



**STARTERKIT**

**EVBQE128**

**Evaluation Board  
for Freescale  
Flexis QE128**

**User's Manual**



**SofTec™  
Microsystems**



# **EVBQE128**

## **Evaluation Board for Freescale Flexis QE128 Microcontrollers (80-Pin LQFP)**

### **User's Manual**

Revision 1.1



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# 1 Introduction

## 1.1 Overview

The EVBQE128 Evaluation Board has been designed for the evaluation, demonstration and debugging of the Freescale Flexis QE128 Microcontrollers (MC9S08QE128 and MCF51QE128).

The EVBQE128 can be used as a standalone application or can be controlled by a host PC via its built-in microDART™ interface.

## 1.2 Package Contents

The EVBQE128 package includes the following items:

- The EVBQE128 evaluation board;
- 80-pin LQFP MC9S08QE128 and MCF51QE128 microcontrollers;
- A USB cable;
- A pick-up vacuum pump;
- A universal, 12 V DC power supply;
- System software DVD-ROM, including CodeWarrior™ Development Studio;
- A Quick Start Guide sheet.

## 1.3 Supported Devices

The EVBQE128 Evaluation Board supports the following devices:

- MC9S08QE128;
- MCF51QE128;
- And any other pin-to-pin compatible devices.

## 1.4 Recommended Reading

- Freescale microcontroller-specific datasheets and application notes;
- EVBQE128 Schematic.





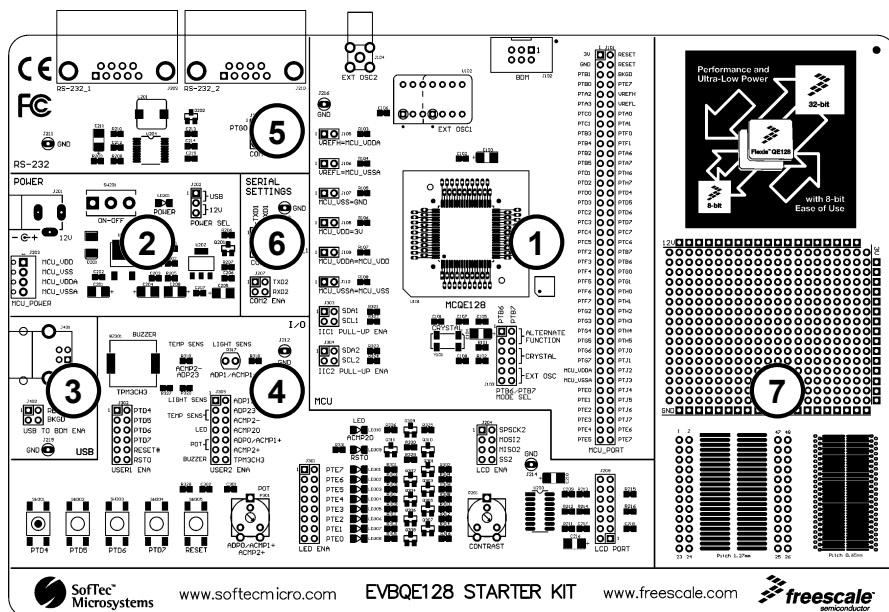
## 2 Hardware Features

### 2.1 Evaluation Board Features

The EVBQE128 board features:

1. An "MCU" section containing:
  - An 80-pin LQFP socket accepting either the MC9S08QE128 or the MCF51QE128 microcontroller;
  - A crystal oscillator, a provision for a clock module, a provision for a connector for providing an external clock source, together with jumpers to select the clock source;
  - A BDM connector for in-circuit debugging/programming with an external instrument;
  - A female header connectors with all of the MCU signals.
2. A power supply section containing:
  - A 12 V DC barrel input connector (2.1 mm);
  - A four-way micro terminal block for providing specific power supplies and voltage references to the microcontroller;
  - A jumper to select the power supply source (USB bus or barrel connector);
  - A power on/off switch.
3. A built-in "microDART INTERFACE" section (with the main circuitry mounted on the back of the board) which allows the host PC to communicate with the microcontroller through a standard USB interface. Jumpers are present to configure this module. Thanks to the microDART in-circuit debugging firmware, BDM commands are sent to the target microcontroller through the USB bus. Additionally, a virtual COM port is automatically available over the same USB connection. This virtual COM port can be used by standard terminal programs, like HyperTerminal, to send/receive serial characters to/from the target microcontroller.
4. An "I/O" section containing:
  - A Reset push-button;
  - Four additional push-button;
  - One potentiometer;
  - Eight dip-switches;

- A piezoelectric buzzer;
  - A light sensor;
  - A temperature sensor;
  - Ten user LEDs;
  - A circuitry for driving and external LCD;
  - A series of jumpers to connect/disconnect the above controls to/from the microcontroller.
5. An “RS-232” section containing two RS-232 connectors together with a jumper to enable the RS-232 communication.
  6. A “SERIAL SETTINGS” section containing jumpers to select communication options.
  7. A prototype area.



The EVBQE128 Evaluation Board

## 2.2 microDART Interface

Thanks to the microDART in-circuit debugging firmware, CodeWarrior can send BDM commands to the target microcontroller through the USB bus.

Additionally, when you plug the USB cable into the PC, a “virtual” COM port is automatically created and, through this port, serial data can be transferred to/from the target microcontroller. In other words, a terminal application such as HyperTerminal is able to use the virtual COM port as if it were a normal COM port and send and receive characters normally.

This serial communication and BDM communication work simultaneously: CodeWarrior can be used to work with the target microcontroller while HyperTerminal sends and receives characters.

### **2.2.1 Hot Plug-In**

The “Hot Plug-In” feature gives you the possibility to connect to a target microcontroller that is running an application and to trace and debug the current running code without the need of a complete erase and re-program of the flash memory.



## 3 Software Setup

### 3.1 Overview

Before connecting the Evaluation Board to the PC, it is recommended that you install CodeWarrior first, so that the appropriate USB driver will be automatically found by Windows when you connect the Evaluation Board.

### 3.2 Host System Requirements

The Evaluation Board is controlled by CodeWarrior Development Studio. The following hardware and software are required to run the CodeWarrior user interface together with the Evaluation Board:

- A 200-MHz (or higher) PC compatible system running Windows 2000 or Windows XP;
- 128 MB of available system RAM plus 1 GB of available hard disk space;
- A USB port;
- DVD-ROM drive for installation.

### 3.3 Installing CodeWarrior Development Studio

To install the CodeWarrior Development Studio, insert the CodeWarrior DVD-ROM into your computer's DVD-ROM drive. A startup window will automatically appear. Follow the on-screen instructions.



## 4 Hardware Setup

### 4.1 First Connection

The Evaluation Board is connected to a host PC through a USB port. Connection steps are listed below in the recommended flow order:

1. Install all the required system software as described in the previous section.
2. Power the board through either the barrel connector or the USB connector, making sure that the "POWER SEL" jumper selects the correct power source.
3. Make sure the "ON-OFF" switch is in the "ON" position. The "POWER" LED will turn on.
4. Insert one end of the USB cable into a free USB port of the PC.
5. Insert the other end of the USB cable into the USB connector on the Evaluation Board.
6. The first time the Evaluation Board is connected to the PC, Windows recognizes the instrument and starts two separate "**Found New Hardware Wizard**" procedures: one for the main USB driver and one for the USB virtual COM port driver.
7. The first "**Found New Hardware Wizard**" procedure asks you to specify the USB driver to use for the instrument. On Windows XP (SP2) the following dialog box will appear.



Select the "**No, not this time**" option and click the "**Next >**" button.

8. The following dialog box will appear.



Click the **“Next >”** button.

9. Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear.



Click the **“Finish”** button to exit from the **“Found New Hardware Wizard”** procedure.

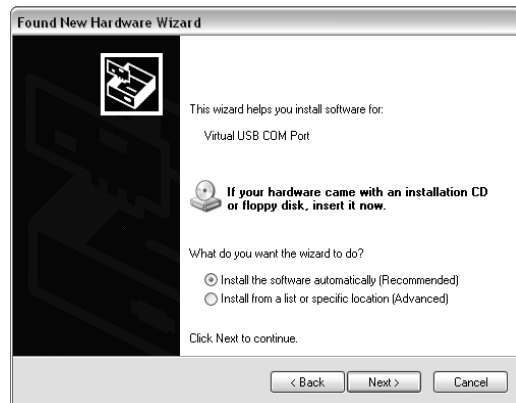
10. The Evaluation Board's main USB driver is now installed on your system.
11. The second **“Found New Hardware Wizard”** procedure asks you to specify the USB virtual COM driver to use. On Windows XP (SP2) the following dialog box will appear.





Select the **“No, not this time”** option and click the **“Next >”** button.

12. The following dialog box will appear.



Click the **“Next >”** button.

13. Depending on your Windows settings, the following warning may appear.



**Note:** *this warning is related to the fact that the USB driver used by the Evaluation Board is not digitally signed by Microsoft, and Windows considers it to be potentially malfunctioning or dangerous for the system. However, you can safely ignore the warning, since every kind of compatibility/security test has been carried out by SofTec Microsystems.*

Click the **“Continue Anyway”** button.

14. Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear.



Click the **“Finish”** button to exit from the **“Found New Hardware Wizard”** procedure.

15. The Evaluation Board's USB virtual COM driver is now installed on your system.

# 5 Operating Modes

## 5.1 Overview

The Evaluation Board can work in two modes: “standalone” mode and “host” mode.

## 5.2 Standalone Mode

In standalone mode, no PC connection is required. Both microcontrollers are factory programmed with the same sample application.

To run the built-in example:

1. Power off the board.
2. Put either the MC9S08QE128 or MCF51QE128 microcontroller in the socket.
3. Ensure that all of the jumpers in the “I/O” sections are inserted.
4. Power on the board.
5. Press the “PTD4” push-button. The value of the ADP0/PTA0 potentiometer will be displayed on the PTE[7..0] LEDs.
6. Press the “PTD5” push-button. The value of the light sensor will be displayed on the PTE[7..0] LEDs.
7. Press the “PTD6” push-button. The ADP0/PTA0 potentiometer will vary the frequency of the sound played by the buzzer.
8. Press the “PTD7” push-button. The value of the temperature sensor will be displayed on the PTE[7..0] LEDs.

The output of the potentiometer, light sensor and temperature sensor is also sent to the host PC (if connected) through the virtual COM port over the USB connection. To see the data sent to the virtual COM port, do the following:

1. Ensure that the J206 jumpers (“COM1 ENA”) select the “MDI” position;
2. Connect the board to the PC through the USB connection;
3. Start your terminal utility (e.g. HyperTerminal) with these parameters:

Baud rate: 9600  
Data bits: 8  
Parity: None  
Stop bits: 1  
Flow control: None

## 5.3 Host Mode

In host mode the program execution is controlled by the host PC through the “USB” connector. You can use the PC to debug the application by, for example, executing the program step by step and watching how the microcontroller registers vary, using the provided CodeWarrior Development Studio.



**Note:** *the MC9S08QE128 and MCF51QE128 devices contain a single-wire background debug interface which supports in-circuit programming of on-chip non-volatile memory. This system does not interfere with normal application resources. It does not use any user memory or locations in the memory map. The Background Debug Module (also known as Background Debug Controller, BDC) uses a single-wire communication interface (via the BKGD line) to allow non-intrusive access to target system memory and registers.*

To work in host mode (using the built-in microDART interface):

- Make sure that the board is powered on;
- Make sure that the “RESET” and “BKGD” jumpers in the “microDART INTERFACE” section are inserted;
- Connect the host PC to the board through the provided USB cable.

# 6 Application Tutorial

## 6.1 Overview

MC9S08QE128 and MCF51QE128 devices share the same peripherals and registers. Software written for one device can be easily recompiled for the other.

This section will provide a step-by-step guide on how to launch a MC9S08QE128-based project and get started with the CodeWarrior user interface. Later, the same project will be converted for the MCF51QE128 device.

## 6.2 MC9S08QE128 Step-by-Step Tutorial

The sample application is the same as the one described in the *“Standalone Mode”* section above.

1. Make sure that the MC9S08QE128 device is present in the socket.
2. Set up the board so that it works in host mode (see “Host Mode” above).
3. Ensure that the Evaluation Board is connected to the PC (via the USB cable) and that the board is powered on.
4. Start CodeWarrior by selecting it in the Windows Start menu.
5. From the CodeWarrior main menu, choose **“File > Open”** and choose the **“\Program Files\Freescale\[CodeWarrior Folder]\(CodeWarrior Examples)\HCS08\Evaluation Board Examples\EVBQE128\C\Demo\Demo.mcp”**.
6. Click **“Open”**. The *Project* window will open.
7. The code of this example is contained in the **“main.c”** file. Double click on it to open.
8. From the main menu, choose **“Project > Debug”**. This will compile the source code, generate an executable file and download it to the evaluation board.
9. A new debugger environment will open. From the main menu, choose **“Run > Start/Continue”**. The program will be executed in real-time.
10. From the main menu, choose **“Run > Halt”**. The program execution will stop. The next instruction to be executed is highlighted in the *Source* window.
11. From the main menu, choose **“Run > Single Step”**. The instruction highlighted in the *Source* window will be executed, and the program execution will be stopped immediately after.
12. From the main menu, choose **“Run > Start/Continue”**. The application will restart from where it was previously stopped.

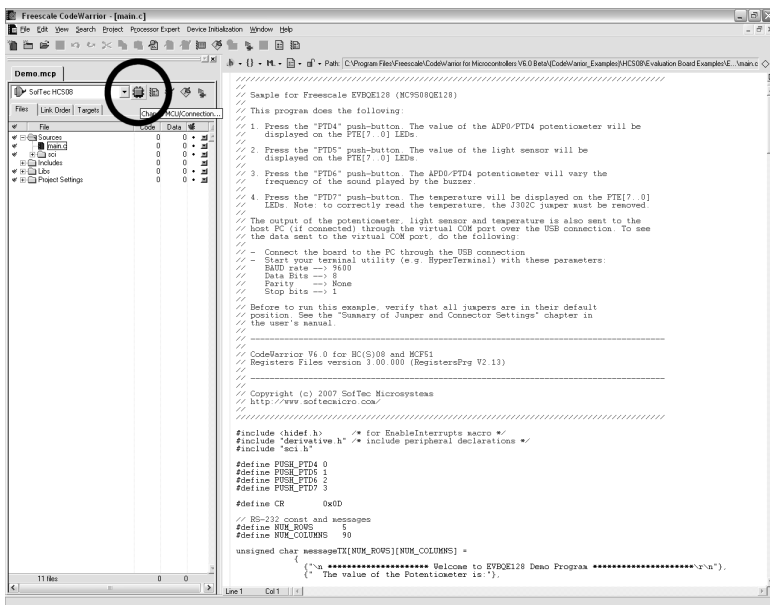
Congratulations! You have successfully completed this tutorial! You can continue to experiment with the CodeWarrior user interface and discover by yourself its potentialities. For

an in-depth guide of all of the user interface features, select **“Help > CodeWarrior Help”** from CodeWarrior Development Studio’s main menu.

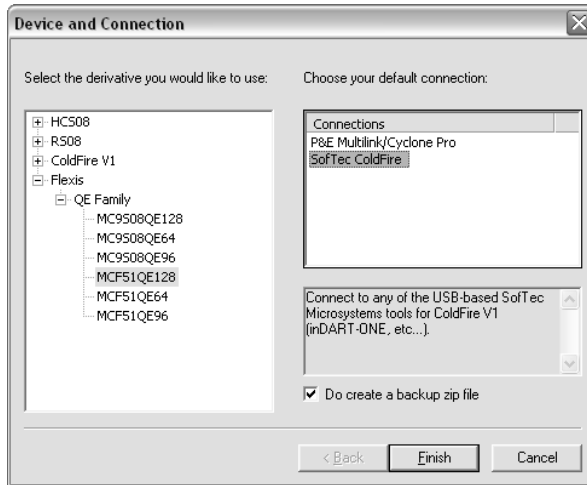
## 6.3 Converting the Example for the MCF51QE128

The same example illustrated above can be easily converted to work with the MCF51QE128 device.

1. Open the project you want to convert. In this case, from the CodeWarrior main menu, choose **“File > Open”** and choose the **“\Program Files\Freescale\CodeWarrior\Examples\HCS08\Evaluation Board Examples\EVBQE128\C\Demo\Demo.mcp”**.
2. In the project pane, click the **“Change MCU/Connection”** button (see below).



The following dialog box will appear.



3. In the tree on the left, choose the **MCF51QE128** device and, on the connections list, choose “**SofTec ColdFire**”. Click the “**Finish**” button. Project conversion is done and the new project is ready to be compiled.

A similar procedure may be used to convert a MCF51QE128 project into a MC9S08QE128 project.

## 6.4 Additional Examples

Two additional examples are provided:

- **DemoLCD.** Shows how to drive the optional 16x2 LCD controller. A string is shifted from right to left on the first LCD row. Any LCD based on the HD44780U (LCD-II) controller is correctly driven. Make sure to comment/uncomment the appropriate delay line in the `delay.c` file depending on which device you are working with.
- **MicroDartDemo.** Shows how to communicate with the target microcontroller through the microDART interface.





# 7 Hot Plug-In

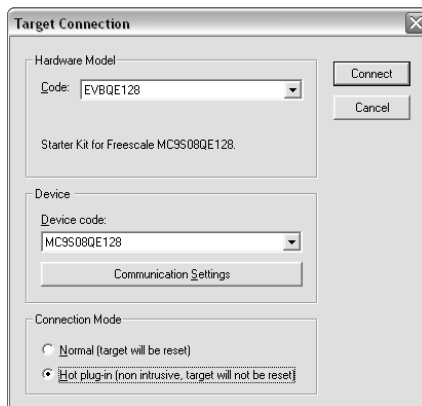
## 7.1 Overview

The “Hot Plug-In” feature gives you the possibility to connect to a target microcontroller that is running an application and to trace and debug the current running code without the need of a complete erase and re-program of the flash memory.

## 7.2 How to Enable Hot Plug-In

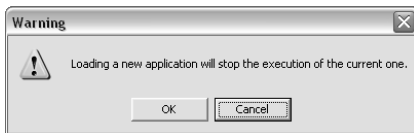
While the target application is running:

1. Launch CodeWarrior.
2. Open the target application project.
3. Start a debugging session (“**Project > Debug**”). The following dialog box will appear.



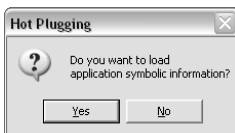
Make sure that the “**Hot plug-in**” connection mode is selected, then click the “**Connect**” button.

4. The following dialog box will appear.



Click "**Cancel**".

5. The following dialog box will appear.

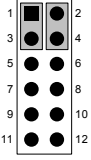

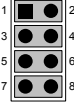





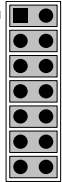
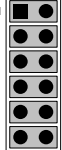


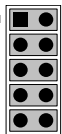
Click "**Yes**". You will enter the debugging environment.


6. After issuing an halt command ("**Run > Halt**"), the Program Counter and all of the other registers are updated with the actual microcontroller values.

## 8 Jumper and Connector Settings

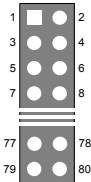



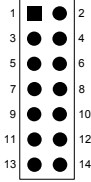
### 8.1 Jumpers

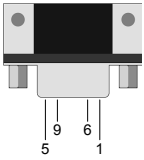
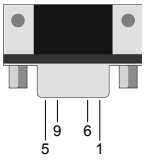

Name	Reference	Description/Pinout
J103		<b>PTB6/PTB7 MODE SELECTION</b>  <b>1-3, 2-4 ("ALT. FUNCTION"):</b> PTB6 and PTB7 lines are used either as I <sup>2</sup> C lines (must be enabled via software) or as user I/Os (default)  <b>5-7, 6-8 ("CRYSTAL"):</b> PTB6 and PTB7 lines are connected to the Y101 crystal oscillator  <b>9-11, 10-12 ("EXT OSC"):</b> PTB6 and PTB7 lines are connected to the U102 external oscillator ("EXT OSC1")
J202		<b>POWER SELECTION</b>  <b>1-2 ("USB"):</b> Power supply is taken from the USB bus <b>2-3 ("12V"):</b> Power supply is taken from the barrel connector (default)
J204		<b>LCD ENABLE</b>  <b>Installed:</b> Connects the SPI2 function of the microcontroller to the LCD driving circuitry (default)  <b>Not Installed:</b> The SPI2 function of the microcontroller is not connected to the LCD driving circuitry
J205		<b>COM ENABLE</b>  <b>1-2 ("ON=1"):</b> Enables the RS-232 transceiver (ANDed with PTG0) (default) <b>2-3 ("OFF"):</b> RS-232 transceiver disabled
J206		<b>MDI/COM1 SELECTION</b>  <b>1-3, 2-4 ("MDI"):</b> TXD1 and RXD1 signals of the microcontroller are routed to the microDART interface (default)  <b>3-5, 4-6 ("COM1"):</b> TXD1 and RXD1 signals of the microcontroller are routed to the RS-232 transceiver

Name	Reference	Description/Pinout
J207		<p><b>COM2 ENABLE</b></p> <p><b>Installed:</b> TXD2 and RXD2 signals of the microcontroller are routed to the RS-232 transceiver (default)</p> <p><b>Not Installed:</b> TXD2 and RXD2 signals of the microcontroller are not routed to the RS-232 transceiver</p>
J301		<p><b>LED ENABLE</b></p> <p><b>Installed:</b> The “PTEx” LEDs are connected to the PTE[7..0] ports of the microcontroller (default)</p> <p><b>Not Installed:</b> The “PTEx” LEDs are not connected to the microcontroller</p>
J302		<p><b>USER1 ENABLE</b></p> <p><b>Installed:</b> Connects the indicated microcontroller signals to the relative I/O device (default)</p> <p><b>Not Installed:</b> The indicated microcontroller signal is not connected to any I/O device</p>
J303		<p><b>IIC1 PULL-UP ENABLE</b></p> <p><b>Installed:</b> Enables 10KOhm pull-up resistors on SDA1 and SCL1 signals of the microcontroller (default)</p> <p><b>Not Installed:</b> Disables 10KOhm pull-up resistors on SDA1 and SCL1 signals of the microcontroller</p>
J304		<p><b>IIC2 PULL-UP ENABLE</b></p> <p><b>Installed:</b> Enables 10KOhm pull-up resistors on SDA2 and SCL2 signals of the microcontroller (default)</p> <p><b>Not Installed:</b> Disables 10KOhm pull-up resistors on SDA2 and SCL2 signals of the microcontroller</p>
J305		<p><b>USER2 ENABLE</b></p> <p><b>Installed:</b> Connects the indicated microcontroller signal to the relative push-button (default)</p> <p><b>Not Installed:</b> The indicated microcontroller signal is not connected to a push-button</p>

Name	Reference	Description/Pinout
J402		<b>USB TO BDM ENABLE</b>  <b>All installed:</b> <b>The microDART interface is enabled (default)</b>  <b>Not Installed:</b> The microDART interface is disabled

## 8.2 Connectors

Name	Reference	Description/Pinout
J101		MCU pin replication
J102		<b>BDM Connector</b> <ol style="list-style-type: none"> <li>1. BKGD</li> <li>2. GND</li> <li>3. N.C.</li> <li>4. RESET</li> <li>5. N.C.</li> <li>6. 3V</li> </ol>
J201		<b>12 V DC Power Supply Input Connector (Barrel, 2.1 mm)</b> <ol style="list-style-type: none"> <li>1. 12 V DC</li> <li>2. GND</li> </ol>
J203		<b>MCU POWER Connector</b> <ol style="list-style-type: none"> <li>1. MCU_VDD</li> <li>2. MCU_VSS</li> <li>3. MCU_VDDA</li> <li>4. MCU_VSSA</li> </ol>
J208		<b>LCD Connector</b> <ol style="list-style-type: none"> <li>1. GND</li> <li>2. 5V</li> <li>3. CONTRAST</li> <li>4. RS</li> <li>5. GND</li> <li>6. EN</li> <li>7. GND</li> <li>8. GND</li> <li>9. GND</li> <li>10. GND</li> <li>11. DB4</li> <li>12. DB5</li> <li>13. DB6</li> <li>14. DB7</li> </ol>

Name	Reference	Description/Pinout
J209		<b>RS-232_1 Connector</b> <ol style="list-style-type: none"> <li>Connected to pins 4, 6</li> <li>TX</li> <li>RX</li> <li>Connected to pins 1, 6</li> <li>GND</li> <li>Connected to pins 1, 4</li> <li>N.C.</li> <li>N.C.</li> <li>N.C.</li> </ol>
J210		<b>RS-232_2 Connector</b> <ol style="list-style-type: none"> <li>Connected to pins 4, 6</li> <li>TX</li> <li>RX</li> <li>Connected to pins 1, 6</li> <li>GND</li> <li>Connected to pins 1, 4</li> <li>N.C.</li> <li>N.C.</li> <li>N.C.</li> </ol>
J401		<b>USB Connector</b> <ol style="list-style-type: none"> <li>5 V DC USB Bus Power Supply Line</li> <li>USB D-</li> <li>USB D+</li> <li>GND</li> </ol>





## 9 Troubleshooting

### 9.1 USB Driver Problems

If you connected the Evaluation Board to the PC before installing CodeWarrior, the Evaluation Board's USB drivers may not have been correctly installed on your system. Unplugging and replugging the USB cable is of no use, since Windows has marked the devices as "disabled". As a consequence, the PC cannot communicate with the Evaluation Board.

To restore/upgrade the USB drivers (provided CodeWarrior has been installed), perform the following steps under Windows XP:

1. Connect the Evaluation Board to the PC.
2. Open the Control Panel (**Start > Settings > Control Panel**).
3. Open the **"System"** options.
4. Select the **"Hardware"** tab.
5. Click the **"Device Manager"** button.
6. Two **"EVBQE128"** devices will be shown with an exclamation mark next to it.
7. For each device, double click on it and, in the **"General"** tab, click the **"Reinstall Driver"** button. Follow the on-screen instructions.

### 9.2 Communication Problems between the PC and the Demo Board

1. Make sure that the "BKGD" and "RESET" jumpers in the "USB" section are inserted.
2. Make sure that the microcontroller is powered:
  - Make sure that the "ON-OFF" switch in the "POWER SUPPLY" section selects the "ON" position;
  - Make sure that the "POWER SEL" jumper in the "POWER" section selects the appropriate power supply source.

### 9.3 Problems with RS-232 Communication

The Jumper J205 allows the user to control the state of the RS-232 transceiver: when the position 1-2 ("ON", default position) is selected, the RS-232 transceiver is enabled (with the aid of an external pull-up), but the user has the option to turn the transceiver off (on) by driving the PTG0 line of the microcontroller low (high).

When the position 2-3 ("OFF") is selected, the RS-232 transceiver is powered off via

hardware, without the need of any microcontroller action, in order to minimize the power consumption of the board.

In order to communicate via the RS-232\_2 COM port, you must remove the "ACMP2-ENA" and "ADP0/ACMP1+ ENA" jumpers. These pins are shared with other I/O functions that can generate hardware conflicts with the RS-232 communication.



