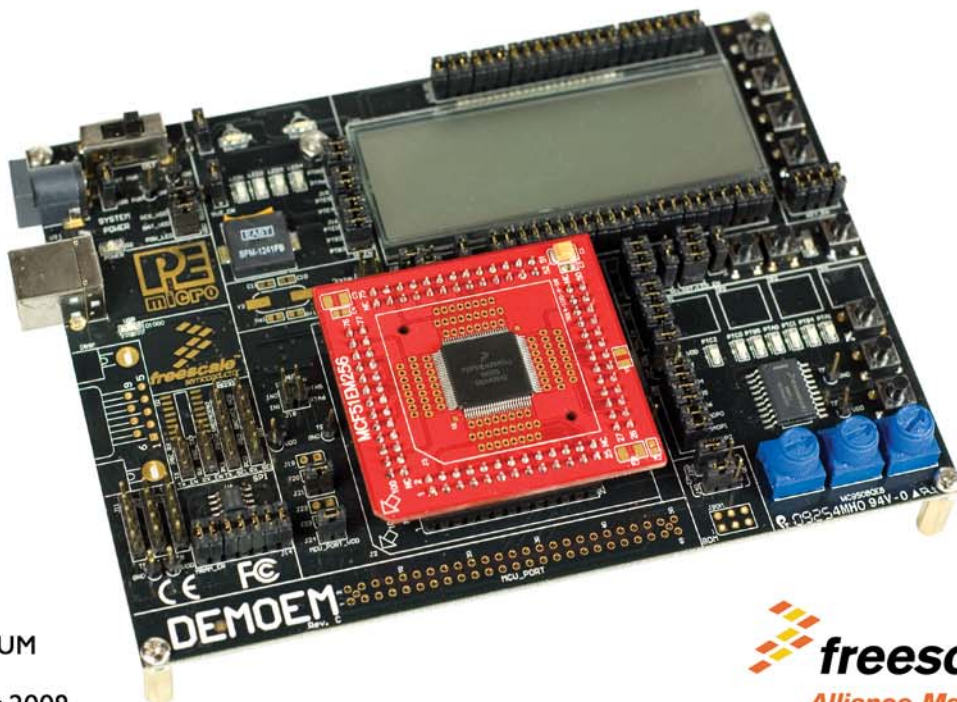


# PE micro

## DEMOEM User Manual



DEMOEMUM  
Rev. 1.02  
December 2009



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Manual version 1.02

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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 onboard 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 SC11 or SC13 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

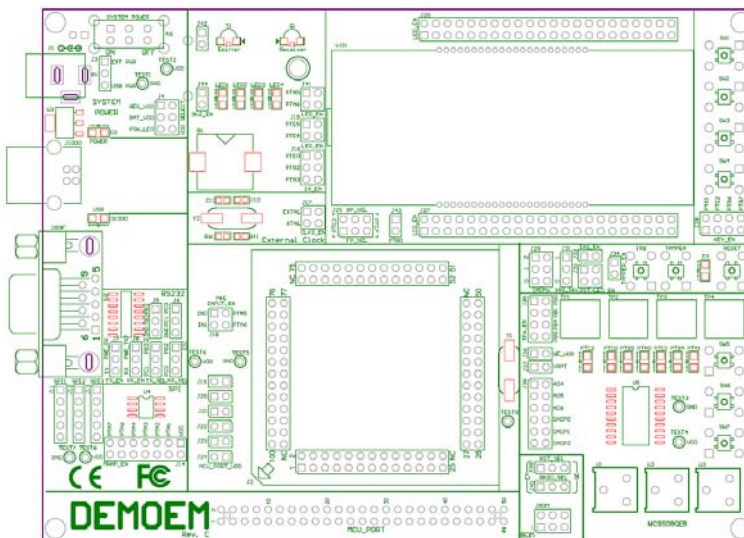
#### Serial Communication:

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

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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



**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.

MCU_PORT_VDD	J1		
1	VDD	PTA0/RGPIO0/IRQ/CLKO	2 PTA0
3	VSS	RESETB	4 EM RESET
PTB3 5	PTB3/RGPIO11/KBIIP3/CMP2P2/TX1	PTC2/BKGD/MS	6 BKGD
PTB2 7	PTB2/RGPIO10/KBIIP2/CMP2P1/RX1	NC	8
PTB6 9	PTB6/RGPIO14/KBIIP4/TMRCLK1/AD14	VREFH	10 <del>MCU VREFH</del>
PTB7 11	PTB7/RGPIO15/KBIIP5/TMRCLK2/AD15	VREFL	12 <del>MCU VREFL</del>
PTA5 13	PTA5/RGPIO5/TPMCH0/AD11	PTE3/MOSI3/MISO3	14 PTE3
PTA6 15	PTA6/RGPIO6/TPMCH1/AD12	PTE4/MISO3/MOSI3	16 PTE4
PTA1 17	PTA1/RGPIO1/MOSI1	PTE5/SCLK3	18 PTE5
PTA2 19	PTA2/RGPIO2/MISO1/AD10	PTE6/SSB3/TX2	20 PTE6
PTA3 21	PTA3/RGPIO3/SCLK1	AD6	22 AD6
PTA4 23	PTA4/RGPIO4/SSB1	AD7	24 AD7
AD4 25	AD4	PTC1/KBIIP7/XTAL2/TX3	26 PTC1
AD5 27	AD5	PTC0/KBIIP6/EXTAL2/RX3	28 PTC0
DADP0 29	DADP0	DADM0	30 DADM0
DADP1 31	DADP1	DADM1	32 DADM1
DADP2 33	DADP2	DADM2	34 DADM2
DADP3 35	DADP3	DADM3	36 DADM3
PTE2 37	PTE2/CMP1P2	PTB1/RGPIO9/KBIIP1/SSB3/TX2	38 PTB1
PTA7 39	PTA7/RGPIO7/TPMCLK/CMP1P3/AD13	PTB0/RGPIO8/KBIIP0/CMP1P1/RX2	40 PTB0
PTE0 41	PTE0/CMP1O/AD8	PTB4/RGPIO12/SCL/CMP2P3	42 PTB4
PTE1 43	PTE1/CMP1P4/AD9	PTB5/RGPIO13/SDA/CMP2P4	44 PTB5
MCU_VDDA 45	MCU_VDDA	NC	46
MCU_VSSA 47	MCU_VSSA	EXTAL1	48 <del>EXTAL1</del>
VREFO 49	VREFO	XTAL1	50 <del>XTAL1</del>

DEMOEM 25X2 HEADER

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

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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:

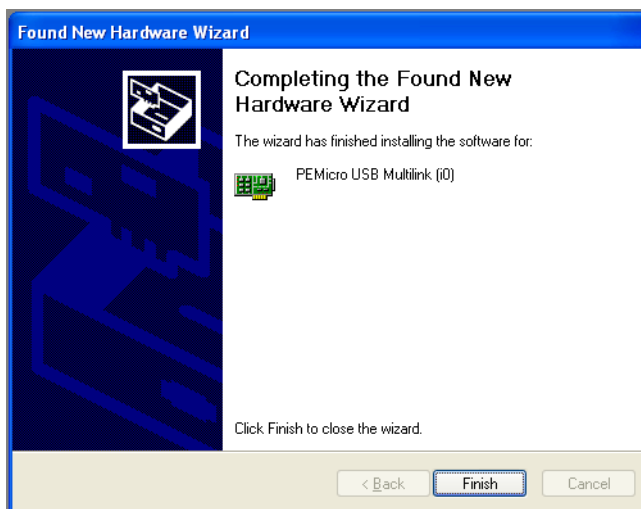
1. Install the required software, as described in the previous section.
2. Make sure that jumpers J3 and J4 are configured per the default settings described in **Section 2.5 - DEMOEM Jumper/Connector Quick Reference**.
3. Connect the DEMOEM Base Board to the PC via the USB cable.
4. The operating system 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.

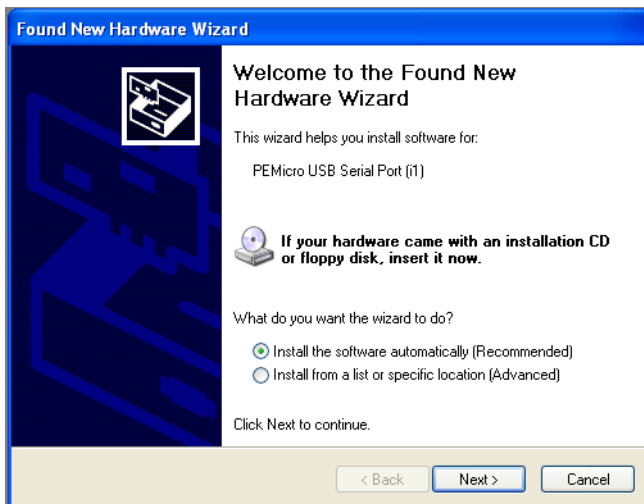
5. Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear:



**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

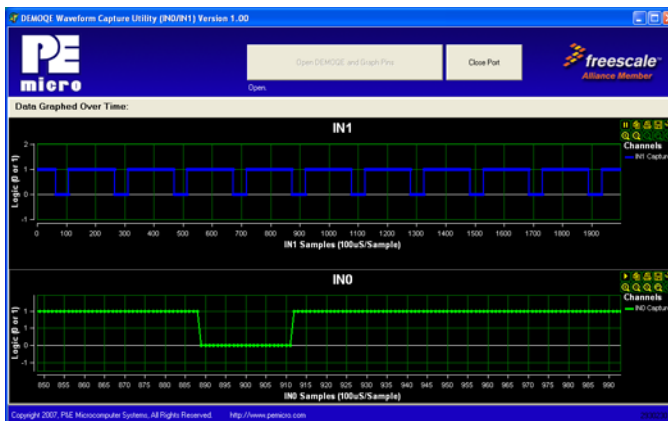
The DEMOEM has an optional BDM header for debugging and programming the on-board EM device using an external BDM hardware tool, such as P&E's USB Multilink or Cyclone PRO. Please refer to **Section 9 - TRANSITIONING TO YOUR OWN TARGET** for more information. A user can take advantage of this mode to 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.

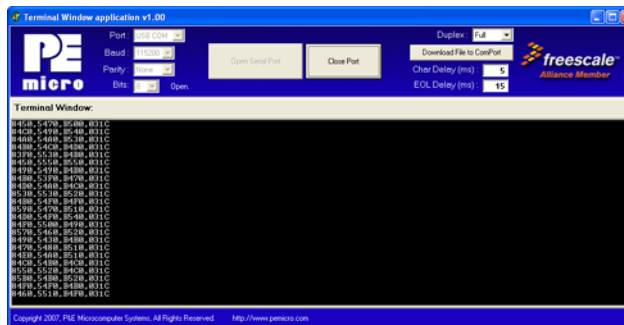
To start using this application, please plug in a USB cable into the DEMOEM board. Once the USB and Power LEDs light up, indicating the proper enumeration on the USB port, click on the Open DEMO and Graph Pins button. The logic channel graphs should be reflecting data captured from the IO pins connected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

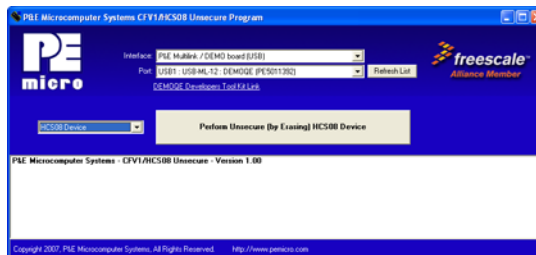
To start using this application, please choose COM or virtual USB COM settings from the drop down Port menu. This specifies the port on the evaluation board that will be used for serial data transmission. Please make sure that the jumpers on header J7 and J8 are set accordingly. Prior to starting serial 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.

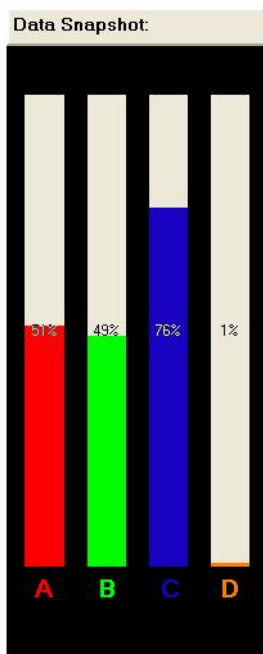
All data to be displayed must be in hexadecimal format. The data can be accepted and displayed either as incoming byte values (\$00-\$FF) or word values (\$0000-\$FFFF). The data format indicates whether the data is byte or word data. The graphical components automatically size their range depending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



**Figure 6-4: 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 are moved 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 Data Format, each incoming data command affecting the graphing component must have new data for all four waveforms. An example graph is shown here:

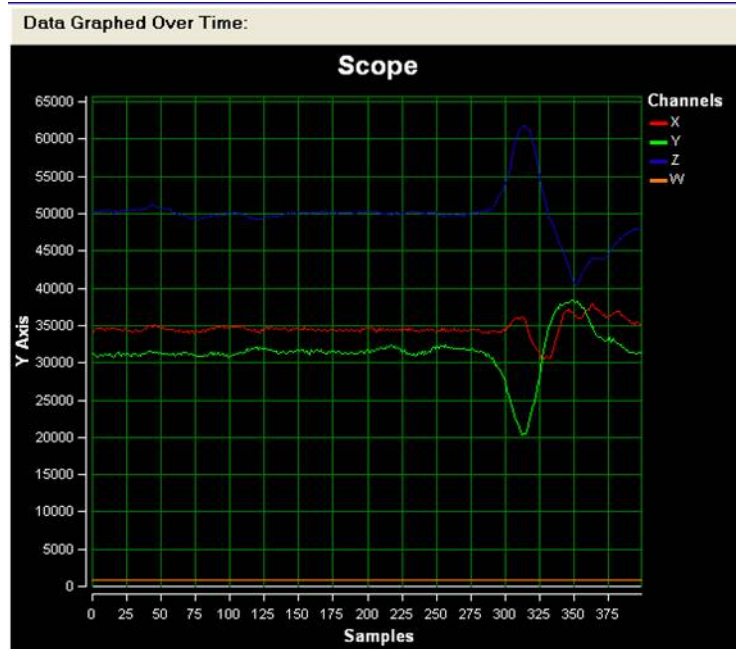


Figure 6-5: Serial Grapher Graphing Component

## 6.4.2 Data Format

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

### 6.4.2.1 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.

### 6.4.2.2 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.

## 7 JUMPER SETTINGS

### 7.1 System Power

#### 7.1.1 J3 - Power Source Selection

The EM processor may obtain its power from the on-board regulator, USB port, external battery, or through MCU\_PORT J1. The on-board regulator obtains its input from a 2.1mm barrel connector. The on-board regulator can regulate the output to 3.3V. Power input is selected by using the J3, J4, and J24 headers.

Select the USB port to supply microcontroller VDD. This is the default setting.



**Figure 7-1: Power Source Selection Header (J3)**

### 7.1.2 J4 - VDD Selection



**Figure 7-2: VDD\_SELECT Option Header (J4)**

### 7.1.3 J24 - MCU PORT

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.

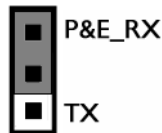


MCU\_PORT\_VDD

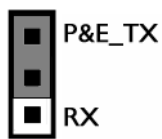
**Figure 7-3: MCU\_PORT Header (J24)**

## 7.2 Virtual Serial Port

The DEMOEM board has a built-in virtual serial port which may be connected to the EM processor's SCI or SCI3 Rx and Tx. 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. It can be enabled or disabled by installing or removing the jumpers of J7 and J8.



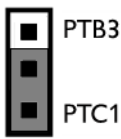
**Figure 7-4: TX\_EN Header (J7)**



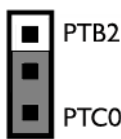
**Figure 7-5: RX\_EN Header (J8)**

### 7.3 Serial Port

Headers J5 and J6 provide convenient access points for SCI1 and SCI3 signals, respectively. J9 allows selection of the SCI1 or SCI3 TxD signal. Header J10 is used to select the SCI1 or SCI3 RxD signal.



**Figure 7-6: TX\_SEL Header (J9)**



**Figure 7-7: RX\_SEL Header (J10)**

**Note:** The default connection is to the SCI3 signals.

### 7.4 SPI Port

The DEMOEM board provides three headers for convenient access to SPI module signals: J11 for SPI1, J12 for SPI2, and J13 for SPI3. The signals are arranged as below:



Figure 7-8: SPI Port Header

## 7.5 EEPROM Enable

The DEMOEM includes a serial SPI memory for non-volatile data storage. Header J14 configures control signals for the EEPROM IC (U4).

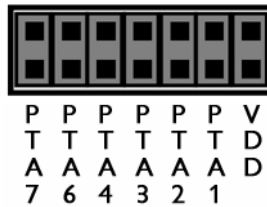


Figure 7-9: EEPROM Enable (J14)

## 7.6 LED Display Port

The DEMOEM has 4 LEDs connected to signals PTE4, PTE5, PTA5, and PTA6 that may be driven by 5V. They can be enabled or disabled by installing or removing the corresponding jumpers, J15 & J41, in the LED\_EN header.

### 7.6.1 J15 - LED Display Enable Port Port 1 LED\_ENABLE1

Enables port connections PTE5 and PTE4 to LED circuits. This is the default setting.



Figure 7-10: LED Display Enable Header LED\_EN (J15)

### 7.6.2 J41 - LED Display Enable Port Port 2 LED\_ENABLE2

Enables port connections PTA5 and PTA6 to LED circuits. This is the default setting.

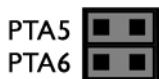


Figure 7-11: LED Display Enable Header LED\_EN (J41)

## 7.7 IR Interface

### 7.7.1 J16 - IR\_EN Header

The DEMOEM includes an infrared communications interface whose signals are connected with SCI1 and are jumper enabled by J16.



Figure 7-12: IR\_EN Header (J16)

### 7.7.2 J42 - PTB0 IR Capacitor

Connects a 0.1 uF bypass capacitor to PTB0.



Figure 7-13: PTB0 IR Capacitor (J42)

### 7.7.3 J43 - PTB0 IR Enable

Connects PTB0 to the IR circuitry.





PTB0

**Figure 7-14: PTB0 IR Enable (J43)**

## 7.8 External Crystal Circuitry

The DEMOEM design incorporates, but has not populated, a crystal circuit for XOSC2. Jumper 17 enables the EXTAL2 and XTAL2 signal connections when populated.



**Figure 7-15: External Crystal Circuitry CLK2\_EN (J17)**

## 7.9 P&E's Input Capture Header

### 7.9.1 J18 - P&E's Logic Analyzer Inputs IN0/IN1

The logic analyzer inputs are marked on one side of the J18 jumper. The inputs allow P&E's PC-based logic analyzer application to display these signals in real-time.



By installing both jumpers, the logic analyzer pins IN0 and IN1 will be connected to PTA5 and PTA6 respectively.



By removing these jumpers IN0 and IN1 will be unconnected. The user may connect these signals, via wires, to any other signals on the

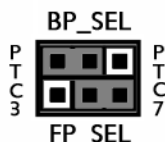
processor which they wish to view on the PC.

**Figure 7-16: Jumper Settings for Input Signals to P&E’s Embedded Multilink, P&E INPUT\_EN (J18)**

### 7.10 LCD Module

The DEMOEM brings all LCD signals to two 22x2 headers, J26 and J27. By default all jumpers are installed.

Header 25 is used to demonstrate FP/BP selection.

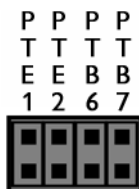


**Figure 7-17: LCD Module Header (J25)**

By default, LCD0 controls BP0 and LCD4 controls FP0.

### 7.11 P&E Light Touch Switch Enable Header

#### 7.11.1 J28 - Light Touch Switch Enable KEY\_EN



**Figure 7-18: Jumper Settings for Light Touch Switch Enable KEY\_EN (J28)**

Enables the corresponding switch. Each jumper may be individually installed or removed. By default, all jumpers are installed to enable all the switches.

### 7.12 Differential Analog Channel Inputs

The DEMOEM board brings DADM0, DADM1, and DADM2 signals to header

29, which may be connected to GND by installing the jumpers. By default they are connected to GND.



**Figure 7-19: Differential Analog Channel Inputs Header DADMx (J29)**

The DEMOEM board brings DADP0, DADP1, and DADP2 signals to header 38, which is shared with the LEDs for QE8.IRQ, RESET, and TAMPER Buttons

### 7.12.1 J31 - IRQ Button

The DEMOEM board has an IRQ button enabled by jumper position 32. When enabled it is connected to either a pullup or a pulldown resistor, determined by jumper J31.

By default it is connected to a pulldown resistor.



**Figure 7-20: IRQ Pull-Up/Pull-Down Enable (J31)**



**Figure 7-21: IRQ\_EN (J32)**

The DEMOEM board has a RESET button and LED enabled by Header J33.

**7.12.2 J33 - Reset Switch Enable and Reset LED Display Enable Jumper  
RESET\_EN**



Enables the Reset Switch and the Reset LED Display. Each jumper may be individually installed or removed. This is the default setting.

**Figure 7-22: Reset Switch and Reset LED enable Jumper (J33)**

**7.12.3 J34 - Tamper Button Enable**

The DEMOEM has a Tamper button enabled by jumper 34.



**Figure 7-23: Tamper Button Enable Jumper (J34)**

**7.13 Touch Pads**

The DEMOEM implements 4 touch pads, enabled by jumper J35.



**Figure 7-24: Touch Pad TPx\_EN Header (J35)**

**7.14 QE8-Related Jumper Settings**

The DEMOEM incorporates a QE8 device, which obtains power from jumper J36. Its 6 PWM channels are connected via jumper J38 to DEMOEM ADC inputs. Its BKGD and Reset debugging signals are selected via jumpers J39 and J40. Please see the corresponding section for the header definition.



Figure 7-25: QE8 Device Power QE\_VDD (J36)

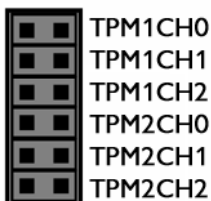


Figure 7-26: PWM to ADC Header (J38)

#### 7.14.1 Debugging Signal Selection Headers



Figure 7-27: Reset Selection (J39)



Figure 7-28: BKGD Selection (J40)

#### 7.15 VBAT Header

The DEMOEM provides a configurable connection from the coin-cell CR2032 battery to the IRTC supply pin, via jumper 37. If a jumper is installed, the cell battery will provide power to the VBAT pin of the daughter card MCU.

## 7.16 Piezo Buzzer

Jumper 44 Connects PTE6 to the piezo buzzer circuitry.



**Figure 7-29: Piezo Buzzer BUZ\_EN (J44)**

## 7.17 Optional Jumpers For Various VDD And VSS

The DEMOEM provides 5 jumpers, J19 through J23, for different VDD and VSS connections on the bottom of the board. By default, they are not populated and are shorted correspondingly with zero-ohm resistors in parallel, except J21 which is populated. The user may take off the zero-ohm resistor and install a corresponding jumper.

# 8 DEMOEM CODE DEVELOPMENT SOFTWARE

The DEMOEM includes P&E's Embedded Multilink circuitry, so no external hardware BDM tool is needed to debug and program the DEMOEM. A user only needs to connect the DEMOEM to their PC to start developing code for it.

The DEMOEM package comes with an evaluation edition of Freescale's CodeWarrior studio. In addition, P&E's evaluation software for HCS08 and ColdFire® V1 is available in the DEMOEM Resources section of the Getting Started DVD, or online at [www.pemicro.com](http://www.pemicro.com). A user may use either CodeWarrior or P&E software tools to develop code for the DEMOEM.

## 8.1 Using CodeWarrior With The DEMOEM

The CodeWarrior for Microcontrollers studio supports Freescale's HCS08 and ColdFire V1 devices. It offers C, C++, and assembly-level support, and provides debugging capabilities based on P&E's debug and programming technologies.

A programming or debug session with the project-based CodeWarrior IDE may be launched by double-clicking on the project name (the format is *projectname.mcp*) from your file storage. The DEMOEM tutorials, FAQs, and quick start guide are easy to follow and will allow you use pre-built templates

to begin creating a new project in a short time.

## **8.2 Using P&E Software With The DEMOEM**

P&E offers software tools for Freescale's HCS08 and ColdFire V1 devices that can be used to develop code for the DEMOEM board.

### **8.2.1 P&E Software Tools for HCS08 Microcontrollers**

For Freescale's HCS08 devices, P&E offers an integrated development environment, which combines a command-line assembler, in-circuit debugger, and flash memory programmer. The assembler includes features such as a full string replacement macro, conditional assembly, include files, and more. The debugger supports both assembly and C source-level debugging. The programmer can program/reprogram both internal and external flash devices in-circuit.

### **8.2.2 P&E's Software Tools for ColdFire® V1 Microcontrollers**

P&E offers an integrated development environment for Freescale's ColdFire V1 devices, which combines a GNU C compiler, in-circuit debugger, and flash memory programmer. The debugger supports both assembly and C source-level debugging. The programmer can program/reprogram both internal and external flash devices in-circuit.

## **9 TRANSITIONING TO YOUR OWN TARGET**

Once you have finished working with the DEMOEM and are ready to build your own target, you will need a hardware tool to allow you to develop using your own board. P&E's USB Multilink and P&E's Cyclone PRO offer two effective solutions, depending on your needs. Both work with Freescale's CodeWarrior as well as P&E software, and both provide a seamless transition to working with your own hardware.

The USB Multilink is a development tool that is functionally comparable to the Embedded Multilink circuitry on the DEMOEM. It will enable you to debug your code and program it onto your target. The Cyclone PRO is a more versatile and robust development tool with advanced features and production capabilities.

More information is available below to assist you in choosing the appropriate development tool for your needs.

## 9.1 Hardware Solutions At A Glance

The USB Multilink offers an affordable and compact solution for your development needs, and allows debugging and programming to be accomplished simply and efficiently. Those doing rapid development will find the USB Multilink easy to use and fully capable of fast-paced debugging and programming.

The Cyclone PRO is a more complete solution designed for both development and production. The Cyclone PRO features automated power switching, multiple communications interfaces (including USB, Ethernet, and Serial), stand-alone programming functionality, and many other advanced capabilities.

Below is an overview of the features and intended use of the USB Multilink and Cyclone PRO.

### 9.1.1 USB Multilink Key Features

- Direct user control of target's execution
- Programming and debugging capabilities
- Read/write registers and memory values
- Compact and lightweight
- Communication via USB 2.0
- Supported by P&E software and Freescale's CodeWarrior

### 9.1.2 Cyclone PRO Key Features

Advanced programming and debugging capabilities, including:

- PC-Controlled and User-Controlled Stand-Alone Operation
- Interactive Programming via Host PC
- In-Circuit Debugging, Programming, and Testing
- Compatible with Freescale's ColdFireV1, HCS08, RS08, and HC(S)12(X) microcontroller families
- Communication via USB, Serial, and Ethernet Ports
- Multiple image storage
- LCD screen menu interface



- Supported by P&E software and Freescale's CodeWarrior

## 9.2 Working With P&E's USB Multilink



**Figure 9-1: P&E's USB Multilink (USB-ML-12 shown)**

### 9.2.1 Product Features & Implementation

P&E's USB Multilink Interface (USB-ML-12) connects your target to your PC and allows the PC access to the Background Debug Mode (BDM) on Freescale's ColdFireV1, HCS08, RS08, and HC(S)12(X) microcontrollers. It connects between a USB port on a Windows 2000/XP/2003/Vista machine and a standard 6-pin debug connector on the target.

By using the USB Multilink Interface, the user can take advantage of the background debug mode to halt normal processor execution and use a PC to control the processor. The user can then directly control the target's execution, read/write registers and memory values, debug code on the processor, and program internal or external FLASH memory devices. The USB Multilink enables you to debug, program, and test your code on your board.

### 9.2.2 Software

The USB Multilink Interface works with Codewarrior as well as P&E's in-circuit debugger and flash programmer to allow debug and flash programming of the target processor. P&E's USB Multilink Development Packages come with the USB Multilink Interface, as well as flash programming software, in-circuit debugging software, Windows IDE, and register file editor.

## 9.3 Working With P&E's Cyclone PRO



Figure 9-2: P&E's Cyclone PRO

### 9.3.1 Product Features & Implementation

P&E's Cyclone PRO is an extremely flexible tool designed for debugging, testing, and in-circuit flash programming of Freescale's ColdFireV1, HC08, HCS08, RS08, and HC(S)12(X) microcontrollers. The Cyclone PRO connects your target to the PC via USB, Ethernet, or Serial Port and enables you to debug your code, program, and test it on your board. After development is complete the Cyclone PRO can be used as a production tool on your manufacturing floor.

For production, the Cyclone PRO may be operated interactively via Windows-based programming applications as well as under batch or .dll commands from a PC. Once loaded with data by a PC it can be disconnected and operated manually in a stand-alone mode via the LCD menu and control buttons. The Cyclone PRO has over 3Mbytes of non-volatile memory, which allows the on-board storage of multiple programming images. When connected to a PC for programming or loading it can communicate via the ethernet, USB, or serial interfaces.

### 9.3.2 Software

The Cyclone PRO comes with intuitive configuration software and interactive programming software, as well as easy to use automated control software. The Cyclone PRO also functions as a full-featured debug interface, and is supported by Freescale's CodeWarrior as well as development software from P&E.

P&E's Cyclone PRO is also available bundled with additional software as part of various Development Packages. In addition to the Cyclone PRO, these

Development Packages include in-circuit debugging software, flash programming software, a Windows IDE, and register file editor.

## 10 TROUBLESHOOTING

### 10.1 DEMOEM Is Undetected

**Q:** The connection assistant indicates that my DEMOEM is undetected even though I have connected the hardware to my USB port. What should I do?

**A:** The connection assistant, which displays in either Codewarrior or P&E's development software, is a dialog which allows the user to connect to the DEMOEM hardware. If this dialog indicates that the DEMOEM hardware is not connected to the PC, the first step is to make sure that the DEMOEM hardware is connected to the PC via a USB 2.0 high-speed cable. If it is connected, unplug and then plug in the USB cable on the DEMOEM board and click refresh in the connection assistant. If the hardware still does not show up, try the following remedies:

#### **(A) Re-Enable the USB driver**

If you connected the DEMOEM interface prior to the installation of P&E's Embedded Multilink drivers, Windows will not have been able to find the appropriate driver and may have disabled the device. The DEMOEM board shows up in Window's device manager as a "P&E Multilink," since it contains P&E's Embedded Multilink circuitry. If you unplug and then plug in the device, Windows will automatically disable it even if you have installed the drivers. To force windows to try to load the driver again, perform the following steps while the DEMOEM interface is connected to the computer:

1. Open the Control Panel (Start Button->Settings->Control Panel)
2. Double Click the "System" Icon
3. Select the "Hardware" tab
4. Click the "Device Manager" Button
5. The "P&E Multilink" device will be shown with an exclamation mark next to it. Double-click this device.
6. Click the "Reinstall Driver..." button and follow the dialog instructions to have Windows automatically install the driver.

#### **(B) Re-Install the USB driver**

If the Multilink device does not show up in the device manager, use the driver installation utility located in the DEMOEM Resources on the DVD-ROM. After driver installation, unplug the DEMOEM from the PC and reboot the PC. When the reboot has completed, connect the interface to the PC with the USB 2.0 cable. Run the software again to see if the interface is now detected.

If you have an error attempting to install the drivers, please view the installation troubleshooting FAQ on P&E's website at:

[http://www.pemicro.com/faqs/faq\\_view.cfm?id=89](http://www.pemicro.com/faqs/faq_view.cfm?id=89).

### **(C) Test for installation of the USB driver files**

To test the driver installation, use the driver test utility in the DEMOEM Resources of the DVD-ROM to make sure all files were properly installed. This may give some indication of what the problem is.

### **(D) Using a USB Hub**

The DEMOEM is a high-power USB device. If a USB Hub is used, it must be a self-powered hub (i.e., with its own power supply). If the Hub is not self-powered the DEMOEM will not work. In general, USB ports located directly on the PC are high-power (self-powered) ports.

## **10.2 CodeWarrior Installation Fails (WinDriver Error)**

**Q:** When I try to install the Codewarrior or P&E software, installation fails with this message: "There are currently 2 open applications using WinDriver. Please close all applications and press Retry. To reload WinDriver, press Cancel and reboot." How do I solve this?

**A:** Some software applications on your PC are connected to the WinDriver system driver which manages P&E's USB connections. This system driver needs to be disabled for the installation to continue. Directions to disable Windriver are as follows:

In Windows Explorer, right-click on My Computer and select Properties from the drop-down menu.

1. Select the Hardware tab.
2. Click on the Device Manager button.
3. Select the "System Devices" in the Device Manager window.
4. Expand the tree index (+) for System Devices.
5. At the bottom of the System Devices list you should see the Win-

Driver item.

6. Right-click on WinDriver and select Disable from the drop-down menu.
7. Click Yes/OK when the confirmation dialog appears.

WinDriver is now disabled and you should be able to complete the installation. After the installation finishes, you should re-enable the WinDriver system driver using the following steps:

In Windows Explorer, right-click on My Computer and select Properties from the drop-down menu.

1. Select the Hardware tab.
2. Click on the Device Manager button.
3. Select the "System Devices" in the Device Manager window.
4. Expand the tree index (+) for System Devices.
5. At the bottom of the System Devices list, you should see a WinDriver item.
6. Right-click on WinDriver and select Enable from the drop-down menu.

Reboot your PC after the installation finishes.

If you are unable to disable the WinDriver system driver in the above fashion, you can delete the file `c:\windows\system32\windrvr6.sys` and then reboot your machine. You should then re-run the installer and complete the procedure. Reboot your machine after the installation has finished.



## — Freescale Controller Continuum —

...68HC08/S08/RS08/(S)12(X) ... ColdFire® V1 ... ColdFire® V2/V3/V4 ... Power Architecture® ... ARM® ...



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