TC-6000 Series Expansion Modules User's Manual

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Introduction

TC-6000 expansion modules provide peripheral interfaces to TC-6000 series railway computers.

The following topics are covered in this chapter:

- **Overview**
- **Package Checklist**
- **Available Modules**
- **TC-6000 Series Module Specifications**
  - TC-DK10-T/TC-DK20-T Specifications
  - TC-SP04-DB44-T Specifications
  - TC-CP02-DB-T Specifications
  - TC-SW04-M12-4P-T/TC-SW04-M12-8P-T Specifications
  - TC-SATA-T Specifications (Available on Request)

Overview

TC-6000 series expansion modules may provide a 2.5 inch mass storage module with customizable anti-vibration and temperature management features; four-port (without PoE) Gigabit- or megabit-Ethernet switch modules, both with M12 connectors; a mini PCIe carrier module with four sockets; a serial module supporting four software-selectable RS-232/422/485 interfaces over a single DB-44F connector (cable adapter); or an optically isolated CAN module with two ports. These modules let system integrators and administrators easily add additional storage capacity, Ethernet ports and/or bandwidth, as well as serial, PCIe, and CAN interfaces to the TC-6000 series of train computers.

All of the TC-6000 modules are compliant with the essential sections of the EN 50155 Class TX standard, guaranteeing the TC-6000 is a highly dependable computing platform specialized for a wide variety of on-board railway applications.

Package Checklist

Each package ships with a single TC-6000 series expansion module.

NOTE: Please notify your sales representative if the module is damaged en route.

Available Modules

- **TC-DK10-T:** 4 PCIe mini card slots with PCIe and USB interfaces on slot 1 and USB interfaces on slots 2, 3 and 4; 4 SIM card sockets; -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-DK20-T:** 4 PCIe mini card slots with PCIe and USB interfaces, 4 SIM card sockets, -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-SP04-DB44-T:** 4 RS-232/422/485 serial interfaces over a single DB44 connector; cable sold separately, -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-CP02-DB-T:** 2 optically isolated CAN interfaces with DB9 connectors, -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-SW04-M12-4P-T:** 4-port Megabit Ethernet switch with M12 D-coded connectors, -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-SW04-M12-8P-T:** 4-port Gigabit Ethernet switch with M12 A-coded connectors, -40 to 70°C operating temperature (EN 50155 Class TX)
- **TC-SATA-T (Available on request):** 1-slot carrier module for 2.5-inch SATA mass storage drives, with heater, vibration protections, accelerometer, and temperature sensor, -40 to 70°C operating temperature (EN 50155 Class TX)

TC-6000 Series Module Specifications

TC-DK10-T/TC-DK20-T Specifications

Mini PCIe Card

Interface: 4 sockets, total

• Socket 1 on both TC-DK10-T and TC-DK20-T: USB 2.0 / PCIe V1.0

• Sockets 2, 3, and 4 on the TC-DK10-T: USB 2.0

• Sockets 2, 3, and 4 on the TC-DK20-T: USB 2.0 / PCIe V1.0

SIM Card Socket: 4 sockets reserved for cellular applications

Wireless Antenna Hole: 5 reserved for QMA antenna connectors

Physical Characteristics

Dimensions: 186 x 118 x 20 mm (7.32 x 4.65 x 0.79 in)

Weight: 220 g

Environmental Limits

Operating Temperature: -40 to 70°C (-40 to 158°F) (EN 50155 Class TX)

Storage Temperature: -40 to 85°C (-40 to 185°F)

Ambient Relative Humidity: 5 to 95% (non-condensing)

TC-SP04-DB44-T Specifications

Serial Port Interface

Serial Standards:

RS-232/422/485, software-selectable

Connector Type:

1 DB44 connector serving all 4 interfaces; special cable (CBL-M44M25x4-50 BK), required contact Moxa for details)

Serial Communication Parameters

Data Bits: 5, 6, 7, 8

Stop Bits: 1, 1.5, 2

Parity: None, Even, Odd, Space, Mark

Flow Control: RTS/CTS, XON/XOFF, ADDC® (automatic data direction control) for RS-485

Baudrate: 50 bps to 921.6 Kbps (non-standard baudrates supported; see Chapter 4 for details)

Physical Characteristics

Dimensions: 186 x 118 x 20 mm (7.32 x 4.65 x 0.79 in)

Weight: 234 g

Environmental Limits

Operating Temperature: -40 to 70°C (-40 to 158°F) (EN 50155 Class TX)

Storage Temperature: -40 to 85°C (-40 to 185°F)

Ambient Relative Humidity: 5 to 95% (non-condensing)

TC-CP02-DB-T Specifications

CAN Interface

Interface:

2 optically isolated CAN 2.0 A/B ports

Signal: CAN-H, CAN-L

Isolation: 2 kV

Speed: 1 Mbps

Connector Type: DB9 male

Physical Characteristics

Dimensions: 186 x 118 x 20 mm (7.32 x 4.65 x 0.79 in)

Weight: 227 g

Environmental Limits

Operating Temperature: -40 to 70°C (-40 to 158°F) (EN 50155 Class TX)
Storage Temperature: -40 to 85°C (-40 to 185°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

TC-SW04-M12-4P-T/TC-SW04-M12-8P-T Specifications

Ethernet Interface

Standard:
4 Ethernet M12 switch ports: auto-sensing 10/100 Mbps (TC-SW04-M12-4P-T) or 10/100/1000 Mbps (TC-SW04-M12-8P-T)
Protection: 1.5 kV magnetic isolation protection
Connector Type: 4-pin M12 D-coded/8-pin M12 A-coded

Physical Characteristics

Dimensions: 186 x 118 x 20 mm (7.32 x 4.65 x 0.79 in)
Weight: 278 g

Environmental Limits

Operating Temperature: -40 to 70°C (-40 to 158°F) (EN 50155 Class TX)
Storage Temperature: -40 to 85°C (-40 to 185°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

TC-SATA-T Specifications (Available on Request)

SATA Interface

Description: Hot swappable, with 1 storage slot for 2.5 inch HDD or SSD, built-in vibration protection, onboard accelerometer, temperature sensor, and Intelligent Heating Solution
LEDs: 4 total: 1 for drive activity, 1 for heater activity, and 2 user-configurable

Physical Characteristics

Weight: 393 g
Dimensions: 186 x 118 x 20 mm (7.32 x 4.65 x 0.79 in)

Environmental Limits

Operating Temperature: Wide Temp. Models: -40 to 70°C (-40 to 158°F) (EN 50155 Class TX)
Storage Temperature: -40 to 85°C (-40 to 185°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

2

Hardware Introduction

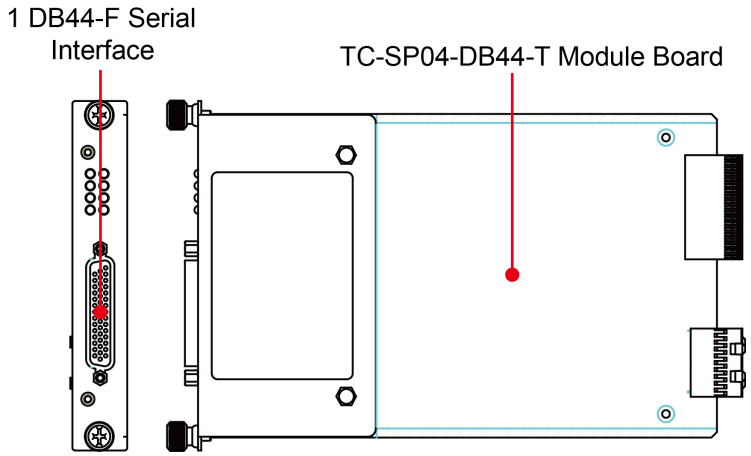
The TC-6000 series expansion modules are designed to work with Moxa's TC-6000 train computers. By providing different modules with different connectors, the TC-6000 series offers convenient flexibility for users who would like to easily build precise industrial solutions requiring a variety of communication interfaces.

The following topics are covered in this chapter:

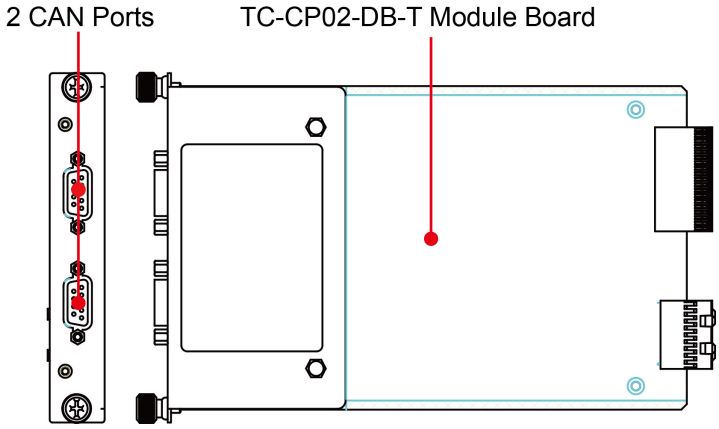
- **Appearance**
  - TC-SP04-DB44-T
  - TC-CP02-DB-T
  - TC-DK10-T/TC-DK20-T
  - TC-SW04-M12-4P-T/TC-SW04-M12-8P-T
  - TC-SATA-T
- **Dimensions**

Appearance

TC-SP04-DB44-T

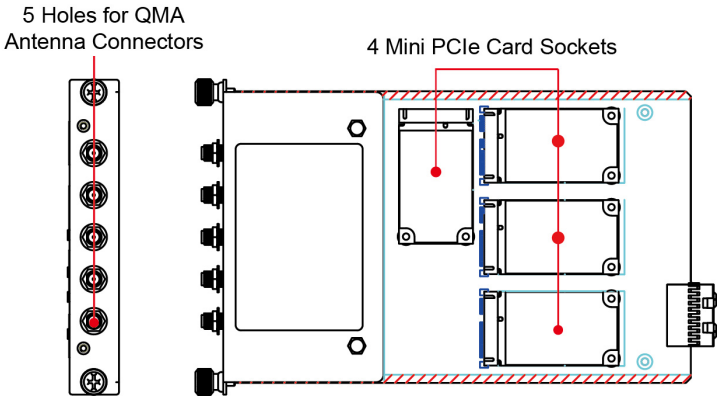


TC-CP02-DB-T

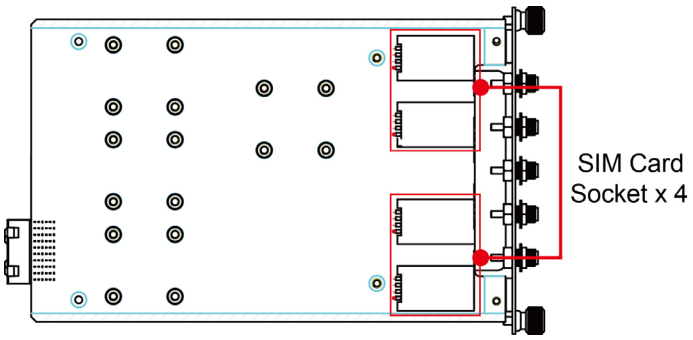


TC-DK10-T/TC-DK20-T

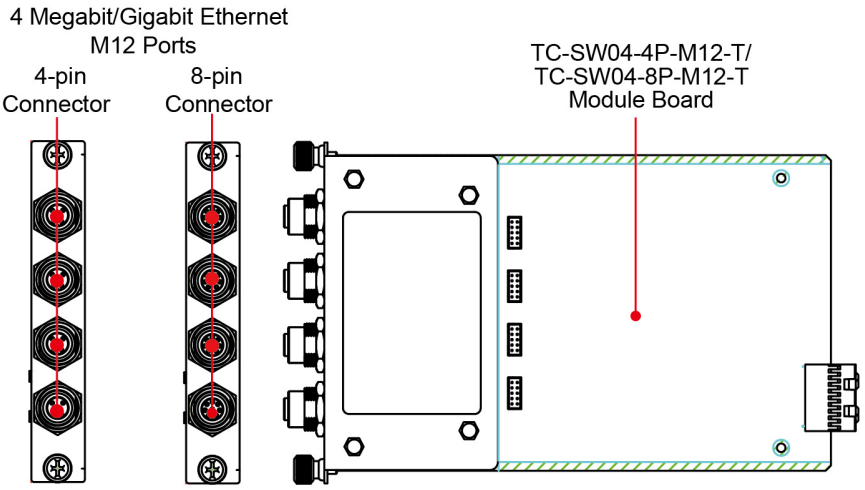
Front



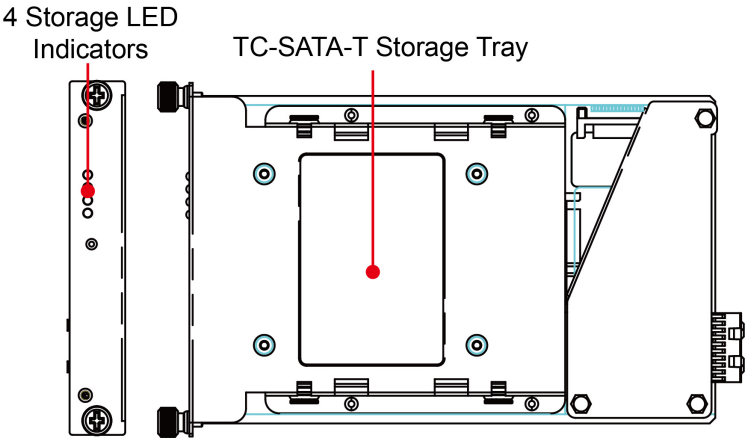
Rear



TC-SW04-M12-4P-T/TC-SW04-M12-8P-T

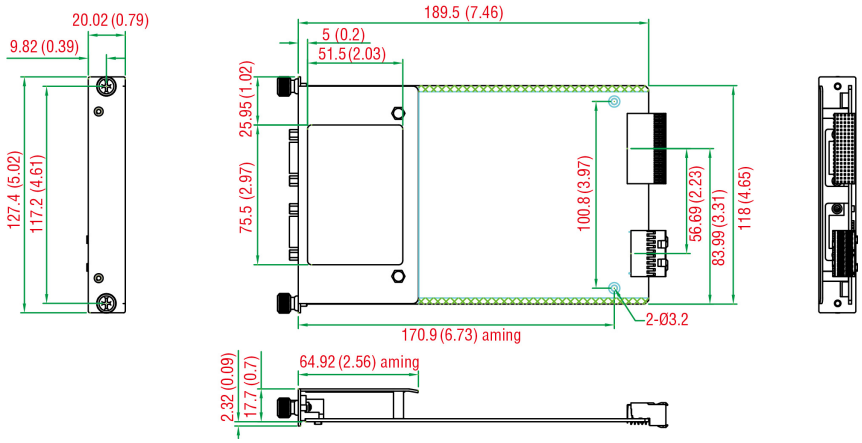


TC-SATA-T



Dimensions

All modules share the same dimensions.



3

Hardware Connection Description

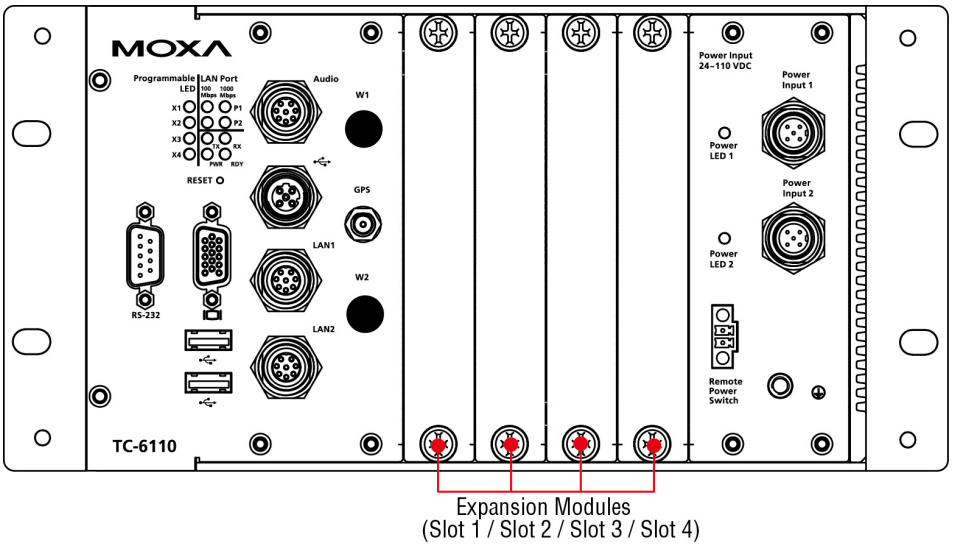
In this chapter, we show how to connect the embedded computers to the network and to various devices.

The following topics are covered in this chapter:

- **Installing the TC-6000 Series Expansion Modules**
- **Connecting Data Transmission Cables**
  - TC-SP04-DB44-T Serial Port Module
  - TC-CP02-DB-T CAN Bus Module
  - TC-SW04-M12-4P-T/TC-SW04-M12-8P-T Switch Module
- **Installing Cellular Modules on the TC-DK10-T and TC-DK20-T**
  - Installing a Cellular Module
- **Installing the SSD/HDD into the TC-SATA Module**

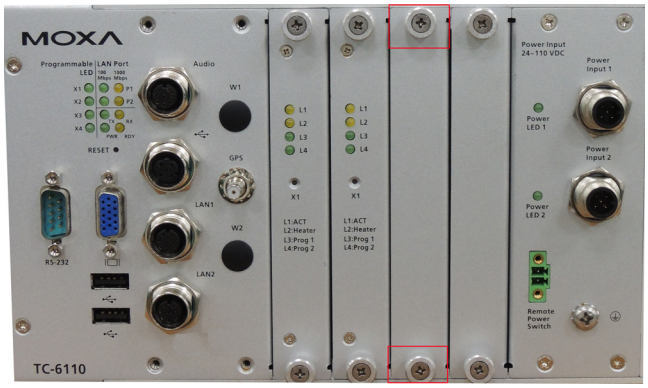
Installing the TC-6000 Series Expansion Modules

The TC-6000 train computers come with four expansion module slots on the front panel. Refer to the following figure for the location of these slots.



To insert the TC-6000 series expansion modules into the TC-6000 train computer, follow the steps below.

1. Loosen the thumbscrews and remove the coverplate.



2. Insert the module into the slot, being careful not to damage the card as you slide it into to the motherboard connector. Once you have secured it into the slot, fasten the screws to lock it in.

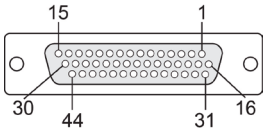
NOTE Note that the TC-SATA-T storage module can be inserted in slots 1, 2, or 3. However, slot 3 does not feature the Intelligent Heating Solution (IHS). In addition, except for the TC-SATA-T storage module, other modules do not support hot swap/plug function. Power off the TC-6000 computer before removing or inserting the modules.

Connecting Data Transmission Cables

In this section we explain how to connect the TC-6000 series expansion modules to devices.

TC-SP04-DB44-T Serial Port Module

Use a serial cable to plug your serial device into the module's serial port with DB44 connectors that can serve 4 serial interfaces and can be configured for RS-232, RS-422, or RS-485 communication by software. The pin assignments are shown in the following figure and tables.



RS-232

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	TxD3	13	TxD0	25	DTR1	37	GND
2	RxD3	14	RxD0	26	DSR1	38	–
3	RTS3	15	RTS0	27	–	39	DCD1
4	–	16	CTS3	28	CTS0	40	–
5	TxD2	17	DTR3	29	DTR0	41	GND
6	RxD2	18	DSR3	30	DSR0	42	DCD0
7	RTS2	19	–	31	DCD3	43	–
8	–	20	CTS2	32	–	44	GND
9	TxD1	21	DTR2	33	GND		
10	RxD1	22	DSR2	34	–		
11	RTS1	23	–	35	DCD2		
12	–	24	CTS1	36	–		

RS-422 & 4-wire RS-485

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	RxD3(+)	13	RxD0(+)	25	RxD1(-)	37	GND
2	TxD3(+)	14	TxD0(+)	26	–	38	–
3	–	15	–	27	–	39	TxD1(-)
4	–	16	–	28	–	40	–
5	RxD2(+)	17	RxD3(-)	29	RxD0(-)	41	GND
6	TxD2(+)	18	–	30	–	42	TxD0(-)
7	–	19	–	31	TxD3(-)	43	–
8	–	20	–	32	–	44	GND
9	RxD1(+)	21	RxD2(-)	33	GND		
10	TxD1(+)	22	–	34	–		
11	–	23	–	35	TxD2(-)		
12	–	24	–	36	–		

2-wire RS-485

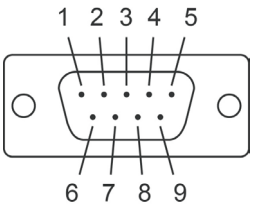
Pin	Signal	Pin	Signal	Pin	Signal
1	Data3+(B)	16	–	31	–
2	–	17	Data3-(A)	32	–
3	–	18	–	33	GND3
4	–	19	–	34	–
5	Data2+(B)	20	–	35	–
6	–	21	Data2-(A)	36	–
7	–	22	–	37	GND2
8	–	23	–	38	–
9	Data1+(B)	24	–	39	–
10	–	25	Data1-(A)	40	–
11	–	26	–	41	GND1
12	–	27	–	42	–
13	Data0+(B)	28	–	43	–
14	–	29	Data0-(A)	44	GND0
15	–	30	–		

Do not remove the isolation sticker on the back of the module.

TC-CP02-DB-T CAN Bus Module

The TC-CP02-DB-T offers two CAN bus ports with DB9 male connectors. Use a cable to plug your CAN device into the module's serial port. The pin assignments are shown in the following table:

DB9 Male



CAN bus Pinouts

PIN	CAN
1	*-*
2	*CAN-L*
3	*-*
4	*-*
5	*-*
6	*-*
7	*CAN-H*
8	*-*
9	*-*

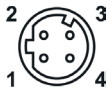
Do not remove the isolation sticker on the back of the module.

TC-SW04-M12-4P-T/TC-SW04-M12-8P-T Switch Module

The TC-SW04-M12-4P-T switch module comes with 4 auto-sensing 10/100 Mbps switched ports, and the TC-SW04-M12-8P-T switch module comes with 8. Connect one end of the Ethernet cable to the module and the other end to the network or device you wish to add to the network. Pin assignments are shown below.

TC-SW04-M12-4P-T

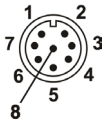
PIN	TX
1	TD+
2	RD+
3	TD-
4	RD-



Housing:shield

TC-SW04-M12-8P-T

PIN	Con.
1	TRD3+
2	TRD4+
3	TRD4-
4	TRD1-
5	TRD2+
6	TRD1+
7	TRD3-
8	TRD2-



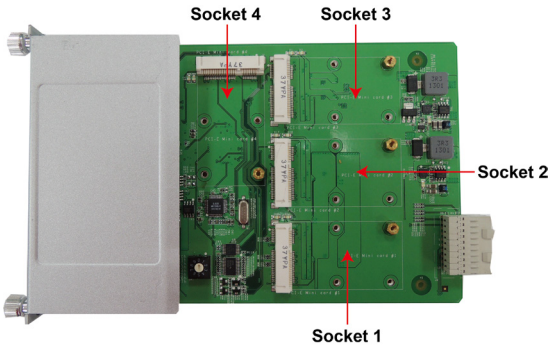
Installing Cellular Modules on the TC-DK10-T and TC-DK20-T

The TC-DK10-T and TC-DK20-T have four mini PCIe sockets that allow you to install four cellular modules. However, they come with different interfaces. Check the following table for details.

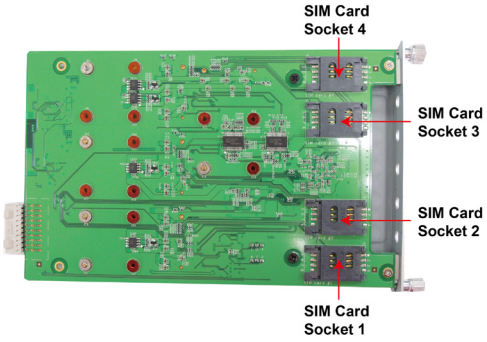
Model	TC-DK10-T				TC-DK20-T			
Interface	Socket 1	Socket 2	Socket 3	Socket 4	Socket 1	Socket 2	Socket 3	Socket 4
PCIe V1.0 (One Lane)	☐	--	--	--	☐	☐	☐	☐
USB 2.0	☐	☐	☐	☐	☐	☐	☐	☐

Before installing a cellular module, verify the locations of the mini PCIe sockets on the front side and match them to the SIM sockets on the rear. If you install a cellular module in socket 1, you will need to install a SIM card in SIM socket 1.

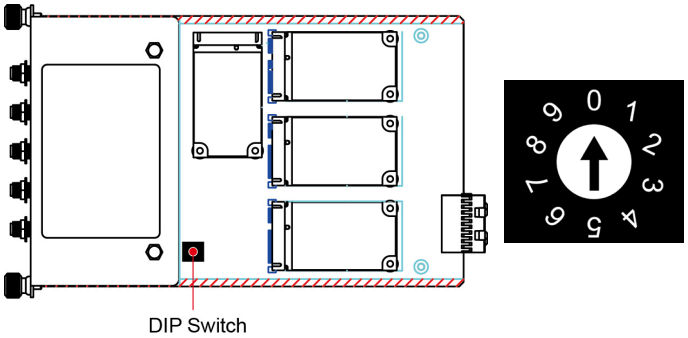
Front View



Rear View



Note that you must specify a different SMBus address for each TC-DK01-T/TC-DK20-T module. This is done by adjusting the DIP switch. The diagram below shows the location of the DIP switch, and provides a table that maps the DIP switch value to the SMBus address it is associated with.



Value	SMBus Address
0	0x27
1	0x26
2	0x25
3	0x24
4	0x23
5	0x22
6	0x21
7	0x20

ATTENTION

You must be sure to set each module's SMBus address to a distinct value. Do not set any cards with duplicate values, or you will create unpredictable behavior (bugs) in your system.

Slot	Value	Address
1	1	0x26
2	2	0x25
3	3	0x24
4	4	0x23

Installing a Cellular Module

A single cellular accessory package includes a cellular module, a cellular antenna cable (that ends in an F type barrel connector on one and a crimped slider on the other), two black screws, a locking washer, and a nut. Follow the steps below to install a cellular module.

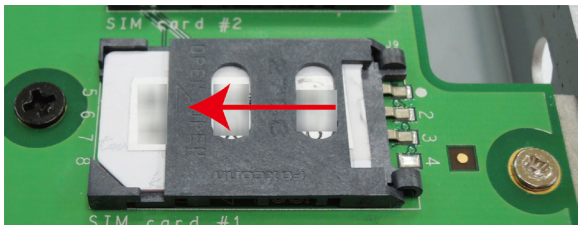
1. Insert the cellular module into the socket. Secure the module with 2 black screws.

2. Connect the antenna cable to the module. Make sure that the cable has been securely fastened.

3. Slide the F type connector of the antenna cable into the antenna hole on the face of the module. Slide the locking washer over the barrel connector, and then secure the connector to the face of the module using the nut.

4. After you have installed the antenna's barrel connector to the face of the module, connect the cellular antenna.

5. Next, insert the SIM card for the cellular module. Pull up the SIM card slot and insert the SIM card. When finished, replace the holder and slide the slot towards the catch to fasten the holder

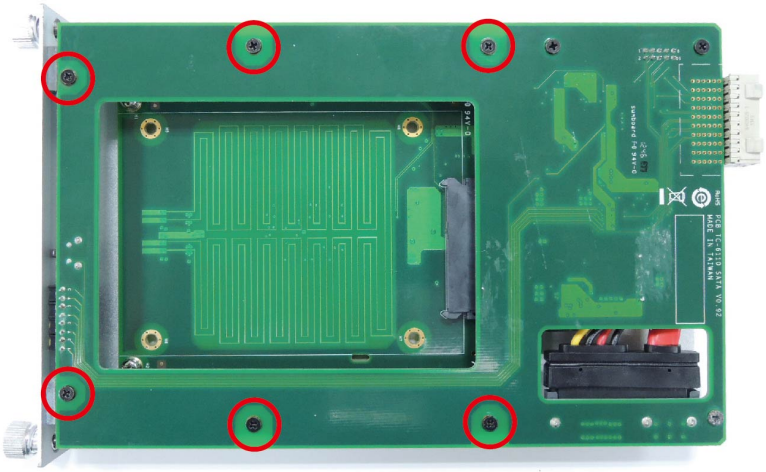


6. You can use the same procedure to install another cellular module on another socket.

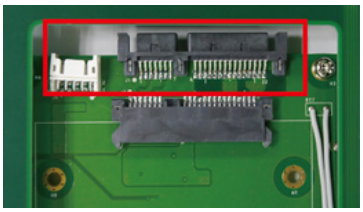
Installing the SSD/HDD into the TC-SATA Module

Follow these steps to install the SSD/HDD into the TC-STAT storage module. The TC-STAT storage module has a double-PCB design, with an upper PCB and a lower PCB. The upper PCB is the module's main board.

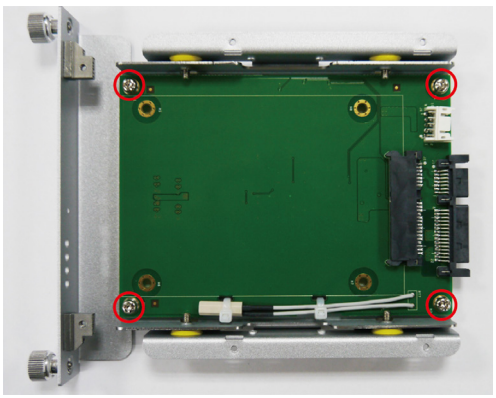
1. Remove the storage tray from the computer.
2. Remove the six screws that fasten the upper PCB to the storage tray. These are circled in red, on the figure below. Note that it is not necessary to remove the remaining three screws.



3. Detach the SATA power and data interfaces from the main board by carefully sliding the tray away from the main PCB.

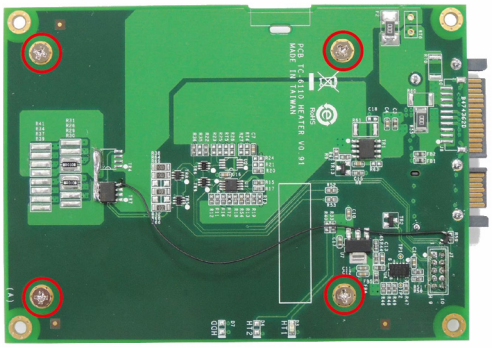


4. Remove the four screws securing the lower PCB to the module tray, and remove the lower PCB.



5. Slide the SSD/HDD into the lower PCB in such a way that the module's data and power interface securely connect with the PCB's power and data interface.

6. Carefully turn the tray over and fasten the drive to the PCB using the holes indicated in the photo.



7. Fasten the lower PCB to the module's tray (drive-side up, as shown) using the four screw holes shown at right.

8. First, connect the upper PCB / main board's power and data cables to the lower PCB interface. Then complete the installation by fastening the drive tray to the main PCB using the six screws.

9. You may now insert the storage tray back into the TC-6110 and tighten the external thumbscrews.

Note that each removable drive module has a hot-swap button and four LED indicators. To hot swap storage drives you will need to first install the **Moxa hot swap software package**, as described in the **TC-6110 software manual**. Once installed, to hot swap a drive you must use a sharp object to push the hot swap button (labeled **X1**, on the front panel map) and wait until the L1 LED indicator goes dark, indicating the drive has unmounted and is ready for extraction. The L3 and L4 LEDs are programmable, to be defined by users. Refer to the software manual for more details about the Moxa hot swap software package and programming the LEDs. The following table describes the functions associated with each LED and button.

LED Indicator/Button		Function
L1	On	HDD is accessing data
	Off	No activity
L2	Blinking	Heater is on in specific environments. Refer to the following conditions: • Below 55°C when power is available. • Below 15°C when system is on.
	Off	Heater is off
L3		Defined by admin
L4		Defined by admin
X1		Hot-swap button, for unmounting drives

4

Software Installation and Programming Guide

In this chapter we discuss software installation and programming for the TC-6000 series expansion modules TC-SP04-DB44-T, TC-CP02-DB-T, and TC-DK10-T/TC-DK20-T.

The following topics are covered in this chapter:

- **Linux System Peripherals Programming Guide**
  - Prerequisite for Installing Peripheral Modules
  - TC-SP04-DB44-T: Serial Port
  - TC-CP02-DB-T: CAN Bus Interface
  - TC-DK10-T/TC-DK20-T: mini PCIe Interface
- **Windows System**
  - TC-SP04-DB44-T: Driver Installation
  - TC-SP04-DB44-T: Configuring Serial Port Mode
  - TC-CP02-DB-T: Driver Installation
  - TC-CP02-DB-T CAN Module: Programming Guide
  - TC-DK10-T/TC-DK20-T: Enabling/Disabling USB Socket Power

Linux System Peripherals Programming Guide

Prerequisite for Installing Peripheral Modules

Two methods can be used for installing required drivers and utilities. One method uses APT for an automated online installation, while the other involves downloading the driver from the Moxa website and installing it by hand.

Installation of Linux Modules Using APT

To guarantee you are getting safe software from the correct source, Moxa's repository packages are encrypted with a Gnu Privacy Guard (GPG) key. Before installing the modules, you should add the Moxa GPG key. You can find the GPG key on the product CD or at the Moxa website. Upload the key to the TC-6000 and add it with the following command.

```
Moxa:~# apt-key add MOXA-SYS-DEBIAN-KEY
```

To use APT to download and install software, you must first add the Moxa repository to the sources file, found at `/etc/apt/source.list`.

1. First, back up your sources.list file:

```
Moxa:~# cp /etc/apt/sources.list /etc/apt/sources.listBAK
```

2. Add the Moxa repository by using the echo command

```
Moxa:~# echo 'deb http://debian.moxa.com/debian wheezy main' >> /etc/apt/source.list
```

3. Update the package list for retrieving the latest package list.

```
Moxa:~#  apt-get update
Get:1 http://debian.moxa.com wheezy Release.gpg [490 B]
Hit http://debian.moxa.com wheezy Release
Hit http://debian.moxa.com wheezy/main i386 Packages
Ign http://debian.moxa.com wheezy/main Translation-en_US
Ign http://debian.moxa.com wheezy/main Translation-en
Hit http://ftp.us.debian.org wheezy Release.gpg
Hit http://security.debian.org wheezy/updates Release.gpg
Hit http://ftp.us.debian.org wheezy-updates Release.gpg
Hit http://ftp.us.debian.org wheezy Release
Hit http://security.debian.org wheezy/updates Release
Hit http://ftp.us.debian.org wheezy-updates Release
Hit http://security.debian.org wheezy/updates/main Sources
Hit http://ftp.us.debian.org wheezy/main Sources
Hit http://security.debian.org wheezy/updates/main i386 Packages
Hit http://ftp.us.debian.org wheezy/main i386 Packages
Hit http://ftp.us.debian.org wheezy/main Translation-en
Hit http://security.debian.org wheezy/updates/main Translation-en
Hit http://ftp.us.debian.org wheezy-updates/main Sources
Hit http://ftp.us.debian.org wheezy-updates/main i386 Packages/DiffIndex
Hit http://ftp.us.debian.org wheezy-updates/main Translation-en/DiffIndex
Fetched 490 B in 2s (195 B/s)
Reading package lists... Done
```

4. Next, use **`apt-get search tc6000`** to check if your package list has been updated.

```
Moxa:~# apt-cache search tc6000
tc6000-mpcie-power - utility for control the mini-PCIe power status.
tc6000-mxser - module of MOXA's serial devices
tc6000-qmi-modules - modules for QMI devices
tc6000-setinterface - a utility for get or set the mode for serial interfaces.
```

```
tc6000-socketcan - modules for CAN device using socketCAN
```

The following table shows the packages required for each expansion modules:

Expansion Module	Driver Package Name	Utility Packages Name
TC-SP04-DB44-T	tc6000-mxser	tc6000-setinterface
TC-CP02-DB-T	tc6000-socketcan	
TC-DK10-T/TC-DK20-T	tc6000-qmi-modules	libqmi-glib1, libqmi-utils , tc6000-mpcie-power

After setting up the repository, use **apt-get** or **Aptitude** to install the package.

```
Moxa:~#  apt-get install package-name
```

To uninstall the package, use the following command.

```
Moxa:~#  apt-get remove package-name
```

Installing Linux Modules from the Moxa Website

The following table shows the various drivers and utilities required for each expansion module. You may acquire these kernel modules from the Moxa website, on the TC-6000 Expansion Modules product page, which should be at **http://www.moxa.com/support/sarch_result.aspx?prod_id=1990**. Click into the **Drivers** link, and download the correct kernel module according to the chart below:

Expansion Module	Kernel Module Package	Utility Package
TC-SP04-DB44-T	tc6000-mxser_1.15.21_i386.deb	tc6000-setinterface_1.0_i386.deb
TC-CP02-DB-T	tc6000-socketcan_1.0_i386.deb	
TC-DK10-T/TC-DK20-T	tc6000-qmi-modules_1.0_i386.deb	libqmi-glib1_1.8.0-1_i386.deb, libqmi-utils_1.8.0-1_i386.deb, tc6000-mpcie-power_1.0_i386.deb libffi5_3.0.10-3_i386.deb libglib2.0-0_2.33.12+really2.32.4-5_i386.deb

To install a package you have downloaded from the website, navigate to the directory it is stored in and type:

```
Moxa:~#  dpkg -i package-file
```

To uninstall the package, use

```
Moxa:~#  dpkg -r package-file
```

TC-SP04-DB44-T: Serial Port

The TC-SP04-DB44-T may be accessed over the Linux console as a terminal (**tty**) device node. The Moxa driver creates a special device node that is identified as a **ttyM*** device. The TC-SP04-DB44-T device nodes are listed from **/dev/ttyM0** to **/dev/ttyM15,** depending on how many expansion modules inserted. The UART API allows you to configure these device nodes for RS-232, RS-422, 4-wire RS-485, or 2-wire RS-485.

The serial port kernel module for the TC-SP04-DB44-T is **mxser.ko**, and has been pre-installed at **/lib/modules/3.2.0-4-686-pae/updates/drivers/tty/mxser.ko**. Whenver the module is loaded the serial ports will be automatically enabled whenever the system boots up.

ATTENTION

The maximum baudrate for the serial ports is 115,200; the stock serial ports on the TC-6000 series do not support baudrates beyond this maximum. However, the serial port expansion module does support baudrates up to 921,600. Standard baudrates are: 50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, and 921600. To configure the above code for a standard baudrate connection, simply insert the number at the indicated line.

Non-standard baudrates are more fully explained below

WARNING

If you use the **stty** command to get interface stats from a connection configured for a non-standard baudrate, the system will return a rate of 0.

TC-SP04-DB44-T: Configuring the Baudrate

Example Script #1: Setting the Baudrate)

```
#define MOXA                0x400
#define MOXA_SET_SPECIAL_BAUD_RATE     (MOXA+100)
#define MOXA_GET_SPECIAL_BAUD_RATE     (MOXA+101)
#include    <termios.h>
    struct termios  term;
    int         fd, speed;
    fd = open("/dev/ttyM8", O_RDWR);
    tcgetattr(fd, &term);
    term.c_cflag &= ~(CBAUD | CBAUDEX);
    term.c_cflag |= B4000000;
    tcsetattr(fd, TCSANOW, &term);
    speed = 115200;
    ioctl(fd, MOXA_SET_SPECIAL_BAUD_RATE, &speed);
```

Example Script #2: Return the Baudrate

```
#define MOXA                0x400
#define MOXA_SET_SPECIAL_BAUD_RATE     (MOXA+100)
#define MOXA_GET_SPECIAL_BAUD_RATE     (MOXA+101)
#include    <termios.h>
    struct termios  term;
    int         fd, speed;
    fd = open("/dev/ttyM8", O_RDWR);
    tcgetattr(fd, &term);
    if ( (term.c_cflag & (CBAUD|CBAUDEX)) != B4000000 ) {
        // On this line, you may insert a standard baud rate
    } else {
        ioctl(fd, MOXA_GET_SPECIAL_BAUD_RATE, &speed);
    }
```

Non-Standard Baudrates and Baudrate Inaccuracy

Moxa's drivers allow engineers to configure our serial devices for non-standard baudrates. Theoretically, these devices may be set for any baudrate; however, in practice the only non-standard rates that will communicate at the chosen baudrate are whole number factors of the base rate, 921,600 bps. For any non-standard rates that are not a whole number factor of 921,600, there will be some inaccuracy in transmission speed relative to the configured rate.

Standard baudrates are 50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, and 921600. Moxa's drivers allow for any whole number factor of 921,600 to be used without any performance loss (i.e., inaccuracy or deviation from the TBR) in the configured modulation rate. To calculate the relative inaccuracy for non-standard baudrates that are not a whole number factor of 921,600, use the formula below:

$$\text{Root formula: Inaccuracy} = \frac{\text{TBR} - 921600/(\text{Factor} + \text{ENUM}/8)}{(\text{TBR})\ 100}$$

The variables in this equation are described below:

TBR = The **Target Baud Rate**, i.e., any non-standard baudrate
Factor = 921,600/TBR (rounded down to the integer)
ENUM = 8 * (921600/Target baudrate - Factor) (Round up or down)

As an example, below we show you how to calculate the transmission inaccuracy at a target baudrate (TBR) of 500,000 bps:

$$\text{Target (non-standard) Baud Rate} = 500{,}000$$

$$\text{Factor} = \frac{921{,}600}{500{,}000} = 1.8, \text{ then round down to the nearest integer to get } \mathbf{1}.$$

$$\text{ENUM} = 8\left(\frac{921{,}600}{500{,}000} - 1\right) = 6.7, \text{ round to the nearest integer to get } \mathbf{7}.$$

$$\text{Inaccuracy} = \frac{500{,}000 - 921600/(1 + 7/8)}{(500{,}000)\ 100} = 1.696 = 1.7\%$$

This result indicates that for a device configured at the non-standard rate of 500,000 bps, the actual modulation rate will deviate around 2% from the configured baudrate.

TC-SP04-DB44-T: Configuring Serial Port Modes

Use the **setinterface** command to retrieve the parameters of the serial port configuration. The usage is **$:~# setinterface [device node] [interface option]**. The **device node** is the tty device to be configured. For the serial ports, Moxa uses a proprietary driver whose device nodes are identified with the marker **M**. Serial ports 1 to 4 on card 1 are referred to as **ttyM0** to **ttyM3**, and **ttyM4** to **ttyM7** refer to ports 1 to 4 on the second card and so on. The **interface option** is a number between 0 and 3 that will determine what serial interface should be configured for the port in question. For example:
$:~# setinterface /dev/ttyM0 0
sets the first serial port on the first card for RS-232 communications. Refer to the examples below for details.

```
Moxa:~# setinterface
    Usage: setinterface device-node [interface-no]
    device-node - /dev/ttyM0 ~ /dev/ttyM15
    interface-no    - following:
    none - to view now setting
    0 - set to RS232 interface
    1 - set to RS485-2WIRES interface
    2 - set to RS422 interface
    3 - set to RS485-4WIRES interface
Moxa:~#
```

Checking Current Serial Settings

To check the current interface setting, type the following. The system should display a response as below.

```
Moxa: ~# setinterface /dev/ttyM0
Now setting is RS485-2WIRES interface.
```

In the example above, port 1 on card 1 is configured as a 2-wire RS-485 interface. After entering the lines of code below, port 1 gets reset as an RS-422 interface.

```
Moxa: ~# setinterface /dev/ttyM0 2
Moxa: ~# setinterface /dev/ttyM0
```

```
Now setting is RS422 interface.
```

ATTENTION

Serial interfaces ***will shift device node identifiers*** depending upon the location and number of cards mounted in the platform. E.g. if there are originally two cards mounted in the machine, and card number 1 is removed, then the second card's number will change from **/dev/ttyM4** to **/dev/ttyM7** to **/dev/ttyM0** and **/dev/ttyM3**.
If a user wants to configure the machine for fixed serial interface device node identifiers, you can create a UDEV rule in **/etc/udev/rules.d/**. For help with this, you may consult the UDEV manual files, another Linux manual, or Moxa technical support for more details.

The system default for TC-SP04-DB44-T interfaces is RS-232. By editing the device manager's rule scripts, it is possible to set all serial ports to one of the serial protocols (RS-485 or RS-422) instead. The following steps describe how to do so.

1. Edit Moxa's custom rules file for the device manager, which can be found at `/etc/udev/rules.d/96-moxa.rules`. Add the following command to `96-moxa.rules`: `RUN+="/bin/setinterface /dev/ttyM%n 0"`

```
# Set the device, TC-SP04-DB44-T, 0x1393:0x1042 default as 232 mode interface
DRIVERS=="mxser", ATTRS{vendor}=="0x1393", ATTRS{device}=="0x1042",
RUN+="/bin/setinterface /dev/ttyM%n 0"

"96-moxa.rules"
```

ATTENTION

The **VendorID** for the TC-SP04-DB44-T is **0x1393**, and the **DeviceID** is **0x1042**.

2. To change the default serial interface mode, edit the `setinterface` command you have just added to the Moxa rules file (`/etc/udev/rules.d/96-moxa.rules`). This will cause the Linux kernel to automatically set the TC-6000 series module to your preferred interface at every reboot.
   - For RS-232, use `RUN+="/bin/setinterface /dev/ttyM%n 0"`
   - For RS-485 2-wire, use `RUN+="/bin/setinterface /dev/ttyM%n 1"`
   - For RS-422, use `RUN+="/bin/setinterface /dev/ttyM%n 2"`
   - For RS-485 4-wire, use `RUN+="/bin/setinterface /dev/ttyM%n 3"`
3. When finished, you must un-mount the writable file system and reboot your computer

```
Moxa:~# umount /
Moxa:~# reboot
```

4. Once the computer restarts, confirm that the interfaces have been reset to your preferred interface settings.

```
Moxa:~# setinterface /dev/ttyM0
Now setting is RS485-2WIRES interface.
```

TC-CP02-DB-T: CAN Bus Interface

The TC-CP02-DB-T module provides TC-6000 series computers with a CAN bus interface. CAN is a broadcast serial bus standard for connecting electronic control units (ECUs). Each node is able to send and receive messages, but not simultaneously: a message (consisting primarily of an ID—usually chosen to identify the message-type/sender—and up to eight message bytes) is transmitted serially onto the bus, one bit after another. This signal-pattern codes the message (in NRZ) and is sensed by all nodes.

The Moxa TC-CP02-DB-T module provides the CAN bus interface for industrial CAN communication. TC-6000 series computer provide the SocketCAN interface for industrial CAN communication. The SocketCAN concept

extends the Berkeley sockets API in Linux by introducing a new protocol family, PF_CAN, that coexists with other protocol families like PF_INET for the Internet Protocol.

You can use the file control interface to read, write or control the CAN interface as a file for easy CAN programming.

TC-CP02-DB-T: Driver Installation

The drivers for Moxa TC-SP04-DB44-T module include **can.ko**, **can_raw.ko**, **can_bcm.ko**, **can_dev.ko**, **sja1000.ko,** and **plx-pci.ko** . These have all been pre-installed under:
`/lib/modules/3.2.0-4-686-pae/updates/drivers/net/can`
Some drivers will be loaded by the boot process when modules are inserted; others must be loaded manually, using **modprobe**:

```
Moxa:~# modprobe can
Moxa:~# modprobe can_raw
Moxa:~# modprobe can_bcm
```

You may set modules to load automatically at boot by listing them in the **/etc/modules** file.

TC-CP02-DB-T: Configuring the Socket CAN Interface

After the modules have been loaded, the next step is to configure the CAN interface and start it as a standard net interface. Here's an example with bitrate 12500:

```
# ip link set can0 up type can bitrate 12500
# ip link set can1 up type can bitrate 12500
```

The SocketCAN information is stored under `/proc/net/can`; you can determine what version is being used by using the **cat** command:

```
Moxa~:# cat /proc/net/can/version
```

and return usage/operating statistics thus:

```
Moxa~:# cat /proc/net/can/stats
```

TC-CP02-DB-T: Sample Script for the SocketCAN API

The following code is a working example of the SocketCAN API in use; this code sends a CAN packet using the raw interface. It is based on the notes documented in the Linux Kernel (https://www.kernel.org/doc/Documentation/networking/can.txt).

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <string.h>

#include <net/if.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <sys/ioctl.h>

#include <linux/can.h>
#include <linux/can/raw.h>

int
main(void)
{
    int s;
```

```
    int nbytes;
    struct sockaddr_can addr;
    struct can_frame frame;
    struct ifreq ifr;

    char *ifname = "can0";

    if((s = socket(PF_CAN, SOCK_RAW, CAN_RAW)) < 0) {
        perror("Error while opening socket");
        return -1;
    }

    strcpy(ifr.ifr_name, ifname);
    ioctl(s, SIOCGIFINDEX, &ifr);

    addr.can_family  = AF_CAN;
    addr.can_ifindex = ifr.ifr_ifindex;

    printf("%s at index %d\n", ifname, ifr.ifr_ifindex);

    if(bind(s, (struct sockaddr *)&addr, sizeof(addr)) < 0) {
        perror("Error in socket bind");
        return -2;
    }

    frame.can_id  = 0x123;
    frame.can_dlc = 2;
    frame.data[0] = 0x11;
    frame.data[1] = 0x22;

    nbytes = write(s, &frame, sizeof(struct can_frame));

    printf("Wrote %d bytes\n", nbytes);

    return 0;
}
```

The following is sample code for reading data.

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <string.h>

#include <net/if.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <sys/ioctl.h>

#include <linux/can.h>
#include <linux/can/raw.h>

int
main(void)
{
       int i;
       int s;
       int nbytes;
       struct sockaddr_can addr;
       struct can_frame frame;
```

```
	struct ifreq ifr;

	char *ifname = "can0";

	if((s = socket(PF_CAN, SOCK_RAW, CAN_RAW)) < 0) {
		perror("Error while opening socket");
		return -1;
	}

	strcpy(ifr.ifr_name, ifname);
	ioctl(s, SIOCGIFINDEX, &ifr);

	addr.can_family  = AF_CAN;
	addr.can_ifindex = ifr.ifr_ifindex;

	printf("%s at index %d\n", ifname, ifr.ifr_ifindex);

	if(bind(s, (struct sockaddr *)&addr, sizeof(addr)) < 0) {
		perror("Error in socket bind");
		return -2;
	}

	nbytes = read(s, &frame, sizeof(struct can_frame));

	if (nbytes < 0) {
		perror("Error in can raw socket read");
		return 1;
	}

	if (nbytes < sizeof(struct can_frame)) {
		fprintf(stderr, "read: incomplete CAN frame\n");
		return 1;
	}

	printf("  %5s  %03x   [%d] ", ifname, frame.can_id, frame.can_dlc);
	for (i = 0; i < frame.can_dlc; i++)
		printf(" %02x", frame.data[i]);
	printf("\n");

	return 0;
}
```

TC-DK10-T/TC-DK20-T: mini PCIe Interface

Moxa's TC-DK10-T and TC-DK20-T support 4 PCIe mini card sockets. However, they come with different interfaces. Check the following table for details:

Model	TC-DK10-T				TC-DK20-T			
Interface	Socket 1	Socket 2	Socket 3	Socket 4	Socket 1	Socket 2	Socket 3	Socket 4
PCIe V1.0 (One Lane)	✓	--	--	--	✓	✓	✓	✓
USB 2.0	✓	✓	✓	✓	✓	✓	✓	✓

NOTE You can use at most two TC-DK10-T/TC-DK20-T modules on a TC-6000 train computer, and the maximum number of mini PCIe sockets that can be used is eight.

TC-DK10-T/TC-DK20-T: Configuring Power Controls

The TC-DK10-T/TC-DK20-T module comes with the capability of automating a device's power state. Note, however, that this function is provided primarily for powering on and off a PCIe module that uses a USB interface. It is **NOT** advisable to use this function with PCIe devices, since the devices could be damaged. It is also not advisable to use the power control feature with USB DOM devices, because these devices involve the mounting and unmounting of file systems, and while the Linux system will be able to automatically mount the USB DOM file systems as they come online, without careful scripting it will not be able to automatically unmount the file systems once the device goes offline.

WARNING

Using the TC-DK10-T/TC-DK20-T's onboard power controls for controlling PCIe or USB-DOM devices is discouraged. Using the onboard power controls for controlling PCIe and USB-DOM devices may damage the devices (PCIe) or corrupt data (USB-DOM). ***Any use of the TC-DK10-T/TC-DK20-T's automated, onboard power controls with PCIe and USB-DOM devices is undertaken at the user's own risk.***

Note that there is a further limitation: **If you install a mini PCIe module that uses non-standard pin definitions—such as Sierra Wireless module MC8090, MC9090, MC7304, MC7354—do not use the power control function on the TC-DK10-T/TC-DK-20-T module.** If you enable the power control function for such a module, all access for SMBus will be locked until the system is rebooted. Read the specifications of the mini PCIe modules you use carefully.

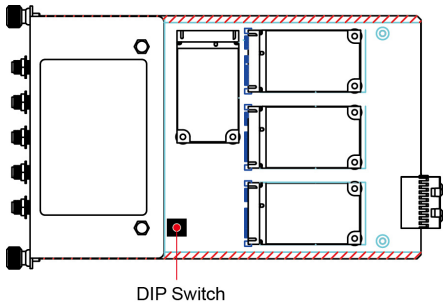
The command for manipulating the PCIe card's power feature is **mpcie-power**. The precise syntax is as follows, with **chip address** indicating **the card to be configured,** and **slot_number** indicating the number of the card slot located on the TC-DK10-T/TC-DK20-T board itself. If the on/off flag is not specified, the command will return the current power status:

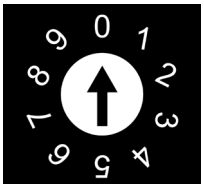
```
# mpcie-power <address> <slot_number> [on/off flag]
```

The off flag is 0, and the on flag is 1.
Fox example, if you want to power off USB connectivity on slot 1 with some card, issue the following command:

```
# mpcie-power 0x27 1 0
```

Note that you can specify a different chip address for each TC-DK10-T/TC-DK20-T module by adjusting the DIP switch. The location of the DIP switch is shown in the following figure. Refer to the mapping table to determine which Chip Address corresponds to which DIP Switch Value:





DIP Switch Value	Chip Address
0	0x27
1	0x26
2	0x25
3	0x24
4	0x23
5	0x22
6	0x21
7	0x20

ATTENTION

The **mpcie-power** command should not be used with the power on-off feature with a USB DOM module. This is because when a USB DOM module is powered on, the Linux system will automatically mount its partitions, but when it is powered off the system cannot automatically unmount its partitions.

Any use of the TC-DK10-T/TC-DK20-T's automated, onboard power controls with PCIe interfaces and USB-DOM devices is undertaken at the user's own risk.

Windows System

The following table shows the packages required for each expansion modules:

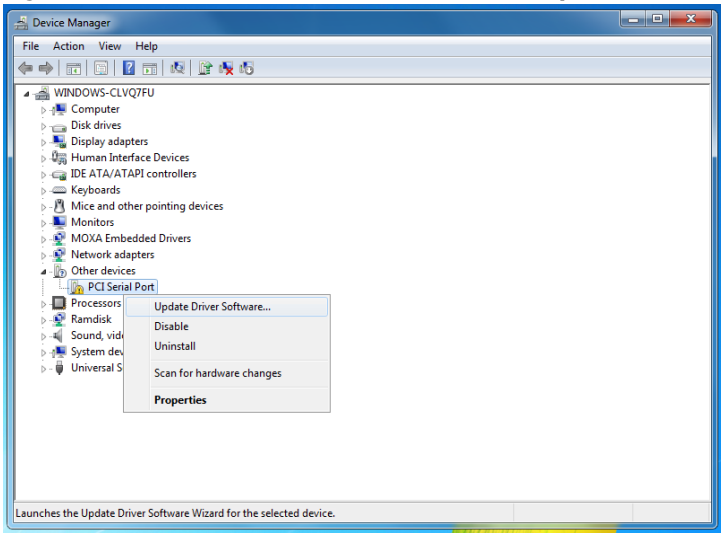
Module	Driver Package	Utility Package
TC-SP04-DB44-T	TC-SP04-DB44_mxser_1.18.2_Win7_x86.zip	
TC-CP02-DB-T	TC-CP02_mxcan_1.0_Win7_x86.zip	TC-CP02_sample_1.0_Win7_x86.zip
TC-DK10-T/ TC-DK20-T		TC-DK00_sample_1.0_Win7_x86.zip

The drivers used in this section can be obtained from the official website:
http://www.moxa.com/product/TC-6000-Series-Expansion-Modules.htm

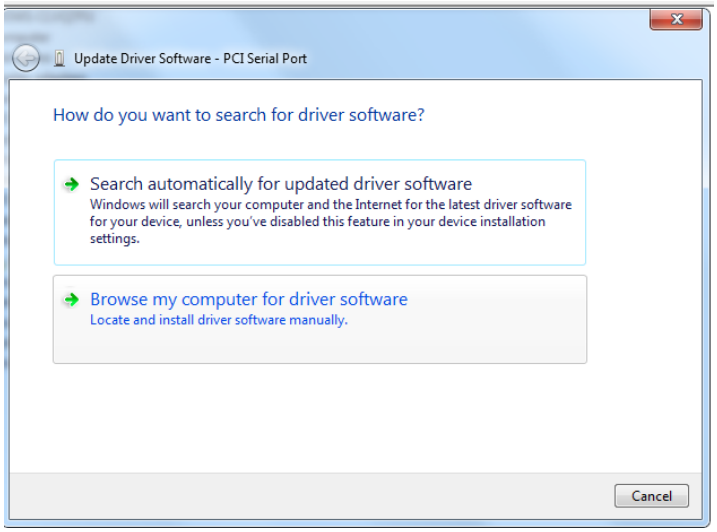
TC-SP04-DB44-T: Driver Installation

Before using the TC-SP04-DB44-T expansion module, you need to update the driver. Install the driver before mounting the expansion module in the slot.

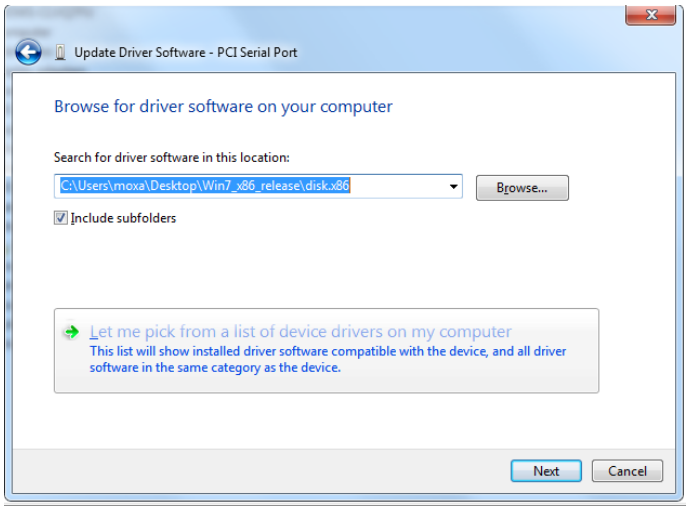
1. Right-click the **PCI Serial Port** device and select **Update Driver Software**.



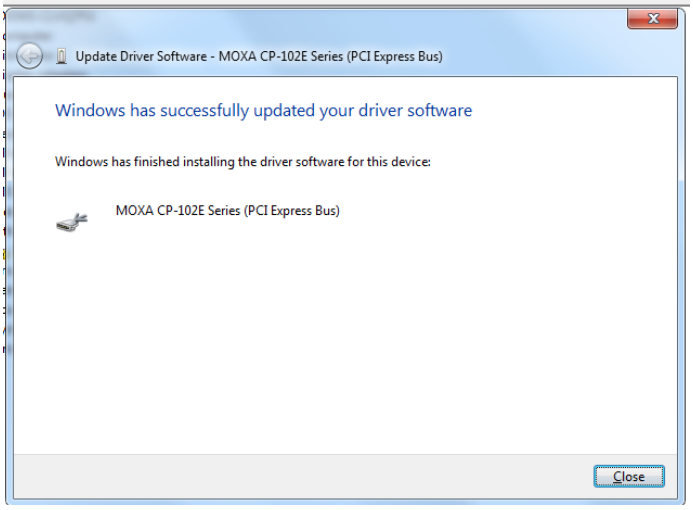
2. Click **Browse my computer for driver software** to **install** using default settings.



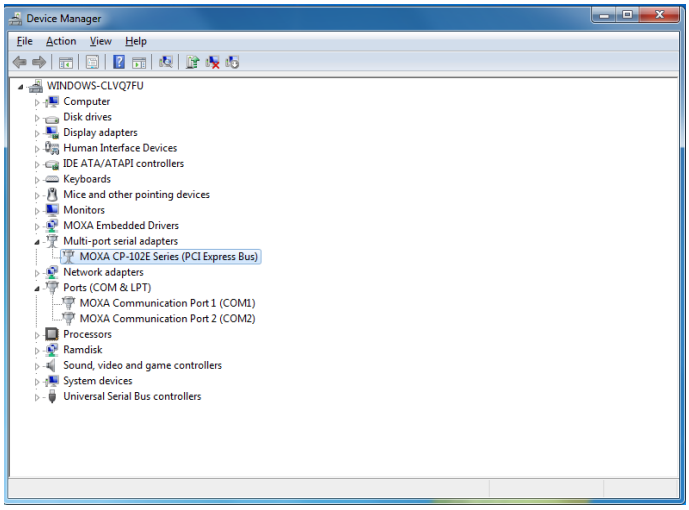
3. Click **Next** to start the installation.



4. Click **Close** to complete the installation.



5. The driver will be **installed** automatically. The module should be listed in the Device Manager window. At this point you can start using the module.

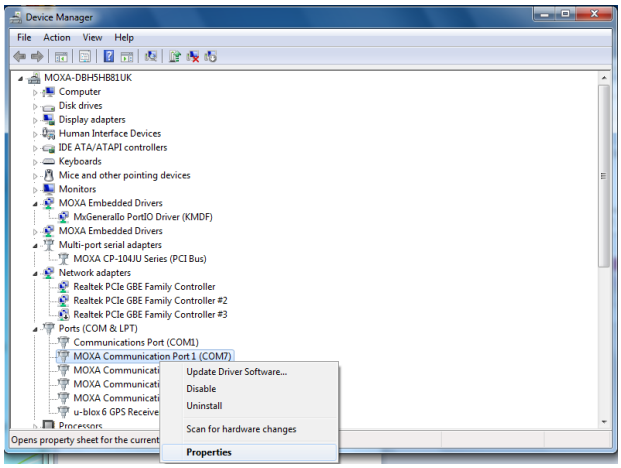


TC-SP04-DB44-T: Configuring Serial Port Mode

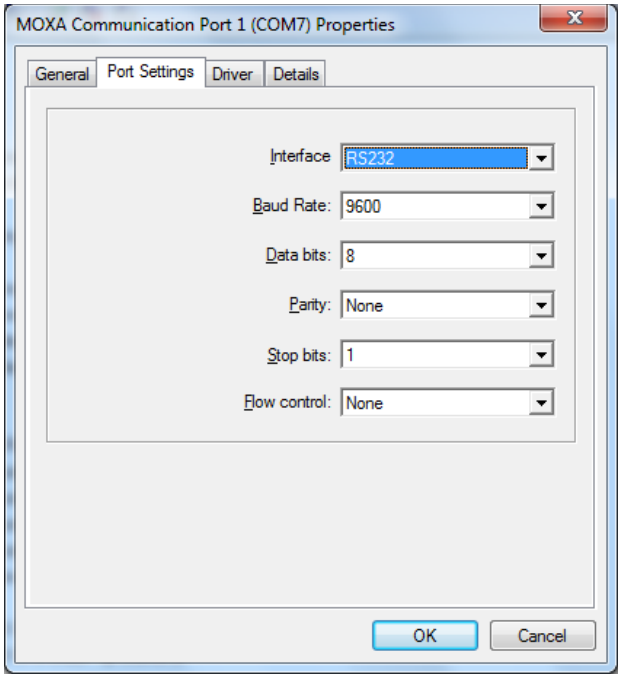
Take the following steps to configure the properties of each COM port:

1. Go to **Control Panel → System and Security → Device Manager → Ports (COM & LPT)** and select the COM port, such as **Moxa Communication Port 1 (COM7)**.

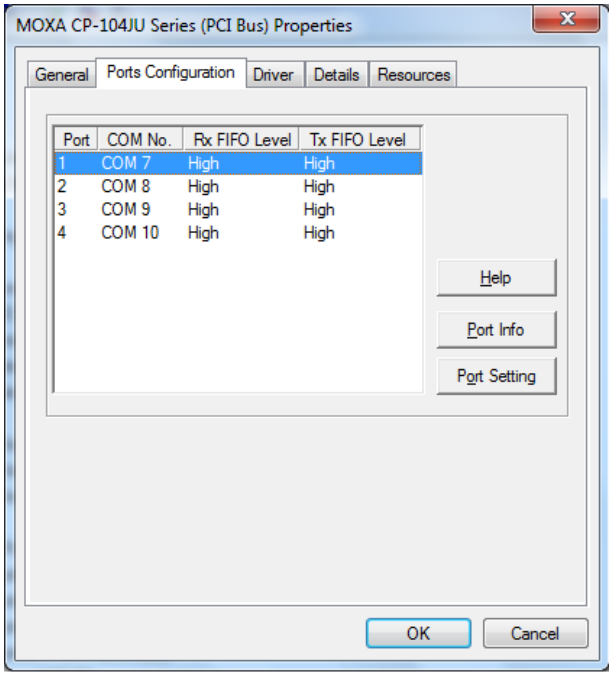
2. Right-click the COM port and then click **Properties**.



3. Click the **Port Settings** tab and then select the interface you would like to use.

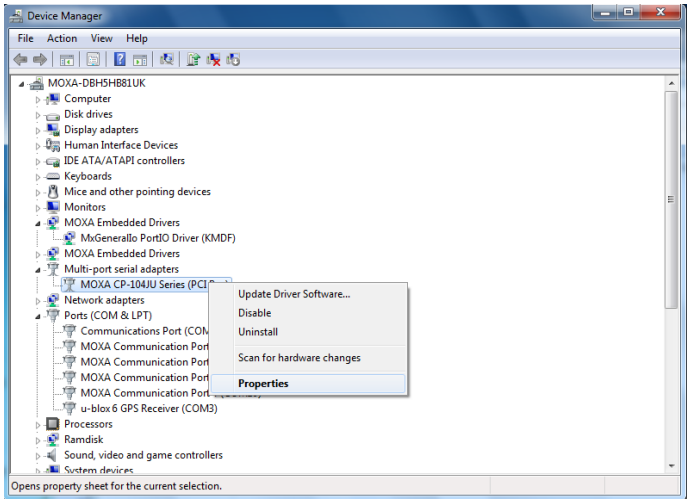


4. Click **OK** to apply the settings.

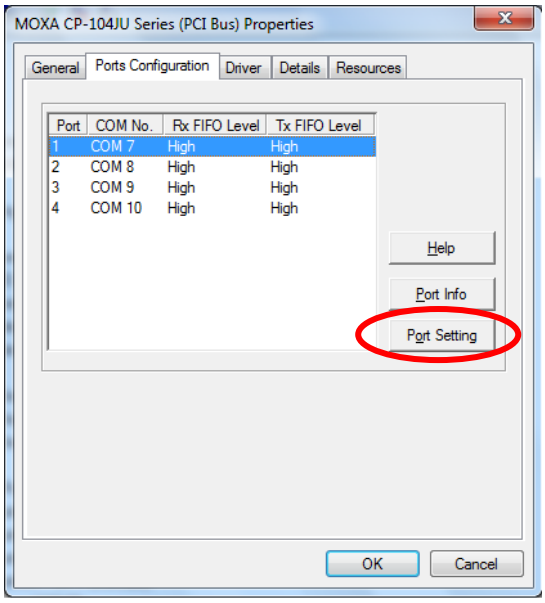


In some situations, you may want to change the port name to match the name used by your program. Take the following steps to change port names:

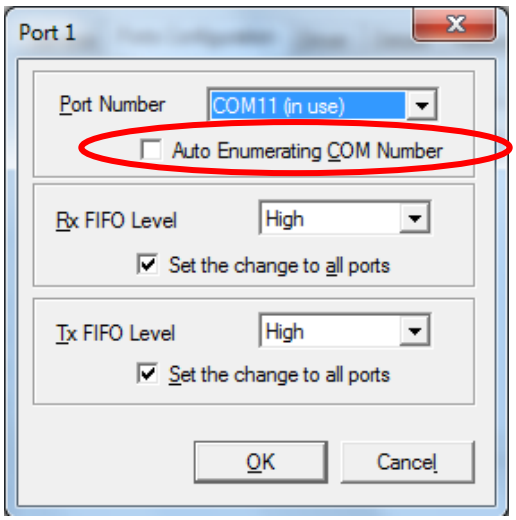
1. Go to **Control Panel** → **System and Security** → **Device Manager** → **Multi-port serial adapters** and select the adapter.
2. Right-click the adapter and select **Properties**.



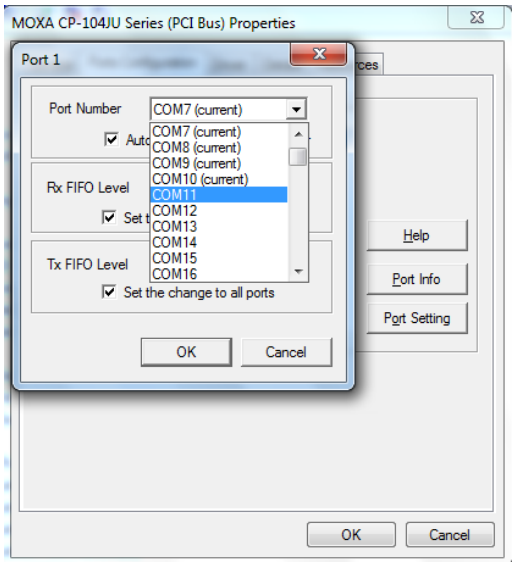
3. Click the **Port Configuration** tab, select the port, and then click **Port Setting**.



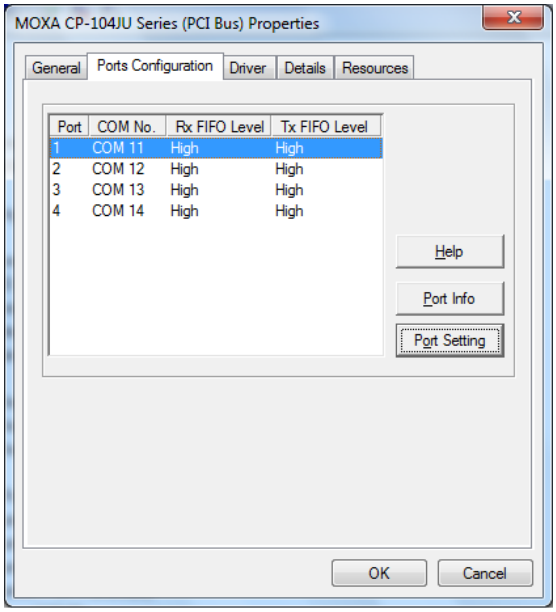
4. To change the port name separately, uncheck **Auto Enumerating COM Number**.



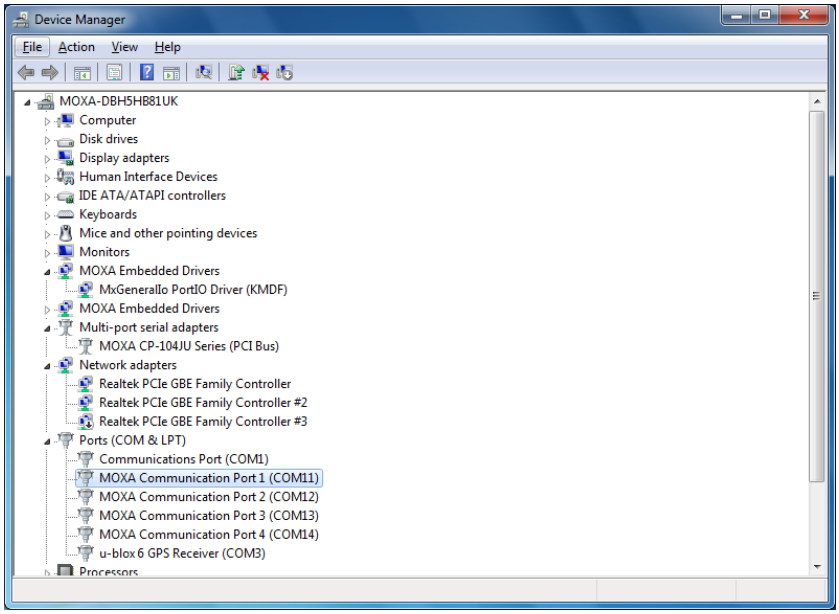
5. Select the new port name and then click **OK**.



6. Make sure the port names are correct, and then click **OK** to activate the settings.



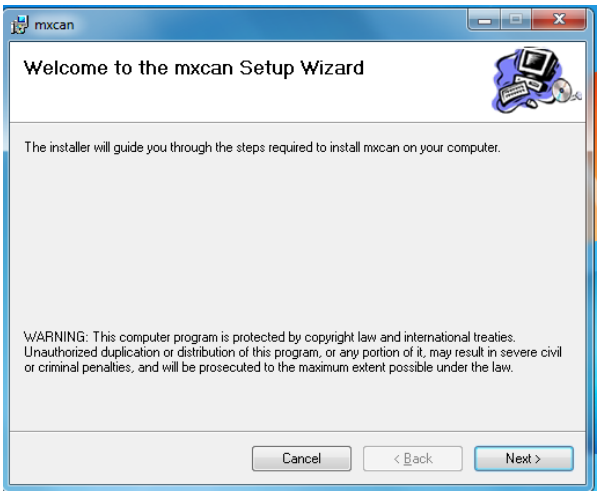
7. Refer to **Ports (COM & LPT)** to verify that the port names have been changed.



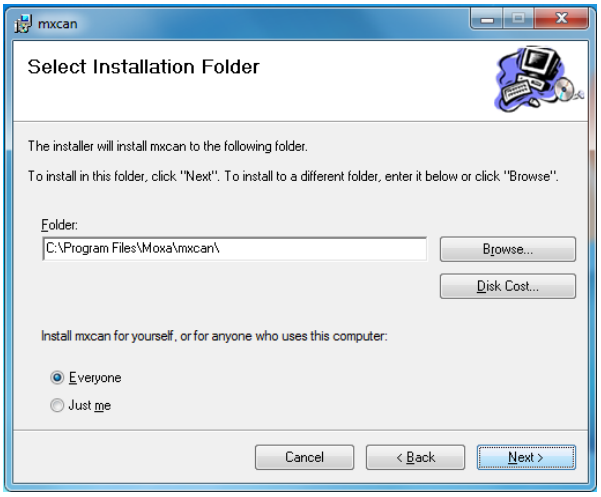
TC-CP02-DB-T: Driver Installation

Before using the TC-CP02-DB-T expansion module, you need to update the driver. Install the driver before inserting the expansion module in the slot. Take the following steps to install the CAN BUS driver:

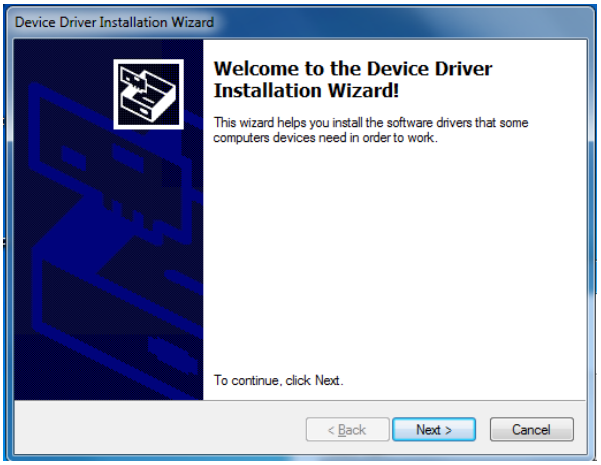
1. Double-click **mxcan_setup.msi** to open the setup wizard that will install the module. Click **Next**.
2. Click **Next** to accept the installer defaults, and then click through the next dialog to install the driver.



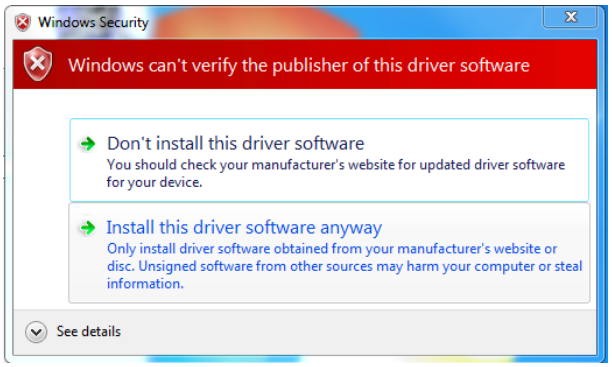
3. Click **Next** to continue, or click **Browse** to select the folder to install the driver.



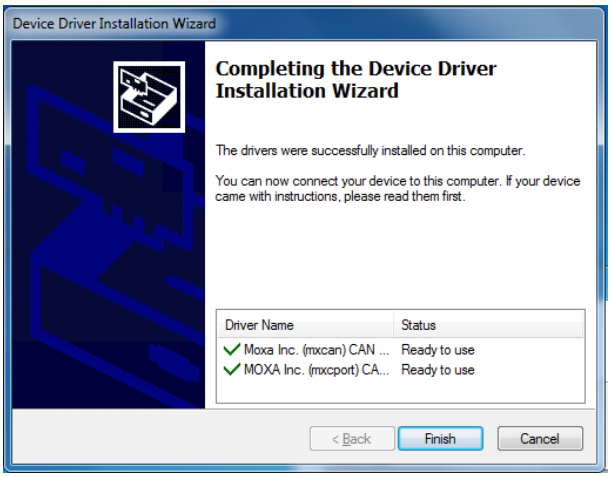
4. Click **Next** to continue.



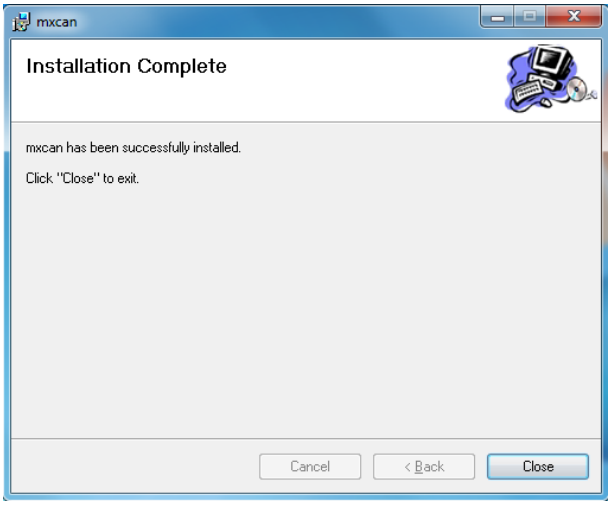
5. Select **Install this driver software anyway** twice to continue.



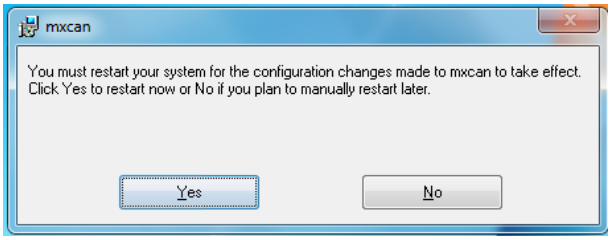
6. Click **Finish**.



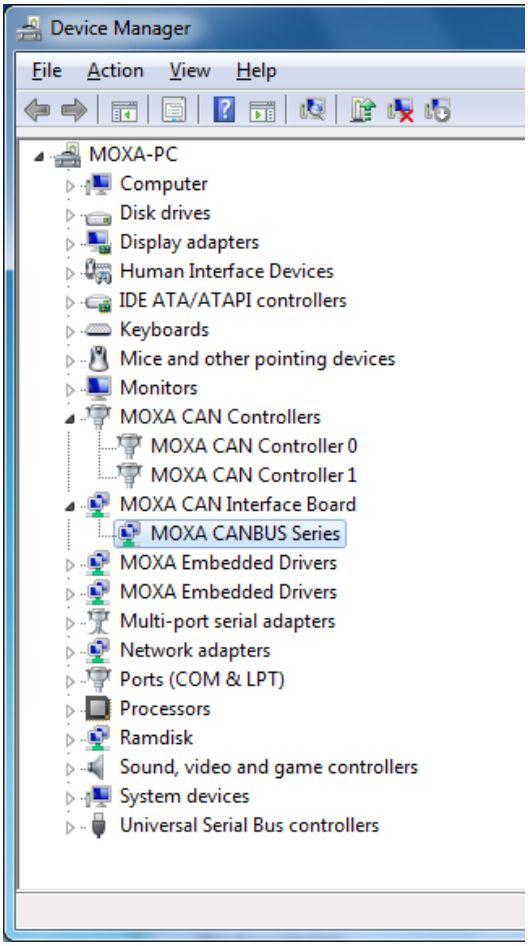
7. After the driver is installed, click **Close** to complete the driver setup.



8. Click **Yes** to shut down the computer and install the TC-CP02 driver and then boot up again.



9. Next, open the **Windows Device Manager**, right click on the computer located at the top of the tree, and select **Scan for hardware change** to finish the installation.



TC-CP02-DB-T CAN Module: Programming Guide

Note that the driver and example code can be obtained from the official website:
http://www.moxa.com/product/TC-6000-Series-Expansion-Modules.htm
Refer to the following table for an introduction to the sample code for the TC-CP02-DB-T CAN module.

Sample Code	Description
mxcan_get_filter	Gets the filter values
mxcan_get_registers	Gets the register values
mxcan_get_status	Gets the CAN bus status
mxcan_ioctl_gettiming	Gets the bus timing of an open port.
mxcan_ioctl_settiming	Sets the bus timing of an open port.
mxcan_read	Reads data into a buffer from an open port (the size should be a multiple of the CANMSG size)
mxcan_set_filter	Sets the filter values
mxcan_write	Writes data into a buffer from an open port (the size should be a multiple of the CANMSG size)

Moxa CAN Bus Library

int mxcan_close (int fd)	
Description	Close an open port.
Input	<fd> the open port
Return Value	None

unsigned int mxcan_get_bus_timing (int fd)	
Description	Gets the bus timing of an open port.
Input	<fd> the open port
Return Value	0 on failure, otherwise the bus speed in KHz

int mxcan_get_parameters (int fd, CANPRM * param)	
Description	Gets the parameter of an open port.
Input	<fd> the open port
Output	< param> pointer to the CANPRM structure
Return Value	0 on failure, otherwise returns a negative value

int mxcan_get_registers (int fd, unsigned char * buffer, int num)	
Description	Gets the register values of an open port.
Input	<fd> the open port
Output	< buffer > pointer to a buffer for these values <num> number of register values; for a module with sja1000 chipset, the value must be 32
Return Value	0 on success; other numbers indicate failure

int mxcan_get_stat (int fd, CANBST * stat)	
Description	Gets the statistics of an open port.
Input	<fd> the open port
Output	< stat > pointer to a container of the statistics
Return Value	0 on success; other numbers indicate failure

int mxcan_inqueue (int fd)	
Description	Gets the number of received bytes that are queued in the driver of an open port.
Input	<fd> the open port
Return Value	0 on failure; otherwise the number of bytes

int mxcan_open (int port)	
Description	Open a can port given the port number.
Input	<port> port number starting from 1; in Linux, open port 1 will open /dev/can0
Return Value	-1 on failure; otherwise returns fd

int mxcan_outqueue (int fd)	
Description	Gets the number of bytes waiting to be transmitted to a can port.
Input	<fd> the open port
Return Value	-1 on failure; otherwise the number of bytes

int mxcan_purge_buffer (int fd, unsigned int purge)	
Description	Purges the buffers of an open port.
Input	<fd> the open port
Output	< purge> 1: received data buffer; 2: transmit data buffer; otherwise: both
Return Value	0 on success; otherwise failure

int mxcan_read (int fd, char * buffer, int size)	
Description	Reads data into a buffer from an open port (the size should be a multiple of the CANMSG size)
Input	<fd> the open port
Output	<buffer> pointer to the buffer
Return Value	0 on failure (data not available); otherwise the number of bytes read

int mxcan_set_bus_timing (int fd, unsigned int speed)	
Description	Sets the bus timing of an open port.
Input	<fd> the open port
Output	<speed> bus timing in Hz
Return Value	0 on success; otherwise returns a negative number

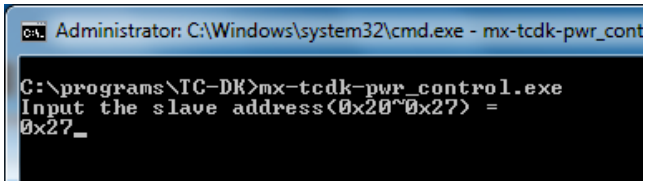
int mxcan_set_parameters (int fd, CANPRM * param)	
Description	Sets the parameters of an open port.
Input	<fd> the open port <param> pointer to the CANPRM structure
Output	<speed> bus timing in Hz
Return Value	0 on success; otherwise returns a negative number

int mxcan_write (int fd, char * buffer, int size)	
Description	Writes data to the open port
Input	<fd> the open port <buffer> pointer to the data <size> size of the data (should be a multiple of the CANMSG size)
Return Value	0 on failure; otherwise the number of bytes written

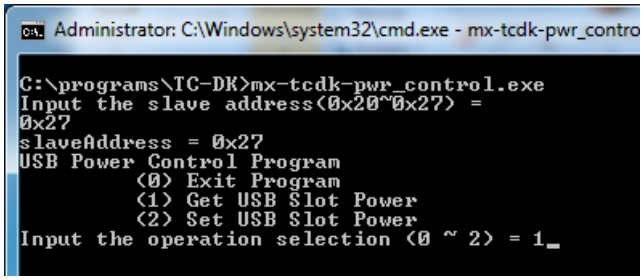
TC-DK10-T/TC-DK20-T: Enabling/Disabling USB Socket Power

Take the following steps to get the current USB power status.

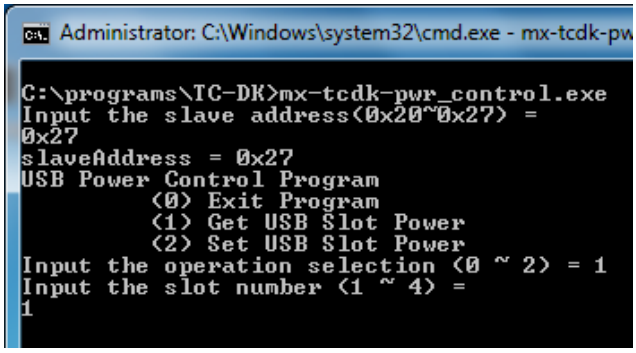
1. Execute **mx-tcdk-pwr-control.exe** under **\\TC-DK00-Windows\SampleCode\Release** in the product DVD.
2. Enter the slave address according to the switch jumper on the TC-DK10-T/TC-DK20-T modules.



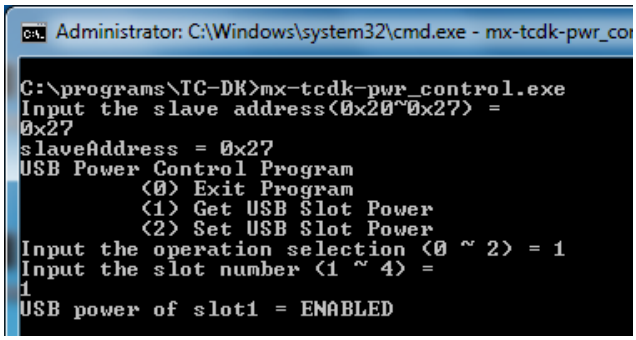
3. Select **(1) Get USB Slot Power** to get current USB power status.



4. Select the slot number. (For example, 1 for socket 1)

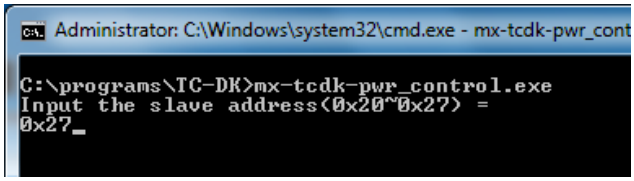


5. You will get the USB power status of socket 1.

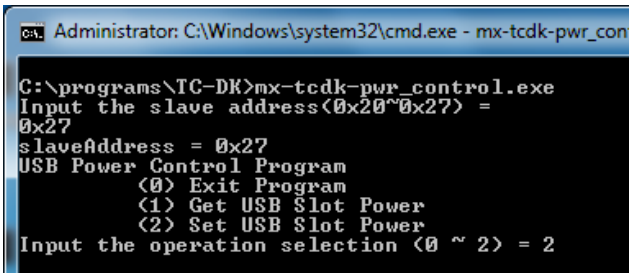


Take the following steps to disable/enable the USB power.

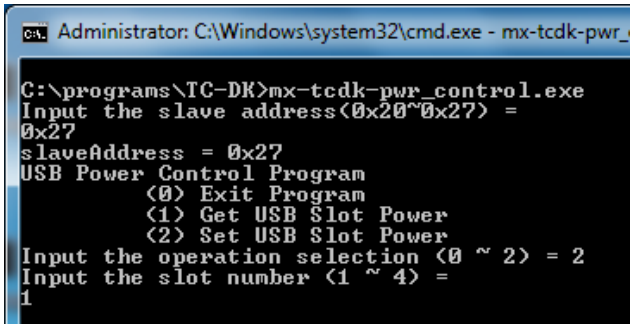
1. Execute **mx-tcdk-pwr-control.exe**.
2. Enter the slave address according to the switch jumper on TC-DK10-T/TC-DK20-T modules.



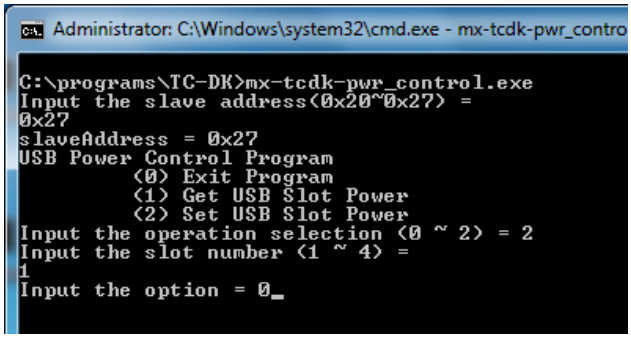
3. Select **(2) Set USB Slot Power** to get the current USB power status.



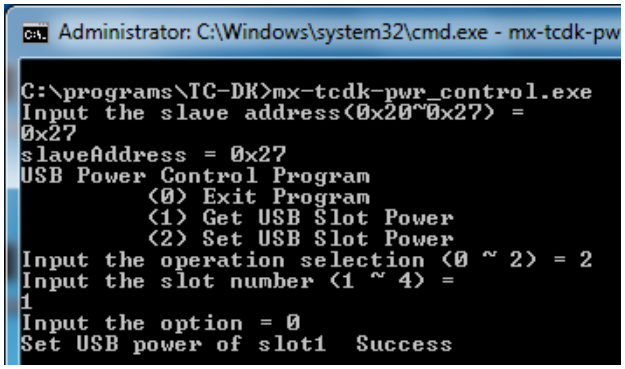
4. Select the slot number. (For example, 1 for socket 1).



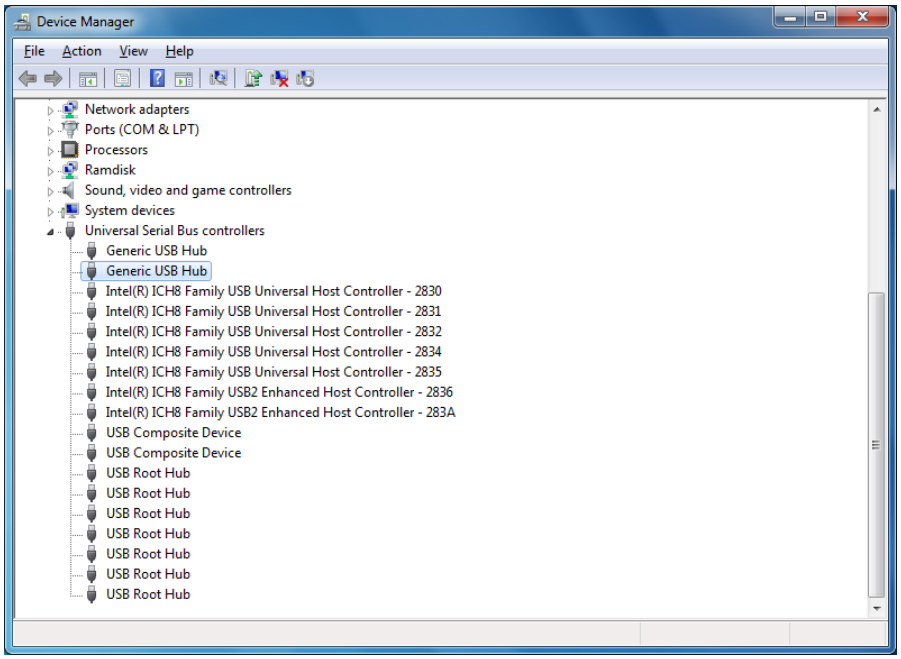
5. Enter the option to disable/enable the USB power. (For example, entering **0** disables USB power)



6. Check if the USB power has been set successfully.



7. Check the **Windows Device Manager** to see if the device is disabled.



ATTENTION

Using the TC-DK10-T/TC-DK20-T's onboard power controls (mx-tcdk-pwr-control.exe) for control of PCIe or USB-DOM devices is discouraged. Using the onboard power controls for control of PCIe and USB-DOM devices may damage the devices (PCIe) or corrupt data (USB-DOM). ***Any use of the TC-DK10-T/TC-DK20-T's automated, onboard power controls with PCIe and USB-DOM devices is undertaken at the user's own risk.***