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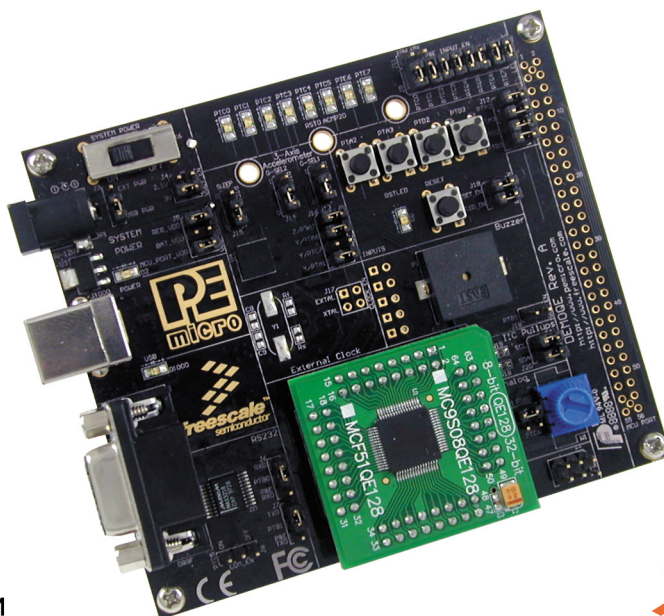
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# DEMO9S08QE8 User Manual



DEMO9S08QE8UM  
Rev. 1.01  
September 2009

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Alliance Member

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Manual version 1.01



1	INTRODUCTION .....	1
1.1	Overview .....	1
1.2	Package Contents .....	1
1.3	Supported Devices .....	1
1.4	Recommended Materials On DEMOQE Resources CD .....	1
1.5	Handling Precautions .....	2
2	HARDWARE FEATURES .....	2
2.1	DEMOQE Base Board Features .....	2
2.2	On-Board Logic Analyzer .....	4
2.3	On-Board Virtual Serial Port .....	4
2.4	DEMOQE Daughter Card Features .....	5
3	SYSTEM SETUP .....	5
3.1	Overview .....	5
3.2	Operating System Requirements .....	5
3.3	Software Setup .....	5
3.4	Quick Startup .....	6
3.5	Hardware Setup .....	7
4	OPERATING MODES .....	10
4.1	Overview .....	10
4.2	Debug Mode .....	10
4.3	Run Mode .....	11
4.4	External BDM Mode .....	11
5	DEMOQE TOOLKIT PC APPLICATIONS .....	11
5.1	DEMOQE Logic Analyzer Application .....	11
5.2	DEMOQE Terminal Application .....	12
5.3	DEMOQE Unsecure Application .....	13
5.4	DEMOQE Accelerometer Demo Application .....	14
5.5	DEMOQE Serial Grapher Application .....	15
6	DEMONSTRATION MICROCONTROLLER APPLICATIONS .....	18
6.1	Quick Start Application .....	18
6.2	Serial Accelerometer Application .....	19

7	JUMPER SETTINGS .....	19
7.1	System Power .....	19
7.2	RS232 Communications .....	21
7.3	LED Display Port .....	23
7.4	Input and Reset Switches .....	23
7.5	3-Axis Accelerometer Jumper Settings .....	25
7.6	Buzzer .....	27
7.7	IIC Pull-up .....	27
7.8	Analog Input Potentiometer .....	28
7.9	Optional External Crystal Circuitry Jumper Enable .....	28
7.10	Optional Jumpers For Various VDD And VSS .....	28
8	DEMO9S08QE8 CODE DEVELOPMENT SOFTWARE .....	29
8.1	Using CodeWarrior With The DEMO9S08QE8 .....	29
8.2	Using P&E Software With The DEMO9S08QE8 .....	29
9	TRANSITIONING TO YOUR OWN TARGET .....	29
9.1	Hardware Solutions At A Glance .....	30
9.2	Working With P&E's USB Multilink .....	31
9.3	Working With P&E's Cyclone PRO .....	32
10	TROUBLESHOOTING .....	33
10.1	DEMO9S08QE8 Is Undetected .....	33
10.2	CodeWarrior Installation Fails (WinDriver Error) .....	34

# **1 INTRODUCTION**

## **1.1 Overview**

The DEMO9S08QE8 is a low-cost development system designed for demonstrating, evaluating, and debugging the Freescale MC9S08QE8 microcontroller. P&E's Embedded Multilink circuitry on the DEMO9S08QE8 board allows the processor on the DEMO9S08QE8 to be debugged and programmed via USB from the PC. In addition, the demo board can be powered using the USB bus.

## **1.2 Package Contents**

The DEMO9S08QE8 package includes the following items:

- DEMOQE Base Board with a MC9S08QE8 Daughter Card installed
- 2-cell AAA battery package
- USB Cable
- Quick Start Guide
- Freescale Warranty Card

## **1.3 Supported Devices**

The DEMO9S08QE8 supports the MC9S08QE8CLC device.

## **1.4 Recommended Materials On DEMOQE Resources CD**

- DEMO9S08QE8 Embedded Multilink hardware interface driver
- DEMO9S08QE8 User Manual (this document)
- DEMO9S08QE8 Quick Start Guide
- DEMO9S08QE8 Quick Start Application Source Code

- DEMO9S08QE8 Base Board and Daughter Cards Schematics
- DEMO9S08QE8 Component Breakdown List
- DEMOQE Toolkit Applications
- Links to P&E Evaluation Software
- Links to Freescale documentation, P&E Discussion Forums, and DEMO9S08QE8 FAQs.

## 1.5 Handling Precautions

Take care to handle the package contents, including the DEMOQE base board and MC9S08QE8 daughter card, in a manner such as to prevent electrostatic discharge.

## 2 HARDWARE FEATURES

The DEMO9S08QE8 is a demonstration and development system for Freescale's MC9S08QE8 microcontroller. Application development is quick and easy using P&E's Embedded Multilink circuitry and the included software tools and examples. An optional BDM port is provided to allow use of an external BDM interface such as P&E's Cyclone PRO automated programmer or USB Multilink. The USB Multilink is functionally comparable to the DEMO9S08QE8's Embedded Multilink circuitry.

**Note:** The DEMO board's onboard Embedded Multilink circuitry is intended to function with the onbaord processor and any daughter cards that may be included. It cannot be used to communicate with other devices.

### 2.1 DEMOQE Base Board Features

- On-board Logic Analyzer
- On-board Virtual Serial Port
- Asymmetrically positioned 4 8x2 male connectors for interchangeable daughter cards
- P&E's Embedded Multilink circuitry populated on the bottom
- RS-232 Serial Port w/ DB9-F Connector
- SCI signals connected to P&E's Embedded Multilink through jumpers

- ON/OFF Power Switch w/ LED indicator
- A 5VDC to 8VDC power supply input barrel connector

**Note:** The DEMOQE board power connector is incorrectly labelled as 5-12VDC. The maximum voltage is 8VDC.

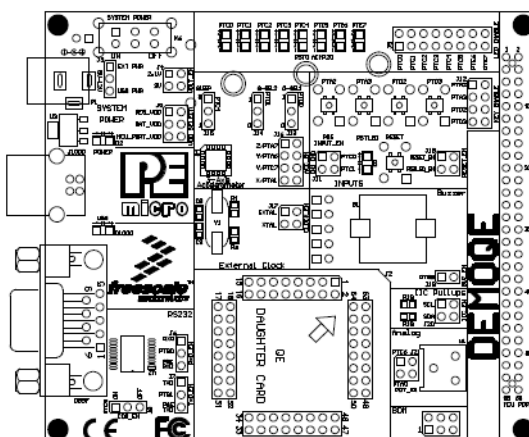
- Power Input Selection Jumpers for selecting the input voltage source:
  - Power Input from Embedded Multilink to LDO regulator
  - Power Input from DC Power Jack to LDO regulator
  - Regulated VDD Output at 3.0V
  - Regulated VDD Output at 2.1V
  - Power Input from Battery
  - Power Input from MCU\_PORT connector
- RESET Push Button and LED indicator w/ Enable
- Optional External Crystal Circuitry Layout (not populated)
- User Features:
  - 3-axis Accelerometer w/Enable
  - 8 User LED's w/ Enable
  - 4 User Push Buttons w/ Enable
  - 1 Piezzo Buzzer w/ Enable
  - IIC Pullups w/ Enable
  - 10K Ohm POT w/ Enable
- Option Jumpers:
  - COM\_EN for 1.8V to 4.25V RS232 Transceiver
  - TXD\_EN for SCI\_TXD to Embedded Multilink
  - RXD\_EN for SCI\_RXD to Embedded Multilink
  - INPUT\_EN for two input channels to Embedded Multilink
- Specifications:
  - Board Size 3.5 x 4.0
  - Power Input:



- USB Cable: 5VDC, 500mA max
- DC Power Jack: 2.5/5.5mm barrel connector, 5VDC to 8VDC Center Positive

**Note:** The DEMOQE board power connector is incorrectly labelled as 5-12VDC. The maximum voltage is 8VDC.

- Two AAA Battery Cells



**Figure 2-1: DEMOQE Top Component Placement**

## 2.2 On-Board Logic Analyzer

The DEMOQE board has a built-in 2-channel logic analyzer which may be used to display captured data in real-time on a host PC. The logic analyzer channels (IN0/IN1) are connected to the PTC0 and PTC1 signals on the DEMOQE board by default via the J11 jumpers. The channels may be connected to any of the processor pins by wire jumpers (not included).

The DEMOQE Logic Analyzer Utility, included in the DEMOQE Toolkit on the accompanying CD-ROM, displays the logic analyzer signals on a PC.

## 2.3 On-Board Virtual Serial Port

The DEMOQE board has a built-in virtual serial port which may be connected to the QE processor's SCI RXD/TXD. This allows certain PC applications to

be able to connect in a serial fashion to the microcontroller without the actual use of serial port hardware.

The DEMOQE Terminal Window Utility, included in the DEMOQE Toolkit on the accompanying CD-ROM, is a generic serial port utility which works with the DEMOQE virtual serial port or actual serial port hardware.

## **2.4 DEMOQE Daughter Card Features**

- Four bottom-mounted asymmetrically positioned 8x2 female connectors to mate with the DEMOQE Base Board
- A top-mounted MC9S08QE8CLC chip

# **3 SYSTEM SETUP**

## **3.1 Overview**

P&E's Embedded Multilink driver is required to operate the DEMO9S08QE8 using a PC. The Embedded Multilink driver should be installed with the CodeWarrior Development Studio software or from the DEMOQE Resources in the CD-ROM before the PC is connected to the DEMO9S08QE8.

## **3.2 Operating System Requirements**

The following are the resources required to run the CodeWarrior Development Studio and the DEMO9S08QE8:

- A PC-compatible system running Windows 2000, Windows XP, or Windows Vista
- 128MB of available system RAM, and 1GB of available hard disk space
- A CD-ROM drive for software installation
- A USB port

## **3.3 Software Setup**

### **3.3.1 Installing CodeWarrior Development Studio**

To install the CodeWarrior Development Studio, insert the CodeWarrior CD

into your computer's CD-ROM drive. A start-up window will automatically appear. Select CodeWarrior Installation and follow the on-screen instructions.

### 3.3.2 Installing P&E Resources

Use the DEMOQE Resources CD-ROM to access and install P&E resources for the DEMO9S08QE8. These materials are not required for operation. The support materials contained on the DEMOQE Resources CD-ROM are listed in **Section 1.4 - Recommended Materials On DEMOQE Resources CD**.

## 3.4 Quick Startup

Only a few steps are required to get the DEMO9S08QE8 up and running:

- Step 1. If you do not have CodeWarrior Development Studio version 6.0 installed on your computer, please install it using the accompanying CD-ROM. Additional information regarding CodeWarrior can be found at [www.freescale.com](http://www.freescale.com).
- Step 2. Remove the DEMO9S08QE8 demonstration board from its anti-static pouch. The green MC9S08QE8 daughter card should be plugged into the header on the base board.
- Step 3. Connect the USB cable from your computer to the DEMO9S08QE8 demonstration board. Depending on your operating system, you may need to follow steps to install the USB driver from the DEMOQE Resources CD-ROM. Once the USB cable is connected properly the green USB LED on the DEMO9S08QE8 should illuminate.
- Step 4. Turn on the DEMO9S08QE8 power switch (K6). The red Power LED should illuminate.
- Step 5. Press the buttons labelled PTA2 and PTA3. When each button is pressed a different tone will be emitted, and the light intensity of the PTC0 LED will change. The LEDs labelled PTC1 and PTC2 (for PTA2) or PTC3 and PTC4 (for PTA3) should illuminate. In addition, the light intensity of the LED labeled PTC1 should vary as the potentiometer is rotated.
- Step 6. Optionally, you may run the DEMOQE Logic Analyzer Application available in the DEMOQE toolkit on the CD. This PC-based application graphs the IN0 and IN1 signals on the DEMOQE board. If both J11 jumpers are installed, IN0 shows PTC0 and IN1

shows PTC1. Push button PTA2 and turn the potentiometer to change these signals. This application may also be found at:  
<http://www.pemicro.com/fixedlinks/demoQEt toolkit.html>.



**Figure 3-1: DEMOQE Logic Analyzer Application**

## 3.5 Hardware Setup

### 3.5.1 First-Time Connection

The DEMO9S08QE8 may be connected to a PC through a USB port. Connection steps are listed below in typical order:

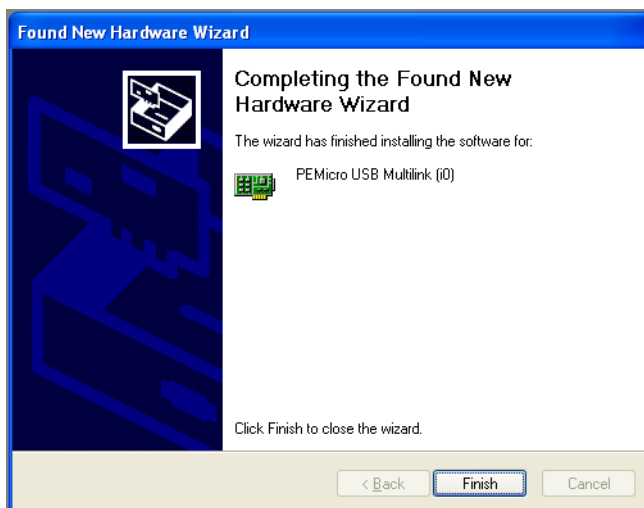
1. Install the required software, as described in the previous section.
2. Make sure the jumpers for USB\_PWR, 3V for VOLT\_EN, and REG\_VDD for VDD\_SELECT are installed.
3. Plug the USB cable A-M connector into a free USB port of the PC.
4. Plug the USB cable B-M connector into the USB connector on the DEMOQE Base Board.
5. The operating system will recognize P&E's Embedded Multilink circuitry and P&E's USB to Serial circuitry. Depending on the operating system, you may see the "Found New Hardware Wizard" dialog, helping you to install software for "PEMicro USB Multilink (i0). On Windows XP (SP2), the following dialog will appear:



**Figure 3-2: Found New Hardware Wizard Dialog (1 of 4)**

Select the “Install the software automatically (Recommended)” option and click the “Next” button.

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



**Figure 3-3: Found New Hardware Wizard Dialog (2 of 4)**

Click the “Finish” button to exit the current “Found New Hardware Wizard”.

7. Depending on the operating system, you may see the “Found New Hardware Wizard” dialog again, helping you to install software for “PEMicro USB Serial Port (i1). On Windows XP (SP2), the following dialog will appear:

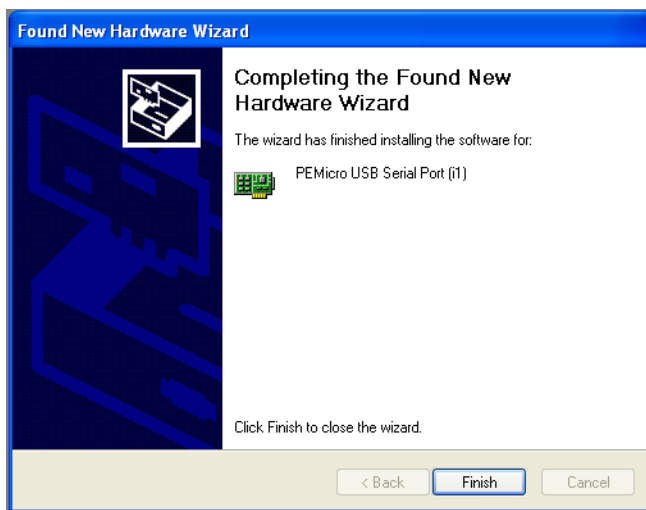


**Figure 3-4: Found New Hardware Wizard Dialog (3 of 4)**

Select the “Install the software automatically (Recommended)” option and click the “Next” button.

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





**Figure 3-5: Found New Hardware Wizard Dialog (4 of 4)**

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

If the DEMO9S08QE8 hardware interface driver is now properly installed on your system, the green USB LED on the DEMOQE Base Board should be illuminated. In addition, if you turn on the system power of the DEMO9S08QE8 you will see the red Power LED illuminate.

## **4 OPERATING MODES**

### **4.1 Overview**

The DEMO9S08QE8’s Embedded Multilink circuitry, featured hardware components, and optional external BDM header make it a versatile development tool. Below are some of the featured operating modes of the DEMO9S08QE8.

### **4.2 Debug Mode**

A host communicates with the DEMO9S08QE8 through the Embedded Multilink circuitry. Either the CodeWarrior Development Studio or P&E’s HCS08 software tools will work with the DEMO9S08QE8. Please refer to

**Section 8 - DEMO9S08QE8 CODE DEVELOPMENT SOFTWARE** for more information.

### 4.3 Run Mode

The DEMO9S08QE8's rich component list empowers it to perform a variety of tasks. Once an application is developed, debugged, and programmed properly into the QE8 internal flash memory, it can run with or without connecting to a host.

### 4.4 External BDM Mode

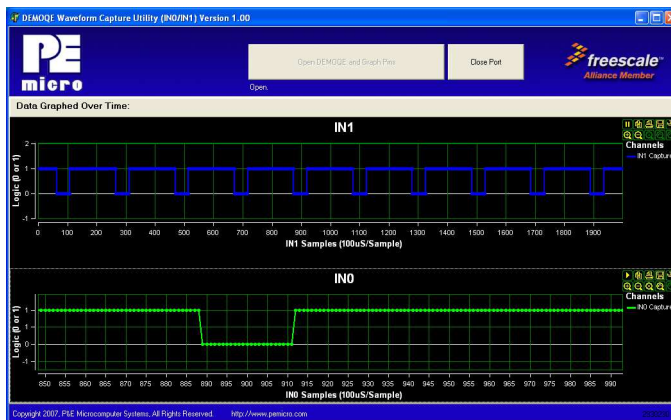
The DEMO9S08QE8 has an optional BDM header for debugging and programming the on-board QE8 device using an external BDM hardware tool, such as P&E's USB Multilink or Cyclone PRO. Please refer to **Section 9 - TRANSITIONING TO YOUR OWN TARGET** for more information. A user can take advantage of this mode to develop a target-specific QE8 system and compare it with the DEMO9S08QE8 when necessary.

## 5 DEMOQE TOOLKIT PC APPLICATIONS

P&E provides several Windows PC-based applications which work with the DEMO9S08QE8 board. These applications are collectively referred to as the DEMOQE Toolkit. The following applications are included in the toolkit:

### 5.1 DEMOQE Logic Analyzer Application

The DEMOQE board has a built-in two-channel logic analyzer. This analyzer allows the IN0 and IN1 signals to be captured by the PC and displayed for the user. The IN0 and IN1 signals may be connected to any of the MCU signals which the user would like to view. By default, they are connected to the PTC0 and PTC1 pins of the MCU by jumper J11. At the time of this release, the logic analyzer runs at a capture rate of 10khz.



**Figure 5-1: Logic Analyzer Application**

This PC-based application is used to display the logic analyzer data on the PC. The logic analyzer data is displayed in real-time and each waveform may be paused, zoomed, and printed.

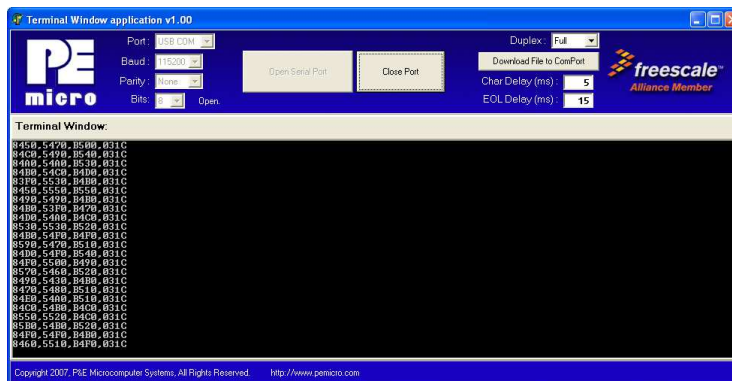
If the microcontroller-based Quick Start Application is programmed into the MCU, the IN0 channel will show the PWM output on pin PTC0 whose duty cycle is controlled by the potentiometer (W1). The IN1 channel shows the PWM output on channel PTC1 which drives the buzzer.

This PC-based application is included on the CD-ROM that accompnys the DEMOQE, and may also be found at:

<http://www.pemicro.com/fixedlinks/demoQEtoolkit.html>.

## 5.2 DEMOQE Terminal Application

This PC-based application acts as a standard serial port terminal application on the PC. It works with standard serial ports as well as the virtual serial port on the DEMOQE board. The application includes settings to adjust the COM port number, baud rate, parity, and number of data bits. There is a button to take a file on the PC and transmit it out of the serial port. There are also delays which are automatically inserted in the transmission output to prevent overruns. It is recommended that these defaults not be changed.



**Figure 5-2: DEMOQE Terminal Application**

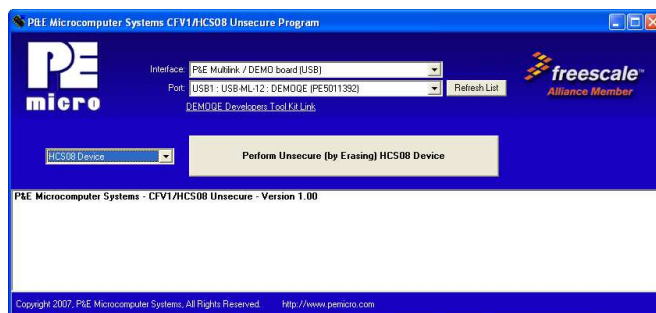
The terminal window may be set for full duplex or half duplex. In full duplex mode, only received characters are displayed in the terminal window. In half duplex mode, both transmitted and received characters are displayed.

This PC-based application is included on the CD-ROM that accompanys the DEMOQE, and may also be found at:

<http://www.pemicro.com/fixedlinks/demoQEtoolkit.html>.

### 5.3 DEMOQE Unsecure Application

This application allows secure HCS08 microcontrollers to be unsecured. The Unsecure application will erase a secure device to make it unsecure. This application works with the DEMOQE board as well as other user hardware connected to the PC via the USB Multilink or Cyclone PRO hardware interfaces.



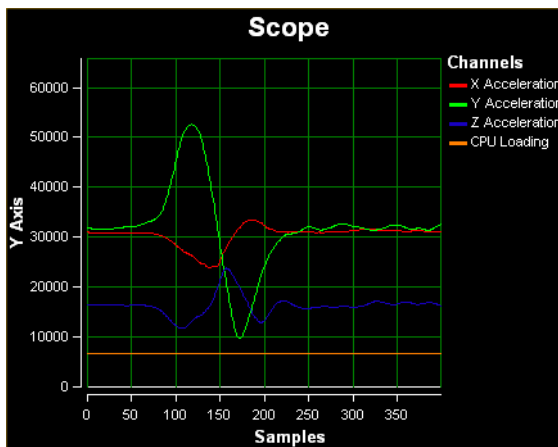
**Figure 5-3: DEMOQE Unsecure Application**

This PC-based application is included on the CD-ROM that accompanys the DEMOQE, and may also be found at:

<http://www.pemicro.com/fixedlinks/demoQEtoolkit.html>.

## 5.4 DEMOQE Accelerometer Demo Application

This PC-based application will graph serial data output from the microcontroller-based serial accelerometer application documented in **Section 6.2 - Serial Accelerometer Application**. The graphed data includes the magnitude of the X, Y, and Z accelerometer signals, as well as the current processor loading. For this application to work properly, the *microcontroller-based* serial accelerometer application must be programmed into the microcontroller which is plugged into the DEMOQE board.



**Figure 5-4: Accelerometer Demo Application**

The data that is graphed may come from either the PC serial port or the virtual serial port on the DEMOQE board. The serial port of the microcontroller on the DEMOQE board is routed to either serial port hardware or the virtual COM port based upon the setting of jumpers J6 and J7.

This PC-based application is included on the CD-ROM that accompanies the DEMOQE, and may also be found at:

<http://www.pemicro.com/fixedlinks/demoQEt toolkit.html>.

## 5.5 DEMOQE Serial Grapher Application

This PC-based application is a more generalized version of the accelerometer demo application. It may be used with the microcontroller based serial accelerometer application or customer microcontroller code which transmits data in the correct format. The serial graphing utility allows incoming data on the PC serial port, or one of P&E's virtual serial ports, to be automatically graphed in time or displayed upon a series of bar graphs. The virtual serial port exists on several of P&E's embedded USB multilink designs including the DEMOQE board.

This PC-based application is included on the CD-ROM that accompanies the DEMOQE and may also be found at:

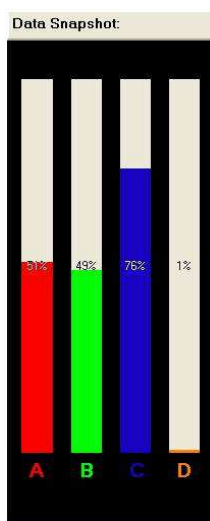
<http://www.pemicro.com/fixedlinks/demoQEt toolkit.html>.



All data to be displayed must be in hexadecimal format. The data can be accepted and displayed either as incoming byte values (\$00-\$FF) or word values (\$0000-\$FFFF). The data format indicates whether the data is byte or word data. The graphical components automatically size their range depending upon the incoming data.

### 5.5.1 Visual Components

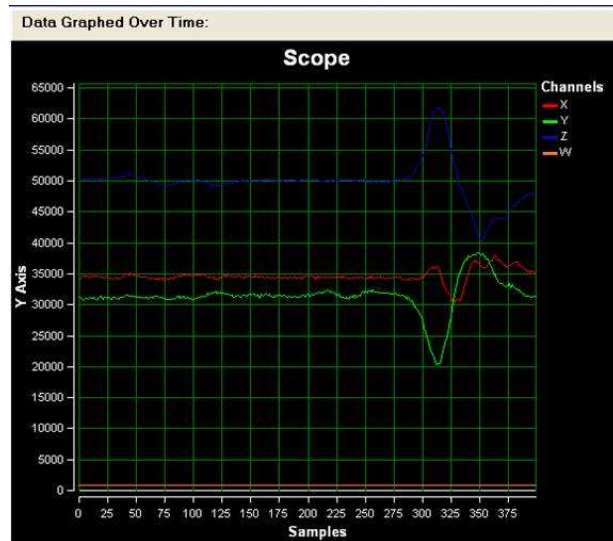
The Bar Graph has four separate bars A, B, C, and D. On each bar a percentage value is displayed which indicates the current value relative to the full range. A byte value of \$7F (max is \$FF) would show up as approximately 50% as would a word value of \$7FFF (max is \$FFFF). As can be seen in the data formatting section, all four bars must be written at the same time. The bars are shown here:



**Figure 5-5: Serial Grapher Bar Graph**

The graphing component shows four waveforms X, Y, Z, and W. The magnitude axis either has a range of \$00-\$FF (if byte values are incoming on the serial port) or \$0000-\$FFFF (if word values are incoming). Each new set of values which comes through the serial port is added to the far right side of the graph and the rest of the data values move to the left. The vertical axis displays the incoming data as the magnitude of each waveform, and the horizontal axis displays the number of samples. The graph has a limited size,

so older samples will eventually fall off the left part of the graph. As can be seen in **Section 5.5.2 - Data Format**, each incoming data command affecting the graphing component must have new data for all four waveforms. An example graph is shown here:



**Figure 5-6: Serial Grapher Graphing Component**

## 5.5.2 Data Format

The data format is broken into two sections depending upon whether the incoming data is in byte format or word format.

### 5.5.2.1 Byte Formatted Data

There are two commands which may be accepted. Both commands must end in the special characters `#$0D` and `#$0A` which are CR (carriage return) and LF (line feed). The accepted commands are:

*WnnZnnYnnXnn*

The nn values are 00-FF and correspond in order to the data displayed on the following graph lines : W, Z, Y, X.

*AnnBnnCnnDnn*

The nn values are 00-FF and correspond in order to the data displayed on the

following bar graphs lines : A, B, C, D.

### 5.5.2.2 Word Formatted Data

There are three commands which may be accepted. All commands must end in the special characters `#$0D` and `#$0A` which are CR (carriage return) and LF (line feed). The accepted commands are:

*nnnn,nnnn,nnnn,nnnn*

The nnnn values are 0000-FFFF and correspond in order to the data displayed on both the graph and bar graphs as follows: X/A, Y/B, Z/C, W/D.

*nnnn:nnnn:nnnn:nnnn*

The nnnn values are 0000-FFFF and correspond in order to the data displayed the graphing component as follows: X, Y, Z, W.

*nnnn=nnnn=nnnn=nnnn*

The nnnn values are 0000-FFFF and correspond in order to the data displayed on the bar graph component as follows: A, B, C, D.

## 6 DEMONSTRATION MICROCONTROLLER APPLICATIONS

The following microcontroller applications are designed to run on the QE8 processors.

### 6.1 Quick Start Application

The function of the Quick Start microcontroller application is to play a different tone and illuminate a different LED for each of the buttons which may be pressed on the DEMO9S08QE8 board. The potentiometer controls the intensity of two LEDs on the DEMO9S08QE8 board, via PWM signals. This application comes pre-programmed into the memory of the QE8 processor.

The source code for this Quick Start Application is included on the CD-ROM included with the DEMOQE, and may also be found at:

<http://www.pemicro.com/fixedlinks/demoQEtoolkit.html>.

## 6.2 Serial Accelerometer Application

This microcontroller application samples the state of the on-board three-axis accelerometer using on-chip A/D converter channels. This data is converted into ASCII characters and sent out using the serial pins of the QE8 processor. These serial pins may be connected to either serial port hardware or to P&E's virtual serial port (which is part of the Embedded Multilink design). This connection is controlled by jumpers J6 and J7.

P&E has two PC-based DEMOQE Toolkit applications which allow the serial port data generated by this application to be graphed. These are documented in **Section 5.4 - DEMOQE Accelerometer Demo Application** and **Section 5.5 - DEMOQE Serial Grapher Application**.

The source code for this microcontroller based Serial Accelerometer Application is included on the CD-ROM included with the DEMOQE and also may be found at <http://www.pemicro.com/fixedlinks/demoQEt toolkit.html>.

## 7 JUMPER SETTINGS

### 7.1 System Power

The QE8 processor may obtain its power from either the on-board regulator, a 2-cell battery pack, or through MCU\_PORT J1. The on-board regulator obtains its input from either the Embedded Multilink circuitry or a 2.5mm barrel connector. The on-board regulator can regulate the output to either 2.1V or 3V. The DEMO9S08QE8 is fully functional at both voltages. Power input and voltage selection are achieved by using 3 option headers.

#### 7.1.1 J3 - Regulator Input Selection Jumper

Jumper 3 determines whether the DEMO9S08QE8's on-board regulator obtains its power from the DC power jack or from the Embedded Multilink circuitry. The regulator input selection is mutually exclusive. It prevents power input contention from damaging the board and the host. **Figure 7-1** shows the regulator input selection details.



Select regulator input from DC power jack. A 5-8VDC center positive power supply must be used.

The DEMOQE board power connector is incorrectly labelled as 5-12VDC. The maximum voltage is 8VDC.



Select regulator input from the Embedded Multilink circuitry, which derives its power from the USB bus

**Figure 7-1: PWR Selection Header (J3)**

## 7.1.2

### J4 - Regulator Output Selection Jumper VOLT\_EN

The regulator can output either a 2.1VDC or 3VDC voltage for the DEMO9S08QE8. The VOLT\_EN jumper J4 selects the voltage. **Figure 7-2** shows the regulator output selection details.



Select regulator output to be 2.1V.

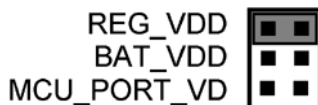


Select regulator output to be 3V

**Figure 7-2: Regulator Voltage Output Selection VOLT\_EN (J4)**

## 7.1.3

### J5 - VDD Source Selection Jumper VDD\_SELECT



Select the regulator to supply microcontroller VDD. This is the default setting.



Select the battery pack to supply microcontroller VDD



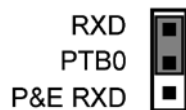
Select the MCU\_PORT to supply microcontroller VDD. This setting also allows power to be supplied to the target connected to the MCU\_PORT. By default this jumper is installed.

**Figure 7-3: VDD\_SELECT Option Header (J5)**

## 7.2 RS232 Communications

The DEMO9S08QE8 integrates an RS232 transceiver for the microcontroller SCI signals. The transceiver operates from 1.8V to 4.25V, and it can be enabled or disabled via jumper settings or through firmware control. The DEMO9S08QE8 also integrates the SCI signal into the Embedded Multilink circuitry. A user can communicate with the microcontroller SCI module via either the on-board DB9 connector or the Embedded Multilink circuitry. There are three jumpers associated with SCI communication.

### 7.2.1 J6 - SCI RXD Signal Selection Jumper RXD\_EN



Connects the microcontroller PTB0/RXD signal to the RS232 transceiver.

