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User's Manual

Renesas Starter Kit for M16C/26A

User's Manual

RENESAS 16-BIT SINGLE-CHIP
MICROCOMPUTER
M16C FAMILY / M16C/Tiny SERIES

Renesas Electronics
www.renesas.com

Rev.3.00 2007.08

Table of Contents

Chapter 1. Preface

Cautions

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Glossary

ADC	Analog Digital Converter	IRQ	Interrupt ReQuest
CPU	Central Processing Unit	LED	Light Emitting Diode
DAC	Digital Analog Converter	LSI	Large Scale Integration
E8a	E8a On-chip debugger module	MCU	Microcontroller
HEW	High-performance Embedded Workshop		

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.

NOTE: This manual describes the technical details of the Renesas Starter Kit for M16C/26A hardware. The Quick Start Guide and Tutorial Manual provide details of the software installation and debugging environment.

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.

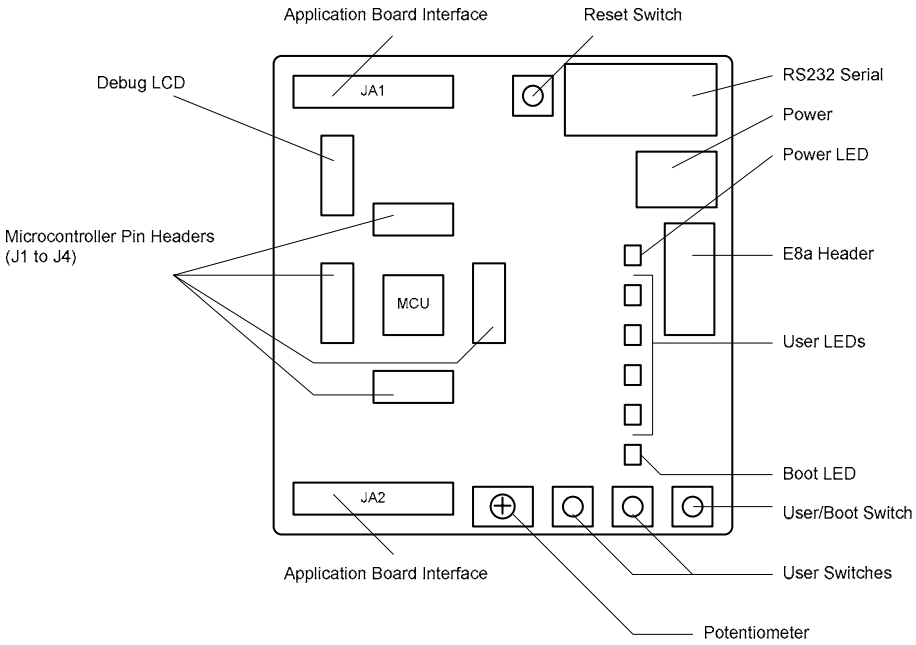

Figure 4-1: Board Layout

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.

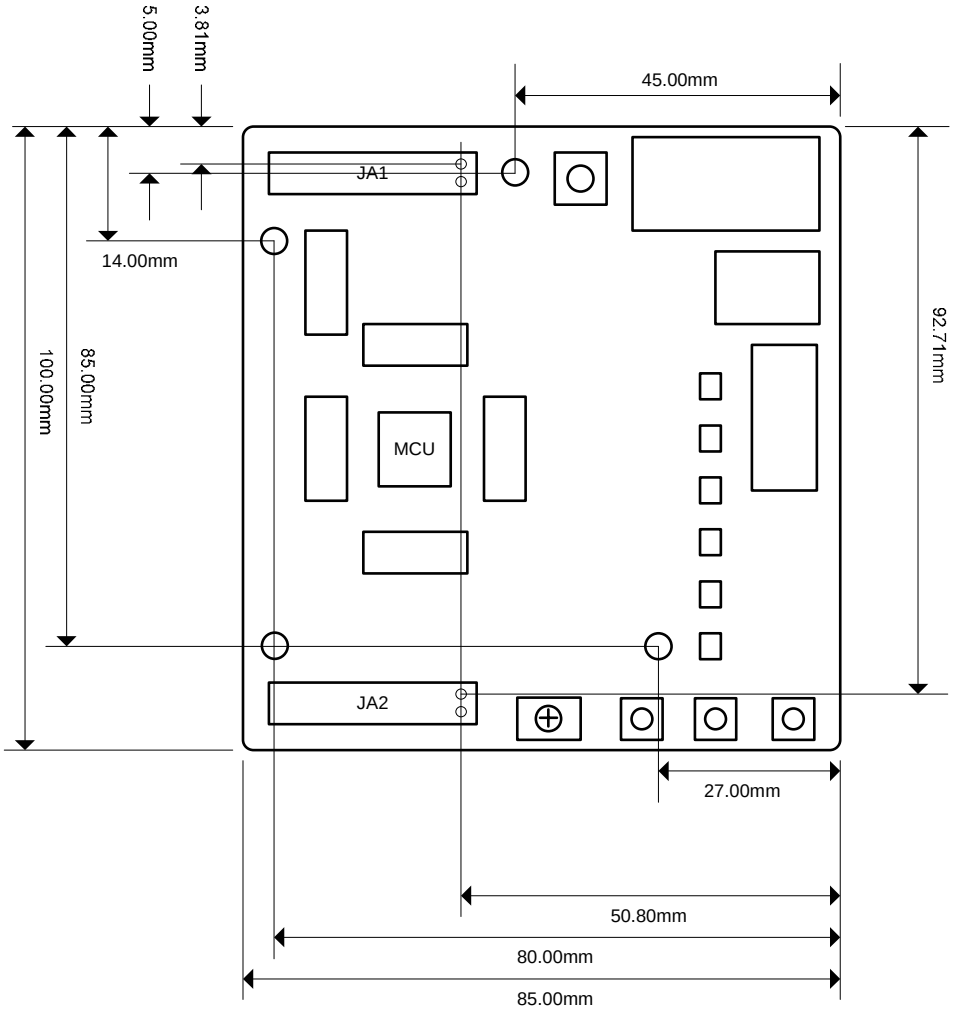

Figure 4-2 : Board Dimensions

Chapter 5. Block Diagram

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

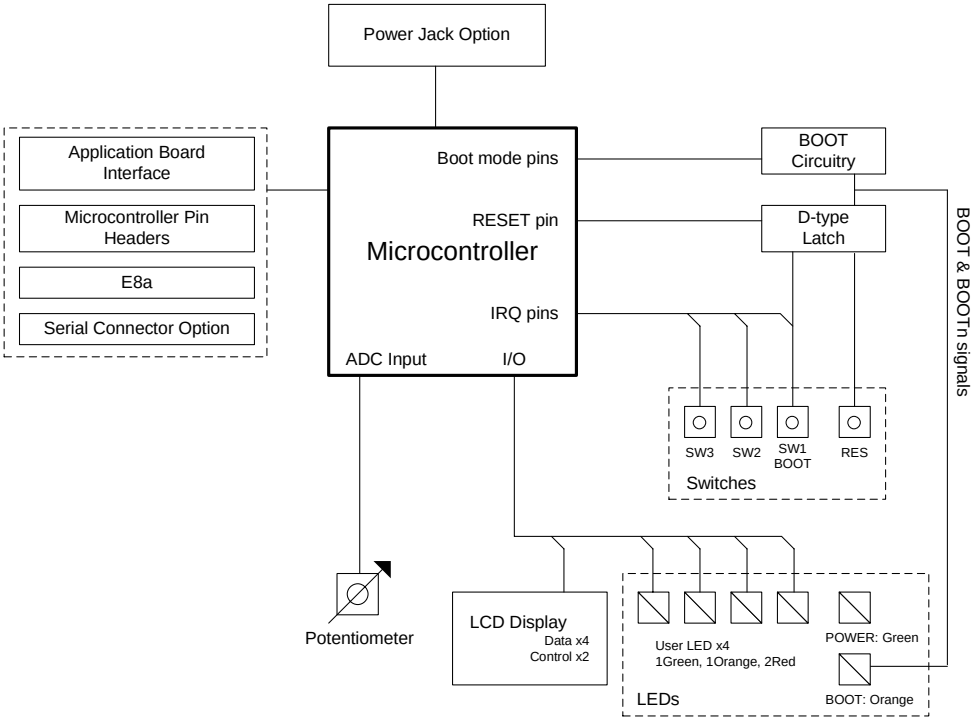

Figure 5-1: Block Diagram

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

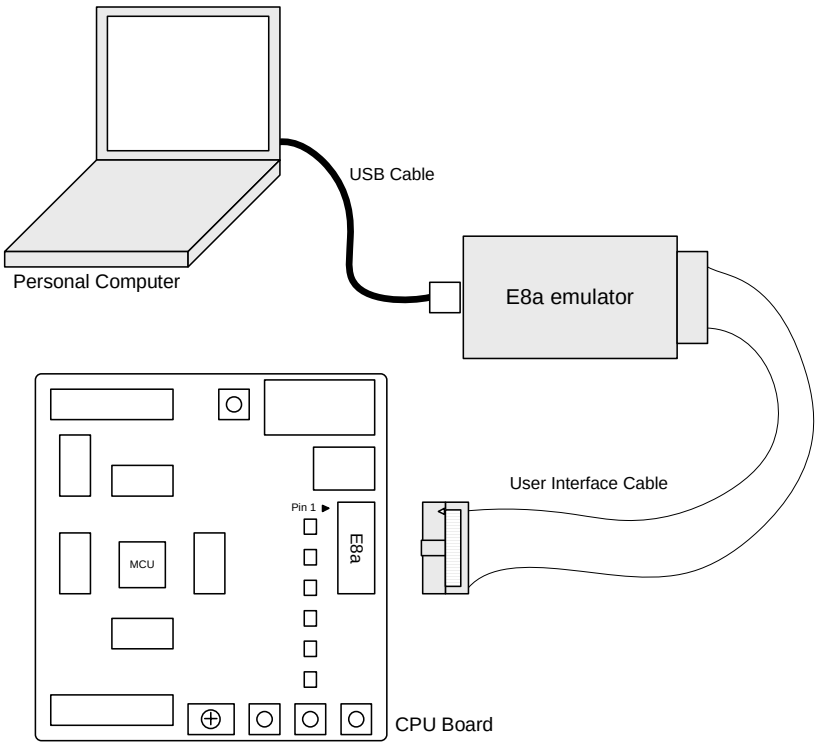

Figure 5-2 : Renesas Starter Kit Connections

Chapter 6. User Circuitry

6.1. Switches

There are four switches located on the Renesas Starter Kit. 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.	RESET Pin 7
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.	INT0 Pin14 (Port 8, pin 3)
SW2*	Connects to an IRQ input for user controls.	INT1 Pin17 (Port 8, pin 4)
SW3*	Connects to the ADC trigger input. Option link allows connection to IRQ input. The option is a pair of 0R links.	ADTRG Pin 36 (Port 1, pin 5) *OR* INT3 Pin34 (Port 1, pin 7)

Table 6-1: Switch Functions

*Refer to schematic for detailed connectivity information.

6.2. LEDs

There are six LEDs on the Renesas Starter Kit 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 10.4	40
LED1	Orange	Port 10.5	39
LED2	Red	Port 10.6	38
LED3	Red	Port 10.7	37

Table 6-2: LED Port

6.3. Potentiometer

A single turn potentiometer is connected to AN2.4 (P9.3) of the microcontroller. This may be used to vary the input analog voltage value to this pin between AVCC and Ground.

6.4. Serial port

The microcontroller programming serial port 1 is connected to the E8a connector. This serial port can optionally be connected to the RS232 transceiver as well by fitting zero Ohm option resistors and fitting the D connector. In addition the RS232 transceiver should be enabled. The connections to be moved are listed in the table 6-3.

Description	Function	Fit for RS232
TxD1	Programming Serial Port	R51
RxD1	Programming Serial Port	R52

Table 6-3: Serial Port settings

A Secondary serial port is connected to the application headers.

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 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	LCD_RS	3
5	R/W (Wired to Write only)	-	6	LCD_E	2
7	No Connection	-	8	No Connection	-
9	No Connection	-	10	No Connection	-
11	LCD_D4	33	12	LCD_D5	32
13	LCD_D6	31	14	LCD_D7	30

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
R16	Power Supply	**Connects J5 to Board_VCC**	J5 disconnected from Board_VCC	R18
R17	MCU Power Supply	**Supply to MCU**	Fit Low ohm resistor to measure current	R18, R19, R20
R18	Power Supply	**Connects Board_VCC to board voltage line**	Board_VCC disconnected from board voltage line	R16, R17, R19, R20
R19	Power Supply (External 5V)	**Connects CON_5V (external 5V) to Board_VCC**	CON_5V disconnected from Board_VCC	R17, R18, R20
R20	Power Supply (External 3V3)	Connects CON_3V3 (external 3.3V) to Board_VCC	**CON_3V3 disconnected from Board_VCC**	R17, R18, R19
R21	User I/O Power Supply	**Connects Board_VCC to SW2, 3 and LED0-3**	Board_VCC disconnected from SW2, 3 and LED0-3	

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
R1	Oscillator (Main clock)	**Connects X1 (or X2) to MCU**	Connects external clock to MCU	R2, R3, R4
R2	Oscillator (Main clock)	**Connects X1 (or X2) to MCU**	Connects external clock to MCU	R1, R3, R4
R3	Oscillator (Main clock)	Connects external clock to MCU	**Connects X1 (or X2) to MCU**	R1, R2, R4
R4	Oscillator (Main clock)	Connects external clock to MCU	**Connects X1 (or X2) to MCU**	R1, R2, R3
R5	Oscillator (Sub clock)	**Connects X3 to MCU**	Connects external sub clock to MCU	R6, R7, R8
R6	Oscillator (Sub clock)	**Connects X3 to MCU**	Connects external sub clock to MCU	R5, R7, R8
R7	Oscillator (Sub clock)	Connects external sub clock to MCU	**Connects X3 to MCU**	R5, R6, R8
R8	Oscillator (Sub clock)	Connects external sub clock to MCU	**Connects X3 to MCU**	R5, R6, R7

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
R50	RS232 Serial	Disables RS232 Serial Transceiver	**Enables RS232 Serial Transceiver**	R51, R52
R51	Programming Serial Port	Connect programming serial port TX1 to RS232 Serial port (E8a remains connected)	**Only E8a connected**	
R52	Programming Serial Port	Connect programming serial port RX1 to RS232 Serial port (E8a remains connected)	**Only E8a connected**	

Table 6-7: Serial Configuration Links

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

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R10	ADC	**Connects Board_VCC to AVCC**	Disconnects Board_VCC from AVCC	R11, R12, R13, R14,R15
R11	ADC	Connects CON_AVCC to AVCC	**Disconnects CON_AVCC from AVCC**	R10, R12, R13, R14, R15
R12	ADC	**Connects Board_VCC to VREF**	Disconnects Board_VCC from VREF	R10, R11, R13, R14, R15
R13	ADC	Connects CON_VREF to VREF	**Disonnects CON_VREF from VREF**	R10, R11, R12, R14, R15
R14	ADC	**Connects Ground to AVSS**	Disconnects Ground from AVSS	R10, R11, R12, R13, R15
R15	ADC	Connects CON_AVSS to AVSS	**Disonnects CON_AVSS from AVSS**	R10, R11, R12, R13, R14
R65	Potentiometer	**Connects AD_POT to MCU port P9_3 (P9_3 connected to IO_3)**	Disconnected	

Table 6-8: Analog Configuration Links

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

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R59	MCU Pin Function Select	**Connects IIC_SDA to MCU port P7_0**	Disconnected	R60
R60	MCU Pin Function Select	Connects TMR0 to MCU port P7_0	**Disconnected**	R59
R61	MCU Pin Function Select	**Connects IIC_SCL to MCU port P7_1**	Disconnected	R62
R62	MCU Pin Function Select	Connects TRIGa to MCU port P7_1	**Disconnected**	R61
R63	MCU Pin Function Select	**Connects TRISTn to MCU port P10_4**	Disconnected	R64
R64	MCU Pin Function Select	Connects IO_4 to MCU port P10_4	**Disconnected**	R63

Table 6-9: MCU Pin Function Select 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
R53	E8a	**Enables E8a**	Do not fit the option resistor	
R56	SW1	**Connects SW1 to MCU port P8_3**	Disconnected	
R57	SW3 (ADTRG input)	**Connects SW3 to MCU port P1_5(ADTRG pin)**	Disconnected	R58
R58	SW3 (IRQ input)	Connects SW3 to MCU port P1_7(IRQ pin)	**Disconnected**	R57
R66	LCD	**Connects LCD_D4 to MCU port P6_0 (P6_0 connected to CTSRTS)**	Disconnected	R67, R68, R69, R70, R71
R67	LCD	**Connects LCD_D5 to MCU port P6_1 (P6_1 connected to SCIaCK)**	Disconnected	R66, R68, R69, R70, R71
R68	LCD	**Connects LCD_D6 to MCU port P6_2 (P6_1 connected to SCIaRX)**	Disconnected	R66, R67, R69, R70, R71
R69	LCD	**Connects LCD_D7 to MCU port P6_3 (P6_3 connected to SCIaTX)**	Disconnected	R66, R67, R68, R70, R71
R70	LCD	**Connects LCD_RS to MCU port P9_0 (P9_0 connected to IO_0)**	Disconnected	R66, R67, R68, R69, R71
R71	LCD	**Connects LCD_E to MCU port P9_1 (P9_1 connected to IO_1)**	Disconnected	R66, R67, R68, R69, R70

Table 6-10: Other Option Links

6.7.Oscillator Sources

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

Table 6-11: Oscillators / Resonators details the oscillators that are fitted and alternative footprints provided on this Renesas Starter Kit:

Component		
Main clock (X1)	Fitted	10 MHz (HC/49U package)
Main clock (X2)	Not Fitted	10 MHz (e.g. Murata CSTCE10M0G55)
Sub clock (X3)	Fitted	32.768kHz (90SMX package)

Table 6-11: 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 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 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 Renesas Starter Kit supports Boot mode and Single chip mode.

Details of programming the FLASH memory is described in the M16C/26A 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:

CNVSS	RP/ P8_5	P1_6	**LSI State after Reset End**
High	Low	High	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 pins above are held in their boot states 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 P1_6 pin and RP/P8_5 pins are pulled high by 100k resistors and the CNVSS is pulled low by a 100k resistor.

When an E8a is used these three pins are controlled by the E8a.

7.2. Single chip mode

As CNVSS is being pulled down by a 100k resistor, 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 M16C/26A Group Hardware Manual for details of Single chip mode.

CNVSS	RP/ P8_5	P1_6	**LSI State after Reset End**
Low	High	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 M16C/26A 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	IO_2	1	2	IO_1*	2
3	IO_0*	3	4	CNVSS_E8C	4
5	XCIN	5	6	XCOUT	6
7	RESn	7	8	CON_XOUT	8
9	Ground	9	10	CON_XIN	10
11	UC_VCC	11	12	RP_E8A	12

Table 9-1: J1

J2					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IRQ1*	13	2	IRQ0*	14
3	MO_UD	15	4	MO_Un	16
5	MO_Up	17	6	TRIGb	18
7	TMR1	19	8	MO_Wn	20
9	MO_Wp	21	10	MO_Vn	22
11	MO_Vp	23	12	IIC_SCL/TRIGa*	24

Table 9-2: J2

J3					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IIC_SDA/TMR0*	25	2	E8_TTX	26
3	E8_TRX	27	4	SCLK_E8D	28
5	E8_BUSY	29	6	SCIaTX*	30
7	SCIaRX*	31	8	SCIaCK*	32
9	CTSRTS*	33	10	IRQ3*	34
11	P16_E8B	35	12	ADTRG*	36

Table 9-3: J3

J4					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IO_7	37	2	IO_6	38
3	IO_5	39	4	TRISTn/IO_4*	40
5	AD3	41	6	AD2	42
7	AD1	43	8	R_AVSS	44
9	AD0	45	10	R_VREF	46
11	R_AVCC	47	12	IO_3*	48

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	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	Analogue Supply	CON_AVCC	47	6	Analogue Supply	CON_AVSS	44
7	Analogue Reference	CON_VREF	46	8	ADTRG	ADTRG*	36
9	ADC0	AD0	45	10	ADC1	AD1	43
11	ADC2	AD2	42	12	ADC3	AD3	41
13	DAC0	NC	-	14	DAC1	NC	-
15	IOPort0	IO_0*	3	16	IOPort1	IO_1*	2
17	IOPort2	IO_2	1	18	IOPort3	IO_3*	48
19	IOPort4	IO_4*	40	20	IOPort5	IO_5	39
21	IOPort8	IO_6	38	22	IOPort7	IO_7	37
23	IRQ3	IRQ3*	34	24	NC	NC	-
25	I²C Bus	IIC_SDA*	25	26	I²C Bus	IIC_SCL*	24

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	RESn	7	2	External Clock Input	CON_XIN*	10
3	Interrupt	RP_E8A	12	4	Regulated Supply 1	GND	-
5	WDT overflow	NC	-	6	Serial Port	SCIaTX*	30
7	Interrupt	IRQ0*	14	8	Serial Port	SCIaRX*	31
9	Interrupt	IRQ1*	13	10	Serial Port	SCIaCK*	32
11	Motor up/down	MO_UD	15	12	Serial Port Handshake	CTSRTS*	33
13	Motor control	MO_Up	17	14	Motor control	MO_Un	16
15	Motor control	MO_Vp	23	16	Motor control	MO_Vn	22
17	Motor control	MO_Wp	21	18	Motor control	MO_Wn	20
19	Timer Output	TMR0*	25	20	Timer Output	TMR1	19
21	Timer Input	TRIGa*	24	22	Timer Input	TRIGb	18
23	Interrupt	P16_E8B	35	24	Tristate Control	TRISTn*	40
25	SPARE	XCOUT*	6	26	SPARE	XCIN*	5

Table 9-6: JA2 Standard Generic Header

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 Personal Computer USB port via an E8a. An E8a is supplied with the Renesas Starter Kit product.

10.2. Mode Support

High-performance Embedded Workshop 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

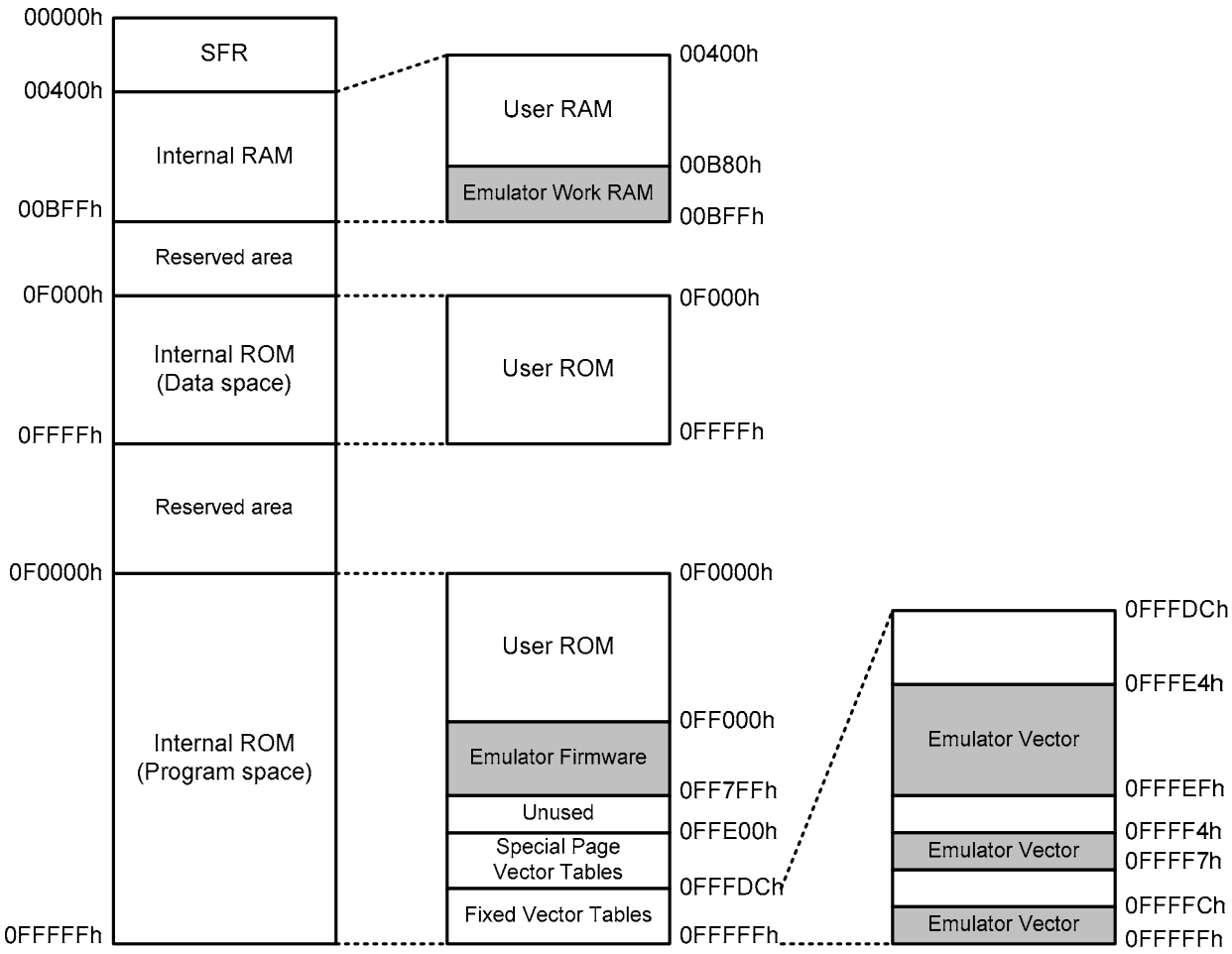

Figure 10-1: Memory Map

Chapter 11. Component Placement

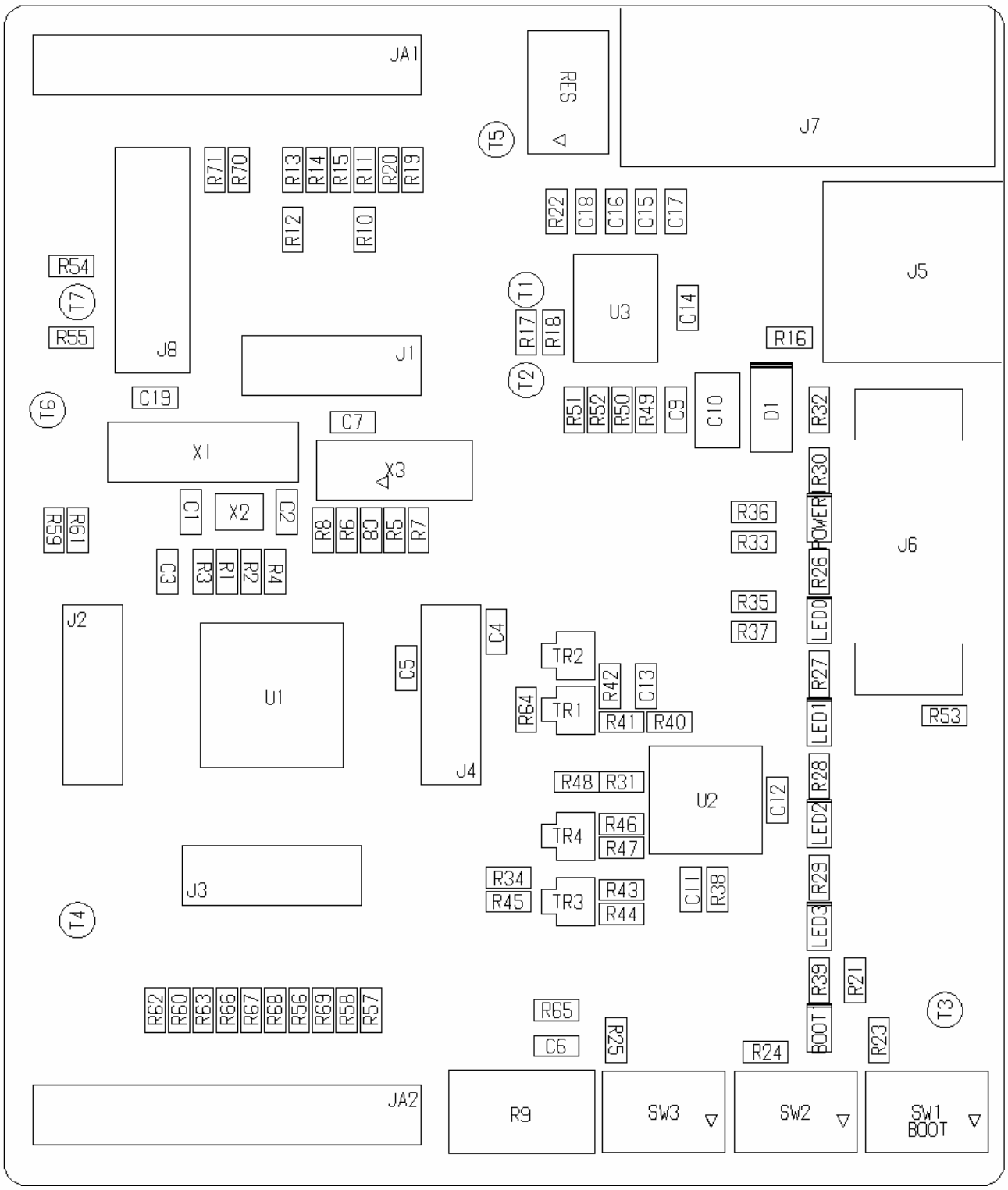

Figure 11-1: Component Placement

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 M16C/26A series microcontrollers refer to the M16C/26A Group Hardware Manual.

For information about the M16C/26A assembly language, refer to the M16C/60, M16C/20, M16C/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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Europe: tools.support.eu@renesas.com

Japan: csc@renesas.com

General information on Renesas Microcontrollers can be found on the Renesas website at: http://www.renesas.com/.

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