V2400 Series Expansion Modules
User's Manual

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V2400 Series Expansion Modules User's Manual

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Table of Contents

1

Introduction

Moxa's EPM series modules, which include modules with serial ports, a wireless/GPS card, a digital input/output channel card, a CANbus card, a mini PCI/PCIe card, a VGA/DVI-I display card, and a 2-slot mini PCIe card, work with Moxa's V2422 and V2426 embedded computers, giving end-users the ability to set up and expand a variety of industrial applications.

The following topics are covered in this chapter:

Overview

Moxa's EPM series modules, which include modules with serial ports, a wireless/GPS card, a digital input/output channel card, a CANbus card, a mini PCI/PCIe card, a VGA/DVI-I display card, and a 2-slot mini PCIe card, work with Moxa's V2422 and V2426 embedded computers, giving end-users the ability to set up and expand a variety of industrial applications.

Package Checklist

The EPM Series includes the following models:

- **EPM-3032:** Module with 2 isolated RS-232/422/485 ports with DB9 connectors
- **EPM-3337:** Module with HSDPA, GPS, WLAN (11n)
- **EPM-3438:** Module with 8 DIs and 8 DOs with 3 KV digital isolation protection, and a 2 KHz counter
- **EPM-3112:** Module with 2 isolated CAN ports with DB9 connectors
- **EPM-3552:** VGA and DVI-I display module
- **EPM-DK01:** Mini PCI and mini PCIe expansion module
- **EPM-DK02:** 2-slot mini PCIe expansion module

Each model is shipped with the following items:

- 1 EPM-3032, 3337,3438, 3112, 3552, DK01, or DK02 expansion module

NOTE: Please notify your sales representative if any of the above items are missing or damaged.

Product Features

The EPM series expansion modules have the following features:

- PCI slots for interface expansion
- EPM-3032: 2 isolated RS-232/422/485 ports with DB9 connectors
- EPM-3112: 2 isolated CAN ports with DB9 connectors
- EPM-3337: HSDPA, GPs, WLAN (11a/b/g/n)
- EPM-3438: 8+8 DI/DO with 3 KV digital isolation protection, 2 KHz counter
- EPM-3552: VGA or DVI-I display module
- EPM-DK02: 2-slot Mini PCIe expansion module

EPM Module Specifications

EPM-3032 Specifications

Serial Interface

Serial Standards: 2 RS-232/422/485 ports, software-selectable (DB9 male)
Isolation: 2 KV digital isolation

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 user's manual for details)

Serial Signals

RS-232: TxD, RxD, DTR, DSR, RTS, CTS, DCD, GND

RS-422: TxD+, TxD-, RxD+, RxD-, GND

RS-485-4w: TxD+, TxD-, RxD+, RxD-, GND

RS-485-2w: Data+, Data-, GND

Physical Characteristics

Weight: 137 g

Dimensions: 104 x 121 x 34 mm (4.09 x 4.76 x 1.34 in)

Environmental Limits

Operating Temperature: -40 to 70°C (-40 to 158°F)

EPM-3112 Specifications

CANbus Communication

Interface: 2 optically isolated CAN2.0A/2.0B compliant ports

CAN Controller: Phillips SJA1000T

Signals: CAN-H, CAN-L

Isolation: 2 KV digital isolation

Speed: 1 Mbps

Connector Type: DB9 male

Physical Characteristics

Weight: 127 g

Dimensions: 104 x 121 x 34 mm (4.09 x 4.76 x 1.34 in)

Environmental Limits

Operating Temperature: -25 to 55°C (-13 to 131°F)

EPM-3337 Specifications

Cellular Interface

Frequency Bands:

- UMTS/HSDPA: Triple band, 850/1900/1900 MHz
- GSM/GPRS/EDGE: Quad band, 850/900/1800/2100 MHz
- GSM Dass: Small MS

Output Power:

- Class 4 (2 W) for GSM850/900
- Class 3 (0.25 W) for UMTS/HSDPA
- Class E2 (0.5 W) for EDGE850/900
- Class E2 (0.4 W) for EDGE1800/1900
- Class 1 (1 W) for GSM1800/1900

HSDPA Interface

3GPP Release 5:

- 3.6 Mbps, UL 384 Kbps
- UE CAT. [1-6], 11, 12 supported
- Compressed mode (CM) supported according to 3GPP TS25.212

GPS Interface

Tracking: Tracks up to 13 satellites, L1 1575.42 MHz

Accuracy Position: 2.5 m CEP; 5.0 m SEP

Protocols: NMEA-0183 V2.3, E911 AGPS Control plane, GPS dedicated AT commands, Date WGS-84

Tracking sensitivity: -158 dBm (with active antenna)

Start-up Time:

- Hot start: <3s
- Cold start: 30s
- Warm start: 30s

GPS active antenna supply: 3.3 V

WLAN Interface

Supported Modes:

• IEEE 802.11a/b/g/n for client/bridge mode

• IEEE 802.11b/g/n for AP mode (Linux OS only)

Standards:

• IEEE 802.11a/b/g/n for Wireless LAN

• IEEE 802.11i for Wireless Security

Operating Channels (central frequency):

• US: 2.412 to 2.462 GHz (11 channels), 5.18 to 5.24 GHz (4 channels)

• EU: 2.412 to 2.472 GHz (13 channels), 5.18 to 5.24 GHz (4 channels)

• USA: 1 to 11 (2400 to 2483.5 MHz)

• Europe: 1 to 13 (2400 to 2483.5 MHz)

• Japan: 1 to 14 (2400 to 2497 MHz)

802.11g:

• USA: 1 to 11 (2400 to 2483.5 MHz)

• Europe: 1 to 13 (2400 to 2483.5 MHz)

• Japan: 1 to 13 (2400 to 2497 MHz)

802.11a:

• USA: 36 to 165 (5180 to 5825 MHZ)

• Europe: 36 140 (5180 to 5700 MHz)

• Japan: 7 to 11 (5035 to 5055MHz),183 to 189 (4915 to 4945 MHz)

Security: 64-bit and 128-bit WEP encryption, WPA /WPA2-Personal and Enterprise (IEEE 802.1X/RADIUS, TKIP and AES)

Transmission Rates:

• 802.11b: 1, 2, 5.5, 11 Mbps

• 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps

• 802.11n: 6 to 300 Mbps (multiple rates supported)

TX Transmit Power:

• 802.11b: 1 to 11 Mbps: Typ. 18 dBm (± 1.5 dBm)

• 802.11g: 6 to 24 Mbps: Typ. 18 dBm (± 1.5 dBm); 36 to 48 Mbps: Typ. 17 dBm (± 1.5 dBm); 54 Mbps: Typ. 15 dBm (± 1.5 dBm)

• 802.11a: 6 to 24 Mbps: Typ. 17 dBm (± 1.5 dBm) 36 to 48 Mbps: Typ. 16 dBm (± 1.5 dBm); 54 Mbps: Typ. 14 dBm (± 1.5 dBm)

TX Transmit Power MIMO:

• 802.11a/n (20/40 MHz): MCS15 20 MHz: Typ. 13 dBm (± 1.5 dBm); MCS15 40 MHz: Typ. 12 dBm (± 1.5 dBm)

• 802.11g/n (20/40 MHz): MCS15 20 MHz: Typ. 14 dBm (± 1.5 dBm); MCS15 40 MHz: Typ. 13 dBm (± -1.5 dBm)

RX Sensitivity:

• 802.11b:

-92 dBm @ 1 Mbps, -90 dBm @ 2 Mbps, -88 dBm @ 5.5 Mbps, -84 dBm @ 11 Mbps

• 802.11g:

-87 dBm @ 6 Mbps, -86 dBm @ 9 Mbps, -85 dBm @ 12 Mbps, -82 dBm @ 18 Mbps, -80 dBm @ 24 Mbps, -76 dBm @ 36 Mbps, -72 dBm @ 48 Mbps, -70 dBm @ 54 Mbps

• 802.11a:

-87 dBm @ 6 Mbps, -86 dBm @ 9 Mbps, -85 dBm @ 12 Mbps, -82 dBm @ 18 Mbps,
-80 dBm @ 24 Mbps, -76 dBm @ 36 Mbps, -72 dBm @ 48 Mbps, -70 dBm @ 54 Mbps

RX Sensitivity MIMO:

• 802.11a/n:

-68 dBm @ MCS15 40 MHz, -70 dBm @ MCS7 40 MHz, -69 dBm @ MCS15 20 MHz, -71 dBm @ MCS7 20 MHz

• 802.11g/n:

-68 dBm @ MCS15 40 MHz, -70 dBm @ MCS7 40 MHz, -69 dBm @ MCS15 20 MHz,
-71 dBm @ MCS7 20 MHz

AP-only Protocols: ARP, BOOTP, DHCP, dynamic VLAN-Tags for 802.1X-Clients, STP/RSTP (IEEE 802.1D/w)
Default Antenna: 2 dBi dual-band omni-directional antenna, RP-SMA (male)
Connector for External Antennas: RP-SMA (female)

Physical Characteristics

Weight: 220 g
Dimensions: 104 x 121 x 34 mm (4.09 x 4.76 x 1.34 in)

Environmental Limits

Operating Temperature: -25 to 55°C (-13 to 131°F), EN 50155 Class T1

EPM-3438 Specifications

Digital Input

Input Channels: 8, source type
Input Voltage: 0 to 30 VDC at 25 Hz
Digital Input Levels for Dry Contacts:
• Logic level 0: Close to GND
• Logic level 1: Open
Digital Input Levels for Wet Contacts:
• Logic level 0: +3 V max.
• Logic level 1: +10 V to +30 V (Source to DI)
Counter Frequency: 2 KHz (DI0 only)
Connector Type: 10-pin screw terminal block (8 DI points, DI Source, GND)
Isolation: 3 KV optical isolation

Digital Output

Output Channels: 8, sink type, 0 to 30 VDC
Output Current: Max. 200 mA per channel
On-state Voltage: 24 VDC nominal, open collector to 30 VDC
Connector Type: 9-pin screw terminal block (8 DO points, GND)
Isolation: 3 KV optical isolation

Physical Characteristics

Weight: 120 g
Dimensions: 104 x 121 x 34 mm (4.09 x 4.76 x 1.34 in)

Environmental Limits

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

EPM-3552 Specifications

Display

Graphics Controller: DsiplayLink DL-195
VGA Interface: 15-pin D-sub connector (female)
DVI Interface: 24-pin DVI-I connector (female)
Resolution: Up to 1920x 1600 (2048 x 1152 for wide screen) resolution

Physical Characteristics

Weight: 130 g
Dimensions: 104 x 121 x 34 mm (4.09 x 4.76 x 1.34 in)

Environmental Limits

Operating Temperature: -25 to 55°C (-13 to 131°F)

EPM-DK01 Specifications

PCI Express Mini Slot

Interface: PCIExpress V1.0 (one lane)

USB 2.0 Bus SIM Card Holder: Reserved for Cellular applications

Mini PCI Slot

Interface: PCI

Bus Frequency: 32-bit, 33 MHz PCI

Physical Characteristics

Weight: 117 g

Environmental Limits

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

EPM-DK02 Specifications

PCI Express Mini Slot

Interface:

Slot 1: PCIExpress V1.0 (one lane) / USB 2.0

Slot 2: USB 2.0

USB 2.0 Bus SIM Card Holder: Reserved for cellular applications

Physical Characteristics

Weight: 125 g

Environmental Limits

Operating Temperature: -25 to 55°C (-13 to 131°F), EN 50155 Class T1

2

Hardware Introduction

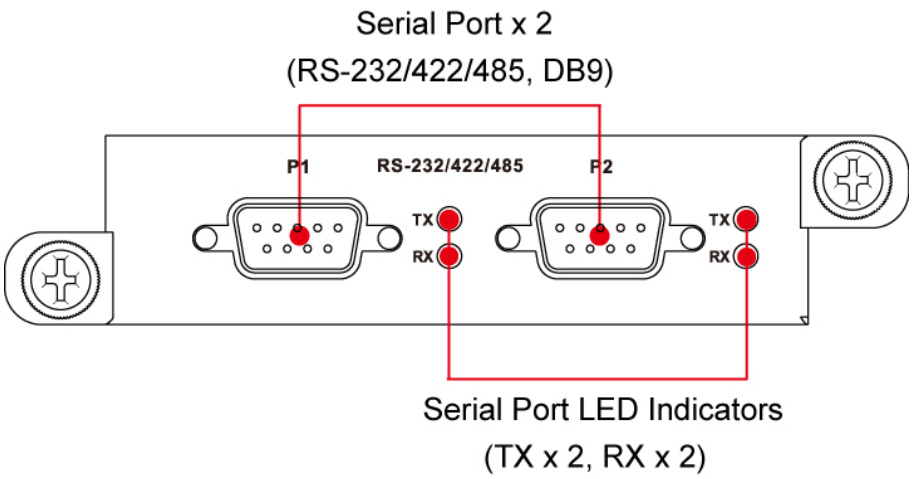
The EPM Series expansion modules are designed to work with Moxa's V2422 and V2426 embedded computers. By providing different modules with different connectors, the EPM series offers the greatest flexibility and convenience for users who would like to easily establish industrial applications that require different communication interfaces.

The following topics are covered in this chapter:

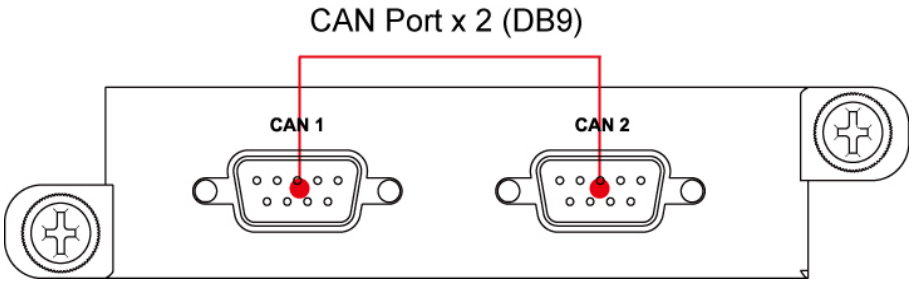
- **Appearance**
  - EPM-3032
  - EPM-3112
  - EPM-3337
  - EPM-3438
  - EPM-3552
  - EPM-DK01
  - EPM-DK02
- **Dimensions**

Appearance

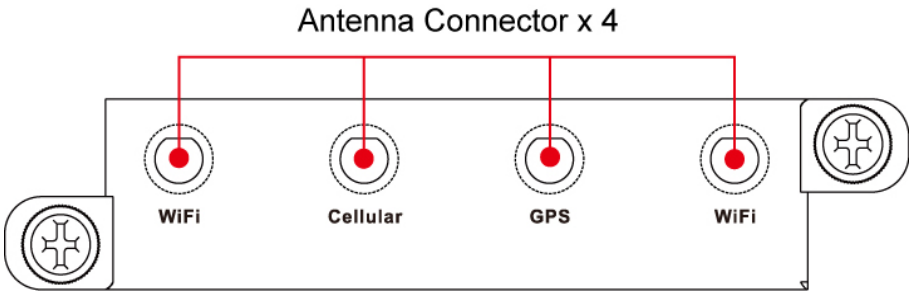
EPM-3032



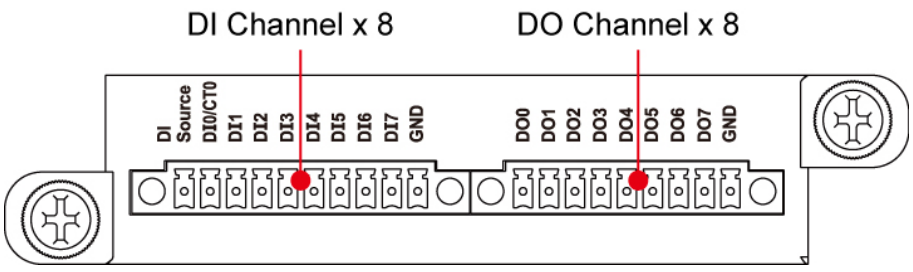
EPM-3112



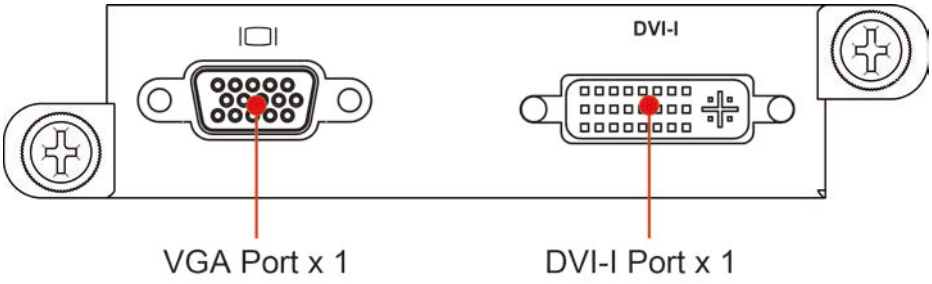
EPM-3337



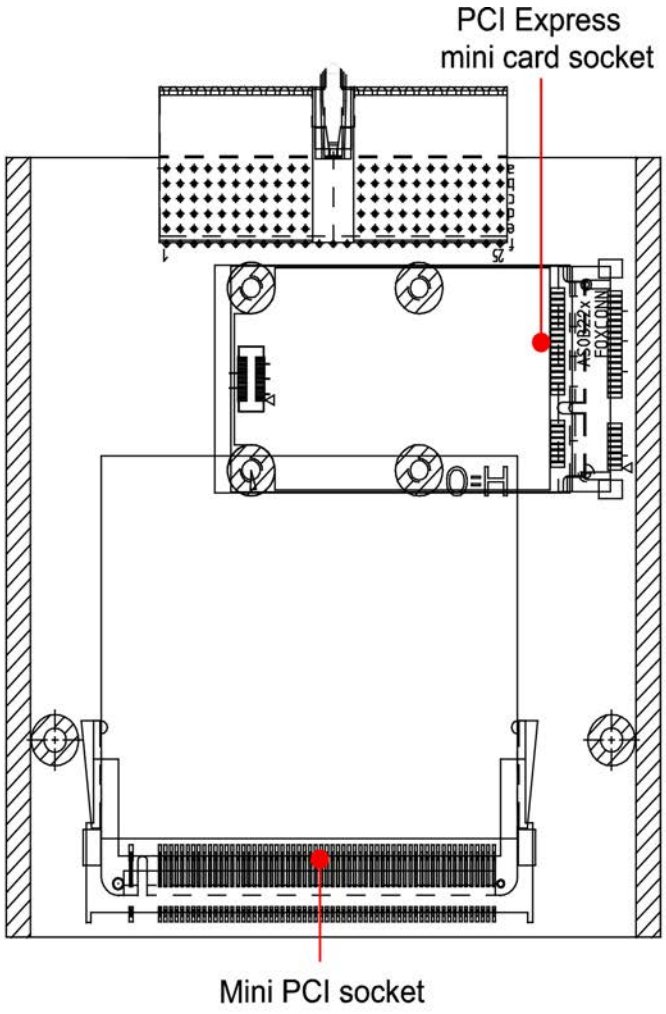
EPM-3438

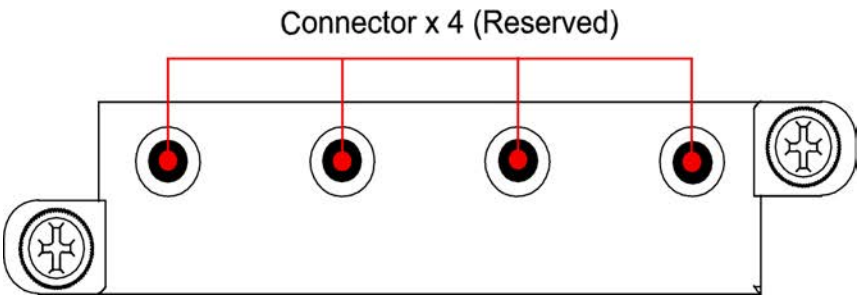


EPM-3552

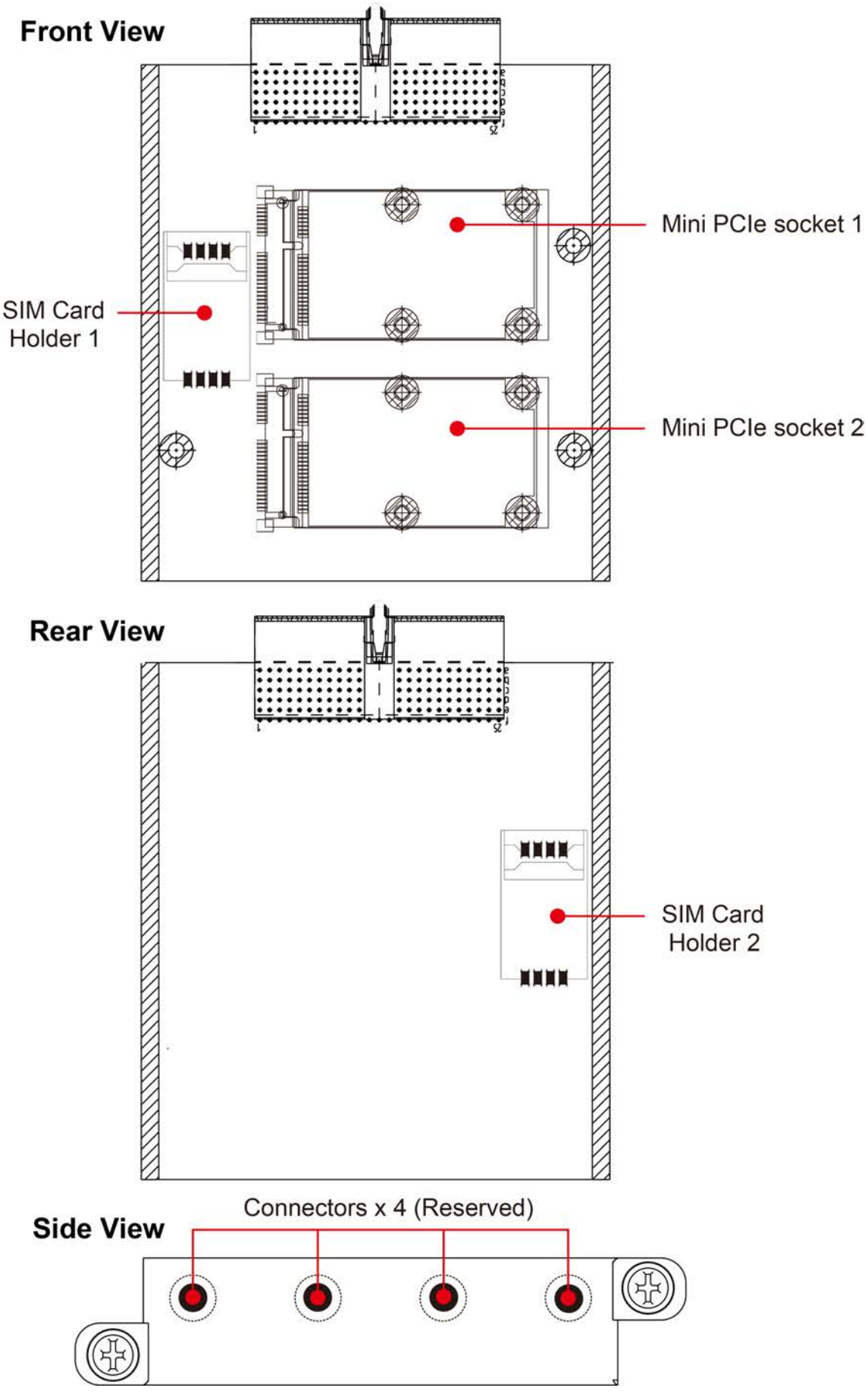


EPM-DK01

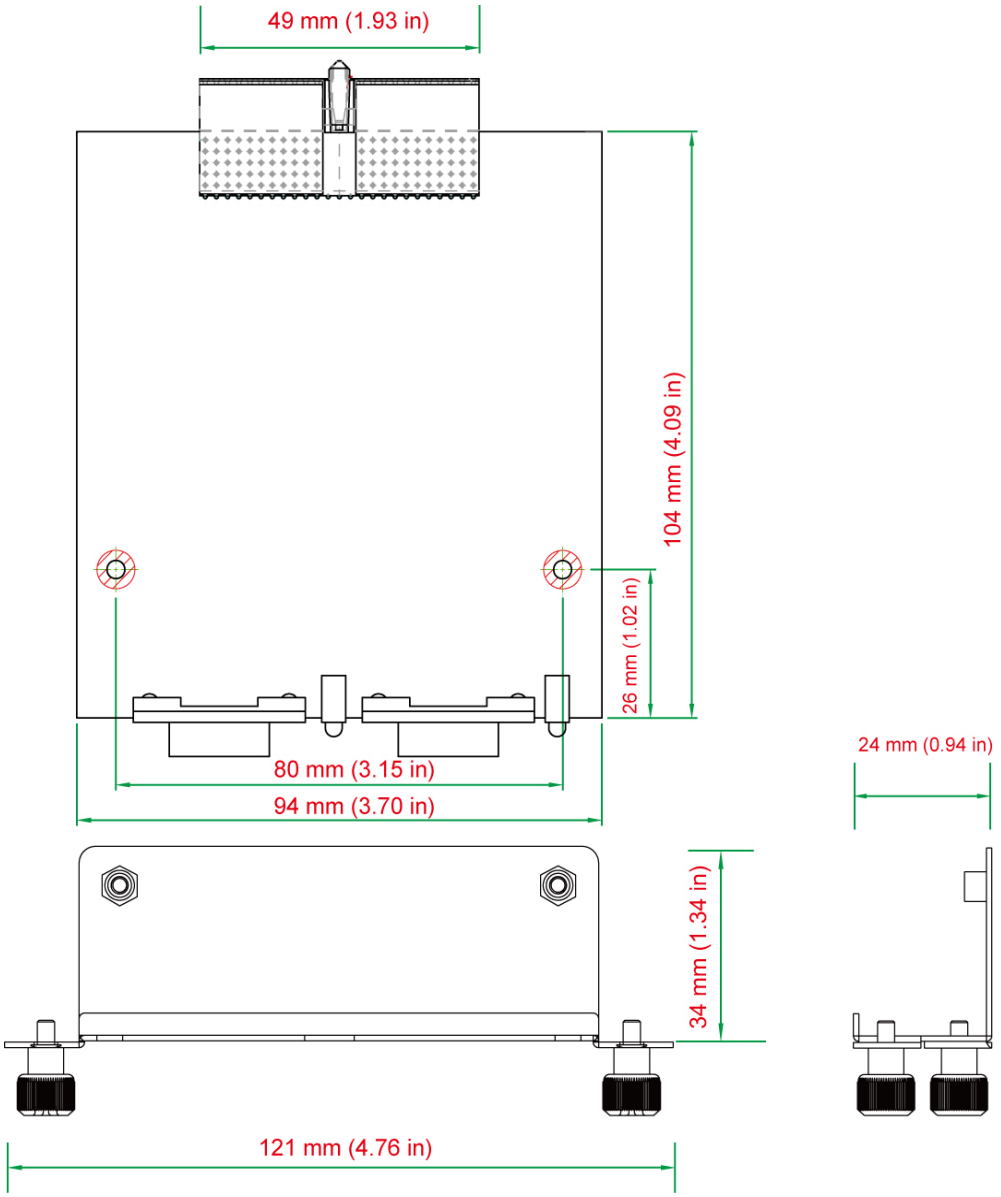




EPM-DK02


Front View
Mini PCIe socket 1
SIM Card
Holder 1
Mini PCIe socket 2
Rear View
SIM Card
Holder 2
Side View
Connectors x 4 (Reserved)

Dimensions


49 mm (1.93 in)
104 mm (4.09 in)
26 mm (1.02 in)
80 mm (3.15 in)
94 mm (3.70 in)
24 mm (0.94 in)
34 mm (1.34 in)
121 mm (4.76 in)

3

Hardware Connection Description

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

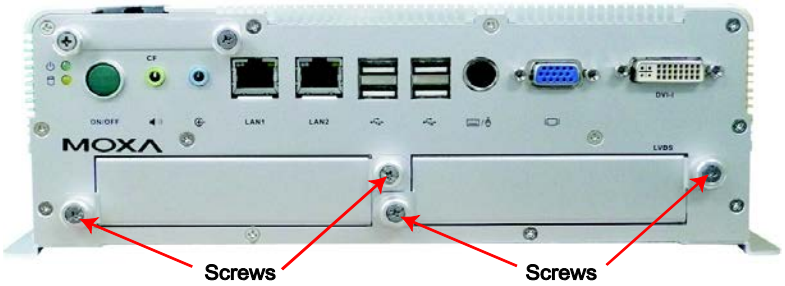
The following topics are covered in this chapter:

- **Installing the EPM Expansion Modules**
- **Connecting Data Transmission Cables**
  - Connecting to the EPM-3032 Serial Port Module
  - Connecting to the EPM-3337 Wireless/GPS Module
  - Connecting to the EPM-3438 DI/DO Module
  - Connecting to the EPM-3112 CANbus Port Module
  - Connecting to the EPM-DK01 Module
  - Connecting to the EPM-3552 Display Module
  - Connecting to the EPM-DK02 Module
  - Configuring the Power On/Off Function Jumper for Socket 1

Installing the EPM Expansion Modules

The EPM series expansion modules are designed to work with Moxa's V2422 and V2426 embedded computers. Below we describe how to insert the modules into the embedded computer slots.

1. Remove the module cover screws.



2. Remove the cover from the slot.

3. Gently insert the module into the slot.

4. When finished, tighten the screws to hold the module in place.

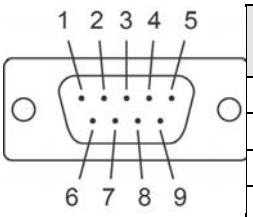
Connecting Data Transmission Cables

In this section we explain how to connect the EPM modules to devices.

Connecting to the EPM-3032 Serial Port Module

Use a serial cable to plug your serial device into the module's serial port. Serial ports 1 and 2 have male DB9 connectors and can be configured for RS-232, RS-422, or RS-485 communication by software. The pin assignments are shown in the following table:

DB9 Male Port

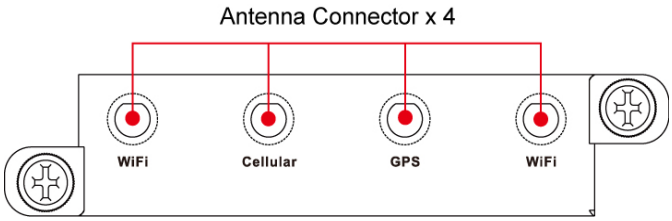


RS-232/422/485 Pinouts

Pin	RS-232	RS-422	RS-485 (4-wire)	RS-485 (2-wire)
1	DCD	TxDA(-)	TxDA(-)	–
2	RxD	TxDB(+)	TxDB(+)	–
3	TxD	RxDB(+)	RxDB(+)	DataB(+)
4	DTR	RxDA(-)	RxDA(-)	DataA(-)
5	GND	GND	GND	GND
6	DSR	–	–	–
7	RTS	–	–	–
8	CTS	–	–	–

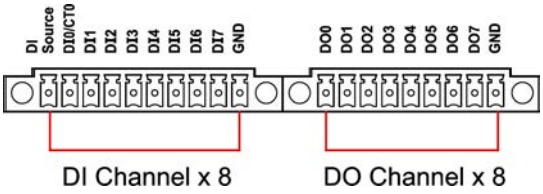
Connecting to the EPM-3337 Wireless/GPS Module

The EPM-3337 module comes with 4 connectors that can be used to connect antennas, including 2 WiFi antennas, 1 cellular antenna, and 1 GPS antenna. Refer to the following figure for the location of the different antennas.

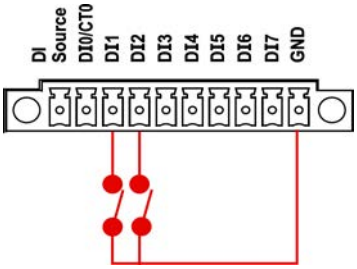


Connecting to the EPM-3438 DI/DO Module

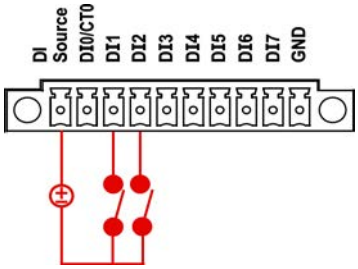
The EPM-3438 module comes with 8 digital input channels and 8 digital output channels. See the following figures for pin definitions and wiring methods.



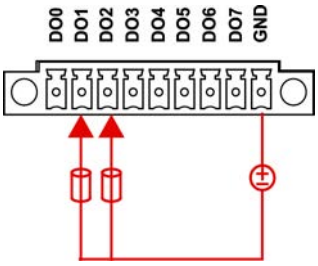
Digital Input
Dry Contact Wiring



Digital Input
Wet Contact Wiring



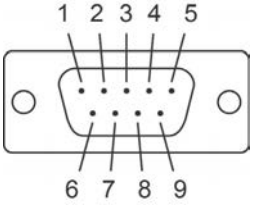
Digital Output Wiring



Connecting to the EPM-3112 CANbus Port Module

The EPM-3112 offers two CANbus 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

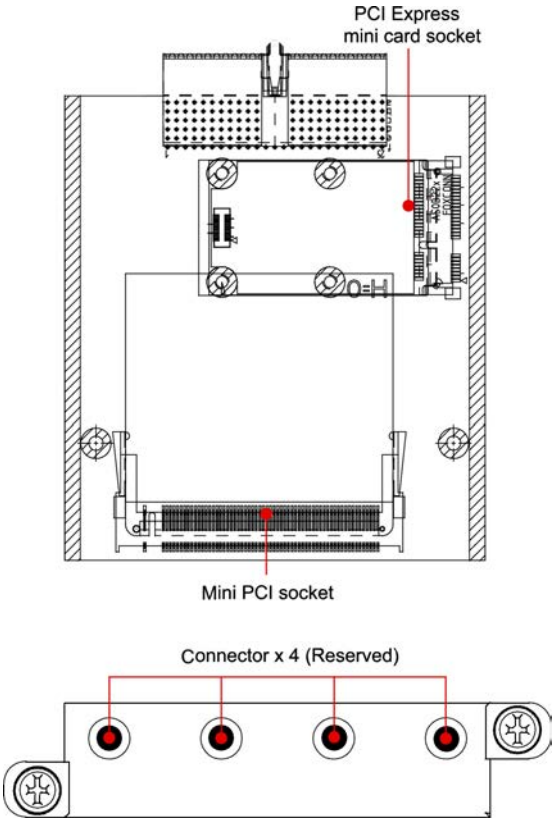


CANbus Pinouts

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

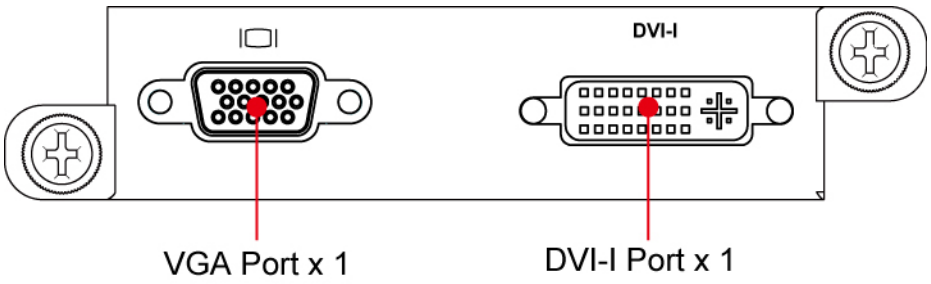
Connecting to the EPM-DK01 Module

The EPM-DK01 offers a mini-PCI and a mini-PCIe sockets, allowing users to insert a mini-PCI or a mini-PCIe card. See the following figure for the specific locations when installing these cards. Meanwhile, if you need to connect the antenna, use the connectors on the exterior panel.



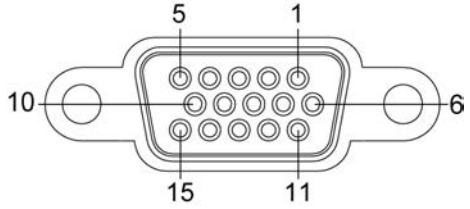
Connecting to the EPM-3552 Display Module

The EPM-3552 display modules comes with a VGA connector and a DVI-I connector. Use a cable to connect the display to the connector on the module.



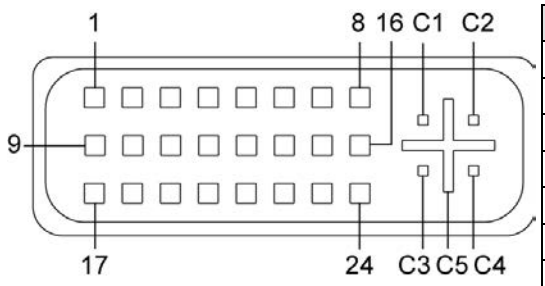
The pin assignments are shown in the following tables.

D-Sub 15 Connector Pin Assignments



Pin No.	Signal Definitions
1	RED
2	GREEN
3	BLUE
4	–
5	GND
6	CRT_DETECT#
7	GND
8	GND
9	+5V
10	GND
11	–
12	DDC_DATA
13	HSYNC
14	VSYNC
15	–

DVI-I Connector Pin Assignments

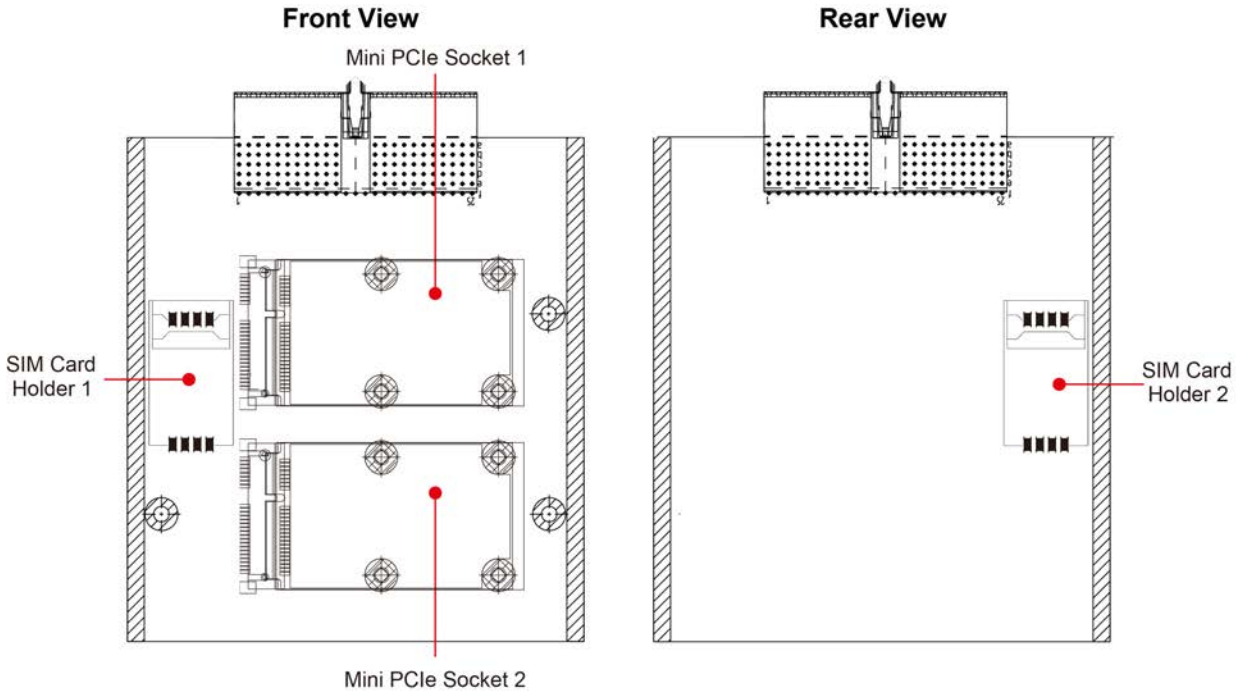


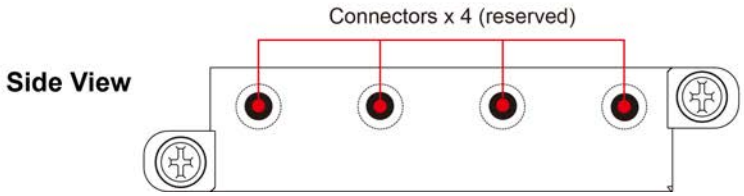
Pin No.	Signal Definition
1	T.M.D.S. Data2-
2	T.M.D.S. Data2+
3	T.M.D.S. Data2/4 Shield
4	T.M.D.S. Data4-
5	T.M.D.S. Data4-
6	DDC Clock
7	DDC Data
8	Analog Vertical Sync
9	T.M.D.S. Data1-
10	T.M.D.S. Data1+
11	T.M.D.S. Data1/3 Shield
12	T.M.D.S. Data3-
13	T.M.D.S. Data3+
14	+5V Power
15	Ground (return for +5V, HSync, and VSync)
16	Hot Plug Detect
17	T.M.D.S. Data0-
18	T.M.D.S. Data0+
19	T.M.D.S. Data0/5 Shield
20	T.M.D.S. Data5-
21	T.M.D.S. Data5+
22	T.M.D.S. Clock Shield
23	T.M.D.S. Clock+
24	T.M.D.S. Clock-
C1	Analog Red
C2	Analog Green
C3	Analog Blue
C4	Analog Horizontal Sync
C5	Analog Ground (analog R, G, B return)

Connecting to the EPM-DK02 Module

The EPM-DK02 has 2 mini PCIe sockets that allow users to insert two mini PCIe cards for cellular communication. The figures below show the specific locations on the module to install these cards. Note that while both sockets provide a mini PCIe interface, socket 1 supports either mini PCIe or USB 2.0 signals, whereas socket 2 only supports USB 2.0 signals.

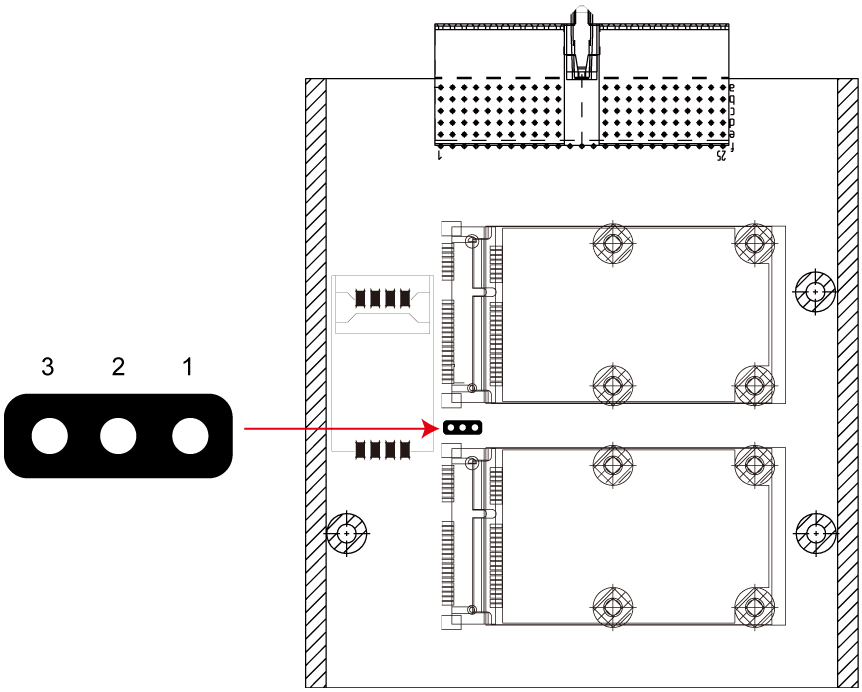
Connect the cellular module to the mini PCIe socket, and insert the SIM card into the SIM card holder. Be sure to tighten the screw in the screw holder so that the module will be firmly installed. Note that the second SIM card holder is located on the back of the module. If you need to connect the antenna, use the connectors on the exterior panel.





Configuring the Power On/Off Function Jumper for Socket 1

Socket 1 of the EPM-DK02 module offers the power on/off function, which activated using the jumper setting shown in the following figure.



1. Place the jumper on pins 1 and 2 to enable the power on/off control function.
2. Place the jumper on pins 2 and 3 to disable the power on/off control function. In this case, the power will always be on.

NOTE This jumper configuration is for socket 1 only.

4

Software Installation and Programming Guide

In this chapter we discuss software installation and programming guide for the EPM-3032, EPM-3337, and EPM-3438 expansion modules.

The following topics are covered in this chapter:

- **Linux System**
  - EPM-3032 Driver Installation
  - EPM-3032 Programming Guide
  - EPM-3438 Driver Installation
  - EPM-3438 Programming Guide
  - EPM-3337 Driver Installation
  - EPM-3112 Driver Installation
  - EPM-3112 Programming Guide
  - EPM-3552 Driver Installation
  - EPM-3552 Chipset Configuration
  - EPM-DK02 Driver Installation
- **Windows System**
  - EPM-3032 Driver Installation
  - Configuring Serial Port Mode
  - Changing UART Mode Through Programming
  - EPM-3438 Driver Installation
  - EPM-3438 Programming Guide
  - EPM-3337 Driver Installation
  - Wireless Module Driver Installation
  - Configuring the GPRS/HSDPA Connection (without GPS)
  - Enabling GPS Functionality
  - Configuring a Wireless Connection
  - Getting Wireless Module Information
  - EPM-3112 Driver Installation
  - EPM-3112 Programming Guide
  - EPM-3552 Driver Installation
  - EPM-3552 Configuration
  - Setting the Display to Extend Mode with the Windows Properties
  - EPM-3552 Patch File Installation
  - EPM-DK02 Driver Installation
  - Controlling EPM-DK02 Power On/Off

Linux System

EPM-3032 Driver Installation

The EPM-3032 supports Linux standard termios control. The normal tty device node is located at /dev/ttyM8, ttyM9. /dev/ttyM16 and ttyM17 are the second device files for the EPM-3032 module. The Moxa UART Device API allows you to configure ttyMx for RS-232, RS-422, 4-wire RS-485, or 2-wire RS-485.

The EPM-3032 driver has been pre-installed at the following location, and will be loaded automatically when the system boots up.

```
Moxa:~# /lib/modules/2.6.30-bpo.2-686/kernel/drivers/char/mxser.ko
```

EPM-3032 Programming Guide

Example to set the baud rate

```
#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 to get the baud rate

```
#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 ) {
        // follow the standard termios baud rate define
    } else {
        ioctl(fd, MOXA_GET_SPECIAL_BAUD_RATE, &speed);
    }
```

Baud rate inaccuracy

```
Divisor = 921600/Target Baud Rate. (Only Integer part)
ENUM = 8 * (921600/Targer - Divisor) ( Round up or down)
Inaccuracy = (Target Baud Rate – 921600/(Divisor + (ENUM/8))) * 100%
E.g.,
To calculate 500000 bps
Divisor = 1, ENUM = 7,
Inaccuracy = 1.7%
```

*For reliable performance, inaccuracy should be under 2%

Special Note

The embedded serial ports do not support special baud rates and the maximum baud rate is only 115200 bps. However, the expansion board can support special baud rates and maximum baud rates of up to 921600 bps.

If the target baud rate is not a special baud rate (e.g. 50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600), the termios cflag will be set to the same flag.

If you use stty to get the serial information, you will get speed equal to 0.

Configure Serial Port Mode

Use “setinterface” command to retrieve the parameters of the serial port configuration.

```
Moxa:~# setinterface
    Usage: setinterface device-node [interface-no]
    device-node - /dev/ttyMn; n = 0,1,2,...
    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:~#
```

The different serial modes use specific parameters.

1 – set to RS485-2WIRES interface

2 – set to RS422 interface

3 – set to RS485-4WIRES interface

To check the current interface setting:

```
Moxa: ~# setinterface /dev/ttyM8
Now setting is RS485-2WIRES interface.
```

In this case, Serial Port 1 is set as RS-485 2-wire. (M0 refers to port 1, and M1 refers to port 2, and so on)

To change the current interface setting:

```
Moxa: ~# setinterface /dev/ttyM8 2
Moxa: ~# setinterface /dev/ttyM8
Now setting is RS422 interface.
```

In this case, Serial Port 1 has been changed and is set as RS-422 mode.

To load the settings as the Default Value:

When OS boots up, the default interface mode of the EPM-3032 is RS232. If you want to change the default interface mode, please use the following steps:

First remount the read-only root file system in writable mode.

```
Moxa:~# mount -o remount,rw /dev/hda1 /
Moxa:~#
```

Next, edit **/etc/udev/rules.d/96-moxa.rules**. Add the following description to **96-moxa.rules**. The VendorID of the EPM-3032 must be **0x1393**and the DeviceID must be **0x1022**. For example:

```
# Set the device, EPM-3032, 0x1393:0x1022 default as 232 mode interface
DRIVERS=="mxser", ATTRS{vendor}=="0x1393", ATTRS{device}=="0x1022",
RUN+="/bin/setinterface /dev/ttyM%n 0"

"96-moxa.rules"
```

Edit the command line **RUN+="/bin/setinterface /dev/ttyM%n 0"**.

If you want to set the serial mode to RS-232, use the following parameter.

RUN+="/bin/setinterface /dev/ttyM%n 0"

If you want to set the serial mode to RS-485 2-wire, use the following parameter.

RUN+="/bin/setinterface /dev/ttyM%n 1"

If you want to set the serial mode to RS-422, use the following parameter.

RUN+="/bin/setinterface /dev/ttyM%n 2"

If you want to set the serial mode to RS-485 4-wire, use the following parameter.

RUN+="/bin/setinterface /dev/ttyM%n 3"

When finished, remember to umount the writable root file system.

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

Reboot your computer.

```
Moxa:~# reboot
Moxa:~#
```

Once the computer restarts, confirm that the setting has been loaded as the default value.

```
Moxa:~# setinterface /dev/ttyM8
Now setting is RS485-2WIRES interface.
Moxa:~#
```

EPM-3438 Driver Installation

Upload the package to embedded computer and to the tmpfs, /dev/shm.

```
root:~# scp epm3438-2.6.30-bpo.2-686.deb root@192.168.30.123:/dev/shm
root:~#
```

Install the package

```
Moxa:~# cd /dev/shm
Moxa:~# mount -o remount,rw /
Moxa:~# dpkg -i ./epm3438-2.6.30-bpo.2-686.de
Moxa:~# umount /
```

After the driver installs, you can use lsmod to check if the epm3438 module is loaded in the kernel.

```
Moxa:~# lsmod|more
Module                  Size  Used by
epm3438                 4620  0
…
```

In /etc/init.d/moxainit.sh will add the `modprobe epm3438` and `modprobe -r epm3438` lines.

```
Moxa:~# vi /etc/init.d/moxainit.sh
…
start)
…
    modprobe moxa_device_dio device="v2400"
    modprobe mxser
    modprobe epm3438
    …
    ;;
stop)
    …
    modprobe -r epm3438
    modprobe -r moxa_swtd
    modprobe -r moxa-device-dio
    ;;
...
```

If you need to uninstall the driver, you can use this command:

```
Moxa:~# mount -o remount,rw /
Moxa:~# dpkg -r epm3438
Moxa:~# umount /
```

EPM-3438 Programming Guide

Digital I/O

Digital input/output channels are featured in some models of Moxa embedded computers, including the UC-7408, UC-8410, IA240, IA260, W406 and EPM-3438. These channels can be accessed at run-time for control or monitoring using the functions in the following sections. Digital Output channels can be set to high or low via each port starting from 0. The Digital Input channels can be used to detect the state change of the digital input signal. The header file of digital I/O functions is *mxdgio.h*, which is located in the *digit_input_change* directory for Linux.

Moxa functions for DI/DO

Function	**HANDLE mxdgio_epm3438_open(int HWIndex);**
Description	This function opens access to the DIO device.
Input	<HWIndex> The first or second EPM-3438 board.
Output	None
Return	When successful, this function returns an access to the DIO device. Otherwise, there is an error.

Function	**void mxdgio_close(HANDLE fd);**
Description	This function closes the access to the DIO device.
Input	<fd> The access to the device.
Output	None
Return	None

Function	**int mxdgio_get_input_signal(HANDLE fd, int port);**
Description	This function gets the signal state of a digital input channel.
Input	<fd> The access to the device. <port> port #
Output	<state> DIO_HIGH (1) for high, DIO_LOW (0) for low
Return	Returns 1 for a high signal or 0 for a low signal, if successful. Otherwise, it returns a value of -1.

Function	**int mxdgio_get_output_signal(HANDLE fd, int port);**
Description	This function gets the signal state of a digital output channel.
Input	<fd> The access to the device. <port> Port number
Output	None
Return	Returns 1 for a high signal or 0 for a low signal, if successful. Otherwise, it returns a value of -1.

Function	**int mxdgio_set_output_signal_high(HANDLE fd, int port);**
Description	This function sets a high signal to a digital output channel.
Input	<fd> The access to the device. <port> Port number.
Output	none.
Return	When successful, this function returns 0. When an error occurs, it returns -1.

Function	**int mxdgio_set_output_signal_low(HANDLE fd, int port);**
Description	This function sets a low signal to a digital output.
Input	<fd> The access to the device. <port> Port number.
Output	none.
Return	When successful, this function returns 0. When an error occurs, it returns -1.

Moxa I/O control definitions for COUNTER

```
#define    COUNTER_NODE1          "/dev/epm_3438_counter1"
#define    COUNTER_NODE2          "/dev/epm_3438_counter2"
```

Function	**int mxdgio_epm3438_get_counter(int fd);**
Description	get the counter value
Input	<fd> The access to the counter device. <port> Port number.
Output	none.
Return	the counter value

Function	**int mxdgio_epm3438_clear_counter(int fd);**
Description	Clear the counter value
Input	<fd> The access to the counter device. <port> Port number.
Output	none.
Return	0:clear success; -n: clear fail

Special Note

1. We have provided an example in CD **digit_input_change**. The mxdgio.h defines the convenient API for DIO and COUNTER programming.
2. The DO initial status is HIGH. If you want the initial DO status to be LOW, you should add one line in /etc/modules to load epm_3438.ko with epm3438_DO2LOW=1;

```
Moxa: ~# modinfo /lib/modules/2.6.30-bpo.2-686/kernel/drivers/char/epm_3438.ko
filename:    /lib/modules/2.6.30-bpo.2-686/kernel/drivers/char/epm_3438.ko
description:  EPM-3438: DIO/Counter module
author:      jared_wu@moxa.com
license:     GPL
depends:
vermagic:    2.6.30-bpo.2-686 SMP mod_unload modversions 686
parm:        epm3438_DO2LOW:Reset DO to LOW. 0. Set DO to High (default). 1. Set DO
to LOW. (int)
Moxa: ~# mount -o remount,rw /
Moxa: ~# vi /etc/init.d/moxainit.sh
…
# Load the EPM-3438 DIO driver.
modprobe epm_3438 epm3438_DO2LOW=1
…
Moxa: ~# umount /
```

This DIO sample program shows how users can develop a set of higher layer functions using preliminary DIO functions from the peripheral I/O library. These functions allow user applications to focus on event handling when events occur. A callback function is defined by the programmer to associate with an event. The source code files of the sample program are located in the *samples/mxphio/digit_input_change* directory for Linux Four higher layer functions, **digit_io_timer_init**, **digit_io_timer_dispatch**, **digit_io_timer_add_callback**, and **digit_io_timer_dispatch_quit**, are provided. Four callback functions in the sample are added for four different events: **DGTIO_GET_INPUT_STATE_CHANGE**, **DGTIO_GET_INPUT**, **DGTIO_GET_OUTPUT**, and **DGTIO_SET_OUTPUT**, via the **digit_io_timer_add_callback** function.

```
mngr = digit_io_timer_init();
...
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_INPUT_STATE_CHANGE,
interval, input_chg_cb, &port) < 0) {
...
}
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_INPUT, interval, input_get_cb,
&port) < 0) {
...
```

}

if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_SET_OUTPUT, interval, output_set_cb, &port) < 0) {

...

}

if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_OUTPUT, interval, output_get_cb, &port) < 0) {

...

}

digit_io_timer_dispatch(mngr);

Examples

DIO Program Source Code File Example

File and Folder: digit_input_change/digit_io_timer.c

Description: Routines to operate timer functions on digital IO port.

```
#include <stdio.h>
#include <stdlib.h>
#if !defined(_WIN32_WCE) && !defined(WIN32)
#include <time.h>
#endif
#include "digit_io_timer.h"
/* callback function */
static void
dgio_input_change_exec(DGIOMNGR *mngr, DGIOITEM *item)
{
   int sig;
   HANDLE fd=mngr->fd[item->HWIndex];
   switch(item->mode)
   {
   case DGTIO_GET_INPUT:
        sig = mxdgio_get_input_signal(fd, item->port);
        item->cb(item->HWIndex, item->port, sig, item->arg);
        break;
   case DGTIO_GET_OUTPUT:
        sig = mxdgio_get_output_signal(fd, item->port);
        item->cb(item->HWIndex, item->port, sig, item->arg);
        break;
   case DGTIO_GET_INPUT_STATE_CHANGE:
        sig = mxdgio_get_input_signal(fd, item->port);
        if (item->last_signal!=sig)
        {
            item->cb(item->HWIndex, item->port, sig, item->arg);
        }
        break;
   case DGTIO_SET_OUTPUT:
        sig = item->cb(item->HWIndex, item->port, item->last_signal, item->arg);
        if (sig)
        {
            mxdgio_set_output_signal_high(fd, item->port);
        }
```

```
        else
        {
            mxdgio_set_output_signal_low(fd, item->port);
        }
        break;
    default:
        return;
    }
    item->last_signal = sig;
}
/* release the timer operation
*/
static void
dgio_input_change_release(DGIOMNGR *mngr)
{
    int i;
    DGIOITEM *item, *next;
     item=mngr->list;
     while(item)
     {
        next = item->next;
        free(item);
        item = next;
     }
     for ( i=0; i<HW_TOTAL; i++ )
        if (mngr->fd[i])
            mxdgio_close(mngr->fd[i]);
}
/* this function initilizes a timer manager
     Returns:
        Return a pointer to the manager.
*/
DGIOMNGR*
digit_io_timer_init(void)
{
    DGIOMNGR *mngr;
    mngr = (DGIOMNGR*) calloc(1, sizeof(DGIOMNGR));
    if (mngr)
    {
     mngr->fd[0] = mxdgio_open();
#if 1 // Jared, 08-10-2010, support the second EPM-3438
     mngr->fd[1] = mxdgio_epm3438_open(0); // The first EPM-3438
     mngr->fd[2] = mxdgio_epm3438_open(1); // The second EPM-3438
#endif
        if (mngr->fd[0] < 0)
        {
            free(mngr);
            mngr = NULL;
        }
    }
    return mngr;
}
/*  add a digital io timer with a selected operation mode
    Inputs:
        <mngr> timer manager
```

```
        <HWIndex> specify which hardware device;
            0: embedded DIO, 1: EPM-3438 #1, 2: EPM-3438 #2
        <port> specify which DIO pin
        <mode> the operation mode on the port
        <interval> the interval (in milliseconds) between 2 calls to a user-defined
function
        <cb> the user-defined callback function
        <arg> argument to the function
    Returns:
        0 on sucess, otherwise failure
*/
int
digit_io_timer_add_callback(DGIOMNGR *mngr, int HWIndex, int port, int mode, int
interval, digit_io_cb_t cb, void *arg)
{
   DGIOITEM *item;
   item = (DGIOITEM*) calloc (1, sizeof (DGIOITEM));
   if (!item)
      return -1;
   item->next = mngr->list;
    mngr->list = item;
   item->cb  = cb;
   item->arg = arg;
   item->HWIndex = HWIndex; // Jared, 08-10-2010, HWIndex to support multiple boards
   item->port = port;
   item->mode = mode;
    item->interval = interval;
    item->next_time = interval;
    // Jared, 08-10-2010, HWIndex to support multiple boards
    item->last_signal =  mxdgio_get_input_signal(mngr->fd[HWIndex], port);
   return 0;
}
void
digit_io_timer_dispatch_quit(DGIOMNGR *mngr)
{
   if (mngr) mngr->dispatch = 0;
}
#define MAX_TIME 0XFFFFFFFF
/*  start and dispatch the timer operations
   Inputs:
      <mngr> the manager
    Returns:
        none
*/
void
digit_io_timer_dispatch(DGIOMNGR *mngr)
{
   DGIOITEM *item;
    unsigned int ms_sleep, n;
#if !defined(_WIN32_WCE) && !defined(WIN32)
   struct timeval to;
#endif
    mngr->dispatch = 1;
   while(mngr->list && mngr->dispatch)
   {
```

```
        for (item = mngr->list; item != NULL; item = item->next)
        {
            if (mngr->now_time < item->next_time)  /* not yet */
                continue;
            n = mngr->now_time - item->next_time;
            /* over due, executable */
            item->next_time = mngr->now_time+item->interval-n; /* move to the next
time */
            dgio_input_change_exec(mngr, item);
        }
        ms_sleep = MAX_TIME;
        /* get the amount of time to sleep */
        for (item = mngr->list; item != NULL; item = item->next)
        {
            if (mngr->now_time < item->next_time)  /* not yet */
            {
                n = item->next_time - mngr->now_time;
                if (n < ms_sleep) ms_sleep = n;
                continue;
            }
        }
        if (ms_sleep!=MAX_TIME)
        {
#if !defined(_WIN32_WCE) && !defined(WIN32)
            to.tv_sec  = ms_sleep/1000;
            to.tv_usec = (ms_sleep%1000)*1000;
            if (select (0, NULL, NULL, 0, &to) != 0) /* sleep */
                break;
#else
            Sleep(ms_sleep);
#endif
            mngr->now_time += ms_sleep;
        }
    }
    dgio_input_change_release(mngr);
}
File and Folder: digit_input_change/main.c
Description: This program is an example to operate timer functions on digital IO ports.
#include <stdio.h>
#include <stdlib.h>
#include "digit_io_timer.h"
static int
input_chg_cb(int HWIndex, int port, int sig, void *arg)
{
       printf("input_chg_cb() HWIndex %d port %d sig %d\n", HWIndex, port, sig);
       return 0;
}
static int
input_get_cb(int HWIndex, int port, int sig, void *arg)
{
       printf("input_get_cb() HWIndex %d port %d sig %d\n", HWIndex, port, sig);
       return 0;
}
static int
output_set_cb(int HWIndex, int port, int last_sig, void *arg)
```

```
{
	printf("output_set_cb() HWIndex %d port %d last sig %d\n", HWIndex, port,
last_sig);
	last_sig++;
	last_sig %= 2;
	printf("new sig=%d\n", last_sig);
	return last_sig;
}
static int
output_get_cb(int HWIndex, int port, int sig, void *arg)
{
	printf("output_get_cb() HWIndex %d port %d sig %d\n", HWIndex, port, sig);
	return 0;
}
#define INTERVAL	10000
int
#if defined(_WIN32_WCE)
WINAPI
WinMain( HINSTANCE hInstance, HINSTANCE hPrevInstance, LPTSTR lpCmdLine, int
nCmdShow )
#else
main(int argc, char *argv[])
#endif
{
	DGIOMNGR *mngr;
	int HWIndex;
	int port;
	int interval;
#if defined(_WIN32_WCE)
	int	argc;
	char cmdline[256], *argv[32];
	WideCharToMultiByte(CP_ACP, 0, (LPCTSTR)lpCmdLine, 255, cmdline, 256, NULL,
NULL);
	argc = split_line(argv+1, 32, cmdline)+1;
#endif
	if (argc > 1) interval = atoi(argv[1]);
	else interval = INTERVAL;
	mngr = digit_io_timer_init();
	if (mngr == NULL) {
		printf("digit_io_timer_init() error\n");
		return -1;
	}
	HWIndex=0; // HWIndex=0 for embedded DIO
	for (port = 0; port < 1; port++) {
	   if (digit_io_timer_add_callback(mngr, HWIndex, port,
DGTIO_GET_INPUT_STATE_CHANGE, interval, input_chg_cb, &port) < 0) {
		printf("add %d input change callback error\n", port);
		   return -2;
	   }
	   if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_INPUT,
interval, input_get_cb, &port) < 0) {
	      printf("add %d input callback error\n", port);
	      return -3;
	   }
```

```
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_SET_OUTPUT, interval,
output_set_cb, &port) < 0) {
            printf("add %d set output callback error\n", port);
            return -4;
         }
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_OUTPUT, interval,
output_get_cb, &port) < 0) {
            printf("add %d get output callback error\n", port);
            return -5;
         }
      }
      / / HWIndex=1 for EPM-3438 board #1; HWIndex=2, for EPM-3438 board #2
      for (HWIndex = 0; HWIndex < HW_TOTAL; HWIndex++ ) {
            for (port = 0; port < 8; port++) {
                  /* since list is LIFO last callbacks are added first */
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_INPUT_STATE_CHANGE,
interval, input_chg_cb, &port) < 0) {
                        printf("add %d input change callback error\n", port);
                        return -2;
                  }
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_INPUT, interval,
input_get_cb, &port) < 0) {
                        printf("add %d input callback error\n", port);
                        return -3;
                  }
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_SET_OUTPUT, interval,
output_set_cb, &port) < 0) {
                        printf("add %d set output callback error\n", port);
                        return -4;
                  }
if (digit_io_timer_add_callback(mngr, HWIndex, port, DGTIO_GET_OUTPUT, interval,
output_get_cb, &port) < 0) {
                        printf("add %d get output callback error\n", port);
                        return -5;
                  }
            }
      }
      digit_io_timer_dispatch(mngr);
      return 0;
}
Examples
Counter Program Source Code File Example
File and Folder: digit_input_change/tcounter.c
Description: This file is an example of the EPM-3438 couter programming.
read the counter value.
read the counter value and clear the counter.
#include      <stdio.h>
#include      <stdlib.h>
#include      <sys/time.h>
#include      <fcntl.h>
#include      <unistd.h>
#include      <signal.h>
#include      “mxdgio.h”  // For counter reading or clear
#define COUNTER_NODE1   "/dev/epm_3438_counter1" // The first EPM-3438
#define COUNTER_NODE2   "/dev/epm_3438_counter2" // The second EPM-3438
```

```
int main(int argc, char * argv[])
{
       int retval;
       int fd, fd2, len;
       unsigned int counter_value;
       fd=open(COUNTER_NODE1, O_RDONLY);
       while( 1 ) {
              printf("\nSelect a number of menu, other key to exit.   \n\
       1. Get counter value                          \n\
       2. Clear the counter                           \n\
       Others. quit                                  \n\
Choose : ");
              scanf("%d", &retval);
              if ( retval == 1 ) {   // Get counter without reset
                     counter_value = mxdgio_epm3438_get_counter(fd);
                     printf("EPM-3438 board #1 counter:%d\n", counter_value);
              }
              else if ( retval == 2 ) { // Get counter with reset
                     retval = mxdgio_epm3438_clear_counter(fd);
                     if ( retval < 0 )
                            printf("EPM-3438 board #1 counter reset fail\n");
              }
              else {
                     break;
              }
       }
       close(fd);
       return 0;
}
```

EPM-3337 Driver Installation

Moxa's EPM-3337 module supports both 3G/GPS and wireless functionality. This section introduces how to configure these functions in the Linux platform.

1. Make root file system writable

```
Moxa:~# mount -o remount,rw /
```

2. Install the file **epm3337.deb**

```
Moxa:/home# dpkg -i epm3337.deb
```

3. Setup 3G module to Mdm mode

   EPM-3337's 3G module supports multiple modes, issue **lsusb** to get information:

   - 0681:0040 - MdmNet mode (the default factory setting)
   - 0681:0047 - Mdm mode (for Linux)

   Now convert EPM-3337 module with the **moxa_hc25_setup_mdm.sh** script at **/home**

```
Moxa:/home# sh moxa_hc25_setup_mdm.sh
```

   Confirm that the conversion is completed

```
Moxa:/home# lsusb

Bus 001 Device 010: ID 0681:0047 Siemens Information and Communication
```

   Note: You only need to do this conversion once.

4. Configure the driver to load at startup
   The default run-level is 2 (setup in **/etc/inittab**). Issue the following command

```
Moxa:/etc/rc2.d# mv N98moxa hc25 load driver
```

   Note: You need to reboot to load the driver or issue **/etc/init.d/moxa_hc25_load_driver**

5. Install software from internet for wireless functionality

```
Moxa:/home# apt-get install wpasupplicant wireless-tools
```

6. Create the correct links for wpa_supplicant

```
Moxa:/etc/network/if-up.d# ln -sf /etc/wpa_supplicant/ifupdown.sh
wpasupplicant
Moxa:/etc/network/if-down.d# ln -sf /etc/wpa_supplicant/ifupdown.sh
wpasupplicant
Moxa:/etc/network/if-pre-up.d# ln -sf /etc/wpa_supplicant/ifupdown.sh
wpasupplicant
Moxa:/etc/network/if-post-down.d#ln -sf
/etc/wpa_supplicant/ifupdown.sh wpasupplicant
```

7. Mount root file system (/) as read-only

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

8. Reboot your device to complete installation

ATTENTION

ppp 2.4.4 may get the incorrect DNS after connection; here are two workaround solutions:

1. **Assign the DNS manually**
   Comment the option "**usepeerdns"in /dev/pppt/chtgprs**. Then assign a DNS /etc/resolv.conf manually.

```
#usepeerdns    # use the DNS servers from the remote network
```

2. Remove **ppp 2.4.4** and install **ppp-2.4.5.deb**

```
Moxa:~# apt-get remove ppp
Moxa:/home# dpkg -i ppp-2.4.5.deb
```

The EPM-3337's Two Operating Modes

The EPM-3337 module has two modes:

1. **Normal Mode:** Supports only GPRS/HSDPA functionality (without GPS).
   The allocation of ports is:
   - Modem port: **/dev/ttyACM0**
   - Command port: **/dev/ttyUSB0**
2. **Multiplexer Mode:** Supports both GPRS/HSDPA and GPS functionality.
   A multiplexer program must be run to put the module into multiplexer mode. The allocation of ports is:
   - Modem port: /dev/pts/0
   - Command port: /dev/pts/1
   - GPS port: /dev/pts/2

Note: If you do not need the GPS functionality, use normal mode for better performance.

Normal mode—GPRS/HSDPA functionality only

This section illustrates how to establish a connection with pppd configuration. The example files used are listed below:

- **/etc/ppp/peers/chtgprs**: a pppd additional option file
- **/etc/chatscripts/chtgprs-connect**: chat file for connection
- **/etc/chatscripts/chtgprs-disconnect**: chat file for disconnection

Take the following steps to set up your pppd:

1. Configure the file **/etc/ppp/peers/chtgprs**.
   a. First, check if the name of the modem port is correct. It should be **/dev/ttyACM0** for the first module, **/dev/ttyACM1** for the second one, and so on.
   b. Make sure the "local" option is enabled. This option ignores the CD (Carries Detect) signal.
2. Configure **/etc/chatscripts/chtgprs-connect**.
   a. First, check the **packet data protocol type** and **Access point name** of the ISP;
      a basic command is AT+CGDCONT=1,"<packet_data_protocal_type>", "<APN>"
   b. Check the ATD dialout number;
      a basic command is ATD<number>
3. Read configuration file to connect.
   a. pppd call chtgprs
4. Finally, examine connection state.
   a. If the connection is ok, a device ppp0 (or pppn) is established. Issue the command **ifconfig ppp0** to view its information.

Multiplexer mode—GPS and GPRS/HSDPA dual functionality

GPS functionality is only enabled in the module's multiplexer mode. In multiplexer mode, the system uses a pseudo terminal slave (pts) instead of reading serial ports (/dev/ttyACMx) to communicate.

This section describes how to set up GPS functionality, work with the gpsd daemon, and change the pppd configuration file for modem port **/dev/pts/0.**

The following steps illustrate how to set up GPS and use gpsd:

1. Set the module to multiplexer mode at startup

```
Moxa:/etc/rc2.d# mv N99moxa_hc25_mux_script S99moxa_hc25_mux_script
```

   Note: If you insert two EPM-3337 modules, you can set **module_num=2** in **/etc/init.d/moxa_hc25_mux_script**
2. Reboot the embedded computer.
3. The multiplexer will now automatically start at bootup. It will occupy a modem port, /dev/ttyACM0, and generate three virtual terminal ports.

```
Moxa:~# ls  /dev/pts/
0  1  2  ptmx
```

   /dev/pts/0: Modem port
   /dev/pts/1: Command port
   /dev/pts/2: GPS port

NOTE

1. The command port in multiplexer mode only accepts AT commands with the suffix \r\n (i.e., carriage return and new line). You can see the echo example in "Enable GPS port by issuing command," or set the terminal output flag with command **stty -F /dev/pts/1 opost onlcr**. The option **onlcr** translates *newline* to *carriage return+newline*.
2. For the second EPM-3337 module, the allocation will be
   /dev/pts/3: Modem port
   /dev/pts/4: Command port
   /dev/pts/5: GPS port

ATTENTION

The number assigned to pts is affected by remote log in programs (e.g., ssh or telnet). Therefore, it is advisable to perform moxa_hc25_mux at startup to make sure the pts number is 0 to 2. If there is more than 1 EPM-3337 module, the number of pts increases to 3 to 5, and so on.

4. Enable the GPS port by issuing a command to the command port.

```
Moxa:~# cat < /dev/pts/1 &

Moxa:~# echo -e "AT^SGPSS=4\r"> /dev/pts/1
Moxa:~# killall cat
```

5. Check for NMEA data from the GPS port (/dev/pts/2)

```
Moxa:~# cat < /dev/pts/2
$GPGSV,1,1,04,24,28,123,37,21,09,054,31,19,52,213,,23,47,270,*74
$GPGGA,061824.0,2458.835139,N,12133.055835,E,1,05,19.7,-103.5,M,,,,*1
4
$GPRMC,061824.0,A,2458.835139,N,12133.055835,E,,,290710,,,A*68
$GPGSA,A,3,24,21,06,31,16,,,,,,,,25.5,19.7,18.5*29
$GPVTG,,T,,M,0.0,N,0.0,K*4E
```

6. Install gpsd daemon.

```
Moxa:~# apt-get install gpsd
```

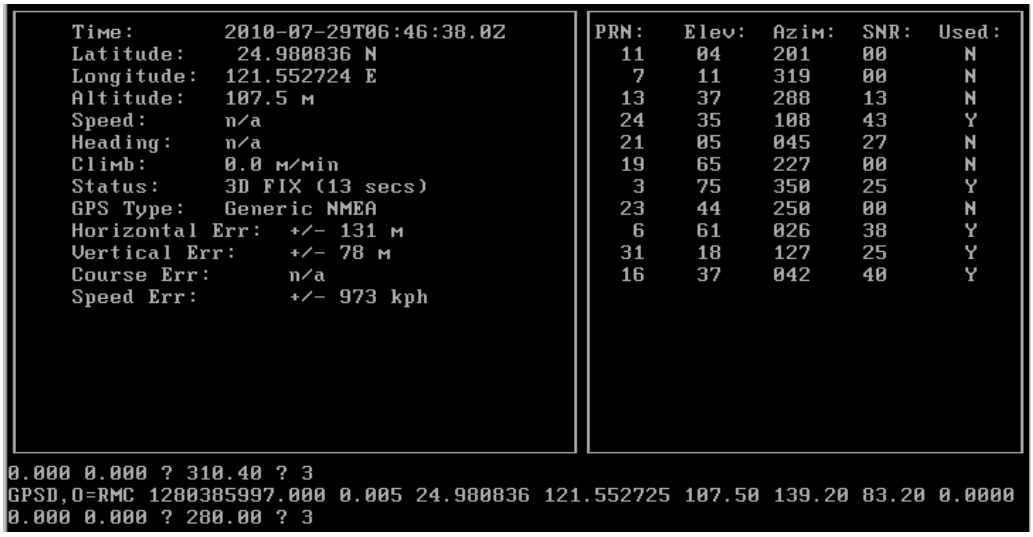
7. Start gpsd to read NMEA data from the GPS port (/dev/pts/2).

```
Moxa:~# gpsd /dev/pts/2
```

8. On the remote computer, use **ssh** to connect to Moxa's embedded computer and issue the **cgps** command. You will see the following information:

```
Moxa:~# cgps
```

If cgps gets non-null data from gpsd, it will display the following message:



NOTE You can issue AT^SGPSS=0 to the command port to stop GPS information.

```
Moxa:~# cat < /dev/pts/1 &
Moxa:~# echo -e "AT^SGPSS=0\r"> /dev/pts/1
Moxa:~# killall cat
```

ATTENTION

View the following reference for more information about gpsd.

- man gpsd
- man cgps
- http://gpsd.berlios.de/

As described in this section, in multiplex mode the modem port is **dev/pts/0** instead of /dev/ttyACM0. Check that the modem port is **/dev/pts/0** at /etc/ppp/peers/chtgprs.

```
# See /etc/ppp/option for detail
/dev/pts/0   # modem port used
115200       # speed
```

Now you can connect GPRS/HSDPA through pppd

```
Moxa:~# pppd call chtgprs
```

Troubleshooting for pppd

To troubleshoot pppd connection problems, open /etc/ppp/peers/chtgprs and then take the following steps:

- Enable the **debug** option and **logfile /var/ppp.log** option.
- Add the **-V** option in /usr/sbin/chat.

```
#Debug option---
#You call tail -f /var/ppp.log &
debug
logfile /var/ppp.log
connect    "/usr/sbin/chat -v -V -f /etc/chatscripts/chtgprs-connect"
```

See **/var/ppp.log** for a more detailed message.

Setting up a Wireless Connection

In this section we introduce how to connect to an access point with WEP/WPA/WPA2(RSN) encryption. The connection program is **wpa_supplicant**.

The basic command is **wpa_supplicant -i <interface> -c <configuration file> -B** (the **-B:** option forces it to run in the background).

1. **Example 1**: Connect to AP (SSID: test_wep) with WEP key 1234567890(hex)
   a. Write a configure file test_wep.conf as below

```
network={
       ssid="test_wep"
       key_mgmt=NONE
       wep_key0=1234567890
       wep_key1="abcde"
       wep_key2="1234567890123"
       wep_tx_keyidx=0
       priority=5
}
```

   b. Connect with the following commands:
      wpa_supplicant -i wlan0 -c test_wep.conf -B
   c. Use iwconfig to check the connection state

```
wlan0    IEEE 802.11abgn  ESSID:"test_wep"
        Mode:Managed  Frequency:2.462 GHz  Access Point:
00:1F:1F:8C:0F:64
        Bit Rate=36 Mb/s   Tx-Power=27 dBm
        Retry min limit:7   RTS thr:off   Fragment thr:off
        Encryption key:1234-5678-90   Security mode:open
        Power Management:off
        Link Quality=37/70  Signal level=-73 dBm
        Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
        Tx excessive retries:0  Invalid misc:0   Missed beacon:0
```

2. **Example 2:** Connect to AP (SSID: test_wpa) with WPA key “1234567890” (ascii)
   a. Write a configuration file **test_wpa_wpa2.conf**, as shown below:

```
network={
       ssid="test_wpa"
       key_mgmt=WPA-PSK
       proto=WPA RSN
       pairwise=TKIP CCMP
       group=TKIP CCMP
       psk="1234567890"
}
```

   b. Connect with the following command:

   wpa_supplicant -i wlan0 -c test_wpa_wpa2.conf –B

   c. Use **iwconfig** to check the connection state:

```
wlan0    IEEE 802.11abgn  ESSID:"test_wpa"
         Mode:Managed  Frequency:2.462 GHz  Access Point:
00:1F:1F:8C:0F:64
         Bit Rate=36 Mb/s   Tx-Power=27 dBm
         Retry min limit:7   RTS thr:off   Fragment thr:off
         Encryption
key:157A-1DBD-B0C3-7CC8-0F9C-D059-2881-F815-E4DB-3705-6969-8253-865E-
4DF0-FDB8-AEC1 [2]   Security mode:open
         Power Management:off
         Link Quality=34/70  Signal level=-76 dBm
         Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
         Tx excessive retries:0  Invalid misc:0   Missed beacon:0
```

3. **Example 3:** Connect to AP (SSID: test_wpa2) with WPA2 key "1234567890" (ascii)
   a. The configuration file **test_wpa_wpa2.conf** can also apply to a WPA2 connection. Follow the directions in example 2 to get the following results:

```
wlan0    IEEE 802.11abgn  ESSID:"test_wpa2"
         Mode:Managed  Frequency:2.462 GHz  Access Point:
00:1F:1F:8C:0F:64
         Bit Rate=1 Mb/s   Tx-Power=27 dBm
         Retry min limit:7   RTS thr:off   Fragment thr:off
         Encryption key:8546-8201-6DCA-8A37-6EE6-AD44-8D3F-6553 [2]
Security mode:open
         Power Management:off
         Link Quality=40/70  Signal level=-70 dBm
         Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
         Tx excessive retries:0  Invalid misc:0   Missed beacon:0
```

ATTENTION

View the following references for more information about wpa_supplicant.
Website: http://hostap.epitest.fi/wpa_supplicant/
The configuration README:
http://hostap.epitest.fi/gitweb/gitweb.cgi?p=hostap.git;a=blob_plain;f=wpa_supplicant/README

Getting Wireless Card Information

The program **iw** is a new nl80211 based CLI configuration utility. It can get more complete information than iwconfig for 802.11n. Although still under development, it contains some useful functionality.

To get the connection data, you can issue "iw dev <interface> station dump"

```
Moxa:~# iw dev wlan0 station dump
Station 00:1f:1f:8c:0f:64 (on wlan1)
      inactive time:  35696 ms
      rx bytes:      98054
      rx packets:    364
      tx bytes:      733
      tx packets:    7
      signal:        -75 dBm
      tx bitrate:     MCS 42 40Mhz
```

ATTENTION

View the following reference for more information about iw.
http://linuxwireless.org/en/users/Documentation/iw

EPM-3112 Driver Installation

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.

Moxa EPM-3112 module provides the CAN bus interface for industrial CAN communication. Users can use the library or file control interface (ioctl) to read, write or control the CAN interface as a file for easy CAN programming.

1. Make root file system writable

```
Moxa:~# mount -o remount,rw /
```

2. Install the file **epm3112.deb**

```
Moxa:/home# dpkg -i epm3112.deb
```

3. Mount root file system read-only

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

4. Then **modprobe moxa_can** or reboot your device to finish this installation

EPM-3112 Programming Guide

CANBUS Library

A simple library mxcanbus_lx.c is offered; see the following sub-sections for details:

Moxa functions for CANbus

Function	**unsigned int mxcan_get_bus_timing (unsigned int fd)**
Description	Get the bus timing of an opened port.
Input	<fd> the opened port
Output	None
Return	0 on failure, otherwise the bus speed in KHz

Function	**int mxcan_get_parameters (unsigned int fd, CANPRM *param)**
Description	Get the parameter of an opened port.
Input	<fd> the opened port
Output	<param> pointer to a structure of CANPRM
Return	0 on success. Otherwise return a negative value

Function	**int mxcan_get_registers (unsigned int fd, unsigned char *buffer, int num)**
Description	Get the register values of an opened port.
Input	<fd> the opened port <num> number of register values. For module with sja1000 chipset, the value must be 32
Output	<buffer> point to a buffer for these values
Return	0 on success, otherwise failure

Function	**int mxcan_get_stat (unsigned int fd, CANBST *stat)**
Description	Get the statistics of an opened port.
Input	<fd> the opened port
Output	<stat> point to a contianer of statistics
Return	0 on success, otherwise failure

Function	**int mxcan_inqueue (unsigned int fd)**
Description	Get the number of received bytes that are queued in the driver of an opened port.
Input	<fd> the opened port
Output	None
Return	< 0 on failure, the number of bytes

Function	**unsigned int mxcan_open (int port)**
Description	Open a can port by the port number
Input	<port> port number starting from 1. In Linux, open port 1 will open /dev/can0
Output	None
Return	0 on failure, otherwise return fd

Function	**int mxcan_outqueue (unsigned int fd)**
Description	Get the number of bytes waiting for being transmitted to a can port.
Input	<fd> the opened port
Output	None
Return	< 0 on failure, the number of bytes

Function	**int mxcan_purge_buffer (unsigned int fd, unsigned int purge)**
Description	Purge the buffers of an opened port.
Input	<fd> the opened port <purge> 1: receive data buffer, 2: transmit data buffer, otherwise: both
Output	None
Return	0 on success, otherwise failure

Function	**int mxcan_set_bus_timing (unsigned int fd, unsigned int speed)**
Description	Set the bus timing of an opened port.
Input	<fd> the opened port <speed> bus timing in KHz. The available values are 5/10/20/40/50/80/100/125/200/250/400/500/666/800/1000
Output	None
Return	0 on success, otherwise returns a negative value

Function	**int mxcan_set_nonblocking (unsigned int fd)**
Description	Set the opened fd to be non-blocking.
Input	<fd> the opened port
Output	None
Return	0 on success, otherwise returns a negative value

Function	**int mxcan_set_parameters (unsigned int fd, CANPRM *param)**
Description	Set the parameter of an opened port.
Input	<fd> the opened port <param> pointer to a structure of CANPRM
Output	None
Return	0 on success, otherwise return a negative value

Moxa definitions for CANbus

```
#define mxcan_close(fd)                    close((int)fd)
#define mxcan_read(fd, buffer, size, hndl)  read((int)fd, buffer, size)
#define mxcan_write(fd, buffer, size, hndl) write((int)fd, buffer, size)
```

Example Code

You can download the library / example code from MOXA website.
http://www.moxa.com/support/support_home.aspx

ATTENTION

View the following reference for more information
http://en.wikipedia.org/wiki/Controller_area_network

EPM-3552 Driver Installation

The Moxa EPM-3552 module provides the capability of using the display on Moxa's V2422 and V2426 computers.

1. Make the root file system writable.

```
Moxa:~# mount -o remount,rw /
```

2. Install the package **epm3552.deb**.

```
Moxa:/home# dpkg -i epm3552.deb
```

3. Install **gconf-editor**.

```
Moxa:~# apt-get install gconf-editor
```

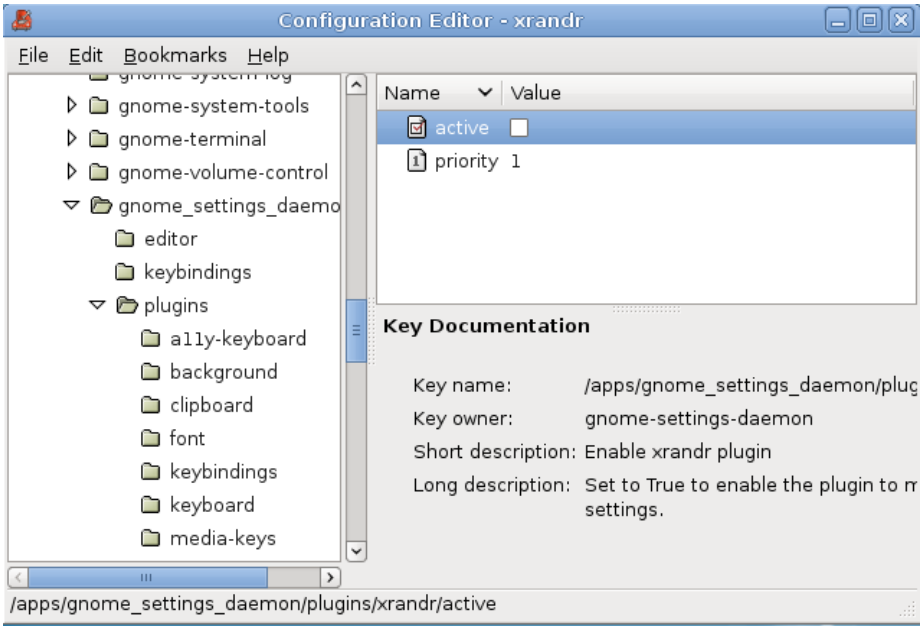
4. Install **grandr**.

```
Moxa:~# apt-get install grandr
```

5. Start the GNOME desktop environment.

```
Moxa:~#/etc/init.d/gdm start
```

6. Disable the **xrandr** plug-in of **gnome-settings-daemon** due to its poor xrandr support. In gnome, launch **Applications → System Tools → Configuration Editor**, and then cancel the xrandr active options at the path **/apps/gnome_settings_daemon/plugins/xrandr/**.



7. Mount the root file system as read-only.

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

EPM-3552 Chipset Configuration

As the V2422 and V2426 computers have already offered the VGA and DVI display outputs, this section illustrates how to configure EPM-3552 to display an independent desktop, so that users can use both displays simultaneously.

1. Connect a monitor to the EPM-3552 module before booting the computer.
2. Back up the original configuration file located at **/etc/X11/xorg.conf**.
3. Rename the new configuration file from **xorg.conf-epm3552-dual** to **xorg.conf**.
   Note: For built-in Intel chipset, it is only necessary to setup the Virtual size at the Screen section. Please remove the “Right-of” option in monitor section if existed.

```
Section "Screen"
        Identifier      "Screen_Intel"
        Device          "Device_Intel"
        Monitor         "VGA"
        SubSection "Display"
                Depth   24
                Virtual 3840 1080
        EndSubSection
```

   The value “3840 1080” is the maximum resolution of the desktop shared by the built-in VGA/DVI port, which is 1920 x1080 x 2.

4. Set up the initial mode of the built-in VGA/DVI ports. The default value is the maximum resolution of the monitor; you can adjust it in **/etc/X11/Xsession.d/45xrandr.**
   a. Display an extended desktop.

```
#Resolution
res=1920x1080
#Extended mode
xrandr --output TMDS-1 --mode $res --right-of VGA   --output VGA --mode $res
#Clone mode
```

b. Display a clone desktop

```
#Resolution
res=1920x1080
#Extended mode
#xrandr --output TMDS-1 --mode $res --right-of VGA   --output VGA --mode $res
#Clone mode
xrandr --output TMDS-1 --mode $res --same as VGA --output VGA --mode $res
xrandr --output TMDS-1 --mode $res --same-as VGA --output VGA --mode $res
```

The syntax is as follow:

- output: TMDS-1 (DVI) / VGA (VGA)

- right-of: the position in extended desktop

- same-as: for clone mode setting

- mode: resolution

5. Next start the X windows:

startx or /etc/init.d/gdm start

NOTE When you plug in 2 EPM3552 modules, uncomment the setting for Device_DL2 / Monitor_DL2/ Screen_DL2 sections and the Screen 2 option in the Server Layout Section.

When finished, connect a monitor to the second EPM-3552 module and reboot your system to activate the settings.

```
#Setting for the second EPM3552 module
Section "Device"
        Identifier      "Device_DL2"
        driver          "displaylink"
        Option          "fbdev" "/dev/fb1"
EndSection

Section "Monitor"
        Identifier      "Monitor_DL2"
EndSection

Section "Screen"
        Identifier      "Screen_DL2"
        Device          "Device_DL2"
        Monitor         "Monitor_DL2"
        SubSection "Display"
                Depth   24
        EndSubSection
EndSection


Section "ServerLayout"
        Identifier      "945G-Layout"
        Screen 0 "Screen_Intel" 0 0
        Screen 1 "Screen_DL1" LeftOf "Screen_Intel"
```

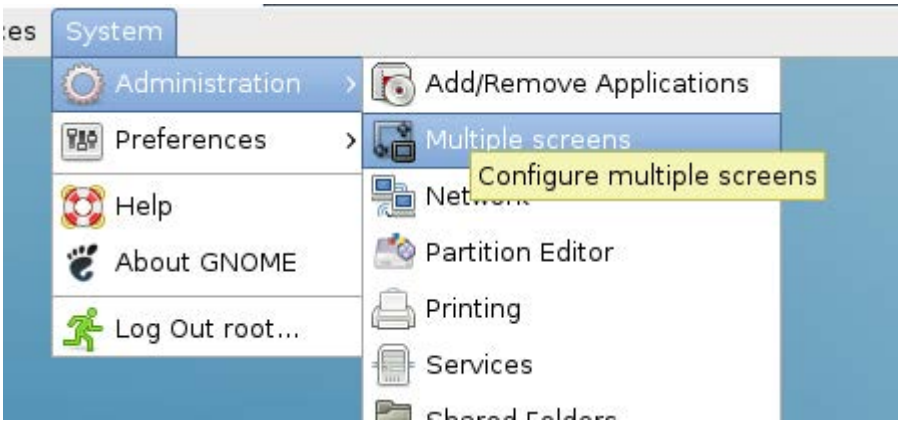
NOTE For Linux systems, the EPM-3552 display module cannot work with the V2422/2426 computers' built-in VGA/DVI-I display when in Extended Mode or Mirror Mode. Due to limitations of the Linux RandR design, the EPM-3552 display module can only work alone as an independent display.

Configuration for Displaying only on the EPM-3552

Back up your **/etc/X11/xorg.conf** file and then rename **xorg.conf-epm3552-single** to **xorg.conf.** Next, start Xwindow to launch the display only on the EPM-3552 module.

Dynamically Changing the Display Resolution

In this section we explain how to temporarily change the resolution and mode. To change the settings permanently, modify the file **/etc/X11/Xession.d/45xrandr**. For the EPM-3552 module, only the current driver can display the maximum resolution of a connected monitor. Therefore, even the "Modes" Option in **xorg.conf** cannot adjust its resolution. For the built-in VGA/DVI port driven by an Intel chipset, use **xrandr** or **grandr**, located in **System → Administration → Multiple Screens**, to change the layout and resolution.



Note: After testing, grandr will be reset to default layout (clone mode) when a setting is changed. When you adjust the resolution, choose the preferred layout before applying settings.

ATTENTION

1. Due to limitations of the driver, connect the monitor to the EPM-3552 module before booting up the computer.
2. The built-in VGA/DVI port only supports clone and extended mode; dual head mode is not supported.
3. Click the following link for more information on XRandR and man xrandr: http://www.x.org/wiki/Projects/XRandR
4. Click the following link for more information on Xorg configuration: https://wiki.ubuntu.com/X/Config/Resolution

EPM-DK02 Driver Installation

Moxa's EPM-DK02 module supports 2 mini PCIe slots for connecting mini PCIe modules. The two slots support different feature as described below:

- **Slot 1:** Supports both mini PCI Express and USB 2.0.
- **Slot 2:** Supports USB 2.0 USB.

Installation

1. Make the root file system writable.

```
Moxa:~# mount -o remount,rw /
```

2. Install the epmdk02.deb package at **EPM-DK02\package**.

```
Moxa:/home# dpkg -i epmdk02.deb
```

3. Mount the root file system (/) as read-only.

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

4. Load the Moxa EPM-DK02 driver.
   You can manually load with following command:

```
Moxa:~# modprobe moxa_dk02
```

   Or add the following lines in /etc/rc.local to loads driver at startup automatically.

```
modprobe moxa_dk02
```

Configuring Power Control Tool

After the installation is completed, use the command **mx-dk02-control** to power on or power off the USB connectivity of the Mini PCIE slot.

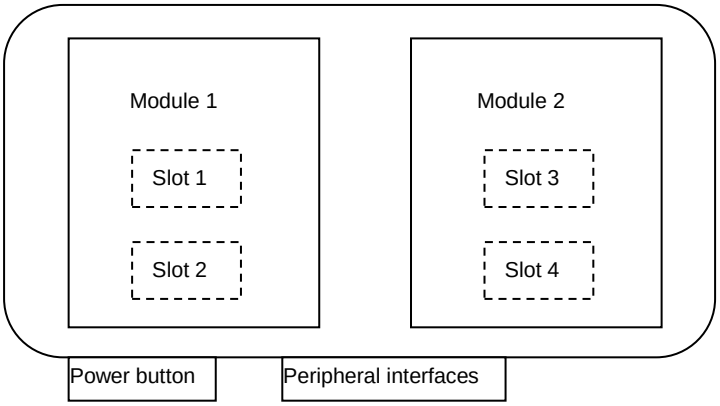
Here is its syntax:

```
mx-dk02-control slot_num [1/0]
```

Fox example, if you want to power off the USB connectivity of slot 1, issue the following command:

```
Moxa:~# mx-dk02-control 1 0
```

Note that the slot number depends on its position in the Moxa v242x embedded computer:



ATTENTION

The major aim of the **mx-dk02-control** command is to reset a USB GPRS/HSPDA module; it is not advisable to use 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. Then, when it is powered off, the system cannot automatically umount its partitions.

Note that the power on/off control function is only suitable for devices that have a USB interface. If you are using a device with a PCIe interface, do not enable the power on/off control function, since doing so could damage the device.

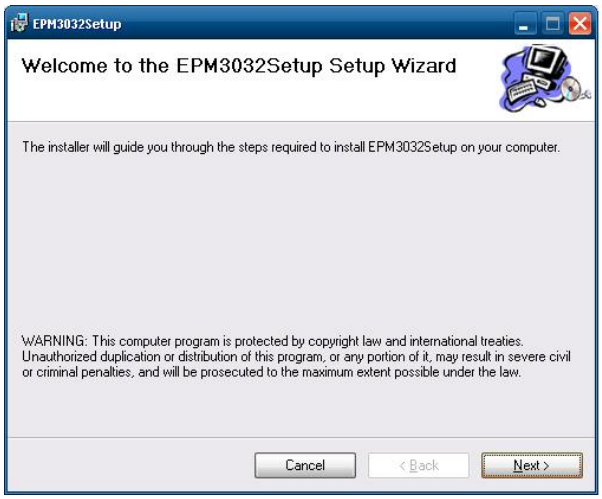
Windows System

EPM-3032 Driver Installation

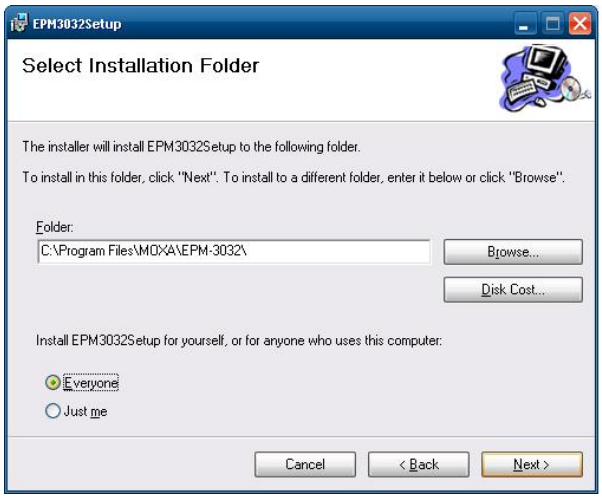
Before using the EPM-3032 expansion module, you need to update the driver. Install the driver before inserting the expansion module in the slot.

Use the following steps to install the EPM-3032 module driver:

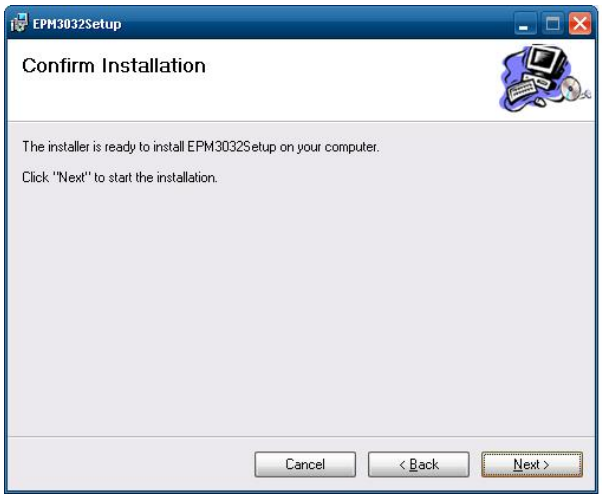
1. Execute **EPM3032Setup.exe** to install the driver and then click **Next**.



2. Click **Next** to **install** using default settings.



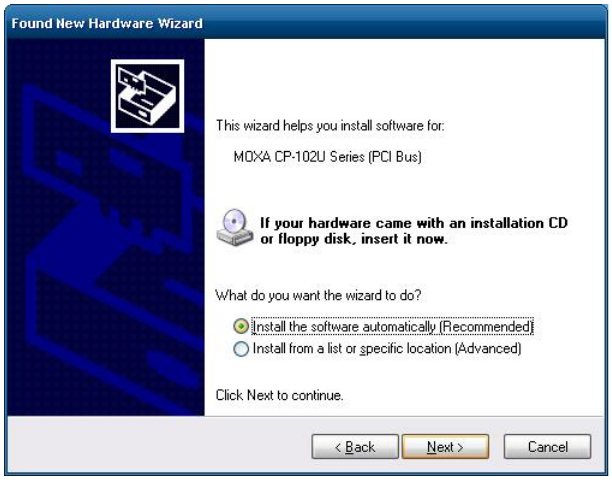
3. Click **Next** to start the installation.



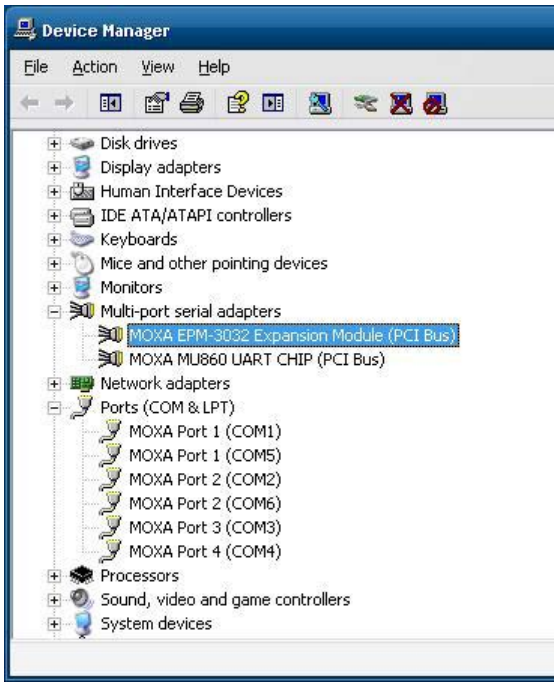
4. Click **Close** to complete the installation.

5. At this point, shut down the computer and insert the EPM-3032 expansion module into the embedded computer, and then reboot the computer.
6. The system will locate the new hardware; select **No, not this time** and then click **Next**.

7. Select **Install the software automatically** and then click **Next**.



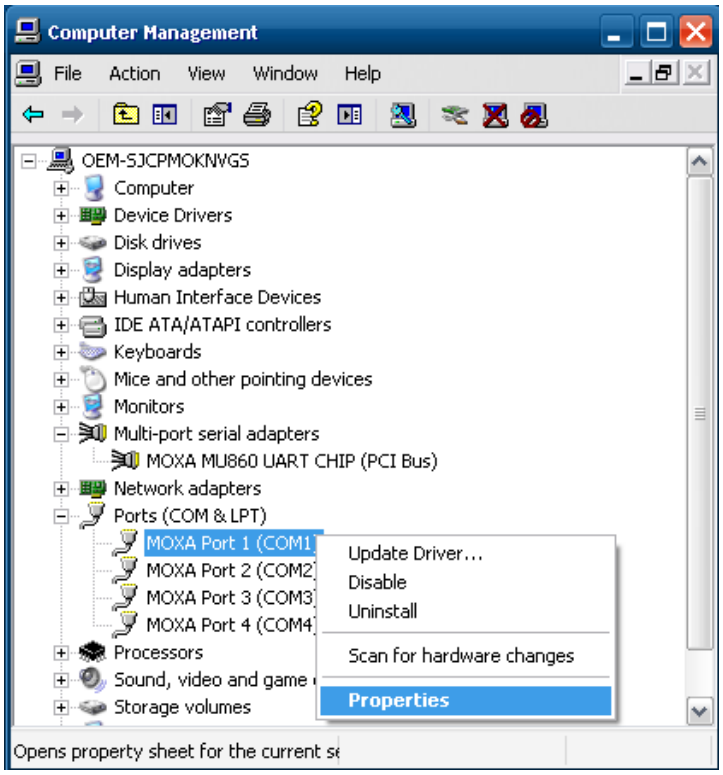
8. The driver will be **installed** automatically. The module should be listed in the Device Manager window. At this point you can start using the module.



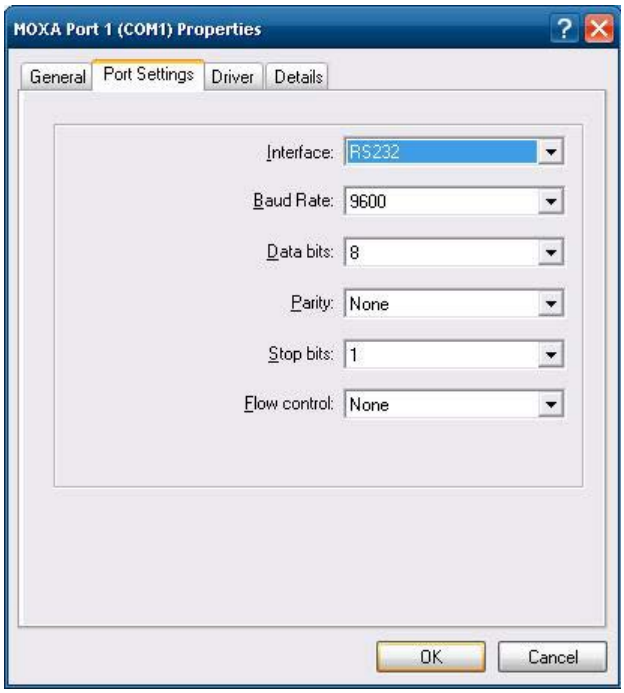
Configuring Serial Port Mode

Take the following steps to configure the operation mode of each COM port:

1. Go to the **Control Panel → Ports (COM & LPT)** and select the COM port; e.g., MOXA Port 0 (COM1).
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.



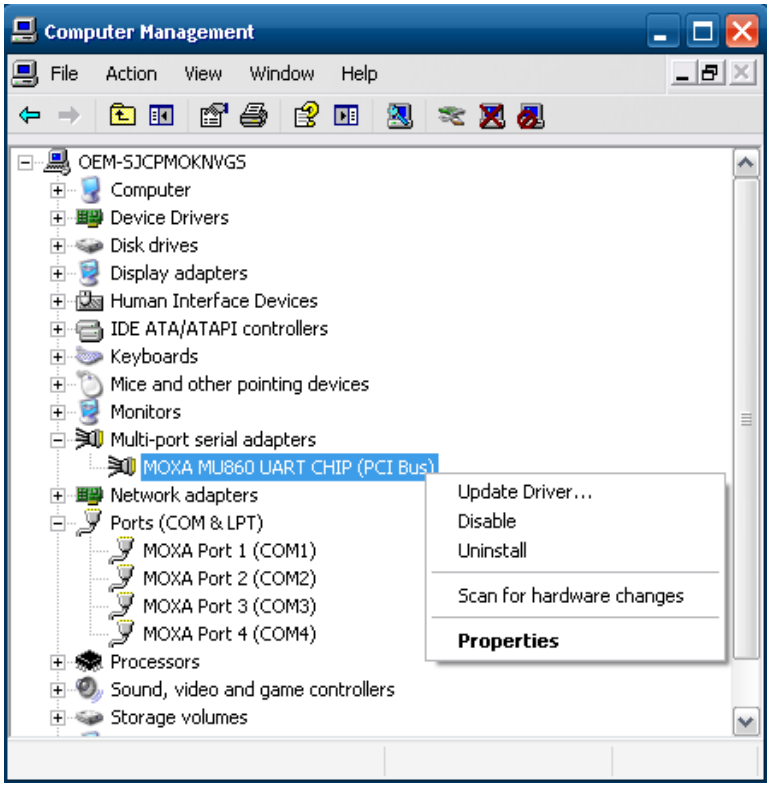
4. Click **OK** to apply the settings.



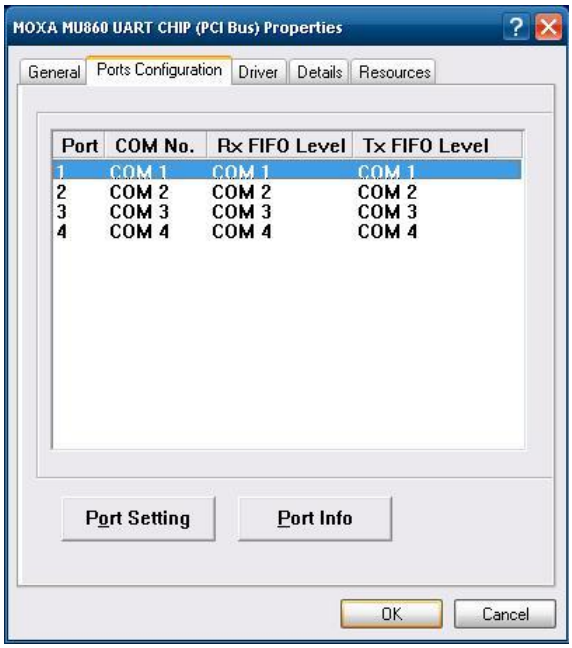
In some situations, you may want to change the port name to match the name used by your program. Take the following steps to change port names:

1. Go to **Control Panel → Multi-port serial adapters** and select the adapter.

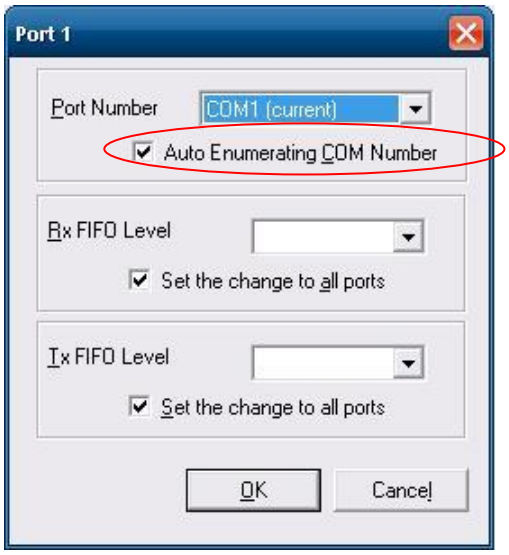
2. Right-click the adapter and select **Properties**.



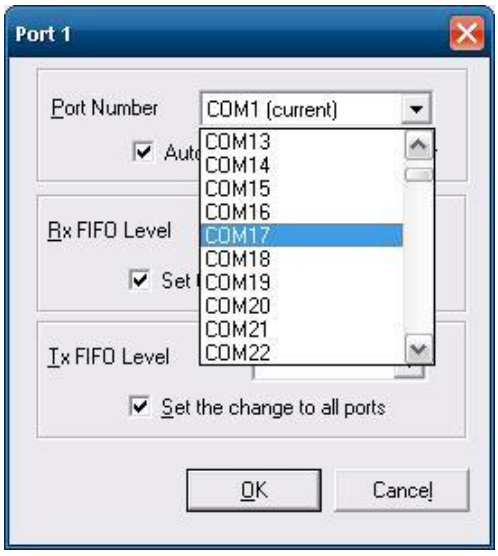
3. Click the **Port Configuration** tab, select the port, and then click **Port Setting**.



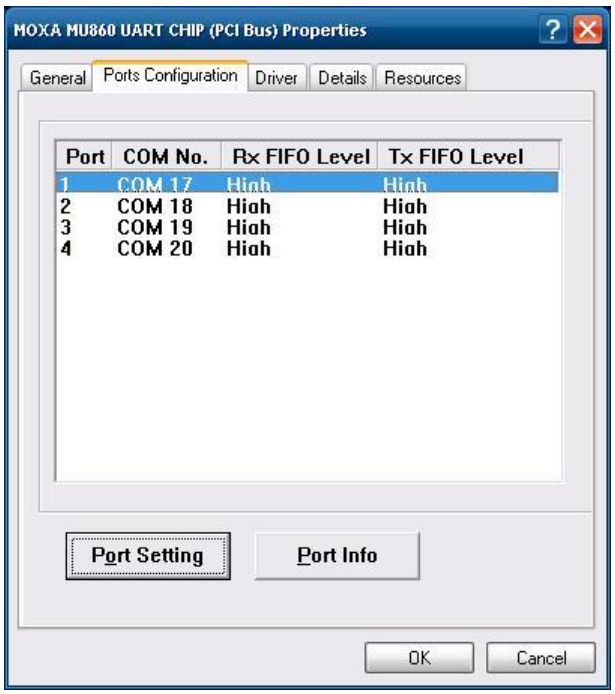
4. To change the port name separately uncheck **Auto Enumerating COM Number**.



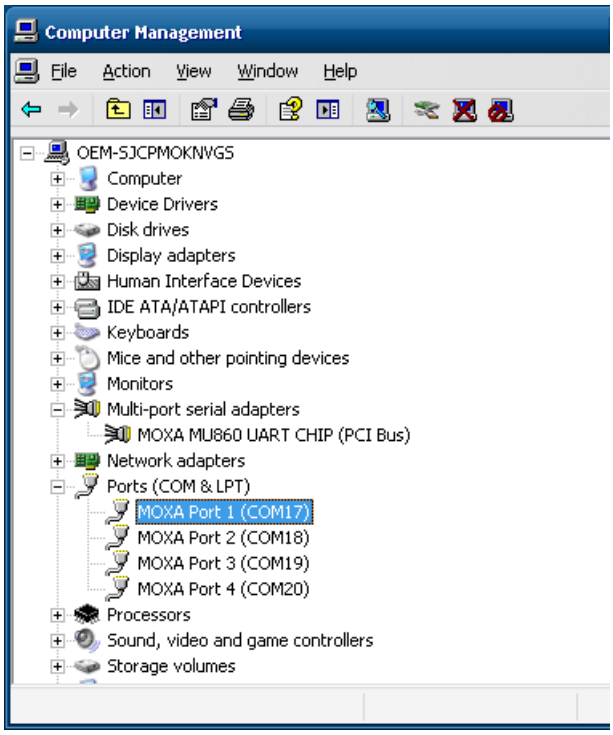
5. Select the new port name and then click **OK**.



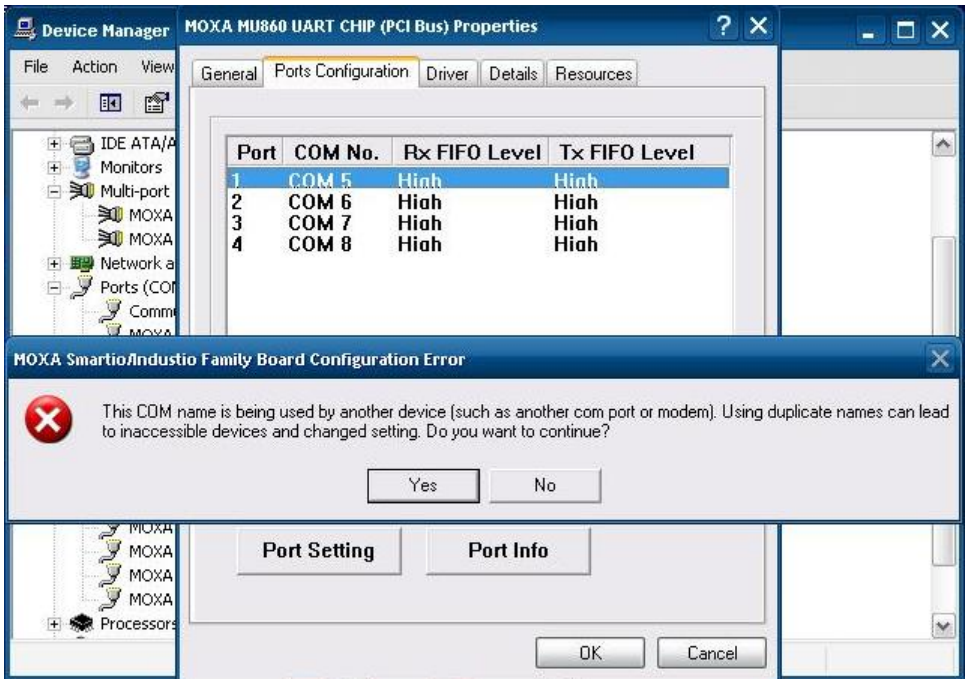
6. Make sure the port names are correct, and then click **OK** to activate the settings.



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



NOTE Make sure each port name is unique; using duplicate names will result in some devices being inaccessible.



Changing UART Mode Through Programming

You can set the operation mode through programming. The example “UartMode” shown here can be found in **\examples\C++** in the Software DVD.

The code snippet is as follows:

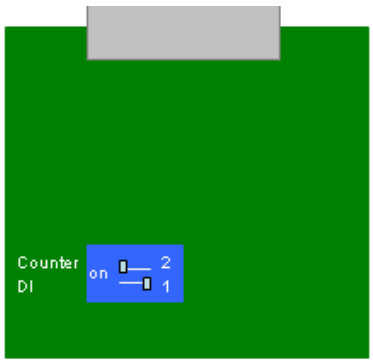
```
int port=0,mode=0;
    int n=0;
    WCHAR sin;
    WCHAR wcs_port[3],wcs_mode[3];
    printf("UART Mode Test Program\n");
    printf("\t (0) Exit Program\n");
    printf("\t (1) Display UART Mode\n");
    printf("\t (2) Set UART Mode\n");
    sin=getwchar();
    n=_wtoi(&sin);


    do
   {
      switch (n)
      {
         // if char == '1', display the UART Mode
         case 1:
               printf("Input the Port Number (5~8) = \n");
               wscanf(L"%s",wcs_port);
               port=_wtoi(wcs_port);
               mode=uart_getmode(port);
               if(mode==(-1))
               {
                   printf("Invalid value!!\n");
                   break;
               }
               printf("COM%d=%s\n",port,mode_array[mode]);

            break;
         // if char == '2', Set the UART Mode
         case 2:

               //Get Port Number
               printf("Input the Port Number (5~8) = \n");
               wscanf(L"%s",wcs_port);
               port=_wtoi(wcs_port);

               //Get Mode Value
            printf("Input the Mode value (0 ~ 3) = ");
               wscanf(L"%s",wcs_mode);
               mode=_wtoi(wcs_mode);

               //Set UART Mode
               if(uart_setmode(port,mode)==-1)
               {
                   printf("Invalid value!!\n");
                   printf("Set UART Mode Fail!!\n");
```

```
            }
            else
            {
                printf("COM%d=%s\n",port,mode_array[mode]);
            }
          break;
    }
     getwchar();
    sin = getwchar();
    n = _wtoi(&sin);
} while (n != 0);
 return 0;
```

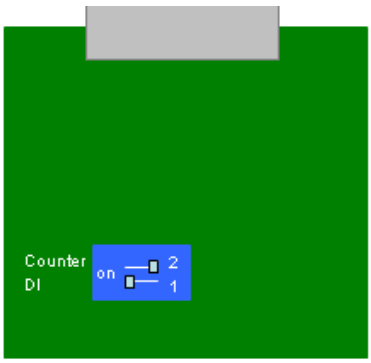
EPM-3438 Driver Installation

Before installing the EPM-3438, select counter mode or DI mode for the module.

If DIP switch 1 on the EPM-3438 is on, the DI0 will work in digital input port mode. The DI0 just reflects whether the input signal status is HIGH or LOW. If DIP switch 2 on the EPM-3438 is on, the DI0 works as a 16-bit counter. The counter is increased when the input pulse is toggled from low to high. See the following figures for DIP switch settings.



Counter mode

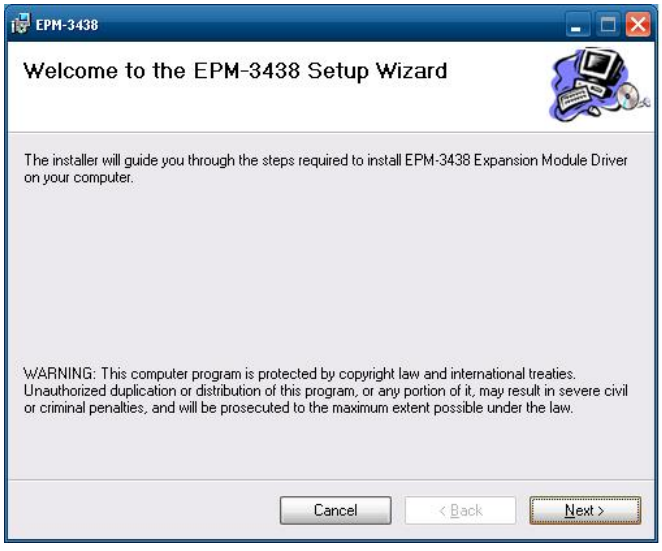


DI mode

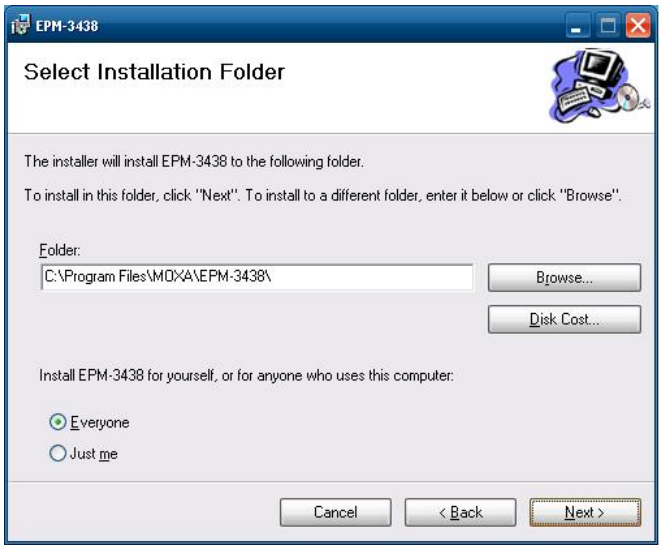
Before using the EPM-3438 expansion module, you need to update the driver. Be sure to install the driver before inserting the expansion module in the slot.

Take the following steps to install the EPM-3438 module driver:

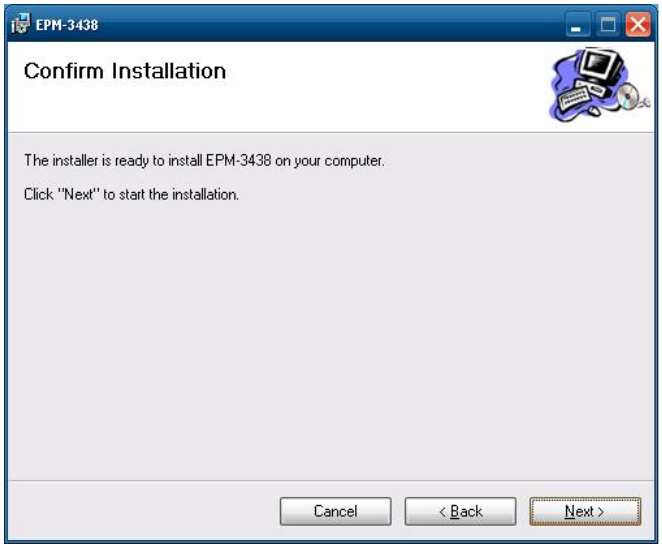
1. Run **EPM3438Setup.exe** to begin installation and then click **Next**.



2. Click **Next** to install using the default settings.



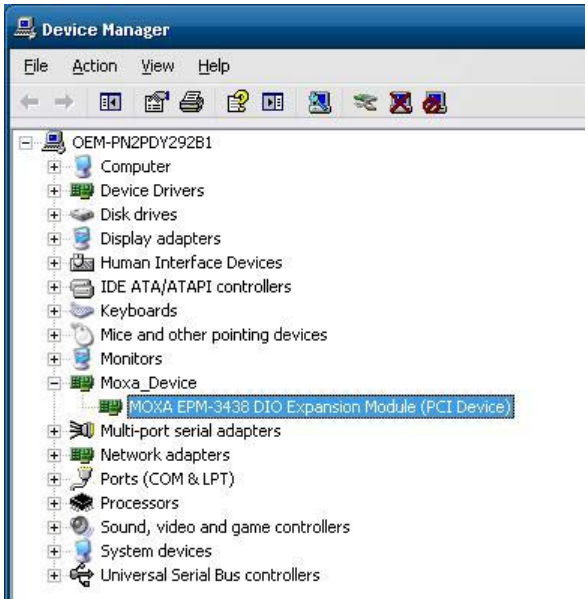
3. Click **Next** to begin the installation.



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

5. Shut down the computer, insert the EPM-3438 expansion module into the embedded computer, and then reboot the computer.

6. The system will find the new hardware and install the driver automatically. The module is now ready to use.



EPM-3438 Programming Guide

Some operations can be configured through programming; the following "DIO" example can be found on the software DVD at **\examples\C++**.

Moxa functions for DI/DO

Function	**HANDLE mxdgio_epm3438_open(int HWIndex);**
Description	This function opens access to the DIO device.
Input	<HWIndex> The first or second EPM-3438 board.
Output	None
Return	When successful, this function returns an access to the DIO device. Otherwise, there is an error.

Function	**void mxdgio_close(HANDLE fd);**
Description	This function closes the access to the DIO device.
Input	<fd> The access to the device.
Output	None
Return	None

Function	**int mxdgio_get_input_signal(HANDLE fd, int port);**
Description	This function gets the signal state of a digital input channel.
Input	<fd> The access to the device. <port> port #
Output	<state> DIO_HIGH (1) for high, DIO_LOW (0) for low
Return	Returns 1 for a high signal or 0 for a low signal, if successful. Otherwise, it returns a value of -1.

Function	**int mxdgio_get_output_signal(HANDLE fd, int port);**
Description	This function gets the signal state of a digital output channel.
Input	<fd> The access to the device. <port> Port number
Output	None
Return	Returns 1 for a high signal or 0 for a low signal, if successful. Otherwise, it returns a value of -1.

Function	**int mxdgio_set_output_signal_high(HANDLE fd, int port);**
Description	This function sets a high signal to a digital output channel.
Input	<fd> The access to the device. <port> Port number.
Output	none.
Return	When successful, this function returns 0. When an error occurs, it returns -1.

Function	**int mxdgio_set_output_signal_low(HANDLE fd, int port);**
Description	This function sets a low signal to a digital output.
Input	<fd> The access to the device. <port> Port number.
Output	none.
Return	When successful, this function returns 0. When an error occurs, it returns -1.

Moxa I/O control definitions for COUNTER

#define	COUNTER_NODE1	"/dev/epm_3438_counter1"
#define	COUNTER_NODE2	"/dev/epm_3438_counter2"

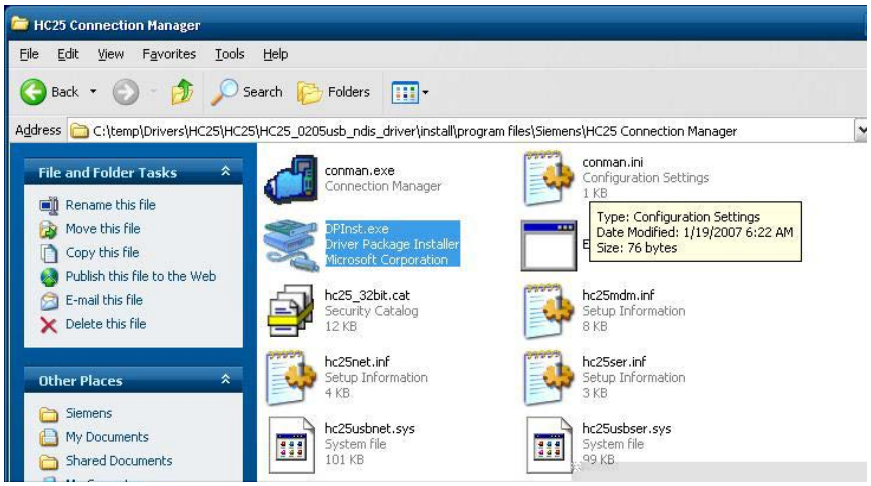
Function	**int mxdgio_epm3438_get_counter(int fd);**
Description	get the counter value
Input	<fd> The access to the counter device. <port> Port number.
Output	none.
Return	the counter value

Function	**int mxdgio_epm3438_clear_counter(int fd);**
Description	Clear the counter value
Input	<fd> The access to the counter device. <port> Port number.
Output	none.
Return	0:clear success; -n: clear fail

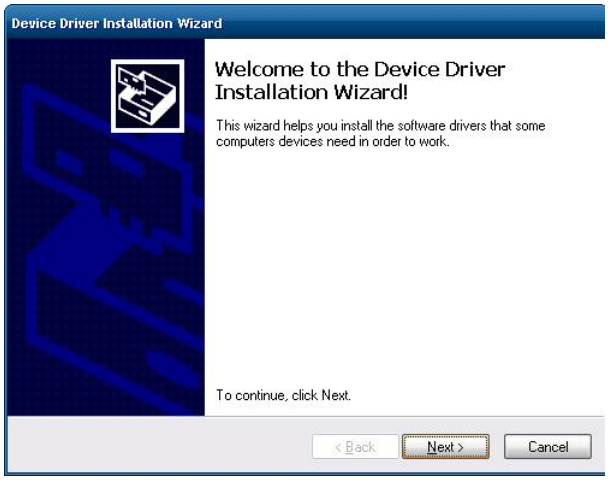
EPM-3337 Driver Installation

Take the following steps to install the 3G/GPS driver:

1. Open the directory **HC25\HC25_0205ussb_ndis_driver\install\program files\Siemens\HC25 Connection Manager** and then double-click **DPInst.exe**.



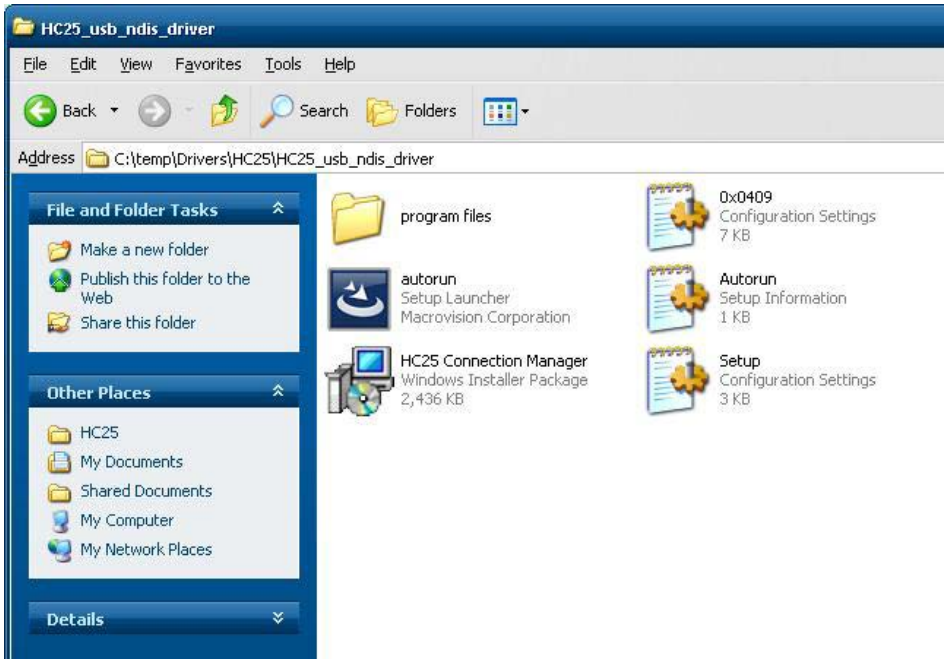
2. Click **Next.**



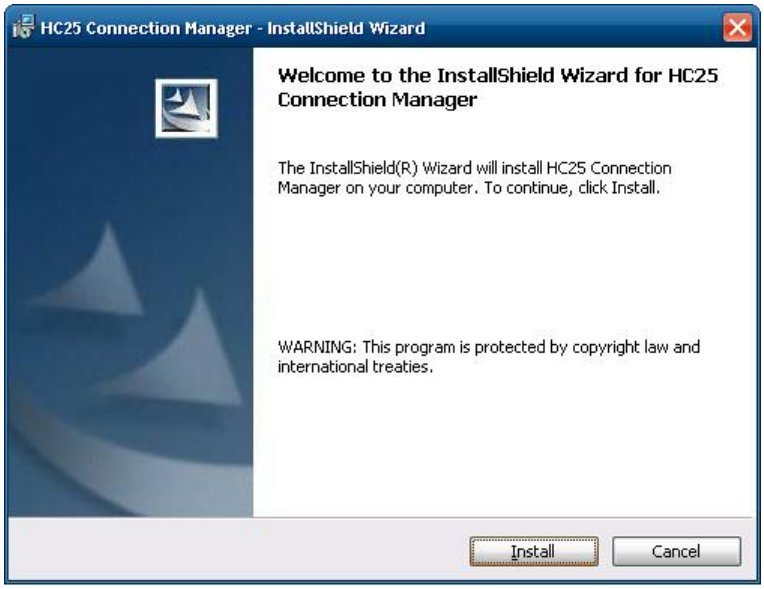
3. Wait for the driver to install.

4. Click **Finish** to complete the driver installation.

5. Navigate to the **\HC25\HC25_usb_ndis_driver\program files** directory and double-click **HC25 Connection Manager.msi**.

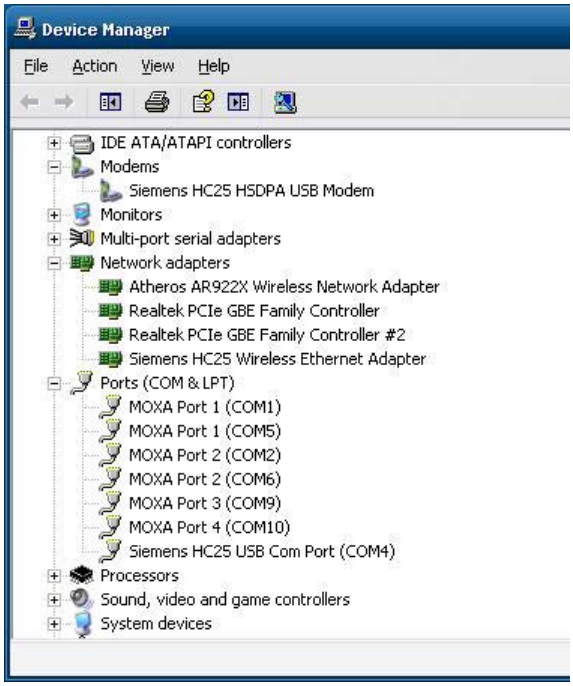


6. Click **Install**.

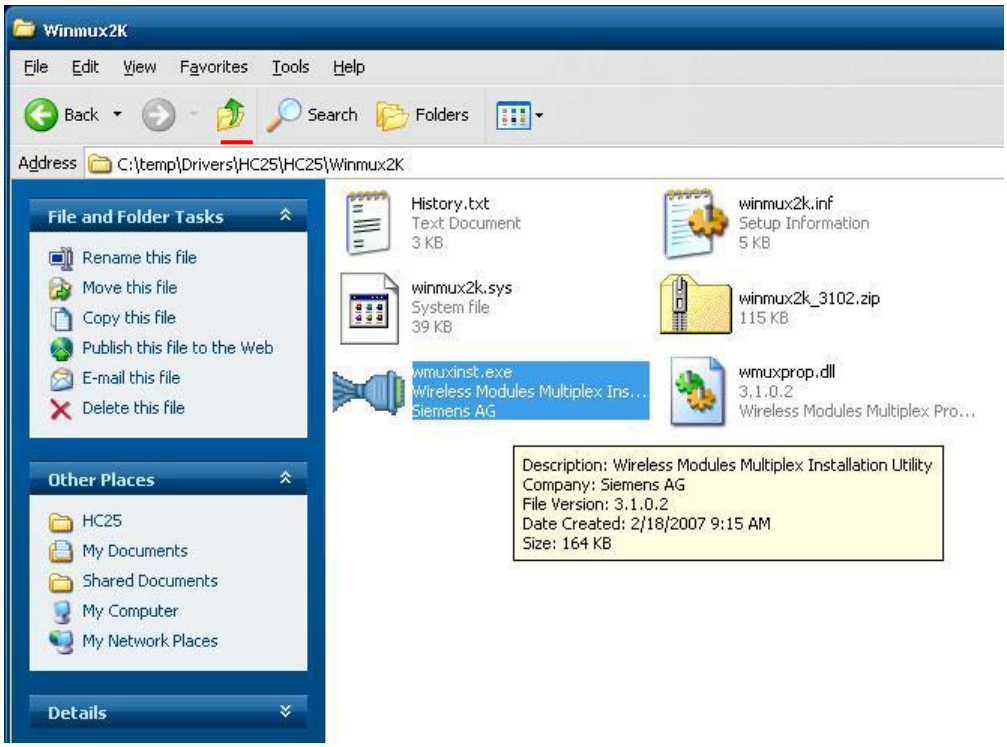


7. During the **installation** process, if you encounter the following error message, just ignore it and click **OK**.

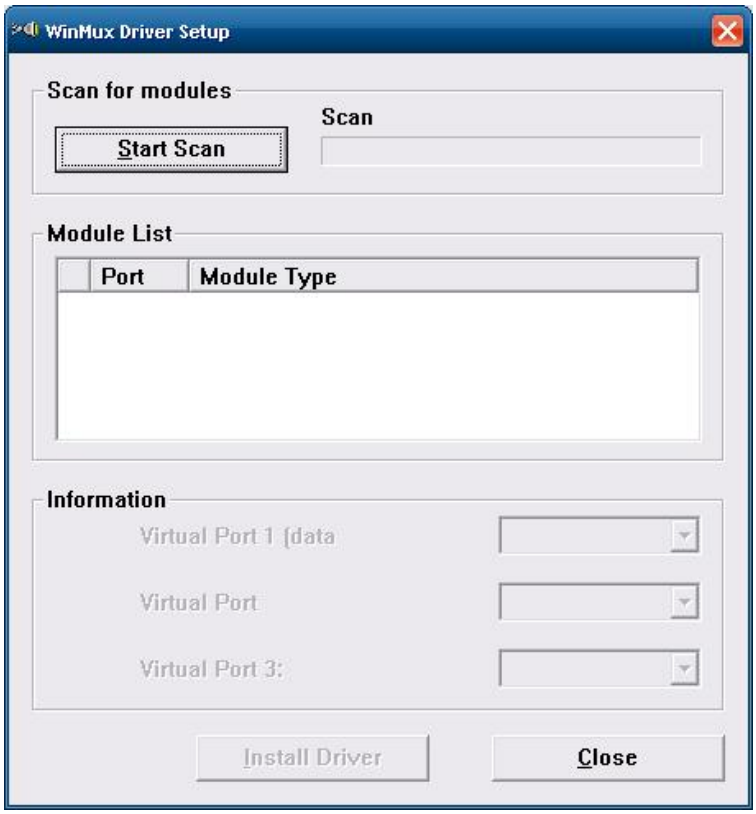
8. After the installation is completed, you should see **Siemens HC25 HSDPA USB Modem**, **Siemens HC25 Wireless Ethernet Adapter**, and **Siemens HC25 USB COM Port** in the Device Manager window.



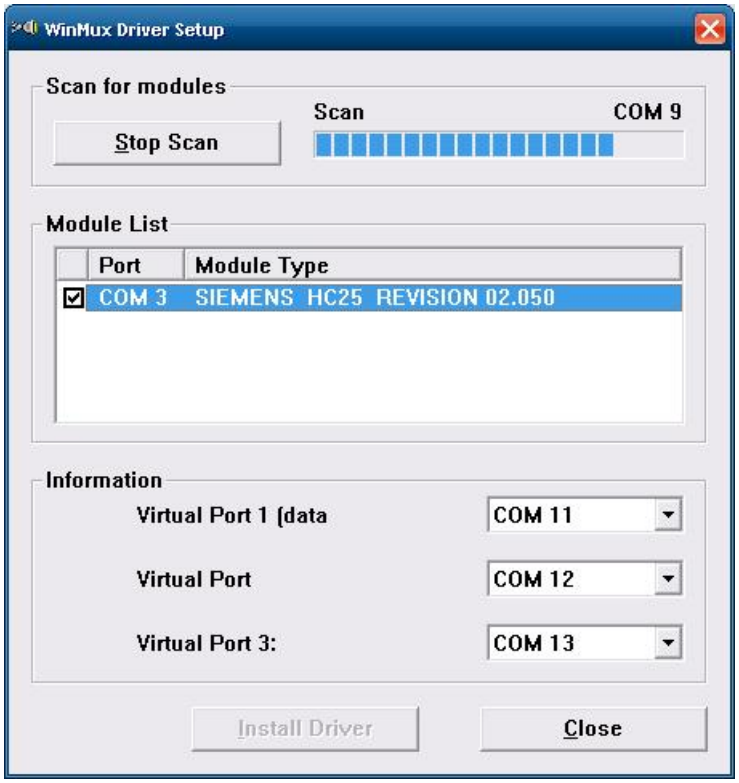
9. Change to the **Winmux2K** directory and double-click **wmux2k.exe**.



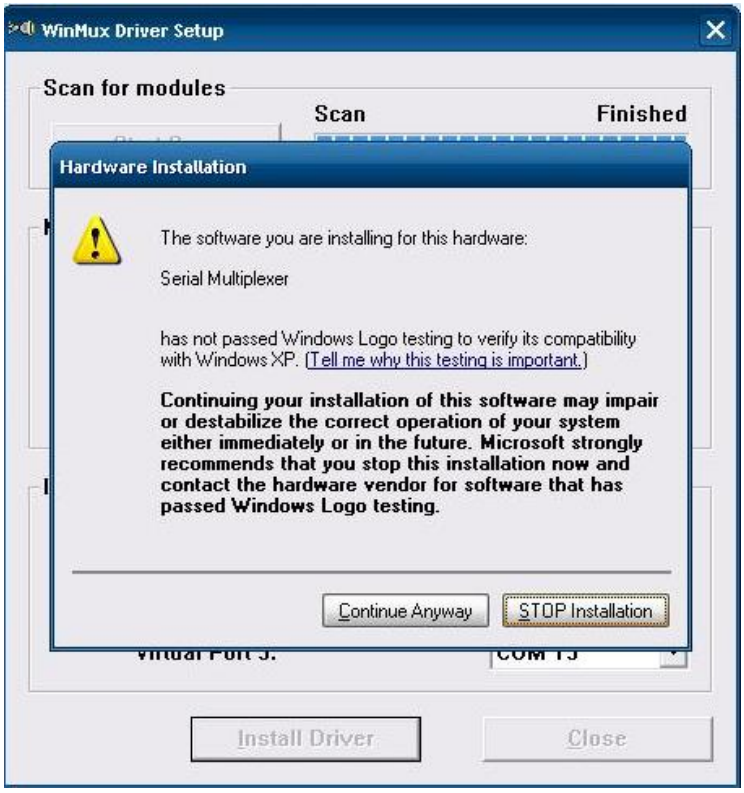
10. Click **Start Scan**.



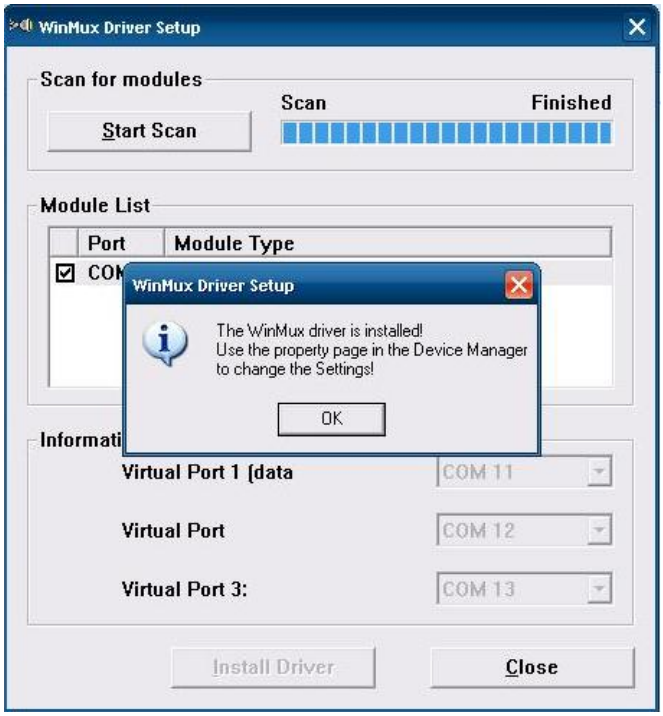
11. Click **Install Driver** once the scan is complete.



12. Click **Install Driver** and then **Continue Anyway** once the scan is complete.

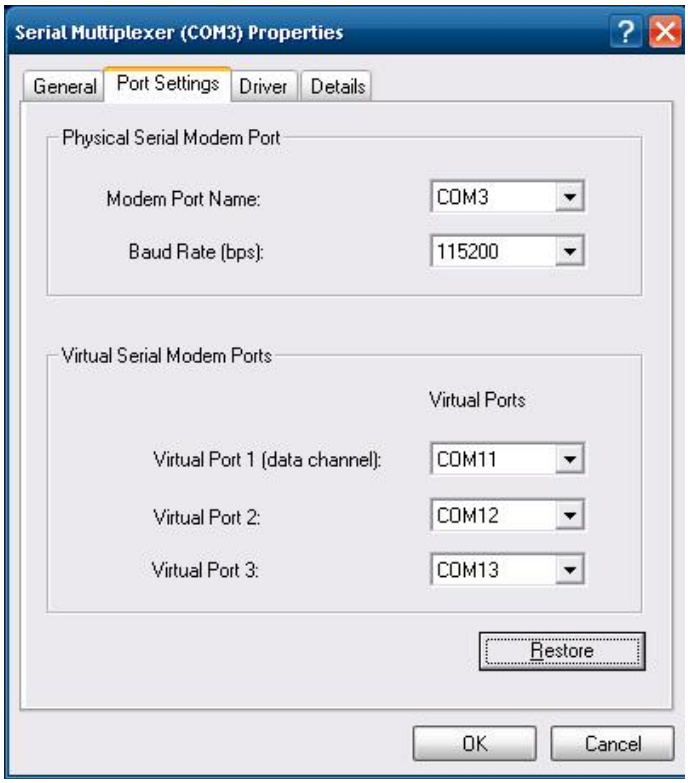


13. Click **OK** to complete the installation.



14. **Serial Multiplexer** should appear in you the Device Manager window.

15. Right-click on **Serial Multiplexer** and select **Properties**. You will see that 3 virtual serial modem ports have been generated; you can change the port numbers using the drop-down lists.



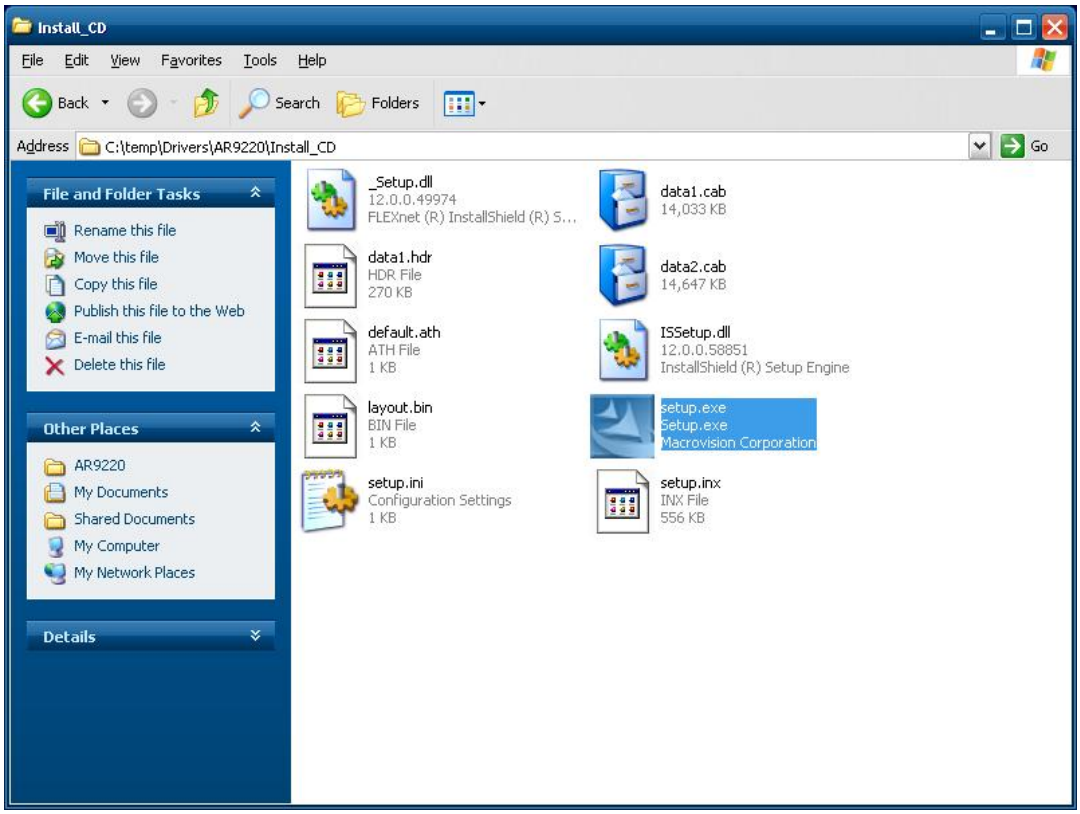
NOTE Make sure each port name is unique; duplicate names will create glitches.

Wireless Module Driver Installation

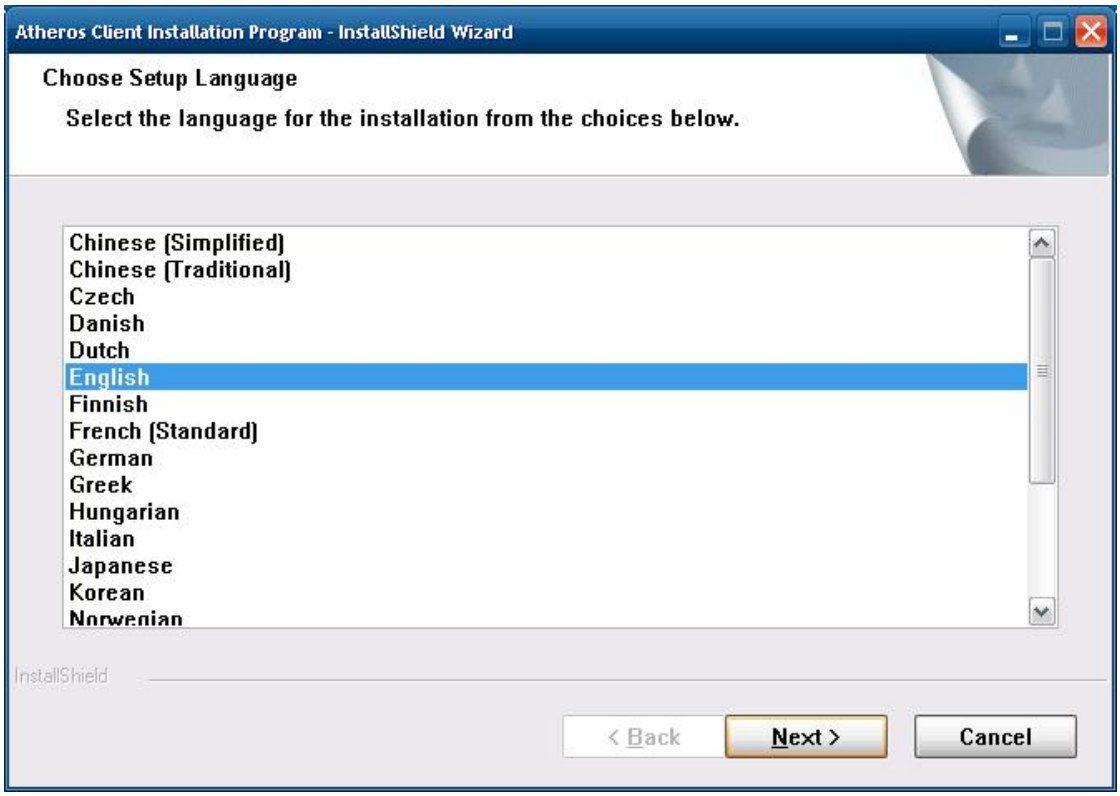
Take the following steps to install the wireless driver:

1. Click **Cancel** to stop searching for drivers when you first install the module.

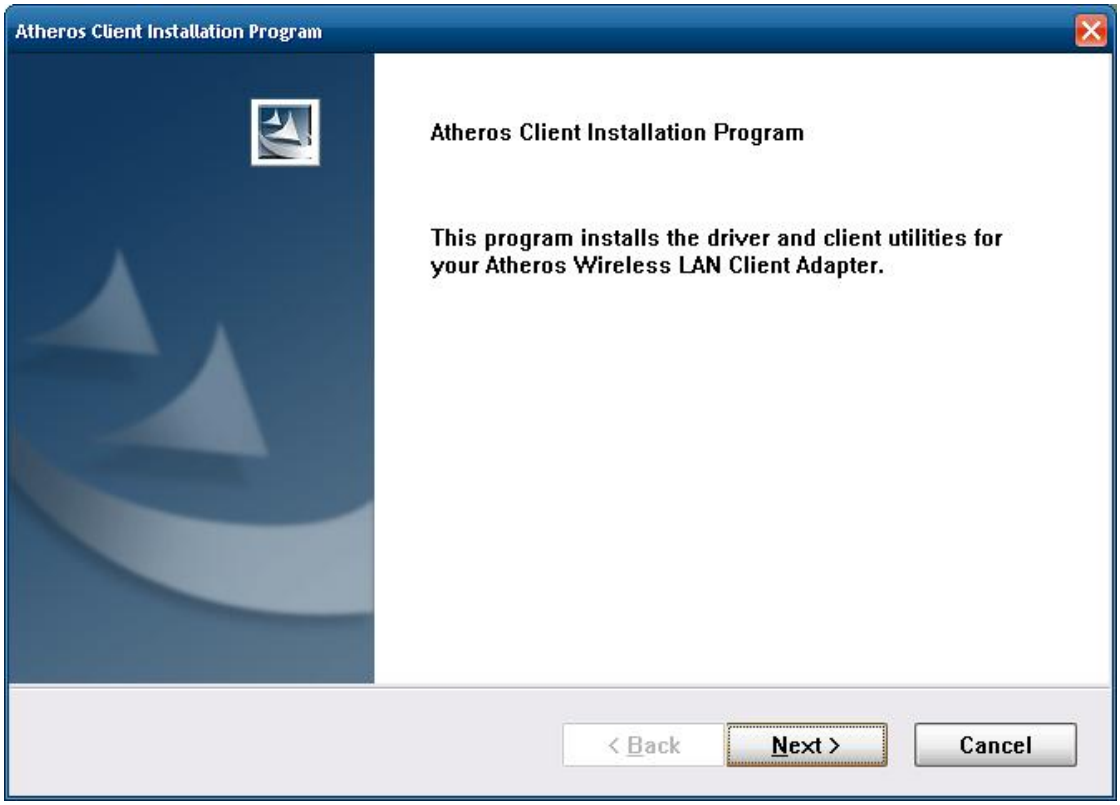
2. Navigate to the **Install_CD** directory and double-click **setup.exe** to install the driver.



3. Click **Next**.

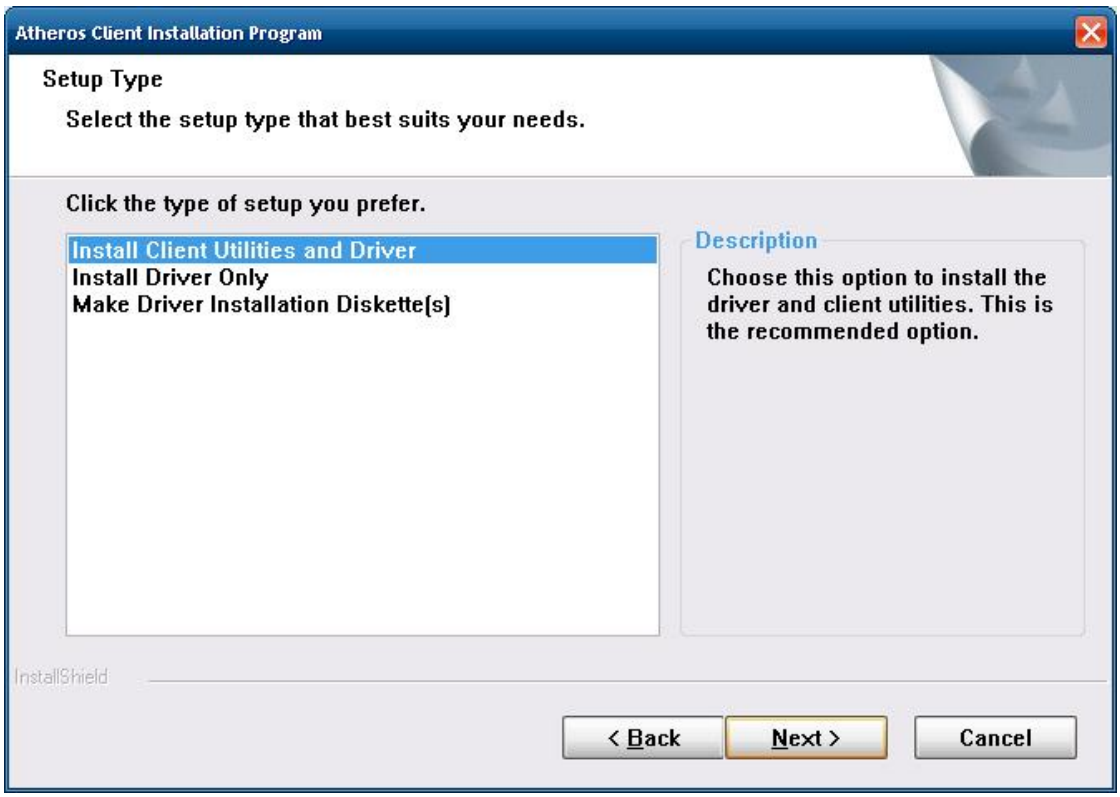


4. **Click Next**.

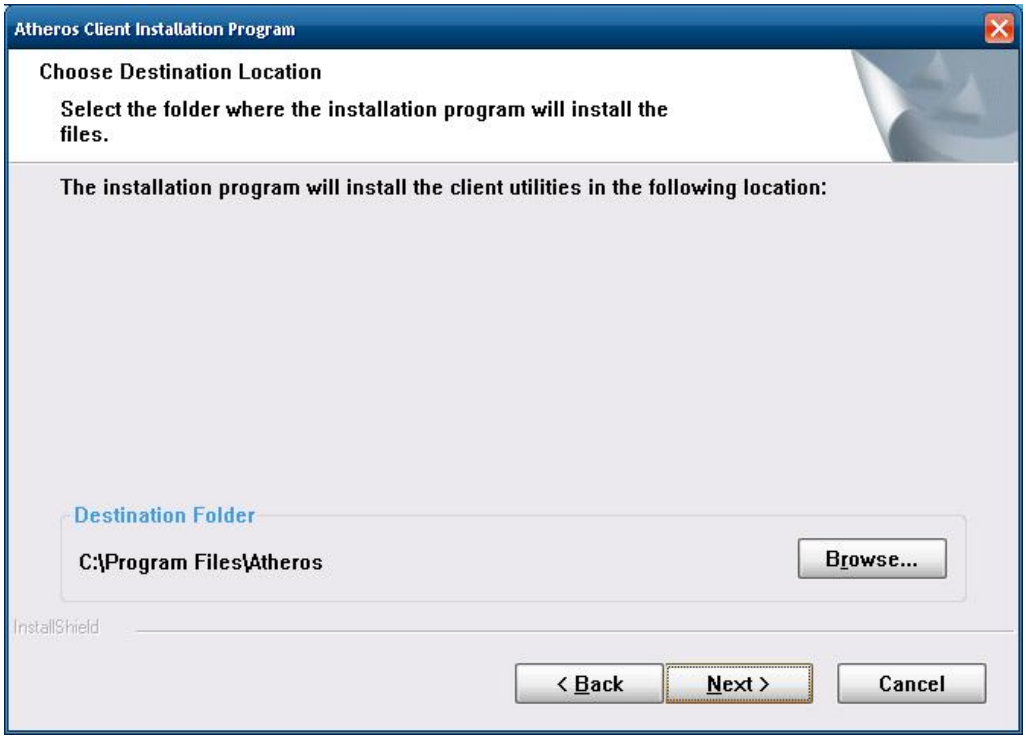


5. Select **I accept the terms of the license agreement** and then click **Next**.

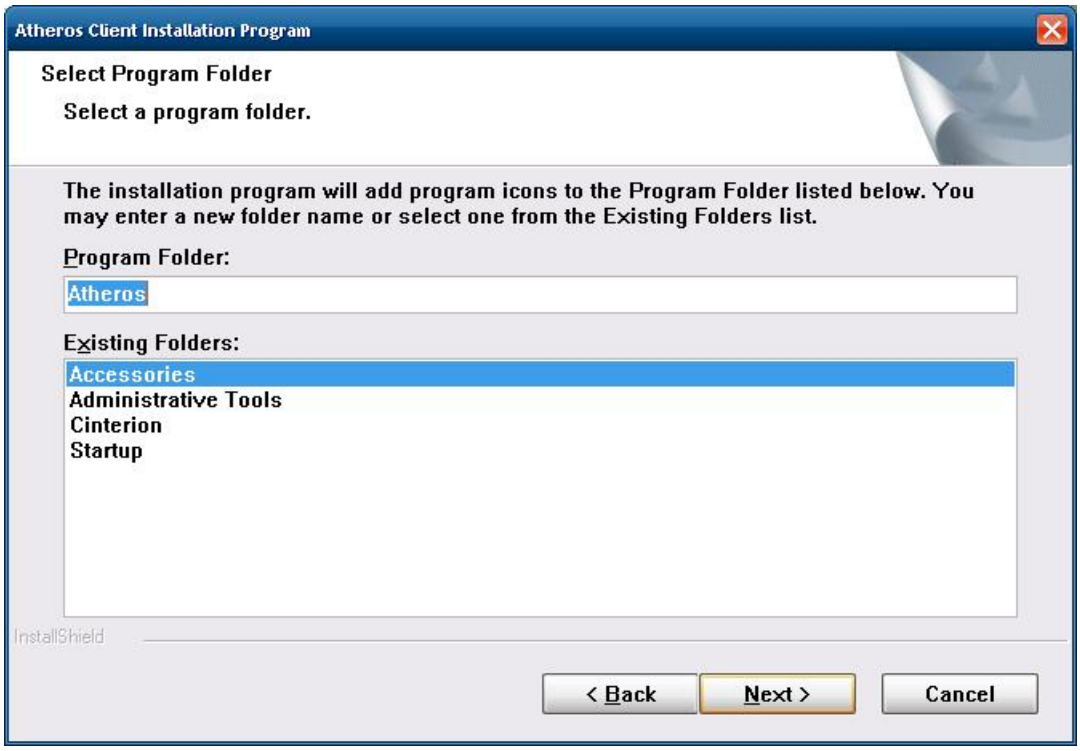
6. Select **Install Client Utilities and Driver** and then click **Next**.



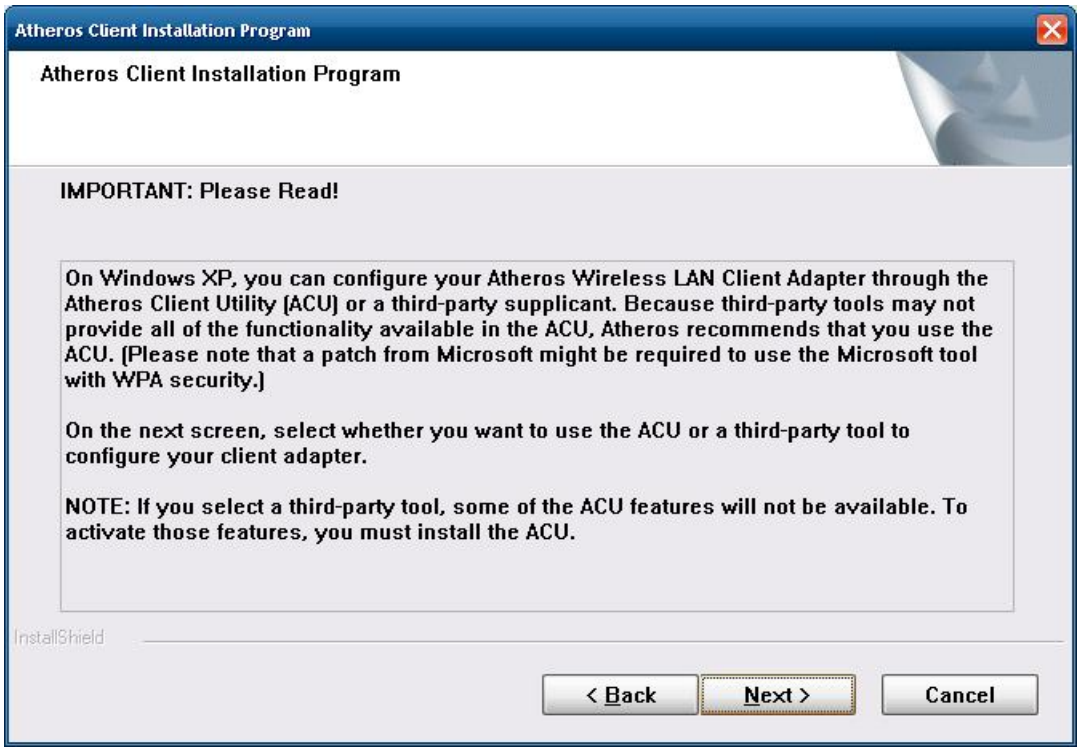
7. Click **Next**.



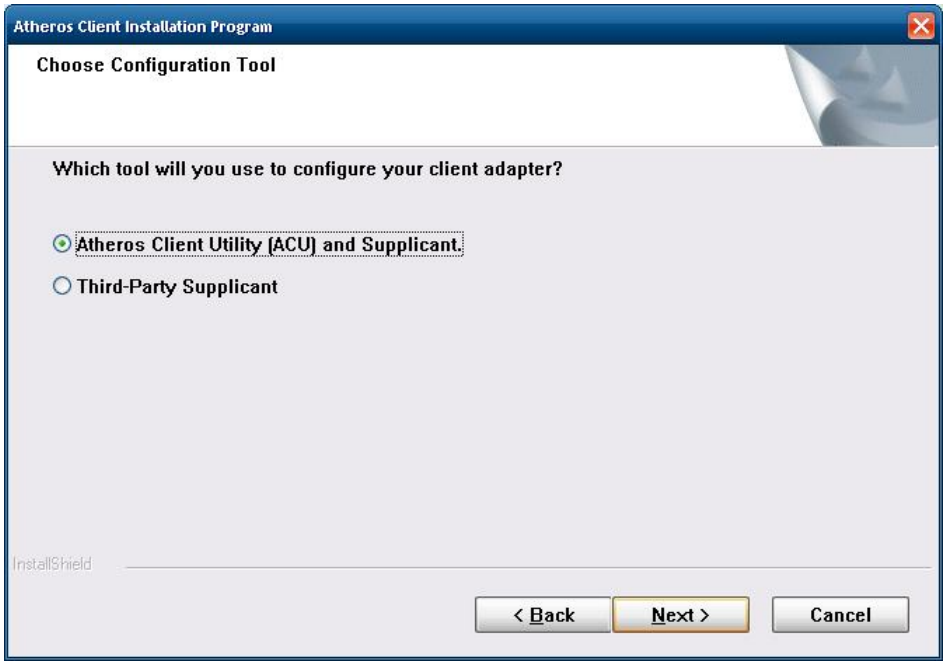
8. Click **Next**.



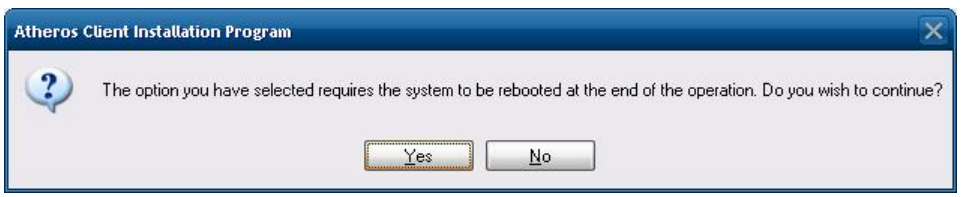
9. Click **Next**.



10. Select **Atheros Client Utility (ACU) and Supplicant** and then click **Next**.

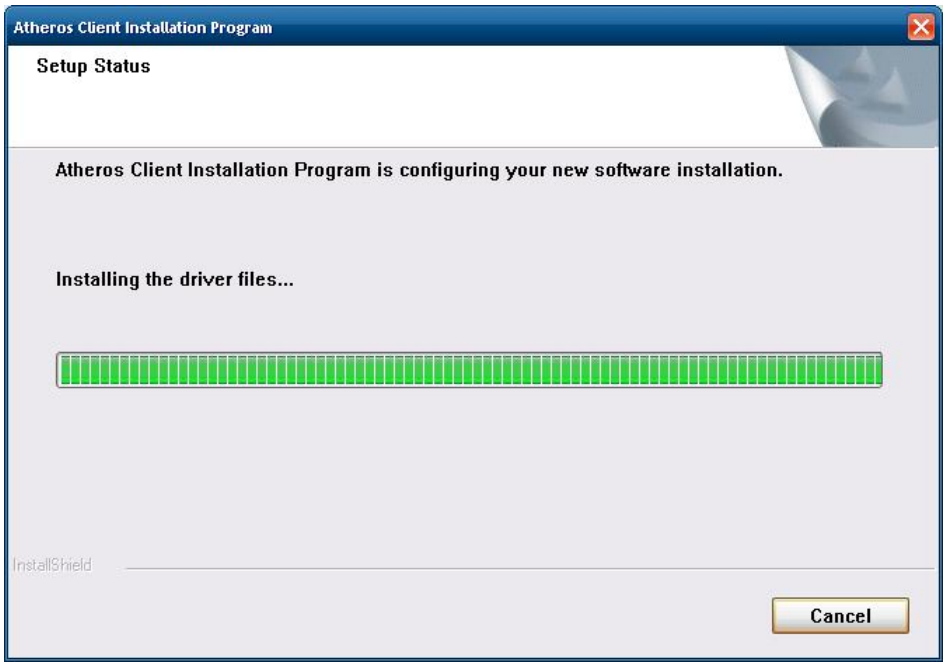


11. Click **Yes**.

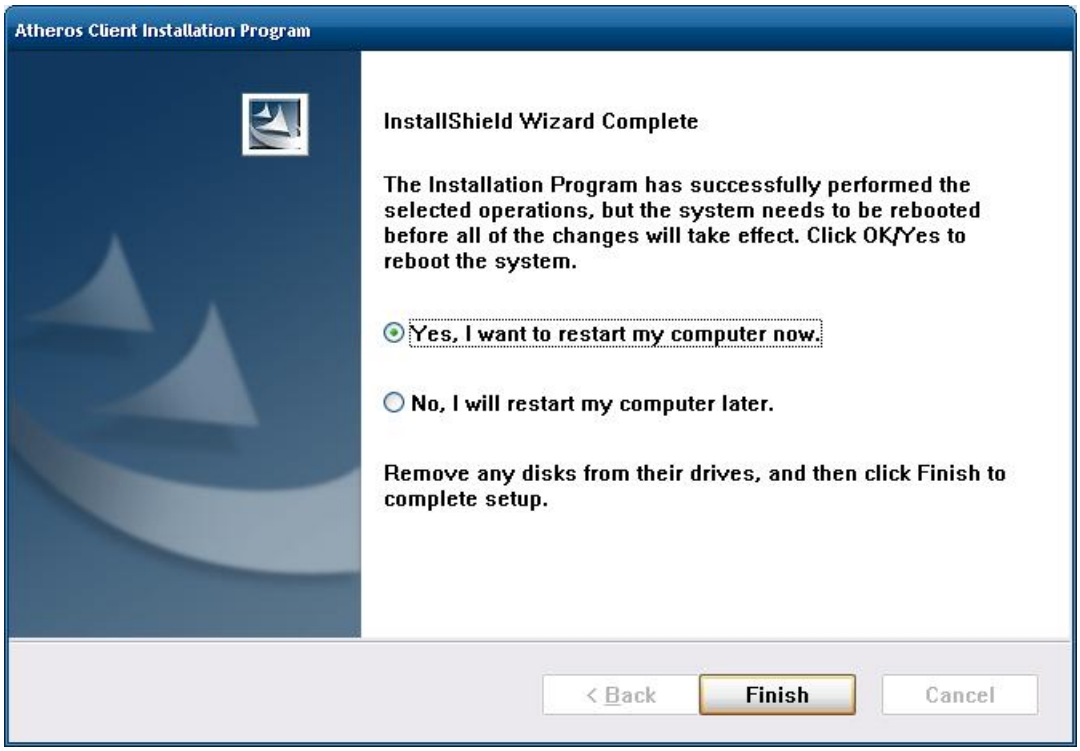


12. Click **OK**.

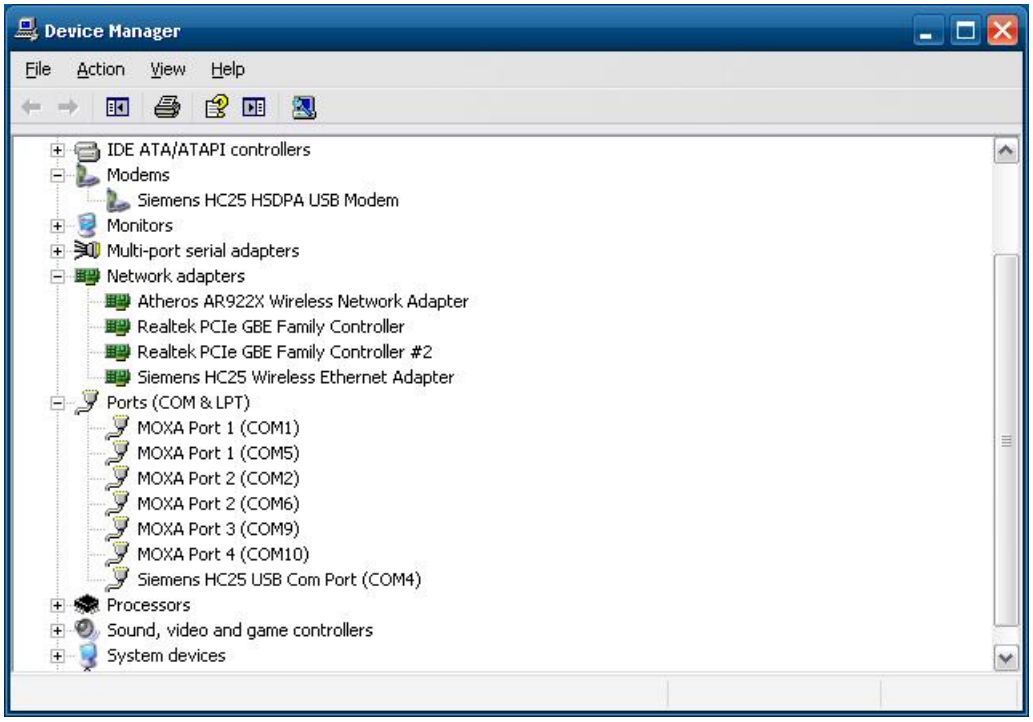
13. Wait for the driver to be installed.



14. Select **Yes, I want to restart my computer now** and then click **Finish**.



15. After the installation is complete, you should see **Siemens HC25 HSDPA USB Modem**, **'Siemens HC25 Wireless Ethernet Adapter**, and **Siemens HC25 USB COM Port** in the Device Manager window.

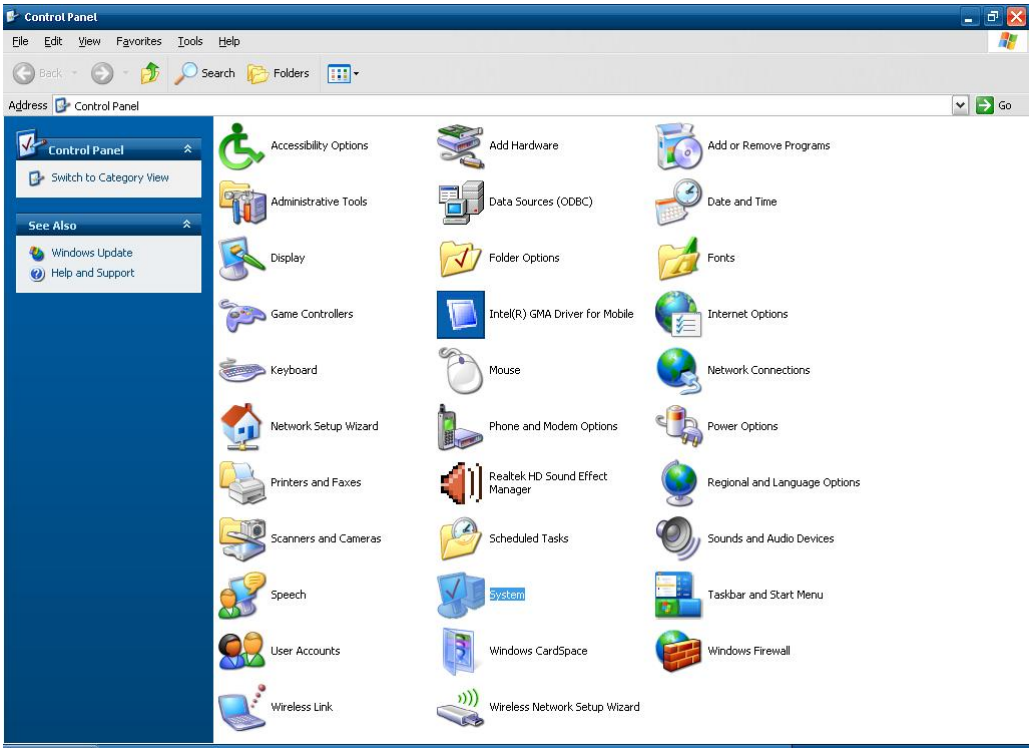


Configuring the GPRS / HSDPA Connection (without GPS)

In this section we illustrate how to establish a connection using the **Siemens HC25 Connection Manager** utility.

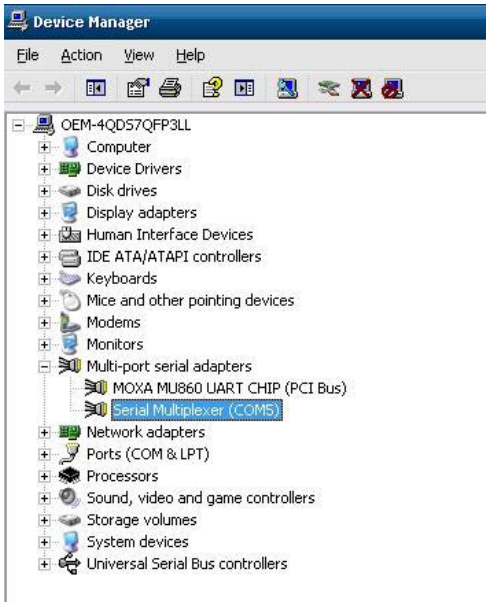
Take the following steps to configure the 3G/GPS and wireless driver:

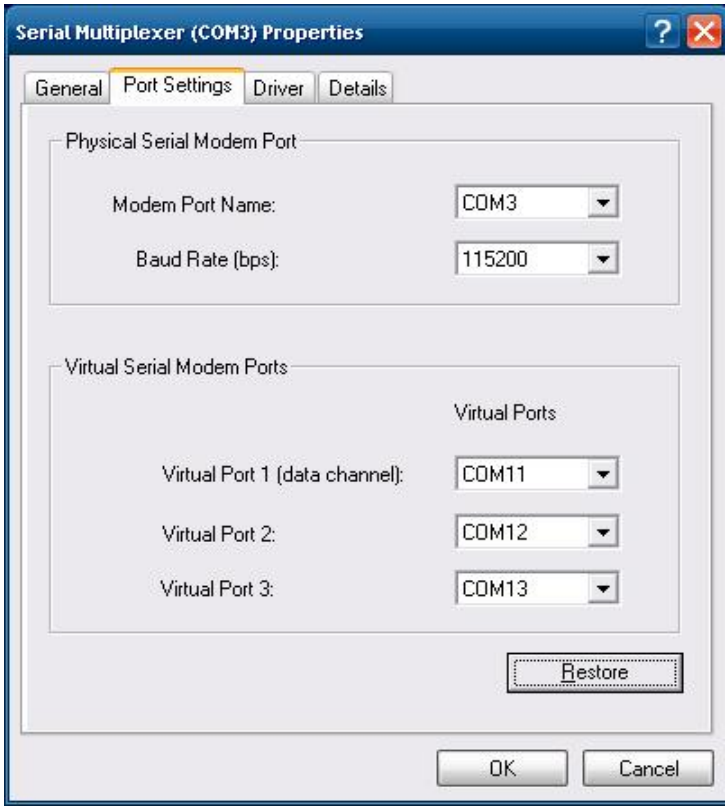
1. Go to **Control Panel → System**.



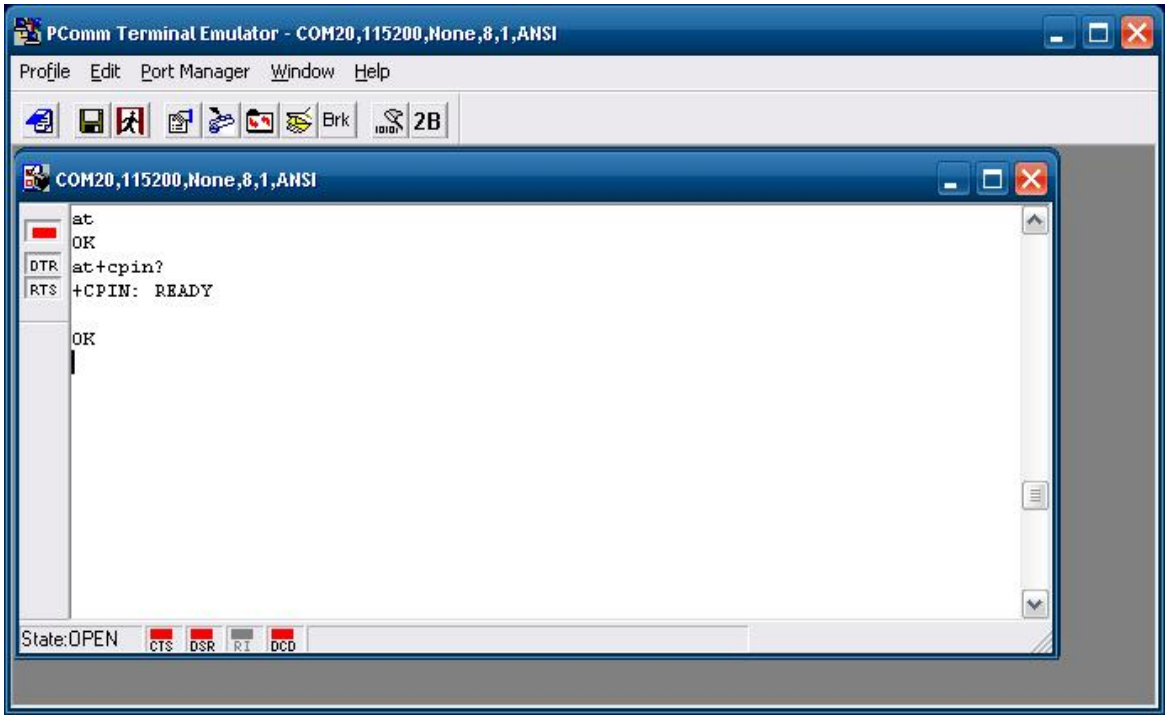
2. Click **Hardware → Device Manager**.

3. Right-click **Serial Multiplexer → Properties → Port Settings**.

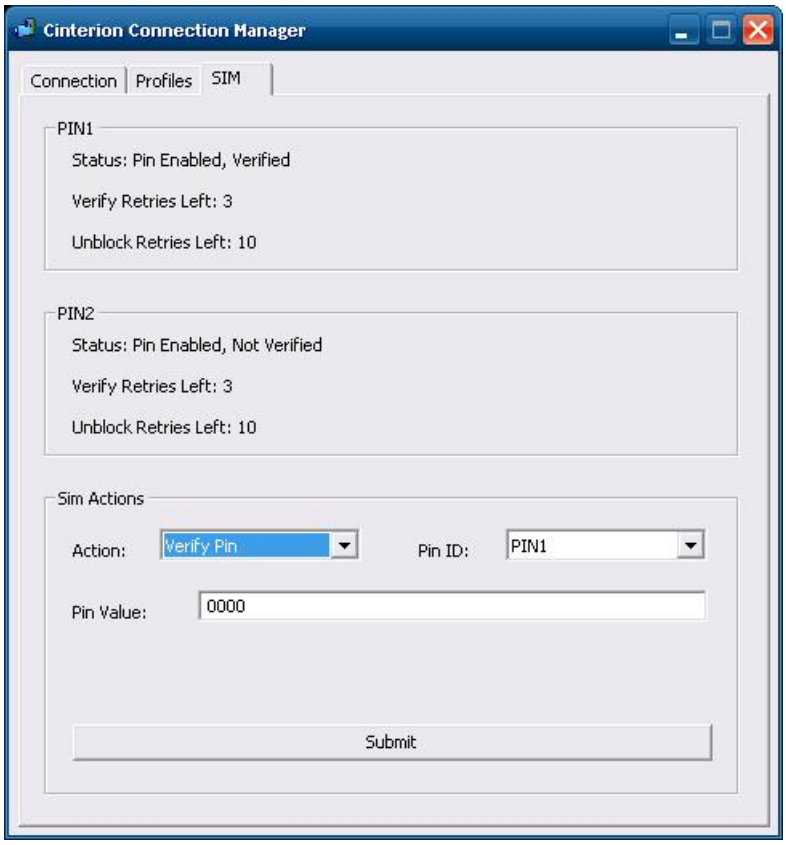




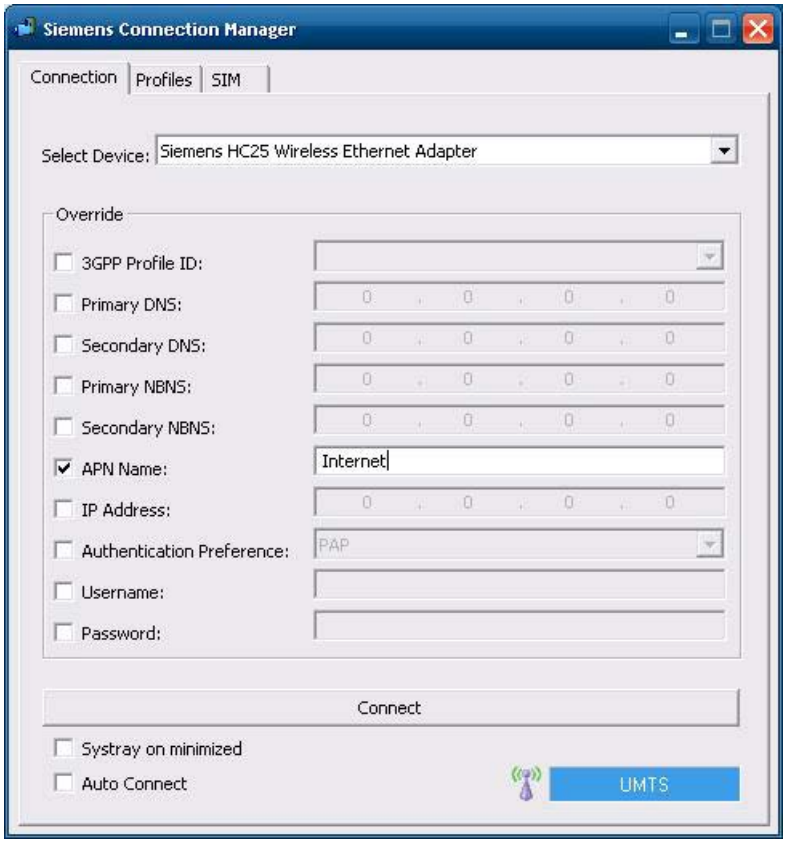
4. Open **Virtual Port 2** (e.g., COM12) and enter **at+cpin?**. Make sure the SIM card status is ready or the connection may fail.



NOTE Before you verify the SIM card status, check whether or not the PIN code has been submitted.

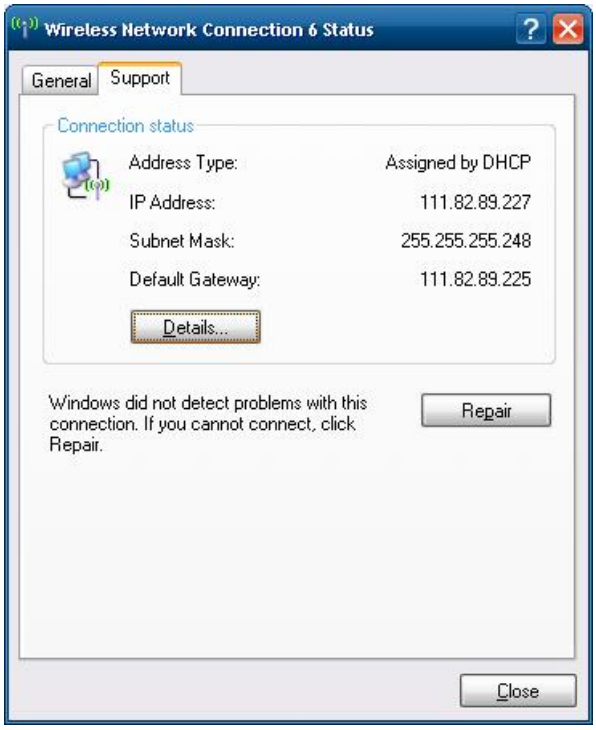


5. Select the device from the drop-down list and then enter the APN Name.

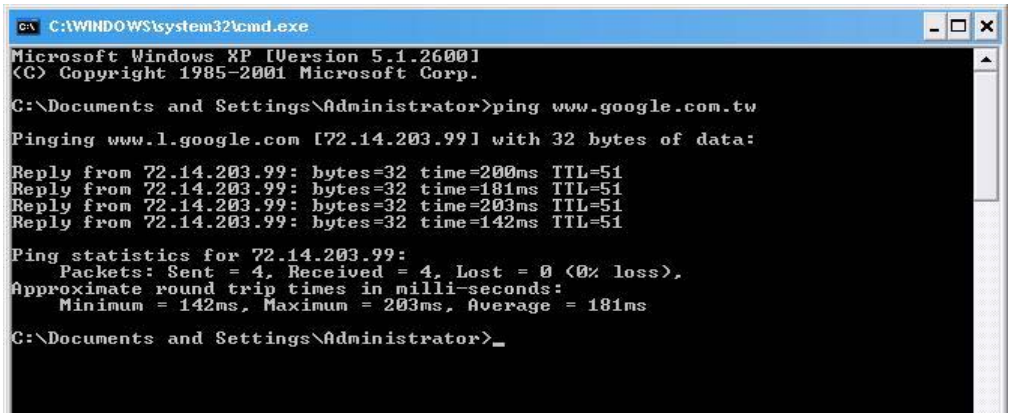


6. Click **Connect** to connect to the Internet and establish the wireless connection.

NOTE Do not close the program while the connection is being established, or the device driver may not work properly.



7. At this point you can access this wireless network connection.

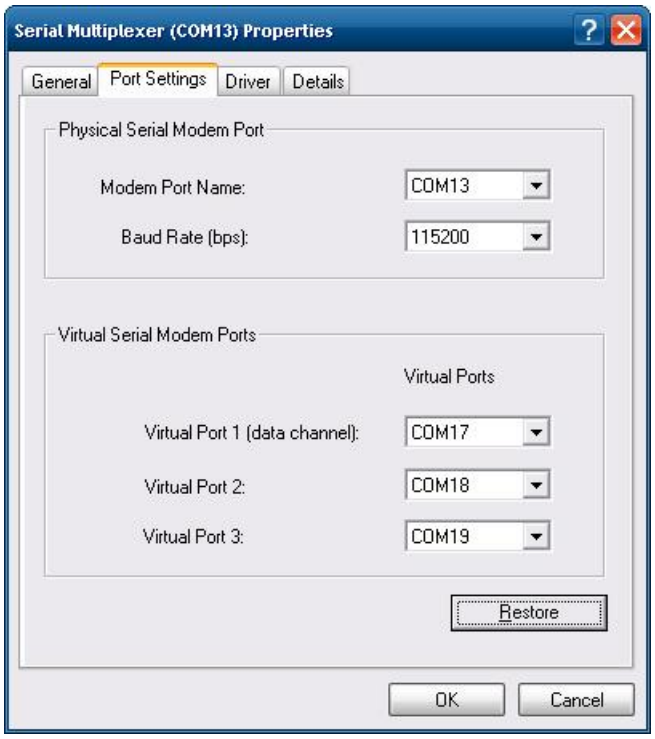


Enabling GPS Functionality

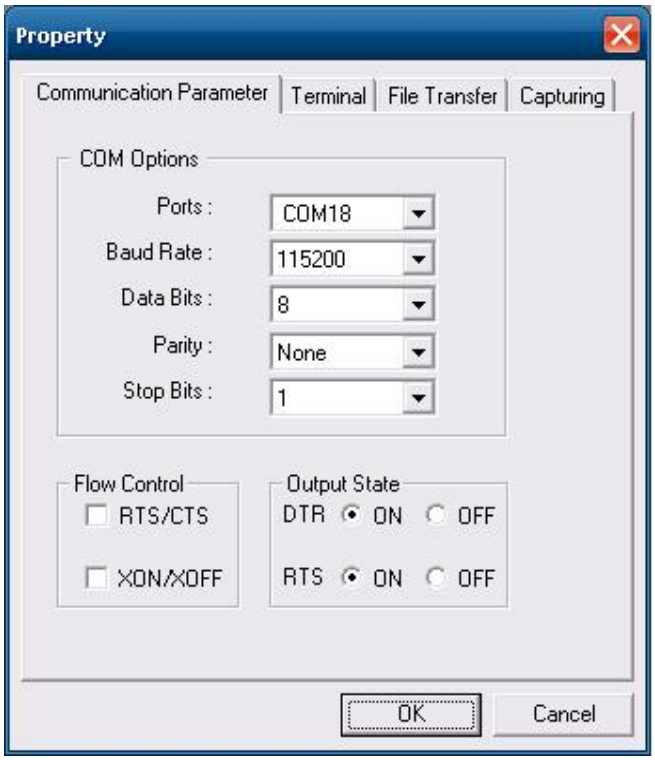
GPS functionality is only enabled when the module is in multiplexer mode. A **Winmux2K** driver is available for configuring the module in multiplexer mode. In multiplexer mode, the system will generate virtual COM ports to communicate, and the modem port will become one of the virtual COM ports.

Take the following steps below to enable GPS functionality:

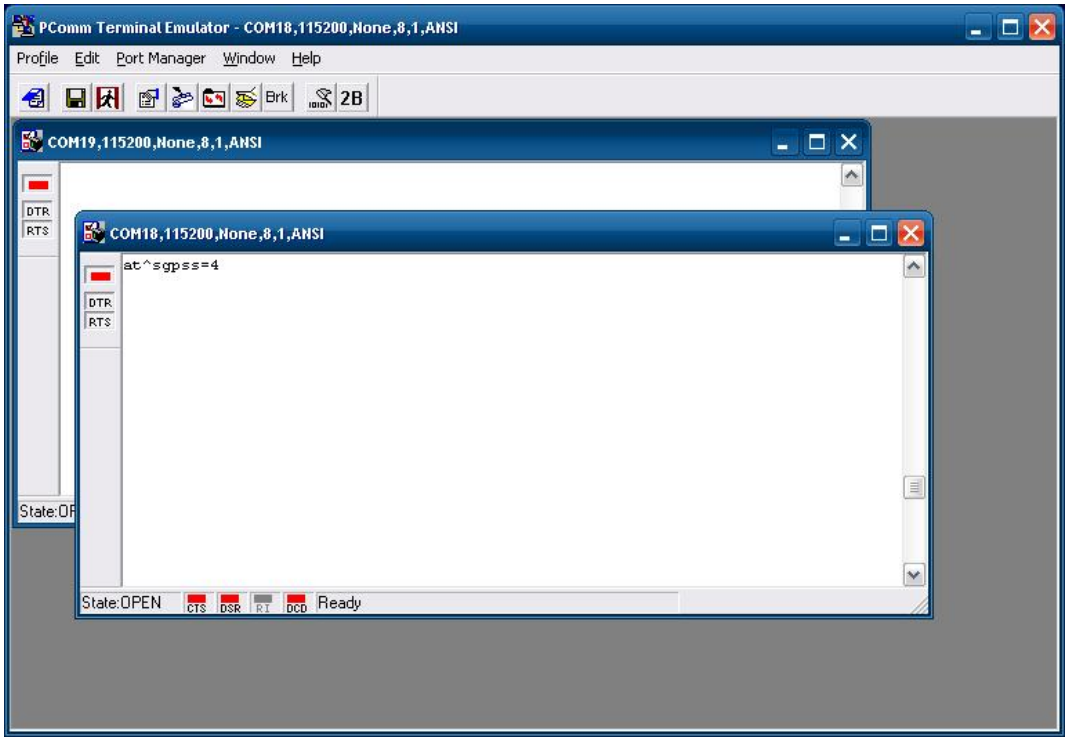
1. Start the **Device Manager** and check the three virtual COM ports.



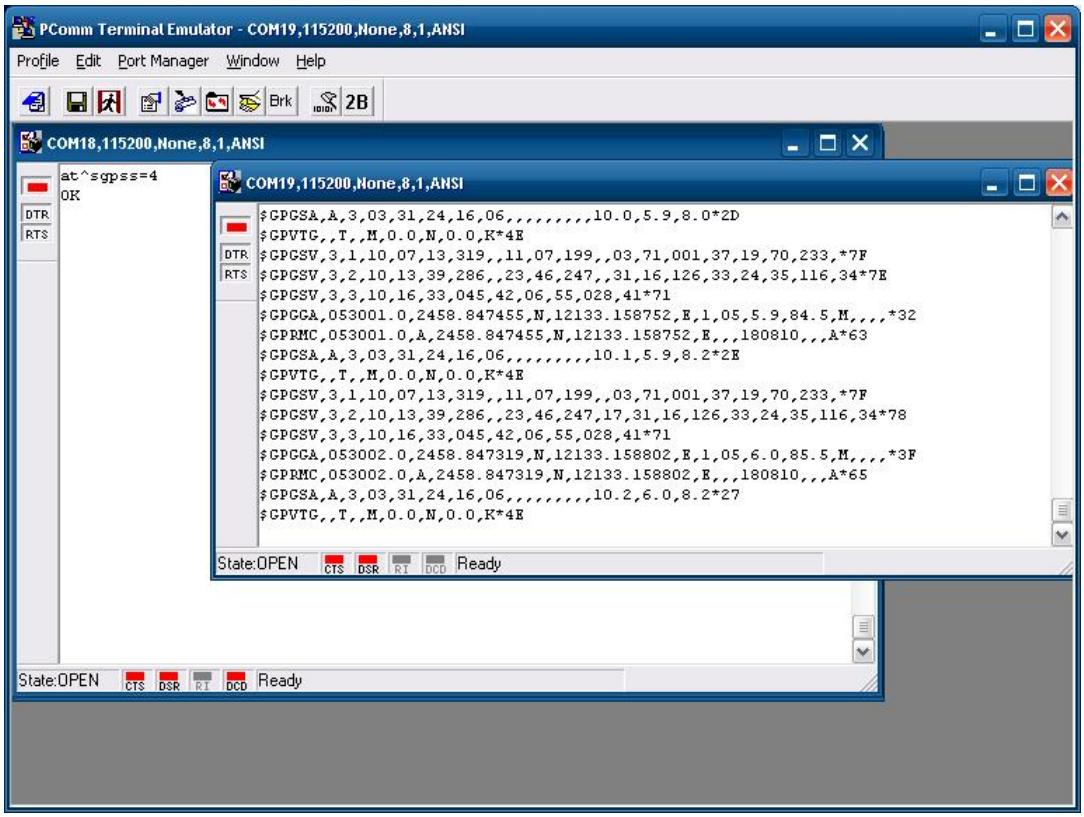
2. Start **Terminal Emulator** and then open the 2nd virtual COM port (COM18).



3. Enter **at^sgpss=4** to enable GPS functionality.



4. Receive the **information** returned through GPS and verify that the position value is correct.

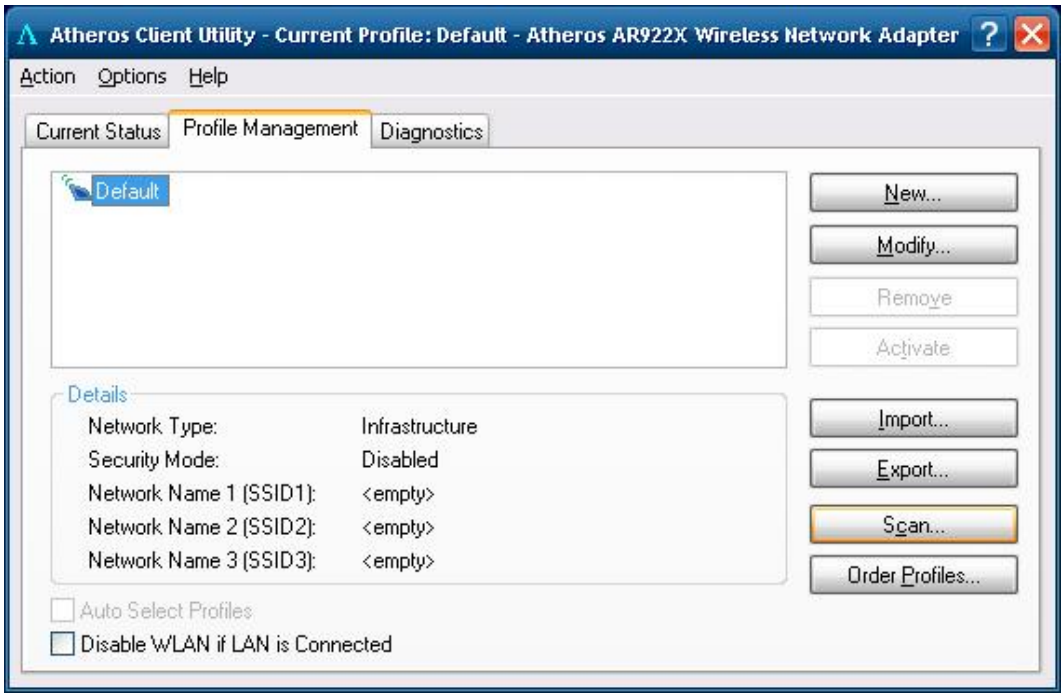


Configuring a Wireless Connection

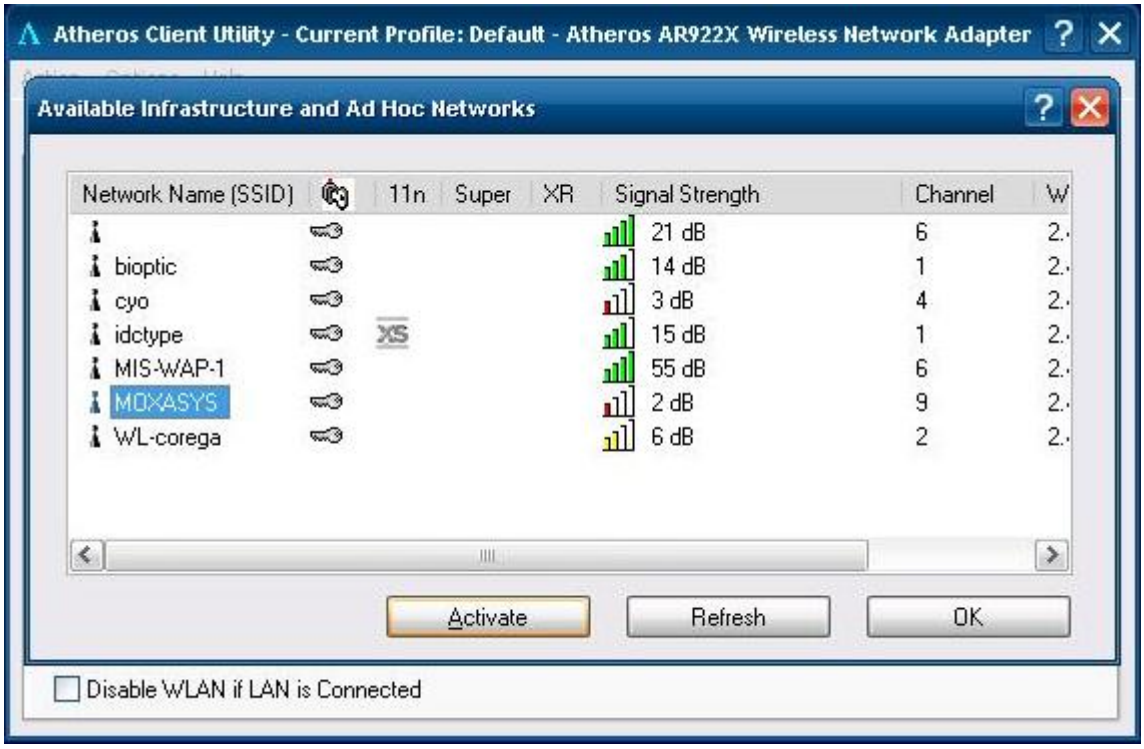
The EPM-3337 module includes a wireless module. In this section we explain how to connect to an access point with WEP/WPA/WPA2(RSN) encryption.

Take the follow the steps to configure a wireless connection:

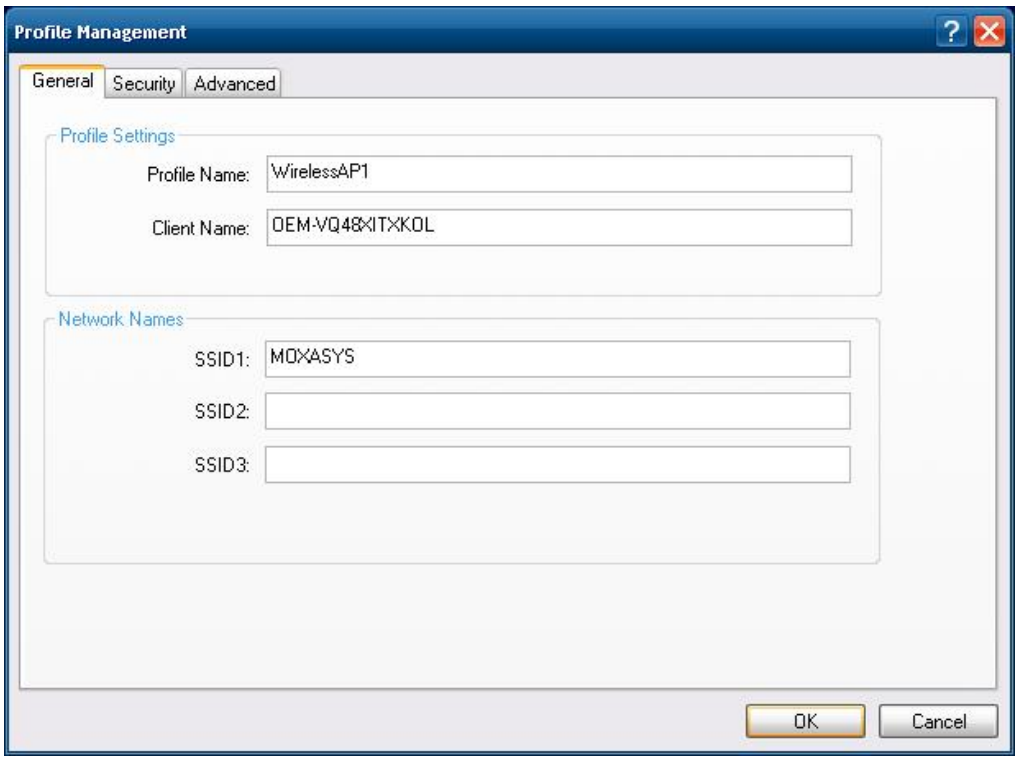
1. Double-click on the **Atheros client utility** shortcut on the desktop. Click on the **Profile Management** tab, and then click the **SCAN** button.



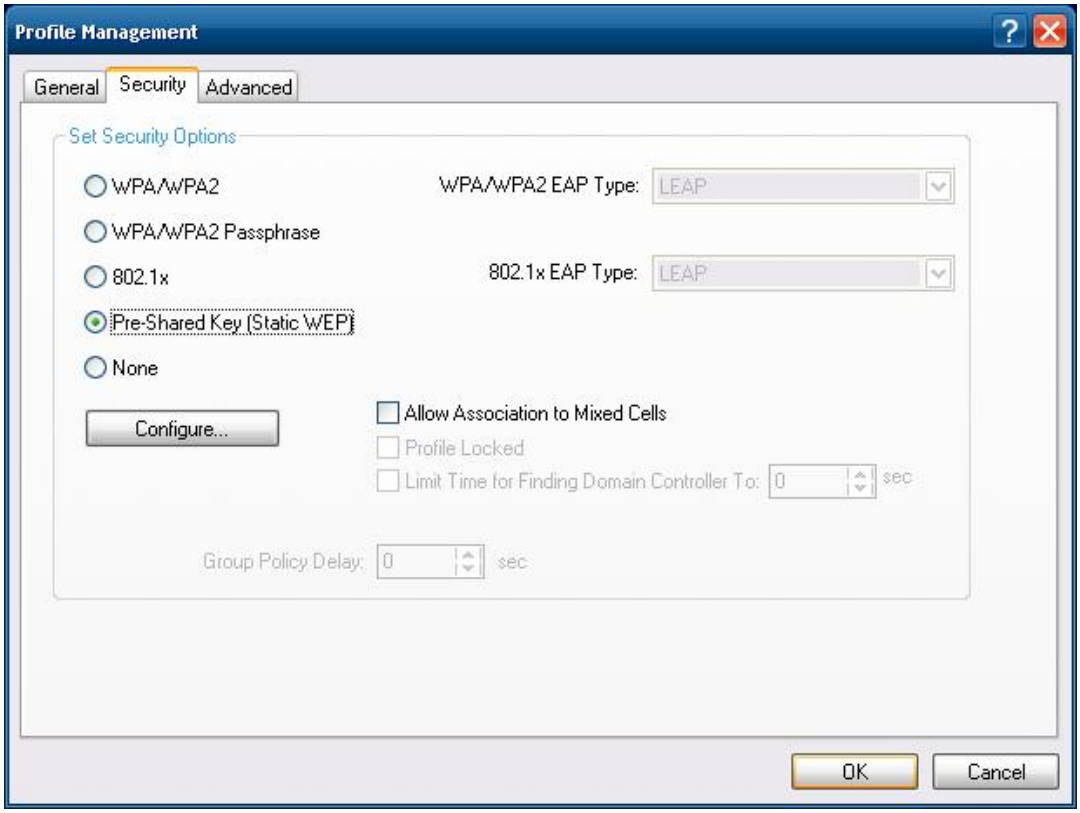
2. Select the access point that you want to connect to and then click **Activate**.



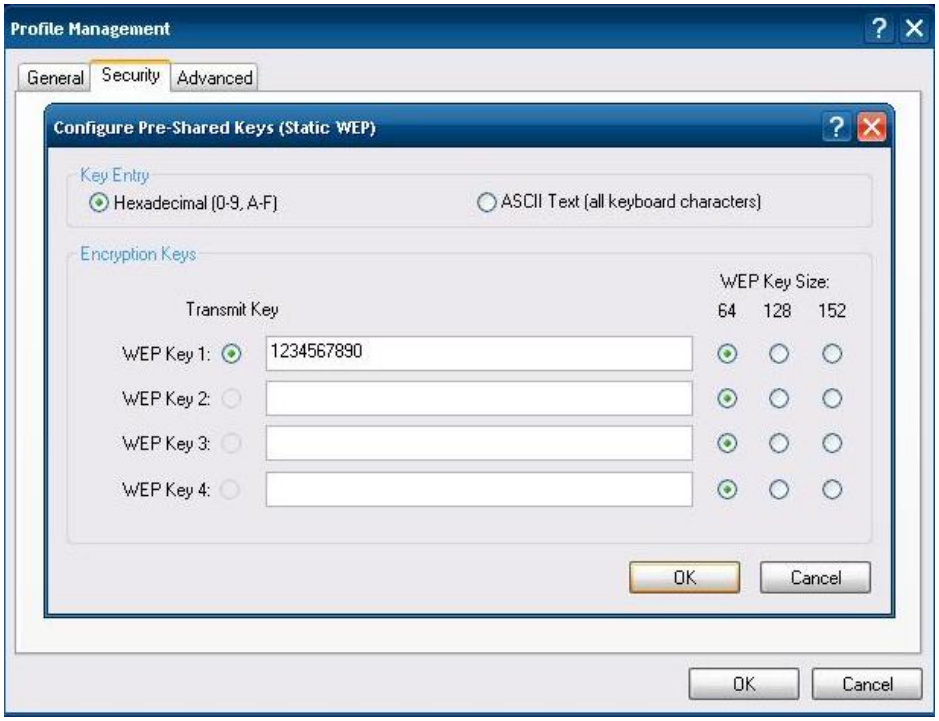
3. Enter the **Profile Name** and then select the **Security** tab.



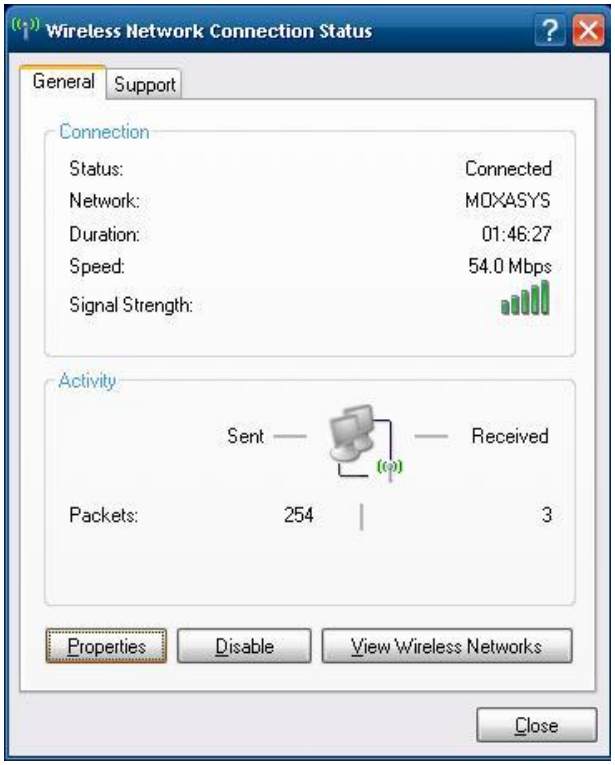
4. Select the security option for your network and then click **Configure**.



5. Enter the password.



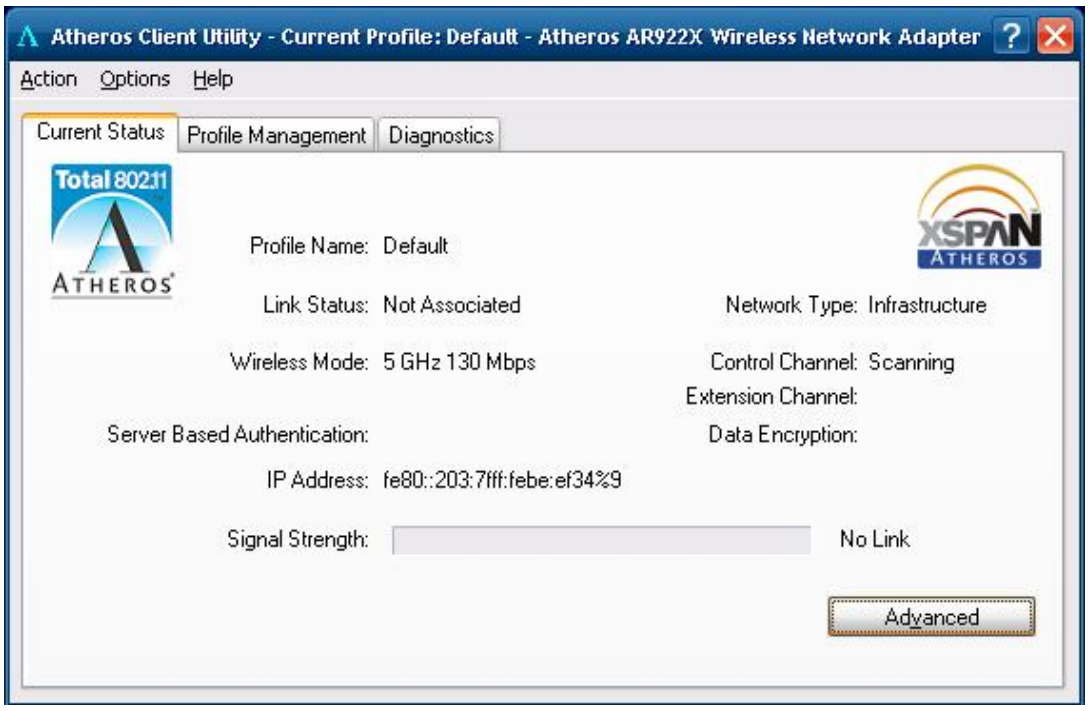
6. The connection will now be established.



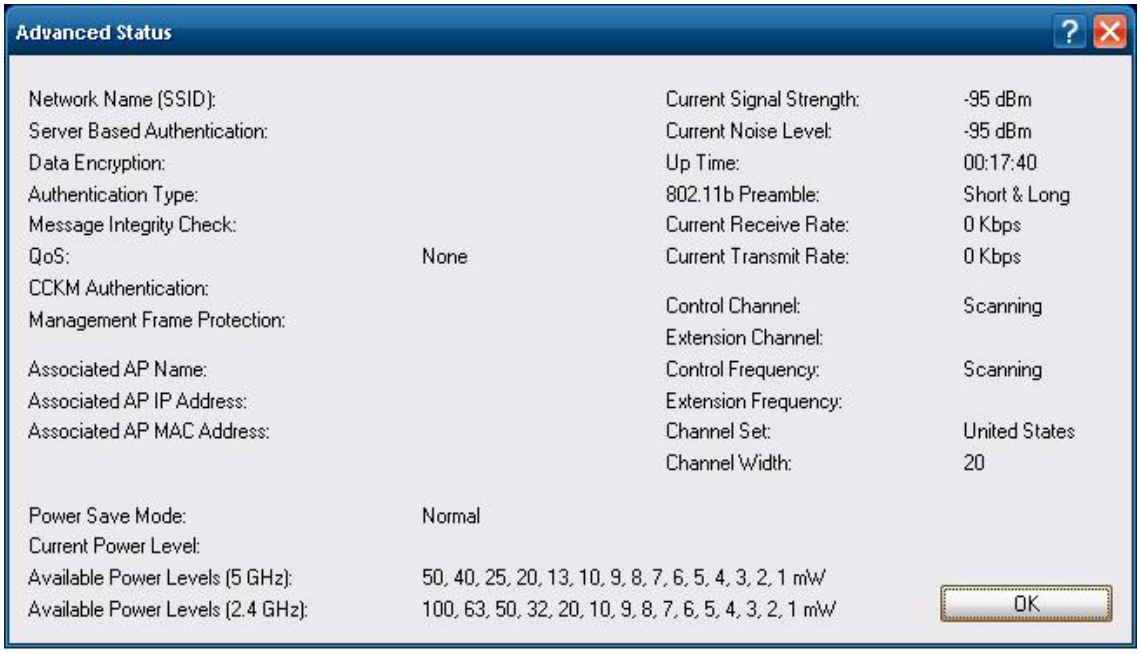
Getting Wireless Module Information

The **Atheros Client Utility** can be used to get wireless information and to manage wireless connections.

1. Double-click the **Atheros client utility** shortcut on the desktop and then select the **Current Status** tab.



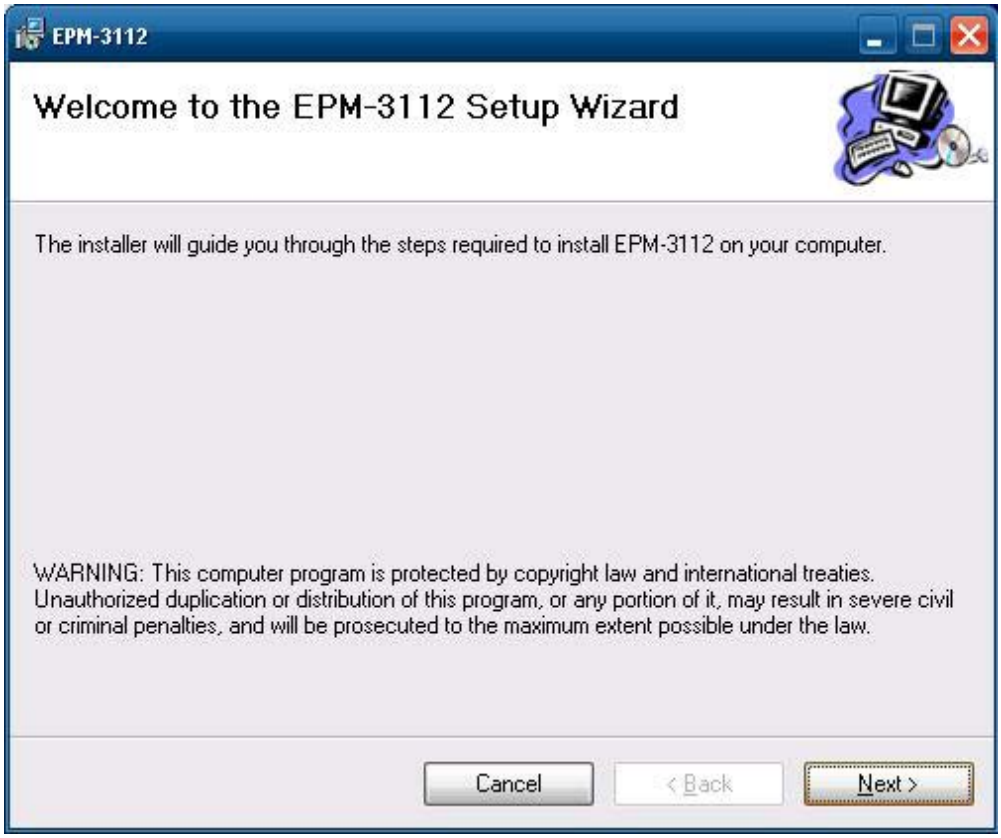
2. Click the **Advanced** button. You will see the status of the current wireless connection.



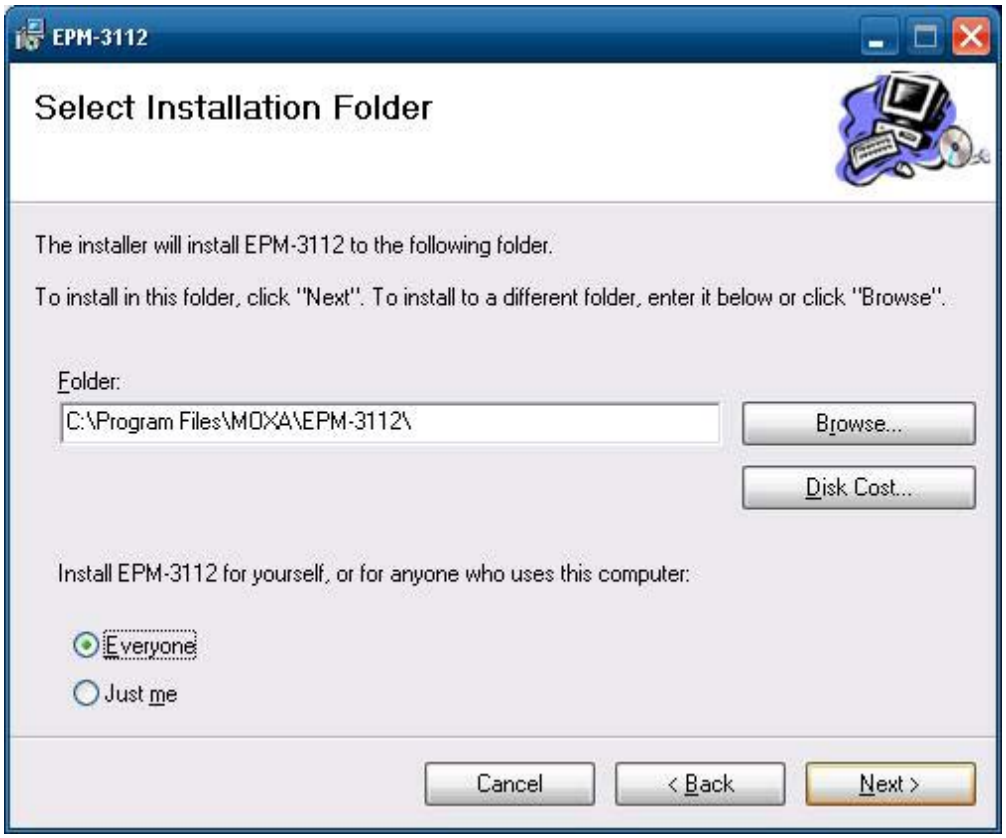
EPM-3112 Driver Installation

Take the following steps to install the CANBUS driver:

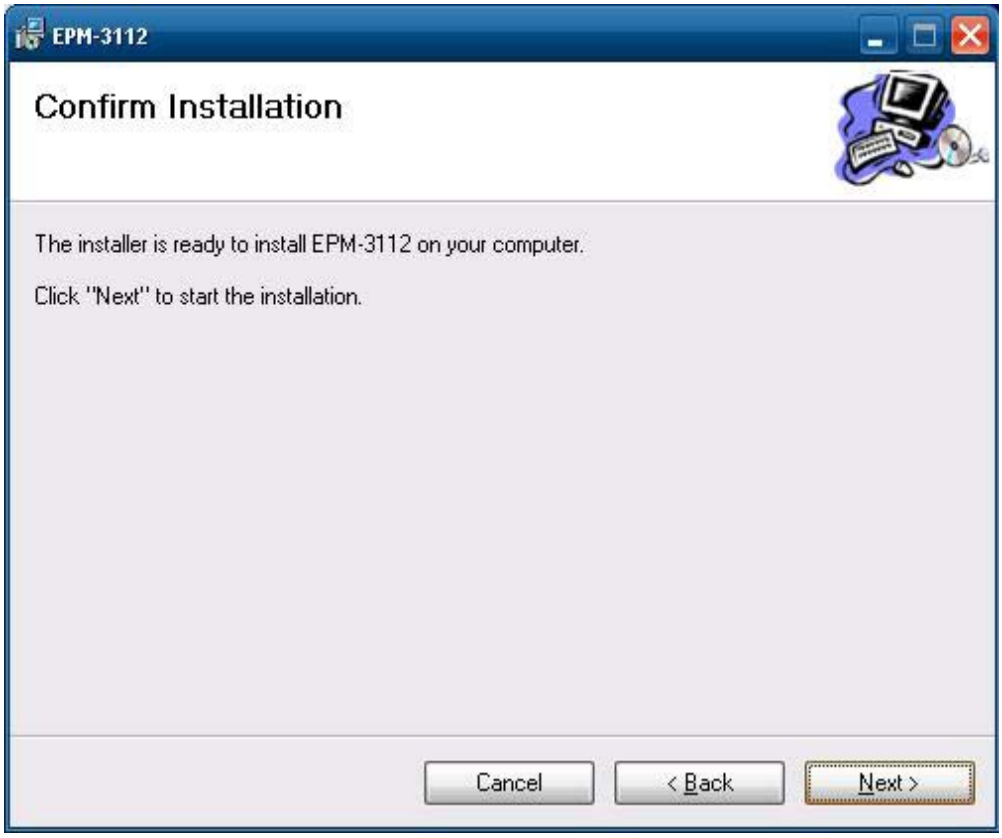
1. Double-click **EPM-3112_V1.0.msi** to install the module driver and then click **Next**.



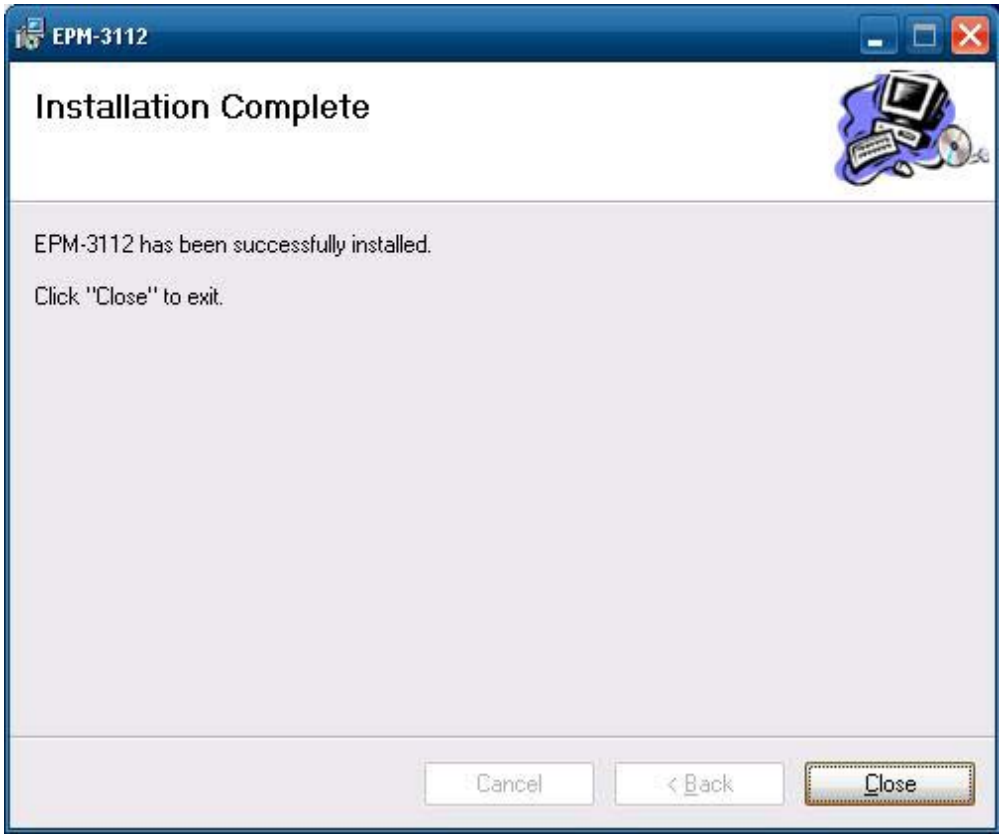
2. Click **Next** to continue.



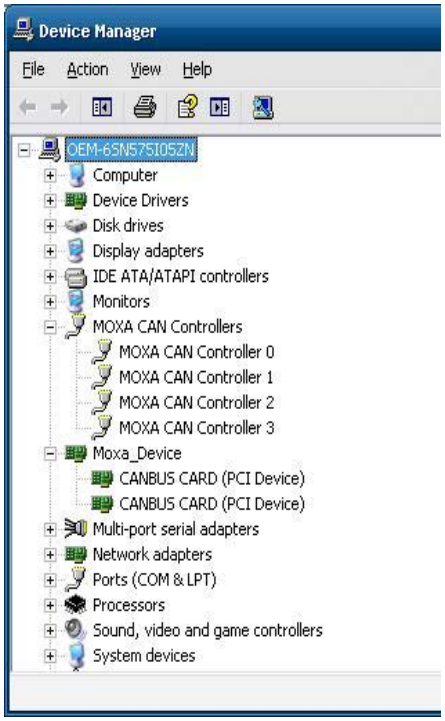
3. Click **Next** to start the driver installation.



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



5. Click **Action → Scan for hardware change** to install the module driver automatically.



EPM-3112 Programming Guide

CANBUS 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_nonblocking (int fd)	
Description	Sets the open fd to be non-blocking.
Input	<fd> the open port
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_set_read_timeout (int fd, unsigned int to)	
Description	Sets data reading timeout of an open port.
Input	<fd> the open port <to> timeout in milliseconds
Return Value	0 on success; otherwise failure

int mxcan_set_write_timeout (int fd, unsigned int to)	
Description	Sets data writing timeout of an open port.
Input	<fd> the open port <to> timeout in milliseconds
Return Value	0 on success; otherwise failure

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

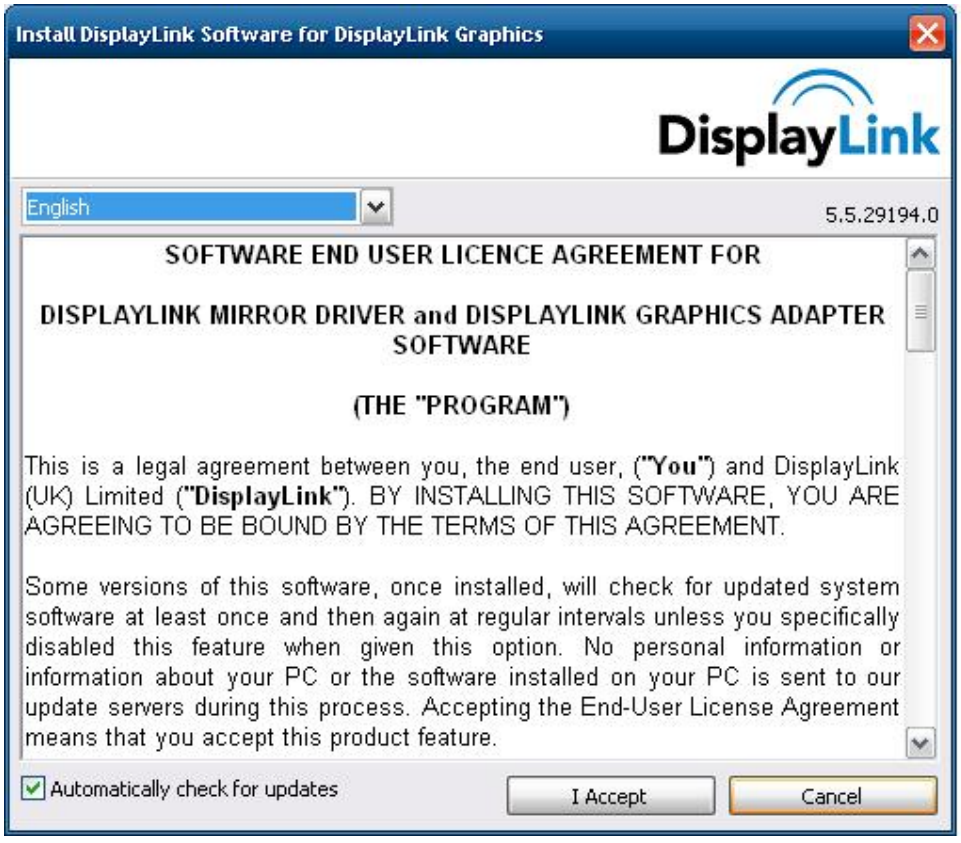
EPM-3552 Driver Installation

Take the following steps to install the EPM-3552 module driver.

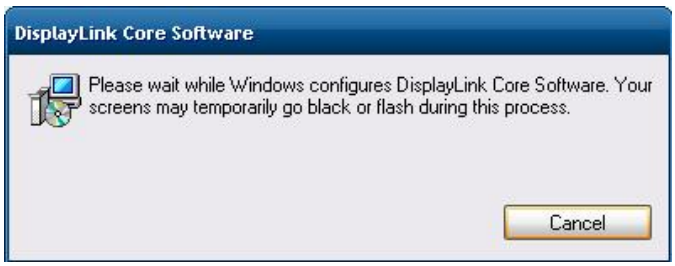
ATTENTION

The driver must be installed first. Do not install the EPM-3552 module in the computer before installing the driver.

1. Double click **DisplayLink-5.5.29194.exe** in the **Driver** folder on the software CD-ROM, and then click **I Accept** to accept the software end user license agreement.

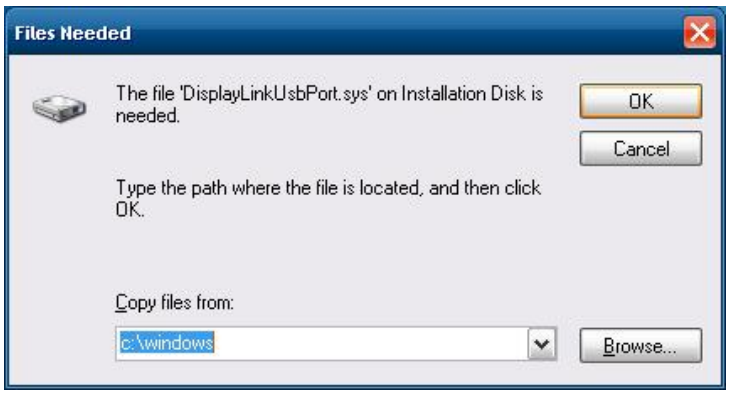


NOTE During the installation, the screen may flash or go black.

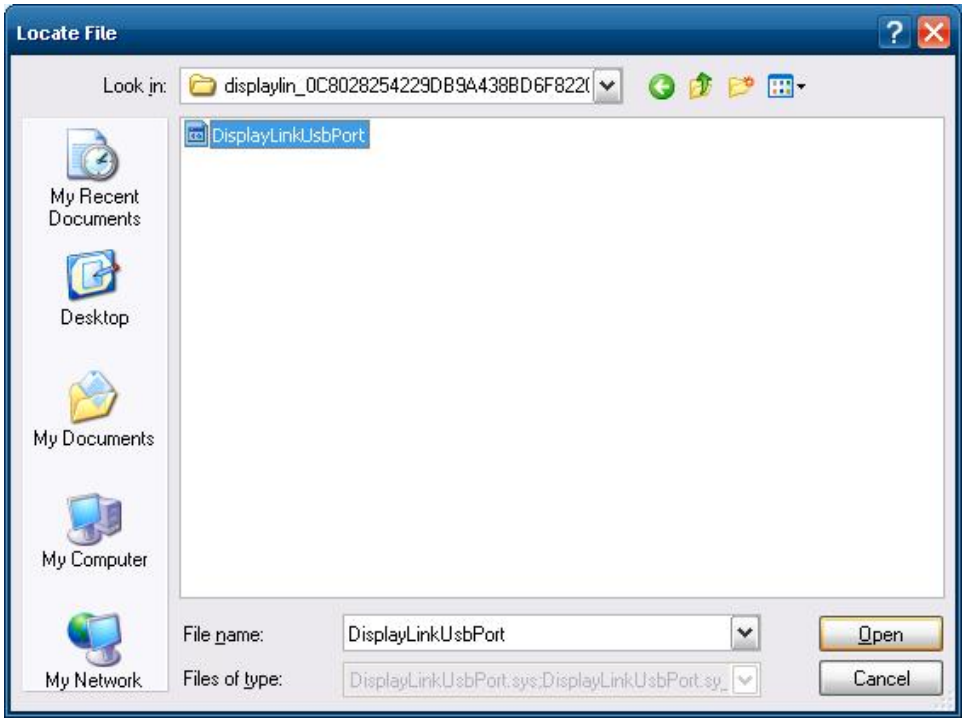


2. When finished, install the EPM-3552 module in your embedded computer. The following or similar message will appear on the toolbar.

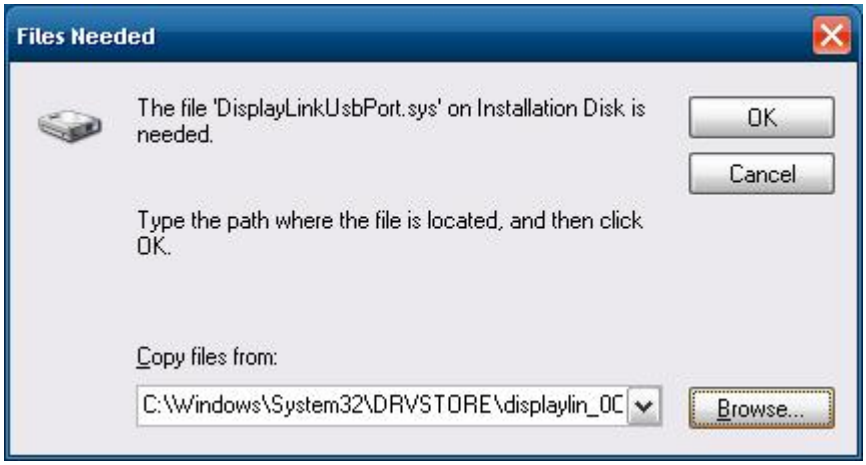
3. Assign a specific path for the installation driver by clicking **Browse**, and then select the following path where the driver is located:
C:\Windows\system32\DRVStore\displaylin_0C8028254229DB9



4. Select **DisplayLinkUsbPort** and then click **Open**.



5. Click **OK** to complete the installation.



NOTE During the installation, the screen may flash or go black.

EPM-3552 Configuration

When the EPM-3552 module has been installed, an icon appears on the taskbar to give you access to the **DisplayLink manager menu**.

1. Click the **DisplayLink** icon on the taskbar  . The menu will appear as shown below.

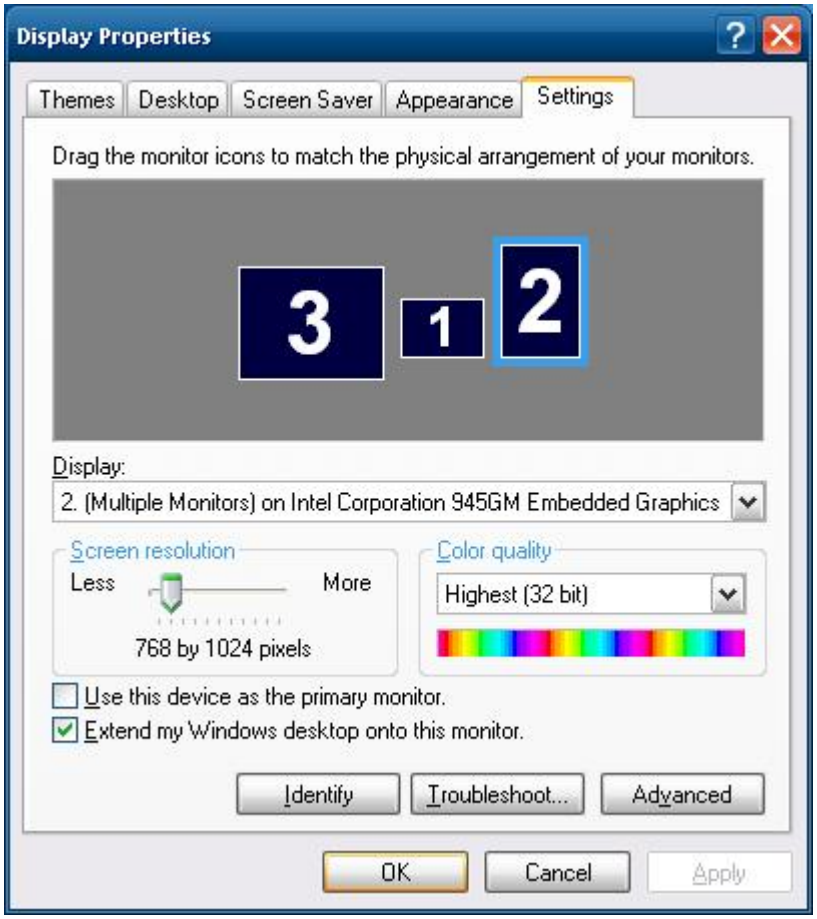
2. Select an option from the menu. The following table lists which options are available.

Menu Options	Sub-menu Options	Descriptions
Screen Resolution		Displays a list of available resolutions. Some resolutions may be enclosed by square brackets ([ ]).
Screen Rotation	Normal	No rotation is applied to the display.
	Rotated Left	Rotates the extended or mirrored display by 270 degrees.
	Rotated Right	Rotates the extended or mirrored display by 90 degree.
	Upside-Down	Rotates the extended or mirrored display by 180 degrees.
Extend To	Right	Extends the display to the right of the main display.
	Left	Extends the display to the left of the main display.
	Above	Extends the display above the main display.
	Below	Extends the display below the main display.
Extent		Extends your desktop onto the secondary display.
Set as Main Monitor		Sets the secondary display as the main display.

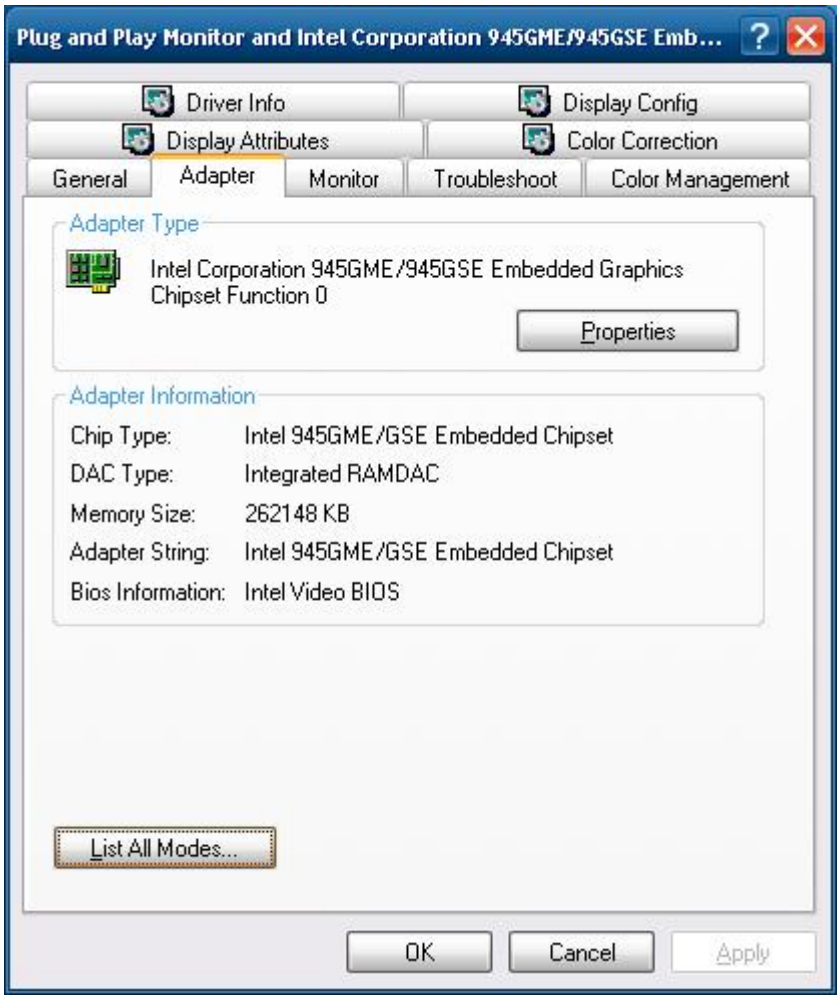
Notebook Monitor Off		Switches off the display of an attached notebook and makes the DisplayLink display primary.
Mirror		Copies what is on the main display and reproduces it on the secondary display.
Off		Switches off the secondary display
Fit to TV		Opens a GUI to change the size of the Windows desktop so it fits on a V screen.

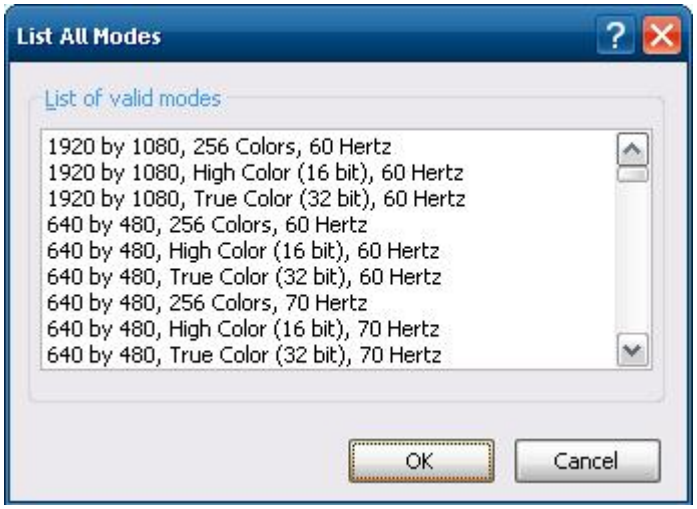
Setting the Display to Extend Mode with the Windows Properties

1. Right-click the display and select **Properties ➔ Settings**.
2. Checkmark the **Extend my windows desktop onto this computer** option.
3. Adjust the screen resolution by dragging the **Screen resolution** slide bar.
4. Select the **Color quality** from the drop-down list.
5. In the gray zone, select the monitor icons to match the physical arrangement of the monitors.
6. Click **OK** to save your settings.



For more detailed settings, including the refresh rate, click **Advanced Settings ➔ Adapter** tab **➔ List All Modes**. All valid combinations of resolution, color quality, and refresh rate are listed. For CRT monitors, we suggest using a high refresh rate to avoid the discomfort caused by monitor flicker. Flat panel monitors do not flicker, so a lower refresh rate is adequate.





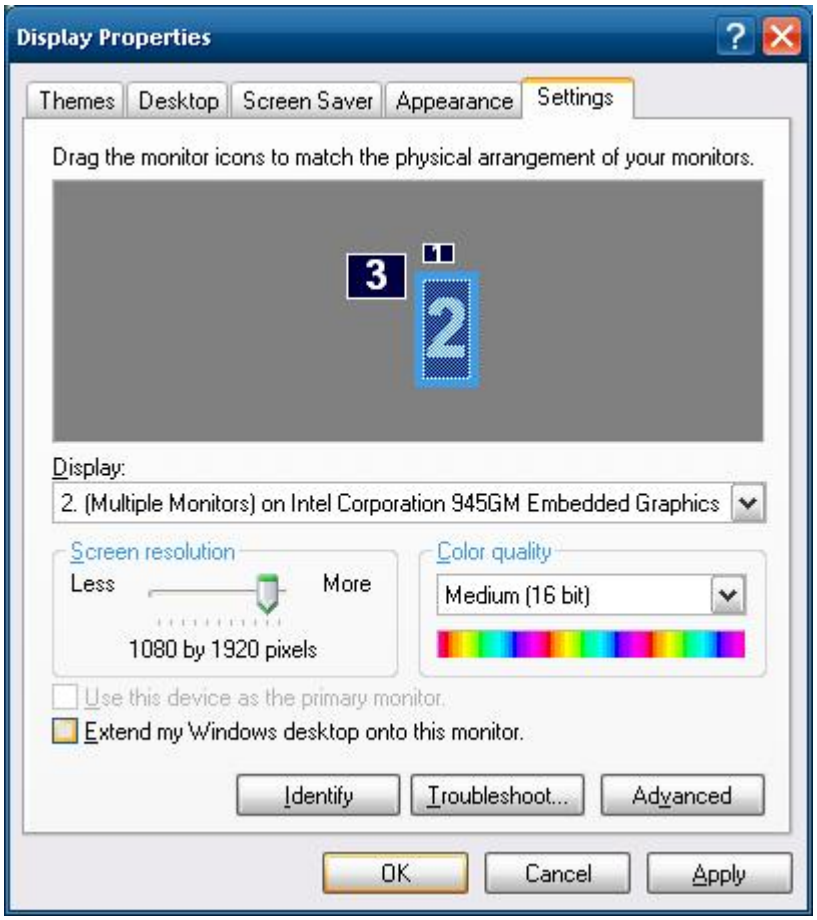
Setting the Display to Extend Mode with the DisplayLink Properties

1. From the taskbar, click the **DisplayLink** icon.
2. Select **Extend**.

Setting the Display to Mirror Mode with DisplayLink Properties

To use the Mirror Mode, you must use the DisplayLink Properties. To do this:

1. Right-click the display, and then select **Properties → Settings**.
2. Uncheck the **Extend the desktop onto this monitor** option.
3. Click **Apply**.



4. From the taskbar, click the **DisplayLink** icon.
5. Select **Mirror**.

NOTE The display resolution of the primary display and the display may be changed to a lower resolution. In mirror mode, both screens must output the same resolution, which may not be the maximum resolution of the display. This mode is NOT recommended if you are using the display as the primary laptop display, since it is unlikely to provide the optimum resolution for the display. See **Setting the Display as the Primary Display** section for details.

Setting the Display as the Primary Display with Windows Properties

Take the following steps to make the display the primary display.

1. Right-click the display and then select **Properties → Settings**.
2. Checkmark the **This is my main monitor** option.
3. Click **Apply**.

NOTE On some PCs and laptops, it is necessary to disable the main display. This is because many primary graphics card drivers tend to make the laptop screen the primary screen if it is enabled. The only workaround for this is to disable the laptop screen to allow another screen to be the primary display.

To disable the main display, clear the **Extend the desktop onto this monitor** checkbox.

Disabling the Laptop Screen

1. Check the **This is my main monitor** option.
2. Select the primary display (Display 1).
3. Uncheck the **Extend the desktop onto this monitor** option.
4. Click **Apply**.

The display remains as the primary display if the PC enters hibernate or suspend mode or is rebooted. If the display is detached, the main display will once again become the primary display.

Setting the Display as the Primary Display with DisplayLink Properties

1. From the taskbar, click the **DisplayLink** icon.
2. Select **Set as Main Monitor**.

EPM-3552 Patch File Installation

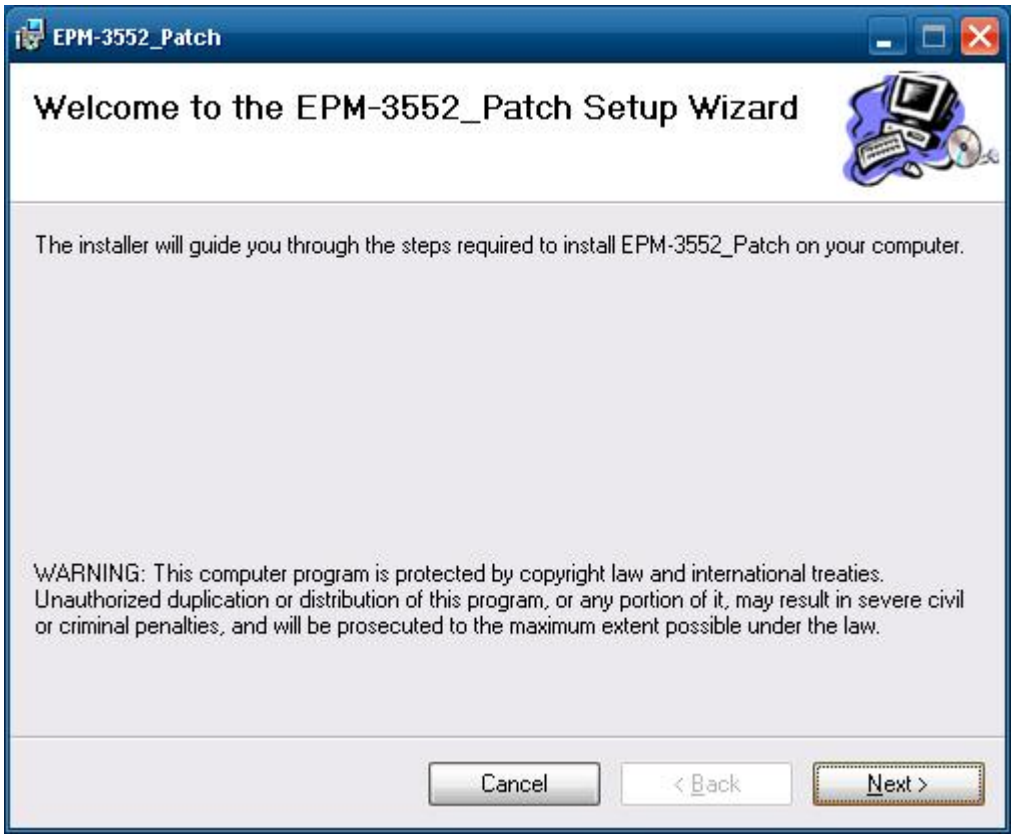
Known Technical Issues

The following technical issues will be apparent if you do not install the EPM-3552 patch file.

1. When powering off the V2422/2426 computer, the display connecting to an EPM-3552 module running Extended Mode also shows the shutdown screen. Normally, the display connecting to the EPM-3552 module should remain blank.
2. When the EMP-3552 module has been mounted and the V2422/2426 computer has been powered on, no image shows on the display connected to the DVI-I connector of the V2422/2426 computer. Normally, the image should be visible.

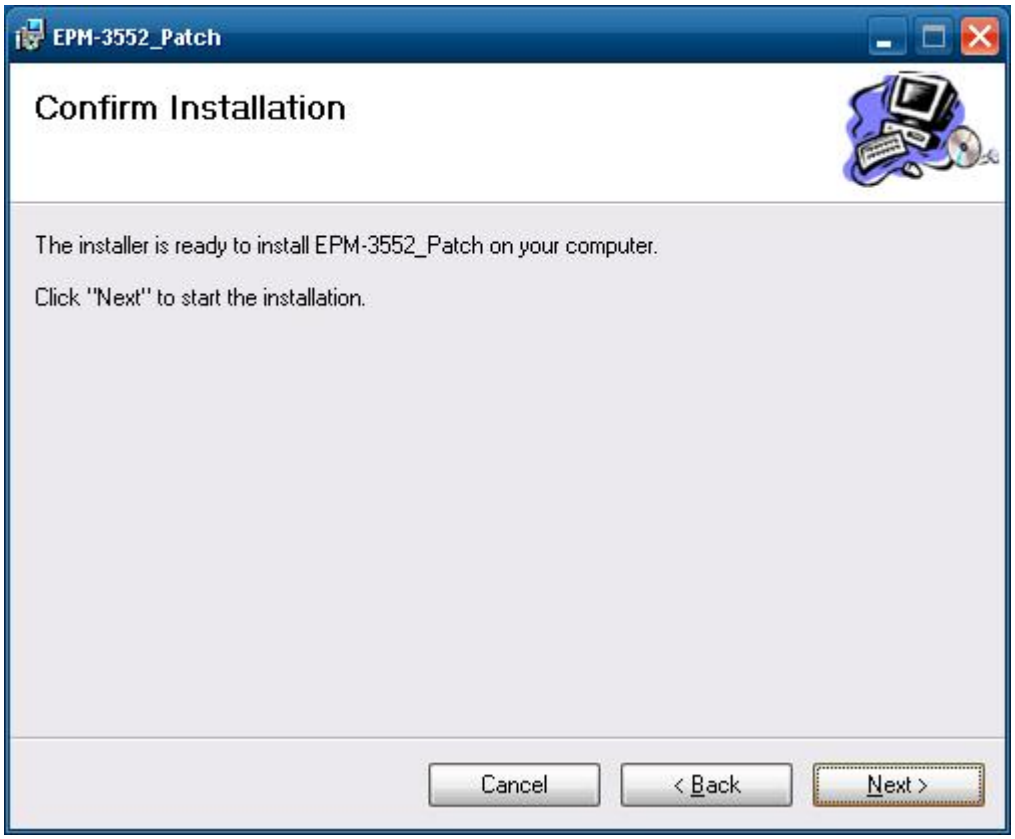
Installing the Patch File

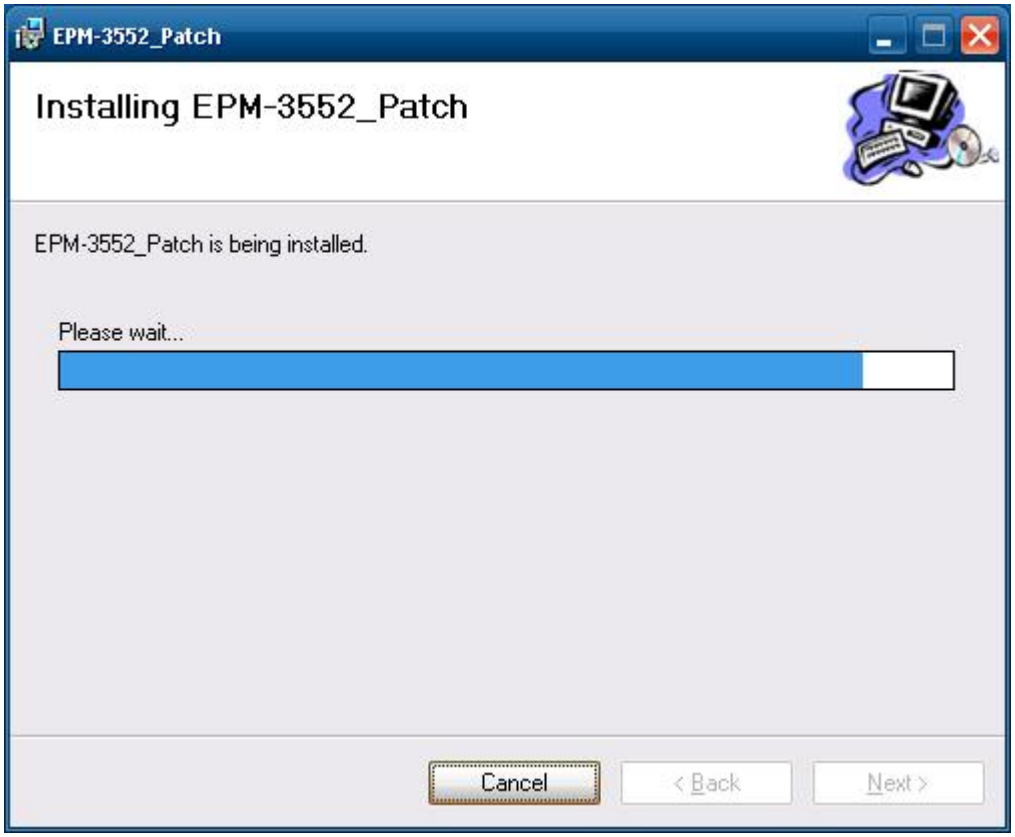
1. Download the patch file from http://www.moxa.com/support.
2. Double click **Setup.exe** to start the **Setup Wizard**, and then click **Next** to continue.



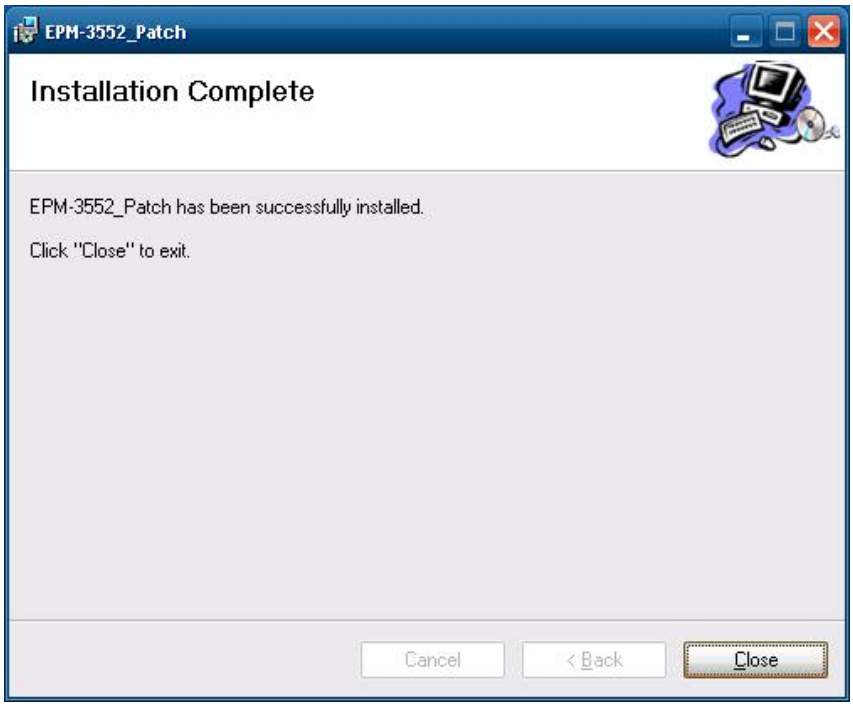
3. Click **Next** to continue.

4. Click **Next** to install the patch file.





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



6. Restart the computer by clicking **Start ➔ Turn Off Computer ➔ Restart**.

EPM-DK02 Driver Installation

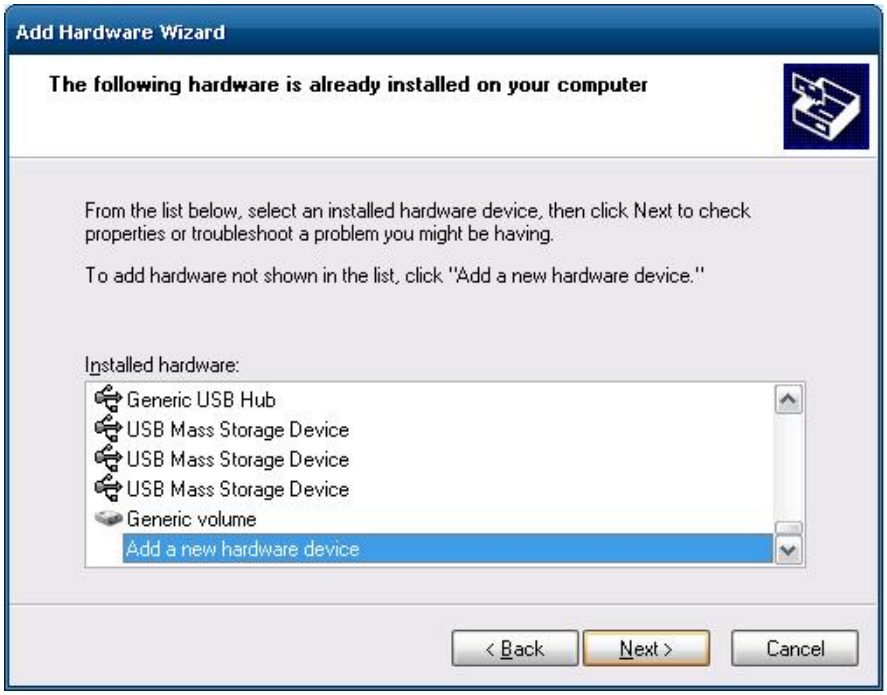
The driver must be installed before using the power control function. Take the following steps to install the driver:

1. Click **Add Hardware** from the control panel.

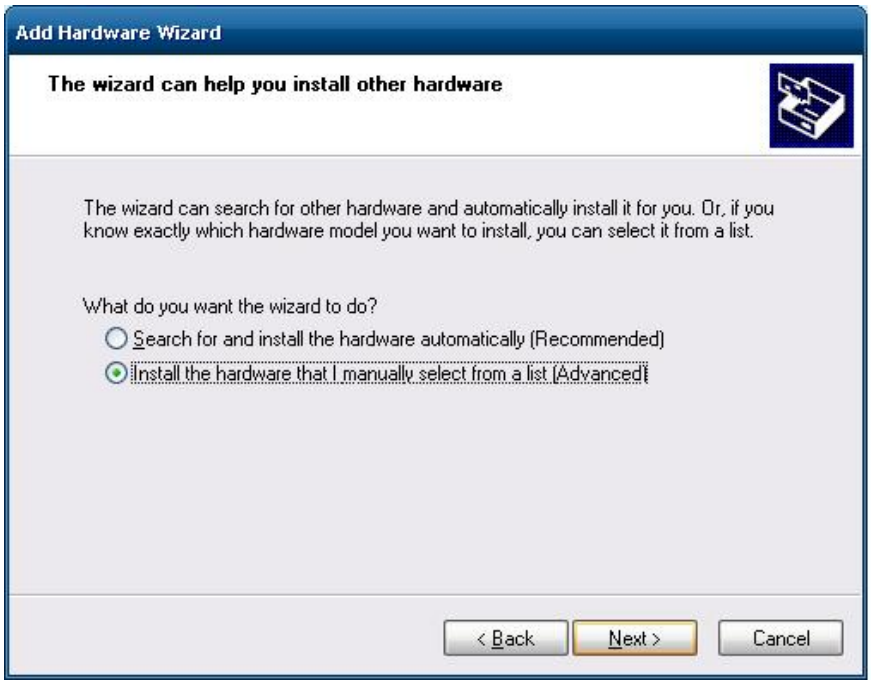
2. Click **Next**.

3. Select **Yes, I have already connected the hardware.**

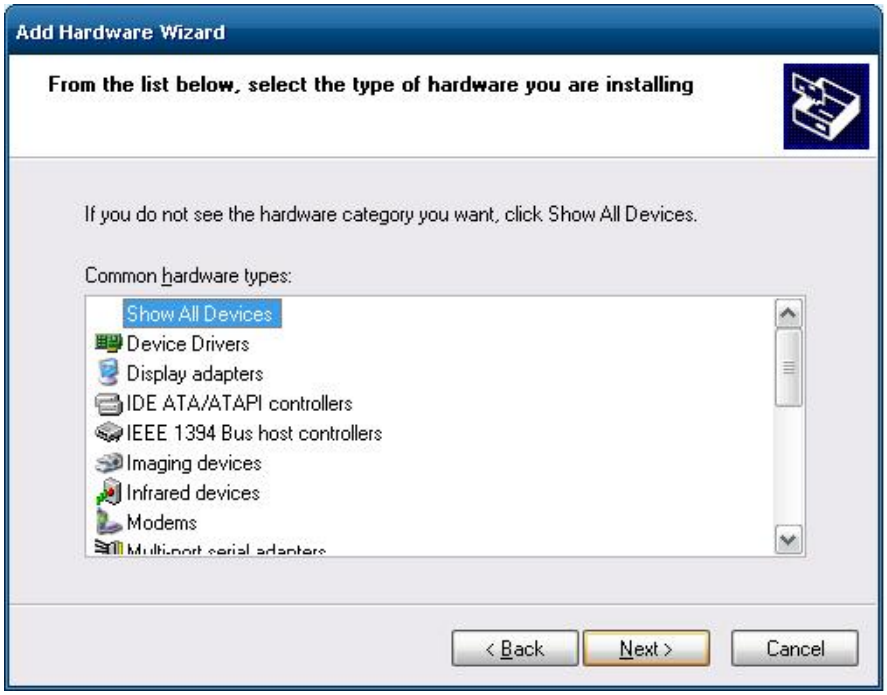
4. Select **Add a new hardware device**, and click **Next**.



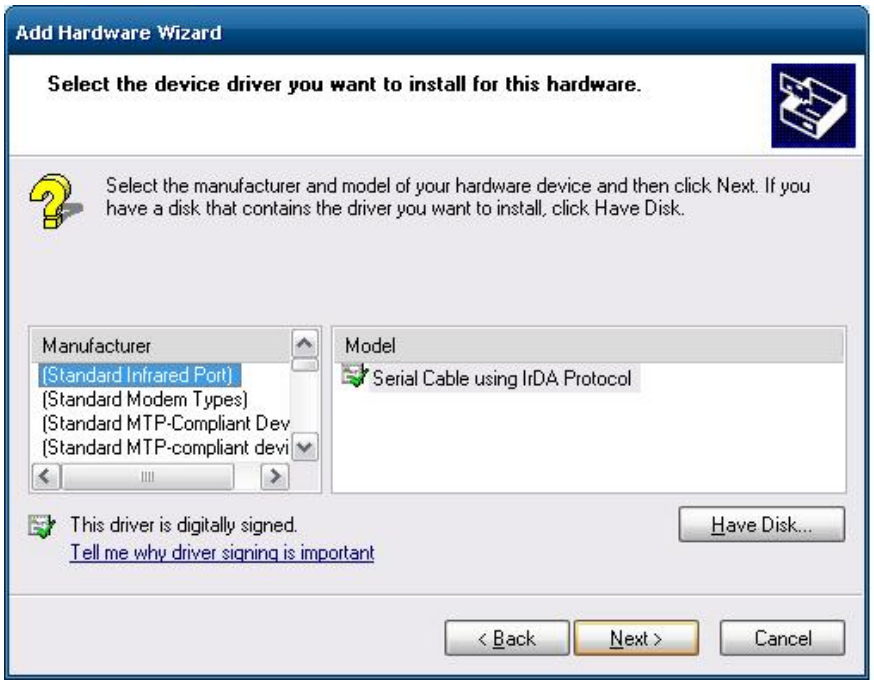
5. Select **Install the hardware that I manually select from a list (Advanced)** and click **Next**.



6. Select **Show All Devices** and click **Next**.

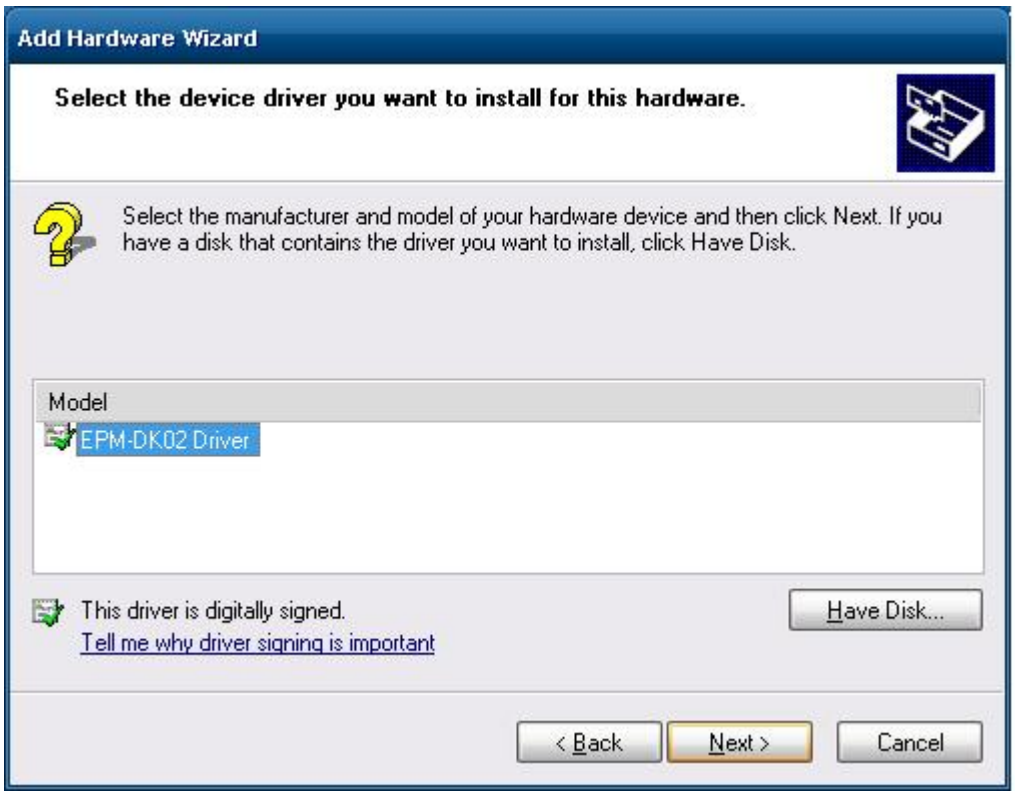


7. Click **Have Disk.**



8. Select the **mxdk02.inf** from the path **EPM-DK02\driver** in the CD-ROM, and click **OK**.

9. Select Model and click **Next**.



10. Click **Next**.

11. Click **Finish** to complete.

Controlling EPM-DK02 Power On/Off

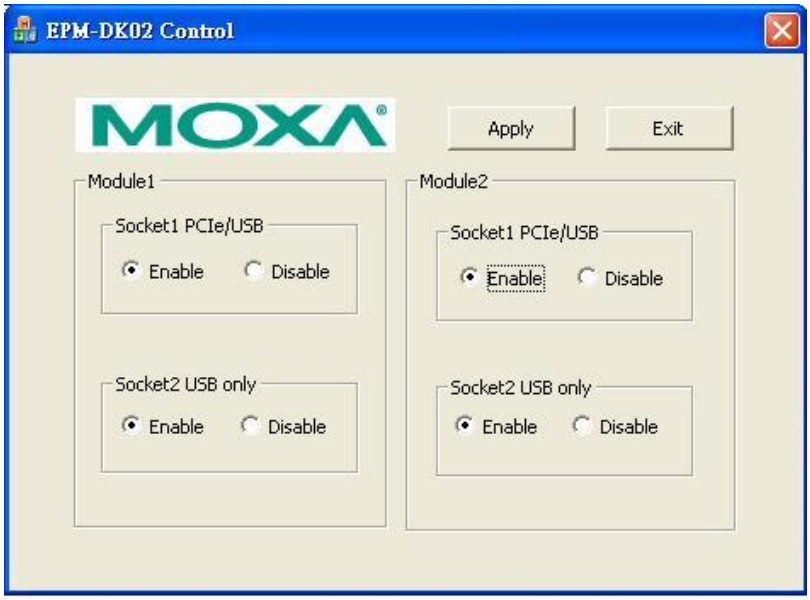
The EPM-DK02 module provides a power control function that lets you control the power of a USB device so that you can enable or disable the device. This section introduces how to configure this function to enable/disable a USB DOM.

Note that the power on/off control function is only suitable for devices that have a USB interface. If you are using a device with a PCIe interface, do not enable the power on/off control function, since doing so could damage the device.

Getting current power status

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

1. Execute **mx-dk02-control_mfc.exe**, located on the CD-ROM at **EPM-DK02\examples\C++\EPM-DK02_Example_Build_11060819\release**.

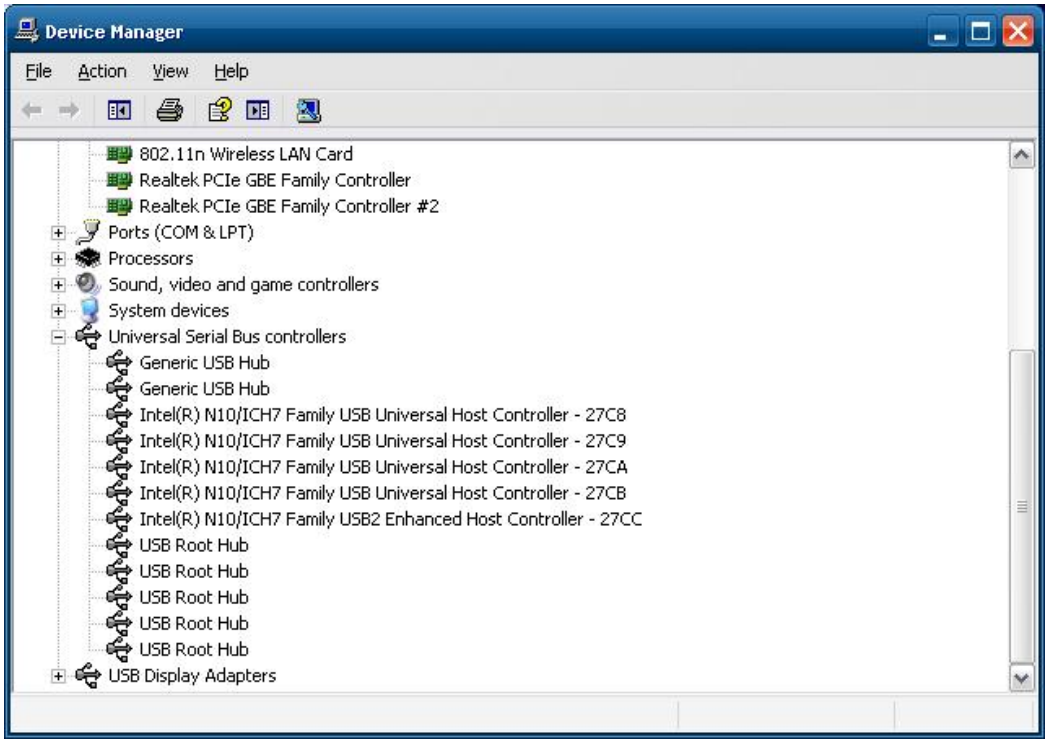


2. Check if current power status is enabled or disabled.

Disabling Socket Power

Take the following steps to disable the USB power-on socket:

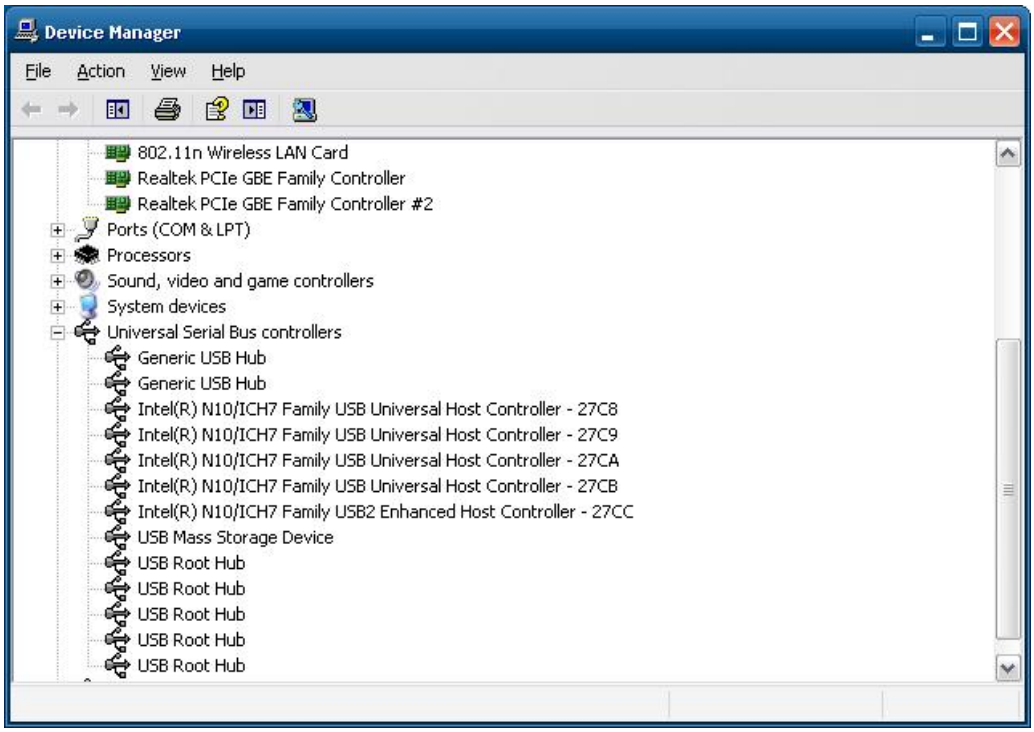
1. Execute **mx-dk02-control_mfc.exe.**
2. Select the socket and change the status.
3. Clicks apply to take effect.
4. Check if the device is disabled.



Enabling Socket Power

Take the following steps to enable the USB power-on socket:

1. Execute **mx-dk02-control_mfc.exe.**
2. Select the socket and change the status.
3. Clicks apply to take effect.
4. Check if the device is enabled

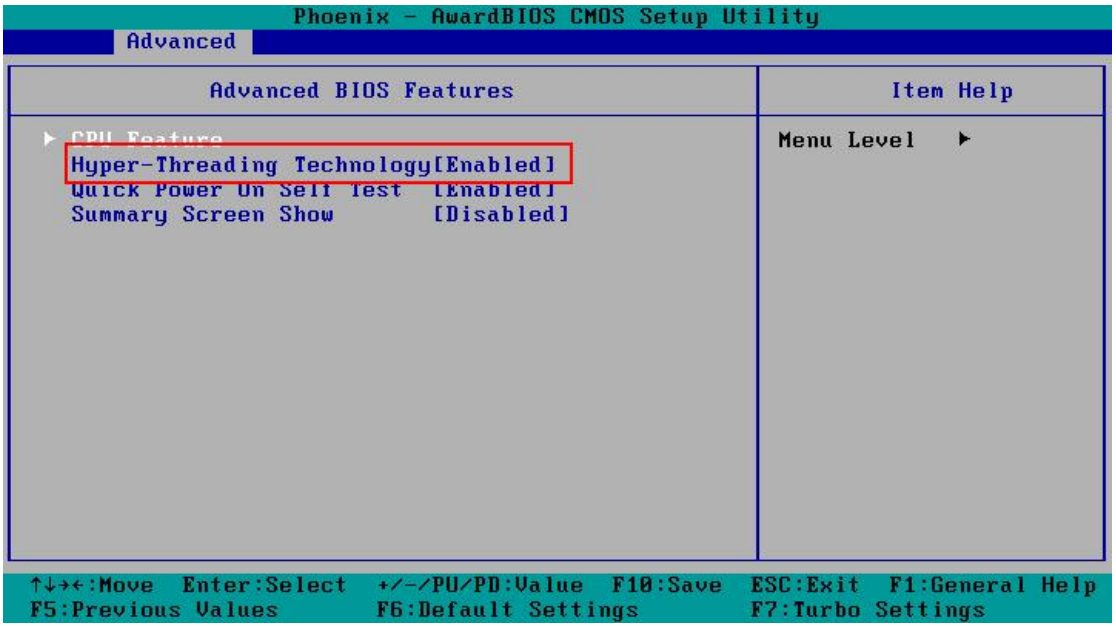


A

Video Performance Table for the EPM-3552 Module

The EPM-3552 is a display module that provides a VGA and DVI output function for V2422and V2426 computers. The module is used as the additional display option apart from the VGA/DVI provided by the V2422 and V2426 computers. Moxa provides the display performance tables so that users can optimize the EPM-3552 for specific applications.

This table was produced from an actual performance test with the following parameters: video codec, audio codec, film resolution, frame per second, and bit rates. We strongly suggest that you enable the **Hyper-Threading Technology** function in the BIOS to ensure better performance of the EPM-3552 display module.



If you would like to use high resolution solutions for your applications, we suggest using the onboard VGA/DVI outputs on the V2422/2426 computers. The EPM-3552 display module is suitable for the applications that require lower resolution for displaying text and small-size figures.

EPM-3552 Display Module Performance on Linux Systems

Player		mplayer 1.0rc2-4.3.2-DFSG-free					On-board VGA/DVI performance on V24XX		VGA/DVI performance on EPM-3552		
					Model		V2422/2426-LX		EPM-3552-LX		
	Container	Video Codec	Audio Codec	Resolution	FPS	BitRate (kbps)	System CPU loading	Media Player /CPU loading	System CPU loading	Media Player/CPU loading	Suggested Configuration
WMV3X	WMV	WMV3x	WMA9	1920 x 1080	29.97	15000	51.4	47.5	46.6	30.7	
	WMV	WMV3x	WMA9	1680 x 1050	29.97	12000	50.7	46.8	48.8	33	
	WMV	WMV3x	WMA9	1440 x 900	29.97	10000	50.1	46	49.9	33.5	
	WMV	WMV3x	WMA9	1280 x 720	29.97	8000	41	38.5	45.8	31.1	
	WMV	WMV3x	WMA9	1024 x 600	29.97	7000	29.8	28.4	48.3	33.9	
	WMV	WMV3x	WMA9	800 x 480	29.97	6000	20.9	20.1	33.9	23.8	
	WMV	WMV3x	WMA9	640 x 400	29.97	4000	14.4	13.7	22.7	16.2	
	WMV	WMV3x	WMA9	320 x 200	29.97	2000	6.5	6	8.1	6.5	★
WMV2X	WMV	WMV2x	WMA8	1920 x 1080	29.97	15000	49.1	45.5	46.7	32.4	
	WMV	WMV2x	WMA8	1680 x 1050	29.97	12000	48.8	44.9	48	33.4	
	WMV	WMV2x	WMA8	1440 x 900	29.97	10000	47	43.1	48.4	34	
	WMV	WMV2x	WMA8	1280 x 720	29.97	8000	42	38	46.4	32.5	
	WMV	WMV2x	WMA8	1024 x 600	29.97	7000	28.1	26.8	44.3	31.7	★
	WMV	WMV2x	WMA8	800 x 480	29.97	6000	18.9	18	29.9	21.2	★
	WMV	WMV2x	WMA8	640 x 400	29.97	4000	13	12.3	20	14.2	★
	WMV	WMV2x	WMA8	320 x 200	29.97	2000	6	5.4	7.1	5.6	★
MPEG-2	MPEG-PS	MPEG-2	ac3	1920 x 1080	29.97	15000	43.64	39.2	32	17.1	
	MPEG-PS	MPEG-2	ac3	1680 x 1050	29.97	12000	36.6	32.9	33.7	18.4	
	MPEG-PS	MPEG-2	ac3	1440 x 900	29.97	10000	27.9	25.4	34.4	18.8	
	MPEG-PS	MPEG-2	ac3	1280 x 720	29.97	8000	20.7	18.6	31.5	17.2	
	MPEG-PS	MPEG-2	ac3	1024 x 600	29.97	7000	15.2	13.6	32.2	17.8	★
	MPEG-PS	MPEG-2	ac3	800 x 480	29.97	6000	10.9	9.7	22.7	13	★
	MPEG-PS	MPEG-2	ac3	640 x 400	29.97	4000	7.6	6.5	16.1	9.1	★
	MPEG-PS	MPEG-2	ac3	320 x 200	29.97	2000	3	2.5	4.9	3.1	★
H.264 / MPEG-4	MPEG-4	H.264/M 4 AVC	M4 AAC	1920 x 1080	29.97	15000	51.7	47.4	41.7	27.6	
	MPEG-4	H.264/M 4 AVC	M4 AAC	1680 x 1050	29.97	12000	51.5	47.3	44.6	29.7	
	MPEG-4	H.264/M 4 AVC	M4 AAC	1440 x 900	29.97	10000	44.7	42.1	45.6	30.2	
	MPEG-4	H.264/M 4 AVC	M4 AAC	1280 x 720	29.97	8000	33	31.6	42.4	28.9	
	MPEG-4	H.264/M 4 AVC	M4 AAC	1024 x 600	29.97	7000	24.5	23.4	42.4	29.1	★
	MPEG-4	H.264/M 4 AVC	M4 AAC	800 x 480	29.97	6000	18.2	17.6	30.3	21	★
	MPEG-4	H.264/M 4 AVC	M4 AAC	640 x 400	29.97	4000	12.9	11.9	20.8	14.6	★
	MPEG-4	H.264/M 4 AVC	M4 AAC	320 x 200	29.97	2000	5.9	5.5	7.4	5.8	★

AVI	AVI	MS/MPG 4v2	pcm	1920 x 1080	29.97	15000	48.8	42.7	35.2	19.9	
	AVI	MS/MPG 4v2	pcm	1680 x 1050	29.97	12000	38.3	34.2	36	21.1	
	AVI	MS/MPG 4v2	pcm	1440 x 900	29.97	10000	28.9	26	36.7	21.2	
	AVI	MS/MPG 4v2	pcm	1280 x 720	29.97	8000	21.4	19.2	34.2	19.4	
	AVI	MS/MPG 4v2	pcm	1024 x 600	29.97	7000	15.9	14.1	32.7	19.2	★
	AVI	MS/MPG 4v2	pcm	800 x 480	29.97	6000	10.6	9.4	22.6	13.2	★
	AVI	MS/MPG 4v2	pcm	640 x 400	29.97	4000	7.2	6.1	15.4	8.8	★
	AVI	MS/MPG 4v2	pcm	320 x 200	29.97	2000	2.74	2	4.4	2.6	★
AVI (DivX)	AVI	DivX-5	mp3	1920 x 1080	29.97	15000	49.1	42.6	35.8	20.4	
	AVI	DivX-5	mp3	1680 x 1050	29.97	12000	37.9	34.4	36.8	21.4	
	AVI	DivX-5	mp3	1440 x 900	29.97	10000	28.6	26.1	36.9	21.7	
	AVI	DivX-5	mp3	1280 x 720	29.97	8000	21.5	19.6	34	20	
	AVI	DivX-5	mp3	1024 x 600	29.97	7000	15.9	14.2	33.8	20	★
	AVI	DivX-5	mp3	800 x 480	29.97	6000	10.9	9.8	23	13.6	★
	AVI	DivX-5	mp3	640 x 400	29.97	4000	7.5	6.6	16	9.3	★
	AVI	DivX-5	mp3	320 x 200	29.97	2000	3.2	2.8	5	3.4	★

EPM-3552 Display Module Performance on Windows Systems

Player	**Media Player Classic - Home Cinema v1.4.1.2834**					**On-board VGA/DVI performance on V24XX**		**VGA/DVI performance on EPM-3552**		
Film Parameters						**V2422/V2426-XPE**		**EPM-3552**		
Container	Video Codec	Audio Codec	Resolution	FPS	BitRate (KBS/)	System CPU loading	Media Player /CPU loading	System CPU loading	Media Player/CPU loading	Suggested Configuration
WMV	WMV3x	WMA9	1920 x 1080	29.97	15000	52.4	50.6	95.9	47.8	
WMV	WMV3x	WMA9	1680 x 1050	29.97	12000	52	50.1	96.7	48.5	
WMV	WMV3x	WMA9	1440 x 900	29.97	10000	50.1	48.4	92.7	47.9	
WMV	WMV3x	WMA9	1280 x 720	29.97	8000	37.7	35.7	90.4	46.6	
WMV	WMV3x	WMA9	1024 x 600	29.97	7000	29.2	27.7	74.9	35.8	
WMV	WMV3x	WMA9	800 x 480	29.97	6000	23.1	21.6	67	26.3	★
WMV	WMV3x	WMA9	640 x 400	29.97	4000	23.5	21.9	53.6	22	★
WMV	WMV3x	WMA9	320 x 200	29.97	2000	10.5	9	23.1	10.7	★
WMV	WMV2x	WMA8	1920 x 1080	29.97	15000	48.1	46.9	92.5	47.2	
WMV	WMV2x	WMA8	1680 x 1050	29.97	12000	46.1	44.8	91.8	46.4	
WMV	WMV2x	WMA8	1440 x 900	29.97	10000	38.1	36.4	86.1	44.8	
WMV	WMV2x	WMA8	1280 x 720	29.97	8000	29.4	28	75.7	36.4	
WMV	WMV2x	WMA8	1024 x 600	29.97	7000	21.2	19.7	63.9	25.3	★
WMV	WMV2x	WMA8	800 x 480	29.97	6000	19.3	17.9	57	19.2	★
WMV	WMV2x	WMA8	640 x 400	29.97	4000	17.6	16.2	47.4	19.6	★
WMV	WMV2x	WMA8	320 x 200	29.97	2000	8.1	6.7	19.5	8.3	★

MPEG-PS	MPEG-2	ac3	1920 x 1080	29.97	15000	42.6	40.9	95.4	47.4	
MPEG-PS	MPEG-2	ac3	1680 x 1050	29.97	12000	36.2	34.7	94.5	46.4	
MPEG-PS	MPEG-2	ac3	1440 x 900	29.97	10000	28.1	26.7	80.4	34	★
MPEG-PS	MPEG-2	ac3	1280 x 720	29.97	8000	21.7	20.1	68.8	24.9	★
MPEG-PS	MPEG-2	ac3	1024 x 600	29.97	7000	17	15.5	60.5	19.2	★
MPEG-PS	MPEG-2	ac3	800 x 480	29.97	6000	12.8	11.6	54.6	14.1	★
MPEG-PS	MPEG-2	ac3	640 x 400	29.97	4000	9.6	8.3	39.6	10.8	★
MPEG-PS	MPEG-2	ac3	320 x 200	29.97	2000	5.3	3.9	16.7	5.8	★
MPEG-4	H.264/M4 AVC	M4 AAC	1920 x 1080	29.97	15000	54.3	51.8	91.7	44.4	
MPEG-4	H.264/M4 AVC	M4 AAC	1680 x 1050	29.97	12000	43.9	43.1	93.1	45.2	
MPEG-4	H.264/M4 AVC	M4 AAC	1440 x 900	29.97	10000	36.6	35.1	85.4	41.4	
MPEG-4	H.264/M4 AVC	M4 AAC	1280 x 720	29.97	8000	28.5	26.8	77.6	34.2	★
MPEG-4	H.264/M4 AVC	M4 AAC	1024 x 600	29.97	7000	21.8	20.3	67	26.1	★
MPEG-4	H.264/M4 AVC	M4 AAC	800 x 480	29.97	6000	16.5	15	60.5	19.1	★
MPEG-4	H.264/M4 AVC	M4 AAC	640 x 400	29.97	4000	11.9	10.4	43.5	14.2	★
MPEG-4	H.264/M4 AVC	M4 AAC	320 x 200	29.97	2000	6.7	5.1	17.9	6.2	★
AVI	MS/MPG4v2	pcm	1920 x 1080	29.97	15000	51.8	50.1	94.2	48.3	
AVI	MS/MPG4v2	pcm	1680 x 1050	29.97	12000	51.4	49.9	92.7	48	
AVI	MS/MPG4v2	pcm	1440 x 900	29.97	10000	51.4	49.6	89.6	47.8	
AVI	MS/MPG4v2	pcm	1280 x 720	29.97	8000	50.6	49.1	88.2	47.8	
AVI	MS/MPG4v2	pcm	1024 x 600	29.97	7000	36.4	35	78.4	40.8	
AVI	MS/MPG4v2	pcm	800 x 480	29.97	6000	24.9	23.4	67.7	27.2	★
AVI	MS/MPG4v2	pcm	640 x 400	29.97	4000	17.1	15.5	48.9	18.2	★
AVI	MS/MPG4v2	pcm	320 x 200	29.97	2000	6.1	4.6	17	5.4	★
AVI	DivX-5	mp3	1920 x 1080	29.97	15000	47.9	46.3	78.5	34.4	
AVI	DivX-5	mp3	1680 x 1050	29.97	12000	41.8	39.9	81.3	36.6	
AVI	DivX-5	mp3	1440 x 900	29.97	10000	33.5	31.9	85.7	41.1	
AVI	DivX-5	mp3	1280 x 720	29.97	8000	27.1	25.4	74.6	32.2	★
AVI	DivX-5	mp3	1024 x 600	29.97	7000	19.7	18.2	64.6	23.3	★
AVI	DivX-5	mp3	800 x 480	29.97	6000	14.9	13.2	56.8	16.6	★
AVI	DivX-5	mp3	640 x 400	29.97	4000	10.9	9.4	39.8	12.5	★
AVI	DivX-5	mp3	320 x 200	29.97	2000	6.4	4.9	17.1	5.6	★