



Application Note

Firmware Change Using TwinCAT 2

Applicable Products:

Yaskawa SERVOPACKs with CANopen over EtherCAT



Product: Yaskawa SERVOPACKs with CANopen over EtherCAT	Doc#: AN.MTN.04
Title: Firmware Change Using TwinCAT 2	

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1. About This Document

This document is intended for EtherCAT Master Developers, Distributors, or End Users who require Yaskawa SERVOPACK EtherCAT firmware change for machine use, or compatibility testing.

This document does not describe firmware version release notes. For firmware version release notes, contact your Yaskawa sales representative.

2. Important Notices

1. Disconnect the servomotor from the machine or the servomotor from the Yaskawa SERVOPACK prior to applying the firmware change.
2. Installing firmware changes all CoE parameters to default (servo parameters are not affected).

If default parameters are not acceptable:

- Use SigmaWin to save existing CoE parameters prior to installing firmware.
- Use SigmaWin to write the saved CoE parameters after installing firmware.



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3. Hardware Setup

3.1. Obtain equipment:

- TwinCAT 2 software (www.beckhoff.com)
 - Example: TwinCAT 2.11 R3, Build 2241
- PC to install TwinCAT
 - PC hardware compatible with TwinCAT is necessary.
 - Refer to:

https://infosys.beckhoff.com/english.php?content=../content/1033/tcquickstart/html/tcquickstart_intro.htm&id=5660950696076406469
- Yaskawa SERVOPACK + Input power
 - Yaskawa SERVOPACK EtherCAT firmware version must be 0x00050000 or greater to accept firmware change.
 - Refer to “**Appendix C: Reading SERVOPACK EtherCAT Version**” to determine firmware version.
- Ethernet cable
- Firmware archive
 - Contains firmware file (*.bap), MD5 checksum file (*.md5), and ESI file(s).
 - Contact your Yaskawa sales representative to obtain the firmware archive.
- **Optional:** An MD5 hash generator or verification utility
 - Verify MD5 hash of firmware files

Note: ESI files are not necessary to perform firmware change.



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3.2. Setup Equipment:

- Install TwinCAT 2 with all default options
 - Leave serial number blank to use the software as demo.
 - Reboot the PC, as requested by the Installer after installation completes.
- Connect PC's EtherCAT port to Yaskawa SERVOPACK's EtherCAT IN port, with Ethernet cable.
 - Connecting additional Yaskawa SERVOPACKs to the network for updating multiple SERVOPACKs is possible.
- Apply power to the Yaskawa SERVOPACK.
- Disconnect SigmaWin (if connected) and digital operator (if connected).
- **Optional:** Use an MD5 generator to verify MD5 hash of firmware file with the *.md5 file in the firmware archive.
 - **Note:** Yaskawa does not provide an MD5 generator. MD5 generators are typically available as free utilities obtainable from the Internet.

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3.3. Check Compatibility:

Certain hardware versions (module hardware revisions) support certain firmware versions. Check that the hardware version is compatible with the firmware version to be applied.

3.3.1. Hardware Version Check

To check the hardware version, remove the card cover and examine the board.

The hardware version is visible from the back of the card.

Below is an example of hardware version **REV. B**.





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3.3.2. Hardware Compatibility With Firmware Version

For the table below, the entries mean the following:

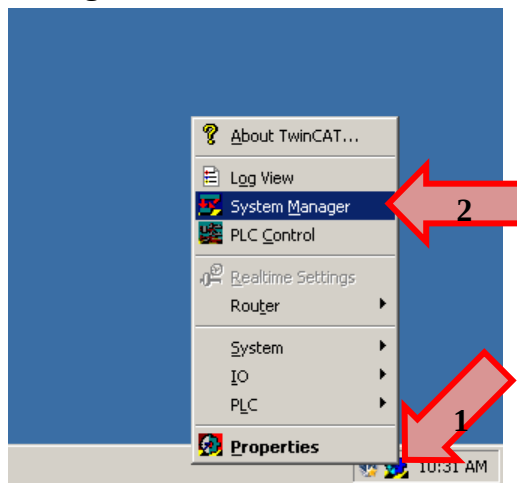
No: Indicates the Hardware Version MAY NOT be changed to this Firmware Version.

Yes: Indicates the Hardware Version may be changed to this Firmware Version.

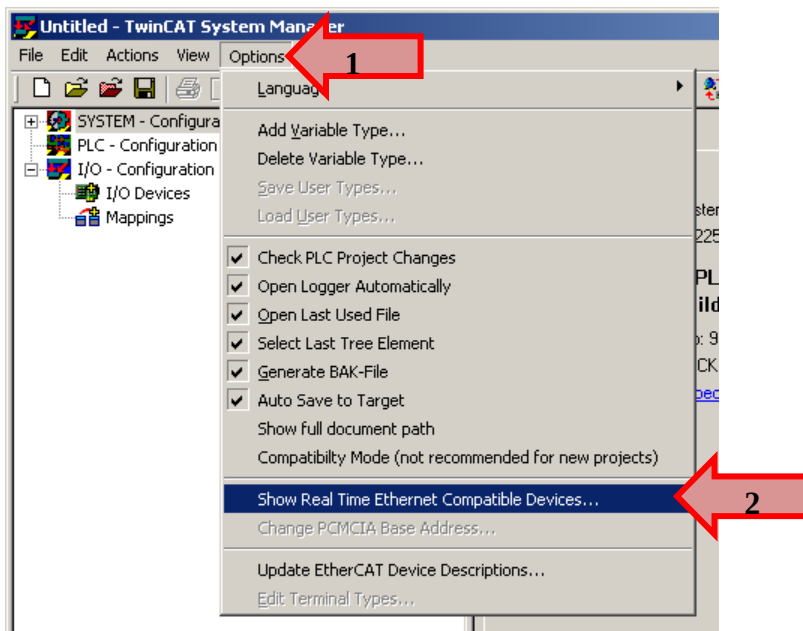
		Hardware Version		
		REV. A	REV. B	REV. C
Firmware Version	5.00	No	Yes	No
	5.04	No	Yes	No
	6.00	No	Yes	No
	6.03	No	Yes	Yes
	7.00	No	Yes	No
	7.01	No	Yes	Yes

4. TwinCAT Setup

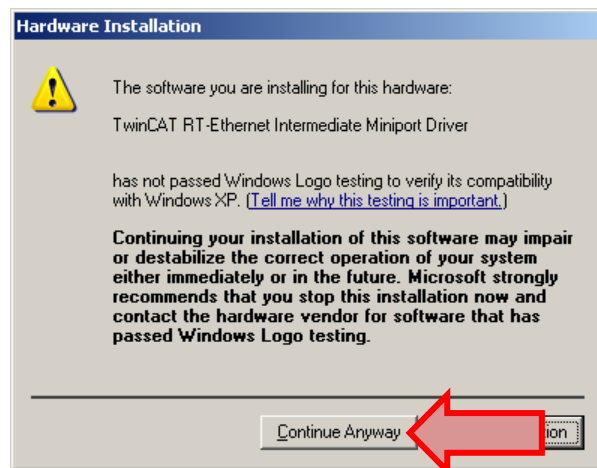
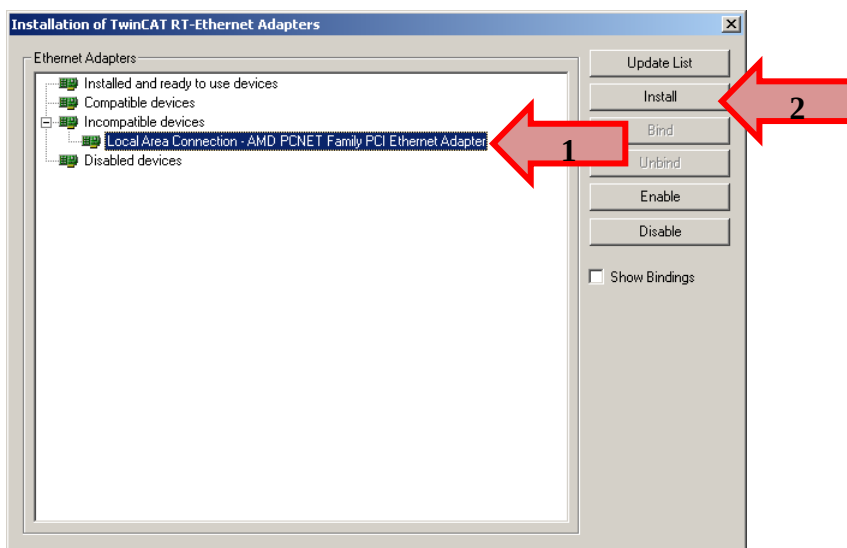
- Run TwinCAT system manager
 - Example: Right-click the **TwinCAT icon** in the system tray and select “**System Manager**”.



- From the “**Options**” menu, select “**Show Real Time Ethernet Compatible Devices...**”



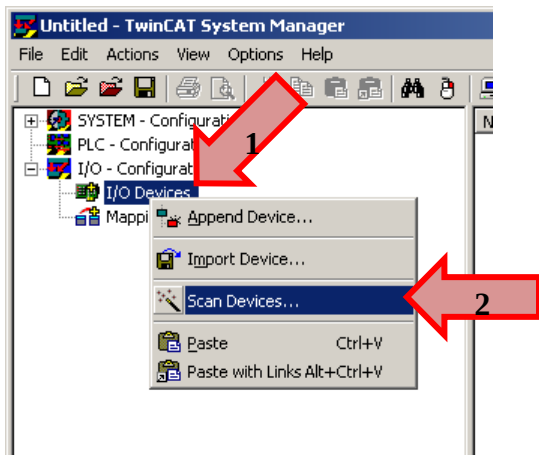
- Select the Ethernet adapter (may appear under either “Compatible devices” or “Incompatible devices”).
- Click the button “Install”, and “Continue Anyway” in the pop-up window, then close the “Installation of TwinCAT RT-Ethernet Adapters” window.



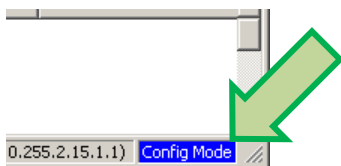
- If this step fails, the PC may not be compatible. Refer to: https://infosys.beckhoff.com/english.php?content=../content/1033/tcquickstart/html/tcquickstart_intro.htm&id=5660950696076406469

5. Connect TwinCAT to Yaskawa SERVOPACK

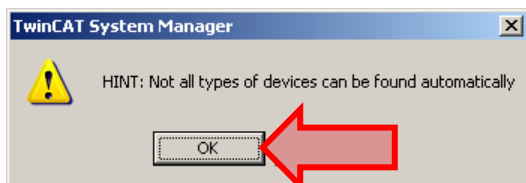
- Right-click “I/O Devices” and select “Scan Devices...”



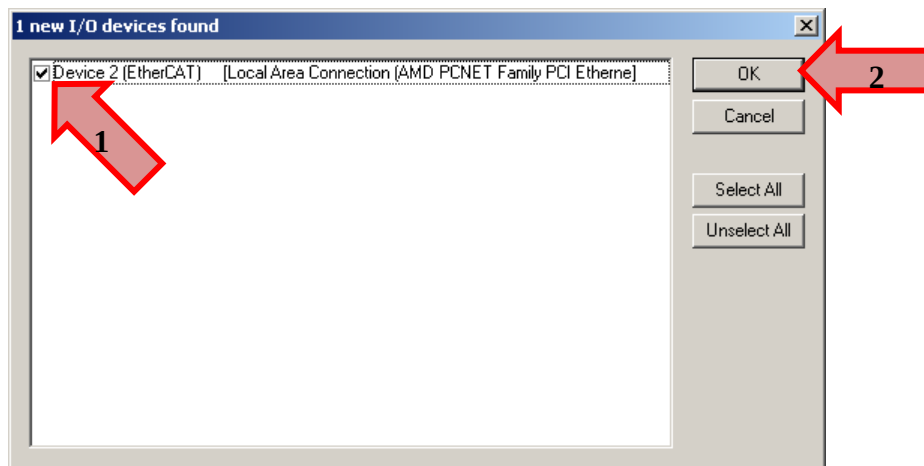
Note: If “Scan Devices...” is grayed out, change TwinCAT to Config mode by pressing Shift+F4, pressing “OK” to the pop-up, and waiting for the lower-right corner of TwinCAT to state, “Config Mode”.



- Click “OK” in the pop-up.

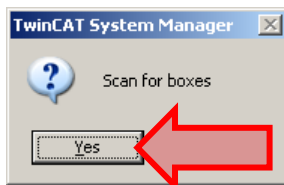


- Select the device with “**(EtherCAT)**” following the device number, then click “**OK**”.



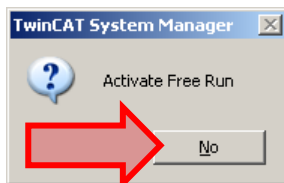
Note, if the value in the parentheses states, “**RT-Ethernet**”, refer to “**Appendix A: Troubleshooting TwinCAT**”

- Click “**Yes**” to scan for boxes (slave devices on the network).



Note: If devices were found that have associated ESI files loaded into TwinCAT, then another option box appears, asking to “**Append linked axes to NC-Configuration**”. Select either option in that option box.

- Click “**No**” when TwinCAT shows the “**Activate Free Run**” option box.



Note: Selecting “**Yes**” may prevent the SERVOPACK from remaining in “**BOOT**” state, necessary for firmware modification.

6. Prepare Yaskawa SERVOPACK

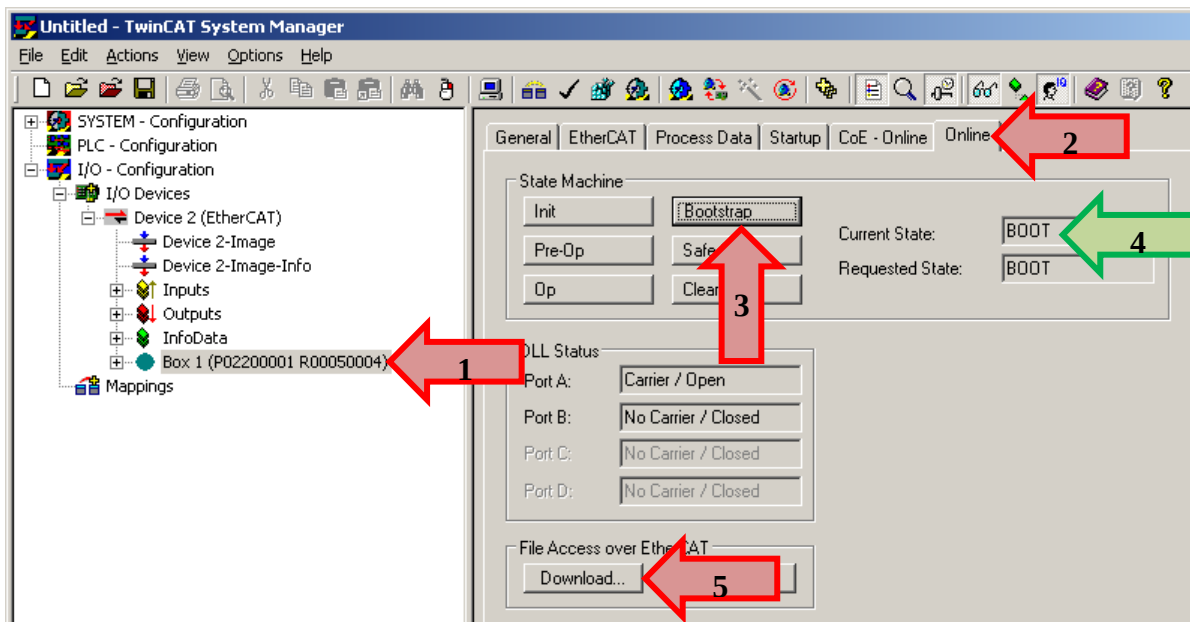
- (1) Select the Yaskawa SERVOPACK under the EtherCAT device in the I/O Devices tree.
Note: If the SERVOPACK's ESI file was not loaded into TwinCAT, **"Box"** will appear.
Select **"Box"**.

In addition, the current firmware can be determined at this point. Refer to **"Appendix C: Reading SERVOPACK EtherCAT Version"**.

(2, 3) Select the **"Online"** tab, then press the **"Bootstrap"** button.

(4) Check that the **"Current State"** reads **"BOOT"**.

(5) Click the **"Download..."** button.



Note: If the **"Current State"** does not read **"BOOT"** after the above procedure step 4, refer to **"Appendix A: Troubleshooting TwinCAT"**.

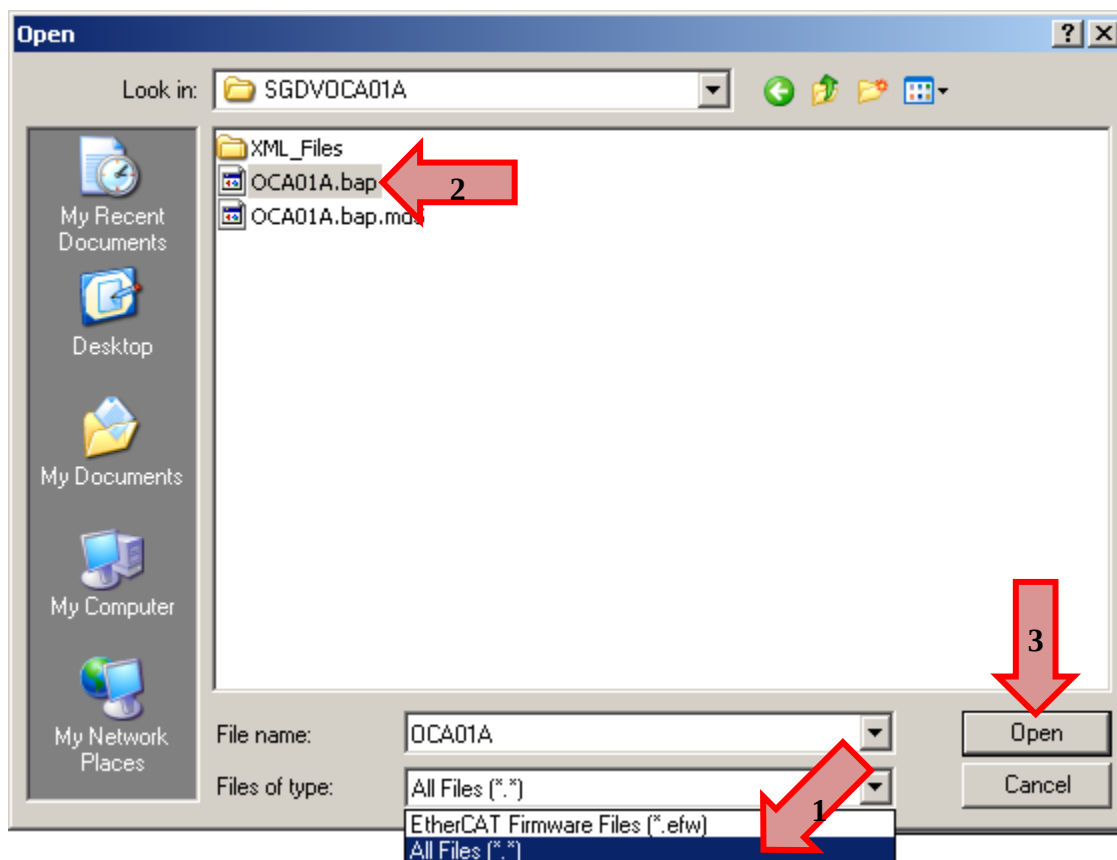
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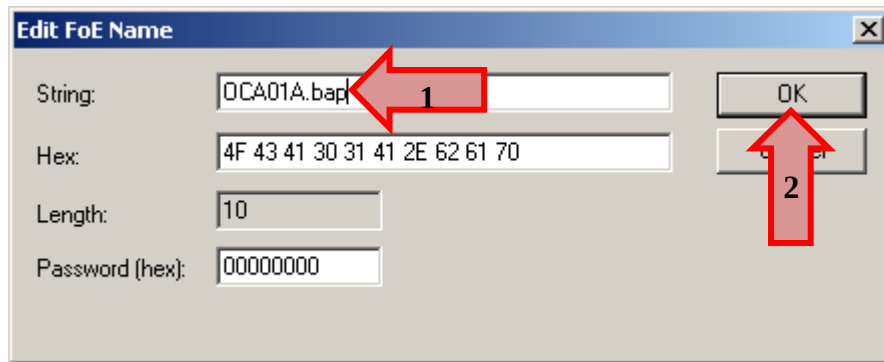
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7. Yaskawa SERVOPACK Firmware Installation

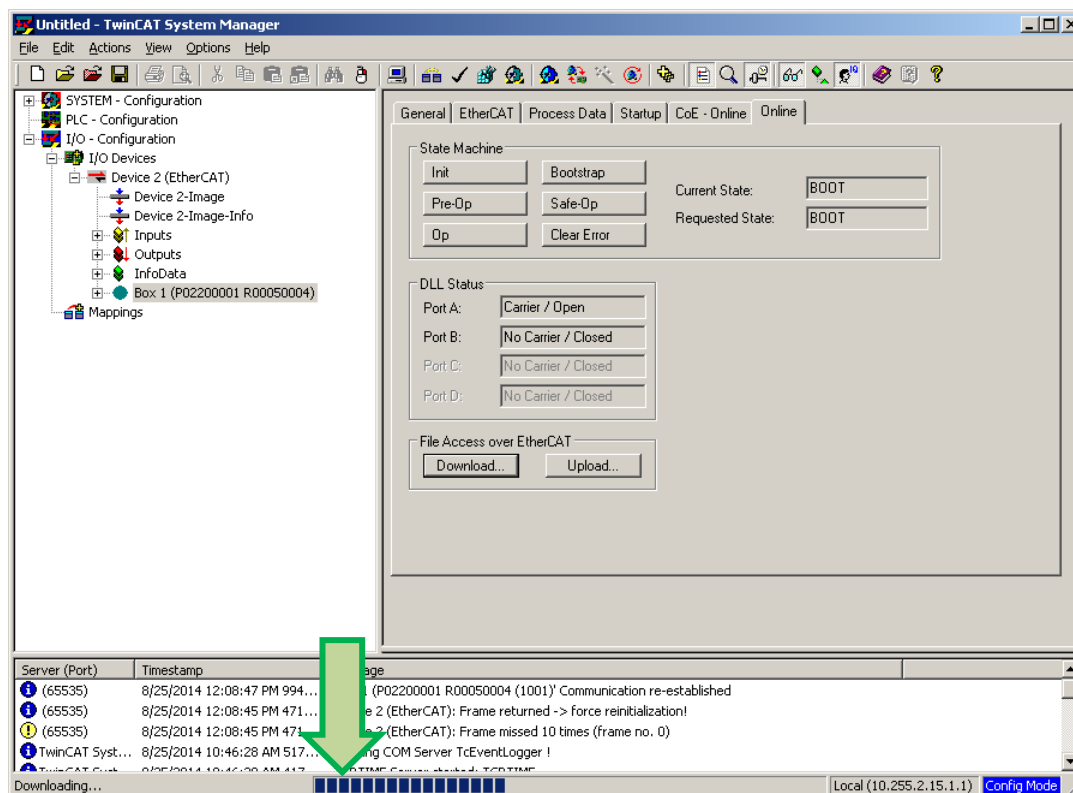
- (1) Select “All Files (*.*)” from the “Files of type:” dropdown box.
Navigate to the location of the firmware file (*.bap file).
- (2) Select the file.
- (3) Click “Open”.



- Add “.bap” to the “String:” field (the result is: OCA01A.bap), then click “OK”.



- A progress bar appears in the Status strip to indicate the progress of the file transfer.
Note: The duration of the file transfer is approximately 30 seconds.



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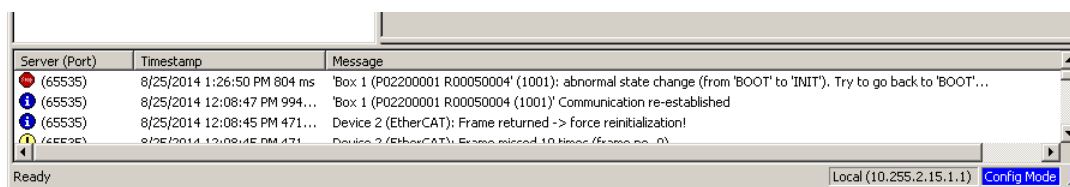
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- After the progress bar completes, the following occurs:
 - The Yaskawa SERVOPACK will write the transferred file to the device, which takes approximately 25 seconds.
 - The Yaskawa SERVOPACK will reboot after the writing.
 - The EtherCAT communications will be interrupted when the Yaskawa SERVOPACK reboots.

Note: TwinCAT may output an error message when communications is interrupted.

This message may depend on if the ESI file was loaded into TwinCAT or not.

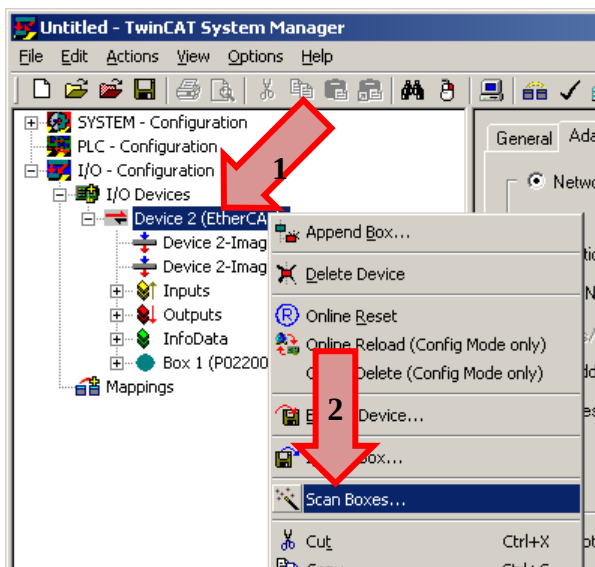
The image below shows the message at the top of the Logger Output window after the SERVOPACK reboots, if the ESI file was not loaded into TwinCAT.



- If no indications exist that the Yaskawa SERVOPACK rebooted, see “**Appendix B: Troubleshooting SERVOPACK**”.

8. Verify Yaskawa SERVOPACK Firmware

- Right click the **EtherCAT** device under “I/O Devices”.
Select “**Scan Boxes...**”



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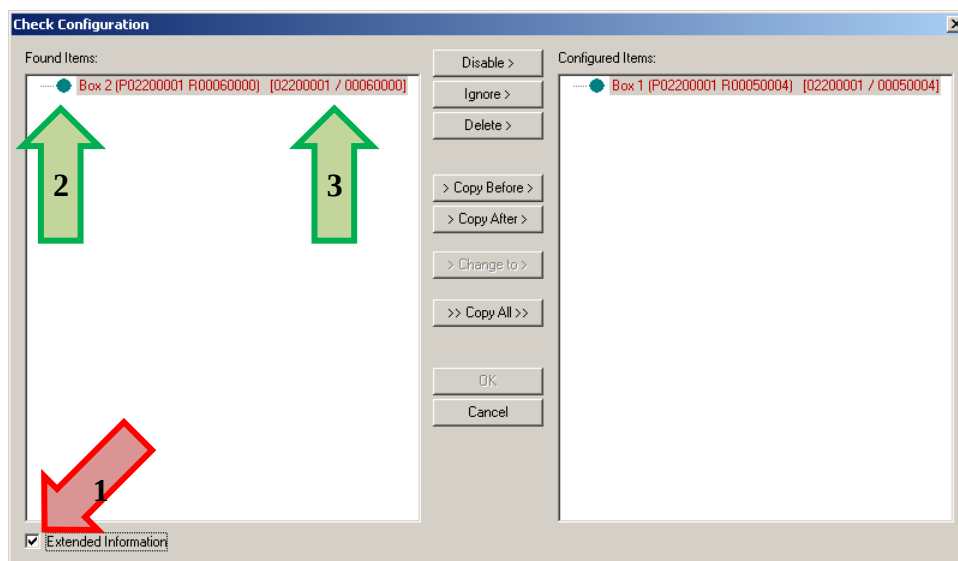
- (1) Select the “**Extended Information**” checkbox at the bottom of the window.
- (2) The “**Found Items:**” list shows the current information of the slaves on the network.
- (3) The value that appears in the brackets is in Hexadecimal format, and shows the “**Product code**” and “**Revision number**” which correspond to the CANopen over EtherCAT objects:
 - 1018:02h “Identity Object: Product code”
 - 1018:03h “Identity Object: Revision number”

The “Revision number” is in the format: xxxzzzyy (hex), where:

- xxxx: Major revision
- zz: Minor revision, High
- yy: Minor revision, Low
- Example: 00050004

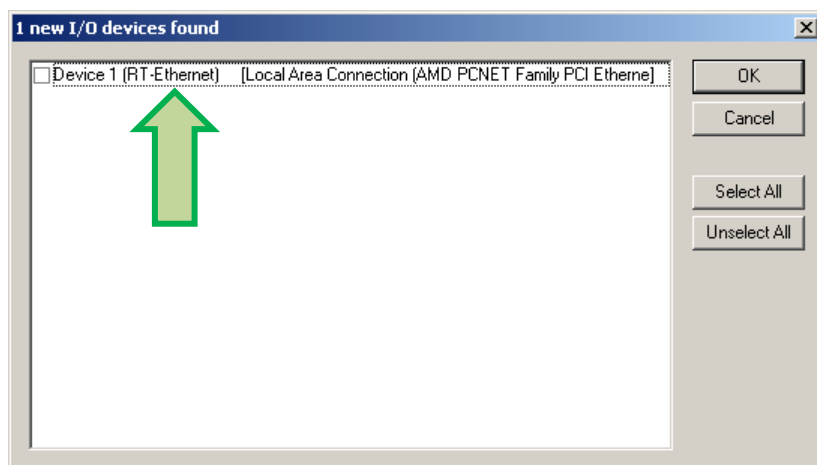
Yaskawa SERVOPACK EtherCAT versions are currently specified as: xxxz.yy, where:

- xxxx: Major revision, without leading zeroes
- yy: Minor revision, Low
- Examples:
 - “Revision number” 00050004 corresponds to Yaskawa SERVOPACK EtherCAT version 5.04.
 - “Revision number” 00060000 corresponds to Yaskawa SERVOPACK EtherCAT version 6.00.



Appendix A: Troubleshooting TwinCAT

- **Issue:** In section “5. Connect TwinCAT to Yaskawa SERVOPACK”, after the step, “Click ‘OK’ in the pop-up”, “(RT-Ethernet)” appears rather than “(EtherCAT)”.

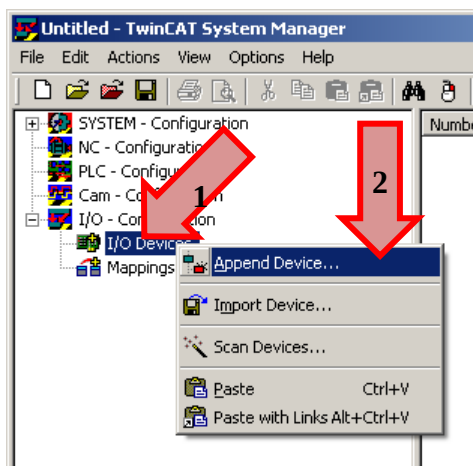


- **Solution:** First verify the following:
 - Verify:
 - The correct Ethernet port on the PC with TwinCAT is connected to the Yaskawa SERVOPACK’s IN port.
 - Consider using a different Ethernet port on the PC.
 - Remove all other devices on the EtherCAT network.
 - The Yaskawa SERVOPACK is powered on.
 - For SGD V, the 7-segment display has some segments lit.

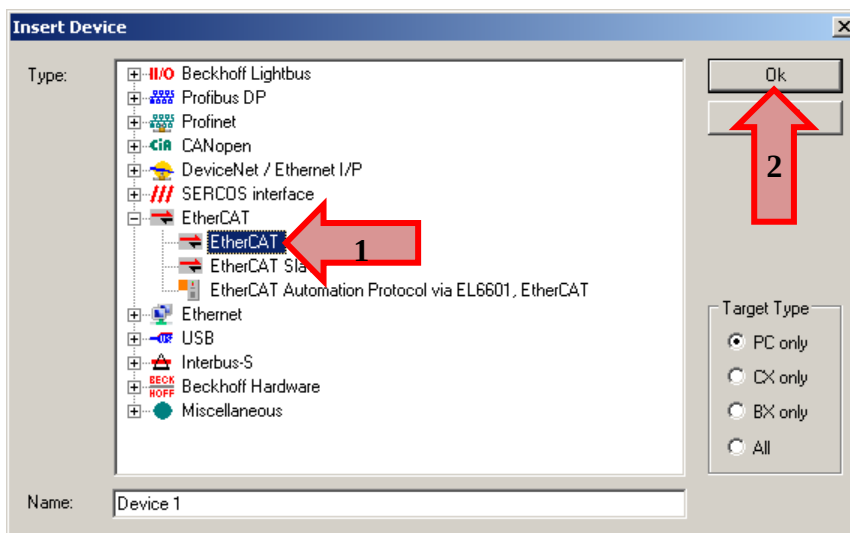
- After the previous verification, if repeating the procedure “5. **Connect TwinCAT to Yaskawa SERVOPACK**” still produces this issue, then proceed to add the EtherCAT Adapter manually by following the procedure:

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

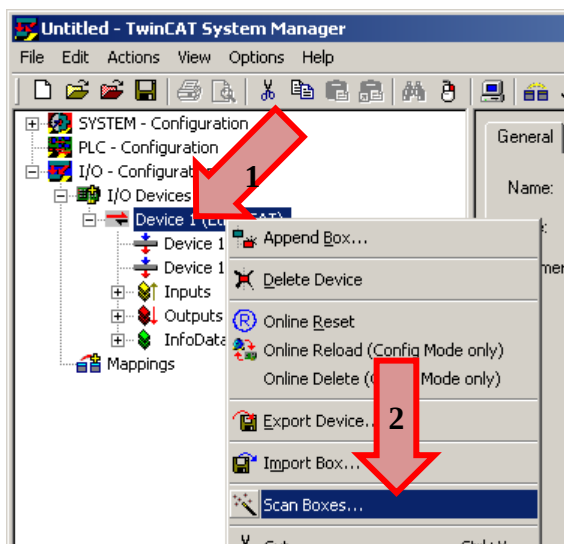
Select “**Append Device...**”



- Select “**EtherCAT**” under the “**EtherCAT**” category, then click “**Ok**”.

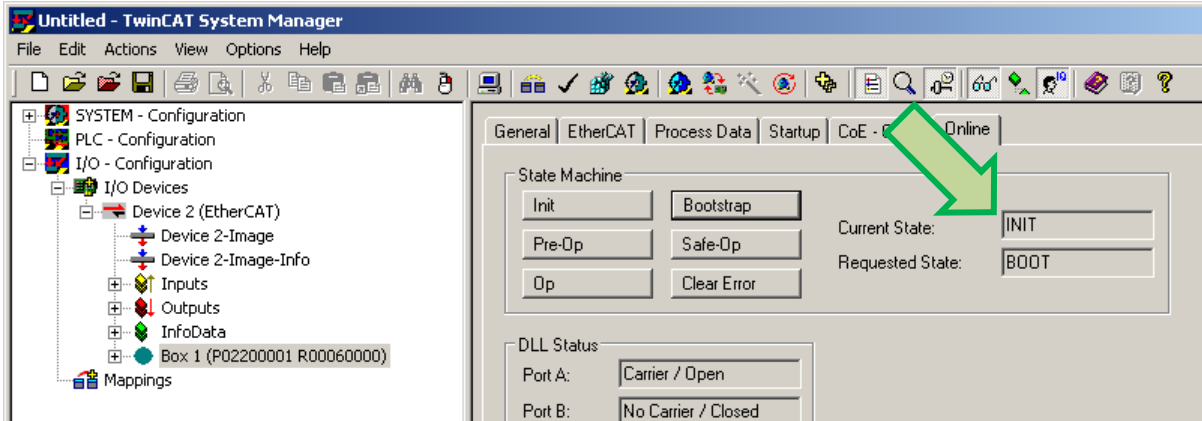


- Right-click the EtherCAT device.
Select **“Scan Boxes...”**

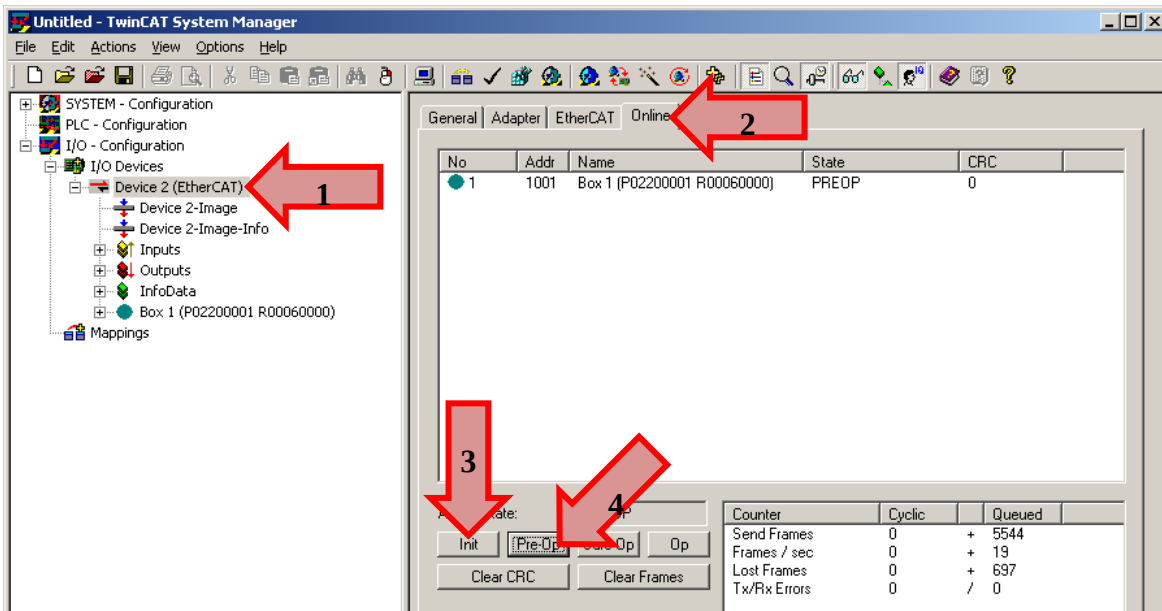


- Proceed with the step **“Click ‘No’ when TwinCAT shows the ‘Activate Free Run’ option box.”** in step **“5. Connect TwinCAT to Yaskawa SERVOPACK”** above, and proceed with the steps normally.

- **Issue:** In section “6. Prepare Yaskawa SERVOPACK”, after the step “Select the “Online” tab, then press the “Bootstrap” button.”, the “Requested State:” states “BOOT”, but the “Current State:” does not read “BOOT”.



- **Solution:** Select the EtherCAT device under “I/O Devices”. Select the “Online” tab, click “Init”, then click “Pre-OP”.



- Redo the steps in “6. Prepare Yaskawa SERVOPACK” and proceed with the steps normally.



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Appendix B: Troubleshooting SERVOPACK

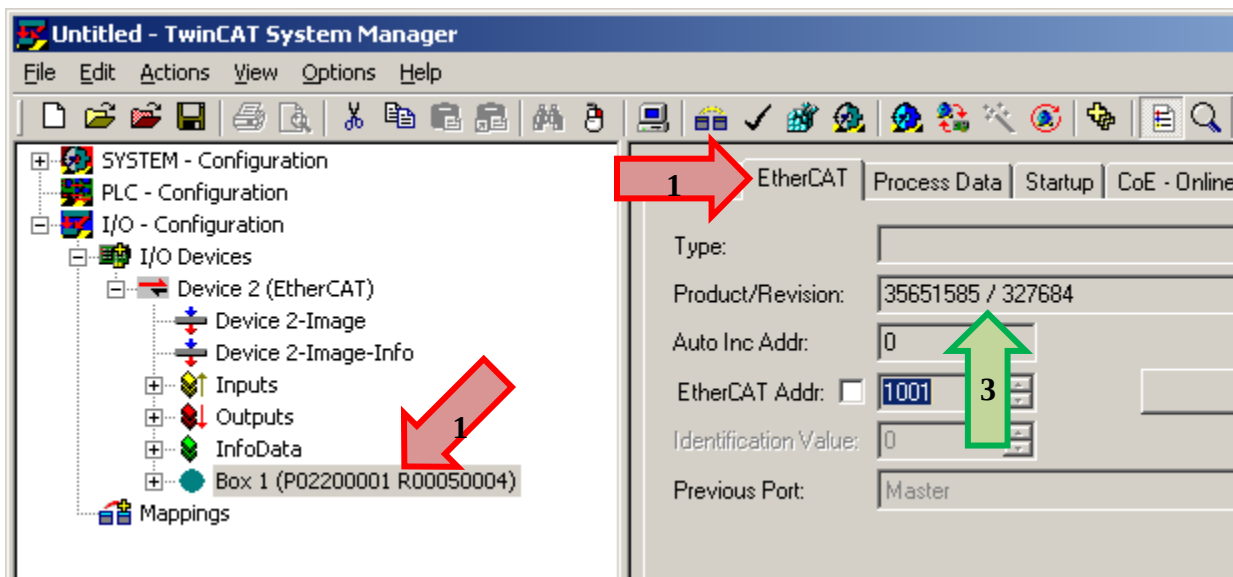
- **Issue:** In section “7. Yaskawa SERVOPACK Firmware”, in the step “**After the progress bar completes, the following occurs:**”, no indications exist that the Yaskawa SERVOPACK rebooted.
- **Solution:** If using a USB communications cable, disconnect the cable. If using a Digital Operator, disconnect the Digital Operator. If using serial communications, disconnect the cable.

After performing the above items, proceed with section “6. Prepare Yaskawa SERVOPACK”, step “**Click the ‘Download...’ button.**”, and proceed with the steps normally.

Appendix C: Reading SERVOPACK EtherCAT Version

The Yaskawa SERVOPACK EtherCAT firmware version can be read by the following procedure:

- After performing the steps prior to “6. Prepare Yaskawa SERVOPACK”, selecting the slave, then the “**EtherCAT**” tab will show the “**Product/Revision:**”, which shows the Yaskawa SERVOPACK’s “**Product code**” and “**Revision number**”.



- The “**Revision number**” is displayed in decimal.
- Details about the “**Product code**” and “**Revision number**” are found in “8. Verify Yaskawa SERVOPACK Firmware”.



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Appendix D: SERVOPACK Alarms & AL Status Codes

SERVOPACK alarms:

Alarm Code	Alarm Name	Cause	Investigative Action	Corrective Action
A.A51	Firmware change system error.	Fault occurred in the EtherCAT (CoE) Network Module.	--	Repair or replace the EtherCAT (CoE) Network Module.
		Firmware update function not compatible with hardware and installed firmware	Manufacturing date is newer than 2020.08, and Soft Version is 0007 (Check in SigmaWin+ Product Information for the EtherCAT module)	Contact Yaskawa Support
A.A52	Factory firmware image booted up.	Power supply turned off during firmware change.	Check SERVOPACK wiring.	Execute firmware change again.
A.A53	Firmware change procedure or file format error.	• Incorrect file extension, non *.bap file. • Incompatible *.bap file and option card. • *.bap file contents is corrupted. • *.bap file was downloaded while not in BOOT mode.	Verify that *.bap file is correct.	Execute firmware change again.
A.A54	Flash size insufficient for firmware change.	Hardware version of the EtherCAT (CoE) Network Module is incompatible with firmware change function.	--	Contact Yaskawa Sales Representative.





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AL Status Codes:

The following AL Status codes notify the EtherCAT master that a problem has occurred during firmware change.

- 0x9000: Unexpected file sent though FoE (file extension was not .bap)
- 0x9001 – 0x9004: Incorrect or corrupt firmware file.
- 0x9005 – 0x9006: Internal error.
- 0x9007: Incorrect or corrupt firmware file.
- 0x9008: Firmware change aborted due to state change (e.g. from Pre-Op state or Bootstrap state).
- 0x9009: A firmware file was discovered upon entering Bootstrap or Pre-Op state. It is assumed that the firmware file was sent though FoE in a state other than Bootstrap or Pre-Op and has been deleted.
- 0x900A: Internal error.
- 0x900B: Hardware does not support firmware change.
- 0x900D: Internal error.
- 0x900E: Internal error.
- 0x900F: Incompatible FoE update situation (e.g. Flashing FW 6.00 or 7.00 to incompatible hardware; flash FW 6.03 or 7.01 instead)