INTRODUCTION

This application note discusses the Fail-Safe Monitoring and Clock Switching features on the new 8/14/20-pin Flash microcontroller family. This new family of microcontrollers takes Microchip's Mid-Range Family of products to the next level with its new 8 MHz internal oscillator that can be switched in real time from 8 MHz down to 31 kHz (8 steps). In addition, the device contains a fail-safe feature that monitors the external (primary) oscillator and will automatically switch over to the internal (secondary) oscillator if the primary oscillator fails. These new features make applications more robust in the event of a primary oscillator failure and allow greater flexibility by using the clock frequency switching capabilities of the internal oscillator.

This application note will discuss the following:

• Enabling and monitoring the fail-safe option on the PIC16F684
• Switching clock frequencies using the 8 MHz internal oscillator on the PIC16F684
• Example Application

ENABLING THE FAIL-SAFE FEATURE

The fail-safe feature is enabled by setting bit 11 (FCMEN) in the configuration word of the device. Figure 1 shows an example configuration word setup in MPLAB® IDE. Please refer to the PIC16F684 Data Sheet (DS41202) or the PIC16F684 Programming Specification (DS40060) for more information on the configuration word.

MONITORING FOR AN EXTERNAL OSCILLATOR FAILURE

OSCCON<3> (OSTS) indicates whether the device is running from the primary or secondary oscillator. When a failure on the primary oscillator is detected, the device will switch over to its secondary oscillator and clear OSCCON<3> (OSTS). Also, when a failure occurs, an interrupt can be generated by setting PIE1<2> (OSFIE). To attempt to restart the primary oscillator, set OSCCON<0> (SCS) and then clear OSCCON<0> (SCS). Please refer to the PIC16F684 Data Sheet (DS41202) for more information on fail-safe monitoring.

SWITCHING INTERNAL OSCILLATOR FREQUENCIES

The PIC16F684 internal oscillator can be switched from 8 MHz down to 31 kHz (8 steps) in real time. OSCCON<6:4> (IRCF<2:0>) bits are used to set the frequency for running the internal oscillator. Please refer to the PIC16F684 Data Sheet for more information on the OSCCON register.

EXAMPLE APPLICATION

This example application demonstrates the fail-safe monitoring and clock switching features on the PIC16F684. This application was written using the HI-TECH C Compiler and the MPLAB® IDE development platform.
HARDWARE

The application uses a LCD display to show whether the device is running from the primary or secondary oscillator and the frequency that the secondary oscillator is running at. An external crystal oscillator is used as the primary oscillator. The primary crystal oscillator is installed in a socket where it could be easily inserted and removed while the application is running. A potentiometer is used to select the secondary oscillator frequency (See Figure A-1).

FIRMWARE

Reading The Potentiometer

The A/D converter is used to read the voltage coming from the potentiometer. A Timer0 interrupt is used to periodically sample the voltage coming from the potentiometer. When an A/D converter interrupt occurs, a binary search algorithm is used to select 1 of the 8 possible internal oscillator frequencies, based on the result of the A/D conversion. The code snippet in Example 1 demonstrates the Timer0 and A/D Interrupt handler routines. A flowchart for the Interrupt Service Routine (ISR) is shown in Figure 3.

Switching Secondary Oscillator Frequencies

The secondary internal oscillator frequency can be easily switched by masking out the OSCCON<6:4> bits and loading the step corresponding to the desired frequency. The code snippet in Example 3 demonstrates loading OSCCON<6:4>.

EXAMPLE 1: TIMER0 AND A/D INTERRUPT

```c
if ((TOIE & TOIF) == SET) //If a Timer0 Interrupt, Then
{
    GODONE = SET;       //Start an A/D Conversion
    TOIF = CLEAR;       //Clear Timer0 Interrupt Flag
}
else if ((ADIE & ADIF) == SET) //If an A/D Complete Interrupt, Then
{
    current = ADRESH;   //If Potentiometer Changed Position, Then
    if (current != prev)
    {
        ClockSwitch();  //Update Secondary Oscillator Frequency
        prev = current;
        ADIF = CLEAR;    //Clear A/D Interrupt Flag
    }
}
```

EXAMPLE 2: TIMER1 INTERRUPT

```c
if ((TMRIE & TMR1IF) == SET) //If a Timer 1 Interrupt, Then
{
    if (OSTS == SECONDARY) //Try and restart primary oscillator
    {
        SCS = SET;
        SCS = CLEAR;
    }
    TMR1IF = CLEAR;        //Clear Timer1 Interrupt Flag
}
```

EXAMPLE 3: OSCCON<6:4>

```c
OSCCON &= 0B10001111; //Mask out OSCCON<6:4>
OSCCON |= OSC_8_MHZ << 4; //Switch internal oscillator to 8MHz
```
Updating the LCD Display

The LCD is updated in the main program. A flowchart for the main routine program is shown in Figure 2.

CONCLUSION

This application note demonstrates through example how easily the fail-safe monitoring and clock frequency switching features on the new 8/14/20-pin Flash microcontrollers can be used to improve the flexibility and robustness in an application.

REFERENCES


FIGURE 2: MAIN ROUTINE FLOW CHART

Start

Initialize PIC16F684

Update Display

FIGURE 3: INTERRUPT ROUTINE FLOW CHART

Start

Timer0 Interrupt? Yes

Start A/D Conversion

No

Timer1 Interrupt? Yes

Device running from internal (secondary) oscillator?

No

Yes

Attempt to restart external (primary) oscillator

A/D Interrupt? Yes

Did user input change?

No

Yes

Switch clock frequency

No

No

Done
APPENDIX A: SCHEMATICS

FIGURE A-1: FAIL-SAFE AND CLOCK SWITCHING SCHEMATIC

(1) THE CRYSTAL POSITION IS SOCKETED SO THAT DIFFERENT FREQUENCY COMPONENTS CAN BE INSERTED.
(2) REFER TO THE CRYSTAL MANUFACTURER DATASHEET TO SELECT THE APPROPRIATE VALUES FOR C1 AND C2.
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