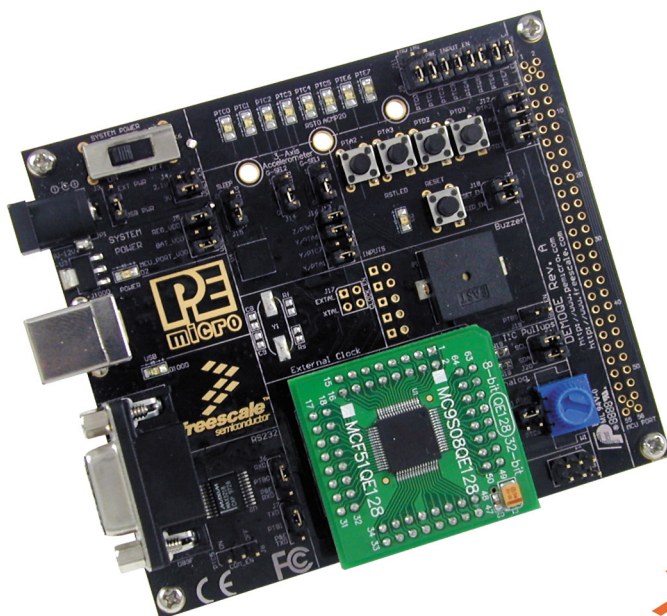




# DEMOQE128 User Manual



DEMOQE128UM

 **freescale™**  
Alliance Member

## Purchase Agreement

P&E Microcomputer Systems, Inc. reserves the right to make changes without further notice to any products herein to improve reliability, function, or design. P&E Microcomputer Systems, Inc. does not assume any liability arising out of the application or use of any product or circuit described herein.

This software and accompanying documentation are protected by United States Copyright law and also by International Treaty provisions. Any use of this software in violation of copyright law or the terms of this agreement will be prosecuted.

All the software described in this document is copyrighted by P&E Microcomputer Systems, Inc. Copyright notices have been included in the software.

P&E Microcomputer Systems authorizes you to make archival copies of the software and documentation for the sole purpose of back-up and protecting your investment from loss. Under no circumstances may you copy this software or documentation for the purpose of distribution to others. Under no conditions may you remove the copyright notices from this software or documentation.

This software may be used by one person on as many computers as that person uses, provided that the software is never used on two computers at the same time. P&E expects that group programming projects making use of this software will purchase a copy of the software and documentation for each user in the group. Contact P&E for volume discounts and site licensing agreements.

P&E Microcomputer Systems does not assume any liability for the use of this software beyond the original purchase price of the software. In no event will P&E Microcomputer Systems be liable for additional damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use or inability to use these programs, even if P&E Microcomputer Systems has been advised of the possibility of such damage.

By using this software, you accept the terms of this agreement.

© 2011 P&E Microcomputer Systems, Inc. "MS-DOS" and "Windows" are registered trademarks of Microsoft Corporation. "Freescale" and "ColdFire" are registered trademarks of Freescale, Inc. "IBM" and "PowerPC" are registered trademarks of IBM corporation.

P&E Microcomputer Systems, Inc.  
98 Galen St.  
Watertown, MA 02472  
617-923-0053  
<http://www.pemicro.com>

Manual version 1.08, March 2011



---

1	INTRODUCTION .....	1
1.1	Overview .....	1
1.2	Package Contents .....	1
1.3	Supported Devices .....	1
1.4	Recommended Materials On Breaking Bit Boundaries DVD-ROM .....	2
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
2.5	DEMOQE128 JUMPER/CONNECTOR QUICK REFERENCE .....	5
3	GETTING STARTED WITH THE DEMOQE128 .....	7
3.1	Quick Start Guide .....	7
3.2	LAB 1: Learn How to use DEMOQE Toolkit Utilities .....	10
3.3	LAB 2: Migrate Quickly from 8-Bit To 32-Bit .....	12
3.4	LAB 3: Measure Performance between 8-Bit and 32-Bit .....	15
3.5	LAB 4: Learn how to use CodeWarrior .....	20
4	SYSTEM SETUP .....	20
4.1	Overview .....	20
4.2	Operating System Requirements .....	21
4.3	Software Setup .....	21
4.4	Quick Startup .....	22
4.5	Hardware Setup .....	23
5	OPERATING MODES .....	26
5.1	Overview .....	26
5.2	Debug Mode .....	26
5.3	Run Mode .....	27
5.4	External BDM Mode .....	27
6	EMBEDDED MULTILINK TOOLKIT PC APPLICATIONS .....	27
6.1	Logic Analyzer Application .....	27

---

6.2	Terminal Application .....	28
6.3	Unsecure Application .....	29
6.4	Accelerometer Demo Application .....	30
6.5	Serial Grapher Application .....	32
6.6	Multilink Serial Re-Director Application .....	35
7	<b>DEMONSTRATION MICROCONTROLLER APPLICATIONS.....</b>	<b>36</b>
7.1	Quick Start Application .....	36
7.2	Serial Accelerometer Application .....	37
8	<b>JUMPER SETTINGS .....</b>	<b>37</b>
8.1	System Power .....	37
8.2	RS232 Communications .....	39
8.3	LED Display Port .....	41
8.4	Input and Reset Switches .....	41
8.5	3-Axis Accelerometer Jumper Settings .....	43
8.6	Buzzer .....	43
8.7	IIC Pull-up .....	44
8.8	Analog Input Potentiometer .....	44
8.9	Optional External Crystal Circuitry Jumper Enable .....	44
8.10	Optional Jumpers For Various VDD And VSS .....	45
9	<b>DEMOQE128 CODE DEVELOPMENT SOFTWARE .....</b>	<b>45</b>
9.1	Using CodeWarrior With The DEMOQE128 .....	45
9.2	Using P&E Software With The DEMOQE128 .....	45
10	<b>TRANSITIONING TO YOUR OWN TARGET .....</b>	<b>46</b>
10.1	Hardware Solutions At A Glance .....	46
10.2	Working With P&E's USB Multilink or USB Multilink Universal .....	48
10.3	Working With P&E's Cyclone PRO .....	49
11	<b>TROUBLESHOOTING .....</b>	<b>50</b>
11.1	DEMOQE128 Is Undetected .....	50
11.2	CodeWarrior Installation Fails (WinDriver Error) .....	51

# **1 INTRODUCTION**

## **1.1 Overview**

The DEMOQE128 is a low-cost development system designed for demonstrating, evaluating, and debugging the Freescale MC9S08QE128 and MCF51QE128 microcontrollers. P&E's Embedded Multilink circuitry on the DEMOQE128 board allows the processor on the DEMOQE128 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 DEMOQE128 package includes the following items:

- DEMOQE Base Board with a MC9S08QE128 Daughter Card installed
- MCF51QE128 Daughter Card
- DVD Breaking Bit Boundaries - Getting Started With QE128
- USB Cable
- Quick Start Guide
- Freescale Warranty Card

## **1.3 Supported Devices**

The DEMOQE128 supports the following devices:

- MC9S08QE128CLH
- MCF51QE128CLH

## **1.4 Recommended Materials On Breaking Bit Boundaries DVD-ROM**

- Freescale MC9S08QE128 reference manual and datasheet
- Freescale MCF51QE128 reference manual and datasheet
- DEMOQE Base Board Schematic
- DEMOQE128 Daughter Card Schematic
- DEMOQE Toolkit Applications
- P&E Embedded Multilink driver installation guide and resources

## 1.5 Handling Precautions

Take care to handle the package contents, including the DEMOQE base board, MC9S08QE128 daughter card, and MCF51QE128 daughter card, in a manner such as to prevent electrostatic discharge.

## 2 HARDWARE FEATURES

The DEMOQE128 is a demonstration and development system for Freescale's MC9S08QE128 and MCF51QE128 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 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 DEMOQE128'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

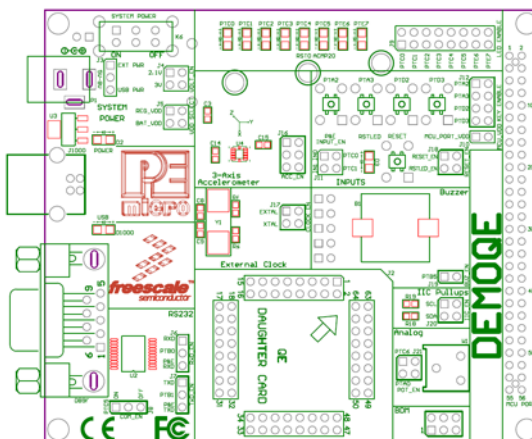
**Note:** The DEMOQE Rev. A & B board power connector is incorrectly labelled as 5-12VDC. The maximum voltage is 8VDC.

- 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 Rev. A & B board power connector is incorrectly labelled as 5-12VDC. The maximum voltage is 8VDC.

- Two AAA Battery Cells



**Figure 2-1: DEMOQE128 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 DVD-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 DVD-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 MC9S08QE128CLH or MCF51QE128CLH chip

## 2.5 DEMOQE128 JUMPER/CONNECTOR QUICK REFERENCE

### Default Jumper Settings

The following is a list of default jumper settings for DEMOQE board. The settings listed indicated the “on” (or installed) position.

**Table 2-1. Default Jumper Settings**

Jumper	Default Setting
J3	2-3
J4	3-4
J5	1-2
J6	2-3
J7	2-3
J8	2-3

**Table 2-1. Default Jumper Settings**

<b>Jumper</b>	<b>Default Setting</b>
J9	1-2 3-4 5-6 7-8 9-10 11-12 13-14 15-16
J10	1-2
J12	1-2 3-4 5-6 7-8
J16	1-2 3-4 5-6
J17	1-2 3-4
J18	1-2 3-4
J19	1-2
J20	1-2 3-4
J21	3-4
J24	1-2

## MCU Port Connector Pinout

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

VDD	1	2	PTA5/IRQ/TPM1CLK/RESET
VSS	3	4	PTA5/IRQ/TPM1CLK/RESET
PTB1/KB1P5/TxD1/ADP5	5	6	PTA4/ACMP1/OIBKGD/MS
PTB0/KB1P4/RxD1/ADP4	7	8	PTE7/TPM3CLK (n/c for 32 LQFP)
PTA2/KB1P2/SDA1/ADP2	9	10	VREFH
PTA3/KB1P3/SCL1/ADP3	11	12	VREFL
PTC0/TPM3CH0	13	14	PTA0/KB1P0/TPM1CH0/ADP0/ACMP1+
PTC1/TPM3CH1	15	16	PTA1/KB1P1/TPM2CH0/ADP1/ACMP1-
PTB3/KB1P7/MOSI1/ADP7	17	18	PTF0/ADP10 (n/c for 32 LQFP)
PTB4/TPM2CH1/MISO1	19	20	PTF1/ADP11 (n/c for 32 LQFP)
PTB2/KB1P6/SPSCK1/ADP6	21	22	PTA6/TPM1CH2/ADP6
PTB5/TPM1CH1/SS1	23	24	PTA7/TPM2CH2/ADP9
PTD1/KB2P1/MOSI2	25	26	PTH6/SCL2 (n/c for 32 LQFP)
PTD2/KB2P2/MISO2	27	28	PTH7/SDA2 (n/c for 32 LQFP)
PTD0/KB2P0/SPSCK2	29	30	PTD4/KB2P4 (n/c for 32 LQFP)
PTD3/KB2P3/SS2	31	32	PTD5/KB2P5 (n/c for 32 LQFP)
PTC2/TPM3CH2	33	34	PTD6/KB2P6 (n/c for 32 LQFP)
PTC3/TPM3CH3	35	36	PTD7/KB2P7 (n/c for 32 LQFP)
PTC4/TPM3CH4/RSTO	37	38	PTC7/TxD2/ACMP2-
PTC5/TPM3CH5/ACMP0	39	40	PTC6/RxD2/ACMP2+
(n/c for 32 LQFP) PTF2/ADP12	41	42	PTB7/ISCL1/EXTAL
(n/c for 32 LQFP) PTF3/ADP13	43	44	PTB6/SDA1/XTAL
(n/c for 32 LQFP) PTF4/ADP14	45	46	PTG0 (n/c for 32 LQFP)
(n/c for 32 LQFP) PTF5/ADP15	47	48	PTG1 (n/c for 32 LQFP)
(n/c for 32 LQFP) PTF6/ADP16	49	50	PTH0 (n/c for 32 LQFP)
(n/c for 32 LQFP) PTF7/ADP17	51	52	PTH1 (n/c for 32 LQFP)
(n/c for 32 LQFP) PTG2/ADP18	53	54	PTE6 (n/c for 32 LQFP)
(n/c for 32 LQFP) PTG3/ADP19	55	56	NC

Figure 2-2: MCU Port Connector Pinout

## 3 GETTING STARTED WITH THE DEMOQE128

The DEMOQE128 is a low-cost board targeting quick microcontroller evaluation. The board includes two plug-in daughter cards to demonstrate the ease of migration between the Flexis QE128, 8-bit S08 and 32-bit ColdFire V1 microcontrollers. The board also includes a power terminal to measure the ultra-low power consumption of the Flexis QE128 devices.

This getting started chapter serves two purposes. The first is to install all necessary software and demonstrate some basic DEMOQE128 features. The second is to demonstrate with a few simple labs the key benefits of the QE128 microcontroller.

### 3.1 Quick Start Guide

The quick start guide walks you through the initial software installation and board test.

## STEP 1: INSTALL CODEWARRIOR FOR MICROCONTROLLERS

CodeWarrior installation is a **one-time required step** before connecting the board to your computer.

1. Insert the provided Breaking Bit Boundaries DVD into your computer and a menu page will appear on your default browser.
2. Click on the following image to download the CodeWarrior installer to



your computer. Follow the prompts to save file CW\_MCU\_V6\_0.exe to your computer.

3. Once the download is complete, double-click on the CW\_MCU\_V6\_0.exe executable file to run the installation.
4. Follow the on-screen instructions until the installation is complete.

## STEP 2: INSTALL DEMOQE TOOLKIT

DEMOQE Toolkit install is a **one-time required step**. The DEMOQE Toolkit includes graphical utilities that run on your computer and help speed up your development. These utilities take development beyond the hardware. They interact with the target microcontroller over the same USB Multilink reference design on the board that allows you to debug using CodeWarrior. Additionally, you can debug your microcontroller in CodeWarrior while simultaneously using one of the following utilities: Logic Analyzer, Serial Grapher, Terminal Window, and Accelerometer Demo Grapher.

1. Insert the provided Breaking Bit Boundaries DVD into your computer and a menu page will appear on your default browser.
2. Click on "DEMOQE128" and then on "Other DEMOQE128 Resources" in the navigation panel on the left side of the DVD menu. This will launch the P&E DEMOQE Resources menu.
3. From this new menu, click on "Drivers & DEMOQE Toolkit" to launch the appropriate menu for downloading the toolkit.
4. From this new menu, click on "DEMOQE Toolkit." Follow the prompt

to save file “DEMOQE\_Toolkit.zip” to your computer.

5. Extract the zip file to the desired location on your computer, creating a DEMOQE\_Toolkit folder that includes all the graphical utilities.

Some of the toolkit applications capture and display data from the DEMOQE128 board. The faster the PC is, the more rapid and smooth the data display in these utilities will be.

For more information on the DEMOQE Toolkit, see the board user manual (DEMOQE128UM.pdf) included in the DVD under “DEMOQE128 > DEMOQE128 User Manual” in the navigation panel on the left side of the DVD menu. For new and upgraded utilities to the DEMOQE Toolkit visit <http://www.pemicro.com/fixedlinks/demoQEt toolkit.html>.

### **STEP 3: CONNECT DEMOQE128 BOARD TO COMPUTER**

USB driver installation is a **one-time required step** that requires CodeWarrior installation first.

1. Remove the board from the anti-static pouch. The green 8-bit MC9S08QE128 daughter card will be mounted on the base board.
2. Connect the provided USB cable from a free USB port on your computer to the USB connector on the board. If a HUB is used, it must be self-powered.
3. The operating system will recognize your board as new hardware and will prompt you to install the USB drivers. Choose the recommended option to install the software automatically. (USB drivers for your board were pre-loaded in CodeWarrior installation.)
4. Follow the on-screen instructions until all USB driver installations are complete. The green USB LED on the board should illuminate.

### **STEP 4: TEST BOARD BY RUNNING QUICK START APPLICATION**

Now that you have successfully completed the software and hardware setup, test your board by interacting with the Quick Start Application that is pre-loaded in the microcontroller’s on-chip flash memory.

The programmed application samples the microcontroller's general purpose input pins. These pins are connected to push buttons and perform two actions. The first action is to illuminate the respective LED with either a general purpose output pin or a pulse-width modulated signal pin. The second action is to play a different tone per push button on the speaker, using a pulse-width modulated signal programmed at different frequencies. The application samples the potentiometer using the microcontroller's analog-to-digital converter and uses the result to vary the light intensity of two LEDs by changing their pulse-width modulated signal's duty cycle.

1. Turn the SYSTEM POWER switch to the ON position. The red POWER LED will illuminate and the application will start automatically.
2. Press push buttons labeled PTA2, PTA3, PTD2, and PTD3. A different tone will be emitted from speaker when each push button is pressed, and the corresponding LEDs labeled PTC1, PTC2, PTC3, and PTC4 will illuminate.
3. Rotate the potentiometer (W1) to vary the light intensity of the LEDs labeled PTC0 and PTC5.
4. Now that your board is functional, try out the provided labs in DEMOQE128 Labs section to learn more about the Flexis QE128 microcontrollers and other features included with your board.

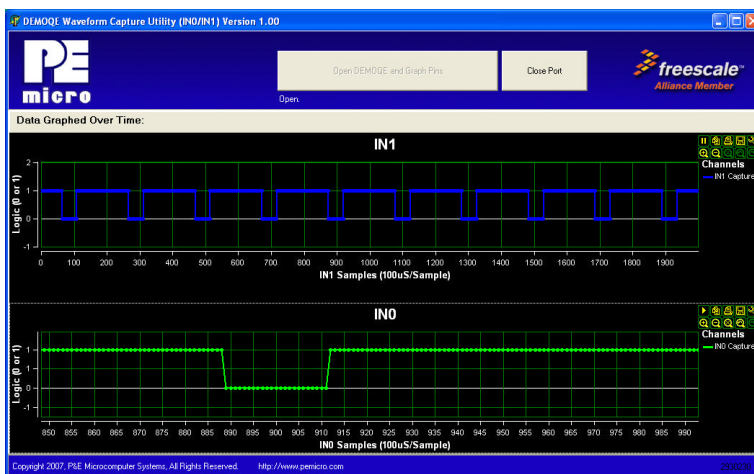
### 3.2 LAB 1: Learn How to use DEMOQE Toolkit Utilities

This lab will show you how to use one of several graphical utilities in DEMOQE Toolkit included with your board. Instructions to download these utilities to your computer are provided in Step 2 of the **Section 3.1 - Quick Start Guide**. Make sure to use only one utility at a time, as the utilities all share the same USB resource. The toolkit utilities may be used at the same time that an application is being debugged and programmed on the DEMOQE128 board from within CodeWarrior.

With the Quick Start Application (which comes pre-loaded in the microcontroller's on-chip flash memory) running we will use the DEMOQE Logic Analyzer utility. This PC-based utility graphs the IN0 and IN1 signals on

the board. For convenience, if both J11 jumpers are installed, IN0 graphs PTC0 activity and IN1 graphs PTC1 activity. If you would like to graph other microcontroller signals, you can use wire jumpers from IN0 and IN1 to the respective signals on the board's MCU PORT.

1. Make sure the board is powered ON and that the Quick Start Application is running.
2. Open the DEMOQE Logic Analyzer utility from within the DEMOQE\_Toolkit folder by double-clicking on the LogicAnalyzer.exe file.
3. In the utility, click on the "Open DEMOQE and Graph Pins" button to begin graphing IN0 and IN1. These signals will be continually graphed at a sampling rate of 10Khz.



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

4. Press the push button labeled PTA2. This will cause a fixed duty cycle pulse-width modulation signal to be output on the PTC1 pin. The PTC1 waveform is shown on analyzer channel IN1.
5. Rotate the potentiometer W1. This will change the duty cycle of the variable pulse-width modulation signal output on the PTC0 pin. The PTC0 waveform is shown on analyzer channel IN0.

6. Click on the “Close Port” button when you are finished using the utility.

Some of the toolkit applications capture and display data from the DEMOQE128 board. The faster the PC is, the more rapid and smooth the data display in these utilities will be.

Note that the above image is shown with the IN0 channel zoomed in. Each analyzer channel has several features including the ability to be zoomed and paused. For more information on DEMOQE Toolkit, see the board user manual (DEMOQE128UM.pdf) included in the DVD under “DEMOQE128 > DEMOQE128 User Manual” in the navigation panel on the left side of DVD menu. For the latest DEMOQE Toolkit utilities, please visit <http://www.pemicro.com/fixedlinks/demoQEToolkit.html>.

### 3.3 LAB 2: Migrate Quickly from 8-Bit To 32-Bit

This lab will show you how to quickly migrate an application between the 8-bit and 32-bit Flexis QE128 microcontrollers. The Flexis brand delivers pin-to-pin compatibility, one development tool, and the same peripherals between the 8-bit and 32-bit devices. This lab will demonstrate an upward migration from 8-bit to 32-bit, but the opposite is just as simple. Continuing with the Quick Start Application that is pre-loaded in the microcontroller’s on-chip flash memory, you will now use the CodeWarrior MCU Change Wizard to retarget and rebuild your project from the 8-bit to the 32-bit QE128 microcontroller.

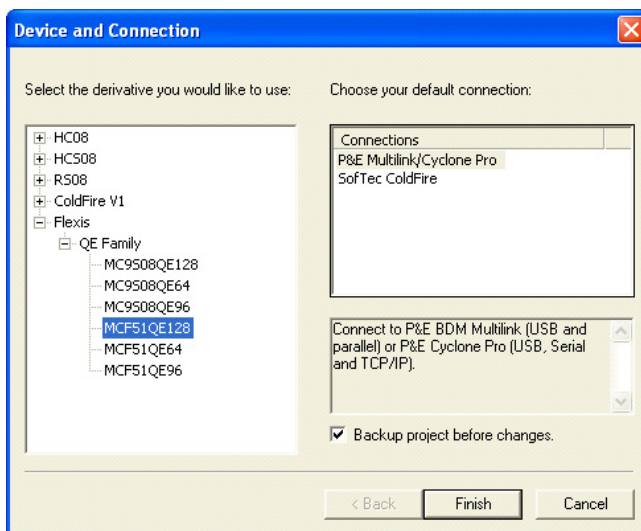
1. Open CodeWarrior for Microcontrollers. From the Windows Start menu, locate it under “Programs>Freescale CodeWarrior>CW for Microcontroller V6.0>CodeWarrior IDE” path.
2. Click on “Load Example Project” from the CodeWarrior startup dialog. If the startup dialog is not shown, it may be opened from the CodeWarrior menu by clicking “File” and then “Startup Dialog...”.
3. From the Example Projects menu, open the tree to select: HCS08>Evaluation Board Examples>DEMOQE128>DEMOQE128\_Quick\_Start\_S08.

4. Give the example a new project name (e.g., Lab2), set desired location, and click “Create Project.” This will open the project for the pre-loaded Quick Start Application you are running on the 8-bit microcontroller.
5. Open the MCU Change Wizard to switch the project to the 32-bit microcontroller by clicking on the following button in the project panel:



**Figure 3-4: MCU Change Wizard Button**

6. From the wizard, change the microcontroller selection from the 8-bit “MC9S08QE128” to the 32-bit “MCF51QE128” in the Flexis>QE Family tree as shown in image below.



**Figure 3-5: MCU Change Wizard**

7. Click “Finish.” In the background CodeWarrior will transform your project to the 32-bit microcontroller with no software changes needed. An informational “Project Messages” window may appear letting you know that changes have been made to the project.

8. If the Logic Analyzer utility is open, click the “Close Port” button on that utility.
9. Turn the board power switch to OFF.
10. Switch the green 8-bit S08 daughter card with the red 32-bit Cold-Fire V1 daughter card. Make sure to align pin 1 (as marked by arrows) on the daughter card with pin 1 on the board.
11. Turn the board power switch to ON.
12. Compile the transformed Quick Start Application and start the process of programming it into the flash on the 32-bit QE128 microcontroller by clicking on the debugger launch button shown here :



**Figure 3-6: IDE Debugger Launch Button**

13. From the Connection Manager menu, select “USB1: DEMOQE” port and click on “Connect (Reset).”
14. From the Loader Warning menu, click on “OK” to allow the debugger to mass erase the microcontroller’s on-chip flash memory and program it with the new application.
15. Click on the GO button in the debugger to run the application. The GO button is shown here:



**Figure 3-7: Debugger GO Button**

16. Repeat Step 4 of the Quick Start Guide instructions to observe the 32-bit QE128 device running the same application as the 8-bit QE128 device did previously.
17. Repeat Lab 1 instructions to graph the PTC0 and PTC1 signals in the Logic Analyzer utility.
18. Click on the “Close Port” button and close the Logic Analyzer utility when you are finished using it.

### 3.4 LAB 3: Measure Performance between 8-Bit and 32-Bit

This lab will highlight the performance differences between the 8-bit and 32-bit QE128 microcontrollers and demonstrate how these microcontrollers can interface easily with an external sensor. You will also see how to use another one of several software utilities included with your board. Instructions to download these utilities to your computer are provided in Step 2 of this Quick Start Guide. Make sure to use only one utility at a time, as the utilities share the same USB resource.

The Accelerometer Application reads the X, Y, and Z axes of the 3-axis accelerometer on the DEMOQE board using the microcontroller's analog to digital converter. It outputs a processed version of the accelerometer data on the microcontroller's serial communication interface. This processed data is a rolling average of the raw accelerometer data, or a filtered version of the raw accelerometer data, depending on the selected mode. The application in this lab will output the data as 16-bit integer values to highlight the data processing capabilities of the 32-bit ColdFire V1. The application also displays the cycle count ("C"), which is the number of MCU bus cycles required for the CPU to process the last 16 accelerometer readings for the selected mode.

#### Setup demo:

1. Open CodeWarrior for Microcontrollers. From the Windows Start menu, locate it under "Programs>Freescale CodeWarrior>CW for Microcontroller V6.0>CodeWarrior IDE" path.
2. Click on "Load Example Project" from the CodeWarrior startup dialog. If the startup dialog is not shown, it may be opened from the CodeWarrior menu by clicking "File" and then "Startup Dialog...".
3. From the Example Projects menu, open the tree to select: HCS08>Evaluation Board Examples>DEMOQE128>DEMOQE\_Accelerometer\_S08.
4. Give the example a new project name (e.g., Lab3), set the desired location, and click "Create Project." This will open the Accelerometer Application for the 8-bit microcontroller.
5. Launch the AccelerometerDemo utility from within the DEMOQE\_Toolkit folder by double-clicking on the Accelerometer-

Demo.exe file.

6. See the DEMOQE128 User Manual for more details on the Accelerometer Demo utility.
7. Set “Port” to “USB COM.”
8. Set “Baud” rate to 115200.
9. Turn the board power switch to OFF position.
10. Make sure the green 8-bit S08 daughter card is plugged in to the board. The board jumpers should all be set to the default settings shown in the Quick Start Guide.
11. Turn the board power switch to the ON position and make sure that the debugger window is closed.

#### **Run demo on 8-bit S08:**

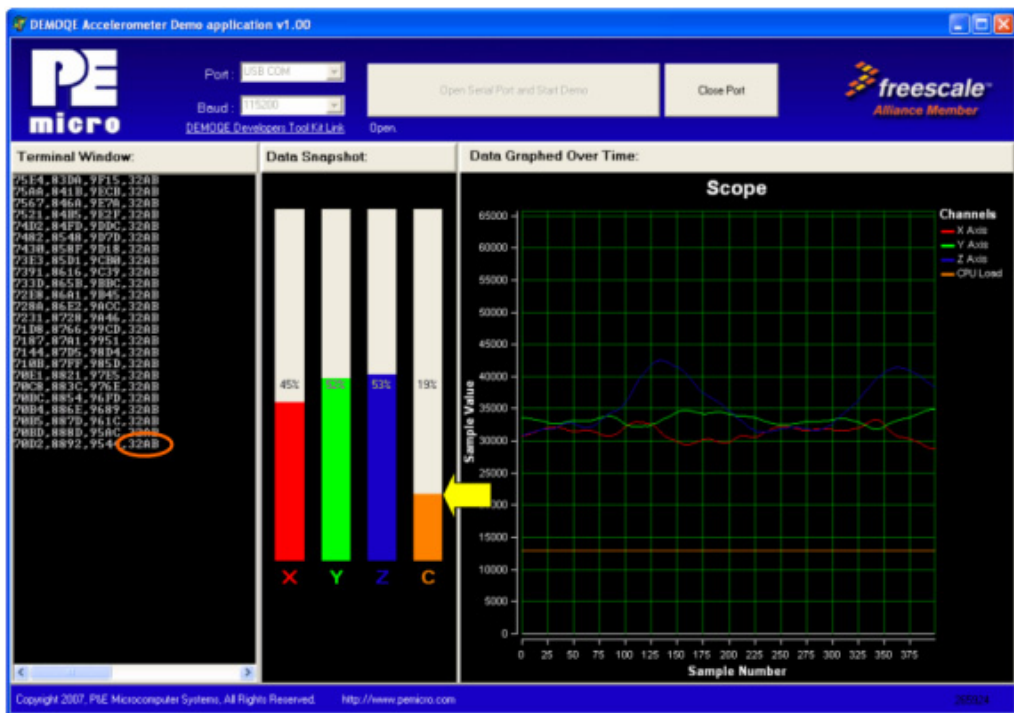
1. Compile the Accelerometer Application and start the process of programming it into the flash of the 8-bit QE128 microcontroller by clicking on the debugger launch button shown here :



2. From Connection Manager menu, select “DEMOQE on the USB1” port and click on “Connect (Reset).”
3. From the Erase and Program Flash menu, click on “Yes” to allow the debugger to mass erase the microcontroller’s on-chip flash memory and program it with the new application.
4. Click on the GO button in the debugger to run the application. The GO button is shown here:



5. Bring the Accelerometer Demo utility to the front and click the “Open Serial Port and Start Demo” button.



**Figure 3-8: AccelerometerDemo running on 8-bit S08 QE128 in data averaging mode. Yellow arrow highlights the bus cycles required to average the last 16 readings of the 3 axes. Value shown in orange circle is the number of bus cycles in hex.**

6. Move the board around to demonstrate the 3-axis accelerometer.
7. Observe the output in the Accelerometer Demo utility.
8. Click the button labeled PTA3 on the board to enable data averaging, and move the board.
9. Click the button labeled PTA2 on the board to enable data filtering, and move the board.

### Change device to 32-bit ColdFire V1:

1. Click "Close Port" in the Accelerometer Demo utility.

2. Close the “True-Time Simulator & Real-Time Debugger” window.
3. Bring the CodeWarrior IDE window to the front with the Accelerometer Application project for the 8-bit microcontroller.
4. Open the MCU Change Wizard to switch the project to the 32-bit microcontroller by clicking on the following button in the project panel:



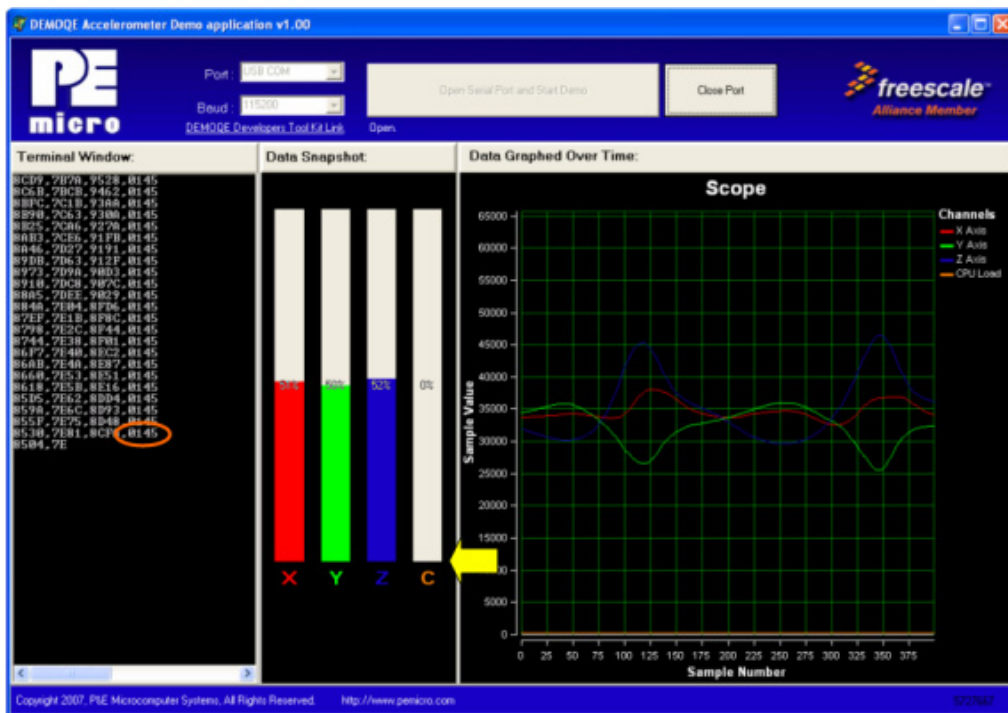
5. From the wizard, change the microcontroller selection from the 8-bit “MC9S08QE128” to the 32-bit “MCF51QE128” in the Flexis>QE Family tree.
6. Click “Finish.” In the background CodeWarrior will transform your project to the 32-bit microcontroller with no software changes needed.
7. Turn board power switch to OFF.
8. Switch the green 8-bit S08 daughter card with the red 32-bit ColdFire V1 daughter card. Make sure to align pin 1 (as marked by arrows) on daughter card and with pin 1 on the board.
9. Turn board power switch to ON.

#### **Run demo on 32-bit ColdFire V1:**

1. Compile the Accelerometer Application and start the process of programming it into the flash of the 32-bit QE128 microcontroller by clicking on the debugger launch button shown here :



2. From the Connection Manager menu, select the “USB1: DEMOQE” port and click on “Connect (Reset).”
3. From the Loader Warning menu, click on “OK” to allow the debugger to mass erase the microcontroller’s on-chip flash memory and program it with the new application.
4. Click on the GO button in the debugger to run the application.
5. Bring the Accelerometer Demo utility to the front and click the “Open Serial Port and Start Demo” button.



**Figure 3-9: Accelerometer Demo running on 32-bit ColdFire V1 QE128 in data averaging mode. Yellow arrow highlights the bus cycles required to average the last 16 readings of the 3 axes. Value shown in orange circle is the number of bus cycles in hex.**

6. Move the board around to demonstrate the 3-axis accelerometer.
7. Observe the output in the Accelerometer Demo utility.
8. Click the button labeled PTA3 on the board to enable data averaging, and move the board.
9. Click the button labeled PTA2 on the board to enable data filtering, and move the board.

The accelerometer demo shows the performance gains of the 32-bit ColdFire

V1 CPU over the 8-bit S08 CPU. In the data averaging and data filtering modes, a considerable amount of 16-bit and 32-bit math is required. The S08 CPU is capable of performing these tasks, but it requires a substantial portion of its bandwidth. In contrast, the ColdFire V1 CPU performs the same tasks with only a very small portion of its bandwidth. With Flexis QE128 microcontrollers, you can pick and choose the CPU that best matches your performance needs.

### 3.5 LAB 4: Learn how to use CodeWarrior

This lab will direct you to several CodeWarrior tutorials that will show you how to maximize your time to market. The tutorials walk you through various development tool features, and cover the following types of projects:

- C Programming
  - Assembly Programming
  - Using Processor Expert
  - C Programming with Device Initialization
  - Assembly Programming with Device Initialization
1. Open CodeWarrior for Microcontrollers. From the Windows Start menu locate it under “Programs>Freescale CodeWarrior>CW for Microcontroller V6.0>CodeWarrior IDE” path.
  2. Click on “Run Getting Started Tutorial” from the CodeWarrior startup dialog. If the startup dialog is not shown, it may be opened from the CodeWarrior menu by clicking “File” and then “Startup Dialog...”.
  3. From the Freescale CodeWarrior Tutorials menu select the tutorial you would like to view.
  4. Select “Click here to start tutorial” and follow on-screen instructions.

## 4 SYSTEM SETUP

### 4.1 Overview

P&E's Embedded Multilink driver is required to operate the DEMOQE128 using a PC. The Embedded Multilink driver should be installed with the CodeWarrior Development Studio software or from the DEMOQE Resources in the DVD-ROM before the PC is connected to the DEMOQE128.

## **4.2 Operating System Requirements**

The following are the resources required to run the CodeWarrior Development Studio and the DEMOQE128:

- 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 DVD-ROM drive for software installation
- A USB port

## **4.3 Software Setup**

### **4.3.1 Installing CodeWarrior Development Studio**

To install the CodeWarrior Development Studio, Follow the instructions in the **Section 3.1 - Quick Start Guide**.

### **4.3.2 Installing P&E Resources**

Use the DEMOQE Resources in the DVD-ROM to access and install P&E resources for the DEMOQE128. These materials are not required for operation. The DEMOQE Resources in the Breaking Bit Boundaries DVD-ROM contains the following supporting materials:

- DEMOQE128 Embedded Multilink hardware interface driver
- DEMOQE128 User Manual (this document)
- DEMOQE128 Quick Start Guide
- DEMOQE128 Quick Start Application Source Code
- DEMOQE128 Base Board and Daughter Cards Schematics
- DEMOQE128 Component Breakdown List
- DEMOQE Toolkit Applications

- Links to P&E Evaluation Software
- Links to Freescale documentation, P&E Discussion Forums, and DEMOQE128 FAQs.

## 4.4 Quick Startup

Only a few steps are required to get the DEMOQE128 up and running. Please reference **Section 3.1 - Quick Start Guide**.

## 4.5 Hardware Setup

### 4.5.1 First-Time Connection

The DEMOQE128 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:

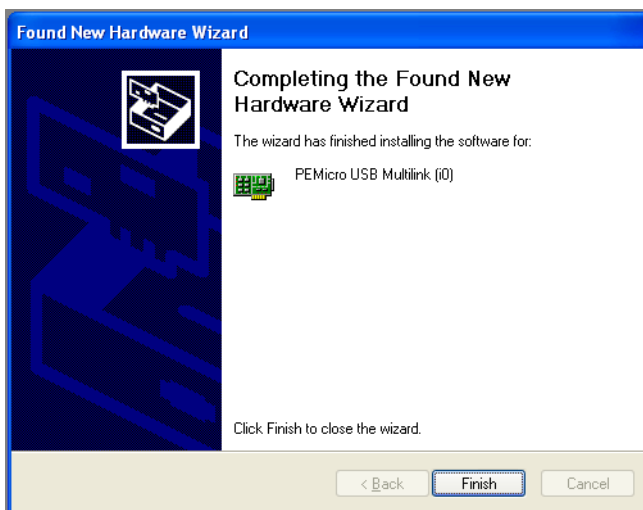


**Figure 4-10: Found New Hardware Wizard Dialog (1 of 4)**

Select the "Install the software automatically (Recommended)" option

and click the “Next” button.

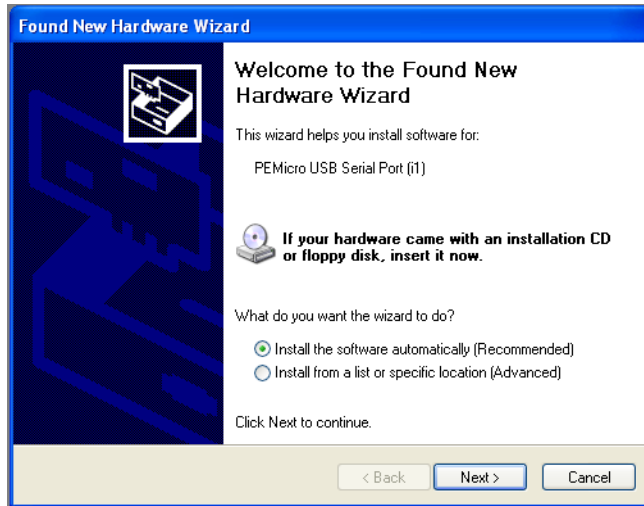
6. Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear:



**Figure 4-11: Found New Hardware Wizard Dialog (2 of 4)**

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

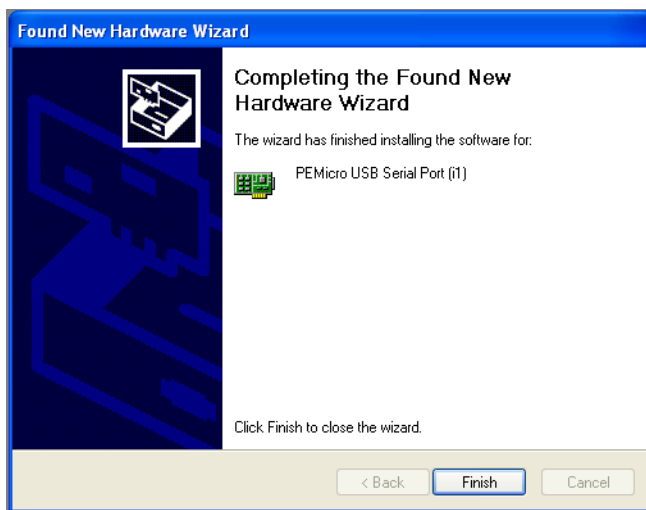
7. Depending on the operating system, you may see the “Found New Hardware Wizard” dialog again, helping you to install software for “PEMicro USB Serial Port (i1). On Windows XP (SP2), the following dialog will appear:



**Figure 4-12: 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 4-13: Found New Hardware Wizard Dialog (4 of 4)**

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

If the DEMOQE128 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 DEMOQE128 you will see the red Power LED illuminate.

## 5 OPERATING MODES

### 5.1 Overview

The DEMOQE128’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 DEMOQE128.

### 5.2 Debug Mode

A host communicates with the DEMOQE128 through the Embedded Multilink circuitry. Either the CodeWarrior Development Studio or P&E’s HCS08/CFV1 software tools will work with the DEMOQE128. Please refer to **Section 9** -

**DEMOQE128 CODE DEVELOPMENT SOFTWARE** for more information.

### 5.3 Run Mode

The DEMOQE128's rich component list empowers it to perform a variety of tasks. Once an application is developed, debugged, and programmed properly into the QE128 internal flash memory, it can run with or without connecting to a host.

### 5.4 External BDM Mode

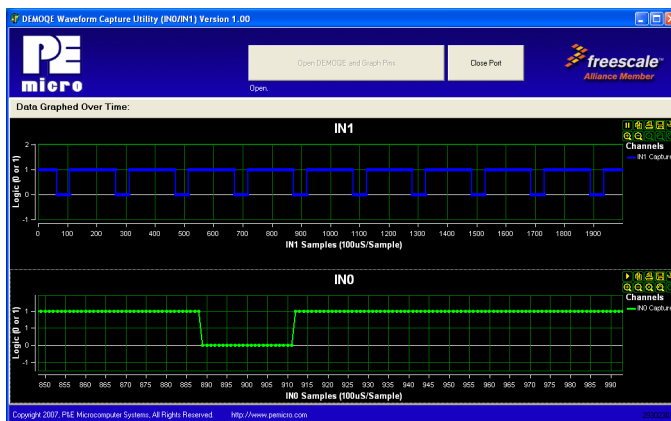
The DEMOQE128 has an optional BDM header for debugging and programming the on-board QE128 device using an external BDM hardware tool, such as P&E's USB Multilink or Cyclone PRO. Please refer to **Section 10 - TRANSITIONING TO YOUR OWN TARGET** for more information. A user can take advantage of this mode to develop a target-specific QE128 system and compare it with the DEMOQE128 when necessary.

## 6 EMBEDDED MULTILINK TOOLKIT PC APPLICATIONS

P&E provides several Windows PC-based applications which work with the DEMOQE128 board. These applications are collectively referred to as the Embedded Multilink Toolkit. The following applications are included in the toolkit:

### 6.1 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 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 evaluation board. Once the USB and Power LEDs light up, indicating the proper enumeration on the USB port, click on the Open DEMOQUE and Graph Pins button. The logic channel graphs should be reflecting data captured from IO pins connected to IN0 and IN1 header pins on the DEMOQUE evaluation board.

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.

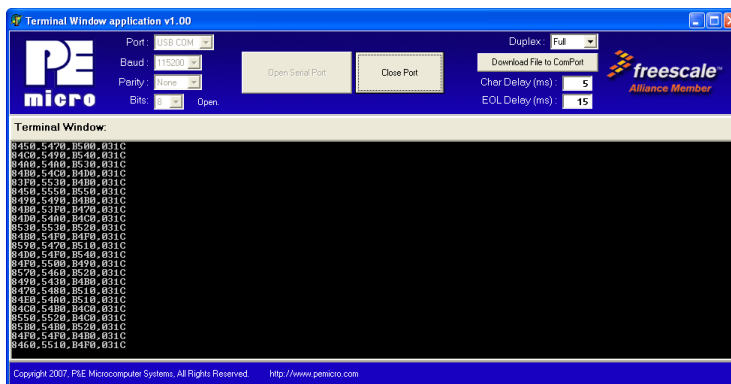
This PC-based application is included on the DVD-ROM that accompanies the DEMOQUE, and may also be found at:

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

## 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 DEMOQUE 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 6-2: 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.

To start using this application, please choose a COM or virtual USB COM settings from a drop down Port menu. By doing so, you are specifying the port on the evaluation board that will be used for serial data transmission. Please make sure that jumpers on headers J6 and J7 are set accordingly. Prior to starting serial data capture, please specify 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.

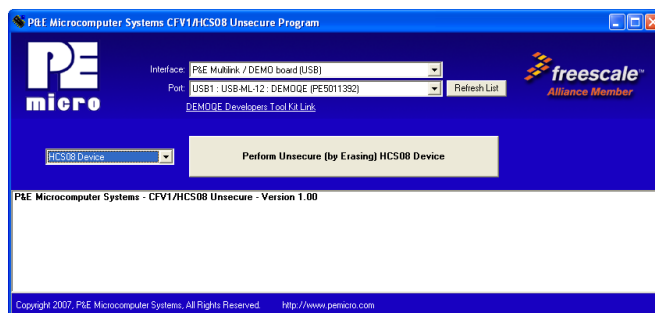
This PC-based application is included on the DVD-ROM that accompanies the DEMOQE, and may also be found at:

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

## 6.3 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 DEMOQE board as well as other user hardware connected to the PC via the USB Multilink or Cyclone PRO hardware interfaces.



**Figure 6-3: DEMOQE Unsecure Application**

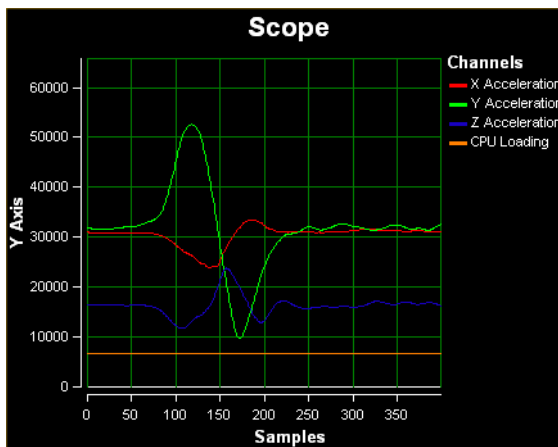
In order to unsecure a device with this application, please specify the hardware interface that you are using. If your P&E Multilink or Cyclone Pro is successfully detected, the name of a corresponding device will appear in the Port text box. Please select HCS08 or CFV1 from the Select Architecture drop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

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

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

## 6.4 Accelerometer Demo Application

This PC-based application will graph serial data output from the microcontroller-based serial accelerometer application documented in **Section 7.2 - 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 6-4: 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. To properly configure accelerometer and potentiometer resources on the DEMOQE evaluation board, please make sure the J16 jumpers are all installed.

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 on headers J6 and J7 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 button. After the serial data is captured by the application you will see raw data in the Terminal Window. In the meantime, the Data Snapshot window will display the accelerometer and potentiometer data levels in the form of a bar graph. 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 DEMOQE Accelerometer Demo Application.

This PC-based application is included on the DVD-ROM that accompanies

the DEMOQE, and may also be found at:

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

## 6.5 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.

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 the jumpers on headers J6 and J7 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 button. The graphing of data can be paused and the scale on the X and Y axes can be changed via a tool bar located in the top right corner of the DEMOQE Serial Grapher Application.

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

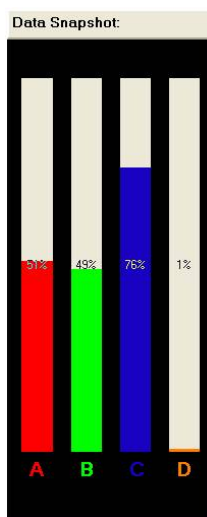
<http://www.pemicro.com/fixedlinks/DEMOToolkit.html>.

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.

### 6.5.1 Visual Components

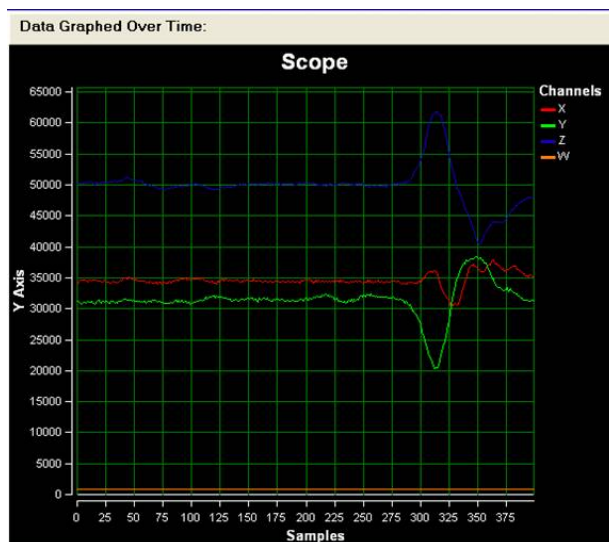
The Bar Graph has four separate bars A, B, C, and D. On each bar a percentage value is displayed which indicates the current value relative to the full range. A byte value of \$7F (max is \$FF) would show up as approximately

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 6-5: 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 6.5.2 - 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 6-6: Serial Grapher Graphing Component**

## 6.5.2 Data Format

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

### 6.5.2.1 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.

### 6.5.2.2 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*

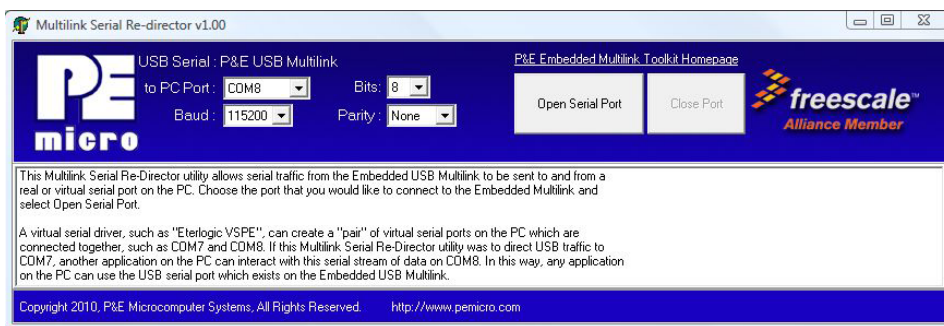
The nnnn values are 0000-FFFF and correspond in order to the data displayed the graphing component as follows: X, Y, Z, W.

*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.

## 6.6 Multilink Serial Re-Director Application

The Embedded USB Multilink on the DEMO board contains a USB serial port. The Multilink Serial Re-Director utility helps enable any PC application to interact with this serial port by allowing serial traffic from the Embedded USB Multilink to be sent to and from a real or virtual serial port on the PC. This tool can then be used in conjunction with a virtual serial driver to allow the DEMO board to communicate with your application.



**Figure 6-7: Multilink Serial Re-Director Application**

The Multilink Serial Re-Director interface allows you to select the specific PC Port, real or virtual, that you wish to use for communications. You may also set the number of bits, baud rate, and parity type. Clicking Open Serial Port will then establish communications on that port.

A virtual serial driver, such as “Enterlogic VSPE,” can then be used to pair this port with a second virtual serial port. For example, a user who has set up communications on COM7 using the Multili Serial Re-Director can then pair it with COM8 using a virtual serial driver. Any application on the PC can then interact with the serial stream of data on COM8, thereby making use of the USB serial port on the Embedded USB Multilink.

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

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

## 7 DEMONSTRATION MICROCONTROLLER APPLICATIONS

The following microcontroller applications are designed to run on the QE128 processors.

### 7.1 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 DEMOQE128 board. The potentiometer controls the intensity of two LEDs on the DEMOQE128 board, via PWM signals. This application comes pre-programmed into the memory of the QE128 processor.

Usage of this application can be seen in the **Section 3.1 - Quick Start Guide** of the manual.

## 7.2 Serial Accelerometer Application

This microcontroller application samples the state of the on-board three-axis accelerometer using on-chip I2C channels. This data is converted into ASCII characters and sent out using the serial pins of the QE128 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 6.4 - Accelerometer Demo Application** and **Section 6.5 - Serial Grapher Application**.

Usage of this application is documented in the **Section 3.4 - LAB 3: Measure Performance between 8-Bit and 32-Bit**.

## 8 JUMPER SETTINGS

### 8.1 System Power

The QE128 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 DEMOQE128 is fully functional at both voltages. Power input and voltage selection are achieved by using 3 option headers.

#### 8.1.1 J3 - Regulator Input Selection Jumper

Jumper 3 determines whether the DEMOQE128'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 8-1** shows the regulator input selection details.



Select regulator input from DC power jack. A 5-8VDC center positive

power supply must be used.

**Note:** The DEMOQE Rev. B 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 8-1: PWR Selection Header (J3)**

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

The regulator can output either a 2.1VDC or 3VDC voltage for the DEMOQE128. The VOLT\_EN jumper J4 selects the voltage. **Figure 8-2** shows the regulator output selection details.



Select regulator output to be 2.1V.



Select regulator output to be 3V

**Figure 8-2: Regulator Voltage Output Selection VOLT\_EN (J4)**

#### 8.1.3 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

**Figure 8-3: VDD\_SELECT Option Header (J5)**

#### 8.1.4 J10 - MCU\_PORT\_VDD



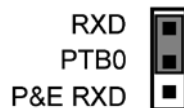
Select the MCU\_PORT to supply microcontroller VDD. This setting also allows power to be supplied to the target connected to the MCU\_PORT. By default this jumper is installed.

**Figure 8-4: MCU\_PORT\_VDD Option Header (J10)**

## 8.2 RS232 Communications

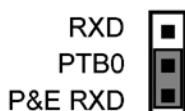
The DEMOQE128 integrates an RS232 transceiver for the microcontroller SCI signals. The transceiver operates from 1.8V to 4.25V, and it can be enabled or disabled via jumper settings or through firmware control. The DEMOQE128 also integrates the SCI signal into the Embedded Multilink circuitry. A user 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.

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



Connects the microcontroller PTB0/RXD signal to the RS232

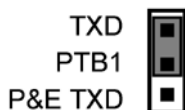
transceiver.



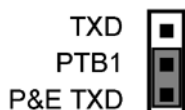
Connects the microcontroller PTB0/RXD signal to the Embedded Multilink SCI circuitry. This is the default setting.

**Figure 8-5: SCI RXD Signal Selection Jumper RXD\_EN (J6)**

### 8.2.2 J7 - SCI TXD Signal Selection Jumper TXD\_EN (J7)



Connects the microcontroller PTB1/TXD signal to the RS232 transceiver.



Connects the microcontroller PTB1/TXD signal to the Embedded Multilink SCI circuitry. This is the default setting.

**Figure 8-6: SCI TXD Signal Selection Jumper TXD\_EN (J7)**

### 8.2.3 J8 - SCI Transceiver Enable COM\_EN (J8)



Enables the SCI Transceiver. The user may control PTC5 in firmware

to enable or disable the transceiver.



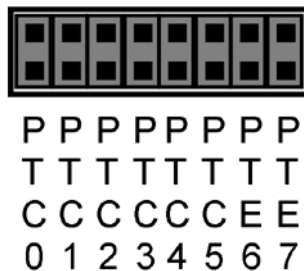
Disables the SCI Transceiver. This is the default setting.

**Figure 8-7: SCI Transceiver Enable/Disable Selection COM\_EN (J8)**

### 8.3 LED Display Port

The DEMOQE128 has 8 LEDs connected to signals PTC0, PTC1, PTC2, PTC3, PTC4, PTC5, PTE6, and PTE7. They can be enabled or disabled by installing or removing the corresponding jumper, J9, in the LED\_ENABLE header.

#### 8.3.1 J9 - LED Display Enable Port LED\_ENABLE



Enables all LED outputs. This is the default setting.

**Figure 8-8: LED Display Enable Header LED\_ENABLE (J9)**

### 8.4 Input and Reset Switches

The DEMOQE128 has an option to connect two signals, PTC0 and PTC1, to the Embedded Multilink for signal processing. The two signals are connected or disconnected to IN0 or IN1 correspondingly, via jumpers P&E INPUT\_EN (J11).

The DEMOQE128 has 4 switches that are connected to signals PTA2, PTA3,

PTD2, and PTD3 respectively, and are enabled or disabled by the 4 corresponding jumpers KEY\_ENABLE (J12).

The DEMOQE128 has one Reset switch and one Reset LED associated with it. These are enabled or disabled by the two corresponding jumpers RESET\_EN (J18).

#### 8.4.1 J11 - P&E's Logic Analyzer Inputs IN0/IN1

The logic analyzer inputs are marked on one side of the J11 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 PTC0 and PTC1 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 8-9: Jumper Settings for Input Signals to P&E's Embedded Multilink, P&E INPUT\_EN (J11)**

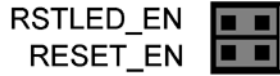
#### 8.4.2 J12 - Light Touch Switch Enable Jumper KEY\_ENABLE



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

**Figure 8-10: Jumper Settings for Light Touch Switches KEY\_ENABLE (J12)**

#### 8.4.3 J18 - 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 8-11: Reset Switch and Reset LED enable Jumper (J18)**

**Note:** The J29 labels for RSTLED\_EN and RESET\_EN are incorrectly switched on the DEMOQE board silk screen. The correct label is as displayed above.

### 8.5 3-Axis Accelerometer Jumper Settings

The DEMOQE128 integrates a 3-axis accelerometer. Jumper16 connects its I2C signals and INT to the MCU.

#### 8.5.1 J16 - Accelerometer Signal Connection Jumper ACC\_EN



The accelerometer output signals are jumper settable to SDA, SCL, PTA1.

**Figure 8-12: Accelerometer Signal Output ACC\_EN (J16)**

### 8.6 Buzzer

The DEMOQE128 integrates a Piezo Transducer whose resonant frequency is 4.0KHz. Jumper J19 connects to PTB5 to control this buzzer.

#### 8.6.1 J19 - Buzzer enable jumper BUZ\_EN



Enables Buzzer to be controlled by PTB5. This is the default setting.

**Figure 8-13: Accelerometer Signal Output ACC\_EN (J19)**

## 8.7 IIC Pull-up

The DEMOQE128 provides external pull-up resistors for SCL and SDA lines, enabled by installing the corresponding jumpers on J20. By default both jumpers are installed.

### 8.7.1 J20 - IIC Pullup Enable Jumpers IIC\_EN



Enables IIC external pullup. This is the default setting.

**Figure 8-14: IIC External Pullup Enable IIC\_EN (J20)**

## 8.8 Analog Input Potentiometer

The DEMOQE128 provides an easy access 10Kohm potentiometer whose output may be connected to PTC6 and/or PTA0, selectable by J21, POT\_EN.

### 8.8.1 J21 - Potentiometer Output Selection Jumpers POT\_EN



Selects the potentiometer output connection. By default it is connected to PTA0.

**Figure 8-15: Potentiometer Output Selection Jumpers POT\_EN (J21)**

## 8.9 Optional External Crystal Circuitry Jumper Enable

The DEMOQE128 provides external crystal circuitry without components populated. A user may use jumper J17, CLOCK\_EN, to enable the external crystal circuitry.

### 8.9.1 J17 - External Crystal Circuitry Enable Jumpers CLOCK\_EN



Enables or disables the external crystal circuitry. Both positions must

be installed to enable use of crystal circuitry.

**Figure 8-16: External Crystal Circuitry Enable Jumper CLOCK\_EN (J17)**

## 8.10 Optional Jumpers For Various VDD And VSS

The DEMOQE128 provides 5 jumpers, J22 through J26, 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 J24 which is populated. A user may take off the zero-ohm resistor and install a corresponding jumper.

# 9 DEMOQE128 CODE DEVELOPMENT SOFTWARE

The DEMOQE128 includes P&E's Embedded Multilink circuitry, so no external hardware BDM tool is needed to debug and program the DEMOQE128. A user only needs to connect the DEMOQE128 to their PC to start developing code for it.

The DEMOQE128 package comes with a special edition of Freescale's CodeWarrior studio. In addition, P&E's evaluation software for HCS08 and ColdFire® V1 is available 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 DEMOQE128.

## 9.1 Using CodeWarrior With The DEMOQE128

The CodeWarrior 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. Its tutorials, FAQs, and quick start guides are easy to follow and will allow you use pre-built templates to begin creating a new project in a short time. Codewarrior tutorials can be followed based on the instructions of **Section 3.5 - LAB 4: Learn how to use CodeWarrior**.

## 9.2 Using P&E Software With The DEMOQE128

P&E offers software tools for Freescale's HCS08 and ColdFire V1 devices

that can be used to develop code for the DEMOQE128 board.

### **9.2.1 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.

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

For Freescale's ColdFire V1 devices P&E offers an integrated development environment, 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.

## **10 TRANSITIONING TO YOUR OWN TARGET**

Once you have finished working with the DEMOQE128 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 or USB Multilink Universal and P&E's Cyclone PRO each offer effective solutions, depending on your needs. All work with Freescale's CodeWarrior as well as P&E software, and provide a seamless transition to working with your own hardware.

The USB Multilink and USB Multilink Universal are development tools that are functionally comparable to the Embedded Multilink circuitry on the DEMOQE128. Each 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.

### **10.1 Hardware Solutions At A Glance**

The USB Multilink and USB Multilink Universal offer an affordable and compact solution for your development needs, and allow debugging and

programming to be accomplished simply and efficiently. Those doing rapid development will find them 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.

#### **10.1.1 USB Multilink & USB Multilink Universal 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
- Multilink Universal supports Freescale Qorivva MPC55xx/56xx, HCS08, HC(S)12(X), RS08, ColdFire V1/+V1, ColdFire V2-4, and Kinetis ARM.

#### **10.1.2 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

## 10.2 Working With P&E's USB Multilink or USB Multilink Universal



**Figure 10-1: P&E's USB Multilink (left) and USB Multilink Universal**

### 10.2.1 Product Features & Implementation

P&E's USB Multilink Interface and USB Multilink Universal connect your target to your PC and allow the PC access to the Background Debug Mode (BDM) on Freescale's ColdFireV1, HCS08, RS08, and HC(S)12(X) microcontrollers. The USB Multilink Universal is an all-in-one interface that will also work with Freescale ColdFire V2-4, Qorivva MPC55xx/56xx, and Kinetis MCUs. Each Multilink connects between a USB port on a Windows 2000/XP/2003 machine and a standard debug connector on the target.

By using either the USB Multilink or USB Multilink Universal 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. This enables you to debug, program, and test your code on your board.

### 10.2.2 Software

The USB Multilink and USB Multilink Universal interfaces work with Codewarrior as well as P&E's in-circuit debuggers and flash programmers to allow debug and flash programming of the target processor. Many of P&E's Development Packages include the USB Multilink or USB Multilink Universal interface, as well as flash programming software, in-circuit debugging software, Windows IDE, and a register file editor.

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



**Figure 10-2: P&E's Cyclone PRO**

### 10.3.1 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 onboard storage of multiple programming images. When connected to a PC for programming or loading it can communicate via the ethernet, USB, or serial interfaces.

### 10.3.2 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.

## 11 TROUBLESHOOTING

### 11.1 DEMOQE128 Is Undetected

**Q:** The connection assistant indicates that my DEMOQE128 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 DEMOQE128 hardware. If this dialog indicates that the DEMOQE128 hardware is not connected to the PC, the first step is to make sure that the DEMOQE128 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 DEMOQE128 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 DEMOQE128 interface prior to installing P&E's Embedded Multilink drivers, Windows will not have been able to find the appropriate driver and may have disabled the device. The DEMOQE128 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 DEMOQE128 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 DEMOQE Resources on the DVD-ROM. After driver installation, unplug the DEMOQE128 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 DEMOQE 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 DEMOQE128 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 DEMOQE128 will not work. In general, USB ports located directly on the PC are high-power (self-powered) ports.

## **11.2 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 WinDriver 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.

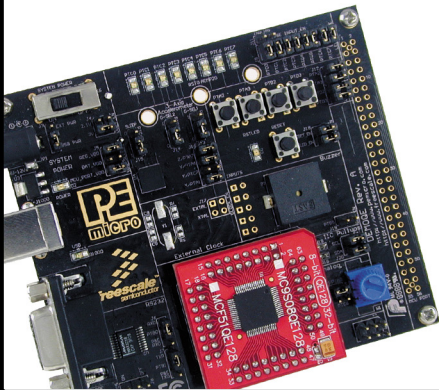
1. Select the Hardware tab.
2. Click on the Device Manager button.
3. Select the "System Devices" in the Device Manager window.
4. Expand the tree index (+) for System Devices.
5. At the bottom of the System Devices list, you should see a WinDriver item.
6. Right-click on WinDriver and select Enable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



DEMOQE128UM



©2011, P&E Microcomputer Systems, Inc. All rights reserved.

P&E Microcomputer Systems, Inc.  
98 Galen St.  
Watertown, MA 02472

[www.pemicro.com](http://www.pemicro.com)

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc.  
All other product or service names are the property of their respective owners.  
© Freescale Semiconductor, Inc. 2010.