

CSM-08RG60

Development Module for Freescale MC9S08RG60

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REVISION HISTORY

Date	Rev	Comments
July 16, 2004	A	Initial Release
May 31, 2005	B	Corrected pin-out on connector J1. Applied standard formatting. Added Table of Figures and Table of Tables.
February 16, 2006	C	Minor formatting corrections.

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 CSM-08RG60 module:
 - 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 B** 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.

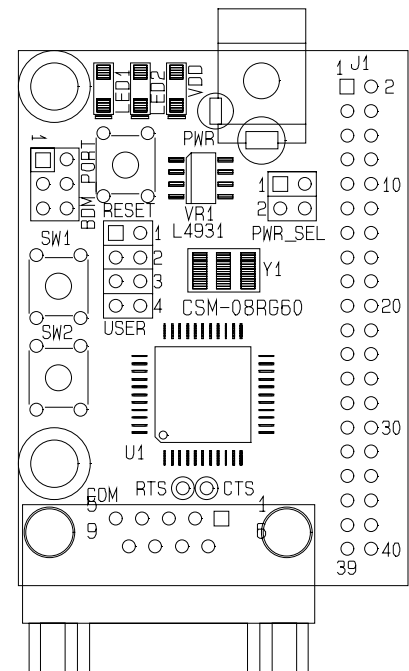
Cut-Trace – a circuit trace connection between component pads. The circuit trace may be cut using a knife to break the default connection. To reconnect the circuit, simply install a suitably sized 0-ohm resistor or attach a wire across the pads.

FEATURES

The CSM-08RG60 is an evaluation or demonstration module for the MC9S08RG60 microcontroller. The included wall plug, DB9 serial cable, sample software tools, examples, and debug monitor makes application development quick and easy. A background DEBUG port is provided for development tool use and is compatible with HCS12 BDM interface cables and software. A 40-pin connector allows connecting the CSM-08RG60 module to an expanded evaluation environment.

Features:

- ◆ MC9S08RG60 CPU
 - ◆ 60K Byte Flash
 - ◆ 2K Bytes Ram
 - ◆ 40 I/O lines (44-pin package)
 - ◆ Timer/PWM
 - ◆ SCI and SPI Communications Ports
 - ◆ 12 Key Board Wake-up Ports
 - ◆ BDM DEBUG Port
 - ◆ Analog Comparator
 - ◆ 8Mhz Internal Bus Operation
 - ◆ 8 High Current Pins
- ◆ Power Input Selection Jumper
- ◆ 16 MHz Ceramic Resonator
- ◆ Regulated +3.3V power supply
- ◆ Optional power input from Connector J1
- ◆ Optional power output through Connector J1
- ◆ RS-232 Serial Port w/ DB9 Connector
- ◆ 2 Channel, 16 bit, Timer/Pulse Width Modulator (TPM) with Input Capture, Output Compare, and PWM capability
- ◆ On-Chip Analog Comparator with internal reference and full rail-to-rail operation
- ◆ User Components Provided
 - ◆ 3 Push Switches; 2 User, RESET
 - ◆ 3 LED Indicators ; 2 User , V_{DD}
- ◆ Jumpers
 - ◆ Disable User Functions
 - ◆ Power Select
- ◆ Connectors
 - ◆ 40-pin MCU I/O Connector
 - ◆ 2.0mm Barrel Connector Power Input
 - ◆ DEBUG BDM Connector
 - ◆ DB9 Communications Connector
- ◆ Supplied with DB9 Serial Cable, Documentation (CD), Manual, and Wall plug type power supply.



Specifications:

Module Size 2.2" x 1.6"

Power Input: +9VDC @ 200 mA typical, +5 to +16VDC range

GETTING STARTED

The CSM-08RG60 is a fully assembled, fully functional development module for the Freescale MC9S08RG60 microcontroller. The module comes with a serial cable, power supply, and an embedded serial binary monitor for stand-alone operation. Support software for this development module is provided for Windows 95/98/NT/2000/XP operating systems.

The user should also be familiar with the hardware and software operation of the target HCS08. Refer to the MC9S08RG60 User Manual and Reference Manual for further details. The demonstration module's purpose is to promote the features of the MC9S08RG60 and to assist the user in quickly developing an application with a known working environment. Users should be familiar with memory mapping, memory types, and embedded software design for quick, successful, application development.

Application development may be performed by using the embedded serial interface monitor, or a compatible HCS08 BDM cable with supporting host software. The included serial monitor provides an effective and low cost debug method. Note that when a BDM cable is used for debugging, the BDM pod should be powered from an external supply.

A serial debug monitor is provided in the MC9S08RG60 internal flash memory and uses some HCS08 resources for operation. See application note, AN2140, from Freescale for complete details. User application may be executed by loading the program start address into the Reset Vector (0xFBFE, 0xFBFF) and loading the program into device Flash Memory. The monitor remains in protected flash memory for future use if needed.

REFERENCE DOCUMENTATION

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

CSM08RG60_SCH_A.pdf	CSM-08RG60 Module Schematic Rev. A
CSM08RG60_MAN_A.pdf	CSM-08RG60 User Guide Rev. A (this document)
MC9S08RG60/D.pdf	MC9S08RG60 Device User Guide
AN-2140	HCS08 Serial Monitor Application Note
AN-2493	HCS08 Low-Power Modes Application Note
AN-2596	Using the HCS08 On-Chip Debug System Application Note
AN-2616	Getting Started with HCS08 and CodeWarrior Application Note
2616SW.zip	CodeWarrior software zip file.
MON_PLUS_DEMO_RG60.s19	Object Code for installed demo programs

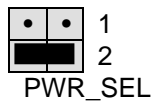
STARTUP

Three example programs are pre-loaded into the CSM-08RG60 module. The programs are:

- 1) **Debug monitor**
- 2) **Stop3 demo**
- 3) **Paced-loop demo**

To start the DEMO programs, install the PWR_SEL jumper as show in the figure below, then apply power to the module through the PWR jack.

Figure 1: PWR_SEL Jumper - Demo



The **Stop3** demo program executes by default at power on or at RESET. Stop3 demonstrates operation of the microcontroller in low power, stop3, mode. This demo program uses the real time interrupt (RTI) to recover from stop3 mode. In stop3 mode, clocks are halted and only IRQ, KBI, LVI, and RTI interrupts occur. When using the serial debugger, you can not trace through the demo code once you have reached a stop instruction.

If the **GO** button is pressed in the debugger program, the user can no longer halt or trace program code because no clocks are provided to the serial communications module.

With Stop3 running, LED1 flashes approximately twice a second. While the LED is off, the MCU is in low-power, stop3 mode, and remains in stop3 mode until the next RTI. An RTI is generated periodically by the MCU timer. During Stop3 execution, press and hold SW1 for at least 0.5 sec. LED1 turns on for approximately 3 seconds. Pressing SW2, for at least 0.5 sec, causes LED2 to turn-on.

The **Software-paced Loop demo** program executes when SW2 is held down at power-up. The software-paced loop program causes LED1 and LED2 to flash. LED1 flashes once each second. LED2 flashes once every two seconds. Both LEDs blink at a 50% duty cycle.

The **Debug Monitor** program is executed when SW1 is held down at power-up. The serial debugger, when used with a host PC and CodeWarrior software, enables a user to erase device FLASH memory, program FLASH memory, load application programs, and debug the application programs. The debug monitor dedicates COM as its connection to the host PC and does not use the traditional background debug mode, thereby eliminating the necessity for a background debug mode cable. Free software is available for use on a PC to interface with the serial monitor. Refer to application note AN2140 for a full explanation for using the debugger.

Starting the Demo Programs

Configuration jumpers must be installed before you can run the demo programs. To run the Demo programs install all 4 User Interface jumpers (User-1 through User-4). Install the PWR_SEL jumper as shown above to select the on-board voltage regulator.

Pushbutton switches are used to select between installed demo programs. The switches are read by the MCU at the rising edge of RESET. Hold down the chosen pushbutton while applying power or while pressing the RESET switch. The actions of the switches are shown in the table below.

Table 1: Demo Program Selection

Switch (SWx)	Demo Program Executed
No Switch held down	Stop3 Demo
SW2	Paced-Loop Demo
SW1	Debug Monitor

DEBUG MONITOR OPERATION

See application note AN2140 for complete details of serial monitor operation. Basic operation is provided in the following sections. The monitor occupies 1K bytes of flash memory and uses about 50 bytes of stack space. It provides a binary command set via the COM port.

MEMORY MAP

Table 2: Monitor Memory Map

0x0000 – 0x0045	Direct Page Register Space. See the 9S08RG60 User Manual for details
0x0046 - 0x0845	RAM memory space Monitor Stack Pointer = 0x0845
0x 0846 - 0x17FF	Lower flash block – User application memory
0x1800 - 0x182B	9S08RG60 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 (Protected)

COMMUNICATION:

The MCU supports a maximum 38.4K bps serial communication rate on the SCI interface port.

POWER ON or RESET PROMPT:

The monitor provides a binary prompt to the module COM port.

COMMANDS:

User commands can not be entered via a terminal program such as AxIDE or HyperTerminal. The monitor commands are binary and not compatible with keyboard (ASCII) entry or display. Host based software should be used to interface with the monitor on the serial communication port to provide development support.

INTERRUPT SERVICE SUPPORT:

The monitor enables automatic hardware vector relocation in the MC9S08RG60; the user interrupt vector table is found between 0xFBCC and 0xFBFF. Users do not have access to the SCI, SWI, and RESET vectors while the monitor is operating. Programming the user Reset vector (0XFBFE:0xFBFF) causes the monitor to execute the user program on Reset. See the AN2140 application note for user interrupt application.

BDM PORT

The Debug or BDM port is a 6-pin header compatible with a Freescale Background Debug Mode (BDM) Pod. This allows the connection of a background debugger for software development, programming, and debugging in real-time without using HCS08I/O resources.

Table 3: BDM Port

BGND/PTG0	1	2	GND	See the HCS08 Reference Manual for complete documentation of the BDM.
N/C	3	4	RESET*	
N/C	5	6	V _{DD}	

OPERATION

The CSM-08RG60 module provides development platform to assist in application development. Access to MCU ports is available through the MCU_PORT connector. The MCU_PORT connector may be used to interface power to the module as well as RS-232 communications signals. Care must be exercised when using the MCU_PORT to power the module; only regulated +3.3V should be applied to this connection.

Five option jumpers and 3 cut-traces configure default module operation. Enabling a jumper-controlled option requires installing a jumper, or shunt, across the appropriate header pins. Removing the shunt disables the option. An option that is enabled by a cut-trace can be disabled by removing the circuit trace between the cut-trace component pads. Install a suitably sized 0-ohm resistor or piece of wire to re-enable the option.

Reset Switch

The RESET switch provides a method to asynchronously reset to the module. Pressing the RESET switch applies a low voltage level to the PTD1/RESET* input. A bias resistor prevents spurious RESET input to the MCU.

Timing

A ceramic oscillator (Y1) provides a 16.0 MHz base operating frequency to the MCU. This supports an 8.0 MHz internal operating frequency. The HCS08 uses dedicated oscillator inputs. This crystal input is not routed to the MCU Port connector

POWER SUPPLY

Power is supplied to the module through a 2.0mm barrel connector at location PWR or through connector J1. Power may also be sourced off-module through connector J1. The PWR_SEL jumper controls this configuration.

PWR Jack

The PWR connector accepts 2.0 – 2.1mm barrel plug and allows the module to be powered from a transformer plugged into a standard wall outlet. Input voltage should be limited to between +5VDC and +16VDC. Input voltage of +9VDC at 200 mA is typical. This input uses an on-board +3.3V regulator to power the module.



PWR_SEL Jumper



The PWR_SEL jumper selects the source of power input to the CSM-08RG60 module or allows regulated +3.3VDC to be provided to J1 for use by external circuits. The module may be powered from the 2.0mm barrel connector (PWR) or from the 40-pin MCU connector (J1). Power input at the PWR jack must be DC voltage between +5V and +16V. Power input on the MCU connector **must be** regulated voltage between +3.0VDC and +3.3VDC. The MCU_PORT connector input allows use of batteries, or other alternate sources, to power the module. Damage may occur if the MCU_PORT power input pins are over-driven. Refer to the table below to determine correct PWR_SEL jumper setting.



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
- 2  input connected to J1-1 (+) and J1-3 (-)

- 1  Module powered from external +5VDC - +16VDC
- 2  connected to PWR Terminal Block. J1-1 is open or not connected.

- 1  Module powered from external +3.0VDC - +3.3VDC
- 2  connected to J1-1 (+) and J1-3 (-). Module provides +3.3VDC output (up to 50 mA) at pin J1 for use by external circuits.

Communications

The CSM-08RG60 module provides a single SCI communications port. This port is connected to the MCU_PORT and to the COM connector. An RS-232 translator (U2) provides RS-232 signal level to TTL/CMOS logic level translation. 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 the signals if a suitably interface is used. As added development support, hardware flow control signals RTS and CTS are available on the logic side of U2. These signals are routed to vias located near the transceiver (U2). 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 opening cut-traces CT1, and CT2. Simply remove the circuit trace between the cut-trace pads to open the circuit. To restore the circuit functionality, install a 1206 size, 0-ohm, resistor or a short piece of wire across the cut-trace pads.

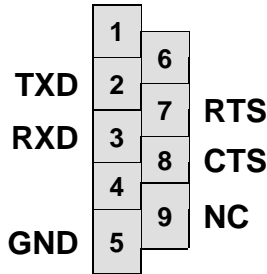
Table 4: COM Connections

HCS08 Port	COM Signal	I/O PORT Connector	Signal Disable
PTB0/TXD1	COM TXD OUT	3	CT1
PTB1/RXD1	COM RXD IN	4	CT2

COM Connector

A standard 9-pin Dsub connector provides external connections for the COM port. The COM port is used by default with the serial debug monitor. Component U2 provides RS-232 translation services. The figure below details the DB9 connector.

Figure 3: COM Connector



Female DB9 connector that interfaces to the HCS08 internal COM 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.

Connector J1

Power may be supplied to the module through pins J1-1 and J1-3. Use of this option requires a regulated voltage input limited to range of +3.0VDC to +3.3VDC. This input is connected directly to the module power and ground planes. Care should be exercised not to over-drive this input. This connection may also be used to source power from the on-board regulator to external modules attached to connector J1. The PWR_SEL option header determines how power is routed to and from the module.

Table 5: MCU I/O Port Connector

VX	1	2	PTD2/IRQ
GND	3	4	PTD1/RESET*
PTB0/TXD	5	6	PTD0/BKGD/MS
PTB1/RXD	7	8	PTB2
PTC0/KBI2P0	9	10	PTB3
PTC1/KBI2P1	11	12	PTB4
PTD6/TPMCH0	13	14	PTB5
PTB7/TPMCH1	15	16	PTB6
PTC4/MOSI	17	18	PTD4/ACMP-
PTC5/MISO	19	20	PTD5/ACMP+
PTC6/SPSCK	21	22	PTA0/KBI1P0: User SW1, if enabled
PTC7/SS*	23	24	PTA1/KBI1P1: User SW2, if enabled
PTE0	25	26	PTA2/KBI1P2
PTE1	27	28	PTA3/KBI1P3
PTE2	29	30	PTC2/KBI2P2
PTE3	31	32	PTC3/KBI2P3
PTE4	33	34	PTA4/KBI1P4
PTE5	35	36	PTA5/KBI1P5
PTE6	37	38	PTAA6/KBI1P6
PTE7	39	40	IRO

Note:
MCU signals PTD3 and PTA7 are not routed to the MCU_PORT connector

User Options

LED Indicators

Indicators LED1 and LED2 are enabled from HCS08 I/O ports by the USER option bank. When enabled, each LED is active low and illuminates when a logic low signal is driven from the respective MCU I/O port. MCU ports PTA7 and PTD3 drive LED1 and LED2 respectively. The table below details the user jumper settings.

Pushbutton Switches

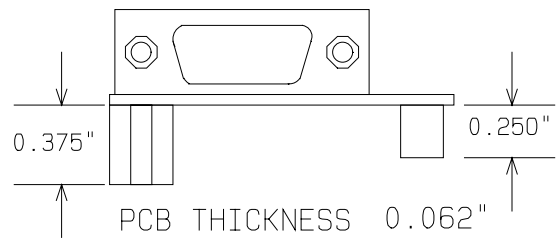
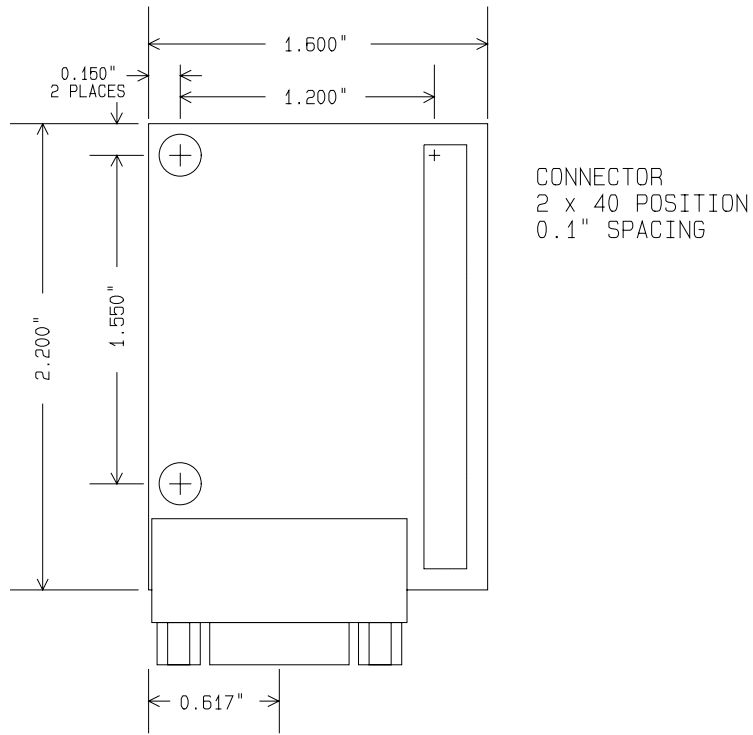
Two push button switches provide momentary active low input for user applications. Switches SW1 and SW2 are enabled to the HCS08 I/O ports by the USER option bank. SW1 and SW2 provide input to HCS08 I/O ports PTA0 and PTA1 respectively. These switches are also used for DEMO program selection during RESET or POR (provided the DEMO program is installed in flash at start-up). The table below details the user jumper settings.

Table 6: User Option Jumper Settings

Jumper	On	Off	MCU PORT
User 1	Enable SW1	Disable Sw1	PTA0 (33)
User 2	Enable SW2	Disable Sw2	PTA1 (34)
User 3	Enable LED1	Disable LED1	PTA7 (44)
User 4	Enable LED2	Disable LED2	PTD3 (27)

APPENDIX A

Mechanical Details



APPENDIX B

BILL OF MATERIALS

Item	Qty	Title	Ref(m)	Vendor	Vend-P/N
1	3	Cap, Tant, 10uF, 10V, SMB	C9, C12, C13	FAI	
2	0	Cap, Tant, 10uF, 10V, SMB	C2 DO NOT INSTALL	FAI	
3	5	Cap, Mon, .1uF, 50V, 0805	C1, C5, C8, C10, C11	EMTEK	
4	4	Cap, Mon, 1uF, 16V, 0805	C3, C4, C6, C7	EMTEK	
5	3	Res, Carbon, 330 ohm, 1/16W, 5%, 0805	R4, R5, R7	EMTEK	
6	1	Res, Carbon, 4.7K ohm, 5%, 0805	R2	EMTEK	
7	2	Res, Carbon, 10K ohm, 5%, 0805	R3, R6	EMTEK	
8	1	Res, Carbon, 1M ohm, 5%, 1/16w, 0805	R1	EMTEK	
9	1	Ind, Filter, 680 uH, 1210	L1	Digi-Key	445-1157-1-ND
10	1	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D1	Mouser	625-BAT54C
11	3	LED, Green, w/reflector, 1206, SMT	LED1, LED2, +3.3V	FAI	SML-010MTT86
12	1	IC, Dual RS232 XCVR, 3.3V, ESD, 16SOIC	U2	Arrow	ICL3232EBCN
13	1	Resonator, Cer, 16.00MHz, w/Caps, 3Pos, SMT	Y1	Digi-Key	PX160BCT-ND
14	1	IC, MCU, MC9S08RG60, 44LQFP	U1	Freescale	Customer Provided Part
15	1	VReg, LDO, 3.3V, 250mA, 8 SOIC	VR1	Mouser	511-L4931CD33
16	3	Sw, PB, 5mm Sq, Thru	SW1, SW2, RESET	EMTEK	EG1827
17	6	Hdw, Shunt, 2 Pos, .1"	PWR_SEL(2), USER(4)	EMTEK	
18	1	Conn, 2x20 Socket Hdr, Pass Thru, .1", Bottom Entry, SMT	J1 INSTALL ON BOTTOM	Samtec	SSM-120-L-DV-K-BE-A
19	1	Conn, 2mm, Pwr Jack, Barrel, Thru, RA	PWR	EMTEK	
20	1	Conn, Dsub, 9P, F, RA, PCB Mount	SC11	EMTEK	
21	1	Conn, 2x2 Pin Header, .1" Ctr, Thru	PWR_SEL	EMTEK	
22	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	BDM_PORT	EMTEK	
23	1	Conn, 2x4 Pin Header, .1" Ctr, Thru	USER	EMTEK	
24	2	Hdw, Stand-off, .250x.375, Hex, Alum		Mouser	534-2202
25	2	Hdw, Screw, 4-40x3/8, 18-8, SS		On-Shore	0406PPMS
26	1	PCB, DEMO9S08RG60 1.6"x2.2", 2 Sided, Rev F		Axiom	AXM-0328