Introduction:

Gives an idea about using the oscillation stop detection function to detect the failure of the external clock oscillator. Two point LEDs are used to study the characteristics of on chip oscillation stop detector.

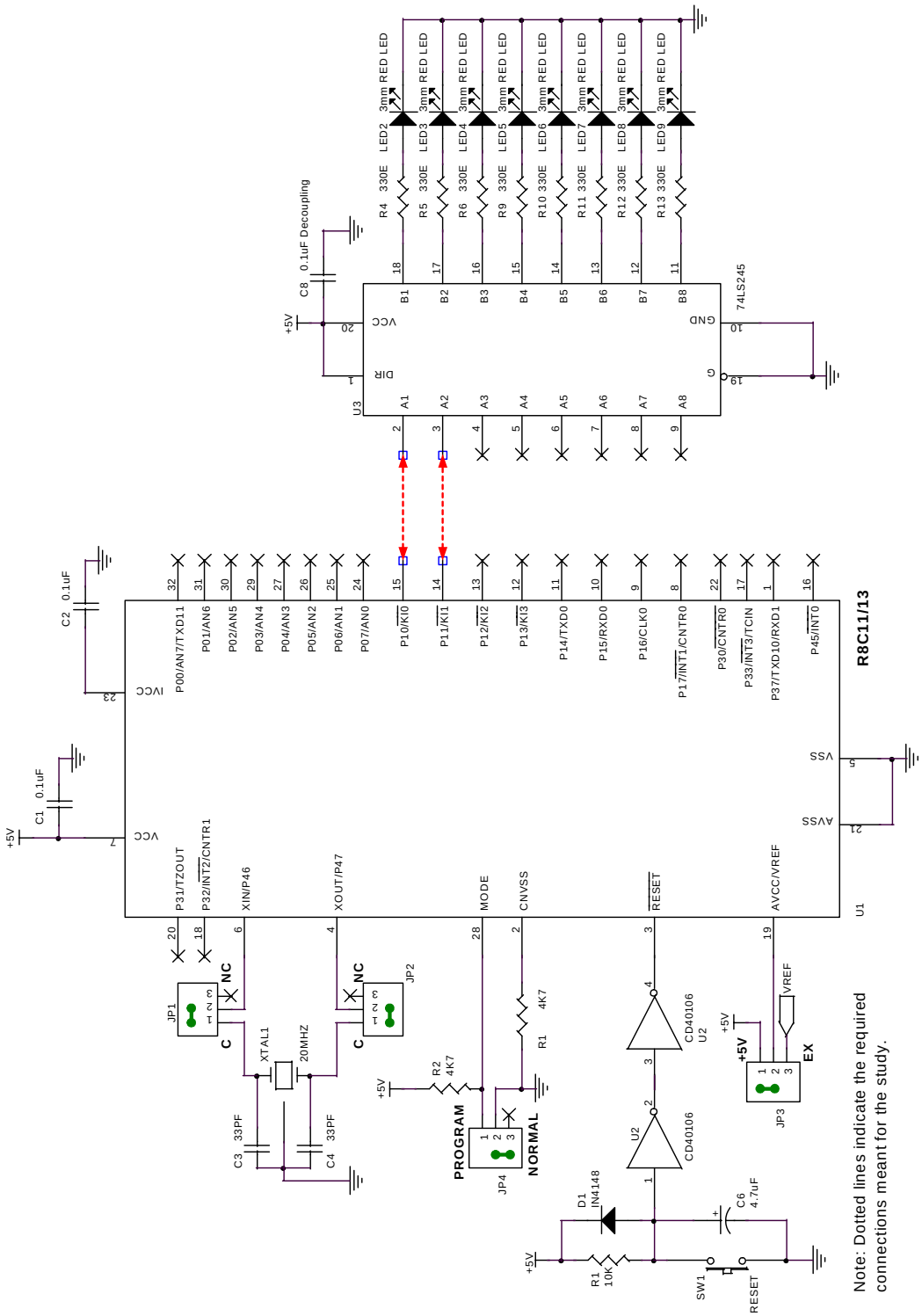
Hardware:

Two point LEDs are used to study the oscillation stop detection function. The LEDs are connected to the port lines P10 and P11 with proper drivers. The TTL buffer IC 74LS245 is used to drive the point LEDs.

The main crystal oscillator is connected to the Xin and Xout pins of micon through two jumpers JP1 and JP2 in the micon top board. To disconnect the external crystal oscillator from the micon circuit, simply remove any one shorting link from either of jumper JP1 or JP2.

In topview simulator, the main external crystal oscillator enabled during the device selection. Otherwise it can also enabled/disabled in CPU status window by checking or unchecking the option “Connect External Main Clock(Xin)” under External Clock(Xin) heading.

Circuit:


R8C11/13
74LS245
3mm RED LED
330E
0.1uF Decoupling
0.1uF
33PF
20MHZ
4K7
10K
4.7uF
IN4148
CD40106
PROGRAM
NORMAL
NC
VREF
EX
Note: Dotted lines indicate the required connections meant for the study.

Connections:

Connect the port lines P10 and P11 to two point LEDs.

Functional Description:

About Oscillator Stop Detection:

The oscillation stop detection function is meant to detect the failure of main clock oscillator. The oscillation stop detection function can be enabled and disabled by the OCD1 and OCD0 bits in the OCD register.

The details of the oscillation stop detection function are listed below:

Item	Specification
Oscillation stop detectable clock and frequency bandwidth	$f(X_{IN}) \geq 2$ MHz
Enabling condition for oscillation stop detection function	Set OCD1 to OCD0 bits to "11_2" (oscillation stop detection function enabled)
Operation at oscillation stop detection	Oscillation stop detection interrupt occurs

When the main clock corresponds to the CPU clock source and the OCD1 and OCD0 bits are "11_2" (oscillation stop detection function enabled), the system is placed in the following state if the main clock comes to a halt:

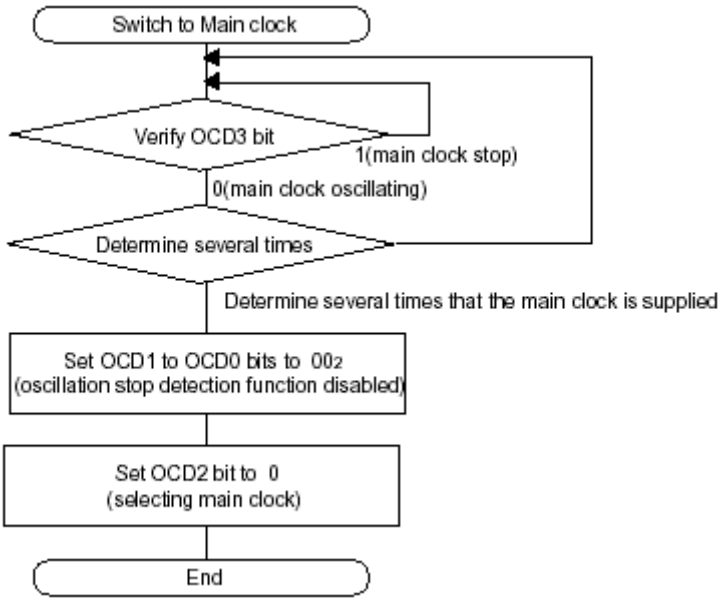
- OCD register OCD2 bit = 1 (selecting on-chip oscillator clock)
- OCD register OCD3 bit = 1 (main clock stopped)
- CM1 register CM14 bit = 0 (low-speed on-chip oscillator oscillating)
- Oscillation stop detection interrupt request occurs

How to Use Oscillation Stop Detection Function

- The oscillation stop detection interrupt shares the vector with the watchdog timer interrupt. If the both oscillation stop detection and watchdog timer interrupts are used, the interrupt source must be identified. The following table gives interrupt conditions for these interrupt sources.

Generated Interrupt Factor	Bit showing interrupt factor
Oscillation stop detection ((a) or (b))	(a) The OCD3 bit in the OCD register = 1
	(b) The OCD1 to OCD0 bits in the OCD register = 11_2 and the OCD2 bit = 1
Watchdog timer	The D43 bit in the D4INT register = 1
Voltage detection	The D42 bit in the D4INT register = 1

- When the main oscillator starts oscillating after failure, the clock source for the CPU clock and peripheral functions must be switched to the main clock in the program. The procedure for switching the clock source from the low-speed on-chip oscillator to the main clock is shown below.



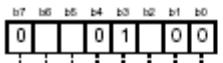
- To enter wait mode while using the oscillation stop detection function, set the CM02 bit to “0” (peripheral function clocks are not turned off during wait mode).
- Since the oscillation stop detection function is set in preparation for main clock stop due to external factors, set the OCD1 and OCD0 bits to “00_2” (oscillation stop detection function disabled).
- When using the low-speed on-chip oscillator clock for the CPU clock and clock sources of peripheral functions after detecting the oscillation stop, set the HR01 bit in the HR0 register to “0” (low-speed on-chip oscillator selected) and the OCD1 and OCD0 bits to “11_2” (oscillation stop detection function enabled). When using the high-speed on-chip oscillator clock for the CPU clock and clock sources of peripheral functions after detecting the oscillation

stop, set the HR01 bit to “1” (high-speed on-chip oscillator selected) and the OCD1 and OCD0 bits to “11_2” (oscillation stop detection function enabled).

Registers used:

CM0 - System clock control register 0
CM1 - System clock control register 1
OCD - Oscillation stop detection register 1

CM0 - System Clock Control Register 0:



Symbol CM0 | Address 000616 | After reset 6816

Bit symbol	Bit name	Function	RW
$\overline{\text{(b1-b0)}}$	Reserved bit	Set to “0”	RW
CM02	WAIT peripheral function clock stop bit	0 : Do not stop peripheral function clock in wait mode 1 : Stop peripheral function clock in wait mode	RW
$\overline{\text{(b3)}}$	Reserved bit	Set to “1”	RW
$\overline{\text{(b4)}}$	Reserved bit	Set to “0”	RW
CM05	Main clock (XIN-XOUT) stop bit[2, 4]	0 : On 1 : Off[3]	RW
CM06	CPU clock division select bit 0[5]	0 : CM16 and CM17 valid 1 : Divide-by-8 mode	RW
$\overline{\text{(b7)}}$	Reserved bit	Set to “0”	RW

Notes

Data H’08 is moved to CM0 register to start external oscillator clock and enable CM16 and CM17 bits in CM1 register.

CM1 - System Clock Control Register 1:

Symbol CM1 | Address 000716 | After reset 2016

Bit symbol	Bit name	Function	RW
CM10	All clock stop control bit[4,7]	0 : Clock on 1 : All clocks off (stop mode)	RW
(b1)	Reserved bit	Set to "0"	RW
(b2)	Reserved bit	Set to "0"	RW
CM13	Port XIN-XOUT switch bit[7]	0 : Input port P46, P47 1 : XIN-XOUT pin	RW
CM14	Low-speed on-chip oscillation stop bit[5,6]	0 : Low-speed on-chip oscillator on 1 : Low-speed on-chip oscillator off	RW
CM15	XIN-XOUT drive capacity select bit[2]	0 : LOW 1 : HIGH	RW
CM16	CPU clock division select bit 1[3]	b7 b6 0 0 : No division mode 0 1 : Division by 2 mode 1 0 : Division by 4 mode 1 1 : Division by 16 mode	RW
CM17			RW

The register CM1 is loaded with H'E8 to enable Xin and Xout pins and select divide by 16 clock to CPU.

OCD - Oscillation Stop Detection Register 1:

Symbol OCD | Address 000C16 | After reset 0416

Bit symbol	Bit name	Function	RW
OCD0	Oscillation stop detection enable bit	b1 b0 0 0: The function is disabled[4] 0 1: Avoid this setting 1 0: Avoid this setting 1 1: The function is enabled[7]	RW
OCD1			
OCD2	System clock select bit[6]	0: Select main clock[7] 1: Select on-chip oscillator clock[2]	RW
OCD3	Clock monitor bit[3, 5]	0: Main clock on 1: Main clock off	RO
(b7-b4)	Reserved bit	Set to "0"	RW

Main clock is switched on by clearing the bit OCD3 and the oscillation stop detection function enabled by setting the bits OCD0 and OCD1.

Software Description:

Two point LEDs are used to study the characteristics of on chip oscillation stop detector. First LED will be switched on if the external oscillator fails and the second LED will be flashed with periodic interval. When the external oscillator fails, the micon will get the clock from internal low speed oscillator (125KHZ). User can note the change in flashing rate of second LED due the failure of external oscillator.

The files used in this module are listed below:

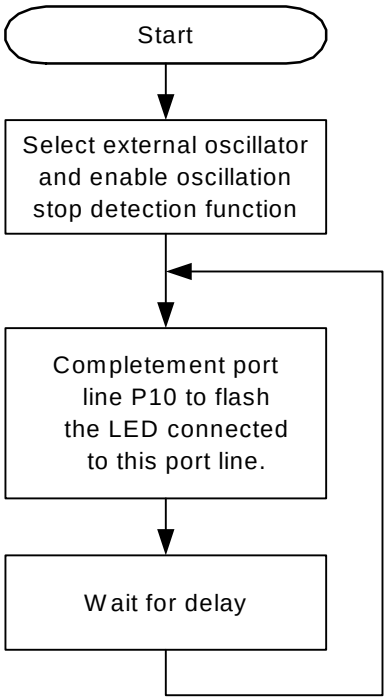
Files	*Description*
Demo19.C	Main file for this module, will select the external oscillator as the clock source for CPU and other peripherals. One LED will be flashed with periodic interval. Another LED will be switched on if the external oscillator fails.

The functions in the file “Demo19.C” and short descriptions are listed below:

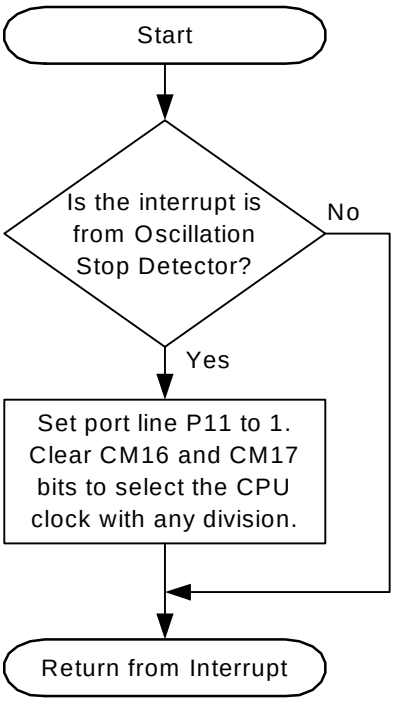
Functions	*Description*
main	This is the main function of this module and will select the external oscillator as clock source of CPU and other peripherals and enables the oscillation stop detection function. After selecting the oscillator, one LED will be flashed with a time delay. Another LED will be switched on if external oscillator fails. **Input**: None. **Output** : None.
MCUInitialize	Selects the external oscillator as clock source for the CPU and other peripherals and enables the oscillation stop detection function. **Input**: None. **Output** : None.
LVD_Int_Func	Interrupt service routine for low voltage detector, oscillation stop detection and watchdog timer. **Input**: None. **Output** : None.

Program Flow:

Main Program



Oscillation Stop Detection Interrupt Service Routine



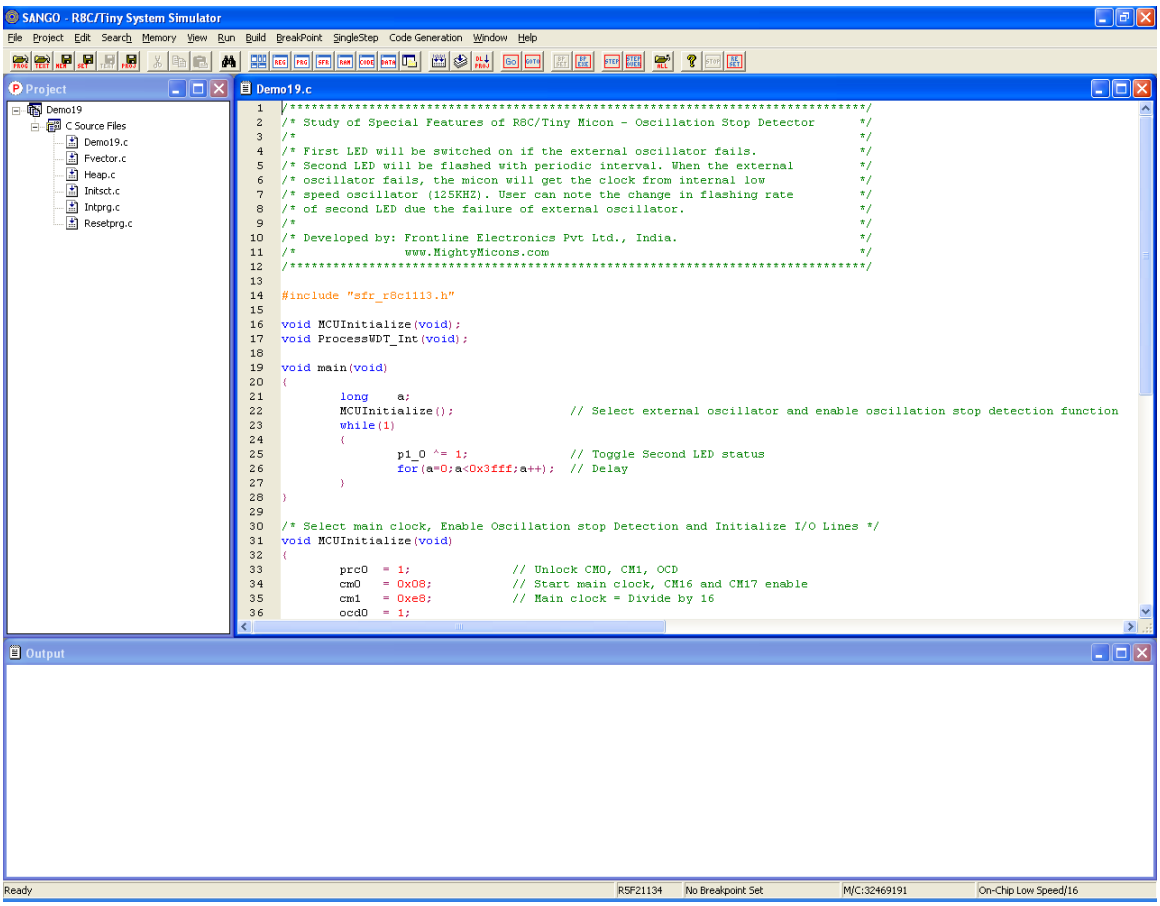
Execute Demo:

LED connected to port line P10 will be flashing with periodic interval using external oscillator as clock source. When the external oscillator fails (This can be simulated by simply removing any one shorting link in the jumpers connecting the crystal to the micon in top board), the micon will get the clock from internal low speed oscillator operating at 125KHZ and LED connected to the port line P11 will switched on to indicate the failure of external clock. You can note the change in flashing rate of the LED connected in the port line P10 due the failure of external oscillator.

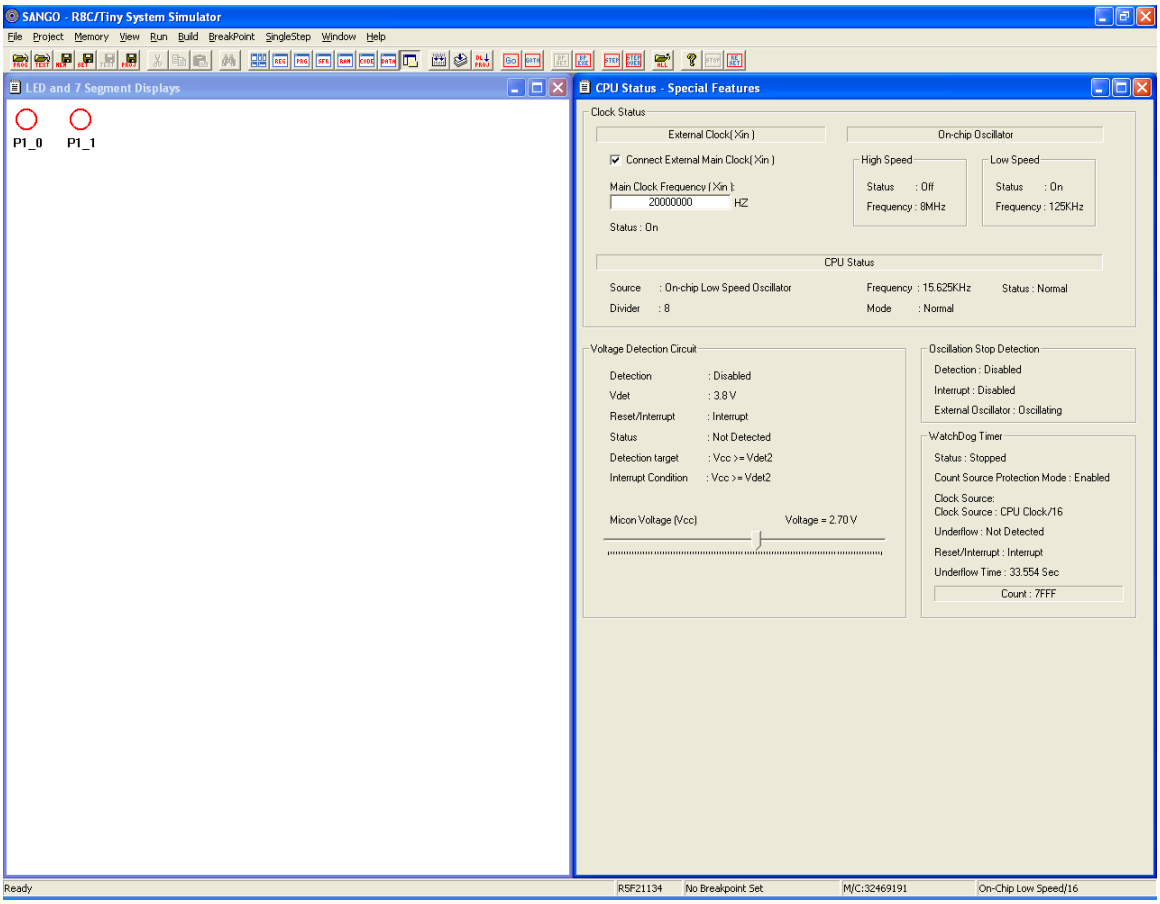
Use Topview Simulator to Verify the Design.

Open the project Demo19 in the R8C/Tiny System Simulator using **Open Project** option from **Project menu**. The project window opens up along with the Demo19.c file. Use **Build** option from **Build** menu to compile the project. An output window captures the compiler ouput.

Use **Project** -> **Download Project** from main menu to download the .mot file into the simulator's memory for simulation.



Connect point LEDs to the port line P10 and P11 using LED module setting. Open the LED and CPU status window and arrange them as shown for better visibility.



Down load the program using **Download Project** command in **Project** menu.

Run the program using **Go** command in **Run** menu.

Now the LED connected to the port line P10 will get flashing. Now you can watch the right side bottom coner of the screen that indicates the external clock is active. To disconnect the external clock to CPU simply uncheck the option “Connect External Main Clock(Xin)” under the heading External Clock(Xin).

The LED connected to the port line P11 will starts glowing to indicate that the external oscillatorhas failed. Now you can see in the status bar, the internal oscillator is used as CPU clock.