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SKP8CMINI15
SKP8CMINI17

User's Manual

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1.0 Introduction

The SKP8CMINI-17* (and the SKP8CMINI-15) Starter Kit Plus (SKP) is a compact system to evaluate Renesas software development tools and the R8C/Tiny microcontrollers (MCU). The kit also includes sample code, documentation, and tutorial to jumpstart development.

The software development tools that come with the kit include the High-performance Embedded Workshop HEW, NC30WA C-compiler/Assembler/Linker, and FoUSB (Flash-over-USB™) Programmer.

The HEW Debug Interface, together with the In-Circuit Debugger (RTA-FoUSB-MON), provides a real-time, source-level debug environment. The FoUSB Programmer application, with the In-Circuit Debugger (ICD), allows in-system programming of the R8C/Tiny flash MCU.

The ICD provides a convenient USB (Universal Serial Bus) interface between the Mini R8C board and the PC. This interface reduces resource requirements on the R8C/Tiny MCU, allows faster code downloads and, can also be used to program other Renesas Flash MCU's using Flash-over-USB™.

*NOTE: this manual also applies to the SKP8CMINI-15. If using the SKP8CMINI-15, replace any references to the SKP8CMINI-17 with SKP8CMINI-15.

2.0 Kit Contents

This section describes the contents of SKP8CMINI-17 product package. When unpacking your kit, please check to see that all products listed below are included.

2.1 SKP8CMINI-17 Starter Kit Plus (SKP) Product List
Table 2-1 lists the products included in the kit.

Table 2-1 SKP8CMINI-17 Product List

Product Name	Qty	Remark
Mini R8C Board	1	R8C/Tiny target board
In-Circuit Debugger (RTA-FoUSB-MON)	1	Hardware programmer & debugger
6' Mini USB Cable	1	ICD to PC
CD ROM	1	Auto-install program HEW4 IDE & software debug interface NC30WA Compiler/Assembler FoUSB programming software Manuals Sample programs

2.1.1 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 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:\Workspace and C:\RENESAS\SKP8CMINI17 folder on your machine. Development tools can be found under C:\RENESAS (NC30WA Compiler, and FoUSB Programmer) and HEW (High-performance Embedded Workshop) is installed into c:\program files. Documentation, sample code, and other SKP related files could be found in the C:\RENESAS\SKP8CMINI17 folder.

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 SKP8CMINI-17 Starter Kit Plus and the SKP8CMINI-15 Starter Kit Plus 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.

"Flash-Over-USB" is a trademark of Renesas Technology America, Inc. All trademarks are the property of their respective owners.

4.0 System Connectivity

The following lists the hardware and software products required for using the SKP8CMINI-17 Starter Kit Plus.

- Host Computer with available USB port (supplied by user)
- Mini R8C Board
- In-Circuit Debugger/ Programmer (RTA-FoUSB-MON)
- Mini USB Cable
- Software Tools (HEW4, NC30WA Compiler, FoUSB Programmer)

Figure 4-1 shows the system connectivity for the SKP8CMINI-17.

Figure 4-1 SKP8CMINI-17 Connectivity

4.1 Host Computer Requirements

The minimum requirement to be able to use the software that comes with the kit is a PC with an available USB port and Microsoft Windows 98, ME, 2000, or XP operating system.

4.2 Mini R8C Board

The Mini R8C board provides a compact evaluation and development environment for the R8C/Tiny series of MCU. It has two switches (pushbutton and slide) and LED's for user interface. It also has a CdS cell and thermistor on board.

4.3 In-Circuit Debugger

The ICD provides a plug-and-play debugging and programming interface to the Mini R8C board by using the host computer's Universal Serial Bus (USB). The USB port also provides power to the Mini R8C board and ICD thereby eliminating the need for an external power supply.

NOTE:
The ICD can be used to connect to other boards (i.e. customer target boards) with an R8C or M16C Flash MCU. For details, please see ICD User's Manual included with the kit (Start > All Programs > RENESAS-TOOLS > SKP8CMINI17 > Document Descriptions).

4.4 Development Tools

Aside from SKP documentation and sample code, the SKP installer program also installs the development tools. Please see the quick start guide on how to run the SKP installer.

4.4.1 HEW

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 NC30WA Evaluation Version C Compiler

The evaluation version of the M3T-NC30WA V.5.30 Release 02 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 ICD. This debug interface provides a highly efficient evaluation environment. Features include:

- Source-line debug for assembly language C language
- Single step command (does not limit number of breakpoints).
- Run command with **4** breakpoints* for the R8C/17 and R8C/15
- RAM monitor function
- C variable "watch" window

Note: The number of breakpoints will vary depending on the M16C flash MCU used.

4.4.4 FoUSB (Flash-over-USB^{TM}) Programmer

User programs can run on the Mini R8C board without the host computer running HEW by programming the on-board R8C/Tiny flash MCU with firmware using FoUSB Programmer software and ICD. It can also be used to program other Renesas R8C and M16C Flash MCU's.

5.0 Hardware

5.1 Mini R8C Board

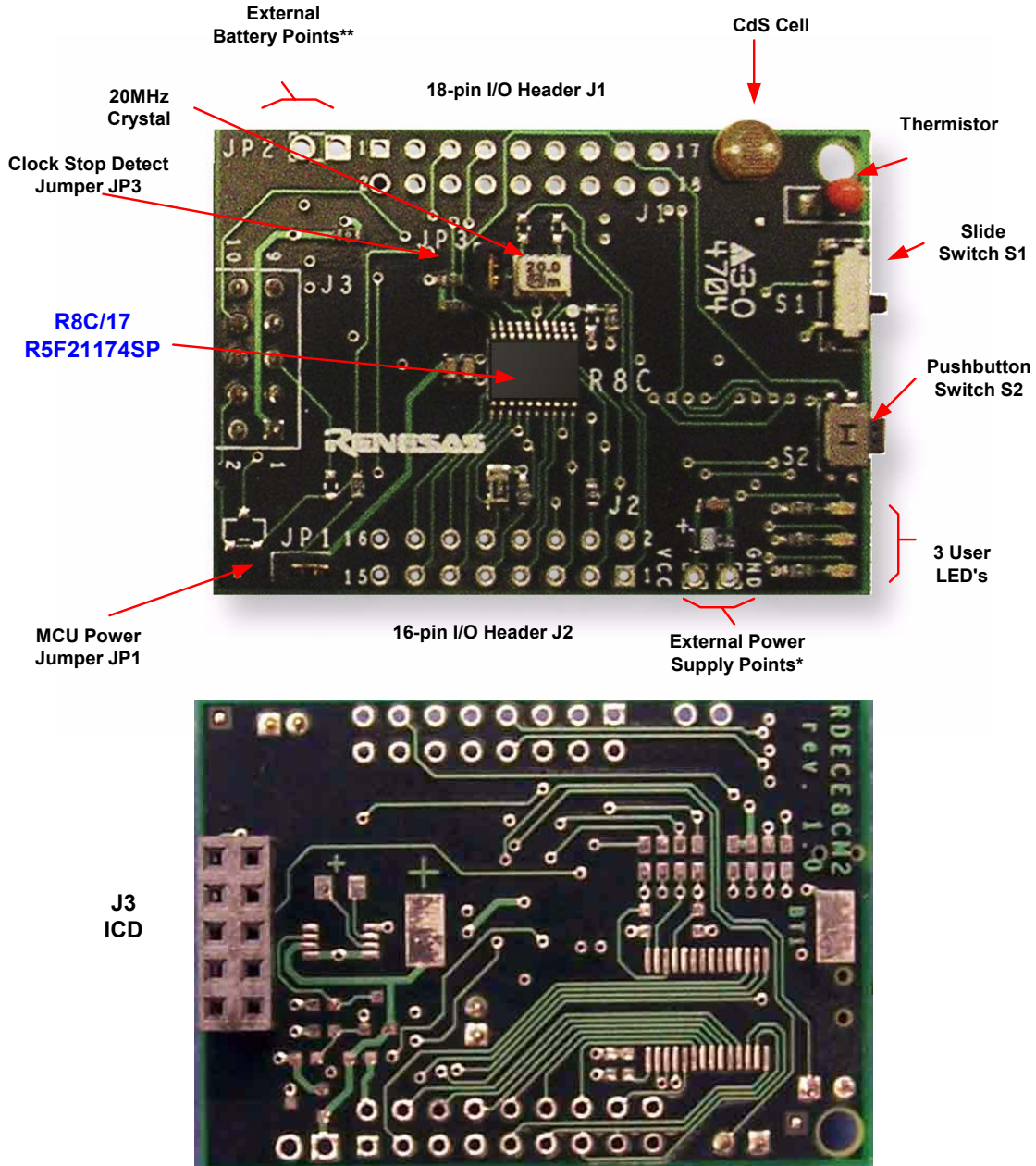Figure 5-1 shows the Mini R8C Board with major components identified.

Figure 5-1. Mini R8C Board

Note:
* Connect an external power supply to these points to power the board when not using the ICD.

** Use this jumper (JP2) when connecting batteries or an external supply to power to the add-on on-board voltage regulator. The bottom side of the board can be populated with a voltage regulator circuit and battery holder for stand-alone operation. See Appendix G for more information.

5.1.1 R8C/Tiny Series of Microcontrollers

The R8C/Tiny Series of 16-bit single-chip, flash microcontroller (MCU) is available in several configurations of peripheral functions and features. The Hardware Manual for the R8C/17 group of microcontrollers can be found on the C:\RENESAS\SKP8CMINI17\Docs folder of your PC under the filename '**r8c17_hardware_manual_revx.x.pdf**' after SKP software installation or from the Start menu (Start > All Programs > RENESAS-TOOLS > SKP8CMINI17 > Document Descriptions).

5.1.2 Block Diagram

The Mini R8C Board incorporates an R5F21174SP (20 pin SSOP) from the R8C/17 group of microcontrollers. Figure 5-2 shows the Mini R8C Board block diagram.
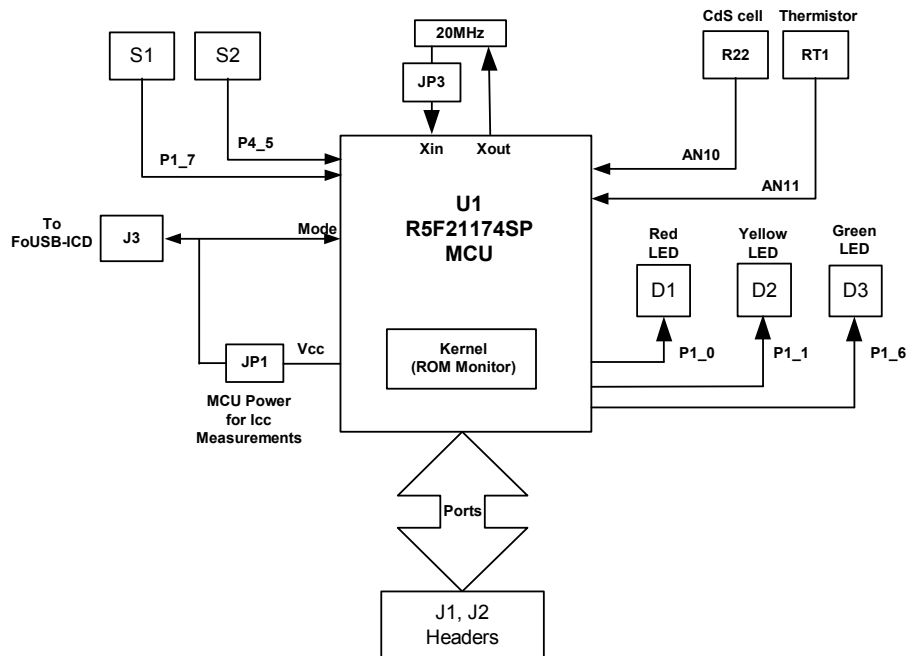
Figure 5-2. Mini R8C Board Block Diagram

5.1.3 External Power Supply Points

The external power supply points can be used to operate the Mini R8C Board without power from the ICD. This is a direct connection with Vcc and Ground on the board. Please see the schematic in Appendix C. An external power supply that can provide 2.7V to 5.5V and 100mA can be used. However, when used with the ICD (in target power mode), 3.3V is the minimum voltage for proper operation.

5.1.4 External Battery Points (using on-board voltage regulator circuit)

An external battery (or power supply) can be connected to JP2 for operation with the voltage regulator circuit. The Mini R8C Board has provisions for a voltage regulator circuit but does not come with this circuit populated. For more information please see the schematic in Appendix C and expansion circuit description in Appendix G.

6.0 System Operation & Limitations

The kit provides sophisticated debugging features at a low cost but it does have some limitations when used with the HEW Debugger and ICD. Section 6.1 introduces the ROM monitor program and how it is used. The limitations when this ROM monitor is running with the user program are listed in table 6-1.

Table 6-1 Systems Limitations During Debug (when used with the ICD)

Item	Please Refer To
User Limitations	6.2 Pin Usage Limitations
	6.3 Memory Map
	6.4 Status After Reset
	6.5 Register Operation Limitations
	6.6 Limitations on Interrupts
Debugger Limitations	6.7 Stop or Wait Mode Limitations
	6.8 User Program's Real-time Capability

6.1 Kernel (ROM Monitor) Introduction

During debug, a small program, called a kernel, is downloaded to the R8C/17. The kernel communicates with HEW through the ICD about MCU status during user code debugging operations.

There are no special steps required in the user program to make use of the ICD. 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 ICD downloads the kernel to the R8C/17 if it does not exist (e.g. blank device or programmed with FoUSB Programmer). After downloading the kernel, the R8C/17 is ready for downloading code.

Connecting the ICD without starting HEW will not affect the lines connected between the ICD and the R8C/17 – the ICD keeps the lines in high-impedance state. The ICD only drives the pins after HEW or FoUSB Programmer attempts to connect..

After program debug and verification, you can then create and download a binary, Intel (.hex) or Motorola (.mot), file to the R8C/17. This operation erases the kernel and only leaves the user program.

6.2 Pin Usage Limitations

The Mode and Reset pins are used for communication between the Mini R8C board kernel and the host computer through the ICD. For details, please see ICD (RTA-FoUSB-MON) User Manual Section 5, Target M16C ROM Monitor Resources.

6.3 Memory Map

Figure 6-2 shows the R5F21174FP memory map. The user memory area includes:
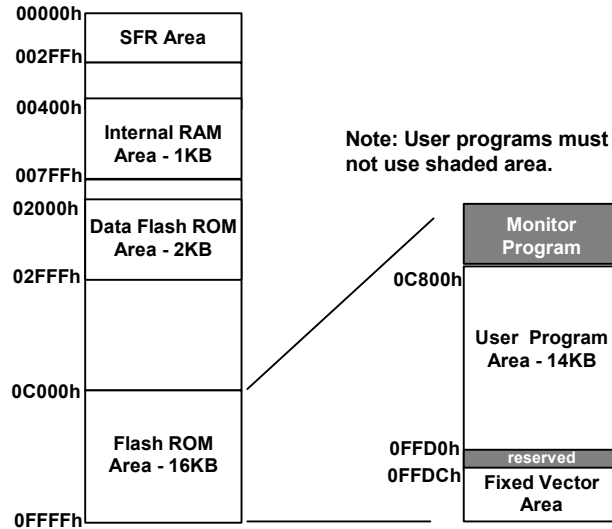- RAM area – 1K Bytes
- Flash ROM area – 14 KB

Figure 6-2 R5F21174SP Memory Map

Note there are no limitations regarding user RAM. However, approx. 2k bytes of user Flash ROM are utilized by the kernel.

6.4 Status After Reset

Table 6-2 lists the value of the UART1 register initialized by the kernel when the Mini R8C starter board is reset. The register status depends on the MCU's internal operation performed after a reset.

Table 6-2. Initial Register Values After Reset

Register Name	Initial Value After Reset
UART1	Set for external clock synchronous mode

6.5 Register Operation Limitations

Table 6-3 lists registers with modification limitations. Modifying the contents of these registers are modified may cause the kernel to operate incorrectly.

Table 6-3. Limitations on Register Operation

Register Name	Restriction
Address Match Interrupt Enable Register	Do not change
Address Match Interrupt Register 0	Do not change
Address Match Interrupt Register 1	Do not change
High-speed On-Chip Oscillator Control Registers 1 (HRA0, HRA1, HRA2)	The kernel sets the high-speed on-chip oscillator to 8MHz. Do not modify or disable it.

6.6 Limitations on Interrupts - Vectors that reside in the Hardware Vector Table

Table 6-4 lists the limitations on hardware interrupt vector addresses.

Table 6-4. Interrupt Vector Addresses

Interrupt Cause	R8C/17 Vector Address	Kit Specification

Undefined	0FFDCH ~ 0FFDFH	User available
Overflow	0FFE0H ~ 0FFE3H	User available
BRK Instruction	0FFE4H ~ 0FFE7H	User available
Address Match	0FFE8H ~ 0FFEBH	User inhibited
Single-step	0FFECH ~ 0FFEFH	User inhibited
Watchdog Timer	0FFF0H ~ 0FFF3H	User available
Reserved	0FFF4H ~ 0FFF7H	Reserved
Reserved	0FFF8H ~ 0FFFBH	Reserved
RESET	0FFFCH ~ 0FFFFH	User available (Note 1)

NOTES:
(1) The monitor program transparently relocates the Reset vector to the reserved area.

6.7 Stop or Wait Mode Limitations

To use Stop or Wait modes in the user's program, start the debugger in free-run mode. If you want to debug, close the RAM, C Watch and ASM Watch Windows before actually debugging. Furthermore, set a breakpoint or take other necessary measures when getting out of Stop or Wait mode in order to ensure that no windows operations will be performed until the program stops at the breakpoint.

6.8 User Program's Real-Time Capability

Please be aware that, even if the kernel stops the user program (kernel in "STOP" state), the hardware peripherals will continue to run. Therefore, interrupts may not be serviced properly.

While the user program is running (kernel is in "RUN" state), there is no overhead on the application code, UNLESS a RAM monitor window is open in HEW. This window requires periodic communication with the MCU. This communication suspends normal application operation while servicing the request (approximately 2000 BCLK cycles for each 16 bytes of data displayed in the window are used per window update).

6.9 Performing Debug Using Symbols

Normally when a new project is started, debugging symbols are enabled. If you are unable to debug your program using symbols in HEW, add the debug option [-g] before compiling the programs.

For more information, see the HEW user's manual.

7.0 Mini R8C Board Specifications

7.1 Hardware Specifications

Table 7-1 lists the specifications of the Mini R8C Board.

Table 7-1. Mini R8C Board Specifications

Item	Specification
MCU	R5F21174SP
Clocks	Main Clock: 20MHz Crystal
Memory (Internal)	RAM: 1 KB Flash ROM: 16KB (14KB user) + 1k x2 Data Flash
Connector	[J1 & J2]: Expansion connectors [J3]: Debugger interface
Sensors	[R22]: CdS Cell connected to AN10 (P12) [RT1]: Thermistor connected to AN11 (P13)
Jumpers	[JP1]: MCU power – for MCU Icc measurements [JP2]: External battery or power supply connection [JP3]: Oscillation Stop Detect function
Switches	[S1]: Slide switch (connected to P17) [S2]: Pushbutton switch (connected to P45)
LED's	[D1] (Red): User output (connected to P10) [D2] (Yellow): User output (connected to P11) [D3] (Green): User output (connected to P16)

7.2 Operating Environment

Table 7-2 lists the environmental conditions for using and storing the Mini R8C 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.

Table 7-2. Operating Environment

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

Appendix A. Troubleshooting Guide

This section discusses possible problems you may encounter while installing the software (and drivers) and while running HEW or FoUSB Programmer applications. 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 ICD is not recognized. This may also cause the device status to indicate that the device is not working properly. An indication of this problem is the ICD status yellow LED - it blinks about 2-3 times a second. When the driver is installed properly, the yellow LED should only blink every second.

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. If the ICD appears under the Universal Serial Bus Controllers with NO red X or yellow exclamation point, the driver was installed properly.

If you are using Windows 2000 or Windows XP, you need to have Administrator privileges to be able to install the drivers.

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

- Double-click on 'Renesas USB-Monitor' and a Renesas USB-Monitor 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:\RENESAS\FoUSB\USB Drivers' folder on your PC and install 'usbmon.sys' driver.
- If this process does not work, please try the instructions below.

For cases where in the driver was not installed properly by Windows (Windows 98, Windows 2000) or not listed in the Device Manager > Universal Serial Bus Controllers, please try the following:

- Unplug the USB Cable so Windows removes driver from memory.
- Delete the driver 'usbmon.sys' from '\WINNT\SYSTEM32\DRIVERS\ folder in Windows 2000 or \WINDOWS\SYSTEM32\DRIVERS folder in Windows 98.
- Plug in ICD and try installing the driver as written above, but use the driver from the CD. The folder is C:\RENESAS\FoUSB\USB Drivers.

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

HEW allows you to launch multiple "Slave HEW's". If more that one HEW is opened in a debug session and/or the FoUSB Programmer software is also running, erratic behavior can result. Having more than one ICD installed can also cause erratic problems or cause HEW to crash.

A.2.2 Cannot Connect to Target

When the message 'Can't connect with the target' 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.

Please connect the ICD to your PC. Note: Regardless of whether the ICD is bus or target-powered, please connect target board to ICD board first before plugging the USB cable to your PC. Please see section 4 on system (SKP8CMINI-17) connectivity.

- The ICD has no power (Power LED on ICD is off).

Please ensure that the Power Mode switch on the ICD is on the 'USB' side. In 'Target' position, the ICD is powered from the target side.

- USB was not selected on the Init dialog box.

Please select 'USB' from the Init dialog box that is displayed right after you start a debug Session.

- The selected MCU on the ICD board and the actual target MCU (R8C/17) do not match.

Close the error message by clicking on 'OK' button, and then click on the 'Cancel' button of the Init window. Make sure you select R5F21174.mcu' (or'R5F21154.mcu' if using R8C/15). If the MCU loaded on the ICD is different, HEW will re-program the ICD to match it.

- The target MCU is damaged.

Try a different target board and see if HEW will connect as you may have a damaged board or MCU.

A.2.3 Issues that may come up During Debug Operations

While using HEW to debug user code, some issues may come up because the limitations discussed in section 6 were not satisfied. These 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 hangs	• Changes were made to SFR's or other memory locations causing MCU mode changes.
Breakpoints do not seem to work	• System is in "FreeRun" mode. Change the RUN mode to "Sampling" from the "Init" window (Emulator System icon).
HEW locks up (cannot stop program) or Communication error message is displayed.	• Changes were made to SFR's or other memory locations causing MCU mode changes (e.g. High speed oscillator modified or stopped). • Ensure no limitations in Section 6 were violated. • Re-initialize the system without closing HEW. See note below. • Do a hardware reset. User-program runaway may be corrupting the kernel (RAM, interrupt vectors, flags, etc.) Close HEW, reset hardware (disconnect & reconnect USB cable), and then restart.
Download problems	• Filenames or directory names contain spaces or special characters. • HEW project not properly set up (startup files missing or out of order, files added to wrong member, etc). Try creating a new project and adding your source files to it. For details, please see HEW user's manual.

To re-initialize the system without closing HEW, try the following:

- Press the [OK] button on the error dialog box to close it.
- When an Exit dialog box appears, press the [Cancel] button to close it.
- Click HEW reset Icon.

After initialization, debugging can resume. However, it is recommended that you download your program again before debugging.

Note: If it has been identified that there are problems with the ICD, please see the ICD's (RTA-FoUSB-MON) user's manual and troubleshooting.

Appendix B. Reference Manuals

| Item	Title	Description
1.	**Mini R8C SKP Quick-Start Guide**	Document that will help you get started on using the SKP8CMINI.
2.	**Mini R8C SKP User's Manual**	Installation and operation guide for the SKP8CMINI.
3.	**Mini R8C Board Schematic**	Schematic diagram for the Mini R8C board.
4.	**Mini R8C Board BOM**	Bill of materials for the Mini R8C board.
5.	**R8C/17 Group Hardware Manual** **R8C/15 Group Hardware Manual**	Specifications for the R8C/17 MCU. Specifications for the R8C/15 MCU.
6.	**R8C Series Software Manual**	This document details the instruction set and timing information for the R8C series CPU cores.
7.	**HEW User's Manual**	High-performance Embedded Workshop User's Manual.
8.	**NC30WA User's Manual**	ANSI C-language programming guide for the R8C/Tiny and M16C series MCUs.
9.	**AS30 User's Manual**	Assembly language programming guide for the R8C/Tiny and M16C/20/60 series MCUs.
11.	**M16C/20/60 and R8C C Language Manual**	C Language Programming manual for M16C and R8C family MCUs.
12.	**M16C/20/60 Series Sample Programs**	Sample programs and application notes for the M16C/20/60 and R8C series MCUs.
13.	**RTA-FoUSB-MON User's Manual**	User guide and operation manual for the ICD.

Appendix C. J1 & J2 Pin Assignment

J1	
Pin No.	**I/O Expander Signal (U3)**
1	Vcc
2	GND
3	PP24
4	PP18
5	PP23
6	PP17
7	PP22
8	PP16
9	PP21
10	PP15
11	PP20
12	PP14
13	PP19
14	PP13
15	P45_INT0 (MCU Signal)
16	PP12
17	Vcc
18	GND

| J2	
Pin No.	**MCU Signal (U1)**
1	Xin/P46
2	Xout/P47
3	P35_SCL_SSCK
4	P37_CNTRO_SSO
5	P34_SDA_SCS
6	P33_TCin
7	P10_KI0
8	P11_KI1
9	P12_AN10
10	P13_AN11
11	P14_TxD0
12	P15_RxD0
13	P16_CLK0
14	P17_INT10
15	Vcc
16	GND

Appendix D. Board Dimensions

Mini R8C board dimensions are provided here for making connections to user defined add-on boards.
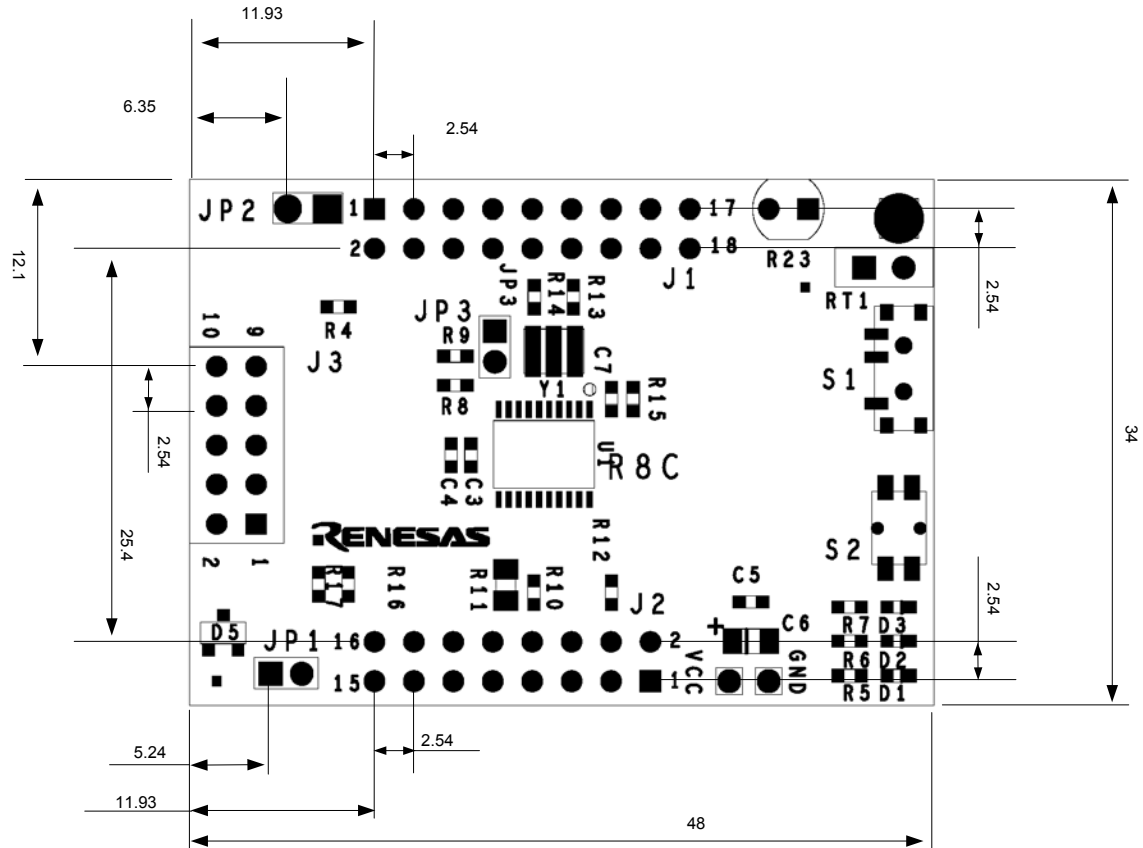
Appendix E. Expansion Circuit

Additional circuitry has been implemented on the bottom side of the Mini R8C board to provide a port expander and a battery power boost voltage regulator circuit (user supplied components). The schematic details this circuit and the BOM specifies all the parts (included as separate files on the SKP CD). The data sheets for the voltage regulator and port expander are also included on the SKP CD. Ensure R4 is removed (top side) before adding the voltage regulator. Use port expander MAX7300 and add R21 for the SKP8CMINI-17 and use the MAX7301 and add R22 for the SKP8CMINI-15.
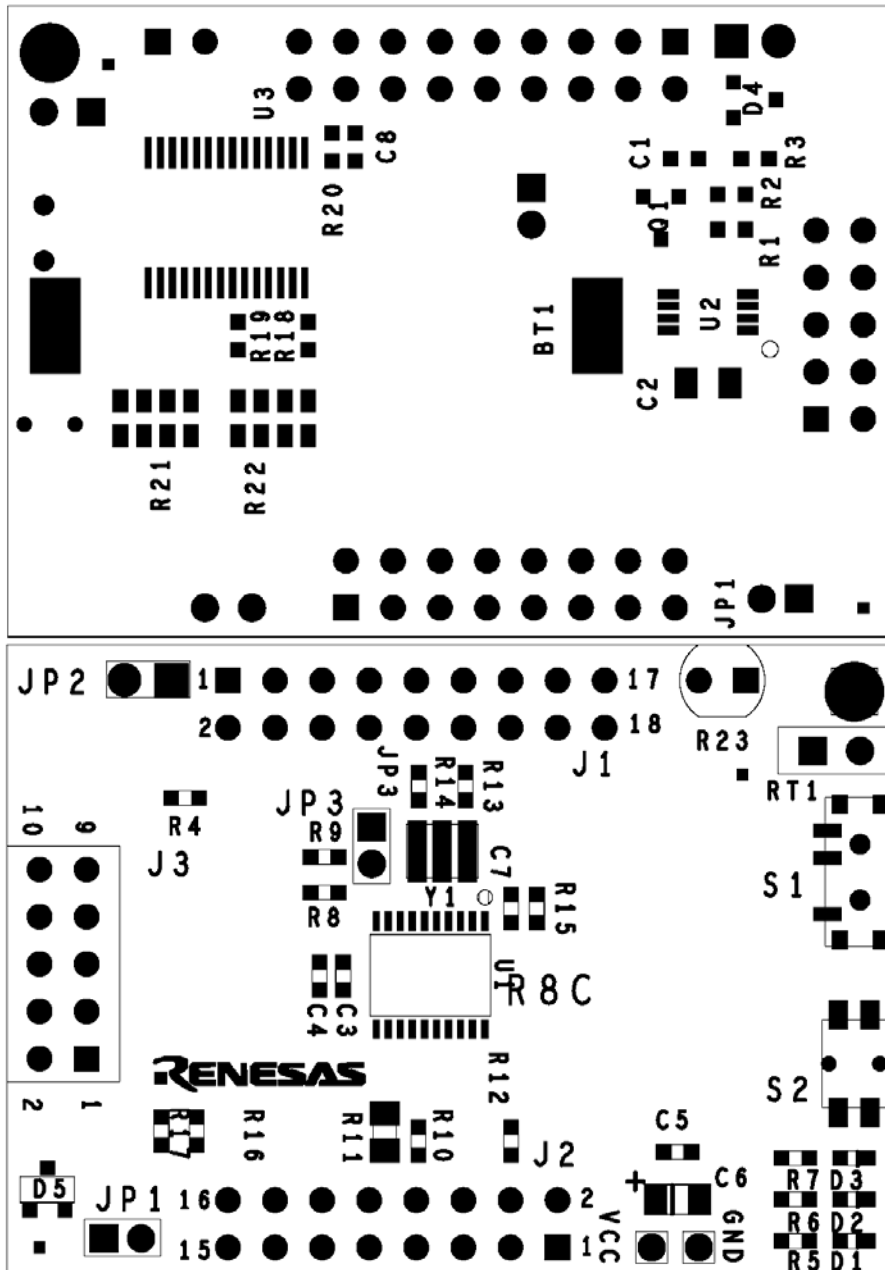
Appendix F. SKP8CMINI-17 Schematic and Bill of Materials

The SKP8CMINI-17 Schematic is available as a separate document, SKP8CMINI-17_Schematic.pdf.

The SKP8CMINI-17 Bill of Materials is available as a separate document, SKP8CMINI-17_BOM.pdf.

Appendix G. In-Circuit Debugger

For details on how to use the ICD, please see RTA-FoUSB-MON User's Manual.

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