AS064-AIRFRSHNRREFZ

Quick Start Guide for AS064 Air Freshener

This application note describes the working of an Automatic Air Freshener, using a 10-pin RL78/G15 microcontroller and a “Single Pole Four Throw” slide switch timed at 40 minutes, 20 minutes and 10 minutes. 12 bit interval timer is used for this application. This wakes up the microcontroller from stop mode every 273 milli seconds, to perform several operations based on the state of microcontroller.

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1. Introduction

Air fresheners are versatile products that can be used for multiple different environments. These fragrant sprays have been used in many ways to create a more pleasant atmosphere. They can be used in many different places and may provide different benefits. It has a flexi-control timer that sprays every 10, 20 or 40 minutes, allowing you to control fragrance intensity. The battery-operated room freshener keeps your space fragrant 24x7 without any hassle.

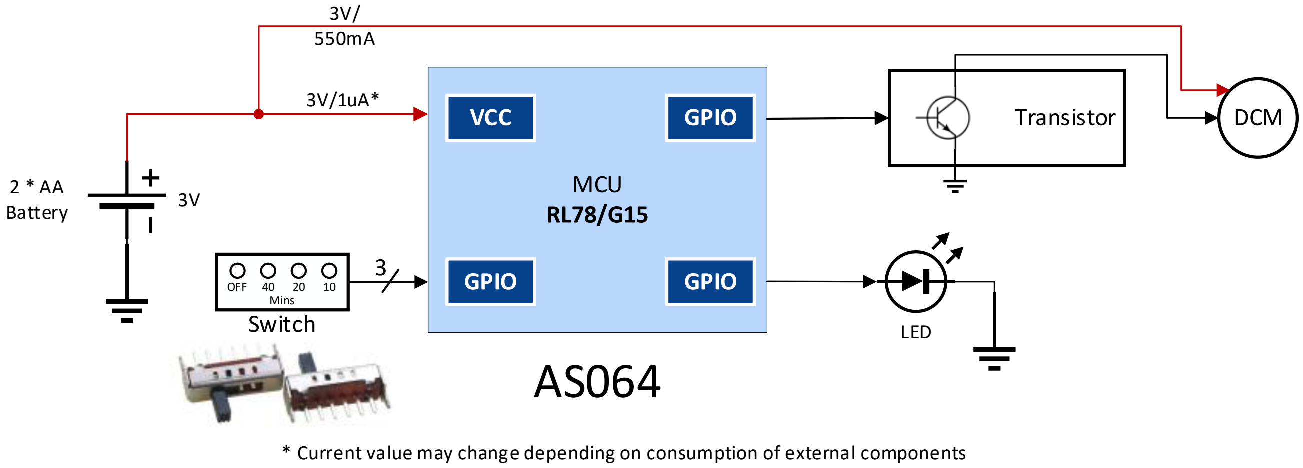


Figure 1: Block Diagram of Air Freshener

2. Scope of the document

The scope of the document is to explain the AS064 Air Freshener hardware and guide the user to get started on the same with step-by-step procedure on operating each module on the board.

3. AS064 Air Freshener Hardware

MCU Section

The RL78/G15 is a general-purpose microcontroller with a 16MHz operating frequency. There is a wide lineup available, including the smallest 8-pin package in the RL78 Family, and support for a wide range of operating ambient temperatures from -40°C to 125°C. The built-in high-speed on-chip oscillator with high accuracy (±1.0%), the data flash, the rich serial interfaces, and the comparator make it ideal for compact applications where space comes at a premium.

The circuit starts with the battery compartment, which supplies power to the entire unit. The RL78/G15 MCU is powered 3V from 2 * AA batteries. The microcontroller regulates this power and directs it to the necessary components. The microcontroller (MCU) is programmed with a timing algorithm. It keeps track of the set intervals (e.g., 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 MCU. 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 is provided to indicate different statuses. Blinking light might indicate the device is working normally.

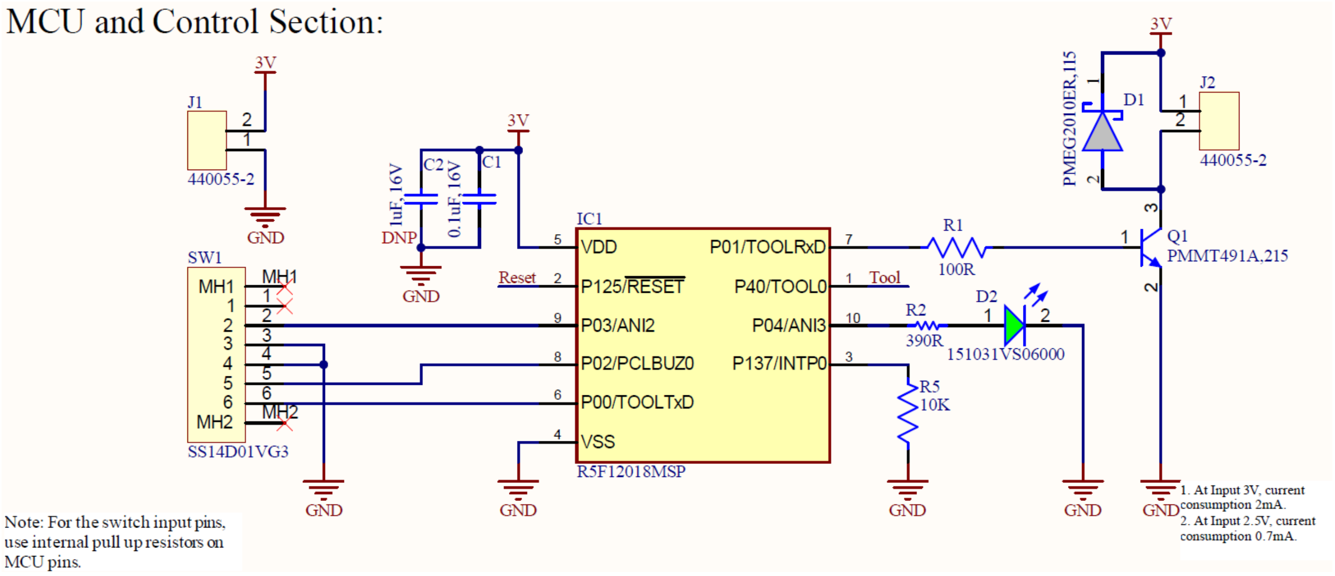


Figure 2: MCU Section

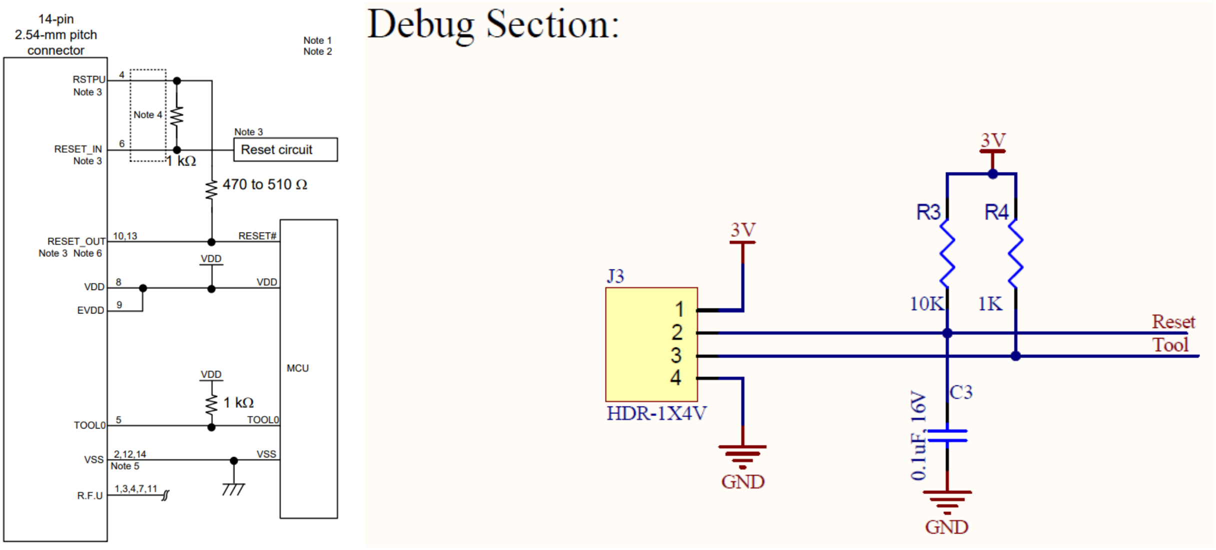


Figure 3: Debug Section for MCU

Figure 3 shows a recommended circuit for connection between the 14-pin connector and the RL78/G15 MCUs. For more information, please refer the E1/E20/E2 Emulator, E2 Emulator Lite Additional Document for User's Manual.

4. Board Design

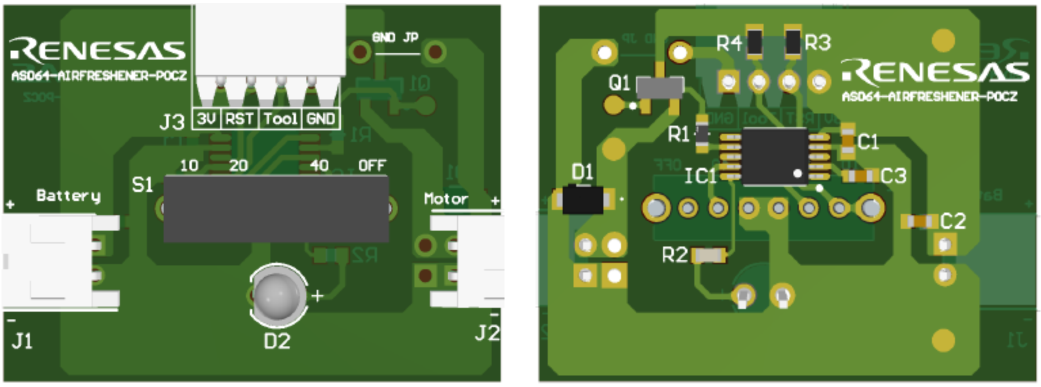


Figure 4: AS064-AIRFRSHNRREFZ Image Top and Bottom

4.1 Schematic Diagram

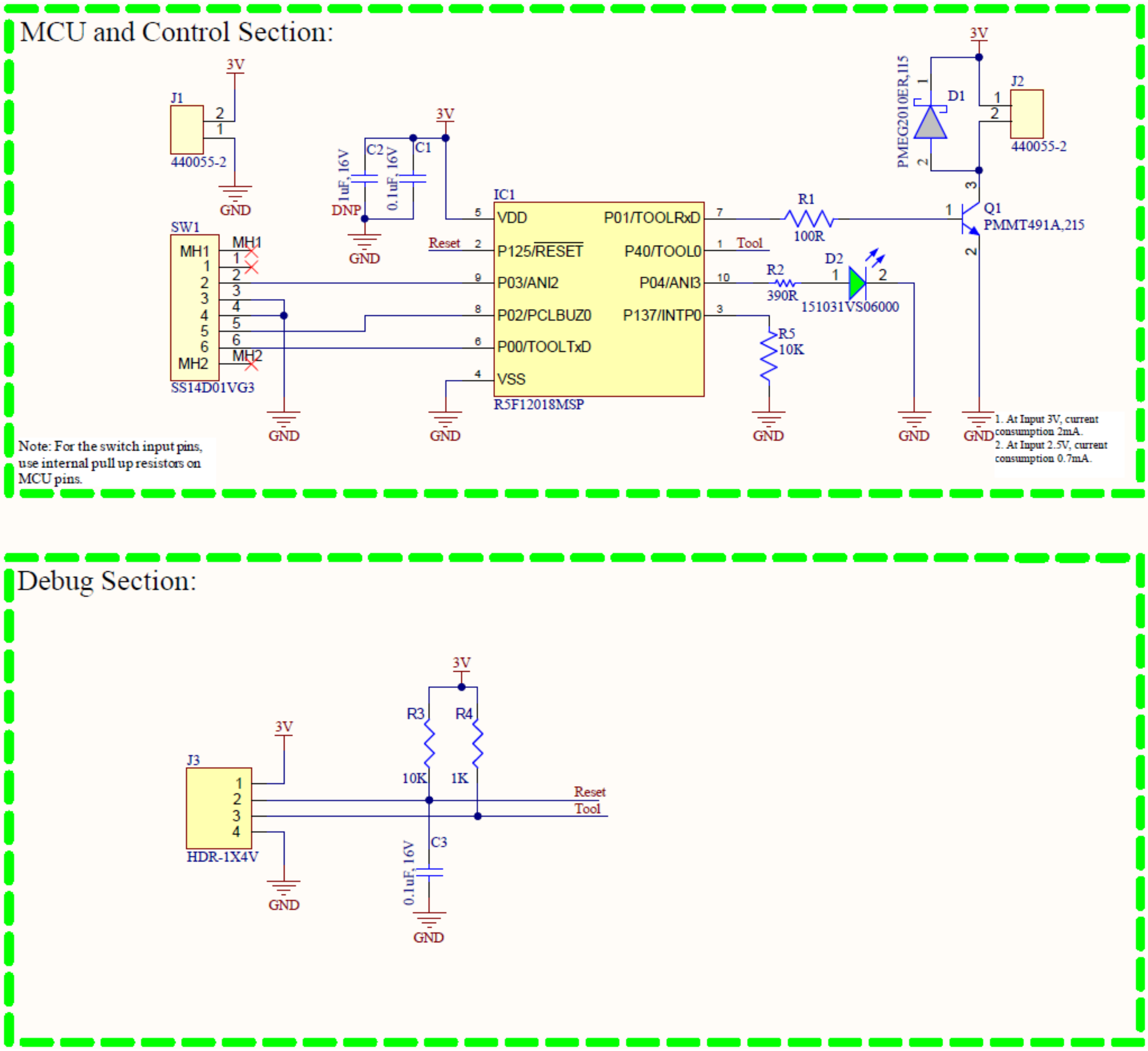


Figure 5: AS064-AIRFRSHNRREFZ Schematics

4.2 Bill of Materials (BOM)

Table 1: AS064-Air Freshener BOM

Qty	Designator	Description	Manufacturer	Manufacturer Part #
2	C1, C3	0.1 µF ±10% 16V Ceramic Capacitor X7R 0603 (1608 Metric)	Wurth Electronics	885012206046
0	C2	Capacitor, 1uF Multilayer Ceramic MLCC 16 V, X7R Dielectric 0603 Surface Mount	Wurth Electronics	885012206052
1	D1	Rectifier Diode, Schottky, 1 Phase, 1 Element, 20V V(RRM), Silicon	Nexperia	PMEG2010ER,115
1	D2	Green 568nm LED Indication - Discrete 2.2V Radial	Wurth Electronics	151031VS06000
1	IC1	True low-power platform, 54-µA/MHz operating current, TA = 125°C operation, from 8 to 20 pins, 4 to 8 KB code flash memory, 1 KB RAM, 2.4 to 5.5 V	Renesas	R5F12018MSP
2	J1, J2	Board Connector, 2 Contact(s), 1 Row(s), Male, Right Angle, 0.079-inch Pitch, Solder Terminal, Locking, Natural Insulator, Receptacle		
1	J3	Header, 1X4, 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	R1	100 Ohms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Moisture Resistant Thick Film	Yageo	RC0603FR-07100RL
1	R2	General Purpose Chip Resistor, 390 Ohm, +/- 1%, -55 to 155 degC, 0603 (1608 Metric), RoHS, Tape and Reel	Yageo	RC0603FR-07390RL
2	R3, R5	Chip Resistor, 10 KOhm, +/- 1%, 01 W, -55 to 155 degC, 0603 (1608 Metric), Chip Resistor, 10 KOhm, +/- 1%, 01 W, -55 to 155 degC, 0603 (1608 Metric).	YAGEO	RC0603FR-0710KL
1	R4	1 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Moisture Resistant Thick Film	YAGEO	RC0603FR-071KL
1	SW1	SWITCH SLIDE SP4T 0.3A 30V	C & K COMPONENTS	SS14D01VG

4.3 Board Layout

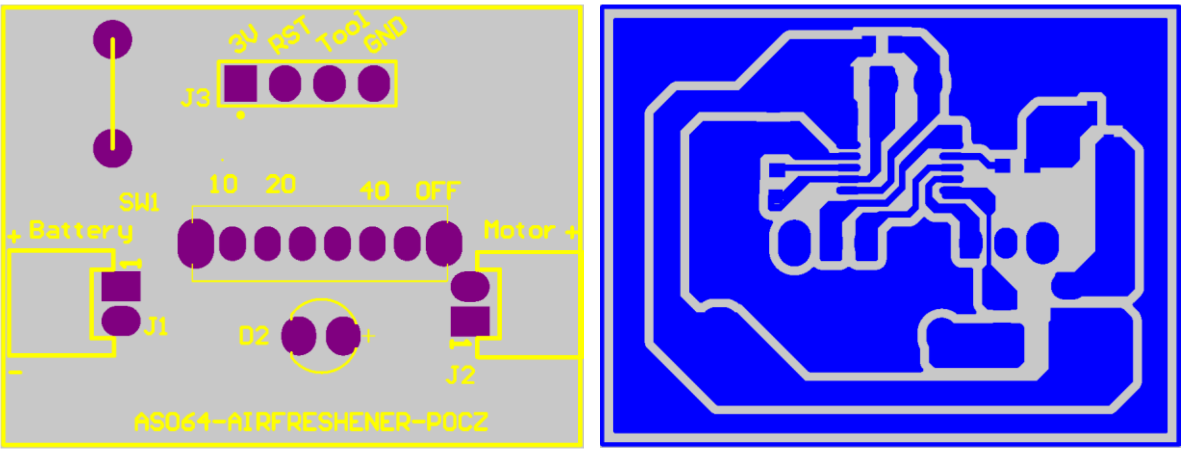


Figure 6: Top and Bottom Layer

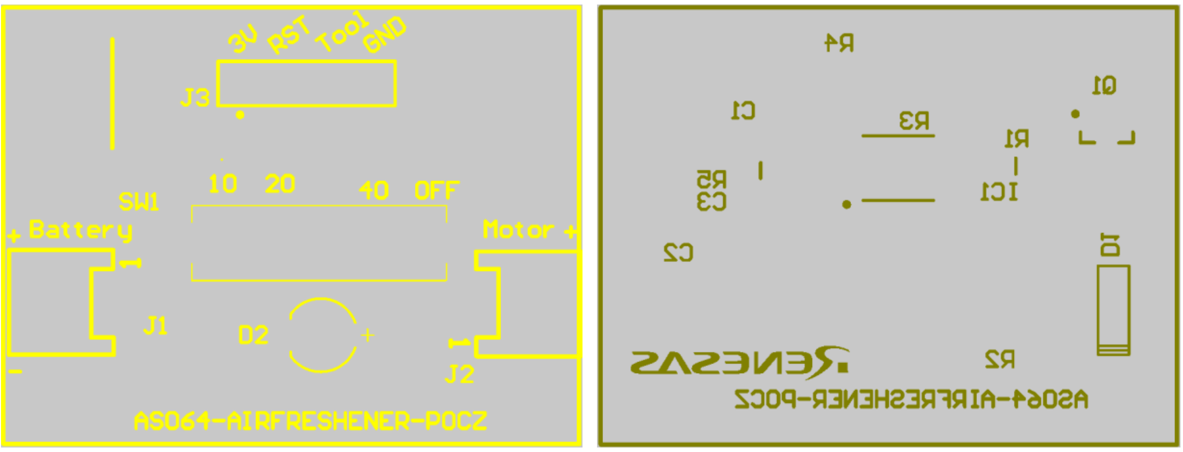


Figure 7: Top and Bottom Silkscreen Overlay

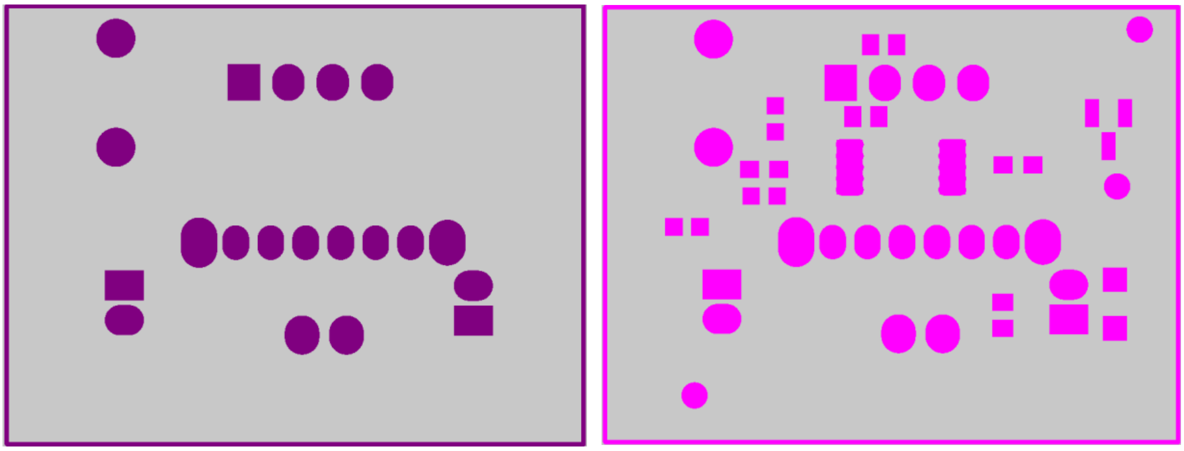


Figure 8: Top and Bottom Solder Mask

5. AS064 Air Freshener Software

5.1 Specifications

Table 2: Peripheral Function and Uses

Peripheral Function	Use
The 12-bit interval timer interrupt	The 12-bit interval timer interrupt wakes up the microcontroller from stop mode at every interrupt as per the interval value
P00	Switch input
P01	LED output
P02	Switch input
P03	Switch input
P04	Output for motor control

5.2 Switch States

Switch Configuration for different Modes.

Table 3: List of Pins to be Used.

Modes	P00	P02	P03
Off	1	1	1
40 min	1	1	0
20 min	1	0	1
10 min	0	1	1

5.3 Outline of Operation

This application note describes how to configure RL78/G15 for Air Freshener application.

This setup is followed by operation for checking different system steps and states before executing stop mode. 12-bit interval timer wake up the MCU from stop mode every 250ms to check the states again, based on the switch position and time period.

1. Initialize the TAU
   - Use the interval timer mode as timer operation mode.
   - Set the operation as 12-bit count mode.
   - Set the interval value as 250ms (maximum value)
   - Set the priority level.
2. Initialise I/O port.
   - Initialise ports according to table 2.
3. Define Time Period and Switch States
   - Minute count for 1 minute in real time is 240, accordingly it is 2400 for 10 minutes, 4800 for 20 minutes and 9600 for 40 minutes.
   - Define Switch Positions- hex value for OFF, ten minutes, twenty minutes and forty minutes are 0x7,0x6,0x5,0x3 respectively.

4. Define Operation States
   - Include step states in order.

I. Switch_State - to check current position with previous position, if same, it goes to stop mode to execute stop instruction, if not time_init function is called where the time period designated by the switch position is decremented. This also occurs in stop mode as its operable in stop mode.

II. Spray- Triggered when the minute count hits zero, signaling the end of the set time period and prompting the freshener to spray. Bit 1 of port 0 is made 1, for output.

III. Stop_mode= stop instruction is executed.

5.4 Algorithm Flowchart

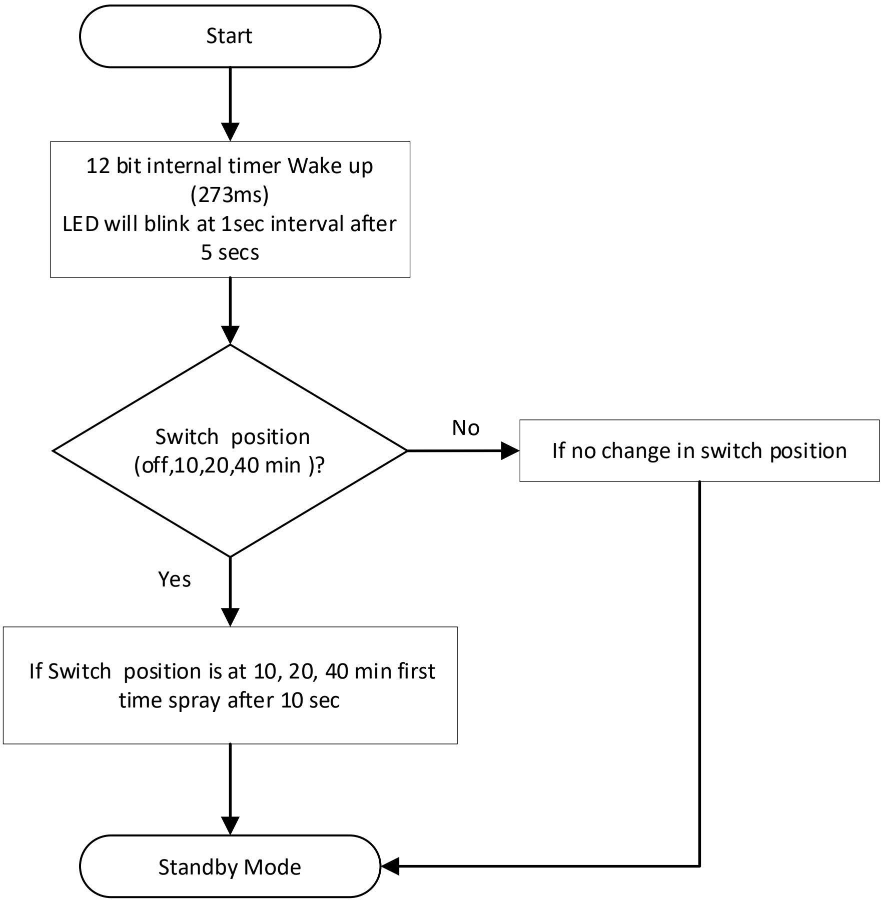

Start
12 bit internal timer Wake up (273ms)
LED will blink at 1sec interval after 5 secs
Switch position (off,10,20,40 min)?
No
If no change in switch position
Yes
If Switch position is at 10, 20, 40 min first time spray after 10 sec
Standby Mode

Figure 9: Algorithm Flowchart

6. Software Explanation

6.1 List of Constants

Table 4: lists global variables.

Table 4: Global Variables

unsigned char	pre_sw_pos	Previous position of the switch	check_switch_position()
unsigned char	current_sw_pos	Current position of the switch	check_switch_position()

6.2 List of Variables

Table 5: lists global variables.

Table 5: Global Variables

Type	Variable Name	Description	Function Used
enum :en_step_stop	step_stop	System steps and states	typedef enum
uint16_t	counter	Assigning time period for decrement based on switch position	time_init ()
unsigned int	timer_count	Provides delay after spray enabling release of motor	r_Config_IT_interrupt()
unsigned char	blink_flag	enables led blinking every 5 sec	r_Config_IT_interrupt()
unsigned int	wait_count	To provide delay after changing switch position, for spraying	r_Config_IT_interrupt()

6.3 List of Functions

Table 6 shows a list of functions.

Table 6: Functions

Function name	Outline
freshener_steps	Define system steps and states
check_switch_position	Reading the current switch position
time_init	Assign and decrement time period set by switch position

6.4 Specification of Functions

The function specifications of the sample code are shown below.

Table 7: Functions

freshener_steps()	
Declaration	void freshener_steps(void)
Description	This function is used to define system steps and states.
Argument	None
Return Value	None

check_switch_position()	
Declaration Description	int_check_switch_position() Reading the current switch position
Argument	None
Return Value	None

time_init()	
Declaration	time_init ()
Description	Decrement time set by switch position
Argument	None
Return Value	None

6.5 Flag Variables

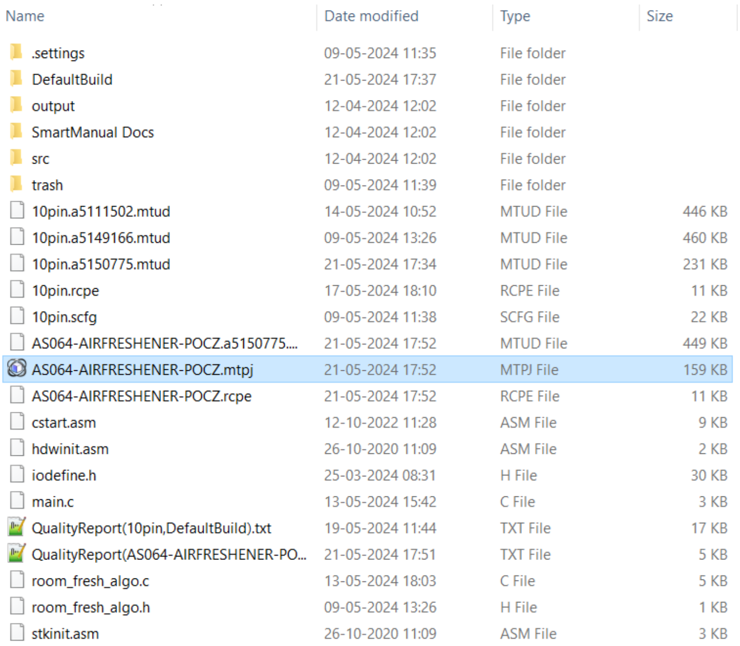
Table 8: Flag Variables

Type	Variable Name	Description	Function Used
Bool	count_en	To indicate counter has to decrement at every 12-bit timer interrupt	time_init ()
unsigned char	delay_flag	To indicate occurrence of spray mode and to use it in the timer interrupt to provide delay after spraying	Freshener: Case Spray
unsigned char	wait_flag	To indicate wait_count has to decrement, (for freshener to spray after a certain delay)	r_Config_IT_interrupt ()
unsigned char	blink_flag	enables led blinking every 5 sec	r_Config_IT_interrupt ()

7. Software Overview

7.1 Debugging using CS+

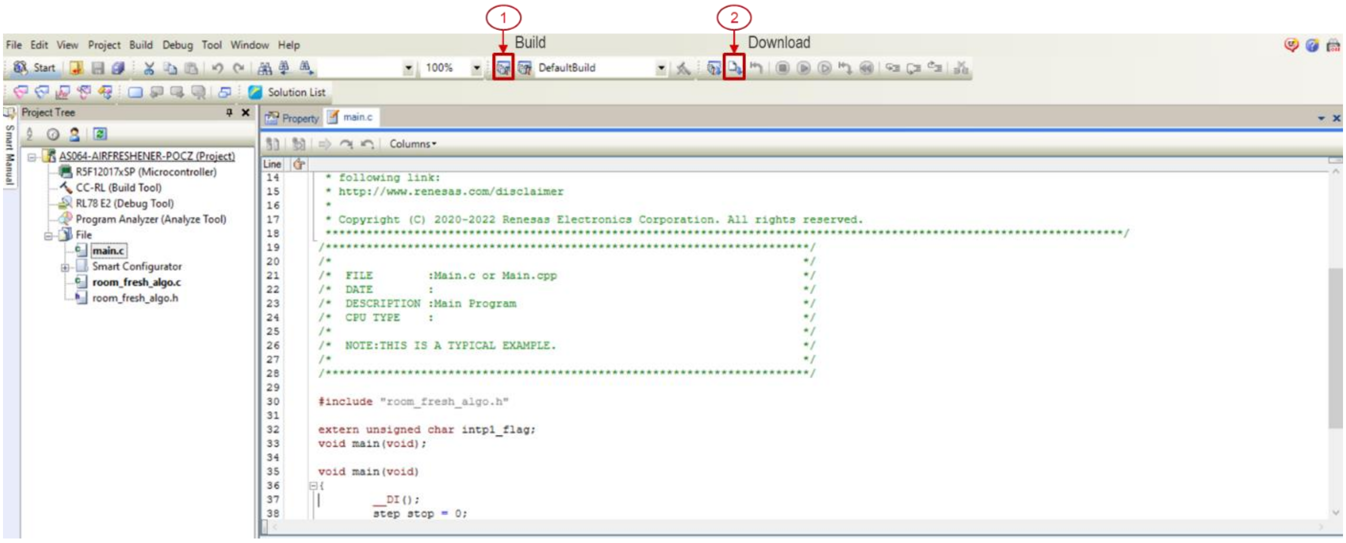
1. RL78/F14 can be programmed and debugged using CS+. Below are the steps to debug RL78/F14 using CS+. Open the RL78/G15 project in CS+ by double clicking the xxx.mtpj.



Name	Date modified	Type	Size
.settings	09-05-2024 11:35	File folder	
DefaultBuild	21-05-2024 17:37	File folder	
output	12-04-2024 12:02	File folder	
SmartManual Docs	12-04-2024 12:02	File folder	
src	12-04-2024 12:02	File folder	
trash	09-05-2024 11:39	File folder	
10pin.a5111502.mtud	14-05-2024 10:52	MTUD File	446 KB
10pin.a5149166.mtud	09-05-2024 13:26	MTUD File	460 KB
10pin.a5150775.mtud	21-05-2024 17:34	MTUD File	231 KB
10pin.rcpe	17-05-2024 18:10	RCPE File	11 KB
10pin.scfg	09-05-2024 11:38	SCFG File	22 KB
AS064-AIRFRESHENER-POCZ.a5150775....	21-05-2024 17:52	MTUD File	449 KB
AS064-AIRFRESHENER-POCZ.mtpj	21-05-2024 17:52	MTPJ File	159 KB
AS064-AIRFRESHENER-POCZ.rcpe	21-05-2024 17:52	RCPE File	11 KB
cstart.asm	12-10-2022 11:28	ASM File	9 KB
hdwinit.asm	26-10-2020 11:09	ASM File	2 KB
iodefine.h	25-03-2024 08:31	H File	30 KB
main.c	13-05-2024 15:42	C File	3 KB
QualityReport(10pin,DefaultBuild).txt	19-05-2024 11:44	TXT File	17 KB
QualityReport(AS064-AIRFRESHENER-PO...	21-05-2024 17:51	TXT File	5 KB
room_fresh_algo.c	13-05-2024 18:03	C File	5 KB
room_fresh_algo.h	09-05-2024 13:26	H File	1 KB
stkinit.asm	26-10-2020 11:09	ASM File	3 KB

Figure 10: .mtpj file in the project

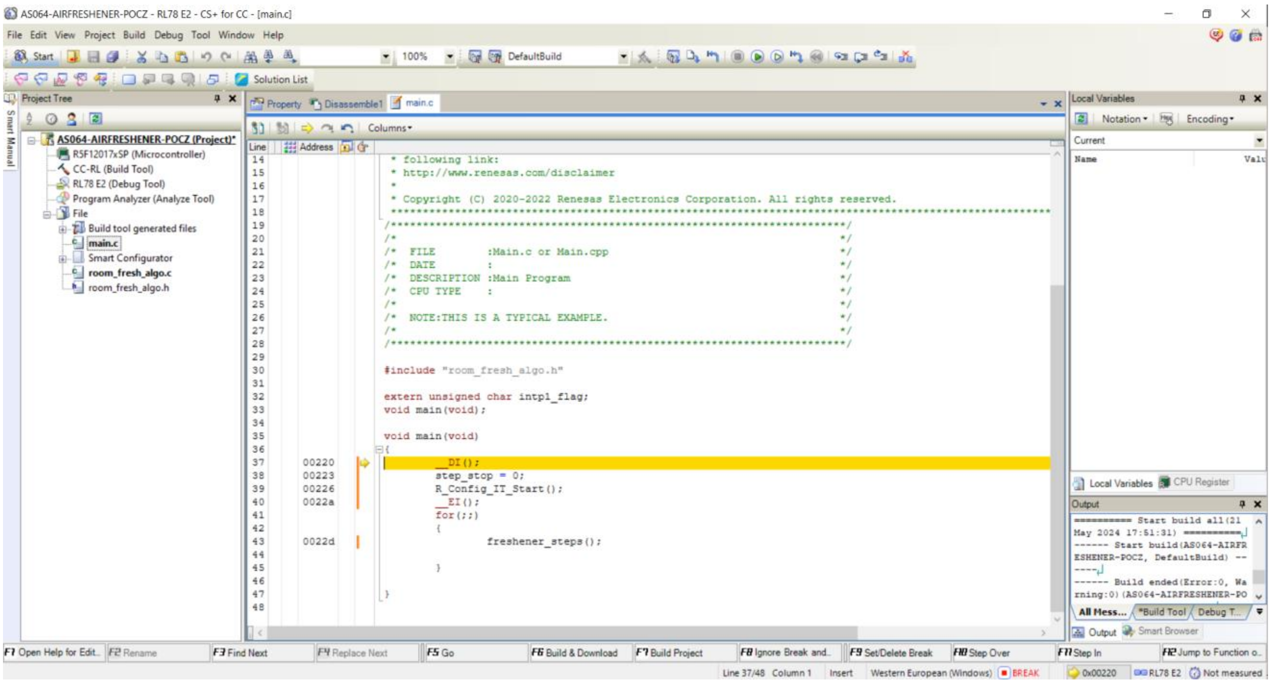
2. Once the project opens, click on build icon (marked as 1 in Figure: 11), or press F7 to build the project. Once build is successful, click on download icon (marked as 2 in Figure: 11), or press F6 to download the project.



```
 * following link:
 * http://www.renesas.com/disclaimer
 *
 * Copyright (C) 2020-2022 Renesas Electronics Corporation. All rights reserved.
 *********************************************************************************************************/
/**********************************************************************/
/*                                                                    */
/*  FILE        :Main.c or Main.cpp                                   */
/*  DATE        :                                                     */
/*  DESCRIPTION :Main Program                                         */
/*  CPU TYPE    :                                                     */
/*                                                                    */
/*  NOTE:THIS IS A TYPICAL EXAMPLE.                                   */
/*                                                                    */
/**********************************************************************/

#include "room_fresh_algo.h"

extern unsigned char intp1_flag;
void main(void);

void main(void)
{
        __DI();
        step stop = 0;
```

Figure 11: Build and Download the project

3. Once download is successful CS+ will open debug window as below:



AS064-AIRFRESHENER-POCZ - RL78 E2 - CS+ for CC - [main.c]

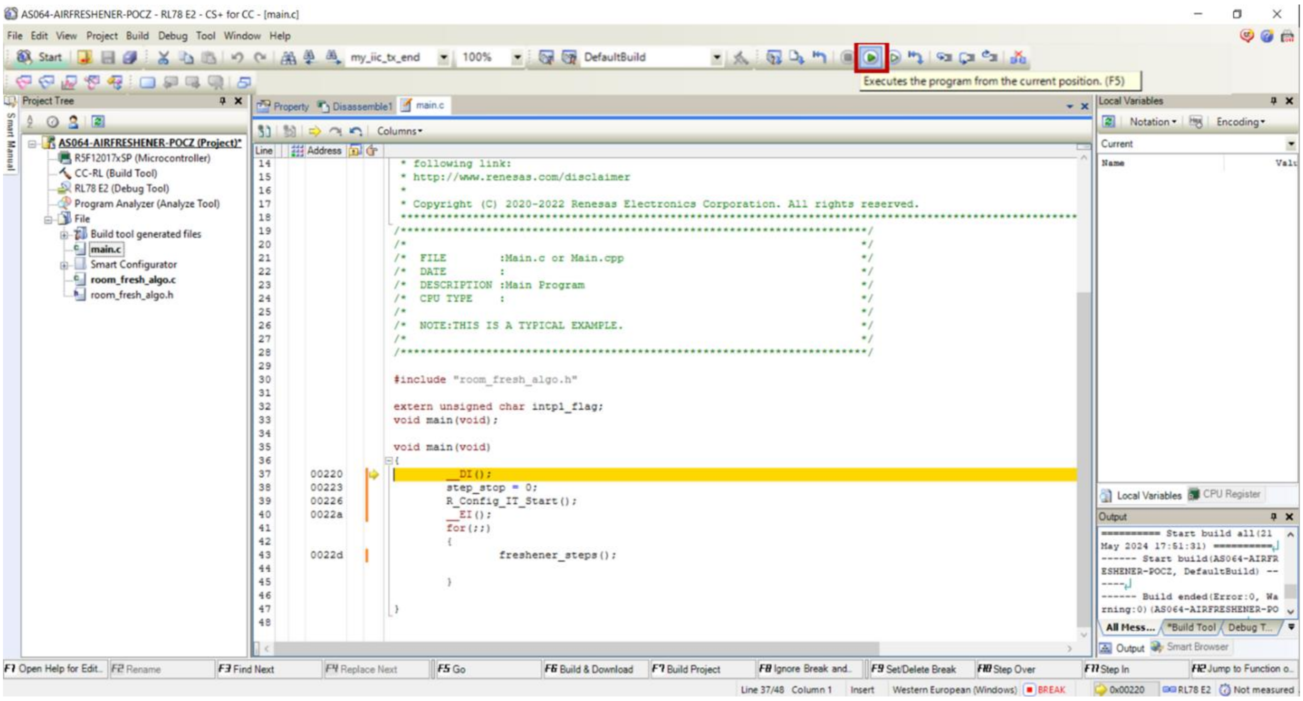
```
     * following link:
     * http://www.renesas.com/disclaimer
     *
     * Copyright (C) 2020-2022 Renesas Electronics Corporation. All rights reserved.
     *********************************************************************************************
    /*******************************************************************************/
    /*                                                                             */
    /*  FILE        :Main.c or Main.cpp                                            */
    /*  DATE        :                                                              */
    /*  DESCRIPTION :Main Program                                                  */
    /*  CPU TYPE    :                                                              */
    /*                                                                             */
    /*  NOTE:THIS IS A TYPICAL EXAMPLE.                                            */
    /*                                                                             */
    /*******************************************************************************/

    #include "room_fresh_algo.h"

    extern unsigned char intpl_flag;
    void main(void);

    void main(void)
    {
00220           __DI();
00223           step_stop = 0;
00226           R_Config_IT_Start();
0022a           __EI();
                for(;;)
                {
0022d                   freshener_steps();

                }

    }
```

```
========== Start build all(21 May 2024 17:51:31) ==========
------ Start build(AS064-AIRFRESHENER-POCZ, DefaultBuild) ------
------ Build ended(Error:0, Warning:0)(AS064-AIRFRESHENER-PO
```

Line 37/48 Column 1 Insert Western European (Windows) BREAK 0x00220 RL78 E2 Not measured

Figure 12: Debug Window

4. Once the download is completed click on Execute command as highlighted in Figure:13.



AS064-AIRFRESHENER-POCZ - RL78 E2 - CS+ for CC - [main.c]

Executes the program from the current position. (F5)

```
     * following link:
     * http://www.renesas.com/disclaimer
     *
     * Copyright (C) 2020-2022 Renesas Electronics Corporation. All rights reserved.
     *********************************************************************************************
    /*******************************************************************************/
    /*                                                                             */
    /*  FILE        :Main.c or Main.cpp                                            */
    /*  DATE        :                                                              */
    /*  DESCRIPTION :Main Program                                                  */
    /*  CPU TYPE    :                                                              */
    /*                                                                             */
    /*  NOTE:THIS IS A TYPICAL EXAMPLE.                                            */
    /*                                                                             */
    /*******************************************************************************/

    #include "room_fresh_algo.h"

    extern unsigned char intpl_flag;
    void main(void);

    void main(void)
    {
00220           __DI();
00223           step_stop = 0;
00226           R_Config_IT_Start();
0022a           __EI();
                for(;;)
                {
0022d                   freshener_steps();

                }

    }
```

```
========== Start build all(21 May 2024 17:51:31) ==========
------ Start build(AS064-AIRFRESHENER-POCZ, DefaultBuild) ------
------ Build ended(Error:0, Warning:0)(AS064-AIRFRESHENER-PO
```

Line 37/48 Column 1 Insert Western European (Windows) BREAK 0x00220 RL78 E2 Not measured

Figure 13: Execute the Program

7.2 Flashing & Flash Programmer Settings: Tool Renesas Flash Programmer

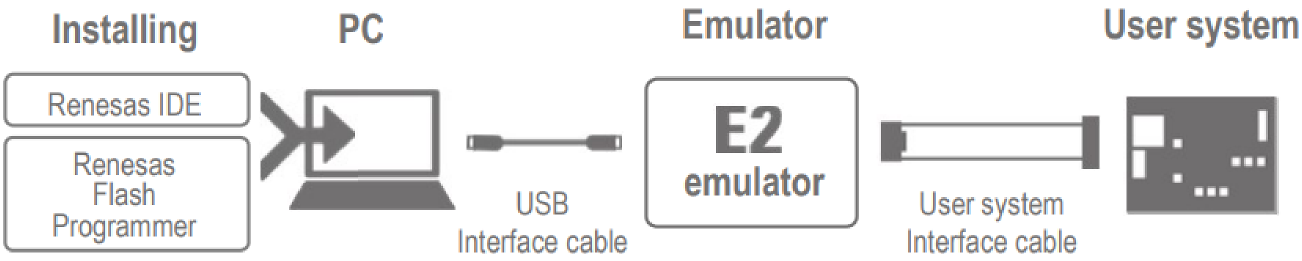
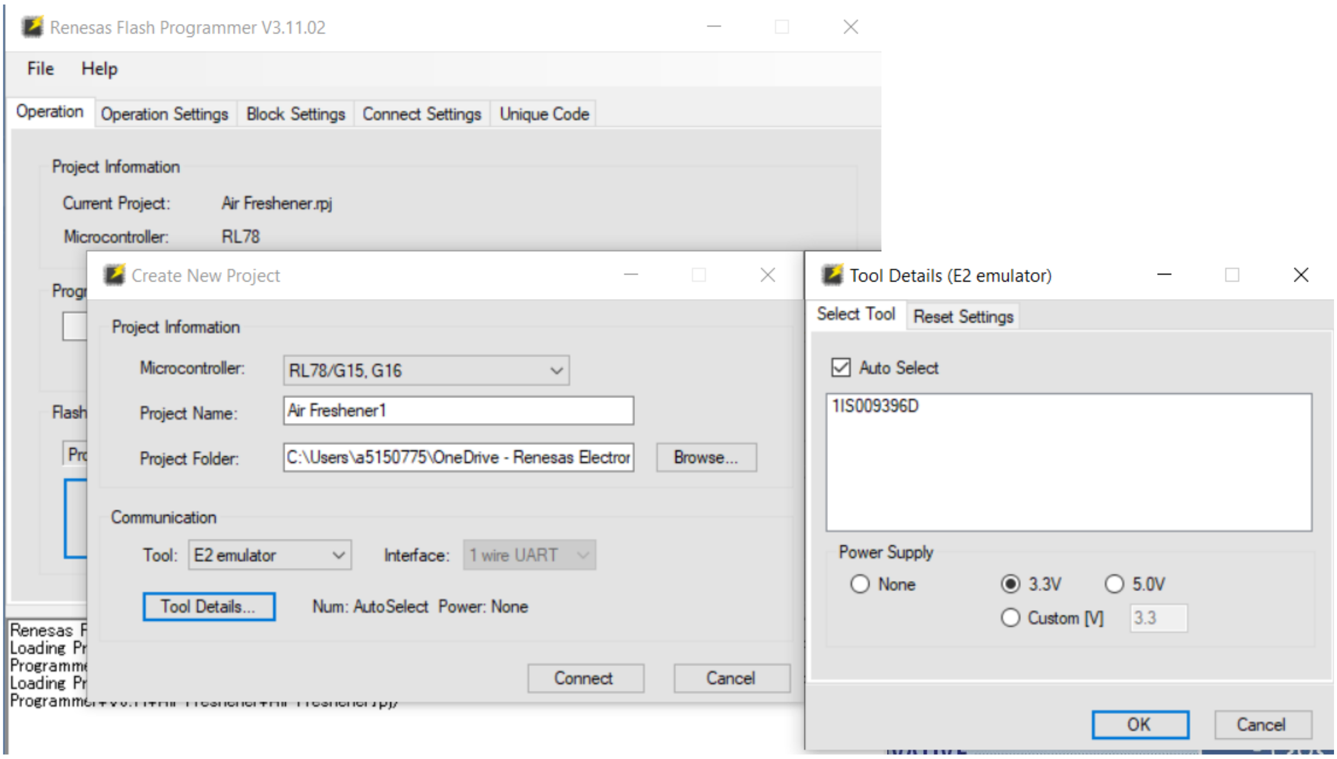


Figure 14: User Environment for Flashing using E2 Emulator

Steps for flashing using Renesas Flash Programmer

1. Connect board to E2 Emulator.
2. Open Renesas Flash Programmer. Create new Project. (Provide the Microcontroller as RL78/G15, G16, Project name and Project folder.) Select Tool Details and provide 3.3V Power Supply.



Project Information

Current Project: Air Freshener.rpj

Microcontroller: RL78

Create New Project

Project Information

Microcontroller: RL78/G15, G16

Project Name: Air Freshener1

Project Folder: C:\Users\a5150775\OneDrive - Renesas Electror

Communication

Tool: E2 emulator Interface: 1 wire UART

Num: AutoSelect Power: None

Tool Details (E2 emulator)

☑ Auto Select

1IS009396D

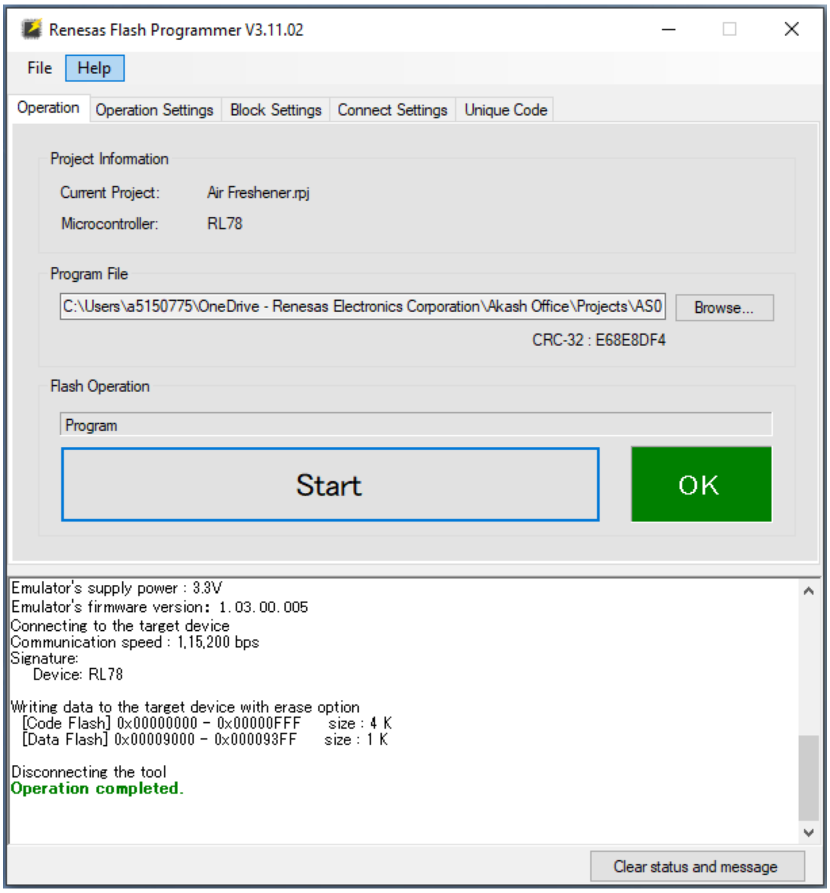
Power Supply

○ None ● 3.3V ○ 5.0V

○ Custom [V] 3.3

Figure 15: New Project creation using Renesas Flash Programmer

3. Click on Operation tab and provide the path of hex file in Program file option.



Current Project: Air Freshener.rpj

Microcontroller: RL78

Program File: C:\Users\a5150775\OneDrive - Renesas Electronics Corporation\Akash Office\Projects\AS0

CRC-32 : E68E8DF4

Program

```
Emulator's supply power : 3.3V
Emulator's firmware version: 1.03.00.005
Connecting to the target device
Communication speed : 1,15,200 bps
Signature:
    Device: RL78

Writing data to the target device with erase option
  [Code Flash] 0x00000000 - 0x00000FFF    size : 4 K
  [Data Flash] 0x00009000 - 0x000093FF    size : 1 K

Disconnecting the tool
Operation completed.
```

Figure 16: Flashing the board by adding Hex File

8. Device Setup

Steps to setup the device

1. Open the Dispenser: Press the designated button or release latch to open the front cover.
2. Insert Batteries: Place 2 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:
5. Timer Settings: The control panel allows you to set the frequency of fragrance release. Common settings include 10 minutes, 20 minutes, 40 minutes, etc.
6. Power On/Off: An on/off switch or button to activate the device.

Device Specifications

The AS064-AIRFRSHNRREFZ, is a battery-operated Air freshener dispenser designed to release fragrance at set intervals. Here’s a basic explanation of its circuit and components:

Main Components

1. Microcontroller: RL78/G15 is used, controlling the timing and activation of the spray mechanism.
2. Power Supply: Typically, 2 AA batteries are used to provide the necessary power.
3. Motor: Operates the spray mechanism to release the fragrance. Motor specifications are mentioned below:

Specifications	Value
Nominal Voltage	3.0V
No Load Current	0.040A
Load Current	0.55A

4. Actuator: Mechanically linked to the motor, it presses down on the aerosol can nozzle to release the fragrance.
5. LED Indicator: Shows the operational status of the device, like when it is on, off, or when batteries are low.
6. Switches/Buttons: For setting the spray intervals and turning the device on or off.

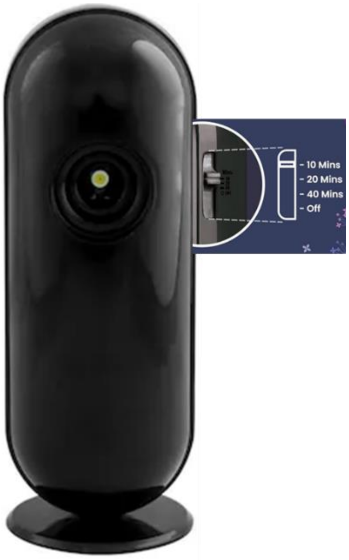


Figure 17: Air Freshener Unit

9. Typical Performance Graphs

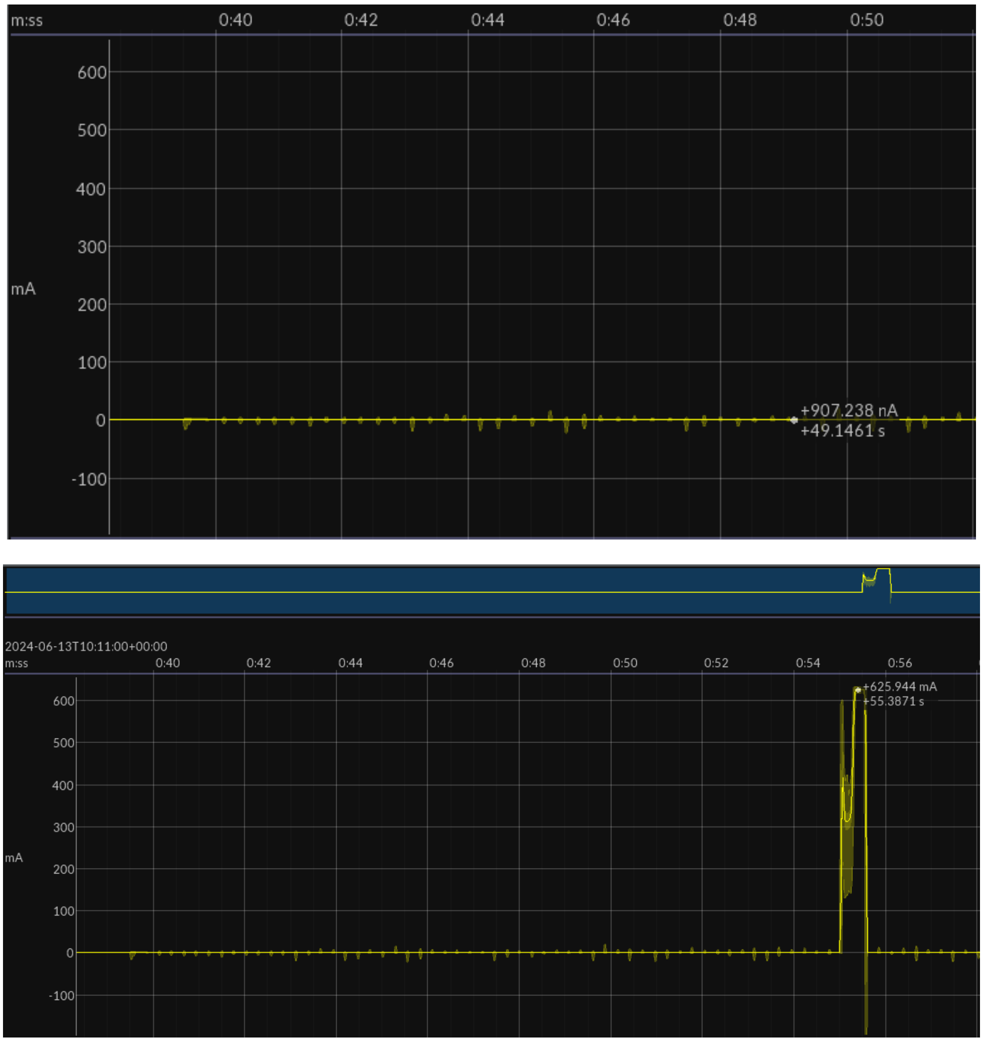


Figure 18: Current Consumption at Standy and during Spray

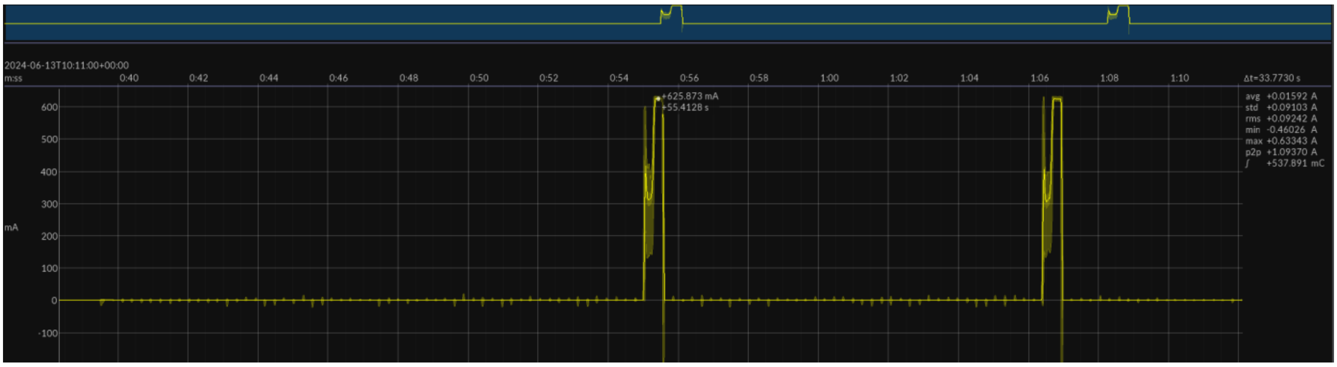


Figure 19: Current Consumption Graph during Standby and during Spray

10. Ordering Information

Part Number	Description
AS064-AIRFRSHNRREFZ	AS064-AIRFRSHNRREFZ Board

11. Revision History

Revision	Date	Description
1.00	May 30, 2024	Initial Release