RL78/G23
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.

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
10		RL78/G13, RL78/G23: Migration Guide from RL78/G13 to RL78/G23	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		Product change notice (PCN)	Web site
5		Part number guide for RL78 family product (the meaning of character in part number)	Doc
6		Semiconductor reliability handbook	Doc
7		RELIABILITY REPORT	Doc
8		RoHS Product Options → Part Number →Package information → RoHS Info	Web site
9	Software information	RL78 Family User's Manual: Software	Doc
10		RL78 Software Porting Guide Porting sample code generated by Smart Configurator (CS+, e2 studio, IAR)	Doc
11	Evaluation board (for general purpose)	RL78/G23-64p Fast Prototyping Board (RL78/G23-64p FPB)	Web site
12		RL78/G23-128p Fast Prototyping Board (RL78/G23-128p FPB)	Web site
13	Solution Board	Capacitive Touch Evaluation System for RL78/G23	Web site
14		RL78/G23 Inductive Proximity Sensor Shield Solution Board	Web site
15	Partner information	Partner products (system solutions provider)	Web site
16		RL78 Partner Ecosystem	Web site

STEP2 DESIGNING AND EVALUATING (2/3)

	Item	Content	Link
Hardware design			
1	Design guide	Hardware design guide	Doc
2	Board simulates	ECAD model Note: ECAD can be found by clicking on the respective part number of the product options.	Web site
3	Other	Resonator and matching circuit information	Doc
4		Package information (package outline information, mount manual, etc.)	Web site
5	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	DALI Solutions	DALI communication Solutions	Web site
3	LoRa®-based Solutions	LoRa®-based Solutions for RL78 Family	Web site
4	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
3	Firmware update	Application note	RL78/G22,RL78/G23,RL78/G24 Firmware Update Module	Doc | Sample

RL78/G23 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	Safety	Safety function
4	Self programming	Flash writing
5	Security / Crypto	Security/Crypto
6	Logic and event link controller (ELCL)	Logic and event link controller
7	SMS	SNOOZE mode sequencer
8	Remote Control	Remote control signal receiving function
9	Arduino	Arduino
10	Connectivity	Wireless of WiFI/BLE/LTE , Wired of Modbus ASCII/RTU
11	LoRa	LoRa-based solution
12	DALI	DALI solution
13	AWS FreeRTOS	AWS connection
14	Flash program	Flash programming
15	Memory Driver	Memory driver
16	File System	FAT file system
17	Sound	ADPCM
18	Firmware update	Firmware update
19	Sensor	Sensor
20	Touch	Capacitive Touch
21	Reality AI	Reality AI
22	Software relation	Software
23	Others	Other

RL78/G23 APPLICATION NOTE [BASIC (1/2)]

Item	Title	Summary	Sample code
1	RL78/G23 Hardware Design Guide	This document is intended to provide the hardware specific information and recommendations on RL78/G23 usage.	-
2	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
3	RL78 Family RL78 Hardware CRC Functions	Many applications need to check the integrity of a code image or data communication stream by using a CRC function to verify data errors have not occurred.	Download
4	RL78/G23 Operation State Switching)	The application note shows the register setting sequence for the switch of RL78/G23 operation state, using the Operation State Control.	Download
5	RL78/G23 CPU Clock Changing and Standby Settings	This application note describes how to change the RL78/G23's CPU clock and set it to standby (changing operation modes).	Download
6	RL78/G23 High-speed On-chip Oscillator (HOCO) Clock Frequency Correction	This application note explains how to correct the oscillation clock frequency of the high-speed on-chip oscillator (HOCO) by using the high-speed on-chip oscillator trimming register (HIOTRM) incorporated in RL78/G23.	Download
7	RL78/G23 Middle-speed On-chip Oscillator (MOCO) Clock Frequency Correction	This application note explains how to correct the oscillation clock frequency of the middle-speed on-chip oscillator (MOCO) by using the middle-speed on-chip oscillator trimming register (MIOTRM) incorporated in RL78/G23.	Download
8	RL78/G23 Low-speed On-chip Oscillator (LOCO) Clock Frequency Correction	This application note explains how to correct the oscillation clock frequency of the low-speed on-chip oscillator (LOCO) by using the low-speed on-chip oscillator trimming register (LIOTRM) incorporated in RL78/G23.	Download
9	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	-
10	Current Consumption Tuning Solution (E2 Emulator, e2 studio)	This application note introduces the current consumption tuning solution using the E2 emulator.	-

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RL78/G23 APPLICATION NOTE [BASIC (2/2)]

Item	Title	Summary	Sample code
11	Current Consumption Tuning Solution(E2 Emulator, CS+)	This application note introduces the current consumption tuning solution using the E2 emulator.	-
12	RL78/G23 Voltage Detector	This application note describes how to use the two voltage detectors (LVD) mounted on the RL78/G23 to detect two voltage values.	Download
13	RL78/G23 Voltage Detection Circuits	This application note explains how to use the two voltage detection circuits (LVDs) incorporated into the RL78/G23 microcontroller.	Download
14	RL78/G23 Using VBAT Pin	This application note describes how to use the VBAT pin (battery backup power) of RL78/G23.	Download
15	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/G23 APPLICATION NOTE [PERIPHERAL (1/2)]

Item	Title	Summary	Sample code
1	RL78/G23 40mA Port Output	This application note shows an example of using 40mA port output setting function to drive the DC motor directly from the pin by changing the allowable low-level output current.	Download
2	RL78/G23 Realtime Clock	This application note shows usage examples of the fixed-cycle interrupt function and the alarm interrupt function of the realtime clock (RTC).	Download
3	RL78/G23 Transferring A/D Conversion Result Using the DTC	This application note describes how to store A/D conversion results of multiple channels in the on-chip RAM using the RL78/G23 DTC and A/D converter (hardware trigger wait mode, select mode, and sequential conversion mode).	Download
4	RL78/G23 How to Use the Output Current Control Ports	This application note describes how to use the output current control ports.	Download
5	RL78/G23 Timer Array Unit (Interval timer)	This application note describes the interval timer function of the timer array unit (TAU).	Download
6	RL78/G23 Timer Array Unit (PWM output)	This application note describes how to use the PWM output function of the timer array unit (TAU).	Download
7	RL78/G23 Timer Array Unit (Pulse Interval Measurement: Period)	This application note describes how the timer array unit (TAU) measures the interval of the pulse.	Download
8	RL78/G23 Timer Array Unit (Pulse Interval Measurement: Width)	This application note describes how the timer array unit (TAU) measures the interval of the pulse.	Download
9	RL78/G23 32-Bit Interval Timer (8-bit counter mode)	This application note describes how to use the 32-bit interval timer channels in 8-bit counter mode.	Download
10	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

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RL78/G23 APPLICATION NOTE [PERIPHERAL (2/2)]

Item	Title	Summary	Sample code
11	RL78/G23 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
12	RL78/G23 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
13	RL78/G23 Serial Array Unit (UART Communication)	This application note explains how to use UART communication through the serial array unit (SAU). ASCII characters transmitted from the device on the opposite side are analyzed to make responses.	Download
14	RL78/G23 UART Reception in STOP Mode Using the UARTA Function	This application node describes how to receive data through UART in STOP mode by using the RL78/G23 serial interface UARTA function and key interrupt function.	Download
15	RL78/G23 Serial Interface UARTA Rev.1.02 (renesas.com)	This application note explains how to use UART communication through the serial interface (UARTA).	Download
16	LIN / UART Controller Usage: Applications and Frequently Asked Questions	This application note describes how to use LIN and UART controllers of various Rensas microcontroller products.	-
17	RL78/G23 I2C Supporting Multiple Slave Address (Master)	This application note describes how to use the master function of the I2C bus by using the IICA serial interface. In the procedure described, you will operate four serial memory areas (256 bytes x 4) specified by different slave addresses.	Download
18	RL78/G23 I2C Supporting Multiple Slave Addresses (Slave)	This application note describes how to use the slave function of the I2C bus that supports multiple slave addresses by using the all addresses matching function of the RL78/G23.	Download
19	RL78/G23 A/D Converter (Scan mode)	This application note describes how to convert an analog voltage to a digital voltage with the RL78/G23 A/D converter (scan mode).	Download
20	RL78/G23 A/D Converter (Software trigger wait mode)	This application note describes how to use the software trigger wait mode (in addition to select mode and one-shot conversion mode) of the A/D converter on the RL78/G23 to convert analog voltages into digital values.	Download
21	RL78/G23 Setting the Window Comparator	This document describes a method to operate the window comparator using the RL78/G23 comparator.	Download

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RL78/G23 APPLICATION NOTE [SAFETY]

Item	Title	Summary	Sample code
1	RL78/G23 Safety Function (A/D Test)	This application note explains the sample code for the A/D test function, which is one of the safety functions of the RL78/G23.	Download
2	RL78/G23 Safety Function (Frequency Detection)	This application note describes the frequency detection function which is one of the safety features offered by the RL78/G23.	Download
3	RL78/G23 Safety Function (Flash Memory CRC Operation Function)	This application note explains how to use the flash memory CRC operation function, which is one of the safety functions incorporated in the RL78/G23.	Download
4	RL78/G23 Method of Setting Flash Read Protection	This application note describes the flash read protection function of the RL78/G23.	-

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RL78/G23 APPLICATION NOTE [SELF PROGRAMMING]

Item	Title	Summary	Sample code
1	RL78 Family Renesas Flash Driver RL78 Type 01 SC version (Flash Common)	This document explains Renesas Flash Driver RL78 Type 01 for the RL78/G2x group in the case of using Smart Configurator(SC).	Download
2	Renesas Flash Driver RL78 Type 01 User's Manual for RL78/G2x	Renesas Flash Driver RL78 Type 01 (hereafter called RFD RL78 Type 01) is software for reprogramming the flash memory in the RL78/G2x.	-
3	RL78 Family Renesas Flash Driver RL78 Type 01 SC version (Code Flash)	This document explains Renesas Flash Driver RL78 Type 01 for the RL78/G2x group in the case of using Smart Configurator(SC).	Download
4	RL78 Family Renesas Flash Driver RL78 Type 01 SC version (Extra Area)	This document explains Renesas Flash Driver RL78 Type 01 for the RL78/G2x group in the case of using Smart Configurator(SC).	Download
5	RL78/G23 Self-Programming Using Boot Swapping via UART communications	This manual is intended to give users an understanding of the methods for using the Renesas Flash Driver (RFD) RL78 Type 01 to reprogram the flash memory in the RL78/G2x microcontroller.	Download
6	RL78 Family Renesas Flash Driver RL78 Type 01 SC version (Data Flash)	This document explains Renesas Flash Driver RL78 Type 01 for the RL78/G2x group in the case of using Smart Configurator(SC).	Download
7	Data FLASH Converter (Data FLASH memory image generation)	The Data FLASH Converter is a windows based tool that generates a Data FLASH memory image from EEPROM emulation data and/or from a program code file that is mapped to the Data FLASH area of a Renesas microcontroller.	-
8	EEPROM Emulation Software RL78 Type 01 User's Manual for RL78/G2x	EEPROM emulation is a feature used to store data in the on-board flash memory in the same way as EEPROM. In EEPROM emulation, EEPROM Emulation Software RL78 Type 01 operates the Renesas Flash Driver (RFD) RL78 Type 01. And RFD writes and reads the data flash memory	Download

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RL78/G23 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 RSA Library: Introduction Guide	This document explains RSA Library for RL78 Family (hereafter referred to as "RSA Library") that depends on MCUs.	Download
3	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
4	RL78 Family True Random Number Generator (TRNG) Software Driver	This document describes the specifications and usage of the software driver that generates random numbers using the true random number generator (TRNG) on an RL78 Family MCU.	Download
5	RL78/G23 Unique ID Read Driver	Each RL78/G2x chip is programmed with a unique ID. The unique ID can be used to prevent unauthorized use of software IP and is useful for managing products individually.	Download
6	RL78/G23 Third-Party Program Protection	This application note describes the third-party program protection functionality of the RL78/G23.	-

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RL78/G23 APPLICATION NOTE [LOGIC AND EVENT LINK CONTROLLER (ELCL)]

Item	Title	Summary	Sample code
1	RL78/G23 LED burst dimming control using ELCL	This application note describes how to implement the LED burst dimming using the logic and event link controller (ELCL).	Download
2	RL78/G23 Overcurrent protection function for converter using ELCL	This application note describes how to implement the overcurrent protection for converters using the logic and event link controller (ELCL).	Download
3	RL78/G23 I2S Communication with ELCL and SPI	This application note describes how to use the logic and event link controller (ELCL) and Serial Array Unit (SAU) to achieve I2S communication.	Download
4	RL78/G23 ELCL Edge Detection Thinning Function	This application note describes how to use the logic and event link controller (ELCL) to thin out edge detection on an input signal.	Download
5	RL78/G23 ELCL Slave Select Pin Function (for 4-wire SPI)	This application note describes how to use the logic and event link controller (ELCL) to implement slave selection terminal in 3-wire serial communication (SPI).	Download
6	RL78/G23 ELCL Chattering Prevention Function	This application note describes how to implement a chattering prevention circuit in hardware using the logic and event link controller (ELCL).	Download
7	RL78/G23 ELCL Manchester Decoder Function	This application note describes how to use the logic and event link controller (ELCL) to decode Manchester code.	Download
8	RL78/G23 ELCL Multiple Parameter Monitoring Function	This application note describes how to monitor multiple input signals (parameters) using the logic and event link controller (ELCL).	Download

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RL78/G23 APPLICATION NOTE [SMS]

Item	Title	Summary	Sample code
1	RL78/G23 SNOOZE Mode Sequencer Application Guide	This application note describes the advantages of using the SNOOZE mode sequencer (SMS) mounted on the RL78/G23.	-
2	RL78/G23 Achieving a Watchdog Timer by Using the SNOOZE Mode Sequencer	This application note describes how to achieve a watchdog timer function by using the SNOOZE mode sequencer (SMS) of an RL78/G23.	Download
3	RL78/G23 SMS Automatically Controlling SPI (Master) Communication	This application note describes how to automatically control SPI master communication by using the]SNOOZE mode sequencer (SMS) of the RL78/G23.	Download
4	RL78/G23 SMS HS300x Humidity sensor control by I2C communication	This application note describes an example of controlling a humidity sensor (HS300x) with RL78/G23 to measure indoor air quality. It uses the SNOOZE mode sequencer (SMS), data transfer controller (DTC) and serial interface IICA (IICA) to control the HS300x with the I2C communication protocol during SNOOZE mode.	Download
5	RL78/G23 SMS Monitoring Execution of Periodical Processing	This application note describes how to monitor execution of periodical processing by using the SNOOZE mode sequencer (SMS) of an RL78/G23 microcomputer.	Download
6	RL78/G23 Dynamically Controlling the Display of a 7-Segment LED Indicator by Using the SMS	This application note describes a method to dynamically control the display of a four-digit 7-segment LED indicator by using the SNOOZE mode sequencer (SMS). The method described uses a cathode-common 7-segment LED indicator.	Download
7	RL78/G23 SMS Button Long Press/Short Press Judgment	This application note describes how to build a button long press/short press judgment system using the SNOOZE mode sequencer.	Download
8	RL78/G23 SMS Smoke Fire Detection Operation	This application note describes how to use the SNOOZE mode sequencer to detect fires.	Download
9	RL78/G23 SMS Fire Detection Operation	This application note describes how to use the SNOOZE mode sequencer to detect fires.	Download
10	RL78/G23 SMS LED Blinking Dimming Control	This application note describes how to control the LEDs using the SNOOZE mode sequencer and the 32-bit interval timer.	Download
11	RL78/G23 SMS Moving Average Calculation	This application note describes how to use the SNOOZE mode sequencer to calculate the moving average of an analog input signal.	Download
12	RL78/G23 SMS Power Supply Monitoring	This application note describes how to build a power supply monitoring system using the SNOOZE mode sequencer.	Download

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RL78/G23 APPLICATION NOTE [REMOTE CONTROL]

Item	Title	Summary	Sample code
1	RL78/G23 Remote Control Signal Reception (AEHA Format, SNOOZE Mode)	This application note describes how to receive remote control signals using a remote control signal receiver (REMC) and SNOOZE mode.	Download
2	RL78/G23 Remote Control Signal Reception (NEC Format, SNOOZE Mode)	This application note describes how to receive remote control signals using a remote control signal receiver (REMC) and SNOOZE mode.	Download
3	RL78/G23 Remote Control Signal Reception (RC-6 Format)	This application note describes how to receive remote control signals using a timer array unit and external interrupts.	Download
4	RL78/G23 Remote Control Signal Reception (NEC Format, STOP Mode)	This application note describes how to receive remote control signals using a remote control signal receiver (REMC) and STOP mode.	Download
5	RL78/G23 Remote Control Signal Reception (AEHA Format, STOP Mode)	This application note describes how to receive remote control signals using a remote control signal receiver (REMC) and STOP mode.	Download

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RL78/G23 APPLICATION NOTE [ARDUINO]

Item	Title	Summary	Sample code
1	RL78/G23 HS300x Sample sketch (Arduino™ sketch)	This application note describes how to use the RL78/G23-64p Fast Prototyping Board (FPB) library for Arduino to display data from the HS3001 sensor on the serial monitor of the Arduino™ IDE.	Download
2	RL78/G23 Timer Sample sketch (Arduino™ sketch)	This application note describes how to use the RL78/G23-64p Fast Prototyping Board (FPB) library for Arduino to control a motor on the serial monitor of the Arduino™ IDE.	Download
3	RL78/G23 Motor Shield Rev3 Sample sketch (Arduino™ sketch)	This application note explains how to use the timer function of the RL78/G23-64p Fast Prototyping Board (FPB) library for Arduino to control a piezoelectric sounder to play a melody after a certain period.	Download

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RL78/G23 APPLICATION NOTE [CONNECTIVITY]

Item	Title	Summary	Sample code
1	RL78 Family US159-DA16XXXMEVZ Wi-Fi Control Module Using Software Integration System	This application note describes the usage of the US159-DA16XXXMEVZ Wi-Fi control module, which conforms to the Software Integration System (SIS) standard.	Download
2	RL78/G22 Wi-Fi Communication (Soft AP mode) with DA16200/DA16600	This application note describes the usage of the US159-DA16XXXMEVZ Wi-Fi control module, which conforms to the Software Integration System (SIS) standard.	Download
3	RL78 Family US159-DA14531EVZ BLE Control Module Using Software Integration System	This application note describes the usage of the US159-DA14531EVZ BLE control module, which conforms to the Software Integration System (SIS) standard.	Download
4	RL78/G22 LTE MQTT Communication	This application note explains how to perform LTE communication using RL78/G22 and RYZ024A. RYZ024A is a cellular module capable of LTE Cat M1/NB1/NB2 communication.	Download
5	RL78/G22 Modbus ASCII/RTU	This Application Note describes a sample program that combines an RL78 microcontroller with a Renesas RS-485 transceiver to enable master/slave functionality over Modbus ASCII/RTU.	Download

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RL78/G23 APPLICATION NOTE [LORA]

Item	Title	Summary	Sample code
1	LoRaWAN® Stack Reference Guide	This application note describes information to use the LoRaWAN® stack and its APIs.	-
2	LoRaWAN Stack Sample Application	This document describes a sample software to use LoRaWAN® stack. This application operates the LoRaWAN stack by user with some commands from a Host PC.	-
3	RL78/G23, RL78/G14 Firmware Update over LoRaWAN® Sample Application	This application note describes a sample application to update a firmware over LoRaWAN®. The process to update the firmware over LoRaWAN is called as FUOTA (Firmware Update Over The Air) and application layer protocols used for the update are standardized in the LoRa Alliance®.	-
4	RL78/G23, RL78/G22, RL78/G14 LoRaWAN® Sensor Demo	This application note describes a LoRaWAN® sensor network solution and introduces how to visualize sensor data transmitted by the RL78/G23, RL78/G22 and RL78/G14 Sensor Node to the Cloud (AWS/Azure/Cayenne) via LoRaWAN® networks.	Download
5	RL78/G23, RL78/G22, RL78/G14 LoRa®-based Wireless Software Package	This software package includes the following sample software and tools to evaluate the LoRa and LoRaWAN based wireless communication software for RL78 devices.	Download
6	Private LoRa® Stack Reference Guide	This application note describes information to use the Private LoRa® stack and its APIs.	-
7	Private LoRa® Stack Sample Application	This document describes a sample software to use Private LoRa® stack. This application operates the Private LoRa stack by user with some commands from a Host PC	-
8	Combination of Private LoRa® and LoRaWAN® Stack Reference Guide	This application note describes information to use the combination of Private LoRa® and LoRaWAN® stack.	-
9	Radio Driver Reference Guide	This application note is an API reference guide for the Radio Driver and MCU timer driver.	-
10	Radio Driver Support Functions for Regional Radio Regulations	This application note provides the information necessary to use the radio drivers described in the Radio Driver Reference Guide in compliance with the regional radio regulations.	-
11	Radio Evaluation Program Commands Reference	This document is the AT Command Reference Manual for the Radio Evaluation Program (RadioEvalApp).	-

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RL78/G23 APPLICATION NOTE [DALI (1/2)]

Item	Title	Summary	Sample code
1	RL78/G23 Lighting communication master board initial firmware DALI communication modulation by SMS	This application note describes the initial firmware for the RL78/G23 lighting communication master board (RTK7RL23LMP00000BJ). Hereinafter, this initial firmware is referred to as "the sample application".	Download
2	DALI Master Controller GUI	The DALI Master Controller GUI is a GUI (Graphical User Interface) that controls the lighting communication master evaluation board capable of communication conforming to the DALI standard.	Download
3	RL78 Family DALI-2 Control Gear Library User's Manual: Basic (102)	As a slave (Control Gear) library for DALI communication, this library realizes the processing of the hardwareindependent part of the DALI102 standard.	-
4	RL78 Family DALI-2 Input Device Library User's Manual: Basic (103)	As the library for Input Devices in DALI communication, this library implements processing of the hardwareindependent parts of the Input Device specifications in the IEC62386-103 standard (DALI103 or later)	-
5	RL78 Family DALI-2 Control Gear Library User's Manual: LED (207)	This library is an extension library dedicated to the DALI102 library, which realizes processing of the hardware-independent part of the DALI102 standard as a library for the slave (Control Gear) in DALI communication.	-
6	RL78 Family DALI-2 Control Gear Library User's Manual: Colour control (209Tc)	This library is an extension library dedicated to the DALI102 library, which realizes processing of the hardware-independent part of the DALI102 standard as a library for the slave (Control Gear) in DALI communication.	-
7	RL78 Family DALI-2 Input Device Library User's Manual: Push Button (301)	This library is an extension library exclusively for the DALI103i library, which is provided as a library for Input Device in DALI communication.	-
8	RL78 Family DALI-2 Input Device Library User's Manual: Push Button (302)	This library is an extension library exclusively for the DALI103i library, which is provided as a library for Input Device in DALI communication.	-
9	RL78 Family DALI-2 Input Device Library User's Manual: Occupancy Sensor (303)	This library is an extension library exclusively for the DALI103i library, which is provided as a library for Input Device in DALI communication.	-
10	RL78 Family DALI-2 Input Device Library User's Manual: Light Sensor (304)	This library is an extension library exclusively for the DALI103i library, which is provided as a library for Input Device in DALI communication.	-

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RL78/G23 APPLICATION NOTE [DALI (2/2)]

Item	Title	Summary	Sample code
11	RL78/G23 DALI-2 Input Device Basic(103) Sample Application	This application note describes a sample application that performs DALI (Digital Addressable Lighting Interface) communication using the RL78/G23 microcontroller.	Download
12	RL78/G23 DALI-2 Input Device Push Button(301) Sample Application	This application note describes a sample application that performs DALI (Digital Addressable Lighting Interface) communication using the RL78/G23 microcontroller.	Download
13	RL78/G23 DALI-2 Absolute Input Device (302) Sample Application	This application note describes a sample application that performs DALI (Digital Addressable Lighting Interface) communication using the RL78/G23 microcontroller.	Download
14	RL78/G23 DALI-2 Input Device Occupancy Sensor(303) Sample Application	This application note describes a sample application that performs DALI (Digital Addressable Lighting Interface) communication using the RL78/G23 microcontroller.	Download
15	RL78/G23 DALI-2 Input Device Light Sensor(304) Sample Application	This application note describes a sample application that performs DALI (Digital Addressable Lighting Interface) communication using the RL78/G23 microcontroller.	Download

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RL78/G23 APPLICATION NOTE [AWS FREERTOS]

Item	Title	Summary	Sample code
1	RL78/G23 Getting Started Guide for Connecting Amazon Web Services in LTE Communication: RL78/G23-128p Fast Prototyping Board + FreeRTOS	This document describes how to connect to Amazon Web Services (AWS) by using a Renesas MCU board combined with a cellular IoT module.	Download
2	Connecting AWS Cloud with FreeRTOS Getting Started Guide for RL78/G23-128p Fast Prototyping Board	This tutorial provides instructions of connecting AWS Cloud with FreeRTOS for getting started with RL78/G23-128p Fast Prototyping Board. If you do not have the RL78/G23-128p Fast Prototyping Board, visit the AWS Partner Device Catalog, and purchase one from our partners.	-
3	RL78/G23 Connecting to Amazon Web Services Using FreeRTOS with RL78/G23-128p Fast Prototyping Board Rev.1.01 (renesas.com)	Amazon FreeRTOS is a real-time operating system that augments the FreeRTOS kernel with libraries for connectivity, security, and over-the-air (OTA) updates. Amazon FreeRTOS also includes some demo applications that demonstrate Amazon FreeRTOS features on qualified boards.	-
4	RL78/G23 Visualization of Sensor Information on Amazon Web Services using RL78/G23-128p Fast Prototyping Board and FreeRTOS	Amazon FreeRTOS is a real-time operating system that enhances the FreeRTOS kernel with functionality for connections, security, and over-the-air (OTA) updates. It includes demo applications for demonstrating the functionality of Amazon FreeRTOS.	Download

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RL78/G23 APPLICATION NOTE [FLASH PROGRAM]

Item	Title	Summary	Sample code
1	RL78 Microcontroller (RL78 Protocol C) 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 A)	This application note describes how to write the program to the internal flash memory of the RL78 microcontroller that supports the RL78 Protocol A.	Download
3	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
4	RL78 Flash Programmer (RL78 Protocol C)	This application note describes how to write the program to the internal flash memory of the RL78 microcontroller that supports the RL78 Protocol C.	Download
5	Flash programmer with Raspberry Pi (RL78 Protocol C)	This application note describes a sample program for a flash programmer that writes to the flash memory of a microcontroller that supports Protocol C.	Download

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RL78/G23 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/G23 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/G23 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/G23 APPLICATION NOTE [FILE UPDATE]

Item	Title	Summary	Sample code
1	RL78/G22, RL78/G23, RL78/G24 Firmware Update Module	This application note describes the firmware update module for the RL78/G22 and RL78/G23,RL78/G24. The module is referred to below as the firmware update module.	Download
2	RL78/G22 OTA Firmware Update for a Secondary MCU	This application note is for a system in which an RX65N microcontroller is used as a primary MCU that communicates with Amazon Web ServicesTM (hereafter, referred to as “AWS”) and an RL78 microcontroller is used as a secondary MCU that receives data measured by sensors.	Download
3	RL78/G23 Updating Firmware by Using UART Communication and Boot Swapping	This application note describes how to update firmware in code flash memory by using an update program that remains in the code flash memory.	Download
4	RL78/G23 Firmware Upgrade Using External Flash Memory via Simplified SPI (CSI) Communication	This application note provides an overview of firmware upgrade using external flash memory.The RL78/G23 can use simplified SPI (CSI) to communicate with external flash memory to obtain data for firmware upgrade from the memory.	Download

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RL78/G23 APPLICATION NOTE [SENSOR (1/2)]

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	-

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RL78/G23 APPLICATION NOTE [SENSOR (2/2)]

Item	Title	Summary	Sample code
11	RL78/G23 HS3001 Sensor Device Sample	This document describes a Renesas microcontroller RL78/G23 application for an HS3001 sensor device using the RL78/G23-128p Fast Prototyping Board.	Download
12	RL78 Family HS400X Sensor Control Module Software Integration System	This document describes a Renesas microcontroller RL78/G23 application for a ZMOD4410 sensor device using the RL78/G23 128-pin Fast Prototyping Board	Download
13	OB1203 Sample application - Sample Code	This application note describes the sample software that is for use with the OB1203 sensor and runs on certain MCUs of the RA family, RX family, and RL78 family, and RE01 group MCUs with 256 KB or 1500 KB of flash memory.	Download
14	FS2012 Sample application - Sample Code	This application note describes the sample software that is for use with the FS2012 flow sensor and runs on certain MCUs of the RA family, RX family, and RL78 family.	Download
15	FS3000 Sample application - Sample Code	This application note describes the sample software that is for use with the FS3000 flow sensor and runs on certain MCUs of the RA family, and RX family, RL78 family.	Download
16	ZMOD4xxx Sample application - Sample Code	This sample software acquires gas data from the ZMOD4410, ZMOD4450 and ZMOD4510 gas sensors and calculates the result. In combination with the I2C driver of the FSP, the sample software controls the ZMOD4410 and ZMOD4510 through the I2C in the MCU to measure gases, acquire ADC data, and calculate the acquired result.	Download
17	HS300x Sample application - Sample Code	This application note describes the sample software that is for use with the HS300x humidity and temperature sensor and runs on certain MCUs of the RA family, RX family, RL78 family, and RZ family.	Download
18	HS400x Sample application - Sample Code	This application note describes the sample software that is for use with the HS400x humidity and temperature sensor and runs on certain MCUs of the RA family, RX family, RL78 family, and RZ family.	Download
19	FS1015 Sample application - Sample Code	This application note describes the sample software that is for use with the FS1015 flow sensor and runs on certain MCUs of the RA family, RX family, and RL78 family.	Download
20	Inductive Proximity Sensing with the RL78/G23	This document will introduce the fundamental concepts of inductive proximity sensing and describe the application developed for the RL78/G23 based proof of concept (PoC).	-

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RL78/G23 APPLICATION NOTE [TOUCH (1/2)]

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/G23 Capacitive Touch Evaluation System Sample Code	This document describes the contents of the sample code for the RL78/G23 Capacitive Touch Evaluation System.	Download
3	Using QE and SIS to Develop Capacitive Touch Applications	This document will demonstrate the needed steps to create an application example that integrates capacitive touch sensing using Renesas RL78 Microcontrollers.	-
4	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).	-
5	RL78/G23 Capacitive Touch Low Power Guide (SMS function)	This application note explains how to use the SNOOZE Mode Sequencer (SMS) to achieve low power consumption with capacitive touch measurement.	Download
6	RL78 Family RL78/G23 Capacitive Touch Low Power Guide (SNOOZE function)	This application note explains the electrostatic Capacity Touch measurement that uses the 32-bit Interval Timer (TML32) and the SNOOZE function of CTSU2L installed in RL78/G23.	Download
7	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.	-
8	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
9	Capacitive Touch Sensing Unit (CTSU2L) Operation Explanation	This application note explains Capacitive Touch Sensing Unit (CTSU2L).The number of output channels of the capacitive sensing unit depends on the product.	-
10	RL78 Family TOUCH Module Software Integration System	This application note describes the RL78 Family TOUCH Module.	Download
11	RL78 Family CTSU Module Software Integration System	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).	Download

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RL78/G23 APPLICATION NOTE [TOUCH (2/2)]

Item	Title	Summary	Sample code
12	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).	-
13	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).	-
14	CTSU Self Test Software	This application note explains the Functional safety solution for capacitive touch of Renesas Electronics.	-
15	RL78/G23 Group Touchless Button Demo Solution Sample Software	This application note describes touchless button demo solution (RTK0EG0036D01001BJ) Software specification using a sample application of self-capacitance method based on Capacitive Touch Sensor Unit2L (CTSU2L), the hardware that detects the contact or approach of human by measuring capacitance generated between touch electrodes and the human body.	Download
16	RL78/G23 Group Touchless Button Electrode Board Sample Software	This Application Note describes the Touchless Button Electrode Board sample software as an application example of the self-capacitance method used in Capacitive Touch Sensing Unit2L (CTSU2L) hardware.	Download
17	Capacitive Sensor Microcontrollers Touchless Button Electrode Board	This application note describes how to use the hardware of the Touchless button electrode board.	-
18	RL78/G23 Self-capacitance Waterproof Touch Button Demo Sample Software	The CTSU2, the enhanced version of the Renesas Capacitive Touch Sensing Unit (CTSU), supports an active shield as one of its anti-noise countermeasures.	Download
19	RL78/G23 Capacitive Touch Evaluation System Factory Default Firmware	This Program file is a factory default firmware for Renesas Capacitive Touch Evaluation System for RL78/G23.	Download
20	RL78/G23 Automatic Liquid Dispenser with Proximity Capacitive Sensing	This document describes a Renesas microcontroller RL78/G23 application for automatic liquid dispenser.	Download

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RL78/G23 APPLICATION NOTE [REALITY AI]

Item	Title	Summary	Sample code
1	RL78 Family Reality AI Control Modules Software Integration System	This application note explains Data Shipper and Data Collector control modules for Renesas Reality AI, and general UART communication module using Software Integration System (SIS)	Download
2	RL78 Family Reality AI Data Acquisition Module (Data Collector / Data Shipper) - Sample Code	This application note describes sample software for data acquisition for Reality AI. Acquired data is converted into any files using Reality AI Data Storage Tool on PC.	Download
3	RL78 Family Reality AI UART Communication Module Software Integration System	This application note explains a UART communication module for Renesas Reality AI using Software Integration System (SIS).	Download
4	RL78 Family Reality AI Data Collector Control Module Software Integration System	This application note explains Reality AI Data Collector control modules for Renesas Reality AI using Software Integration System (SIS).	Download
5	RL78 Family Reality AI Data Shipper Control Module Software Integration System	This application note explains Reality AI Data Shipper control modules for Renesas Reality AI using Software Integration System (SIS).	Download

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RL78/G23 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/G23 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 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
3	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
4	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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