

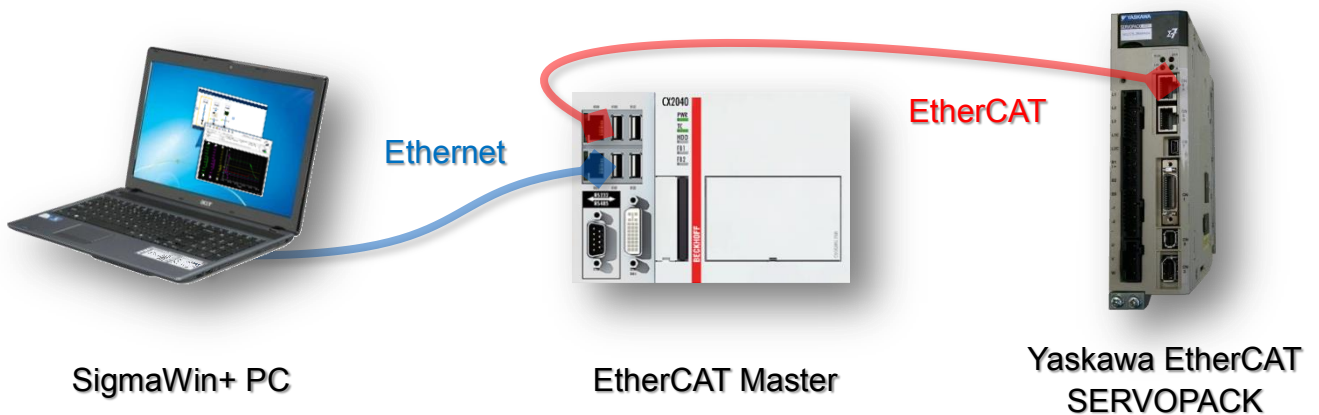
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

About This Document

This document contains the setup procedure for hardware and software to use **SigmaWin+** with a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.



Note: The above diagram is an example setup.

This document's purpose is as follows:

- Provide procedures in **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.
- Provide information about features that an EtherCAT master must support in order for **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.

The intended audience for this document is as follows:

- Machine builders using **SigmaWin+** who set up and tune **Yaskawa EtherCAT SERVOPACKs**.
- EtherCAT master developers who can implement support for Ethernet over EtherCAT.

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Technical Terms

The terms in this document are described in the following tables.

Term	Abbreviation	Meaning
CANopen	CANopen	An upper-layer protocol based on the international CAN standard (EN 50325-4). It consists of profile specifications for the application layer, communications, applications, devices, and interfaces.
CANopen over EtherCAT	CoE	A network that uses Ethernet for the physical layer, EtherCAT for the data link layer, and CANopen for the application layer in a seven-layer OSI reference model.
Controller Area Network	CAN	Communications protocol for the physical layer and data link layer established for automotive LANs. It was established as an international standard as ISO 11898.
Electrically Erasable Programmable Read Only Memory	EEPROM	A ROM that can be electrically overwritten.
Ethernet over EtherCAT	EoE	A network that uses Ethernet for the physical layer, EtherCAT for the data link layer, and Ethernet for the application layer in a seven-layer OSI reference model.
Ethernet for Control Automation Technology	EtherCAT	An open network developed by Beckhoff Automation.
EtherCAT Slave Information	ESI	File with slave device descriptions, defined in the ETG.2000 ESI specification.
OPERATIONAL	OP	The Operational state in the EtherCAT state machine.
PRE-OPERATIONAL	PRE-OP	The Pre-operational state in the EtherCAT state machine.

Term	Meaning
Servomotor	A Yaskawa actuator.
Servo Drive	The combination of a Servomotor and SERVOPACK.
SERVOPACK	A Yaskawa servo amplifier.
SigmaWin+	The engineering tool for setting up and tuning Servo Drives or a computer in which the engineering tool is installed.

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1. System Design

This section describes the necessary system features to use **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.

If the system has already been designed, this section can be used as a reference.

The necessary system features depend on the architecture of the system.

There are 3 architectures described in this document. Each has its own benefits and drawbacks to support using **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.

All of the architectures are referred to by a shorthand naming convention (based on topology), and that convention is described in the following subsection.

1.1. Architecture Naming Convention

Architectures are named based on the device types and order of connection.

The following table describes the symbols in the architecture names.

Symbol	Term	Meaning
-	(cable)	An Ethernet cable connecting between devices
M	Master	EtherCAT Master
S	Slave	Yaskawa EtherCAT SERVOPACK
C	Configuration	Configuration software SigmaWin+ on a PC, not on the EtherCAT master
E	EoE Module	EtherCAT switch port terminal

- In architecture “**C-M-S**”, the PC with the **Configuration** software is connected with a **cable** to the **Master**, and the **Master** is connected with a **cable** to the **Slave**.
 - Basically, a PC with **SigmaWin+** connects to EtherCAT master’s Ethernet port.
- In architecture “**M-S**”, the **Master** is connected with a **cable** to the **Slave**.
 - EtherCAT master runs **SigmaWin+**
- In architecture “**M-S-E-C**”, the **Master** is connected with a **cable** to the **Slave**, and the **Slave** is connected with a **cable** to the **EoE Module**, and the **EoE Module** is connected with a **cable** to a PC with the **Configuration** software.
 - Basically, a PC with **SigmaWin+** connects to the EtherCAT network by use of an Ethernet switch port terminal slave device.

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1.2. System Features

The following table indicates the necessary system features that each architecture must support in order to use **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.

FEATURES		ARCHITECTURE		
		C-M-S 	M-S 	M-S-E-C
Windows PC with SigmaWin+		✓	✗	✓
EtherCAT Master running Windows with SigmaWin+		✗	✓	✗
EtherCAT Master features to support	Set MAC address and IPv4 address of slave ^{*1*2}	✓	✓	✓
	Set up an EoE endpoint ^{*1}	✓	✓	✗
	Route Ethernet packets between Ethernet device (SigmaWin+) and the EoE endpoint ^{*1}	✓	✓	✗
	An Ethernet port for Ethernet communications	✓	✗	✗
	Inclusion of an Ethernet switch port terminal slave device in the system configuration ^{*1*3}	✗	✗	✓

*1 For examples in **TwinCAT 3**, refer to the relevant setup steps sections in this document.

*2 For details of the order of settings, refer to [2.4. Master Requirements](#).

*3 Example Ethernet switch port terminal: **Beckhoff EK1100 + EL6601** combination

✓ = Needs to support

✗ = Does not need to support

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1.3. Benefits & Drawbacks

This section describes each of the architectures' benefits and drawbacks to support using **SigmaWin+** to connect to a **Yaskawa EtherCAT SERVOPACK** over an EtherCAT network.

1.3.1. Architecture "C-M-S" (PC with SigmaWin+ connects to EtherCAT master's Ethernet port)

- This is the typical application for the following reasons:
 - Typical EtherCAT masters do not run **Windows** which is a requirement for architecture "M-S".
 - Additional EtherCAT hardware is necessary for architecture "M-S-E-C".
- **Benefits:**
 - Less wiring than the architecture requiring Ethernet switch port terminal
 - Does not require the Ethernet switch port terminal
 - EtherCAT master does not need to run **Windows**
- **Drawbacks:**
 - More wiring than the architecture where **SigmaWin+** runs on the EtherCAT master
 - Additional EtherCAT master development may be required
 - Separate PC for **SigmaWin+** is necessary
 - The most setup steps and sources of misconfiguration of all architectures

1.3.2. Architecture "M-S" (EtherCAT master runs SigmaWin+)

- **Benefits:**
 - Least wiring of all architectures
 - Least networking components of all architectures
 - Dedicated PC for **SigmaWin+** is not necessary
 - Less setup steps and sources of misconfiguration than the architecture where the **SigmaWin+** PC connects to the EtherCAT master
- **Drawbacks:**
 - Requires EtherCAT master to run on **Windows**
 - Additional EtherCAT master development may be required
 - More setup steps and sources of misconfiguration than the architecture that requires the Ethernet switch port terminal

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1.3.3. Architecture “M–S–E–C” (PC with SigmaWin+ connects to the EtherCAT network by use of an Ethernet switch port terminal slave device)

- **Benefits:**
 - Least development necessary of all architectures, for an EtherCAT master to support **SigmaWin+** over EtherCAT
 - Fewer components in the operating system
 - Fewer components in the EtherCAT stack
 - EtherCAT master does not need to run **Windows**
 - Least setup steps and sources of misconfiguration of all architectures
- **Drawbacks:**
 - The most wiring than all other architectures
 - The most hardware of all architectures
 - Additional hardware module (Ethernet switch port terminal)
 - EtherCAT master must support the hardware module
 - Separate PC for **SigmaWin+** is necessary

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2. Prerequisites

2.1. Yaskawa EtherCAT SERVOPACK Firmware Versions

- The following **Yaskawa EtherCAT SERVOPACKs** and EtherCAT firmware versions support EoE:

Product Model	EtherCAT Firmware
Sigma-5 [Model#: SGD V -xxxxExxxxxxxx2*]	7.00 and above
Sigma SD [Model#: CACR-JUxxxxC*]	8.00 and above
Sigma-7 100V/200V [Model#: SGD7S-xxxFA0* / SGD7S-xxxAA0*]	8.13 and above
Sigma-7 400V, Single Axis [Model#: SGD7S-xxxDA0*]	7.08 and above* 8.14 and above preferred
Sigma-7 400V, Dual Axis [Model#: SGD7W-xxxDA0*]	8.01 and above* 8.14 and above preferred

* Firmware versions lower than 8.14 for 400V SERVOPACKS require setting Pn010 = 4th octet of IP address

- For products not listed, inquire to your **Yaskawa** representative.
- To determine firmware version, the following options are available:
 - Refer to Yaskawa.com document number **AN.MTN.06.ETHERCAT**, section Using Known Working Master To Read Revision Number.
 - Read from CoE object **0x100A** *Manufacturer Software Version*

2.2. Industrial Ethernet Cables

- Cat5e Shielded Twisted-Pair, 2 pairs (not 4 pairs) is recommended
 - Yaskawa** part numbers

Part Number	Part Number Specifications
CM3RRM0-00xx-E	xx = P2 for 0.2 meter, P5 for 0.5 meter
JZSP-CM3RRM0-xx-E	xx = 01 for 1 meter, 03 for 3 meter, 05 for 5 meter, 10 for 10 meter
JZSP-CM3RR00-xx-E	xx = 20 for 20 meter, 30 for 30 meter
JZSP-CM3RR01-xx-E	xx = 40 for 40 meter, 50 for 50 meter

- Unshielded Ethernet cables or low-quality cables may result in **A.A12** and **A.A11** alarms due to electrical noise interference.

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2.3. Electronic Files

- **Yaskawa User's Manuals**
 - **Example:** Sigma-7S 100V/200V:
 - **Sigma-7S EtherCAT (CoE) Communication Reference Product Manual**
 - Yaskawa.com document number: **SIEPS80000155**
 - **SigmaWin+ Operation Manual (for SigmaWin+ 7)**
 - Installed with **SigmaWin+** (Yaskawa.com document number: **SigmaWinPlus_Ver.7**)
 - Found in:
 - Windows Start menu>YASKAWA>SigmaWin+ Ver.7>SigmaWin+ Ver.7 Help
- **Yaskawa SERVOPACK configuration software: SigmaWin+**
 - Yaskawa.com document number: **SigmaWinPlus_Ver.7**
 - The minimum version of **SigmaWin+** that supports communication over EtherCAT is **7.27**.
- (Necessity is dependent on master) ESI file for **Yaskawa EtherCAT SERVOPACK**
 - Refer to the EtherCAT master documentation for the necessity to import ESI files.
 - **Example:** Sigma-7S 100V/200V:
 - Yaskawa.com document number: **Yaskawa_Sigma-7_CoE_ESI_Files**
- (Necessity is dependent on master and architecture) ESI file for Ethernet switch port terminal slave device (if implementing the architecture that requires this device)
 - Contact the device manufacturer for the ESI file
 - **Example: Beckhoff EK1100 + EL6601**, contact **Beckhoff** for the ESI files (they are usually included with **TwinCAT** installations).
 - The architecture that requires this ESI file is the architecture "**M-S-E-C**" (the architecture is described in [1.1. Architecture Naming Convention](#)).

2.4. Master Requirements

Refer to [1.2. System Features](#), table side-heading *EtherCAT Master features to support*.

Additionally, the **Yaskawa EtherCAT SERVOPACK** requires the master to be able to send data in the following order, and expects blank spaces for the unused parameters in the data field in the message from the master:

- MACAddress UINT8[6]
- IPAddress UINT32
- SubnetMask UINT32
- DefaultGateway UINT32
- DNSServerIpAddress UINT32
- DNSName char[32]

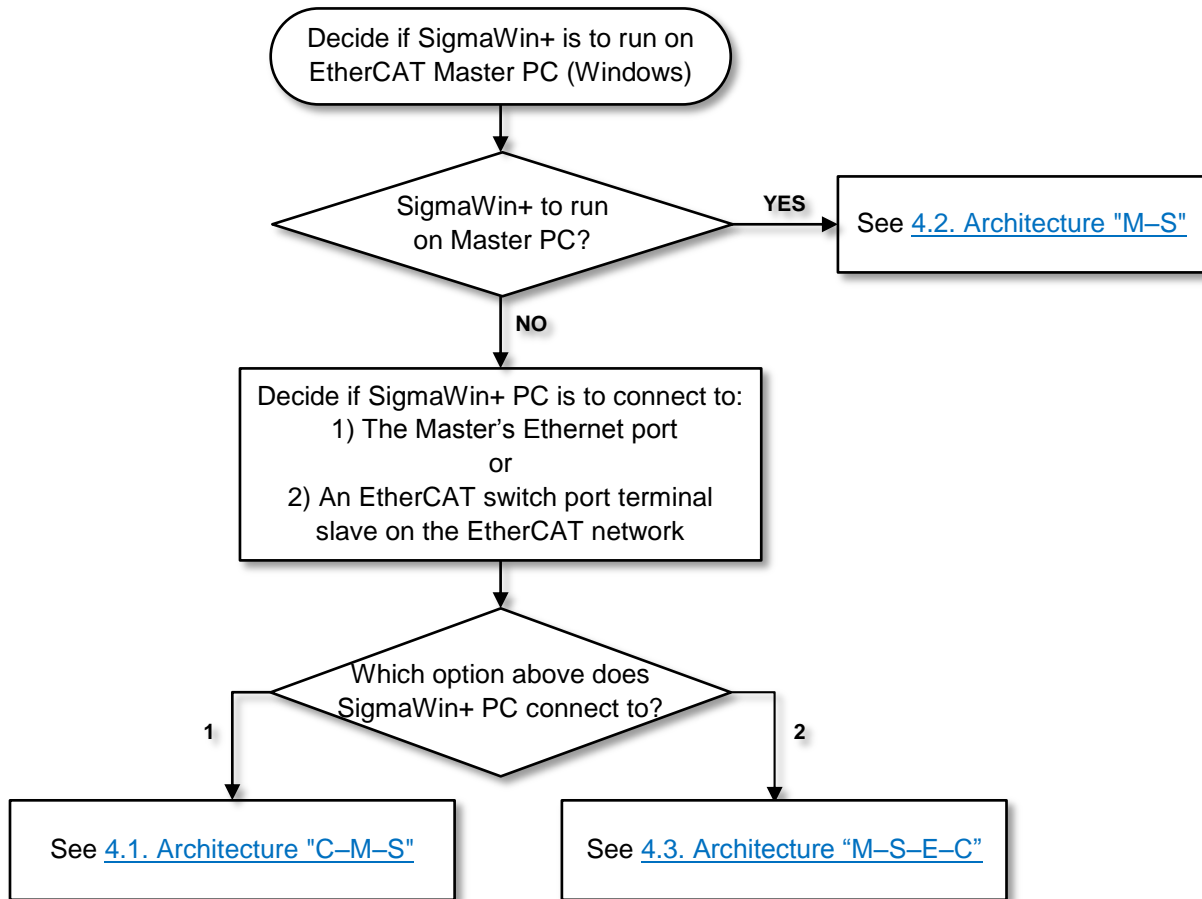
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3. Selecting Applicable Setup Procedure

The following flowchart can assist with determining which setup procedure to follow.



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4. Setup Procedures

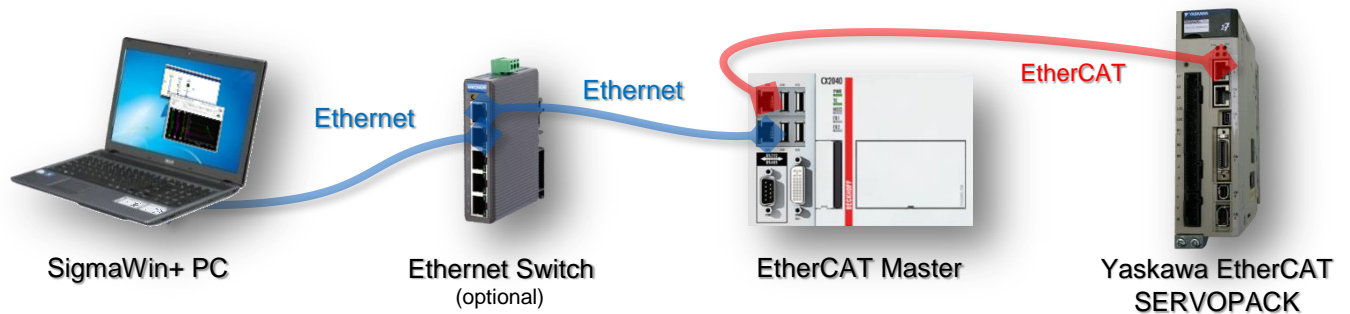
4.1. Architecture “C–M–S”: “PC [With SigmaWin+] — Switch (optional) — Master — Slave”

4.1.1. Introduction

The concept of this architecture is that the PC with **SigmaWin+** connects to the EtherCAT master’s Ethernet port.

This architecture “C–M–S” is defined below, showing devices in connection order:

- “C” – **C**onfiguration – Configuration software **SigmaWin+** on a PC
- “M” – **M**aster – EtherCAT Master
- “S” – **S**lave – **Yaskawa EtherCAT SERVOPACK**



The EtherCAT master must support the following features:

1. Set MAC address and IPv4 address of slave
2. Set up an EoE endpoint
3. Route Ethernet packets between Ethernet device (**SigmaWin+**) and the EoE endpoint
4. An Ethernet port for Ethernet communications

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4.1.2. Hardware Setup

- For the initial test, use only 1 **Yaskawa EtherCAT SERVOPACK** with no other devices on the network (**example:** remove all Ethernet switches and additional axes).
- Connect a single Ethernet cable between the EtherCAT master's **EtherCAT port** and the **IN port** of the **Yaskawa EtherCAT SERVOPACK**.
- Connect a single Ethernet cable between the EtherCAT master's **Ethernet port**, and the PC that has **SigmaWin+**.

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4.1.3. EtherCAT Master Setup Items

Note: For an example setup using **TwinCAT 3**, refer also to [Appendix C: TwinCAT 3 Example For Architecture “C–M–S”](#).

- Set up an IPv4 address that will be used for Ethernet communications with **SigmaWin+**.
 - This address will be used as the Default gateway when setting up the PC with **SigmaWin+**.
 - **Example: 192.168.2.128**
- Set up the EoE endpoint.
 - This establishes the connection between the EoE network and the operating system's network stack.
 - **Note to EtherCAT master developers:** This function to connect between the EoE network and the operating system's network stack depends on the EtherCAT stack. For example, the EtherCAT stack from the vendor **acontis** has this function as an add-on option.
- Enable the routing for Ethernet packets between the Ethernet device (the PC with **SigmaWin+**) and the EoE endpoint.
 - **Note to EtherCAT master developers:** This function of configuring the operating system's network stack to act as a router depends on the operating system. The network stack does not need to support any specific protocols. The network stack needs to be able to forward Ethernet packets from one port to another.
- Set the **MAC address** and **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK**.
 - **Note to EtherCAT master developers:** This function of setting the EtherCAT slave's IPv4 and MAC addresses depends on the EtherCAT master stack. Contact the EtherCAT master stack vendor for details.
 - The EtherCAT address (for EtherCAT node addressing) is independent from the IPv4 address.
 - **Example:**
 - **MAC Address:** **02 01 05 20 03 E9**
 - **IP Address:** **192.168.1.2**

4.1.4. Run EtherCAT

Enable all changed settings in the EtherCAT master, and set the EtherCAT network to **PRE-OP** state.

Note: In the **OP** state, the **SigmaWin+** function **Write All Parameters** will not complete successfully because certain parameters cannot be written in **OP** state (e.g. PDO mapping parameters like **1600h**).

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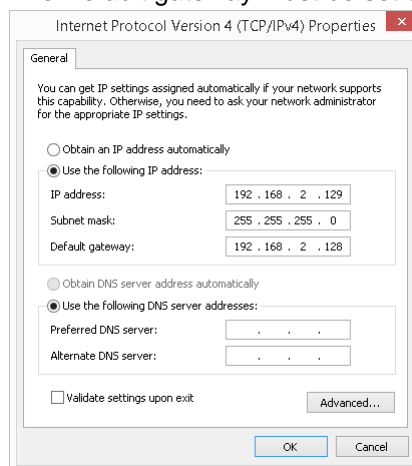
Product(s): Yaskawa EtherCAT SERVOPACKs

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4.1.5. Yaskawa SERVOPACK Configuration Software – SigmaWin+

4.1.5.1. PC IPv4 Address Settings

- **Details:**
 - **Optional:** Setting the IPv4 address of the PC through **Windows** is optional, because **SigmaWin+** has a function to set the IPv4 address.
 - Setting the IPv4 address through **Windows** is recommended for testing the connection for the first time.
 - If the network settings are not set in this step, then **Windows User Account Control** prompts may appear in later steps, due to the **SigmaWin+** function of modifying the PC's network settings.
- **Procedures & Examples:**
 - Set the IPv4 address within the subnet used for the IPv4 address of the EtherCAT Master's Ethernet port used for Ethernet communications with **SigmaWin+** as established in [4.1.3. EtherCAT Master Setup Items](#).
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** is 192.168.2.128.
 - An acceptable IPv4 address for the **SigmaWin+** PC is **192.168.2.129**.
 - Set the Default gateway to the IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+**.
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** is 192.168.2.128.
 - The Default gateway must be set to **192.168.2.128**.



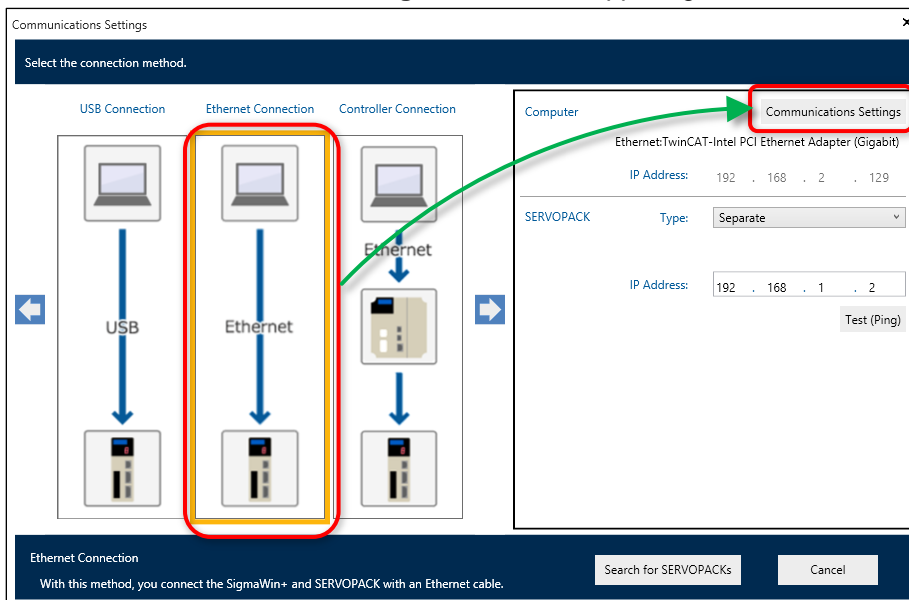
Title: SigmaWin+ Over EtherCAT

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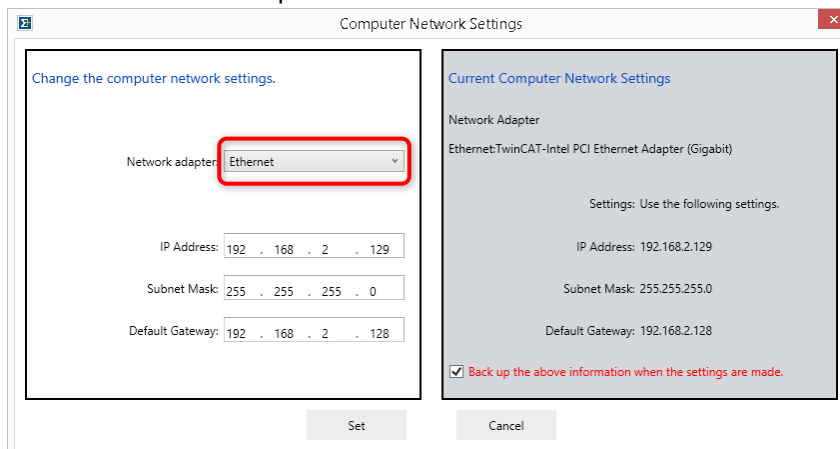
Doc. No. TN.Sigma.01.EtherCAT

4.1.5.2. SigmaWin+ Settings

- Refer to the **SigmaWin+ Help** installed with **SigmaWin+** to locate the windows described in this procedure.
- From the *Communication Settings* window, select **Ethernet Connection** for the connection method.
 - The Left and Right selector arrows may be necessary to use to find **Ethernet Connection**.
- Push the **Communication Settings** button in the upper right corner of the window.



- Select the network adapter used to connect the PC to the EtherCAT master.

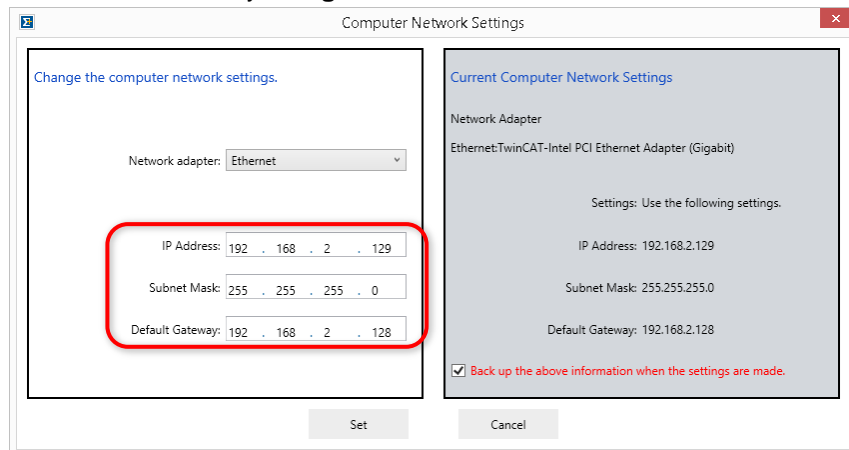


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- Make the settings as follows:
 - Set the IP Address within the subnet used for the IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** that was established in [4.1.3. EtherCAT Master Setup Items](#).
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** is 192.168.2.128.
 - An acceptable IP Address to use in this window is **192.168.2.129**.
 - Set the Default Gateway to the IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** as established in [4.1.3. EtherCAT Master Setup Items](#).
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the EtherCAT master's Ethernet port used for Ethernet communications with **SigmaWin+** is 192.168.2.128.
 - The Default Gateway in **SigmaWin+** must be set to **192.168.2.128**.



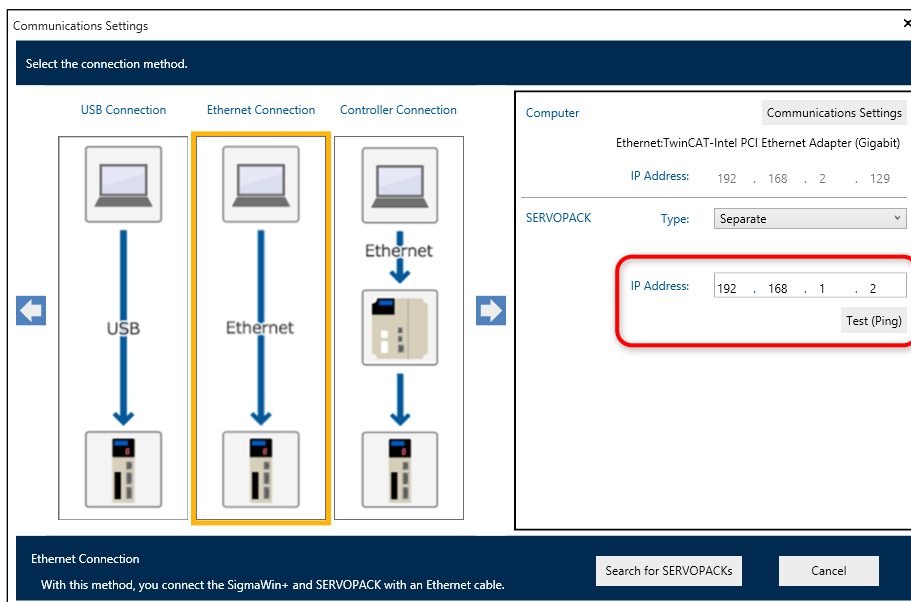
- If the settings on the left do not match the settings on the right, **Windows User Account Control** prompts may appear in later steps.
- Push the **Set** button.

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- In the *Communication Settings* window, for the IP Address field, enter the IPv4 address of the **Yaskawa EtherCAT SERVOPACK** that was established in [4.1.3. EtherCAT Master Setup Items](#).
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the **Yaskawa EtherCAT SERVOPACK** is **192.168.1.2**.
 - The IP Address in this window must be set to **192.168.1.2**.



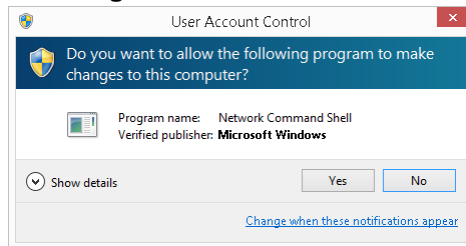
Title: SigmaWin+ Over EtherCAT

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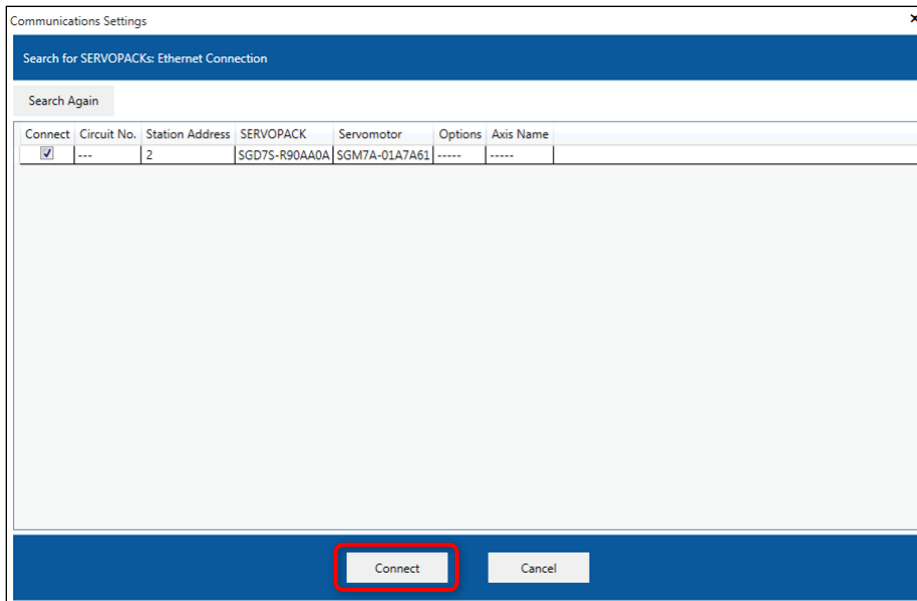
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4.1.5.3. SigmaWin+ Connection

- Push the **Search for SERVOPACKs** button.
 - If the network settings did not match from the step where the network settings are set within **SigmaWin+**, a **Windows User Account Control** prompt may appear.



- If there are any error messages, refer to [Appendix A: Troubleshooting](#).
- The discovered **Yaskawa** SERVOPACK is displayed.
- If there is no checkmark in the **Connect** checkbox, push the box to put a checkmark.
- Push the **Connect** button.



- If there are any error messages, refer to [Appendix A: Troubleshooting](#).

This completes the procedure for “**C-M-S**” architecture to use SigmaWin+ to connect to the Yaskawa EtherCAT SERVOPACK through EtherCAT.

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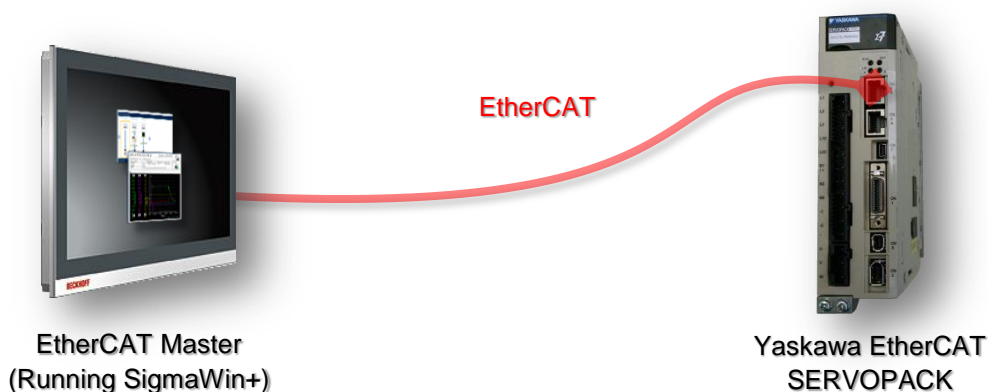
4.2. Architecture “M–S”: “Master [With SigmaWin+] — Slave”

4.2.1. Introduction

The concept of this architecture is that the EtherCAT master runs **SigmaWin+**.

This architecture “M–S” is defined below, showing devices in connection order:

- “M” – **Master** – EtherCAT master running **Windows**, which also contains **SigmaWin+**
- “S” – **Slave** – **Yaskawa EtherCAT SERVOPACK**



The EtherCAT master must support the following features:

1. **Windows** with **SigmaWin+**
2. Set MAC address and IPv4 address of slave
3. Set up an EoE endpoint
4. Route Ethernet packets between Ethernet device (**SigmaWin+**) and the EoE endpoint

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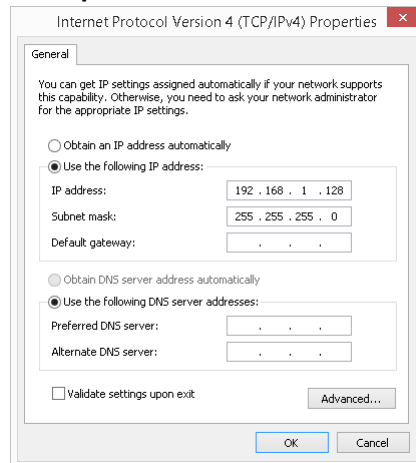
4.2.2. Hardware Setup

- For the initial test, use only 1 **Yaskawa EtherCAT SERVOPACK** with no other devices on the network (**example:** remove all Ethernet switches and additional axes).
- Connect a single Ethernet cable between the EtherCAT master's **EtherCAT port** and the **IN port** of the **Yaskawa EtherCAT SERVOPACK**.

4.2.3. EtherCAT Master Setup

Note: For an example setup using **TwinCAT 3**, refer also to [Appendix D: TwinCAT 3 Example For Architecture “M–S”](#).

- Set the IPv4 address of the Ethernet port that is used for EtherCAT communications.
 - This address will be used as the IP Address when setting up the PC with **SigmaWin+**.
 - **Example: 192.168.1.128**



- Set up the EoE endpoint, enable the routing for Ethernet packets between the Ethernet device (**SigmaWin+**) and the EoE endpoint, and set the **MAC address** and **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK**.
 - Refer to [4.1.3. EtherCAT Master Setup Items](#) for the details and examples.
 - **Note:** Skip the first pullet point *Set up an IPv4 address that will be used for Ethernet communications with **SigmaWin+***.

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4.2.4. Run EtherCAT

Enable all changed settings in the EtherCAT master, and set the EtherCAT network to **PRE-OP** state.

Note: In the **OP** state, the **SigmaWin+** function **Write All Parameters** will not complete successfully because certain parameters cannot be written in **OP** state (e.g. PDO mapping parameters like **1600h**).

Title: SigmaWin+ Over EtherCAT

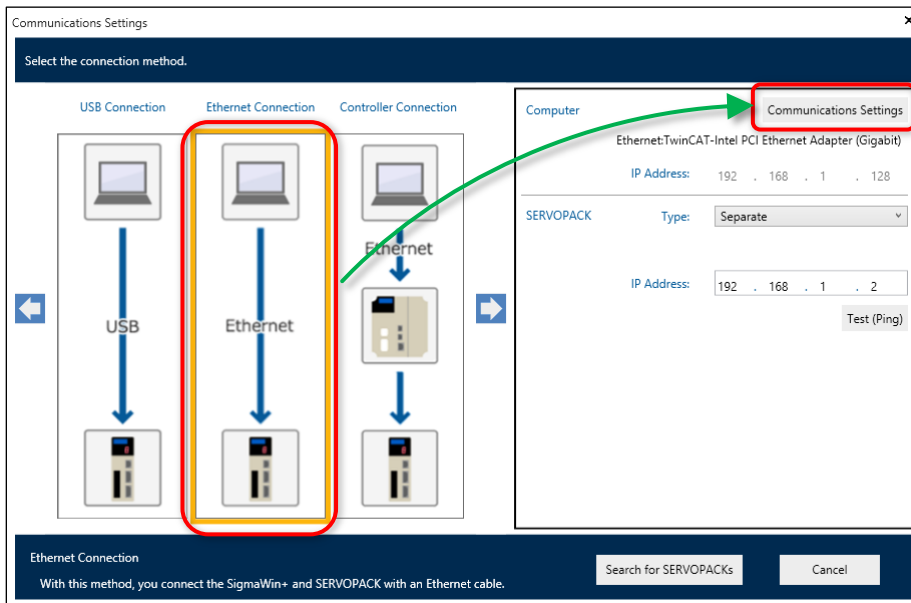
Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

4.2.5. Yaskawa SERVOPACK Configuration Software – SigmaWin+

4.2.5.1. SigmaWin+ Settings

- Refer to the **SigmaWin+ Help** installed with **SigmaWin+** to locate the windows described in this procedure.
- From the *Communication Settings* window, select **Ethernet Connection** for the connection method.
 - The Left and Right selector arrows may be necessary to use to find **Ethernet Connection**.
- Push the **Communication Settings** button in the upper right corner of the window.

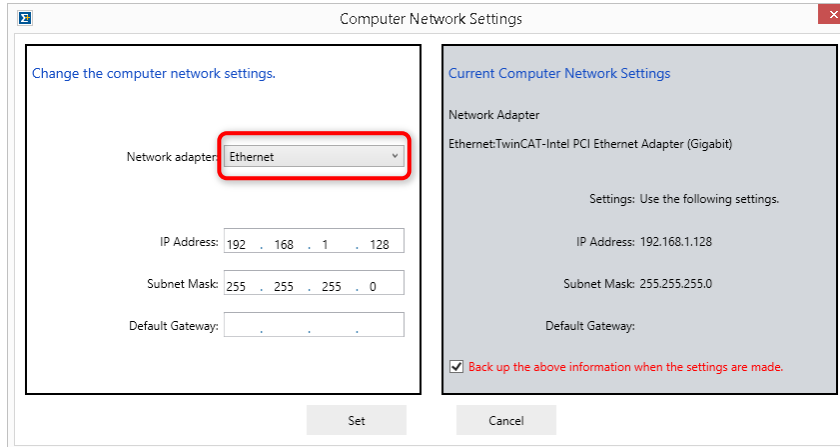


Title: SigmaWin+ Over EtherCAT

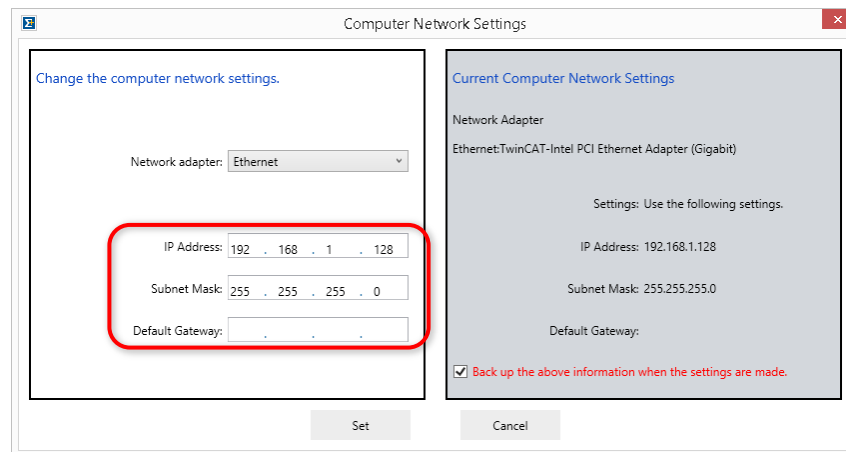
Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- Select the network adapter used to connect the PC to the EtherCAT master.



- Set the IP Address to the same value set in [4.2.3. EtherCAT Master Setup](#) which is the IPv4 address of the EtherCAT master's port used for EtherCAT communications.
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the EtherCAT master's port used for EtherCAT communications is 192.168.1.128.
 - The IP Address in this window must be set to **192.168.1.128**.



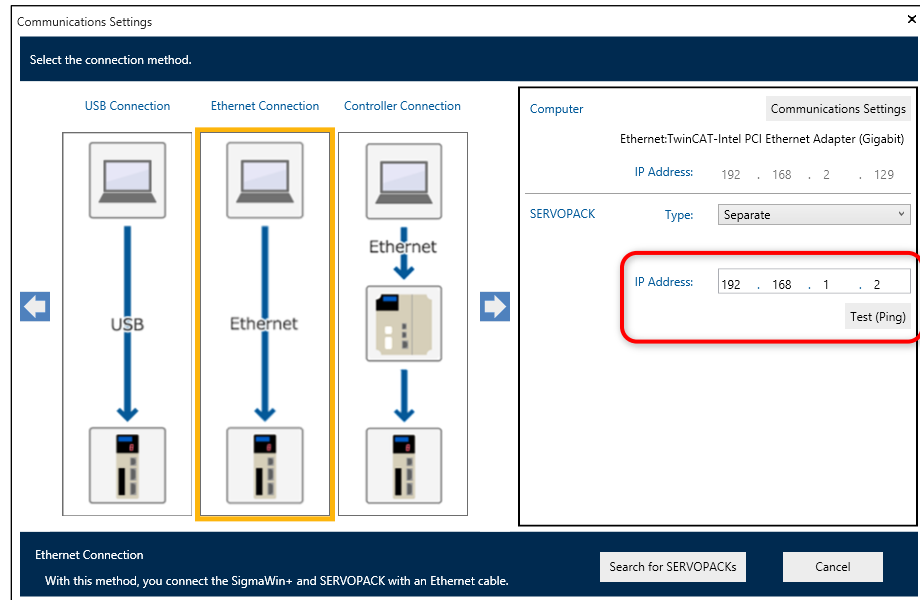
- If the settings on the left do not match the settings on the right, **Windows User Account Control** prompts may appear in later steps.
- Push the **Set** button.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- In the *Communication Settings* window, for the IP Address field, enter the IPv4 address of the **Yaskawa EtherCAT SERVOPACK** that was established in [4.2.3. EtherCAT Master Setup](#).
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the **Yaskawa EtherCAT SERVOPACK** is **192.168.1.2**.
 - The IP Address in this window must be set to **192.168.1.2**.



4.2.5.2. SigmaWin+ Connection

- Connect to the **Yaskawa EtherCAT SERVOPACK** using **SigmaWin+**.
 - Refer to [4.1.5.3. SigmaWin+ Connection](#) for the procedure.

This completes the procedure for “**M-S**” architecture to use SigmaWin+ to connect to the Yaskawa EtherCAT SERVOPACK through EtherCAT.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

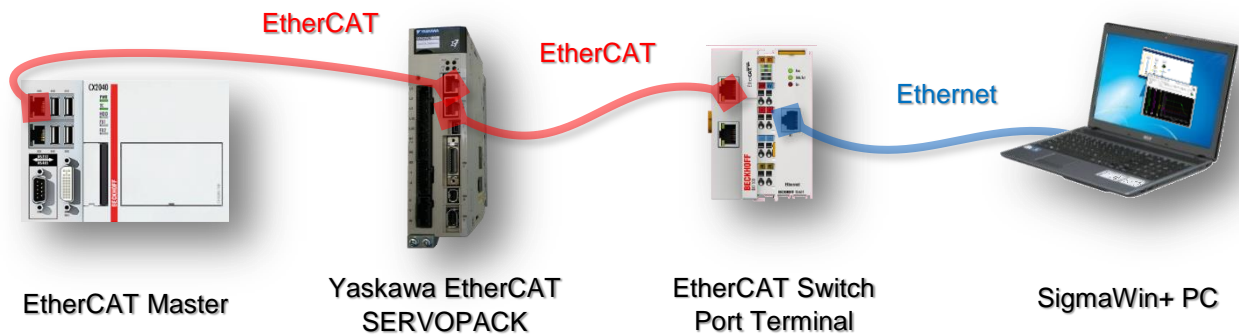
4.3. Architecture “M–S–E–C”: “Master — Slave — EoE Module — PC [With SigmaWin+]”

4.3.1. Introduction

The concept of this architecture is that the PC with **SigmaWin+** connects to the EtherCAT network by use of an Ethernet switch port terminal slave device.

This architecture “M–S–E–C” is defined below, showing devices in connection order:

- “M” – **Master** – EtherCAT Master
- “S” – **Slave** – **Yaskawa EtherCAT SERVOPACK**
- “E” – **EoE Module** – Ethernet switch port terminal
Example: Beckhoff EK1100 + EL6601
- “C” – **Configuration** – Configuration software **SigmaWin+** on a PC



The EtherCAT master must support the following features:

1. Set MAC address and IPv4 address of slave
2. Inclusion of an Ethernet switch port terminal slave device in the system configuration

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

4.3.2. Hardware Setup

- For the initial test, use only 1 **Yaskawa EtherCAT SERVOPACK** with no other devices on the network (**example:** remove all Ethernet switches and additional axes).
- Connect a single Ethernet cable between the EtherCAT master's **EtherCAT port** and the **IN port** of the **Yaskawa EtherCAT SERVOPACK**.
- Connect a single Ethernet cable between the **OUT port** of the **Yaskawa EtherCAT SERVOPACK**, and the **IN port** of the Ethernet switch port terminal.
- Connect a single Ethernet cable between the Ethernet switch port terminal's **port for Ethernet communications** to the **SigmaWin+ PC**.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

4.3.3. EtherCAT Master Setup – Yaskawa EtherCAT SERVOPACK Settings

Note: For an example setup using **TwinCAT 3**, refer also to [Appendix E: TwinCAT 3 Example For Architecture “M–S–E–C”](#).

- Set the **MAC address** and **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK**.
 - Refer to [4.1.3. EtherCAT Master Setup Items](#) for the details and examples.
 - **Note:** Skip all points until the point *Set the **MAC address** and **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK***.

4.3.4. Run EtherCAT

Enable all changed settings in the EtherCAT master, and set the EtherCAT network to **PRE-OP** state.

Note: In the **OP** state, the **SigmaWin+** function **Write All Parameters** will not complete successfully because certain parameters cannot be written in **OP** state (e.g. PDO mapping parameters like **1600h**).

Title: SigmaWin+ Over EtherCAT

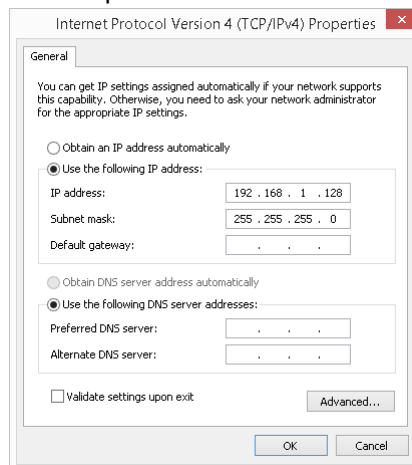
Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

4.3.5. Yaskawa SERVOPACK Configuration Software – SigmaWin+

4.3.5.1. PC IPv4 Address Settings

- **Details:**
 - Refer to [4.1.5.1. PC IPv4 Address Settings](#) or details (refer to below for procedure and example).
- **Procedure & Example:**
 - Set the IPv4 address within the subnet used for the IPv4 address of the **Yaskawa EtherCAT SERVOPACK** that was established in [4.3.3. EtherCAT Master Setup – Yaskawa EtherCAT SERVOPACK Settings](#)
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the **Yaskawa EtherCAT SERVOPACK** is 192.168.1.2.
 - An acceptable IPv4 address for the **SigmaWin+ PC** is **192.168.1.128**.



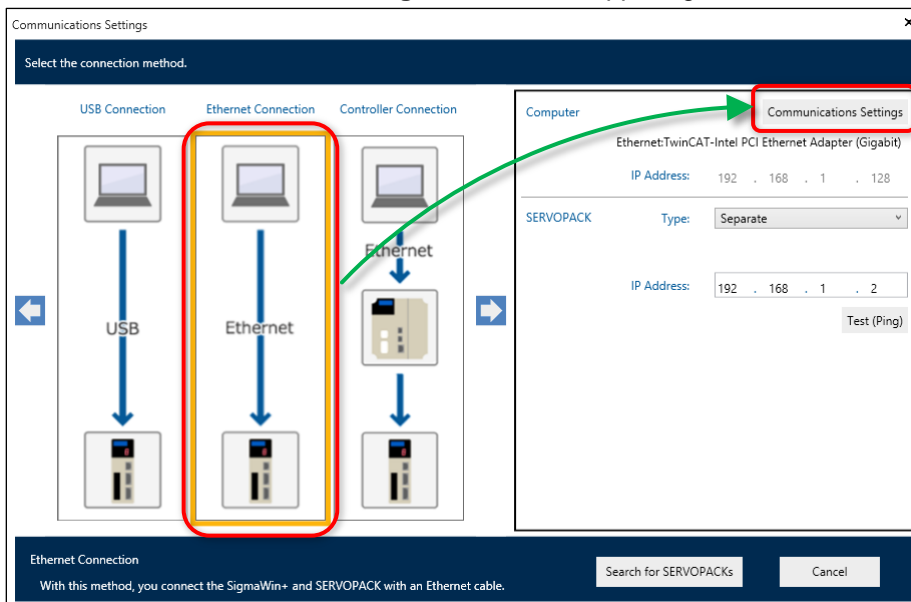
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

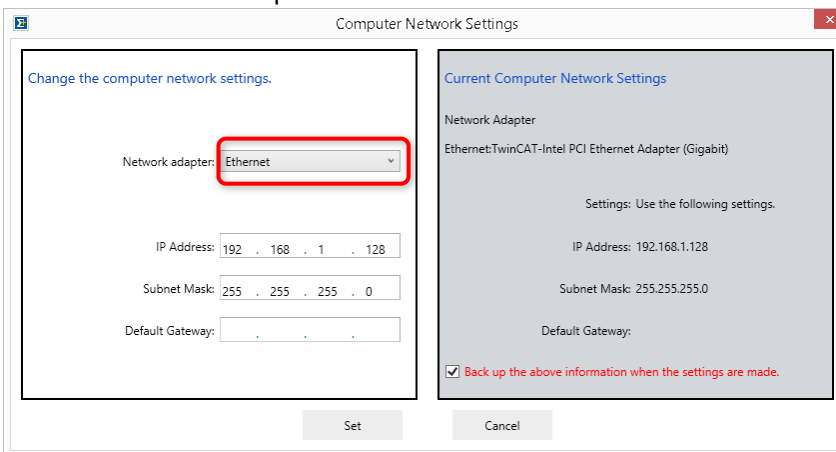
Doc. No. TN.Sigma.01.EtherCAT

4.3.5.2. SigmaWin+ Settings

- Refer to the **SigmaWin+ Help** installed with **SigmaWin+** to locate the windows described in this procedure.
- From the *Communication Settings* window, select **Ethernet Connection** for the connection method.
 - The Left and Right selector arrows may be necessary to use to find **Ethernet Connection**.
- Push the **Communication Settings** button in the upper right corner of the window.



- Select the network adapter used to connect the PC to the EtherCAT master.

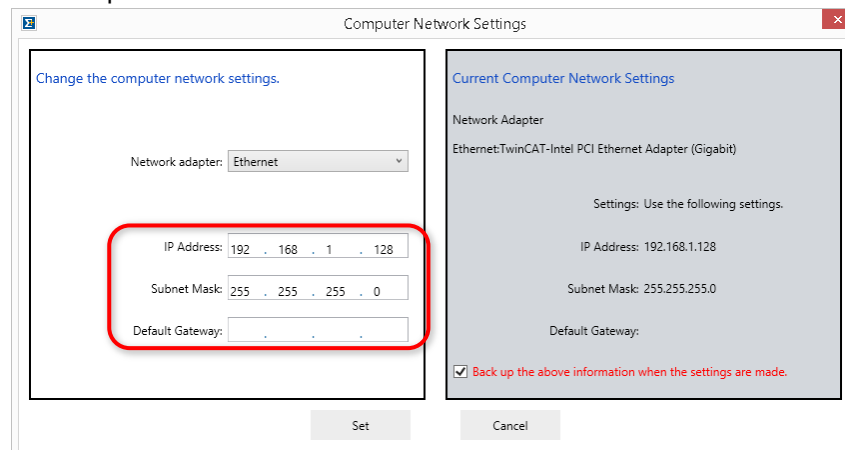


Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- Set the IP Address within the subnet used for the IPv4 address of the **Yaskawa EtherCAT SERVOPACK**.
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the **Yaskawa EtherCAT SERVOPACK** is 192.168.1.2.
 - An acceptable IP Address to use in this window is **192.168.1.128**.



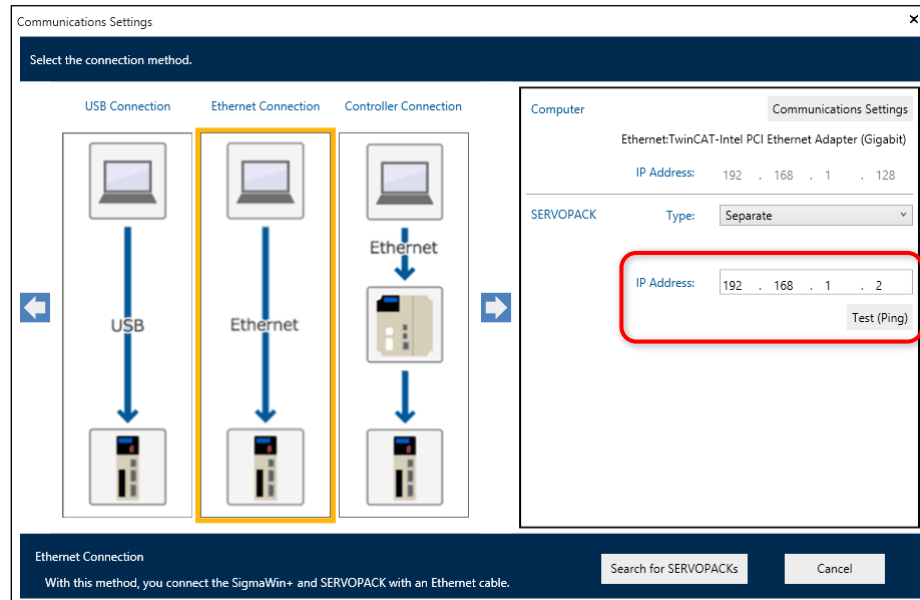
- If the settings on the left do not match the settings on the right, **Windows User Account Control** prompts may appear in later steps.
- Push the **Set** button.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- In the *Communication Settings* window, for the IP Address field, enter the IPv4 address of the **Yaskawa EtherCAT SERVOPACK**.
 - **Example** (based on example settings from the previous sections):
 - The IPv4 address of the **Yaskawa EtherCAT SERVOPACK** is **192.168.1.2**.
 - The IP Address in this window must be set to **192.168.1.2**.



4.3.5.3. SigmaWin+ Connection

- Connect to the **Yaskawa EtherCAT SERVOPACK** using **SigmaWin+**.
 - Refer to [4.1.5.3. SigmaWin+ Connection](#) for the procedure.

This completes the procedure for “**M-S-E-C**” architecture to use SigmaWin+ to connect to the Yaskawa EtherCAT SERVOPACK through EtherCAT.

Title: SigmaWin+ Over EtherCAT

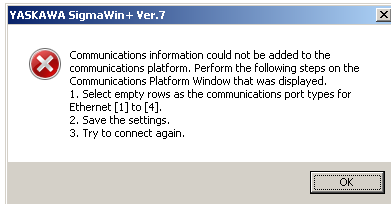
Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

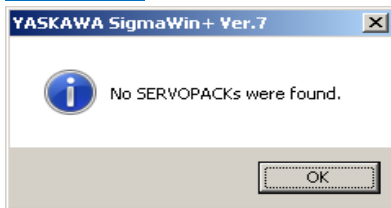
Appendix A: Troubleshooting

List of Problems in this Appendix:

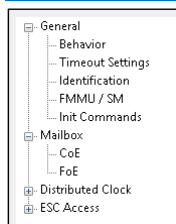
1. [After pushing the button **Search for SERVOPACKs** \(or **Test \(Ping\)**\), a message regarding *“communications information could not be added”* appears.](#)



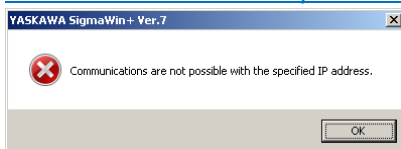
2. [After pushing the button **Search for SERVOPACKs**, SigmaWin+ reports: *No SERVOPACKs were found.*](#)



3. [EoE mailbox settings do not appear for the **Yaskawa EtherCAT SERVOPACK**.](#)



4. [After pushing the button **Search for SERVOPACKs** \(or **Test \(Ping\)**\), SigmaWin+ reports: *Communications are not possible with the specified IP address.*](#)

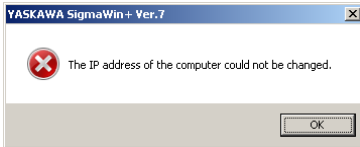


Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

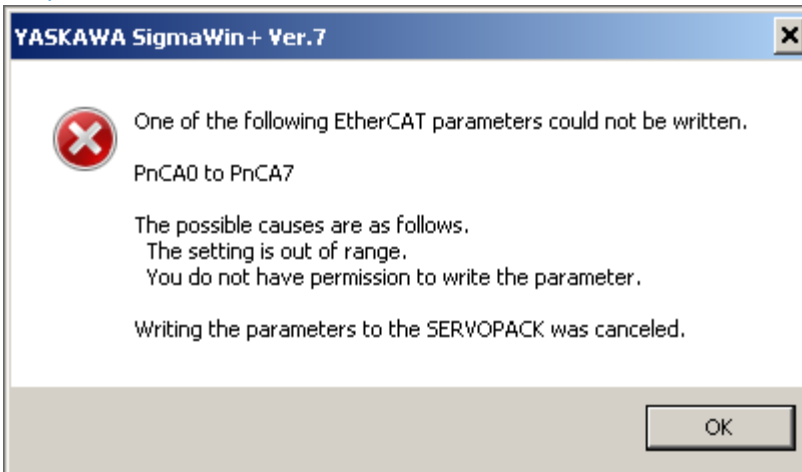
5. [After pushing the button **Search for SERVOPACKs** \(or **Test \(Ping\)**\), **SigmaWin+** reports: *The IP address of the computer could not be changed.*](#)



6. [After pushing the button **Search for SERVOPACKs** \(or **Test \(Ping\)**\), **SigmaWin+** reports: *Set up communications.*](#)



7. [SigmaWin+ communications over EtherCAT is slower than USB.](#)
8. [After pushing “**All Parameters**” in the “**Write to Servo**” category, **SigmaWin+** reports: *One of the following EtherCAT parameters could not be written. PnCA0 to PnCA7. The possible causes are as follows. The setting is out of range. You do not have permission to write the parameter. Writing the parameters to the SERVOPACK was canceled.*](#)



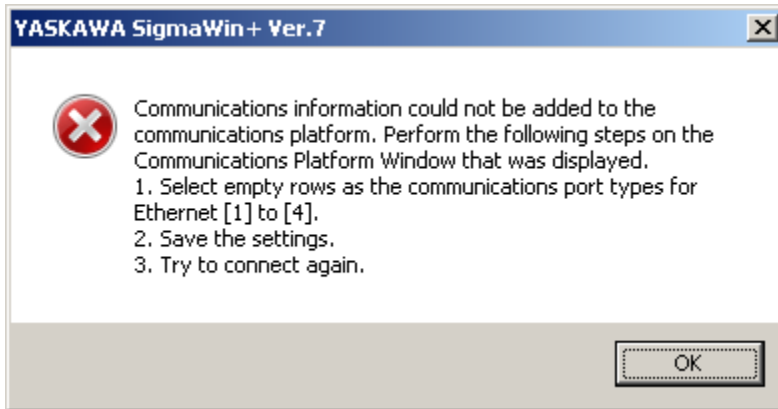
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs


Doc. No. TN.Sigma.01.EtherCAT

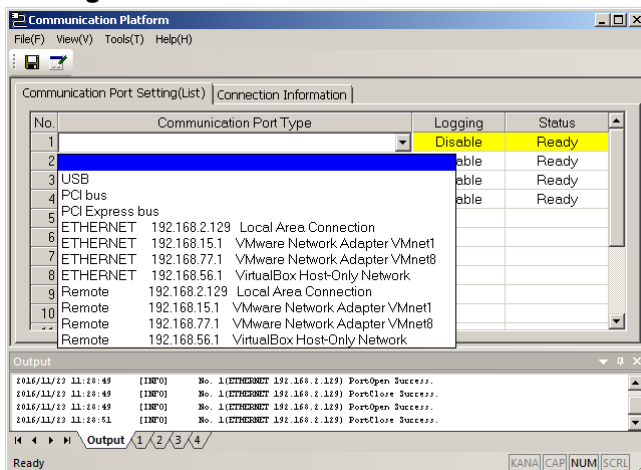
Problem 1:

- After pushing the button **Search for SERVOPACKs (or Test (Ping))**, a message regarding **“communications information could not be added”** appears.



Investigative & Corrective Actions:

- Select the **Communication Platform** from the taskbar . For each row with contents, in the **Communication Port Type** column, select the cell and select **<blank>** as shown in the image below. Save the settings (do not close the **Communication Platform**). Re-attempt connection with **SigmaWin+**.



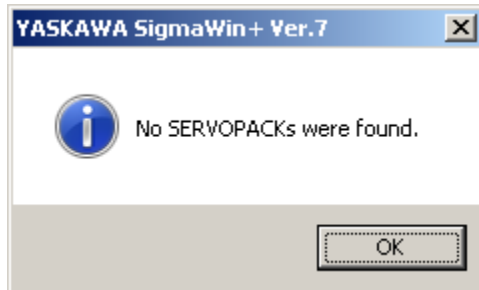
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 2:

- After pushing the button **Search for SERVOPACKs**, SigmaWin+ reports: *No SERVOPACKs were found.*



Investigative & Corrective Actions:

- For 400V SERVOPACKs, if the FW version is below 8.14, set Pn010 = 4th octet of IP address.
- After pushing the **OK** button in the message window shown above, wait 1 minute to allow connection re-attempts. The **Yaskawa EtherCAT SERVOPACK** may appear in the list.
- Push the button **Search Again** to go back to the previous screen, and push **Search for SERVOPACKs** again.
- Check that **Yaskawa EtherCAT SERVOPACK** firmware meets the minimum requirements. Refer to [2.1. Yaskawa EtherCAT SERVOPACK Firmware Versions](#).
- Check that the **SigmaWin+** version is applicable. Refer to [2.3. Electronic Files](#) for version details.
- Search for only 1 **Yaskawa EtherCAT SERVOPACK** at a time. Do not attempt to search for multiple units at the same time. (Simultaneous connection to multiple units is possible for **SigmaWin+** version 7.27 and above, but for some versions of **SigmaWin+** including 7.27, searching for multiple units fails).

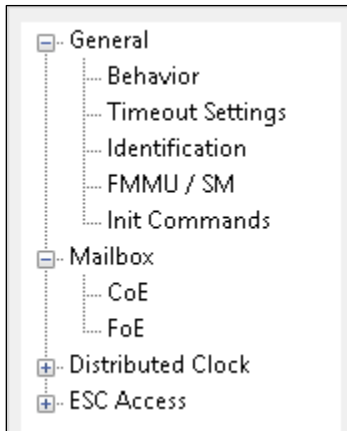
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 3:

- **EoE mailbox settings do not appear for the Yaskawa EtherCAT SERVOPACK.**



Investigative & Corrective Actions:

- Check that the **Yaskawa EtherCAT SERVOPACK** is a version that supports EoE. Refer to [2.1. Yaskawa EtherCAT SERVOPACK Firmware Versions](#) for version details.
- Check that the settings being viewed are for the **Yaskawa EtherCAT SERVOPACK**, rather than the settings for the master.
- Check that the **Yaskawa EtherCAT SERVOPACK's** ESI file is in the correct directory used by the master for ESI files.
- Check that the master applied the correct ESI file to the **Yaskawa EtherCAT SERVOPACK**.
- Restart the master to force the master to re-read the ESI directory, or execute the master function to re-read the ESI directory.

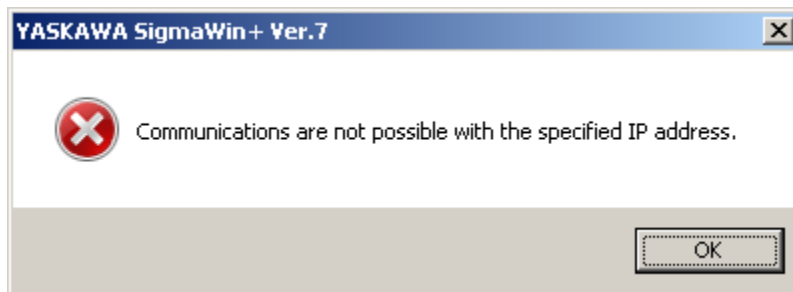
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 4:

- After pushing the button **Search for SERVOPACKs (or Test (Ping))**, SigmaWin+ reports: *Communications are not possible with the specified IP address.*



Investigative & Corrective Actions:

- **SigmaWin+:**
 - Check that **SigmaWin+** is set up as described in this document.
 - The **IPv4 addresses, Subnet masks, and Default gateways** are set up as described in this document.
 - The **IPv4 address** of the **SigmaWin+** PC is different from all other devices on the network. The PC may need to be rebooted to apply new settings.
 - Disable other networking devices (**example:** disable wireless communications)
 - Disable **Windows** Firewall for all **Windows** devices in the architecture.
 - Use **Windows** Ping command to check communications to:
 - The EtherCAT master's IPv4 address for Ethernet communications.
 - If Ping fails, in addition to checking the other items in this section, also check the cabling. The EtherCAT master may require specific wiring such as crossover wiring.
 - The EtherCAT master's IPv4 address used for the EtherCAT port.
 - If Ping succeeds for the above test, but fails for this test, the routing between the Ethernet port in the EtherCAT master and the EtherCAT port may not be set up correctly. Check that the EtherCAT master supports the function and the requirements to support this function.
 - **Example: TwinCAT 3** running on **Windows** supports this function, and the 3rd octet may need to be different between the EtherCAT master's IPv4 address for Ethernet communications (**example: 192.168.2.128**), and the EtherCAT master's IPv4 address for the EtherCAT port (**example: 192.168.1.128**).

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- The **Yaskawa EtherCAT SERVOPACK**.
 - If Ping succeeds for the above tests, but fails for this test, check the Industrial Ethernet cable between the EtherCAT master, and the **Yaskawa EtherCAT SERVOPACK**. Check that the **Yaskawa EtherCAT SERVOPACK** control power is applied (the LEDs are lit, other than the **CHARGE** LED which may be lit without control power). Check that the **SERVOPACK IPv4 address** set in **SigmaWin+** matches the **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK** set up in the EtherCAT master.
- **EtherCAT Master:**
 - Check that the EtherCAT master is set up as described in this document.
 - The **IPv4 addresses**, **Subnet masks**, and **Default gateways** are set up as described in this document.
 - The **IPv4 address** of the EtherCAT master is different from all other devices on the network. The EtherCAT master may need to be rebooted to apply new settings.
 - If the EtherCAT master runs in **Windows**, check **Windows Registry** (regedit.exe):
 - HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters\IPEnableRouter
 - Set registry entry to 1 (data type is **REG_DWORD**)
 - Disconnect other devices not necessary for this procedure, especially from Ethernet ports, until the system is working properly.
 - Do not use hubs or switches for this procedure until the system is working properly.
 - Disable **Windows** Firewall for all **Windows** devices in the architecture.
 - Check that the **Yaskawa EtherCAT SERVOPACK** is set up in the EtherCAT master as described in this document.
 - The **IPv4 address** of the **Yaskawa EtherCAT SERVOPACK** is different from all other devices on the network. This **IPv4 address** must match the **SERVOPACK IPv4 address** set in **SigmaWin+**.
 - Check that the EtherCAT master settings are activated.
 - If the EtherCAT master runs **Windows**, check that the EtherCAT project has been saved, PC has been rebooted after making changes to the routing, and the EtherCAT project has been opened.
 - Check that the EtherCAT master is in **PRE-OP** state (EtherCAT master is running).

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

- **Yaskawa EtherCAT SERVOPACK:**
 - Check that **Yaskawa EtherCAT SERVOPACK** firmware meets the minimum requirements. Refer to [2.1. Yaskawa EtherCAT SERVOPACK Firmware Versions](#).
 - Check that the **Yaskawa EtherCAT SERVOPACK** control power is applied (LEDs besides the **CHARGE** LED are lit).
 - Check that the **Yaskawa EtherCAT SERVOPACK** is in **PRE-OP** state. This can be checked from the master. Also, the **RUN** LED on the **Yaskawa EtherCAT SERVOPACK** is blinking green (200 ms on, 200 ms off) when in **PRE-OP** state.
-

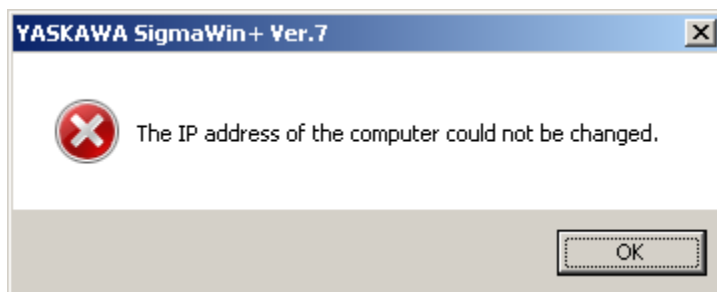
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 5:

- After pushing the button **Search for SERVOPACKs (or Test (Ping))**, SigmaWin+ reports:
The IP address of the computer could not be changed.



Investigative & Corrective Actions:

- Check that the Ethernet cable is connected from the **SigmaWin+** PC to the target device.
 - Check that the IPv4 address settings of the **SigmaWin+** PC are not the same as any other device on the network.
 - Check that the IPv4 address settings in **SigmaWin+** are not the same as any other device on the network.
-

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 6:

- After pushing the button Search for SERVOPACKs (or Test (Ping)), SigmaWin+ reports: *Set up communications.*



Investigative & Corrective Actions:

- Check that the IPv4 address settings of the **SigmaWin+** PC are not the same as any other device on the network.
 - Check that the IPv4 address settings in **SigmaWin+** are not the same as any other device on the network.
-

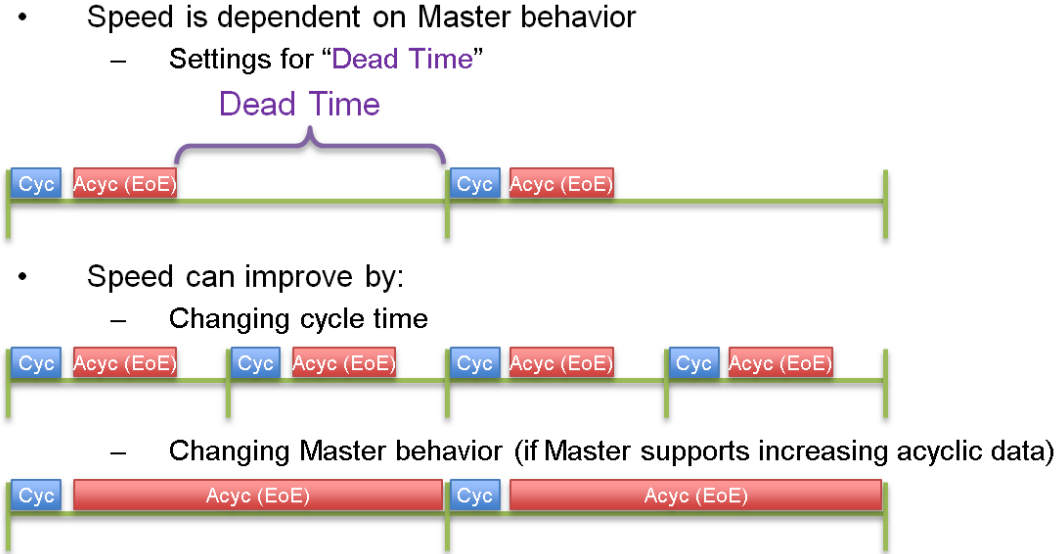
Title: SigmaWin+ Over EtherCAT	
Product(s): Yaskawa EtherCAT SERVOPACKs	Doc. No. TN.Sigma.01.EtherCAT

Problem 7:

- **SigmaWin+ communications over EtherCAT is slower than USB.**

Investigative & Corrective Actions:

- Increasing the EtherCAT cycle time will increase the number of times EoE packets are transmitted.
- The limitation is caused by the master implementation of either the EoE size or Dead Time.
 - Not all masters support changing the setting of either the EoE size or Dead Time.
- Graphical Example:



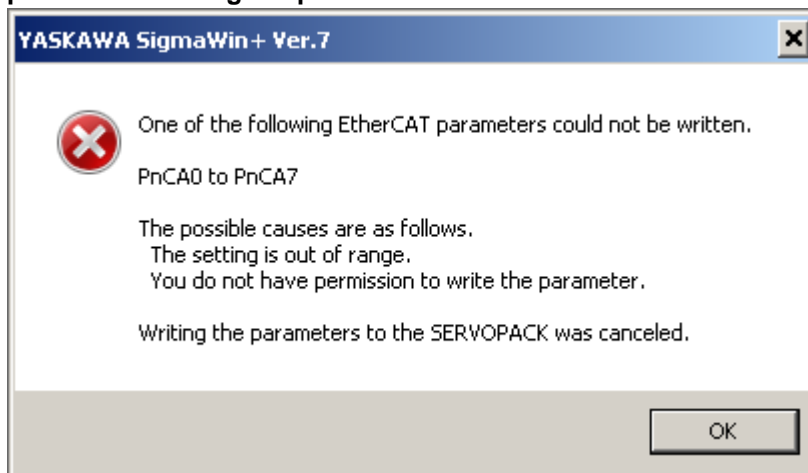
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Problem 8:

- After pushing “All Parameters” in the “Write to Servo” category, SigmaWin+ reports: One of the following EtherCAT parameters could not be written. PnCA0 to PnCA7. The possible causes are as follows. The setting is out of range. You do not have permission to write the parameter. Writing the parameters to the SERVOPACK was canceled.



Investigative & Corrective Actions:

- Check that the **Yaskawa EtherCAT SERVOPACK** is in **PRE-OP** state.
 - This can be checked from the master. Also, the **RUN** LED on the **Yaskawa EtherCAT SERVOPACK** is blinking green (200 ms on, 200 ms off) when in **PRE-OP** state.
 - Parameters **PnCA0** to **PnCA7** are mapped to PDO mapping objects. As specified by the EtherCAT specification, PDO mapping objects can only be written in **PRE-OP** state.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

Appendix B: Limitations

Yaskawa EtherCAT SERVOPACK limitations:

- Refer to [2.1. Yaskawa EtherCAT SERVOPACK Firmware Versions](#) for Yaskawa EtherCAT SERVOPACK model and version limitations.

EtherCAT Master limitations:

- Refer to [2.4. Master Requirements](#) for EtherCAT master feature requirements.

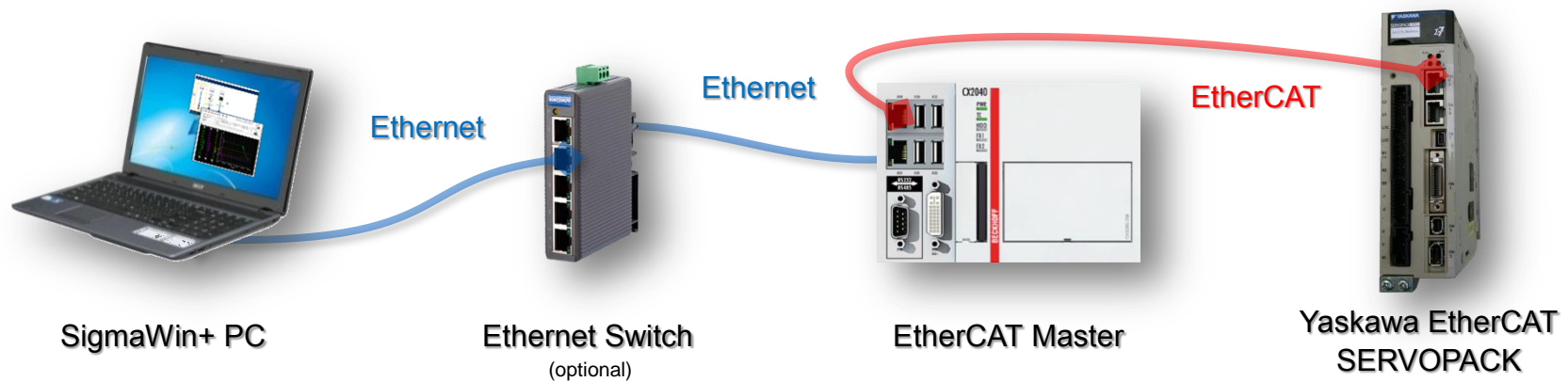
SigmaWin+ limitations:

- Refer to [2.3. Electronic Files](#) for SigmaWin+ version limitations.
- IPv6 IP addressing is not available.

Appendix C: TwinCAT 3 Example For Architecture “C–M–S”

This appendix provides a **TwinCAT 3** example for the “C–M–S” architecture.

Also refer to [4.1. Architecture "C–M–S"](#) for additional details.



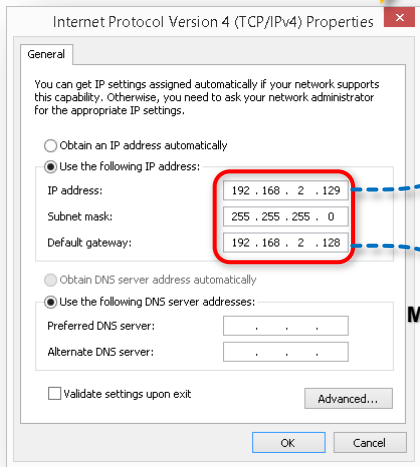
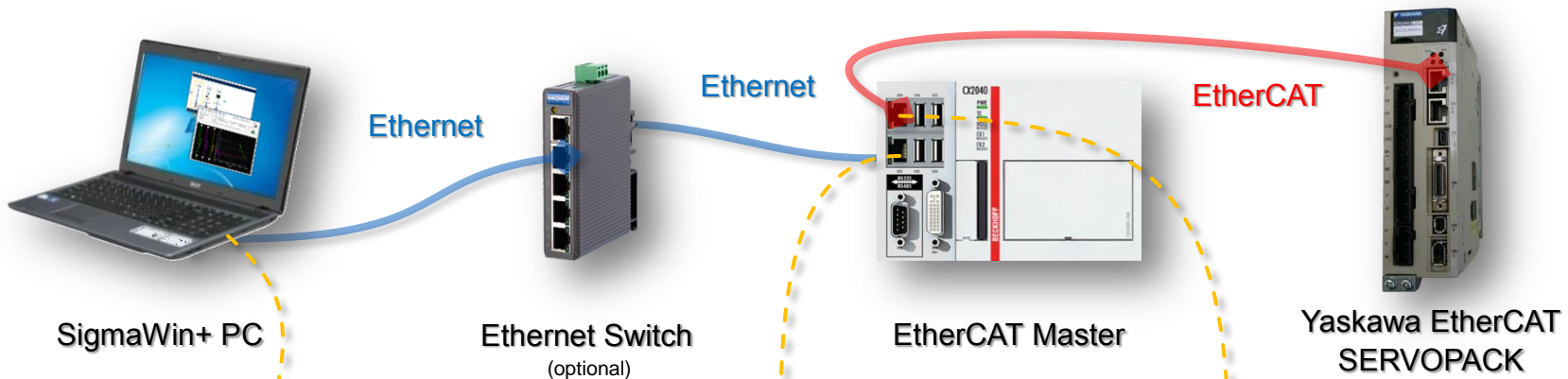
“C–M–S” architecture:

- “C” – **C**onfiguration – Configuration software **SigmaWin+** on a PC
- “M” – **M**aster – EtherCAT Master
- “S” – **S**lave – **Yaskawa EtherCAT SERVOPACK**

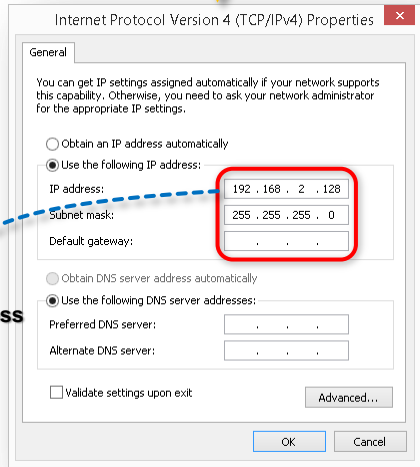
Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

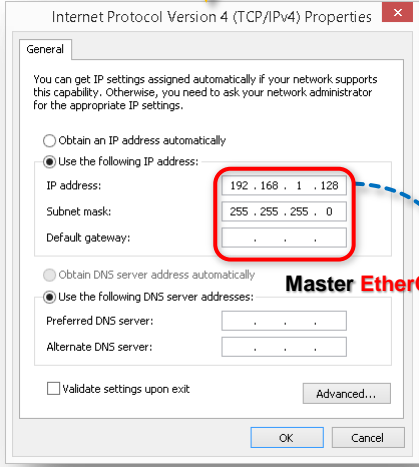
Doc. No. TN.Sigma.01.EtherCAT



SigmaWin+ PC IP Settings



Master Ethernet IP Settings



Master IP Settings (EtherCAT port)

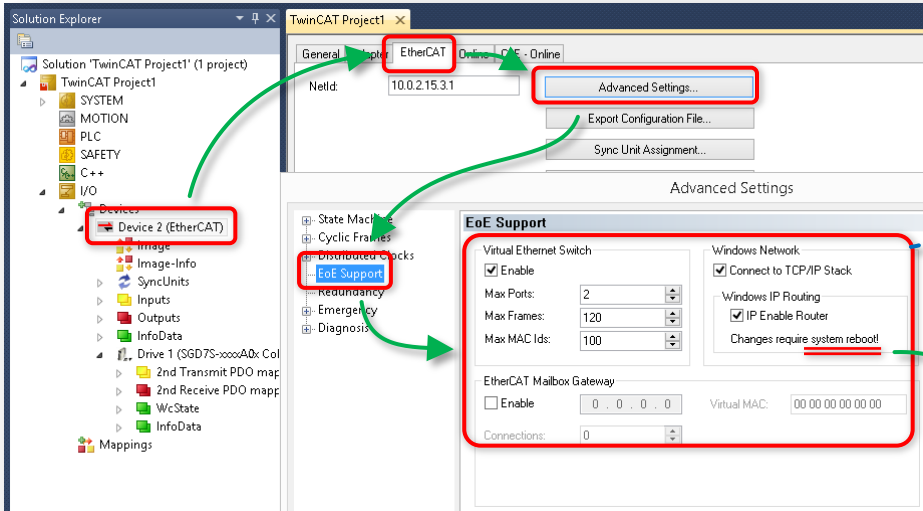
* Required for TwinCAT 3, may not be required for other masters. Also, the 3rd octet must be different from the 3rd octet of IP address of the Master Ethernet port.

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKS

Doc. No. TN.Sigma.01.EtherCAT

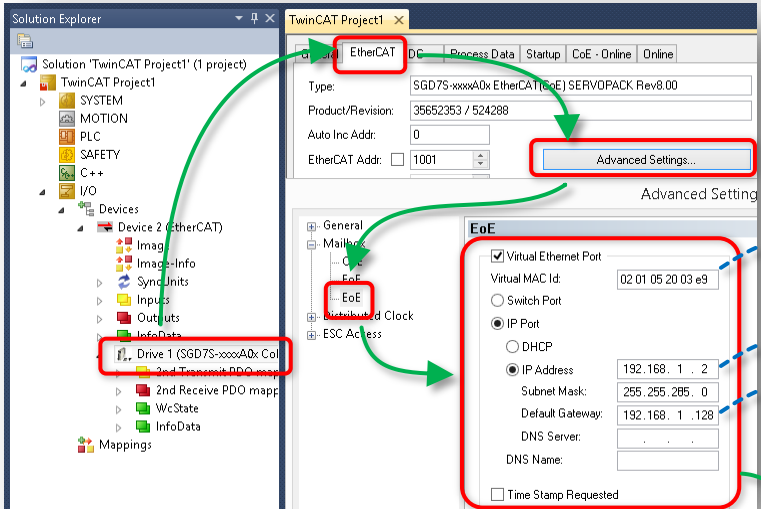
From Master: Master EoE Settings



This area contains the setup for the EoE endpoint and the routing for Ethernet packets between the Ethernet device and the EoE endpoint.



From Master: Slave EoE Settings



MAC Address
May be set automatically

Axis IP Address

Master EtherCAT port IP Address

Activate Configuration & Run

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

SigmaWin+ Settings & Connection

Communications Settings

Select the connection method.

USB Connection **Ethernet Connection** Controller Connection

Computer
Ethernet:TwinCAT-Intel PCI Ethernet Adapter (Gigabit)
IP Address: 192 . 168 . 2 . 129

SERVOPACK Type: Separate

IP Address: 192 . 168 . 1 . 2 Test (Ping)

Search for SERVOPACKs Cancel

Ethernet Connection
With this method, you connect the SigmaWin+ and SERVOPACK with an Ethernet cable.

Computer Network Settings

Change the computer network settings.

Network adapter: Ethernet

SigmaWin+ PC IP Address
IP Address: 192 . 168 . 2 . 129

Subnet Mask: 255 . 255 . 255 . 0

Master Ethernet port IP Address
Default Gateway: 192 . 168 . 2 . 128

Back up the above information when the settings are made.

Set Cancel

Communications Settings

Search for SERVOPACKs: Ethernet Connection

Search Again

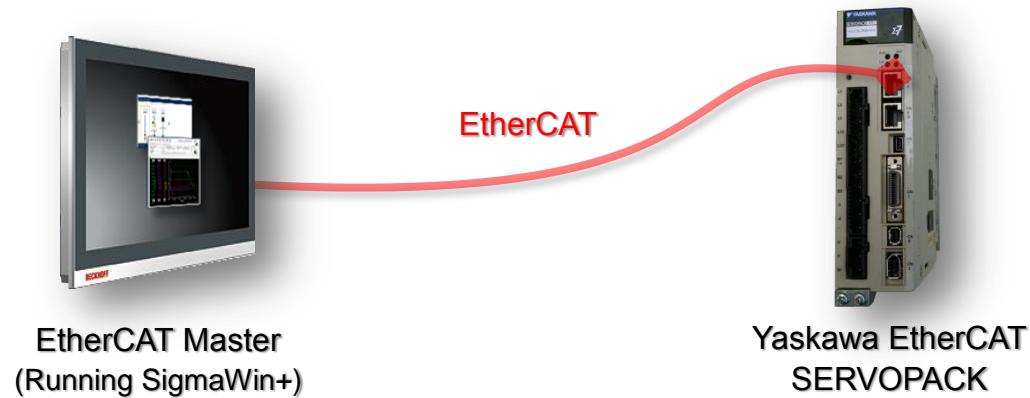
Connect	Circuit No.	Station Address	SERVOPACK	Servomotor	Options	Axis Name
<input checked="" type="checkbox"/>	---	2	SGD7S-R90AA0A	SGM7A-01A7A61	-----	-----

Connect Cancel

Appendix D: TwinCAT 3 Example For Architecture “M–S”

This appendix provides a **TwinCAT 3** example for the “M–S” architecture.

Also refer to [4.2. Architecture "M–S"](#) for additional details.



“M–S” architecture:

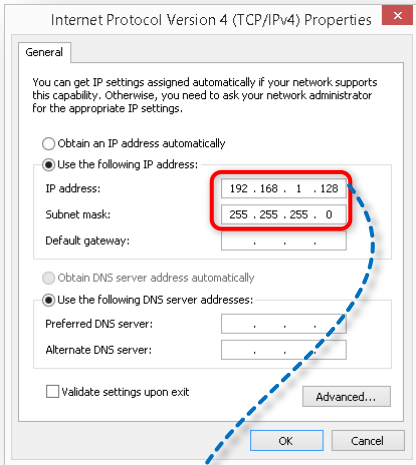
- “M” – **Master** – EtherCAT Master
- “S” – **Slave** – **Yaskawa EtherCAT SERVOPACK**

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKS

Doc. No. TN.Sigma.01.EtherCAT

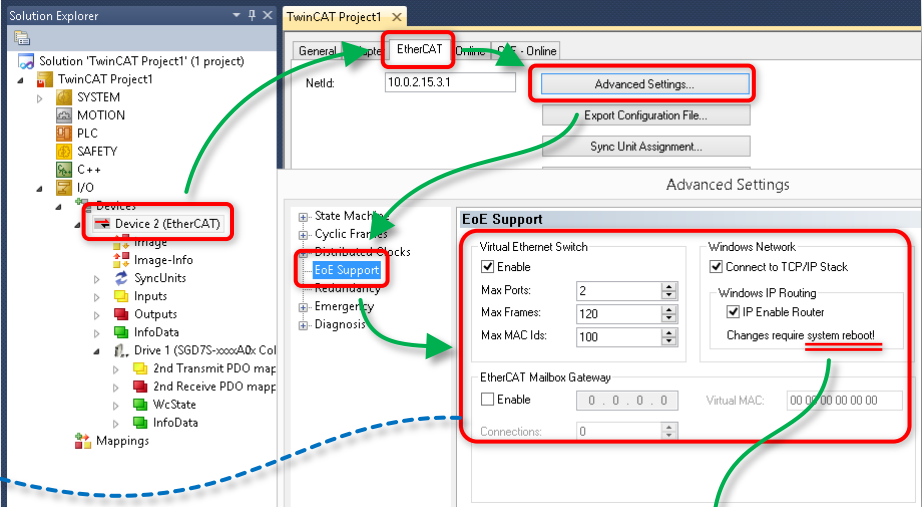
Master IP Settings (EtherCAT Port)



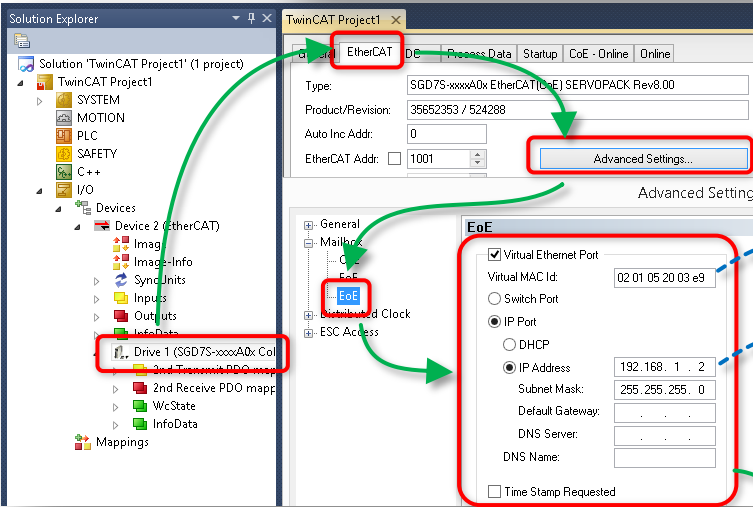
Master EtherCAT port IP Address

From Master: Master EoE Settings

This area contains the setup for the EoE endpoint and the routing for Ethernet packets between the Ethernet device and the EoE endpoint.



From Master: Slave EoE Settings



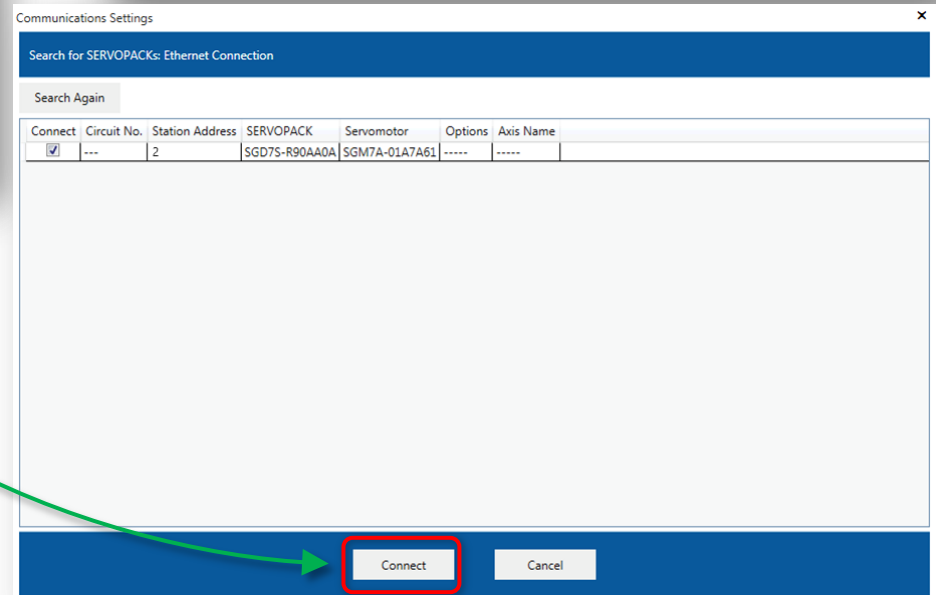
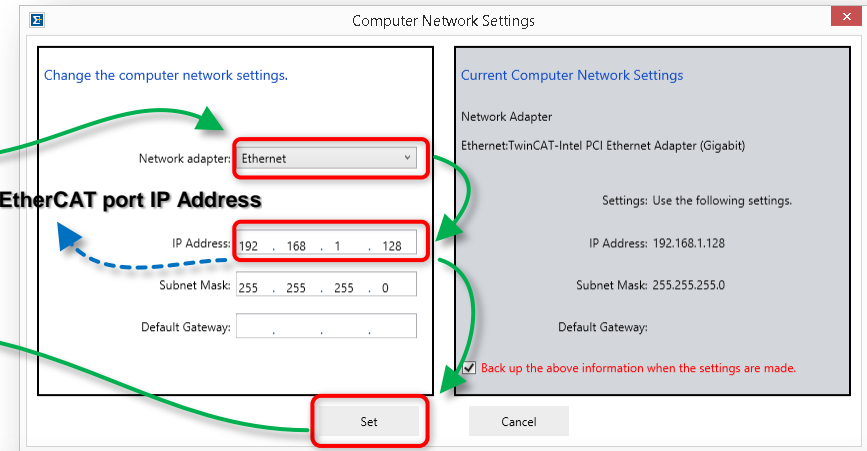
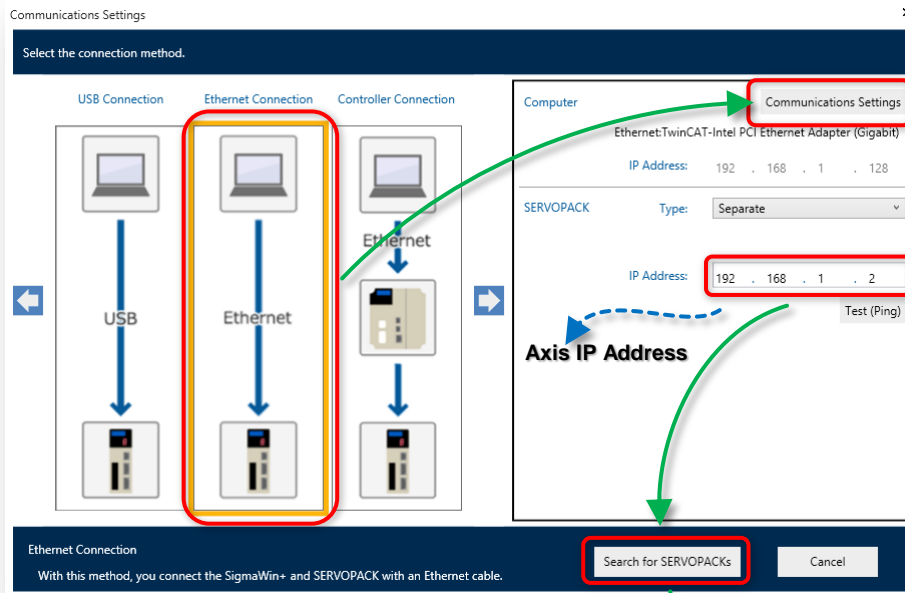
Save Reboot Open

MAC Address
May be set automatically

Axis IP Address

Activate Configuration & Run

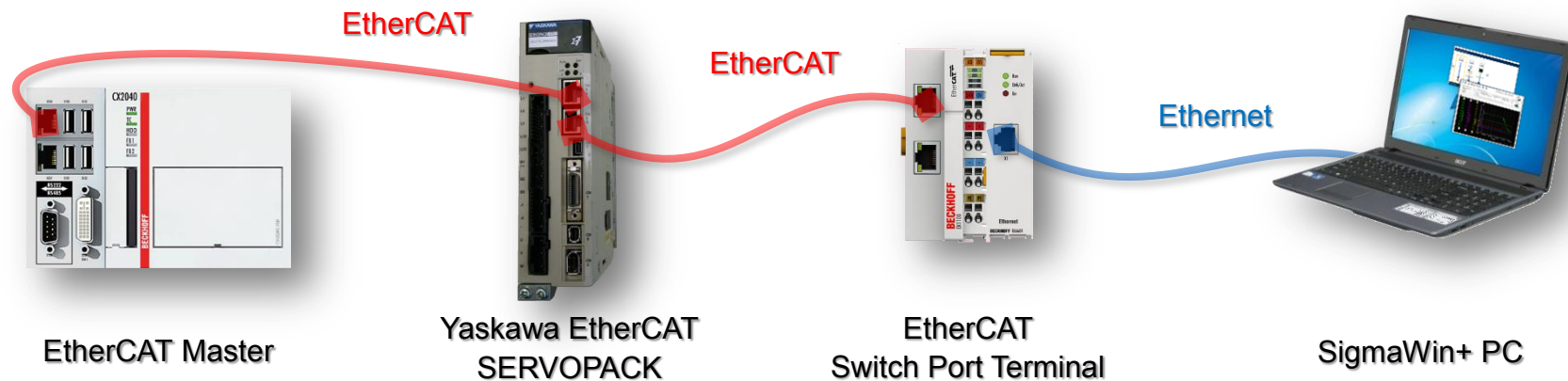
SigmaWin+ Settings & Connection



Appendix E: TwinCAT 3 Example For Architecture “M–S–E–C”

This appendix provides a **TwinCAT 3** example for the “M–S–E–C” architecture.

Also refer to [4.3. Architecture “M–S–E–C”](#) for additional details.



“M–S–E–C” architecture:

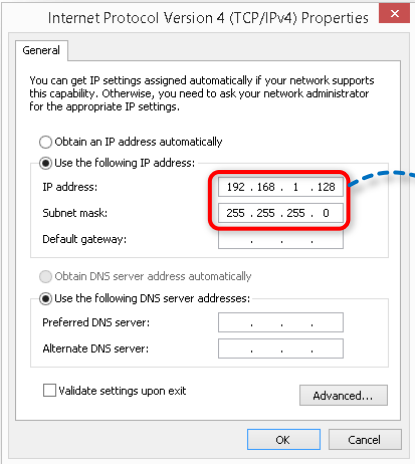
- | | | | | |
|-----|---|----------------------|---|---|
| “M” | – | Master | – | EtherCAT Master |
| “S” | – | Slave | – | Yaskawa EtherCAT SERVOPACK |
| “E” | – | EoE Module | – | EtherCAT switch port terminal |
| “C” | – | Configuration | – | Configuration software SigmaWin+ on a PC |

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

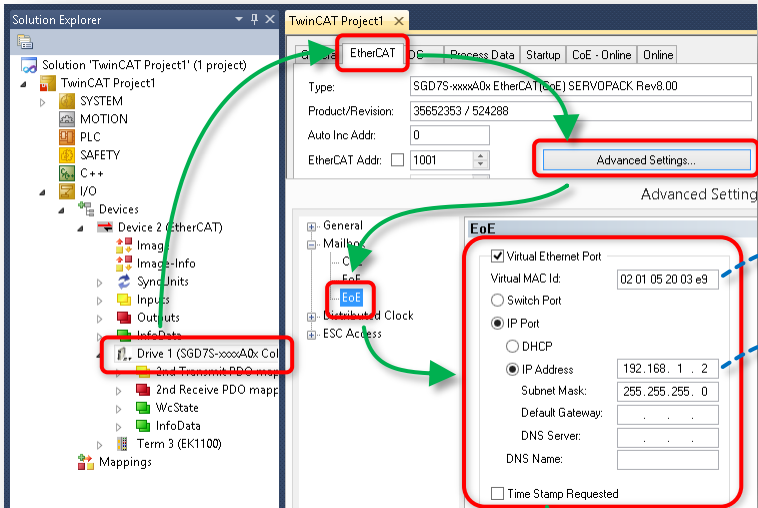
Doc. No. TN.Sigma.01.EtherCAT

SigmaWin+ PC IP Settings



SigmaWin+ PC IP Address

From Master: Slave EoE Settings



MAC Address
May be set automatically

Axis Address

Activate Configuration & Run

Title: SigmaWin+ Over EtherCAT

Product(s): Yaskawa EtherCAT SERVOPACKs

Doc. No. TN.Sigma.01.EtherCAT

SigmaWin+ Settings & Connection

