Renesas Synergy™ Platform

Simple Proximity Sensor Application with Snooze Mode for DK-S3A7

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Introduction

This application note provides an example of how the Snooze function, one of the low current consumption modes of the Renesas Synergy™ Platform MCU, can be used. It describes how Snooze mode is used for UART reception to receive the distance with an object, from a proximity sensor (PmodMAXSONAR™) connected to the DK-S3A7 Synergy MCU Group board.

Target Device

DK-S3A7 Synergy MCU Group board kit

Required Resources

To build and run the application, you will need:

- A Renesas Synergy DK-S3A7 board v3.0
- A PC running Microsoft® Windows® 7 with the following Renesas software installed:
  - e² studio ISDE 5.4.0.023
  - Synergy Software Package (SSP) v1.3.0
  - Synergy Standalone Configurator (SSC) 5.4.0.023 (only applicable to IAR EW for Synergy).

You can download the required Renesas software and documentation from the Renesas Synergy™ Gallery, and see recommended documentation in the Reference Documentation section of this application note.

(https://synergygallery.renesas.com).

Contents

1. Overview

Renesas Synergy™ MCUs have a variety of functions for realizing low current consumption of the system. One of those functions is Snooze mode. In Snooze mode, certain events that occur while the MCU is in Standby state, are processed without waking the CPU. In this way, low current consumption as well as prompt handling of events are realized. This application note introduces UART reception as an example of how Snooze mode can be used. In this example, the distance with an object is received from a proximity sensor (PmodMAXSONAR™) that is connected to the DK-S3A7 Synergy MCU board, and the received result is displayed on the LEDs. By using Snooze mode here, the operating current of the MCU is reduced.

The main SSP modules which are used in this application, are listed in the Table below.

Table 2 Relevant SSP modules

Module Type	Module Name
HAL driver	SCI UART Driver
	SCI Common Driver
	Low Power Mode Driver
	GPT Timer Driver

2. Hardware

2.1 Hardware Configuration

A block diagram and an external view of the DK-S3A7 are shown in Figures 1 and 2 below. Also, the required DK-S3A7 Synergy MCU board settings for running the application, as well as the connection between the DK-S3A7 and the PmodMAXSONAR™ are shown in Table 4 and Figure 3 below. Note that while the PMOD pins are used for connection, the pin assignments differ, so a separate cable must be supplied.

Table 3 Hardware configuration

Device	Product Name	Connection with the DK-S3A7	Description
Main Board	DK-S3A7M v2.0	-	-
-	USB cable	By J15	Power supply/debugger connection
Proximity sensor	PmodMAXSONAR™	By PMOD A/2.54 mm pitch cable	Distance measurement
-	2.54 mm pitch cable	PMOD A	Sensor connection

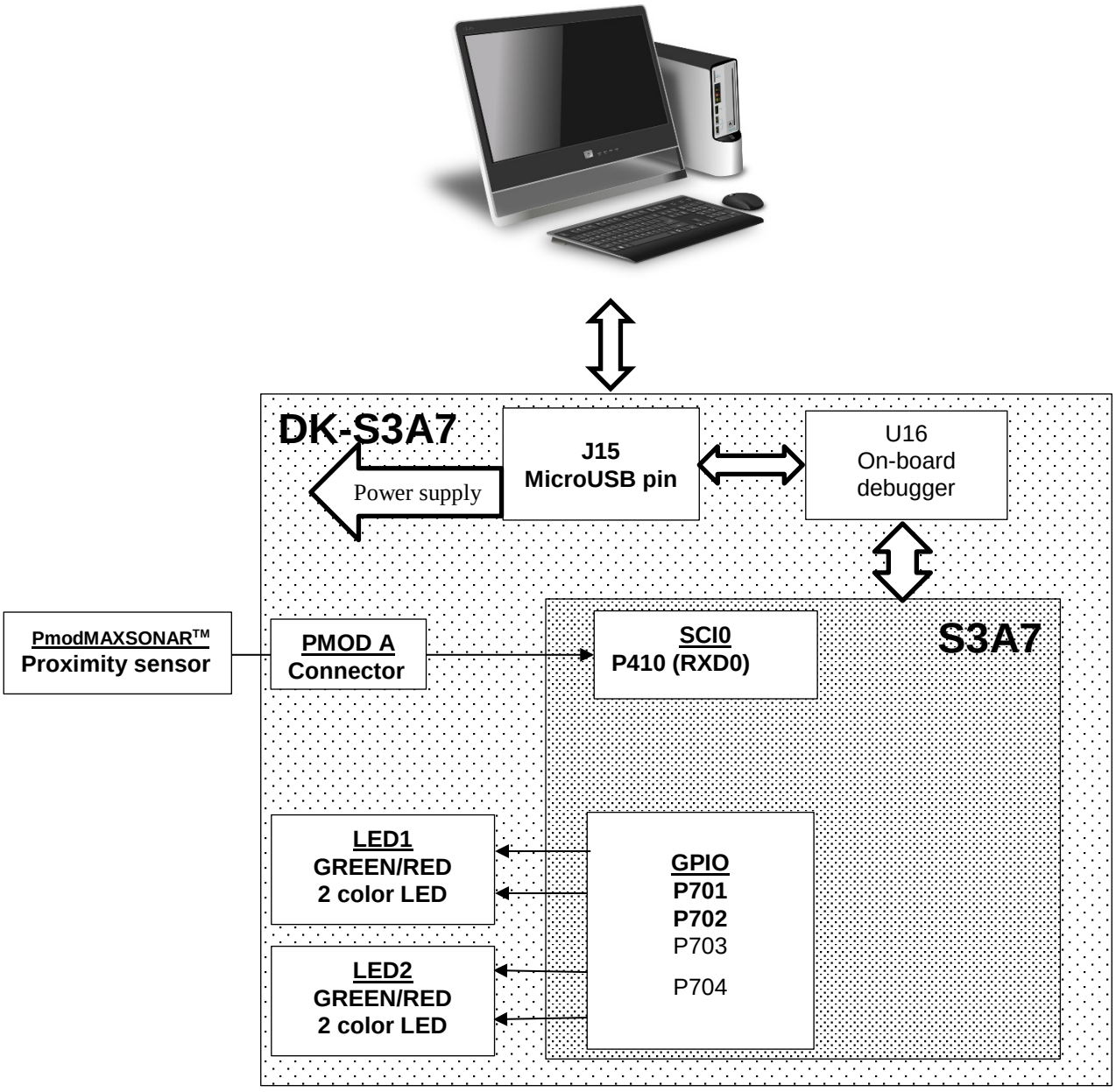

Figure 1 Block diagram

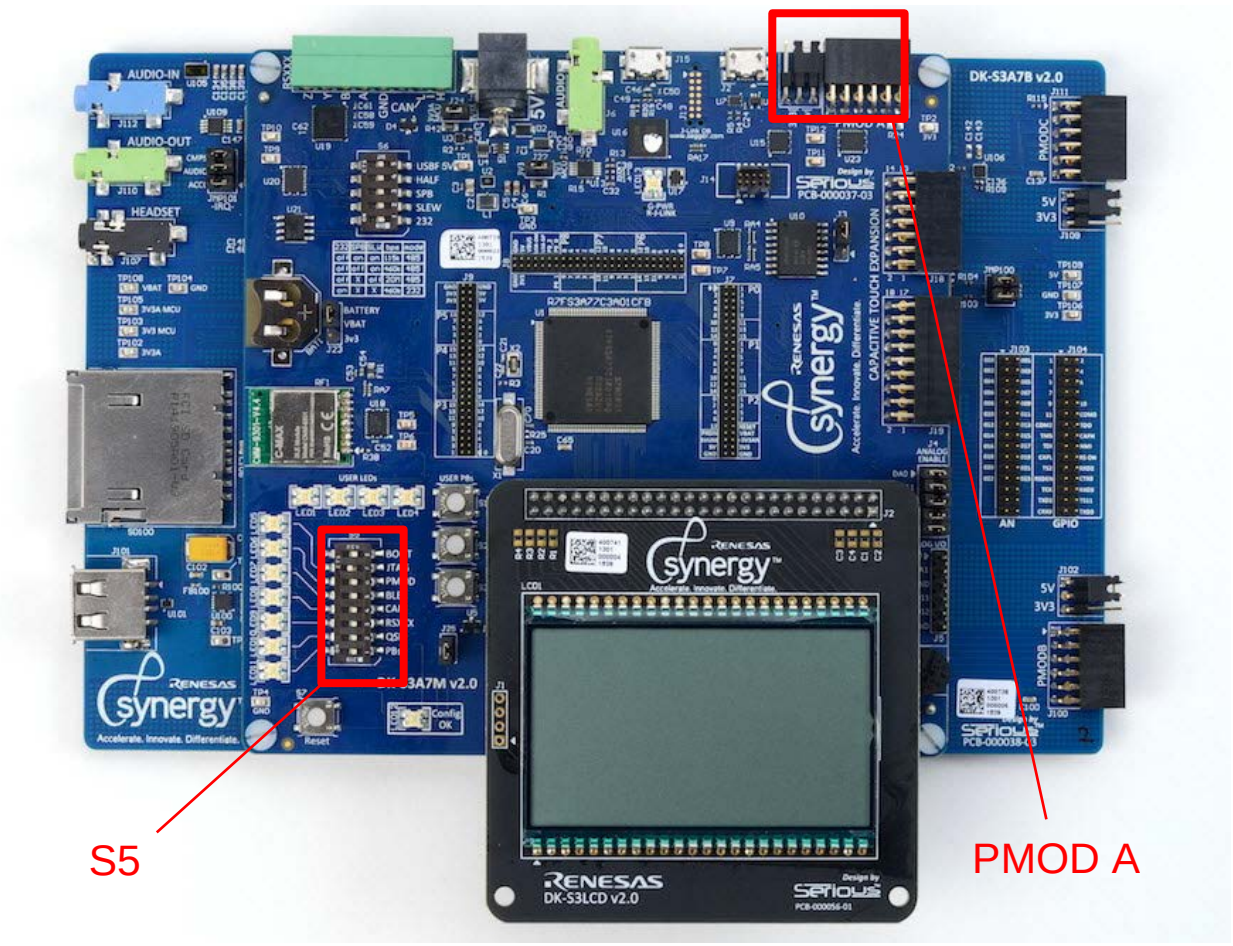

Figure 2 External view of the DK-S3A7

Table 4 DK-S3A7 S5 switch settings

No.	Name	Setting*1
S5-1	PBs	ON
S5-2	QSPI	OFF
S5-3	RSXXX	OFF
S5-4	CAN	OFF
S5-5	BLE	OFF
S5-6	PMOD	ON
S5-7	JTAG	ON
S5-8	BOOT	OFF

*1: Grayed out settings are arbitrary

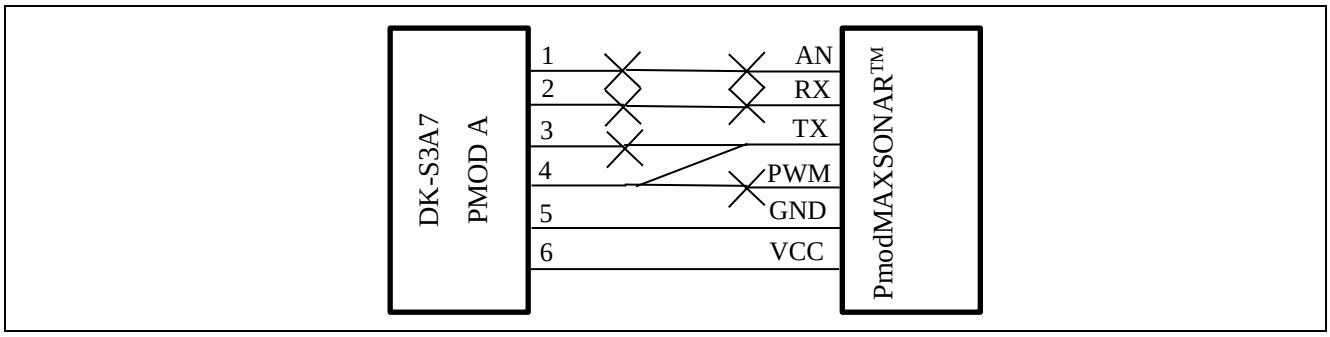

Figure 3 Connection diagram of DK-S3A7 and PmodMAXSONAR™

2.2 Clock Settings

The clock settings in the ISDE Synergy Configuration for this application note are given in the below Table. Some clocks may have limitations on the clocks that can be used that apply in the use of Snooze mode. See the Reference Documents section of this application note for a link to the *S3A7 User's Manual: Microcontrollers* when making any setting changes.

Table 5 Clock settings

Clock	Frequency	Calculation Formula
XTAL	12 MHz	-
HOCO	32 MHz	-
LOCO	32768 Hz	-
MOCO	8 MHz	-
SUBCLK	32768 Hz	-
PLL	48 MHz	= XTAL ÷ 2 × 8
Clock Src	32 MHz	= HOCO
ICLK	32 MHz	= Clock Src / 1
PCLKA	32 MHz	= Clock Src / 1
PCLKB	32 MHz	= Clock Src / 1
PCLKC	32 MHz	= Clock Src / 1
PCLKD	32 MHz	= Clock Src / 1
BCLK	16 MHz	= Clock Src / 2
EBCLK	8 MHz	= BCLK / 2
UCLK	32 MHz	= Clock Src
FCLK	16 MHz	= Clock Src / 2

2.3 Pin Settings

The pin settings in the ISDE Synergy Configuration for this application note, are given in the Table below.

Table 6 Pin Settings

Category	Classification	Item	Setting Value
Ports	P7/ P701	Mode	Output mode (Initial Low)
		Pull up	None
		Drive Capacity	Low
		Output type	CMOS
	P7/ P702	Mode	Output mode (Initial Low)
		Pull up	None
		Drive Capacity	Low
		Output type	CMOS
	P7/ P703	Mode	Output mode (Initial Low)
		Pull up	None
		Drive Capacity	Low
		Output type	CMOS
	P7/ P704	Mode	Output mode (Initial Low)
		Pull up	None
		Drive Capacity	Low
		Output type	CMOS
Peripherals	Connectivity: SCI/ SCI0	Pin Group Selection	_B only
		Operation Mode	Asynchronous UART
	Connectivity: SCI/ SCI3	Pin Group Selection	Mixed
		Operation Mode	Disable

3. Functional Specification of the Proximity Sensor

The functional details of the proximity sensor are described below.

The proximity sensor (PmodMAXSONAR™) measures the distance with an object and sends the resulting data by UART, approximately every 50 msec.

The S3A7 Synergy MCU receives the UART data, and lights up LED1 and/or LED2 depending on the distance. Table 7 below, shows the possible LED light combinations.

The S3A7 Synergy MCU, during periods of waiting for UART reception, stops the clock and maintains Software Standby mode. In this way, the current consumption is significantly reduced.

When the S3A7 Synergy MCU detects a UART start bit (falling edge of the RX signal), it transitions to Snooze mode and starts the UART reception. In Snooze mode, the received UART immediately begins processing after the clock stabilizes, without waking the CPU. There is no loss of received data.

When a UART reception end interrupt occurs, the S3A7 MCU transitions to normal mode and processing of received data by the CPU begins. In this example, the end interrupt occurs the moment the first 1-byte is received, and from the 2nd byte onwards, UART reception processing occurs in parallel with the CPU processing.

The figure below, outlines the processing steps involved in a single cycle.

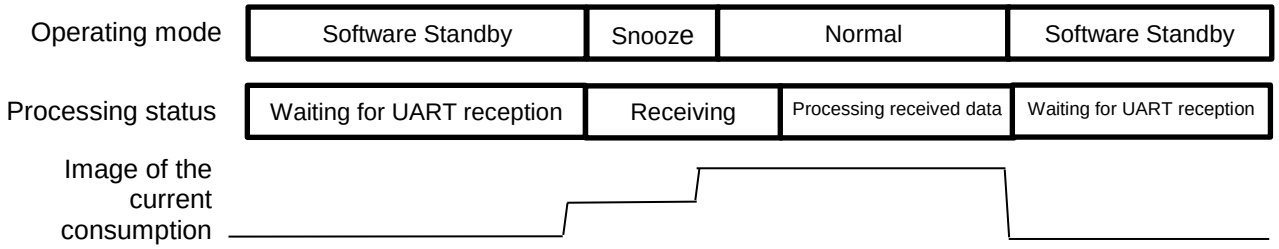

Figure 4 Conceptual diagram of UART reception by Snooze mode

Table 7 Distance and the corresponding LED light combinations

Distance (in inches)	LED1		LED2	
	Red	Green	Red	Green
-10	ON	-	ON	-
10-20	-	-	ON	-
20-30	-	-	-	-
30-40	-	-	-	ON
40-	-	ON	-	ON

4. Software Operation

The flowchart for the application note is shown in the figure below.

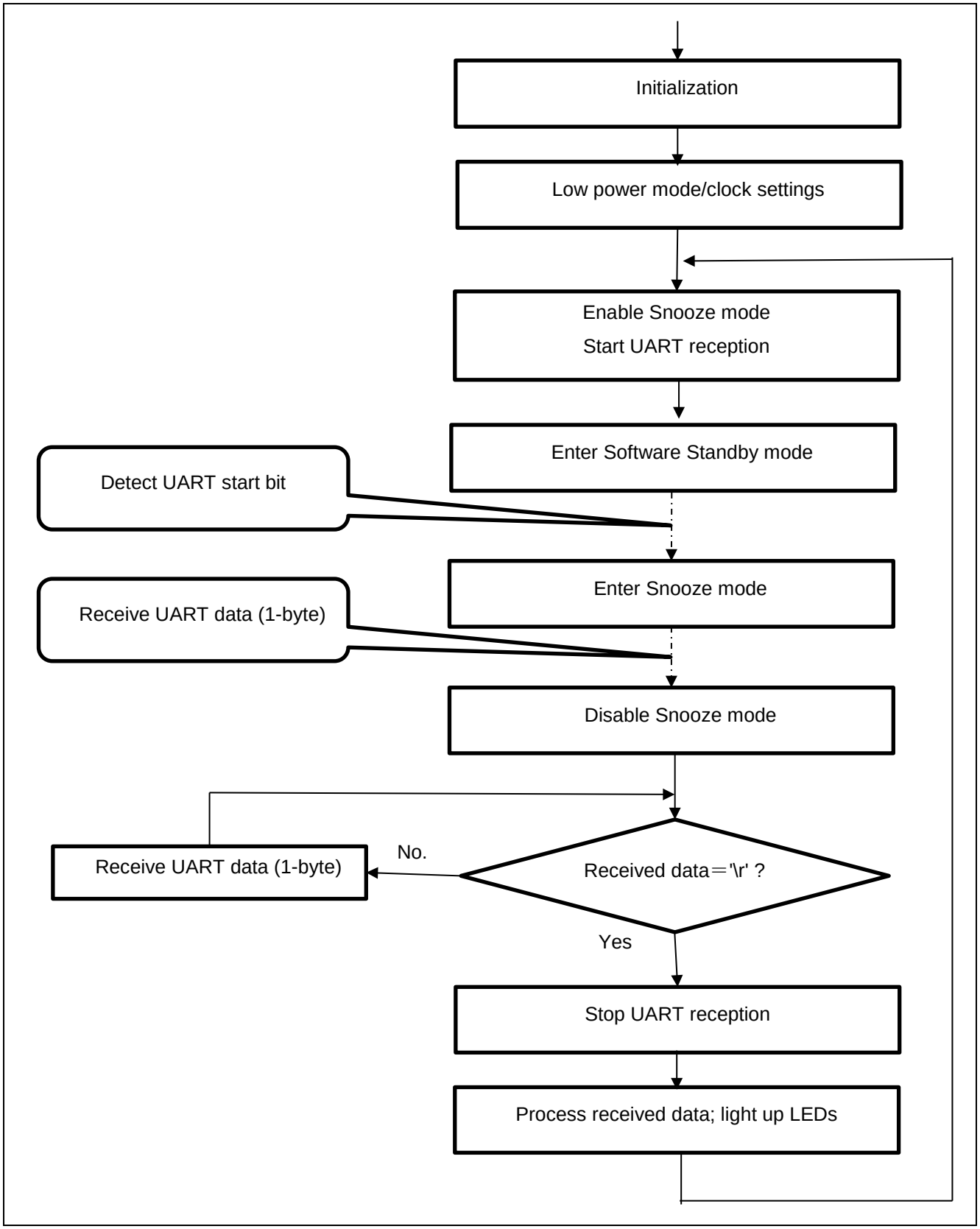

Figure 5 Flowchart

5. Reference Documents

You can download the required Renesas software from the Renesas Synergy™ Gallery (https://synergygallery.renesas.com).

- Renesas, "Renesas Synergy™ *Development Kit DK-S3A7 v2.0 User's Manual* (R12UM0003EU0100)".
https://www.renesas.com/en-us/doc/products/renesas-synergy/doc/r12um0003eu0100_synergy_dk_3a7.pdf
- Renesas, "S3A7 User's Manual: Microcontrollers (R01UM0002EU0120)".
https://www.renesas.com/en-us/doc/products/renesas-synergy/doc/r01um0002eu0120-synergy-s3a7.pdf?key=dbc3eb40c7bb0ce150a5a57a61f01c0c
- Renesas, "Renesas Synergy™ Software Package *SSP User's Manual* (R01US0315EU0100)".
https://www.renesas.com/en-us/doc/products/renesas-synergy/doc/r01us0315eu0100-synergy-ssp-v130.pdf

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Mar 18, 2016	-	Initial release
1.01	Jun 10, 2016	-	SSP1.1.0 support
1.10	Sep 21, 2017	-	SSP1.2.0 support

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