Renesas Synergy™ Platform

PWM Waveform Output to Control Dimming of LEDs

Introduction

The Renesas Synergy™ Platform was proposed as a solution for issues such as the growing complexity of embedded systems development, increasing costs, and longer development times. Renesas Synergy™ Software Package (SSP) comes with a warranty that guarantees proper operation of the RTOS, the HAL driver, and the software framework. It allows developers to concentrate solely on creating their applications. This application note uses LED dimming control as an example to explain how development is done.

The SSP functions used are:

- Thread-X® OS for scheduling of threads
- Messaging Framework for inter-thread communication
- ADC Framework for regular periodic AD conversion
- External IRQ Framework for external interrupt processing
- GPT Timer HAL Driver for PWM waveform output

Target Device

- DK-S3A7 v3.0

Required Resources

To implement the PWM Waveform Output to Control Dimming of LEDs application example, you need:

- Renesas Synergy™ DK-S3A7 v3.0 kit
- Micro USB cable (included)
- Synergy Software Package (SSP) 1.4.0, 1.5.0
- e^2 studio ISDE v6.2.1
- IAR Embedded Workbench® for Renesas Synergy™ 8.23.1
- Renesas Synergy™ Synergy Standalone Configurator (SSC) v6.2.1

Download all the required Renesas (SSP) from the Renesas Synergy™ Gallery (www.renesas.com/synergy/software).

Contents

1. Overview

This document demonstrates how the SSP is used for development, using the application example where the dimming of LEDs is controlled by the PWM waveform output.

Table 1. Operating Environment

e² studio	v6.2.1
IAR EW for Synergy and Renesas Synergy™ Standalone Configurator (SSC)	v8.23.1, v6.2.1
Renesas Synergy™ Software Package (SSP)	v1.4.0, v1.5.0
DK-S3A7 evaluation board	DK-S3A7 v3.0

The SSP modules which are used in this application are listed in the following table.

Table 2. Relevant SSP Modules

Module Type	Module Name
Framework	Messaging Framework
	ADC Framework
	External IRQ Framework
HAL driver	ADC Driver
	DTC Transfer Driver
	GPT Timer Driver
	External IRQ Driver

2. Hardware

2.1 Hardware Configuration

A block diagram and an external view are shown in Figure 1 and Figure 2. The required DK-S3A7 Synergy MCU Group board settings for running the application are shown in Table 4 and Table 5.

Table 3. Hardware configuration

Device	Product Name	Connection with the DK-S3A7	Description
Main Board	DK-S3A7	—	—
—	USB cable	By J15	Power supply

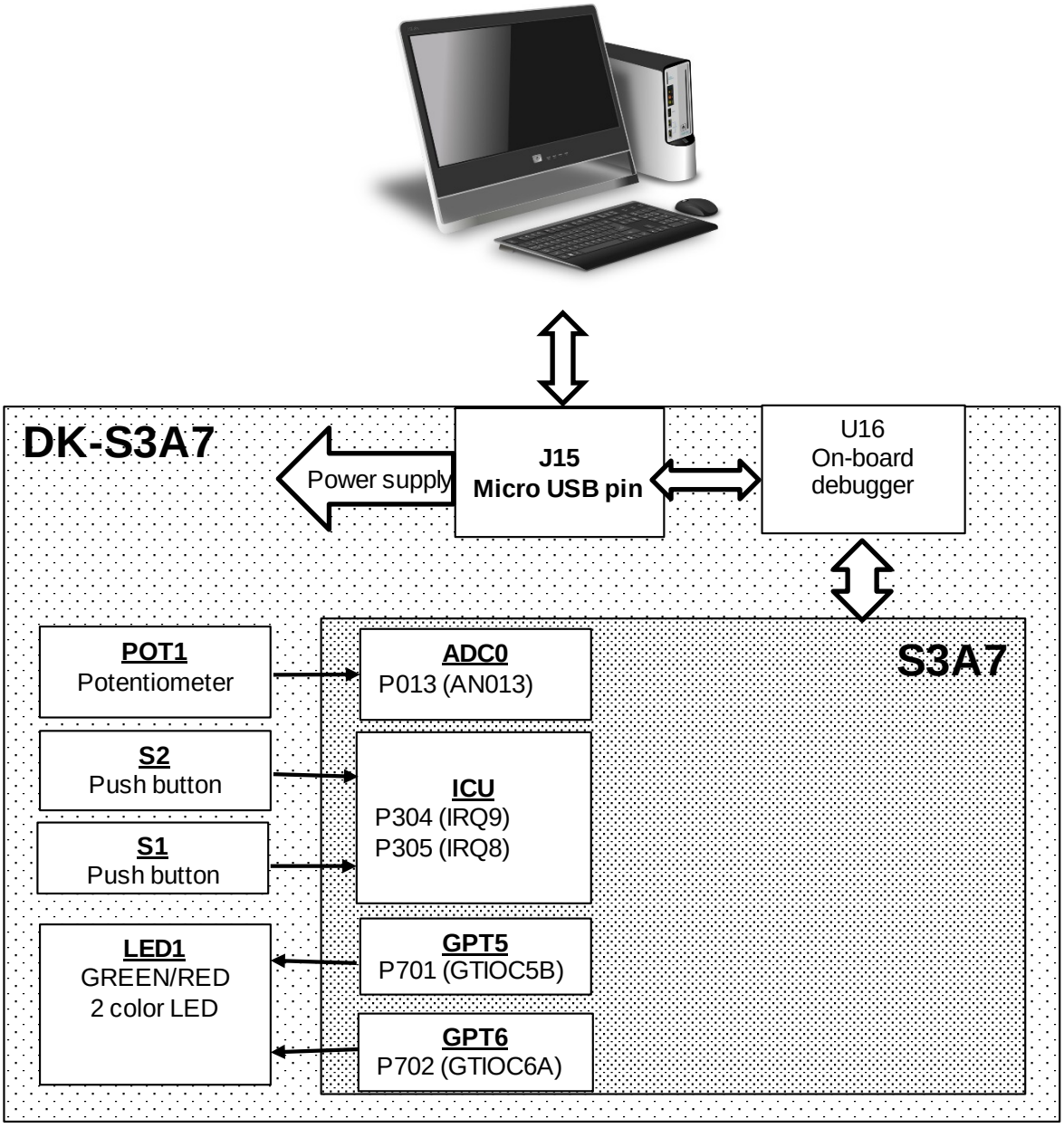

Figure 1. Block Diagram

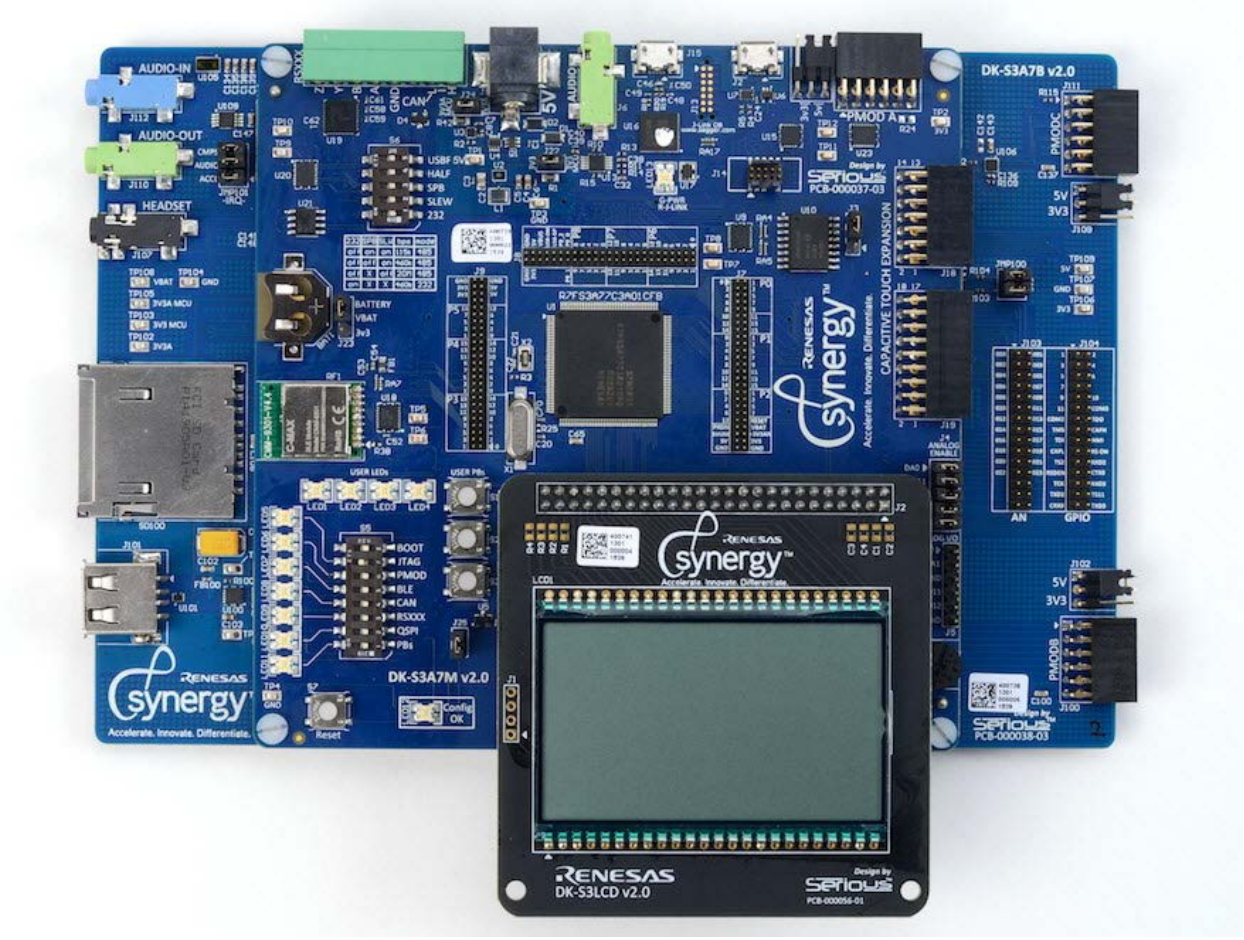

Figure 2. External View

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

Table 5. DK-S3A7 J4 Jumper Settings

No.	Name	Setting*1
J4-1	DA0	Disconnect
J4-2	DA1	Disconnect
J4-3	AN011	Disconnect
J4-4	AN012	Disconnect
J4-5	AN013	Connect

*1: Grayed out settings are arbitrary

2.2 Clock Settings

The clock settings in the ISDE Synergy Configuration for this application example are given in Table 6.

Table 6. Clock Settings

Clock	Frequency	Calculation Formula
XTAL	12 MHz	-
HOCO	24 MHz	-
LOCO	32768 Hz	-
MOCO	8 MHz	-
SUBCLK	32768 Hz	-
PLL	48 MHz	= XTAL ÷ 2 × 8
Clock Src	48 MHz	= PLL
ICLK	48 MHz	= Clock Src / 1
PCLKA	48 MHz	= Clock Src / 1
PCLKB	24 MHz	= Clock Src / 2
PCLKC	48 MHz	= Clock Src / 1
PCLKD	48 MHz	= Clock Src / 1
BCLK	24 MHz	= Clock Src / 2
EBCLK	12 MHz	= BCLK / 2
UCLK	48 MHz	= Clock Src
FCLK	24 MHz	= Clock Src / 2

2.3 Pin Settings

The pin settings in the ISDE Synergy Configuration for this application example are given in Table 7.

Table 7. Pin Settings

Category	Classification	Item	Setting Value
Ports	P3/P304	Mode	Input mode
		Pull up	None
		IRQ	IRQ9
	P3/P305	Mode	Input mode
		Pull up	None
		IRQ	IRQ9
Peripherals	Timer: GPT/GPT05	Pin Group Selection	Mixed
		Operation Mode	GTIOCA or GTIOCB
		GTIOCA	None
		GTIOCB	P701
	Timer: GPT/GPT06	Pin Group Selection	Mixed
		Operation Mode	GTIOCA or GTIOCB
		GTIOCA	P702
		GTIOCB	None
	Analog: ADC/ADC0	Operation Mode	Custom
		AN013	P013

3. Functional Specifications for LED Dimming Control

The details of the functionality for LED dimming control are:

- Brightness of LED1 that is mounted on the DK-S3A7 Synergy MCU Group board is controlled by PWM waveform output from a timer of the Synergy MCU.
- LED1 can emit two colors, green and red. The brightness of the two colors is individually adjustable.
- Brightness of the red light from LED1 is controlled by the potentiometer (POT1) on the DK-S3A7 MCU.
- Resistance of the potentiometer (POT1) is read by an AD convertor of the Synergy MCU. The timing for reading of the resistance is controlled by a periodic interrupt from a timer of the Synergy MCU.
- Brightness of the green light from LED1 is controlled by push switches (S1 and S2) on the DK-S3A7 board. S1 raises the brightness and S2 lowers the brightness.
- Pressing of push switches (S1 and S2) is detected by sending external interrupts to the Synergy MCU.

4. Software Configuration

In addition to the SSP, the software configuration of this application note consists of the four threads listed in Table 8. The relationship between the threads is shown in Figure 3.

Table 8. List of Threads

Symbol	Function	Source File
red_led_thread	Periodically measures the variable resistance (POT1), and changes the brightness of the red light from LED1 based on the measured value.	src\red_led_thread_entry.c
green_led_thread	Changes the brightness of the green light from LED1 in response to the notification from sw1_thread and sw2_thread.	src\green_led_thread_entry.c
sw1_thread	Detects 'S1-Pressed' and sends the 'S1-Pressed' notification to green_led_thread.	src\sw1_thread_entry.c
sw2_thread	Detects 'S2-Pressed' and sends the 'S2-Pressed' notification to green_led_thread.	src\sw2_thread_entry.c

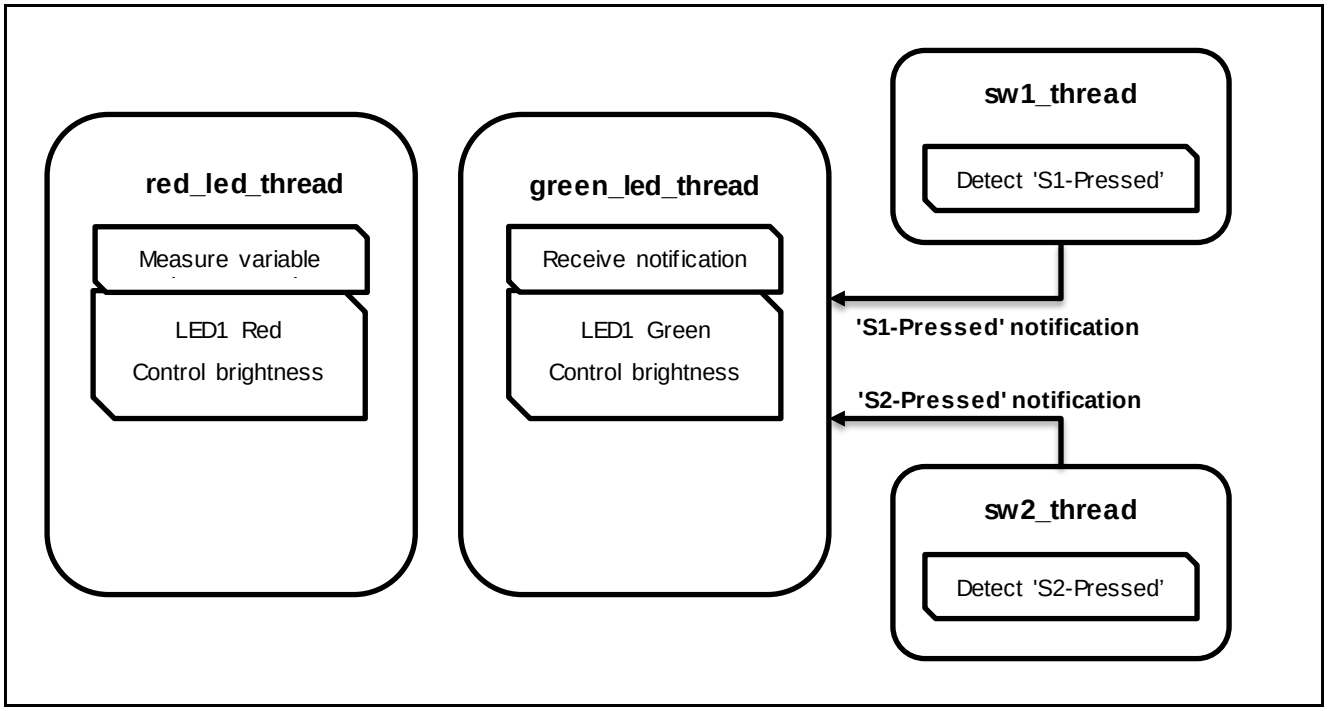

Figure 3. Thread Configuration

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	www.renesas.com/synergy/software
Synergy Software Package	www.renesas.com/synergy/ssp
Software add-ons	www.renesas.com/synergy/addons
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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Mar.18.16	—	Initial release
1.01	Jun.10.16	—	Support for SSP 1.1.0
1.10	Sep.21.17	—	Support for SSP 1.2.0
1.20	Mar.21.19	—	Support for SSP 1.4.0 and 1.5.0
		6	Changed “the green light from **LED2**” to “the green light from **LED1**”

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