Software Guide for NS-RX231

<SPEAKER>

Contents

1 Load the Project

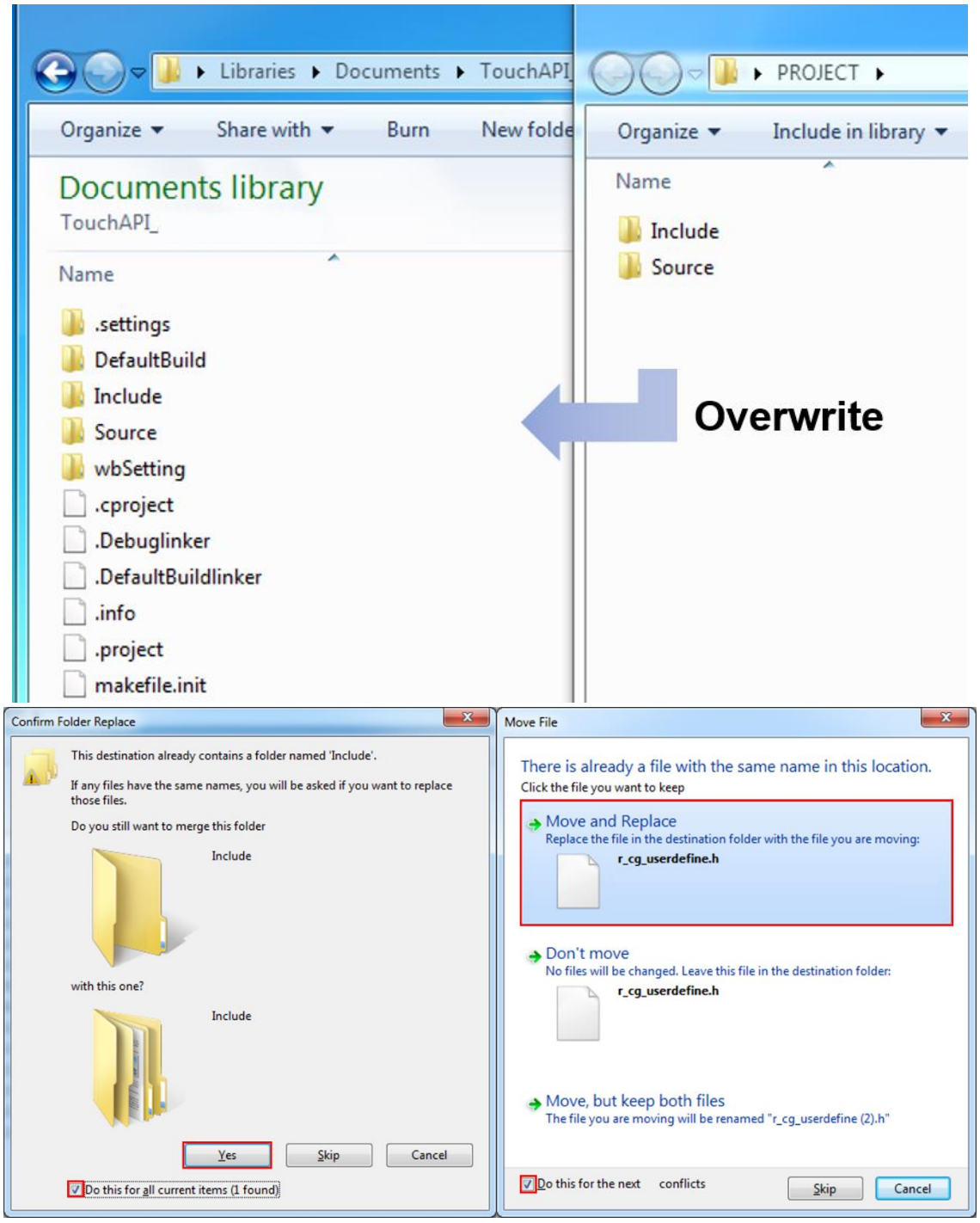

Figure 1-1 Overwrite the source file

Overwrite the attached source file with the project created by the Workbench6 First step guide wizard and run it in e2studio.

2 Summary

In the case of an 8-bit timer, it is 4 when used as 8-bit, but it can be used as a 16-bit timer by combining two. The biggest advantage of the 16-bit timer is that when the timer is 8-bit, the range of the counter

value is from 0 to 255 (2^8-1), while the 16-bit timer is from 0 to 65535 (2^{16}-1). Since the range that can be specified is widened, it is possible to fine-tune the timer's triggering time.

The timer can increase the internal counter value to generate an interrupt at a certain value.
For example, in the case of an overflow interrupt, an interrupt occurs when the counter value exceeds the maximum value (overflow).

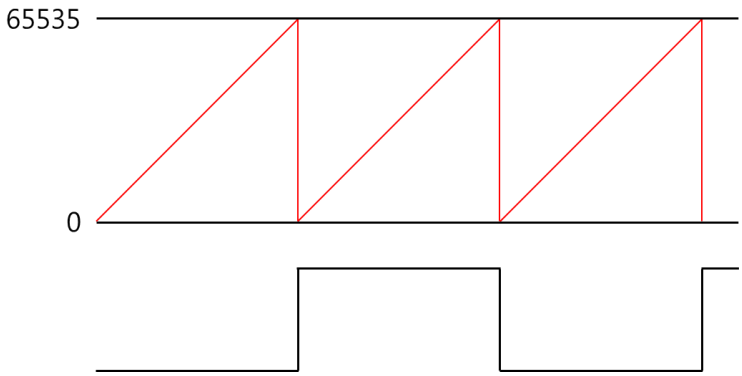

Figure 2-1 Example of overflow interrupt

However, in the case of a compare interrupt, an interrupt occurs when the counter becomes the specified comparison value

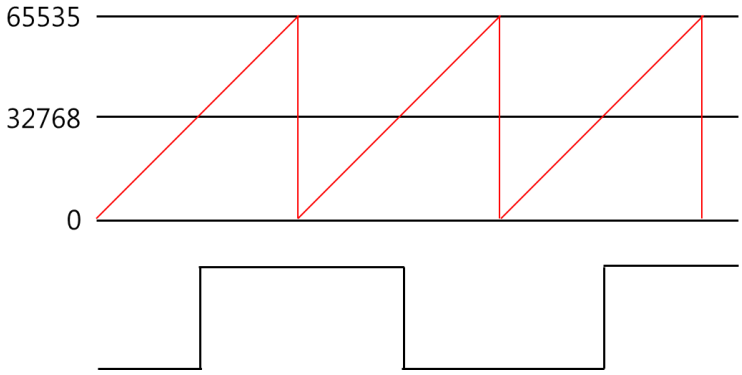

Figure 2-2 Do not reset counter when performing compare interrupt

When the compare interrupt is executed, if the counter is not reset at the same time, the result shown on the left in Figure 2-3 will be displayed. As a result, only the overflow interrupt and the start time will be faster, and the result will be the same.

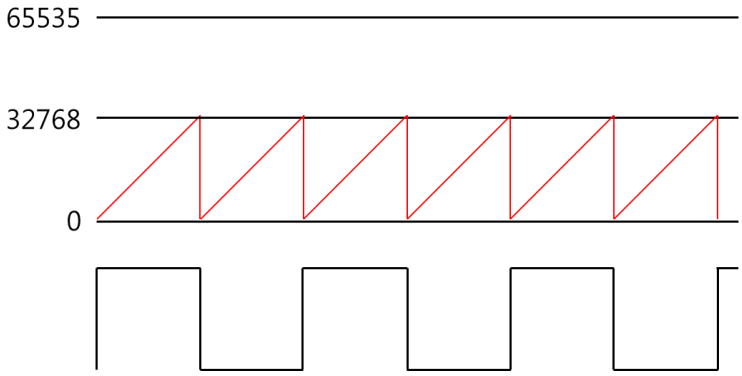

Figure 2-3 Counter reset when compare interrupt is executed

If the counter reset is executed simultaneously with the compare interrupt execution shown in Figure 2-3, it will be possible to repeat it several times in a short time.

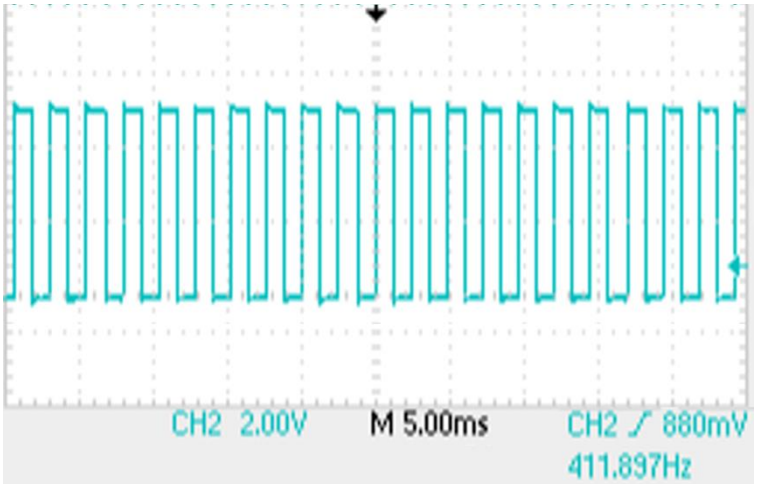

Figure 2-4 Waveform of the oscilloscope with a value of 32768

$$\text{TCORA value} * \text{Desired Frequency[Hz]} = \text{Timer Operating Frequency[Hz]}$$

$$7\text{FFF}(32768 - 1) * 411.897[\text{Hz}] = 13497040[\text{Hz}]$$

For example, the middle Do(C) of the piano scale has a frequency of 523Hz. 1Hz means to vibrate once per second. In other words, to express a medium Do(C), it should sound 523 times per second. In order to express sound, it is priority to adjust the speed of the timer.

And, You can then calculate the formula and create the desired frequency.

$$\frac{\text{Timer Operating Frequency[Hz]}}{\text{Desired Frequency[Hz]}}/\text{Prescaler} = \text{TCORA value}$$

$$\frac{13497040[\text{Hz}]}{523[\text{Hz}]}/1 = 25806$$

3 Source Code

```
void request(touch_result_t ts_result){
    uint8_t i, count = 0;
    uint8_t ledValue[16] = {0,};

    ledValue[0] = 0x01;
    ledValue[1] = 0x02;
    ledValue[7] = 0x08;
    ledValue[8] = 0x20;
    ledValue[12] = 0x40;
    ledValue[15] = 0x80;

    PORTB.PODR.BYTE = 0x00;

    if(ts_result.button[0] >> 15){
        PORTB.PODR.BYTE = ledValue[0];
        count++;
    }
    for(i = 0 ; i < 16 ; i++){
        if((ts_result.button[1] >> i) & 0x01){
            PORTB.PODR.BYTE |= ledValue[i+1];
            count++;
        }
    }
    tone(count);
}

void tone(uint8_t temp){
    uint16_t scaleArr[6] = {523,587,659,699,784,880};
    if(temp != 0){
            result = 13497061/scaleArr[temp-1];
            TMR01.TCORA = result;
            tmrLength = 19+temp*3;
        }
}
```

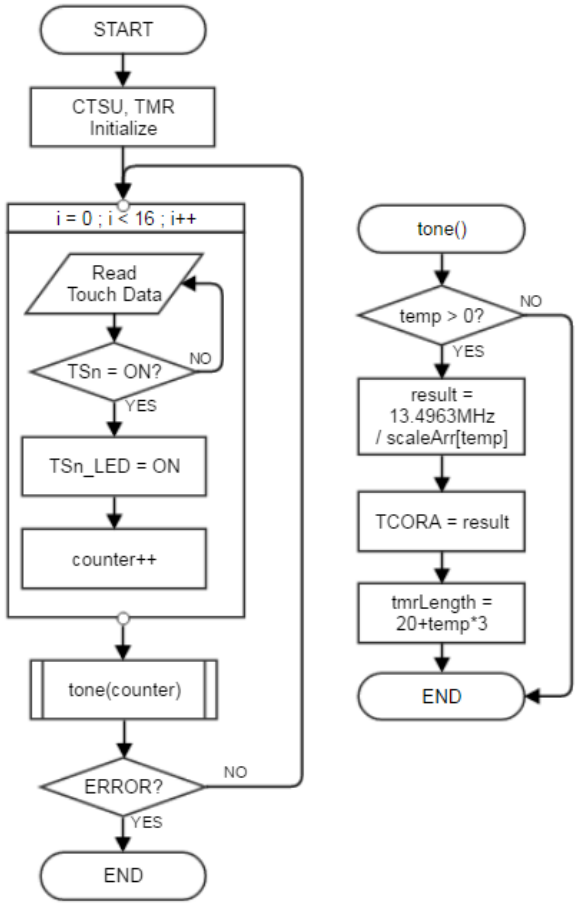

Figure 3-1 Source code and flowchart

To change the TCORA value to match the desired frequency, adjust the tmrLength.
When the timer is running, and if tmrLength is 1 or more, tmrLength is subtracted by 1 to create a constant frequency

Touch the button to increase the count. If the count is increased, the multi-touch will recognize the number of touches, and the frequency will increase to Do(C), Re(D),Mi(E), Fa(F), Sol(G), La(A).

4 Debugging

Figure 4-1 Connect NS-RX231 to power adapter and E1 debugger.

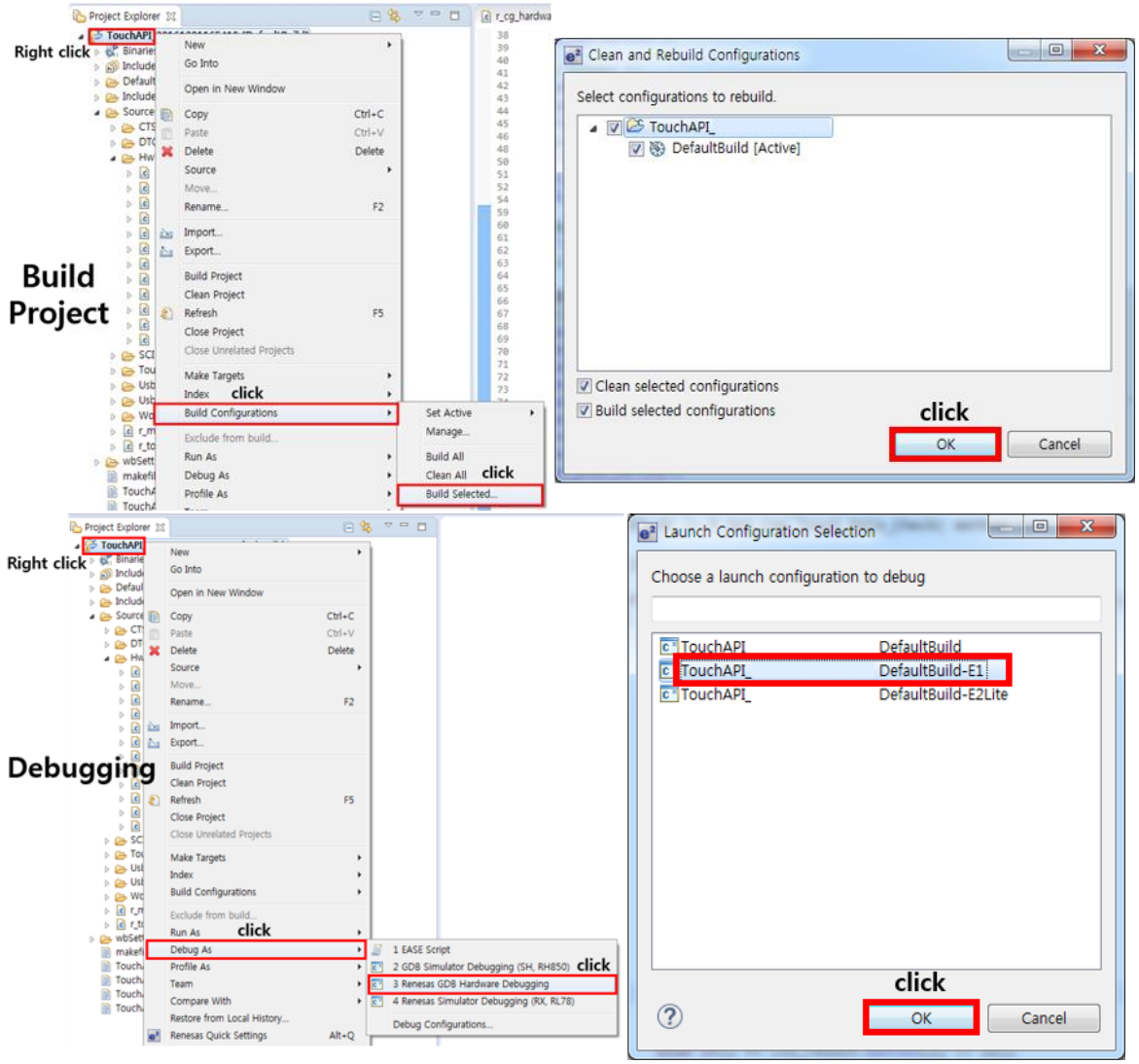

Figure 4-2 Project Build and Debugging

5 Execution

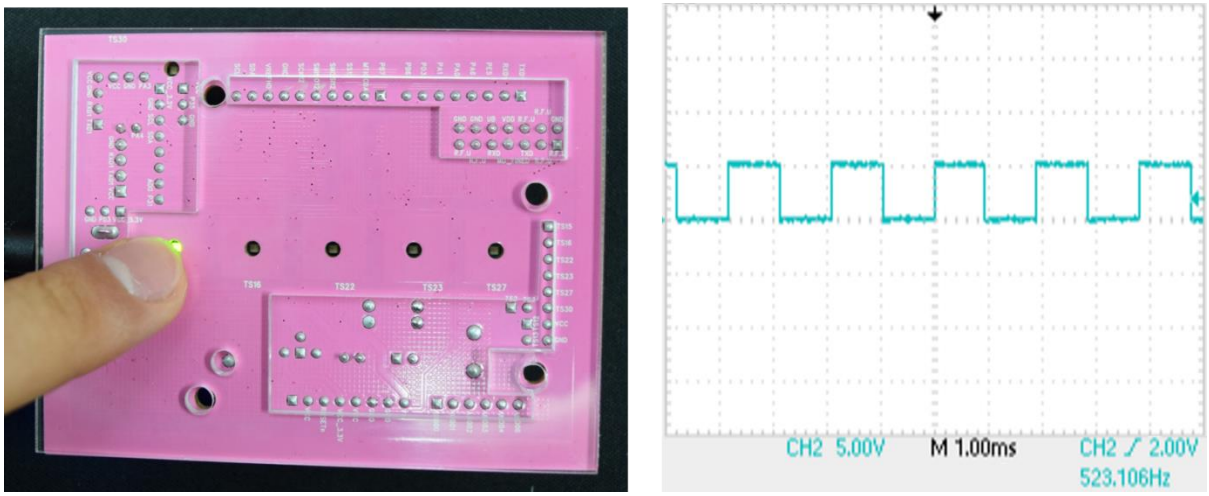

Figure 5-1 When the touch count is 1 → Do(C) 523[Hz]

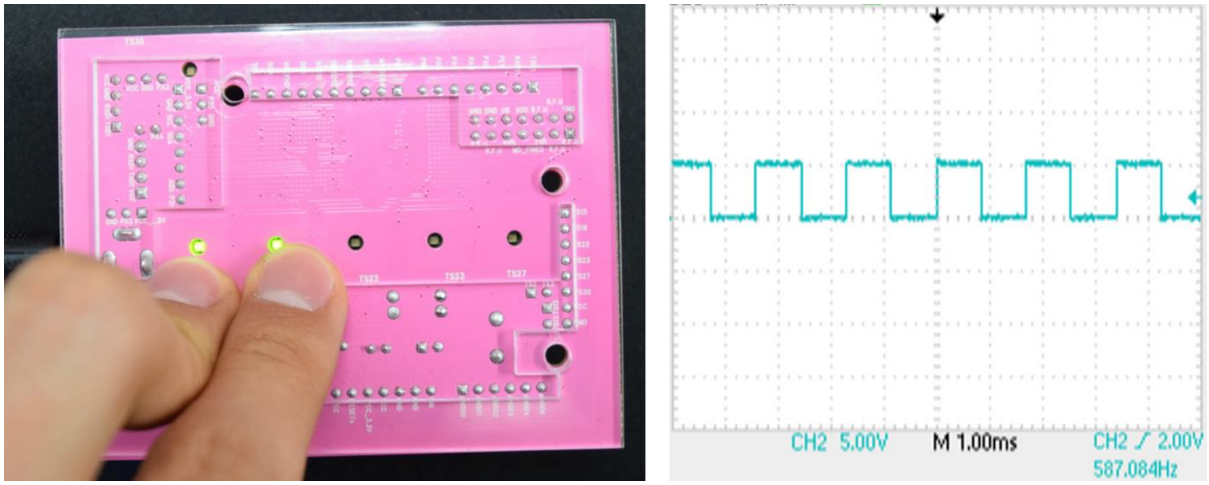

figure 5-2 When the touch count is 2 → Re(D) 587[Hz]

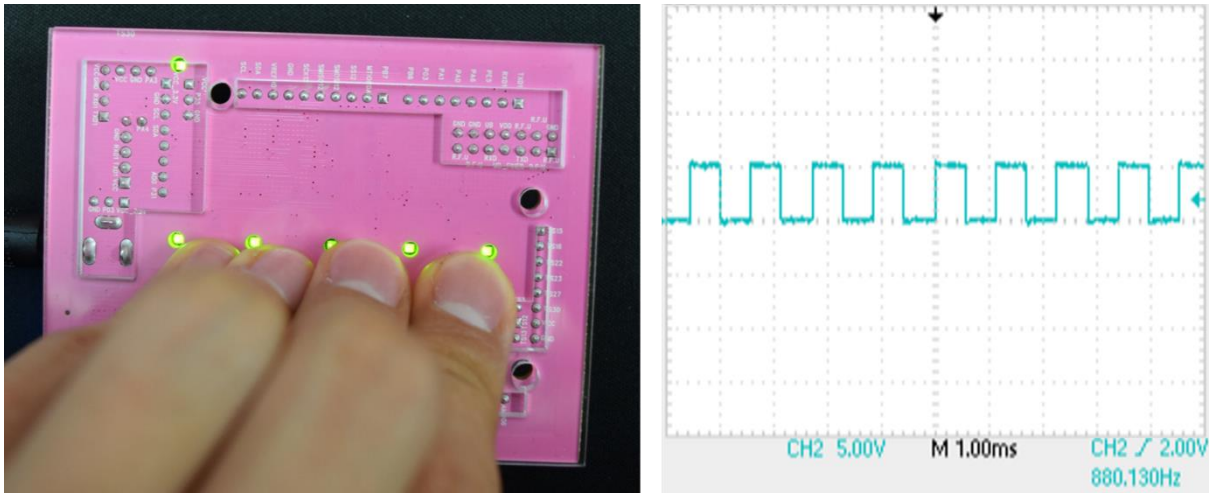

Figure 5-3 When the touch count is 6 → La(A) 880[Hz]

6 Schematic

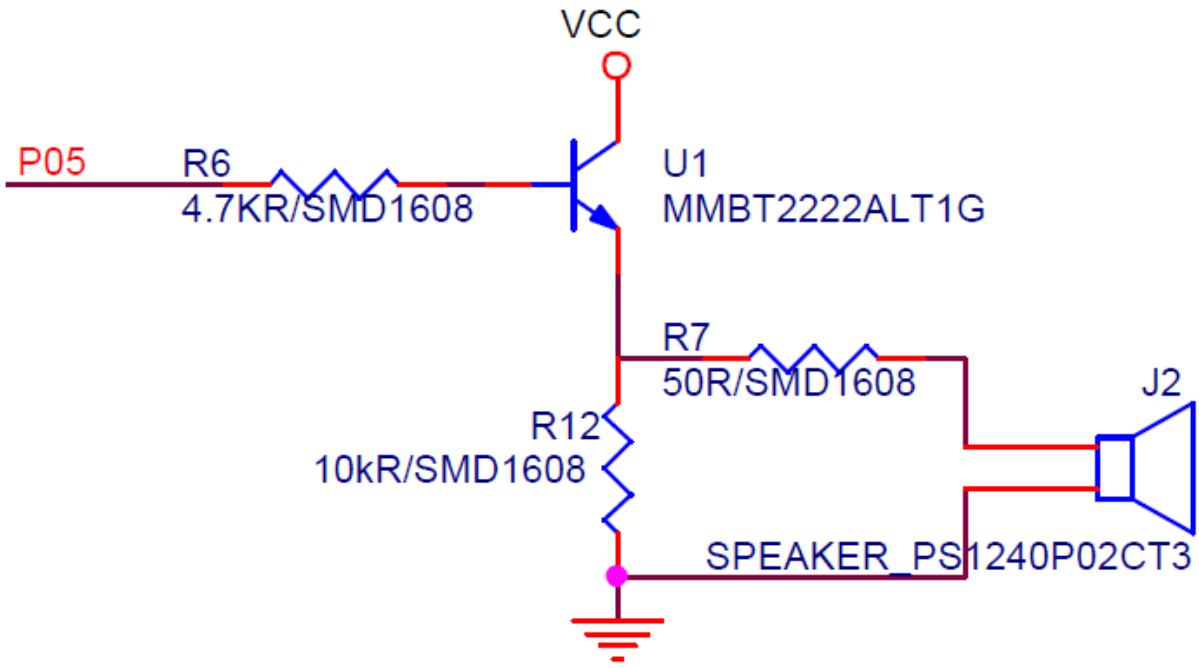

Figure 6-1 Speaker part circuit of NS-RX231