Smoke Detector Workshop User Guide

Revision: V1.00 Date: August 24, 2022

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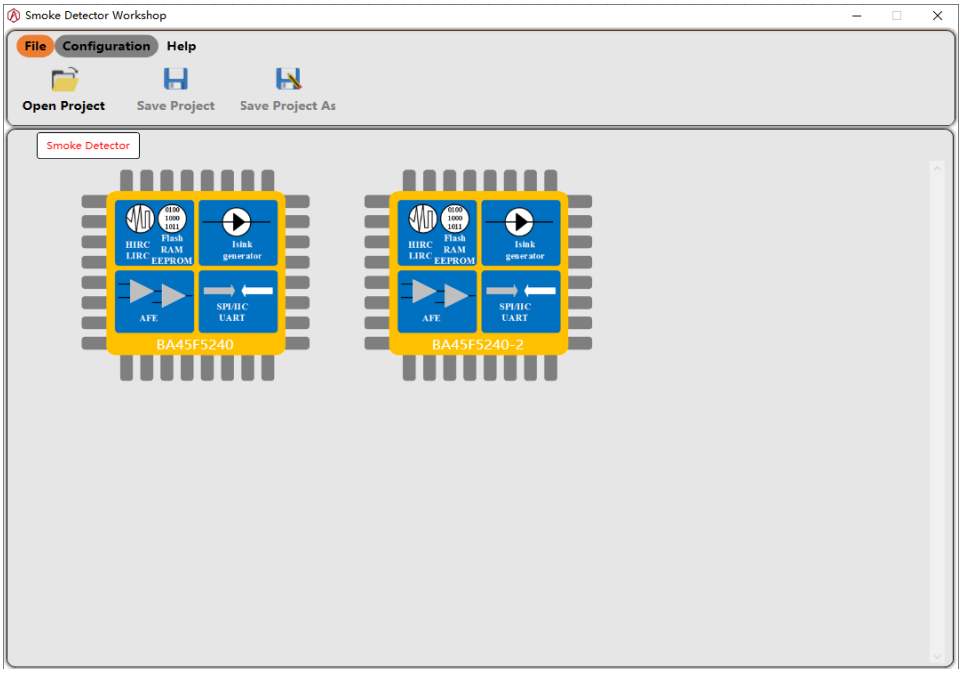
1. General Description

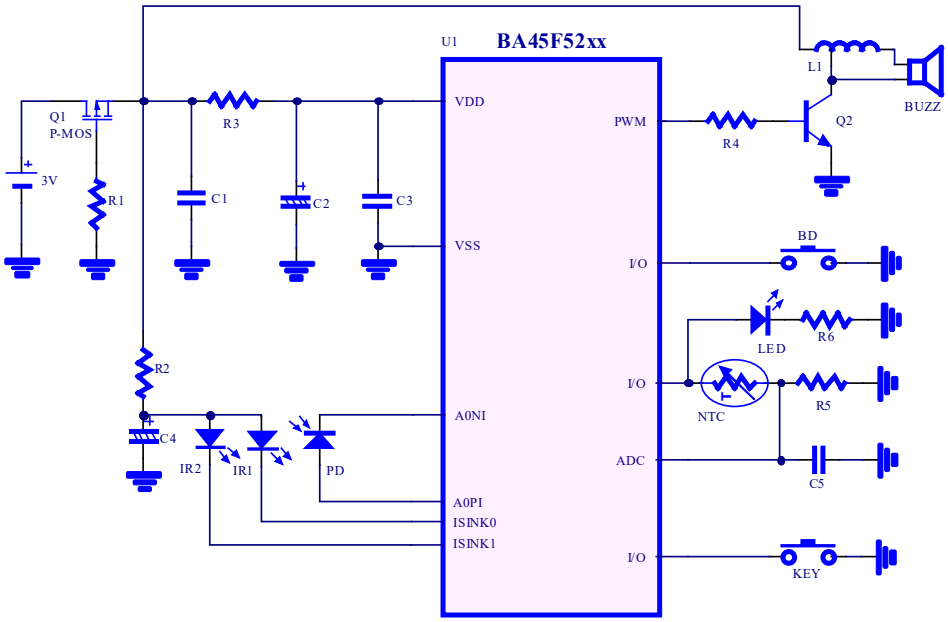
1.1 Smoke Detector Workshop Introduction

The Smoke Detector Workshop is designed for the Holtek BA45F5xxx series to generate initialisation code. The Holtek BA45F5xxx series of MCUs are suitable for use in photoelectric smoke detection products. The platform can be used to configure the clock, I/O and various peripheral functions of the MCU, and also includes hardware standby power consumption evaluation, AFE parameter debug function, etc. It supports three interface languages, Simplified Chinese, Traditional Chinese and English. By proper use, the Smoke Detector Workshop can reduce the development time thus shortening the development period of smoke detection products. The figure below shows the initial interface of the software, which may vary with the platform update.

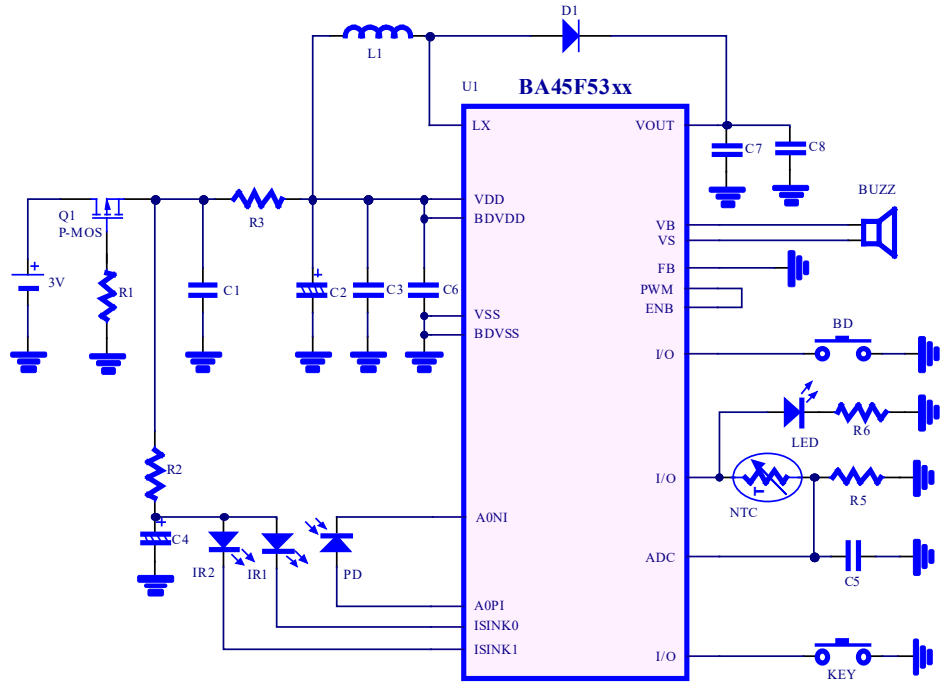


1.2 Reference Application Circuit

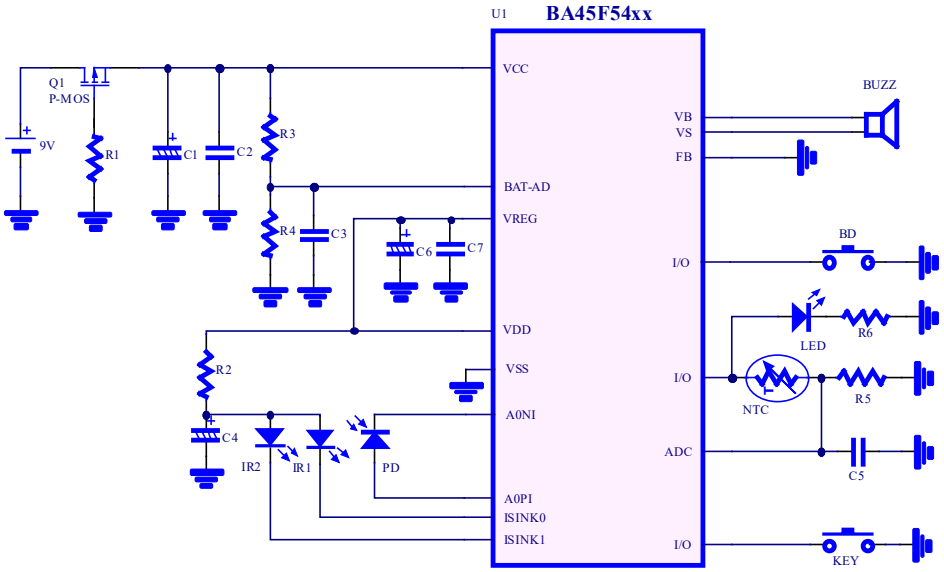
- Reference Application Circuit for the BA45F52xx series



- Reference Application Circuit for the BA45F53xx series



- Reference Application Circuit for the BA45F54xx series

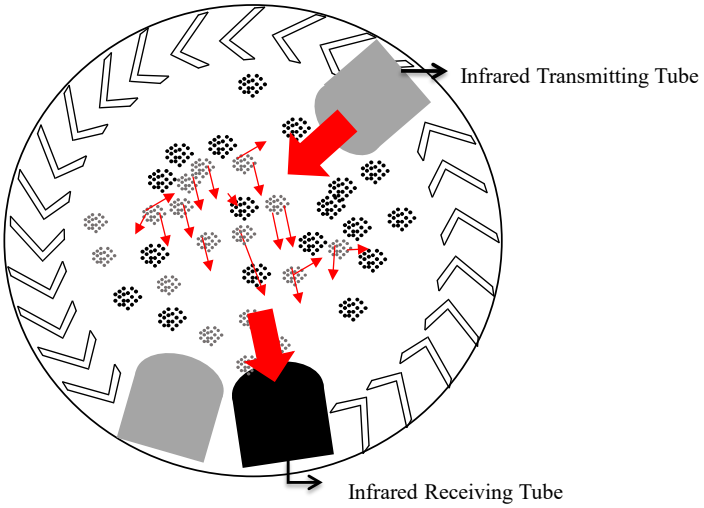


The application reference circuits of the BA45F52xx, BA45F53xx and BA45F54xx series of MCUs are shown above, and the schematic description are as follows.

- MOS is used to prevent power supply reverse connection.
- BD port is used for air calibration.
- KEY is used to activate hardware self-check.
- Buzzer and LED are used for sound and light alarm.
- The BA45F52xx series of MCUs require a 3-pin inductor boosting circuit to drive the buzzer. The BA45F53xx and BA45F54xx series of MCUs include an internal piezoelectric buzzer drive circuit, the corresponding application reference circuits provided above use an external-driving (2-pin) buzzer.
- Temperature Detection (NTC) is used for temperature compensation, sharing the same enable pin with the LED.
- IR1 and IR2 are infrared transmitting tubes, PD is an infrared receiving tube; they together with smoke detection chambers are used for smoke detection. IR2 can be omitted for single-channel applications.

Explanation of the basic principles of smoke detection:

When a fire occurs, most incendiary substances are accompanied by the production of particles, called smoke, at all stages of combustion. Some smoke is lighter or gray in color, called white smoke, and some smoke is dark black, called black smoke. White smoke has a scattering effect on light and therefore scatters the light that shines on it. Black smoke has a different particle size than white smoke and has a strong ability to absorb light. It absorbs most light radiation that shines on it generating a very weak scattered light, and also affects the scattering of light by other smoke particles. Taking white smoke as an example, the following figure shows a certain smoke detector chamber (maze) with a light scattering type structure. Under the normal smoke-free situation, the receiving tube cannot receive the light emitted by the transmitting tube, therefore there is no current generated. When a fire occurs, the generated white smoke enters the maze and the light emitted by the transmitting tube is scattered by white smoke. The scattered light is received by the receiving tube, and the higher the white smoke concentration, the stronger the scattered light received.



1.3 Description of Program Basic Functions

In order to reduce the difficulty of smoke detection product development, the program exported by the Smoke Detector Workshop contains not only the initialisation program of various configurations but also the basic functions of single-channel smoke detection, which is suitable for mazes of a photoelectric light scattering structure. The program includes smoke (mainly white smoke) alarm detection, low battery voltage detection, battery internal resistance detection, IR tube fault detection, key-triggered self-check, temperature compensation, voltage compensation, etc., which are in line with the basic requirements of certifications.

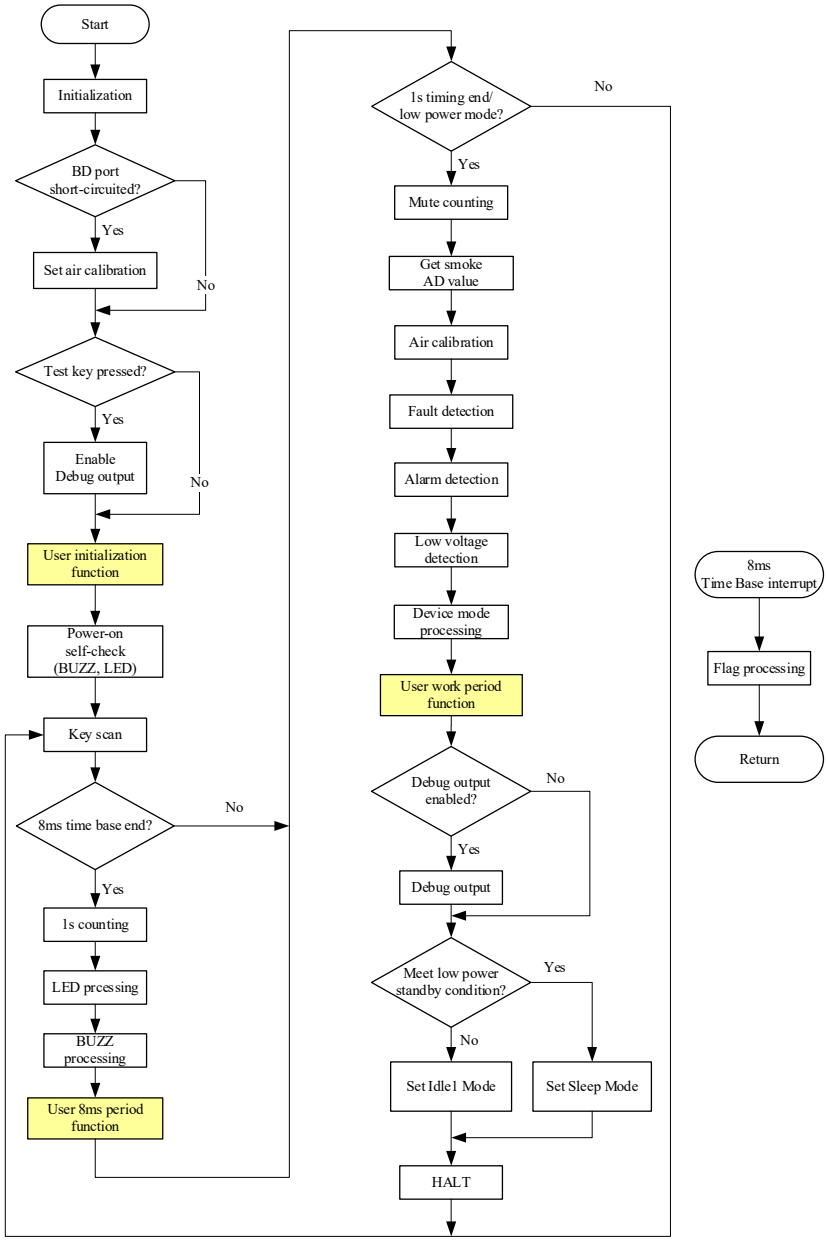
- The basic functions of the smoke detection are described below:

1. After power-on, the LED blinks once (driven by a high level) and the buzzer rings once. If calibration is not implemented or fails, the LED will be always on. If calibration has been implemented, the device will enter the normal standby mode.
2. Calibration mode: short connect BD to GND and power on under the smoke-free situation, the device will enter the air calibration mode, with the LED blinking once every 1s which lasts for several seconds. After the calibration is successful, the device enters the standby mode, otherwise the LED will be always on.
3. Standby mode: the LED blinks once every 5 work periods.
4. Low voltage mode: when the smoke detector is in the standby mode and its power supply voltage is less then the low voltage alarm threshold, the LED blinks once and the buzzer rings once every 5 work periods. The low voltage alarm threshold is 2.7V for the smoke detectors using the BA45F52xx and BA45F53xx series and is 7V for the smoke detectors using the BA45F54xx series.
5. Smoke warning mode: when the smoke concentration reaches the half of the alarm threshold, the smoke detector enters the fast detect mode where the work period is fixed at 1s.
6. Smoke alarm mode: when the smoke concentration exceeds the standard, the LED blinks consecutively, the buzzer loops in a pattern of ringing 3 times and then stopping 1 time.
7. Key-triggered self-check mode: pressing the key during standby can emulate the smoke alarm mode with the same buzzer and LED working status. It is used to detect if the device is working properly.
8. Device fault mode: if the IR tube is open or short-circuited, the device will enter fault mode, where the LED blinks twice and the buzzer rings twice every 5 work periods.

9. Mute mode: the device will enter the mute mode if the key is pressed after the alarm. The mute time is determined by user's setting and has a default value of 90s.
10. Work period in sleep mode: it is determined by user's setting and has a default value of 8s.
11. Work period in non-sleep mode: it is fixed at 1s.

Note: The program includes standby mode, low voltage mode, smoke warning mode, smoke alarm mode, key-triggered self-check mode, device fault mode, air calibration mode and calibration fault mode, of which the work period is fixed at 1s except for the standby mode, low voltage mode and device fault mode.

- The flowchart of the exported program is as follows, and the processes may vary slightly with the version update. Among them, the three processes of the yellow background are user functions, which can be implemented according to user's requirements.

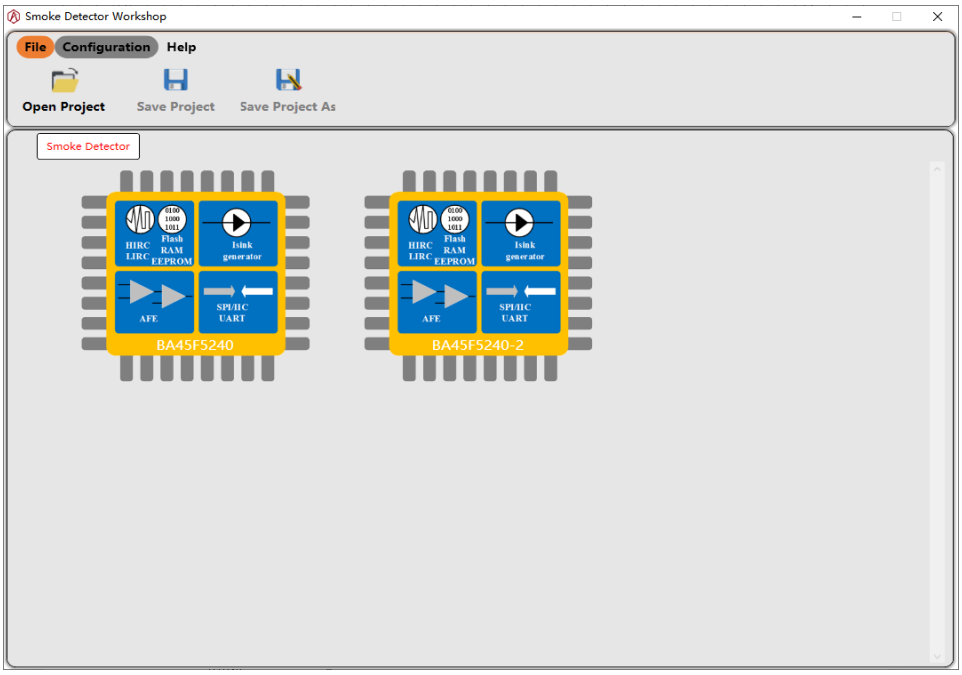


2. Configuration Description

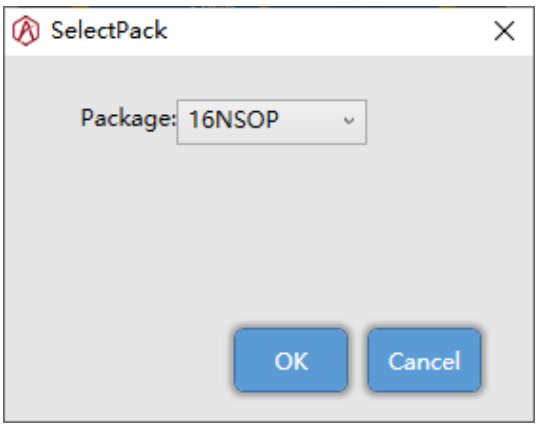
The Smoke Detector Workshop will display the currently supported MCU models after being opened. The Workshop will be gradually updated to support more MCU models and the configurable content of different MCUs may vary. The following section will use the BA45F5240-2 as an example to introduce the configuration and usage of the Workshop.

2.1 Model and Package Selection

After the Smoke Detector Workshop software is opened, there are three buttons shown in the top left corner of the interface: “File”, “Configuration” and “Help”, as shown below.

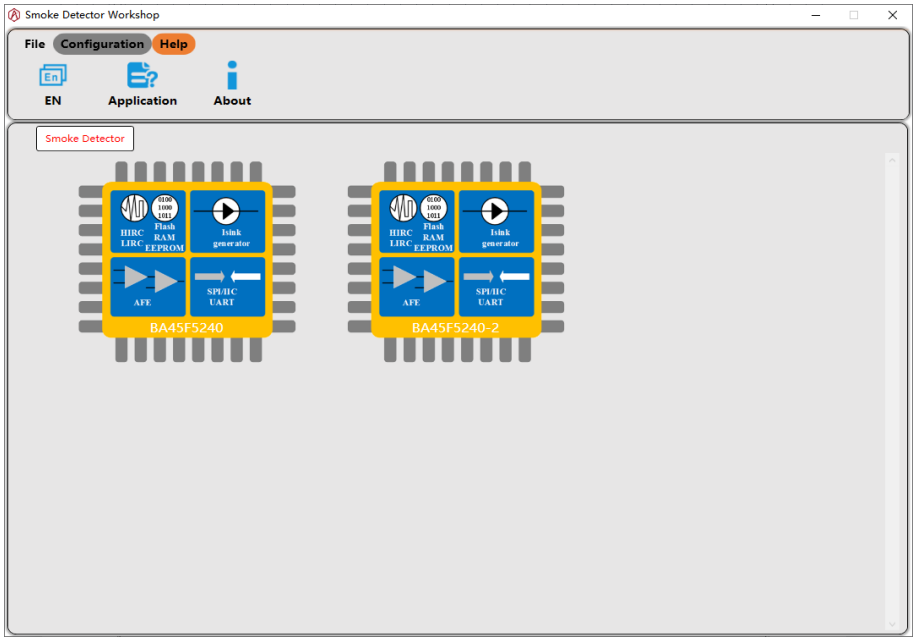


a. Click “File → Open Project” to open the project file (.sdw format) previously saved when exporting the program. To create a new project, first select the MCU model, and then select the package. The interface for package selection is as follows.



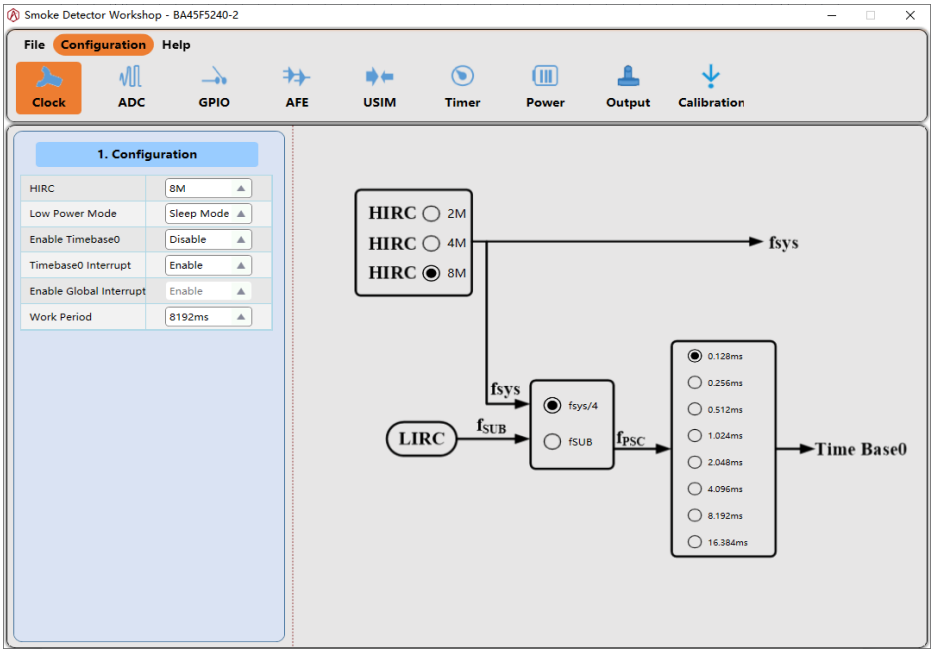
b. The configuration button is invalid to click if no project is opened or created. After a project is opened or created, it will automatically switch to the relevant configuration interface for further configurations including clock, I/O, various peripherals, etc.

c. As shown below, clicking the first icon in the “Help” menu will switch the interface language, Simplified Chinese, Traditional Chinese or English. Clicking the “Application” icon will open the Smoke Detector Workshop User Guide. Clicking the “About” icon can check the platform version.



2.2 Clock Configuration

The software will switch to the configuration interface when a project is created or opened. The following figure shows the clock configuration page. On the left, users can click on the gray triangle symbol of the option boxes to unfold the drop-down options, and select different clocks and time-out periods on the right.



a. HIRC: This series of MCUs include an integrated high speed 2/4/8MHz RC that provides a system clock to the MCU, saving external crystal oscillators. This series of MCUs adopt a 4T architecture, which means the instruction period is 0.5μs if the HIRC frequency is 8M (8MHz). It is recommended to select the 8M option.

b. Low Power Mode: If “Sleep Mode” is selected, the MCU runs once per work period while standby. If “None” is selected, the MCU runs at a full speed all the time, with a fixed work period of 1s. It is recommended to select Sleep Mode to reduce standby power consumption. Note that when in the Sleep Mode the high and low speed oscillators of the MCU will be switched off, therefore those peripheral functions which require a clock source, such as Time Base and Timer Modules, will stop operation.

c. Enable Timebase0: Timebase0, equivalent to a simple timer, is used to provide fixed-period interrupt signals. It can be disabled if not used. If this function is required, first select Enable, and then configure the clock source and time-out period on the right of the user interface. The LIRC is an MCU integrated 32kHz RC.

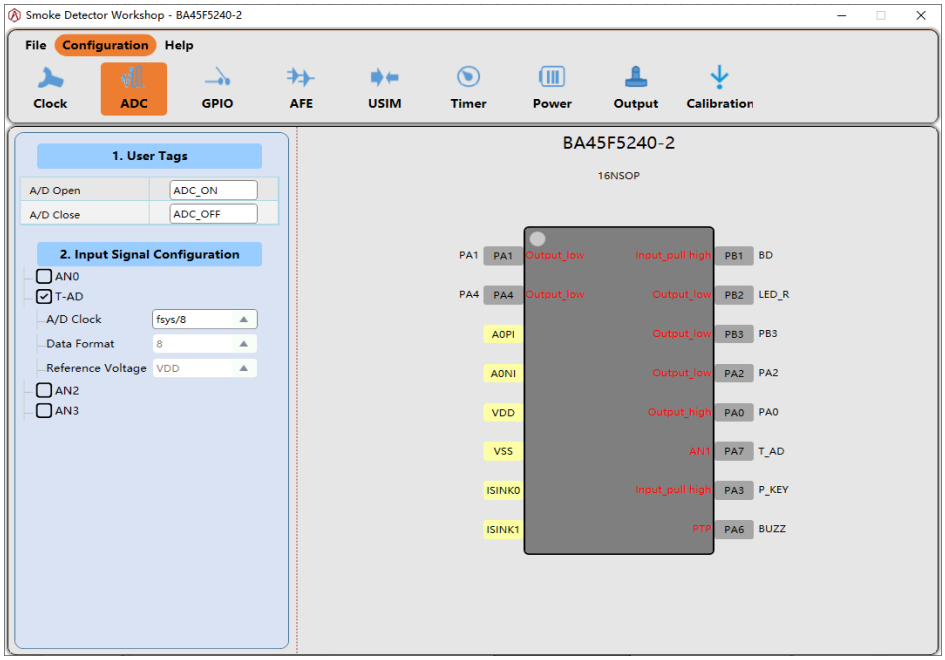
d. Timebase0 Interrupt: It is used to determine whether an interrupt signal is generated when the timebase0 time-out period finishes. If select Enable, the timebase0 interrupt processing function should be implemented by user code. Note that the timebase0 interrupt can not be normally triggered when in the Sleep Mode as the clock sources are switched off. If the function is not used, select Disable.

e. Enable Global Interrupt: It is enabled and cannot be changed, otherwise the exported program will malfunction.

f. Work Period: It determines how often the MCU runs while standby. The work period setting takes effect only when a low power mode is selected. The shorter the work period, the greater the standby power consumption. It is recommended to select 8192ms.

2.3 ADC Configuration

This series of MCUs include a 12-bit resolution A/D converter. Click the ADC icon to switch to its configuration page, as shown below.



a. User Tags: The tags for A/D open and close can be defined by users. The custom tags must conform to the naming conventions, that is, tag names can only contain numbers, letters and underscores. Tag names cannot begin with a number, nor can they have only numbers. Different tags must not have the same name and tags cannot be the same as reserved words (keywords) for C and assembly languages. Incorrect tag names will cause compilation to fail, and it is generally recommended to remain the default tag names.

b. Input Signal Configuration: The supported A/D input signals are listed here. There is a channel selected by default, and this channel is used for T_AD function, i.e. temperature detection in the temperature compensation mode, which cannot be canceled. At the same time, its data format and reference voltage cannot be changed.

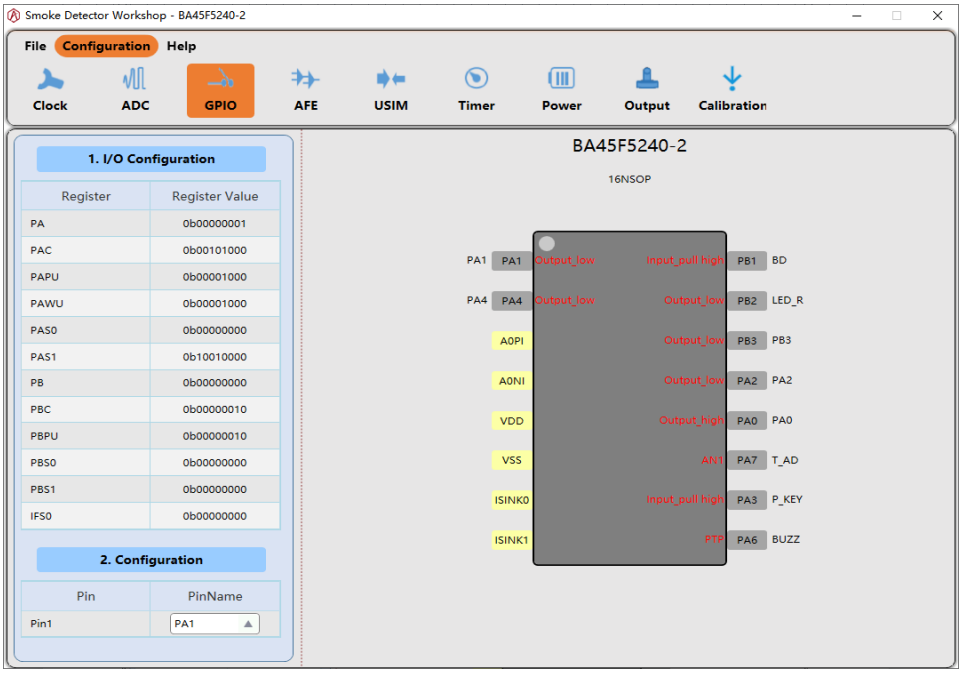
c. A/D Clock: It selects the A/D converter clock source, the selectable range of which is affected by HIRC. It is recommended to remain the default value.

d. Data Format: It is A/D resolution selection. Select 8 for 8-bit resolution, i.e. to take the higher 8 bits of the 12-bit result. 12 means 12-bit resolution. Users can set the data format according to their requirements.

e. Reference Voltage: It selects the A/D reference voltage, which can be the supply voltage (V_{DD}) of the MCU or the input voltage of the VREF pin. Note that the input voltage of the VREF pin cannot be larger than V_{DD}.

2.4 GPIO Configuration

Click the GPIO icon to switch to the GPIO configuration page. Users should correctly configure pin functions according to the schematics.



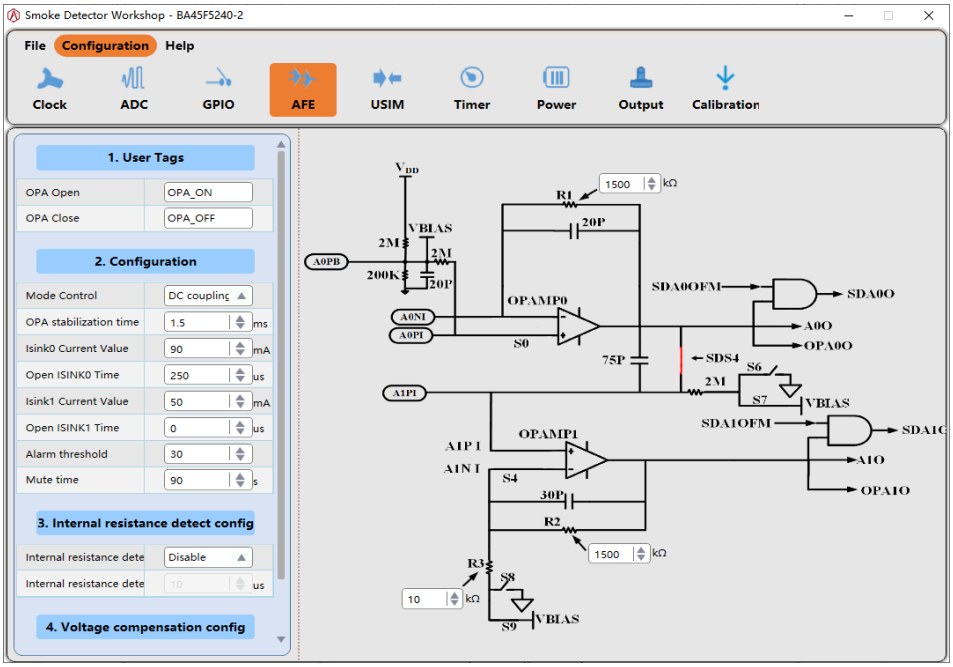
a. I/O Configuration: The relevant I/O register values of the current configuration are listed on the left. Click an I/O on the right and the function assigned to the I/O will automatically pop up. Users can select which functions are required to assign. To ensure the exported program can be implemented properly, there are several functions that each must be assigned with an I/O, including BD for air calibration, LED_R for sound and light alarm, T_AD for temperature A/D

sample, P_KEY for key-triggered self-check, and BUZZ for sound and light alarm. If these pin functions are overwritten when assigning other pin functions, a window will pop up prompting "xx: function cannot be empty, please select again".

b. Pin1 Configuration: This configuration option is only available if the BA45F5240-2 supplied in the 16-pin NSOP package is selected. For this package, the MCU's PA1 and PA5 share the pin1 location, in which case only one I/O can be selected at a time. It is recommended to set pin1 to PA1.

2.5 AFE Configuration

This series of MCUs include a smoke detector AFE circuit with the operational amplifier's gain programmable, which can be used for smoke detectors' IR optical signal detection. Smoke detection and alarm are core functions of smoke detectors, so AFE-related parameters must be measured and correctly configured, otherwise it will affect the performance of smoke detectors. The test method for partial parameters will be described in the "2.10 Calibration Function" section. Click the AFE icon to switch to the AFE configuration page.



a. User Tags: The tags for OPA open and close can be defined by users. The custom tags must conform to the naming conventions, otherwise incorrect tag names will cause compilation failure. It is generally recommended to remain the default tag names.

b. Mode Control: AC or DC coupling mode; DC coupling mode is recommended.

c. OPA Stabilization Time: In order to obtain a stable OPA output, it takes a certain amount of time to turn on the OPA, and this parameter needs to be measured.

d. ISINK0 Current Value: It configures the current value when the transmitting tube is turned on. When other conditions are the same, the larger the ISINK0 value, the larger the output of the OPA, and the greater the standby power consumption. This parameter is an important factor affecting the standby power consumption and needs to be measured.

e. Open ISINK0 Time: After turning on ISINK0, it is generally necessary to delay a certain amount of time to sample the A/D signal. When other conditions are the same, the larger the time to turn on ISINK0, the greater the standby power consumption. This parameter needs to be measured.

f. ISINK1 Current Value: ISINK1 is usually used for smoke detectors with a dual-transmitter and single-receiver structure and this parameter needs to be measured. It can be omitted if used in a single-transmitter structure.

g. Open ISINK1 Time: After turning on ISINK1, it is generally necessary to delay a certain amount of time to sample the A/D signal. When other conditions are the same, the larger the time to turn on ISINK1, the greater the standby power consumption. This parameter needs to be measured. Set the time to 0 if not used.

h. Alarm Threshold: The smaller this value, the more sensitive the smoke alarm. It needs to be measured.

i. Mute Time: Press the key after the alarm to enter the mute mode. It is recommended to set the mute time to 90s if the national standard is implemented or to 540s for the European standard.

j. Internal Resistance Detect: It is used to detect the battery internal resistance, which once reaches a certain value will trigger the low voltage alarm notifying users to change a battery. Generally, the European standard has this requirement, in which case the parameter needs to be measured. Users can disable the function if the national standard is implemented.

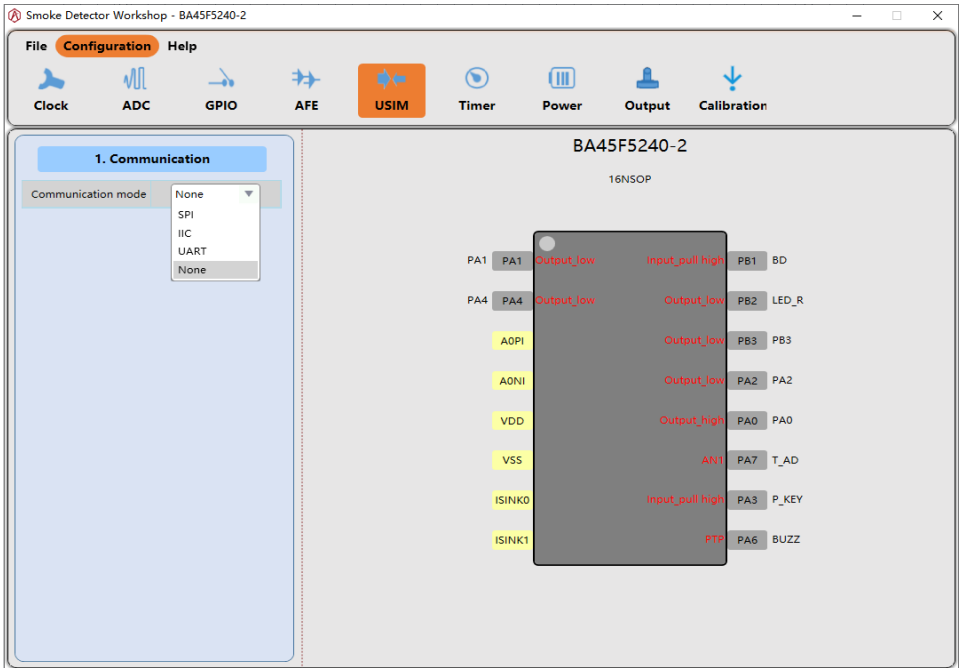
k. Voltage Compensation: In order to avoid inaccurate A/D conversion resulted from fluctuations in power supply, the voltage compensation function is recommended. The voltage compensation coefficient is calculated as follows, where 1.2V is V_{BG} voltage, the value of which may differ in different MCUs, refer to the internal reference voltage characteristics of the relevant MCU datasheet. If the MCU power supply is 3V, the voltage compensation coefficient is 307.2/3=102.4, then take the integer 102. If the MCU power is 5V, the voltage compensation coefficient is 307.2/5=61.44, then take the integer 61.

$$\text{Coefficient} = \frac{1.2V}{V_{MCU}} \times 256 = \frac{307.2}{V_{MCU}}$$

l. R1, R2, R3 Resistance Configuration: The value of R1, R2 and R3 can be configured on the right of the interface. These resistance values affect the OPA magnification. The larger R1 and R2, the greater the magnification. The smaller R3, the greater the magnification. These parameters need to be measured.

2.6 USIM Configuration

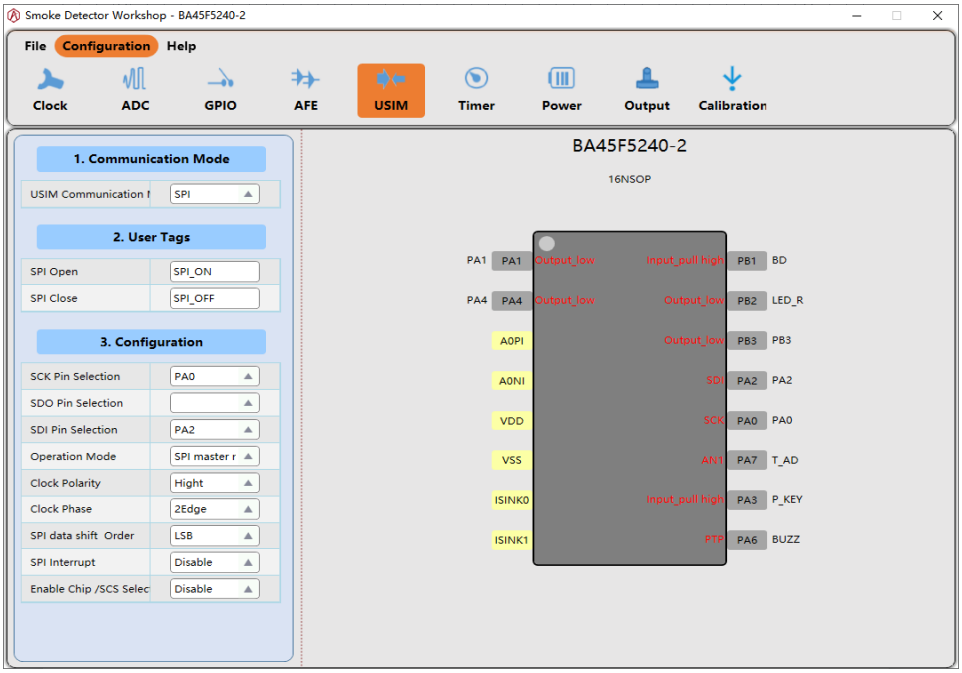
This series of MCUs contain a Universal Serial Interface Module, including the four-line SPI interface, the two-line IIC interface and the two-line UART interface types, to allow an easy method of communication with external peripheral hardware. Only one of the three interfaces can be used at a time, select None if no interface is used. Click the USIM icon to switch to the USIM configuration page.



Note: for some MCU models their Serial Interface Module (SIM) only includes the IIC and SPI functions, the UART function is configured indendently.

2.6.1 SPI Configuration

Click the small triangle symbol of the communication mode option box to unfold the drop-down menu, then select SPI to call out the SPI configuration page, as shown below.



a. User Tags: The tags for SPI open and close can be defined by users. The custom tags must conform to the naming conventions, otherwise incorrect tag names will cause compilation failure. It is generally recommended to remain the default tag names.

b. SCK, SDO, SDI Pin Selection: Note that the necessary functions mentioned in the GPIO Configuration section cannot be overwritten when assigning the SPI relevant pins, otherwise a window will pop up to prompt users to reselect pin. It is recommended to first assign the necessary functions to other unused pins.

c. Operation Mode: It allows to select master mode with different clock sources or slave mode.

d. Clock Polarity, Clock Phase: These two items configure the SPI data sampling active edge.

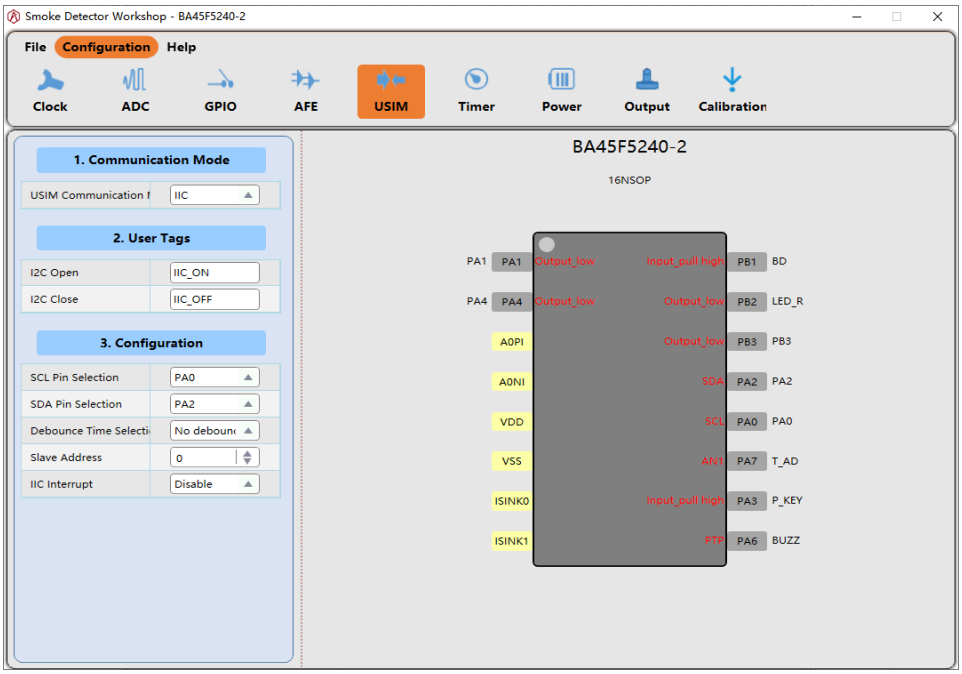
e. SPI Data Shift Order: It configures how the SPI data is transferred, MSB first or LSB first.

f. SPI Interrupt: An interrupt will be generated when the SPI data transmission is completed if the SPI interrupt function is enabled, however, the SPI interrupt processing function needs to be implemented by user code.

g. Enable Chip $\overline{\text{SCS}}$ Selection: First select the $\overline{\text{SCS}}$ pin function, then select Enable.

2.6.2 IIC Configuration

Click the small triangle symbol of the communication mode option box to unfold the drop-down menu, then select IIC to call out the IIC configuration page, as shown below. Note that the IIC interface can only operate in slave mode. If it is required to use the MCU as an IIC master device, the relevant functions need to be implemented by the program.



a. User Tags: The tags for IIC open and close can be defined by users. The custom tags must conform to the naming conventions, otherwise incorrect tag names will cause compilation failure. It is generally recommended to remain the default tag names.

b. SCL, SDA Pin Selection: Note that the necessary functions mentioned in the GPIO Configuration section cannot be overwritten when assigning the IIC relevant pins, otherwise a window will pop up to prompt users to reselect pin.

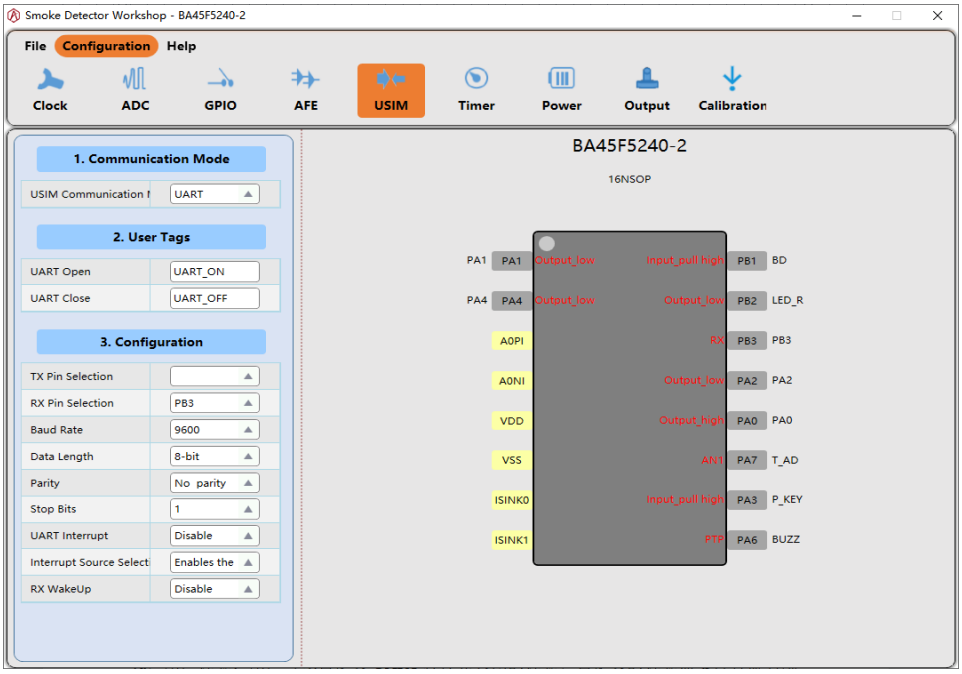
c. Debounce Time Selection: Select “No debounce”.

d. Slave Address: The MCU address as a slave device. It should be noted that the lowest bit of the address is the read/write flag.

e. IIC Interrupt: An interrupt signal will be triggered when a byte of data has been transmitted or received by the IIC interface or when an IIC address match occurs. The IIC interrupt processing function needs to be implemented by user code.

2.6.3 UART Configuration

Click the triangle symbol to unfold the pull-down menu and select UART to call out the UART configuration page.



a. User Tags: The tags for UART open and close can be defined by users. The custom tags must conform to the naming conventions, otherwise incorrect tag names will cause compilation failure. It is generally recommended to remain the default tag names.

b. TX, RX Pin Selection: The necessary functions previously mentioned cannot be overwritten when assigning the UART relevant pins, otherwise a prompt window will pop up.

c. Baud Rate: UART is an asynchronous communication interface which requires the both sides to communicate with each other using the same baud rate. The available range of the baud rate is affected by HIRC.

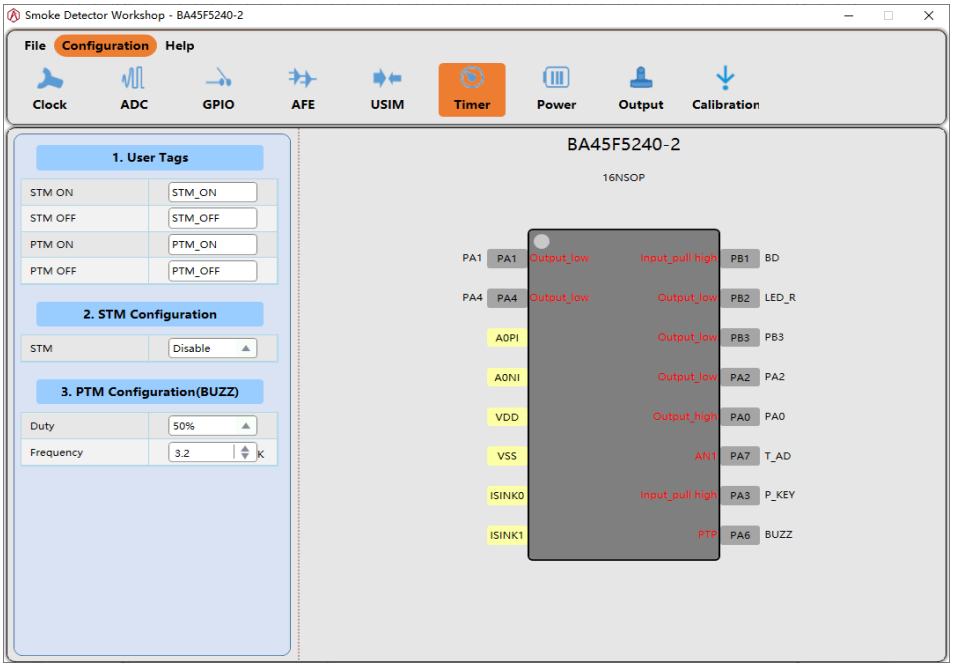
d. Data Length, Parity, Stop Bits: It is generally recommended to remain their default values.

e. UART Interrupt, Interrupt Source Selection: If the interrupt function is enabled, an interrupt signal will be generated when a certain condition occurs, while the UART interrupt processing function needs to be implemented by user code.

f. RX WakeUp: When the MCU is in Sleep mode, an RX pin falling edge can wake up the MCU if this function is enabled.

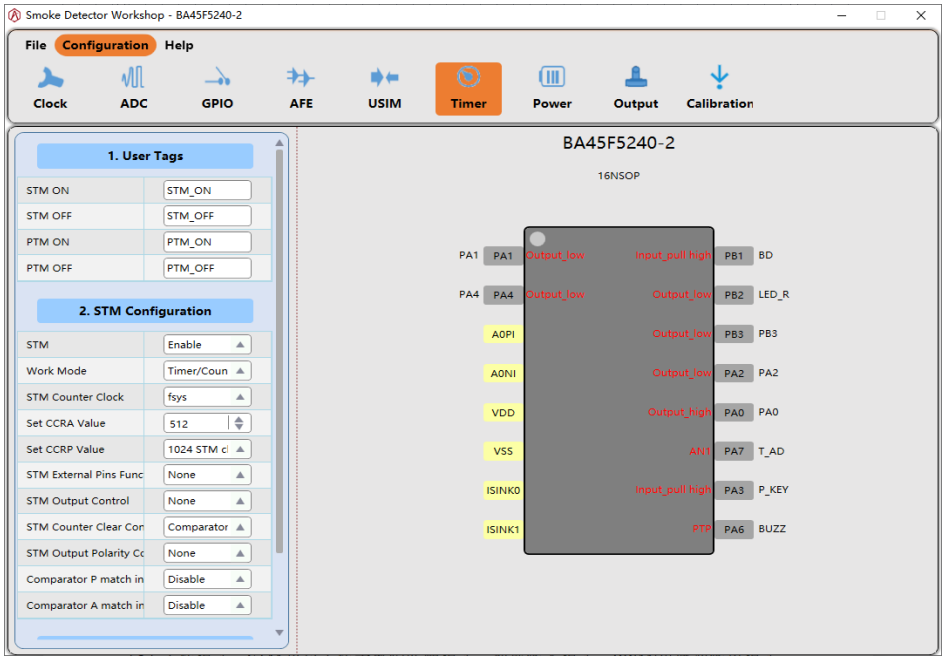
2.7 Timer Configuration

This series of MCUs include several STMs and PTMs, while the specific number of timers may differ in different MCUs. Users can define the STM and PTM on/off tags. The PTM is used for buzzer function. The STM can be individually enabled or disabled according to users' requirements. Click the Timer icon to switch to the timer configuration page.



2.7.1 STM Configuration

If it is necessary to use the STM, or known as Standard Type TM, select Enable and then the STM related configuration will pop up, as shown below.

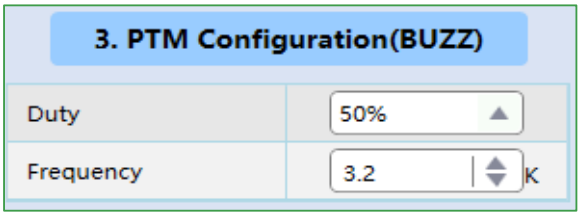


a. Operation Mode: The STM contains four operation modes, which are Compare Match Output, Capture Input, PWM/Single Pulse Output and Timer/Event Counter modes. Users can select an appropriate mode according to their own needs.

b. Others: For more detailed meaning of other configurations, refer to the MCU datasheet. Note that the clock sources are switched off when in the Sleep Mode, therefore the timer relevant interrupt can not be normally triggered if the timer operates by using an internal clock source.

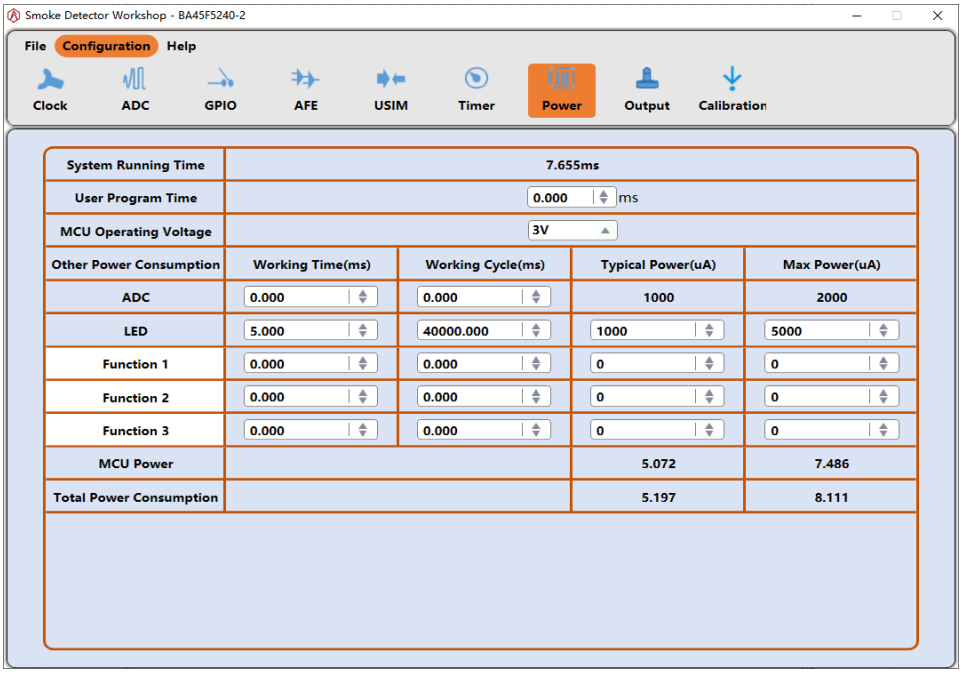
2.7.2 PTM Configuration

The PTM is fixed to work in the PWM output mode to drive the buzzer, and the user can configure the frequency and duty of the PWM output. It should be noted that the buzzer referred to here is a piezoelectric ceramic buzzer, which generally has a suitable resonant frequency of about 3.2kHz, and the user needs to select an appropriate frequency according to the characteristics of the buzzer used.



2.8 Power Consumption Evaluation

This function is used to help users evaluate the actual situation of standby power consumption (not alarm power consumption) based on the current configuration, which may be biased and is for user reference only. Click the Power icon to switch to the power consumption evaluation page.

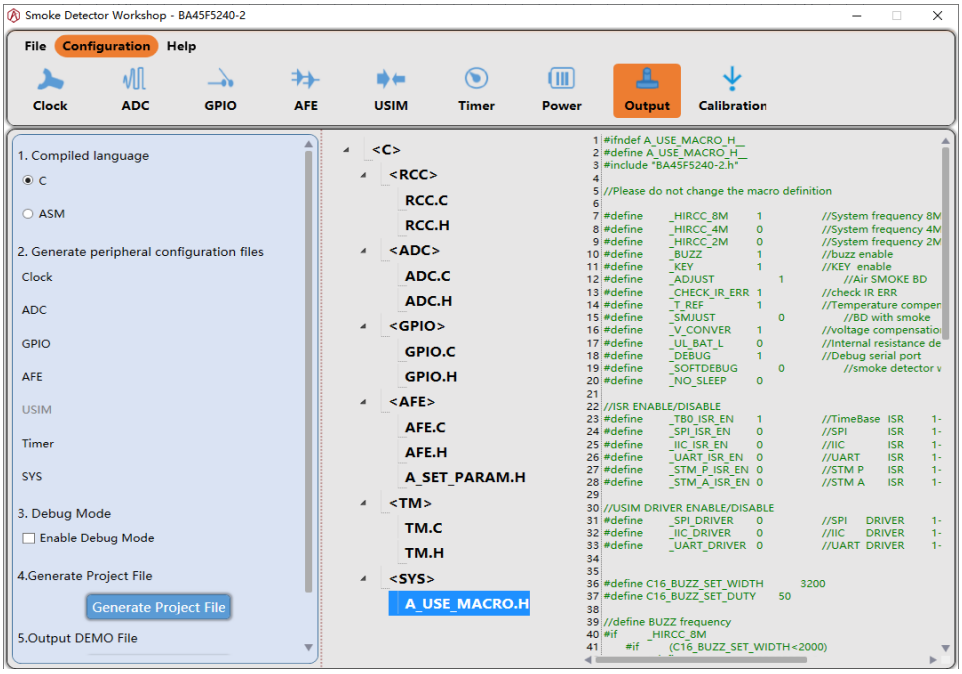


The power consumption of sleep mode is generally smaller than that of non-sleep mode. In addition to partial MCU functions, users can also manually input the working time, working cycle and working current of other peripheral functions, which can make the power consumption evaluation more accurate.

a. MCU Operating Voltage: Users can select 3V or 5V. This selection will affect the HIRC calibration voltage at the time of programming. The value that is closest to the supply voltage is recommended. For instance, it is recommended to set the MCU operating voltage to 5V if the power supply is 4.5V, or to 3V in the case of a power supply of 3.3V. In addition, the BA45F54xx series are high voltage MCUs which support a 9V power supply and includes an LDO to provide a 3.3V output.

2.9 Output Settings

After all configurations have been correctly completed, go to the output configuration page by clicking the Output icon. As shown below, click the relevant file in the middle directory tree to preview the code of the current configuration on the right. The files can be individually saved by right-clicking the file name.



a. Compiled Language: It supports the assembly language (.asm) and C language (.c), which can be selected by users' requirements.

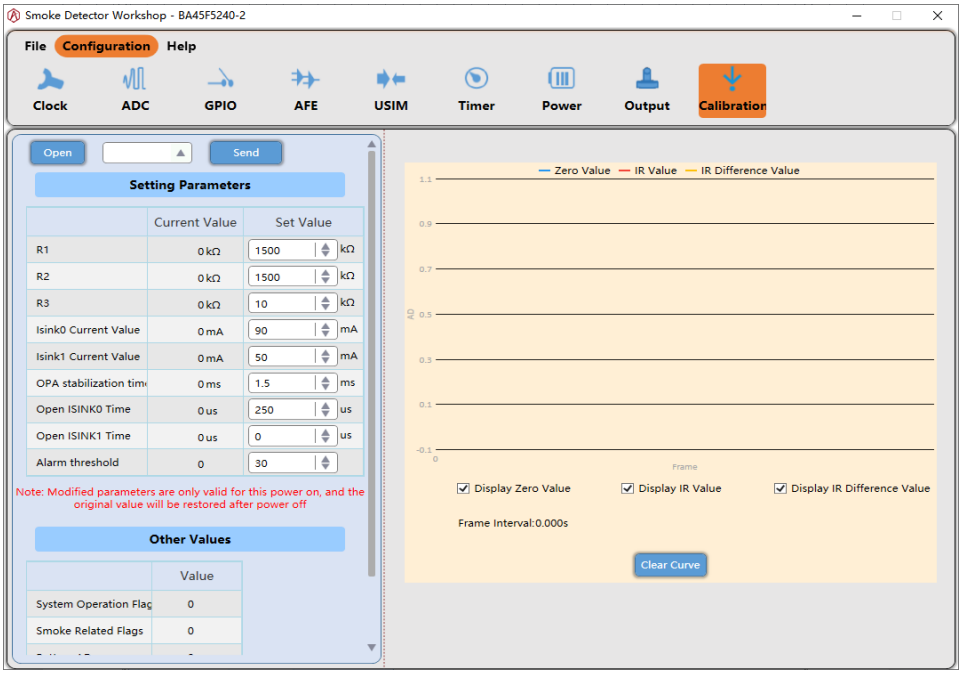
b. Enable Debug Mode: It is used to debug some of the parameters mentioned in the "2.5 AFE Configuration" section. After checking this function, a pop-up window will prompt "Debug mode will occupy PA4 (TX) and PA1 (RX), the baud rate is 9600". If the parameters to be measured mentioned in the AFE Configuration section have not be determined, it is recommended to select Enable Debug Mode. After the AFE parameters are debugged, uncheck this option and re-export the project to reduce the standby power consumption.

c. Generate Project File: After all clock and peripheral functions have been configured correctly, click the "General Project File" button and select the storage path to export the configuration project (.sdw) and configuration code. Use the HT-IDE3000 to open the project file (Project. pjtx) and recompile it to confirm that there is no problem, and then use e-Link or e-WriterPro to program the .MTP format file under the Output folder into the MCU.

d. Output DEMO File: The DEMO file, i.e. the code corresponding to the BA45F5xxx development board provided by ANCHIP, is independent of the user's previous configurations and is for user evaluation reference only.

2.10 Calibration Function

As the smoke detection chamber (maze) and infrared tubes used by different users may be different, the AFE parameters configured by the user at the beginning may not be accurate, and it is necessary to use the Calibration function of the Smoke Detector Workshop to debug the parameters and finally determine the appropriate AFE parameters. Go to the debug page by clicking the Calibration icon.



a. Select “Enable Debug Mode” before exporting the project. Correctly assign pins first if an assignment conflict prompt pops up. Export the project and use the HT-IDE3000 to open the project file (Project.pjtx) and recompile it to confirm that there is no problem. Then use e-Link or e-WriterPro to program the .MTP format file under the Output folder into the MCU. Supply power to the MCU, at which point the MCU should be in calibration fault mode with the LED always on.

b. Use a USB-to-TTL cable to connect the computer and MCU’s TX, RX and GND pins. Note that MCU’s TX should be connected to the serial port’s RX and MCU’s RX connected to serial port’s TX. Open the calibration page of the Smoke Detector Workshop, select the correct COM port, click the “Open” button, and then wait for at least one work period, after which the received current value will be displayed on the left and the graphical curve on the right. The curve contains the Zero Value, IR Value and IR Difference Value.

c. Zero Value means the 8-bit A/D value of the receiving tube output when IR transmission is not turned on. IR Value means the 8-bit A/D value of the receiving tube output at the moment of turning on the IR transmission. IR Difference Value equals to IR value minus zero value. The IR value and IR difference value increase significantly from a smoke-free environment to a smoky environment, while the zero value is not affected.

d. In a smoke-free environment, the zero value should be in the range of 5~50, the IR value should be in the range of 50~200, the IR value plus alarm threshold must be less than 240, and the IR difference value should be in the range of 20~180. In addition, the fluctuation range of these three values in a smoke-free environment cannot be too large. Generally, a fluctuation range of less than 10 times of the A/D value is considered qualified.

e. R1, R2, R3 Resistence Values: These three values affect the OPA magnification. Adjust the three resistors to ensure that the IR value and IR difference value are in a proper range. The zero value is usually not affected by the OPA magnification. If it is too high or too low, check the hardware.

f. ISINK0 Current Value: If the IR value is too high or too low, adjust the ISINK0 current value to keep the IR value in the normal range.

g. ISINK1 Current Value: It is used for dual-channel detection and is configured in the same way as ISINK0. Ignore it if not used.

h. OPA Stabilization Time: It mainly affects the zero value. Adjust this value to minimize the fluctuation range of the zero value.

i. Open ISINK0 Time: Keep the other parameters unchanged and increase this value from the minimum value until there is no significant increase in IR value.

j. Open ISINK1 Time: Keep the other parameters unchanged and increase this value from the minimum value until there is no significant increase in IR value. Set the time to 0 if not used.

k. Alarm Threshold: It should be measured in a smoky environment. After other AFE parameters are configured, first place the smoke detector in a smoke-free environment and record the IR Difference Value 1. Then place the device in a smoky environment that reaches the alarm threshold concentration, record the IR Difference Value 2. Alarm Threshold = IR Difference Value 2 - IR Difference Value 1.

l. Other Values: They are used for debugging and can be ignored.

m. Note: After all AFE parameters are adjusted, click the “Send” button so that the new AFE parameters will be sent to the MCU. Additionally, the modified parameters are only valid for this power-on, and the original AFE parameter values will be restored after the MCU is powered off.

n. After the AFE parameters have been calibrated correctly, click the Output icon again to cancel the “Enable Debug Mode” option to reduce the standby power consumption. Click “Generate Project File” again to export the new AFE parameter code, then recompile and program the file to the MCU.

3. FAQ

1. Q: What are the differences between the BA45F5240 and BA45F5240-2?

   A: The BA45F5240-2 is only supplied in the 16-pin NSOP package. The BA45F5240-2’s PA1 and PA5 are both externally bounded to the pin 1 location, which cannot be used simultaneously.

2. Q: What type of smoke detection products is the Smoke Detector Workshop suitable for?

   A: The BA45F5xxx series of MCUs are suitable for use in photoelectric smoke detection products. Electric smoke detection products are developed basing the principle that smoke generated during fire can change the propagation characteristics of light. However, photoelectric smoke detection products can be divided into light shading type and light scattering type according to maze structure. The program generated by the Smoke Detector Workshop is suitable for photoelectric scattering type of smoke detection products.

3. Q: If a peripheral is misconfigured, is it necessary to reconfigure all configuration contents and export the file again?

   A: Not necessary. When exporting the project, a project (.sdw) file will also be generated in addition to the code. Directly open the project, select the project file to restore the original configuration and then modify the misconfigured item.

4. Q: Why does the Smoke Detector Workshop prompt “Error：Failed to Build” when exporting a project?

   A: If such an error prompt pops up, click “OK” so that a window for the compilation result will pop up, where users can locate the file for the compilation error and the cause of the error. If users cannot resolve the problem, please contact ANCHIP for help: service@anchip.cn.

5. Q: Why the data from MCU cannot be received when using the AFE parameter debug function?

   A: First, check if the “Enable Debug Mode” option is selected before exporting the project. If yes, use an oscilloscope or logic analyzer to check whether the MCU TX pin has data output and whether the baud rate is correct or not. If the baud rate is not accurate, the cause may be that the HIRC calibration voltage during programming is incorrect, refer to the “2.8 Power Consumption Evaluation” section for details.

6. Q: In the exported code project, what is the purpose of the folder “UserCode”?

   A: This folder contains the user function file (UserFunction) and interrupt function file (UserISR), which is to facilitate program transfer so that users only need to replacing the UserCode folder when exporting new projects. The UserFunction file contains three functions. S_USER_INIT is a user initialization function, which is executed once after power-on. S_USER_8MS_WORK_PERIOD is a user 8ms period function, which is not executed when in the standby state and executed once every 8ms when in the non-standby state. S_USER_1S_WORK_PERIOD is a user 1s period function, which is executed once every work period when in the standby state, and executed once every 1s when in the non-standby state. The UserISR file contains the interrupt processing functions. After enable the interrupt functions, place the corresponding interrupt processing functions in this file. In most cases, ANCHIP only recommends that users modify files in the UserCode folder, with other exported files unchanged.

7. Q: What should be noted by users when modifying the files in the UserCode folder?

   A: (a). All variables (RAM) will be cleared to zero after MCU power-on, therefore, it is recommended that users do not assign initial values when defining global variables.

   (b). During the execution of the user 8ms period function, the program execution time should not exceed 8ms, otherwise it may result in abnormal program period.

8. Q: Why are some A/D values abnormally small?

   A: Almost all A/D values in the platform-derived program use the 8-bit A/D data format. The problem may occur if the user select 12-bit data format, refer to the “2.3 ADC Configuration” section for more details.

9. Q: How to modify the temperature compensation threshold?

   A: In order to simplify the operation, the exported program uses the method of segment compensation. The ASM\SYS\A_USE_MACRO.inc (Assembly language path) file or the C\SYS\A_USE_MACRO.h (C language path) file contains macro definitions for temperature compensation, including temperature fault high and low thresholds, temperature compensation high and low thresholds, temperature compensation high and low constants. Users only need to modify the initial compensation thresholds and initial compensation values according to the measured results.

10. Q: Is the low voltage alarm threshold a fixed a value? Can it be modified?

    A: It cannot be modified on the platform but can be modified by users after the program is exported. A macro definition of C_BAT_LOW (i.e., low voltage threshold AD value) can be found in the A_USE_MACRO file. For MCUs which use V_{BG} for low voltage detection, the low voltage threshold is calculated as follows, and the fractional part of the calculation result

is rounded. For instance, to change the low voltage threshold to 3.6V, users only need to change the value of this macro definition to 85.

$$C\_BAT\_LOW = \frac{V_{BG}}{V_{LOW}} \times 256 = \frac{307.2}{V_{LOW}}$$

11. Q: What is the BD function used for?

    A: The BD function is used for air calibration, with the purpose of recording the output of the IR receiving tube in the smoke-free environment. The output of the IR receiving tube increases when there is smoke and triggers a smoke alarm when it is increased to a preset alarm threshold. The operation method of air calibration is as follows. After programming the program into the MCU, short connect the BD pin to GND in a smoke-free environment, and then power on, at which point the air calibration is automatically triggered with the LED blinking once per second. After the air calibration is successfully completed, the device will enter the normal standby mode. There is no need to short connect BD to GND again the next time of power-on.

12. Q: Where can users look up the instruction set in assembly language?

    A: The relevant MCU datasheet provides a description of the assembly instruction set. To download relevant MCU datasheet, refer to Holtek's website.

13. Q: Can this series of MCUs detect black smoke?

    A: Yes. The ISINK1 channel can be used to detect black smoke. However, black smoke detection function needs to be implemented by users as the program exported by the Smoke Detector Workshop only contains single-channel detection.

14. Q: Other questions, suggestions or bugs?

    A: Please contact ANCHIP for feedback: service@anchip.cn.