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DEMO9S08QB8 User Manual



DEMO9S08QB8UM
Rev. 1.03
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1 INTRODUCTION

1.1 Overview

The DEMO9S08QB8 is a low-cost development system designed for demonstrating, evaluating, and debugging the Freescale MC9S08QB8 microcontroller. P&E's Embedded Multilink circuitry on the DEMO9S08QB8 board allows the processor on the DEMO9S08QB8 to be debugged and programmed via USB from the PC. In addition, the demo board can be powered using the USB bus.

Note: Freescale has an older device called 908QB8. 908QB8 is different from this new 9S08QB8 device. When searching for “QB8” online resources, make sure that the resources pertain to the 9S08QB8 device and NOT the 908QB8 device.

1.2 Package Contents

The DEMO9S08QB8 package includes the following items:

- DEMOQE Base Board with a MC9S08QB8 Daughter Card installed
- 2-cell AAA battery package
- USB Cable
- Quick Start Guide
- Freescale Warranty Card

1.3 Supported Devices

The DEMO9S08QB8 supports the MC9S08QB8CWL device.

1.4 Recommended Materials On DEMO9S08QB8 Resources CD

- DEMO9S08QB8 Embedded Multilink hardware interface driver

- DEMO9S08QB8 User Manual (this document)
- DEMO9S08QB8 Quick Start Guide
- DEMO9S08QB8 Quick Start Application Source Code
- DEMO9S08QB8 Base Board and Daughter Cards Schematics
- DEMO9S08QB8 Component Breakdown List
- DEMOQE Toolkit Applications
- Links to P&E Evaluation Software
- Links to Freescale documentation, P&E Discussion Forums, and DEMO9S08QB8 FAQs.

1.5 Handling Precautions

Take care to handle the package contents, including the DEMOQE base board and MC9S08QB8 daughter card, in a manner such as to prevent electrostatic discharge.

2 HARDWARE FEATURES

The DEMO9S08QB8 is a demonstration and development system for Freescale's MC9S08QB8 microcontroller. Application development is quick and easy using P&E's Embedded Multilink circuitry and the included software tools and examples. An optional BDM port is provided to allow use of an external BDM interface such as P&E's Cyclone PRO automated programmer or USB Multilink. The USB Multilink is functionally comparable to the DEMO9S08QB8'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 DEMOQE Base Board Features

- On-board Logic Analyzer
- On-board Virtual Serial Port
- Asymmetrically positioned 4 8x2 male connectors for interchangeable daughter cards

- P&E's Embedded Multilink circuitry populated on the bottom
- RS-232 Serial Port w/ DB9-F Connector
- SCI signals connected to P&E's Embedded Multilink through jumpers
- ON/OFF Power Switch w/ LED indicator
- A 5VDC to 8VDC power supply input barrel connector

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

- Power Input Selection Jumpers for selecting the input voltage source:
 - Power Input from Embedded Multilink to LDO regulator
 - Power Input from DC Power Jack to LDO regulator
 - Regulated VDD Output at 3.0V
 - Regulated VDD Output at 2.1V
 - Power Input from Battery
 - Power Input from MCU_PORT connector
- RESET Push Button and LED indicator w/ Enable
- Optional External Crystal Circuitry Layout (not populated)
- User Features:
 - 3-axis Accelerometer w/Enable
 - 8 User LED's w/ Enable
 - 4 User Push Buttons w/ Enable
 - 1 Piezzo Buzzer w/ Enable
 - IIC Pullups w/ Enable
 - 10K Ohm POT w/ Enable
- Option Jumpers:
 - COM_EN for 1.8V to 4.25V RS232 Transceiver
 - TXD_EN for SCI_TXD to Embedded Multilink
 - RXD_EN for SCI_RXD to Embedded Multilink
 - INPUT_EN for two input channels to Embedded Multilink

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 MC9S08QB8CWL chip

2.5 DC9S08QB8 Specific Connections

The labels on the DEMOQE do not necessarily represent actual pin port function from the MC9S08QB8 microcontroller. In order to take full advantage of the DEMOQE Base Board resources, MC9S08QB8 signals are mapped to the DEMOQE Base Board 64-Pin Header as following:

SIGNALS OF QB8	SIGNALS OF DEMOQE BOARD
PTA0-3	PTA0-3
PTA4/BKGD	PTA4/BKGD
PTA5/RESET	PTA5/RESET
PTA6	PTD2/KEY
PTA7	PTD3/KEY
PTB0-1	PTB0-1
PTB2/ADP	PTA6/ADP
PTB3/ADP	PTA7/ADP

SIGNALS OF QB8	SIGNALS OF DEMOQE BOARD
PTB4-5	PTB4-5
PTB6/XTAL	PTB6/XTAL
PTB7/EXTAL	PTB7/EXTAL
PTC0-5	PTC0-5
PTC6	PTE6/LED
PTC7	PTE7/LED

2.6 Signal Mapping of DC9S08QB8 to MCU_PORT

Signal Mapping

MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL	MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL
1	VDD	2	PTA5/IRQ/TCLK/ ~RESET
3	VSS	4	PTA5/IRQ/TCLK/ ~RESET
5	PTB1/KBIP5/TxD/ ADP5	6	PTA4/ACMPO/BKGD/ MS
7	PTB0/KBIP4/RxD/ ADP4	8	PTC7
9	PTA2/KBIP2/ADP2	10	VREFH
11	PTA3/KBIP3/ADP3	12	VREFL
13	PTC0	14	PTA0/KBIP0/ TPMCH0/ADP0/ ACMP+

Signal Mapping

MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL	MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL
15	PTC1	16	PTA1/KBIP1/ADP1/ACMP-
17	NC	18	NC
19	PTB4	20	NC
21	NC	22	PTB2/KBIP6/ADP6
23	PTB5/TPMCH0	24	PTB3/KBIP7/ADP7
25	NC	26	NC
27	PTA6	28	NC
29	NC	30	NC
31	PTA7	32	NC
33	PTC2	34	NC
35	PTC3	36	NC
37	PTC4	38	NC
39	PTC5	40	NC
41	NC	42	PTB7/EXTAL
43	NC	44	PTB6/EXTAL
45	NC	46	NC
47	NC	48	NC
49	NC	50	NC
51	NC	52	NC

Signal Mapping

MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL	MCU PORT NUMBER	MC9S08QB8 PIN SIGNAL
53	NC	54	PTC6
55	NC	56	NC

3 SYSTEM SETUP

3.1 Overview

P&E's Embedded Multilink driver is required to operate the DEMO9S08QB8 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 DEMO9S08QB8.

3.2 Operating System Requirements

The following are the resources required to run the CodeWarrior Development Studio and the DEMO9S08QB8:

- 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

3.3 Software Setup

3.3.1 Installing CodeWarrior Development Studio

To install the CodeWarrior Development Studio, insert the CodeWarrior CD into your computer's DVD-ROM drive. A start-up window will automatically appear. Select CodeWarrior Installation and follow the on-screen instructions.

Note: After installation of CodeWarrior 6.2, it is also required that you install the S08QB8 service pack.

3.3.2 Installing P&E Resources

Use the DEMOQE Resources DVD-ROM to access and install P&E resources for the DEMO9S08QB8. These materials are not required for operation. The support materials contained on the DEMOQE Resources DVD-ROM are listed in **Section 1.4 - Recommended Materials On DEMO9S08QB8 Resources CD**.

3.4 Quick Startup

Only a few steps are required to get the DEMO9S08QB8 up and running:

- Step 1. Make sure that both CodeWarrior Development Studio v.6.2 and the S08QB8 service pack are installed on your PC. Additional information regarding CodeWarrior can be found at www.freescale.com.
- Step 2. Remove the DEMO9S08QB8 demonstration board from its anti-static pouch. The green MC9S08QB8 daughter card should be plugged into the header on the base board.
- Step 3. Connect the USB cable from your computer to the DEMO9S08QB8 demonstration board. Depending on your operating system, you may need to follow steps to install the USB driver from the DEMOQE Resources DVD-ROM. Once the USB cable is connected properly the green USB LED on the DEMO9S08QB8 should illuminate.
- Step 4. Turn on the DEMO9S08QB8 power switch (K6). The red Power LED should illuminate.
- Step 5. First press the button labeled "PTA2." The buzzer will sound and PTC0 will output a fixed 75% duty cycle pulse width modulation (PWM) signal. LEDs PTC0 to PTC2 remain on.

Press the PTA2 button a second time. the buzzer will sound again and the PTC0 PWM duty cycle will change to 25%. LEDs PTC0, PTC1, and PTC3 are illuminated.

Press the PTA2 button a third time, and then rotate the potentiometer. The light intensity of LED PTC0 and the tone of the

buzzer will vary as you rotate.

Pressing the PTA2 button a fourth time or pressing the PTA3 button at any time will turn off the buzzer sound and all the LEDs.

- Step 6. Optionally, you may run the DEMOQE Logic Analyzer Application available in the DEMOQE toolkit on the CD. This PC-based application graphs the IN0 and IN1 signals on the DEMOQE board. If both J11 jumpers are installed, IN0 shows PTC0 and IN1 shows PTC1. Push button PTA2 three times after reset and turn the potentiometer to change these signals. This application may also be found at:

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



Figure 3-1: DEMOQE Logic Analyzer Application

3.5 Hardware Setup

3.5.1 First-Time Connection

The DEMO9S08QB8 may be connected to a PC through a USB port. Connection steps are listed below in typical order:

1. Install the required software, as described in the previous section.
2. Make sure the jumpers for USB_PWR, 3V for VOLT_EN, and REG_VDD for VDD_SELECT are installed.
3. Plug the USB cable A-M connector into a free USB port of the PC.

4. Plug the USB cable B-M connector into the USB connector on the DEMOQE Base Board.
5. The operating system will recognize P&E's Embedded Multilink circuitry and P&E's USB to Serial circuitry. Depending on the operating system, you may see the "Found New Hardware Wizard" dialog, helping you to install software for "PEMicro USB Multilink (i0). On Windows XP (SP2), the following dialog will appear:



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

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

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

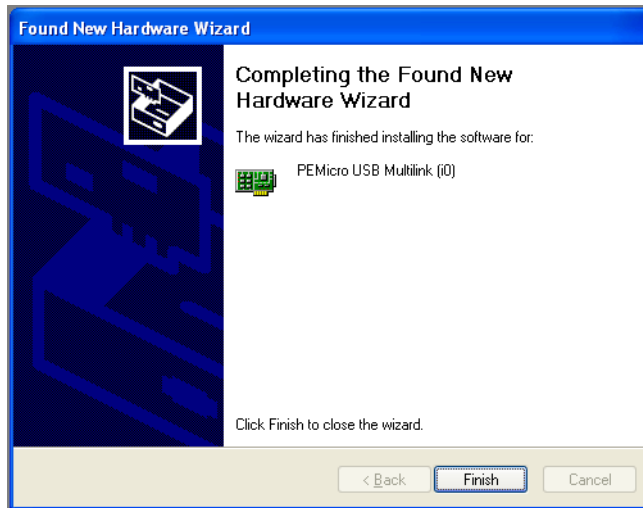


Figure 3-3: Found New Hardware Wizard Dialog (2 of 4)

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

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



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

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

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

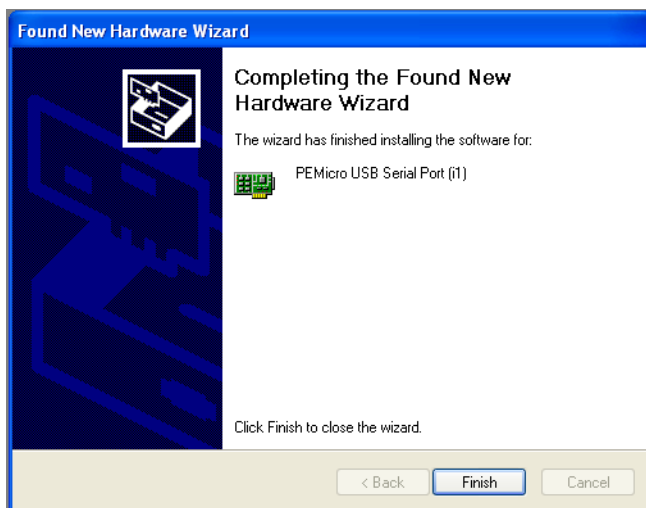


Figure 3-5: Found New Hardware Wizard Dialog (4 of 4)

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

If the DEMO9S08QB8 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 DEMO9S08QB8 you will see the red Power LED illuminate.

4 OPERATING MODES

4.1 Overview

The DEMO9S08QB8’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 DEMO9S08QB8.

4.2 Debug Mode

A host communicates with the DEMO9S08QB8 through the Embedded Multilink circuitry. Either the CodeWarrior Development Studio or P&E’s HCS08 software tools will work with the DEMO9S08QB8. Please refer to

Section 8 - DEMO9S08QB8 CODE DEVELOPMENT SOFTWARE for more information.

4.3 Run Mode

The DEMO9S08QB8's rich component list empowers it to perform a variety of tasks. Once an application is developed, debugged, and programmed properly into the QB8 internal flash memory, it can run with or without connecting to a host.

4.4 External BDM Mode

The DEMO9S08QB8 has an optional BDM header for debugging and programming the on-board QB8 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 QB8 system and compare it with the DEMO9S08QB8 when necessary.

5 DEMOQE TOOLKIT PC APPLICATIONS

P&E provides several Windows PC-based applications which work with the DEMO9S08QB8 board. These applications are collectively referred to as the DEMOQE Toolkit. The following applications are included in the toolkit:

5.1 DEMOQE Logic Analyzer Application

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

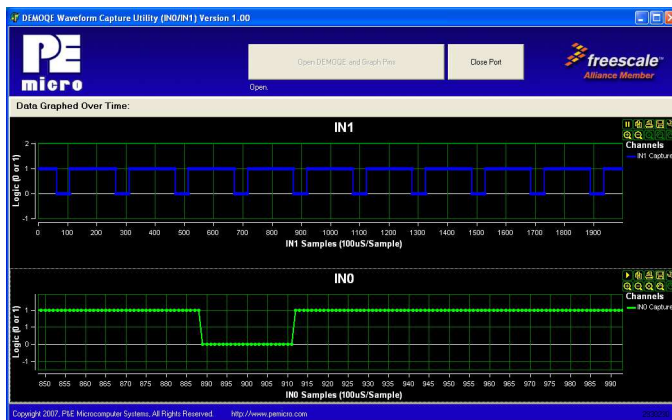


Figure 5-1: Logic Analyzer Application

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

If the microcontroller-based Quick Start Application is programmed into the MCU, the IN0 channel will show the emulated PTC0 signal to have the same output as the PWM signal at port PTB5 (driving the Buzzer). The IN1 channel will show the PWM period waveform on channel PTC1.

- Step 1. Press the button labeled “PTA2.” The PTC0 pin will output a fixed 75% duty cycle pulse width modulation (PWM) signal. The Buzzer sound is also turned on.
- Step 2. Press the PTA2 button a second time. The PTC0 PWM duty cycle will change to 25%. The Buzzer remains on.
- Step 3. Press the PTA2 button a third time. The duty cycle is controlled by the potentiometer (W1). The illumination of LED PTC0 and the tone of the Buzzer will vary as you rotate the potentiometer.
- Step 4. Press PTA2 a fourth time, or press button PTA3 at any time, to turn off the Buzzer and all LEDs.

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/demoQEtoolkit.html>.

5.2 DEMOQE Terminal Application

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

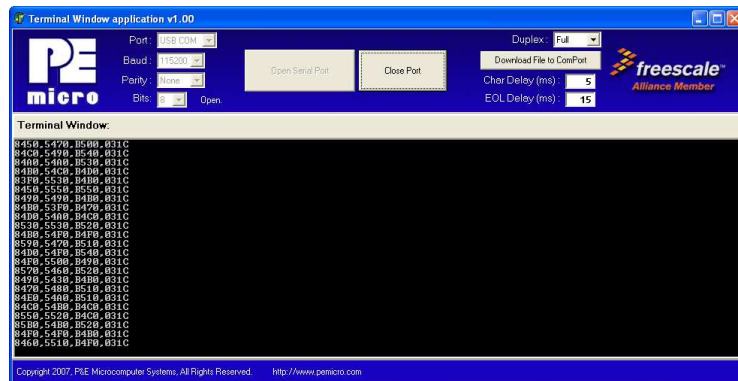


Figure 5-2: DEMOQE Terminal Application

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

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

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

5.3 DEMOQE Unsecure Application

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

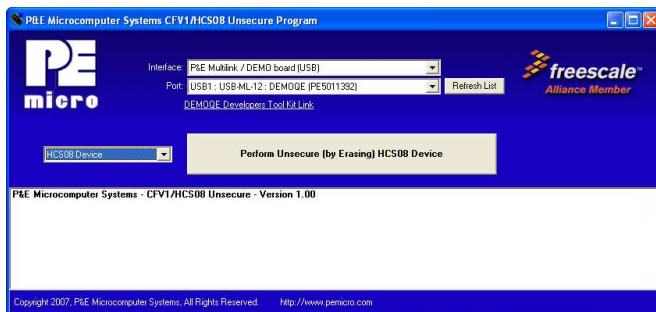


Figure 5-3: DEMOQE Unsecure Application

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

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

5.4 DEMOQE Accelerometer Demo Application

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

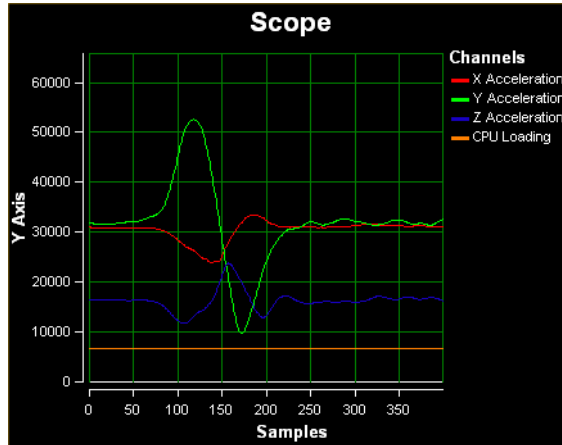


Figure 5-4: Accelerometer Demo Application

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

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

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

5.5 DEMOQE Serial Grapher Application

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

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

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

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

5.5.1 Visual Components

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

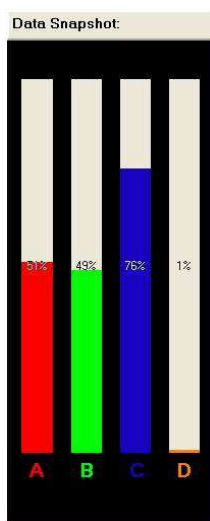


Figure 5-5: Serial Grapher Bar Graph

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

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

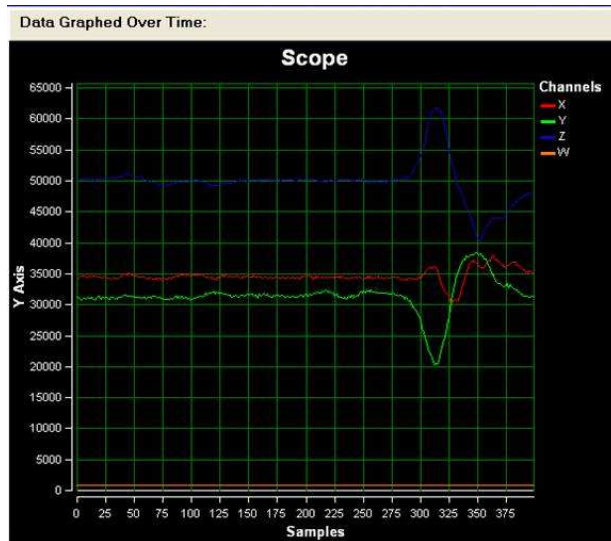


Figure 5-6: Serial Grapher Graphing Component

5.5.2 Data Format

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

5.5.2.1 Byte Formatted Data

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

WnnZnnYnnXnn

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

AnnBnnCnnDnn

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