

Renesas Demonstration Kit (RDK) for RL78  
User's Manual: Hardware

RENESAS MCU  
RL78 Family

Release 1.0

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This Renesas Demonstration 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 Demonstration Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

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# Chapter 1. Preface

## Cautions

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All rights reserved. The RDK design, documentation, and demo software are intended to improve understanding and time-to-market for RL78-based designs. Duplication of the design, documentation, and demonstration software is encouraged.

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## Glossary

ADC	Analog to Digital Converter	MCU	Microcontroller Unit
CPU	Central Processing Unit	NC	No Connection
DAC	Digital to Analog Converter	PC	Program Counter
EMC	Electromagnetic compatibility	PMOD	Peripheral Module
ESD	Electrostatic Discharge	RAM	Random Access Memory
I/O	Input / Output	ROM	Read-Only Memory
LCD	Liquid Crystal Display	RDK	Renesas Demonstration Kit
LED	Light Emitting Diode	SDRAM	Synchronous Dynamic Random Access Memory

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## Chapter 2. Purpose

This RDK is an evaluation and demonstration tool for Renesas RL78 low-power microcontrollers. The goal is to provide the user with a powerful debug and demonstration platform targeted at common applications. A set of human/machine interfaces are tightly integrated with the features of the RL78 and the software demonstration programs providing the user with an accessible platform to rapidly evaluate and customize.

Target Applications and Features:

### Audio

- Stereo audio driver connected to the PWM interface
- Amplified on-board speaker and external audio jack.
- On-board microphone to demonstrate sampling, FFT/FPU capabilities
- Volume Control Potentiometer

### User Interface

- Graphical LCD
- User pushbutton switches and a reset switch.
- On-board LEDs

### Communications

- RS-232 Interface
- I<sup>2</sup>C, SPI with Debug through the Beagle connector from Total Phase
- Application Header to support several external WiFi modules.
- PMOD connections to support a variety of generic PMOD devices (WiFi, Bluetooth, RF, and much more).

### Memory Storage

- Micro SD card slot
- 512KB Serial EEPROM
- 512KB On-chip Flash Memory

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## Digital Sensors

- 3 – Axis Accelerometer
- Temperature Sensor
- Ambient Light Sensor

## Power Control

- FET Circuit for DC output
- TRIAC Circuit for AC output

## User Code and Application Debugging

- On-board debugger for high-quality source code debugging (TK interface)
- User circuit breadboard area

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## Renesas Online

The Renesas RDK online experience is complemented by the online Renesas ecosystem.

- Renesas Interactive: [www.RenesasInteractive.com](http://www.RenesasInteractive.com)
  - Free Online Learning
- Renesas Rulz: [www.RenesasRulz.com](http://www.RenesasRulz.com)
  - Online community
  - Online user forums
  - <http://www.renesasrulz.com/community/demoboards/rdkrl78g13> - Online support site for this RDK
- University Program: [www.RenesasUniversity.com](http://www.RenesasUniversity.com)
  - Support for Professors and Students
  - Support for University Kits (QSKs)
- Renesas Microcontroller Samples (America Customers)
  - Free of charge
  - Request directly from [www.America.Renesas.com/samples](http://www.America.Renesas.com/samples)

Develop and submit your sample programs to demonstrate these features to the online community: [www.RenesasRulz.com/community/renesas\\_products/rl78](http://www.RenesasRulz.com/community/renesas_products/rl78)



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## Chapter 3. Power Supply

### 3.1. Requirements

This RDK gets its power from the debugger mini USB connection or optionally from a regulated 5V power supply. The optional power jack is a center positive connector using a 2.1 mm barrel. An alternate power header is located next to the power jack (J5).

The RDK PCB can also be loaded with an optional 5.5V super cap (C73), part number EEC-S0HD334H.

**Warning:** The RDK is neither under nor over-voltage protected. Use a 5V REGULATED center positive supply.

### 3.2. Power-Up Behavior

When the RDK is purchased it has the Theremin Demo pre-programmed into the Renesas microcontroller. The code exercises the user LCD, Speaker and Accelerometer on the RDK. The LCD powers up with X and Y axis lines on the LCD. Switch 3 turns the speaker ON. The program takes samples from the accelerometer and changes the tone frequency and volume of the speaker as the board is tilted left, right, front, and back. The name of the factory demo project is "RL78Theremin".

# Chapter 4. Board Layout

## 4.1. Component Layout

The following diagram shows the top layer component layout.

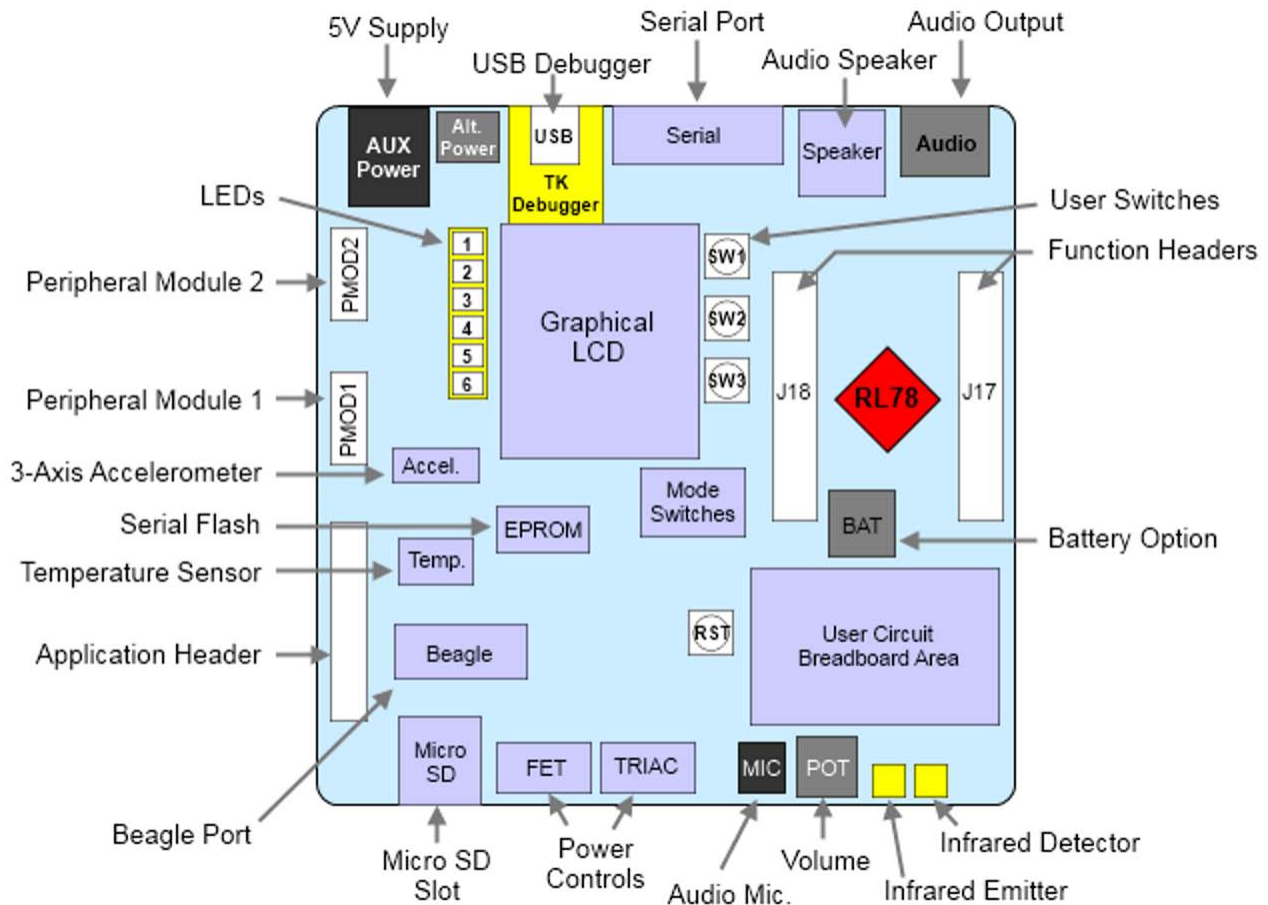


Figure 4-1: Board Layout

## 4.2. Board Dimensions

The following diagram gives the board dimensions (5.1"x5.1") and connector locations. All through hole connectors are on a common 0.1" grid for easy interfacing.

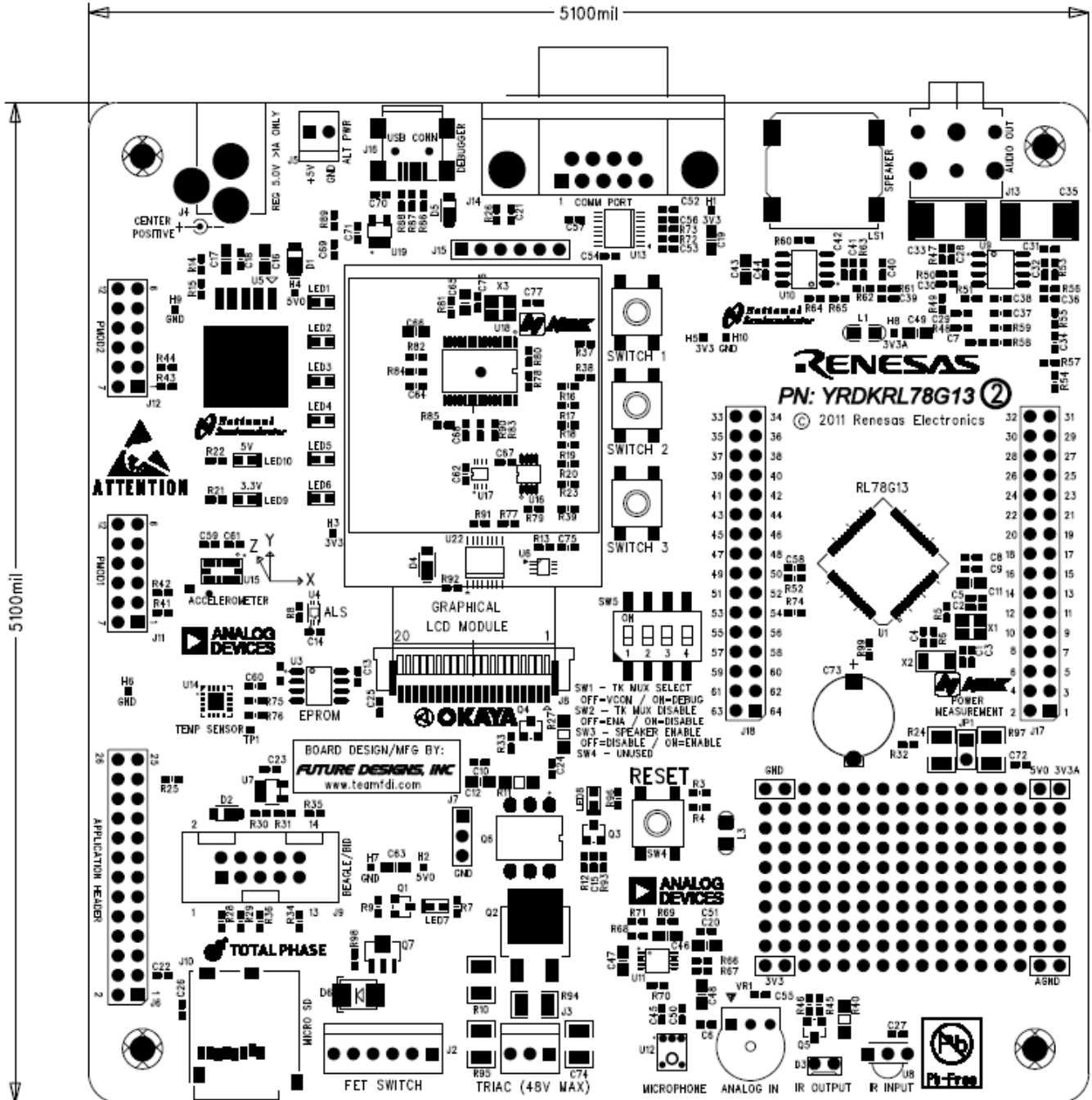


Figure 4-2: Board Dimensions

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## Chapter 5. Block Diagram

Figure 5-1 shows the CPU board components and their connectivity.

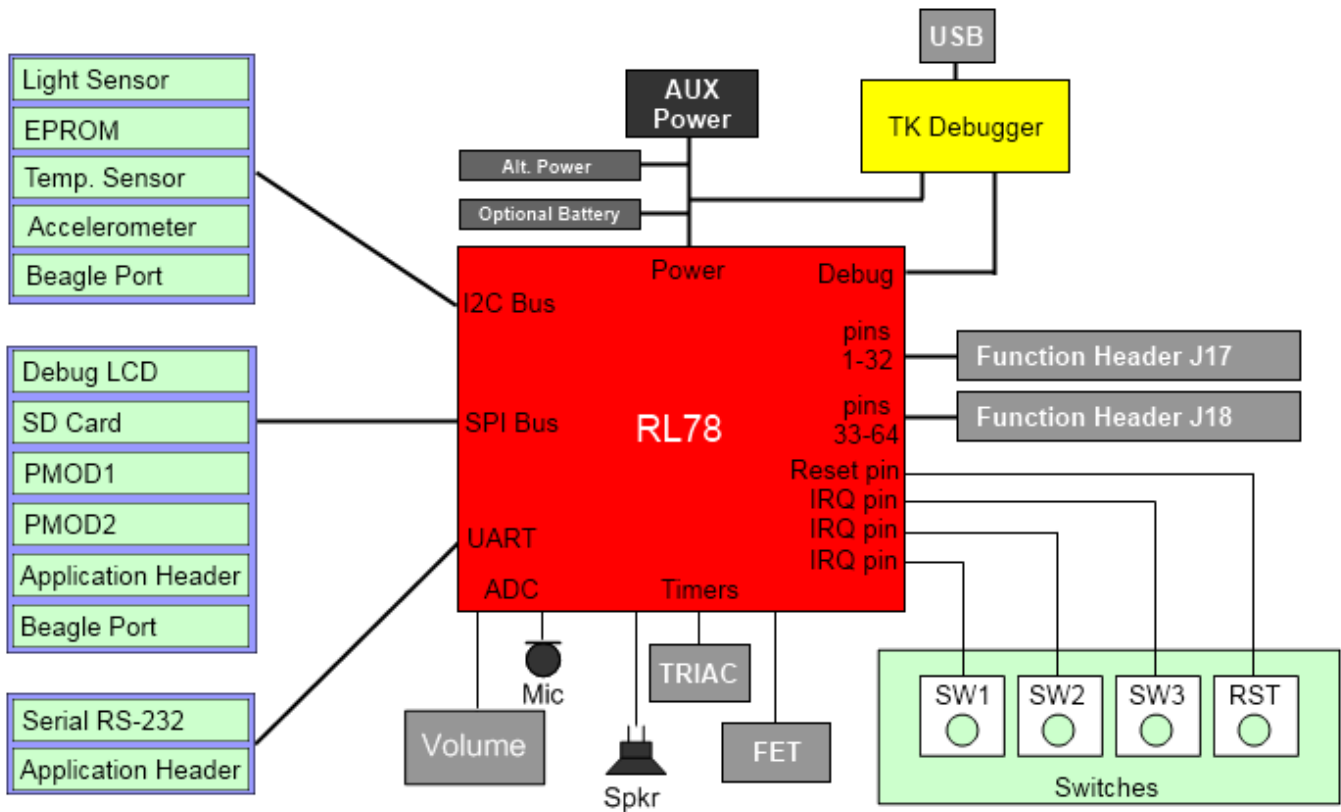


Figure 5-1: Block Diagram

Figure 5-2 shows host PC connection to the RDK board.

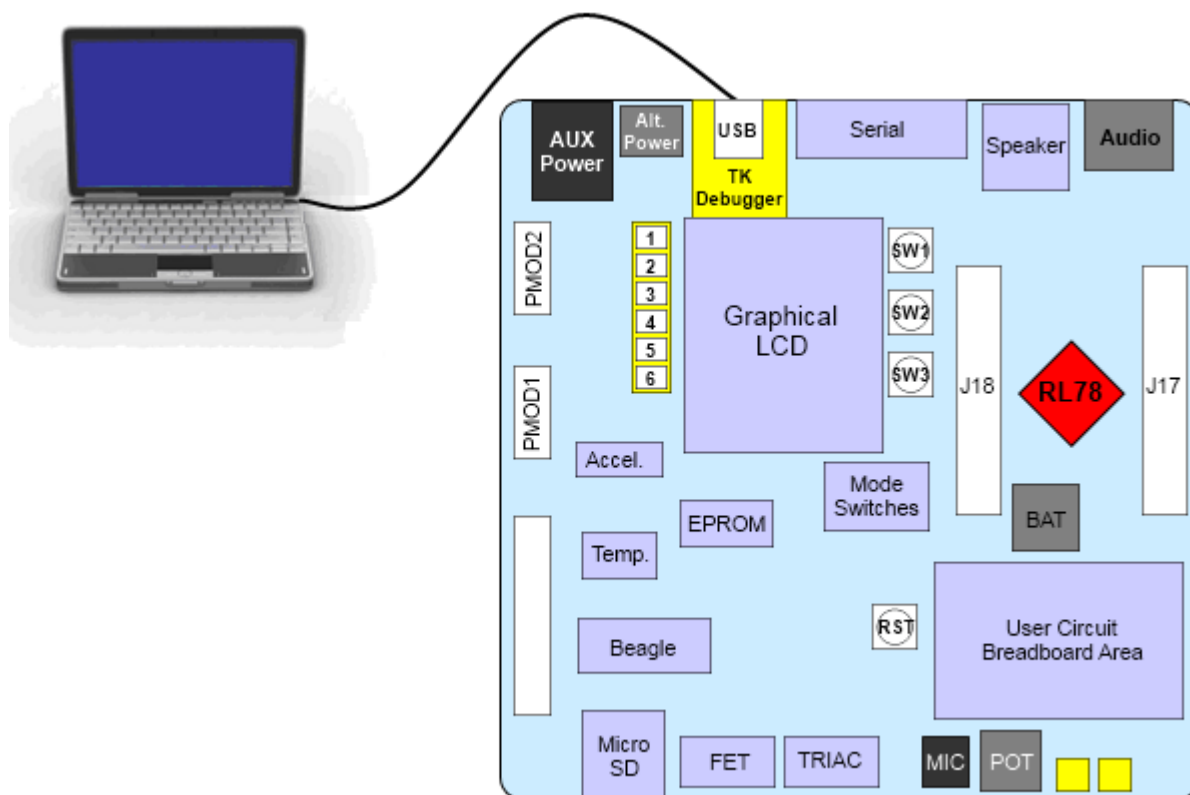


Figure 5-2: RDK Connections

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# Chapter 6. User Circuitry

## 6.1. Switches

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

Switch	Function	RL78
SWITCH 1	Connects to an interrupt line for user controls.	INTP0, P137 (pin 9)
SWITCH 2	Connects to an interrupt line for user controls.	INTP1, P50 (pin 33)
SWITCH 3	Connects to an interrupt line for user controls.	INTP2, P51 (pin 34)
RESET	When pressed, the RL78 is reset.	/RESET , (pin 6)

**Table 6-1: Switch Functions**

## 6.2.Debug LCD Module

A debug LCD module is supplied on the RDK. The debug LCD module uses an SPI interface to reduce the pin allocation. Software contrast control is also provided. The module supplied with the RDK uses 3.3v. The display is a 96 x 64 graphics display and uses a white LED backlight. The backlight is on by default and can be toggled OFF by setting P70 (BL-ENA) low. Note there is a footprint, LCD1, for a 2 x 8 character display. This display is not populated – but can be used in a standard 4 bit nibble configuration if desired. **Table 6-2** shows the pin allocation and signal names used for the graphics LCD connector.

Pin	Circuit Net Name	RL78	Pin	Circuit Net Name	RL78
1	+5V Backlight Positive Anode	-	2	GND	-
3	GND	-	4	GND	-
5	GND	-	6	LCD-CS	P10 (pin 46)
7	RSTOUT#	P130 (pin 57)	8	LCD-RS	P15 (pin 41)
9	+3.3V	-	10	+3.3V	-
11	SCK	P04 (pin 58)	12	MOSI	P02 (pin 60)
13	MOSI	P02 (pin 60)	14	MOSI	P02 (pin 60)
15	+3.3V	-	16	+3.3V	-
17	+3.3V	-	18	+3.3V	-
19	GND	-	20	+3.3V	-

**Table 6-2: Debug LCD Module Connections (J8)**

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## 6.3. LEDs

There are eight LEDs on the RDK board. The green 5V (LED10) and 3V (LED9) LEDs are ON automatically when the board is powered. There are six user LEDs (see table 6-3) that are connected to IO ports and will light when their corresponding port pin is set low. **Table 6-3**, below, shows the user LED pin references and their corresponding microcontroller port pin connections.

Circuit Net Name	Function	Color	RL78
LED1	User Controlled	Red	P55 (pin 38)
LED2	User Controlled	Red	P62 (pin 19)
LED3	User Controlled	Red	P63 (pin 20)
LED4	User Controlled	Green	P52 (pin 35)
LED5	User Controlled	Green	P53 (pin 36)
LED6	User Controlled	Green	P54 (pin 37)
LED7	FET	Green	N/A
LED8	TRIAC	Green	N/A
LED9	3.3V	Green	N/A
LED10	5V	Green	N/A

**Table 6-3: LEDs**

## 6.4. Serial EPROM

A Renesas serial EPROM is provided for user non-volatile storage. This part, R1EX24512ASAAS0A, is 512KB and is accessed by the I2C Bus (IICA0) with the following address with 17 bits:

I2C Address:  $0xA0$  (1010aaxr)      aa = A2:A1 I2C address  
x = A16 of memory address  
r = R/W, Read/Write.

## 6.5. MicroSD Memory Card Slot

A MicroSD memory card slot is provided for file system data storage. This is accessed on the SPI bus (CSI10) using chip select P30 (pin 32) on the RL78.

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## 6.6. Audio (Audio Out, Mic, Speaker, Volume Potentiometer)

An amplified stereo audio output jack is provided and connected to the timer circuit. TO01 is used for Right audio channel and comes out on CPU pin 40. TO02 is used for the Left audio channel and comes out on CPU pin 39. The stereo amp is powered by a National Semi LM4808. The on-board speaker is powered by a LM4889 audio power amplifier which can be disabled by setting P42 low. An on-board Analog Devices Inc. (ADI) Silicon microphone (ADMP401) is connected to the ADC channel AN5 (CPU pin 51) using an ADI SSM2167 low voltage Microphone preamplifier.

## 6.7. Serial port

The Serial module allows the MCU to communicate to a Host PC through the RS-232 connector, J14, using UART0 on the RL78. The serial port is configured in DCE mode allowing direct connection to a PC without a Null modem. The serial module can also be used as a serial debug port. **Table 6-4** contains details of the specific pin functions and their locations.

Description	Function	MCU Pin	Connector Pin
TxD0	Serial Transmission Pin	44	J14.2
RxD0	Serial Reception Pin	45	J14.3

Table 6-4: Serial port pin details

## 6.8. 3-Axis Accelerometer

The RDK includes an Analog Devices ADXL345 3-axis accelerometer. The part is accessed by the I2C Bus (IICA0) with the following address:

I2C Address: 0x3A (0011101r) where r = R/W

## 6.9. Digital Temp Sensor

The RDK includes an ADT7420 Digital Temperature Sensor. The part is accessed by the I2C Bus (IICA0) with the following address:

I2C Address: 0x90 (10010aar) where aa = A1:A0, r = R/Wn



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## 6.10. Potentiometer

A single turn potentiometer is connected to the ADC channel AN4 (CPU pin 52) of the microcontroller. This may be used to vary the input analog voltage value to this pin between 3V3A and Ground.

**Note:** The potentiometer is fitted to offer an easy way of supplying a variable analog input to the controller. It does not necessarily reflect the accuracy of the controllers ADC. Please see the device manual for details.

## 6.11. Infrared Emitter & Detector

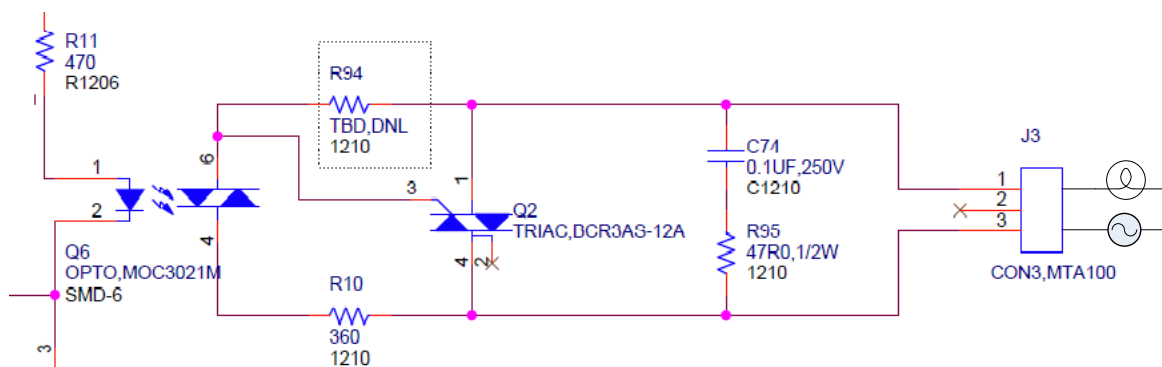
An infrared emitter (IR-LED, part TSKS5400S) and infrared detector (IR-DET, part TSOP98238) are included on the RDK. The IR emitter is designed to use the burst capabilities of the RL78 Clock/Buzzer Output (PCLBUZ0) and is output on CPU pin 64. The IR detector can be used with either the TI03 or INTP4 interfaces on the RL78 to detect IR bursts on CPU pin 21.

**Note:** These IR emitter and IR detector are positioned close together on the board. The detector will receive the output of the emitter.

## 6.12. TRIAC

A Renesas Triac, Q2 (Part number: BCR3AS-12A) designed for low power use is included on the RDK. The Triac can be turned ON by an I/O pin of the CPU to control an AC load. The Triac connections are to be in series with a low-voltage AC source (48VAC RMS Maximum) and a load at J3 between 1 & 3, as shown in the schematic below. It can turn the load ON and OFF but is not intended for dimming or proportional (phase) control. When the MCU pin 30 is set to HIGH, the transistor Q6 is turned on, which turns on the input of the opto-coupler. The opto-coupler output allows current to flow to the Gate of Q2. Resistor R10, 360 ohm, limits current to the Triac Gate. When the load is turned ON, as MCU Pin 30 is set to HIGH, LED8 will turn on at the same time.

The below is an example of a connection diagram when a light bulb is connected as a load.



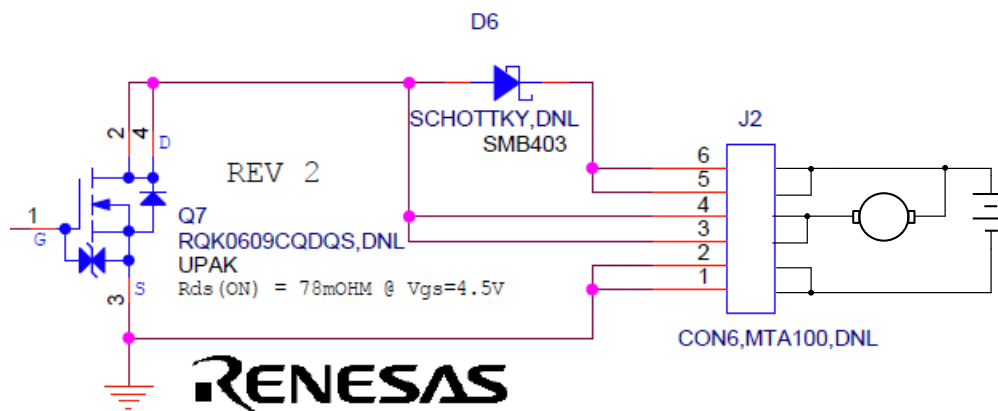
**Note:** DO NOT USE LINE VOLTAGE! For safety, an isolation transformer is required.

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## 6.13. FET

A Renesas N-channel power switching MOSFET (part number: RQKD609CQDQS) Q7 with low on resistance ( $R_{ds(ON)} = 78\text{m}\Omega$  typ.) is included on the RDK. The MOSFET will switch a load (ON/OFF) connected between header J2-5&6 and J2-3&4. The power to the MOSFET is supplied from external source from header J2-1&2 (ground or negative) to J2-5&6 (positive, up to 60V max). The MOSFET will switch the load ON or OFF by PWM waveform output from the RL78 timer channel TO05 on CPU pin 31. LED7 will Turn ON when the MOSFET is ON.

A schottky flywheel diode which matches with the MOSFET ratings (2A at 60V) is added to catch flyback currents when using inductive loads such as small motors. The below is an example of connection diagram when external motor or lamp is connected to the MOSFET. Using PWM can vary the motor speed.



## 6.14. Oscillator Sources

All crystals are provided by NDK. The RDK supplies the RL78 with an external main system clock crystal unit (X1), part number NX3225GA, and subsystem clock crystal unit (X2), part number NX3215SA. The TK debugger has a USB clock crystal unit (X3), part number NX3225SA. **Table 6-5** details the crystals that are fitted on the RL78 RDK.

Component	Function	Frequency
Crystal (X1)	Main System Clock (X1)	12 MHz
Crystal (X2)	Subsystem Clock (XT1)	32.768 KHz
Crystal (X3)	Debugger USB Clock	16 MHz

**Table 6-5: Oscillators / Resonators**

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## 6.15. Reset Circuit

The RDK includes a user reset pushbutton switch which is connected to the internal reset circuit on the RX62N (RES#) and reset input on the Segger J-Link Debugger (TRESin). The RX62N (RES#) can also be reset by the debugger (TRESout).

There is a peripheral reset control line connected to PC2 (pin 49) on the RX62N which can be used to reset major peripherals at once. This includes the Ethernet PHY, Beagle Port, Application Header, and Debug LCD.

## 6.16. Total Phase Beagle Debug Header

The Beagle I2C/SPI Protocol Analyzer is a non-intrusive USB-based bus monitor that can capture, display, and filter I2C and SPI data as it appears on the bus. Using both the Data Center Software and Beagle analyzer, users can easily view I2C bus traffic (up to 4 MHz) and SPI bus traffic (up to 24 MHz) in real time. Additional functionality allows engineers to filter data against a wide variety of parameters, or instantly search for specific hexadecimal or ASCII data patterns during a live capture. The Beagle analyzer is fully supported on Windows, Linux, and Mac OS X, and comes with free software, free APIs, free technical support, and free software/firmware upgrades.

Total Phase manufactures powerful and affordable USB, I2C, SPI, and CAN tools for embedded systems engineers. The complete line of Total Phase host adapters and protocol analyzers are the development and debugging tools of choice for Fortune 500 companies, small businesses, and research institutions all over the world.

For more technical information, online demos, and ordering information, visit [www.totalphase.com](http://www.totalphase.com).

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## Chapter 7. Mode Switch

This RDK has an on-board module with 4 switches (SW5) for controlling TK MUX Select, TK MUX Disable, and Speaker Enable. **Table 7-1** below shows common settings for SW5.

Mode	TK MUX Select	TK MUX Disable	Speaker Enable	SW5.4
Run	ON	ON	ON	ON
Debug	ON	OFF	ON	ON
Virtual COM	OFF	OFF	ON	ON

**Table 7-1: Common Mode Configurations**

TK MUX Select (SW5.1)

- ON sets the USB connection (J16) for debugging purposes.
- OFF sets the USB connection (J16) as a virtual communication port.

TK MUX Disable (SW5.2)

- ON disables the TK debugger and puts the RL78 in normal operation.
- OFF enables the TK debugger and puts the RL78 in debug operation.

The Speaker Enable (SW5.3)

- ON – enables the on-board speaker
- OFF – disables the on-board speaker

SW5.4 is not used.

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## Chapter 8. Programming Methods

The RDK is intended for use with IAR and includes an integrated Renesas TK debugger. Refer to RL78 Family Hardware Manual for details of programming the microcontroller without using these tools. The on-board TK debugger is pre-programmed at the factory and configured for normal operation. Should the TK debugger become inoperable – it will need to be returned to Renesas for repair.

**Note:** SW5 must be set to debug mode to program the RL78. Please refer to the Mode Switch chapter for how to configure the RDK for programming.

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## Chapter 9. Headers

### 9.1. PMOD™ Interfaces

Two Digilent PMOD™ (Interface Type 2A, expanded SPI) connection headers are available on the RDK. These interfaces can be access on the SPI bus using chip selects P71 (pin 28) for PMOD1 and P72 (pin 27) for PMOD2. PMOD™ Interface connections are shown in **Table 9-1**.

Pin	Signal	Direction	PMOD1		PMOD2	
			Circuit Name	RL78	Circuit Name	RL78
1	SS	Out	PMOD1-CS	P71 (pin 28)	PMOD2-CS	P72 (pin 27)
2	MOSI	Out	MOSI	SO10	MOSI	SO10
3	MISO	In	MISO	SI10	MISO	SI10
4	SCK	Out	SCK	SCK10	SCK	SCK10
5	GND	-	Ground	-	Ground	-
6	VCC	-	3V3	-	3V3	-
7	INT	In	PMOD-IRQA	INTP10 (pin 23)	PMOD-IRQA	INTP10 (pin 23)
8	RESET/INT	Out	PMOD-IRQB	P77, INTP11 (pin 22)	PMOD-IRQB	P77, INTP11 (pin 22)
9	N/S	N/S	PMOD_PIN9	P75 (pin 24)	PMOD_PIN9	P75 (pin 24)
10	N/S	N/S	PMOD_PIN10	P00 (pin 62)	PMOD_PIN10	P00 (pin 62)
11	GND	-	Ground	-	Ground	-
12	VCC	-	3V3	-	3V3	-

**Table 9-1: PMOD™ Interfaces**

### 9.2. Application Header (WIFI Module)

The application header J6 can be fitted with a WIFI module. These devices can be accessed UART2 or the SPI bus (CS10) using chip select P73 (pin 26) on the RL78. WIFI interrupt requests can be received on INTP8 (pin 25) on the RL78. As of November 2011, several WiFi modules were available and some units released for RL78 by Gainspan Corp. and RedPine Signals were qualified, more information at :

- <http://www.gainspan.com/>
- <http://www.redpinesignals.com/>

### 9.3. Expansion Headers

Table 9-2 and Table 9-3 show the controller pin headers and their corresponding microcontroller connections. The header pins connect directly to the MCU pin. Note that the J17/J18 header numbers match the MCU pin numbers.

J17 Pin	MCU Pin	RDK Function (MCU Port)	J17 Pin	MCU Pin	RDK Function (MCU Port)
1	1	Not Used (P120)	2	2	WIFI Power Off (P43)
3	3	Speaker Amp. Shutdown (P42)	4	4	MIC Amp. Shutdown (P41)
5	5	TOOL0 (P40)	6	6	RESETn
7	x		8	x	
9	9	User Switch 1 (P137)	10	x	
11	x		12	x	
13	13	GND	14	14	GND
15	15	3V3_MCU	16	15	3V3_MCU
17	17	I <sup>2</sup> C SCL (P60)	18	18	I <sup>2</sup> C SDA (P61)
19	19	LED2 (P62)	20	20	LED3 (P63)
21	21	Infrared Input (P31)	22	22	PMOD IRQB (P77)
23	23	PMOD IRQA (P76)	24	24	PMOD PIN9 (P75)
25	25	WIFI IRQ (P74)	26	26	WIFI SPI CS (P73)
27	27	PMOD2 SPI CS (P72)	28	28	PMOD1 SPI CS (P71)
29	29	LCD Backlight Enable (P70)	30	30	TRIAC PWM (P06)
31	31	FET PWM (P05)	32	32	SD SPI CS (P30)

Table 9-2: J17 Expansion Header

J18 Pin	MCU Pin	RDK Function (MCU Port)	J18 Pin	MCU Pin	RDK Function (MCU Port)
64	64	Infrared Output (P140)	63	63	Ambient Light Sensor INT (P141)
62	62	PMOD PIN10 (P00)	61	61	Audio Generator PWM (P01)
60	60	SPI Bus MOSI (P02)	59	59	SPI Bus MISO (P03)
58	58	SPI Bus SCK (P04)	57	57	Peripheral Reset (P130)
56	56	Not Used (P20)	55	55	Not Used (P21)
54	54	Not Used (P22)	53	53	Not Used (P23)
52	52	POT Input (P24)	51	51	MIC Input (P25)
50	50	Audio Loopback Input (P26)	49	49	Audio Filter Input (P27)
48	48	WIFI GPIO26 (P147)	47	47	WIFI GPIO25 (P146)
46	46	LCD SPI CS (P10)	45	45	RS-232 UART RXD (P11)
44	44	RS-232 UART TXD (P12)	43	43	WIFI UART TXD (P13)
42	42	WIFI UART RXD (P14)	41	41	LCD Reg. Select (P15)
40	40	Right Audio Output (P16)	39	39	Left Audio Output (P17)
38	38	LED1 (P55)	37	37	LED6 (P54)
36	36	LED5 (P53)	35	35	LED4 (P52)
34	34	User Switch 3 (P51)	33	33	User Switch 2 (P50)

**Table 9-3: J18 Expansion Header**



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# Chapter 10.Code Development

## 10.1. Overview

Note: For all code debugging using RL78 IAR software tools, the CPU board must be connected to a PC USB port via the on-board TK interface and debugger.

Due to the continuous process of improvements undertaken by Renesas and IAR, the user is recommended to review the information provided on the Renesas website at <http://www.renesas.com/RL78> to check for the latest tool updates and manuals.

## 10.2. Memory Map

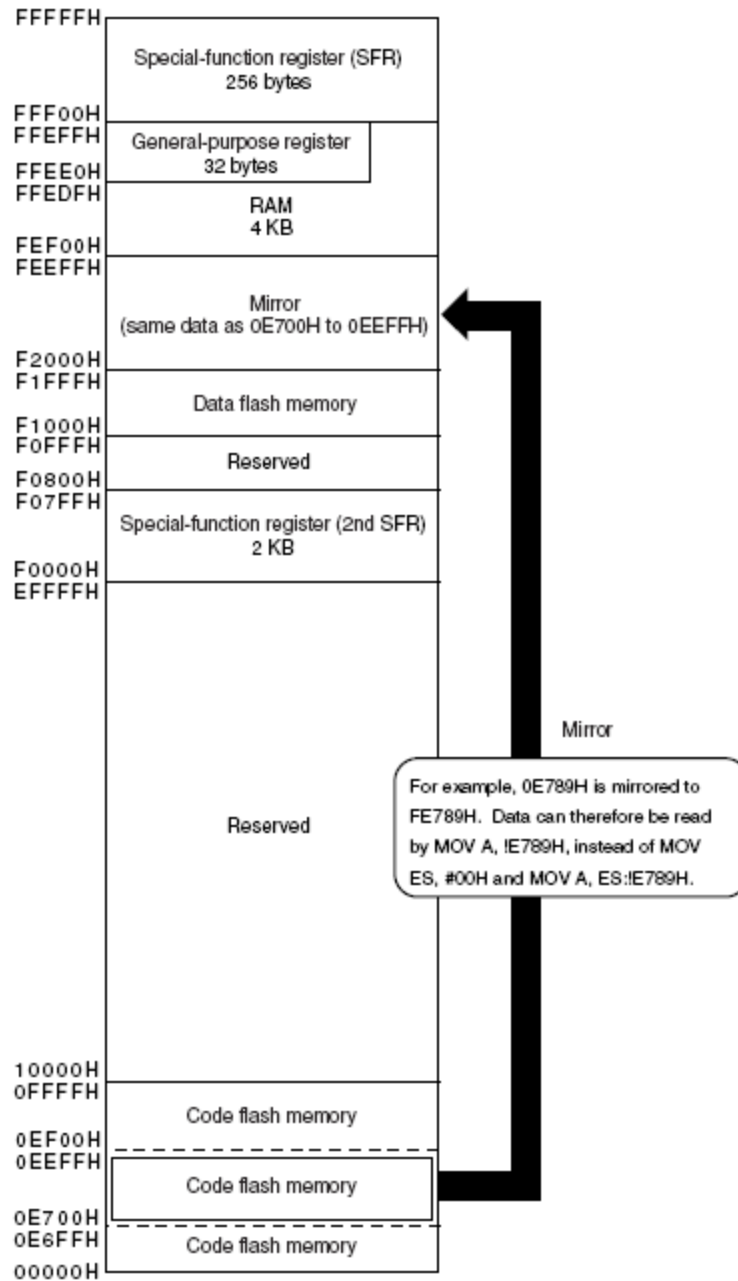


Table 10-1: Memory Map

# Chapter 11. Component Placement

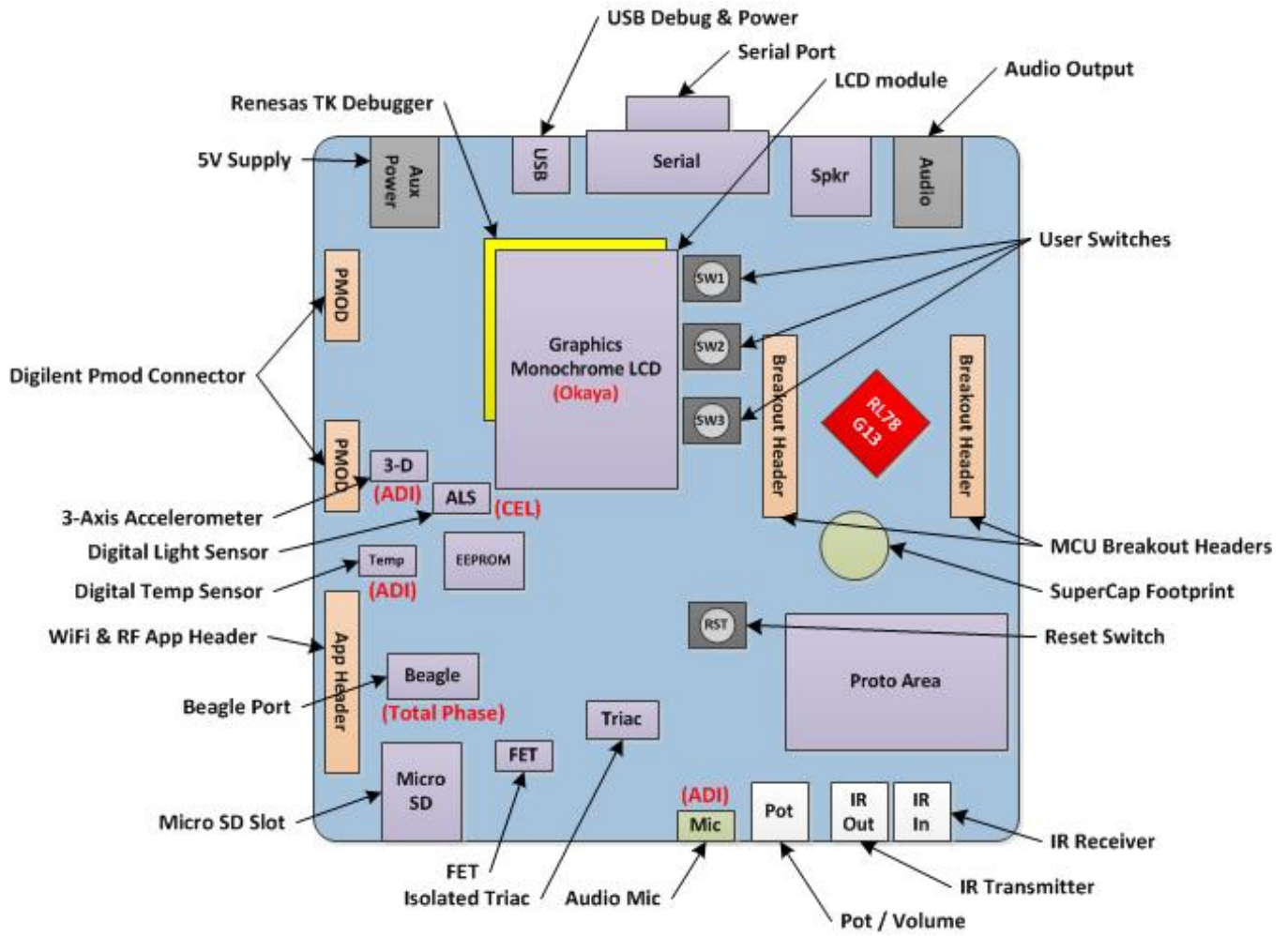


Table 11-1: Component Placement – Front view

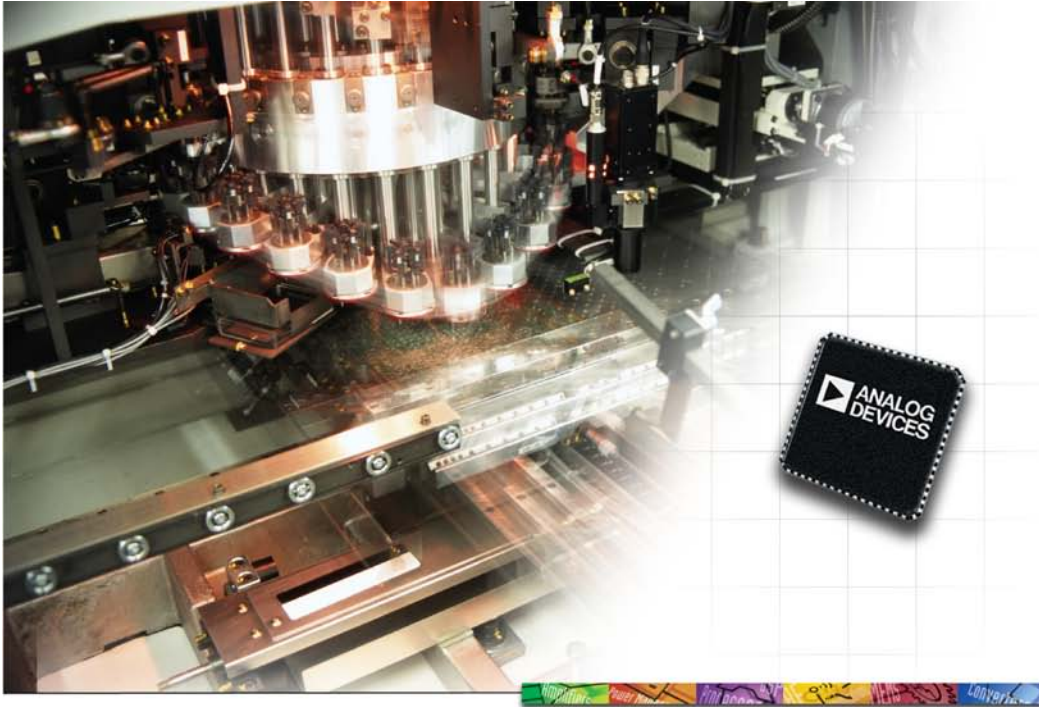
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## Chapter 12. Additional Information

### 12.1. Hardware Partner Information

Hardware partners played an integral role in the definition, development, and deployment of this RDK. Without their numerous contributions, this project would not have been possible. Contributors include National Semiconductor for their LM4808 and LM4889 audio amplifiers. Analog Devices supplied the ADXL345 3-Axis Accelerometer, SSM2167 microphone preamplifier and ADMP401 digital microphone as well as the ADT7420 temp sensor and ADM3101E RS-232 line driver / receiver. NDK contributed all 3 crystals for the board. Okaya provided the 96 x 64 backlit graphics LCD. TotalPhase provided the connectors to interface to their beagle serial channel debugger. And finally, Future Designs, Inc. provided the hardware customization, schematic capture, PCB design and layout, manufacturing, and Supply Chain Management services for this RDK. For more information or to contact our partners please refer to their websites:

- Analog Devices – <http://www.analog.com>
- Future Designs – <http://www.teamfdi.com>
- NDK - <http://www.ndk.com/en/>
- National Semiconductor – <http://www.national.com>
- Okaya – <http://www.okaya.com>
- Totalphase – <http://www.totalphase.com>



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## Analog Devices Products Featured in the Renesas Demonstration Kit

### ADXL345 Low Power, 3-Axis Digital *i*MEMS Accelerometer

- $\pm 2$  g,  $\pm 4$  g,  $\pm 8$  g, and  $\pm 16$  g ranges
- Ultralow power
  - From 30  $\mu$ A to 140  $\mu$ A in full measurement mode
  - 0.1  $\mu$ A in standby mode at  $V_S = 2.5$  V (typ)
- Supply Voltage: 2.0 V to 3.6 V
- 10-bit to 13-bit / 4mg resolution
- SPI and I<sup>2</sup>C digital interfaces
- Temp range:  $-40^{\circ}$ C to  $+85^{\circ}$ C
- 3 mm  $\times$  5 mm  $\times$  1 mm LGA package



### ADMP401 Analog Output, Omni-Directional *i*MEMS Microphone

- SNR: 62 dBA
- Flat Frequency Response: 100 Hz to 15 kHz
- PSRR: 70 dBV
- Sensitivity: -42 dBV
- Current Consumption: < 250  $\mu$ A
- 4.72 mm  $\times$  3.76 mm  $\times$  1.00 mm SMT package

### SSM2167 Low Power Microphone Preamp

- Low shutdown current < 2  $\mu$ A
- Adjustable compression ratio and noise gate threshold
- Low noise and distortion: 0.2% THD + N
- 20 kHz bandwidth
- Single 3 V operation

### ADT7420 High Accuracy, 16-Bit Digital Temp Sensor

- $\pm 0.25^{\circ}$ C temp accuracy from  $-20^{\circ}$ C to  $+105^{\circ}$ C
- I<sup>2</sup>C-compatible interface
- Supply voltages: 2.7 V to 5.5 V
- Operating temperature:  $-40^{\circ}$ C to  $+150^{\circ}$ C
- LFCSP package

### ADM3101 $\pm 15$ kV ESD Protected, Single-Channel RS-232 Line Driver/Receiver

- Conforms to EIA/TIA-232E and CCITT V.28 Specifications
- Data Rate: 460 kbps
- 0.1  $\mu$ F charge pump capacitors
- Contact discharge:  $\pm 8$  kV ap discharge:  $\pm 15$  kV

[www.analog.com](http://www.analog.com)





## ***Future Designs, Inc.***

*A True Technology and Solutions Provider*

Future Designs, Inc., provided the hardware customization, schematic capture, and PCB design for the YRDKRL78G13 platform for Renesas.

In addition, FDI provided full turn-key manufacturing, automated functional test and packaging for the production kits.

### **FDI offers a full range of turn-key product design and production support**

- Schematic capture
- Printed Circuit Board layout & design
- New product conceptual design & prototypes
- PTH to SMT conversions
- Design/redesign for manufacturing (DFM)
- Design for test (DFT)
- High-volume/cost-effective designs
- Production for low-volume, high-mix or high-volume cost-sensitive designs
- One-stop shopping for all of your engineering and production needs
- Successful 21 year history of design and production for partner customers

### **FDI Strategic Alliances**



- **Renesas Alliance Partner**  
*Microcontrollers and Embedded Design*



- **Arrow ACES Partner**  
*Proud Member Arrow Consulting Engineering Services*



- **Avnet Partner**  
*Franchise Distribution Agreement for Embedded Products*

FDI has been a supplier of development kits and tools to the embedded engineering community for almost 15 years. We offer a variety of tools for  $\mu$ C development, Flash ISP programmer, MDIO Clause 22 and Clause 45, I<sup>2</sup>C.

**[www.teamfdi.com](http://www.teamfdi.com)**

**256-883-1240**



#### Color TFT LCDs

- > Size (Diagonal) : 3.5" - 7"
- > Resolution: QVGA - WVGA
- > Backlight: LED
- > Interface: 18 bit TTL RGB
- > Touch Panel: Resistive, capacitive, projected capacitive
- > Daylight readable options



#### Chip On Glass (COG)

- > Custom and Standard
- > No PCB, light weight, low cost
- > Minimum external components
- > Text, graphic and segment type
- > High resolution/duty displays
- > RGB or white LED backlight



#### Custom LCDs

- > Full or semi custom
- > Color, graphic, COG, panels
- > Ruggedized displays
- > System on display
- > Tailor made form factor



Okaya  
Graphic LCD



Display Device  
for Technology

#### Graphic LCDs

- > Wide range of size & resolutions
- > TAB, COG, COB ICs
- > Yellow green, blue, white, LED backlights
- > Extended and wide operating temp range
- > Semi and full custom options
- > Touch panels available
- > TN, STN, FSTN, ASTN technology

#### Alphanumeric/Text LCDs

- > 8 character x 1 line to 40 character x 4 lines
- > COG, COB ICs
- > Yellow green, blue, white LED backlights
- > TAB, COG, COB ICs
- > Extended and wide operating temp range
- > Semi and full custom options
- > TN, STN, FSTN, ASTN technology

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**Beagle USB 480  
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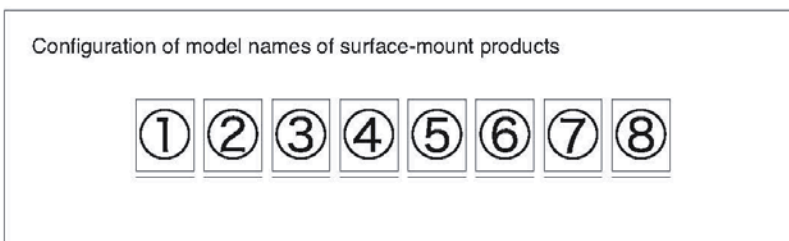
[www.totalphase.com](http://www.totalphase.com)

# Quartz Crystal Units



## ■ Model Names of Surface-mount (SMD) Products

Our system for surface-mount (SMD) product model names is as follows:



- ① Symbol for NDK: N
- ② Symbols for products: See Table 1.

Table 1 Symbols for products

Product symbol	Product
X	Crystal oscillator
T	Temperature-compensated crystal oscillator (TCXO)
H	Oven-controlled crystal oscillator (OCXO)
V	Voltage-controlled crystal oscillator (VCXO)
P	Simple packaged crystal oscillator (SPXO)
Z	Crystal clock oscillator
M	Monolithic filter
S	SAW device

- ③④ The nominal length (mm) of a product main body in the longitudinal direction is expressed in two digits. The third digit is rounded off.
- ⑤⑥ The nominal length (mm) of a product main body in the lateral direction is expressed in two digits. The third digit is rounded off.  
 Examples: 6.0 mm x 3.5 mm is expressed as 6035.  
 11.8 mm x 5.5 mm is expressed as 1255.

- ⑦ Symbols for constituent materials and sealing methods: See Table 2.

Table 2 Symbols for sealing methods

Product sealing category	Symbol	Product sealing method	Package material	
			Base	Cover
Hermetic sealing	C	Adhesive sealing	Ceramics	
	M	Resin molding	Resin	
	P	Adhesive sealing	Resin	
	G	Glass sealing	Ceramics	
	R	Resistance weld sealing	Ceramics	Metal
	S, D	Seam weld sealing	Ceramics	Metal
Non-hermetic sealing	A	Au/Sn sealing	Ceramics	Metal
	W	—	Board	Metal
	X	—	Board	Non-metal
	Y	—	Mold	Metal
	Z	—	Mold	Non-metal
Others	B	A printed board on which multiple crystal elements were mounted with a nameplate attached to its top surface		

- ⑧ Detailed symbols for the order of model name registration: A to Z  
 When products designed as lead-mount ones have been converted during secondary processing into surface-mount ones, the product model names given before secondary processing are conventionally used to describe them.  
 Example: AT-41CD2 (AT-41 with a pedestal)

# Analog Products

## Selection Guide

[national.com](http://national.com)

2011

Data Conversion

Amplifiers

Temperature Sensors

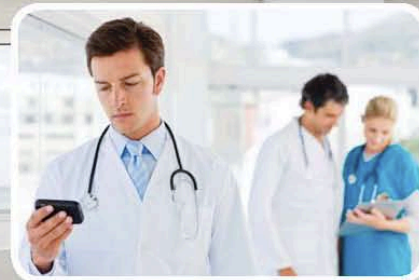
Clock and Timing

Interface

Audio

Power Management

Design Tools



### RenesasUniversity

- ▶ For educators and students. Teach with professional grade tools. Learn MCUs with a modern architecture.

[RenesasUniversity.com](http://RenesasUniversity.com)

### Alliance Partners

- ▶ The Alliance Partner Program allows you to connect instantly with hundreds of qualified design consulting and contracting professionals.

[America.Renesas.com/Alliance](http://America.Renesas.com/Alliance)

### Renesas Interactive

- ▶ Gain the technical knowledge you need. Evaluate research, and learn at your own pace, where you want, when you want, for free.

[RenesasInteractive.com](http://RenesasInteractive.com)



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*Think it. Build it. Post it.*

### MyRenesas

- ▶ Customize your data retrieval needs on the Renesas website. You'll receive updates on the products that you're interested in.

[America.Renesas.com/MyRenesas](http://America.Renesas.com/MyRenesas)

### RenesasRulz

- ▶ A forum and community site to share technical information, questions and opinions with others who use Renesas MCUs and MPUs.

[RenesasRulz.com](http://RenesasRulz.com)

### Renesas Samples

- ▶ Get a first-hand look at our products. Let us know your needs, and we'll get some samples out to you. It's that simple.

[America.Renesas.com/Samples](http://America.Renesas.com/Samples)

**RENESAS**

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## Renesas Contact Information

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

For information about the RL78 series microcontrollers refer to the RL78 Family hardware manual.

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

Online technical support and information is available at: [http://www.renesas.com/renesas\\_starter\\_kits](http://www.renesas.com/renesas_starter_kits)

### Technical Contact Details

America: [techsupport.rta@renesas.com](mailto:techsupport.rta@renesas.com)

Europe: [tools.support.eu@renesas.com](mailto:tools.support.eu@renesas.com)

Japan: [csc@renesas.com](mailto:csc@renesas.com)

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

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Renesas Demonstration Kit (RDK) for RL78

User's Manual

Publication      Rev.1.00    Nov 23 2011

Date

Published by:      **Renesas Electronics America, Inc.**

2880 Scott Boulevard

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## Mass-Market Group

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