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User's Manual

Renesas Starter Kit

RSKR8C13 User's Manual

RENESAS SINGLE-CHIP MICROCOMPUTER M16C FAMILY / R8C/Tiny SERIES

Renesas Electronics
www.renesas.com

Rev.1.00 2006.04

Table of Contents

Chapter 1. Preface

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Glossary

CPU	Central Processing Unit	RTE	Renesas Technology Europe Ltd.
HEW	High-performance Embedded Workshop	RSO	Renesas Solutions Organisation.
LED	Light Emitting Diode	RSK	Renesas Starter Kit
PC	Program Counter		

Chapter 2. Purpose

This RSK is an evaluation tool for Renesas microcontrollers.

Features include:

- Renesas Microcontroller Programming.
- User Code Debugging.
- User Circuitry such as Switches, LEDs and potentiometer(s).
- User or Example Application.
- Sample peripheral device initialisation code.

The RSK board contains all the circuitry required for microcontroller operation.

Chapter 3. Power Supply

3.1. Requirements

This RSK operates from a 3V to 5V power supply.

A diode provides reverse polarity protection only if a current limiting power supply is used.

All RSK boards are supplied with an E8 debugger. This product is able to power the RSK board with up to 300mA. When the RSK is connected to another system then that system should supply power to the RSK.

All RSK boards have an optional centre positive supply connector using a 2.1mm barrel power jack.

Warning

The RSK is neither under nor over voltage protected. Use a centre positive supply for this board.

3.2. Power – Up Behaviour

When the RSK is purchased the RSK board has the 'Release' or stand alone code from the example tutorial code pre-programmed into the Renesas microcontroller. On powering up the board the user LEDs will start to flash. After 200 flashes, or after pressing a switch the LEDs will flash at a rate controlled by the potentiometer.

Chapter 4. Board Layout

4.1. Component Layout

The following diagram shows the top layer component layout of the board.

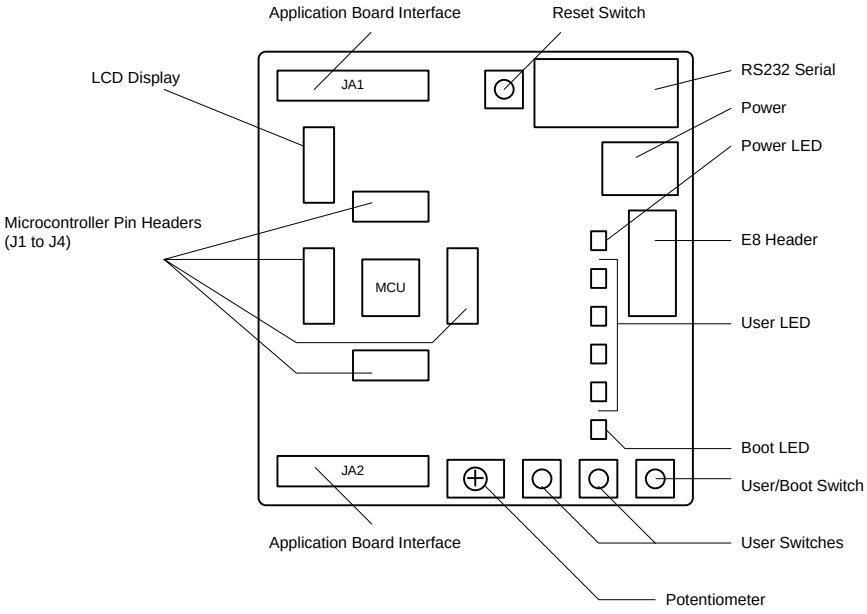

Figure 4-1: Board Layout

4.2. Board Dimensions

The following diagram gives the board dimensions and connector positions. All through hole connectors are on a common 0.1" grid for easy interfacing.

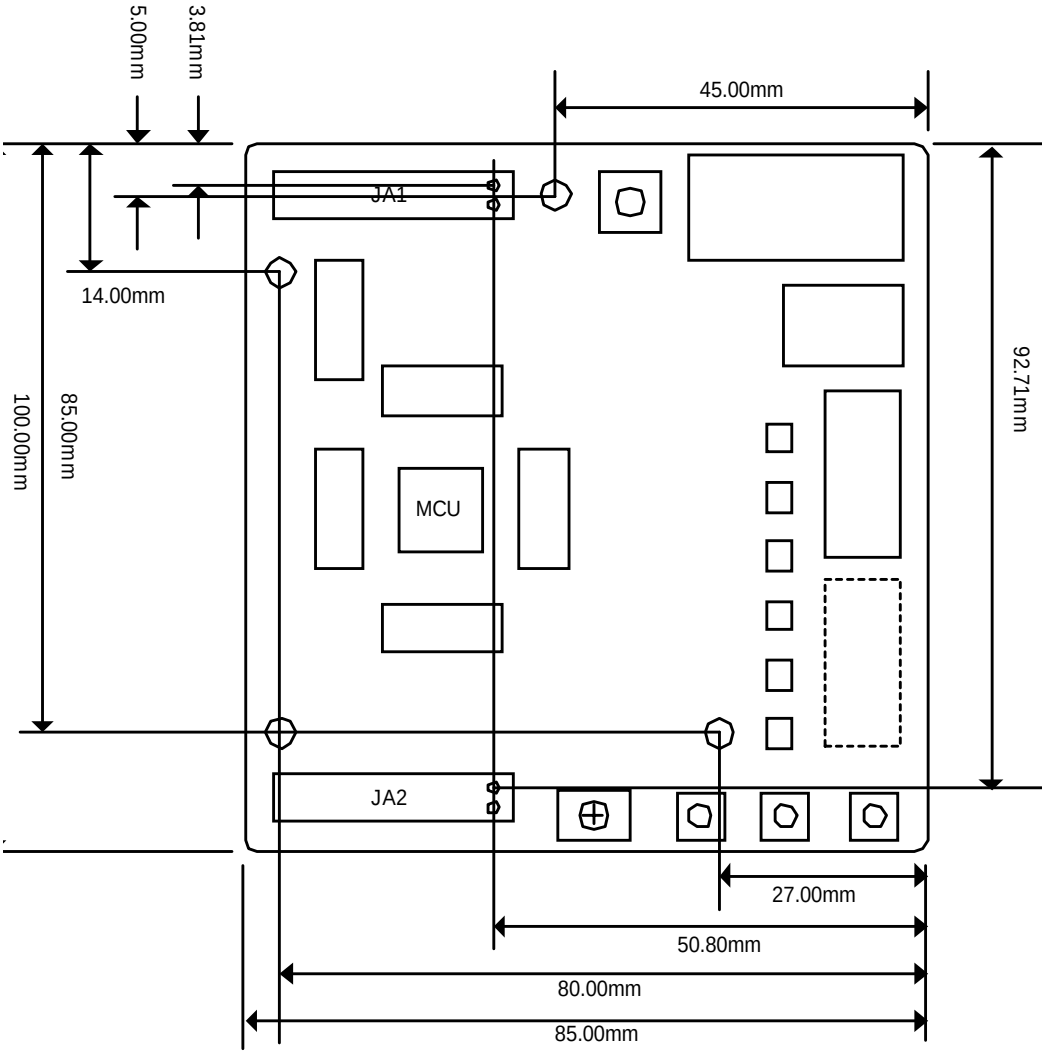

Figure 4-2 : Board Dimensions

Chapter 5. Block Diagram

Figure 5-1 is representative of the CPU board components and their connectivity.

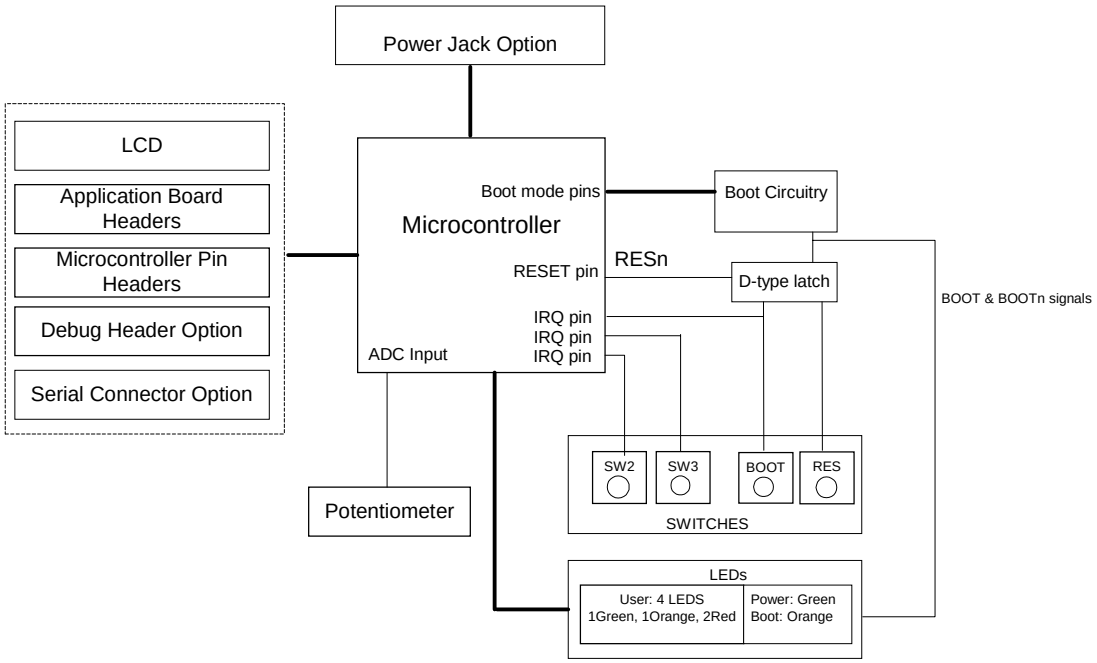

Figure 5-1: Block Diagram

Figure 5-2 is representative of the connections required to the RSK.

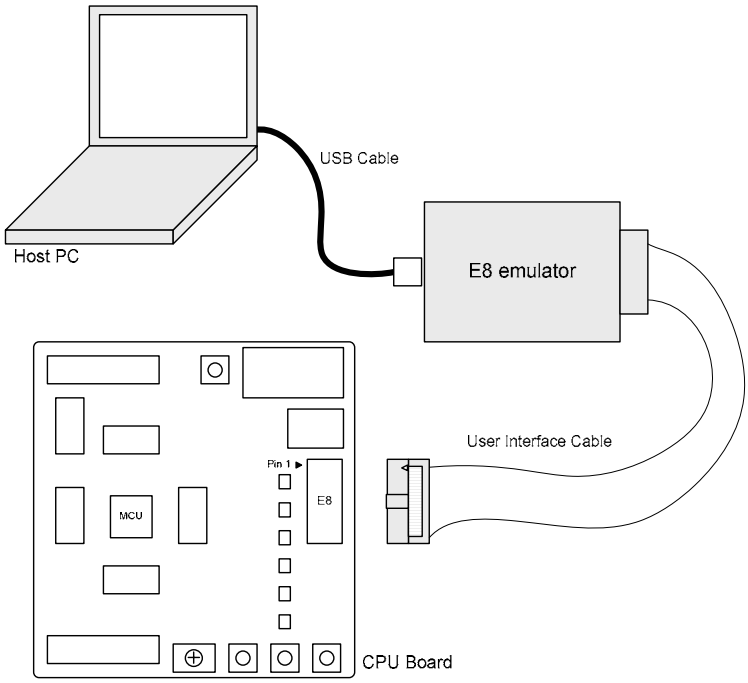

Figure 5-2 : RSK Connections

Chapter 6. User Circuitry

6.1. Switches

There are four switches located on the RSK. The function of each switch and its connection are shown in Table 6-1.

Switch	Function	Microcontroller
RES	When pressed, the RSK microcontroller is reset.	RESn Pin 3
SW1/BOOT*	Connects to an IRQ input for user controls. The switch is also used in conjunction with the RES switch to place the device in BOOT mode when not using the E8 debugger.	INT0 Pin16 (Port 4, pin 5)
SW2*	Connects to a Key In Interrupt input line for user controls.	KI0 Pin15 (Port 1, pin 0)
SW3*	Connects to a Key In Interrupt input line for user controls	KI1 Pin14 (Port 1, pin 1)

Table 6-1: Switch Functions

*Refer to schematic for detailed connectivity information.

6.2. LEDs

There are six LEDs on the RSK board. The green 'POWER' LED lights when the board is powered. The orange BOOT LED indicates the device is in BOOT mode when lit. The four user LEDs are connected to an IO port and will light when their corresponding port pin is set low.

Table 6-2, below, shows the LED pin references and their corresponding microcontroller port pin connections.

LED Reference (As shown on silkscreen)	Colour	Microcontroller Port Pin function	Microcontroller Pin Number
LED0	Green	Port 1.4	11
LED1	Orange	Port 1.5	10
LED2	Red	Port 1.6	9
LED3	Red	Port 1.7	8

Table 6-2: LED Port

6.3. Potentiometer

A single turn potentiometer is connected to AN4 (P0.3) of the microcontroller. This may be used to vary the input analogue voltage value to this pin between AVCC and Ground.

6.4. Serial port

The microcontroller programming serial port 1 is connected to the E8 connector. This serial port can optionally be connected to the RS232 transceiver as well by fitting option resistors. The connections to be fitted are listed in the table 6-3.

Description	Function	Fit for RS232
TxD1	Programming Serial Port	R40
RxD1	Programming Serial Port	R41

Table 6-3: Serial Port settings

A Secondary serial port is connected to the application headers. This is shared with the LEDs.

6.5. LCD Module

A LCD module is supplied to be connected to the connector J8. This should be fitted so that the LCD module lies over J1. Care should be taken to ensure the pins are inserted correctly into J8.The LCD module uses a 4 bit interface to reduce the pin allocation. No contrast control is provided; this is set by a resistor on the supplied display module. The module supplied with the RSK only supports 5V operation.

Table 6-4 shows the pin allocation and signal names used on this connector.

J8					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	Ground	-	2	5V Only	-
3	No Connection	-	4	DLCDRS	31
5	R/W (Wired to Write only)	-	6	DLCDE	30
7	No Connection	-	8	No Connection	-
9	No Connection	-	10	No Connection	-
11	DLCD4	27	12	DLCD5	26
13	DLCD6	25	14	DLCD7	24

Table 6-4: LCD Module Connections

6.6.Option Links

Table 6-5 below describes the function of the option links contained on this RSK board.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R1	Oscillator	Connects X1 (or X2) to Microcontroller	Disconnects X1 (or X2) from Microcontroller	R2, R3, R4
R2	Oscillator	Connects X1 (or X2) to Microcontroller	Disconnects X1 (or X2) from Microcontroller	R1, R3, R4
R3	Oscillator	Connects external clock to Microcontroller	Disconnects external clock from Microcontroller	R1, R2, R4
R4	Oscillator	Connects external clock to Microcontroller	Disconnects external clock from Microcontroller	R1, R2, R3
R5	A/D Converter	Connects Board_VCC to VREF	Disconnects Board_VCC from VREF	R6, R7, R8
R6	A/D Converter	Connects CON_AVCC to VREF	Disconnects CON_AVCC from VREF	R5, R7, R8
R7	A/D Converter	Connects GND to AVSS	Disconnects GND from AVSS	R5, R6, R8
R8	A/D Converter	Connects CON_AVSS to AVSS	Disconnects Con_AVSS from AVSS	R5, R6, R7
R10	Power Supply	Connects J5 to Board_VCC	J5 disconnected from Board_VCC	R11, R13, R14
R11	Microcontroller Power Supply	Supply to Microcontroller	Fit Low ohm resistor to measure current	R10, R13,R14
R13	Power Supply (External 5V)	Connects CON_5V (external 5V) to Board_VCC	CON_5V disconnected from Board_VCC	R10, R11, R14
R14	Power Supply (External 3V3)	Connects CON_3V3 (external 3.3V) to Board_VCC	CON_3V3 disconnected from Board_VCC	R10, R11,R13
R39	RS232 Driver	Disables RS232 Serial Transceiver	Enables RS232 Serial Transceiver	
R40	RS232 Serial	Connect TX1 to RS232 Serial port (E8 remains connected)	Only E8 connected	R41
R41	RS232 Serial	Connect RX1 to RS232 Serial port (E8 remains connected)	Only E8 connected	R40
R42	E8	Use E8	Disconnect E8	
R45	SW1	Connects SW1 to P4_5	SW drives BOOT only	R46,R47

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R46	Application Board Interface	Connect MO_UD of application board interface to P4_5	Disconnect MO_UD of application board interface	R45, R47
R47	Application Board Interface	Connect IRQ0 of application board interface to P4_5	Disconnect IRQ0 of application board interface	R45, R46
R48	Application Board Interface	Connect MO_Vn of application board interface to P3_1	Disconnect MO_Vn of application board interface	R49
R49	Application Board Interface	Connect TMR1 of application board interface to P3_1	Disconnect TMR1 of application board interface	R48
R50	Application Board Interface	Connect MO_Wn of application board interface to P3_2	Disconnect MO_Wn of application board interface	R51
R51	Application Board Interface	Connect IRQ1 of application board interface to P3_2	Disconnect IRQ1 of application board interface	R50
R52	Application Board Interface	Connect TRIGa of application board interface to P3_3	Disconnect TRIGa of application board interface	R53
R53	Application Board Interface	Connect IRQ2 of application board interface to P3_3	Disconnect IRQ2 of application board interface	R52
R54	Application Board Interface	Connect TRISTn of application board interface to P1_3	Disconnect TRISTn of application board interface	R55
R55	Application Board Interface	Connect IRQ3 of application board interface to P1_3	Disconnect IRQ3 of application board interface	R54
R56	Application Board Interface	Connect MO_Un of application board interface to P3_0	Disconnect MO_Un of application board interface	R57
R57	Application Board Interface	Connect TMR0 of application board interface to P3_3	Disconnect TMR0 of application board interface	R56
R58	Application Board Interface	Connect AD3 of application board interface to P0_4	Disconnect AD3 of application board interface	R59, R71
R59	Application Board Interface	Connect IO_3 of application board interface to P0_4	Disconnect IO_3 of application board interface	R58, R71
R60	Application Board Interface	Connect AD1 of application board interface to P0_6	Disconnect AD1 of application board interface	R61, R73
R61	Application Board Interface	Connect IO_5 of application board interface to P0_6	Disconnect IO_5 of application board interface	R60, R73
R62	Application Board Interface	Connect TRIGb of application board interface to P1_7	Disconnect TRIGb of application board interface	R63
R63	Application Board Interface	Connect IO_7 of application board interface to P1_7	Disconnect IO_7 of application board interface	R62

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R64	Application Board Interface	Connect AD2 of application board interface to P0_5	Disconnect AD2 of application board interface	R65, R72
R65	Application Board Interface	Connect IO_4 of application board interface to P0_5	Disconnect IO_4 of application board interface	R64, R72
R66	Application Board Interface	Connect AD0 of application board interface to P0_7	Disconnect AD0 of application board interface	R67, R74
R67	Application Board Interface	Connect IO_6 of application board interface to P0_7	Disconnect IO_6 of application board interface	R66, R74
R68	LCD module	Connect LCD_RS to P0_2	Disconnect LCD_RS	
R69	LCD module	Connect LCD_E to P0_1	Disconnect LCD_E	
R70	Potentiometer	Connect AD_POT to P0_3	Disconnect AD_POT	
R71	LCD module	Connect LCD_D4 to P0_4	Disconnect LCD_D4	R58,R59
R72	LCD module	Connect LCD_D5 to P0_5	Disconnect LCD_D5	R64, R65
R73	LCD module	Connect LCD_D6 to P0_6	Disconnect LCD_D6	R60,R61
R74	LCD module	Connect LCD_D7 to P0_7	Disconnect LCD_D7	R66, R67

Table 6-5: Option Links

6.7.Oscillator Sources

A crystal oscillator or ceramic resonator is fitted on the RSK and used to supply the main clock input to the Renesas microcontroller.

Table 6-6: Oscillators / Resonators

details the oscillators that are fitted and alternative footprints provided on this RSK:

Component		
Resonator (X1)	Fitted	20 MHz
Crystal (X2)	Not Fitted	20 MHz (HC/49U package)

Table 6-6: Oscillators / Resonators

6.8.Reset Circuit

The CPU Board includes a simple latch circuit that links the mode selection and reset circuit. This provides an easy method for swapping the device between Boot Mode, User Boot Mode and User mode. This circuit is not required on customers boards as it is intended for providing easy evaluation of the operating modes of the device on the RSK. Please refer to the hardware manual for more information on the requirements of the reset circuit.

The Reset circuit operates by latching the state of the boot switch on pressing the reset button. This control is subsequently used to modify the mode pin states as required.

The mode pins should change state only while the reset signal is active to avoid possible device damage.

The reset is held in the active state for a fixed period by a pair of resistors and a capacitor. Please check the reset requirements carefully to ensure the reset circuit on the user's board meets all the reset timing requirements.

Chapter 7. Modes

The RSK supports Boot mode and Single chip mode.

Details of programming the FLASH memory is described in the R8C/13 Group Hardware Manual.

7.1. Boot mode

The boot mode settings for this RSK are shown in Table 7-1: Boot Mode pin settings below:

MODE	LSI State after Reset End
Low	Boot Mode

Table 7-1: Boot Mode pin settings

The software supplied with this RSK supports Boot mode using an E8 and HEW only. However, hardware exists to enter boot mode manually, do not connect the E8 in this case. Press and hold the SW1/BOOT. The mode pin is held in its boot state while reset is pressed and released. Release the boot button. The BOOT LED will be illuminated to indicate that the microcontroller is in boot mode.

When neither the E8 is connected northe board is placed in boot mode as above, the Mode pin is pulled high by a 100k resistor.

When an E8 is used the Mode pin is controlled by the E8.

7.2. Single chip mode

Because the Mode pin is pulled high, this RSK will always boot in Single Chip mode when the E8 is not connected and the boot switch is not depressed. Refer to R8C/13 Group Hardware Manual for details of Single chip mode.

MODE	LSI State after Reset End
High	Single Chip Mode

Table 7-2: Single Chip Mode pin settings

Chapter 8. Programming Methods

The board is intended for use with HEW and the supplied E8 debugger. Refer to R8C/13 Group Hardware Manual for details of programming the microcontroller without using these tools.

Chapter 9. Headers

9.1. Microcontroller Headers

Table 9-1 to Table 9-4 show the microcontroller pin headers and their corresponding microcontroller connections. The header pins connect directly to the microcontroller pins. * Marked pins are subject to option links.

J1					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	E8_TRX	1	2	CNVSS_E8D	2
3	RESn	3	4	CON_XOUT	4
5	GND	5	6	CON_XIN	6
7	UC_VCC	7	8	TRIGb/IO_7*	8

Table 9-1: J1

J2					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	SCIaCK	9	2	SCIaRX	10
3	SCIaTX	11	4	TRISTn/IRQ3*	12
5	MO_Wp	13	6	MO_Vp	14
7	MO_Up	15	8	MO_UD/IRQ0*	16

Table 9-2: J2

J3					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	TRIGa/IRQ2*	17	2	MO_Wn/IRQ1*	18
3	R_AVCC/VREF*	19	4	MO_Vn/TMR1*	20
5	R_AVSS	21	6	MO_Un/TMR0*	22
7	IVCC	23	8	AD0/IO_6*	24

Table 9-3: J3

J4					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	AD1/IO_5*	25	2	AD2/IO_4*	26
3	AD3/IO_3*	27	4	MODE_E8B	28
5	IO_2*	29	6	IO_1*	20
7	IO_0*	31	8	E8_TTX	32

Table 9-4: J4

9.2. Application Headers

Table 9-5 and Table 9-6 below show the standard application header connections.

JA1							
Pin	Header Name	RSK Signal Name	Device Pin	Pin	Header Name	RSK Signal Name	Device Pin
1	Regulated Supply 1	CON_5V	-	2	Regulated Supply 1	GROUND	-
3	Regulated Supply 2	CON_3V3	-	4	Regulated Supply 2	GROUND	-
5	Analogue Supply	CON_AVCC	19	6	Analogue Supply	CON_AVSS	21
7	Analogue Reference	NC	-	8	ADTRG	NC	-
9	ADC0	AD0	24	10	ADC1	AD1	25
11	ADC2	AD2	26	12	ADC3	AD3	27
13	DAC0	NC	-	14	DAC1	NC	-
15	IOPort0	IO_0*	11	16	IOPort1	IO_1*	10
17	IOPort2	IO_2	9	18	IOPort3	IO_3*	8
19	IOPort4	IO_4*	27	20	IOPort5	IO_5	26
21	IOPort8	IO_6	25	22	IOPort7	IO_7	24
23	IRQ3	IRQ3*	12	24	I²C Bus (3rd pin)	NC	-
25	I²C Bus	IIC_SDA*	-	26	I²C Bus	IIC_SCL*	-

Table 9-5: JA1 Standard Generic Header

JA2							
Pin	Header Name	RSK Signal Name	Device Pin	Pin	Header Name	RSK Signal Name	Device Pin
1	Reset	RESn	3	2	External Clock Input	CON_XIN	6
3	Interrupt	NC	-	4	Regulated Supply 1	GND	-
5	SPARE	NC	-	6	Serial Port	SCIaTX*	11
7	Interrupt	IRQ0*	16	8	Serial Port	SCIaRX*	10
9	Interrupt	IRQ1*	18	10	Serial Port	SCIaCK*	9
11	Motor up/down	MO_UD*	16	12	Serial Port Handshake	NC	-
13	Motor control	MO_Up	15	14	Motor control	MO_Un*	22
15	Motor control	MO_Vp	14	16	Motor control	MO_Vn*	20
17	Motor control	MO_Wp	13	18	Motor control	MO_Wn*	18
19	Timer Output	TMR0*	22	20	Timer Output	TMR1*	20
21	Timer Input	TRIGa*	17	22	Timer Input	TRIGb*	8
23	Interrupt	IRQ2*	37	24	Tristate Control	TRISTn*	12
25	SPARE	NC	-	26	SPARE	NC	NC

Table 9-6: JA2 Standard Generic Header

Chapter 10.Code Development

10.1. Overview

Note: For all code debugging using Renesas software tools, the RSK board must be connected to a PC USB port via an E8. An E8 is supplied with the RSK product.

10.2. Mode Support

HEW connects to the Microcontroller and programs it via the E8. Mode support is handled transparently to the user.

10.3. Breakpoint Support

HEW supports breakpoints on the user code, both in RAM and ROM.

Double clicking in the breakpoint column in the code sets the breakpoint. Breakpoints will remain unless they are double clicked to remove them.

10.4. Memory Map

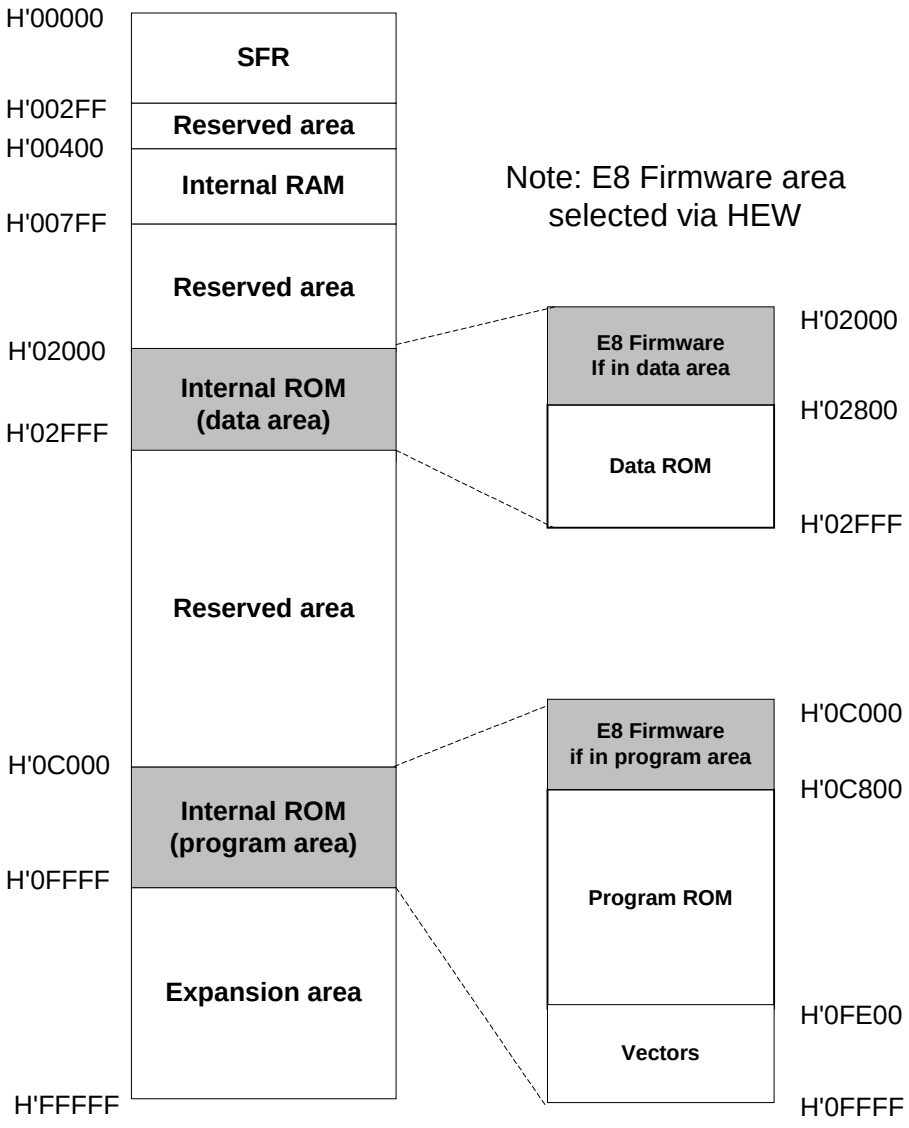

Figure 10-1: Memory Map

Chapter 11. Component Placement

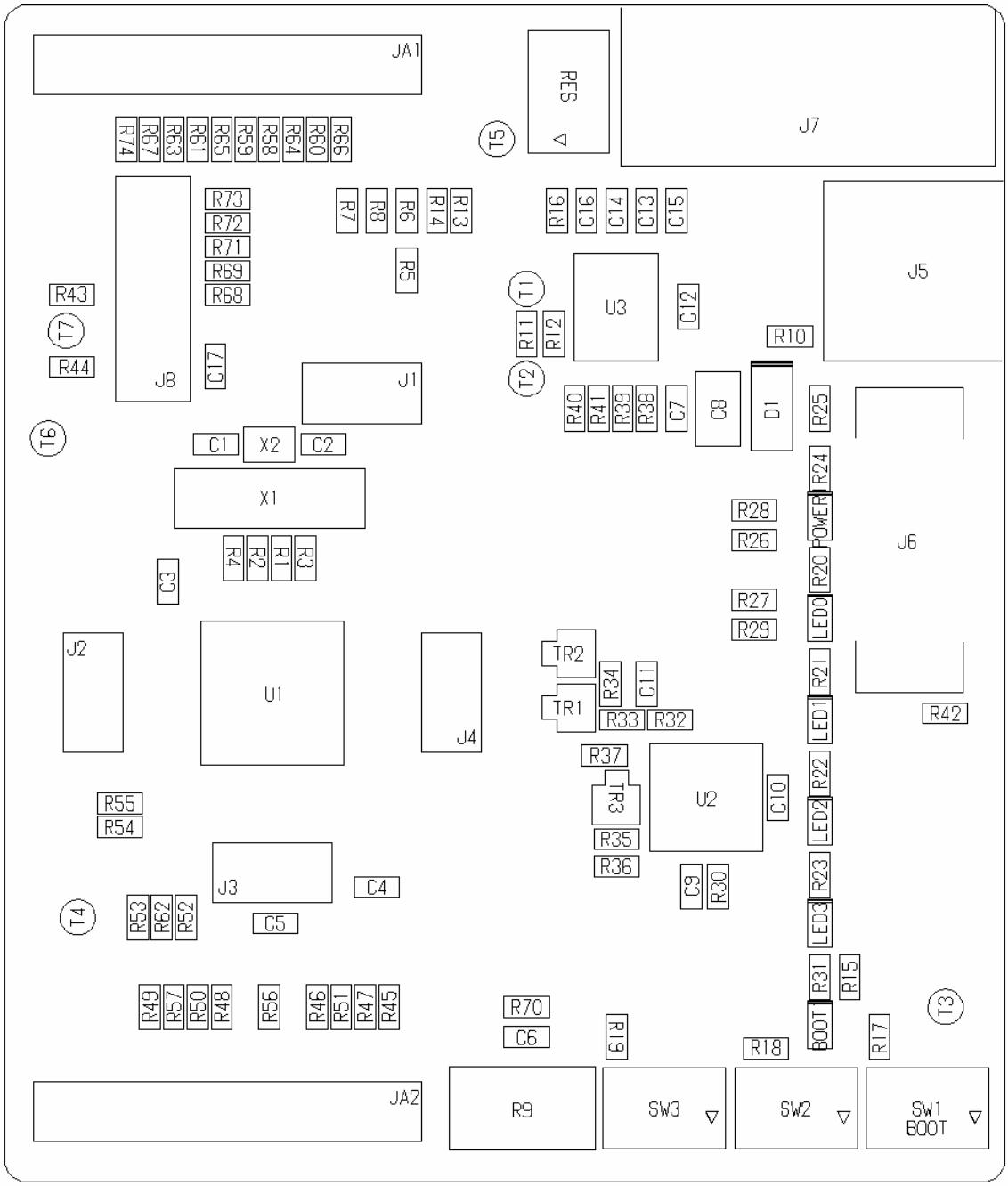

Figure 11-1: Component Placement

Chapter 12. Additional Information

For details on how to use High-performance Embedded Workshop (HEW, refer to the HEW manual available on the CD or from the web site.

For information about the R8C/13 series microcontrollers refer to the R8C/13 Series Hardware Manual

For information about the R8C/13 assembly language, refer to the R8C/Tiny Series Software Programming Manual.

Online technical support and information is available at: http://www.renesas.com/rsk

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