



# User's Manual

# QEC-M-043T

DMP Vortex86EX2

EtherCAT Master Controller

4.3" HMI with Resistive Touch Screen

(Revision 1.0A)

## REVISION

DATE	VERSION	DESCRIPTION
2022/06/015	Version1.0A	First Release

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For EtherCAT solution service, support or tutorials, 86Duino IDE introduction, functions, languages, libraries, etc. Please visit the QEC website:

- QEC: <https://www.qec.tw/>

This Manual is for the QEC series.

## SAFETY INFORMATION

- Read these safety instructions carefully.
- Please carry the unit with both hands and handle it carefully.
- Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
- Do not expose your QEC device to rain or moisture to prevent shock and fire hazards.
- Power Input voltage +24VDC @ 220mA (Typ.)
- Operating temperature between -20~+70°C.
- Keep away from humidity.
- When external storage is the main operating system storage, please turn off the power before inserting or removing it. Do not open the cabinet to avoid electrical shock. Refer to your nearest dealer for qualified personnel servicing.
- Never touch un-insulated terminals or wire unless your power adaptor is disconnected.
- Locate your QEC device as close as possible to the socket outline for easy access and avoid force caused by the entangling of your arms with surrounding cables from the QEC device.
- If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.

### **WARNING!**



*DO NOT ATTEMPT TO OPEN OR TO DISASSEMBLE THE CHASSIS (ENCASING) OF THIS PRODUCT. PLEASE CONTACT YOUR DEALER FOR SERVICING FROM QUALIFIED TECHNICIAN.*

# Content

Content .....	iv
Ch. 1 General Information .....	6
1.1 Introduction .....	7
1.1.1 QEC-M Systems Diagram .....	8
1.1.2 Software Support .....	8
1.2 Specifications .....	9
1.3 Dimensions.....	11
1.4 Ordering Information .....	12
Ch. 2 Hardware System .....	13
2.1 General Technical Data .....	14
2.2 General Summary .....	15
2.2.1 Giga LAN.....	15
2.2.2 EtherCAT Interface .....	15
2.2.3 Power Connector .....	16
2.2.4 Micro SD Card Slot.....	16
2.2.5 Audio .....	17
2.2.6 RS-485.....	17
2.2.7 Micro USB .....	17
2.2.8 Status LEDs .....	18
2.2.9 LCD.....	18
Ch. 3 Quick Start guide .....	19
3.1 Package Contents.....	20
3.2 Hardware Configuration .....	20
3.3 Software Driver Installation .....	20
3.4 Set up the QEC-M for 86Duino.....	21
Plugin the power supply .....	21
Connect the USB cable with PC.....	21
Verify if the device is detected or not.....	22
Write your first sketch .....	22
Upload your first sketch! .....	24
Ch. 4 Software Function .....	25
4.1 Software Description .....	26

4.2	Function List.....	26
	EthercatMaster Class Functions .....	26
	EthercatDevice_XXX Class General Functions.....	27
	EthercatDevice_Generic Class Functions .....	28
4.3	Function Description.....	29
	Warranty .....	32

# Ch. 1

## General Information

### [1.1 Introduction](#)

#### [1.1.1 QEC-M Systems Diagram](#)

#### [1.1.2 Supported Software](#)

### [1.2 Specifications](#)

### [1.3 Dimensions](#)

### [1.4 Ordering Information](#)

# 1.1 Introduction

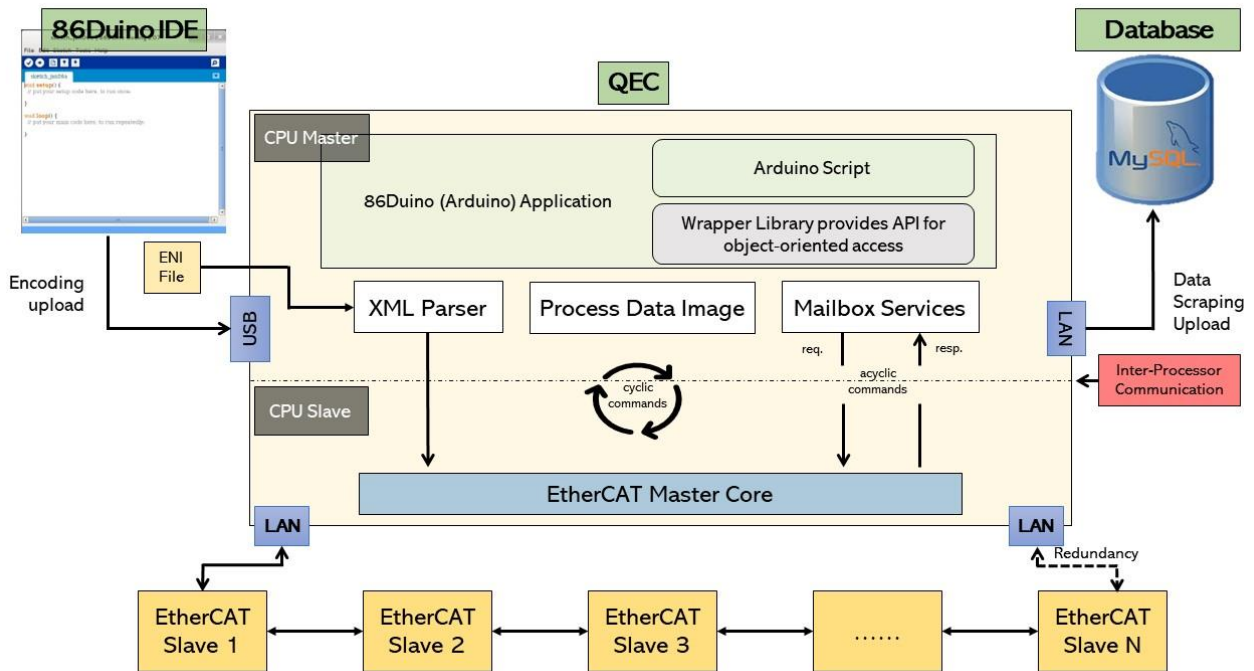
QEC (Quick to EtherCAT) is an Arduino-based EtherCAT System solution, through the Vortex86EX2 processor developed by DMP Electronics, meets the requirements of hardware and software Real-time. Become an EtherCAT device whose hardware and software are user-friendly and satisfy all users who expect to use EtherCAT in the market.

The list below gives a short summary of the master features:

- Designed as a real-time Arduino Integrated development environment
- Distributed Clocks support
  - Configuration of the slave's DC parameters through the application interface.
  - Synchronization (offset and drift compensation) of the distributed slave clocks to the reference clock.
  - Optional synchronization of the reference clock to the master clock or the other way round.
- CANopen over EtherCAT (CoE)
  - SDO upload, download and information service.
  - Slave configuration via SDOs.
  - SDO access from userspace and from the application.
- File Access over EtherCAT (FoE)
  - Loading and storing files via the command-line tool.
  - Updating a slave's firmware can be done easily.
- Configuring EtherCAT cable redundancy
  - Two independent Ethernet interfaces can be used for EtherCAT cable redundancy.
  - Cable redundancy offers resilience for the cabling.
  - Interruptions of the EtherCAT communication due to broken wires or unplugged LAN cables are avoided.
- 86Duino IDE (Arduino based)
  - Simple-to-use API of Arduino with many examples
  - ArduBlock (Scratch tool)
  - HMI Editor (HMI design tool)
  - 86EVA (EtherCAT-based Virtual Arduino)



## 1.1.1 QEC-M Systems Diagram



## 1.1.2 Software Support

The 86Duino integrated development environment (IDE) software makes it easy to write code and upload it to QEC-M. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Arduino IDE, Processing, DJGPP, and other open-source software.



## 1.2 Specifications

### CPU BOARD SPECIFICATIONS

CPU	DMP Vortex86EX2 Processor, Master:600MH/Slave 400MHZ
Memory	1GB DDRIII onboard
Storage	32MB SPI Flash / MicroSD / eMMC onboard (Option)
LCD Display	4.3-inch TFT 800×480 Resolution LCD with Restive touch screen
LAN	1Gbps Ethernet RJ45 x1 10/100Mbps Ethernet RJ45 x2 for EtherCAT
Expansion	Mini PCIe x 1 with Micro SIM Card Holder
I/O Connector	Power DC Input/Output Connector x1 Micro USB (Type-B) x1 Micro SD Slot x1 USB 2.0 Host x1 Speaker x1 RS485 x1 RJ45 x3
Protocol	EtherCAT
Control Cycle Time	125 μs (min.)
Software Support	86Duino IDE <small>(The environment is written in Java and based on Arduino IDE, Processing, DJGPP, and other open-source software)</small>

### MECHANICAL & ENVIRONMENT

Power Connector	6-pin Power Input /Output
Power Requirement	+24VDC @ 220mA (Typ.)
Power Consumption	7Watt (Typical)
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30 ~ +85°C
Operating Humidity	0% ~ 90% Relative Humidity, Non-Condensing
Dimensions	129.07 x 95.02 x 29.6 mm
Weight	290g

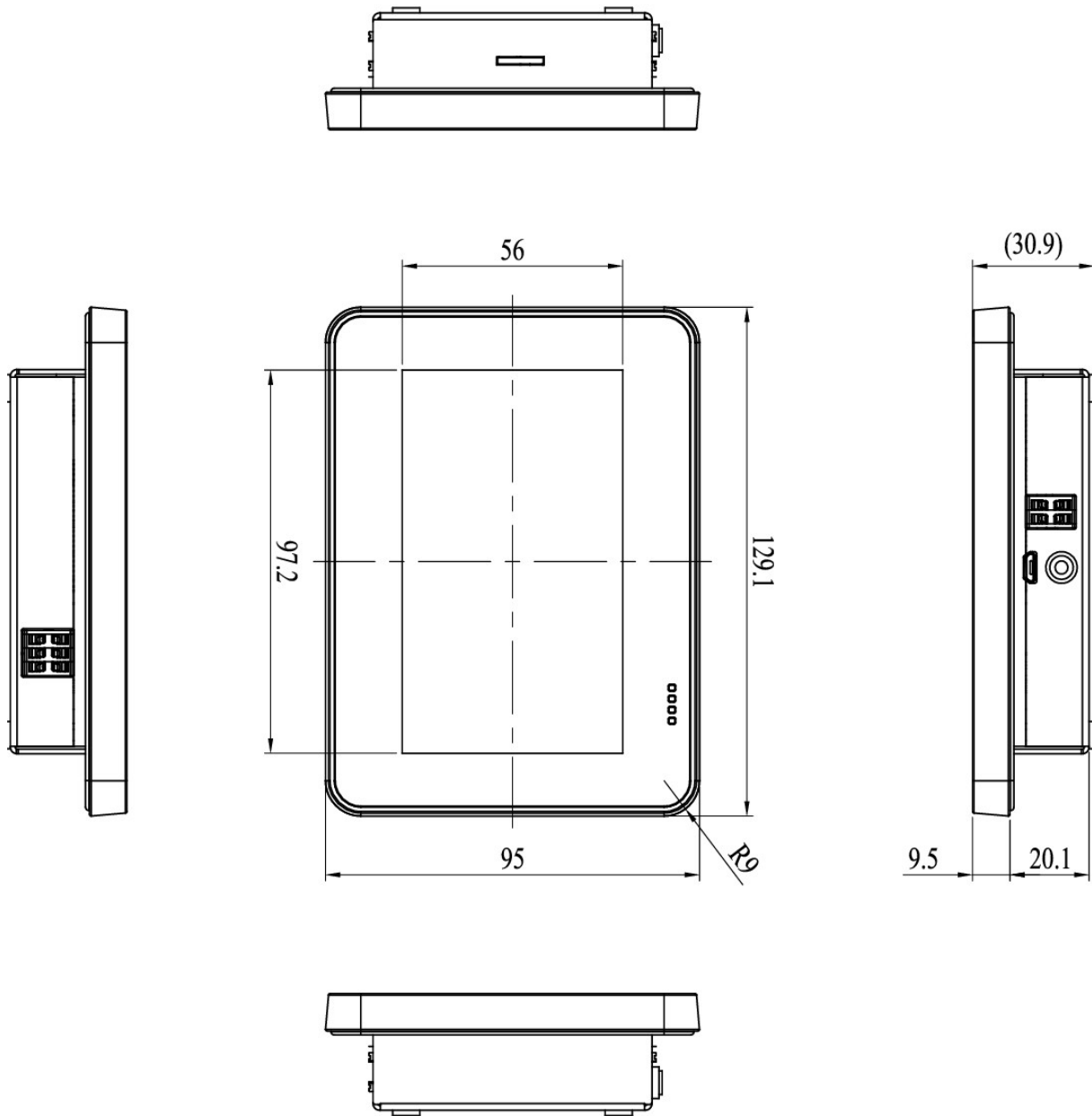
## LCD GENERAL SPECIFICATIONS

Display Type	4.3" WVGA TFT LCD
Display Pixel	800 x 480
Display Color	16.7M
Backlight Type	10 chips white LED
Contrast Ratio	1500: 1
Viewing Angle	Vertical 160°, Horizontal 160°
Luminance	400 cd/m <sup>2</sup>
Module outline (mm)	105.50 (W) x 67.20 (H) x 3.0 (D)
Active area (mm)	95.04 (W) x 53.86 (H)

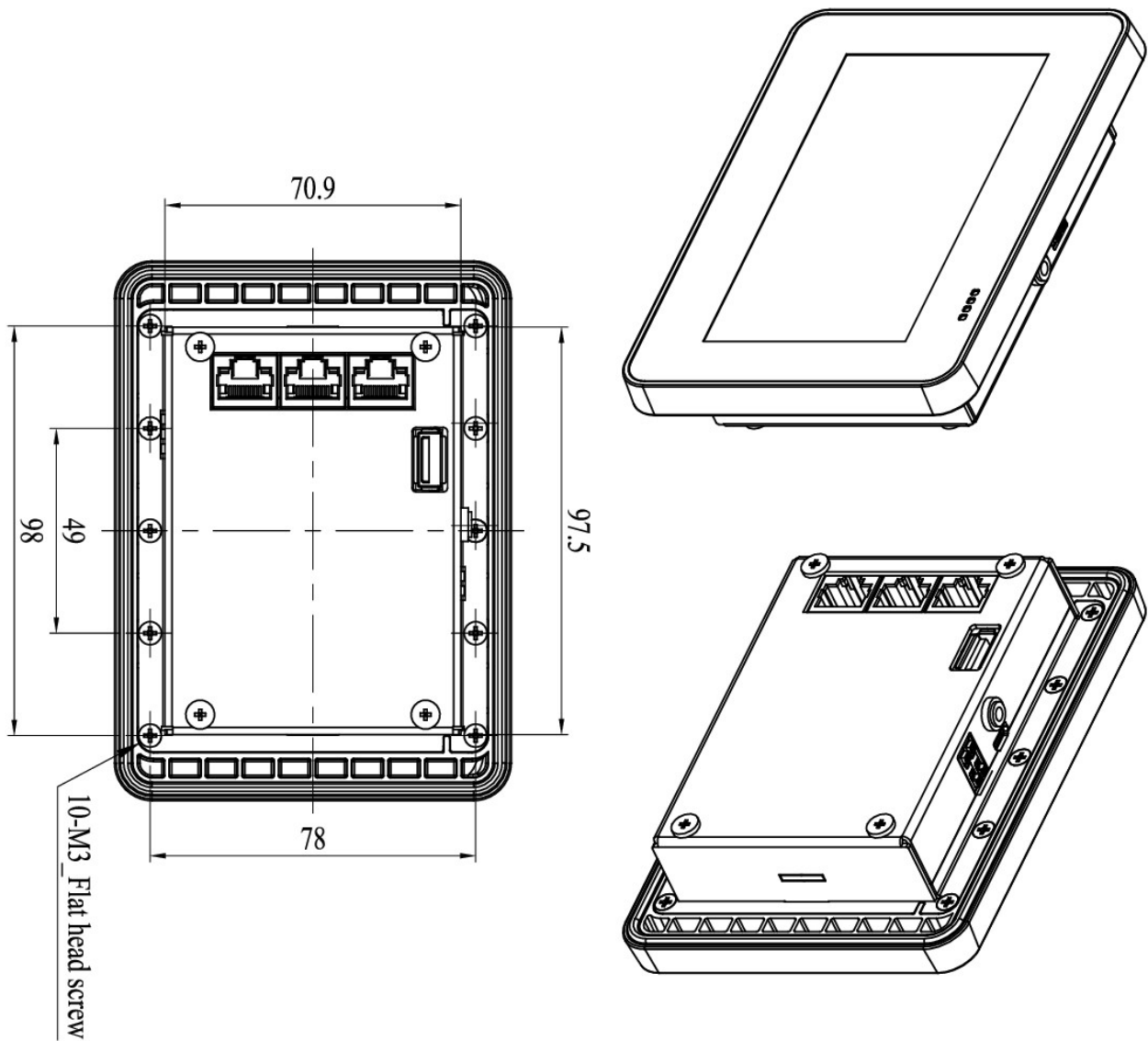
## TOUCHSCREEN

Type	Analog Resistive
Resolution	Continuous
Transmittance	80%
Controller	PS/2 interface
Durability	1 million

## 1.3 Dimensions



(Unit: mm)



(Unit: mm)

## 1.4 Ordering Information

PART NUMBER	DESCRIPTION
QEC-M-043T	Vortex86EX2 Processor 600MHz-based EtherCAT Master Controller, support Arduino

# Ch. 2

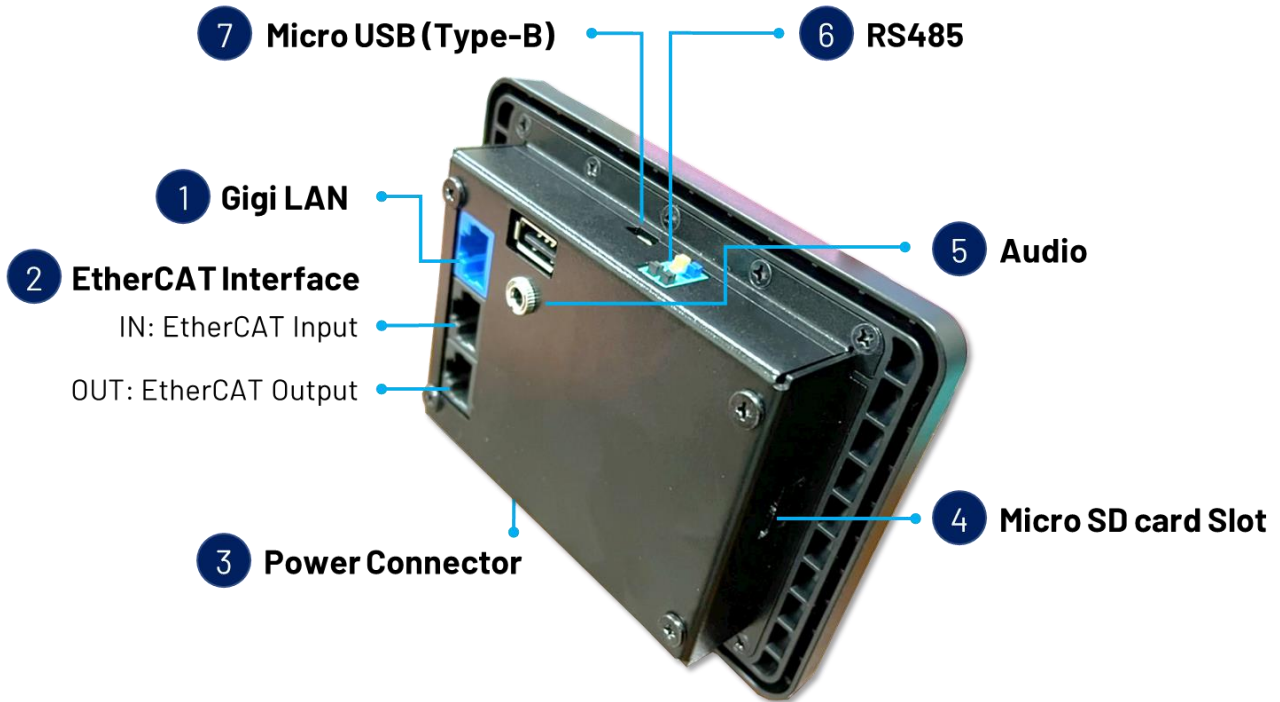
## Hardware System

[2.1 CPU Board Outline](#)

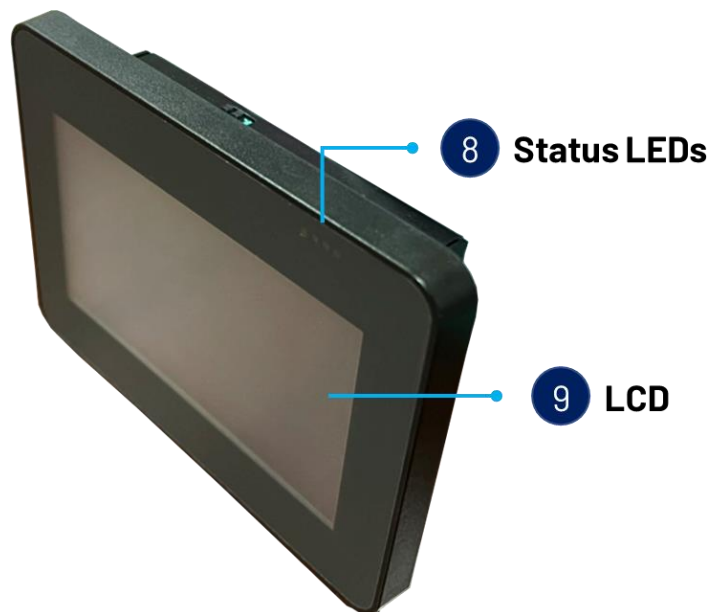
[2.2 Connector Summary](#)

## 2.1 General Technical Data

Back View:




Front View:



## 2.2 General Summary

No.	Description	Type Narrative	Pin #	
1	Giga LAN	External RJ45 Connector (Gold finger)	8-pin	
2	EtherCAT Interface		IN	8-pin
			OUT	8-pin
3	Power Connector	Terminal Block Interface	6-pin	
4	Micro SD Card Slot	Micro SD Card Slot	-	
5	Audio	HD Audio	-	
6	RS-485	Terminal Block Interface	4-pin	
7	Micro USB	Micro USB (Type-B)	-	
8	Status LEDs	External Status LEDs	-	
9	LCD	4.3" TFT LCD	-	


### 2.2.1 Giga LAN

	Pin #	Signal Name	Pin #	Signal Name
 8 2,1	1	FGND	2	G_TXC+
	3	G_TXC-	4	G_RXC+
	5	G_RXC-	6	IN_Up
	7	Up	8	UGND



### 2.2.2 EtherCAT Interface


EC IN (LAN1)

	Pin #	Signal Name	Pin #	Signal Name
 8 2,1	1	FGND	2	LAN1_LTXC+
	3	LAN1_LTXC-	4	LAN1_LRXC+
	5	LAN1_RXC-	6	IN_Up
	7	Up	8	UGND






## EC OUT (LAN2)

	Pin #	Signal Name	Pin #	Signal Name
 8 2,1	1	FGND	2	LAN2_TXC+
	3	LAN2_TXC-	4	LAN2_RXC+
	5	LAN2_RXC-	6	IN_Up
	7	Up	8	UGND



## 2.2.3 Power Connector

	Pin #	Signal Name	Pin #	Signal Name
	1	Vs+	2	Vp+
	3	Vs- (GND)	4	Vp- (GND)
	5	F.G	6	F.G



## 2.2.4 Micro SD Card Slot



Standard Micro SD Slot.

You can put a bootable Micro SD card.

## 2.2.5 Audio



HD Audio (Line-Out).

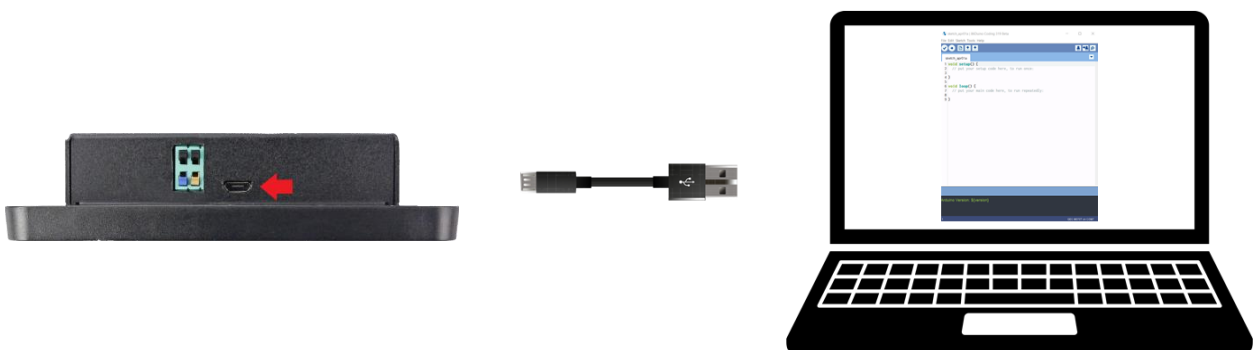
## 2.2.6 RS-485



4-pin RS485.

## 2.2.7 Micro USB

The Micro USB is mainly for programming upload.



For quick start guide, please see [Ch. 3](#).

## 2.2.8 Status LEDs



Customized 4 color: Red, Orange, Green, Yellow.  
1\* Power Status (Right/Green) / 3\* Undefined

## 2.2.9 LCD



LCD Display, 4.3-inch TFT 800×480 Resolution LCD with Restive touch screen.

# Ch. 3

## Quick Start guide

[3.1 Package Contents](#)

[3.2 Hardware Configuration](#)

[3.3 Software Driver Installation](#)

[3.4 Set up the QEC-M for 86Duino](#)

## 3.1 Package Contents

The package includes the following items:

- QEC-M
- Cable-set
- Product warranty card

If any of these items are missing or damaged, contact the dealer.

Save the shipping materials and carton to ship or store the product in the future.

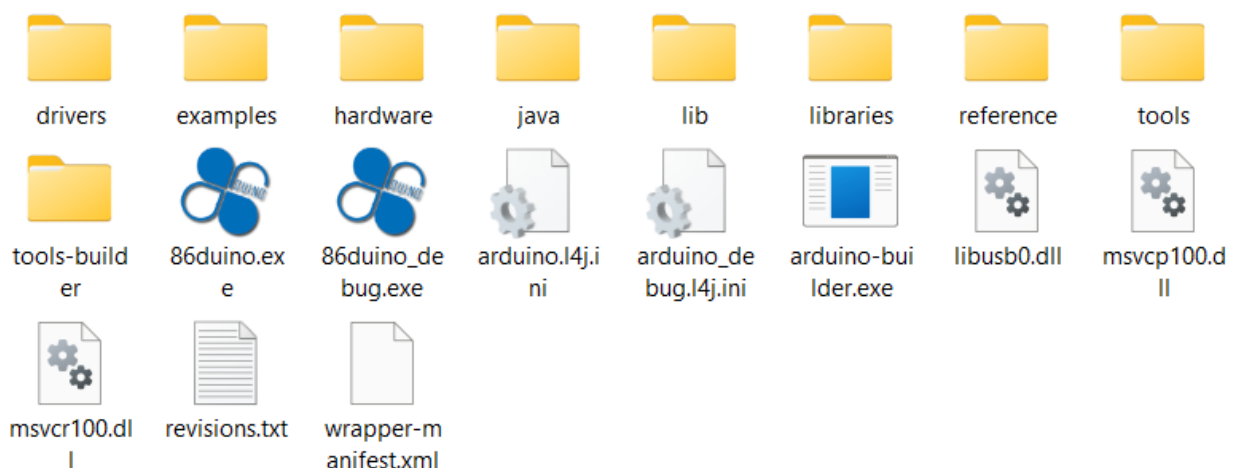
## 3.2 Hardware Configuration

The QEC-M Series will preinstall the development environment before shipping. User just needs to download the software and follow this user manual to set up the system configuration.

## 3.3 Software Driver Installation

You would download the software for QEC-M Series in the following steps:

1. Go to QEC website > Software and scroll down to find the "Download." Choose the corresponding 86Duino IDE version and download.
2. You will get a zip file, and please extract it.
3. After the above steps, you can see 86duino.exe.



## 3.4 Set up the QEC-M for 86Duino

This section works with the QEC-M products series and is based on Windows OS.

### Plugin the power supply

There are two groups for the Power Supply in QEC-M-043T, Vs and Vp; Both power requirements can be range in 5V to 56V wide Voltages. After powering on, you'll see the power LED light up.



*Note: Vs for the system power; Vp for the peripheral power.*

### Connect the USB cable with PC

Please use the Micro USB to USB from QEC-M-043T to your PC which install the 86Duino IDE.

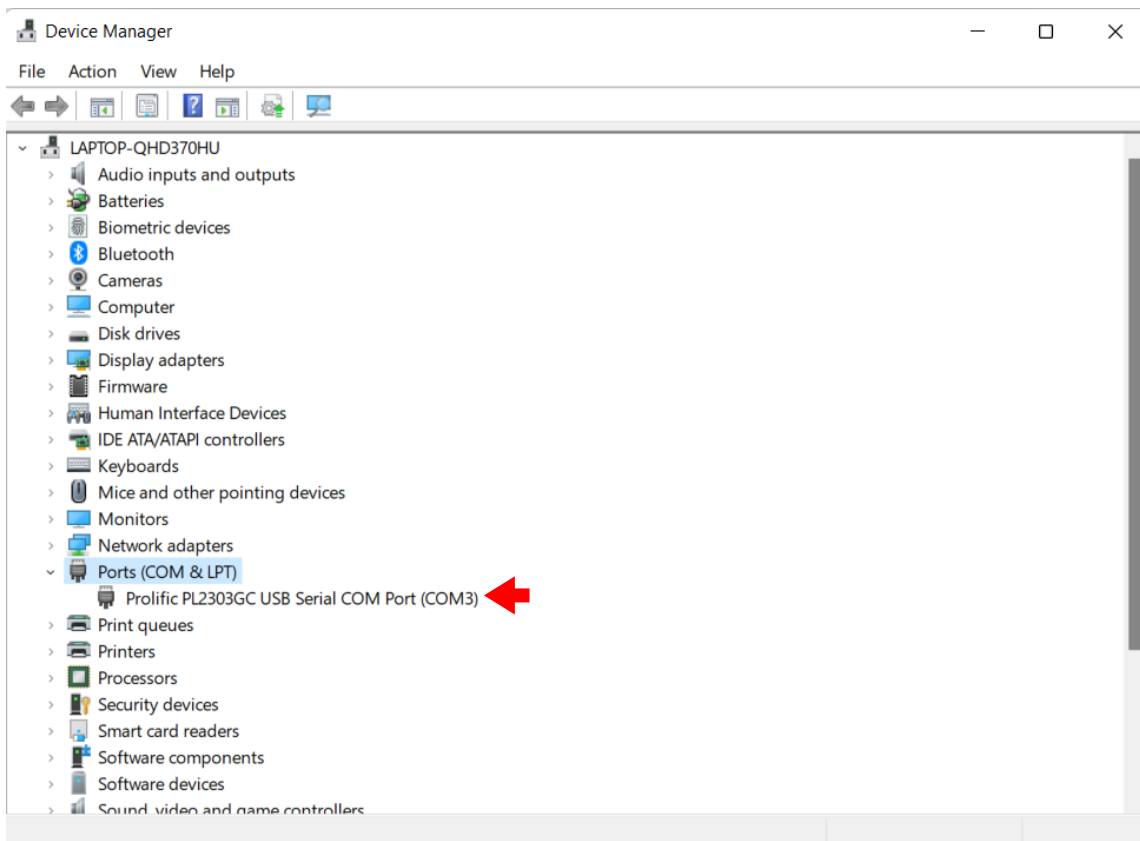


You will be like the below image after connecting the device.



## Verify if the device is detected or not

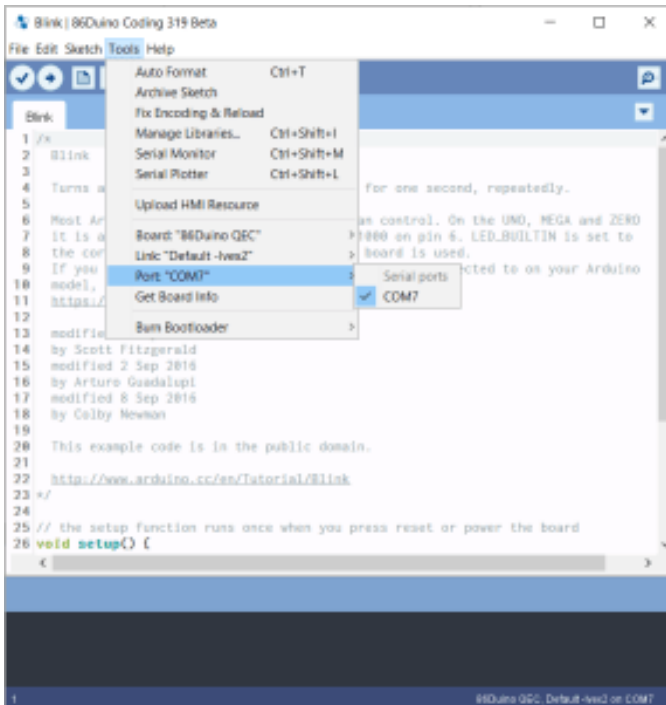
Open Device Manager -> Ports (COM & LPT) in your PC and expand the ports, you should see that the "Prolific PL2303GC USB Serial COM Port (COMx)" is detected, if not you need to install the required drivers.



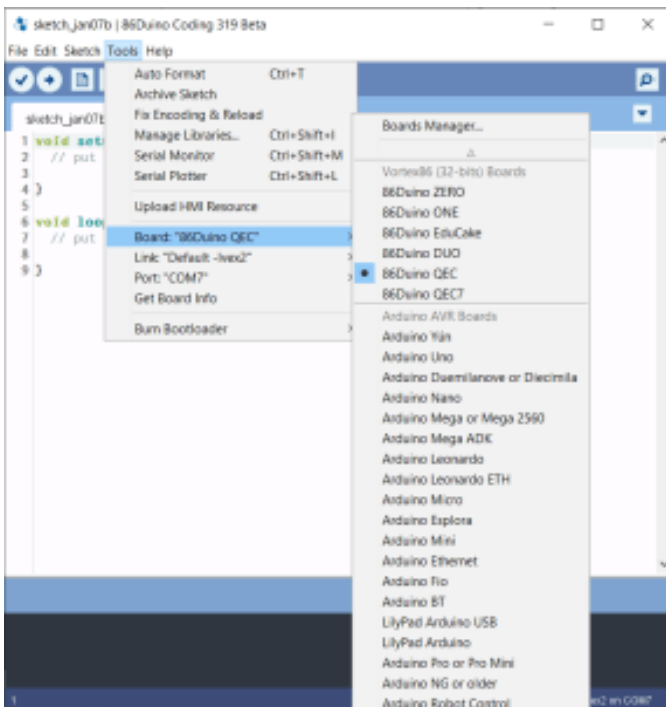
## Write your first sketch

- Open the 86Duino IDE
- Open the Tools menu from Menu bar

- Select the assigned COM port for QEC-M-043T.(Here is COM7)



- Select "86Duino QEC" for the board.



- Put your code into the editor.



## Upload your first sketch!

Hit the right arrow button (upload) next to the upload button. Now while the code uploads, you should see the LEDs next to Tx and Rx blinking indicating data transfer between the board and the computer.

If this is your first time running 86Duino sketch files, we suggest you check out [how to set up the QEC-M-043T for 86Duino](#) before proceeding.

Video: <https://youtu.be/ZMNMtvRCLbs>

# Ch. 4

## Software Function

[4.1 Software Description](#)

[4.2 Function List](#)

[4.3 Function Description](#)

## 4.1 Software Description

The 86Duino IDE developed by the QEC team is specially designed for industrial field control systems, bringing simple and powerful functions into the industrial field through the open-source Arduino.

Please visit [qec.tw](http://qec.tw) for 86Duino IDE details.

## 4.2 Function List

Used in QEC series products.

### EthercatMaster Class Functions

Initialization Functions:

- begin()
- end()
- isRedundancy()
- libraryVersion()
- firmwareVersion()

Access to slave information Functions:

- getSlaveCount()
- getVendorID()
- getProductCode()
- getRevisionNumber()
- getSerialNumber()
- getAliasAddress()
- getSlaveNo()

Control Functions:

- start()
- stop()
- getSystemTime()
- getWorkingCounter()

- getExpectedWorkingCounter()

## **EthercatDevice\_XXX Class General Functions**

### Access to slave information Functions:

- getVendorID()
- getProductCode()
- getRevisionNumber()
- getSerialNumber()
- getAliasAddress()
- getSlaveNo()
- readSII()
- readSII8()
- readSII16()
- readSII32()
- writeSII()
- writeSII8()
- writeSII16()
- writeSII32()

### Process Data Objects (PDO) Functions:

- pdoBitWrite()
- pdoBitRead()
- pdoGetOutputBuffer()
- pdoGetInputBuffer()
- pdoWrite()
- pdoWrite8()
- pdoWrite16()
- pdoWrite32()
- pdoRead()
- pdoRead8()
- pdoRead16()
- pdoRead32()

### CANopen over EtherCAT (CoE) Functions:

- sdoDownload()
- sdoDownload8()

- sdoDownload16()
- sdoDownload32()
- sdoUpload()
- sdoUpload8()
- sdoUpload16()
- sdoUpload32()
- getODlist()
- getObjectDescription()
- getEntryDescription()

File over EtherCAT (FoE) Functions:

- readFoE()
- writeFoE()

## **EthercatDevice\_Generic Class Functions**

Universal objects for various brands of EtherCAT devices.

Initialization Functions:

- attach()
- detach()

## 4.3 Function Description

Usage restrictions:

- Zone1 => Before master.begin()
- Zone2 => After master.begin()[Before master.start()]
- Zone3 => After master.start()

API	Functions Description	Limitation			Cyclic Callback Suitability
		Zone1	Zone2	Zone3	
<b>EthercatMaster Function</b>					
<b>Initialize Functions</b>					
<b>begin</b>	EtherCAT Master Initialize. All slaves will enter PRE-OP state if success.	-	-	-	
<b>end</b>	EtherCAT Master shutdown.		V		
<b>isRedundancy</b>	Check EtherCAT uses redundancy or not.		V	V	V
<b>libraryVersion</b>	The version of EtherCAT Master library.	V	V	V	V
<b>firmwareVersion</b>	The version of EtherCAT firmware. Call this after begin().		V	V	V
<b>Get Slave Information Functions</b>					
<b>getSlaveCount</b>	Get the Count of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getVendorID</b>	Get the Vendor ID of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getProductCode</b>	Get the Product Code of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getRevisionNumber</b>	Get the Revision Number of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getSerialNumber</b>	Get the Serial Number of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getAliasAddress</b>	Get the Alias Address of the EtherCAT Slave on the EtherCAT bus.		V	V	V
<b>getSlaveNo</b>	Get the Number of the EtherCAT Slave according to the Alias Address, Vendor ID, Product Code, Revision Number, and Serial Number.		V	V	V
<b>Control Functions</b>					
<b>start</b>	Start EtherCAT communication: Automatic Freerun mode.		V		
<b>stop</b>	Stop EtherCAT Master.			V	
<b>getSystemTime</b>	Get system time of current cycle.			V	V
<b>getWorkingCounter</b>	Get working counter of current cycle.			V	V
<b>getExpectedWorkingCounter</b>	Get expected working counter.			V	V
<b>EthercatDevice_XXX Class General Function</b>					

<b>Access to EtherCAT Slave information functions</b>					
<b>getVendorID</b>	Get the Vendor ID of the EtherCAT Slave.		V	V	V
<b>getProductCode</b>	Get the Product Code of the EtherCAT Slave.		V	V	V
<b>getRevisionNumber</b>	Get the Revision Number of the EtherCAT Slave.		V	V	V
<b>getSerialNumber</b>	Get the Serial Number of the EtherCAT Slave.		V	V	V
<b>getAliasAddress</b>	Get the Alias Address of the EtherCAT Slave.		V	V	V
<b>getSlaveNo</b>	Get the Number of the EtherCAT Slave.		V	V	V
<b>readSII</b>	Read the EEPROM of the EtherCAT Slave.		V	V	
<b>readSII8</b>	Read the EEPROM of the EtherCAT Slave. (8-bit)		V	V	
<b>readSII16</b>	Read the EEPROM of the EtherCAT Slave. (16-bit)		V	V	
<b>readSII32</b>	Read the EEPROM of the EtherCAT Slave. (32-bit)		V	V	
<b>writeSII</b>	Write the EEPROM of the EtherCAT Slave.		V	V	
<b>writeSII8</b>	Write the EEPROM of the EtherCAT Slave. (8-bit)		V	V	
<b>writeSII16</b>	Write the EEPROM of the EtherCAT Slave. (16-bit)		V	V	
<b>writeSII32</b>	Write the EEPROM of the EtherCAT Slave. (32-bit)		V	V	
<b>Process Data Objects (PDO) Functions</b>					
<b>pdoBitWrite</b>	Write Bit of Process Data Output.			V	V
<b>pdoBitRead</b>	Read Bit of Process Data Input.			V	V
<b>pdoGetOutputBuffer</b>	Get Slave Process Data Output Pointer.			V	V
<b>pdoGetInputBuffer</b>	Get Slave Process Data Input Pointer.			V	V
<b>pdoWrite</b>	Write Slave Process Data Output.			V	V
<b>pdoWrite8</b>	Write Slave Process Data Output. (unit8_t)			V	V
<b>pdoWrite16</b>	Write Slave Process Data Output. (unit16_t)			V	V
<b>pdoWrite32</b>	Write Slave Process Data Output. (unit32_t)			V	V
<b>pdoRead</b>	Read Slave Process Data Input.			V	V
<b>pdoRead8</b>	Read Slave Process Data Input. (unit8_t)			V	V
<b>pdoRead16</b>	Read Slave Process Data Input. (unit16_t)			V	V
<b>pdoRead32</b>	Read Slave Process Data Input. (unit32_t)			V	V
<b>CAN Application Protocol over EtherCAT (CoE) Functions</b>					
<b>sdoDownload</b>	(CoE) Write the object to EtherCAT Slave device.		V	V	
<b>sdoDownload8</b>	(CoE) Write the object to EtherCAT Slave device. (unit8_t)		V	V	
<b>sdoDownload16</b>	(CoE) Write the object to EtherCAT Slave device. (unit16_t)		V	V	
<b>sdoDownload32</b>	(CoE) Write the object to EtherCAT Slave device. (unit32_t)		V	V	
<b>sdoUpload</b>	(CoE) Read the object from EtherCAT Slave device to EtherCAT Master.		V	V	
<b>sdoUpload8</b>	(CoE) Read the object from EtherCAT Slave device to EtherCAT Master. (unit8_t)		V	V	

<b>sdoUpload16</b>	(CoE) Read the object from EtherCAT Slave device to EtherCAT Master. (unit16_t)		V	V	
<b>sdoUpload32</b>	(CoE) Read the object from EtherCAT Slave device to EtherCAT Master. (unit32_t)		V	V	
<b>getODlist</b>	(CoE) Get the object list from EtherCAT Slave device to EtherCAT Master.		V	V	
<b>getObjectDescription</b>	(CoE) Get the object list's Description from EtherCAT Slave device to EtherCAT Master.		V	V	
<b>getEntryDescription</b>	(CoE) Get the entry description with Slave index.		V	V	
<b>File over EtherCAT (FoE) Functions</b>					
<b>readFoE</b>	(FoE) Read Slave file.		V		
<b>writeFoE</b>	(FoE) Write Slave file.		V		
<b>EthercatDevice_Generic Functions (For all of EtherCAT Device generic objects)</b>					
<b>Initialize Functions</b>					
<b>attach</b>	Specify the EtherCAT Slave number and mount it on the EtherCAT Master.		V	V	
<b>detach</b>	Dismount the EtherCAT slave object.		V	V	



# 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.

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