ICOP Technology Inc.

Start Guide

EK1814 : EtherCAT Coupler with integrated digital inputs/outputs with 86EVA

86Duino Coding IDE 501

EtherCAT Library

(Version 1.0)

Revision

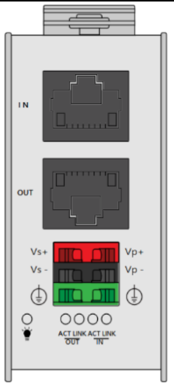
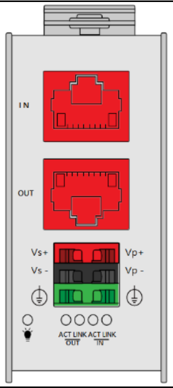
Date	Version	Description
2025/12/22	Version1.0	New release.

Preface

In this guide, we will show you how to use the EtherCAT MDevice **QEC-M-01** and the **EK-1814** series (EtherCAT Coupler with integrated digital inputs/outputs).

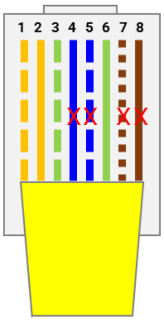
Notes QEC’s PoE (Power over Ethernet)

In QEC product installations, users can easily distinguish between PoE and non-PoE: if the RJ45 house is red, it is PoE type, and if the RJ45 house is black, it is non-PoE type.

	
Non-PoE type	PoE type

PoE (Power over Ethernet) is a function that delivers power over the network. QEC can be equipped with an optional PoE function to reduce cabling. In practice, PoE is selected based on system equipment, so please pay attention to the following points while evaluating and testing:

1. The PoE function of QEC is different and incompatible with EtherCAT P, and the PoE function of QEC is based on PoE Type B, and the pin functions are as follows:



T568B Color

PINS	10/100 DC on Spares (Mode B)
1	Rx+
2	Rx-
3	Tx+
4	DC+
5	DC+
6	Tx-
7	DC-
8	DC-

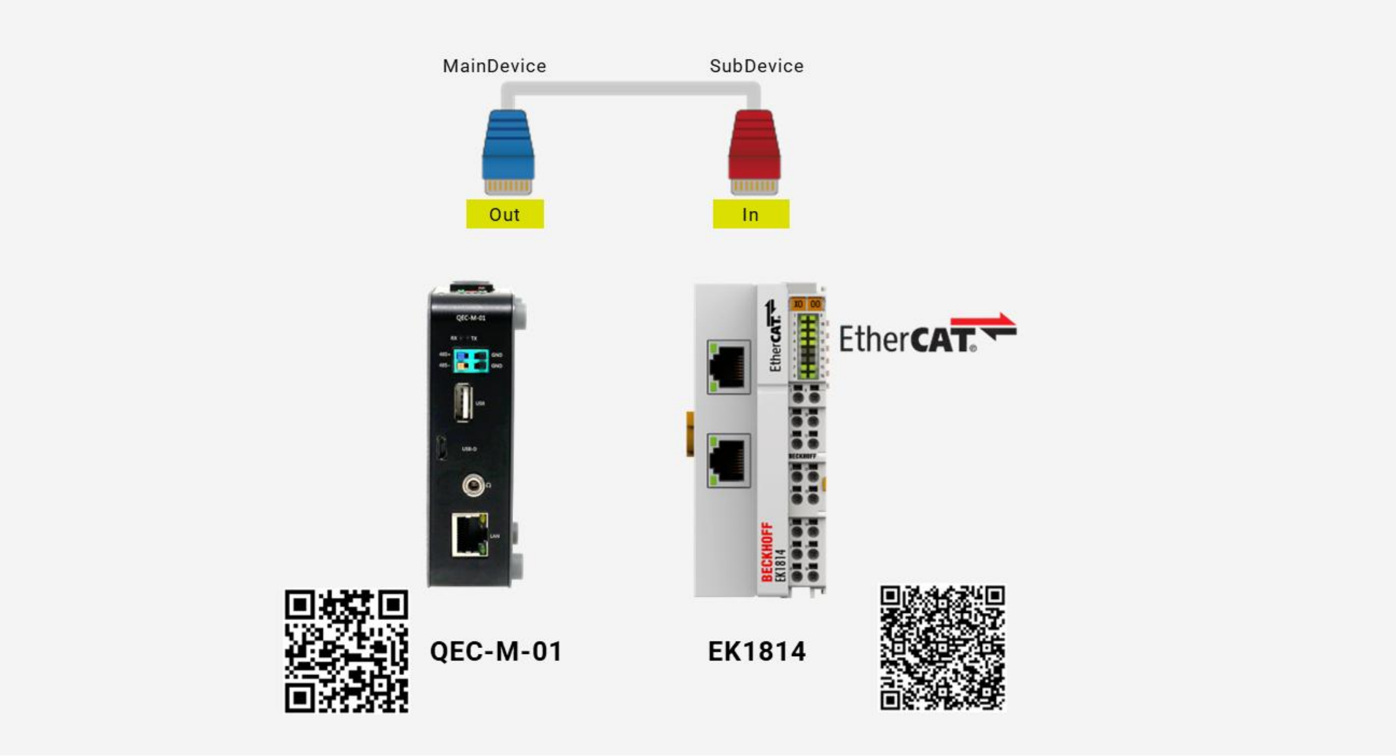
2. When connecting PoE and non-PoE devices, make sure to disconnect Ethernet cables at pins 4, 5, 7, and 8 (e.g., when a PoE-supported QEC EtherCAT MDevice connects with a third-party EtherCAT SubDevice).

3. QEC’s PoE power supply is up to 24V/3A.

1. Connection and wiring hardware

The following devices are used here:

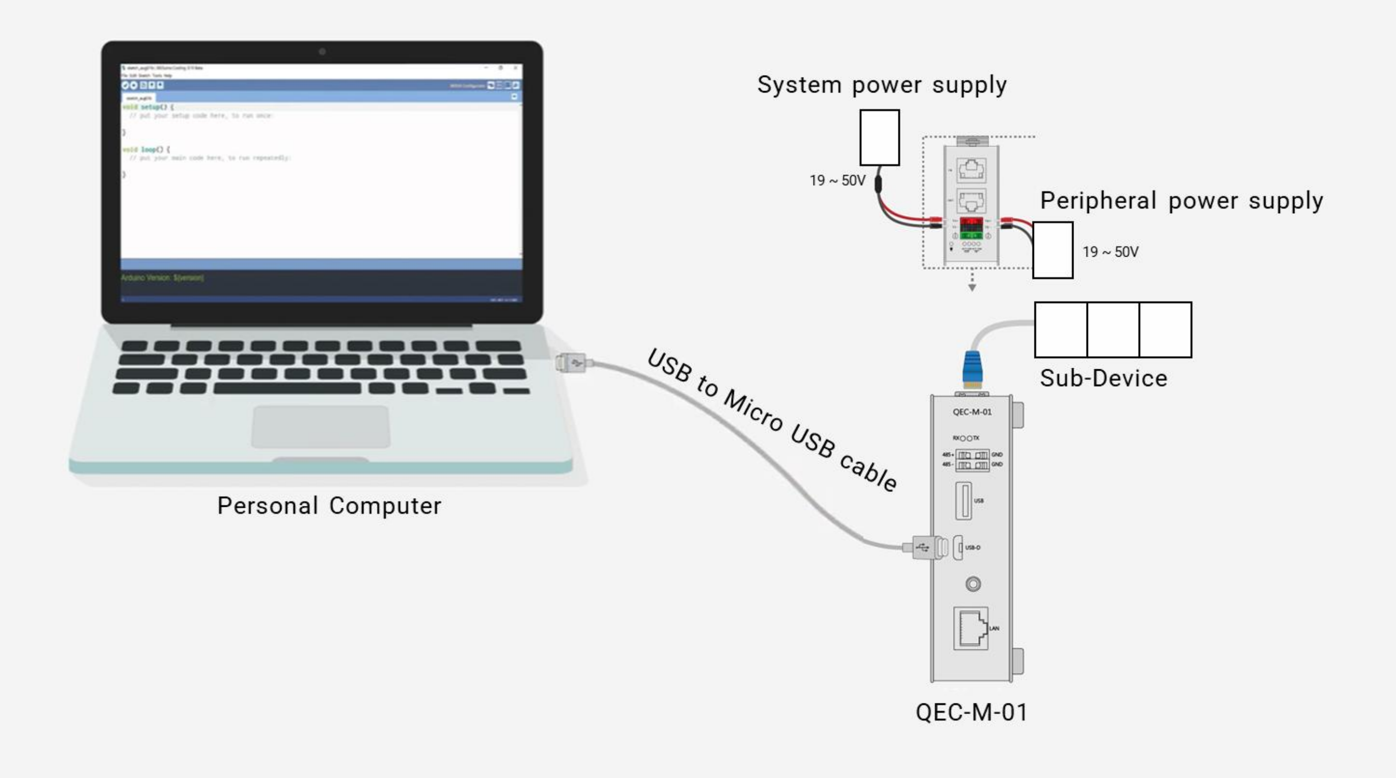
1. QEC-M-01 (EtherCAT MDevice)
2. EK-1814 series (EtherCAT Coupler with integrated digital inputs/outputs)
3. 24VDC power supply & EU-type terminal cable & LAN cable



1.1 QEC-M-01

QEC EtherCAT MDevice.

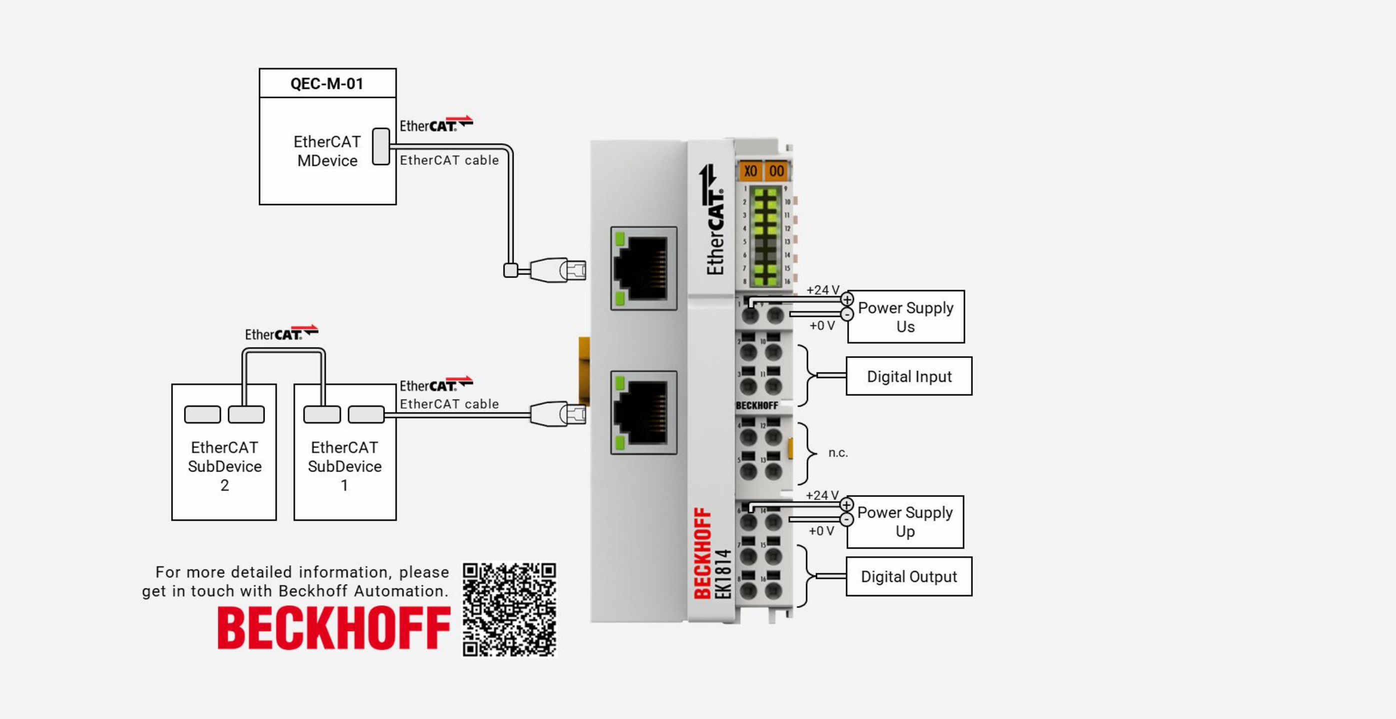
1. Power Supply: Connect to Vs+/Vs- and Vp+/Vp- power supplies via EU terminals for 24V power.
2. EtherCAT Connection: Using the EtherCAT Out port (On the top side) connected to the EtherCAT In port of EtherCAT SubDevice via RJ45 cable.



1.2 EK1814

The **Beckhoff EK1814** is an EtherCAT Coupler featuring **integrated digital I/O** (DI/DO). It can be used as an EtherCAT SubDevice in a QEC EtherCAT network to provide basic discrete input sensing and output driving.

The diagram shows a typical wiring example with a **QEC MDevice (e.g., QEC-M-01)** and an EtherCAT network.

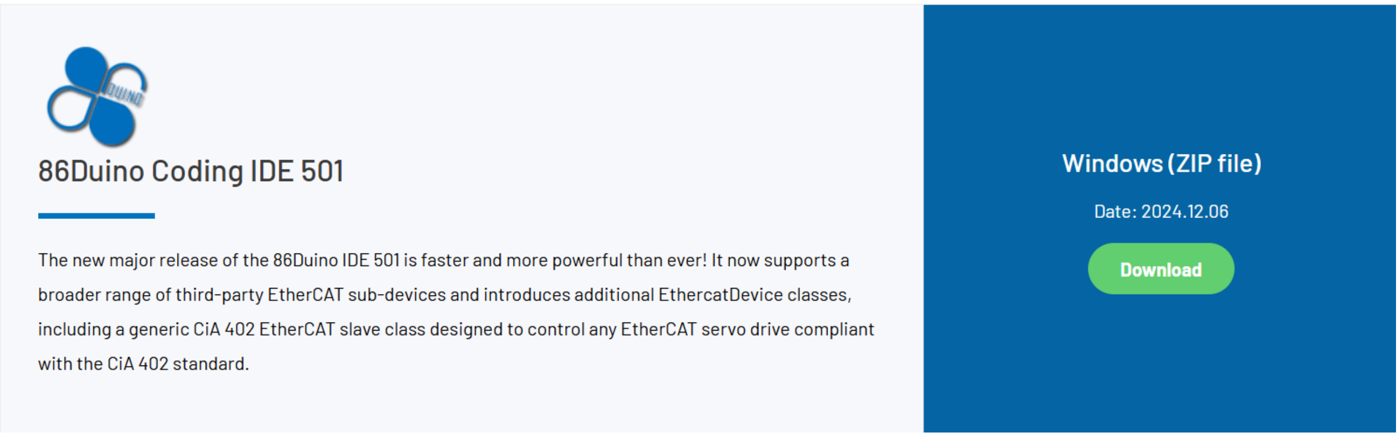


Connections are grouped by function:

- EtherCAT
  - IN: Connect to QEC MDevice EtherCAT port (or previous SubDevice).
  - OUT: Connect to next SubDevice.
- Power & Grounding
  - Us (Electronics / sensor supply): +24 V / 0 V (GND).
  - Up (Output supply): +24 V / 0 V (GND).
- Digital Inputs (DI)
  - Input 1–4: Connect external input signals referenced to the Us 0 V (GND).
- Digital Outputs (DO)
  - Output 1–4: Powered by Up +24 V.
  - Note (DO type): EK1814 DO channels are Sourcing (PNP) outputs. This means the output sources +24 V to the load when ON; wire the load return to 0 V (Up).
- Indicators / LEDs
  - PWR / RUN / Link/Act: Module and EtherCAT link status.
  - Channel LEDs: DI/DO channel status (Input 1–4, Output 1–4).

2. Software/Development Environment

Download 86duino IDE from https://www.qec.tw/software/.



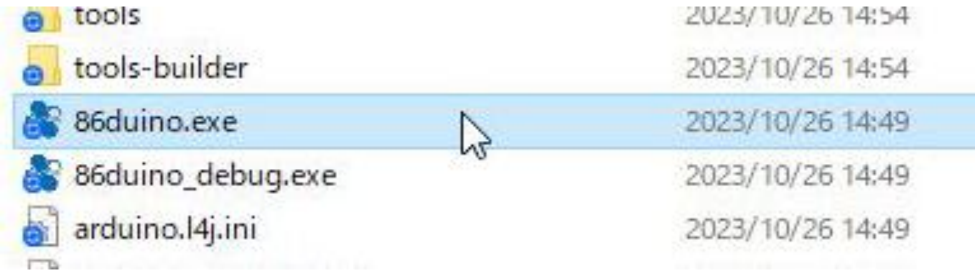
86Duino Coding IDE 501

The new major release of the 86Duino IDE 501 is faster and more powerful than ever! It now supports a broader range of third-party EtherCAT sub-devices and introduces additional EthercatDevice classes, including a generic CiA 402 EtherCAT slave class designed to control any EtherCAT servo drive compliant with the CiA 402 standard.

Windows (ZIP file)

Date: 2024.12.06

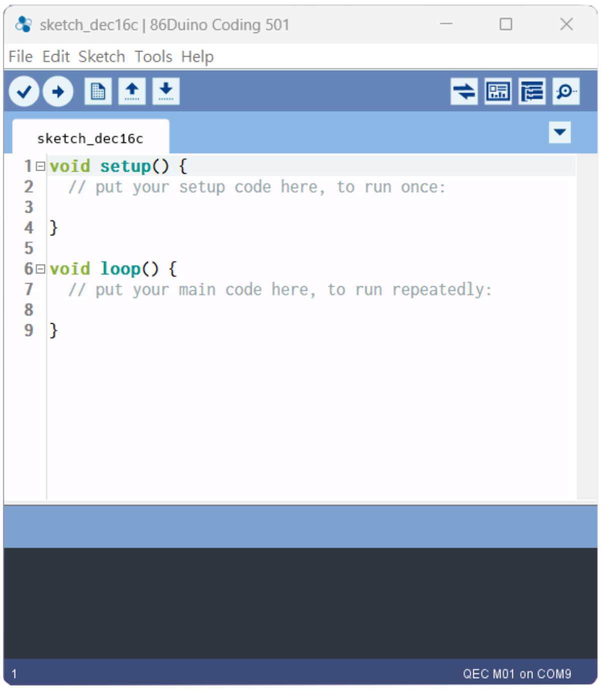
After downloading, please unzip the downloaded zip file, no additional software installation is required, just double-click 86duino.exe to start the IDE.



tools	2023/10/26 14:54
tools-builder	2023/10/26 14:54
86duino.exe	2023/10/26 14:49
86duino_debug.exe	2023/10/26 14:49
arduino.l4j.ini	2023/10/26 14:49

***Note**: If Windows displays a warning, click Details once and then click the Continue Run button once.

86Duino Coding IDE 501+ looks like below.



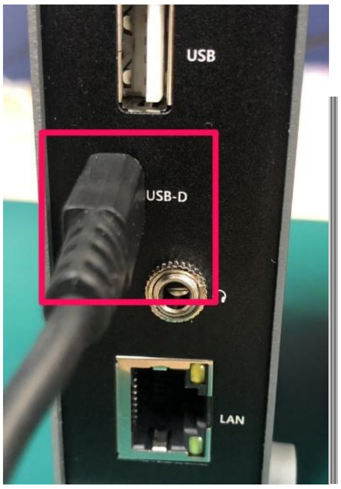
sketch_dec16c | 86Duino Coding 501

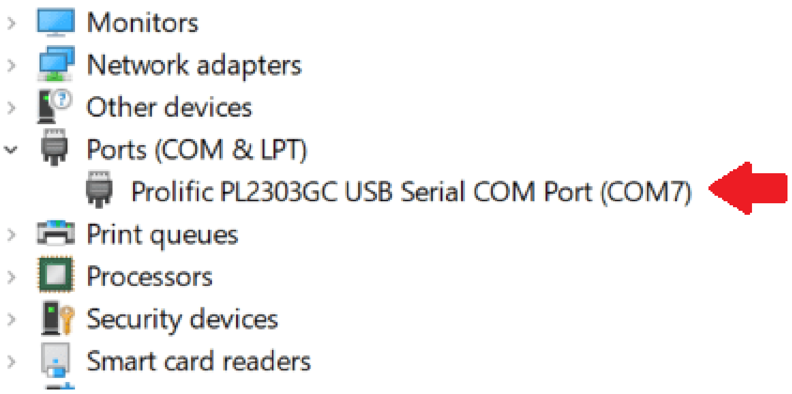
```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

3. Connect to PC and set up the environment

Follow the steps below to set up the environment:

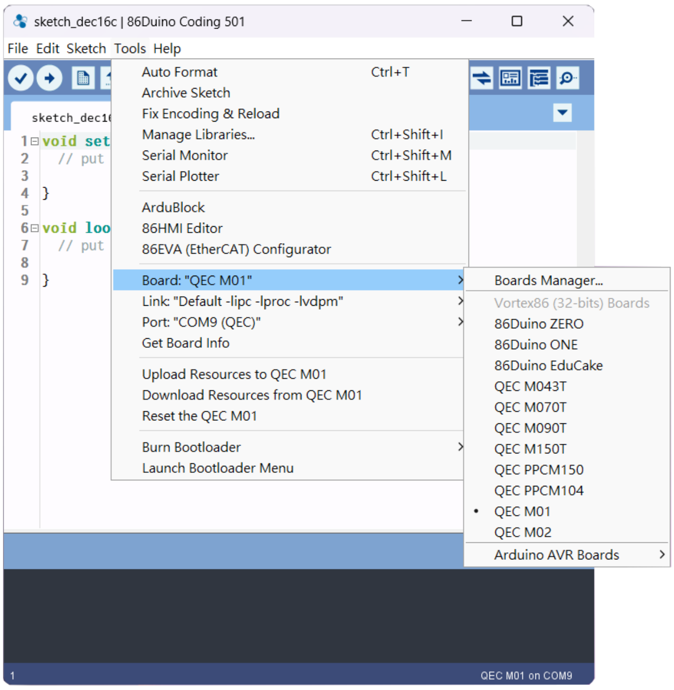
1. Connect the QEC-M-01 to your PC via a Micro USB to USB cable (86Duino IDE installed).
2. Turn on the QEC power.
3. Open “**Device Manager**” (select in the menu after pressing Win+X) ->” **Ports (COM & LPT)**” in your PC and expand the ports; you should see that the “**Prolific PL2303GC USB Serial COM Port (COMx)**” is detected; if not, you will need to install the required drivers.
   (For Windows PL2303 driver, you can download here)



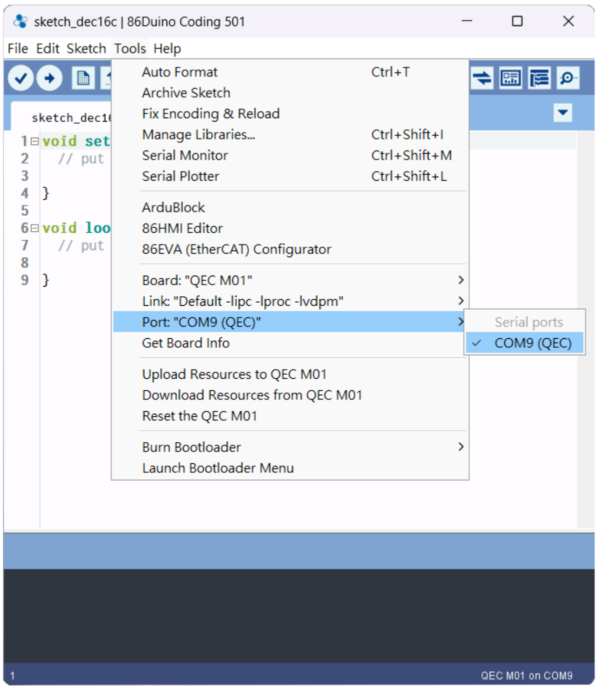


- Monitors
- Network adapters
- Other devices
- Ports (COM & LPT)
  - Prolific PL2303GC USB Serial COM Port (COM7)
- Print queues
- Processors
- Security devices
- Smart card readers

4. Open the 86Duino IDE.
5. Select the correct board: In the IDE's menu, select “**Tools**” > “**Board**” > “**QEC-M01**” (or the QEC MDevice model you use).
6. Select Port: In the IDE's menu, select “**Tools**” > “**Port**” and select the USB port to connect to the QEC MDevice (in this case, COM9 (QEC)).



```
void set
  // put
}

void loo
  // put
}
```


sketch_dec16c | 86Duino Coding 501
File Edit Sketch Tools Help
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
ArduBlock
86HMI Editor
86EVA (EtherCAT) Configurator
Board: "QEC M01"
Link: "Default -lipc -lproc -lvdpm"
Port: "COM9 (QEC)"
Get Board Info
Upload Resources to QEC M01
Download Resources from QEC M01
Reset the QEC M01
Burn Bootloader
Launch Bootloader Menu
Serial ports
✓ COM9 (QEC)
QEC M01 on COM9

4. Use 86EVA with code

This example shows how to operate the EtherCAT MDevice (QEC-M-01) and the EK-1814 series (EtherCAT Coupler with integrated digital inputs/outputs) through the 86Duino IDE's graphical low-code programming tool, 86EVA.

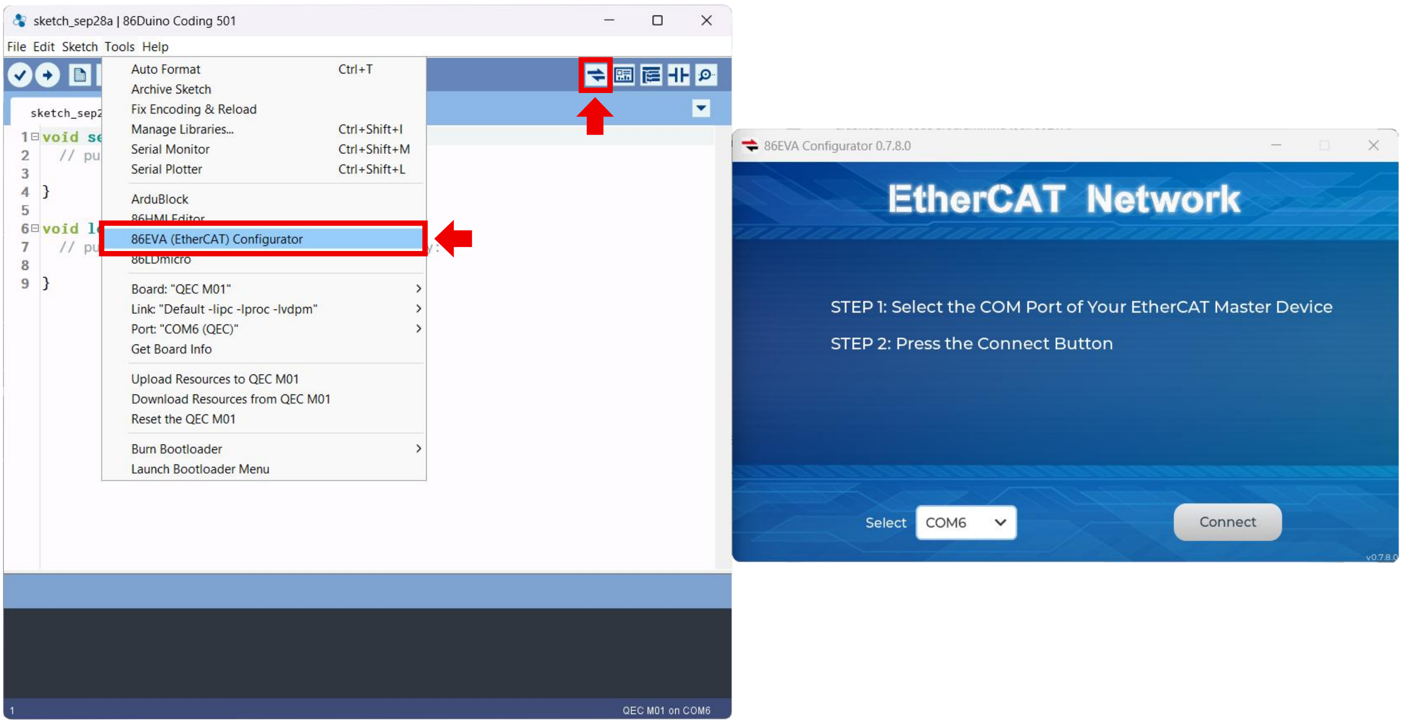
Software Tools Description:

- **86EVA (EVA, EtherCAT-Based Virtual Arduino):**
  is a graphical EtherCAT configuration tool based on the EtherCAT Library in the 86Duino IDE and is one of the development kits for 86Duino.

In this section, we will periodically toggle EK1814 DO0 (HIGH/LOW), then read and print EK1814 DI0 after a short settling delay to verify that the input state reflects the output change.

Step 1: Turn on 86EVA and scan

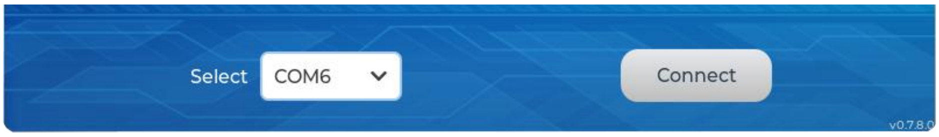
The 86EVA tool can be opened via the following buttons.


sketch_sep28a | 86Duino Coding 501
File Edit Sketch Tools Help
sketch_sep2
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
ArduBlock
86HMI Editor
86EVA (EtherCAT) Configurator
86LDmicro
Board: "QEC M01"
Link: "Default -lipc -lproc -lvdpm"
Port: "COM6 (QEC)"
Get Board Info
Upload Resources to QEC M01
Download Resources from QEC M01
Reset the QEC M01
Burn Bootloader
Launch Bootloader Menu
QEC M01 on COM6
86EVA Configurator 0.7.8.0
EtherCAT Network
Select
COM6
Connect
v0.7.8.0

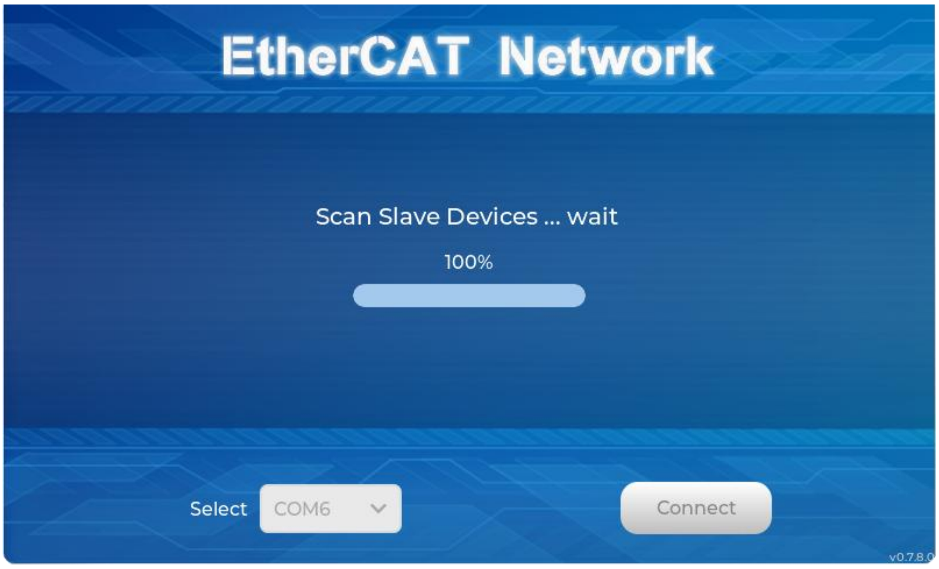
STEP 1: Select the COM Port of Your EtherCAT Master Device

STEP 2: Press the Connect Button

Please select the correct COM port and then click the "**Connect**" button.



Once you have confirmed that the correct COM port has been selected of QEC-M-01, press the Connect button to start scanning the EtherCAT network.

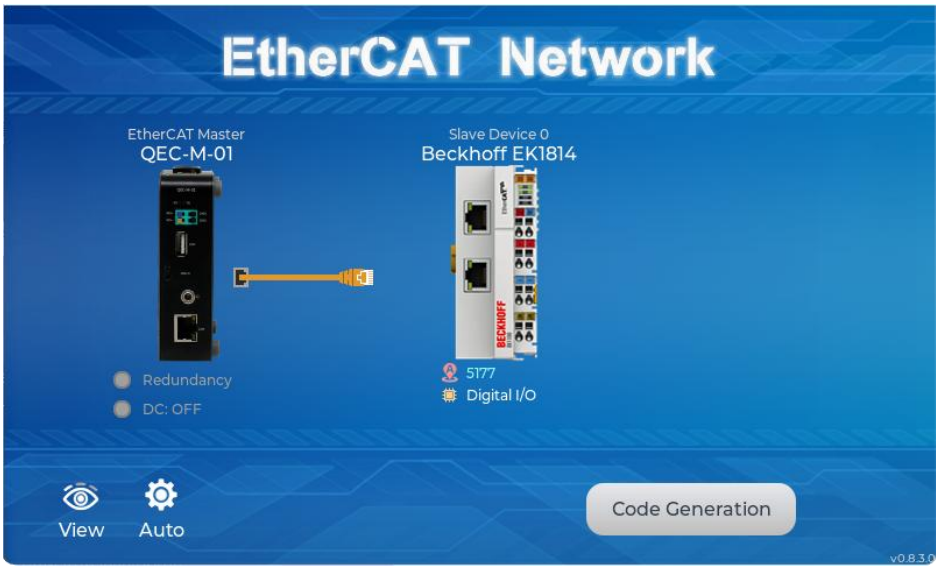


EtherCAT Network

Scan Slave Devices ... wait

100%

The connected devices will be displayed after the EtherCAT network has been scanned.



EtherCAT Network

EtherCAT Master
QEC-M-01

Slave Device 0
Beckhoff EK1814

5177
Digital I/O

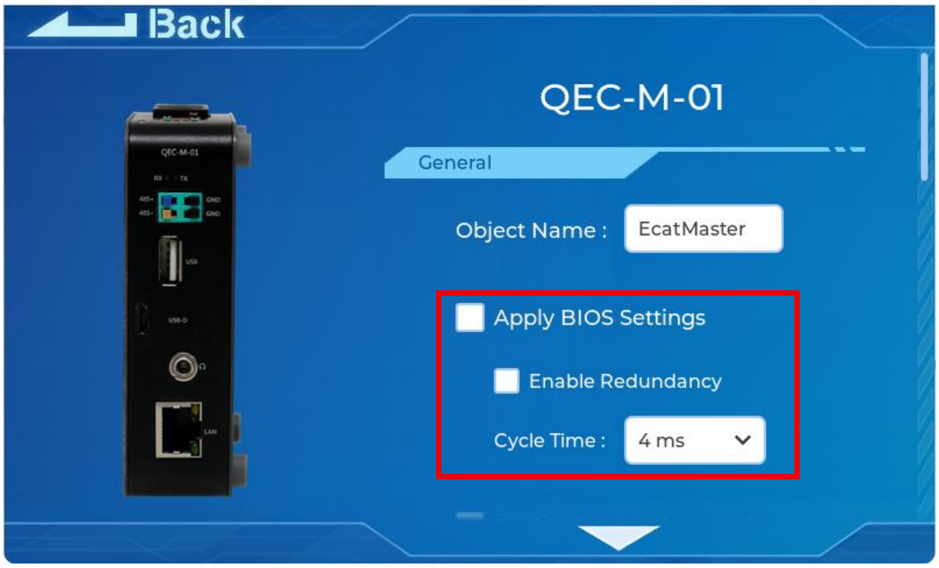
○ Redundancy
○ DC: OFF

Step 2: Set the parameters

Press on the scanned device image to enter the corresponding parameter setting screen.

Step 2.1: QEC-M-01

Press on the image of the QEC-M-01 to see the parameter settings.



Object Name : EcatMaster

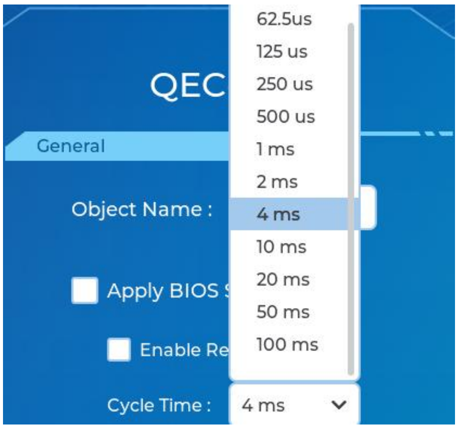
□ Apply BIOS Settings

□ Enable Redundancy

Cycle Time : 4 ms

Please check the following configures.

1. Turn off the "**Apply BIOS Settings**".
2. Select "**4ms**" to the Cycle Time.

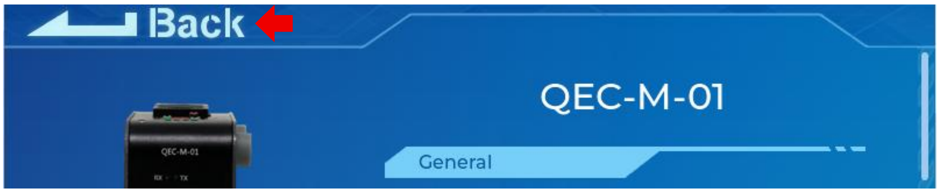


□ Apply BIOS

□ Enable Re

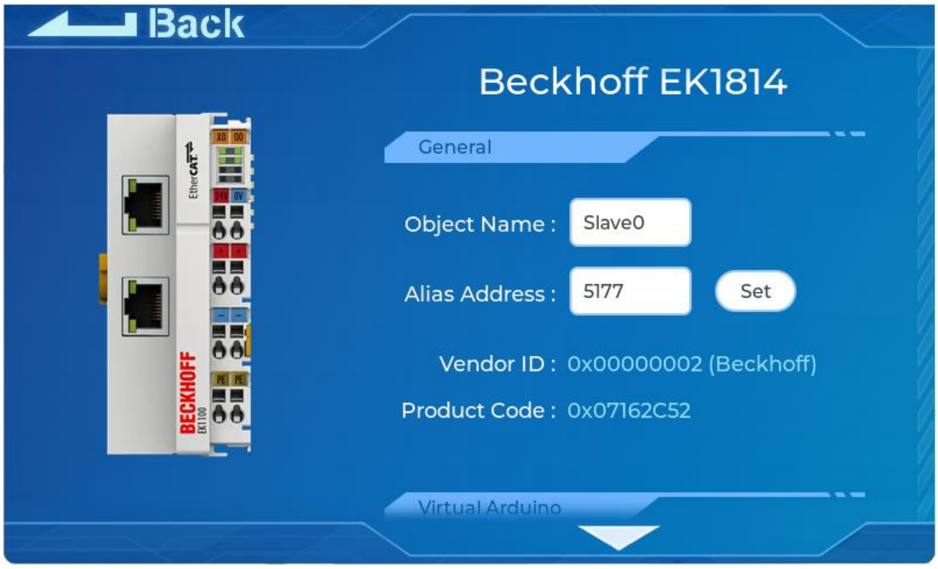
Cycle Time : 4 ms

Click "**Back**" in the upper left corner to return.



Step 2.2: EK1814

Press on the image of the EK1814 to see the parameter settings.



Beckhoff EK1814

Object Name : Slave0

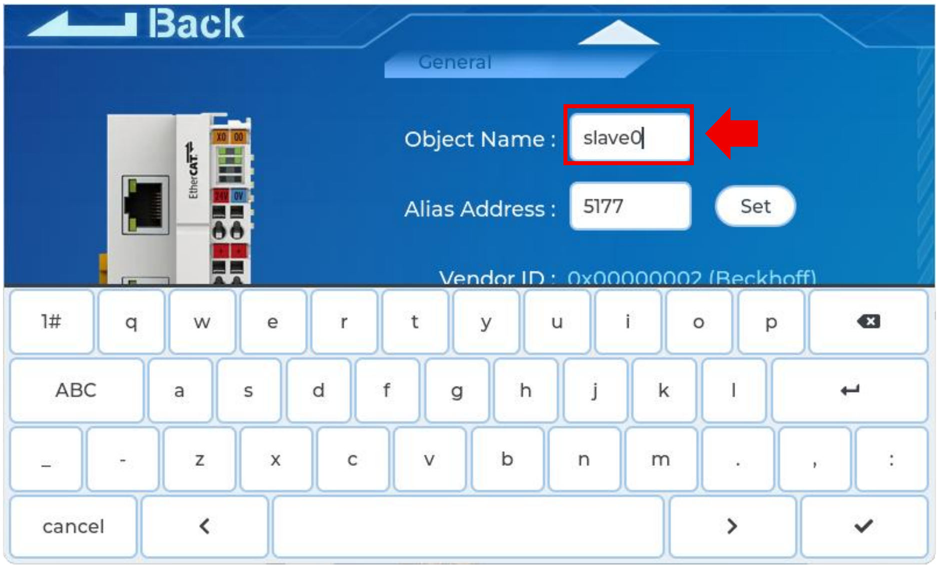
Alias Address : 5177

Vendor ID : 0x00000002 (Beckhoff)

Product Code : 0x07162C52

The page will show the Object Name, Alias Address, Vendor ID, Product Code, and Virtual Arduino Mapping.

Please change the Object Name to “**slave0**”.
It’ll appear a keyboard after you click the Object Name.

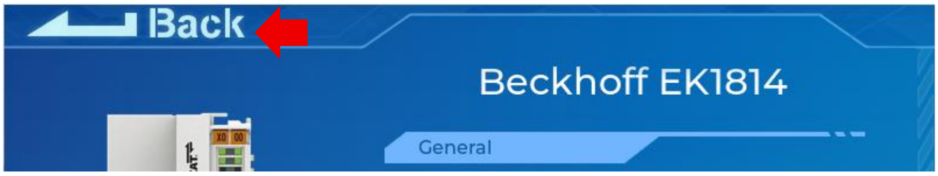


Object Name : slave0

Alias Address : 5177

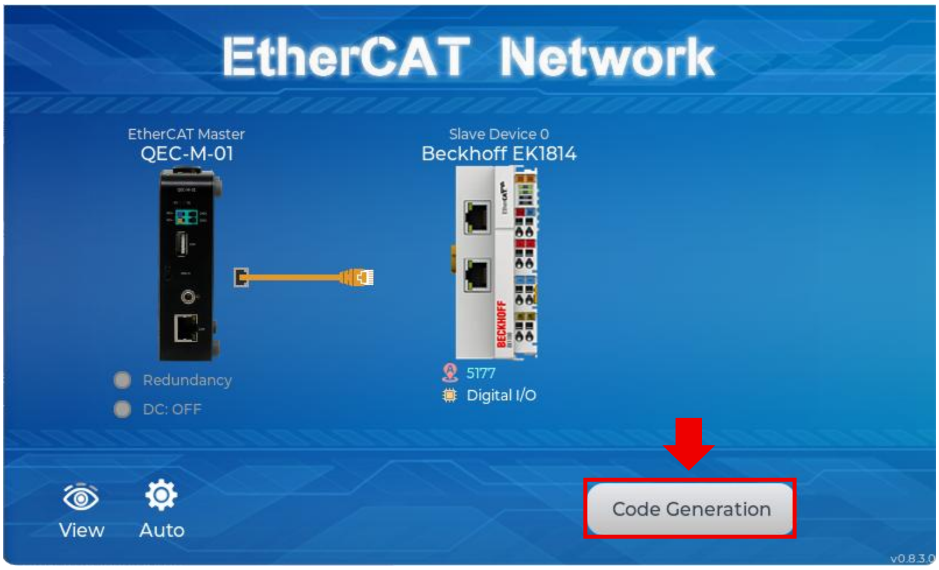
Vendor ID : 0x00000002 (Beckhoff)

Click "**Back**" in the upper left corner to return.

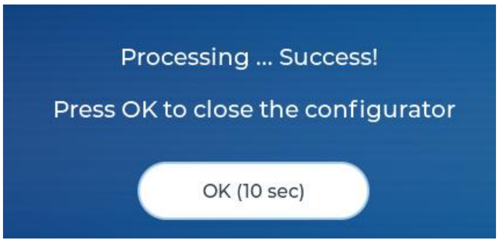


Step 3: Generate the code

Once you've set your device's parameters, go back to the home screen and press the "**Code Generation**" button in the bottom right corner.



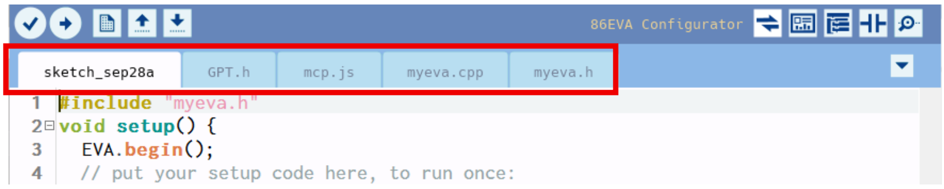
When you're done, click the "**OK**" button to turn off 86EVA, or it will close in 10 seconds.


Processing ... Success!

Press OK to close the configurator

The generated code and files are as follows:

- sketch_sep10b: Main Project (.ino, depending on your project name)
- myeva.cpp: C++ program code of 86EVA
- myeva.h: Header file of 86EVA



```
#include "myeva.h"
void setup() {
  EVA.begin();
  // put your setup code here, to run once:
```

***Additional note:**

After 86EVA generates code, the following code will be automatically generated in the main program (.ino), and any of them missing will cause 86EVA not to work.

1. `#include “myeva.h”` : Include EVA Header file
2. `EVA.begin();` in `setup()` : Initialize the EVA function

Step 4: Write the code

Before operating the EtherCAT network, you must configure it once. The process should be from Pre-OP to OP mode in EtherCAT devices. 86EVA will automatically handle the EtherCAT State Machine in the background.

The programming code from 86EVA are set as the following by default:

- EK1814 module: EthercatDevice_Generic object.
- EtherCAT mode: ECAT_SYNC.

And here is the setting by users:

- EtherCAT Cycle time: 4 milliseconds (Depend on EK1814 3ms filter).
- The EthercatMaster object ("EcatMaster") represents the **QEC-M-01**, while the EthercatDevice_Generic object ("slave0") represents the **EK1814** module.

In this section, we will periodically toggle EK1814 DO0 (HIGH/LOW), then read and print EK1814 DI0 after a short settling delay to verify that the input state reflects the output change.

A. In Setup Function:

In the `setup()` function, initialize Serial communication and bring up the EtherCAT network to OP mode. Follow the steps below:

1. Initialize Serial Communication
   - Start serial communication at a baud rate of 115200.
2. Start the 86EVA
   - Use the `EVA.begin()` function to start and initialize the EtherCAT network.

B. In Loop Function:

In the `loop()` function, toggle one PDO output bit periodically and read back one PDO input bit for verification.

1. Set DO Bit via PDO (ON)
   - Use `slave0.pdoBitWrite(0, HIGH)` to set PDO bit 0 (DO 0) to HIGH.
   - Wait 50 ms (`delay(50)`) used to wait for DI to reflect the DO change and for EtherCAT to refresh the input PDO data before reading.
2. Read DI Bit via PDO and Print Result
   - Use `slave0.pdoBitRead(0)` to read PDO bit 0 (DI 0).
   - Print the value to "Serial: "EK1814 DI 0: <value>".
3. Hold Time
   - Wait 3000 ms (`delay(3000)`) before changing the state.
4. Set DO Bit via PDO (OFF) and Repeat
   - Use `slave0.pdoBitWrite(0, LOW)` to set PDO bit 0 (DO 0) to LOW.
   - Wait 50 ms, read back `pdoBitRead(0)` again, print the result, and wait 3000 ms.

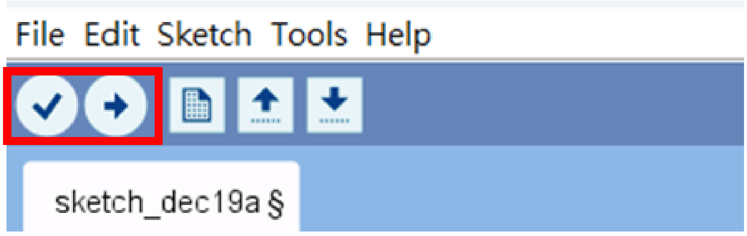
5. Code Logic Summary
   - `pdoBitWrite(n, HIGH/LOW)`: drives PDO bit n (commonly used for DO mapping).
   - `pdoBitRead(n)`: reads PDO bit n (commonly used for DI mapping).
   - The example toggles output every ~3 seconds and logs the corresponding input bit state.

***Note** (EK1814 DO Type): EK1814 DO channels are Sourcing (PNP) outputs. When the DO is ON, it sources +24 V to the load, and the load return should be wired to 0 V (Up).

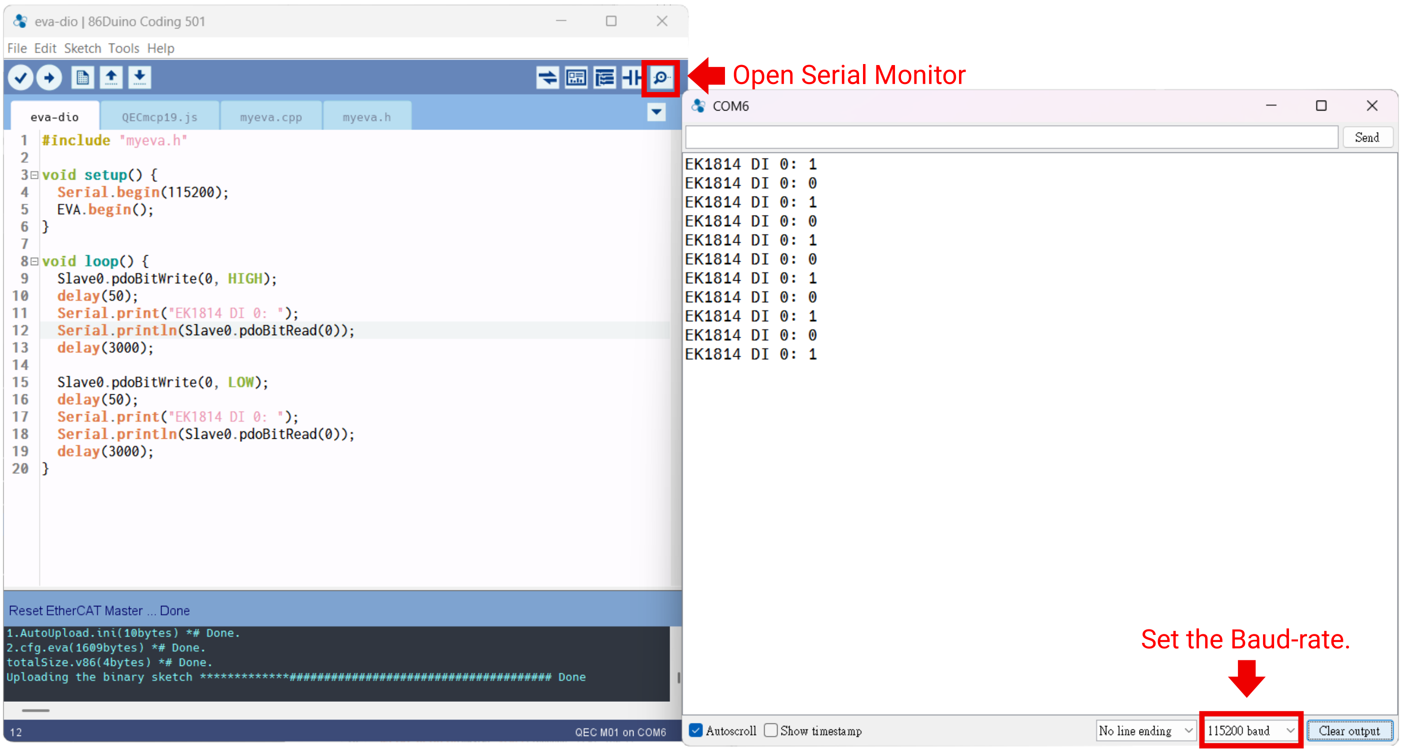
The example code is as follows:

```
#include "myeva.h"

void setup() {
  Serial.begin(115200);
  EVA.begin();
}

void loop() {
  Slave0.pdoBitWrite(0, HIGH);
  delay(50);
  Serial.print("EK1814 DI 0: ");
  Serial.println(Slave0.pdoBitRead(0));
  delay(3000);

  Slave0.pdoBitWrite(0, LOW);
  delay(50);
  Serial.print("EK1814 DI 0: ");
  Serial.println(Slave0.pdoBitRead(0));
  delay(3000);
}
```

***Note:** Once the code is written, click on the toolbar to ✓ compile, and to confirm that the compilation is complete and error-free, you can click ➜ to upload.



After you successfully upload the program to the QEC-M-01, you can open the Serial Monitor on 86Duino IDE. Please check the Serial baud rate is same as your setting.



Open Serial Monitor

```
#include "myeva.h"

void setup() {
  Serial.begin(115200);
  EVA.begin();
}

void loop() {
  Slave0.pdoBitWrite(0, HIGH);
  delay(50);
  Serial.print("EK1814 DI 0: ");
  Serial.println(Slave0.pdoBitRead(0));
  delay(3000);

  Slave0.pdoBitWrite(0, LOW);
  delay(50);
  Serial.print("EK1814 DI 0: ");
  Serial.println(Slave0.pdoBitRead(0));
  delay(3000);
}
```

```
Reset EtherCAT Master ... Done
1.AutoUpload.ini(10bytes) *# Done.
2.cfg.eva(1609bytes) *# Done.
totalSize.v86(4bytes) *# Done.
Uploading the binary sketch *************###################################### Done
```

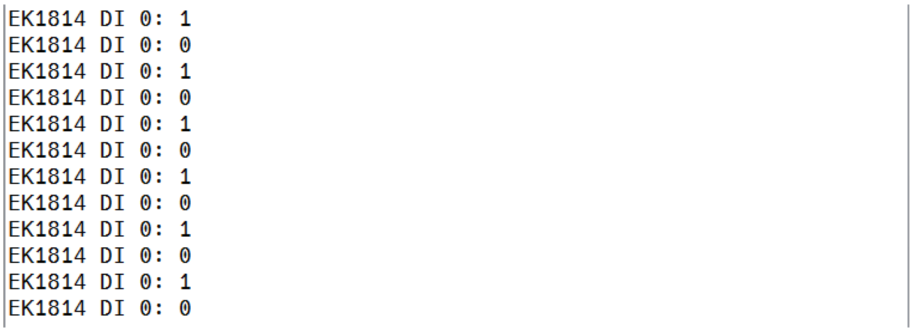
12 QEC M01 on COM6

```
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
```

Set the Baud-rate.

115200 baud

If the EtherCAT communication configuration is successful, it will print the EK1814 DI 0 value to the serial monitor.

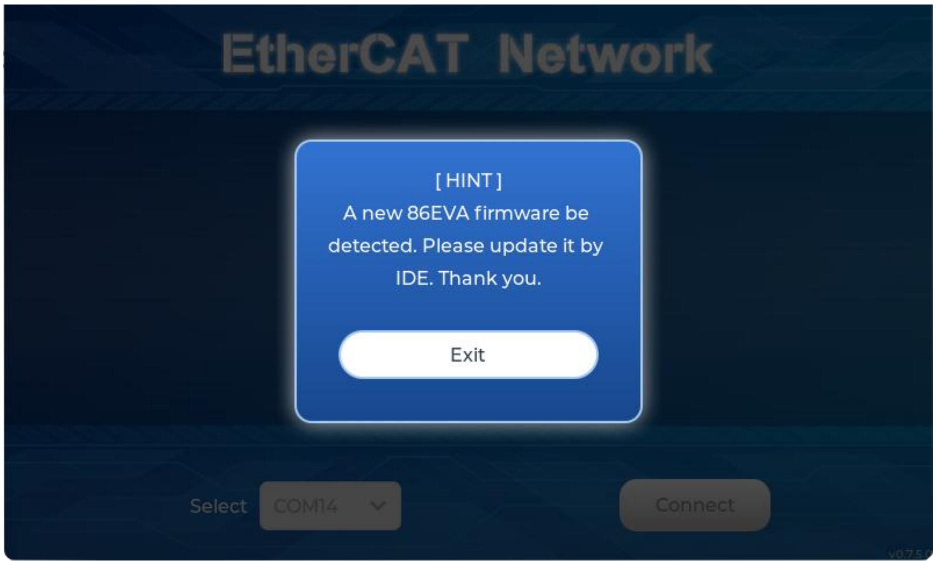


```
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
EK1814 DI 0: 1
EK1814 DI 0: 0
```

Troubleshooting

QEC-M-01 cannot successfully upload code

When you are unable to successfully upload code, please open 86EVA to check if your QEC EtherCAT MDevice's environment is abnormal. As shown in the figure below, please try updating your QEC EtherCAT MDevice's environment, which will include the following three items: Bootloader, EtherCAT firmware, and EtherCAT tool.



[HINT]
A new 86EVA firmware be detected. Please update it by IDE. Thank you.

Now, we will further explain how to proceed with the update:

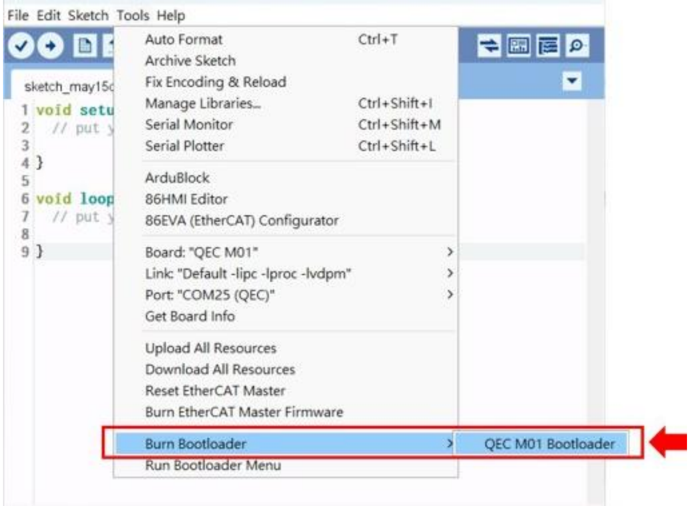
Step 1: Setting up QEC-M

1. Download and install 86Duino IDE 500+ (or a newer version).
   You can download it from Software.
2. Connect the QEC-M: Use a USB cable to connect the QEC-M to your computer.
3. Open 86Duino IDE: After the installation is complete, open the 86Duino IDE software.
4. Select Board: From the IDE menu, choose "**Tools**" > "**Board**" > "**QEC-M-01**" (or the specific model of QEC-M you are using).
5. Select Port: From the IDE menu, choose "**Tools**" > "**Port**" and select the USB port to which the QEC-M is connected.

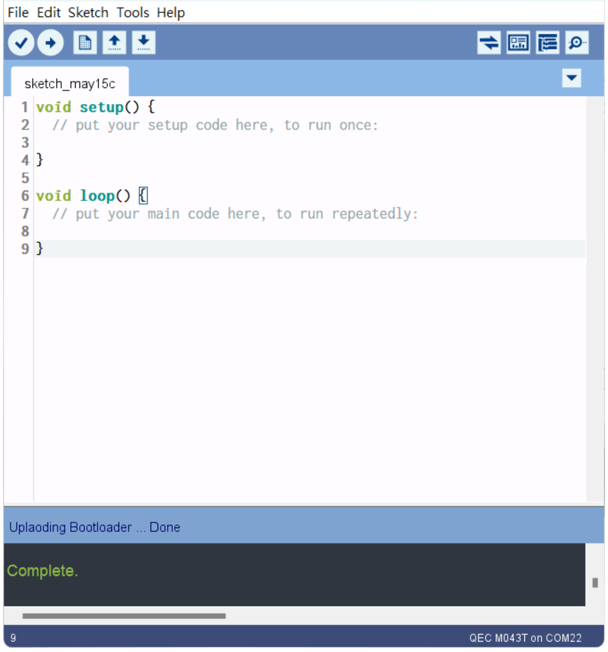
Step 2: Click "Burn Bootloader" button

After connecting to your QEC-M product, go to "**Tools**"> "**Burn Bootloader**".
The currently selected QEC-M name will appear. Clicking on it will start the update process, which will take approximately 5-20 minutes.

- QEC-M-01:



Step 3: Complete the Update



```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

Uplaoding Bootloader ... Done

```
Complete.
```

After completing the above steps, your QEC-M has been successfully updated to the latest version of the development environment.

Warranty

This product is warranted to be in good working order for a period of one year from the date of purchase. Should this product fail to be in good working order at any time during this period, we will, at our option, replace or repair it at no additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster. Vendor assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use, misuse of, originality to use this product. Vendor will not be liable for any claim made by any other related party. Return authorization must be obtained from the vendor before returned merchandise will be accepted. Authorization can be obtained by calling or faxing the vendor and requesting a Return Merchandise Authorization (RMA) number. Returned goods should always be accompanied by a clear problem description.