RL78/G16
GUIDE FOR ENGINEER

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EMBEDDED PROCESSING 2ND BUSINESS DIVISION
EMBEDDED PROCESSING PRODUCT GROUP
RENESAS ELECTRONICS CORPORATION

The information/materials required at the time of product development summarized and listed for each development phase. Application notes are a list of regrouped by contents.
Please use it as a guidebook when developing.

CONTENT

We summarized and listed up various information and materials required at the time of product development by each development phase.

Also, You can select what you need for your application from our rich selection of application notes that describing how to use a peripheral punction, example applications, how to create a program, and more.

Please use these information, materials and application notes as a guidebook when developing.

List of information and materials required for product development

STEP1 MCU SELECTION

	Item	Content	Link
1	Hardware information	Datasheet	Doc
2	Products & Solutions	RL78 Family Features	Web site
3		Video	Web site
4		Blog	Web site
5		Reference designs (Winning combination)	Web site
6	Product longevity program (PLP)	Overview of product longevity program (PLP)	Web site
7		Product selection (product selector) Note: Refer to PLP column in the chart.	Web site
8	Product Specification Comparison	Introductory Guide to RL78 Microcontrollers	Web site
9		RL78 FAMILY Selection Guide	Doc

STEP2 DESIGNING AND EVALUATING (1/3)

	Item	Content	Link
Common			
1	Hardware	User's manual: Hardware	Doc
2		Hardware manual guide (Electrical Characteristic edition)	Doc
3		Technical update (errata information)	Web site
4		Part number guide for RL78 family product (the meaning of character in part number)	Doc
5		Semiconductor reliability handbook	Doc
6		RELIABILITY REPORT	Doc
7		RoHS Product Options → Part Number →Package information → RoHS Info	Web site
8	Software information	RL78 Family User's Manual: Software	Doc
9		RL78 Software Porting Guide Porting sample code generated by Smart Configurator (CS+, e2 studio, IAR)	Doc
10	Evaluation board (for general purpose)	RL78/G16 Fast Prototyping Board (RL78/G16 FPB)	Web site
11	Solution Board	Capacitive Touch Evaluation System for RL78/G16	Web site
12	Partner information	Partner products (system solutions provider)	Web site
13		RL78 Partner Ecosystem	Web site

STEP2 DESIGNING AND EVALUATING (2/3)

	Item	Content	Link
Hardware design			
1	Board simulates	ECAD model Note: ECAD can be found by clicking on the respective part number of the product options.	Web site
2	Other	Resonator and matching circuit information	Doc
3		Package information (package outline information, mount manual, etc.)	Web site
4	Development environment	E1/E20/E2 Emulator, E2 Emulator Lite Additional Document for User's Manual (Notes on Connection of RL78)	Doc
Software design			
1	Software information	Getting Started with the RL78 Family Development Environment	Web site
2		RL78 Family Development Environment — Development Tools	Web site
3		RL78 Family Development Environment — Software	Web site
4		RL78 Smart Configurator User's Guide: e² studio	Doc
5		RL78 Smart Configurator User's Guide: CS+	Doc
6		RL78 Smart Configurator User's Guide: IAREW	Doc
7	Training information	RL78 Family Software & Tool Course (Video Collection)	Web site
8	System design	RL78 Low Power MCU	Doc

STEP2 DESIGNING AND EVALUATING (3/3)

	Item	Content	Link
Solution			
1	Capacitive Touch portal page	Capacitive Touch Sensor Solutions	Web site
2	IoT Solutions	IoT Solutions	Doc
Support			
1	Support information	FAQ (frequently asked inquiries)	Web site
2		RL78 forum (community)	Web site
3		Ask to technical support Note: Please click login in the upper right corner	Web site

STEP3 MASS PRODUCTION

	Item		Content	Link
1	Writing a program	Programmer	PG-FP6	Web site
2		Writing tool	Renesas flash programmer (GUI tool for PC)	Web site

RL78/G16 APPLICATION NOTE

SUPPLEMENTARY INFORMATION: PLEASE REFER TO THE APPLICATION NOTE LIST AS NECESSARY.

#	Main items	Overview
1	Basic	Hardware Design/Clock/Voltage/Memory
2	Peripheral	MCU peripheral function
3	Self programming	Flash writing
4	Security / Crypto	Security/Crypto
5	Connectivity	Bluetooth LE, Zigbee, Modbus ASCII/RTU
6	Flash program	Flash programming
7	Memory Driver	Memory driver
8	File System	FAT file system
9	Sound	ADPCM
10	Sensor	Sensor
11	Touch	Capacitive Touch
12	Software relation	Software
13	Others	Other

RL78/G16 APPLICATION NOTE [BASIC]

Item	Title	Summary	Sample code
1	RL78 Family Board Support Package Module Using Software Integration System	The Renesas board support package SIS module (r_bsp) forms the foundation of any project that uses Software Integration System (SIS) modules.	Download
2	RL78 Family RL78 Low Power MCU	The purpose of this application note is to show prospective users the advantages of the new Renesas RL78 low power 16bit MCU family over the major 8/16/32 low power MCU competitors, and how to utilize key RL78 low power features	-
3	Current Consumption Tuning Solution (E2 Emulator, e2 studio)	This application note introduces the current consumption tuning solution using the E2 emulator.	-
4	Current Consumption Tuning Solution(E2 Emulator, CS+)	This application note introduces the current consumption tuning solution using the E2 emulator.	-
5	RL78 Minimizing Power Consumption when Sensing Switch Inputs	This document describes methods to minimize power dissipation when monitoring switch inputs.	-

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RL78/G16 APPLICATION NOTE [PERIPHERAL]

Item	Title	Summary	Sample code
1	RL78/G16 Realtime Clock2	This application note shows usage examples of the fixed-cycle interrupt function and the alarm interrupt function of the realtime clock 2 (RTC2).	Download
2	RL78/G16 Timer Array Unit (Interval timer)	This application note describes the interval timer function of the timer array unit (TAU).	Download
3	RL78/G16Timer Array Unit (PWM output)	This application note describes how to use the PWM output function of the timer array unit (TAU).	Download
4	RL78/G16 Timer Array Unit (Pulse Interval Measurement: Period)	This application note describes how the timer array unit (TAU) measures the interval of the pulse.	Download
5	RL78/G16 Timer Array Unit (Pulse Interval Measurement: Width)	This application note describes how the timer array unit (TAU) measures the interval of the pulse.	Download
6	RL78/G14, RL78/G1C, RL78/L12, RL78/L13, RL78/L1C, RL78/G23 Group Clock Synchronous Single Master Control Software Using CSI Mode of Serial Array Unit	This application note explains clock synchronous control of a single master by using the 3-wire serial I/O communications (CSI mode) of the serial array unit (SAU) of the RL78/G14, RL78/G1C, RL78/L12, RL78/L13, RL78/L1C, RL78/G23 Group and describes how to use the sample code for this application.	Download
7	RL78/G16 Handshake-based SPI Slave Transmission/Reception	This application note describes how the serial array unit (SAU) performs slave transmission/reception by the simple SPI (CSI).	Download
8	RL78/G16 Handshake-based SPI Master Transmission/Reception	This application note describes how the serial array unit (SAU) performs master transmission/reception by the simple SPI (CSI).	Download
9	RL78/G16 Serial Array Unit (UART Communication)	This application note explains how to use UART communication through the serial array unit (SAU).	Download
10	RL78/G16 Serial Interface IICA (for Master Transmission/Reception)	This application note describes master transmission and reception implemented via serial interface IICA.	Download
11	RL78/G16 Serial Interface IICA (for Slave Transmission/Reception)	This application note describes slave transmission and reception implemented via the serial interface IICA.	Download
12	RL78/G16 A/D Converter	This application note describes how to use the the A/D converter on the RL78/G16 to convert analog voltages into digital values.	Download
13	RL78/G15 Temperature Alarm Device Utilizing Comparator Function	This application note describes how to use the comparator function of RL78/G15 to sound a buzzer (via the clock output/buzzer output control circuit) when a set temperature is exceeded by comparing the analog input voltage at the IVCMP pin with an internal reference voltage.	Download

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RL78/G16 APPLICATION NOTE [SELF PROGRAMMING]

Item	Title	Summary	Sample code
1	RL78/G15 Group and RL78/G16 Group Renesas Flash Sample Program Type 01 SC Version (Flash Common)	This document explains Renesas Flash Sample Program Type 01 for the RL78/G15 group and RL78/G16 group in the case of using Smart Configurator(SC). It is an outline about positioning of the Common file for Renesas Flash Sample Program Type 01.	Download
2	RL78/G15 Group and RL78/G16 Group Renesas Flash Sample Program Type 01 SC Version (Code Flash)	This document explains Renesas Flash Sample Program Type 01 for the RL78/G15 group and RL78/G16 group in the case of using Smart Configurator(SC).	Download
3	RL78/G15 Group and RL78/G16 Group Renesas Flash Sample Program Type 01	This application note is intended to give users an understanding of the methods for using the Renesas Flash Sample Program Type 01(RFSP Type 01) for RL78/G15 group and RL78/G16 group.	Download
4	RL78/G15 Group and RL78/G16 Group Renesas Flash Sample Program Type 01 SC Version (Data Flash)	This document explains Renesas Flash Sample Program Type 01 for the RL78/G15 group and RL78/G16 group in the case of using Smart Configurator(SC).	Download

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RL78/G16 APPLICATION NOTE [SECURITY / CRYPTO]

Item	Title	Summary	Sample code
1	RL78 Family AES Library: Introduction Guide	This document explains AES Library for the RL78 Family (hereafter referred to as "AES Library") that depends on MCUs.	Download
2	RL78 Family SHA Hash Function Library: Introduction Guide	This document explains SHA Hash Function Library for the RL78 Family (hereafter referred to as "SHA Libraly") that depends on MCUs	Download
3	RL78 Family How to change devices in the sample project for the DSP Library and the Security Library	This document describes the procedures for migrating the driver and middleware sample code projects shown in the table below to other RL78 family devices	-

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RL78/G16 APPLICATION NOTE [CONNECTIVITY]

Item	Title	Summary	Sample code
1	RI78/G15 HS300x sensor data communication with Bluetooth LE DA14531	This application note describes a sample program to control the DA14531MOD on the RL78/G15 to perform wireless communication.	Download
2	RL78/G15 Wireless Communication with the XBee ZB 2SC and HS300x (AT Solution)	This application note describes a sample program to control the XBee ZB S2C on the RL78/G15 to perform wireless communication.	Download
3	RL78/G15 Wireless Communication with the XBee ZB S2C and HS300x	This application note describes a sample program to control the XBee ZB S2C on the RL78/G15 to perform wireless communication.	Download

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RL78/G16 APPLICATION NOTE [FLASH PROGRAM]

Item	Title	Summary	Sample code
1	RL78 Family RL78 Microcontroller (RL78 Protocol B) Serial Programming Guide	This application note describes the specifications of the boot firmware in RL78 microcontrollers. If the firmware is used in a way that does not conform with the descriptions in this document, correct operation is not guaranteed.	-
2	RL78 Flash Programmer (RL78 Protocol B)	This application note describes how to write the program to the internal flash memory of the RL78 microcontroller that supports the RL78 Protocol B.	Download
3	Flash programmer with Raspberry Pi (RL78 Protocol B)	This application note describes a sample program for a flash programmer that writes to the flash memory of a microcontroller that supports Protocol B.	Download

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RL78/G16 APPLICATION NOTE [MEMORY DRIVER]

Item	Title	Summary	Sample code
1	RL78 Family Serial NOR Flash Memory Control Module Software Integration System	This application note describes the serial NOR flash memory control module conforming to the Software Integration System (SIS).	Download
2	RX Family, RL78 Family, 78K0R/Kx3-L Macronix International MX25/66L Family Serial NOR Flash Memory Control Software	This application note describes how to control MX25/66L serial NOR flash memory, manufactured by Macronix International Co., Ltd., using an MCU manufactured by Renesas Electronics, and it explains the usage of the sample code provided for that purpose.	Download

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RL78/G16 APPLICATION NOTE [FILE SYSTEM]

Item	Title	Summary	Sample code
1	RL78 Family Open Source FAT File System M3S-TFAT-Tiny: Introduction Guide	This document explains the usage of the Open Source FAT File System M3S-TFAT-Tiny for RL78 Family (hereafter referred to as "TFAT library") along with a sample program.	Download
2	RL78 Family SPI mode MultiMediaCard Driver: Introduction Guide	This application note describes the integration method for enabling use of the M3S-TFAT-Tiny open-source FAT file system (referred to below as the TFAT library) and SPI mode multimedia card driver (referred to below as the MMC driver) in combination.	Download
3	RL78 Family Example of Integration of SPI Mode Multimedia Card Driver into M3S-TFAT-Tiny Open-Source FAT File System	This application note describes the integration method for enabling use of the M3S-TFAT-Tiny open-source FAT file system (referred to below as the TFAT library) and SPI mode multimedia card driver (referred to below as the MMC driver) in combination.	Download

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RL78/G16 APPLICATION NOTE [SOUND]

Item	Title	Summary	Sample code
1	RL78 Family Sound Playback/Compression System (Original ADPCM Codec) M3S-S2-Tiny: Introduction Guide	This document explains M3S-S2-Tiny for the RL78 Family (hereafter referred to as "S2 library").	Download

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RL78/G16 APPLICATION NOTE [SENSOR]

Item	Title	Summary	Sample code
1	RL78 Family Sensor I2C Communication Middleware Control Module Software Integration System	This application note explains sensor I2C communication middleware control module for Renesas sensors using Software Integration System (SIS).	Download
2	RL78 Family Sensor Control Modules Software Integration System	This application note explains the sensor control modules for HS300x and HS400x (Renesas high performance relative humidity and temperature sensor), FS2012, FS3000 and FS1015 (Renesas High Performance Flow Sensor Module), ZMOD4410 and ZMOD4510 (Digital Gas Sensors), OB1203 (Heart Rate, Blood Oxygen Concentration, Pulse Oximetry, Proximity, Light and Color Sensor) and I2C communication middleware for Renesas sensors using Software Integration System (SIS).	-
3	RL78 Family HS300x Sensor Control Module Software Integration System	This application note explains the sensor control module for Renesas sensor HS300x (Renesas high performance relative humidity and temperature sensor) using Software Integration System (SIS).	Download
4	RL78 Family HS400X Sensor Control Module Software Integration System	This application note explains the sensor control module for Renesas sensor HS400x (Renesas high performance relative humidity and temperature sensor) using Software Integration System (SIS).	Download
5	RL78 Family FS2012 Sensor Control Module Software Integration System	This application note explains the sensor control modules for FS2012 (Renesas High Performance Flow Sensor Module) using Software Integration System (SIS).	Download
6	RL78 Family FS3000 Sensor Control Module Software Integration System	This application note explains the sensor control module for FS3000 (Renesas air velocity sensor) sensor using Software Integration System (SIS).	Download
7	RL78 Family FS1015 Sensor Control Module Software Integration System	This application note explains the sensor control module for FS1015 (Renesas air velocity sensor) sensor using Software Integration System (SIS).	Download
8	RL78 Family OB1203 Sensor Control Module Software Integration System	This application note explains the sensor control module for OB1203 (Heart Rate, Blood Oxygen Concentration, Pulse Oximetry, Proximity, Light and Color Sensor) using Software Integration System (SIS).	Download
9	RL78 Family ZMOD4410, ZMOD4450 and ZMOD4510 Sensor Control Module Software Integration System	This application note explains the sensor control modules for ZMOD4410, ZMOD4450 and ZMOD4510 (Digital Gas Sensors) using Software Integration System (SIS)	Download
10	Sensor Software Combination Manual	This application note describes code changes required to use the multiple sensor software combinations and runs on certain MCUs of the RA family, RX family, RL78 family and RZ family	-
11	Digital angle meter using I2C communication	This application note explains how to receive acceleration data from a gyro sensor (BMX055), convert it into angle data, and display the sensor's tilt information on an LCD (ACM1602NI-FLW-FBW-M01) using I2C communication.	Download

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RL78/G16 APPLICATION NOTE [TOUCH]

Item	Title	Summary	Sample code
1	Capacitive Sensor Microcontrollers CTSU Capacitive Touch Introduction Guide	This application note is an introduction guide for customers who use the Capacitive Touch Sensor Unit (Capacitive Touch Sensing Unit: hereinafter referred to as CTSU) for the first time.	-
2	RL78/G16 Capacitive Touch Evaluation System Sample Code	This document describes the sample code for the RL78/G16 Capacitive Touch Evaluation System.	Download
3	Capacitive Sensor Microcontrollers CTSU Capacitive Touch Electrode Design Guide	This application note describes how to design electrode patterns, with sample patterns for reference, for MCUs embedding the Capacitive Touch Sensing Unit (CTSU).	-
4	Using the standalone version of QE to Develop Capacitive Touch	This application note explains the steps to create an application example that uses capacitive touch sensing using Renesas RL78 Microcontrollers.	-
5	RL78 Family Using QE (standalone ver.) to Develop Touch Applications for FPB board	This application note explains the steps to create an application example that uses capacitive touch sensing using the RL78/G22 FPB (Fast Prototyping Board) (product name: RTK7RLG220C00000BJ) with mounted touch electrodes.	Download
6	RL78 Family TOUCH Module Software Integration System	This application note describes the RL78 Family TOUCH Module.	Download
7	RL78 Family CTSU Module Software Integration System	This application note describes the CTSU Module.	Download
8	Capacitive Sensor MCU QE for Capacitive Touch Advanced Mode Parameter Guide	QE for Capacitive Touch is a tool that generates tuning data which is used by Renesas MCU which have the CTSU peripheral (Capacitive Touch Sensing Unit).	-
9	Capacitive Sensor MCU Capacitive Touch Noise Immunity Guide	The Renesas Capacitive Touch Sensor Unit (CTSU) can be susceptible to noise in its surrounding environment because it can detect minute changes in capacitance, generated by unwanted spurious electrical signals (noise).	-
10	CTSU Self Test Software	This application note explains the Functional safety solution for capacitive touch of Renesas Electronics.	-

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RL78/G16 APPLICATION NOTE [SOFTWARE RELATION]

Item	Title	Summary	Sample code
1	RL78 Software Porting Guide Porting sample code generated by Smart Configurator (CS+, e2 studio, IAR)	This application note describes how to port a software generated by RL78 Smart Configurator to another RL78. As an example, this application note explains the procedure to port the RL78/G23 sample code to the RL78/G15 sample code.	-
2	RL78 Software Porting Guide RL78/G13 sample code porting (CC-RL) (CS+, e2 studio)	This application note describes how to port the RL78/G13 peripheral sample code to another RL78.	-
3	RL78 Software Migration Guide Source Code Migration from Assembly Language to C Language CC-RL	This application note describes how to migrate the program in the assembly language for the CS+, which is the integrated development environment (IDE), to the inline assembler functions in the C language.	-
4	RL78 Software Migration Guide Migrating from CA78K0R to CC-RL (CS+)	This application note describes how to replace the source codes created by the CA78K0R C compiler for the integrated development environment CS+ with the source codes supported by the CC-RL C compiler for the integrated development environment CS+.	-
5	RL78 Debugging Functions Using the Serial Port	This application note describes how to use the RL78 debugging functions using the serial port.	-
6	RL78 Family C compiler CC-RL Programming Techniques	This application note describes how to reduce the code size, increase the execution speed, and programming techniques to avoid bugs when using the C compiler CC-RL.	-
7	RL78 Family C Compiler Package (CC-RL) Application Guide: Programming Techniques	This application note describes methods of programming for efficiency in terms of code size, speed of execution, and ROM size.	-
8	IAR Embedded Workbench for RL78 Programming Techniques	This application note describes how to reduce the code size, increase the execution speed, and programming techniques to avoid bugs when using IAR Embedded Workbench for RL78.	-
9	Integrated Development Environment e² studio How to use IAR Systems compiler in e² studio	This document describes the procedure for using the IAR Systems compiler on the e2 studio.	-

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RL78/G16 APPLICATION NOTE [OTHERS]

Item	Title	Summary	Sample code
1	RL78 Family Notes and Countermeasures Against Noise	This document describes notes and countermeasures against noise for the RL78 Family.	-
2	RL78/G16 Measuring Distance to an Object with Ultrasonic Sensor	This application note describes an example to measure distance to an object with ultrasonic sensor.	Download
3	RL78 Family FFT Library: Deployment Guide	This document provides information for deploying FFT Library. Fast Fourier transform (FFT) is an algorithm that executes the discrete Fourier transform at high speed.	Download
4	RL78 Family RL78 Digital Signal Controller Library - Filter	This document presents the specifications for a Digital Signal Controller(DSC) Library function library for the Renesas RL78 which includes generic specifications, detailed specifications for filter algorithm kernels and guidelines for the DSC Library API.	Download
5	Application execution from RAM	A lot of applications require the code execution from RAM like for example due to safety reasons or e.g. in case of bootloader for flash self-programming. This document will help you to set-up the projects based on the IAR environment.	-

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