

# DEMO9RS08KB12

---

Demonstration Board for Freescale MC9RS08KB12  
Microcontroller

## USER GUIDE



Web Site: [www.axman.com](http://www.axman.com)

Support: [support@axman.com](mailto:support@axman.com)

# CONTENTS

<b>CAUTIONARY NOTES</b> .....	<b>4</b>
<b>TERMINOLOGY</b> .....	<b>4</b>
<b>FEATURES</b> .....	<b>5</b>
<b>REFERENCES</b> .....	<b>6</b>
<b>MEMORY MAP</b> .....	<b>6</b>
<b>SOFTWARE DEVELOPMENT</b> .....	<b>7</b>
<b>DEVELOPMENT SUPPORT</b> .....	<b>7</b>
INTEGRATED BDM .....	7
BDM_PORT HEADER.....	7
<b>POWER</b> .....	<b>8</b>
POWER SELECT .....	8
PWR_SEL .....	8
VX_EN.....	9
<b>RESET SWITCH</b> .....	<b>10</b>
<b>LOW VOLTAGE RESET</b> .....	<b>10</b>
<b>TIMING</b> .....	<b>10</b>
<b>COMMUNICATIONS</b> .....	<b>10</b>
COM PORT .....	10
VIRTUAL COM PORT .....	11
COM_SEL .....	11
COM CONNECTOR .....	11
<b>USER OPTIONS</b> .....	<b>12</b>
PUSHBUTTON SWITCHES.....	12
LED INDICATORS .....	12
POTENTIOMETER.....	12
<b>MCU I/O PORT</b> .....	<b>13</b>



## 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 DEMO9RS08KB12 board:
  - a) This product as shipped from the factory with associated power supplies and cables, has been verified to meet with requirements of CE and 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 nearby electronic equipment. If such interference is detected, suitable mitigating measures should be taken.

## TERMINOLOGY

This development module utilizes option select jumpers to configure default board operation. Terminology for application of the option jumpers is as follows:

Jumper – a plastic shunt that connects 2 terminals electrically

Jumper on, in, or installed – jumper is a plastic shunt that fits across 2 pins and the shunt is installed so that the 2 pins are connected with the shunt.

Jumper off, out, or idle – jumper or shunt is installed so that only 1 pin holds the shunt, no 2 pins are connected, or jumper is removed. It is recommended that the jumpers be placed idle 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 suitable sized 0-ohm resistor or attach a wire across the pads.

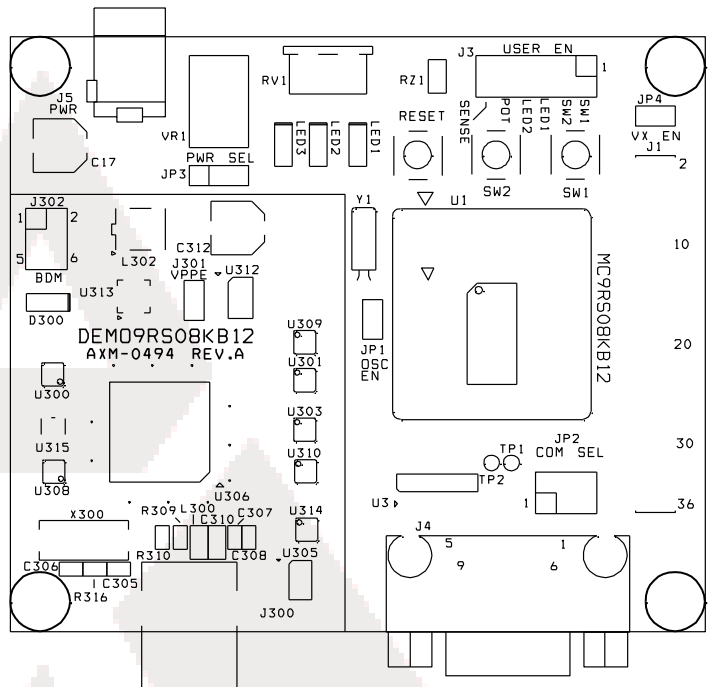
Signal names followed by an asterisk (\*) denote active-low signals.

# FEATURES

The DEMO9RS08KB12 is a demonstration board for the MC9RS08KB12 microcontroller. Application development is quick and easy with the integrated USB-BDM, sample software tools, and examples. An optional BDM\_PORT port is also provided to allow use of a BDM\_PORT cable. A 36-pin MCU Port connector provides access to all IO signals on the target MCU.

## Features:

- MC9S08KB12, 20 SOIC
  - 12K Bytes Flash
  - 256 Bytes RAM
  - 12Ch, 10-bit ADC
  - 2-Ch, Timer/PWM
  - Internal Clock Source
  - 18 GPIO
- Optional 32 kHz XTAL pads (not installed)
- Integrated USB-BDM
- BDM\_PORT header for BDM cable support (not installed)
- MCU\_PORT socket header for access to MCU IO signals
- On-board +5V regulator
- Power Input Selection Jumpers
  - Optional Power from USB-BDM or MCU\_PORT connector
  - Power input from USB-BDM
  - Power input from on-board regulator
  - Optional Power output through Connector J1
- User Components Provided
  - 3 Push Switches; 2 User, 1 Reset
  - LED Indicators; 2 User, VDD, D300
  - 5K ohm POTs w /LP Filter
  - Photo Transistor Light Sensor w/ Amplifier
- Jumpers
  - Power Select
  - VSEL
  - VX\_EN
  - USER\_EN
  - COM\_EN
  - VPPE
- Connectors
  - 40-pin MCU I/O Connector
  - 2.0mm Barrel Connector
  - BDM\_PORT (not installed)
  - USB Connectors
  - DB9 Connector



## Specifications:

Board Size 3.5" x 3.0"

# REFERENCES

The following reference documents are available on the CD or DVD provided with this board in Acrobat Reader format. These documents are also available at [www.axman.com/support](http://www.axman.com/support).

DEMO9RS08KB12 _UG.pdf	DEMO9RS08KB12 User Guide (this document)
DEMO9RS08KB12 _QSG.pdf	DEMO9RSOUKB12 Quick Start Guide
DEMO9RS08KB12 _SCH_A.pdf	DEMO9RS08KB12 Schematic Rev. A
DEMO9RS08KB12 _Silk_A.pdf	DEMO9RS08KB12 Top Silk, Rev A
DEMO9RS08KB12 _Def_SH.pdf	DEMO9RS08KB12 Default Shunt Placement
x494_FT.zip	Demo CodeWarrior Project

# MEMORY MAP

Figure 1 below shows the default memory map for the MC9RS08KB12 immediately out of reset. Refer to the MC9RS08KB12 Reference Manual (RM) for further details.

**Figure 1: Memory Map**

\$0000	Fast Access Ram	14 bytes
\$000D		
\$000E	D[X]	
\$000F	Register X	
\$0010	Frequently Used Registers	
\$001E		
\$001F	PAGESEL	
\$0020		
\$004F	REGISTERS	
\$0050	RAM	112 bytes
\$00BF		
\$00C0	Page Window	
\$00FF		
\$0100	RAM	128 bytes
\$017F		
\$0180	Unimplemented	
\$01FF		
\$0200	High Page Registers	
\$023F		
\$0240	Unimplemented	
\$0FFF		
\$1000	FLASH	12,288 bytes
\$3FFF		

**NOTE:** Any access to an unimplemented memory area causes reset.

# SOFTWARE DEVELOPMENT

Software development requires the use of a compiler or an assembler supporting the HCS08 instruction set and a host PC operating a debug interface. CodeWarrior Development Studio for Microcontrollers is supplied with this board for application development and debug. Refer to the supporting CodeWarrior documentation for details on use and capabilities.

## DEVELOPMENT SUPPORT

Application development and debug for the target MC9RS08KB12 is supported through the integrated Background Debug Mode (BDM) interface. An optional 6-pos BDM\_PORT header allows connecting an external HCS12/HCS08 BDM cable. The BDM\_PORT header is not installed in default configurations.

### Integrated BDM

The DEMO9RS08KB12 board features an integrated BDM. The integrated USB BDM supports application development and debugging via background debug mode. The integrated BDM is fully supported by CodeWarrior development tools.

The integrated USB BDM provides power and ground to the target board eliminating the need to power the board externally. Power from the USB BDM is derived from the USB bus. The integrated USB BDM is designed to sink a maximum of 300mA of current from the USB bus. Therefore, total current consumption for the target board, and connected circuitry, **must not exceed 300mA**. This current limit describes the current supplied by the USB cable to the BDM circuit, the target board, and any connected circuitry. Excessive current drain will violate the USB specification causing the bus to disconnect. Damage to the host PC USB hub or the target board may result.

### BDM\_PORT Header

A compatible HCS12 BDM cable may also attach to the 6-pin BDM interface header (BDM\_PORT). Figure 2 below shows the pin-out for the BDM\_PORT header.

Figure 2: BDM\_PORT Header

BKGD	1	2	GND
	3	4	RESET*
	5	6	VDD

See the MC9RS08KB12 Reference Manual for details

**NOTE:** The BDM\_PORT header is not installed in default configuration.

# POWER

The DEMO9RS08KB12 may be powered from the integrated USB-BDM or from an on-board voltage regulator and external power connector. The desired power source is selected using the PWR\_SEL option header.

For application development and debug, the board may be powered from the integrated USB BDM. As noted above, total current consumption from this source is limited to 300 mA. A 2.0mm, center-positive, barrel connector (VIN) and on-board regulator supports stand-alone operation and higher power requirements.

Power may also be applied to connector J1 or the board may be configured to supply power from connector J1 to external circuitry.

**CAUTION:**  
Damage to the board may result if voltages greater than +5.5V are applied at connector J1 input.



## POWER SELECT

Power may be applied to the board through the integrated BD, a 2.0mm barrel connector and on-board regulator, or through connector J1. Power selection is achieved using 2 selection headers: the PWR\_SEL option header and the VX\_EN option header.

### ***PWR\_SEL***

The PWR\_SEL option header allows the user to select power input either from either an external power source connected to the VIN connector or from the integrated USB-BDM. Figure 3 below details the PWR\_SEL header connections.

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

- JP3  Selects power input from the on-board regulator
- JP3  Selects power input from the integrated BDM



**CAUTION:**

Do not configure the target board to draw more than 300mA when powered from the integrated USB BDM. Damage to the target board or host PC may result otherwise.

Power from the integrated BDM is drawn from the USB bus and is limited to **300 mA**. This current limit accounts for the total current supplied over the USB cable to the BDM circuit, the target board, and any connected circuitry. Current drain in excess of value violates the USB specification and will cause the USB bus to disconnect. This will cause the board to exhibit power cycling where the board appears to turn off and back on continually. Damage to the host PC or the target board may result.

Voltage input to the on-board regulator should be kept at or below +12V to prevent the regulator from over heating.

**VX\_EN**

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

Power may also be sourced to off-board circuitry through the J1 connector. The current supplied from the USB bus or the on-board regulator limits current available 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**



**CAUTION:**

Do not exceed available current from USB-BDM or on-board regulator when sourcing power through connector J1 to external circuitry.

## RESET SWITCH

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

The MC9RS08KB12 MCU applies a multiplexed RESET\* input. To use the RESET switch, the RESET pin must be enabled (SOPT1\_RSTPE). Refer to the MC9RS08KB12 Reference Manual for details on configuring and using the RESET\* input.

## LOW VOLTAGE RESET

Both the MC9RS08KB12 apply an internal Low Voltage Detect (LVD) circuitry. The LVD holds the MCU in reset until applied voltage reaches the appropriate level. The LVD also protects against under-voltage conditions. Consult the MC9RS08KB12 Reference Manual for details on LVD operation.

## TIMING

Default timing for the DEMO9RS08KB12 is provided by the MC9RS08KB12 internal timing source which is active out of RESET. External circuitry for an external 32 kHz XTAL oscillator is provided; however, these components are not populated in default configuration. Refer to the MC9RS08KB12 Reference Manual for details on configuring the timing source.

## COMMUNICATIONS

Serial communication on the DEMO9RS08KB12 board is supported through an RS-232 physical layer interface and DB-9 connector and through a virtual serial port implemented in the USB-BDM. The COM\_SEL option header selects between the applied serial function.

### COM Port

An RS-232 transceiver provides RS-232 to TTL/CMOS logic level translation between the COM connector and the MCU. 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 on connector J1. Hardware flow control signals RTS and CTS are available on the logic side of the RS-232 transceiver and are routed to test point vias located near the transceiver. RTS has been biased properly to provide handshaking if required.

RS-232 signals TXD and RXD are connected to the MCU through the COM\_SEL option header. **Error! Reference source not found.** below shows the RS-232 signal connections.

**Figure 5: COM Connections**

MCU Port	COM Signal	I/O PORT CONNECTOR
PTB1/KBIP5/TXD/ADP5	TXD	J1-5
PTB0/KBIP4/RXD/ADP4	RXD	J1-7

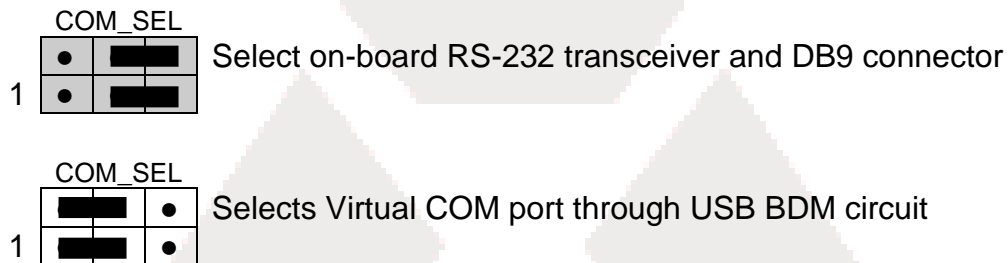
## Virtual COM Port

The integrated USB-BDM provides a serial link from the target MCU to the host PC through the host application. Refer to the P&E Multilink documentation for further details.

## COM\_SEL

The COM\_SEL option header selects between the virtual serial port implemented through the USB-BDM or the RS-232 PHY. Figure 6 below shows the shunt positions to select between the two options.

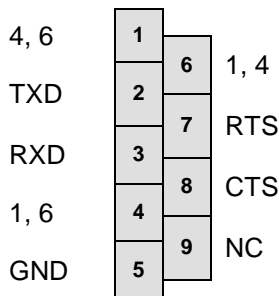
**Figure 6: COM\_EN Option Header**



## COM Connector

A standard 9-pin Dsub connector provides external connections for the SCI 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 7 below, shows the pin-out of the DB9 connector.

**Figure 7: COM Connector**



Female DB9 connector that interfaces to the HC(S)08 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 DEMO9RS08KB12 includes various input and output devices to aid application development and debug. User I/O includes 2 momentary pushbutton switches, 2 green LEDs, 1 potentiometer, 1 Light Sensor. Each device may be enabled or disabled individually with the USER\_EN option header. Each user enable is clearly marked as to functionality.

## Pushbutton Switches

Two push button switches provide momentary, active-low input, for user applications. External pull-ups internal bias the switches for proper operation. Pushbutton switches SW1 and SW2 are enabled to the MCU I/O ports by the USER\_EN option bank. Figure 8 below shows the jumper setting for the pushbutton switches.

## LED Indicators

Two LEDs provide visual output for user applications. Both LEDs are configured for active-low operation. Figure 8 below shows the jumper setting for the LED's.

## 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. The potentiometer is connected between VDD and GND with the center tap providing the divider output. Figure 8 below shows the jumper setting for the POT.

## Light Sensor

A surface-mount phototransistor, at RZ1, provides light sensitive, variable input for user applications. Current flow within the phototransistor is inversely proportional to light intensity incident on the surface of the device. A rail-to-rail OP amp at U5 boosts the photocell output to useable levels. Figure 8 below shows the jumper setting for the Light Sensor.

**Figure 8: USER\_EN Option Jumper Settings**

Jumper	On	Off	MCU PORT
SW1	Enable SW1	Disable SW1	PTA2/KBIP2/SDA/RXD/ADP2
SW2	Enable SW2	Disable SW2	PTA3/KBIP3/SCL/TXD/ADP3
LED1	Enable LED1	Disable LED1	PTB4/TPCH0
LED2	Enable LED2	Disable LED2	PTB5/TPMCH1
POT	Enable POT	Disable POT	PTA0/KBIP0/TPMCH0/ADP0/ACMP+
RZ1	Enable TEMP	Disable TEMP	PTA1/KBIP1/TPMCH1/ADP1/ACMP-

## MCU I/O PORT

The MCU I/O PORT connector provides access to the MC9RS08KB12 I/O signals. Figure 9 below show the pin-out for the MCU I/O connector.

**Figure 9: MCU I/O PORT – J1**

VDD	1	2	PTA5/TCLK/RESET*/VPP
VSS	3	4	PTA5/TCLK/RESET*/VPP
PTB1/KBIP5/TXD/ADP5	5	6	PTA4/ACMPO/BKGD/MS
PTB0/KBIP4/RXD/ADP4	7	8	PTB7/SCL/EXTAL
PTA2/KBIP2/SDA/RXD/ADP2	9	10	PTB6/SDA/XTAL
PTA3/KBIP3/SCL/TXD/ADP3	11	12	
PTA5/TCLK/RESET*/VPP	13	14	
PTA0/KBIP0/TPMCH0/ADP0/ACMP+	15	16	
PTB3/KBIP7/ADP7	17	18	PTA1/KBIP1/TPMCH1/ADP1/ACMP-
PTB4/TPMCH0	19	20	PTA0/KBIP0/TPMCH0/ADP0/ACMP+
PTB2/KBIP6/ADP6	21	22	
PTB5/TPMCH1	23	24	
PTA1/KBIP1/TPMCH1/ADP1/ACMP-	25	26	
PTB6/SDA/XTAL	27	28	
PTC0/ADP8	29	30	
PTC1/ADP9	31	32	
PTC2/ADP10	33	34	
PTC3/ADP11	35	36	