

# DEMO908QC16

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Demonstration Board for Freescale MC68HC908QC16

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## REVISION

Date	Rev	Comments
May 5, 2005	A	Initial Release
June 3, 2005	B	Updated FCC certification as Class A
June 20, 2005	C	Updated USB powered, stand-alone mode configuration.

## CAUTIONARY NOTES

- 1) Electrostatic Discharge (ESD) prevention measures should be used when handling this product. ESD damage is not a warranty repair item.
- 2) Axiom Manufacturing does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under patent rights or the rights of others.
- 3) EMC Information on the DEMO908QC16 board:
  - a) This product as shipped from the factory with associated power supplies and cables, has been verified to meet with requirements **FCC** as a **CLASS A** product.
  - b) This product is designed and intended for use as a development platform for hardware or software in an educational or professional laboratory.
  - c) In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate prevention measures.
  - d) Attaching additional wiring to this product or modifying the products operation from the factory default as shipped may effect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

## TERMINOLOGY

This development board uses option selection jumpers. A jumper is a plastic shunt that connects 2 terminals electrically. Terminology for application of the option jumpers is as follows:

Jumper on, in, or installed - jumper is installed such that 2 pins are connected together.

Jumper off, out, or idle - jumper is installed on 1 pin only. It is recommended that jumpers be idled by installing on 1 pin so they will not be lost.



- DB9 Serial Connector
- 2, 4-pos LIN Connectors
- Supplied with USB Cable, LIN Cable, Documentation (CD), and Manual.

**Specifications:**

Board Size 3.1" x 3.2"

Power Input: 9VDC typical, +7VDC to +18VDC

NOTE: LIN functionality enabled only when powered from PWR connector.

## REFERENCES

Reference documents are provided on the support CD in Acrobat Reader format.

DEMO908QC16_UG.pdf	DEMO908QC16 User Guide (this document)
DEMO908QC16_SCH_A.pdf	DEMO908QC16 Board Schematic Rev. A
DEMO908QC16QS.pdf	DEMO908QC16 Quick Start Guide
DEMO908QC16_LED.zip	CodeWarrior LED Demonstration application
DEMO908QC16_ATD.zip	CodeWarrior ATD Demonstration application
AN2627.pdf	Cycle-by-Cycle Instruction Details for HC08 MCU's

## GETTING STARTED

To get started quickly, please refer to the DEMO908QC16 Quick Start Guide. This quick start will illustrate how to connect the board to the PC, run a LED test program, install the correct version of CodeWarrior Development Studio, and load an Analog to Digital (ATD) test program using CodeWarrior.

## OPERATING MODES

The DEMO908QC16 board operates in two basic modes Run Mode, or MON08 Debug Mode. Run Mode allows the user application to execute from Power-On or Reset. MON08 Debug Mode allows the development and debug of applications via the MON08 embedded debug monitor. See the related sections below for quickly starting the board in the desired operating mode. The board has been preloaded with a demonstration program that operates in Run Mode. The +5V LED will light when power is applied to the board.

### RUN Mode

Run mode allows the user application to execute when power is applied to the board or the RESET button is pressed. Use the following settings to configure the DEMO908QC16 board for RUN Mode using the USB bus to power the board.

1. Connect a serial communication cable (not included) between the board and a host PC if needed.

2. Connect auxiliary equipment to board if needed.
3. Configure the board option jumpers as shown.

**Table 1: Run Mode Setup**

PWR_SEL	Pin1 – Pin2 (VB)
COM_SEL	Pin1 – Pin3 (COM) Pin2 – Pin4
VX_EN	ON if required
USER_EN	ON if required
USB-MON08	Jumper “B” OFF Jumper “I” OFF Jumper “J” ON Others Don’t Care

4. Connect the USB cable to an open USB port on the host PC and attach to the USB port on the target board. +5V LED will light and the loaded application will begin to execute.

## MON08 Mode

MON08 Debug Mode supports application development and debug using the internal HC08 Debug monitor. MON08 mode is accessible using integrated USB-MON08 or an external USB-MON08 cable. Use of the integrated MON08 debugger requires only a host PC with an available USB port and an A/B USB cable. The USB cable used must be USB 2.0 compliant. A 16-pin MON08 header supports the use of an external MON08 cable. This header must be installed by the user if an external MON08 cable is to be used. The steps below describe using the integrated USB-MON08.

1. Connect a serial communication cable (not included) between the board and a host PC if needed.
2. Connect auxiliary equipment to board if needed.
3. Install and launch CodeWarrior Development Studio for HC(S)08, P&E PKG08Z tool set, or other software capable of communicating with the HC08 MCU.
4. Configure the board option jumpers as shown.

**Table 2: MON08 Mode Setup**

PWR_SEL	Pin1 – Pin2 (VB)
COM_SEL	Pin1 – Pin3 (COM) Pin2 – Pin4
VX_EN	ON If Required
USER_EN	1 – 4 ON if Required 5 & 6 OFF
USB-MON08	All ON

NOTE: For use with an external MON08 cable, remove all USB-MON08 jumpers. Other setting remain the same.

5. Connect the supplied USB cable between an available USB port on the host PC and the USB connector on the board.
6. Hosting development software will establish MON08 communication.

## MEMORY MAP

The table below shows the default MC68HC908QC16 memory map. Memory access to unimplemented locations will cause an illegal-address reset. Refer to the MCU data sheet for further details.

**Table 3: Memory Map**

0x0000 – 0x003F	Direct Page Registers	64 bytes
0x0040 – 0x023F	RAM	512 bytes
0x0240 – 0x024F	Registers	16 bytes
0x0250 – 0x27FF	Unimplemented	9648 bytes
0x2800 – 0x2A1F	Auxiliary ROM	544 bytes
0x2A20 – 0x2F7D	Unimplemented	1374 bytes
0x27FE – 0x27FF	Auxiliary ROM	130 bytes
0x3000 – 0xBDFF	Unimplemented	36352 bytes
0xBE00 – 0xFDFF	Flash Memory	16K bytes
0xFE00 – 0xFE1F	Miscellaneous Registers	32 bytes
0xFE20 – 0xFF7D	Monitor ROM	350 bytes
0xFF7E – 0xFFAF	Unimplemented	50 bytes
0xFFB0 – 0xFFBD	Flash	14 bytes
0xFFBE – 0xFFC1	Miscellaneous Registers	4 bytes
0xFFC2 – 0xFFCF	Flash	14 bytes
0xFFD0 – 0xFFFF	User Vectors	48 bytes

## SOFTWARE DEVELOPMENT

Software development will require the use of an HC08 assembler or compiler and a host PC operating a MON08 debug interface. Supplied with this board is the CodeWarrior Develop-



ment Studio™ for HC(S)08 and the Axiom MON08 IDE for Windows. Both tool sets support Debugging and Flash programming on the DEMO908QC16.

## DEVELOPMENT SUPPORT

Application development and debug for the target MC68HC908QC16 is supported through the MON08 Debug interface. The debug interface consists of an integrated USB-MON08 debugger or an optional 16-pin MON08header. The MON08 header is not installed in default configuration but may be installed by the user if necessary. Note that when using an external MON08 cable, all jumpers on the USB-MON08 ENABLE header should be removed.

### Integrated MON08

The DEMO908QC16 board features an integrated USB-MON08 debugger from P&E Microcomputer Systems. The integrated debugger supports application development and debugging via the internal monitor. All necessary signals, including high-voltage, clock, data, and configuration signals, are provided by the integrated debugger. A USB, type B connector allows connecting the target board to the host PC.

The integrated debugger provides +5V power and ground to target board eliminating the need to power the board externally. Power from the USB-MON08 is derived from the USB bus; therefore, total current consumption for the target board, and connected circuitry, must not exceed **500mA**. Excessive current drain will violate the USB specification and will cause the USB bus to disconnect. Damage to the host PC USB hub or the target board may result.

#### *Option Header*

A 16-pin header (USB-MON08 ENABLE) allows the user to disconnect the integrated debugger from the target board. This allows the stand-alone operation of the target board. In stand-alone operation, the target board must be power from connector J1 or the PWR connector.

To use the board in stand-alone operation when powered from the USB cable, remove shunts at position "B" and "I". The shunt at position "J" must remain on to supply power to the board. The other shunt positions are "Don't Care".

**Table 4: USB-MON08 Enable Header**

			Jumper On	Jumper Off	Signal
<b>J</b>	<b>14</b>	<b>13</b>	Enabled	Disabled	VB (+V out)
<b>I</b>	<b>12</b>	<b>11</b>	Enabled	Disabled	PTA3/RST*
<b>F</b>	<b>10</b>	<b>9</b>	Enabled	Disabled	PTA1/T1CH1
<b>E</b>	<b>8</b>	<b>7</b>	Enabled	Disabled	PTA4/OSC2
<b>D</b>	<b>6</b>	<b>5</b>	Enabled	Disabled	PTA0/T1CH0
<b>C</b>	<b>4</b>	<b>3</b>	Enabled	Disabled	PTA5/OSC1
<b>B</b>	<b>2</b>	<b>1</b>	Enabled	Disabled	PTA2/IRQ*

NOTE: To use the board in stand-alone operation when powered from the USB cable, remove the shunt at position “B” and the shunt at position “I”. The shunt at position “J” must remain ON. Other shunt positions are “Don’t Care”.

### Data Rate

The data rate over the USB bus is controlled by the USB\_SPEED header. When shipped from the factory, the DEMO908QC16 is configured for high-speed operation. If the user encounters a communication failure, data rate may be reduced by setting this option jumper to Full.

**Figure 1: USB\_SPEED Option Header**

USB_SPEED		Configuration:
HIGH		FULL Select USB high-speed data rate
HIGH		FULL Select USB full-speed data rate
HIGH		FULL Select USB high-speed data rate

### MON08 Header

A MON08 compatible programming cable may be attach to the 16-pin MON08 port. Use of this port requires the user to install a 2x8, 01” center, pin header. Use of this feature requires an externally powered MON08 cable. The terminal program used with the MON08 cable should be set to a baud rate of 9600. Set handshaking as required by the terminal MON08 cable used. Refer to MC68HC908QC16 documentation for further details.

**Figure 2: MON08 Debug Port**

			GND	See the HC08 Reference Manual for complete MON08 documentation
			PTA3/RST*	
			PTA2/IRQ*	
			PTA0	
			PTA4	
			PTA1	
PTA5/OSC1				
V <sub>DD</sub>				

NOTE: When using and external MON08 cable, disable the integrated USB-MON08 debugger by removing all jumpers on the USB-MON08 ENABLE header.

NOTE: This header is not installed in default configuration.

### VTST\_EN

VTST voltage level is not provided on this board. The MON08 debug cable used must provide all configuration voltage levels necessary to force the MCU into MON08 mode.

# POWER

The DEMO908QC16 is designed to be powered from the USB\_MON08 debugger during application development. A 2.0mm barrel connector is available to support LIN functionality and for stand-alone operation. As an added feature, the board may source power through connector J1 OR supply power to external circuitry connected to J1.

The integrated MON08 debugger simplifies application development by eliminating the need for an external MON08 cable. During application development, the board draws power from the USB bus through the integrated USB-MON08 connector. Total current consumption, of the board and connected circuitry, must be limited to less than **500mA**. Excessive current drain will cause the USB bus to disconnect and may damage the target board or the host PC. USB bus violations may also cause the host PC to reboot sporadically.

A 2.0mm barrel connector input has been provided to support LIN functionality and allow stand-alone operation. Voltage input at this connector must be limited to between +7V and +18V. An LDO voltage regulator at VR1 converts the input voltage to the +5V rail on the target board. VR1 will shut down if the connected circuit draws excessive current or over-heats. Stand-alone operation is supported through connector J1 but power input on this connector will not support LIN functionality. Use caution when powering the target board from connector J1. No protection is applied on this power input

CAUTION: J1 power input connects directly to the voltage rails on the board. Power input must be regulated, 5VDC.

## POWER SELECT

Power may be applied to the board through the integrated USB-MON08 circuitry, a 2.0mm barrel connector, or through connector J1. Two option headers configure power routing on the target board, PWR\_SEL and VX\_EN.

### *PWR\_SEL*

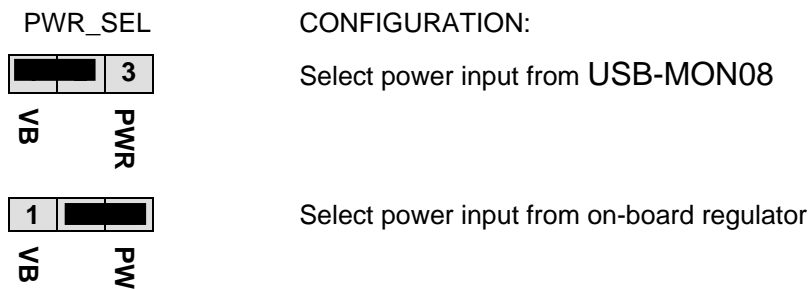
The PWR\_SEL option header selects power input from either the integrated USB-MON08 debugger or from the on-board voltage regulator. Pin 1 connects to the power output from the integrated BDM. Pin 3 connects to the on-board voltage regulator output. Pin 2 provides power to the target board voltage rail. Figure 3 below shows the PWR\_SEL header selection options.

Power from the integrated BDM is drawn from the USB bus and is limited to **500mA**. Excessive current drain will violate the USB specification and will cause the USB bus to disengage. The host PC may also spontaneously reboot.

The on-board voltage regulator (VR1) accepts power input through a 2.0mm barrel connector (PWR). Input voltage should be limited to between +7V to +18V. A voltage regulator at VR1 provides a +5V fixed output limited to 250mA. Over-temperature and over-current limit built into the voltage regulator provides protection from excessive stresses. Use caution when at-

tempting to power off-board circuitry through connector J1 or when connecting external circuitry. Drawing excessive current will lead to VR1 shutdown.

**Figure 3: PWR\_SEL Option Header**

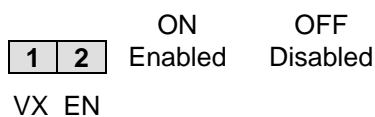


### VX\_EN

The VX\_EN option header is a 2-pin jumper that connects input J1-1 directly to the target board +5V voltage rail. J1-3 is hard-wired to the ground plane. Use of this feature requires a regulated +5V input power source. This power input is decoupled to minimize noise input but is not regulated. Care should be exercised when using this feature as no protection is applied on this input and damage to the target board may result if over-driven. Also, do not attempt to power the target board through this connector while also applying power through the USB-MON08 or the PWR connector; damage to the board may result.

The VX\_EN option header also allows the user to supply power to off-board circuitry through connector J1. Current limitation of the USB bus or the on-board regulator must be considered when attempting to source power to external circuitry. Excessive current drain may damage the target board, the host PC USB hub, or the on-board regulator. The figure below details the VX\_EN header connections.

**Figure 4. VX\_EN Option Header**



NOTE: Do not exceed available current supply from USB-MON08 cable or on-board regulator when sourcing power through connector J1 to external circuitry.

NOTE: This header is not installed in default configuration.

## RESET SWITCH

The RESET switch provides a method to apply an asynchronous RESET to the MCU. The RESET switch is connected directly to the RST\* input on the MCU. Pressing the RESET switch applies a low voltage level to the RST\* input. A pull-up bias resistor on the RST\* input allows normal MCU operation. Shunt capacitance ensures an adequate input pulse width.

# LOW VOLTAGE INHIBIT

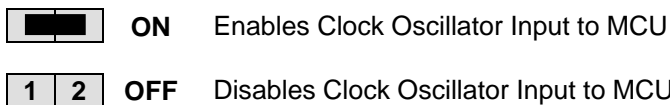
The MC68HC908QC16 utilizes an internal Low Voltage Inhibit (LVI) protect against under-voltage conditions. The LVI is enabled for low-voltage operation out of RESET. To use this feature, the user should configure the LVI for high-voltage operation. Consult the MCU Device User Guide for details on configuring LVI operation.

# TIMING

The DEMO908QC16 has 2 timing sources available to the user. The internal oscillator operates at one of four, user selectable internal timing frequencies: 25.6MHz, 12.8 MHz, 8.0 MHz, or 4.0 MHz. Out of reset, the internal oscillator is set to 4MHz with a frequency tolerance of less than 25%. An 8-bit register allows trimming the internal oscillator to a tolerance of 0.4%. Refer to the MC68HC908QC16 Device User Guide for details on internal oscillator operation.

An 8.0MHz crystal oscillator is also available as alternate timing source. The crystal is configured for Pierce mode operation. An option jumper enables/disables the use of the external oscillator to the MCU. The external oscillator is connected to MCU inputs PTA5/OSC1 and PTA4/OSC2 on the MCU. The user must configure the MCU for operation with the external clock source. Refer to the MC68HC908QC16 Device User Guide for details.

**Figure 5: OSC\_EN Option Header**



# COMMUNICATIONS

The DEMO908QC16 board provides a single Enhanced Serial Communications Interface (ESCI) port. The ESCI port may be configured for RS-232 serial communications or for LIN serial communications. RS-232 communications are supported through a DB9 connector. LIN communications are supported through two, 4-pin Molex connectors.

The COM\_SEL option header selects the communications protocol applied by the user.

## LIN Communications

The DEMO908QC16 applies the MC33661D Local Interconnect Interface (LIN) physical layer (PHY) for use in developing automotive control applications. The MC33661D PHY support LIN bus functionality for input voltages between +7V and +18V. Only power applied to the PWR connector will enable the LIN bus. The COM\_SEL option header selects the LIN interface (see COM\_SEL above). Two, 4-pin, Molex connectors provide off-board connectivity. Figure 6 shows the pin-out for the LIN connectors and mating connector part numbers.

**Figure 6: LIN Connector**

LIN I/O	4	3	$V_{SUP}$
GND	2	1	GND

REF: Mating Connector, Molex P/N,  
39-01-2040, Housing  
39-00-0039, Socket

NOTE: Board must be powered from the PWR connector with  $V_{IN}$  +7V and 18V.

## RS-232

An RS-232 transceiver provides RS-232 signal level to TTL/CMOS logic level translation on the COM connector. The COM connector is a 9-pin Dsub, right-angle connector. A ferrite bead on shield ground provides conducted immunity protection. Communication signals TXD and RXD are routed from the transceiver to the MCU. These signals are also available at connector J1. Hardware flow control signals RTS and CTS are available on the logic side of U3. These signals are routed to vias located near the transceiver (U3). RTS has been biased properly to support handshaking if needed.

Communications signals TXD and RXD also connect to general purpose Port B signals. The RS-232 translator should be disconnected at the COM\_SEL option header if the general-purpose I/O signals are used.

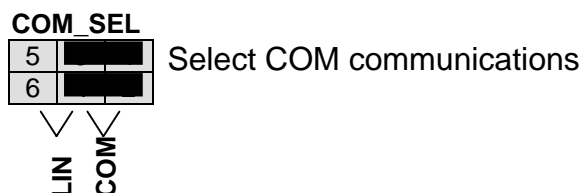
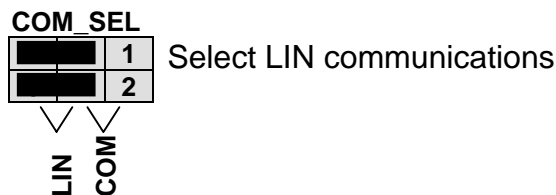
**Figure 7: COM Connections**

MCU Port	COM Signal	I/O PORT CONNECTOR
PTB5/TXD	TXD OUT	J1-5
PTB4/RXD	RXD IN	J1-7

### COM\_SEL

The communications mode is determined by the COM\_SEL jumper. This 3-pin jumper allows the user to select between RS-232 communications and LIN communications.

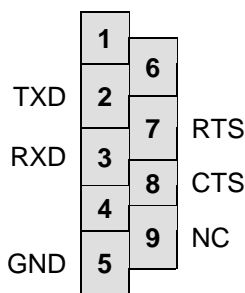
**Figure 8: COM\_SEL Option Header**



## COM Connector

A standard 9-pin Dsub connector provides external connections for the ESCI port. The Dsub shell is connected to board ground through a ferrite bead. The ferrite bead provides noise isolation on the RS-232 connection.

**Figure 9: COM Connector**



Female DB9 connector that interfaces to the HC08 internal SCI1 serial port via the U2 RS232 transceiver. It provides simple 2 wire asynchronous serial communications without flow control. Flow control is provided at test points on the board.

**Pins 1, 4, and 6 are connected together.**

## USER OPTIONS

The DEMO908QC16 includes various user input and output devices to aid application development. User I/O devices include 2 momentary pushbutton switches, 4 green LEDs, 1 potentiometer, and 1 photocell. Each device may be enabled or disabled individually by the USER option header. The USER \_EN header is labeled to easily identify which jumper affects each user device.

### Pushbutton Switches

Two push button switches provide momentary active-low input for user applications. Switches SW1 and SW2 are enabled to the HC08 I/O ports by the USER-1 and USER-2 enable jumpers. SW1 and SW2 provide input to HC08 I/O ports PTA4 and PTA5 respectively. Table 5 below shows the user jumper settings and user signal connections.

### LED Indicators

Four LED indicators provide active-high visual output for user applications. Indicators LED1 through LED4 are enabled from HC08 I/O ports by the USER-3 through USER-6 enable jumpers. MCU ports PTB6, PTB7, PTD6, and PTD7 drive LED1, LED2, LED3, and LED4 respectively. Table 5 below shows the user jumper settings and user signal connections.

## Potentiometer

A 5k ohm, thumb-wheel type, potentiometer at RV1 provides variable resistance input for user applications. The output is the result of a voltage divider that changes as the thumb-wheel is turned. This device is connected to the MCU on signal PTA0. Table 5 below shows the user jumper settings and user signal connections.

The potentiometer is not available while in monitor mode. When using the potentiometer the user should requires removing USB-MON08 Enable jumper 'D' to disable the MON08 COM signal. Otherwise, results may be unpredictable.

NOTE: User-5 option jumper must be removed to enter monitor mode.

NOTE: USB-MON08 ENABLE-D jumper must be removed to use this function.

## Photocell

A photoconductive photocell provides light sensitive, variable resistance input for user applications. Device resistance is inversely proportional to light intensity incident on the surface of the device. A rail-to-rail OP amp at U2 boosts the photocell output to useable levels. This signal is available to the MCU on signal PTA1. Table 5 below shows the user jumper settings and user signal connections.

NOTE: User-6 option jumper must be removed to enter monitor mode. The jumper may be reinstalled after RESET.

**Table 5: User Option Jumper Settings**

Jumper	On	Off	MCU PORT
USER-1	Enable SW1	Disable SW1	PTA5 (U1-4)
USER-2	Enable SW2	Disable SW2	PTA4 (U1-5)
USER-3	Enable LED1	Disable LED1	PTB6 (U1-3)
USER-4	Enable LED2	Disable LED2	PTB7 (U1-2)
USER-5	Enable LED3	Disable LED3	PTD6 (U1-21)
USER-6	Enable LED4	Disable LED4	PTD7 (U1-20)
USER-7	Enable RV1	Disable RV1	PTA0 (U1-13)
USER-8	Enable RZ1	Disable RZ1	PTA1 (U1-12)

NOTE: USER-6 and USER-7 must be disabled to enter Monitor mode



# I/O PORT CONNECTOR

This port connector provides access to DEMO908QC16 I/O signals.

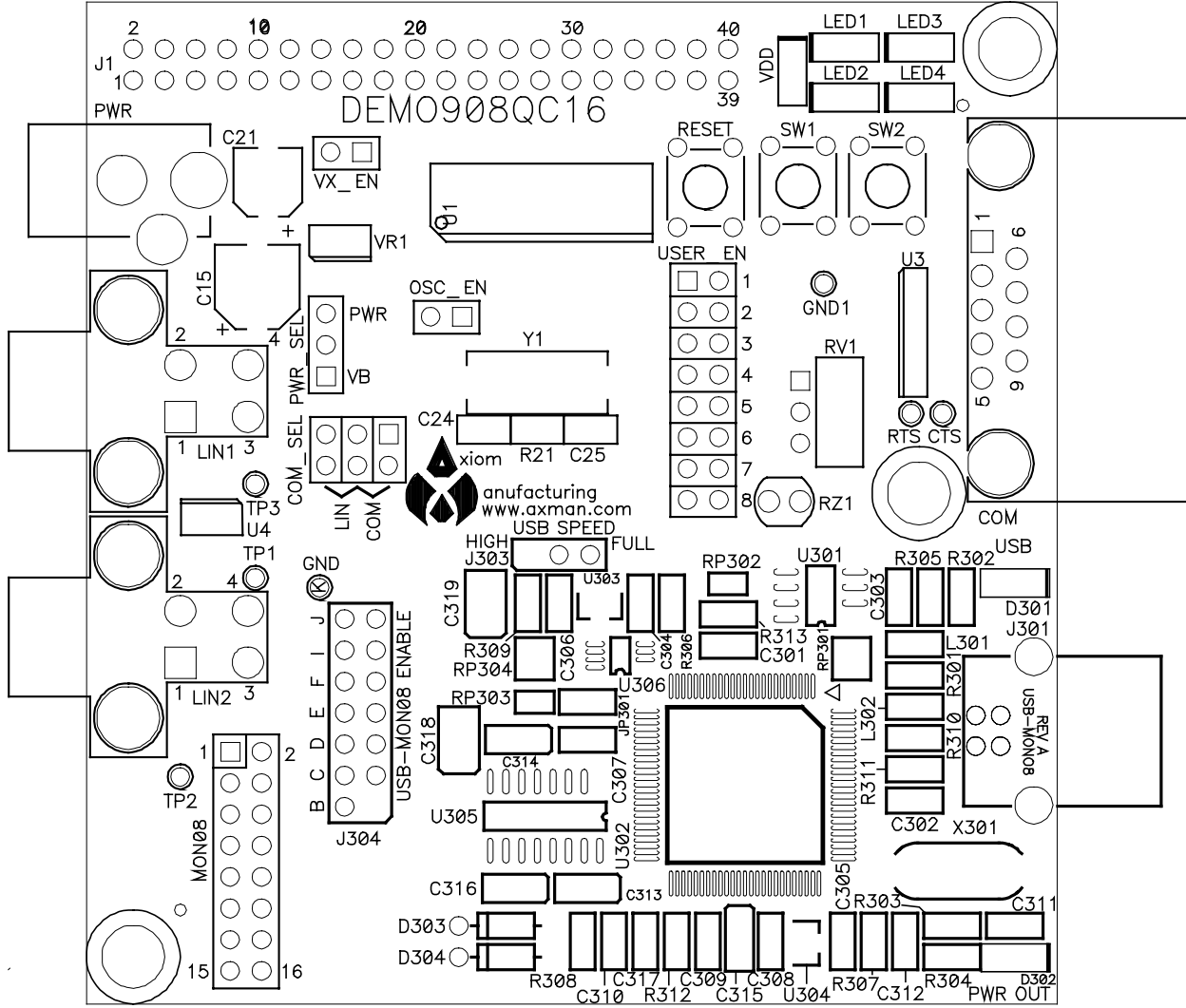
**Figure 10: MCU I/O Port Connector**

VX	1	2	PTA2/IRQ*/KBI2/TCLK
GND	3	4	PTA3/RST*/KBI3
PTB5/TX/AD9	5	6	
PTB4/RX/AD8	7	8	
PTA5/OSC1/AD3/KBI5	9	10	
PTA4/OSC2/AD2/KBI4	11	12	
PTB6/TCH2	13	14	
PTB7/TCH3	15	16	
PTB1/MOSI/AD5	17	18	
PTB2/MISO/AD6	19	20	
PTB0/SCK/AD4	21	22	
PTB3/SS*/AD7	23	24	
PTA0/TCH0/AD0/KBI0	25	26	
PTA2/IRQ*/KBI2/TCLK	27	28	

Note:  
All user component signals are available at connector J1

# APPENDIX A

## Silkscreen



# APPENDIX B

## BILL OF MATERIALS

Item	Qty	Title	Ref(m)	Mfr	Mfr-P/N
1	5	Cap, Tant, 10uF, 10V, SMB	C4, C13, C22, C318, C319	Avx	TAJB106K010R
2	1	Cap, Elect, 100uF, 16V, Alum, 6.6x5.4mm	C15	Nichicon	UWX1C101MCL1GB
3	1	Cap, Elec, 10uF, 35V, Alum, SMC	C21	Nichicon	UWX1V100MCL1GB
4	4	Cap, Tant, .1uF, 35V, SMA	C313, C314, C315, C316	vishay	293D104X0035A2T
5	24	Cap, Mon, .1uF, 50V, X7R, 0805	C1, C2, C3, C5, C6, C7, C8, C9, C10, C12, C16, C17, C19, C20, C23, C301, C302, C304, C305, C306, C307, C308, C309, C310		
9	4	Cap, Mon, .01uF, 50V, 0805	C11, C14, C18, C303		
11	4	Cap, Cer, 22pF, NP0/COG, 0805	C24, C25, C311, C312	Pana-sonic	ECJ-2VC1H220J
12	1	Res, Ntwk, 100 ohm, 5%, Isolated, 4P2R, SMD	RP303	CTS	742C043101JCT
13	1	Res, Ntwk, 100 ohm, 5%, Isolated, 8P4R, SMD	RP304	CTS	742C083101JCT
14	1	Res, Ntwk, 10K ohm, 5%, Isolated, 4P2R, SMD	RP302	CTS	742C043103JCT
15	1	Res, Ntwk, 10K ohm, 5%, Isolated, 8P4R, SMD	RP301	CTS	742C083103JCT
30	2	Res, 1M ohm, 5%, 0805	R21, R303		
18	2	Res, 47K ohm, 5%, 0805	R1, R13		
19	5	Res, 10K ohm, 5%, 0805	R6, R7, R10, R16, R20,		
29	1	Res, 1.5K ohm, 5%, 0805	R302		
20	5	Res, 1K ohm, 5%, 0805	R17, R306, R307, R308, R313,		
23	1	Res, 20K ohm, 5%, 0805	R11		
24	1	Res, 33K ohm, 5%, 0805	R19		

25	7	Res, 680 ohm, 5%, 0805	R2, R3, R8, R9, R18, R304, R305		
28	1	Res, 510 ohm, 5%, 0805	R301		
26	2	Res, 33 ohm, 1%, 0805	R310, R311		
27	1	Res, 200 ohm, 1%, 0805	R309	Yageo	9C08052A2000FKHFT
31	1	Clock Osc., 8.0Mhz, 5V, CMOS Out, SMT, 5x7mm	Y1	ECS	ECS-80-18-5PDN-TR (CSM-7)
32	1	XTAL, 12.000MHz, 18pf, HC49/US, SMT	X301	Citizen	HCM49-12.000MABJT
33	1	Res, Variable, 5K ohm, 3/8 vert adj. W/ knob	RV1	Bourns	3352W-1-502
34	1	Photocell, 30K -1M	RZ1	Photonic	PDV-P9003
36	1	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D3	General Semi	
37	2	Diode, Rect, S1A, 1A, 50V, DO214AC	D2, D4	Vishay	S1A
38	1	Diode, Zener, 8.7V, 500mW, 5%, DO-35, thru	D303	Diodes Inc	1N5238B-T
40	1	Ind, Ferrite, EMI, 330 ohm @ 100 MHz, 1.5A, 0805	FB1	Murata	BLM21P331SG
41	2	Ind, Ferrite, EMI, 600 ohm @ 100 MHz, 500mA, 1206	L301, L302	Steward	HZ1206E601R-00
38	1	Ind, Filter, 680 uH, 5%, Ferrite, 1812	L1	Pana-sonic	ELJ-FB681JF
43	6	LED, Green, w/reflector, 1206, SMT	LED1, LED2, LED3, LED4, VDD, D301	Rohm	SML-010MTT86
44	1	LED, Yellow, w/reflector, 1206, SMT	D302	Rohm	SML-010YTT86
46	1	IC, MCU, MC68908QC16, 28SOIC	U1	Frees-cale	MC68908QC16CDZ
48	1	IC, LIN XCVR, MC33661D,SOIC8	U4	Frees-cale	MC33661D
49	1	IC, MCU, MC9S12UF32PU, Programmed, 100TQFP, ID 0x01	U302	P&E	UF32-MON08-5V
50	1	IC, Dual RS232 XCVR, 3V - 5V, ESD, 16SOIC	U3	Intersil	ICL3232ECBN
51	1	IC, OPAMP, Single, SOT23-5	U2	Fairchild	LMV321AS5X
52	1	IC, LV Sense, Reset, 5V, 8SOIC	U301	On Semi	MC34164D-5R2
53	2	Trans, MOSFET, P-Ch, -20V, -3.7A, SOT-23	U303, U304	IR	IRLML6402TR
54	1	IC, Dual RS232 XCVR, 5V, 16SOIC	U305	Intersil	HIN232ACBN
55	1	IC, Buffer, 3S, Dual Gate, 8SSOP	U306	TI	SN74LVC2G125DCT
56	1	VReg, LDO, 5V, 250mA, 8 SOIC	VR1	STM	L4931CD50
57	3	Sw, PB, 5mm Sq, Thru	RESET_SW, SW1, SW2	E-Switch	EG1827

58	1	Conn, 2x20 Socket Hdr, Pass Thru, .1", Bottom Entry, SMT	J1	Samtec	SSM-120-L-DV-K-BE-A
59	2	Conn, Mini-fit 4 position, RA, thru	LIN1, LIN2	Molex	39-29-5043
60	1	Conn, Dsub, 9P, F, RA, PCB Mount	COM		
68	1	Conn, Sckt, USB, Type B, Horiz, thru	J303	Keystone	924K
61	2	Conn, 1x2, Pin Header, .1" Ctr, Thru	OSC_EN, VX_EN		
63	2	Conn, 1x3 Pin Header, .1" Ctr, Thru	PWR_SEL, J303		
64	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	COM_SEL		
66	1	Conn, 2x7 pin hdr, .1" ctr, thru	J304		
67	1	Conn, 2x8 Pin Header, .1" Ctr, Thru	USER_EN		
69	1	Conn, 2mm, Pwr Jack, Barrel, Thru, RA	PWR		
72	14	Hdw, Shunt, 2 Pos, .1"	USER_EN(8), COM_SEL(2), VX_EN, PWR_SEL, OSC_EN, J303	Generic	
73	3	Hdw, Stand-off, .250x.375, Hex, Alum	MTG1, MTG2, MTG3	Keystone	2202
74	3	Hdw, Screw, 4-40x3/8, 18-8, SS	MTG1, MTG2, MTG3	On-Shore	0406PPMS
75	0	DO NOT INSTALL COMPONENTS	C317, R312, D304, JP301, MON08		
76	1	PCB, DEMO908QC16, 2 layer, 3.1" x 3.2", Rev D		Axiom	AXM-0369
77		<b>ASSEMBLY</b>			
65	1	Assmbly Cost			
66	1	Assy, Cable, USB, A-B, 1.8 m, Black		Kobiconn	172-1024
79	1	Assy, Cable, LIN, 24in, 4pos - 4pos, Latch		Axiom	CBL-LIN001
67	1	Media, Support CD, HC(S)08			
68	1	Media, CodeWarrior CD, HC(S)08			
69	1	Media, Service Pack CD			
70	1	Doc, Printed, User Guide		Axiom	DOC-0369-010
71	1	Foam Set			
72	1	Shipping box			