Attack of the SpYder

Discover Freescale's MC9S08 micro, SpYder and CodeWarrior

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In this short series of articles we add Freescale's powerful MC9S08 device to the diverse and colourful palette of 8-bit microcontrollers that have graced our pages these past two or three decades! This month you'll get to know MC9S08's cronies called SpYder and CodeWarrior; next month we have a nice application project for you to build. For your benefit we're going to use a micro housed in an 16-pin DIP case!

Freescale Semiconductor ranks among the market leaders in microcontrollers — yet their tool set and distribution networks were unattainable to the hobbyist market until 2006 as their tool solutions, both hardware and software, were price inhibitive. Since breaking off from Motorola they have placed a strong focus on the mass market and with the recent addition of an e-commerce site, free samples, free of charge compilers and debuggers and low cost hardware tools Freescale's microcontroller families are now accessible to all. *Elektor Electronics*, in exclusive cooperation with Freescale, is happy to be instrumental in this. The latest tool, the SpYder, manufactured by SofTec Microsystems with a normal resale price of about £ 20 (30) is another strong step into this marketplace.

Where it all came from

The roadmap shown in **Figure 1** shows how Motorola/Freescale's cores have evolved. The HC05 and HC11 8-bit cores were introduced in the 1980s and were widely used by all kinds of developers. In the late 1990s the HC08 (8-bit) and HC12 (16-bit) cores were introduced but were never widely adopted by the mass market. In very early 2000's the HCS12 16-bit core followed by the HCS08 8-bit core were introduced with the key new feature on the Background Debug Module (BDM).

The 8-bit HCS08, and — introduced

SpYder is a bug eating, MCU spying tool for 8- and 16- legged microcontrollers

last year — the RS08 microcontrollers contain a single-wire background debug interface, supporting in-circuit programming of on-chip non-volatile memory and sophisticated non-intrusive debug capabilities. It is this module which enables the development of these low cost, easy to use tools. The

BDM connection will also be present on the 32-bit microcontroller 68K/ColdFire™ V1 core products which will be available later this year.

BDM: do-it-yourself or buy one

In 2005 *freegeeks.net* (now integrated in www.freescale.net) provided the HCS12 microcontroller community with an open source tool named TBDML, and with 1454 downloads in the first 12 months it was hailed a great success. Now the equivalent tool for their 8-bit BDM enabled microcontrollers is available in two forms. You can choose the OSBDM for the HCS08's which you can find details of on the Freescale forums [1]. This self build tool has a BOM (bill of materials) of under $10.

Alternatively, you can buy a ready made SpYder which supports MC-

9S08QG, MC9S08QD and MC9RS08KA 8-bit microcontrollers to date, and as more microcontrollers are announced this list will grow.

The SpYder Discovery kit will be sold through Elektor as of this magazine issue.

OSBDM and SpYder essentially do the same thing. They interface between your development environment (Windows PC based) and your target microcontroller as shown in **Figure 2**. The key aim of these tools is to provide a tool which is cheap and easy for enthusiasts, students etc. to use.

More about SpYder and BDM

The 2*g* accelerometer we'll describe in part 2 of this series is controlled by Freescale's MC9S08QG8 MCU and the SpYder Discovery Kit.
The Kit is a new USB-to-BDM development tool for Freescale's MC9S08QG, MC9S08QD and MC9RS08KA 8-bit microcontrollers (**Figure 3**). For those of you unfamiliar with BDM, it is Freescale's version of ICD, debugWIRE, JTAG etc., used on their recent 8- and 16-bit products.

The BKGD (BacKGrounD) pin on these devices provides this single-wire background debug interface to the on chip debug modules. See the Development Tools chapter of any HCS08 or RS08 datasheet for more information about these debug modules and how

MC9S08QG4/QG8 features

- 4-8k Flash, capable of EEPROM emulation
- 512bytes of RAM
- Internal Clock Source (ICS)
- Up to 10 MHz bus
- On-chip oscillator
- Frequency locked loop to generate the CPU clock from the internal oscillator.
- External crystal support (16-pin only) up to 10MHz bus
- 2% accuracy over full operating range
- Power saving modes
- Serial Communication
- I²C (synchronous), SPI (synchronous), and SCI (asynchronous) Timers
- 2-channel Timer/PWM Module (TPM)
- An 8-bit modulo timer module (MTIM) with 8-bit prescaler
- Analogue Modules
- 8-channel, 10-bit ADC, including temp sensor
- Analogue comparator
- Development Tools: SpYder08 & CodeWarrior Special Edition (free)
- On chip ICE and BDM
- 8-pin packages – PDIP (!), NB-SOIC, DFN
- 16-pin packages – PDIP (!), TSSOP, QFN

Freescale & Elektor

Elektor is proud and glad to acknowledge its exclusive cooperation with Freescale Semiconductor Inc. for the benefit of its readers. The cooperation covers not only publishing articles based on Freescale microcontrollers and other semiconductor devices, but also sales of SpYder kits at a reduced price. There's more in the pipeline so stay tuned.
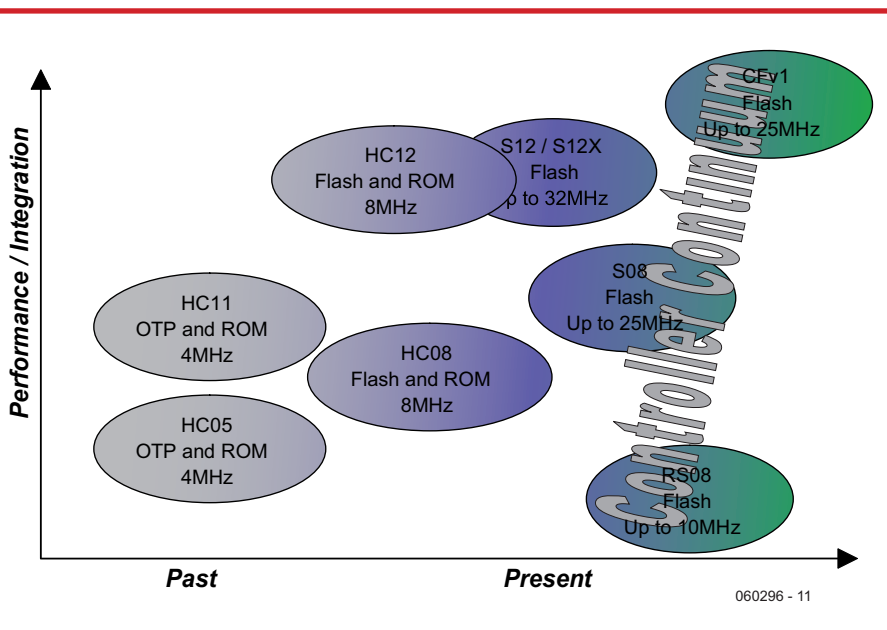

Figure 1. Core roadmap of a selection of Freescale micros released onto the market.
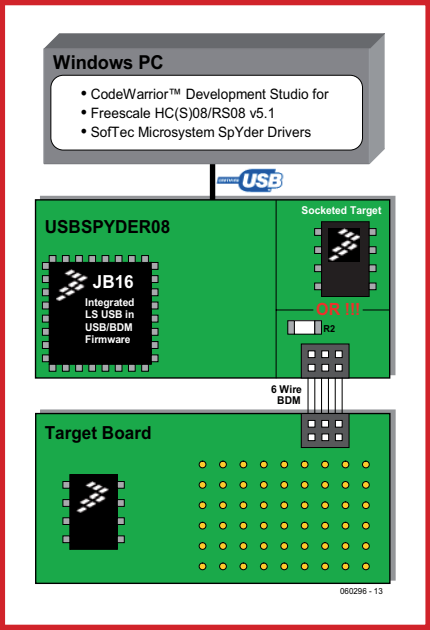
Figure 2. SpYder comfortably seated between the PC's USB and a Freescale microcontroller board with BDM connectivity.
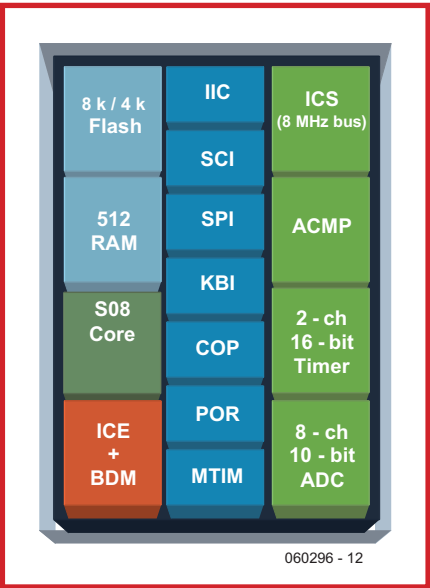

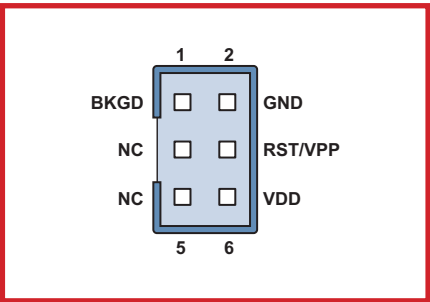Figure 3. What's inside an MC9S08 micro — globally, that is!

Figure 4. Freescale BDM connector pinout.

to use them. While the interface is single wire, typically a 6-pin connector, a BDM port is used to interface with the target as shown in **Figure 4**.

The primary function of this pin is for bidirectional serial communication of active background mode commands and data transfer. During reset, this pin is used to select between starting in active background mode or by

starting the user's application program. Additionally, this pin requests a timed sync response pulse, allowing a host development tool to determine the correct clock frequency for background debug serial communications. BDC commands are sent serially from a host computer to the BKGD pin of the target HCS08 or RS08 MCU. All commands and data are sent MSB-first using a custom BDC communications protocol. With a single-wire background debug interface it is possible to use a relatively simple interface pod to translate commands from a host computer into commands for the BDC.

In the case of the SpYder Discovery Kit, a low-speed universal serial bus (USB) interface is used.

The tool takes the form of a USB Flash Memory Stick.
Together with the CodeWarrior IDE, SpYder provides you with everything you need to write, compile, download, in-circuit emulate and debug user code. Full-speed program execution allows you to perform hardware and software testing in real time. The tool works up to bus speeds of 10 MHz, supports the 3.3 V operation range of the microcon-

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MC9S08QG8CPBE is just a long name
for an 8-bit micro in a 16-pin PDIP case

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trollers and has on board a socketed target microcontroller which can be replaced with other supported PDIP packaged parts available in small sample quantities FOC from http://www.freescale.com. To increase the flexibility of the tool, it has a BDM connector for off-board debugging of the supported products in other packages, or if you need to develop along with other board components.

Meet CodeWarrior

Freescale's CodeWarrior™ Development Studio for HC(S)08/RS08 with its award winning integrated development environment (IDE) has a quick start guide which eases installation and helps create a first example project, and more than 100 example

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What is the MC9S08QG8CPBE microcontroller and how to get one

For next month's accelerometer project you will need to order up an MC9S08QG8CPBE as it will be the main controller in the system. It is a small (8 and 16 pin), fully featured microcontroller device from the Freescale S08 family. The device includes the main features shown in the inset. The datasheet can be found at

www.freescale.com/files/microcontrollers/doc/data_sheet/MC9S08QG8.pdf

You can get hold of free samples of the MC68HCS08QG8 DIP parts from here

www.freescale.com/webapp/sps/site/overview.jsp?
nodeId=0109840078695970592869294489&tid=FSH

Click on 8-bit microcontrollers and search for MC9S08QG8CPBE, then follow the instructions to receive free samples.

YES it is a 16-pin DIP IC! To place the order simply type the part number specified, click on the Order Sample button and follow the steps required to finalize the order. At any one time you can only order a maximum of four samples.

Note: the supply of free samples is at the discretion and terms of Freescale and not in any way governed by Elektor Electronics

projects are available to assist in your design efforts.

The Project Wizard (**Figure 5**) can be used to create a working project (Assembly or C) in as few as seven mouse clicks, and users can change target microcontrollers and the debug/Flash programming connection in an open project.

The IDE features an intuitive project manager and build system; a highly optimized compiler; a graphical, source-level debugger; integrated profiling capabilities; a full chip simulator and more.

The free 'Special Edition' of the CodeWarrior™ Development Studio for HC(S)08 and RS08 devices can be downloaded from the Freescale web site. It's just not possible to print the exact url here as the file is behind an extensive login procedure. At the time of writing, the download is shown as a 'Featured Tool' on the Freescale 8-bit microcontrollers page [2]. It should be noted that the download is fairly large at about 283 Mbytes. Fortunately, the Special Edition is included on the CD-ROM you get with the Softec SpYder Discovery kit.

Lots more information on CodeWarrior for various Freescale microcontroller families and platforms may be found on [3], including special releases for professional users.
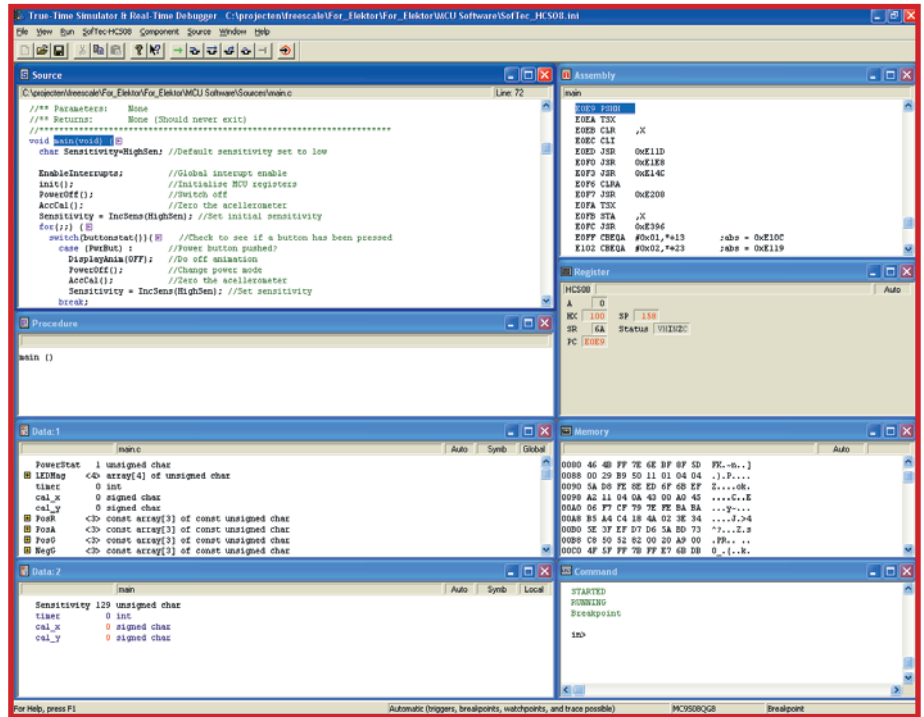
For a number of our readers invariably

Figure 5. CodeWarrior's Project Wizard in action. Full debugging on a running program can be seen here.

suspicious about special offers we print that CodeWarrior Special Edition allows projects of up to 64 k to be developed using assembler, and 16 k in C.

An in-depth introduction to CodeWarrior can be found in application note AN2616 [4].

In-circuit debugging can be achieved within the CodeWarrior IDE when your PC is connected to the target application with a BDM cable such as the SpYder.

Next month

In a follow-up article we'll discuss setting up SpYder and CodeWarrior for the benefit of our first project, a 2*g*, 2-axis accelerometer with LED readout, based on an MC9S08QG8CPBE microcontroller. The project will be built on two small PCBs which will come with a free gift.

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SpYder Discovery kit

Thanks to a special arrangement with Freescale Semiconductor, the Spyder Discovery kit is a available from Elektor at a price of just £ 6.45 (Euro 9.75 / US$ 12.70) plus postage & packing. SpYder allows you to program and debug code for MC9S08 micros, in conjunction with CodeWarrior Development Studio for RS08/HC08 devices (free download or on enclosed CD-ROM).

It should be noted that the photograph shows an early version of the Softec kit supplied to beta testers. The final version supplied to Elektor customers comes with an 8-pin PDIP MC-9S08QG8 sample, and the SpYder plug-in board encapsulated in a plastic housing.

Web links

[1] www.freescale.net/forums and http://forums.freescale.com/freescale/board?board.id=8BITCOMM

[2] www.freescale.com/webapp/sps/site/homepage.jsp?nodeId=0162468449&tid=FSH

[3] www.freescale.com/webapp/sps/site/overview.jsp?nodeId=01272694011860

[4] www.freescale.com/files/microcontrollers/doc/app_note/AN2616.pdf