DEMO908QB8

Demonstration Board for Freescale MC68HC908QB8

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REVISION

Date	Rev	Comments
March 18, 2005	A	Initial Release

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 DEMO908QB8 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.

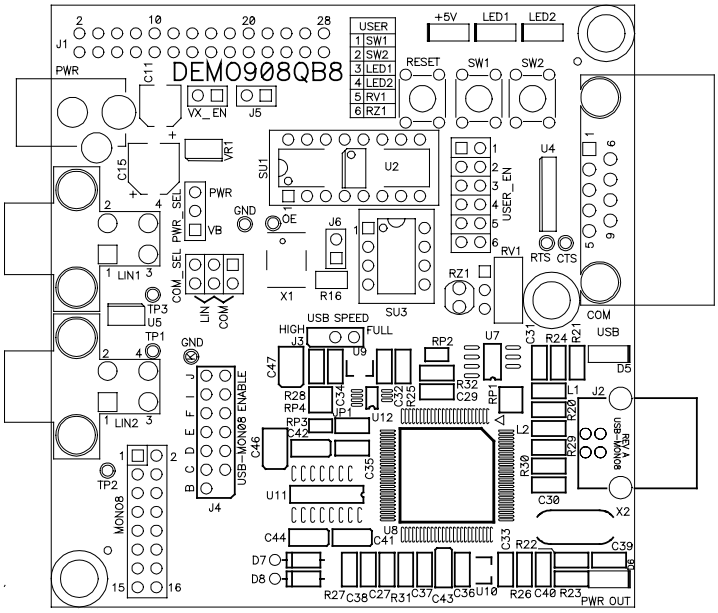
Jumper off, out, or idle - jumper is installed on 1 pin only. It is recommended that jumpers be idled by installing on 1 pin so they will not be lost.

FEATURES

The DEMO908QB8 is an evaluation or demonstration board for the MC68HC908QB8 microcontroller. Development of applications is quick and easy with the integrated USB-MON08, sample software tools, and examples. An optional MON08 port is also provided to allow use of a MON08 cable. A 28-pin connector allows connecting the DEMO908QB8 board to an expanded evaluation environment.

Features:

- MC68HC908QB8 CPU
  - 8K Byte Flash
  - 256 Bytes RAM
  - Internal Oscillator
  - Up to 13 I/O lines, 1 Input Only
  - Timer Interface Board
  - ESCI and SPI Communication Ports
  - 6 Key-Board Wake-up Ports
  - Analog to Digital Comparator (ATD)
  - Default 1Mhz Internal Bus Operation
- 16TSSOP MCU w/ optional 16-DIP, and 8-DIP sockets
- Integrated USB-MON08 Cable
- MON08 Header for MON08 Cable Support
- LIN Bus Connectivity
- RS-232 Serial Port w/ DB9 Connector
- Internal Oscillator Trimmable to 0.4%
- External 9.8304 MHz Clock Oscillator (not installed in default configuration)
- 4-Ch, 16-bit, Timer Interface Board
- 10-Ch, 10-bit Analog to Digital Converter (ATD)
- Power Input Selection Jumper
  - Regulated +5V power supply
  - Optional power input from Connector J1
  - Optional power output through Connector J1
- User Components Provided
  - 3 Push Switches; 2 User, 1 Reset
  - 3 LED Indicators; 2 User, 1 +5V
- Jumpers
  - Disable User Functions
  - Power Select
  - COM_SEL
  - J6 (OSC_EN not installed)
  - J5 (VTST_EN not installed)
- Connectors



- 28-pin MCU I/O Connector
- 2.0mm Barrel Connector
- MON08 Pin Header (not installed)
- DB9 Serial Connector
- 4-pin LIN Connectors
- Supplied with DB9 Serial Cable, Documentation (CD), and Manual.

Specifications:

Board Size 3.1” x 3.2”

Power Input: 9VDC typical, +6VDC to +18VDC

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

REFERENCES

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

DEMO908QB8_UG.pdf	DEMO908QB8 User Guide (this document)
DEMO908QB8_SCH_C.pdf	DEMO908QB8 Board Schematic Rev. C
DEMO908QB8QS.pdf	DEMO908QB8 Quick Start Guide
DEMO908QB8_LED.zip	CodeWarrior LED Demonstration application
DEMO908QB8_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 DEMO908QB8 Quick Start Guide. This quick start will show the user 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 DEMO908QB8 board operates in two basic modes Run Mode, or MON08 Debug Mode. Run Mode supports user application operation from Power-On or Reset. MON08 Debug Mode supports 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 operation mode.

The board has been preloaded with a demonstration program. The demo program operates in the Run Mode. The +5V LED will light when power is applied to the board.

RUN Mode

Run mode allows user application to function when power is applied to the board. Use the following settings to configure the DEMO908QB8 board for RUN Mode to get started quickly.

1. Connect a serial communication cable (not inlcuded) between the board and a host PC if needed for the application. Launch supporting host communication software as needed.

2. Connect auxiliary equipment to board as required by application.

3. Configure the board option jumpers for run mode.

Table 1: Run Mode Setup

PWR_SEL	Pin2 – Pin3 (PWR)
COM_SEL	Pin1 – Pin3 (COM) Pin2 – Pin4
VX_EN	As Required
USER_EN	As Required
USB-MON08	All jumpers removed

4. Apply power to the board. Loaded application will begin to execute.

MON08 Mode

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

1. Connect COM port serial communication cable between board and host PC if needed for the application. Launch supporting host communication software as needed.
2. Connect auxiliary equipment to board as required by application.
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 for MON08 mode.

Table 2: MON08 Mode Setup

PWR_SEL	Pin1 – Pin2 (VB)
COM_SEL	Pin1 – Pin3 (COM) Pin2 – Pin4
VX_EN	As Required
USER_EN	1 – 4 As Required 5 & 6 Not Installed
USB-MON08	All jumpers installed

NOTE: For use with an external MON08 cable, remove all USB-MON08 jumpers

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.

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 along with the Axiom MON08 IDE for Windows for Debugging and Flash programming.

A powerful source code generation tool called DriveWay™ is also provided on the support CD. This can generate C source code for the HC08 microcontroller peripherals, based on setup. See the DriveWay™ readme.txt file for more information.

MEMORY MAP

The table below shows the MC68HC908QB8 memory map. Accessing reserved memory locations will produce unpredictable results. Accessing unimplemented locations will produce an illegal-address reset.

Table 3: Memory Map

0x0000 – 0x003F	I/O Registers	64 bytes
0x0040 – 0x013F	RAM	256 bytes
0x0140 – 0x27FF	Unimplemented	9920 bytes
0x 2800 – 0x2A1F	Auxiliary ROM	544 bytes
0x2A20 – 0x2F7D	Unimplemented	1374 bytes
0x2F7E – 0x2FFF	Auxiliary ROM	130 bytes
0x3000 – 0xDDFF	Unimplemented	44,544 bytes
0xDE00 – 0xFDFF	Flash Memory	8192 bytes
0xFE00 – 0xFF7D	Status, Control, Monitor ROM	432 bytes
0xFF7E – 0xFFAF	Unimplemented	50 bytes
0xFFB0 - 0xFFFF	Flash, Flash Protect, Osc Trim, Vectors	80 bytes

NOTE: Accessing reserved memory locations can have unpredictable results
NOTE: Accessing unimplemented memory locations will cause an illegal-address reset.

DEVELOPMENT SUPPORT

Application development and debug for the target MC68HC908QB8 is supported through the MON08 Debug interface. The debug interface consists of an integrated USB-MON08 debugger and an optional 16-pin header (MON08). The MON08 header is not installed in default

configuration and may be installed by the user if necessary. Note that when using an external MON08 cable, all jumpers on the USB-MON08 ENABLE header must be removed.

Integrated MON08

The DEMO908QB8 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 provides connection from 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. Damage to the host PC USB hub or the target board may result.

A 16-pin header (USB-MON08 ENABLE) allows disconnecting 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. The Table below details the function of the USB-MON08 Enable header.

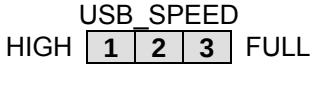
Table 4: USB-MON08 Enable Header

			Jumper On	Jumper Off	Signal
J	**14**	**13**	Enabled	Disabled	VB (V out)
I	**12**	**11**	Enabled	Disabled	PTA3/RST*
F	**10**	**9**	Enabled	Disabled	PTA1/TCH1
E	**8**	**7**	Enabled	Disabled	PTA4/OSC2
D	**6**	**5**	Enabled	Disabled	PTA0/TCH0
C	**4**	**3**	Enabled	Disabled	PTA5/OSC1
B	**2**	**1**	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”. Otherwise the MCU will be forced into monitor mode out of reset.

Communications over the USB bus is controlled by the USB_SPEED header. When shipped from the factory, the DEMO908QB8 is configured for high-speed operation. If the user encounters a communication failure, USB communication speed may be reduced by setting this option jumper to Full.

Figure 1: USB_SPEED Option Header



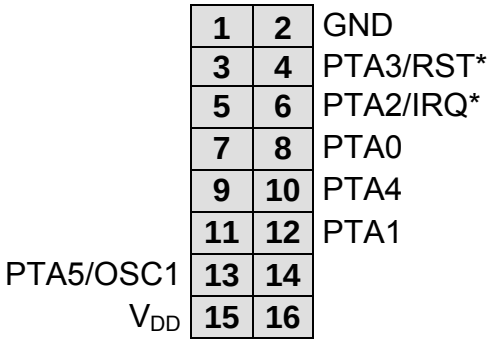
Configuration:
1 – 2: Selects USB High-speed communications
2 – 3: Selects USB Full-speed communications

CAUTION: Do not allow current drain to exceed 500mA when powered from the USB-MON-08 BDM

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. When using the MON08 programming cable, the VTST_EN option jumper forces the MCU to enter monitor mode. Some MON08 cables can supply VTST directly eliminating the need to set the VTST_EN option jumper. The MCU supports monitor mode communications at 9600 bps. Refer to MC68HC908QB8 documentation for further details.

Figure 2: MON08 Debug Port



See the HC08 Reference Manual for complete MON08 documentation

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.

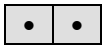
VTST_EN

The VTST_EN circuitry allows the user to force the target MCU into monitor mode. This circuitry is not installed in default configuration but is described here to allow the user to install if needed. Refer to the board schematic to install this circuit functionality if necessary.

When using an unpowered external MON08 programming cable, the VTST _EN jumper (J5) enables the high voltage input necessary to force the MCU into monitor mode. A zener diode at D1 sets the appropriate voltage level on the MCU IRQ* signal line. Use of an external MON08 programming cable requires voltage input at the PWR connector greater than +9V.

Figure 3: VTST_EN Option Header


ON IRQ* signal line set to 8.2V. MON08 monitor mode enabled


OFF IRQ* signal line pulled up to V_{DD}. MON08 monitor mode disabled

NOTE: This header is not installed in default configuration.
NOTE: Use of this option requires +9VDC input on PWR connector or use of self-powered BDM cable.

MCU PACKAGE OPTIONS

The DEMO908QB8 provides footprint locations for 3 different packages. **Only 1 target MCU package may be installed at a time**. Applicable signals are routed to all target MCU locations. Installing multiple packages simultaneously will cause signal corruption and may result in damage to the device.

A 16-pin TSSOP package is installed during the manufacturing process. The board also provides an 8-pin socket and a footprint for a 16-pin socket. The 16-pin socket is not installed in default configuration.

POWER

The DEMO908QB8 is designed to be powered from the USB_MON08 debugger during application development. A 2.0mm barrel connector has been applied to support LIN functionality and stand-alone operation. The board may also be powered through connector J1. This connection may also be used to supply power from the board to external circuitry.

During application development, the board draws power from the USB bus through the integrated UBS-MON08 connector. Total current consumption, of the board and connected circuitry, must be limited to less than 500 mA. Excessive current drain will violate the USB specification and may damage the board or the host PC. At minimum, USB bus violations will cause the host PC to reboot sporadically.

A 2.0 mm barrel connector input has been provided to the user to support LIN functionality and allow stand-alone operation. Voltage input at this connector must be limited to between +6V and +18V. Voltage regulators VR1 and VR2 outputs will shut down if the connected circuit draws excessive current. Stand-alone operation is supported though connector J1 but power input on this connector will not support LIN functionality.

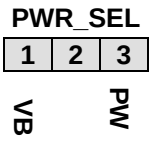
POWER SELECT

Power may be applied to the board through the integrated USB-MON08 circuitry, a 2.0mm barrel connector, or through connector J1. Power selection is achieved by using 2 separate option headers: PWR_SEL option header and the VX_EN option header.

The PWR_SEL option header selects power input either from the integrated USB-MON08 circuitry 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. The figure below details the PWR_SEL header connections.

PWR_SEL

Figure 4: PWR_SEL Option Header



CONFIGURATION
1 – 2: Selects power input from USB-MON08
2 – 3: Selects power input from on-board regulator

Power from the integrated BDM is drawn from the USB bus and is limited to 500 mA. Excessive current drain will violate the USB specification and may result in damage to the host PC or the target board. At minimum, excessive current drain will cause the host PC to spontaneously reboot. Power is provided through the integrated BDM to the target board.

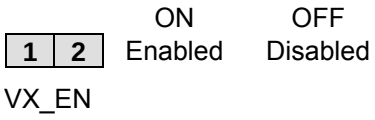
The on-board voltage regulator (VR1) accepts power input through a 2.0mm barrel connector (PWR). Input voltage may range from +6V to +18V. The voltage regulator (VR1) provides a +5V fixed output limited to 250mA. Over-temperature and over-current limit built into the voltage regulator provides protection from excessive stresses. Consider the maximum output current limit of VR1 when attempting to power off-board circuitry through connector J1.

VX_EN

The VX_EN option header is a 2-pin jumper that connects / disconnects 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; 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.

Power may be sourced to off-board circuitry through the J1 connector. 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 5. 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 MC68HC908QB8 utilizes an internal Low Voltage Inhibit (LVI) protect against under-voltage conditions. The LVI is enabled for 2.2Voperation out of RESET. The user must configure the LVI for +5V operation is this feature is to be used. Consult the MC68HC908QB8 reference manual for details on configuring LVI operation.

TIMING

The DEMO908QB8 has 2 timing sources available to the user. The internal oscillator operates at one of three, user selectable internal timing frequencies: 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 MC68HC908QB8 data sheet for details on internal oscillator operation.

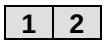
An alternate clock oscillator has also been provided. An option jumper enables/disables the use of the external oscillator to the MCU. The external oscillator is connected to PTA5 on the MCU. The user must configure the MCU for operation with the external clock source. Refer to the MC68HC908QB8 data sheet for details.

The alternate clock oscillator input is not installed in default configuration. Refer to the board schematic to populate this option and associated circuitry.

Figure 6: J6 Option Header



ON Enables Clock Oscillator Input to MCU



OFF Disables Clock Oscillator Input to MCU

NOTE: This option header is not installed in default configuration.

COMMUNICATIONS

The DEMO908QB8 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 a pair of 4-pin Molex connectors.

The COM_SEL option header selects the communications protocol applied by the user.

RS-232

An RS-232 translator provides RS-232 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. 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 2-wire RS-232 communications.

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.

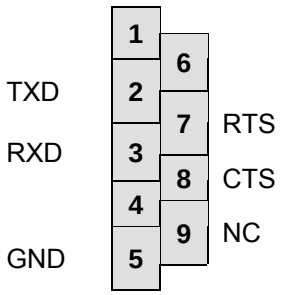
Figure 7: COM Connections

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

COM 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. The figure below details the DB9 connector.

Figure 8: COM Connector



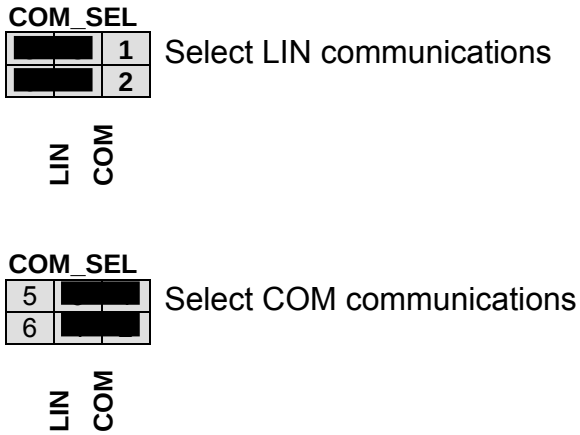
Female DB9 connector that interfaces to the HC08 internal SCI1 serial port via the U2 RS232 transceiver. It provides simple 2 wire asynchronous serial communications without flow control. Flow control is provided at test points on the board.

Pins 1, 4, and 6 are connected together.

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. The figure below shows the different configurations.

Figure 9: COM_SEL Option Header



LIN Communications

The DEMO908QB8 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 +6V 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. The figure below shows the pin-out of the LIN connector looking into the connector.

Figure 10: LIN Connector



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} +6V and 18V.

USER OPTIONS

The DEMO908QB8 includes various User input and output devices to aid application development. User I/O devices include 2 momentary pushbutton switches, 2 green LEDs, 1 potentiometer, and 1 photocell. Each device may be enabled or disabled individually by the USER option header. A table marked on the board indicates which USER option connects to each I/O 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 option bank. SW1 and SW2 provide input to HC08 I/O ports PTA4 and PTA5 respectively. The table below details the user jumper settings.

LED Indicators

Indicators LED1 and LED2 are enabled from HC08 I/O ports by the USER option bank. Each LED is active low and illuminating when a logic low signal is driven from the respective MCU I/O port. MCU ports PTB6 and PTB7 drive LED1 and LED2 respectively. The table below details the user jumper settings.

Potentiometer

A 5k Ω, 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. The table below details the user jumper settings.

The potentiometer is not available while in monitor mode. Using the potentiometer requires disabling the MON08 COM signal. This requires removing USB-MON08 Enable jumper 'D'. 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. The table below details the user jumper settings.

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 RV1	Disable RV1	PTA0 (U1-13)
User-6	Enable RZ1	Disable RZ1	PTA1 (U1-12)

NOTE: USER-5 and USER-6 must be disabled to enter Monitor mode

I/O PORT CONNECTOR

This port connector provides access to DEMO908QB8 I/O signals.

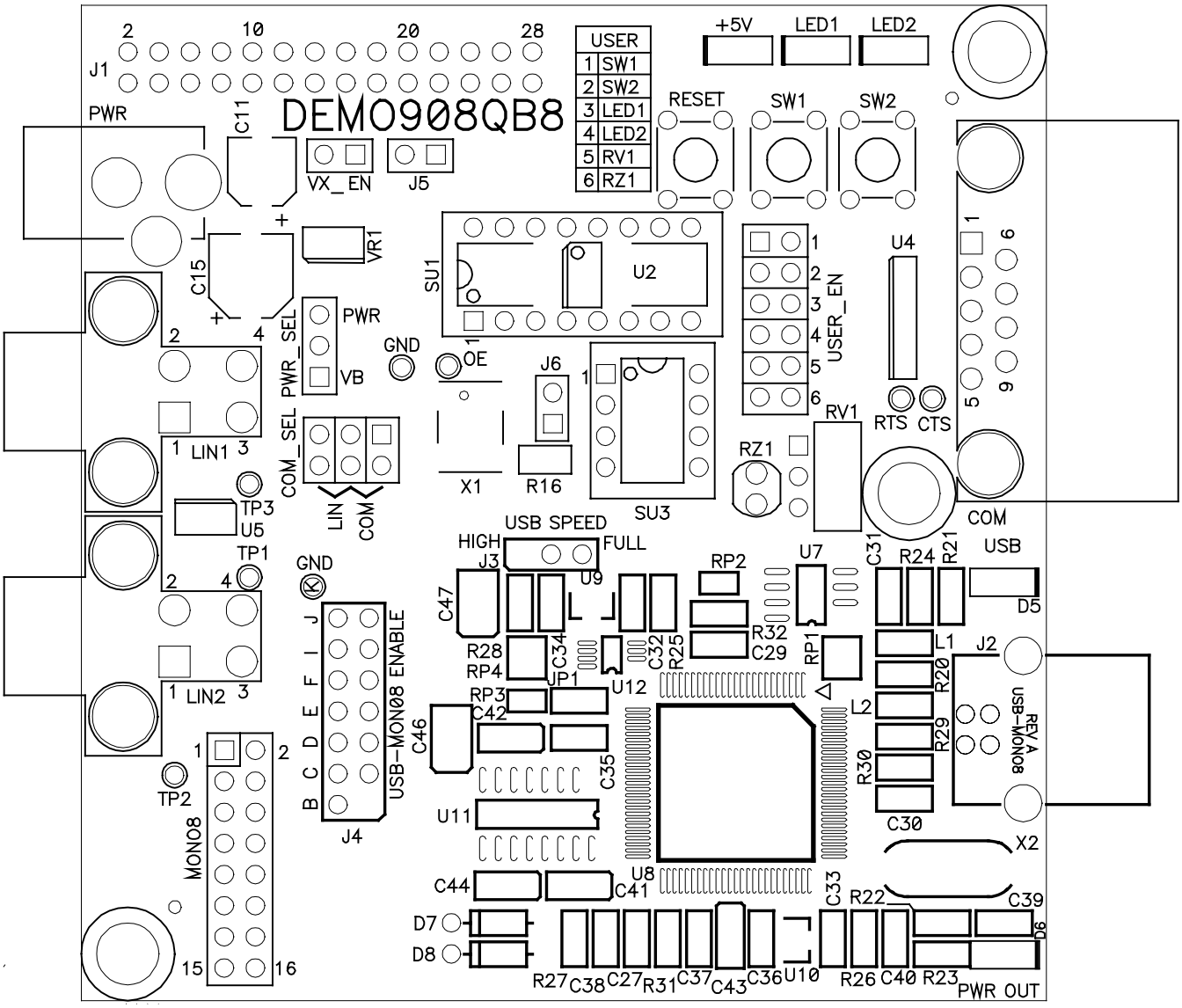
Figure 11: MCU I/O Port Connector

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

Mechanical Details



APPENDIX B

BILL OF MATERIALS

Item	Qty	Title	Ref(m)	Mfr	Mfr-P/N
1	5	Cap, Tant, 10uF, 10V, SMB	C12, C23, C26, C46, C47	Avx	TAJB106K010R
2	1	Cap, Elect, 100uF, 16V, Alum, SMD	C15	Nichicon	UWX1C101MCL1GB
3	1	Cap, Elec, 10uF, 35V, Alum, SMC	C11	Nichicon	UWX1V100MCL1GB
4	4	Cap, Tant, .1uF, 35V, SMA	C41, C42, C43, C44	vishay	293D104X0035A2T
5	25	Cap, Mon, .1uF, 50V, X7R, 0805	C1, C2, C6, C8, C9, C10, C14, C16, C17, C18, C19, C20, C22, C25, C28, C29, C30, C34, C35, C36, C37, C38, C48		
6	0	Cap, Mon, .1uF, 50V, X7R, 0805	C3 **DO NOT INSTALL**		
7	0	Cap, Cer, .1uF, 25V, X7R, 0805	C45 **DO NOT INSTALL**	Panasonic	ECJ-3VB1E104K
8	2	Cap, Cer, 1000pF, 50V, X7R, 10%, 0805	C32, C33	Kemet	C0805C102K5RACTU
9	5	Cap, Mon, .01uF, 50V, 0805	C7, C13, C21, C24, C31		
10	0	Cap, Cer, 39pF, 50V, 0805	C4 **DO NOT INSTALL**	Yageo	0805CG390J9B200
11	2	Cap, Cer, 22pF, NP0/COG, 0805	C39, C40	Panasonic	ECJ-2VC1H220J
12	1	Res, Ntwk, 100 ohm, 5%, Isolated, 4P2R, SMD	RP3	CTS	742C043101JCT
13	1	Res, Ntwk, 100 ohm, 5%, Isolated, 8P4R, SMD	RP4	CTS	742C083101JCT
14	1	Res, Ntwk, 10K ohm, 5%, Isolated, 4P2R, SMD	RP2	CTS	742C043103JCT
15	1	Res, Ntwk, 10K ohm, 5%, Isolated, 8P4R, SMD	RP1	CTS	742C083103JCT
16	4	Res, 100K ohm, 5%, 0805	R8, R10, R14, R15		
18	2	Res, 47K ohm, 5%, 0805	R1, R9		
19	5	Res, 10K ohm, 5%, 0805	R4, R5, R6, R11, R19		
20	5	Res, 1K ohm, 5%, 0805	R18, R25, R26, R27, R32		
21	0	Res, 1K ohm, 5%, 0805	R7, R31 **DO NOT INSTALL**		
22	0	Res, 100 ohms, 5%, 0805	R16 **DO NOT INSTALL**		
23	1	Res, 20K ohm, 5%, 0805	R12		
24	1	Res, 33K ohm, 5%, 0805	R17		
25	5	Res, 680 ohm, 5%, 0805	R2, R3, R13, R23, R24		
26	2	Res, 33 ohm, 1%, 0805	R29, R30		
27	1	Res, 200 ohm, 1%, 0805	R28		
28	1	Res, 510 ohm, 5%, 0805	R20		
29	1	Res, 1.5K ohm, 5%, 0805	R21		
30	1	Res, 1M ohm, 5%, 0805	R22		

31	0	Clock Osc., 9.8304Mhz, 5V, CMOS Out, SMT, 5x7mm	X1 **DO NOT INSTALL**	Epson	SG-8002CA-PWT
32	1	XTAL, 12.000MHz, 18pf, HC49/US, SMT	X2	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
35	0	Diode, Zener, 8.2V, 5%, 225mW, SOT23	D1 **DO NOT INSTALL**	ON Semi	MMBZ5237BLT1
36	1	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D2	General Semi	BAT54
37	2	Diode, Rect, S1A, 1A, 50V, DO214AC	D3, D4	Vishay	S1A
38	1	Diode, Zener, 8.7V, 500mW, 5%, DO-35, thru	D7	Diodes Inc	1N5238B-T
39	0	Diode, Zener, 8.7V, 500mW, 5%, DO-35, thru	D8 **DO NOT INSTALL**	Diodes Inc	1N5238B-T
40	1	Ind, Ferrite, EMI, 330 ohm @ 100 MHz, 1.5A, 0805	FB1	Murata	BLM21P331SG
41	1	Ind, Ferrite, EMI, 600 ohm @ 100 MHz, 500mA, 1206	L1, L2	Steward	HZ1206E601R-00
42	1	Ind, Filter, 680 uH, 1210	L3	TDK	NLC322522-681K
43	4	LED, Green, w/reflector, 1206, SMT	LED1, LED2, +5V, USB	Rohm	SML-010MTT86
44	1	LED, Yellow, w/reflector, 1206, SMT	PWR_OUT	Rohm	SML-010YTT86
45	0	IC, MCU, MC68908QB8, 16DIP	U1 **DO NOT INSTALL**	Motorola	MC68908QB8CP
46	1	IC, MCU, MC68908QB8, 16TSSOP	U2	Motorola	MC68908QB8CDT
47	0	IC, MCU, MC68908QT8, 8DIP	U3 **DO NOT INSTALL**	Motorola	MC68908QT8CP
48	1	IC, LIN XCVR, MC33661D,SOIC8	U5	Motorola	MC33661D
49	1	IC, MCU, MC9S12UF32PU, 100TQFP	U8	Motorola	MC9S12UF32PU,
50	1	IC, Dual RS232 XCVR, 3V - 5V, ESD, 16SOIC	U4	Intersil	ICL3232ECBN
51	1	IC, OPAMP, Single, SOT23-5	U6	Fairchild	LMV321AS5X
52	1	IC, LV Sense, Reset, 5V, 8SOIC	U7	On Semi	MC34164D-5R2
53	2	Trans, MOSFET, P-Ch, -20V, -3.7A, SOT-23	U9, U10	IR	IRLML6402TR
54	1	IC, Dual RS232 XCVR, 5V, 16SOIC	U11	Intersil	HIN232ACBN
55	1	IC, Buffer, 3S, Dual Gate, 8SSOP	U12	TI	SN74LVC2G125DCT
56	1	VReg, LDO, 5V, 250mA, 8 SOIC	VR1	STM	L4931CD50
57	3	Sw, PB, 5mm Sq, Thru	SW1, SW2, RESET	E-Switch	EG1827
58	1	Conn, 2x14 Socket Hdr, Pass Thru, .1", Bottom Entry, SMT	J1 **INSTALL ON BOTTOM**	Samtec	SSM-114-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		
61	1	Conn, 1x2, Pin Header, .1" Ctr, Thru	VTST_EN		
62	0	Conn, 1x2, Pin Header, .1" Ctr, Thru	J5, J6 **DO NOT INSTALL**		
63	2	Conn, 1x3 Pin Header, .1" Ctr, Thru	PWR_SEL, USB_SPEED		
64	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	COM_SEL		
65	1	Conn, 2x6 Pin Header, .1" Ctr, Thru	USER_EN		
66	1	Conn, 2x7 pin hdr, .1" ctr, thru	J4		
67	0	Conn, 2x8 Pin Header, .1" Ctr, Thru	MON08 **DO NOT INSTALL**		
68	1	Conn, Sckt, USB, Type B, Horiz, thru	J2	Keystone	924K
69	1	Conn, 2mm, Pwr Jack, Barrel, Thru, RA	PWR		

70	0	Sckt, IC, 16 DIP, 0.3"	SU1 **DO NOT INSTALL**		
71	1	Sckt, IC, 8 DIP, 0.3"	SU3		
72	17	Hdw, Shunt, 2 Pos, .1"	PWR_SEL(1), COM_SEL(2), USER(6), MON08_EN(7), VX_EN(0), USB_SPEED(1)	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 COMPONENT	JP1 **DO NOT INSTALL**		
76	1	PCB, DEMO908QB8, 2 layer, 2.2" x 4.5", Rev D		Axiom	AXM-0345
77		**ASSEMBLY**			
78	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