

# DEMO908AP64

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Demonstration Module for Freescale 68HC908AP64

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# 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 DEMO908AP64 module:
  - a) This product as shipped from the factory with associated power supplies and cables, has been verified to meet with requirements the 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 module 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.

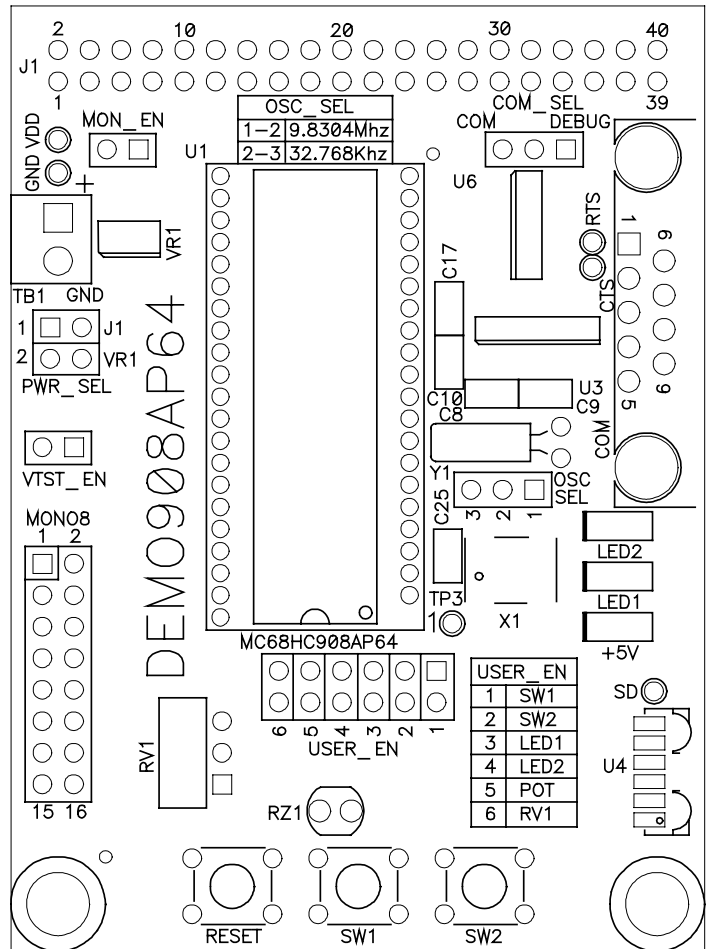
Cut-Trace – a circuit trace connection between component pads. The circuit trace may be cut using a knife to break the default connection. To reconnect the circuit, simply install a suitably sized 0-ohm resistor or attach a wire across the pads.

# FEATURES

The DEMO908AP64 is an evaluation or demonstration module for the 68HC908AP64 microcontroller. Development of applications is quick and easy with the included wall plug, DB9 serial cable, sample software tools, and examples. The MON08 port is provided for development tool application and is compatible with HC08 monitor interface cables and software. The module provides options to allow MON08 access through the COM port also. A 40-pin MCU I/O connector (J1) allows interfacing the DEMO908AP64 module to external connections.

## Features:

- ◆ 68HC908AP64 CPU
  - ◆ 60K Byte Flash
  - ◆ 2K Bytes Ram
  - ◆ 40 I/O lines (44-pin package)
  - ◆ 2 Channel Timer/PWM, 16 bit
  - ◆ SCI and SPI Communications Ports
  - ◆ 12 Key Board Wake-up Ports
  - ◆ IrDA Serial Port
  - ◆ Analog Comparator, R/R
  - ◆ 8Mhz Internal Bus Operation
  - ◆ 8 High Current Pins
- ◆ Power Input Selection Jumper
  - Optional power input from Connector J1
  - Optional power output through Connector J1
- ◆ 32.768KHz Crystal or 9.8304MHz Clock
- ◆ Regulated +5V power supply
- ◆ RS-232 COM Serial Port w/ DB9 Connector
- ◆ Optional MON08 Interface through COM Port
- ◆ Full-duplex IrDA Interface, low speed
- ◆ User Components Provided
  - 3 Push Switches; 2 User, 1 Reset
  - 3 LED Indicators; 2 User, 1 +3.3V
- ◆ Option Jumpers
  - ◆ 6 - User Component Enables
  - ◆ 2 - Power Select
  - ◆ 1 - OSC\_SEL
  - ◆ 1 - COM\_SEL
  - ◆ 1 - MON\_EN
  - ◆ 1 - VTST\_EN
- ◆ Connectors
  - ◆ 40-pin MCU I/O Connector, stack through type
  - ◆ 2-Position, Screw-type, Power Input Terminal Block
  - ◆ MON08 Debug Cable Header
  - ◆ DB9 Serial COM Connector
- ◆ Supplied with DB9 Serial Cable, Documentation (CD), and Manual.



## Specifications:

Module Size 2.2" x 3.1"

Power Input: +6 to +16VDC, 9VDC typical

## Reference Documentation

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

DEMO908AP64_SCH_C.pdf	DEMO908AP64 Module Schematic Rev. C
DEMO908AP64_UG.pdf	DEMO908AP64 User Guide (this document)
MC68HC908AP64/D.pdf	68HC908AP64 Device User Guide

See the HC08 Support CD provided with this board for all the documentation and support files provided.

## GETTING STARTED

The DEMO908AP64 Module operates in two basic Modes, Run Mode or MON08 Debug Mode. Run Mode supports user application operation from Power On or Reset condition. 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 module in the desired operation mode.

The Module may be operating a Demonstration (DEMO) program when shipped from the factory. If so the Module kit contents will include a Quick Start document explaining the operation of the Demonstration program. The demo program operates in RUN Mode.

No matter the operating mode, the module must be powered to operate. The +5V power indicator will only light with the module regulator powered by the input Term Block (TB1) and the PWR\_SEL option being properly configured to power the module circuits from the on-board regulator or from the VX supply and ground connections on the J1 MCU I/O connector. Refer to the PWR\_SEL option and J1 connector chapter for more detail on these selections.

## RUN MODE

RUN Mode operates the HC08 application contained in the internal flash memory from Reset or Power On condition. Use the following settings to configure the DEMO908AP64 module for RUN Mode to get started quickly.

1. Configure PWR\_SEL option for input supply to power the module. If supply is via J1 connection, install module on J1 external connection in powered down condition.
2. Connect COM port serial communication cable between module and host if needed for the application. Launch supporting host software to for the module communication.

3. Set module options for RUN Mode:

VTST_EN	Off / open / idle
MON_EN	Off/ open / idle
COM_EN	2-3 (COM position)
OSC_SEL	As needed for application operation, 32Khz Crystal or 9.8304Mhz Clock
USER_EN	Enabled as needed for application operation

4. Power On the Module. Application will begin to execute.

## MON08 DEBUG MODE

MON08 Debug Mode operates the HC08 internal MON08 debug monitor from Power On. This mode is possible by setting Module options or by applying a supporting development cable on the Debug Port. For Debug cable application the MON\_EN option must be Off / open / idle and the OSC\_EN option should be set according to the debug cable requirements (open or clock selected). Use the following settings to configure the DEMO908AP64 module for MON08 Debug Mode via the COM port:

1. Configure PWR\_SEL option for input supply to power the module. If supply is via J1 connection, install module on J1 external connection in powered down condition. Note that the VTST\_EN option requires 9VDC minimum applied at TB1 to function correctly.
2. Connect one end of the supplied 9-pin serial cable to a free COM port on the PC. Connect the other end of the cable to the COM port connector on the DEMO908AP64 module.
3. Install and launch the PC Hosting software for the MON08 communication interface. This may be a C compiler with IDE and MON08 communication or another MON08 debug hosting type software.
4. Set the Module options for MON08 Debug Mode:

VTST_EN	ON / Installed on both pins (required if the Reset vector is not erased in the flash memory)
MON_EN	ON / Installed on both pins
COM_EN	1-2 (DEBUG position)
OSC_SEL	1-2 (9.8304Mhz Clock position)
USER_EN	Enabled as needed for application operation

5. Apply power to the module. This may be applied by TB1, J1, or Debug cable operation.
6. Hosting development software will establish MON08 communication now.

## 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 Motorola MCUEz HC08 assembler tools along with the Axiom MON08 IDE for Windows for Debugging and Flash programming. A demonstration or evaluation copy of a C compiler may also be provided.

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

0x0000 - 0x005F	Direct Page Register Space. See the 908AP64 User Manual for details	96 bytes
0x0060 - 0x085F	SRAM Memory space Stack and Data Memory	2K bytes
0x 0860 - 0xFBFF	Flash Memory User application memory	61K bytes
0xFC00 – 0xFFCF	Utility Memory Status, Control, MON08 ROM	975 bytes
0xFFD0 - 0xFFFF	Vectors and Security Memory	47 bytes

**NOTE:** The memory map above generally describes the MCU Memory Map. Refer to the MC68HC908AP64 documentation for a detailed memory map.

## OPERATION

The DEMO908AP64 module provides input and output features to assist in microcontroller application development. The user has access to MCU ports through connector J1. Connector J1 is a 40-position pass-through socket type connector mounted on the bottom of the module. Insertion of pin headers is possible from the top or bottom of the module. This allows stacking or connecting the module as needed. Connector J1 may be used to apply power to the module as well as RS-232 communications signals. Care must be exercised when using the MCU\_PORT to power the module, as only regulated +5V DC should be applied to this connection. The PWR\_SEL option also configures the module to provide regulated +5V to an external device attached to connector J1.

Three option jumper blocks and 3 cut-traces setup module operation. Enabling an associated option requires installing a jumper, or shunt, across the appropriate header pins so that both pins are connected via the jumper. Removing the shunt disables the associated option. A cut-trace option can be disabled by cutting the circuit trace between the cut-trace component pads with a razor knife. Install a 0805 SMT 0-ohm resistor or modification wire with a soldering iron to re-enable the option if needed.

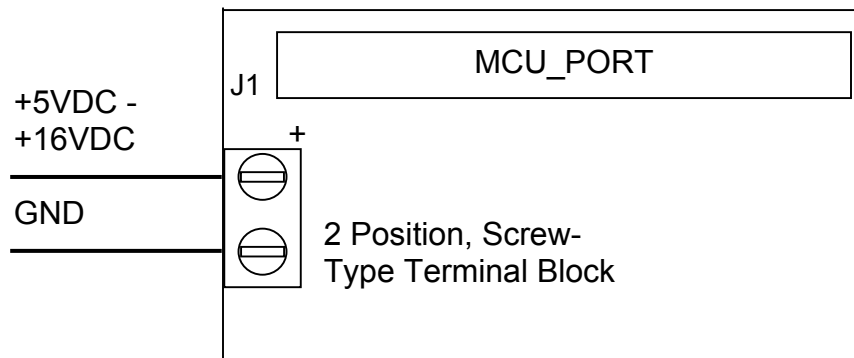
## POWER SUPPLY

Input power may be applied by external connection to a 2 position terminal block and 3.3V regulator or directly from connector J1. The input supply is selected by the PWR\_SEL option.

### *TB1 – Terminal Block*

The TB1 terminal block allows external voltage to be supplied to the module. Input voltage should be limited to +5VDC and +16VDC; +9VDC is typical. The terminal block is a 3.55mm, screw-type, connector that accepts a maximum 18 AWG wire. An on-board voltage regulator (VR1) converts the input voltage to the +3.3VDC used by the module.

*Figure 1: TB1 Terminal Block Connector*



### *Connector J1*

Connector J1 is a 40-pin, surface-mount, socket header mounted on the bottom of the module. The connector is mounted over plated-through holes in the PCB. The socket is a pass-through type socket designed to allow header insertion from either the top or bottom. This provides maximum flexibility in connecting the module to an expansion environment or test equipment. Connector J1 provides access to all MCU signals.

Power may be supplied to the module through pins J1-1 (+V) and J1-3 (GND). Use of this option requires voltage input regulated at +3.3VDC. This input is connected directly to the module power and ground planes. Care should be exercised not to over-drive this input. J1 can also be used to source power from the on-board regulator to external modules. The PWR\_SEL option header determines how power is routed to and from the module.



**NOTE:** Power output from the module is limited by the 250 mA maximum output of the on-board voltage regulator.





### *PWR\_SEL Jumper*

The PWR\_SEL jumper selects the source of power input to the module, or allows regulated +3.3VDC to be provided to J1 for use by external circuits. The module takes voltage input from the 2-position on-board voltage regulator or from the 40-pin MCU connector (J1). Power input at the terminal block must be DC voltage between +5VDC and +16VDC. Power input on the MCU connector **must be** regulated voltage between +3.0VDC and +3.3VDC. The MCU\_PORT connector power input allows use of batteries, or other alternate sources, to power the module.

**CAUTION:** Module damage may occur if the MCU\_PORT power input pin (J1-1) is over-driven.

The PWR\_SEL option jumper provides 3 possible configurations; source power from the PWR connector, source power from J1, or source power from PWR and supply power to J1. The figures below show the settings for each configuration.

*Figure 2: PWR\_SEL Jumper Settings*

- 1  Module powered from external +3.0VDC - +3.3VDC input connected to J1-1 (+) and J1-3 (-)
- 2  Module powered from external +5VDC - +16VDC connected to TB1 Terminal Block. J1-1 is open or not connected.
- 1  Module powered from external +5VDC - +16VDC connected to TB1 Terminal Block. Module provides +3.3VDC output (up to 50 mA) at pin J1 for use by external circuits.
- 2 

**NOTE:** Power output from the module is limited by the 250 mA maximum output of the on-board voltage regulator.

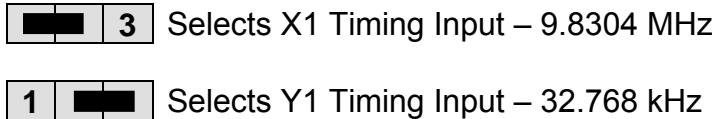
## **Reset Switch**

The RESET switch provides a method to apply an asynchronous reset to the module. Pressing the RESET switch applies a low voltage level to the RST\* input. A resistor tied to the high voltage rail prevents spurious RESET input to the MCU. A capacitor tied to ground holds the signal line low for a sufficient amount of time.

## Timing

The DEMO908AP64 provides two timing sources. A 9.8304 MHz clock oscillator, at X1, supports debug monitor operation. A 32.768 kHz crystal oscillator at Y1 provides the base operating frequency to the MCU for normal operation. The user should refer to the HC08 device user manual for information on frequency selection. The OSC\_SEL jumper selects the timing input source.

*Figure 3: OSC\_SEL Jumper Settings*



## RS-232 Communications

The DEMO908AP64 module provides a single SCI communications port. This port is connected to the MCU\_PORT connector and to the COM connector. An RS-232 translator (U3) provides RS-232 signal level to TTL/CMOS logic level translation on the COM port. Signals TXD and RXD are routed between the transceiver and the MCU. These signals are also routed to connector J1. RS-232 communication signals input on J1 must be TTL/CMOS logic levels; no translation support is provided through this path. The transceiver output may also be driven off-module if a suitably interface is used. As added development support, 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.

Use of the J1 connector to input RS-232 signals requires disabling the on-board RS-232 transceiver to prevent signal corruption. Disabling the on-board transceiver is accomplished by removing the COM\_SEL jumper. Details on the COM\_SEL jumper are shown in the table below.

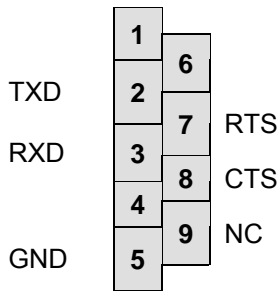
*Table 2: COM Connections*

HC08 Port	COM Signal	I/O PORT Connector
PTB2/TXD	TXD OUT	J1-5
PTB3/RXD	RXD IN	J1-7

## COM Connector

A standard 9-pin Dsub connector provides external connections for the SCI port. The SCI port provide an alternate interface for use with the MON08 monitor. Component U3 provides RS-232 translation services. The figure below details the DB9 connector.

Figure 4: COM Connector

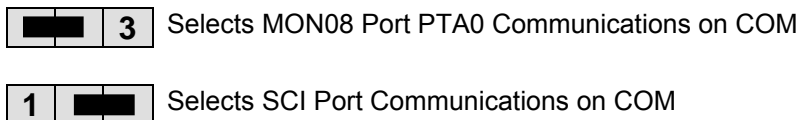


Female DB9 connector that interfaces to the HC08 internal SCI1 serial port via the U2 RS232 transceiver. It provides simple 2 wire asynchronous serial communications without flow control. Flow control is provided at test points on the module.

**Pins 1, 4, and 6 are connected together for status NULL to the host.**

The communications mode of the COM port is determined by the COM\_SEL jumper. This 3-pin jumper allows the user to select between SCI serial communications and single-wire MON08 communications.

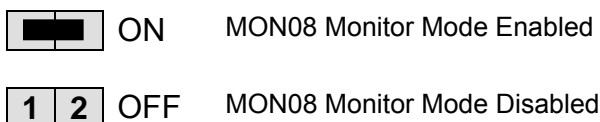
Figure 5: COM\_SEL Jumper Settings



## Single-Wire MON08 Communications

The module provides MON08 access through the COM connector. MON08 on the COM port is enabled by the COM\_SEL, the MON\_EN, OSC\_SEL, and VTST\_EN option jumpers. This allows MON08 debugging without the expense of a 3<sup>rd</sup>-party MON08 pod. The table above shows the selection settings for the COM\_SEL jumper. See the MON08 Debug Mode section for more details.



Figure 6: MON\_EN Jumper Setting



## VTST\_EN





The VTST\_EN jumper enables the voltage level necessary to place the MCU in MON08 monitor mode. An 8.2V zener diode at D1 sets the appropriate voltage level on the MCU IRQ\* signal line. When using the MON08 monitor mode, the input voltage on TB1 must be 9VDC minimum.

Figure 7: VTST\_EN Jumper Setting

	ON	IRQ* signal line set to 8.2V. MON08 monitor mode force entry enabled.
	OFF	IRQ* signal line pulled up to V <sub>DD</sub> . MON08 monitor mode available if Reset vector is erased.

The following table details the settings necessary to configure the MCU for MON08 monitor mode operation via the COM port.

Figure 8: Single-Wire MON08 Setup

MON_EN		ON	Single-Wire MON08 Enabled
VTST_EN		ON	MCU in Monitor Mode
COM_SEL			MON08 Signaling Enabled
OSC_SEL			9.8304 MHz Oscillator selected

**NOTE:** To utilize the single-wire MON08 monitor mode, the input voltage must exceed 9.0VDC.

## USER Components

The DEMO908AP64 provides 2 user push switches, 2 LED indicators, a potentiometer, and photocell circuit for user application. To isolate assigned I/O ports from these features, the USER EN option is provided.

Table 3: User EN Option Settings

Jumper	On	Off	MCU PORT
User 1	Enable SW1	Disable SW1	PTD0 (U1-3)
User 2	Enable SW2	Disable SW2	PTD1 (U1-2)
User 3	Enable LED1	Disable LED1	PTB4 (U1-13)
User 4	Enable LED2	Disable LED2	PTB5 (U1-8)
User 5	Enable RV1	Disable RV1	PTA4 (U1-29)
User 6	Enable RZ1	Disable RZ1	PTA5 (U1-28)

## *SW1 and SW2 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 PTD0/KBI0 and PTD1/KBI1 respectively.

## *LED1 and LED2 Indicators*

Indicators LED1 and LED2 are enabled from HC08 I/O ports by the USER EN option. The LED indicators are active low and will illuminate when a logic low (0 value) signal is driven from the respective MCU I/O port. MCU ports PTB4/T1CH0 and PTB5/T1CH1 drive LED1 and LED2 respectively.

## *RV1 Potentiometer*

A 5k  $\Omega$ , thumb-wheel potentiometer at RV1 provides variable resistance output for user applications. The device provides a 0 to VDD (+5V typically) output to the PTA4/ADC4 input when enabled.

## *RZ1 Photocell*

RZ1 is visible light sensitive photocell with an amplifying OPAMP circuit that provides a variable voltage output for user applications. Circuit output voltage of .5V to VDD typically and is inversely proportional to light intensity on the surface of the RZ1 device (VDD = Dark). When enabled the circuit output voltage is provided to MCU port PTA5/ADC5 input for user application.

## **Infrared Transceiver**

A IRDA serial infrared transceiver at U4 supports infrared serial communications of 2.4K – 115.2 Kbps to a typical distance of 1 meter. The transceiver (ZHX1010) combines an infrared emitting diode (IRED), a PIN photodiode detector, a digital AC coupled IRLED driver, and a receiver/decoder with noise discrimination circuitry in a single, miniature package.

The IRDA transceiver connects to the MCU I/O signals PTC7/SCRXD and PTC6/SCTXD. Both signals are also available at connector J1. The IRDA transceiver may be removed from the MCU I/O connections by opening cut-traces CT2 and CT3. The cut-traces maybe restored by installing a 0805 SMT 0-ohm resistor or wire modification with a solder iron.

# APPENDIX A

## I/O PORT CONNECTORS

### MON08 PORT

The MON08 port is a 16-pin header compatible with a Motorola MON08 Monitor Mode Pod. This allows the connection of a background debugger for software development, programming, and debugging in real-time without using HC08 I/O resources.

	<b>1</b>	<b>2</b>	GND
	<b>3</b>	<b>4</b>	RST*
	<b>5</b>	<b>6</b>	IRQ1*
	<b>7</b>	<b>8</b>	
	<b>9</b>	<b>10</b>	PTA0
	<b>11</b>	<b>12</b>	PTA2
OSC1	<b>13</b>	<b>14</b>	PTA1
V <sub>DD</sub>	<b>15</b>	<b>16</b>	PTB0

See the HC08 Reference Manual for complete MON08 documentation

### MCU I/O Port Connector

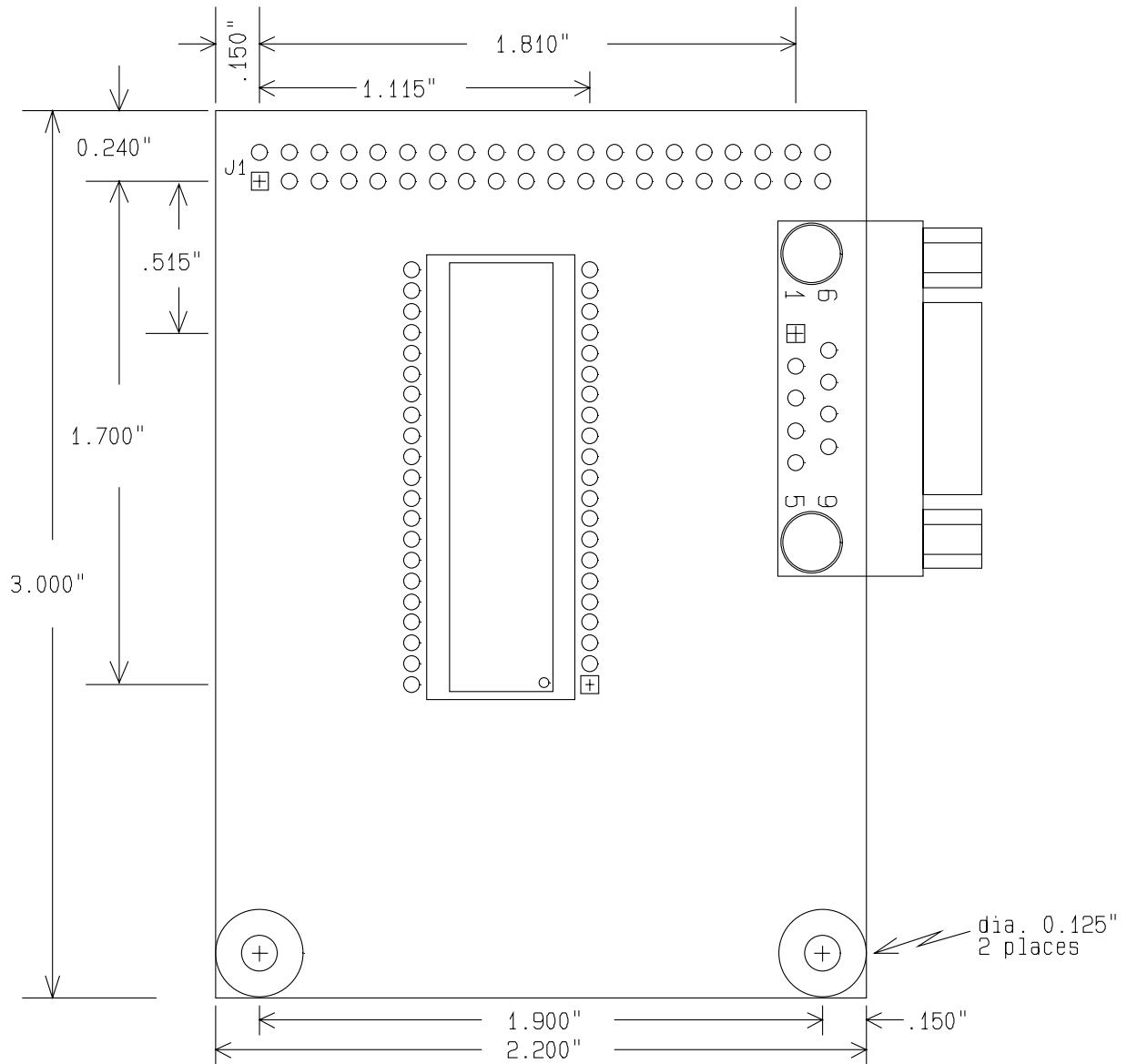
This port connector provides access to DEMO908AP64 I/O signals.

VX	<b>1</b>	<b>2</b>	IRQ1*
GND	<b>3</b>	<b>4</b>	RST*
PTB2/TXD	<b>5</b>	<b>6</b>	
PTB3/RXD	<b>7</b>	<b>8</b>	
PTD0/KBI0	<b>9</b>	<b>10</b>	PTA0/ADC0
PTD1/KBI1	<b>11</b>	<b>12</b>	PTA1/ADC1
PTB4/T1CH0	<b>13</b>	<b>14</b>	PTA2/ADC2
PTB5/T1CH1	<b>15</b>	<b>16</b>	PTA3/ADC3
PTC3/MOSI	<b>17</b>	<b>18</b>	PTA4/ADC4
PTC2/MISO	<b>19</b>	<b>20</b>	PTA5/ADC5
PTC5/SPSCK	<b>21</b>	<b>22</b>	PTA6/ADC6
PTC6/SS*	<b>23</b>	<b>24</b>	PTA7/ADC7
PTD1/KBI2	<b>25</b>	<b>26</b>	PTB0/SDA
PTD3/KBI3	<b>27</b>	<b>28</b>	PTB1/SCL
PTD4/KBI4	<b>29</b>	<b>30</b>	PTD6/KBI6
PTD5/KBI5	<b>31</b>	<b>32</b>	PTD7/KBI7
	<b>33</b>	<b>34</b>	PTB6/T2CH0
	<b>35</b>	<b>36</b>	PTB7/T2CH1
	<b>37</b>	<b>38</b>	PTC7/SCRXD
	<b>39</b>	<b>40</b>	PTC6/SCTXD

Note:  
All user component signals are available at connector J1

# APPENDIX B

## Mechanical Details



# APPENDIX C

## BILL OF MATERIALS

Item	Qty	Title	Reference	Mfr Name	Mfr P/N
1	3	Cap, Elec, 10uF, 10V, Tant, SMA	C2, C9, C12	Kemet	T491A106K010
2	5	Cap, Mon, .1uF, 50V, 0805	C1, C5, C8, C10, C11	Meritek	MA080525U104M500
3	4	Cap, Mon, 1uF, 16V, 0805	C3, C4, C6, C7		
4	3	Res, Carbon, 330 ohm, 1/16W, 5%, 0805	R4, R5, R7		
5	1	Res, Carbon, 4.7K ohm, 5%, 0805	R2		
6	2	Res, Carbon, 10K ohm, 5%, 0805	R3, R6		
7	1	Res, Carbon, 1M ohm, 5%, 1/16w, 0805	R1		
8	1	Resonator, Cer, 16.00MHz, w/Caps, 3Pos, SMT	Y1	Panasonic	EFO-BM1605E5
9	1	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D1	General Semiconductor	
10	3	LED, Green, w/reflector, 1206, SMT	LED1, LED2, +3.3V	Rohm	SML-010MTT86
11	1	IC, Dual RS232 XCVR, 3.3V, 16SOIC	U2	Intersil	ICL3232ECBN
12	1	IC, MCU, 68HC908AP64, 44LQFP	U1	Motorola	MC9S08G60
13	1	VReg, LDO, 3.3V, 250mA, 8 SOIC	VR1	STM	L4931CD33
14	3	Sw, PB, 5mm Sq, Thru	SW1, SW2, RESET	E-Switch	EG1827
15	6	Hdw, Shunt, 2 Pos, .1"		Generic	
16	2	Hdw, Hex Standoff, 4-40 Thd, .375", Al		Keystone	2202
17	2	Hdw, Screw, 4-40, 1/4", Pan Head, SS, Captive Washer			
19	1	Conn, 2x20 Socket Hdr, Pass Thru, .1", Bottom Entry, SMT	J1	Samtec	SSM-120-L-DV-K-BE-A
20	1	Conn, Term Blk, 2Pos, 3.55mm, thru	TB1	On Shore Technology	ED555/2DS
21	1	Conn, Dsub, 9P, F, RA, PCB Mount	SCI1		
22	1	Conn, 1x3 Pin Header, .1" Ctr, Thru	PWR_SEL		
23	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	BDM_PORT		
24	1	Conn, 2x4 Pin Header, .1" Ctr, Thru	USER		
25	1	PCB, 68HC908AP64DEMO Module			