

# RL78G13

Renesas Starter Kit User's Manual  
(IAR Embedded Workbench)

RENESAS MCU  
RL78 Family / G1X Series

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This Renesas Starter Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures;

- ensure attached cables do not lie across the equipment
- reorient the receiving antenna
- increase the distance between the equipment and the receiver
- connect the equipment into an outlet on a circuit different from that which the receiver is connected
- power down the equipment when not in use
- consult the dealer or an experienced radio/TV technician for help NOTE: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken;

- The user is advised that mobile phones should not be used within 10m of the product when in use.
- The user is advised to take ESD precautions when handling the equipment.

The Renesas Starter Kit does not represent an ideal reference design for an end product and does not fulfil the regulatory standards for an end product.

# How to Use This Manual

## 1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the RSK hardware functionality, and electrical characteristics. It is intended for users designing sample code on the RSK platform, using the many different incorporated peripheral devices.

The manual comprises of an overview of the capabilities of the RSK product, but does not intend to be a guide to embedded programming or hardware design. Further details regarding setting up the RSK and development environment can found in the tutorial manual.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the RL78G13 Group. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User's Manual	Describes the technical details of the RSK hardware.	RSKRL78G13 User's Manual	R20UT0776EG
Tutorial	Provides a guide to setting up RSK environment, running sample code and debugging programs.	RSKRL78G13 Tutorial Manual	R20UT0614EG
Quick Start Guide	Provides simple instructions to setup the RSK and run the first sample, on a single A4 sheet.	RSKRL78G13 Quick Start Guide	R20UT0615EG
Software Help Manual	Describes the functionality of the sample code.	RSKRL78G13 Software Help Manual	R20UT0747EG
Schematics	Full detail circuit schematics of the RSK.	RSKRL78G13 Schematics	R20UT0458EG
Hardware Manual	Provides technical details of the RL78G13 microcontroller.	RL78G13 Group Hardware Manual	R01UH0146EJ

## 2. List of Abbreviations and Acronyms

<b>Abbreviation</b>	<b>Full Form</b>
ADC	Analogue-to-Digital Converter
bps	bits per second
CAN	Controller-Area Network
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DMA	Direct Memory Access
E1	On-chip Debugger
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
HEW	High-performance Embedded Workshop
IIC	Philips™ Inter-Integrated Circuit connection bus
IRQ	Interrupt Request
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Micro-controller Unit
MTU	Multifunction Timer Unit
PC	Program Counter
PWM	Pulse Width Modulation
RSK	Renesas Starter Kit
RAM	Random Access Memory
SFR	Special Function Register
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

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## **1. Overview**

### **1.1 Purpose**

This RSK is an evaluation tool for Renesas microcontrollers. This manual describes the technical details of the RSK hardware. The Quick Start Guide and Tutorial Manual provide details of the software installation and debugging environment.

### **1.2 Features**

This RSK provides an evaluation of the following features:

- Renesas microcontroller programming
- User code debugging
- User circuitry such as switches, LEDs and a potentiometer
- Sample application
- Sample peripheral device initialisation code

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

## 2. Power Supply

### 2.1 Requirements

This RSK is supplied with an E1 debugger. The debugger is able to power the RSK board with up to 200mA. When the RSK is connected to another system then that system should supply power to the RSK. All RSK and RSK+ boards have an optional centre positive supply connector using a 2.0mm barrel power jack.

This RSK supports one voltage input. Details of the external power supply connection are shown in **Table 2-1** below.

Connector	Supply Voltages	J13 Setting			J10 Setting	
		Position 1	Position 2	Position 3	Do	Not Fit
PWR	Regulated, 5V DC	Pins 1 and 2 shorted, connects the external unregulated power to Board_VDD.	Pins 2 and 3 shorted, connects the regulated power to Board_VDD.	All pins open, no power supplied to Board_VDD.		

**Table 2-1: Main Power Supply Requirements**

This RSK should only be supplied with a regulated power supply.
---

### 2.2 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 any switch, the LEDs will flash at a rate controlled by the potentiometer.



### 3. Board Layout

#### 3.1 Component Layout

Figure 3-1 below shows the top component layout of the board.

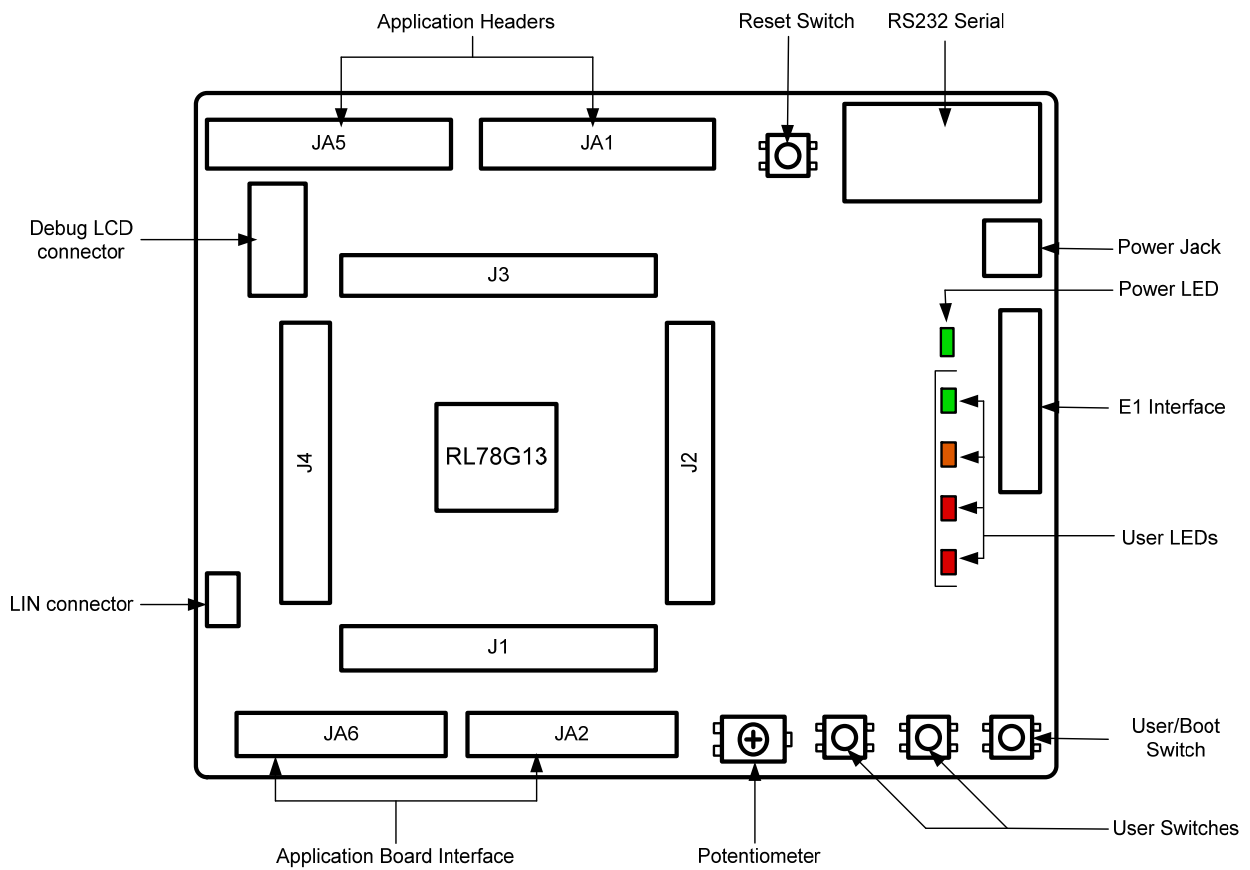


Figure 3-1: Board Layout

### 3.2 Board Dimensions

Figure 3-2 below gives the board dimensions and connector positions. All the through-hole connectors are on a common 0.1 inch grid for easy interfacing.

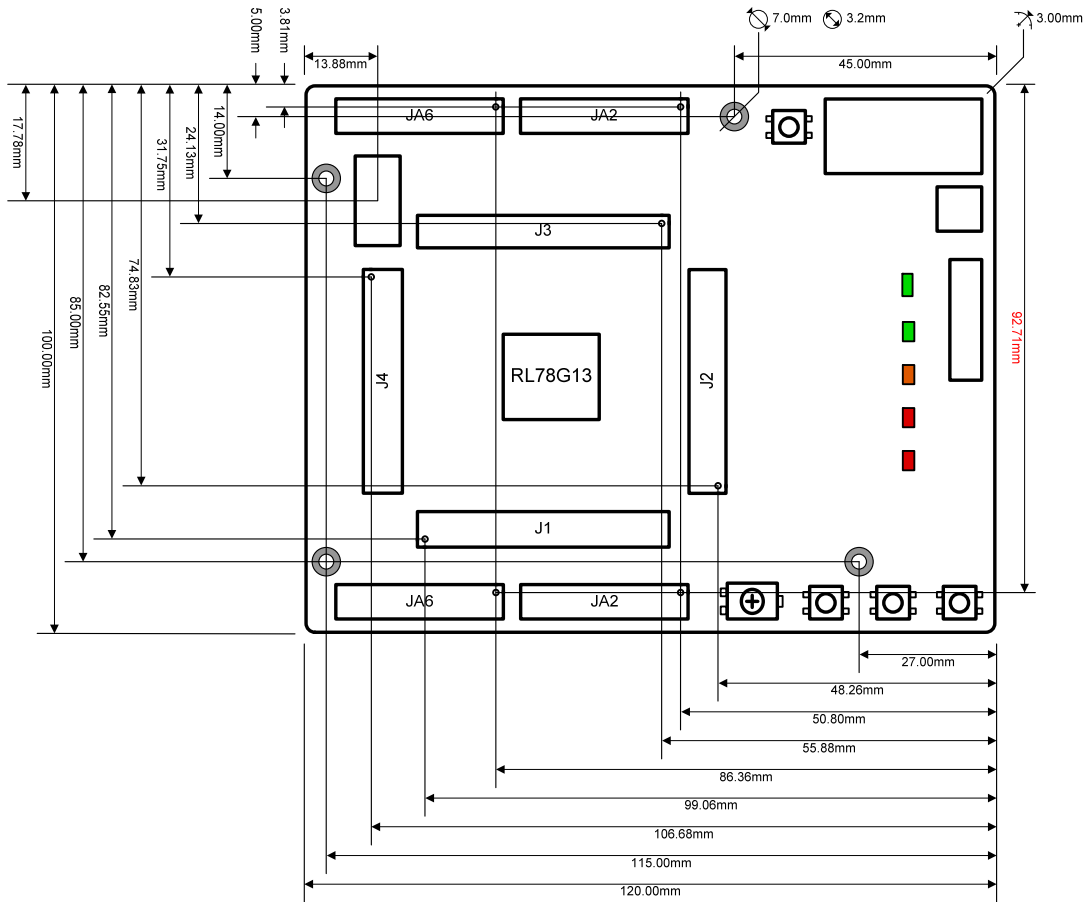


Figure 3-2: Board Dimensions

### 3.3 Component Placement

Figure 3-3 below shows placement of individual components on the top-side PCB.

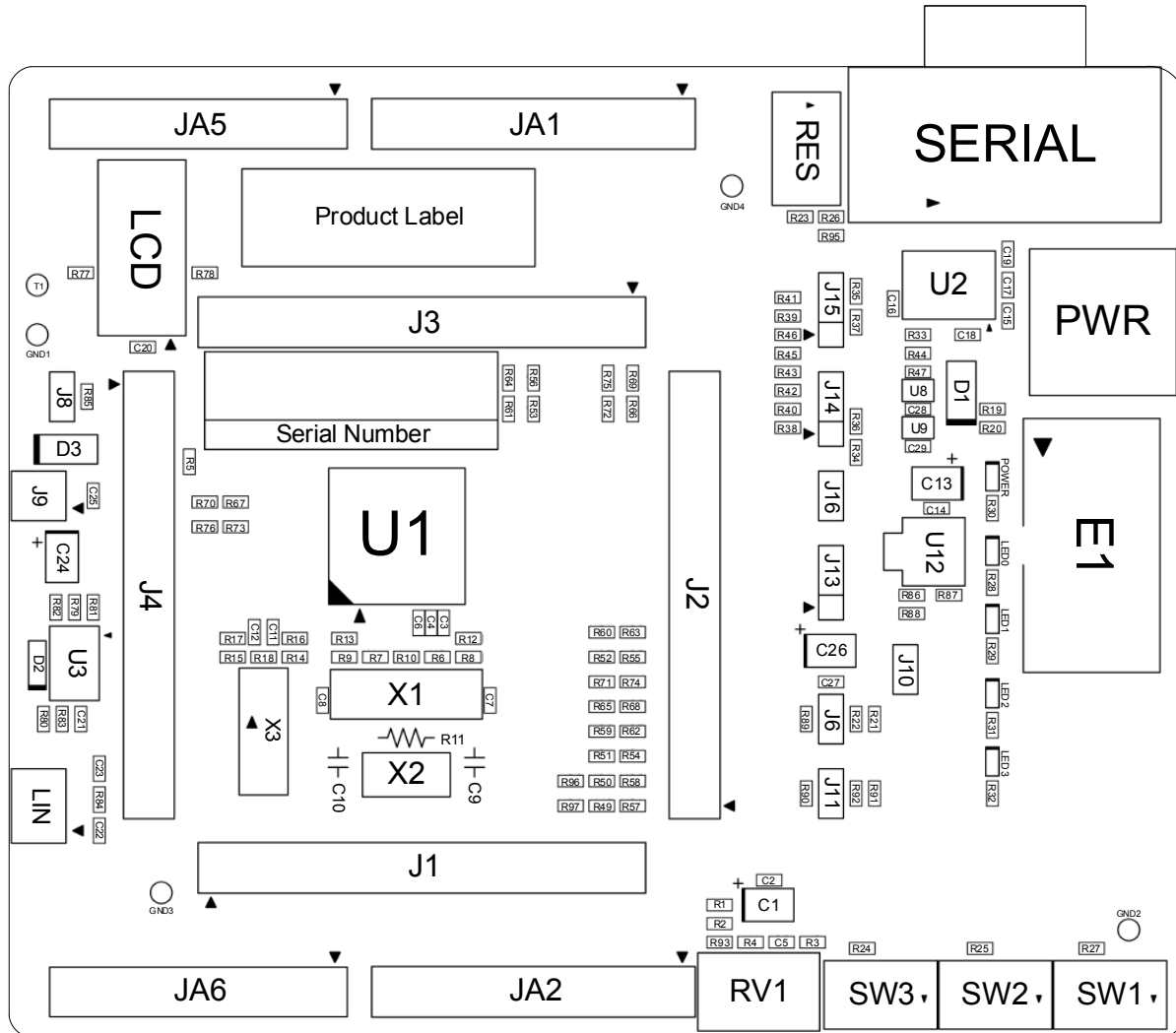


Figure 3-3: Top-Side Component Placement

## 4. Connectivity

### 4.1 Internal RSK Connections

The diagram below shows the RSK board components and their connectivity to the MCU.

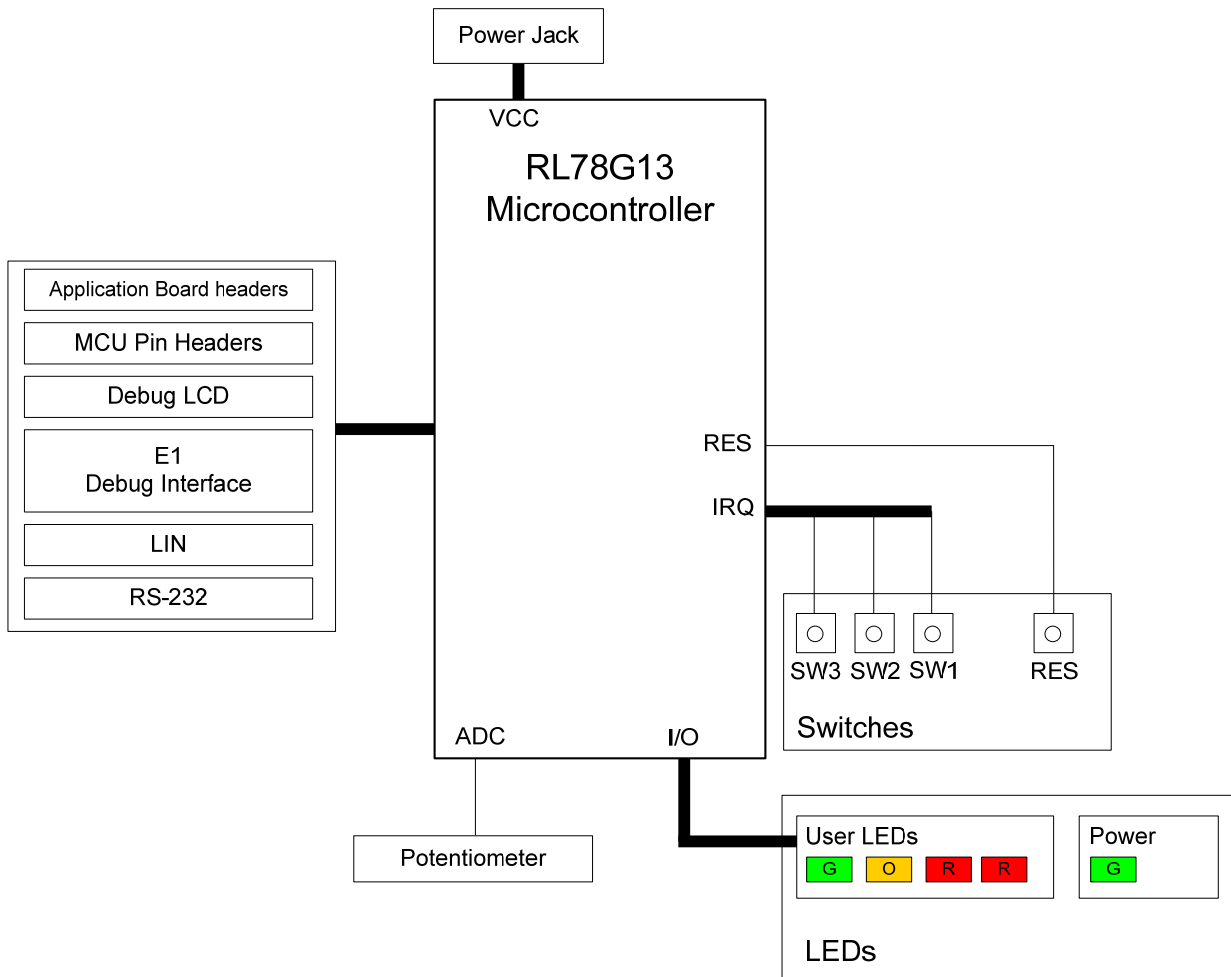
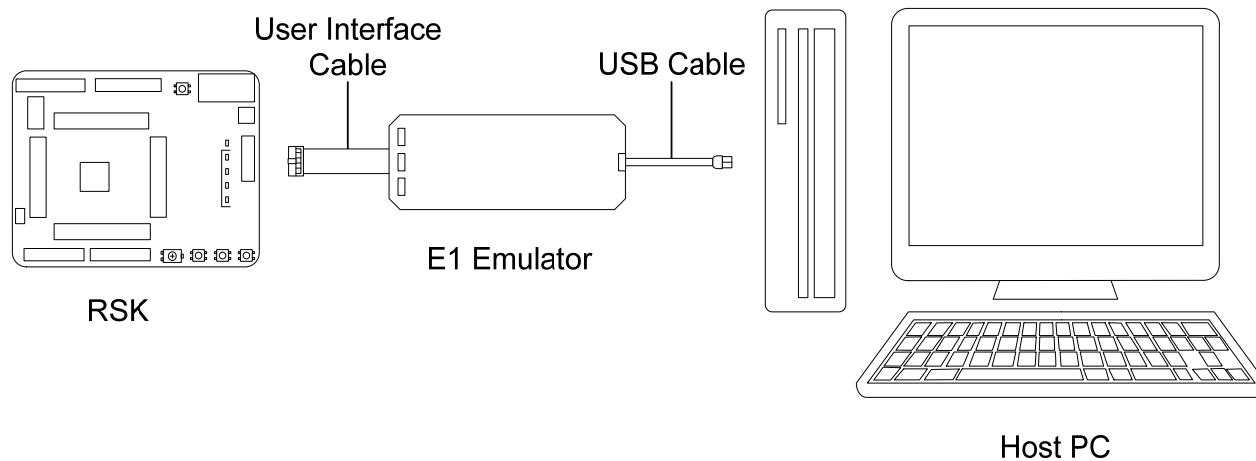


Figure 4-1: Internal RSK Block Diagram

## 4.2 Debugger Connections

The diagram below shows the connections between the RSK, E1 debugger and the host PC.



**Figure 4-2: Debugger Connection Diagram**

## 5. User Circuitry

### 5.1 Reset Circuit

RSK is using the on chip power on reset on RL78G13 to generate the required reset signal, and it can also be triggered from the RES switch. Refer to the RL78G13 hardware manual for details regarding the reset signal timing requirements, and the RSKRL78G13 board schematics for information regarding the reset circuitry in use on the RSK.

### 5.2 Clock Circuit

A clock circuit is fitted to the RSK to generate the required clock signal to drive the MCU, and associated peripherals. Refer to the RL78G13 hardware manual for details regarding the clock signal requirements, and the RSKRL78G13 board schematics for information regarding the clock circuitry in use on the RSK. Details of the crystals fitted to the RSK are listed in **Table 5-1** below.

Crystal	Function	Default Placement	Frequency	Device Package
X1	Main MCU crystal	Fitted	20 MHz	HC49/4U
X2	Internal RSK Testing Only	Unfitted	n/a	n/a
X3	Sub-Clock crystal	Fitted	32.768 KHz	Encapsulated, SMT

**Table 5-1: Crystals**

### 5.3 Switches

There are four switches located on the RSK board. The function of each switch and its connection is shown in **Table 5-2**. For further information regarding switch connectivity, refer to the RSKRL78G13 board schematics.

Switch	Function	MCU Connection
RES	When pressed, the microcontroller is reset.	RESET#, Pin 6
SW1	Connects to an IRQ (INTP1) input for user controls.	P50, Pin 33
SW2	Connects to an IRQ (INTP2) input for user controls.	P51, Pin 34
SW3	Connects to an IRQ (INTP4) input for user controls.	P31, Pin 21

**Table 5-2: Switch Connections**

### 5.4 LEDs

There are five LED's on the RSK board. The function of each LED, its colour, and its connections are shown in **Table 5-3**.

LED	Colour	Function	MCU Connection
POWER	Green	Indicates the status of the 5V power rail.	No connection
LED0	Green	User operated LED.	P52, Pin 35
LED1	Orange	User operated LED.	P53, Pin 36
LED2	Red	User operated LED.	P62, Pin 19
LED3	Red	User operated LED.	P63, Pin 20

**Table 5-3: LED Connections**

## 5.5 Potentiometer

A single-turn potentiometer is connected as a potential divider to analogue input ANI6, P26. The potentiometer can be used to create a voltage between Board\_VDD and GROUND.

The potentiometer is fitted to offer an easy method of supplying a variable analogue input to the microcontroller. It does not necessarily reflect the accuracy of the controller's ADC. Refer to the device hardware manual for further details.

## 5.6 Debug LCD Module

A debug LCD module is supplied with the RSK, and should be connected to the LCD header.

Care should be taken when installing the LCD module to ensure pins are not bent or damaged. The LCD module is vulnerable to electrostatic discharge (ESD); therefore appropriate ESD protection should be used.

The debug LCD module uses a 4-bit interface to reduce pin allocation. No contrast control is provided, as this is set by a resistor supplied on the display module. Connection information for the debug LCD module is provided in **Table 5-4** below.

Debug LCD Header					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	Ground	-	2	Board_5V	-
3	No Connection	-	4	DLCDRS	P55, Pin 38
5	R/W (Pulled to ground)	-	6	DLCDE (pulled to ground)	P54, Pin 37
7	No Connection	-	8	No Connection	-
9	No Connection	-	10	No Connection	-
11	DLCDD4	P70, Pin 29	12	DLCDD5	P71, Pin 28
13	DLCDD6	P72, Pin 27	14	DLCDD7	P73, Pin 26

**Table 5-4: LCD Header Connections**

## 5.7 RS232 Serial Port

Channel 0 of the Serial Array Unit 0 (SAU0) is connected to the standard RS232 header fitted to the RSK. Alternatively, channel 2 of SAU0 or channel 0 of SAU1 can be connected to the RS232 transceiver by making changes to the configurations to the jumpers and option links (refer to §6). Connections between the RS232 header and the microcontroller are listed in the following **Table 5-5** below.

SCI Signal	Function	MCU Connection	RS232 Connection
TxD0	SAU0 Channel 0 Transmit Signal.	P12, Pin 44	U2, Pin 13
RxD0	SAU0 Channel 0 Receive Signal.	P11, Pin 45	U2, Pin 15
TxD1	SAU0 Channel 2 Transmit Signal.	P02, Pin 60	*
RxD1	SAU0 Channel 2 Receive Signal.	P03, Pin 59	*
TxD2	SAU1 Channel 0 Transmit Signal.	P13, Pin 43	*
RxD2	SAU1 Channel 0 Receive Signal.	P14, Pin 42	*

**Table 5-5: Serial Port Connections**

\* This connection is not available in the default RSK configuration - refer to §6 for the required modifications.

## 5.8 Local-Interconnect Network (LIN)

A LIN transceiver IC is fitted to the RSK, and connected to the LIN MCU peripheral. For further details regarding the LIN protocol and supported modes of operation, please refer to the RL78G13 hardware manual.

The connections for the LIN microcontroller signals are listed in **Table 5-6** below.

<b>LIN Signal</b>	<b>Function</b>	<b>MCU Connection</b>
LINTXD	LIN Data Transmission.	P13, Pin 43
LINRXD	LIN Data Reception.	P14, Pin 42
LINNSLP	LIN Transceiver Device Sleep Control.	P06, Pin 30

**Table 5-6: LIN Connections**



## 6. Configuration

### 6.1 Modifying the RSK

This section lists the option links that are used to modify the way RSK operates in order to access different configurations. Configurations are made by modifying link resistors or headers with movable jumpers.

A link resistor is a 0Ω surface mount resistor, which is used to short or isolate parts of a circuit. Option links are listed in the following sections, detailing their function when fitted or removed. Bold, blue text indicates the default configuration that the RSK is supplied with. Refer to the component placement diagram (§3) to locate the option links and jumpers.

When removing soldered components, always ensure that the RSK is not exposed to a soldering iron for intervals greater than 5 seconds. This is to avoid damage to nearby components mounted on the RSK.

When modifying a link resistor, always check the related option links to ensure there is no possible signal contention or short circuits. Because many of the MCU's pins are multiplexed, some of the peripherals must be used exclusively. Refer to the RL78G13 hardware manual and RSKRL78G13 board schematics for further information.

### 6.2 MCU Configuration

Table 6-1 below details the option links associated with configuring the MCU's emulator support.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R95	<b>Connects E1 Debug Connector (pin 6) to RESETn (MCU, pin 6) via R26.</b>	Disconnects E1 Debug Connector (pin 6) from RESETn (MCU, pin 6).	R26

**Table 6-1: MCU Option Links**

### 6.3 ADC Configuration

Table 6-2 below details the function of the option links associated with the Analogue-to-Digital circuit.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R1	<b>Connects AVREFP (MCU, pin 56) to UC_VDD.</b>	Disconnects AVREFP (MCU, pin 56) from UC_VDD.	R2, R93
R2	Connects AVREFP to UC_VDD.	<b>Disconnects AVREFP (MCU, pin 56) from UC_VDD.</b>	R1, R93
R3	<b>Connects RV1 to ADPOT (MCU, pin 50).</b>	Disconnects RV1 from ADPOT (MCU, pin 50).	R4, R93
R4*	<b>Connects Board_VDD to RV1.</b>	Disconnects Board_VDD from RV1.	R3, R93
R5	Connects AVREFM (MCU, pin 55) to GROUND.	<b>Disconnects AVREFM (MCU, pin 55) from GROUND.</b>	-
R93*	Connects AVREFP (MCU, pin 56) to RV1 and Board_VDD.	<b>Disconnects AVREFP (MCU, pin 56) from RV1.</b>	R2, R4

**Table 6-2: ADC Option Links**

\*Do not power the board with both of these references fitted.

## 6.4 RS232 Serial Port Configuration

Table 6-3 below details the function of the option links associated with serial port configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R36	Connects T1IN (U2, pin 13) to TXD0 (U1, pin 12) or TXD1 (U1, pin 02) or TXD2 (U1, pin 13) or RS232TX, bypassing J14.	Disconnects T1IN (U2, pin 13) from TXD0 (U1, pin 02) or TXD2 (U1, pin 13) or RS232TX.	R38, R39, R42, R45, R76, J14
R37	Connects R1OUT (U2, pin 15) to RXD0 (U1, pin 11), RXD1 (U1, pin 3) or RXD2 (U1, pin 14) or RS232RX, bypassing J15.	Disconnects R1IN (U2, pin 15) from RXD0 (U1, pin 11) or RXD1 (U1, pin 3) or RXD2 (U1, pin 14) or RS232RX	R40, R43, R46, R41, R70, J15
R38	Connects RS232TX to T1IN (U2, pin 13).	Disconnects RS232TX from T1IN (U2, pin 13).	R36, R39, R42, R45, J14
R39	Connects TXD2 (U1, pin 13) to T1IN (U2, pin 13).	Disconnects TXD2 (U1, pin 14) from T1IN (U2, pin 13).	R36, R45, R42, R38 J14
R40	Connects RS232RX to R1OUT (U2, pin 15).	Disconnects RS232RX from R1OUT (U2, pin 15).	R37, R43, R46, R41, J15
R41	Connects RXD2 (U1, pin 14) to R1OUT (U2, pin 15).	Disconnects RXD2 (U1, pin 14) from R1OUT (U2, pin 15).	R37, R43, R46, R40, J15
R42	Connects TXD0 (U1, pin 12) to T1IN (U2, pin 13).	Disconnects TXD0 (U1, pin 12) from T1IN (U2, pin 13).	R36, R38, R39, R45, J14
R43	Connects RXD0 (U1, pin 11) to R1OUT (U2, pin 15).	Disconnects RXD0 (U1, pin 11) from R1OUT (U2, pin 15).	RR37, R40, R41, R46, J15
R44	Connects SHDN (U2, pin 20) to GROUND. Shuts down the RS232 transceiver.	Disconnects SHDN (U2, pin 20) from GROUND allowing SHDN to be pulled to Board_EVDD0, enabling the RS232 transceiver.	R33
R45	Connects TXD1 (U1, pin 2) to T1IN (U2, pin 13).	Disconnects TXD1 (U1, pin 2) from T1IN (U2, pin 13).	R36, R38, R39, R42, J14
R46	Connects RXD1 (U1, PIN 3) to R1OUT (U2, pin 15).	Disconnects RXD1 (U1, PIN 3) from R1OUT (U2, pin 15).	R37, R40, R41, R43, J15

Table 6-3: RS232 Serial Port Option Links

Table 6-4 below details the different configurations and functions of the RS232 serial jumpers.

Reference	Position One	Position Two	Position Three	Related Ref.
J14*	Pins 1 and 2 shorted. Connects T1IN (U2, pin 13) to TXD0 (U1, pin 12).	Pins 2 and 3 shorted. Connects T1IN (U2, pin 13) to U8 (pin 4) and TOOL0.	All pins open. Same as Position One configuration.	R36, R38, R39, R42, R45
J15*	Pins 1 and 2 shorted. Connects R1OUT (U2, pin 15) to RXD0 (U1, pin 11).	Pins 2 and 3 shorted. Connects R1OUT (U2, pin 15) to U8 (pin 1).	All pins open. Same as Position One configuration.	R37, R40, R41, R43, R46
J16*	Pins 1 and 2 shorted. Connects R2OUT (U2, pin 10) to RESETn (U1, pin 6) via U9.	All pins open. Disconnects R2OUT (U2, pin 10) from RESTEn (U1, pin 6) via U9.	-	R37, R40, R41, R43, R46

Table 6-4: RS232 Serial Port Jumpers

\* By default, this jumper is not fitted to the RSK. R36 is fitted by default and TXD0 is connected to RS232

transceiver.

\*By default, this jumper is not fitted to the RSK. R37 is fitted by default and RXD0 is connected to RS232 transceiver.

\*By default, this jumper is not fitted to the RSK

## 6.5 LIN Configuration

Table 6-5 below details the function of the option links associated with LIN configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R83	<b>When fitted in conjunction with R84, the LIN operates in master mode.</b>	When removed in conjunction with R84, the LIN operates in slave mode.	R84, D2
R84	<b>When fitted in conjunction with R83, the LIN operates in master mode.</b>	When removed in conjunction with R83, the LIN operates in slave mode.	R83, D2
R85	<b>Connects Board_EVDD0 to VBAT, bypassing J8.</b>	Disconnects Board_EVDD0 from VBAT.	J8

**Table 6-5: LIN Option Links**

Table 6-6 below details the different configurations and functions of the LIN jumpers.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
J8*	Connects Board_EVDD0 to VBAT, bypassed by R85.	<b>Disconnects Board_EVDD0 from VBAT.</b>	R85

**Table 6-6: LIN Port Jumpers**

\* By default, this jumper is not fitted to the RSK. R85 is fitted by default and Board\_EVDD0 is connected to BAT.

## 6.6 IRQ & General I/O Pin Configuration

Table 6-7 below details the function of the option links associated with IRQ and general I/O pin configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R51	Connects SW3_INTP4 (MCU, pin 21) to SW3.	Disconnects SW3_INTP4 (MCU, pin 21) from SW3.	R54
R52	Connects IO1_DLCDD5 (MCU, pin 28) to DLCDD5 (LCD, pin 12).	Disconnects IO1_DLCDD5 (MCU, pin 28) from DLCDD5 (LCD, pin 12).	R55
R53	Connects LINRXD_RxD2 (MCU, pin 42) to LINRXD.	Disconnects LINRXD_RxD2 (MCU, pin 42) from LINRXD.	R56
R54	Connects SW3_INTP4 (MCU, pin 21) to INTP4 (JA1, pin 23).	Disconnects SW3_INTP4 (MCU, pin 21) from INTP4 (JA1, pin 23).	R51
R55	Connects IO1_DLCDD5 (MCU, pin 28) to IO1 (JA1, pin 16).	Disconnects IO1_DLCDD5 (MCU, pin 28) from IO1 (JA1, pin 16).	R52
R56	Connects LINRXD_RxD2 (MCU, pin 42) to RxD2 (JA6, pin 12).	Disconnects LINRXD_RxD2 (MCU, pin 42) from RxD2 (JA6, pin 12).	R53
R59	Connects IO4_INTP8 (MCU, pin 25) to IO4 (JA1, pin 19).	Disconnects IO4_INTP8 (MCU, pin 25) from IO4 (JA1, pin 19).	R62
R60	Connects IO0_DLCDD4 (MCU, pin 29) to DLCDD4 (LCD, pin 11).	Disconnects IO0_DLCDD4 (MCU, pin 29) from DLCDD4 (LCD, pin 11).	R63
R61	Connects LINTXD_TxD2 (MCU, pin 43) to LINTXD.	Disconnects LINTXD_TxD2 (MCU, pin 43) from LINTXD.	R64
R62	Connects IO4_INTP8 (MCU, pin 25) to INTP8 (JA5, pin 10).	Disconnects IO4_INTP8 (MCU, pin 25) from INTP8 (JA5, pin 10).	R59
R63	Connects IO0_DLCDD4 (MCU, pin 29) to IO0 (JA1, pin 15).	Disconnects IO0_DLCDD4 (MCU, pin 29) from IO0 (JA1, pin 15).	R60
R64	Connects LINTXD_TxD2 (MCU, pin 43) to TXD2 (JA6, pin 9).	Disconnects LINTXD_TxD2 (MCU, pin 43) from TXD2 (JA6, pin 9).	R61
R65	Connects IO3_DLCDD7 (MCU, pin 26) to DLCDD7 (LCD, pin 14).	Disconnects IO3_DLCDD7 (MCU, pin 26) from DLCDD7 (LCD, pin 14).	R68
R66	Connects SW1_INTP1 (MCU, pin 33) to SW1.	Disconnects SW1_INTP1 (MCU, pin 33) from SW1.	R69
R67	Connects ANI16_RxD1 (MCU, pin 59) to ANI16 (JA5, pin 1).	Disconnects ANI16_RxD1 (MCU, pin 59) from ANI16 (JA5, pin 1).	R70
R68	Connects IO3_DLCDD7 (MCU, pin 26) to IO3 (JA1, pin 18).	Disconnects IO3_DLCDD7 (MCU, pin 26) from IO3 (JA1, pin 18).	R65
R69	Connects SW1_INTP1 (MCU, pin 33) to INTP1 (JA2, pin 9).	Disconnects SW1_INTP1 (MCU, pin 33) from INTP1 (JA2, pin 9).	R66
R70	Connects ANI16_RxD1 (MCU, pin 59) to RxD1 (JA6, pin 7).	Disconnects ANI16_RxD1 (MCU, pin 59) from RxD1 (JA6, pin 7).	R67
R71	Connects IO2_DLCDD6 (MCU, pin 27) to DLCDD6 (LCD, pin 13).	Disconnects IO2_DLCDD6 (MCU, pin 27) from DLCDD6 (LCD, pin 13).	R74
R72	Connects SW2_INTP2 (MCU, pin 34) to SW2.	Disconnects SW2_INTP2 (MCU, pin 34) from SW2.	R75
R73	Connects ANI17_TxD1 (MCU, pin 60) to ANI17 (JA5, pin 2).	Disconnects ANI17_TxD1 (MCU, pin 60) from ANI17 (JA5, pin 2).	R76
R74	Connects IO2_DLCDD6 (MCU, pin 27) to IO2 (JA1, pin 17).	Disconnects IO2_DLCDD6 (MCU, pin 27) from IO2 (JA1, pin 17).	R71

Table 6-7: IRQ & General I/O Option Links (Continued Overleaf)

**Table 6-8** below details the function of the option links associated with IRQ and general I/O pin configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R75	Connects SW2_INTP2 (MCU, pin 34) to INTP2 (JA2, pin 23).	Disconnects SW2_INTP2 (MCU, pin 34) from INTP2 (JA2, pin 23).	R72
R76	Connects ANI17_TxD1 (MCU, pin 60) to TxD1 (JA6, pin 8).	Disconnects ANI17_TxD1 (MCU, pin 60) from TxD1 (JA6, pin 8).	R73
R96	Connects SDAA0 (JA1, pin 25) and SCLA0 (MCU, pin 26) pull-up resistors to Board_EVDD0.	Disconnects SDAA0 (JA1, pin 25) and SCLA0 (MCU, pin 26) pull-up resistors from Board_EVDD0.	R49, R50, R97
R97	Connects SDAA0 (MCU, pin 25) and SCLA0 (MCU, pin 26) pull-up resistors to Board_5V.	Disconnects SDAA0 (MCU, pin 25) and SCLA0 (MCU, pin 26) pull-up resistors from Board_5V.	R49, R50, R96

**Table 6-8: IRQ & General I/O Option Links (Continuation)**

## 6.7 Power Supply Configuration

**Table 6-9** below details the function of the option links associated with power supply configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R19	Connects external power supply from PWR1 to Board_5V VIN (U12, pin 3) and J13 (pin 1).	Disconnects external power supply from PWR1 to Board_5V VIN (U12, pin 3) and J13 (pin 1).	R20
R20	Connects CON_5V to PWR1.	Disconnects CON_5V from PWR1.	R19
R21	Connects CON_3V3 to Board_VDD.	Disconnects CON_3V3 from Board_VDD.	R89, J13
R22	Connects UC_VDD to Board_VDD, bypassing J6.	Disconnects UC_VDD from Board_VDD.	R21, R89, J6
R89	Connects external power supply to Board_VDD.	Disconnects external power supply from Board_VDD.	R21
R90	Connects external power supply to Board_EVDD0.	Disconnects external power supply from Board_EVDD0.	R91
R91	Connects CON_3V3 to Board_EVDD0.	Disconnects CON_3V3 from Board_EVDD0.	R90
R92	Connects UC_EVDD0 to Board_EVDD0, bypassing J11.	Disconnects CON_3V3 from Board_EVDD0.	R90, R91, J11

**Table 6-9: Power Supply Option Links**

**Table 6-10** below details the different configurations and functions of the Power Supply jumpers.

Reference	Position One	Position Two	Position Three	Related Ref.
J6*	Pins 1 and 2 shorted. UC_VDD is connected to Board_VDD.	<b>All pins open.</b> <b>UC_VDD disconnected from Board_VDD.</b> <b>(UC_VDD connected to Board_VDD by default due to R22).</b>	-	R22
J10	Pins 1 and 2 shorted. U12 (voltage regulator) outputs 1.8V to be used as Board_VDD.	<b>All pins open.</b> <b>U12 outputs 3.3V to be used as Board_VDD.</b>	-	J13
J11*	Pins 1 and 2 shorted. UC_EVDD0 is connected to Board_VDD.	<b>All pins open.</b> <b>UC_EVDD0 disconnected from Board_VDD.</b> <b>(UC_EVDD0 connected to Board_VDD by default due to R92).</b>	-	R92
J13	<b>Pins 1 and 2 shorted.</b> <b>Board_VDD, UC_VDD and UC_EVDD0 powered from PWR1 or CON_5V.</b>	Pins 2 and 3 shorted. Board_VDD, UC_VDD and UC_EVDD0 powered from U12's regulated power output.	All pins open. Do not use this setting.	J10

**Table 6-10: Power Supply Jumpers**

\*By default, this jumper is not fitted to the RSK. R22 is fitted by default and UC\_VDD is connected to Board\_VDD.

\*By default, this jumper is not fitted to the RSK. R92 is fitted by default and UC\_EVDD0 is connected to Board\_EVDD0.

## 6.8 Clock Configuration

Table 6-11 below details the function of the option links associated with clock configuration.

Reference	Link Fitted Configuration	Link Removed Configuration	Related Ref.
R6	<b>Connects X1 (MCU, pin 11) to the crystal X1.</b>	Disconnects X1 (MCU, pin 11) from the crystal X1.	R10, R12
R7	<b>Connects X2 (MCU, pin 10) to the crystal X1.</b>	Disconnects X2 (MCU, pin 10) from the crystal X1.	R10, R13
R8	Connects X1 (MCU, pin 11) to the crystal X2.	<b>Disconnects X1 (MCU, pin 11) from the crystal X2.</b>	
R9	Connects X2 (MCU, pin 10) to the crystal X2.	<b>Disconnects X2 (MCU, pin 10) from the crystal X2.</b>	
R12	Connects signal X1 (MCU, pin 11) to crystal X1 (X2). (NEVER FIT crystal X1 and crystal X2 SIMULTANEOUSLY).	<b>Disconnects X1/X2 (MCU, pin 11) from CON_X1 (J1, pin 11).</b>	-
R13	Connects signal X2 (MCU, pin 10) to crystal X1 (X2). (NEVER FIT crystal X1 and X2 SIMULTANEOUSLY).	<b>Disconnects X1/X2 (MCU, pin 10) from CON_X1_EXCLK (J1, pin 10).</b>	-
R14	Connects XT1 (MCU, pin 8) to CON_XT1 (J1, pin 8)	<b>Disconnects XT1 (MCU, pin 8) from CON_XT1 (J1, pin 8).</b>	R12
R15	Connects XT2 (MCU, pin 7) to CON_XT2 (J1, pin 7)	<b>Disconnects XT2 (MCU, pin 7) from CON_XT2 (J1, pin 7).</b>	R13
R16	<b>Connects XT1 (MCU, pin 8) to crystal X3.</b>	Disconnects XT1 (MCU, pin 8) from crystal X3.	R14
R17	<b>Connects XT2 (MCU, pin 7) to crystal X3.</b>	Disconnects XT2 (MCU, pin 7) from crystal X3.	R15

Table 6-11: Clock Option Links

## 7. Headers

### 7.1 Application Headers

This RSK is fitted with application headers, which can be used to connect compatible Renesas application devices or as easy access to MCU pins.

**Table 7-1** below lists the connections of the application header, JA1.

Application Header JA1					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	5V	-	2	EXTAL	10
3	3V3	-	4	0V	
5	AVcc	-	6	AVss	55
7	AVref	56	8	ADTRG	-
9	AD0	54	10	AD1	53
11	AD2	52	12	AD3	51
13	DAC0	-	14	DAC1	-
15	IO_0	29	16	IO_1	28
17	IO_2	27	18	IO_3	26
19	IO_4	25	20	IO_5	24
21	IO_6	23	22	IO_7	22
23	IRQ3	21	24	IIC_EX	NC
25	IIC_SDA	18	26	IIC_SCL	-

**Table 7-1: Application Header JA1 Connections**

**Table 7-2** below lists the connections of the application header, JA2.

Application Header JA2					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	RESET	6	2	EXTAL	10*
3	NMI	-	4	Vss1	13, 14
5	WDT_OVF	-	6	SClTX	44
7	IRQ0	9	8	SClRX	45
9	IRQ1	33*	10	SClCK	46
11	M1_UD	-	12	CTSRTS	-
13	M1_Up	-	14	M1_Un	-
15	M1_Vp	-	16	M1_Vn	-
17	M1_Wp	-	18	M1_Wn	-
19	TimerOut	61	20	TimerOut	31
21	TimerIn	62	22	TimerIn	39
23	IRQ2	34	24	M1_POE	-
25	M1_TRCCLK	-	26	M1_TRDCLK	-

**Table 7-2: Application Header JA2 Connections**



Table 7-3 below lists the connections of the application header, JA5.

Application Header JA5					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	AD4*	59	2	AD5	60
3	AD6	48	4	AD7	49
5	CAN1TX	-	6	CAN1RX	-
7	CAN2TX	-	8	CAN2RX	-
9	AD8	40	10	IRQ5*	25
11	AD10	-	12	AD11	-
13	TIOCoA	-	14	TIOCoB	-
15	TIOCoC	-	16	M2_TRISTn	-
17	TCLKC	-	18	TCLKD	-
19	M2_Up	-	20	M2_Un	-
21	M2_Vp	-	22	M2_Vn	-
23	M2_Wp	-	24	M2_Wn	-

Table 7-3: Application Header JA5 Connections

Table 7-4 below lists the connections of the application header, JA6.

Application Header JA6					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	DREQ	-	2	DACK	-
3	TEND	-	4	STBYn	-
5	RS232TX	-	6	RS232RX	-
7	SCIbRX*	59	8	SCIbTX	60
9	SClckTX*	43	10	SCIbCK*	58
11	SClckCK	41	12	SClckRX	42
13	Reserved	-	14	Reserved	-
15	Reserved	-	16	Reserved	-
17	Reserved	-	18	Reserved	-
19	Reserved	-	20	Reserved	-
21	Reserved	-	22	Vss	-
23	Unregulated_Vcc	-	24	GROUND	13/14

Table 7-4: Application Header JA6 Connections

## 7.2 Microcontroller Ring Headers

Table 7-5 below lists the connections of the microcontroller pin header, J1.

Microcontroller Pin Header, J1					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	ANI19	1	2	P43	2
3	P42	3	4	P41	4
5	TOOL0	5	6	RESETn	6
7	CON_XT2	7*	8	CON_XT1	8*
9	INTP0	9	10	CON_X2_EXCLK	10*
11	CON_X1	11*	12	NC	-
13	GROUND	13/14	14	GROUND	13/14
15	UC_VDD	15	16	UC_EVDD0	16
17	NC	-	18	NC	-
19	NC	-	20	NC	-
21	NC	-	22	NC	-
23	NC	-	24	NC	-
25	NC	-	26	NC	-
27	NC	-	28	NC	-
29	NC	-	30	NC	-
31	NC	-	32	NC	-
33	NC	-	34	NC	-
35	NC	-	36	NC	-

**Table 7-5: Microcontroller Pin Header, J1**

**Table 7-6** below lists the connections of the microcontroller pin header, J2.

Microcontroller Pin Header, J2					
Pin	Circuit Net name	MCU Pin	Pin	Circuit Name	MCU Pin
1	P60_SCLAO	17	2	P61_SDAA0	18
3	LED2	19	4	LED3	20
5	SW3_INTP4	21	6	IO7	22
7	IO6	23	8	IO5	24
9	IO4_INTP8	25	10	IO3_DLCDD7	26
11	IO2_DLCDD6	27	12	IO1_DLCDD5	28
13	IO0_DLCDD4	29	14	LINNSLP	30
15	TO05	31	16	P30	32
17	NC	-	18	NC	-
19	NC	-	20	NC	-
21	NC	-	22	NC	-
23	NC	-	24	NC	-
25	NC	-	26	NC	-
27	NC	-	28	NC	-
29	NC	-	30	NC	-
31	NC	-	32	NC	-
33	NC	-	34	NC	-
35	NC	-	36	NC	-

**Table 7-6: Microcontroller Pin Header, J2**

Table 7-7 below lists the connections of the microcontroller pin header, J3.

Microcontroller Pin Header J3					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	SW1_INTP1	33	2	SW2_INTP2	34
3	LED0	35	4	LED1	36
5	DLCDE	37	6	DLCDRS	38
7	TI02	39	8	INTP5	40
9	SCK20n	41	10	LINRXD_RxD2	42
11	LINTXD_TxD2	43	12	TxD0	44
13	RxD0	45	14	SCK00n	46
15	P146	47	16	ANI18	48
17	NC	-	18	NC	-
19	NC	-	20	NC	-
21	NC	-	22	NC	-
23	NC	-	24	NC	-
25	NC	-	26	NC	-
27	NC	-	28	NC	-
29	NC	-	30	NC	-
31	NC	-	32	NC	-
33	NC	-	34	NC	-
35	NC	-	36	NC	-

Table 7-7: Microcontroller Pin Header, J3

**Table 7-8** below lists the connections of the microcontroller pin header, J4.

Microcontroller Pin Header J4					
Pin	Circuit Net Name	MCU Pin	Pin	Circuit Net Name	MCU Pin
1	P27	49	2	ADPOT	50
3	ANI5	51	4	ANI4	52
5	ANI3	53	6	ANI2	54
7	AVREFM	55	8	AVREFP	56
9	P130	57	10	SCK10n	58
11	ANI16_RxD1	59	12	ANI17_TxD1	60
13	TO00	61	14	TI00	62
15	P141	63	16	P140	64
17	NC	-	18	NC	-
19	NC	-	20	NC	-
21	NC	-	22	NC	-
23	NC	-	24	NC	-
25	NC	-	26	NC	-
27	NC	-	28	NC	-
29	NC	-	30	NC	-
31	NC	-	32	NC	-
33	NC	-	34	NC	-
35	NC	-	36	NC	-

**Table 7-8: Microcontroller Pin Header, J4**

\*Denotes that the Microcontroller's pin header circuit name is not directly connected to the Microcontroller.

## 8. Code Development

### 8.1 Overview

For all code debugging using Renesas software tools, the RSK board must be connected to a PC via an E1 debugger. An E1 debugger is supplied with this RSK product.

For further information regarding the debugging capabilities of the E1 debuggers, refer to the E1 Emulator User's Manual (R20UT0398EJ).

### 8.2 Compiler Restrictions

The compiler supplied with this RSK is fully functional from first use. By default the compiler is set to build a maximum of 16k code and data. To use the compiler with programs greater than this size you need to purchase the full tools from your distributor.

The protection software for the compiler will detect changes to the system clock. Changes to the system clock back in time may cause the trial period to expire prematurely.

### 8.3 Mode Support

The RL78G13 microcontroller only supports single-chip operating mode.

### 8.4 Debugging Support

The E1 emulator (as supplied with this RSK) supports break points, event and basic functionality. For further details, refer to the E1 Emulator User's Manual (R20UT0398EJ).

### 8.5 Address Space

Figure 8-1 below details the address space of MCU in its different operating modes. For further details, refer to the RL78G13 group hardware manual.

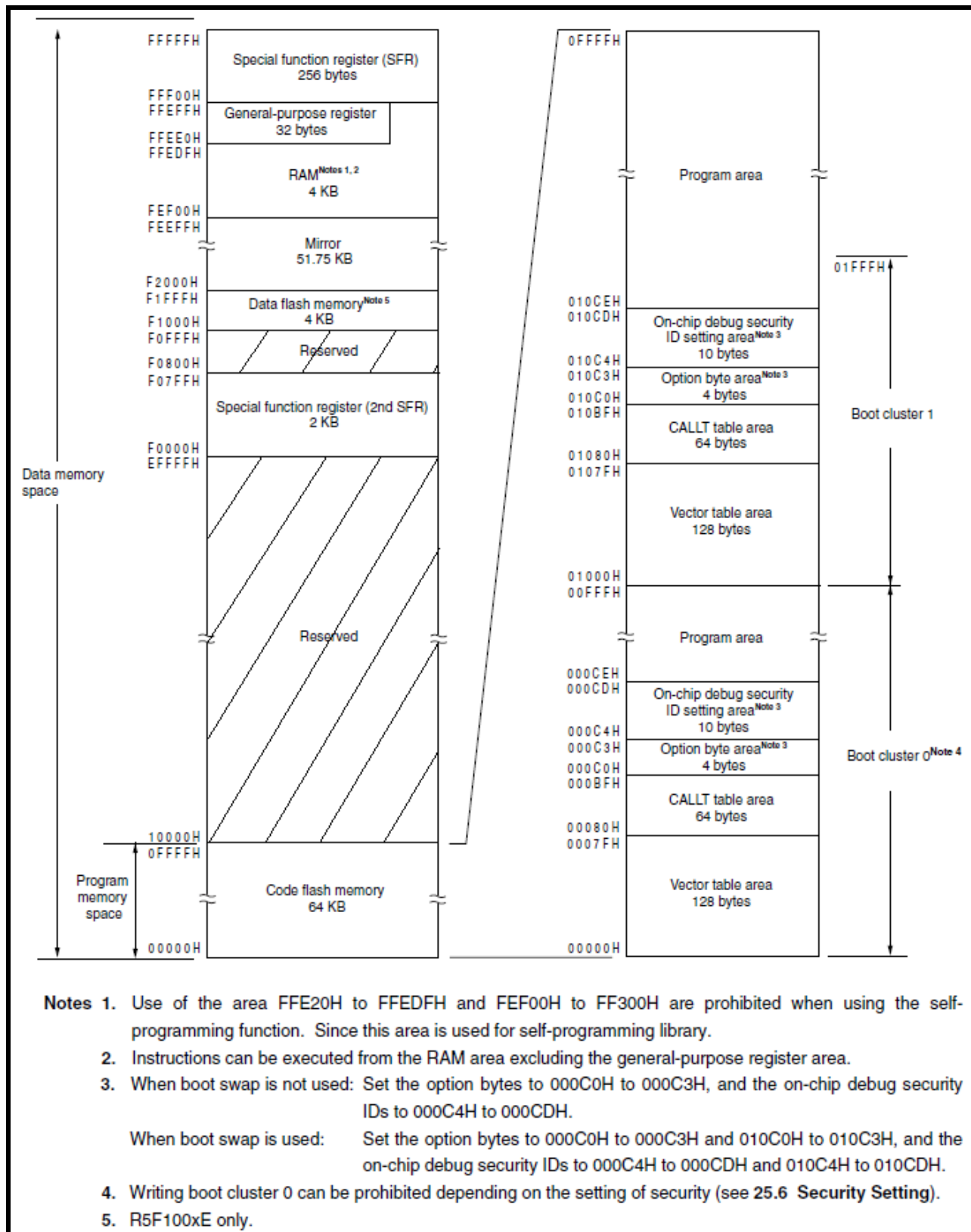


Figure 8-1: MCU Address Space Diagram

## 9. Additional Information

### Technical Support

For details on how to use IAR Embedded Workbench refer to Help from the menu bar within the IAR Embedded Workbench.

For information about the RL78G13 series microcontrollers refer to the RL78G13 Group hardware manual.

For information about the RL78G13 assembly language, refer to the RL78 Series Software Manual.

Online technical support and information is available at: <http://www.renesas.com/rskrl78g13>

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