M68EVB908GB60

Development Board for Motorola M9S08GB60

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Cautionary Notes

1) Electrostatic Discharge (ESD) prevention measures should be applied whenever handling this product. ESD damage is not a warranty repair item.

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3) EMC Information on the M68EVB908GB60 board:

a) This product as shipped from the factory with associated power supplies and cables, has been tested and meets 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 also cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

Terminology

This development board applies option selection jumpers. Terminology for application of the option jumpers is as follows:

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.

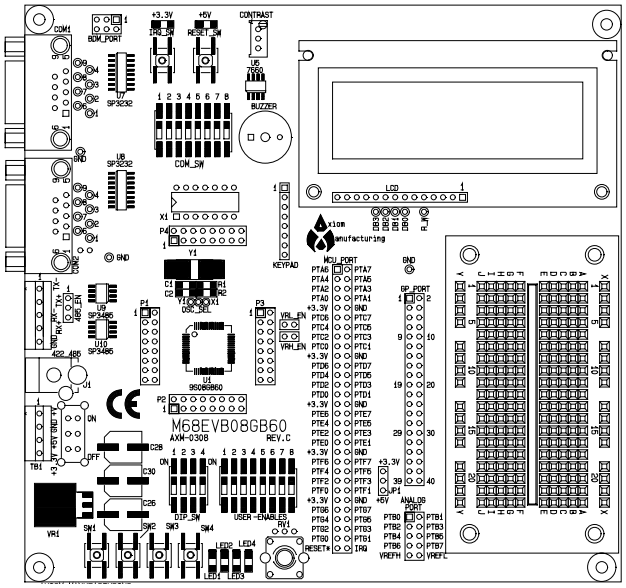
Jumper off, out, or idle = jumper or shunt is installed so that only 1 pin holds the shunt, no 2 pins are connected, or jumper is removed. It is recommended that the jumpers be idled by installing on 1 pin so they will not be lost.

This development board applies hard wired option selections (VRH_EN and VRL_EN). These option selections apply a circuit trace between the option pads to complete a default connection. This type connection places an equivalent Jumper Installed type option. The circuit trace between the option pads maybe cut with a razor blade or similar type knife to isolate the default connection provided. Applying the default connection again can be performed by installing the option post pins and shunt jumper, or by applying a wire between the option pads.

FEATURES

The M68EVB08GB60 is an evaluation or development board for the M9S08GB60 microcontroller. Development of applications is quick and easy with the included DB9 serial cable, sample software tools, examples, and debug monitor. The prototyping area provides space to apply the CPU I/O to your needs. The BDM port is provided for development tool application and is compatible with HCS08 BDM interface cables and software.

Features:



- M9S08GB60 CPU
  - * 60K Byte Flash
  - * 4K Bytes Ram
  - * 56 I/O lines (64 pins)
  - * 5 channel TPM 2 Timer
  - * 3 channel TPM 1 Timer
  - * 8 Channel 10 BIT A/D
  - * SPI and IIC Serial Ports
  - * 2 x SCI Serial Ports
  - * Key Wake-up Ports
  - * BDM Port
  - * Clock generator w/ PLL
  - * up to 40Mhz operation
- 32Khz or 4MHz reference Crystal oscillator
- Clock oscillator optional
- Regulated +3.3V and 5V power supplies
- COM1 Serial Port w/ RS232 DB9-S Connector
  - * SCI0 Serial Port
- COM2 CAN Serial Port w/ RS232 DB9-S Connector or RS422/485 connector.
  - * SCI1 Serial Port
- ON/OFF switch w/ Power Indicator
- User Components Provided
  - * 4 LED Indicators (PTF0-3)
  - * 4 position DIP switch (PTB4-7)
  - * 4 Push Switches (PTA4-7)
  - * 2x16 character LCD Module (PTG3-7, PTE6-7)
  - * Buzzer (PTD0)
- MCU Port connector provides all digital I/O
- Analog Port connector provides analog inputs or PTB outputs
- Large 2” x 5” Prototype Area
- Supplied with DB9 Serial Cable, Utility Support disk (CD), Manuals, and Wall plug type power supply.

Specifications:

Board Size 6” x 6.2”
Power Input: +6 - +20VDC, 9VDC typical
Current Consumption: 50ma @ 9VDC input

The M68EVB908GB60 is provided operating the Motorola binary monitor. The monitor allows serial interface to host based development environments for source level debugging operations.

GETTING STARTED

The M68EVB908GB60 single board computer is a fully assembled, fully functional development board for the Motorola M9S08GB60 microcontroller. Provided with wall plug power supply and serial cable. Support software for this development board is provided for Windows 95/98/NT/2000/XP operating systems.

Development board users should also be familiar with the hardware and software operation of the target HCS08 device, refer to the provided Motorola User Guide for the device and the HCS08 Reference Manual for details. The development board purpose is to assist the user in quickly developing an application with a known working environment or to provide an evaluation platform for the target HCS08. Users should be familiar with memory mapping, memory types, and embedded software design for the quickest successful application development.

Application development maybe performed by applying the embedded serial interface monitor, or by applying a compatible HCS08 BDM cable with supporting host software. The monitor provides an effective and low cost debug method.

The serial monitor is provided in the development board HCS08 device internal flash memory and applies some HCS08 resources for operation. See the AN2140 application note from Motorola for complete details. After the user application is tested under monitor control, the code can be configured for dedicated operation and programmed into the device.

Reference Documentation

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

AN2140 – HCS08 Serial Monitor application note.
9S08GB_GT60UM.pdf – 9S08GB60 user manual
CPU08RM.pdf – CPU08 core user manual with instruction set
M68EVB908GB60_SCH_C.pdf – M68EVB908GB60 board schematics

M68EVB908GB60 Startup

Follow these steps to connect and power on the board for the default Monitor operation.

1) A version of integrated development software that applies the monitor for development purposes should be applied first. Follow the installation and set-up instructions provided with this software. To verify the monitor is installed and operating, proceed to the following steps.

2) Install AxIDE terminal software and launch or configure HyperTerminal for a direct connection to the PC COM port to be applied for serial communication with the M68EVB908GB60 board. Set the baud rate to 115.2K baud, 8 data bits, 1 stop bit, and no parity. Software and hardware flow controls should be disabled.

3) Connect the M68EVB908GB60 board COM1 serial connector to the host PC COM port

with the provided serial cable.

4) Apply power to the EVB board by installing the wall plug power supply between a wall outlet and the J1 Power Jack on the board.

5) Left Click the mouse in the terminal window on the PC display or make the terminal window active for keyboard entry. Type the “Enter” key and observe the display for the monitor prompt.

6) Close AxIDE or HyperTerminal software and apply the development software now.

MONITOR OPERATION

See the AN2140 application note on the monitor for complete details of operation. Basic operation is provided in this manual. The monitor occupies 1K bytes of flash memory and up to 64 bytes of stack space. It provides a binary command set via the SCI1 or COM1 port.

COMMUNICATION:

The monitor provides default 115.2K baud serial communication on the COM1 (SCI1) interface port. Optional lower baud rate operation can be detected by the monitor for an automatic change of baud rate during sign-on. User can type the Enter key repeatedly to allow the monitor to sign on at a lower baud rate.

POWER ON or RESET PROMPT:

The monitor will provide a text prompt to the serial COM1 interface to provide an indication that it is operating after the baud rate is detected. User or controlling software must send “Enter” key for prompt to appear.

COMMANDS:

No user commands can be applied with a keyboard with software such as HyperTerminal or AxIDE. The monitor commands are binary and not compatible with keyboard (ASCII) entry or display. Host based software should interface with the monitor on the serial communication port to provide development support.

INTERRUPT SERVICE SUPPORT:

The monitor applies the 9S08GB60 lower interrupt vector table from 0xFBCC to 0xFBFF for user interrupts. User will not have access to the SCI1, SWI, and RESET vectors while the monitor is operating. Programming the user Reset vector will cause the monitor to execute the user program on Reset. See the AN2140 application note for user interrupt application.

MONITOR MEMORY MAP:

0x0000 0x007F	9S08GB60 Direct Page Register Space. See the 9S08GB60 User Manual for details
0x0080 0x107F	9S08GB60 ram memory space Monitor Stack Pointer = 0x107F
0x1080 0x17FF	9S08GB60 Lower flash block
0x1800 0x182B	9S08GB60 High Page Register block
0x182C 0xFBCB	User Application Flash Memory
0xFBCC 0xFBFF	User Interrupt Vectors See AN2140 for details on application
0xFC00 0xFFFF	Monitor Flash Memory Space

M68EVB908GB60 OPERATION

The M68EVB908GB60 board provides many input and output features to assist in application development. These features may be isolated from the applied HCS08 I/O ports by the option switches or jumpers. This allows alternate use of the HCS08 I/O ports for other application and connection on the MCU_PORT connector. Caution should be observed so that the HCS08 I/O port pin applied to an on board feature is not also applied to external components by the user.

POWER SUPPLY

Input power is applied by external connection to the J1 power jack or TB1 power terminal block. The input supply is enabled to the voltage regulators by the ON_OFF switch. The

regulators are protected from reverse voltage by diode D3 and current limited by fuse FZ1. Input voltage is regulated to +5V supply by VR1 and the +5V supply is regulated to the +3.3V supply by VR2. With +6 to +20VDC applied and the ON_OFF switch in the ON position, the +5V and +3.3V Indicators should be ON.

Fuse FZ1 will open during an over current condition. To reset FZ1, power should be removed from the board and a cooling period of 20 minutes provided before reapplying power. During the cooling period the cause of the over current condition should be corrected.

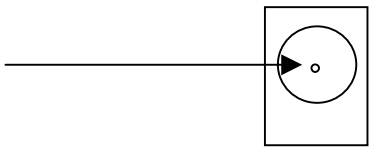
ON_OFF Switch

The ON_OFF slide switch provides board power on and off control. With the switch in the ON position, the +5V and +3.3V power indicators should light. If no power indications occur, review power and I/O connections and refer to the Troubleshooting guide in this manual.

J1 Power Jack

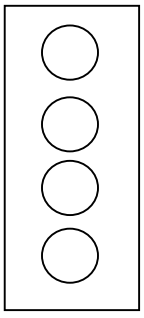
J1 provides the default power input to the board. The J1 power jack accepts a standard 2.0 ~ 2.1mm center barrel plug connector (positive voltage center) to provide the +VIN supply of +6 to +20 VDC (+9VDC typical).

+Volts, 2mm center



TB1 Power Connector

TB1 provides access to the +VIN, GND (power ground), +5V and +3.3V power supplies. The +VIN connection is not switched by the ON-OFF switch or fused. The +5V and +3.3V positions can source 50ma each to external circuits. Applying +5V or +3.3V externally to power the board from TB1 should not be performed. If the user needs more power, an additional voltage regulator or source should be applied with a common ground connected at the TB1 GND connection.

TB1	1		+VIN
	2		GND
	3		+5V
	4		+3.3V

RESET_SW

The RESET switch provides for manual application of the HCS08 RESET* signal.

IRQ_SW

The IRQ switch provides for manual application of the HCS08 IRQ signal. The switch applies and active low level or falling edge signal. Note that the HCS08 internal pull-up device must be enabled on this signal to operate correctly.

OSC_SEL

The OSC_SEL option jumper provides selection between the Y1 crystal oscillator circuit and an external X1 clock source or GP Port. The Y1 crystal oscillator is selected by default.

X1 CLOCK OSCILLATOR

The X1 socket is provided to install a standard 5V compatible CAN type clock oscillators. The clock oscillator application will generate particular frequencies of operation of the HCS08 device. The user should refer to the HCS08 device user manual for information on frequency selection. The OSC_SEL option jumper will select between the crystal oscillator or the X1 clock source for the HCS08 device. User should also note that the GP Port may provide a signal to drive the X1 clock signal. In this case, the X1 clock oscillator should not be installed.

COM Ports and COM Switch

The COM_SW provides HCS08 I/O port to communication peripheral connections on the evaluation board. This allows the user to apply the provided communication transceivers and ports, or to apply the associated I/O to other purposes. The switch positions should be reviewed first if any operational problems are encountered with the COM1, COM2, or 422_485 ports. Position 8 serves as the BUZZER enable option.

COM_SW	HCS08 Port	COM Signal	MCU_PORT
1	PTE1/RXD1	COM1 RXD IN	38
2	PTF6	COM2 CD OUT	41
3	PTD6/TPM2CH3	COM2 DTR IN	21
4	PTC1/RXD2	COM2 RXD IN	18
5	PTF7	COM2 RTS OUT	42
6	PTD7/TPM2CH4	COM2 CTS IN	22
7	PTC1/RXD2	422_485 RXD IN	18
8	PTD0/TPM1CH0	BUZZER OUT	27

Notes:

1) COM_SW position 4 and 7 should not be ON at the same time.

2) HCS08 device port pins PTE0/TXD1 and PTC0/TXD2 are applied to the COM1 and COM2 / 422_485 serial ports respectfully as outputs for the serial communication operation.

COM1

The COM1 port provides standard 9 pin connection with RS232 type interface to the HCS08 SCI1 peripheral. Refer to the COM SW for enabling the HCS08 RXD1 signal applied to this port. The COM1 port is applied by default with the Monitor. The HCS08 TXD1 and RXD1 signals are converted to RS232 levels by U7 and provided to the COM1 connector. Following is the DB9S connection reference.

COM1

1	**1**		X
TXD1	**2**	**6**	6
RXD1	**3**	**7**	7
4	**4**	**8**	8
GND	**5**	**9**	9

The **COM-1** port has a Female DB9 connector that interfaces to the HCS08 internal SCI1 serial port via the U7 RS232 transceiver. It applies simple 2 wire asynchronous serial without flow controls.
1,4,6 connected and 7,8 connected

COM SW position 1 will isolate the SCI1 RXD1 pin (PTE1) from the transceiver.

The 1,4,6,7,8, and 9 pins provide RS232 flow control and status. These are connected on the on the bottom of the development board to provide a NULL status returned to the host. the DB9 connector locations are provided access pads behind the connector. User may isolate the connection pads by cutting the associated circuit trace on the bottom of the board. The user may then apply flow control or status connections to the host by applying HCS08 I/O signals and additional **RS232 level conversion.** COM2 provides these signals.

COM2

The COM2 port provides standard 9 pin connection with RS232 type interface to the HCS08 SCI2 peripheral. Note that COM2 is shared with the 422_485 serial port also. Following is the DB9S connection reference.

COM2

(CD) 1	**1**		X
TXD2	**2**	**6**	6 (idle)
RXD2	**3**	**7**	7 (CTS)
(DTR) 4	**4**	**8**	8 (RTS)
GND	**5**	**9**	9

The **COM-2** port has a Female DB9 connector that interfaces to the HCS08 internal SCI2 serial port via the U8 RS232 transceiver. It applies simple 2 wire asynchronous serial with optional hardware flow controls.

COM Switch operation with COM2 notes:
1) COM SW position 4 will connect or isolate the SCI2 RXD pin (PTC1) from the transceiver.
2) COM_SW position 2 will connect or isolate HCS08 PTF6 as the RS232 CD output signal control.
3) COM_SW position 3 will connect or isolate HCS08 PTD6/TPM2CH3 as the RS232 DTR input control signal.
4) COM_SW position 5 will connect or isolate HCS08 PTF7 as the RS232 RTS output signal control.
5) COM_SW position 6 will connect or isolate HCS08 PTD7/TPM2CH4 as the RS232 CTS input control signal.

The COM2 connector connections provide the same access test pads for pins 1, 4, 6, 7, 8, and 9 as the COM1 port.

422_485 Port

The 422_485 port provides the HCS08 SCI2 operation of a high-speed 2 or 4 wire RS485 or RS422 compatible network. This type of interface provides higher baud rates over longer distances due to the application of differential drivers and receivers. The network type also allows multiple receivers on the same wire pair so that a master / slave communication type can be achieved. The 422_485 port cannot be operated at the same time as COM2 due to the sharing of the HCS08 SCI2 channel.

422_485 Connector

1	4W TX+	
2	4W TX-	
3	4W RX-	2W TX- / RX-
4	4W RX+	2W TX+ / RX+
5	GND	GND

Notes:
1) 4W TX is enabled at all times with 485_EN option open or in the 2WEN setting.
2) 4W TX output is controlled by HCS08 PTF7 with 485_EN in the 4WEN position.
3) 2W TX output must be enabled by the 485_EN 2WEN option installed.
4) 2W or 4W TX output is enabled by HCS08 PTF7 with a logic high. 485_EN option installed.

COM Switch position 7 will connect or isolate HCS08 RXD2 as the 422_485 receive signal.

485_EN

This option jumper installed will connect the HCS08 I/O port PTF7 as transmit enable control signal for the 422_485 serial port. The option allows for operation in the 2W 485 mode (2WEN) or 4W 422 mode (4WEN). The active level of the enable signal is logic high. Operation of the enable signal is to provide a transmitter on and off control so that multiple nodes can be placed on the 485_422 network.

USER_ENABLE Switch

The USER ENABLE switch provides a method to enable or connect user components applied to the HCS08 I/O ports. The development board user should be familiar with the input and output application so that port conflicts do not occur. Following is the connection reference table:

USER ENABLE	USER COMPONENT	HCS08 PORT	PORT DIRECTION	ALTERNATE PORT
1	4 Position DIP Switch	PTB4/AD4 – PTB7/AD7	Input	ANALOG 5 - 8
2	SW1 to SW4	PTA4 /KBD4 – PTA7/KBD7	Input	MCU 1 – 4
3	RV1 Potentiometer	PTB0/AD0	Input	ANALOG 1
4	LCD PORT	PTG3 – PTG7 and PTE6 – PTE7	See LCD Port operation	MCU 31-32, 51-54, 56
5	LED 1	PTF0	Output	MCU 47
6	LED 2	PTF1	Output	MCU 48
7	LED 3	PTF2	Output	MCU 45
8	LED 4	PTF3	Output	MCU 46

Note: LED indicators are active logic low.

LCD DISPLAY and PORT

A 32 character (2 x 16) LCD display is provided on the development board for applications that require this type of display output. Display I/O operation is enabled by the USER ENABLE switch position 4 in the ON position. An optional LCD PORT is located under the display so that the provided display can be replaced by a smaller or larger version by the user. CONTRAST adjustment is provided to allow the use of extended temperature displays also.

Operation of the LCD display or port is in nibble or 4 bits wide data mode. The HCS08 I/O ports PTG3 – PTG7 and PTE6 –PTE7 provide the data and control signals. Display commands or data should be formatted to provide low nibble (LSB bits of byte value) on first transaction then high nibble (MSB bits of byte value) on the second transaction. Example software driver is provided on the support CD to assist the user in applying this device.

The following table reflects the I/O port pin application to the LCD Port:

HCS08 PORT PIN	LCD PORT SIGNAL	NOTES
PTG4	DB4	Bi-directional data bit (LSB)
PTG5	DB5	Bi-directional data bit
PTG6	DB6	Bi-directional data bit
PTG7	DB7	Bi-directional data bit (MSB)
PTG3	Read/Write* (R/W)	Output only, 0 = Write, 1 = Read *See Note 1
PTE6	Register Select (RS)	Output only, 0 = Command, 1 = Data
PTE7	Enable (EN)	Output only, 0 = idle, 1 = active

Note 1: Normally the display is always written to: PTG4-7 Data = outputs and PTG3 R/W = 0. Caution must be observed if the display is to be Read so that the PTG4-7 data lines are set for INPUT mode prior to the PTG3 R/W signal being set to 1. Port contention will occur if the sequence is violated.

Display Read / Write Transactions

The user should apply these sequences to read and write the LCD display.

INITIALIZE DISPLAY (From Reset or Power On condition)

1) Pause 100ms to allow display to power on.

2) Configure Ports:

PORT	DIRECTION	DATA
PTG3	OUTPUT	0
PTG4-7	OUTPUT	0
PTE6-7	OUTPUT	0

3) Enable Display:

```
Write command – 0x3        ; Initialize 4 bit data mode
Delay – 5ms
Write command – 0x3        ; Initialize 4 bit data mode
Delay – 2ms
Write command – 0x3        ; Initialize 4 bit data mode
Delay – 2ms
Write command – 0x2        ; Initialize 4 bit data mode
Delay – 2ms
Command Write – 0x28       ; Set display lines and font
Command Write – 0x06       ; Set entry mode, shift right
Command Write – 0x0E       ; Set display on, cursor on, blink on
Command Write – 0x01       ; Clear display and home cursor
```

COMMAND WRITE Sequence

Note: Most commands require a post processing delay, 2ms is applied typically.

PORT	DIRECTION	DATA or NOTES
PTG3 (R/W)	OUTPUT	0
PTE6-7 (RS-EN)	OUTPUT	0
PTG4-7 (DB4-7)	OUTPUT	Command Byte Data bits D4 – D7
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTE7 (EN)	OUTPUT	0
PTG4-7 (DB4-7)	OUTPUT	Command Byte Data bits D0 – D3
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTE7 (EN)	OUTPUT	0
Delay 2ms.		Delay before next data or command access.

COMMAND READ sequence

Note: Command Read provides display busy status or current cursor location.

PORT	DIRECTION	DATA or NOTE
PTE6-7 (RS-EN)	OUTPUT	0
PTG4-7 (DB4-7)	INPUT	NA
PTG3 (R/W)	OUTPUT	1
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTG4-7 (DB4-7)	INPUT	Status Byte Data bits D4 – D7
PTE7 (EN)	OUTPUT	0
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTG4-7 (DB4-7)	INPUT	Status Byte Data bits D0 – D3
PTE7 (EN)	OUTPUT	0

DISPLAY DATA WRITE Sequence

Note: Data writes require a post processing delay, 100us applied typically.

PORT	DIRECTION	DATA or NOTE
PTG3 (R/W)	OUTPUT	0
PTE7 (EN)	OUTPUT	0
PTE6 (RS)	OUTPUT	1
PTG4-7 (DB4-7)	OUTPUT	Byte Data bits D4 – D7
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTE7 (EN)	OUTPUT	0
PTG4-7 (DB4-7)	OUTPUT	Command Byte Data bits D0 – D3
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTE7 (EN)	OUTPUT	0
Delay 100us.		Delay before next data or command access.

Display Data READ sequence

PORT	DIRECTION	DATA or NOTE
PTE7 (EN)	OUTPUT	0
PTE6 (RS)	OUTPUT	1
PTG4-7 (DB4-7)	INPUT	NA
PTG3 (R/W)	OUTPUT	1
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTG4-7 (DB4-7)	INPUT	Byte Data bits D4 – D7
PTE7 (EN)	OUTPUT	0
		Delay for Set-up time of 500ns.
PTE7 (EN)	OUTPUT	1
		Delay for access time of 500ns.
PTG4-7 (DB4-7)	INPUT	Status Byte Data bits D0 – D3
PTE7 (EN)	OUTPUT	0

RV1 User Potentiometer

The User Potentiometer provides an adjustable linear voltage from 0 to 3.3V. The voltage signal is made available to HCS08 port PTB0 or analog input AD0 by the USER ENABLE switch position 3. The HCS08 ADC module can measure the input voltage to allow user application response to the input voltage level.

DIP Switch

The DIP switch is provides 4 positions for user application. The on position applies a logic low level to the respective PTB4 - PTB7 input port. The switch is enabled to connect to the input port by USER ENABLE position 1. Example application of the DIP switch would be to apply a 485 or 422 node address for a network.

SW1 – SW4 Push Switches

The push switches provide momentary active low input for user applications. The switches provide input to HCS08 ports PTA4 – PTA7 when USER ENABLE position 2 is ON. Input ports PTA4 – PTA7 provide KBD4 – 7 input interrupt capability also. Typical application would be to provide program control or menu selection input.

SW4 on HCS08 PTA7 also provides the Monitor Reset operation. Enabling the Push Switches and holding SW4 down during RESET will return a user Reset application to monitor control.

BUZZER

The BUZZER provides audio indications under user application control. When enabled by USER ENABLE position 3, the HCS08 PTD0/TPM2CH4 output will control audio indications generated by the BUZZER. Active logic high signal on the PTD0 signal will enable audio output from the BUZZER. The user application can modulate the Buzzer with high and low signals to generate custom sound effects.

BREADBOARD

The Breadboard area provides a convenient and fast interconnection for prototyping circuits on the M68EVB908GB60 board. User may apply 22-24GA solid core wire (stripped) to make connections between the I/O port connectors and the breadboard. Soldering not required.

9S08GB60 PORT CONNECTORS

MCU_PORT

The MCU PORT provides access to the 9S08GB60 I/O ports.

PTA6/KBD6	1	2	PTA7/KBD7
PTA4/KBD4	3	4	PTA5/KBD5
PTA2/KBD2	5	6	PTA3/KBD3
PTA0/KBD0	7	8	PTA1/KBD1
3.3V	9	10	GND
PTC6	11	12	PTC7
PTC4/CLKOUT	13	14	PTC4
PTC2/SDA	15	16	PTC3/SCL
PTC0/TXD2	17	18	PTC1/RXD2
3.3V	19	20	GND
PTD6/TPM2CH3	21	22	PTD7/TPM2CH4
PTD4/TPM2CH1	23	24	PTD5/TPM2CH2
PTD2/TPM1CH2	25	26	PTD3/TPM2CH0
PTD0/TPM1CH0	27	28	PTD1/TPM1CH1
3.3V	29	30	GND
PTE6	31	32	PTE7
PTE4/MOSI	33	34	PTE5/SPSCK
PTE2/SS*	35	36	PTE3/MISO
PTE0/TXD1	37	38	PTE1/RXD1
3.3V	39	40	GND
PTF6	41	42	PTF7
PTF4	43	44	PTF5
PTF2	45	46	PTF3
PTF0	47	48	PTF1
3.3V	49	50	GND
PTG6	51	52	PTG7
PTG4	53	54	PTG5
PTG2/EXTAL	55	56	PTG3
PTG0/BGND/MS	57	58	PTG1/XTAL
RESET*	59	60	IRQ

Notes:
1) PTA0-7 also assigned to KEYPAD port.
2) PTA4-7 also provide Push Switch Sw1-4 input if enabled.
3) PTE0 –1 provide SCI1 I/O to COM1 if enabled.
4) PTC0-1 provide SCI2 I/O to COM2 or the 422_485 port if enabled.
5) PTD0 provides BUZZER output if enabled.
6) PTG1-2 are the Y1 XTAL and EXTAL signals by default. R46 and R47 isolate the MCU PORT pins to prevent crystal operation interference.
7) PTG0 is the BGND signal if a BDM is connected.
8) PTG3-G7 and PTE6-7 provide LCD display interface if enabled.

ANALOG PORT (PTB)

The **ANALOG** port provides access to the Port B I/O or Analog signals.

PTB0/AD0	1	2	PTB1/AD1
PTB2/AD2	3	4	PTB3/AD3
PTB4/AD4	5	6	PTB5/AD5
PTB6/AD6	7	8	PTB7/AD7
VREFH	9	10	VREFL

Notes:
1) PTB4-7 provide DIP Switch input if enabled.
2) PTB0 provides RV1 user pot input if enabled.

VRH_EN and VRL_EN

VRH and VRL analog signals are connected to VDDA and Ground potentials respectfully by the VRH_EN and VRL_EN option positions. The VRH and VRL signals may be isolated from the default potentials by a cut with a razor blade or knife between the option pads on the development board. Alternate VRH or VRL signals may then be applied at the ANALOG Port. To restore the default connection, a 1x2 pin post header can be installed to allow option jumper use or a wire jumper can be installed between the option pads.

KEYPAD (PTA)

The KEYPAD PTA connector provides interface for the HCS08 port A / KBD signals or applying a keypad. When applied as a KEYPAD connector, the interface is for a passive 4 x 4 matrix (16 key) keypad device.

1	PTA0/KBD0
2	PTA1/KBD1
3	PTA2/KBD2
4	PTA3/KBD3
5	PTA4/KBD4
6	PTA4/KBD5
7	PTA6/KBD6
8	PTA7/KBD7

This interface is implemented as a software key scan. Pins PTA0-3 are used as column drivers which are active high outputs. Pins PTA4-7 are used for row input and will read high when their row is high.

See the file **`Key08.ASM`** for an example program using this connector.

GP PORT and JP1

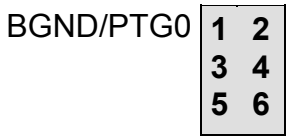
The GP Port is provided for backward compatibility with the CMS08GP32 development board MCU PORT. The JP1 option jumper selects the GP Port voltage source of 3.3V or 5V. Refer to the schematic diagram for connections to this port.

P1 - P4 HCS08 Header Ring

P1 - P4 provide a header ring for all I/O of the HCS08 device. User should refer to the M68EVB908GB60 board schematic diagram for connector pin connections. All HCS08 I/O is available from the other I/O Ports on the board.

BDM PORT

The BDM port is a 6 pin header compatible with a Motorola Background Debug Mode (BDM) Pod. This allows the connection of a background debugger for software development, programming and debugging in real-time without using HCS08 I/O resources.



See the HCS08 Technical Reference Manual for complete documentation of the BDM.

TROUBLESHOOTING

The M68EVB908GB60 is fully tested and operational before shipping. If it fails to function properly, inspect the board for obvious physical damage first. Verify the communications setup as described under GETTING STARTED.

The most common problems are improperly configured communications parameters, and attempting to use the wrong COM port.

1. Verify that your communications port is working by substituting a known good serial device or by doing a loop back diagnostic.

2. Verify the power source, Indicators are ON?. You should measure a minimum of 9 volts between the GND and +VIN connections on the TB1 power connector with the standard power supply provided.

3. If no power indications or voltage is found, verify the wall plug connections to 115VAC outlet and the power connector.

4. Verify the logic power source. You should measure +5 volts between the GND and +5V connections on the TB1 power connector. If the +VIN supply is good and this supply is not +5V, immediately disconnect power from the board. Contact support@axman.com by email for instructions and provide board name and problem.

5. Disconnect all external connections to the board except for COM1 to the PC and the wall plug.

6. Make sure that the RESET line is not being held low or the RESET indicator is not lit.

7. Contact support@axman.com by email for further assistance. Provide board name and describe problem.

TABLE 1: LCD Command and Character Codes

Command codes are used for LCD setup and control of character and cursor position. The BUSY flag (bit 7) may be tested before any command updates to verify that any previous command is completed. A read of the command address will return the BUSY flag status and the current display character location address.

Command	Code	Delay
Clear Display, Cursor to Home	$01	1.65ms
Cursor to Home	$02	1.65ms
Entry Mode:		
Cursor Decrement, Shift off	$04	40us
Cursor Decrement, Shift on	$05	40us
Cursor Increment, Shift off	$06	40us
Cursor Increment, Shift on	$07	40us
Display Control:		
Display, Cursor, and Cursor Blink off	$08	40us
Display on, Cursor and Cursor Blink off	$0C	40us
Display and Cursor on, Cursor Blink off	$0E	40us
Display, Cursor, and Cursor Blink on	$0F	40us
Cursor / Display Shift: (nondestructive move)		
Cursor shift left	$10	40us
Cursor shift right	$14	40us
Display shift left	$18	40us
Display shift right	$1C	40us
Display Function (default 2x40 size)	$3C	40us
Character Generator Ram Address set	$40-$7F	40us
Display Ram Address and set cursor location	$80- $FF	40us

LCD Character Codes

$20	Space	$2D	-	$3A	:	$47	G	$54	T	$61	A	$6E	n	$7B	{
$21	!	$2E	.	$3B	;	$48	H	$55	U	$62	B	$6F	o	$7C	|
$22	“	$2F	/	$3C	{	$49	I	$56	V	$63	C	$70	p	$7D	}
$23	#	$30	0	$3D	=	$4A	J	$57	W	$64	D	$71	q	$7E	>
$24	$	$31	1	$3E	}	$4B	K	$58	X	$65	E	$72	r	$7F	<
$25	%	$32	2	$3F	?	$4C	L	$59	Y	$66	F	$73	s		
$26	&	$33	3	$40	Time	$4D	M	$5A	Z	$67	G	$74	t		
$27	‘	$34	4	$41	A	$4E	N	$5B	[	$68	H	$75	u		
$28	(	$35	5	$42	B	$4F	O	$5C	Yen	$69	I	$76	v		
$29	)	$36	6	$43	C	$50	P	$5D	]	$6A	J	$77	w		
$2A	*	$37	7	$44	D	$51	Q	$5E	^	$6B	K	$78	x		
$2B	+	$38	8	$45	E	$52	R	$5F	_	$6C	L	$79	y		
$2C	,	$39	9	$46	F	$53	S	$60	`	$6D	M	$7A	z		