seconds after step1, adjustment operation will be automatically aborted.





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Appendix I: Disable Overtravels Using a Digital Operator

The information below contains resources to assist in changing Pn50A = 8xxx, and Pn50B = xxx8.

The below information is in multiple sources:

- Σ -V Series User's Manual Design and Maintenance Command Option Attachable Type
 - Yaskawa.com document number: SIEPS80000060
 - Section 4.2.3 Part (2)
- Σ -V Series User's Manual Operation of Digital Operator
 - Yaskawa.com document number: SIEPS80000055
 - Section 2.1.1 Part (1)

(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to enable or disable the overtravel function.

If the overtravel function is not used, no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.1□□□ [Factory setting]	Inputs the Forward Run Prohibited (P-OT) signal from CN1-7.	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation.		
Pn50B	n.□□□2 [Factory setting]	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-8.		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation.		

A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to 3.3.1 *Input Signal Allocations* for details.





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2.1.1 Parameter Setting

(1) Operation Example 1: Setting the Parameters for Selecting Functions

There are some parameters which require the setting of each digit such as Pn000 (function selection basic switch) and Pn001 (function selection application switch 1).







This example shows the operation procedure to set “1” (reverse rotation) for Pn000.0 (motor direction selection).

Step	Display after Operation	Keys	Operation
1	<pre> BB -PRM/MON- Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000 </pre>		Press the  Key to select the parameter/monitor mode.
2	<pre> BB -PRM/MON- Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000 </pre>	 	Press the  or  Key to move the cursor to “Un.”
3	<pre> BB -PRM/MON- Pn000= n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000 </pre>	 	Press the  or  Key to switch “Un” to “Pn.”





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Step	Display after Operation	Keys	Operation
4	<pre> BB - P R M / M O N - P n 0 0 0 = n.0 0 0 0 <u>0</u> U n 0 0 2 = 0 0 0 0 0 U n 0 0 8 = 0 0 0 0 0 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0 </pre>		Press the  Key to move the cursor to the setting side (to the position of the first digit of Pn000.0).
5	<pre> BB - P R M / M O N - P n 0 0 0 = n.0 0 0 0 <u>1</u> U n 0 0 2 = 0 0 0 0 0 U n 0 0 8 = 0 0 0 0 0 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0 </pre>		Press the  Key once to set “1” for the first digit of Pn.000.0.
6	<pre> A . 9 4 1 - P R M / M O N - P n 0 0 0 = n.0 0 0 0 <u>1</u> U n 0 0 2 = 0 0 0 0 0 U n 0 0 8 = 0 0 0 0 0 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0 </pre>		Press the  Key. The new setting of Pn000 is written to the SERVOPACK. The cursor moves to the parameter number side and the warning A.941 is displayed.
7	To enable the change in the setting, turn the power OFF and ON again.*		

* When the setting is modified, the parameters whose modified setting is validated only after setting validation, the warning A.941 “Change of Parameters Requires the Setting Validation” is displayed. Turn the power OFF then ON to clear the warning and validate the new setting.

Note: The drive must be reset (Digital Operator Fn030 or cycle power) for the settings in Pn50A and Pn50B to take effect.





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Appendix J: Disable Overtravels Using SigmaWin+

The information below contains resources to assist in changing Pn50A = 8xxx, and Pn50B = xxx8.

The below information is in multiple sources:

- Σ -V Series User's Manual Design and Maintenance Command Option Attachable Type
 - Yaskawa.com document number: SIEPS80000060
 - Section 4.2.3 Part (2)
- SigmaWin+ Σ -V Component Online Manual
 - File name: SigmaWinFV.pdf
 - This is installed with SigmaWin+
 - Section 4.1.2

(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to enable or disable the overtravel function.

If the overtravel function is not used, no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.1□□□ [Factory setting]	Inputs the Forward Run Prohibited (P-OT) signal from CN1-7.	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation.		
Pn50B	n.□□□2 [Factory setting]	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-8.		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation.		

A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to 3.3.1 *Input Signal Allocations* for details.





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4.1.2 Editing Parameters Online

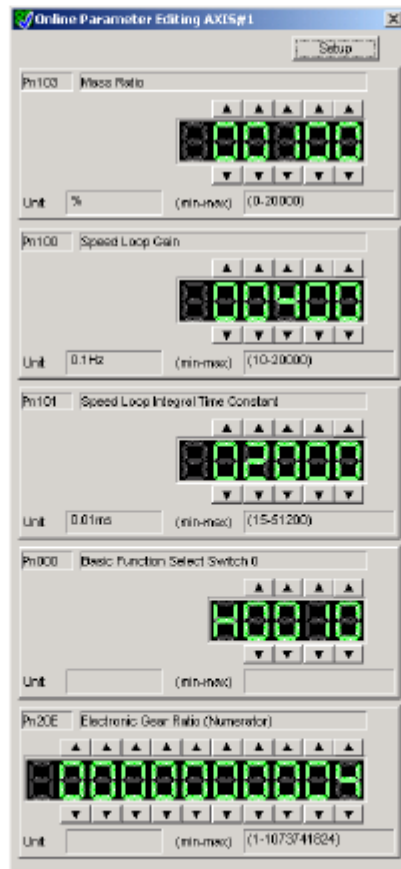
Parameters can be viewed or edited in the Online Parameter Editing window.

NOTE

- Values edited in the Online Parameter Editing box are also immediately changed in the SERVOPACK.
- If the power to the SERVOPACK is turned off or the communication between the SERVOPACK and the SigmaWin+ is interrupted while editing parameters online, the edited values will not be saved in the SERVOPACK.
- Safety Module parameters (Pcxx) cannot be set or edited in the Online Parameter Editing box.

Edit parameters online using the following procedure.

1. In the SigmaWin+ Σ -V component main window, click **Parameters** and then click **Edit Online Parameters**. The Online Parameter Editing box appears. The previously saved parameter settings will be displayed.



Online Parameter Editing Box



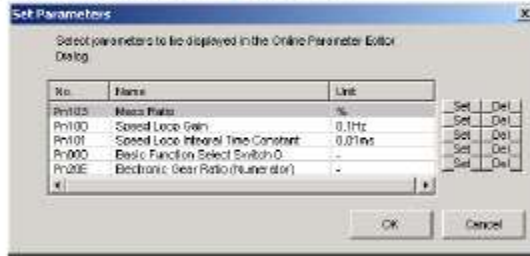


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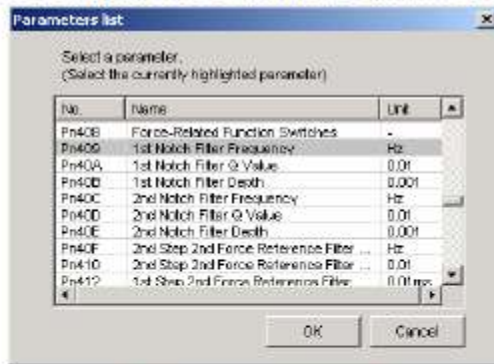
Doc#: ENG.09.126.MTN

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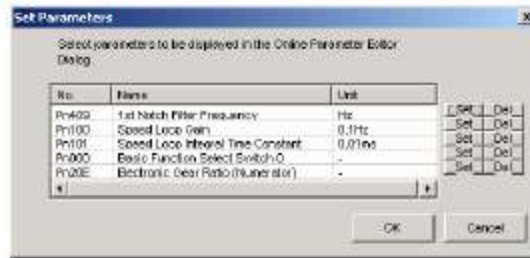
- To change the values of the settings, click the setting arrows to raise or lower the value. If an upper or lower limit is displayed, make sure that the setting is within the limit. Modified values are also immediately changed in the SERVOPACK. Click Setup to view different parameters.



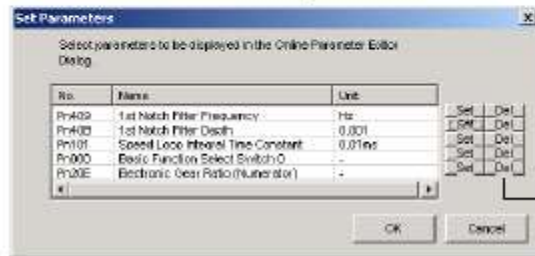
- Click Set to view a parameter other than the "Moment of Inertia Ratio."



- Select the parameter to be edited, and click OK.



- If there are still parameters to be edited, click Set for the parameter to be edited and set these in the same manner as the first parameter.



Deletes the parameter displayed at left.



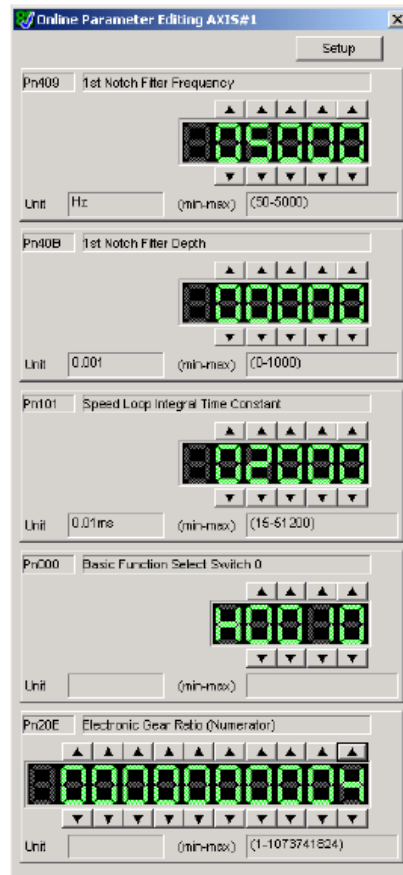
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To view other parameters, click **Del** to delete the currently displayed parameter and then click **Set**.

- Click **OK** when parameter setting is complete.



- To change the values of the settings, click the setting arrows to raise or lower the value. If an upper or lower limit is displayed, make sure that the setting is within the limit. Modified values are also immediately changed in the SERVOPACK.

Note: The drive must be reset (SigmaWin Software Reset or cycle power) for the settings in Pn50A and Pn50B to take effect.





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Appendix K: Disable Overtravels Using CoE

The information below contains resources to assist in changing Pn50A = 8xxx, and Pn50B = xxx8.

The below information is in multiple sources:

- Σ -V Series User's Manual Design and Maintenance Command Option Attachable Type
 - Yaskawa.com document number: SIEPS80000060
 - Section 4.2.3 Part (2)
- Σ -V Series User's Manual EtherCAT (CoE) Network Module
 - Yaskawa.com document number: SIEPC72082904
 - Section 8.5 Part (1)
 - Section 8.2 Part (5)
 - Section 8.5 Part (2)
- After setting objects 0x250A and 0x250B either option is possible:
 - Store the parameter change into EEPROM with object 0x1010, then either:
 - Cycle power for new settings to take effect
 - Set object 0x2700 = 1 for new settings to take effect
 - Set object 0x2700 = 1
 - Parameter change is not stored in EEPROM.



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(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to enable or disable the overtravel function.

If the overtravel function is not used, no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.1□□□ [Factory setting]	Inputs the Forward Run Prohibited (P-OT) signal from CN1-7.	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation.		
Pn50B	n.□□□2 [Factory setting]	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-8.		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation.		

A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to 3.3.1 *Input Signal Allocations* for details.

8.5 Manufacturer Specific Objects

(1) SERVOPACK Parameters (2000h-26FFh)

Object 2000h to 26FFh are mapped to SGD V SERVOPACK parameters (Pnxxx).

An object index 2xxxh is corresponding to a Pnxxx in SGD V SERVOPACK parameter. (e.g., Object 2100h is same as Pn100)





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(5) Store Parameters (1010h)

With this object, the setting value of parameters can be stored in the non-volatile memory.

Index	Sub	Name	Data Type	Access	PDO Mapping	Value	EEPROM
1010h	0	Largest subindex supported	USINT	RO	No	4	No
	1	Save all parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFFF (Default: 0x00000001)	No
	2	Save communication parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFFF (Default: 0x00000001)	No
	3	Save application parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFFF (Default: 0x00000001)	No
	4	Save manufacturer defined parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFFF (Default: 0x00000001)	No

By reading data of an object entry, the SERVOPACK provides its capability to save parameters.

Bit	Value	Meaning
1	0	The SGD V SERVOPACK does not save parameters autonomously
0	0	The SGD V SERVOPACK does not save parameters on command
	1	The SGD V SERVOPACK saves parameters on command

In order to avoid storage of parameters by mistake, storage is only executed when a specific signature is written to the appropriate sub-index. The signature that shall be written is “save.”

Signature	MSB			LSB
ASCII	e	v	a	s
hex	65h	76h	61h	73h

By writing “save” to Sub-Index 1, all parameters are stored.

By writing “save” to Sub-Index 2, the communication parameters (Object 1000h to 1FFFh) are stored.

By writing “save” to Sub-Index 3, the application parameters (Object 27xxh and 6xxxh) are stored.

By writing “save” to Sub-Index 4, the SERVOPACK parameters (Object 2000h to 26FFh) are stored

- Note 1. If a wrong signature is written, the SGD V SERVOPACK refuses to store and responds with Abort SDO Transfer.
 2. If the storing parameters are executing, 0 will be returned by read this object.
 3. Sub-Index 1 and Sub-Index 4 can be written only in Switch on Disabled state (Servo off state).
 4. After the storing parameters by Sub-Index 1 or Sub-Index 4, power on reset or executing the parameter configuration (Object 2700h) is necessary to transit into the Operation Enabled state.





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(2) User Parameter Configuration (2700h)

This object enables all User parameter settings, and initializes the all position values.

Before restarting operation without turning the power supply OFF and then ON again after having changed the following objects, this object must be executed to enable new settings.

- Object 2701h, 2702h and 2703h
- SERVOPACK parameters which need power on reset.

Index	Sub	Name	Data Type	Access	PDO Mapping	Value	EEPROM
2700h	0	User Parameter Configuration	UDINT	RW	No	0 to 0xFFFFFFFF (Default: 0)	No

■ Procedure

1. Change FSA state to “Switch on Disabled.”
2. Set new parameter setting value.
3. Set object 2700h to 1 for activating the “new” user settings.
When processing is completed, the value of object 2700h is reset to 0.





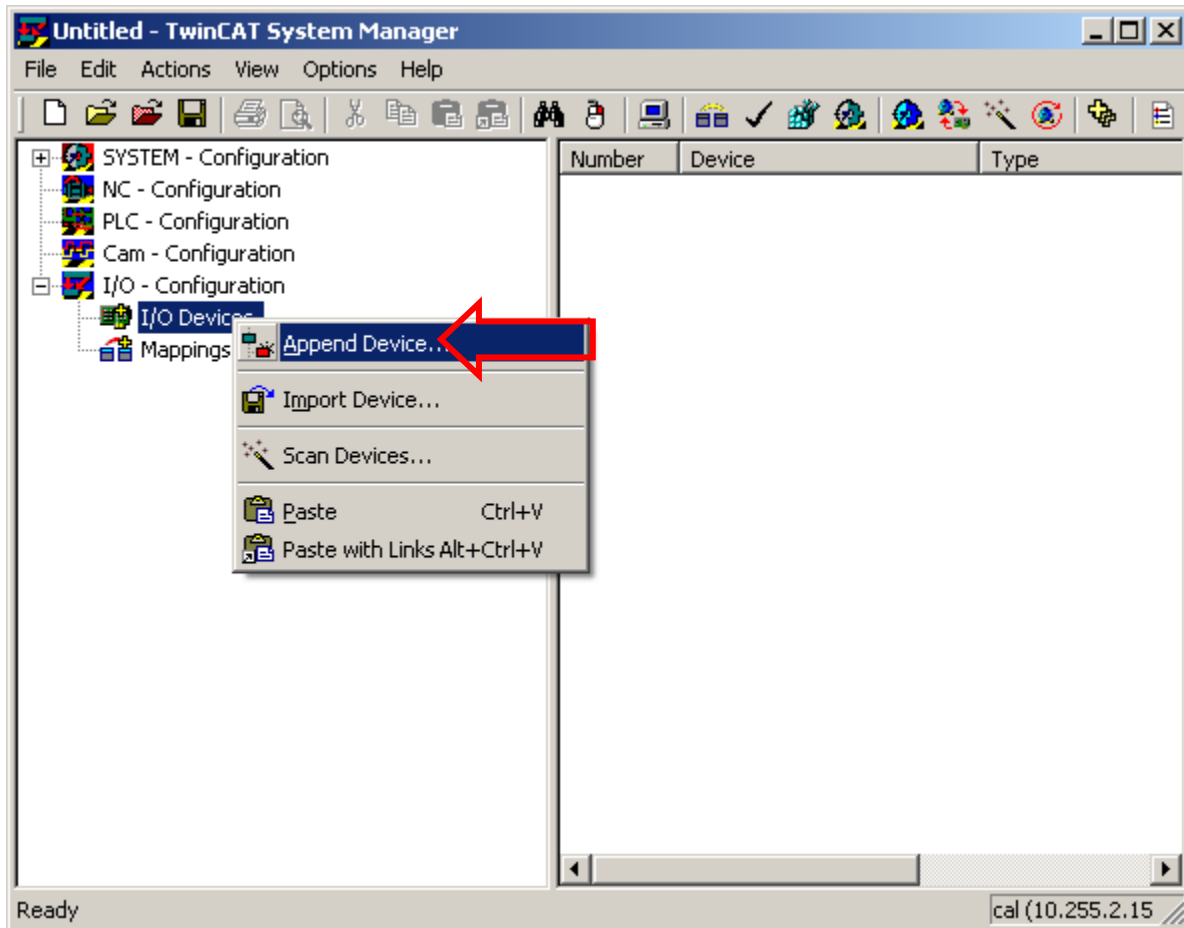
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Appendix L: Adding EtherCAT Adapter Manually

- In TwinCAT System Manager, right click “I/O Devices” under “I/O Configuration”.
- Select “Append Device...”



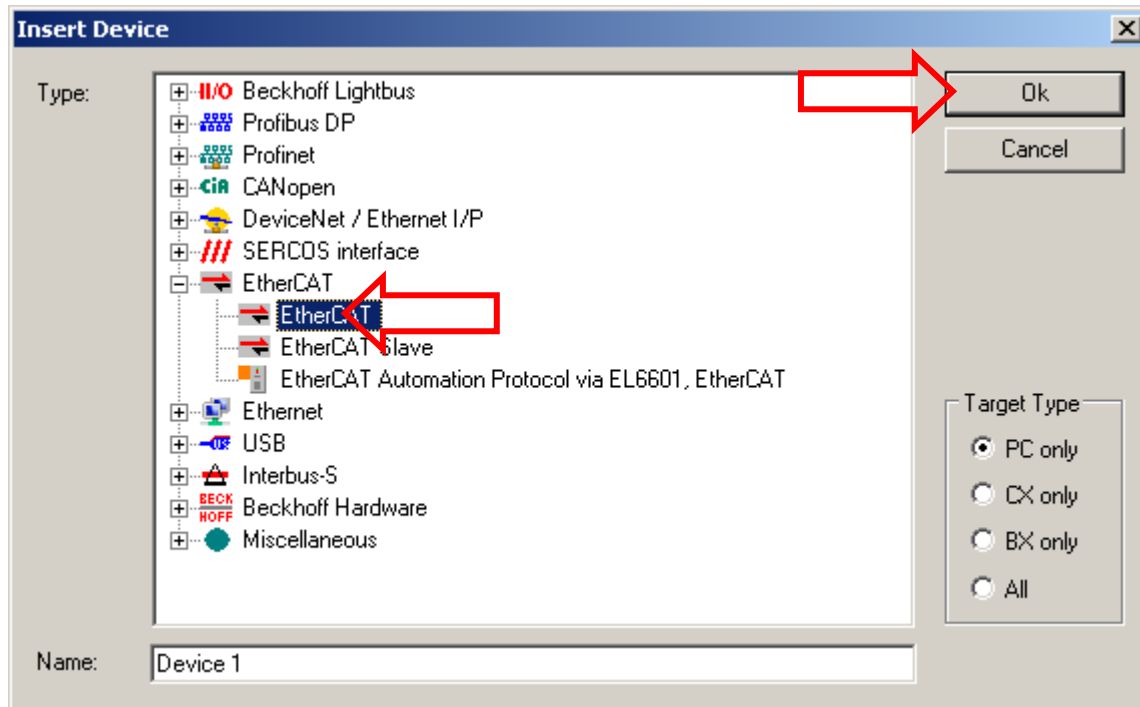


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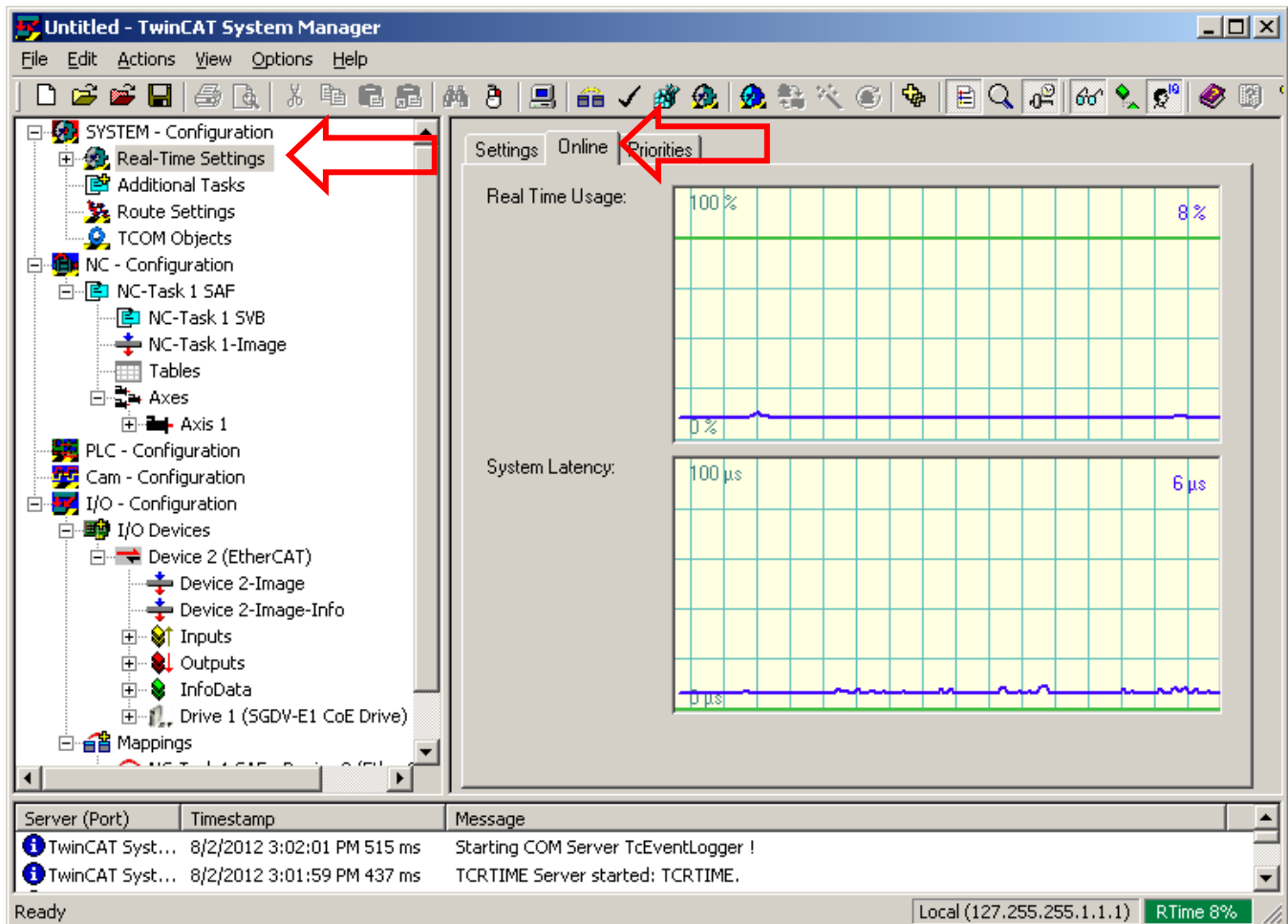
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- Select “EtherCAT” under the “EtherCAT” category.
- Press “Ok”.



Appendix M: TwinCAT Real Time Usage

- To determine if the IPC’s processor is insufficient, view the Real Time Usage in TwinCAT
 - Under “SYSTEM – Configuration”, select “Real-Time Settings”.
 - Select the “Online” tab.
 - Real Time Usage is displayed on the plot.
 - A Real Time Usage that exceeds 80% at any time indicates that the IPC’s CPU is insufficient.





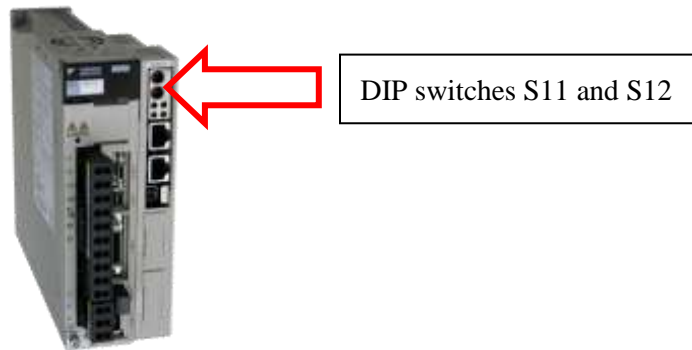
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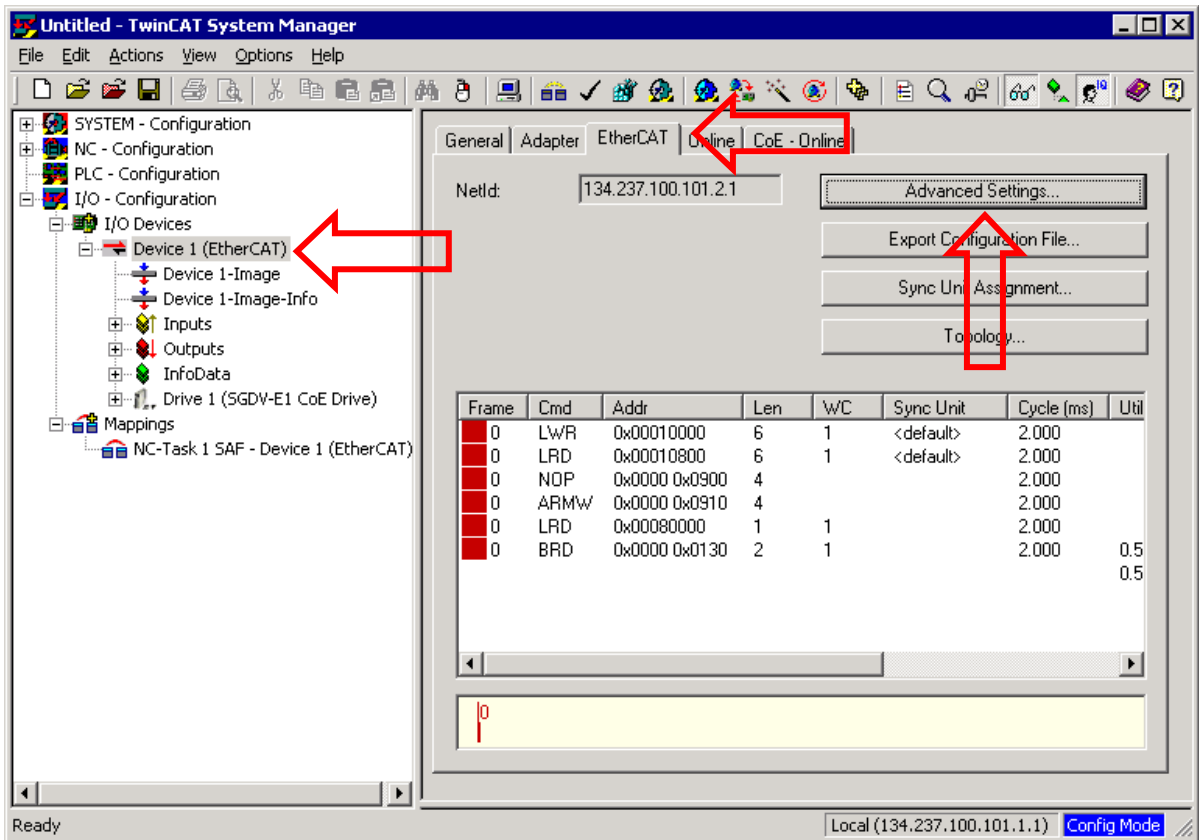
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Appendix N: Manual Axis Addressing

- Manual axis addressing is also known as:
 - Secondary Address
 - Station Alias
 - Explicit Device ID
- Masters may require manual axis addressing and do not perform automatic axis addressing.
- For SGDVs:
 - The hardware rotary DIP switches are labeled “S11” and “S12”
 - The DIP switches must be set to the desired station alias as follows:
 - Station Alias = (S11 setting) × 16 + (S12 setting)



- TwinCAT 3: Refer to TwinCAT documentation for setting TwinCAT 3 to use Secondary Address.
- TwinCAT 2:
 - Start TwinCAT System Manager in Admin mode
 - Contact Beckhoff to request details about running TwinCAT in Admin mode.
 - Select the EtherCAT device under “I/O – Configuration”
 - Select the “EtherCAT” tab
 - Press the “Advanced Settings...” button.



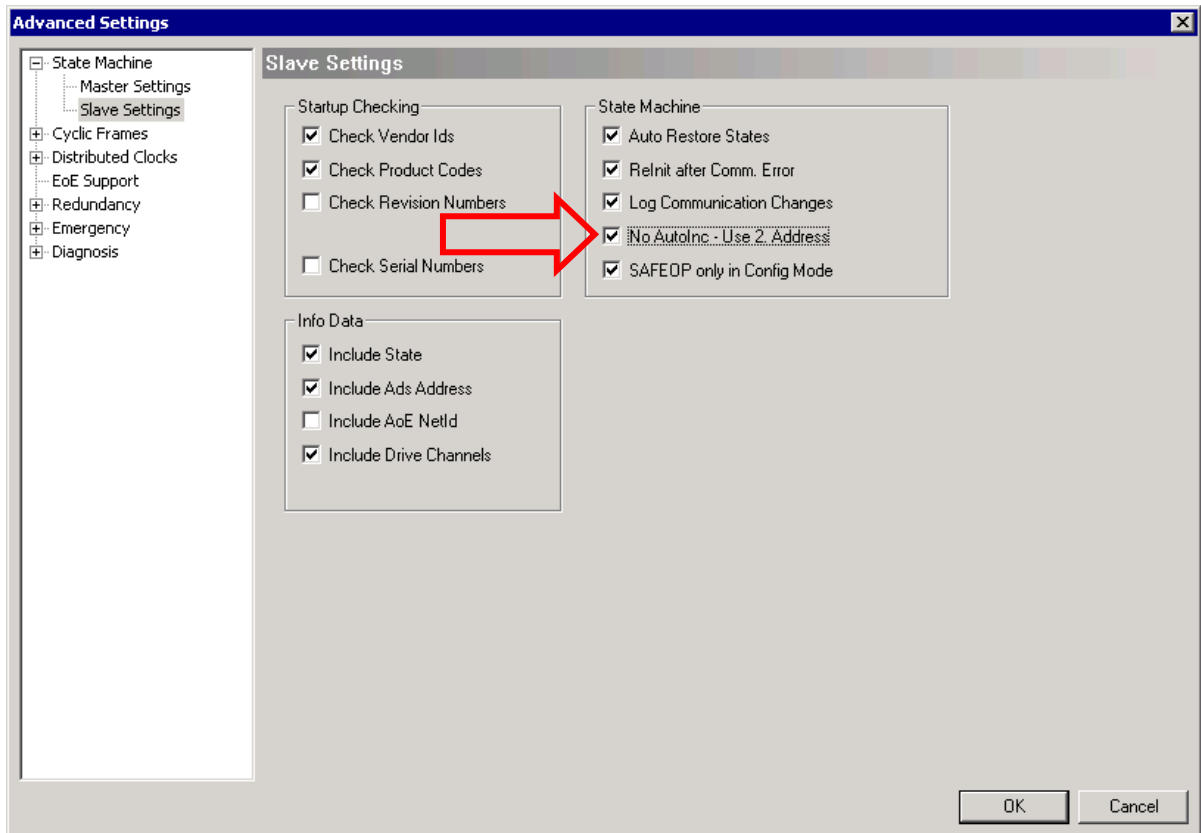


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- Select “Slave Settings” under “State Machine”
- Put a solid check mark in the checkbox next to “No AutoInc – Use 2. Address”
 - A grayed check mark (or marking other than a check or blank) indicates that the second address of the nodes on the network will be used if specified by the device. Otherwise, automatic addressing will be used.



- TwinCAT versions may require additional settings for the secondary addressing to be enabled
 - See TwinCAT documentation for complete details.





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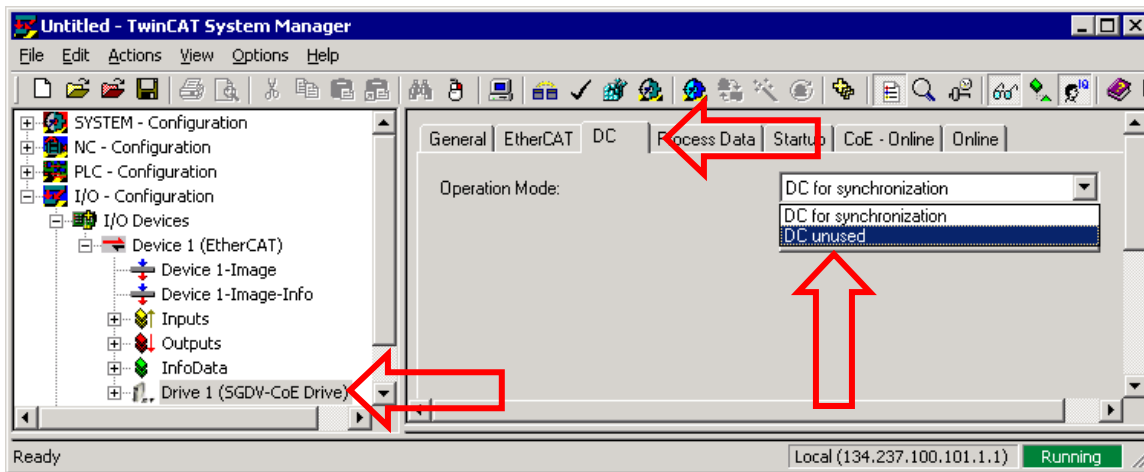
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Appendix O: Setting Distributed Clocks

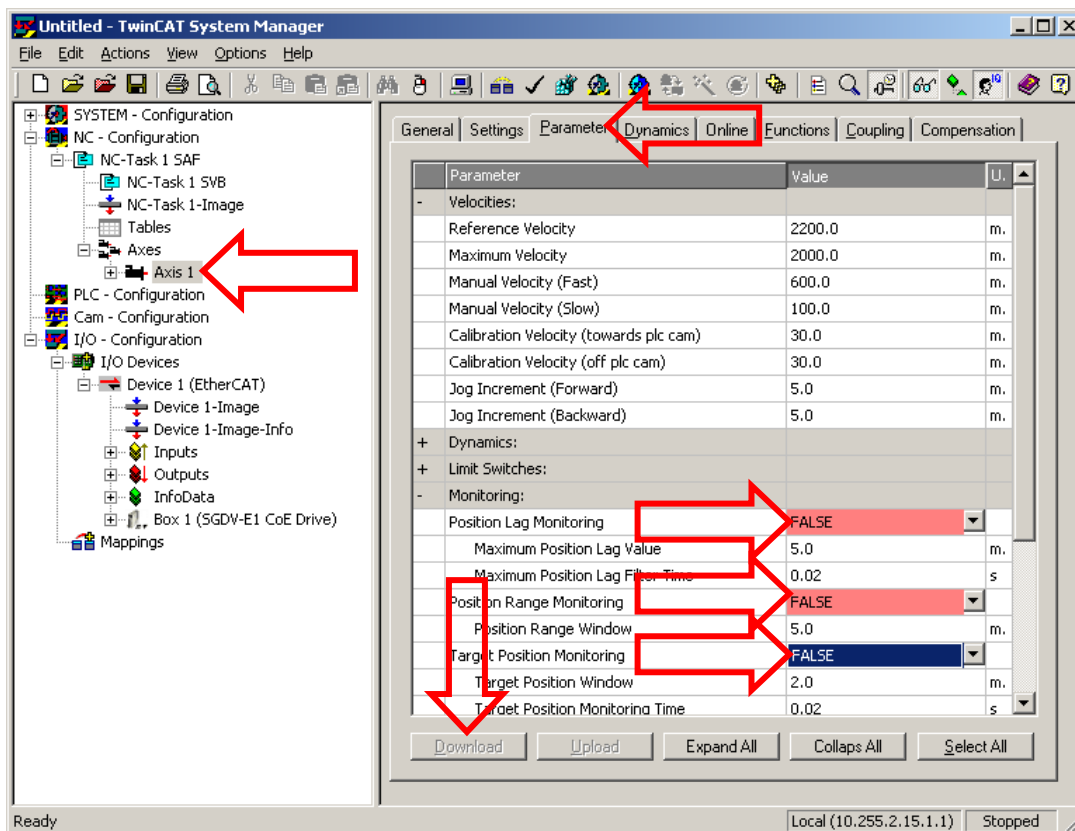
The settings for the Distributed Clock on the Yaskawa Drive can be modified.

- Select the Yaskawa Drive in TwinCAT System Manager
- Select the “DC” tab.
- Select the DC method from the “Operation Mode:” dropdown.
- For the Sigma-5 SGD V, the default setting is “DC for synchronization” (DC is enabled)

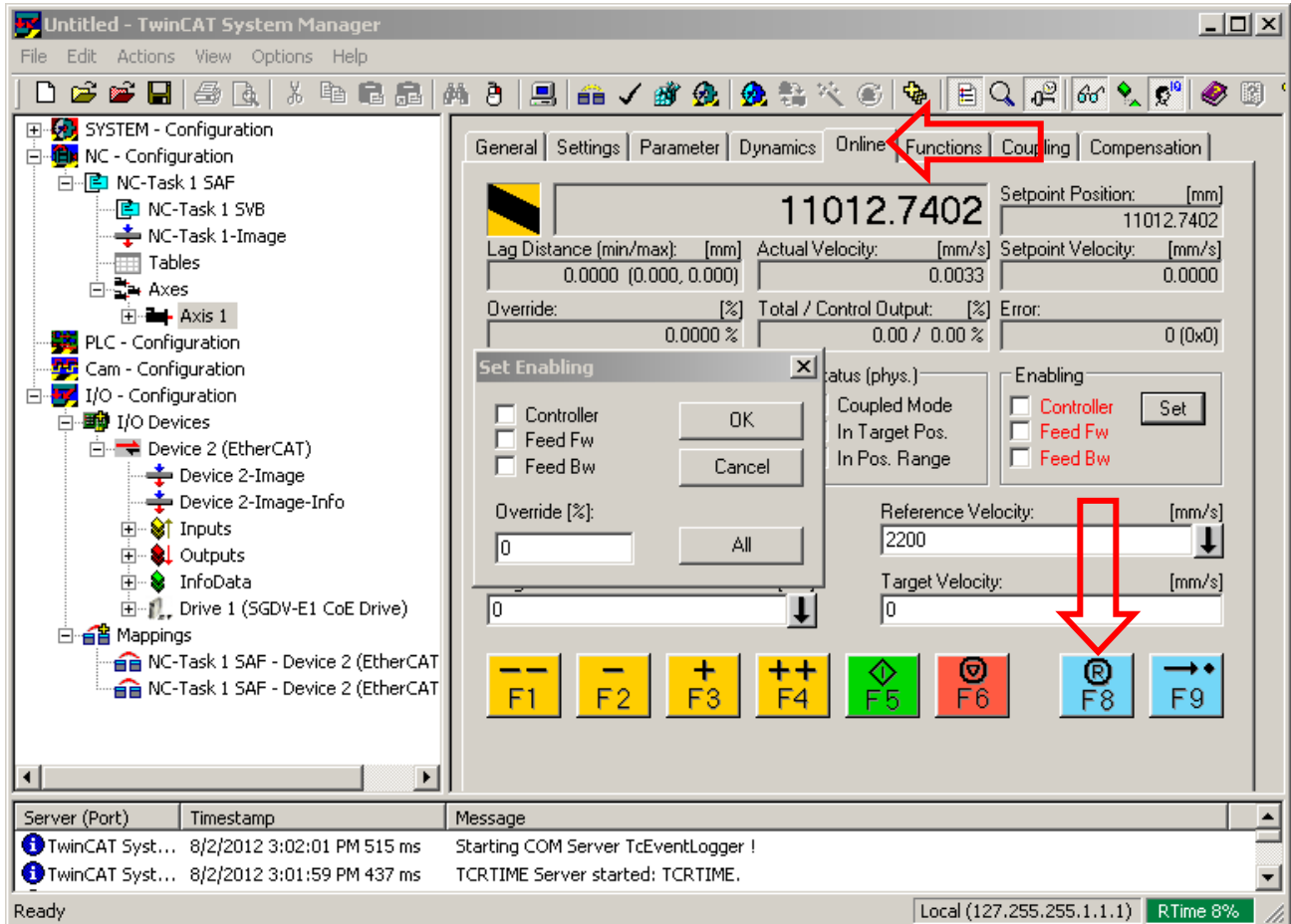


Appendix P: Disabling TwinCAT Position Monitoring

- TwinCAT’s default position monitoring is designed for low resolution encoders.
 - TwinCAT position errors occur during normal testing operation for Yaskawa drives
- Disable TwinCAT’s position monitoring for test operation.
 - Set TwinCAT into Run mode
 - Select “Axis 1” from the “NC – Configuration”
 - Select the “Parameter” tab
 - Select “False” from the dropdown menus for:
 - Position Lag Monitoring
 - Position Range Monitoring
 - Target Position Monitoring
 - Highlight each “False” selection (control-click the 3 items until they are highlighted)
 - Press the “Download” button



- Reset the error caused by position monitoring
 - Select the “Online” tab
 - Press the “F8” button





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Appendix Q: Discontinuities During Motion

If the following **Symptoms** are apparent, investigate the items in the “**Investigative Items**” list below.

Symptoms:

- Discontinuities are apparent during motion
- Alarm A.A11 or A.A12 occurs
- A TwinCAT error occurs

Investigative Items:

- Disable TwinCAT position monitoring
 - See “Appendix P: Disabling TwinCAT Position Monitoring”
- The NIC might be incompatible.
 - See “Appendix B: TwinCAT Compatible NICs”
- Try a different Ethernet port on the IPC.
- Try a different IPC.
- Check that Distributed Clocks are enabled.
 - See “Appendix O: Setting Distributed Clocks”
- Check for Shielded Ethernet cable used for communications.
- Check for Line Topology (remove any devices between Master and Slave).
- Check that SigmaWin or Digital Operator Jog function with no load is OK.
- Set EtherCAT cycle time to 2ms (TwinCAT SAF timing default).
 - See “7.8 Additional Test Motion: Modified Cycle Time” for details on how to set cycle time.
- Increase Task priority in TwinCAT.
- Try using 3 meter to 10 meter Shielded Ethernet cable.
- Try using latest firmware for EtherCAT slave.
- Check that the cable is plugged into the IN port of the slave.
- When importing a project, the Ethernet adapter must be selected to be used for EtherCAT.
 - Select Device # (EtherCAT), then the Adapter tab, then Search, then select the Ethernet adapter.