

AS064-1-SMRTAFRREFZ

Smart Air Freshener

Introduction

This guide describes the AS064-1 Smart Air Freshener (AS064-1-SMRTAFRREFZ) hardware and how it employs Bluetooth Low Energy (BLE) for seamless connectivity with mobile devices. It features a compact design housing a scent dispenser and a BLE module. Users control it via a dedicated mobile app, enabling remote scent customization and scheduling. Energy-efficient DA14531MOD BLE technology enables extended battery life while automatic firmware updates ensure continuous performance enhancements. The AS064-1 Smart Air Freshener provides a convenient and customizable solution for maintaining a fresh and inviting atmosphere in homes or commercial spaces.

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1. Overview

The AS064-1 Smart Air Freshener uses a DA14531MOD Bluetooth Low Energy (BLE) Module that integrates modern technology to enhance user experience and efficiency. The system consists of a scent dispenser, BLE module and a control unit. The scent dispenser releases fragrance at set intervals or based on user input.

The BLE module enables wireless communication with smartphones or other BLE-enabled devices, allowing users to control and customize the air freshener via a dedicated app. Users can set schedules, adjust fragrance intensity, and receive notifications for low fragrance levels or battery status. The app may also provide data on usage patterns and air quality.

BLE provides real-time data such as battery percentage, scheduled fragrance release, ensuring efficient use of the scent. The BLE Module processes user commands, managing the operation of the dispenser. Power is typically supplied by batteries, ensuring portability. The compact design and integration with smart home systems enhance convenience, making the smart air freshener a modern solution for maintaining a pleasant indoor environment.

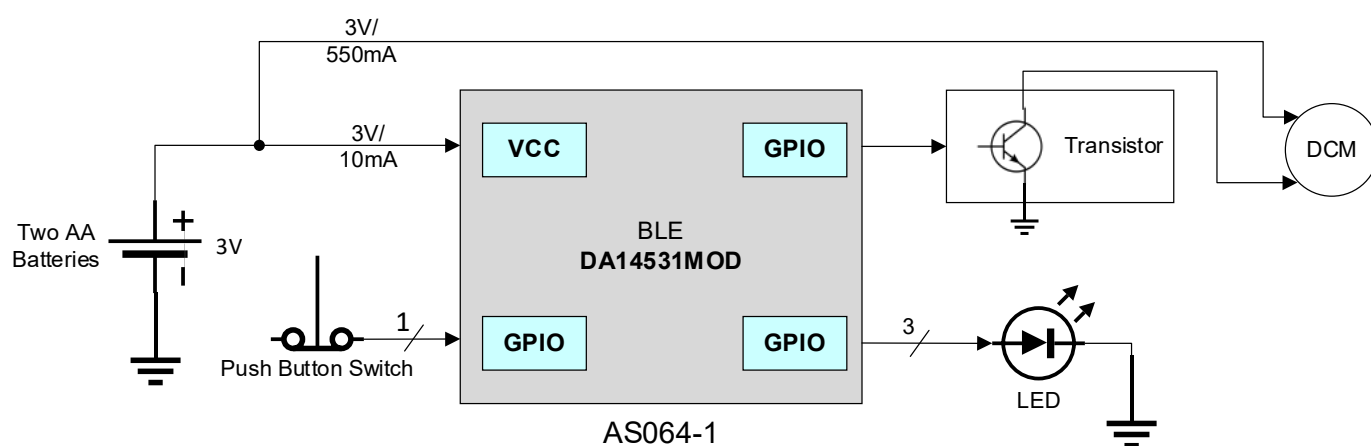


Figure 1. AS064-1 Smart Air Freshener Block Diagram

2. AS064-1 Smart Air Freshener Hardware

The BLE Smart Air Freshener module integrates several key hardware components to ensure functionality, connectivity, and user control. The module's essential hardware components are:

1. **BLE Module:** The DA14531 SmartBond TINY™ Module is the Bluetooth® Low Energy (BLE) solution. The DA14531 SmartBond TINY™ Module, based on a very small and low power Bluetooth 5.1 system-on-chip (SoC), incorporates the DA14531 SoC advantages to an integrated module.
2. **Control Interface – Buttons/Switches:** For manual control and setting adjustments, switches are provided to switch the device ON/OFF and to change the spray duration.
3. **LED Indicators:** Display the duration of the spray. Three LEDs are provided to indicate the spray duration, (in other words, 10 minutes, 20 minutes and 40 minutes).

The circuit starts with the battery compartment supplying power to the entire unit. The DA14531MOD is powered at 3V from two AA batteries. The BLE module regulates this power and directs it to the necessary components. The BLE module is programmed with a timing algorithm and RTC setup. It keeps track of the set intervals (for example, 10, 20, 40 minutes) and triggers the motor to activate the spray mechanism at these intervals. This timing can be set using external switches or buttons connected to the BLE or using the BLE Mobile Application. When the MCU sends a signal to the motor, it turns on for a short duration. This motor is connected to an actuator which is designed to press down on the aerosol can's nozzle, releasing a burst of fragrance. The LED indicates different statuses.

2.1 MCU and Motor Drive Schematics

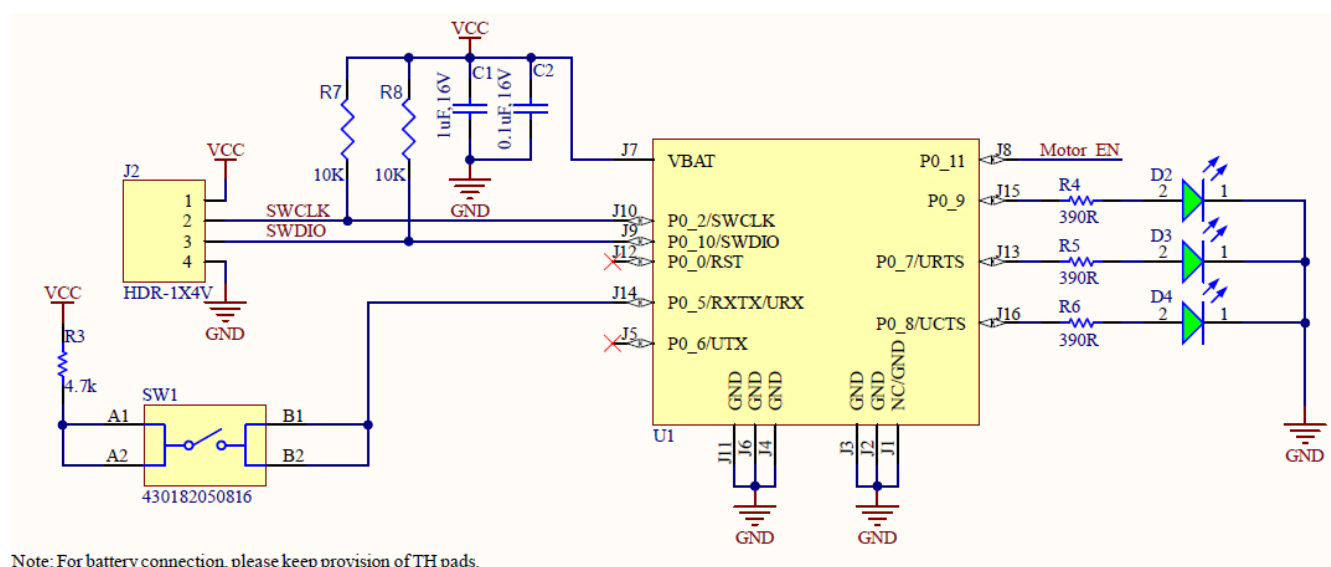


Figure 2. MCU Section Schematic

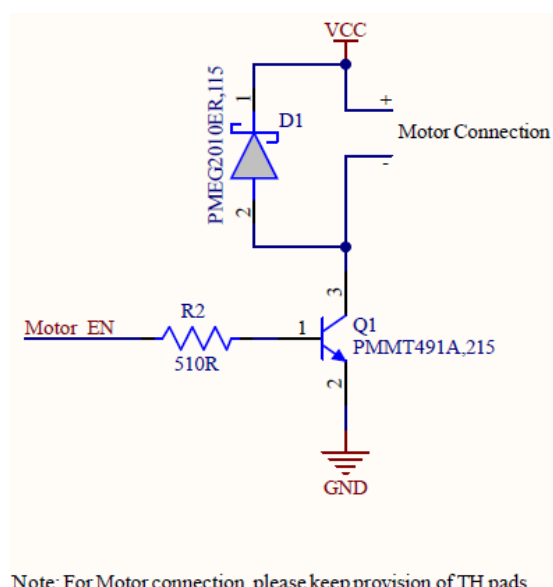


Figure 3. Motor Drive Section Schematic

3. Board Design



Figure 4. AS064-1-SMRTAFR_REFZ Board Image 3.1

Board Schematic

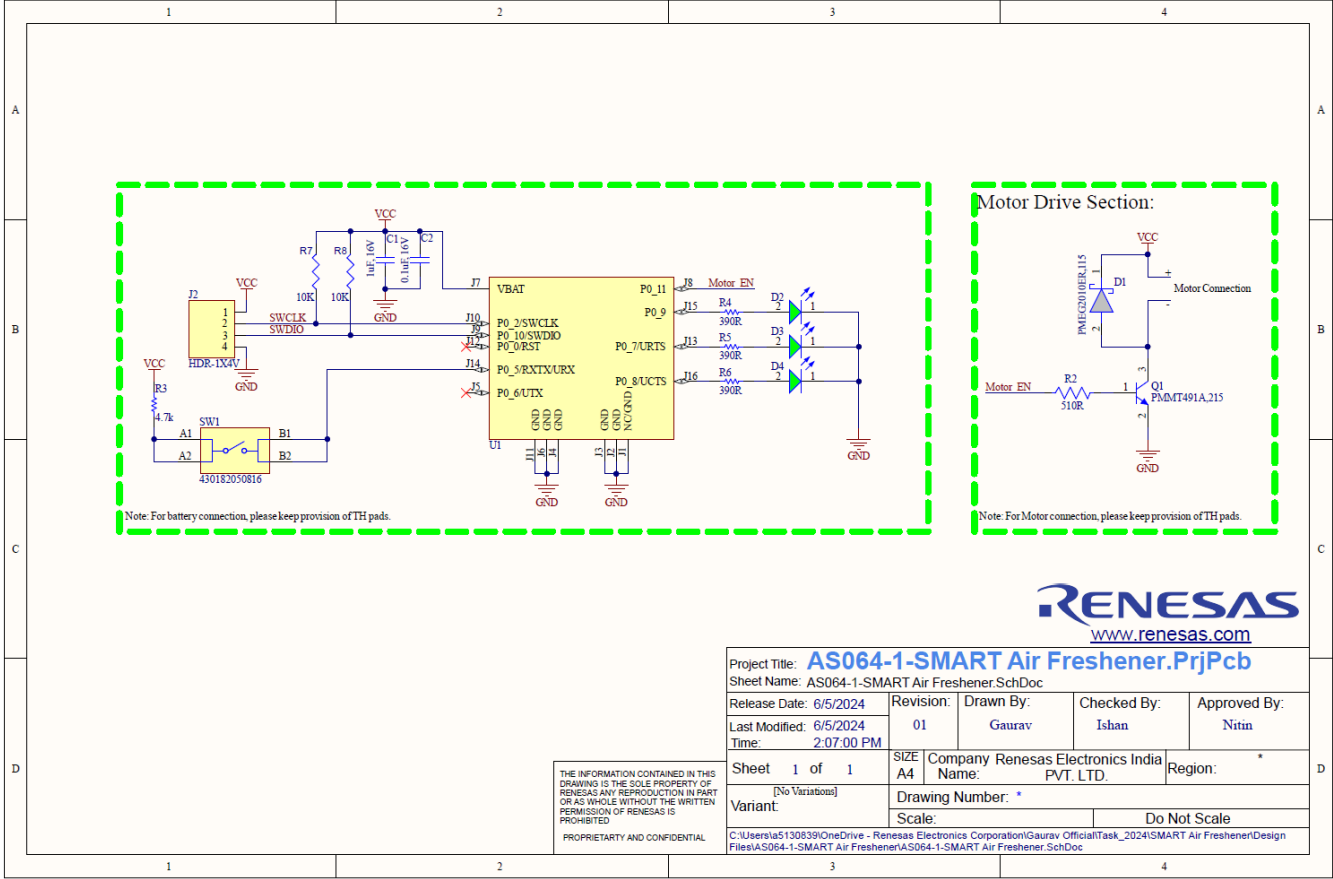


Figure 5. AS064-1-SMRTAFR_REFZ Board Schematic

3.2 Bill-of-Materials (BOM)

Table 1. AS064-1-Smart Air Freshener Bill-of-Materials (BOM)

Qty	Designator	Description	Manufacturer	Manufacturer Part #
1	C1	Capacitor, 1 μ F Multilayer Ceramic MLCC 16V, X7R Dielectric 0603 Surface Mount	Würth Electronics	885012206052
1	C2	0.1 μ F $\pm$ 10% 16V Ceramic Capacitor X7R 0603 (1608 Metric)	Würth Electronics	885012206046
1	D1	Rectifier Diode, Schottky, 1 Phase, 1 Element, 20V V(RRM), Silicon	Nexperia	PMEG2010ER,115
3	D2, D3, D4	Green 570nm LED Indication – Discrete 2V 0805 (2012 Metric)	Würth Electronics	150080VS75000
1	J2	Header, 1 $\times$ 4, 0.1"	Würth Elektronik	61300411121
1	Q1	Small Signal Bipolar Transistor, 1A I(C), 40V V(BR)CEO, 1-Element, NPN, Silicon, TO-236AB	Nexperia	PMMT491A,215
1	R2	510 Ω $\pm$ 1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Moisture Resistant Thick Film	Yageo	RC0603FR-07510RL
1	R3	Chip Resistor, 4.7k Ω , $\pm$ 1%, 0.1 W, -55 to 155 °C, 0603 (1608 Metric)	YAGEO	RC0603FR-134K7L
3	R4, R5, R6	General Purpose Chip Resistor, 390 Ω , $\pm$ 1%, -55 to 155 °C, 0603 (1608 Metric), RoHS, Tape and Reel	Yageo	RC0603FR-07390RL
0	R7, R8	Chip Resistor, 10k Ω , $\pm$ 1%, 01 W, -55 to 155 °C, 0603 (1608 Metric)	YAGEO	RC0603FR-0710KL
1	SW1	Tactile Switch SPST-NO Top Actuated Surface Mount	Würth Electronics	430182050816
1	U1	DA14531MOD, Bluetooth Low Energy 5.1 Module, SM	Renesas Electronics	DA14531MOD-00F01002

3.3 Board Layout

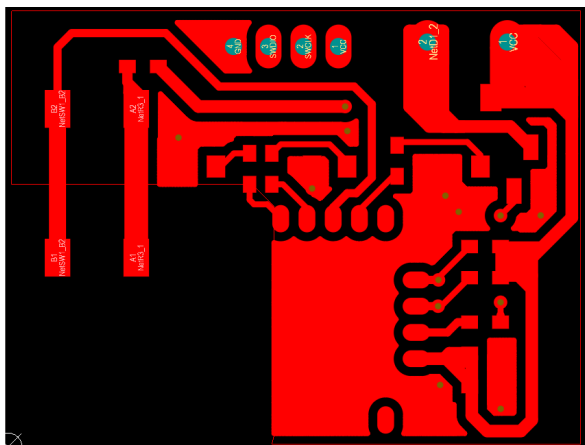


Figure 6. Top Layer

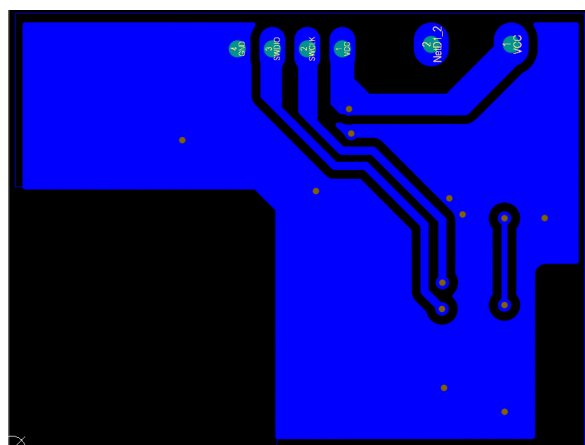


Figure 7. Bottom Layer

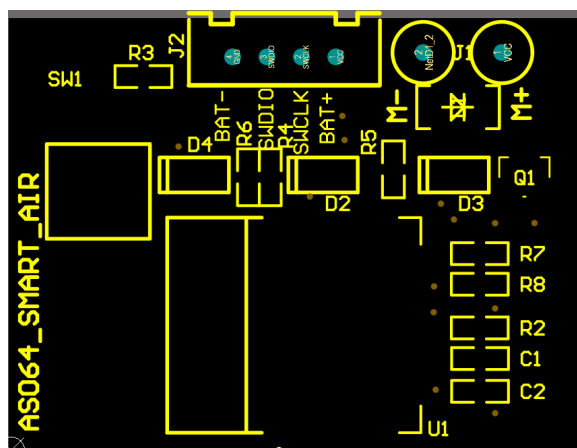


Figure 8. Top Silkscreen Overlay

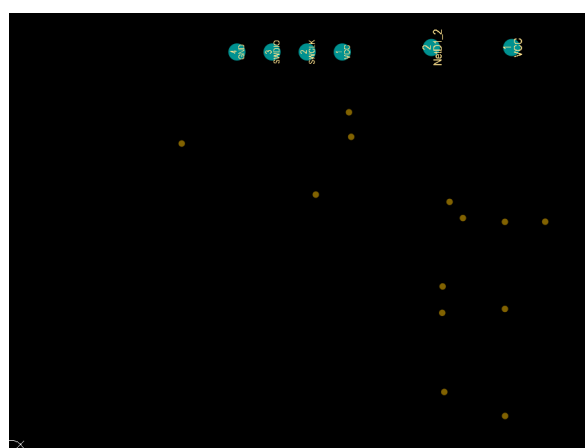


Figure 9. Bottom Silkscreen Overlay

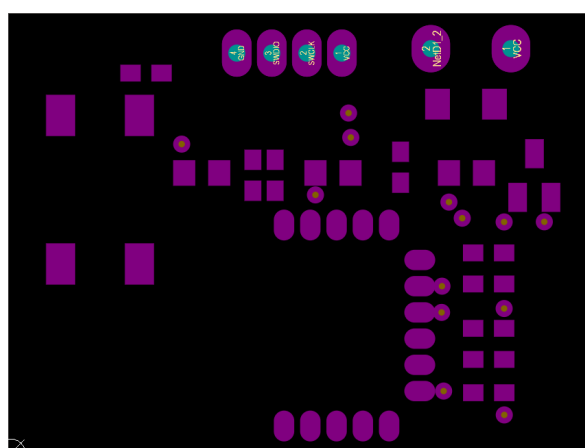


Figure 10. Top Solder Mask

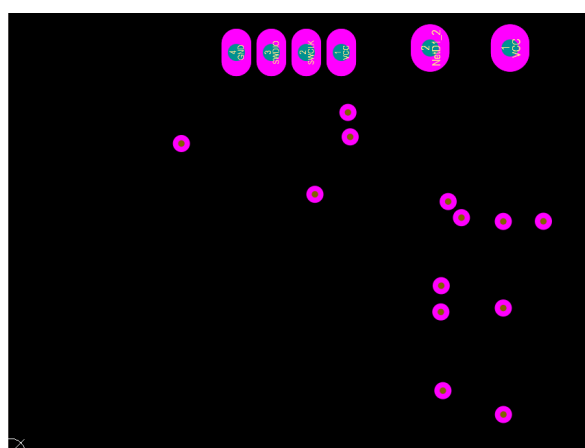


Figure 11. Bottom Solder Mask

4. AS064-1 Smart Air Freshener Software

4.1 Specifications

Table 2. Peripheral Functions and Usage

Peripheral Function	Use
P07	LED output
P08	LED output
P09	LED output
P05	Switch input
P011	Output for motor control

4.2 Switch States

Table 3 shows the switch configurations for different modes.

Table 3. Switch States

Switch State	Use
Single-Press on Switch	10-minute Mode D3 LED
Second Press	20-minute Mode D2 LED
Third Press	40-minute Mode D4 LED
Fourth Press	OFF Mode

4.3 Algorithm Flowchart

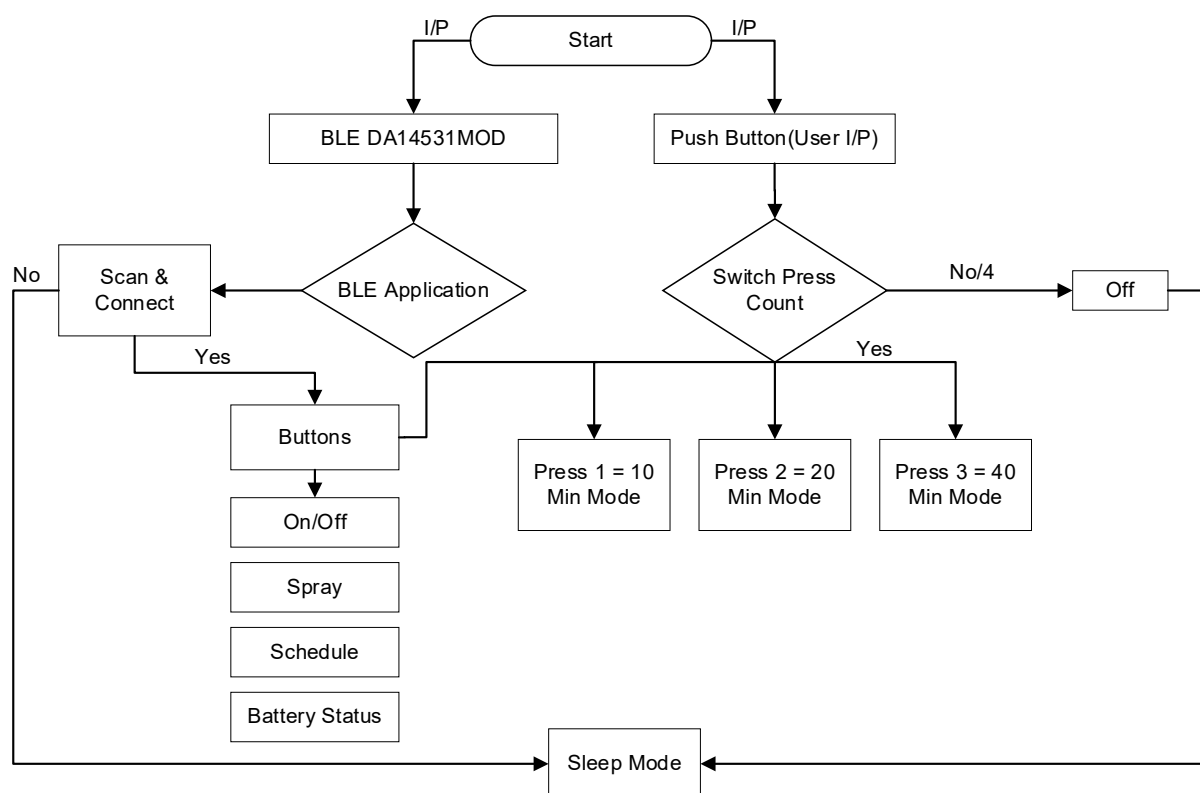


Figure 12. Algorithm Flowchart

4.4 Software Overview

4.4.1 Debugging using Keil V5

1. DA14531MOD can be coded using Keil μ Vision v5.39 with SDK version SDK_6.0.22.1401. For this project, `ble_app_peripheral` example has been used to locate SDK_6.0.22.1401.

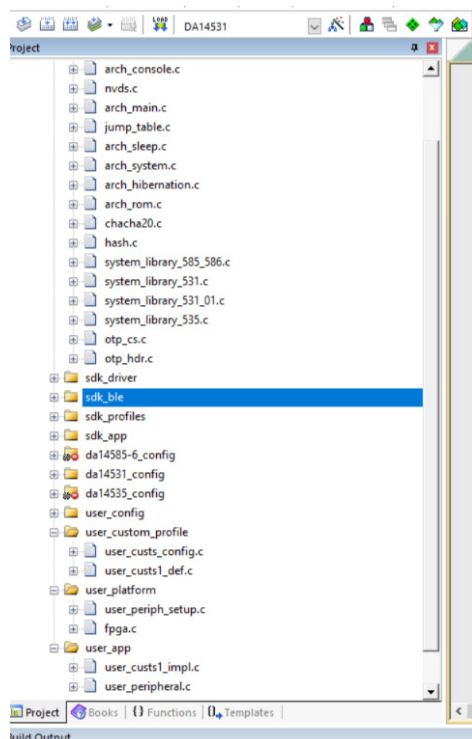


Figure 13. Keil .uvprojx File in the Project

2. When the project opens, click on the build icon (see Figure 14, item 1) or press F7 to build the project. Once the build is successful, click on the eye icon (see Figure 14, item 2) or press F5 to download the project.

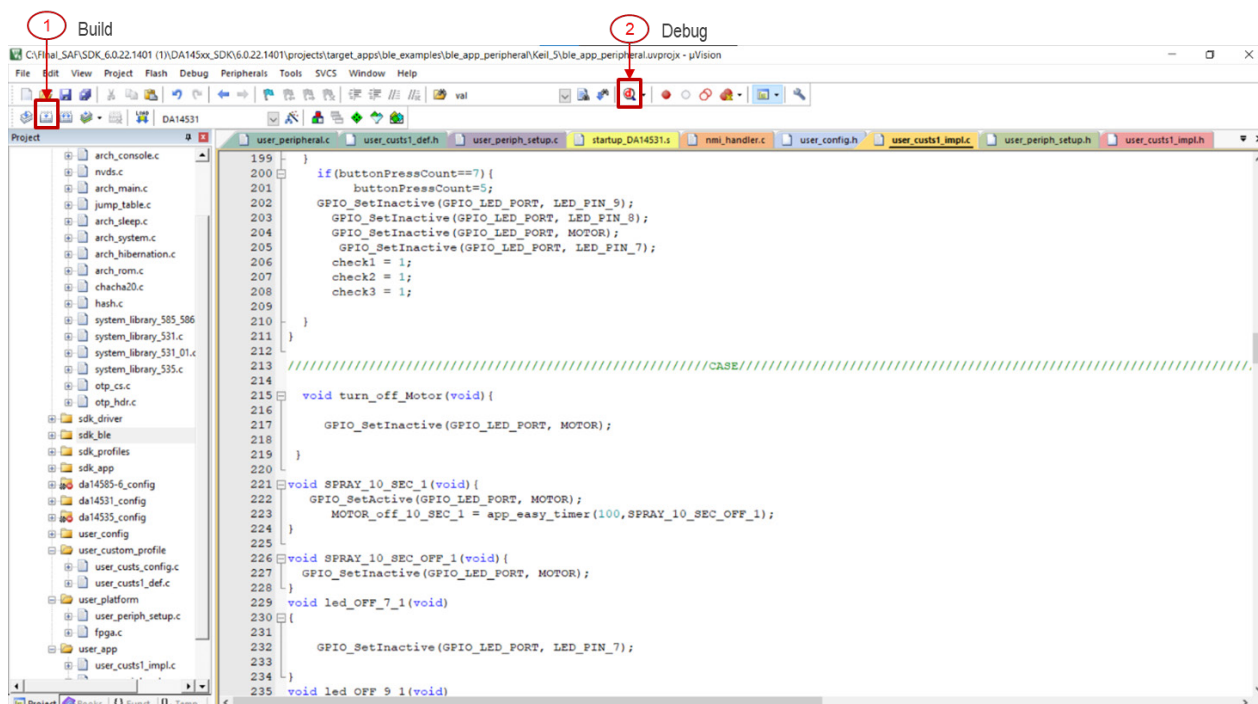


Figure 14. Build and Debug the Project

3. Upon a successful download, Keil opens the debug window as shown in Figure 15.

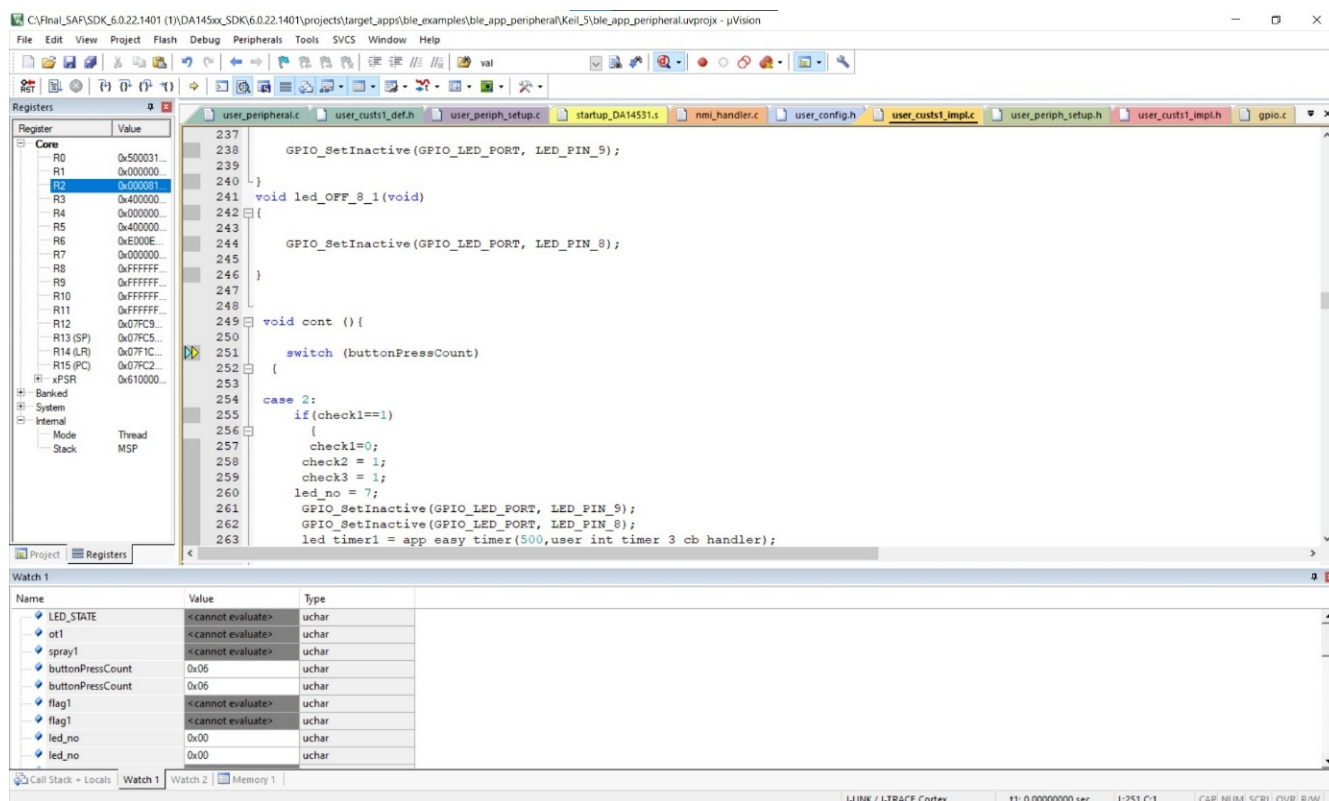


Figure 15. Debug Window

4.4.2 Renesas SmartBond Flash Programmer Settings



Figure 16. User Environment for Flashing using Renesas SmartBond Flash Programmer

Steps for flashing using Renesas Smart Bond Flash Programmer:

1. Download Renesas SmartBond flash Programmer.
2. Open the SmartBond flasher and locate the **.hex** file generated in the following required location:
 SDK_6.0.22.1401
 (1)\DA145xx_SDK\6.0.22.1401\projects\target_apps\ble_examples\ble_app_peripheral\Keil_5\out_DA14531\Objects

5. Device Setup

1. Open the Dispenser: Press the designated button or release latch to open the front cover.
2. Insert Batteries: Place the required number of AA batteries into the battery compartment.
3. Insert Refill Canister: Place the refill canister inside the dispenser with the nozzle facing outward.
4. Settings – Timer Settings: Use the control panel switch to set the fragrance release frequency timer settings. Common settings include 10 minutes, 20 minutes, 40 minutes, etc. (see [Table 4](#))

Table 4. Switch Operation

Switch	Mode
Single-Press on Switch	10-minute Mode D3 LED
Second Press on Switch	20-minute Mode D2 LED
Third Press on Switch	40-minute Mode D4 LED
Fourth Press on Switch	OFF Mode

5.1 Main Components

The AS064-1-SMRTAFRREFZ is a battery-operated air freshener dispenser designed to release fragrance at set intervals. An overview of its circuitry and components is as follows:

1. Microcontroller: DA14531MOD is used, controlling the timing and activation of the spray mechanism.
2. Power Supply: Typically, two AA batteries are used to provide the necessary power.
3. Motor: Operates the spray mechanism to release the fragrance. Motor specifications are mentioned below:
4. Actuator: Mechanically linked to the motor, it presses down on the aerosol can nozzle to release the fragrance.
5. LED Indicator: Shows the interval of spray and device On/Off.
6. Switches/Buttons: For setting the spray intervals and turning the device on or off.



Figure 17. Air Freshener Dispenser Unit Components

6. Ordering Information

Part Number	Description
AS064-1-SMRTAFRREFZ	AS064-1-SMRTAFRREFZ Board

7. Revision History

Revision	Date	Description
1.00	Nov 27, 2024	Initial release.

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