Applications Engineering



Powerful Processors – Easy to Use™

# SKP38602

# User's Manual

Rev. 1.0 March 2006



### **Table of Contents**

1.0 Introduction	.2
2.0 Contents of Product Package	. 3
3.0 Limited Guarantee and Support	.4
<ul> <li>4.0 System Connectivity</li></ul>	.5.5.5.6.6
<ul> <li>5.0 Hardware</li></ul>	.7 .7 .8 .9 .9
6.0 System Operation & Limitations       1         6.1 Kernel (ROM Monitor) Introduction       1         6.2 Pin and Peripheral Limitations       1         6.3 Memory Map       1         6.4 Register Operation Limitations       1         6.5 Limitations on Interrupts       1         6.6 Stop or Wait Mode Limitations       1         6.7 User Program's Real-Time Capability       1         6.8 Performing Debug Using Symbols       1	10 10 11 11 11 12 12
7.0 SKP38602 Board Specifications       1         7.1 Hardware Specifications       1         7.2 Power Supply Requirements       1         7.3 Operating Environment       1	13 13 13 13
Appendix A. Troubleshooting Guide	14 17 18 19 20

## 1.0 Introduction

The SKP38602 StarterKit Plus (SKP) is a low-cost development environment for evaluating H8/Super Low Power (SLP) series of microcontrollers (MCU) using the H8/38602 and Renesas software development tools. The kit comes with a complete software development tool chain including, HEW (IDE, GUI, Debugger), C-compiler, assembler, and linker, and the E8 in-circuit Debugger.

A real-time, source-level debug environment is implemented using the HEW debugging interface with the E8 hardware. The E8 also allows for programming H8/SLP devices within HEW.

The E8 and firmware provide a convenient USB (Universal Serial Bus) interface between the SKP38602 board and the host PC. This interface reduces resource requirements on the H8/38602 MCU, allows faster code downloads and, can also be used with many other Renesas Flash MCU's, SKP's, and user's target boards.



## 2.0 Contents of Product Package

This section describes the contents of the SKP38602 product package. When unpacking your SKP38602, please check to see that all products listed below are included.

#### 2.1 SKP38602 StarterKit Plus Product List

Table 2-1 lists the products included in the SKP38602.

Product Name	Quantity	Remark
CKD20000 De and	Quantity	
SKP38602 Board	1	H8/38602 SKP Board
E8 Debugger	1	HEW Debugger/ USB
		Programmer Interface Device
		(includes 14pin ribbon cable)
Mini USB Cable	1	Connects E8 to the Host PC
Quick Start Guide	1	Assists user in installing the
		tools and launching them for the
		first time.
SKP CD-ROM	1	Auto-install program
		HEW (IDE), C-compiler,
		assembler, and linker
		Manuals
		Tutorials
		Sample programs
Promotional CD	-	Evaluation versions of 3 <sup>rd</sup> party
		tools may be included with the
		kit

#### Table 2-1 SKP38602 Product List

#### 2.1.1 SKP CD-ROM

The CD-ROM contains the electronic manuals and software necessary for developing programs. Your computer must have Netscape Navigator® or Microsoft®'s Internet Explorer to view the help files and Adobe Acrobat Reader to view the manuals.

Insert the enclosed CD into your computer and SKP installer will auto-start. The SKP installer program will create a 'C:\Renesas' and 'C:\Workspace' folder on your PC. Documentation, sample code, and other SKP related files are in the 'C:\Renesas\SKP38602'. HEW is installed in the 'C:\Program files\Renesas' folder by default.

If the SKP installer program does not start up, browse the CD's root folder and double-click on '*skp\_installer.exe*' to start installation.

### 3.0 Limited Guarantee and Support

Renesas Technology America, Inc., warrants the SKP38602 to be free from component or assembly defect for a period of 180 days from the date of purchase. Settlement is limited to repair or replacement of the product only. Renesas Technology America, Inc., does not assume any liability arising out of the application or use of any product, circuit or procedure described herein. No other liability or warranty apply, expressed or implied. Software warranty is limited to replacement of the CD only. While every attempt has been made to ensure accurate documentation, Renesas Technology America, Inc., cannot be held responsible for error or omissions and reserves the right to make changes without further notice.

## Warning!

The MCU on this product, the H8/38602 (HD64F38602R) is a 3.3 volt device. Applying over 4.3 volts to this kit will damage the MCU and void the warranty.

## RENESAS

## 4.0 System Connectivity

The following lists the hardware and software products required for using the SKP38602 StarterKit Plus.

- Host Computer (supplied by user)
- SKP38602 Board
- E8 Debugger
- Mini USB Cable
- Target Cable
- Software Tools (HEW IDE, Compiler/Linker), installed on host computer.

Figure 4-1 shows the system connectivity for the SKP38602.



Figure 4-1 SKP38602 System Connectivity

#### 4.1 Host Computer Requirements

The minimum requirement to be able to use the software that comes with the SKP38602 is a PC with a USB port and Microsoft Windows 2000, or XP.

#### 4.2 SKP38602 Board

The SKP38602 board provides an evaluation and development environment for the H8/38602 MCUs. See section 5.0 'Hardware' for more details.

#### 4.3 E8 Debugger

The E8 provides a plug-and-play debugging and programming interface to the H8/38602 Eval Board via the host computer's Universal Serial Bus (USB). The USB port also provides power to the H8/38602 board and E8 thereby eliminating the need for an external power supply. The E8 can also be used to Debug code on a user's target board, see the "H8/38602 notes for the E8 Debugger" available from the Start menu (Start > Programs > RENESAS > SKP38602 > All Documents)"

#### 4.4 Software Development Tools

The SKP installer program installs all the development tools. For details on installation, see the Quick Start Guide or see the Troubleshooting guide in Appendix A, if required. A brief description



of all the included tools follows. Please refer to the individual Tool manuals for detailed information.

#### 4.4.1 HEW (High-performance Embedded Workshop)

HEW provides a Graphical User Interface (GUI) that integrates the software development tools and includes the C-compiler, assembler, linker, debugger and editor.

#### 4.4.2 H8S, H8/300 Evaluation Version C Compiler

The evaluation version of the H8S, H8/300 compiler (version 6.1.1.0) is provided with the same functionality as the commercial version except that link size will be restricted to 64 Kbytes on and after the 61st day from when you begin using the compiler. Contact your local sales representative if you wish to purchase a full license.

#### 4.4.3 Hew Debug Interface

HEW communicates with a kernel (i.e. a ROM monitor program) on the target MCU through the E8 Debugger. This debug interface provides a highly efficient evaluation environment. Features include:

- Source-line debug for assembly language and C language
- Source editing in debug window
- Single step command.
- 3 hardware breakpoints\* (events): 2 address and 1 data breakpoint.
- Up to 255 software breakpoints
- C variable "watch" window
- And more

\*Note: The number of hardware breakpoints will vary depending on the flash MCU used.

#### 4.4.4 Renesas AutoUpdater

Included with HEW 4.0 and later is the Renesas AutoUpdater utility. This utility can be configured to automatically search our website for updates of the Renesas tools installed on your PC. See the HEW User's Manual on how to use this feature.

#### 4.4.5 Documentation, sample Projects and Project Generators

The SKP includes a full set of user documentation, sample projects, and Project Generators (a project generator is a template to create a project for a specific target). After installing the CD, the sample projects can be found in the C:\Renesas\SKP38602\sample\_code folder. Documentation can be browsed by using the "Manual Navigator" from the Start menu (Start > Programs > RENESAS > SKP38602 > All Documents).



## 5.0 Hardware

#### 5.1 SKP38602 Board

Figure 5-1 shows the SKP38602 Board with major components identified.



Figure 5-1. SKP38602 Board



#### 5.2 SKP38602 Board Block Diagram

The SKP38602 board incorporates an HD64F38602FP (32-pin QFP) from the H8/300H Super Low Power series of microcontrollers designated as U1. Figure 5-2 shows the SKP38602 block diagram.



Figure 5-2. SKP38602 Board Block Diagram

#### 5.3 H8/38602 Group of MCUs

The H8/38602 group of 16-bit single-chip, flash microcontrollers (MCU) is part of the H8/300H Super Low Power series devices. The hardware and software manuals for the H8/38602 group of microcontrollers can be found under C:\Renesas\SKP38602\Docs folder in your PC or by using the "Manual Navigator" from the Start menu (Start > Programs > RENESAS > SKP38602 > All Documents) after SKP software installation.

#### 5.4 SKP38602 Board Jumper Configuration

#### 5.4.1 JP1: MCU (U1) Power

JP1 is used to connect the Vcc pins of the H8/38602 MCU to the Vcc/MCU Power of the board. It can be used to measure current/power consumption of the MCU during various modes of operation. Do not apply power to the SKP without an ammeter across the JP1 pins or JP1 pins shorted.

JP1 is shorted by default.

#### 5.4.2 JP2: Clock Source Select

JP2 is used to determine the MCU clock source after reset: pulled hi, the MCU uses the external (9.83 MHz) crystal, if pulled low, the MCU will use the on-chip oscillator. The E8 will work in either mode, but for debugging, the crystal must not be removed.

Pins 1 and 2 of JP2 are shorted by default (external crystal used as clock source).

## 6.0 System Operation & Limitations

The SKP38602 provides sophisticated debugging features at a low cost but it does have some limitations when used with the debugger. Section 6.1 introduces the kernel program and its purpose. The limitations when this kernel is running with the user program are listed in table 6-1. For details on debugging H8/38602 MCUs, see the "E8 Emulator User's Manual" and "E8 Emulator, Additional Document for User's Manual, notes on Connecting the H8/38602RF" available from the Start menu (Start > Programs > RENESAS > SKP38602 > All Documents)".

ltem	Please Refer To	
	6.2 Pin and Peripheral Limitations	
Lisor Limitations	6.3 Memory Map	
	6.4 Low Power Modes	
	6.5 Limitations on Interrupts	
Dobuggor Limitations	6.6 Stop or Wait Mode Limitations	
Debugger Limitations	6.7 User Program's Real-time Capability	

#### Table 6-1 System Limitations (when debugging)

#### 6.1 Kernel Introduction

During debug, a small program, called a kernel, is downloaded to the H8/38602. The kernel communicates with HEW through the E8 regarding MCU status during user code debugging operations.

There are no special configurations steps required in the user project to make use of the E8 (only need to select "Download emulator firmware" option when HEW attempts to connect to the MCU). The operation of the kernel is transparent to the user but there are some limitations and these are discussed from section 6.2.

After starting a HEW debug Session, the E8 downloads the kernel to the H8/38602. After downloading the kernel, the H8/38602 is ready for downloading user code.

Connecting the E8 without starting HEW will not affect the lines connected between the E8 and the H8/38602 – the E8 keeps the lines in high-impedance state. The E8 only drives the pins after HEW (or FDT\*) attempts to connect.

After completing program debug and verification with HEW, the image can be programmed into the H8/38602 by disconnecting the E8 III then reconnecting using the "Flash memory writing" option. This procedure erases the kernel and leaves only the user program.

#### 6.2 Pin and Peripheral Limitations

While the MCU can use the on-chip oscillator while debugging, a clock signal must be connected to the OSC1 pins when the E8 is connected (e.g. do not remove X2). Pins E7\_0 to E7\_2 are dedicated to debugging (although E7\_2 is also used for clock source select). Do not connect these pins to any other circuit. While the NMI pin is used for debugging with the E8, it is possible for user's code to use the NMI pin but debugging features are restricted. For details, see the "H8/38602 notes for the E8 Debugger" available from the Start menu (Start > Programs > RENESAS > SKP38602 > All Documents)".

\* FDT is a Renesas MCU flash erase/write program not supplied with this kit.

#### 6.3 Memory Map

The H8/38602 memory map and reserved addresses are shown on Figure 6-2.



#### Figure 6-2 HD64F38602R Memory Map with E8 Restricted Areas.

Note:. The E8 uses a two-word stack pointer for values stored on a user program break. Therefore, the stack area needs to be 4 bytes larger than what the user program requires.

#### 6.4 Low-Power Mode

During a user program break, the CPU operating frequency is forced to the system clock ( $\phi$ ) for high-speed operation. It is recommended that for accurate low power evaluation, download your application code without the debug kernel (use the "Flash memory writing" option) and evaluate without the debugger (requires optional 3.3 volt supply).

#### 6.5 Limitations on Interrupts

For full feature debugging, the NMI interrupt is used by the E8 and therefore the vector is unavailable to the user. Any attempts to write to this vector are ignored and if user selects 'Debug > Verify Memory...', HEW will report a verify error.

#### 6.6 Sleep instruction Limitations

When the interrupt mask bit (I) in the condition code register (CCR) is 1, do not perform step execution of the SLEEP instruction. If the step execution is performed and not finished correctly, disconnect and restart the E8.

#### 6.7 User Program's Real-Time Capability

Be aware that while the kernel is in a "STOP" state, the hardware peripherals will continue to run. Therefore, interrupts may not be serviced properly. Also, the watchdog timer will not be serviced and will likely time out if active.

While the kernel is in a "RUN" state, there is no overhead on the application code UNLESS the user initiates the "Refresh" command in the 'Memory' window.

#### 6.8 Watchdog Timer

When the E8 is activated, the watchdog timer is disabled. The user program should not enables the watchdog.



## 7.0 SKP38602 Board Specifications

#### 7.1 Hardware Specifications

Table 7-1 lists the specifications of the SKP38602 Board.

Item	Specification
MCU	HD64F38602R
Clocks	Main Clock: crystal 9.8304MHz or on-chip oscillator
	Sub Clock: 32.768kHz crystal
Memory	RAM: 1kB
	Flash ROM: 16kB
Connectors	[J5]: 14 Pin connector for E8
	[J1-J2, J3-J4]: 2, 50 pin (user supplied) headers (for user target connection)
Jumpers	[J12]: MCU Power for Icc Measurements
	[J8]: selects on-chip oscillator or external clock after reset
LED's	[power] (Green)
	[LED1] (Red): User output (connected to P82)
	[LED2] (Red): User output (connected to P10)

#### Table 7-1. SKP38602 Board Specifications

#### 7.2 Power Supply Requirements

The SKP38602 Board will draw 35mA (max). With the E8, the current draw will be about 85mA.

#### 7.3 Operating Environment

Table 7-2 lists the environmental conditions for using and storing the SKP38602 board. When storing the board, place it in a conductive bag and then in the packing box your product was shipped in from the factory.

Environmental Condition	Ambient Temperature	Ambient Humidity
Operating	0 - 55°C	30 to 80% (non-condensing)
	(No corrosive gas allowed)	
Storage	-30 to 75°C	30 to 80% (non-condensing)
	(No corrosive gas allowed)	

#### Table 7-2. Operating Environment



## Appendix A. Troubleshooting Guide

This section discusses possible problems you may encounter while installing the software (and drivers) and while running the HEW debugger. This section also discusses the countermeasures and solutions to resolve these problems.

If, for any reason, you cannot resolve the problem, please contact your Renesas representative for assistance.

#### A.1 USB Driver Problems

This section discusses the usual problems with the driver installation and how to fix it. The most common problem encountered is that Windows did not properly install the driver and so the E8 is not recognized. This may also cause the device status to indicate that the device is not working properly.

Before trying the following steps, try restarting your PC and see if this resolves the problem. You can check the status using the Device Manager. Expand the "Renesas Emulator" entry, and if the "Renesas E-Series USB Driver" exists with NO red 'X' or yellow exclamation point, the driver was installed properly.

#### NOTE: Windows 2000 or XP, requires Administrator privileges to install the drivers.

For cases where the 'Device Status' states the device is not working properly, please try the following:

- Click on 'Renesas Emulator' and Double-click on 'Renesas E-Series USB Driver'; a properties dialog box appears.
- Click on 'Driver' tab and click on 'Update Driver' button.
- Select 'Display a list...' and click on 'Have Disk' button.
- Specify and locate the 'C:\Windows\systems32\Drivers' folder on your PC and install 'E1usb.sys' driver.

#### A.2 Debugging Problems

This section discusses the cause of the problem and countermeasures to resolve it. The common problems encountered with debugging are:

- Erratic debug behavior
- Cannot connect to target
- Issues that may come up during debug operations

#### A.2.1 Erratic Debug Behavior

- Users' must realize that when setting "hardware" breakpoints (events), the (assembler) instruction that the breakpoint is on is executed before program break. As a result, C watch variables may not seem to update properly or the break will occur after a branch instruction far from where the breakpoint is set. Note that for software breakpoints, the break occurs before the current instruction.
- HEW allows you to launch multiple "Slave HEW's". If more that one HEW is opened in a debug session and/or the FDT Programmer software is also running, erratic behavior can result.

#### A.2.2 Cannot Connect to Target

When the message "Connector Disconnected" or "Boot failed" is displayed when attempting to connect, there are several reasons that may cause this message to appear. Each cause and the corresponding countermeasure are discussed below.

• The SKP is not connected correctly.

Check the connection between the E8 and the PC, ands the SKP connection. See section 4 on system (SKP38602) connectivity.

• The E8 has no power (ACT LED on E8 is off).

Ensure that the Mode switch under the cover on the E8 is in the "1" position.

• The selected MCU on the E8 board and the actual target MCU (H8/38602) do not match.

Close the error message by clicking on 'OK' button, and then click on the 'Cancel' button in the next window. Re-connect F to the E8 (you may need to disconnect f first) Make sure you select 'H8/38602F'. If the MCU loaded on the E8 is different, HEW will re-program the E8 to match it.

• The target MCU is damaged.

Try a different target board and see if the HEW will connect as you may have a damaged board or MCU. Warning! The MCU on this product, the H8/38602 (HD64F38602R) is a 3.3 volt device. Applying over 4.3 volts to this kit will damage the MCU and void the warranty.

• System Seems to Lock up at "Connecting"

Occasionally, HEW cannot proceed past the "Connecting" window. This typically is due to a



bad connection to the target, or selecting the wrong target MCU. Hew will time out eventually, but if you do not wish to wait, hit Ctrl-Alt-Del keys and cancel HEW.



#### A.2.3 Issues that may come up During Debug Operations

While debugging user code, some issues may come up because the limitations discussed in section 6 were not satisfied. The common issues are listed on table A.2, including the countermeasures.

#### Table A.2. Problems while Debugging

Problem	Possible Cause/s and Solution
After stepping a few instructions, HEW cannot "stop" or locks up	<ul> <li>MCU stack has over-run, or restricted memory areas were accessed.</li> </ul>
HEW locks up (cannot stop program) or Communication error message is displayed.	<ul> <li>Ensure no limitations in Section 6 were violated.</li> <li>Do a hardware reset. User-program runaway may be corrupting the kernel (RAM, interrupt vectors, flags, etc.) Close debug session, and then restart.</li> <li>User program enables watchdog timer. Close debug session, remove watchdog code in source files, recompile and restart the debug session.</li> </ul>

Note: If it has been identified that there are problems with the E8, please see the E8 user's manual.



## Appendix B. Reference Manuals

Manuals are accessible from the Windows Start menu "Start > Programs > RENESAS > SKP38602 > All Documents"

ltem	Title	Description
1.	SKP38602 Quick-Start Guide	Gets you up and running with the SKP38602.
2.	SKP38602 User's Manual	This Document.
3.	SKP38602 Board Schematic	Schematic diagram for the SKP38602 Starter Kit board.
4.	H8/38602 Group Hardware Manual	Operation and Specifications for the H8/38602 MCU.
5.	H8/300H Series Software Manual	Instruction set for the H8/300H series CPU cores.
6.	E8 Emulator Users Manual	E8 Debugger Manual
7.	E8 Notes for H8/38602	E8 Debugger information specific to the H8/38602
10.	HEW 4.x User's Manual	High-performance Embedded Workshop User's Manual.

## RENESAS

## Appendix C. Expansion Headers

J1 Pin	Function
1	CON_AVCC
2	CON_X2
3	CON_OSC2
4	CON_OSC1

J3 Pin		Function
1	P30	
2	PB4	
3	PB2	
4	PB0	
J5 Pin		Function
J5 Pin 1	TEST	Function
J5 Pin 1 2	TEST P83	Function
J5 Pin 1 2 3	TEST P83 P10	Function

J7 Pin	Function
1	E7_1
2	P90
3	P92
4	P32

J2 Pin	Function
1	CON_X1
2	RESn
3	GND
4	+3.3V

J4 Pin		Function
1	P31	
2	PB5	
3	PB3	
4	PB1	
J6 Pin		Function
1	D04	
	P04	
2	P64 P82	
2 3	P82 P11	

J9 Pin	Function
1	E7_2
2	E7_0
3	P91
4	P93



## Appendix D. MB-H838602 PCB Layout



For SKP updates, see: <u>www.renesas.com/skp</u>