User's Manual

Renesas Demonstration Kit (RDK) for RL78

User's Manual: Hardware

RENESAS MCU

RL78 Family

Release 2.0

Disclaimer

By using this Renesas Demonstration Kit (RDK), the user accepts the following terms. The RDK is not guaranteed to be error free, and the User assumes the entire risk as to the results and performance of the RDK. The RDK is provided by Renesas on an “as is” basis without warranty of any kind whether express or implied, including but not limited to the implied warranties of satisfactory quality, fitness for a particular purpose, title and non-infringement of intellectual property rights with regard to the RDK. Renesas expressly disclaims all such warranties. Renesas or its affiliates shall in no event be liable for any loss of profit, loss of data, loss of contract, loss of business, damage to reputation or goodwill, any economic loss, any reprogramming or recall costs (whether the foregoing losses are direct or indirect) nor shall Renesas or its affiliates be liable for any other direct or indirect special, incidental or consequential damages arising out of or in relation to the use of this RDK, even if Renesas or its affiliates have been advised of the possibility of such damages.

Precautions

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.

Table of Contents

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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Website: http://www.renesas.com/

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

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
- E Ink Display
- User pushbutton switches and a reset switch.
- On-board LEDs

Communications

- On board WiFi Module from GainSpan
- RS-232 Interface
- I^2C, 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

- 256KB On-chip Flash Memory

Digital Sensors

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

Power Control

- FET Circuit for DC output
- TRIAC Circuit for AC output with Zero Crossing Detector

User Code and Application Debugging

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

Renesas Online

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

- Renesas Interactive: www.RenesasInteractive.com
    - Free Online Learning
- Renesas Rulz: www.RenesasRulz.com
    - Online community
    - Online user forums
    - http://www.renesasrulz.com/community/demoboards/rdkrl78g14 - Online support site for this RDK
- University Program: 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

Develop and submit your sample programs to demonstrate these features to the online community: www.RenesasRulz.com/community/renesas_products/rl78

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 power jack is a center positive connector using a 2.1 mm barrel. An optional alternate power header is located next to the power jack (J5).

The RDK PCB is also be loaded with a 3.3V 0.08F super cap (C72), part number XH414HG.

Warning: The RDK is neither under nor over-voltage protected. To prevent damage, 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”.

IS THIS STILL ACCURATE?

Chapter 4. Board Layout

4.1. Component Layout

The following diagram shows the top layer component layout.

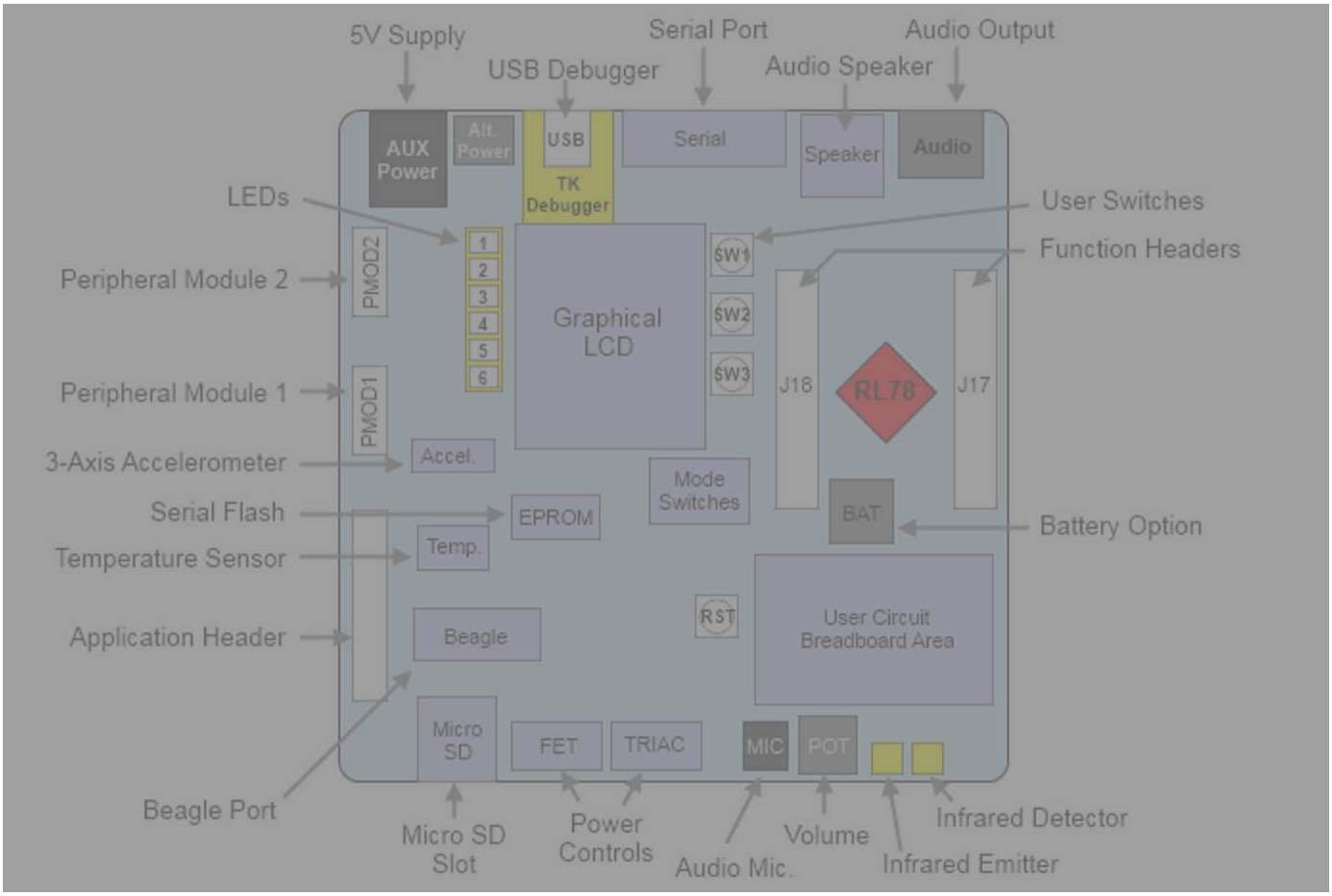

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Figure 4-1: Board Layout

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.

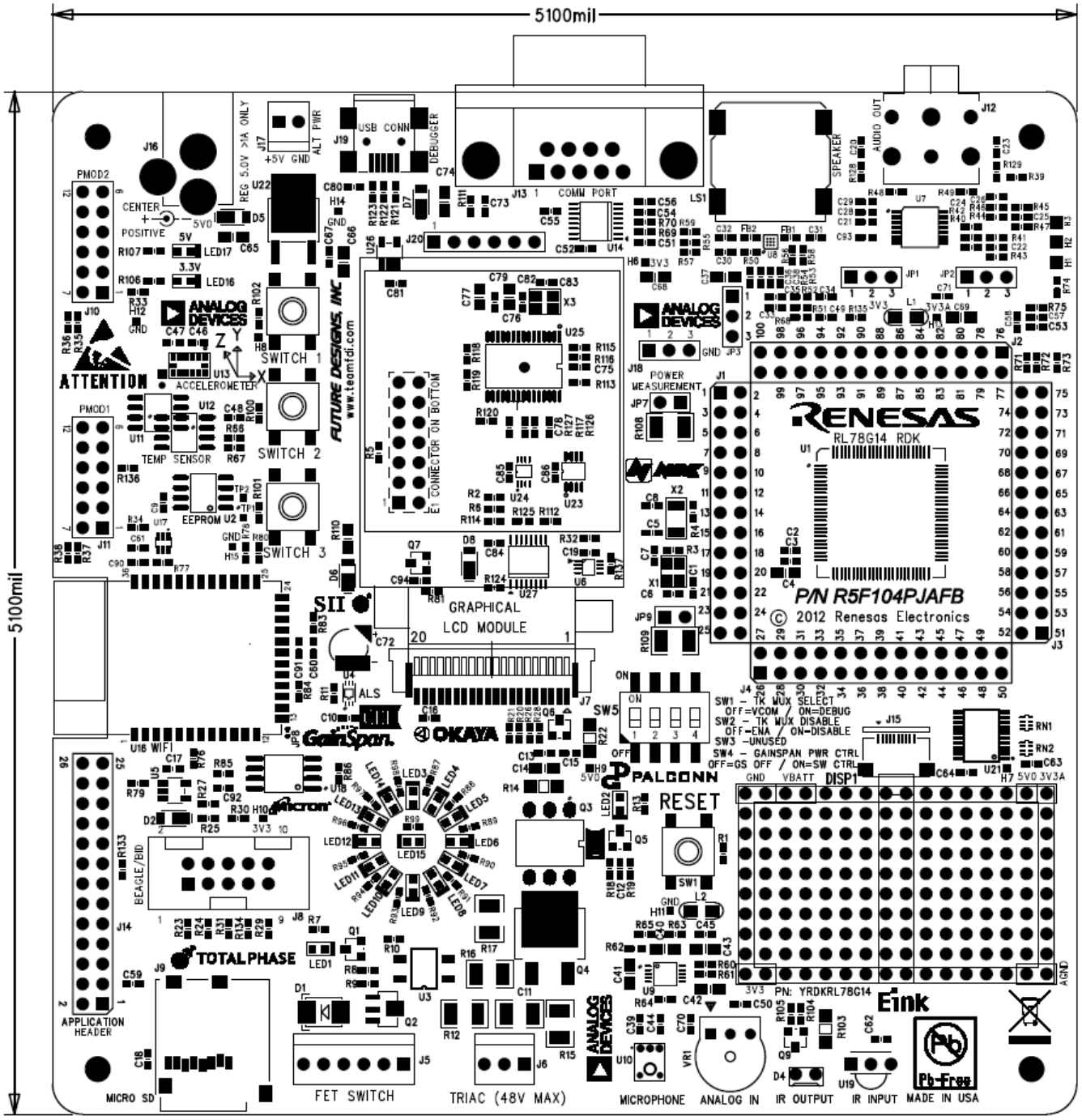

Figure 4-2: Board Dimensions

Chapter 5. Block Diagram

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

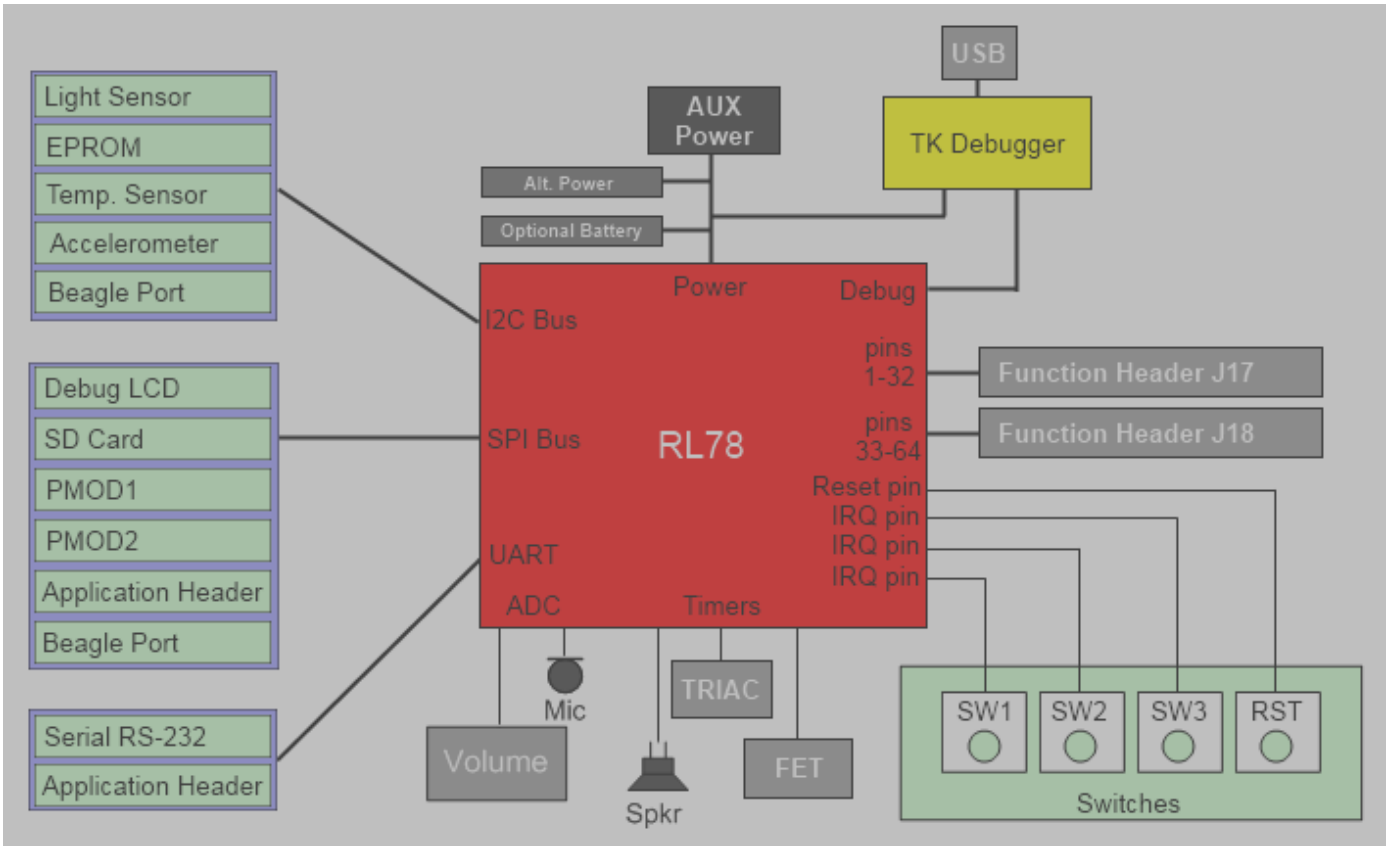

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Figure 5-1: Block Diagram

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

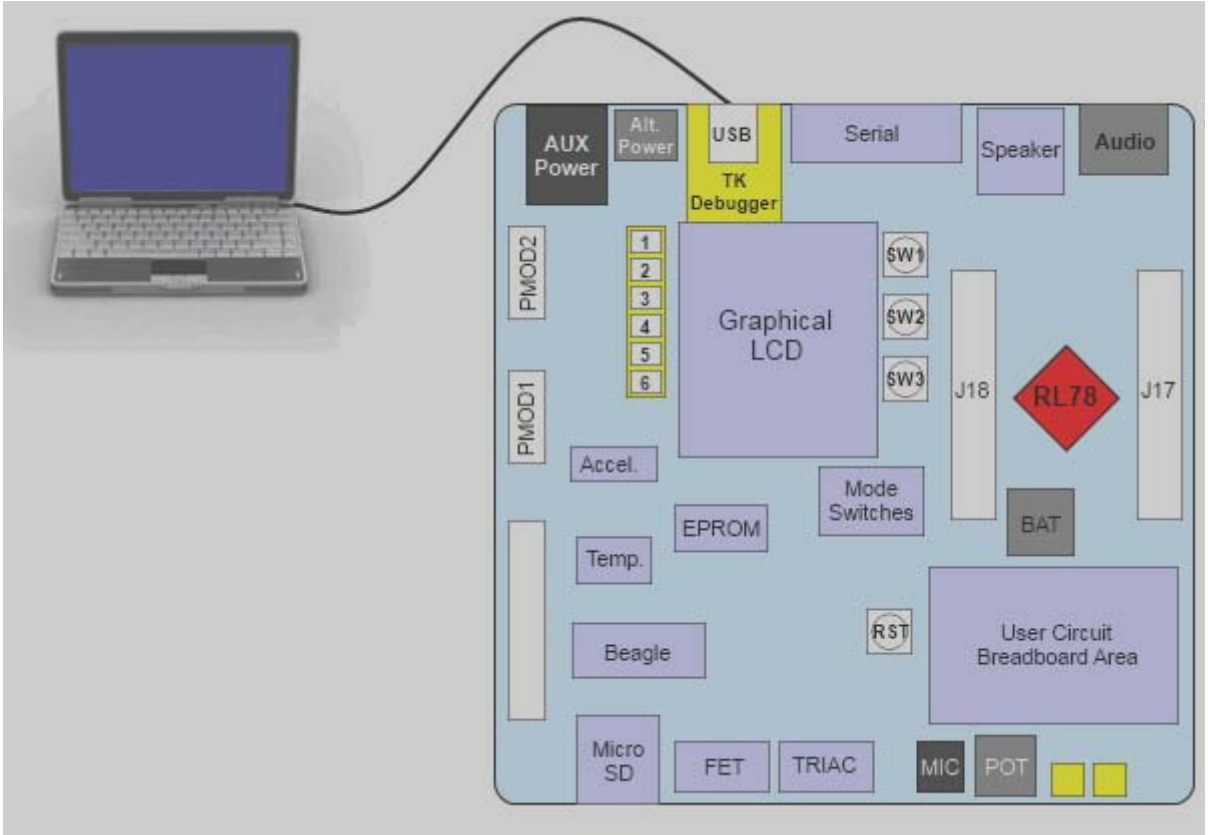

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Figure 5-2: RDK Connections

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.	INTP10, P76 (pin 34)
SWITCH 2	Connects to an interrupt line for user controls.	INTP8, P74 (pin 36)
SWITCH 3	Connects to an interrupt line for user controls.	INTP9, P75 (pin 35)
RESET	When pressed, the RL78 is reset.	/RESET , (pin 13)

Table 6-1: Switch Functions

6.2.Debug LCD Module

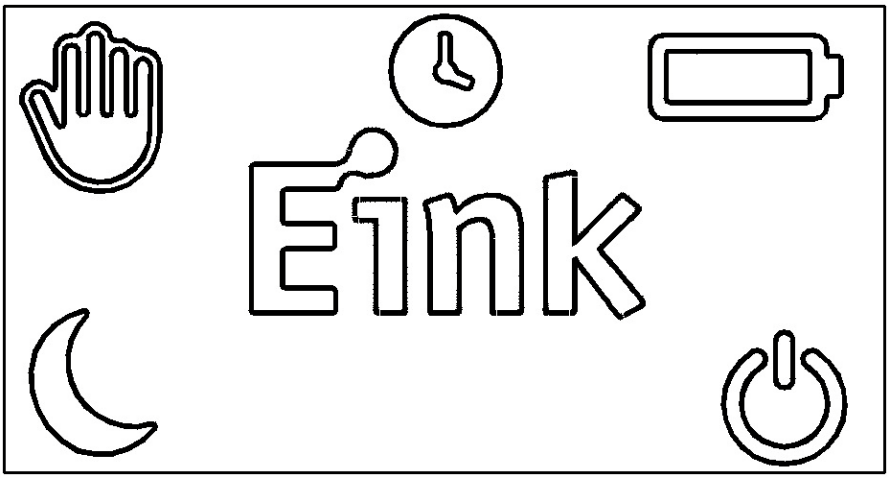
A debug LCD module is supplied on the RDK. The debug LCD module uses an SPI interface to reduce the pin allocation. Software contrast control is also provided. The module supplied with the RDK uses 3.3v. The display is a 96 x 64 graphics display and uses a white LED backlight. The backlight is ON by DEFAULT and can be toggled OFF by setting P00 (BL-ENA, pin 97) LOW. 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	P145 (pin 98)
7	RSTOUT#	P130 (pin 91)	8	LCD-RS	P146 (pin 73)
9	+3.3V	-	10	+3.3V	-
11	SCK	P70 (pin 40)	12	MOSI	P72 (pin 38)
13	MOSI	P72 (pin 38)	14	MOSI	P72 (pin 38)
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)

6.3. E Ink Display

The E Ink segmented display is ultra-thin, rugged, and flexible enabling engineers and designers to add high contrast displays to products where power and space limitations have made it impossible to do so before.

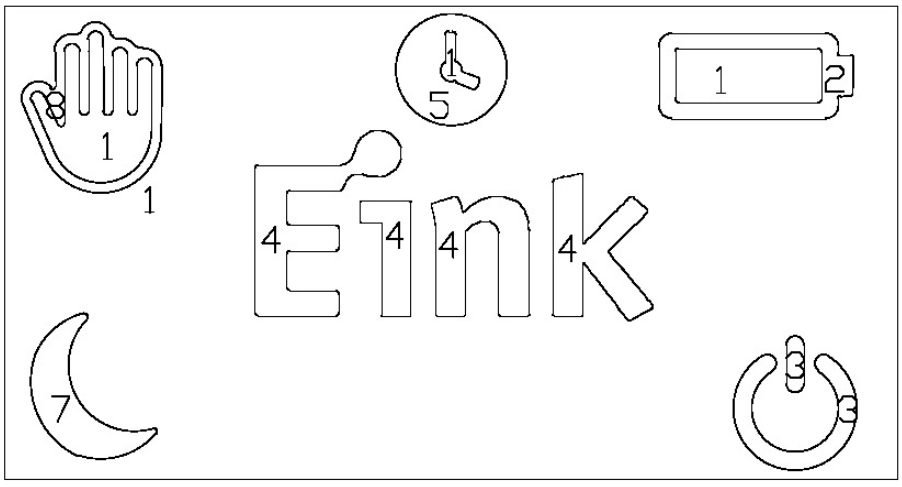


E Ink Display Icons

The E Ink display is driven by inverting level-shifter IC (74AHCT540) connected to the RL78G14 GPIO bits.

Refer to the RDK schematic for specific details on the operation of the E Ink Display interface circuitry or to the E Ink website at: www.eink.com for details on the display technology.

The icon mapping is illustrated in the diagram below and detailed in Table 6-3.



E Ink Display Icon Mapping

Icon	Description	RL78G14 Pin	RL78G14 Port
1	Field (Background)	45	P81
2	Battery	50	P86
3	‘PWR’ Indicator	51	P87
4	E Ink Logo	44	P80
5	Clock	74	P147
6	Unused	N/A	N/A
7	Sleep Mode (Moon)	78	P154
8	Stop (Hand)	79	P153
N/A	Top Plane	67	P12

Table 6-3: E Ink Display Icon Mapping

6.4. LEDs

There are seventeen LEDs on the RL78 RDK board. The green 5V (LED17) and 3V (LED16) LEDs are ON automatically when the board is powered. There are thirteen user LEDs (see table 6-3) that are connected to IO ports and will light when their corresponding port pin is set low. Table 6-4, below, shows the LED functions and for the user LEDs, pin references and their corresponding microcontroller port pin connections.

Circuit Net Name	Function	Color	RL78
LED1 (FET-PWM)	User Controlled / FET Activity	Green	P11 (pin 68)
LED2 (TRIAC-PWM)	User Control / TRIAC Activity	Green	P10 (pin 69)
LED3 (RLED1)	User Controlled	Red	P62 (pin 26)
LED4 (GLED1)	User Controlled	Green	P42 (pin 10)
LED5 (RLED2)	User Controlled	Red	P63 (pin 27)
LED6 (GLED2)	User Controlled	Green	P43 (pin 9)
LED7 (RLED3)	User Controlled	Red	P64 (pin 29)
LED8 (GLED3)	User Controlled	Green	P44 (pin 8)
LED9 (RLED4)	User Controlled	Red	P65 (pin 30)
LED10 (GLED4)	User Controlled	Green	P45 (pin 7)
LED11 (RLED5)	User Controlled	Red	P66 (pin 31)
LED12 (GLED5)	User Controlled	Green	P152 (pin 80)
LED13 (RLED6)	User Controlled	Red	P67 (pin 32)
LED14 (GLED6)	User Controlled	Green	P101 (pin 70)
LED15	User Controlled	Orange	P41 (pin 11)
LED16	3.3V	Green	N/A
LED17	5V	Green	N/A

Table 6-4: LEDs

6.5. GainSpan WiFi Module (U16)

The GainSpan WiFi module utilizes either serial UART or SPI interfaces, enabling connection to any embedded design utilizing a 8/16/32-bit microcontroller via simple commands. The GS1011M is an ideal solution for organizations with limited or no Wi-Fi or RF expertise, as it not only dramatically reduces RF design time but also removes the burden of testing and certification, allowing customers to focus on their core application, product or expertise. The module supports data rates up to 11 Mbps, is compliant with 802.11b and meets regulatory and Wi-Fi Alliance requirements.

The GainSpan module is connected to a dedicated WiFi-only SPI interface and optionally the UART3 of the RL78.

Note that dip switch (SW5) position 4 controls the power enable/disable of the GainSpan WiFi module. Refer to Section 7 for details on the switch function.

Refer to the GainSpan website (www.gainspan.com) for specific details on the function of the module and the datasheet.

Pin	Circuit Net Name	RL78	Pin	Circuit Net Name	RL78
1	Ground	-	19	Ground	-
2	WIFI-SPI-IRQ (GPIO28)	INTP11 (pin 33)	20	Switched 3.3V (VDDIO)	-
3	N/C (GPIO31)	-	21	WI-FI NOTIFY (GPIO19)	P120 (pin 4)
4	N/C (ADC1)	-	22	WIFI-PWMOUT (PWMO)	P151 (pin 81)
5	WIFI-SPI-MOSI	SO31 (pin 56)	23	N/C (GPIO9)	-
6	WIFI-SPI-CS	P55 (pin 59)	24	N/C (GPIO8)	-
7	WIFI-SPI-CLK	SCK31 (pin 58)	25	WIFI-MODE (GPIO26)	P56 (pin 60)
8	WIFI-SPI-MISO	SI31 (pin 57)	26	WIFI-PGM (GPIO27)	P57 (pin 61)
9	WIFI-WAKE	P73 (pin 37)	27	N/C (GPIO3)	-
10	VBAT	-	28	N/C (GPIO2)	-
11	N/C (ALARM2)	-	29	WIFI-RXD (UART0_TX)	RXD3 (pin100)
12	Power Ctrl (DC-DC-CTRL)	-	30	WIFI-TXD (UART0_RX)	TXD3 (pin99)
13	N/C (GPIO21)	-	31	N/C (GPIO24)	-
14	MSPI-CS (EEPROM)	-	32	N/C (GPIO25)	-
15	MSPI-CLK (EEPROM)	-	33	RSTOUTn (EXT_RESETn)	P130 (pin 90)
16	N/C (EEPROM)	-	34	N/C (1V8)	-
17	MSPI-DIN (EEPROM)	-	35	WIFIVIN (VIN_3V3)	-
18	MSPI-DOUT (EEPROM)	-	36	Ground	-

Table 6-5: GainSpan Module Connections (U16)

6.6. Serial EPROM (U2)

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.
```

6.7. MicroSD Memory Card Slot (J9)

A MicroSD memory card slot is provided for file system data storage. This is accessed on the SPI bus (CSI10) using chip select P142 (pin 1) on the RL78.

6.8. Audio (Audio Out, Mic, Speaker, Volume Potentiometer)

An amplified stereo headphone audio output jack is provided and connected to the timer circuit. TO02 is used for Right audio channel and comes out on RL78 pin 62. TO01 is used for the Left audio channel and comes out on RL78 pin 63. The headphone amp (U7) is an ON Semi NCP2811 and may be disabled by setting P04 (pin 93) low. The on-board speaker is powered by a SCM2377 (U8) audio power amplifier with gain control via P102 (pin 92) and can be disabled by setting P06 (pin 41) low. An on-board Analog Devices Inc. (ADI) Silicon microphone ADMP401 (U10) is connected to the ADC channel ANI5 (pin 25) using an ADI SSM2167 (U9) low voltage Microphone preamplifier that may be disabled by setting P05 (pin 42) low.

6.9. Serial port (U14/J13)

The Serial module allows the MCU to communicate to a Host PC through the RS-232 connector, J13, using UART1 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 6-6 contains details of the specific pin functions and their locations.

Description	Function	MCU Pin	Connector Pin
TxD1	Serial Transmission Pin	95	J14.2
RxD1	Serial Reception Pin	94	J14.3

Table 6-6: Serial port pin details

6.10. 3-Axis Accelerometer (U13)

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
```

6.11. Digital Temp Sensor (U11)

The RDK includes an ADT75 (U11) Digital Temperature Sensor. An optional alternate sensor, ADT7410 (U12), may be utilized. The part is accessed by the I2C Bus (IICA0) with the following address:

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

6.12. Ambient Light Sensor (U4)

The RDK includes a Renesas Ambient Light Sensor (Part Number: PH5551A2NA1). This part is accessed by the I2C bus (ICA0) with the following address:

```
I2C Address: 0x72 (0111001r) where r = R/Wn
```

6.13. Potentiometer (VR1)

A single turn potentiometer is connected to the ADC channel ANI8 (pin 82) 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.

6.14. Infrared Emitter (D4) & Detector (U19)

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 3. The IR detector can be used with either the TI03 or INTP4 interfaces on the RL78 to detect IR bursts on CPU pin 28.

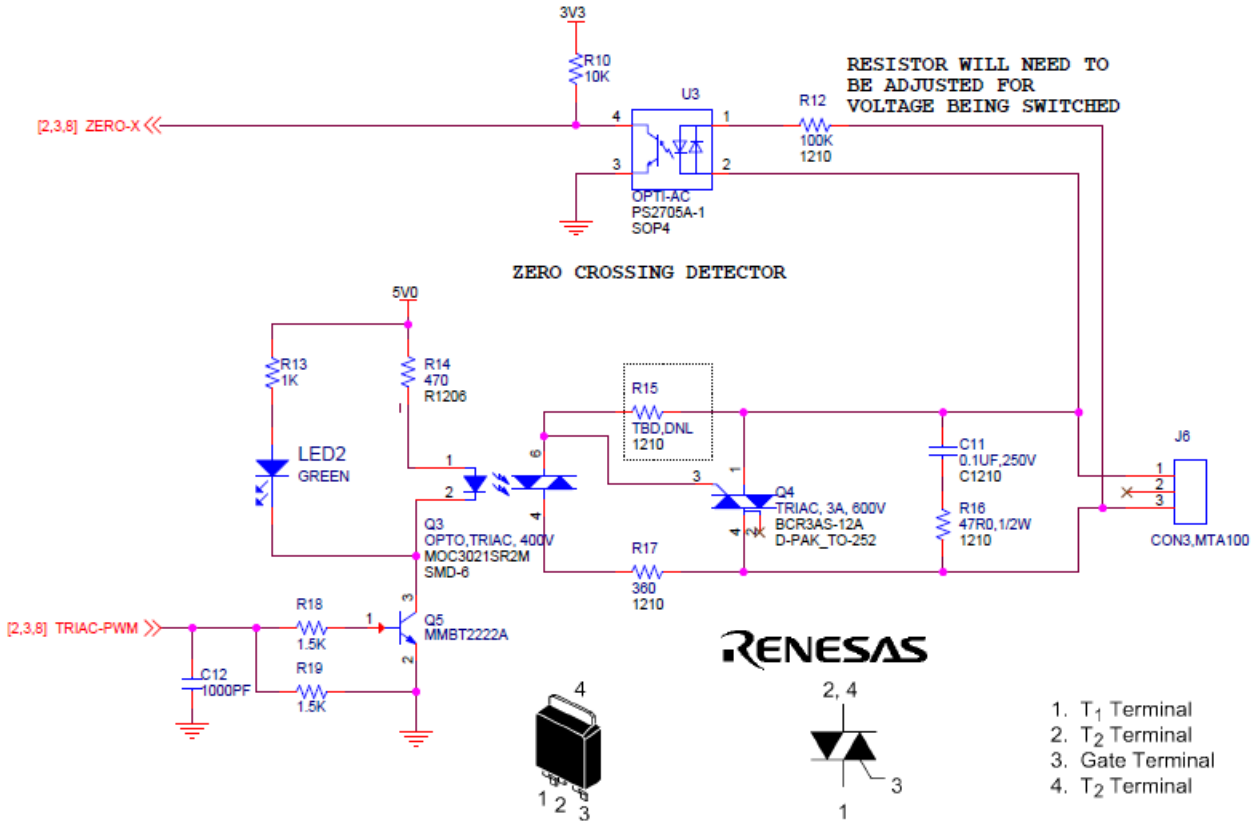
Note: These IR emitter and IR detector are positioned close together on the board. The detector will receive the output of the emitter.

6.15. TRIAC (Q3) & Zero Crossing Detector (U3)

A Renesas Triac, 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 RL78 pin 69 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 RL78 Pin 69 is set to HIGH, LED2 will turn on at the same time.

A Zero Crossing detector circuit is available for applications that require switching the TRIAC only during zero crossing events. This signal, 'ZERO-X' is present on INTP0, RL78 pin 16.

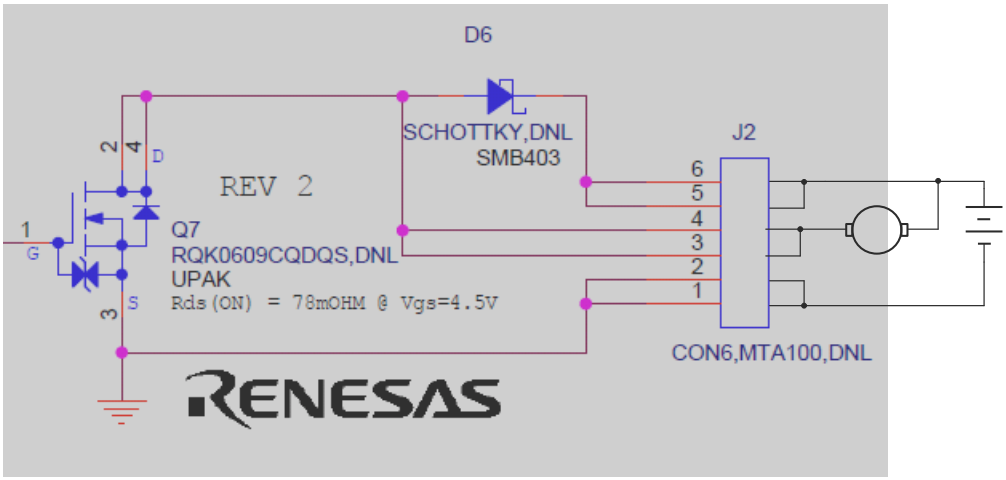


Note: DO NOT USE LINE VOLTAGE! For safety, an isolation transformer is required.

6.16.FET (Q2)

A Renesas N-channel power switching MOSFET (part number: RQKD609CQDQS) Q7 with low on resistance (Rds(ON) = 78mOHM typ.) is included on the RDK. The MOSFET will switch a load (ON/OFF) connected between header J5-5&6 and J5-3&4. The power to the MOSFET is supplied from external source from header J5-1&2 (ground or negative) to J5-5&6 (positive, up to 60V max). The MOSFET will switch the load ON or OFF by PWM waveform output from the RL78 timer channel TRDIOD1 on CPU pin 68. LED1 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.



6.17.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 6-7 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 6-7: Oscillators / Resonators

6.18. Reset Circuit

The RDK includes a user reset pushbutton switch (SW1) which is connected to the internal reset circuit on the RL78 (RESET#) and reset output from the TK Debugger (T-RESETn).

There is a peripheral reset control line connected to P130 (pin 91) on the RL78 which can be used to reset major peripherals at once. This includes the WiFi, Beagle Port, Application Header, and Debug LCD.

6.19.Total Phase Beagle Debug Header (J8)

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.

Chapter 7. Mode Switch

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

Mode	TK MUX Select	TK MUX Disable
Run	ON	ON
Debug	ON	OFF
Virtual COM	OFF	OFF

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.

SW5.3 is not used.

GainSpan WiFi Power Enable/Disable (SW5.4)

- ON Enables software control over the GainSpan power
- OFF Disables the GainSpan power completely

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.

Chapter 9. Headers

9.1. PMOD™ Interfaces

Two Digilent PMOD™ (Interface Type 2A, expanded SPI) connection headers are available on the RDK. These interfaces utilize separate SPI busses and can be accessed using chip selects P82 (pin 46) for PMOD1 and P83 (pin 47) for PMOD2. PMOD™ Interface connections are shown in Table 9-1.

			PMOD1		PMOD2	
Pin	Signal	Direction	Circuit Name	RL78	Circuit Name	RL78
1	SS	Out	PMOD1-CS	P82 (pin 46)	PMOD2-CS	P83 (pin 47)
2	MOSI	Out	PMOD1-MOSI	SO20 (pin 66)	MOSI	SO21 (pin 38)
3	MISO	In	PMOD1-MISO	SI20 (pin 65)	MISO	SI21 (pin 39)
4	SCK	Out	PMOD1-SCK	SCK20 (pin 64)	SCK	SCK21 (pin 40)
5	GND	-	Ground	-	Ground	-
6	VCC	-	3V3	-	3V3	-
7	INT	In	PMOD-IRQA	P46, INTP1 (pin 6)	PMOD-IRQB	P47, INTP2 (pin 5)
8	RESET/INT	Out	PMOD-IRQB	P47, INTP2 (pin 5)	PMOD-IRQA	P46, INTP1 (pin 6)
9	N/S	N/S	PMOD_PIN9	P110 (pin 71)	PMOD_PIN9	P110 (pin 71)
10	N/S	N/S	PMOD_PIN10	P111 (pin 72)	PMOD_PIN10	P111 (pin 72)
11	GND	-	Ground	-	Ground	-
12	VCC	-	3V3	-	3V3	-

Table 9-1: PMOD™ Interfaces

9.2. Application Header

The application header J14 can be fitted with a WIFI module or other optional IO module. These devices can be accessed UART2 or the SPI bus (CSI10) 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/

J17 Pin	MCU Pin	RDK Function (MCU Port)	J17 Pin	MCU Pin	RDK Function (MCU Port)
1	-	5V	2	-	Ground
3	-	3.3V	4	-	Ground
5	65	GPIO (P14)	6	69	GPIO (P10)
7	64	GPIO (P15)	8	68	GPIO (P11)
9	63	GPIO (P16)	10	67	GPIO (P12)
11	62	GPIO (P17)	12	66	GPIO (P13)
13	79	GPIO (P153)	14	16	GPIO (P137)
15	48	APP-WIFI-CS (P84)	16	91	RSTOUT# (P130, inverted by U6)
17	49	APP-WIFI-PWROFF (P85)	18	78	GPIO (P154)
19	38	MOSI (P72/SO21)	20	40	SCK (P70/SCK21)
21	55	LIN-TXD (P51/TXD0)	22	39	MISO (P71/SI21)
23	52	APP-WIFI-IRQ (P30/INTP3)	24	54	LIN-RXD (P50/RXD0)
25	77	APP-WIFI-GPIO25 (P155)	26	76	APP-WIFI-GPIO26 (P156)

Table 9-2: Application Header

9.3.Expansion Headers (J1-J4)

Table 9-3 through Table 9-6 show the controller pin headers and their corresponding microcontroller connections. The header pins connect directly to the MCU pin. Note that the J1-J4 header numbers match the MCU pin numbers.

J1 Pin	MCU Pin	RDK Function (MCU Port)	J1 Pin	MCU Pin	RDK Function (MCU Port)
1	1	SD-CS (P142)	2	2	ALS-IRQ (P141)
3	3	IR-OUTPUT (P140)	4	4	Unused (P120)
5	5	PMOD-IRQB (P47)	6	6	PMOD-IRQA (P46)
7	7	GLED4 (P45)	8	8	GLED3 (P44)
9	9	GLED2 (P43)	10	10	GLED1 (P42)
11	11	ORLED (P410	12	12	TK TOOL0 (P40)
13	13	RESETn input to RL78	14	14	32.768KHz XTAL2 (P124)
15	15	32.768KHz XTAL1 (P123)	16	16	ZERO-X (P137)
17	17	12MHz XTAL2 (P122)	18	18	12MHz XTAL1 (P121)
19	19	REGC	20	20	Ground
21	21	Ground	22	22	3.3V
23	23	3.3V	24	24	(P60)
25	25	(P61)			

Table 9-3: J1 Expansion Header

J4 Pin	MCU Pin	RDK Function (MCU Port)	J4 Pin	MCU Pin	RDK Function (MCU Port)
26	26	RLED1 (P62)	27	27	RLED2 (P63)
28	28	IR-INPUT (P31)	29	29	RLED3 (P64)
30	30	RLED4 (P65)	31	31	RLED5 (P66)
32	32	RLED6 (P67)	33	33	WIFI-SPI-IRQ (P77)
34	34	SWITCH1 (P76)	35	35	SWITCH3 (P75)
36	36	SWITCH2 (P74)	37	37	WIFI-WAKE (P73)
38	38	MOSI (P72)	39	39	MISO (P71)
40	40	SCK (P70)	41	41	SPK-SHDNn (P06)
42	42	AMP-SHDNn (P05)	43	43	Ground
44	44	EINK-CS# (P80)	45	45	EINK-TP-HIGH# (P81)
46	46	PMOD1-CS (P82)	47	47	PMOD2-CS (P83)
48	48	APP-WIFI-CS (P84)	49	49	APP-WIFI-PWROFF (P85)
50	50	EINK-CLR# (P86)			

Table 9-4: J4 Expansion Header

J1 Pin	MCU Pin	RDK Function (MCU Port)	J1 Pin	MCU Pin	RDK Function (MCU Port)
51	51	Unused (P87)	52	52	APP-WIFI-IRQ (P30)
53	53	3.3V	54	54	LIN-RXD (P50)
55	55	LIN-TXD (P51)	56	56	WIFI-SPI-MOSI (P52)
57	57	WIFI-SPI-MISO (P53)	58	58	WIFI-SPI-CLK (P54)
59	59	WIFI-SPI-CS (P55)	60	60	WIFI-MODE (P56)
61	61	WIFI-PGM (P57)	62	62	PWMAUD-R (P17)
63	63	PWMAUD-L (P16)	64	64	PMOD1-SCK (P15)
65	65	PMOD1-MISO (P14)	66	66	PMOD1-MOSI (P13)
67	67	Unused (P12)	68	68	FET-PWM (P11)
69	69	TRIAC-PWM (P10)	70	70	GLED6 (P101)
71	71	PMOD-PIN9 (P110)	72	72	PMOD-PIN10 (P111)
73	73	LCD-RS (P146)	74	74	Unused (P147)
75	75	LINNSLP (P100)			

Table 9-5: J3 Expansion Header

J2 Pin	MCU Pin	RDK Function (MCU Port)	J2 Pin	MCU Pin	RDK Function (MCU Port)
76	76	APP-WIFI-GPIO26 (P156)	77	77	APP-WIFI-GPIO25 (P155)
78	78	Unused (P154)	79	79	Unused (P153)
80	80	GLED5 (P152)	81	81	WIFI-PWMOUT (P151)
82	82	VRES (P150)	83	83	PWMLP-IN (P27)
84	84	AUD-R-FB (P26)	85	85	MIC-INPUT (P25)
86	86	Unused (P24)	87	87	DACAUD-R (P23)
88	88	DACAUD-L (P22)	89	89	Unused (P21)
90	90	Unused (P20)	91	91	EXTRST (P130)
92	92	SPK-GAIN (P102)	93	93	HEADPH-SDn (P04)
94	94	DB9-RXD (P03)	95	95	DB9-TXD (P02)
96	96	PWMLP-OUT (P01)	97	97	BL-ENA (P00)
98	98	LCD-CS (P145)	99	99	WIFI-TXD (P144)
100	100	WIFI-RXD (P143)			

Table 9-6: J2 Expansion Header

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

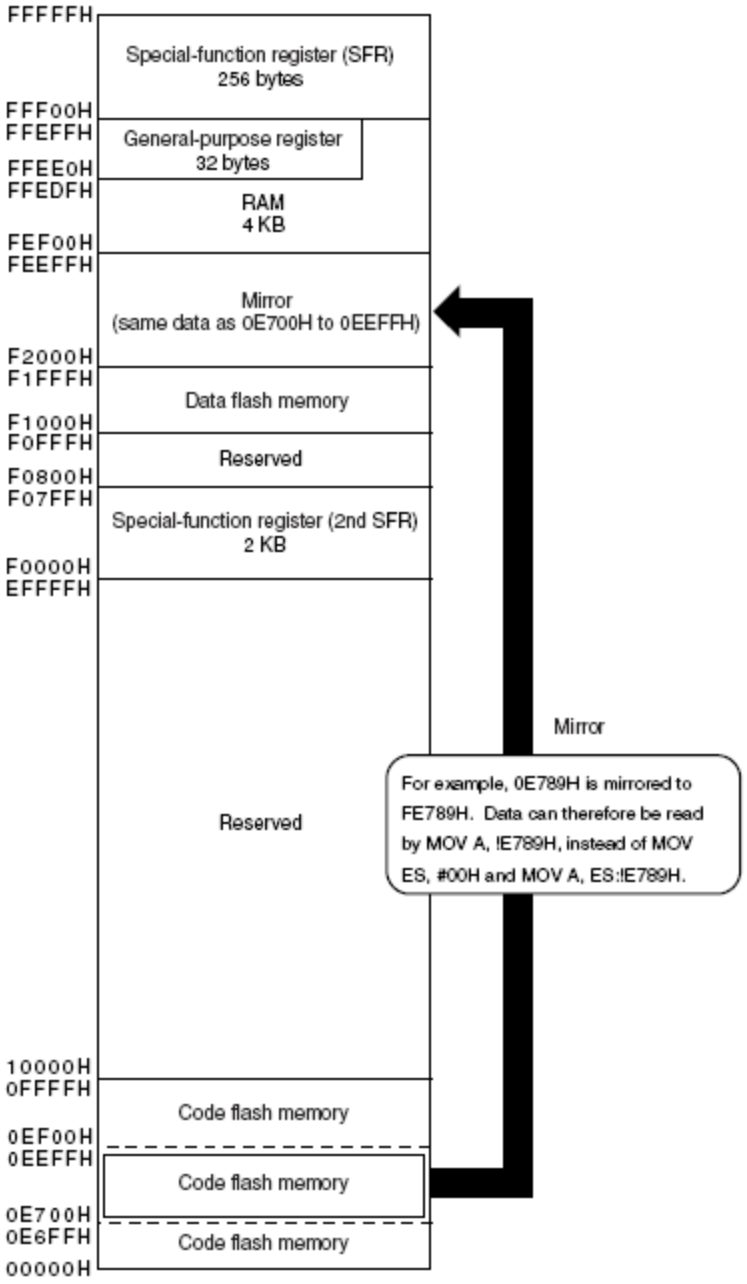
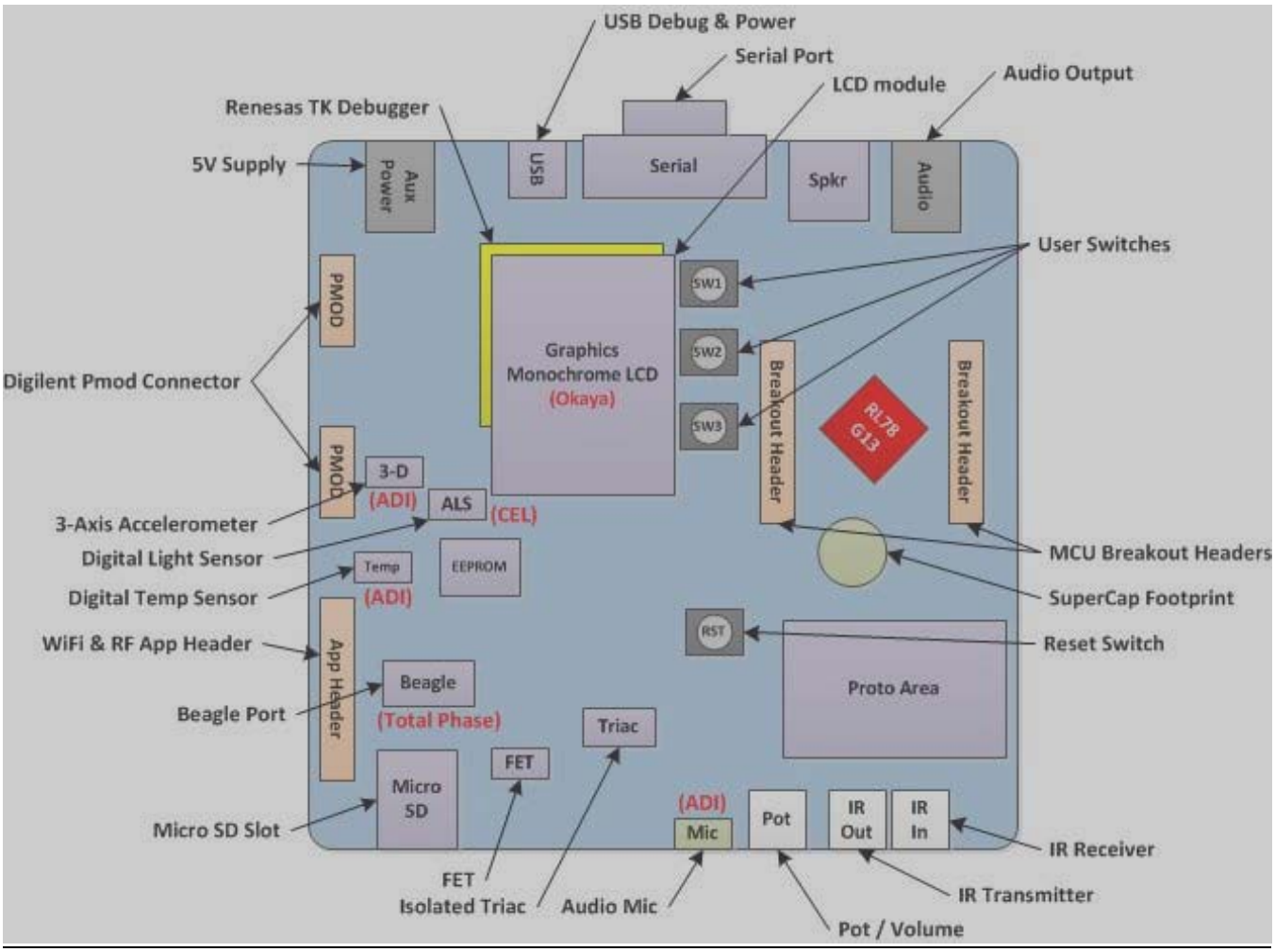


Table 10-1: Memory Map

Chapter 11. Component Placement



NEEDS UPDATING

Table 11-1: Component Placement – Front view

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: Analog Devices supplied the ADXL345 3-Axis Accelerometer, SSM2167 microphone preamplifier and ADMP401 digital microphone as well as the ADT75 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. Eink provided the ePaper Display. 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
- Eink Display - http://www.eink.com
- Future Designs – http://www.teamfdi.com
- GainSpan - http://www/gainspan.com
- NDK - http://www.ndk.com/en/
- Okaya – http://www.okaya.com
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ADMP401 Analog Output, Omni-Directional *i*MEMS Microphone

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- Flat Frequency Response: 100 Hz to 15 kHz
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- LFCSP package

ADM3101 ±15 kV ESD Protected, Single-Channel RS-232 Line Driver/Receiver

- Conforms to EIA/TIA-232E and CCITT V.28 Specifications
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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.

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■ Model Names of Surface-mount (SMD) Products

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

Configuration of model names of surface-mount products

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
	A	Au/Sn sealing	Ceramics	Metal
Non-hermetic sealing	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)

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12.2. 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

Technical Contact Details

America: techsupport.rta@renesas.com
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/

Renesas Demonstration Kit (RDK) for RL78

User's Manual

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