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AMENDMENT HISTORY

Version	Date	Description
Ver 1.0	2012/09/05	First issue
Ver 1.1	2013/09/23	1.Revise the Driving/Sink maximal support amount on the Feature from 8 to 16 (P1.0~P1.7 P2.0~P2.7) 2.Revise the description of dual clock sources on the Feature (Change into RTC clock source)
Ver 1.2.	2014/04/16	1. Modify system clock 2. Modify electrical characteristics
Ver 1.3	2014/12/05	Added Midi description
Ver 1.4	2015/07/10	1. Add ADC description 2. Add RTC description 3. Page 15, add external crystal application circuit (low clock)



1 INTRODUCTION

SNC81510S is a four-channel voice synthesizer IC with push-pull direct drive circuit. It built in a powerful 8-bit controller and 32 I/O pins. By programming through the controller in SNC81510S, user's varied applications including voice section combination; key trigger arrangement, output control, and other logic functions can be easily implemented.

The WPU is a 4-channel wave table music synthesizer compatible with standard MIDI stream format.

2 FEATURES

2.1. CPU

- ◆ Single Power Typical: 2.2V~5.5V
- ◆ Powerful Built-in 8-bit Controller
- ◆ RAM: 432*8 bits.
- ◆ 832K*15 bits shared ROM for program and voice data
- ◆ Maximum 64K program ROM.
- ◆ CPU clock is programmable: 8MHz, 4MHz, 2Mhz or 1Mhz
- ◆ System clock: internal OSC 8.192Mhz \pm 3 %
- ◆ I/O Pins:
 - 32 I/O pins (P0.0~P0.7, P1.0~P1.7, P2.0~P2.7, P3.0~P3.7)
- ◆ Timer/Counter
 - 8-bit TimerA/Counter
 - 12-bit TimerB/Counter
 - 8-bit Sampling Rate CounterX4: SRC0, SRC1, SRC2, SRC3
 - Timer1 (1ms, 4ms, 8ms, 16ms)
 - RTC Timer (0.25s, 0.5s, 1s, 4s)
 - WDT Timer (0.25s)
 - PWMIO Timer0 (1ms, 2ms, 4ms, 8ms, 16ms, 32ms, 64ms, 128ms)
 - 16-bit TimerC with Capture Timer Function
- ◆ External interrupt Source x3: INT0 INT1 INT2 .
- ◆ Maximum 8 H/W PWMIO with 256-level brightness control.
- ◆ Maximum 16 set IO(P1.0~P1.7 P2.0~P2.7) with High driving (8mA)/sink (16mA) current.
- ◆ IR function is provided*2: IRA IRB
- ◆ RTC Clock source
 - Internal low clock : RC oscillator – about 32KHz at 3V, 64KHz at 5V
 - External oscillator : 32768 Hz (connect pin shared with P00 , P01)
- ◆ Operating Mode
 - Normal
 - Idle
 - Sleep
- ◆ Low Voltage Reset (LVR:2.0V)



- ♦ Low Voltage Detector (LVD)
 - 4 levels (2.2V/2.4V/2.6V/2.8V)
- ♦ 16-channel comparator for Cap sensing application.
- ♦ 16-channel 8-bit software ADC.
- ♦ Serial Peripheral Interface (SPI)
 - Support master mode only.
- ♦ 12 interrupt source
- ♦ Built-in 8*8 Multiplier

2.2. WPU

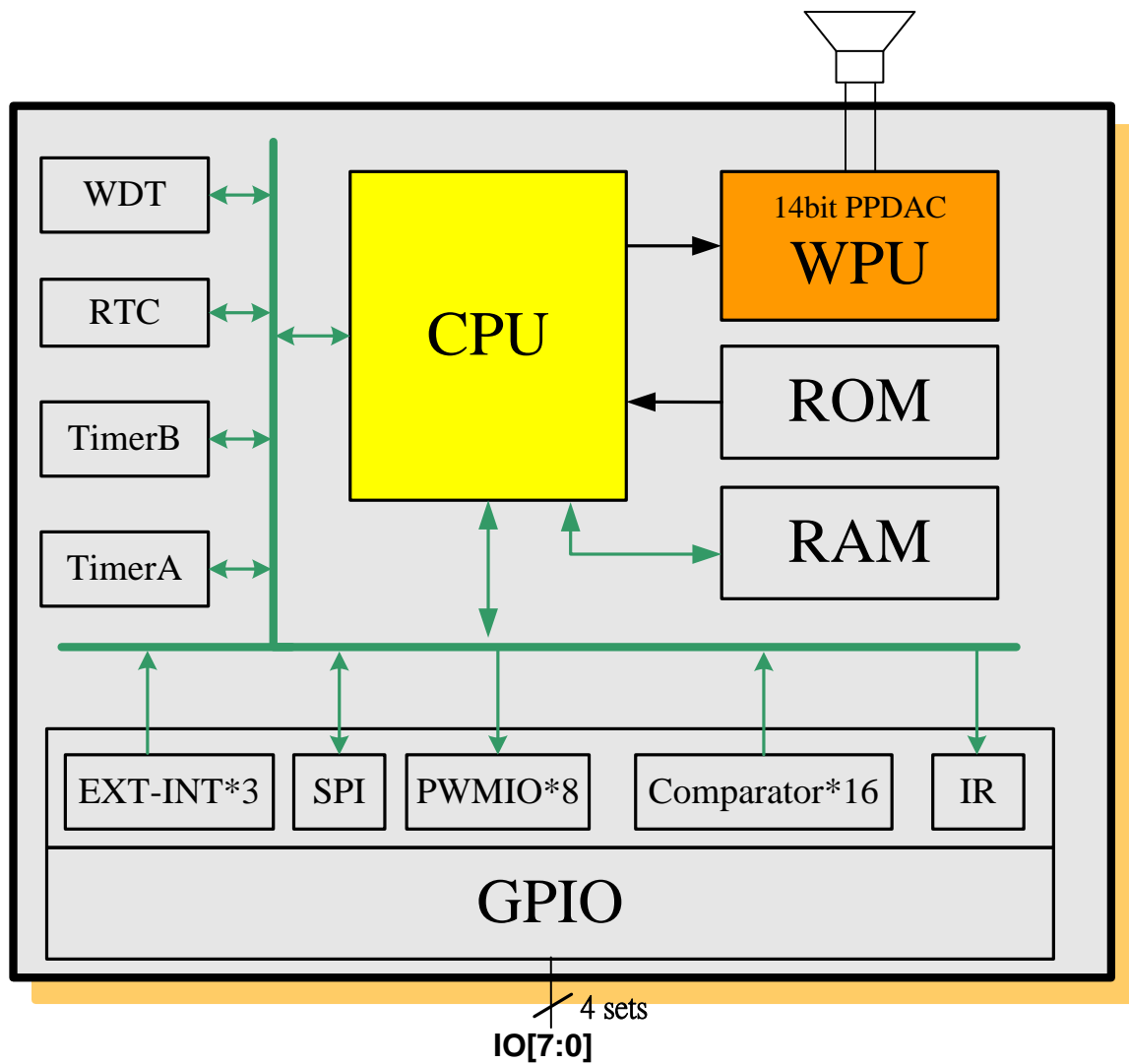
- ♦ Maximum 4 CH Voice/MIDI synthesizer, compatible with General MIDI stream format.
- ♦ Voice Duration: 510 sec (@ 6KHz sample rate)
- ♦ 4 channels with four playing modes:
 - 4-bit ASDPCM
 - 5-bit ASDPCM
 - 6-bit ASDPCM
 - PCM
- ♦ 14-bit Push Pull DAC with 8-levels global(analog) volume control
- ♦ Adaptive playing speed from 4K to 64K Hz @1channel.
- ♦ Event Mark function supported.



3 PIN ASSIGNMENT

Symbol	I/O	Function Description
P00/LXIN	I/O	IO or external 32KHz crystal LXin
P01/LXOUT	I/O	IO or external 32KHz crystal LXout
P02 ~ P07	I/O	Bit7 ~ Bit2 of I/O port 0
P10 ~ P17	I/O	Bit7 ~ Bit0 of I/O port 1
P20 ~ P27	I/O	Bit7 ~ Bit0 of I/O port 2
P30 ~ P37	I/O	Bit7 ~ Bit0 of I/O port 3
VDDPP	P	Positive power supply for Direct Drive PPDAC
GNDPP	P	Negative power supply for Direct Drive PPDAC
CVDD	P	Positive power supply for internal circuit
VDD	P	Positive power supply for I/O
GND	P	Negative power supply
RST	I	Chip Reset (Active low)
TestM	I	Test Pin
BN0	O	Direct Drive negative output
BP0	O	Direct Drive positive output

4 Block Diagram



5 FUNCTION DESCRIPTION

5.1. ROM

SNC81510S contains a substantial 832K words (15-bit) internal ROM, which is shared by program and resource data. Program, voice and data are shared within this same 832K words ROM.

5.2. RAM

SNC81510S contains 432 bytes RAM (432 x 8-bits). The 432 byte RAM is divided into 2 bank (bank0, bank1, 256 bytes RAM for each bank).

Bank Num	Address Range	Description	Total Size (Bytes)
0	0x000 ~ 0x04F	Special Registers	80
	0x050 ~ 0x057	PWMIO Duty Register 1~8 Or User Data	8
	0x058 ~ 0x05F	User Data	8
	0x060 ~ 0x07F	Stack_Buffer	32
	0x080 ~ 0x0FF	User Data	128
1	0x100 ~ 0x11F	Channel RAM0	32
	0x120 ~ 0x13F	Channel RAM1 Or User Data	32
	0x140~0x15F	Channel RAM2 Or User Data	32
	0x160~0x17F	Channel RAM3 Or User Data	32
	0x180~0x1FF	User Data	128

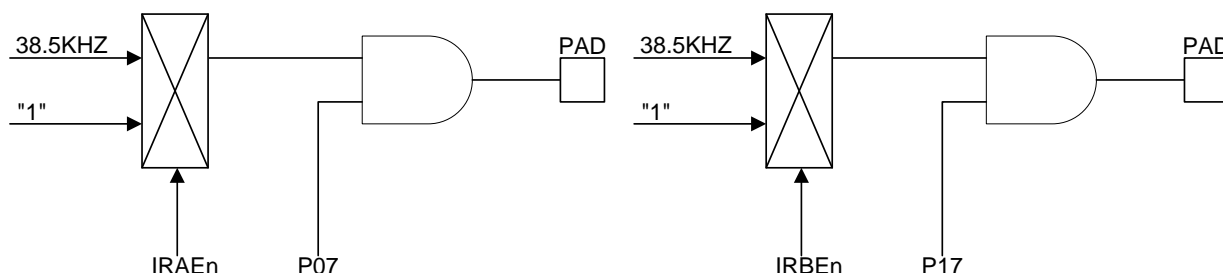
Stack_Buffer default size is 32 bytes. User can fine tune in each project.

5.3. Power Down Mode

Entering the IC into Stop Mode will stop the system clock for power savings. Any transition (L→H or H→L) on any I/O pin can be used to start the system clock and return to normal operating mode.

5.4. IR Function

SNC81510S provides two IR modules. It will generate 38.5 KHz signal at P07 or P17 when IR enable.



5.5. I/O Ports

There are 32 general I/O ports P0, P1, P2 and P3. Any I/O can be individually programmed as either input(Pull-Low or Pull-High), output or floating. When I/O is set to input, any valid data transition (H→L or L→H) of each I/O port can wake-up the chip from power-down mode.

5.6. Multi-function of I/Os

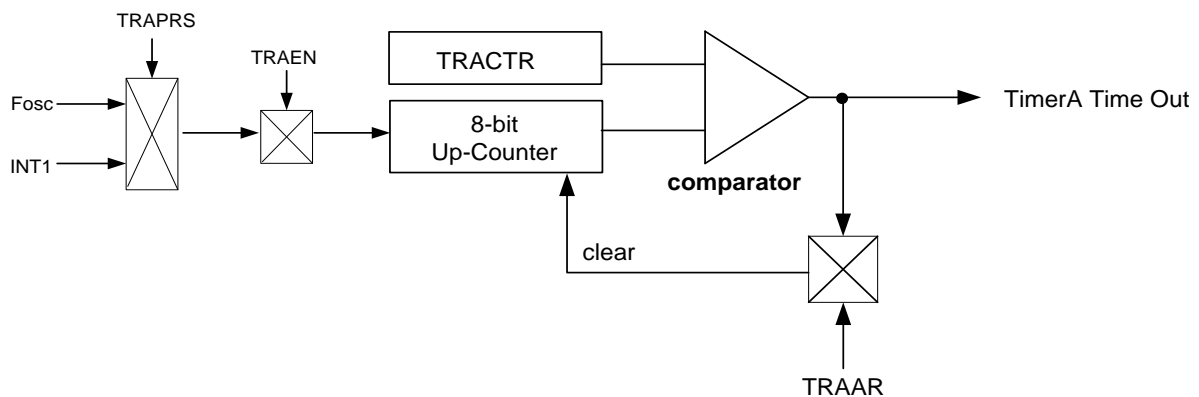
Function	P0								P1							
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
External interrupt 0			V													
External interrupt 1				V												
External interrupt 2					V											
IRA								V								
IRB																V
SPI					DI	DO	SCK	CS								
LXin,LXout	V	V														
PWMIO0~7									V	V	V	V	V	V	V	V
HIGH DRIVE/SINK IO									V	V	V	V	V	V	V	V
Comparator ch0~7									V	V	V	V	V	V	V	V
Comparator output			V													
	P2								P3							
Comparator ch8~15	V	V	V	V	V	V	V	V								
HIGH DRIVE/SINK IO	V	V	V	V	V	V	V	V								

5.7. 8-bit Sampling Rate Counters

The sampling rate counter is designed in voice channel to be able to play diverse voices at different sample playing rates. The playing rate can be adaptively set up among from the wide ranges of 4 KHz to 64 KHz. This architecture yields a high-quality voice synthesis that sounds very close to its original source when played through the same amplifier and speaker circuitry.

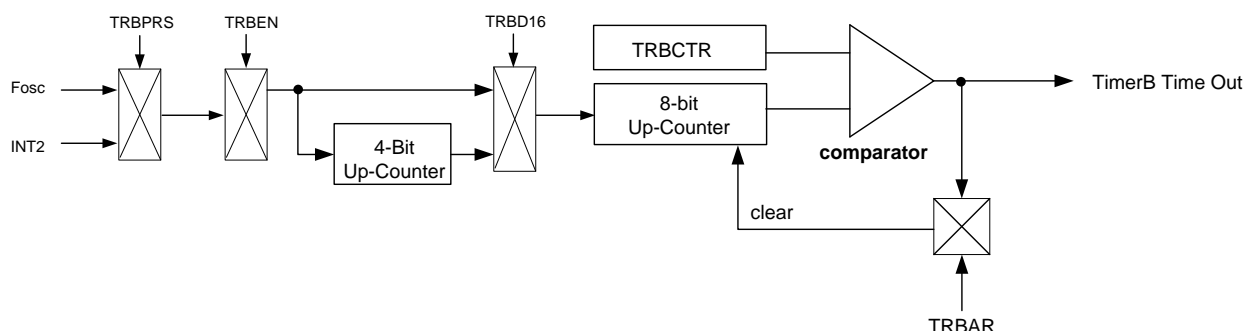
5.8. TimerA 8-BIT TIMER/COUNTER

TimerA is an 8-bit binary up-counting timer with auto-reload function and event counter function. If a successful event occurs (counting value = setting value), it will issue a time out signal to TimerA interrupt service and continue counting with auto-reload first.



5.9. TimerB 12-BIT TIMER/COUNTER

TimerB is an 12-bit binary up-counting timer with auto-reload function and event counter function. If a successful event occurs (counting value = setting value), it will issue a time out signal to TimerB interrupt service and continue counting with auto-reload first.



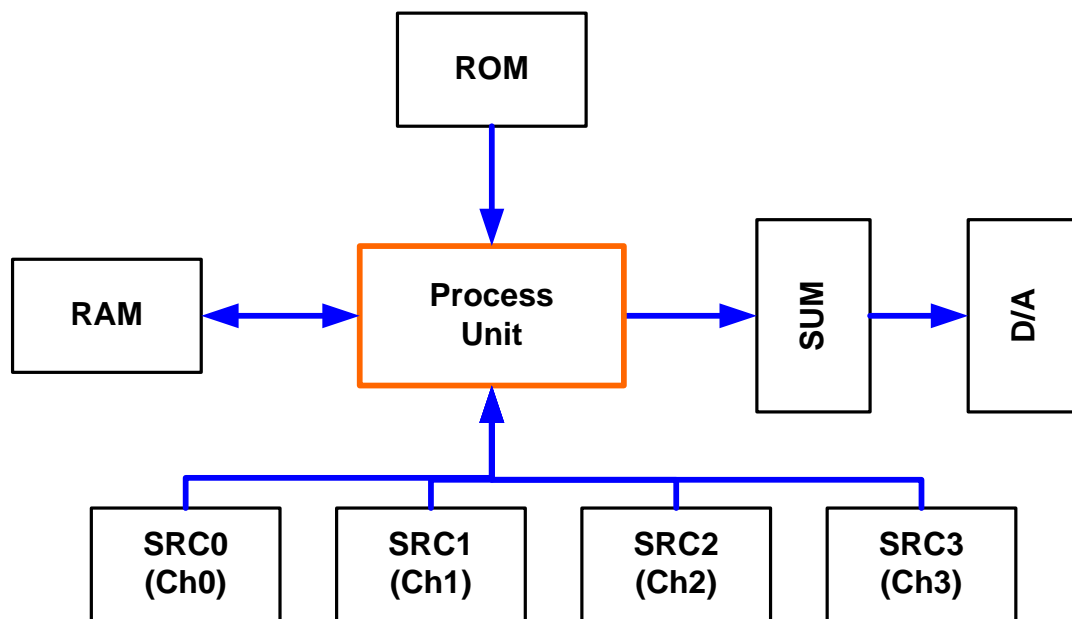
5.10. Interrupt

At the moment when SNC81510S enters the interrupt service routine, the GIE bit (in INTEN) will be cleared to "0" for blanking other interrupt. However, during this stage, other enabled interrupt sources still can issue their requests but the requests are queued in INTRQ. GIE will be restored to "1" while CPU exits ISR. Then the other valid interrupt can be granted and served immediately.

Interrupt Source	Priority	Entry Location	Descriptions
TimerA	0	0x10	Timer A interrupt
TimerB	1	0x14	Timer B interrupt
WPUCH0	2	0x18	Channel 0 buffer empty
INT0	3	0x1C	External INT 0
WPUCH1	4	0x20	Channel 1 buffer empty
INT1	5	0x24	External INT 1
WPUCH2	6	0x28	Channel 2 buffer empty
INT2	7	0x2C	External INT 2
WPUCH3	8	0x30	Channel 3 buffer empty
PWMT0	9	0x34	PWMIO counter 0 interrupt
COMP	10	0x38	Comparator edge trigger
TimerC	11	0x3C	Timer C interrupt for Cap sensing

5.11. Wave Processing Unit (WPU)

The Wave Processing Unit (WPU) provides 4 channel voice channels. A high-performance multi-channel music synthesizer is built-in to provide high-quality wave-table melody playback. Most of standard MIDI format can be accessed through the MIDI to Melody convert software. The voice playing can support PCM, 4-bit ASDPCM, 5-bit ASDPCM and 6-bit ASDPCM compression format. Below figure is WPU structure.



WPU function diagram

5.12. PWMIO

SNC81510S support 8 PWMIO (P10~P17). Each I/O has 8-bit independent duty register, and the 8-bit register are comparing with 8 bits counter. If set use PWMIO function and internal counter start at 000H, the mapping I/O will set High. The 8 bits counter increment until the corresponding duty register, and then will reset the mapping IO pin.

5.13. Serial Peripheral Interface (SPI)

The SPI (serial peripheral interface) is a synchronous serial bus that provides good support for communication with SPI-compatible peripheral devices, such as serial EEPROM, serial flash, and etc.

SPI_CK Clock Rate maximum $F_{osc} / 2 = 4\text{MHz}$



5.14. Comparator

The analog comparator compares negative input voltage, and then output the result to comparator output terminal. The comparator has multi-input selection for different applications. The comparator negative input terminal is up to 16-channel controlled by CMCH[3:0]. The comparator positive input terminal has four selections controlled by CM0S[1:0]. The comparator output terminal connects to GPIO pin P0.2 and connects to internal path. There is a programmable direction function to decide comparator trigger edge for indicator function.

SNC81510S build-in 32768Hz ILRC for idle mode clock source. Standby current is according to the number of Wake-up Key (4 or 8 or 16 Channel) and wakeup time per 0.5Sec or 1Sec by ILRC. The table below is cap sensor standby current estimated.

VDD=3V,Count value=200		
Wake-up Key Number	Wake up Time (S)	Standby Current
16 CH	0.5 S	206.12 uA
16 CH	1 S	104.48 uA
8 CH	0.5 S	104.26 uA
8 CH	1 S	61.376 uA
4 CH	0.5 S	56.9 uA
4CH	1 S	34.14uA
VDD=3V,Count value=100		
Wake-up Key Number	Wake up Time (S)	Standby Current
16 CH	0.5 S	103 uA
16 CH	1 S	52.48 uA
8 CH	0.5 S	52.18 uA
8 CH	1 S	30.688 uA
4 CH	0.5 S	32.397 uA
4 CH	1 S	19.44 uA

5.15. System clock

The system clock source is from the internal high-speed oscillator built in the SNC81510S chip. The high-speed oscillator uses RC type oscillator circuit. The frequency is affected by the voltage and temperature of the system and the following two diagrams is shown up the relation.

The figure <5-1> shows up the relationship between the high-clock frequency and Voltage.

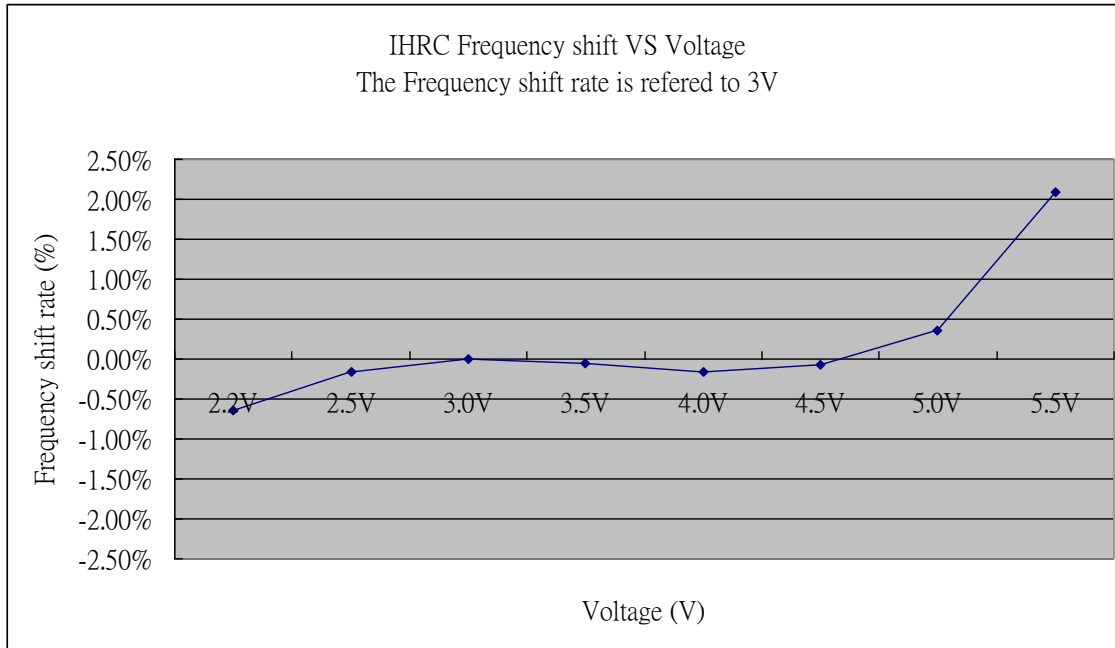


Figure <5-1>

The Figure <5-2> shows up the relationship between the high-clock frequency and temperature at VDD=3V.

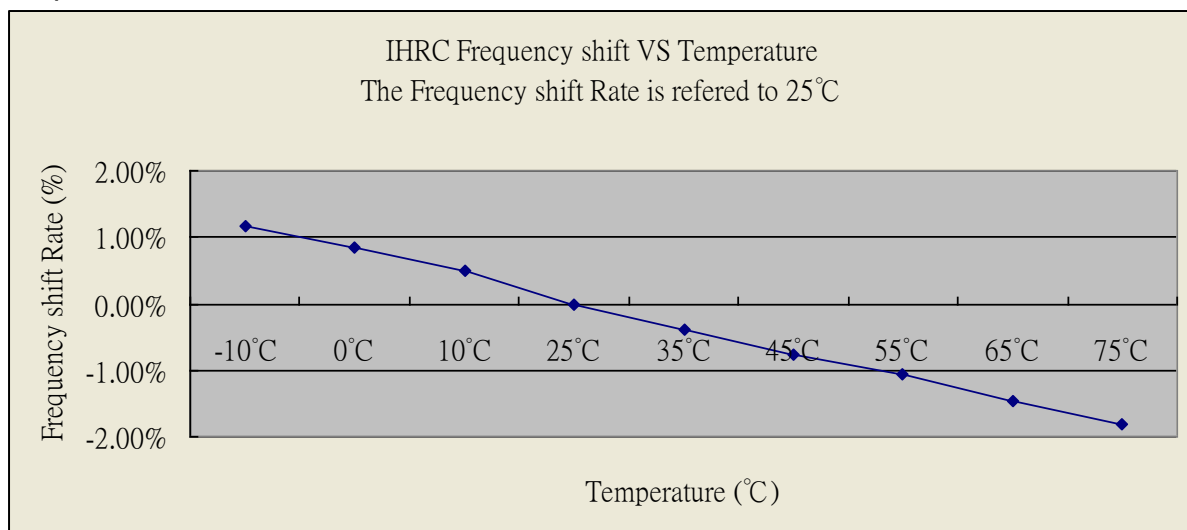
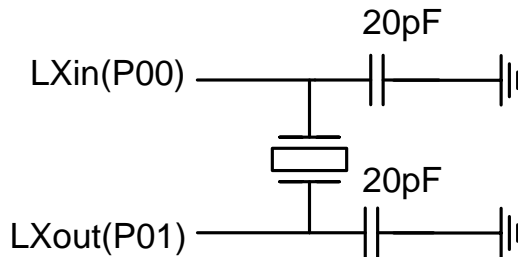


Figure <5-2>

5.16. RTC

Real Time Clock (RTC) timer provides an accuracy timer for digital clock use. It should be connect XTAL by P00 and P01. P00 and P01 can be set as normal I/O or XTAL.

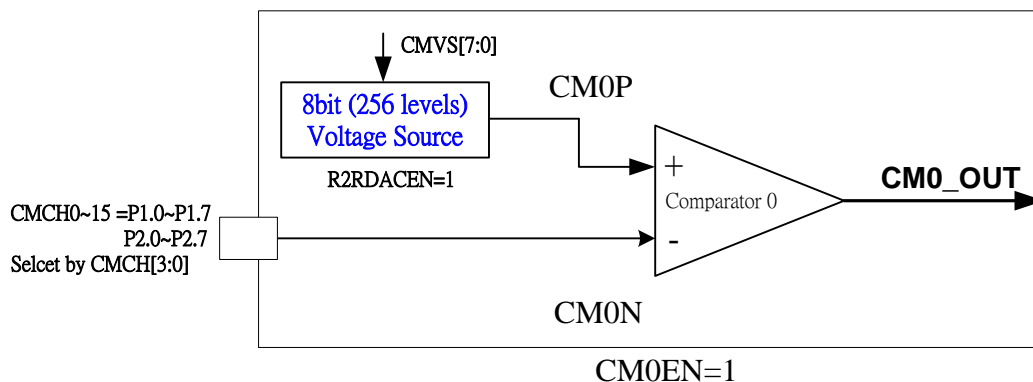
In idle mode, chip can wake up for a regular interval time by RTC timer set.



5.17. ADC

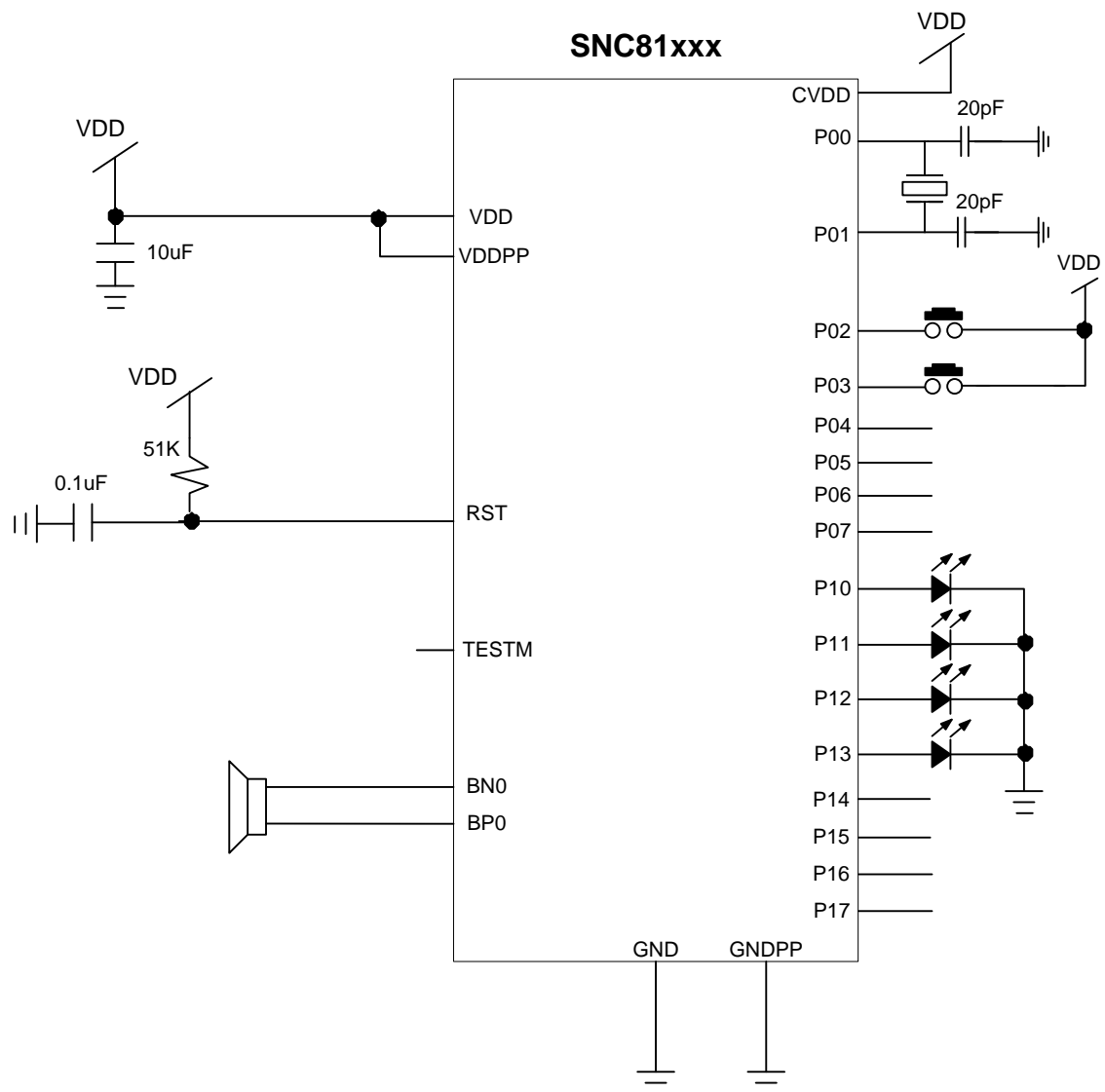
Comparator has another operation mode, analog to digital converter mode. It can measure voltage have not great change, like battery voltage measurement.

The negative input terminal connects to external input pin. The positive input terminal connects to internal 8-bit voltage source. Adjust 8-bit voltage level until comparator output change from high to low (or low to high), and then get the value of ADC.

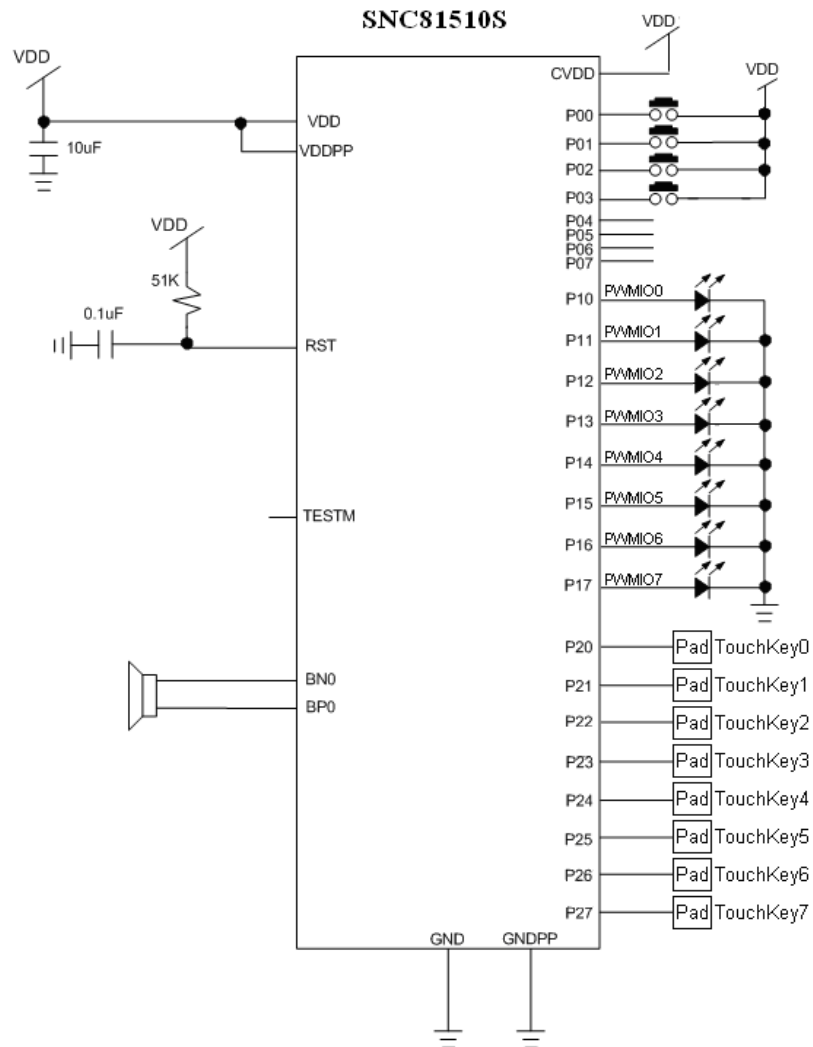


6 APPLICATION CIRCUIT

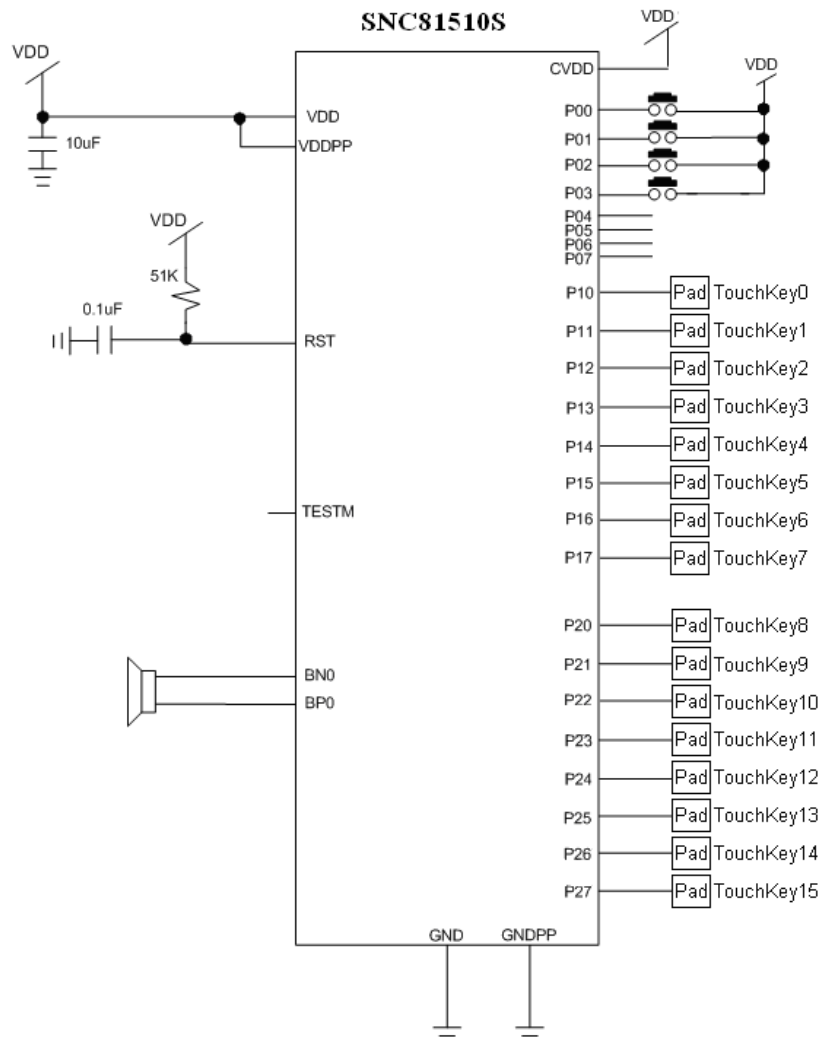
- ◆ Power Supply: 3.0V or 4.5V
- ◆ System Clock: Rosc 8.192Mhz ($\pm 3\%$)
- ◆ Low Clock: External Crystal
- ◆ Voice output: Direct Drive Output



- ◆ Power Supply: 3.0V or 4.5V
- ◆ System Clock: Rosc 8.192Mhz ($\pm 3\%$)
- ◆ Voice output: Direct Drive Output



- ◆ Power Supply: 3.0V or 4.5V
- ◆ System Clock: Rosc 8.192Mhz ($\pm 3\%$)
- ◆ Voice output: Direct Drive Output



7 ABSOLUTE MAXIMUM RATING

Items	Symbol	Min	Max	Unit.
Supply Voltage	V_{DD-V}	-0.3	6.0	V
Input Voltage	V_{IN}	$V_{SS}-0.3$	$V_{DD}+0.3$	V
Operating Temperature	T_{OP}	0	55.0	°C
Storage Temperature	T_{STG}	-55.0	125.0	°C

8 ELECTRICAL CHARACTERISTICS

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Operating Voltage	V_{DD}	2.2	-	5.5	V	
Standby Current	I_{SBY}	-	2 3	-	μA	$V_{DD}=3V$ $V_{DD}=4.5V$
Idle mode operating current using ILRC	I_{SOPR}	-	2 5	-	μA	$V_{DD}=3V$ $V_{DD}=4.5V$
Idle mode operating current using 32768 X'tal	I_{SOPR}	-	3.5 10	-	μA	$V_{DD}=3V$ $V_{DD}=4.5V$
Operating Current (Push-Pull Turn On)	I_{OPR}	-	4.5 5.5	-	mA	$V_{DD}=3V$, no load $V_{DD}=4.5V$, no load
Operating Current (Push-Pull Turn OFF)	I_{OPR}	-	2 3	-	mA	$V_{DD}=3V$, no load $V_{DD}=4.5V$, no load
Input pull low impedance of P0~P3	R_i	-	700K	-	Ω	$V_{DD}=3V$
Input pull high impedance of P0~P3	R_i	-	500K	-	Ω	$V_{DD}=3V$
Input High level	V_{IH}	-	0.7 V_{DD}	-	V	
Input Low level	V_{IL}	-	0.3 V_{DD}	-	V	
Normal I/O port Drive Current P0,P3	I_{OD}	-	4 9	-	mA	$V_{DD}=3.0V$, $V_O=2.4V$ $V_{DD}=4.5V$, $V_O=3.6V$
Normal I/O port Sink Current P0,P3	I_{OS}	-	6 12	-	mA	$V_{DD}=3.0V$, $V_O=0.4V$ $V_{DD}=4.5V$, $V_O=0.58V$
High drive I/O Drive Current P1,P2	I_{OD}	-	8 16	-	mA	$V_{DD}=3V.0$, $V_O=2.4V$ $V_{DD}=4.5V$, $V_O=3.6V$
High drive I/O Sink Current P1,P2	I_{OS}	-	16 30	-	mA	$V_{DD}=3.0V$, $V_O=0.4V$ $V_{DD}=4.5V$, $V_O=0.58V$
Push-Pull current	I_{PP}	-	70	-	mA	$V_{DD}=3V$, Output 1Khz Sin wave.
Push-Pull current	I_{PP}	-	100	-	mA	$V_{DD}=4.5V$, Output 1Khz Sin wave.
IR Carrier Frequency	Fir	-	38.5	-	KHz	
Internal ROOSC Frequency	F_{OSC}	7.946	8.192	8.438	Mhz	$V_{DD}=3V$ Temp.=25°C Max : +3% Min : - 3%

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