

Renesas Synergy™ S124

R12AN0074EU0100

Rev.1.00

Sensor Panel Board User Guide

Nov 15, 2017

Introduction

This User guide describes about the Renesas Sensor Panel Board. In this Sensor Panel solution, Renesas Synergy™ S124 Microcontroller Group and Renesas RL78/G1D Bluetooth Low Energy (hereafter called BLE) are the highlighted Components. Using this Sensor Panel Board, developers can easily start to evaluate on Renesas Lighting solution, using RL78/G1D Bluetooth® wireless connectivity and Renesas Synergy™ S124 device including Temperature sensor, Light sensor and necessary user interface.

Target Device

R7FS124773A01CFM

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1. Overview

The Sensor Panel Board uses the Renesas Synergy™ S124, 32-MHz Arm® Cortex®-M0+ microcontroller with 256 KB of code flash, 24 KB of SRAM, and 4 KB of data flash. It has two push button switches, one reset button, and three LEDs for user interface; Bluetooth® RY7011 module and onboard micro-B USB for communication; and one PMOD™ connector for expansion. For interacting with surrounding environment, it also includes Temperature Sensor, Light sensor, passive infrared (PIR) sensor, Reed Switch (Tilt Switch) with two LED indicators, Hall Effect Switch, and two open drain outputs. There are a 5 volt center positive DC power connector (cylindrical male diameter 5.5mm) and the same micro-B USB connector from external power and has internal power supply provided by Li-ion Battery (Type: NCR18650BF or equivalent) with battery charger including 3.3 volt regulated output to provide onboard power. For development, the board has two Programming/Debugging contactors: standard 9-pin JTAG contactor for S124 device and 14-pin (2x7, 0.1 inch) connector for RY7011 module. Two 4-screw terminals are included for two general purpose switch inputs and two open drain output as well.

Figure 1 shows top and bottom view of the Sensor Panel Board.

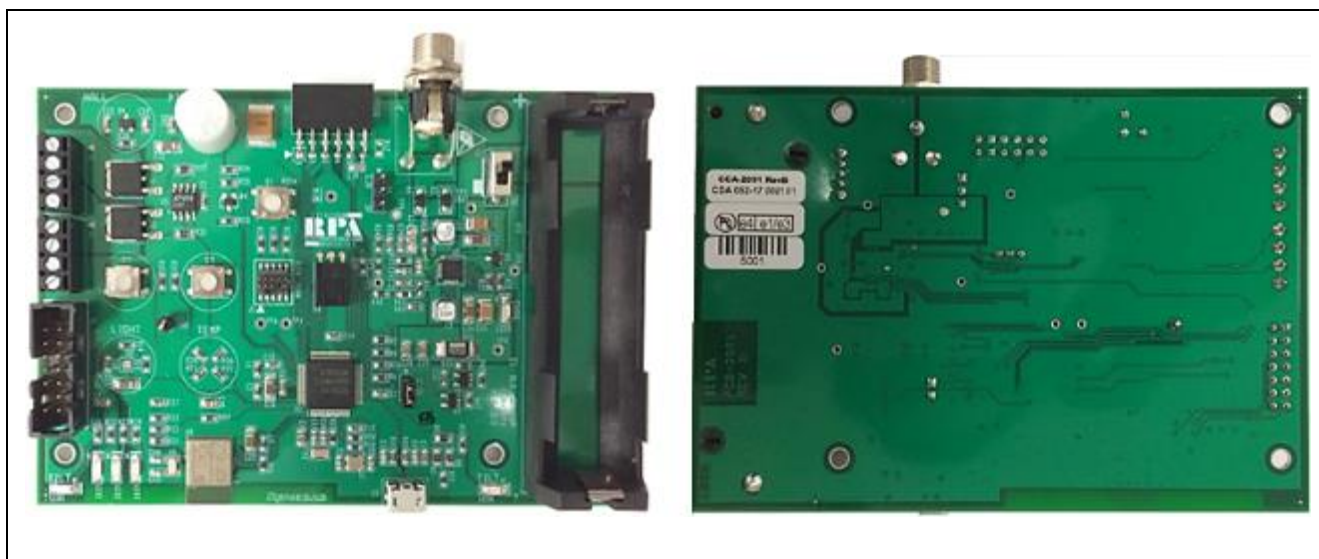


Figure 1 Sensor Panel Board

1.1 Specification Outline

The specification of Sensor Panel Board is described as below Table 1.

Table 1 Sensor Panel Board Specification

Item	Content
Dimension	3.25 inch x 4.725 inch
Mounting Hole Dimension	2.650 inch x 3.375 inch, Φ 1/8 inch
Operation Power Supply Voltage	5.0 V
Maximum Power Supply Current	100 mA
Operating Ambient Temperature/Humidity	0°C to +60°C, 10% to 80% RH (non condensing)

2. Sensor Panel System

Figure 2 shows the Sensor Panel System Block diagram. Typically the Sensor Panel board has five sections: Renesas Synergy™ S124 microcontroller (MCU), Bluetooth®, user input/output, Sensors, and regulated power supply with battery. Renesas Synergy™ S124 device is populated along with RL78/G1D BLE module (RY7011). Thus the acquisition of data from sensors are processed by S124 device and then transmitted through the Bluetooth® module RY7011. To connect with external device like thermostat, it has two digital inputs and two open drain outputs for controlling the device. In addition, there is one 12-pin PMOD™ connector so that you can utilize on adding more sensor like Accelerometer or LCD display. You can also monitors the environment parameter using board sensors like temperature, light, PIR, reed switch and Hall Effect switch. The Sensor Panel board is suitable to evaluate and develop various sensor applications with S124 device. Using slide switch (S5), the Sensor Panel board can be powered up with Li-ion battery or external power source.

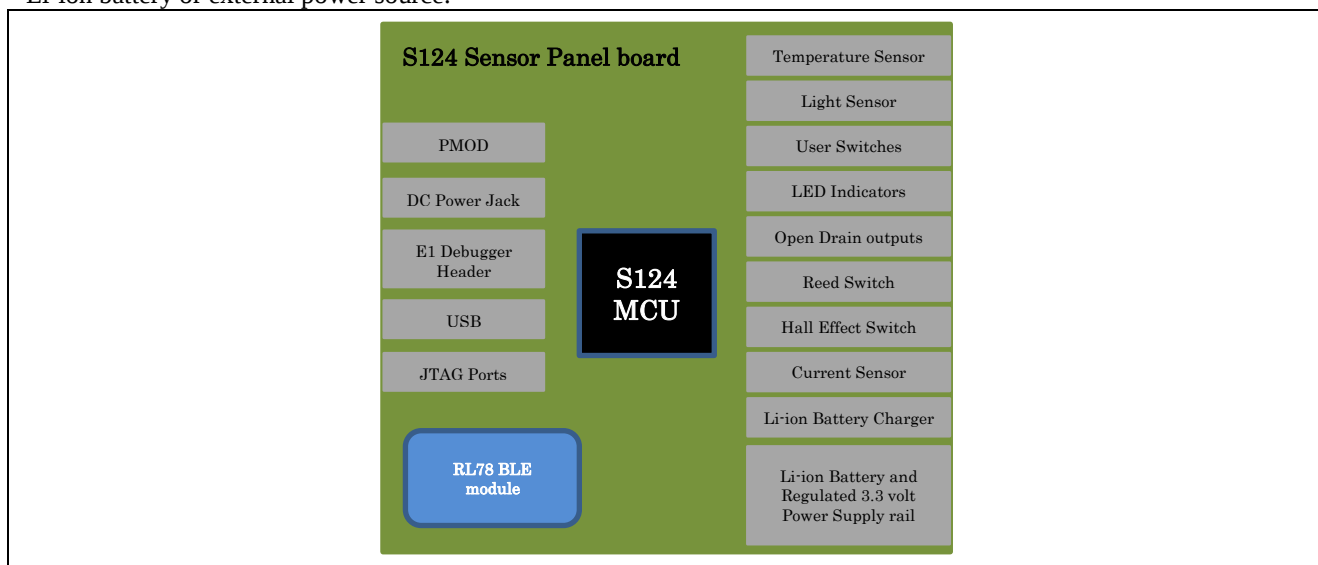


Figure 2 Renesas Synergy™ S124 Sensor Board System Block diagram

2.1 Renesas Synergy™ S124 device

This Sensor Panel board uses JTAG programming/debugging interface for S124 device. The JTAG signals can be used through JTAG connector (J1). Use the SEGGER J-Link for programming to the board and debugging for development. See detail in schematics sheet 2 of 6.

Table 2 JTAG

JTAG Description	Renesas Synergy™ S124 Microcontroller	
	Function Name	Pin
Test Mode Select	TMS/SWDIO	P108 (P1_8)
Test Clock	TCK/SWCLK	P300 (P3_0)
Test Data Out	TDO	P109 (P1_9)
Test Data In	TDI	P110 (P1_10)
Reset	RESET#	RESET#

To enable JTAG debug with S124 target on the Sensor Panel board, use with jumper JP1 for boot mode as below.

- Insert shunt jumper at JP1 SCI boot mode (serial programming mode).
- Remove shunt jumper at JP1 Normal boot mode.

2.2 RL78/G1D module (RY7011)

This RY7011 is a Bluetooth Low Energy module incorporated with the RL78/G1D device, 32-MHz crystal resonator for the RF section, and PCB antenna. This module has been certified on Japan's Radio Law, FCC certification, IC regulation, CE mark requirements, and the Bluetooth v4.1 specification. Thus it is suitable to use on Sensor Panel board yet low power consumption as below:

- RF transmission: 4.3 mA (TYP.)
- RF reception: 3.5 mA (TYP.)
- RF sleep (POWER_DOWN mode): 0.3 μA (TYP.)

3. Building Sample Project

3.1 Renesas Synergy™ S124 Firmware

This Sensor Panel board populates with Renesas Synergy™ S124 microcontroller to evaluate with onboard sensors. Thus, Sensor Panel board can be used as development platform. When using this Sensor Panel board, PMOD™ module can be added for extended feature through UART or CSI peripheral. For debugging and programming to S124 device, you can use JTAG connector (J1) with SEGGER J-Link debugger. For using S124 programmer/debugger tool and detail project development, refer Renesas website.

(Note: SEGGER J-Link download link: <https://www.segger.com/downloads/jlink>)

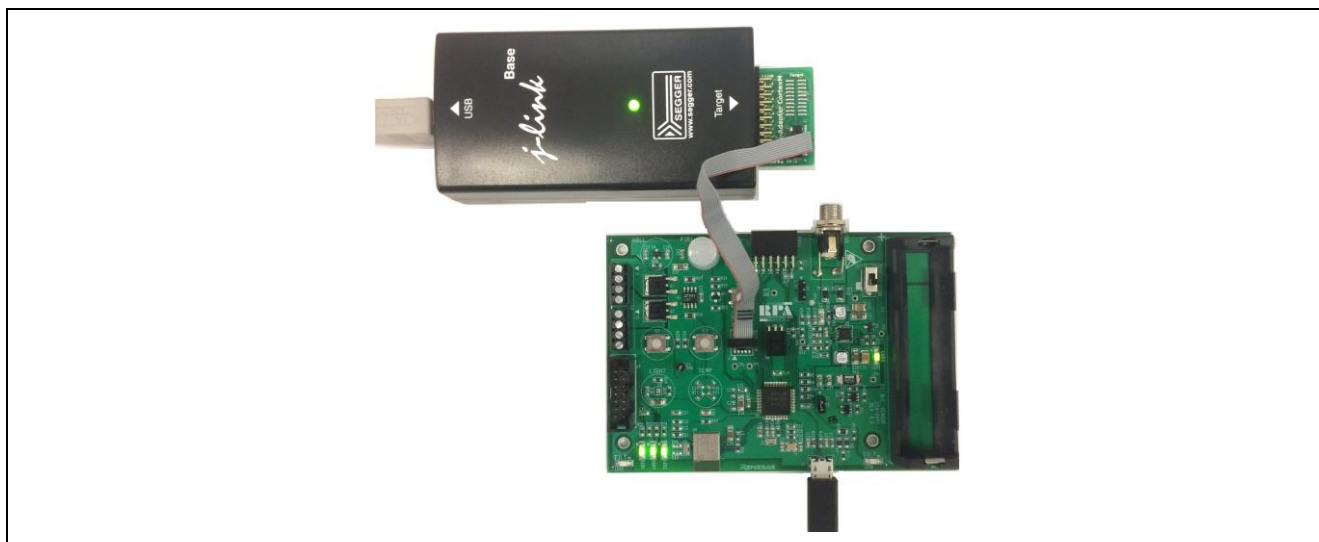
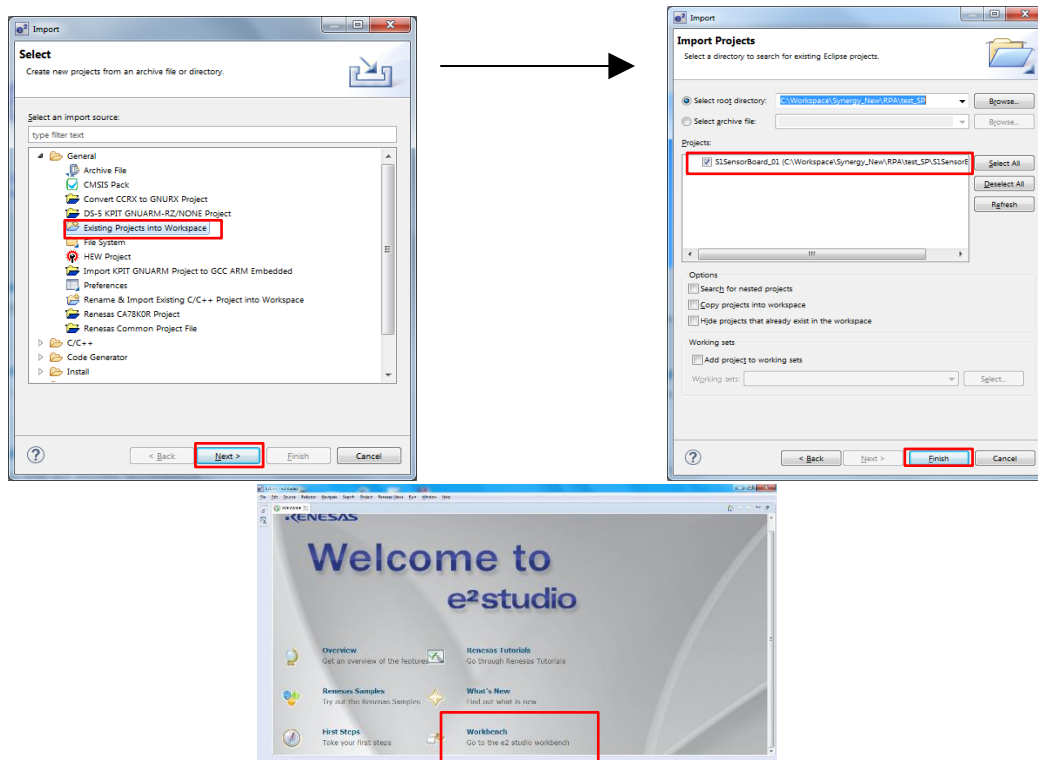


Figure 3 Renesas Synergy™ S124 Hardware Programming/Debugging setting

In order to build and debug the Renesas Synergy™ S124 firmware, you need e² studio version 5.3 or later and Renesas Synergy™ Software Package (SSP) 1.20. To begin debugging, import the project (**s1_Sensor_board_01**) from the following folder.

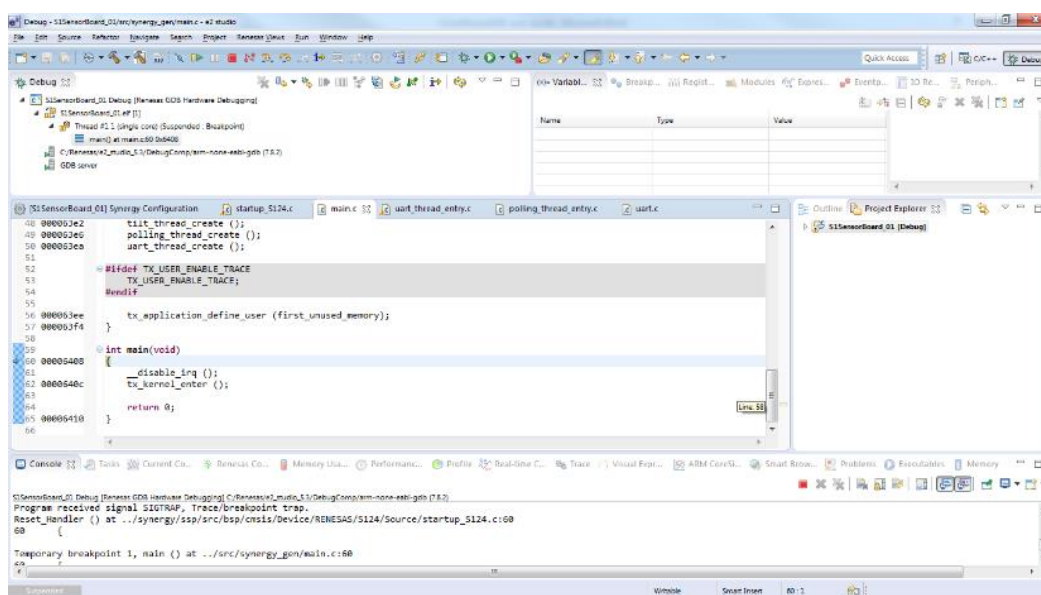
\\.\ Renesas_Sensor_Panel_Demo\ Synergy_project\S124.

Figure 4 e² studio Workspace environment Import Projects

3.1.1 Importing the Renesas Synergy™ Project in e² studio Workspace

To import the project into e² studio workspace, following the below step 1 to 5.

1. First, launch the e² studio workspace.
2. Select **Import** from the File pulldown menu.
3. Select **Existing Projects into Workspace** from General, and click **Next**.
4. Browse the projects folder, select the files, and click **Finish**.
5. Clicking **Workbench** in the Welcome screen opens the Workspace (see Figure 5) and selects **Build All** (to build all the projects) from Project pulldown menu.

Figure 5 e² studio Workspace environment

3.1.2 Debugging the Renesas Synergy™ Project in e² studio Workspace

1. To enable JTAG debug function on the S124 Sensor Panel board, do the following (see Figure 3).
The S124 Sensor Panel board uses JTAG as its programming/debugging interface. Insert shunt jumper at the JP1 location (ON position) on Sensor Panel Board.
 - A. Attach the J-Link connector (J1) to the SEGGER J-Link debugger unit.
 - B. Supply power to the Sensor Panel Board using provided battery or +5 VDC Power via USB micro-B (J2).
 Figure 3 shows the debug setting with SEGGER J-Link debugger.

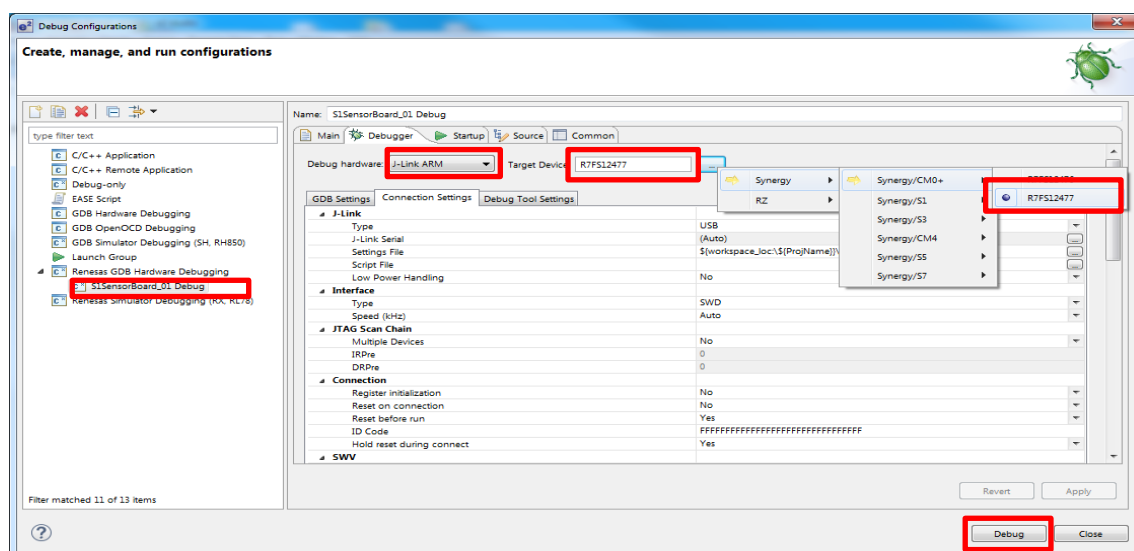


Figure 6 e² studio workspace debugging setup

2. Set the Debug configuration by selecting a project to debug.
 3. Figure 6 shows the Debug Configuration window.
 4. Select Debug Configuration from the Run pulldown menu.
 5. Right-click Renesas GDB hardware Debugging.
 6. Select New from the options menu to create a new debug launch.
 7. Select the **Debugger** tab (see Figure 6).
 8. Select Arm's **J-Link** for debug hardware and **R7FS12477** for Target Device.
 9. Click **Debug** to start debugging.
- Figure 7 shows the **Debug** window. Click **Resume** (F8) to run the program in Debug mode.

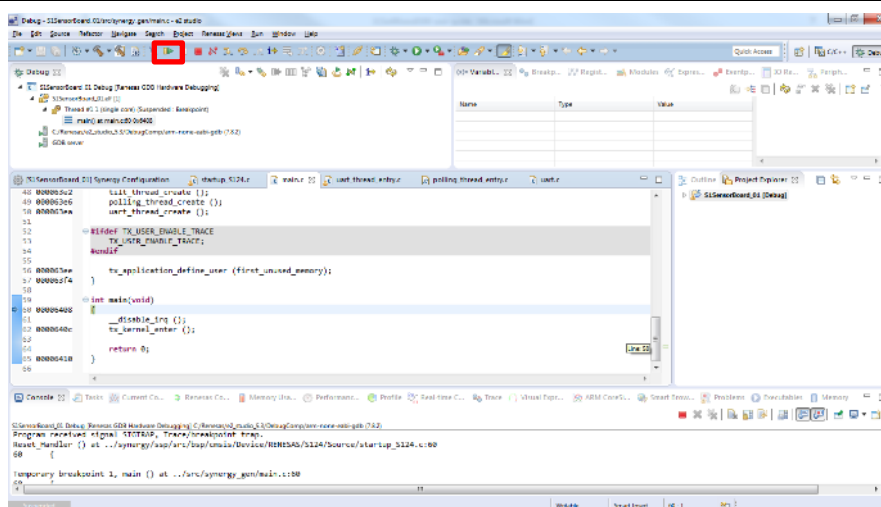


Figure 7 e² studio workspace in debugging mode for Renesas Synergy™ S124

3.2 Renesas RL78/G1D Firmware

This Sensor Panel board populates with Renesas Bluetooth® module, RY7011 that includes RL78/G1D device to evaluate for Bluetooth® communication. Thus, Sensor Panel board is suitable for developing a wireless communication platform.

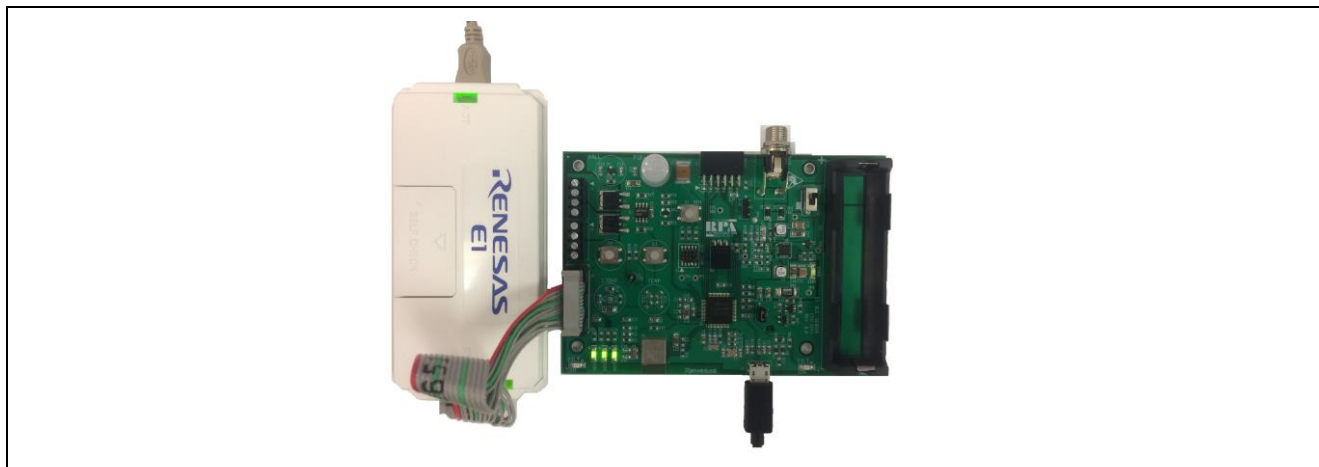


Figure 8 RL78/G1D device Hardware Programming/Debugging setting

To build the RL78/G1D beacon firmware, you need e² studio version 5.3 or later and the CCRL compiler v1.00.

3.2.1 Importing the RL78/G1D Project in e² studio Workspace

1. To begin debugging, import the project (R5F11AGJ_Beacon) from the following folder and follow the procedure in section 3.1.1.

\\.\Renesas_Sensor_Panel_Demo\RL_project\uart_beacon\

Figure 9 shows the project in the e² studio for Renesas Beacon firmware project.

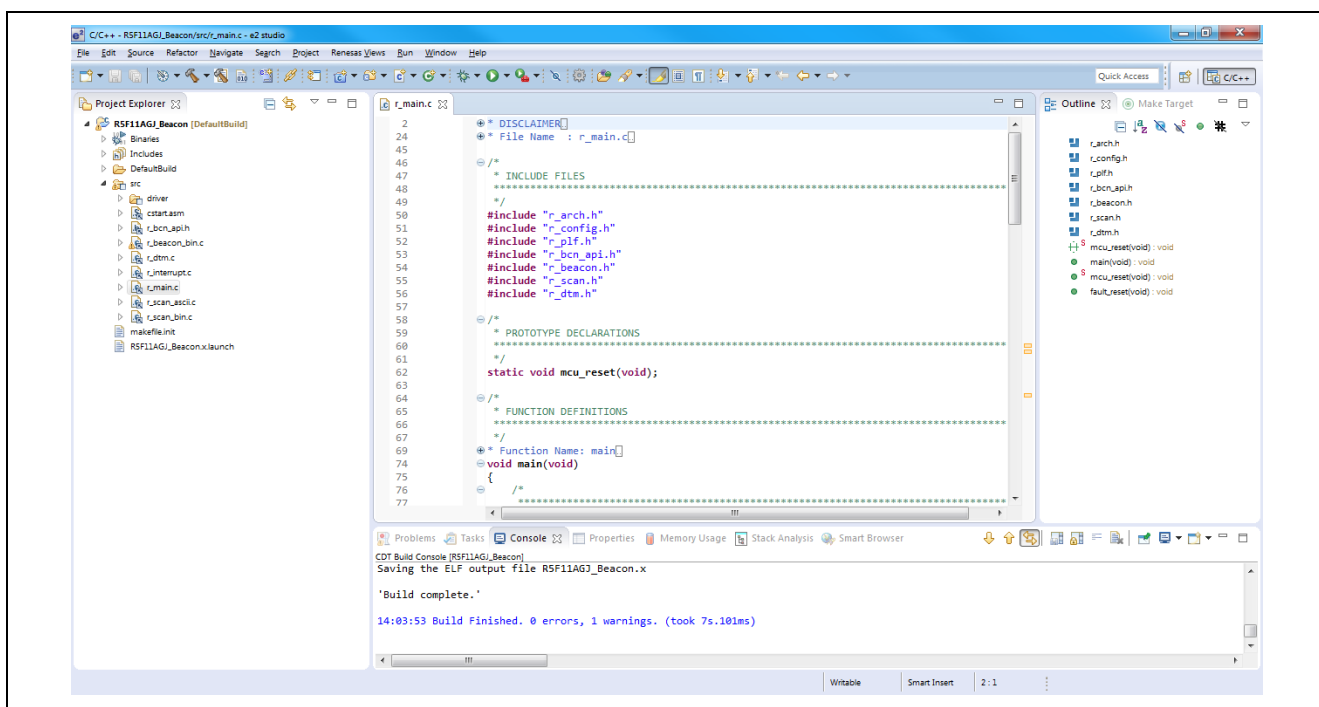


Figure 9 e² studio with RL78 / G1D firmware project

2. Select Rebuild All from the Project pulldown menu to build the project.
The binary image output (R5F11AGJ_Beacon.hex) is placed in the following folder.
\\.\Renesas_Sensor_Panel_Demo\RL_project\uart_beacon\Project_Source\application\project\e2_cc\BLE_Software\R5F11AGJ_Beacon

3.2.2 Debugging the RL78/G1D Project in e² studio Workspace

1. To enable debug function on Sensor Panel board for the RL78/G1D device, do the following (see Figure 10). The Sensor Panel board uses E1 as its programming/debugging interface.
 - A. Attach the 14-pin connector (J9) to the E1 debugger unit.
 - B. Supply power to the Sensor Panel Board using provided battery or +5 VDC Power via USB micro-B (J2). Figure 9 shows the debug setting with SEGGER J-Link debugger.

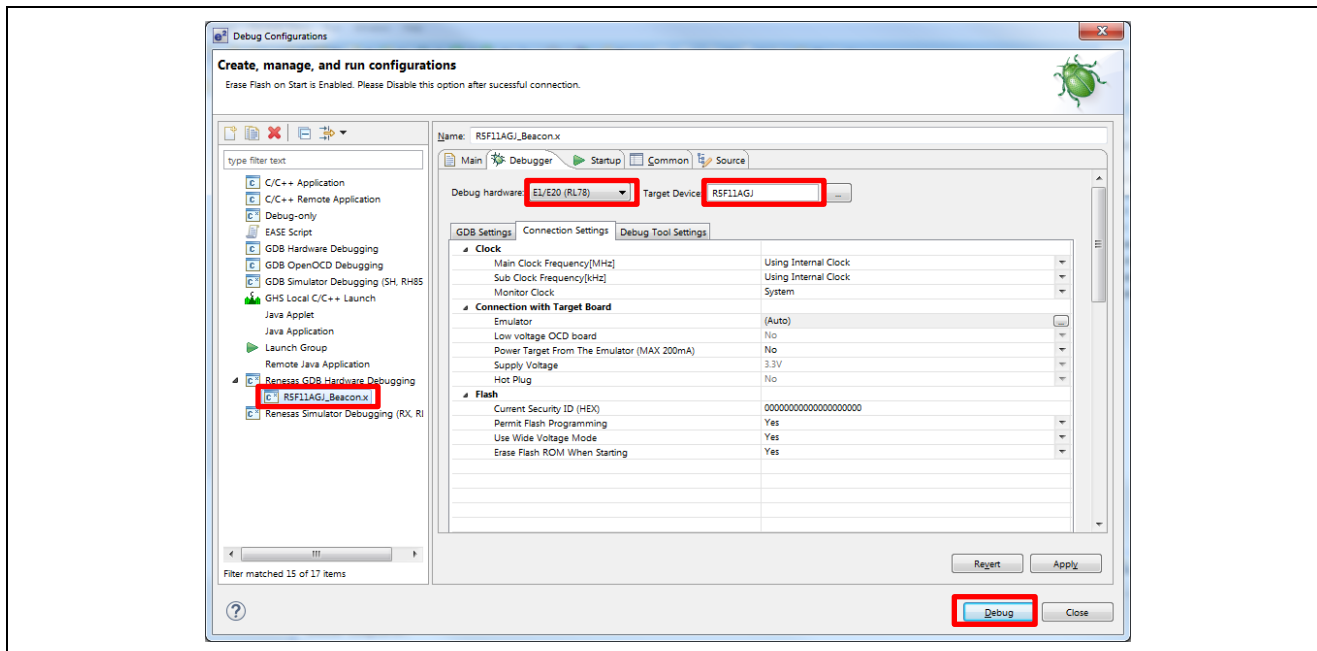


Figure 10 e² studio workspace in debugging mode for RL78/G1D

2. Set the Debug configuration by selecting a project to debug. Figure 10 shows the Debug Configuration window.
3. Select Debug Configuration from the Run pulldown menu.
4. Right-click Renesas GDB hardware Debugging.
5. Select New from the options menu to create a new debug launch.
6. Select the **Debugger** tab (see Figure 6).
7. Select **E1/E20(RL78)** for debug hardware and **R5F11AGJ** for Target Device.
8. Click **Debug** to start debugging.

Figure 11 shows the **Debug** window. Click **Resume** (F8) to run the program in Debug mode.

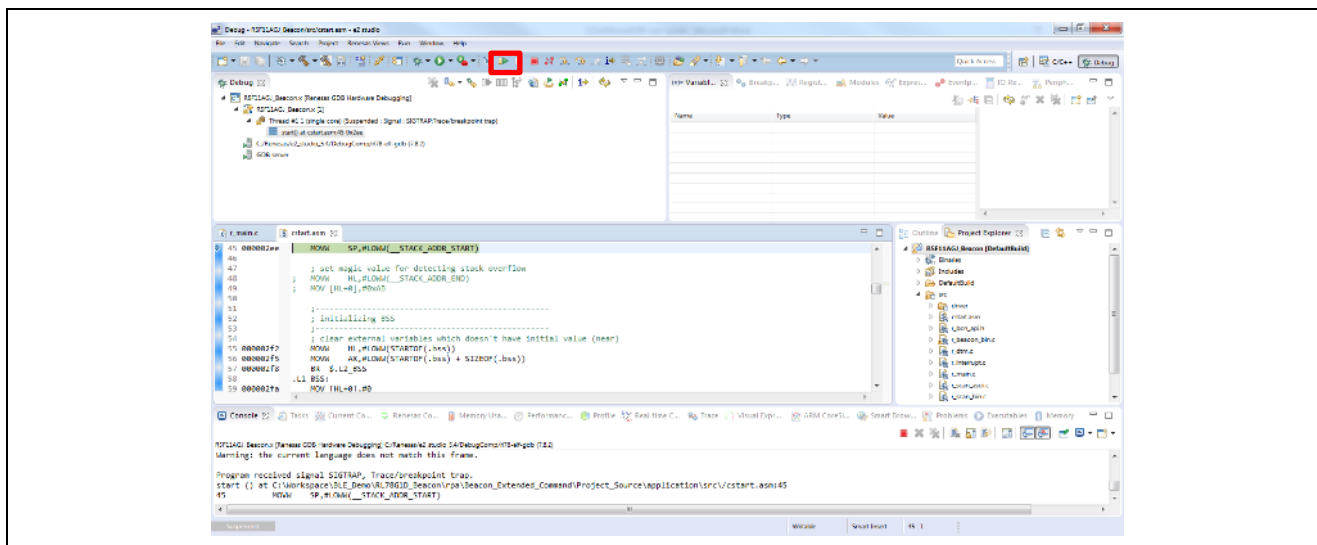


Figure 11 e² studio workspace in debugging mode for RL78/G1D

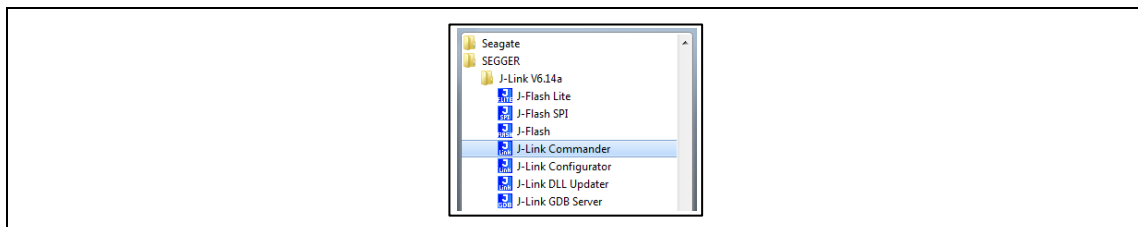
4. Programming to Sensor Panel

4.1 Renesas Synergy™ S124 device

Step 1. Attach the J-Link connector (J1) to the SEGGER J-Link debugger unit and attach PC USB connector via micro USB cable for power supply. See Figure 3.

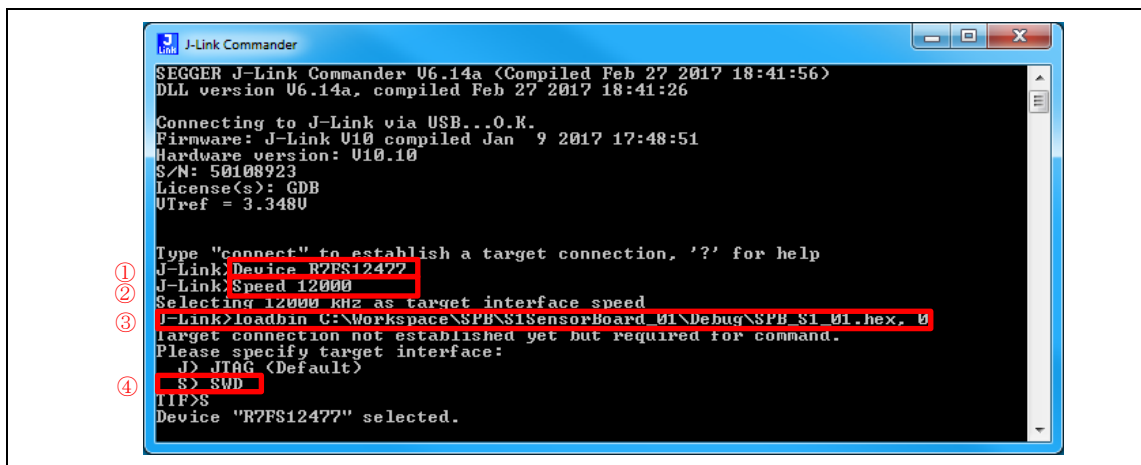
Note: Set up the Sensor Panel board with remove the shunt jumper at JP1 location.

Step 2. Open J-Link Commander from Start menu in All Programs, SEGGER folder.



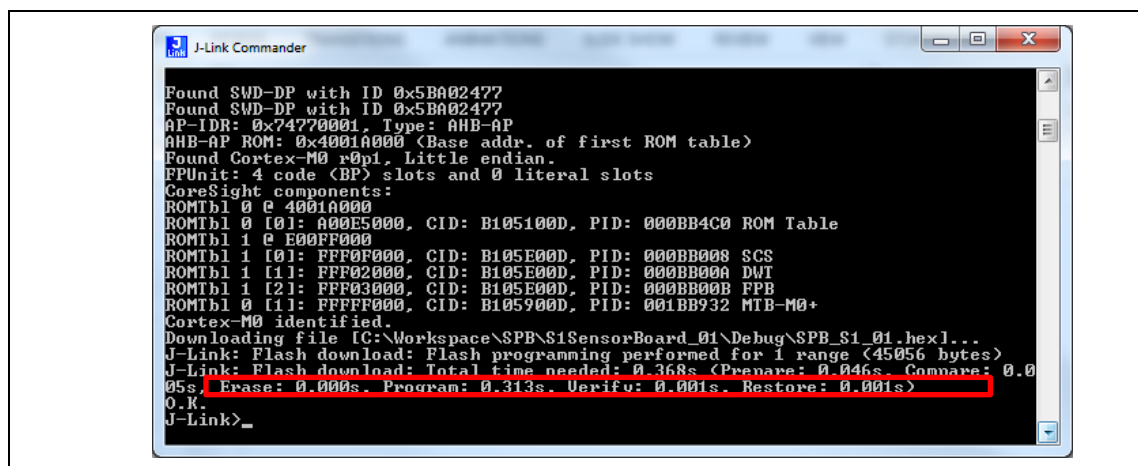
Step 3. Enter the below commands to program target device.

1. Device R7FS12477
2. Speed 12000
3. loadbin C:\...\ROM_File\file_name.hex, 0
4. S



Step 4. Note: This Healthcare Meters Kit includes following Hex files for respective modules

- a. The S7G2 Starter Kit (scanner) : Security_Panel_S7.hex
- b. The S124 Sensor Panel (beacon): Security_Panel_S124.hex



Step 5. After programming, disconnect the board from the PC to evaluate.

4.2 RL78/G1D module (RY7011)

To program the RL78/G1D Bluetooth®, you use the E1 programmer and perform the following steps:

- Step 1.** Connect the Renesas E1 programmer/Debugger to connector J9 on the Sensor Panel board. See Figure 8 for connection.
- Step 2.** To program RL78/G1D Beacon project output (R5F11AGJ_Beacon_SPB.hex), launch the Renesas Flash Programmer (RFP). See Figure 12 for applicable screens.
- Step 3.** Create a new project. Select the RL78 device and set the power supply to 3.3 Volts. Click OK.
- Step 4.** Select the Operation tab to load the program file (R5F11AGJ_Beacon_SPB.hex).
- Step 5.** Click Start to begin to program.

For details on RFP usage, refer to [R20UT3841E](#).

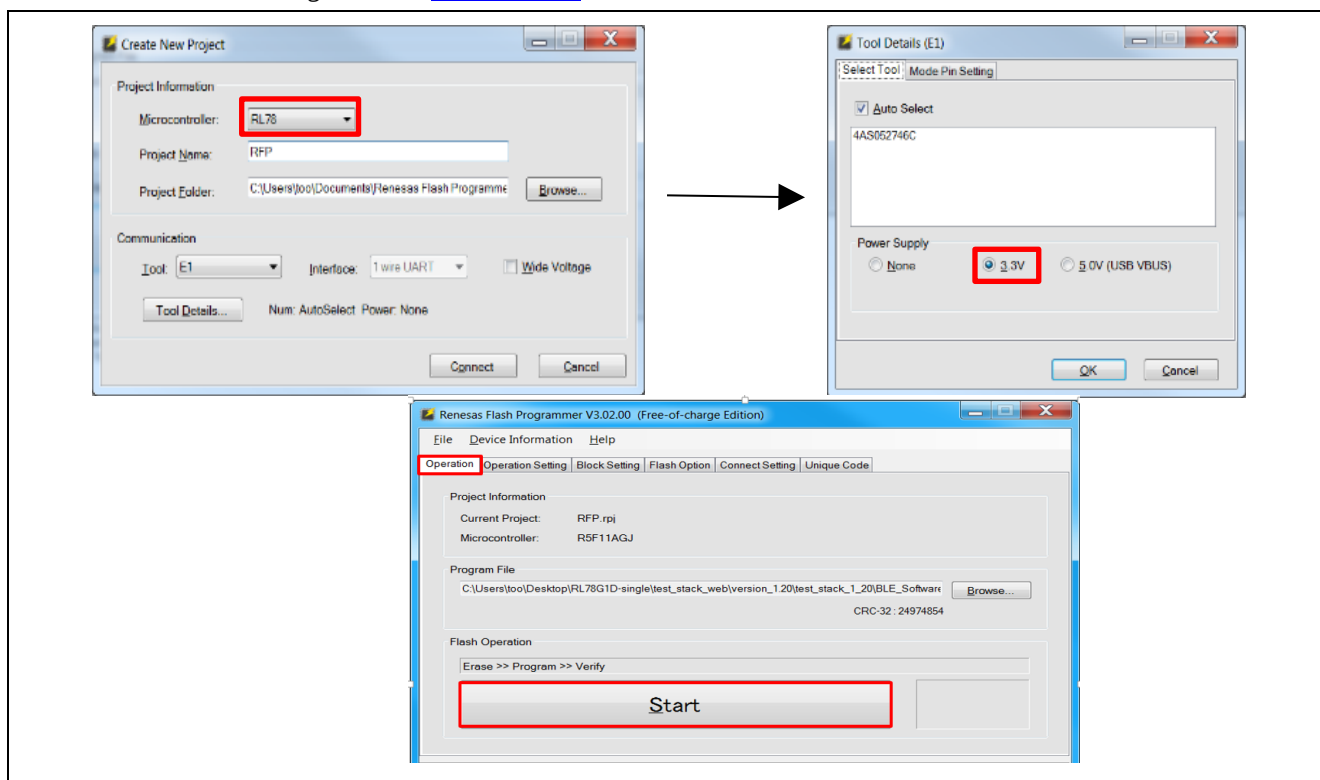


Figure 12 Renesas Flash Programmer

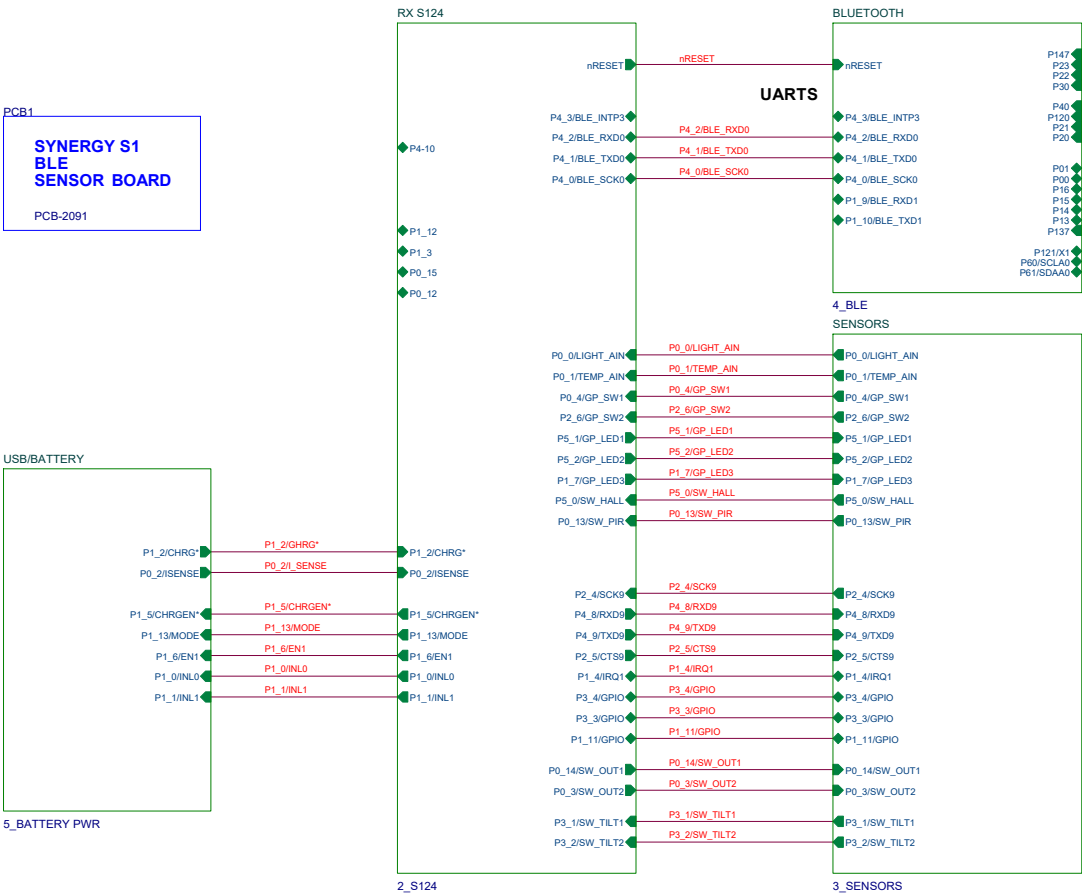
5. Circuit Diagram

This section shows the Sensor Panel board schematics in total 6 sheets and RL78/G1D Module (RM-110-RFB-2) schematics in total one sheet.

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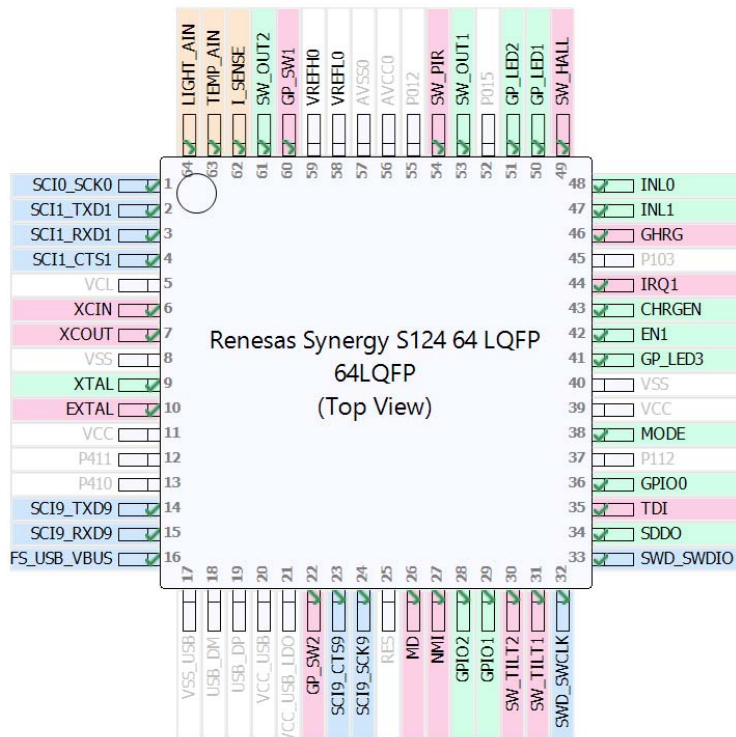
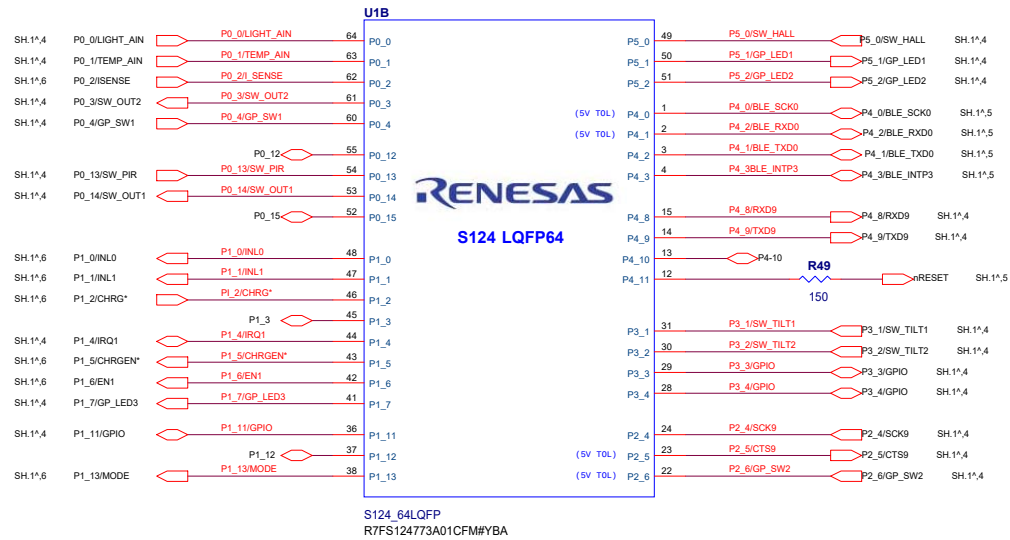
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PORT	FUNCTION	SIGNAL
P0_0	AN000	P0_0/LIGHT_AIN
P0_1	AN001	P0_1/TEMP_AIN
P0_2	INPUT	P0_2/I_SENSE
P0_3	OUTPUT	P0_3/SW_OUT2
P0_4	INPUT	P0_4/GP_SW1
P0_10	-	-
P0_11	-	-
P0_12	-	-
P0_13	INPUT	P0_13/SW_PIR
P0_14	OUTPUT	P0_14/SW_OUT1
P0_15	-	-

PORT	FUNCTION	SIGNAL
P1_0	OUTPUT	P1_0/INL0
P1_1	OUTPUT	P1_1/INL1
P1_2	INPUT	PI_2/GHRG*
P1_3	-	-
P1_4	IRQ1	P1_4/IRQ1
P1_5	OUTPUT	P1_5/CHRGEN*
P1_6	OUTPUT	P1_6/EN1
P1_7	OUTPUT	P1_7/GP_LED3
P1_11	OUTPUT	P1_11/GPIO
P1_12	-	-
P1_13	OUTPUT	P1_13/MODE

PORT	FUNCTION	SIGNAL
P2_4	SCK9	P2_4/SCK9
P2_5	CTS9	P2_5/CTS9
P2_6	INPUT	P2_6/GP_SW2

PORT	FUNCTION	SIGNAL
P3_1	INPUT	P3_1/SW_TILT1
P3_2	INPUT	P3_2/SW_TILT2
P3_3	OUTPUT	P3_3/GPIO
P3_4	OUTPUT	P3_4/GPIO

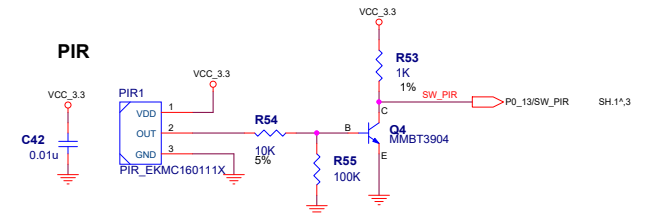
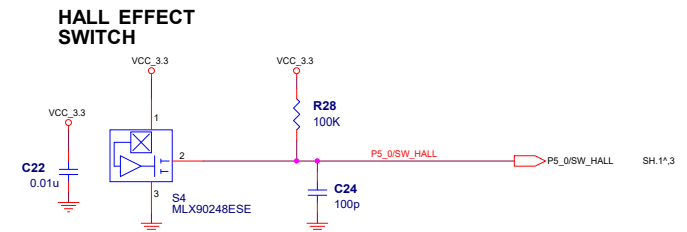
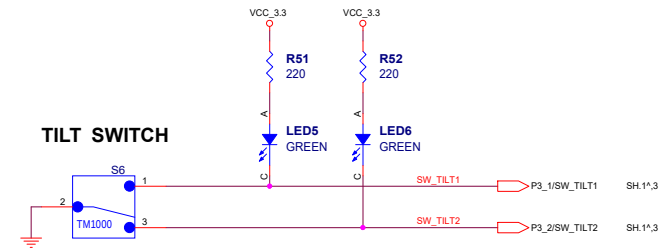
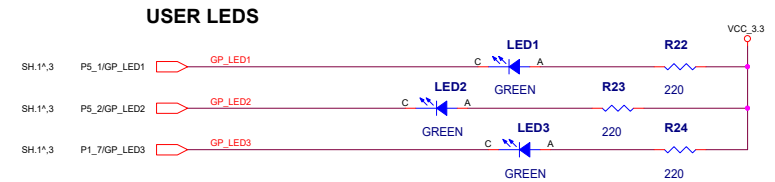
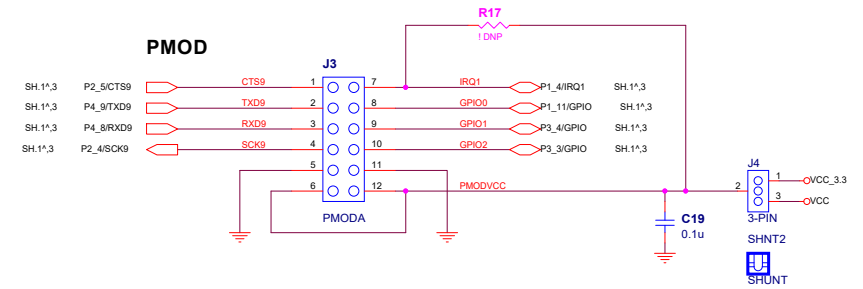
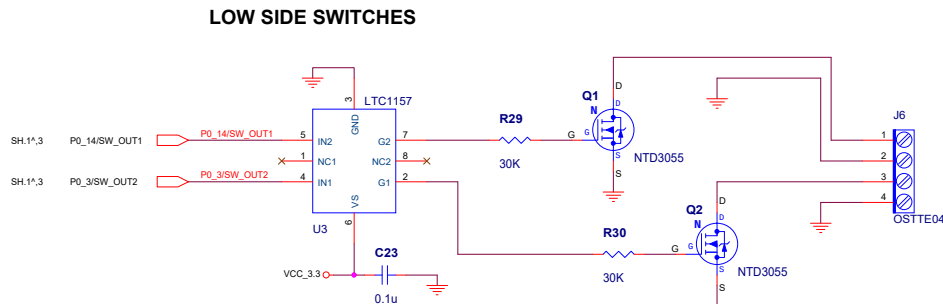
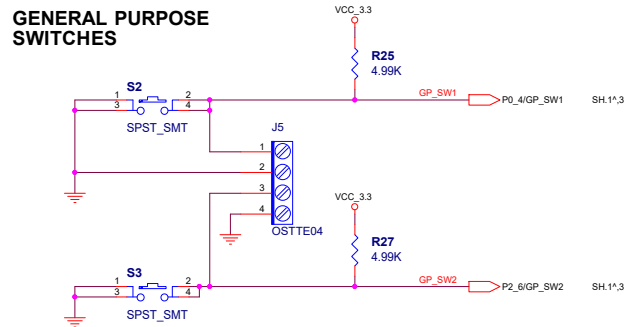
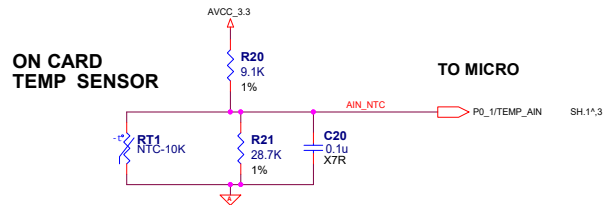
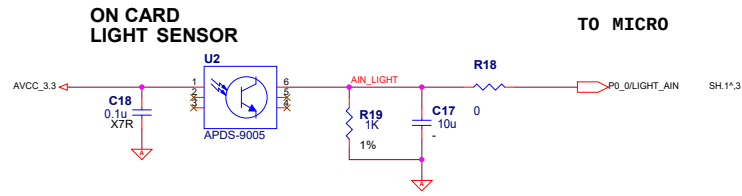
PORT	FUNCTION	SIGNAL
P4_0	SCK1_B	P4_0/BLE_SCK0
P4_1	TXD1_B	P4_2/BLE_RXD0
P4_2	RXD1_B	P4_1/BLE_TXD0
P4_3	-	-
P4_8	RXD9	P4_8/RXD9
P4_9	TXD9	P4_9/TXD9
P4_10	-	-
P4_11	-	-

PORT	FUNCTION	SIGNAL
P5_0	INPUT	P5_0/SW_HALL
P5_1	OUTPUT	P5_1/GP_LED1
P5_2	OUTPUT	P5_2/GP_LED2

CORE INTERFACE

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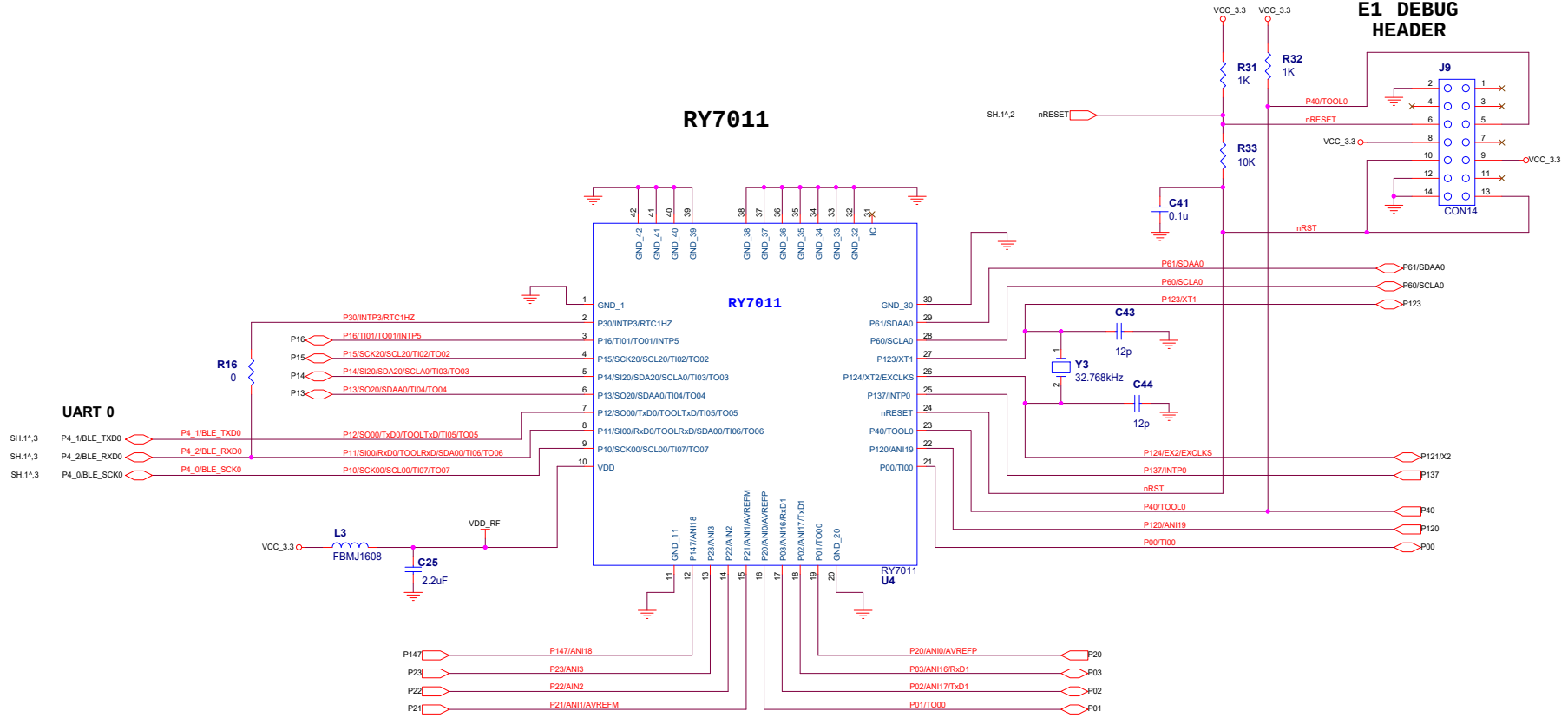
SENSORS

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RY7011

**E1 DEBUG
HEADER**

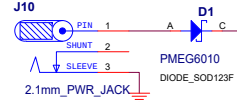


RENESAS BLUETOOTH MODULE

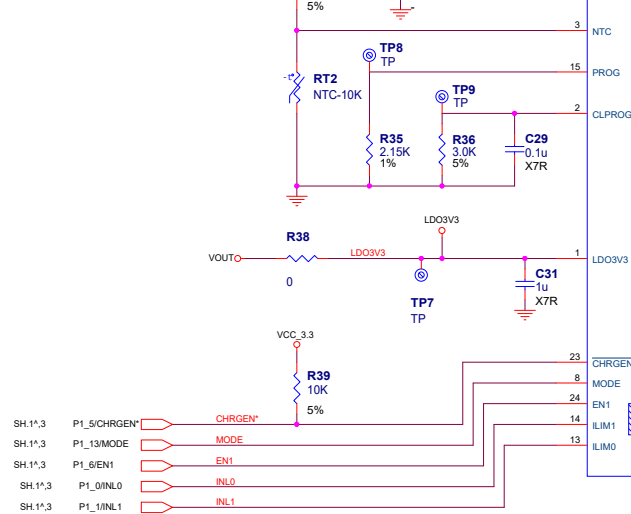
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EXT +5V SUPPLY



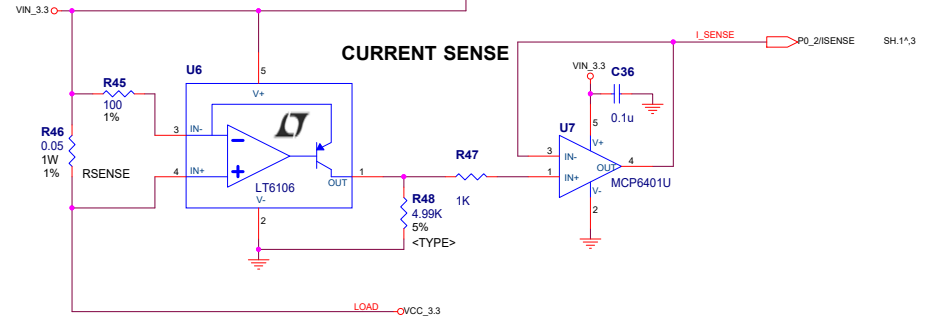
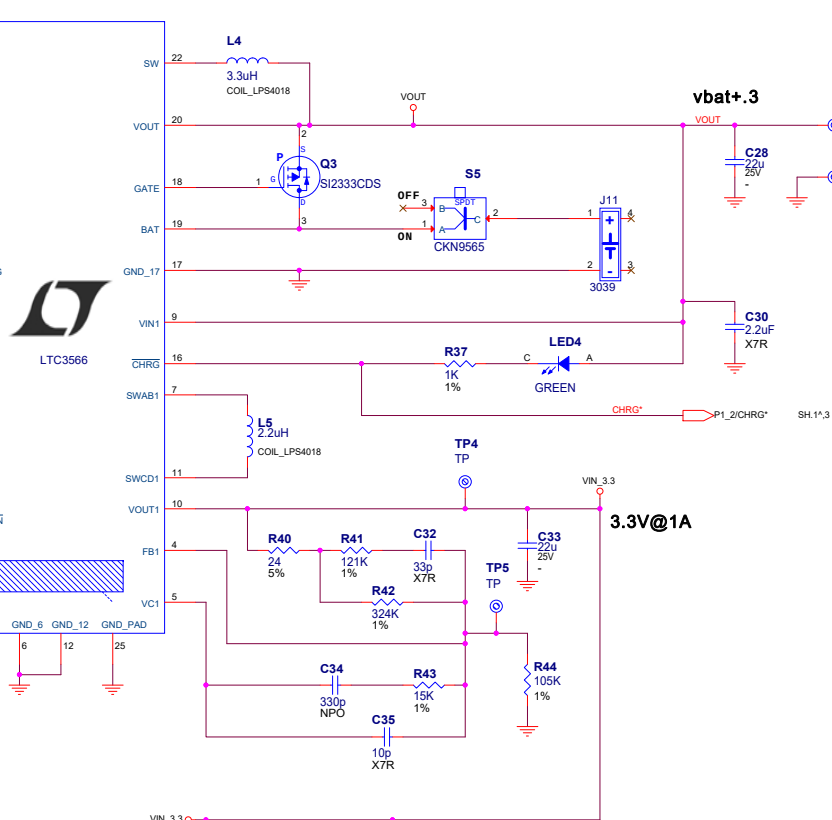
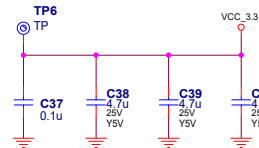
USB



SH.1*,3	P1_5/CHRGEN	CHRGEN*
SH.1*,3	P1_13/MODE	MODE
SH.1*,3	P1_8/EN1	EN1
SH.1*,3	P1_0/INL0	INL0
SH.1*,3	P1_1/INL1	INL1

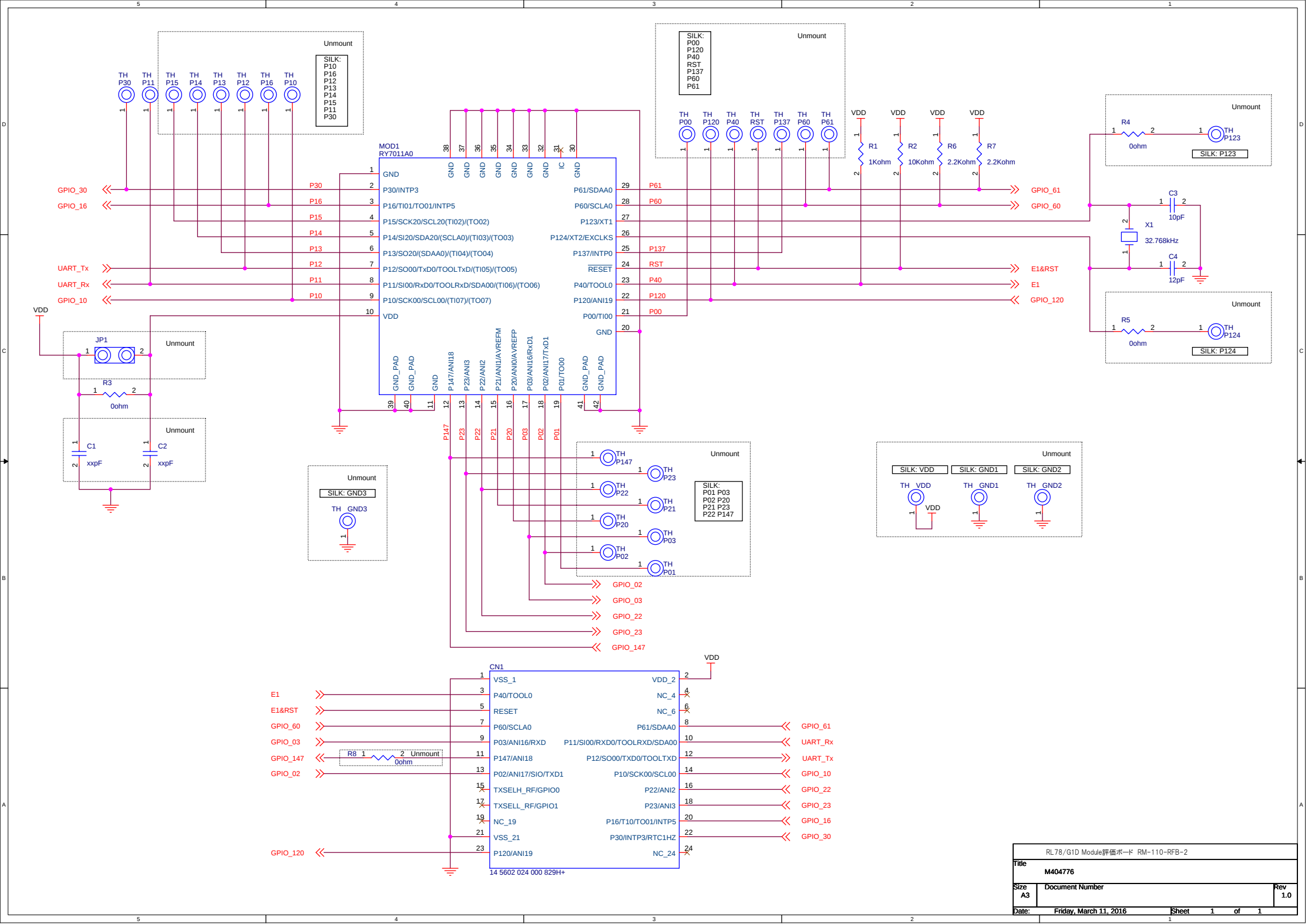
INPUT CURRENT LIMIT SETTINGS

ILIM1	ILIM0	CURRENT LIMIT
0	0	100mA (1X)
0	1	1A (10X)
1	0	SUSPEND (500uA)
1	1	500mA (5X)



3.3V PWR

THIS DOCUMENT CONTAINS SECTIONS WHICH ARE CONSIDERED CONFIDENTIAL AND PROPRIETARY TO			
SYNERGY S1 BLE SENSOR BOARD			
SIZE	CAGE CODE	DWG NO	REV
C	5D7K6	SCH-2091	B0
SCALE	NONE	DATE	1/3/17
SHEET	6	OF	6



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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Nov 15, 2017	–	Initial Release

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

- The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

The state of the product is undefined at the moment when power is supplied.

- The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

- When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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