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## F<sup>2</sup>MC-8FX Family MB95200 Series 8-Bit Microcontroller Smoke Detector Demo Reference Solution

**Associated Part Family: MB95200 Series**

This application note describes the features of a Smoke Detector demo board.

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## 1 Overview

This Demo board is a smoke detector which is used to detect fire. It is a photoelectric detector that senses the infrared refracted by mote or dust caused by fire. The MCU is Cypress MB95202K from MB95200 series.

This demo set supports the following features:

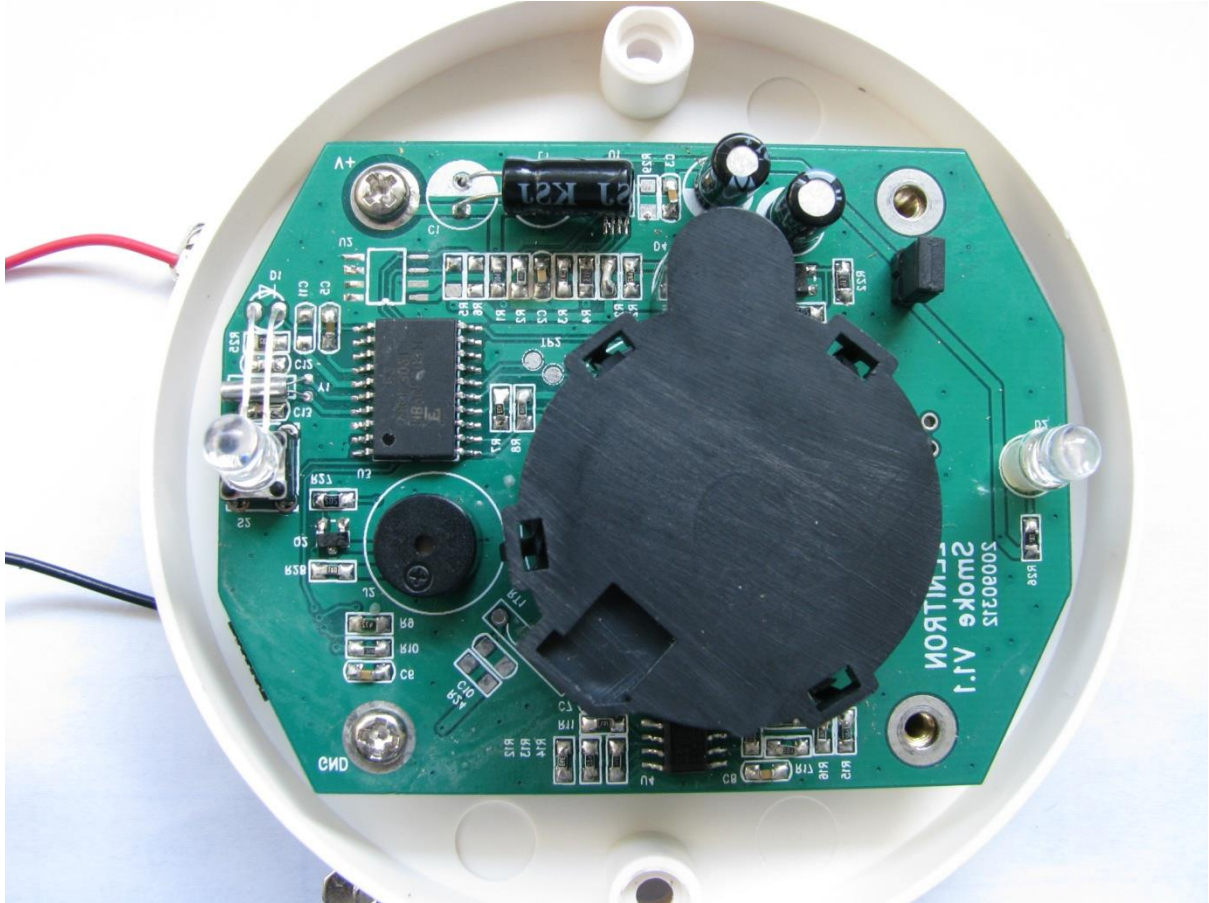
- High dB alarm
- Powered by battery
- Low power consumption

## 2 Demo Platform

### 2.1 Platform

Figure 1 shows the platform of smoke detector. D1 and D2 are alarm LEDs. The key is used for self-test.

Figure 1. Demo Platform



### 3 Features

#### 3.1 High dB Alarm

The sound is higher than 70 dB in the field of 3 m. When the detector is fixed lower than 5 m above the floor, it can cover 60 m<sup>2</sup>.

#### 3.2 Powered by Battery

The detector is battery powered equipment. Two 5# batteries can drive it. It runs at 1.8 V to 3.3 V DC voltage.

#### 3.3 Low Power Consumption

In battery powered system, the power consumption is a key parameter. There is a table below to illuminate the main current consumptions.

Table 1. Current Consumption

Test Condition	DC to DC	Amplifier	MCU	Others	Total
3 V	65 mA (EMH7600)	20 mA	10 mA	5 mA	100 mA*3 V=300 mW

In 3 V condition, the total current is 100 mA. If it is powered by two 5# batteries which have a capacity of 2300 mAh, the batteries can last 958 days which is calculated by this formula:

$$(2300 \text{ mAh} \cdot 1000) / (100 \text{ mA} \cdot 24 \text{ h}) = 958,$$

Of course this is an ideal data. The actual time will be shorter. The designer can reduce the power consumption by using low power consumption ICs, reducing the system leak current, and using more perfect firmware and so on.

## **4 Functions**

### **4.1 Normal State Indication**

When power is on, D1 and D2 will flash for one time to indicate that the demo works normally.

### **4.2 Self-test Function**

In order to test the demo, we can press the key. The buzzer will sound periodically when the key is continuously pressed. That means the detector is in normal state.

### **4.3 Low Battery Output Warning**

In this demo set, the DC-DC converter has battery capacity monitor function which can supply a signal to the MCU to warn low battery output. When low battery output occurs, the buzzer will sound and the LEDs will flash at the same time.

### **4.4 Automatic Alarm**

The detector senses the refracted light that reflects the thickness of mote or dust. Stronger light means more mote or dust, and also means high risk of fire. When the thickness of the mote or dust rises up to a threshold, the red fire-alarm light will flash first, then buzzer will sound for 11s later.

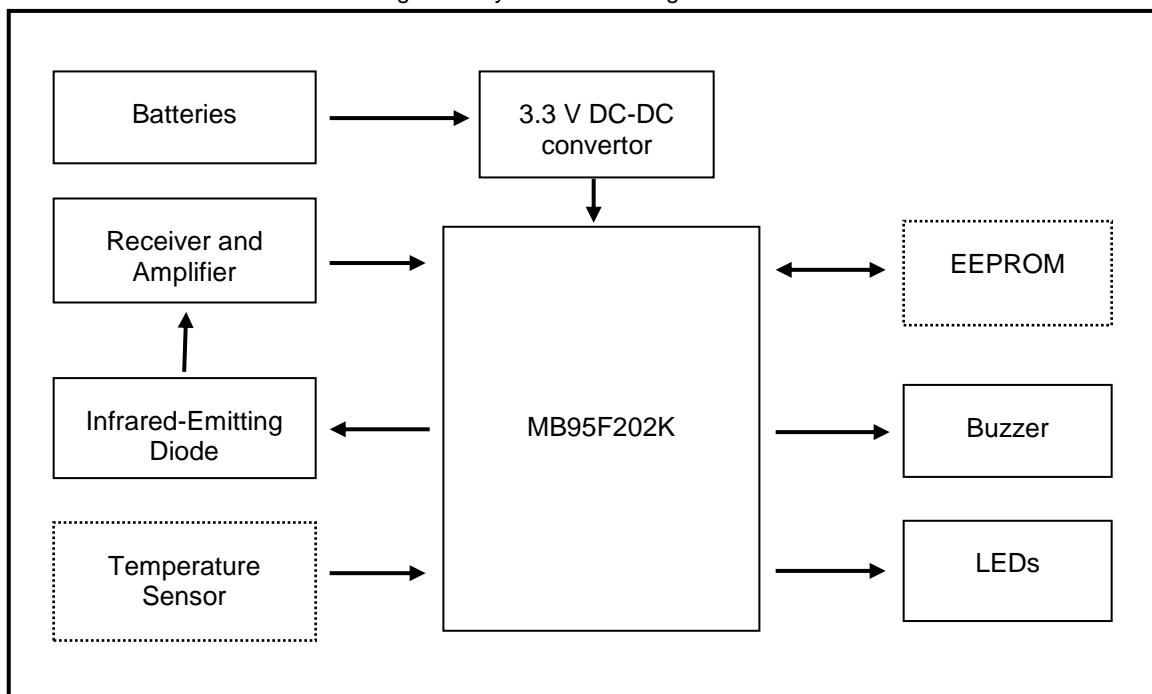
## 5 Hardware

### 5.1 System Block Diagram

The demo system contains the following elements as shown in [Figure 2](#).

- MCU
- DC/DC boost converter
- IR receiver and amplifier circuit
- IR LED driver
- EEPROM
- Buzzer
- Temperature sensor

Figure 2. System Block Diagram

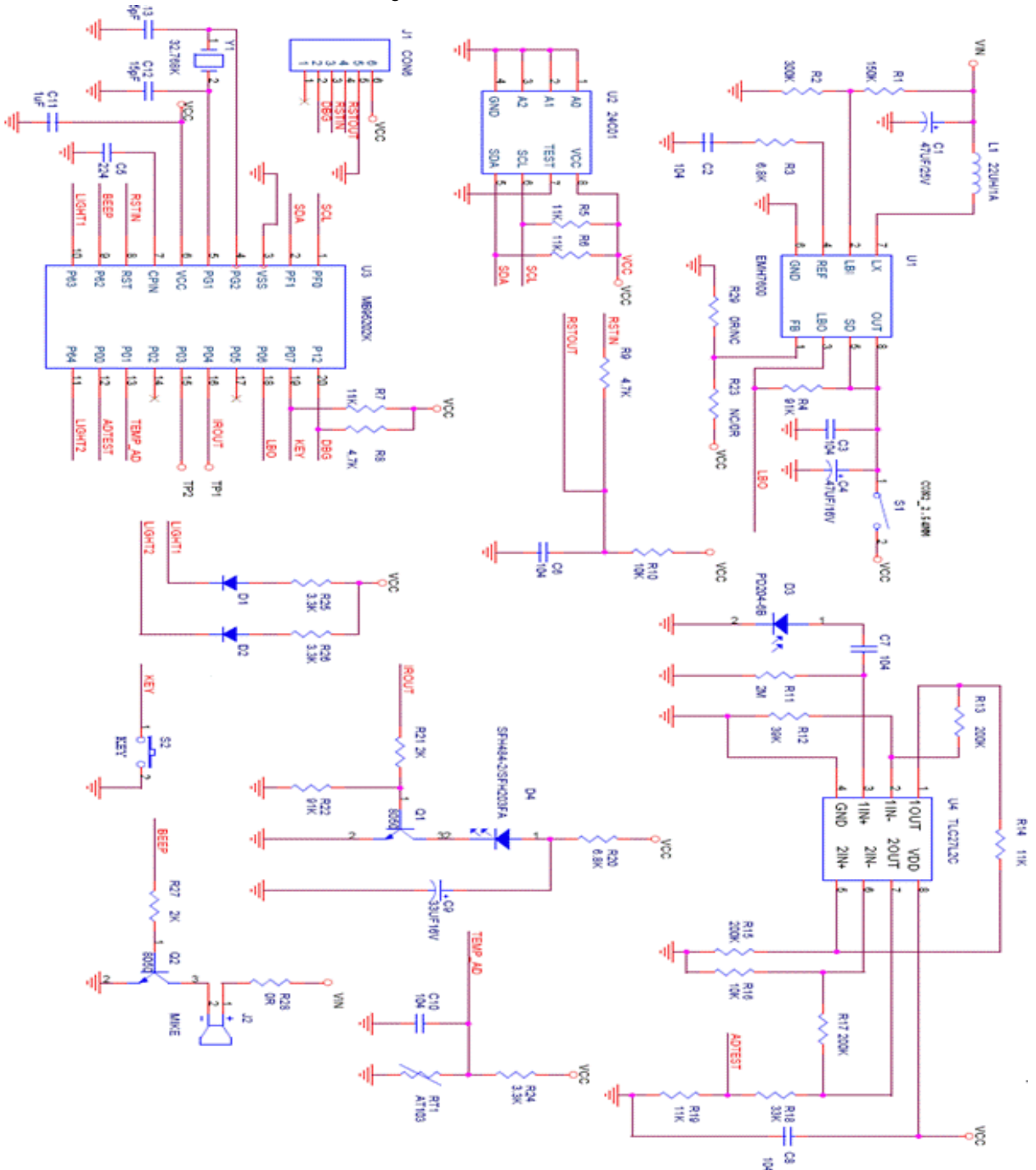


## 5.2 Schematic

This schematic is a full version, and the temperature and EEPROM are alterable devices.

Figure 3 shows the schematic.

Figure 3. Smoke Detector



### 5.3 Modules

Some main modules will be introduced in this section.

#### ■ MCU

In this demo, the MCU is MB95F202K from Cypress excellent MB95200 series. It has following main features:

- 4 KB FLASH, 240 bytes RAM
- 4 clock resources: main OSC, sub OSC, main CR, sub CR.
- 2 channels of 8/16bits timer
- LIN module supporting main and slave mode
- 6 channels for 8/10bit A/D
- LVD

So, this MCU is absolutely competent in this system. The peripheral circuit is like [Figure 4](#).

Figure 4. MCU

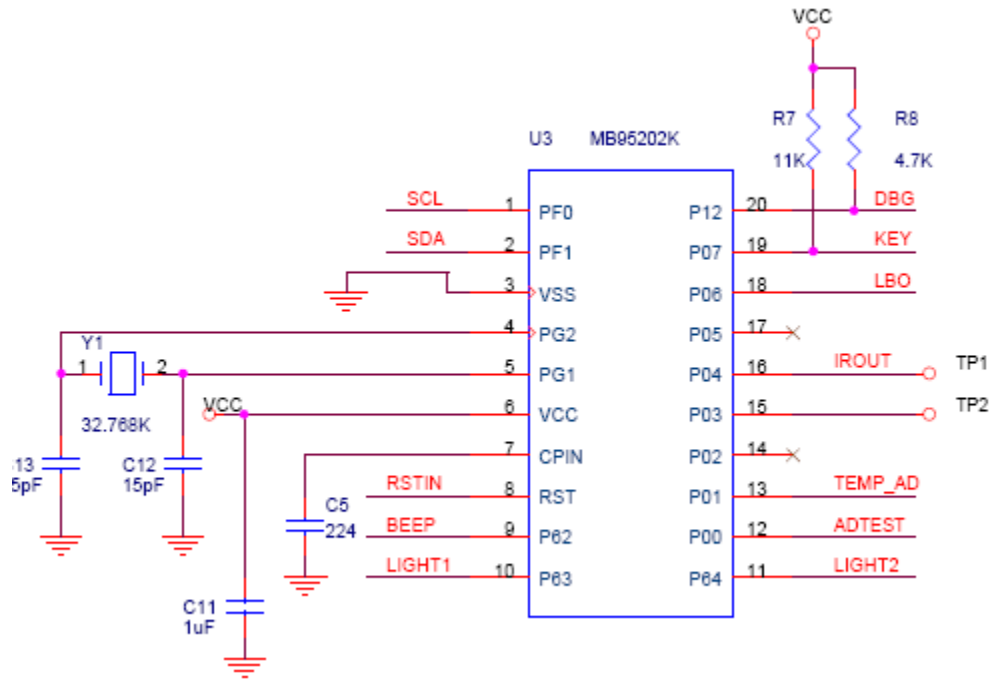




Table 2 shows the pin assignment.

Table 2. Pin Assignment

Number	Pin	Function
1	PF0	EEPROM clock
2	PF1	EEPROM data
8	RST	REST input
9	P62	Buzzer
10	P63	LED D1
11	P64	LED D2
12	P00	Voltage input transformed from reflected infrared current
13	P01	Temperature input
16	P04	Infrared output
18	P06	Monitor the battery capacity
19	P07	Key input
20	P12	One line debug

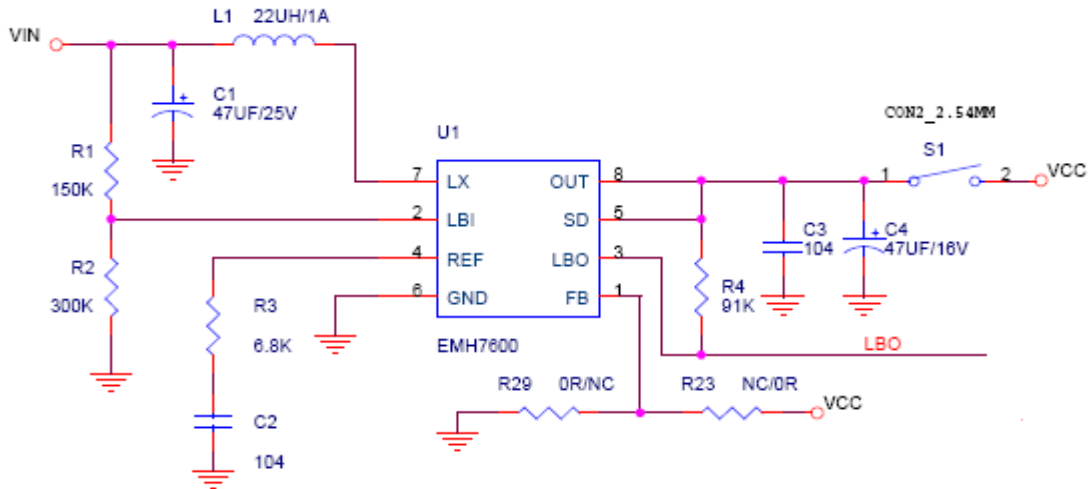
■ DC-DC Boost Converter

The DC-DC boost converter is used to fix the power output at 3.3 V when the battery voltage is lower than 3V. In this design, we select EMH7600 which is a boost converter with 0.3 V – 6 V input and 3.3 V output. The output current is up to 500 mA. About this part, the efficiency has to be considered. Low efficiency will bring huge power consumption.

This IC has a battery capacity monitoring function which is useful here. The pin LBI is battery comparator input and LBO is the output. When the voltage on LBI is lower than 1.195 V, the LBO will switch to low from high level.

Figure 5 gives the DC-DC circuit.

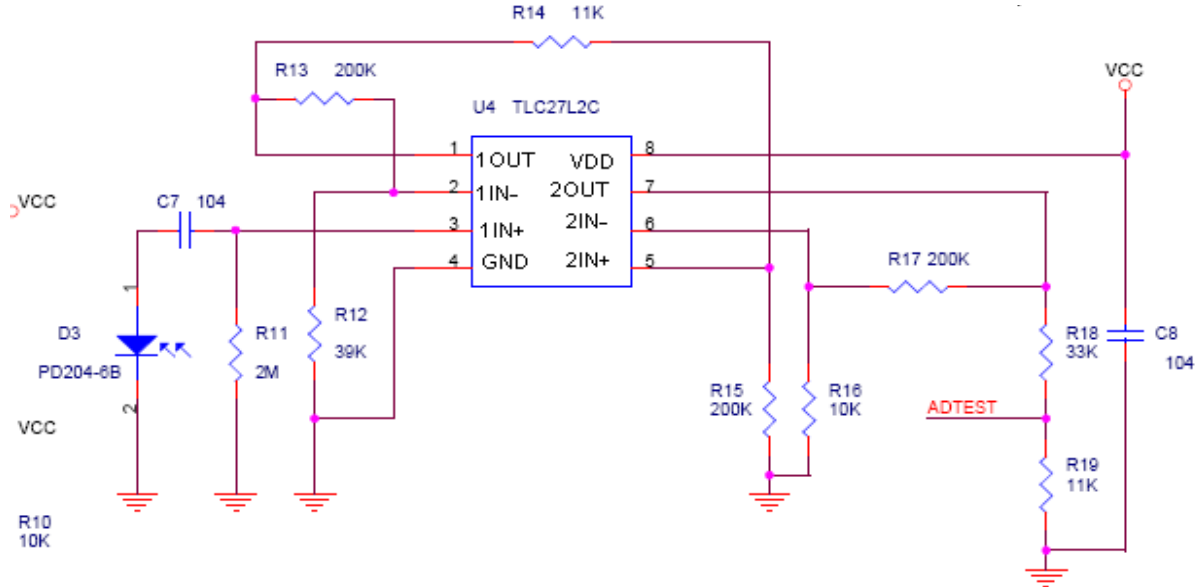
Figure 5. DC-DC



■ IR Receiver and Amplifier Circuit

This demo is a photoelectric detector which contains an IR-emitted diode and an IR-received diode. The IR-received diode is fixed in a dark cavity. Amplifiers circuit is needed here to magnify the signal for the following AD stage. The current was transformed to voltage before the amplifier. The amplifier circuit contains two stage amplifiers with total plus of 50 times. PD204-6B is IR receiver.

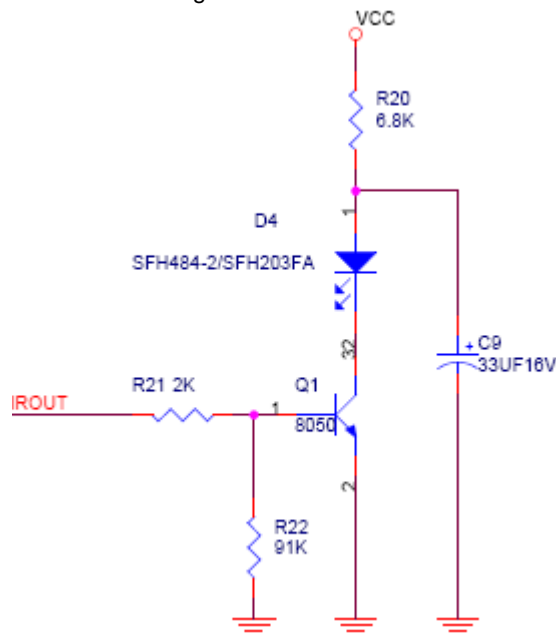
Figure 6. Amplifier Circuit



■ IR Emitter Circuit

Actually IR emitter is an IR emitting diode. It is driven by a dynatron. Figure 7 shows the circuit.

Figure 7. IR Emitter



## 6 Firmware

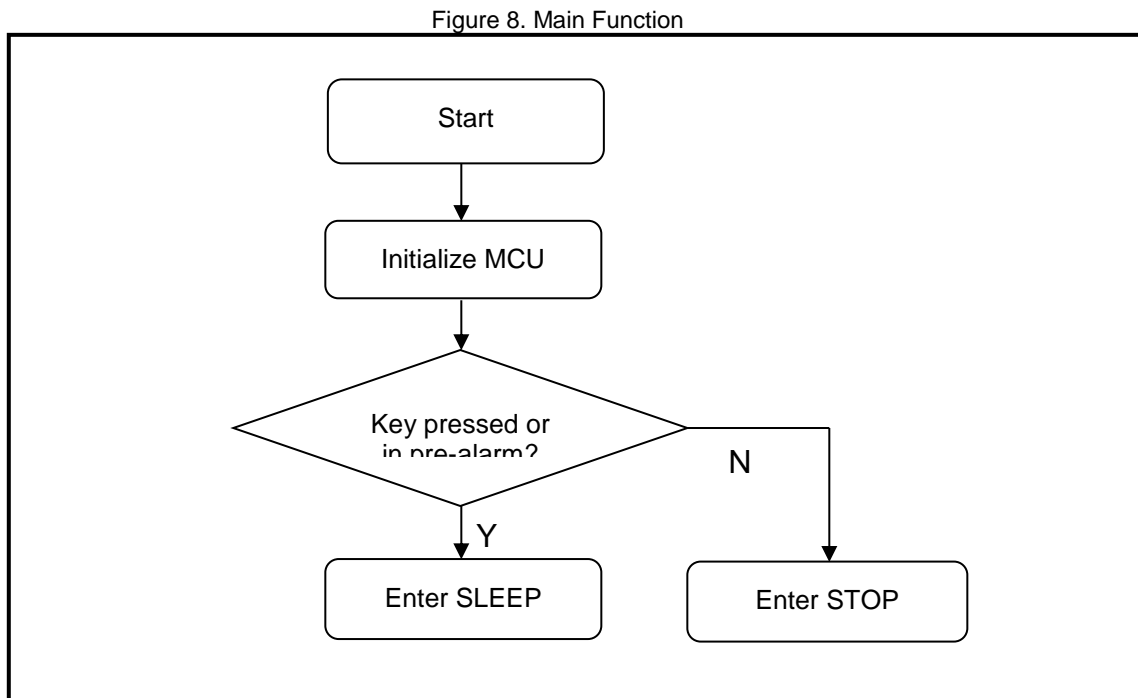
As many battery powered systems, to reduce power consumption from firmware side is as important as hardware side. Sleeping with periodical wake-up is a widely used method to reduce the power consumption, so does this demo.

### 6.1 Flow Chart

#### 6.1.1 Main Function

The Low power modes are set in the main function. The MCU can enter SLEEP or STOP mode according to the key and alarm state.

Figure 8 illuminates the main function.

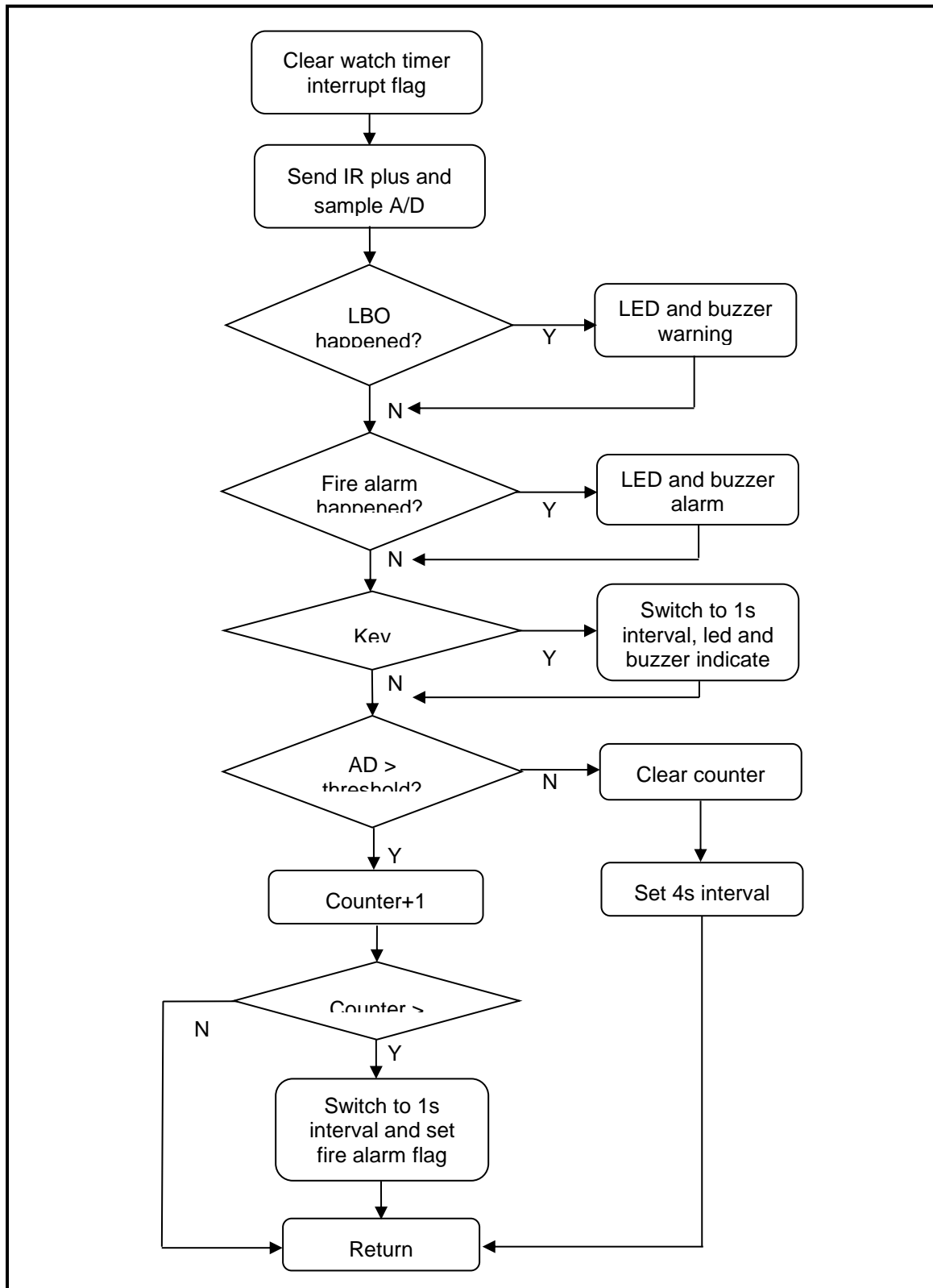


#### 6.1.2 Watch Timer ISR

Usually, the MCU will be waked up by watch timer interrupt one time in every 4s. MCU will give a plus to the infrared LED, and samples the voltage input at the same time when it is waked up. If it is the first time that the A/D value is greater than the threshold, the wake-up interval will be set to 1s and start a counter.

Figure 9 illuminates the watch timer ISR (see next page)

Figure 9. Watch Timer ISR

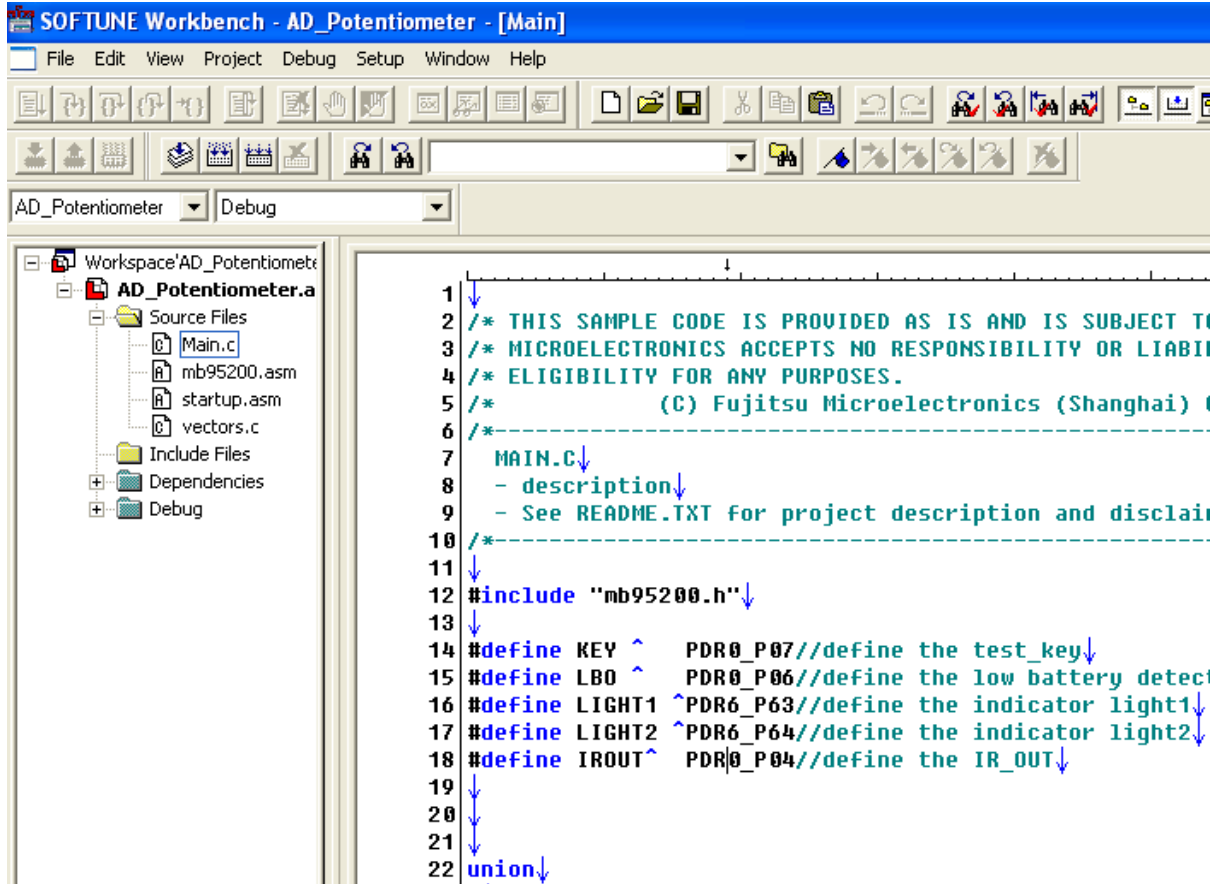


**NOTE:** LBO means low battery output.

## 6.2 Project

In this project, all functions and definitions can be found in main.c. The others are files supplied by Cypress. Mb95200.asm is a memory definition. startup.c is start file. vectors.c is a vector definition.

Figure 10. Project



## 7 Additional Information

For more information on Cypress MB95200 products, please visit following website:

<http://www.cypress.com/MB95200>

## Document History

Document Title: AN204734 – F<sup>2</sup>MC-8FX Family MB95200 Series 8-Bit Microcontroller Smoke Detector Demo Reference Solution

Document Number: 002-04734

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	HUAL	11/04/2009	Initial release
*A	5250250	HUAL	05/18/2016	Migrated Spansion Application Note MCU-AN- 500054-E-10 to Cypress format.
*B	5844486	MALI	08/04/2017	Updated logo and copyright

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