



ARROW ARIS EDGE S3 Board

User's Guide

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1. Introduction

1.1. Description

ARIS EDGE S3 board, developed by RELOC for Arrow Electronics, is a ready-to-use Internet of Things (IoT) hardware and software platform that enables users to get their IoT applications up and running quickly, exploiting the Renesas Synergy development framework.

Based on Renesas Synergy S3A3 MCU with a 48-MHz ARM Cortex-M4 core with floating point unit (FPU), the ARIS EDGE S3 board has a host of features that equip it for smart sensing, IoT operations and small HMI design. Communication with other devices and the cloud is enabled by means of a flexible multi-protocol radio module, supporting Bluetooth Low Energy, Thread and ZigBee stacks. Board sensing capabilities include motion detection via 9-degrees-of-freedom IMU with sensor fusion capabilities, environmental temperature, humidity, pressure and ambient light sampling.

The Renesas Synergy Platform helps to accelerate IoT and HMI designs: a proven combination of hardware and software makes development easier and faster, thus encouraging innovation and product differentiation. The combination of Arrow ARIS EDGE S3 board and Renesas Synergy software platform enables developers to reduce time-to-market and decreases the total cost of ownership of a product over its lifetime.

1.2. Kit contents

The following items are included in the box:

- 1x ARIS EDGE S3 board
- 1x USB type A-male to mini-B-male cable



2. System overview

2.1. Board main features

ARIS EDGE S3 board main features are summarized in the picture below.

Silicon Labs Mighty Gecko MGM111 module Multi-protocol module supporting BLE, Thread and ZigBee stacks **Bosch BME280** 100 High Pressure, humidity and • MANA temperature sensor **Bosch BNO055** High performance MEMS 9-degrees-of-freedom IMU with sensor fusion capabilities **Renesas Synergy S3A3** ARM Cortex-M4 CPU • Up to 48-MHz core clock 512 KB code flash • 96 KB SRAM • **On-Board J-Link USB Device** On-Board J-Link programming micro-USB connector providing connector access to the native S3 USB peripheral AMS TSL25711FN

Ambient light sensor



2.2. Block diagram

An overview of the functional blocks of ARIS EDGE S3 board is shown in the figure below.





3. Getting started

3.1. ARIS EDGE S3 pre-programmed demo

The ARIS EDGE S3 board is pre-programmed with a demo application which continuously monitors the on-board sensors and sends collected data on Bluetooth Low-Energy (BLE) network.

The Synergy S3 device takes care of sampling sensors data whereas the MGM111 multi-protocol module establishes the BLE communication with a BLE client.

Additional information about the internal demo software behavior can be found in "BLE Sensors demo" document.

In order to test ARIS EDGE S3 functionalities by means of pre-programmed demo application

- 1. download the free ARIS Tools smartphone App from
 - a. Apple App Store[™] (<u>https://itunes.apple.com/us/app/aris-tools/id1161792783</u>) or
 - b. Google Play[™] (<u>https://play.google.com/store/apps/details?id=com.demo.rlc.arisapp</u>);
- 2. power supply the ARIS EDGE S3 board through either J2 or J5 USB connector



- open the ARIS Tools smartphone App and select your ARIS EDGE S3 from the device list. The application
 - a. shows sensor values in real-time through the BLE communication channel,
 - b. enables user to remotely control the board LEDs by means of App buttons.



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3.2. Creating and debugging a sample "Blinky" project

3.2.1 Prerequisites

The following development tools should be installed before trying to either create a project or use any example based on ARIS board:

- e² studio v5.4.0.023 or later release •
- Synergy Software Package v1.3.3 or later release •

Please refer to the Synergy Gallery website for more information and for obtaining the required software.

3.2.2 ARIS EDGE S3 BSP

ARIS EDGE S3 Board Support Package (BSP) provides a default configuration for ARIS EDGE S3 board peripherals.

ARIS EDGE S3 BSP is available for download at the following link:



http://www.reloc.it/download/products/ARIS-EDGE-S3/reloc.aris_edge3.1.3.3.zip

In order to install it, please unzip the archive and copy the file "Reloc.Aris_Edge3.1.3.3.pack" in the following directory:

%e2_studio_install_dir%\internal\projectgen\arm\Packs

where

%e2 studio install dir% is typically the folder "C:\Renesas\e2 studio\"

3.2.3 Creating and building a demo project

To create a Synergy project with the ARIS EDGE S3 board as a target, please follow the following steps within e² studio:

- Select File \rightarrow New \rightarrow Synergy C Project in the e² studio main menu
- Assign a new project name and select GCC toolchain

A license file is required for using Synergy platform; an evaluation license is provided with SSP in the following directory:

%e2 studio install dir%\internal\projectgen\arm\Licenses

Please refer to <u>Synergy Gallery</u> website for additional information about obtaining development and production licenses.

| e2 studio - Project Configuration (Synergy C Project) | — 🗆 X | | | | | |
|---|--------------------------------------|--|--|--|--|--|
| e2 studio - Project Configuration (Synergy C Project) | | | | | | |
| Specify the new project details | | | | | | |
| Speeny the new project details. | | | | | | |
| Project | Toolchains | | | | | |
| | | | | | | |
| Project name test | GCC ARM Embedded | | | | | |
| Use <u>d</u> efault location | | | | | | |
| Location: D:\Workspace\Renesas\SYN_540023_SSP133\test Browse | | | | | | |
| | | | | | | |
| License | | | | | | |
| License file: | Change license file | | | | | |
| $\label{eq:c:Renesas} C:\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$ | enses\SSP_License_Example_EvalLicens | | | | | |
| License Details: | | | | | | |
| CUSTOMER INFORMATION: | ^ | | | | | |
| Company: Renesas Electronics America Inc. | | | | | | |
| UserName: Renesas Synergy Evaluation User | | | | | | |
| Email: noreply@renesas.com | | | | | | |
| LICENSE INFORMATION: | | | | | | |
| Issued: 08/08/2017 | | | | | | |
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| < | > | | | | | |
| Visit the Apps Gallery for license file and Pack file downloads | | | | | | |
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| ? < <u>Back</u> <u>Next</u> > | Einish Cancel | | | | | |
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• Select the "aris_edge3" board and verify the other parameters accordingly to the picture below

| e² e2 studio - Project Configuration (Synergy C Project) — 🛛 🛛 🗙 | | | | | | | |
|---|--|----------------|----------------|---|---|----|--|
| e2 studio - Projec Select the board sup | 2 studio - Project Configuration (Synergy C Project) Select the board support that you require. | | | | | | |
| Device Selection SSP version: 1.3.3 Board: aris_e Device: R7FS | edge3 3A37A3A01CFM | > > | | | | | |
| Select Tools Toolchain: Toolchain version: Debugger: | GCC ARM Embedded 4.9.3.20150529 J-Link ARM | | ~ | Available Tools GCC ARM Embedd 4.9.3.20150529 4.8.4.20140725 Debuggers J-Link ARM RTOS Express Logic T Smart Manual IO Registers Su Software Manu | ied hreadX pported al Supporte | ed | |
| ? | | < <u>B</u> ack | <u>N</u> ext > | <u>F</u> inish | Cance | el | |

• Select the "Blinky with ThreadX" project template and confirm with the Finish button:





• You should now be able to build the project by clicking on the Build button:



Compilation should end without any error or warning.

3.2.4 Board configuration and connection

Connect the ARIS EDGE S3 board to your PC through the mini-USB port - J5: this connection provides board with power supply and represents the interface for project flashing and debugging via on-board J-Link programmer.

Ensure that J15 jumper is open, i.e. the on-board J-Link debugger is connect to the S3 MCU.

Jumpers P1, P2 and P3 (populated in the default configuration) route power to the Synergy MCU and to peripheral components. P1 can also be used to measure the current consumption of the S3 device.

Please refer to following chapters for additional information about the board power supply distribution.

3.2.5 Program and debug S3 project

In order to check the correct behavior of the sample "Blinky" application start the Debug by selecting Run \rightarrow Debug from the menu; if there are no errors the "Blinky" application will be downloaded to the ARIS EDGE S3 board and the development environment will automatically switch to the Debug Perspective.

Click on Resume (F8) two times in order to execute the application. LED2 and LED3 should start blinking.

3.3. Flashing a binary firmware on MGM111 multi-protocol radio module

MGM111 device can be programmed through either the on-board J-Link debugger or using an external SEGGER J-Link programmer connected to J4 connector. In order to use the on-board J-Link debugger ensure that J15 jumper is short, i.e. the on-board J-Link debugger is connect to the MGM111 module.

In terms of software, SEGGER J-Link Software Pack can be used for flashing MGM111 device. SEGGER pack includes J-Link Commander, a command-line based tool, and J-Flash, a GUI-based software.

Please download and install the latest J-Link Software and Documentation Pack from the following link:

https://www.segger.com/downloads/jlink/#J-LinkSoftwareAndDocumentationPack

3.3.1 J-Link Commander tool

J-Link Commander (JLink.exe) is a free command-line based utility that allows to download a binary firmware into the flash memory of a target microcontroller. It supports simple commands, such as memory program and dump, application launch, halt, step, etc. J-Link Commander is part of the J-Link Software and Documentation package and, after SEGGER software installation, it can be found at

%j-link_install_dir%\JLink.exe

where

```
%j-link_install_dir% is the J-Link software installation folder (e.g. "C:\Program Files\SEGGER\
JLink V630d\").
```

In order to download a binary file into MGM111 module

- using the on-board J-Link debugger
 - connect the ARIS EDGE J5 mini-USB port to the PC
 - o short J15 jumper
- otherwise, using an external SEGGER J-Link debugger
 - o connect J-Link to the PC
 - supply ARIS EDGE S3 with power, e.g. via J2 micro-USB port
 - o connect J-Link debugger to target ARIS EDGE via J4 port
- remove jumper J14 (preventing S3 to control MGM111 reset signal)
- start J-Link Commander
- enter the requested settings (e.g. target device, interface settings, etc.) and launch programming procedure using the following commands

Device EFR32MG1PxxxF256



```
si SWD
speed a
erase
loadfile "%path_to_binaries%/firmware.srec"
exit
```

where <code>%path_to_binaries%</code> is the path to application firmware

- J-Link Commander executes the flash download and prints out the time statistics on success
- restore J14 jumper.

3.3.2 J-Flash tool

The J-Flash software is a separate software tool from SEGGER which requires an extra license. In particular, J-Flash license is bound to the serial number of a J-Link programmer. If you own a license bounded to a SEGGER J-Link debugger, exploit J4 connector to connect the external SEGGER programmer to the MGM111 module.

• Remove jumper J14 (preventing S3 to control MGM111 reset signal). Start J-Flash software, select the option to create a new project and press Start J-Flash button:

| Welcome to J-Flash | | | | | |
|---|---------------|--|--|--|--|
| Please select one of the following start options: | | | | | |
| C Open recent project: Other | – | | | | |
| Create a new project. | | | | | |
| Do not show this message again. | Start J-Flash | | | | |

• select EFR32MG1PxxxF256 as a target device and confirm the choice:



| Create New Project | — × | | | | |
|-------------------------------|-------------|--|--|--|--|
| Target Device | | | | | |
| Silicon Labs EFR32MG1PxxxF256 | | | | | |
| Little endian | | | | | |
| Target Interface | Speed (kHz) | | | | |
| SWD 💌 | 4000 💌 | | | | |
| | ОК | | | | |

- from J-Flash menu:
 - o Select File \rightarrow Open data file in order to select the desired firmware file;
 - o Select Target \rightarrow Connect;
 - o Select Target \rightarrow Manual Programming \rightarrow Program & Verify.
- if the operation is successful, the following confirmation message will be displayed:



• restore J14 jumper.



4. Connectors

This chapter gives an overview of ARIS EDGE S3 connectors placement and their functionalities.









4.1. Arduino expansion connector

Connectors J6, J7, J8 and J9 provide user with a standard Arduino shield expansion slot.



| Signal | Description | | |
|--------------------|---|--|--|
| NC | Not connected | | |
| VIN | Input voltage | | |
| MCU_nRST | MCU reset signal (active low) | | |
| +3V3 | +3.3V power supply | | |
| GND | Ground connections | | |
| P0_00-04, P0_10-11 | Analog inputs directly connected to MCU | | |
| P2_05-06 | I2C interface (IIC1_A) shared with on-board sensors | | |
| +3V3ANA_MCU | Analog reference | | |
| P4_00-22, P4_11 | SPI port (SCI1_B); | | |
| | GPIO P4_11 is used as SPI chip select signal | | |
| P0_15 | GPIO shared with Light Sensor interrupt | | |
| P0_14 | Digital to analog converter (DA0) | | |
| P1_04-07 | GPIOs directly connected to MCU | | |
| P1_02-03 | SPI port (SCI0_A) slave select and clock signals; | | |
| | P1_01-02 ports can be used as MOSI / MISO terminals | | |
| P1_00-01 | SCI0_A uart transmitter and receiver signals | | |



4.2. JTAG connectors

The ARIS EDGE S3 development kit features an on-board SEGGER J-Link debugger (see J5 mini-USB port), which can be used to program and debug both the Synergy S3 microcontroller and MGM111 module.

The ARIS EDGE S3 board includes additional JTAG connectors, detailed below for reference:

- J1 JTAG connector which can be used to program and debug Synergy S3 with an external J-Link debugger;
- J4 JTAG connector routed to the Silicon Labs Mighty Gecko system-on-chip (MGM111 module);
- J13 E1 programmer connector routed to the Renesas RX621 chip. Such a chip provides users with the on-board SEGGER J-Link facility, thus it should not be erased and/or reprogrammed.

4.3. USB device port

The ARIS EDGE S3 board is equipped with a USB Full-Speed (12 Mbps) device port on J2 connector. ARIS EDGE S3 can be powered through this interface (see diode D1).





5. Usage

This chapter describes how to connect, configure and interact with the ARIS EDGE S3 board.

5.1. Power supply

The ARIS EDGE S3 board can be supplied with power from

- the mini-USB port J5,
- the micro-USB port J2,
- or the battery connector B1.

Please Note: it is not recommended to use more than one power supply source at the same time.



In order to power supply ARIS EDGE S3 board either from J2 or J5, short J3 pins 2 and 3 (populated in the default configuration). Otherwise, short J2 pins 1 and 2 to exploit battery connector B1.



5.2. Power enable and measurement

P1, P2 and P3 (populated in the default configuration) provide power to the Synergy S3 MCU, sensors and radio module, respectively (i.e. connect the input power sources to the board loads).

They can also be used to measure the current consumption of the ARIS EDGE S3 circuitry sections.



J10 and J11 (*not* populated in the default configuration) could be used to provide power to the Arduino connectors; before placing a jumper please check that current consumption of the shield is within maximum values provided by the +5V input and +3.3V regulated power supply.



5.3. Push buttons, LEDs and buzzer

ARIS EDGE S3 developer is provided with a basic user interface, including buttons, LEDs and buzzer.

Buttons and LEDs are directly connected to both Renesas Synergy S3 MCU (SW1, SW2, LED2, LED3) and Silicon Labs Mighty Gecko module (SW3, LED5).



Buttons and LEDs positions are highlighted in the picture below.



Mapping of the user interface to the S3 microcontroller and MGM111 module pins is provided below.

| Device | Port | Schematic Signal | Description |
|---------------------|-------|------------------|----------------------------------|
| Synergy S3 | P3_01 | UI_SW1 | SW1 tactile switch |
| | RES# | MCU_nRST | SW2 tactile switch connected |
| | | | to MCU reset signal (active low) |
| | P1_13 | UI_LED1 | LED3 Blue LED |
| | P3_03 | UI_LED2 | LED2 Orange LED |
| | P5_01 | UI_BUZ | BZ1 buzzer |
| Mighty Gecko module | PA3 | RF_SW | SW3 tactile switch |
| | PA4 | RF_LED | LED5 Blue LED |

Schematic extracts are provided as an additional reference.







Synergy S3 tactile switch and LEDs.







Mighty Gecko tactile switch and LED.



6. Board layout

Top and bottom board layouts (component placement and overlay) are provided for reference purposes. For additional details see ARIS EDGE S3 schematics and layout document, "ARROW ARIS EDGE R1D2 schematics silk.pdf".

