**Freescale Semiconductor**
User Guide

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# Getting Started with the S12 University Board Microcontroller Learning Kit Project Board

Using the S12UB Microcontroller Student Labs Program

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## 1 Introduction

This is a basic user guide for the S12UB Revision B, the first production release of the S12UB student kit, available for order beginning in November, 2006, Part Number LFEBS12UB. It includes the S12UB board, AC to 12V DC universal power supply, RS-232 DB9 serial cable, CodeWarrior software, S12UB distribution disk software, and small pre-stripped jumper wire kit.

A companion I/O kit is available, Part Number LFEBS12UBLAB, which includes; 12V DC Incondescent light bulb, 12V DC relay, LCD display, Keypad, Mechanical Encoder, and small 12V DC motor.

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# 2 Software Setup

The following software installation is a one-time, required procedure per host PC that you intend to use with the S12 University Board and Learning Labs. After completing the software setup on your host PC, all projects and relevant materials will be installed on your PC. A rich GUI interface will also be installed allowing you to navigate among the lab projects. Note that CodeWarrior Development Studio HC12 v4.5 should be installed for the S12UB Distribution Disk to work as intended.

- To install and register CodeWarrior development tools for HC(S)12 MCUs onto a host PC, complete the instructions outlined in sections A of the CodeWarrior Development Studio for Freescale 68HC12/HCS12/HCS12X/XGATE Microcontrollers quick start pamphlet found inside the supplied case labeled CodeWarrior Development Studio for HCS12(X) Microcontrollers Academic Edition.

**NOTE**

Academic Edition development tools are full-featured and not for commercial development. They may only be licensed to students, faculty, and staff of accredited institutions.

**NOTE**

Periodically check http://www.freescale.com/codewarrior for updates and patches to your development tools. For questions on CodeWarrior development tools, go to http://www.freescale.com/support

# 3 Hardware Setup

## 3.1 Unpack

- Open the shipping carton and remove the contents. Verify all packing list items have been received.
- Inspect the project board for damage that may have occurred during shipping. If damage is found, contact the manufacturer at support@freescale.com for assistance.

# 4 Hardware Design

The S12UB hardware design has two main sections, DEBUG (POD) and TARGET, each having its own DG128 S12 microcontroller. Except for sharing a +5V power supply, the two sections are completely separate circuits. Click to see S12UB Schematic.

## 4.1 DEBUG Section

The DEBUG circuitry can run either of two freescale semiconductor debugging applications, D-Bug12 (in POD Mode) and SerMon GDI (Codewarrior). Only one is loaded into the DEBUG microcontroller at a time, and both use a serial RS-232 interface to the Personal Computer (PC). The S12UB board is shipped with D-Bug12 loaded set at 9600 Baud, 8 data bits, no parity, one stop bit, with XON/XOFF handshaking. The DEBUG circuitry is easily recognized on the S12UB board because it is surrounded by a thick white boarder.

Over the years D-Bug12 has evolved from a traditional debug monitor, to a stand-alone debugger, see D-Bug12 user guide. Traditionally the term monitor refers to a monitor program resident on the same microcontroller that was being programmed. A good example is the HC11 BUFFALO monitor, which is shipped with the HC11 evaluation boards. These boards have one microcontroller on-board. This single microcontroller is used as a debugger and a target device.

With the introduction of Background Debug Mode (BDM), on-board HC12 and HCS12 devices, we can now run a “monitor like” program on a separate debug microcontroller, often called a software development tool or POD, and debug the target microcontroller over BDM. The name POD refers to any stand-alone software development device, or software tool, that connects to the TARGET through the BDM cable.

The S12UB has a dedicated debug microcontroller called DEBUG or POD. Having a separate POD microcontroller has several advantages; First it can be designed to accommodate several debuggers, D-Bug12 and SerMon for example. Next, because no monitor is resident on the TARGET microcontroller, we have complete access to all TARGET microcontroller resources. This is a big advantage because it more realistically mimics a real-world embedded development environment.

D-Bug12 is a general purpose debugging tool. When used in DEBUG (POD) mode it can be used to debug applications, look at memory, write small user programs and dissassemble code. When using D-Bug12 on the S12UB make sure the 6-wire BDM cable is connected between the DEBUG BDM OUT and TARGET BDM IN.

SerMon GDI is the General Purpose Serial Interface for the Codewarrior Debugger. It is designed to support up to two hardware breakpoints using the breakpoint module on the S12. To use SerMon on the S12UB make sure the BDM cable is connected between the DEBUG BDM OUT and TARGET BDM IN.

The DEBUG tool, either D-Bug12 or CodeWarrior SerMon GDI, can be used to debug other S12 targets. Just move the ribbon cable over to the other Target.

For teaching purposes D-Bug12 is used at the beginning of the course and then SerMon GDI is loaded to teach the Codewarrior Tools, and C Programming.

## 4.2 TARGET Section

The TARGET circuitry mimics an actual system design. Common input and output devices are pre-wired to the DG128 microcontroller. Core labs 1 through 12 do not require any wiring to complete the labs. Hookup labs 13 through 17 teach interfacing to different I/O devices, and require wiring up the circuit. Advanced labs 18 through 21 focus on advanced topics dealing with software design and automotive communication busses.

## 4.3 Reprogramming the DEBUG (POD) microcontroller

To change from D-Bug12 to SerMon GDI and back again, the DEBUG (POD) bootloader is used and works as follows-

### Changing from D-Bug12 to SerMon GDI

1) Power S12UB down. Make sure the BDM cable between POD and TARGET is in place.

2) Jumper POD J5 pins 1 and 2. This will change PAD0 = 1 invoking the D-Bug12 bootloader.
3) Setup hyperterm session for the following:

RS-232 Serial Port INTERFACE Using DB9 Cable between S12UB POD and PC.
9600 Baud
8 data bits
No parity
1 Stop bit
XON/XOFF Handshaking

Bootloader always starts up at 9600 baud.

4) Make sure Hyperterminal is on-line and power up S12UB.
5) A startup bootloader menu will be shown. If not, press POD Reset SW2. Menu should be shown.
6) Select Set Baud Rate letter c.
7) Select 57600 baud number 3. Changing the baud reduces the time to download SerMon DGI.
8) Go off-line with hyperterm, change the baud to 57600 under properties. Apply and OK.
9) Hit return to make sure link is good. Should see bootloader menu again.
10) Erase the POD Flash by pressing selection a. No need to hit return.
11) When POD Flash is erased menu will be shown.
12) Program Flash by pressing selection b. No need to hit return.
13) In hyperterm under transfer select send text file. Send file, find SerMon108.s19 under the SUPPORT\TOOLS\SERMON Folder on the Distribution Disk, or on your hard drive if loaded. Select file.
14) Hyperterm will send the S19 file with progress shown with "*" feedback.
15) When the down load is complete the menu will be shown again.
16) SerMon is now loaded into the POD Flash
17) Move POD J5 jumper to pins 2 and 3. This will configure Debug circuitry in POD mode.
18) Reset the POD by pressing SW2 POD Reset push button switch.
19) The POD can now be used with the Codewarrior debugger.

**Changing from SerMon GDI to D-Bug12**

1) Power S12UB down. Make sure the BDM cable between POD and TARGET is in place.
2) Jumper POD J5 pins 1 and 2. This will change PAD0 = 1 invoking the D-Bug12 bootloader.
3) Setup hyperterm session for the following:

RS-232 Serial Port INTERFACE Using DB9 Cable between S12UB POD and PC.
9600 Baud
8 data bits
No parity
1 Stop bit
XON/XOFF Handshaking

Bootloader always starts up at 9600 baud.

4) Make sure Hyperterminal is on-line and power up S12UB.
5) A startup bootloader menu will be shown. If not, press POD Reset SW2. Menu should be shown.
6) Select Set Baud Rate letter c.
7) Select 57600 baud number 3. Changing the baud reduces the time to download D-Bug12.

8) Go off-line with hyperterm, change the baud to 57600 under properties. Apply and OK.
9) Hit return to make sure link is good. Should see bootloader menu again.
10) Erase the POD flash by pressing selection a. No need to hit return.
11) When POD Flash is erased menu will be shown.
12) Program Flash by pressing selection b. No need to hit return.
13) In hyperterm under transfer select send text file. Send file, find db12DP256-8.s19 under the SUPPORT\TOOLS\DEBUG12 Folder on the Distribution Disk or on your hard drive if loaded. Select file.
14) Hyperterm will send the S19 file with progress shown with "*" feedback.
15) When the down load is complete the menu will be shown again.
16) D-Bug12 is now loaded into the POD Flash
17) Move POD J5 jumper to pins 2 and 3. This will configure Debug circuitry in POD mode.
18) Reset the POD by pressing SW2 POD Reset push button switch.
19) The POD is now running D-Bug12. The D-Bug12 baud is stored in EEPROM so if changed to a different baud, like 57600 this should be still resident unless the EEPROM is erased using the Bootloader menu selection d.

# 5 Other Requirements

The S12UB Distribution Disk contains a rich GUI front end that allows easy navigation of the Labs contained in the program. While operation of this GUI is not required to access the study material or to perform project builds; the following minimum system requirements apply to its operation:

| Windows | Macintosh | Linux |
|---|---|---|
| Intel® Pentium® II 450MHz or faster processor (or equivalent) | PowerPC® G3 500MHz or faster processor<br><br>Intel Core™ Duo 1.83GHz or faster processor | Modern processor (800MHz or faster) |
| 128MB of RAM | 128MB of RAM | 512MB of RAM, 128MB of Graphics Memory |

To obtain optimal performance however, a Pentium® IV or equivalent system is recommended.

# 6 Open issues

Currently, some of the advanced labs in this package remain under development.

# 7 Revision History

| Version | Date | Revised By | Description of Changes |
|---|---|---|---|
| 1.3 | 2007-09-13 | Mark Robbins | Initial Version |
| | | | |

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