CSM-12C32

Development Module for Freescale MC9S12C32

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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 CSM-12C32 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 nearby electronic equipment. If such interference is detected, suitable mitigating measures should be taken.

TERMINOLOGY

This development module uses option selection jumpers and cut-traces to setup default configuration. 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 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.

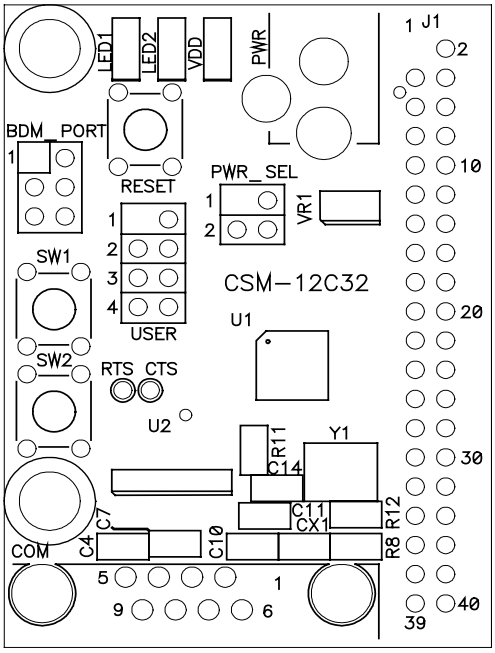
Cut-Trace – a circuit trace connection between component pads. The circuit trace may be cut using a razor knife to break the default connection. To reconnect the circuit, simply install a suitably sized 0-ohm resistor or attach a wire across the pads.

FEATURES

The CSM-12C32 is an evaluation or demonstration module for the FREESCALE MC9S12C32 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 the CSM-12C32 module to be connected to an expanded evaluation environment such as the Axiom Manufacturing, MCU Project Board.

Features:

- MC9S12C32 MCU, 48 QFP
  - 32K Byte Flash EEPROM
  - 2K Bytes RAM
  - 31 I/O lines
  - Timer/PWM
  - SCI and SPI Communications Ports
  - Key Wake-up Port
  - BDM DEBUG Port
  - CAN 2.0 Module
  - Analog Comparator
  - 8 Mhz Internal Bus Operation Default
  - 25 MHz Bus Operation using internal PLL
  - +3.3VDC to +5VDC operation
- 40 pin connector provides access to most MCU I/O signals
- Power Input Selection Jumper
- On-board, regulated +5V power supply
- Optional power input from Connector J1
- Optional power output through Connector J1
- 16 MHz Ceramic Resonator
- RS-232 Serial Port w/ DB9 Connector



- 8-Ch, 10-bit, Analog Comparator with full rail-to-rail operation and external trigger capability
- 8-Channel, 16-bit Timer with Input Capture, Output Compare, and PWM capabilities
- User Components Provided
  - 3 Push Button Switches: 2 User, RESET
  - 3 LED Indicators: 2 User, VDD
- 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, +6 to +16VDC range

GETTING STARTED

The CSM-12C32 Development Module is a fully assembled, fully functional development module for the Freescale MC9S12C32 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.

Users should be familiar with the hardware and software operation of the target MCU. Refer to the MC9S12C32 User Manual and Reference Manual for details on MCU operation. The module's purpose is to promote the features of the MC9S12C32 and to assist the user in quickly developing an application in 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 binary monitor, or any compatible MCU BDM cable with supporting host software. The included 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 debug monitor is loaded in the MC9S12C32 internal flash memory and uses some MCU resources for operation. User application may be executed by loading the program start address into the Reset Vector (0xF7FE, 0xF7FF) and loading the program into device Flash Memory. The monitor remains in protected flash memory for future use if needed.

Refer to the MC9S12C32 Reference Manual for details on using a BDM pod with the CSM-12C32 module. Refer to Appendix A for a pin-out of the BDM_PORT connector.

Reference Documentation

Reference documents are provided on the support CD in Acrobat Reader format. More information can be found in the Application Notes section of the Freescale Web site.

CSM12C32_SCH_B.pdf	CSM-12C32 Module Schematic Rev B
CSM12C32_UG.pdf	CSM-12C32 User Guide (this document)
9S12C32DGV1.pdf	MC9S12C32 Device User Guide
9S12C32_ZIP.zip	Zip file containing Device Block User Guides
AN2548.pdf	Serial Monitor Program for HCS12 MCU's

Debug Monitor Operation

Memory Map

Table 1: Monitor Memory Map

0x0000 - 0x03FF	Direct Page Register Space. See the MC9S12C32 User Manual for details
0x 0800- 0x0FFF	RAM memory space Initial Monitor Stack Pointer = 0x1000
0x4000- 0x07FF	16K Fixed Flash EEPROM Block 1
0x8000 - 0xBFFF	Page Window Fixed Flash EEPROM Block 1
0xC000 - 0xF77F	Fixed Flash EEPROM Block 2
0xF780 – 0xF7FF	Relocated MCU Vectors
0xF800 - 0xFFFF	Serial Monitor – Protected MCU Vectors

NOTE: The same Flash Block is visible at reset in both $4000-$7FFF and $8000-$BFFF ranges.
NOTE: Expanded Mode is not available on this module.

COMMUNICATION

The MCU supports a default 38.4K bps serial communication rate on the COM interface port within RS-232.

POWER ON or RESET PROMPT

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

COMMANDS

User commands can not be entered through an ASCII terminal program such as Windows® HyperTerminal or AxIDE. The monitor commands are binary and not compatible with ASCII entry or display. Host based software should interface with the monitor on the serial communication port to provide development support.

INTERRUPT SERVICE SUPPORT

Users do not have access to the SCI, SWI, and RESET vectors while the monitor is operating. Loading the starting address of the user program into the Reset vector (0XF7FE:0xF7FF) causes the monitor to execute the user program on Reset or POR.

CSM-12C32 Operation

The CSM-12C32 module provides input and output features designed to assist embedded application development. Access to MCU port signals is available through module the connector J1. This connector may also be used to input power to the module or to output power to attached modules. RS-232 communications signals may also be input through connector J1. Care must be exercised when using the J1 to power the module, as only regulated voltage in the range of +3.3V to +5V (+/- 5%) should be supplied to this connection. The on-board regulator provides a fixed +5V voltage to the module.

Five option jumpers and 3 cut-traces control module operation. Enabling a jumper option requires installing a shunt across the associated header pins. Removing the shunt disables the associated option. An option enabled by a cut-trace can be disabled by removing the circuit trace between the cut-trace component pads. Use a sharp knife to cut the embedded circuit trace. Be careful not to damage adjacent circuitry. To re-enable the option, simply install a suitably sized 0-ohm resistor or piece of wire across the cut-trace component pads.

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 determines the source of input power.

PWR

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 +6VDC and +12VDC. Input voltage of +9VDC @ 200 mA is typical. This input supplies an on-board +5V regulator which power the module.

Connector J1

Power may be supplied to the module through the pins J1-1 and J1-2. Use of this option requires a regulated voltage input limited to the range of +3.3VDC to +5VDC (+/- 5%). This input is connected directly to the module power and ground planes. Care should be exercised not to over-drive this input. Use of connector J1 to supply +3.3V to the module requires disabling the voltage supervisor (LV1) by opening cut-trace CT-1. See the Low-Voltage Detect section below.

This connection may also be used to source +5V power from the on-board regulator to external modules attached to connector J1. The PWR_SEL option header determines how power is routed to the module.

PWR_SEL Jumper

The PWR_SEL jumper is a 4-position option header that configures power routing on the CSM-12C32 module. The module may be powered by an external transformer connected to the PWR connector or through connector J1. The module may also source power to auxiliary modules connected to the connector J1. Damage may occur if the J1 power input pins are over-driven. Refer to the Table 3 below to determine correct PWR_SEL jumper setting.

Table 2: PWR_SEL Jumper Settings

Shunt Position	Power Option Selected
1	Regulated +3.3VDC to +5VDC from connector J1
2	On-board regulator connected to PWR connector
1 & 2	On-board regulator connected to PWR connector and sourcing power through connector J1

Reset Switch

The RESET switch provides an asynchronous reset input to the MCU. Pressing the RESET switch produces a low-voltage level on the /RESET input to the MCU. The low-voltage supervisor (LV1) holds the RESET line low for approximately 150 ms after the pushbutton is released.

Low-Voltage Detect

A DS1813 (LV1) provides POR, low-voltage detect, and pushbutton reset services for the module. At power-on, LV1 holds the MCU in reset for 150 ms after V_{CC} reaches approximately 4.35V. During normal operation, LV1 asserts /RESET when V_{CC} falls below 4.35V and holds /RESET for 150 ms after VCC returns to normal. The push-button operation is described in the paragraph above. Use of connector J1 to supply +3.3V to the module requires disabling LV1.

LV1 may be removed from the operation by opening cut-trace CT1. 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.

Timing

A ceramic resonator (Y1) provides a 16.0 MHz base operating frequency to the MCU. This allows a default 8.0 MHz internal operating frequency. Higher frequencies are possible using the embedded PLL. The resonator output is routed to the MCU only and is not available at the MCU Port connector (J1). The MCU ECLK output is available to the user at connector J1.

Communications

The CSM-12C32 module provides a single RS-232 communications port. An RS-232 transceiver (U2) provides RS-232 signal level to TTL/CMOS logic level translation. RS232 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 are suitably buffered. 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. Otherwise, signal corruption may occur. 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.

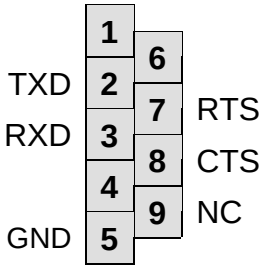
Table 3: Serial COM Connections

COM Signal	MCU Port	Connector J1	Signal Disable
TXD	PS1/TXD	5	CT5
RXD	PS0/RXD	7	CT4

COM Connector

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

Figure 1: COM Connector



Female DB9 connector that interfaces to the DCE serial port via an RS232 transceiver. It provides simple 2-wire asynchronous serial communications without flow control. A straight-through serial cable may be used to a DTE device such a PC

Pins 1, 4, 6, and 9 are routed to the User I/O Signal Breakout connector located adjacent to the breadboard.

User Options

Indicators LED1 and LED2 are connected to the MCU I/O ports by the USER option bank. When the appropriate USER jumper is installed, the assigned LED is active. Each LED is active low. A low voltage level driven out on the appropriate MCU port causes the LED to light. MCU ports PA0 and PB4 drive LED1 and LED2 respectively.

Two push button switches provide momentary, active low, input to the MCU for user applications. Switches SW1 and SW2 are connected to the MCU I/O ports by the USER option bank. SW1 and SW2 provide input to MCUI/O ports PE0 and PP5 respectively. The table below shows the user jumper settings.

Table 4: User Option Jumper Settings

Jumper	On	Off	MCU Signal
User 1	Enable SW1	Disable SW1	PE0/XIRQ*
User 2	Enable SW2	Disable SW2	PP5 /KWP5
User 3	Enable LED1	Disable LED1	PA0
User 4	Enable LED2	Disable LED2	PB4

APPENDIX A

I/O Port Connectors

Debug Port

The Debug or BDM port is a 6-pin header compatible with the 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 MCUI/O resources.

BKGD/MODC	1	2	GND
N/C	3	4	RESET*
N/C	5	6	$+V_{DD}$

See the MCU Reference Manual for details of BDM operation.

J1 Connector

Connector J1 provides access to CSM-12C32 I/O port signals.

V_X	1	2	PE1/IRQ*
GND	3	4	RESET*
PS1/TXD	5	6	MODC/BKGD
PS0/RXD	7	8	NC
PP5/KWP5	9	10	NC
PE0/XIRQ*	11	12	NC
PT0/PW0/IOC0	13	14	NC
PT1/PW1/IOC1	15	16	NC
PM4/MOSI	17	18	PAD00/AN00
PM2/MISO	19	20	PAD01/AN01
PM5/SCK	21	22	PB4
PM3/SS*	23	24	PA0
PE4/ELCK	25	26	PM1/TXCAN
PE7/XCLKS	27	28	PM0/RXCAN
PAD02/AN02	29	30	PT2/PW2/IOC2
PAD03/AN03	31	32	PT3/PW3/IOC3
PAD04/AN04	33	34	PT4/PW04/IOC4
PAD05/AN05	35	36	PT5/IOC5
PAD06/AN06	37	38	PT6/IOC6
PAD07/AN07	39	40	PT7/IOC7

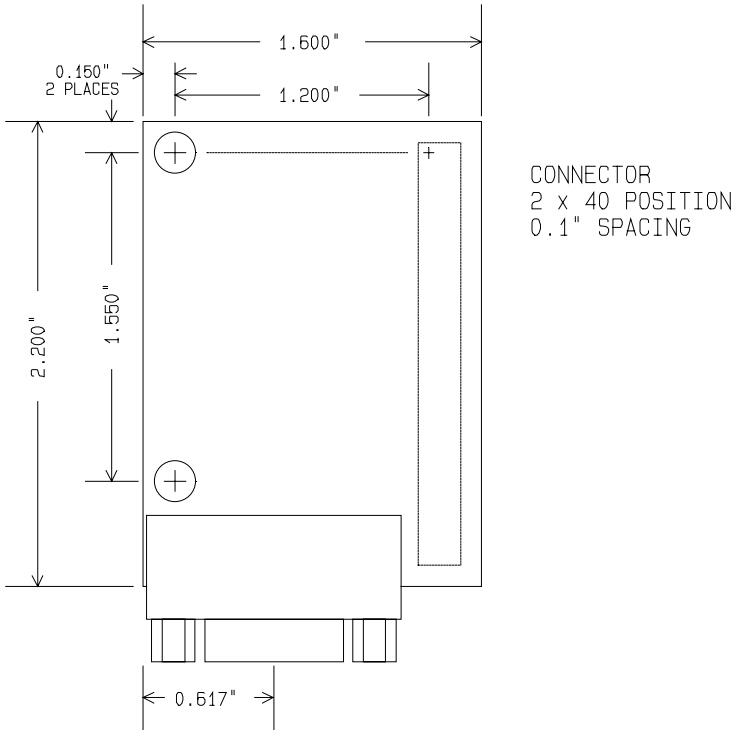
Default Signal Assignments

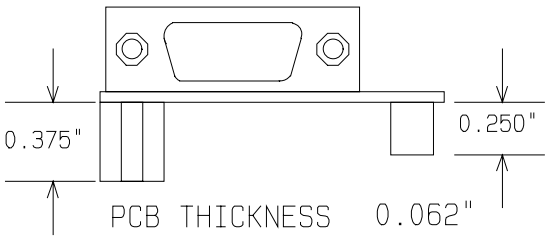
MCU PORT	Signal	Disable
PS1/TXD	COM1 TXD	CT-5
PS0/RXD	COM1 RXD	CT-4
PE1/IRQ*	SW1	User1
PP5/KWP5	SW2	User2
PA0	LED1	User3
PB4	LED2	User4

Note: Default signal assignment should be disabled to use the signal at connector J1

APPENDIX B

Mechanical Details





APPENDIX C

Bill of Materials

Item	Qty	Title	Ref(m)	Mfr	Mfr-P/N
		BOM, CSM12C32, AXM-0332			
1	4	Cap, Tant, 10uF, 10V, SMB	C3, C13, C16, C19, C20	Avx	TAJB106K010R
2	2	Cap, Mon, .01uF, 50V, 0805	C6, C10		
3	5	Cap, Mon, 1uF, 16V, 0805	C1, C4, C7, C8, C9		
4	8	Cap, Mon, .1uF, 50V, 0805	C5, C11, C12, C15, C17, C18, C21, C22		
5	1	Cap, Mon, 4700pF,10%, 0805	CX1	Kemet	C0805C472K5RACTU
7	1	Cap, Mon, 470pF, 50V, 5%, 0805	C14	Kemet	C0805C471J5GAC7025
8	1	Res, Carbon, 1M ohm, 5%, 1/16w, 0805	R12		
9	3	Res, Carbon, 10K ohm, 5%, 0805	R2, R3, R10		
10	1	Res, Carbon, 5.1k ohm , 5%, 0805	R8		
11	3	Res, Carbon, 4.7K ohm, 5%, 0805	R1, R4, R11		
12	3	Res, Carbon, 1K ohm, 1/16W, 5%, 0805	R6, R7, R9		
13	1	Resonator, Cer, 16.00MHz, w/Caps, 3Pos, SMT	Y1	Panasonic	EFO-BM1605E5
14	2	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D1, D3	General Semiconductor	
15	3	LED, Green, w/reflector, 1206, SMT	LED1, LED2, +5V	Rohm	SML-010MTT86
20	1	IC, MCU, MC9S12C32, 16MHz, 48QFP	U1	Freescale	MC9S12C32CFA
19	1	IC, Dual RS232 XCVR, 3.3V, ESD, 16SOIC	U2	Intersil	ICL3232ECBN
21	1	IC, 5.0V, EconoReset, w/PB, 10%, SOT-23	LV1	Dallas	DS1813R
22	1	VReg, LDO, 5.0V, 250mA, 8 SOIC	VR1	STM	L4931CD50
23	1	Ind, 10uH, 1210, SMT	L1	Vishay	IMC1210SY100K
24	3	Sw, PB, 5mm Sq, Thru	RESET, SW1, SW2		
23	1	Conn, 2.1mm, Pwr Jack, Barrel, Thru, RA	PWR		
30	1	Conn, Dsub, 9P, F, RA, PCB Mount	COM		
31	1	Conn, 2x2 Pin Header, .1" Ctr, Thru	PWR_SEL		
32	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	BDM		
33	1	Conn, 2x4 Pin Header, .1" Ctr, Thru	USER		
28	1	Conn, 2x20 Pin Header, .1" Ctr, Thru	J1		
25	5	Hdw, Shunt, 2 Pos, .1"			
34	1	PCB, CSM12C32 Module, 1.6"x2.2", 2-Layer, 2-Sided			

APPENDIX D

Schematic