RA2E1 Group
Handbook for RA2E1

Introduction

This document compiles useful information for each stage of device selection, development, and Mass production. You can also select what you need for your application from our rich selection of application notes that describe how to use a peripheral function, example applications, how to create a program, and more.

Please utilize these information, materials and application notes as a handbook when developing.

Target Device

RA2E1 Group

Contents

1. The table of information and materials needed for Device Selection, Development and Mass production.

1.1 Step1: Device Selection

This section summarizes the information that is useful for the preliminary survey phase (Step1-1) and for the evaluation phase for device performance and features (Step1-2) when selecting the device.

1.1.1 Step1-1: Preliminary survey phase

#	Item	Contents	Link
1	**Hardware information**	Datasheet	Doc
2	**Products & Solutions**	RA Family Flyer	Doc
3		RA Family Brochure	Doc
4		Video	Web site
5		Blog	Web site
6		Reference designs (Winning combination)	Web site
7	**Product longevity program (PLP)**	Overview of product longevity program (PLP)	Web site
8		Product selection (product selector) Note: Refer to PLP column in the chart.	Web site
9	**Product Specification Comparison**	RA Family Product Selector	Web site
10		Capacitive Touch Sensor Solution Brochure	Doc
11		Industrial Networks Brochure	Doc
12		Building Automation Brochure	Doc
13		White Paper: Solving IoT Security Issues with Embedded Microcontrollers	Doc
14		White Paper: Securing your IP and Protecting Sensitive Data	Doc
15		White Paper: Security for the Connected World	Doc

1.1.2 Step1-2: Evaluation phase for device performance and features

#	Item	Contents	Link
User's Manual / Documentation			
1	**Document**	User's manual: Hardware	Doc
2		Technical update (errata information)	Web site
3		Product change notice (PCN)	Web site
4		Product Advisory (PA)	Doc
5		RA Family NOMENCLATURE (the meaning of character in part number)	Doc
6		Semiconductor reliability handbook	Doc
7		RELIABILITY REPORT	Doc
8		RoHS Note: Product Options → Part Number →Package information → RoHS Info	Web site
9		Renesas RA Family Beginner's Guide	Doc
10		Renesas Flexible Software Package (FSP) User's Manual	Web site
Evaluation Board			
11	**Evaluation Board (for General purpose)**	Evaluation Kit for RA2E1 MCU Group (EK-RA2E1)	Web site
12		Fast Prototyping Board for RA2E1 MCU Group (FPB-RA2E1)	Web site
13	**Solution Board**	RA2E1 IO-Link Pressure Sensor Solution Demonstration Kit	Web site
14		Self-Capacitance Waterproof Button Solution	Web site
15		PTX105R Pmod™ Board for IoT	Web site
Evaluation environment (set up method)			
16	**Hardware development**	EK-RA2E1 – Quick Start Guide	Doc
17		FPB-RA2E1-Quick Start Guide	Doc
18	**Software development**	EK-RA2E1 Example Project Bundle	Doc
19		RA Family Development Environment - RA Flexible Software Package (FSP)	Web site
20		Migrating Projects to New FSP Version	Doc
Solution			
21	**HMI**	Capacitive Touch Sensor Solutions	Web site
22	**LoRa Solution**	LoRa®-based Solutions for RA Family	Web site
23	**Functional Safety**	IEC/UL 60730 Functional Safety for Home Appliances	Web site
24		IEC 61508 Functional Safety for Industrial Applications	Web site
25	**Security**	IoT Security	Web site
26	**Motor Control**	Motor and Inverter Control Solutions	Web site
Training			
27	**Training information**	RA Family Video Library	Web site
28		Software & Tool Course solution menu	Web site
29		RA Family Software&Tool Course(Video Collection)	Web site
Partner			
30	**Partner information**	Partner products (system solutions provider)	Web site
31		RA Family Partner Ecosystem	Web site

1.2 Step2: Product Design, Development

This section summarizes useful information for product design and development.

#	Item	Contents	Link
1	**Board Design**	RA2 Quick Design Guide	Doc
2		EK-RA2E1 v1 - Design Package	Doc*
3		FPB-RA2E1 v1 - Design Package	Doc*
4		ECAD model Note: ECAD can be found by clicking on the respective part number of the product options.	Web site
5		Design Guide for Main Clock Circuits and Sub-Clock Circuits Rev.1.01	Doc
6		Design Guide for Sub-Clock Circuits	Doc
7		Package information (package outline information, mount manual, etc.)	Web site
8		IBIS Model for RA2E1	Doc
9		QFN Mounting manual	Doc
10	**Software Design**	System Specifications for Standard Boot Firmware	Doc
11		Secure Bootloader for RA2 MCU Series	Doc
12		Renesas LPWA Power Estimator	Doc
13		Renesas LPWA Studio	Doc
14		Using QE and FSP to Develop Capacitive Touch Applications	Doc
15		Usage of Schmitt Trigger Input Pins on RA2E1	Doc
16	**Development environment**	Converting Applications from e² studio to IAR or Keil	Doc

* It requires My Renesas account to access the contents.

1.3 Step3: Mass Production

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

Supportive information

Get help from our technical staff and community.

#		Link
1	FAQ (frequently asked inquiries)	Web site
2	RA forum (community)	Web site
3	RA Online Training Modules	Web site
4	Technical support	Web site

2. Summary of information by category

This part shows the information about application notes by the category.
(Note: To access contents of sample code, My Renesas account is required.)

Overview

#	Main Item	Description
1	Basic	Hardware Design / Software for start-up / Clock / Voltage / Memory
2	Peripheral	MCU peripheral function
3	Safety	Safety function
4	Security	Security function
5	Sensor	Solutions for sensor
6	Connectivity	Connectivity solutions for wireless and wired connectivity
7	Touch	Solutions for capacitive Touch
8	LoRa	LoRa-based solutions
9	Others	Others

2.1 RA2E1 Application note [Basic]

#	Title	Contents	Sample code
1	RA2 Quick Design Guide	This document answers common questions and points out subtleties of the RA2 MCU that might be missed unless the hardware manual was extensively reviewed.	-
2	EK-RA2E1 Example Project Bundle	This document describes the contents of the Example Project Bundle for the EK-RA2E1 kit. The Example Projects contained within the bundle show how to write code for the various Renesas Flexible Software Package (FSP) modules supported by the EK-RA2E1 kit.	Download
3	Renesas RA Family System Specifications for Standard Boot Firmware	This document describes the specification of standard boot firmware for Renesas RA microcontrollers.	-
4	Design Guide for Main Clock Circuits and Sub-Clock Circuits	This application note introduces recommended resonators for the RX and RA families along with the relevant resonator matching evaluation results, oscillation evaluation methods, and some recommendations on board design as information for the design of the main clock oscillation circuit and the sub-clock oscillation circuit	-
5	Design Guide for Sub-Clock Circuits	This document describes how to minimize MCU's noise error risk when using a low capacitive load (CL) resonator.	-
6	RA family MCU Injection current to prevent damage to MCU	This document describes recommended condition of injection current so that the MCU will not be damaged if the abnormal injection current occurs accidentally.	-
7	Getting Started with Low Power Applications for RA2L1/RA2E1 Group	This Application Note describes how you can reduce the effective power consumption of the RA Microcontroller using Low Power Modes (LPMs).	Download
8	Usage of Schmitt Trigger Input Pins on RA2E1	This document answers common questions and points out subtleties in the usage of the Schmitt Trigger Input Pins on the RA2E1.	-
9	Flash Memory Programming	This application note details the process of programming flash memory in Renesas RA MCUs.	-

2.2 RA2E1 Application note [Peripheral]

#	Title	Contents	Sample code
1	Low Power Application (Use of ADC, DTC and ELC at Snooze mode) for FPB-RA2E1 and FPB-RA2E2 – Application Project	This application note describes the features of RA2E1 and RA2E2 MCUs that are useful for low-power operation, typically required for logging data for long durations.	Download
2	RA2L1/RA2E1 Group Example of Low Power Application (Data Logger)	This application note describes the features of RA2L1 MCU that are useful for low-power operation, typically required for logging data for long durations.	Download
3	Getting Started with Low Power Applications for RA2L1/RA2E1 Group	This Application Note describes how you can reduce the effective power consumption of the RA Microcontroller using Low Power Modes (LPMs).	Download

2.3 RA2E1 Application note [Safety]

#	Title	Contents	Sample code
1	NIST SP800-90B Entropy Assessment Report for RA2E1	This report indicates the results of the in-company entropy assessment done for RA2E1.	-
2	NIST SP800-22r1a Random Number Statistical Test Report for RA2E1	This report indicates the results of Random Number Statistical Test gained from RA2E1.	-
3	RA Family IEC 60730/60335 Self Test Library for RA MCU (CM4_CM23)	This Application Note provides guidelines of how to use flexible sample software routines to assist with compliance with IEC60730 class B safety standards. These routines have been certified by VDE Test and Certification Institute GmbH and a copy of the Test Certificate is available in the download package for this Application Note	Download

2.4 RA2E1 Application note [Security]

#	Title	Contents	Sample code
1	Securing Data at Rest Utilizing the Renesas Security MPU	This application project discusses the considerations for securing Data at Rest in an embedded system and provides guidelines on how to use the Security MPU hardware feature of the RA Family MCUs to implement a secure Data at Rest solution.	Download
2	Secure Bootloader for RA2 MCU Series	This application note guides you through secure bootloader creation using the MCUboot Module with TinyCrypt for enhanced security on the Renesas EK-RA2E1 kit.	Download

2.5 RA2E1 Application note [Sensor]

#	Title	Contents	Sample code
1	HS300x Sample application	This application note describes the sample software that is for use with the HS300x humidity and temperature sensor and runs on RA family MCUs.	Download
2	RA2E1 HS3001 Sensor Device Sample	This document describes a Renesas microcontroller RA2E1 application for an HS3001 sensor device using the RA2E1 Fast Prototyping Board.	Download
3	RA2E1 ZMOD4410 Sensor Device Sample	This document describes a Renesas microcontroller RA2E1 application for a ZMOD4410 sensor device using the RA2E1 Fast Prototyping Board.	Download

2.6 RA2E1 Application note [Connectivity]

#	Title	Contents	Sample code
1	Examples of IO-Link Solutions	This application note describes a sample application to realize IO-Link communication with RA2E1 using the EK-RA2E1, IA Sensor Network Connector Board, ZSSC3240 Evaluation Board, and EK-RA2E1 Change Board.	Download
2	RA Ethernet Design and Custom PHY Setup using FSP	This application note describes Ethernet designs in general, provides a brief introduction to the RA Ethernet controller and interface to the PHY peripheral. It provides design guidelines when using the RA MCU with RMII modes for Ethernet specific applications.	-
3	RA Azure IoT Cloud Connectivity Solution	The objective of this Application Project is to demonstrate the Renesas RA Azure IoT Cloud Connectivity solution by providing a fully working solution that sends sensor data to the Microsoft® Azure IoT Central cloud over Wi-Fi/Ethernet connection and using HAL drivers and middleware provided with Renesas FSP.	Download

2.7 RA2E1 Application note [Touch]

#	Title	Contents	Sample code
1	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).	-
2	Using QE and FSP to Develop Capacitive Touch Applications	This document demonstrates the necessary steps for creating an application example that integrates capacitive touch sensing using Renesas RA Microcontrollers.	-
3	RA Family, RL78 Family, RX Family, Renesas Synergy™ Platform CTSU Self Test Software	This application note explains the Functional safety solution for capacitive touch of Renesas Electronics.	-
4	RA2E1 Group Sensor & Touchless key Demo Board	This application note explains hardware specification of RTK0EA0005D00001BJ board, which realizes non-contact button (touchless key) operation by Capacitive touch sensor and various sensor control by RA2E1 MCU.	-
5	RA2E1 Sensor & Touchless key Demo Sample Software	This application note explains demo software for RA2E1 Sensor & Touchless key demo.	Download
6	RA2E1 Group Sensor & Touchless key demo evaluation tool “Sensor & Touchless key Monitor”	This application note explains how to use RA2E1 Group Sensor & Touchless key demo evaluation tool “Sensor & Touchless key Monitor”.	-
7	QE for Capacitive Touch usage for Keil® MDK	This document will demonstrate how to generate QE code for Capacitive Touch in e² studio and copy QE code to Keil® MDK for ARM using Renesas RA Microcontrollers.	-
8	QE for Capacitive Touch usage for IAR EWARM	This document will demonstrate how to generate QE code for Capacitive Touch in e² studio and copy the QE code to IAR EW for ARM using Renesas RA Microcontrollers.	-
9	QE for Capacitive Touch 3D Gesture Recognition Application Development Guide	This application note explains how to perform 3D gesture recognition incorporating AI using the capacitive touch sensor compatible development support tool (QE for Capacitive Touch).	-
10	Capacitive Touch Ripple Noise Prevention Guide	This application note is a guide for users who use the capacitive touch sensor unit (CTSU) in the self-capacitance method, helping them understand how ripple noise from the power supply or peripheral circuit affects CTSU measurement values and on touch detection and take noise countermeasures.	-
11	Capacitive Touch Software Filter Sample Program	This application note describes software filters in for capacitive touch systems.	Download
12	Capacitive Touch Noise Immunity Guide	This application note describes ways to improve noise immunity for products using the Renesas Capacitive Touch Sensor Unit (CTSU) in accordance with the IEC’s noise immunity standards (IEC61000-4).	-
13	Capacitive Sensor MCU QE for Capacitive Touch Advanced Mode Parameter Guide	This application note describes "Advanced mode” Tuning and the adjustable-CTSU parameters of QE for Capacitive Touch.	-
14	Capacitive Sensor Microcontrollers CTSU Capacitive Touch Introduction Guide	This application note is an introduction guide for customers who use the Capacitive Touch Sensor Unit (CTSU) for the first time.	-

2.8 RA2E1 Application note [LORA]

#	Title	Contents	Sample code
1	LoRaWAN® Stack Sample Application	This document describes sample software to use LoRaWAN® stack. This application operates the LoRaWAN stack by user with some commands from a Host PC.	-
2	LoRaWAN® Stack Reference Guide	This application note describes information to use the LoRaWAN® stack and its APIs.	-
3	Combination of Private LoRa® and LoRaWAN® Stack Reference Guide	This application note describes information to use the combination of Private LoRa® and LoRaWAN® stack.	-
4	Private LoRa® Stack Reference Guide	This application note describes information to use the Private LoRa® stack and its APIs.	-
5	Private LoRa® Stack Sample Application	This document describes sample software to use Private LoRa® stack. This application operates the Private LoRa stack by users with some commands from a Host PC.	-
6	RA2E1, RA2L1 LoRaWAN® Sensor Demo	This application note describes a LoRaWAN® sensor network solution and introduces how to visualize sensor data transmitted by the RA2E1, RA2L1 or RA0E1 Sensor Node to the Cloud (AWS/Azure) via LoRaWAN® networks.	Download
7	RA2E1, RA2L1 LoRa®-based Wireless Software Package	This software package includes useful sample software and tools to evaluate the LoRa and LoRaWAN based wireless communication software for RA devices.	Download
8	Radio Driver Reference Guide	This application note is an API reference guide for the Radio Driver and MCU timer driver. The Radio Driver supports LoRa®-based modulation technology and (G)FSK modulation.	-
9	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.	-
10	Radio Evaluation Program Commands Reference	This document is the AT Command Reference Manual for the Radio Evaluation Program (RadioEvalApp).	-

2.9 RA2E1 Application note [Others]

#	Title	Contents	Sample code
1	RA2E1 to RA2E3 Migration Guide: Hardware	This application note explains the differences and points to note when migrating from RA2E1 group to RA2E3 group.	-
2	Software Project Migration Example to RA2E3 from RA2E1	This application note describes how to migrate an existing project for the RA2E1 MCU using Renesas Flexible Software Package (FSP) to the RA2E3 MCU.	Download
3	Converting Applications from e² studio to IAR or Keil	This application note provides guidelines to create projects in IDEs such as IAR Embedded Workbench for ARM and Keil Microcontroller Development Kit while using projects in Renesas e2 studio IDE as reference.	-
4	Migrating Projects to New FSP Version	This application note describes the steps to migrate an existing RA Project to a newer FSP pack version, and then build and run the example project.	-
5	Exception Handling	This application note explains how to handle exceptions on Renesas RA family MCUs with Arm® Cortex®-M cores for user applications using the Flexible Software Package (FSP).	Download

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jan.10.2025	-	First edition issued