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RENESAS

Renesas Starter Kit for R8C/2D

User's Manual

RENESAS SINGLE-CHIP MICROCOMPUTER

M16C FAMILY / R8C/Tiny SERIES

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Renesas Solutions Corp.
www.renesas.com

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Chapter 1. Preface

Cautions

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Website: http://www.renesas.eu   (Europe)

                http://www.renesas.com   (Global)

Glossary

CPU	Central Processing Unit	PC	Program Counter
HEW	High-performance Embedded Workshop	RSK	Renesas Starter Kit
LCD	Liquid Crystal Display	LED	Light Emitting Diode
LIN	Local Interconnect Network		
E8a	E8a Debug module	CD	Compact Disc

Chapter 2. Purpose

This Renesas Starter Kit 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 Renesas Starter Kit board contains all the circuitry required for microcontroller operation.

Chapter 3. Power Supply

3.1. Requirements

This Renesas Starter Kit operates from a 3V to 5V power supply.

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

All Renesas Starter Kit boards are supplied with an E8a debugger. This product is able to power the Renesas Starter Kit board with up to 300mA. When the Renesas Starter Kit is connected to another system then that system should supply power to the Renesas Starter Kit.

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

Warning

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

3.2. Power – Up Behaviour

When the Renesas Starter Kit is purchased the Renesas Starter Kit 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.
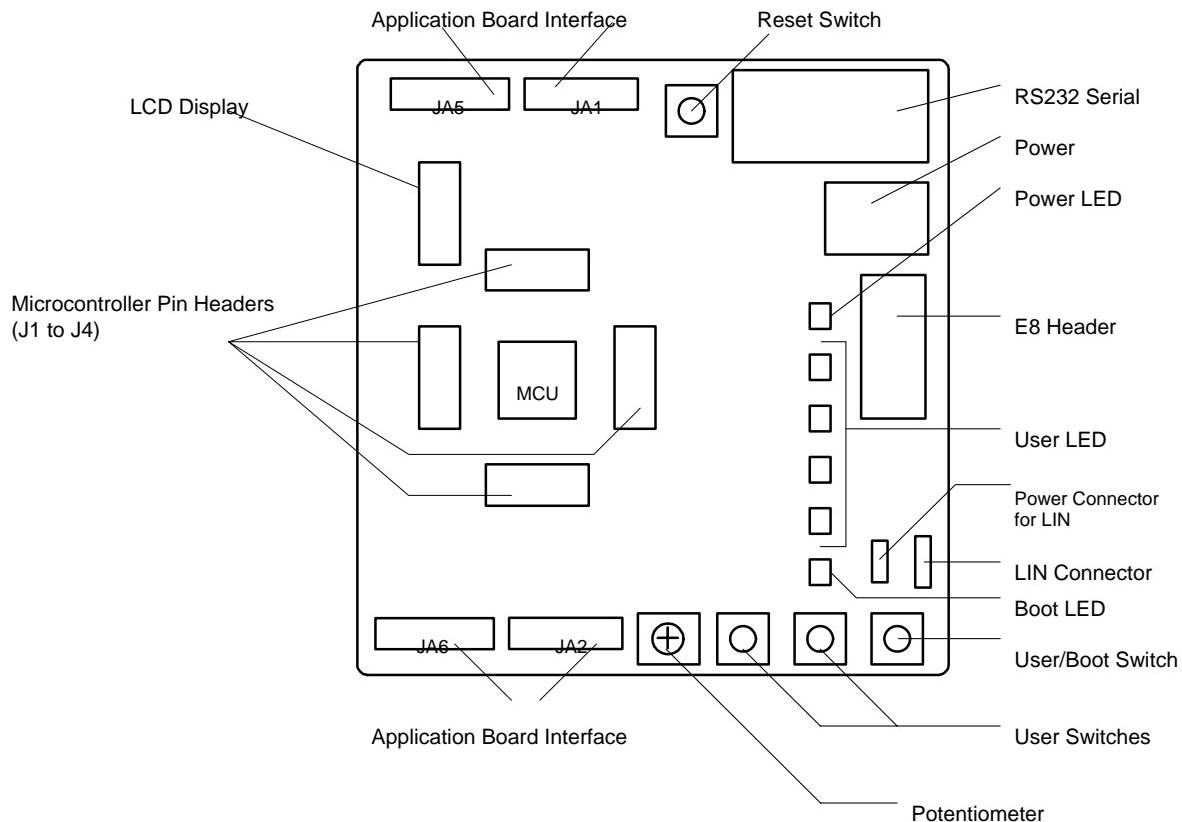
Figure 4-1: Board Layout

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.
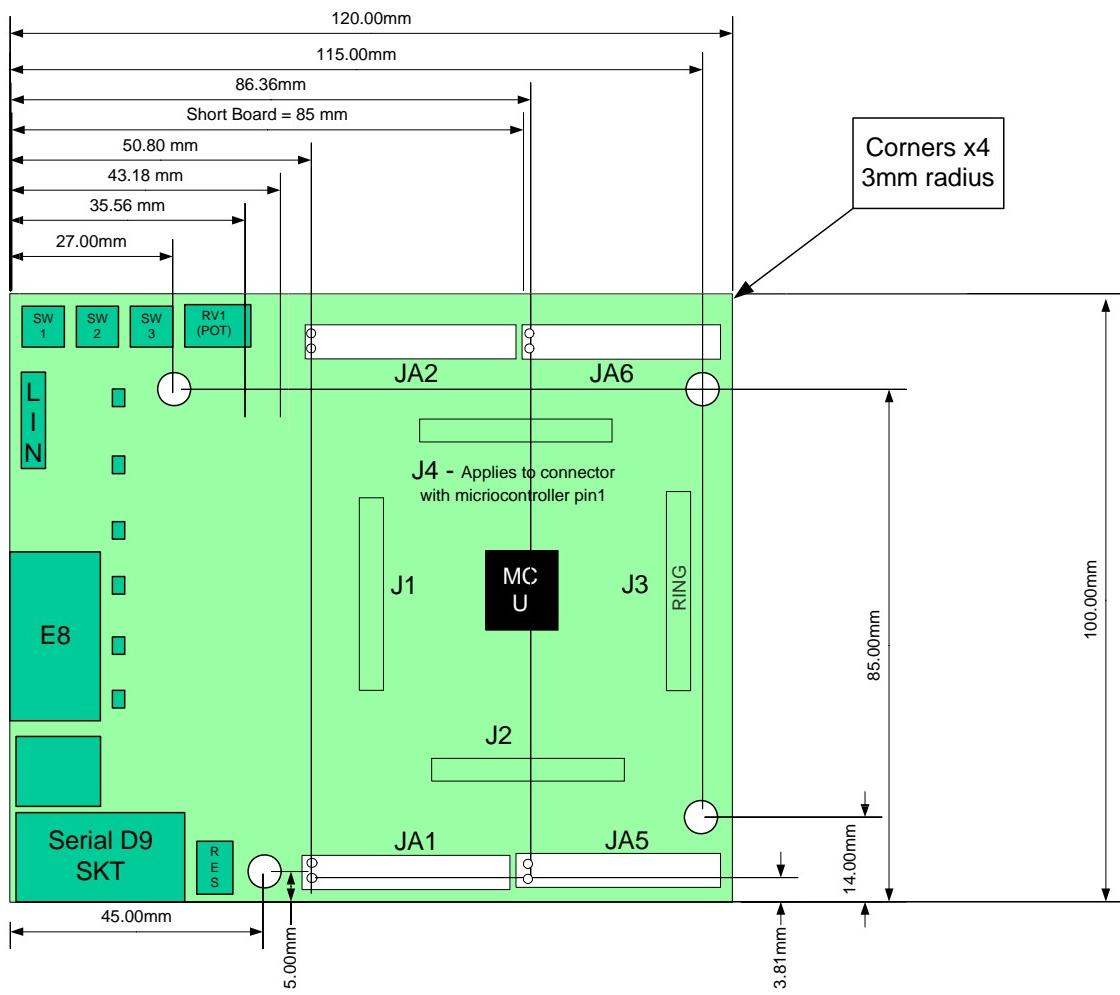
Figure 4-2 : Board Dimensions

Chapter 5. Block Diagram

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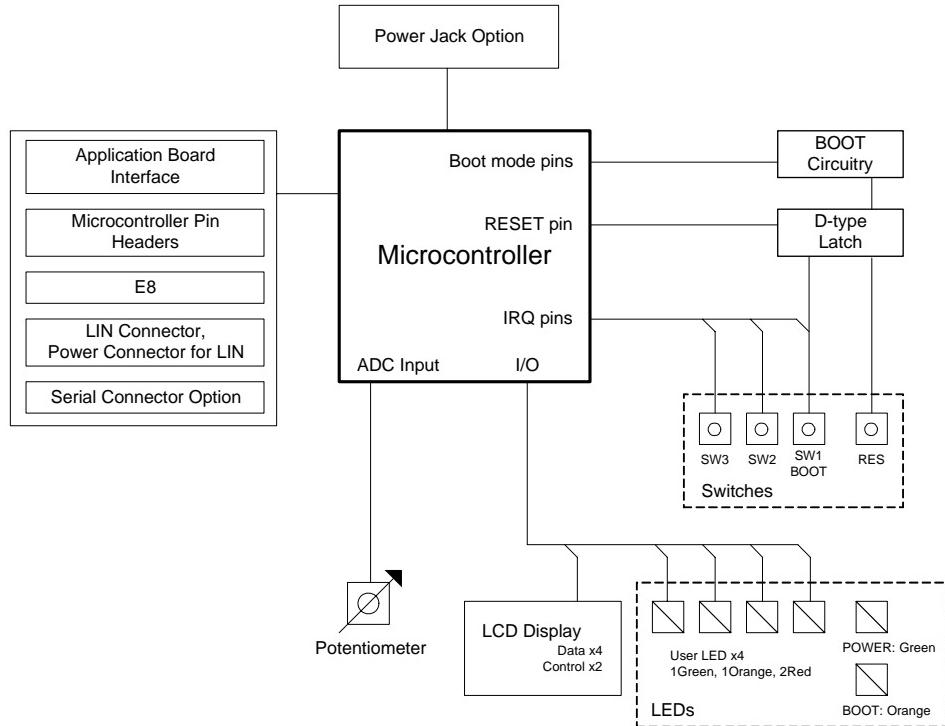
Figure 5-1: Block Diagram

Figure 5-2 is representative of the connections required to the Renesas Starter Kit.
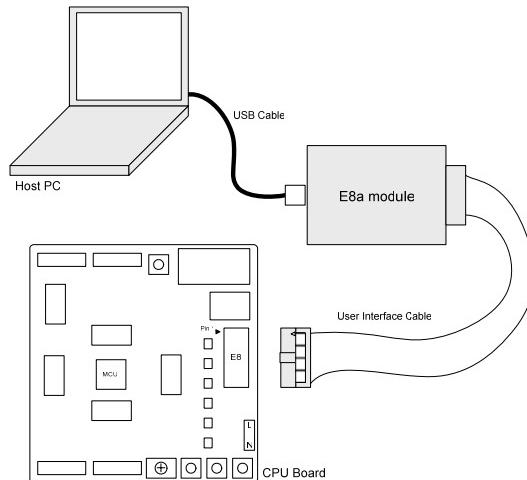
Figure 5-2 : Renesas Starter Kit Connections

Chapter 6. User Circuitry

6.1. Switches

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

| Switch	Function	Microcontroller
RES	When pressed, the board microcontroller is reset.	**RESETn** Pin9
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 E8A debugger.	**INT0n** Pin44 (Port 4, pin 5)
SW2*	Connects to an IRQ Interrupt input line for user controls.	**INT1n** Pin52 (Port 3, pin 6)
SW3*	Connects to a Key In Interrupt input line for user controls	**INT2n** Pin53 (Port 3, pin 2)

Table 6-1: Switch Functions

*Refer to schematic for detailed connectivity information.

6.2. LEDs

There are six LEDs on the CPU 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 6.0	43
LED1	Orange	Port 6.1	72
LED2	Red	Port 6.2	71
LED3	Red	Port 3.3	1

Table 6-2: LED Port

6.3. Potentiometer

A single turn potentiometer is connected to AN8 (P1.0) of the microcontroller. This may be used to vary the input analog voltage value to this pin between VREF and Ground.

6.4. Serial port

This RSK provides two serial ports to the user. The serial port 1 has already been configured for use. To use serial port 2 the user needs to configure the option links as given in **Table 6-3**.

Description	Fit for RS232
TxD2	R34
RxD2	R33

Table 6-3: Serial Port settings

6.5. LCD Module

A LCD module is supplied to be connected to the connector 'LCD'. This should be fitted so that the LCD module lies over 'JA1' and 'JA5'. Care should be taken to ensure the pins are inserted correctly into 'LCD' connector. 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 Renesas Starter Kit 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	38
5	R/W (Wired to Write only)	-	6	DLCDE	37
7	No Connection	-	8	No Connection	-
9	No Connection	-	10	No Connection	-
11	DLCD4	42	12	DLCD5	41
13	DLCD6	40	14	DLCD7	39

Table 6-4: LCD Module Connections

6.6. Option Links

Table 6-5 below describes the function of the option links associated with Power configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R10	Power Source	**Board can be powered from PWR connector**	Disable external power connector	R44, R45
R37	Microcontroller Power Supply	**Supply power to Microcontroller**	Fit Low ohm resistor to measure current.	-
R44	Power Source Configuration	**Connects external 5V supply to the RSK.**	Disconnects external 5V supply to the RSK.	R10, R45
R45	Power Source	Connects regulated 3.3V voltage source to Board_VCC	**Disconnects regulated 3.3V voltage source from Board_VCC**	R10, R44

Table 6-5: Power configuration links

Table 6-6 below describes the function of the option links associated with Clock configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R42	Main clock Oscillator Configuration	Connects external clock to MCU	**Disconnects external clock connection to MCU**	R46, R47, R52
R46	Main clock Oscillator Configuration	Connects external clock to MCU	**Disconnects external clock connection to MCU**	R42, R47, R52
R47	Sub clock Oscillator Configuration	Connects external clock to MCU	**Disconnects external clock connection to MCU**	R42, R46, R52
R52	Sub clock Oscillator Configuration	Connects external clock to MCU	**Disconnects external clock connection to MCU**	R42, R46, R47
R48	Main clock Oscillator Configuration	**On board crystal (X1) is connected to the CPU.**	On board crystal (X1) is disconnected from the CPU.	R42, R46
R53	Sub clock Oscillator Configuration	**On board crystal (X2) is connected to the CPU.**	On board crystal (X2) is disconnected from the CPU.	R47, R52

Table 6-6:   Clock configuration links

Table **6-7** below describes the function of the option links associated with serial configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R11	Serial Port Configuration	**Connects serial port TXD1 to SERIAL D-type connector.**	Disconnects serial port TXD1 from SERIAL D-type connector.	R22
R21	Serial Port Configuration	Disables RS232 Serial Transceiver	**Enables RS232 Serial Transceiver**	-
R22	Serial Port Configuration	**Connects serial port RXD1 to SERIAL D-type connector.**	Disconnects serial port RXD1 from SERIAL D-type connector.	R11
R25	Serial Port Configuration	Routes RS232 serial port Rx to application connector (JA6)	**Disconnects RS232 serial port Rx from application connector (JA6)**	R30
R30	Serial Port Configuration	Routes RS232 serial port Tx to application connector (JA6)	**Disconnects RS232 serial port Tx from application connector (JA6)**	R25
R33	Serial Port Configuration	Connects serial port RXD2 to SERIAL D-type connector.	**Disconnects serial port TXD2 from SERIAL D-type connector.**	R34, R38, R39
R34	Serial Port Configuration	Connects serial port TXD2 to SERIAL D-type connector.	**Disconnects serial port RXD2 from SERIAL D-type connector.**	R33, R38, R39
R38	Serial Connector	Connects Alternate serial (CH2) to D connector	**Disconnects Alternate serial from D connector.**	R33, R34, R39
R39	Serial Connector	Connects Alternate serial (CH2) to D connector	**Disconnects Alternate serial from D connector.**	R33, R34, R38

Table 6-7: Serial configuration links

Table **6-8** below describes the function of the option links associated with LIN configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R3	LIN Interface	**Connects RXD0 pin of the microcontroller to the RXD pin of LIN transceiver**	RXD0 can be used for serial communication.	R7, R8
R7	LIN Interface	**Connects CLK0 pin of the microcontroller to the NSLP pin of LIN transceiver**	CLK0 can be used for serial communication.	R3, R8
R8	LIN Interface	**Connects TXD0 pin of the microcontroller to the TXD pin of LIN transceiver**	TXD0 can be used for serial communication.	R3, R7
R27	LIN Interface	**Board_VCC supplies power to LIN.**	External supply can be connected to VBAT.	-
R5	LIN Interface	**LIN operates in Master mode**	LIN operates in Slave mode	-

Table 6-8: LIN Configuration Links

Table 6-9 below describes the function of the option links associated with serial configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R36	Analog configuration	**PIN 57 connected to ADPOT**	PIN 57 disconnected from ADPOT	R66
R66	Analog configuration	PIN 57 connected to AN8 on JA5	**PIN 57 disconnected from AN8**	R36
R40	Analog configuration	**UC_VCC supplies the reference voltage for Analog section.**	CON_VREF can be used to supply the reference voltage for Analog section.	R41
R41	Analog configuration	CON_VREF supplies the reference voltage for Analog section.	**UC_VCC can be used to supply the reference voltage for Analog section.**	R40

Table 6-9: Analog configuration links

Table 6-10 below describes the function of the option links associated with other options. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R49	Pin function select	**PIN 76 connected to AN0 on JA1**	PIN 76 disconnected from on JA1	R58
R58	Pin function select	PIN 76 connected to DA1 on JA1	**PIN 76 disconnected from DA1**	R49
R56	Pin function select	**PIN 74 connected to AN1 on JA**	PIN 74 disconnected from AN1 on JA	R59
R59	Pin function select	PIN 74 connected to DA0 on JA	**PIN 74 disconnected from DA0**	R56
R63	Pin function select	PIN 46 connected to INT3n on JA1	**PIN 46 disconnected from INT3n**	R67
R67	Pin function select	**PIN 46 connected to RXD1 on JA6**	PIN 46 disconnected from RXD1	R63
R57	Pin function select	PIN 73 connected to AN2 on JA1	**PIN 73 disconnected from AN2**	R62
R62	Pin function select	**PIN 73 connected to CLK1 on JA6**	PIN 73 disconnected from CLK1	R57

Table 6-10: Pin function configuration links

6.7. Oscillator Sources

A crystal oscillator is fitted on the board and used to supply the main/sub clock input to the Renesas microcontroller.

Table 6-10 details the oscillators that are fitted and alternative footprints provided on this board:

Component		
Crystal (X1)	Fitted	20 MHz (HC/49U package)
Sub clock (X2)	Fitted	32.768 kHz (90SMX package)

Table 6-10: Oscillator Configuration

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 and Single chip 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 Renesas Starter Kit. 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 pin 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 customers' board meets all the reset timing requirements.

6.9. LIN Interface

This Renesas Starter Kit has hardware LIN interface. The interface is available on connector 'LIN'. The connector 'J5' functions as power connector for LIN. The device can be operated either in 'Master' mode or 'Slave' mode. The device performs LIN communication in cooperation with Timer RA and UART0.

For more details on LIN interface please refer to R8C/2C Group, R8C/2D Group Hardware Manual.

Chapter 7. Modes

This Renesas Starter Kit supports Boot mode and Single chip mode.

Details of programming the FLASH memory is described in the R8C/2C Group, R8C/2D Group Hardware Manual.

7.1. Boot mode

The Boot mode settings for this Renesas Starter Kit 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 Renesas Starter Kit supports Boot mode using an E8a and High-performance Embedded Workshop only. However, hardware exists to enter boot mode manually, do not connect the E8a 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 E8a is connected nor the board is placed in boot mode as above, the MODE pin is pulled high by a 4.7k resistor.

When an E8a is used the MODE pin is controlled by the E8A.

7.2. Single chip mode

Because the MODE pin is pulled high, this Renesas Starter Kit will always boot in Single chip mode when the E8a is not connected and the boot switch is not depressed. Refer to R8C/2C Group, R8C/2D 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 High-performance Embedded Workshop and the supplied E8a debugger. Refer to R8C/2C Group, R8C/2D 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	LED3	1	2	PIN2	2
3	PIN3	3	4	PIN4	4
5	PIN5	5	6	MODE	6
7	CON_XCIN	7	8	CON_XCOUT	8
9	RESETn	9	10	CON_XOUT	10
11	GROUND	11	12	CON_XOUT	12
13	VCC	12	14	PIN14	14
15	TRCIOC	14	16	TRCIOB	16
17	TRCIOA	16	18	TRCCLK	18
19	PIN19	18	20	PIN20	20

Table 9-1: J1

J2					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	PIN21	21	2	PIN22	22
3	Wn	23	4	Vn	24
5	Wp	25	6	Vp	26
7	Un	27	8	TRIGb	28
9	Up	29	10	TRDCLK	30
11	TRIGa	31	12	CLK0	32
13	RXD0	33	14	TXD0	34
15	PIN35	35	16	TRISTn	36
17	DLCDE	37	18	DLCDRS	38
19	DLCD7	39	20	DLCD6	40

Table 9-2: J2

J3					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	DLCD5	41	2	DLCD4	42
3	LED0	43	4	INT0n	44
5	TXD1	45	6	RXD1_INT3n*	46
7	CLK2	47	8	RXD2	48
9	TXD2	49	10	TMR1	50
11	TMR0	51	12	INT1n	52
13	INT2n	53	14	AN11	54
15	AN10	55	16	AN9	56
17	ADPOT_AN8*	57	18	IO_7	58
19	IO_6	59	20	IO_5	60

Table 9-3: J3

J4					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IO_4	61	2	IO_3	62
3	IO_2	63	4	IO_1	64
5	IO_0	65	6	AN7	66
7	AN6	67	8	AN5	68
9	AN4	69	10	AN3	70
11	LED2	71	12	LED1	72
13	AN2_CLK1*	73	14	AN1_DA0*	74
15	CON_VREF	75	16	AN0_DA1*	76
17	GROUND	77	18	VCC	78
19	UD	79	20	PIN80	80

Table 9-4: J4

9.2. Application Headers

Table 9-5 to Table 9-8 below show the standard application header connections. * Marked pins are subject to option links.

JA1							
Pin	Header Name	Circuit Net Name	Device Pin	Pin	Header Name	Circuit Net 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	Analog Supply	NC	---	6	Analog Supply	NC	---
7	Analog Reference	CON_VREF*	77	8	ADTRG	NC	---
9	ADC0	AN0*	76	10	ADC1	AN1*	74
11	ADC2	AN2*	73	12	ADC3	AN3	70
13	DAC0	DA0*	74	14	DAC1	DA1*	76
15	IOPort0	IO_0	65	16	IOPort1	IO_1	64
17	IOPort2	IO_2	63	18	IOPort3	IO_3	62
19	IOPort4	IO_4	61	20	IOPort5	IO_5	60
21	IOPort8	IO_6	59	22	IOPort7	IO_7	58
23	IRQ3	INT3n	46	24	I²C Bus (3rd pin)	NC	---
25	IIC_SDA	SDA	2	26	IIC_SCL	SCL	80

Table 9-5: JA1 Standard Generic Header

JA2							
Pin	Header Name	Circuit Net Name	Device Pin	Pin	Header Name	Circuit Net Name	Device Pin
1	Reset	RESETn	9	2	External Clock Input	CON_XIN*	12
3	Interrupt	NC	---	4	Regulated Supply 1	VSS1 (GND)	---
5	WDT overflow	NC	---	6	Serial Port	TXD0	34
7	Interrupt	INT0n	44	8	Serial Port	RXD0	33
9	Interrupt	INT1n	52	10	Serial Port	RXD0	32
11	Motor up/down	UD	79	12	Serial Port Handshake	NC	---
13	Motor control	Up	29	14	Motor control	Un	27
15	Motor control	Vp	26	16	Motor control	Vn	24
17	Motor control	Wp	25	18	Motor control	Wn	23
19	Timer Output	TMR0	51	20	Timer Output	TMR1	50
21	Timer Input	TRIGa	31	22	Timer Input	TRIGb	28
23	Interrupt	INT2n	53	24	Tristate Control	TRISTn	36
25	SPARE	---	---	26	SPARE	---	---

Table 9-6: JA2 Standard Generic Header

JA5							
Pin	Generic Header Name	CPU board Signal Name	Device Pin	Pin	Generic Header Name	CPU board Signal Name	Device Pin
1	AD4	AN4	69	2	AD5	AN5	68
3	AD6	AN6	67	4	AD7	AN7	66
5	CAN1TX	---	---	6	CAN1RX	---	---
7	CAN2TX	---	---	8	CAN2RX	---	---
9	AD8	AN8	57	10	AD9	AN9	56
11	AD10	AN10	55	12	AD11	AN11	54
13	TIOC0A	TRCIOA	17	14	TIOC0B	TRCIOB	16
15	TIOC0C	TRCIOC	15	16	M2_TRISTn	---	---
17	TCLKC	TRCCLK	18	18	TCLKD	TRDCLK	30
19	M2_Up	---	---	20	M2_Un	---	---
21	M2_Vp	---	---	22	M2_Vn	---	---
23	M2_Wp	---	---	24	M2_Wn	---	---

Table 9-7: JA5 Optional Generic Header

JA6									
Pin	Generic Header Name		CPU board Signal Name	Device Pin	Pin	Generic Header Name		CPU board Signal Name	Device Pin
1	DMA		---	---	2	DMA		---	---
3	DMA		---	---	4	Standby (Open drain)		---	---
5	Host Serial		RS232TX*	---	6	Host Serial		RS232RX*	---
7	Serial Port		RxD2	48	8	Serial Port		TxD2	49
9	Serial Port	Synchronous	TXD1	45	10	Serial Port		CLK2	47
11	Serial Port	Synchronous	CLK1*	73	12	Serial Port	Synchronous	RXD1*	46
13	Reserved				14	Reserved			
15	Reserved				16	Reserved			
17	Reserved				18	Reserved			
19	Reserved				20	Reserved			
21	Reserved				22	Reserved			
23	Reserved				24	Reserved			
25	Reserved				26	Reserved			

Table 9-8: JA6 Optional Generic Header

Table 9-9 below shows the LIN header connections.

J5		
Pin	Function	Signal Name
1	Power Supply (for LIN module)	VBAT
2	GROUND	GND
LIN		
Pin	Function	Signal Name
1	Power Supply (for LIN module)	VBAT
2	LIN Bus Line	LIN
3	GROUND	GND

Table 9-9: LIN Headers

Chapter 10. Code Development

10.1. Overview

Note: For all code debugging using Renesas software tools, the Renesas Starter Kit board must be connected to a PC USB port via an E8a. An E8a is supplied with the Renesas Starter Kit product.

10.2. Mode Support

High-performance Embedded Workspace connects to the Microcontroller and programs it via the E8a. Mode support is handled transparently to the user.

10.3. Breakpoint Support

High-performance Embedded Workshop 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
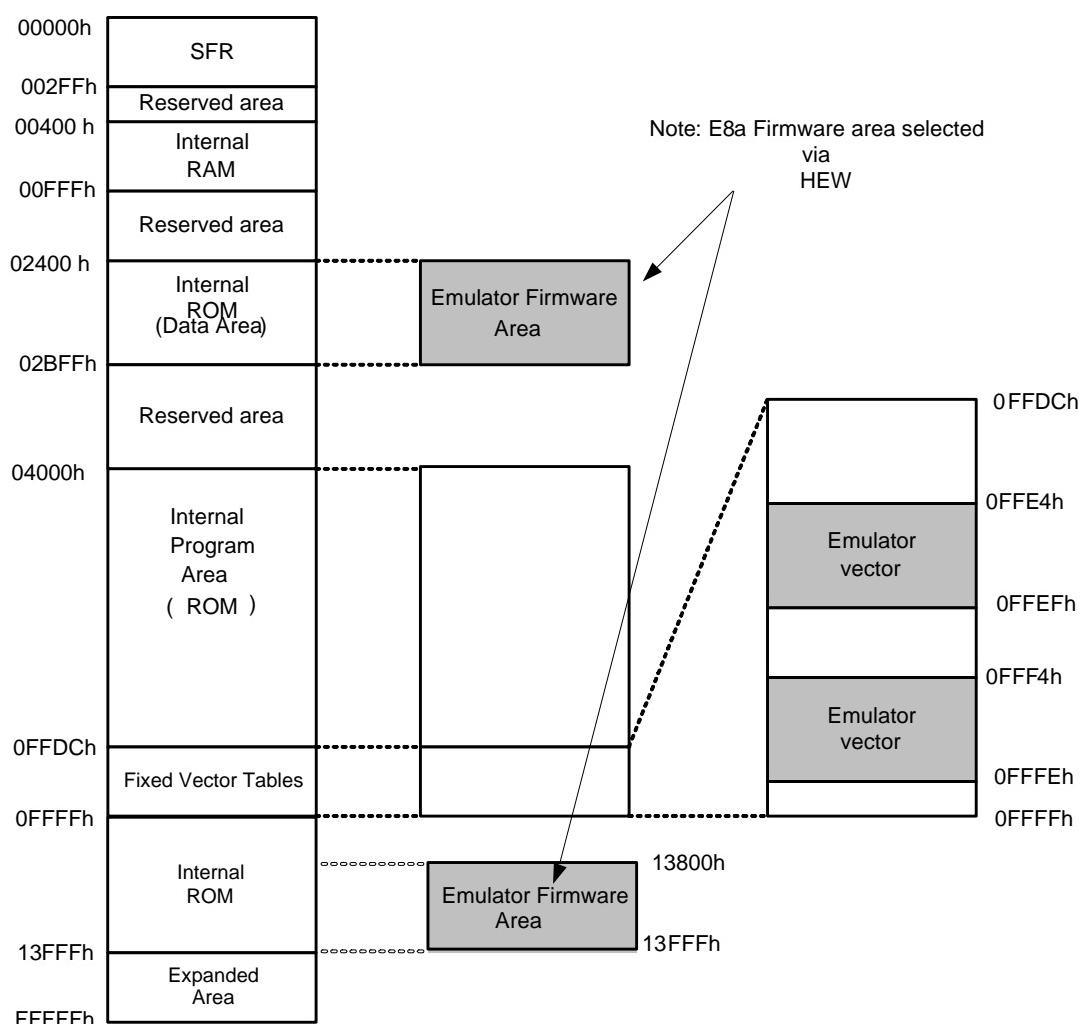
Figure 10-1 : Memory Map

Chapter 11. Component Placement
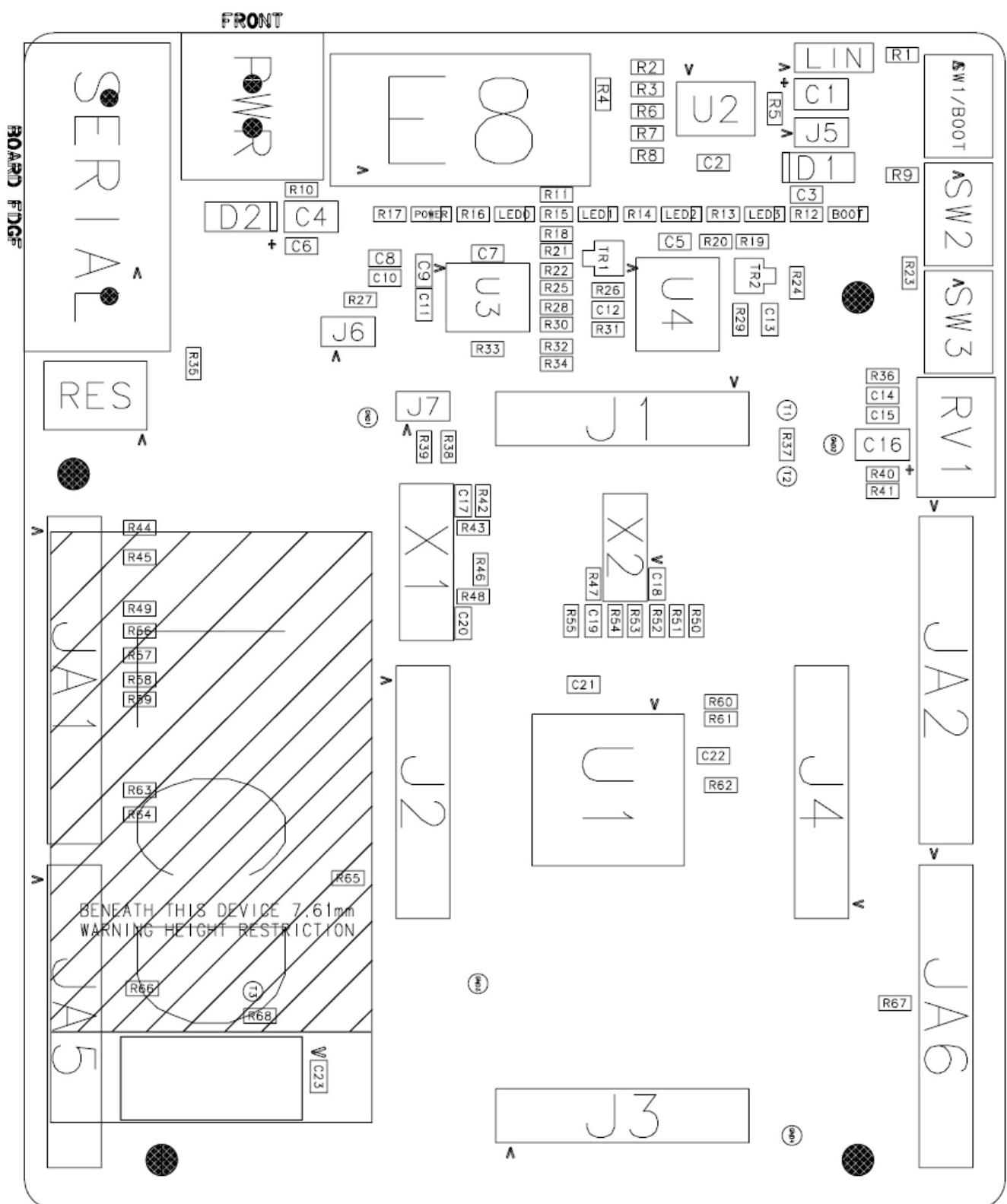
Figure 11-1 : Component Placement

Chapter 12. Additional Information

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

For information about the R8C/2D group microcontrollers, refer to the R8C/2C Group, R8C/2D Group Hardware Manual.

For information about the R8C/2D assembly language, refer to the R8C/Tiny Series Software Programming Manual.

Online technical support and information is available at:

http://www.renesas.com/renesas_starter_kits

Technical Contact Details

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General information on Renesas Microcontrollers can be found on the Renesas website at:

http://www.renesas.com/.

Renesas Starter Kit for R8C/2D
User's Manual

RENESAS

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