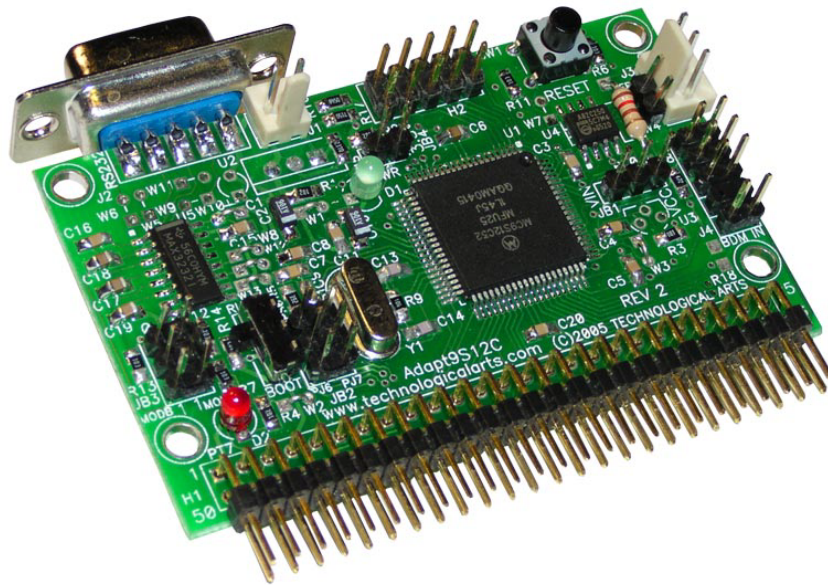


# Using Your Adapt9S12C Microcontroller Module



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Revision 1 - September 2016

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### ESD WARNING

This product, like all microcontroller products, uses semiconductors that can be damaged by electrostatic discharge (ESD). When handling, care must be taken so that the devices are not damaged. Damage due to inappropriate handling is not covered by the warranty.

The following precautions must be taken:

- Do not open the protective conductive packaging until you have read the following, and are at an approved anti-static work station.
- Use a conductive wrist strap attached to a good earth ground.
- If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe. Always disconnect the microcontroller from the prototyping board when it is being worked on.
- Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD-sensitive electronic component.
- Use an approved anti-static mat to cover your work surface.

# 1 INTRODUCTION

## 1.1 WELCOME!

With **Adapt9S12C**, you are now ready to explore the power and versatility of Freescale/NXP's advanced 16-bit microcontroller family! **Adapt9S12C** gives you the opportunity to explore the 9S12C family's potential at a very affordable price!

## 1.2 SUPPORT

To help you get the most out of this product, and to make the experience as enjoyable and productive as possible, we've put together a comprehensive website, loaded with resources, support, and applications information. If you experience any difficulties, or need help with your application, you'll find the latest information, software, and troubleshooting help, as well as discussion groups where you can network with people around the globe to get the answers you need.

## 1.3 PRODUCT CONFIGURATION

**Adapt9S12C** includes all the essential support circuitry that 90% of applications use (e.g. crystal, voltage regulator, reset switch, RS232 interface), without tying up port pins with costly interface circuits that most users won't need (e.g. clock/calendar chip, serial EEPROM). It is form-factor compatible with our original 68HC11 product, the immensely-popular Adapt11, and is offered with the legendary "SB" connector option (a Technological Arts innovation), enabling it to be plugged directly into a solderless breadboard-- just like a big chip. In fact, the module can be ordered with any one of more than a dozen connector options, making a vast range of configurations possible when coupled with the complete selection of prototyping cards, backplanes, and application cards that are available from Technological Arts. From MCU evaluation, training, product development, hobby or school projects, and semi-custom solutions all the way to being embedded right into a commercial product or system, Adapt9S12C is a very cost-effective product. The board is currently offered in two versions, which differ only in memory sizes:

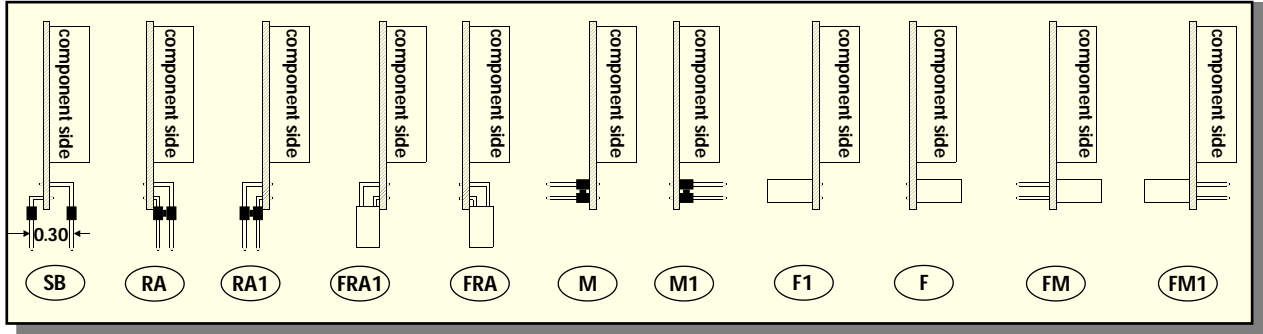
- Adapt9S12C32 has 32K Flash (program memory) and 2K RAM (data memory)
- Adapt9S12C128 has 128K Flash (program memory) and 4K RAM (data memory)

## 1.4 ADAPT9S12C VS. TRADITIONAL EVALUATION BOARDS

Most available evaluation and development systems tend to be too expensive and bulky for embedding into a real application, so they lie on a shelf gathering dust once you've reached a certain point in the learning curve. Or maybe you think up some clever way to hack it apart and make it fit inside your robot or product prototype. Even then, the prototyping area provided is often limited, and does not lend itself to re-usability. And what if you burn out a chip the night before the contest or product demo? What a mess to repair or re-design!

**Adapt9S12C** solves all of these problems and more! Since it brings out practically all I/O lines and control signals to a standard 50-pin interface connector (H1) and 10-pin auxiliary connector (H2), it is modular and re-usable. Interface cards can be unplugged and upgraded, or the whole system can be re-configured at the last minute. What's more, the program memory can be erased and re-programmed in seconds, right in place. The multitude of connector options enables you to use the module in whatever way best suits your application-- board-stacking, end-to-end (planar), backplane, ribbon cables, etc. A full range of accessories including backplanes, prototyping cards, and application-specific cards is available, and more accessories are being developed all the time. Make a point to visit our website from time to time, just to see what's new.

**Standard Connector Options (use NC for “no connector”)**



When used with the RA1 connector option, a prototyping card, experimenter card, demo card, or motor driver card can be plugged directly onto the I/O connector, forming a planar arrangement. Advantages of this configuration are easy access to all I/O pins for probing and measurement, and easy prototyping of your interface circuits. What’s more, the detachable nature of the cards means that you can easily replace them with other cards. You can build up a collection of different application circuits, and use them all with the same microcontroller board. This is especially advantageous in an educational environment, where the student can progress from simple to more complex applications throughout a semester, or from one course to the next-- perhaps even incorporating the board into a final project. In fact, where budgets are tight, different students can share the same microcontroller module, and plug in their own interface cards when it’s their turn to use it.

**1.5 USING ADAPT9S12C WITH SOLDERLESS BREADBOARDS**

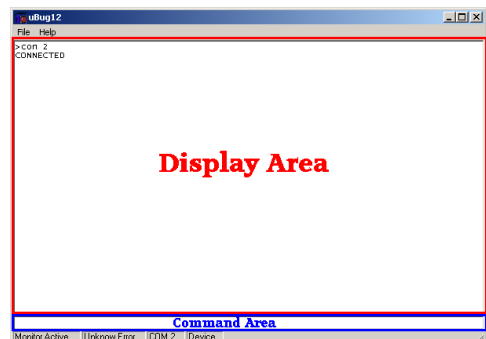
When used with the SB connector option (or optional adapter, #ADHDR50-F), the module will easily plug vertically into any standard solderless breadboard. The resulting footprint is equivalent to a 50-pin narrow DIP, and has a similar pin-numbering sequence (ie. wraps around the end, from pin 25 to 26). Plug the adapter into your breadboard, wire up your circuits, as required, and then plug the module into the adapter. If you want to access signals on H2 as well, you’ll need a 10-pin ribbon cable and a breadboard adapter (#ADIDC10-M) to bring those signals down to the breadboard. Note that pin-numbering of the 10-pin connector is like a typical ribbon cable connector, with odd-numbered pins on one row and even-numbered pins on the other.



Another popular breadboarding approach is a planar configuration utilizing a card mounted with a solderless “experimenter” board that plugs into H1. This card (#AD12EXPH1-FRA1) features a 50-pin dual-row receptacle (“F”-style connector) next to the breadboard section, giving you easy access to all of the I/O signals. To build your circuit, it’s just a matter of plugging lengths of ordinary #22 hookup wire between the signals on the receptacle and the places you need them on the breadboard.

**1.6 RESIDENT DEBUG/MONITOR**

Residing in a 2K protected block of on-chip flash memory is Freescale’s versatile Serial Monitor program. When used with uBug12JE (a free multi-platform application created by Technological Arts), you can display and edit memory and registers, erase and program flash, set breakpoints, and do instruction tracing. Flip a switch on the board to Run mode, and your program runs automatically from Flash, following reset or powerup. See Chapter 2 and Appendix A for details on uBug12JE and the resident monitor.



## 1.7 COMMUNICATIONS

An RS-232C serial interface port connector (9-pin D-sub) is included, enabling communication with a PC com port, or any other device which has an RS-232 serial port, via a standard 9-pin serial port extension cable. The RS-232 channel is implemented via the SCI of the MCU, and when the board is reset in Load mode, the resident Serial Monitor uses this port to communicate with an appropriate program running on your PC (e.g. UBug12, CodeWarrior, or NoICE12). In Run mode, the RS-232 port is available for your application.

The module includes physical layer support for Controller Area Network (CAN), with CANHI, GROUND, and CANLO signals brought out to J3. A mating 3-pin Molex connector is available from Technological Arts (#HPCT3). A 120-Ohm terminating resistor is included on the board, and can be activated by shorting link W4.

In passing, it should be mentioned that the MCU also supports Serial Peripheral Interface (SPI). Since this is a logic-level protocol, meant for local communications among peripheral chips, no transceivers are required. Commonly used SPI chips and modules include: serial memory (e.g. EEPROM, Flash), temperature sensors, clock/calendar chips, DACs, MP3 decoders, SD cards, etc.

See the 9S12C datasheets for details on all of these subsystems.

## 1.9 JUMPER OPTIONS

The user has a choice of selecting PJ6 and PJ7 or PS0 and PS1 to be brought out to the I/O connector (H1). The selection is implemented via jumper block JB2. By bringing out PS0 and PS1, the SCI can be accessed at the logic level, and is useful for such applications as GPS and serial LCD interfacing. In these applications, it would be better to develop with a BDM pod (such as our USBDMILT) instead of the resident serial monitor.

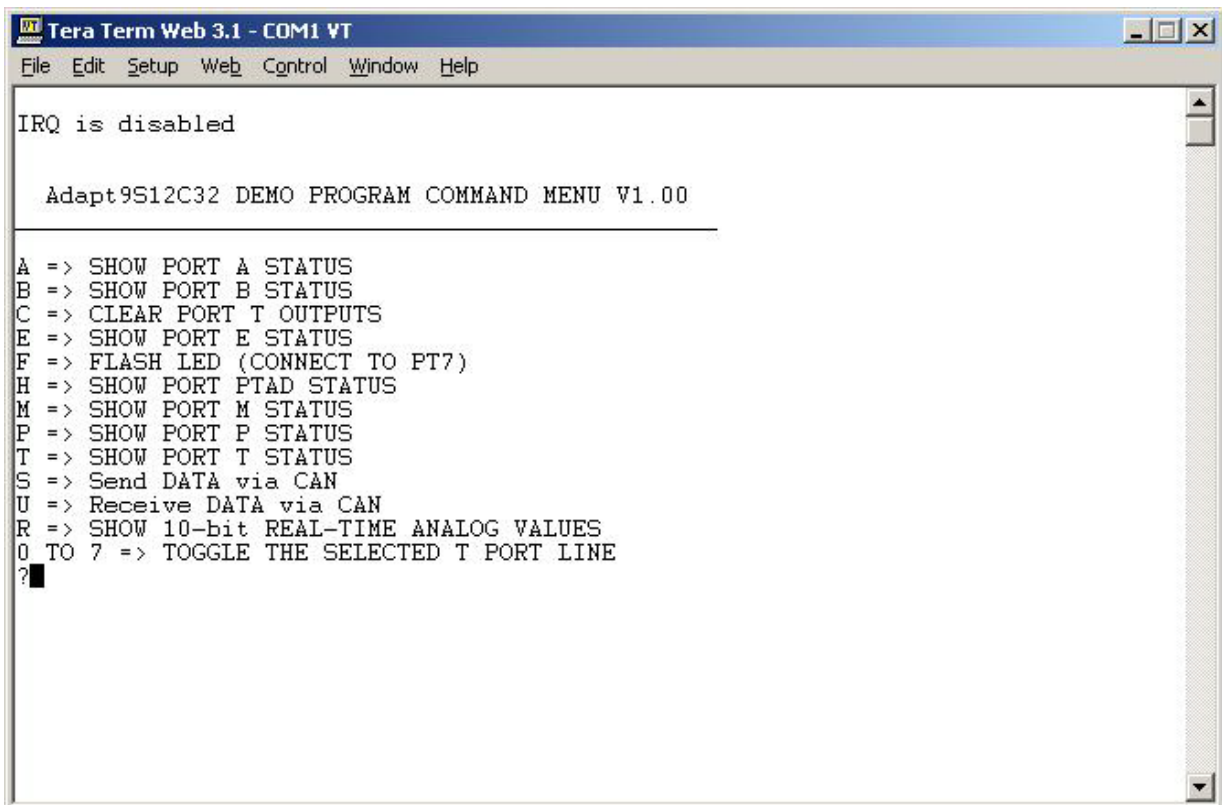
MCU Mode Select jumper block JB3 provides access to the microcontroller's MODA and MODB pins, for implementing single-chip mode, narrow expanded mode, and wide expanded mode. The default setting is Single-chip Mode (MODA=MODB=0). Refer to the 9S12C data sheet for details on implementing other modes.

## 2 GETTING STARTED

### 2.1 USING THE DEMO PROGRAM

All Adapt9S12C modules come pre-programmed with a Demo program in Flash. The user interface for this demo program is accessible via any terminal program. Follow the instructions below to perform a quick operational check on the module before using it in your application.

- Be sure to read and follow the Safe Handling Procedures for ESD, included with your shipment (and outlined inside this manual's front cover).
- Perform a visual check of the hardware for any damage during transit.
- Connect the 9-pin serial port (J2) to a com port of a personal computer, using a standard 9-pin serial extension cable.
- Launch a terminal program, such as Hyperterminal or TeraTerm.
- Configure the terminal program to connect to the com port at 9600 baud.
- Set switch SW2 to the RUN position (i.e. up, away from the 50-pin connector H1).
- Connect an appropriate power source to J1 (at least 6VDC and not more than 14VDC). When using the mating cable assembly supplied, note that the Red wire is POSITIVE and the Black wire is NEGATIVE (Ground). **Failure to observe proper polarity may damage the onboard voltage regulator!** The green LED (D1) will illuminate, indicating power is present.
- The Demo Program's menu will be displayed in the terminal window, as shown in the figure below, confirming that the module is properly transmitting serial data.
- Hit <ENTER> and the menu will be re-displayed, confirming that the module is receiving serial data.
- The above steps demonstrate that power is correctly applied, the MCU is running properly, and the serial interface is functioning normally.



```
Tera Term Web 3.1 - COM1 VT
File Edit Setup Web Control Window Help

IRQ is disabled

Adapt9S12C32 DEMO PROGRAM COMMAND MENU V1.00
-----
A => SHOW PORT A STATUS
B => SHOW PORT B STATUS
C => CLEAR PORT T OUTPUTS
E => SHOW PORT E STATUS
F => FLASH LED (CONNECT TO PT7)
H => SHOW PORT PTAD STATUS
M => SHOW PORT M STATUS
P => SHOW PORT P STATUS
T => SHOW PORT T STATUS
S => Send DATA via CAN
U => Receive DATA via CAN
R => SHOW 10-bit REAL-TIME ANALOG VALUES
0 TO 7 => TOGGLE THE SELECTED T PORT LINE
?█
```

## 2.2 GETTING STARTED WITH UBUG12

- .. Locate and install the free application called uBug12, available in our online Support Library
- .. Connect the RS232 port to a com port of a personal computer, using the cable supplied
- .. Launch uBug12
- .. Set switch SW2 to the LOAD position
- .. Connect a DC power source of between 6 and 14V to J1
- .. Activate the serial port connection by entering CON x (where x is the comport you are using; usually 1 or 2)
- .. uBug12 will display a short message, followed by its command prompt
- .. The Module is now ready to accept your commands (see Appendix B for a list of uBug12 commands)

To download a program into flash and execute it, follow these steps:

- .. Type **fbulk** <enter> at the uBug12 prompt to erase any existing program
- .. Type **fload** <enter>
- .. From the displayed file browser, select the program's output file (typically a .s19 or .s28 file)
- .. After loading has finished, move SW2 to the RUN position, and press the Reset button (SW1)
- .. The program will run
- .. If you wish to debug the program, move SW2 back to the LOAD position and press Reset
- .. The uBug12 prompt will appear
- .. Use uBug12 commands to debug your code

## 2.3 POWER OPTIONS

A DC power supply is included with most bundle configurations. It is the recommended power source when you're starting out. If for some reason it's not convenient (eg. you don't want an extension cord trailing around behind your robot :>), there are a couple of alternatives:

**Option 1:** connect a DC voltage of 6 Volts or more (maximum: 14 VDC) via the external power connector, J1. Your DC supply does not need to be regulated, but it should be capable of supplying at least 100 mA (more if you will be using a BDM pod, or you're driving other circuits as well). If your supply will also be driving motors, make sure to isolate it before feeding it into the module (to protect the MCU from electrical noise generated by the motor coils). You can do this by putting inductors (10uH, nominal) in series with both the + and - leads. Preferably, use the red & black power wire provided (order code: PCJ1-8). Red is positive, and black is negative (ground). *CAUTION! Make sure you have the polarity correct!*

**Option 2:** supply regulated 5VDC (or 3V if using 3V mode) via the appropriate pins on the module. See module pinout diagram in Appendix C for the Vcc and GROUND pins to use. *CAUTION! Leave J1 unconnected. Double-check your connections before applying power! If you are applying 3V, be sure to read the notes on 3-Volt operation in chapter 3.*

## 2.4 TIPS FOR SUCCESSFUL APPLICATION DEPLOYMENT

*Assemblers.* There are several assemblers available (e.g. AS12, MiniIDE, IASM12, CodeWarrior), and each has its own syntax to be aware of.

*Register Block.* The register block default location is \$0000 through \$03FF, and there are a few hundred registers! You'll need to locate the relevant registers for the subsystems you plan to use, and make sure they are properly configured.

*RAM location.* Following reset, the memory map configuration has the register block overlapping RAM, starting at \$0000, with registers taking priority, so the first 1K bytes of RAM are not usable. In order to free up all of the RAM. the monitor program re-maps RAM to start at \$3800 through \$3FFF (via the RAMinit register). You'll probably want to do the

same thing in your programs. This means you'll need to initialize the Stack Pointer to \$4000 (on the HCS12, the stack pointer points to the address following the top of the stack).

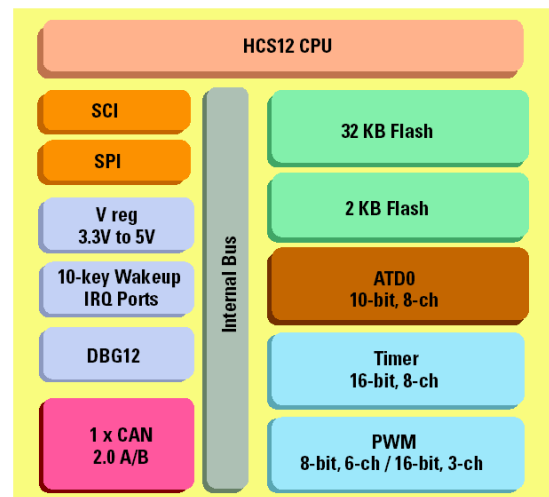
*High-speed Bus.* The default bus speed is half the crystal frequency of 8 MHz, so it is 4 MHz. If you enable the PLL, it can be even higher (up to 24 Mhz, as is done by the serial monitor). This will mean changing some initialization values for control registers and calculating delay constants if you are using any software timing loops.

*I/O Ports.* The digital I/O ports on the HCS12 are very flexible. Besides selecting the direction of each port pin via a Data Direction Register, there are registers controlling output drive level (standard and reduced), internal pullup and pulldown resistors, and output logic polarity (i.e. true or inverted logic).

*COP Watchdog.* This is automatically enabled following reset. Therefore you have to choose whether you're going to service it, or disable it.

*Write-Once Registers.* The MCU implements a WriteOnce rule on sensitive registers. What this means is that, following reset, you have one chance to write them, then they become "Read Only". The advantage of this is that you have more control of when you alter these register values. To take advantage of this safeguard, you should initialize all the registers that are crucial, even if the default values are what you want. That way, if your code runs amok, or there are any glitches which try to change register values, they will be protected.

*Flash Programming.* Your s-records must contain an even number of bytes, and begin on an even address boundary if you're going to "burn" them into flash. Some assemblers will generate this format for you but others, such as the included AS12, don't. In the latter case, you'll need to use the Freescale utility called SRECCVT.





## 3 HARDWARE DESIGN FEATURES

### 3.1 3-VOLT OPERATION

The 9S12C can operate on 3 to 5 V, while maintaining full bus speed capability. To support 3 Volt operation, Adapt9S12C incorporates an adjustable regulator whose output voltage is set by a resistive voltage divider. The circuit has been designed such that simply inserting a shorting jumper causes the regulator's output to shift from 5V to 3.3V. When operated at 3V, there are a few precautions that should be noted, however.

The logic pins are *not* 5V-tolerant, so you will need to take the necessary steps to prevent damage to the I/O pins of the MCU. Also, the maximum VRH voltage is limited to 3.3V, so any external voltage or precision voltage reference you supply should be scaled accordingly. One last point is that some BDM pods will not work with 3 Volt targets, so you should check the specs of the BDM pod you intend to use. A good choice is our USBDMILT, which works at both 3.3V and 5V.

### 3.2 ABOUT THE VOLTAGE REGULATOR

Adapt9S12C includes an LM1117V voltage regulator. Housed in a TO-220 package, it is capable of handling 800 mA. Other nice features are: reasonably low quiescent current (<5mA, typical), and low dropout voltage (1V @ 800 mA). To compensate for long lead-in wires, you may want to add capacitance of 100uF at, or close to, connector J1. Absolute maximum input voltage is listed as 15V. Refer to the manufacturer's data sheet for more.

**Heatsinking.** Because the regulator is mounted on the underside of the circuit board, with the package body parallel to the plane of the board, it can be safely attached to a heatsink. Many clip-on heatsinks are available for use with TO-220 packages. Another option is to mount the board on a sheet of aluminum, using standoffs and insulated hardware. If the appropriate length is chosen for the standoffs, the tab of the regulator will lie flush with the aluminum sheet, and can be coated with silicone grease and bolted (or riveted) to the plate (tightening a nut and bolt will require a little ingenuity). **CAUTION!** *Unlike some other voltage regulators, the metal tab is not Ground-- it is connected to Vout so, in most cases, you will need a heatsink insulation kit.*

### 3.3 VOLTAGE REFERENCE

The voltage reference (VRH) used for the analog-to-digital converter subsystem defaults to the Vcc rail. If you need a more precise, lower-noise reference, you may populate U3 with a reference device. If it is less than 5V (e.g. 4.096V or 2.50V) JB1 pins 2 and 3 can be jumpered together to supply the reference from the Vcc rail. However, if you use a 5V voltage reference, you'll need to supply it from the Vin rail, so short JB1 pins 1 and 2. Never short JB1 pins 1 and 2 without a voltage reference chip populated for U3. If you do so, you'll damage the MCU.

### 3.4 ADDITIONAL INPUT/OUTPUT PINS

An additional I/O connector is located on the upper edge of the module, providing access to an another 8-pin I/O port (PORTP). The extra two pins on the connector bring out Ground and Vcc for convenience. This means a standard 10-pin ribbon cable may be used to interface them to your circuit. We make a 10-pin solderless breadboard adapter (#ADIDC10-M) which can be used with a 10-conductor ribbon cable (#RC10FF6) to bring the extra pins down to your solderless breadboard.

## 4 WRITING SOFTWARE

### 4.1 IMPACT OF THE SERIAL MONITOR

When you are working without a BDM pod, the Serial Monitor program is the only method available to load and erase flash. It is in a protected block of flash, so there's no way to accidentally erase it. There are two modes, controlled by switch SW2: Run and Load. The monitor mode is detected immediately following reset by checking the position of switch SW2. When working with the monitor program in place, there are a few points to be noted:

- 1) while the user vectors are implemented by the monitor at 0xF780 to 0xF7FF, you don't really have to worry about it, because the monitor program will automatically adjust them when your s-record is loaded.
- 2) the monitor relocates RAM to the address range 0x3800 to 0x4000 from the default location after MCU reset of 0x0000 to 0x07FF.
- 3) the monitor program enables the phase-locked loop (PLL), so the target is running at 24Mhz (when in LOAD mode) and not at the startup speed of 4Mhz.
- 4) the user code must clear the CCR I-Bit, either via a CLI in assembler or via the `INTR_ON()` in ICC12.
- 5) SCIO cannot be used by the user program when in LOAD mode, since it is dedicated to the monitor program.
- 6) COP cannot be disabled in Load mode.
- 7) to ensure your program runs correctly in Run mode, you'll need to initialize everything you need (e.g. enable PLL, relocate RAM, clear the COP, supply reset and interrupt vectors). If you initialize these settings in the same way as the monitor program does, then you'll be able to run your program either via uBug12 in Load mode (i.e. with monitor active) or in Run mode following powerup or reset.

### 4.2 USING CODEWARRIOR

CodeWarrior supports loading and debugging your application via the Serial Monitor. Just select Serial Monitor for the Target Connection type. Remember to use the parameters mentioned above if you want to take advantage of the integrated debugger. Otherwise, you could simply use CodeWarrior to compile your project and load it into flash without debugging.

### 4.3 USING A BDM POD

If you have a BDM pod, you can erase the resident monitor program completely. This will free up all the MCU resources for your program (most importantly, the SCIs). Without the monitor in place, the RAM will be at the default location following reset, so make sure to use the correct compiler/linker settings. Also, the PLL won't be enabled, so the bus speed will be 4 MHz. You can use CodeWarrior for loading and debugging your code with our USBDMILT pod by selecting TBDML as the Target Connection type. If you're not using CodeWarrior, you can use the HCS12 Programmer app included with the USBDM project on Sourceforge. Check the Product Usage tab on the USBDMILT product web page for links and instructions on using the USBDMILT. For other BDM pods, refer to the pod's application notes for help.

## 5 APPLICATION CARDS

If you'd like to get started interfacing common electronic devices such as LEDs, switches, relays, etc., you may consider purchasing the optional Demo Card (Adapt9S12DemoH1, shown). It includes a light sensor, thermistor, bargraph LED, DIP switch, potentiometer, audio transducer, and a couple of logic MOSFETs, and it provides support for an optional character LCD. Details for its use are provided in the next section.

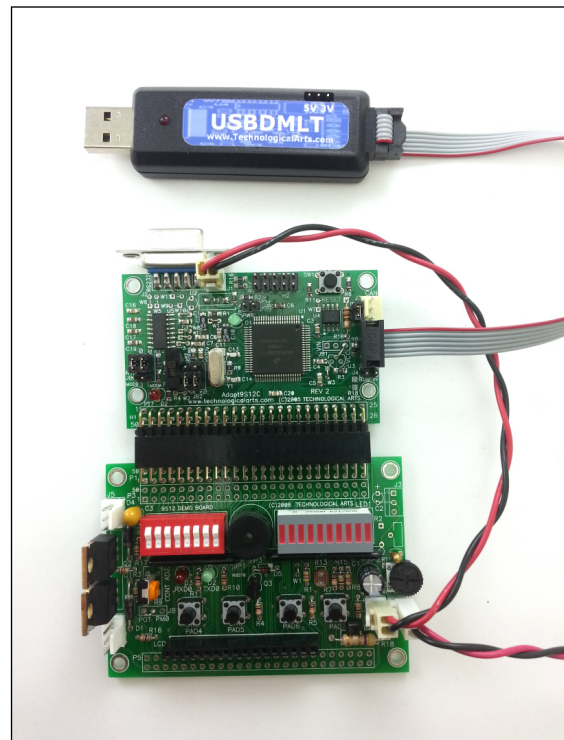
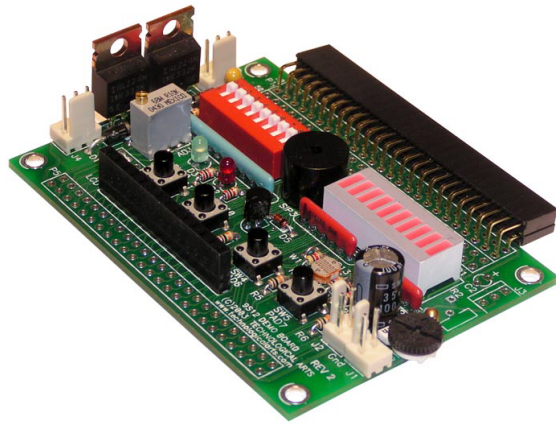
Several other Application Cards are available, including:

- a Display/Keypad/Keyboard Interface (#DKKI) which supports character LCDs, PS/2 keyboard, and/or matrix keypads, and provides an ample prototyping area for constructing custom interface circuits or attaching a solderless breadboard. Communication with the LCD is accomplished via the SPI, using a 74HC595 serial shift register, reducing the number of port pins required.
- a Servo/Sensor Interface Module (#AD9S12SSIM) which supports standard robotics applications (hobby servo control, IR distance-measuring sensors, sonar distance-measuring sensors, audio microphone, audio transducer, etc.)
- a Quad Motor Driver module, capable of driving four DC motors or two bipolar stepper motors, as well as a solenoid or relay (#AD11QMDH)

Check the subcategory called Application Cards on our website to browse the currently available selection.

### 5.1 TIPS FOR USING THE DEMO CARD

Using an Adapt9S12C module fitted with an RA or RA1 style connector, you can easily attach a Demo card fitted with an FRA or FRA1 style connector, respectively. The Demo Card is supplied with a double-ended power cable which you should plug between J1 on the Adapt9S12C module and J2 on the Demo card. Then plug in your power supply to J1 on the Demo card, as shown in the adjacent photo. If you're planning to use the USBDMILT pod, you should isolate the USB power by removing the shorting plug completely from the 5V-3V slot on the top of the USBDMILT case. Otherwise, there will be a power conflict between the Adapt9S12C regulator and the USB 5V supply from your PC, causing erratic operation. Also, to safely use the audio transducer on the Demo card, you should limit your external power supply voltage to 9VDC (maximum). A higher voltage may cause damage to the transducer. Finally, Adapt9S12C must be operated at 5V-- the Demo card will not function properly at 3V.



## Pin Function Mapping

H1 Pin#	Adapt9S12C	Demo Card
1	PM2	LCD DB4
2	PM4	LCD DB5
3	PM5	LCD DB6
4	PM3	LCD DB7
5	PJ7/PP7	LED D2 GRN
6	PT7	S1
7	PT6	S2
8	PT5	S3
9	PT4	S4
10	PT3	S5
11	PT2	S6
12	PT1	S7
13	PT0	S8
14	PB7	SPKR
15	PB6	LCD CONTRAST
16	PB5	VOUT
617	PB4	DRIVER1/SEG8
18	PB3	DRIVER2/SEG9
19	PB2	LCD RS
20	PB1	LCD E
21	PB0	LCD R/W*
22	AN00	
23	AN01	TEMP
24	AN02	POT
25	AN03	LIGHT
26	AN04	SW5
27	AN05	SW4
28	AN06	SW3
29	AN07	SW2
30	VRH	
31	VRL	AGND
32	PE3	
33	PE4	
34	PE2	
35	PA7	LED SEG7
36	PA6	LED SEG6
37	PA5	LED SEG5
38	PA4	LED SEG4
39	PA3	LED SEG3
40	PA2	LED SEG2
41	PA1	LED SEG1
42	PA0	LED SEG0
43	PE7	
44	RESET*	
45	PE0	
46	PE1	
47	VCC	VCC (+5V)
48	PJ6	LED D3 RED
49	GROUND	GROUND
50	GROUND	GROUND





## APPENDIX A - SERIAL MONITOR

### INTRODUCTION

This appendix describes the Freescale 2-Kbyte monitor program for the HC9S12 series MCU. This program supports 23 primitive debug commands to allow FLASH / EEPROM programming and debug through an RS232 serial interface to a personal computer. These include commands to reset the target MCU, read or modify memory (including FLASH /EEPROM memory), read or modify CPU registers, go, halt, or trace single instructions. In order to allow a user to specify the address of each interrupt service routine, this monitor redirects interrupt vectors to an unprotected portion of FLASH just below the protected monitor program. This monitor is intended to be device unspecific, this single application with very slight modification should execute on any HC9S12 derivative. A user on a tight budget can evaluate the MCU by writing programs, programming them into the MCU, then debug using only a serial I/O cable and free software (uBug12) for their personal computer.

This monitor does not use any RAM other than the stack itself. The COP watchdog is utilized for a cold reset function; user code should not disable the COP (ie. by writing 0x00 to COPCTL). This development environment assumes you reset to the monitor when you are going to perform debug operations. If your code takes control directly from reset, and then an SCIO interrupt or a SWI attempts to enter the monitor, the monitor may not function because SCIO, the phase locked loop (PLL), and memory initialization registers may not be initialized as they would be for a cold reset into the monitor. There is no error handling for the PLL. If the frequency source is missing or broken, the monitor will not function. The monitor sets the operating speed of the MCU to 24 MHz. Modification of the MCU speed by the user with out considerations for the monitor program will render the monitor nonfunctional. If the PLL loses lock during operation, the monitor will fail.

### BLOCK PROTECTION

In order to prevent accidental changes to the monitor program itself, the 2 Kbyte block of FLASH memory where it resides (\$F800-\$FFFF), is block protected. Additionally all write commands are restricted from modifying the monitor memory space. The only way to change the contents of this protected block is to use a BDM-based development. In the lowest cost applications where the monitor is used with an SCI serial interface to the RS232 serial port on a personal computer, there is no way to accidentally erase or modify the monitor software.

### COP CONFIGURATION

The monitor as written creates hard reset function by using the COP watchdog timer. It does so by enabling the COP and waiting for a COP timeout reset to occur. If the user application uses the COP two issues must be considered.

- If the COP is disabled in the user application, the monitor will be unable to perform a hard reset and will soft reset to the start of the monitor instead.
- The monitor does not service the COP timer. If the user application implements COP timer servicing, upon re-entry into the monitor a hard reset is likely to occur.

### 9S12C MEMORY CONFIGURATION

- 1) Register space is \$0000-\$03FF.
- 2) Flash memory is any address greater than \$4000. All paged addresses are assumed to be Flash memory.
- 3) RAM ends at \$3FFF and builds down to the limit of the device's available RAM.
- 4) External devices attached to the multiplexed external bus interface are not supported.

## **SERIAL PORT USAGE**

In order for this monitor to function the SCIO serial interface is used. It is assumed that the monitor has exclusive use of this interface. User application code should not implement communications on this serial channel. This monitor accommodates RS232 serial communications through SCIO at 115.2 Kbaud. For applications requiring the use of SCIO, you should purchase a BDM pod which allows for more advanced debugging.

## **VECTOR REDIRECTION AND INTERRUPT USE**

Access to the user vectors is accomplished via a jump table located within the monitor memory space. This table points all interrupt sources to a duplicate vector table located just below the monitor. (\$F780-\$F7FE). The monitor will automatically redirect vector programming operations to these user vectors. The user's code can therefore continue to implement the normal (non-monitor) vector locations (\$FF80-\$FFFE). If execution of an interrupt with an un-programmed vector is attempted, behavior is undefined. For this reason, the user is strongly encouraged to implement a software trace for all vectors, as is good programming practice. The monitor depends on interrupts being available for monitor re-entry after GO or TRACE commands. Therefore, it is important that the user application executes with interrupts enabled.



## APPENDIX B - CORE UBUG12 COMMAND LIST\*

### ----- REGISTERS -----

RD	- Register Display
RM <RegisterName> <Data8/16>	- Register Modify
CCR <Data8>	- Set CCR register
D <Data16>	- Set D register
PC <Data16>	- Set PC register
PP <Data8>	- Set PP register
SP <Data16>	- Set SP register
X <Data16>	- Set X register
Y <Data16>	- Set Y register

### ----- MEMORY MODIFY -----

BF <StartAdd> <EndAdd> <Data8>	- Block fill
BFW <StartAdd> <EndAdd> <Data16>	- Block fill word
MD <StartAdd> [<EndAdd>]	- Memory display
MDW <StartAdd> [<EndAdd>]	- Memory display word
MM <Address> <Data8>	- Memory modify byte
MMW <Address> <Data16>	- Memory modify word

### ----- FLASH -----

FBULK	- Flash bulk erase
FLOAD	- Flash load

### ----- DEVICE INFO -----

DEVICE	- Get device name
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### ----- GO/HALT -----

GO [<StartAddress>]	- Start execution
HALT	- Halt execution
RESET	- Reset target

### ----- GUI -----

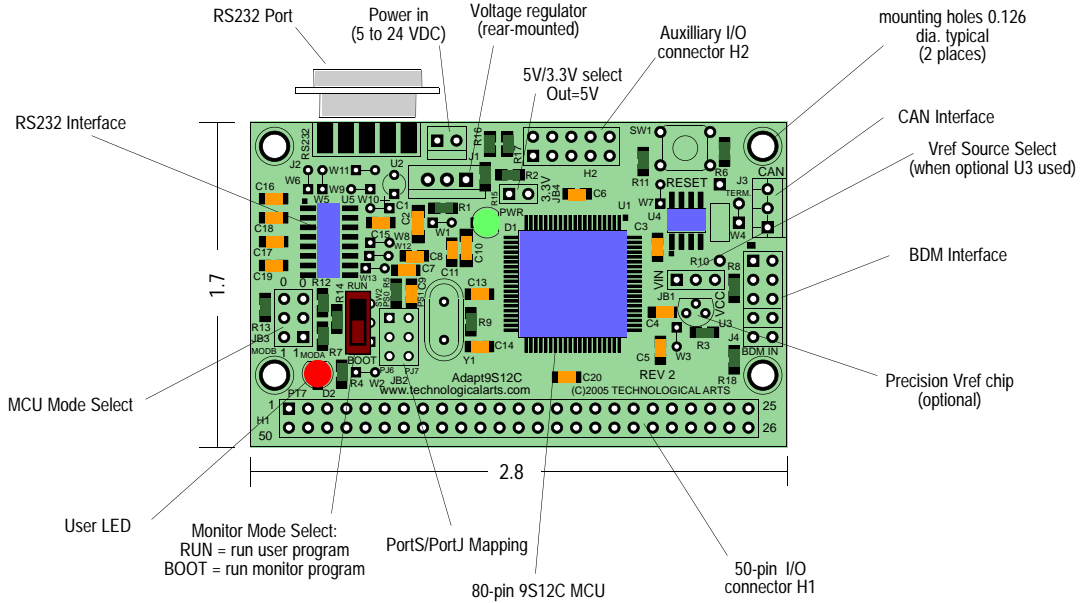
CON<Comport>	- Connect to target
DISCON	- Disconnect from target
EXIT	- Terminate GUI
HELP	- Display help
OP <Opacity%>	- Set main GUI opacity

\*For a complete list of commands and their syntax in the current version of uBug12, type help at the command prompt.

# Adapt9S12C Module

## Features and Pin Configuration

Dimensions in inches



H1 Pin Assignments

PIN #	NAME	PIN #	NAME
1	PM2/MISO	50	GROUND
2	PM4/MOSI	49	GROUND
3	PM5/SCK	48	PS0 or PJ6 (set by JB2)
4	PM3/SS*	47	Vcc
5	PS1 or PJ7 (set by JB2)	46	PE1 (IRQ*)
6	PT7/IOC7	45	PE0 (XIRQ*)
7	PT6/IOC6	44	RESET*
8	PT5/IOC5	43	PE7 (XCLKS*)
9	PT4/IOC4/PW4	42	PA0/ADDR8/DATA8
10	PT3/IOC3/PW3	41	PA1/ADDR9/DATA9
11	PT2/IOC2/PW2	40	PA2/ADDR10/DATA10
12	PT1/IOC1/PW1	39	PA3/ADDR11/DATA11
13	PT0/IOC0/PW0	38	PA4/ADDR12/DATA12
14	PB7/ADDR7/DATA7	37	PA5/ADDR13/DATA13
15	PB6/ADDR6/DATA6	36	PA6/ADDR14/DATA14
16	PB5/ADDR5/DATA5	35	PA7/ADDR15/DATA15
17	PB4/ADDR4/DATA4	34	PE2 (R/W*)
18	PB3/ADDR3/DATA3	33	PE4 (ECLK)
19	PB2/ADDR2/DATA2	32	PE3 (LSTRB*)
20	PB1/ADDR1/DATA1	31	Vana
21	PB0/ADDR0/DATA0	30	VRH
22	PAD00/AN00	29	PAD04/AN04
23	PAD01/AN01	28	PAD05/AN05
24	PAD02/AN02	27	PAD06/AN06
25	PAD03/AN03	26	PAD07/AN07

H2 Pin Assignments

PIN #	NAME	PIN #	NAME
1	PP0/KWP0/PW0	2	PP7/KWP7
3	PP1/KWP1/PW1	4	PP6/KWP6/ROMCTL
5	PP2/KWP2/PW2	6	PP5/KWP5/PW5
7	PP3/KWP3/PW3	8	PP4/KWP4/PW4
9	Vcc	10	GND



Order Codes:  
 AD9S12C32M-□  
 AD9S12C128M-□  
 (specify H1 connector option code)

Standard Connector Options (use "NC" for no connector)

