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DEMOEM User Manual
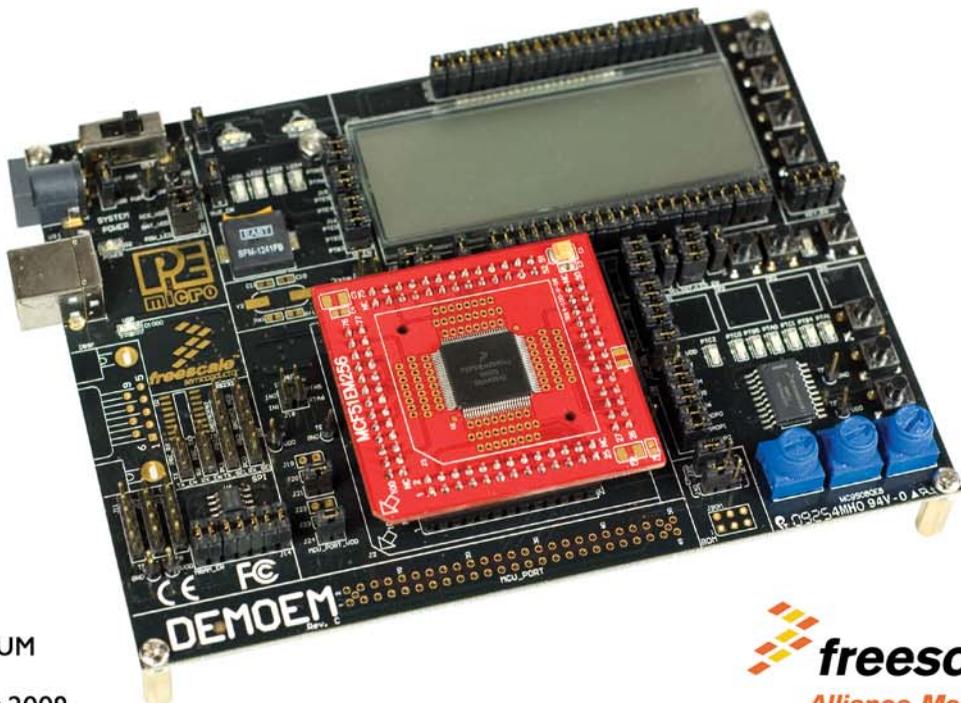
DEMOEMUM
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1   INTRODUCTION

1.1   Overview

The DEMOEM is a low cost development system supporting Freescale MCF51EM256 and MCF51EM128 microcontrollers. It consists of a DEMOEM Base Board and a DCF51EM256 Daughter Card. P&E's Embedded Multilink circuitry on the DEMOEM board allows the processor connected to the DEMOEM to be debugged and programmed via USB from a PC. In addition, the demo board can be powered using the USB bus.

1.2   Package Contents

The DEMOEM package includes the following items:

- DEMOEM Base Board with a DCF51EM256 Daughter Card installed
- Getting Started DVD - Getting started with the series of microcontrollers
- USB A-to-B Cable
- Quick Start Guide
- Freescale Warranty Card

1.3   Supported Devices

The DEMOEM supports the following devices:

- MCF51EM256
- MCF51EM128

1.4   Recommended Materials On The Getting Started DVD-ROM

- Freescale MCF51EM256 reference manual and datasheet

- • DEMOEM Base Board and Daughter Card schematic

- • P&E Embedded Multilink Toolkit applications

- • P&E Embedded Multilink driver installation guide and resources

1.5   Handling Precautions

Take care to handle the package contents, including the DEMOEM Base Board and DCF51EM256 Daughter Card, in a manner such as to prevent electrostatic discharge.

2   HARDWARE FEATURES

The DEMOEM is a demonstration and development system for Freescale's MCF51EM256 microcontrollers. 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 the 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 DEMOEM'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   DEMOEM Base Board Features

- • On-board Logic Analyzer

- • On-board Virtual Serial Port

- • Four (4) asymmetrically positioned 13x2 male connectors for interchangeable daughter cards

- • P&E's Embedded Multilink circuitry populated on the underside

- • SCI signals connected to P&E's Embedded Multilink through jumpers

Board:

- • Mother/daughter card approach. Daughter card contains only MCU and power bypass caps:

- Connectors for MCF51EM256 100-pin LQFP (DCF51EM256)
- PCB coloring:
  - Black-colored mother board
  - Red-colored daughter card
- Freescale Form Factor Parameters must be followed
  - 50-pin (2x25-pin) connector labeled MCU_PORT (J1) to bring out some device signals
  - MCU_PORT (J1) has a (2.54 pitch, dual row) through-hole Female connector: 2x25 Socket Header, Pass Thru, .1", Bottom Entry, SMT

BDM interface:

- Integrated P&E Embedded Multilink Circuitry
  - MDI interface features:
    - SCI signals from Embedded Multilink connected through jumper to SCI1 or SCI3 pins of EM MCU
    - "Logic analyzer" inputs to timer channels of Embedded Multilink to header pins
  - Embedded Multilink design populated on bottom of board

- BDM Connector (6-pin Header) (not populated)
- Jumpers (J39 and J40) to select programming the MCU daughter card or the MC9S08QE8 on the DEMOEM

Power:

- Power LED
- Board power via the USB connection
- On board Voltage Regulator with 3.3V output to MCU
- Barrel style power connector (2.1 mm)
- AAA battery holder for 2 batteries. (Alternate board power supply).
- Power switch for all board power

- Layout for jumper from board VDD to MCU VDD pins, with layout for an optional zero ohm resistor to permanently connect these signals.

- Layout for jumper from MCU VDD to MCU VDDA and from MCU VSS to MCU VSSA pins, with populated zero ohm resistor shorting jumper pins.

- Layout for jumper from MCU VDDA to MCU VREFH and from MCU VSSA to MCU VREFL pins, with populated zero ohm resistor shorting jumper pins

- All power traces are minimum double width

- Four test points for GND

- Four test point for VDD

- Voltage input jumpers

  - powered DEMO via on-board voltage regulator (3.3V)

  - powered DEMO via on-board USB BDM (3.3V)

  - powered DEMO via on-board battery (3.0V)

  - supply 3.3V power to the MCU_PORT header if the board is powered though the on-board regulator or USB

- Noise filter in the VDD to VDDA, VSS and VSSA connection in order to improve ADC accuracy

MCU:

- Reset switch with optional LED indicator.

- IRQ Button

- Crystal circuit for 32kHz to 16MHz crystal for XOSC2 input (not populated)

  - Use circuit components recommended by crystal manufacturer and MCU data sheet.

  - Footprint for jumpers to disable XTAL from MCU

  - 0 ohm resistors in parallel with jumper footprints to connect XTAL circuit

- Jumpers to disable all the user I/O functions from additional circuitry

LCD and UI:

- 3V LCD Glass
    - Jumpers (J25) to configure front and back plane selection
- 4 Buttons
- 4 LEDs
- 4 Touch cap pads (require software developed for touch sensing with standard I/Os)

Independent RTC:

- Coin-cell (CR2032) lithium battery holder with connection to MCF51EMxx VBAT pin
- Tamper button connected to TAMPER pin
- 32.768 kHz Crystal with its circuitry connected in EXTAL1 and XTAL1 pins
    - Optional crystal footprint on DCF51EM256 daughter card (not populated)
    - Piezo buzzer for IRTC alarm

Analogue Signal Syntheses:

- MC9S08QE8 (20-pin SOIC) with:
    - Three Potentiometers
    - 6 PWM outputs with low-pass filters in order to generate 60/50 Hz signals connected to Nucleus ADC inputs via jumpers
    - 6 LEDs, one for each PWM output
    - 1 LED connected to a GPIO
    - 3 buttons

Serial Communication:

- IR interface (Tx and Rx). Connected with SCI1. (External circuitry

designed to use the internal PRACMP for Rx and considering higher current capability in the Tx pin)

- RS-232 circuitry with BD9 connector connected to SCI3 through jumpers (whole circuit not populated)

- Drive four 5V LEDs using MCF51EMxx PTE4, PTE5, PTA5, and PTA6, jumper for disabling connection

- EEPROM serial SPI1 memory for NVM data storage

- Header pins for user connector or convenient monitoring of every serial port

- Specifications:

  - Board Size 6.0 x 4.5

  - Daughter Card Size 2.0 x 2.1

  - Power Input:

    - USB Cable: 5VDC, 500mA max

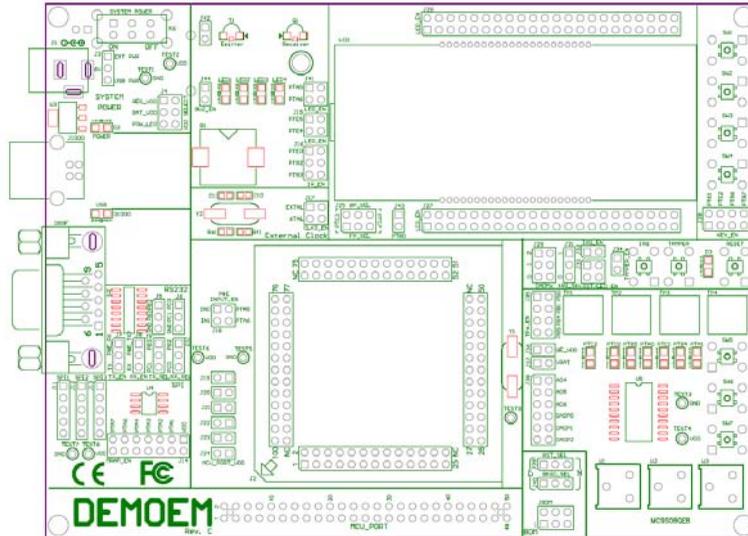 - DC Power Jack: 2.1/5.5mm barrel connector, 6VDC Center Positive

DEMOEM User Manual

Figure 2-1: DEMOEM Top Component Placement

2.2   On-Board Logic Analyzer

The DEMOEM 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 PTA5 and PTA6 signals on the DEMOEM board by default via the J41 jumpers. The channels may be connected to any of the processor pins via wire jumpers (not included).

The Logic Analyzer Utility, included in the P&E Embedded Multilink Toolkit on the accompanying DVD-ROM, displays the logic analyzer signals on a PC.

2.3   On-Board Virtual USB Port

The DEMOEM board has a built-in virtual serial port which may be connected to the EM 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 Terminal Window Utility, included in the P&E Embedded Multilink Toolkit on the accompanying DVD-ROM, is a generic serial port utility which works with the DEMOEM virtual serial port or actual serial port hardware.

2.4 DEMOEM Daughter Card Features

- Four (4) bottom-mounted asymmetrically positioned 13x2 female connectors to mate with the DEMOEM Base Board
- A top-mounted MCF51EM256 chip

2.5 DEMOEM Jumper/Connector Quick Reference

Default Jumper Settings

The following is a list of default jumper settings for DEMOEM board. The settings listed indicate the "on" (or installed) position. More detailed description of the jumper settings are available in **Section 7 - JUMPER SETTINGS**.

Default Jumper Settings

JUMPERS	SETTINGS	DESCRIPTION
J3	2&3	Power Source
J4	1&2, 5&6	VDD_SELECT
J5	ALL OFF	SCI1
J6	ALL OFF	SCI3
J7	ALL OFF	Virtual Serial Rx Enable
J8	ALL OFF	Virtual Serial Tx Enable
J9	ALL OFF	SCI1/SCI3 Tx Select
J10	ALL OFF	SCI1/SCI3 Rx Select
J11	ALL OFF	SPI1
J12	ALL OFF	SPI2
J13	ALL OFF	SPI3
J14	ALL ON	EEPROM Enable

Default Jumper Settings

J15	ALL ON	Port E LED Enable
J16	ALL ON	Infrared Comm Enable
J17	ALL OFF	XOSC2 Enable
J18	ALL ON	P&E Logic Analyzer
J19	Not Populated	MCU_VSSA
J20	Not Populated	MCU_VREFL
J21	1&2	MCU_VDD
J22	Not Populated	MCU_VDDA
J23	Not Populated	MCU_VREFH
J24	1&2	MCU_PORT_VDD
J25	2&4, 3&5	LCD Plane Selection
J26	ALL ON	LCD Pin Connections
J27	ALL ON	LCD Pin Connections
J28	ALL ON	Touch Switches Enable
J29	ALL ON	DADMx to GND
J31	2&3	IRQ Pull-Up, Pull-Down
J32	1&2	IRQ Switch Enable
J33	ALL ON	Reset Switch, LED Enable
J34	1&2	Tamper Switch Enable
J35	ALL ON	Touch-Pad Enable

Default Jumper Settings

J36	1&2	QE8 Vdd
J37	OFF	IRTC VBAT Supply
J38	ALL ON	QE8 PWM to ADC
J39	1&2	Debug Reset EM/QE
J40	1&2	Debug BKGD EM/QE
J41	ALL ON	PTA LED Enable
J42	1&2	PTB0 IR Capacitor
J43	1&2	PTB0 IR Enable
J44	1&2	Piezo Buzzer Enable

MCU Port Connector Pinout

The following is the pinout for the MCU Port connector on the DEMOEM board.

Figure 2-2: MCU Port Connector Pinout

3   GETTING STARTED WITH THE DEMOEM

The DEMOEM is a low-cost board targeting quick microcontroller evaluation.

Please refer to the DEMOEM Quick Start Guide and Labs for instructions on how to install software, connect the DEMOEM to your PC, and run quick demonstrations.

4   SYSTEM SETUP

4.1   Overview

P&E's Embedded Multilink driver is required to operate the DEMOEM using a PC. The Embedded Multilink driver should be installed with the CodeWarrior

Development Studio software or from the DEMOEM Resources in the Getting Started DVD-ROM before the PC is connected to the DEMOEM.

4.2   Operating System Requirements

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

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

4.3   Software Setup

4.3.1   Installing CodeWarrior Development Studio

To install the CodeWarrior Development Studio, follow the instructions on the DVD-ROM.

4.3.2   Installing P&E Resources

Use the DEMOEM Resources in the DVD-ROM to access and install P&E resources for the DEMOEM. These materials are not required for operation. The DEMOEM Resources in the Getting Started DVD-ROM contains the following support materials:

- DEMOEM Embedded Multilink hardware interface driver
- DEMOEM User Manual (this document)
- DEMOEM Base Board and Daughter Cards Schematics
- DEMOEM Component Breakdown List
- P&E Embedded Multilink Toolkit PC Applications
- P&E Evaluation Software
- Links to Freescale documentation, P&E Discussion Forums, and DEMOEM FAQs.

4.4 Quick Startup

Only a few steps are required to get the DEMOEM up and running. Please reference the Quick Start Guide.

4.5 Hardware Setup

4.5.1 First-Time Connection

The DEMOEM 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 that jumpers J3 and J4 are configured per the default settings described in **Section 2.5 - DEMOEM Jumper/Connector Quick Reference**.

3. Connect the DEMOEM Base Board to the PC via the USB cable.

4. 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 to assist you with software installation for "PEMicro USB Multilink (i0)." On Windows XP (SP2), the following dialog will appear:

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

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

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

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

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

6. Depending on the operating system, you may see the "Found New Hardware Wizard" dialog again to assist you with software installation for "PEMicro USB Serial Port (i1)." On Windows XP (SP2), the following dialog will appear:

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

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

7. Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear:
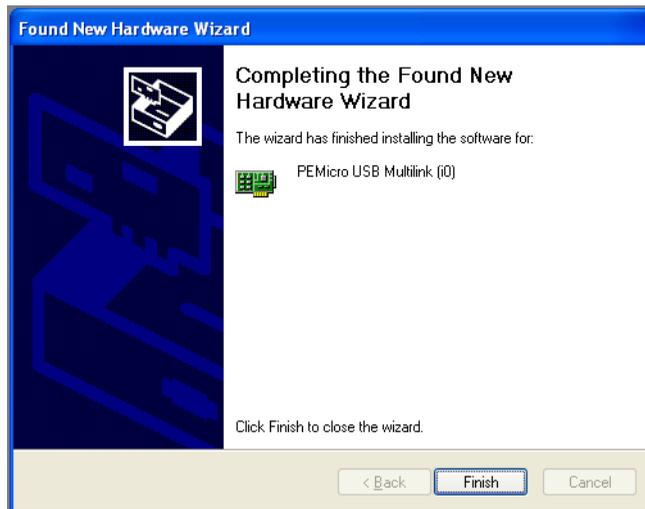
Figure 4-4: Found New Hardware Wizard Dialog (4 of 4)

Click the "Finish" button to exit the "Found New Hardware Wizard."

If the DEMOEM hardware interface driver is now properly installed on your system, the green USB LED (D1000) on the DEMOEM Base Board should be illuminated. In addition, if you turn on the system power of the DEMOEM you will see the red Power LED (D2) illuminate.

5   OPERATING MODES

5.1   Overview

The DEMOEM'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 DEMOEM.

5.2   Debug Mode

A host communicates with the DEMOEM through the Embedded Multilink circuitry. Either the CodeWarrior Development Studio or P&E's HCS08/CFV1 software tools will work with the DEMOEM. Please refer to **Section 8 -**

DEMOEM CODE DEVELOPMENT SOFTWARE for more information.

5.3   Run Mode

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

5.4   External BDM Mode

The DEMOEM has an optional BDM header for debugging and programming the on-board EM 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 EM system and compare it with the DEMOEM when necessary.

6   P&E EMBEDDED MULTILINK TOOLKIT PC APPLICATIONS

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

6.1   Logic Analyzer Application

The DEMOEM 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 PTA5 and PTA6 pins of the MCU by jumper J18. At the time of this release, the logic analyzer runs at a capture rate of 10KHz.
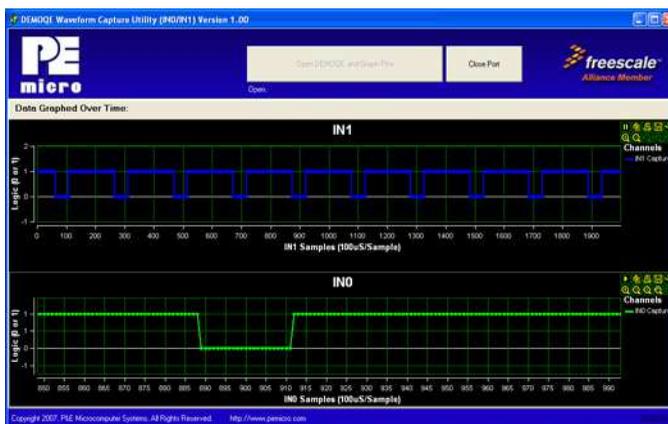
Figure 6-1: Logic Analyzer Application

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.

To start using this application, please plug in a USB cable into the DEMOEM board. Once the USB and Power LEDs light up, indicating the proper enumeration on the USB port, click on the Open DEMO and Graph Pins button. The logic channel graphs should be reflecting data captured from the IO pins connected to the IN0 and IN1 header pins on the DEMOEM evaluation board.

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

http://www.pemicro.com/fixedlinks/demotoolkit.cfm.

6.2   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 DEMOEM 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 into the transmission output to prevent overruns. It is recommended that these defaults not be changed.
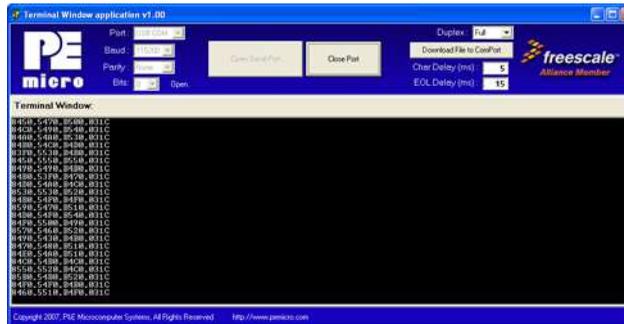
Figure 6-2: Terminal Application

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.

To start using this application, please choose COM or virtual USB COM settings from the drop down Port menu. This specifies the port on the evaluation board that will be used for serial data transmission. Please make sure that the jumpers on header J7 and J8 are set accordingly. Prior to starting serial data capture, please specify the Baud, Parity and Bits settings to reflect the parameters at which your serial communication interface is operating. Once your port settings are configured, please plug a USB or DB9 serial cable into the evaluation board and click on the Open Serial Port button.

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

http://www.pemicro.com/fixedlinks/demotoolkit.cfm.

6.3 DEMOEM Unsecure Application

This application allows secure CFV1 and HCS08 microcontrollers to be unsecured. The Unsecure application will erase a secure device to make it unsecure. This application works with the DEMOEM board as well as other user hardware connected to the PC via the USB Multilink or Cyclone PRO hardware interfaces.

Figure 6-3: Unsecure Application

In order to unsecure a device with this application, please specify the hardware interface that you are using. If your P&E Multilink or Cyclone PRO is successfully detected, the name of a corresponding device will appear in the Port text box. Please select HCS08 or CFV1 from the Select Architecture drop down menu and press the Perform Unsecure button. The application will finish unsecuring and erasing the device shortly thereafter.

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

http://www.pemicro.com/fixedlinks/demotoolkit.cfm.

6.4 Serial Grapher Application

This PC-based application is a generalized version that may be used with custom 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 as a series of bar graphs. The virtual serial port exists on several of P&E's Embedded Multilink designs including the DEMOEM board.

To start using this application, please choose COM or virtual USB COM settings from the drop-down Port menu. By doing so, you are specifying the port on the evaluation board that will be used for transmitting captured accelerometer data via a COM or USB serial port. Please make sure that jumpers J7 and J8 are set accordingly. Prior to starting serial data capture, please specify the Baud setting to reflect the parameter at which your serial communication interface is operating. Once your port settings are configured, please plug a USB or DB9 serial cable into the evaluation board and click on the Open Serial Port and Start Demo buttons. The graphing of data can be

paused and the scale of the X and Y axes can be changed via a tool bar located in the top right corner of the Serial Grapher Application.

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.

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

http://www.pemicro.com/fixedlinks/demotoolkit.cfm.

6.4.1   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: